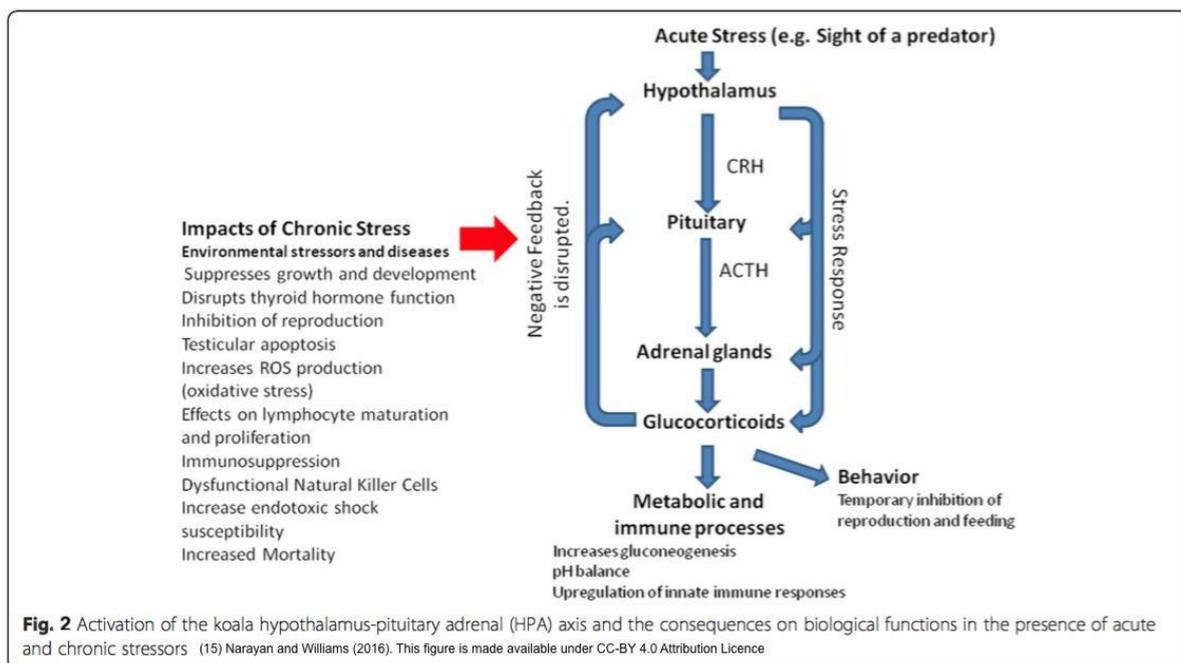


koala health and can cause lymphoma, leukaemia and other cancers (8). This is despite the presence of piRNAs which act as an innate frontline immune response but aren't always successful at stopping the virus inserting itself into the genome (9). The genomic locations of the inherited copies of KoRV vary between individuals which means reinfection and mutation takes place. The resulting higher mutational load in koala populations is known to increase the likelihood of cells becoming cancerous and possibly shortens the time for the tumours to develop (10). This retroviral endogenization process is believed to have an immunosuppressing effect on koalas' health (11). While studies on total KoRV virus load and variations in Chlamydia load and strains did not initially support this belief, a clear link was found when studying a new potentially more virulent strain of KoRV 'KoRV-B' (12).

Another key threat is habitat clearance or loss. Since European colonisation of Australia, more and more koala habitat has been replaced with urban areas, roads, agriculture, and areas of natural resource harvesting including logging. Habitat loss and fragmentation may result in additional stressors such as reduced resource availability or nutritional deficiency if preferred koala feed trees are sparse, predation or injury due to additional habitat edges and extra ground level travel, increased competition between koalas, changes to social contact and breeding opportunities within and between koala populations which may result in a decline in genetic diversity/ allelic richness reducing robustness in future generations.(13, 14). Habitat loss and fragmentation, as well as other acute or long-term challenging stimuli, can result in the activation of the neuroendocrine system and the release of glucocorticoids (stress hormones). Fig 2 (15) indicates the main impacts of chronic stress on koalas and how stress affects their behaviour, and metabolic and immune processes.



Studies using faecal glucocorticoid metabolites (FGM) indicate that koalas impacted by trauma or disease have raised FGM levels subject to the type of environmental stressor. The results suggest that FGM levels for koalas in areas of cleared habitat can be significantly higher than for any other stressor recorded (16, 17). Of particular concern is how stress might suppress the koala's immune system which can progress a Chlamydial infection to clinical disease (18). When koalas are experiencing chronic stress, energy is focused on ongoing glucocorticoid production, at the expense of other bodily functions. As a result, chronic stress can prohibit growth, reproduction and immunity, all of which are required for survival (19). A more recent study suggests Chlamydial disease is already present in 2/3 of koalas infected. The study suggests earlier observations did not capture the true rate of disease as many koalas do not display obvious signs of disease (20).

While further research may be needed on the koala's response to environmental stressors, the connection between KoRV suppressing the immune system and Chlamydia seriously threatens the survival of the koala. It has long been accepted that female koalas with chlamydial clinical disease will become infertile as a result of reproductive tract infection (21,22). Male koalas with the disease have been found to have infection in their penile urethra, prostate and bulbourethral glands. The inflammatory response to Chlamydia in these areas is believed to impair male fertility. Inflammation in other parts of the male reproductive system impairs spermatogenesis and sperm transport (23). The study by Hulse et al found damaged sperm and reduced sperm motility in diseased male koalas (22). With earlier reference to a study that claims 2/3 of koalas already have chlamydial clinical disease, the potential for infertility and a reduction in fecundity is alarming.

As disease is already threatening the health and fecundity of koalas in Queensland, NSW and ACT, the other threats and stressors in Figure 1 will only exacerbate the decline. There are frequent reports of koala populations threatened with habitat clearance, sick or maimed koalas in care, and infighting between politicians as part of

plans to weaken or strengthen State legislation. A decision to uplist the koala to threatened could finally require States to recognise the importance of the koala as an iconic native species, its contribution to the economy, and the need to have adequate measures in place to protect koalas from the threats.

Threats and stressors are also addressed in further questions in this document.

Q2. Can you provide additional data or information relevant to this assessment?

Yes. Full references are provided to published papers. Port Stephens Koalas raw data on interventions is available for scrutiny.

Theses:

(containing primary research on koalas are available online in institutional repositories)

Ward, S. J. (2002) Koalas and the community : a study of low density populations in Southern Sydney, University of Western Sydney <https://researchdirect.westernsydney.edu.au/islandora/object/uws:265>

Hay, G. V. (2003) Identification of individual koalas : microsatellite analysis of faecal DNA, University of Western Sydney <https://researchdirect.westernsydney.edu.au/islandora/object/uws:451>

Thompson, J. (James Athol) (2006). *The comparative ecology and population dynamics of koalas in the koala coast region of south-east Queensland*. PhD Thesis, School of Integrative Biology, University of Queensland <https://espace.library.uq.edu.au/view/UQ:158282>

Ruiz_Rodriguez (2015) Population genetics of the koala (*Phascolarctos cinereus*), University of Illinois. <https://www.ideals.illinois.edu/handle/2142/73012>

Charalambous, R. (2019) Understanding the physiological impacts of stress on the Australian marsupial species, the Koala (*Phascolarctos cinereus*), within New South Wales and South Australia, University of Western Sydney <https://researchdirect.westernsydney.edu.au/islandora/object/uws:54050/>

Rivera, P. 2020, Factors driving the distribution of the koala in a modified landscape, B.Science (Hons) thesis, School of Life and Environmental Sciences, Deakin University. <https://dro.deakin.edu.au/view/DU:30139130>

Article:

Lunney, D. Wells, A., and Miller, I. (2016) An Ecological History of the Koala *Phascolarctos cinereus* in Coffs Harbour and its Environs, on the Mid-north Coast of New South Wales, c1861-2000, Proc. Linn. Soc. N.S.W., 138

Datasets:

NSW Planning Portal data: <https://pp.planningportal.nsw.gov.au/local-development-performance-monitoring-ldpm>

NSW Landcover change reporting:

<https://www.environment.nsw.gov.au/topics/animals-and-plants/native-vegetation/landcover-monitoring-and-reporting/2019-landcover-change-reporting/unexplained-clearing>

Q3. Have you been involved in previous state, territory or national assessments of this species/subspecies? If so, in what capacity?

The Koala Koalition [EcoNetwork Port Stephens](#) (KKEPS) has been formed very recently by individuals and representatives from local organisations interested in the environment in Port Stephens, and specifically to try to help conserve koala habitat in Port Stephens. KKEPS hopes to provide information to other member groups, and liaise with stakeholders, helping us to gain more momentum in this disheartening battle. All members are very aware of the decline of koala populations and threats to those remaining across Port Stephens. Many have been members of environmental groups for over 20 years and have a broad range of experience and qualifications.

This extremely high risk of extinction was made abundantly clear in the NSW Parliamentary Enquiry into Koala Populations and their Habitat released in June 2020 after a year-long Inquiry. "It must be a gamechanger for the government to protect more koala habitat if they don't want to see the koala become extinct before 2050, said Committee Chair and Greens MP Cate Faehrmann." The full report is available here: [PC7 - Koala populations and habitat - Report 3 - 30 June 2020.pdf \(nsw.gov.au\)](#). Erica Walsh and I wrote a submission to this enquiry (for Port Stephens Koalas).

The main person compiling this submission is Erica Walsh, who is now living in the UK, but was an active member of Port Stephens Koalas Habitat Committee while I was President. She has Environmental

qualifications from Queensland and the UK and was a volunteer with Port Stephens Koalas. Coral Berry has also assisted with local knowledge and data..

I (Carmel Northwood) am also preparing responses to this submission. I was President of Port Stephens Koalas from 2015-2019, and a member of the committee of Hunter Koala Preservation Society from 2010-2015 (from which Port Stephens Koalas was formed). As such I was involved in the submission made by David Paull in 2015 to the NSW Scientific Committee for Threatened Species to have “The Koala population located in the Port Stephens area (north of the Hunter River, east of the Pacific Highway and south of Nelson Bay/Karuah River)” changed from Vulnerable to Endangered status.

The Final Determination of NSW Threatened Species Scientific Committee was to reject this nomination as Endangered, their report being published on the NSW Legislation website on 17th August, 2018. The following quotes from that report clarify that this was decided on a legislative framework basis, even though the koalas were recognised as being under threat of extinction:

“13. The NSW Scientific Committee established under the Threatened Species Conservation Act 1995 made a Preliminary Determination to support a proposal to list a population of the Koala Phascolarctos cinereus (Goldfuss, 1817) in the Port Stephens area (north of the Hunter River, east of the Pacific Highway and south of Nelson Bay/Karuah River) as an endangered population as, in the opinion of the NSW Scientific Committee, the population is facing a very high risk of extinction in NSW in the near future as determined in accordance with Clauses 11, 13 and 14 of the Threatened Species Conservation Regulation 2010.” (p. 5)

“21. As the Koala is listed as a threatened species under the Biodiversity Conservation Act 2016 and the Environment Protection and Biodiversity Conservation Act 1999 the population of the Koala Phascolarctos cinereus (Goldfuss, 1817) in the Port Stephens area (north of the Hunter River, east of the Pacific Highway and south of Nelson Bay/Karuah River) is ineligible to be listed under the Biodiversity Conservation Act 2016.” (p.9).

Another member of the KKEPS, Myall Koala and Environmental Group (MKEG) applied and had the koala population in Hawks Nest and Tea Gardens (on the north side of Port Stephens) listed as Endangered in August 1999 by NSW Threatened Species Scientific Committee. This group has made a separate submission indicating koala sightings have become very rare now.

Tweed/Brunswick Koalas were listed as Endangered in August 2016. I was aware of this process, being at the time a committee member of the NSW Wildlife Council.

PART 1 – INFORMATION TO ASSIST LISTING ASSESSMENT

SECTION B - DO YOU HAVE ADDITIONAL INFORMATION ON THE ECOLOGY OR BIOLOGY OF THE SPECIES/SUBSPECIES? (If no, skip to section C)

Biological information

Q4. Can you provide any additional or alternative references, information or estimates on longevity, average life span and generation length?

Published koala research:

Reference	Life expectancy	Sexual maturity	Start breeding	Young ^{-yr}
Eberhard 1972; Martin 1981; Smith 1979; White and Kunst 1990		2 - 3 yrs	2 – 3 yrs	1
Port Macquarie Hospital	Wild Coastal: Female 15-18 yrs Male 10-15 yrs Captivity: Both 15+ yrs	2-3 yrs female 3 yrs male		
Martin and Handasyde 1990		2 yrs	Competition with older/ bigger males may delay breeding until 4 or 5 yrs old (Martin & Handasyde 1990)	

Reference	Breeding
Eberhard 1972; Martin 1981; McLean and Handasyde 2007; Smith 1979; White and Kunst 1990	Consecutive years if females in good condition

Reference	Generation time	SD	Observed
Philipps 2000	6.02	n=28, range 3-9, SD =1.93	NE NSW Chlamydia positive population
Philipps 2000	5.6 adult females	n=17, range 2-8, SD =1.90	NE NSW Chlamydia positive population
Philipps 2000	7.8 breeding females		NE NSW Chlamydia positive population
Kjeldsen et al 2019	6.03		VIC island population

Influences on joey sex

Whisson and Carlyon (2010) reported that heavier (koala) females were generally the earliest to breed, the heaviest bred at either ends of the breeding season and tended to produce female joeys. They referred to work by Clark (1978), Dique et al (2003), Ellis et al (2002), Gordon et al (1990), Mitchell (1990) and Mitchell and Martin (1990) that suggested male-biased dispersal females are more likely to produce males early in their reproductive lives. It could also be that younger females are less heavy. Other research including McLean and Handasyde (2007) believe there is unity between the sex of joeys by the end of the breeding season.

Fecundity

Fecundity of breeding-age individuals (body mass of >6 kg—McLean and Handasyde 2007) was variable among years, ranging from 52% in 1997–1998 to approximately 67% in 2005–2006 and 2006–2007.

Martin and Handasyde (1990) reported that the most significant factor influencing fecundity is incidence of *Chlamydomphila psittaci* (synonym *Chlamydia psittaci*) infection of the reproductive tract.

In *Chlamydomphila*-infected populations fecundity is between 0% and 56% compared to between 66% and 81% in *Chlamydomphila*-free populations (Martin and Handasyde 1990; McLean and Handasyde 2007).

Q5. Do you have any additional information on the ecology or biology of the species/subspecies not in the current advice?

Published koala research:

	Male (QLD) (kg)	Female (QLD) (kg)	Male (VIC) (kg)	Female (VIC) (kg)	Male (NSW) (kg)	Female (NSW) (kg)
Whisson & Ashman 2020	-	-	9.8 - 12.0	7.1 - 9.2	-	-
Jackson 2005	4.2 - 9.1	4.1 - 7.3	9.5 - 14.9	7.0 - 11	-	-
McLean 2007	-	-	-	6.3 - 6.8	-	-
OEH 2021	-	-	-	-	6 - 12	5 - 8

Local knowledge:

Koalas in the wetland coastal areas of Port Stephens are known to be very reliant on the leaves of the *Melaleuca Quinquinervia* as well as the *Eucalyptus Robusta* (swamp mahogany) that generally grow together. They eat the silvery tips (new growth) and are especially keen on the flower buds that appear after rainfall. This species is never mentioned as koala food.

The koalas of Port Stephens seem to have the Koala Retrovirus (KoRV-A), but do not have any symptoms of it, according to Dr Don Hudson (vet for Port Stephens Koalas).

We do seem to have continuing recurrence of Cryptococcosis cases in the Soldiers Point Area that has been researched for 5 years or more by University of Sydney's Prof Mark Krockenberger and Dr Laura Schmetzmann eg Comparing immunochromatography with latex antigen agglutination testing for the diagnosis of cryptococcosis in cats, dogs and koalas, June 2020. Prof Krockenberger and Associate Prof Damien Higgins are the leads in the [Koala Health Hub](#).

Field research was carried out during 2019-20 by [OWAD](#) using scat detection dogs and DNA analysis, and published by WWF in January 2021. They used scat from wild koalas, and from koalas in care at Port Stephens Koalas hospital and sanctuary.

The 2020 Port Stephens Koalas Population Study report is available here: <https://www.wwf.org.au/ArticleDocuments/353/pub-study-port-stephens-koala-population-18Jan21.pdf.aspx>. The DNA investigation identifies that Port Stephens koalas are already genetically different due to habitat fragmentation. The more eastern "peninsula" koalas are already less allelic rich than those in the west of Port Stephens. The report concluded that "reconnecting habitat must be an urgent priority for their survival".

Dr Don Hudson, vet for Port Stephens Koalas, did his Master's thesis on chlamydia symptoms in koalas being brought on in dry weather due to stress.

Dr Edward Narayan did a study of the stress hormone Cortisone on koalas in care while he was at the University of Western Sydney in 2018-19. He now manages THE STRESS LAB at the University of Queensland and their research focuses on assessing the hormonal biology of animals across different production systems. He has found that koala stress levels may vary across 30 days from a single event.

SECTION C - ARE YOU AWARE OF THE STATUS OF THE TOTAL NATIONAL POPULATION OF THE SPECIES/SUBSPECIES? (If no, skip to section D)

Population size

Q6. Has the survey effort for this taxon been adequate to determine its national adult population size? If not, please provide justification for your response.

A complete and accurate survey to assess the national adult population size of koalas would require time, money and the use of both inventive techniques at a local scale and new optimised technology to detect koalas at a large scale and local scale. Koalas do not have time; strengthened protection measures need to be in place to halt the rate of decline. It can be argued that there is enough evidence and local knowledge of the threats, particularly the impact of disease, habitat loss and fragmentation, to not require an accurate total number of adult koalas in order to act.

Local data which indicates a reduction in koala data should be taken as seriously as any population estimates. Koala rescue data, particularly related to the Black Summer bushfires, will indicate recent losses. A reduction in readily available data should also be used as evidence that the status of the koala has changed. This is not to be confused with koala sightings as the numbers can vary subject to local interest or calls to record sightings. A recent study by Dissanayake et al (2019) claims that koala sighting data can be used to refine koala distribution and population estimates derived from active surveying (1). There are problems with using sighting data to calculate or refine population estimates. An increase in sightings can be indicative of more koalas finding their habitat within or at the edge of urbanisation, with the same koala(s) being recorded more than once rather than an actual increase in numbers. Sightings should primarily be used to indicate koala range rather than population numbers.

It is also important to not estimate future koala numbers based on estimated/ known adult population size given how stress and disease can impact fertility and therefore fecundity. As mentioned in Q. 4, fecundity can be between 0% and 56% in populations with chlamydial disease (2, 3).

Studies on captive koalas have shown that koalas can become hypervigilant to human presence and activities rather than becoming desensitised (4). It is, therefore, that any surveys employed to get a more accurate picture of koala populations are not invasive and disruptive.

OWAD Environment, who has prepared a number of in depth studies on koalas in Port Stephens using their purpose-bred professional field detection dogs to locate evidence of koalas (scat, pap or live individuals), finds that using detection dogs is a quick and efficient way to survey fairly large areas with minimal disturbance. The scat and pap evidence has also been useful to assess gender, disease presence, recent breeding and genetic connections (5).

Cristescu et al (2015) support the use of detection dogs as research has shown that detection dog teams can outperform human-only teams when circumstances allow them to work off leash. Dog teams are known to have a 100% detection rate and can be 19 times more efficient than current scat survey methods and 153% more accurate than human teams. They are also less likely to have false positive scat and pap sightings. Cristescu et al suggest that detection dog surveys should be a vital tool in koala conservation (6).

Recognising that accurate abundance estimation can be useful for conservation management of threatened species, Hamilton et al (2020) recommend using drones and other technology to assess species in complex or

potentially inaccessible environments. They propound the need for accurate and reliable data if management programmes are to be improved. The use of Remotely Piloted Aircraft Systems (RPAS) otherwise known as drones have the potential to gather data quickly, accurately and fairly cheaply, but there are obstacles. Hamilton et al identify the need for a robust methodology when it comes to applying machine learning techniques to the drone if it is to automatically detect individual animals in remotely sensed imagery; accurate automatic detection can reduce bias and increase accuracy and precision of wildlife surveys. To have widespread use, the drones need to be able to accurately survey a variety of habitats and to different survey designs. Their survey results were promising despite limited use of automated machine learning in ecological applications (7, 8)

In recent surveys of Port Stephens and Gilead, Witt et al (2020) utilised and assessed three survey methods for the direct detection of koalas: Spotlight (systematic spotlighting), drones (RPAS) with thermal imaging, and the refined diurnal radial search component of the spot assessment technique (SAT). They found drones using thermal imaging cameras have potential to be an accurate, efficient and effective alternative to Spotlight and SAT (9).

Beyer 2018 calls for a joint approach if surveys are to capture more detailed information to guide management plans. While automatic detection of individuals using thermal imagery may give an efficient and accurate population count, it is only with accurate and efficient ground level surveys, such as with koala detection dogs, that you can also see tree species use, assess disease status, condition of adults, presence of joeys, sex and genetic connections (10).

Q7. Do you consider the way the population size has been derived to be appropriate? Are there any assumptions and unquantified biases in the estimates? Did the estimates measure relative or absolute abundance? Do you accept the estimate of the total population size of the species/ subspecies? If not, please provide justification for your response.

No.

Please see answers to Q.6 and Q. 12, plus answers to do with threats in Qs 1, 9 and 11.

OWAD used their scat sniffer dogs to produce part of the ecological reports for the Kings Hill Urban Expansion area (aka Balickera) that is being planned for north of Raymond Terrace on land that is one of the last healthy breeding populations in Port Stephens. The [Joint Regional Planning Panel \(JRPP\)](#) is back in discussions with developers about the concept design. Their idea of having a public hearing on this development was to use Zoom on 23rd December 2020 – such an inconvenient time for all of us with an interest, but our request for an adjournment was refused. I understand that they decided to get an independent assessment done but I don't know if that has been achieved. Unless those reports have been accessed, the population of that area would not be known.

Another area where koalas are breeding is between three main roads around Salamander: Nelson Bay Rd, Port Stephens Drive and Salamander Way. I have been writing to NSW Environment Minister Matt Keane, our local NSW MP Kate Washington and MLC Cate Faehrmann about expanding the Tomaree National Park in an effort to protect this population. There are many parcels of land where koalas still survive, but the wildlife corridors are being constantly interfered with so that all wildlife are constantly at risk. The community works hard to retain habitat, such as the NSW buy-back of the Mambo Wetlands Reserve after it was sold off. Just last week an important parcel of land bordering the Jean Shaw reserve in Hawks Nest was sold too. This area and land to the north of Hawks Nest, particularly on the western side of the Mungo Brush Road provides a much needed link through to National Park where there are other surviving koalas. Port Stephens Koalas recently released Bombah Point Daisy to the north. Retaining wildlife corridors for koalas (and other species) is an urgent necessity.

A local group fought very hard for the Brandy Hill Quarry not to be granted an extension, but it was approved by the Federal Environment Minister Sussan Ley last year when Dr Steven Philips reported that koalas were merely passing through, not breeding there. That was infuriating for all of us who know that koalas move constantly through their territory to browse trees and to breed in the right season, but it's not the first time he's concluded the same thing to the detriment of koala populations. Philips was not independent having been involved with the original EIS and should never have been employed in that capacity. Truly independent ecologists were those from Newcastle University, including Ryan Witt, who produced a very different report concluding that koalas were in residence on the quarry land where there was indeed very suitable habitat for them. I still cannot believe that rocks won out over saving koalas. Surely there is another already cleared area where rocks can be obtained to make concrete for Sydney projects by the largest company in the world i.e. Heidelberg Cement.

There are so many small pockets of koala populations in Port Stephens that haven't been reliably estimated – see response to next question.

Q8. If not, can you provide a further estimate of the current population size of mature adults of the species/subspecies (national extent)? Please provide supporting justification or other information.

Local information:

David Paull, in his supporting information provided to the NSW Scientific Committee in March 2015 said: "Given the projected overall decline in Koala numbers in the LGA, current population may be less than 200 animals, with around or less than 100 animals in each the Tillegerry and Tomaree sub-populations and an unknown number of mature animals in the Tomago Sandbeds/Raymond Terrace/Medowie areas or the northern parts of the LGA." (page 17)

There have been several more recent studies undertaken in the Port Stephens area trying to establish the size of the koala population. Dr Steve Philips of Biolink for the Port Stephens Council:

- Saving our Species Report, Managing Koala Populations for the future, constituent populations of the Central ARKS Port Stephens Sub-Area of March 2018,
- Aspects of the distribution and abundance of Koalas in the Port Stephens Local Government Area 1920-2015, of October 2016,
- Kings Hill, Tomago and Medowie Koala Hub Assessments, of February 2019.

The main methods of counting populations seem to include:

1. Walking through the bush looking for them in both daylight and at night using torches
2. Sample Assessment Technique (SAT) where a food tree and 50m surrounds is quickly searched for koalas and their scat during a 15-minute visit to nominated GPS locations
3. Drone searches and interpretation of heat sensor views of trees
4. Scat detection dogs and DNA investigations.

The results of these techniques can vary widely. For instance:

- Dr Paull above estimated 100 on the Tomaree Peninsula in 2015.
- Dr Steve Philips reported in 2017 that the much smaller Anna Bay koala hub (ARK) supported about 130 koalas after SAT field research in 2016. (I helped with some of the night spotlighting.)
- Soon after Ryan Witt and Chad Berenak searched the same area but found only 3 koalas. Their article: Witt_2020 "Real-time drone derived thermal imagery outperforms traditional survey methods for an arboreal forest mammal" argues that Drones are much more efficient and reliable than spotlighting and SAT. In fact, SAT rated the least reliable method.

How can the huge disparity in population numbers be explained? I am certain the true number of koalas in that Anna Bay "hub" area was somewhere between the two assessments. It is unfortunate that OWAD didn't survey that same "Hub" area but a bushfire had burned through there the month before their field searches in May 2020. Two juvenile koalas have been rescued from the edge of that area since, so there are survivors but no one knows how many

I've been volunteering at the Port Stephens Koala Sanctuary since it opened in September 2020. There is one large yard currently occupied by 6 females. One of the tasks is to ensure all 6 of them are still in their yard. It can sometimes take more than 15 minutes for two experienced volunteers to find them in just 3 trees. Sometimes they will be close to the trunk between branches, or lying along the top of a branch, amongst dense foliage; in many different positions according to weather conditions, and there is one called Tilly that moves to remain hidden. I know that they could not reliably be found by a drone.

I believe the best method of finding koalas to come up with reliable population estimates would be to use scat detection dogs, and DNA analysis to find out how many koalas there are. The DNA analysis can easily be used to find out gender, how closely related they are through mitochondrial DNA, whether they have chlamydia or KoRV, their allelic richness, etc. The field research is not cheap, but it would be much more reliable than other methods. Considering the size of the area needing to be searched in NSW, I believe it is outside the resources of the government to fund this, but it would not be outside the resources of developers to fund such investigations on land they wish to clear, or for specific projects to be conducted. Dogs can be trained to find Quoll and other threatened species' scats too.

In any case, I really do not think it is not important to know how many koalas there are for the purposes of their conservation. This continual spending of money to try to count them is a waste of resources and doesn't help their survival.

The OWAD/WWF Port Stephens report is significant because (1) amazingly, not even that very basic work had been done by anyone in the Port Stephens region before; and (2) because it is an absolutely shocking example of what happens when a government entity adopts a Koala management strategy (Port Stephens has had a Comprehensive Koala Plan of Management (CKPoM) since 1999) that isn't based on sound science. Here in Port Stephens, the horrendously incorrect definitions of "Koala hubs" and saying that koalas are just passing through rather than living in habitat that developers want to destroy, is literally allowing fragmentation and precipitating

extinction. Through better planning based on sound basic science, we could very well have achieved the current human population and infrastructure in Port Stephens without sacrificing Koala populations. Look at Brisbane City Council for example, incomparably more urbanisation and incomparably more infrastructure, yet Koalas in Brisbane City Council LGA are doing incomparably better and are incomparably more secure in the short, medium and long terms than they are in Port Stephens. And the thing is, good conservation planning is highly effective at keeping wild koalas safely & happily in the wild, and is not even hard nor expensive; and is incomparably cheaper than throwing millions of dollars at hospitals to put band-aids on a gushing wound. Of course, you still want investment in wildlife hospitals, sure. But investing in hospitals does NOT constitute a habitat management strategy let alone a conservation strategy. Just like human hospitals are no substitute for healthy lifestyles.

If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible species/subspecies numbers, and also choose the level of confidence you have in this estimate:

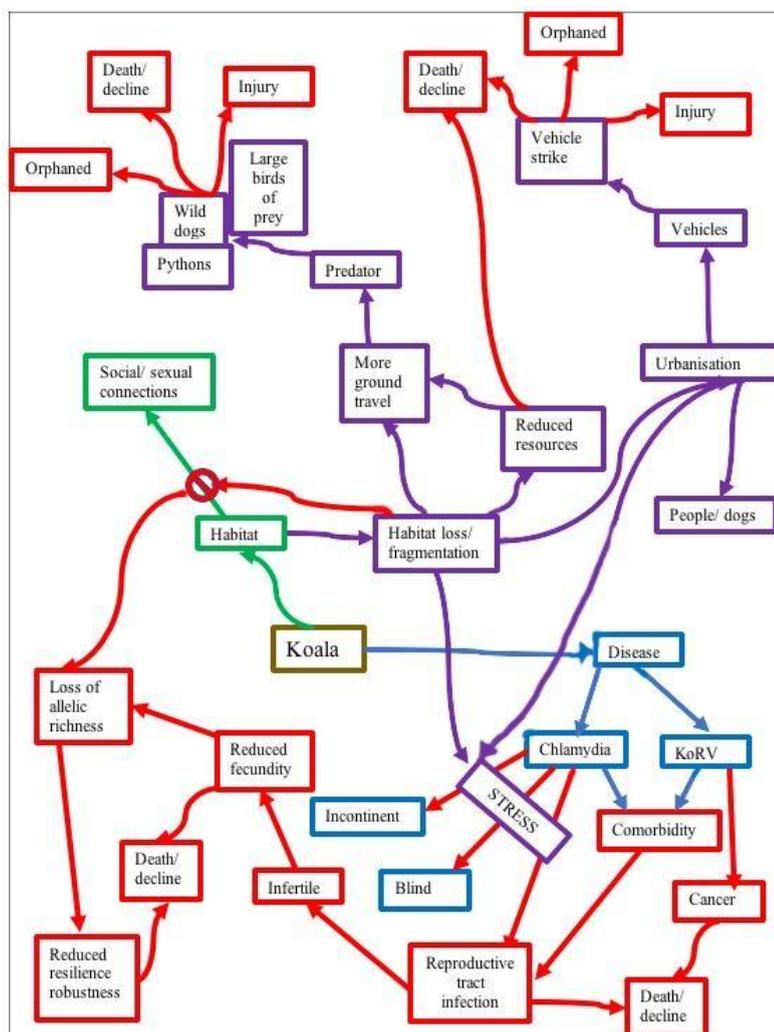
Number of mature individuals is estimated to be in the range of:
 1–10 000

Level of your confidence in this estimate:
 31–50% - more than a guess, some level of supporting evidence

SECTION D - ARE YOU AWARE OF TRENDS IN THE OVERALL POPULATION OF THE SPECIES/ SUBSPECIES? (If no, skip to section E)

Q9. Does the current and predicted rate of decline used in the assessment seem reasonable? Do you consider that the way this estimate has been derived is appropriate? If not, please provide justification of your response.

No. Firstly, the losses due to the Black Summer bushfires need to be taken into account, both in terms of habitat area and in terms of lives lost.



Secondly, the current and future rates of decline need to be looked at as a big picture. While the two key issues facing koalas at present are disease (KoRV and Chlamydia) and habitat loss/ fragmentation, the latter can result in direct impacts, such as reduced resources, reduced social contact with other koalas, but will also cause stress which can affect their mortality, immunity and fertility.

Figure 3 (left) is a very rudimentary look at how some of the threats and stressors connect. While there may be elements missing, or the flow could be better presented, it hopefully represents the notion that the threats and stressors are connected and in the most end in death/ decline.

The blue lines/ borders are associated with disease until they become life threatening and turn red,

The purple lines/ borders are associated with threats until they also become life threatening and turn red.

The No Entry sign in between habitat and social/sexual connections is to represent how habitat loss and fragmentation may

make contact between koala populations difficult, dangerous or impossible. In the long term this will have huge implications on the survival of populations as they will lose allelic richness and become less robust.

Charalambous and Narayan (2020) undertook a 29 year retrospective analysis of koala rescue in NSW. It included data from Port Stephens Koalas which showed that between 3 rescue sites the most common prognosis was disease, i.e. Chlamydia. As incidents increased long term, and release decreased, euthanasia also increased. The suburbs where the highest number of koalas were found prior to being reported as sighted or admitted into clinical care were Salamander Bay (335 koalas), Anna Bay (276 koalas) and One Mile (195 koalas). 51.5% had signs of Chlamydia while 24% was presenting with signs of clinical infection. Any environmental stressor can result in a physiological stress response which in turn can compromise the immune system allowing the disease to take hold, which can lead to various other health issues, including loss of fertility, or death (1).

The study by Witt et al (2020) looking at efficient use of drones and thermal imagery included survey sites in Port Stephens, namely near Ferodale, on the Tilligerry peninsula and on the Tomaree peninsula (2). Despite only selecting sites considered to be either preferred or supplementary koala habitat as per Lunney *et al.* (1998) (3), all three survey techniques found no more than 12 individual koalas.

The 2021 OWAD study (3) of koala populations in Port Stephens took samples from 278 locations plus collected 9 scat samples from the Port Stephens Koala Hospital for genetic analysis. 45 of 60 samples could be tested and revealed 39 unique individuals. KoRV-A was detected in 100% of individuals (39/39), while *C. pecorum* was detected in 36% of individuals (14/39)

“Phylogenetic analysis indicated that Koalas sampled in this study were historically connected. Contemporary population genetic analysis, however, indicates that Koalas from the Tilligerry and Tomaree Peninsulas (referred to as ‘the peninsula’) are now significantly different from those sampled further inland, suggesting that gene flow between peninsula and inland Koalas has been restricted over recent generations. Peninsula Koalas were also found to be less genetically diverse than inland Koalas, suggesting that peninsula Koalas may be losing genetic diversity due to a lack of successful migration from outside of the peninsula.... future management of Koalas in the Port Stephens LGA should consider the impact habitat fragmentation is having on the population. Removal of key Koala habitat within the region has resulted in the genetic differentiation of Koalas on the peninsula from those inland.” (3, pg. 1).

Q10. Are you able to provide an estimate of the total population size during the early 2000s (at or soon after the start of the most recent three generation)? Please provide justification for your response.

Graphs of rescues and releases of Port Stephens Koalas (and formerly Hunter Koala Preservation Society) have shown plummeting numbers since 2005 when 166 koalas were rescued or found dead until now when rescues are becoming quite rare. PSK have confirmed that in 2020 there were 46 live rescues in 2020 with 5 koalas found dead, and in 2021 (up to the 8th July 2021) there have been 20 live rescues and 2 found dead.

Dr David Paull, in supporting information provided to the NSW Scientific Committee in March 2015 said: “Given that the primary factors involved in Koala deaths (discussed below) has not diminished but increased in this time, it is suggested that this is entirely unsustainable for the population’s continued survival. The data suggests an approximate 30% decline in the Koala population since the early 2000s when it was estimated to be 300-500 mature animals (Lunney *et al.* 2007). The decline in death in 2014 is most likely attributed to a fall in overall numbers in Koalas in the LGA.” Page 7.

From being very involved in not only the statistics but in rescuing and burying dead koalas, I believe motor vehicles have caused the deaths of 5-10% of the population over the last 20 years. We still have a population that includes young adults and aged adults, and koalas are still being rescued without microchips (although we’ve microchipped all that came into care for over 20 years).

Two of our local roads are among the worst in NSW according to (Department of Planning Industry and Environment (DPIE) for koala deaths but nothing at all has been done about the carnage on Port Stephens Drive and Nelson Bay Road. [Koala vehicle strike fact sheet 1: Wildlife vehicle strike and contributing factors \(nsw.gov.au\)](#), June 2020. [Koala Vehicle Strike Fact sheet 2 - How to keep koalas off road | NSW Environment, Energy and Science](#), June 2020.

If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible species/subspecies numbers, and also choose the level of confidence you have in this estimate.

Number of mature individuals is estimated to be in the range of:
 50 000–100 000

Level of your confidence in this estimate:
 31–50% - more than a guess, some level of supporting evidence

Q11. Are you able to comment on the extent of decline in the species/subspecies' total population size over the last approximately 15-20 years (i.e., three generations)? Please provide justification for your response.

NSW makes available a range of data from various departments which indicate the ongoing and increasing level of threats to koala populations. Two key datasets are the amount of woody vegetation lost in NSW between 1998 and 2019, and applications determined and approved in NSW, with their construction values, between 2007 and 2019.

Applications approved by type and proportion of determined applications that are approved.

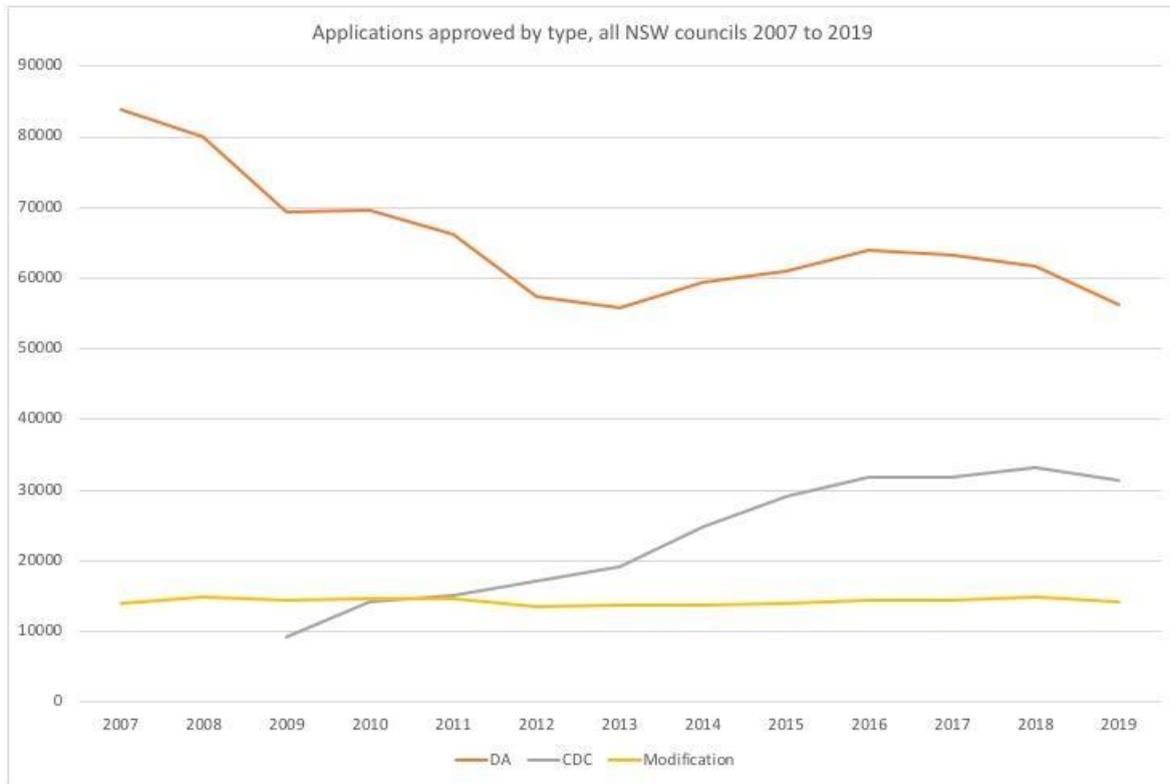


Figure 4. Applications approved by type for all NSW councils, 2007 to 2019

NSW Planning Portal Local Development Performance Monitoring (LDPM) dashboard
<https://pp.planningportal.nsw.gov.au/local-development-performance-monitoring-ldpm> Accessed July 2021

The number of applications received and approved by NSW councils has, overall, declined since 2007. The proportion of applications approved by one or other of the approving bodies, however, has been 100% since 2009, whether the application is a DA (development application), CDC (complying development certificate) or Modification.

Focussing on Port Stephens LGA, the statistics on the determination and approval of CDCs, DAs and modifications over the last thirteen years gives an indication of how much development has taken place and how high the approval rate is. Port Stephens is otherwise a very tranquil leafy coastal to inland area with an important koala hub located at Kings Hill and koala populations on the Tomaree and Tilligerry peninsulas. A development application for Kings Hill is currently being assessed by the Hunter JRRP (see <https://www.planningportal.nsw.gov.au/planning-panel/concept-development-residential-subdivision>). The DA footprint is currently home to at least three resident aggregations (1). The Port Stephens based Hansen mine extension was approved in an area used by an actively breeding koala population.

Except for 2007 and 2008, a **minimum** of 99.5% of CDCs were determined and approved by Port Stephens Council.

A **minimum** of 97.4% of DAs were determined and approved by Port Stephens Council

A **minimum** of 97.7% of modifications were determined and approved by Port Stephens Council.

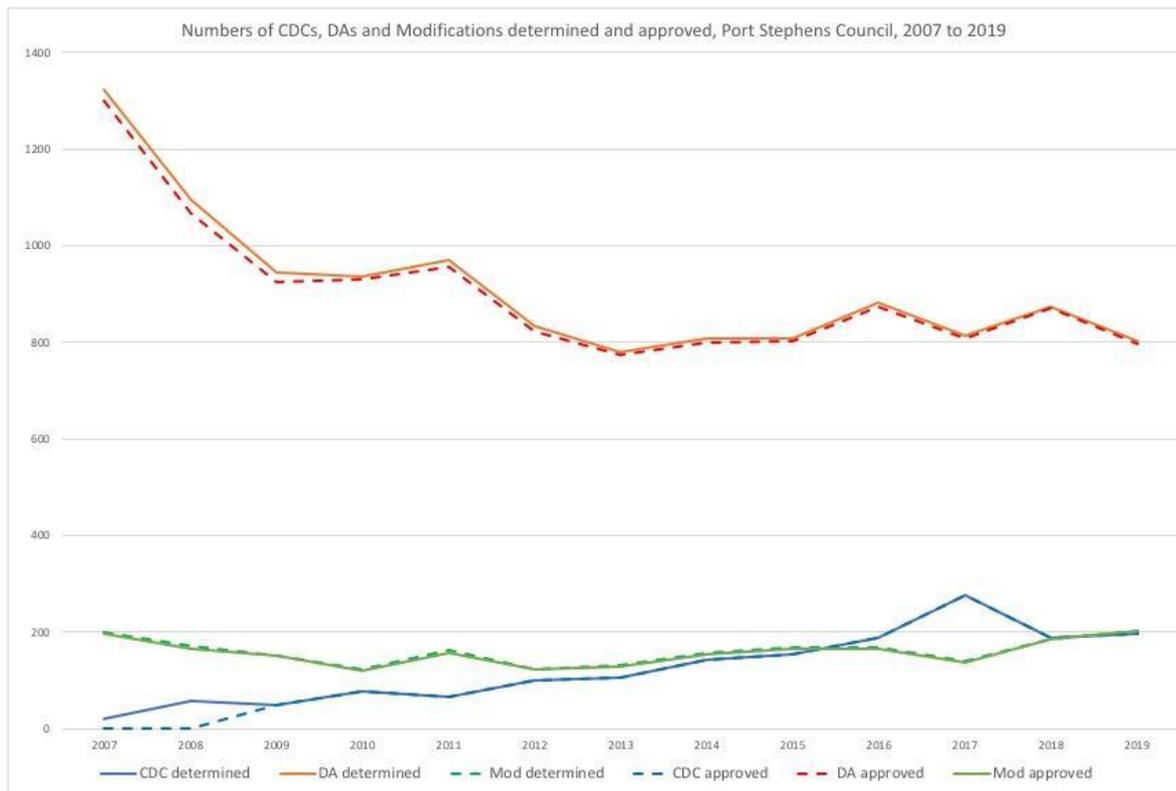


Figure 5. Numbers of CDCs, DAs and Modifications determined and approved by Port Stephens Council, from 2007 to 2019

NSW Planning Portal Local Development Performance Monitoring (LDPM) dashboard
<https://pp.planningportal.nsw.gov.au/local-development-performance-monitoring-ldpm> Accessed July 2021

The downward trend of applications determined and approved followed by a levelling off from 2012 only indicates the number of applications and not the size or value of applications. Data that included the area, vegetation cover and land use per application was not found.

Construction values

Figure 6 (overleaf) shows a steady increase in construction value since 2011 for all the approved applications in NSW. Compare the steady increase with the threefold rapid increase in construction value for Port Stephens for approved development in Figure. This highlights how the number of applications can be misleading without further data on the applications themselves.

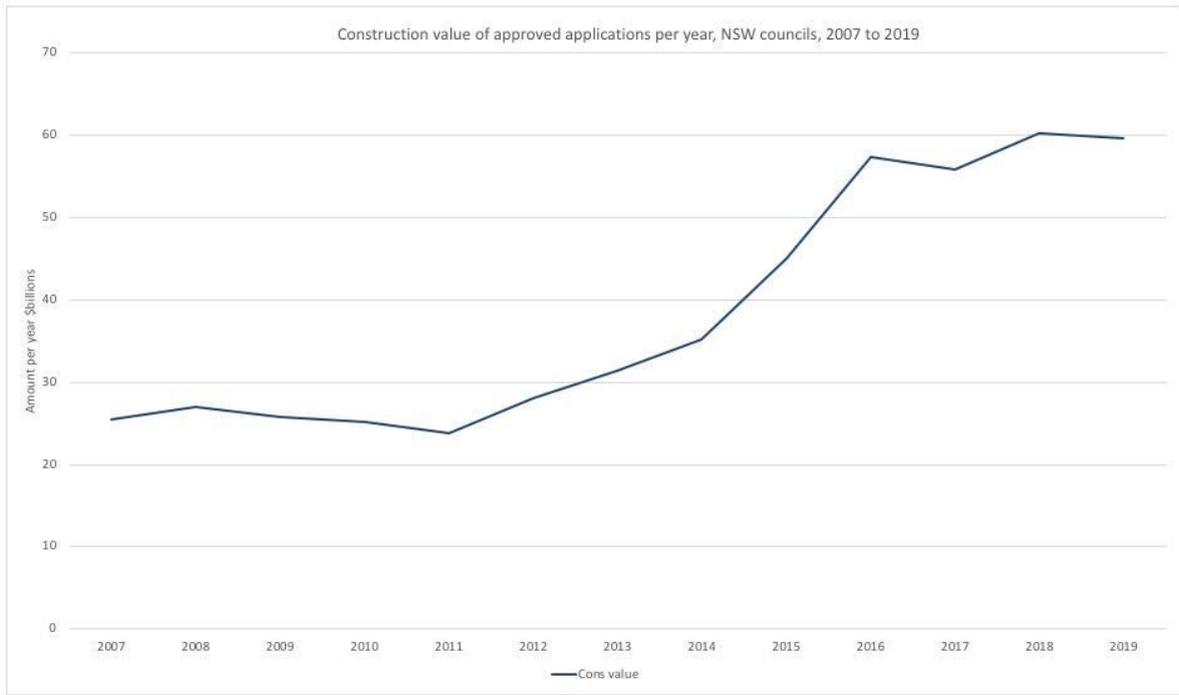


Figure 6. Construction values of approved applications per year, NSW councils, 2007 - 2009

NSW Planning Portal Local Development Performance Monitoring (LDPM) dashboard
<https://pp.planningportal.nsw.gov.au/local-development-performance-monitoring-ldpm> Accessed July 2021

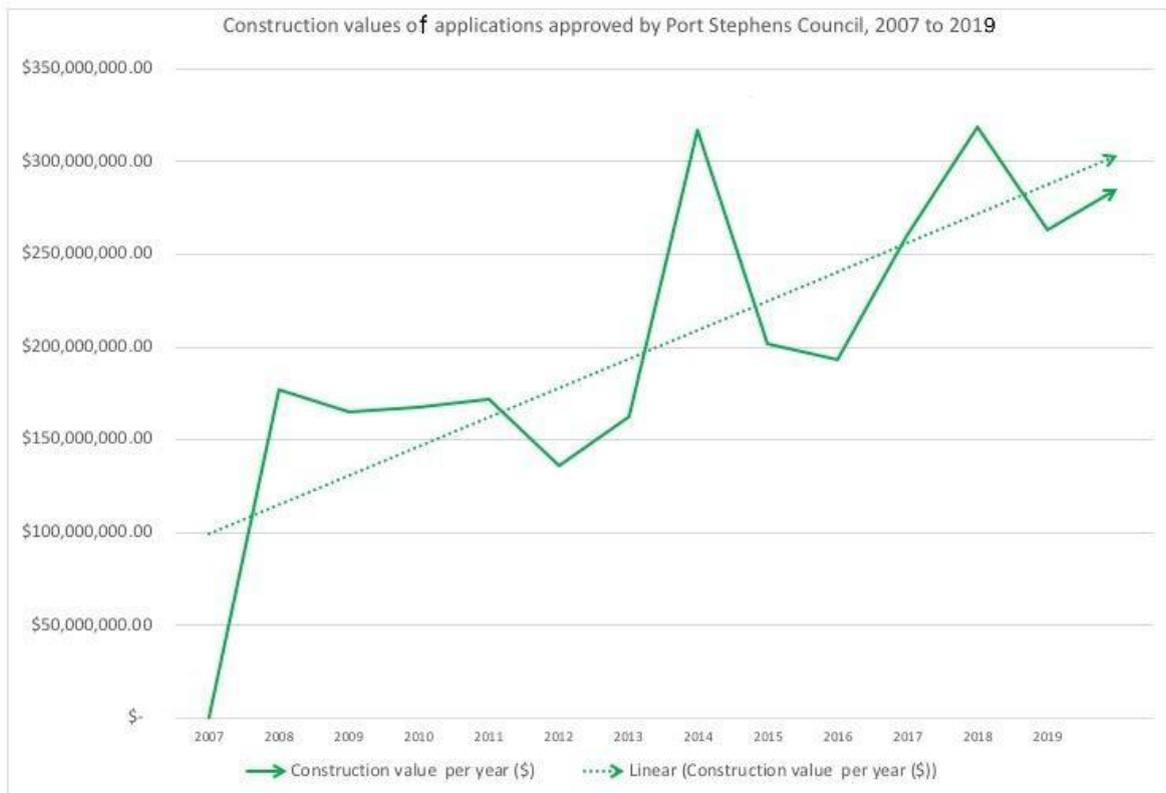


Figure 7. Construction values of applications approved by Port Stephens Council, 2007 to 2019

NSW Planning Portal Local Development Performance Monitoring (LDPM) dashboard
<https://pp.planningportal.nsw.gov.au/local-development-performance-monitoring-ldpm> Accessed July 2021

Loss of woody vegetation

While the above figures look at the volume, value and percentage of application that are approved, this data is not translated into the amount of land that is cleared. While not all woody vegetation is classifiable as prime koala habitat, and not all land has been assessed and approved for development, the 2019 Statewide Landcover and Tree (SLAT) data gives an indication of habitat that has been cleared for agriculture, infrastructure and for the timber industry.

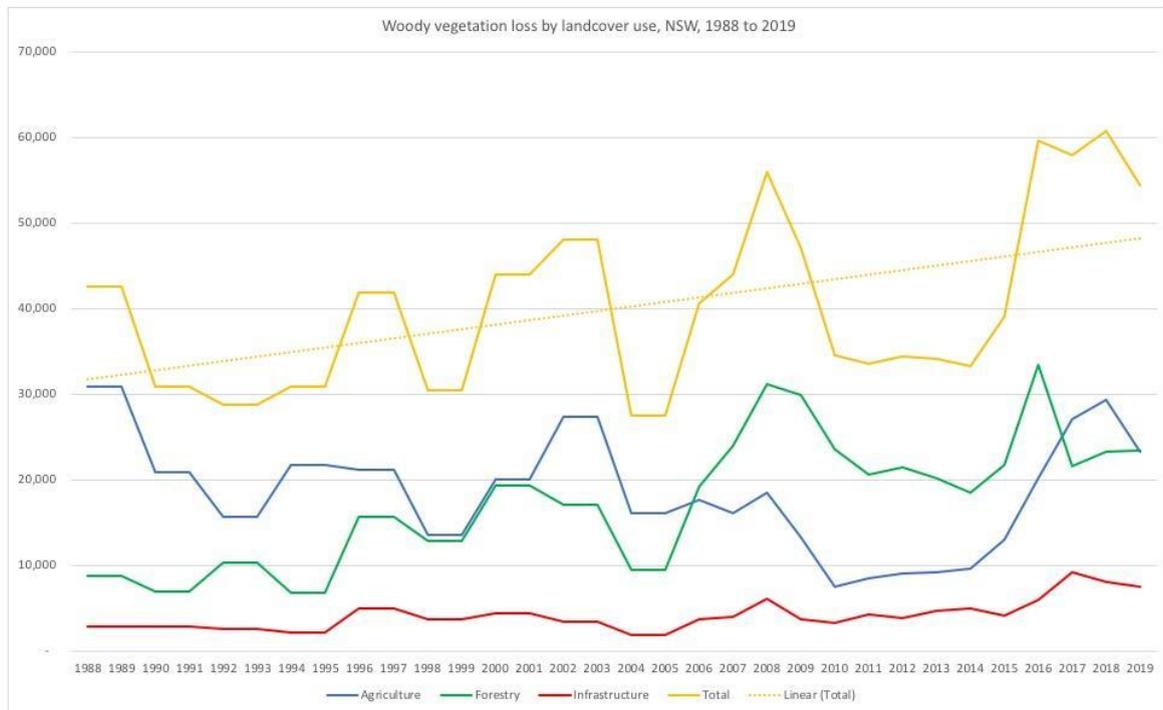


Figure 8. Woody vegetation loss by landcover use, NSW 1988 to 2019.

<https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Native-vegetation/results-woody-vegetation-change-statewide-landcover-2019.xlsx>? Accessed July 2021

The Total line shows an uphill trend, which if it continues could see more habitat lost and more habitat fragmentation which can impact reduce the volume and quality of preferred koala feed trees, impact koala movements and increase ground cover travel making them at risk of predation, and impact social connections and breeding opportunities, potentially weakening allelic richness and future survival. The data comes from two assessment techniques, Landsat and SPOT/Sentinel (2). An overlap of data existed for 2010 and 2011, so I have used median numbers for each. The total area of woody vegetation cleared between 1988 and 2019, as identified by Landsat and SPOT/ Sentinel adds up to more than 1,281,350 hectares.

Q12. Please provide (if known) any additional evidence which shows the population is stable, increasing or declining.

With few population surveys, it is easy to look at koala sightings as an indication of koala numbers. Koala sightings are subject to popularity, ease of the sighting and koalas may be recorded multiple times in one location. That said patterns in koala sightings using the same dates but at multiple locations could be indicative of change.

Figures 9 and 10 present BioNet koala sighting data from the NSW SEED (The Central Resource for Sharing and Enabling Environmental Data in NSW). Although the database contains data prior to 1980, it is very patchy so has been discarded in my analysis.

Although the sighting data is on different scales for figures 9 and 10, the locations are presenting similar peaks and troughs in sightings. On both diagrams, there is a peak in sightings between 1988 and 1992. In Figure 9 the sightings at this time are under 35 for each location, while in Figure 10 the sightings are under 200.

The start of the next shared peak in both diagrams is between 2011 and 2019, after which the sightings seem to drop.

This may not be evidence of a decline in numbers but given so many locations fluctuated in sightings in a similar way, it may be of interest.

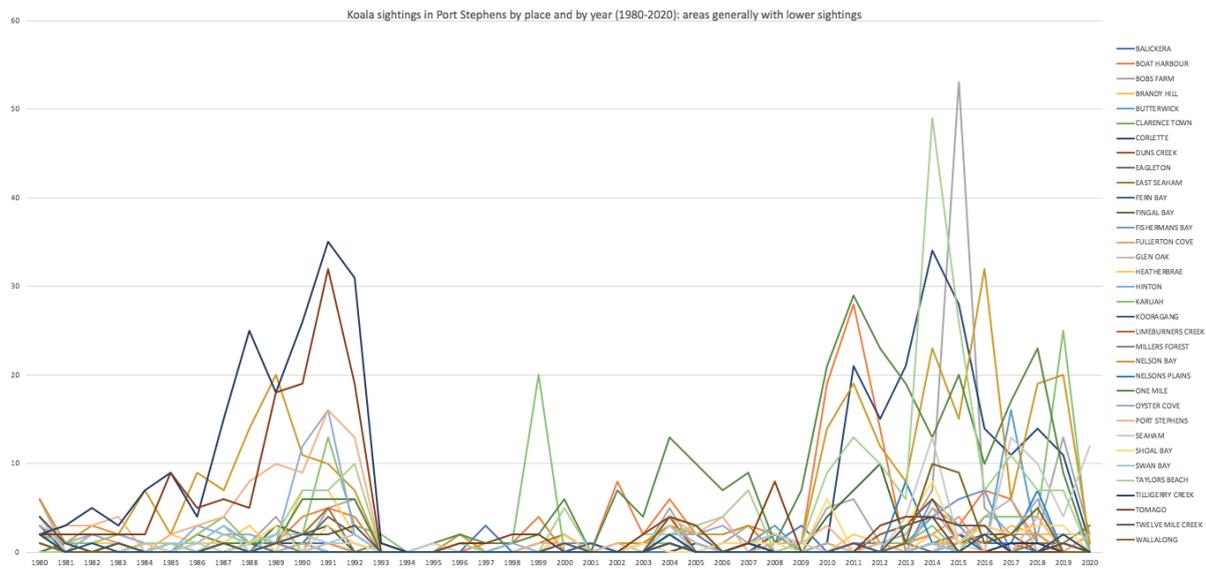


Figure 9. Koala sightings in Port Stephens by place and by year (1980 to 2020): areas generally with lower sightings. Source: NSW SEED (<https://www.seed.nsw.gov.au>)

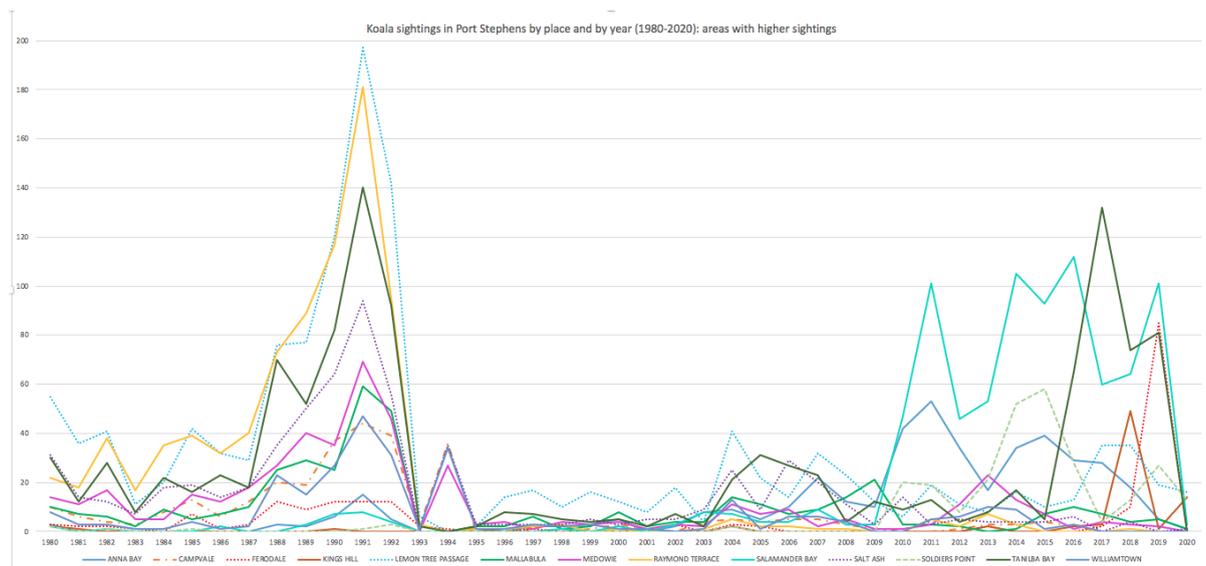


Figure 10. Koala sighting in Port Stephens by place and by year (1980 to 2020): areas generally with higher sightings. Source: NSW SEED (<https://www.seed.nsw.gov.au>)

Koala interventions

Three studies looking retrospectively at koala rescue and hospital data determined the major causes of mortality as being vehicle collisions, chlamydiosis associated debilitation and infertility. (1, 2, 3). Data on koala interventions can be important as a way to see and maybe understand patterns and trends in the decline of koalas.

Figure 11 (overleaf) quite clearly shows a downward trend in the number of koalas found dead between 2994 and 2020 and the number found alive but in need of assistance. In 1995, PSK carried out the live rescue of 93 koalas in just one year. Aside from a peak in 2006 (n=114), the annual live rescue figures dropped below 60 after 2020 falling to 46 in 2020. For the number of koalas found dead, in 1996 the number was 55, reducing to 23 in 2018 and 5 in 2020.

The koalas are no more street savvy than before, no less likely to be suffering from disease, Under no less threat of predation on the edge of habitat or in fragmented areas. The local communities are very quick to call the WINC (Wildlife In Need of Care) or PSK helplines when finding an ill, distressed or dead koala (call data not available). The PSK intervention data, therefore, should be indicative of a decline in the number of koalas in Port Stephens, which may be supported by the recent study by OWAD Environment (4).

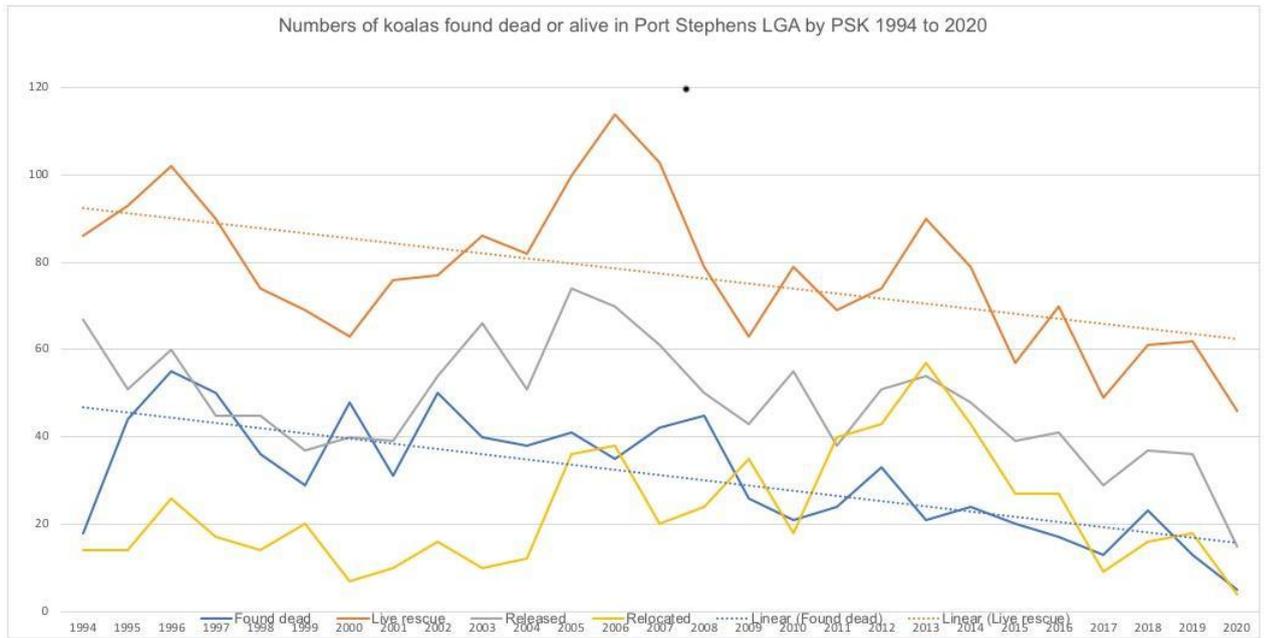


Figure 11. Number of koalas found dead or alive in Port Stephens LGA by PSK 1994 to 2020. Source: PSK (2021) PSK Data Analysis All records to 28-4-21

Local case study: Karuah

Karuah has witnessed a decline in koala numbers, both observed and expected due to drastic changes in the local habitat. Before 1980, landholders cleared a large amount of land north of Karuah for agriculture. However, from the 1990s, there has been a steady clearing of land for housing, mining and the Pacific Highway Bypass. Much of this land clearance has not been undertaken with any substantial corridors to link them to wider habitat areas such as National Parks or Conservation Areas.

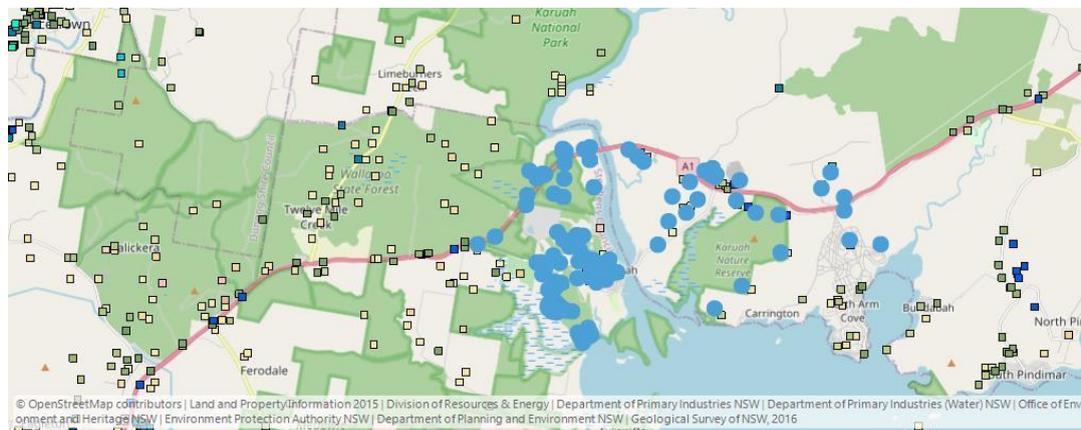


Figure 12. Wide view of Karuah with koala sightings from all years (as taken from SEED).

Habitat clearance will increase the risk of predation due to the extra time spent by koalas at ground level. Wild dogs and foxes are in high prevalence in the Karuah and mid-north coast areas. The Port Macquarie Hospital treats many cases of dog/dingo attacks. The hospital also treats many koalas for car accidents and Chlamydia.

The Lone Pine Fire in 2016 came from Balickerra, Twelve Mile Creek, Swan Bay to Karuah, taking out over 9,000 hectares of koala habitat. No official number of koala deaths have been found yet, but Firefighters said they saw many koalas trying to escape the fire, but they could not save them. Balickerra, Twelve Mile Creek, Swan Bay all had koalas go through this fire. These koalas probably had some relationship to Karuah koalas and vice versa. Hence, the northwest area of Post Stephens Koalas would have been severely reduced by the fire. Rescuers took the two fire surviving koalas to Port Macquarie Koala Hospital and were diagnosed with Chlamydia.

Global warming has been captured by the annual average temperature of 25.3 being recorded in 2019. This is the highest reading for the past 31 years, coupled with the second-lowest rainfall in 30 years of 729 m. The lowest rainfall of 541 m was in 1980. There seems to be a correlation between two or more years of good rainfall and koala sightings on BioNet. Perhaps koala's are well nourished by well-watered trees.

Given a koala needs 100 trees to survive, then the loss of koala habitat from fires and land clearing will impact their population in this area. In addition, other threats will reduce their ability to reproduce and live a normal life span.

The raw data is given in Appendix 1.

Local case study: Balickera

Balickera is home to one of the inland clusters of koalas in Port Stephens. A recent study has shown that these genetically connected koala populations are becoming isolated due to habitat loss and fragmentation (4). Analysis of scat samples revealed limited gene flow between the populations which can result in reduced allelic richness or genetic diversity, reducing their chance to adapt and survive. But it's not just isolation between coastal and inland koalas that is a concern; the separation of koalas in Ferodale and Balickera due to the Pacific Highway is also reducing gene flow between these neighbouring populations.

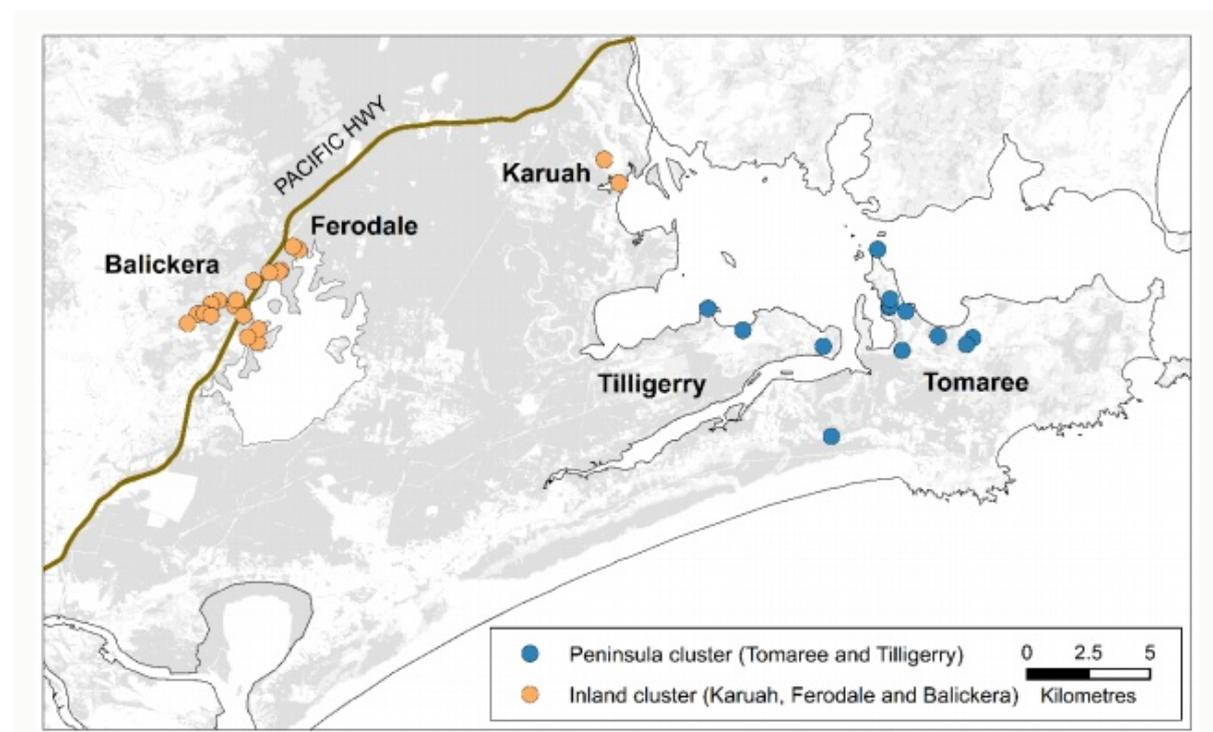


Figure 13. Port Stephens koala populations recently researched by OWAD/ Wild DNA for a WWF report (5)

Sightings have generally been quite low with a few a year other than when 6 was recorded in 1980. This is despite uninterrupted tree canopies on the northern side of Italia Road, although the southern side is largely cleared with various businesses operating there including the Boral quarries, racing car tracks, Hunter Valley Paintball centre.

Evidence of Chlamydia increased from 10% to 23% between 2005 and 2008. A 2021 study revealed that 40% of koalas had Chlamydia and 100% had KoRV-A (4, 6, 7).

In November 2016, the Lone Pine bush fire started in Balickera and spread across the Pacific Highway to Karuah. More than 9,000 hectares were burnt with rescuers from Port Stephens Koalas fearing that the koala population in the burnt areas were decimated. The area was too large to undertake a black walk review of the area for dead and injured koalas. (8).

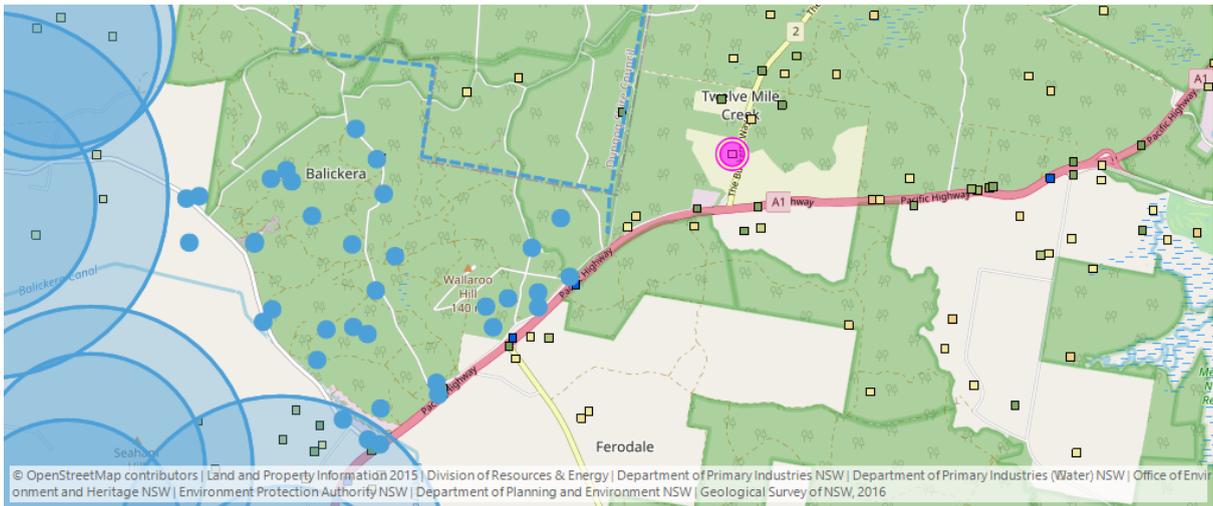


Figure 14. View of Balickera with koala sightings from all years (as taken from SEED).

The raw data is given in Appendix 2.

Local case study: Twelve Mile Creek

Twelve Mile Creek was also subjected to the Lone Pine Fire in 2016 that saw over 9,000 hectares burn. Much of the land has also been cleared for agriculture and mining along Buckets Way until you reach Talbots Trails. North of Buckets Way and west of Pacific Highway the land has also been cleared. Sightings of koalas in the area have also included kills by dogs and 11 deaths by vehicle strikes since 2011. In addition the population will also likely be suffering from Chlamydia and KoRV-A.



Figure 15. View of Twelve Mile Creek with koala sightings from all years (as taken from SEED).

The raw data is given in Appendix 3.

Local case study: Tilligerry Peninsula

An extensive area of bush was subjected to fire on August 18th/ 19th in 2018. Almost 2,00 hectares was burnt between Salt Ash and Taniilba Bay with local media calling it an 'unprecedented winter inferno' (9). Fifteen volunteers from Port Stephens Koalas and about the same number from WINC (Wildlife In Need of Care) conducted a 'black walk' on Wednesday 22nd August 2018 through burnt bushland in Salt Ash, Oyster Cove and Taniilba Bay where animals are known to frequent or have been released in order to search for injured animals. They only came across a dead echidna and an otherwise healthy lace monitor. Simone Aurino from PSK was quoted as saying "We don't want any animals hurt or injured. But if we haven't come across any yet, it usually means that they've died. And if not, they've been out there for two days hurt and suffering."(10) While two male koalas at Oyster Cove were sighted, and a female called Jasmine, which frequents Tilligerry Habitat was sighted, other koalas are likely to have been lost to the fire.

More recent sightings have been in coastal areas of Tanilba Bay, Lemon Tree Passage and Mallabula as most of the bushland was burnt. There has even been a recent sighting of a juvenile in Lemon Tree Passage and local residents are hearing koalas bellow there.



Figure 16: Area of land burnt in the August 2018 bushfire on the Tilligerry Peninsula

SECTION E - ARE YOU AWARE OF INFORMATION ON THE TOTAL RANGE OF THE SPECIES/ SUBSPECIES? (If no, skip to section F)

Current Distribution/range/extent of occurrence, area of occupancy

Q.13. Does the assessment consider the entire geographic extent and national extent of the species/subspecies? If not, please provide justification for your response.

Local information:

I am unable to verify any compilation of geographic extent mapping on a national extent that is not historical. So much has changed so radically in the last 20 years, even in the summer of 2019-20 due to the raging bushfires, that it would be an enormous task.

On a more local level in Port Stephens, the maps that accompany the Comprehensive Koala Plan of Management (CKPOM) are over 20 years out of date. One of the primary aims of the CKPOM was to compile data on the destruction and restoration of habitat. While Port Stephens Council have reported on their efforts at piecemeal restoration projects, there is no mechanism to keep track of habitat destruction. My enquiries as a committee member have only been partially answered by staff saying it would be too time consuming to keep track of the information that is not required to be reported by developers and is not always obvious from approved Development Applications.

Although the CKPOM is out of date, there is no legislative framework that allows updating of the CKPOM or even the mapping due to NSW legislative changes and waiting for the outcome of the politically fraught updating of the koala SEPP. It seems that the Federal Government should take responsibility for the identification urgently needed changes and protection of koala habitat that the States are unable to do, tying the hands of local councils to implement worthwhile changes.

I have been more reliant on the rescue and release statistics of Port Stephens Koalas (and formerly Hunter Koala Preservation Society) because their compilation has been done very reliably since 1995 through the long term efforts of Mr Murray Black who uploads the data onto the NSW Wildlife Atlas quarterly as part of the licensing requirements for all Wildlife Rehabilitation groups in NSW.

Q.14. Has the survey effort for this species/subspecies been adequate to determine its national distribution? If not, please provide justification for your response.

I am unable to judge the adequacy of this scientific work that so often must use maths formulas applied to small sampling efforts that results in my opinion in guesstimates and is not at all reliable.

In NSW the best data available of where koalas still survive may be that recorded by licensed wildlife rehabilitation organisations and reported to the Office of Environment and Heritage (now a part of DPIE).

Q.15. Is the distribution described in the assessment accurate? If not, please provide justification for your response and provide alternate information.

The consultation document on page 16 states “Other bioregions had smaller, but significant Koala populations (<3,000 individuals): Murray-Darling Depression (55), South East corner (655)”(1). Given Port Stephens Koalas is one of the LGAs with a significant number of sightings, has a potentially important koala hub at Kings Hill (although this under threat and a DA is being assessed by the Hunter JRPP) and given Port Stephens reported 56 koalas dying in 2012 either from dogs, vehicles, disease, unsuitable environment, fire, or from injuries cause by these reasons, which is an unfortunate yet sizeable amount, surely suggests that Port Stephens should have been included as one of the bioregions that has smaller but significant populations.

With regard to the BioNet koala species sighting data for Port Stephens, koalas are more widely spotted in Lemon Tree Passage, Tanilba Bay, Salamander Bay, Raymond Terrace and Salt Ash which are represented as larger wedges in the sunburst diagram (Figure 12). Sightings are not an indication of higher numbers of koalas, and the areas of highest sightings doesn't completely tally with the higher number of koalas needing treatment (2) which were Salamander Bay (n=335), Anna Bay (n=276) and One Mile (n=195).

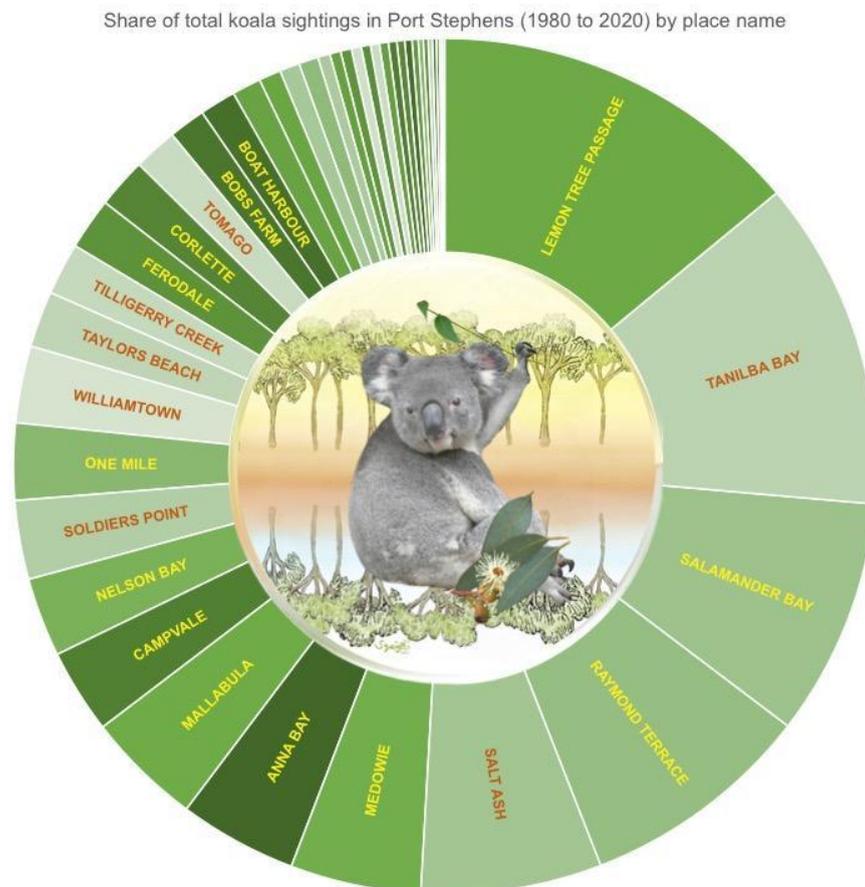


Figure 17. Share of total koala sightings in Port Stephens (1980 to 2020) by place name. Source: NSW SEED (<https://www.seed.nsw.gov.au>).

Local information:

The records compiled by the NSW [wildlife rehabilitation organisations](#) would be accurate. Only those capable of knowing the species encountered are creating the records. There is no guess work.

Our rescuers have gone out to respond to calls from members of the public about koalas that turn out to be possums or even dead kangaroos on the road so I know how unreliable even sightings can be. Mathematical extrapolations are simply justified academic guesses.

Q.16. Do you agree that the way the current extent of occurrence and/or area of occupancy have been estimated is appropriate? Please provide justification for your response.

Local information:

Any current extent of occurrence/occupancy areas would have to have been confirmed since the devastating fires of the summer 2019-20 when so many millions of acres of habitat was destroyed by wildfires where no animals could have survived. I have participated in enough "Black walks" through burnt out bushland to know how little survives. Everything turns to ash, and koalas who do not run but merely climb higher into the treetops, have little chance of survival.

Port Stephens Koalas still has a female Eila in permanent care at the Sanctuary who received burns to all four paws in a small fire in part of the Mambo Wetlands Reserve in early 2019. She and her joey were rescued. The joey was released soon after but some of Eila's claws have been permanently affected (growing weirdly) so that she has not been released.

Q.17. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the extent of occurrence and/or area of occupancy.

David Paull, in his nomination for Port Stephens Koalas east of the highway provided this further information in March 2015:

"NSW Wildlife Atlas records on the distribution of Koalas have been assessed separately over 2 periods corresponding to the average Koala generation length of 6 years (Gordon *et al.* 1990). This dataset also has limitations for this analysis though shows broad trends in the changing distribution of the Koala across the LGA. This analysis shows a marked decline in the distribution of the Koalas between the periods 2009-2015 and 2003-2009, despite overall numbers of records remaining similar (approximately 500). In particular the level of occupancy has declined significantly or disappeared from the northern parts of the LGA (Seaham, Wallalong areas), Tomago, Williamstown and Medowie areas. Maps depicting the 'area of occupancy' from 2003-2009 and 2009-2015 were gridded and compared (Appendix 3a-b). This analysis found the Koala's geographic distribution has declined from 61 grid squares in the earlier period to 34 grid squares in the latter, or a decline in occupancy by 43.3% over two Koala 'generations'."

I am not aware of any further research having been done in this regard since that time, but anecdotally many in the community are noticing the decline of sightings and hearing koalas bellowing so you should assume the extent of occupancy has shrunk very much since then.

SECTION F - ARE YOU AWARE OF TRENDS IN THE TOTAL RANGE OF THE SPECIES/SUBSPECIES? (If no, skip to section G)

Past Distribution/range/extent of occurrence, area of occupancy

Q.18. Do you consider that the way the historic distribution has been estimated is appropriate? Please provide justification for your response.

Unable to comment.

Q.19. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the former extent of occurrence and/or area of occupancy.

Unable to comment.

PART 2 – INFORMATION FOR CONSERVATION ADVICE ON THREATS AND CONSERVATION ACTIONS

SECTION G - DO YOU HAVE INFORMATION ON THREATS TO THE SURVIVAL OF THE SPECIES/ SUBSPECIES? (If no, skip to section H)

Q.20. Do you consider that all major threats have been identified and described adequately?

Please see responses to Q.1, Q.6, Q.9, Q.11 and Q.12. In brief, environmental stressors including habitat clearance/ fragmentation and associated impacts including possible reduction in PKFTs and potentially more ground travel, proximity to urbanisation, people and dogs, vehicle strikes, climatic conditions can result in physiological stress response which can impact koalas' immunity making them more susceptible to chlamydial clinical disease. In addition, habitat clearance can lead to an increase in predation and reduce genetic connections with other populations.

Q.21. To what degree are the identified threats likely to impact on the species/subspecies in the future?

Without adequate legal protection, and effective conservation management tools to improve koala health and population connectivity, the threats identified in Figure 1 (Q.1) will continue to push koalas in Queensland, New South Wales and ACT to extinction. Reduction in numbers. Reduction in fertility. Reduced fecundity. Reduced allelic richness. Reduction in resilience and robustness. Increased mortality.

Q.22. Are the threats impacting on different populations equally, or do the threats vary across different populations?

The threats may vary depending on the area, land use and land cover and the LGA's appetite for development, but it is likely that the threats are the same. For example, in areas near Coffs Harbour and Bellingen, the timber industry is clearing large areas of land. In other areas, habitat clearance may be for development or agriculture.

Q.23. Can you provide additional or alternative information on past, current or potential threats that may adversely affect the species/subspecies at any stage of its life cycle?

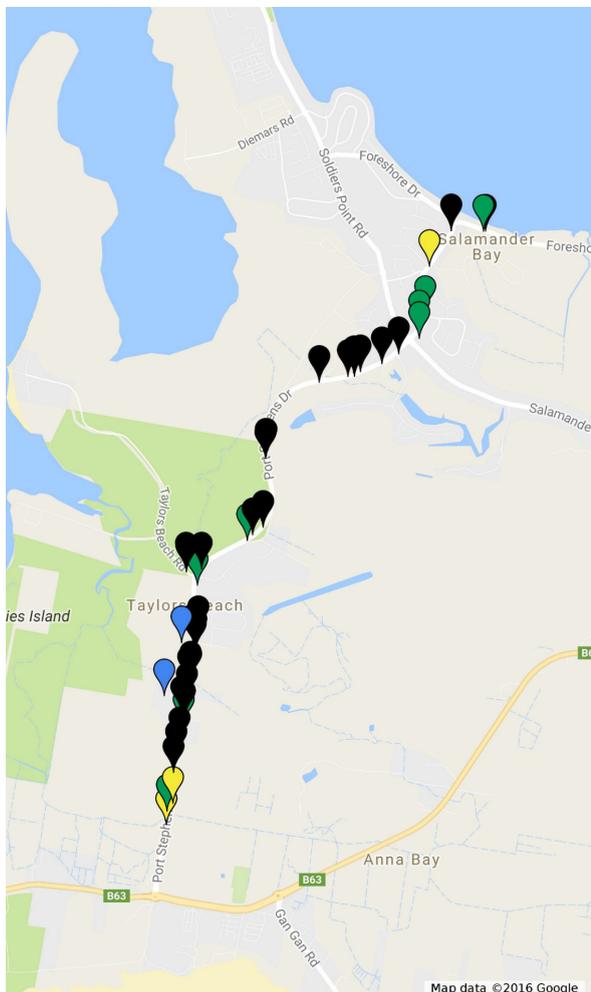


Figure 18. Koala encounters on Port Stephens Drive, 2011 to 2016.

Black – Motor Vehicle
Green – Unsuitable Environment
Yellow – Disease
Blue – Other

Several years ago, there were 5 deaths in quick succession of young male koalas weighing approximately 4kg on Port Stephens Drive near Horizons Golf Course. The Golf Course has remnant habitat and the other side of the road is Tilligerry Reserve. It seems they were trying to disperse, but didn't make it across the 80kph road. This kind of carnage occurs as soon as the weather warms up to 25 degrees when the mating season is beginning and young males are forced out to find their own patch of habitat. The CKPOM committee recommended discussions between Port Stephens Council and Save our Species funding within DPIE (ref Paul Hillier) to provide urgent mitigation methods that have not yet been employed. It won't be long until spring arrives and young koalas will again have to run the gauntlet.

Enquiries about reducing the speed limits of the most fatal roads for koalas have been met at Council with the advice that it would not be at all possible politically within the community. Koalas are unlikely to survive motor vehicle impacts of higher than 80 kph. Most main roads in this LGA that run through habitat on both sides are 80-100kph. A lethal combination.

Q.24. Can you provide supporting data/justification or other information for your responses to these questions about threats?

Please see the references listed for Q.1, Q.6, Q.9, Q.11 and Q.12

SECTION H - DO YOU HAVE INFORMATION ON CURRENT OR FUTURE MANAGEMENT FOR THE RECOVERY OF THE SPECIES/SUBSPECIES? (If no, skip to section I)

Q.25. What planning, management and recovery actions are currently in place supporting protection and recovery of the species/subspecies? To what extent have they been effective?

Legislation

NSW has a history of increasingly weakened legislation in regard to protection mechanisms for koala habitat. In addition, only a handful of CKPoMs (Comprehensive Koala Plans of Management) are in existence and they are largely ineffective, as is the ARKS designation.

In March 2020, the previous NSW State Environmental Planning Policy 44 (1995) was replaced by the State Environmental Planning Policy (Koala Habitat Protection) 2019 (1) under the Environmental Planning and Assessment Act 1979. The key changes included a new definition of 'core koala habitat', an extended number of tree species recognised as koala feed trees, two new mapping layers in the development application process and new Koala Habitat Protection Guidelines.

The NSW State Government tried to pass the Local Land Services Amendment (Miscellaneous) Bill 2020 on 19th November 2020. The Bill not only excluded privately owned koala habitat from SEPP protections, it also potentially overrode protection for coastal wetlands and littoral rainforests in rural land, and nearly allowed a new category of habitat clearing. In the Upper House, koala inquiry member Catherine Cusack crossed the floor defeating the Bill by one vote. She was relieved of her post (2).

As a result of the defeat, the NSW Premier scrapped the new SEPP 2019 and SEPP 2020 commenced on the 30th November and is more akin to SEPP 44 with the narrow koala habitat definitions.

In March 2020, the NSW Government advised that it would be amending the Rural Fires Act 1997 (3). Assented to on the 25th November 2020, after suspending Parliament business to get the Bill passed quickly, the Bushfires Legislation Amendment Act 2020 allows the clearance of rural land up to 25m away from their property boundary or fence line. WWF Australia estimated that for Clarence Valley, Port Stephens, Shoalhaven and Wollondilly up to 44,293ha of forest could be at risk if all rural landholders cleared to the maximum extent. This area includes 12,000ha of high quality koala habitat (4).

100RB

Carrying out vegetation clearing work in accordance with Rural Boundary Clearing Code

1. (1) Vegetation clearing work may be carried out on a holding under this section if all of the following apply—
 1. (a) the vegetation clearing work is carried out within 25 metres of the holding's boundary with adjoining land,
 2. (b) the vegetation clearing work is carried out on land in a rural zone,
 3. (c) the vegetation clearing work is carried out by or with the authority of the owner of the holding,
 4. (d) the vegetation clearing work is carried out for the purpose of bush fire hazard reduction,
 5. (e) a Rural Boundary Clearing Code is in force under this Division,
 6. (f) the vegetation clearing work is carried out in accordance with the Rural Boundary Clearing Code.
2. (2) Vegetation clearing work may be carried out under this section despite any requirement for a licence, approval, consent or other authorisation for the work made by the *Biodiversity Conservation Act 2016* or the *Environmental Planning and Assessment Act 1979* or any other Act or instrument made under an Act (other than the Rural Boundary Clearing Code).
3. (3) A person is not guilty of an offence under any of the following Acts merely because of the carrying out of vegetation clearing work under this section—
 1. (a) *Environmental Planning and Assessment Act 1979*,
 2. (b) *Fisheries Management Act 1994*,
 3. (c) *Heritage Act 1977*,
 4. (d) Part 5A of the *Local Land Services Act 2013*,

5. (e) *Protection of the Environment Operations Act 1997*,
 6. (f) *Soil Conservation Act 1938*.
4. (4) To avoid doubt, this section does not limit or prevent the clearing of vegetation authorised under the *Local Land Services Act 2013*.

In the recent second reading of the Federal Environment Protection and Biodiversity Conservation Amendment (Standards and Assurance) Bill 2021 on June 21st 2021, two politicians highlighted the weakening of environmental laws and referenced the risks to koalas (5):

Terri Butler (*Griffith, Australian Labor Party, Shadow Minister for the Environment and Water*)

"I don't need to tell you about the environmental problems in this country. You all know them. We're a world leader in mammal extinctions. We're in a situation now where we're in a biodiversity crisis. We're in a situation now where Australians are worried after the bushfire crisis, after what they're hearing about climate change, after what they're hearing about the extinctions. They're worried about native species. They're worried about whether their grandkids are going to be able to see live koalas. They're worried about what's going to happen with all of the native species that they're under threat. They're worried about the fact that this government seems to have <https://www.openaustralia.org.au/mp/?m=678> just given up on getting recovery plans done at all, let alone on time, that they don't seem to be able to get the key threatening processes documents together to abate those threats, that they seem to be comprehensively unable to respond to the gauntlet that's been thrown down to them by Graeme Samuel through this process about the state of decline that our Australian environment is in. Australians are worried about that."

Alicia Payne (Canberra, Australian Labor Party)

"I rise today to speak on the Environment Protection and Biodiversity Conservation Amendment (Standards and Assurance) Bill 2021. Labor will not support the weakening of the environmental laws. We're in the middle of a biodiversity crisis, an extinction crisis, and we should be doing so much better than this. We should be strengthening environmental laws, not weakening them. As the member for Griffith, our shadow minister for the environment, said, we're very happy to work with the government on getting these changes right if they will scrap this bill and come back with something that delivers stronger protections for our precious natural environment; a better solution for businesses, who are waiting too long to get approvals through; and a tough cop on the beat to ensure that the decisions that are made have proper compliance attached to them."

Development approvals

With nearly 100% approval rates for DAs, CDCs and Modifications across in Port Stephens and similar rates across NSW (6), even when the development footprint is within an ARK and disrupts koala habitat, it is important that the planning system is made far more transparent and any Council ecologists are impartial. An uplift to Threatened would potentially provide an impetus to redress the balance between economic interests concerning traditional industries, such as logging, mining and agriculture, political infighting, and the protection of an iconic native species and its generation of tourist dollars.

Economy

A 2020 INFER analysis paper (Investment Framework for Environmental Resources)(7) looked at the value of the koala as an Australian asset. Previous estimates of the economic value, or what the koala brings to the Australia economy, have varied between between \$1.1billion for 2006 (Hundloe and Hamilton, 1997), \$1.15 billion annual willingness to pay (WTP) nationally to protect koalas estimate (Tisdell and Nantha, 2007) and \$3.2 billion based on the economic value of koalas (Conrad 2014). Unfortunately, even significant estimates like these have not been enough to keep koala habitat safe.

Q.26. Can you recommend any additional or alternative specific threat abatement or conservation actions that would aid the protection and recovery of the species/subspecies?

The first priority should be to afford more protection to koalas and koala habitat, otherwise conservation efforts will be hampered by legal habitat clearance.

Q.27. Would you recommend translocation (outside of the species' historic range) as a viable option as a conservation actions for this species/subspecies?

No.

The more robust, disease free koalas are located in Victoria and South Australia. They are not known to have resistance to infection (1). Studies of translocations within Victoria found that translocating disease-free koalas into areas where *Chlamydia* is present, and vice versa, has a low chance of success because the health, fecundity and longevity of the uninfected koalas declines as a result of being as they infected (2).

[Nearly half of Coomera koalas die after Gold Coast relocation - ABC News](#) Steven Philips. 'Over the five years, koala losses due to disease, predation or road trauma totalled 50 per cent for the resident group that remained at East Coomera, compared to only 42 per cent for the relocation group.' (3)

Relocation to islands has been particularly problematic with over-population and then having to cull them, e.g. Kangaroo Island, but also moving koalas to mainland areas such as the Otways has proved an ecologically unsound result.

Koalas are an "iconic umbrella species" meaning other threatened wildlife survive in the same habitat and it isn't possible to move the whole ecological community. Using offsets by developers to "pay for" destruction of habitat is also fraught by noncompliance and failure to thrive (even planted trees die) in different areas. Koalas have already evolved to have a gut flora unique to being able to digest the leaves of trees within their own habitat. Moving them can starve them, e.g. koalas in the Otways refusing to eat anything other than the manna gum and starving as a result.

No koalas' habitat should be destroyed before conservation efforts are made to find alternative suitable habitat as is happening now. Removing trees as soon as the koala has moved to the next one is simply starving the koala. Reports that land clearing have increased in NSW and Queensland since koalas were declared Vulnerable must be noted and acted upon when koalas are Endangered. Developers seem to find it cheaper and more expedient to simply deal with the limited consequences and small fines imposed for clearing habitat without even bothering to apply for permission.

SECTION I - DO YOU HAVE INFORMATION ON STAKEHOLDERS IN THE RECOVERY OF THE SPECIES/SUBSPECIES?

Q.28. Are you aware of other knowledge (e.g., traditional ecological knowledge) or individuals/groups with knowledge that may help better understand population trends/fluctuations, or critical areas of habitat?

Olivia Woosnam and her partner Alex Dudkowski from [OWAD Environment](#) are Koala Ecology Experts who have been preparing reports on their fieldwork for nearly 10 years. I believe their method of using koala sniffer dogs to retrieve scat and then have the DNA analysed is cutting edge. Olivia and Alex are presently committed to a 7 week field research exercise and so are unable to submit anything to your enquiry. Some of their recent projects are listed on their website here: [OWAD Environment Recent Projects](#).

Olivia recently emailed me this information to include in this submission:

"There is incredible work going on in South East Queensland, almost entirely funded by Brisbane City Council (and minor input from other Councils + private entities, but it is very largely Brisbane Council). Collaborative work OWAD / Federation University / University of Queensland which amongst others inform Brisbane Council's Wildlife Movement Solutions Program, Bushland Acquisition Program, their biodiversity conservation planning overlay and development restrictions, their targeted revegetation programs, and more. Among "more" is close collaboration with other Councils who share populations with Brisbane LGA. Brisbane has the tips of 3 distinct populations within their LGA, so they work closely with the other relevant LGAs to manage each one of those populations. (Each of these 3 populations face different challenges and hence require a different management response.) Fed Gov can contact Brisbane City Council directly if they want to know more."

"This is the Federation University version of the work we have been doing in Brisbane for the last 6 years: <https://federation.edu.au/news/articles/protecting-queenslands-koalas>

And here is the link to the 2018 technical report:

https://www.researchgate.net/publication/336047690_2018_Brisbane_City_Council_Koala_Population_Study

Note that results presented in that report are limited to the boundaries of Brisbane LGA, and that there is a whole lot more data both outside/beyond Brisbane LGA and more data in the last 3 years both in Brisbane and other LGAs since that report was written. A number of peer-reviewed papers in the pipeline. One recently came out about KorV-B, a joint paper the people from Fed Uni and Peter Timms (Uni of Sunny Coast) that utilised a subset of samples we recently sampled in SEQ.

https://www.researchgate.net/publication/347834482_Phylogenetic_and_geographical_analysis_of_a_retrovirus_during_the_early_stages_of_endogenous_adaptation_and_exogenous_spread_in_a_new_host."

[Mark Aitkens from RPS Australia](#) worked with OWAD on the ecological reports for the Kings Hill Urban Development proposal (aka Balickera area north of Raymond Terrace). They were able to identify specific *E. tereticornis* trees that were particularly valuable as food trees because of their genetic makeup and the soil's richness. I don't understand the science, but it would be so beneficial to be able to identify the best trees to

preserve in a proposed development area and connect them with the wildlife corridor to keep the koalas connected and allelic rich.

Dr Ryan Witt and Associate Professor John Clulow from the University of Newcastle's [Our Alliance - FAUNA Research Alliance](#) have been doing research work, including on koala populations in this area recently.

Q.29. Are you aware of any cultural or social importance or use that the species/subspecies has?

"Incredible by Nature" is the new marketing strategy for Port Stephens. Apart from the newly built Koala Sanctuary and Hospital, tours onto the water to see (and swim with) dolphins and to watch whales are big business here. Our wonderful nature is a multi-billion dollar drawcard in every state of Australia. There will be no need for a Koala Hospital when our koalas are gone. The Sanctuary will become just another Zoo. Right now it houses wild koalas that are no longer releasable into the wild, because they are blind or disabled in some way that means they can no longer survive in the wild. It is wonderful to see koalas living in very natural surroundings instead of having to put them to sleep because zoos will not take them. They cannot display disabled animals. Recently though, Port Stephens Koalas has kept captive some healthy koalas that have no safe habitat to return to because of continual habitat destruction and lack of will to maintain wildlife corridors. That is a sad indictment of the lack of commitment by the local and state governments to support our iconic koala.

Carol Ridgeway-Bissett is the Maiangal traditional knowledge-holder and custodian of the land around Nelson Bay. I have met her many times and she is very much aware of the dire straits of many important cultural sites and the difficulty the community has in conserving them eg [Wanda Wetlands woes: Claim that Tomaree heritage site is neglected | Port Stephens Examiner | Nelson Bay, NSW](#). To give some historical perspective, Worimi elder, Carol Ridgeway-Bissett says of her childhood experience 60 years ago on the Tomaree Peninsula, that seeing koalas along with lots of lizards, echidnas and small birds was common on her way to school in Soldiers Point. She says that all these creatures and the bush are interconnected so that when there is imbalance, for instance removal of native vegetation, the relationship is disrupted. Koalas are one of the many animals that still cling to existence here as do many other protected species of fauna and flora. Carol is very actively expressing her views in media and by making submissions on many local environmental and cultural matters of concern.

The wider group of First Australians, the [Worimi](#) people, are also strongly represented in this area but I personally have less contact with them.

Q.30. What individuals or organisations are currently, or potentially could be, involved in management and recovery of the species/subspecies?

The Koala Koalition EcoNetwork Port Stephens (KKEPS) has been recently formed to help nearly 30 small environmental groups respond in a more cooperative and coordinated way to the many simultaneous challenges to conserve koala habitat from development in this area. We are hoping to bring more public pressure to bear by sending out the message more widely and effectively when voices are needed. Many members of environmental groups like myself have been around long enough to fight to save the same piece of valuable habitat on multiple occasions as there is no way to protect it for the long term. It is soul-destroying but Port Stephens people are strongly community oriented and continue on.

NSW Wildlife rehabilitation groups have for years and years rescued, rehabilitated and released thousands of koalas but weak environmental laws in NSW are making it ever easier for their habitat to be destroyed. To save koalas and other wildlife, that must change, and there must be a way to stop development that destroys the last remaining places where koalas are healthy and breeding. It is up to government intervention and policy. Many individuals and organisations are already doing all they can to halt the destruction of habitat, without much success at all.

Identifying where koalas are breeding, or likely to move in to breed, and conserving that habitat is the key to turning around this situation. All those hours of work should be turned to identifying corridors that MUST be retained to provide effective corridors to large areas of bushland where wildlife can continue to live safely. The application mosaics of cultural burns instead of allowing huge wildfires that destroy millions of hectares in mere weeks is another necessity.

In Port Stephens Council over the years, I have noticed that the staff of the Natural Resources department can well identify those developments that should not be approved, or their effects could be mitigated on local wildlife, but it the Planning Department is tasked with pushing ahead and the elected Councillors and Mayors support that approach. I understand there may be some Councils that work with more insight, but the culture of "development above all" must be changed.

There are many hundreds of organisations and thousands of individuals that could do more with their time to help with the recovery of the species if so much time was not having to be spent in trying to save habitat from destruction. Local councils, Land Care groups, and Koala Koalition EcoNetwork Port Stephens would be honoured to have the opportunity.

Q.31. How aware of this species/subspecies are land managers where the species/subspecies is found?

Koalas are difficult to spot in any tree, but most land managers who live on the land will know if koalas are present. When people merely buy land for development, they are not connected with it or what is on it.

Many are reluctant to acknowledge koalas live on their land for fear they will have restrictions imposed on the development of the whole of their land that will cause it to devalue, others are reluctant for anyone to know they are there in order to protect them from others less interested in their survival.

Although they may be in the minority, there are people who would like to find a way to conserve parts of their land for flora and fauna, while developing other parts of it to source an income. Many are the stories of people buying bush blocks for conservancy who are horrified by the actions of their neighbours to the contrary. I believe identifying corridors and major bushland areas as imperative for conservancy may help people to find land more suitable for their particular concerns and interests. There would have to be some lands restored to provide linkages, and some lands acquired using public funds or through environmental marketing campaigns.

Q.32. What level of awareness is there with individuals or organisations around the issues affecting the species/subspecies?

Significant given numbers protesting against weakened legislation, campaigning for a moratorium on habitat clearance and supporting plans for the Great Koala National Park

- a. Where there is awareness, what are these interests of these individuals/organisations?
- b. Are there populations or areas of habitat that are particularly important to the community?

The list changes quickly according to what parcel of land comes up for sales that carries pristine bushland or provides known corridors. I recently compiled the following list on request of the NSW Greens MLC, Cate Faehrmann, as habitat needing urgent protection in Port Stephens.

List of important habitat needing protection, as sent to Cate Faehrmann, NSW Greens MLC

Dear Cate,

Thank you for continuing the discussion on vital Koala habitat needing conservation in Port Stephens. The EcoNetwork Koala Coalition of Port Stephens has been formed to help respond to the mounting challenges of development/clearing of core koala/wildlife habitat throughout Port Stephens. Membership is hoped to expand as we establish ourselves, but on first enquiries through these groups I would like to point out the following areas are of particular concern to the Port Stephens community. Parcels of land constantly come to light as being at risk such as the urgent insertion made here while I have been compiling this response.

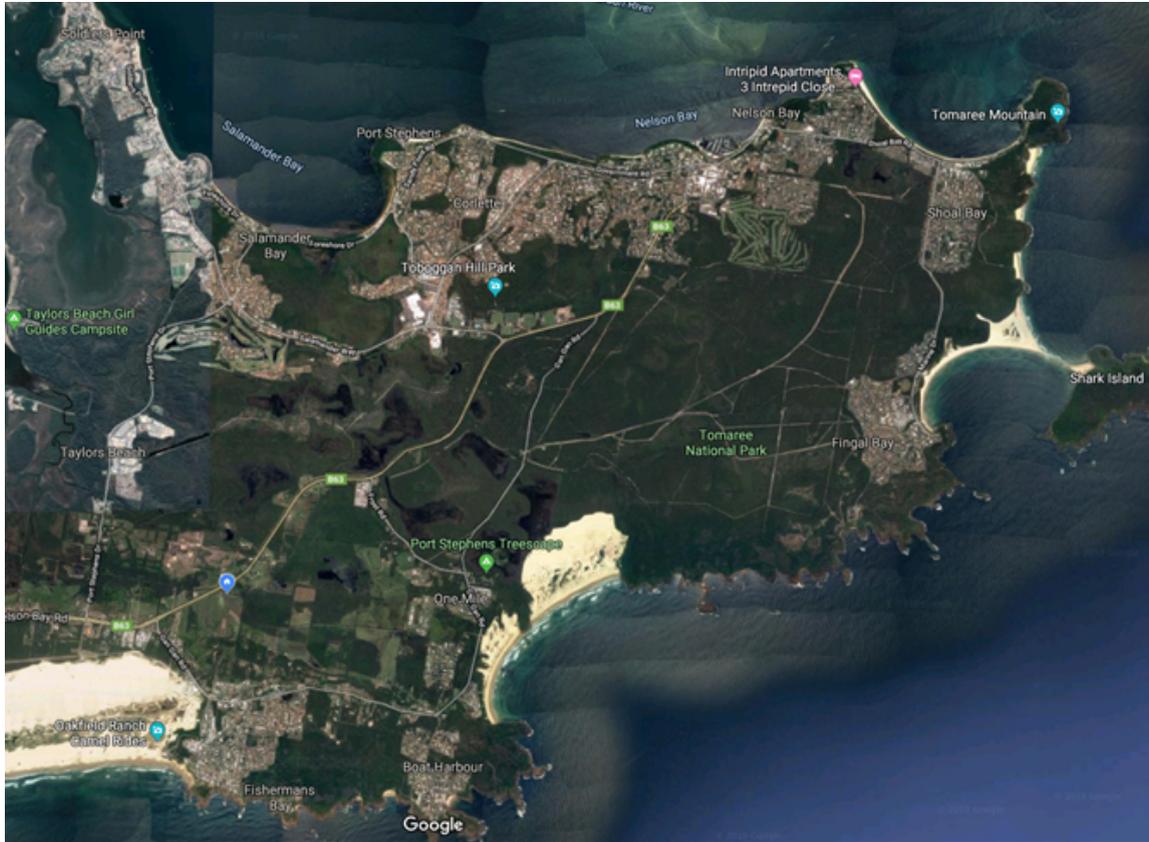
Urgent insertion:

Jean Shaw Reserve Hawks Nest - land adjoining was thought to be reserve but is up for sale by EOI by 9/7/21

Kate Washington MP posted on her [Facebook](#) 7/7/21 with a link to the Newcastle Herald article and photo today. There is core koala habitat on this land and Myall Koala and Environment Group know it is where koalas most often cross the road. The land links through to the National Park.



1. **One Mile to Mambo** (Anna Bay/Salamander) koala breeding hub being incorporated into Tomaree National Park - thank you for pursuing this. It will also connect through to Taylors Beach and the Tilligerry Conservation Area. I understand that Kate Washington has been invited to walk through this area on Monday 26 July with Sue Olsson from NPA so it is pleasing there is growing awareness of the need to protect it. A big slab of this corridor is crown land, so there is no purchase cost involved, just a transfer, and it is mostly zone E2 so there is no great 'opportunity cost'. The next two development sites are close to it.



2. Fishermans Bay - LandCom/Urban Growth Housing development between Hanson Ave Anna Bay and Fishermans Bay Road

Development in pristine coastal bushland was prevented by the Anna Bay Action Group which is now called [South Tomaree Community Association Inc. | Facebook](#). Kate Washington was involved in preventing its development in 2012/3. The community still wants the land to be added to the adjoining Tomaree National Park. "Urban Growth has voluntarily withdrawn the D.A. for the Fisherman's Bay development site" - reported STCA in August 2015 following involvement from the Newcastle Legal Centre.

[Anna Bay housing is not worth the cost | Newcastle Herald | Newcastle, NSW](#) stated "On recent legal advice there is hope. One course of action that could be taken is that the Minister for Primary Industries, the person responsible for Crown land, could revoke the Crown land reservation so that the Minister for the Environment can acquire the land through agreement." The following photo is taken from this article.

The land is still zoned residential so there is an opportunity cost in protecting it now, even though no purchase cost.



3. Former Gan Gan Army Camp

Retiring Port Stephens Councillor John Nell advised EcoNetwork in January 2021 that the former Gan Gan Army Camp is now privately owned. It is bounded by the Crown Land across Nelson Bay Road through to the back of Bunnings along Port Stephens Drive - ie the Mambo to One Mile koala breeding hub. John Nell advised that "any attempt to rezone part or all of either parcel of Land needs to be strongly resisted. The owners ...[have] prepared various plans for redevelopment and rezoning of the old Army Camp. The first attempt a long time ago involved an attempt to acquire a small parcel of road reserve and because of a quirk in the zoning system, if that had been successful, the whole of the Army camp would have automatically been rezoned." Currently E2 zoning.

John Nell wrote to Matt Keane in September 2020 requesting that the Gan Gan Army Camp site be included in Tomaree National Park - note the Port Stephens Examiner map taken from their article on March 5 2020 [Mixed reviews to redevelopment plans for former Gan Gan Army Camp | Port Stephens Examiner | Nelson Bay, NSW](#). The bright emerald green triangle is the land in question. Quite a bit of it is treeless wetland so beware of offers that conserve that section only.



4. Hawks Nest Growth Area 1 & 2 (known as North Hawks Nest)

You may be aware that Hawks Nest Tea Gardens koalas were listed as Endangered in NSW in 1999. Due largely to the hard work of Myall Koala Environmental Group, koalas are still found there. Port Stephens Koalas released Bombah Point Daisy to the north of Hawks Nest last month.

Myall Koala Environmental Group has major reservations about proposed redevelopments for North Hawks Nest considered in isolation, due to the environmental significance of this locality as a vegetated corridor linking the Hawks Nest township and the Myall Lakes National Park. This corridor facilitates a migration path for wildlife, particularly Koalas, to and from the town and the Park. "We would really like to see a properly planned and implemented development strategy for the entire corridor on both sides of Mungo Brush Road, similar to the one proposed by Crownlands Development in the early 2000's (see *separate .pdf file for photo*). That plan reserved the entire western side of Mungo Brush Road as National Park and the eastern side would have a limited footprint of development, about equivalent in size to that identified in the document. We would ask Council and the State Planning Department to PLEASE revisit their earlier plans to come up with a coordinated strategy on what to do about North Hawks Nest that satisfies the landowners while retaining the acknowledged environmental attributes of this locality."

There are two over 55s "caravan park" DAs in the system with Great Lakes Council who do not have a policy to prevent these developments on Rural zoned land. North Hawks Nest is zoned Rural although it used to have a unique zoning to protect the habitat.

5. Elizabeth Ave, Raymond Terrace - Extension of M1 expressway

Boomerang Park Action Group has been maintaining the present corridor of bushland including 6c Elizabeth Avenue, Raymond Terrace. It belongs to the Muree Golf Club and has been on the market for over a year. The triangle shaped land measures 8.44 hectares and is zoned as RU2. The eastern side of this property is parallel to the Pacific Highway. This road will eventually become the M1. It is possible that the Roads and Maritime Services will not allow access from the M1 into this site. Hence access will be through Raymond Terrace and via Elizabeth Avenue. There is bushland on both sides of the Highway which can support wildlife. This land is important because its north side connects to bushland that is the corridor that koalas used to enter the Muree Golf Course, the Pioneer Cemetery and Boomerang Park. Muree Golf Course is mapped on the Port Stephens Comprehensive Koala Plan of Management as core habitat. Boomerang Park is not on the KoPM but has core koala habitat. The Group has been planting koala habitat along the north edge of the triangle. Coral Berry can provide more detailed information of her discussions with RMS.

The property for sale is inside the red triangle.





'Boomerang Park has good connectivity with surrounding habitat offering means of dispersal off the Park via Muree Golf Course. The existence of connecting habitat implies that re-use of the Park by Koalas and other fauna is highly possible at any time' David Paull, Ethical Ecology Australia, (ABN 57227012954) 'Review of environmental matters within planning document relating to the rezoning and development of Boomerang Park, Raymond Terrace, 2016.

6. **KINGS HILL URBAN DEVELOPMENT AREA north of Raymond Terrace**

I know you are already aware of this one, but I couldn't leave it aside. Rumour has it that the developer was willing to reduce the footprint of the development taking into consideration the reports of his own Ecology reports, but that Council wants the maximum yield from Kings Hill that will bring them at least \$90 million in the fairly short term.

7. **Brandy Hill Quarry** - I think we've beaten on this by Sussan Ley's decision. Shame on the 'independent' ecologist who told the Federal Government that the koalas don't live on this land - that they only pass through! Koalas don't have nests, of course they're passing through!

8. **Martins Creek Quarry - Dungog shire**

Martins Creek Railway Ballast Quarry currently has an amended development application on public exhibition ([link to the exhibited documents here](#)) The proposal being exhibited is an amendment to the 2016 EIS and SSDA that was previously exhibited in November 2016 and also follows on from the largest decision in the NSW Land & Environment Court history that in 2019 led to the operator of the quarry being restrained from unlawful operations at the site which it had been conducting since 2012. This planning process is independent and unrelated to the court action.

The Amendment DA is seeking approval for the following;

- 1,100,000 tonne per annum extraction for 25 years
- Clearing of 21Ha of native vegetation containing EPBC threatened species (Koalas, Slaty Red Gums, swift Parrots, Regent Honey eaters and Spotted Quolls)
- 500,000 tpa transport of product by road
- 600,000 tpa transport of product by rail from the site
- 280 truck movements per day (peak) 140 loaded/140 empty
- 40 truck movements per hour (peak) 20 loaded/20 empty

We hope as many concerned residents can lodge submissions objecting to the proposal. In relation to the human/built environment impacts we have summarized these in a [link on our website](#), primarily MCQAG is recommending that residents with "Lived Experiences" of past unlawful operations detail in their submissions how the above parameters will result in a return to those impacts that have impacted them and their communities historically, we are advising that residents pay particular attention to the amenity and social impacts (sense of place, social fabric, rural amenity etc) that can NOT be explained away in technical studies relating to noise, vibration or air quality.

Submission date has been extended to 31 July. Contact point is James Ashton 0413 616 677 Secretary MCQAG

Cate, this is merely a snapshot of habitat under threat. It hasn't been properly considered, eg Medowie has had major developments constructed (or still being constructed) that puts their wildlife corridors under severe pressure. You may have seen the photos of the koala named Medowie Matt clinging to a construction frame there. More thought needs to go into this, but I understand that time is always of the essence. We hope that the may help with bringing more resources together.

I am aware that you will be meeting with Caitlin Spiller tomorrow so we hope to have some feedback from her on this information to discuss at our next meeting.

Kind regards,

Carmel Northwood
On behalf of EcoNetwork Koala Coalition Port Stephens
0422 22 5437

7/7/21

PART 3 – ANY OTHER INFORMATION

Q.33. Do you have comments on any other matters relevant to the assessment of this species/subspecies?

We don't pretend to understand the complexities of Commonwealth and State legislation and regulations but we do have concerns about their affects. In particular, the interaction between the Commonwealth EPBC Act (and resultant regulations), the NSW Biodiversity and Conservation Act 2016 (and regulations) and the Common Assessment Method (ref Myall Koalas Environment Group submission).

NSW Environmental laws are almost at stalemate due to politics. Many processes, such as approval of CKPoMs are bogged down, waiting for the results of the koala habitat SEPP changes. In the meantime, koala habitat is being destroyed at unprecedented rates.

Communities become worn out with the constant process of having to fight for wildlife and their habitat. As soon as one DA is refused, another arises. Multiple challenges are almost impossible to address with limited resources.

Everyone seems to think that if you want to be on the winning side of this saga of Environment vs Development, you would not choose the Environment. Money talks and it's winning. Soon we will leave nothing to our children but zoos, unless something happens to turn this around so we can protect bushland into the future.

REFERENCES

Question 1:

- 1) Portfolio Committee No. 7 - Planning and Environment (2020) Koala populations and habitat in New South Wales, Sydney, NSW: the Committee, June 2020
- 2) Lisa Cox (2020) Land-clearing in NSW rises nearly 60% since laws were relaxed, The Guardian, 2nd July 2020.
<https://www.theguardian.com/environment/2020/jul/02/land-clearing-new-south-wales-rises-60-per-cent-since-laws-relaxed>, accessed 12th July 2021
- 3) DPIE (2020) Wildlife and Conservation Bush re Recovery: Immediate Response January 2020
- 4) PSK (2021) PSK Data Analysis All records to 28-4-21
- 5) OWAD Environment/ WildDNA/ Federation University (2021) 2020 Port Stephens Koala Population Study Report
- 6) Stoye J. P. (2006) Koala retrovirus: a genome invasion in real time. *Genome Biol.* 7:241.
- 7) Greenwood AD, Ishida Y, O'Brien SP, Roca AL, Eiden MV. (2018) Transmission, evolution, and endogenization: lessons learned from recent retroviral invasions. *Microbiol Mol Biol Rev* 82:e00044-17. <https://doi.org/10.1128/MMBR.00044-17>.

- 8) Ishida, Y. et al (2014) Proliferation of Endogenous Retroviruses in the Early Stages of a Host Germ Line Invasion, *Molecular Biology and Evolution*, 32(1):109–120 doi:10.1093/molbev/msu275
- (9) Yu T, Koppetsch BS, Pagliarani S, Johnston S, Silverstein NJ, Luban J, Chappell K, Weng Z, Theurkauf WE. (2019) The piRNA Response to Retroviral Invasion of the Koala Genome. *Cell*. 17 Oct 2019;179(3):632-643.e12. doi: 10.1016/j.cell.2019.09.002
- (10) Leibniz Institute for Zoo and Wildlife Research (IZW) (2021) Retroviruses are re-writing the koala genome and causing cancer." *ScienceDaily*. 26 February 2021. <www.sciencedaily.com/releases/2021/02/21
- (11) Greenwood AD, Ishida Y, O'Brien SP, Roca AL, Eiden MV. (2018) Transmission, evolution, and endogenization: lessons learned from recent retroviral invasions. *Microbiol Mol Biol Rev* 82:e00044-17. <https://doi.org/10.1128/MMBR.00044-17> p.7 110
- (12) Waugh CA, Hanger J, Loader J, King A, Hobbs M, Johnson R, Timms P. (2017) Infection with koala retrovirus subgroup B (KoRV-B), but not KoRV-A, is associated with chlamydial disease in free-ranging koalas (*Phascolarctos cinereus*). *Sci Rep*. 9 March 2017;7(1):134. doi: 10.1038/s41598-017-00137-4
- (13) Mbora DN, McPeck MA (2009) Host density and human activities mediate increased parasite prevalence and richness in primates threatened by habitat loss and fragmentation. *J Anim Ecol* 78: 210–218.
- (14) Brearley G, Rhodes J, Bradley A, Baxter G, Seabrook L, Lunney D, Liu Y, McAlpine C (2013) Wildlife disease prevalence in human modified landscapes. *Biol Rev* 88: 427–442.
- (15) Narayan, E. J., and Williams, M. (2016) Understanding the dynamics of physiological impacts of environmental stressors on Australian marsupials, focus on the koala (*Phascolarctos cinereus*), *BMC Zoology* (2016) 1:2, 10.1186/s40850-016-0004-8
- (16) Hing S, Narayan E, Thompson RCA, Godfrey S (2014) A review of factors influencing the stress response in Australian marsupials. *Conserv Physiol* 2: doi:10.1093/conphys/cou027.
- (17) Narayan, E. (2019) Physiological stress levels in wild koala sub-populations facing anthropogenic induced environmental trauma and disease, *Scientific Reports*, 9:6031, <https://doi.org/10.1038/s41598-019-42448-8>
- (18) Canfield P Love D Mearns G Farram E (1991) Chlamydial infection in a colony of captive koalas. *Aust Vet J* 68: 167–169.
- (19) Chrousos, G. P. (2009) "Stress and disorders of the stress system". *Nature Reviews Endocrinology*. 5 (1), 374-381
- (20) Robbins, A., Hanger, J., Jelocnik, M. et al. (2019) Longitudinal study of wild koalas (*Phascolarctos cinereus*) reveals chlamydial disease progression in two thirds of infected animals. *Sci Rep* 9, 13194. <https://doi.org/10.1038/s41598-019-49382-9>
- (21) Hangar, J. and Loader, J. (2009) Infectious Disease in Koalas: Implications for Conservation, Koala Conservation Conference, Friends of the Koala, SouthernCross University, Lismore, 22nd May 2009
- (22) Hulse L, Beagley K, Larkin R, Nicolson V, Gosálvez J, Johnston S. (2021) The effect of Chlamydia infection on koala (*Phascolarctos cinereus*) semen quality. *Theriogenology*, ;167:99-110. doi: 10.1016/j.theriogenology.2021.03.016. Epub 2021 Mar 27. PMID: 33813053
- (23) Palmieri C., Hulse, L., Pagliarani, S., Larkin, R., Higgins, D. P., Beagley, K., and Johnston, S., (2019) Chlamydia pecorum Infection in the Male Reproductive System of Koalas (*Phascolarctos cinereus*), *Veterinary Pathology*, 56(2) 300-306, doi:10.1177/0300985818806963

Question 2:

References given in the answer

Question 4:

Dique, D. S., Thompson, J., Preece, H. J., Penfold, G. C., De Villiers, D. L., and Lesliw, R. S. (2003), Koala mortality on roads in south-east Queensland: the koala speed-zone trial. *Wildlife Research* 30:419–426.

Eberhard, I. H. (1972) Ecology of the koala *Phascolarctos cinereus* (Goldfuss), on Flinders Chase, Kangaroo Island. Ph.D. dissertation, University of Adelaide, Adelaide, Australia.

Ellis, W. A. H., Melzer, A., Carrick, F. N., and Hasegawa, M. et al (2002) Tree use, diet and home range of the koala (*Phascolarctos cinereus*) at Blair Athol, central Queensland. *Wildlife Research* 29:303–311.

Gordon, G., D. G. and McGreevy, and Lawrie, B. C. (1990) Koala population turnover and male social organization. Pp. 189–192 in *Biology of the koala* (A. K. Lee, K. A. Handasyde, and G. D. Sanson, eds.). Surrey Beatty, Sydney, Australia.

Kjeldsen, S. R., Raadsma, H. W., Leigh, K. A., Tobey, J. R., Phalen, D., Krockenberger, A., Ellis, W. A., Hynes, E., Higgins, D. P., and Zenger, K. R. (2019) Genomic comparisons reveal biogeographic and anthropogenic impacts in the koala (*Phascolarctos cinereus*): a dietary-specialist species distributed across heterogeneous environments, *Heredity*, 122:525–544, <https://doi.org/10.1038/s41437-018-0144-4>

Martin, R. W. (1981) Age-specific fertility in three populations of the koala, *Phascolarctos cinereus* Goldfuss, in Victoria. *Australian Wildlife Research* 8:275–283.

Martin, R., and Handasyde, K. (1990) Population dynamics of the koala (*Phascolarctos cinereus*) in southeastern Australia. Pp. 75– 84 in *Biology of the koala* (A. K. Lee, K. A. Handasyde, and G. D. Sanson, eds.). Surrey Beatty, Sydney, Australia.

McLean, K., and Handasyde, K. A. (2007) Sexual maturity, factors affecting the breeding season and breeding in consecutive seasons in populations of overabundant Victorian koalas (*Phascolarctos cinereus*). *Australian Journal of Zoology* 54:385–392.

Mitchell, P. J. (1990) The home ranges and social activity of koalas — a quantitative analysis. Pp. 171–187 in *Biology of the koala* (A. K. Lee, K. A. Handasyde, and G. D. Sanson, eds.). Surrey Beatty, Sydney, Australia.

Mitchell, P. J., and Martin, R. W. (1990) The structure and dynamics of koala populations—French Island in perspective. Pp. 97–108 in *Biology of the koala* (A. K. Lee, K. A. Handasyde, and G. D. Sanson, eds.). Surrey Beatty, Sydney, Australia.

Phillips, S. S. (2000) Population concerns and the koala conservation debate, *Conservation Biology*, 14(3), pp. 650-659.

Port Macquarie Hospital <https://www.koalahospital.org.au/page/koala-fags/> Accessed 21st July 2021

Smith, M. (1979) Notes on reproduction and growth in the koala, *Phascolarctos cinereus* (Goldfuss). *Australian Wildlife Research* 6:5–12.

Whisson, D. A., and Carlyon, K. (2010) Temporal variation in reproductive characteristics of an introduced and abundant island population of koalas, *Journal of Mammology*, 91(5):1160–1167, doi: 10.1644/09-MAMM-A-384.1

White, N. A., and Kunst, N. D. (1990) Aspects of the ecology of the koala in southeastern Queensland. Pp. 109–116, in *Biology of the koala* (A. K. Lee, K. A. Handasyde, and G. D. Sanson, eds.). Surrey Beatty, Sydney, Australia.

Question 5:

Jackson, S. (Ed) (2005) *Koala Phascolarctos cinereus: Captive Husbandry Guidelines*, CSIRO Publishing, Melbourne

McLean, K., and Handasyde, K. A. (2007) Sexual maturity, factors affecting the breeding season and breeding in consecutive seasons in populations of overabundant Victorian koalas (*Phascolarctos cinereus*). *Australian Journal of Zoology* 54:385–392.

OEH (2021) NSW Threatened Species Koala profile <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10616> Accessed 21st July 2021

Whisson, D.A., and Ashman, K. R. (2020) When an iconic native animal is overabundant: The koala in southern Australia, *Conservation Science and Practice*. 2020;2:e188, <https://doi.org/10.1111/csp2.188>

Question 6:

(1) Dissanayake, R. B., Stevenson, M., Allavena, R., and Henning, J. (2019) The value of long-term citizen science data for monitoring koala populations, *Scientific Reports*, 9:10037, <https://doi.org/10.1038/s41598-019-46376-5>

- (2) Martin, R., and Handasyde, K. (1990) Population dynamics of the koala (*Phascolarctos cinereus*) in southeastern Australia. Pp. 75– 84 in *Biology of the koala* (A. K. Lee, K. A. Handasyde, and G. D. Sanson, eds.). Surrey Beatty, Sydney, Australia.
- (3) McLean, K., and Handasyde, K. A. (2007) Sexual maturity, factors affecting the breeding season and breeding in consecutive seasons in populations of overabundant Victorian koalas (*Phascolarctos cinereus*). *Australian Journal of Zoology* 54:385–392.
- (4) Larsen, M. J., Sherwen, S. L., and Rault, J.-L. (2014) Number of nearby visitors and noise level affect vigilance in captive koalas, *Applied Animal Behaviour Science* 154 (2014) 76–82, <http://dx.doi.org/10.1016/j.applanim.2014.02.005>
- (5) OWAD Environment/ WildDNA/ Federation University (2021) 2020 Port Stephens Koala Population Study Report
- (6) Cristescu, R.H. et al. (2015) Accuracy and efficiency of detection dogs: a powerful new tool for koala conservation and management. *Sci. Rep.* 5, 8349; DOI:10.1038/ srep08349.
- (7) Hamilton, G., Corcoran, E., Denman, S., Hennekam, M. E., and Koh, L. P. (2020) When you can't see the koalas for the trees: Using drones and machine T learning in complex environments, *Biological Conservation* 247: 108598. <https://doi.org/10.1016/j.biocon.2020.108598>
- (8) Corcoran, E., Denman, S., Hanger, J., Wilson, B., and Hamilton, G. (2019) Automated detection of koalas using low-level aerial surveillance and machine learning, *Scientific Reports*, 9:3208 | <https://doi.org/10.1038/s41598-019-39917-5>
- (9) Witt, R. R., Beranek, C. T., Howell, L. G., Ryan, S. A., Clulow, J., Jordan, N. R., et al. (2020) Real-time drone derived thermal imagery outperforms traditional survey methods for an arboreal forest mammal. *PLoS ONE* 15(11): e0242204. <https://doi.org/10.1371/journal.pone.0242204>
- (10) Beyer H. L., de Villiers, D., Loader, J., et al. (2018) Management of multiple threats achieves meaningful koala conservation outcomes. *J Appl Ecol.* 2018;55:1966– 1975. <https://doi.org/10.1111/1365-2664.13127>

Question 9:

- (1) Charalambous R, Narayan E (2020) A 29- year retrospective analysis of koala rescues in New South Wales, Australia. *PLoS ONE* 15(10): e0239182. <https://doi.org/10.1371/journal.pone.0239182>
- (2) Witt, R. R., Beranek, C. T., Howell, L. G., Ryan, S. A., Clulow, J., Jordan, N. R., et al. (2020) Real-time drone derived thermal imagery outperforms traditional survey methods for an arboreal forest mammal. *PLoS ONE* 15(11): e0242204. <https://doi.org/10.1371/journal.pone.0242204>
- (3) Lunney, D., Phillips, S., Callaghan, J., and Coburn, D. (1998) 'Determining the distribution of koala habitat across a shire as a basis for conservation: a case study from Port Stephens, New South Wales'. *Pacific Conservation Biology* 4: 186–196.

Question 11:

- (1) Biolink (2018) Kings Hill Koala Habitat Assessment: Final Report to Kings Hill Developments
- (2) NSW DPIE (2021) Woody vegetation change: Statewide Landcover and Tree Study Summary report <https://www.environment.nsw.gov.au/research-and-publications/publications-search/woody-vegetation-change-statewide-landcover-tree-study-summary-report-2019>

Question 12:

- (1) Gonzalez-Astudillo, V. (2018) Analysis of Morbidity and Mortality of Wild Koala in South-East Queensland using Passive Surveillance Data. PhD thesis. 183 pgs. School of Veterinary Science, e University of Queensland.
- (2) Gonzalez-Astudillo, V., Allavena, R., McKinnon, A., Larkin, R. & Henning, J. (2017) Decline causes of Koalas in South East Queensland, Australia: a 17-year retrospective study of mortality and morbidity. *Sci. Rep.* 7, 42587, <https://doi.org/10.1038/srep42587>
- (3) Charalambous R, Narayan E (2020) A 29- year retrospective analysis of koala rescues in New South Wales, Australia. *PLoS ONE* 15(10): e0239182. <https://doi.org/10.1371/journal.pone.0239182>
- (4) OWAD Environment/ WildDNA/ Federation University (2021) 2020 Port Stephens Koala Population Study Report

- (5) WWF (2021) Indications of limited gene flow to 'isolated' Port Stephens koalas, WWF News, 20th February 2021, <https://www.wwf.org.au/news/news/2021/indications-of-limited-gene-flow-to-isolated-port-stephens-koalas>
- (6) Port Stephens Comprehensive Koala Plan of Management (CKPoM) Steering Committee Submission 38, pp 6-7
- (7) Dr Jon Hanger, Submission 34 Attachment 1. Jon Hanger and Jo Loader, "Infectious Diseases in Koalas: Implication for conservation", p.2
- (8) Norris, S., and Cronshaw, D. (20) Fire rips through koala habitat at Limeburners, Twelve Mile Creek, Balickera and Karuah, Port Stephens Examiner, 10th November 2016, <https://www.portstephensexaminer.com.au/story/4285857/lone-pine-fire-triggers-colony-fears-video/>
- (9) Cronshaw, D. (2018) Salt Ash: Bushfire tears through thousands of hectares an 'unprecedented' winter inferno, Newcastle Herald, 19th August 2018, <https://www.newcastleherald.com.au/story/5593642/the-photos-from-the-fire-you-could-feel-the-heat/>
- (10) Watts, E.-M. (2018) Port Stephens Koalas, WINC and national parks coordinate 'black walk' through Tilligerry bush burned by fire, Port Stephens Examiner, 22nd August 2018, <https://www.portstephensexaminer.com.au/story/5601676/wildlife-groups-walk-through-blackened-bushland/>

Question 15:

- (1) Charalambous R, Narayan E (2020) A 29- year retrospective analysis of koala rescues in New South Wales, Australia. PLoS ONE 15(10): e0239182. <https://doi.org/10.1371/journal.pone.0239182>

Question 25:

- (1) NSW (2019) State Environmental Planning Policy (Koala Habitat Protection) 2019 <https://legislation.nsw.gov.au/view/pdf/asmade/epi-2019-658>
- (2) Wahlquist, C. and Cox, L. (2020) NSW 'koala war' flares as Gladys Berejiklian sacks parliamentary secretary for crossing floor <https://www.theguardian.com/australia-news/2020/nov/20/nsw-koala-war-flares-as-gladys-berejiklian-sacks-parliamentary-secretary-for-crossing-floor>, The Guardian, 19th November 2020
- (3) NSW (2020) Bushfires Legislation Amendment Act 2020, <https://legislation.nsw.gov.au/view/pdf/asmade/act-2020-37>
- (4) Cox, L. (2020) Bush and koalas found to be threatened by 'gratuitous' NSW land-clearing plan, The Guardian, 25th October 2020, <https://www.theguardian.com/environment/2020/oct/26/bush-and-koalas-found-to-be-threatened-by-gratuitous-nsw-land-clearing-plan> Accessed 22nd July 2021
- (5) <https://www.openaustralia.org.au/debates/?id=2021-06-22.10.1&s=speaker%3A10963>
- (6) NSW Planning Portal Local Development Performance Monitoring (LDPM) dashboard <https://pp.planningportal.nsw.gov.au/local-development-performance-monitoring-ldpm>
- (7) Park, G., and Robert, A. (2020) INFFER analysis – Koala Conservation: Final Report, Natural Decisions, <https://www.environment.gov.au/system/files/resources/9d85470b-45f9-4e70-b5a5-21a502d57c9a/files/koala-conservation-inffer-report.pdf> Accessed 22nd July 2021

Question 27:

- (1) NSW DECC (2008) Recovery plan for the koala (*Phascolarctos cinereus*), Sydney
- (2) Martin, R., and Handasyde, K. (1990) Population dynamics of the koala (*Phascolarctos cinereus*) in southeastern Australia. Pp. 75– 84 in *Biology of the koala* (A. K. Lee, K. A. Handasyde, and G. D. Sanson, eds.). Surrey Beatty, Sydney, Australia
- (3) Lee, A.K., Martin, R.W. and Handasyde, K.A. 1990b. 'Experimental translocation of koalas to new habitat'. p. 299–312 in *Biology of the Koala*. Lee, A.K., Handasyde, K.A. and Sanson, G.D. (eds). Surrey Beatty & Sons, Sydney.
- (3) Forbes, T., and O'Brien, C. (2018) Nearly half of Coomera koalas die after Gold Coast relocation, ABC News, 2nd August 2021, <https://www.abc.net.au/news/2018-08-02/koalas-die-at-new-gold-coast-location/10065004>

APPENDIX 1 Karuah case study raw data

Area Name	Heatherbrae, KARUAH	Fire History or SEED/ GEEBAM	Bush Fire Prone Area SEED map	SEED KLH map ratio	FLOODS	DISEASE (% popn)	Land Clearance	Predators (Dingo/ dogs and foxes)	Annual temp (c)	Annual Rainfall (William-town weather stations)	Koalas observed	Scratch Scats & Tracks	Dead	Road kill	Injured	Barriers	
1979	yes								23.7	788.67							
1980	yes								24.5	541	4	0	0	0	0		
1981	yes								23.2	1096	1	0	0	0	0		
1982	yes								23.2	994.2	1	0	0	0	0		
1983	yes								23.3	1018.6	2	0	0	0	0		
1984	yes								22.8	1098.8	1	0	0	0	0		
1985	yes								22.8	1143.4	0	0	0	0	0		
1986	yes								23.1	886.6	1	0	0	0	0		
1987	yes								23.3	1317.4	0	0	0	0	0		
1988	yes								23.4	1128	0	0	0	0	0		
1989	yes								22.6	1176	3	0	0	0	0		
1990	yes								22.9	1738	1	0	0	0	0		
1991	yes								23.9	768	13	0	0	0	1		
1992	yes								22.2	1171	0	0	0	0	1		
1993	yes								23	885.4	4	0	0	1	2		
1994	yes								23.5	1010	0	0	0	0	0		
1995	yes								22.9	1037.8	0	0	0	0	0		
1996	yes								23	942.4	2	0	0	0	0		
1997	yes								23.6	1079.2	0	0	0	0	0		
1998	yes								23.5	1560.2	1	4	1	0	0		
1999	yes								23	1541.1	3	8	28	0	0		
2000	yes								23.4	995.6	0	0	0	0	0		
2001	yes								23.8	1227	0	0	0	0	0		
2002	yes								24.1	1053	0	2	0	0	0		
2003	yes								23.4	897	1	0	0	0	0		
2004	yes								23.8	1115.8	0	0	0	0	0		
2005	yes								23.9	997	0	0	0	0	0		
2006	yes								23.9	1066.2	0	0	0	0	0		
2007	yes								23.8	1329	0	0	0	0	0		
2008	yes								22.8	1463.6	0	0	0	1	0		
2009	yes								24.1	no record	0	0	0	0	0		

High presence of wild dog/ foxes in Karuah reported in Hunter Regional Pest Animal Management Plan 2018-2023. Control programmes ceased in 2018. Landcare Group are educating locals about control of dogs/ foxes

Significant land clearing over the past few decades, for farming north side of the Karuah River and the Branch Lane. Clearing for hosing around North Arm Cove and quarry.

N/A. Flooding happens in Stroud and Booral

10% PS Koalas diseased. Within 10% of popn, 85% have signs of Chlamydia

Chlamydia increased from 13% in 2005 to 25% in 2008 (Reference 1)

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community survey - 6 observed

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

Karuah has no fire history in GEEBAM. Karuah is a high bushfire prone area

Karuah is a high bushfire prone area

Scratch & Tracks. Spike in sightings could be result of a survey

Dan Lunney Community Wildlife

APPENDIX 2 Balickera case study raw data

APPENDIX 3 Twelve Mile Creek case study raw data

