Appendix

Understanding values of the Central Coast Ecological Grid:

The Distribution of Wildlife

2020

Central Coast Council

EXECUTIVE SUMMARY

Understanding the distribution of wildlife is important to inform the development of the ecological grid of the Central Coast Green Grid. This is achieved by identifying which habitats are most important for wildlife and designing corridors between different important areas. An understanding of the distribution of feral animals is also important to ensure effective control measures are put in place.

Council completed surveys for insectivorous microbats and ground-dwelling mammals across 100 sites throughout a variety of public land tenures. Bird surveys were also completed on these sites targeting birds that were using winter flowering Eucalypts. Microbats were surveyed through an ultrasonic detector that records microbat foraging activity, referred to as echolocation, and ground-dwelling mammals were detected through motion-activated cameras. Birds were surveyed through direct observation.

The surveys detected 17 species of microbat, including eight threatened species, 16 species of native ground-dwelling and/ or climbing mammals, including four threatened species, five species of introduced mammals, three species of reptiles and 82 bird species, including two exotic species and four threatened species.

These results show the importance of natural areas in the Central Coast for biodiversity. The results of these surveys have been used to inform the development of the ecological grid and associated projects of the Central Coast Green Grid Plan, during the Green Grid implementation plans.

INTRODUCTION

The Central Coast Local Government Area contains records for over 200 threatened fauna species. While records collected over many years are useful for informing the general distribution of species, they cannot be used to determine the relative importance of habitat for species. This is where regional surveys, conducted using the same method at multiple sites are important, as this way results are comparable both spatially and temporally.

Regional surveys were completed in the late 1990s as part of the NSW Government's Comprehensive Regional Assessment (CRA) project, while the former Gosford City Council completed a survey across most Coastal Open Space System (COSS) lands in 2012. The COSS surveys detected a total of 62 species, predominantly mammals. Since this time no regional surveys have been completed. While these surveys were comprehensive, they did occur beyond Council land tenure in the former Gosford LGA. Since 2012, there has been a significant drought, heatwaves, several storms, and wildfires which may have affected fauna populations.

This survey was completed to inform the development of the Ecological Grid, as part of the Central Coast Green Grid Plan. Specifically, these surveys aimed to understand:

1. The value of the current public conservation network towards conserving mammals and birds.
2. The areas with greatest fauna activity and where corridors should be placed to allow for their movement.
3. The distribution of feral animals in the region to help guide mitigating their impact on wildlife values within the Ecological Grid.
4. The types of habitats that contain the greatest diversity of fauna so that those habitats can be targeted during future private land protection and acquisition programs.

METHOD

Study Area

The Central Coast Local Government Area contains around 75% native vegetation cover, and 25% of the land area is contained within formal conservation reserves, managed by NSW National Parks and Wildlife Service. Due to the high level of native vegetation cover, wildlife species diversity is high, with at least 132 threatened fauna species having previously been recorded in the area. The study area contains a high diversity of vegetation types, including rainforest, wet-sclerophyll forest, dry sclerophyll forests and woodlands, and heath. Despite this high level of native vegetation cover and reservation, areas are also subject to fragmentation from rural residential, environmental living, and general urban development land uses.

Survey design

Throughout State Forest, National Park, and Council lands, 100 comprehensive survey sites were established (Figure 1). These were at varying distances from roads and residential development, and were located across a fragmentation gradient, with native vegetation cover varying from 14% to 100% within a 1 km radius of the site. Sites were also established across a range of vegetation types, including wet sclerophyll forest (see Photograph 1) and rainforest, heathland (see Photograph 2), dry sclerophyll forests and woodlands (see Photograph 3), and forested wetlands (see Photograph 4).

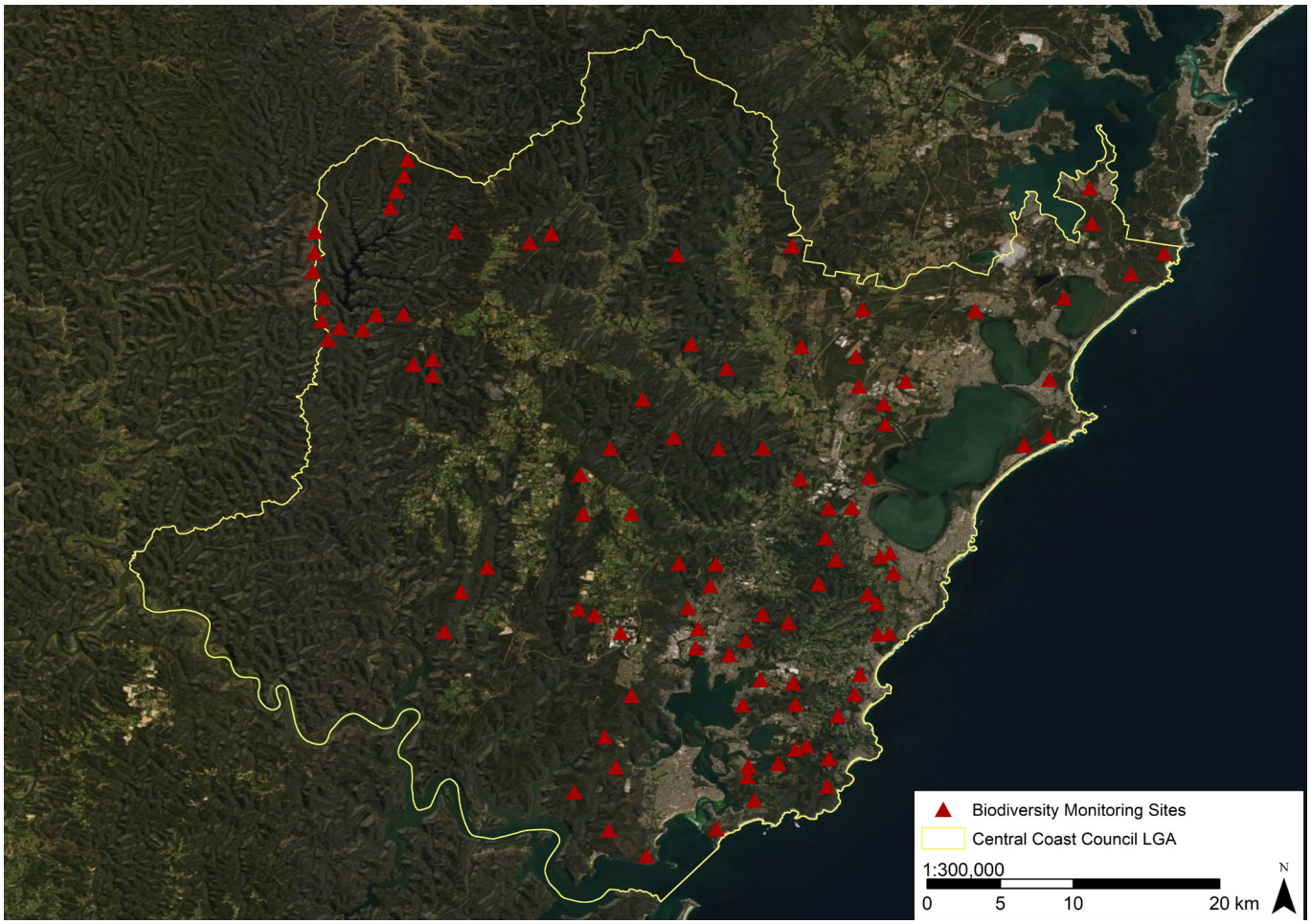

Figure 1: The location of the 100 monitoring sites used for this study.

Photograph 1: Example of wet sclerophyll forest survey site.

Photograph 2: Example of heathland survey site.

Photograph 3: Example of a dry sclerophyll woodland site that was recently burnt.

Photograph 4: Survey site located within a forested wetland.

FIELD SAMPLING

Microbats

Surveys for microbats occurred between February and April 2020. At each of the 100 sites, a single ultrasonic bat detector (Anabat Express) was placed for four consecutive nights between February and April 2020. To avoid vandalism in small urban bushland remnants, the detector was placed away from flyways in an area with the least amount of dense vegetation.

Terrestrial Fauna - Predominantly Mammals

Throughout State Forest, National Park, and Council lands, 100 comprehensive survey sites were established (Figure 1). These were at varying distances from roads and residential development, and were located across a fragmentation gradient, with native vegetation cover varying from 14% to 100% within a 1 km radius of the site. Sites were also established across a range of vegetation types, including wet sclerophyll forest (see Photograph 1) and rainforest, heathland (see Photograph 2), dry sclerophyll forests and woodlands (see Photograph 3), and forested wetlands (see Photograph 4).

Diurnal Birds

Birds were surveyed to co-inside with flowering of Spotted Gum (Corymbia maculata) in July- August 2020, and Swamp Mahogany (Eucalyptus robusta) in May 2020. Bird surveys also occurred at the same 100 sites. A single experienced ornithologist completed 10-minute fixed count surveys where all species heard or observed on the site or flying overhead were counted. These surveys occurred between sunrise and noon.

Habitat Assessment

At each site, a brief habitat assessment was undertaken to determine 1) the dominant tree species at each site; 2) the percentage foliage cover of the canopy, midstorey and ground stratum; 3) the relative abundance of fallen logs; and 4) the presence of large, old trees that likely contain hollows.

DATA ANALYSIS

Data collected from the ultrasonic bat detectors were analysed by specialists from the Forest Science Centre, NSW Department of Primary Industries using an automated call recogniser with call validation by a specialist. Microbat calls, where possible, were determined to be definite, possible, or probable. Only definite calls were used to indicate whether an individual species was present at a site. However, for the level of microbat activity for each site, being the number of flybys past each detector, the possible and probable calls were included.

Remote camera images were analysed with subtle changes in photos examined to determine if fauna were present, in particular for night time images. A species was considered present if it was recorded at one of the two cameras, on at least one occasion across the 14 nights of the camera deployment. The number of independent occurrences for each species at each of the 100 sites was recorded. A visit was considered independent when at least one hour had elapsed between subsequent images of individual species.

Analyses in a geographical information system (GIS) occurred to determine relevant attributes around the site, which are outlined in Table 1.

Table 1:
The type of habitat attributes identified around monitoring sites and the ranges in values across all sites in this study

Attribute type at site	Range
Dominant vegetation type at each site	1. Wet sclerophyll forest and rainforest. 2. Dry sclerophyll forest and woodland. 3. Forested wetland. 4. Heathland.
Time since last fire	0 – Over 30 years
Distance to nearest sealed road	20 – 6171 m
Native vegetation cover within 1 km radius	14 – 100%

RESULTS

Insectivorous Microbats

The microbat detectors recorded 88,600 noise files, of which 27,754 could be attributed to microbat species or groups. Surveys recorded 18 species (or groups of species[1]) of microbat, including eight threatened species, being the Little Bent-wing Bat (*Miniopterus australis*), East Coast Freetail Bat (*Mormopterus norfolkensis*), Large-eared Pied Bat (*Chalinolobus dwyeri*), Eastern Bent-wing Bat (*Miniopterus orianae oceanensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*) and Eastern (*Southern*) Myotis (*Myotis macropus*). The sites where these species were detected are shown in Figures 2-9 and the frequency of detection is shown in Table 2. Overall bat diversity across the study region is shown in Figure 10, and bat activity is shown in Figure 11.

The greatest number of passes were recorded in dry sclerophyll forest and woodland, and forested wetlands, with less passes occurring in wet sclerophyll forest and rainforest, and the lowest number of passes occurring in heathland (Figure 12). The greatest number of microbat passes occurred in areas that had not been burnt in the past 30 years, however areas that had between 16–30 years ago had less passes than sites burnt 5–15 years ago (Figure 13). Sites burnt in the past five years, including those burnt only months before sampling in the 2019–20 Black Summer fires, had the lowest activity levels (Figure 13). There was a positive effect of microbat activity near sealed roads, with reducing activity further from sealed roads (Figure 14). There was no clear pattern in relation to the effect of fragmentation on microbat activity, with areas of high vegetation cover having the greatest level of microbat cover, followed by very low levels of vegetation cover, with sites in continuous bushland (usually larger public land holdings) having the lowest average level of microbat passes (Figure 15).

Photograph 5: The Lesser-long Eared Bat *(Nyctophilus geoffroyi)*, one of the microbat species known on the Central Coast.

Photograph 6: The Little Bentwing Bat *(Miniopterus australis)* , one of the threatened species recorded in this study (see Figure 2).

[1] For Long-eared Bats (*Nyctophilus species*; see Photo 5), calls cannot be annotated to an individual species, with two species occurring on the Central Coast, being the Lesser Long-eared Bat (*Nyctophilus geoffroyi*) and the Greater Long-eared Bat (*Nyctophilus gouldi*).

DISTRIBUTION OF THREATENED MICROBAT SPECIES

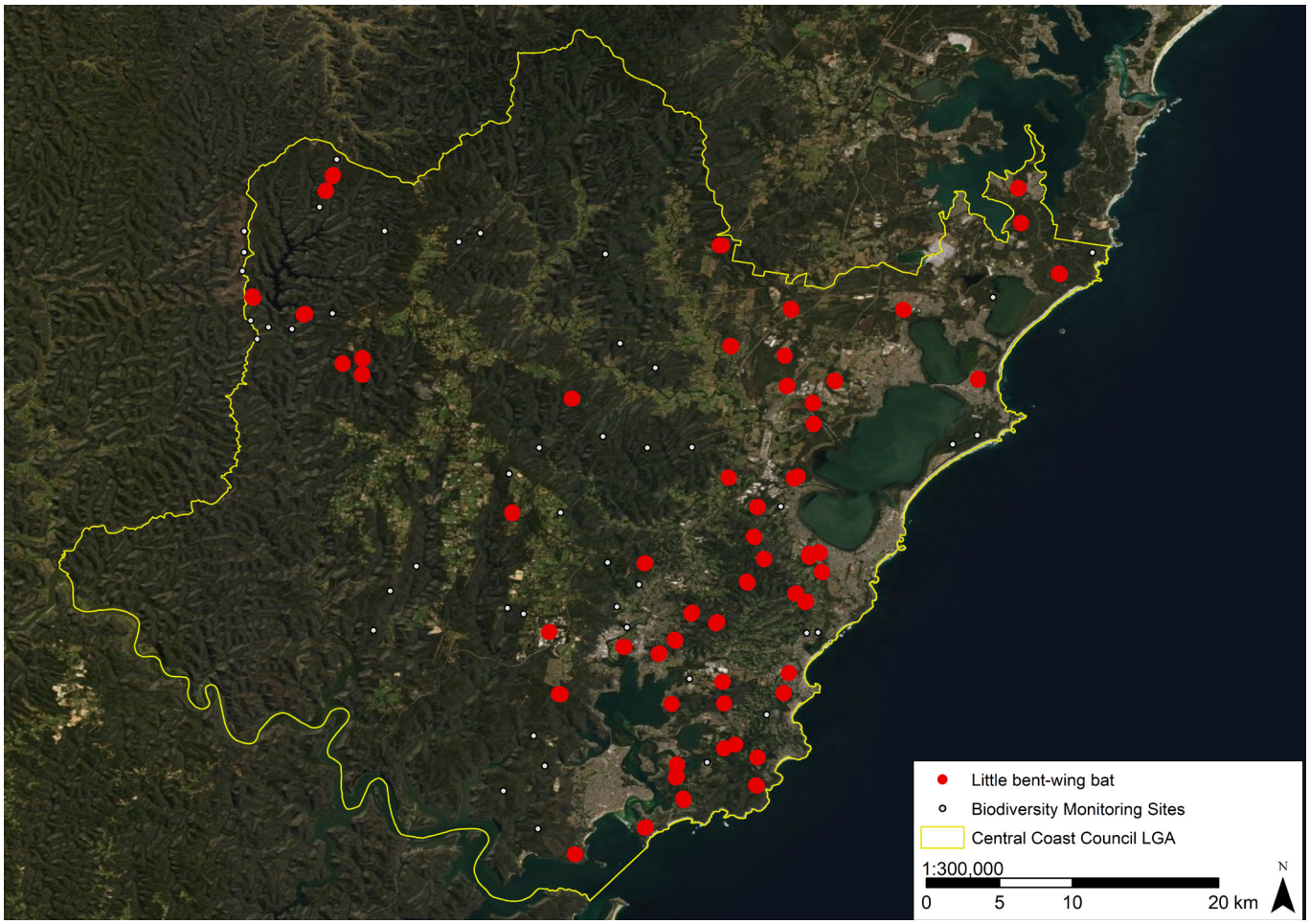

Figure 2: Distribution of the Little Bent-wing Bat recorded in this study.

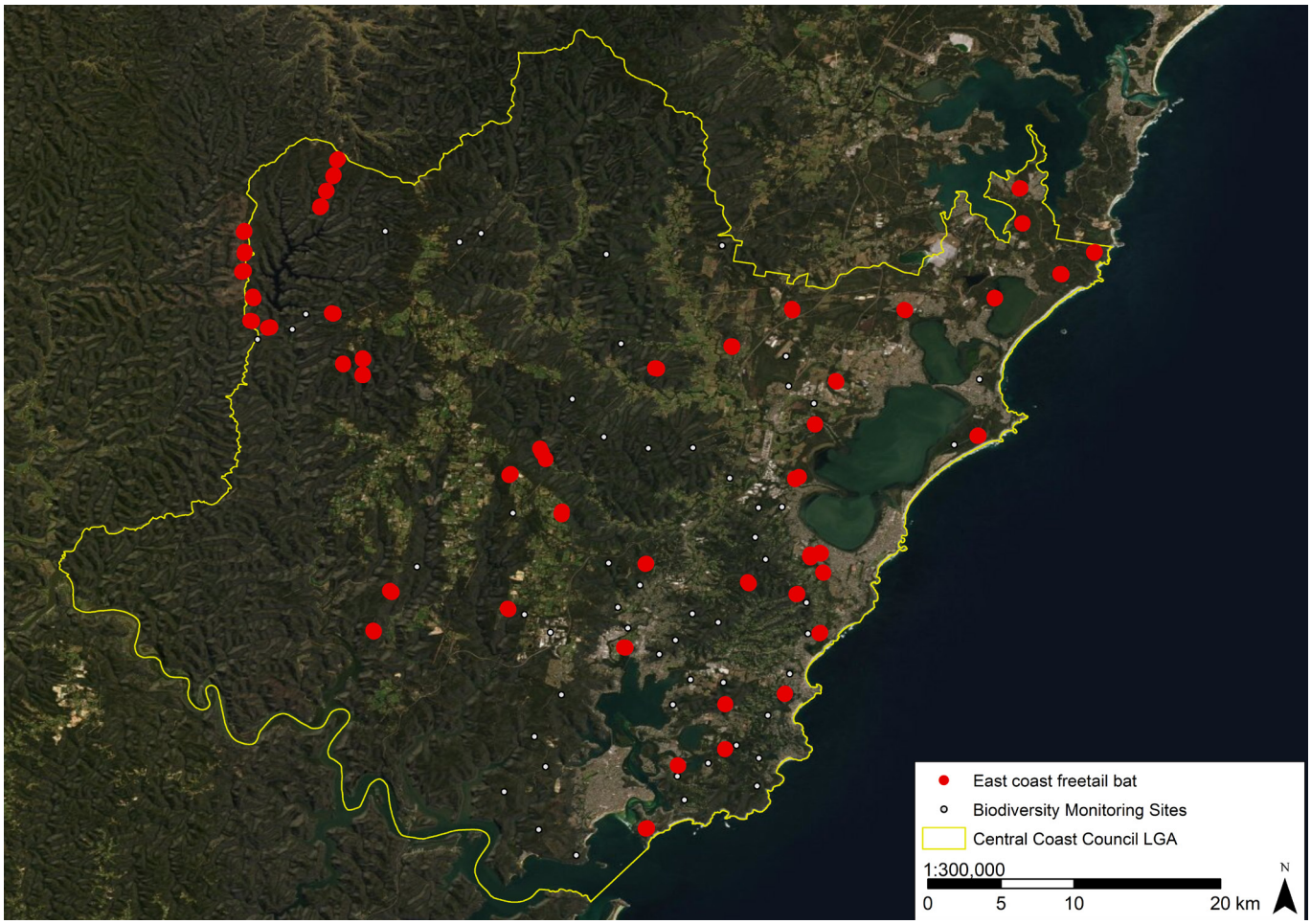

Figure 3: Distribution of the East Coast Freetail Bat recorded in this study.

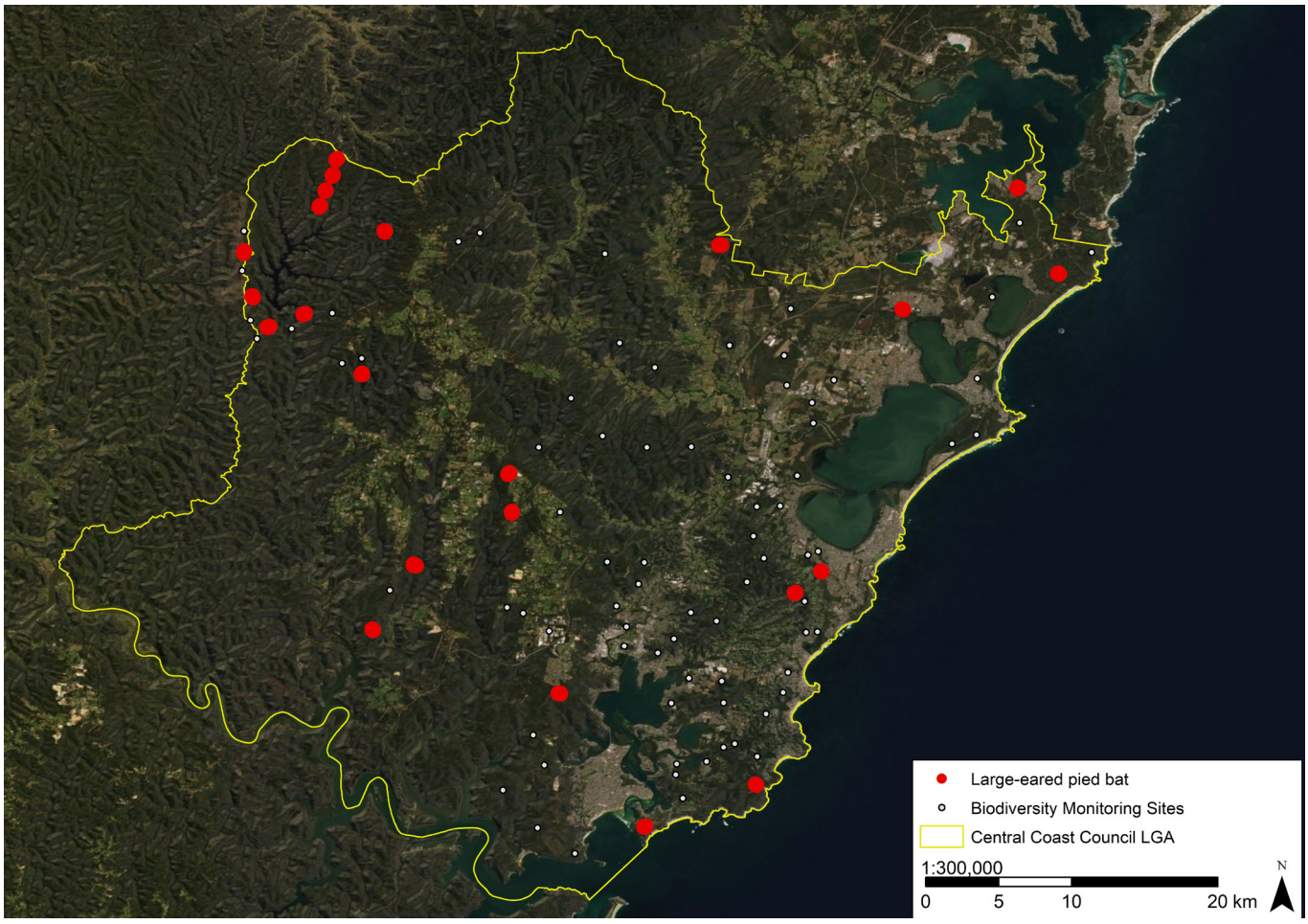

Figure 4: Distribution of the Large-Eared Pied Bat recorded in this study.

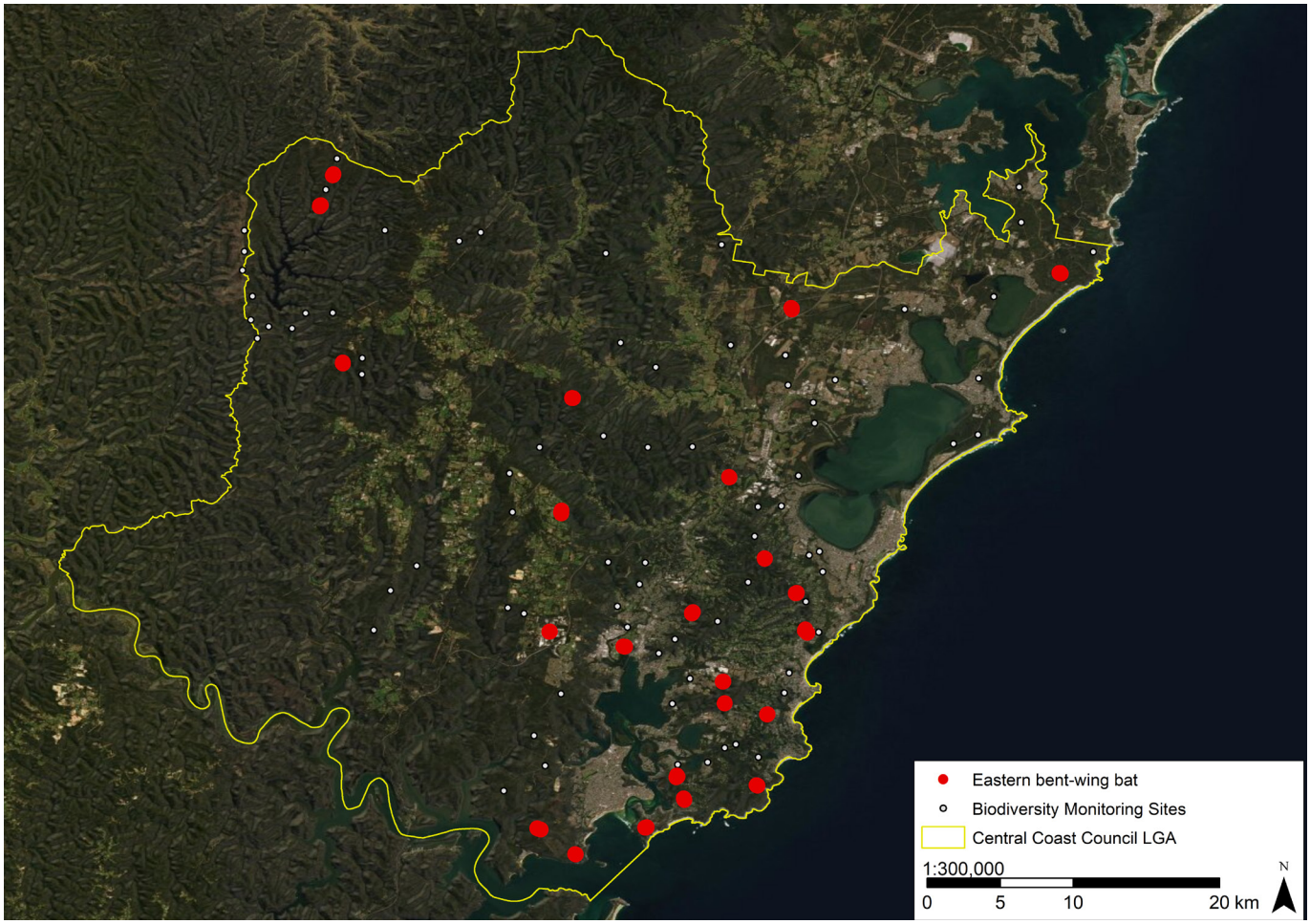

Figure 5: Distribution of the Eastern Bent-wing Bat recorded in this study.

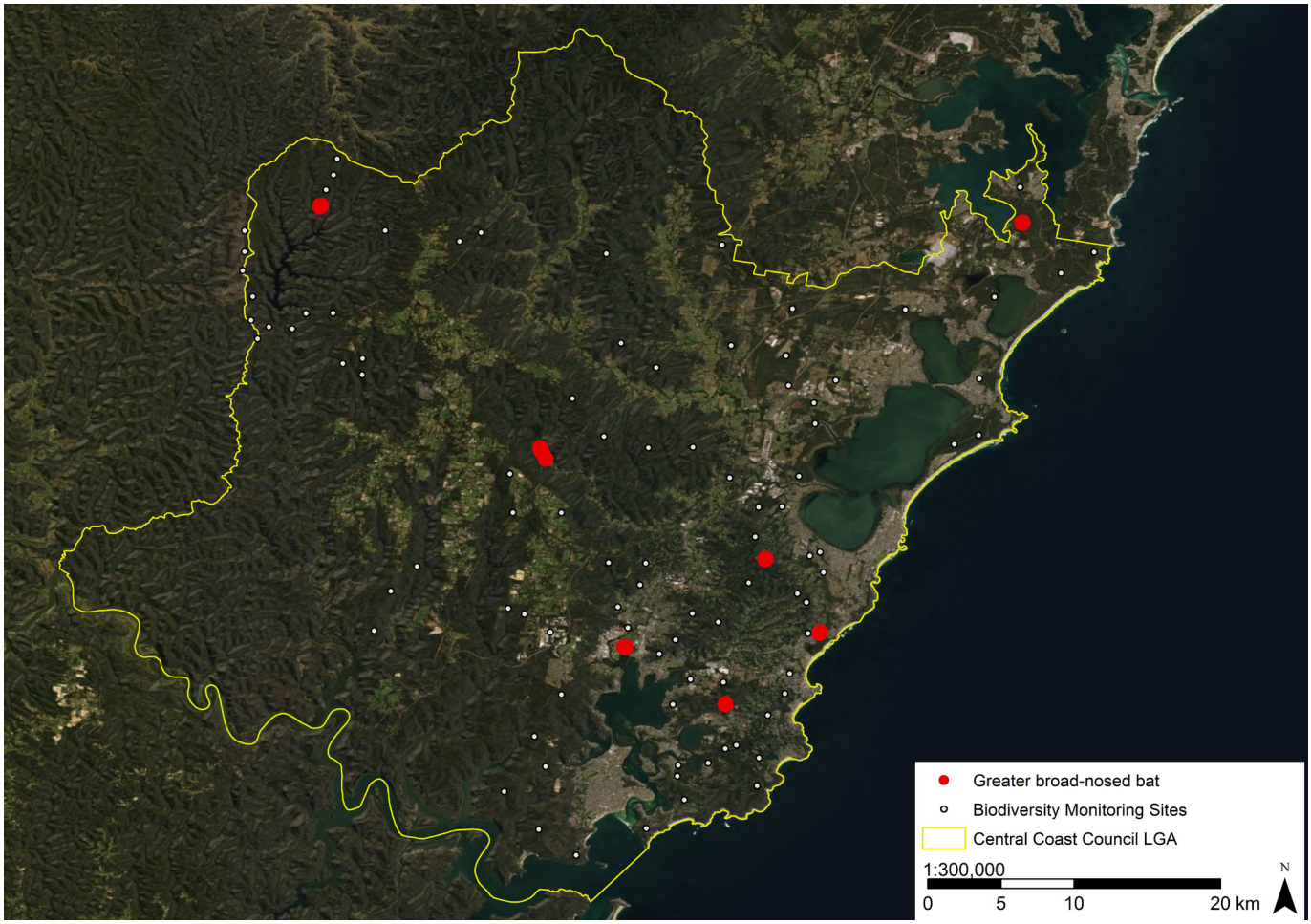

Figure 6: Distribution of the Greater Broad-nosed Bat recorded in this study.

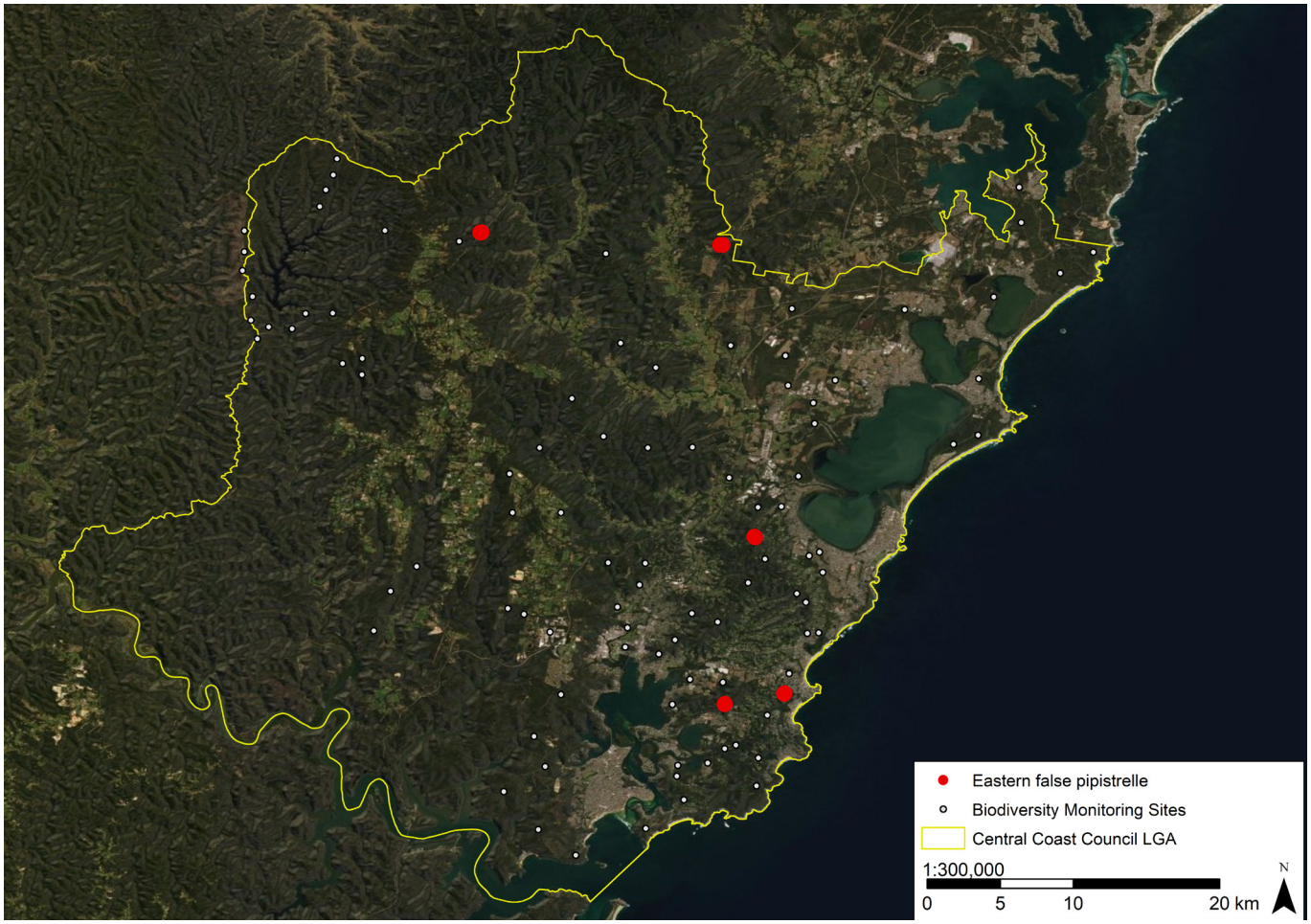

Figure 7: Distribution of the Eastern False Pipistrelle recorded in this study.

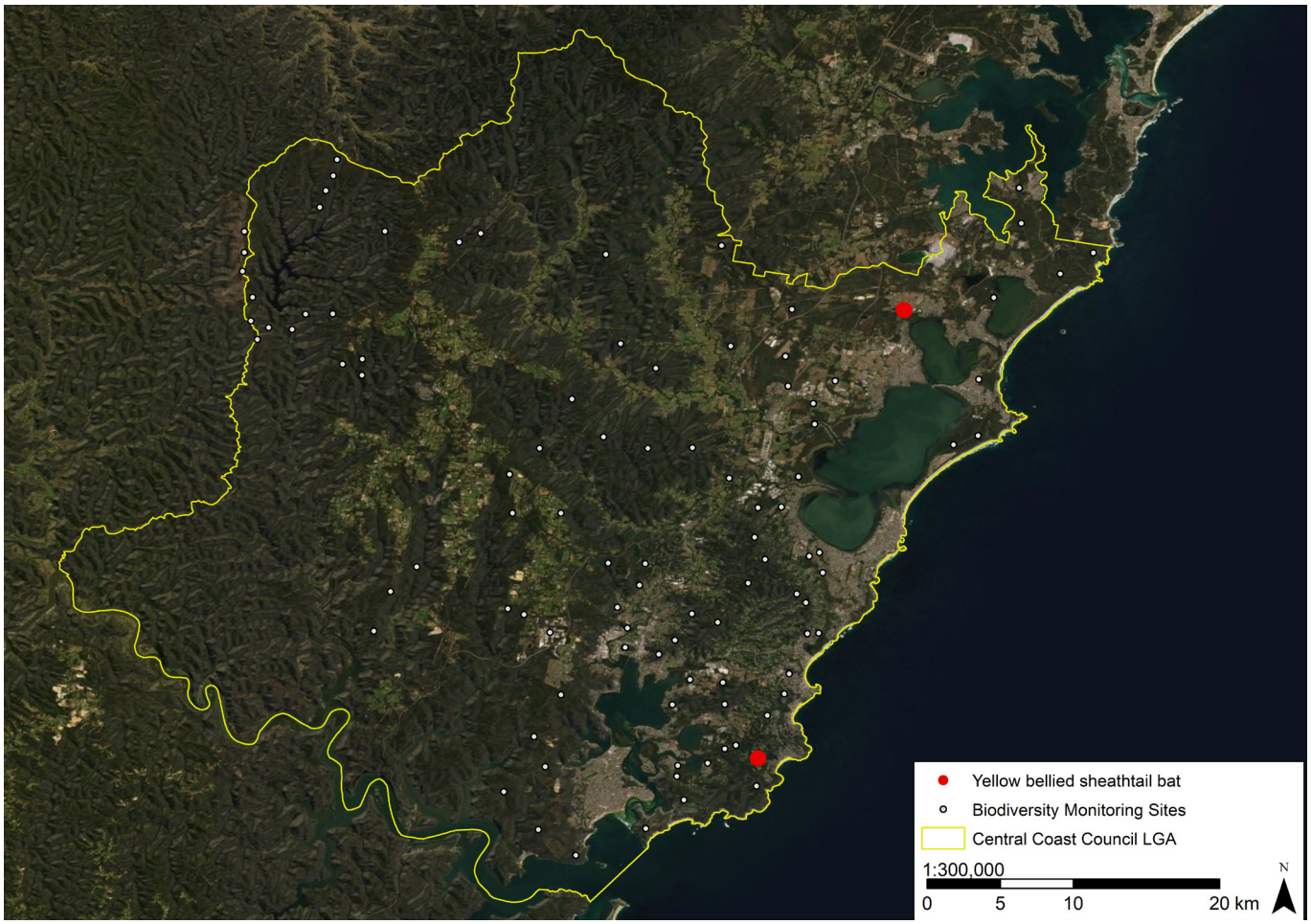

Figure 8: Distribution of the Yellow-bellied Sheathtail Bat.

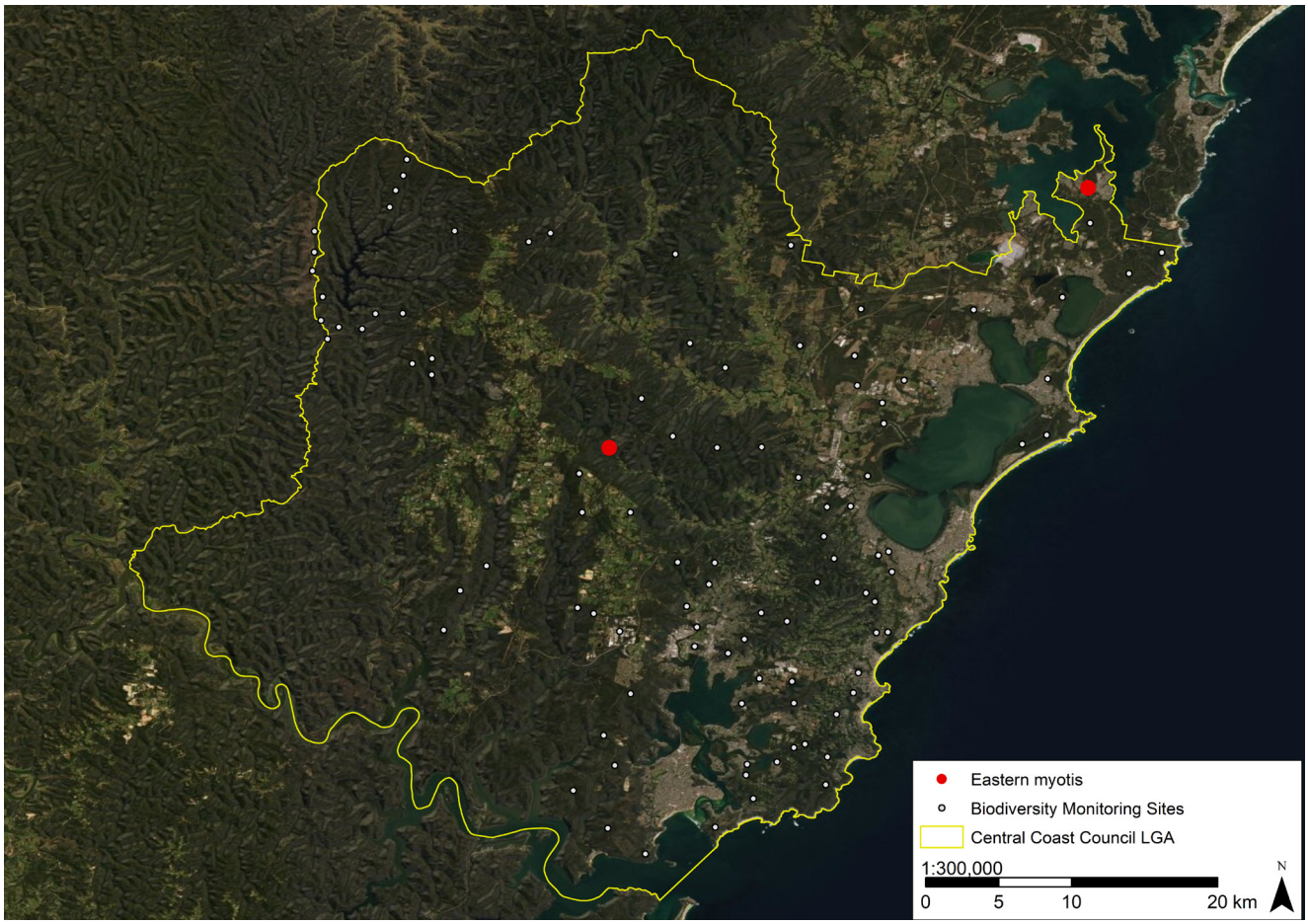

Figure 9: Distribution of the Eastern (Southern) Myotis from this study (note sampling rarely occurred near waterways where this species occurs).

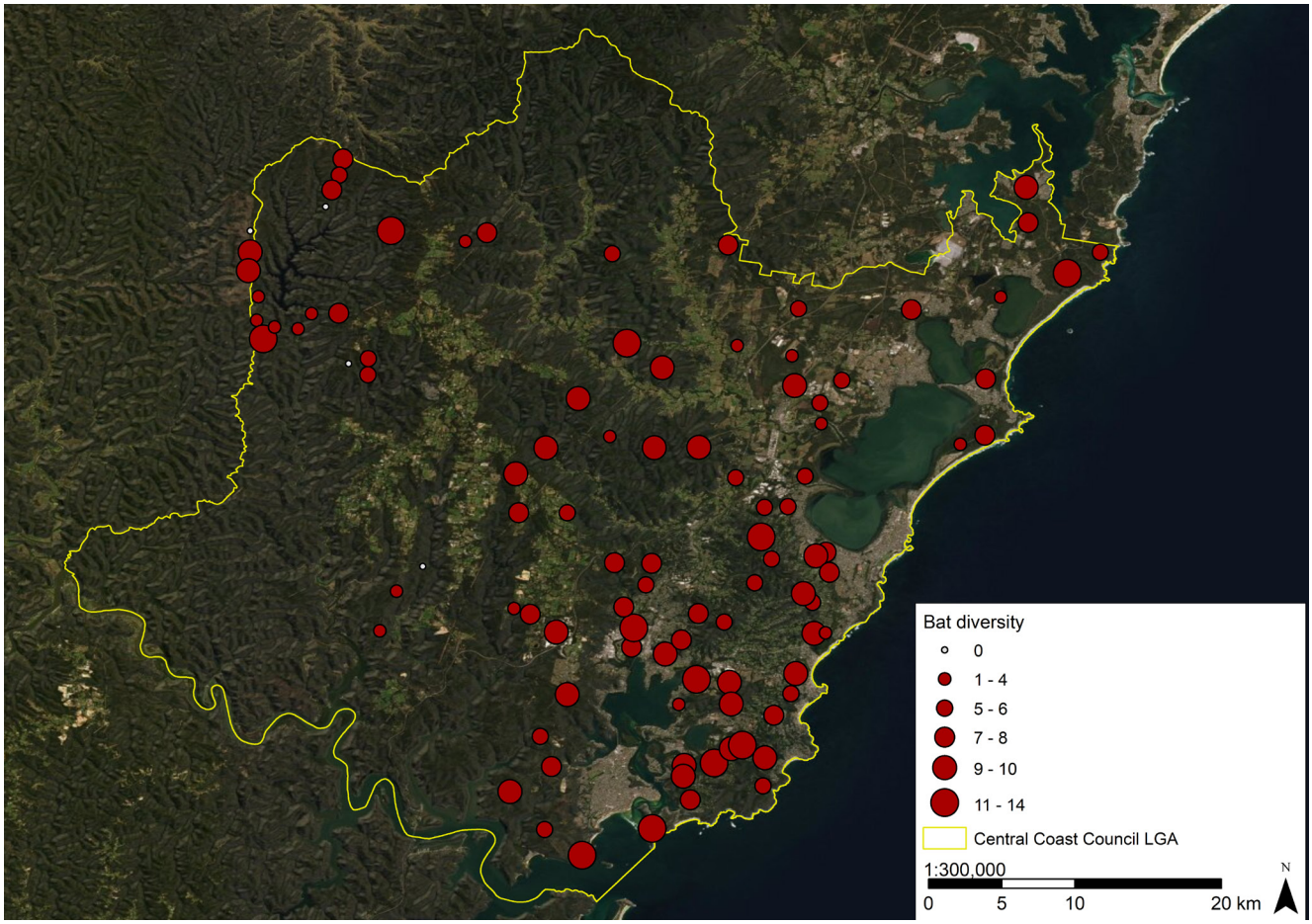

Figure 10: Microbat diversity across all 100 monitoring sites. Points represent microbat diversity, where larger points indicate greater diversity. Empty points recorded no calls that could be reliably attributed to individual species.

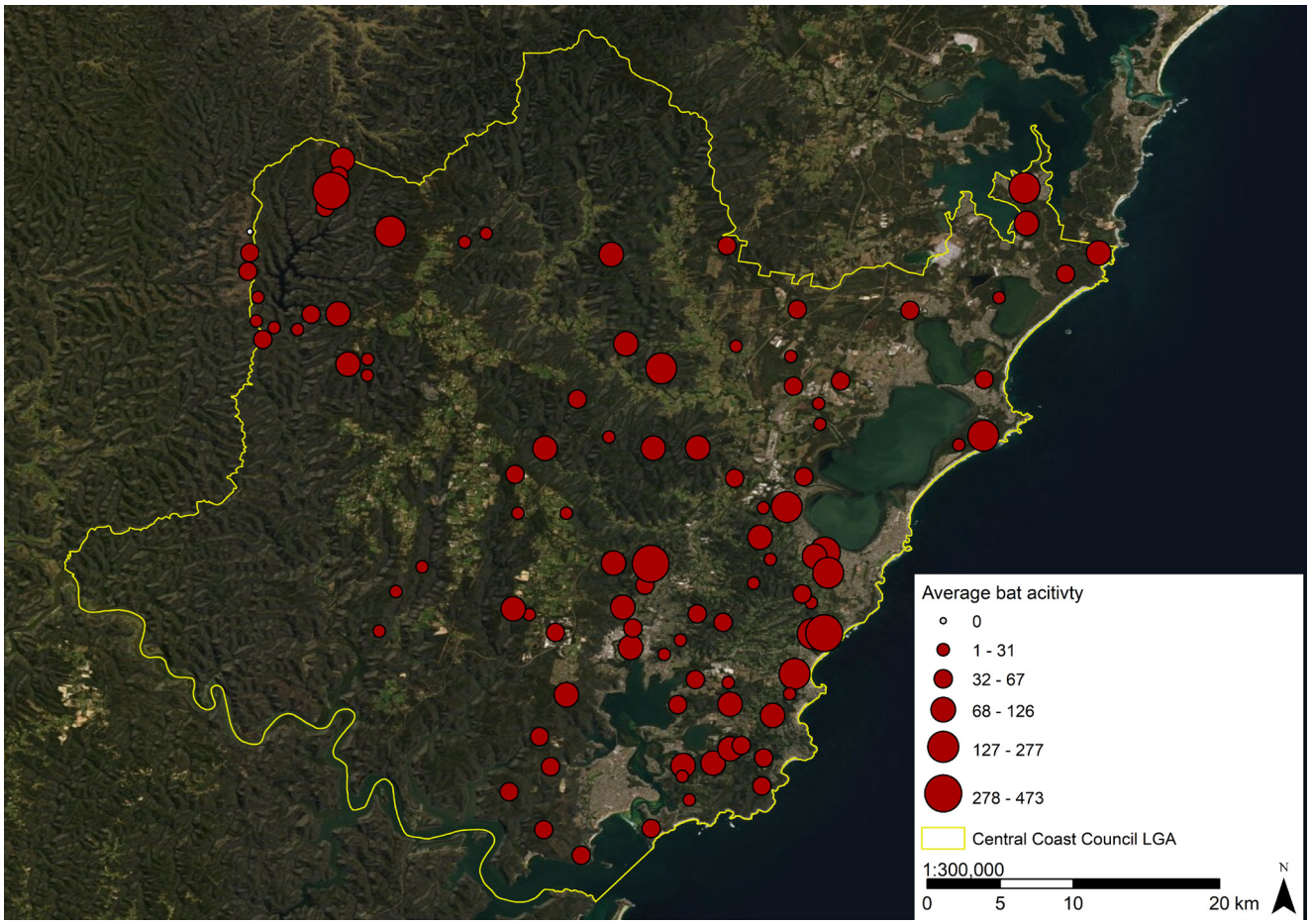

Figure 11: Average microbat activity at each site across the 100 monitoring sites. Points represent average microbat activity across the four survey nights, where larger points indicate greater activity. Empty points recorded no microbat activity.

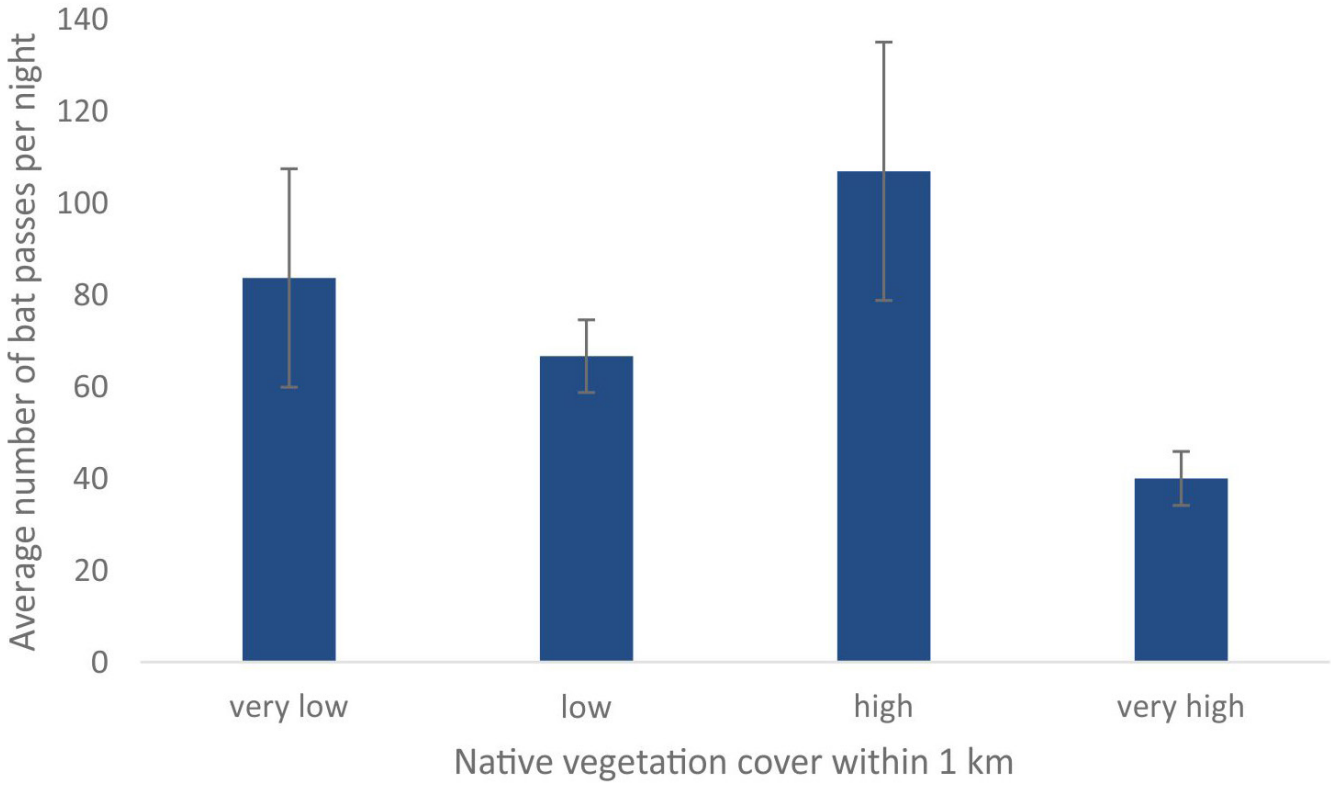

Figure 12: Average number of microbat passes per site in different broad vegetation types.

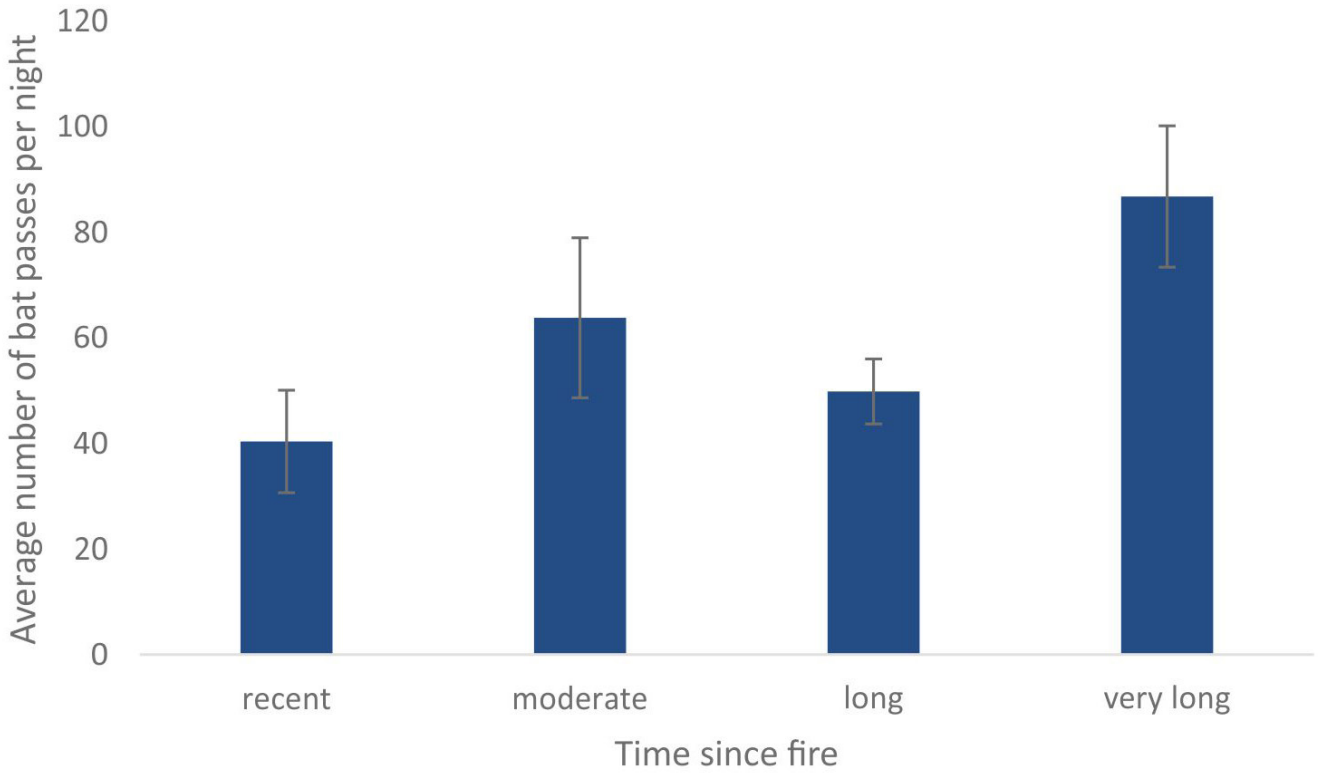

Figure 13: Average number of microbat passes per site in relation to time since fire.
Recently burnt are areas burnt in the past five years, moderately long unburnt are sites burnt between 5–15 years before sampling, long unburnt sites burnt between 16–30 years ago and very long unburnt burnt at least 30 years ago.

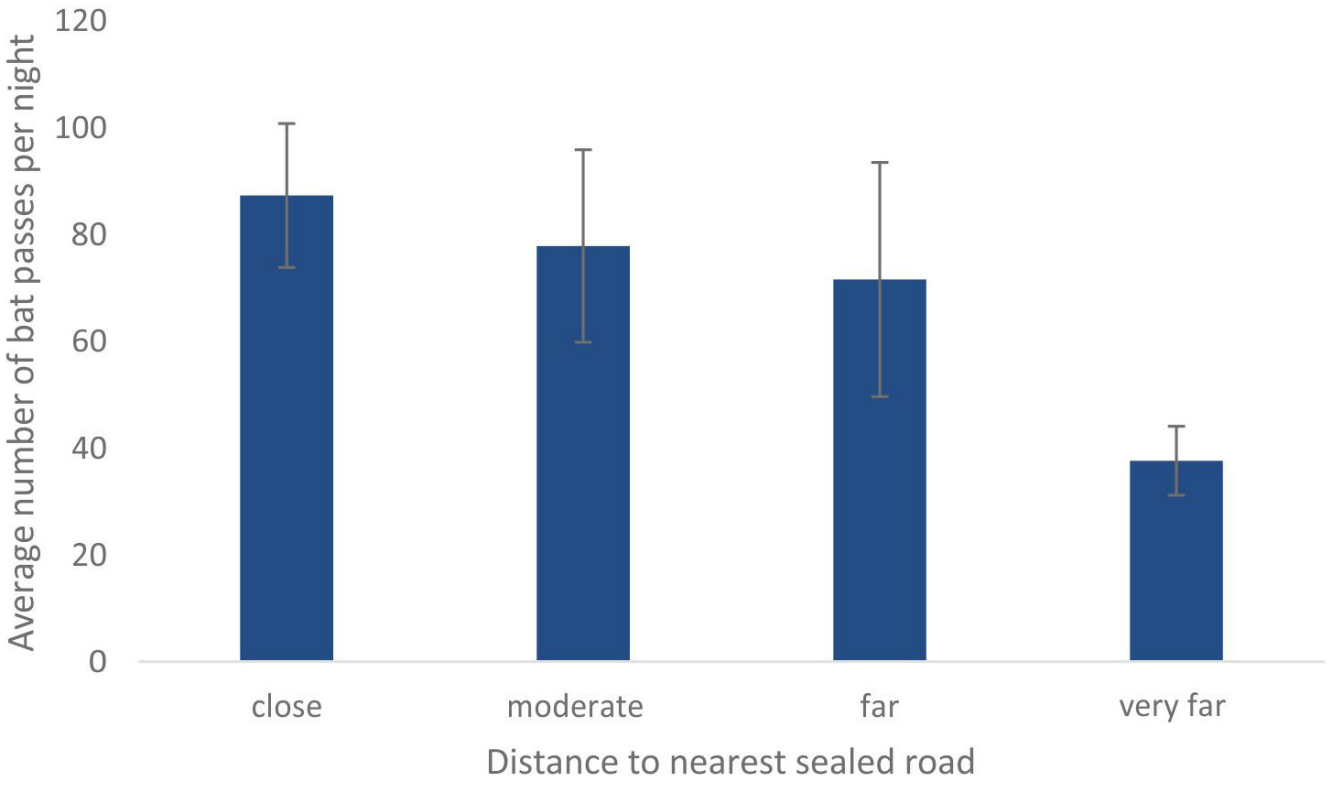

Figure 14: Average number of microbat passes per site in relation to distance from sealed road.
Close sites are between 5–100 m from a sealed road, moderate distance is 100–500 m from a sealed road, far is 500–1500 m from a sealed road, while very far is 1500–5000 m from a sealed road.

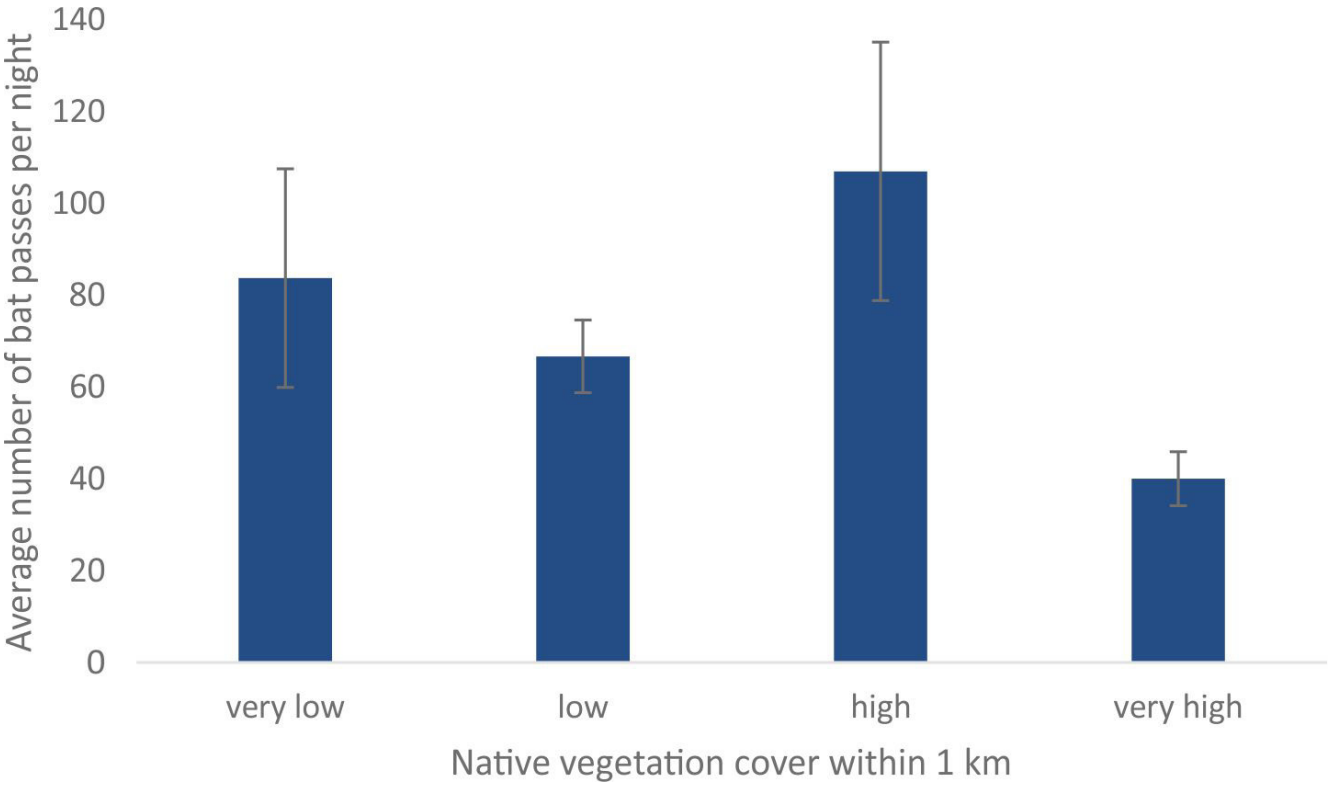

Figure 15: Average number of microbat passes per site in relation to level of native vegetation cover within 1 km of each site. Very low cover is less than 33% mapped native vegetation (within 1 km), low native vegetation cover is 34–66% (within 1 km), high is between 67–85% native vegetation cover (within 1 km) and very high is more than 85% vegetation cover (within 1 km).

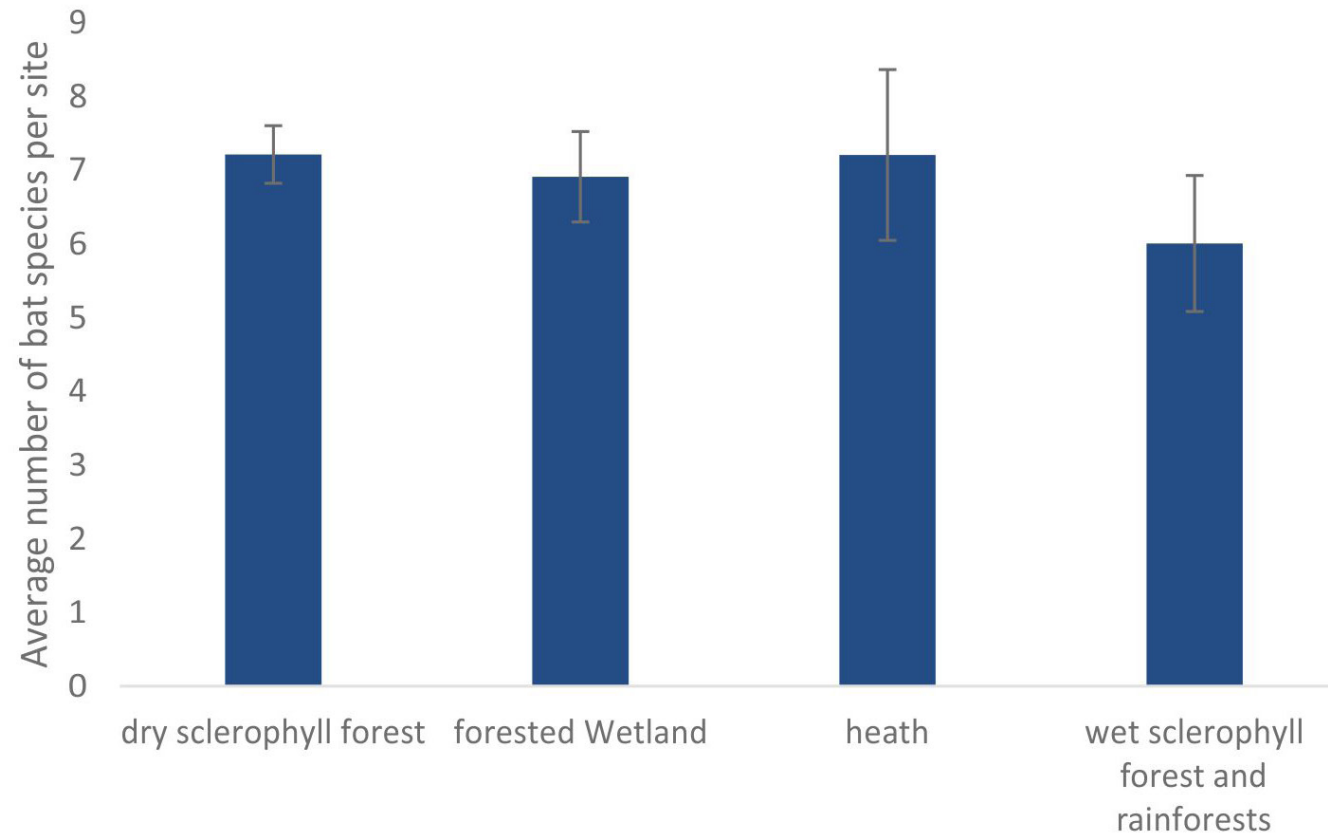

Figure 16: Average number of microbat species per site in different broad vegetation types

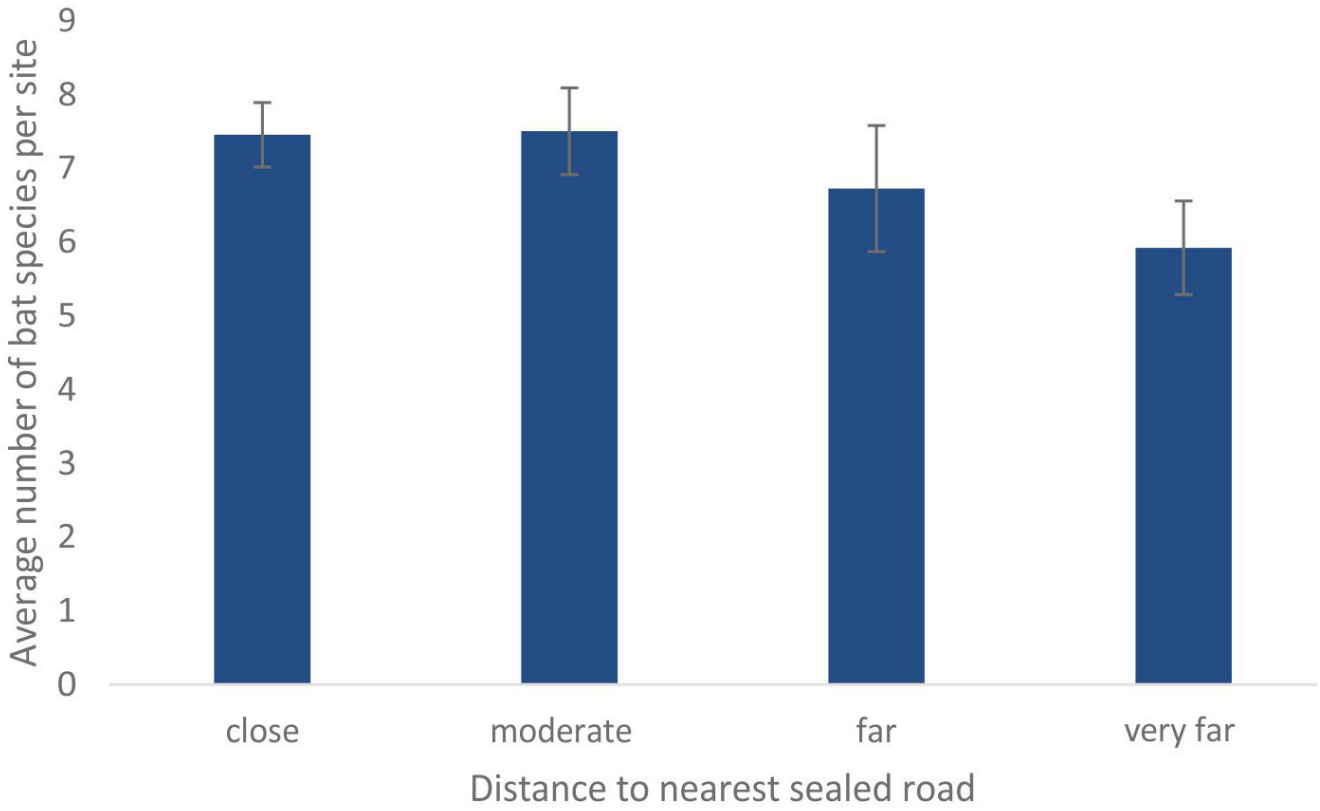

Figure 17: Average number of microbat species per site in relation to distance from sealed road.
Close sites are between 5–100m from a sealed road, moderate distance is 100–500m from a sealed road, far is 500–1500m from a sealed road, while very far is 1500–5000m from a sealed road.

Table 2: The number of sites with different microbat species recorded during the survey of 100 sites throughout the Central Coast region.

Common name	Scientific name	Number of sites recorded
Gould's Wattled Bat	*Chalinolobus gouldii*	89
Long-eared Bat1	*Nyctophilus species*	75
Eastern Forest Bat	*Vespadelus pumilus*	73
Eastern Horseshoe Bat	*Rhinolophus megaphyllus*	70
Southern Freetail Bat	*Mormopterus species 3*	69
Little Bent-wing Bat*	*Miniopterus australis*	56
East Coast Freetail Bat*	*Mormopterus norfolkensis*	47
Eastern Freetail Bat	*Mormopterus ridei*	47
Eastern Broad-nosed Bat	*Scotorepens orion*	33
White-striped Mastiff Bat	*Tadarida australis*	33
Large Forest Bat	*Vespadelus darlingtoni*	29
Chocolate Wattled Bat	*Chalinolobus morio*	24
Large-eared Pied Bat*	*Chalinolobus dwyeri*	23
Eastern Bent-wing Bat*	*Miniopterus schreibersii oceanensis*	23
Greater Broad-nosed Bat*	*Scoteanax rueppellii*	8
Eastern False Pipistrelle*	*Falsistrellus tasmaniensis*	5
Yellow-bellied Sheathtail Bat*	*Saccolaimus flaviventris*	2
Eastern (Southern) Myotis*[2]	*Myotis macropus*	2

*Denotes threatened species

[2] The Eastern Myotis is likely to be more common in the region than these results suggest, due to most of these survey sites not being located adjacent to water bodies or streams, where this species forages.

GROUND-DWELLING FAUNA

A total of 48,721 camera images were recorded, of which 19,266 contained photos of fauna. From these, fauna in 678 images could not be confidently identified. Thus, 18,588 images were used for analysis. The remote camera surveys recorded 16 species of native ground-dwelling and/ or climbing mammals, including four threatened species being the Koala (*Phascolarctos cinereus;* Photograph 7), Spotted-tailed Quoll (*Dasyurus maculatus*), Long-nosed Potoroo (*Potorous tridactylus*) and Eastern Pygmy Possum (*Cercartetus nanus*), five species of introduced mammals and three species of reptiles.

The surveys also recorded introduced species, being the Red Fox (*Vulpes vulpes*), domestic and wild Dogs (*Canis sp*), domestic and feral Cats (*Felis catus*), various species of Deer, rabbits and rodents. Table 3 outlines all fauna detected using remote camera traps.

Photograph 7: A Koala captured at one of the remote camera monitoring sites

Photograph 8: An Echidna captured at one of the remote camera monitoring sites.

Photograph 9: A Superb Lyrebird captured at one of the remote camera monitoring sites.

Photograph 10: A Long-nosed Bandicoot captured at one of the remote camera monitoring sites.

Photograph 11: A pair of Swamp Wallabies captured at one of the remote camera monitoring sites

Table 3: Species of ground-dwelling (terrestrial) fauna recorded by the remote camera surveys, across 100 sites.

Common Name	Scientific Name	Number of Sites Where Species Was Recorded
Native Mammals		
Antechinus	*Antechinus species*	41
Common Brush-tailed Possum	*Trichosurus vulpecula*	49
Common Ringtail Possum	*Pseudocheirus peregrinus*	6
Short-beaked Echidna	*Tachyglossus aculeatus*	9
Eastern Grey Kangaroo	*Macropus giganteus*	2
Eastern Pygmy Possum	*Cercartetus nanus*	4
Koala*	*Phascolarctos cinereus*	2
Long-nosed Bandicoot	*Perameles nasuta*	31
Superb Lyrebird	*Menura novaehollandiae*	24
Northern Brown Bandicoot	*Isoodon macrourus*	1
Long-nosed Potoroo*	*Potorous tridactylus*	2
Spotted-tailed Quoll*	*Dasyurus maculatus*	1
Unidentified rodent	*Rattus/ Mus species*	55
Sugar Glider	*Petaurus breviceps*	2
Swamp Wallaby	*Wallabia bicolor*	88
Bare-nosed Wombat	*Vombatus ursinus*	4

*Denotes threatened species

Common Name	Scientific Name	Number of Sites Where Species Was Recorded
Introduced Mammals		
Feral and domestic Cat+	*Felis catus*	9
Deer+	*various*	6
Domestic and wild Dog+	*Canis familiaris*	17
Red Fox+	*Vulpes vulpes*	52
European Rabbit+	*Oryctolagus cuniculus*	1
Birds		
Australian Brush Turkey	*Alectura lathami*	28
Laughing Kookaburra	*Dacelo novaeguineae*	9
Tawny Frogmouth	*Podagus strigoides*	5
Reptiles		
Lace Monitor	*Varanus varius*	9
Land Mullet	*Bellatorias major*	8
Red-bellied Black Snake	*Pseudechis porphyriacus*	1

*Threatened species
+Introduced species

TERRESTRIAL FAUNA, PREDOMINANTLY MAMMALS

Across the 100 sites, the number of detected species ranged from one to 11 (Figure 20). There were three threatened mammal species detected, being the Koala, Long-nosed Potoroo, and Spotted-tailed Quoll (Figure 21). There were seven ground dwelling fauna species detected by remote cameras with more than 10 occurrence records across the study region. These included *Antechinus* species (Figure 22), the Australian Brush Turkey (Figure 23), the Common Brushtail Possum (Figure 24), the introduced Red Fox (Figure 25), the Long-nosed Bandicoot (Figure 26), all species of rodents, which could not accurately be identified from images (Figure 27) and the Swamp Wallaby (Figure 28).

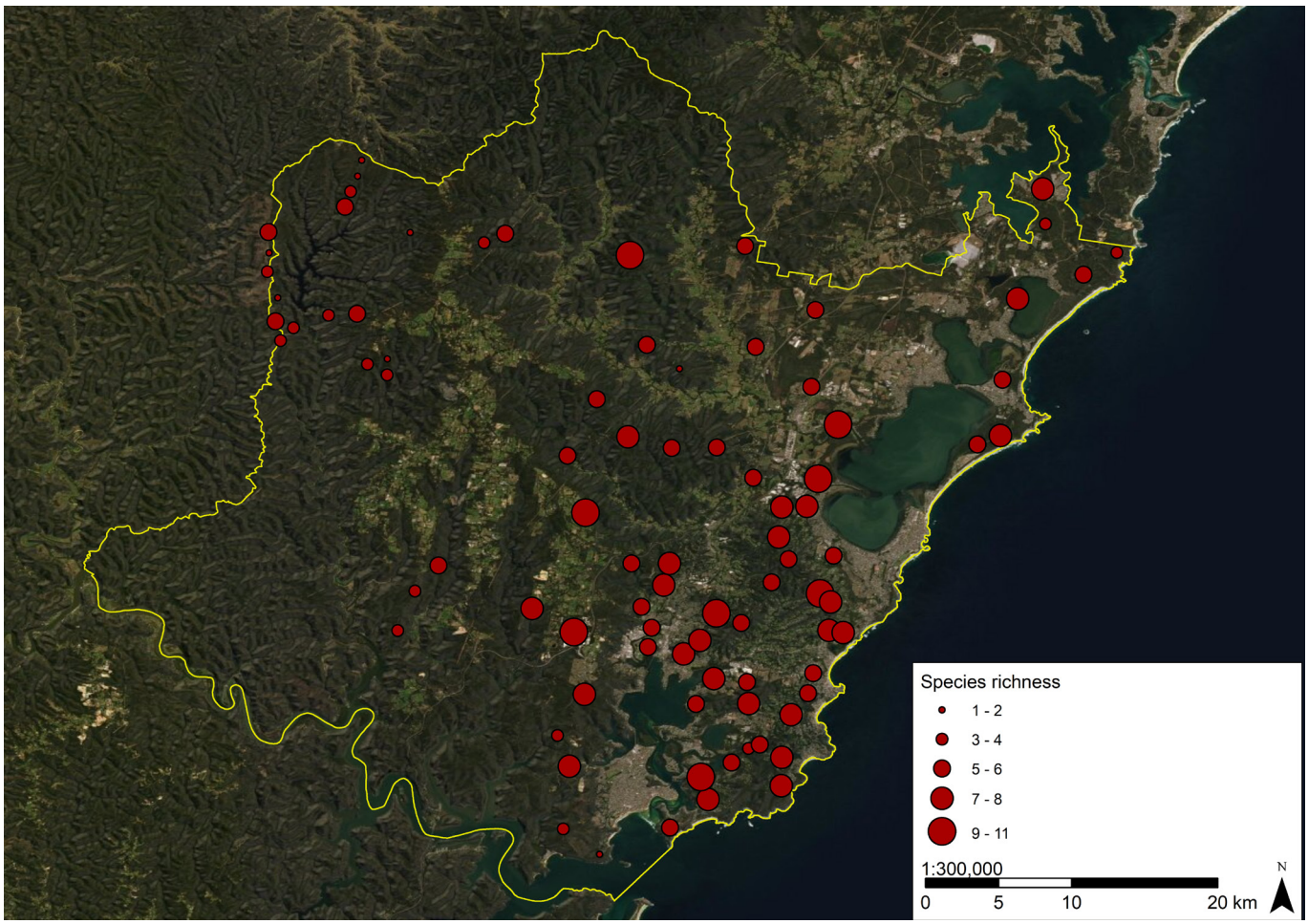

Figure 20: The total species richness of ground fauna at biodiversity monitoring sites within the Central Coast LGA. Points represent number of species at a given site, where larger points indicate greater species diversity.

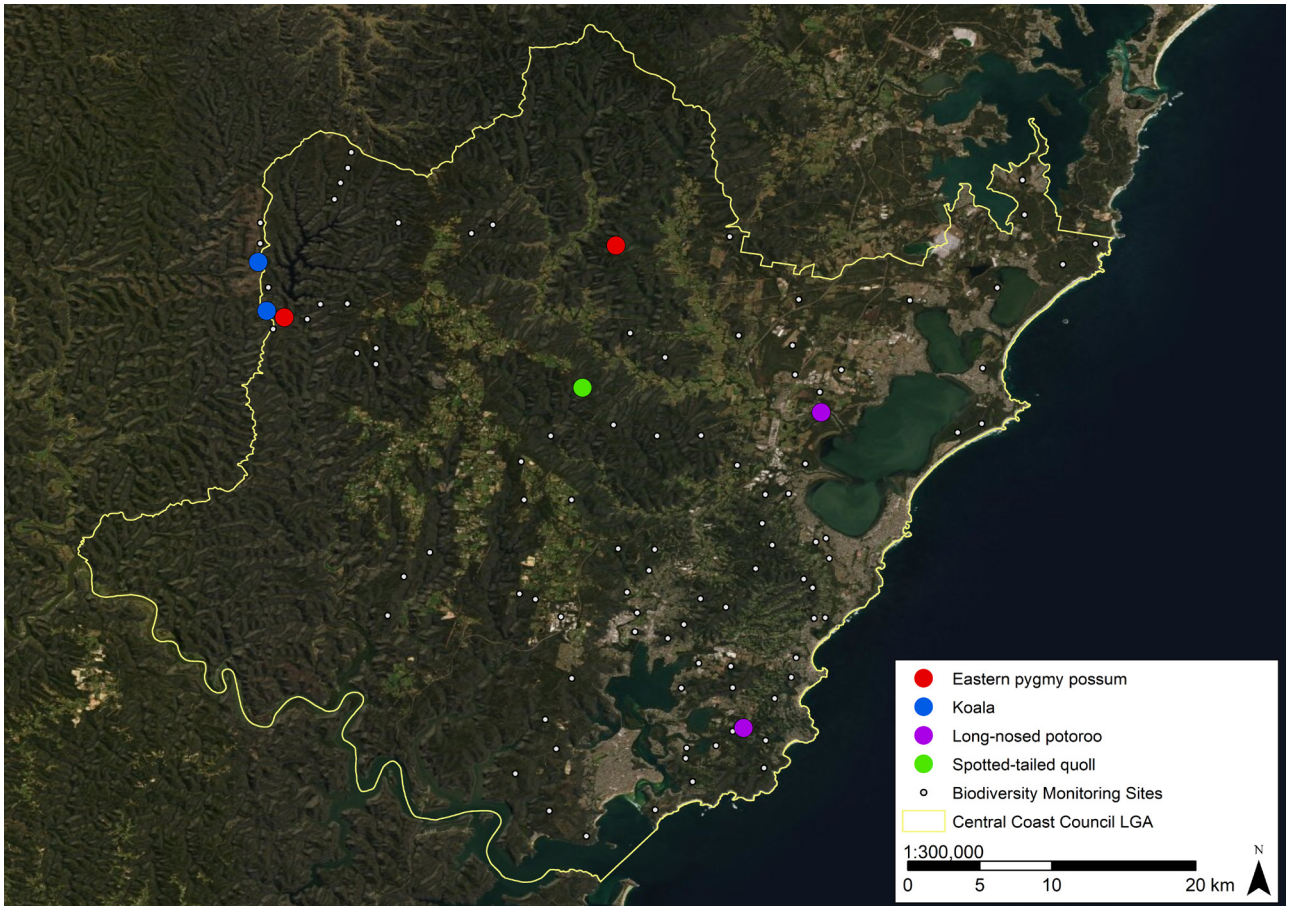

Figure 21: Distribution of threatened mammal species recorded in this study.

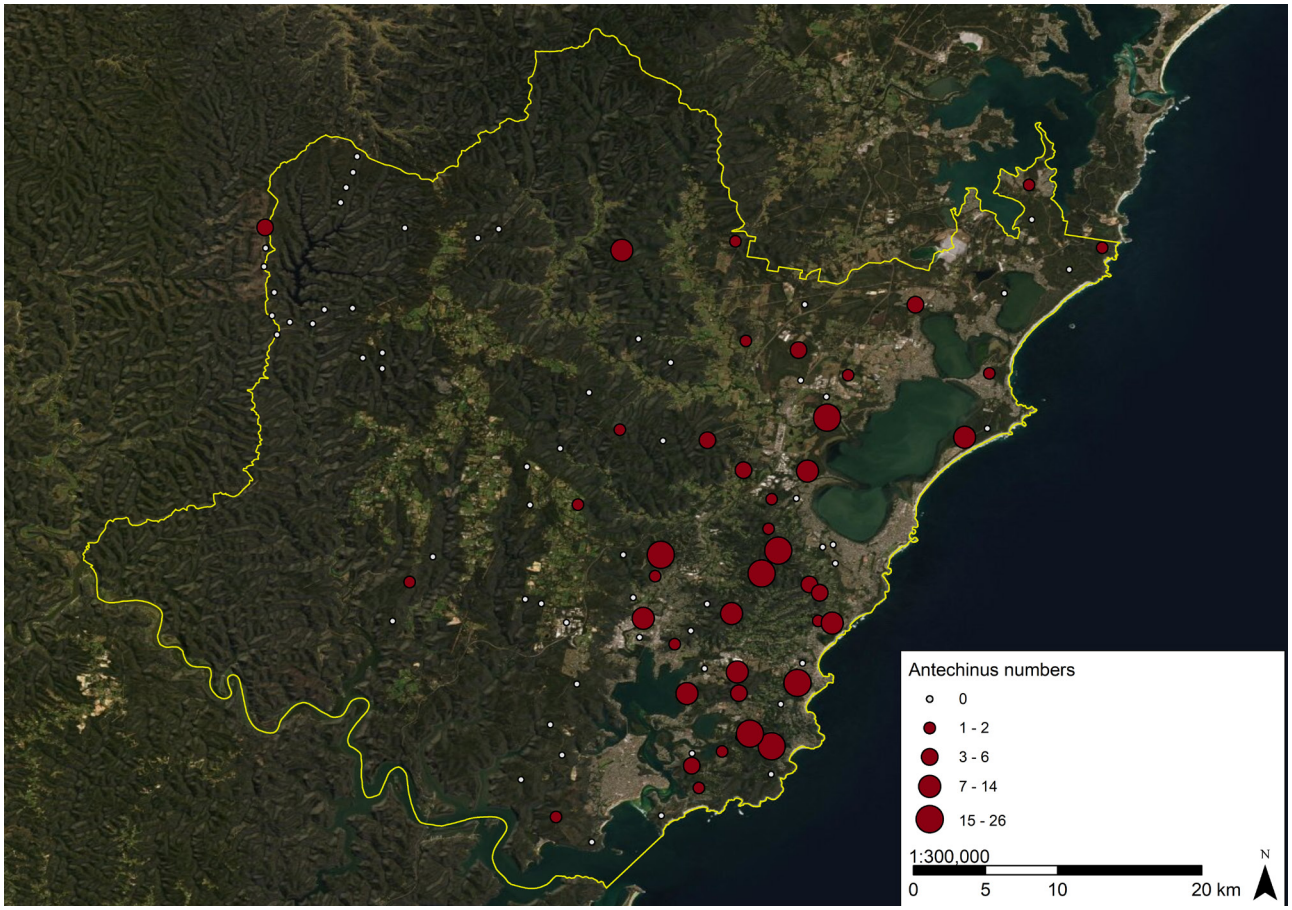

Figure 22: The location and number of occurrences of *Antechinus* species within the Central Coast LGA. Antechinus could not be identified to species level from camera images. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

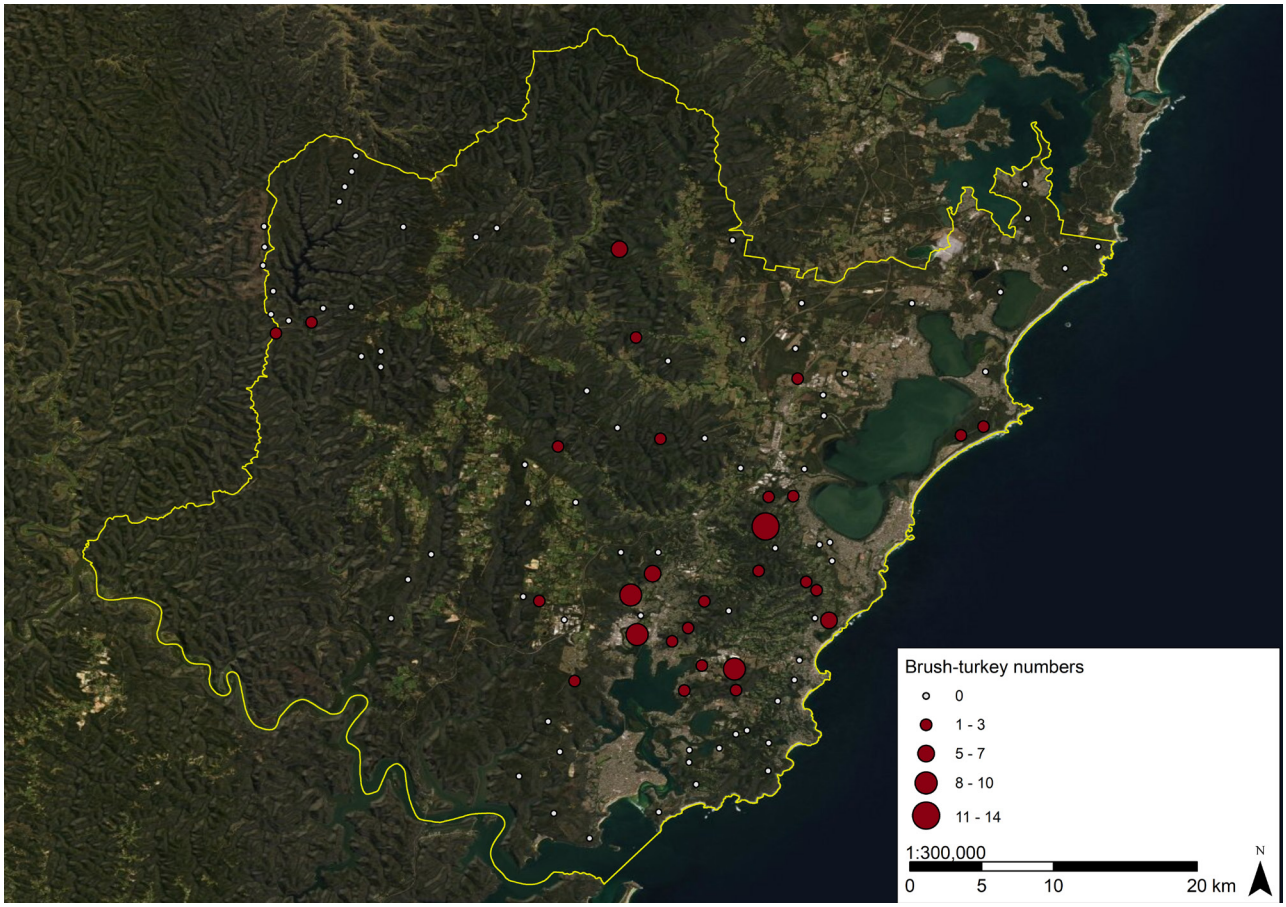

Figure 23: The location and number of occurrences of the Australian Brush-turkey within the Central Coast LGA.
Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

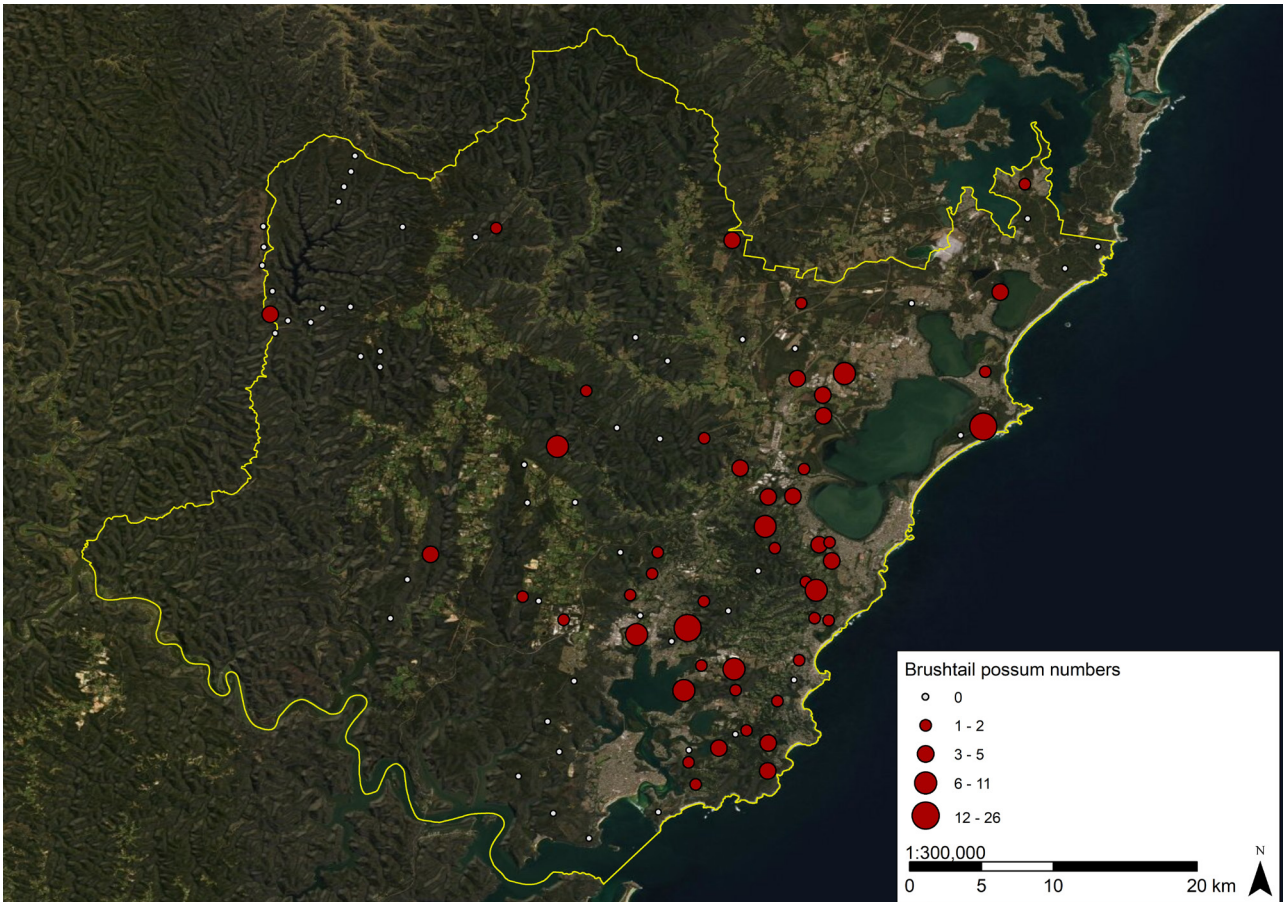

Figure 24: The location and number of occurrences of the Common Brushtail Possum within the Central Coast LGA.
Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

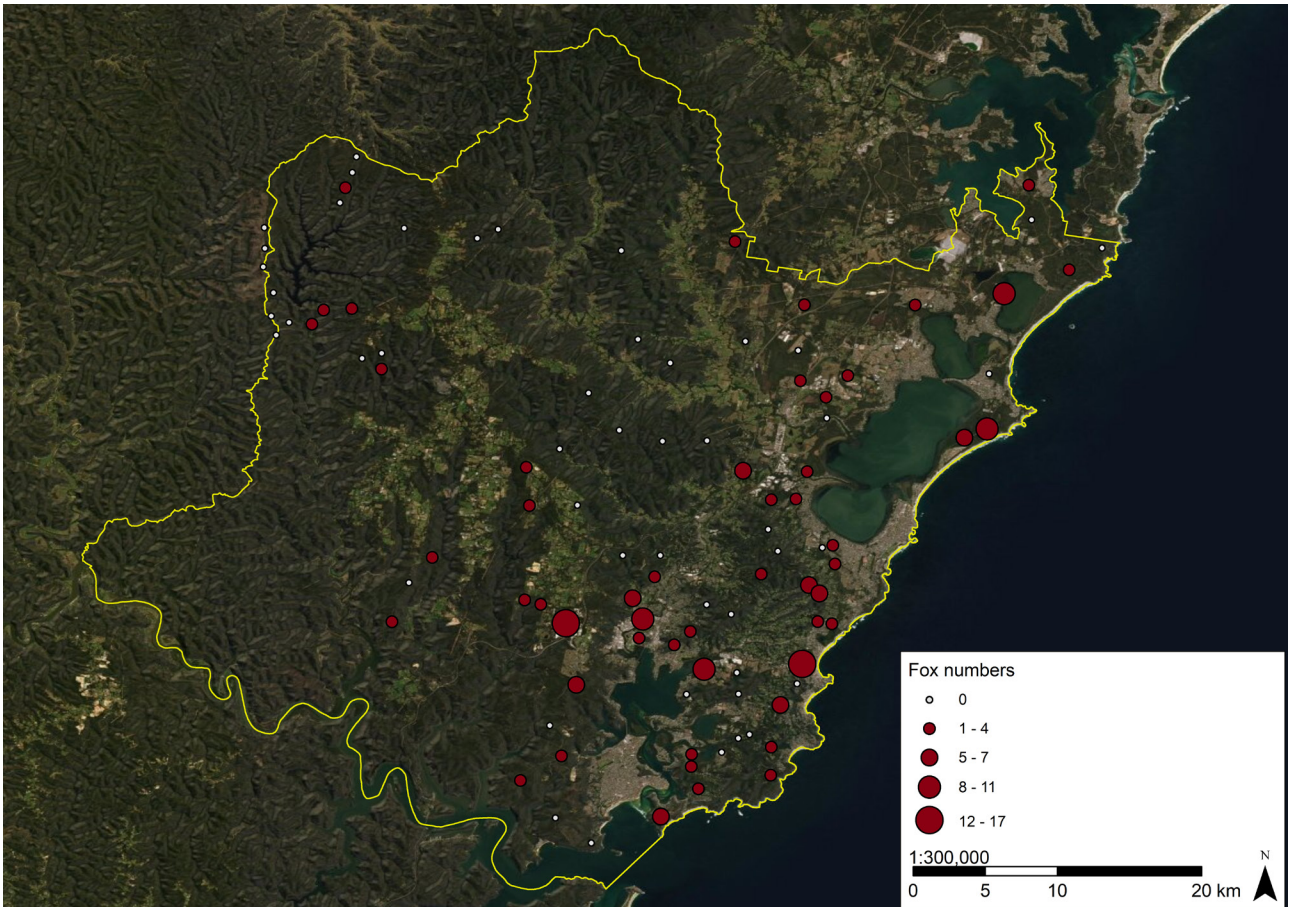

Figure 25: The location and number of occurrences of the introduced Red Fox within the Central Coast LGA.
Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

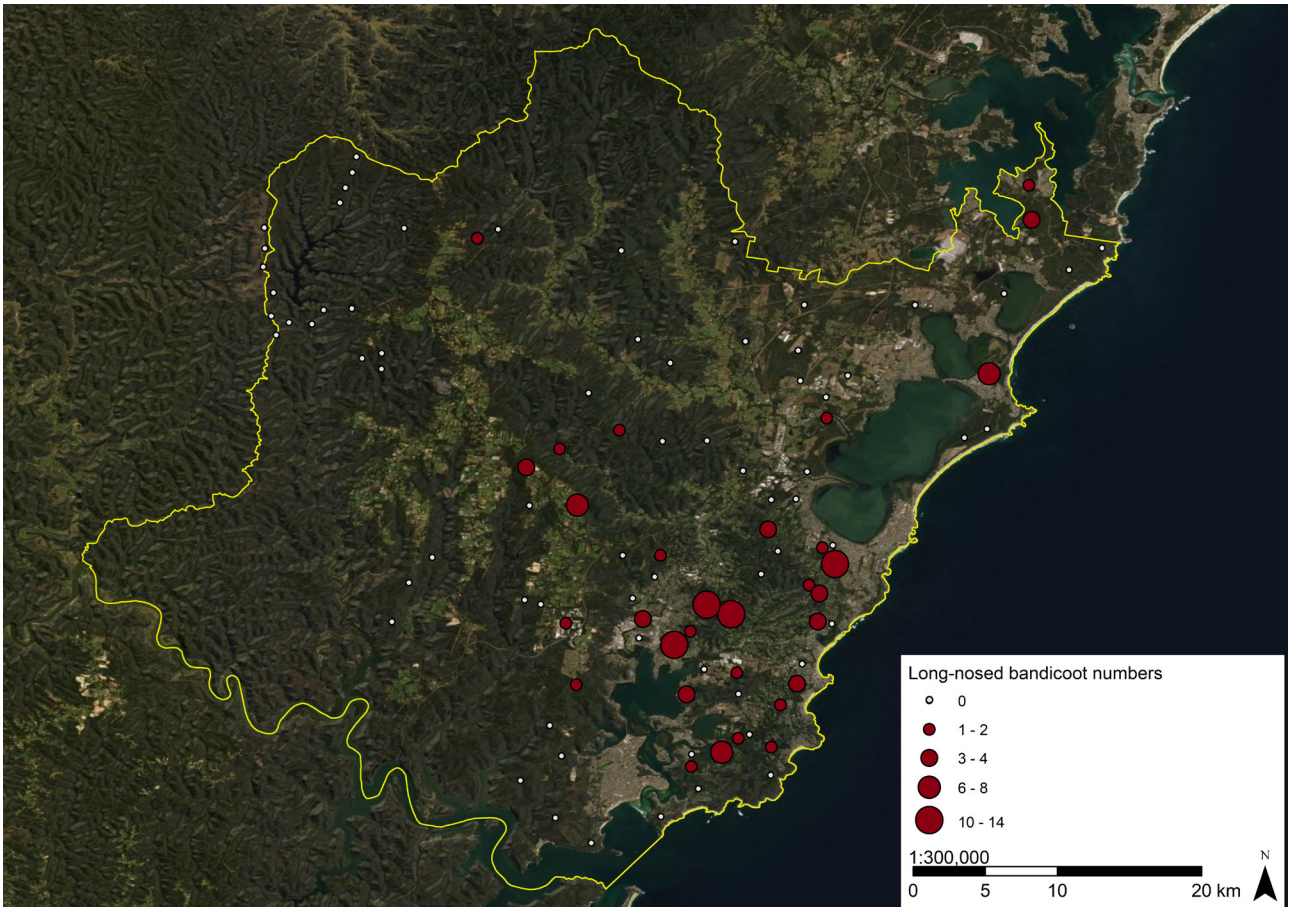

Figure 26: The location and number of occurrences of Long-nosed Bandicoot within the Central Coast LGA.
Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

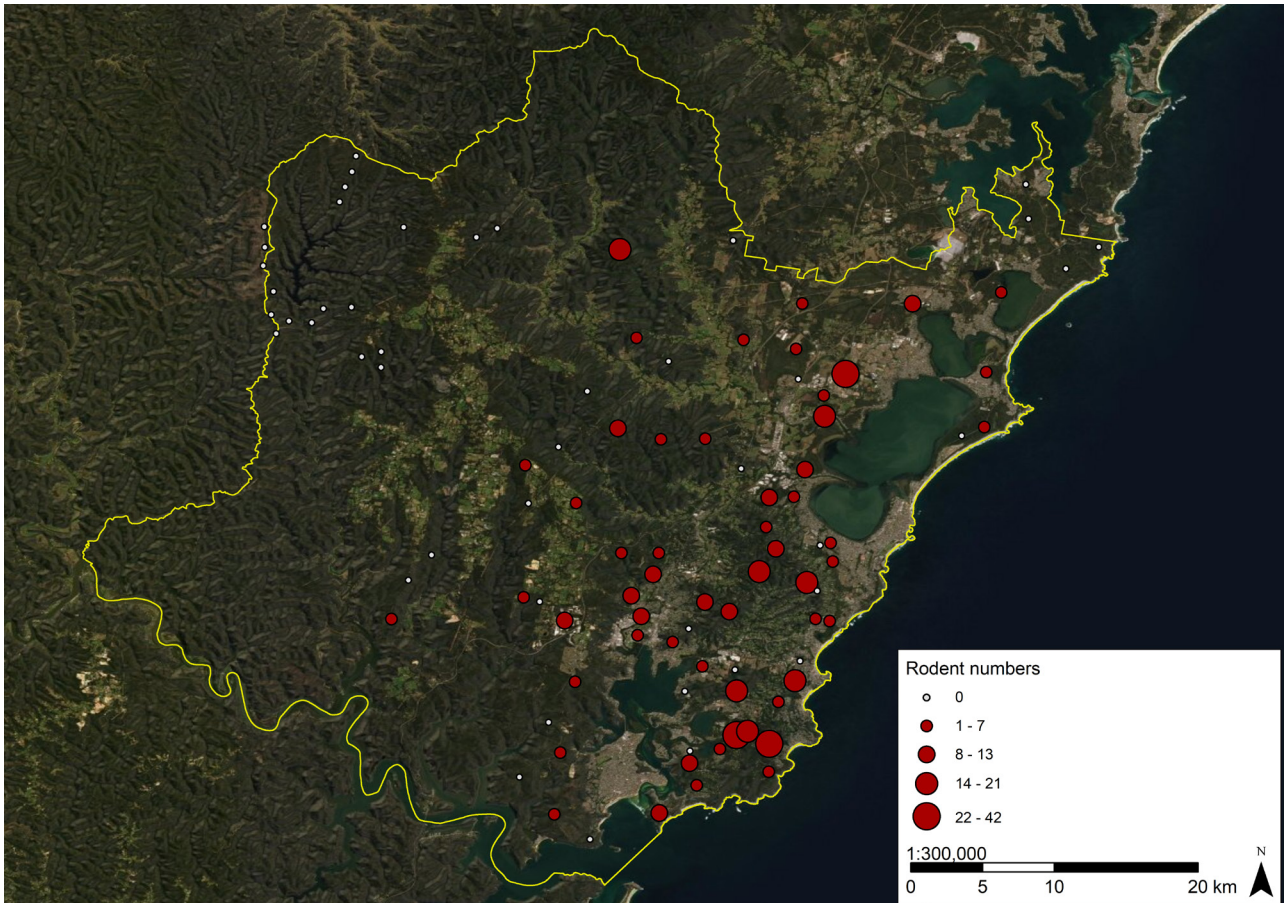

Figure 27: The location and number of occurrences of all rodents within the Central Coast LGA. Rodents could not be identified to species level and is inclusive of both native and introduced rodent species. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

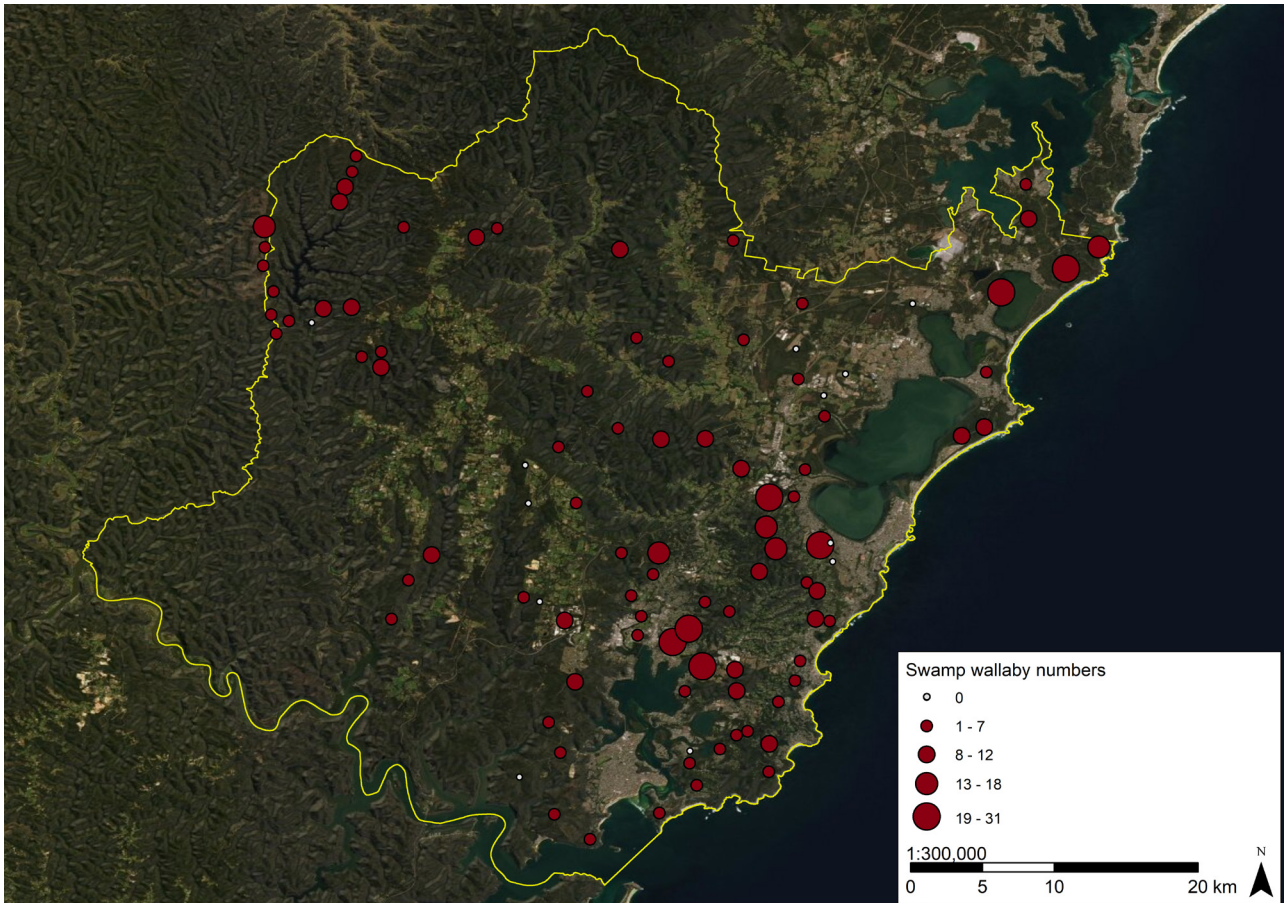

Figure 28: The location and number of occurrences of Swamp Wallaby within the Central Coast LGA. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

The greatest diversity of native terrestrial and climbing mammals occurred in wet sclerophyll forest and forested wetlands, with less diversity being recorded in dry sclerophyll forest (Figure 29). The greatest species diversity occurred in areas that were long and very long unburnt for native terrestrial and climbing mammals, in relation to time since fire (Figure 30). Sites that had been recently burnt or that had a moderate time since fire had less species diversity (Figure 30). Sites close or at a moderate distance from a sealed road had the greatest diversity of native terrestrial and climbing mammals, with sites at a greater distance from sealed roads having less species diversity (Figure 31). Species diversity in areas with very low, low and high levels of native vegetation within a 1 km radius of the survey sites had the greatest diversity of native terrestrial and climbing mammals, with less diversity being recorded in sites with greater levels of native vegetation cover (Figure 32).

Overall exotic mammal diversity was low. Forested wetlands were most likely to contain a greater diversity of exotic mammals, with similar average diversity being recorded in dry sclerophyll forest and heath, and the lowest average exotic mammal diversity occurring in wet sclerophyll forest (Figure 29). Similar diversity of exotic mammals occurred across all fire treatments, however recently burnt sites had fewer exotic mammals than sites that had a longer period since fire (Figure 30). Sites close or at a moderate distance from a sealed road had the greatest diversity of exotic mammals, with less exotic mammal species being recorded further from roads (Figure 31). Areas with the lowest level of native vegetation cover had a greater average number of exotic mammals, with fewer exotic mammals being recorded in areas that contained greater vegetation coverage (Figure 32).

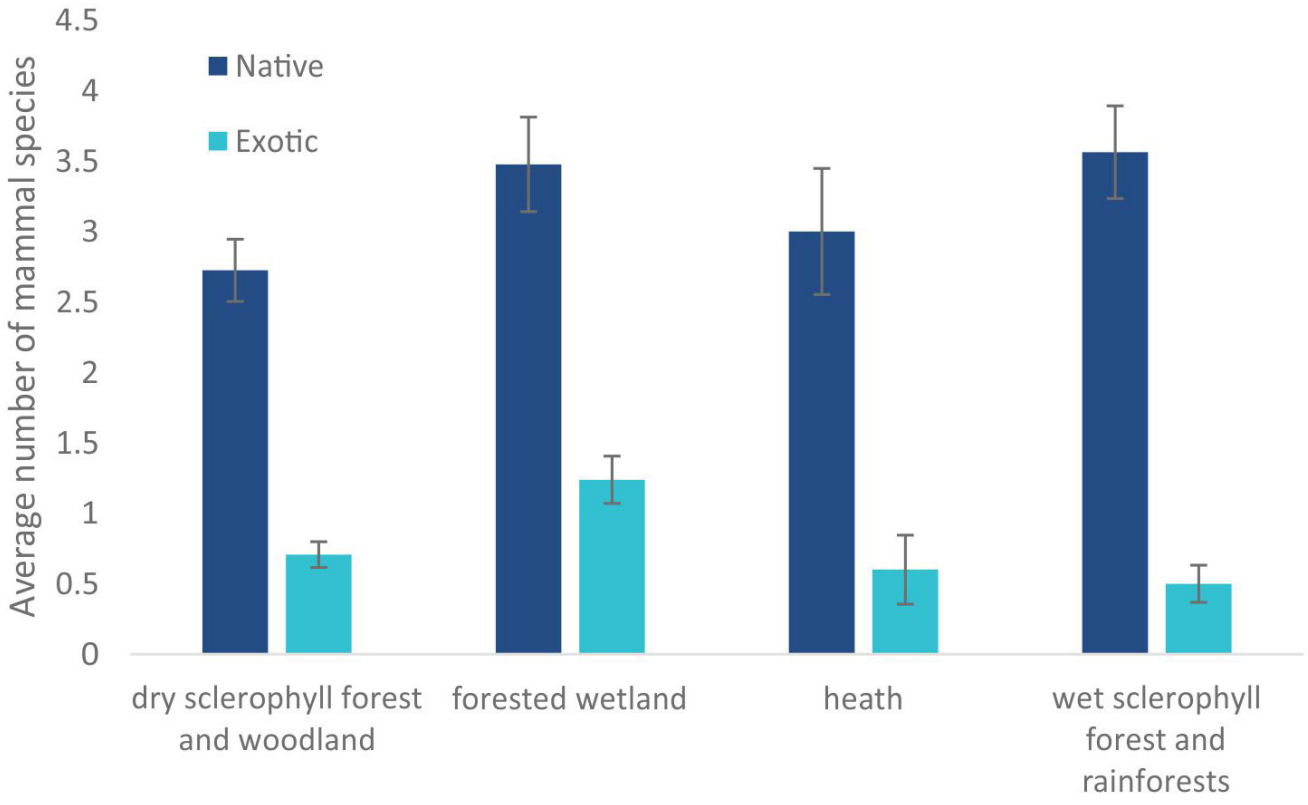

Figure 29: average number of native and exotic mammal species in broad vegetation types, where rodents are assumed to be native.

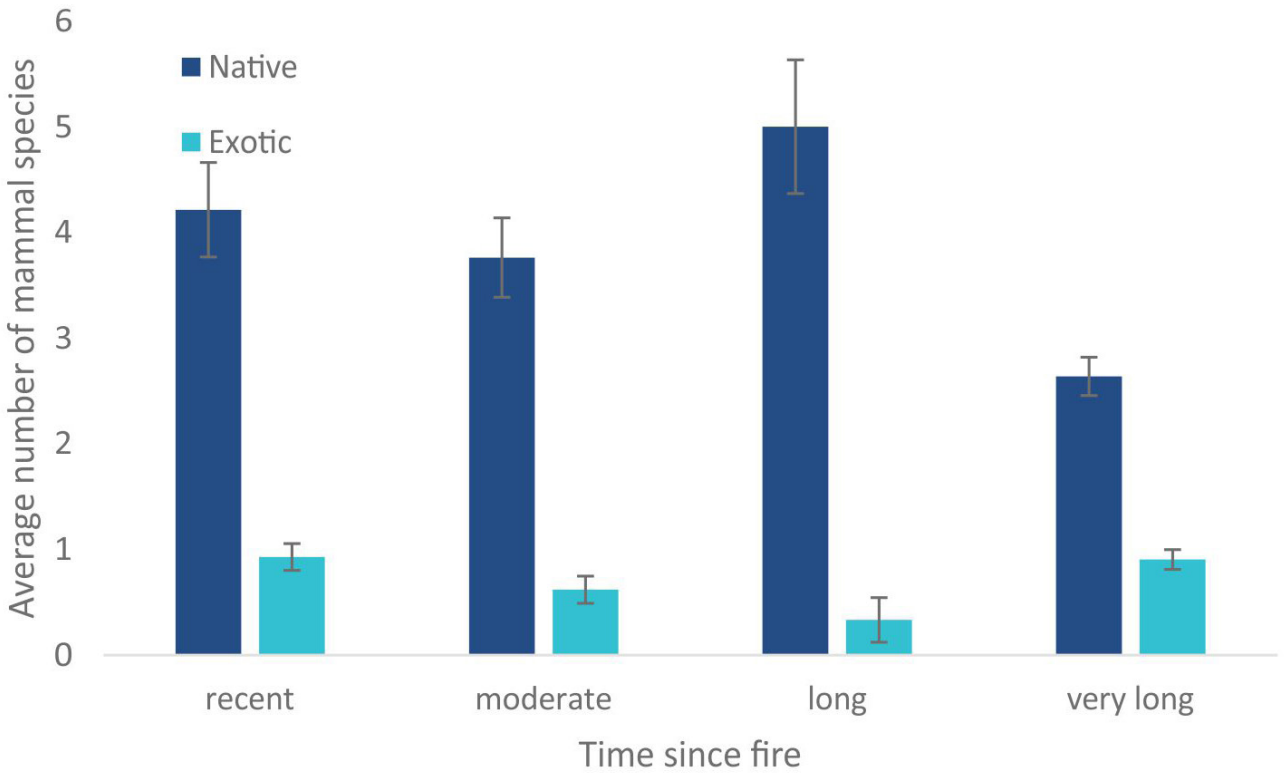

Figure 30: average number of native and exotic mammal species in relation to time since fire, where rodents are assumed to be native. Recently burnt are areas burnt in the past five years, moderately long unburnt are sites burnt between 5–15 years before sampling, long unburnt sites burnt between 16–30 years ago and very long unburnt burnt at least 30 years ago.

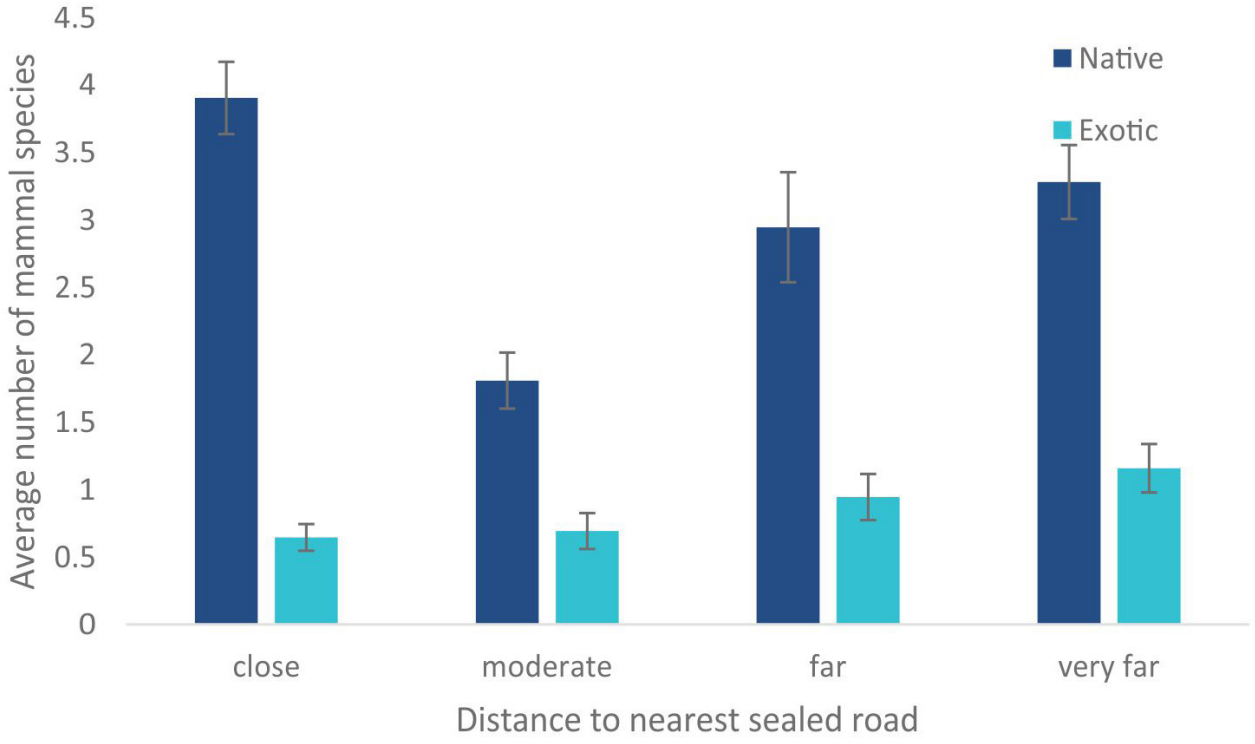

Figure 31: average number of native and exotic mammal species in relation to distance from sealed roads, where rodents are assumed to be native. Close sites are between 5–100 m from a sealed road, moderate distance is 100–500 m from a sealed road, far is 500–1500 m from a sealed road, while very far is 1500–5000 m from a sealed road.

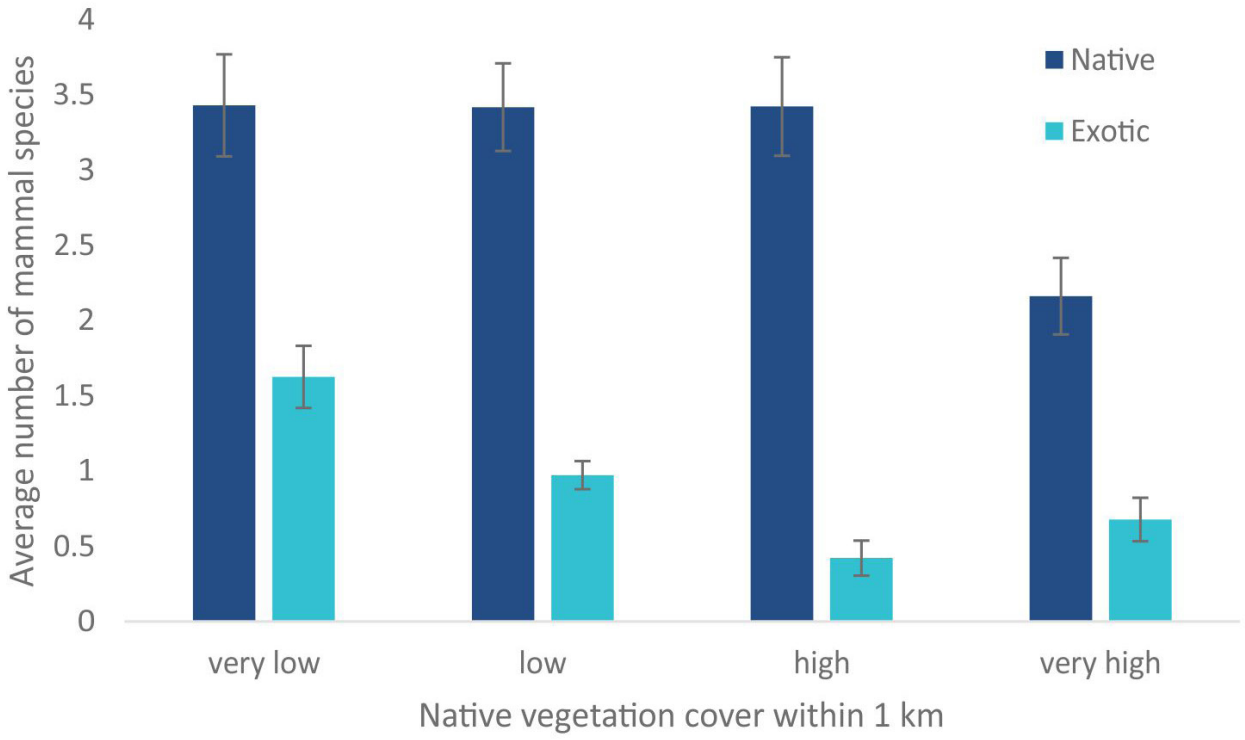

Figure 32: average number of native and exotic mammal species in relation to the amount of native vegetation cover within a 1 km radius of each site, where rodents are assumed to be native. Very low cover is less than 33% mapped native vegetation (within 1 km), low native vegetation cover is 34–66% (within 1 km), high is between 67–85% native vegetation cover (within 1 km) and very high is more than 85% vegetation cover (within 1 km).

BIRDS

Surveys recorded 82 species of birds, including four threatened species (Table 4). Diversity of birds at each site ranged from 1 to 19 species. The recorded threatened species included the Little Lorikeet, Swift Parrot, Varied Sittella, and White-bellied Sea Eagle. The location of these threatened species is shown in Figure 33.

Table 4: Bird species and their predominant diets, captured across 100 sites.

Scientific Name	Common Name	Predominant Diet	Number of Sites Detected
Alisterus scapularis	Australian king-parrot	Seeds and fruit	9
Gymnorhina tibicen	Australian magpie	Invertebrates and meat	11
Anthus novaeseelandiae	Australian pipit	Invertebrates	1
Corvus coronoides	Australian raven	Invertebrates and meat	7
Chenonetta jubata	Australian wood duck	Plant material	2
Geopelia humeralis	Bar-shouldered dove	Seeds	7
Zoothera lunulata	Bassian thrush	Invertebrates	1
Manorina melanophrys	Bell miner	Lerp	16
Coracina novaehollandiae	Black-faced cuckoo-shrike	Invertebrates	7
Macropygia phasianella	Brown cuckoo-dove	Seeds and fruit	5
Gerygone mouki	Brown gerygone	Invertebrates	39
Acanthiza pusilla	Brown thornbill	Invertebrates	62
Melithreptus brevirostris	Brown-headed honeyeater	Invertebrates and nectar	2
Phaps elegans	Brush bronzewing	Seeds and fruit	1
Alectura lathami	Australian Brush turkey	Seeds, fungi, invertebrates.	3
Acanthiza reguloides	Buff-rumped thornbill	Invertebrates	1
Acridotheres tristis	Common Myna+	Invertebrates, seeds, food waste.	3
Falcunculus frontatus	Crested shrike-tit	Invertebrates	1
Platycercus elegans	Crimson rosella	Seeds and fruit	11
Platycercus eximius	Eastern rosella	Seeds and fruit	5
Acanthorhynchus tenuirostris	Eastern spinebill	Nectar	58
Psophodes olivaceus	Eastern whipbird	Invertebrates	24
Eopsaltria australis	Eastern yellow robin	Invertebrates	28
Cacomantis flabelliformis	Fan-tailed cuckoo	Invertebrates	10

Lichenostomus fuscus	Fuscous honeyeater	Invertebrates and nectar	1
Eolophus roseicapilla	Galah	Seeds	3
Pachycephala pectoralis	Golden whistler	Invertebrates	46
Cracticus torquatus	Grey butcherbird	Invertebrates and small vertebrates	14
Rhipidura albiscapa	Grey fantail	Invertebrates	70
Colluricincla harmonica	Grey shrike-thrush	Invertebrates	21
Chrysococcyx basalis	Horsfield's bronze cuckoo	Invertebrates	2
Dacelo novaeguineae	Laughing kookaburra	Invertebrates and small vertebrates	13
Meliphaga lewinii	Lewin's honeyeater	Invertebrates and nectar	59
Cacatua sanguinea	Little corella	Seeds	2
Glossopsitta pusilla	Little Lorikeet*	Fruits and nectar	1
Anthochaera chrysoptera	Little Wattlebird	Nectar	32
Grallina cyanoleuca	Magpie lark	Invertebrates	6
Vanellus miles	Masked Lapwing	Invertebrates	1
Dicaeum hirundinaceum	Mistletoebird	Nectar	9
Glossopsitta concinna	Musk lorikeet	Nectar and fruit	4
Phylidonyris novaehollandiae	New Holland honeyeater	Nectar	20
Philemon corniculatus	Noisy friarbird	Nectar	2
Manorina melanocephala	Noisy miner	Nectar	18
Cracticus nigrogularis	Pied butcherbird	Invertebrates and small vertebrates	2
Strepera graculina	Pied currawong	Invertebrates and small vertebrates	5
Trichoglossus moluccanus	Rainbow lorikeet	Nectar and fruits	45
Anthochaera carunculata	Red wattlebird	Nectar	9
Neochmia temporalis	Red-browed finch	Seeds	18
Climacteris erythrops	Red-browed treecreeper	Invertebrates	1
Petroica rosea	Rose robin	Invertebrates	5
Ptilonorhynchus violaceus	Satin bowerbird	Fruits	9
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	Nectar and fruits	1
Myzomela sanguinolenta	Scarlet honeyeater	Nectar	16
Chrysococcyx lucidus	Shining bronze cuckoo	Invertebrates	1
Zosterops lateralis	Silvereye	Invertebrates	31

Spilopelia chinensis	Spotted dove+	Seeds and food waste.	2
Pardalotus punctatus	Spotted pardalote	Invertebrates	60
Cinclosoma punctatum	Spotted quail-thrush	Invertebrates	1
Pardalotus striatus	Striated pardalote	Invertebrates	3
Acanthiza lineata	Striated thornbill	Invertebrates	39
Cacatua galerita	Sulphur-crested cockatoo	Seeds and fruits	2
Malurus cyaneus	Superb fairy-wren	Invertebrates	14
Menura novaehollandiae	Superb lyrebird	Invertebrates	13
Lathamus discolor	Swift Parrot*	Nectar	1
Lopholaimus antarcticus	Topknot pigeon	Fruits	1
Daphoenositta chrysoptera	Varied Sittella*	Invertebrates	1
Malurus lamberti	Variegated fairy-wren	Invertebrates	16
Hirundo neoxena	Welcome swallow	Invertebrates	9
Haliastur sphenurus	Whistling kite	Vertebrate animals	1
Haliaeetus leucogaster	White-bellied sea eagle*	Vertebrate animals	2
Sericornis frontalis	White-browed scrubwren	Invertebrates	51
Phylidonyris niger	White-cheeked Honeyeater	Nectar	17
Lichenostomus leucotis	White-eared honeyeater	Invertebrates and nectar	12
Melithreptus lunatus	White-naped honeyeater	Invertebrates and nectar	23
Cormobates leucophaea leucophaea	White-throated treecreeper	Invertebrates	35
Rhipidura leucophrys	Willie wagtail	Invertebrates	2
Leucosarcia melanoleuca	Wonga pigeon	Fruits	6
Acanthiza nana	Yellow thornbill	Invertebrates	11
Lichenostomus chrysops	Yellow-faced honeyeater	Invertebrates	76
Calyptorhynchus funereus	Yellow-tailed black cockatoo	Seeds	7
Sericornis citreogularis	Yellow-throated scrubwren	Invertebrates	1
Lichenostomus melanops	Yellow-tufted honeyeater	Nectar	1

**Denotes threatened species*
+Denotes introduced species

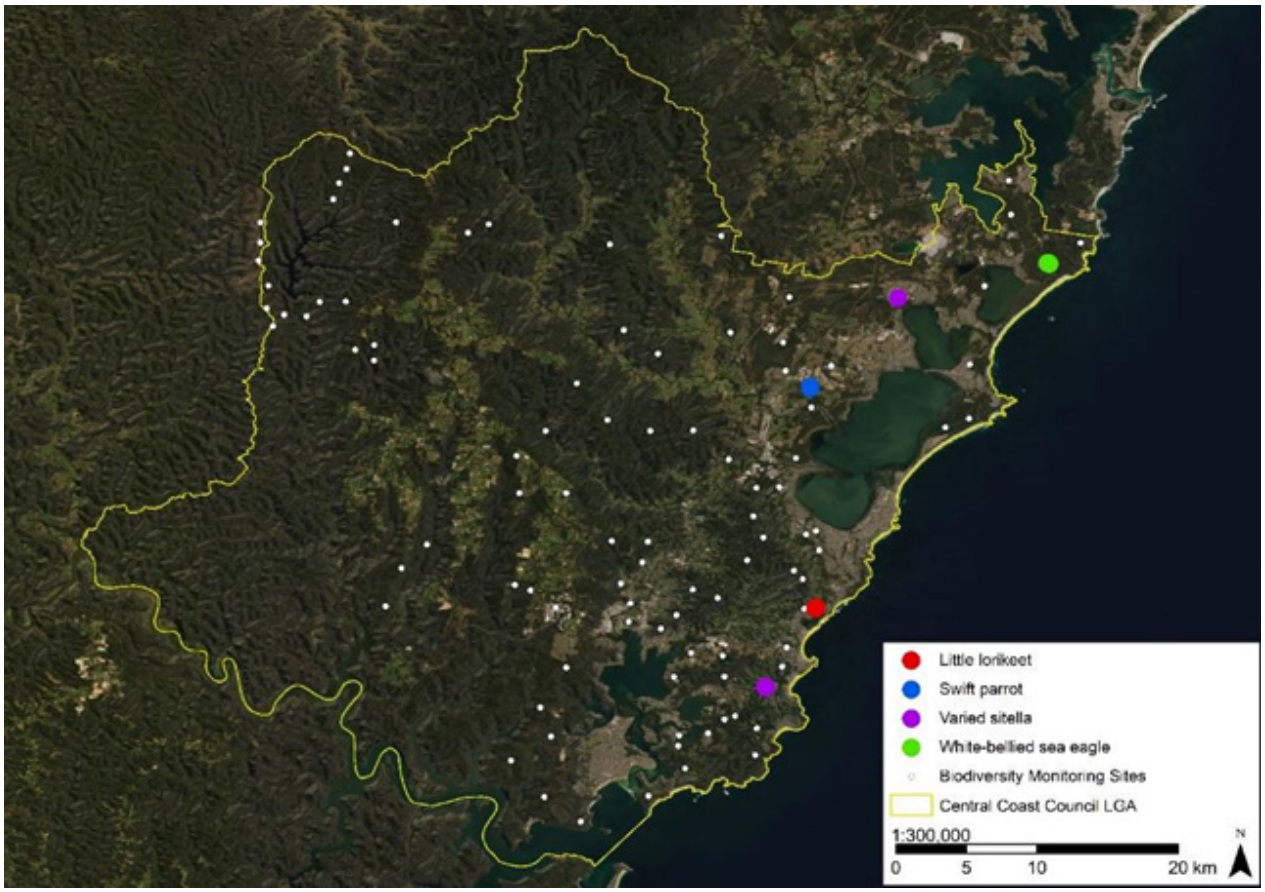

Figure 33: The location of threatened bird species recorded in this study

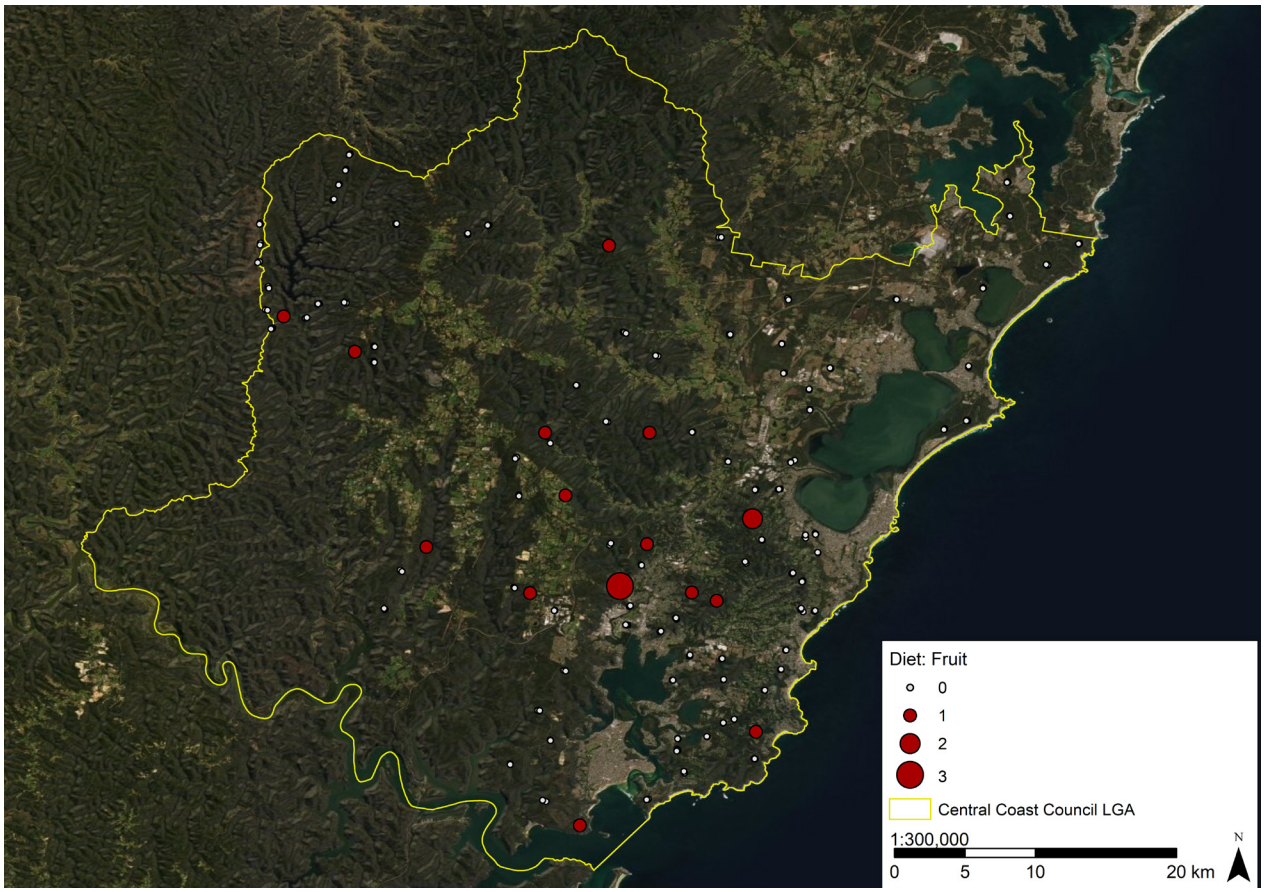

Figure 34: The location and number of occurrences of bird species that are primarily frugivorous (fruit eating) within the Central Coast LGA. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

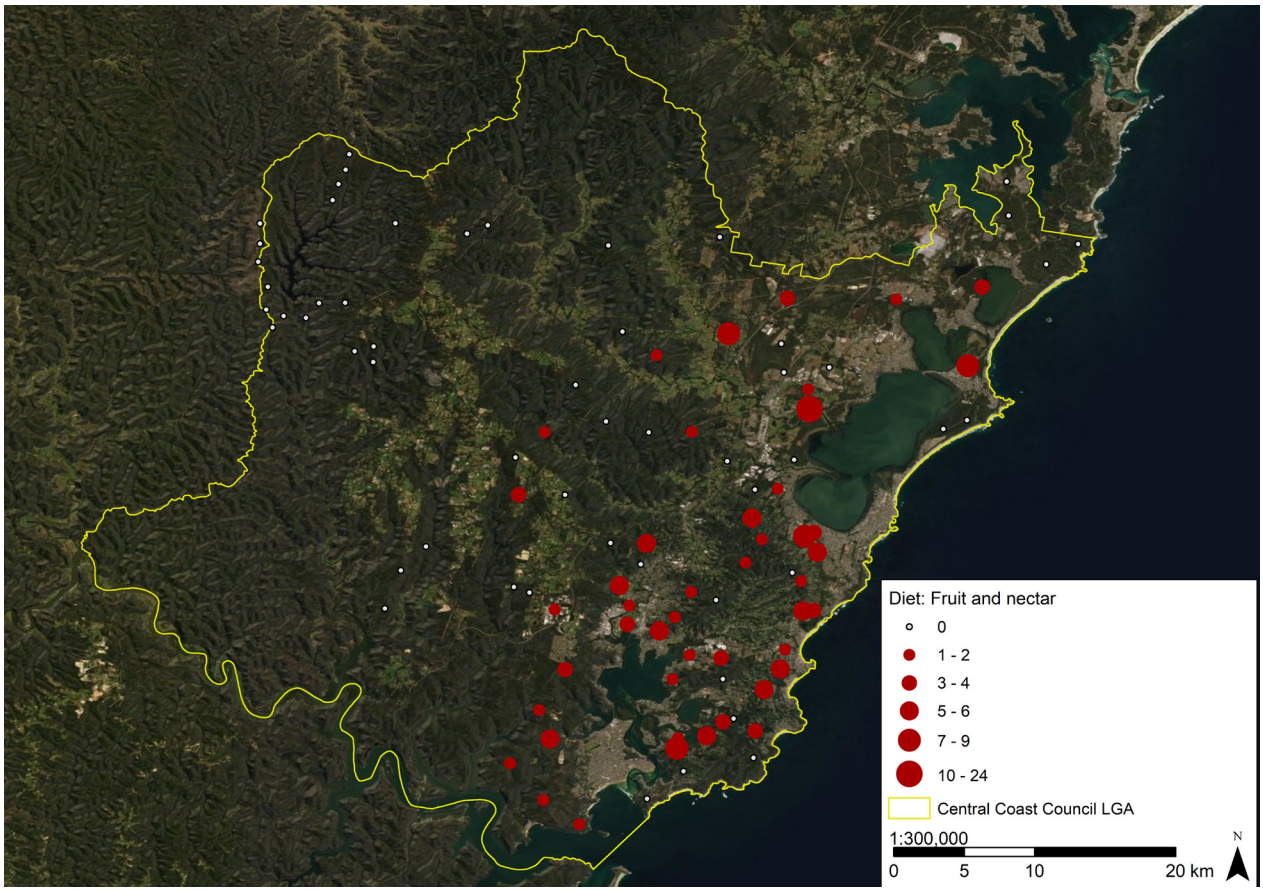

Figure 35: The location and number of occurrences of birds that are primarily frugivorous and nectivorous (i.e. those that eat both fruit and nectar) within the Central Coast LGA. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

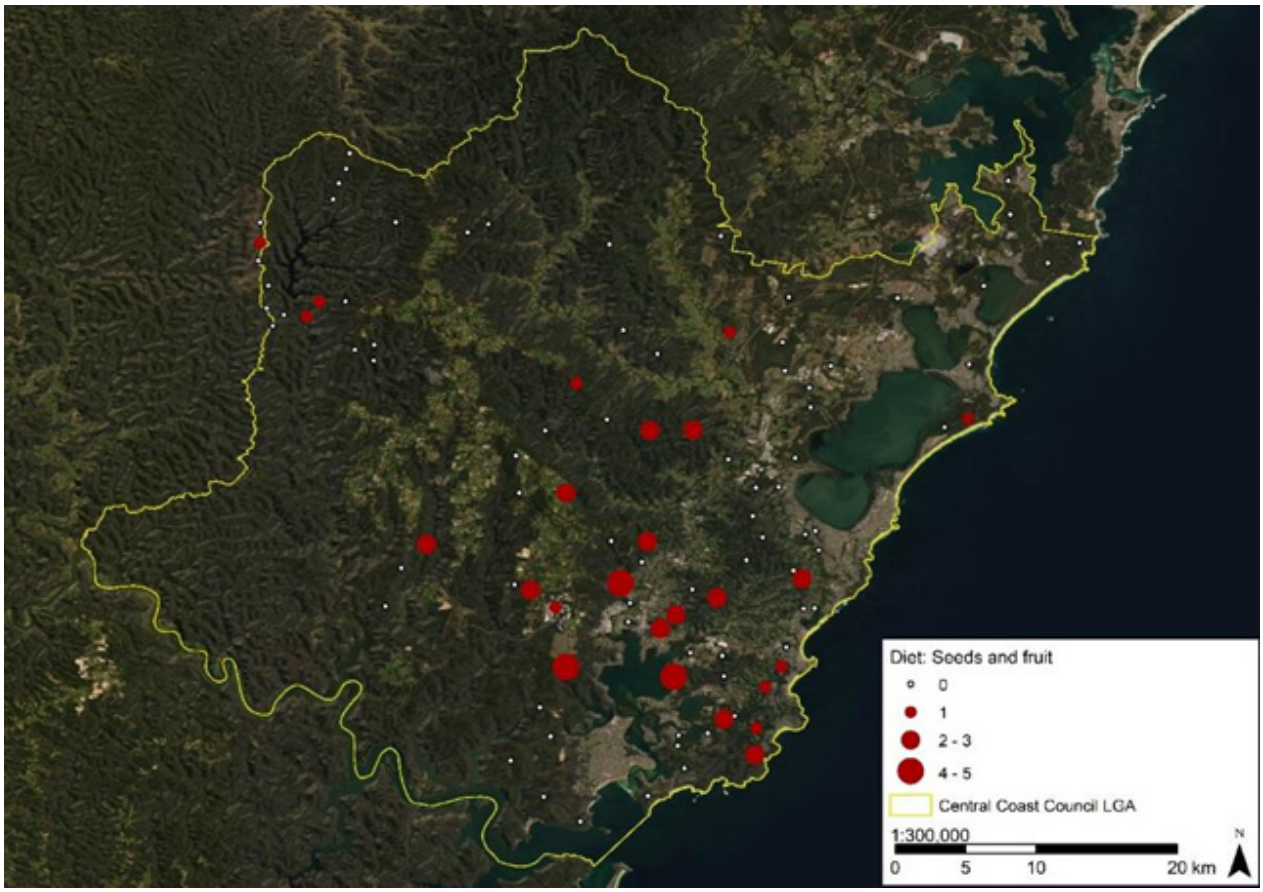

Figure 36: The location and number of occurrences of birds that are primarily granivorous (grain eating) and frugivorous within the Central Coast LGA. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

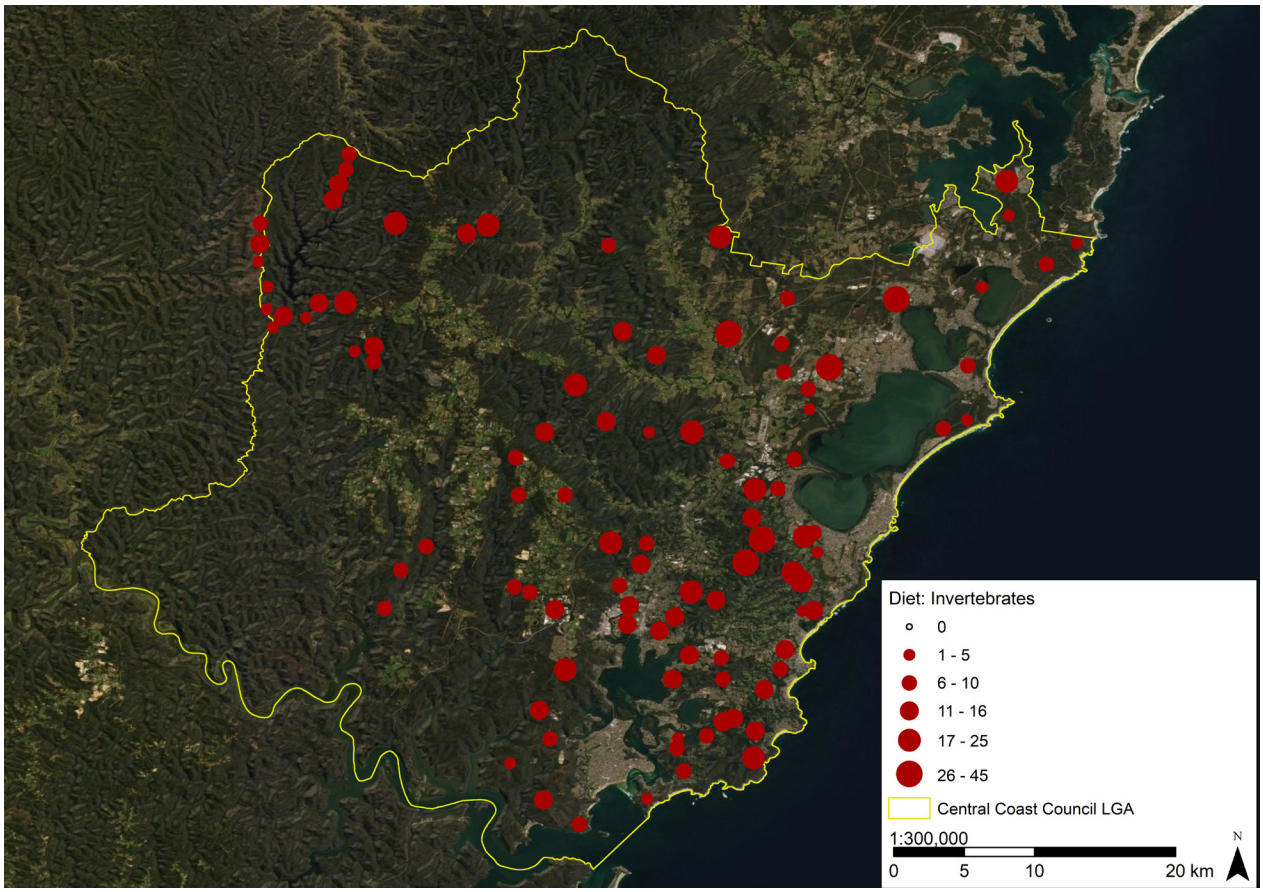

Figure 37 The location and number of occurrences of birds that are primarily insectivorous within the Central Coast LGA. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

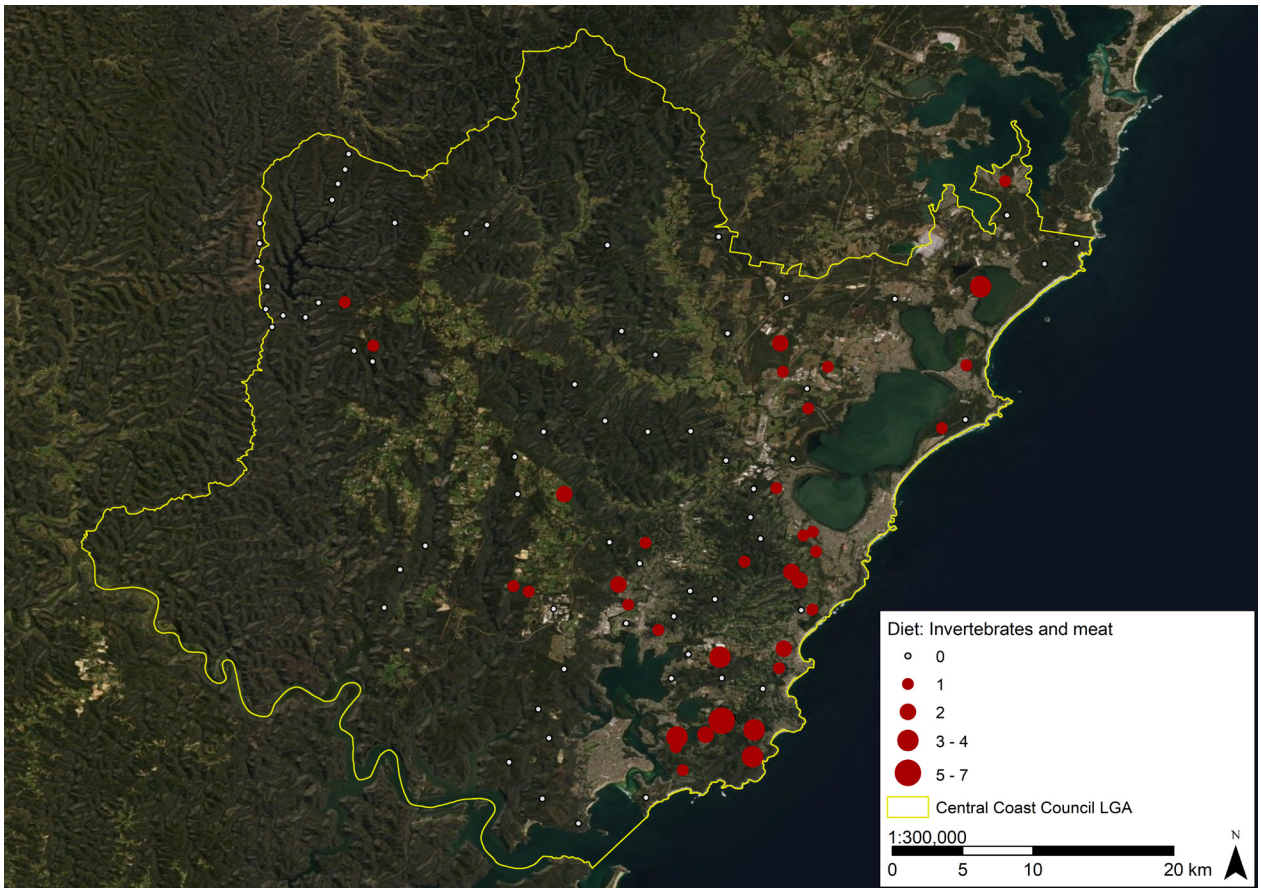

Figure 38: The location and number of occurrences of birds that are generalist insectivores and carnivores within the Central Coast LGA. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

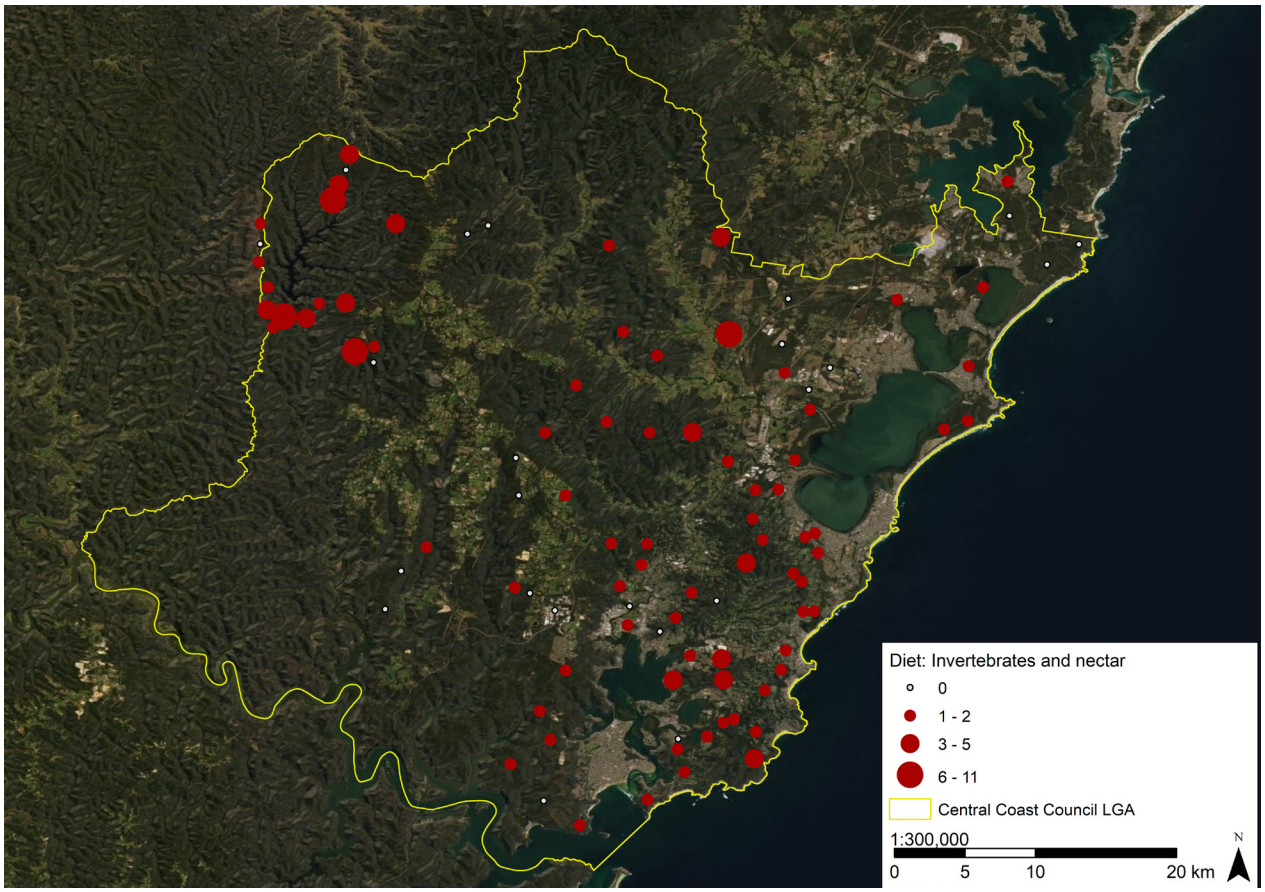

Figure 39: The location and number of occurrences of birds that have a generalist diet of invertebrates and nectar within the Central Coast LGA. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

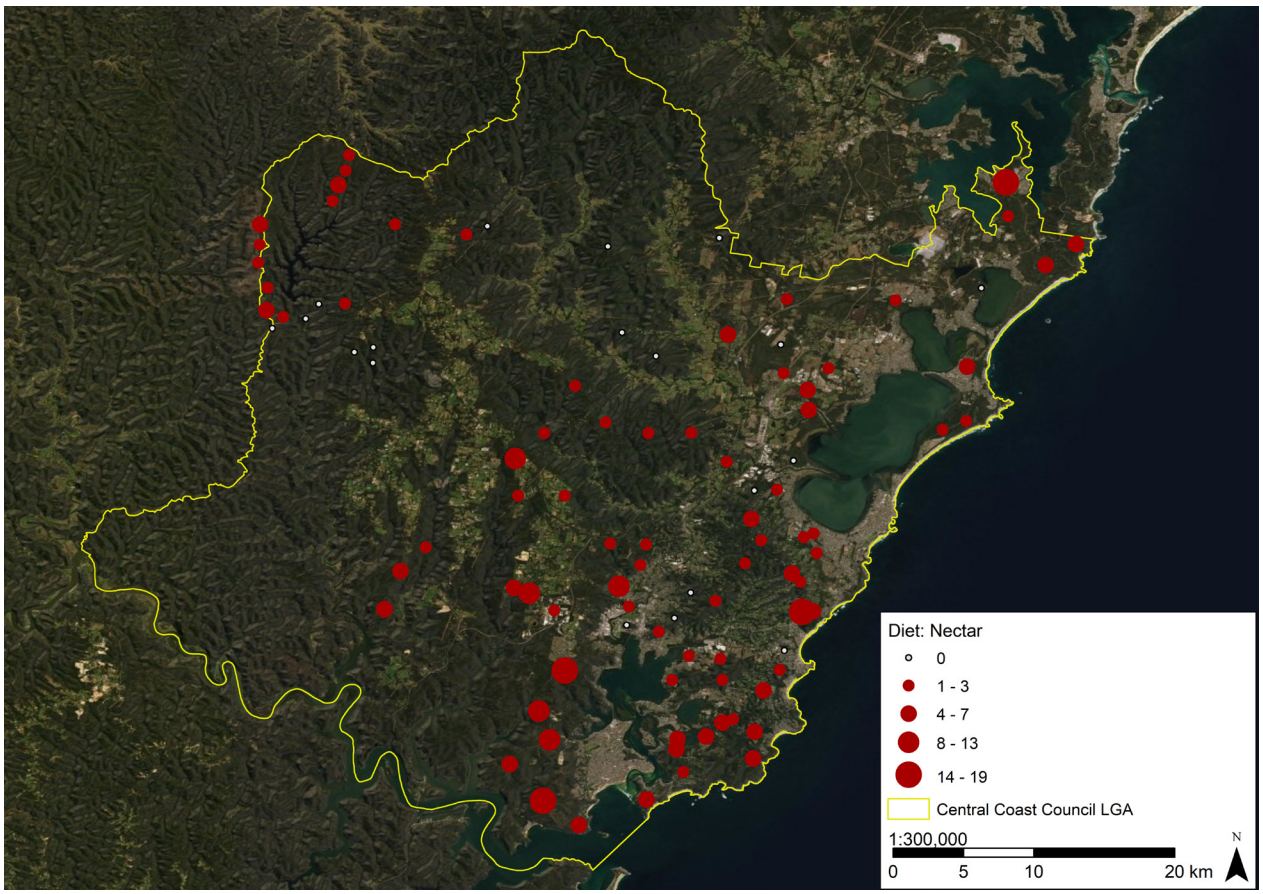

Figure 40: The location and number of occurrences of birds that are primarily nectivorous within the Central Coast LGA. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

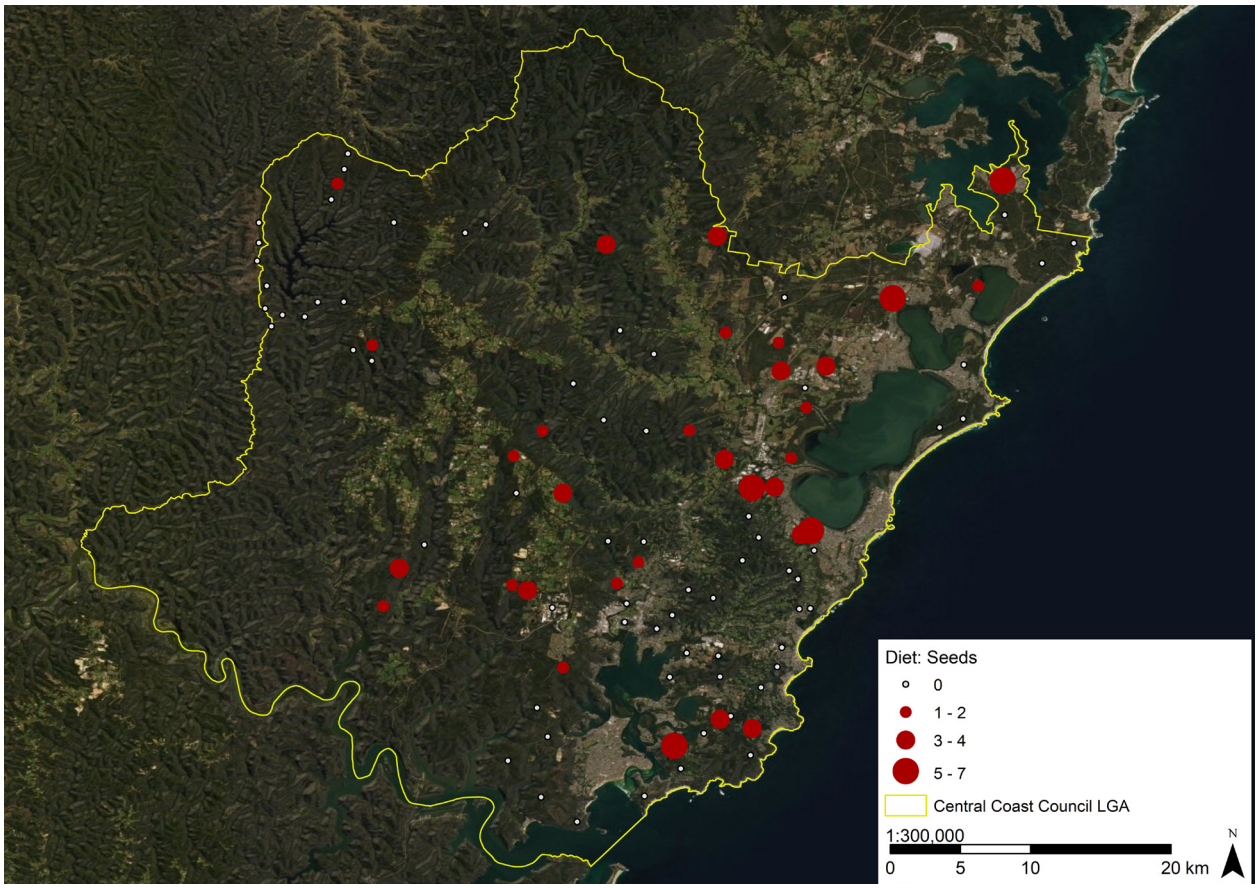

Figure 41: The location and number of occurrences of birds that are primarily granivorous within the Central Coast LGA. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

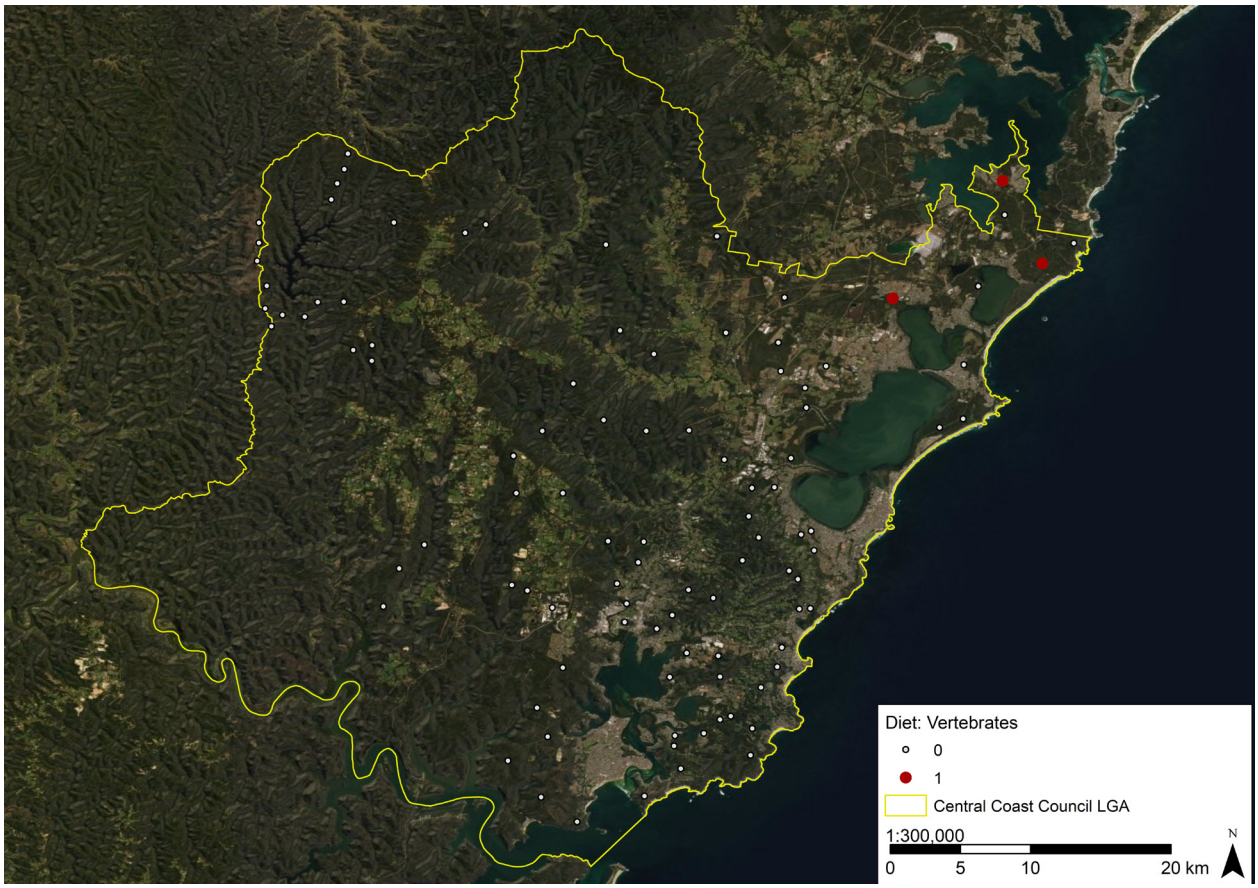

Figure 42: The location and number of occurrences of birds of prey within the Central Coast LGA. Points represent number of occurrences, where larger points indicate greater occurrence. Empty points had no occurrences.

Wet sclerophyll forests and rainforests had the greatest level of bird diversity, followed by dry sclerophyll forests and woodlands and forested wetlands that had similar diversity, with heathland recording the lowest diversity (Figure 43). There was a negative effect of recent fire, with increasing diversity the longer the time since fire, however sites sampled six months after the 2019–20 Black Summer fires contained an average of between 4–6 bird species (Figure 44). The highest diversity of bird species was recorded at a close distance to a road, with less bird species being recorded further from roads (Figure 45). There was no real effect of percentage of native vegetation cover on bird diversity (Figure 46).

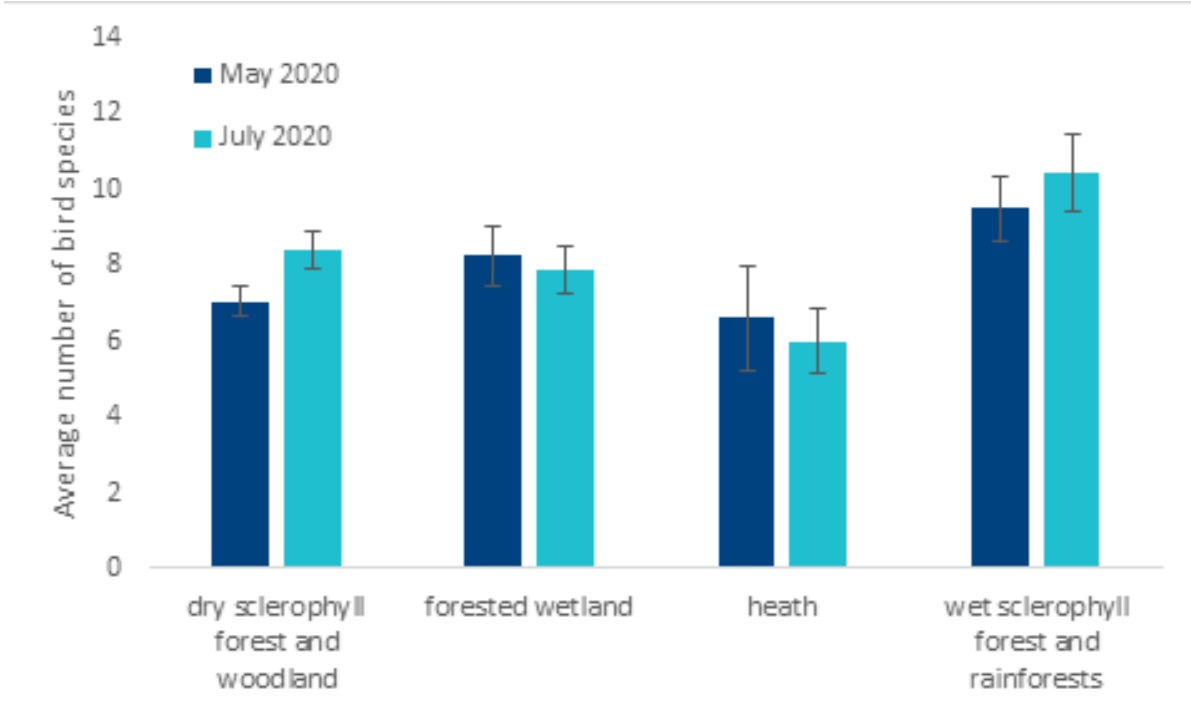

Figure 43: Average number of diurnal bird species in different vegetation types.

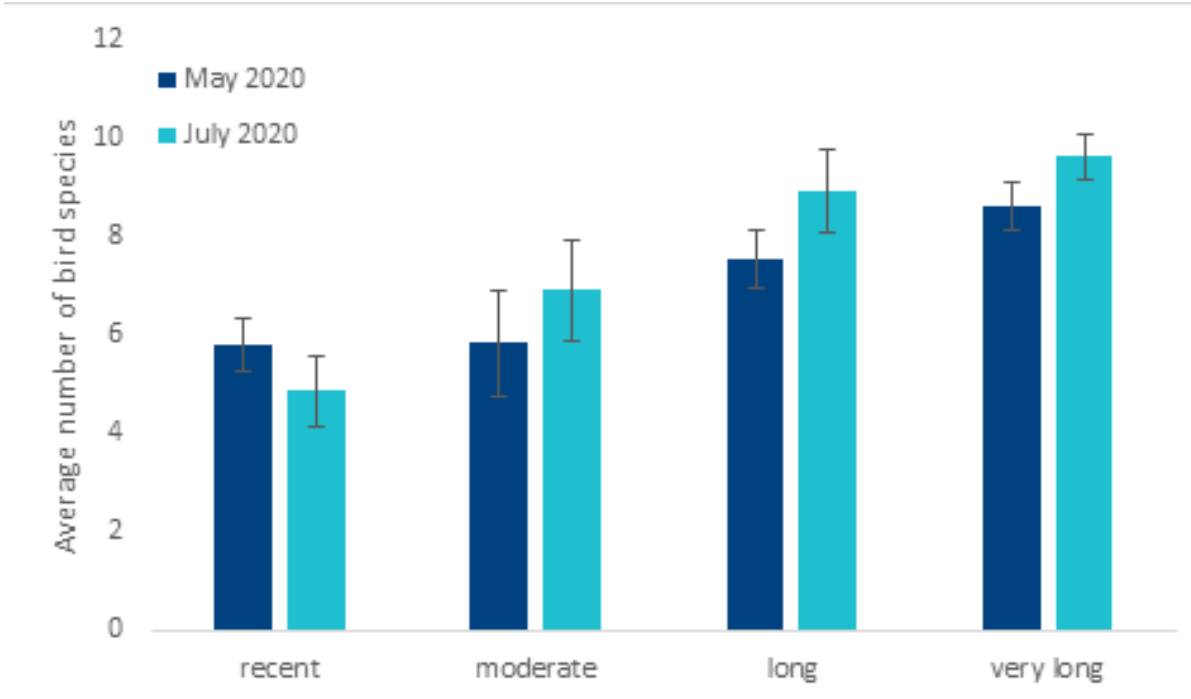

Figure 44: Average number of diurnal bird species in relation to time since fire. Recently burnt are areas burnt in the past five years, moderately long unburnt are sites burnt between 5-15 years before sampling, long unburnt sites burnt between 16-30 years ago and very long unburnt burnt at least 30 years ago.

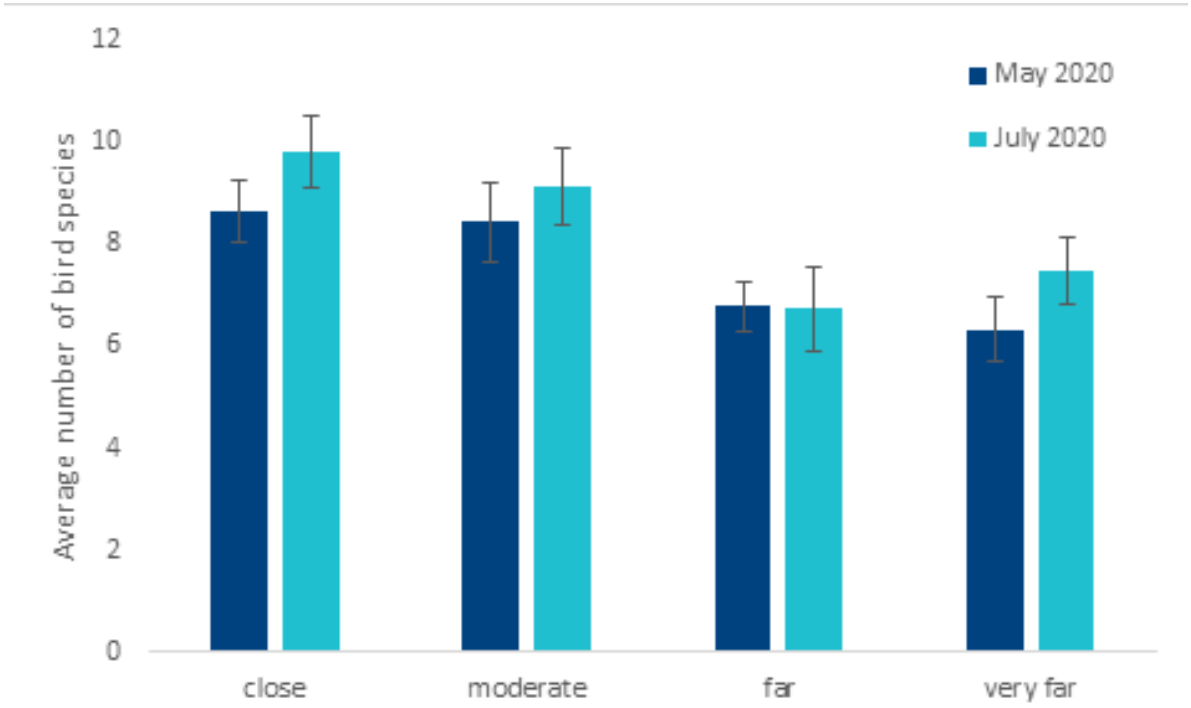

Figure 45: Average number of diurnal bird species in relation to distance from sealed road. Close sites are between 5-100 m from a sealed road, moderate distance is 100-500 m from a sealed road, far is 500-1500 m from a sealed road, while very far is 1500-5000 m from a sealed road.

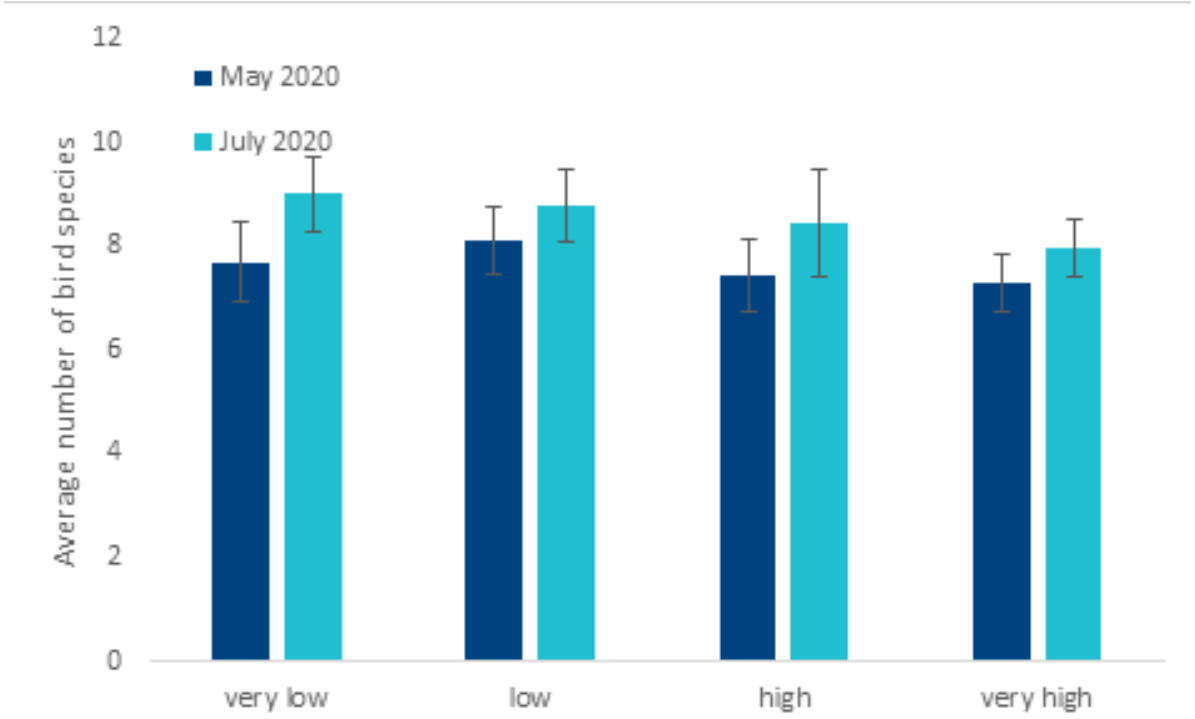

Figure 46: Average number of diurnal bird species in relation to level of native vegetation cover within 1 km of each site. Very low cover is less than 33% mapped native vegetation (within 1 km), low native vegetation cover is 34-66% (within 1 km), high is between 67-85% native vegetation cover (within 1 km) and very high is more than 85% vegetation cover (within 1 km).

CONCLUSIONS

These surveys recorded 132 species of fauna, showing the high diversity of species on the Central Coast. The surveys recorded 14 threatened species, however a range of these were detected infrequently, on less than five sites, such as the Koala (two sites), the Spotted-tailed Quoll (1 site) and the Swift Parrot (one site). While some threatened species were recorded infrequently, others (predominately microbat species) were relatively common and occured at more than 20 sites. Sites closer to the coast often contained greater fauna activity and diversity, compared to sites west of the M1 Motorway.

These surveys did not target nocturnal birds or arboreal marsupials with detections being recorded incidentally when these species were at or close to the ground. As such, additional surveys completing spotlighting and passive call recording should be undertaken to fully understand the distribution of these species. A high diversity of forest and woodland birds were recorded, however, surveys did not occur across all seasons. Bird diversity would increase if targeted surveys also occurred in spring and summer and within aquatic habitats, such as along creeks and in freshwater wetlands. Long-term monitoring of these sites in the future will capture more information about how dynamics of fauna within the Central Coast shift through space and time.

Large scale systematic wildlife surveys provide valuable insights on the distribution and abundance of threatened and non-threatened wildlife. Populations of some species may shift temporarily or permanently in response to climate change. For example, species uncommon to the Central Coast have been observed in increased numbers during prolonged dry periods experienced in inland areas of NSW. Most recently, during the intense 2019-2020 'black summer' bushfires the Central Coast supported birds that fled fire affected areas including the Wompoo Fruit-Dove and threatened Gang-gang Cockatoo.

Ecological grid surveys undertaken as part of the current study may be used to inform future strategic biodiversity planning projects, including deciding where additional conservation areas are required or where conservation projects should be focused. It is also recommended that the surveys are repeated at regular intervals to determine the status of biodiversity across the Central Coast and to understand if species numbers are declining. Citizen science projects that focus on repeated and large-scale data collection of wildlife observations also advance knowledge of biodiversity within the Central Coast. Uptake of these projects should be encouraged (e.g. FrogID, Birds in Backyards) as these applications can help identify management and policy actions that promote biodiversity.

ACKNOWLEDGEMENTS

The NSW National Parks and Wildlife Service and Forestry Corporation of NSW provided permission to undertake surveys on land under their management.

Field surveys were completed by Ecologists from the Australian National University and NSW Department of Industry while data analysis and report writing was completed by Ecologists from Council and the University of Technology Sydney.

Photos in this report were taken by Drs Chris McLean and Ross Crates.