The Murray-Darling Basin
Environmental Water Knowledge
Research project

Vegetation theme: predicting outcomes in response to flow and other drivers

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EWKR Environmental Water Knowledge & Research
LA TROBE UNIVERSITY
CSIRO
Australian Government
Commonwealth Environmental Water Office

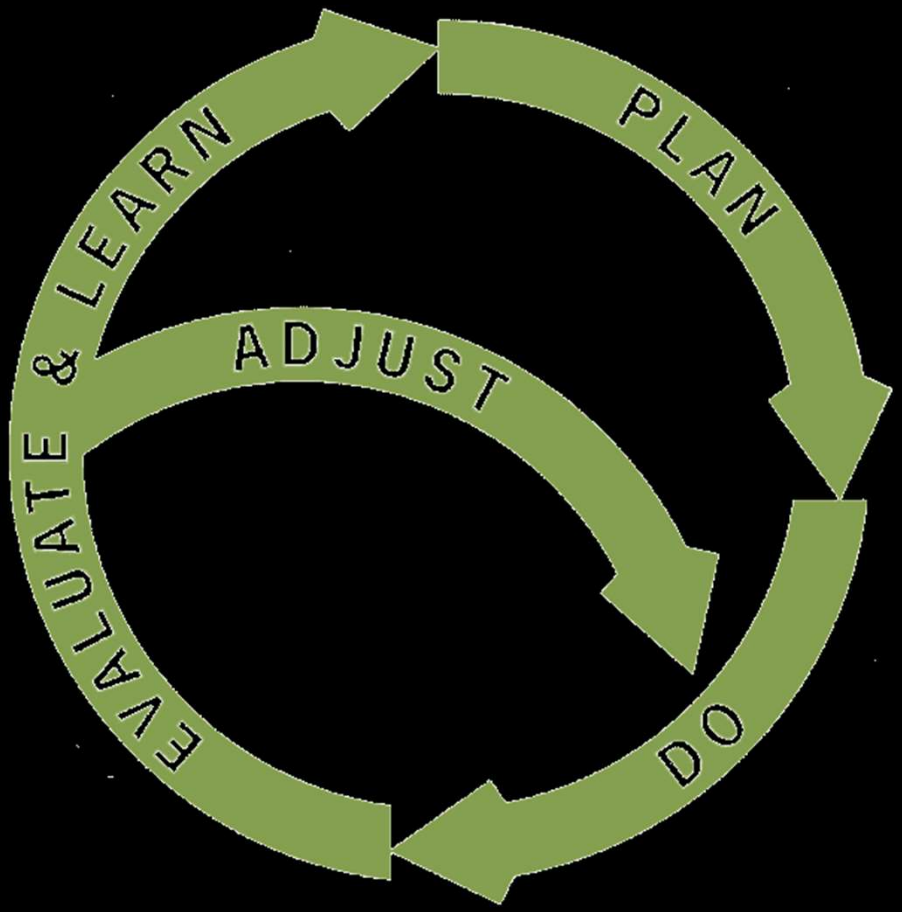
Leadership group

- ARI (DELWP)
- ARI (GU)
- CSIRO
- MDFRC / LTU
- NSW OEH/ UNSW
- SARDI
- TropWater (JCU)

Overarching question

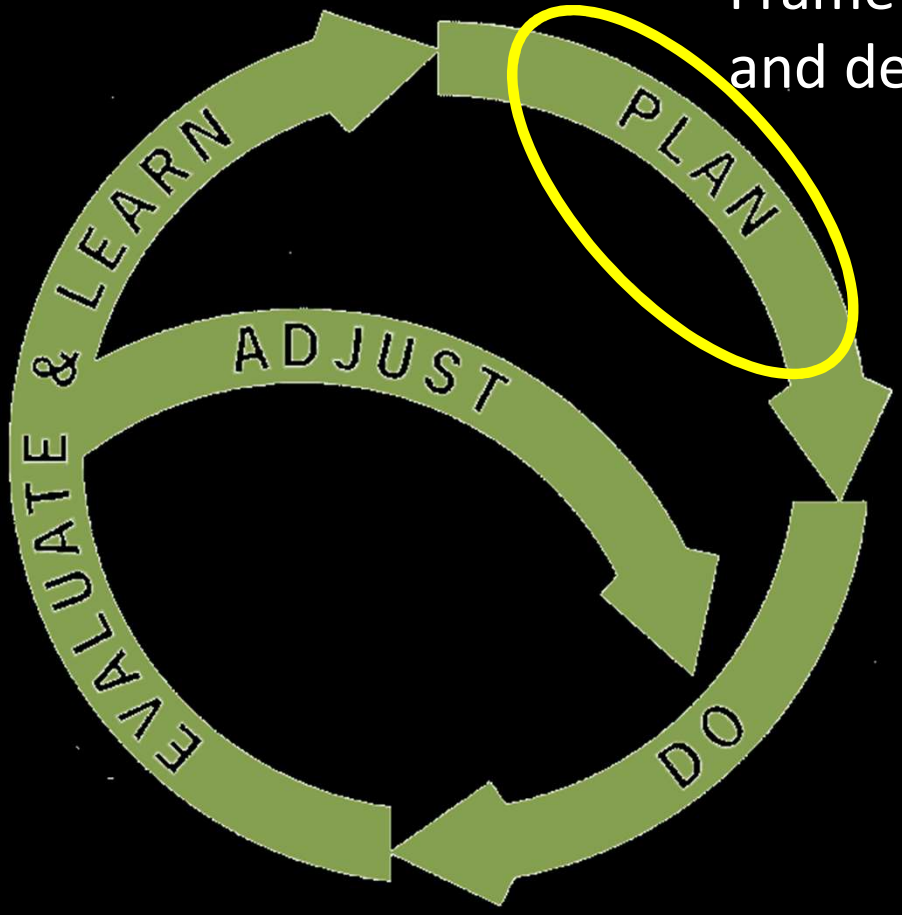
- *What are the drivers of sustainable populations and diverse communities of water-dependent vegetation?*
- Scope
  - Non-woody vegetation
  - Woody recruitment
  - 4 EWKR sites

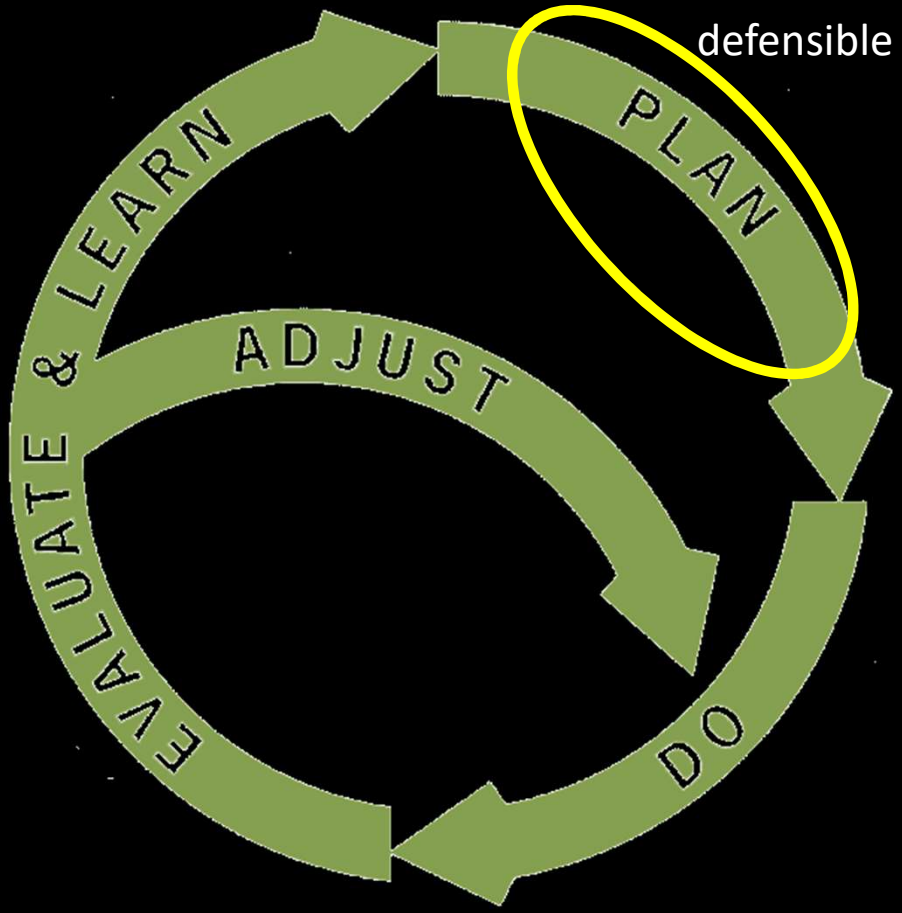
Adaptive environmental water management



How do our EWKR research questions relate to the adaptive management cycle?

Framework to develop robust and defensible objectives





Framework to develop robust and defensible objectives

How to identify SMART indicators

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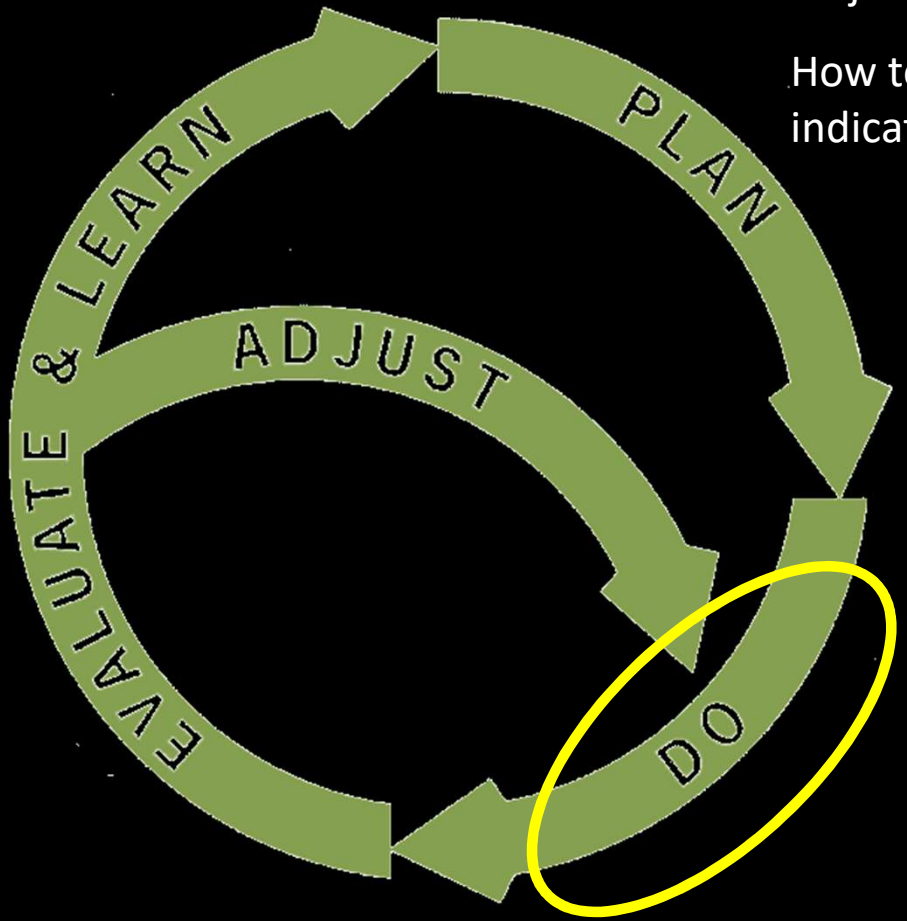
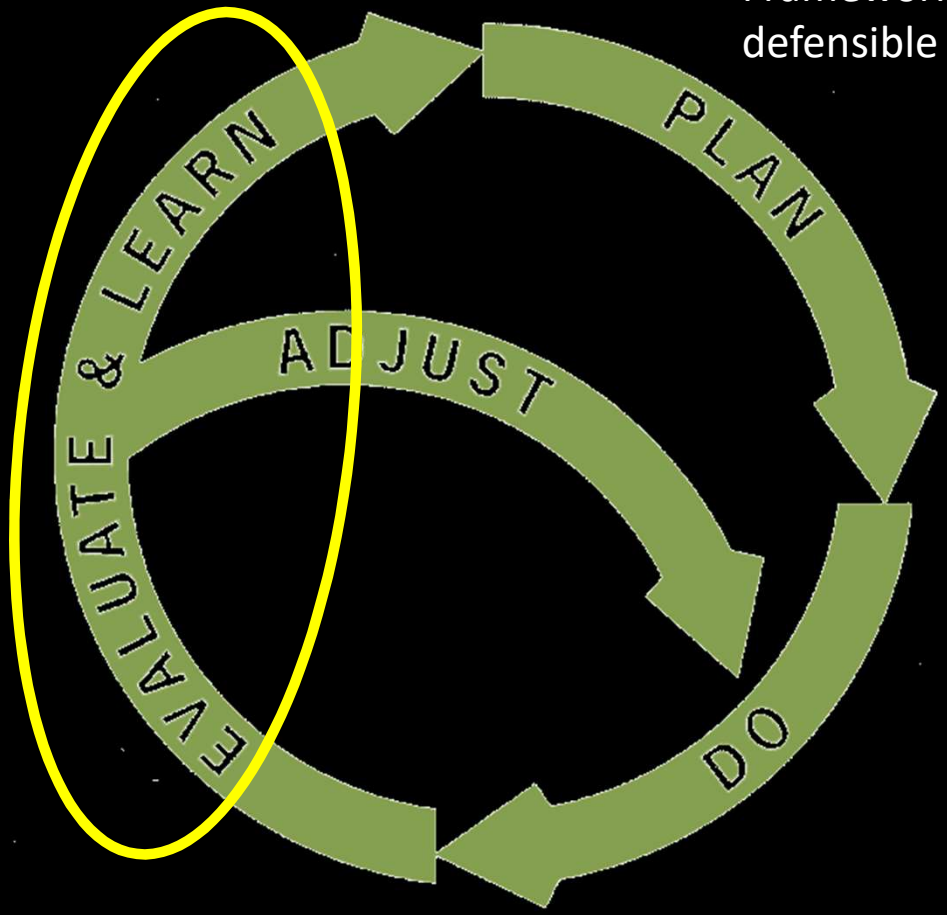
How to identify SMART indicators



What drives vegetation responses to watering actions?

- Flow regime (pulse, short to long-term)
- Climate
- Vegetation structure
- Soil seed banks

How can we learn more from existing data?



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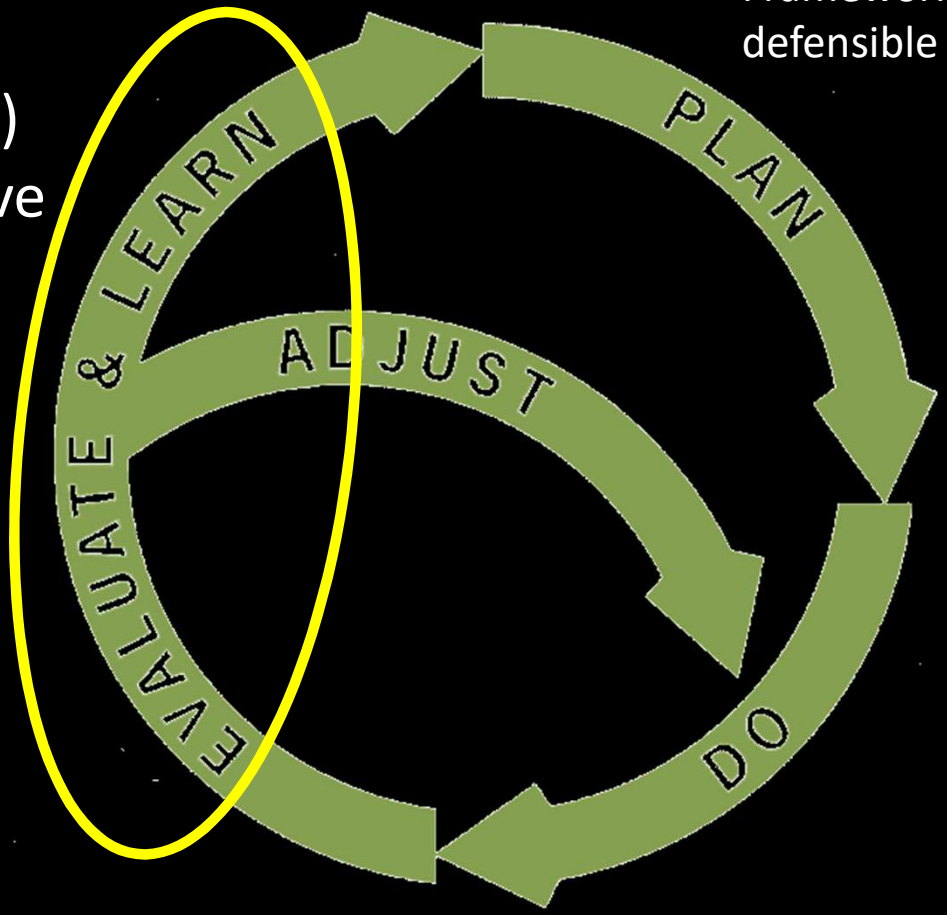

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EWKR vegetation theme research questions

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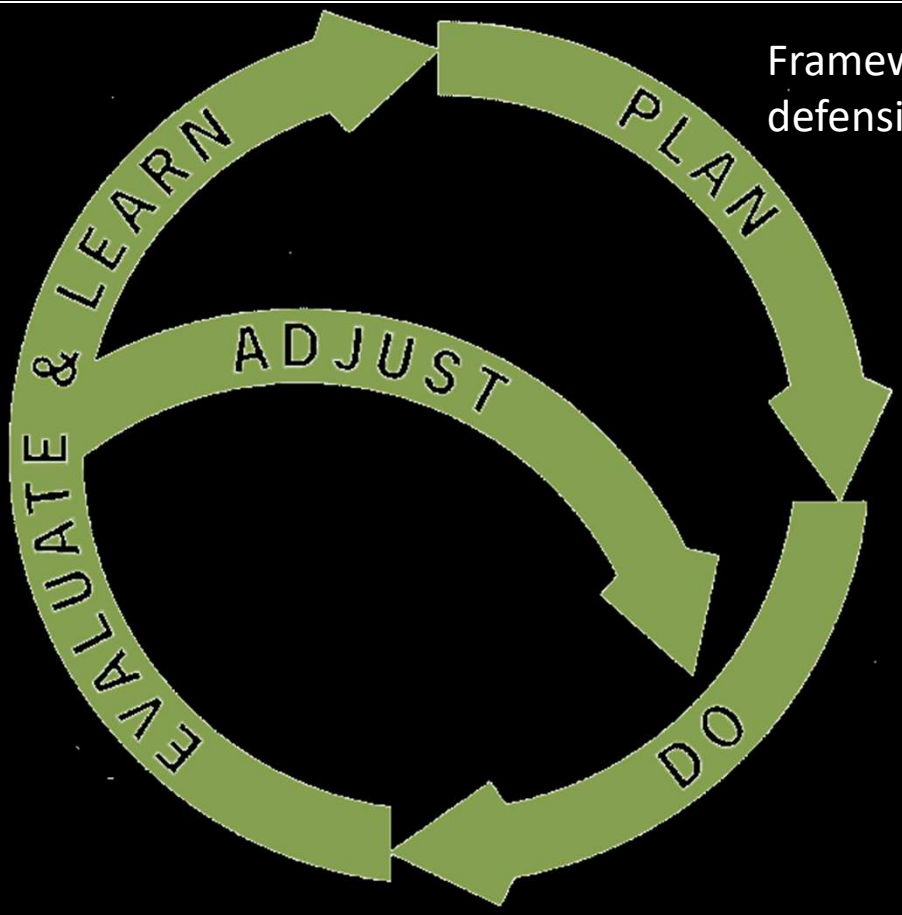

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Research components

Water dependent vegetation?





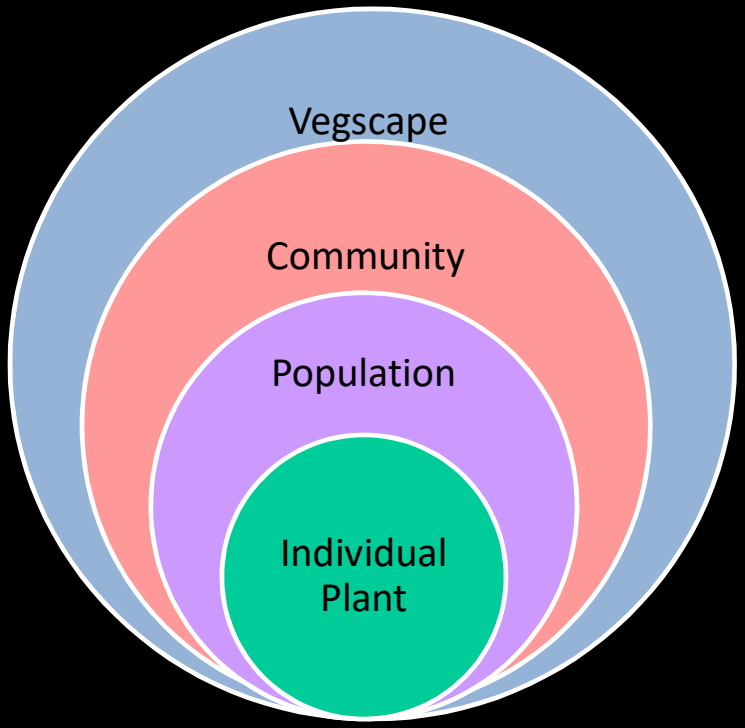

Plan: what are we watering for and why?

- The ‘what and the why’
- What does vegetation response mean?




Plan

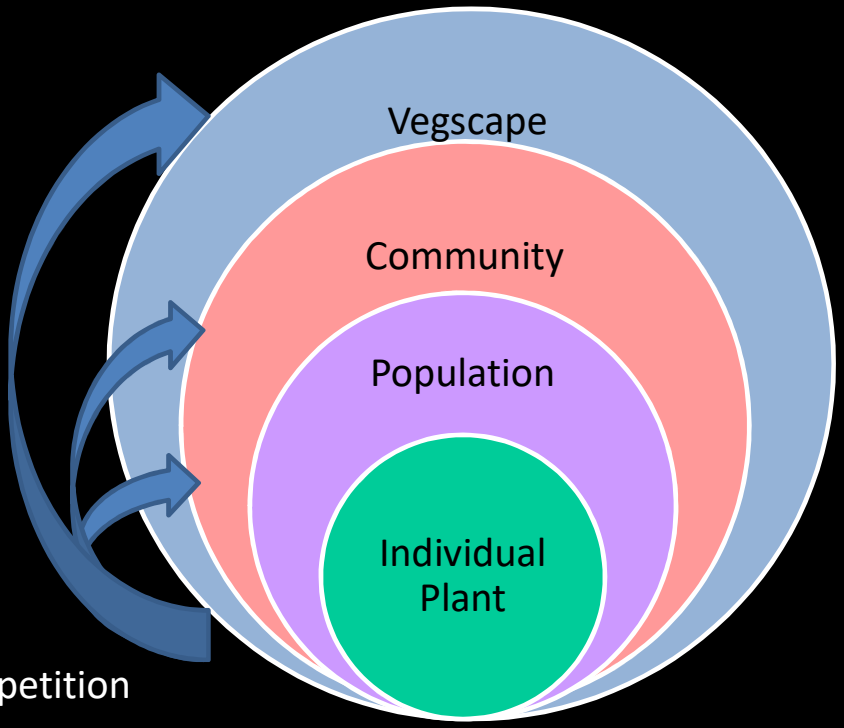
- Function and structure
- Lignum
  - Extent, presence/absence vs structure



Level of Ecological Organisation

Traits

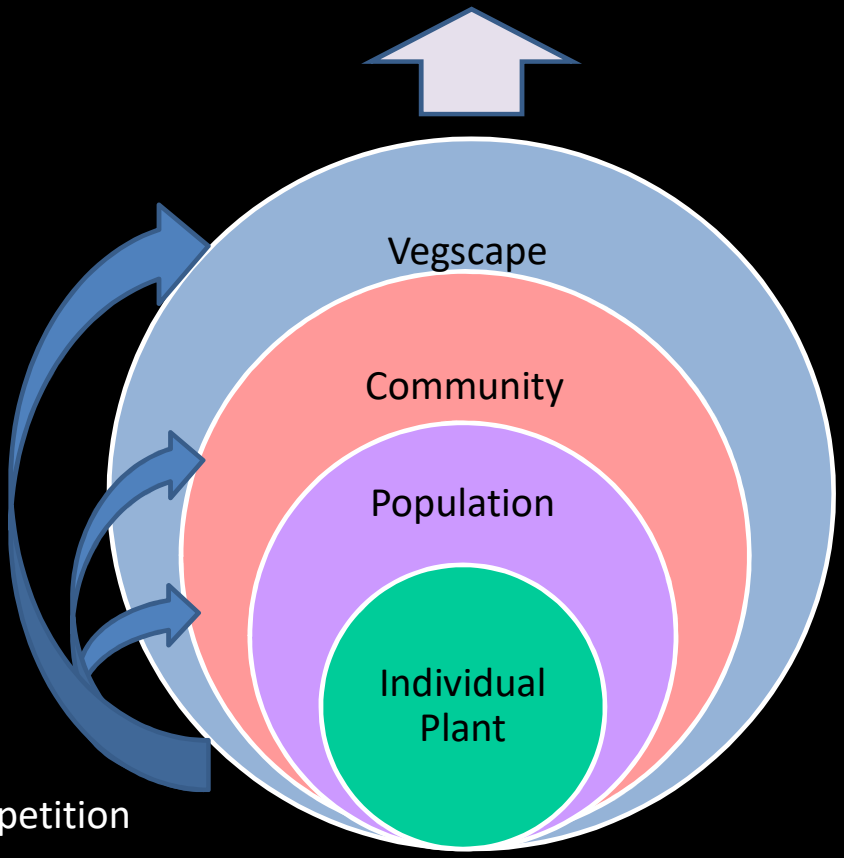
- Composition
  - species richness
  - diversity
- Structure
  - distribution
  - density
  - strata
- Processes
  - seed survival
  - Interspecific competition
  - Terrestrialisation



Level of Ecological Organisation

Functions and values

Habitat – regulating – production - information



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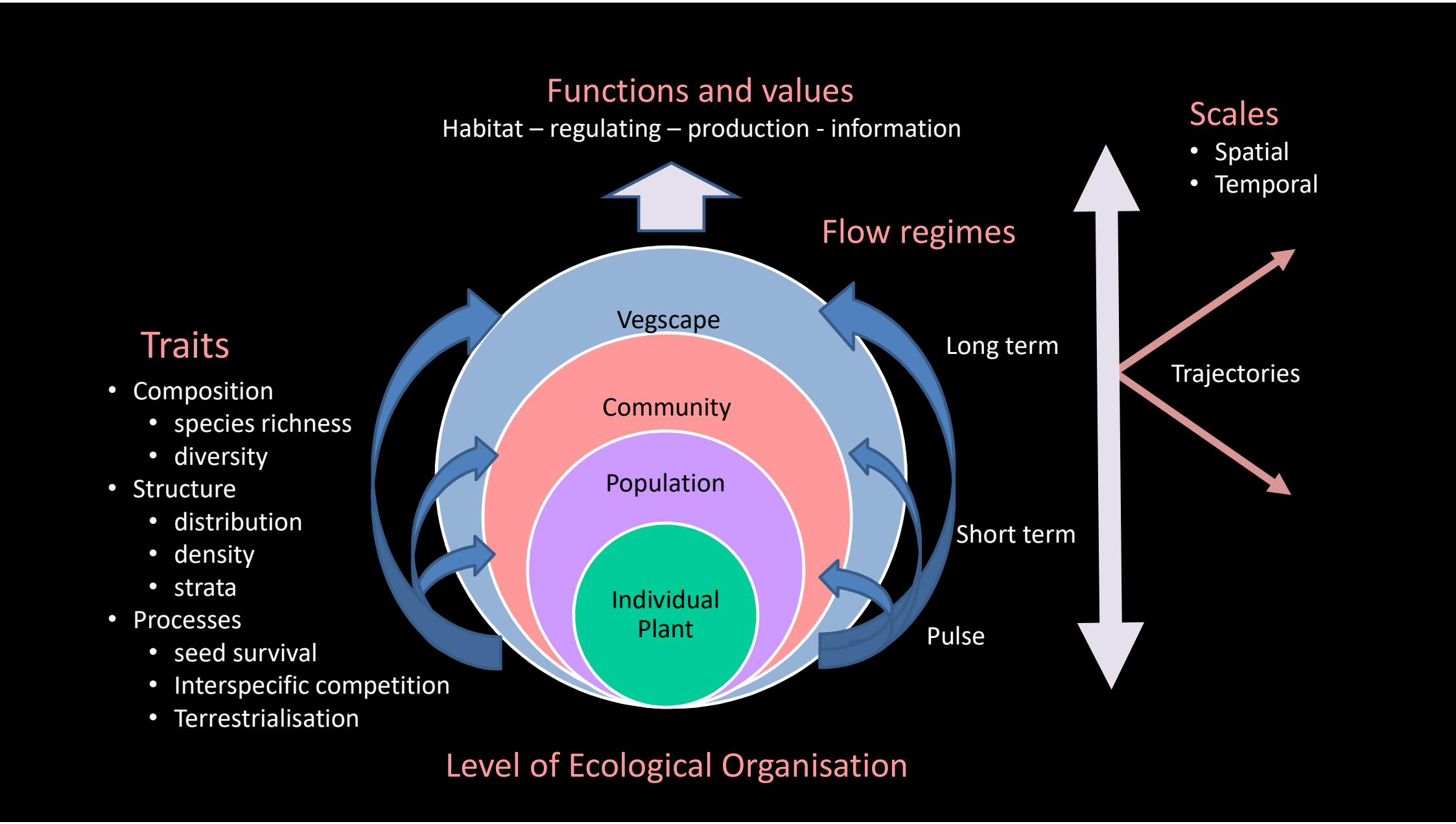
Functions and values
Habitat – regulating – production - information
Scales
• Spatial
• Temporal
Flow regimes
Traits
• Composition
• species richness
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• Structure
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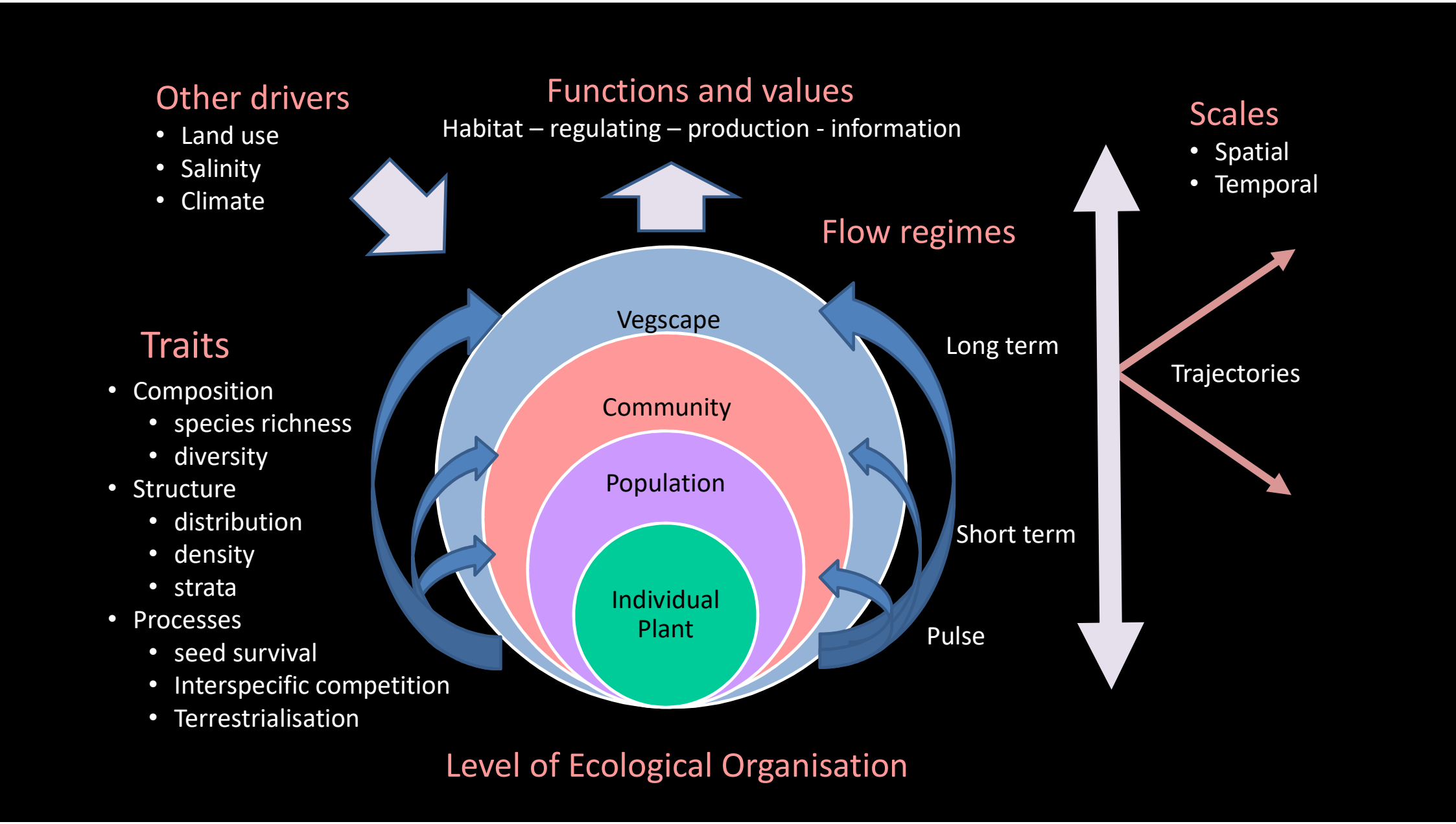
• Processes
• seed survival
• Interspecific competition
• Terrestrialisation
Vegscape
Community
Population
Individual Plant
Long term
Short term
Pulse
Trajectories
Level of Ecological Organisation


Other drivers
• Land use
• Salinity
• Climate
Functions and values
Habitat – regulating – production - information
Scales
• Spatial
• Temporal
Flow regimes
Traits
• Composition
• species richness
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Framework to develop robust and defensible objectives

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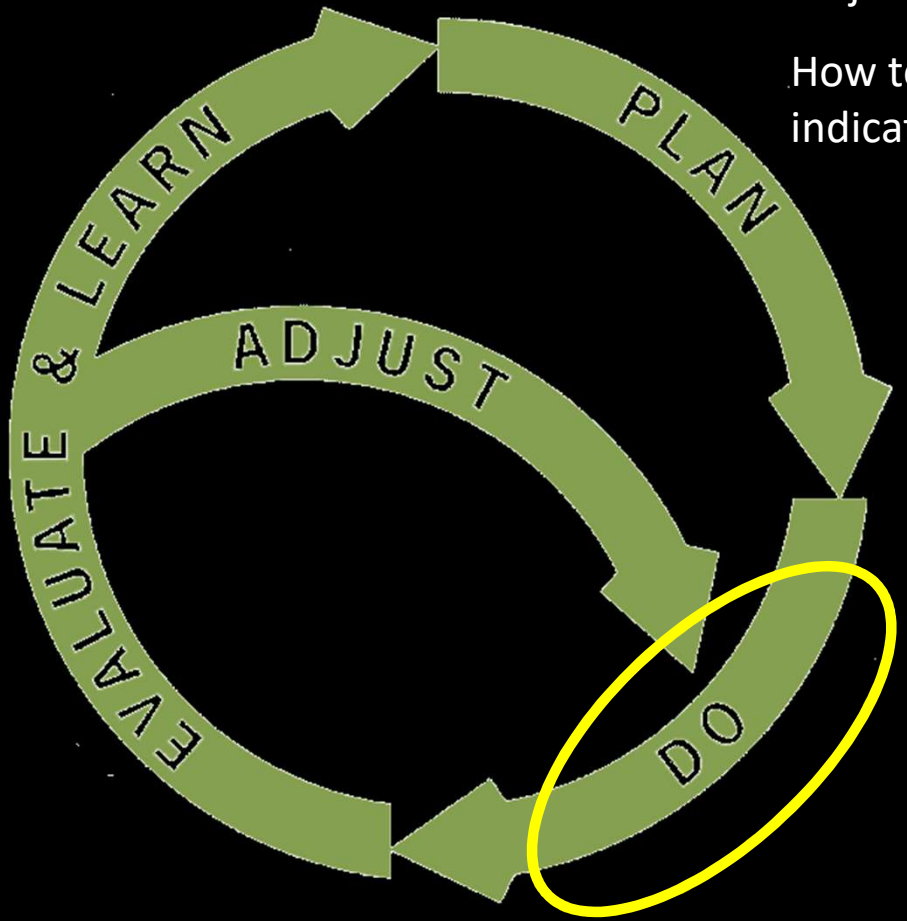

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- Climate
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Do

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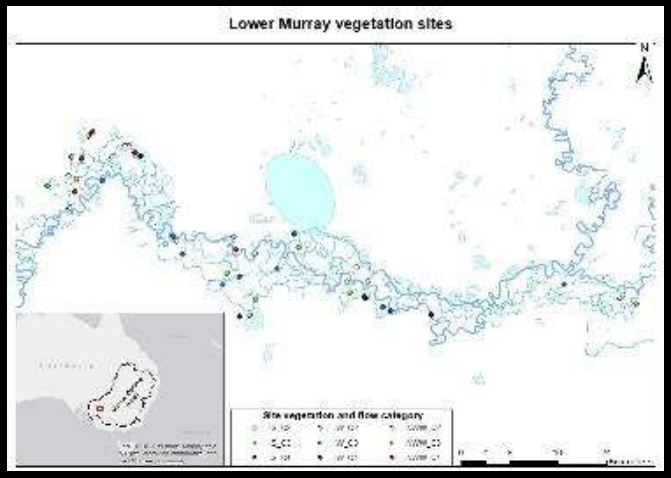


Do: woody seedling responses

- Vulnerable stage, key to distribution and population sustainability
- Woody seedlings are sparse, patchy and variable in space and time
  - Not a clear relationship with flood history
  - Existing canopy may limit recruitment
  - No resident soil seed bank
- Influence of flood pulse

Do: woody seedling responses

- Seedling establishment in response to 5 watering treatments (dry, wet, alternating)
- Three species
  - River Red Gum
  - Black Box
  - Coolibah

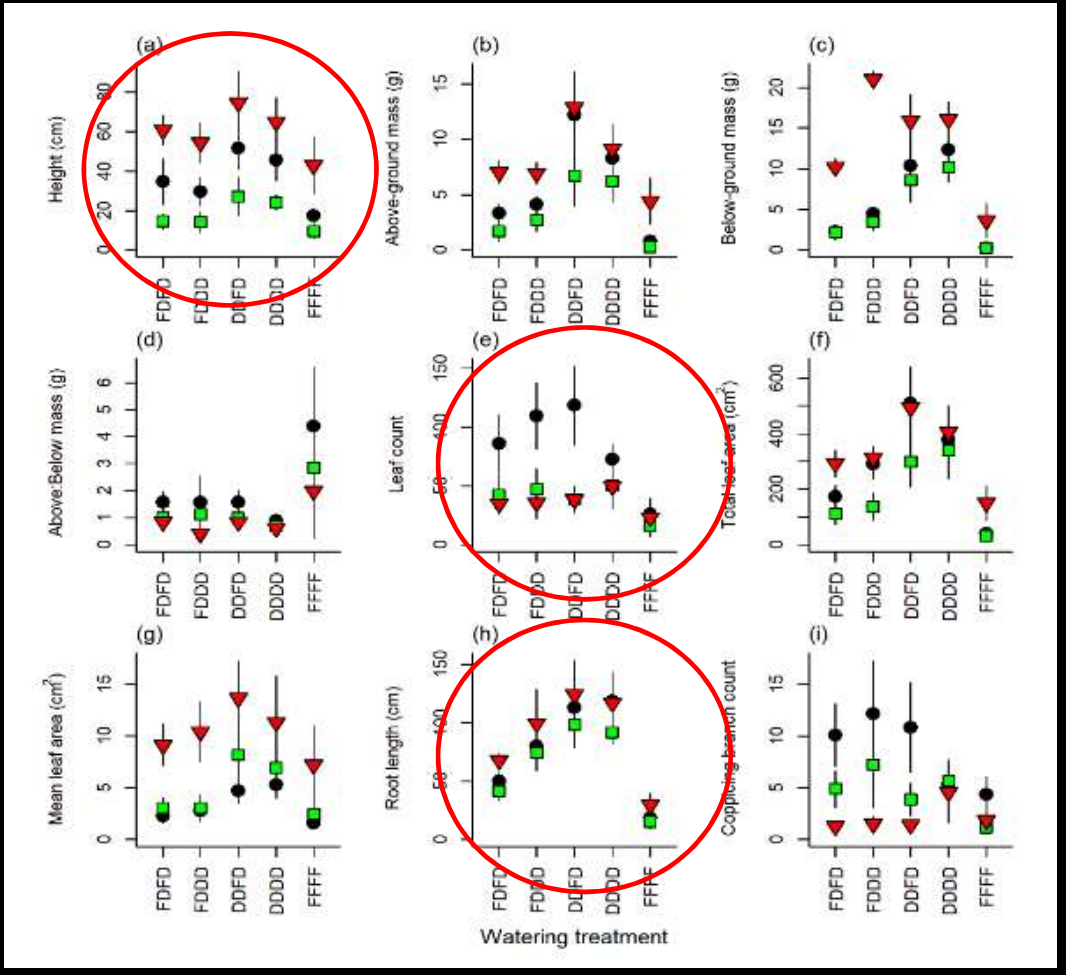
Do: Seedling mesocosm results

- Measured individual traits
  - Height, root length, biomass

River Red Gum

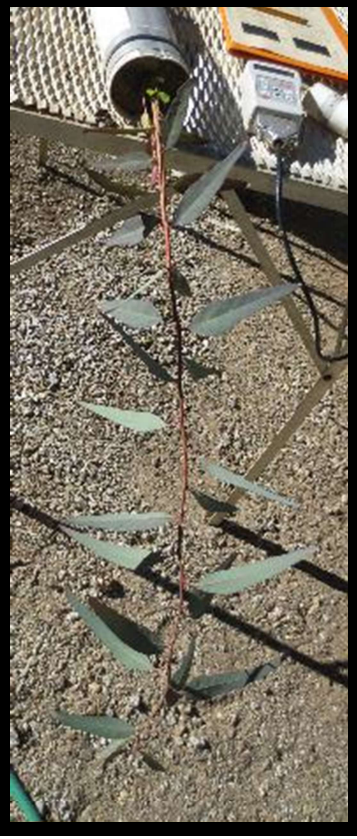
Black Box

Coolibah



Do: Seedling mesocosm results

- Strategies reflect distribution and likely inundation regime
- Different strategies for the 3 species



Do: Seedling mesocosm results

- Constant flooding suppresses growth
  - But very flood tolerant
  - For control need to flood very early in their life (~3 months)

Do: Seedling mesocosm results

- Importance of inter-flood dry period
  - Provide a dry period following germination to enable root development and growth

Do: Seedling mesocosm results

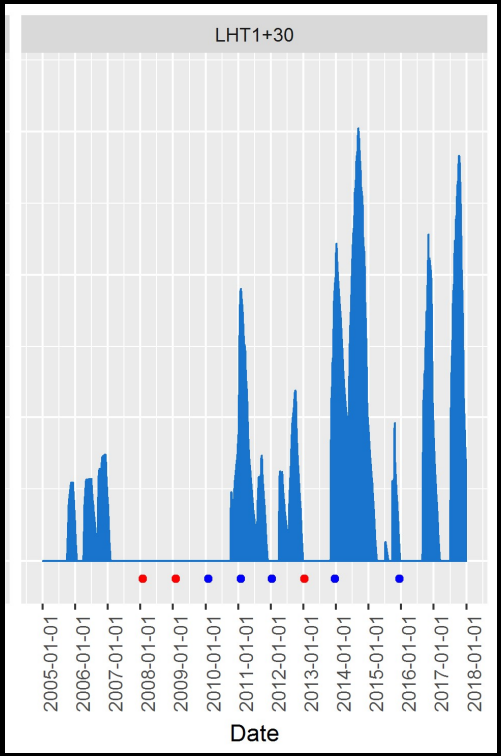
- Coolibah and Black Box more sensitive to the timing of floods
  - Did better under a later flood
  - Allow a dry period of 6 months or so before top up flooding

Do: non-woody vegetation response

- What drives non-woody vegetation responses to watering actions?
  - Watering history (flow pulse, short to long-term,)
  - Climate
  - Vegetation structure
  - Soil seed banks
- We did this through multi-lines of evidence
  - Big Data synthesis and analysis
  - Field surveys and germination trials

Do: non-woody vegetation response

- Can we use existing long-term data to determine the influence of flow and climate history on vegetation responses?



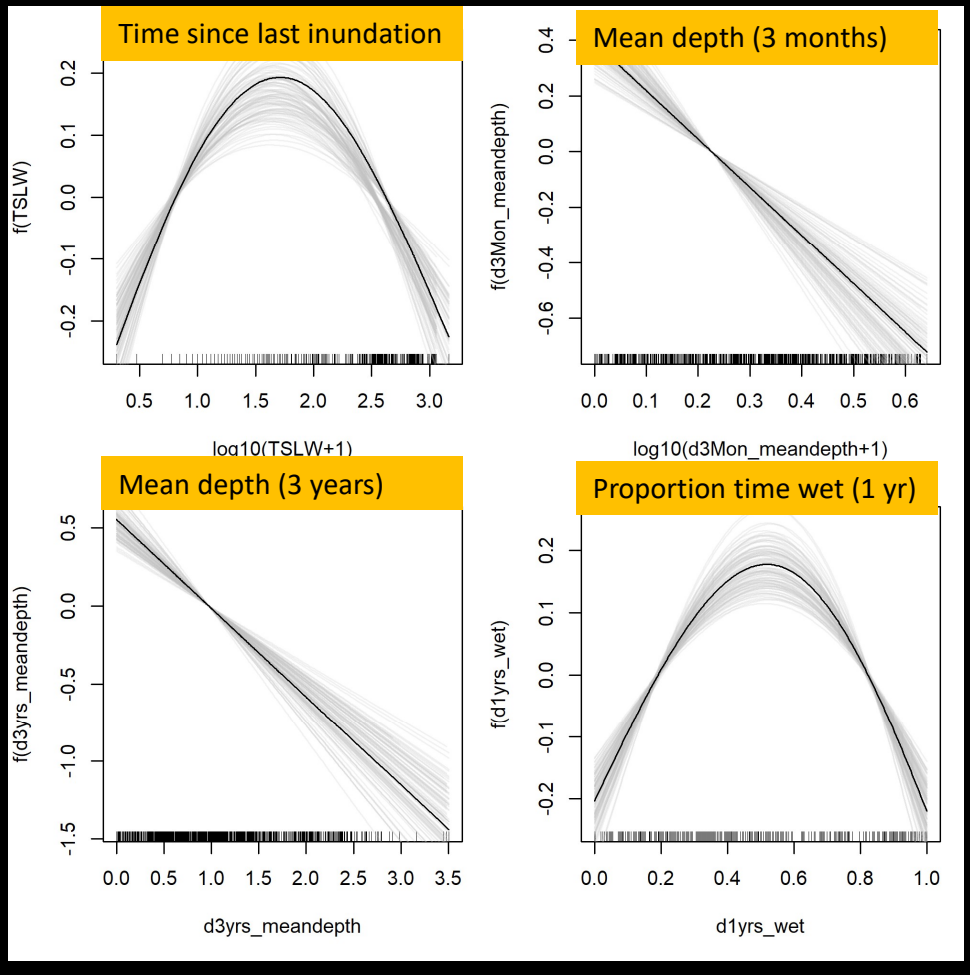
Hattah Lakes TLM data 2008-16

Do: non-woody vegetation response

Wetland plants

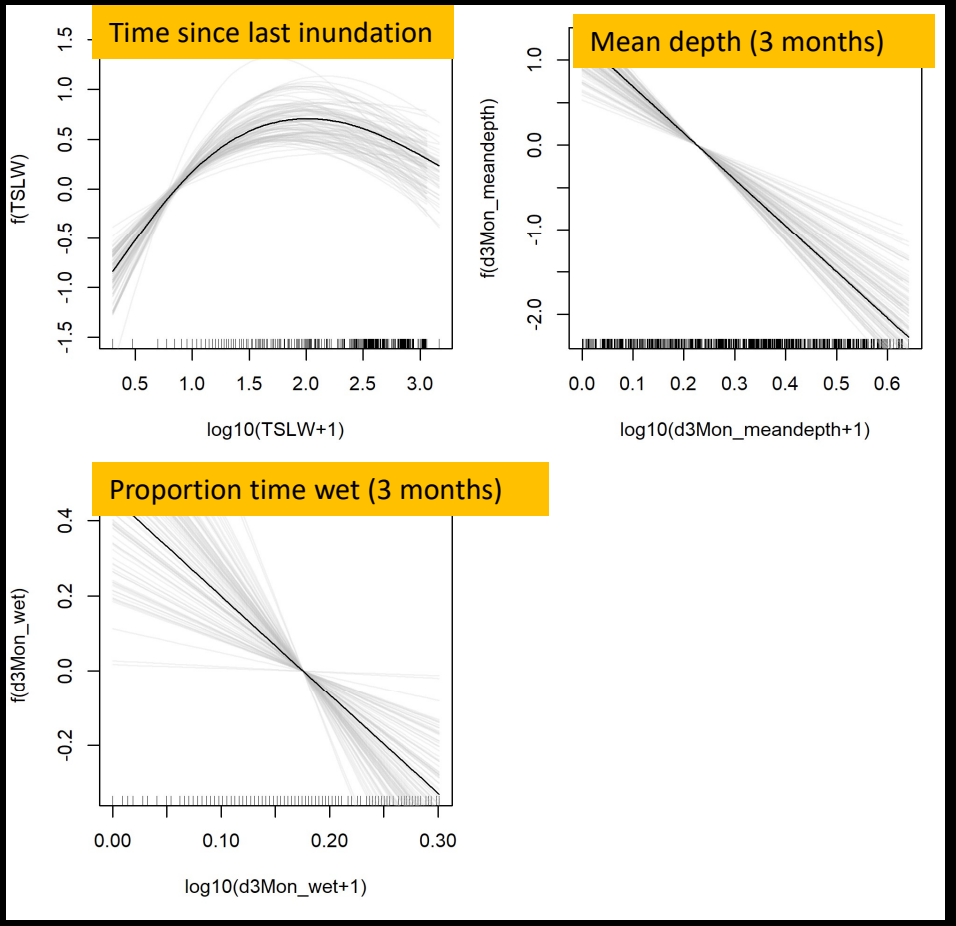
- Water depth
- Time-since-last inundation
- Proportion time wet

- Recent (3 months) and short-term regimes (3 years) most important



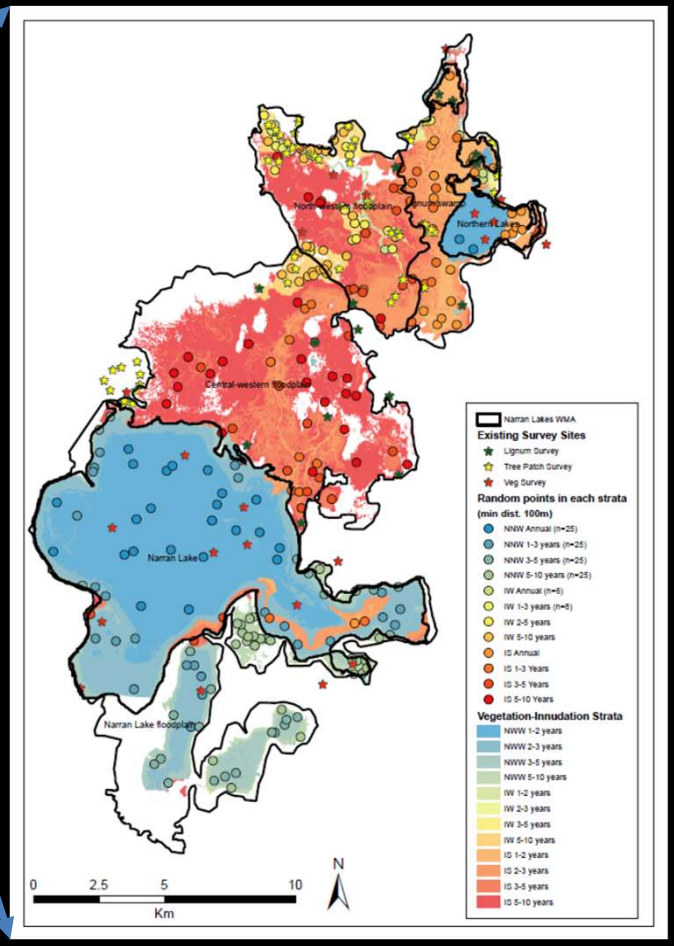
Do: non-woody vegetation response

- Terrestrial plants
  - Strong negative influence of recent inundation
  - Non-linear relationship with time-since-last inundation
- Recent regime (3 months) most important



Do: non-woody vegetation response

- 4 wetland systems
  - 180 sites
  - Autumn 2017, 2018
- 4 flood frequencies
  - Near annual (Cat 1)
  - 1.5-3 years (Cat 2)
  - 3-5 years (Cat 3)
  - 5-10 years (Cat 4)
- 3 vegetation structural types
  - Non-woody wetlands (NWW)
  - Inland shrublands (IS)
  - Inland woodlands (IW)



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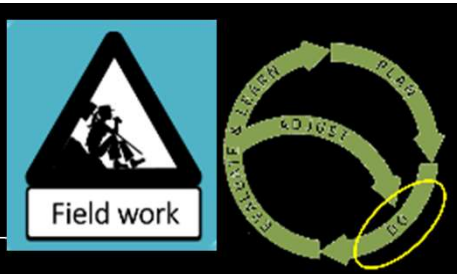
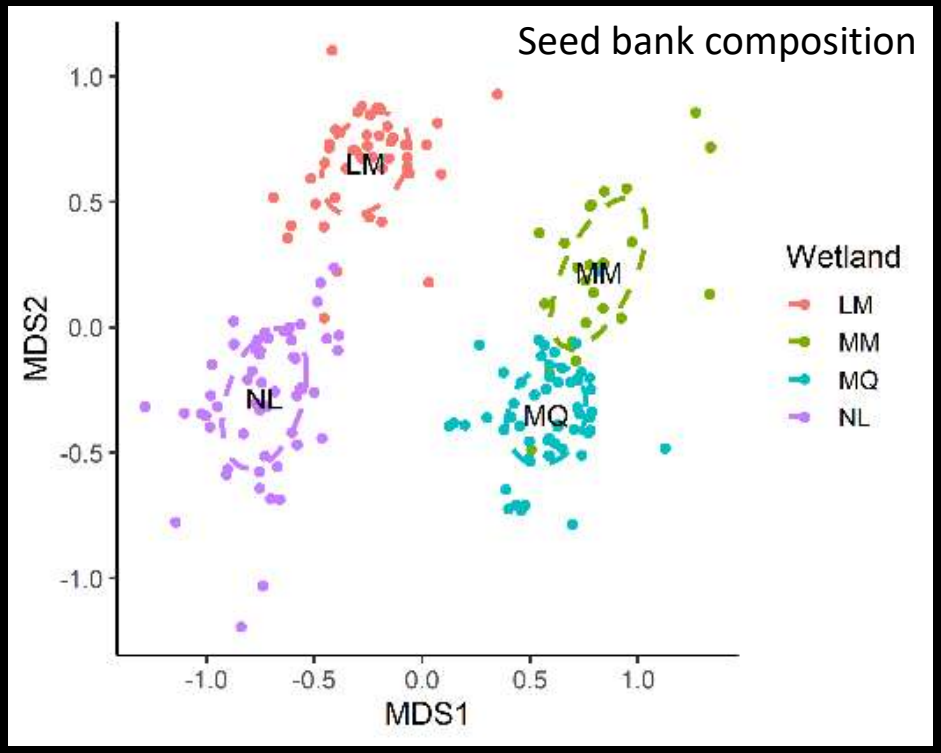


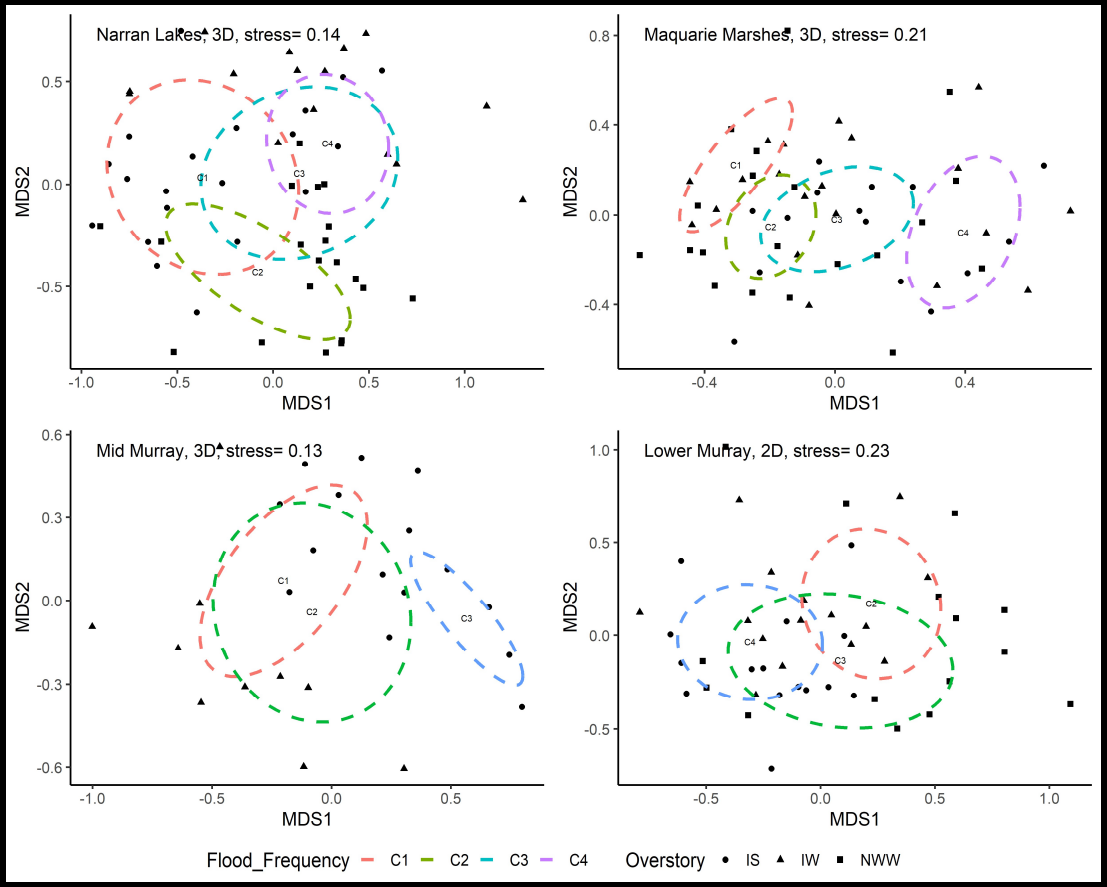
- Outcomes
  - Overwhelming influence of location



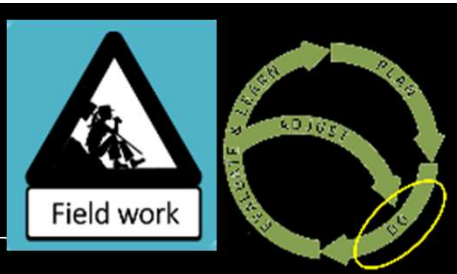
Do: non-woody vegetation response

- Outcomes
  - Within locations there are different influences

Location	Recent conditions	Flood Frequency	Vegetation structure
Macquarie Marshes	Complete flooding	Strong	Weak
Narran Lakes	No recent flooding	Weak	Strong
Mid Murray	Partial flooding	Moderate	Strong
Lower Murray	Partial flooding	Weak	Weak



Do: non-woody vegetation response



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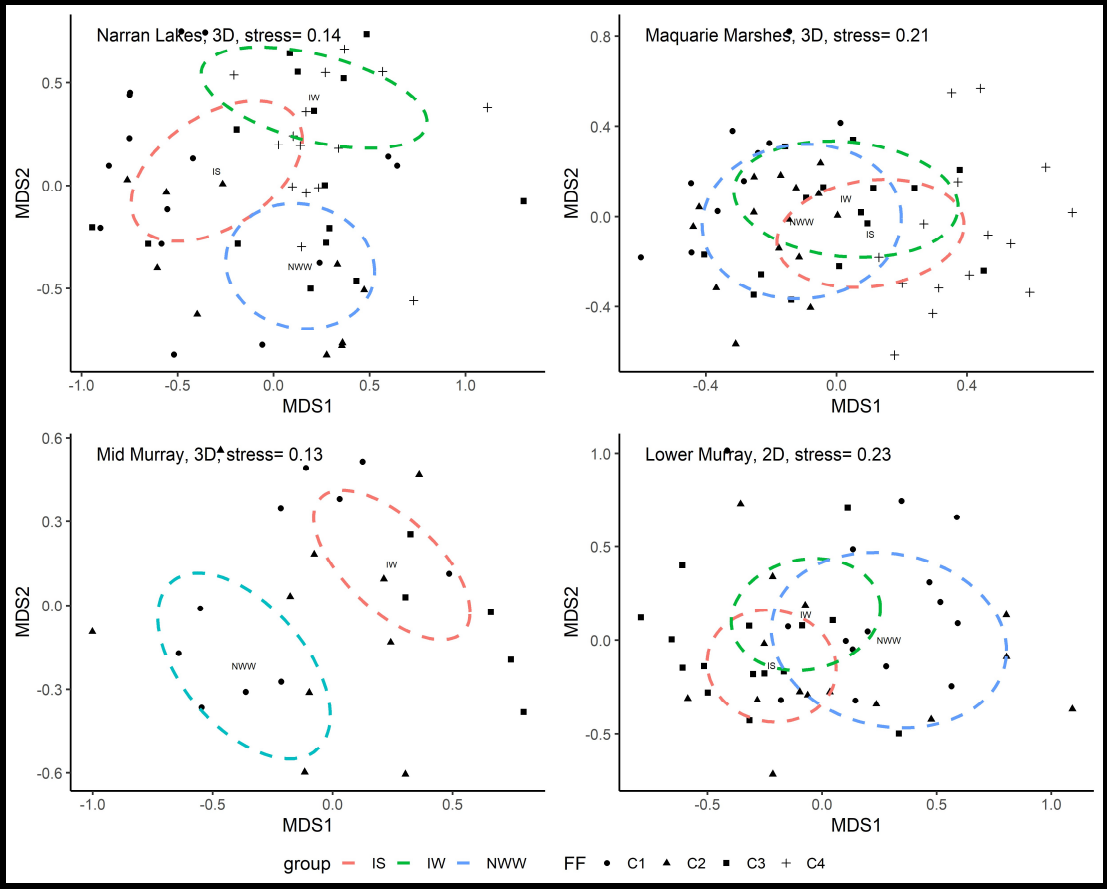
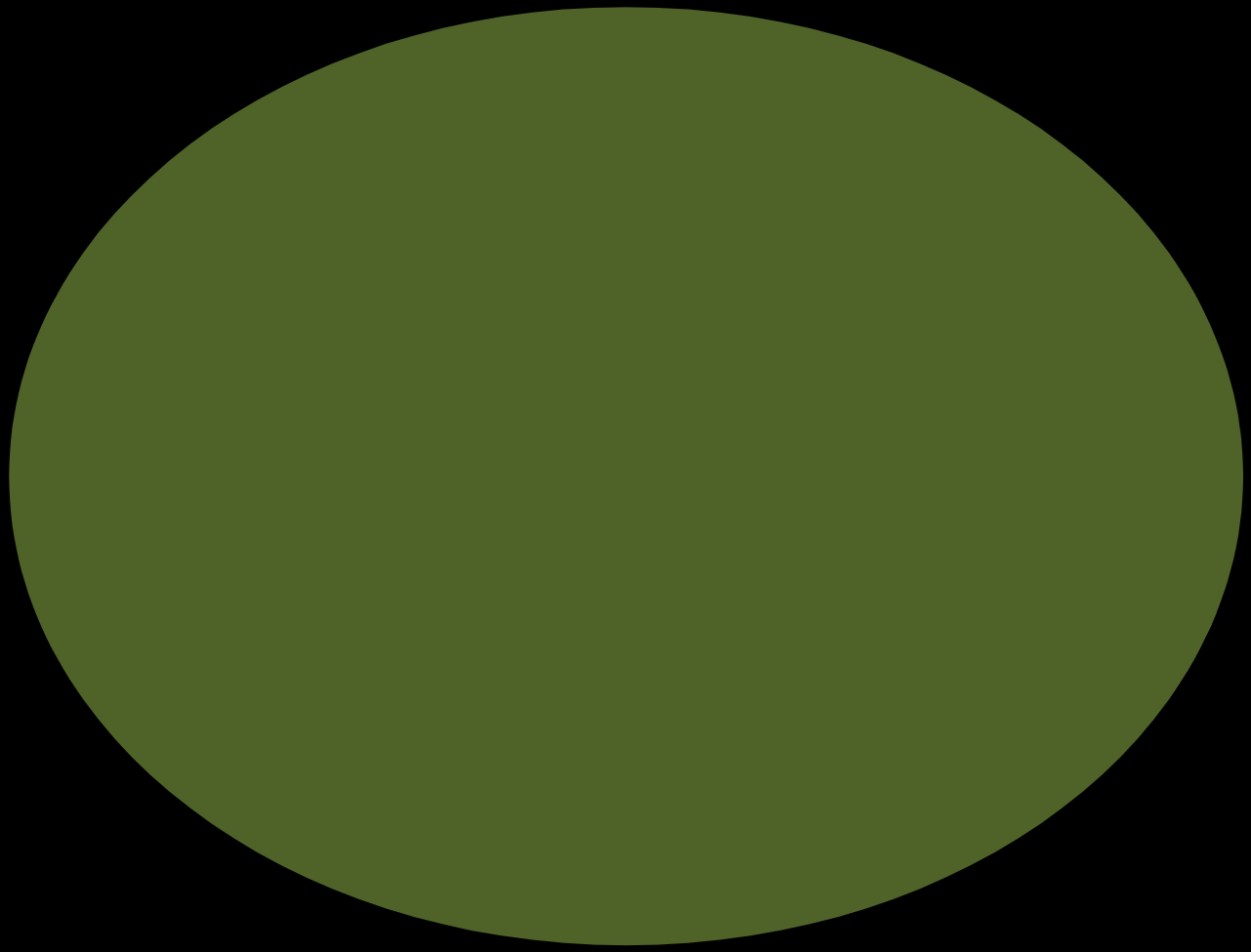


Do: non-woody vegetation response

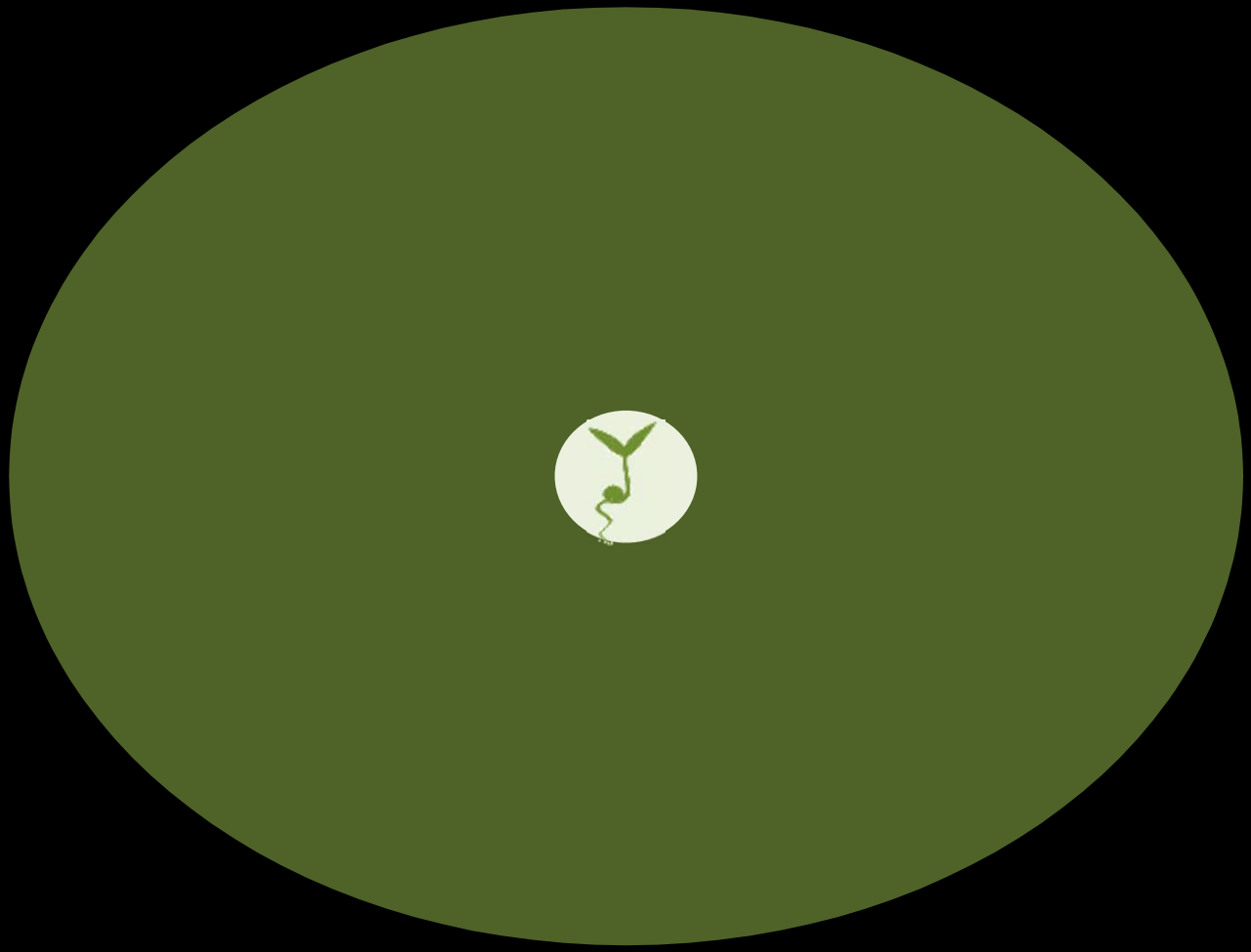
Basin



Do: non-woody vegetation response

Basin

Local

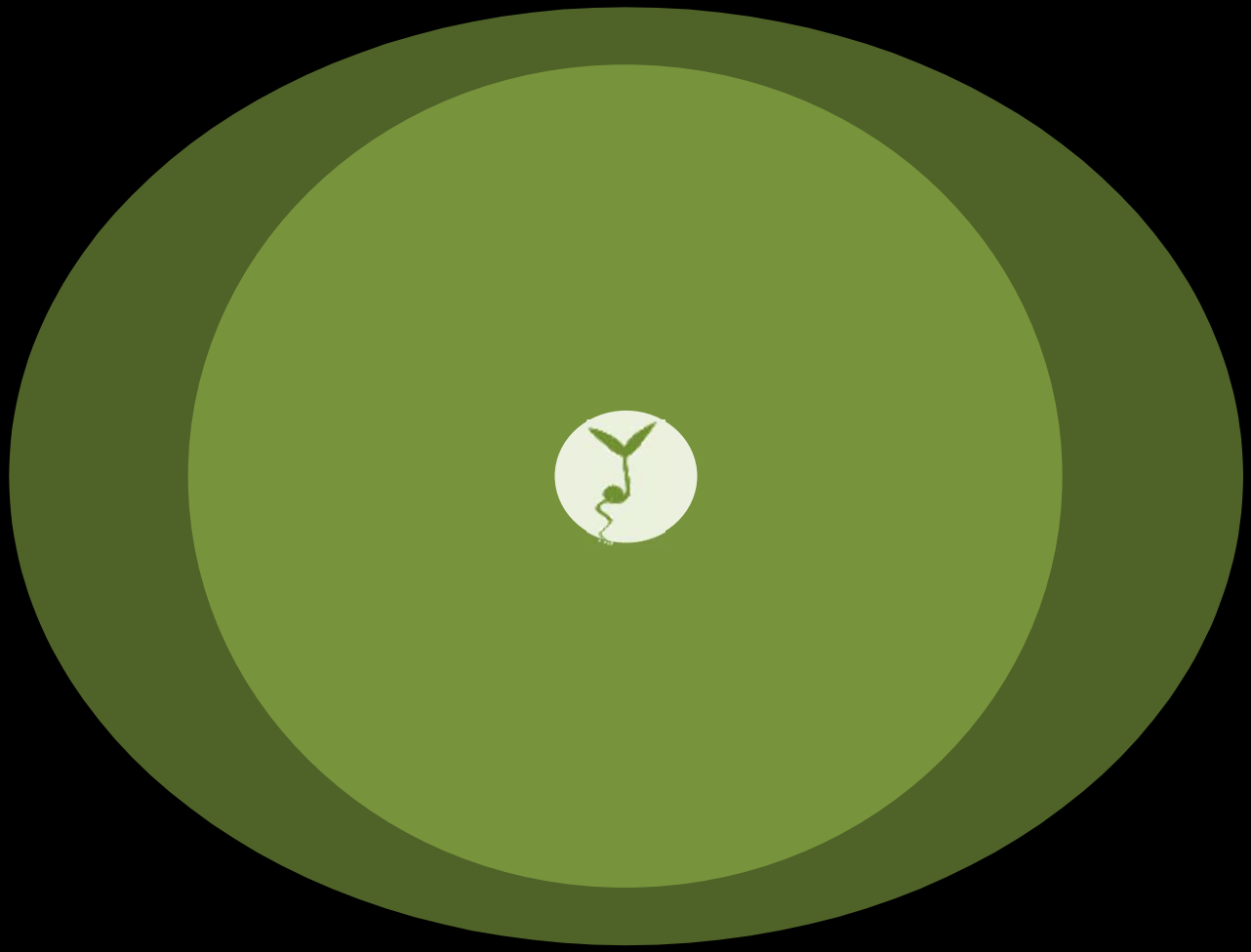


Do: non-woody vegetation response

Basin

Local

Location



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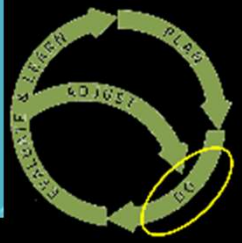
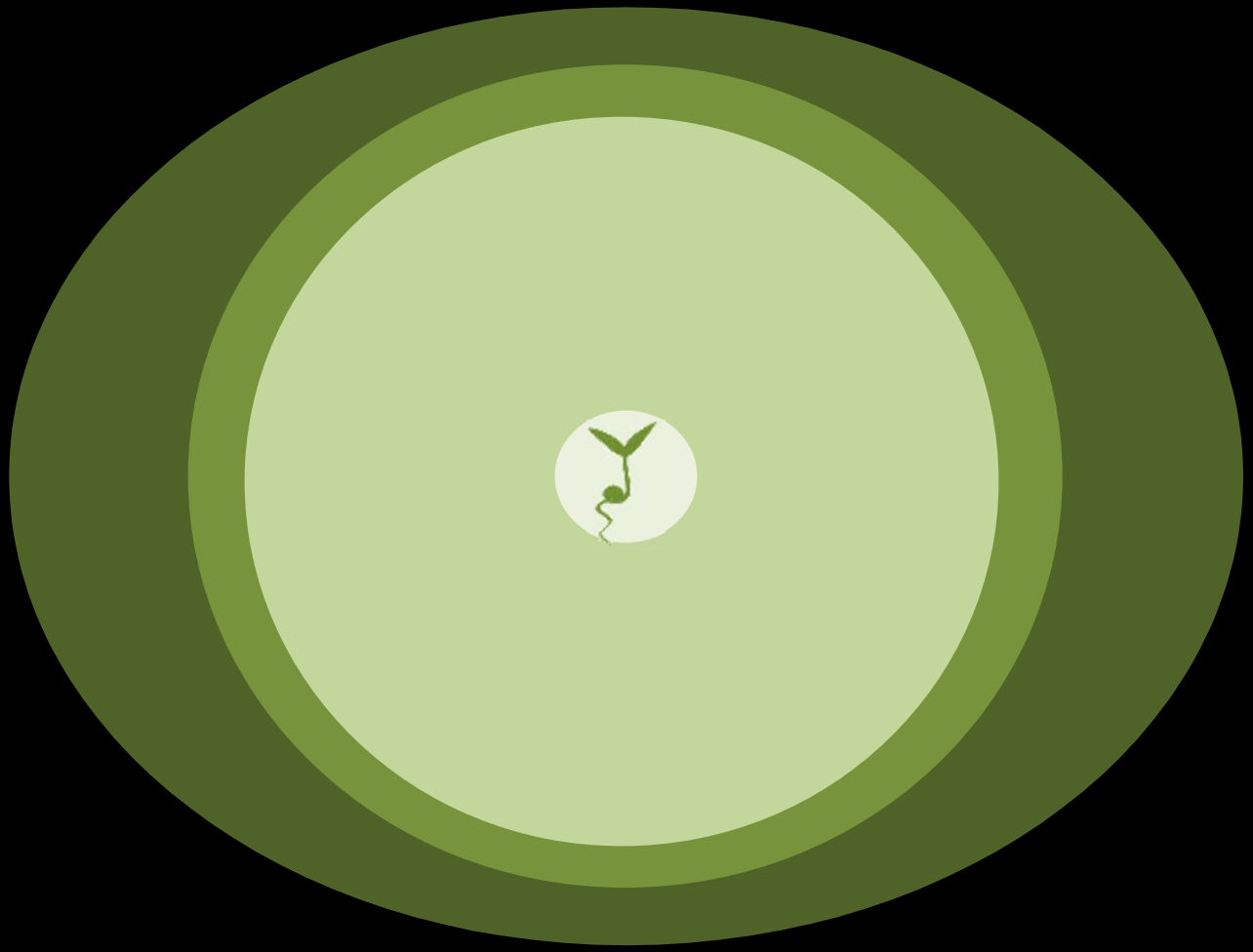


Basin

Local

Location

Recent flow regime



Do: non-woody vegetation response

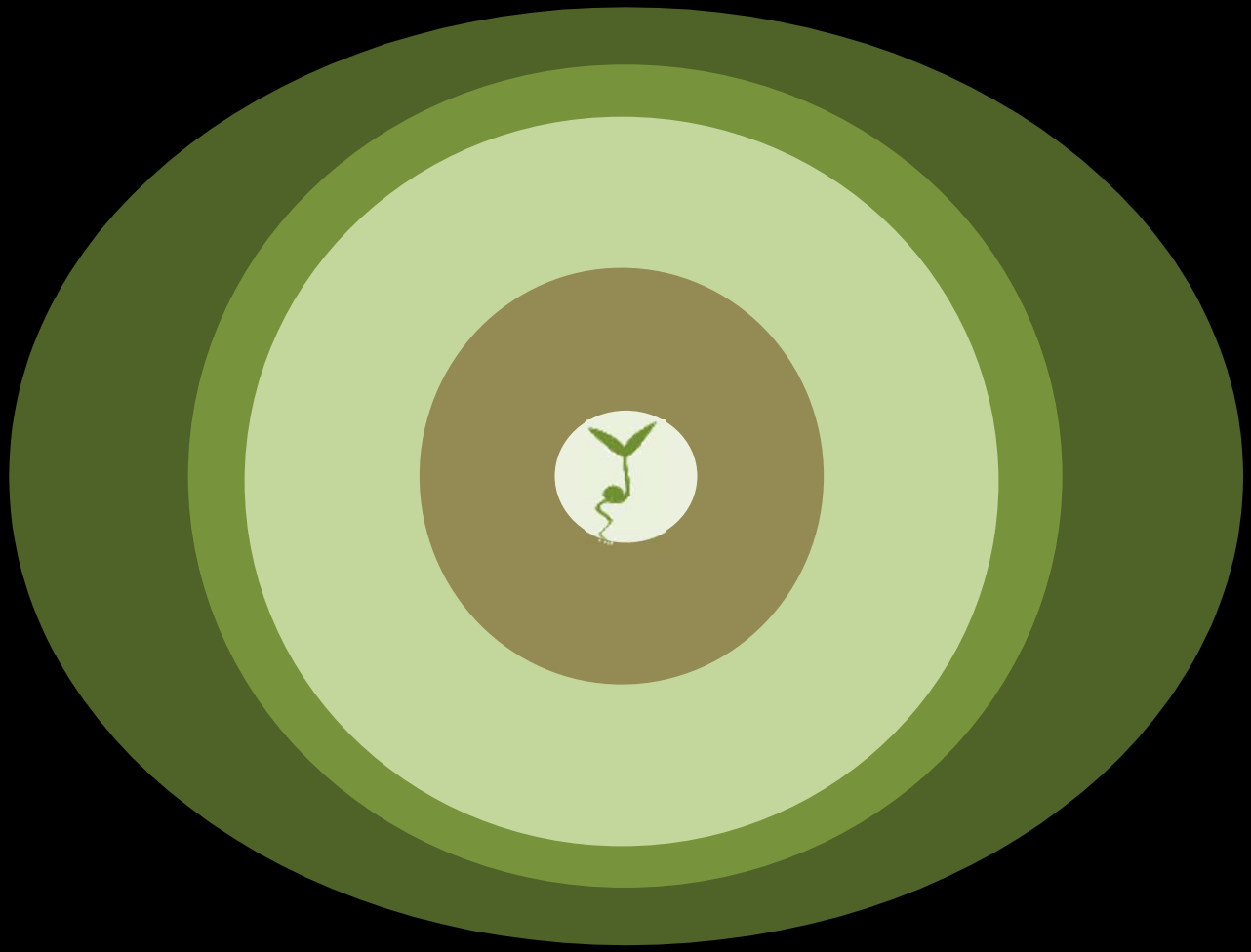
Basin

Local

Location

Recent flow regime

Vegetation structure



Dry in the medium term regime

Do: non-woody vegetation response

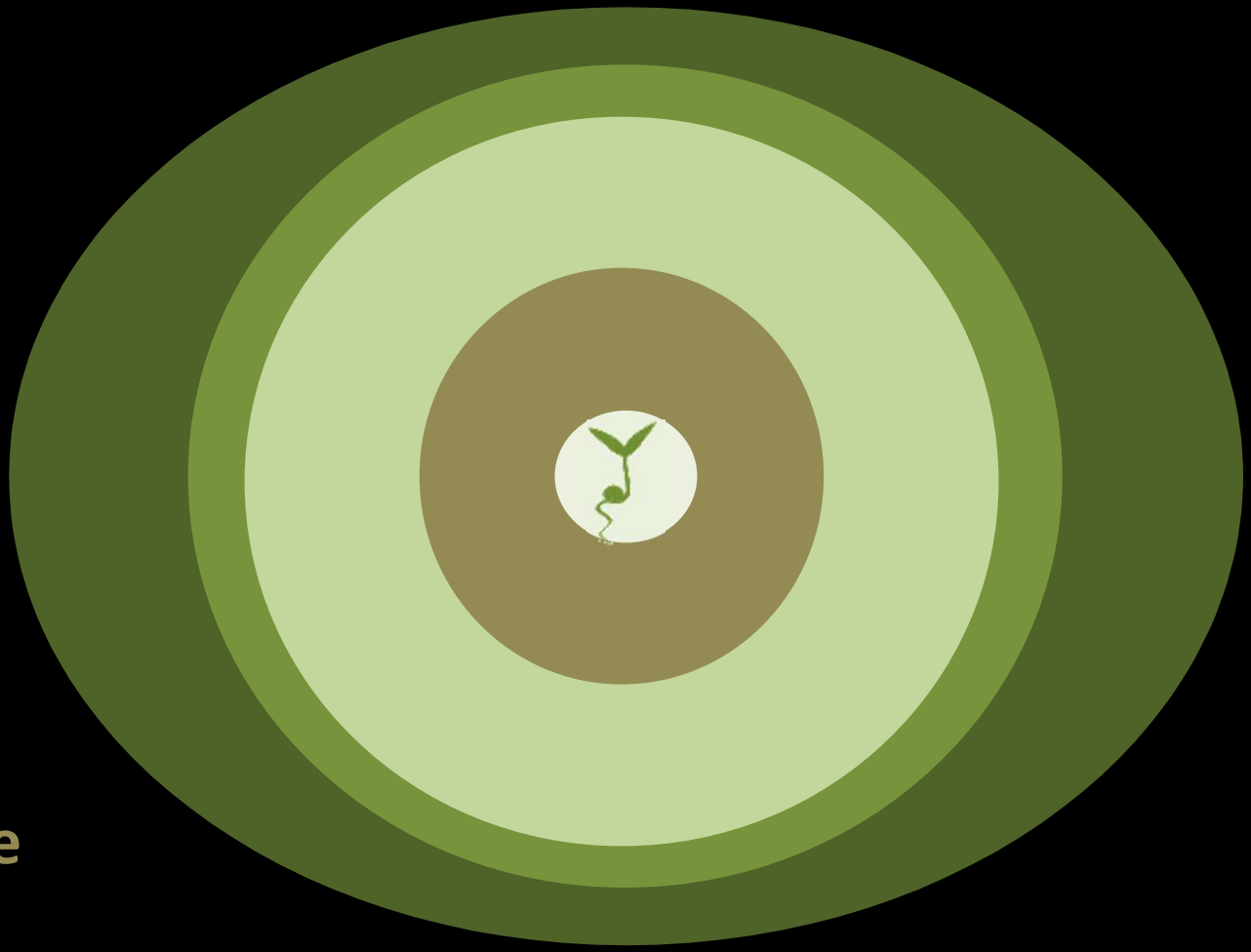
Basin

Local

Location

Recent flow regime

Medium to long term flow regime



Wet in the medium term regime

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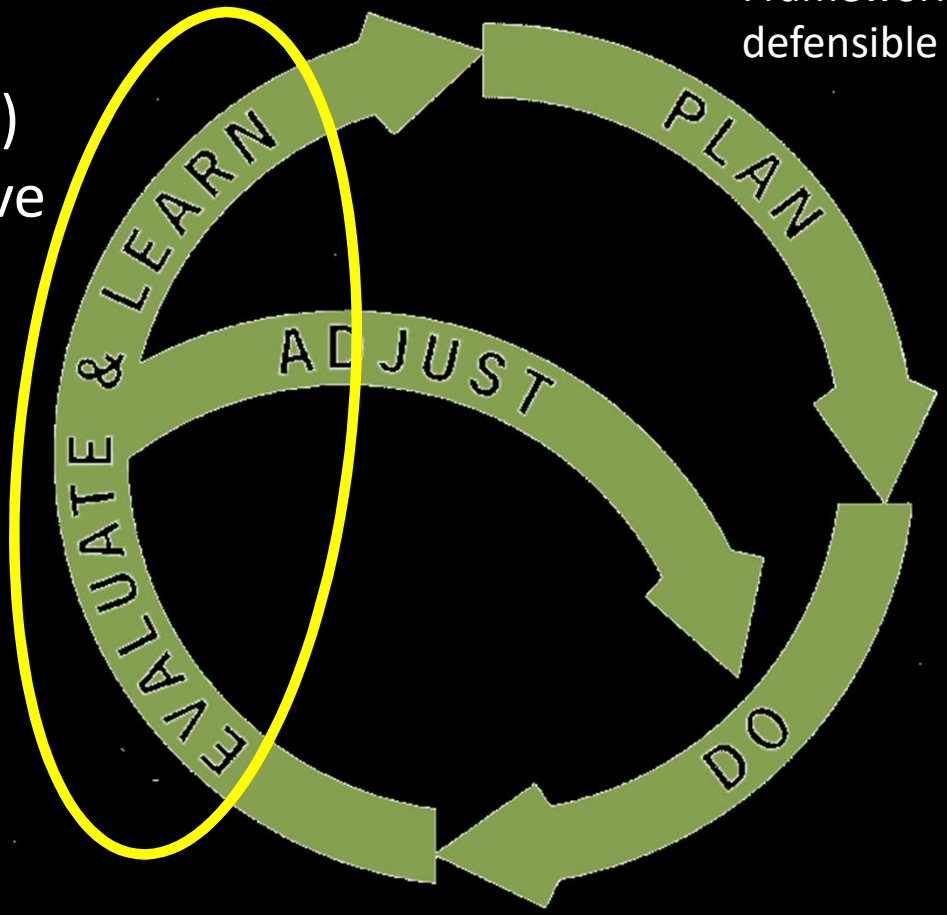
How can we learn more from existing data?



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Evaluate and learn

- Consistent classification: e.g. species, communities, vegscape
- Align and develop response indicators

- Traits and strategies

- Complementary data
- Analytical know-how
- Data management

- Consistent approach to data collection
- Sampling protocols

EWKR babies

Acknowledgements:

- The support and inspiration provided by the broader project teams
- Numerous administrative, technical and academic staff, agency staff, and land managers for assistance with: site selection, property access, field data collection, experimental trials, data entry, data analysis, access to complementary data, write-up and communication and project management

Thankyou

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Facebook: https://www.facebook.com/LaTrobeCFE/

Project Collaborators

Future questions

- Test the framework with a diversity of water decision makers
- Develop decision support tools
- Better understand relationships between structure, function and values for different vegetation responses
- Basin-wide inundation mapping (what Rachael does)
- Transferability of predictive relationships (DISC)
- Traits and strategies for a range of wetland-floodplain plant species
- Limits to resilience and key vulnerabilities (e.g. climate change)