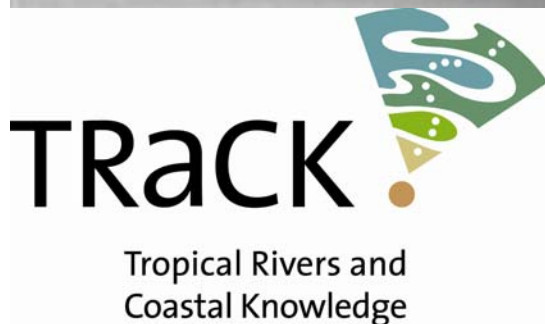


# Food Webs in Tropical river systems



**Neil Pettit, Peter Davies – University of Western Australia**  
**Tim Jardine, Steve Hamilton, Stuart Bunn – Griffith University, QLD**  
**Danielle Warfe, Michael Douglas – Charles Darwin University, NT**



## Tropical Rivers and Coastal Knowledge (TRaCK)

### **Research to underpin sustainable management**

- **Need for development in the north**
- **Need to avoid the mistakes of the south**
- **Lack of basic knowledge of the full implications (environmental, social, cultural, economic) of development scenarios (i.e. allocation)**

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**=> Fundamental need for research**

# TRaCK program



**1. Scenario evaluation**

**2. Assets & values**

**3. Riverscape & coastal settings**

**4. Material budgets**

**5. Food webs & biodiversity**

**6. Enterprise development**

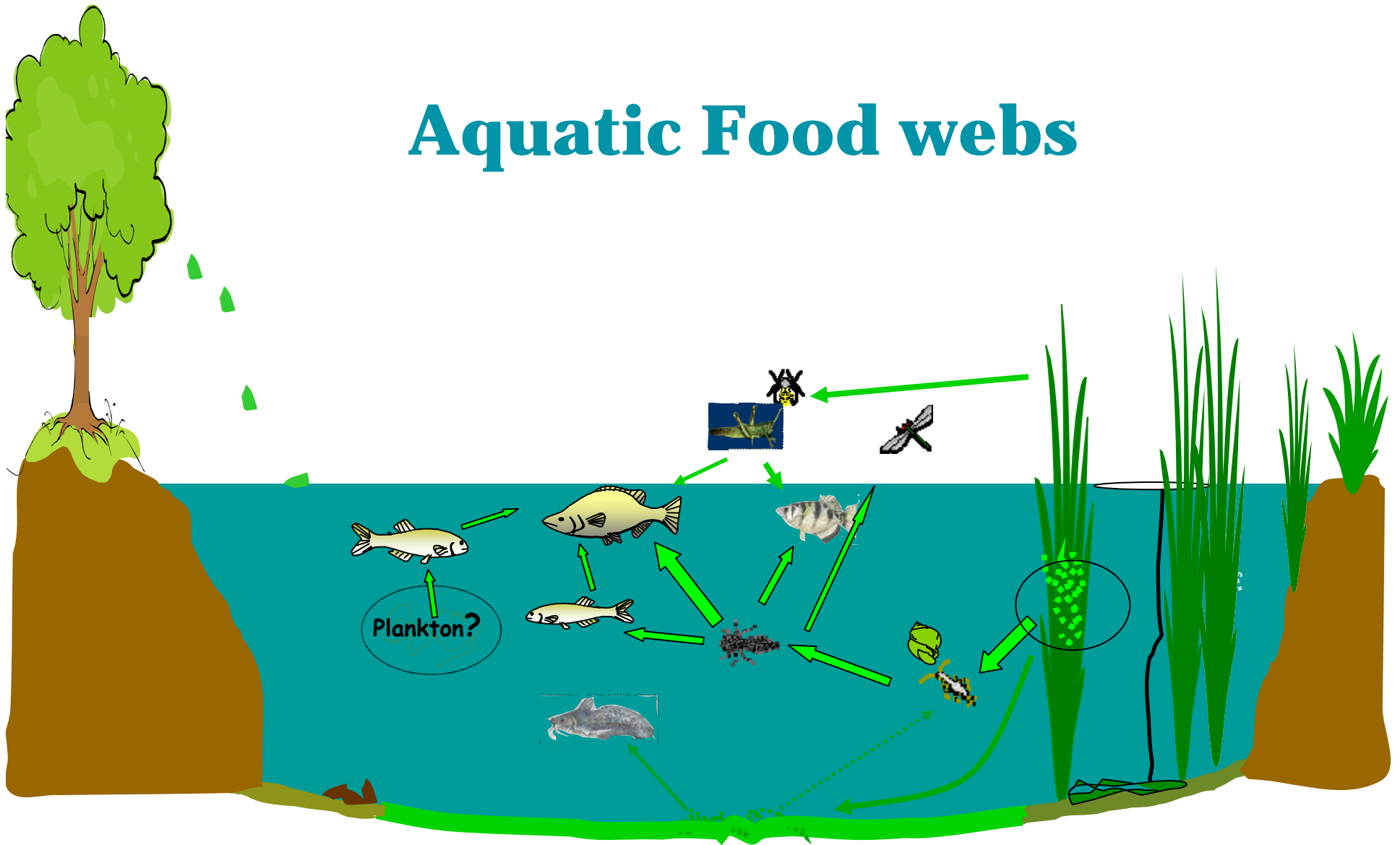
**7. Knowledge and Adoption**

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# Theme 5 Foodwebs & Biodiversity

- Three projects (5.1 Riverine Food Webs, 5.2 Waterholes as Refugia, 5.3 Floodplain Food Webs)
  
- Common threads
  - Sources of primary production supporting food webs
  - Contrasting settings (turbid vs. clear, escarpment vs. alluvial, wet vs. dry, permanent vs. intermittent)
  - Drivers (flow, nutrients, light, consumers)

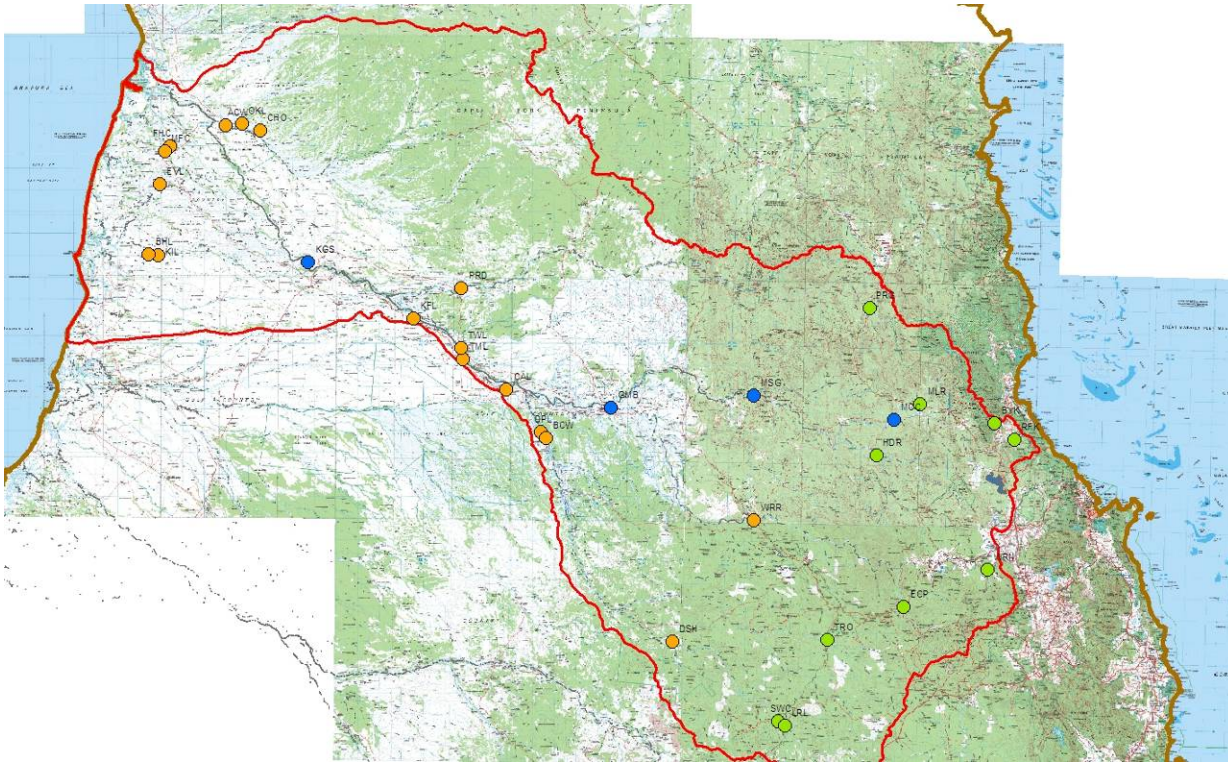
# Aquatic Food webs



# Approach

- Catchment-wide sampling in dry season and floodplain sampling in wet season
  - C, N and (hopefully) S isotopes to determine:
    - Major sources of organic C for consumers
    - Food web structure/food chain length
    - Seasonal changes in diet
  - Link patterns in assemblages and food web structure to environmental variables
    - Turbidity, primary productivity, etc.

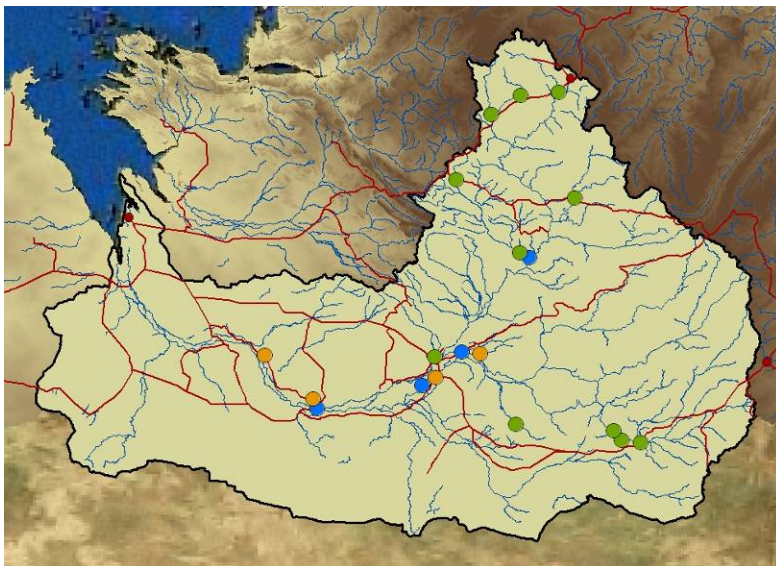
# Sampling Locations



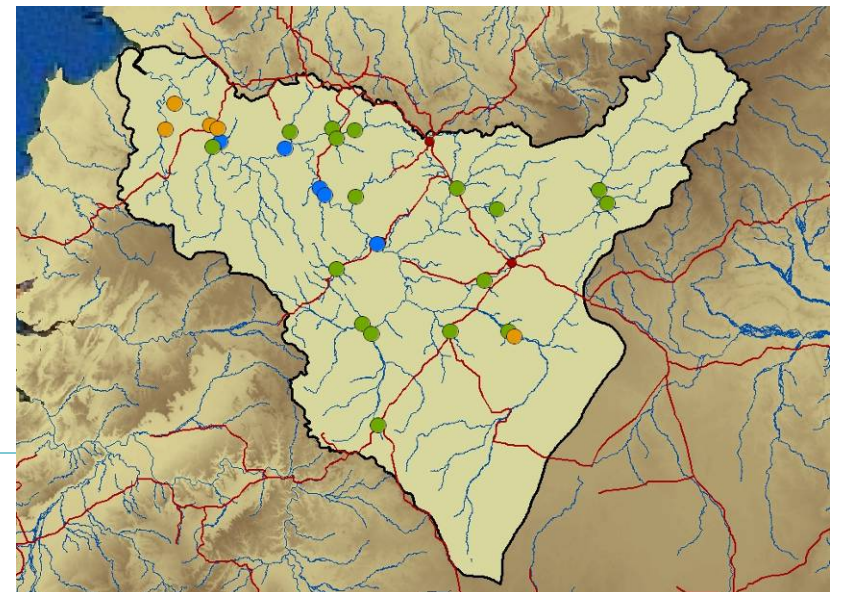
Mitchell River, QLD

**Green = tributary**  
**Blue = main channel**  
**Orange = waterhole**

Fitzroy River, WA



Daly River, NT



# Explaining the Aquatic Food web

- **Examining gut content**
- **Measuring Carbon and Nitrogen stable isotope ratios**

**$^{15}\text{N}/^{14}\text{N}$  ( $\delta^{15}\text{N}$ ) indicates trophic level**

**$^{13}\text{C}/^{12}\text{C}$  ( $\delta^{13}\text{C}$ ) indicates carbon source**

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# Key findings

- Fish\* do not match isotopically with algae growing on the river bottom during the dry season

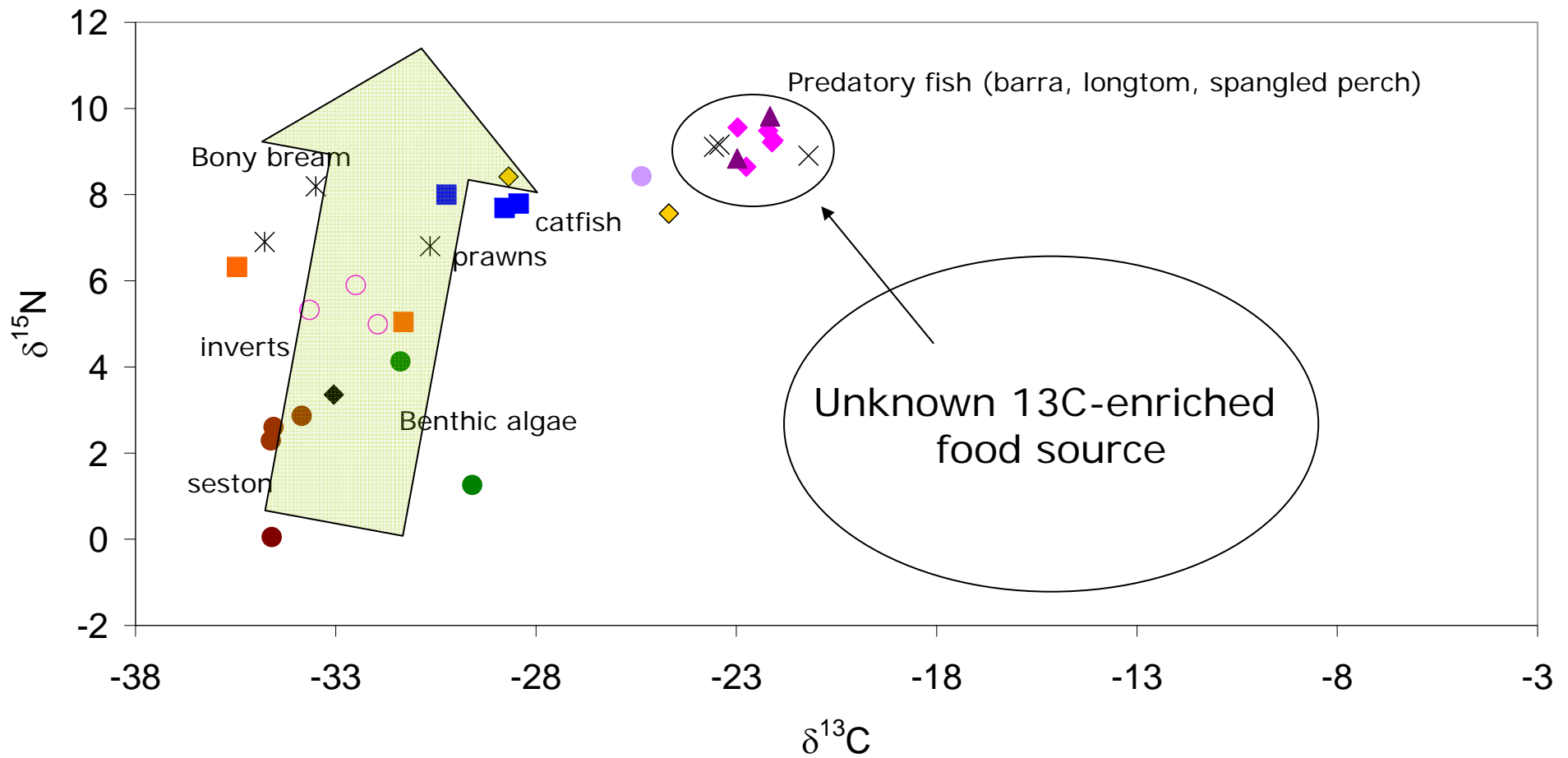
\*barramundi  
longtom  
spangled perch  
rainbowfish  
archerfish



# Key findings

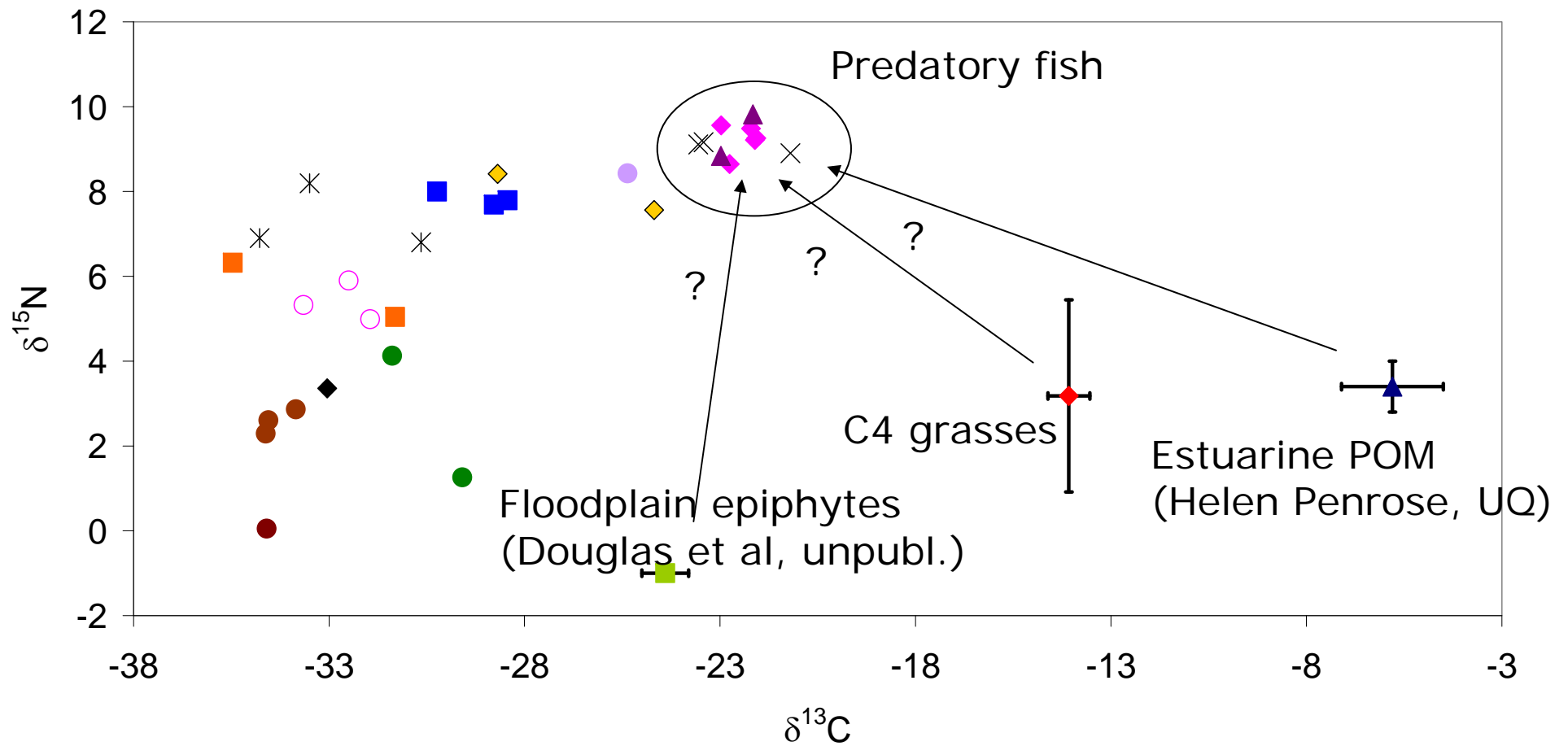


e.g. Fishhole Creek, Mitchell River



# Implications of findings

e.g. Fishhole Creek, Mitchell River



# Implications of findings

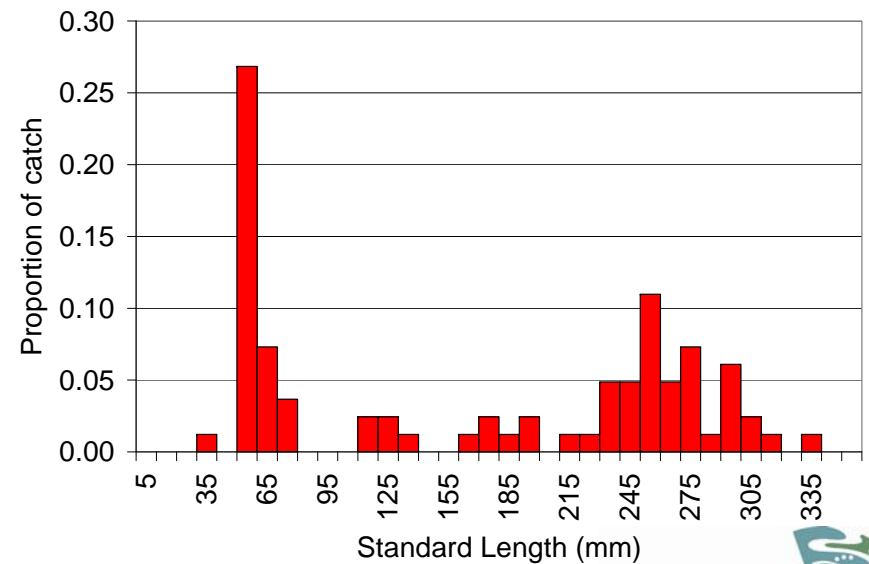
- Three possible explanations
  - 1) Fish come from elsewhere (Upstream-downstream connectivity is important)
  - 2) Fish feed on  $^{13}\text{C}$ -enriched food source on floodplain during wet season (Maximum inundation will yield highest fish biomass)
  - 3) Fish feed on insects that fed on  $\text{C}_4$  grasses (Trapped in surface water during floods)

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A combination of all three?

# Key findings

- Large numbers of estuarine fishes present in freshwater reaches during floods
  - E.g. gizzard shad (*Nematulosa come*)

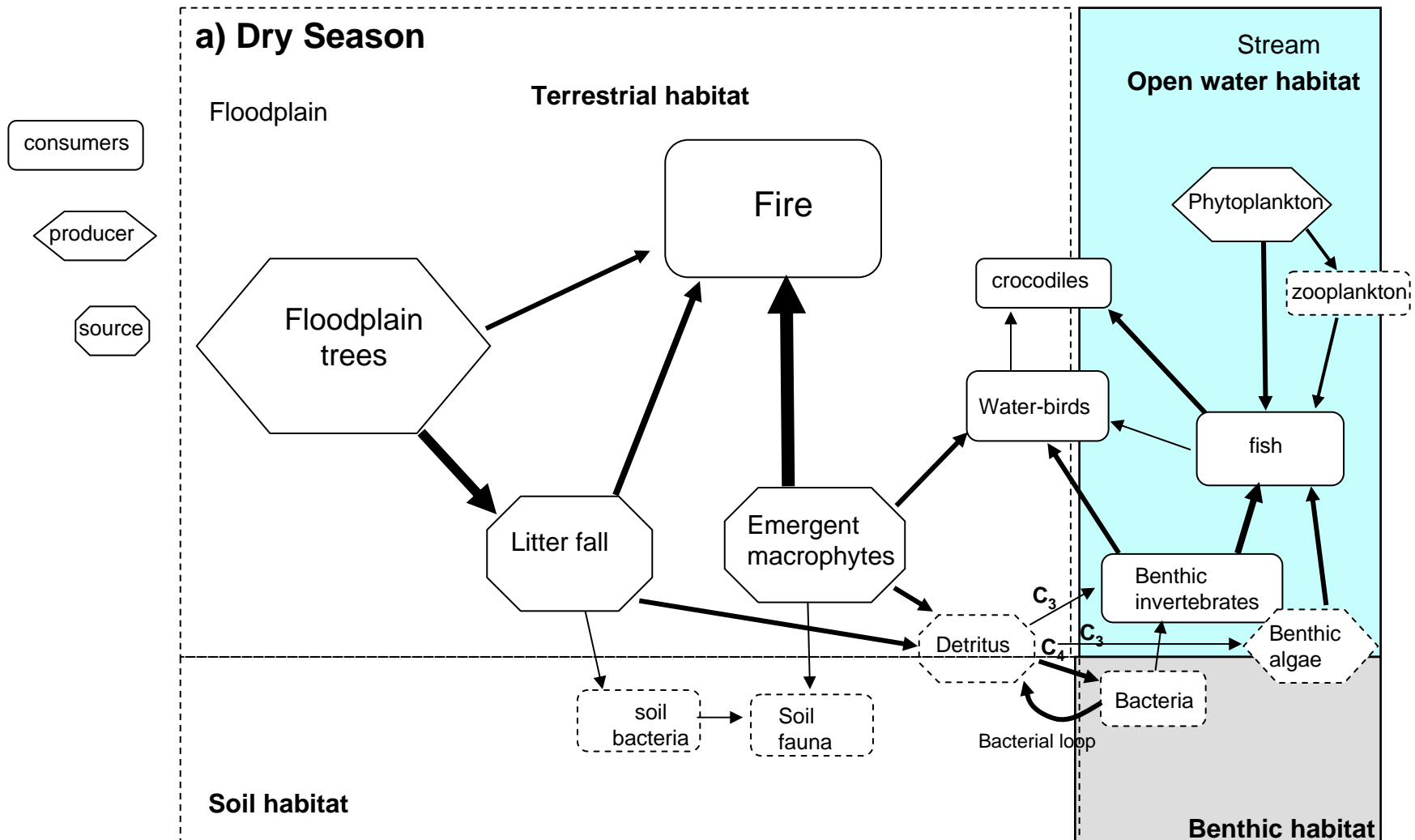


# Implications of findings

- Floods may be important for migration, spawning and dispersal of fishes
- Despite low apparent productivity, there must be sufficient food to attract these fish
  - Floods are critical in maintaining viable fish populations and allowing gene flow between populations

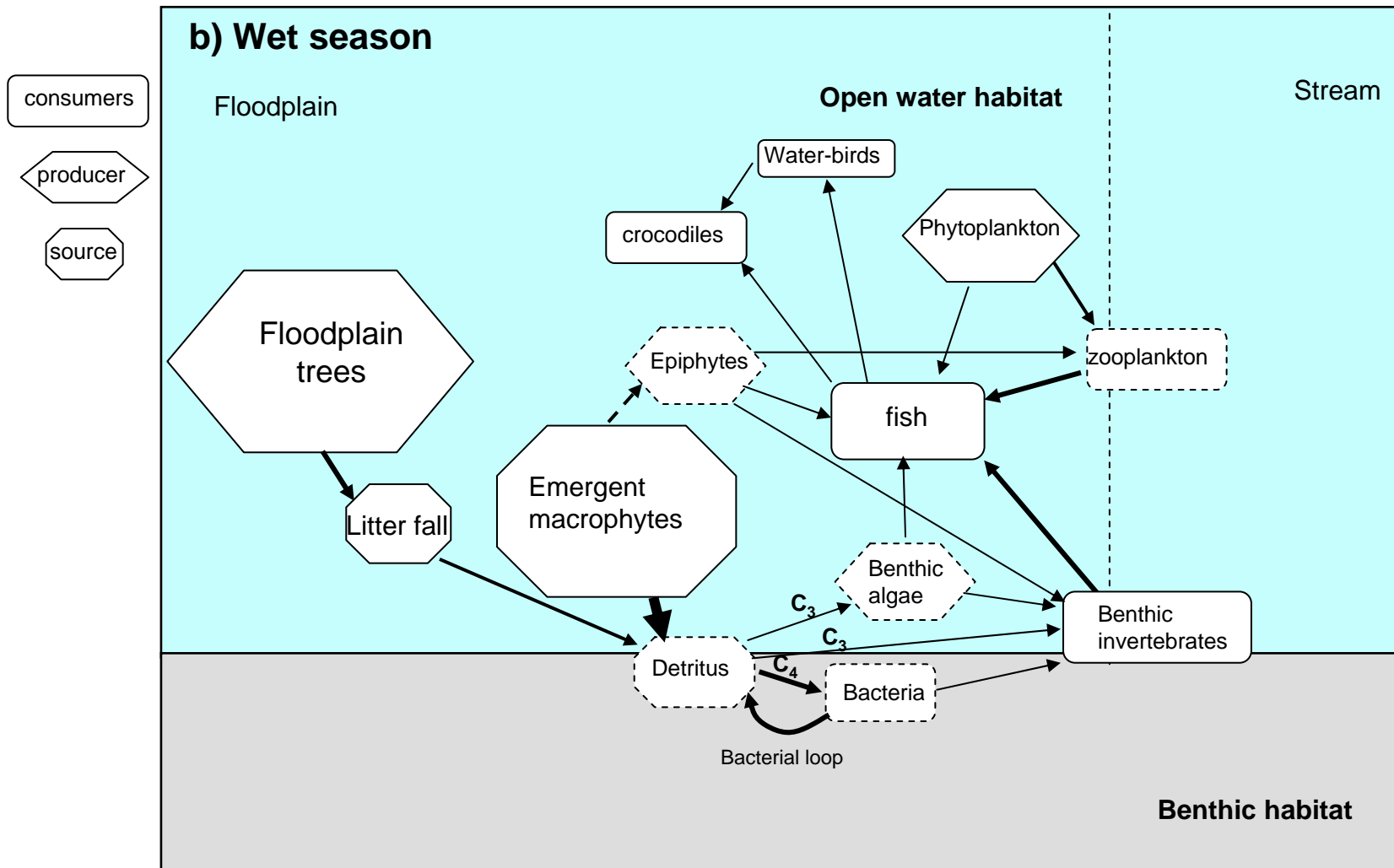


# Carbon fluxes on the floodplain



**Figure 3a:** Dry season fluxes of carbon and generalised foodweb on the floodplain for Magela Creek. Size of boxes give relative contribution to biomass of each group and strength of arrow represent dominant pathways. Boxes with broken lines are items where no data is available.

# Carbon fluxes on the floodplain



**Figure 3b:** Wet season fluxes of carbon and generalised foodweb on the floodplain for Magela Creek.

Size of boxes give relative contribution to biomass of each group and strength of arrow represent dominant pathways. Boxes with broken lines are items where no data is available.

# Fire & Weeds

- **evidence of positive feedback between fires and grass invasion. Increased burning of *Melaleuca* forest.**
  - **link between weed invasion and increased fire frequency and intensity on the floodplain**
  - **other ecological effects**
    - **frog and freshwater turtle aestivate in the dry sediments on the floodplain during the dry season**
-

# Key findings

- Turbidity in tropical waterholes
  - Mitchell & Daly Rivers have lower turbidity than those from central Australia
    - Mitchell, Daly, Fitzroy – range = 1-210 NTU (10-214 cm secchi depth)



- 
- Cooper Creek – 6-15 cm secchi depths

# Implications of findings

- Primary productivity less limited by light penetration; more likely limited by:
  - Nutrients (N & P generally low in the Mitchell)
  - Top-down control (grazing and trampling)

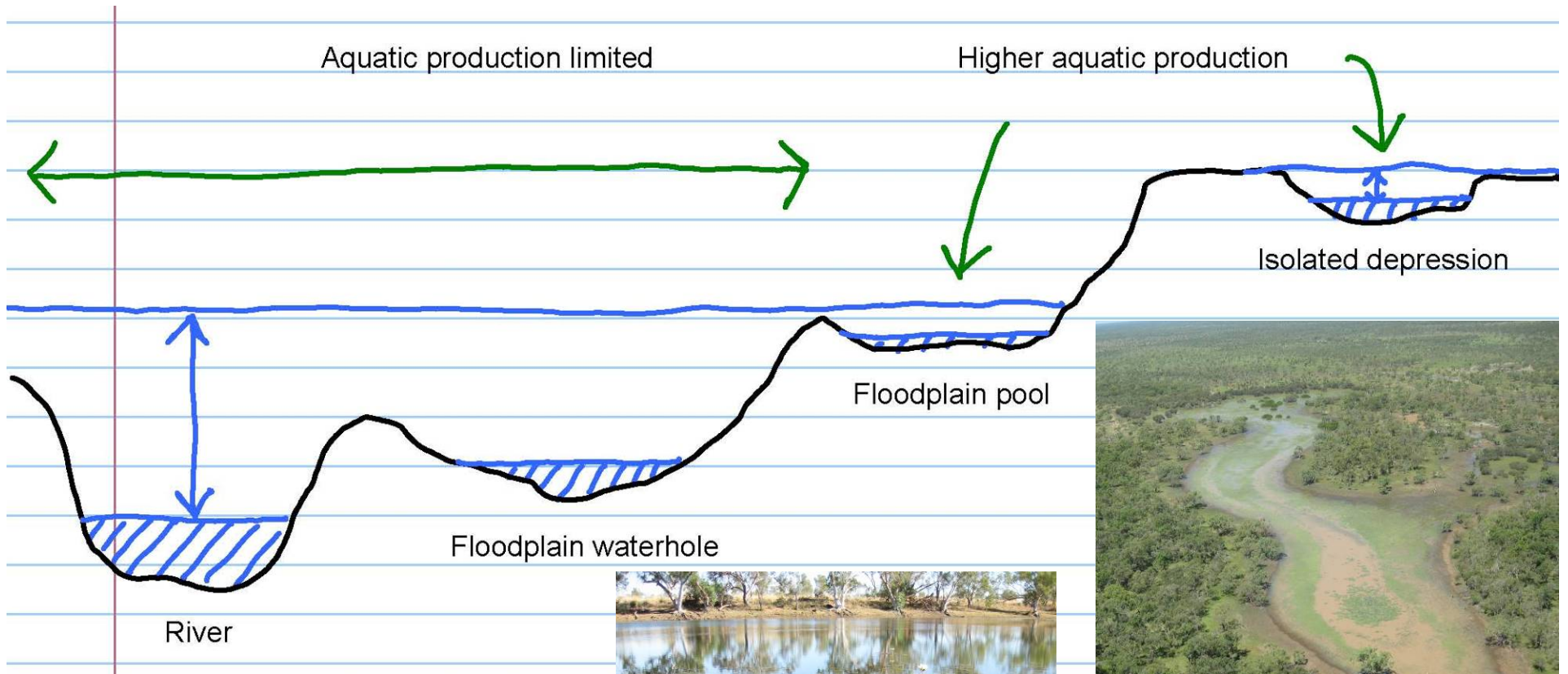


# Comparisons with other floodplain ecosystems

- Recent visits to Mitchell River delta, Weipa area, and lower reaches of Flinders and Norman rivers
- Surprisingly little aquatic production of grasses, forbs, and algae in rivers and fringing floodplains
  - Most vascular plant production probably occurs after flood waters recede
- Areas subject to shallow inundation do support substantial aquatic production
  - e.g., sedge meadows in upper intertidal and supratidal zones; isolated pools; protected enclaves

# Comparisons with other floodplain ecosystems (continued)

- Factors that may conspire against aquatic primary production include:
  - Rapidly fluctuating water levels
  - Short inundation period
  - Turbid water (light limitation)
  - Current
  - Low nutrients in soils and flood waters
- Seawater penetration during the dry season may be an important limitation for vascular plants
  - Mitchell Delta has few freshwater refuges



# Future activities

- Exclusion experiments to determine strength of top down control (4.3, 5.1)
- Isotope analysis of sources and consumers
  - From the Mitchell River floodplain (wet season)
  - From Mitchell River waterholes (early and late dry season)
  - From Daly and Fitzroy River tributaries sampled in mid dry (2008) and late wet (2009)
- Deployment of time-lapse cameras to evaluate impacts of stock and ferals

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- Mt. Pierre Station



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Phil Palmer, Helen Malo,

□ Project team

