Natural Resources Commission
NSW GOVERNMENT

Welcome

Coastal IFOA Monitoring Program 2023
Webinar 2: Fauna Monitoring

The webinar will start shortly

NSW Forest Monitoring Steering Committee

NSW GOVERNMENT Department of Primary Industries

NSW EPA

Forestry Corporation

NSW GOVERNMENT Aboriginal Affairs

NSW GOVERNMENT Planning and Environment

NSW GOVERNMENT Local Land Services

NATIONAL PARKS & WILDLIFE SERVICE N·S·W

THE UNIVERSITY OF MELBOURNE

Australian National University

NSW GOVERNMENT Natural Resources Commission

THE UNIVERSITY OF SYDNEY

Coastal IFOA Monitoring

Fauna monitoring program

Chris Slade: Senior Ecologist

Forestry Corporation

Collaborative science program

NSW Forest Monitoring Steering Committee with independent experts and chaired by the NRC.

Cross-agency Technical Working Group(s) with independent experts

Report on annual basis and for 5-year reviews.

Multi-scale & inquiry driven approach

(Designed to meet Protocol 38)

Landscape scale - multi-species, long-term occupancy trend

Species specific occupancy trends

Targeted question / issue research

To what extent do the Coastal IFOA conditions maintain species occupancy in the landscape?

To what extent do the conditions maintain the population status of focal species?

To what extent do the Coastal IFOA conditions maintain fauna species viability in the landscape?

To what extent are the species-specific management plans effective in maintaining the viability of that species?

How are koalas responding to conditions, including changes in tree retention rates, species, distribution and size?

Can technology improve the probability of detection for a range of species in forestry operations?

Program Development

- Targeted species selection
- Method assessment
- Pilot trial

Plot Establishment

Each Region

- 100 Plots
- 200 sub-plots
- 3 devices per sub-plot (sites)

3 regions

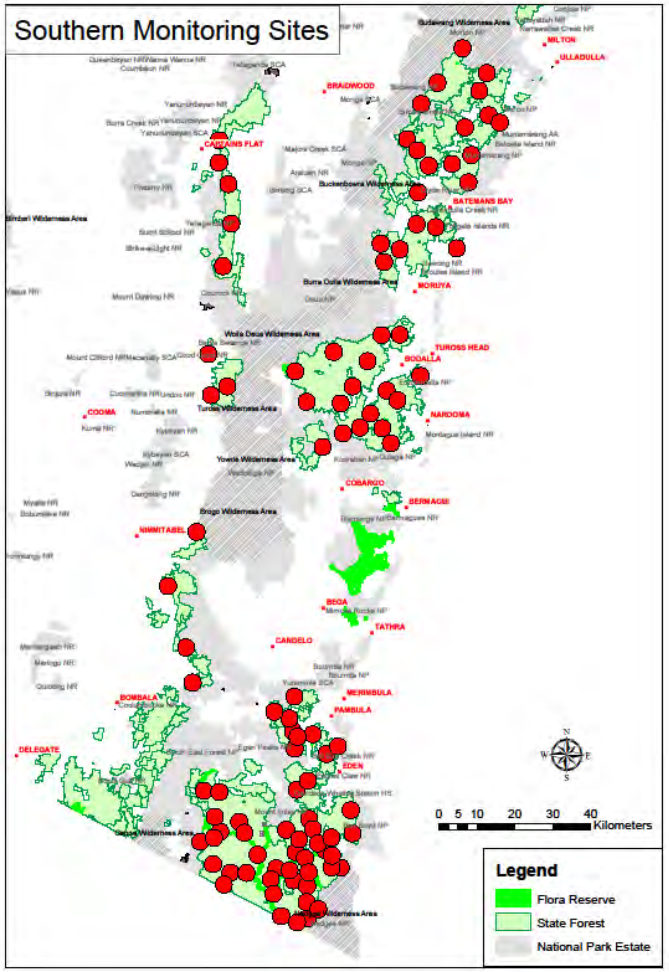
- Upper north east
- Lower north east
- Southern

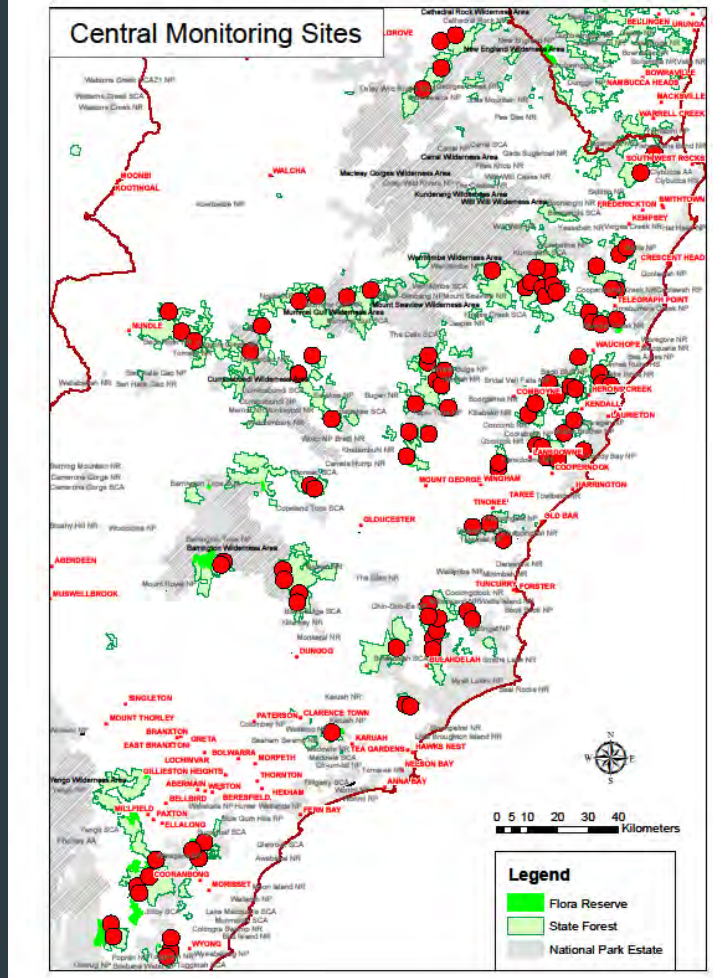
TOTAL 300 Plots – 600 subplots

Plot Selection

- Incorporated several long-term programs
  - Southern brown bandicoot - Eden
  - Large forest owls – Eden
  - Koala – north coast

- Range of factors:
  - Disturbance histories
  - Landscape position
  - Site access / remoteness


Southern Monitoring Sites
0 5 10 20 30 40
Kilometers
Legend
Flora Reserve
State Forest
National Park Estate


Central Monitoring Sites
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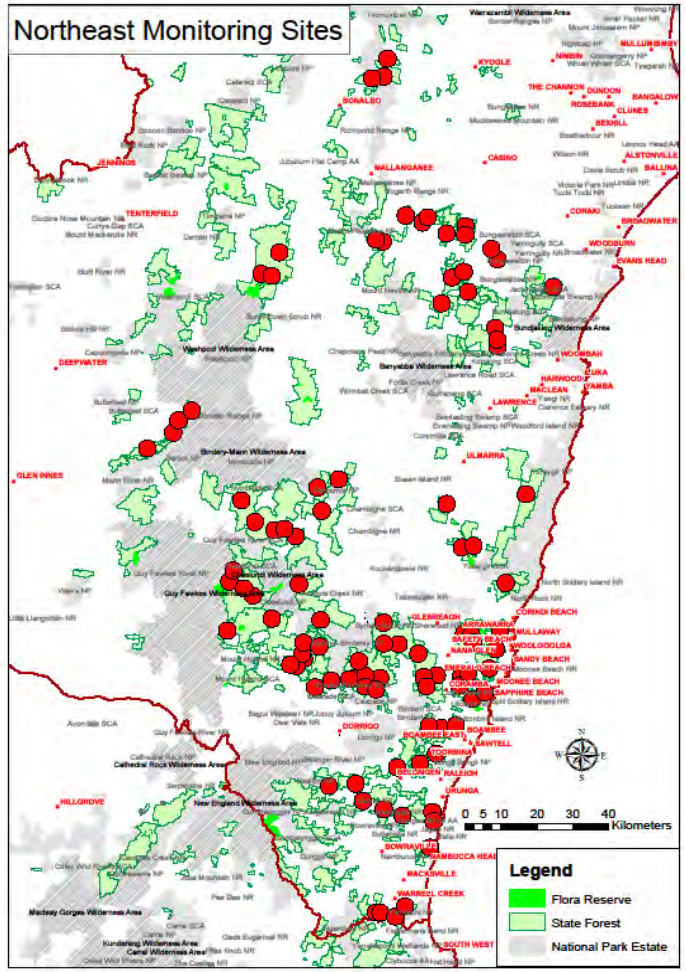
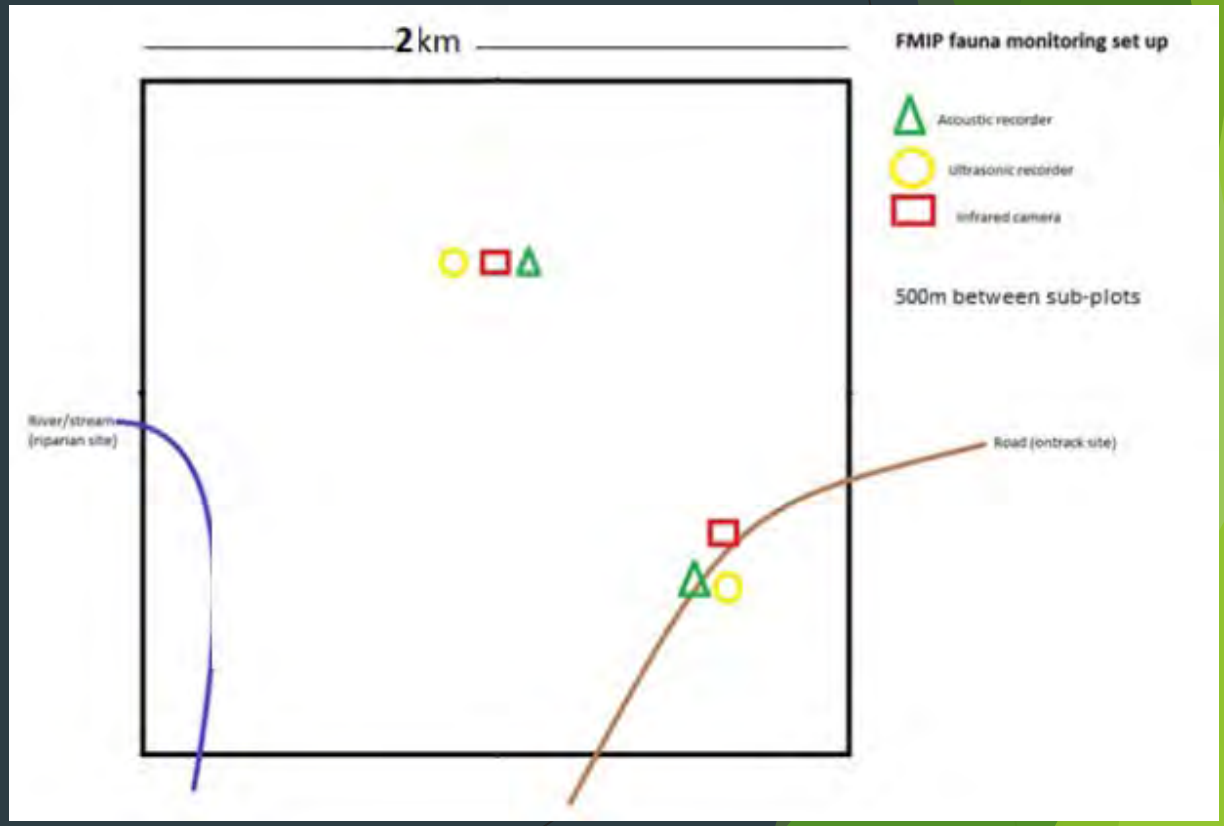
Kilometers
Legend
Flora Reserve
State Forest
National Park Estate


Northeast Monitoring Sites
0 5 10 20 30 40
Kilometers
Legend
Flora Reserve
State Forest
National Park Estate

Plot / Sub-plot

- Plot = 2 sub-plots
- On-Track
  - Remote camera
  - Ultrasonic sound recorder
  - Audio sound recorder
- Off-Track
  - Remote camera
  - Ultrasonic sound recorder
  - Audio sound recorder



Sampling Regime

- 50 annual plots (100 sub-plots) / region / year
- 10 panel plots (20 sub-plots) {sampled once every 5 years}
- TOTAL = 60 / region

- Seasonal split
  - 45 plots (90 sub-plots) sampled each year in spring / region
  - 15 plots (30 sub-plots) sampled each year in autumn / region

- Annual total (East Coast CIFOA area) = 180 plots (360 sub-plots)
- 300 plots (600 sub-plots) sampled over 5 years

- All devices set for 14 nights

  - Noting similar program underway in Pilliga for last 10 years

SiteID	SiteSchedule	FY22_23	FY23_24	FY24_25	FY25_26	FY26_27
N_001	Annual	Spring	Spring	Spring	Spring	Spring
N_010	Annual	Spring	Autumn	Spring	Spring	Spring
N_100	Once Every 5 Years	0	0	0	0	Spring
N_011	Annual	Spring	Spring	Autumn	Spring	Spring
N_012	Annual	Spring	Spring	Spring	Spring	Spring
N_013	Annual	Spring	Autumn	Spring	Spring	Spring
N_014	Annual	Spring	Spring	Spring	Spring	Spring
N_015	Annual	Autumn	Spring	Spring	Spring	Spring
N_016	Annual	Autumn	Spring	Spring	Spring	Spring
N_017	Annual	Spring	Autumn	Spring	Spring	Spring
N_018	Annual	Autumn	Spring	Spring	Spring	Spring
N_019	Annual	Spring	Spring	Spring	Spring	Spring
N_002	Annual	Autumn	Spring	Spring	Spring	Spring
N_020	Annual	Spring	Autumn	Spring	Spring	Spring
N_021	Annual	Spring	Spring	Spring	Spring	Autumn
N_022	Annual	Spring	Spring	Spring	Autumn	Spring
N_023	Annual	Spring	Autumn	Spring	Spring	Spring
N_024	Annual	Spring	Spring	Spring	Autumn	Spring
N_025	Annual	Spring	Spring	Spring	Spring	Autumn
N_026	Annual	Spring	Spring	Spring	Spring	Spring
N_027	Annual	Spring	Spring	Spring	Spring	Autumn
N_028	Annual	Spring	Spring	Spring	Autumn	Spring
N_029	Annual	Spring	Autumn	Spring	Spring	Spring
N_003	Annual	Autumn	Spring	Spring	Spring	Spring
N_030	Annual	Spring	Spring	Spring	Spring	Autumn
N_031	Annual	Spring	Spring	Spring	Autumn	Spring
N_032	Annual	Spring	Spring	Spring	Autumn	Spring
N_033	Annual	Spring	Spring	Spring	Spring	Spring
N_034	Annual	Spring	Spring	Spring	Spring	Spring
N_035	Annual	Spring	Spring	Spring	Spring	Spring
N_036	Annual	Autumn	Spring	Spring	Spring	Spring
N_037	Annual	Spring	Spring	Autumn	Spring	Spring
N_038	Annual	Spring	Spring	Spring	Spring	Autumn
N_039	Annual	Autumn	Spring	Spring	Spring	Spring
N_004	Annual	Spring	Spring	Spring	Autumn	Spring
N_040	Annual	Spring	Autumn	Spring	Spring	Spring
N_041	Annual	Spring	Spring	Autumn	Spring	Spring
N_042	Annual	Spring	Spring	Autumn	Spring	Spring
N_043	Annual	Spring	Spring	Spring	Spring	Spring
N_044	Annual	Spring	Spring	Autumn	Spring	Spring
N_045	Annual	Spring	Spring	Spring	Spring	Autumn
N_046	Annual	Spring	Spring	Spring	Spring	Autumn
N_047	Annual	Spring	Spring	Autumn	Spring	Spring
N_048	Annual	Spring	Spring	Spring	Autumn	Spring
N_049	Annual	Spring	Spring	Autumn	Spring	Spring
N_005	Annual	Spring	Spring	Autumn	Spring	Spring
N_050	Annual	Spring	Spring	Spring	Spring	Spring

SiteID	SiteSchedule	FY22_23	FY23_24	FY24_25	FY25_26	FY26_27
N_065	Once Every 5 Years	0	Spring	0	0	0
N_066	Once Every 5 Years	0	Spring	0	0	0
N_067	Once Every 5 Years	0	Autumn	0	0	0
N_068	Once Every 5 Years	0	Autumn	0	0	0
N_069	Once Every 5 Years	0	Autumn	0	0	0
N_007	Annual	Spring	Spring	Spring	Autumn	Spring
N_070	Once Every 5 Years	0	Spring	0	0	0
N_071	Once Every 5 Years	0	0	Autumn	0	0
N_072	Once Every 5 Years	0	0	Autumn	0	0
N_073	Once Every 5 Years	0	0	Autumn	0	0
N_074	Once Every 5 Years	0	0	Spring	0	0
N_075	Once Every 5 Years	0	0	Autumn	0	0
N_076	Once Every 5 Years	0	0	Autumn	0	0
N_077	Once Every 5 Years	0	0	Spring	0	0
N_078	Once Every 5 Years	0	0	Spring	0	0
N_079	Once Every 5 Years	0	0	Autumn	0	0
N_008	Annual	Spring	Spring	Spring	Spring	Autumn
N_080	Once Every 5 Years	0	0	Autumn	0	0
N_081	Once Every 5 Years	0	0	0	Autumn	0
N_082	Once Every 5 Years	0	0	0	Autumn	0
N_083	Once Every 5 Years	0	0	0	Spring	0
N_084	Once Every 5 Years	0	0	0	Spring	0
N_085	Once Every 5 Years	0	0	0	Autumn	0
N_086	Once Every 5 Years	0	0	0	Spring	0
N_087	Once Every 5 Years	0	0	0	Autumn	0
N_088	Once Every 5 Years	0	0	0	Autumn	0
N_089	Once Every 5 Years	0	0	0	Autumn	0
N_009	Annual	Spring	Autumn	Spring	Spring	Spring
N_090	Once Every 5 Years	0	0	0	Autumn	0
N_091	Once Every 5 Years	0	0	0	0	Autumn
N_092	Once Every 5 Years	0	0	0	0	Autumn
N_093	Once Every 5 Years	0	0	0	0	Autumn
N_094	Once Every 5 Years	0	0	0	0	Autumn
N_095	Once Every 5 Years	0	0	0	0	Spring
N_096	Once Every 5 Years	0	0	0	0	Spring
N_097	Once Every 5 Years	0	0	0	0	Autumn
N_098	Once Every 5 Years	0	0	0	0	Autumn
N_099	Once Every 5 Years	0	0	0	0	Autumn

Remote Camera

- Reconyx Hyperfire
- Camera and bait station
- Lure – Peanut butter / rolled oats / truffle oil / tuna oil

Target species:

Rufous Bettong, Long-nosed bandicoot, Southern brown bandicoot, Spotted-tailed Quoll, Long-nosed Potoroo

MOTION – All settings related to how your camera behaves when motion is detected are grouped under this menu item.

1) Motion Pictures – ON, off

2) Pictures Per Trigger – 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

3) Picture Interval – RapidFire™, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 seconds

4) Motion Videos – on, OFF

a) If On, Video Length – 5 sec, 10 SEC, Dynamic Length

5) Quiet Period – NO DELAY, 5s, 10s, 15s, 30s, 1m, 2m, 3m, 5m

6) Sensitivity - low, low/medium, medium, medium/high, HIGH, very high

Ultrasonic call recorder

Song meter mini bat

Time	Set from your device (Ipad or Iphone)	
Ultrasonic settings	Recording Format	Full Spectrum
	Full Spectrum Sample rate	256 kHz
	Minimum trigger frequency	8 kHz
	Max recording length	15 secs
	Trigger window	2 secs
	Save noise files?	YES
	Left channel gain	12 dB
Location	Set to general region	Use pinpoint to set office location
	Time zone	UTC +10.00 or use the configurator app to set to your phone
Delay start	Off	
Schedule	Record bats 30 min before sunset to 30 min after sunrise	
	Mode	Ultrasonic
	Start	Time 00:00
	Duty Cycle	Always
	End	Time 00:00

- Target bat species
  - Eastern false pipistrelle, Eastern freetail bat, Greater broad-nosed bat, Southern myotis, Yellow-bellied Sheath-tailed bat

Audio call recorder

- Song meter mini

Time	Set from your phone / ipad	
Acoustic settings	Sample rate	22050Hz
	Max recording length	60 mins
	Channel	Left
	Left channel gain	18 dB
	Right channel gain	18 dB
Location	Crescent Head	
	Time zone	UTC +10.00 or use the configurator app to set to your phone
Delay start	Off	
Schedule	Record birds/frogs 24 hours a day	
	Start	Time 00:00
	Duty Cycle	Always
	End	Time 00:00

Target species:

Barking Owl, Masked Owl, Powerful Owl, Sooty Owl, Boobook Owl, Glossy Black-cockatoo, Brown Treecreeper, Rufous Scrub-bird, Varied Sittella, Grey-headed Flying Fox, Koala, Squirrel Glider, Sugar Glider, Yellow-bellied Glider

Sampling Protocols

- Ensuring consistent equipment set up
- Consistent data capture

Standard Operating Procedure

Forestry Corporation

SONG METER MINI BAT

FIRMWARE VERSION – 3.4 – to be used until 2027 unless otherwise advised.

The Song Meter Mini Bat utilizes an ultrasonic microphone for recording bat calls. The Song Meter Mini Bat device will be set up and configured prior to field deployment for acoustic recording.

The following is a quick set up method for the device in the office:

1 Remove the lid from the Song Meter Mini recorder.
2 Insert four or NiMH batteries and a 64 (128) GB SD card.
3 Switch the recorder's power switch to On.
4 If the Bluetooth LED flashes red this indicates that the recorder's internal clock is not set. It will be set when pairing.
5 Make sure Bluetooth is enabled on your mobile device.
6 Launch the app.
7 The Song Meter Mini bat will be detected by the app and will appear in the Recorders screen.
8 Press and hold the Pair button on the Song Meter Mini bat recorder for three seconds. The Bluetooth LED on the recorder will blink green, indicating it is ready to pair.
9 In the app, tap the Pair icon when it appears in the Recorders screen. The recorder's details will turn green, indicating successful pairing.
10 A pop-up asks if you want to set the recorder's time zone to your mobile device's time zone. Tap Yes. Next, a pop-up asks the same about location. Tap Yes.
11 After pairing, tap the Configure icon for the paired Song Meter Mini recorder in the Recorders screen. The Configuration Editor screen will open.
12 Select a preset recording schedule from the dropdown menu and make any desired setting changes.
13 The recording schedule and settings changes load onto the recorder after each change.
14 Format data card.
15 Ensure the Recorder Name is adjusted to the sub-plot name eg C-001-off-BA for each new deployment.
16 Tap the Unpair icon on the Recorders screen and the Song Meter Mini is now ready to deploy and record.

NOTE:
It is important that high quality, new lithium batteries must be used on each equipment deployment. Battery failure is a major cause of data loss in passive devices. Ensuring that you have a good battery management procedure is essential to ensuring good data quality and minimising the risk of having to redeploy gear.

Songmeter mini bat detector settings for the Fauna Monitoring

Time	Set from your device (ipad or Iphone)	
Ultrasonic settings	Recording Format	Full Spectrum
	Full Spectrum Sample rate	256 kHz
	Minimum trigger frequency	8 kHz
	Max recording length	15 secs
	Trigger window	2 secs
	Save noise files?	YES
	Left channel gain	12 dB
Location	Set to general region	Use pinpoint to set office location
	Time zone	UTC +10 00 or use the configurator app to set to your phone
Delay start	Off	
Schedule	Record bats 30 min before sunset to 30 min after sunrise	
	Mode	Ultrasonic
	Start	Time 00:00
	Duty Cycle	Always
	End	Time 00:00

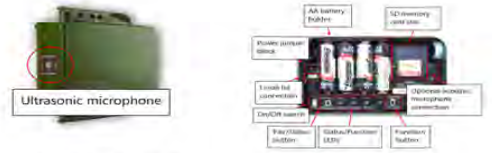


Figure 8: Song Meter Mini Bat

SETTING IN THE FIELD

- Chest height 1.5 – 1.7 m –
- On track sites
  - ~5m from track- theft – Tree selection
  - Small tree so not to block mic
  - Rough bark
  - No shrubs in front of mics- block signal
  - Not obvious from track- theft – Turn on
- Attach to tree
- Aim mic
  - horizontal and slightly down - rain
- Place on south side of trunk if possible – overheating in summer

Ensure to Aim at road or nearby open space flyway

Figure 12: Song Meter Mini Bat. A python lock or strap may be fitted through the top loops in the unit. Photograph: Anna McConville

*******WARNING – MAKE SURE LIDS ARE CLOSED TIGHT AND CLICK INTO POSITION, AS THEY ARE FICKLE*******

CAPTURING SITE IN IPAD

A monitoring plan should already be linked in the IPAD through the PLAN PORTAL.

At site, capture new **SITE** for the SM Mini Bat(as well a site each for the camera and SM Mini)

Site NAME:
Region (N – North, C – Central, S – Southern).
site number (001 – 100),
location ("**on**" or "**off**"),
device (BA – song meter mini Bat) –
eg *C-002-off-BA* – same details as put into songmeter.

(Note use an underscore between region, site number, location, device)

Capture new census – date, people and
In Census notes – add serial number of device being used.
For subsequent seasons/years keep the sites the same just add new census and details.

PICKUP SONG METER MINI

17 Open cover. The unit should be still recording and will show a display when you open it. If it is not recording, use the check status button to see if it will power on. Check that it is switched on. Record the error in the form.
- Switch off and replace cover

18 Remove from tree.

AT CAR:

- Open cover
- Remove SD data card by pressing and sliding card into slot – listen for click – and then slide card out
- Place SD data card into Zip Lock bag with label – ensure label has site name, date, name of person picking up equipment and device type (Song meter Mini BAT - BAT)
- Place Zip lock bag in container in safe place in car.

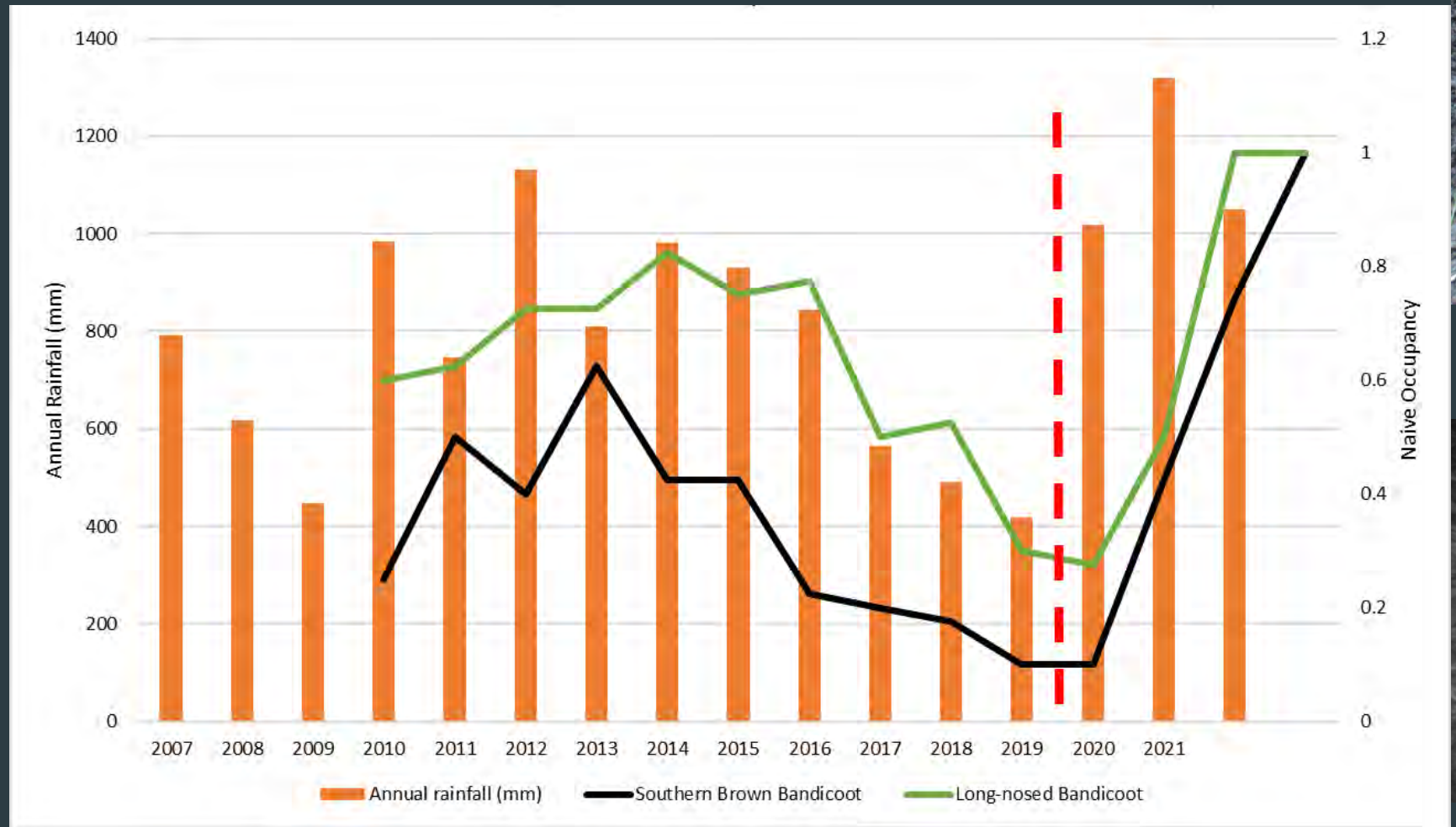
Label:
- Site name – eg C-001-on-BA or C-001-off-BA
- Date –
- Name of person:
- Device Type:
- Device serial number

Species Specific programs

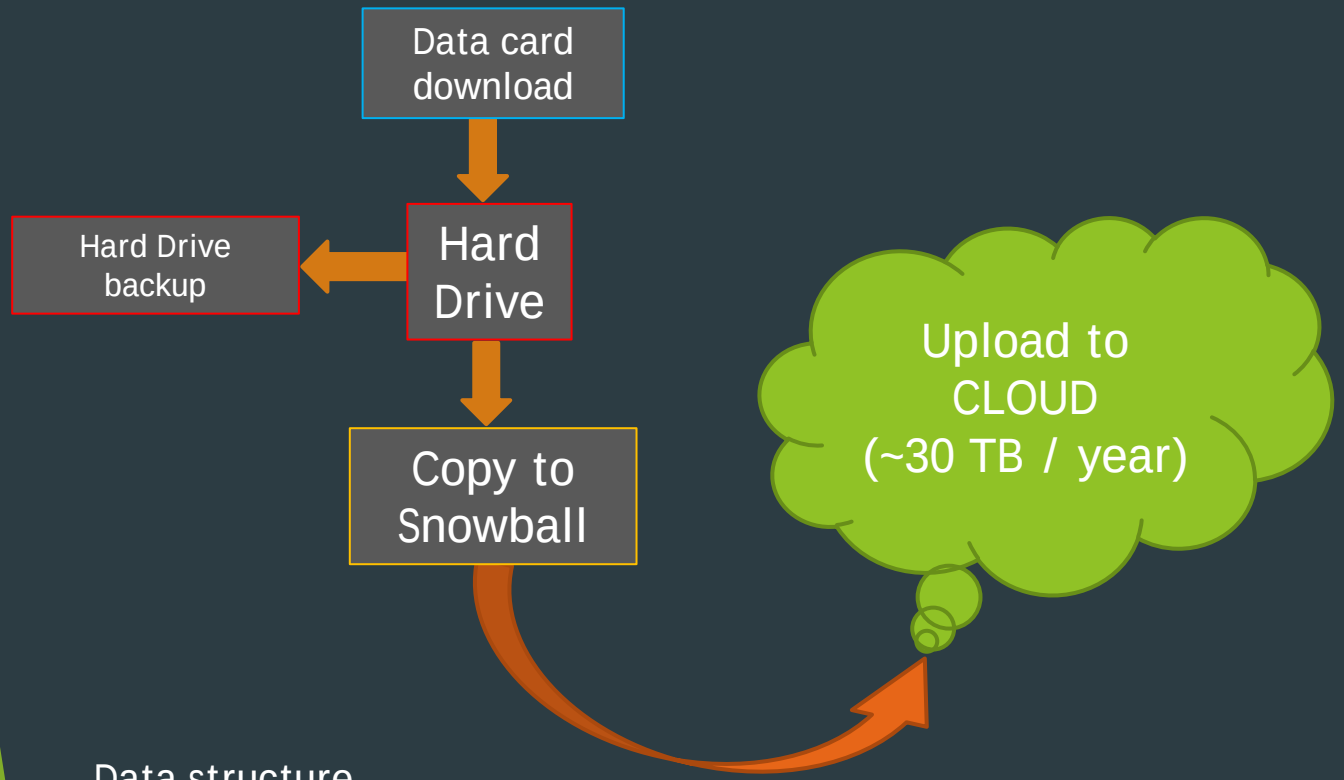
- Southern Brown Bandicoot – Eden
- Yellow-bellied Glider – Bago Plateau
- Smoky Mouse – Eden
- Giant Burrowing Frog – Eden
- Large forest owls - Eden
- Hastings River Mouse – northern tablelands
- Koala – northern forests
- Greater Glider – southern & northern tablelands
- Multiple flora species

Southern Brown Bandicoot & Long-nosed Bandicoot

Annual site occupancy



BIG DATA



Data structure –

- Device
  - Year
    - Season
      - Region
        - Sub-Plot
          - on track
          - off track


C-022-OFF-RC
RECONYX


2023-01-23 9:19:54 PM M 2/5
16°C
HYPERFIRE 2 COVERT
RECONYX

CIFOA Fauna Occupancy Monitoring – Year 1 (2022/23)

Brad Law
With Leroy Gonsalves, Elsa Kohane, Glenyse Villanueva, Traecey Brassil, Isobel Kerr, Chris O'Loughlin , Emma Sawyers

Principal Research Scientist, NSW DPI
Adjunct, Queensland University of Technology

4 December 2023

regional.nsw.gov.au

Fauna Occupancy Monitoring

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]

[a] Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, 1630 Linden Drive, Madison, WI 53706, United States
[b] Primary: Biological Sciences Department and Sustainability Studies Theme, Ohio University, 107 Irvine Hall, Athens, OH 45701, United States
[c] Secondary: Center for Environmental Research, University of Bucharest, 1 N. Balcescu Blvd., Bucharest 010041, Romania
[d] Bioacoustics Research Program, Cornell Lab of Ornithology, Cornell University, 159 Sapsucker Woods Road, Ithaca, NY 14850, United States
[e] Pacific Southwest Research Station, USDA Forest Service, 1731 Research Park Dr., Davis, CA 95618, United States
[f] Pacific Southwest Region, USDA Forest Service, 1323 Club Drive, Vallejo, CA 94592, United States

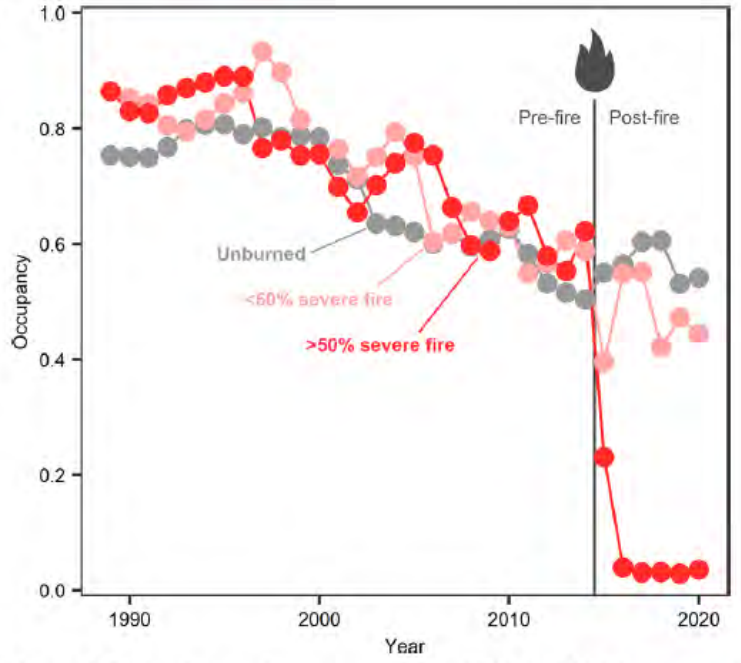
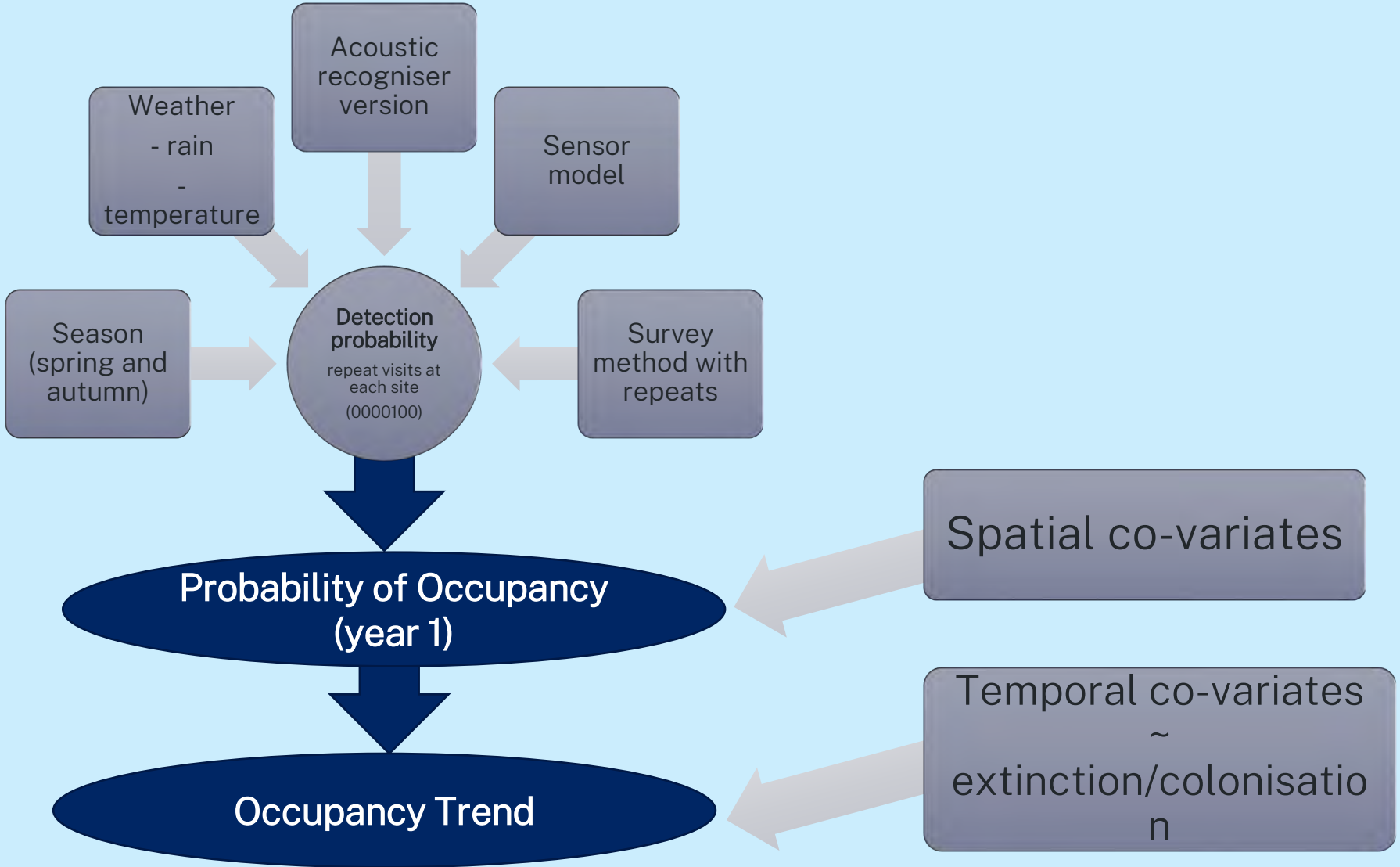


Figure 3 Derived annual occupancy from 1989 to 2020 for spotted owl sites grouped by the percentage of the home-range (1500 m) that experienced severe fire (unburned, <50% severe, >50% severe). The grey vertical line on the x-axis between years 2014 and 2015 indicates the timing of the 2014 King Fire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

Jones et al. 2021

Accounting for imperfect detection using detection history and covariates



Cost effective fauna monitoring - sensors for multiple species

- Cameras (established method)
- Ultrasonics (established method)
- Acoustics (emerging 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

“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

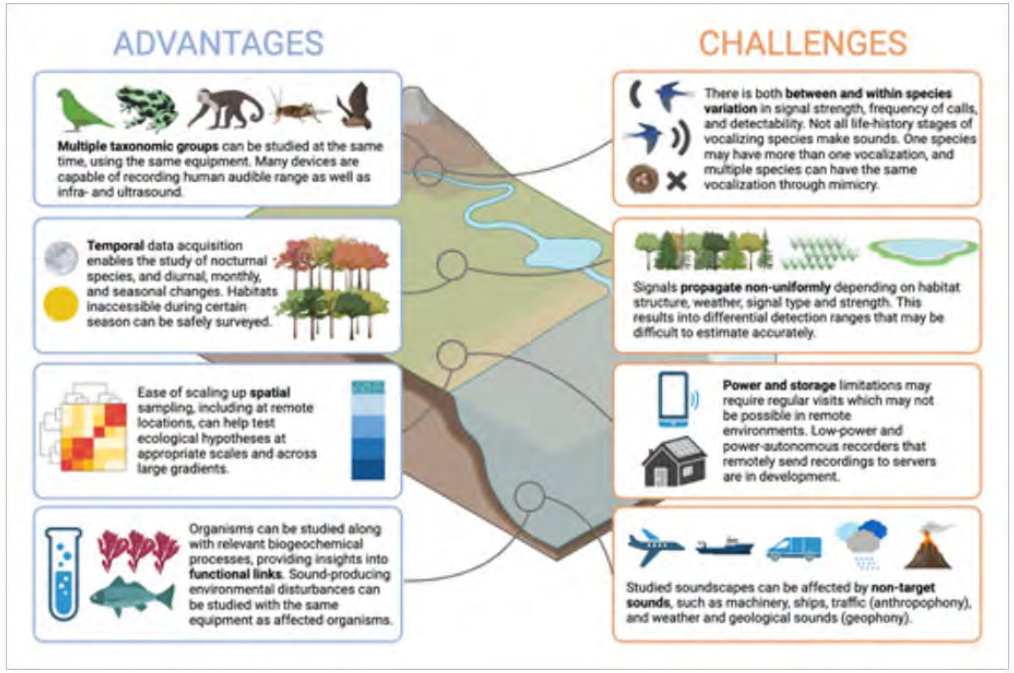
REVIEW | Open Access

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



Acoustics workflow for monitoring

Gibb et al. 2019

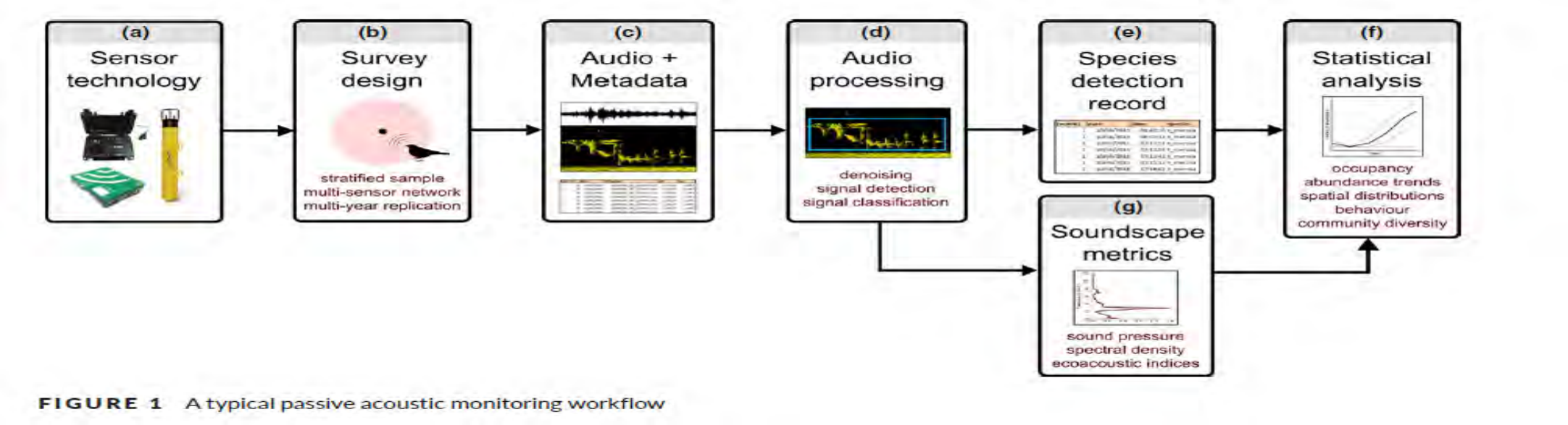


FIGURE 1 A typical passive acoustic monitoring workflow

Stats – occupancy modelling to account for imperfect detection…model occupancy across landscape

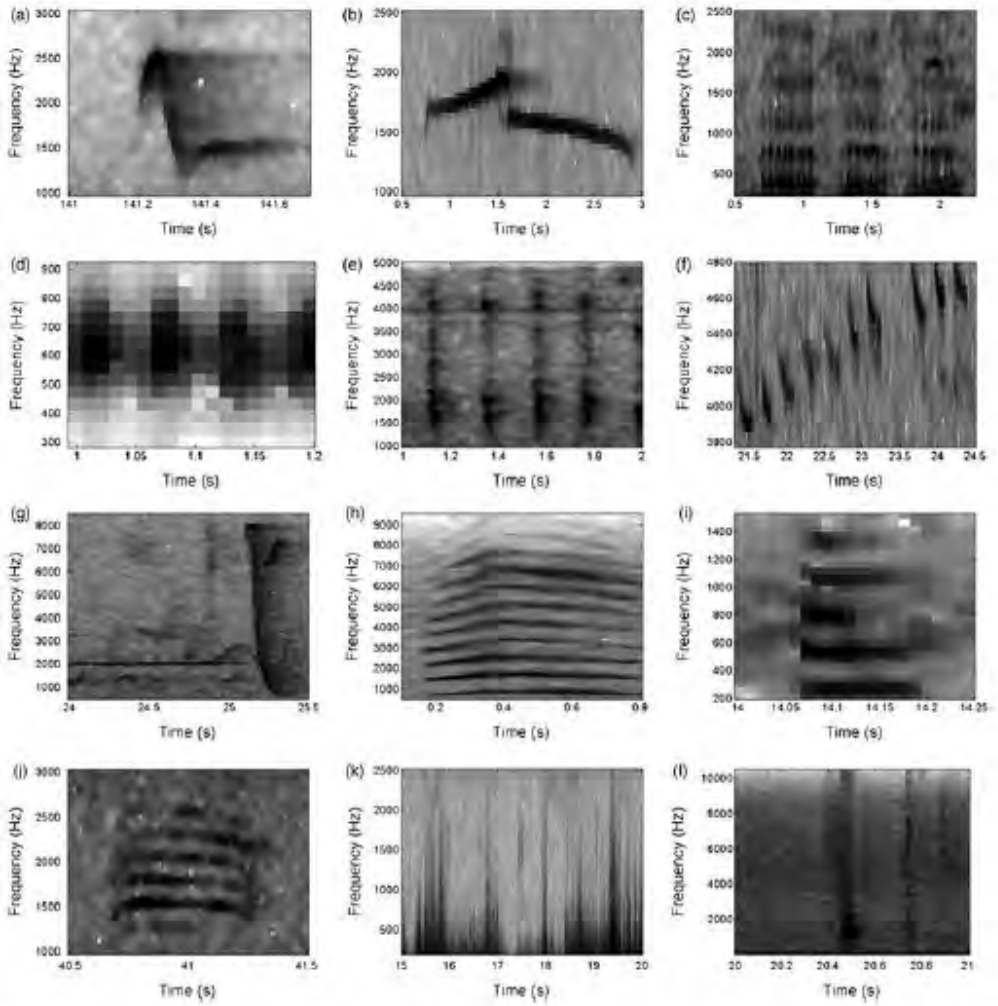
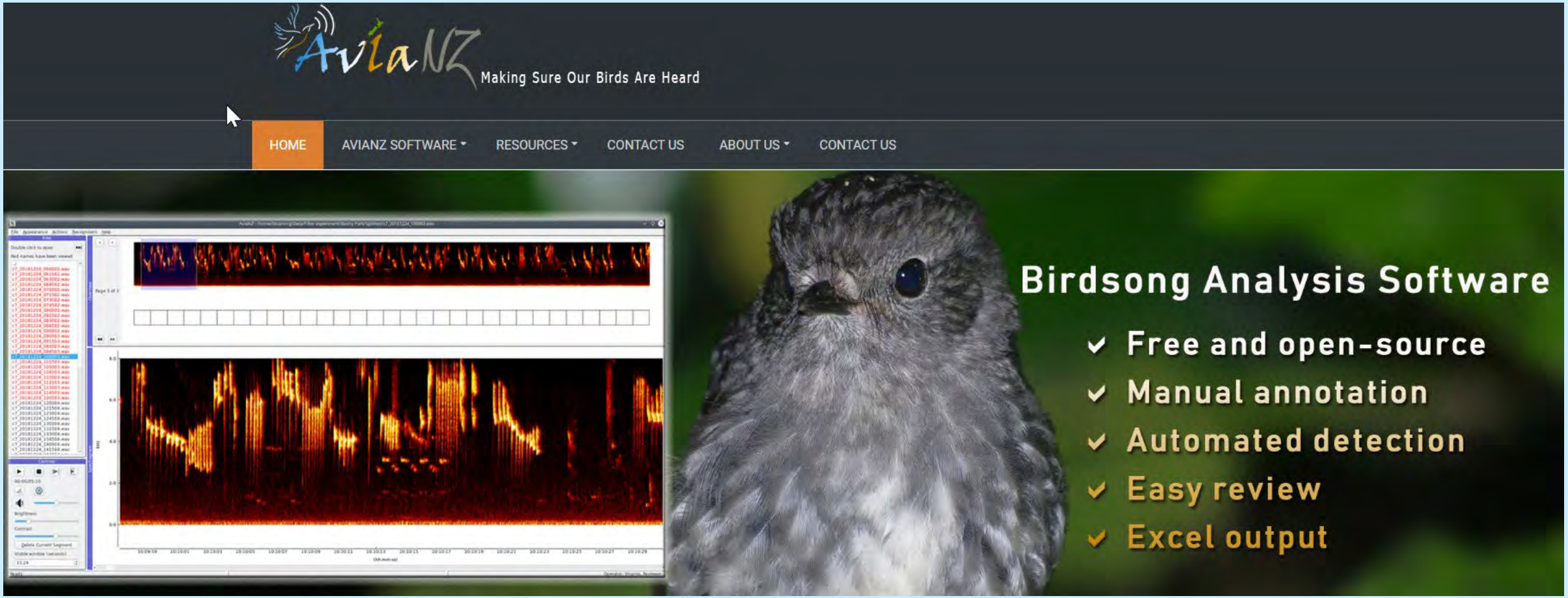


Figure 1. The spectral structure of calls studied in this work. Each image has been extracted from a spectrogram – the x-axis represents time in seconds, the y-axis frequency (Herz), and the grey scale represents acoustic intensity. (a) Currawong *Strepera graculina*; (b) Beach Stone-curlew *Esacus neglectus*; (c) male Koala *Phascolarctos cinereus*; (d) Cane Toad *Bufo marinus*; (e) Asian House Gecko *Hemidactylus frenatus*; (f) Ground Parrot *Pezoporus wallicus*; (g) Eastern Whipbird *Psophodes olivaceus*; (h) female Koala *Phascolarctos cinereus*; (i) human speech, vowel; (j) Torresian Crow *Corvus orru*; (k) wind gusts; (l) canopy rain.

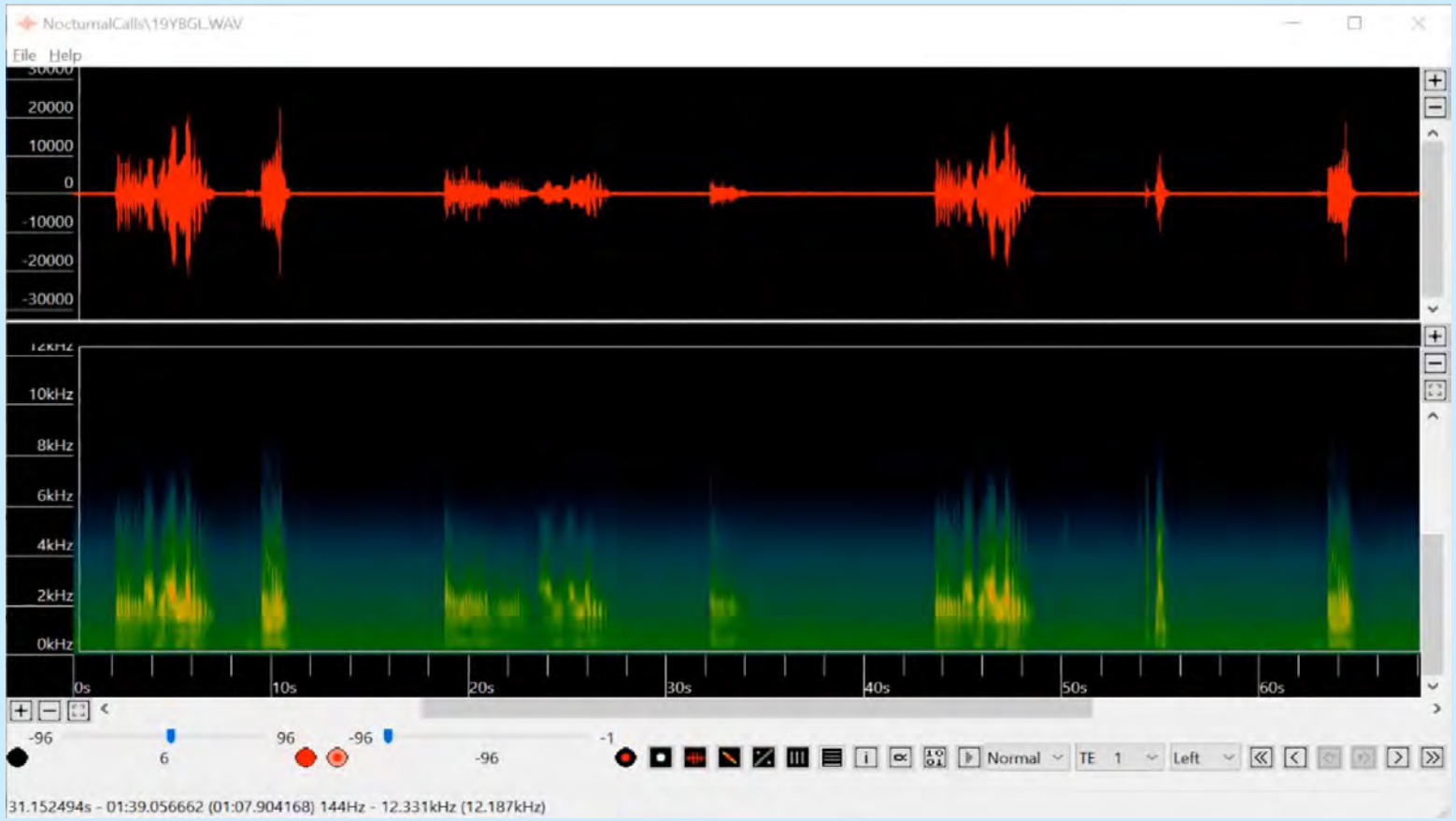
Spectrograms for different species have their own signature

AVIANZ – recogniser development and validation – open source, uses AI (CNN - neural networks)

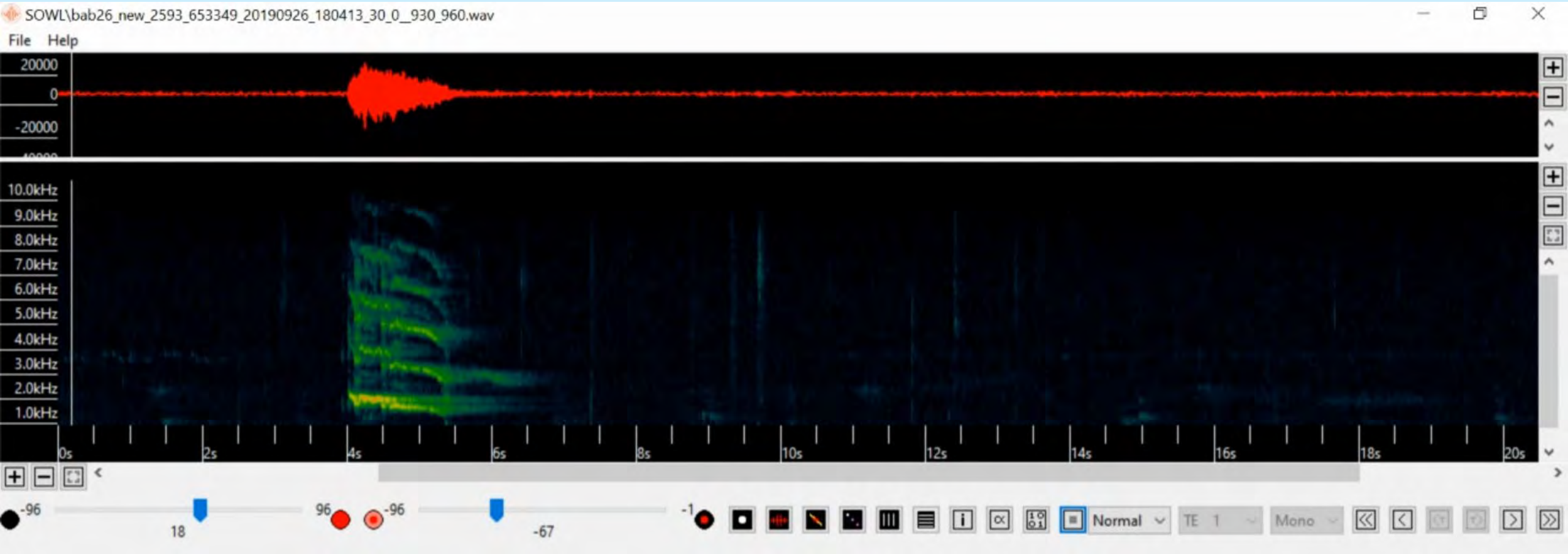


Development of initial acoustic recognisers using AI

- 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



Sooty Owl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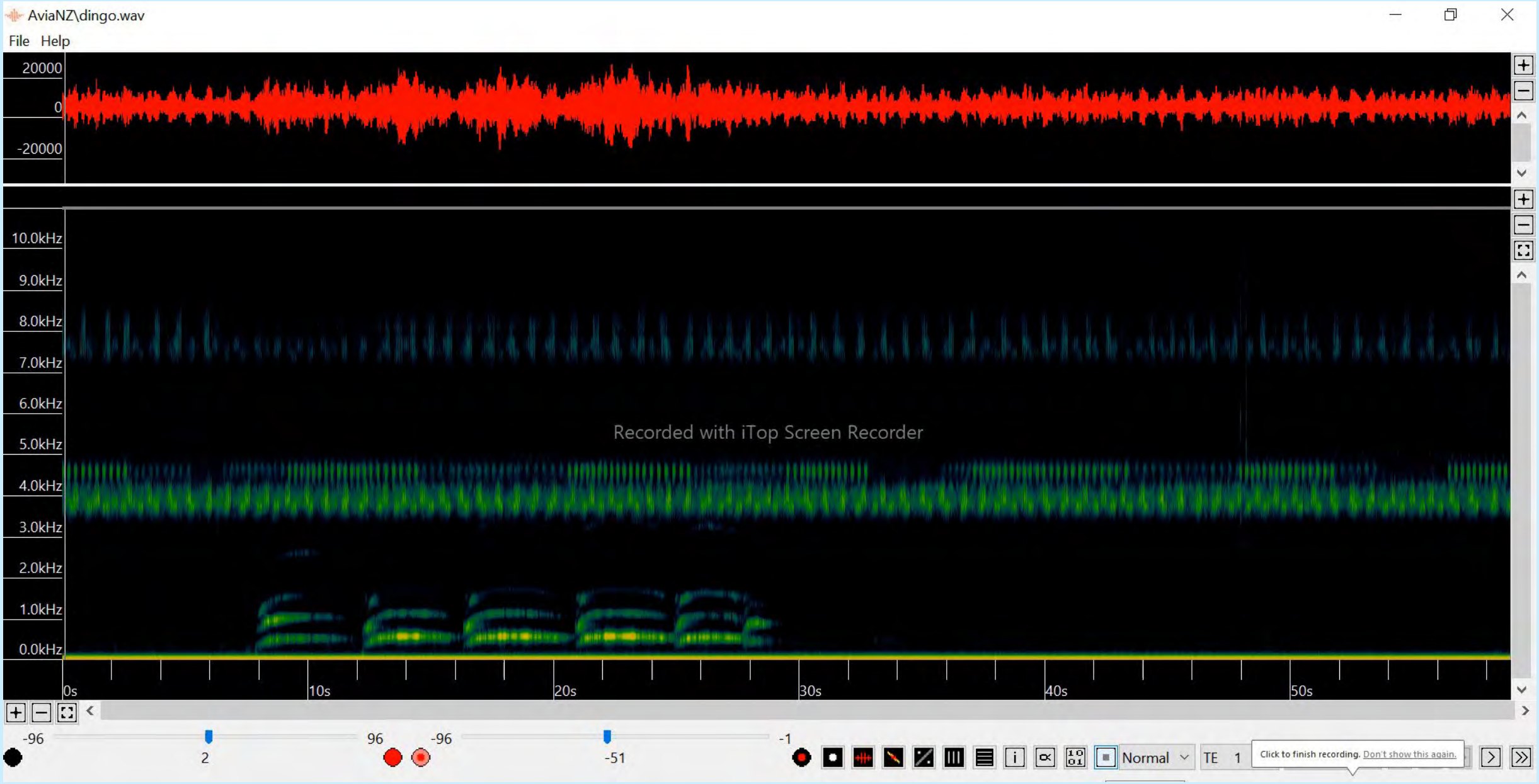
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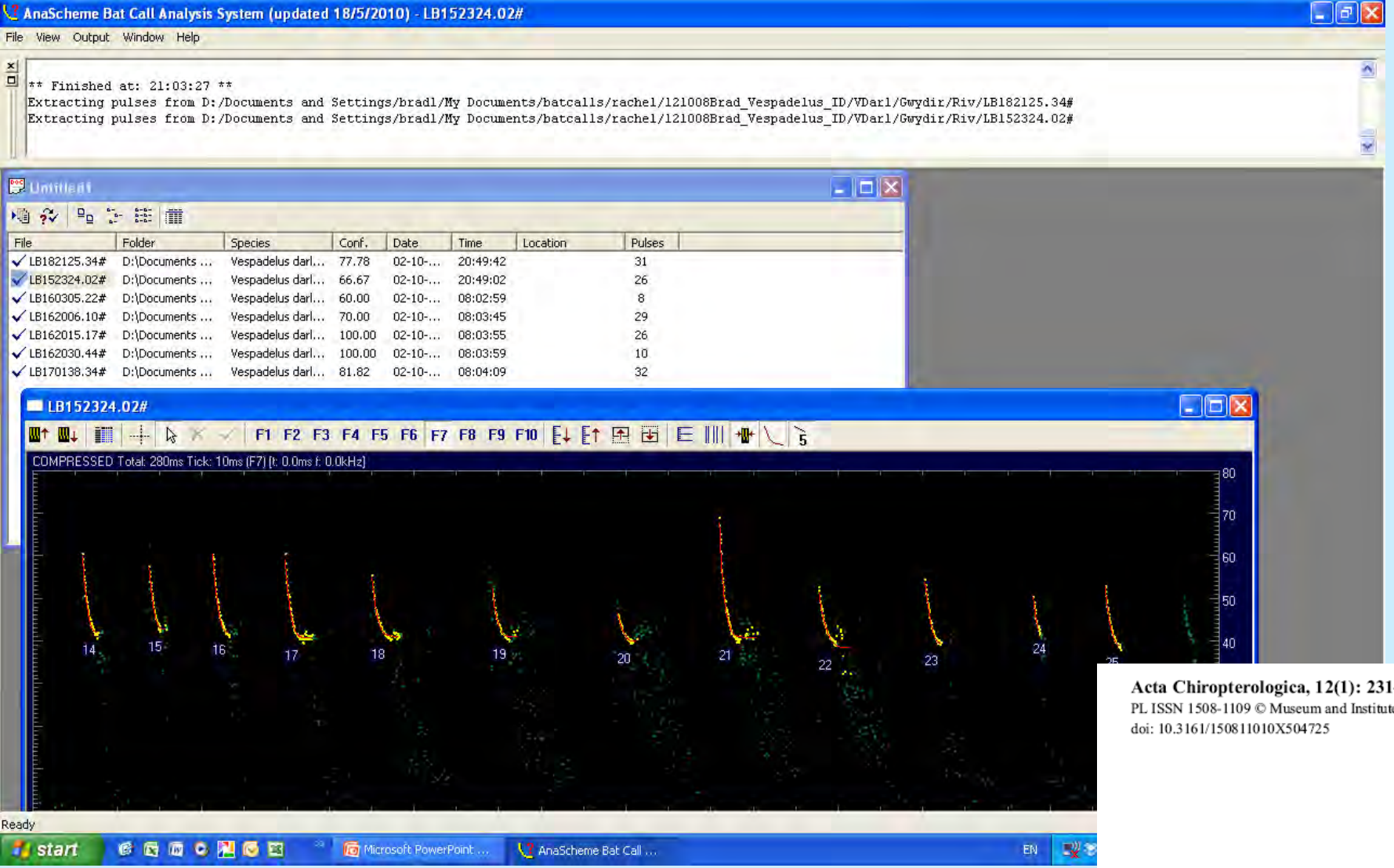
Click to finish recording. Don't show this again.

Bats - Anascheme

- Future analysis with AI? (DPI/DPE SoS project)



Acta Chiropterologica, 12(1): 231–245, 2010
PL ISSN 1508-1109 © Museum and Institute of Zoology PAS
doi: 10.3161/150811010X504725

Reliable automation of bat call identification for eastern New South Wales, Australia, using classification trees and AnaScheme software

MARIA D. ADAMS[1,3], BRADLEY S. LAW[1], and MATTHEW S. GIBSON[2]

[1]*Forest Science Centre, Industry and Investment NSW, PO Box 100, Beecroft NSW 2119, Australia*
[2]*Centre for Environmental Management, School of Science and Engineering, University of Ballarat, PO Box 663, Ballarat Victoria 3353, Australia*
[3]*Corresponding author: E-mail: maria.adams@y7mail.com*

Cameras

- Mega-detector to remove images with no animals
- Image tagging in Exif-Pro software

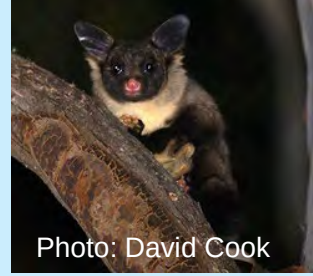
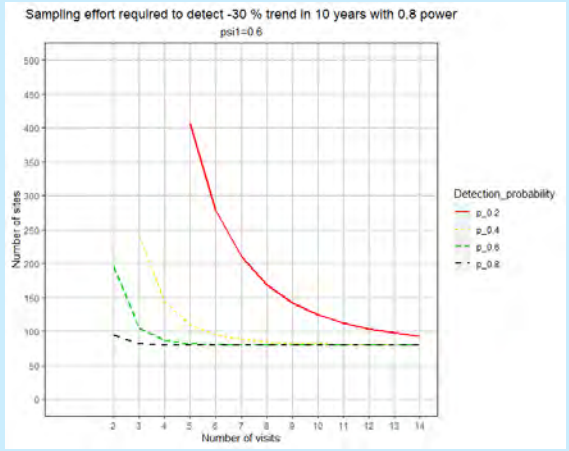


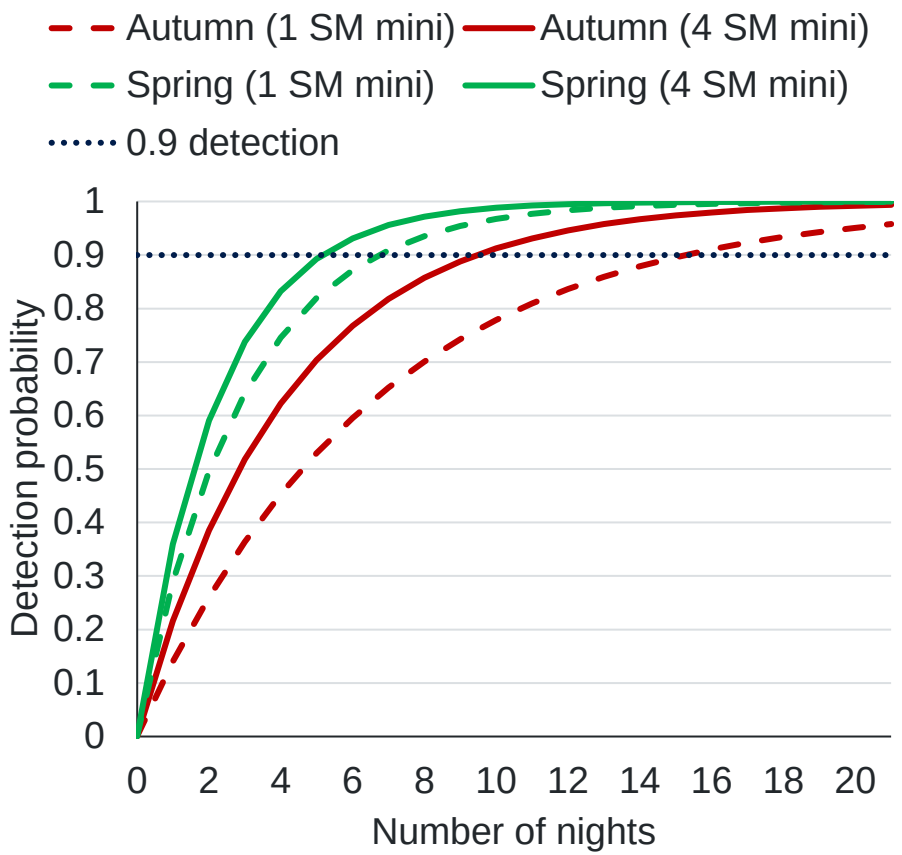
Photo: David Cook

Pilot studies to inform power and survey effort (# sites)

- Pilliga grid-based monitoring program: 2013-ongoing
- DPI Monitoring Feasibility study 2017
- CIFOA Pilots: 2021

- Pilot sampling effort required for detection probability of 0.9 for yellow-bellied glider:
  - 4 SM Mini = 10 nights (autumn), 6 nights (spring).
  - 1 SM Mini = 15 nights (autumn), 7 nights (spring).





Coastal IFOA fauna monitoring plots

to support Coastal IFOA fauna monitoring program

- Approx. 300 monitoring sites across CIFOA region
- Each site has2 subplots = total 600 subplots
- 150 sites remeasured every year
  - 50 in Upper North East subregion
  - 50 in Lower North East subregion
  - 50 in Southern and Eden subregions (combined)
- 30 sites measured once every five years
  - 10 per year in Upper North East subregion
  - 10 per year in Lower North East subregion
  - 10 per year in Southern and Eden subregions (combined)

5-YEAR ROTATING PANEL– 180 SITES PER YEAR

Year	Number of remeasured monitoring sites [1]	Number of rotating monitoring sites [2]	Total number of monitoring sites per year
1	126 (spring) 24 (autumn)	9 (spring) 21 (autumn)	180
2	126 (spring) 24 (autumn)	9 (spring) 21 (autumn)	180
3	126 (spring) 24 (autumn)	9 (spring) 21 (autumn)	180
4	126 (spring) 24 (autumn)	9 (spring) 21 (autumn)	180
5	126 (spring) 24 (autumn)	9 (spring) 21 (autumn)	180
Total number of sites	126 (spring) 24 (autumn)	150	300

[1] Sites monitored every year
[2] Sites monitored every 5 years

Acoustics - raw data

- >120,000 detections so far (spring only)
- 11 species

Species x Region	Number of detections	Number of sub-plots detected	Average of Naïve occupancy
Central	30923		
Koala	1851	49	0.64
Sugar Glider	1668	49	0.64
Boobook	24105	45	0.59
Glossy Black Cockatoo	102	26	0.34
Yellow-bellied Glider	590	26	0.34
Sooty Owl	37	14	0.18
Masked Owl	121	12	0.16
Powerful Owl	194	6	0.08
Grey-headed Flying fox	2216	5	0.07
Barking Owl	39	4	0.05
Squirrel Glider	0	0	0.00
Northern	37113		
Boobook	22985	29	0.97
Koala	1198	24	0.80
Sugar Glider	1428	23	0.77
Grey-headed Flying fox	7684	14	0.47
Yellow-bellied Glider	758	14	0.47
Powerful Owl	2658	13	0.43
Glossy Black Cockatoo	80	8	0.27
Sooty Owl	107	8	0.27
Squirrel Glider	171	8	0.27
Barking Owl	44	2	0.07
Masked Owl			****
Southern	53722		
Sugar Glider	1606	38	0.42
Boobook	49358	33	0.37
Powerful Owl	1579	33	0.37
Masked Owl	154	27	0.30
Sooty Owl	73	20	0.22
Glossy Black Cockatoo	328	15	0.17
Yellow-bellied Glider	599	9	0.10
Koala	25	1	0.01
Barking Owl	0	0	0.00
Grey-headed Flying fox	0	0	0.00
Squirrel Glider	0	0	0.00

Michael Pennay

Bats – raw data

- ~ 400,000 bat detections/passes!
- 19 species/taxa

Species	Number of detections	Num. sub-plots detected	Average of Naïve occupancy per sub-plot across regions/seasons
Vespadelus troughtoni/Vespadelus vulturnus/Vespadelus pumilus	82108	203	0.95
Chalinolobus gouldii	40652	303	0.93
Nyctophilus spp.	10016	303	0.93
Vespadelus vulturnus	24465	108	0.92
Ozimops ridei	9958	270	0.85
Miniopterus orianae oceanensis	33665	256	0.82
Austronomus australis	4878	244	0.77
Rhinolophus megaphyllus	25192	259	0.76
Chalinolobus morio	19583	234	0.75
Vespadelus darlingtoni	34149	219	0.69
Miniopterus australis	73735	200	0.69
Vespadelus regulus	26541	148	0.62
Scotorepens orion	9217	173	0.51
Scotorepens greyii/Scotorepens sp	1395	85	0.43
Micronomus norfolkensis	3063	113	0.34
Falsistrellus tasmaniensis	347	47	0.20
Saccolaimus flaviventris	806	59	0.19
Scoteanax rueppellii	437	26	0.09
Chalinolobus dwyeri	2482	14	0.08
Grand Total	**402689**	**344**	**0.61**

Cameras – raw data

- >14,000 detections with 1 min separation
- >21 species

Species	Number of detections	Num. sub-plots detected	Average of Naïve occupancy
rodent	5295	193	0.76
bird	1393	176	0.70
Long-nosed Bandicoot	627	135	0.58
Swamp Wallaby	889	139	0.57
small Dasyurid	2323	141	0.56
Northern Brown Bandicoot	1069	91	0.49
Common Brushtail Possum	544	81	0.33
Superb Lyrebird	265	75	0.33
Southern Brown Bandicoot	101	23	0.31
Australian Brush-turkey	169	44	0.28
Short-eared Brushtail Possum	202	45	0.27
Common Wombat	145	37	0.24
Eastern Pygmy-possum	29	10	0.22
Mountain Brushtail Possum	97	14	0.19
Cat	223	47	0.17
Lace Monitor	105	31	0.17
Red-necked Wallaby	52	12	0.12
Spotted-tailed Quoll	66	19	0.11
Brushtail possum	12	5	0.11
Red-necked Pademelon	47	15	0.10
Long-nosed Potoroo	36	20	0.10
Unknown mammal	31	21	0.09
Short-beaked Echidna	42	22	0.09
Bandicoot sp.	4	4	0.09
Eastern Grey Kangaroo	24	12	0.08
Dingo/domestic dog	41	18	0.08
Red Fox	39	11	0.07
small mammal	16	13	0.07
Red-bellied Black Snake	2	2	0.06
Unknown macropod	15	12	0.06
Unknown	5	4	0.06
Koala	11	8	0.05
Common Ringtail Possum	27	10	0.05
European cattle	105	4	0.05
Land Mullet	6	4	0.04
bat	1	1	0.04
Parma Wallaby	25	3	0.03
Australian Owlet-nightjar	5	3	0.03
reptile	7	2	0.03
Pig	7	4	0.03
Albert's Lyrebird	3	2	0.03
Brush-tailed Phascogale	2	2	0.03
Red-legged Pademelon	6	1	0.02
deer	1	1	0.02
Eastern Brown Snake	1	1	0.02
Rabbit	2	1	0.02
Horse	2	1	0.01

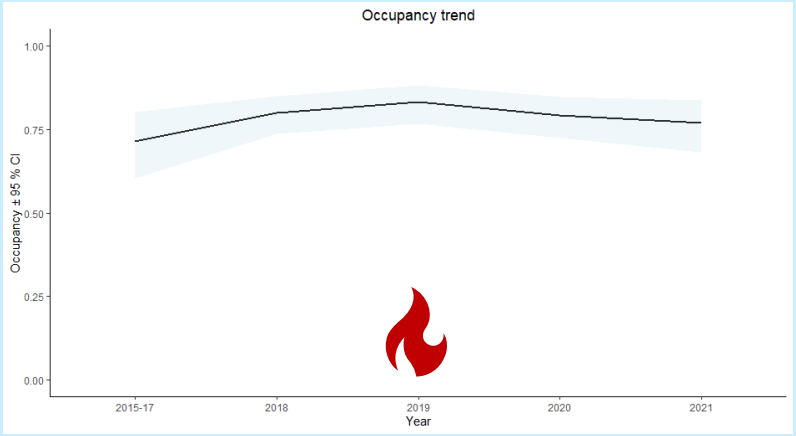
Modelling covariates (GIS-derived)

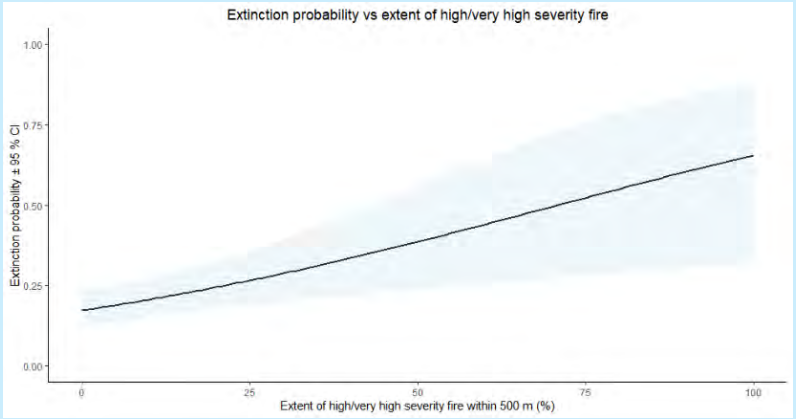
Variable	Description	Detection(p)	Initial Occupancy	Colonisation	Extinction
Sensor type	SM2, SM4, SM-mini, audiomoth	√			
Recogniser Version	Ecosounds version 1, Ecosounds version 2, AviaNZ (CNN15)	√			
Month	Month of survey	√			
Season	Year of survey	√			
Climate		√			
Lagged annual Rainfall	Total annual rainfall over previous 12 months (SILO interpolation), 500 m resolution	√	√	√	√
Lagged annual maximum temperature	Annual mean of the daily maximum temperature over previous 12 months (SILO interpolation), 500 m resolution	√	√	√	√
Precipitation (long-term)	Anuclim, mean annual precipitation in 1 km & 500 m buffer		√		
Mean annual temperature (long-term)	Anuclim, mean annual temperature in 1 km & 500 m buffer		√		
Environmental			√		
DEM	Site elevation (m ASL), mean of 1 km & 500 m buffer		√		
Land tenure	State forest vs national park/reserve		√		
Soil fertility	Mean % of total phosphorous at 0 to 5 cm in 1 km & 500 m buffer		√		
Roughness (100)	Neighbourhood Topographical Roughness based on Standard Deviation of Elevation in circular 100 – m Neighbourhood Mean of roughness in 1 km buffer & 500 m buffer, 30 m resolution		√		
Topographic Position	Mean Topographic Index in 1 km buffer & 500 m buffer		√		
Landscape old growth	% area of mapped old growth in 1 km & 500 m buffer		√		
Landscape rainforest	% area of mapped rainforest in 1 km & 500 m buffer		√		
SMIPS	Soil Moisture Information Processing System (CSIRO); Index of moisture in the top 90 cm. 1 km resolution over previous 12 months		√	√	√
NDVI	NDVI value (mean July-September in survey year) in 1 km & 500 m buffer		√	√	√
Disturbance			√	√	√
Landscape heavy harvesting (< 5 years)	% area of heavy harvesting (<5 years) in 1 km & 500 m buffer		√	√	√
Landscape selective harvesting (< 5 years)	% area of selective harvesting (<5 years) in 1 km & 500 m buffer		√	√	√
Landscape heavy harvesting (5-15 years)	% area of heavy harvesting (5 – 15 years) in 1 km & 500 m buffer		√	√	√
Landscape selective harvesting (5-15 years)	% area of selective harvesting (5 – 15 years) in 1 km & 500 m buffer		√	√	√
Landscape heavy harvesting (16-30 years)	% area of heavy harvesting (16 – 30 years) in 1 km & 500 m buffer		√	√	√
Landscape selective harvesting (16-30 years)	% area of selective harvesting (16 – 30 years) in 1 km & 500 m buffer		√	√	√
Landscape heavy harvesting (> 30 years)	% area of heavy harvesting (>30 years) in 1 km & 500 m buffer		√	√	√
Landscape selective harvesting (> 30 years)	% area of selective harvesting (>30 years) in 1 km & 500 m buffer		√	√	√
Landscape wildfire (high severity)	% area of high severity wildfire 2019/2020 Black Summer Fires in 1 km & 500 m buffer		√	√	√
Landscape wildfire (low severity)	% area of low severity wildfire 2019/2020 Black Summer Fires in 1 km & 500 m buffer		√	√	√

DPI acoustic monitoring from 2015-2021 in north-east NSW across 224 sites

Trend in north-east koala occupancy (public forests) (Law et al. unpubl. data)

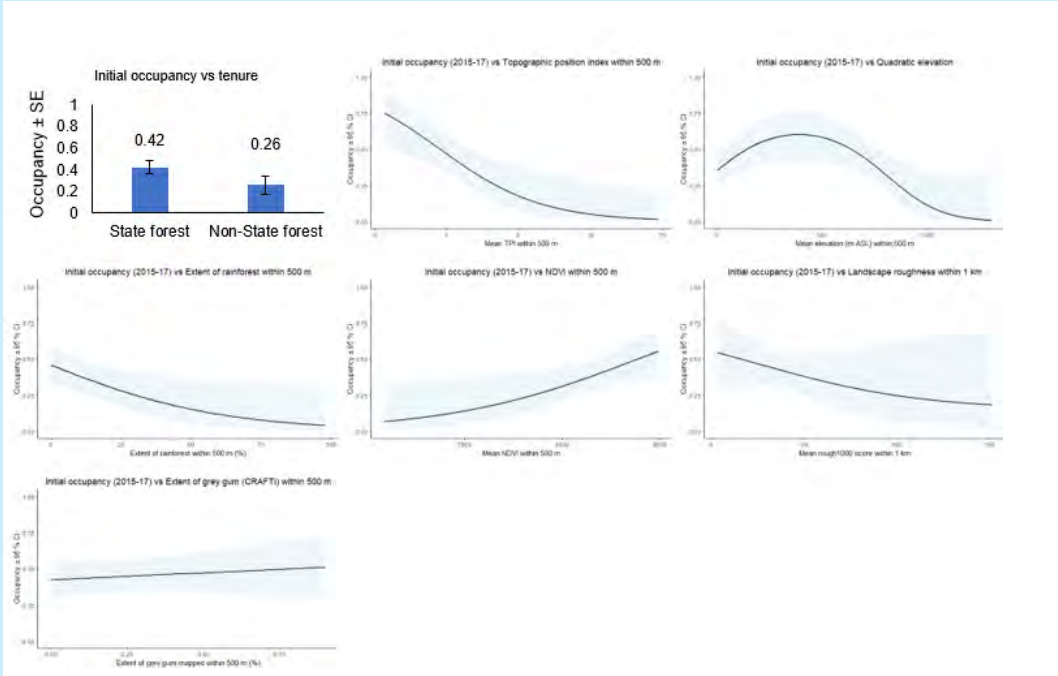
- Koala occupancy relatively stable despite drought and unprecedented wildfire in 2019
- Extent of high severity fire corelated with local extinction probability

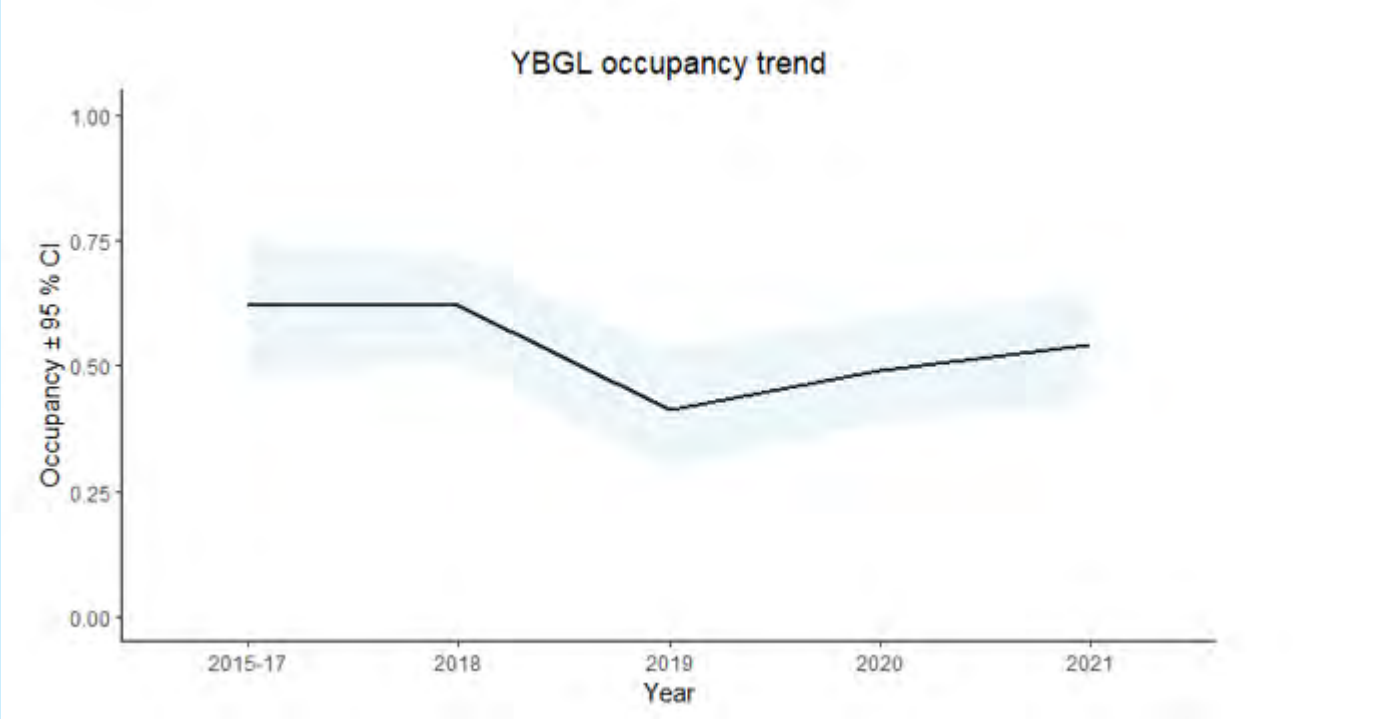


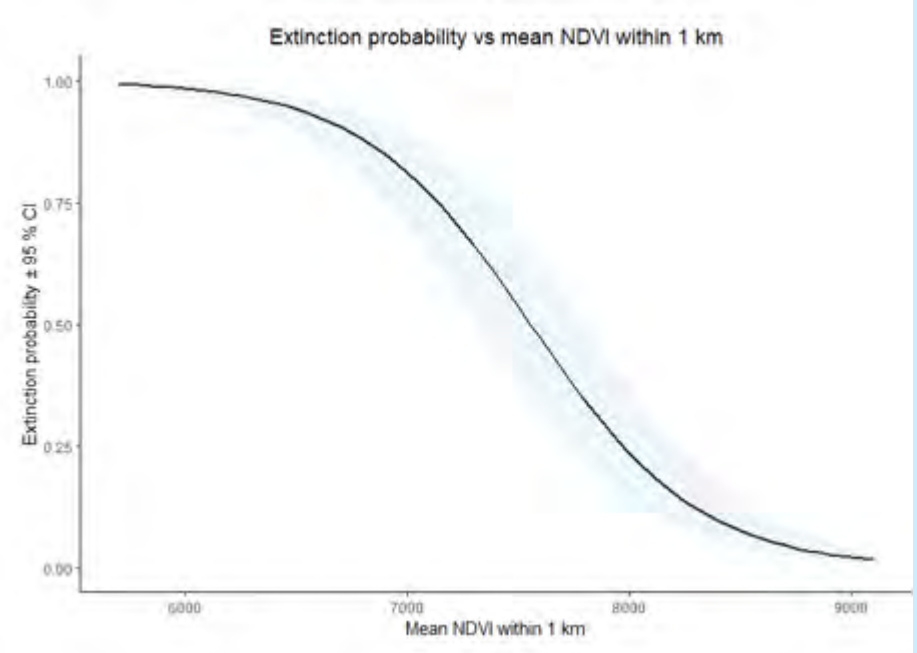


Yellow-bellied glider trend in NE public forests (Law et al. unpubl. data)

Initial occupancy in 2015



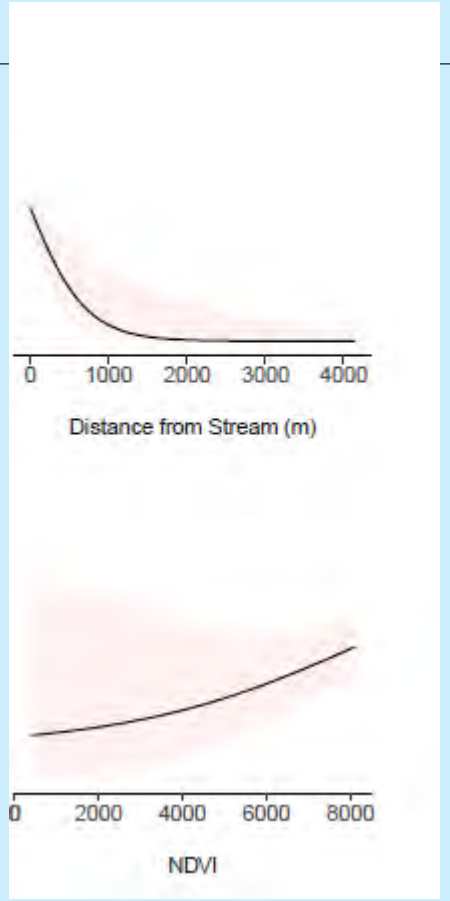




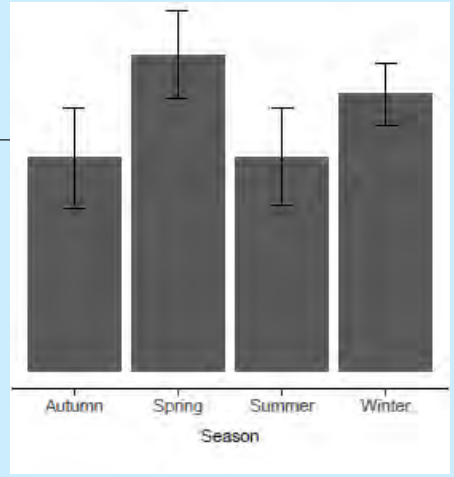
- Occupancy varied from~0.45-0.6
- 34 % decline in 2019

FMIP 1990s Baseline study: e.g. Yellow-bellied Glider (northern) (Kavanagh et al. 2021)

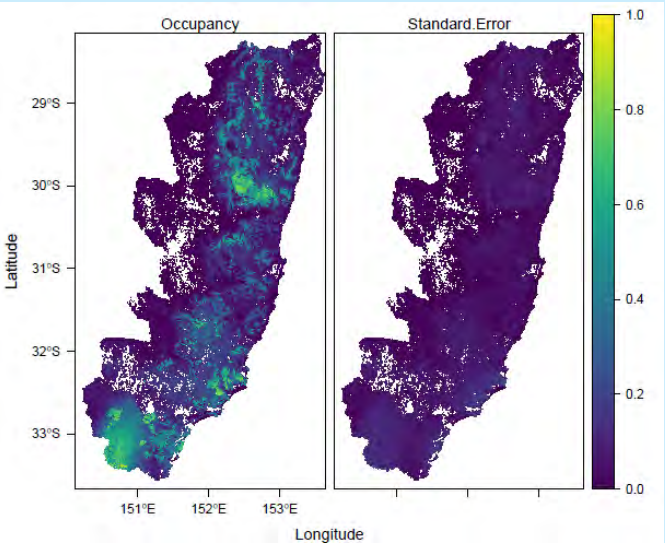
- Requires large tree hollows for denning, exudate feeding
- 292 detection sites and 1808 non-detection sites
- Detection varied with season
- Median occupancy was 0.39±0.05
- Important drivers for occupancy:
  - Many (e.g. tenure, distance from stream (negative), NDVI (positive))



Probability of occupancy



Probability of detection



Summary: 2022/23 (Year 1)


Michael Pennay

- Massive multi-species dataset from acoustics, ultrasonics and cameras
- Seasonal sampling and regionalised data capture
- Provides a strong foundation for future monitoring of species trends
- Can be compared to the past:
  - DPI acoustics monitoring from 2015-2022 (analysis in progress)
  - FMIP baselines from the 1990s (Kavanagh et al. 2021)
  - WildCount for cameras on NPWS estate?
- Potential to be one of Australia's largest terrestrial fauna monitoring programs

NSW GOVERNMENT | Natural Resources Commission

Q&A

Dr Brad Law, Principal Research Scientist at the Forest Science Unit in the NSW Department of Primary Industries

Mr Chris Slade, Senior Ecologist for Hardwood Forests at the Forestry Corporation of NSW

Professor Philip Gibbons, Fenner School of Environment and Society at the Australian National University and an independent advisor on the NSW Forest Monitoring Steering Committee

NSW GOVERNMENT Natural Resources Commission

Upcoming Webinars

Webinar 3: Forest Carbon - Forest carbon of NSW forests – 13 December 12.30-1.30pm

Registrations are now open

To register please visit our website **nrc.nsw.gov.au** or LinkedIn profile “Natural Resources Commission”

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Thank you for joining us today!

This webinar will be available shortly on the Commission's website nrc.nsw.gov.au

The Commission will post responses to unanswered questions on the Commission's website.

Any further questions or feedback please contact us nrc@nrc.nsw.gov.au