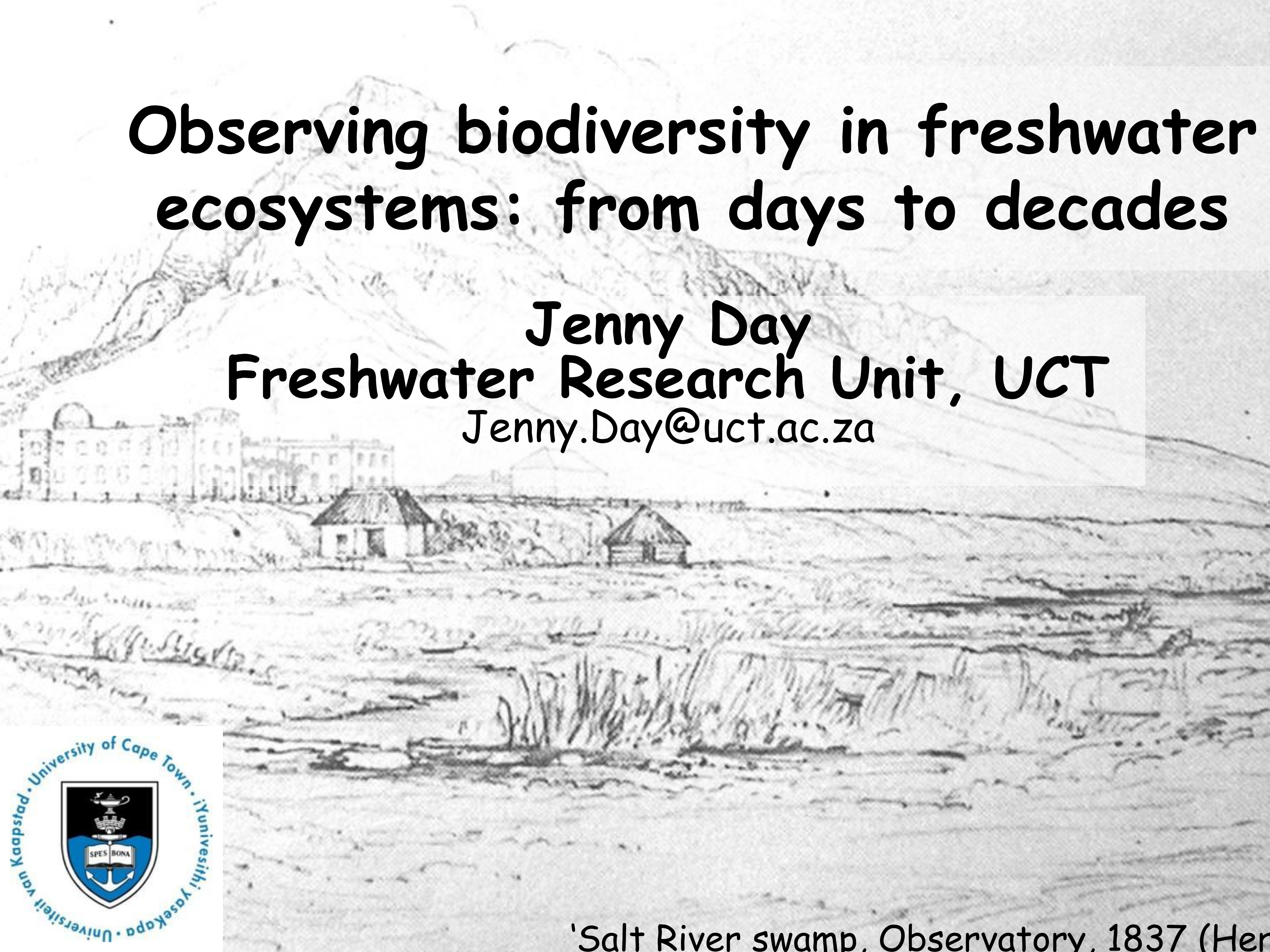

Observing biodiversity in freshwater ecosystems: from days to decades

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'Salt River swamp, Observatory, 1837 (Her

What information do we need in order to understand and manage aquatic biodiversity?

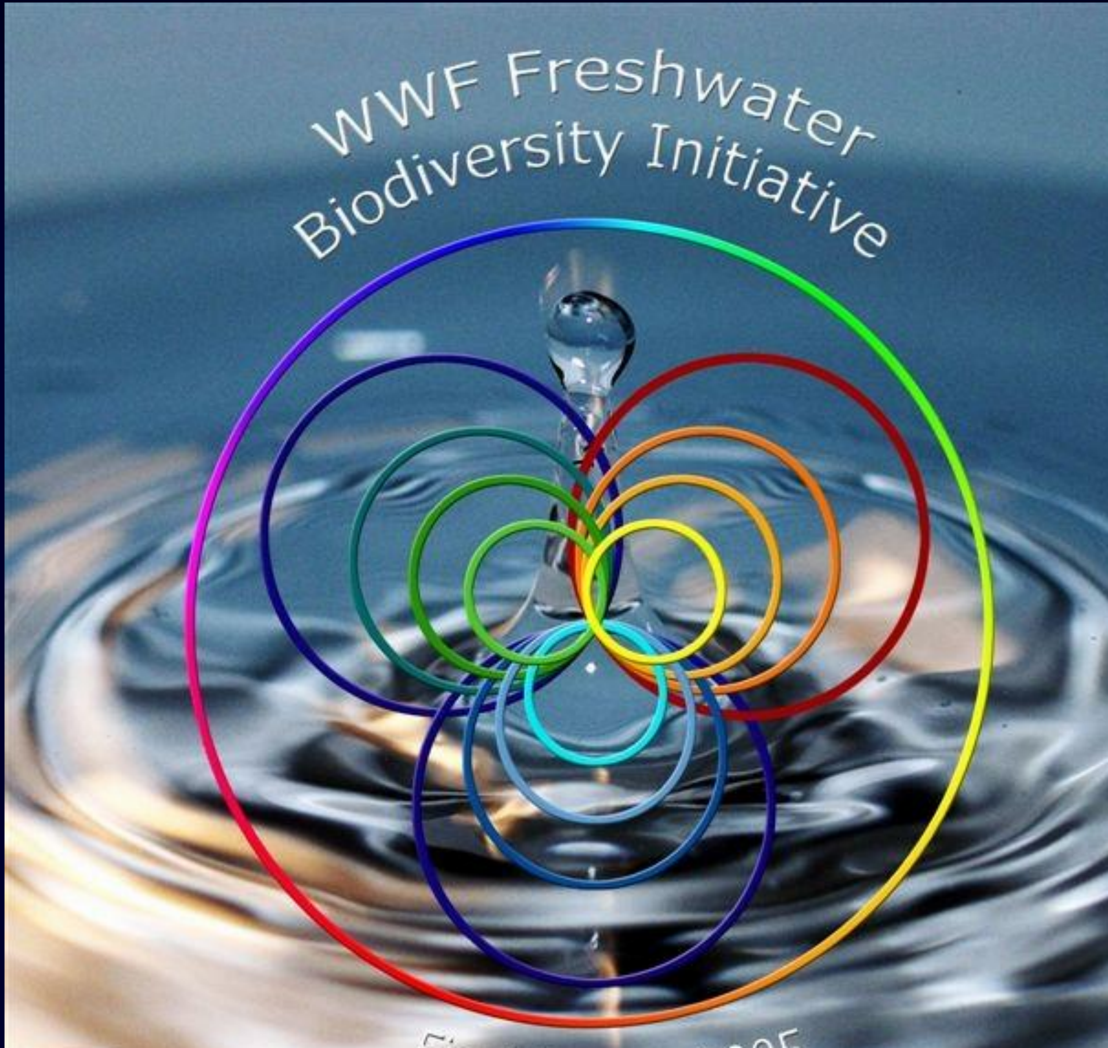
How does biodiversity change in time and space?

What determines biodiversity?

What IS biodiversity?

Biodiversity encompasses . . .

- diversity of types (taxa)
- number of types
- genetic diversity
- ecological diversity



What determines biodiversity –

i.e. how many species, which species, which genomes, which ecosystems?

Ecosystems: mostly geology, climate

Fundamentally, three processes result in biological diversity:

1. evolution: irreversible changes in the genetic composition of a population

2. extinction: species becoming permanently eliminated (the process is both natural and common)

3. dispersal: the movement of organisms away from their points of origin.

Two big questions:

1. how does biodiversity change in time and space?

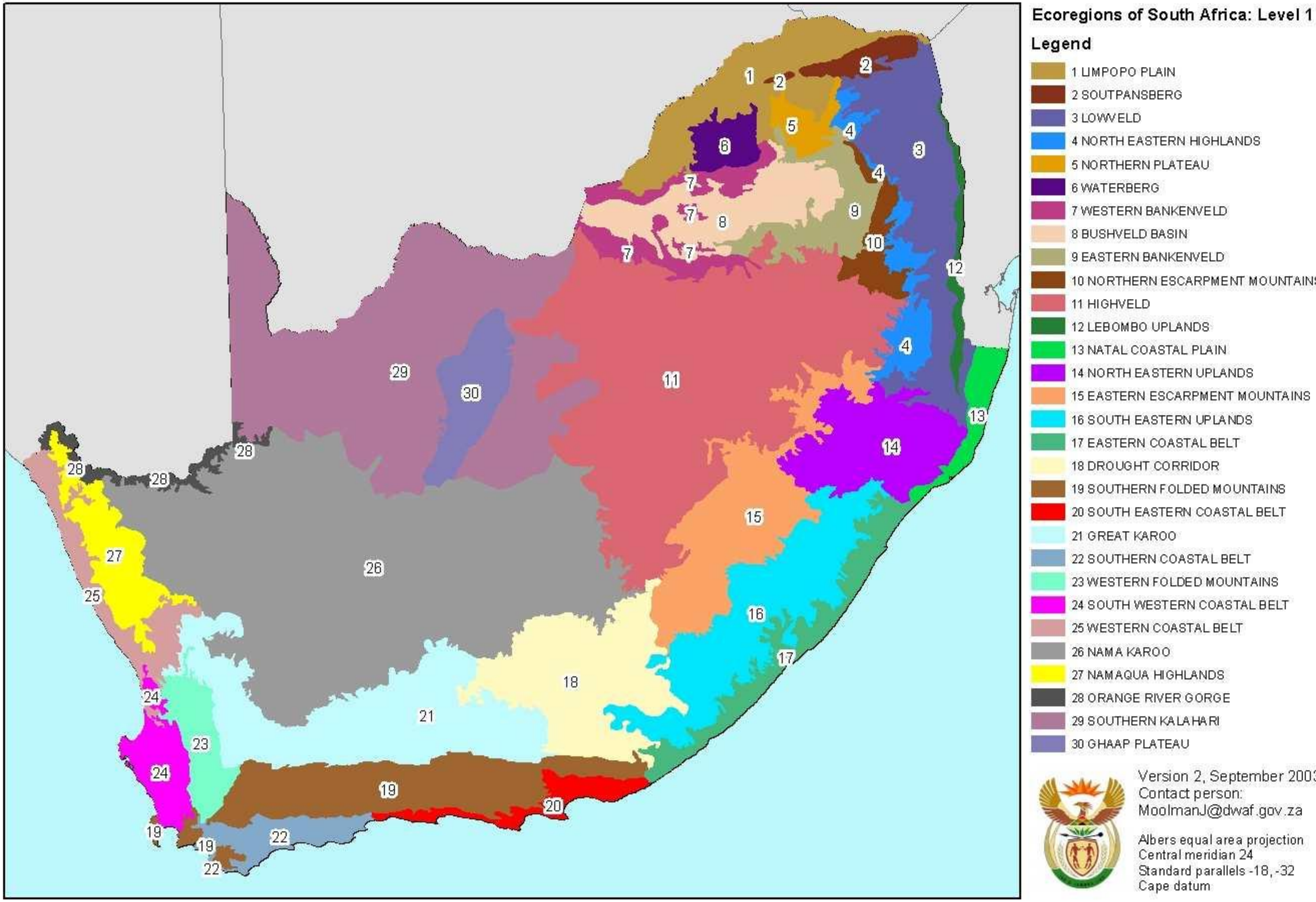
2. and why does biodiversity change in time and space?

Answers to Q1 need long-term data

Freshwater taxa occur where they do if

- the physical habitat is suitable
- chemical & physical conditions in the water are suitable
- suitable suite of co-occurring species e.g. prey, symbionts; manageable levels of predation, pathogens, etc.

What are the limits of 'suitable'?



South African aquatic ecoregions (Dept of Water Affairs)

Present-day patterns of distribution of southern African freshwater forms

Generally, the flora displays less clear-cut patterns than the fauna does.

- Cape: highly endemic, many Gondwanan taxa
- arid west of southern Africa
- highveld and savanna
- Afro-montane (Cape to the Ethiopean highlands)
- Afrotropical

Where (& how fixed) are the boundaries?

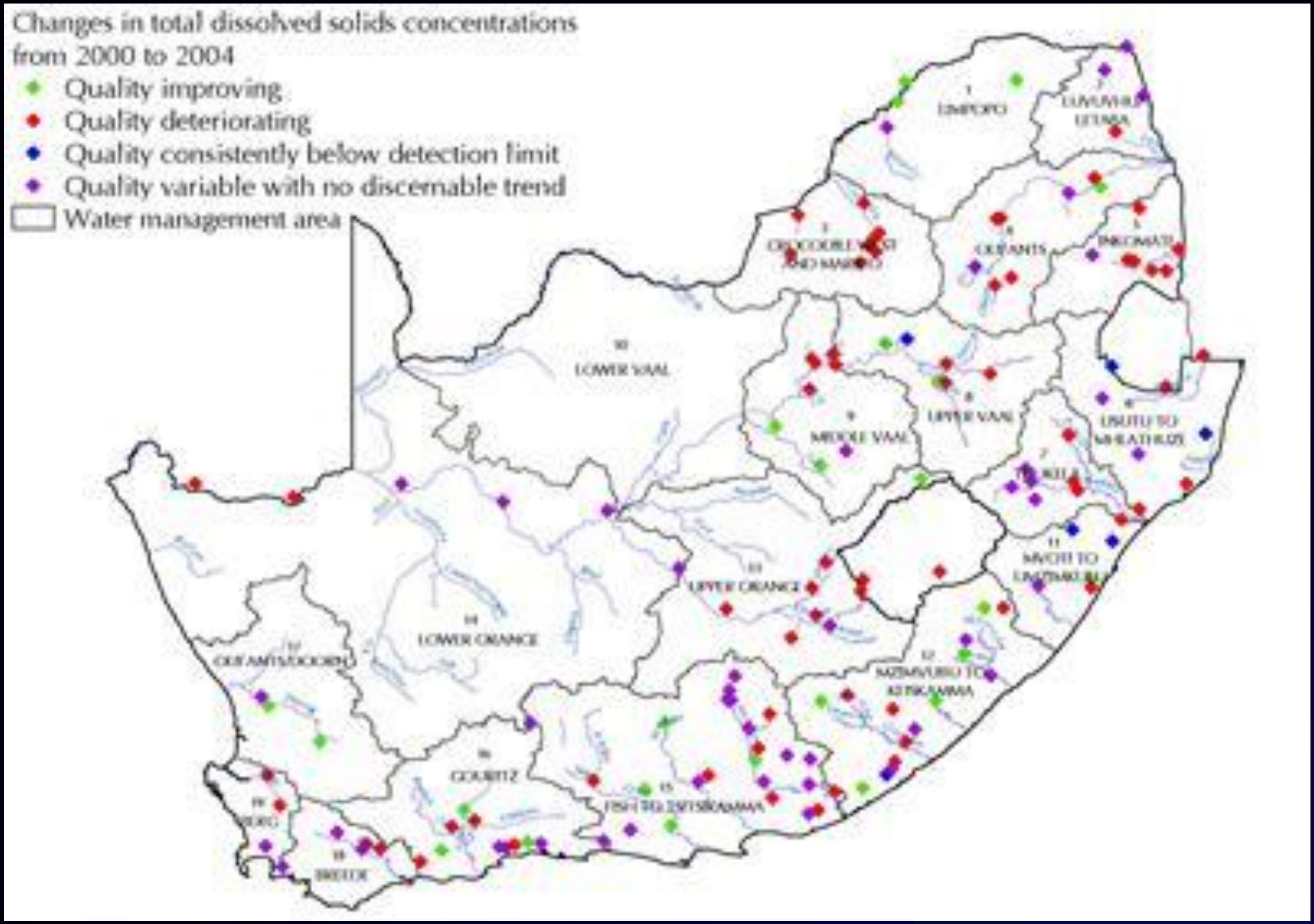
What data sets can assist in the understanding & management of biodiversity?

What do we have?

What do we have?

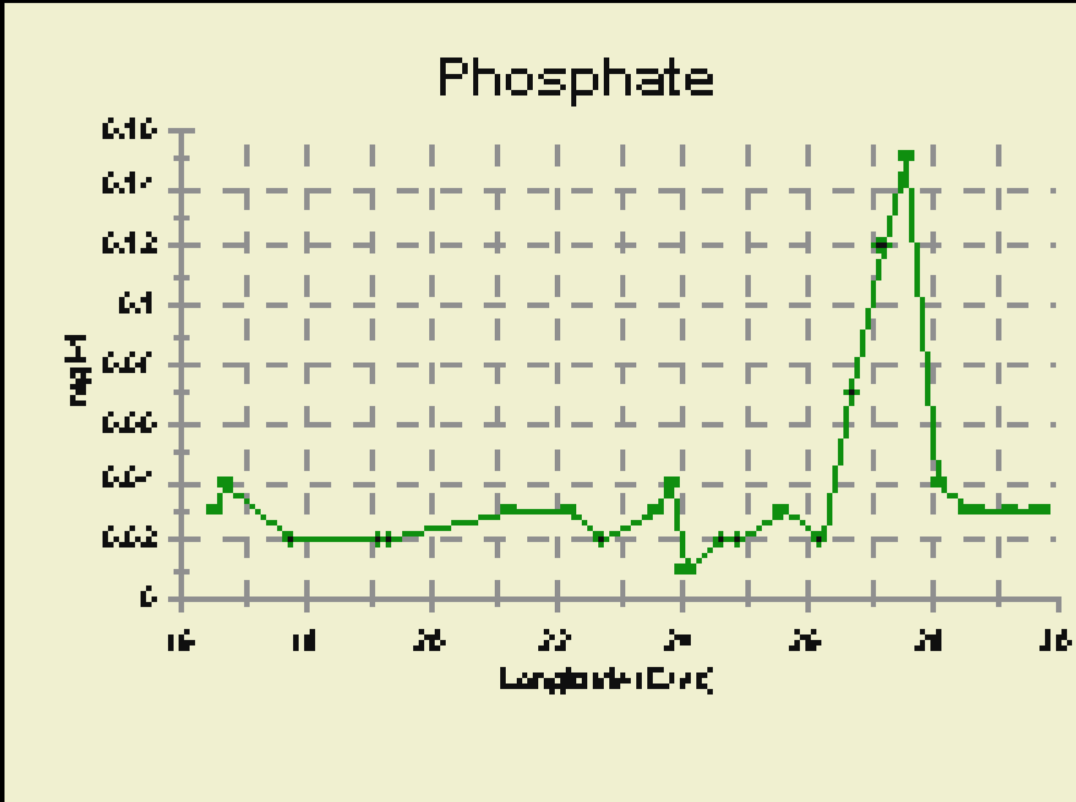
Physical & chemical data: the huge DWA database:

- approx 2000 stations
- mostly on rivers
- many from late 1960s onwards
- many gauged to measure discharge
- chemistry: major ions; nutrients; pH, alkalinity, conductivity, spot temperature measurements, etc.
- some excellent & innovative ways of reporting

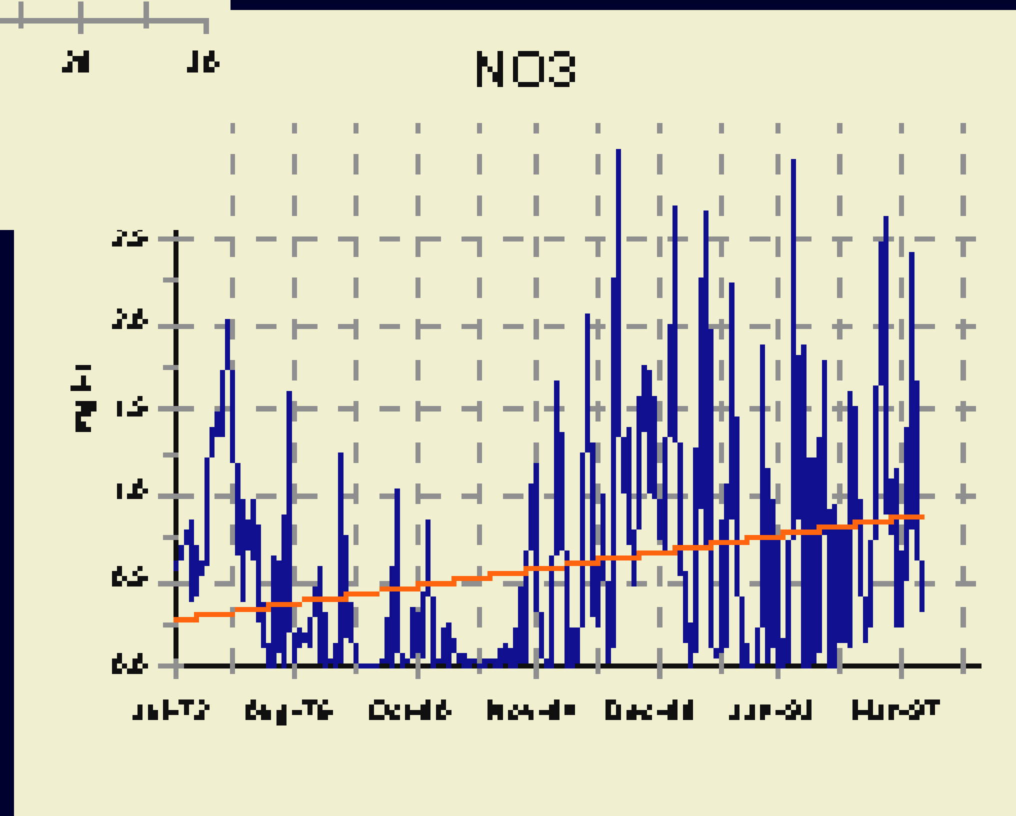


e.g. changes in TDS 2000-2004: improvement, deterioration

DWA water quality data



mean data for individual stations



time-series

What do we have? (cont.)

Physical & chemical data: the huge DWA database:

BUT

- many stations no longer functional
- many lags in analysis and reporting
- list of variables needs revising:
  e.g. include continuous temperature data, chlorophyll, turbidity (all biologically useful)

What other water quality data do we have?

- Time-series from some municipalities, water utilities (mostly nutrients, microbial)

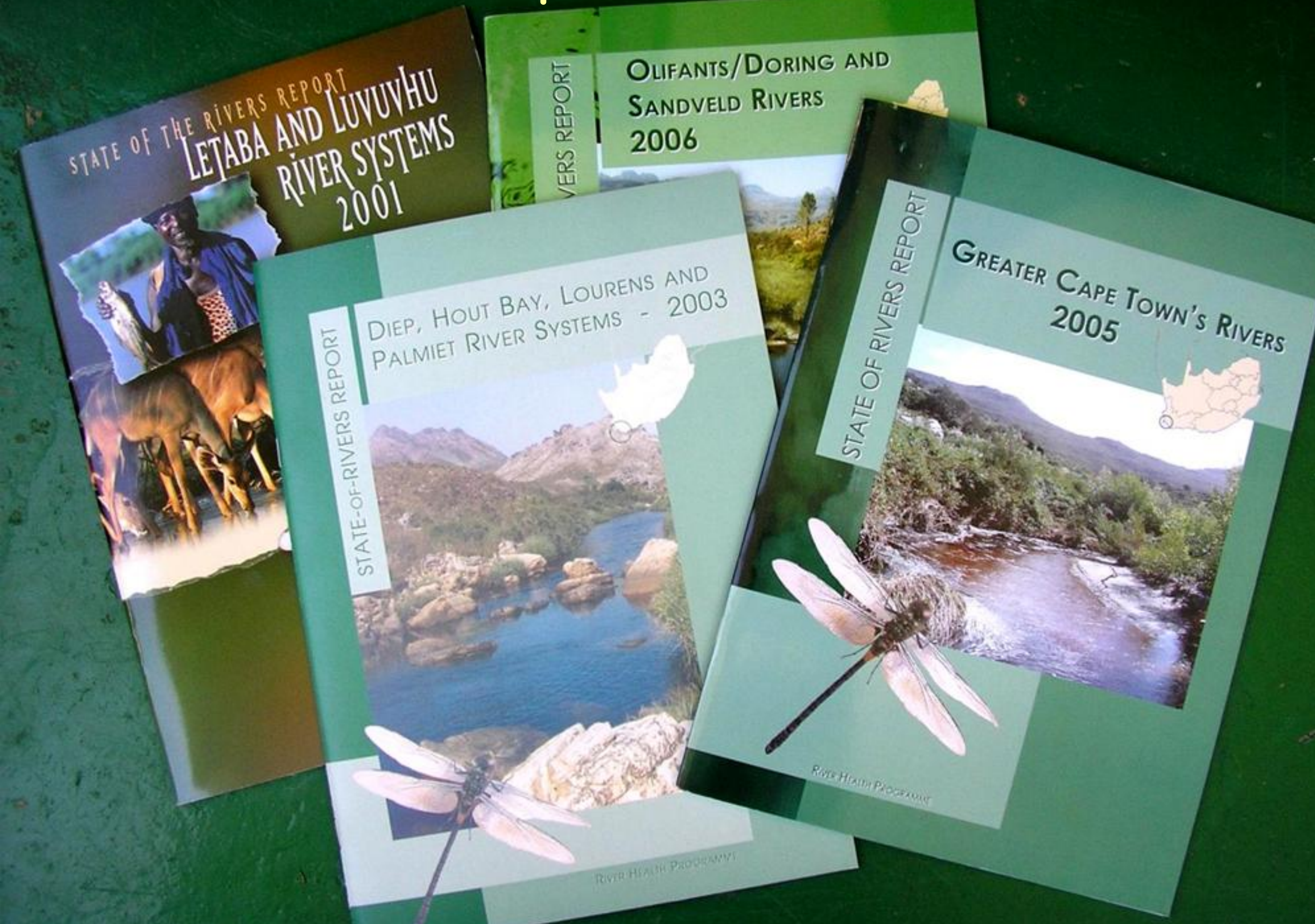
- Microbial data: human pathogens

NB: we know almost nothing about natural microflora of aquatic ecosystems, especially in South Africa

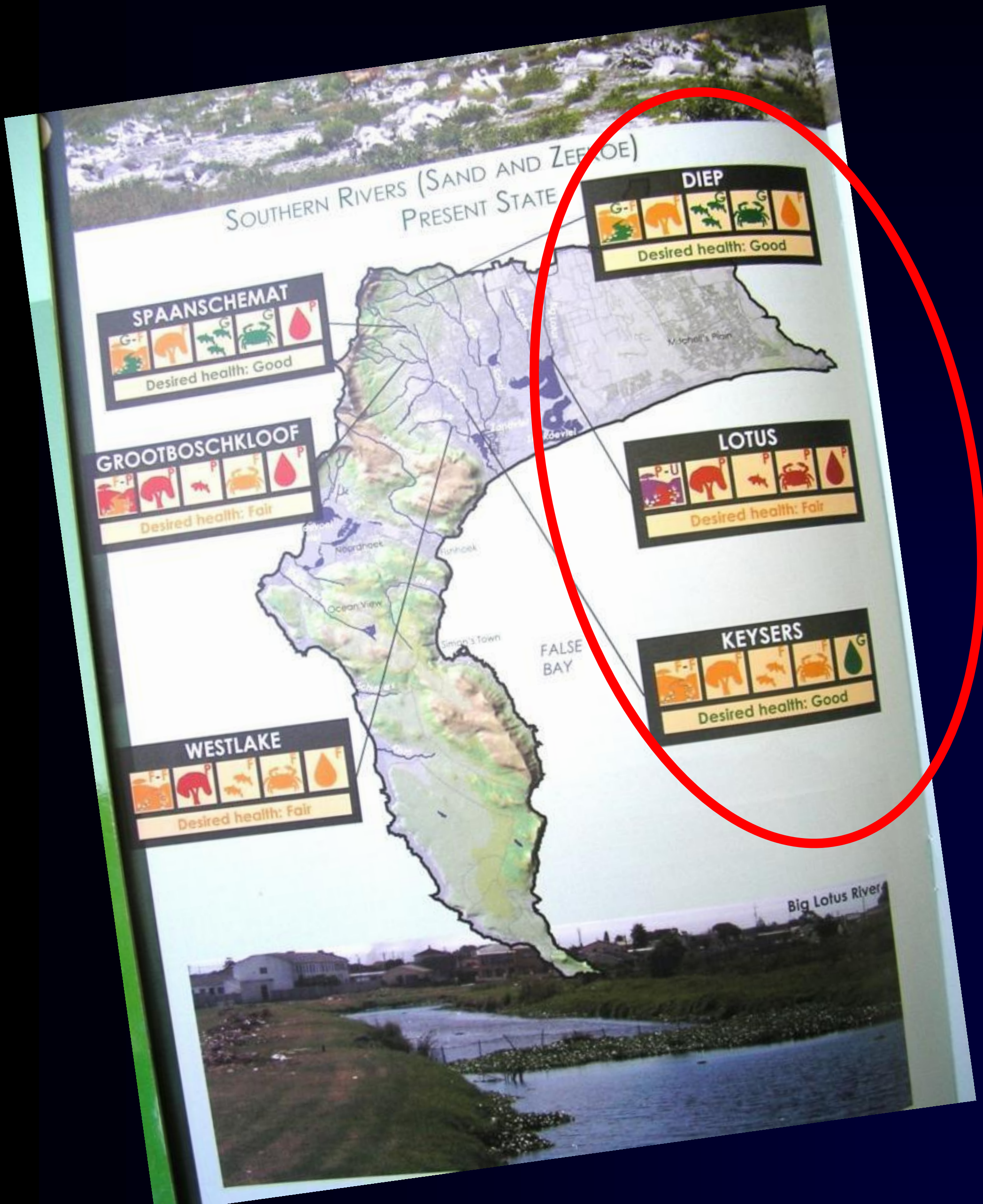
The National Water Act requires monitoring of aquatic ecosystems:

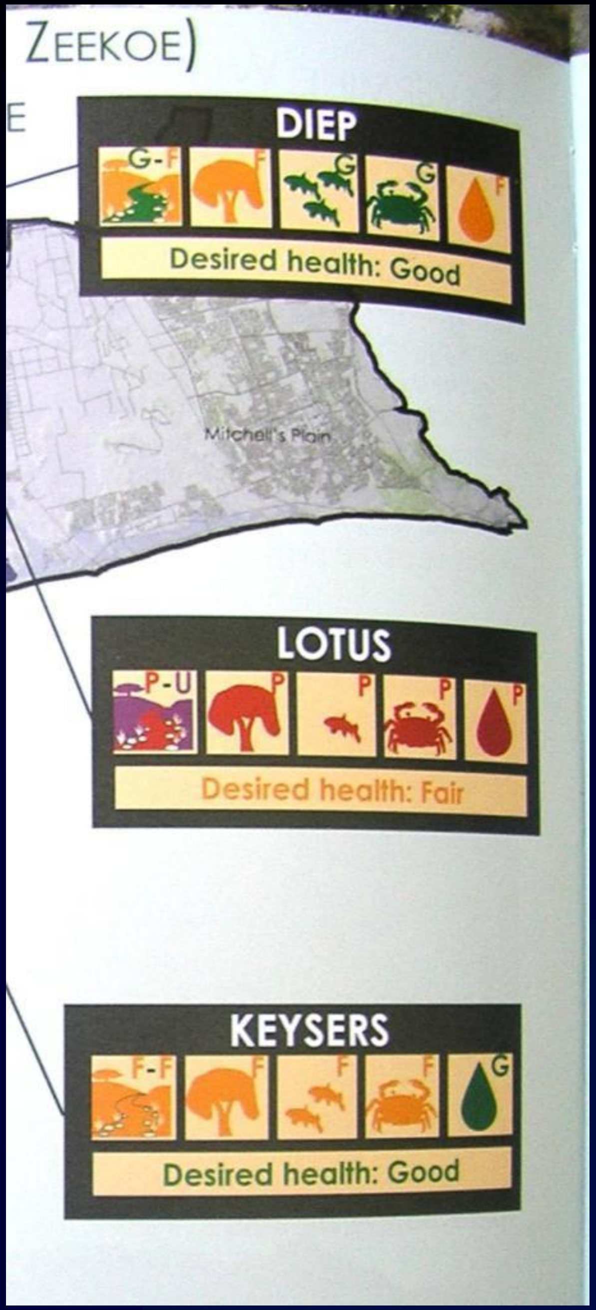
the River Health Programme

"State of the Rivers" Reports



www.csir.co.za/rhp





The RHP:

- was implemented at provincial level by e.g. CapeNature
- was spottily implemented (depending on capacity within Provincial Nature Conservation departments)
- is now in the hands of DWA: even less capacity
- does provide very useful data behind the simplistic icons
- could do with revisiting

General problems in data-collection in SA:

- short-term science (days or weeks)
- management-driven questions
- the "EIA syndrome": quick (and sometimes dirty)

Very little 'blue-water' science, virtually no decade-long programmes:

little opportunity to expand the knowledge base, *especially* in the face of climate change and other anthropogenic disturbances

General problems in data-collection in SA (cont.):

e.g. RHP: a little extra effort could make a big difference

"Reserve determination" data could be used elsewhere as well (how is it curated?)

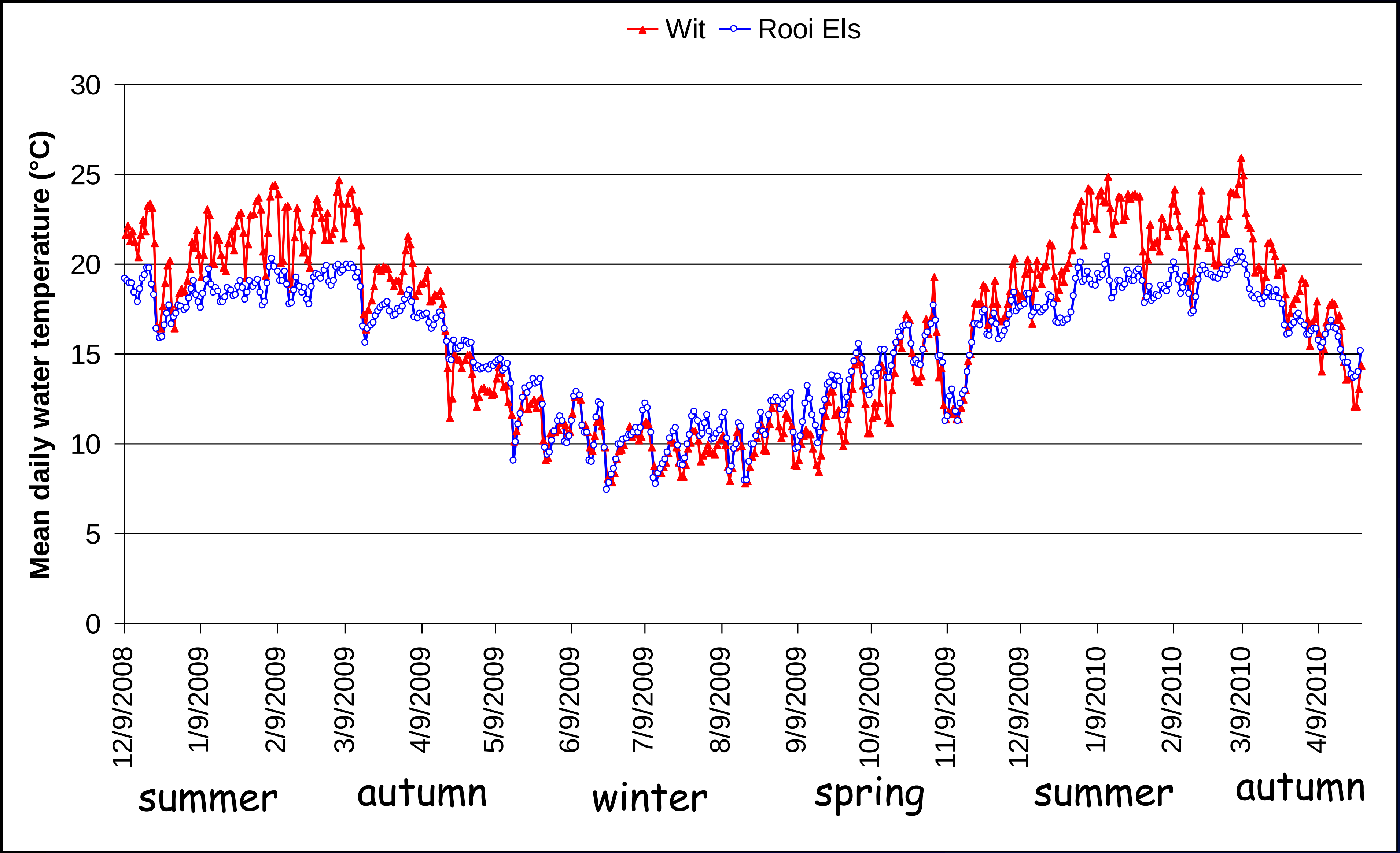
Nonetheless,

some excellent work is being done: e.g. a WRC-funded programme on temperature

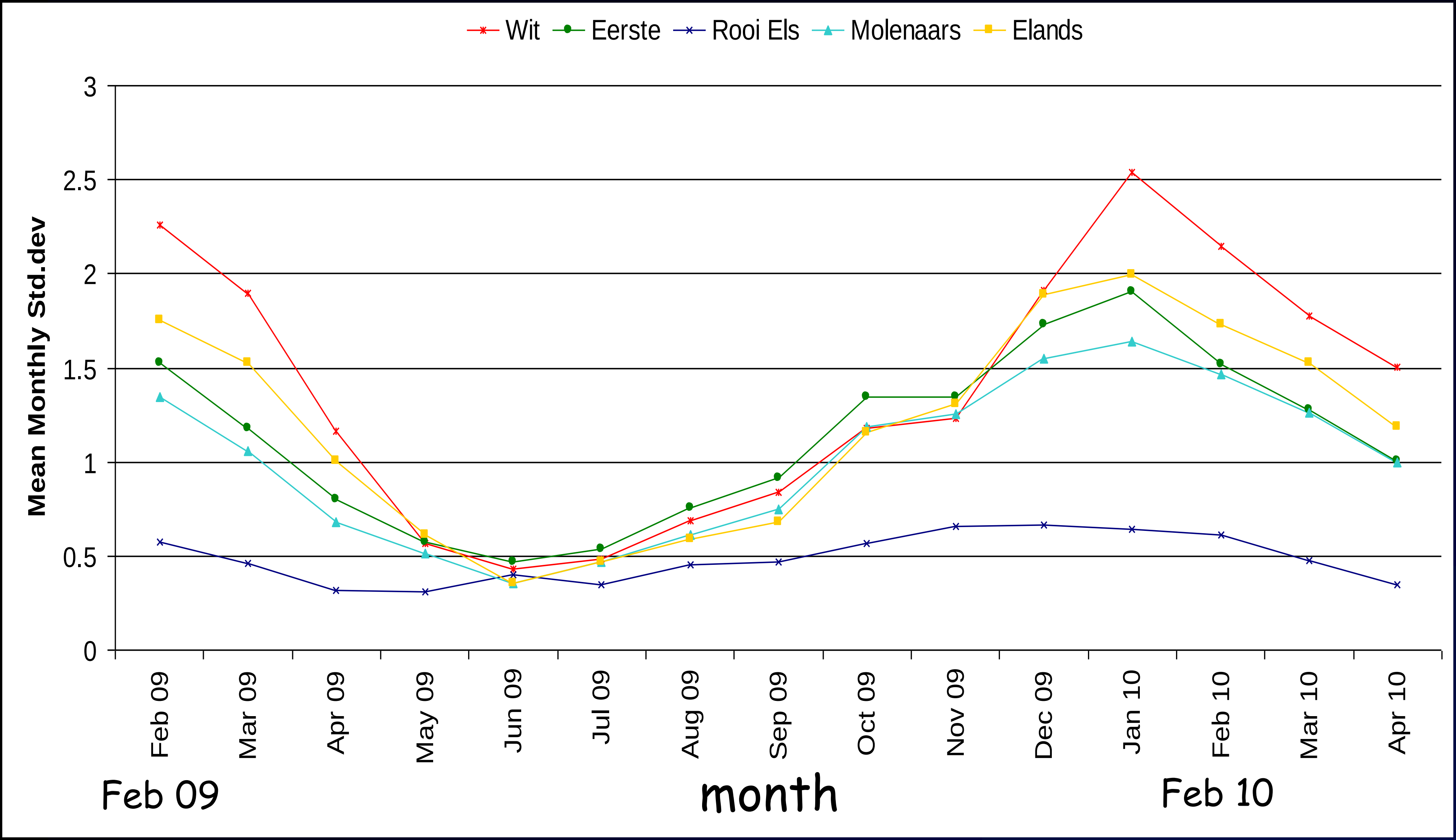
Helen Dallas, Nick Rivers-Moore and team

- temperature loggers in streams
- modelling relationship between air and water temperatures
- temperature tolerances of aquatic invertebrates
- life-history studies (thanks to Vere Ross-Gillespie for images)

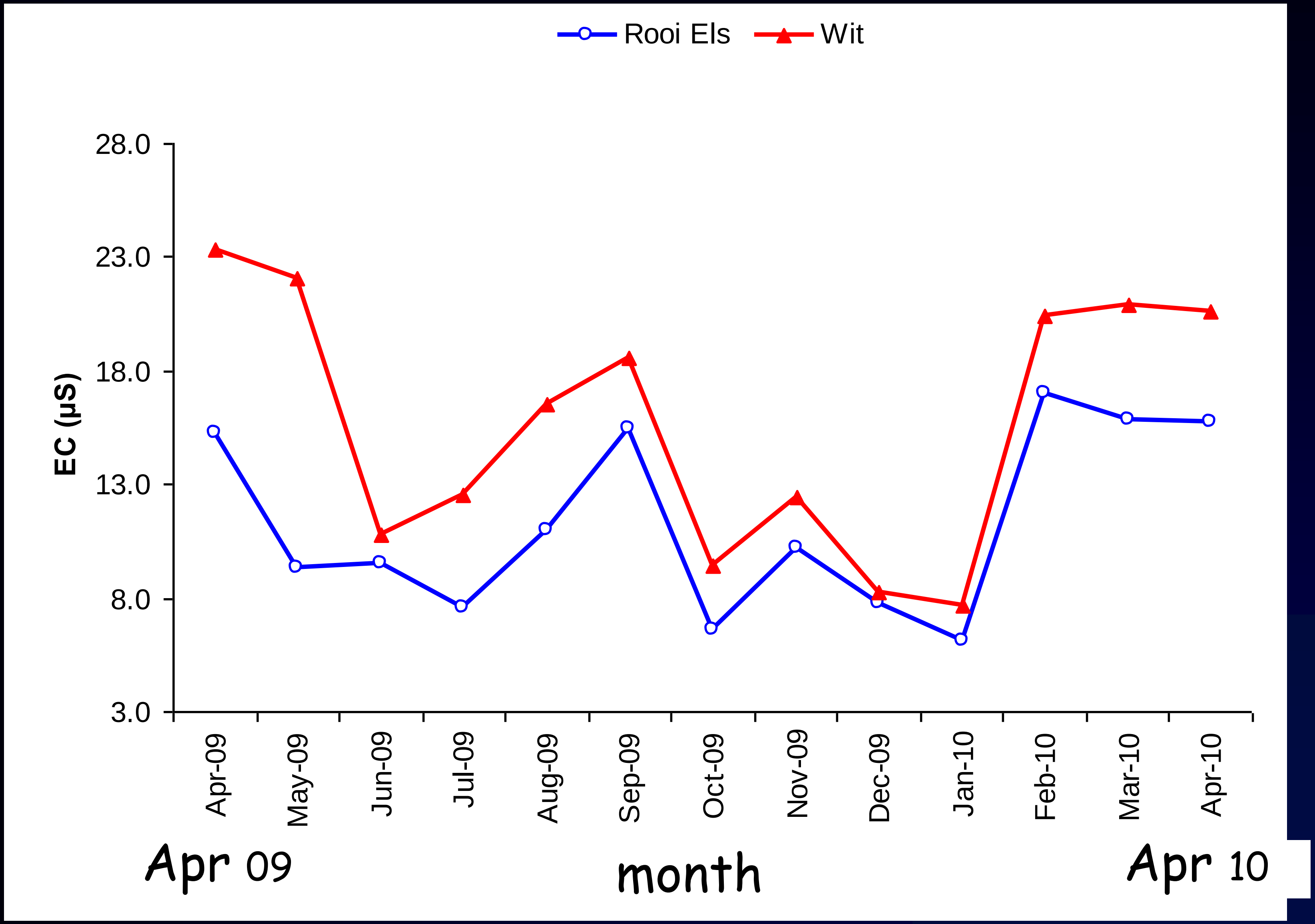
Mean daily water temperature, Wit & Rooiels rivers



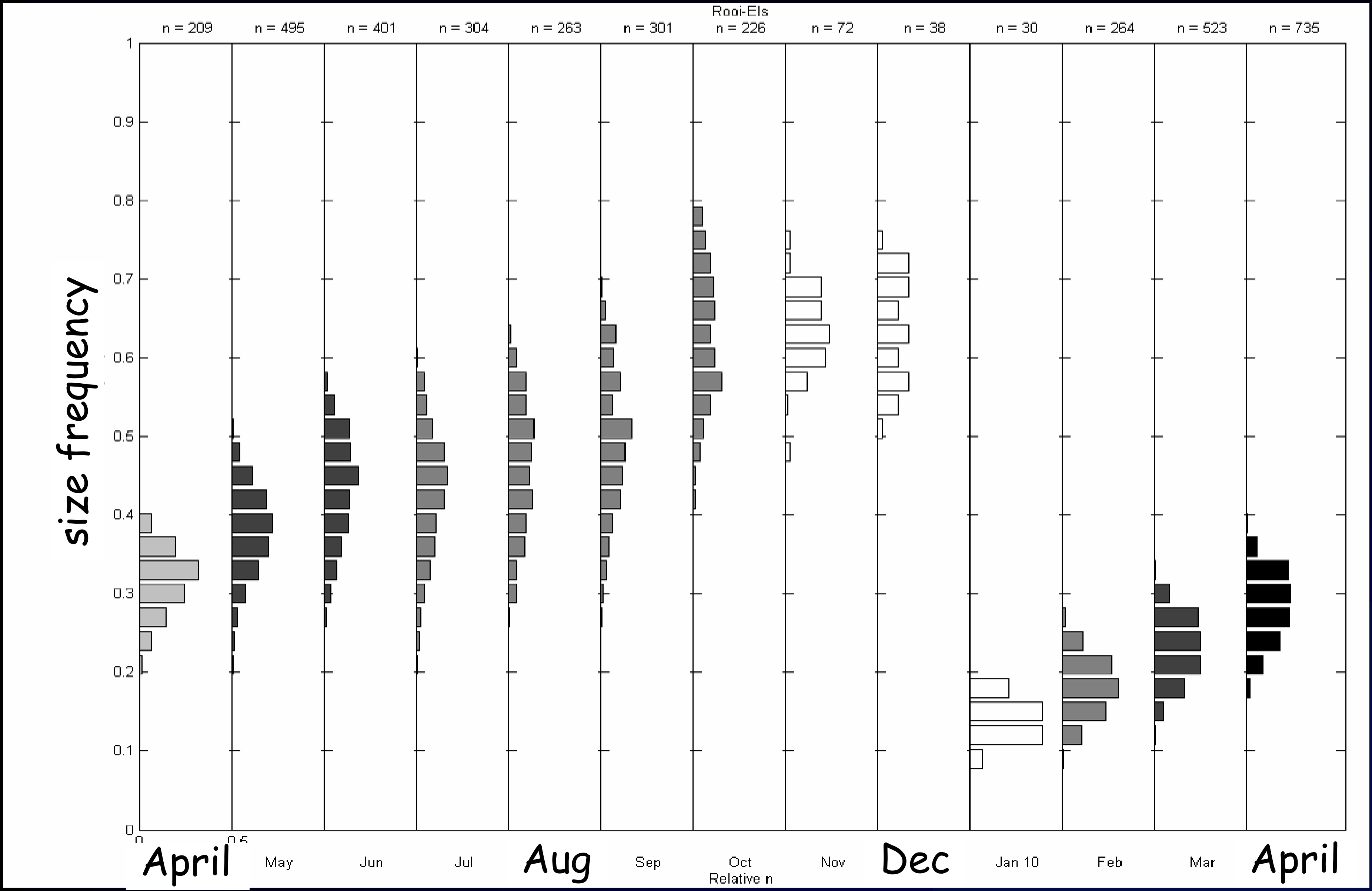
Temperature in five rivers: mean monthly standard deviation



Mean monthly conductivity, Wit & Rooiels rivers



Cohort analysis, *Lestagella*, Rooiels River



What else do we need to do?

- long-term monitoring at specific sites (as at Hubbard Brook): processes, taxa, population dynamics, changes
- inventories, data bases
- reassess existing programmes
- ask the right questions to get biggest "bang for your buck"

For instance,

- use of remote sensing data:

  wetlands inventory: SANBI

- collation of existing data (some are decades old):

  species checklists

  biogeographical patterns

- photographic records:

'Salt River swamp, Observatory, 1837 (Herschel)

Cape Flats from the Bottelary Hills, 1960s

Princess Vlei, early 1980s

Sandvlei, 1970s

Wetlands that no longer exist (from Cape newspapers, 1960s)

Cape Flats wetlands
circa 1982

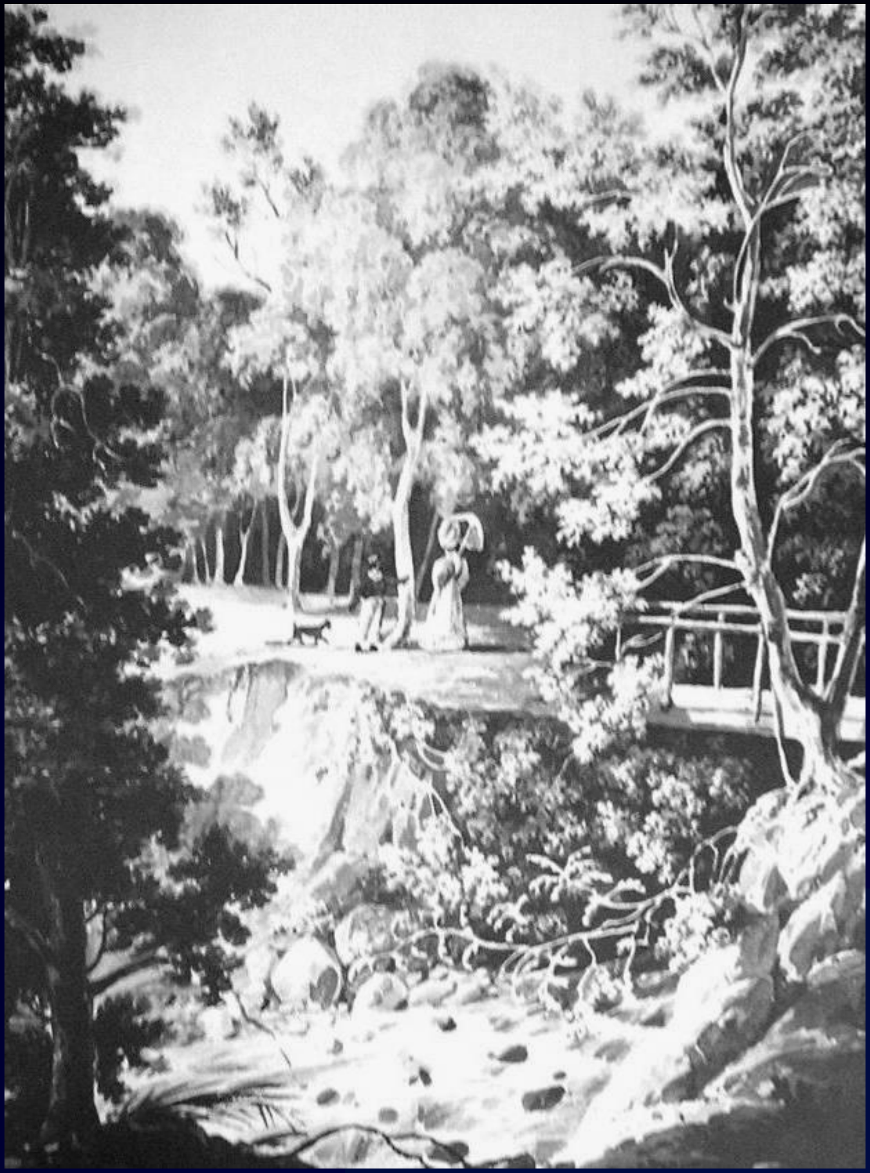


Cape Flats wetlands
circa 1985

Khayalitsha

before and after: the Berg River and its dam

Erosion, Liesbeek River, 1990s



“River Liesbeek 20 September 1832”

Systematic monitoring using photography is

- easy, cheap, quick
- can record systems before 'extinction'
- can record change for better or worse

BUT

- it requires good housekeeping of the database.

Hout Bay, early 1980s