Pirra Jungku and Jila Project

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Photo: Karajarri IPA

SUMMARY

WHY ARE WE DOING THIS PROJECT: The Pirra Jungku and Jila project aims to improve Jungku (fire management), cultural knowledge and biodiversity over the pirra of Karajarri Indigenous Protected Area (IPA) and the Jilji of the Warlu Jilajaa Jumu IPA. We are especially interested in managing Jungku around jilas (desert waterholes).

AIM: We wanted to understand how fire affects different animal species, so we could decide how to manage fire, especially around jilas.

WHAT WE DID: We set up permanent biodiversity monitoring sites at the Edgar Ranges and at Kulgara on the Karajarri IPA, starting in 2018. In 2020, the project extended east - the Ngurrara rangers set up 8 sites at Kuduarra on the Warlu Jilajaa Jumu IPA. Karajarri and Ngurrara have been working together on this project, sharing skills and knowledge. The locations are different distances to permanent water sources, Kuduarra is furthest from water, and Edgars is closest. We have surveyed each site 2-3 times for reptiles, mammals, birds, frogs and bats. By July 2021, we had done 63 site surveys, and over 5600 trap-nights. We used satellite imagery to say what the fire patterns around each site were. In this report, we talk about what we have learned about reptiles and mammals and fire. We have also trialled using eDNA techniques to monitor what animals use jilas. We did this work in collaboration with the Nyangumarta rangers.

WHAT WE FOUND:

- We caught 2497 reptiles from 64 different species; and we caught 149 mammals from 9 different species.
- We found that the seasonal patterns in reptile species and abundance was different at Kuduarra, which is further away from water, than Edgars and Kulgara.
- We found that some reptiles species are most common soon after fire, some are common a few years later, and others much prefer long-unburnt areas. These changes happen because species that are active in the daytime need grass to shelter from predators and the sun, and these are the species that get rare for a while soon after fire.
- Although reptiles care about *when* fires happened, they don't seem to care about how patchy the fires are.
- Mammals were different – soon after fire there are less species and less animals, and it took a few years for them to build back up again. We know that some species are missing or very rare now, and wildfires might have partly caused that loss.

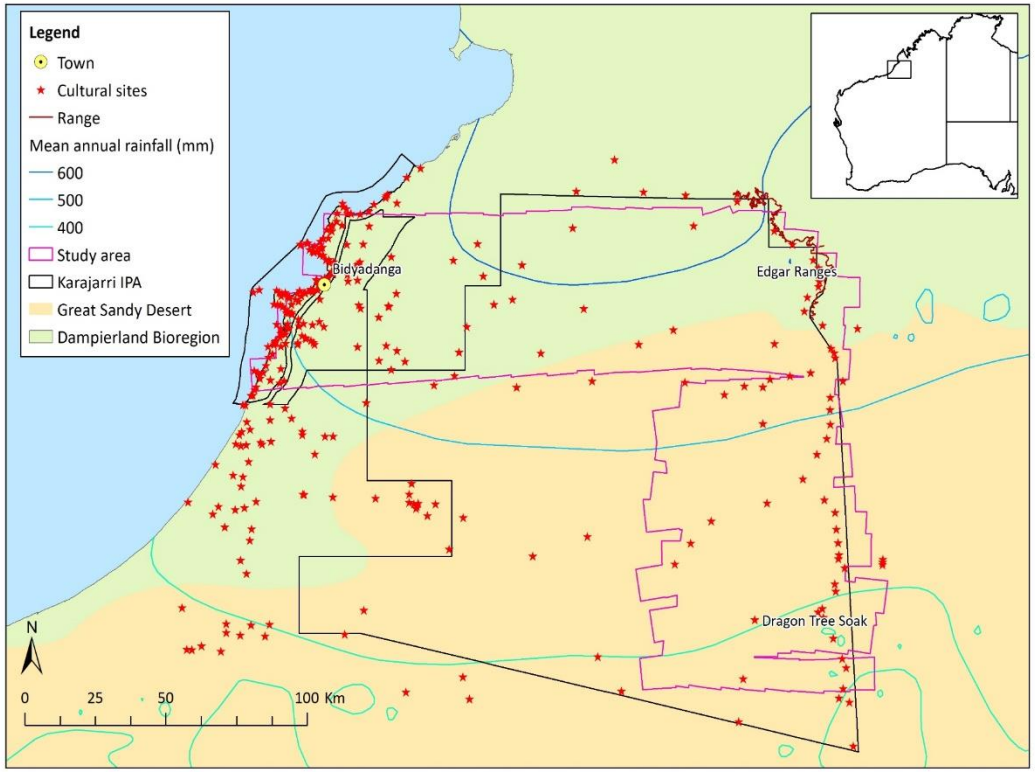
WHAT WE HAVE LEARNED: To look after reptiles, we need a mixt of areas that burnt recently, a few years ago, or a long time ago. If there are lots of wildfires, there will be less variety of reptiles in an area. To look after mammals, we need long-unburnt vegetation scattered about, and we need to make fires burn less often.

NOW WHAT:

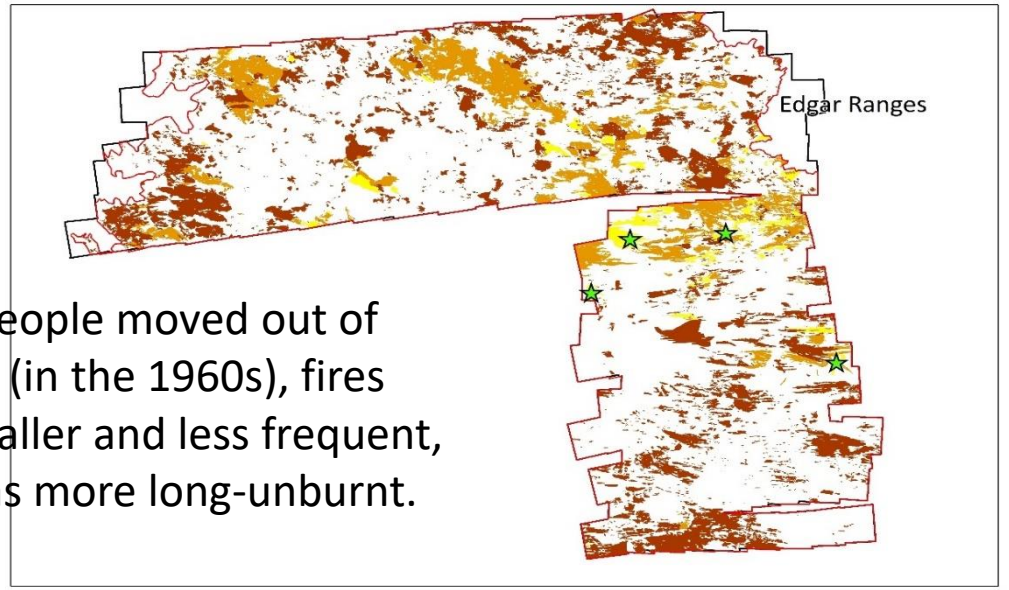
We need to do more work to understand how patchy to make fires. From looking at aerial photographs from the 1940s, we know our old people burnt really small patches. We are planning to do the same things at some of our monitoring sites, close and far from jilas, and then we can measure what happens to the plants and animals. We will use the results of the eDNA trials to design a bigger jila monitoring program.

Why are we doing this project?

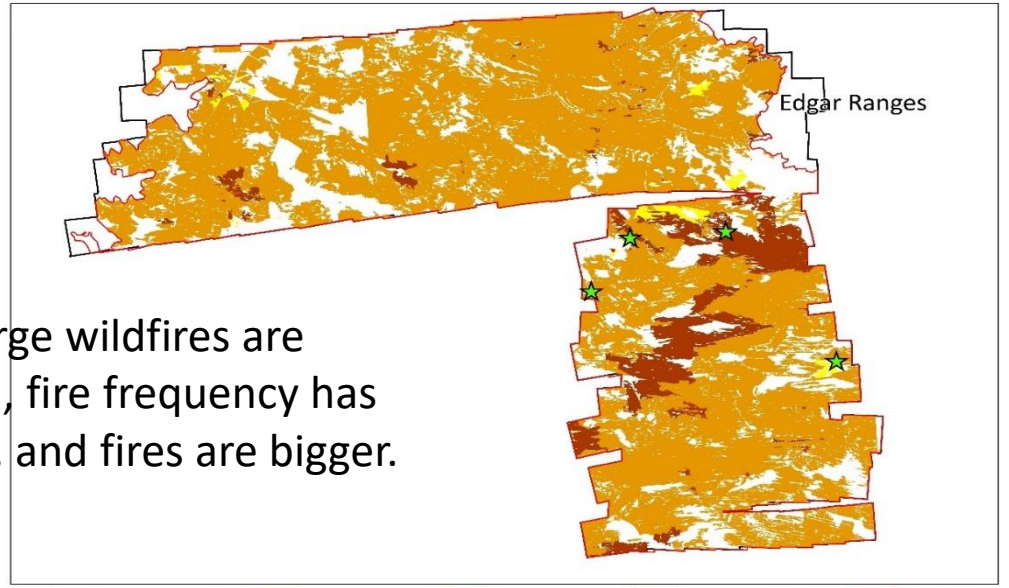
When people lived on country, they lit fires all the time. We can see that by looking at aerial photos from the 1940s and mapping the fire patches.
But now, we live in communities, and it's harder to get onto country to look after it with burning. That's why we use helicopters to get out there.



Firescars of 1-4+ years age, before 1947 (top); 2020 (bottom)



Before people moved out of the Pirra (in the 1960s), fires were smaller and less frequent, there was more long-unburnt.



Now - large wildfires are common, fire frequency has doubled, and fires are bigger.

It’s not just fire that has changed:

New animals arrived – cats, foxes, camels, cattle

So how should we manage fire now?

Photo: H. Kingston; N. Burrows; Ninti One; IA CRC

Project Aim: to understand how plants and animals change with fire, so we can do the right fire management

Photo: H. Bijlani

Photo: A. Jones

What did we do?

- We set up a partnership between Rangers and scientists from Environs Kimberley and the NESP Threatened Species Hub.
- Rangers set the research questions so the work would help fire management in the desert.
- We got our fauna licence and research ethics permits, the first WA Indigenous ranger groups to hold our own.
- Rangers bought their own survey equipment
- Rangers lead the fieldtrips.
- We made our own species guide to help us identify the animals.

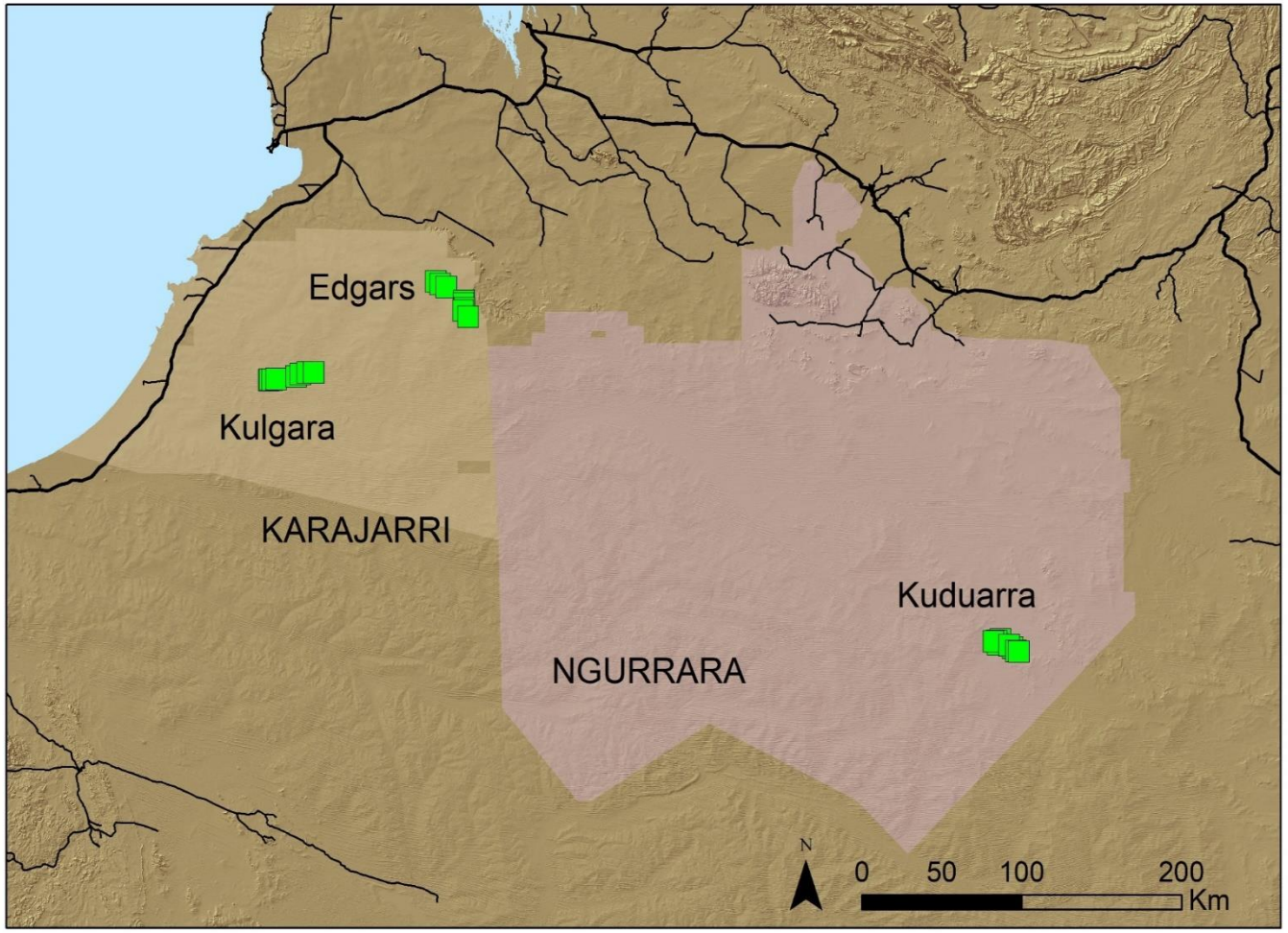
Right-way or two-way science in the field

We want to keep country healthy by using and valuing both scientific and aboriginal knowledge and cultures.

- Rangers started and led this project – rangers set the research question, worked with scientists to design the surveys, did the surveys, collected the data and entered it to databases.
- We used Aboriginal language names as much as possible.
- During surveys, we updated a live ‘scoreboard’ with the day’s results so everyone knew how the survey was going, and what we were finding.
- We taught the scientists about culture, language, colonial history, bush tucker and bush medicine.
- We ran a quiz on the last night of surveys to test what the rangers had learnt about science ways, and what the scientists had learnt about Walmajarri and Karajarri ways, and their pronunciation!

Hamsini, Alfie and Elton inspect the results ‘scoreboard’

What did we do?




Ngurrara rangers, survey at Kuduarra; Photo: H. Bijlani

Set up 24 monitoring sites at 3 places

- Edgars (2018, 2019, 2020)
- Kulgara (2019, 2020, 2021)
- Kuduarra (2020, 2021) with Ngurrara

What did we do?

We did 63 surveys at these 24 monitoring sites

We opened survey sites for about 5 days each, and checked the traps at dawn and dusk

Each site has 18 traps, so overall, we did 5670 trap-nights

We also did 64 bird surveys, 8 bat surveys, 56 vegetation surveys, and bush tucker surveys

1 trapnight = 1 trap open for 1 night

Dug in 240 pitfall traps

Set up 6.3 km drift-fence

Set up 504 funnel traps and 504 camera traps

Photos: S. Legge; A. Jones; H. Bijlani, N. Rakotopare

What did we do?

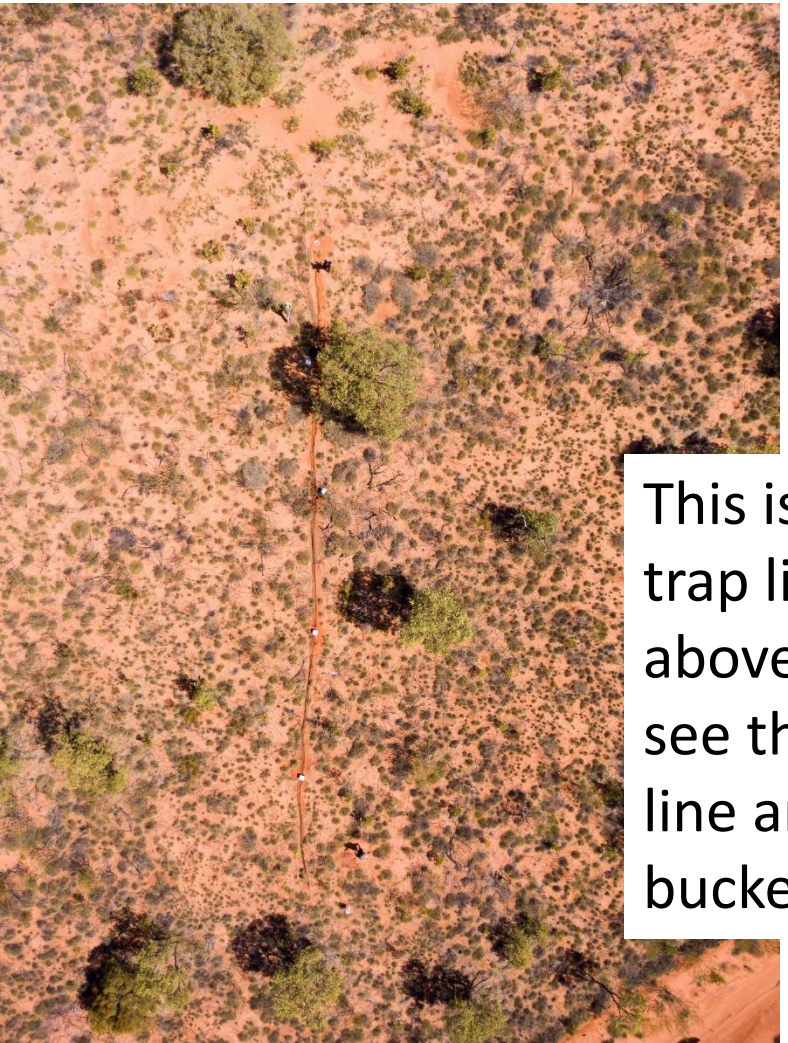
We want to know what animals care about, when it comes to fire

- Is it how long ago the fire burned?
- Is it how big the fire was?
- Is it about how patchy the fires are?

We set our survey sites in places that burnt at different times, so we could answer these questions

So what did we find?

Lets look at Reptiles



This is one of our trap lines from above – you can see the drift fence line and the pitfall buckets

??

Photo: EK

Pantily, Wakura, Northern spiny-tailed gecko
Strophrurus ciliaris

These are our top 6 species


Lerista bipes


Ctenophorus isolepis

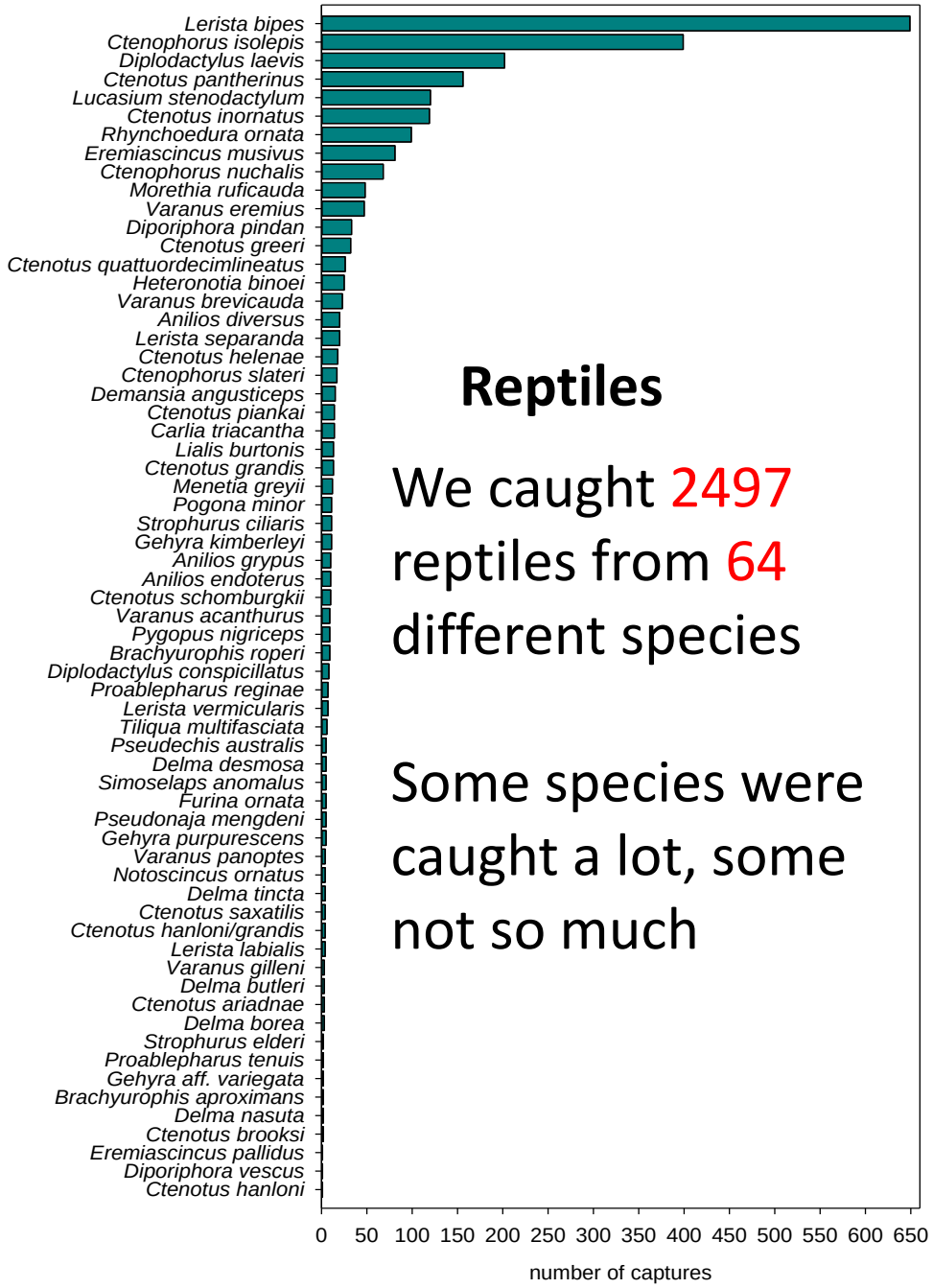

Diplodactylus laevis


Ctenotus pantherinus


Lucasium stenodactylum


Ctenotus inornatus

Photo Credits (clockwise from top left) E. Noakes; J. Miller; J. Miller; A. Jones; J. Miller; S. Legge

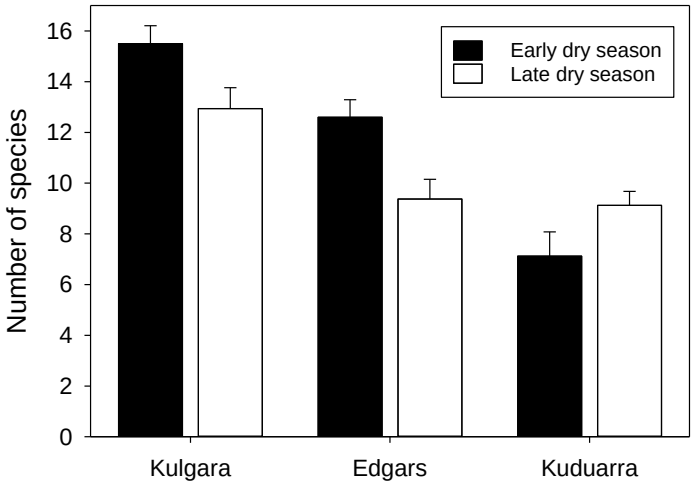


Reptiles

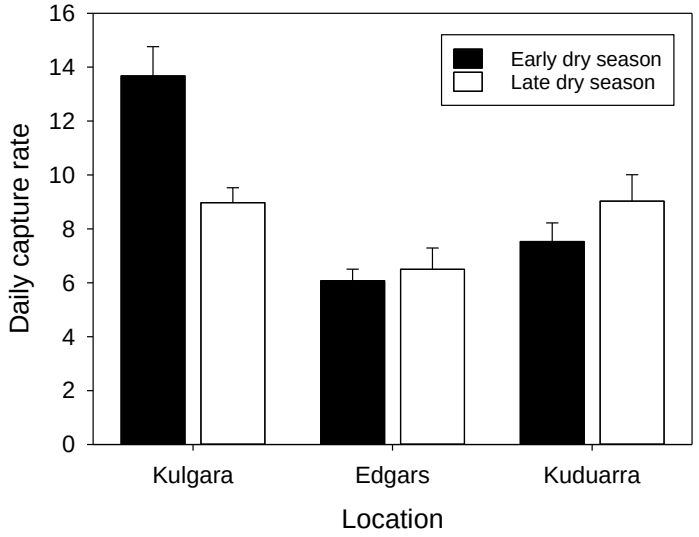
We caught 2497 reptiles from 64 different species

Some species were caught a lot, some not so much

What did we learn?
Background patterns across locations and seasons



- We caught most species at Kulgara
- At Kulgara and Edgars, we caught more species in the early dry season, but Kuduarra was the opposite

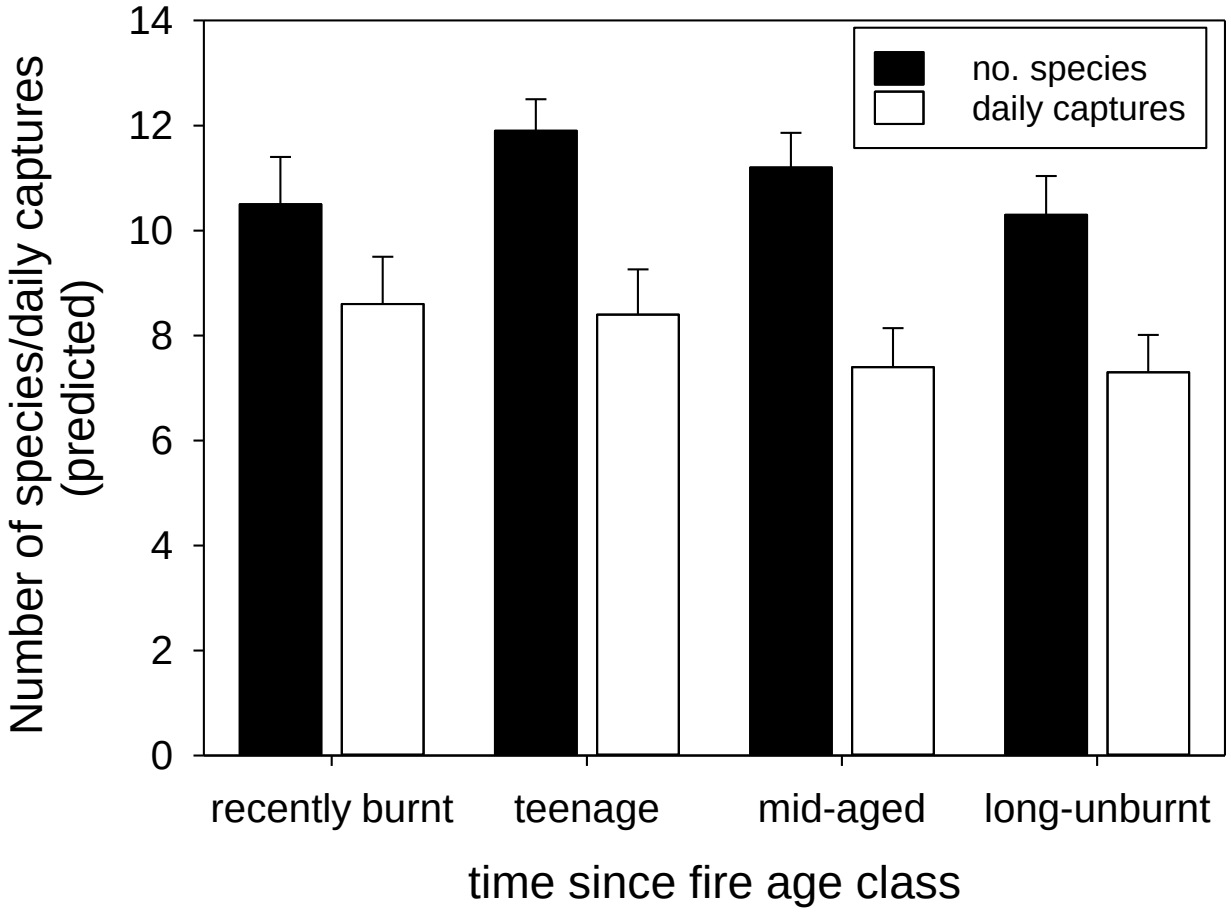


- We caught less animals at sites with wattle
- At Kulgara, we caught more animals in the early dry, but the season didn't make such a difference at Edgars and Kuduarra

Wakura, Pantily

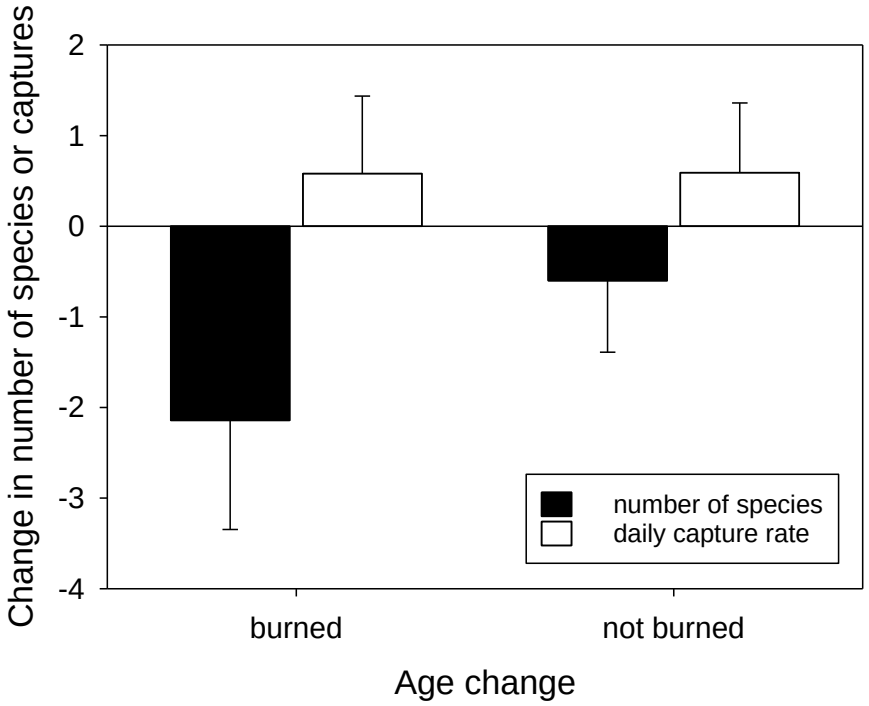

Photo: H. Bijlani

What did we learn?



We caught the same number of species and animals at sites burnt recently or longer ago…

From one year to the next – some sites get burnt, and other sites don't…
We can compare the CHANGE at sites that are burned, or not burned…



Reptiles: if you burn a site or don't burn a site, the change in the number of species and the overall capture rate is the same

….but this doesn't tell you what's happening **under the numbers**….

…because the types of species changes

Some species MUCH prefer recently burnt

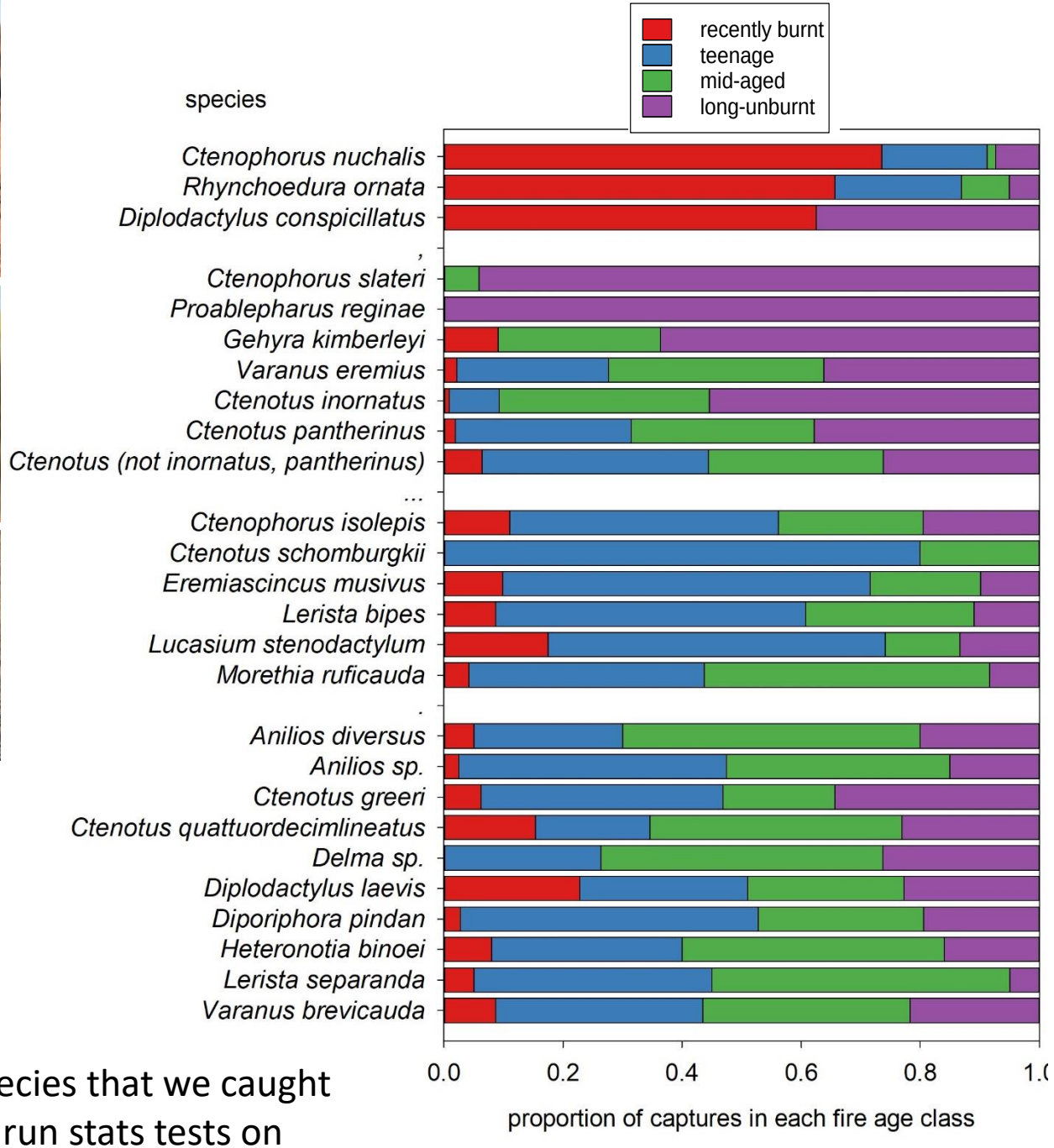
Some species MUCH prefer long-unburnt

Some species MUCH prefer mid-aged

And other species REALLY don't care

Ctenophorus nuchalis, Central netted dragon
Ctenotus pantherinus, Leopard skink
Morethia ruficada, Lined firetail skink
Anilios diversus, Northern blind snake

Photos: V. English; A. Jones; S. MacDonald; S. Legge



These are the species that we caught enough times to run stats tests on

Why are there different species soon after fire, compared to years later?
Is it because some are more killed by fire?

If fire kills reptiles, reptiles that shelter in leaf litter, or on the surface, should be killed more, and be rarer soon after fire.

Different species shelter in different places

Proablepharus tenuis
Northern soil-crevice skink

Ctenotus pantherinus
Leopard skink

Anilios grypus
Long beaked blind snake

Pogona minor
Dwarf bearded dragon

Photos: S. Macdonald; A. Jones; J. Miller; S. Legge

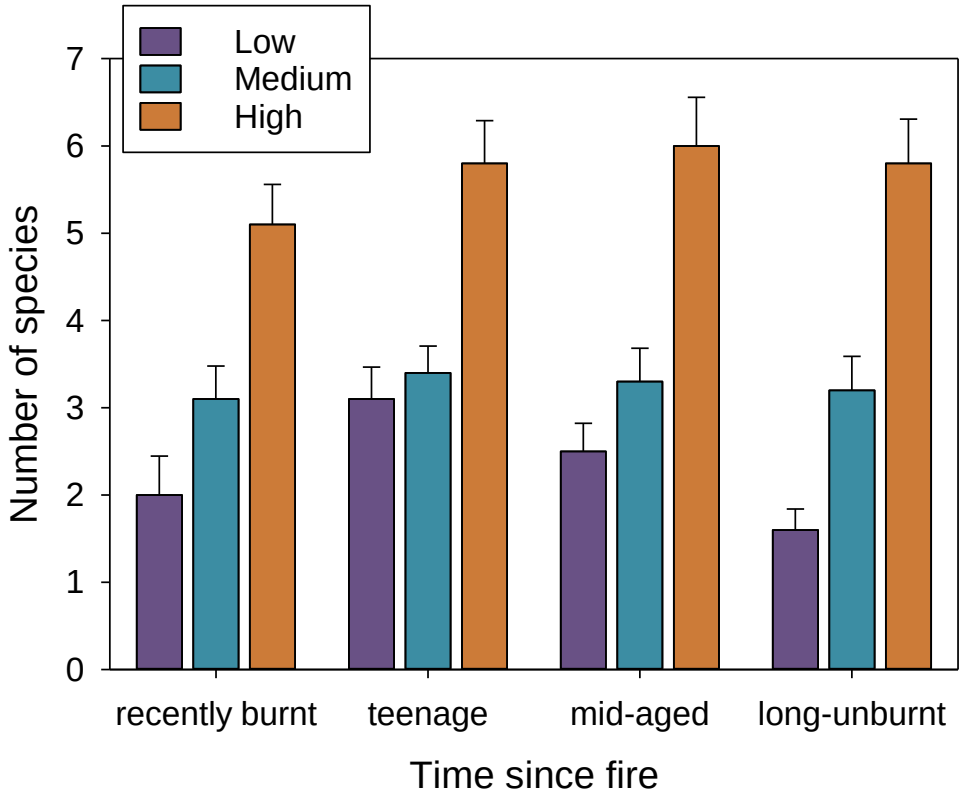
Shelter sites and protection from fire

If fire kills reptiles, then species that shelter in sites with LOW protection should be rare after fire

Low protection if reptile shelters
- in grass or leaf litter
- very old logs

Medium protection if reptile shelters
- shallow burrow
- under small rocks, logs

High protection if reptile shelters
- termite mounds
- deep burrows
- tree hollows
- underground



NO!…all reptiles survive fire the same, doesn't matter where they shelter

OR – is it because after fire, there is no grass cover.

Animals can't hide from hawks and cats, or shelter from the sun

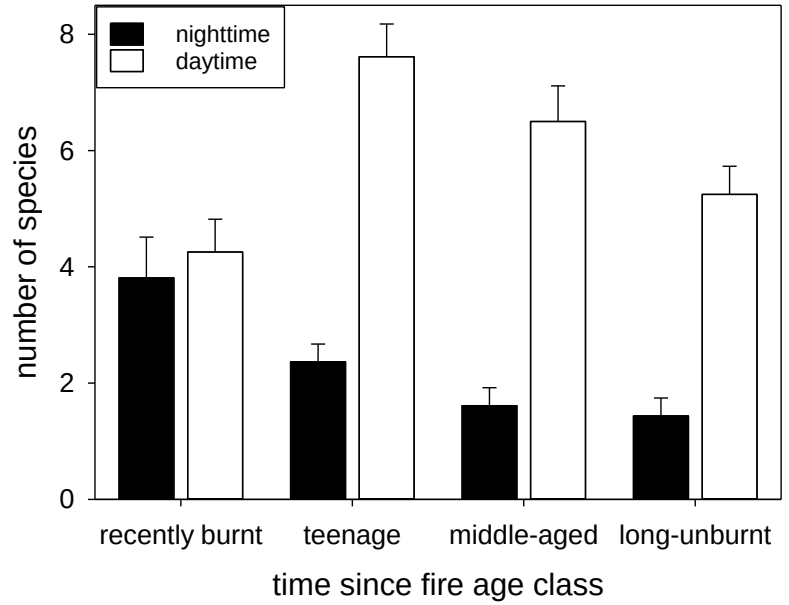
If that is true, then daytime species might be more sensitive to fire than nighttime species

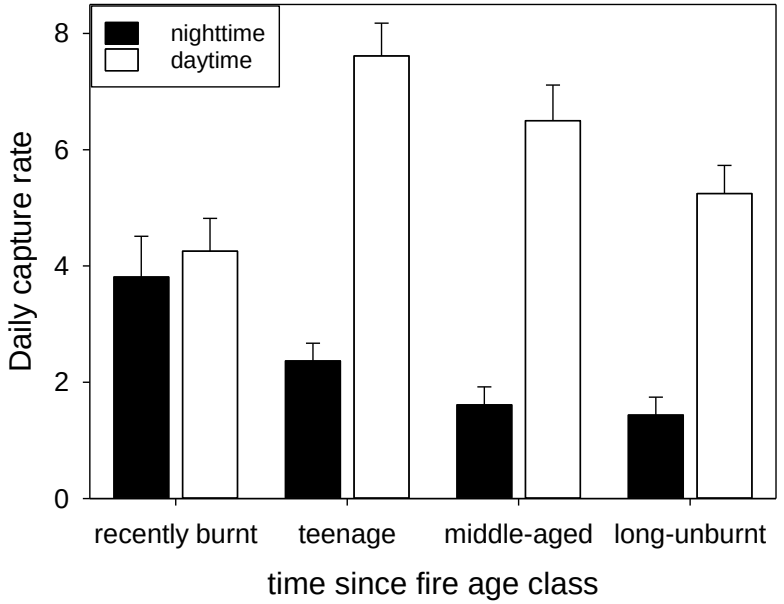
YES!

There are more nighttime species and animals at recently burnt sites

There are more daytime species and animals once the grass recovers from burning

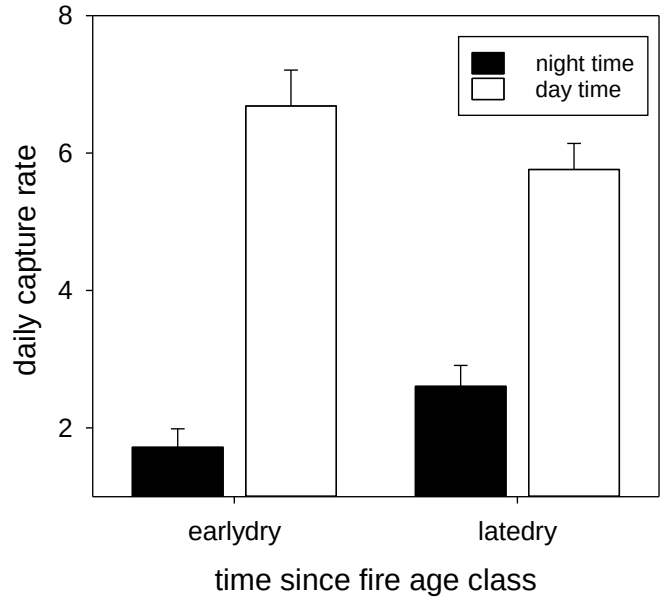
Photos: EK; S. Legge





Daytime species also get less common, and less abundant, as the dry season goes on, and the grass layer gets less

This supports the idea that they need cover, and that's why there are less of them after fire



Photos: J. Miller; S. Legge

Now we know what different reptile species do after fire…
But how about patch size?

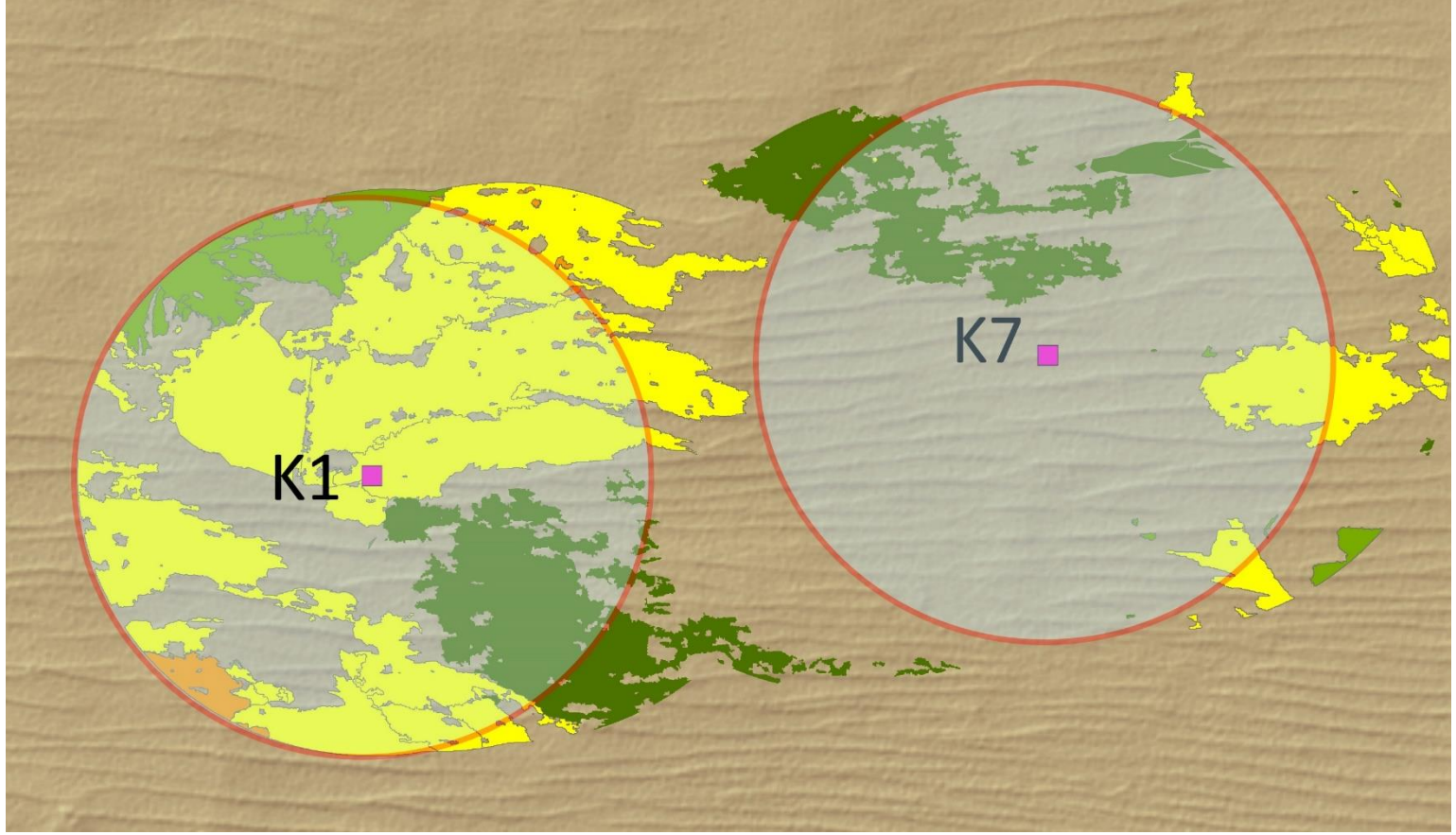
Are small patchy fires better than big fires?

- Reptiles might be able to dash out of the burnt area to cover if something is hunting them
- They might be able to come back to (recolonise) the burnt area faster

Photos: Hannah Cliff

Using hi-res Sentinel satellite imagery:

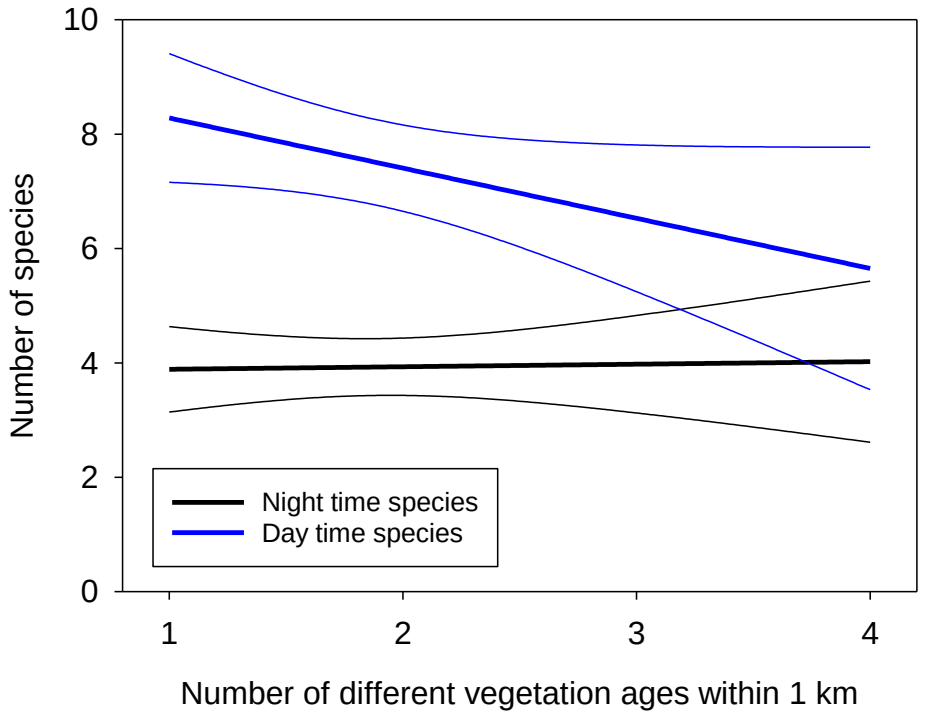
- Measure the PATCH SIZE
- Count the number of different patches within 1 km of site
- Measure the length of edges between patches within 1 km of site



Site in SMALL patch
5 different ages
Lots of edges

Site in BIG patch
3 different ages
Not much edge

Patchiness



Keep on guessing!

Reptiles don’t care about the patchiness of fire!

Checked patch size, number of different aged patches, length of edge – in all cases, reptiles care more about how long ago the site burnt, not about the patch size or patchiness

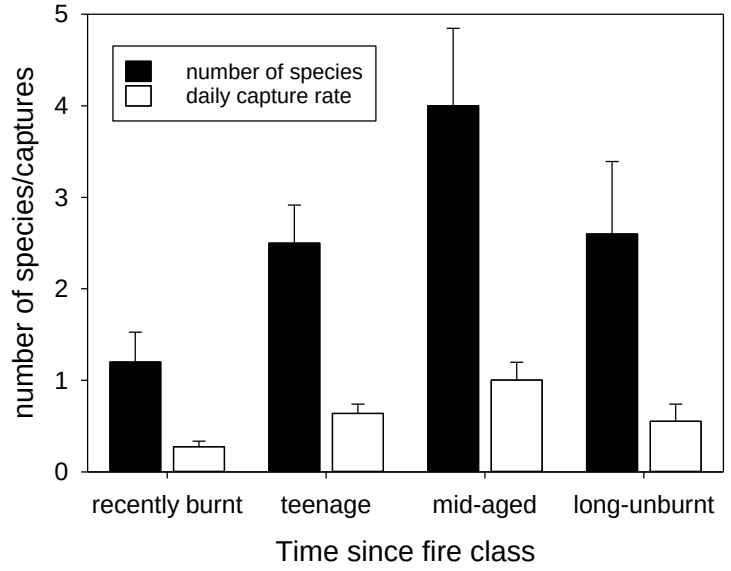
What about Mammals

What happens after fire?

Lesser hairy-footed dunnart
Sminthopsis youngsoni

Spinifex hopping mouse
Notomys alexis

Northern short-tailed mouse
Leggadina lakedownensis



Less species and less animals at sites that were burnt recently
The patchiness of fire makes no difference to mammals in our data

From one year to the next – some sites get burnt, and other sites don't…
What happens to the number of mammal species?

Mammals:
if you burn a site, the number of species goes down a lot

Many mammal species are rare or missing – partly because of fire

Photos:
Wiki CC, Alex Ross, Karajarri rangers

What does our data tell us?

Reptiles

- Animals survive the fire itself ok
- After the fire – species that like open areas do ok, but species that need grass for shelter go down for a few years, then they come back

SO - We need different ages to look after all reptiles

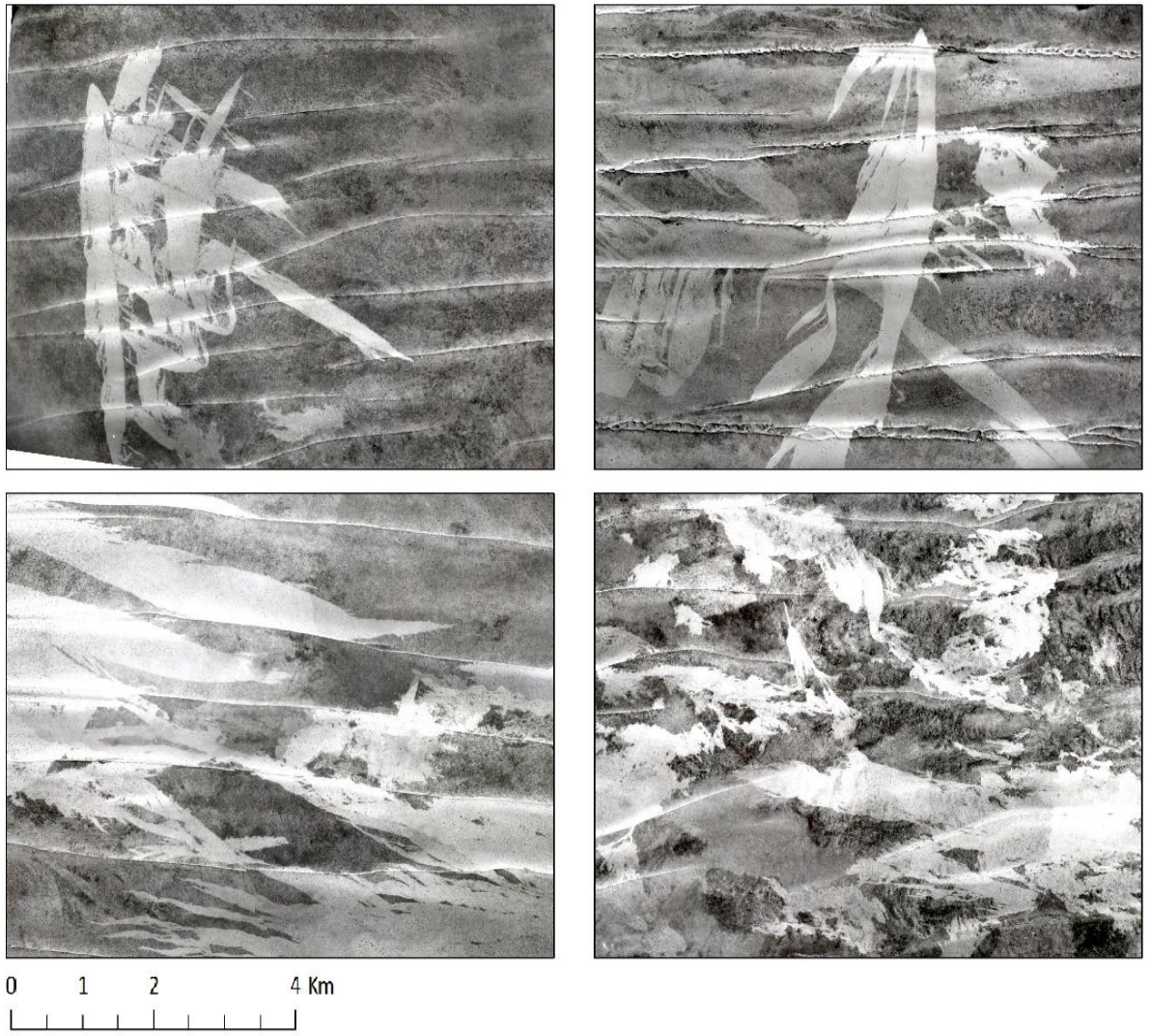
Mammals

- Fire makes them go down for a while

SO - Lower fire frequencies will help them, and more long-unburnt vegetation will help them

Photos: H. Bijlani

Next steps for the biodiversity monitoring program



Photos: National Library Australia

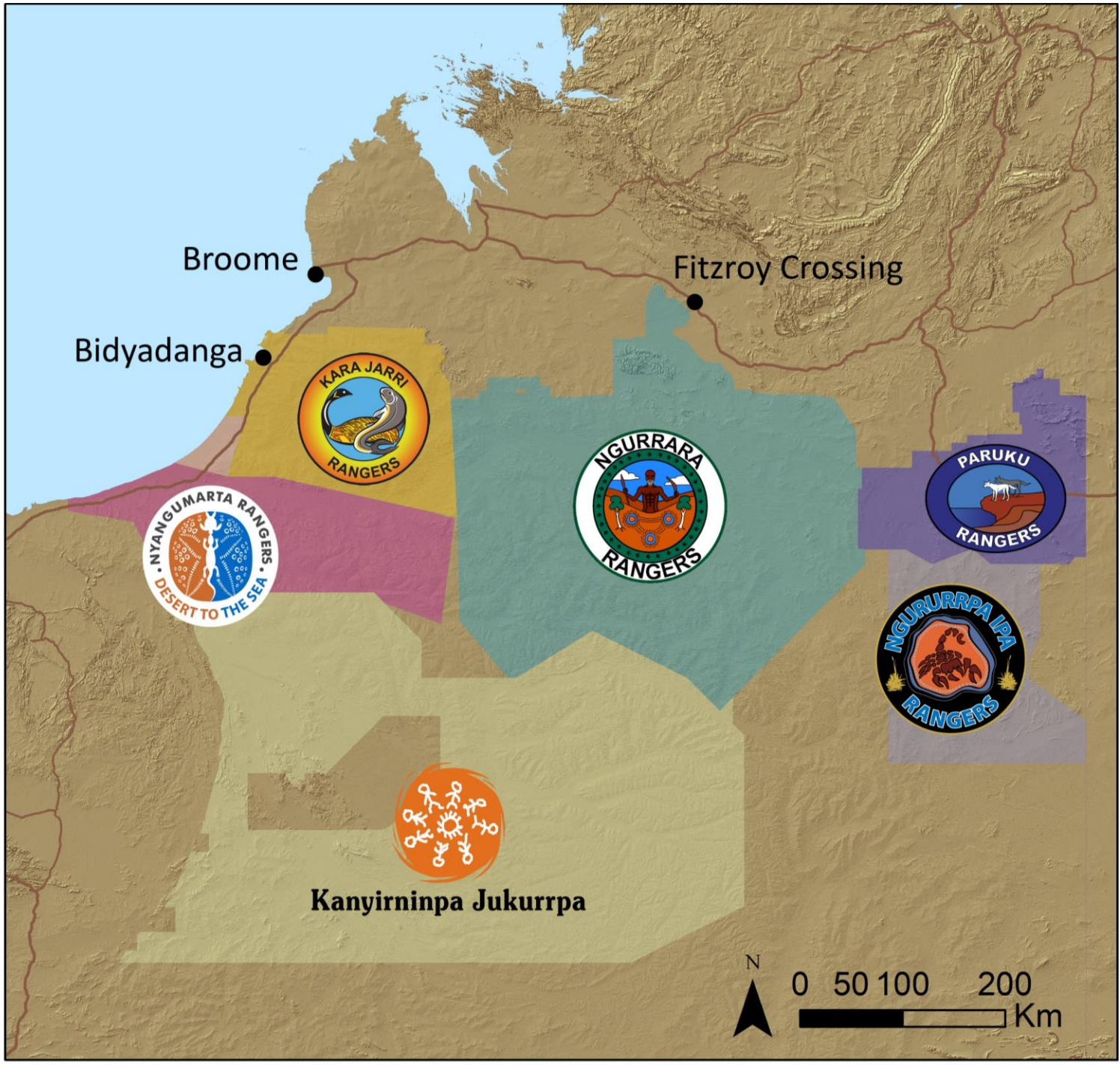
Patch size and patchiness doesn't seem to matter to mammals or reptiles??

Not what we predicted! We need to explore this some more…

- The aerial photos from the 1940s show how the old people burnt lots of small patches
- We could burn like this at half of our sites, then measure what happens over time

Next Steps for the biodiversity monitoring program

- New research questions with Karajarri and Ngurrara
- Expand the project? Other desert groups developing similar work – we may all collaborate in a regional dire and biodiversity project



Trialling eDNA techniques to say what is happening at jilas

Amazing Karajarri rangers sampling water at Injitana Springs

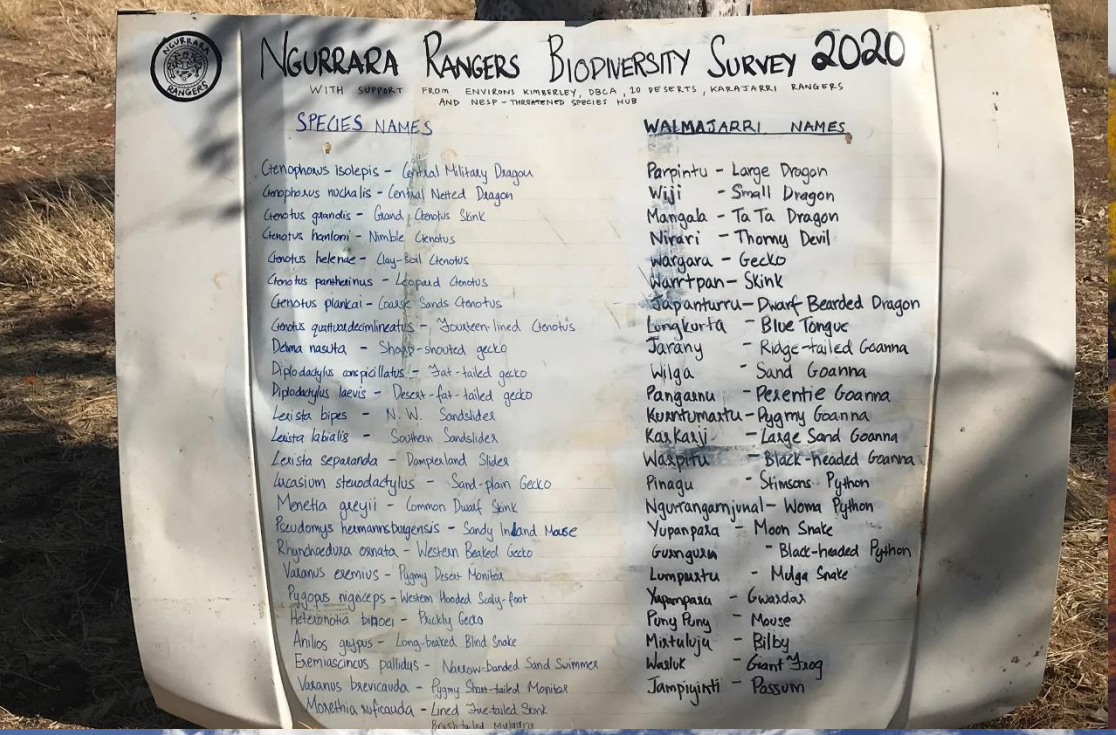
Photo: Courtney Brown

The Karrajarri, Ngurrara, and Nyangumartu rangers have worked together to collect water samples from waterholes on their country. The samples are being used in an eDNA trial to see if this technique can help them monitor what animals are using the waterholes.

If the results are promising, we can use this sampling technique at more waterholes, including ones that our old people tell us that we need to look after.

Ewan Noakes, Sam Bayley, Jackie Wemyss – they've moved onto other work now, but they helped us get this project off and running

Photos; A. Jones, N. Rakotopare, KLC



Surveys at Kuduarra and Kulgara

Photos: N. Rakotopare, EK

Appendix: Analysis notes

Trapping sessions lasted 4-7 days. Species accumulation negligible after day 4, but capture rate maintained over time. Therefore used species total for whole trapping session, but converted capture totals into daily capture rate to account for variation in survey duration. Quantified time-since-fire (TSF) using MODIS, Sentinel imagery and ground-truthing. Quantified patch size, heterogeneity (number of TSF ages and edge length) using Sentinel imagery.

Questions:

- Does the species richness and abundance of reptiles change with TSF or measures of patchiness?
- What causes the changes in species richness and abundance?
    - Is it direct mortality from the fire?
        - Prediction: species that shelter in sites more highly protected from fire will be more common in recently burnt sites compared to species that shelter in sites with low protection from fire.
    - Is from mortality caused by the loss of veg cover, which protects from exposure and predators?
        - Prediction: diurnal species will be more affected by fire than nocturnal species
        - Prediction: diurnal species will decrease over the dry season ad cover diminishes
    - Which species are early seral stage specialists, mid-stage and late post-fire stage specialists?

Analysis approach:

Linear Mixed Models

- Random term = Site
- Fixed effects = Location + Year + Season + Habitat+ TSF + Heterogeneity + Patch size+ Edgelength
- Fit main effects and second-order interactions involving fire
- Use backward selection to achieve final model; with forward selection to sub alternative fire variables as a check
- Checked diagnostic plots for error distribution and need for poisson or negative binomial models

Matched pairs:

- Calculate change in species richness and daily capture rate from one year to the next. Assign pair to ‘burned’ or ‘not burned’ category. Use ANOVA to examine differences among the categories.

Individual species vegetation age preferences:

- Chi-square heterogeneity test of captures in each vegetation age class against the expected (total captures split between age classes according to the proportion in which they were sampled).

Contact: SarahMariaLegge@gmail.com

Thank you

The Karrajarri rangers and the Ngurrara rangers thank the Karajarri and Walmajarri communities, and the people from the TSR Hub, Environs Kimberley, WA DBCA and 10 Deserts that have worked with them on the surveys.

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