

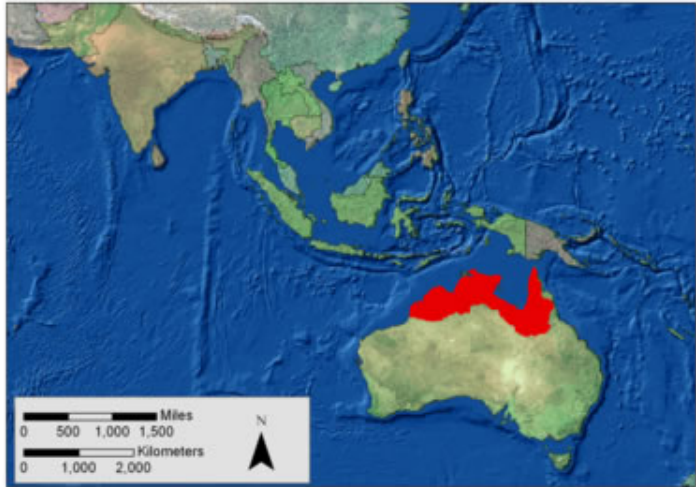
CLIMATE CHANGE AND MANAGEMENT OF TROPICAL WATERS IN THE AUSTRALIAN DRY TROPICS

Damien Burrows and Barry Butler

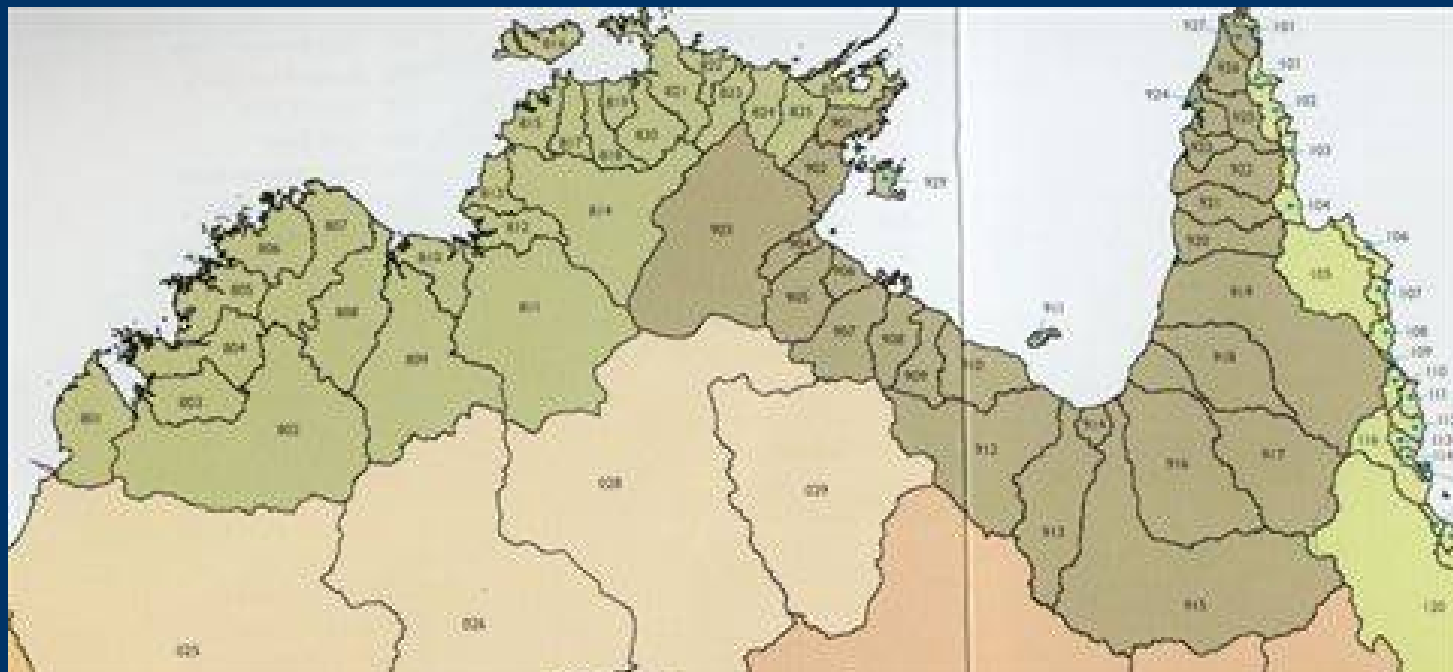
Australian Centre for Tropical Freshwater Research
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Pressure to Develop North Australia



- Northern part of Australia has very low population and thus development but most of the country's rainfall
- There is now much pressure to further develop this vast region – to become an 'international foodbowl'.
- This would be a 21st century development of a relatively intact region - can we manage it right?



Features of Dry Tropical Streams

- Most waterways run for only short periods
- Aquatic resources concentrated into discrete waterholes for most of the time
- Occupy a very small area, but are very important for protecting aquatic resources
- Small size and limiting conditions make them vulnerable to impacts incl. climate change



Major Climate Change Scenarios

- Lower dry season rainfall
- Reduced dry season streamflow
- Greater disconnection between habitats
- Higher water temperatures
- Smaller, more vulnerable waterholes (and less of them)

Northern Australia Aquatic Adaptation Priorities

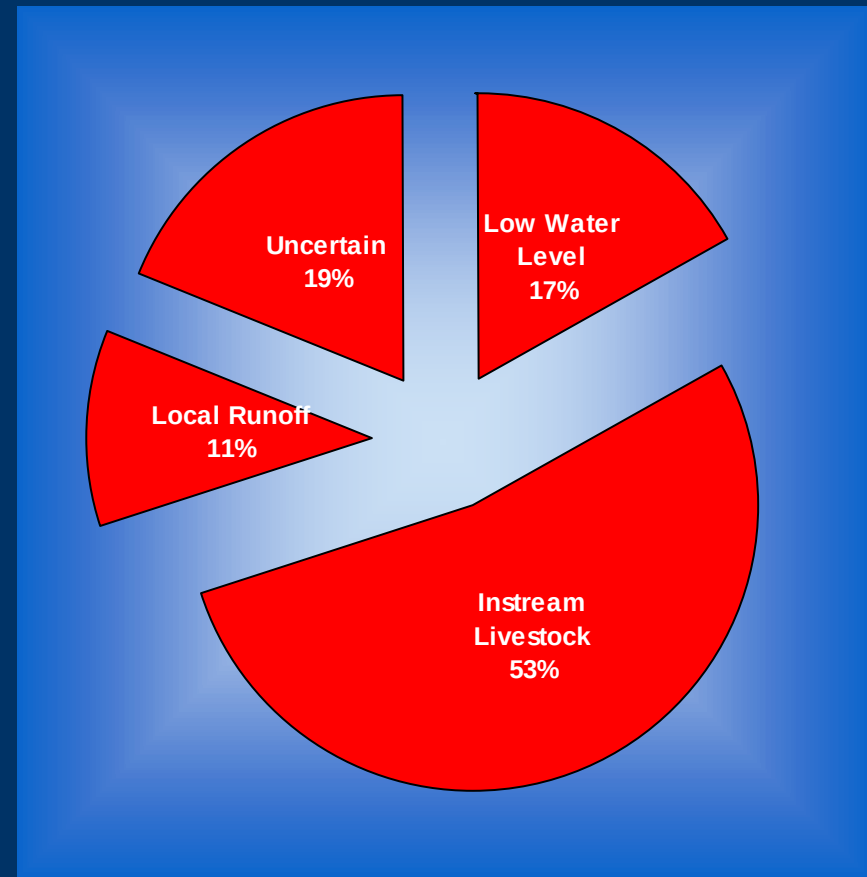
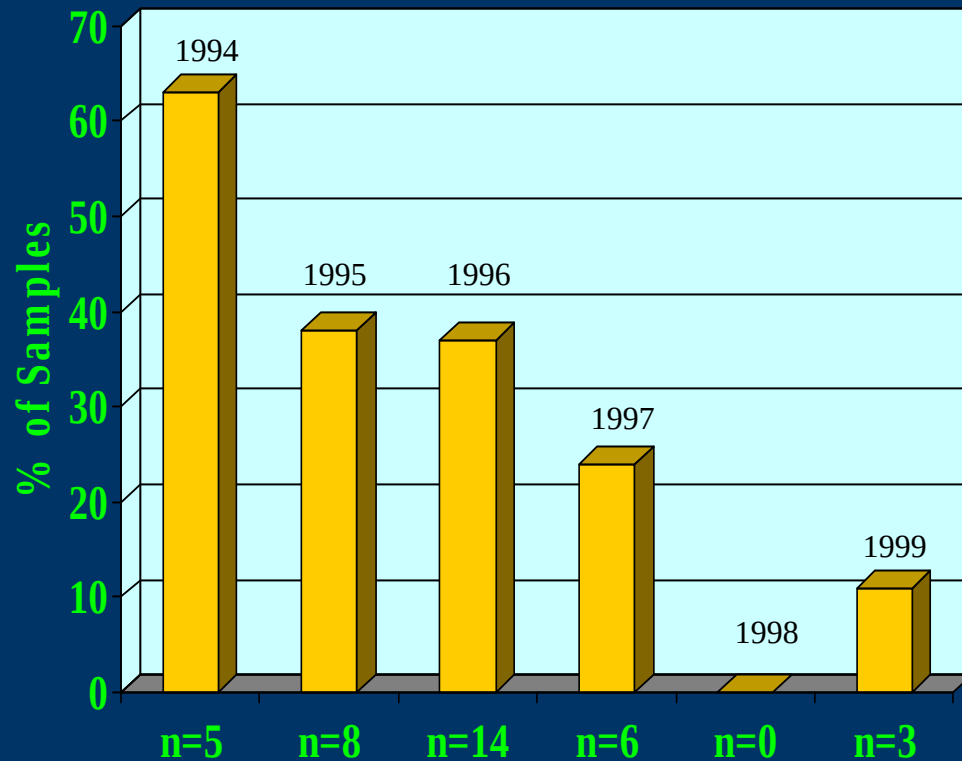
- Identification and protection of key assets
- Adapting land management practices
- Increased distribution and impact of exotic species
- Tolerance thresholds for key fauna/flora and ecological processes

Land Management

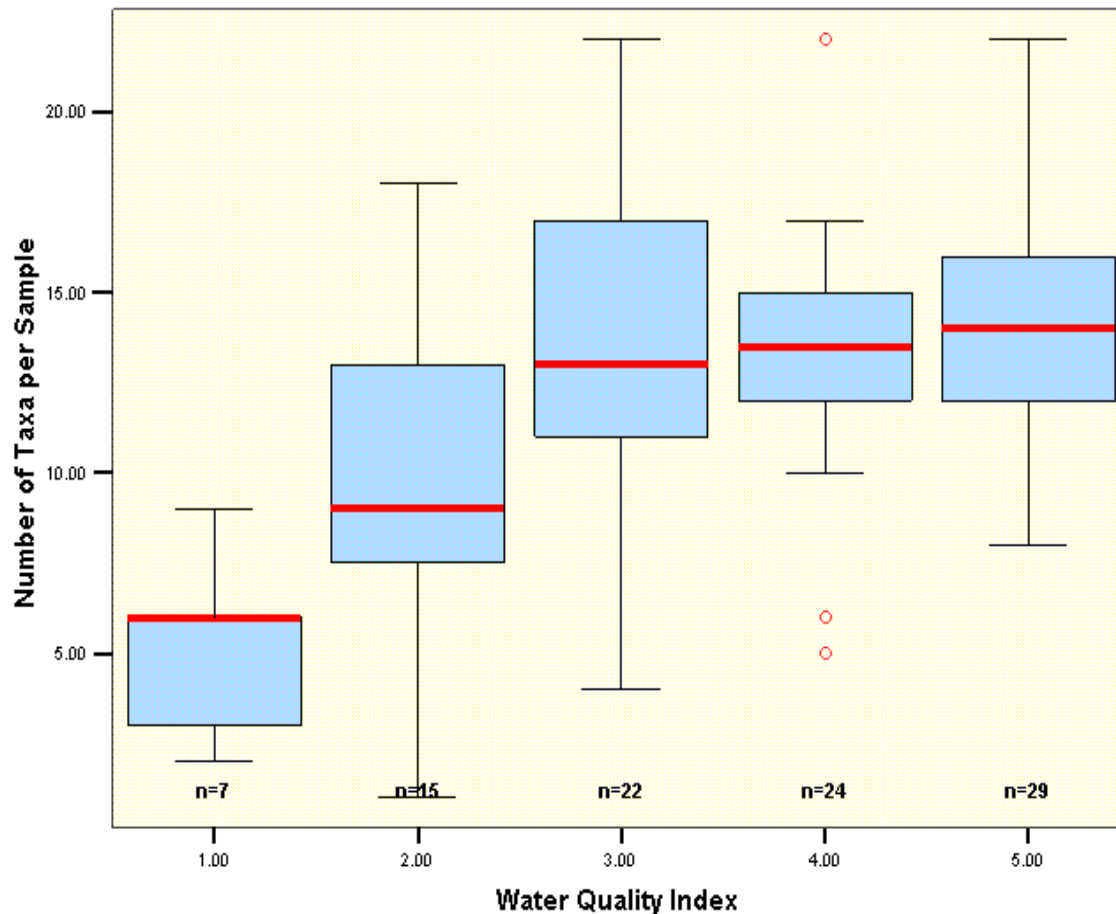
- Cattle grazing is dominant land use
- Feral pigs and riparian weeds are great threats to northern aquatic ecosystems
- The land requires active management (eg, fire, weeds, etc.)



Instances of Poor Water Quality n=36



Effects of Water Quality on Biota



Riparian Fencing

- Most common means of managing unrestricted cattle access to waterholes
- Significant improvement in water quality and riparian vegetation cover
- High degree of adoption by landowners and govt incentives – considered to be very successful
- Climate change will heighten the need for such management
- Science needed to prioritise fencing locations



Figure 1 Comparison of Water Clarity at Fenced and Unfenced Sites

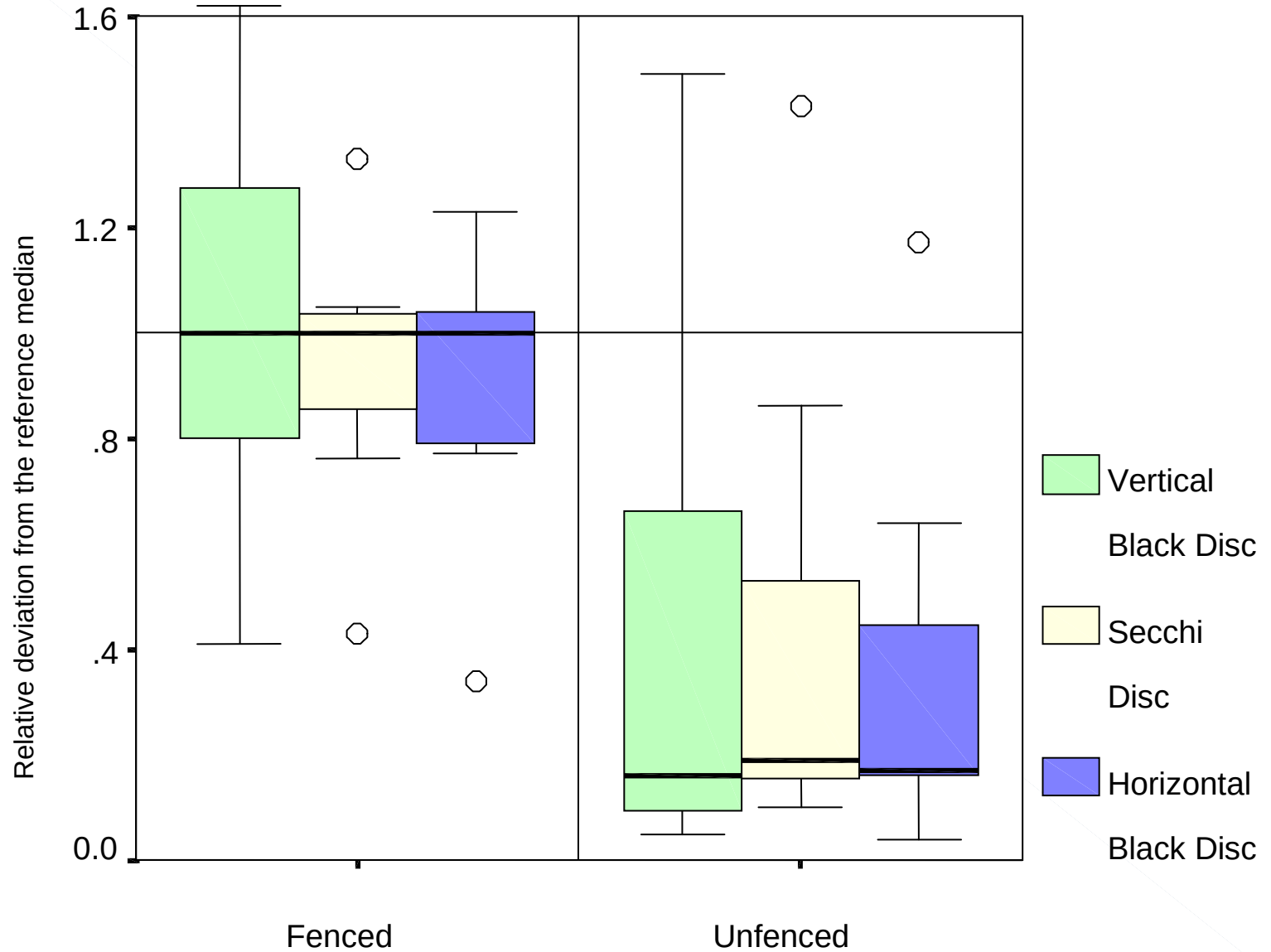
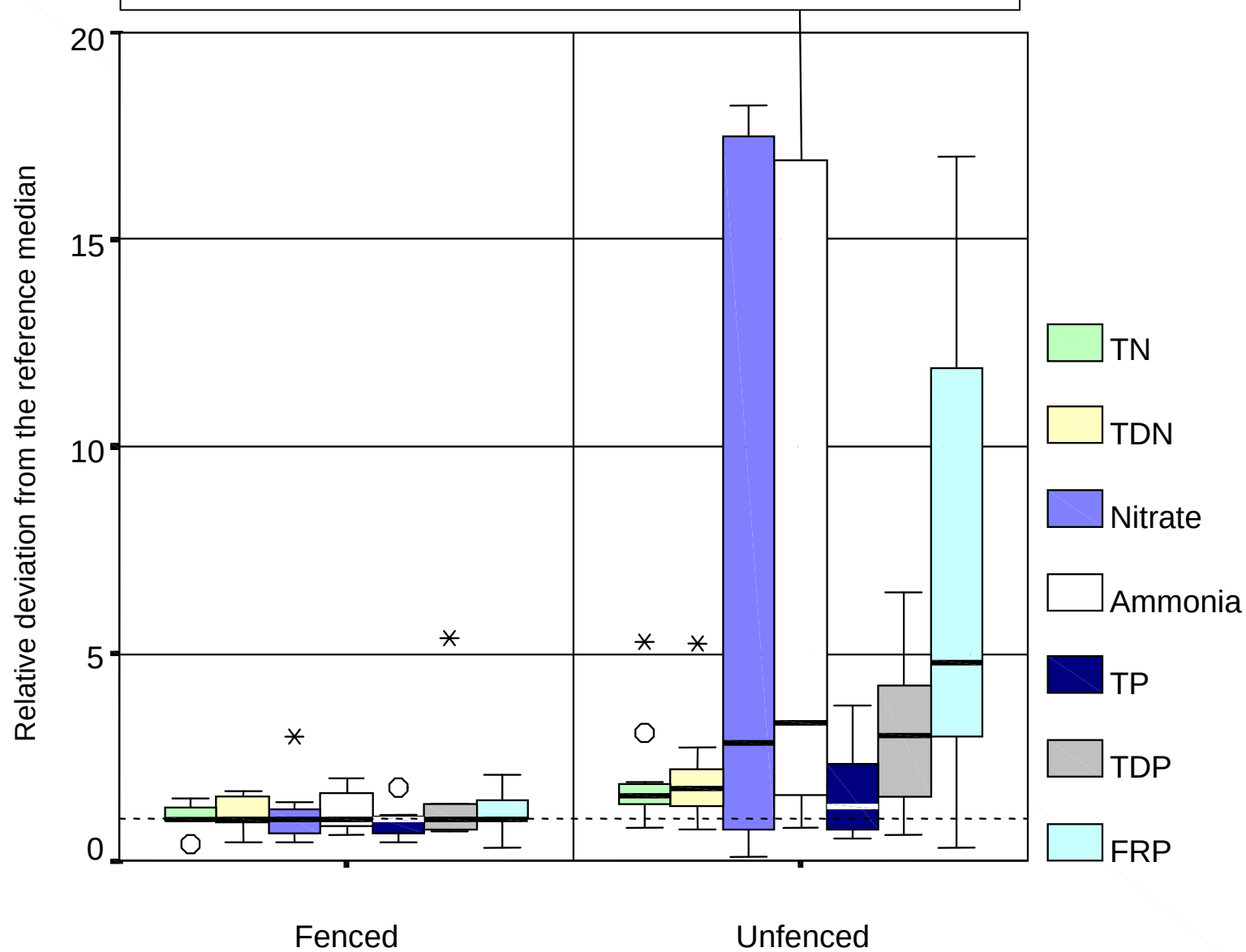


Figure 3 Comparison of Nutrient Levels at Fenced and Unfenced Sites



Feral Pigs

- Major problem in northern Australia
- Devastate waterholes and wetlands
- Lots of effort on control but little on impact
- Fencing trial just being completed now
- Pigs completely turnover the substrate, greatly affecting water quality, especially water clarity
- Almost aquatic and semi-aquatic plants and associated birds
- Predate upon turtles and other fauna



Identifying Assets

- Increasing development pressure, climate change and the need to prioritise limited management funding (ie, there are thousands of waterbodies out there but only a few will get funding or better management, so how do we strategically select which ones)
- Need to identify environmental assets, record their ecological status and management requirements
- The challenge is how to do this rapidly over large, remote catchments with little existing baseline information
- Remote sensing study focused on permanency and water clarity as these have significant ecological meaning and can be assessed using satellite imagery
- Trialled across northern catchments

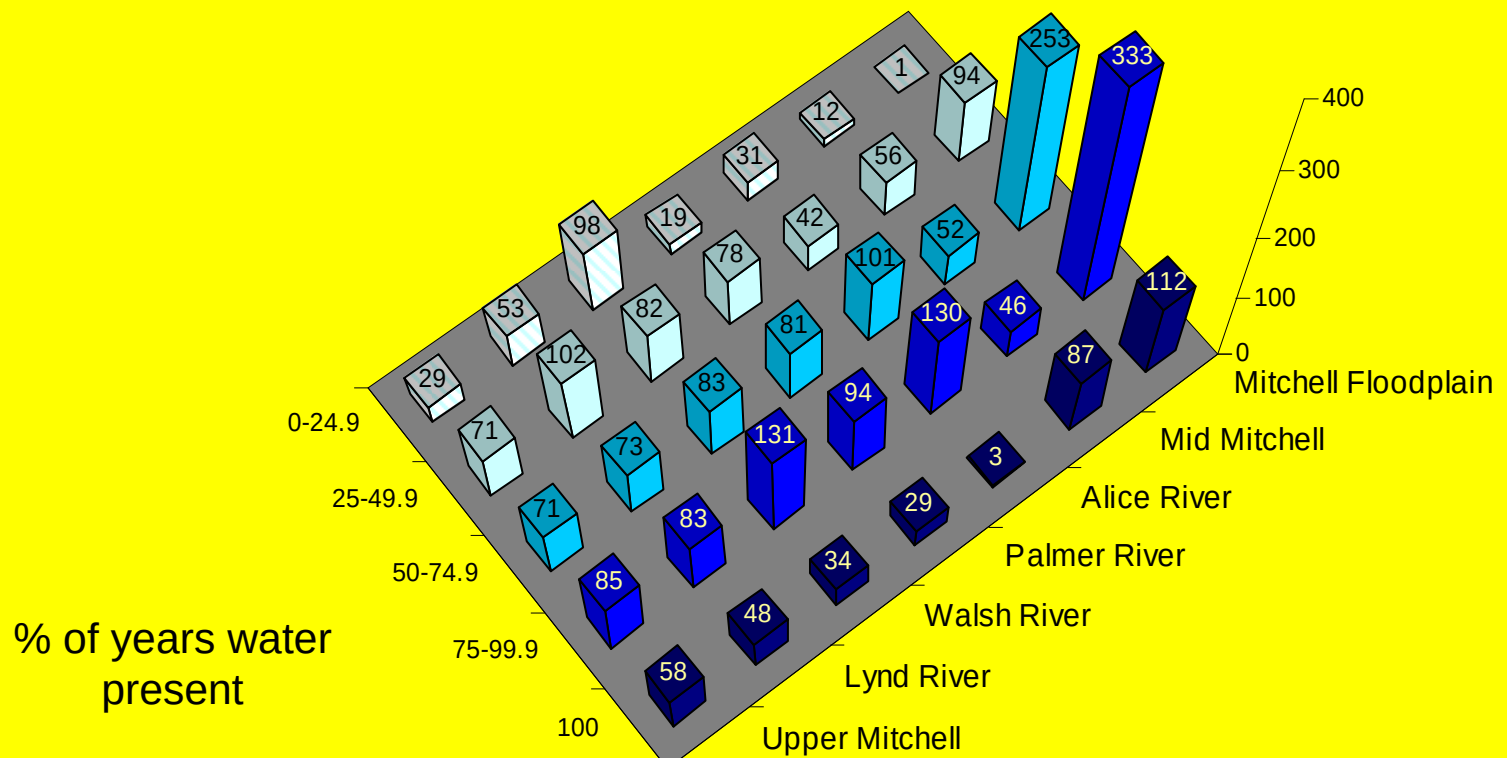
Permanency

- For riverine waterbodies, more permanent waterbodies more valuable than less permanent
- Analysis based on data layer originally produced by DNRW for water resource assessment, using an archive of 19 dry season LANDSAT images (1986-2005)
- Water presence categorised based on frequency of occurrence in annual dry season images
- Only waterbodies large enough to be detected are included, but most waterbodies smaller than this less likely to persist anyway

Permanence of Waterbodies

Comparison of Mitchell subcatchments

Abundance and permanency of waterbodies (n=2755)

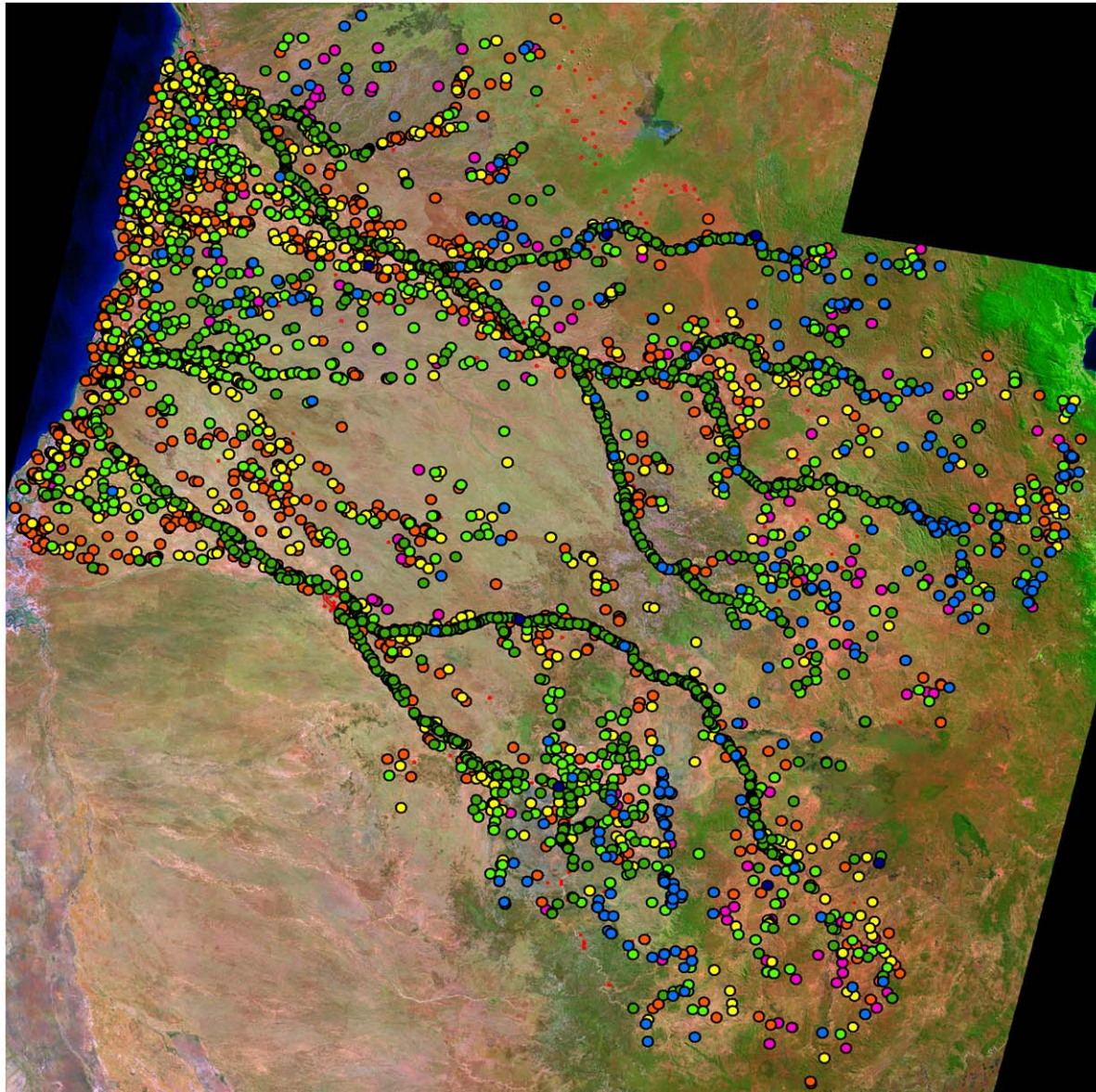


Water Clarity

- Major driver of ecological attributes/function
- Readily detected by satellite sensors and also readily observed by people



Water Clarity - All Waterbodies



Legend

Always very clear



Very clear to clear



Always clear



Usually clear



Usually turbid



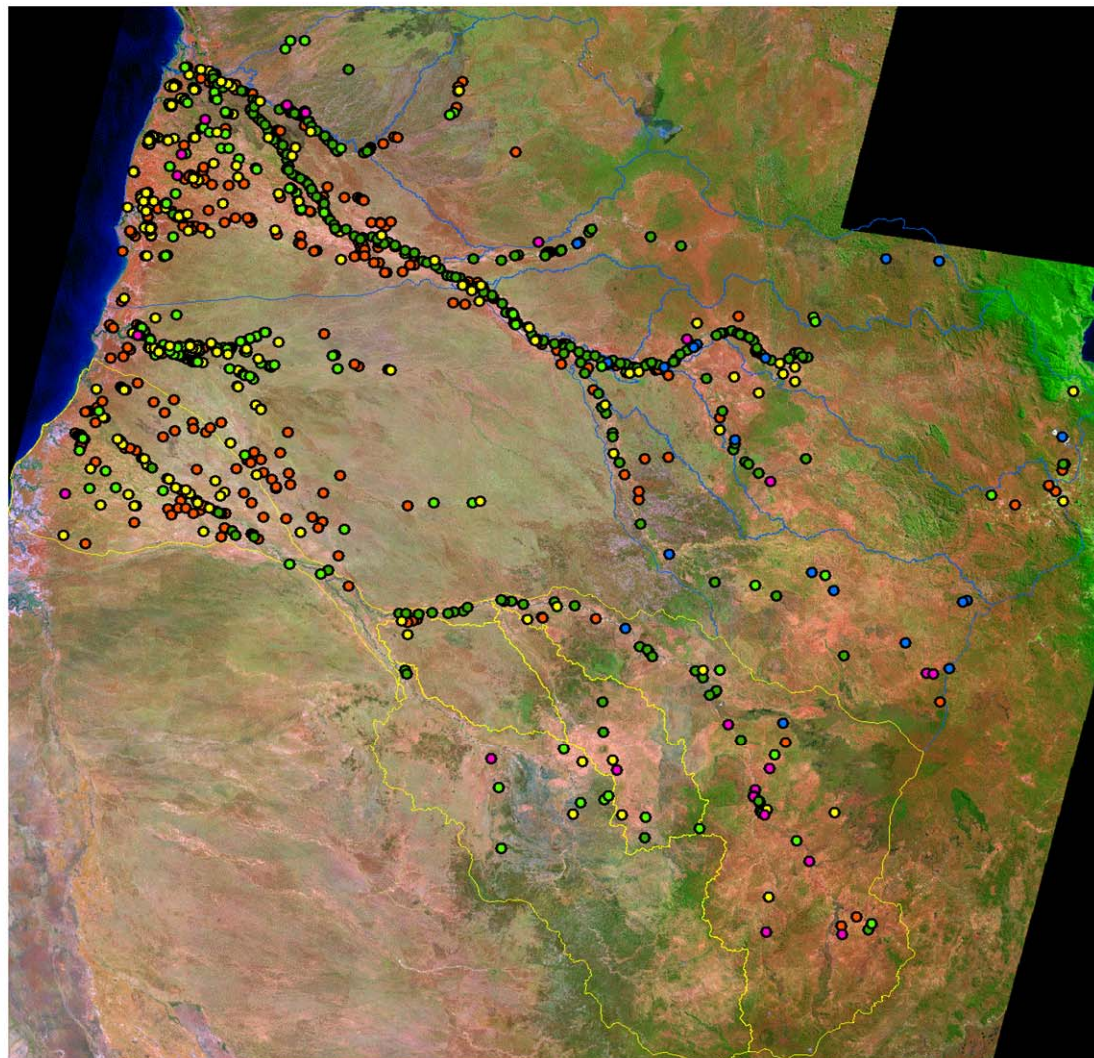
Always turbid



Very clear to turbid



Permanent Waterbodies Only



Always very clear



Very clear to clear



Always clear



Usually clear



Usually turbid



Always turbid



Very clear to turbid



Kilometers

0 45 90 180 270

Advantages

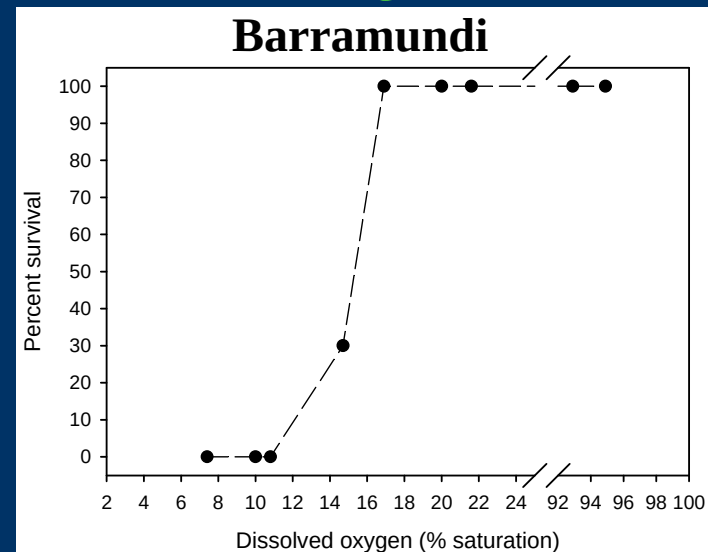
- Large spatial scale covered at low cost
- Temporal scale back in time
- Education tool – creates awareness of the need to take more notice of waterbodies
- Can add in other attributes to database (eg, vegetation, functional values)
- Also need to obtain local knowledge - devised a questionnaire for this with simple questions requiring no technical knowledge, but the answers provide ecological meaning

Water Quality Effects and Tolerance

- Higher temperature
- Lower dissolved oxygen content
- Lower DO may be more relevant as it is currently the most important water quality parameter in the tropics

Fish Tolerance to High Temperature and Low Dissolved Oxygen

- Australian fish may not be as tolerant as other tropical species
- Recently tested the major fish species of northern Australia and their thresholds are regularly, if not constantly, exceeded
- Any further reductions may have strong effect as they are near limits already
- Some exotic species are more tolerant of low DO and high temperature than our native species



Invasive Fish

- Key high risk species are favoured by climate change
- Lower flow and water volumes increase interactions with native fauna and effects on ecosystem processes
- Higher temperatures enable dispersal to more catchments
- Lower dissolved oxygen enables them to outcompete less tolerant native species

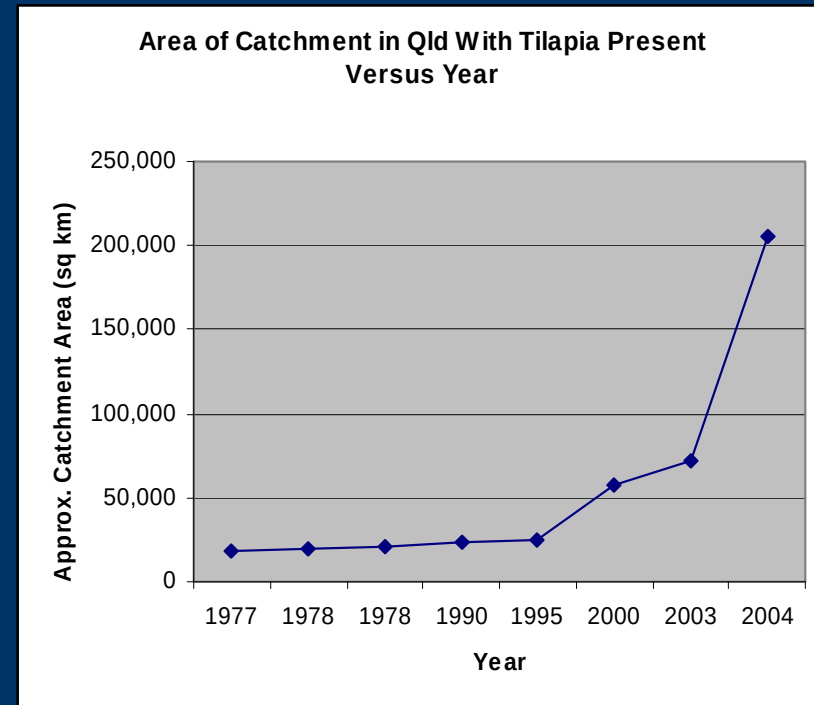
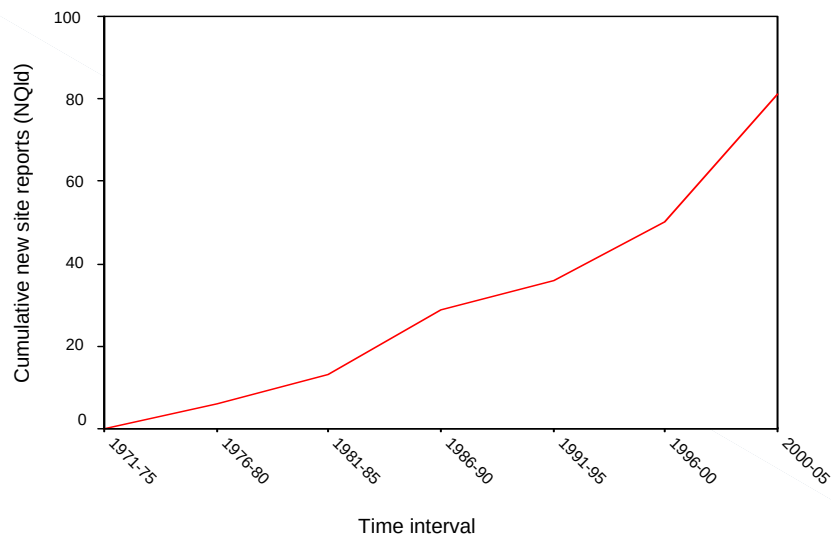
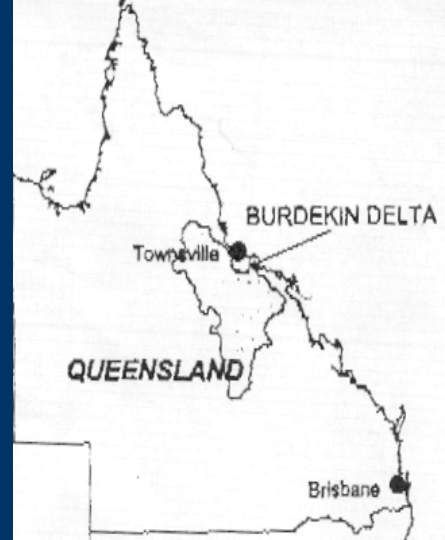
Tilapia – *Oreochromis mossambicus* *Tilapia mariae*

- From Africa, introduced to >70 countries for use in aquaculture and as an aquarium fish
- One of only 8 fish species listed in the top 100 pests in the world – IUCN Global Invasive Species Program (2004)
- New emerging pests from SE Asia – gourami (1996), climbing perch (2008), snakeheads



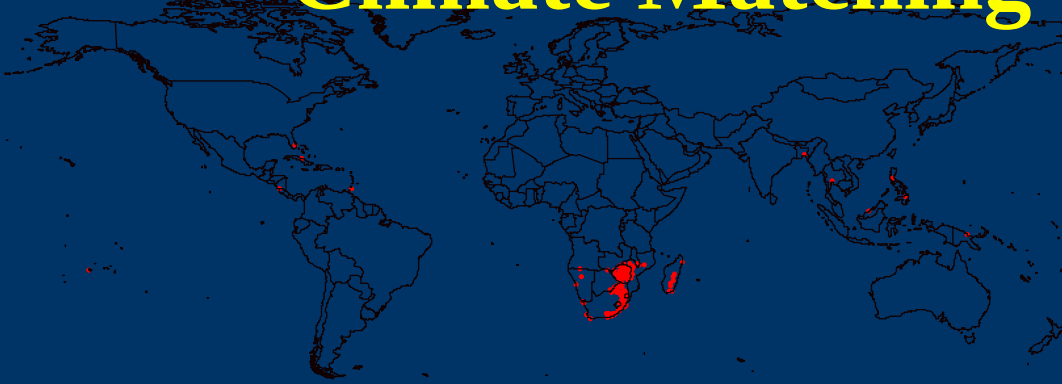
Its Getting Worse

- 10 new infestations in 4 yrs
- Now spreading into more favourable environments – we will really see what they can do

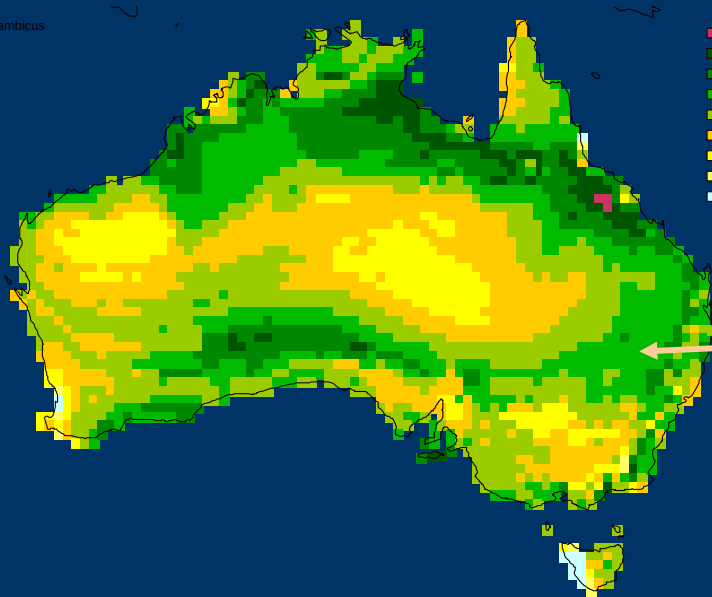


Climate Matching - Tilapia

Oreochromis mossambicus



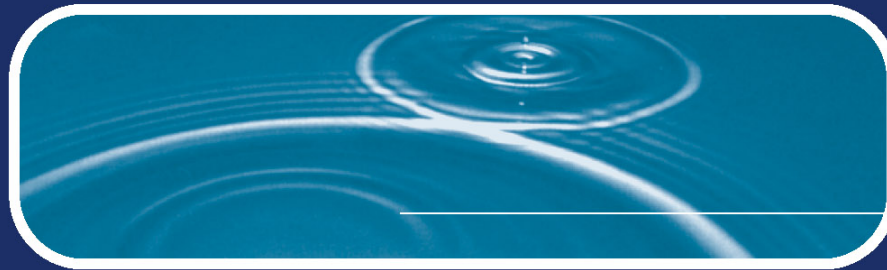
Oreochromis mossambicus



High establishment risk in north Australia, but also the northern Murray-Darling system

Source: Bureau of Rural Sciences 2005

Questions??



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