Canine scent detectives promoting koala population health in Jaliigirr Corridors- Phase 2.

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CANINES FOR WILDLIFE

Report prepared for Jaliigirr Biodiversity Alliance Inc. and Coffs Harbour City Council.

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Contents

Executive Summary

Jaliigirr Biodiversity Alliance and Canines for Wildlife received funding from the Coffs Harbour City Council Environmental Levy Grant 2021-2022 to continue koala scent detection dog surveys in the Sawtell-Toormina-Boambee area, following on from surveys in 2020-21. The funding supported koala scat detection surveys, collection of additional genetic material and genetic analysis of the koala scats collected between 2020-2022.

The targeted sites were within four mapped koala habitat linkages:
Linkage 1: Bongil Bongil NP west via RMS underpass, Titans close, south Boambee;
Linkage 2: Hogbin drive west via RMS underpass to Englands Road and
Linkage 3: Boambee East/Toormina Links: north of Lyons Road, Linden Av, Water Towers and Bruce King Drive.
Linkage 4: West to east sections Bongil Bongil National Park across highway.

Phase 1 (2020-2021) scent detection surveys were completed between September 2020 and March 2021 whilst Phase 2 (2021-2022) scent detection surveys were completed between August 2021 and June 2022.

Twelve sites were surveyed in Phase 2, including return surveys to seven sites from Phase 1 where no scats had been recorded or fresh scats sampled.

Across Phase 1 and 2, a total of 23 sites were surveyed within the four corridor linkages, 74% of the sites had koala scats and 231 scat locations were recorded identifying areas of high koala activity. Forty-seven percent of the positive koala scat sites had fresh koala scat samples collected.

Forty-six koala scat samples were sent to the University of Sunshine Coast (USC) and Diversity Arrays Technology (DArT) for genotyping and analysis. Twenty-nine samples were used to identify individual koalas and six of these were duplicate individuals. Of the 23 individual koalas, 12 were male and 11 female, a sex ratio very close to 1:1. Eight koalas were possibly carriers of the chlamydial pathogen and three were very likely to be carrying the pathogen. The spread of the chlamydial pathogen was even across the landscape, noting that the presence of the pathogen does not equate to the clinical signs of disease (USC 2022).

Population structure was assessed, though the results need to be interpreted with caution due to the small sample size. There are three probable ancestral populations; which is high for a relatively small area (USC 2022). The differences between the groups could reflect genetic clusters of individuals that are genetically more similar to each other. It was noted that if translocated individuals were included in the data set this may influence the “natural” population genetic patterns. There also appears to be a some sub-structuring in this group of koalas particularly north-south of Bonville Creek (USC 2022). The genetic diversity of the sampled Coffs koalas was favourably comparable with other documented koala populations and the degree of inbreeding was lower than the compared populations which is a promising result for the Coffs population (USC 2022, Kjelden et al. 2016).

There appears to be some genetic similarity of groups between koalas east and west of the highway but reflecting the sub-structures identified north and south of the Bonville Creek. There did not appear to be genetic differences due to geographic isolation (USC 2022). This clearly highlights the importance of enhancing and maintaining east-west linkages across the Pacific Highway.

The scat detection surveys clearly demonstrated that koalas are intensively utilising the available koala habitat on public and private lands within the Sawtell-Toormina-Boambee urban and peri-urban area, highlighting the importance of these habitats and movement corridors for sustaining koalas into the future. Coffs Harbour Council reserves link koala habitat in Bongil Bongil National Park north to koala habitat on private land, council and other government land parcels providing important corridors that allow koalas to move and access resources such as food and breeding opportunities.

The use of scent detection dog surveys to map koala habitat usage, activity and genetic analysis has proven to be highly effective. The information provided by the mapped habitat usage, koala activity and genetic diversity, health and relatedness will provide a valuable resource for the improved management and conservation of koala populations in the Toormina-Sawtell-Boambee-Bongil area.

The Coffs Harbour-Bellingen koala population is known to be regionally significant. There would be value in expanding this study elsewhere in the Jaliigirr Corridor, to enable a more informed understanding of the habitat usage within the corridor, genetic diversity and health of this regionally significant koala population. This information could then assist in delivering improved koala conservation and management.

Acknowledgements

Canines for Wildlife thank the Coffs Harbour City Council, NSW National Parks and Wildlife Service and private landholders for support and access to sites. Thanks to Sally Whitelaw and Sally Spunner (CHCC), Justin Couper (JBA), John Turbill (DPE), Martin Smith (NPWS) and Karla Gillies TAFE NSW for assistance with access, planning, logistics and site orientation.

The Coffs Harbour City Council Environmental Levy Grant 2020-21 provided funding for Phase 1 of the project which was delivered through a collaboration between Jaliigirr Biodiversity Alliance and Canines for Wildlife. The Coffs Harbour City Council Environmental Levy Grant 2021-2022 provided funding for Phase 2 of the project which was delivered by Jaliigirr Biodiversity Alliance and Canines for Wildlife and the University of the Sunshine Coast.

Canine scent detectives supporting koala population health in Jaliigirr Corridors.

Project description

The Sawtell-Toormina-Boambee area is known to support an important but fragmented koala population (Lunney et al. 1999). The study focused on the peri-urban, semi-rural and habitat linkage corridors. The project aimed to assess koala activity, genetic diversity, health and habitat usage across the mapped koala habitat and linkage corridors (Figure 1 and 2). Koala activity was assessed through intensive scat detection surveys with a trained koala scent detection dog. Koala scat locations were recorded and mapped. Fresh scat material was collected and sent for genetic analysis.

The targeted sites were within four mapped koala habitat linkages:

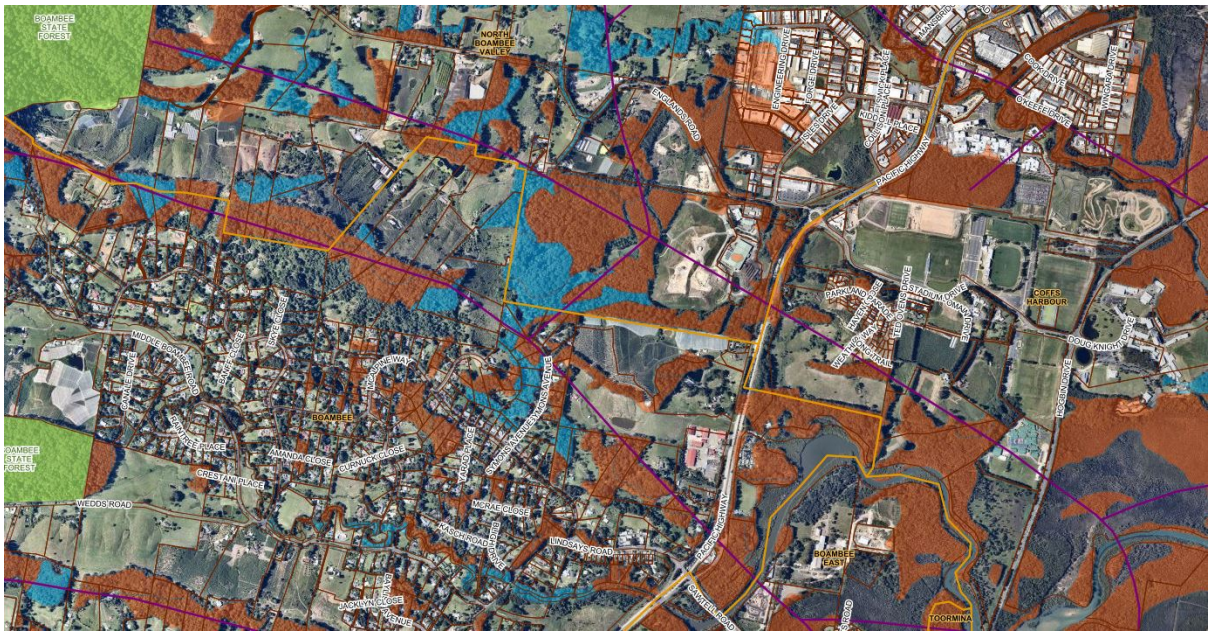
Northern Linkage 2 - Hogbin drive west via RMS underpass to Englands Road and

North-South Linkage 3 - Boambee East/Toormina Links: north of Lyons Road, Linden Av, Water Towers and Bruce King Drive.

Southern Linkage 1 - Bongil Bongil NP west via RMS underpass, Titans close, south Boambee;

Southern Linkage 4 - West to East Bongil Bongil National Park.

Figure 1: Koala mapped habitat and northern corridor linkages (Coffs Harbour City Council).



Key= Orange – Primary Koala Habitat, Blue- Secondary Koala Habitat, Linkages – Purple lines

Figure 2: Koala mapped habitat and southern corridor linkages (Coffs Harbour City Council).

Key= Orange – Primary Koala Habitat, Blue- Secondary Koala Habitat, Linkages – Purple lines

Methodology

The focus areas for survey were identified by a working group including Coffs Harbour City Council (CHCC), Department of Planning, and Environment (DPE), Jaliigirr Biodiversity Alliance (JBA) and Canines for Wildlife (Figures 1 and 2). In Phase 2, locations for additional survey sites were focused in areas where scat material was not located or collected in Phase 1 (Map 3). Linkage 4 survey locations were included to increase the opportunity to collect genetic material from the east and west side of the Pacific Highway.

The Canines for Wildlife survey team comprised Lynn Baker, Jack Nesbitt and Max a certified koala scat detection dog (Canine Detection Certification of Australia).

Each site was divided into 1hectare plots which were systematically searched for koala scats using a 200m x 50m belt transect. The scent detection dog worked off leash, controlled by voice, whistle and hand signals and worked closely with his handler, coursing in zig zag fashion using his nose to locate the presence of koalas and their scats. When a scat was located the dog indicated with a passive response of lying down with his nose near the scat. He was rewarded by playing with a tennis ball. The CFW scent detection dogs are trained to be safe with wildlife.

The detection dog wore an identifying harness to inform the public that it is a koala detection dog as well as a GPS tracking collar. The handler used a Garmin GPS to record the detection dog search

tracks and GPS locations of the koala scats. Weather conditions were recorded to assist in planning surveys as the distance from the scat that the detection dog can detect odour is influenced by weather conditions including temperature, relative humidity, wind direction/speed, cloud cover and rainfall.

The koala scats were recorded in age classes of Fresh: covered in mucus, wet or dry, shiny and dark with distinct green or yellow interior; Moderate – non-shiny but with structural integrity, Old-weathered exterior, crumbly and dried out interior or powdered remnants. The rate of scat decay can vary significantly based on factors such as ground layer and litter structure and moisture, rainfall history over sampling period, invertebrate and vertebrate mammal activity eg bandicoot diggings, burrows (Rhodes et al 2011, Cristescue et al 2018, OWAD 2020).

Fresh koala scats were carefully collected in accordance with the Koala Health Hub collection protocol to minimise abrasion and contamination of the scat. The scats were labelled and placed in a cold esky until they were transferred to a freezer to be stored for genetics analysis.

Due to COVID 19 border closures impacting transport companies; there were delays in transporting the samples for analysis, as the transport chain had to ensure the samples stayed frozen in transit. The frozen koala scat samples were shipped in November 2021 to the University of the Sunshine Coast (USC) laboratory for preparation of the genetic material.

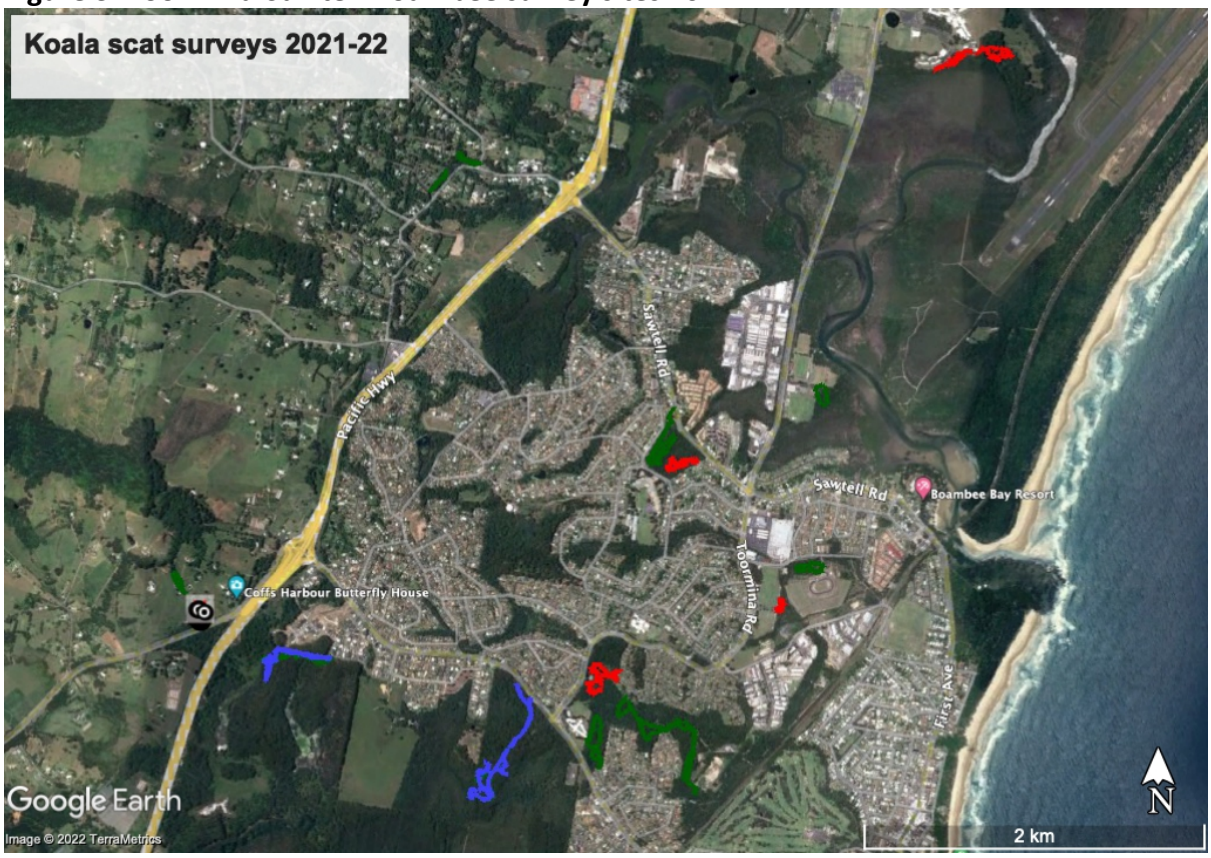
The koala scat samples were then held frozen at the USC laboratory until prepared for analysis in April 2022. The koala scats were processed in the USC Detection Dogs for Conservation genetics laboratory, DNA extracted and sent to the genotyping provider Diversity Arrays Technology, Canberra (DArT) in May 2022. The analysis of the results of genotyping was completed by USC in June 2022. The Coffs Harbour Koala Survey-Genotyping from Scats report (Hohwiesler, Levengood and Cristescu 2022) is referred to as the USC report within this document and is attached as a supporting technical document.

Koala Scat Detection Survey Results

Phase 2 Survey Results (2021-2022)

Twelve sites were surveyed between August 2021 to June 2022, including return surveys to seven sites from Phase 1 where no scats had been recorded or fresh scats sampled (Table 1). Five of these sites were sample twice during Phase 2.

Figure 3: Toormina-Sawtell-Boambee survey sites 2021-22



Five new sites included the Southern Cross Tertiary Campus, Toormina sports field and Toormina velodrome, and two west and eastern linkages within Bongil Bongil National Park.

In Phase 2 the detection dog searched 56.6kms across the 12 sites. A total of 30 separate koala scat locations were recorded on seven of the 12 sites (Table 1). Seven fresh scat samples were collected and stored for genetic analysis (Table 2).

Site 8 at Titans Close was surveyed on the 30 August 2021 with no scats recorded then resurveyed on 3 October 2021 where five scat locations were detected but no fresh scat material was located.

Site 23 at the Coffs Harbour Tertiary Campus was surveyed in June 2022. Six scat locations were recorded with multiple scats sighted. Unfortunately, a dead male koala was located on one of the sites, west of the TAFE campus. The koala was in a state of decomposition so was not collected for autopsy. However, photographs were taken and ear tissue samples were collected and frozen for future genetic analysis.

Weather conditions varied across the survey period, with temperatures ranging from 12 to 28 degrees Celcius, and relative humidity ranging from 49 to 82%. Average wind speed varied from zero to 4.8 k/hr.

Heavy rain events throughout 2021-2022 impacted on the condition of the koala scats and would have degraded or destroyed scats on the ground at the time. Surveys were halted for a period of time after heavy rain to allow time for new koala scat material to accumulate.

Of the four sites surveyed within Linkage 1, all but one recorded koala presence. However, fresh scats were only located at the Bongil Bongil NP site. Both sites in Linkage 2 had koala scats recorded but no fresh scats collected. Linkage 3 had two sites surveyed but no koala scats were located and Linkage 4 had both sites with koala scat records and fresh koala scats collected.

Table 1: Koala records for sites surveyed in Phase 2

Habitat Linkage	Linkage description	Site No.	Kms searched	Scats recorded	Scat collected	Comments
Linkage 1	Bongil Bongil NP west via RMS underpass, Titans close, south Boambee	7	8.1	Yes	Yes	
		8	3.4	Yes	No	Koala sighted in vicinity
		11	7.2	Yes	No	
		14	13.8	No	No	
Linkage 2	Hogbin drive west via RMS underpass to Englands Road.	5	2.5	No	No	
		9	4.3	No	No	
		17	0.7	Yes	No	
		23	9.7	Yes	No	A dead male Koala found (tissue collected and frozen)
Linkage 3	Boambee East/Toormina Links: Lyons Road side of Bongil Bongil NP, Linden Av Water Towers, Bruce King Drive	20	0.7	No	No	
		21	1.3	No	No	
Linkage 4	West-east Bongil	19	2.2	Yes	Yes	
		22	2.7	Yes	Yes	
Total			**56.6**	**7**	**3**	

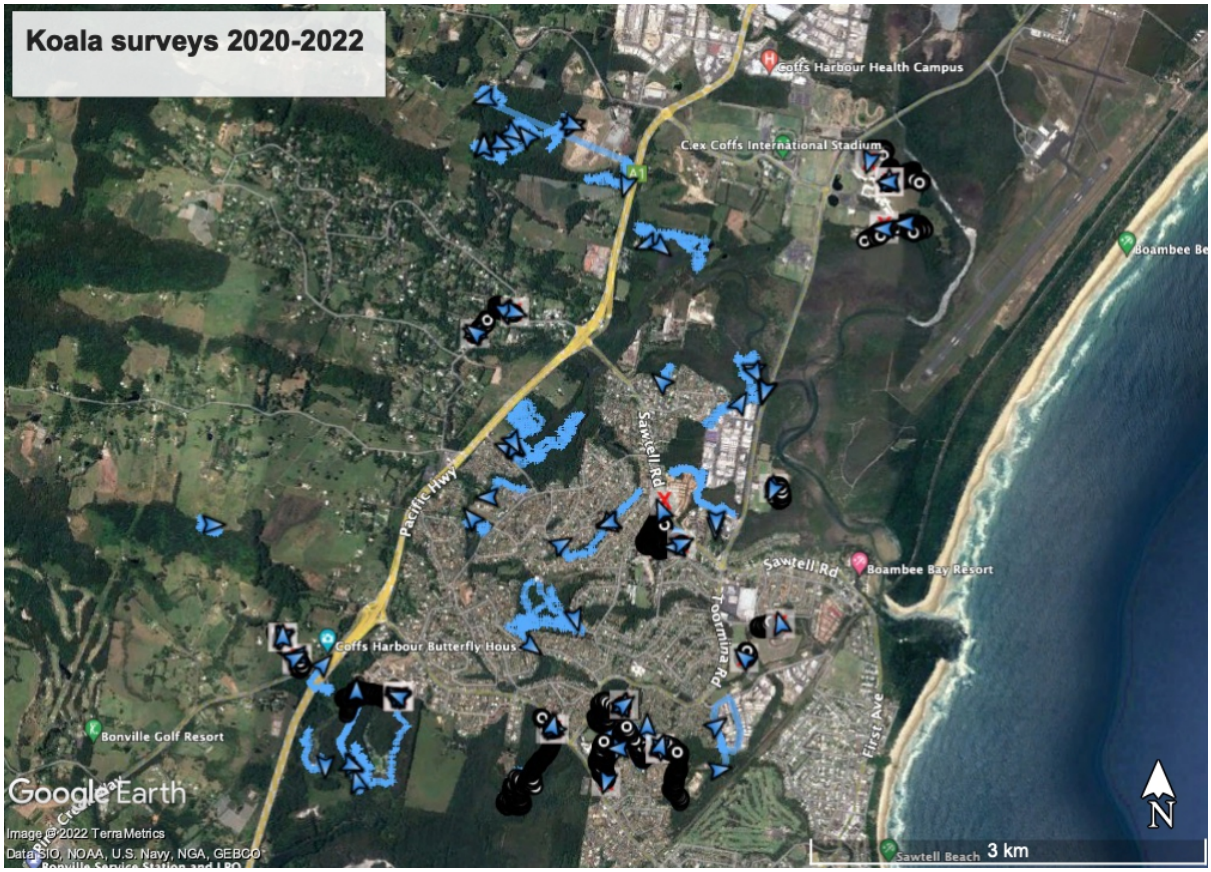
Table 2: Number of koala scat locations and samples collected per site

Habitat Linkages	Site No.	Kms searched	No. of scat locations	No. of fresh genetic samples
Linkage 1	7	8.1	3	1
	8	3.4	5	0
	11	7.2	4	0
Linkage 2	17	0.7	1	0
	23	9.7	6	0
Linkage 4	19	2.2	9	5
	22	2.7	2	1
Totals		**34**	**30**	**7**

Combined koala scat survey results 2020-2022

Across Phase 1 and 2, a total of 231 scat locations were recorded across the 23 sites. Figure 4 shows the overview of sites surveyed within the Toormina-Sawtell-Boambee area. The sites and presence of koala scats are presented in Table 3.

Figure 4 Toormina-Sawtell-Boambee survey sites 2020-22



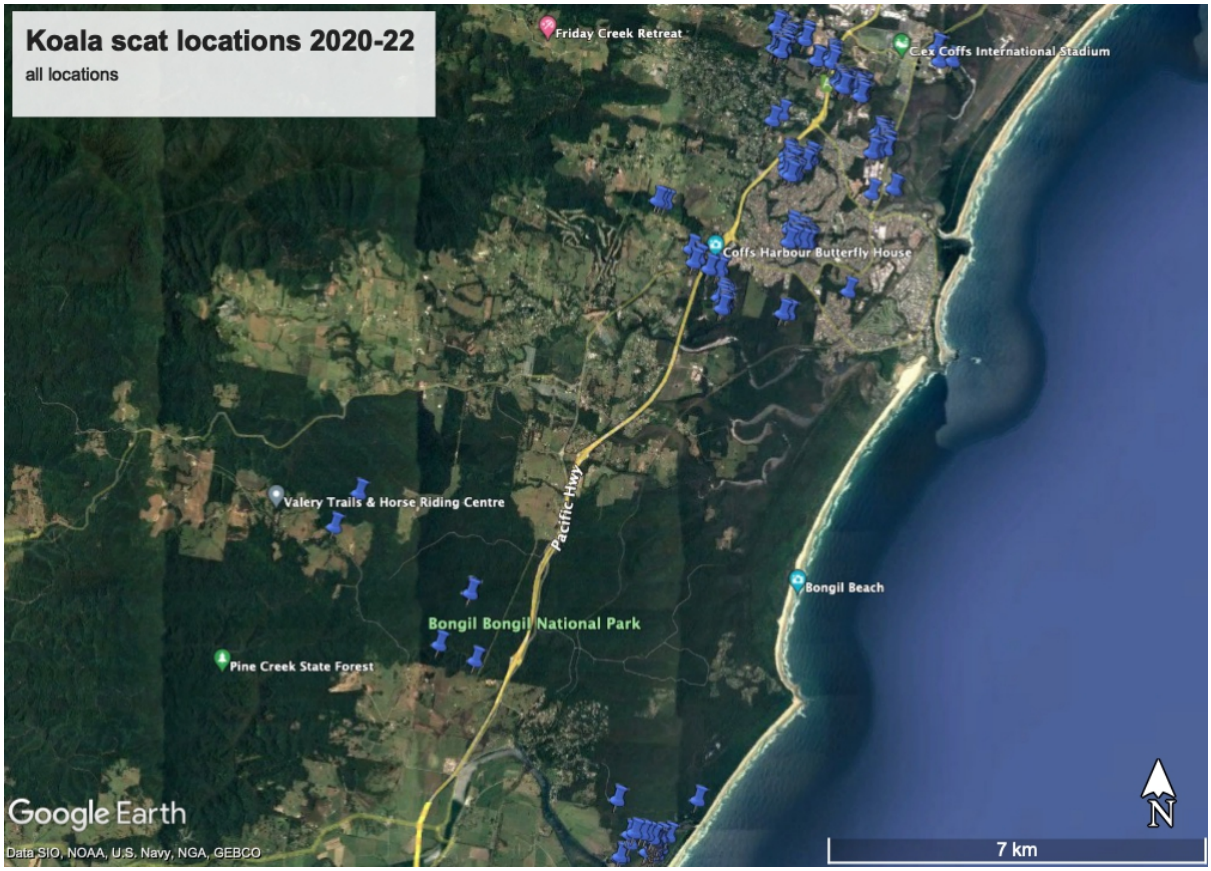
The combined search effort results from the two project phases across 23 sites are summarised in Table 3.

Table 3: Combined 2020-2022 koala records for sites surveyed in Phase 1 and 2.

Habitat Linkage	Linkage description	Site No.	Kms searched	Scats recorded	Scat collected
Linkage 1	Bongil Bongil NP west via RMS underpass, Titans close, south Boambee	3	3.6	Y	N
		7	26.5	Y	Y
		8	3.4	Y	N
		11	13.7	Y	N
		14	31.8	Y	N
		18	2.1	Y	N
Linkage 2	Hogbin drive west via RMS underpass to Englands Road.	2	9.3	Y	Y
		4	7.7	Y	Y
		5	5.2	Y	N
		6	20.97	Y	Y
		9	12.3	N	N
		17	2.1	Y	N
		23	9.7	Y	N
Linkage 3	Boambee East/Toormina Links: Lyons Road side of Bongil Bongil NP, Linden Av Water Towers, Bruce King Drive	1	11.4	Y	Y
		10	3.5	N	N
		12	3.95	N	N
		13	19.8	Y	Y
		15	7.4	Y	N
		16	3.3	N	N
		20	0.7	N	N
		21	1.3	N	N
Linkage 4	West-east Bongil	19	2.2	Y	Y
		22	2.7	Y	Y
TOTAL			**204.62**	**17**	**8**

The general location of 231 scat locations recorded across 23 sites during Phase 1 and 2 is presented in Figure 5. More detailed maps are provided in the Appendix.

Figure 5: Koala scat locations recorded 2020- 2022.



Across Phase 1 and 2 (September 2020 to June 2022), 23 sites were surveyed and the detection dog covered over 200 km in searches. Of the 23 sites, 74% had koala scats recorded and 47% of those sites had fresh scat material collected. A total of 46 koala scat samples were stored and sent for genetic analysis from eight sites across the study area (Table 4).

Eighty-eight percent of sites had more than one scat location recorded and 35% had more than 20 locations recorded (usually with multiple scats per location). Scats of varying sizes were also recorded on a number of sites indicating different individuals utilising the site.

Table 4: Combined 2020-2022 fresh koala scat locations and samples collected

Habitat Linkages	Site No.	No of scat locations	No of samples collected
Linkage 1	3	3	0
	7	23	4
	8	7	0
	11	4	0
	14	1	0
	18	2	0

Linkage 2	2	33	6
	4	44	2
	5	2	0
	6	38	14
	17	2	0
	23*	6	0
Linkage 3	1	26	9
	13	29	5
	15	1	0
Linkage 4	19	9	5
	22	2	1
Totals		**231**	**46**

*dead koala

Koala scat sample genetic suitability.

The age of koala scats, exposure to weather conditions and conditions of storage and transport can significantly affect suitability of scats for analysis. Based on the NSW Koala Health Hub scat collecting protocol it should be assumed that around 50% of samples collected will be suitable for analysis but that this will vary with scat age and quality. (Koala Health Hub: Collecting koala scats in the field protocol). Despite sustained wet conditions throughout the project, 63% of the samples collected for this project were genotyped and provided insight into the genetic diversity and health of the Toormina-Sawtell-Boambee-Bongil populations.

Forty-six koala scat samples were sent to the University of Sunshine Coast (USC) and Diversity Arrays Technology (DArT) for genotyping and analysis (Figure 6). Twenty-nine samples were of good quality and used to identify unique koala individuals. Due to the nature of non-invasive sampling, it is common that duplicate samples are collected, i.e. two or more samples that originate from the same koala. These duplicates are removed from analysis to prevent false outcomes. Six duplicate samples were removed and the analysis was able to confidently identify 23 unique koalas (Figure 7).

Of the 23 koalas, 12 were male and 11 female, a sex ratio very close to 1:1 (Table 5). Eight koalas were possibly carriers of the chlamydial pathogen and three were very likely to be carrying the pathogen. The spread of the chlamydial pathogen was even across the landscape, noting that the presence of the pathogen does not equate to the clinical signs of (Table 5, Figure 8).

Figure 6: Locations of koala scat samples collected by Canines for Wildlife for genetic analysis.

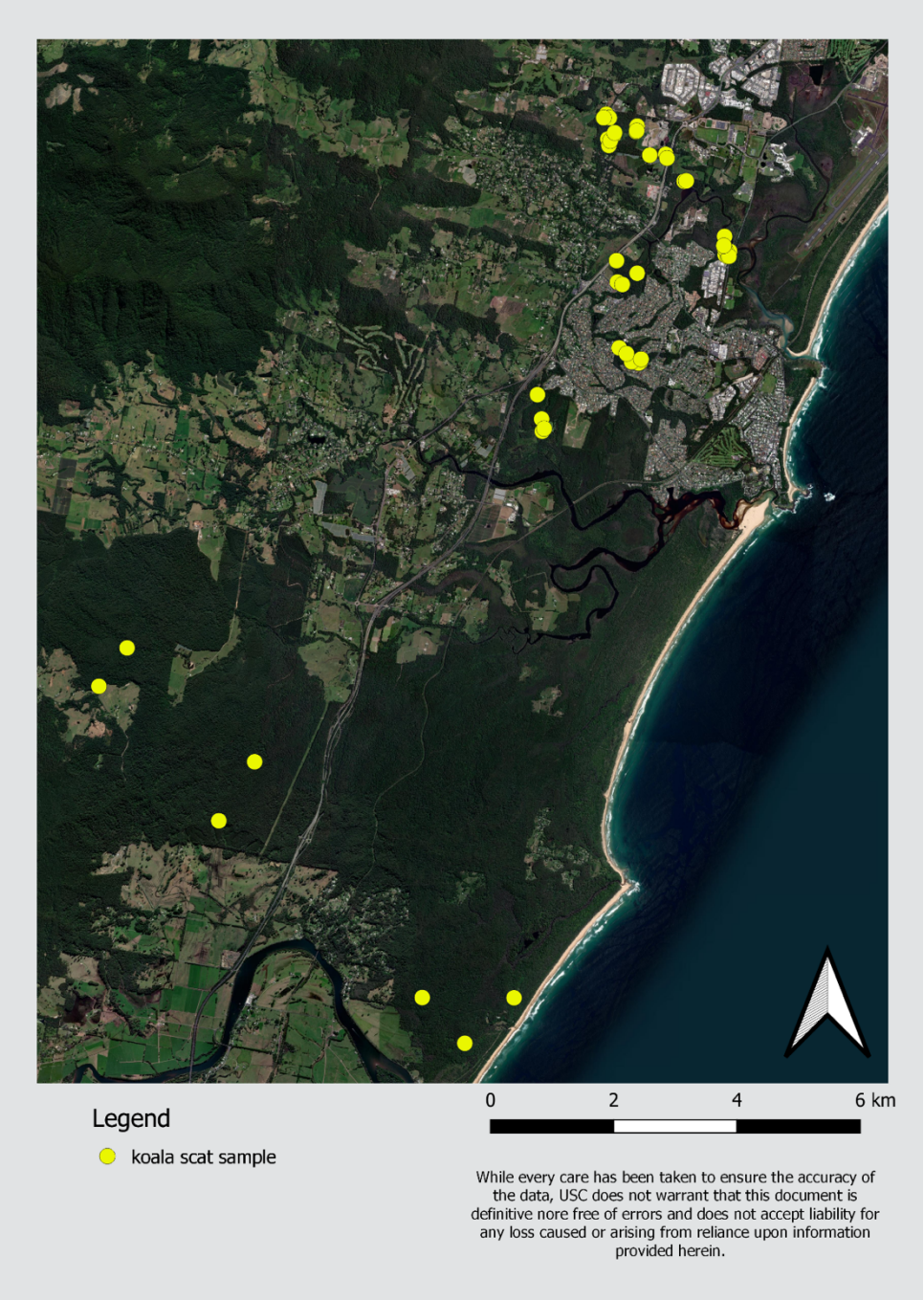


Table 5 presents results for 23 uniquely identified koalas, their gender, chlamydia status and location within the project area. Two female and 1 male were identified at the Hogbin Drive Coffs creek boat ramp and three female koala at the Toormina water towers. The female Individual No.1 was recorded at both of these sites with the samples collected eight days apart; demonstrating that she had moved between the two sites in that period. One male was detected at a private property on the Pacific Highway opposite the New England Waste Facility, three females and two males were recorded on the New England Waste Facility site and four males were identified at Bruce King Drive. In Bongil Bongil National Park and adjacent CH+DLALC land, four females and four males were identified.

Table 5: Individual koalas, gender and chlamydia status by site

Site No.	Location	Koala ID	Sex	Chlamydia
1	Coffs creek boat ramp Hogbin Drive	1	Female	Possible
1	Coffs creek boat ramp Hogbin Drive	3	Female	Possible
1	Coffs creek boat ramp Hogbin Drive	6	Male	Not detected
2	Toormina water towers	1*	Female	Not detected
2	Toormina water towers	2	Female	Not detected
2	Toormina water towers	14	Female	Not detected
4	4** Pacific Hwy	16	Male	Not detected
6	New England Waste Facility	17	Female	Possible
6	New England Waste Facility	18	Male	Possible
6	New England Waste Facility	19	Female	Possible
6	New England Waste Facility	20	Male	Not detected
6	New England Waste Facility	21	Female	Not detected
7	Northwest trail Bongil Bongil NP	5	Female	Not detected
7	Near underpass Bongil Bongil NP	22	Female	Possible
13	Bruce King Drive	4	Male	Not detected
13	Bruce King Drive	7	Male	Not detected
13	Bruce King Drive	8	Male	Possible
13	Bruce King Drive	9	Male	Not detected

19	Cabbage Tree Rd Bongil Bongil NP	10	Female	Not detected
19	Gordons Rd Bongil Bongil NP	11	Male	Likely
19	Mailmans Track Bongil Bongil NP	12	Female	Not detected
19	Mariott trail Bongil Bongil NP	13	Male	Likely
22	Tuckers Rock Rd Bongil Bongil NP	15	Male	Possible
M1.1	CH+D LALC	23	Male	Likely

Figure 7 shows the distribution of genders identified across the study area. The ratio of males to females was almost 1:1 across the study area, with a couple of council reserves having single gender individuals identified. With 231 scat locations recorded and multiple scats of varying sizes, not all individuals present in the study area are likely to be represented in the genetic result, however, the results do indicate a relatively even distribution of males and females across the area.

Figure 7: Map is showing 23 koalas identified as unique individuals, presented in pink for female koalas (N = 11) and blue for male koalas (N = 12) (SCU 2022).

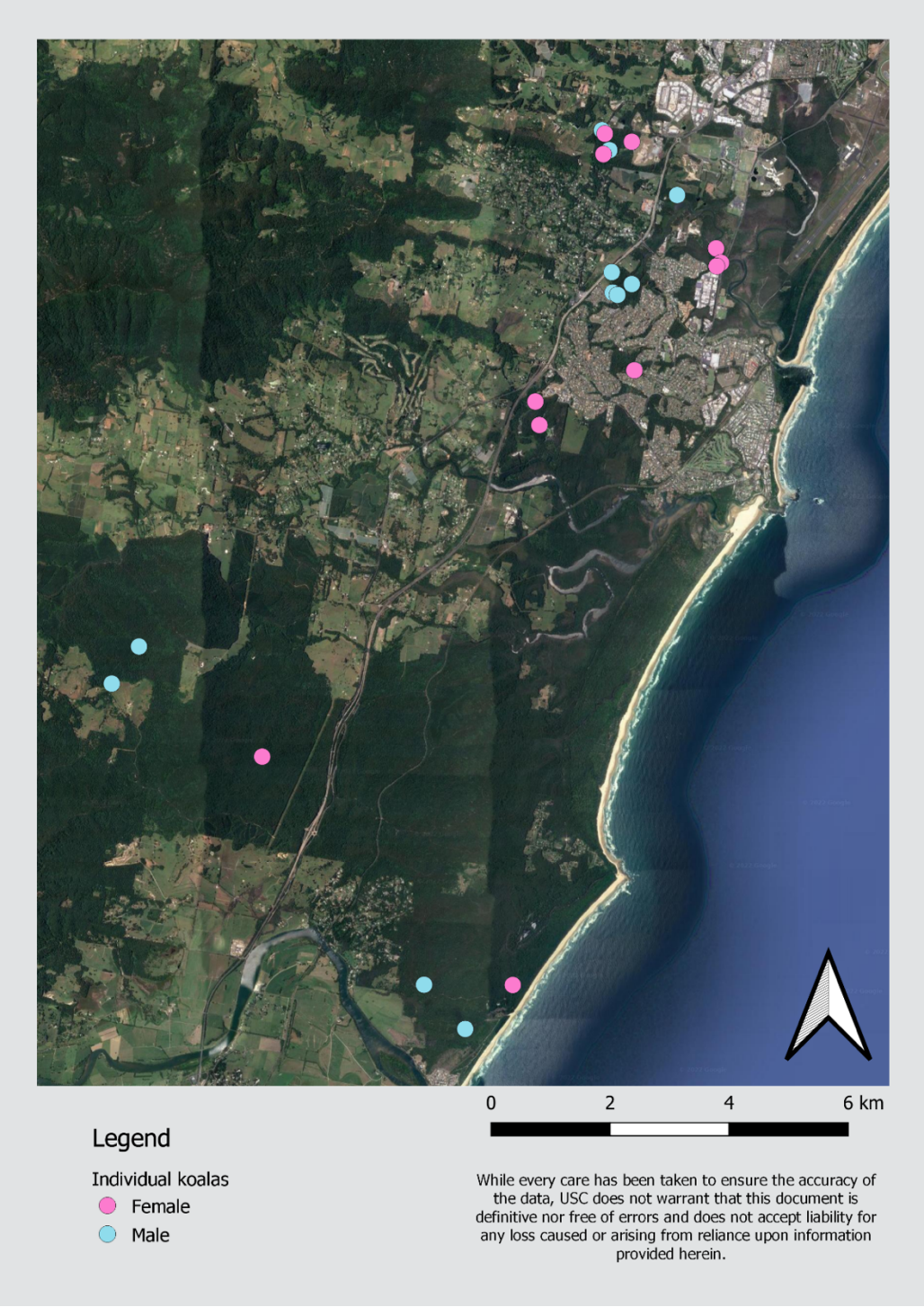
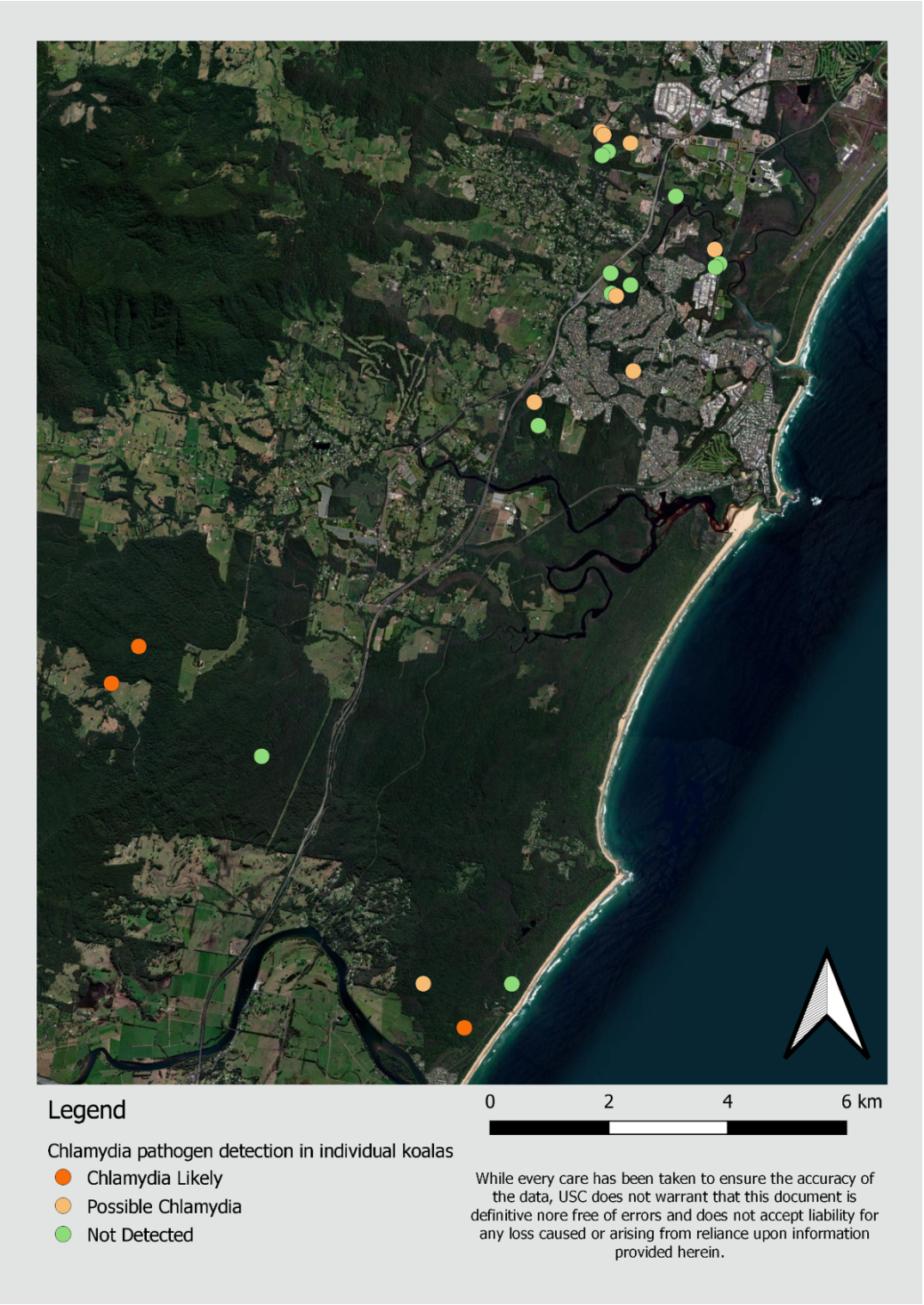


Figure 8 shows the distribution of potentially and likely chlamydia pathogen carrying koalas across the study area.

Figure 8: Map of where the chlamydia pathogen was detected in the genetic sample (USC 2022).



Detection of chlamydia pathogen and diagnosis is categorised into three groups: red dots present koalas with high chlamydial presence (N = 3); orange dots present koalas where low thresholds of the pathogen were detected, therefore a chlamydial infection is possible (N = 8); green dots present koalas where a chlamydial infection is unlikely (N = 12) (taken from SCU 2022 report). Koalas that were chlamydia free and potentially-likely to be carrying a chlamydial infection were distributed across the

study area, though the three samples with likely chlamydia were found in the population south of Bonville Creek. Koalas can carry chlamydia infection without exhibiting symptoms of the disease, but do indicate koalas that are susceptible.

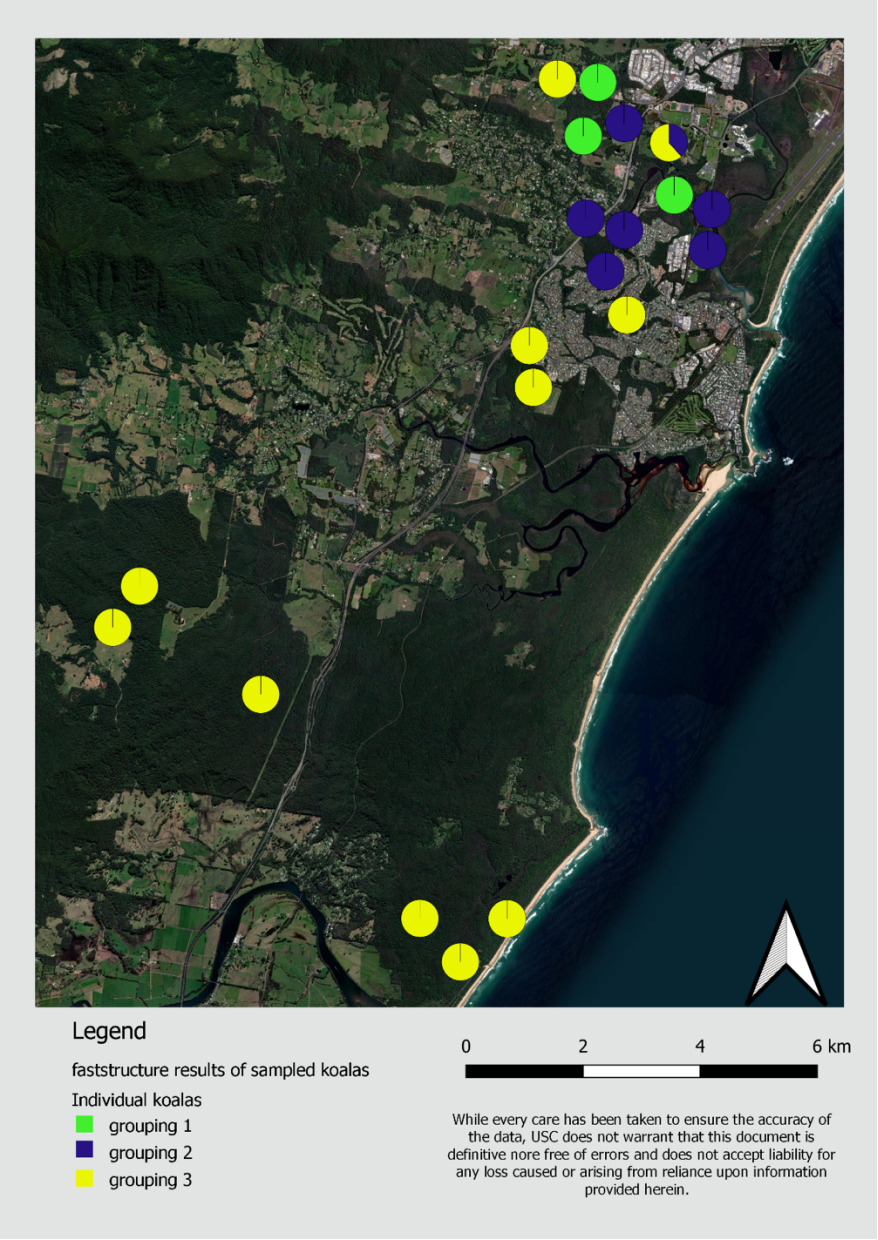
Population structure

A sub-set of 20 individual koalas were analysed to assess population structure, though the results need to be interpreted with caution due to the small sample size. Results indicate there are three probable ancestral populations; which the USC report stated is high for a relatively small area (Figure 9). The differences between the groups was not strong but could reflect genetic clusters of individuals that are genetically more similar to each other. A larger sample size is required for a more in-depth analysis. It was noted that if translocated individuals were included in the data set this may influence the "natural" population genetic patterns. There also appears to be a likely sub-structuring as well as cryptic clines in this group of koalas particularly north-south of Bonville Creek, however there appeared to be no significant genetic differentiation caused by isolation by geographic distance (USC 2022).

The genetic diversity of the 23 koalas was also compared to values from other populations including Redland City Council and across Qld, NSW and Victoria (USC 2022, Kjelden et al. 2016). Heterozygosity was similar to compared populations and the degree of inbreeding was lower than in the compared populations which appears to be a promising result for the population (USC 2022).

From these twenty samples two trends were determined. The first is shown in Figure 9 which maps the most likely number of ancestral populations. Two of these are focused in the Toormina-Sawtell area and the third is represented throughout the study area. The potential for these ancestral populations to be influenced by wildlife rehabilitation releases, reintroductions and translocations was identified (SCU 2022).

Figure 9: Location of three potential ancestral populations.



Note: It is likely that these clusters are groupings of individuals that are more similar to each other than to the remaining individuals, however, a sample size of 20 individuals is likely too small to draw meaningful conclusions (taken from SCU 2022 report).

The second trend is presented in Figure 11 with a significant difference in genetic structure between koalas north and south of Bonville Creek. Genetic similarity appeared in individuals east and west of the Pacific Highway whilst reflecting the north-south sub-structure.

Figure 11: Map showing the results of a spatial Principal Component Analysis. A significant global structure was detected between koalas north and south of the Bonville Creek The colour together with the size of the square represents the magnitude of the genotype differences. (Taken from the SCU 2022 report).

Discussion

Scent detection dogs are highly efficient at detecting koala scat and are regularly used to conduct koala surveys and to collect scat material for genetic analysis (Cristescu et al 2015, Cristescu et al 2018, DPIE 2020, OWAD 2020).

Across Phase 1 and 2 (September 2020 to June 2022), the detection dog covered over 200 km in searches and located 231 koala scat locations. Eighty-eight percent of sites had more than one scat location recorded and 35% had more than 20 locations recorded (usually with multiple scats and varied size per location), demonstrating a high level of usage of the sites by koalas and highlighting the importance of the council reserves and private land in the Toormina-Sawtell-Boambee area providing quality koala habitat.

The lack of evidence of koalas on the negative sites does not preclude the possibility of koalas utilising the site on other occasions (MacKenzie and Royle 2005, Ellis et. al. 2009). Evidence of koalas being found on sites is likely to change with koala tending to utilise different parts of their habitat depending on the season, most notably between winter and summer. Significant rainfall events can impact the likelihood of scats being located and this was mitigated where possible by delaying surveys after heavy rainfall. In addition, several sites that yielded no koala scat detections included creek-lines and swamps that offer potential koala habitat but were not accessible for survey due to standing water resulting from the unseasonal high rainfall during this period. Interestingly, the Armstrong Road Reserve in Toormina appeared to provide quality koala habitat, however, the two surveys of the reserve failed to locate evidence of koala activity.

Twenty-three individual koalas were identified across the study area. The gender of the genotyped individual koalas was evenly split, with a mix of genders represented in most of the sites. Although the individual koala duplicate scat samples were removed for genetic analysis, the genotyping of these samples were still valuable in terms of insight into koala activity. For example, the female koala identified as Koala 1 had scats collected at two different sites. This individual moved from the Coffs creek boat ramp to the Toormina water tower site a direct line distance of 1.6km.

Eight koalas were possibly carriers of the chlamydial pathogen and three were very likely to be carrying the pathogen. The spread of koalas carrying the chlamydial pathogen was even across the landscape (USC 2022).

The population structure analysis indicated three probably ancestral populations which is high for a relatively small area. The differences between the groups could reflect genetic clusters of individuals that are genetically more similar to each other, however, it was noted that a larger sample size would be required to do a more in-depth analysis. The USC report (2022) commented that if translocated individuals were included in the data set this may influence the “natural” population genetic patterns. The appears to be some genetic similarity of groups between koalas east and west of the highway, with more difference appearing between koalas north and south of the Bonville Creek. This clearly highlights the importance of enhancing and maintaining east-west linkages across the Pacific Highway.

The genetic diversity of the 23 koalas was favourably compared to values from other populations including Redland City Council and across Qld, NSW and Victoria (USC 2022, Kjelden et al. 2016). Heterozygosity was similar to compared populations and the degree of inbreeding was lower than in the compared populations. It is of interest that based on these individual koalas, there appeared to be no significant genetic differentiation caused by geographic isolation.

Given the fragmented nature of the reserves within the Toormina-Sawtell-Boambee area the lower degree of inbreeding and comparative genetic diversity is a positive result for the Coffs population. The SCU report (2022) noted that the genetic results indicate potentially interesting population patterns that would be worth further investigation with an increased sample size. The analysed genetic material is now stored and can be expanded by additional genetic material in the future.

Koalas are actively utilising the available koala habitat on public and private lands within the Sawtell-Toormina-Boambee urban and peri-urban area, highlighting the importance of these habitats and movement corridors for sustaining koalas into the future. Coffs Harbour Council reserves link koala habitat in Bongil Bongil National Park north to koala habitat on private land, council and other government land parcels providing important corridors that allow koalas to move and access resources such as food and breeding opportunities. The importance of maintaining access for koalas across the Pacific Highway was also highlighted.

The results have provided key insights into the genetic diversity and health of the population which is a positive outcome given the high degree of habitat fragmentation and ongoing threats to koalas in the area. The koala activity surveys and genetic analysis demonstrate that the Toormina-Sawtell-Boambee-Bongil area emphasises the importance of protecting and maintaining all available koala habitat on council reserves, private land, State Forest and National Park lands within the area.

During the period of 2020-2022 koalas died through impact with vehicles, disease and other causes. In June 2022 two koalas were reported injured or killed on or near Hogbin Drive (J. Couper pers. comm.) and one dead koala was found during the survey. In addition, the genetic results confirmed that individuals are moving between council reserves and have to traverse roads and other reserves and private land. These figures highlight the need for ongoing efforts to reduce koala mortality by providing safe passage between the reserves.

The results from this project could provide interesting material for community education on the significant value of the Toormina-Sawtell-Boambe-Bongil koala population and encourage additional community effort to support the population.

Conclusion

The canine scent detectives surveys have enabled a detailed understanding of koala habitat usage, activity in the Toormina-Sawtell-Boambee-Bongil area, and provided significant insight into the population's genetic diversity and health. The combined knowledge acquired through the project emphasises the importance of protecting and maintaining all available koala habitat on council reserves, private land, State Forest and National Park lands within the area.

The Coffs Harbour-Bellingen koala population is known to be regionally significant. There would be value in expanding this study elsewhere in the Jaliigirr Corridor, to enable a more informed understanding of the habitat usage within the corridor, genetic diversity and health of this regionally significant koala population. This information could then assist in delivering improved koala conservation and management.

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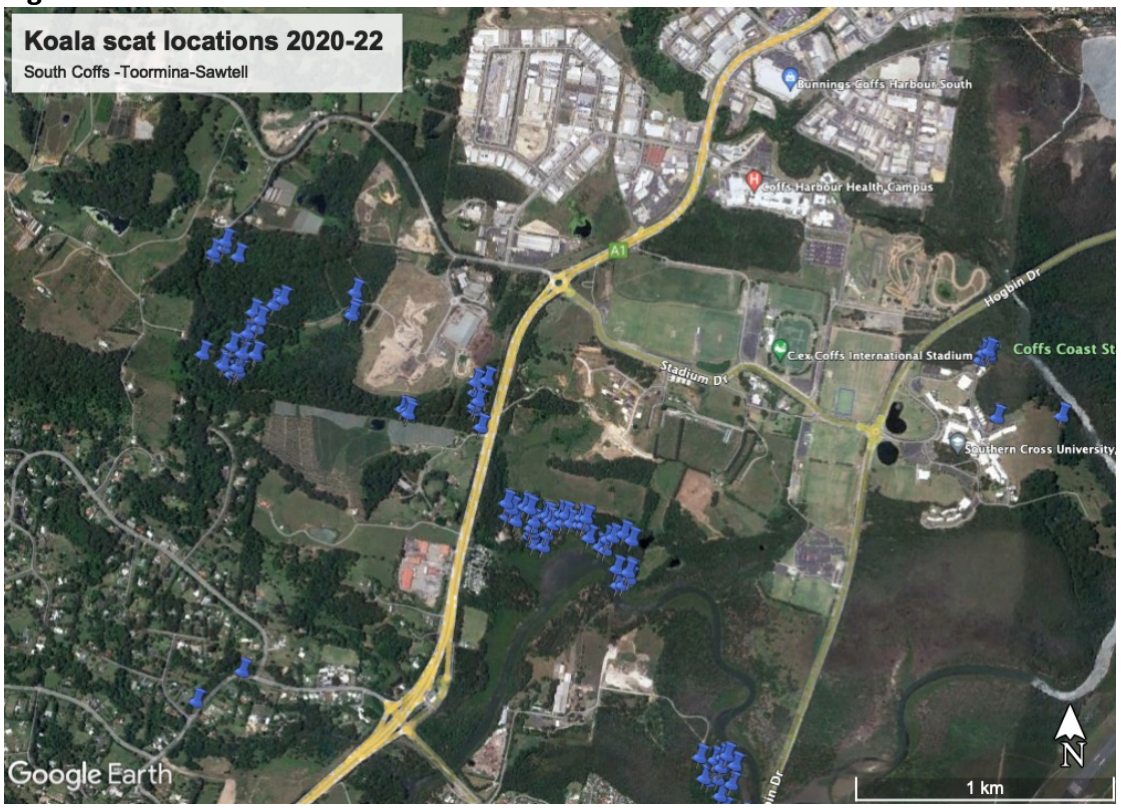
Appendix

Figure 5a and b: Koala scat locations recorded 2020-2022



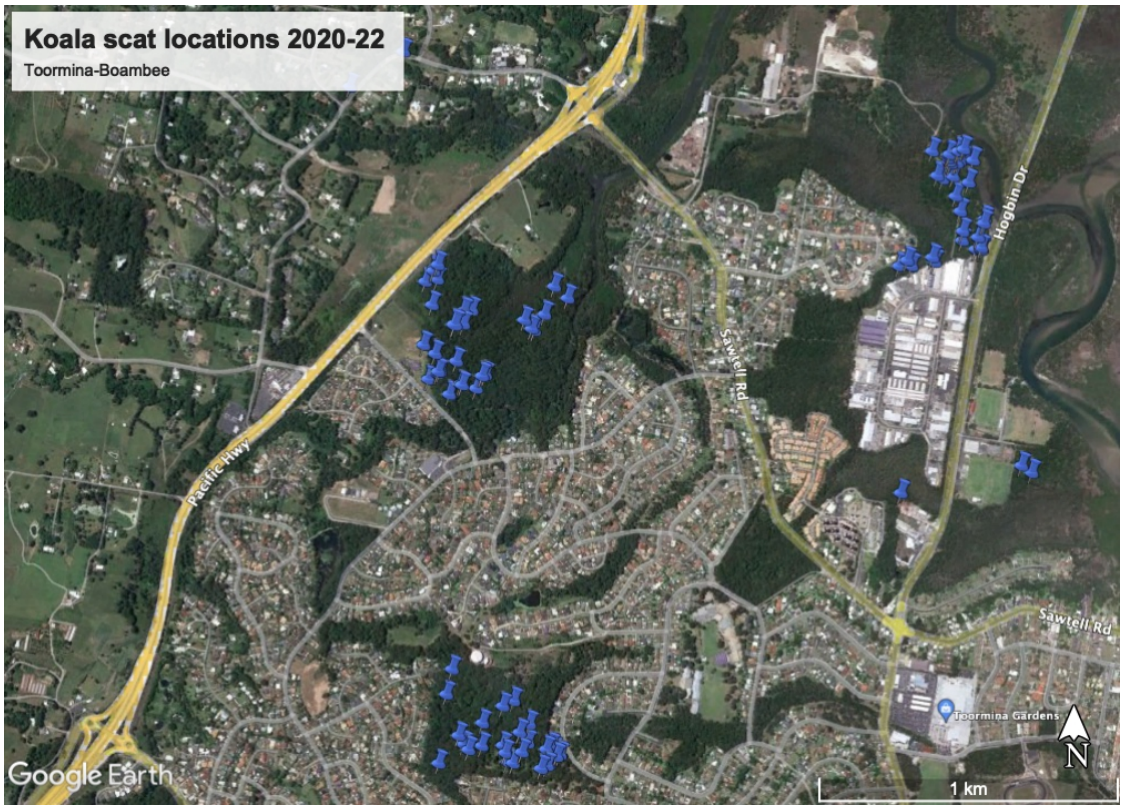


Figure 5 c and d: Koala scat locations recorded 2020-2022