The ongoing animal welfare crisis from deforestation in Australia

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Summary

In the five years from 2016/17 to 2020/21, a substantial area of 2.4 million hectares of forest and woodland habitats, either mature or advanced regrowth, was bulldozed or cleared wholly or partly in Queensland and New South Wales (Qld, NSW). These states are recognised as the Eastern Australia global deforestation hotspot. The bushland being cleared is rich in native animal life, with many species already listed as threatened like Koalas, Gliders and many bird and reptile species.

Most deforestation is for beef pasture development and is concentrated in central and south central Queensland and north central NSW in the Brigalow Belt and Mulga Lands bioregions. Mining, infrastructure, and urban development combined account for only 1%.

However, unlike in rural areas, the harm to animals is ongoing particularly in urban and peri-urban environments where past clearing has resulted in native bushland fragments embedded in a landscape with multiple hazards for wildlife. Animals in fragmented landscapes face inadequate shelter, nesting and food resources, exposure to the elements causing dehydration and starvation, as well as increased human wildlife conflict, domestic cat and dog attacks, collisions with powerlines, structures or vehicles on busy roads and stress-induced diseases.

Deforestation in Qld and NSW has resulted in an average of 100 million animals within the clearing footprint. This includes 1.9 to 4.5 million mammals, 7.4 to 9.3 million birds and over 96 million reptiles of all sizes being injured, killed, or displaced every year on average.

This includes approximately 1,200 Koalas a year on average. Koalas were listed as endangered in 2022 after suffering a rapid decline in Qld and NSW in recent decades due to deforestation, habitat fragmentation and the ongoing death and injury that results from fragmentation particularly in urban and peri-urban environments.

In Queensland, on average 24,000 native animals every year are recorded by RSPCA Qld as being rescued or admitted into care, including over 500 koalas. Most admissions fall in the densely populated southeast of the state where wildlife hospitals are concentrated, but which is no longer where most deforestation happens. Numbers injured or killed directly due to deforestation in southeast Queensland are small. The bulk of rescues are the legacy of past deforestation resulting in fragmentation of native bushland in the urban and peri-urban environment.

Little has improved for wild animals since our last report on this crisis in 2017. Despite some reforms to the Vegetation Management Act in Queensland in 2018, laws and policies in both states have not greatly changed and still allow very large areas of bushland habitat for wildlife to be destroyed every year, likely harming, injuring, and killing millions of native animals every year.

Reducing the toll of suffering and death that results from habitat destruction and fragmentation requires major changes in policy:

- To prohibit or prevent most bushland habitat destruction, especially in areas that remain largely unfragmented;
- To support research to better quantify and understand the impacts of deforestation on forest dependent wildlife, including directly and indirectly impacted individuals;
- To mitigate welfare impacts of any bushland destruction that is allowed through pre-clearing surveys and rehoming of displaced animals;
- To ensure destroyed habitat areas are replaced or offset by restored habitat of the same type and quality;
- To take steps in already developed areas to reduce the ongoing hazards to wildlife from human activities by, for example, establishing wildlife corridors between fragmented areas of previously intact habitat, wildlife bridges over roadways, and stronger controls over human activities within wild habitats;
- To enhance public education about the impacts of deforestation on native animal welfare; and
- To support collaborations between veterinarians, wildlife rescue and conservation organisations, focussing on areas with heavy current deforestation rates or high potential future deforestation risk.

482,616 ha of habitat destruction annually

From 2016/17 to 2020/21 (the last year for which SLATS data were available at time of this analysis), an average of 482,616 hectares of forest and woodland ("bushland") that was at least 15 years old was destroyed per year in whole or part in Queensland and NSW combined (Fig.1). Most of this (386,184 ha) was in Queensland.

An additional much smaller area of 55,681 ha of young bushland regrowth (<15 y.o.) was cleared per year. Young regrowth was excluded from the calculations of animal numbers in this study. Although young regrowth surely also serves as wildlife habitat, the densities of wildlife are relatively unknown compared to mature or advanced bushland.

Bushland destruction appeared to rise to a peak in 2018/19 in Qld and fall thereafter, while in NSW the opposite pattern appeared with destruction falling to the lowest point in the five year period that same year (Fig. 1).

Care must be taken with Qld figures because a newer more sensitive methodology was initiated in 2018 by Queensland's Statewide Tree and Land cover Study (SLATS) which resulted in a significant boost in areas detected as cleared.

This means that areas reported as cleared in the prior years 2016/17 and 2017/18 are lower than they would have been had the new method been employed then, resulting in underestimation of areas cleared for those years.[1]

NSW SLATS has also changed methodologies a number of times through this period and in preceding years and the figures shown are the best available but as in Queensland, may be underestimated in earlier years.

During publication, Queensland SLATS released new figures for 2021/22 on 17/7/2024 reporting 226,585 ha of woody vegetation 15 years or more to the most recent disturbance, substantially less than the average of 386,184 ha per year over the previous five years.[2] However, "disturbance" used to calculate this figure includes natural events other than clearing, such as bushfires and so is likely to underestimate the ecological age and therefore the area of all 15+ year old bushland cleared.[3] Total area cleared in 2021/22 is only 7% less than in 2020–21, and so we do not anticipate that the estimates derived here of animals affected will change substantially. NSW data for 2021/22 have yet to be released.

Image © Paul Hilton / Greenpeace

Fig. 1.

Areas of bushland destroyed in Qld and NSW over the five year study period 2016/17 – 2020/21.

Figures are shown only for bushland that was mature or regrowing for 15 years or more prior to clearing events. Areas of younger regrowth cleared are shown on the graph but excluded from this study for calculations of numbers of animals affected. Repeat clearing events within the same period have also been excluded.
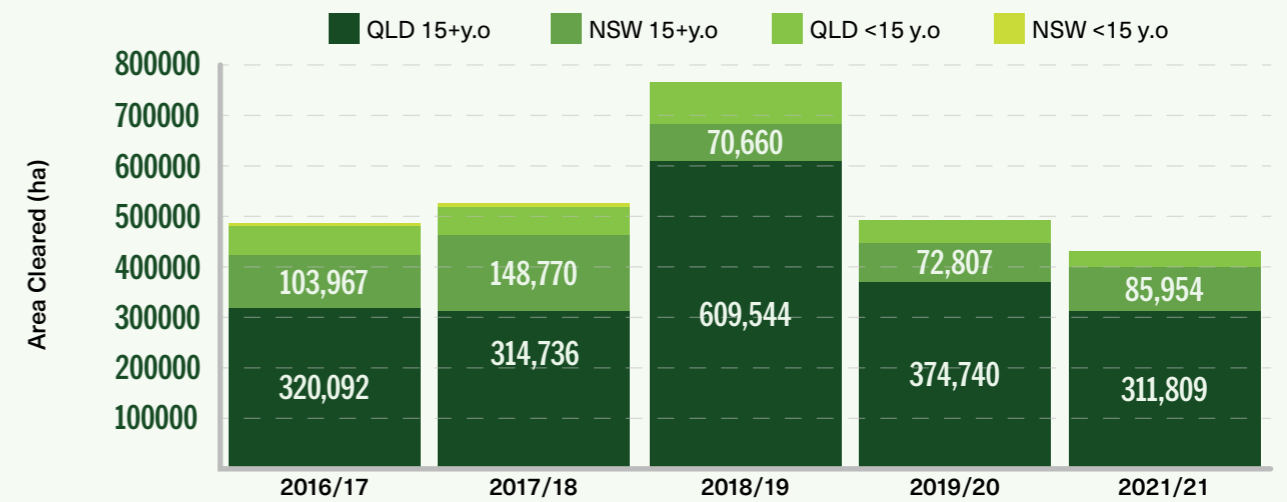

Legend: QLD 15+y.o | NSW 15+y.o | QLD <15 y.o | NSW <15 y.o

Year	QLD 15+	upper
2016/17	320,092	103,967
2017/18	314,736	148,770
2018/19	609,544	70,660
2019/20	374,740	72,807
2021/21	311,809	85,954

Y-axis: Area Cleared (ha)

Fig. 2.

Current (2023) land uses of areas cleared in Qld and NSW from 2016 to 2021.

Crops/plantations
127,317 – 5%

Forestry
48,005 – 2%

Other undeveloped
33,699 – 1%

Developed
26,647 – 1%

Livestock
2,177,402 – 90%
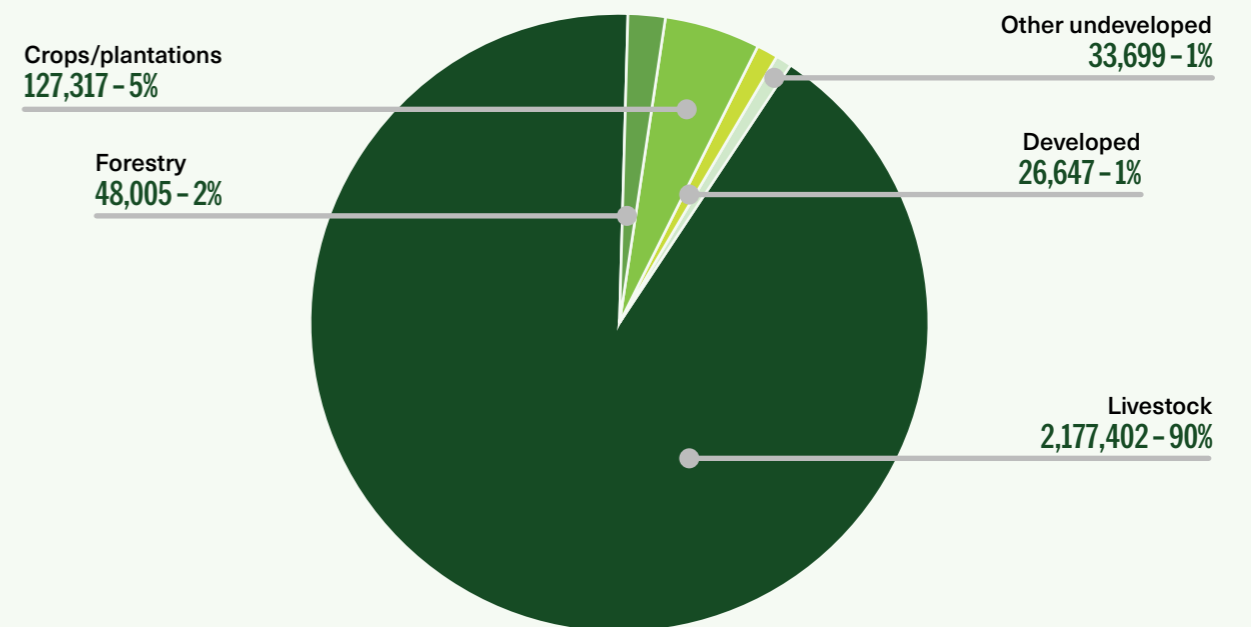
Bushland destruction mostly for livestock pastures

Across the five years in both states, 90% of bushland destruction was attributed to development of livestock pastures, based on ABARES catchment scale land use layer for 2023. Of other land uses, forestry only accounted for 2% while Cropping and Plantations for 5%.

All "hard" development like mining, infrastructure, industry and urban accounted for only 1% (Fig. 2)

Across the five years in both states,

90% of bushland destruction

was attributed to development of livestock pastures

Image © Martin Taylor

100 million animals displaced, harmed or killed annually

Using two methodologies we found that these areas of bushland destroyed annually held approximately 100 million wild mammals, birds and reptiles (Table 1). Reptiles are the most numerous vertebrates in this total, covering a very broad range of body sizes from large monitor lizards down to small legless lizards in the leaf litter or soil, and make up about 95% of total numbers. Mammal numbers range from 1.9 to 4.5 million and birds from 7.4 to 9.3 million displaced or killed annually by bushland destruction in Qld and NSW (Table 1).

Even if only half of all animals in the path of bushland destruction were substantially harmed or killed, this would still be a huge and unacceptable 50 million native animals a year affected, similar to the estimate by Finn and Stephens (2017)[4].

Koalas in Queensland and NSW were uplisted to endangered in 2022 just

10 years

after first being listed as vulnerable

Table 1.

Estimated annual average wild vertebrate numbers within the footprint of clearing of native bushland, either mature or regrowing 15 years or more, Qld and NSW combined.

Million/ year	Based on van Eeden et al. 2020	Based on WWF 2020
Mammals	1.9	4.5
Birds	7.4	9.3
Reptiles	96.5	96.5
	105.8	110.3

Koalas killed

Koalas in Queensland and NSW were uplisted to endangered in 2022 just 10 years after first being listed as vulnerable in 2012 under the national biodiversity legislation, the Environment Protection and Biodiversity Conservation Act (EPBCA). Koalas are highly dependent on intact eucalypt forests. Deforestation and resulting habitat fragmentation are the prime drivers of their rapid recent population decline.[5]

Deforestation does more than remove habitat trees for Koalas. In the urban and peri-urban environments in particular, the resulting fragmentation of forests results in ongoing or continual death and injury of Koalas which have to spend more time on the ground travelling between remaining habitat patches. This exposes them to attacks by wild and domestic dogs, collisions with vehicles on busy roads and stress. Koalas stressed because their habitat has been destroyed and broken up, have reduced immunity and are thus more likely to come down with diseases such as chlamydiosis, which causes great suffering for affected animals.[6]

In southeast Queensland Koala densities and population trends have been modelled by Rhodes et al (2015) based on survey data.[7] In the eight south-eastern local government areas, 380 koalas were estimated to have been killed by the 11,134 ha of deforestation in just this study area over the 2016-21 period, based on the Rhodes et al (2015) mean density model (capped at 100/km^2). This gives an average density of 3.4/km^2. For the SEQ bioregion we used this density average to calculate Koalas likely to have been killed by clearing (App. 2b).

The total number of Koalas losing habitat and presumed killed would be

5,998 over five years

or ~1,200 annually

Unfortunately, not enough is known about Koala densities outside of southeast Queensland to be able to provide more accurate estimates for other bioregions. If the minimum density of 2/km^2 used in earlier work[8] were applied across habitat cleared outside of the SEQ bioregion over the period, and including the SEQ number, the total number of Koalas losing habitat and presumed killed would be 5,998 over five years or ~1,200 annually (App. 2b).

Underestimation

These estimates of animals affected by clearing are likely to underestimate the actual total numbers because they do not include:

- aquatic and near shore marine animals whose habitats are degraded by sediment pollution from clearing, loss of riparian shade and altered stream hydrology (frogs, fish, dugong, marine turtles);
- animals in young regrowth bushland that is cleared; and
- legacy effects of past clearing due to habitat fragmentation and degradation.

Comparison with past estimates

Queensland

- For a reported 446,000 ha of remnant, mature or intact bushland being cleared annually in the late 1990s, an estimated 100 million native vertebrates died, including over two million mammals, 8.5 million forest and woodland birds and 89 million reptiles (such as goannas, geckos and skinks).[9] Both estimates of the area cleared and the numbers killed are similar to those reported here.
- Over the period 2013-15, when rates of land clearing in Queensland were less than those recorded more recently, an estimated 34 million vertebrates lost their habitats to bulldozers every year including 0.9 million mammals, 2.6 million birds and 30.6 million reptiles.[10]

NSW

- 104 million native mammals, birds and reptiles were predicted to die as a result only of approvals for clearing of native vegetation in NSW between 1998 and 2005. Note this is not based on actual clearing, only clearing approved but not yet executed.[11]
- 4.9 million animals were estimated to have died due to deforestation every year over the decade 2005-2015.[12]

Both states

- Based on earlier studies, Finn and Stephens (2017) estimate roughly 50 million animals suffer harm and death annually in Australia due to land clearing.[13]
- van Eeden et al (2020) estimate up to three billion native vertebrates were killed by the catastrophic forest fires of 2019/20.[14]
- From 2010 to 2018, in Qld and NSW, more than 3.7 million native mammals (including at least 1,500 koalas), 6.2 million native birds and 20.2 million reptiles were displaced and/or killed due to the destruction of habitats that could, or should, have been prevented by proper enforcement of the national biodiversity law the EPBCA.[15]

The results here indicate that sadly, little has changed in recent years to alleviate the ongoing suffering and death of tens of millions of native animals due to destruction of their bushland habitats.

Image © RSPCA Queensland

Image © Martin Taylor

Harm to wild animals from bushland destruction

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Injury, suffering and death are faced by wild animals, both those trapped in the path of machinery or those fleeing. Ecologists argue that most if not all animals in the footprint of destruction eventually succumb and die.[16]

> "When an area of native bushland is lost, most of the resident wildlife does not simply relocate. In reality, the vast majority of animals will die. Most will die quickly but others survive for a time before succumbing to starvation, predation or other fates."[17]

When native bushland is cleared or destroyed in whole or part, the animals living there either die directly or have to flee and seek refuge elsewhere. In the process of fleeing and trying to make a home in other habitats already at capacity for individuals of the same species, stress and conflict result in higher rates of injury, morbidity and mortality not only for the refugee animals but also for the residents of the habitats they seek to take refuge in.

Direct harm

Directly experienced harm as a result of deforestation includes:-

- *Trauma:* Machinery and falling trees can break limbs, crush bodies, cause concussions and open wounds.
- *Asphyxiation:* Animals particularly small animals may be trapped or buried by trees, rocks and soil.
- *Starvation:* trapped/buried animals may succumb to starvation, dehydration, heat or cold.
- *Deprivation:* Animals lose their access to food sources and shelters like tree hollows when habitats are cleared.

Indirect harm

Harm to native wildlife is also an indirect consequence of earlier deforestation, and includes:-

- *Trauma:* animals fleeing clearing operations may be at higher risk of misadventures such as being hit by cars or attacked by predators.
- *Intraspecific conflict:* Fleeing animals have to try to make a home in new habitat areas which are likely already at carrying capacity, bringing themselves and other conspecifics into increased conflict, stress, and possible excess injury, starvation or disease as a result.
- *Pollution:* Aquatic, semi-aquatic or nearshore marine animals may also suffer starvation, morbidity and death as a result of sediment pollution of waterways that results from deforestation: frogs, platypus, freshwater fish, or dugong and marine turtles dependent on sea grass that is smothered and killed by excessive sediment. Numbers affected are difficult to estimate.
- *Global warming:* Deforestation contributes to global warming which is also a fast emerging major threat to animal welfare as a result of excessive heat, catastrophic bushfires and extreme weather. After loss of tree cover, forest animals surviving and remaining are more exposed to heat, lack of water and resources and predators.

Ongoing harm

Although clearing for urban, infrastructure and industrial development is a minor component of total annual clearing (Fig. 2), the harm to wildlife is ongoing in highly developed environments. This is because the habitat that remains is highly fragmented, with habitat patches surrounded by a highly hazardous environment of vehicle traffic, fences and other barriers, powerlines, and predatory cats and dogs.

In Queensland

82% of clearing

in 2020-21 was exempt from the law

Admissions into care of native wildlife

Our previous analysis of RSPCA Queensland records shows that admissions into care of forest-dependent wildlife more than tripled from 2011 to 2016.[18]

In this updated analysis however, from 2016 to 2024, vertebrate admission numbers rose slowly from 21,050 in 2016 to 25,505 in 2021 after which annual admissions have declined slightly. Projected admissions for 2024 are 25,022.

A total of 198,759 native wildlife admissions were recorded in RSPCA Qld databases from 2016 to April 2024. Birds comprised the bulk of admissions (65%). The Rainbow Lorikeet dominated bird admissions representing 13% of total admissions (Fig. 3). These numbers are higher than would otherwise be expected as a result of the paralysis syndrome outbreak in the summer of 2023-24 that brought thousands of Rainbow Lorikeets into care.[19]

Marsupials and monotremes accounted for another 30% of admissions. These numbers are dominated by the possums (brushtail and ringtail) which accounted for 22% of all admissions (Fig. 3). Koala admissions were lower than previously reported with 4,616 over the seven year and 4 month period 2016 to April 2024. By comparison in just the four years 2009-2012, 10,139 Koalas had been admitted into care.[20] Numbers of Koalas being injured or killed, although less than in the past, are still dangerously high considering that the southeast Qld population is estimated to average only 16,000 (although with a very wide range from lower 9,194 to upper 224,871 bounds[21]). Also numbers being admitted into care at present are likely to be lower because of the ongoing steep decline in the Koala population.[22]

Admissions are concentrated in southeast Qld where there are three wildlife hospitals RSPCA Qld Wildlife Hospital in Wacol, Australia Zoo Wildlife Hospital on the Sunshine Coast, and Currumbin Wildlife Hospital on the Gold Coast (Fig. 4). Within southeast Qld, the admissions are greatest in outer urban areas where development for housing is most active such as the Brisbane Valley west of Ipswich. Koala hotspots appear even further afield, with hotspots on the Darling Downs and Great Divide (Fig. 5).

Only 29% of admissions had a stated cause. Of these, nearly half (42%) were of animals thought to be in danger, not evidently injured, with the next highest categories being injured by machinery, cars, electrocution or falls (24%), or attacked by other animals, mostly cats and dogs (15%) (Fig. 6).

In contrast, for Koalas, 58% of admissions had a stated cause. Of these the greatest categories were disease (37%), cars etc (31%), in danger (17%) and animal attacks (12%) (Fig. 6).

All wildlife including Koalas had about the same death rate

Fig. 3.

Wildlife taxonomic groups admitted into care 2016-Apr. 2024.

Marsupials – Possums
44,317 – 22%

Amphibians
558 – 0%

Marsupials – other
13,653 – 7%

Reptiles
11,337 – 6%

Monotremes
1,048– 1%

Birds – Rainbow Lorikeets
24,911 – 13%

Birds – other
102,935 – 52%
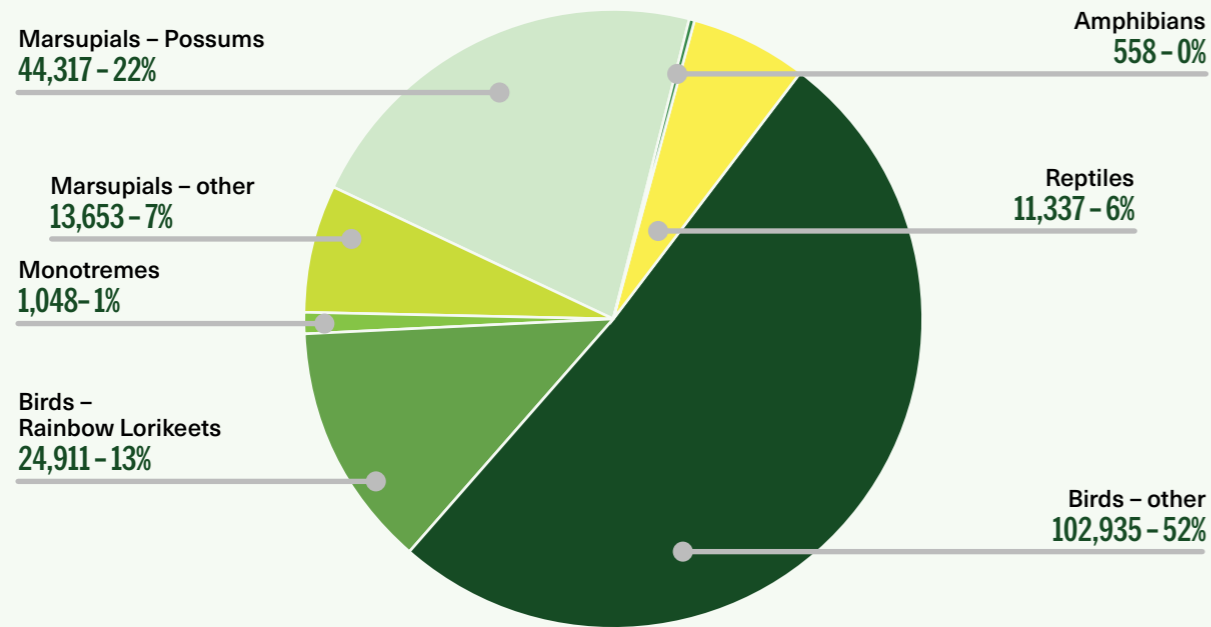
of 66% after coming into care, including euthanasia (Fig. 7).The proportion released back into the wild was a low 12% of all wildlife but nearly double that 23% for Koalas (Fig. 7). Of the numbers left in care according to database records, the fractions eventually released or dying are unknown. The high death rate reflects the number of animals that enter hospitals seriously injured or ill. By Qld law, only animals with a high likelihood of a successful release can be treated. If a successful release is unlikely the animal must be euthanased.

Although bushland destruction itself has a low direct contribution to admissions, accounting for only 1% (Fig. 7), many of the other causes are ongoing legacies of past conversion and fragmentation of bushland by suburbs, infrastructure and roads. Disease in Koalas is known to be worsened by stress and stress may come from displacement and from having to live in more dangerous, fragmented habitat.[23] Similarly misadventures such as flying into windows or powerlines, being trapped in fences or pools, being hit by cars or attacked by domestic dogs and cats are all legacies of past development in the urban and peri-urban environment. These legacy impacts are expected to have a much greater impact on wildlife than the original clearing event because they are ongoing.

Fig. 4.

Admissions into care of all wildlife by originating postcodes, 2016- April 2024.

Admissions from postcode
1 - 10
11 - 100
101 - 1000
1001 - 3000
3001 - 6000

DESI, Esri, TomTom, Garmin, FAO, NOAA, USGS
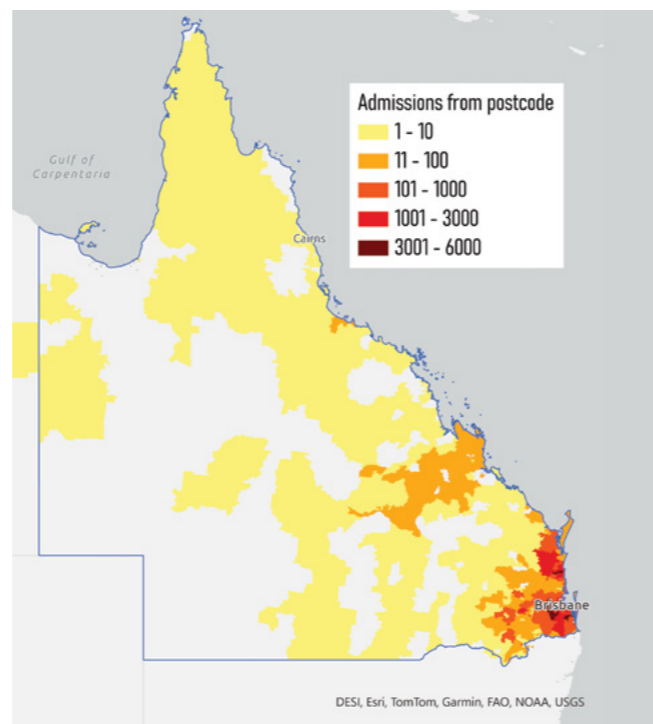
Fig. 5.

Admissions into care from postcodes LEFT for all wildlife, RIGHT for Koalas, 2016- April 2024.

Admissions from postcode
1 - 10
11 - 100
101 - 1000
1001 - 3000
3001 - 6000

Department of Resources, DESI, Esri, TomTom, Garmin, FAO, NOAA, USGS

Admissions from postcode
0 - 10
11 - 50
51 - 100
101 - 350

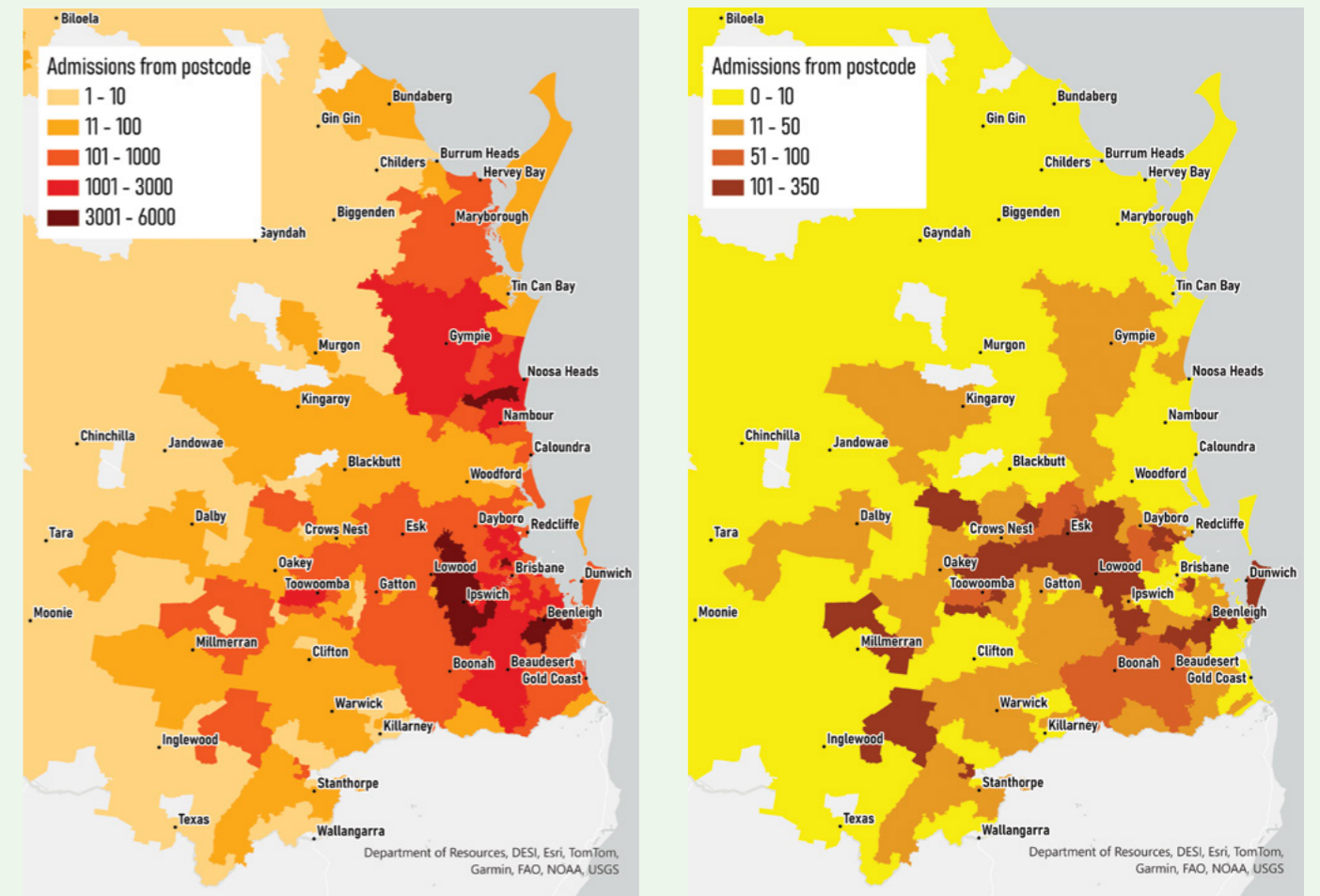Department of Resources, DESI, Esri, TomTom, Garmin, FAO, NOAA, USGS

Image © RSPCA Queensland

Fig. 6.

Causes of admissions into care TOP all wildlife and BOTTOM Koalas, 2016- April 2024.

Categories ordered clockwise greatest to least.

All Wildlife

Trapped/tangled/pool
3,258 – 6%

Disease
5,802 – 10%

Animal attack
(eg cats, dogs)
9,039 – 15%

Car/machinery/
powerlines/buildings
14,053– 24%

Tree clearing
698 – 1%

All others
1,040 – 2%

In danger
(eg nestlings
on ground)
24,432 – 42%

Koalas

Animal attack
317 – 12%

In danger
461 – 17%

Car/machinery/falls
818 – 31%

Other
91 – 3%

Disease
973 – 37%
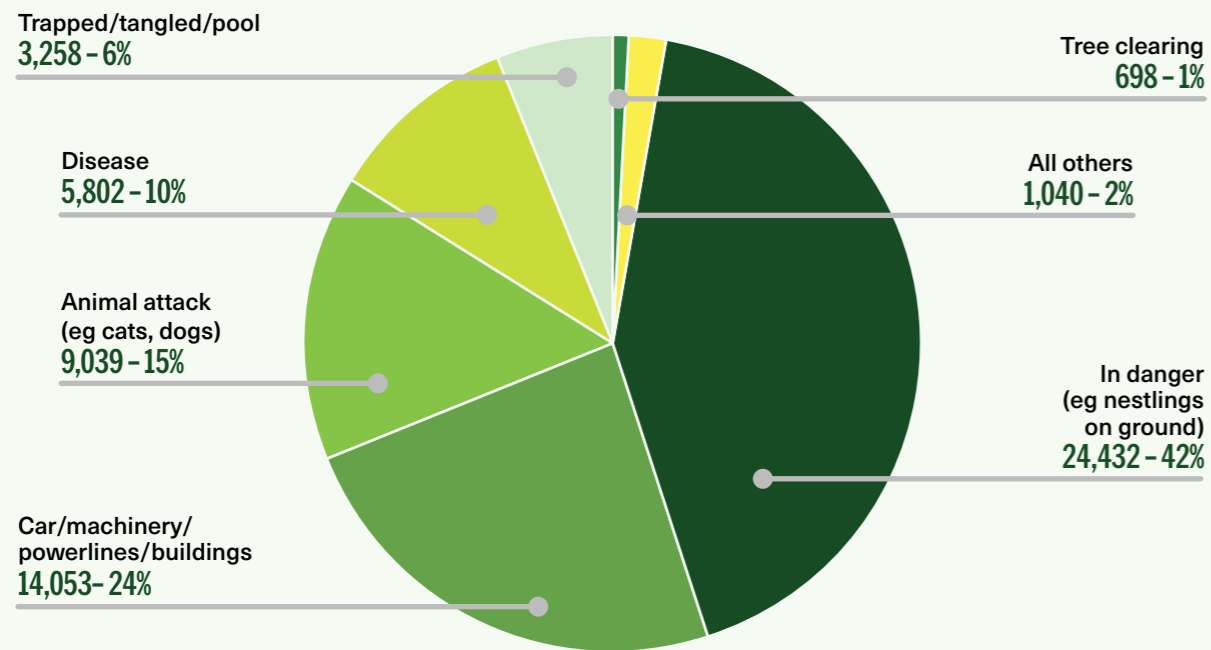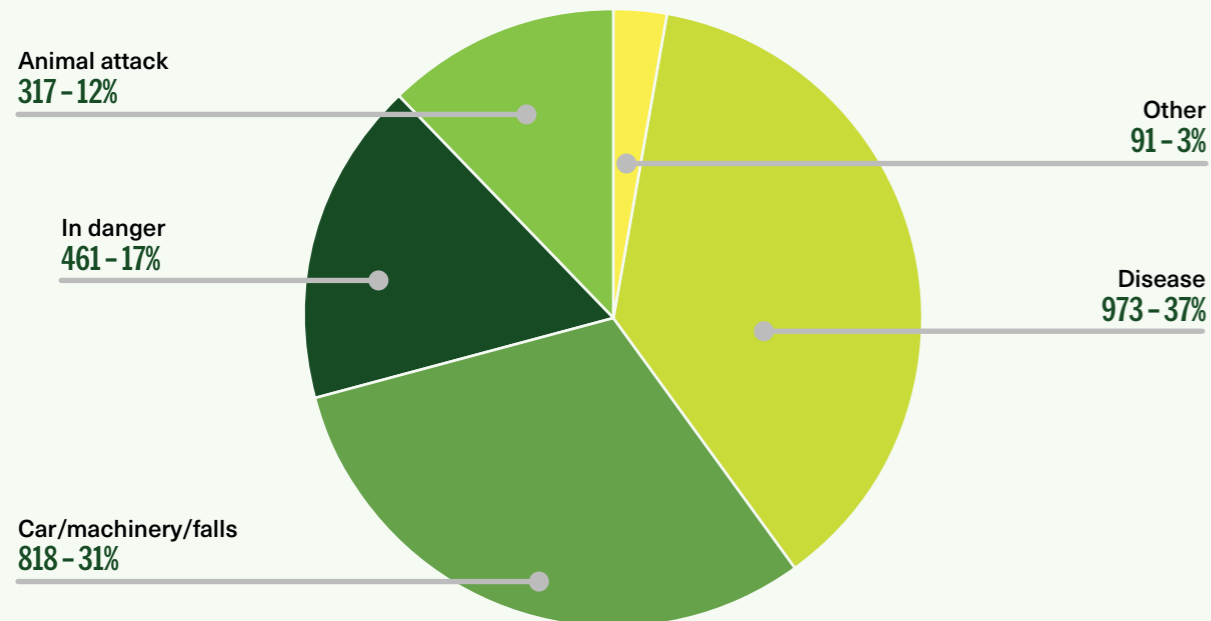
Fig. 7.

Outcomes of admissions into care, TOP all wildlife BOTTOM Koalas, 2016- Apr 2024.

All Wildlife

Released
23,568 – 12%

In care
43,567 – 22%

Dead
131,624 – 66%

Koalas

Released
1,052 – 23%

In care
507 – 11%

Dead
3,057 – 66%

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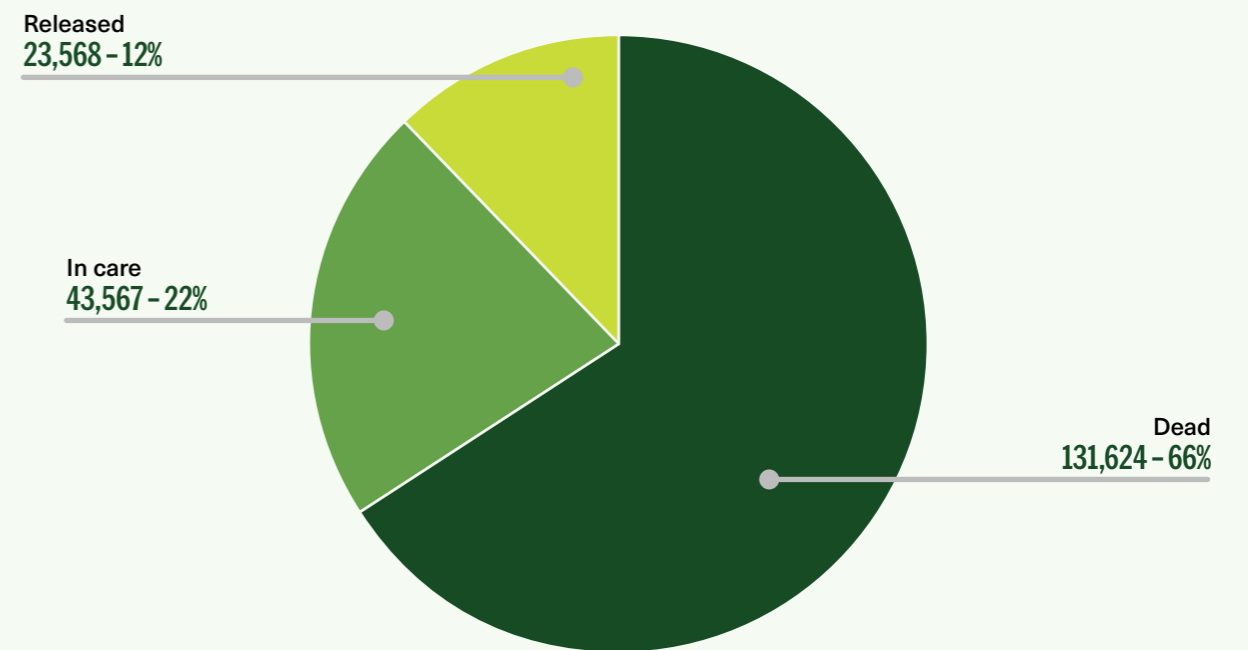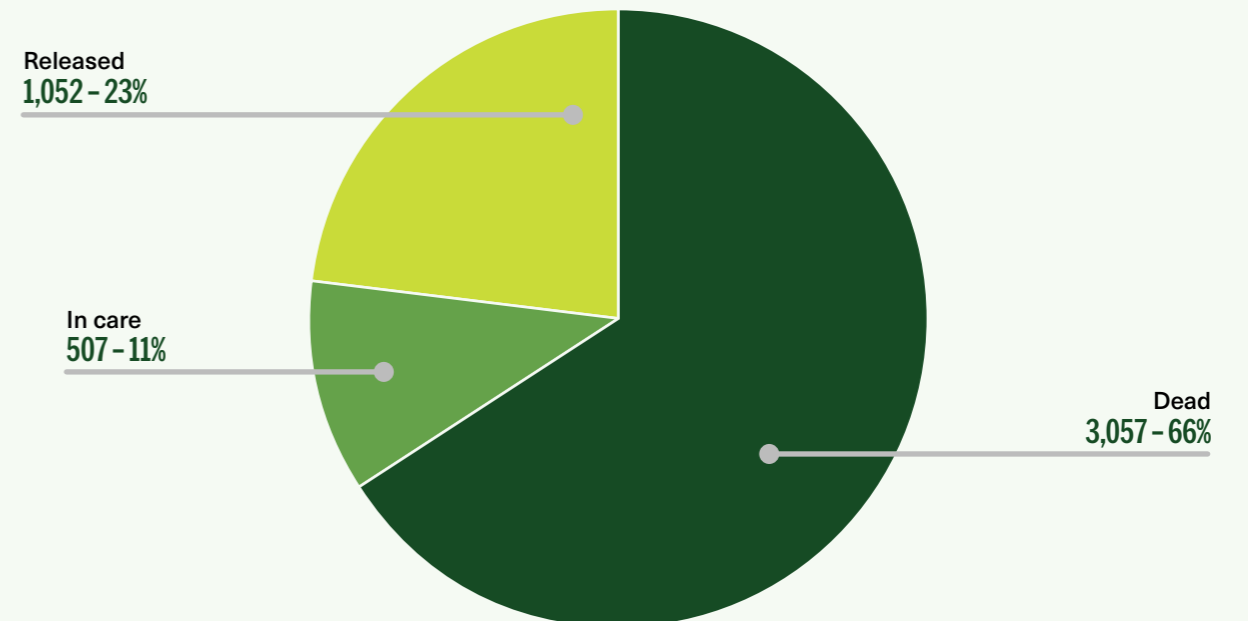
Weakness of existing laws

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As discussed at length in the 2017 report,[24] existing laws are inadequate to prevent the ongoing unmitigated suffering and killing of native wildlife that results from bushland destruction. Little has changed since then.

- Laws that regulate clearing of native vegetation have many exemptions and loopholes and in any case have no regard to wild animal welfare. In Queensland, 82% of clearing in 2020-21 was exempt from the law.[25] In NSW, this is much lower with Category 1 exempt woody clearing representing only about 18% of all clearing.[26] In both jurisdictions most clearing of regulated vegetation is conducted without departmental assessment or permission if certain clearing codes of practice are followed and notification is given. Surveys for wildlife or actions necessary to prevent injury or suffering of wildlife are not included in such codes.

- In Queensland the *Nature Conservation Act* regulates actions that are directed at native animals or their breeding places, but provides a major loophole for habitat destruction that's not directed at the animal itself and can't be reasonably avoided.[27]
- Similarly, in NSW the *Biodiversity Conservation Act* forgives habitat destruction if the person destroying it doesn't know that it is habitat of a protected species. There is no general requirement on persons intending to destroy habitat to conduct surveys to see if native wildlife are present, nor to take actions to mitigate harm to wildlife found in surveys.[28]
- Animal welfare legislation in both states applies only to animals that are in a person's care. Wildlife by definition are excluded because they are not in a person's care until they are already injured and rescued.

Legislative changes required

The ongoing crisis of mass suffering and death of wild animals as a result of destruction of their bushland habitats has changed little since last revealed in 2017.[29]

Alleviating this crisis requires multiple policy reforms. Laws regulating deforestation, conservation and planning laws need to be tightened to prevent most habitat destruction.

Where habitat destruction is to be allowed, amended laws should:-

- require proponents to survey for native wildlife beforehand, and
- require proponents to prevent injury and death of wildlife in the area being cleared such as by re-homing; and
- require genuine offsetting to replace habitats being destroyed. Such offsets must not result in overall net loss of wildlife habitat.[30]

Animal welfare laws should expand culpability to encompass injuries to wildlife that could readily be foreseen to result from destruction of their habitats and require those otherwise legally destroying habitats to take reasonable care to prevent or avoid such injuries to resident wildlife.

Finally, the ongoing toll of injury and death of native wildlife that follows conversion and fragmentation of habitat especially in the urban and periurban environments should be reduced by appropriate controls on development and keeping of pets.

- Vehicle kills of wildlife are estimated to number 10 million a year, and wildlife crossing structures are one of the few mitigations that seem to work to reduce the toll.[31] Road construction is increasingly employing wildlife bridges to prevent collisions with wildlife.[32]
- Councils are increasingly imposing rules to keep cats indoors, and dogs at night, to reduce attacks on wildlife.[33]

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Caveats

The views presented are solely those of the authors and should not be taken to represent those of their affiliated institution, the University of Queensland.

Any mistakes of analysis or fact are the authors' own responsibility.

Much of this analysis involved conversion of spatial data to a common template of 30m pixel size rasters in the Albers Conical Equal-Area Projection used by Qld SLATS. Pixellation of vector data necessarily generates some error in calculation of errors. Previous analyses have shown that these errors are small (<1%).

Image © Martin Taylor

Deforestation in Qld and NSW has resulted in an average of

100 million animals

within the clearing footprint.

Appendices

Appendix 1. Methods

Footprint of clearing

We downloaded SLATS woody cover change spatial layers for Queensland NSW for the period 2000/01 to 2020/21 (the most recent available in both states) and converted all layers to rasters aligned to a common 30m template.

For a given year (eg 2016/17) in the five year study period, if a given pixel had been cleared in the preceding 15 years of SLATS data (eg from 2000/01 to 2015/16) the pixel was flagged as young regrowth <15 years old, otherwise as mature or regrowth 15+ years old at commencement of the year in which it was cleared.

Young regrowth clearing was excluded from the footprint of clearing of interest. Also excluded was any woody cover change due to fire or any other natural causes, or the harvest of plantation timber.

Current land use of areas cleared

We intersected the footprint of areas cleared with Australian Catchment Scale Land Use 50 m pixel scale 2023 release[34], sorted land uses into five broad categories of use, and tabulated areas cleared within each category.

Clearing by bioregions and vegetation types

The final footprint of clearing was intersected by IBRA bioregions in NSW and Qld, and by vegetation or landscape types for which densities were published in the primary sources. The latter were derived from other IBRAv7 and Queensland Broad Vegetation Groups spatial data as shown in Appendix 3.

Estimate of animal numbers in footprint of clearing

Areas of bushland cleared were multiplied by densities applicable for the bioregions, vegetation types or landscapes in which the clearing occurred as tabulated in the following appendices. For mammals and birds two sources were used: a) the earlier density estimates of Cogger et al (2003) and Johnson et al (2007)[35] for Qld and NSW respectively, and b) the updated estimates of van Eeden et al (2020). These were not used entirely as originally used by either source. Where a bioregion or vegetation type lacked a density estimate, the estimate from the other source was substituted (See Appendices).

Animals taken into care

Records for admissions into care of wildlife are held by RSPCA Queensland. The records for 2016 to April 2024 were tabulated by originating postcodes, species, cause of admission and outcome, and tabulated results graphed.

Appendix 2a. Estimation of numbers of mammals within footprint of clearing

STATE	Bioregion	Clearing 15+y.o. 2016-21	Annual	van Eeden (2020) based estimates Density	Source	Est'd no/yr	Based on Cogger et al (2003) and Johnson et al (2007) Density	Source	Est'd no/yr
QLD	BBS	554,681	110,936	1.463	van Eeden et al 2020	162,300	3.93	Cogger et al 2003	435,979
QLD	CHC	2,086	417	2.87	Sub MUL from Cogger et al 2003	1,197	2.87	Sub MUL from Cogger et al 2003	1,197
QLD	DRP	24,611	4,922	0.345	van Eeden et al 2020	1,698	0.345	Sub van Eeden et al 2020	1,698
QLD	MUL	554,798	110,960	2.87	Sub Cogger et al 2003	318,454	2.87	Cogger et al 2003	318,454
QLD	NAN	14,207	2,841	0.42	van Eeden et al 2020	1,193	0.42	Sub van Eeden et al 2020	1,193
QLD	NET	1,764	353	3.424	van Eeden et al 2020	1,208	45.11	Cogger et al 2003	15,917
QLD	SEQ	120,566	24,113	17.608	van Eeden et al 2020	424,586	51.24	Cogger et al 2003	1,235,562
QLD	BBN	351,470	70,294	3.93	Sub Cogger et al 2003	276,256	3.93	Cogger et al 2003	276,256
QLD	CMC	8,431	1,686	0.272	van Eeden et al 2020	459	45.11	Cogger et al 2003	76,061
QLD	CYP	12,694	2,539	4.888	van Eeden et al 2020	12,410	4.888	Sub van Eeden et al 2020	12,410
QLD	DEU	127,553	25,511	3.48	Sub Cogger et al 2003	88,777	3.48	Cogger et al 2003	88,777
QLD	EIU	16,352	3,270	3.639	van Eeden et al 2020	11,901	1.42	Cogger et al 2003	4,644
QLD	GUP	21,208	4,242	2.86	Sub. MGD Cogger et al	12,131	2.86	Sub MGD from Cogger et al 2003	12,131
QLD	MGD	116,354	23,271	2.86	Sub Cogger et al 2003	66,554	2.86	Cogger et al 2003	66,554
QLD	MII	558	112	2.86	Sub. MGD Cogger et al	319	2.86	Sub MGD from Cogger et al 2003	319
QLD	WET	3,510	702	3.298	van Eeden et al 2020	2,315	50.46	Cogger et al 2003	35,418
NSW	AUA	547	109	37.684	van Eeden et al 2020	4,121	17.5	Tablelands, Johnson et al 2007	1,914
NSW	BBS	55,506	11,101	1.463	van Eeden et al 2020	16,241	17.5	Slopes, Johnson et al 2007	194,270
NSW	BHC	967	193	2.87	Sub MUL from Cogger et al	555	17.5	Plains, Johnson et al 2007	3,383
NSW	CHC	191	38	2.87	Sub MUL from Cogger et al	110	17.5	Plains, Johnson et al 2007	670

STATE	Bioregion	Clearing 15+y.o.		van Eeden (2020) based estimates			Based on Cogger et al (2003) and Johnson et al (2007)		
		2016-21	Annual	Density	Source	Est'd no/yr	Density	Source	Est'd no/yr
NSW	COP	81,711	16,342	0.42	van Eeden et al 2020	6,864	17.5	Plains, Johnson et al 2007	285,988
NSW	DRP	109,834	21,967	0.345	van Eeden et al 2020	7,579	17.5	Plains, Johnson et al 2007	384,421
NSW	MDD	28,480	5,696	2.601	van Eeden et al 2020	14,815	17.5	Plains, Johnson et al 2007	99,679
NSW	MUL	8,199	1,640	2.87	Sub MUL from Cogger et al	4,706	17.5	Plains, Johnson et al 2007	28,695
NSW	NAN	13,022	2,604	0.42	van Eeden et al 2020	1,094	17.5	Slopes, Johnson et al 2007	45,576
NSW	NET	24,112	4,822	3.424	van Eeden et al 2020	16,512	17.5	Tablelands Johnson et al 2007	84,392
NSW	NNC	27,587	5,517	11.626	van Eeden et al 2020	64,145	31.36	Coast and range, Johnson et al 2007	173,025
NSW	NSS	30,698	6,140	11.475	van Eeden et al 2020	70,453	17.5	Slopes, Johnson et al 2007	107,444
NSW	RIV	17,777	3,555	1.418	van Eeden et al 2020	5,041	17.5	Plains, Johnson et al 2007	62,218
NSW	SEC	9,334	1,867	5.691	van Eeden et al 2020	10,624	31.36	Coast and range, Johnson et al 2007	58,544
NSW	SEH	40,496	8,099	32.677	van Eeden et al 2020	264,657	17.5	Tablelands Johnson et al 2007	141,736
NSW	SEQ	15,732	3,146	17.608	van Eeden et al 2020	55,400	31.36	Coast and range, Johnson et al 2007	98,668
NSW	SYB	17,915	3,583	4.11	van Eeden et al 2020	14,726	31.36	Coast and range, Johnson et al 2007	112,363
TOTALS		2,412,951	482,590			1,939,402			4,465,559

Appendix 2b. Estimation of numbers of Koalas within footprint of clearing

State	Bioregion	Density/km2	Habitat cleared 2016-21 (km2)	Koalas
NSW	BBS	2	126	252
NSW	COP	2	21	42
NSW	DRP	2	48	96
NSW	NAN	2	45	91
NSW	NET	2	99	199
NSW	NNC	2	202	404
NSW	NSS	2	51	101
NSW	SEC	2	70	140
NSW	SEH	2	76	151
NSW	SEQ	3.4	63	215
NSW	SYB	2	72	144
QLD	BBN	2	310	621
QLD	BBS	2	984	1,969
QLD	CMC	2	35	71
QLD	DEU	2	41	81
QLD	DRP	2	17	34
QLD	EIU	2	33	66
QLD	MUL	2	8	16
QLD	NAN	2	37	73
QLD	NET	2	6	12
QLD	SEQ	3.4	355	1,206
QLD	WET	2	8	16
TOTALS			2,707	5,998

Appendix 3. Estimation of numbers of birds within footprint of clearing

Estimates based on van Eeden et al 2020

STATE	Bioregion	Cleared 15+y.o. 2016-21	Annual	Density	Based on van Eeden et al 2020 Source	Total/yr
QLD	WET	3,510	702	17.2	van Eeden et al 2020	12,096
NSW	SYB	17,915	3,583	18.4	van Eeden et al 2020	66,046
QLD	SEQ	120,566	24,113	17.0	van Eeden et al 2020	410,216
NSW	SEQ	15,732	3,146	17.0	van Eeden et al 2020	53,525
NSW	SEH	40,496	8,099	15.2	van Eeden et al 2020	122,794
NSW	SEC	9,334	1,867	18.0	van Eeden et al 2020	33,515
NSW	RIV	17,777	3,555	16.3	van Eeden et al 2020	58,077
NSW	NSS	30,698	6,140	16.6	van Eeden et al 2020	101,645
NSW	NNC	27,587	5,517	15.5	van Eeden et al 2020	85,667
QLD	NET	1,764	353	19.7	van Eeden et al 2020	6,947
NSW	NET	24,112	4,822	19.7	van Eeden et al 2020	94,944
QLD	NAN	14,207	2,841	21.8	van Eeden et al 2020	61,985
NSW	NAN	13,022	2,604	21.8	van Eeden et al 2020	56,814
QLD	MUL	554,798	110,960	10.2	Acacia woodlands, Cogger et al 2003	1,131,788
NSW	MUL	8,199	1,640	14.0	Plains, Cogger et al 2003	22,956
QLD	MII	558	112	26.0	Euc woodlands, Cogger et al 2003	2,904
QLD	MGD	116,354	23,271	14.0	Plains, Cogger et al 2003	325,791
NSW	MDD	28,480	5,696	11.4	van Eeden et al 2020	64,739
QLD	GUP	21,208	4,242	26.0	Euc woodlands, Cogger et al 2003	110,282
QLD	EIU	16,352	3,270	19.9	van Eeden et al 2020	65,095
QLD	DRP	24,611	4,922	32.0	van Eeden et al 2020	157,350

STATE	Bioregion	Cleared 15+y.o. 2016-21	Annual	Density	Based on van Eeden et al 2020 Source	Total/yr
NSW	DRP	109,834	21,967	32.0	van Eeden et al 2020	702,226
QLD	DEU	127,553	25,511	18.9	Tablelands, Cogger et al 2003	482,150
QLD	CYP	12,694	2,539	20.9	van Eeden et al 2020	53,049
NSW	COP	81,711	16,342	18.2	van Eeden et al 2020	297,540
QLD	CMC	8,431	1,686	33.0	van Eeden et al 2020	55,632
QLD	CHC	2,086	417	14.0	Plains, Cogger et al 2003	5,841
NSW	CHC	191	38	14.0	Plains, Cogger et al 2003	536
NSW	BHC	967	193	14.0	Plains, Cogger et al 2003	2,706
QLD	BBS	554,681	110,936	14.2	van Eeden et al 2020	1,575,328
NSW	BBS	55,506	11,101	14.2	van Eeden et al 2020	157,640
QLD	BBN	351,470	70,294	14.2	Sub BBS van Eeden et al 2020	998,197
NSW	AUA	547	109	12.6	van Eeden et al 2020	1,383
TOTALS		2,412,951	482,590			7,377,407

Table A3b.

Birds estimates based on Cogger et al (2003) and Johnson et al (2007)

		Cleared 15+ y.o.			
	BVT	2016-21	Annual	Density	Number/yr
QLD*	Rainforest	33,543	6,709	33	221,387
	Open forest	85,459	17,092	31	529,843
	Eucalypt woodlands	860,033	172,007	26	4,472,171
	Acacia woodlands	915,702	183,140	10.2	1,868,033
	Tablelands woodlands	6,934	1,387	18.9	26,210
	Grasslands	29,074	5,815	1.3	7,559
	Total	1,930,745	386,149		7,125,203
NSW**	Coast and range	70,568	14,114	30	423,405
	Tablelands	65,155	13,031	30	390,929
	Western slopes	99,226	19,845	35	694,581
	Plains	247,206	49,441	14	692,177
	Total	482,154	868,729		2,201,093
GRAND TOTAL		2,412,900	1,254,878		9,326,296

Table A3c.

Conversion of Queensland Herbarium's Broad Vegetation Groups v6.1 to Cogger et al (2003) Broad Vegetation Types (BVT)

Qld Herbarium DBVG 1:5m	BVT no	Cogger et al 2003 Broad Vegetation Groups
1	1	Rainforest
2	5	Tablelands woodlands
3	3	Eucalypt woodlands
4	2	Open forest
5	3	Eucalypt woodlands
6	3	Eucalypt woodlands
7	3	Eucalypt woodlands
8	3	Eucalypt woodlands
9	4	Acacia woodlands
10	4	Acacia woodlands
11	4	Acacia woodlands
12	3	Eucalypt woodlands
13	6	Grasslands
14	6	Grasslands
15	5	Tableland woodlands
16		Mangroves leave out

Conversion of IBRAv7 Bioregions to Johnson et al 2007 NSW landscape types

Code	Bioregion	NSW landscape
AUA	Australian Alps	Tablelands
BBS	Brigalow Belt South	Slopes
BHC	Broken Hill Complex	Plains
CHC	Channel Country	Plains
COP	Cobar Peneplain	Plains
DRP	Darling Riverine Plains	Plains
MDD	Murray Darling Depression	Plains
MUL	Mulga Lands	Plains
NAN	Nandewar	Slopes
NET	New England Tablelands	Tablelands
NNC	NSW North Coast	Coast and range
NSS	NSW South Western Slopes	Slopes
RIV	Riverina	Plains
SEC	South East Corner	Coast and range
SEH	South Eastern Highlands	Tablelands
SEQ	South Eastern Queensland	Coast and range
SSD	Simpson Strzelecki Dunefields	Plains
SYB	Sydney Basin	Coast and range

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2. https://www.qld.gov.au/environment/land/management/mapping/statewide-monitoring/slats/slats-reports/2021-22-slats-report/key-findings

3. Extract from metadata for SLATS Age product: *"The 'last disturbance' may be due to a clearing event or other disturbance such as fire, flood, drought-related death etc. Note that not all recorded disturbances may result in complete loss of woody vegetation, so the estimated age since disturbance does not always represent the age of the ecosystem."* https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={89095FCF-1404-4400-8219-B1DE7B1FD3F4}

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19. https://www.rspcaqld.org.au/blog/wildlife-conservation/lorikeet-paralysis-syndrome

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26. https://www.environment.nsw.gov.au/topics/animals-and-plants/native-vegetation/landcover-science/2021-nsw-vegetation-clearing-report

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