



Environmental Flows for Northern Australian Rivers & Estuaries

Peter Davies¹, **Danielle Warfe**², Neil Pettit¹, Michael Douglas²,
Stuart Bunn³, Mark Kennard³, Brad Pusey³, Simon Townsend²,
Michele Burford³, Andrew Brooks³, Sue Jackson⁴, Marcus Finn⁴,
Ian Halliday⁵ and Eric Valentine³

¹University of Western Australia

²Charles Darwin University

³Griffith University

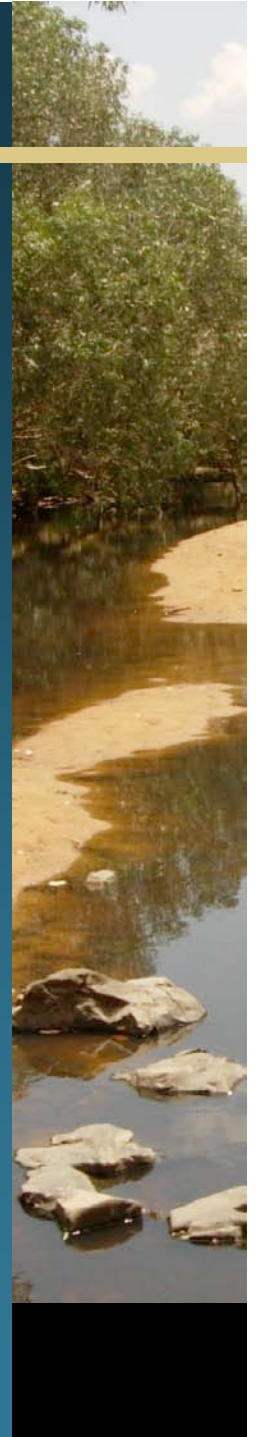
⁴CSIRO

⁵Dept. Primary Industries & Fisheries, Qld.

Environmental flows

Those parts of a river's water required to achieve ecological objectives and/or sustain river health in a particular state, and at a low level of risk.

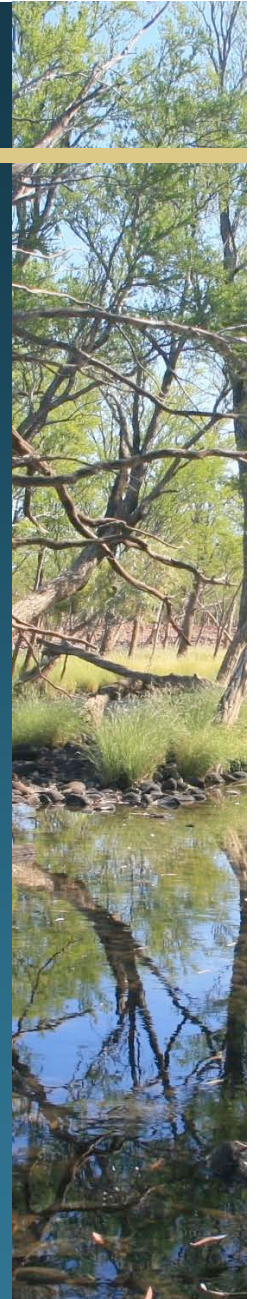
“Providing water for the environment is essential to ensure the restoration of ecological processes and to preserve the biodiversity of water-dependent ecosystems” *National Water Initiative*



The Natural Flow Paradigm

Ecological structure and function of rivers and estuaries evolved to, and driven by, the pattern of naturally occurring (historic) flows

- magnitude
- frequency
- duration
- timing
- predictability



Variability is key

NATURAL FLOW
VARIABILITY



PHYSICAL
HETEROGENEITY



BIODIVERSITY &
ECOSYSTEM PROCESSES

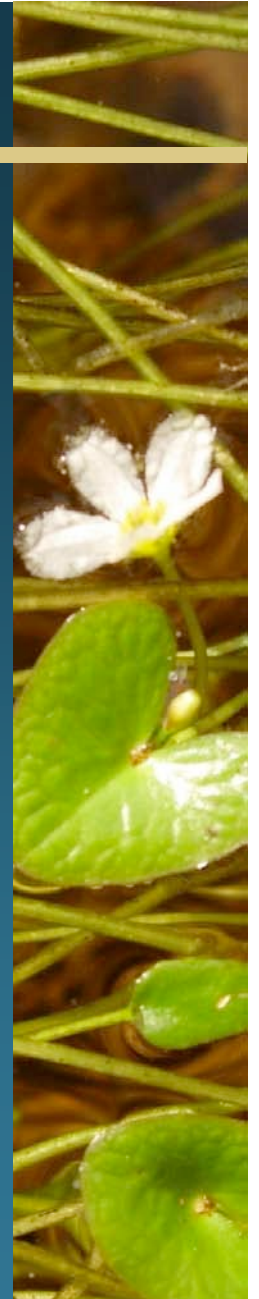
Walker *et al.* 1995. *Regulated Rivers: Research & Management* 11:85

Poff *et al.* 1997. *Bioscience* 47:769

Ward *et al.* 2001. *Regulated Rivers: Research & Management* 17:311

Bunn & Arthington 2002. *Environmental Management* 30:492

Naiman *et al.* 2008. *C.R. Geoscience* doi:10.1016/j.crte.2008.01.002



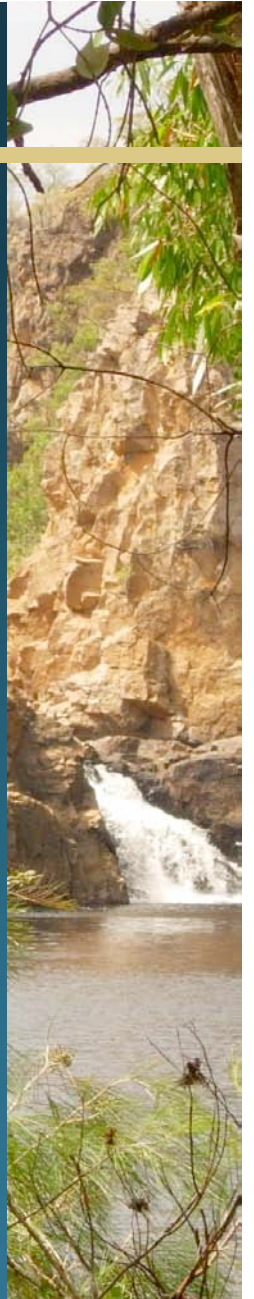
Characteristics of tropical rivers

- Strong seasonal hydrology
- Predominantly intermittent, or stable baseflows during dry
- Largely event-driven during wet
- High inter-annual variability
- High drought severity
- Limited natural storage capacity



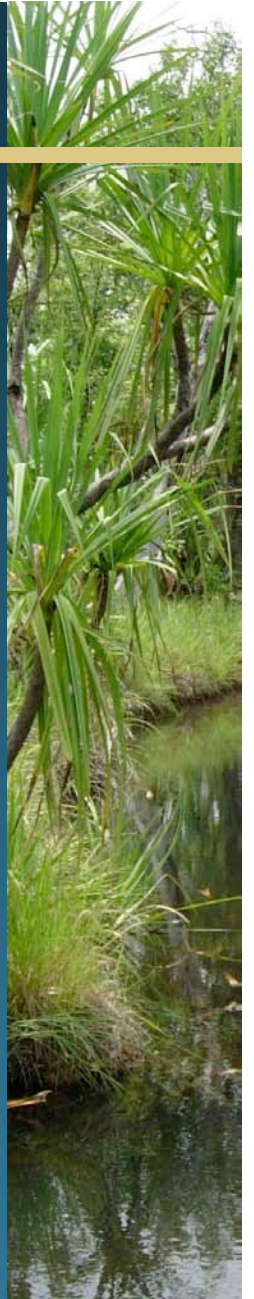
Characteristics of tropical rivers

- Limited primary production
- Greater trophic diversity in fish assemblages
- Omnivory common
- Dynamic riparian and littoral zone



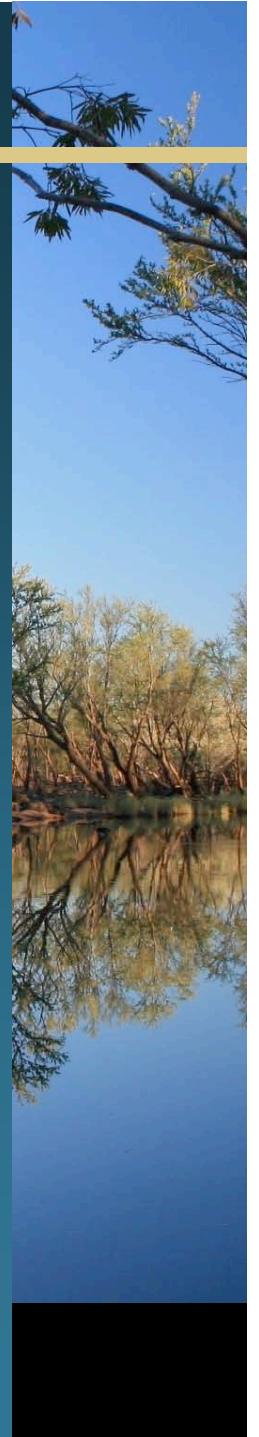
General principles

- Seasonal hydrology is the primary driver of aquatic food-web structure and ecosystem processes
- Hydrological connectivity, when intact, underpins important lateral and longitudinal food-web subsidies



General principles

- River and wetland food webs are strongly dependent on algal production
- A few common macroconsumer species have a disproportionately strong influence on benthic food webs
- Omnivory is widespread and food webs are short



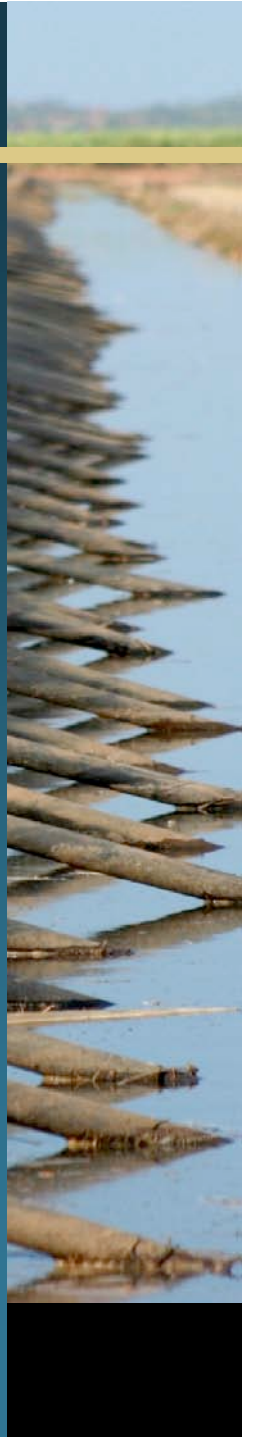
Potential water use impacts

Dry season
abstraction

- hydrological connectivity
- water quality
- instream hydraulics

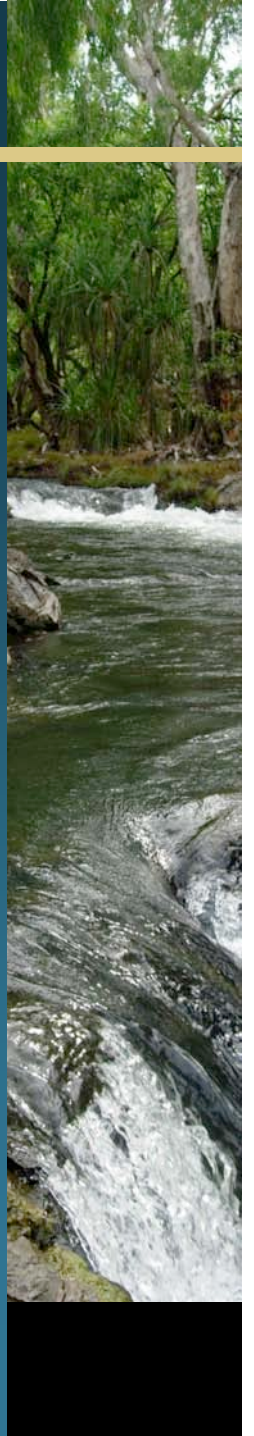
Wet season
flood harvesting

- flood duration & extent
- groundwater recharge
- riparian vegetation
- material transport
- coastal fisheries



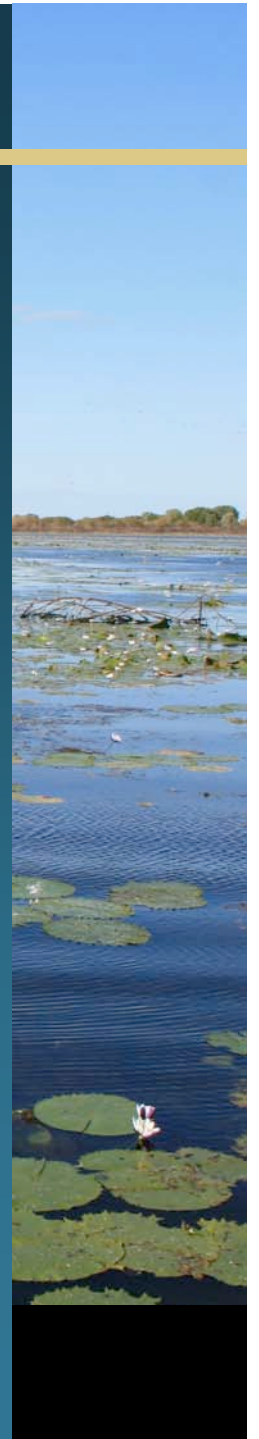
Knowledge gaps

- Site-specific information largely absent
- Empirical flow-ecology relationships
- Defining appropriate variability



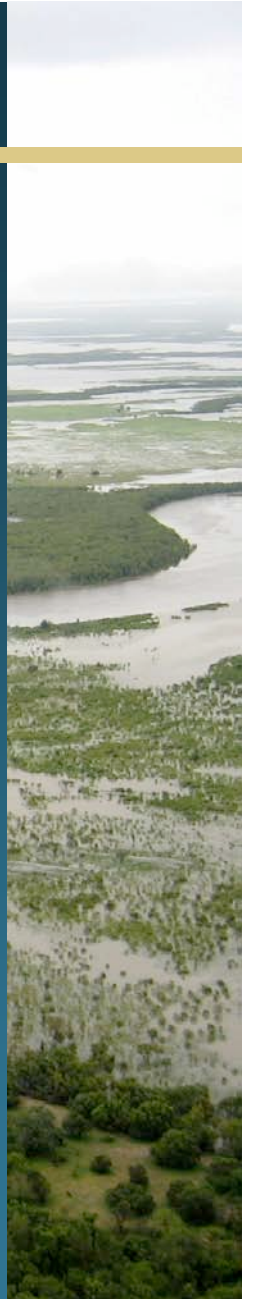
Environmental Flow Tools

- Much of TRaCK research focussed on relationships between flow and ecological structure and function of rivers and estuaries.
- Environmental Flow Tools project (TRaCK Project 5.7) to distill the findings from flow-related TRaCK research for water managers and planners.



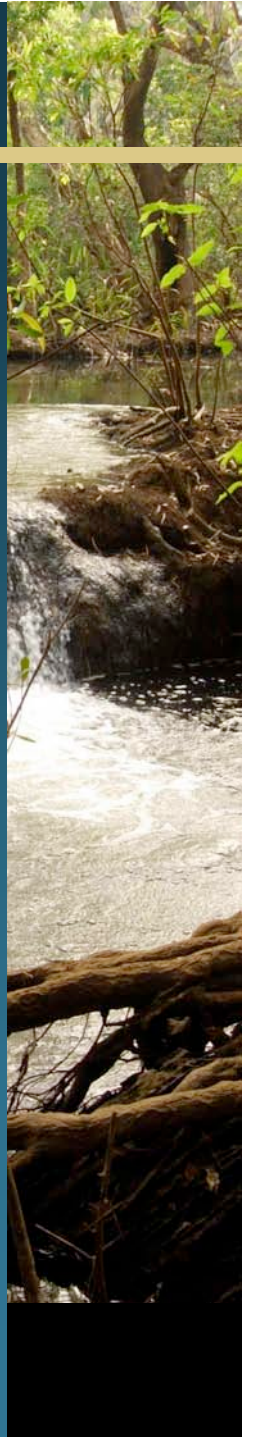
Project objectives

- To highlight attributes of natural flow regimes required for maintenance of ecological and cultural values and assets in northern rivers and estuaries.
- To provide water managers and planners with a set of practical tools and guidelines.
- To provide a consistent and transparent basis for environmental flow prescriptions for northern rivers and estuaries.

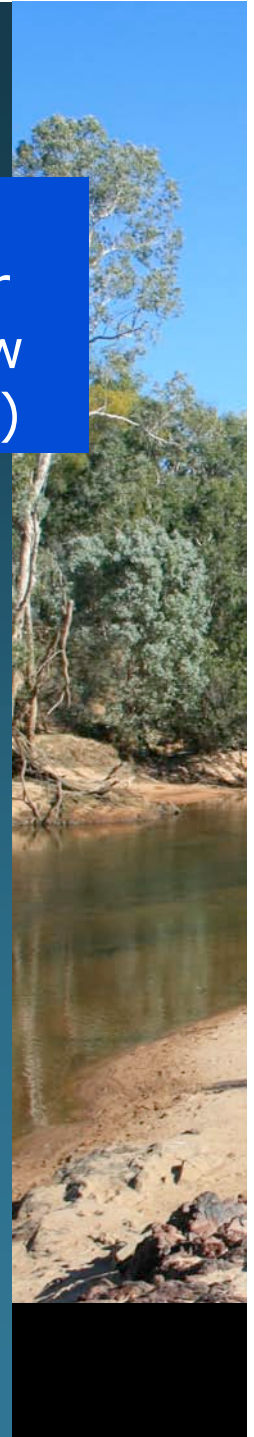
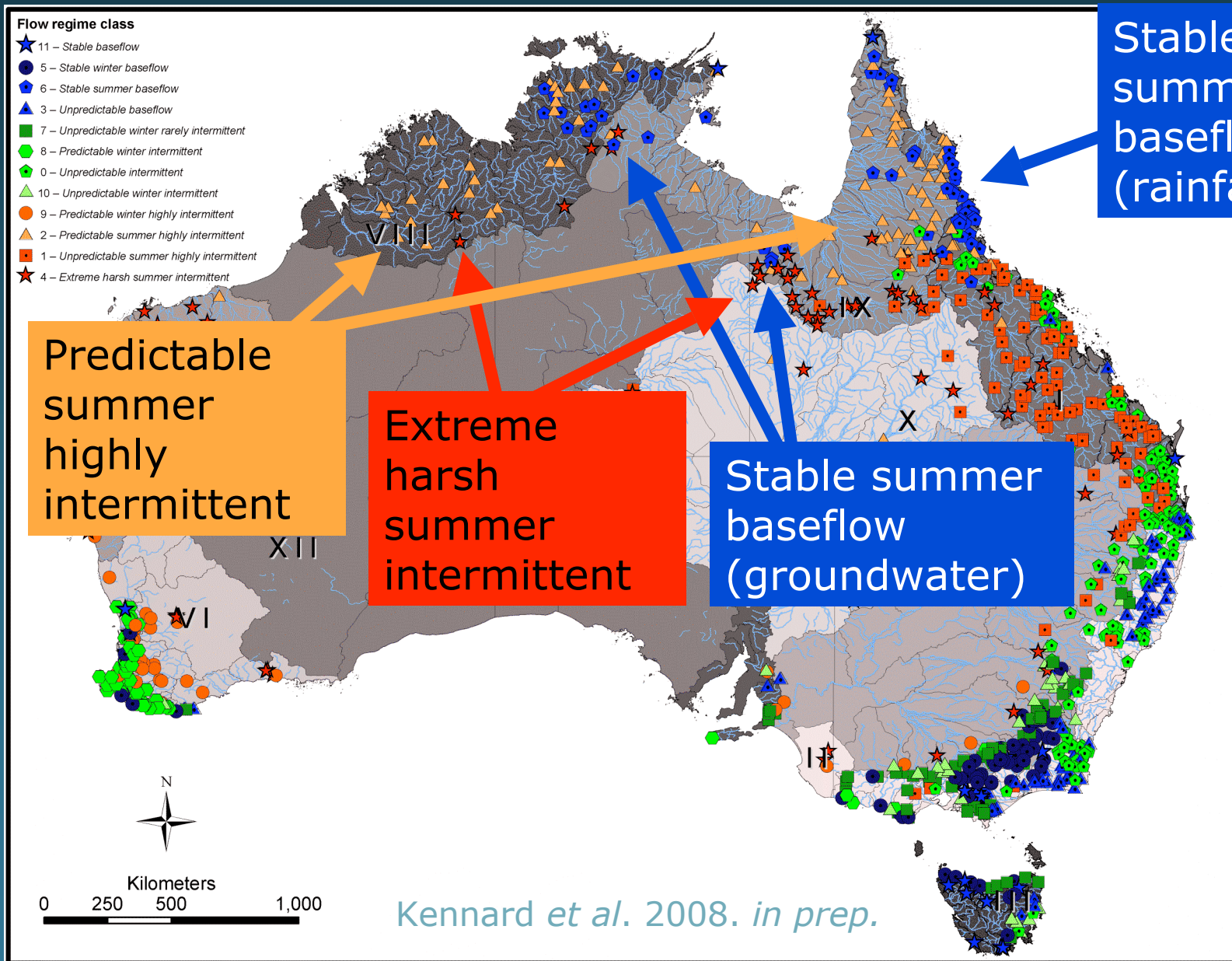


TRaCK flow-related research

- 1.1 Scenario assessment
- 2.2 Indigenous values and river flows
- 3.3 Ecohydrological regionalisation of Australia
- 4.2 Sediment budgets
- 4.3 Nutrients and productivity in the Daly
- 4.4 Bedload transport
- 5.1 Riverine food webs
- 5.2 Refugial waterholes
- 5.3 River-floodplain subsidies
- 5.4 Catchment development and estuarine health
- 5.5 Flow-ecology relationships
- 5.6 Flow impacts on estuarine finfish



Ecohydrological regionalisation

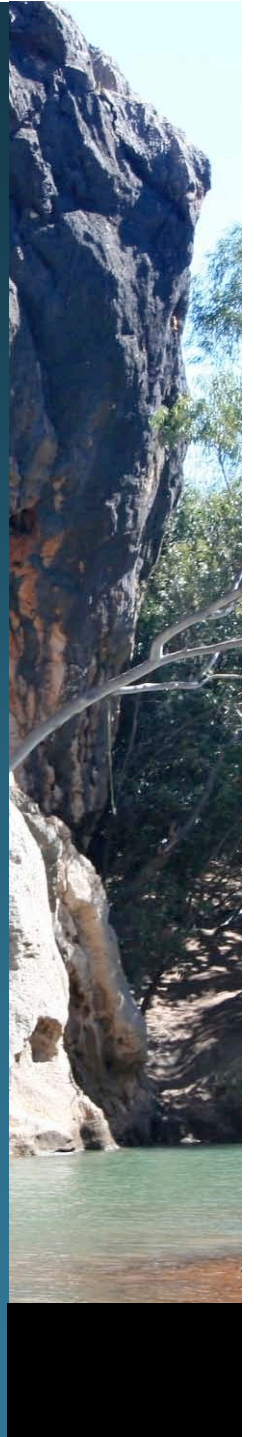


Ecological Limits of Hydrological Alteration (ELOHA)

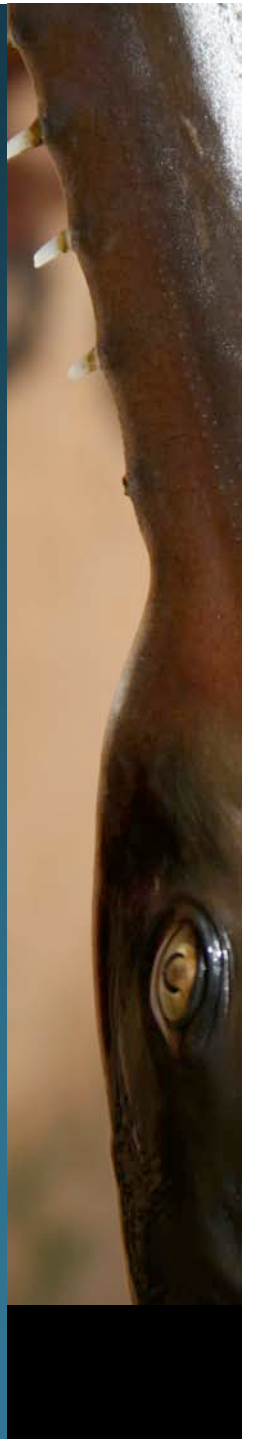
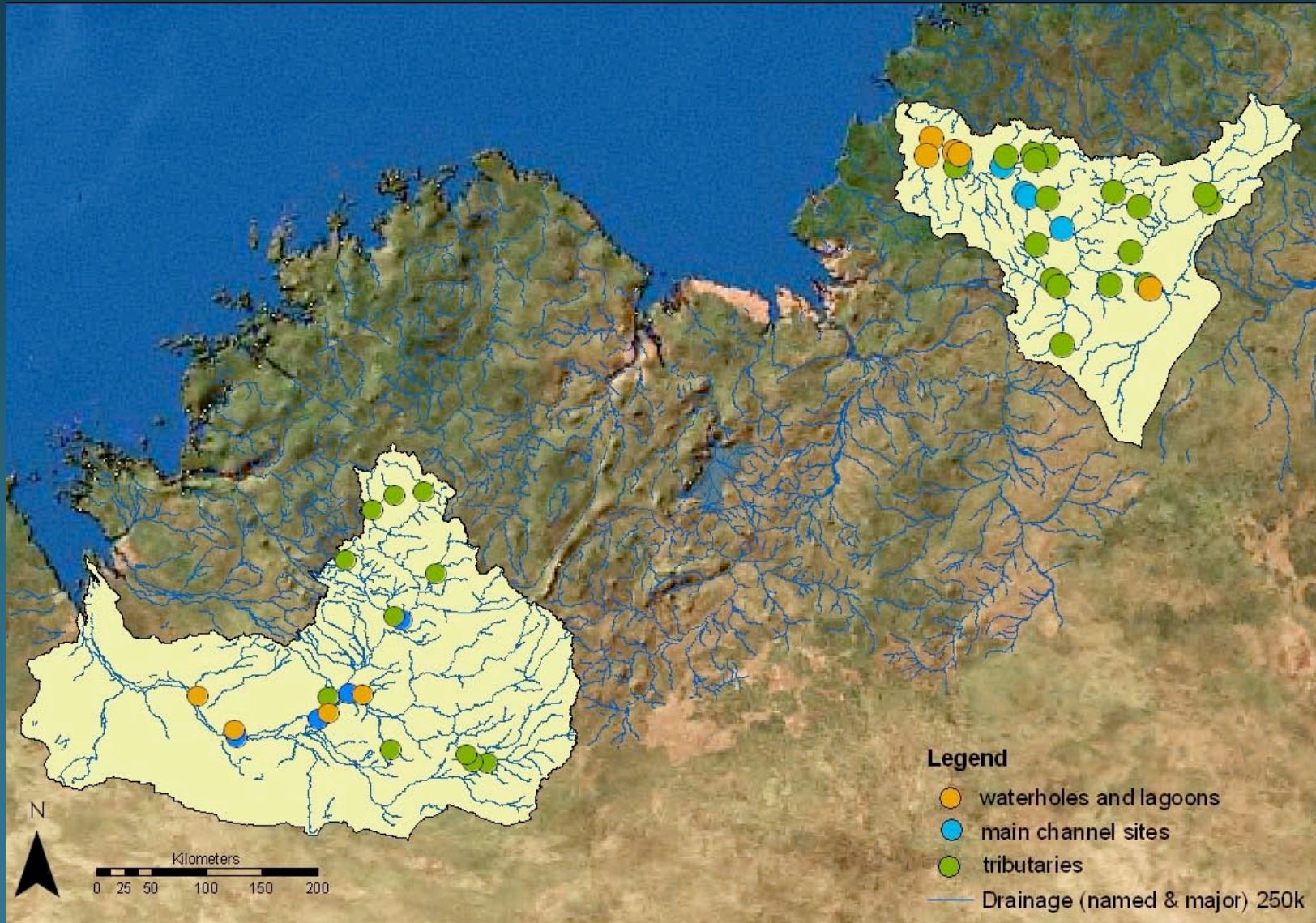
1. Build hydrological foundation of baseline and current hydrographs
2. Classify rivers into distinct flow regime types using ecologically-relevant metrics
3. Establish deviation of current flow conditions from baseline conditions
4. Develop relationships between flow alteration and ecological response for each river "type"

Arthington *et al.* 2006. *Ecological Applications* 16:1311

Poff *et al.* 2008. *in press.*



Food web structure

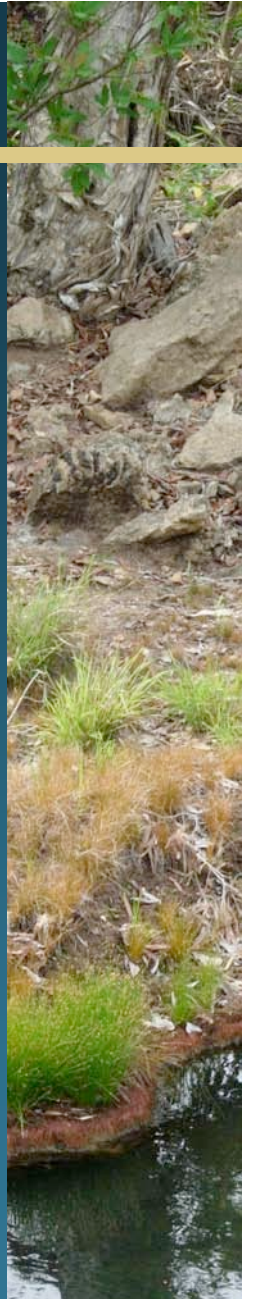


Integration

Consultation with regional water managers and planners

Inputs from TRaCK projects

- Objectives of research project
- Relevant flow factors in research design
- Scale at which project is related to environmental flows
- Major flow-related findings



Integration

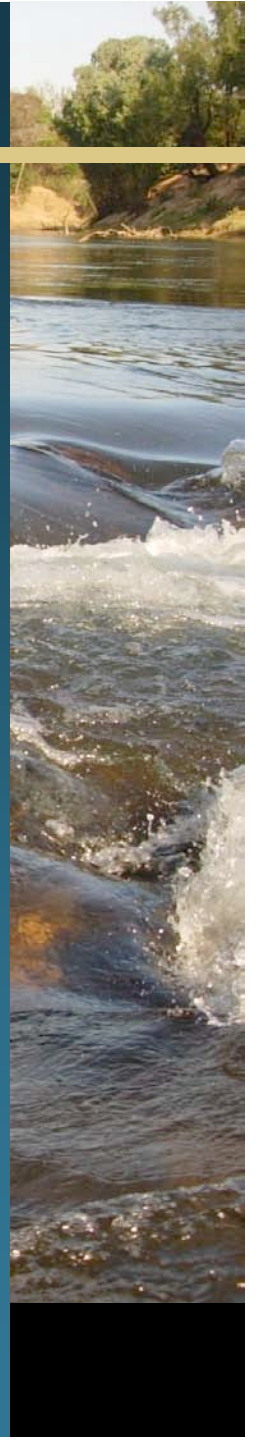
Inputs from TRaCK projects

- Transferral of findings to water allocation management
- Suggested environmental flow tools
- Indicators and guidelines for monitoring water allocations



Flow tools for northern rivers and estuaries

- Values and threats
- Theoretical context (incl. conceptual ecological models)
- Legislative and planning requirements
- Project findings (flow relationships, tools and guidelines)
- Monitoring recommendations



Acknowledgements

TRaCK brings together leading tropical river researchers and managers from Charles Darwin University, Griffith University, University of Western Australia, CSIRO, James Cook University, Australian National University, Geoscience Australia, Environmental Research Institute of the Supervising Scientist, Australian Institute of Marine Science, North Australia Indigenous Land and Sea Management Alliance, and the Governments of Queensland, Northern Territory and Western Australia.



Australian Government

Department of the Environment,
Water, Heritage and the Arts

Land & Water Australia

National Water Commission

TRaCK receives major funding for its research through the Australian Government's Commonwealth Environment Research Facilities initiative; the Australian Government's Raising National Water Standards Programme; Land and Water Australia and the Queensland Government's Smart State Innovation Fund.