Ecological Sustainability in State Forests

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12 October 2024

"passive acoustic monitoring (PAM) has emerged as a transformative tool for applied ecology, conservation and biodiversity monitoring" (Ross et al. 2023)

Functional Ecology
BRITISH ECOLOGICAL SOCIETY

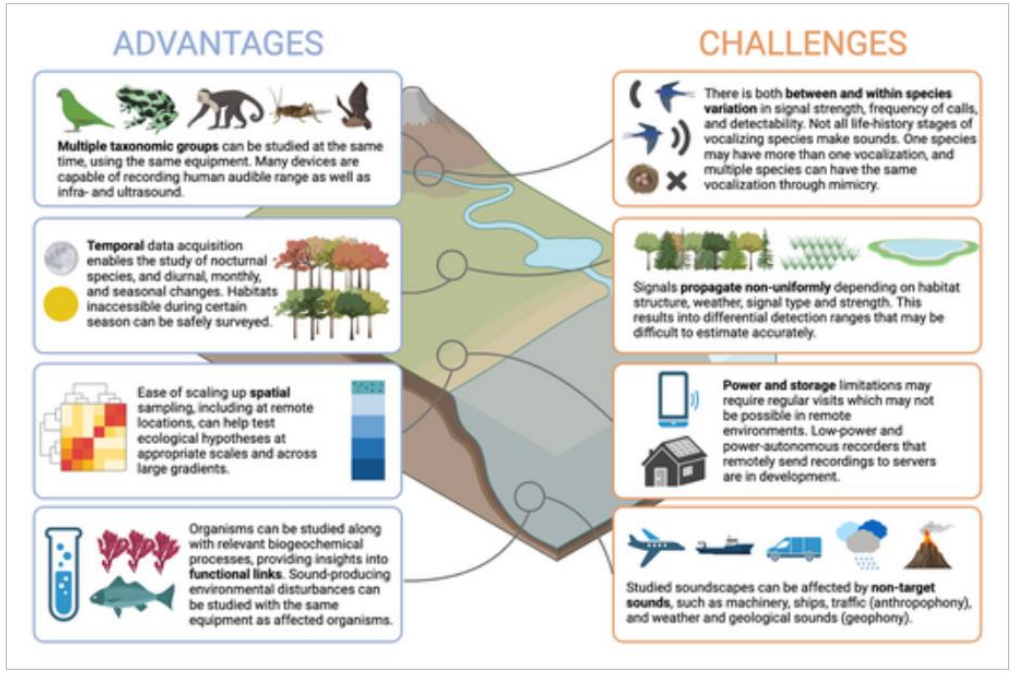
REVIEW | Open Access

Passive acoustic monitoring provides a fresh perspective on fundamental ecological questions

Samuel R. P.-J. Ross, Darren P. O'Connell, Jessica L. Deichmann, Camille Desjonquères, Amandine Gasc, Jennifer N. Phillips, Sarab S. Sethi, Connor M. Wood, Zuzana Burivalova

First published: 20 January 2023 | https://doi.org/10.1111/1365-2435.14275

Handling Editor Oscar Godoy



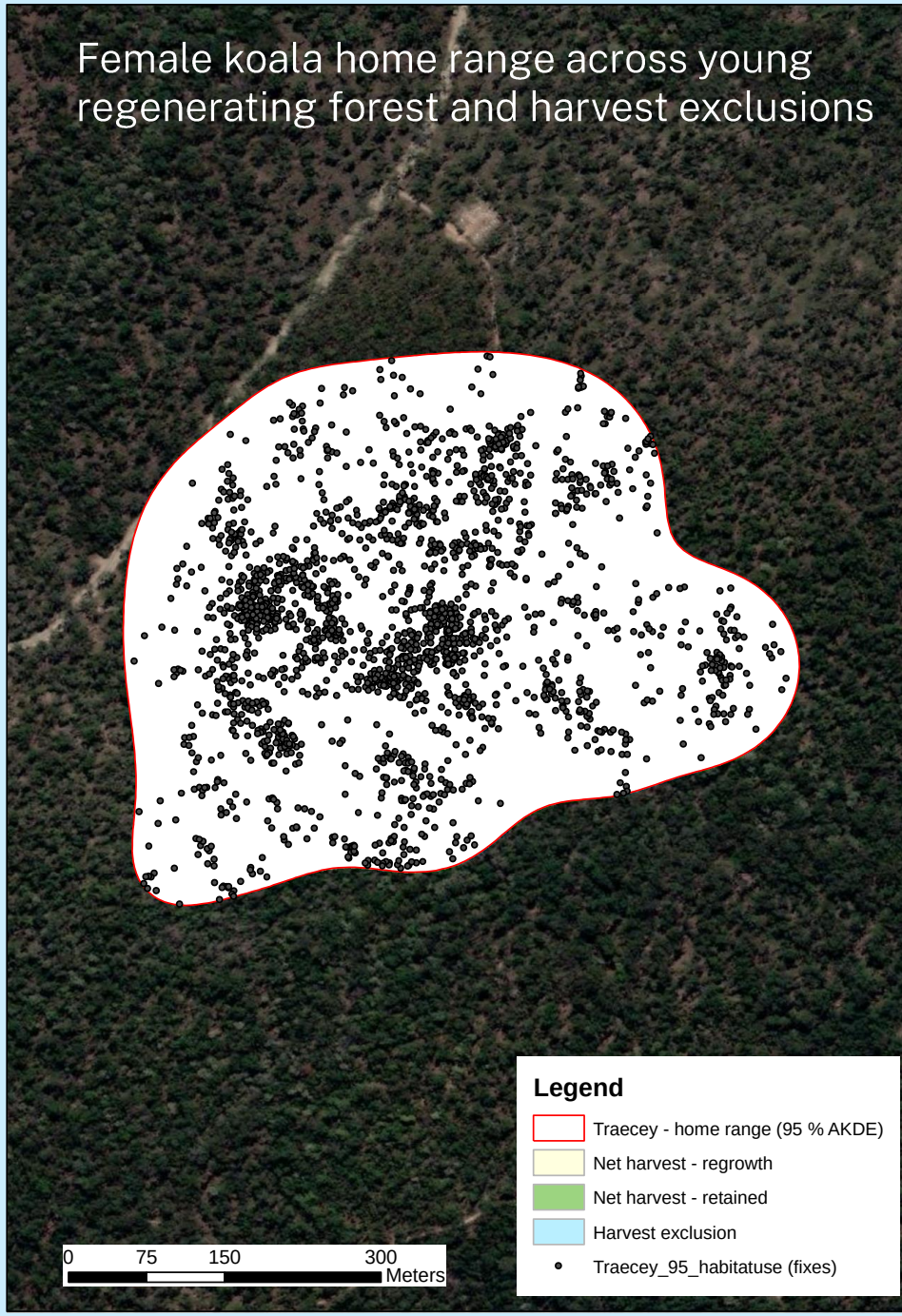
Limitations of acoustics for Koalas

- Restricted to male bellows, although koalas typically occur in 1:1 sex ratio
- Ideal for regional scale assessments of occupancy
- Acoustic arrays can be used for density
- Other methods required for fine-scale habitat use; e.g. GPS-tracking

- Smith and Pile (2024) criticise acoustics suggesting males are transient and broadly distributed across differing habitat quality, but:
  - based on flawed methods not accounting for detection probability (essential for fauna surveys)
  - limited sampling in one forest
  - did not consider DPIRD's radio-tracking and GPS data on male vs female koala habitat use

DPIRD Tracking (>12,000 data points):

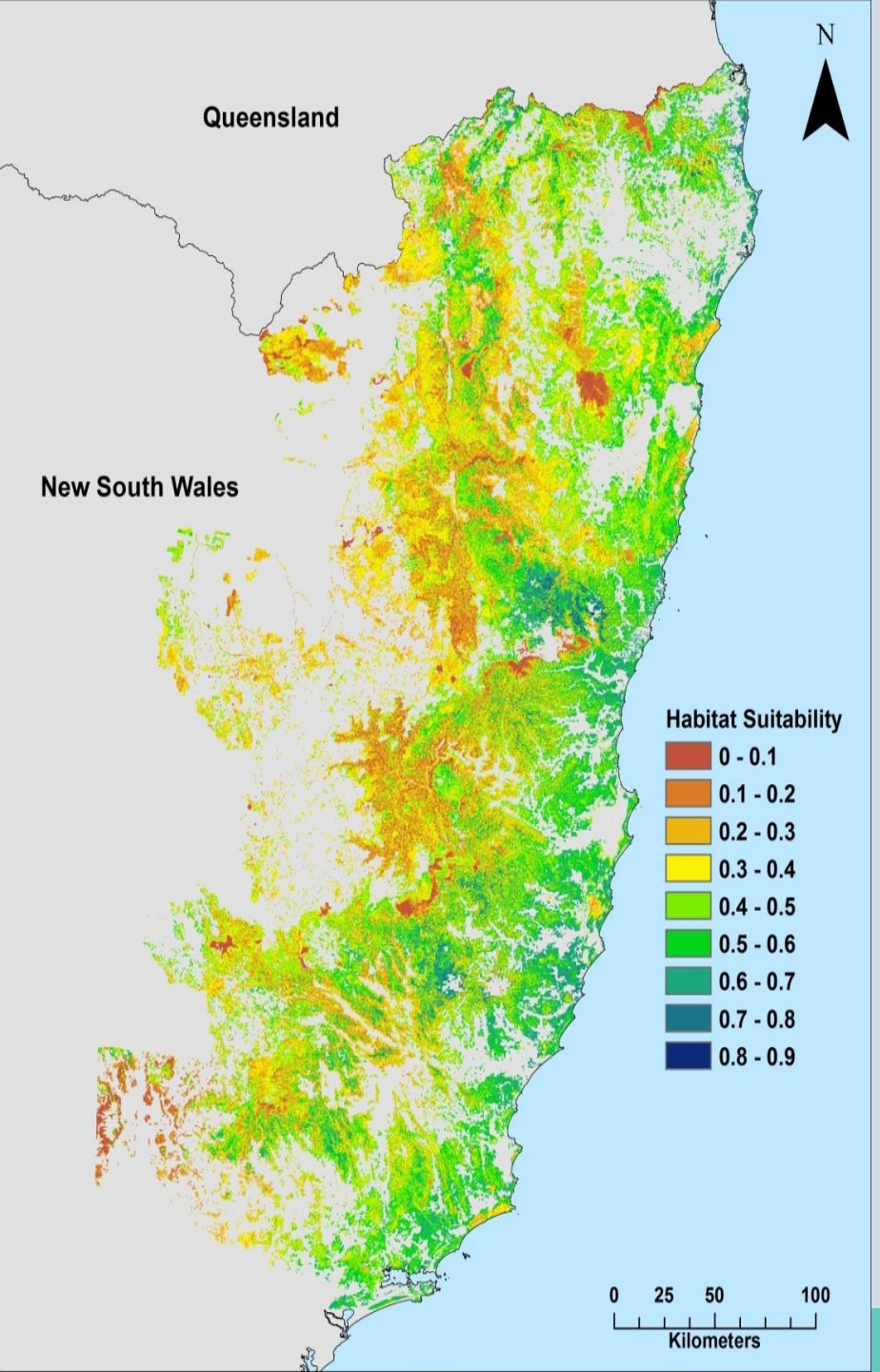
- all koalas were resident in the forestry landscapes studied
- both sexes selected similar tree species and medium-sized tree sizes;
- home ranges of both sexes comprised young regeneration and mature forest in exclusion zones



DPI Koala Research Overview (2014-2024)

- Koala habitat mapping to trigger management in CIFOA
- ***Regional*** studies of koala occupancy (site presence)
  - surveys on public land
  - surveys on private land
  - annual monitoring in north-east NSW since 2015
- ***Local*** studies of koala density
  - Before/after timber harvesting experiment
  - Before/after black summer fires
- GPS tracking of ***individual*** koalas
  - 5-10 years post-harvest

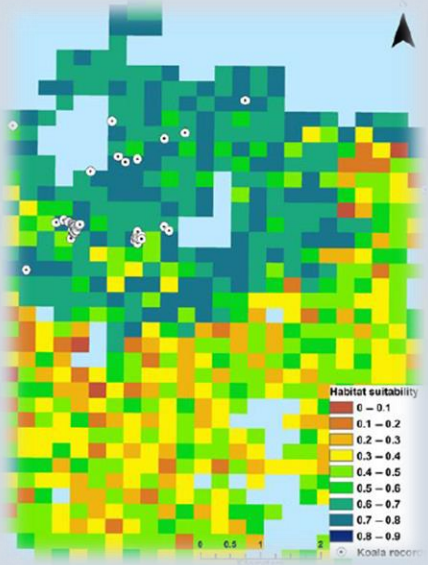
i.e. multiple scales and lines of evidence

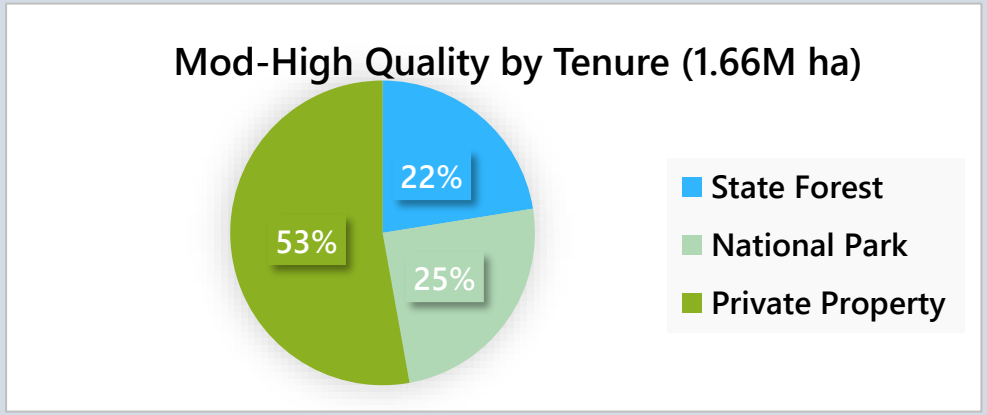


Koala Habitat Model

- field validated (Law et al. 2017)
- 1.7 million ha of moderate to high quality habitat
- now used to guide koala protection in cIFOA
- extended to other regions by DCCEEW

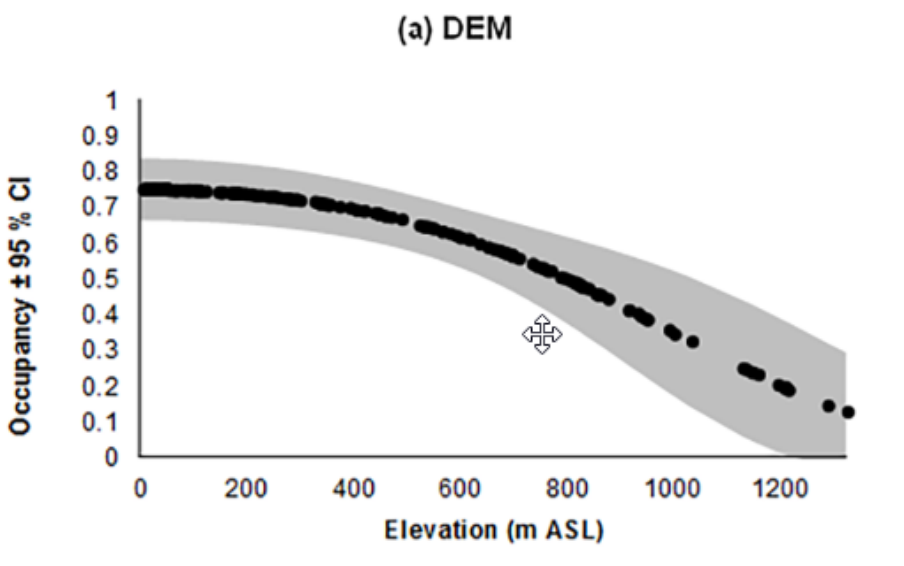
How much is occupied by koalas?

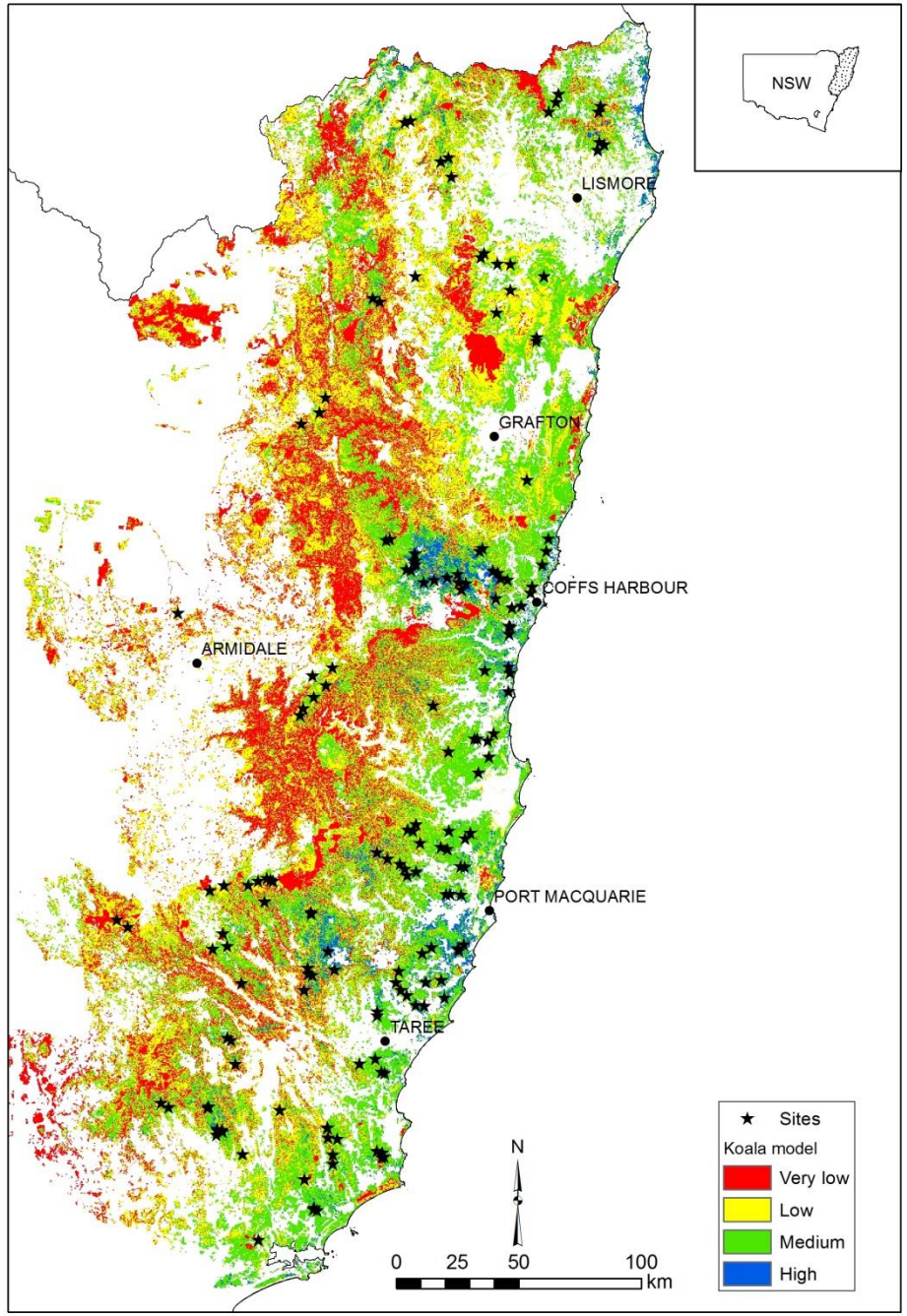




Koala Occupancy in Public Hinterland Forests

- 171 sites (62 SFs; 32 NPs/NRs);
- 14,640 hours of nocturnal recording over 1,464 nights;
- 2,513 bellows recorded
- Mean probability of occupancy in public forest = 0.64 ± 0.04
- No effect on site occupancy for harvest intensity or time since harvest
- Published: Law et al. (2018 - *PLOS*)





Change in koala density before and after selective harvesting (NRC funded)

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scientific reports

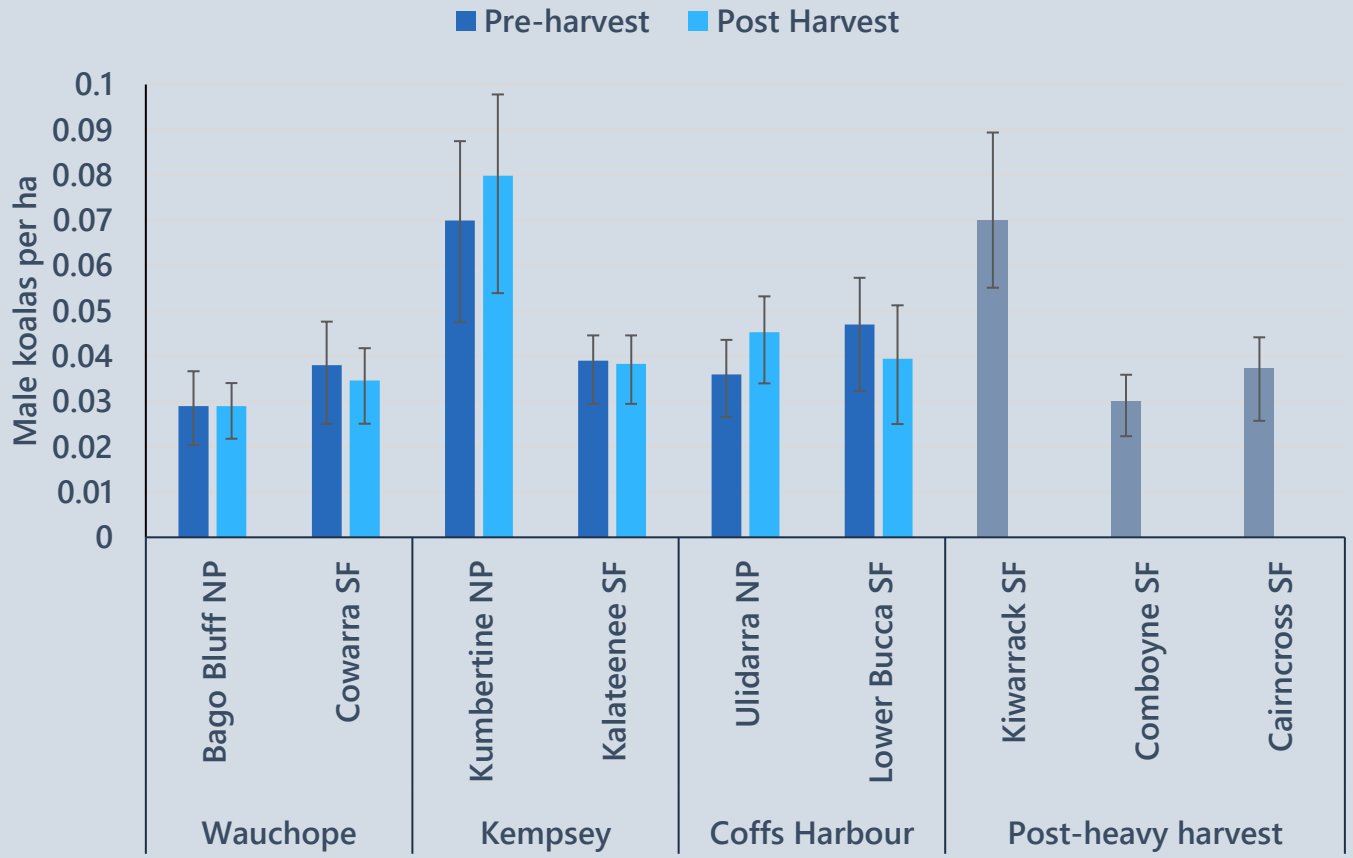
Check for updates

OPEN

Regulated timber harvesting does not reduce koala density in north-east forests of New South Wales

Brad Law[1]✉, Leroy Gonsalves[1], Joanna Burgar[2], Traecey Brassil[1], Isobel Kerr[1], Chris O'Loughlin[1], Phil Eichinski[3] & Paul Roe[3]

Male koala density – no effect of harvesting



(Law et al. 2022 – *Nature Sci. Reports*)

Extensive Harvest Exclusions as per CIFOA Forestry Regulations

- 83 % of public forests already protected and never harvested

State forests

- *General harvest exclusions* –50-60 % of NSW state forests are excluded from timber harvest (since 2018 - an increase on previous practices)
  - Old growth
  - Rainforest
  - Riparian buffers
  - Corridors connecting catchments
  - Wildlife clumps
- *Species specific conditions* - additional protection for key threatened species habitat in harvest area, triggered by survey or habitat maps

- *Koalas*
  - ➢ browse tree retention in harvest areas = 10 per ha in modelled koala habitat, so min of 2,500 trees for every 250 ha of koala habitat
  - ➢ plus general exclusions (above)

Fauna Occupancy Monitoring – trends over time

Ecological Indicators 98 (2019) 492–507

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Original Articles

Detecting small changes in populations at landscape scales: a bioacoustic site-occupancy framework

Connor M. Wood[a,*,1], Viorel D. Popescu[b,c,1], Holger Klinck[d], John J. Keane[e], R.J. Gutiérrez[a], Sarah C. Sawyer[f], M. Zachariah Peery[a]

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[b] Primary: Biological Sciences Department and Sustainability Studies Theme, Ohio University, 107 Irvine Hall, Athens, OH 45701, United States
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[f] Pacific Southwest Region, USDA Forest Service, 1323 Club Drive, Vallejo, CA 94592, United States

USA Spotted Owl (Jones et al. 2021)

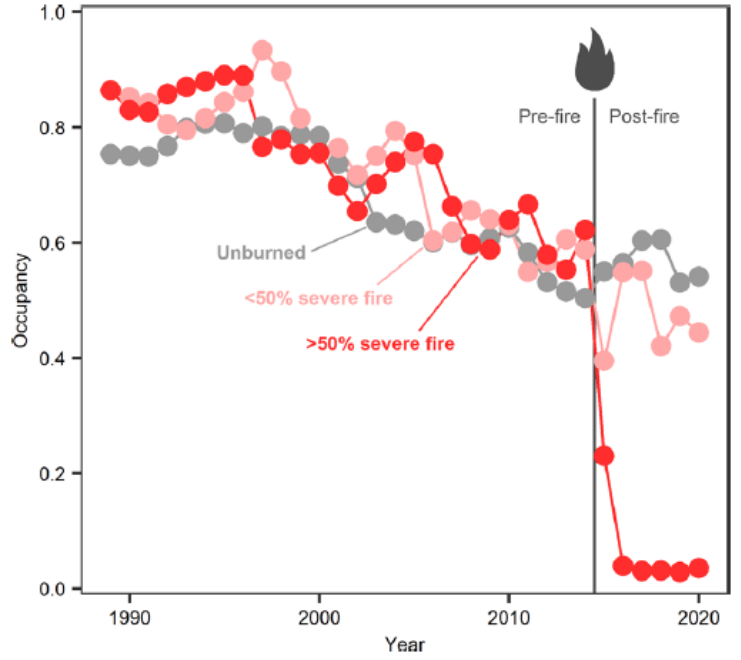
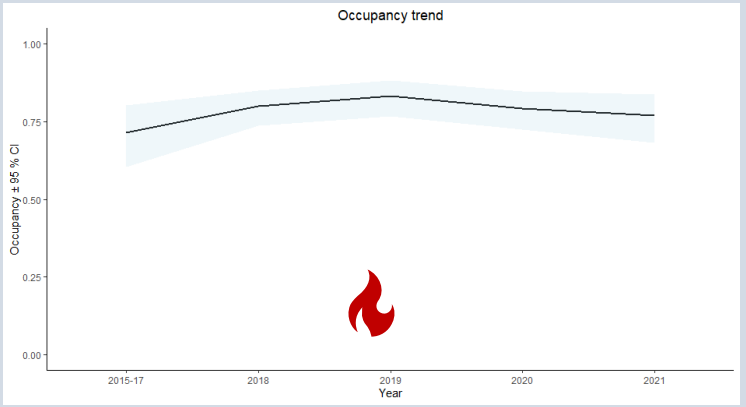
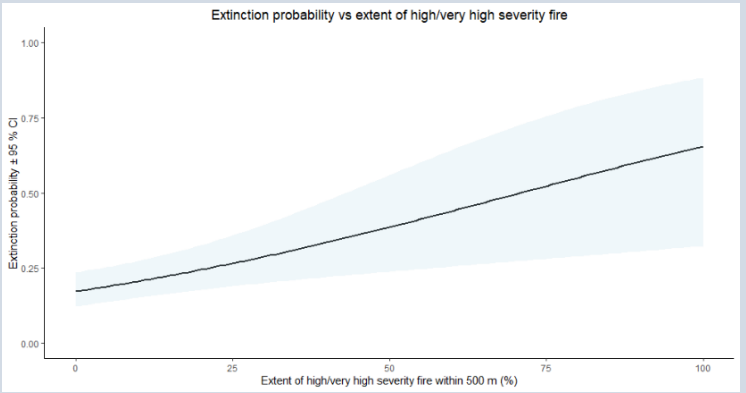


Figure 3 Derived annual occupancy from 1989 to 2020 for spotted owl sites grouped by the percentage of the home-range (1500 m) that experienced severe fire (unburned, <50% severe, >50% severe). The grey vertical line on the x-axis between years 2014 and 2015 indicates the timing of the 2014 King Fire and therefore divides pre- and post-fire occupancy trajectories

Trend in koala occupancy in north-east public forests

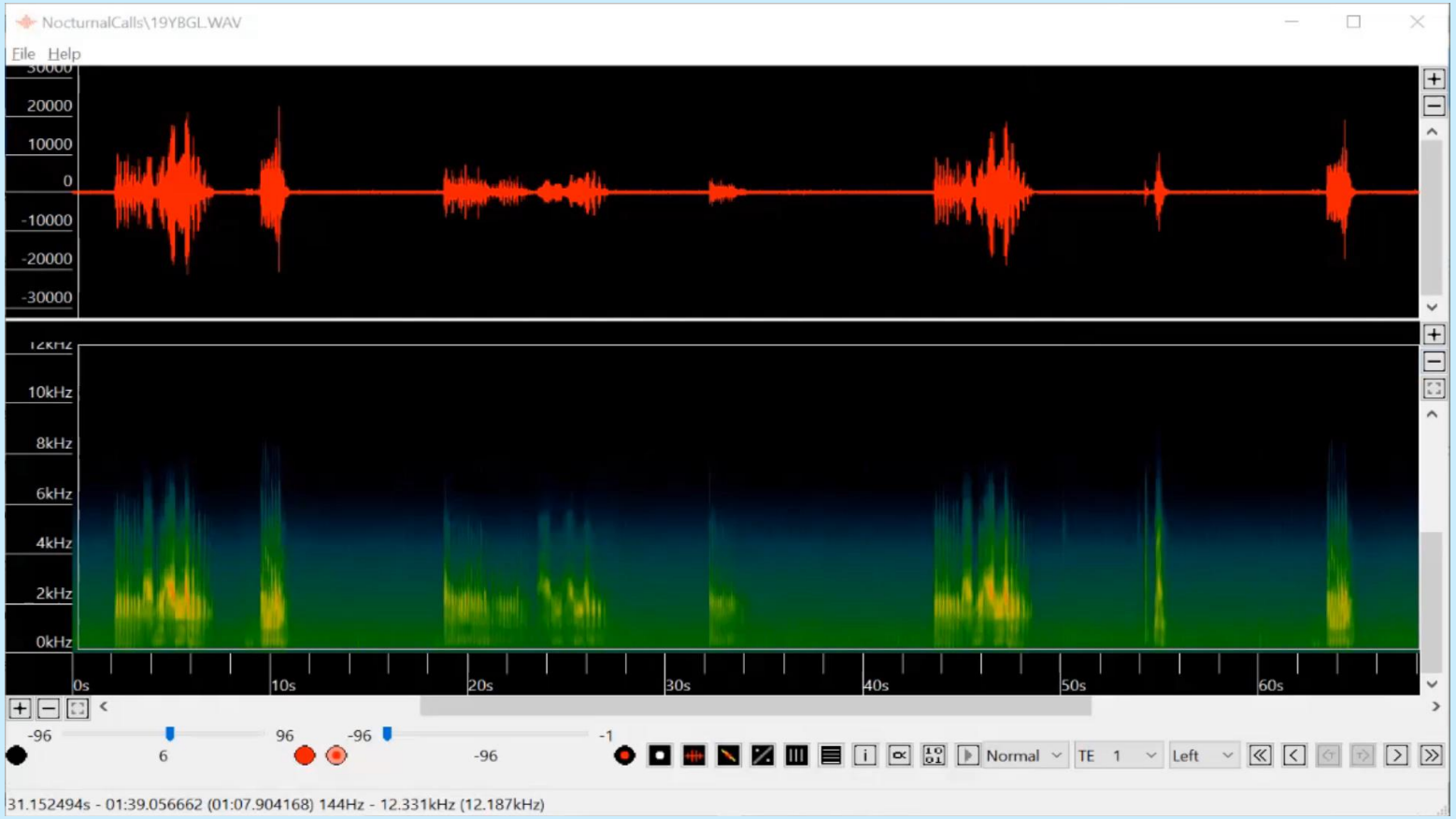
- 224 acoustic sites in hinterland forests from 2015-2021
- Koala occupancy relatively stable despite drought and unprecedented wildfire in 2019
- No effect of timber harvesting or low severity fire
- Extent of high severity fire increased local extinction probability
- ≠ decline at the regional level because extensive severe fire was limited to 11 % of their habitat and offset by colonisation of unoccupied sites



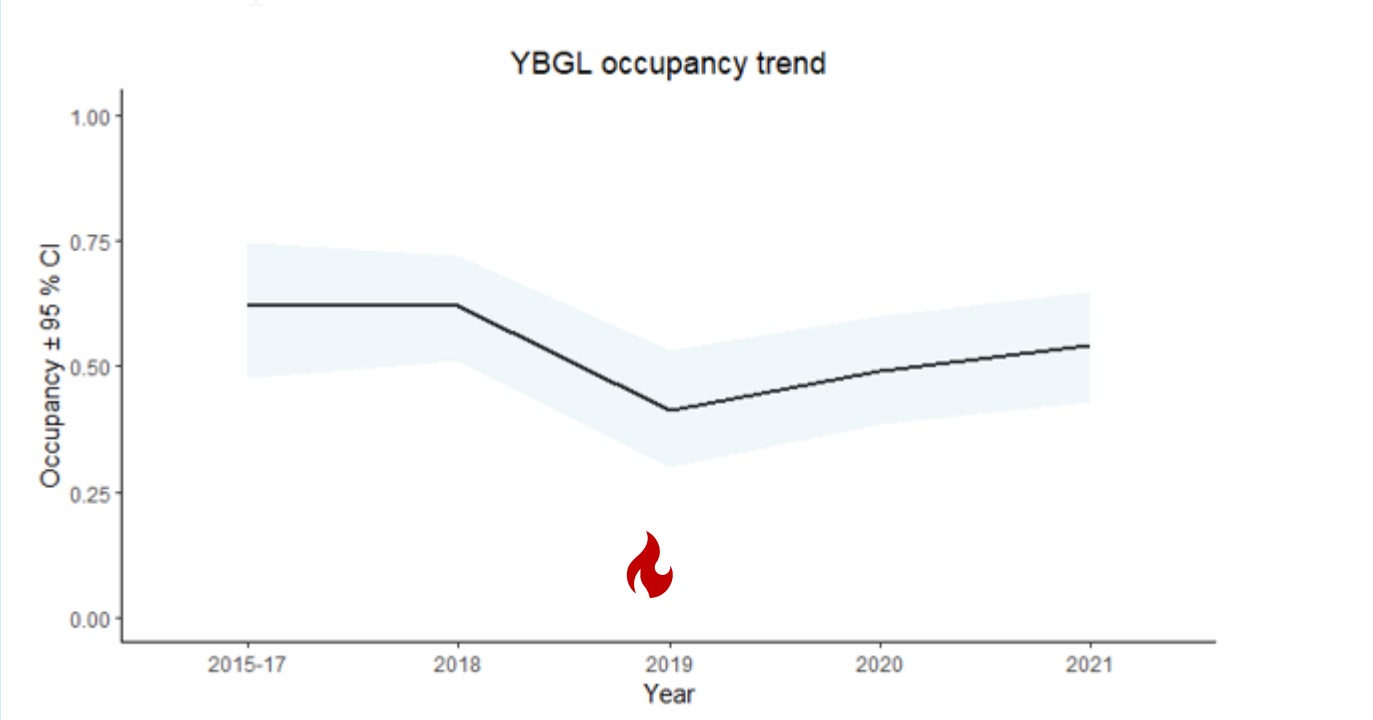


AI acoustic recognisers for cost-effective monitoring

Koala
Yellow-bellied glider
Sugar glider
Squirrel glider
Powerful owl
Sooty owl
Masked owl
Barking owl
Boobook owl
Grey-headed flying fox
Glossy black cockatoo
Gang gang cockatoo

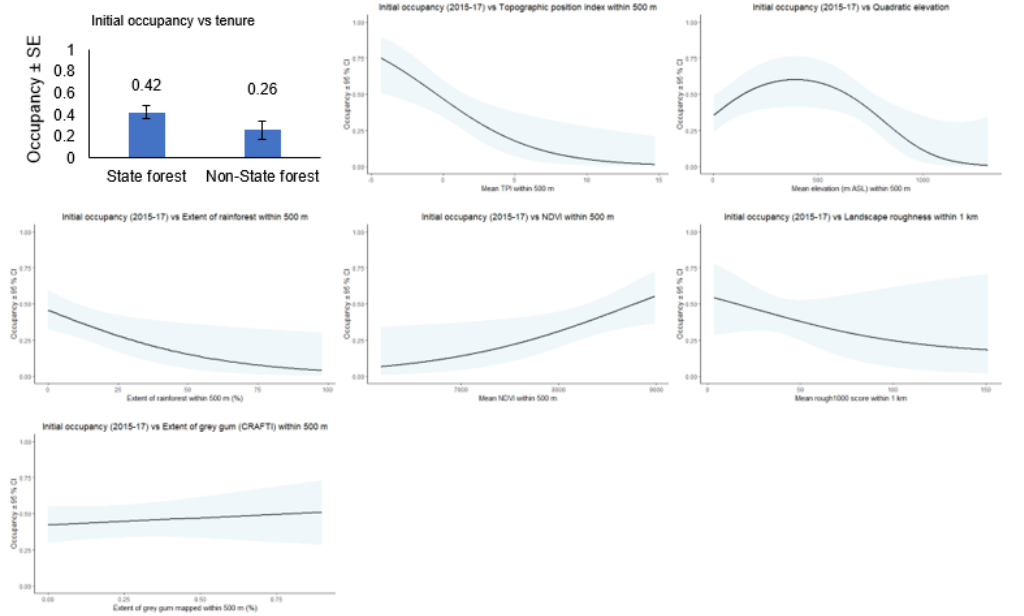


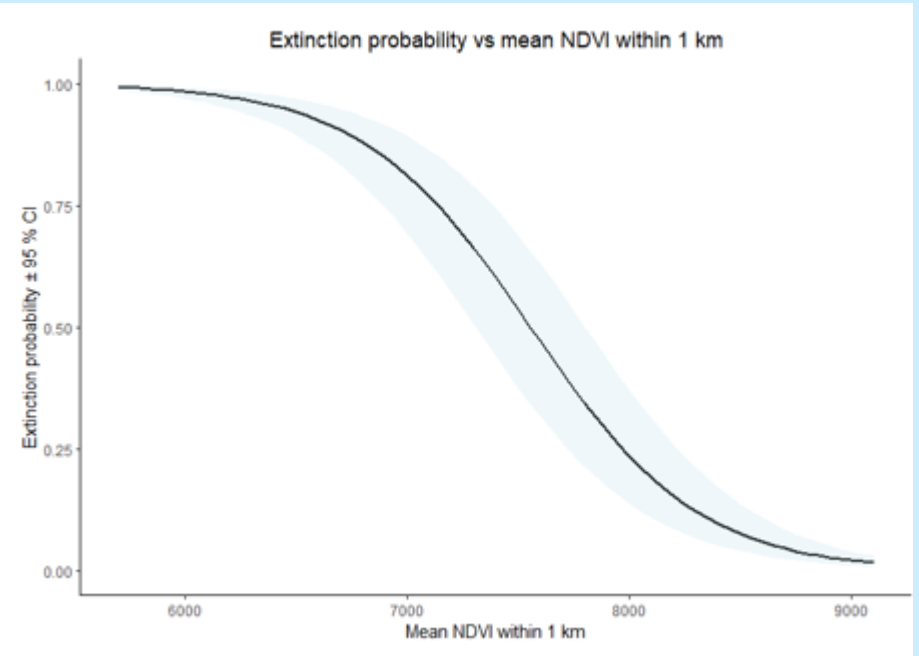
Yellow-bellied glider trend in NE public forests (Law et al. 2024)



- Occupancy varied from~0.45-0.6
- 34 % decline in 2019
- FMIP Baseline occupancy from 1990s = 0.39±0.05 (Kavanagh et al. 2022)

Initial occupancy





CIFOA: Fauna monitoring - sensors for multiple species

- Cameras (established method)
- Ultrasonics (established method)
- Acoustics (newly emerged method)
    - Recognisers for individual species

Reconyx Infrared Trail Camera

Songmeter mini – acoustic and bat

Global Ecology and Conservation 16 (2018) e00493

Contents lists available at ScienceDirect

Global Ecology and Conservation

journal homepage: http://www.elsevier.com/locate/gecco

ELSEVIER

Review Paper

Pairing camera traps and acoustic recorders to monitor the ecological impact of human disturbance

Rachel T. Buxton*, Patrick E. Lendrum, Kevin R. Crooks, George Wittemyer

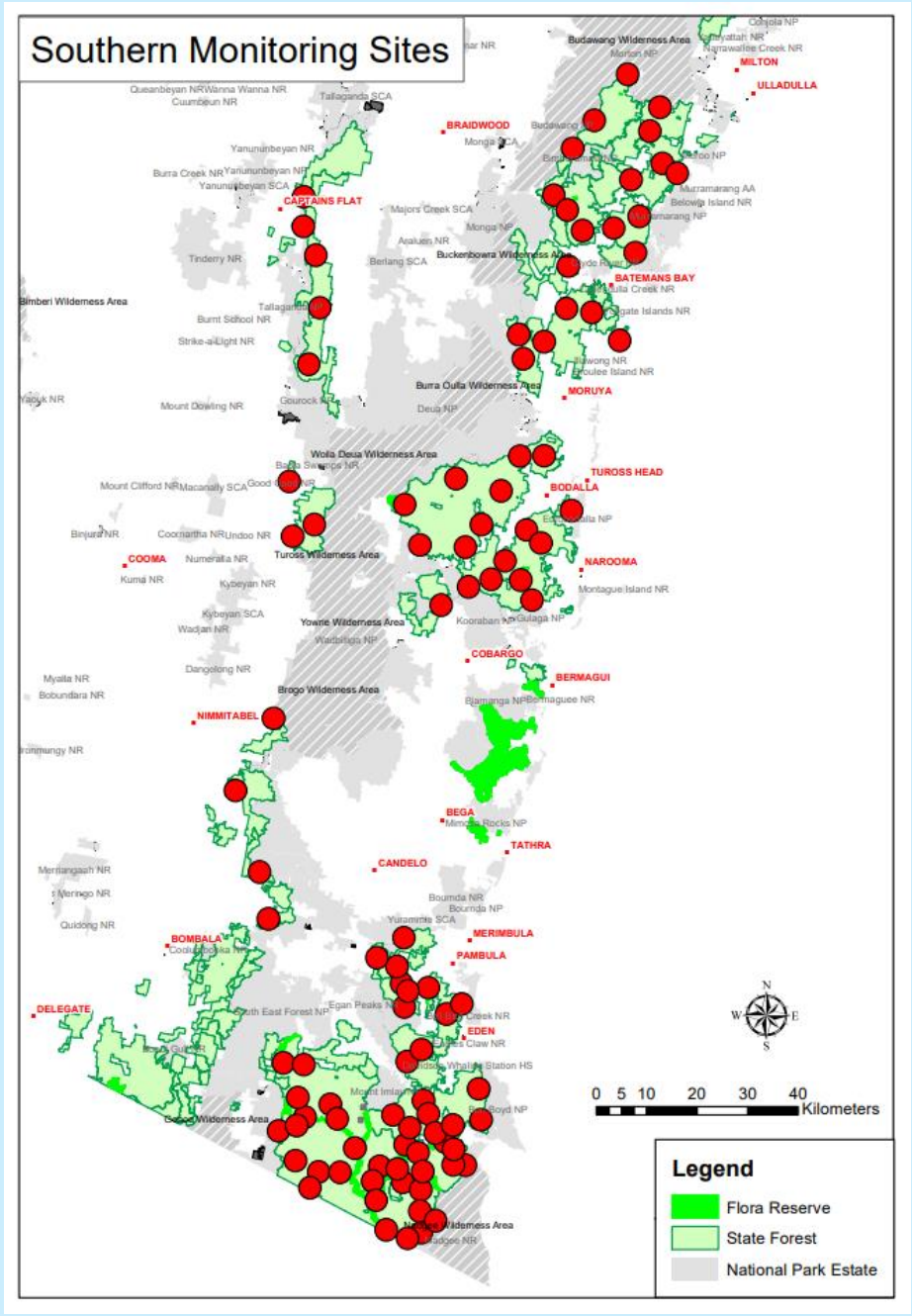
Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, CO, 80523-1474, USA

CIFOA Fauna Monitoring

300 sites across CIFOA region

Each site has two subplots=total 600 subplots

Year 1 sampling in spring 2022



CIFOA Fauna Monitoring (acoustics, cameras, bat detectors):

Year 1 acoustics - raw data

- >211,000 detections (spring 2022, autumn 2023) across all regions
- 11 species detected

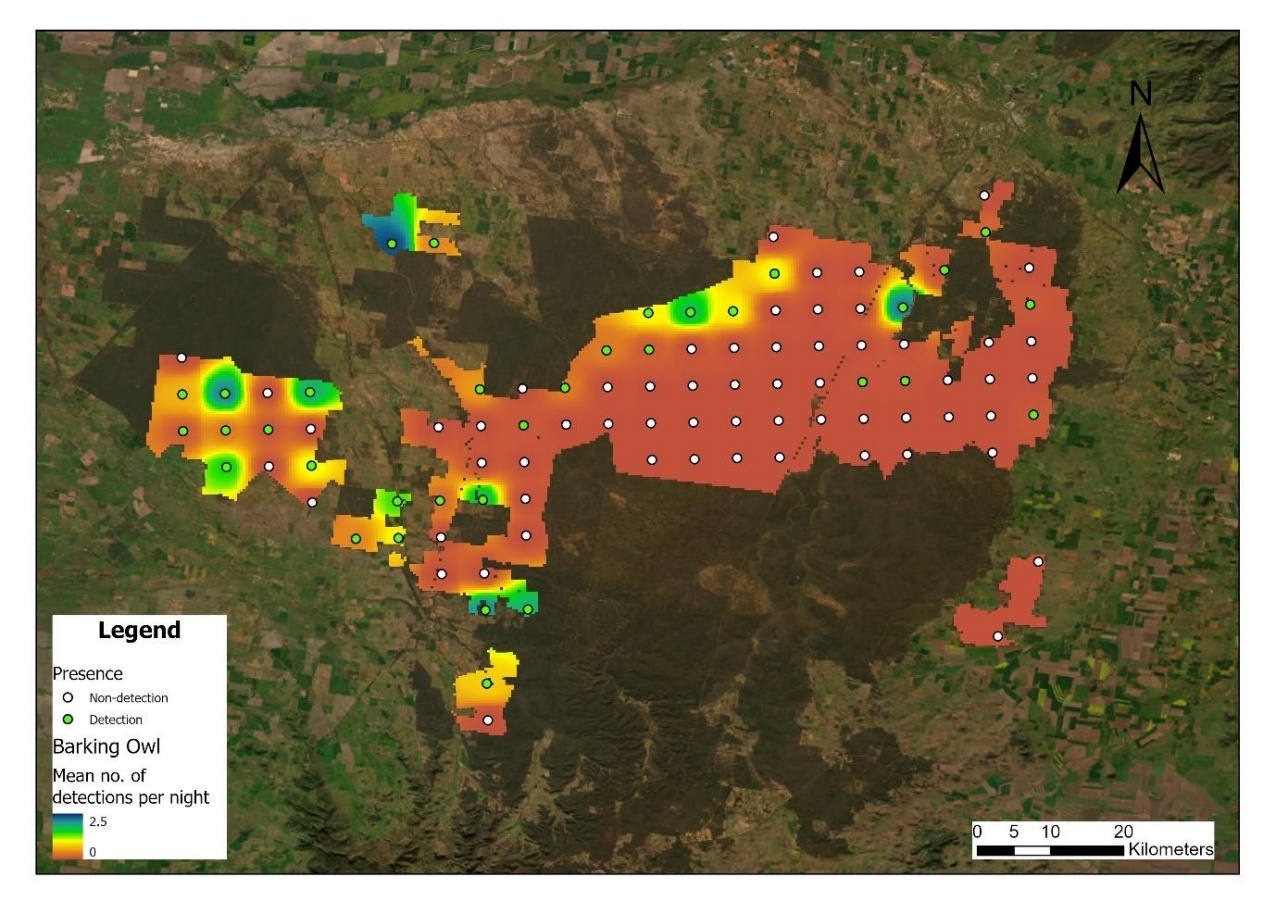
Northern Region - acoustics

	Spring 2022			*Autumn 2023*			**Total**		
Species	**Number of detections**	**Number of sites**	**Naïve occupancy**	**Number of detections**	**Number of sites**	**Naïve occupancy**	**Number of detections**	**Number of sites**	**Naïve occupancy**
Northern									
Barking Owl	44	2	0.07	1683	15	0.21	1727	17	0.167
Glossy Black-Cockatoo	80	8	0.27	258	27	0.38	338	35	0.343
Grey-headed Flying-fox	7684	14	0.47	233	8	0.11	7917	22	0.216
Koala	1194	24	0.8	223	21	0.29	1417	45	0.441
Masked Owl	90	13	0.43	804	55	0.76	894	68	0.667
Powerful Owl	2658	13	0.43	12103	43	0.6	14761	56	0.549 **
Sooty Owl	107	8	0.27	146	26	0.36	253	34	0.333
Southern Boobook	22928	29	0.97	19763	61	0.85	42691	90	0.882
Squirrel Glider	171	8	0.27	607	15	0.21	778	23	0.225
Sugar Glider	1411	23	0.77	3137	53	0.74	4548	76	0.745
Yellow-bellied Glider	758	14	0.47	664	19	0.26	1422	33	0.324
Total	**115,179**			**95,912**			**211,091**		

Naïve occupancy = proportion of sites at which species is detected (not adjusted for imperfect detection)

** 1990s POWL baseline modelled occupancy = 0.56 (Kavanagh et al. 2022)

FCNSW Pilliga (cypress) fauna monitoring program: Barking Owl (2018-2023)

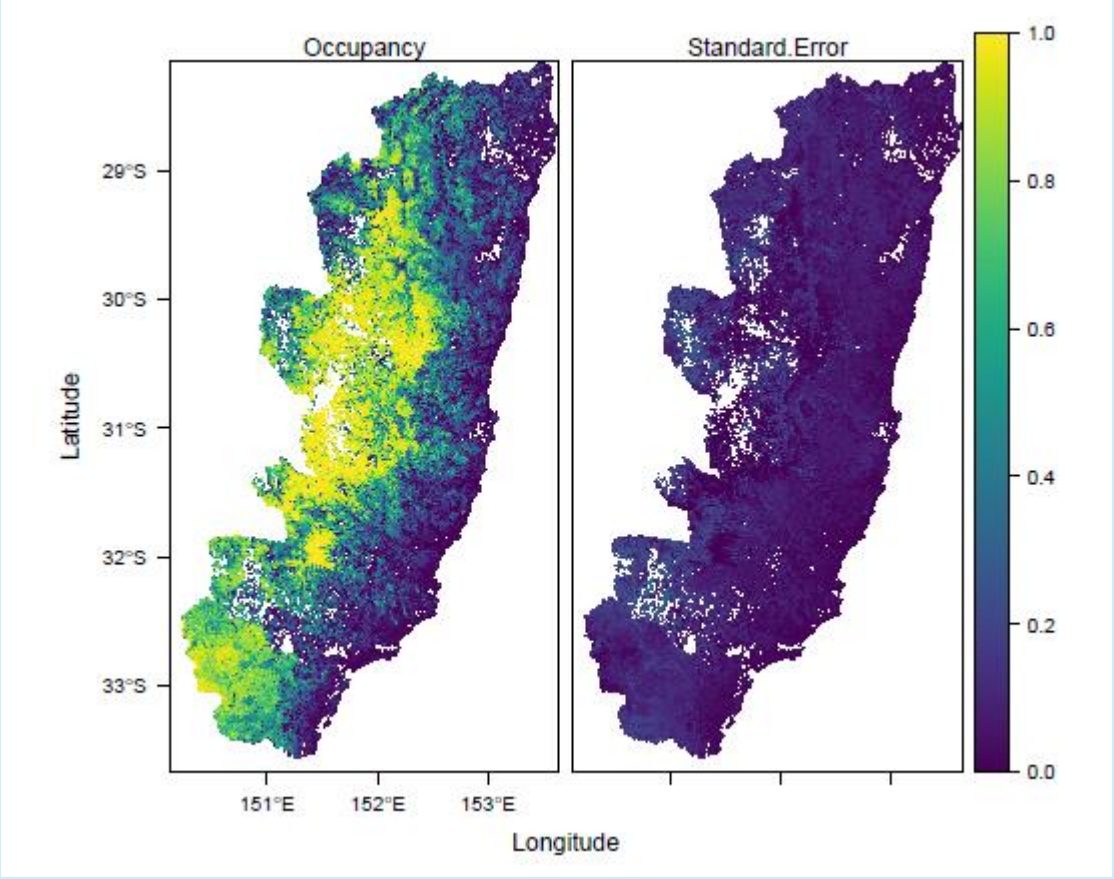


Barking Owl widespread in Pilliga north-west:

- 12,850 calls detected
- Naive occupancy varied among years from 21-40 %
- Naïve occupancy 18 % in 2001 (Milledge 2004).

Greater Glider

- Hollow-dependent, sensitive to warming climate and high severity fire
- Extensive past research by DPI on timber harvesting
- Wildfire frequency and logging intensity have significant negative impacts (McLean et al. 2018).
- Populations can be maintained at or near pre-harvest levels when at least 40% of the original tree basal area is retained throughout harvested areas and retaining harvest exclusions in riparian strips (Kavanagh 2000) – additional wildlife clumps should help
- Detailed occupancy maps developed for northern and southern region available to direct management (Kavanagh et al. 2022)
- Median occupancy probability in 1990s = 0.52 ± 0.05 for northern region and 0.506±0.217 for southern region (Kavanagh et al. 2022).



Threats to Australia's biodiversity

Received: 10 April 2021 | Revised: 22 June 2021 | Accepted: 25 June 2021
DOI: 10.1002/ece3.7920

ORIGINAL RESEARCH

Ecology and Evolution WILEY

A national-scale dataset for threats impacting Australia's imperiled flora and fauna

Michelle Ward[1,2,3] | Josie Carwardine[4] | Chuan J. Yong[1,2] | James E. M. Watson[1,2] | Jennifer Silcock[5,6] | Gary S. Taylor[7] | Mark Lintermans[8] | Graeme R. Gillespie[9,10] | Stephen T. Garnett[11] | John Woinarski[11] | Reid Tingley[12] | Rod J. Fensham[5] | Conrad J. Hoskin[13] | Harry B. Hines[14,15] | J. Dale Roberts[16] | Mark J. Kennard[17,18] | Mark S. Harvey[16,19] | David G. Chapple[12] | April E. Reside[1,2]

- Forestry has a low ranking
- Most species listed as threatened by forestry do not occur in NSW
- Environmental protections

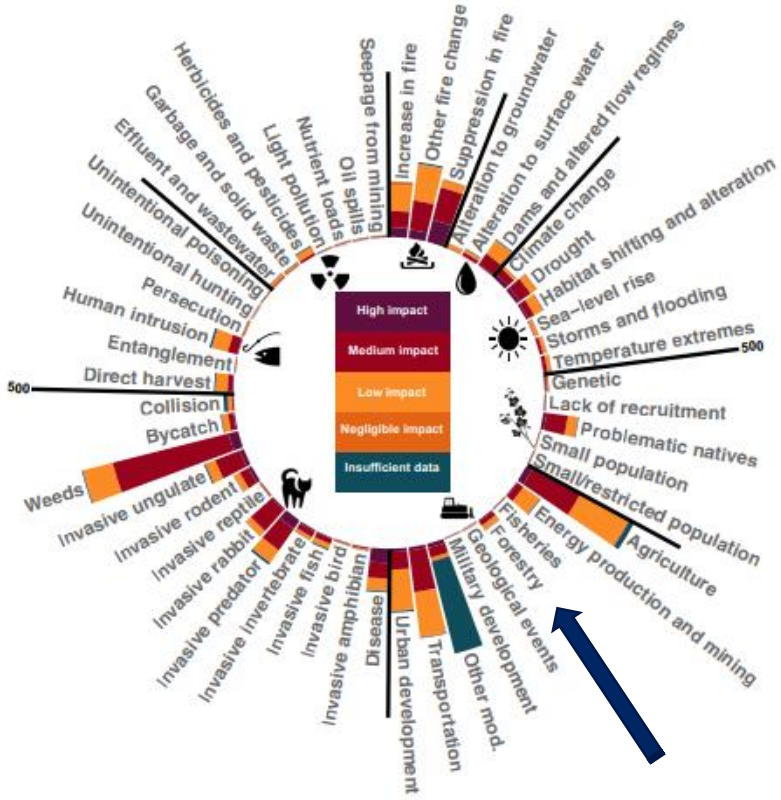


FIGURE 2 Number of threatened Australian taxa and relative level of impact for each subcategory threat, nested within the corresponding broad-level threat class. See Table 2 for symbols representing each broad-level threat. Relative levels of impact are color-coded as dark purple (high impact), maroon (medium impact), tangarine (low impact), bronze (negligible impact), and teal (insufficient data). The scale bar indicates the cumulative number of taxa impacted per threat