# Modelling and mapping habitat for key species across the MDB

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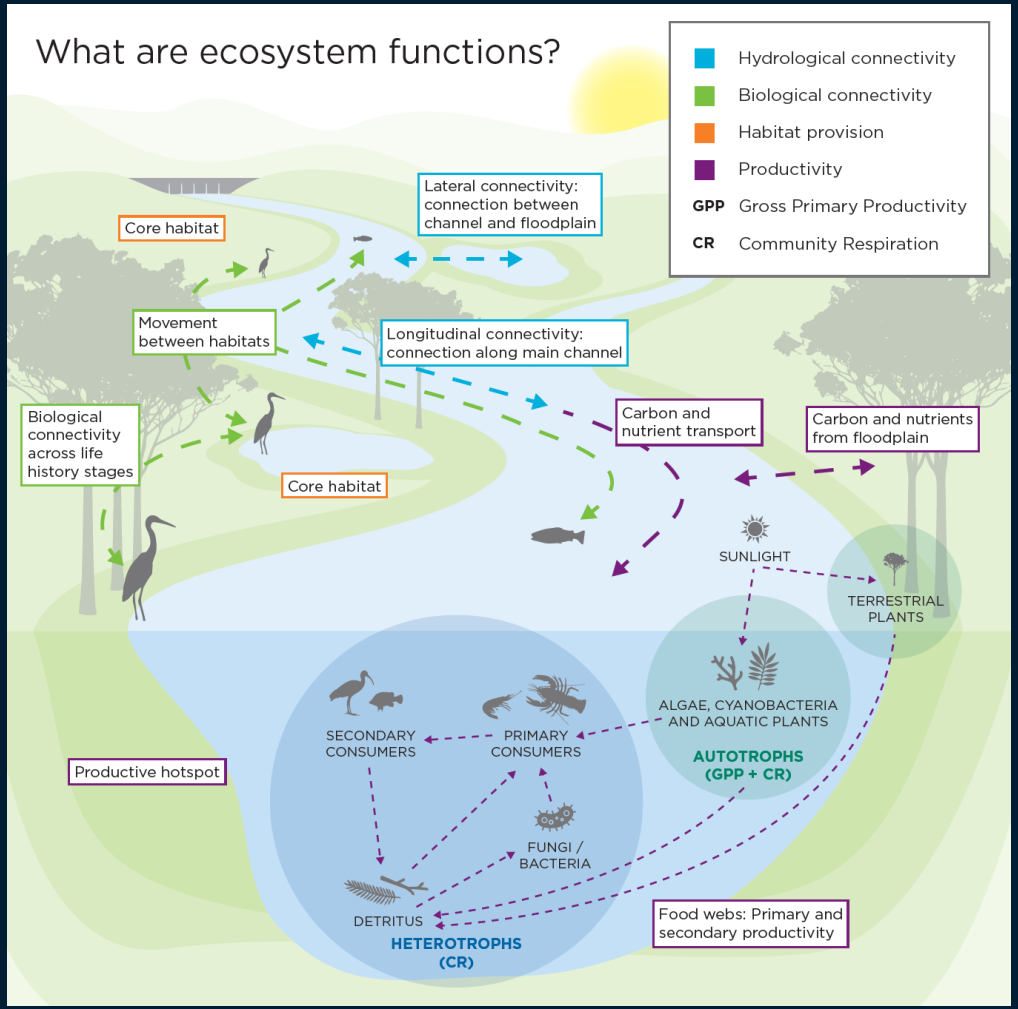
Australia's National Science Agency

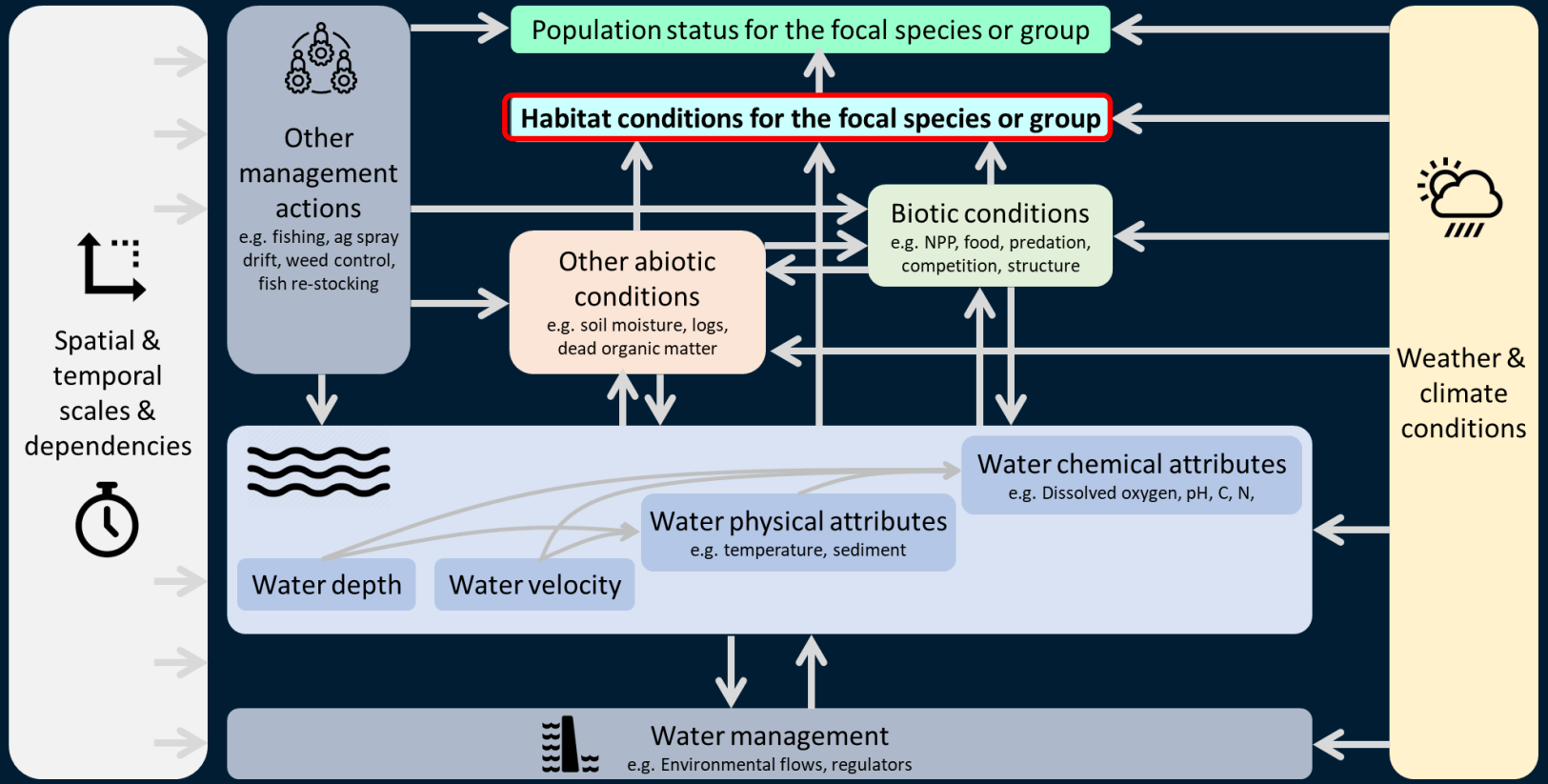
# What are ecosystem functions?



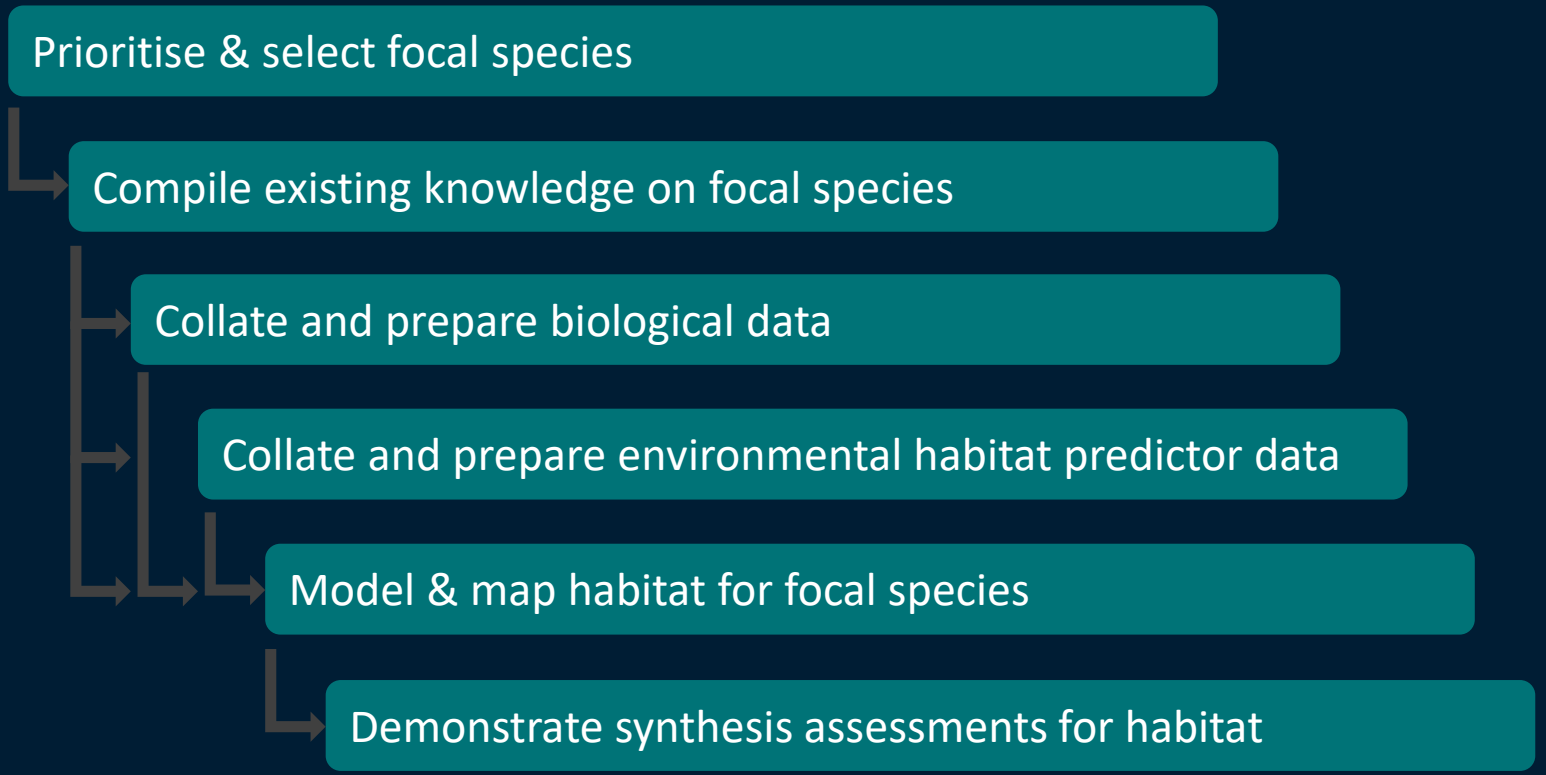
# The science challenge

- Modelling and mapping habitat for focal species at fine spatial and temporal resolution across the whole MDB
- Habitat conditions for water-dependent species can change rapidly
- Preparing and identifying meaningful dynamic habitat predictors
- Account for complex interactions between habitat predictors

# Habitat modelling - concept

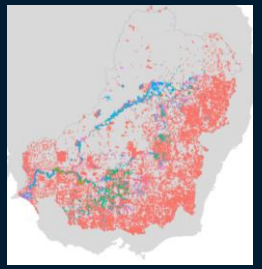


# Research activities



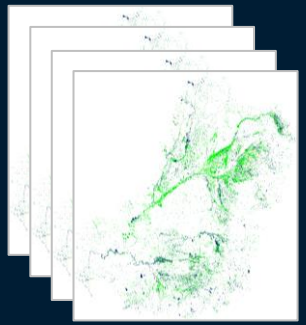
# Spatiotemporal biodiversity modelling

Biological data

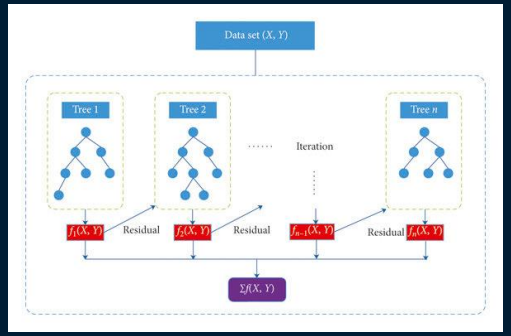


Static predictors

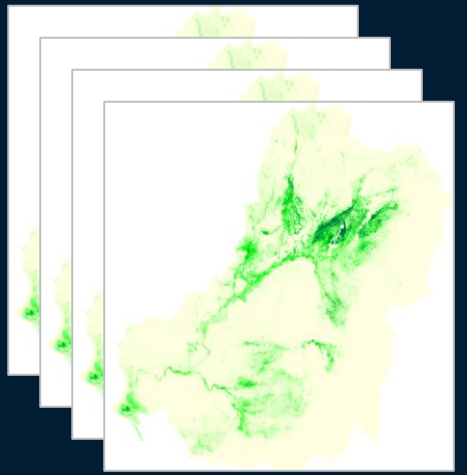
Dynamic predictors



Boosted regression tree




Spatiotemporal predictions of habitat quality



# Prioritising & selecting focal species

Criteria:

1. Change as a consequence of hydrological or hydraulic drivers
2. Broad geographic range and extent
3. Movement over broad and local scales
4. Habitat changes over time
5. Social/policy significance and alignment with management objectives
6. Data and knowledge availability
7. Completeness and distinctiveness (across focal species)

# Prioritising & selecting focal species

## Fish

Murray cod

Golden perch

## Waterbirds

Royal spoonbill

Straw-necked ibis

## Plants

River red gum

lignum

## Macroinverts

Shrimp

## Frogs

Pouched lamprey

Australasian bittern

Musk duck

Black box

Wetland ‘amphibious responder’

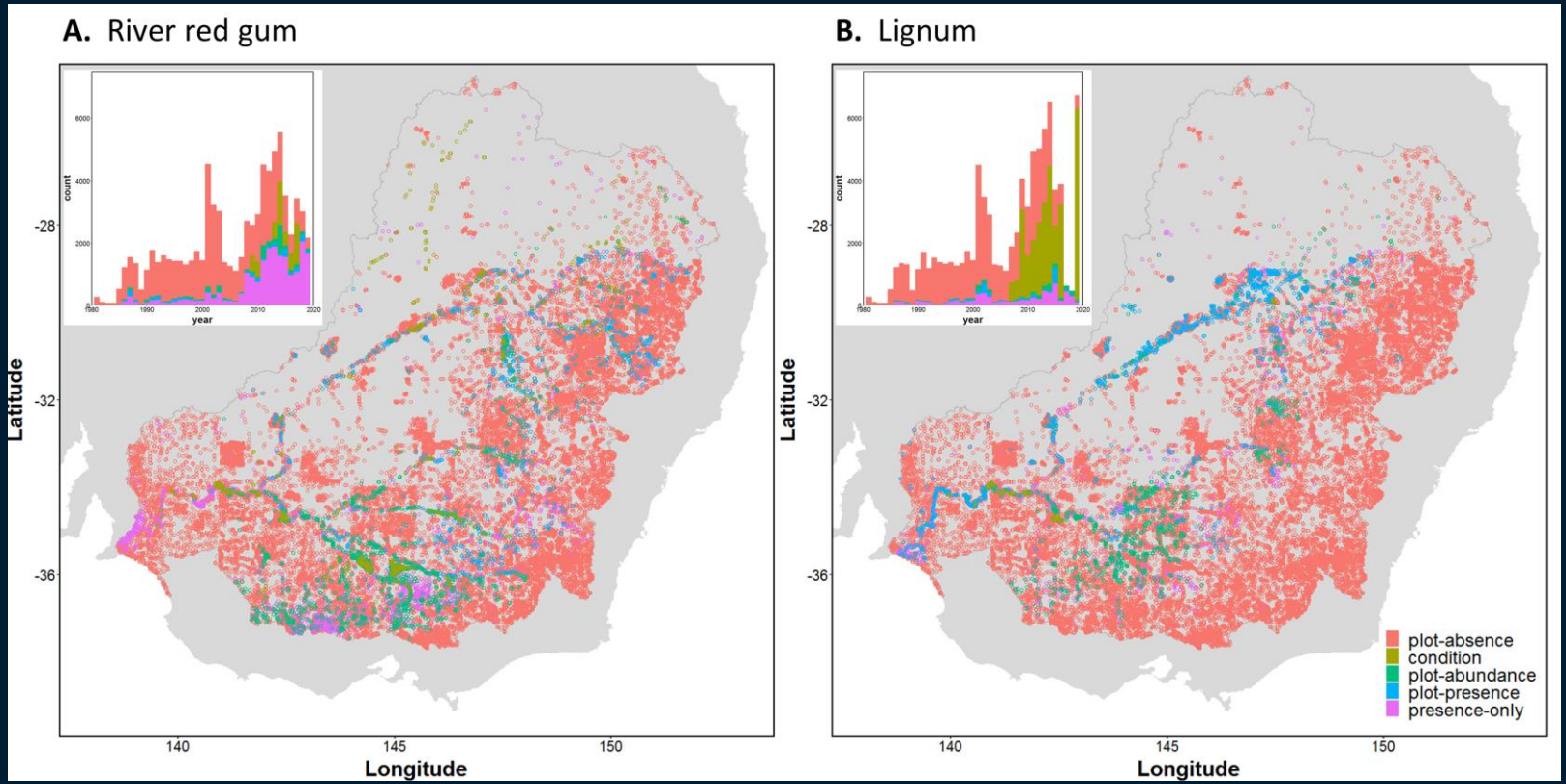
Benthic riverine

Southern bell frog

# Existing knowledge for the focal species

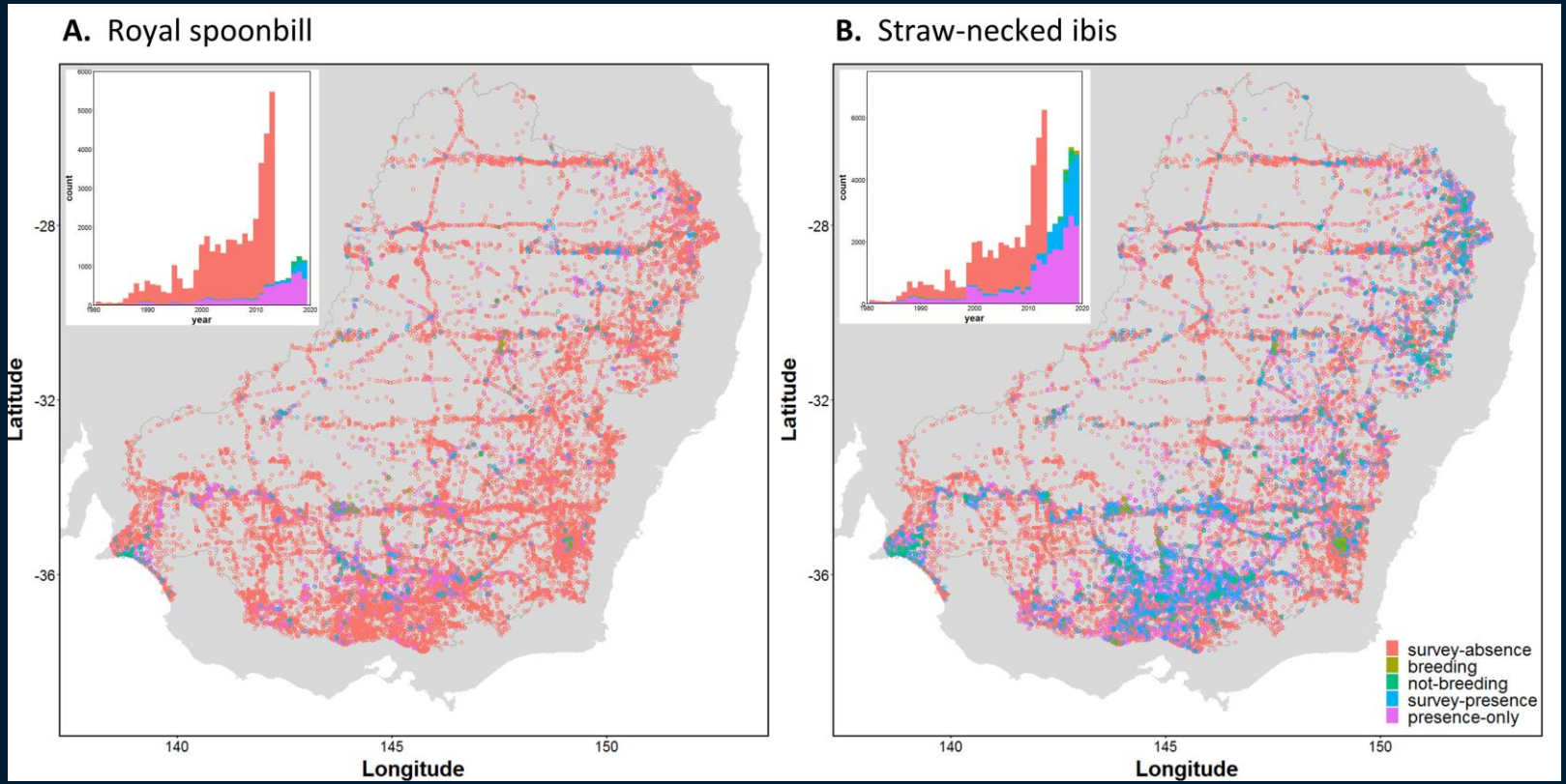
- Key organism attributes
- Current knowledge of habitat requirements
- Current knowledge of movement attributes
- Catalogue of possible datasets
- References to key studies

# Biological data - plants



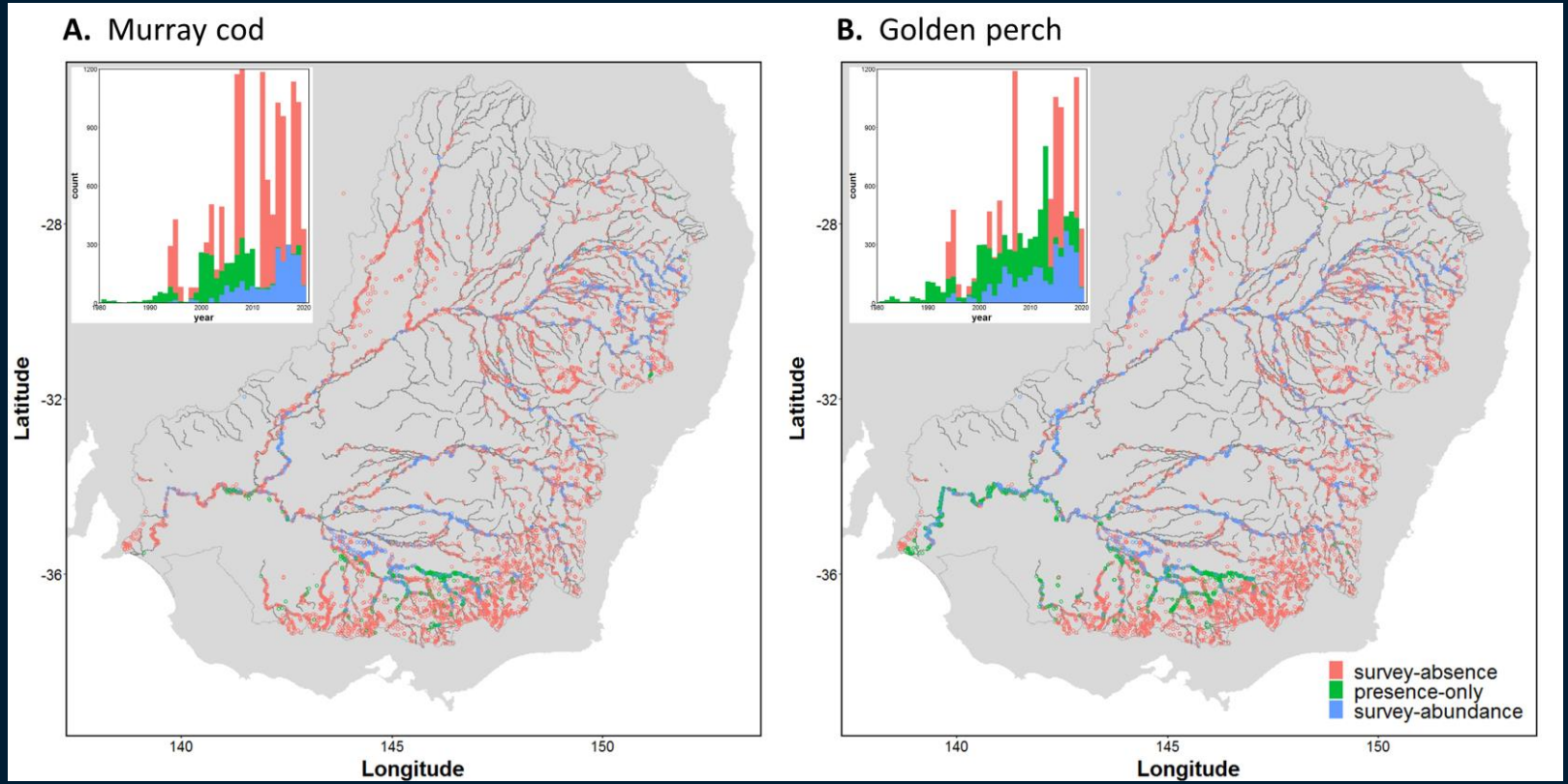

| Species | Presence-only | Presence-absence | Physiological condition |
|---|---|---|---|
| River red gum | 21,116 | pres. = 5,855; abs. = 49,692 | 5,262 |
| Lignum | 6,309 | pres. = 1,864; abs. = 51,520 | 45,126 |

# Biological data - waterbirds



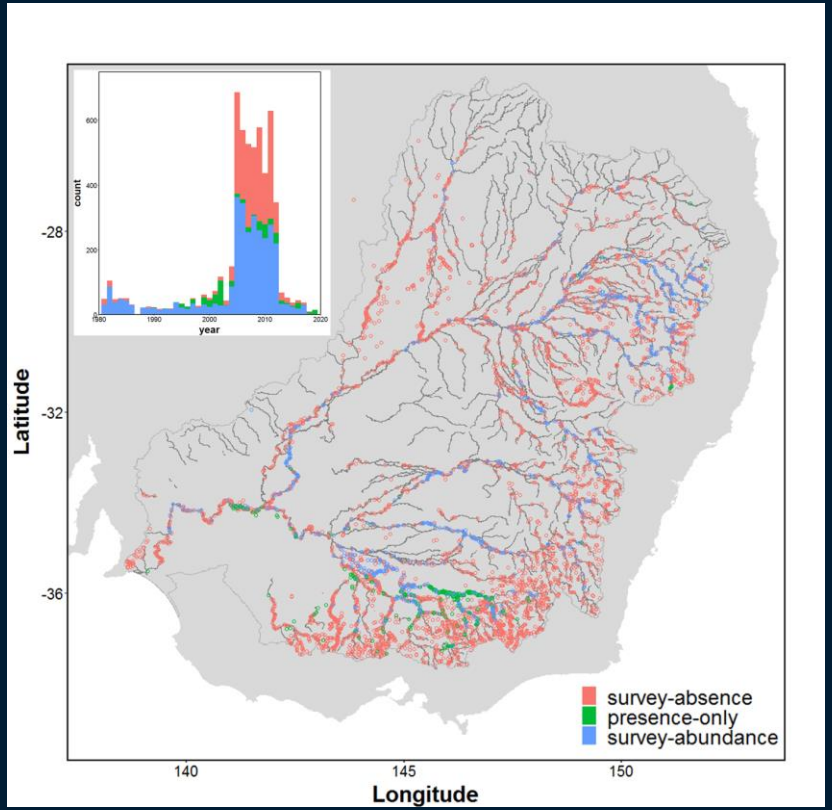

| Species | Presence-only | Presence-absence | Breeding |
|---|---|---|---|
| Royal spoonbill | 8,259 | pres. = 2,079; abs. = 197,759 | breeding = 273; not = 428 |
| Straw-necked ibis | 25,061 | pres. = 12,106; abs. = 189,166 | breeding = 611; not = 934 |

# Biological data - fish




| Species | Presence-only | Abundance-absence | Size surveys |
|---|---|---|---|
| Murray cod | 2,571 | abund. = 2,380; abs. = 15,619 | 2,336 |
| Golden perch | 4,757 | abund. = 3,451; abs. = 14,548 | 2,827 |

# Biological data - shrimp




| Species | Presence-only | Abundance-absence |
|---|---|---|
| Shrimp | 423 | abund. = 3,186; abs. = 2,133 |

# Environmental predictor data for species habitat

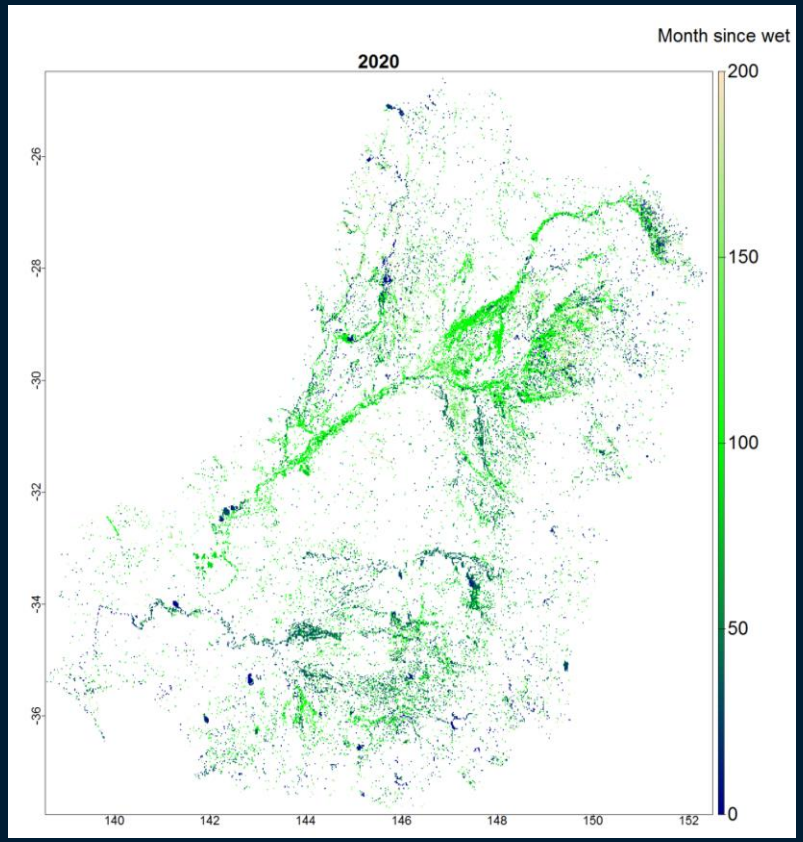
**Static predictors**

- long-term climate
- topography
- soil & substrate
- catchment attributes

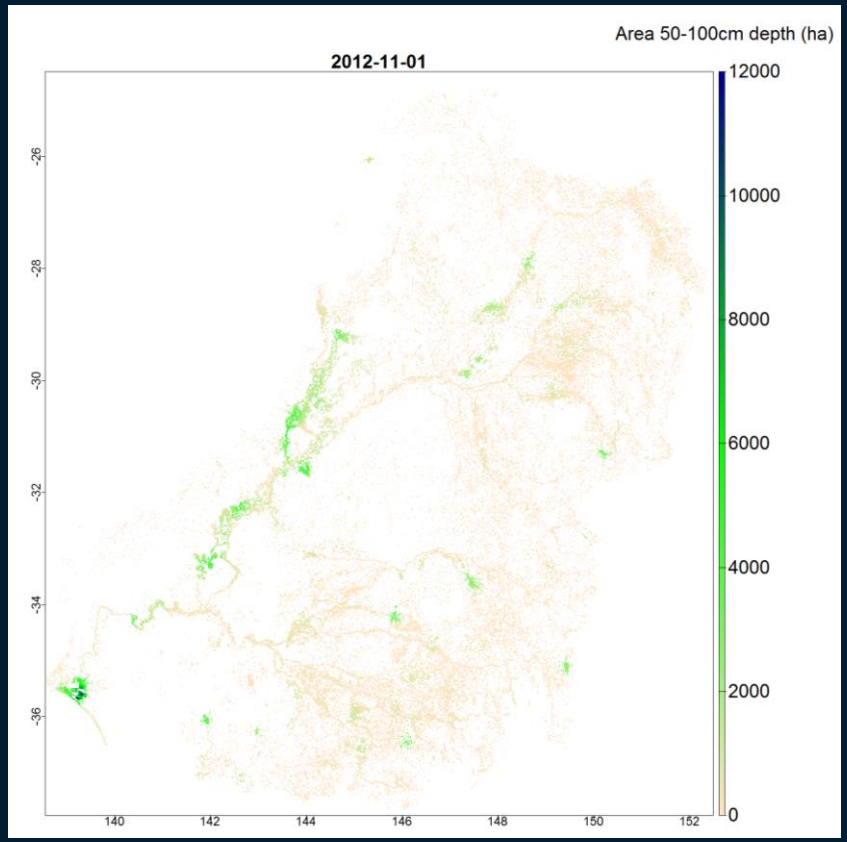
**Dynamic predictors**

- Rainfall
  - precipitation in the preceding 2, 4, 6, 12, 18, 24 months
- From inundation time-series
  - no. months inundated in preceding 1, 2, 3, 4, 5, 6, 10 years
  - frequency inundated in preceding 1, 2, 3, 4, 5, 6, 10 years
  - mean depth inundated in preceding 1, 2, 3, 4, 5, 6, 10 years
  - no. months since last inundation event
  - Area with water in feeding depth range in surrounding 3 or 20 km (also mean and min over previous 6 months)
- From stream flow time-series
  - velocity, flow, depth and width in the preceding 1, 3 years (min. and mean)

# Environmental predictor data for species habitat



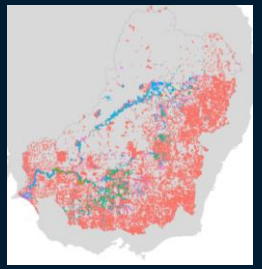

Time since inundation




Area of water in feeding depth range (20 km rad.)

# Spatiotemporal biodiversity modelling

Biological data



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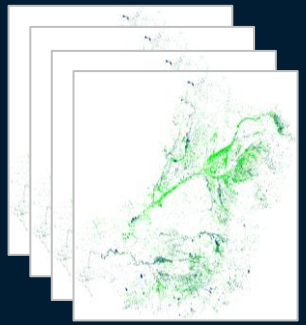

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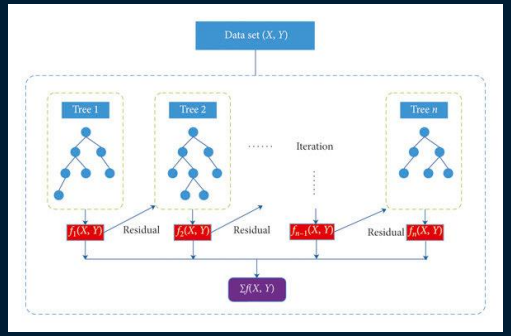


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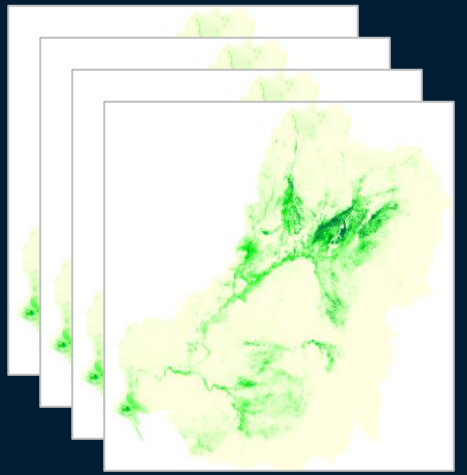


# Habitat model – predictor importance

## Plants

River red gum Lignum

Time since inundated
Rainfall in the previous 4 months

Mean depth inundation (prev. 5 yrs)

## Waterbirds

Royal spoonbill Straw-necked ibis

Area of feeding depth 20km & 3km rad. (mean, prev. 6 mnth)
Time since inundated
Rainfall in the previous 2 months
Mean depth inundation (prev. 10 yrs)

## Fish

Murray cod Golden perch

Mean flow (prev. 3 yrs, 1 yr)
Rainfall in the previous 2 months
Flow
Velocity
Depth; Width

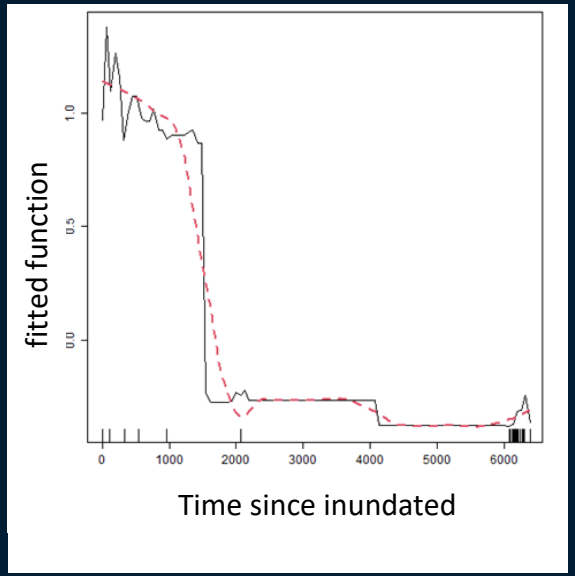
## Macroinvertebrates

Shrimp

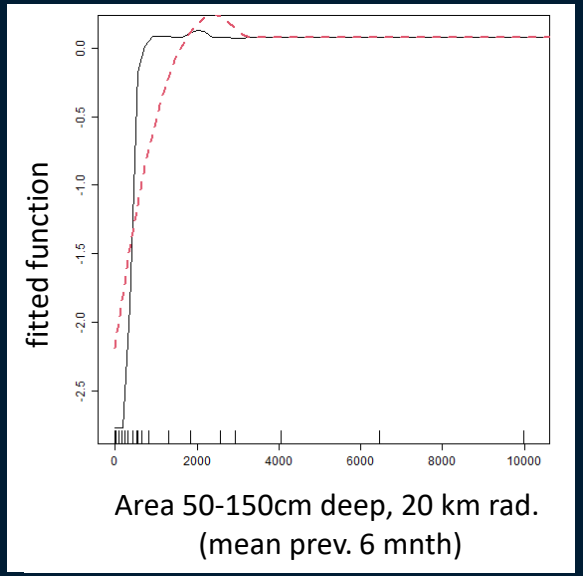
Mean flow (prev. 3 yrs, 1 yr)
Rainfall in the previous 2 months
Flow

# Habitat model – response functions (examples)

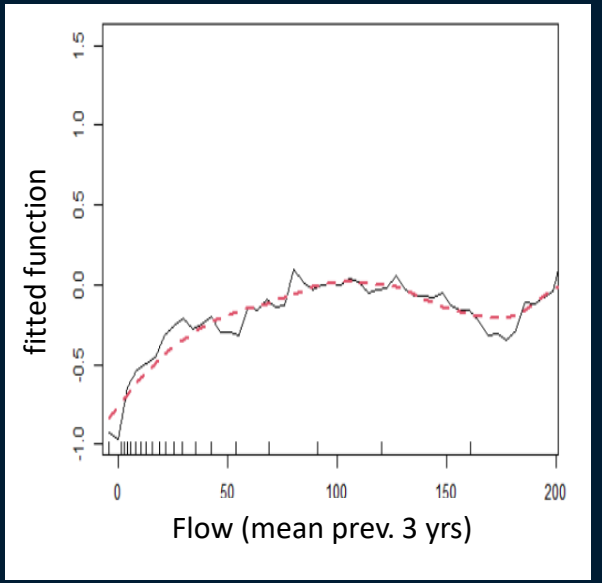
Lignum



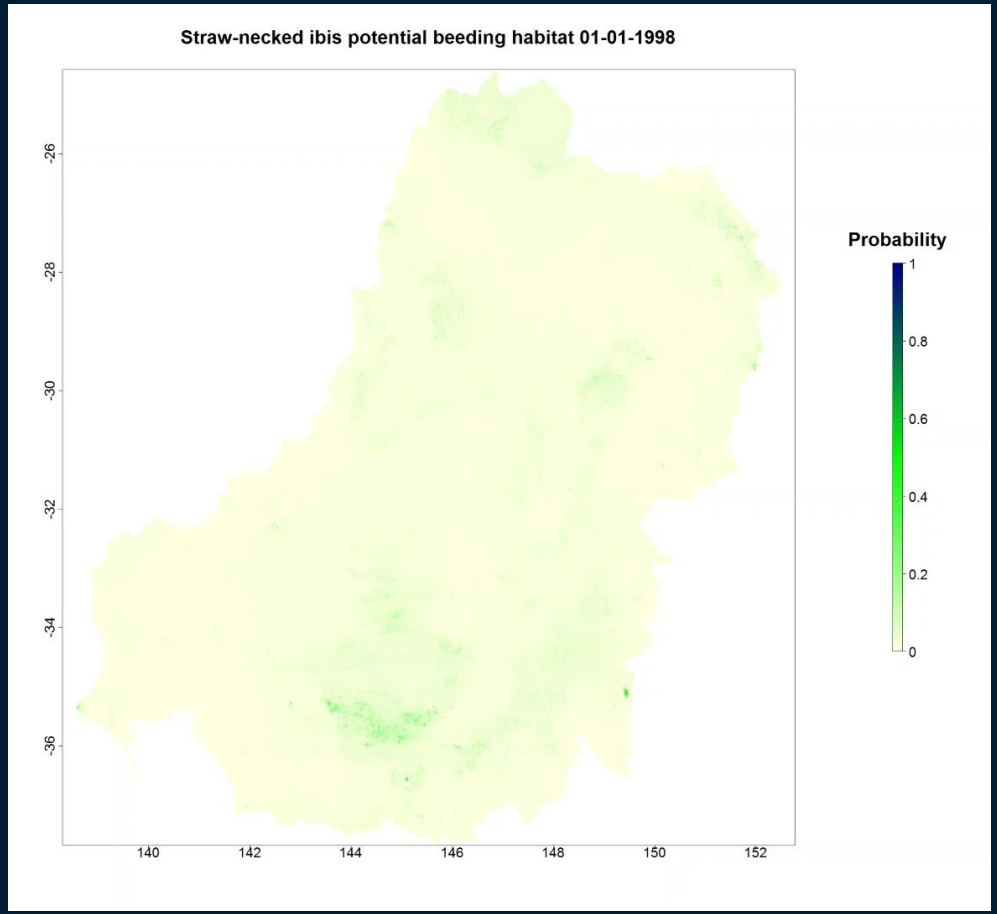

Royal spoonbill



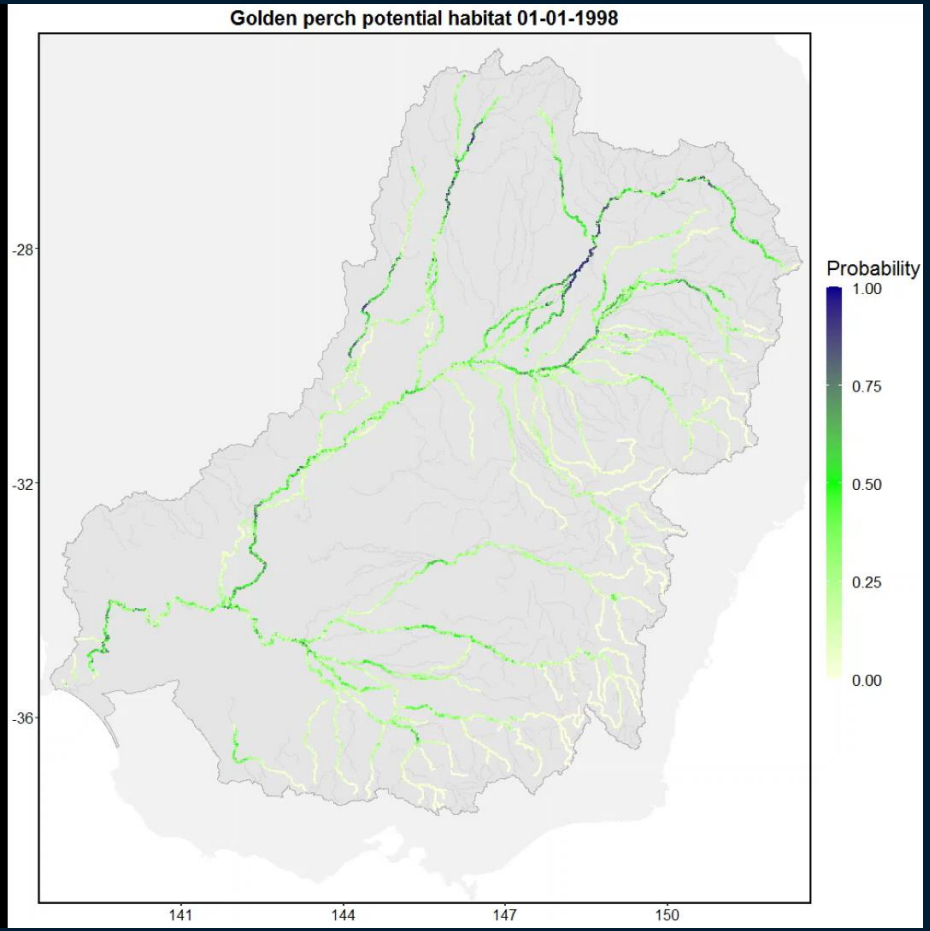

Murray cod



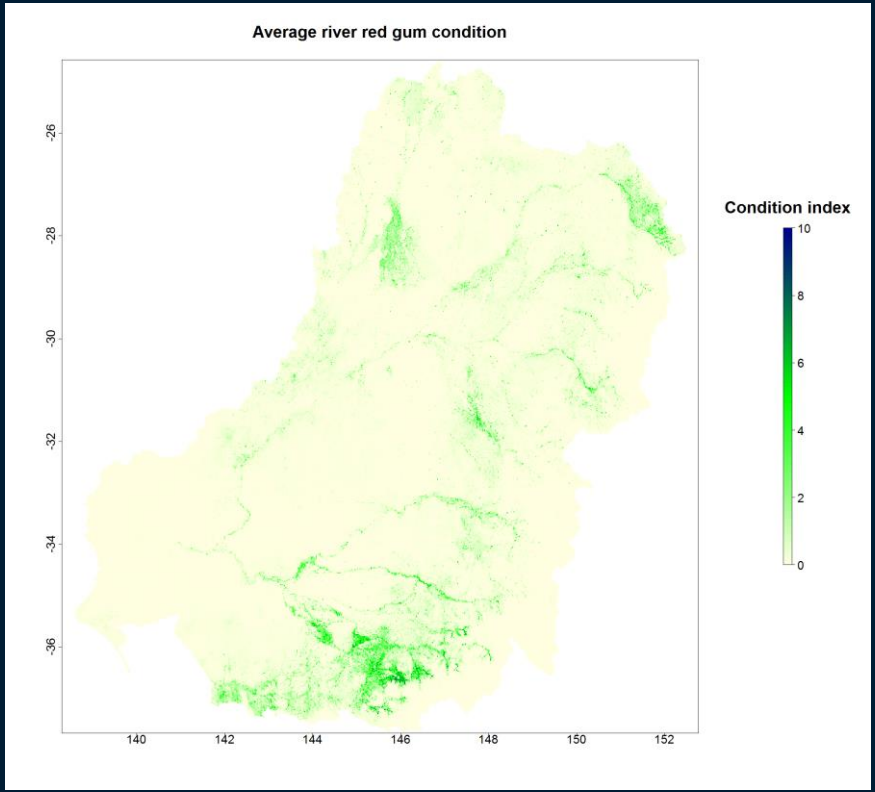
# Spatiotemporal habitat mapping: straw-necked ibis



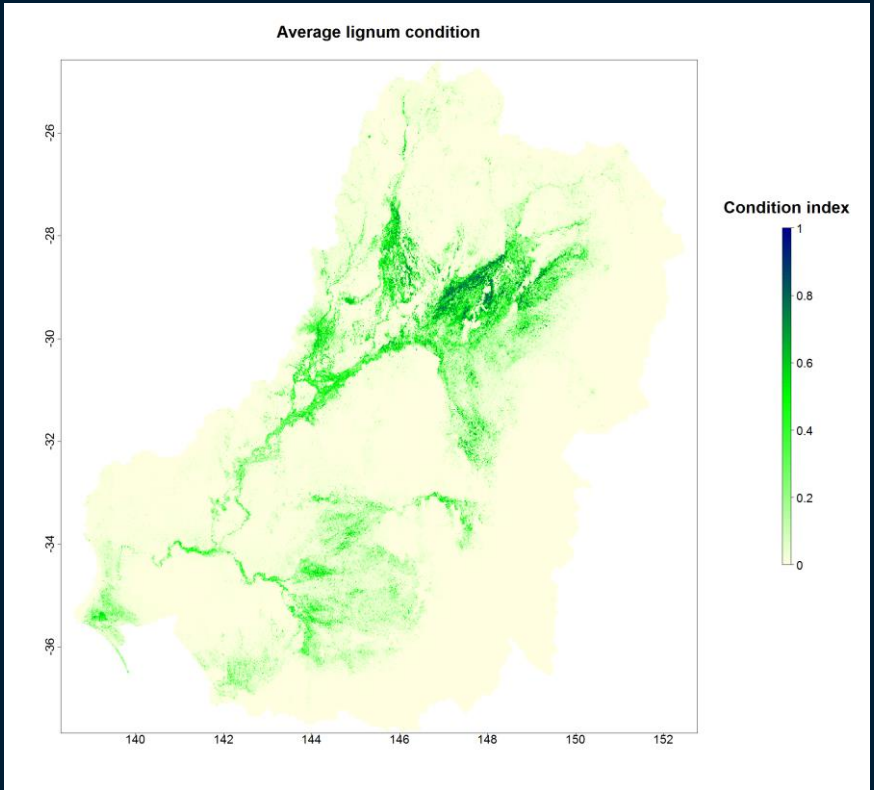
# Spatiotemporal habitat mapping: golden perch



# Synthesis assessments – plants

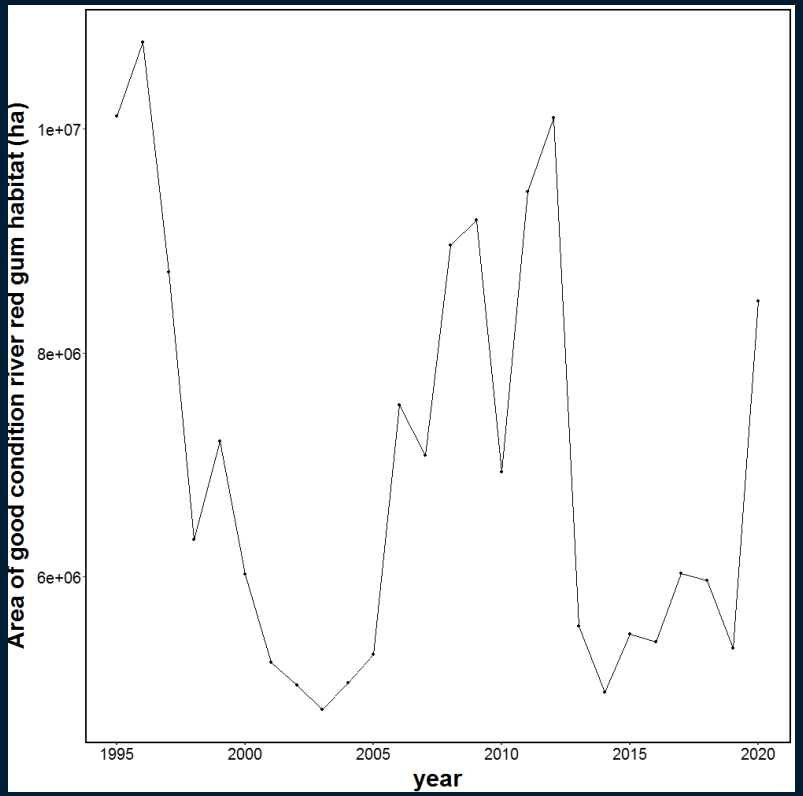



River red gum

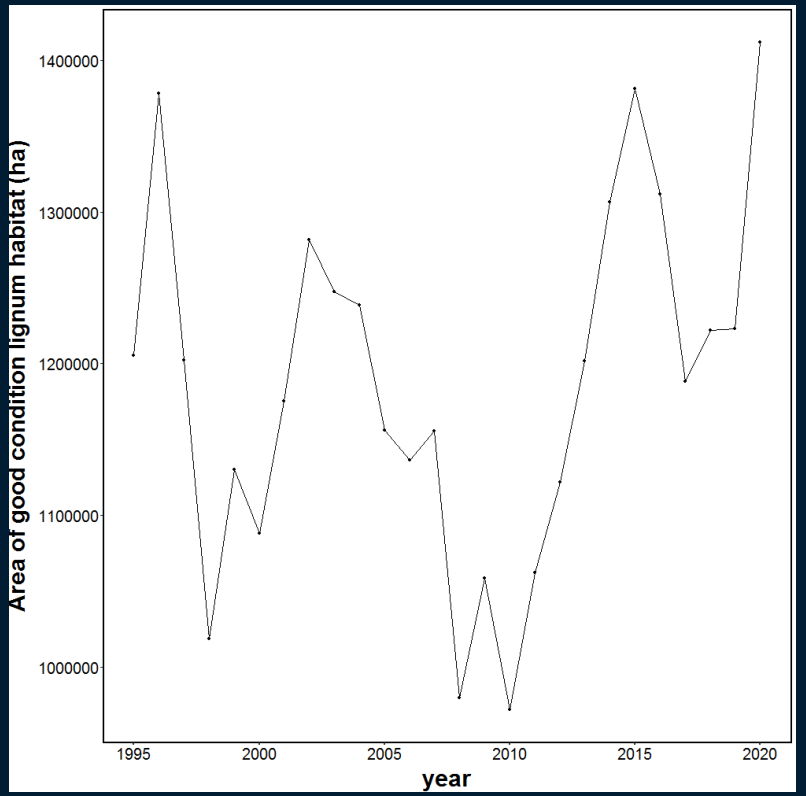



Lignum

# Synthesis assessments – plants

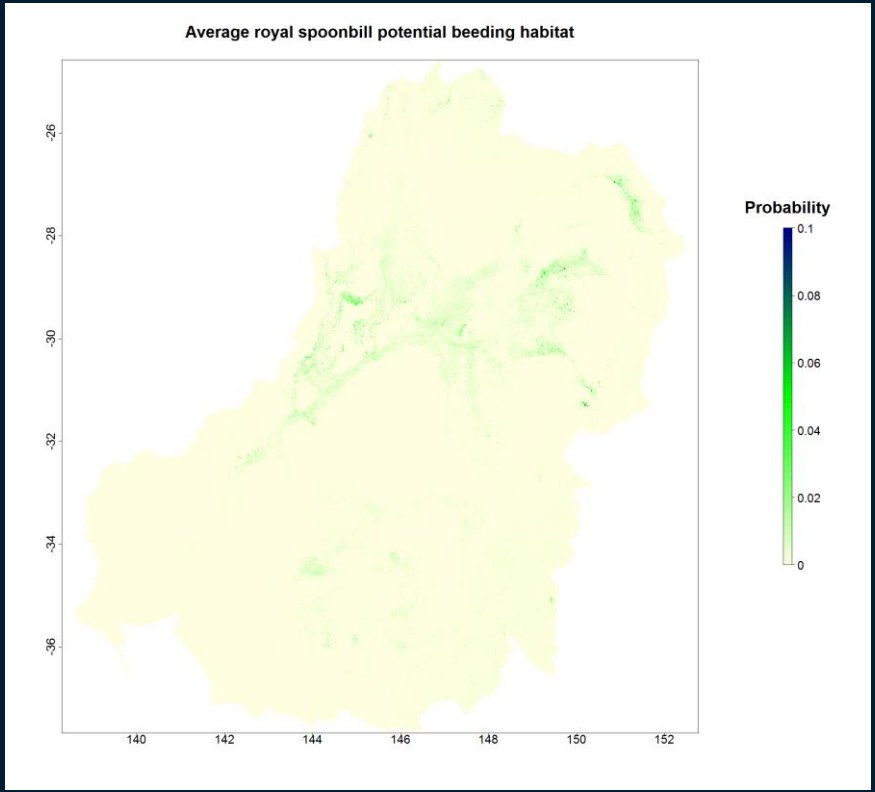



River red gum

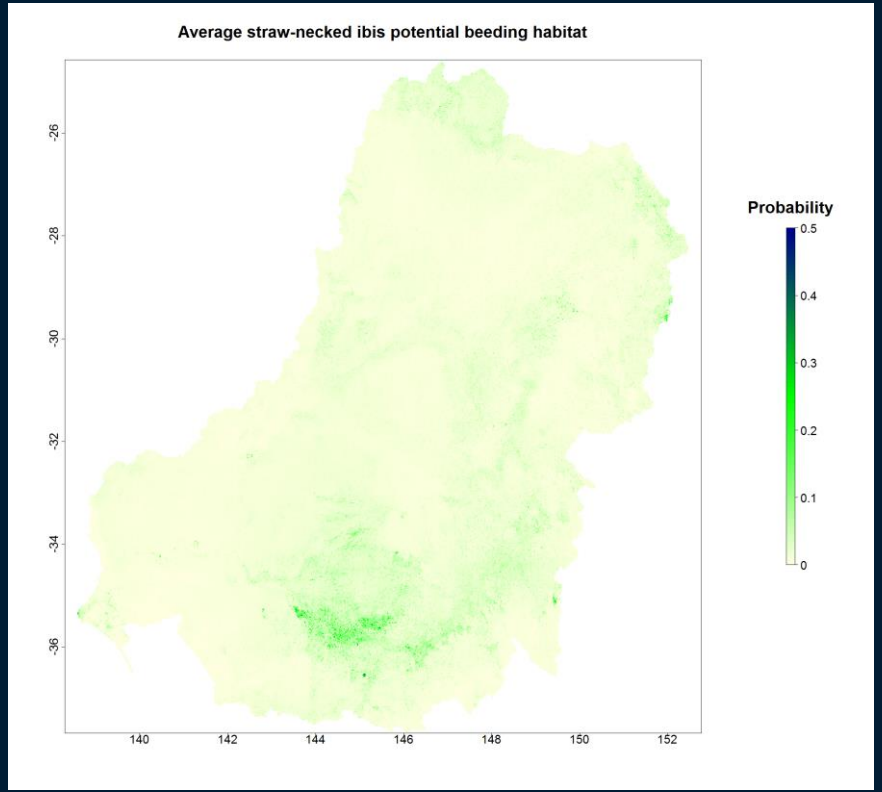



Lignum

# Synthesis assessments – waterbirds

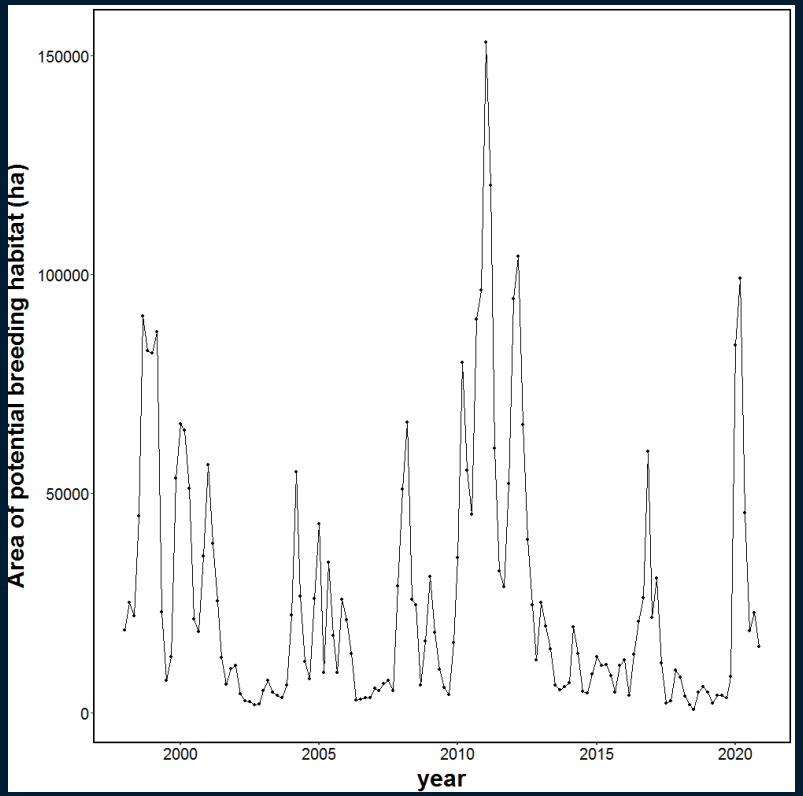



Royal spoonbill




Straw-necked ibis

# Synthesis assessments – waterbirds

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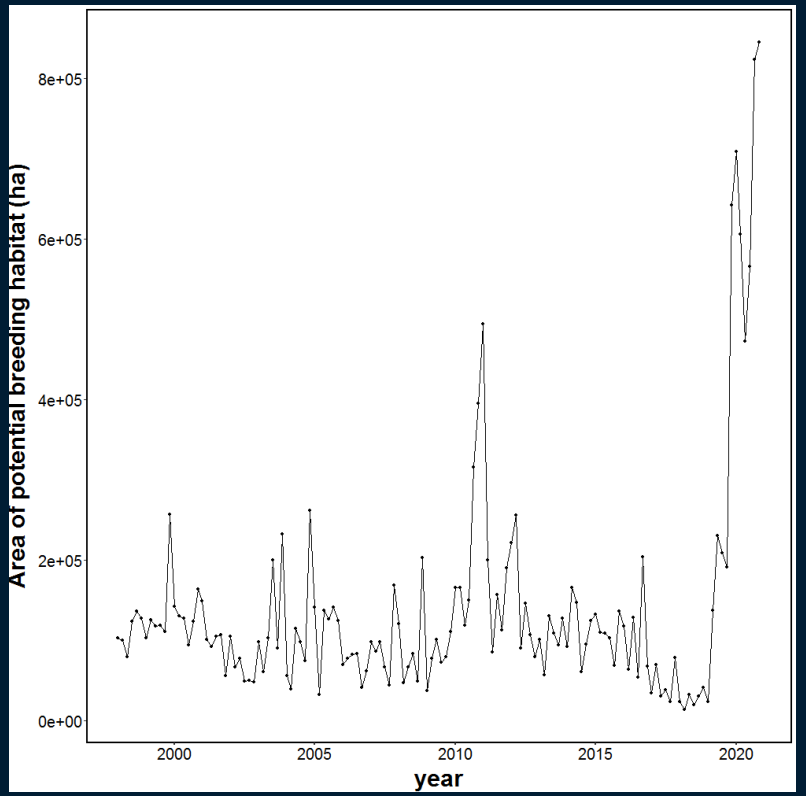
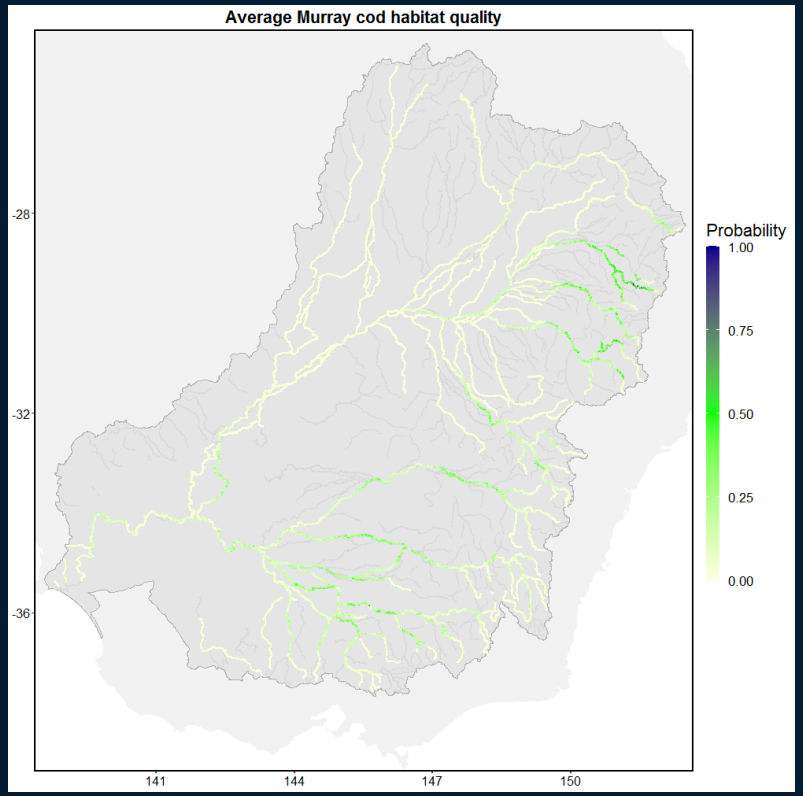
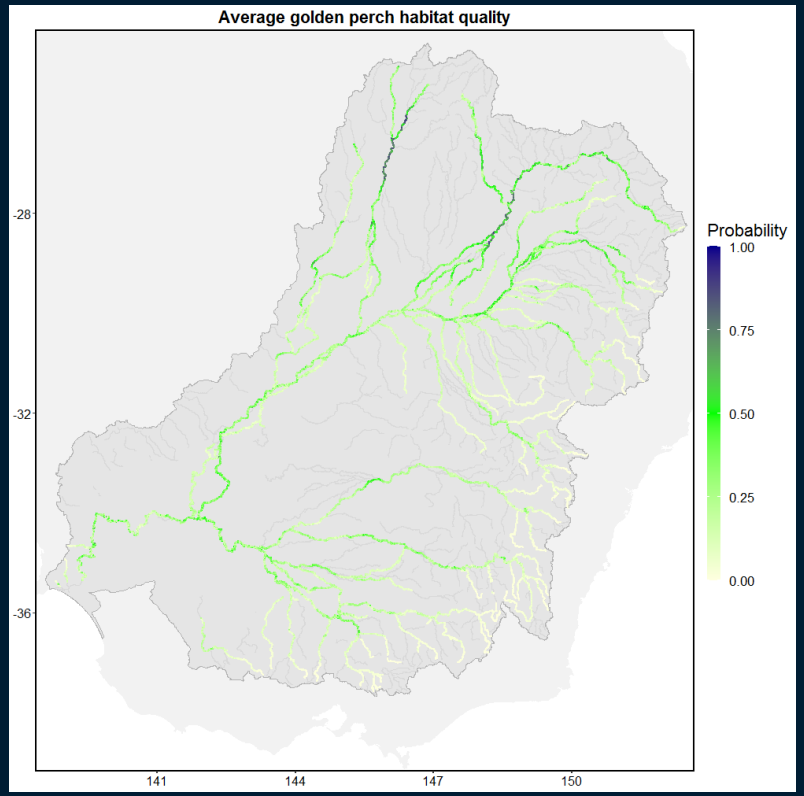



Straw-necked ibis

# Synthesis assessments – fish



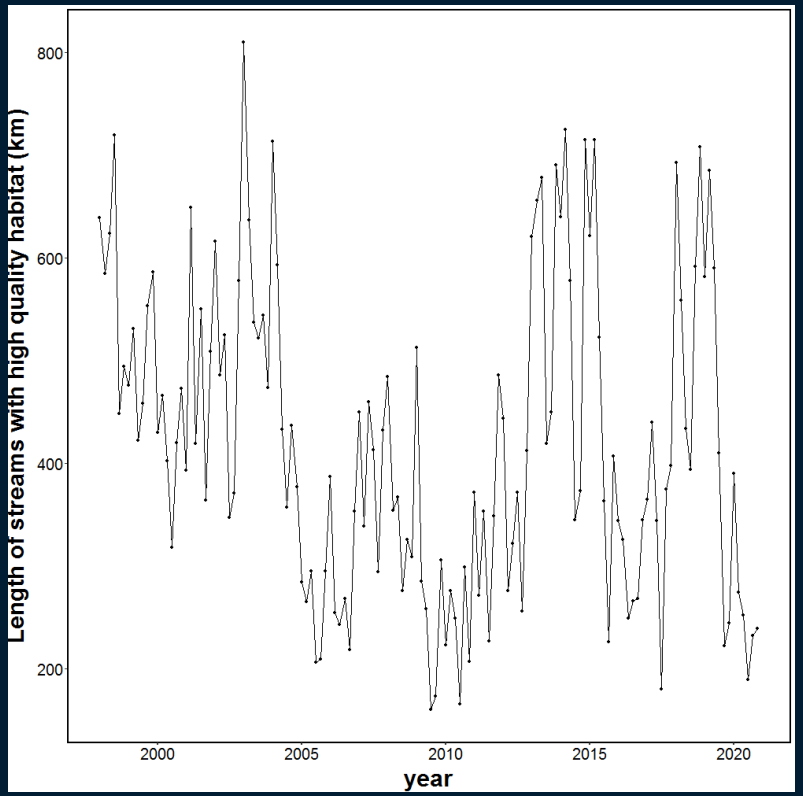

Murray cod



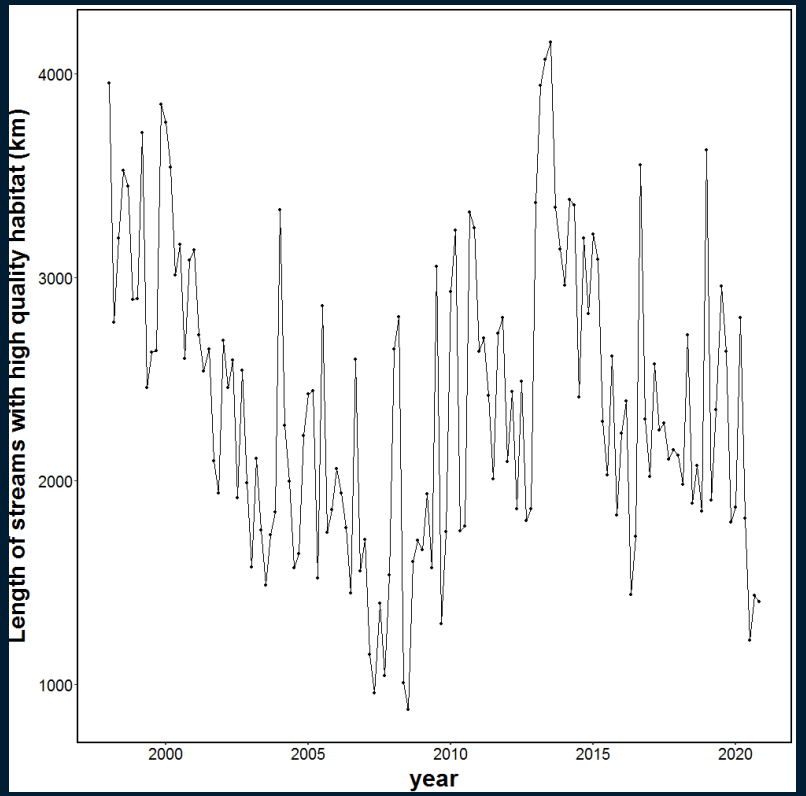

Golden perch

CSIRO

# Synthesis assessments – fish

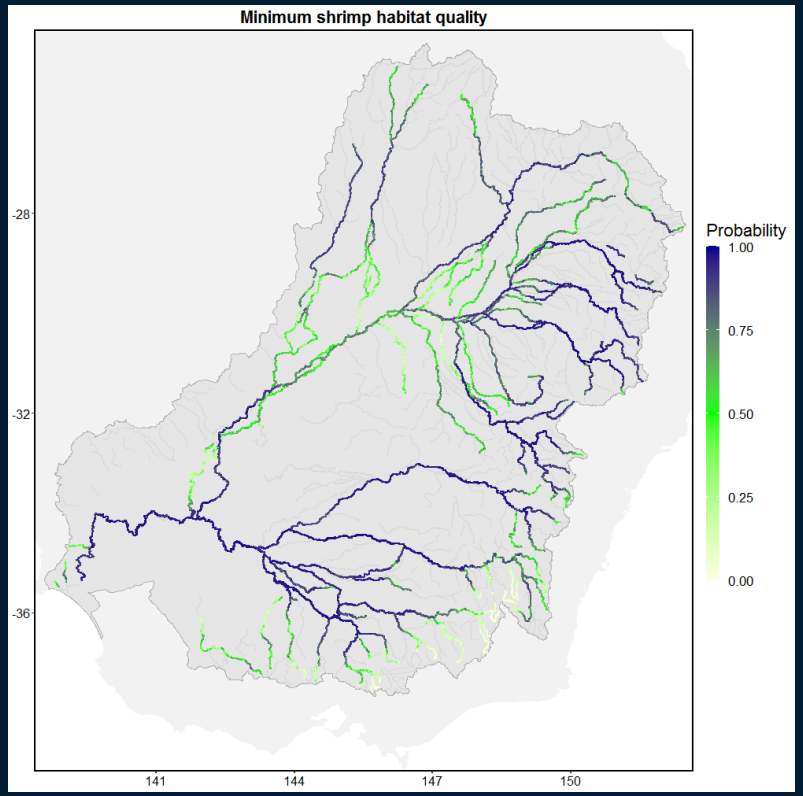


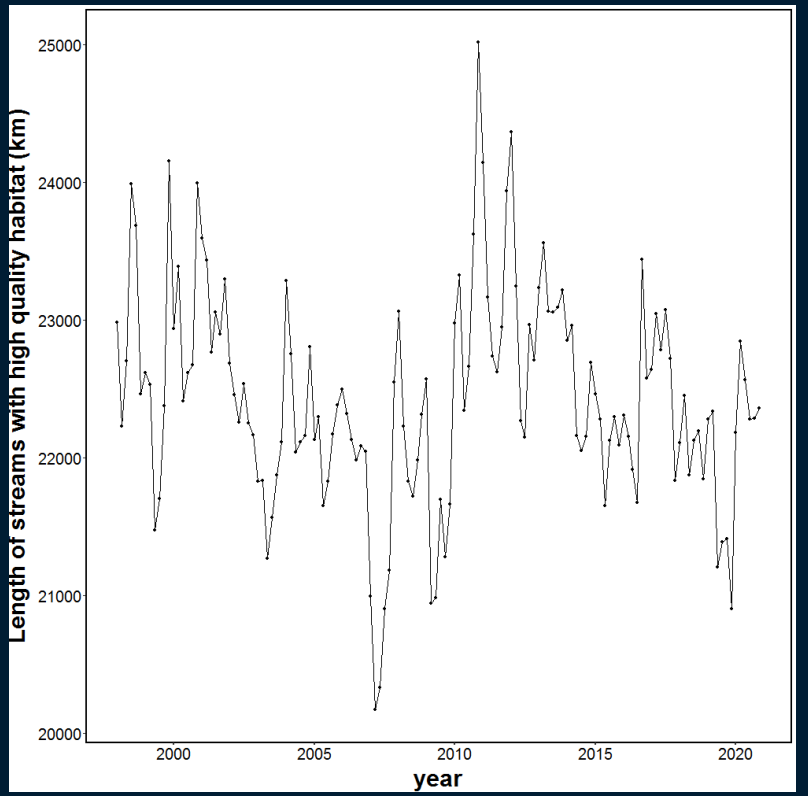

Murray cod




Golden perch

# Synthesis assessments – shrimp



# Key outcomes

- New collated harmonised biological datasets *
- New dynamic predictor layers for future habitat modelling
- New data-driven species habitat response functions *
- New dynamic fine-resolution layers of predicted habitat quality
- Demonstrated synthesis of predicted change in habitat over space & time

# Limitations & further work

- Unpack the model response functions; compare with simpler analyses
- Extend fish & shrimp models to size / abundance (accounting for effort)
- Examine more focal species
- Demonstrate / test use of predicted habitat for focal areas (management)