Queensland Conservation Council

What's at Steak
Deforestation for beef widespread in Queensland

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Key points

- Many corporations and governments around the world have promised to end deforestation in commodity supply chains, with beef a recognised priority.
- Despite tightening of the law in 2018, land clearing and deforestation is widespread, with almost all being for livestock and within that for beef.
- Industry representatives deny or downplay this reality.
- Queensland producers risk being excluded from emerging markets for deforestation-free beef.
- A comparatively small number of beef producers account for a "lion's share" of deforestation.
- In contrast, nine large beef producing companies accounted for very little deforestation. It could be relatively easy for these large companies to act as a flagship for marketing of "deforestation-free" beef in Queensland.

Executive summary

Internationally, governments, corporations and consumers are pushing for deforestation-free products, including for commodities like beef.

Queensland outpaces all other Australian jurisdictions combined in annual bulldozing of forests primarily for beef and is the primary reason why Eastern Australia is listed as a global deforestation front.

Despite tightening of laws in 2018, the latest state government data shows substantial increases in clearing of both remnant (primary or mature) and regrowing (secondary or immature) forests and woodlands.

Some of this increase is a result of actual increased clearing and some attributed to better monitoring methodology. However, the recent increase due to better methodology also means that tree clearing in previous years has been substantially under-estimated.

Of 2.1 million hectares of all woody vegetation cleared in Queensland over a five year study period 2014/15 to 2018/19 (the latest year for which government clearing data has been published):-

- 93% was for livestock pasture development of which 73% was for pastures on beef properties;
- 71% was clearing of forests of any age and 60% was clearing of either remnant (intact or mature) forests or "high value regrowth" forests (more than 15 years old).

Almost all clearing of "high value regrowth" forests over 15 years of age -- totalling over 760,000ha over the five year period -- had previously been "locked-in" as exempt on property maps of assessable vegetation (PMAVs) and so could be cleared without restraints.

- Of all deforestation of endangered regional ecosystems, 78% was for pasture development on beef properties.
- Of all deforestation for pasture development on beef properties 24% was of regional ecosystems deemed endangered due to past land clearing.
- And another 24% of those deemed as of-concern under the *Vegetation Management Act* in Queensland.

[1] https://www.agforceqld.org.au/knowledgebase/article/AGF-01479/

Deforestation for beef pastures destroyed habitats for 388 nationally threatened species and 14 threatened ecological communities over the five year study period.

- The then vulnerable, now endangered Koala lost 0.65% of its entire "likely-to-occur" habitat to beef pasture deforestation over the five year study period, representing 73% of all Koala habitat deforestation statewide.
- The endangered Brigalow ecological community lost 2.34% of its entire "likely-to-occur" habitat to beef pasture deforestation over the five year study period, representing 83% of all Brigalow deforestation statewide.

Ongoing widespread deforestation for livestock production in Queensland is a serious barrier to the ability of Queensland's red meat industry to meet growing market demand for deforestation-free products.

Industry representatives publicly deny deforestation stating, *"there has been no significant clearing of trees in Queensland."*

Although deforestation is widespread, a relatively small number of livestock producers have a disproportionate contribution to deforestation. An estimated 334 beef property owners account for half of all deforestation for pastures on all beef properties over the period.

Conversely, 36% of livestock production capacity in Queensland was deforestation-free over the five year study period, although that could change in future unless there are changes to industry and government policies.

Although deforestation is widespread, a relatively small number of livestock producers have a disproportionate contribution to deforestation. An estimated 334 beef property owners account for half of all deforestation for pastures on all beef properties over the period.

Ending deforestation should not present a significant hurdle for these nine large beef companies, since all deforestation over the five year study represents a tiny fraction of 0.1% of the vast land area they hold, and 97% of the land area is still in uncleared remnant condition. Ceasing all deforestation and allowing endangered forests to regrow naturally would allow recovery to take place.

There is a remarkable opportunity for large beef producers to act as a flagship for their industry and become the first in Australia to offer the first verified and trustworthy deforestation-free beef to the growing numbers of retailers who have committed to selling only deforestation-free products.

Glossary

Vegetation - any woody vegetation including forest.

Land clearing - the partial or total removal of woody vegetation.

Forest - that component of woody vegetation with greater than 20% canopy cover composed of trees that exceed 2m in height, over patches of at least 0.2ha.

Deforestation - the partial or total removal of trees from a forest to the point it is no longer the same forest or is non forest.

SLATS - the Queensland Government's "Statewide Land and Tree Study" eco-sciences unit.

VMA - *Vegetation Management Act 1999* (Queensland).

EPBCA - *Environment Protection and Biodiversity Conservation Act 1999* (Federal).

Koala
© Martin Taylor.

Introduction

Many promises to end deforestation

At CoP26 of the United Nations Framework Convention on Climate Change (UNFCCC), 137 parties including Australia committed to *"working collectively to halt and reverse forest loss and land degradation by 2030".*[2]

In 2010, the Consumer Goods Forum, a peak body for major global and Australian food corporations like Woolworths and McDonald's committed to removing deforestation from supply chains and *net* zero deforestation by 2020.[3] They were later joined by many other major brands.[4]

Recently, the European Union introduced laws to prevent import of products that involve deforestation. Importation of goods including beef and lamb from areas deforested after January 2020 would be banned.[5]

Australia's Red Meat Advisory Council has committed to carbon neutral production by 2030, and Meat and Livestock Australia has released a roadmp to get there. However the need to halt ongoing deforestation to reduce emissions is not mentioned in that roadmap.[6]

Livestock the driver of almost all deforestation in Queensland

Queensland is the main beef producing state in Australia.[7] However, ongoing high levels of deforestation for beef presents a major barrier to the ability of the Queensland industry to meet the growing demand for verified deforestation-free beef.

Ongoing high levels of deforestation undermines the promises of the red meat industry to be carbon neutral by 2030.

Queensland accounts for more tree clearing than all other jurisdictions combined. The majority (73%) of this destruction of forests and woodlands is to develop pastures for beef production.[8] Land clearing in Queensland happens widely throughout the state, although it is concentrated in the central belt of *Acacia*-dominated forests.[9]

Tree clearing for pasture development is widespread and has resurged in recent years due to weakening of state laws in 2013, pervasive failure by pastoralists clearing forests to observe national conservation law, and a corresponding failure of the national regulator to enforce the law.[10]

Misleading national statistics

The National Greenhouse Gas Inventory (NGGI) suggests that deforestation has declined dramatically in Queensland since a ban on broadscale clearing for agriculture came into force in December 2006 and has stayed at a low level. But this is contradicted by the more accurate figures derived from Queensland Government SLATS spatial data which show a dramatic upward resurgence of land clearing after the broadscale clearing ban was mostly overturned in 2013 (Fig. 1).

Comparative analysis reveals that the NGGI forest cover detection is inaccurate and as a result, NGGI figures for deforestation in Queensland may have been underestimated by as much as half in 2018/19. Moreover, the more accurate SLATS detection method used in 2018/19, led to a significant boost in detection of land clearing by as much as 30% (Fig. 1). This suggests that land clearing areas in years prior to 2018/19 were underestimated by SLATS.[11]

NGGI statistics reported to the UN suggest that there is "net forest gain" for the entire country and for Queensland. The Activity Tables for Land Use, Land Use Change and Forestry (LULUCF) Table 1a reports 11,800 ha of primary (remnant or mature) forest cleared and 112,900 ha of regrowth forest re-cleared in Queensland in 2020. Table 1b reports 167,500 ha of new forest. On this basis, NGGI reports a "net forest clearing" of negative 42,800 ha, that is, a "net forest gain".[12] These statistics are used by industry representatives to deny that there is any "significant" land clearing at all in Queensland.[13]

Wedge-tailed eagle
© Martin Taylor.

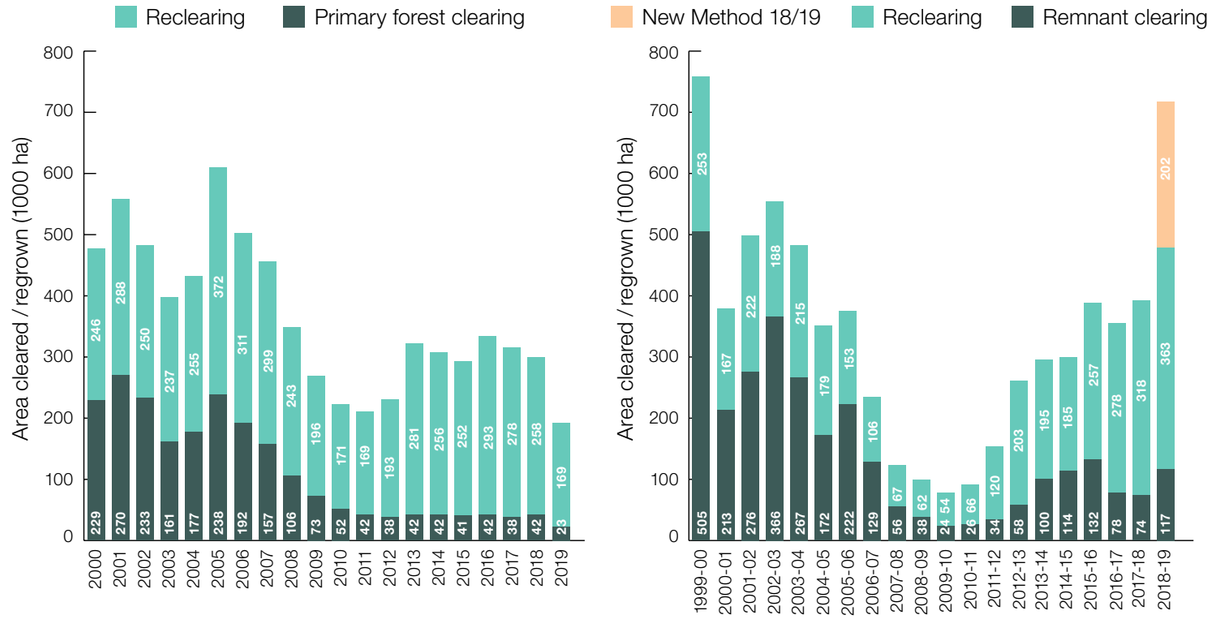


Fig. 1. Reported areas of deforestation of primary and secondary forests in Queensland according to NGGI Activity Tables (left) and clearing of all woody vegetation (including forests) according to the Queensland Government's Statewide Land and Tree Study (SLATS, right). Note: SLATS division into clearing of remnant and reclearing of non-remnant for 2018-19 are not from the published SLATS report. We extrapolated from the SLATS comparison in the Brigalow Belt using the new SLATS method which found a 58% increase in remnant and 14% increase in non-remnant reclearing from 2017/18 to 2018/19 to derive the figures shown for 2018/19 of 117,000 and 363,000 ha respectively.The hatched bar shows the 202,000 ha additional clearing detected by SLATS in 2018/19 which is therefore the best estimate of the improved detection of clearing using the new methodology. SLATS data for 18/19 are based on a new methodology using Sentinel-2 10m imagery whereas in previous years Landsat 30m imagery was used. SLATS has not released any statistics for areas of regrowth as yet.[14]

[2] https://ukcop26.org/glasgow-leaders-declaration-on-forests-and-land-use/
[3] https://www.theconsumergoodsforum.com/press_releases/consumer-goods-industry-announces-initiatives-on-climate-protection/
[4] https://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Forests/New%20York%20Declaration%20on%20Forests_DAA.pdf
[5] https://www.theguardian.com/australia-news/2022/sep/16/australian-farmers-fear-exports-could-be-hurt-by-new-eu-land-clearing-laws
[6] Meat and Livestock Australia (2020) *The Australian Red Meat Industry's Carbon Neutral by 2030 Roadmap* (https://www.mla.com.au/globalassets/mla-corporate/research-and-development/program-areas/environment-and-sustainability/2689-mla-cn30-roadmap_d3.pdf).
[7] Meat and Livestock Australia (2022) *Cattle numbers – as at June 2020 Natural Resource Management Region* (https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/fast-facts--maps/mla_cattle-numbers-map-2022-as-at-june-2020-data.pdf)

[8] The Wilderness Society (2019) Drivers of Deforestation and land clearing in Queensland (https://www.wilderness.org.au/qlddeforestation).
[9] Queensland Government (2021) 2018/19 SLATS Report. (https://www.qld.gov.au/environment/land/management/mapping/statewide-monitoring/slats/slats-reports/2018-19-report)
[10] Taylor MFJ & Blanch S (2020) Pervasive inaction on national conservation law in Queensland 2016-18. WWF-Australia (https://www.wwf.org.au ArticleDocuments/353/pub-pervasive-inaction-on-national-conservation-law-in-queensland-2016-18-Nov20.pdf.aspx).
[11] Taylor MFJ (2022) Deforestation in Queensland 2018/19 nearly double what Australian Government reports to the UN. Unpublished technical report (https:/ www.researchgate.net/publication/360577362_Deforestation_in_Queensland_201819_nearly_double_what_Australian_Government_reports_to_the_UN).
[12] LULUCF Activity Tables from https://ageis.climatechange.gov.au/
[13] See for example https://www.beefcentral.com/news/agriculture-set-to-bust-deforestation-myths/
[14] Reproduced from Taylor MFJ (2022) *Deforestation in Queensland 2018/19 nearly double what Australian Government reports to the UN*. Unpublished technical report (https://www.researchgate.net/publication/360577362_Deforestation_in_Queensland_201819_nearly_double_what_Australian_Government_reports_to_the_UN).

NGGI claims of "net" forest gain are erroneous, ecologically meaningless and misleading.

A pixel may move from "non-forest" to "forest" in NGGI land cover maps[15] simply because an automated classifier of Landsat satellite photos tips the pixel above 20% canopy cover.

- Trees may have just put out more foliage in response to rain, tipping a pixel over 20%, with no real change in numbers of trees on the ground.
- Low resprouting or coppicing of foliage from seeds, stumps and root stocks left after recent clearing, may also tip a pixel over 20%, but this is not yet a forest in any meaningful ecological sense.

Such "new forest" pixel counts cannot legitimately be used in "net" calculations to cancel out destruction of forests which may be ecologically very different, or be decades or centuries old, tens of metres high and full of wildlife.

Any claim to be deforestation-free, must mean there is zero absolute deforestation, regardless how much regrowth there might be elsewhere. The only question to be answered is if an area cleared constituted a native forest at the time of clearing.

Despite recent tightening of laws, land clearing widespread

The state law regulating tree clearing in Queensland, the *Vegetation Management Act 1999* (VMA), was greatly weakened by the short-lived Newman - LNP state government (2012-2015). Weakened laws in Queensland and later, in New South Wales, led to an explosion of forest and woodland destruction that placed Eastern Australia on WWF's list of global deforestation "fronts".[16]

It was not until 2018 that the VMA was amended again.[17] It came as a shock therefore, to see that despite the 2018 tightening of the VMA, clearing rates went up not down, and quite substantially for remnant clearing as opposed to non-remnant (Fig.1).[18]

While state legislation was tightened to protect Queensland's forests and threatened species habitat, significant loopholes in that legislation mean deforestation remains widespread in Queensland.' The state government admitted that something has obviously "gone wrong" and promised a review which at time of writing was still in progress.[19]

Impacts of land clearing on biodiversity are severe

The recent Australian State of the Environment report found *"Industry pressures [on biodiversity] are highest from extensive agriculture and land clearing, which continues to remove or fragment native ecosystems."*[20]

Queensland Government scientists report that land clearing [21]:-

- *"causes species death and habitat loss [and fragmentation]...*
- *"Reduces the resilience of threatened species populations to survive future perturbations such as climate change….*
- *"[has] Significant negative impacts offsite e.g. (sediment runoff into streams, rivers, wetlands and the Great Barrier Reef marine lagoon)...*
- *"[is] A major contributor to climate change...*
- *"[is] Directly responsible for two plant species becoming extinct in the wild...*
- *"[is a] threatening process for many of the 739 threatened flora species and 210 threatened fauna species in Queensland....*

In this report, we use the most recent SLATS data to quantify the deforestation due to beef production in Queensland and profile nine of the biggest known beef producers in Queensland, updating an earlier analysis.[22]

Results and discussion

Land clearing in Queensland has increased, but was also underestimated in the past

From 2014/15 to 2018/19, 2,121,857 ha of woody vegetation was cleared in Queensland ("land clearing"). This analysis removed repeat clearing events within the five year period in the Queensland Government SLATS spatial data to avoid double counting. Of this nearly a third, 32% happened in the most recent year of record 2018/19, representing a significant increase on previous years (Figs 1,2).

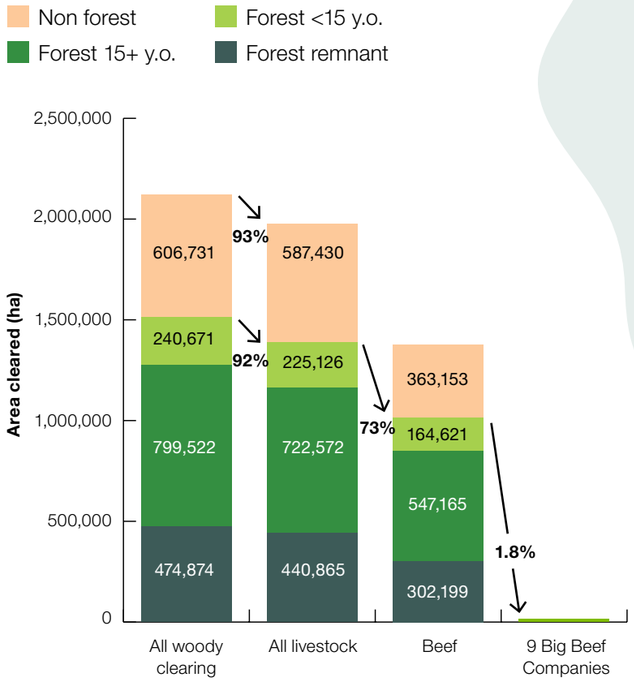


Fig. 2. Clearing of woody vegetation and in the five years from 2014/15 to 2018/19 derived from Queensland Government SLATS spatial data, broken down by vegetation type and contributions from livestock pasture development, within that for beef, and within that for nine large beef producing companies.[23]

The recent Australian State of the Environment report found *"Industry pressures [on biodiversity] are highest from extensive agriculture and land clearing, which continues to remove or fragment native ecosystems."*[20]

[15] Available from https://data.gov.au/search?q=National%20Forest%20and%20Sparse%20Woody%20Vegetation%20Data
[16] https://wwf.panda.org/discover/our_focus/forests_practice/deforestation_fronts_/
[17] https://statements.qld.gov.au/statements/84354
[18] Queensland Government (2020). Statewide Landcover and Trees Study – Methodology overview v1.0 (https://www.qld.gov.au/__data/assets/pdf_file/0033/229398/slats-methodology-overview.pdf)
[19] https://www.brisbanetimes.com.au/national/queensland/queensland-tree-clearing-figures-spark-another-debate-review-20211230-p59kyp.html
[20] p91 in Murphy H & van Leeuwen S (2021). Australia state of the environment 2021: biodiversity, independent report to the Australian Government Minister for the Environment,Commonwealth of Australia, Canberra, DOI: 10.26194/ren9-3639.
[21] Neldner V.J. et al (2017). Scientific review of the impacts of land clearing on threatened species in Queensland. Queensland Government, Brisbane.
[22] The Wilderness Society (2019). Drivers of Deforestation and land clearing in Queensland (https://www.wilderness.org.au/qlddeforestation).

[23] There are some minor divergences from official SLATS figures due to pixellation of polygon source files and due to removal of overlaps by SLATS polygons in later years to prevent double counting of areas cleared within the 5 year period.

SLATS applied the same new methodology comparing clearing detections for 2017/18 and 2018/19 but only for the Brigalow Belt bioregion. SLATS reports a 58% increase in remnant clearing and 14% increase in regrowth ("non-remnant") clearing between these two years. Based on extrapolation of these results statewide, as much as 30% of the clearing detected by SLATS in 2018/19 may be attributable to improved methods newly adopted for that year (Fig. 1 hatched bar).[24]

But this also suggests that clearing in foregoing years was substantially underestimated. Unfortunately, SLATS has announced no plans to apply the new method to prior years to enable estimation of how much past clearing was under-estimated. However, actual clearing has genuinely increased in 2018/19 relative to previous years in the five year period (Fig. 1), despite the VMA having been tightened again in mid 2018.

Most land clearing is of forests

Woody vegetation clearing is not the same as deforestation, and not all deforestation is necessarily of remnant forest.

Forest is taken to be woody vegetation with 20% or higher canopy cover, over a minimum patch size of 0.2ha, following the national definition of forest as used by the National Carbon Accounting System.[25]

Using the whole SLATS woody vegetation clearing and Foliage Projective Cover (FPC) layers, we broke woody vegetation clearing down into four classes mapped at 30m pixel scale[26]:-

1. non-forest whether remnant or non-remnant,
2. non-remnant forest less than 15 years old,
3. non-remnant forest 15+ years old ("high value regrowth" forest),
4. remnant forest.

Of a total of 2,121,798 ha of woody vegetation clearing over the five year period 2014/15 to 2018/19, 22% was of remnant forest, 38% of high value regrowth forests 15+ years old and 11% of young regrowth forests less than 15 years old, a total of 71% forest clearing (Fig. 2).

Clearing of remnant or high value regrowth forests accounted for 60% of all woody clearing (Fig. 2).

Tree clearing in Queensland is mostly exempt from any restrictions

The 2018/19 SLATS report found that 70% of all land clearing is exempt under the state VMA, but provides no breakdown into forest and non-forest, nor of forest age.[27]

Clearing of regrowth forests, even high value regrowth forests (15+ years of age), is almost entirely exempt from restrictions on the relevant state regulated vegetation map (Category X, Fig. 3).

Under the VMA, category C "high value regrowth" means regrowth 15 years and older. However, almost all such regrowth has already been "locked-in" as exempt on PMAVs and remains exempt despite it having regrown towards or even if it has returned to mature forest. Most non-forest vegetation cleared is also exempt because much of it is previously cleared non-remnant (Fig. 3).

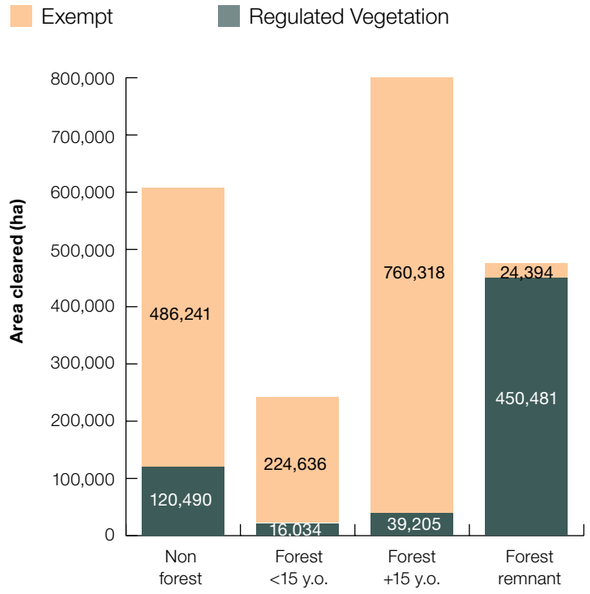


Fig 3. Woody vegetation cleared in Queensland, 2014/15 - 2018/19, classified by vegetation type and whether of regulated or exempt vegetation under the *Vegetation Management Act 1999*[28]
Note: Non-forest includes both remnant and regrowth. Regulated vegetation could be any category B, C or R. Category A is banned to all clearing and is not included in these figures.

Rainbow bee-eater
© Martin Taylor.

[24] Taylor MFJ (2022) *Deforestation in Queensland 2018/19 nearly double what Australian Government reports to the UN*. Unpublished technical report (https://www.researchgate.net/publication/360577362_Deforestation_in_Queensland_201819_nearly_double_what_Australian_Government_reports_to_the_UN).
[25] *"forest is defined as woody vegetation with a minimum 20 per cent canopy cover, at least 2 metres high and a minimum area of 0.2 hectares."* from Australian Government Department of Climate Change, Energy, the Environment and Water (2021) *National Forest and Sparse Woody Vegetation Data (Version 5.0 - 2020 Release)* (https://data.gov.au/dataset/ds-dga-69d09a6c-df77-439f-8bc7-87822cd520fd)
[26] in 2013 for forest cleared 2014/15 to 2017/18, but in 2017 for forest cleared in 2018/19.
[27] Queensland Government (2021) *2018/19 SLATS Report* (cited above).
[28] Note that regulated vegetation map used was current for April 2014 for any clearing over the 2014/15 to 2017/18 period. In mid 2018 there were significant amendments to the regulatory map. Clearing in 2018/19 is therefore referenced against the regulated vegetation map as updated in June 2018. Some of the clearing in the 2017/18 year will have fallen into the post-amendment regulatory map, not the 2014 map to which it is ascribed, leading to possible underestimation of clearing of regulated vegetation in that year.

Photo: Clearing of mature or near mature regrown forest mapped as exempt on a property map near Nanango 2019 © Martin Taylor.

Photo: Regrowing eucalypt saplings poisoned in central Queensland, 2019 © Martin Taylor.

Photo: Typical clearing of forest for pasture in central Queensland in 2019 © Martin Taylor.

Photo: Typical clearing of forest for pasture in central Queensland in 2016 © Martin Taylor.

92% of all forest clearing is for livestock pasture

Pasture clearing (including thinning[29]) accounted for 93% of all woody vegetation clearing in the five year study period and 92% of all forest clearing (Fig. 2). All other clearing purposes combined (forestry, crops, infrastructure, mines and settlements) accounted for a small fraction (7%) of all woody vegetation clearing (Fig. 2).

73% of forest clearing for pasture is for beef

We identified 54,485 land parcels where the primary or secondary land use was beef production as of 2018 according to PriceFinder land sales data. Deforestation just for pasture purposes on these properties represented 73% of all deforestation (Fig. 2), as also found in an earlier analysis.[30]

This is subject to both underestimation and overestimation errors.

Underestimation error derives from the fact that land parcels below 30ha may also be used for beef production, and land parcels which are actually used for beef production may have been missed or mis-attributed to other purposes in the database search.

Overestimation errors derives from the fact that the areas cleared include many isolated forest fragments less than 0.2ha in size, and so do not meet patch size thresholds to be considered forest prior to clearing. Applying this patch size restriction to deforestation we found that "strict" deforestation for pasture on beef properties was less than shown in Fig. 2, at 960,423 ha, representing 45% of all woody vegetation clearing for any purpose, and 67% of deforestation for all purposes of 1,428,159 ha (Table 1).

Another over-estimation error source comes from the reliance here on SLATS attribution of clearing instances to specific "replacement land cover classes". Clearing instances attributed to pasture may in fact have been for crops on a number of properties subject to clearing under former High Value Agriculture permits over the five year period. However, this error is less of concern because it is known that the crops listed as to be planted under these permits are primarily stock feed for beef cattle.

[29] Thinning was categorised as such in SLATS prior to 2018/19. In 2018/19 SLATS the categories changed to *Partial clearing major - Pasture and Partial clearing minor.* Although the latter was not attributed to pasture by SLATS, pasture is the overwhelmingly dominant purpose of partial clearing and both categories were attributed to pasture.

[30] The Wilderness Society, 2019, *Drivers of Deforestation and land clearing in Queensland* (https://www.wilderness.org.au/qlddeforestation).

Beef deforestation is widespread in Queensland

Deforestation for pastures for beef production is widespread in Queensland, with 960,423ha attributed to an estimated 7,757 of a total of 20,202 known owners of beef producing properties.[31]

Most of these owners are individuals or partnerships of named individuals (68%), and only 13% are corporate entities (Fig. 4). Properties engaging in deforestation (a minimum 0.2ha patch size per property), are widespread except in the arid west of the state (Fig. 5).

As noted above properties mapped as deforested for pasture (according to SLATS) on beef properties (according to PriceFinder data) may nonetheless include clearing for cropping especially in the lower Cape York area, although this was primarily for livestock feed crops like sorghum (Fig. 5). Both attribution sources (SLATS and PriceFinder) attribute the majority land use to pasture and beef respectively.

Weed management negligible as a driver of deforestation for pasture

It has been claimed that land clearing is necessitated by weed management.[32]

Since 2014, clearing codes[33] have allowed clearing of native vegetation incidental to removing woody weeds like prickly acacia. From the online register of code notifications[34] we found that weed management code clearing intentions were notified on 1,356 land parcels from 2014 until August 2019 over the study period.

Of 27,893 of all statewide land parcels with some deforestation for pasture (not confined to beef) over the period, only 582 had a weed management notification matching the land parcels descriptors listed in the notification register. At most only 25,000 ha -- 2% of all pasture deforestation over the study period -- might have been associated with woody weed control.

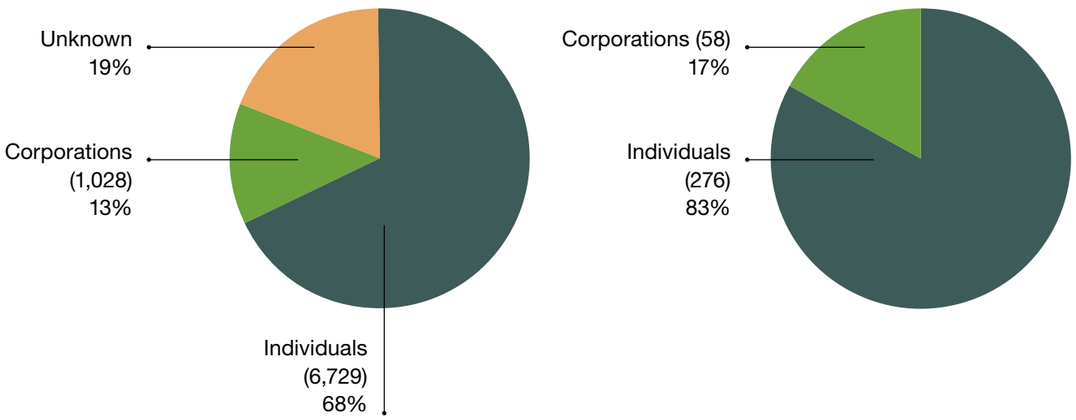


Fig. 4. Types of beef property landowners clearing forests for pasture 2014/15 - 2018/19 by property area: (LEFT) all beef producers and (RIGHT) the minority of known landowners accounting for half of all deforestation.

[31] Note as described in Methods and Caveats there are inevitable under- and over-estimation errors in counting beef property owners, despite efforts made to identify properties with the same or overlapping owners.
[32] eg recent statement that land clearing "is consistent with our need to manage noxious weeds on the property" (https://www.abc.net.au news/2022-09-28/questions-over-land-clearing-in-north-queensland/101478962)
[33] Queensland Government (2022) Clearing Approvals (webpage) (https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals)
[34] Queensland Government (2022) Vegetation management – register of accepted development vegetation clearing code notifications. (https://www.data.qld.gov.au/dataset/vegetation-management-register-of-self-assessable-code-notifications)

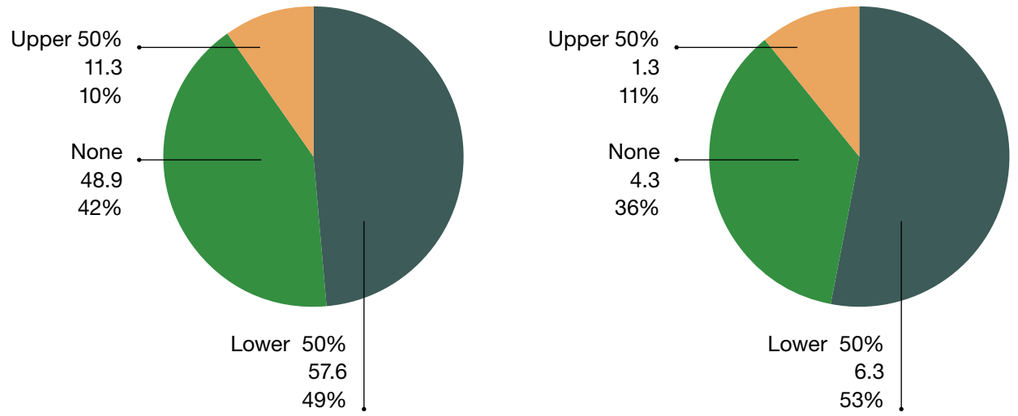


Fig. 6. Beef properties that had no deforestation, that fell in the majority lower half or in the minority upper half of total area deforested for pasture in Queensland from 2014/15 to 2018/19 showing (LEFT) areas of properties (units million hectares) and (RIGHT) estimated stock capacity (units million beef yearling steers) (see map Fig 5).

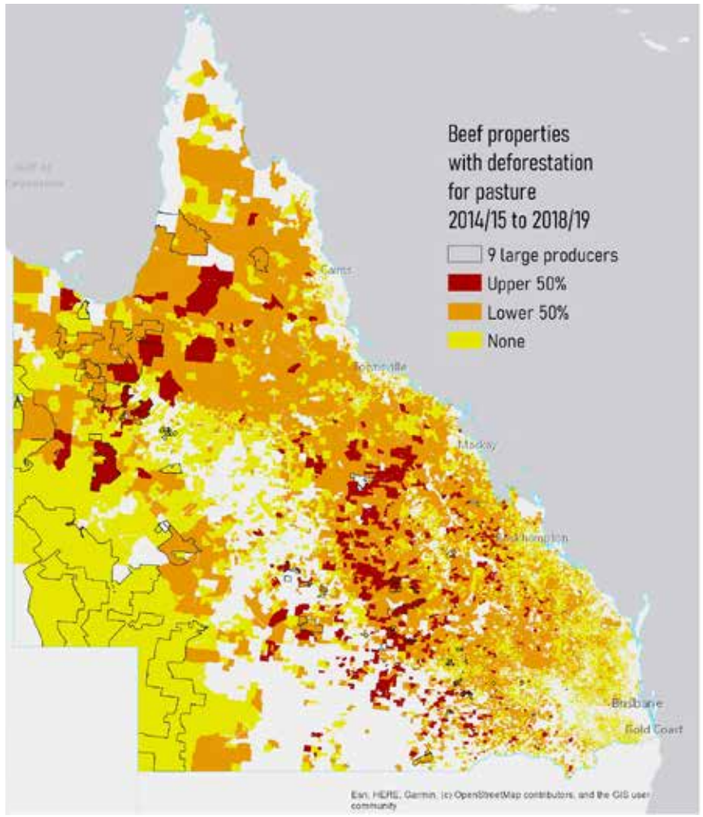


Fig. 5. Beef properties that had no deforestation, that fell in the majority lower half or in the minority upper half of total area deforested for pasture in Queensland from 2014/15 to 2018/19 (see also Fig 4). Overlaid are the properties of nine large beef producing companies. Note that these are whole properties shown, not the areas deforested.

Greater Glider
© Alamy.

A minority of properties account for most beef deforestation

Most deforestation for beef involves relatively small areas. A minority of only 276 individual and 58 corporate beef producers accounted collectively for half of all deforestation on beef properties over the five year period with properties being concentrated in central Queensland and the Gulf catchments (Figs 4, 5). These properties account for 10% by area of all beef production properties and 11% of all beef capacity in the state (Fig. 6).

Nonetheless, the majority of properties accounting for half of all deforestation, accounted for nearly half of all beef production area and 53% of beef capacity (Fig.6).

Only 36% of total beef capacity in the state did not involve deforestation over the five year period (Fig. 6).

Nine large beef companies account for relatively little deforestation

A total of 265 land parcels could be attributed to nine major beef producing companies in Queensland, covering a combined area of 16.7 million ha, nearly 10% of the entire state land area (Fig 5).

These properties have a modelled beef capacity of 0.93 million yearling steers which represents 7.8% of the whole of state beef capacity of 11.9 million yearling steers (Figs. 5,6). The modelled capacity is close to the actual Queensland cattle herd, estimated at 10.5 million by Meat and Livestock Australia. Differences between the estimates arise due to the diversity of actual cattle age structure. Not all cattle are yearling steers. Note also that dairy herds are excluded from this analysis.[35]

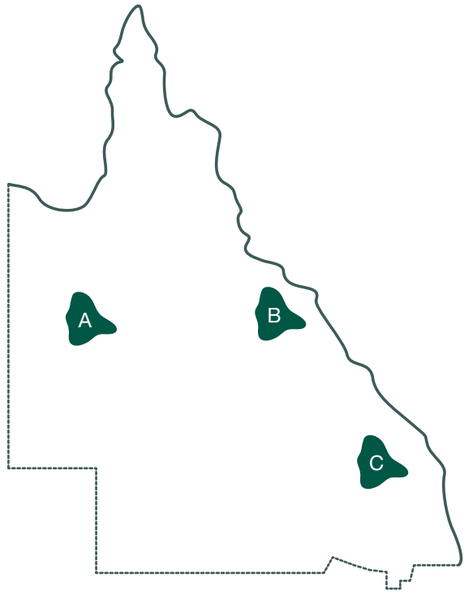
Most of the properties of the nine large companies are situated in far western arid woodlands and grasslands (Fig. 5).

Over the five years 2014/15 to 2018/19, only 1.8% of all deforestation for beef pasture fell on these properties, a total of 17,974 ha (Fig. 2), of which 48% was high value regrowth and 38% was remnant forest.

Nonetheless, some of these properties also fell within the minority accounting for 50% of beef deforestation (overlaps in Fig. 5).

These large companies usually have properties ranging right across the state and may also have properties in other states (Fig. 5). A common pattern is to have grazing lands in the western and northwestern savannahs, and higher productivity coastal or near coastal properties that may include cropping and feedlots (Fig. 7).

Intersecting the 2019 Regional Ecosystems map with the map of these properties, we found that 97% of total land area of these properties is remnant vegetation, and most of it non-forest vegetation.



A

B

C

Fig. 7. Parts of widely separated properties under the same beef production company: A) sparse woody grazing land partly cleared in the western arid zone; B) mostly cleared pastures on the central coast, and C) intensive irrigated farming and feedlot production on the Darling Downs. Imagery courtesy of Bing.

[35] Meat and Livestock Australia (2022) Cattle numbers – as at June 2020 by Natural Resource Management Region (https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/fast-facts--maps/mla_cattle-numbers-map-2022-as-at-june-2020-data.pdf)

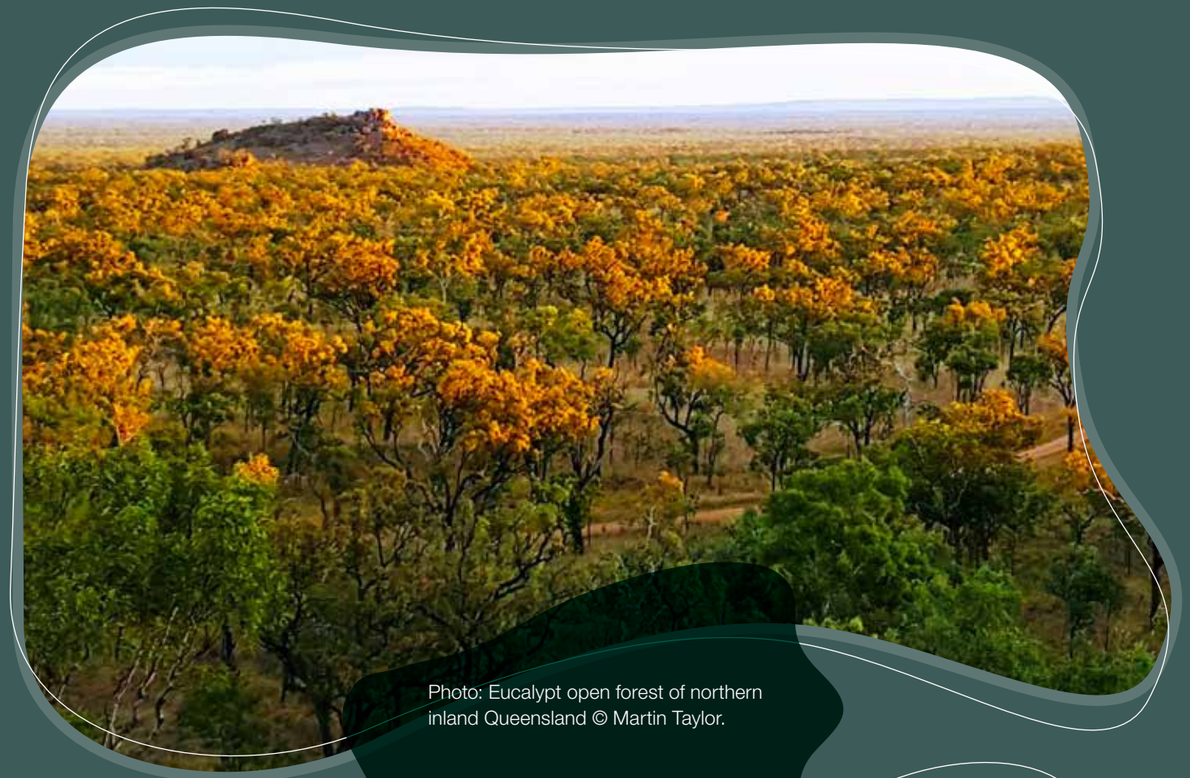
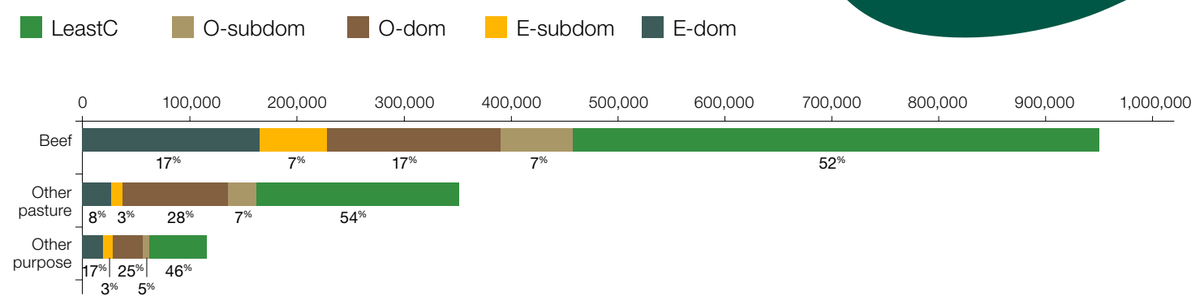


Photo: Eucalypt open forest of northern inland Queensland © Martin Taylor.

Photo: Remnant of the endangered Brigalow ecological community in a road reserve in the western Darling Downs © Martin Taylor.



VMA status (2019)	Beef	Other pasture	Other purpose	Total
E-dom	165,505	27,146	19,209	211,860
E-subdom	62,539	10,340	8,973	81,852
O-dom	161,547	98,444	28,688	288,679
O-subdom	68,667	26,233	6,225	101,125
LeastC	502,165	189,615	52,863	744,643
Total	960,423	351,779	115,957	1,428,159

Fig. 8 and Table 1. Threat status of regional ecosystems deforested for beef and other purposes (% and ha). Note the x-axis area scale is broken between 0.5 and 1 million ha deforested. Key: E-dom = endangered REs 100% or dominant in area deforested, E-subdom = endangered REs sub-dominant,O-dom = of-concern REs100% or dominant, O-subdom = of-concern REs sub-dominant, LeastC = only least concern REs deforested.

Beef dominates deforestation of Queensland threatened regional ecosystems

Deforestation for beef doesn't just impact common forest ecosystems. Threatened ecosystems comprised 48% of the area deforested for pasture on beef properties (Fig. 8, Table 1).

These regional ecosystems are listed (as of 2019) under the VMA as Endangered or Of-Concern, with endangered ecosystems comprising a quarter of beef deforestation (24%) (Fig. 8). Note that deforestation includes both remnant and non-remnant regrowth forests.

Proportions of threatened ecosystems deforested for beef were similar to those for other pasture clearing and clearing for other purposes (Fig. 8). However, just as beef pasture dominated all clearing (Fig. 2), it also dominated the deforestation of threatened ecosystems, with 78% of all deforestation of Endangered ecosystems and 59% of Of-concern ecosystems attributed to pasture on beef properties over the five year study period (Table 1).

Beef dominates deforestation of threatened ecological communities

Deforestation of ecological communities and species listed as threatened under the national *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), was also dominated by deforestation for pastures on beef properties.

For four of fourteen endangered ecological communities experiencing deforestation over the period in Queensland, proportions due to beef deforestation were over 80% (* in Table 2). All others ranged from 8 to 76% (Table 2).

- Endangered Brigalow suffered the highest loss relative to total distribution due to beef deforestation of any TEC with 24,790 ha deforested (23.4 ha per 1000 ha of total likely habitat, or 2.34%, Table 2, line 1).
- Endangered Poplar Box Grassy Woodland suffered the greatest area of absolute beef deforestation of 327,048 ha representing 1.29% of all such habitat (Table 2, line 2).

Table 2. Areas of "likely-to-occur" distributions of threatened ecological communities (TECs) deforested 2014/15 to 2018/19 in Queensland.

ID	TEC[36]	Status (2022)	Total area likely (ha)	Beef deforested (ha)	All purposes (ha)	Beef of all deforested (%)	Of total likely (ha/1000ha)
28	Brigalow*	EN	1,057,809	24,790	29,880	83%	23.4
141	Poplar Box Grassy Woodland*	EN	25,254,806	327,048	385,452	85%	12.9
98	Weeping Myall Woodlands	EN	2,633,341	21,187	27,826	76%	8.0
24	Semi-evergreen vine thicket*	EN	378,448	2,574	3,141	82%	6.8
43	Box Gum Grassy Woodland	CE	484,046	1,825	3,474	53%	3.8
122	Broad leaf tea-tree	EN	54,352	144	567	25%	2.6
171	Coastal Swamp Sclerophyll Forest	EN	1,122,400	2,079	10,762	19%	1.9
26	Great Artesian Basin Springs*	EN	1,143,335	1,789	2,121	84%	1.6
170	Lowland tropical rainforest	EN	171,404	80	549	15%	0.5
101	Lowland Subtropical Rainforest	CE	906,969	263	1,251	21%	0.3
66	Coolibah - Black Box Woodlands	EN	2,225,652	570	2,584	22%	0.3
118	Coastal Saltmarsh	VU	333,662	35	83	42%	0.1
142	Coastal Swamp Oak	EN	89,410	8	69	12%	0.1
76	Littoral Rainforest	CE	52,184	3	39	8%	0.1

[36] Names of TECs have been simplified. Original names can be checked by entering ID number into SPRAT search tool at http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl
* TECs with more than 80% of all deforestation for beef pastures.

Poplar Box Grassy Woodland on Alluvial Plains. (Photo credit: Rosemary Purdie). Reproduced from the *Conservation Advice (including listing advice) for the Poplar Box Grassy Woodland on Alluvial Plains*[37].

Fig. 9. Satellite imagery shows (yellow outline) Northern Hairy Nosed Wombat "likely-to-occur" habitat in and around Epping Forest National Park in central Qld as mapped by the federal Environment Dept (LEFT) in 2013 prior to, and (RIGHT) 2017 after clearing of two patches arrowed and labelled on map (Images from Landsat served through Google Earth Pro).

[37] http://www.environment.gov.au/biodiversity/threatened/communities/pubs/141pb-conservation-advice.pdf

Beef dominates deforestation of threatened species habitats

Deforestation destroyed "likely-to-occur" habitat for 388 terrestrial plants and animals listed as threatened by the Australian Government under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* (Table 3). This included 37 critically endangered species and 124 endangered species. Threatened plants dominated the list of species affected (280 out of 388 or 72%) (Table 3). The 388 species and areas of habitat deforested are listed in Appendix 1.

Extracted from this list in Table 4 are 58 species (41 plants, 17 animals) for which beef pasture deforestation comprised at least half of all deforestation of their "likely-to-occur" habitat, and for which in addition, the loss of total "likely-to-occur" habitat to beef pasture exceeded 0.5% (5 ha/1000ha).

- The then vulnerable, now endangered Koala lost 0.65% of its entire "likely-to-occur" habitat to beef pasture deforestation in just this five year study period, representing 73% of all deforestation statewide (Table 4).
- The critically endangered Northern Hairy Nosed Wombat has a tiny area of "likely-to-occur" habitat mapped around and including its last wild refuge of Epping Forest National Park in central Queensland. Regardless how endangered this rare animal is, patches of "likely-to-occur" habitat were cleared nearby over the period (Table 4, Fig 9).

These figures are the areas of overlap with publicly available maps of "likely-to-occur" habitats as published by the Australian Government. Because these maps are not ground-truthed the resulting figures are subject to over-estimation and under-estimation errors.

Underestimation errors occur for the proportions of total "likely-to-occur" habitat deforested because not all "likely-to-occur" habitat on the maps is or was actually forested, meaning that the areas of total "likely-to-occur" forest habitat are overestimated at the time of clearing. This is evident in Fig 9 where the "likely-to-occur" habitat for Northern Hairy Nosed Wombat includes areas long deforested surrounding the national park. Also this is the only habitat patch mapped by the Dept as habitat. Large areas of remnant forest known to be suitable for the wombat are not included, and neither is the habitat occupied by the colony established further south near St George in 2009.[38]

Conversely, due to the generic and often crude nature of the habitat maps, a patch of forest that was cleared in a given location may not necessarily represent occupied, actual or even potential habitat for that species or community, leading to over-estimation of the areas of habitat deforested. This is also evident in Fig 9 where "likely-to-occur" habitat for Northern Hairy Nosed Wombat consists of large blocks, with very coarse resolution.

Elsewhere it has been shown that in the two years prior to release of the 2018/19 SLATS data:[39]

"Habitats for 265 EPBC Act-listed threatened species covering almost 250,000 hectares were destroyed between 2016 and 2018 in Queensland, with no evidence of any referral and approval under the EPBC Act, including 50,000 hectares of koala habitat.

Of this destruction, 94% was for livestock pasture development, and 79% fell in just two bioregions: Brigalow Belt and Mulga Lands."

This analysis suggests that harm to matters of national significance may be continuing on these beef properties at significant scales.

[38] https://www.qld.gov.au/environment/plants-animals/conservation/threatened-wildlife/threatened-species/featured-projects/northern-hairy-nosed-wombat/creating-new-populations

[39] Taylor MFJ & Blanch S (2021) Pervasive inaction on national conservation law in Queensland 2016-18. WWF report. (https://www.wwf.org.au/ArticleDocuments/353/pub-pervasive-inaction-on-national-conservation-law-in-queensland-2016-18-Nov20.pdf.aspx)

Table 3. Numbers of nationally threatened species losing at least 1ha of "likely-to-occur" habitat to deforestation in Queensland 2014/15 to 2018/19 by taxon group and current status under the EPBC Act.

Taxon	CE	EN	VU	Total
1 Plants	15	85	180	280
2 Invertebrates	3	3		6
3 Frogs	9	4	5	18
4 Reptiles	3	4	12	19
5 Birds	6	16	11	33
6 Mammals	1	12	19	32
Total	37	124	227	388

Table 4. Threatened species losing at least 1 ha of "likely-to-occur" habitat to deforestation 2014/15 to 2018/19 in Queensland, at least half of that to beef pasture and at least 0.5% of all "likely-to-occur" habitat.

Taxon	Species	Status	All likely (ha)	Beef deforestation (ha)	All deforestation (ha)	Beef deforestation (%)	Beef (ha/1000 ha of all likely)
6 Mammals	Northern Hairy-nosed Wombat	CE	3,992	44	44	100%	11.0
6 Mammals	Koala	EN	76,481,458	496,650	673,311	74%	6.5
6 Mammals	Yellow-footed Rock-wallaby	VU	3,024,595	16,609	21,531	77%	5.5
6 Mammals	Greater Glider	VU	32,948,326	164,993	242,284	68%	5.0
5 Birds	Squatter Pigeon	VU	27,697,665	446,350	522,747	85%	16.1
5 Birds	Star Finch	EN	43,787,838	372,302	435,185	86%	8.5
5 Birds	Southern Black-throated Finch	EN	10,128,296	85,387	93,102	92%	8.4
4 Reptiles	Fitzroy River Turtle	VU	6,663,388	131,624	143,550	92%	19.8
4 Reptiles	Ornamental Snake	VU	8,670,548	157,677	173,978	91%	18.2
4 Reptiles	Allan's Lerista	EN	329,747	5,661	5,965	95%	17.2
4 Reptiles	Southern Snapping Turtle	CE	1,675,875	24,867	30,746	81%	14.8
4 Reptiles	Yakka Skink	VU	12,644,412	158,055	197,053	80%	12.5
4 Reptiles	Dunmall's Snake	VU	1,058,176	11,887	18,110	66%	11.2
4 Reptiles	Nangur Spiny Skink	CE	44,312	381	501	76%	8.6
4 Reptiles	Adorned Delma	VU	1,146,936	8,374	14,920	56%	7.3
2 Invertebrates	Boggomoss Snail	CE	40,356	614	747	82%	15.2
2 Invertebrates	Dulacca Woodland Snail	EN	554,508	7,732	9,617	80%	13.9

Taxon	Species	Status	All likely (ha)	Beef deforestation (ha)	All deforestation (ha)	Beef deforestation (%)	Beef (ha/1000 ha of all likely)
1 Plants	Proston Lasiopetalum	CE	9,419	280	469	60%	29.7
1 Plants	Acacia deuteroneura	VU	39,108	1,044	1,064	98%	26.7
1 Plants	Three-veined Hakea	VU	98,685	1,915	1,951	98%	19.4
1 Plants	Zieria verrucosa	VU	86,576	1,647	2,111	78%	19.0
1 Plants	Pultenaea setulosa	VU	104,262	1,971	2,038	97%	18.9
1 Plants	Neoroepera buxifolia	VU	51,789	967	988	98%	18.7
1 Plants	Glen Geddes Bloodwood	VU	109,140	1,932	2,219	87%	17.7
1 Plants	Corymbia clandestina	VU	44,684	763	816	93%	17.1
1 Plants	Capparis thozetiana	VU	49,400	809	824	98%	16.4
1 Plants	Ooline	VU	17,020,086	268,305	333,671	80%	15.8
1 Plants	Solanum johnsonianum	EN	254,746	3,971	4,364	91%	15.6
1 Plants	Solanum dissectum	EN	258,471	4,028	4,421	91%	15.6
1 Plants	Tara Wattle	VU	91,756	1,395	2,059	68%	15.2
1 Plants	Macrozamia platyrhachis	EN	326,713	4,527	4,719	96%	13.9
1 Plants	Pimelea leptospermoides	VU	108,288	1,444	1,796	80%	13.3
1 Plants	Small-leaved Denhamia	VU	584,621	7,763	10,197	76%	13.3
1 Plants	Macrozamia conferta	VU	152,267	1,939	3,647	53%	12.7
1 Plants	Polianthion minutiflorum	VU	103,552	1,311	1,912	69%	12.7
1 Plants	Eucalyptus virens	VU	1,333,206	16,856	19,348	87%	12.6
1 Plants	Xerothamnella herbacea	EN	464,602	5,605	6,441	87%	12.1
1 Plants	Westringia parvifolia	VU	544,061	6,201	10,060	62%	11.4
1 Plants	Yarwun Whitewood	EN	6,864	78	133	58%	11.3
1 Plants	Rhaphidospora bonneyana	VU	304,503	3,430	3,834	89%	11.3
1 Plants	Queensland White Gum	VU	41,060	451	601	75%	11.0
1 Plants	Bertya opponens	VU	430,183	4,321	6,428	67%	10.0
1 Plants	Mt Berryman Phebalium	CE	897,646	8,937	12,515	71%	10.0
1 Plants	Pomaderris clivicola	VU	6,120	60	70	86%	9.9
1 Plants	Cycas megacarpa	EN	2,077,424	19,447	35,445	55%	9.4
1 Plants	Prostanthera sp. Dunmore	VU	45,715	427	606	71%	9.3
1 Plants	Macrozamia cranei	EN	205,622	1,916	3,730	51%	9.3

Taxon	Species	Status	All likely (ha)	Beef deforestation (ha)	All deforestation (ha)	Beef deforestation (%)	Beef (ha/1000 ha of all likely)
1 Plants	Black Ironbox	VU	4,906,658	38,931	46,867	83%	7.9
1 Plants	Microcarpaea agonis	EN	3,926	30	34	87%	7.6
1 Plants	Cycas ophiolitica	EN	1,010,729	7,559	10,540	72%	7.5
1 Plants	Marsdenia brevifolia	VU	1,508,833	11,121	12,818	87%	7.4
1 Plants	Calytrix gurulmundensis	VU	79,841	570	949	60%	7.1
1 Plants	Bean's Ironbark	VU	36,662	243	270	90%	6.6
1 Plants	King Blue-grass	EN	3,178,238	20,844	26,494	79%	6.6
1 Plants	Aristida annua	VU	520,101	3,347	3,589	93%	6.4
1 Plants	Bertya calycina	VU	32,135	195	355	55%	6.1
1 Plants	Bluegrass	VU	36,019,253	211,985	275,409	77%	5.9
1 Plants	Germainia capitata	VU	116,654	599	973	62%	5.1

The endangered Koala in the South East Queensland bioregion © Martin Taylor.

Non-forest species and ecosystems also impacted by clearing

Although we have focussed on impacts of deforestation in this analysis, there is also extensive clearing of non-forest ecosystems negatively affecting grassland and savannah threatened species such as the Gouldian Finch, the Night Parrot and Bluegrass.

Ending deforestation

These results suggest that major steps toward ending deforestation in Queensland and the harm to native species and ecosystems that results, could be made by a relatively small number of actors changing their behaviour:- the minority responsible for the "lion's share" of deforestation and those few large producers.

Of total deforestation for pasture on beef properties, half was attributable to a minority of just 334 landholders. If just these producers committed to deforestation free-production, a very substantial reduction in statewide deforestation would result.

Nine large beef producing companies are responsible for a relatively small amount of overall deforestation compared with the huge scale of their property portfolios. It should therefore be a relatively minor task for these companies to commit to halting all future deforestation, a commitment readily open to third party auditing using freely available spatial data such as that provided by SLATS.

Reversing deforestation

By ending deforestation, including regrowing forests previously cleared, beef producers would also be making a major contribution to reversing deforestation.

Most regrowth forest is exempt under the Queensland VMA and can be, and is, recleared at any time without restraint. By halting re-clearing once regrowth retains forest status, a massive reversal of deforestation would ensue with many if not most threatened regional ecosystems unique to Queensland recovering and eventually coming off the threatened list.

Replanting should be unnecessary because there is usually already abundant regrowth of brigalow in particular, which will grow back if allowed to do so (Fig. 10).

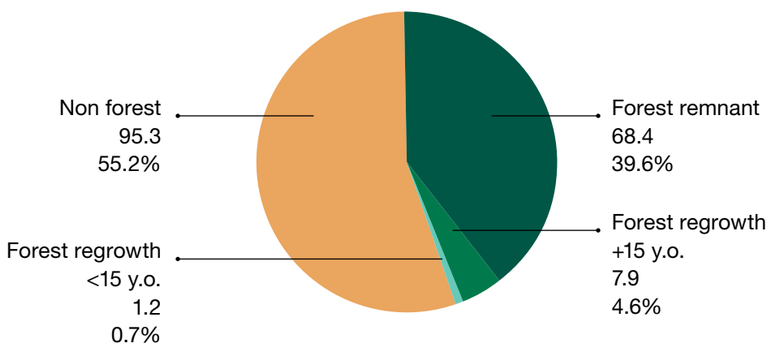


Fig. 10. Vegetation composition in Queensland, 2017-18. Note that a portion of what was non-forest at the time of this analysis may also regrow to forest if allowed to do so. At the time of analysis canopy cover had not reached the 20% threshold to be considered forest.

Methods

1. Beef properties layers

A set of 54,485 land parcels were identified from earlier work as being for beef production either as the primary or the secondary land use. Ownership was duplicated or similar for many properties. We removed punctuation and standardised spellings and abbreviations to reveal identities otherwise not evident. To get a more accurate picture of true ownership and control we lumped together properties with same person or corporation including where multiple people or corporate names were listed against the same parcel usually family members or family companies. Owners were classified as individuals (including partnerships) or corporations, otherwise unknown.

A further 269 land parcels in Queensland were identified as being owned or managed by one of nine large beef producers who have significant operations in Queensland.[40]

2. Vegetation type layer

To classify clearing over the four years 2014/15 to 2017/18 by type of vegetation, we constructed a raster layer of four classes:

1. Non-forest in 2014, identified as any pixels less than 11% Foliage Projective Cover (FPC) in the FPC product for that year produced by SLATS (11% is the SLATS FPC equivalent of 20% canopy cover).[41]
2. Forest in 2014 (all pixels other than in 1 above), non-remnant but younger than 15 years. Pixels were non-remnant if mapped as such in archived Queensland Government's Regional Ecosystems version 9 (REs v9) which was current to 2013. Some unmapped blank spots in version 9 in western Queensland had to be backfilled from the more complete archived RE version 10 current to 2015. If a pixel fell within any of the footprints of woody cover loss from the 15 SLATS layers from 1999/2000 to 2013/14 they were deemed to be less than 15 years old.
3. Forest in 2014, non-remnant but 15 years or older. Any other non-remnant pixels other than in 1 or 2 above.
4. Remnant forest in 2014, where pixels overlapped areas deemed remnant in REs v9 as described above. However, if pixels were cleared at any time in the entire SLATS record, we reclassified them as either 2 or 3 above depending when the most recent clearing event happened.

We did not attempt to derive a similar age class and type layer for vegetation as it was prior to each of the four years simply because suitable FPC and regional ecosystem layers of the right time currencies were not available to do so.

To classify clearing over the most recent 2018/19 SLATS period, by type of vegetation, we constructed a similar raster layer for 2018 of the same four vegetation age and type classes, but using instead the 2018 FPC layer and the REs v11 layer current to 2017, the closest available.

All rasters were 30m x 30m pixel size in the Albers Conical Equal Area projection aligned to the same template.

3. Clearing by vegetation type

We converted SLATS polygons for each of the five years 2014/15 to 2018/19 to rasters aligned to the template with values aligned to the same 8 level purpose types (0 natural loss, 1 pasture, 2 pasture thinning (partial clearing), 3 forestry (including partial forestry clearing), 4 crops, 5 Infrastructure, 6 Mining and 7 Settlements). We combined these rasters into single raster classified by year of clearing and purpose.

For pixels cleared a second time within the five year study period, we assigned the first year of clearing to the pixel to avoid double counting.

Using raster arithmetic we summed areas cleared in each year in each of the four vegetation classes derived above on each lot.

[40] The Wilderness Society (2019) Drivers of Deforestation and land clearing in Queensland (https://www.wilderness.org.au/qlddeforestation).
[41] Scarth P (2012) On the relationship between crown cover, foliage projective cover and leaf area index. figshare. *Journal contribution*. https://doi.org/10.6084/m9.figshare.94249.v1

4. Deforestation layer

We then extracted just the areas of forest cleared over the 5 year period condensed into two classes: pasture clearing and other clearing purposes. This raster we converted back to polygons, and excluded all isolated fragments less than 0.2ha. By unioning this with the beef property layer, we classified areas deforested into three categories: a) clearing for beef pasture, b) for other pasture and c) other non-pasture clearing.

5. Beef properties by beef pasture deforestation

We intersected a) beef pasture clearing from (4) above with the property layers of all beef properties and the properties of the nine large producers and calculated areas of forest cleared for pasture on both sets.

From this we were able to classify each beef property as a) not deforesting at all, b) belonging to the minority of owners responsible for half of all beef pasture deforestation or c) belonging to the majority of smaller scale clearers responsible for the other half.

6. Deforestation of threatened ecosystems and species

We dissolved the Queensland Regional Ecosystems version 12.2 current to 2019,[42] by the VMpoly field which lists the status of each polygon by current Vegetation Management Act threatened status whether least concern, endangered or of concern, within those whether dominant or sub-dominant. For non-remnant areas on the present day layer, we substituted in the pre-clearing VMpoly values.

We then intersected these by the deforestation layer from (4) above and tabulated areas.

Finally, we intersected the Australian Government's "likely-to-occur" maps for threatened species and ecological communities by deforestation layer (4) and tabulated areas of habitats deforested.[43]

7. Estimating cattle production capacity

To estimate cattle production capacity for all beef properties or for the properties of the nine companies, we downloaded a layer of beef stocking densities from the portfolio of layers used in the Multi-Criteria Analysis Shell for Spatial Decision Support and served on the Terrestrial Ecosystem Research Network portal.[44] Units are in "dry sheep equivalents" per hectare and pixel sizes 1km x 1km. We converted these to yearling steer equivalents per 1000 ha using an average of 8 DSEs per yearling steer.[45] We used the 2012-2017 Queensland Land Use layer[46] to clip this layer only to land uses that are relatively undeveloped but excluding all protected areas. We used this layer to sum the totals of predicted yearling steer capacities for the whole state within the footprints of beef producing properties as classified in (5) above.

[42] Department of Environment and Science (2022) *Biodiversity status of pre-clearing and 2019 remnant regional ecosystems - Queensland series* (https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={01972496-CD6D-4314-B0C0-DA0E0421FB0A}).

[43] Australian Government Department of Climate Change, Energy, the Environment and Water (2022) *Australia - Species of National Environmental Significance Distributions (public grids)* and *Australia - Ecological Communities of National Environmental Significance Distributions (public grids)* (both downloaded March 2022 from http://www.environment.gov.au/fed/catalog/search/search.page).

[44] https://mcas.ternlandscapes.net.au/mcas-s/ downloaded 25/8/2022.

[45] Meat and Livestock Australia (2022) Stocking rate (webpage https://www.mla.com.au/extension-training-and-tools/feedbase-hub/persistent-pastures grazing-management/stocking-rate).

[46] Department of Environment and Science (2019) *Land use mapping - 1999 to Current - Queensland* (https://qldspatial.information.qld.gov.au/catalogue custom/detail.page?fid={273F1E50-DD95-4772-BD6C-5C1963CAA594}) extracting only Grazing, Minimum use, Forestry, Rural residential and Marsh land uses

Caveats

No implication is made from this analysis that any landholder the subject of this study has cleared unlawfully or improperly. No analysis of the legal authorities for the tree clearing observed was conducted for this report.

In ascribing land parcels to particular owners, errors may result from the passing of time. Landholders may have sold off properties since this search was conducted and may have purchased others not shown in this analysis.

Areas derived for clearing after conversion from polygons to rasters are subject to minor inaccuracies due to pixelation of more precise polygon boundaries.

Whether areas are accurately described as forest on the basis solely of FPC is also subject to errors. The FPC product is itself subject to error in modelling actual foliage cover from satellite imagery[47]. Also some areas in the arid woodlands and savannahs in particular can fluctuate around the 11% FPC (20% canopy cover) threshold from year to year between nominal "forest" and "non-forest" on the basis of fire, drought or other natural fluctuations alone, with no change in numbers of live standing trees. Also FPC contains no information about species or vegetation height. So it is possible that areas deemed to be forest based on FPC alone, may in fact be low woody shrubland.

Similarly it is possible that some areas, including those cleared, may have included non-native woody weeds like prickly acacia. There is no way available to a desktop analysis to estimate this error. However by quantifying which properties notified for woody weed control under the relevant code we determined that this contribution must be low. In any case, the whole point of notification under the weed management code is that native vegetation would be cleared or killed in the process of killing exotic weeds.

Grey-headed flying fox
© Martin Taylor.

By age-classifying the vegetation we hoped to reduce some of the uncertainty about whether regrowth cleared was in fact a genuine forest. For ages below 15 years, uncertainty is relatively high. For ages 15 and above however, confidence that the area cleared was genuine forest is high.

All errors and omissions are the author's own.

[47] Refer to the error declaration in the metadata https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={DB2F7E79-6D91-4CF2-806C-E25FF982C6E6}

Appendix 1. Threatened species losing at least 1 ha of habitat to deforestation 2014/15 to 2018/19 in Queensland.

Taxon	Species	Status	Total likely (ha)	Beef deforestation (ha)	All deforestation (ha)	Beef (% of all)	Beef (ha/1000ha of Total likely)
6 Mammals	Northern Hairy-nosed Wombat	CE	3,992	44	44	100.00%	11.0
6 Mammals	Koala	EN	76,481,458	496,650	673,311	73.76%	6.5
6 Mammals	Yellow-footed Rock-wallaby	VU	3,024,595	16,609	21,531	77.14%	5.5
6 Mammals	Greater Glider	VU	32,948,326	164,993	242,284	68.10%	5.0
6 Mammals	Northern Quoll	EN	100,100,890	218,045	313,050	69.65%	2.2
6 Mammals	Grey-headed Flying-fox	VU	28,275,335	58,800	129,884	45.27%	2.1
6 Mammals	Large-eared Pied Bat	VU	24,879,217	49,544	78,191	63.36%	2.0
6 Mammals	Mahogany Glider	EN	359,967	537	5,367	10.00%	1.5
6 Mammals	Yellow-bellied Glider	VU	28,173,888	41,066	75,778	54.19%	1.5
6 Mammals	Corben's Long-eared Bat	VU	32,683,233	44,871	79,894	56.16%	1.4
6 Mammals	Bridled Nail-tail Wallaby	EN	251,746	265	356	74.42%	1.1
6 Mammals	New Holland Mouse	VU	10,712,131	6,655	17,056	39.02%	0.6
6 Mammals	Julia Creek Dunnart	VU	2,784,496	1,628	1,705	95.50%	0.6
6 Mammals	Brush-tailed Rock-wallaby	VU	12,511,892	7,278	16,159	45.04%	0.6
6 Mammals	Black-footed Tree-rat	VU	3,703,135	1,848	2,957	62.50%	0.5
6 Mammals	Ghost Bat	VU	89,870,153	44,050	66,759	65.98%	0.5
6 Mammals	Large-eared Horseshoe Bat	VU	11,766,749	5,212	11,242	46.37%	0.4
6 Mammals	Spectacled Flying-fox	EN	1,472,466	631	6,177	10.21%	0.4
6 Mammals	Proserpine Rock-wallaby	EN	71,220	24	80	30.07%	0.3
6 Mammals	Water Mouse	VU	10,138,228	3,307	13,339	24.79%	0.3
6 Mammals	Spot-tailed Quoll	EN	26,368,606	7,827	26,383	29.67%	0.3
6 Mammals	Mount Claro Rock Wallaby	VU	487,240	130	171	76.13%	0.3
6 Mammals	Long-nosed Potoroo	VU	4,803,427	745	4,424	16.84%	0.2
6 Mammals	Yellow-bellied Glider	EN	236,100	36	218	16.59%	0.2
6 Mammals	Bare-rumped Sheath-tailed Bat	VU	20,847,115	3,148	12,632	24.92%	0.2
6 Mammals	Hastings River Mouse	EN	1,246,170	160	353	45.26%	0.1
6 Mammals	Northern Bettong	EN	180,164	23	291	7.73%	0.1
6 Mammals	Spotted-tailed Quoll	EN	425,576	42	330	12.81%	0.1
6 Mammals	Cape York Rock-wallaby	EN	1,099,353	92	191	48.28%	0.1
6 Mammals	Semon's Leaf-nosed Bat	VU	92,356	2	17	10.94%	0.0
6 Mammals	Northern Brushtail Possum	VU	30,616,911	16	16	100.00%	0.0
6 Mammals	Greater Bilby	VU	50,796,747		4	0.00%	0.0
5 Birds	Squatter Pigeon	VU	27,697,665	446,350	522,747	85.39%	16.1
5 Birds	Star Finch	EN	43,787,838	372,302	435,185	85.55%	8.5
5 Birds	Southern Black-throated Finch	EN	10,128,296	85,387	93,102	91.71%	8.4
5 Birds	Capricorn Yellow Chat	CE	465,994	2,097	2,401	87.32%	4.5
5 Birds	Black-breasted Button-quail	VU	5,251,642	23,346	60,689	38.47%	4.4
5 Birds	Red Goshawk	VU	140,961,909	479,481	632,032	75.86%	3.4
5 Birds	Australian Painted Snipe	EN	123,716,780	301,357	472,922	63.72%	2.4
5 Birds	Coxen's Fig-Parrot	EN	955,950	2,296	8,307	27.64%	2.4
5 Birds	Painted Honeyeater	VU	90,497,617	171,677	352,008	48.77%	1.9
5 Birds	White-throated Needletail	VU	65,599,744	78,615	185,726	42.33%	1.2
5 Birds	Grey Falcon	VU	401,637,866	395,883	775,546	51.05%	1.0
5 Birds	Plains-wanderer	CE	27,711,999	19,603	51,886	37.78%	0.7
5 Birds	Gouldian Finch	EN	59,067,255	28,241	29,722	95.02%	0.5
5 Birds	Buff-breasted Button-quail	EN	3,369,079	1,278	8,103	15.78%	0.4
5 Birds	Regent Honeyeater	CE	33,965,104	9,424	31,691	29.74%	0.3
5 Birds	Swift Parrot	CE	34,238,495	8,968	35,696	25.12%	0.3
5 Birds	Nunivak Bar-tailed Godwit	VU	3,909,869	1,022	4,779	21.40%	0.3
5 Birds	Southern Cassowary	EN	2,521,472	535	6,786	7.88%	0.2
5 Birds	Golden-shouldered Parrot	EN	2,088,356	337	544	62.03%	0.2
5 Birds	Eastern Bristlebird	EN	570,273	81	167	48.27%	0.1
5 Birds	Great Knot	CE	3,160,684	388	962	40.36%	0.1
5 Birds	Red Knot	EN	6,271,204	742	3,291	22.54%	0.1
5 Birds	Fairy Prion	VU	5,165,608	573	2,949	19.43%	0.1
5 Birds	Curlew Sandpiper	CE	12,858,064	1,305	5,132	25.43%	0.1
5 Birds	Masked Owl	VU	37,326,992	2,311	13,014	17.76%	0.1
5 Birds	Night Parrot	EN	81,619,147	4,875	7,158	68.11%	0.1
5 Birds	Palm Cockatoo	VU	4,770,242	210	9,948	2.11%	0.0
5 Birds	Rufous Scrub-bird	EN	703,922	25	162	15.24%	0.0
5 Birds	Australasian Bittern	EN	23,206,850	776	16,120	4.82%	0.0

Taxon	Species	Status	Total likely (ha)	Beef deforestation (ha)	All deforestation (ha)	Beef (% of all)	Beef (ha/1000ha of Total likely)
5 Birds	Carpentarian Grasswren	EN	2,458,466	52	98	53.50%	0.0
5 Birds	Crimson Finch	EN	1,881,196	11	82	13.82%	0.0
5 Birds	White-bellied Storm-Petrel	VU	326,980,292	216	714	30.18%	0.0
5 Birds	Bulloo Grey Grasswren	EN	2,709,065		3	0.00%	0.0
4 Reptiles	Fitzroy River Turtle	VU	6,663,388	131,624	143,550	91.69%	19.8
4 Reptiles	Ornamental Snake	VU	8,670,548	157,677	173,978	90.63%	18.2
4 Reptiles	Allan's Lerista	EN	329,747	5,661	5,965	94.90%	17.2
4 Reptiles	Southern Snapping Turtle	CE	1,675,875	24,867	30,746	80.88%	14.8
4 Reptiles	Yakka Skink	VU	12,644,412	158,055	197,053	80.21%	12.5
4 Reptiles	Dunmall's Snake	VU	1,058,176	11,887	18,110	65.64%	11.2
4 Reptiles	Nangur Spiny Skink	CE	44,312	381	501	76.03%	8.6
4 Reptiles	Adorned Delma	VU	1,146,936	8,374	14,920	56.12%	7.3
4 Reptiles	Mary River Turtle	EN	388,092	1,061	14,001	7.58%	2.7
4 Reptiles	Border Thick-tailed Gecko	VU	4,766,431	6,437	14,637	43.98%	1.4
4 Reptiles	Three-toed Snake-tooth Skink	VU	1,221,971	761	10,728	7.09%	0.6
4 Reptiles	Five-clawed Worm-skink	VU	1,419,713	824	1,882	43.79%	0.6
4 Reptiles	Gulbaru Gecko	CE	23,269	5	18	27.11%	0.2
4 Reptiles	Atherton Delma	VU	321,970	51	130	39.08%	0.2
4 Reptiles	Mount Cooper Striped Skink	VU	178,663	27	27	100.00%	0.2
4 Reptiles	Condamine Earless Dragon	EN	316,143	32	161	20.09%	0.1
4 Reptiles	Plains Death Adder	VU	20,876,979	2,091	3,288	63.59%	0.1
4 Reptiles	Gulf Snapping Turtle	EN	1,544,458	29	48	59.48%	0.0
4 Reptiles	Bell's Turtle	VU	1,292,812	13	59	21.51%	0.0
3 Frogs	Eungella Day Frog	EN	805,228	3,659	4,432	82.58%	4.5
3 Frogs	Kroombit Tinker Frog	CE	123,574	409	422	96.95%	3.3
3 Frogs	Fleay's Frog	EN	1,537,632	1,642	8,683	18.91%	1.1
3 Frogs	Magnificent Brood Frog	VU	281,517	219	379	57.90%	0.8
3 Frogs	Australian Lace-lid	VU	1,855,830	704	6,488	10.85%	0.4
3 Frogs	Giant Barred Frog	VU	3,976,989	1,503	14,572	10.31%	0.4
3 Frogs	Kroombit Treefrog	CE	44,941	16	16	100.00%	0.4
3 Frogs	Mountain Frog	EN	1,265,395	378	789	47.94%	0.3
3 Frogs	Mountain Mistfrog	CE	610,449	146	1,349	10.83%	0.2
3 Frogs	McDonald's Frog	CE	23,241	2	52	4.71%	0.1
3 Frogs	Wallum Sedge Frog	VU	436,519	28	689	4.00%	0.1
3 Frogs	Tinkling Frog	CE	295,042	14	354	4.01%	0.0
3 Frogs	Kuranda Tree Frog	CE	47,188	2	616	0.32%	0.0
3 Frogs	Stuttering Frog	VU	2,642,651	4	5	76.67%	0.0
3 Frogs	Elegant Frog	CE	11,836		5	0.00%	0.0
3 Frogs	Mountain-top Nursery-frog	CE	47,248		12	0.00%	0.0
3 Frogs	Neglected Frog	CE	94,110		93	0.00%	0.0
3 Frogs	Tapping Nursery-frog	EN	20,811		5	0.00%	0.0
2 Invertebrates	Boggomoss Snail	CE	40,356	614	747	82.19%	15.2
2 Invertebrates	Dulacca Woodland Snail	EN	554,508	7,732	9,617	80.39%	13.9
2 Invertebrates	Brigalow Woodland Snail	EN	171,904	530	1,541	34.39%	3.1
2 Invertebrates	Australian Fritillary	CE	281,960	90	1,349	6.69%	0.3
2 Invertebrates	Antbed Parrot Moth	EN	1,065,322	223	307	72.67%	0.2
2 Invertebrates	Freshwater Crayfish	CE	23,241	2	52	4.71%	0.1
1 Plants	Proston Lasiopetalum	CE	9,419	280	469	59.69%	29.7
1 Plants	Acacia deuteroneura	VU	39,108	1,044	1,064	98.12%	26.7
1 Plants	Three-veined Hakea	VU	98,685	1,915	1,951	98.12%	19.4
1 Plants	Zieria verrucosa	VU	86,576	1,647	2,111	78.02%	19.0
1 Plants	Pultenaea setulosa	VU	104,262	1,971	2,038	96.70%	18.9
1 Plants	Neoroepera buxifolia	VU	51,789	967	988	97.87%	18.7
1 Plants	Bulberin Nut	EN	100,970	1,793	6,882	26.05%	17.8
1 Plants	Glen Geddes Bloodwood	VU	109,140	1,932	2,219	87.09%	17.7
1 Plants	Corymbia clandestina	VU	44,684	763	816	93.45%	17.1
1 Plants	Capparis thozetiana	VU	49,400	809	824	98.09%	16.4
1 Plants	Ooline	VU	17,020,086	268,305	333,671	80.41%	15.8
1 Plants	Solanum johnsonianum	EN	254,746	3,971	4,364	91.01%	15.6
1 Plants	Solanum dissectum	EN	258,471	4,028	4,421	91.12%	15.6

Taxon	Species	Status	Total likely (ha)	Beef deforestation (ha)	All deforestation (ha)	Beef (% of all)	Beef (ha/1000ha of Total likely)
1 Plants	Macrozamia platyrhachis	EN	326,713	4,527	4,719	95.95%	13.9
1 Plants	Pimelea leptospermoides	VU	108,288	1,444	1,796	80.41%	13.3
1 Plants	Small-leaved Denhamia	VU	584,621	7,763	10,197	76.13%	13.3
1 Plants	Macrozamia conferta	VU	152,267	1,939	3,647	53.16%	12.7
1 Plants	Polianthion minutiflorum	VU	103,552	1,311	1,912	68.60%	12.7
1 Plants	Eucalyptus virens	VU	1,333,206	16,856	19,348	87.12%	12.6
1 Plants	Xerothamnella herbacea	EN	464,602	5,605	6,441	87.03%	12.1
1 Plants	Westringia parvifolia	VU	544,061	6,201	10,060	61.64%	11.4
1 Plants	Yarwun Whitewood	EN	6,864	78	133	58.40%	11.3
1 Plants	Rhaphidospora bonneyana	VU	304,503	3,430	3,834	89.45%	11.3
1 Plants	Queensland White Gum	VU	41,060	451	601	75.01%	11.0
1 Plants	Macrozamia parcifolia	VU	166,900	1,696	4,196	40.43%	10.2
1 Plants	Bertya opponens	VU	430,183	4,321	6,428	67.21%	10.0
1 Plants	Mt Berryman Phebalium	CE	897,646	8,937	12,515	71.41%	10.0
1 Plants	Cossinia australiana	EN	3,280,456	32,598	67,347	48.40%	9.9
1 Plants	Pomaderris clivicola	VU	6,120	60	70	86.10%	9.9
1 Plants	Cycas megacarpa	EN	2,077,424	19,447	35,445	54.87%	9.4
1 Plants	Prostanthera sp. Dunmore	VU	45,715	427	606	70.51%	9.3
1 Plants	Macrozamia cranei	EN	205,622	1,916	3,730	51.36%	9.3
1 Plants	Key's Boronia	VU	10,961	92	308	29.83%	8.4
1 Plants	Black Ironbox	VU	4,906,658	38,931	46,867	83.07%	7.9
1 Plants	Wedge-leaf Tuckeroo	VU	1,911,775	15,074	41,100	36.68%	7.9
1 Plants	Microcarpaea agonis	EN	3,926	30	34	87.38%	7.6
1 Plants	Cycas ophiolitica	EN	1,010,729	7,559	10,540	71.72%	7.5
1 Plants	Marsdenia brevifolia	VU	1,508,833	11,121	12,818	86.76%	7.4
1 Plants	Calytrix gurulmundensis	VU	79,841	570	949	60.04%	7.1
1 Plants	Bean's Ironbark	VU	36,662	243	270	89.74%	6.6
1 Plants	Quassia	VU	4,255,719	28,012	86,541	32.37%	6.6
1 Plants	King Blue-grass	EN	3,178,238	20,844	26,494	78.68%	6.6
1 Plants	Aristida annua	VU	520,101	3,347	3,589	93.24%	6.4
1 Plants	Bertya calycina	VU	32,135	195	355	54.76%	6.1

Taxon	Species	Status	Total likely (ha)	Beef deforestation (ha)	All deforestation (ha)	Beef (% of all)	Beef (ha/1000ha of Total likely)
1 Plants	Bluegrass	VU	36,019,253	211,985	275,409	76.97%	5.9
1 Plants	Germainia capitata	VU	116,654	599	973	61.54%	5.1
1 Plants	Three-leaved Bosistoa	VU	3,954,828	20,069	79,726	25.17%	5.1
1 Plants	Miniature Moss-orchid	VU	2,254,977	11,099	18,123	61.24%	4.9
1 Plants	Blue Devil	EN	32,006	157	159	98.70%	4.9
1 Plants	Salt Pipewort	EN	136,899	652	718	90.83%	4.8
1 Plants	Waxy Cabbage Palm	VU	644,502	3,059	3,130	97.72%	4.7
1 Plants	Mt Larcom Silk Pod	VU	24,727	115	323	35.58%	4.7
1 Plants	Macadamia Nut	VU	1,777,099	8,230	41,762	19.71%	4.6
1 Plants	Plectranthus omissus	EN	34,461	159	335	47.54%	4.6
1 Plants	Austral Cornflower	VU	1,579,348	7,149	10,244	69.79%	4.5
1 Plants	Acacia grandifolia	VU	278,426	1,252	1,572	79.65%	4.5
1 Plants	Belson's Panic	VU	21,144	94	111	84.85%	4.5
1 Plants	Apatophyllum olsenii	VU	24,164	98	105	93.80%	4.1
1 Plants	Macrozamia machinii	VU	206,567	791	1,929	41.01%	3.8
1 Plants	Goodwood Gum	VU	92,482	352	1,958	17.96%	3.8
1 Plants	Hando's Wattle	VU	108,712	407	1,010	40.32%	3.7
1 Plants	Newcastelia velutina	VU	5,990	21	21	100.00%	3.6
1 Plants	Isis Tamarind	EN	16,306	57	221	26.01%	3.5
1 Plants	Boonah Tuckeroo	VU	66,237	224	747	29.93%	3.4
1 Plants	Blotched Sarcochilus	VU	329,371	1,058	3,717	28.46%	3.2
1 Plants	Fontainea venosa	VU	42,738	137	399	34.39%	3.2
1 Plants	Plectranthus leiperi	VU	32,849	104	110	94.52%	3.2
1 Plants	Macrozamia occidua	VU	75,705	239	383	62.46%	3.2
1 Plants	Cycad	EN	234,641	729	4,889	14.90%	3.1
1 Plants	Penda	VU	79,500	244	1,688	14.47%	3.1
1 Plants	Bertya pinifolia	VU	6,422	19	33	57.00%	3.0
1 Plants	Decaspermum struckoilicum	EN	1,469	4	4	100.00%	2.9
1 Plants	Fontainea rostrata	VU	159,757	469	4,826	9.72%	2.9
1 Plants	Hakea maconochieana	VU	1,264,942	3,707	5,176	71.62%	2.9
1 Plants	Omphalea celata	VU	1,642,916	4,728	6,350	74.46%	2.9

Taxon	Species	Status	Total likely (ha)	Beef deforestation (ha)	All deforestation (ha)	Beef (% of all)	Beef (ha/1000ha of Total likely)
1 Plants	Satin-top Grass	VU	100,879	285	586	48.67%	2.8
1 Plants	Pineapple Zamia	EN	1,045,407	2,927	30,786	9.51%	2.8
1 Plants	Aristida granitica	EN	3,359	9	58	15.26%	2.6
1 Plants	Wandering Pepper-cress	EN	382,854	920	2,095	43.92%	2.4
1 Plants	Pterostylis bicornis	VU	43,472	104	114	90.95%	2.4
1 Plants	Daviesia discolor	VU	249,688	589	614	95.94%	2.4
1 Plants	Sporobolus pamelae	EN	456,616	1,071	1,418	75.54%	2.3
1 Plants	Tylophora linearis	EN	1,832,673	4,187	4,373	95.76%	2.3
1 Plants	Durikai Mallee	VU	9,130	21	64	32.17%	2.3
1 Plants	Small-fruited Queensland Nut	VU	666,880	1,485	10,808	13.74%	2.2
1 Plants	Paspalidium grandispiculatum	VU	57,317	126	642	19.61%	2.2
1 Plants	Pink Gidgee	VU	1,223,351	2,403	2,765	86.92%	2.0
1 Plants	Acacia attenuata	VU	322,291	627	14,539	4.31%	1.9
1 Plants	Lloyd's Olive	VU	150,350	289	1,643	17.58%	1.9
1 Plants	Small Helmet-orchid	VU	54,398	104	116	90.12%	1.9
1 Plants	Hairy-joint Grass	VU	8,586,406	14,908	39,634	37.61%	1.7
1 Plants	Lesser Swamp-orchid	EN	4,329,581	6,888	51,389	13.40%	1.6
1 Plants	Acacia ammophila	VU	361,772	567	1,735	32.69%	1.6
1 Plants	Lindsaea pulchella var. blanda	VU	210,155	327	2,212	14.80%	1.6
1 Plants	Coopernookia scabridiuscula	VU	25,163	38	46	82.74%	1.5
1 Plants	Grevillea quadricauda	VU	97,296	140	532	26.35%	1.4
1 Plants	Glossy Spice Bush	EN	288,574	390	3,575	10.91%	1.4
1 Plants	Shiny-leaved Condoo	EN	55,492	74	490	15.01%	1.3
1 Plants	Logania diffusa	VU	29,795	39	45	87.74%	1.3
1 Plants	Curly-bark Wattle	VU	817,311	979	1,368	71.56%	1.2
1 Plants	Cycas platyphylla	VU	1,582,915	1,895	3,053	62.06%	1.2
1 Plants	Austral Toadflax	VU	16,845,745	18,821	39,291	47.90%	1.1
1 Plants	Bacon Wood	VU	184,458	200	1,429	14.02%	1.1
1 Plants	Homoranthus decumbens	EN	322,432	348	2,405	14.48%	1.1
1 Plants	Tectaria devexa	EN	71,870	75	192	38.93%	1.0
1 Plants	Sclerolaena walkeri	VU	15,543,545	15,526	30,736	50.51%	1.0

Taxon	Species	Status	Total likely (ha)	Beef deforestation (ha)	All deforestation (ha)	Beef (% of all)	Beef (ha/1000ha of Total likely)
1 Plants	Tall Velvet Sea-berry	VU	1,784,339	1,762	2,135	82.52%	1.0
1 Plants	Sophora fraseri	VU	913,746	896	1,864	48.07%	1.0
1 Plants	Xerothamnella parvifolia	VU	787,696	738	821	89.93%	0.9
1 Plants	Romnalda strobilacea	VU	45,646	42	164	25.81%	0.9
1 Plants	Triplarina nitchaga	VU	32,154	29	47	62.10%	0.9
1 Plants	Stream Clematis	VU	691,148	611	1,258	48.59%	0.9
1 Plants	Granite Nightshade	EN	185,285	140	158	88.78%	0.8
1 Plants	Capella Potato Bush	CE	121,741	92	249	36.82%	0.8
1 Plants	Mt Ernest Bertya	VU	12,941	10	15	64.57%	0.8
1 Plants	Euphorbia carissoides	VU	1,368,269	971	1,744	55.66%	0.7
1 Plants	Toechima pterocarpum	EN	16,771	12	72	16.40%	0.7
1 Plants	Tephrosia leveillei	VU	260,539	168	344	48.75%	0.6
1 Plants	Spiny Gardenia	EN	185,662	116	384	30.22%	0.6
1 Plants	Mt Stuart Ironbark	VU	16,031	10	28	34.73%	0.6
1 Plants	Swamp Stringybark	EN	53,502	31	1,386	2.22%	0.6
1 Plants	Waxy Sarcochilus	VU	293,530	160	396	40.42%	0.5
1 Plants	Zieria collina	VU	38,269	21	149	13.98%	0.5
1 Plants	Floyd's Walnut	EN	287,449	148	984	15.00%	0.5
1 Plants	Tonsil Orchid	EN	94,654	44	76	57.94%	0.5
1 Plants	Hawkweed	VU	408,129	180	867	20.78%	0.4
1 Plants	Red Silky Oak	VU	194,496	81	464	17.47%	0.4
1 Plants	Wallum Leek-orchid	VU	176,893	72	1,792	4.02%	0.4
1 Plants	Plectranthus torrenticola	EN	36,855	14	200	7.18%	0.4
1 Plants	Possum Nut	VU	376,254	142	1,205	11.79%	0.4
1 Plants	Ant Plant	VU	2,531,042	935	7,757	12.05%	0.4
1 Plants	Scrub Turpentine	CE	8,196,470	3,026	20,140	15.02%	0.4
1 Plants	Sankowskya stipularis	EN	8,268	3	17	18.16%	0.4
1 Plants	Stinking Cryptocarya	VU	484,339	177	990	17.84%	0.4
1 Plants	Velvet Jewel Orchid	VU	481,642	170	3,950	4.30%	0.4
1 Plants	Banished Stink Bush	CE	29,629	10	568	1.84%	0.4
1 Plants	Native Jute	EN	331,635	113	2,140	5.28%	0.3

Taxon	Species	Status	Total likely (ha)	Beef deforestation (ha)	All deforestation (ha)	Beef (% of all)	Beef (ha/1000ha of Total likely)
1 Plants	Phaius pictus	VU	2,140,341	709	6,911	10.26%	0.3
1 Plants	Rusty Desert Phebalium	VU	69,459	23	601	3.82%	0.3
1 Plants	Neisosperma kilneri	VU	15,577	5	41	12.22%	0.3
1 Plants	Tomophyllum walleri	VU	283,096	89	258	34.35%	0.3
1 Plants	Repand Boronia	EN	13,986	4	95	4.56%	0.3
1 Plants	Native Guava	CE	3,857,107	1,190	22,447	5.30%	0.3
1 Plants	Homoranthus lunatus	VU	128,569	38	167	22.82%	0.3
1 Plants	Cycas cairnsiana	VU	537,841	157	183	85.68%	0.3
1 Plants	Granite Boronia	EN	137,518	40	423	9.39%	0.3
1 Plants	Smooth-bark Rose Apple	VU	435,884	119	414	28.67%	0.3
1 Plants	Dwarf Butterfly Orchid	EN	483,269	129	1,080	11.90%	0.3
1 Plants	Asplenium wildii	VU	165,629	44	88	49.75%	0.3
1 Plants	Black-clubbed Spider-orchid	EN	86,530	23	163	13.86%	0.3
1 Plants	McKie's Stringybark	VU	781,213	197	484	40.65%	0.3
1 Plants	Medicosma obovata	VU	16,772	4	20	20.62%	0.2
1 Plants	Aponogeton bullosus	EN	493,518	115	432	26.51%	0.2
1 Plants	Middle Filmy Fern	EN	717,193	162	902	17.94%	0.2
1 Plants	Emu Mountain Sheoak	EN	23,604	5	737	0.71%	0.2
1 Plants	Rat's Tail Tassel-fern	EN	506,490	106	1,166	9.07%	0.2
1 Plants	Thin Feather Orchid	VU	400,315	83	215	38.54%	0.2
1 Plants	Lychnothamnus barbatus	EN	7,847	2	22	7.31%	0.2
1 Plants	Kardomia granitica	VU	19,261	4	47	8.36%	0.2
1 Plants	Drosera prolifera	VU	82,873	16	51	32.50%	0.2
1 Plants	Rough-shelled Bush Nut	VU	1,119,786	219	767	28.52%	0.2
1 Plants	Cooktown Orchid	VU	3,804,758	695	1,234	56.30%	0.2
1 Plants	Callistemon pungens	VU	2,037,796	344	1,543	22.26%	0.2
1 Plants	Diplazium cordifolium	VU	587,802	97	1,313	7.36%	0.2
1 Plants	Chingia australis	EN	482,617	76	363	21.00%	0.2
1 Plants	Lastreopsis walleri	VU	553,175	83	393	21.11%	0.2
1 Plants	Prostanthera clotteniana	CE	72,194	11	137	7.72%	0.1
1 Plants	Holly-leaved Graptophyllum	VU	13,704	2	9	22.87%	0.1

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1 Plants	Ravine Orchid	VU	806,359	115	1,207	9.52%	0.1
1 Plants	Homoranthus porteri	VU	76,095	11	157	6.86%	0.1
1 Plants	Tallebudgera spikemoss	VU	18,490	3	6	41.43%	0.1
1 Plants	Zieria obovata	VU	9,646	1	11	12.50%	0.1
1 Plants	Water Tassel-fern	VU	788,992	108	839	12.87%	0.1
1 Plants	Ozothamnus eriocephalus	VU	47,434	6	14	47.02%	0.1
1 Plants	Grevillea glossadenia	VU	158,872	21	188	11.22%	0.1
1 Plants	Byfield Matchstick	VU	28,097	4	190	1.93%	0.1
1 Plants	Androcalva procumbens	VU	1,513,525	193	202	95.83%	0.1
1 Plants	Allocasuarina thalassoscopica	EN	76,946	10	872	1.12%	0.1
1 Plants	Scented Acronychia	EN	462,797	58	307	18.88%	0.1
1 Plants	Phaleria biflora	VU	143,701	17	49	33.84%	0.1
1 Plants	Canarium acutifolium	VU	271,503	31	432	7.07%	0.1
1 Plants	Corymbia rhodops	VU	34,932	4	25	15.69%	0.1
1 Plants	Square Tassel Fern	VU	400,332	43	453	9.49%	0.1
1 Plants	Carronia pedicellata	EN	395,509	38	387	9.91%	0.1
1 Plants	Marbled Balogia	VU	154,097	15	137	10.82%	0.1
1 Plants	Chocolate Tea Tree Orchid	VU	8,212,791	742	3,806	19.49%	0.1
1 Plants	Nightcap Plectranthus	EN	461,698	41	71	58.39%	0.1
1 Plants	Myola Palm	EN	23,594	2	146	1.36%	0.1
1 Plants	Clear Milkvine	VU	1,156,782	90	309	29.10%	0.1
1 Plants	BlueTassel-fern	EN	1,237,394	95	354	26.84%	0.1
1 Plants	Onionwood	VU	418,546	31	72	43.36%	0.1
1 Plants	Rhinerrhizopsis matutina	VU	1,964,539	129	353	36.49%	0.1
1 Plants	Slender Darling-pea	VU	28,688,971	1,856	2,089	88.83%	0.1
1 Plants	Westringia rupicola	VU	46,117	3	3	100.00%	0.1
1 Plants	Macropteranthes montana	VU	1,155,297	69	124	55.35%	0.1
1 Plants	Purple-flowered Wattle	CE	104,176	6	104	5.69%	0.1
1 Plants	Leafless Tongue-orchid	VU	4,229,215	241	5,034	4.79%	0.1
1 Plants	Dendrobium nindii	EN	915,925	52	180	29.06%	0.1
1 Plants	Native Moth Orchid	EN	633,391	36	812	4.43%	0.1

Taxon	Species	Status	Total likely (ha)	Beef deforestation (ha)	All deforestation (ha)	Beef (% of all)	Beef (ha/1000ha of Total likely)
1 Plants	Velvet Wattle	VU	55,221	2	76	3.07%	0.0
1 Plants	Narrow-leaved Peppermint	VU	2,203,485	86	230	37.20%	0.0
1 Plants	Dark-stemmed Antler Orchid	EN	498,145	18	172	10.55%	0.0
1 Plants	Tylophora rupicola	EN	37,783	1	17	7.85%	0.0
1 Plants	Cepobaculum carronii	VU	3,657,300	126	497	25.35%	0.0
1 Plants	Smooth Davidsonia	EN	82,138	3	6	41.43%	0.0
1 Plants	Tylophora woollsii	EN	2,281,901	72	194	37.36%	0.0
1 Plants	Southern Fontainea	VU	195,771	6	21	29.33%	0.0
1 Plants	Pale Chandelier Orchid	VU	967,274	30	211	14.26%	0.0
1 Plants	Aponogeton prolifer	EN	82,258	3	24	10.29%	0.0
1 Plants	Rupp's Wattle	EN	74,220	2	23	8.68%	0.0
1 Plants	Asplenium pellucidum	VU	70,471	2	2	100.00%	0.0
1 Plants	Slaty Red Gum	VU	1,390,012	35	50	70.75%	0.0
1 Plants	Oreogrammitis reinwardtii	VU	71,012	2	17	10.11%	0.0
1 Plants	Knotweed	VU	842,927	20	26	77.39%	0.0
1 Plants	Torrington Pea	VU	64,701	2	18	8.65%	0.0
1 Plants	Small-leaved Tamarind	EN	181,459	4	30	13.87%	0.0
1 Plants	Rusty Rose Walnut	VU	195,726	4	49	8.56%	0.0
1 Plants	Rose Apple	VU	135,380	3	6	42.43%	0.0
1 Plants	Diplazium pallidum	EN	294,311	5	893	0.58%	0.0
1 Plants	McNutt's Wattle	VU	149,891	3	6	40.00%	0.0
1 Plants	Phlegmariurus lockyeri	VU	354,077	6	337	1.74%	0.0
1 Plants	Antelope Orchid	EN	394,865	6	38	16.00%	0.0
1 Plants	Astrotricha roddii	EN	133,293	2	85	2.28%	0.0
1 Plants	Sweet Myrtle	EN	143,179	2	3	57.89%	0.0
1 Plants	Cooktown Orchid	VU	1,528,524	21	739	2.80%	0.0
1 Plants	Monkey Nut	VU	203,449	3	9	29.90%	0.0
1 Plants	Haines's Orange Mangrove	CE	134,151	2	45	3.82%	0.0
1 Plants	Winged Pepper-cress	EN	9,203,811	117	509	23.03%	0.0
1 Plants	Southern Ochrosia	EN	238,934	3	10	27.79%	0.0
1 Plants	Rock Tassel-fern	CE	213,875	1	33	3.30%	0.0

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1 Plants	Sclerolaena blakei	VU	1,205,369	2	2	100.00%	0.0
1 Plants	Calophyllum bicolor	VU	465,790		2,946	0.00%	0.0
1 Plants	Cape York Vanda	VU	539,332		27	0.00%	0.0
1 Plants	Cardwell Beard Orchid	EN	23,377		145	0.00%	0.0
1 Plants	Cardwell Midge Orchid	EN	46,762		459	0.00%	0.0
1 Plants	Coochin Hills Grevillea	CE	551		2	0.00%	0.0
1 Plants	Cooneana Olive	CE	1,641		59	0.00%	0.0
1 Plants	Crepidium lawleri	EN	47,428		6	0.00%	0.0
1 Plants	Cycas silvestris	VU	48,144		41	0.00%	0.0
1 Plants	Cyperus semifertilis	VU	14,304		4	0.00%	0.0
1 Plants	Dipodium pictum	EN	551,397		55	0.00%	0.0
1 Plants	Drosera schizandra	VU	35,277		17	0.00%	0.0
1 Plants	Endiandra cooperana	EN	4,379		5	0.00%	0.0
1 Plants	Hann Gardenia	VU	70,963		3	0.00%	0.0
1 Plants	Homoranthus montanus	VU	5,196		17	0.00%	0.0
1 Plants	Leionema obtusifolium	VU	4,712		29	0.00%	0.0
1 Plants	Leucopogon sp. Coolmunda	EN	4,666		2	0.00%	0.0
1 Plants	Medicosma elliptica	VU	13,018		368	0.00%	0.0
1 Plants	Mossman Fairy Orchid	CE	23,636		12	0.00%	0.0
1 Plants	Mount Beerwah Mallee	VU	771		2	0.00%	0.0
1 Plants	Ormeau Bottle Tree	CE	1,747		23	0.00%	0.0
1 Plants	Phebalium whitei	VU	9,410		6	0.00%	0.0
1 Plants	Plectranthus habrophyllus	EN	19,560		830	0.00%	0.0
1 Plants	Plesioneuron tuberculatum	EN	58,777		36	0.00%	0.0
1 Plants	Polyscias bellendenkerensis	VU	97,412		76	0.00%	0.0
1 Plants	Prostanthera spathulata	VU	2,322		18	0.00%	0.0
1 Plants	Ristantia gouldii	VU	89,271		85	0.00%	0.0
1 Plants	Sarcochilus hirticalcar	VU	47,831		10	0.00%	0.0
1 Plants	Small Snake Orchid	86,475	2,208,372		13	0.00%	0.0
1 Plants	Small-leaved Hazelwood	2,519	58,523		1	0.00%	0.0
1 Plants	Solanum dunalianum	VU			2,311	0.00%	0.0

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1 Plants	Swamp Daisy	EN			2	0.00%	0.0
1 Plants	Syzygium velarum	VU	19,960		14	0.00%	0.0
1 Plants	Veiny Graptophyllum	EN	6,066		15	0.00%	0.0
1 Plants	Velvet Hopbush	VU	4,732		279	0.00%	0.0
1 Plants	Wallangarra White Gum	VU	20,858		7	0.00%	0.0
1 Plants	Whiskered Rein Orchid	EN	72,128		10	0.00%	0.0
1 Plants	Wispy Umbrella Orchid	VU	48,049		1	0.00%	0.0
1 Plants	Xanthostemon formosus	EN	7,693		5	0.00%	0.0
1 Plants	Yellow Swamp-orchid	EN	87,551		171	0.00%	0.0
1 Plants	Zieria bifida	EN	2,316		5	0.00%	0.0

Yellow-tailed Black-Cockatoo
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