

Conceptualising the natural flux regime in wet-dry tropical rivers



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Scientific underpinnings of TRaCK research

- ✦ Important ecosystem services are provided by rivers, floodplains, and coastal zones
- ✦ Natural flow regimes are critical to ecosystem structure and function
 - ✦ Runoff from land to fluvial system
 - ✦ River-floodplain exchanges
 - ✦ River-estuary-coastal zone linkages
- ✦ Many ecosystem services are supported by natural *fluxes* of water, nutrients, sediments, and organisms
- ✦ Resource development (esp. water) tends to alter flow regimes and associated fluxes



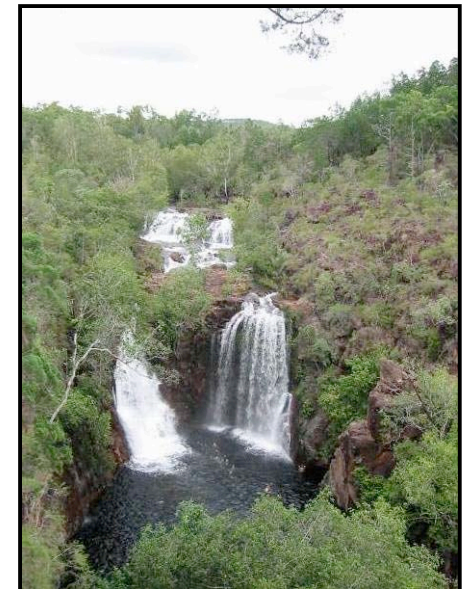
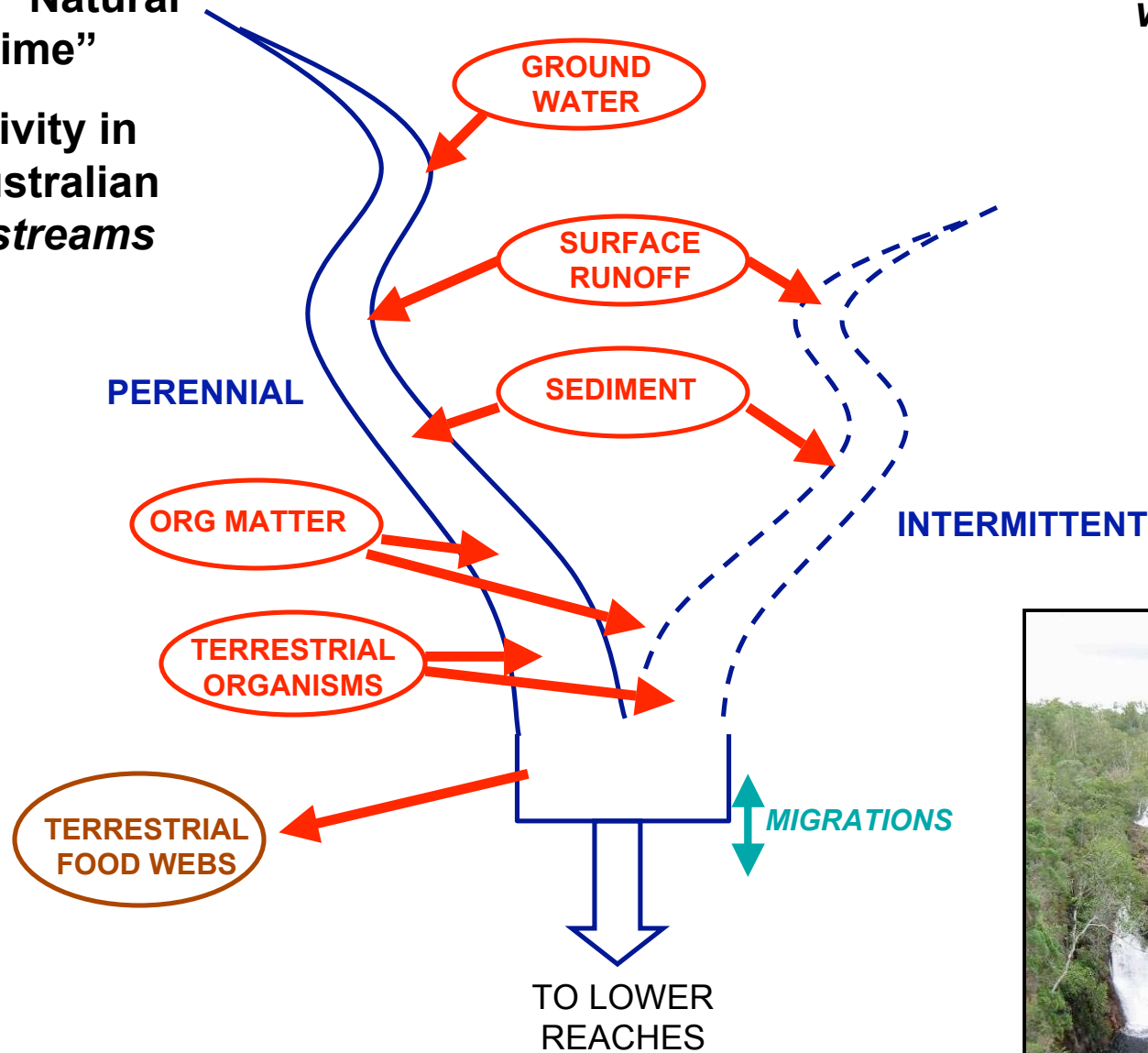
Conceptual bases for TRaCK: Efforts so far

- ✦ Conceptual dimensions of TRaCK discussed at a series of meetings since 2004 including last year at TISORL
 - ✦ Recognized the need for a set of models based on season and riverscape setting
- ✦ Pictorial models by Emily Saeck (Griffith Uni)
- ✦ TISORL workshop focused on connectivity and the natural regime of fluxes
 - ✦ Frequency, timing, duration, rate
 - ✦ Need for quantification of fluxes
 - ✦ Appropriate methods for northern Australia
- ✦ TRaCK 1.1 project is engaged in development of quantitative models (Neil Collier & Colette Thomas)

TRaCK total system model of the "Natural Flux Regime"

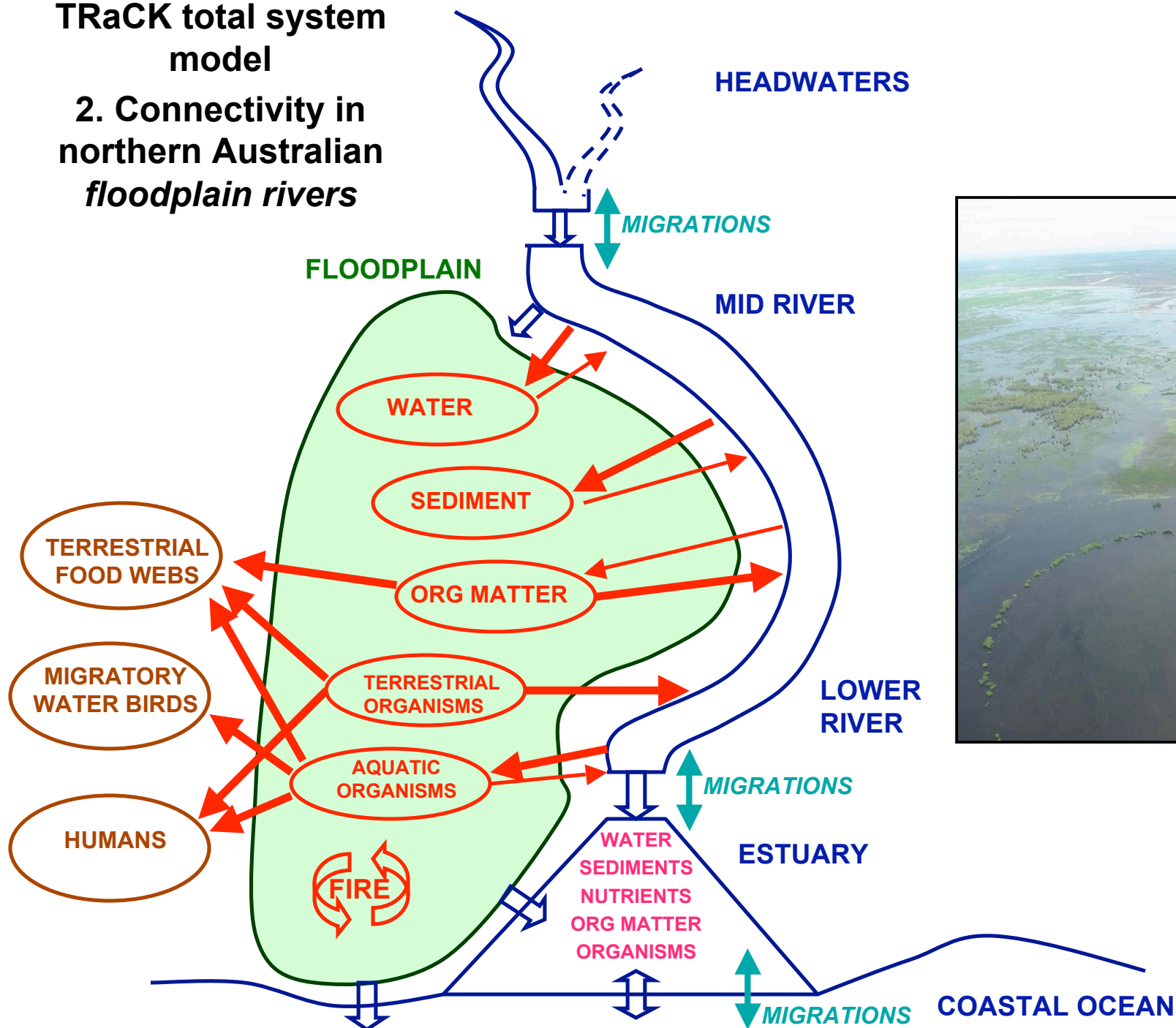
TISORL 2007 workshop

1. Connectivity in northern Australian headwater streams



TRaCK total system model

2. Connectivity in northern Australian floodplain rivers



Value of conceptual ecological models (CEMs)

- ✦ CEMs serve to identify *major* drivers and stressors, their ecological effects, and attributes or indicators of these responses
- ✦ Help to understand complex systems and interacting factors
 - ✦ “Working hypotheses”
 - ✦ Scientific consensus
- ✦ Serve to define and communicate research priorities
- ✦ Useful in planning for conservation (or restoration)
- ✦ Starting point for quantitative models

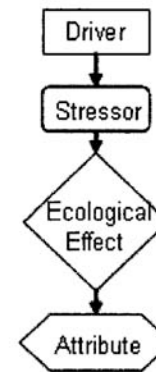


Figure 3. Simplified diagram of a conceptual ecological model.

Ogden et al. 2005. Wetlands 25(5)

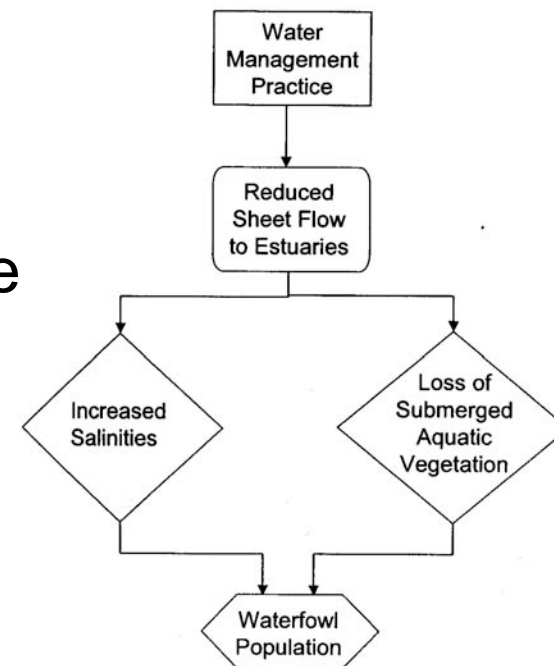
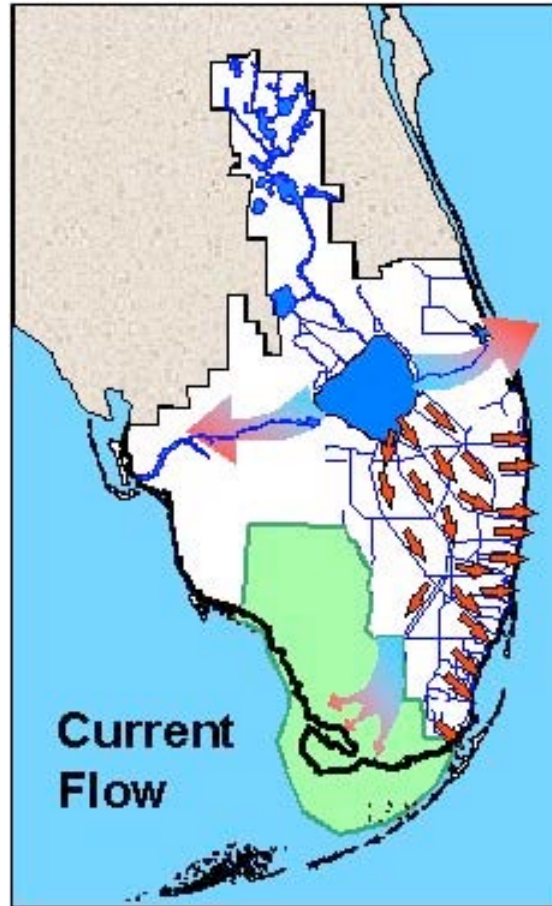


Figure 4. An example of an Everglades working hypothesis as diagramed in a conceptual model.

South Florida as a case study for ecosystem restoration and management



Fact Sheet: **The Comprehensive Everglades Restoration Plan (CERP)** English

Description: The Comprehensive Everglades Restoration Plan (CERP) will improve south Florida's ecosystem by restoring water flows that have changed tremendously over the past century. It is the largest environmental restoration effort in the world.

How It Works: CERP projects will capture and store as much as possible of the 1.7 billion gallons of fresh water a day which is currently released into the Atlantic Ocean and Gulf of Mexico. This water will be stored in above and underground reservoirs. When needed, it will be directed to the wetlands, lakes, rivers and estuaries of south Florida – providing abundant clean, fresh water – while also ensuring future urban and agricultural water supplies.

Connecting With Other Projects: The more than 50 projects that comprise CERP will work in concert with many other ongoing or planned environmental restoration projects of the federal government, state of Florida and local partners.

Geographic Area: The plan covers 16 counties of south Florida, with a growing population of more than 7 million residents.

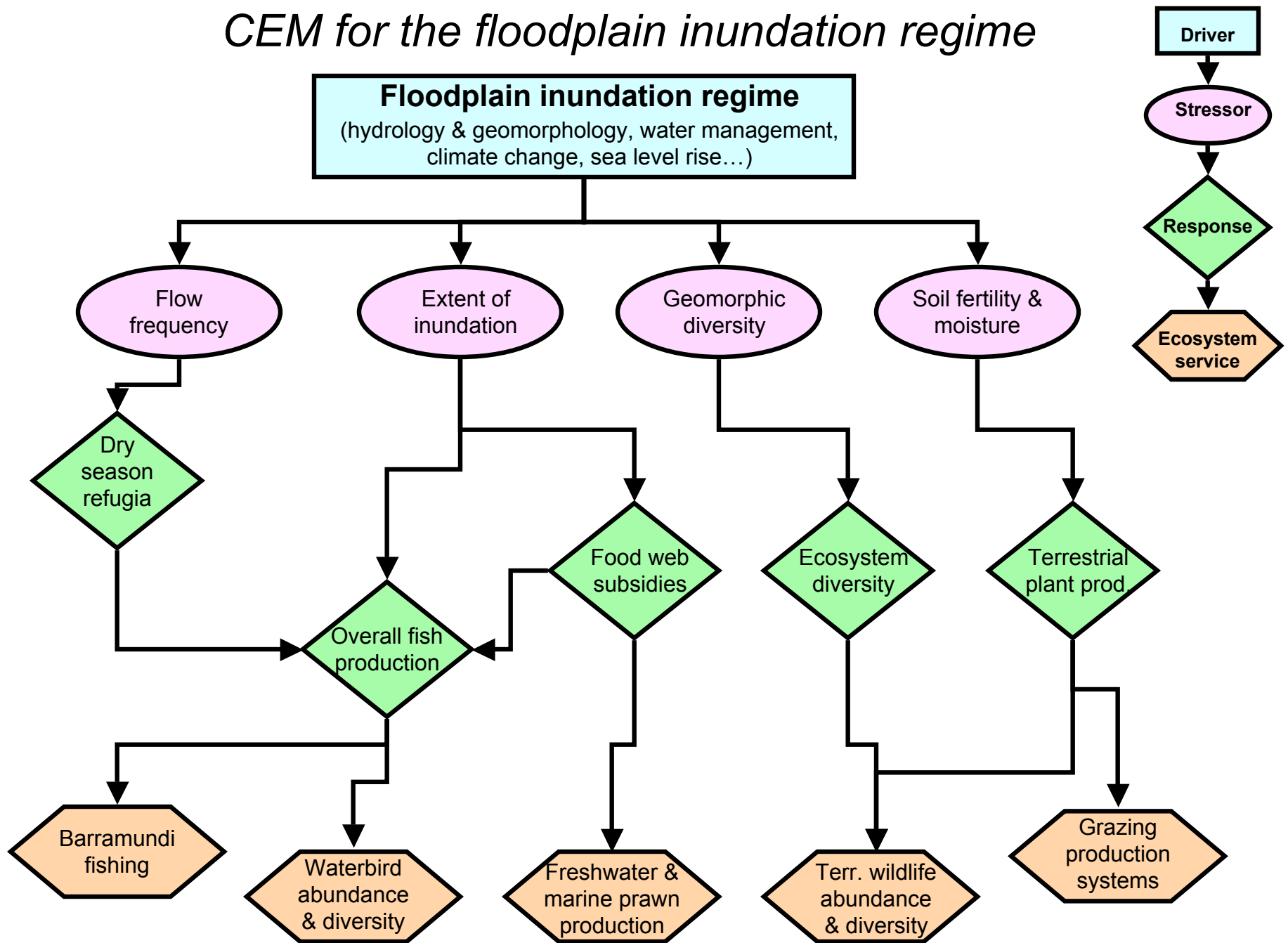
Where We Are Now: Congress authorized the Comprehensive Everglades Restoration Plan in 2000. Today, many individual CERP projects are being designed, land is being acquired, and many other related efforts are underway.

Total System CEM for the Everglades (Ogden et al. 2005)

Everglades regional submodel example (Davis et al. 2005)

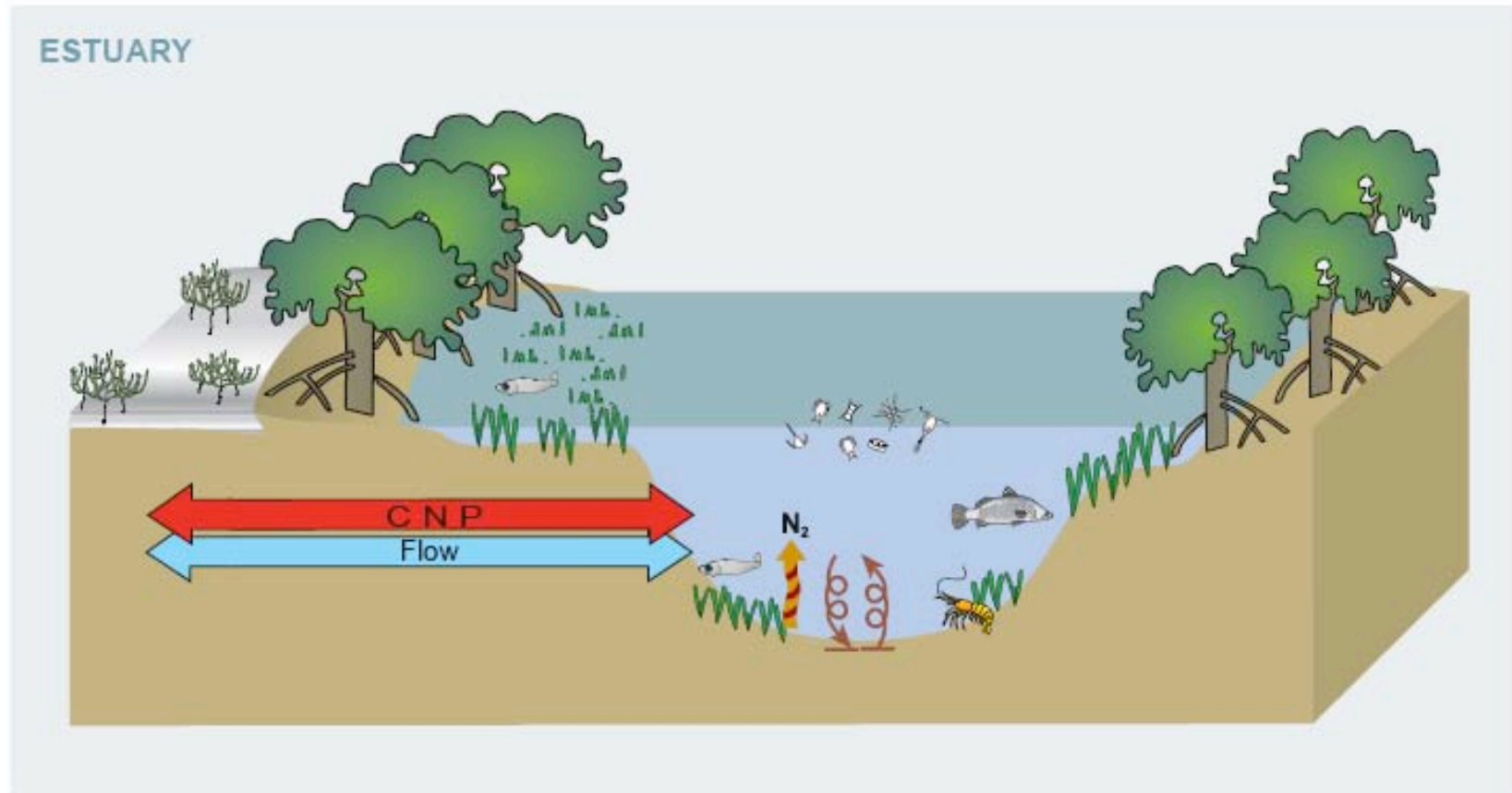
Florida Bay regional submodel example (Rudnick et al. 2005)

CEM for the floodplain inundation regime



Pictorial model: Coastal aquatic production

(by Emily Saeck)

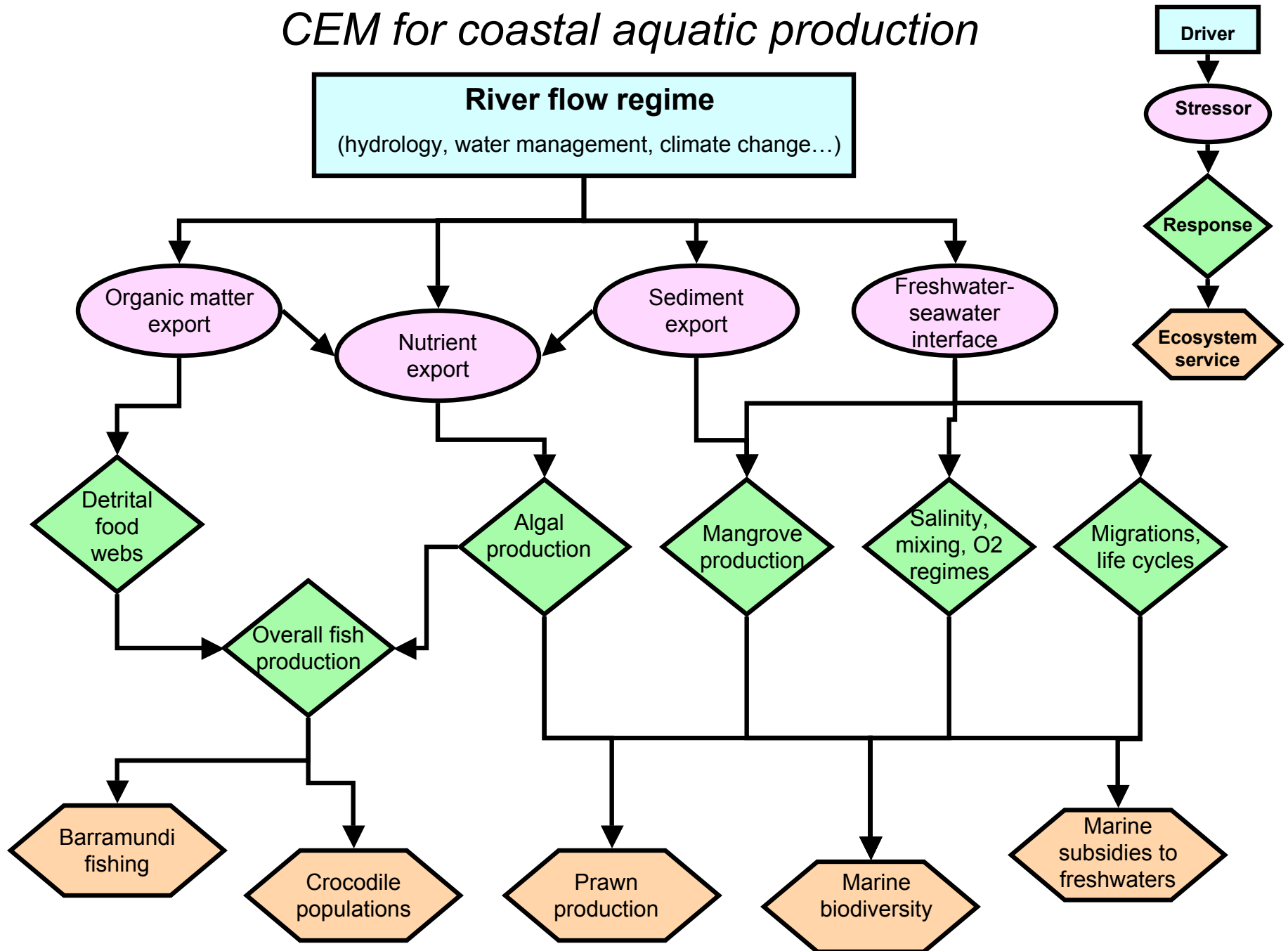


- There is nutrient (carbon, nitrogen & phosphorus) ↔ transfer between saltmarshes 🌿, mangroves 🌳, mudflats & the water column, this is facilitated by tidal processes.

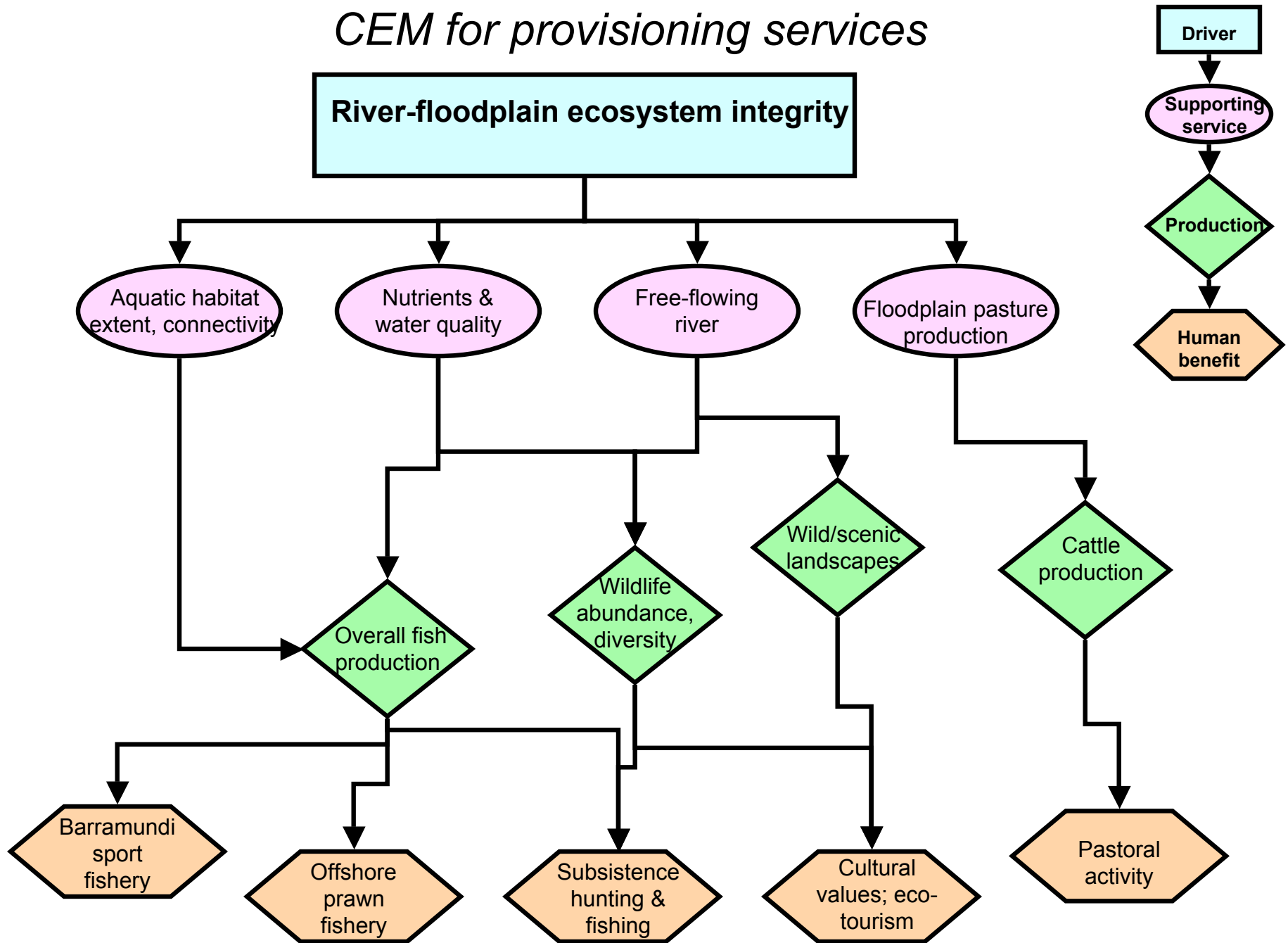
- Mangroves 🌳 & seagrass mudflats 🌿 provide valuable habitat for early stages of fish 🐟 & prawn 🦞 life cycles

- The resuspension & deposition of nutrients & sediments 🌊 in the estuary is influenced by river flow, tidal processes and prevailing weather conditions

CEM for coastal aquatic production



CEM for provisioning services



Usefulness of these models for TRaCK?

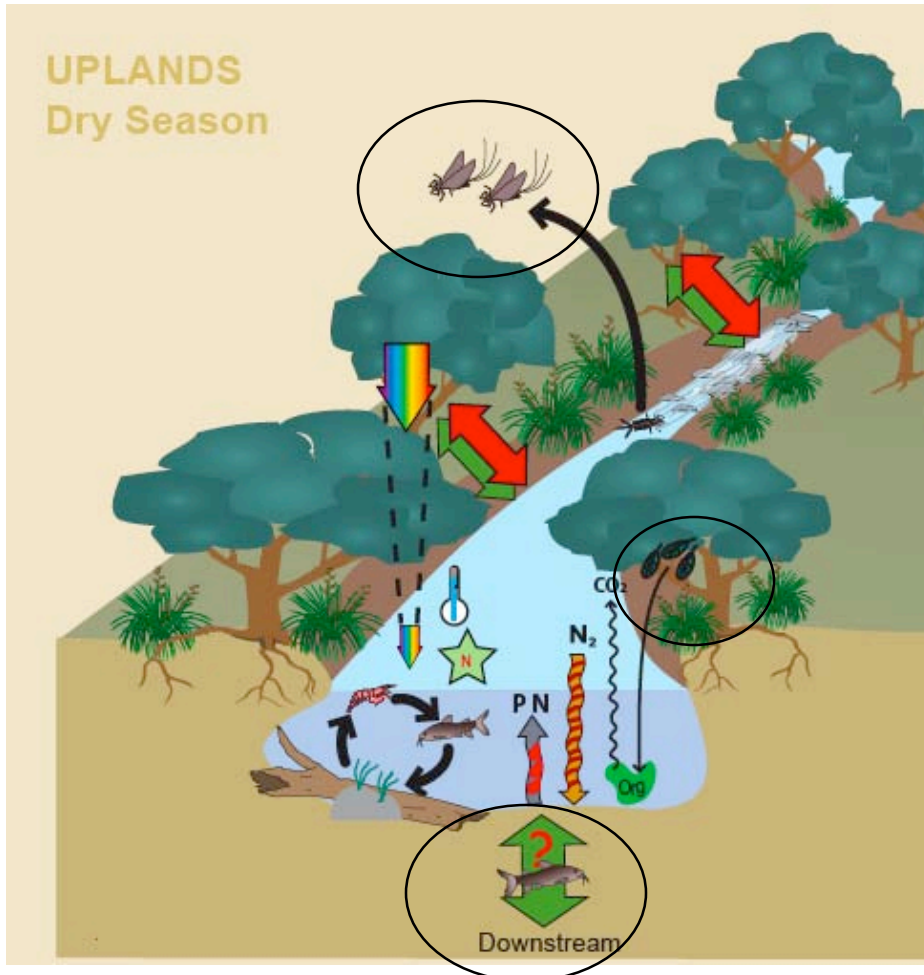
- ✦ Each style has its advantages and disadvantages
- ✦ CEMs may be best to outline causal relationships and the structure of quantitative models
- ✦ Data collection priorities would ideally follow CEMs
- ✦ Pictorial depictions may be better for communicating with lay audiences
- ✦ Should further work on these CEMs be a near-term priority?



Features in the Tropical Rivers Landscape

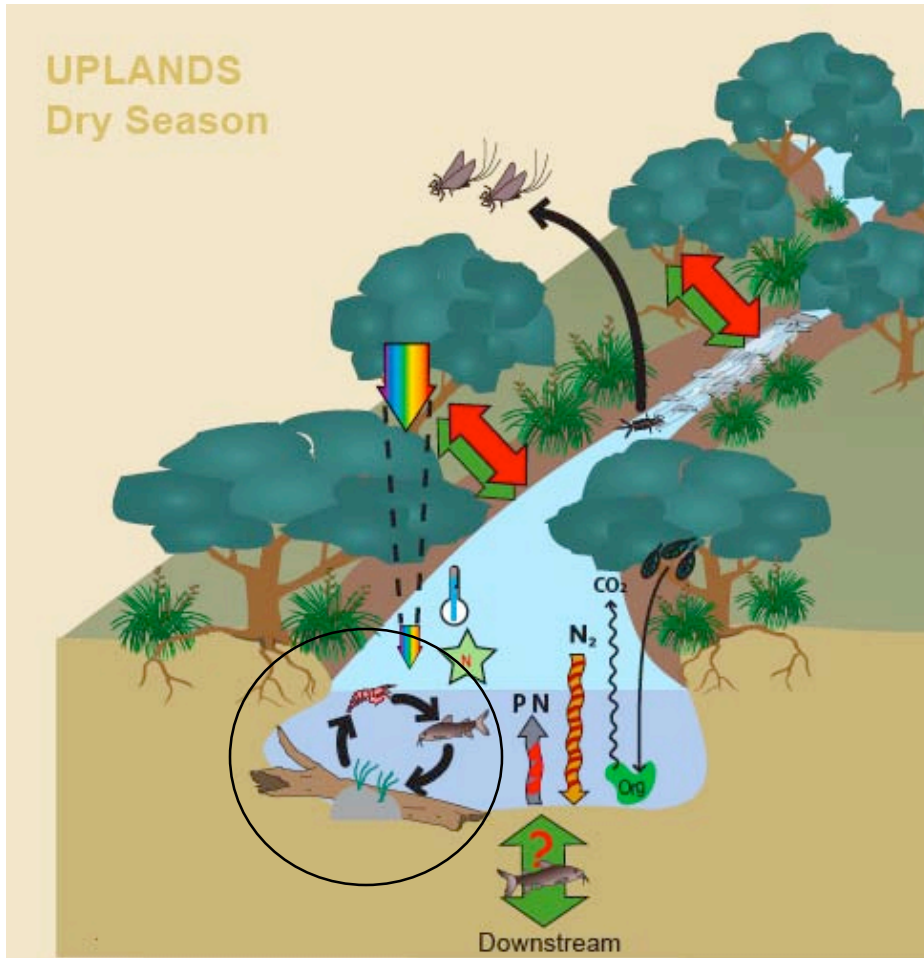


Project 5.1 Food webs: Upland streams



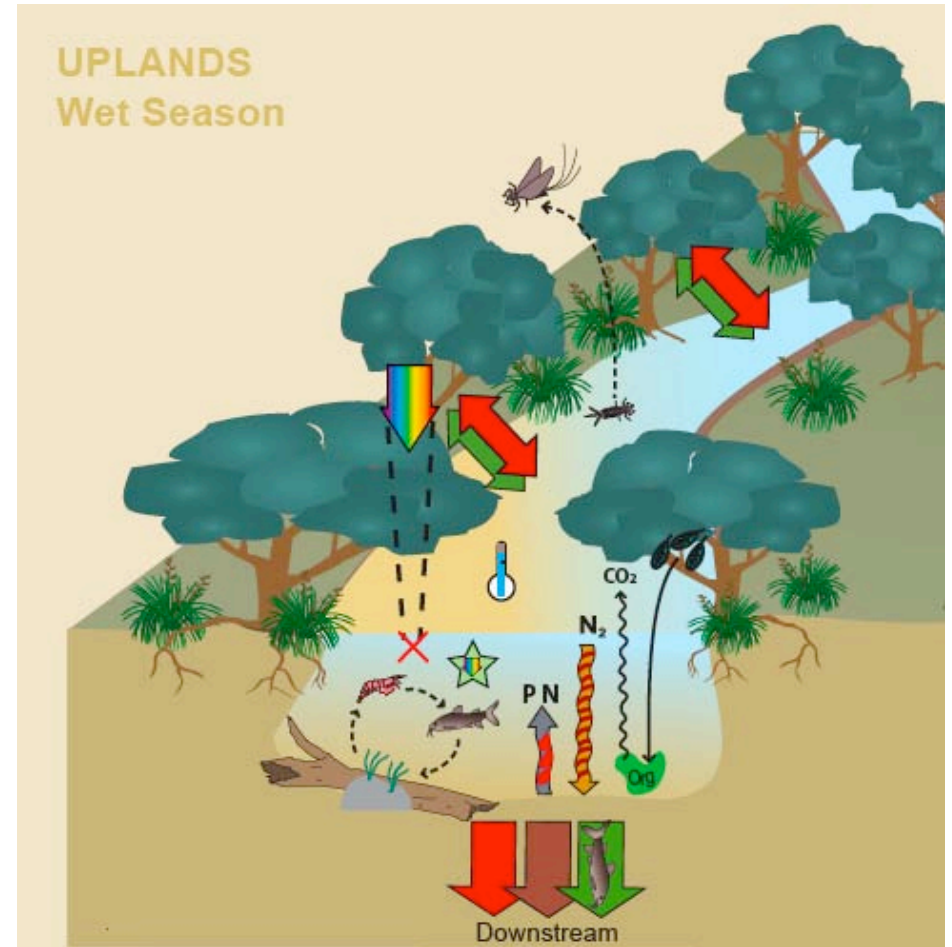
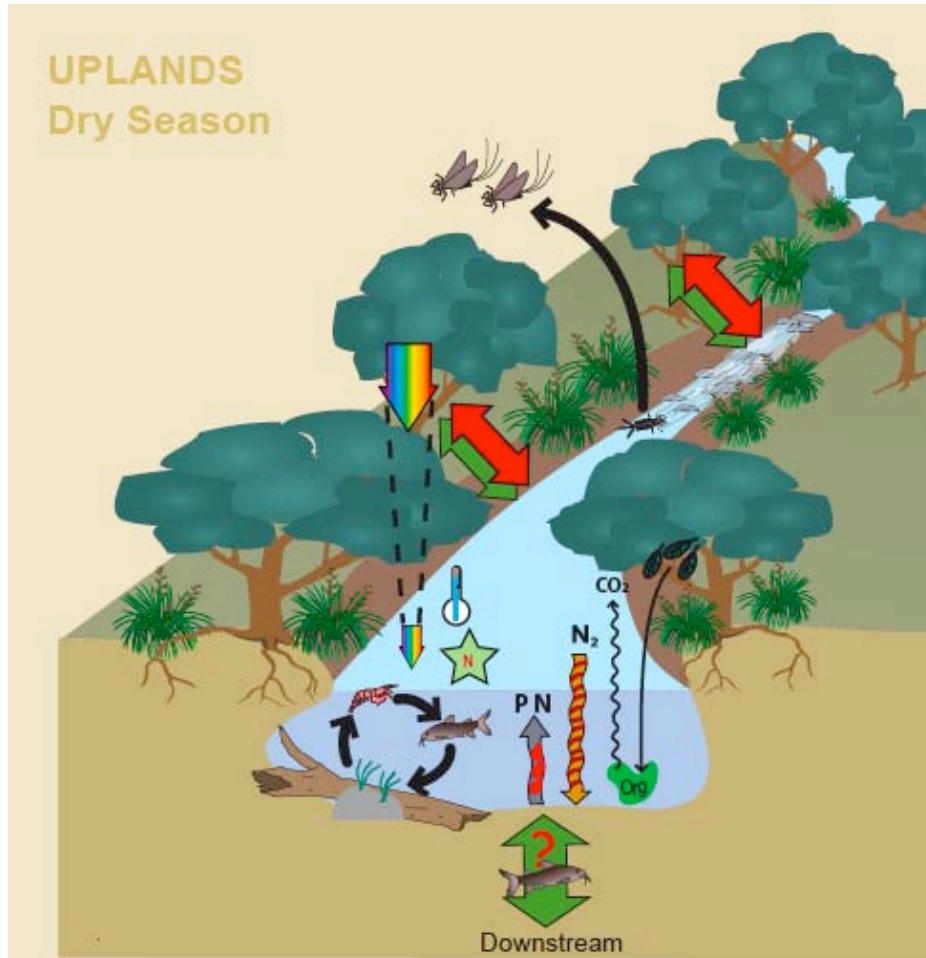
Subsidies

Project 5.1 Food webs: Upland streams



Strong interactors

Project 5.1 Food webs: Upland streams



References for Everglades models

- Ogden, J.C., S.M. Davis, T.K. Barnes, K.J. Jacobs and J.H. Gentile. 2005a. Total system conceptual ecological model. *Wetlands* 25(4):955-979
- Ogden J.C., S.M. Davis, K.J. Jacobs, T. Barnes, and H.E. Fling. 2005b. The use of conceptual ecological models to guide ecosystem restoration in South Florida. *Wetlands* 25(4):795-809
- Rudnick, D.T., P.B. Ortner, J.A. Browder, and S.M. Davis. 2005. Florida Bay conceptual ecological model. *Wetlands* 25(4):870-883.

Distinctive features

Climate:

Wet/dry (strong dry season)

Episodic storm runoff, river flow

Low nutrient status

Low production

Vegetation less palatable

High inorganic turbidity in some systems

Seasonal isolation of floodplain from river

Fewer aquatic refuges

Marine origin of floodplain soils on coastal plains

Macro- to microtidal regimes

Oligotrophic marine

ecosystem