

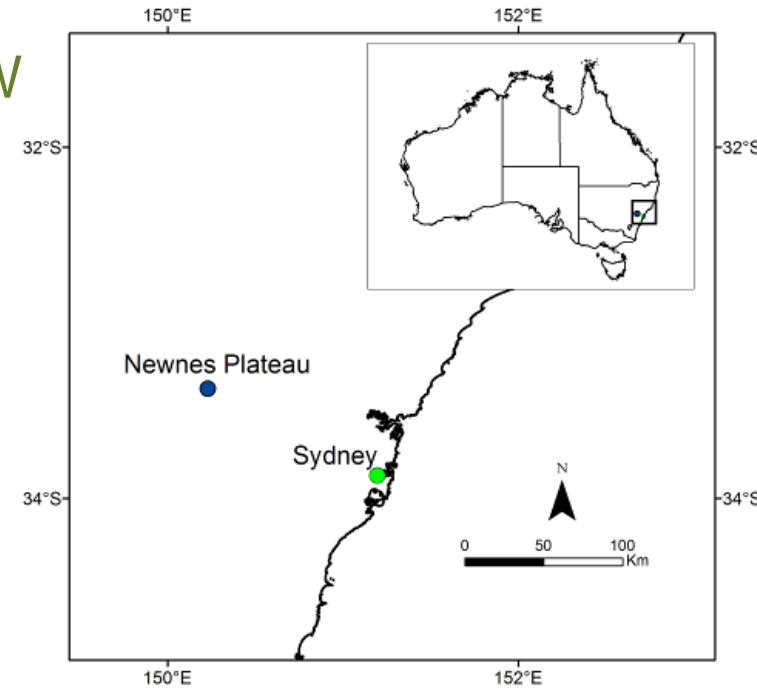


Plant functional groups: An effective indicator for detecting drawdown in groundwater-dependent wetlands?

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Background & study area

- Newnes Plateau, Blue Mountains, NSW
- Underground coal mining has occurred in this region since 1838
- Centennial Coal have monitored wetland condition since 2003
- In 2005, wetland vegetation listed as part of an Endangered Ecological Community under the EPBC Act 1999.



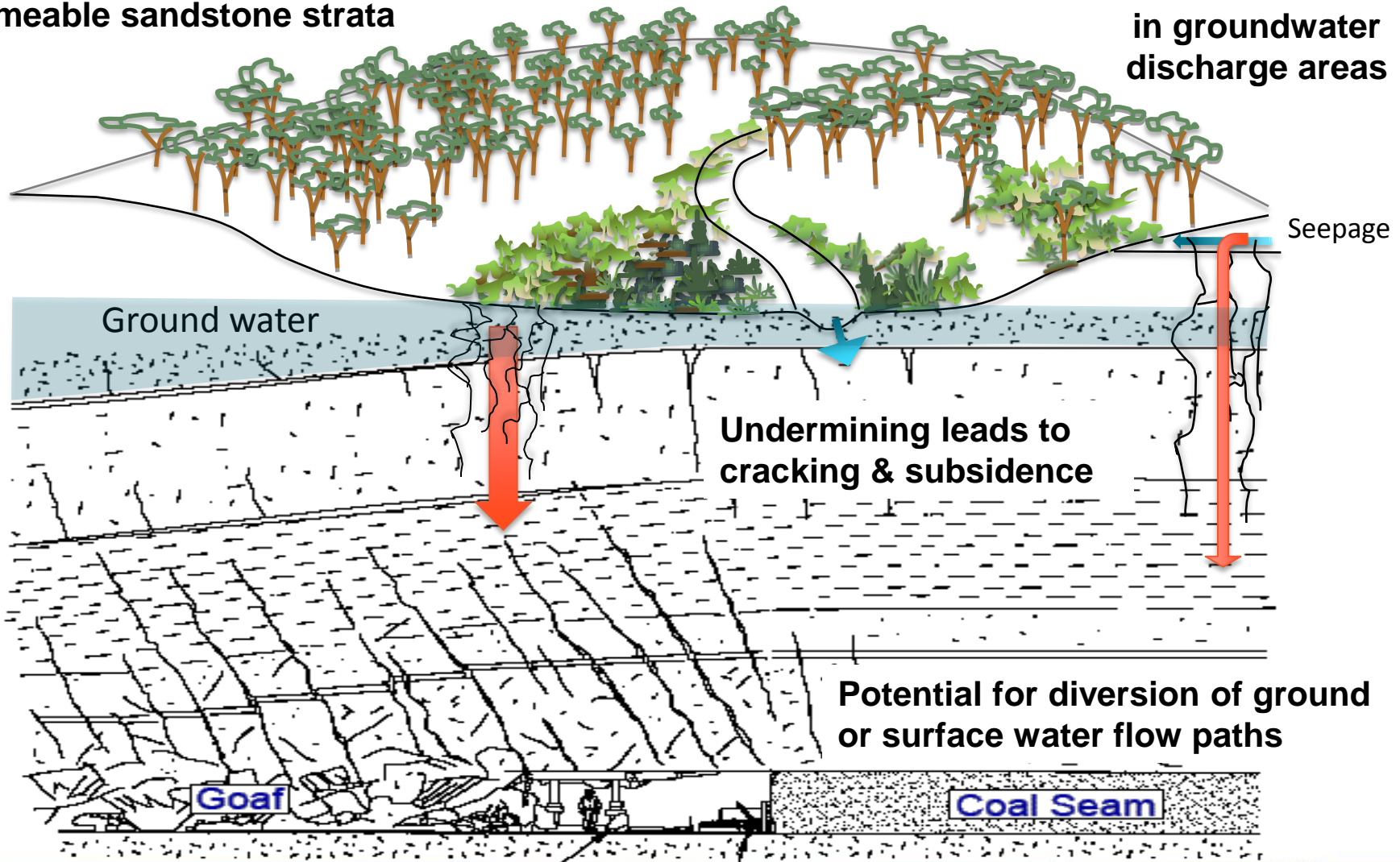
(Map: Lechner *et al* (2012))



Potential impacts of undermining on wetlands

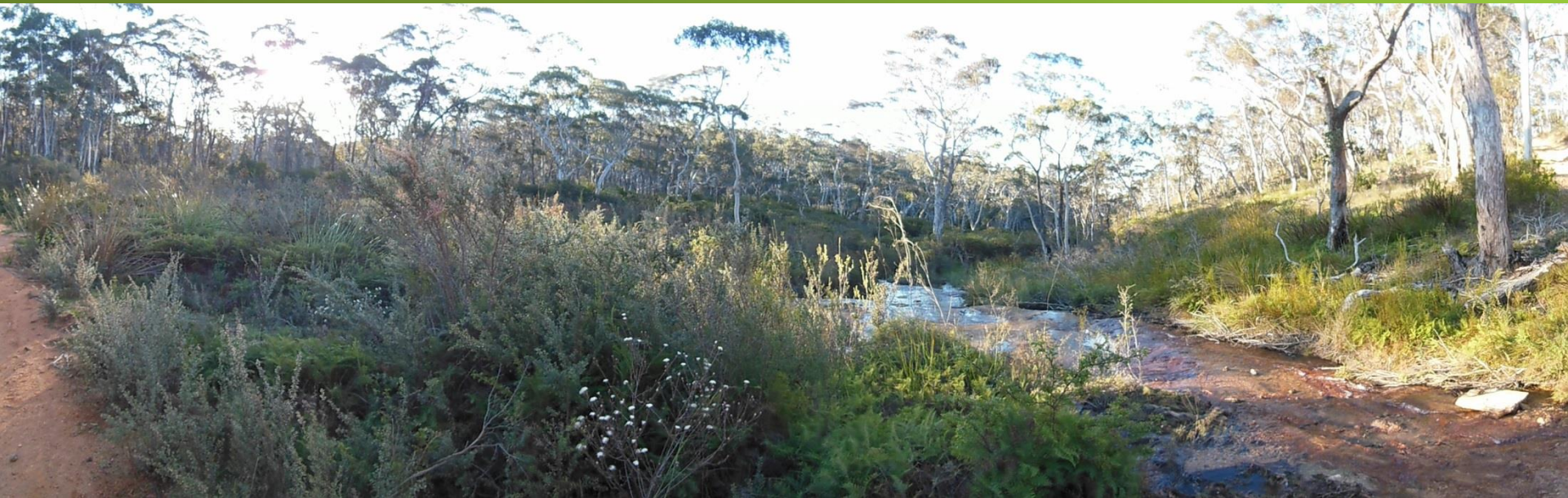
Groundwater confined by claystone bands between more permeable sandstone strata

Wetlands occur in groundwater discharge areas



LINKING VEGETATION COMMUNITY CHANGES TO HYDROLOGICAL IMPACTS

Q. Which indicator species or groups should could be monitored across all wetlands to detect the effects of drying?



Conceptual approach

Analyse available wetland vegetation and hydrology data



Determine main differences in vegetation between wetter and drier sites



Identify potential indicators of wetland drying

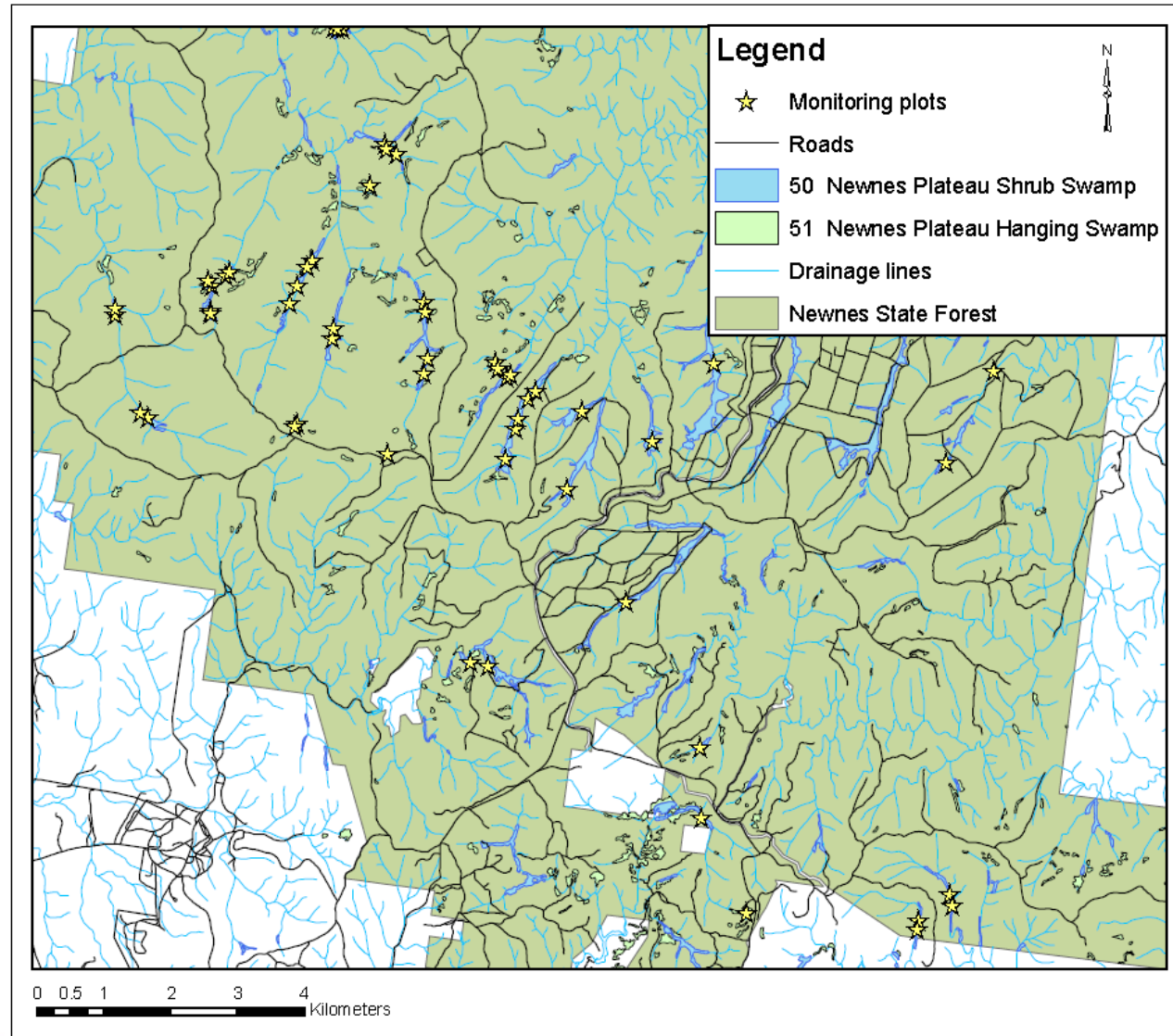


Refine monitoring program design



Vegetation & hydrology data sources

- 52 site condition monitoring plots (20m x 20m)
- Plots established between 2003 & 2012
- Surveyed seasonally
- Additional species point intercept data collected Spring 2012 (~160 points / plot)



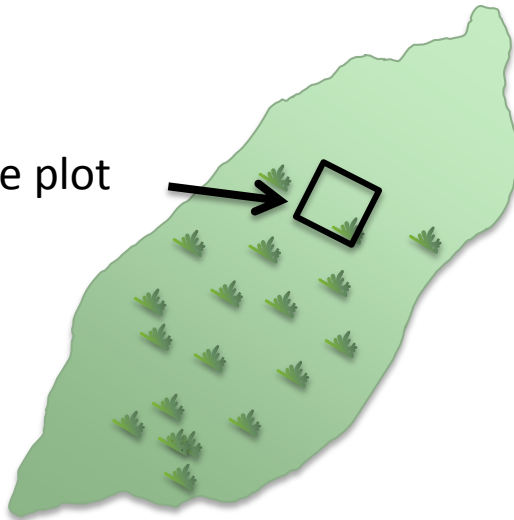
Broad hydrological classification

Site condition notes indicate surface water levels relatively stable across surveys

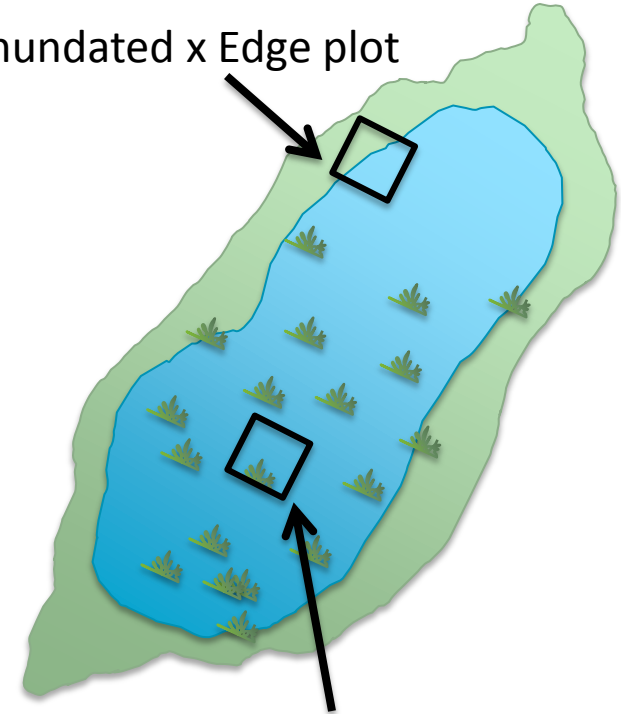
Plots classified by:

- water level (inundated or damp) and
- position (edge or middle)

Damp x Middle plot



Inundated x Edge plot



Inundated x Middle plot

20m x 20m plots

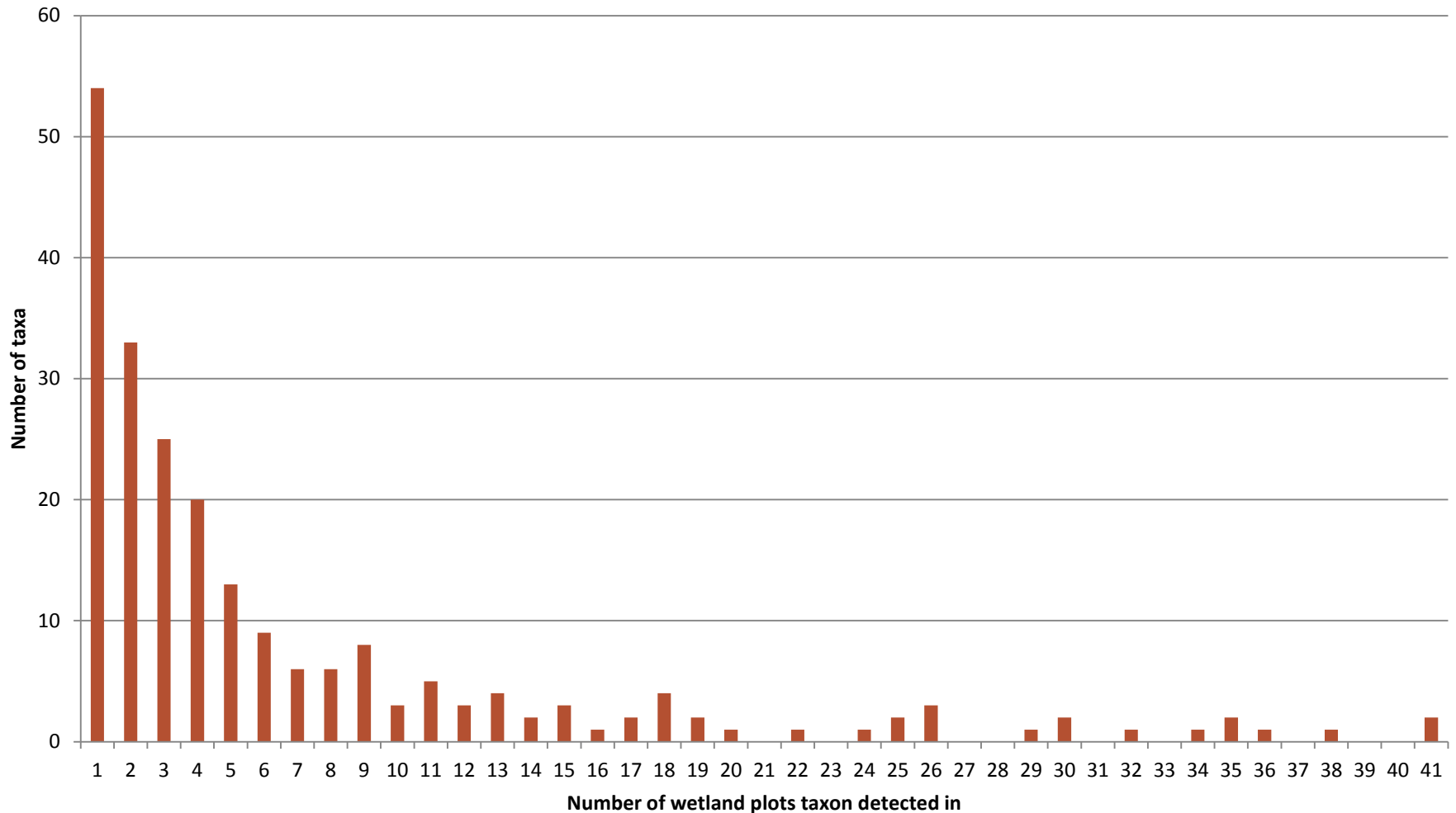


SPECIES LEVEL

- Generalisations at plateau scale difficult due to high variability between plots (including within the categories wet/dry and edge/middle)
- Could not identify suitable indicator species for monitoring across multiple wetlands



Of 222 taxa recorded, 50% were found in 3 plots or less



Functional group classification methods

1. Life forms
2. Water plant functional groups (WPFPG), after Brock & Casanova (1997)
 - Inundation tolerance data from experiments & field observations
3. Wetland indicator categories (WIC), after Reed (1997)
 - Herbarium record collection frequencies (in wetlands / other habitats)



Water plant functional groups (WPFPG)

Functional group		Definition
Terrestrial	Tdr	Dry habitat spp.
	Tda	Damp habitat spp.
Amphibious	Ate	Emergent (e.g. sedges & rushes)
	Atw	Woody (shrubs & trees)
	Atl	Low-growing
	Arp	Plastic growth form
Aquatic		

Brock, M. and M. Casanova. 1997. Plant life at the edge of wetlands: ecological responses to wetting and drying patterns. Pages 181-192 in N. Klomp and I. Lunt, editors. *Frontiers in ecology: Building the links*. Elsevier Science, Oxford



Wetland indicator categories (WIC)

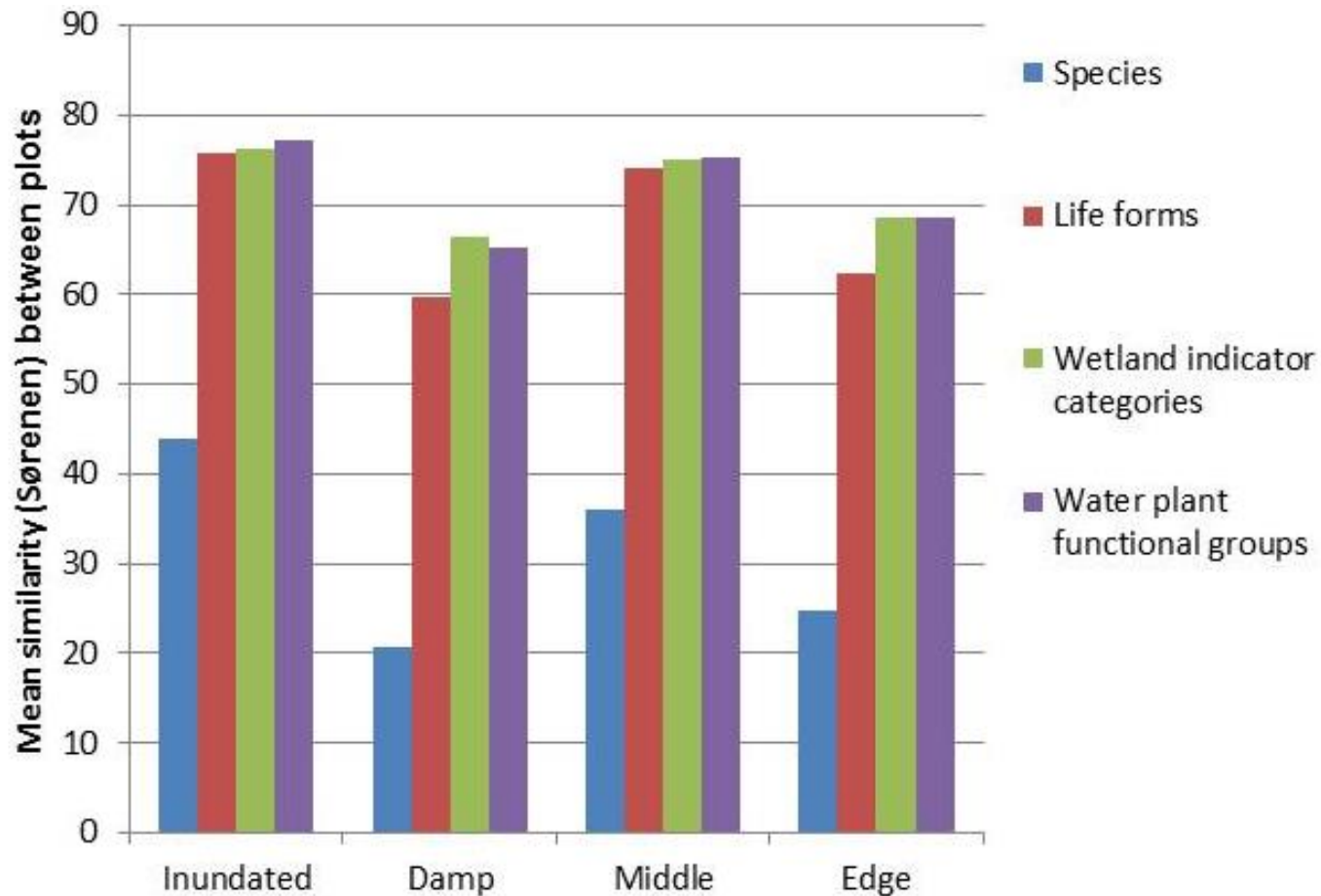
Indicator category	Definition
Obligate Upland (UPL)	Almost never (>99%) found in wetlands
Facultative Upland (FACU)	Usually not (67-99%) found in wetlands
Facultative (FAC)	Equally likely (34-66%) to occur in wetland or non-wetland habitats
Facultative Wetland (FACW)	Usually does (67-99%) occur in wetlands
Obligate Wetland (OBL)	Almost always (>99%) occurs in wetlands

Tiner, R. W. 2012. Defining hydrophytes for wetland identification and delineation. Report prepared by the U.S. Fish and Wildlife Service for the U.S. Army Corps of Engineers.

Reed, P. B. 1997. Revision of the national list of plant species that occur in wetlands. Report produced by the U.S. Fish and Wildlife Service, Washington, DC, in cooperation with the National and Regional Interagency Review Panels (U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Natural Resources Conservation Service)



SIMPER analyses: Within-group similarities

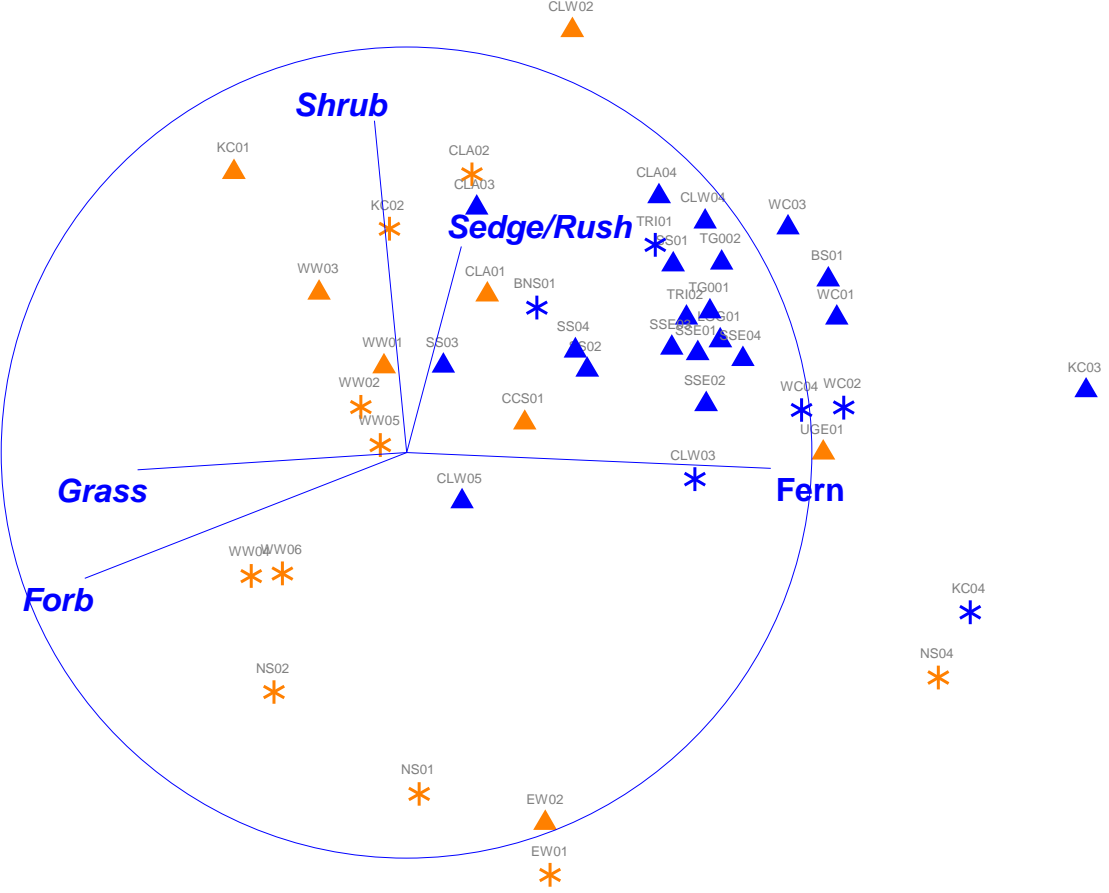


nMDS: Life form relative abundances

Resemblance: S17 Bray Curtis similarity

2D Stress: 0.15

- Plot categories**
- * Inundated Edge
 - ▲ Inundated Middle
 - * Damp Edge
 - ▲ Damp Middle



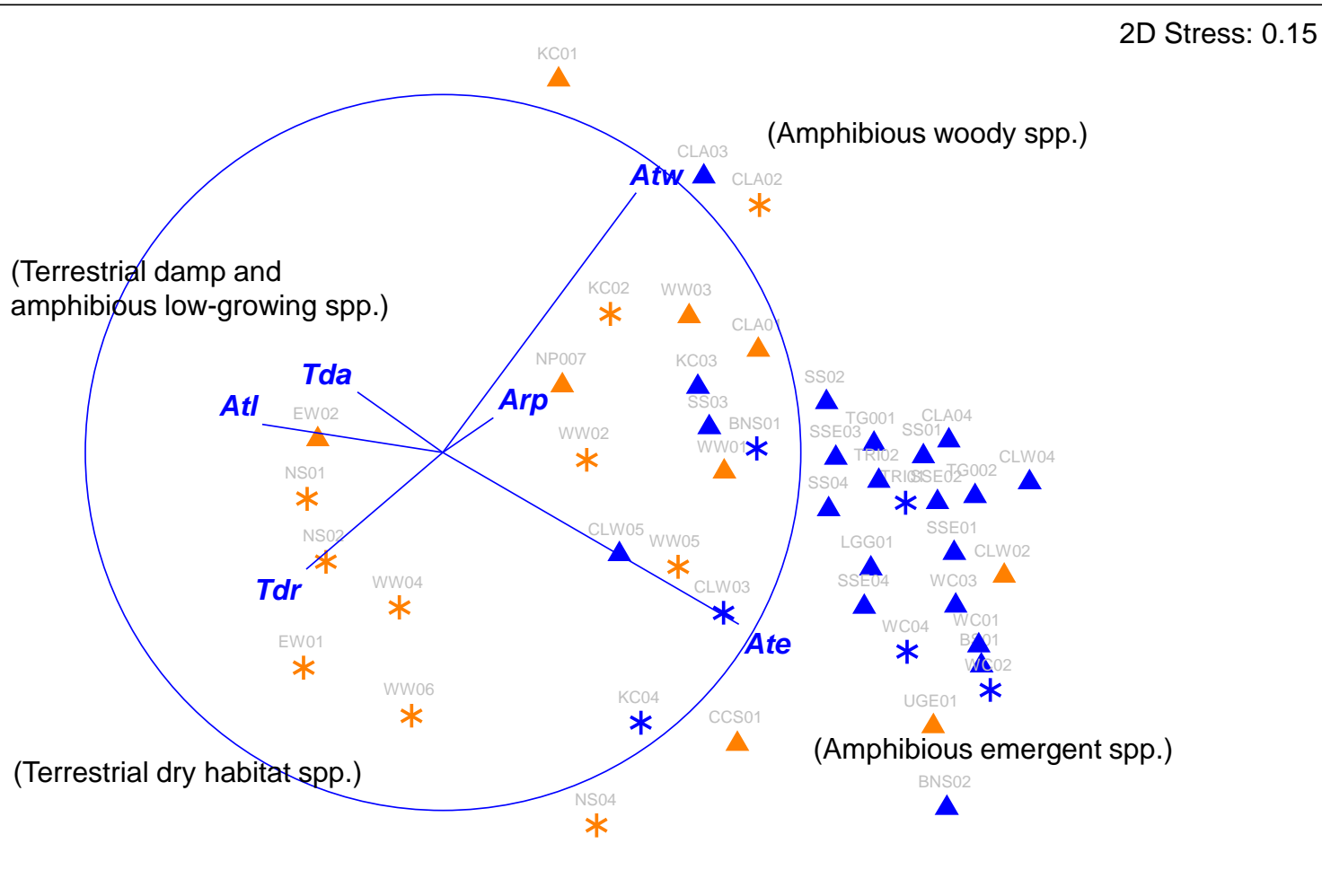
nMDS: Water Plant Functional Group relative abundances

Resemblance: S17 Bray Curtis similarity

2D Stress: 0.15

Plot categories

- * Inundated Edge
- ▲ Inundated Middle
- * Damp Edge
- ▲ Damp Middle

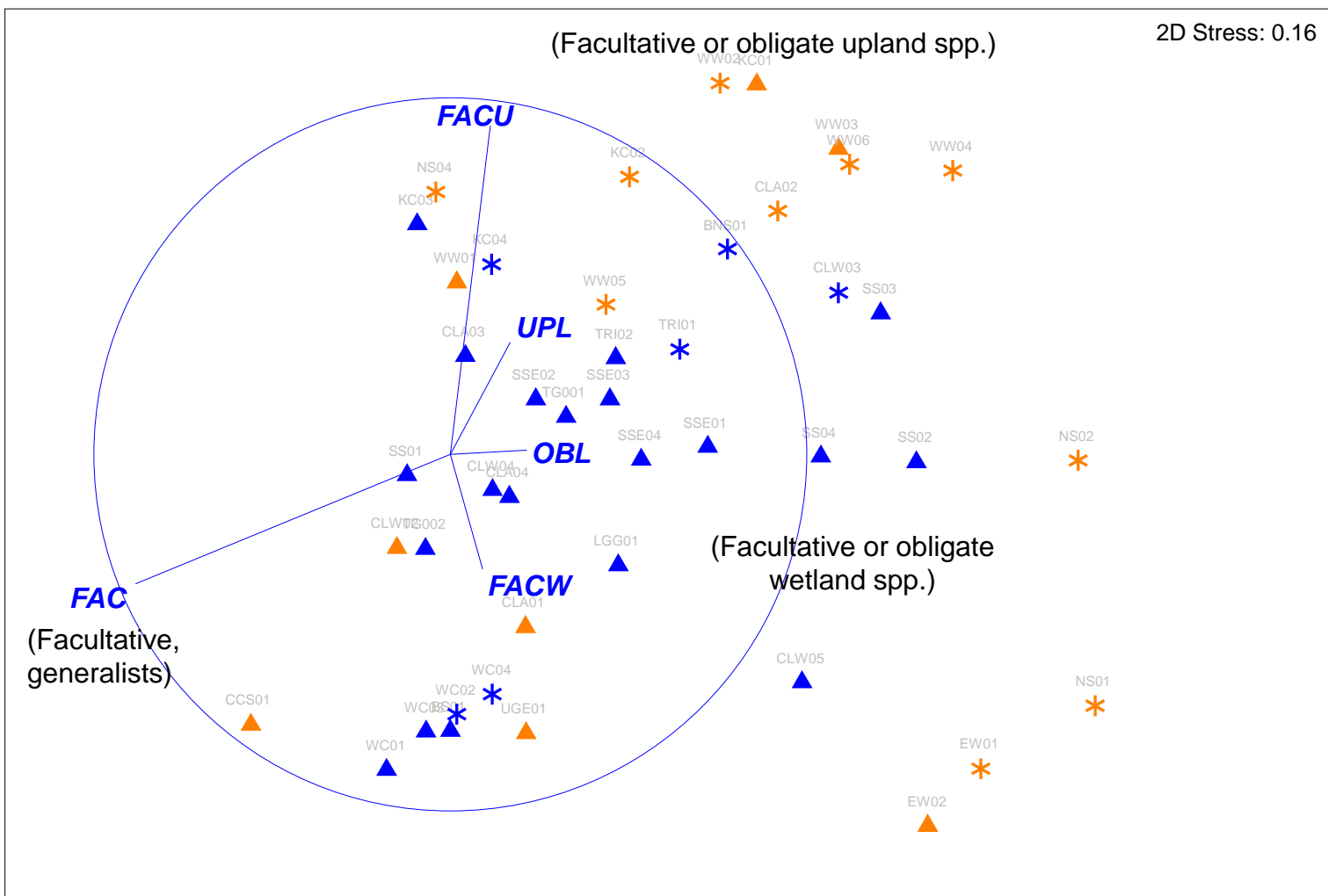


nMDS: Wetland Indicator Category relative abundances

Resemblance: S17 Bray Curtis similarity

2D Stress: 0.16

- Plot categories**
- * Inundated Edge
 - ▲ Inundated Middle
 - * Damp Edge
 - ▲ Damp Middle



Life forms & WPFGs

- 2 factor PERMANOVAs (water table depth x plot position)
- Significant differences ($p < 0.05$) were detected between:
 - Inundated & damp plots (for both WPFG & life forms)
 - Edge & middle plots (for WPFG only)
 - (no sig. interactions)



SUMMARY

- Functional groups were much more broadly applicable than species
- Life forms and WPFG both show promise as indicators of drying
 - Showed much clearer trends than WIC based on water availability
 - WIC classification very time-consuming, with higher degree of classification uncertainty than alternative methods
- WPFG appear best overall
 - Discriminated inundated habitats from damp
 - Discriminated wetland edge from core vegetation (potentially useful for detecting early signs of dryland vegetation encroachment)



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