

**Seasonal Wetland Invertebrate Monitoring: How Much Sampling Is Enough?**

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<http://www.chs.ecu.edu.au/MIWER/>

**Introduction**

- For sampling invertebrate communities it is critical that sampling effort is enough to represent the community
- For monitoring, high priority to minimise lab work and associated costs
- How much sampling is enough, but not too much?

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**Adequate sampling**

- Species accumulation curves (SAC) often used to indicate when sampling is adequate<sup>1</sup>
- Various methods, simplest use incidence of new species
  - Sobs (Species observed) used here
- SAC approximated by semilog curve<sup>2</sup>
  - sampling considered adequate when asymptote approached

<sup>1</sup>(Gotelli & Colwell, 2001) <sup>2</sup>(Ugland et al., 2003)

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**Invertebrate Sampling in Wetlands**

- Wide range of methods can be used
  - Sediment core<sup>1</sup>
  - Ekman grab units<sup>2</sup>
  - Sweep net<sup>3,4</sup>
  - Activity traps<sup>5</sup>
  - Artificial substrates<sup>6</sup>
- Method dependent on wetland depth, size, desired form of data
- But – How many samples?

<sup>1</sup>(de Szalay & Resh, 2000) <sup>2</sup>(Cao et al., 2002) <sup>3</sup>(Foggo et al., 2003) <sup>4</sup>(Suren et al., 2008) <sup>5</sup>(Miller et al., 2008) <sup>6</sup>(Benoit et al., 1998)

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**Seasonal wetlands**

- Commonly occurring worldwide
- Highly productive ecosystems
- Under-represented in the literature
- Distinct from other temporary wetlands due to predictable and regular cyclic inundation

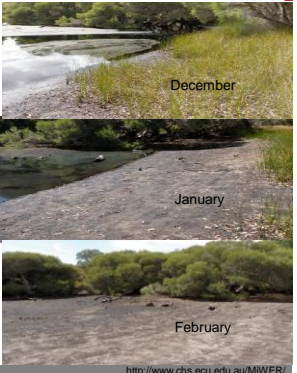
Wetland Category	Characteristics of water regime
Transient	Unpredictable timing and duration of inundation, may only be wet once in ten years or more. Inundation may last days or months.
Seasonal	Alternating wet and dry periods every year, according to season. Fills during wet season and dries predictably. Inundation lasts for months, usually long enough to support macroscopic life.
Near-permanent	Predictable inundation, wet for 90% of the time. May dry out in drought years (supra-seasonal). Most species cannot tolerate desiccation.

(Boulton & Brock, 1999)

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**Seasonal wetlands**

- They dry out every year!
- High degree of environmental variation<sup>1</sup>
- Environmental filtering effect excludes taxa unable to cope with drying, promotes niche-selection<sup>2</sup>
- Long inundation allows competition and succession
- Seasonal wetland may therefore support both 'specialist' and cosmopolitan species<sup>3</sup>



<sup>1</sup>(Gawne & Scholtz, 2006) <sup>2</sup>(Chase, 2007) <sup>3</sup>(Williams, 1996)

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M+W ECU Adequate Sampling in a Seasonal Wetland?

- Question : How many samples are needed to describe taxa richness in seasonal wetlands?



M+W ECU Case Study: Kemerton Wetland Complex



- Southwest WA
- Mediterranean climate
  - hot dry summers
  - cool wet winters
- Complex of shallow seasonal wetlands
- Mostly groundwater fed, interdunal swales
- Inundate at same time as water table rises
- Relatively undisturbed, range of habitats/sizes

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M+W ECU Methods

- Four wetlands
  - Range of habitats, sizes, depths
- Data from 3 consecutive years of invertebrate monitoring in these wetlands (2007, 2008, 2009).

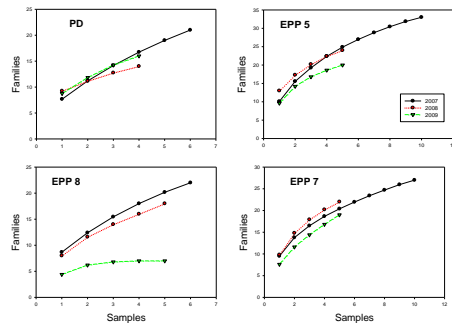


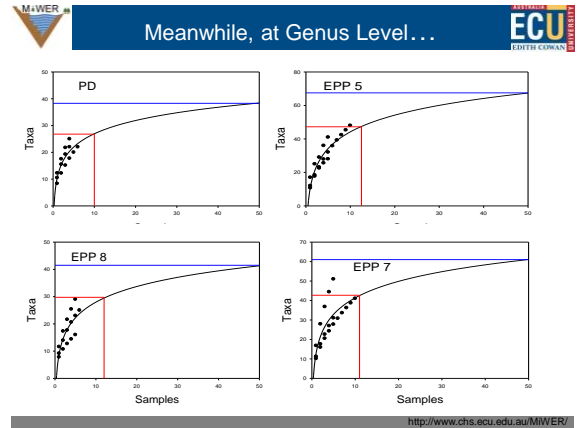
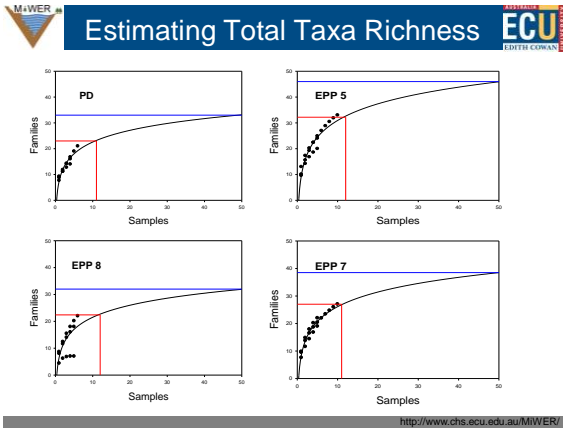
- Samples taken using 10 m transects with sweep net (500 µm)
- Wetlands sampled during end of wet season ( time of peak taxa richness)

M+W ECU Analyses

- Invertebrate samples sorted using 2 mm and 500 µm sieves
  - Identified to family level (common level of resolution) using dissecting microscope
- Community data analysed using PRIMER-6 software
  - Accumulation curves
  - Logarithmic regression used to estimate total taxa richness
    - Extrapolated to 50 samples



M+W ECU Results





### Results: Summary


- Family Level
  - Optimum effort between 10 and 12 samples
  - Captures 70% of estimated total families
- Genus Level
  - Similar optimum sampling effort
  - 2-4 h processing per sample
  - 40 h + per wetland per sampling occasion

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### Discussion

- Taxa richness
  - Desirable measure of diversity
  - Difficult to achieve even at lower resolution
- For monitoring wetlands in this study family resolution looks like a good compromise
- Capturing higher percentages of taxa
  - Cost-prohibitive
  - Intensity may damage wetlands
- For a given budget
  - High frequency, low resolution, or
  - Low frequency, high resolution



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### Conclusions

- Seasonal wetlands in this study appear to require high levels of sampling effort to adequately represent their invertebrate communities
- Implications for proper management of seasonal wetlands
  - Either higher budgets for monitoring
  - Or, alternative methods of assessment (eg functional traits)

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