CKPOM Koala Monitoring Field Survey Report

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INTRODUCTION

Lismore City Council adopted a Comprehensive Koala Plan of Management (CKPoM) in 2013 for the south-eastern section of the Local Government Area (LGA), which supports one of the most significant populations of koalas in New South Wales and is also subject to a range of development and agricultural pressures. The development of the CKPoM was informed through the analysis of historical records of koalas for the Lismore LGA from 1949 to 2010, which was completed by Biolink Ecological Consultants (Biolink 2011).

The CKPoM contains policies and planning provisions which aim to ensure that potential impacts on koalas are addressed through the planning system, but it also details a range of management activities to address current threats to koalas such as clearing of habitat, disease, car hits and dog attacks. Up to date information on the status and distribution of koalas within the CKPoM area helps inform management of threats to koalas and assists in the understanding of the impact of development on this population. This requires regular monitoring surveys to be completed every three years over the CKPOM's 15 year life span.

The first monitoring study for the CKPoM was completed by Biolink Ecological Consultants in 2017 (Biolink 2017) and was intended to provide the baseline for a long-term monitoring programme. That survey utilised a combination of analysis of koala records provided by Friends of the Koala (FOK), covering the period 2011 to 2016, and field surveys. Methods used for the field surveys involved a regular grid (350m x 350m) based rapid Spot Assessment Technique (RGb rSAT), which determines presence/absence of koalas. A 25m radial search for koalas in each survey plot, as well as a 250m x 40m transect, were completed to enable estimation of koala density. Opportunistic sightings of koalas were also recorded throughout the field survey.

Since that time an effort has been made to standardise koala monitoring surveys across New South Wales to ensure that results are comparable between local government areas and across the State as a whole. Therefore, in consultation with other local governments and the Department of Primary Industries and Environment (DPIE), amended survey methods have been used in the current study to ensure consistency in assessment and reporting between the LGAs.

AIMS

The aims of the 2020 Koala Monitoring Survey are to:

- Identify the distribution of koalas and levels of koala activity within the CKPoM area to ensure any changes can be identified in future monitoring surveys;
- Estimate density of koalas across the CKPoM area;
- Review Koala admission records from FOK for the period 2017 to 2020 and calculate the proportions of the various causes of admission from within the CKPoM area.

METHODS

Site Survey

Site Selection

Desktop Site Selection

Sites previously surveyed by Biolink in 2017, which contained preferred koala food trees (PKFTs) at that time, formed the basis of the list of field sites to be surveyed in 2020. PKFTs listed in that report are forest red gum *Eucalyptus tereticornis*, swamp mahogany *Eucalyptus robusta,* tallowwood *Eucalyptus microcorys* and small fruited grey gum *Eucalyptus propinqua*. To increase the number of survey sites, additional candidate sites were identified by overlaying a regularly spaced grid onto polygons of mapped koala habitat in the CKPoM study area in QGIS v3.10. Grid points were spaced 350m apart to be consistent with the methods used for the 2017 survey (Biolink 2017). Where a grid point intersected with a patch of vegetation that was mapped as either "primary" or "secondary A, B or C" koala habitat greater than 0.5 ha in area, these points were added to the list of candidate field survey sites. The koala habitat mapping used was a combination of vegetation mapping completed by Landmark in 2013 and updated by Biolink in 2019 in the Core Koala precinct; habitat mapping derived by Hosking *et al* (2020) using Council's vegetation mapping (Landmark 2013, 2019); and Koala Habitat Information Base Sharing and Enabling Environmental Data (Potential Koala Habitat) (SEED 2019).

Figure 1 displays the 350m grid overlaid on koala habitat used to select candidate sites for survey.

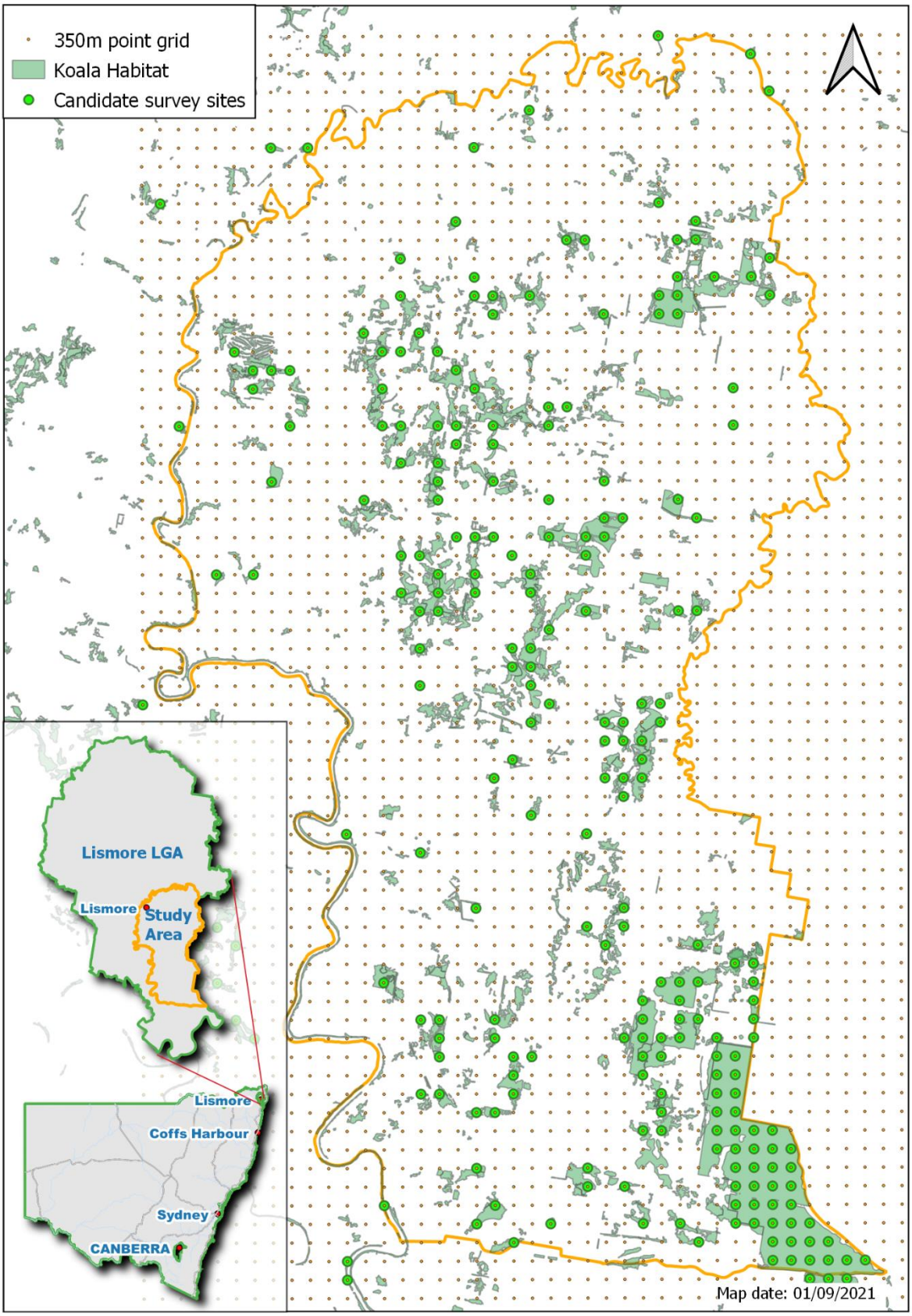


Figure 1 Mapping used to select candidate sites for survey

Subsequently, where access was not granted to candidate sites which were close to a boundary with council land or road reserves, these points were moved onto that land to maximise the number of sites available for survey.

Field Site Selection

A Garmin GPSMAPS 64SX handheld GPS was used in the field to navigate to the pre-selected grid point. If PKFTs or scats were present at that precise location, the closest tree to that grid point was identified as the centre tree and its location was recorded with the GPS. If there were no PKFTs or scats at the pre-selected point, but at least one PKFT was present close by, the site was moved to that tree so long as it did not fall within 350m of another grid point and the new location was recorded. If no PKFTs were found close by within the site boundary and no scats at the original survey location no survey was completed. This ground-truthing of the candidate list of sites in the field resulted in full surveys of a total of 60 sites. Of these 36 were repeat surveys of 2017 field sites. Eight of the sites previously surveyed in 2017 were not resurveyed in 2020 due to access constraints or lack of PKFTs.

Field Sampling

Field sites were sampled using the Spot Assessment Technique (SAT) developed by Phillips and Callaghan (2011). As above, the GPS was used to navigate to the pre-selected sample point in the field where a centre tree was selected. A tree is defined as a live woody stem of any plant species except palms, cycads, tree ferns and grass trees. The 30 trees closest to and including the centre tree, with a minimum diameter at breast height (dbh) of 10cm, were then searched for koala faecal pellets within a 1m radius of the base of the tree. If no pellets were visible on the surface, a small hand rake was used to search through dense leaf litter and search time was standardised as far as possible to 2 minutes per tree.

Each tree was identified to species, where possible. Dbh was measured in cm and the tree was scored as positive or negative for koalas and koala scats.

If sites had insufficient trees to undertake the full SAT a rapid SAT was completed, where 5-7 trees with a minimum dbh of 30cm were sampled to confirm presence/absence of koalas. This ensures that areas which contain low numbers of good quality PKFTs, which may be important koala habitat, are not excluded from survey. In some instances, a targeted tree search was undertaken to confirm the presence/absence of koalas in that area. Where these methods were used, the results are reported separately.

A brief description of the site was recorded to assess the quality of the habitat in terms of its suitability for koalas, i.e. PKFTs are dominant, co-dominant, occasional, etc. Notes were also made on the understorey and ground cover such as the presence of dense lantana, which may restrict movement of koalas, and dense tussocky grassland or litter, which may limit the efficiency of the faecal searches. Cover was ranked into classes based on percentages (0-25%; 26-50%; 51-75%, >75%).

Any signs of disturbance or features which may impact on koalas such as the presence of cattle, evidence of wild dogs, etc. were also recorded.

In addition to the above, a 25m radial search for koalas was completed at each site. If a koala was spotted, the location of the tree it was sitting in was recorded on the GPS. The species and dbh of each tree containing a koala were also recorded, together with information on the koala including life stage, sex, breeding status (if possible) and any evidence of disease.

Any incidental sightings of koalas outside the 25m radial search were also recorded, with the location and information noted above, but these records do not form part of any density estimate.

Landholder Engagement

Survey sites were located on a mix of private and public land. Table 1 outlines the number of sites within each land tenure and the methods of contact for each.

Table 1: Land Tenure, Number of Sites and Method of Contact

Tenure	No.	Communication method
Private – new sites	110	Letter and/or direct call if previous relationship with Environmental Strategies
Private - Repeat Sites	67	Letter and phone call and door knock if no response
Public – Lismore City Council and Road Reserves	5	Internal email to land manager
Public – Flood Refuges and Recreation Trusts	1	Email sent to volunteer management boards. Contacts obtained from Crown Lands
National Parks and Wildlife	15	Email

A copy of the letter sent to private landholders is provided at Appendix 1. Of the 110 of letters sent to new landholders only 23 responses were received.

Field Data Analysis

Koala Activity

The koala 'activity level' at each site was determined by calculating the percentage of the 30 trees searched which scored positive for a koala scat. Activity levels were categorised into three ranks: Low use, Medium (Normal) use and High use, based on activity thresholds developed by Phillips and Callaghan (2011) for medium-high density koala populations on the east coast, but a fourth category (Inactive) was added to be in line with reporting produced by Tweed Valley Council (2019). The activity level at a site indicates how frequently it is used by koalas in the area and therefore gives an indication of whether the site is likely to support a resident population of koalas, or is more likely to be used infrequently, or by low numbers of animals, or only used occasionally by dispersing animals. Table 2 below shows the activity levels referred to in this report and gives an interpretation of each category.

Table 2: Summary of Activity Levels and their Interpretation

Activity Category	Activity Level	Interpretation
High Use	>32.84%	Site regularly used by a resident population of koalas as part of normal ranging behaviour. Significant site of major activity, at higher than normal levels.
Medium (Normal) Use	≥22.52% but ≤32.84%	Site regularly used by a resident population of koalas as part of normal ranging behaviour. Site of major activity at normal levels.
Low Use	>0% but <22.52%	Occasional or transitory use of the site, possibly by dispersing animals, or occupied by only a low density population, possibly due to lower quality habitat
Inactive	0%	Site infrequently used or not used at all by koalas

Scats recorded beneath each tree were also classified as either Intact (outer coating still completely intact) or Degrading (outer coating starting to break down or pierced by an insect). These two categories do not give an accurate indication of the age of scats, as they are known to break down faster in wetland habitats or in areas with abundant invertebrates (Cristescu, R.H. *et al* 2012). However, it does give a simple classification that can be assigned in the field to reduce variability in recording, and gives some indication as to whether koalas repeatedly use the site. Plates 1 and 2 below show examples of scats classified into these two categories.

Plate 1: Examples of Intact Scats

Plate 2: Examples of Degrading Scats

Mapping of Habitat Use and Activity Levels

Maps were created in QGIS v3.10 to display the results of the surveys, showing locations of sites graded as inactive, low, medium or high use in terms of activity levels.

Heat maps, based on the percentage of positive trees recorded at each site, were also created to show 'hot spots' of koala activity. These maps provide an easily interpreted visual display of how koalas are using the landscape across the survey area and which areas are particularly important. The

heat maps were produced automatically in QGIS using a radius of 1km and with maximum value set to auto.

FOK Koala Record Analysis

FOK provided admission records to their Koala Hospital and koala sightings for the Lismore LGA for the period 2017 to 2020. The number of koalas admitted each year from within the CKPoM area were totalled and the relevant percentage due to each cause for admission calculated. For car hits and dog attacks this included individuals that could not be rescued or were already deceased before being admitted, but were actually seen to be hit or attacked. Therefore, admission numbers in the results section of this report include these additional confirmed cases.

All records of koala car hits and dog attacks from 2017 to 2020 across the entire LGA were also reviewed to identify any potential hotspots to be able to address these significant threats to koalas. Maps were produced in QGIS v3.10 to display these records.

A map displaying all koala sightings reported to FOK from within the area covered by the CKPoM over the period July 2017 to December 2020 was also produced.

Limitations

One of the major limitations of the koala field survey was due to the majority of land being in private ownership. Therefore, even though the methods use a regular grid-based survey design to give even coverage of the CKPoM area for surveys, in reality this was not achievable in the field due to access restrictions. This has resulted in clustered survey sites in some areas and none in others, which means that the heat map needs to be interpreted with extreme caution as areas showing no koala activity may be due to no sites being surveyed in the vicinity, rather than koalas not being present.

Other limitations encountered in the field during the surveys could have affected the efficiency of the sampling. These included the presence of dense shrubs, vines or grasses which made raking around the entire perimeter of a tree impossible in some instances. Several snakes were also encountered when raking, so where these were found sampling of that tree ceased. Extensive ant nests and tunnels under some trees also limited the efficiency of scat searches. Due to these limitations, it is possible that some scats could have been missed. However, as these limitations only affected a small number of trees, it is not considered that this would materially affect the findings of this survey. Dense weedy sites dominated by camphor and privet also restricted visibility for the radial search for koalas.

In addition to the limitations mentioned above, in some sites it was not possible to positively identify all trees to species, as no buds or fruiting capsules could be found. Tree identification was also complicated by the high number of eucalypts which have been planted around the Lismore LGA, but do not necessarily naturally occur in this area.

Some limitations were encountered in analysing and mapping the data from FOK as accurate locations were not always available, particularly for older records.

RESULTS

Field Survey

A total of 83 sites were visited in the field. Full SAT surveys were completed on 56 of these sites within the CKPoM area and a further four sites within the wider LGA. Of the remaining 23 sites visited, 18 contained no PKFTs; one could not be accessed; one contained only five PKFTs so it was only possible to complete a rapid SAT; and at the final three targeted scat searches were carried out under a number of PKFTs.

Table 3 below summarises the number of field sites fully sampled within each land tenure, and clearly shows that the majority of survey sites are within private landholdings.

Table 3: Summary of Field Sites within each Land Tenure

Tenure	Sites
Private Land	44
Council owned/managed	13
Nature Reserve (NPWS)	3
Total	60

Koala Activity

Of the 60 sites fully surveyed (including the four outside the CKPoM), koala activity was recorded at 95% (n=57), leaving only three sites where no evidence of koala activity was found. A breakdown of the activity levels recorded across the sites is shown in Table 4 below. This suggests that 74% of sites surveyed support resident populations of koalas (medium and high activity levels), while 57% of sites surveyed display higher than normal levels of activity. The three inactive sites were all located north of the Bruxner Highway. A summary of the results is provided at Appendix 2.

Table 4: Breakdown of Koala Activity Levels

Activity Level	Number	Percentage
High Use	34	57%
Medium (Normal) Use	10	17%
Low Use	13	22%
Inactive	3	5%

Figure 2 below shows the distribution of the 60 sites fully surveyed together with their activity levels.

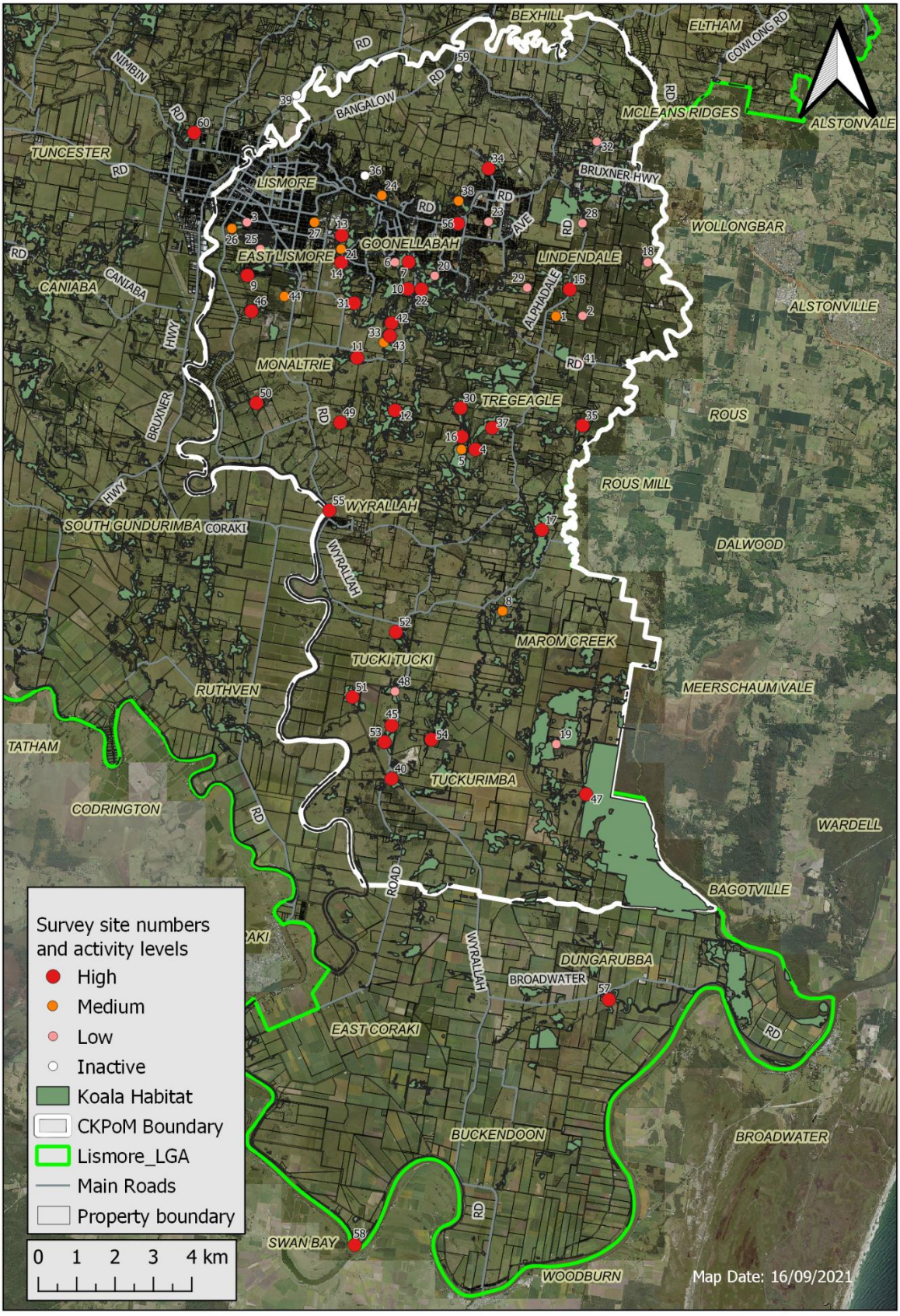


Figure 2: Koala activity levels (high, medium, low) across all surveyed sites (n=60).

Koala presence was also recorded at five other sites visited, but where a full survey was not completed, as well as at a couple of roadside trees randomly checked for scats. The location of sites visited with no PKFTs and / or where only a rapid SAT or targeted search were undertaken is displayed in Figure 3 showing whether koala scats were recorded or not.

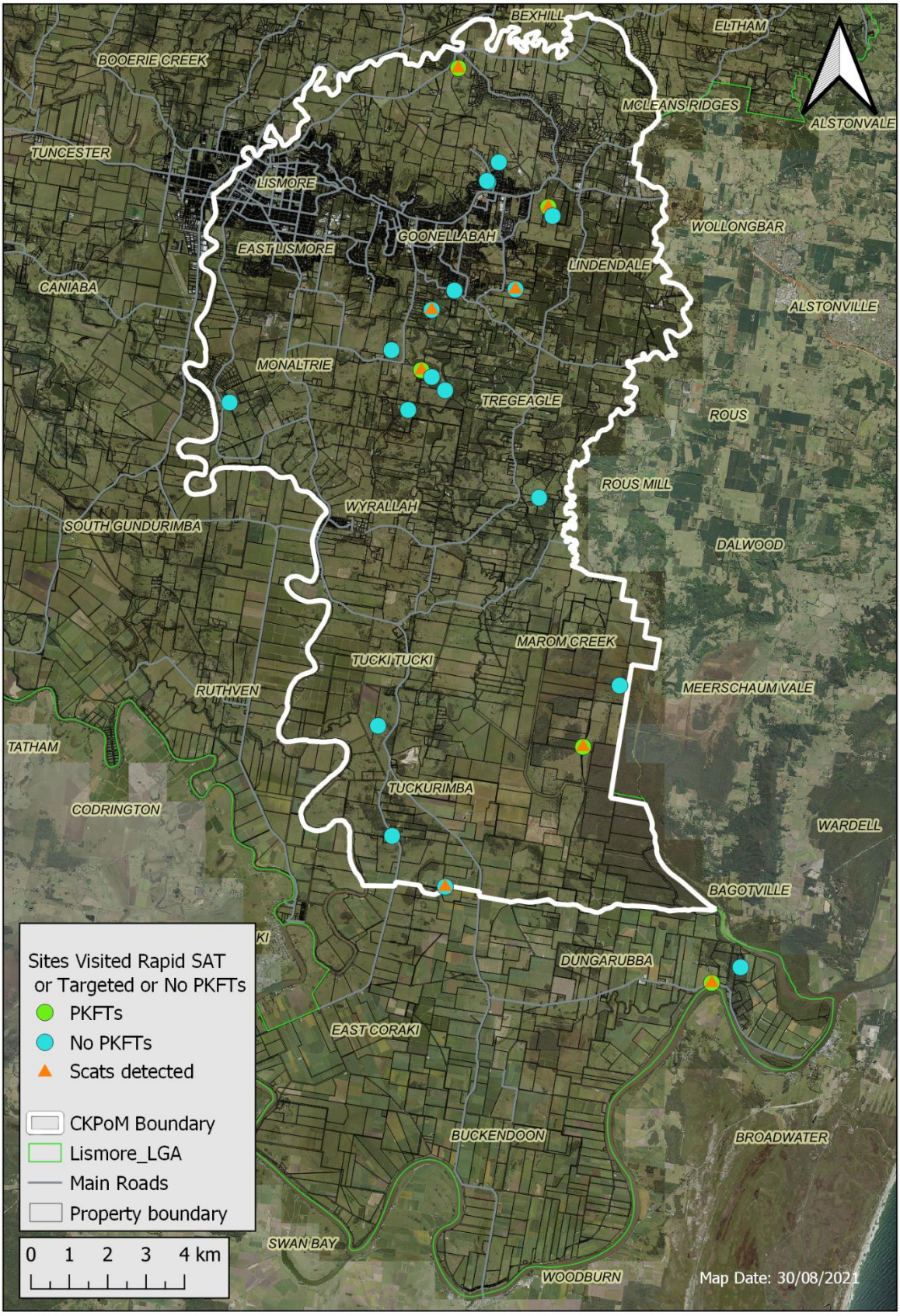


Figure 3: Sites Visited with No PKFTs, rapid SAT or Targeted Tree Search

As different survey methods were used in the 2017 and 2020 surveys, the results are not directly comparable. However, evidence of koala activity was recorded at all 36 of the sites previously surveyed, although 11 were recorded as inactive in 2017.

Koala Activity (CKPoM Area Only)

Only two inactive sites were recorded within the CKPoM area. As above these were both north of the Bruxner Highway. One was at Bexhill in a grazed paddock with scattered mature forest red gums, which appeared to be of good quality for koalas. The other was in Goonellabah where the site was in a steep, overgrown gully with a dense layer of lantana and asparagus vine. Forest red gum was the only primary food tree present and there were no secondary species recorded. 90% of the trees checked for scats were not koala food trees at this latter site.

The low activity sites appeared to be located mainly in the east of the CKPoM area where the habitat is more fragmented. Several of these were in windbreaks which contained the only PKFTs in an area heavily dominated by macadamia plantations. Other low activity sites included two active construction sites, sites in more heavily urbanised areas and dense, weedy sites with no current management. However, two of the sites which displayed only low levels of activity supported what appeared to be good quality habitat for koalas - one a paddock with scattered mature tallow trees and the other the koala reserve at Tucki Tucki.

Areas of medium and high activity were largely concentrated in three areas – between East Lismore down to Skyline Road in Monaltrie, a block of sites further to the south-east in Tregeagle and between Tucki Tucki and Tuckurimba further to the south. More isolated pockets of high activity were recorded in Green Forest in the south-east where there appear to be very few PKFTs but, where these are present, there is heavy use and activity is high. Others are in a band of vegetation extending along the east side of Grennan Road from north to south.

At the Bora Ring in Tucki Tucki, which contained a high percentage of forest red gums and an unidentified planted gum, scats were found under all 30 trees surveyed, giving 100% strike rate, and included fresh and old scats.

Conversely a site in Goonellebah, heavily dominated by privet and camphor, also displayed high levels of activity (60%), even though there were no PKFTs recorded and only 17% of trees raked were a secondary species, mostly brushbox *Lophostemon confertus*. However, this site was in close proximity to good quality habitat with abundant PKFTs. Another site in Goonellabah which was behind housing and was dominated by camphor with a dense, closed canopy, showed 67% activity level, even though 83% of trees searched were camphor. Only one forest red gum and three tallowwoods were recorded in this area. Photographs showing examples of some of the sites surveyed are provided in Appendix 3.

Although, as previously stated, the heat map reproduced at Figure 4 below must be interpreted extremely cautiously, it does show the main areas of koala activity identified from the field surveys.

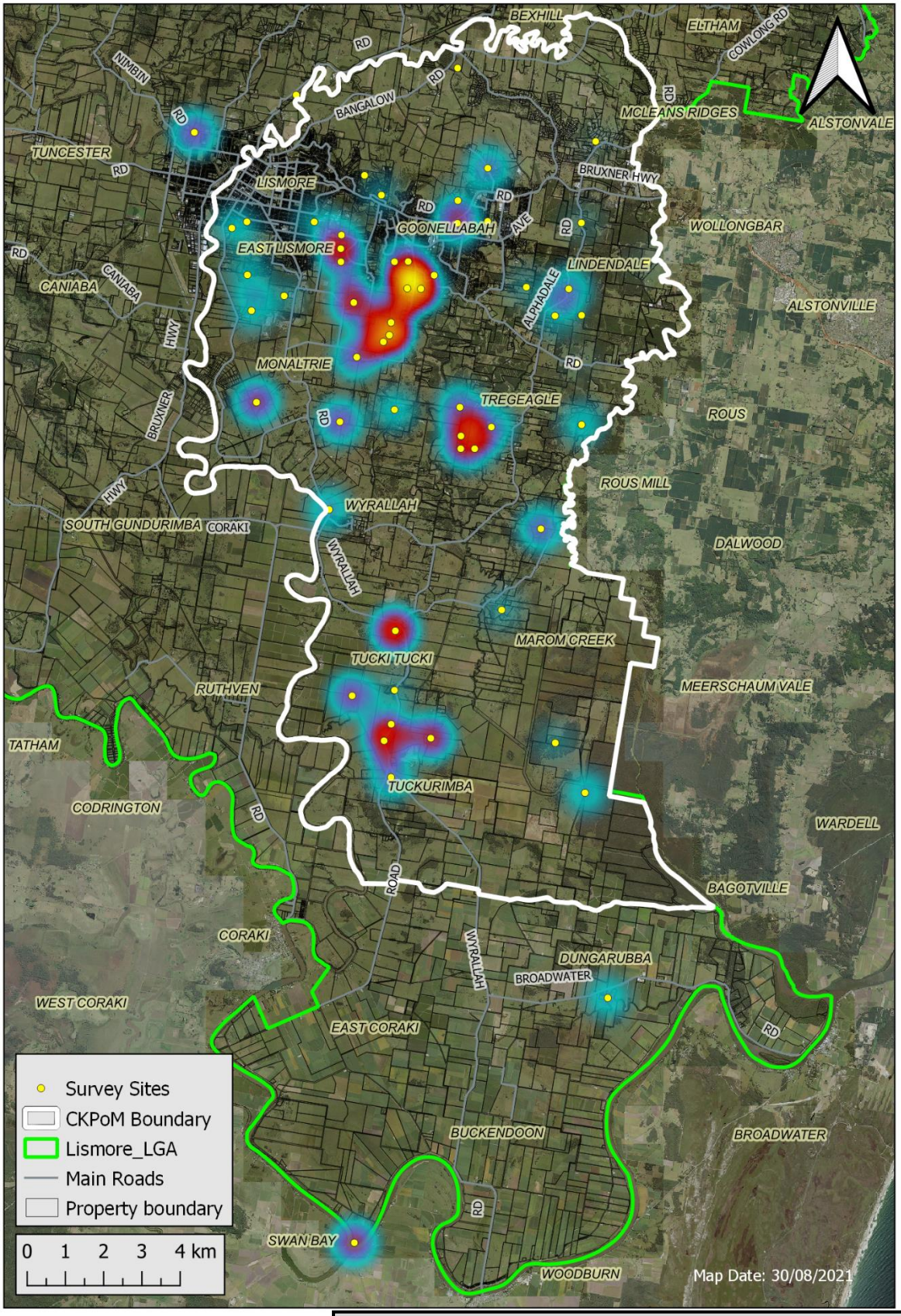


Figure 4: Heat Map of koala activity.

DISCLAIMER: This map should be viewed only in the context of this study. The map represents activity levels at surveyed sites only and does not indicate lack of activity elsewhere.

The main area of activity was recorded in a block of continuous vegetation running from the grounds of Southern Cross University (SCU) in the north heading south and east across to Skyline Road and north towards Goonellabah. In this area the majority of sites were in the high activity level, with scores of more than 60%. Two other blocks of major activity are shown around Tregeagle, mostly associated with a block of vegetation connected to Boggy Creek and either side of Wyrallah Road between Tucki Tucki and Tuckurimba. The site at the Bora Ring along Wyrallah Road, which scored 100%, is also shown as a hot spot of activity on the map.

An area around four sites in Lindendale, where the landscape is dominated by macadamia farms, has also been picked up in the heat mapping as important. Three of these four sites are windbreaks and the other is a lawned area adjacent to a house and macadamia farm with planted eucalypts, which highlights the importance of retaining scattered food trees and tallow windbreaks in an otherwise hostile landscape.

Koala Sightings and (Density) (CKPoM Area Only)

Eight koalas (7 adults and 1 joey) were recorded within the 25m radial searches in the 56 sites surveyed within the CKPoM area. Therefore 7 adult koalas were recorded within 10.98ha (0.196ha x 56) which equates to a density estimate of 0.64 koala/ha. This compares to 0.36 koalas/ha estimated in 2017 from the 25m radial searches. No obvious signs of disease were noted in any of these koalas in 2020, although some were too high in the tree to see clearly. One mother and joey were recorded together, and it appeared that one other female may have had a joey in the pouch but, due to a restricted view, this could not be confirmed so has not been included in the numbers.

Incidental records of koalas were also recorded and in addition to the eight koalas recorded within the radial search, another 22 koalas were sighted within the CKPoM area, giving a total of 30 koalas recorded in the CKPoM area. Several of these showed potential signs of ill health. A breakdown of the age, sex and health status of these koalas is given in Table 5 below with total numbers. Figure 5 shows the location of all koalas sighted during the survey, including those outside the CKPoM boundary.

Table 5: Incidental Sightings of Koalas within CKPoM Area

Life Stage		Sex			Health		
		Male	Female	Unknown	Healthy	Sick	Unsure
Adult	19	7	8	4	7	4	8
Juvenile	1	0	1	0	1	0	0
Joey	2	0	0	2	2	0	0
Total	22	7	9	6	10	4	8

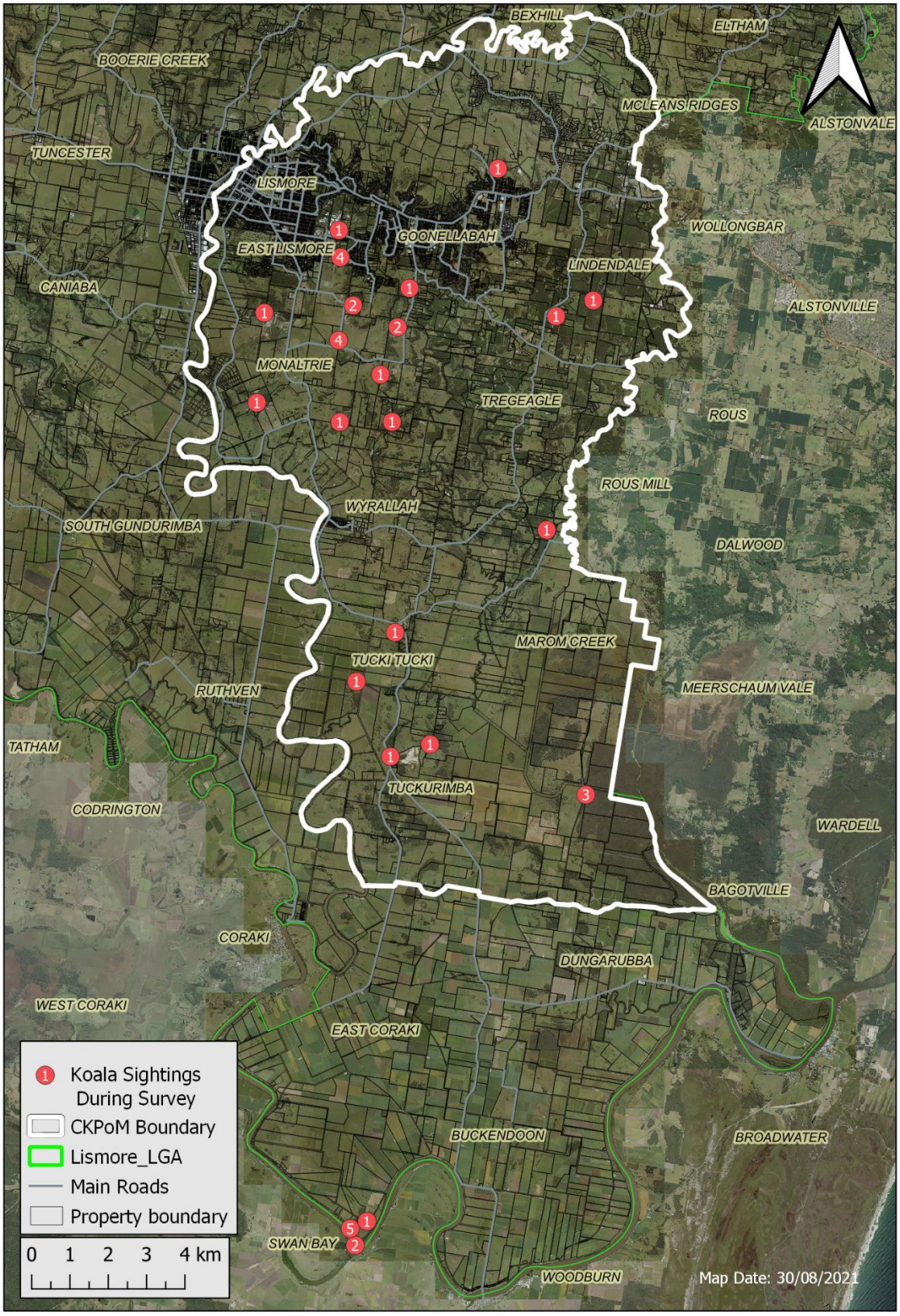


Figure 5: Location of koalas sighted during surveys (number of individual koalas recorded shown numerically within location markers (red circles))

The majority of koalas sighted were around sites with high activity levels. Eighteen (47%) were recorded in East Lismore and Monaltrie, largely in a block of connected trees running from Southern Cross University in East Lismore south and east towards Skyline Road and included four koalas (3 adults and one large joey) in a single forest red gum tree along Skyline Road. One of these koalas appeared to be in poor condition. Another male also recorded along Skyline Road appeared to have an injury or tumour and was rescued and taken to Friends of the Koala. Four koalas were recorded around Tucki Tucki to Tuckurimba and two koalas east of Alphadale Road in Lindendale, close to sites with medium and low activity levels. Only one koala was recorded north of the Bruxner Highway in Goonellabah. Interestingly although the habitat around Green Forest in the south-east of the CKPoM area appears to support few of the primary food trees, three koalas were sighted in a grazed area of land with only three or four forest red gums on the edge of a melaleuca swamp. These were a mum and joey in one tree and an adult male in another, which indicates that a resident, breeding population occurs in that area.

An adult female with joey was also recorded on SCU grounds in East Lismore, confirming a breeding population in this area.

Sites and Koalas Outside CKPoM

Four of the sites fully surveyed were outside the boundary covered by the CKPoM. Of these, one was inactive while the other three all displayed high levels of activity.

The inactive site outside the CKPoM area was on the north bank of the Richmond River in North Lismore. The site was very weedy and dominated by dense privet and coral tree and contained only four forest red gums which had little foliage. No other secondary tree species were recorded.

The three high activity sites were widely spaced, with one in the north-west of Lismore, one just outside the southern boundary of the CKPoM at Kilgin and the other down in the south-west corner near the Richmond Valley border.

The site in the north-west was heavily dominated by privet on a steep, rocky slope, but scats were recorded beneath 20 of the 30 trees (67%), although the majority of these scats were degrading. The site at Kilgin was situated right on the edge of a creek which had recently been flooded, so it is possible that some scats could have been washed away. Again, the majority of scats recorded were degrading, with only one intact scat found. The site contained a high percentage of PKFTs (forest red gums 40%) plus secondary tree species (26%) but searching for scats was inhibited by a dense covering of cabbage palm leaves. While walking into the site it was noted that there was a lot of natural regeneration of forest red gum in the adjacent meadow/paddock.

The final site in the far south-west of the LGA was also in a riparian area heavily dominated by coral tree, which constituted 80% of trees searched, while only two PKFTs (forest red gums) and four secondary koala food trees were recorded. However, scats were found beneath 23 of the 30 trees surveyed giving an activity level of 77% and two koalas were recorded within the radial search. An additional six koalas (including two joeys) were also seen on the property and recorded as incidental sightings, confirming a breeding population. This total of eight koalas represents 21% of all koalas recorded during the entire survey.

Records Analysis - Admissions

Analysis of FOK records confirms that disease is still the main cause for koalas being taken into care in the Lismore area. Across the whole LGA chlamydial disease accounted for between 38% to 44% of admissions annually between 2017 and 2020, with other disease adding another 7%-13% each year. Car hits is the next major threat with around 18%-20% of admissions over this period due to being hit by a car, although there was a spike in 2018 to 28%. Attacks by dogs, although a much smaller proportion of admissions overall, are still a significant contributor with between 5% and 8% of admissions annually.

More than half the koalas admitted to FOK each year from the Lismore LGA come from within the CKPoM area, with percentages varying between 56% to 64% of the total annually over the 2017 to 2020 recording period. Table 6 shows a breakdown of the relative proportions of each cause of admission from the CKPoM area only, with the total number of admissions per year in the final row.

Table 2: Relative proportions for each cause of admission from the CKPoM area

Cause	2017	2018	2019	2020
Abandoned/Dependent on parent	5.8%	0.8%	2.8%	1.4%
Dog attack	8.0%	5.3%	6.3%	4.1%
Attack other	2.2%	0.8%	3.5%	1.4%
Collision car	16.1%	28.0%	19.0%	17.2%
Disease Chlamydia	43.1%	43.2%	47.2%	44.1%
Disease other	6.6%	8.3%	7.7%	8.3%
Entanglement	0%	0.8%	0.7%	0%
Drought	0.7%	0%	0%	2.1%
Extreme heat	0%	0%	0%	0.7%
Flood	1.5%	0%	0%	0%
Fallen from tree	3.6%	0%	2.1%	2.1%
Unknown	3.6%	6.1%	4.2%	2.8%
Unsuitable environment	7.3%	6.8%	6.3%	15.9%
Unknown injured	1.5%	0%	0%	0%
TOTAL NUMBERS	**137**	**132**	**142**	**145**

Figures 6 and 7 respectively display the locations of koala car hits and dog attacks across the whole LGA for the period 2017 to 2020.

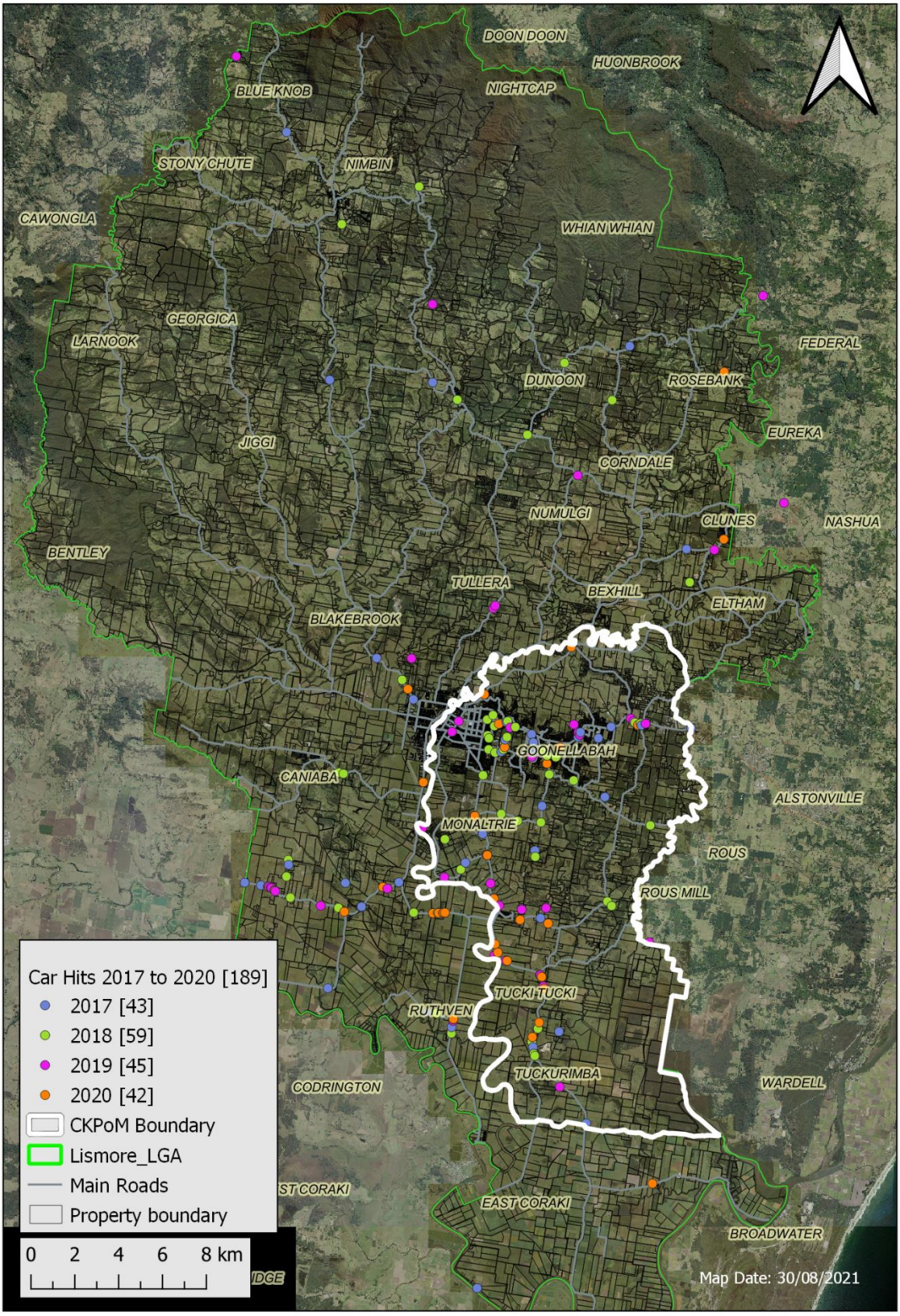


Figure 6: Location of Car Hits across Lismore LGA between 2017 and 2020

Between January 2017 and December 2020, a total of 189 confirmed koala car hits were reported to FOK across the whole LGA. Of these 74% (N=140) resulted in death, while another 5.8% (N=11) could not be captured so their fate remains unknown. Almost twice as many males (N=113) as females (N=58) were hit by cars and 13 of the females had joeys. In some cases it was not possible to confirm the sex of the koala due to its condition (N=19). The actual number of koalas hit by cars will be higher than the reported figure, as not all koalas are reported to FOK and it is not always possible to confirm collision with a car as being the cause of an injury.

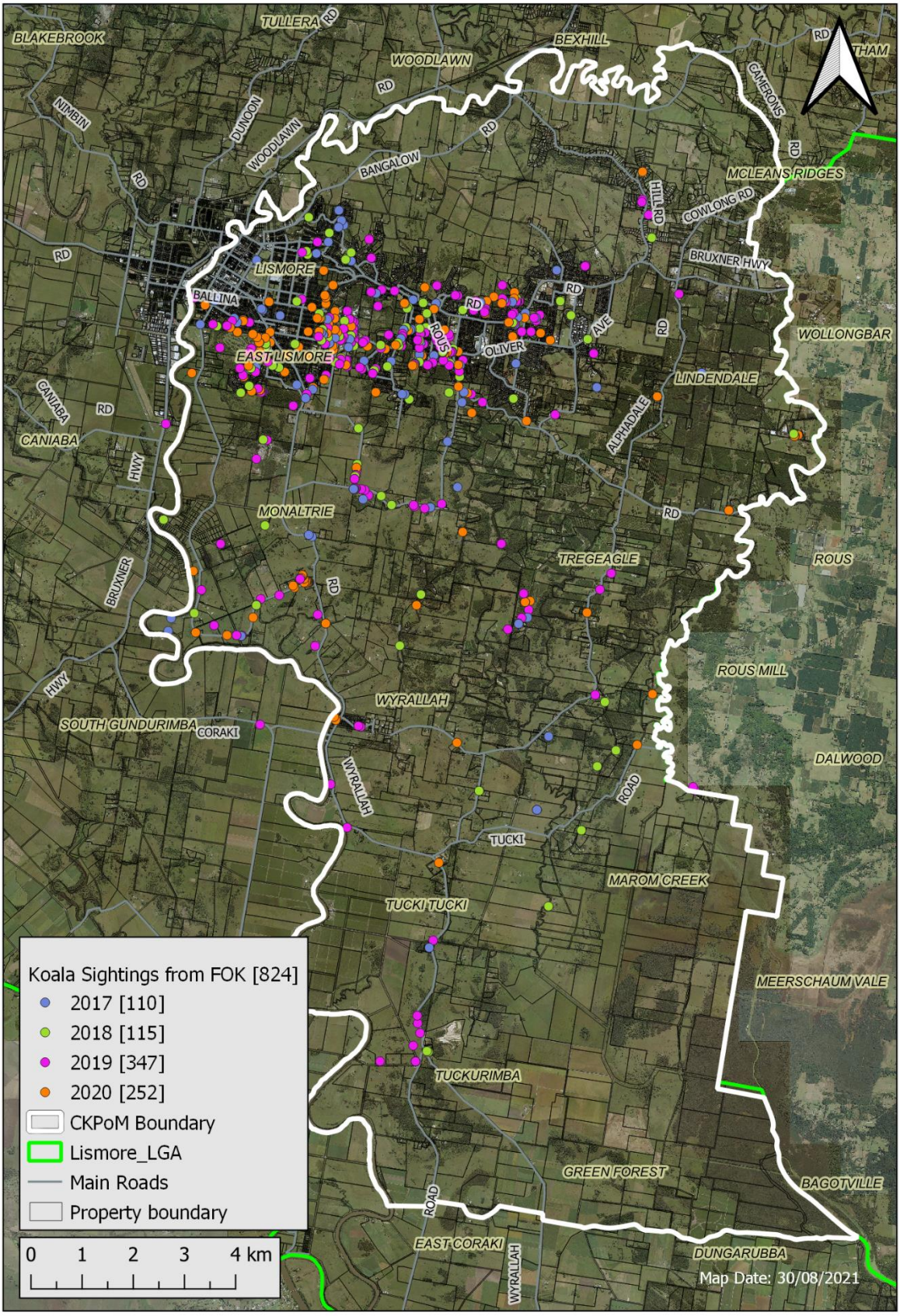
Most reported car hits are on the busier roads where more people are likely to see koalas and report them. Wyrallah Road has several main clusters of car hits, with 11 koalas hit along the section between Tucki Road and Tuckurimba Road between 2017 and 2020, six of which were in a stretch less than 500m long. Another section south of Wyrallah Ferry Road between a bend in the river and Wyrallah Chapel, approximately 1km in length, accounted for five koala car hits in the last two years. Two more clusters along Wyrallah Road are at the junctions with River Bank Road and Durheim Road, where five and three koalas respectively have been hit between 2017 and 2020.

The Bruxner Highway has several sections where koalas are regularly hit. Between Richmond Hill Road and Cowlong Road/Alphadale Road junction seven koalas were hit between 2017 and 2020, with collisions occurring each year. Another five koalas were hit on the Bruxner in the vicinity of the Goonellabah Tavern over the same period.

One of the main collision hotspots identified is also on the Bruxner Highway, although outside the CKPoM area, at McKees Hill. Between 2017 and 2020 FOK received reports of 21 koalas hit between Coraki Road and Fig Tree Lane, as well as an additional five koalas hit close to the highway on side roads along this section. One 2.2km section of this road was responsible for 11 of the 21 koala car hits.

Two other clusters of car hits, also outside the CKPoM area, occur along Coraki Road. One between Flood Reserve Road and Pelican Creek in Ruthven, where seven koalas have been reported hit by cars over the record period, and the other west of the junction with Wyrallah Ferry Road, where eight koalas have been hit in the last two years.

As a point of note, three koalas have also been hit along a section of Skyline Road where exclusion fencing is in place.


BLAKEBROOK
TULLERA RD
BEXHILL
WOODLAWN
RD
NIMBIN
DUNOON
WOODLAWN
BANGALOW
RD
CAMERONS
MCLEANS RIDGES
HILL RD
COWLONG RD
BRUXNER HWY
LISMORE
BALLINA
EAST LISMORE
OLIVER
AVE
WOLLONGBAR
LINDENDALE
ALPHADALE
CANIABA
HWY
MONALTRIE
TREGEAGLE
ROUS
BRUXNER
ROUS MILL
WYRALLAH
SOUTH GUNDURIMBA
CORAKI
DALWOOD
TUCKI
MAROM CREEK
TUCKI TUCKI
MEERSCHAUM VALE
TUCKURIMBA
GREEN FOREST
BAGOTVILLE
EAST CORAKI
DUNGARUBBA
Koala Sightings from FOK [824]
2017 [110]
2018 [115]
2019 [347]
2020 [252]
CKPoM Boundary
Lismore_LGA
Main Roads
Property boundary
0 1 2 3 4 km
Map Date: 30/08/2021

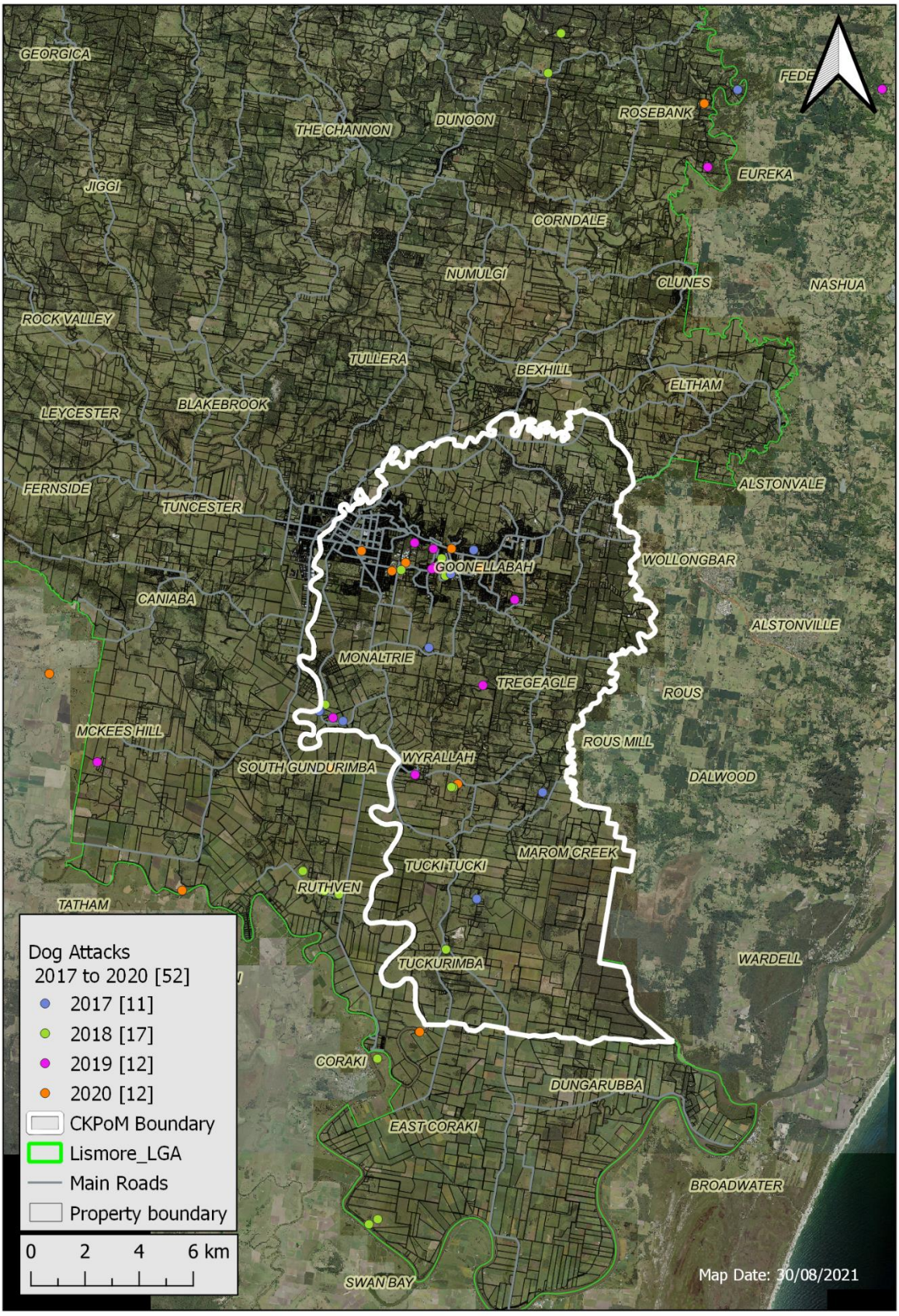


Figure 7: Location of dog attacks across Lismore LGA between 2017 and 2020

Between January 2017 and December 2020, a total of 52 koalas were reported to FOK as being attacked by dogs. Of these, 75% (N=39) resulted in death, while another 13% (N=7) could not be captured so their fate remains unknown. As with car hits, the number is likely to be higher than the reported figure. The majority of dog attacks (63%) occurred within the CKPoM area, with most around East Lismore/Goonellabah and south around the Wyrallah area. There have been five reports of dog attacks along River Bank Road with three in 2017 and one each in 2018 and 2019.

Outside the CKPoM area there was a cluster of four dog attacks along Flood Reserve Road in 2018, and several scattered through the north of the LGA around the Federal, Rosebank, Dorroughby area.

Records Analysis - Sightings

In addition to the above admission figures, koala sightings across the LGA are also recorded. Figure 8 below displays the total number of koala sightings reported to FOK across the entire LGA, together with the numbers from within the CKPoM area, and Figure 9 displays the location of sightings reported within the CKPoM area between July 2017 and December 2020. As can be seen more than half the sightings every year come from within the CKPoM area. The spike in 2019 in the number of sightings submitted to FOK resulted from the high profile koalas received in the media following the drought and terrible fires across Australia.

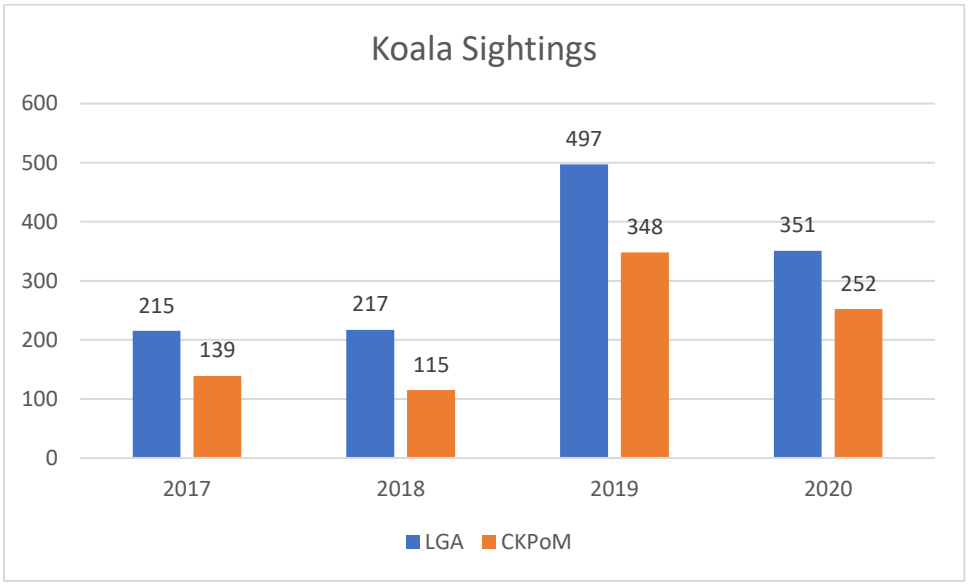


Figure 8: Numbers of Koala Sightings Across the Entire LGA and Within the CKPoM Area

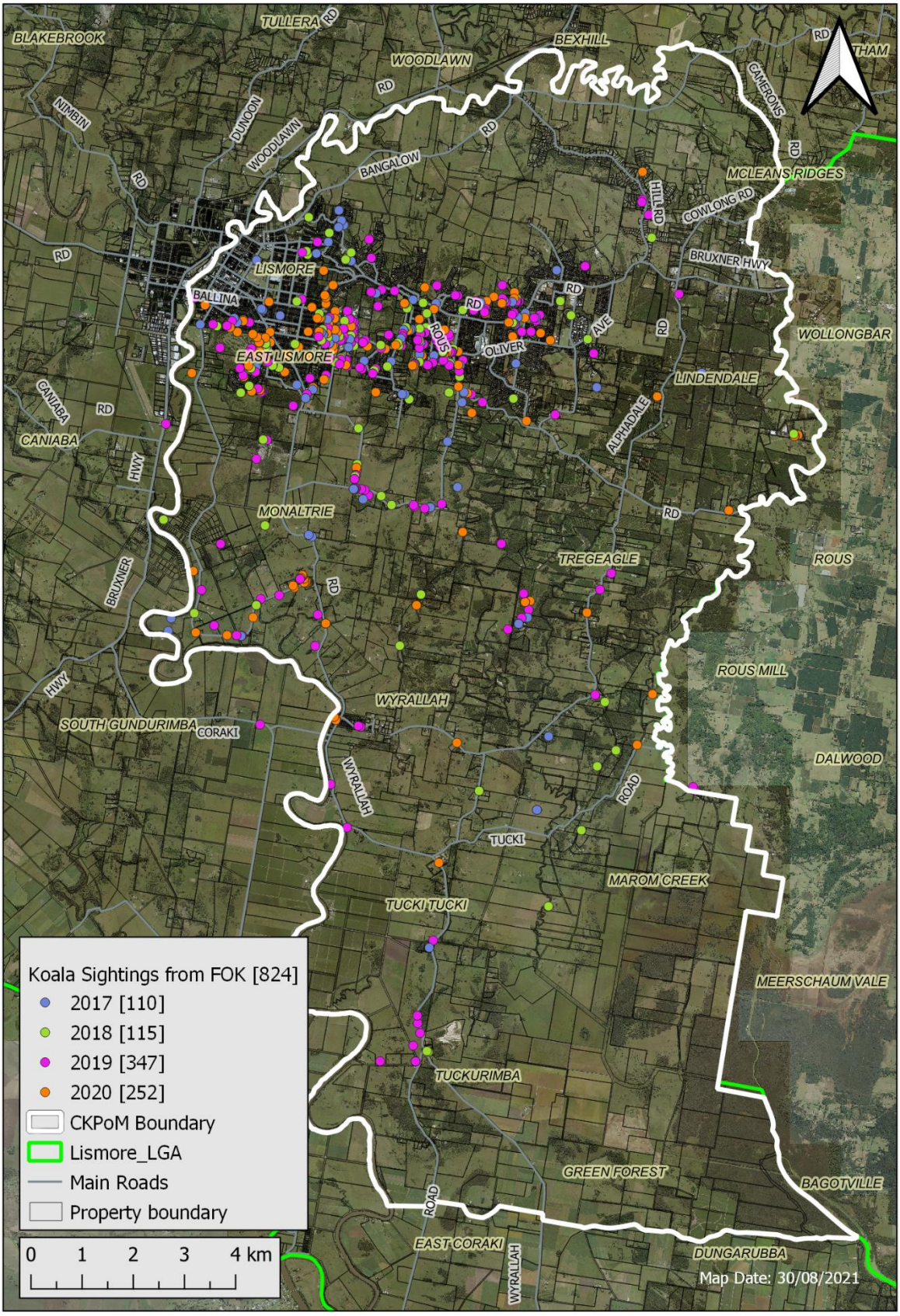


Figure 9: Location of Koala Sightings reported to FOK within the CKPoM Area

DISCUSSION

Survey Findings

Although due to different survey methods being used the results from the 2020 surveys are not directly comparable with those from 2017, it is interesting to note that koala scats were found at 11 of the sites where no evidence of koala activity was recorded in 2017. Only low levels of activity were recorded at five of these sites in 2020, but medium and high levels of activity were recorded at four and two of these sites respectively, indicating resident populations of koalas use these areas. A koala was also recorded in a radial search of one of the previously negative sites. The majority of these medium and high sites fall within two of the three main hotspots of activity identified on the heat map. However, as previously mentioned, due to the irregular survey coverage, areas showing low or no koala activity are likely to be due to a lack of access for surveys in that area, rather than a lack of koalas.

The difference in the 2020 results compared to 2017 is unlikely to be due to an expansion of koala occupancy or increase in numbers in these areas, but more likely due to the different survey methods used. In 2017 only a rapid SAT was completed at sites, which requires searching of only 5-7 PKFTs as opposed to searching a full 30 trees. Future monitoring surveys should pick up any changes in levels of koala activity across the CKPoM area using the full SAT method.

Sites surveyed varied widely in terms of proportions of PKFTs, secondary trees and other tree species searched for scats, but evidence of koalas was found in 57 of the 60 sites surveyed in full. Some sites that contained a high percentage of good quality PKFTs had no evidence of use by koalas, while other sites with very few PKFTs and dominated by non-native species such as camphor, showed high levels of activity. This makes it very difficult to reach any meaningful conclusions in terms of koala habitat, other than koalas are widespread in the Lismore LGA and are surviving in what appear to be sub-optimal habitats. In the east of the CKPoM area, where natural habitat is now highly fragmented due to the extensive coverage of macadamia plantations, koalas were found to be using all six windbreaks surveyed, two of which showed high levels of activity. The windbreaks are largely dominated by tallow, with no other primary food species visible in the wider surroundings. Evidence of koalas was also recorded in several residential gardens with eucalypts scattered across mown lawns. This highlights the importance of windbreaks and scattered, isolated trees to koalas as a food source, as well as a safe corridor for moving from one area to another.

In the south-east of the CKPoM area around Green Forest, again the importance of isolated scattered food trees was highlighted when three koalas were recorded in a small pocket of forest red gums in an area totally dominated by broad leaved paperbark (*Melaleuca quinquenervia*). In another site, just to the north and heavily dominated by swamp box (*Lophostemon suaveolens*) a small patch of five forest red gums was found. Scats were recorded under every one of these red gums, which were showing signs of overbrowsing. One tree in particular had very little foliage remaining (Plate 3) and a dense layer of koala scats, both intact and degrading, was visible around the entire base of the tree (Plate 4), showing its importance to the local koala population.

Plate 3. Overbrowsed forest red gum

Plate 4: Dense layer of koala scats around overbrowsed forest red gum

Despite containing good quality habitat, with numerous mature tallowwoods, only a low level of koala activity was recorded at Tucki Tucki Koala Reserve on Wyrallah Road, and all the scats that were found were already degrading. This site was designated as a reserve for koalas in 1963 as it was well known for its population of resident koalas which were closely monitored. The lack of current activity at this site could be due to a combination of historical actions, which included translocating all the koalas out of the reserve in the 1970s due to concerns of overbrowsing (NPWS 2008), and the high number of koalas that have been hit by cars along Wyrallah Road.

The vast majority of koalas sighted were in forest red gums. Of the 38 koalas sighted in total during the field surveys, which includes those outside the CKPoM area, 23 (60%) were recorded in forest red gums while another was recorded in a coral tree that was physically connected to a forest red gum. Four koalas were recorded in flooded gum *Eucalyptus grandis*, three in brushbox and three in an unidentified eucalypt, possibly Sydney blue gum *Eucalyptus saligna.* A single koala was also recorded in each of lemon scented gum *Corymbia citriodora,* white mahogany *E.acmenoides*, tallowwood *E.microcorys* and a blue lilly pilly *Syzygium oleosum*. It is not known if the high number of koalas recorded in forest red gums is due to it being a highly preferred food tree in this area, or if it is due in part to its open canopy, which makes it easier to spot koalas compared to some other tree species.

There is some protection for koala food trees through planning policy in relation to developments but camphor laurel, a non-native weedy species, is understandably often a target for clearing. Although it is not identified as an important food tree for koalas, it does provide good quality shade during periods of hot weather and is frequently used by koalas, as evidenced by several survey sites heavily dominated by camphor laurel with few PKFTs but with medium or high levels of koala activity. These levels of activity in camphor forest highlight the potential for koalas to be seriously injured, or even killed, during the removal of non-food trees, as there is generally no requirement to check for the presence of koalas prior to their removal.

High activity sites also included dense weedy areas with privet, dense lantana and cockspur. A koala was recorded at the top of a large forest red gum which was totally surrounded by a dense covering of lantana, which obviously suggests that this does not represent a significant deterrent to koala movement. However, dense weeds may limit the opportunity for natural regeneration of PKFTs and, in the case of dense infestations of asparagus vine and others, even kill important food trees which could have in impact on local koala populations. This appears to be a particular issue along riparian areas which are important habitats for koalas, as well as valuable corridors for dispersal.

Landholder Comments

Many landholders commented that they have experienced a significant decline in koala numbers over the years. Although only anecdotal, this was a common theme amongst those landowners that were encountered in the field. Comments from landholders on the potential reasons for decline include wild dogs, fencing, sub-division fragmenting habitat and a significant increase in traffic.

One landholder along Skyline Road commented that her father used to sit all day long watching a continual line of koalas moving past the house but that they have declined to next to nothing over the years and very few are seen now. Another landholder in Marom Creek used to see 5 or 6 koalas every day along his driveway compared to only two in the whole of 2020. He commented that the numbers have declined sharply due to roadkill. Similarly a big decline was reported in Tregeagle over the last 10 years where one landholder used to see 3 or 4 koalas every day, but now feels lucky to see one. A landholder along Wyrallah Road in Monaltrie commented on the increase in traffic, saying that you used to have wait over 1 hour for a car to pass, whereas recently he counted over 70 cars in 10 minutes, and rarely sees koalas now.

A site in the far south-west of the LGA, outside the CKPoM area, supports high numbers of koalas even though suitable habitat is very limited in the surrounding area. According to the landholder many mature trees have died over the last couple of years following the droughts, particularly tallowwoods, and now the forest red gums are starting to die due to overbrowsing by the high number of koalas on the site.

Threats

Habitat loss remains the major issue affecting koalas across Australia, with wildlife conservation often losing out to the competing requirements of development, agriculture and forestry. Although the population of koalas in Lismore is widespread and they occur at a higher density than encountered in other coastal LGAs (Biolink 2017) koalas in the Lismore area are frequently encountered in sub-optimal habitats. This may account, in part, for the high incidence of chlamydial disease in the LGA, as high levels of stress can lead to suppression of the immune system. The loss of and fragmentation of habitat is also largely the reason so many koalas are hit on the roads or attacked by dogs, as they have to move greater distances on the ground between suitable trees/areas of habitat, where they are more vulnerable to these threats. A review of aerial photography shows that the larger blocks of trees along Wyrallah Road are all concentrated close to the road, which is likely to account for the high incidence of car hits in these areas.

Disease remains the major cause of koalas coming into care in the Lismore region. However, there is much optimism surrounding the chlamydia vaccine, which is currently being trialled in Queensland and northern NSW, and it is hoped that a steady reduction in the number of diseased animals will be seen in the near future following vaccination of rehabilitated animals prior to release.

Although on the surface Lismore's koala population appears to be doing well, there is insufficient historical data available to reach an informed conclusion as to whether numbers are stable, increasing or declining. As can be seen from the landholder comments, even though Lismore currently supports a higher than average population of koalas, which is widespread across the LGA, there is no room for complacency. FOK admits approximately 400 koalas a year from their licensed area, the majority of which do not survive due to their injuries or advanced state of disease. This level of loss from the local population cannot be sustainable in the long term. Habitat loss remains a very real and ongoing threat, which is likely to be magnified by climate change, with increases in drought and bushfires. As koalas have been recorded in a wide variety of habitats, it makes it very difficult to predict where they may or may not be impacted by future development, so increasing the availability of good quality, connected habitat across the LGA is critical.

There are currently many groups involved in habitat restoration, regeneration and planting suitable habitat for koalas in strategic areas to maximise safe habitat connections as wildlife corridors. Everyone has a part to play in preserving the koala in the wild into the future and can help by retaining and planting suitable trees, taking care when driving, not only in identified koala zones but also along unlit rural roads, and keeping dogs contained at night when koalas are more likely to be roaming.

RECOMMENDATIONS

As this report will form the baseline for future monitoring of koalas in the CKPoM area, no comparisons can be made with previous reports to identify any changes in the distribution or abundance of koalas, so only general recommendations can be made.

For future monitoring surveys, it is recommended that attempts are made to incorporate new sites into the field study to address gaps in the landscape, and to try to identify the boundaries of and/or habitat connections between the major areas of activity, particularly between the Tregeagle and East Lismore/Goonellabah hotspots.

The importance of tallow windbreaks and isolated paddock trees to koalas needs to be addressed in planning policy documents. These features are generally overlooked in terms of koala habitat and when identifying potential impacts on koalas from tree removal. The development of a Significant Tree Register for the LGA may help to address this issue.

Community support is critical for the long-term survival of the koala, so incentives should be made available to encourage and support the local community and community groups to plant more koala habitat and create safe wildlife corridors across the region.

Weed infestations are killing valuable PKFTs, so support should be provided to landholders and local community groups to undertake weed control in their areas. This is a major issue in riparian areas which are important wildlife corridors and particularly susceptible to weed invasion.

Make sure that landholders are aware of the high use of camphor laurel trees by koalas and that checks for the presence of koalas are required immediately prior to their removal.

Urgently address the major car hit hotspots along Wyrallah Road, the Bruxner Highway and Coraki Road. Plant more koala food trees away from roads to provide more habitat and encourage koalas away from roadkill hotspots.

Seek funding to undertake koala surveys in the north of the LGA which has been largely unsurveyed systematically, to identify critical areas of koala activity.

Encourage everyone to report their koala sightings to FOK, as these records can be used to gain a better understanding of where koalas are and how they are doing in Lismore and other areas, and the data can be used to support koalas in many ways.

ACKNOWLEDGEMENTS

Council would like to thank those Lismore LGA landholders who kindly provided access to their property for survey work and National Parks and Wildlife Service for consent to work on their Nature Reserves. We would also like to acknowledge Friends of the Koala for providing records of koala admissions and sightings for analysis in this report and the field survey team. Thanks also go to Marama Hopkins at Tweed Valley Council and Nicole Gallagher at DPIE for advice in relation to the survey methods to ensure consistency in recording.

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APPENDIX I – Copy of letter sent to private landholders

Our ref: CDR20/7539

Contact: Angie Brace

4 September 2020

Name»
Postal_Street_»
Postal_Suburb»

Dear Sir/Madam

Lismore City Council Koala Study - «Property_Address_No» «Property_Address»

Lismore City Council is undertaking a koala survey in the south-east of the Local Government Area (LGA) and is seeking approval from landholders to access survey sites which are located on private land.

In 2013, Lismore City Council adopted a comprehensive Koala Plan of Management for south-east Lismore. This plan aims to protect the koala population found in the south-east of the LGA, which is considered one of the most significant on the NSW North Coast. To complement this plan Council is undertaking a field study to collect data on koala distribution and activity levels of koala populations across 20,870 hectares. The information gained in this study will help guide management decisions for the koalas in this fragmented landscape and assist in ongoing monitoring of koala populations.

I am writing to you as your property has been selected as containing a potential field study site. Council will undertake the survey between October and December 2020, and completion of each survey site will take approximately 1 hour. The survey technique being used involves undertaking a search for koala scats (or faeces) under 30 trees within a defined area, in addition to a search for koalas within that area. Sites are located at least 350m apart so most properties will contain only one survey site.

Council is seeking your permission to access your property for the purposes of the study. If you approve, Council would appreciate you contacting us by email angie.brace@lismore.nsw.gov.au. by **Friday, 30 September 2020.** If you would like more information about the study please contact Angie Brace on 1300 87 83 87.

Yours sincerely

Angie Brace

APPENDIX 2 – Summary Field Results

New Site Ref	Old site ref		Coordinates		2017	2020	Percentage Positive	Activity Rank	Koala in Radial Yes / No
1	LIS106	56J	535178	6809623	Negative	Positive	30	Medium	Yes x 1
2	LIS102	56J	535872	6809635	Positive	Positive	3	Low	No
3	LIS051	56J	527121	6812080	Positive	Positive	10	Low	No
4	LIS042	56J	533077	6806146	Negative	Positive	40	High	No
5	LIS025	56J	532713	6806147	Negative	Positive	27	Medium	No
6	LIS111	56J	530979	6811035	Positive	Positive	10	Low	No
7	LIS112	56J	531338	6811040	Positive	Positive	67	High	No
8	LIS005	56J	533783	6801931	Negative	Positive	23	Medium	No
9	LIS098	56J	527134	6810691	Positive	Positive	33	High	No
10	LIS010	56J	531314	6810338	Positive	Positive	87	High	Yes x 1
11	LIS056	56J	529994	6808541	Negative	Positive	67	High	No
12	LIS057	56J	530980	6807167	Positive	Positive	40	High	No
13	LIS050	56J	529592	6811734	Positive	Positive	33	High	No
14	LIS085	56J	529578	6811033	Positive	Positive	47	High	No
15	LIS113	56J	535537	6810326	Positive	Positive	50	High	No
16	LIS110	56J	532717	6806480	Positive	Positive	37	High	No
17	LIS077	56J	534808	6804051	Positive	Positive	60	High	No
18	LIS046	56J	537570	6811028	Negative	Positive	7	Low	No
19	LIS037	56J	535185	6798454	Negative	Positive	20	Low	No
20	LIS103	56J	532017	6810682	Negative	Positive	7	Low	No
21	LIS009	56J	529575	6811378	Positive	Positive	30	Medium	No
22	LIS054	56J	531671	6810329	Positive	Positive	77	High	No
23	LIS094	56J	533416	6812091	Positive	Positive	3	Low	No
24	LIS095	56J	530638	6812778	Positive	Positive	23	Medium	No
25	LIS096	56J	527470	6811377	Positive	Positive	7	Low	No

26	LIS031	56J	526728	6811916	Positive	Positive	30	Medium	No
27	LIS125	56J	528881	6812078	Positive	Positive	30	Medium	No
28	LIS126	56J	535867	6812052	Negative	Positive	13	Low	No
29	N/A	56J	534428	6810371	N/A	Positive	20	Low	No
30	LIS121	56J	532690	6807232	Positive	Positive	60	High	No
31	LIS053	56J	529915	6809968	Positive	Positive	87	High	Yes x 1
32	LIS062	56J	536241	6814183	Negative	Positive	7	Low	No
33	LIS101	56J	530688	6808942	Negative	Positive	27	Medium	No
34	LIS048	56J	533420	6813482	Positive	Positive	53	High	No
35	LIS023	56J	535872	6806774	Positive	Positive	40	High	No
36	N/A	56J	530197	6813295	N/A	Negative	0	Inactive	No
37	N/A	56J	533514	6806713	N/A	Positive	53	High	No
38	N/A	56J	532638	6812635	N/A	Positive	23	Medium	No
39	N/A	56J	528409	6815397	N/A	Negative	0	Inactive	No
40	N/A	56J	530889	6797554	N/A	Positive	57	High	No
41	N/A	56J	535783	6808391	N/A	Positive	7	Low	No
42	N/A	56J	530890	6809446	N/A	Positive	60	High	No
43	N/A	56J	530847	6809117	N/A	Positive	70	High	No
44	N/A	56J	528095	6810143	N/A	Positive	23	Medium	No
45	N/A	56J	530893	6798943	N/A	Positive	33	High	No
46	N/A	56J	527240	6809757	N/A	Positive	37	High	No
47	N/A	56J	535962	6797149	N/A	Positive	43	High	Yes x 2
48	LIS073	56J	530980	6799832	Positive	Positive	20	Low	No
49	N/A	56J	529552	6806851	N/A	Positive	67	High	Yes x 1
50	N/A	56J	527371	6807360	N/A	Positive	73	High	Yes x 1
51	N/A	56J	529872	6799687	N/A	Positive	70	High	No
52	N/A	56J	531003	6801385	N/A	Positive	100	High	Yes x 1
53	N/A	56J	530708	6798511	N/A	Positive	77	High	No
54	N/A	56J	531930	6798576	N/A	Positive	83	High	No
55	N/A	56J	529272	6804556	N/A	Positive	47	High	No

56	N/A	56J	532625	6812043	N/A	Positive	63	High	No
Outside	CKPoM								
57	LIS076	56J	536558	6791785	Positive	Positive	43	High	No
58	N/A	56J	529931	6785384	N/A	Positive	77	High	Yes x 2
59	N/A	56J	532632	6816100	N/A	Negative	0	Inactive	No
60	N/A	56J	525747	6814418	N/A	Positive	67	High	No

APPENDIX 3 – Site Photos

Site 10. High Use Site. Dominated by PKFTs
Koala in tree with dense lantana at base

Site 17. High Use Site. Dominated by brushbox.

Site 36. Inactive site. Dense, weedy gully, 10% PKFTs.

Site 60. High Use Site. Steep slope. Dominated by dense privet (80%). Only 20% PKFTs.

Site 47. High Use Site. Open area on edge of paperbark swamp. Site dominated by swamp box. Only two forest red gums present with little foliage. Overbrowsed.

Site 49. High Use Site. Dominated by Hoop Pine. Only 20% PKFTs. By dry river. Koala Present.

Site 51. High Use Site. Wetland. Dominated by Swamp Box. One small patch with forest red gum

Site 55. High Use Site. Riparian. Heavily dominated by coral tree with some camphor. Only 3 forest red gums present. One large mature tree on roadside, adjacent to road hit hotspot.

Site 52. High Use Site. 100% Trees with Koala Scats. Planted Eucalypts. Bora Ring.