



# Groundwater fauna



Measure to manage: what to measure?

Graham Fenwick



# Groundwater fauna: universal biodiversity in all aquifers



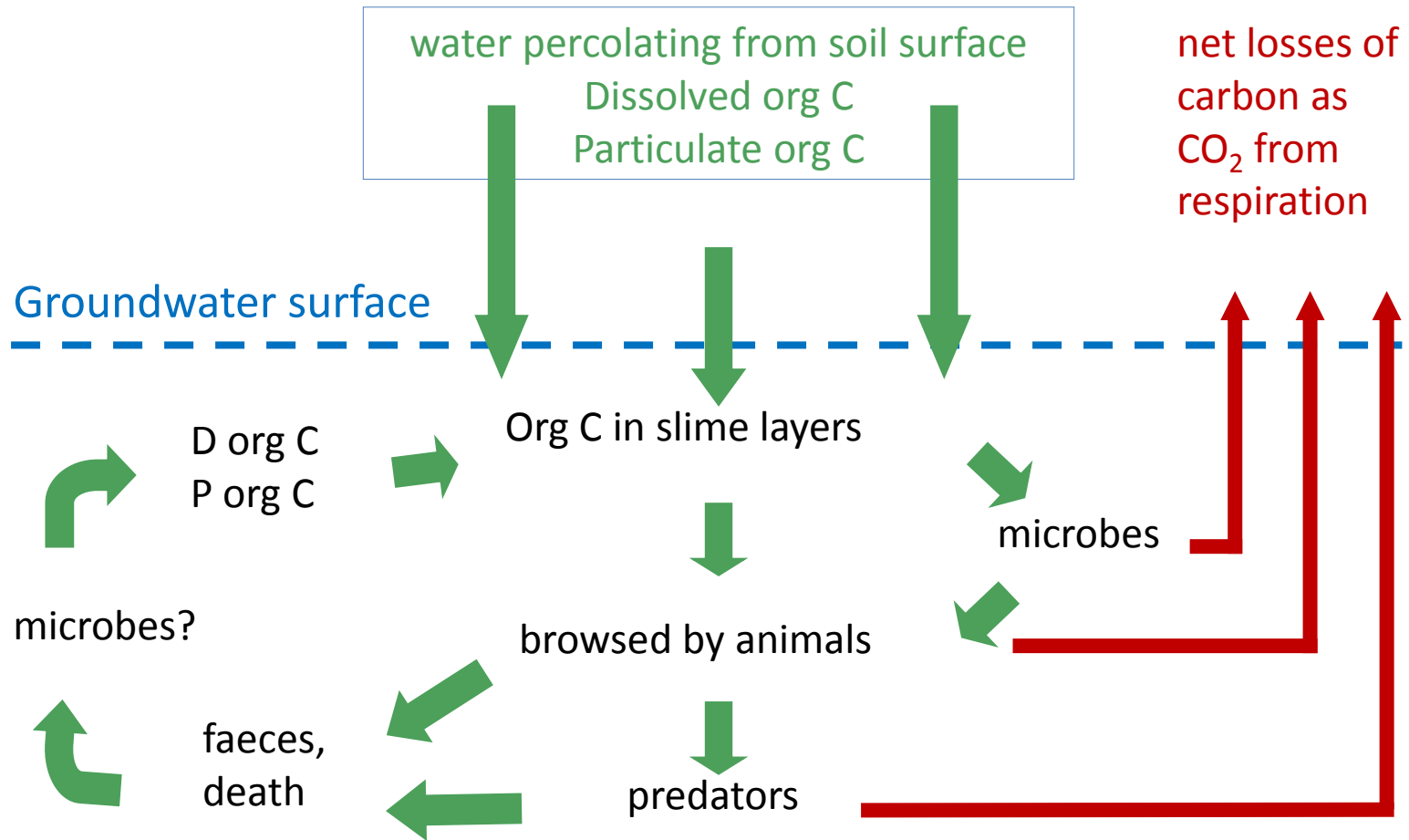
N. Boustead, NIWA



# Stygofauna biodiversity: high diversity



# Groundwaters are naturally functioning ecosystems



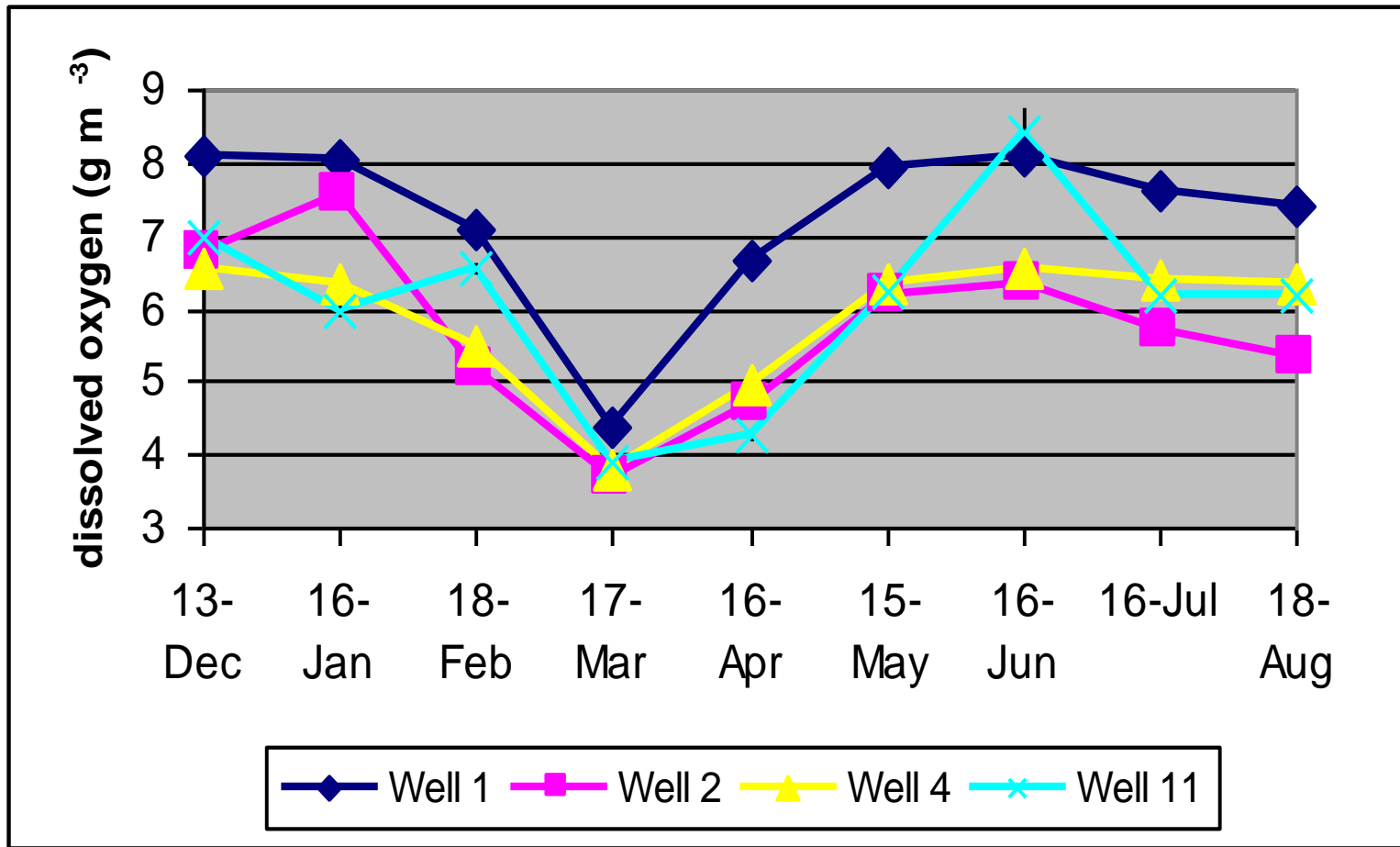
*Excessive organic C loadings kill the fauna*





Excess organic matter &/or reduced dissolved oxygen can lead to dead stygofauna & clogged, anoxic sediments

# Dissolved O<sub>2</sub> in well water (n=2)



# Groundwater ecosystem services: vital to aquifer sustainability

Groundwater is a living resource

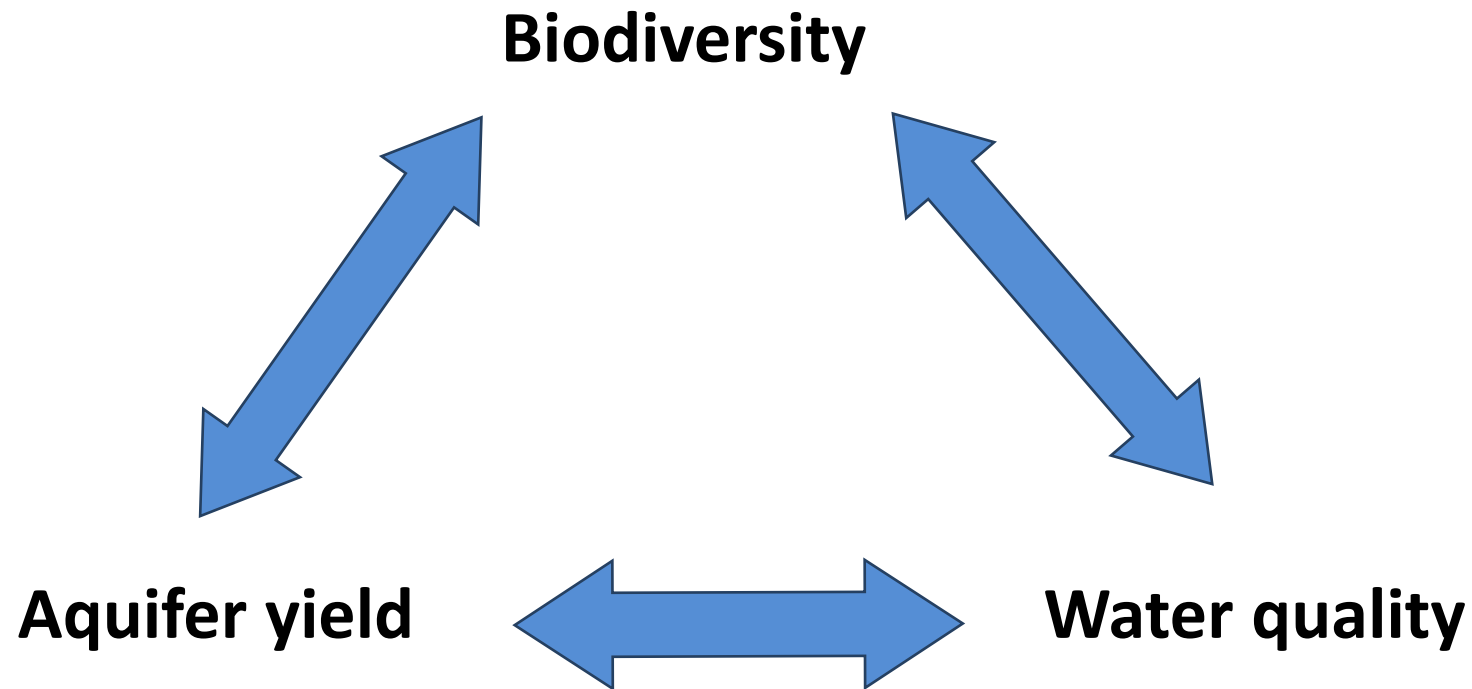
- Contains significant biodiversity

Performs vital ecological services:

- Consumes some potentially harmful microbes
- Removes organic carbon from sediments
- Stygofauna feeding and movement:
  - Maintains aquifer flow and water quality
  - Enhances surface water quality

Essential that managed as living system to sustain the physical resource's value.

# Living groundwater: a better management model





# Researching groundwater biodiversity



# How to manage groundwater biodiversity?

## Policy elements for Selwyn-Waihora (proposed Canterbury Land & Water Regional Plan):

1. Ngai Tahu values: *surface water focus*
2. Managing land to improve water quality: *ok, but info gaps*
3. Catchment & lake restoration: *no consideration*
4. Improved flows:
  - Manage SW & GW as a single resource
  - *No consideration of GW levels or biodiversity*

## Outcomes:

surface water: natural state, minimum flows & WQ limits.

groundwater: max. abstraction rates, *no others identified.*

# Measuring to manage ecosystem health

## Streams:

- QMCI scores  $\geq 5 / \geq 6$
- Dissolved oxygen  $>70\% / >90\%$
- Temperature  $20\text{ }^{\circ}\text{C}$

## Groundwater:

- ??

# Key issues for managing ecological values of GDEs (a)

- Frequency, magnitude & timing of water level fluctuations.
- GW pressure (velocity/flow in unconfined aquifers).
- Direction of hydraulic gradients.
- Base flow conditions & environmental allocations.
- Nutrient loadings & bioaccumulation.
- Presence of threatened, rare, vulnerable or endangered species, populations or ecological communities.



# Key issues for managing ecological values of GDEs (b)

- Presence of indicator, keystone, flagship, endemic or significant species, populations or communities.
- Delivery of ecosystem services
  - carbon processing,
  - nitrification/denitrification,
  - Biodegradation.

Accommodate incomplete knowledge in management.

[NSW Government, Dept of Primary Industries, Office of Water]

<http://www.water.nsw.gov.au/Water-Management/Ecology/Groundwater/default.aspx>

# Key principles for sustainably managing groundwater

- A living system delivering vital ecological services.
- Must manage its WQ to be same or better than that of surface waters into which it discharges.
- To manage effectively, apply
  - principles used for managing streams &
  - develop measures based on key issues identified for Australian GDEs.

# Living groundwater: the management model

