# Frogs in agricultural landscapes

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# TechnEcology Deakin University Research Network

Cross disciplinary network: Ecology, Health, Arts and Education, Engineering, IT, economics

**Goal: generate a wildlife monitoring revolution that engages the community, with quantifiable benefits.**

## The TechnEcology Approach

NEW TECHNOLOGY

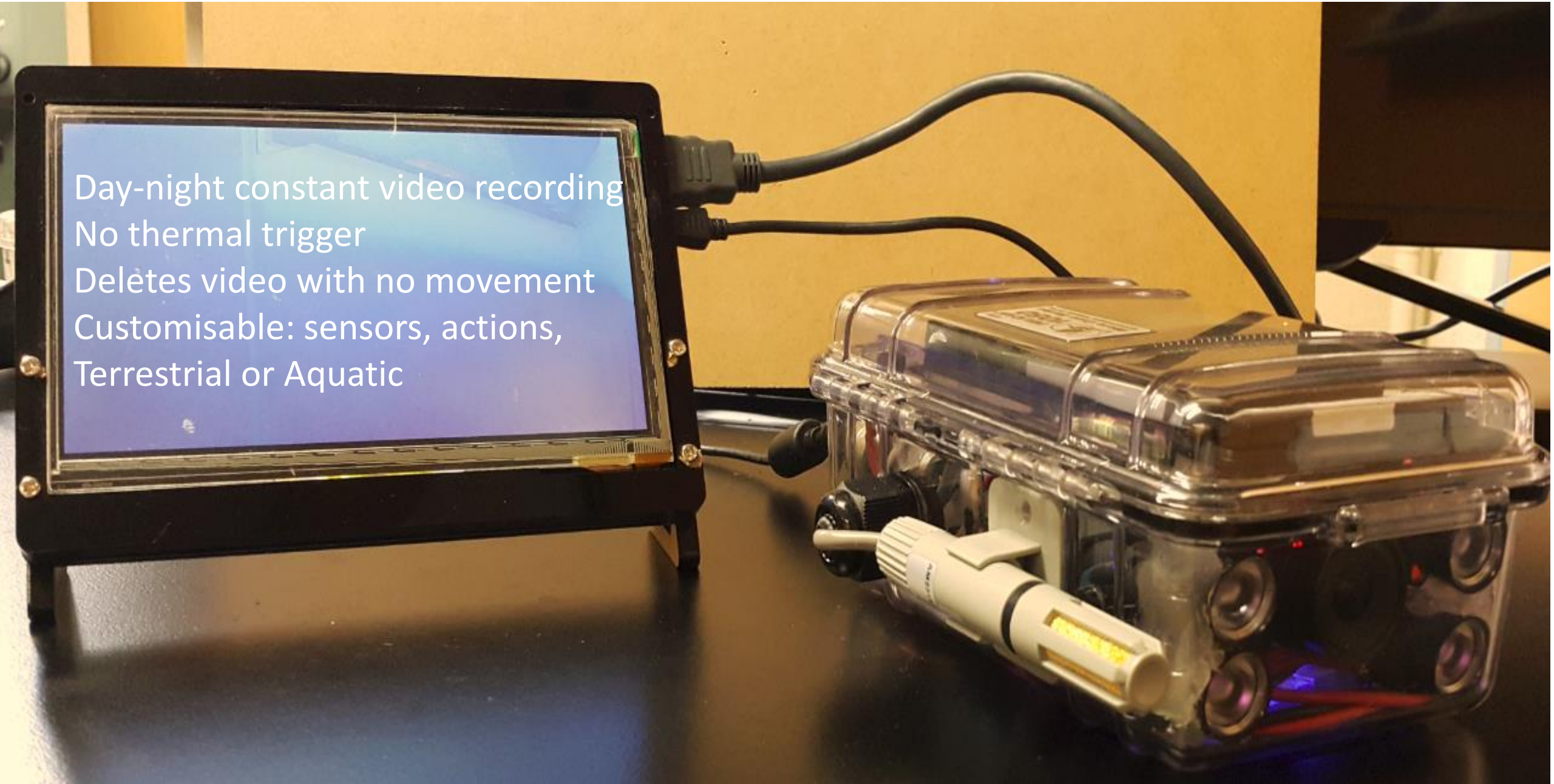
CITIZEN SCIENTISTS

NATURE CONSERVATION

PARTNERS

HEALTH
WELLBEING
ECONOMIC
BENEFITS

# Example; Video Trap

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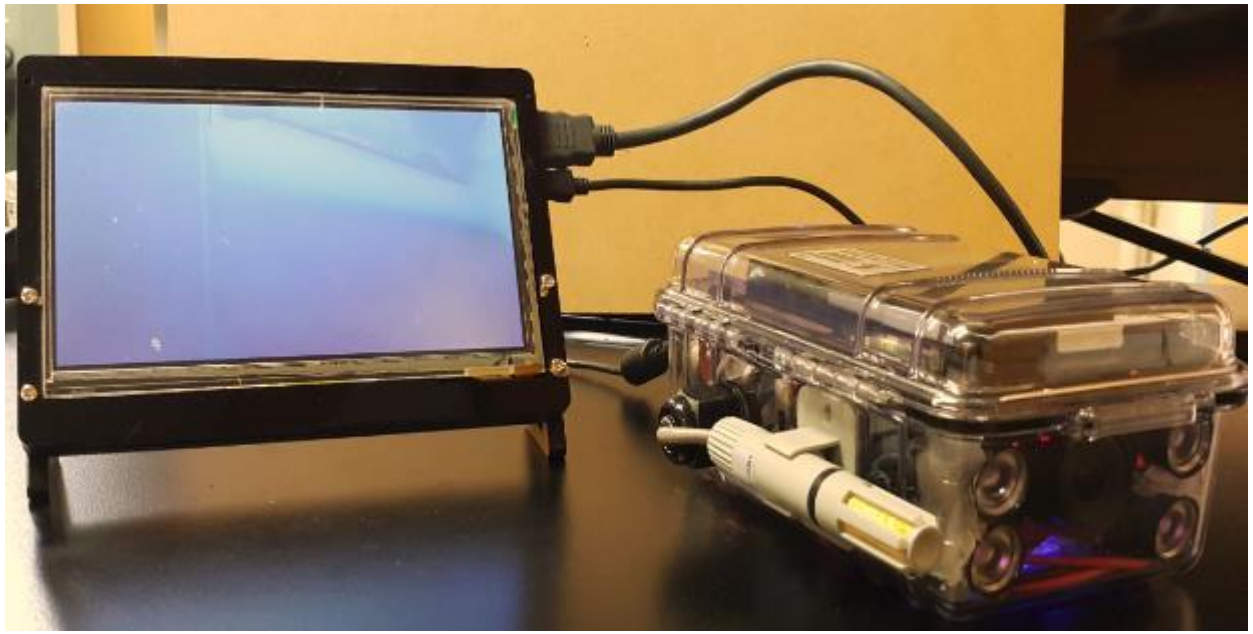
# Artificial intelligence; machine (deep) learning

Already can automate video sorting into with and without moving animals

## Next Steps

- Automate species recognition
- Automate individual recognition



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## Future applications

- Automated wildlife monitoring
- Engaging community through citizen science; big data
- Evaluating engagement, health benefits, economic benefits

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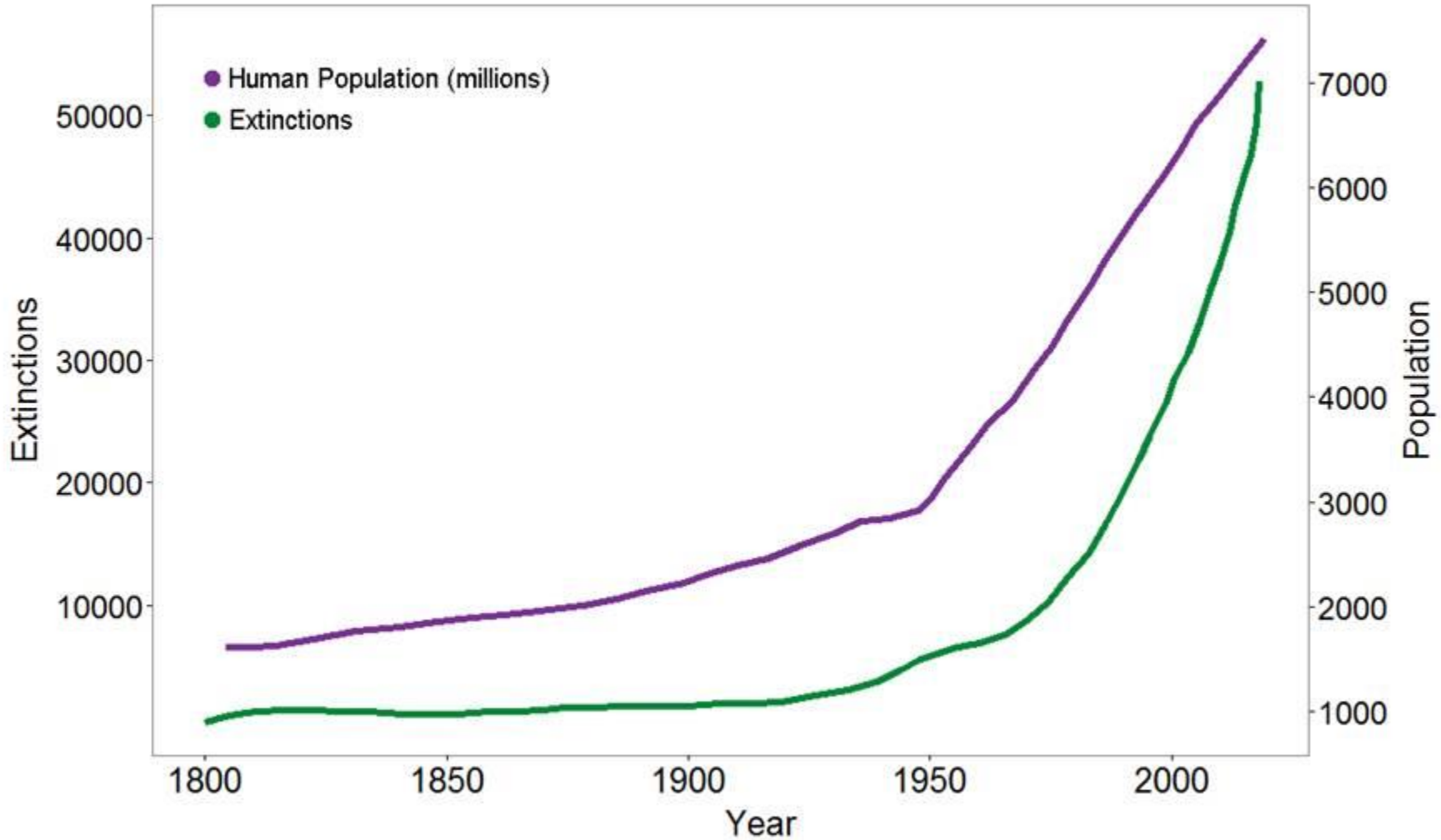
Mozambique
Mozambique Channel

# Humans & The Extinction Crisis



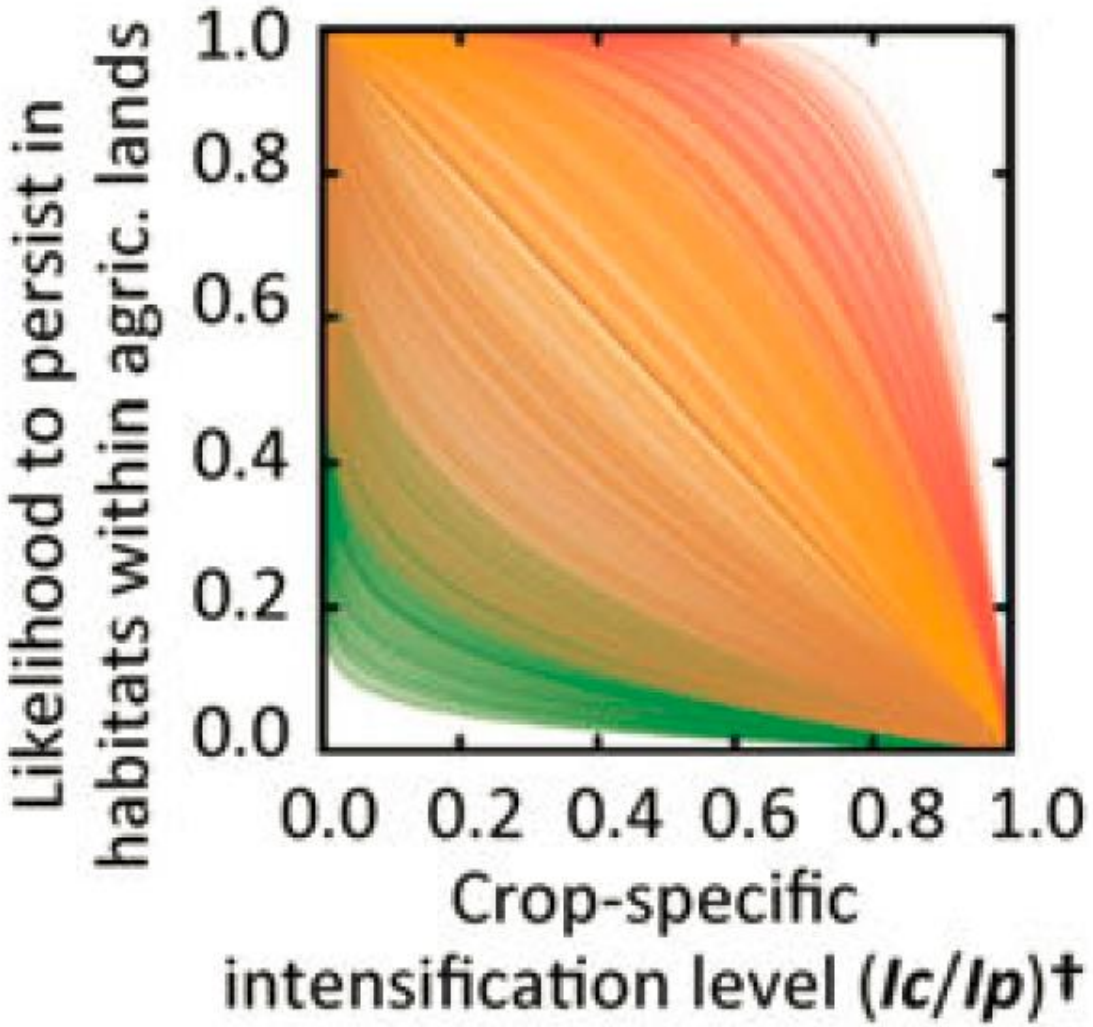

Data source: Scott, J.M. 2008. *Threats to Biological Diversity: Global, Continental, Local*. U.S. Geological Survey, Idaho Cooperative Fish and Wildlife, Research Unit, University Of Idaho.

# Agricultural production must increase 50% by 2050

Photo: Nicole Hansen

# Agricultural intensification

At what cost to biodiversity?

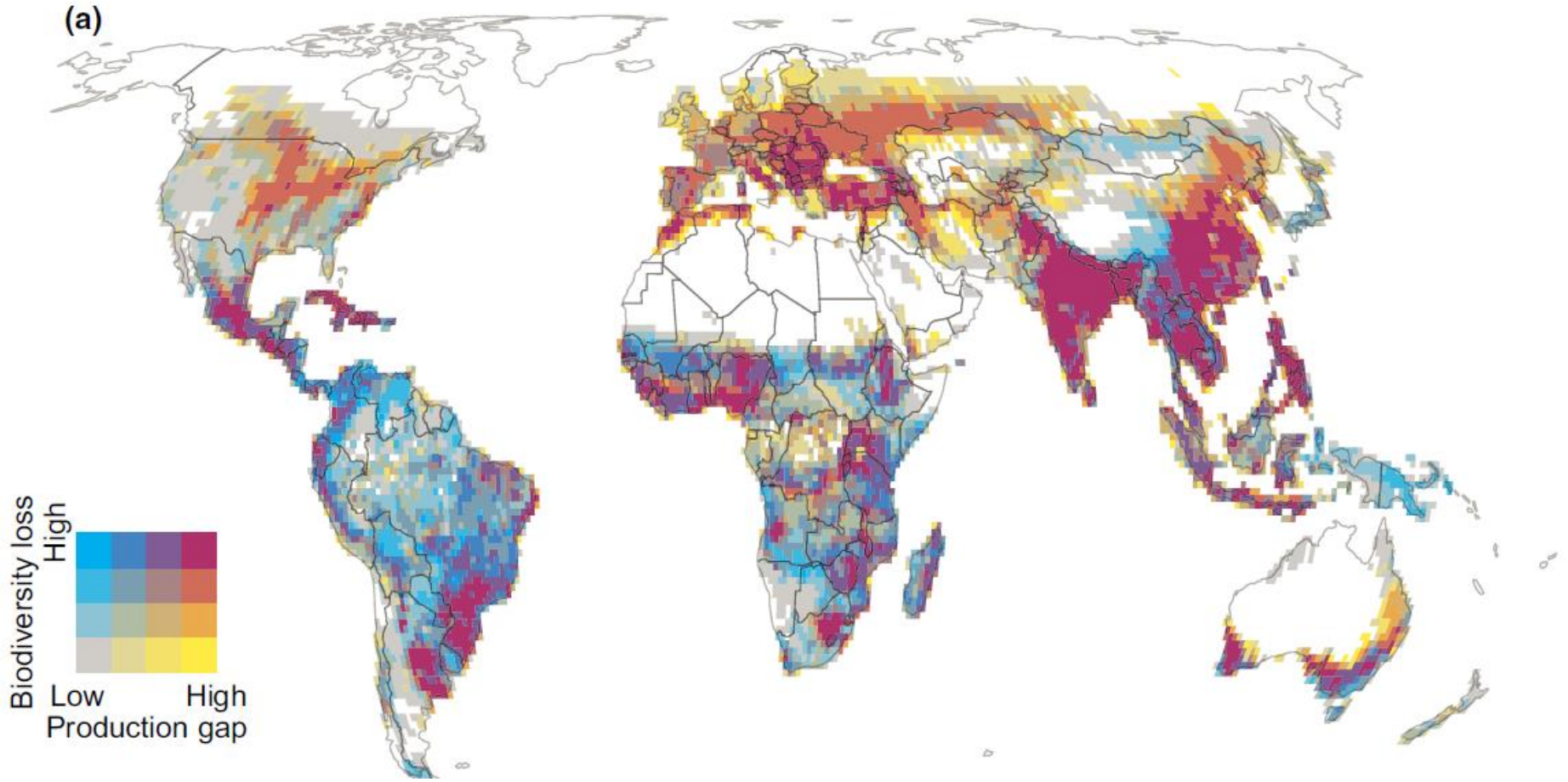



Assumed possible responses (***fun***) to agricultural intensification, deduced from habitat preferences

- Forest specialists
- Natural habitat specialists
- Marginal cropland users
- Regular cropland users

EGLI et al. (2018). Winners and losers of national and global efforts to reconcile agricultural intensification and biodiversity conservation. *Global Change Biology DOI: 10.1111/gcb.14076*

# Biodiversity loss vs production gap




If all croplands intensified  37% biodiversity decline

EGLI et al. (2018). *Global Change Biology DOI: 10.1111/gcb.14076*


Imperative to understand how wildlife use agricultural landscapes
Photo: Nicole Hansen

# Case Studies

- How the matrix influences use of the landscape
  - Dry cropping landscape
  - Mid rainfall grazing landscape
- Frogs of the Victorian Basalt Plains swamps

Nicole Hansen

# Habitat use and movement in dry cropping farmland by frogs

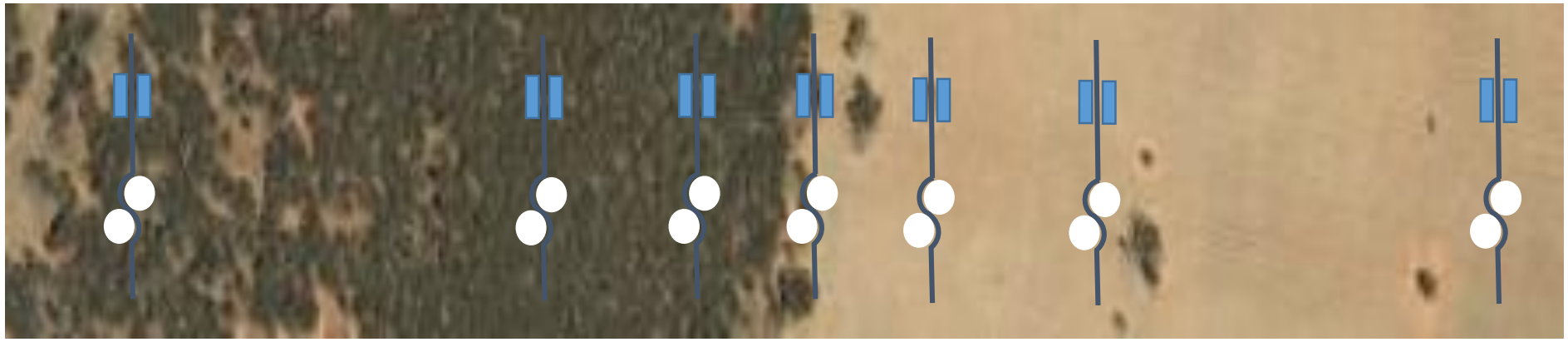
11 sites





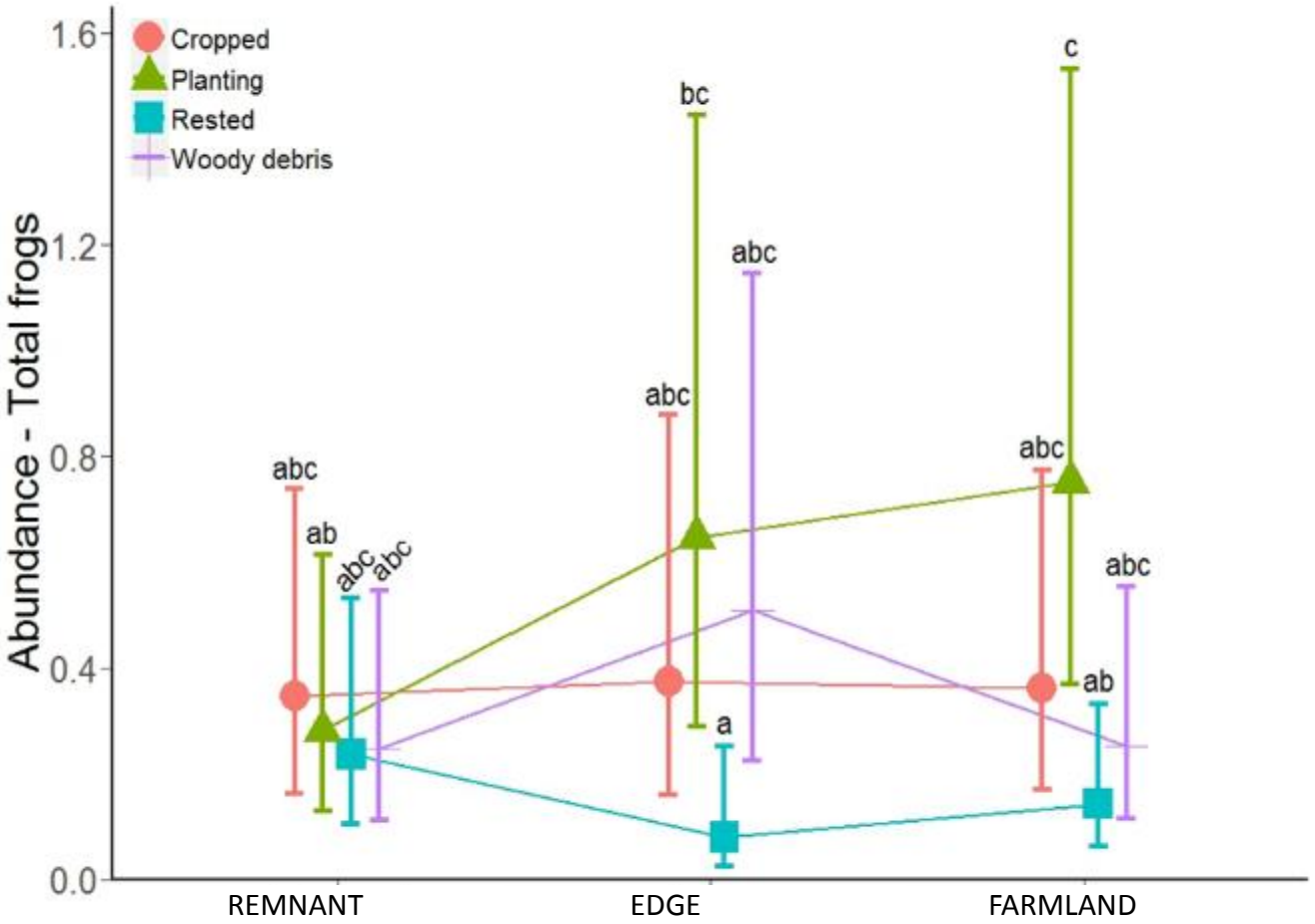

Surveys before and after crop harvesting

Remnant Edge Farmland



200m 75m 20m 0m 20m 75m 200

FROGS

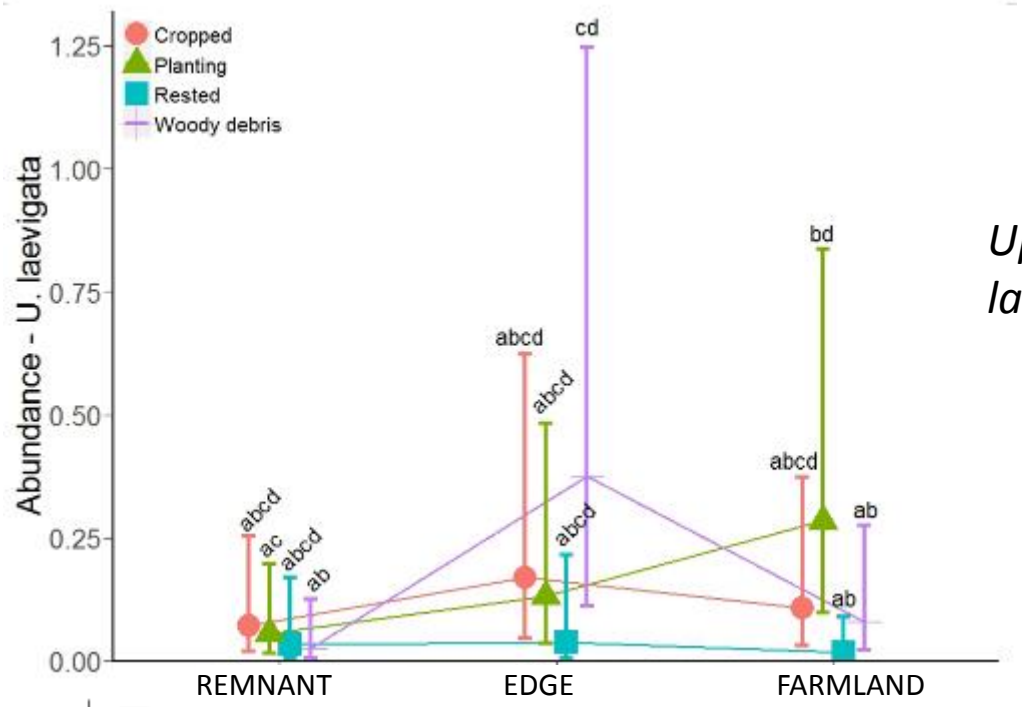


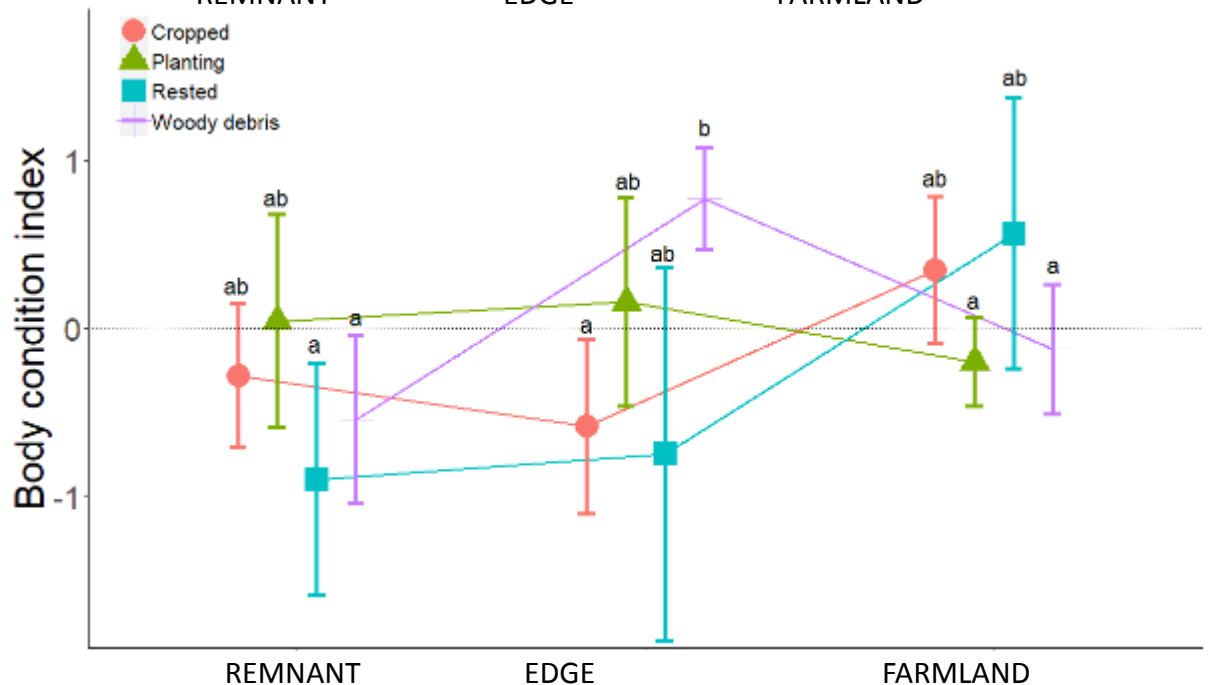

Total frog abundance: highest in plantings

No species richness differences across transects or treatments

Remaining species robust in agricultural landscapes.

12 species may have already been lost (not captured but expected)



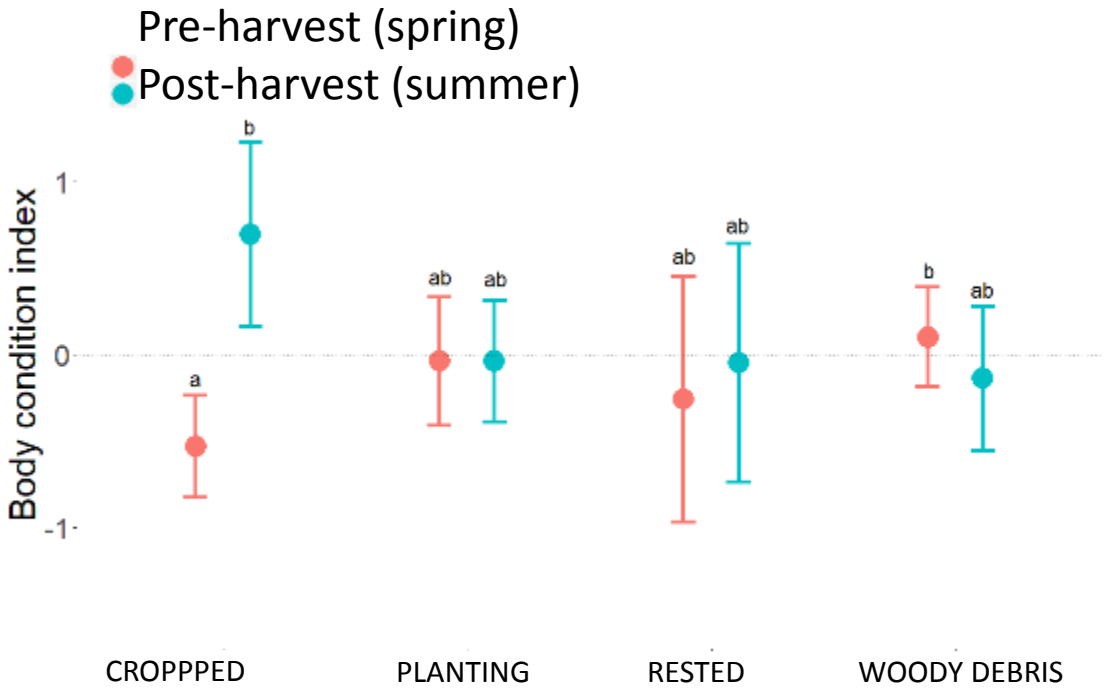




*Uperoleia laevigata*

Highest abundance
And highest body condition
at edge of woody debris

Hard to explain!
Need tracking and foraging data.

*Uperoleia laevigata*

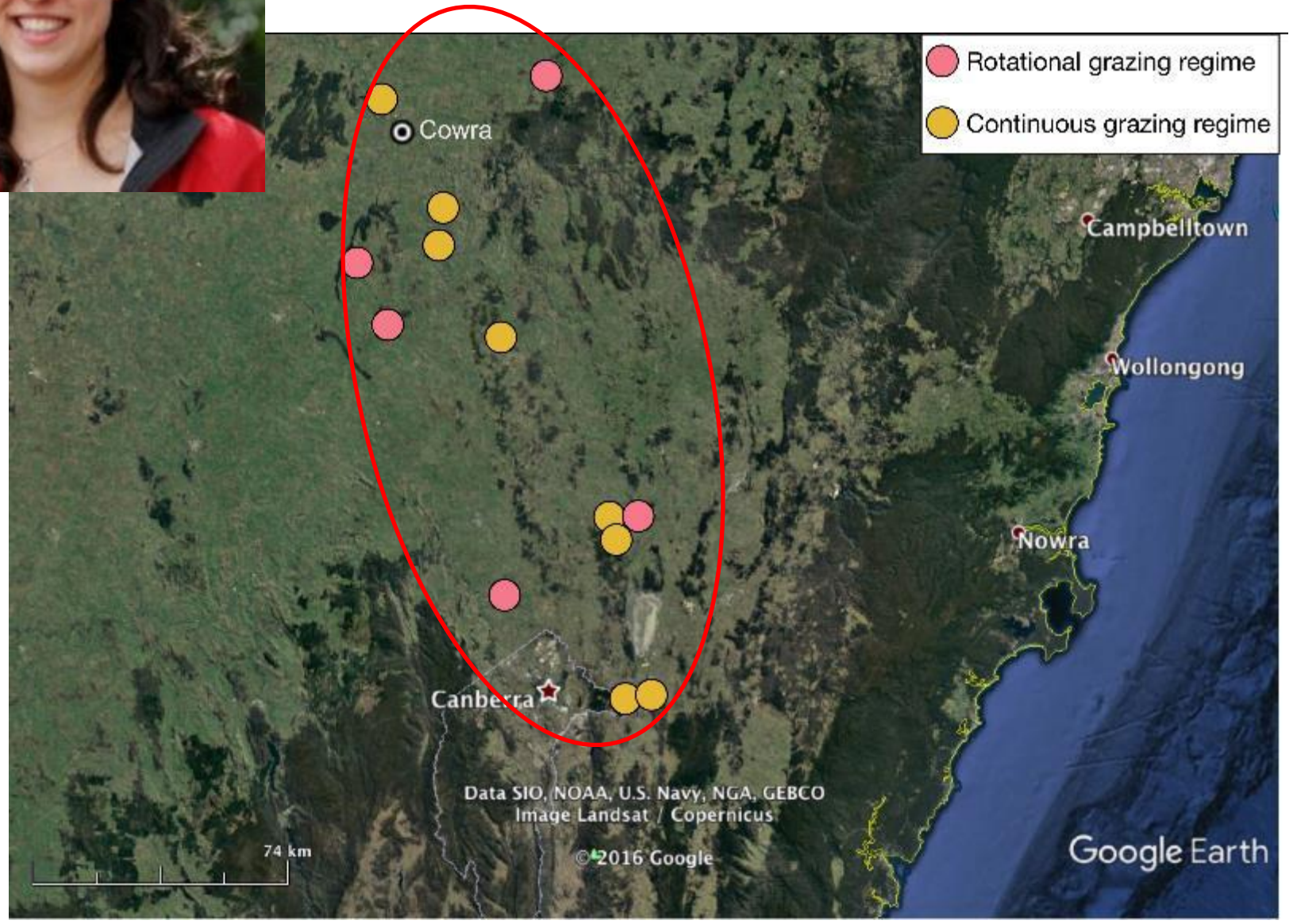



Highest body condition in cropped areas after harvest

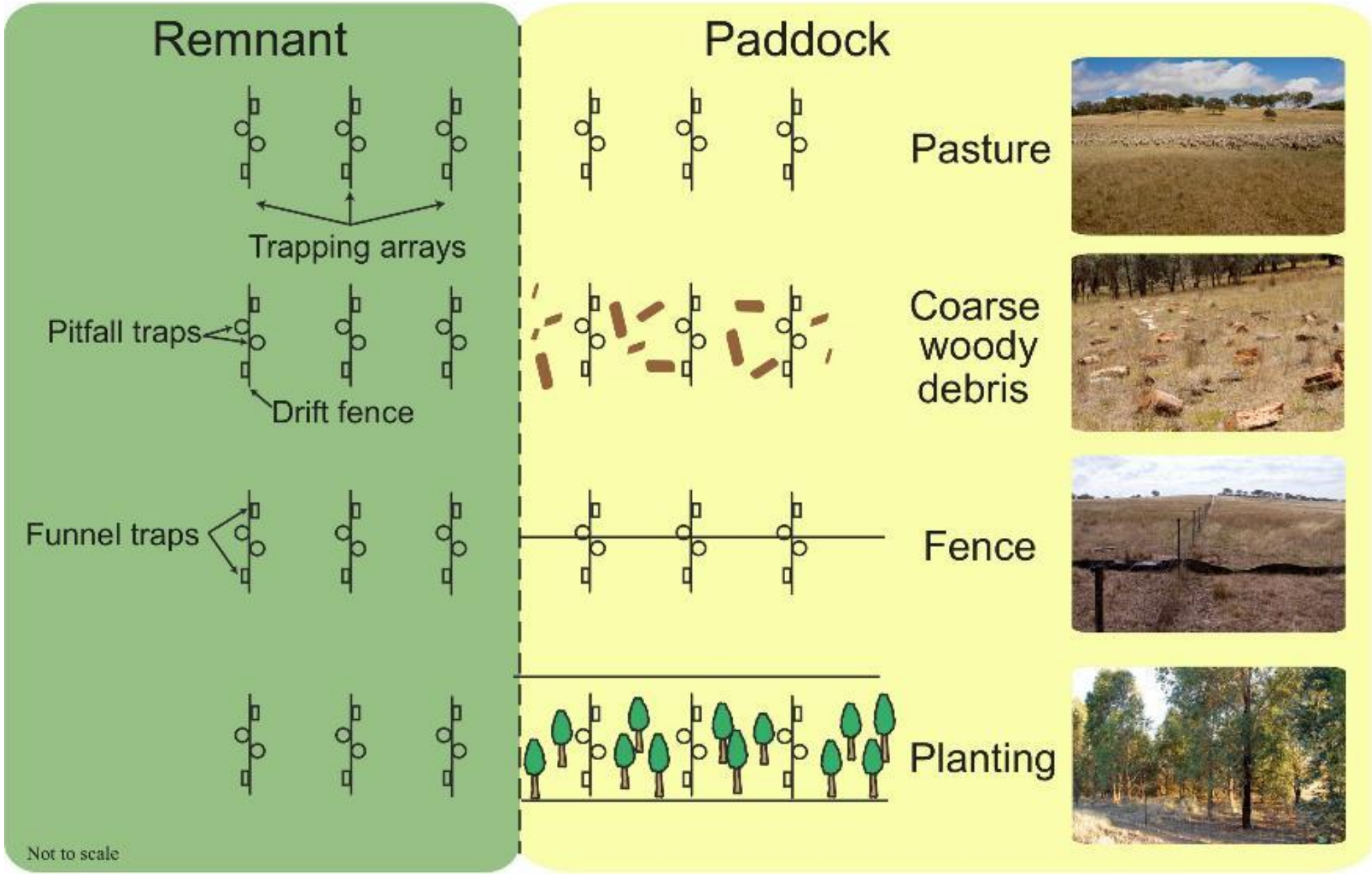
## Stephanie Pulsford

Frogs and reptiles on livestock grazing farms

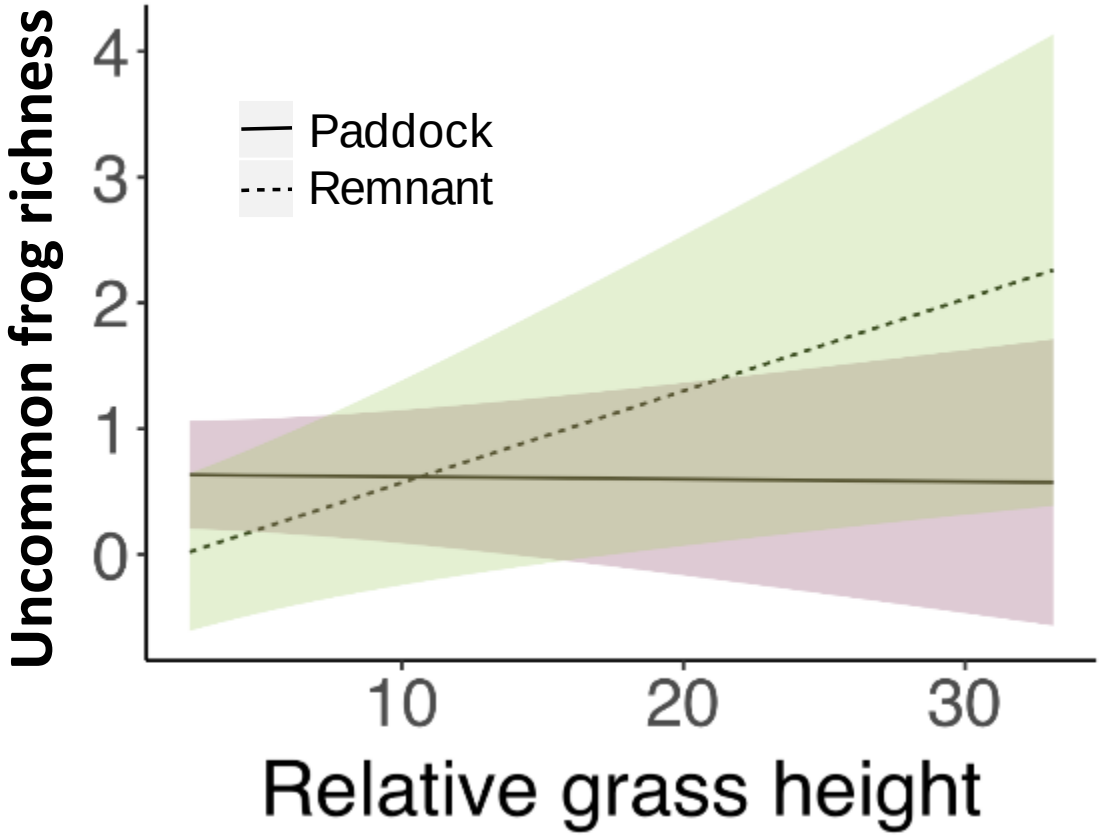
Higher rainfall, smaller paddocks, more trees



# How do different types of paddock influence frogs?



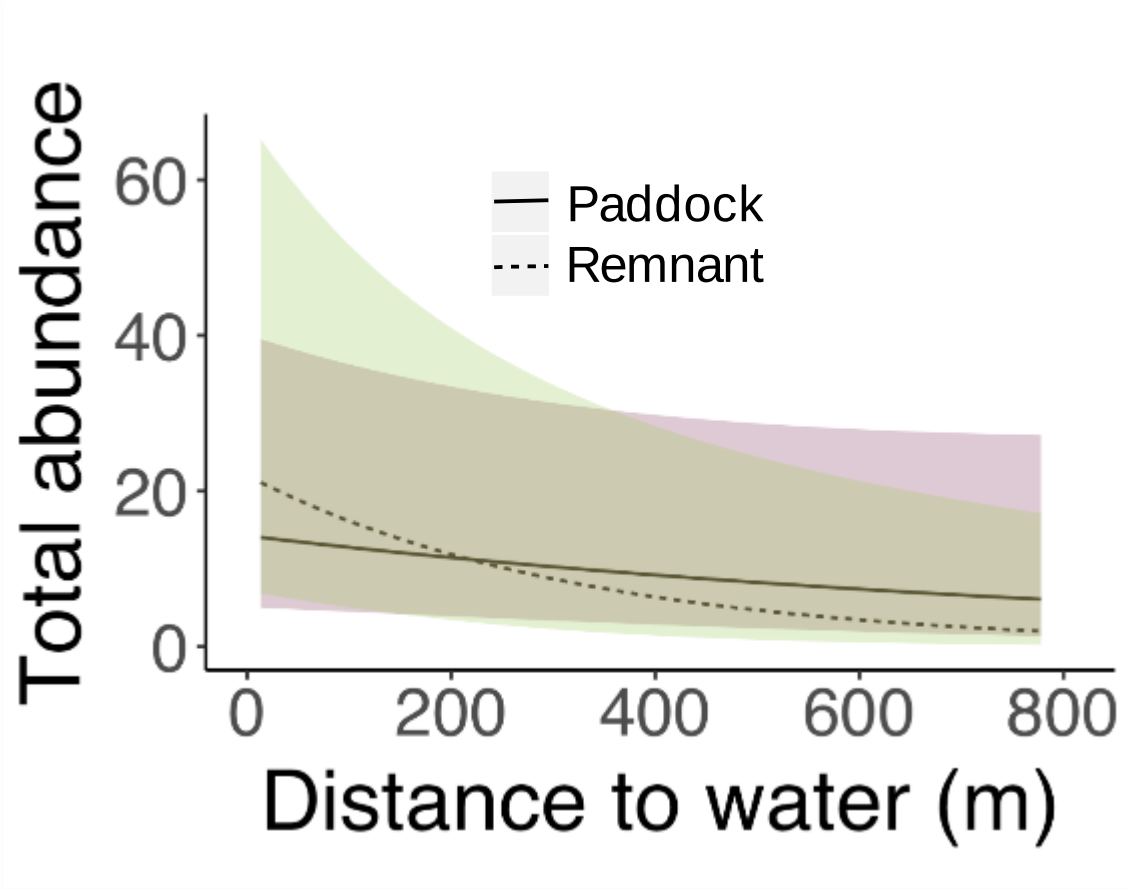
# Frogs - Results



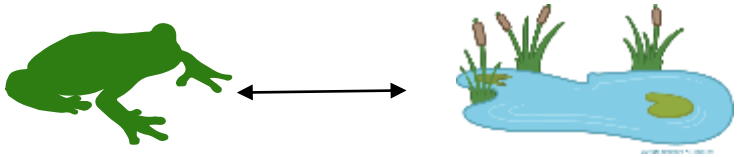

Higher richness with taller ground cover in remnant vegetation, not paddocks

x Paddock vs remnant

# Frogs - Results




Abundance declines with distance to water (maybe slightly faster in remnants than paddocks)



x Paddock vs remnant

Key lessons about how frogs use landscape elements

# Linear Plantings




Important for frogs in dryer landscape

Not so important in the wetter landscape, where animals used all landscape elements




# Frogs

- Use paddocks frequently (body condition even higher in paddocks in some cases)
- Some evidence they may accumulate on linear features
- Remnant condition and proximity to water important
- Habitat specialist species may already be lost


Sam Wallace, Honours project 2017-18

# Do frogs care if their swamp is cropped?

## Discovering the impacts of swamp cropping on frog communities in the lake district of south-western Victoria



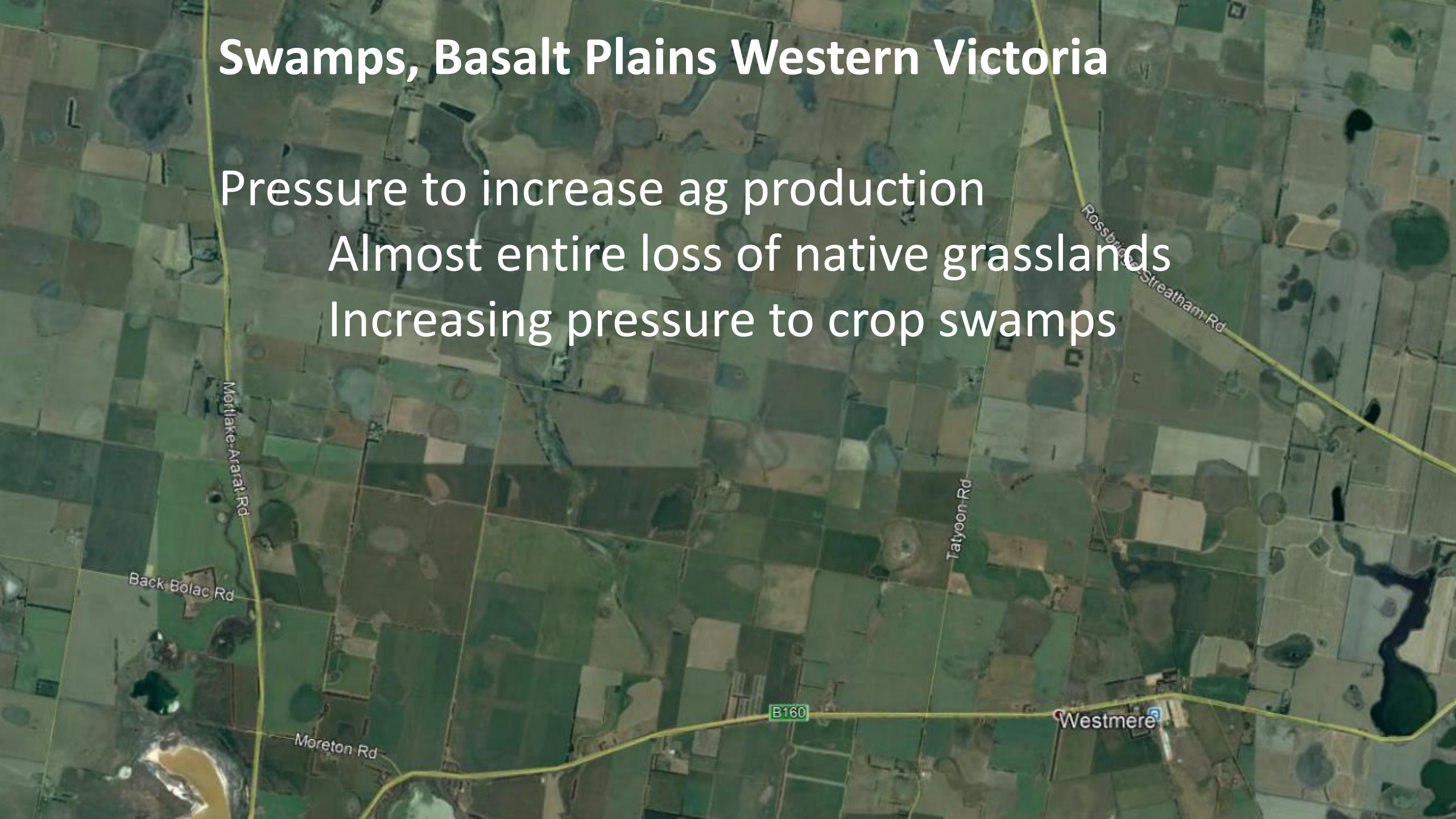


# Swamps, Basalt Plains Western Victoria

Pressure to increase ag production

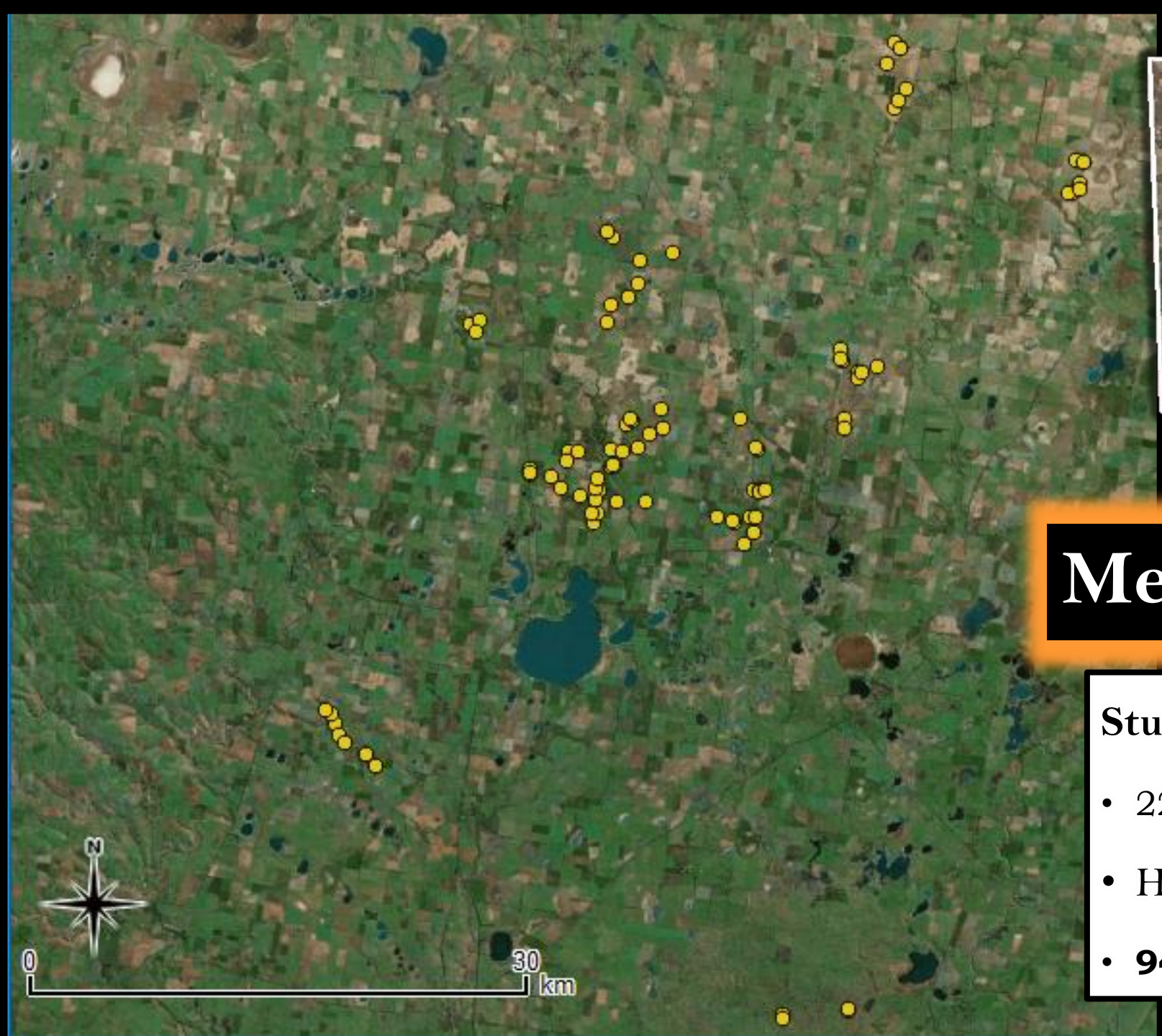
Almost entire loss of native grasslands

Increasing pressure to crop swamps



## Project Questions

1. Does swamp cropping influence frog occurrence?
2. Do frogs need refugia near swamps?
3. Does vegetation quality influence frog occurrence?
4. Does proximity to neighbouring swamps benefit frogs?





# Methods - study sites

**Study sites:** vicinity of Lake Bolac

- 223km from Melbourne
- High density of swamps
- **94 swamp sites selected**

# Site selection – a gradient of habitat condition






# Methods – study design

- Auditory nocturnal surveys
- 15 minute survey length
- 3 survey occasions

# Methods – modelling and survey covariates

## Detection covariates

- Date
- Air temperature
- Cloud cover – clear, overcast, foggy, raining
- Rain index – amount of  rain in the past 24 hours
- Relative humidity
- Wind speed (km/h)

# Methods – site covariates (environmental variables)

**Environmental variables:**

- % cropping of swamp extent
- % cover of vegetation groups (sedge, rush, grass, herb, bryophytes)
- % cover of bare ground, leaf litter
- Average vegetation depth

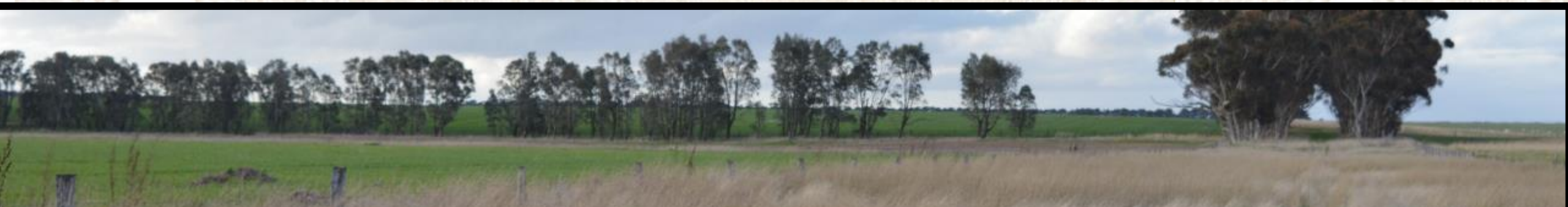
**Converted to *3* principle components for analysis**

# Methods – site covariates (spatial variables)

- Spatial variables are landscape features likely to affect frog detectability

**Spatial variables:**

- Number of swamps within 1km
- Distance to nearest swamp
- Number of refugia (logs, old building material etc.) within 200m
- Distance to nearest refuge



# Results…?

# Results – swamp occupancy and detection rates

| Frog species | Nightly detection rate | Swamp occupancy |
|---|---|---|
| ***Crinia signifera***, Eastern common froglet (**A**) | 85% (0.85) | 92% (0.918) |
| ***Limnodynastes tasmaniensis***, Spotted marsh frog (**B**) | 69% (0.692) | 88% (0.877) |
| ***Litoria ewingii***, Southern brown tree frog (**C**) | 67% (0.673) | 72% (0.717) |
| ***Neobatrachus sudelli***, Common spadefoot toad (**D**) | 33% (0.326) | 34% (0.338) |
| ***Limnodynastes dumerilii***, Pobblebonk (**E**) | 28% (0.275) | 57% (0.567) |

# Detection

| Frog species | Detection model |
|---|---|
| ***Crinia signifera***, Eastern common froglet (**A**) | Wind + Date |
| ***Lim. tasmaniensis***, Spotted marsh frog (**B**) | -- |
| ***L. ewingii***, Southern brown tree frog (**C**) | Date |
| ***N. sudelli***, Common spadefoot toad (**D**) | Date |
| ***Lim. dumerilii***, Pobblebonk (**E**) | Rain + Wind + Date |

No Effect of

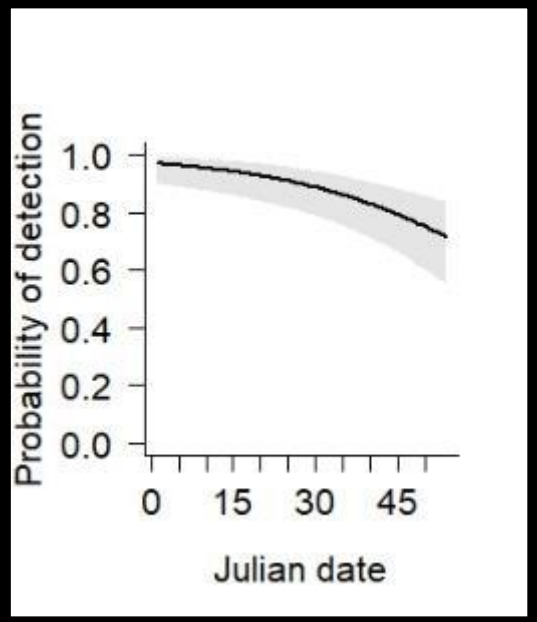
Temperature
Cloud Cover
Relative humidity

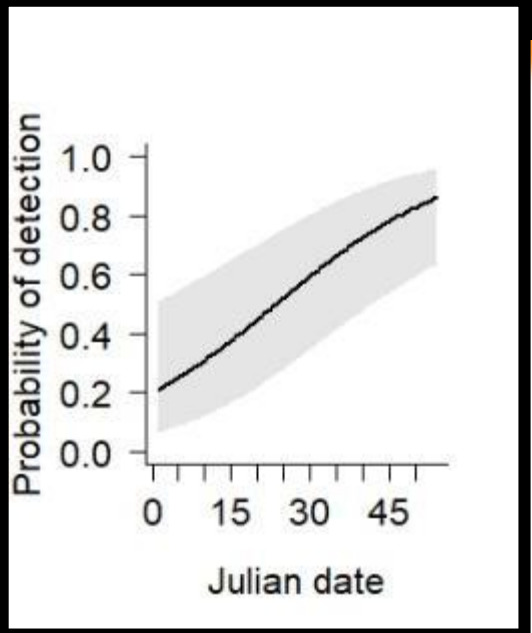




# Results – Date and detectability

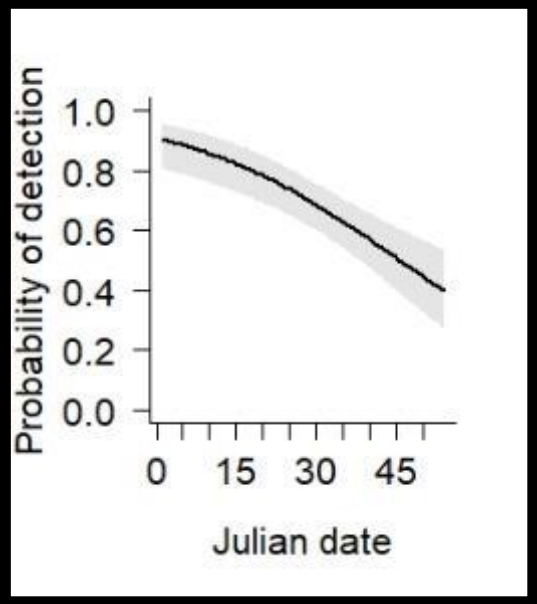
*Crinia signifera*

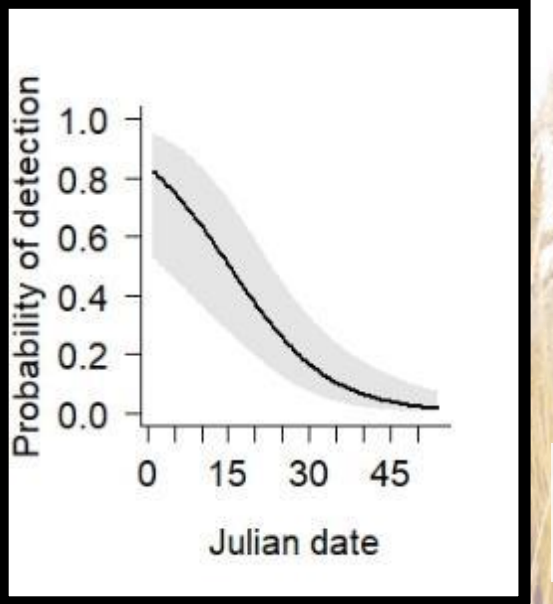



***Lim.dumerilii* (Pobblebonk)**

***Litoria ewingii***



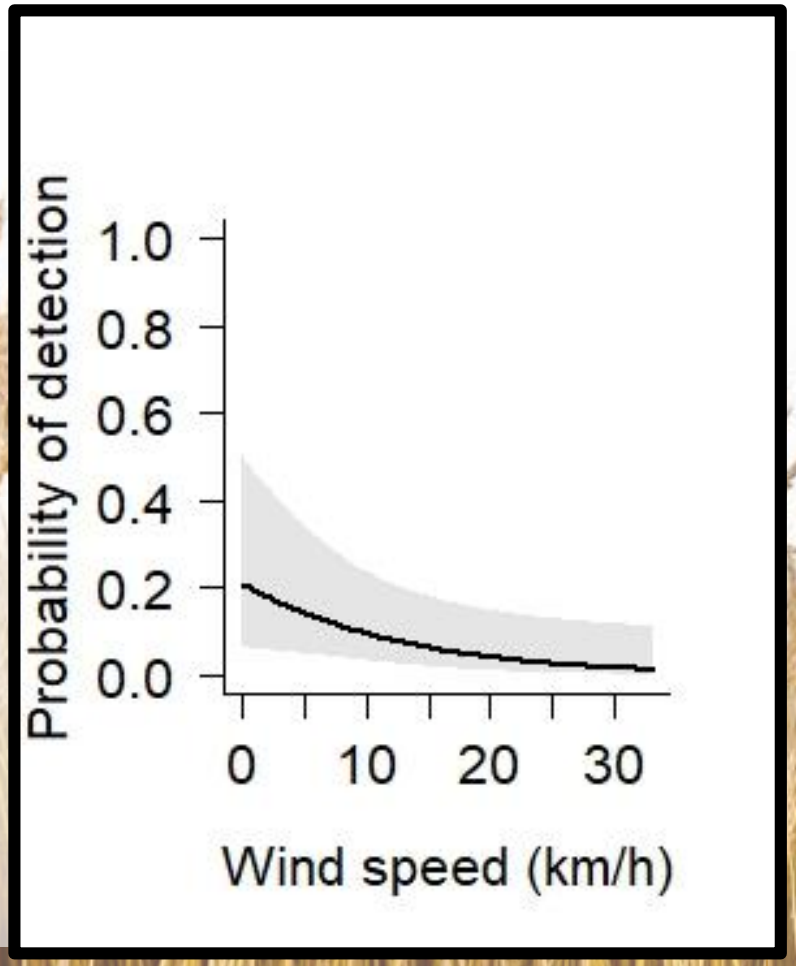

***N. sudelli* (Common spadefoot toad)**

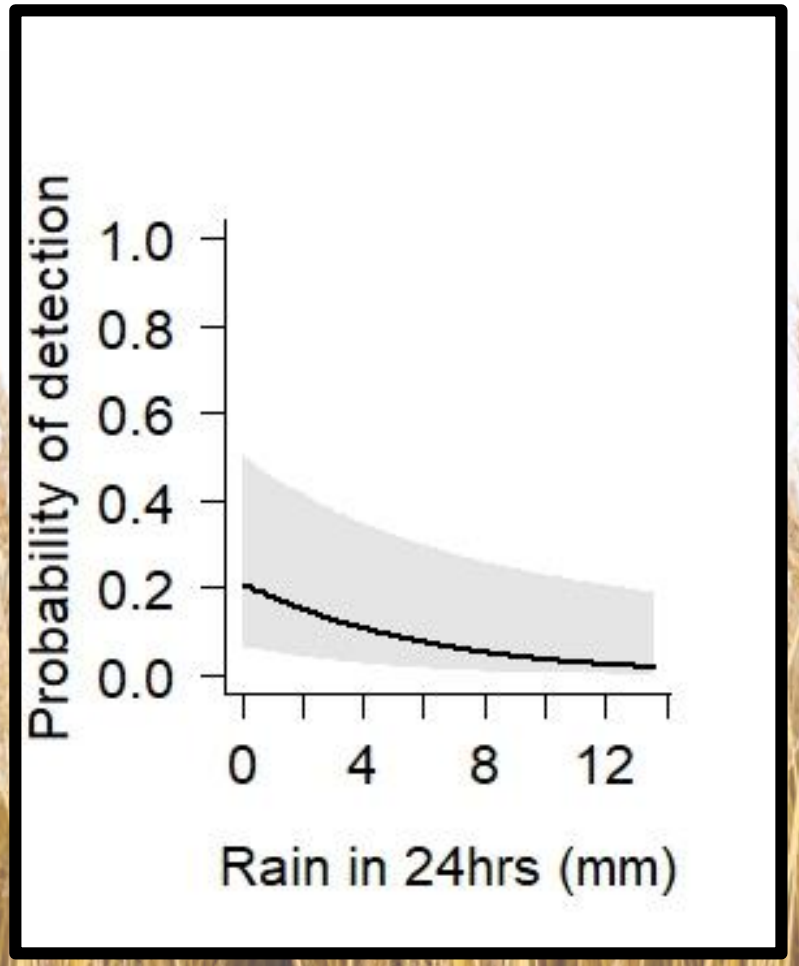
# Results – *Lim. dumerilii* detectability

- Best detection model:

Date + wind speed

+ rain (mm in 24hours)



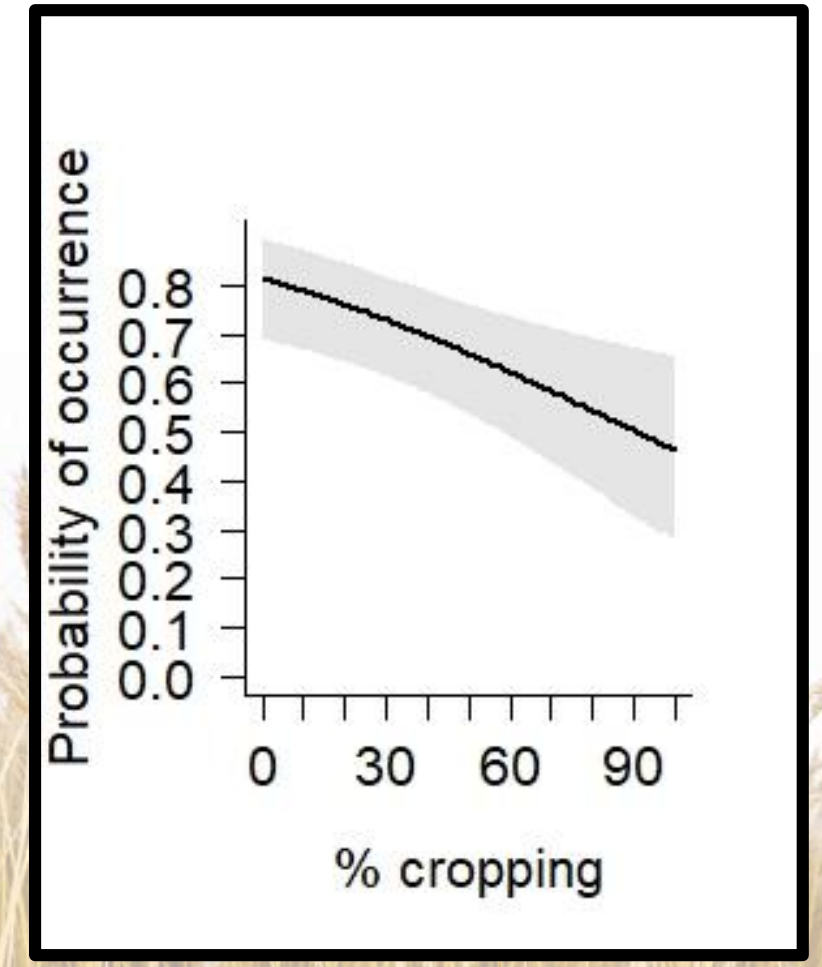
# Results – different model components

| Frog species | No Effect of | Occurrence model |
|---|---|---|
| ***Crinia signifera***, Eastern common froglet (**A**) | No. swamps <1km<br>Distance nearest swamp<br>Distance nearest refuge | -- |
| ***Lim. tasmaniensis***, Spotted marsh frog (**B**) | | Principal component 3 |
| ***L. ewingii***, Southern brown tree frog (**C**) | | % swamp cropping |
| ***N. sudelli***, Common spadefoot toad (**D**) | | -- |
| ***Lim. dumerilii***, Pobblebonk (**E**) | | Refuge no. + principal component 1 |

# Results – occurrence and landscape features

***Litoria ewingii***

**Brown Treefrog**



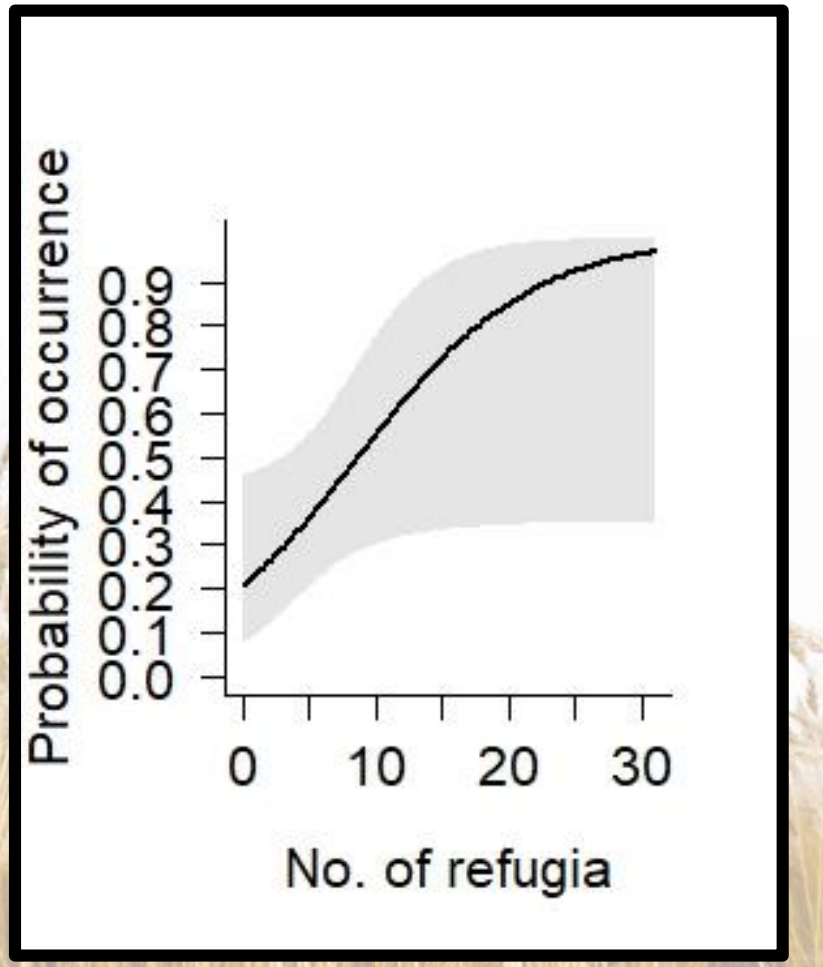

Agricultural intensification drives declines of brown treefrog

# Results – occurrence and landscape features

***Limnodynastes dumerilii***

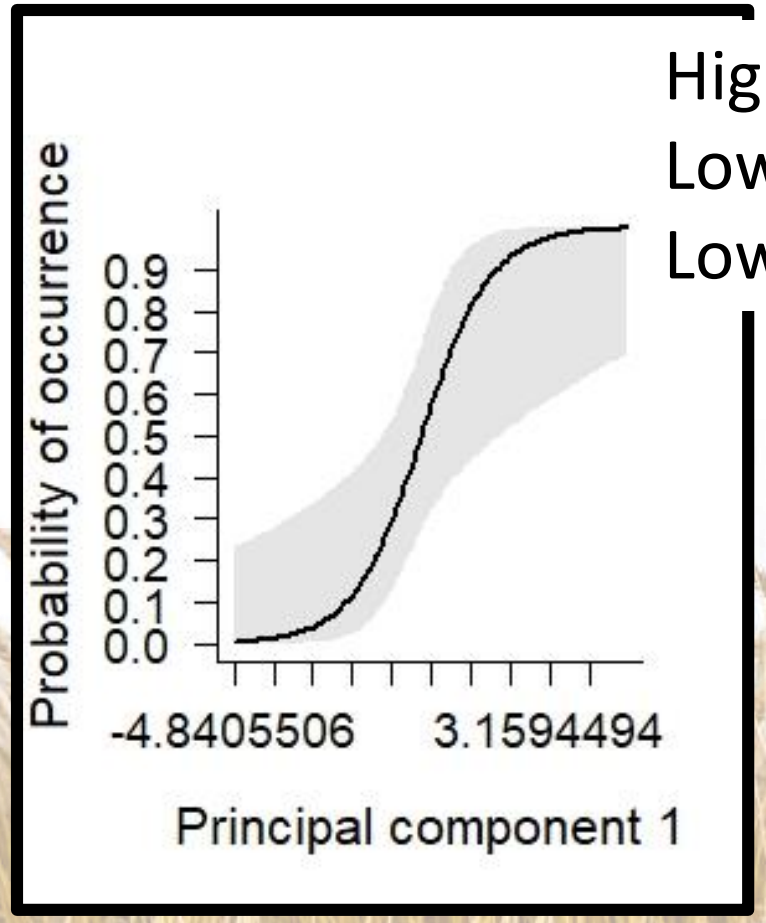
**(Pobblebonk)**

Refugia near swamps critical for Pobblebonks



# Results – occurrence and vegetation quality

***Lim.dumerilii***
**(Pobblebonk)**



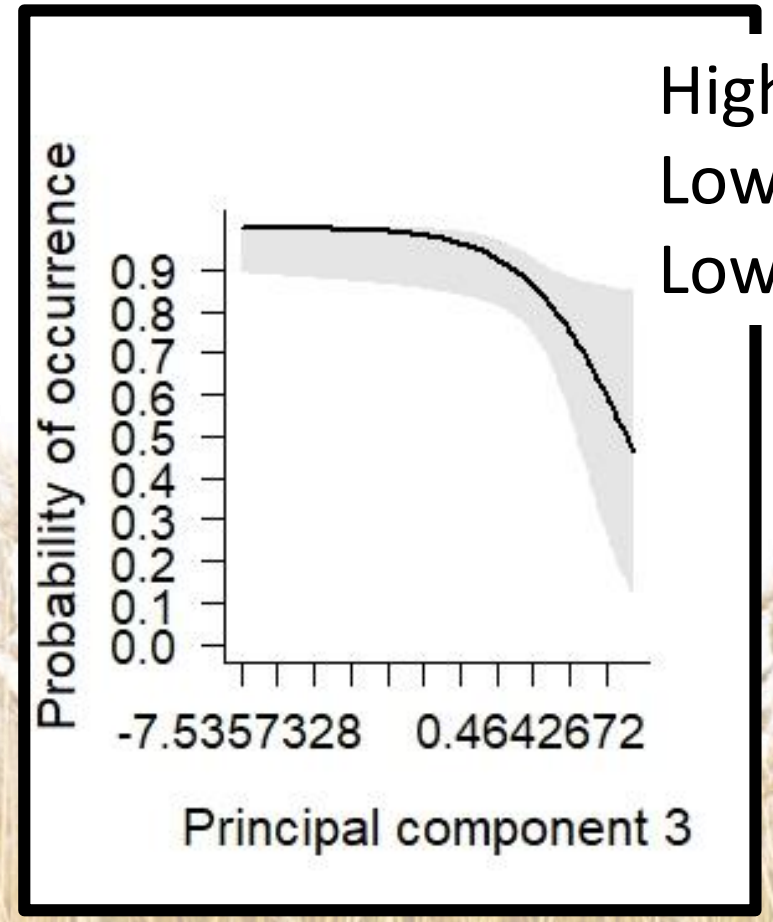

High rush cover
Low herb cover
Low bare ground

High quality vegetation cover in swamps is important

# Results – occurrence and vegetation quality

***Limnodynasts tasmaniensis***

***Spotted marsh frog***




High bare ground
Low grass cover
Low litter cover

High quality vegetation cover in swamps is important

# The Missing Frogs

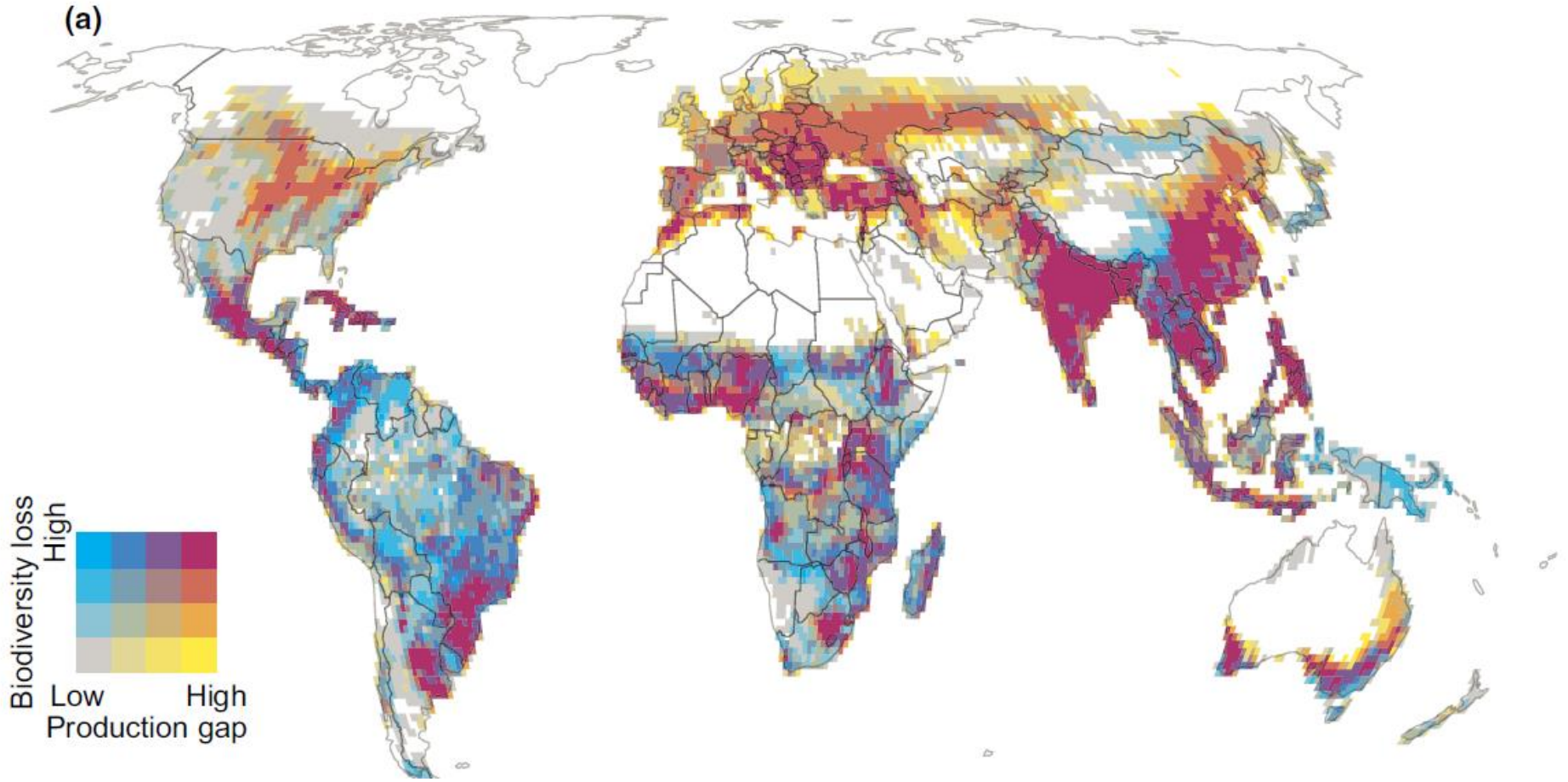
*Growling Grass Frog Litoria raniformis (at one site only)*
Southern toadlet *Pseudophryne semimarmorata*
Bibron's toadlet *Pseudophyrne bibronii*
Eastern smooth frog *Geocrinia Victoriana*
Smooth frog *Geocrinia laevis*

**Sensitive frog species may already have been eliminated (but need to also survey in autumn)**

# For frogs that remain in farmlands….

- Vegetation quality matters; both in swamp and in remnant vegetation
- Frogs may use linear plantings more often in dry country
- Individual species respond to different landscape features;
  - Structures and vegetation in landscape matters for frogs
- Agricultural intensification causes frog declines

# Intensification vs biodiversity




EGLI et al. (2018). *Global Change Biology DOI: 10.1111/gcb.14076*


Photo: Nicole Hansen