An Australian Government Initiative

Primary productivity in the Coorong

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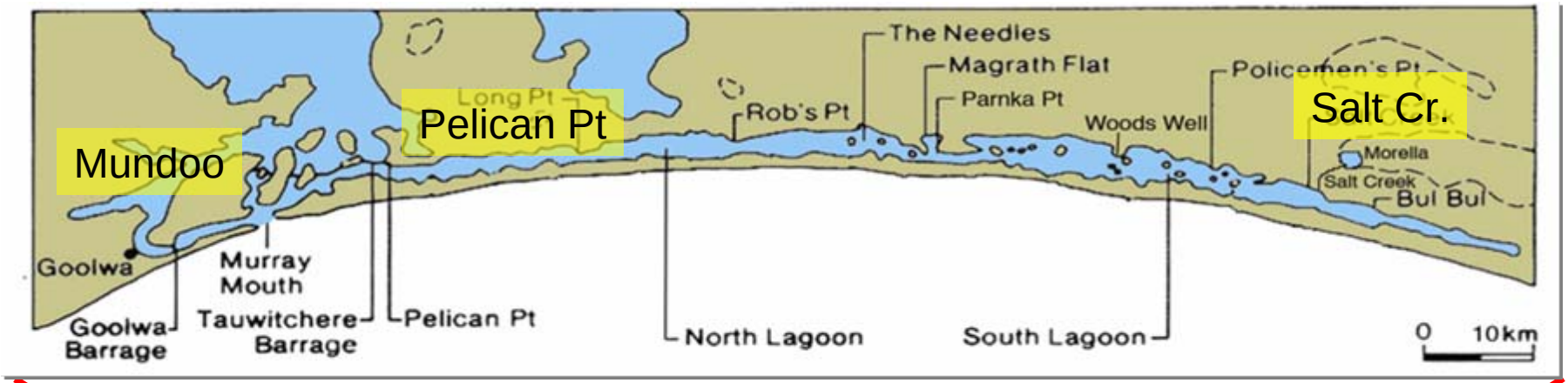
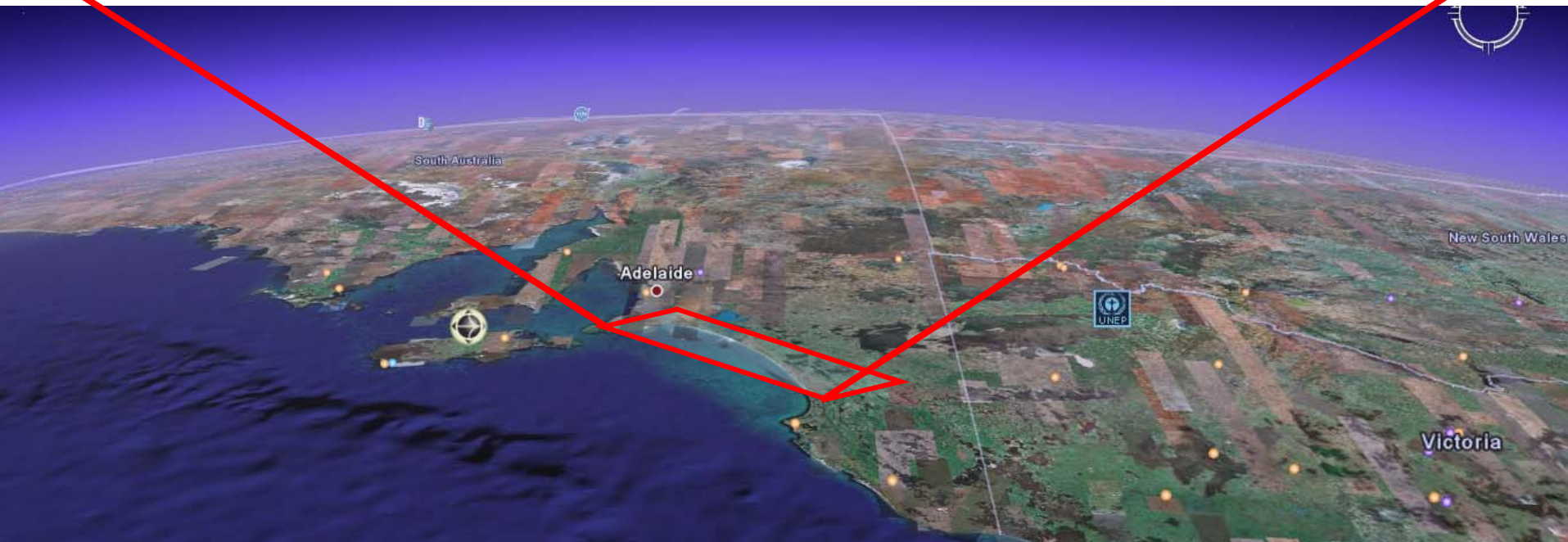
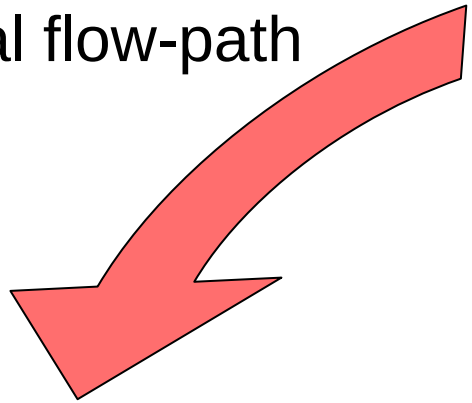
Center for Limnology

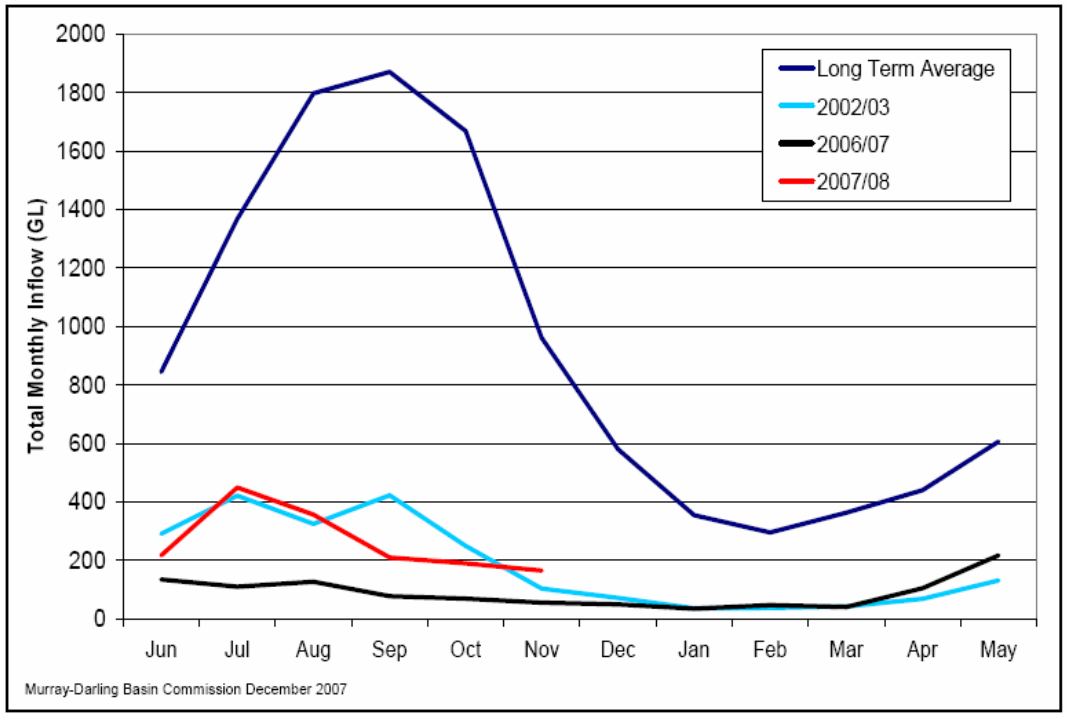
University of Wisconsin

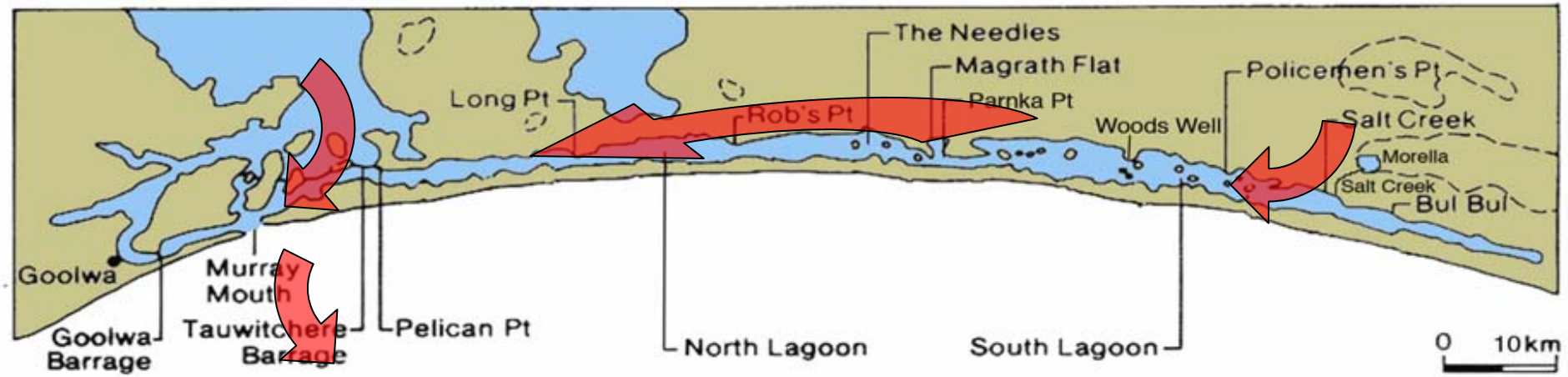

Mundoo
Pelican Pt
Salt Cr.
Long Pt
The Needles
Magrath Flat
Rob's Pt
Parnka Pt
Woods Well
Morella
Salt Creek
Bul Bul
Goolwa
Murray Mouth
Goolwa Barrage
Tauwitchere Barrage
Pelican Pt
North Lagoon
South Lagoon
0 10km

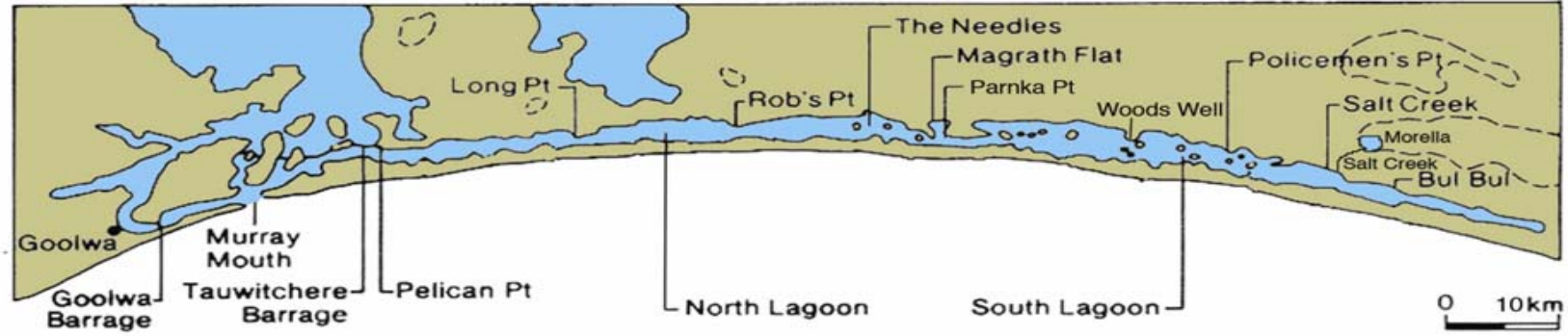

South Australia
Adelaide
New South Wales
Victoria

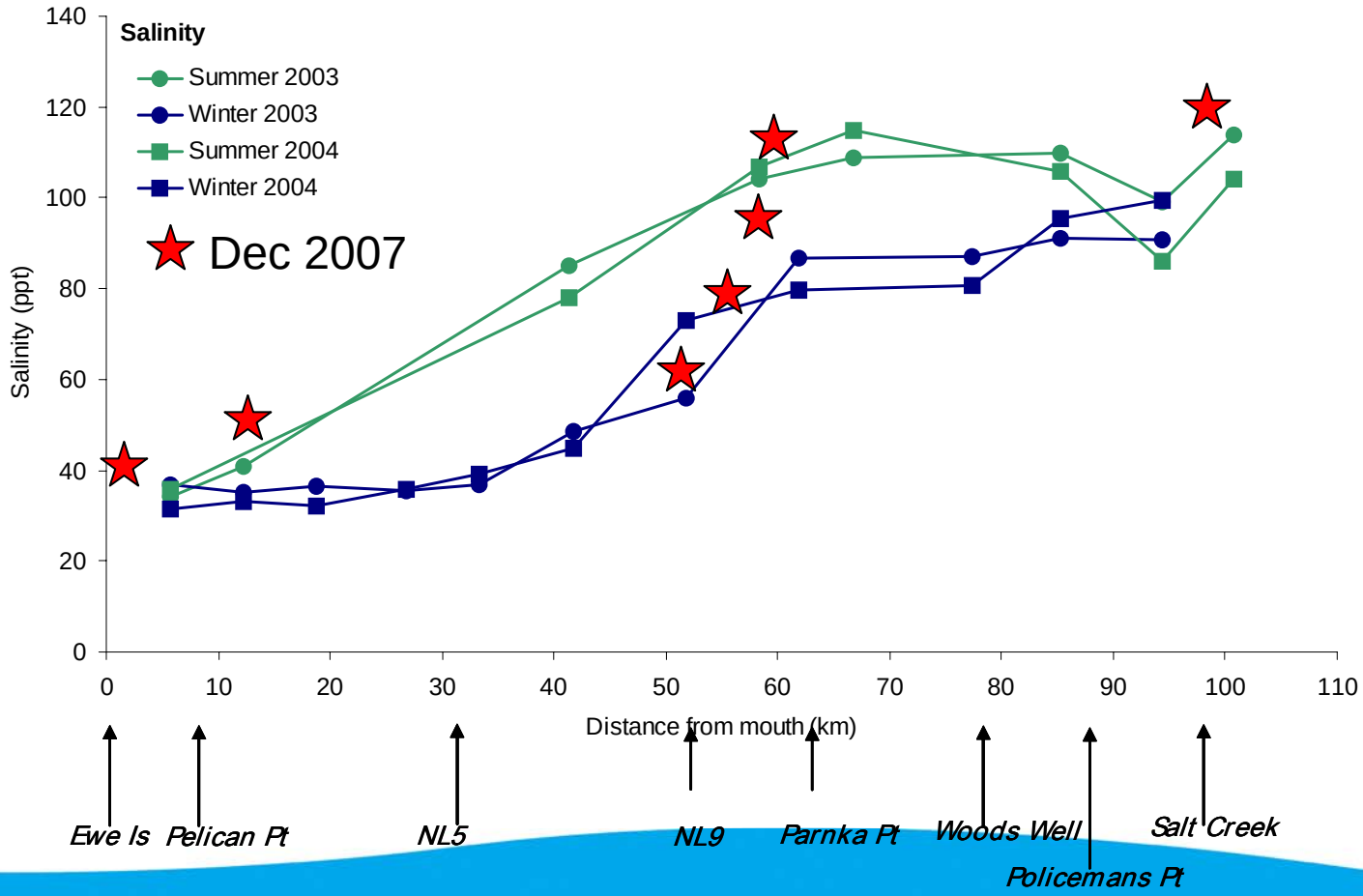
Historical flow-path











Slide courtesy of Kane Aldridge

A new state*

	Historical	Current
Salinity	Saline to hypersaline gradient with seasonal freshening	Saline to chronic hypersaline
Primary producers	Seagrass (*Ruppia megacarpa, R. tuberosa*), algae	Algae
Biodiversity (animal)	Rich	Reduced, with absences in most trophic levels, reduced distributions
Overall ecological health		"Poor"

*Adapted from: Geddes, M.C. 2005. The ecological health of the North and South Lagoons of the Coorong. SARDI RD03/0272-2

The Southern Lagoon – a switch in state

Brine Shrimp

Flock of Banded Stilts

Banded Stilt chick

Slide courtesy of Brian Deegan

From surveys to predictions

"…evaluating the longer-term status of the region under different potential climate and management scenarios…" CLAMM

Models – physical, biogeochemical, foodweb

Future states

Salinity
Nutrient conc.
Biotic abundances

State in 2007

Salinity
Nutrient conc.
Biotic abundances

Models – physical, biogeochemical, foodweb

States under alternative scenarios

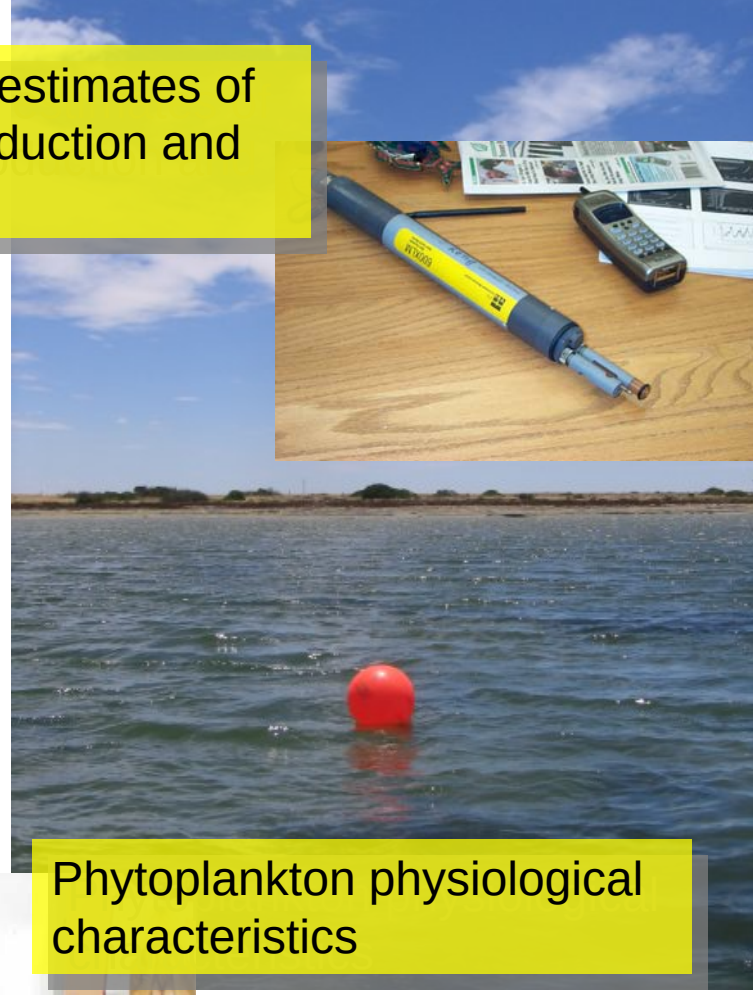
Salinity
Nutrient conc.
Biotic abundances

What are the rates of primary production in the Coorong, and what controls these rates?

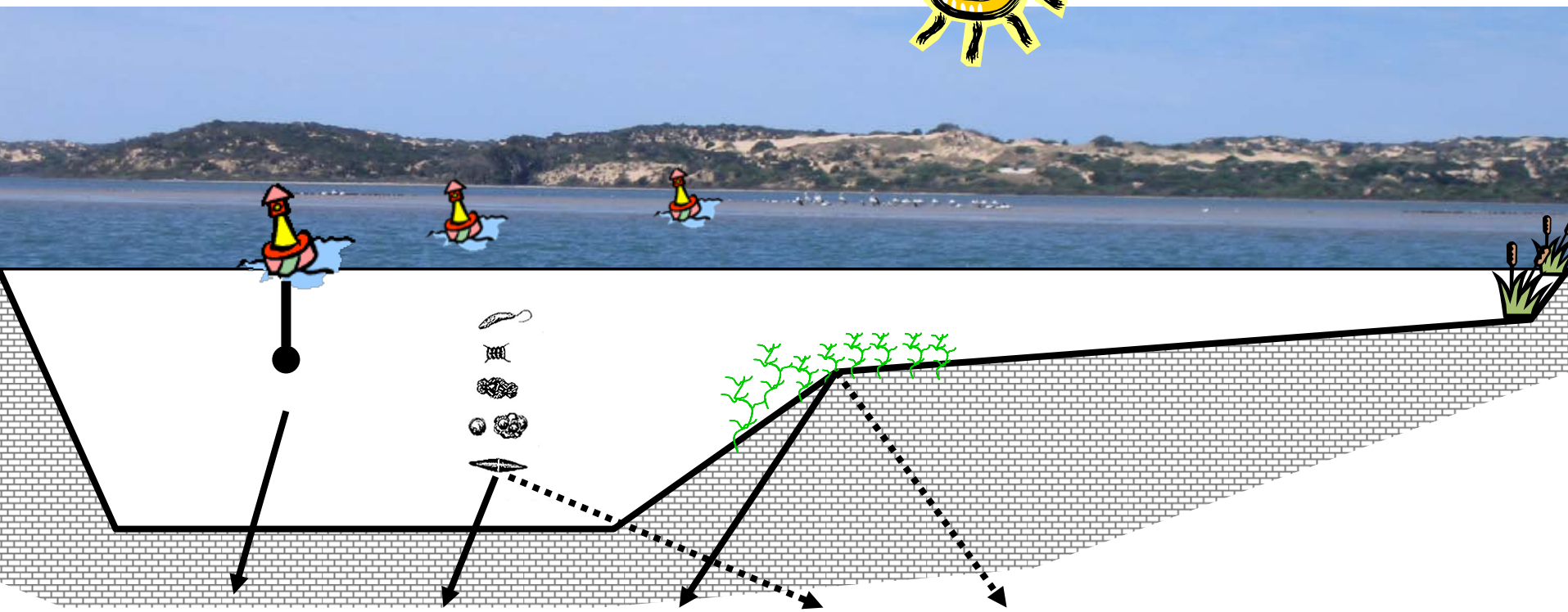

Not pictured: Paul Hanson, Abigail Goodman, Rebecca Lester
Zygmunt Lorenz
Justin Brookes
Rod Oliver
Kane Aldridge
Brian Deegan

Bottle estimates of primary production and respiration

Free-water estimates of primary production and respiration



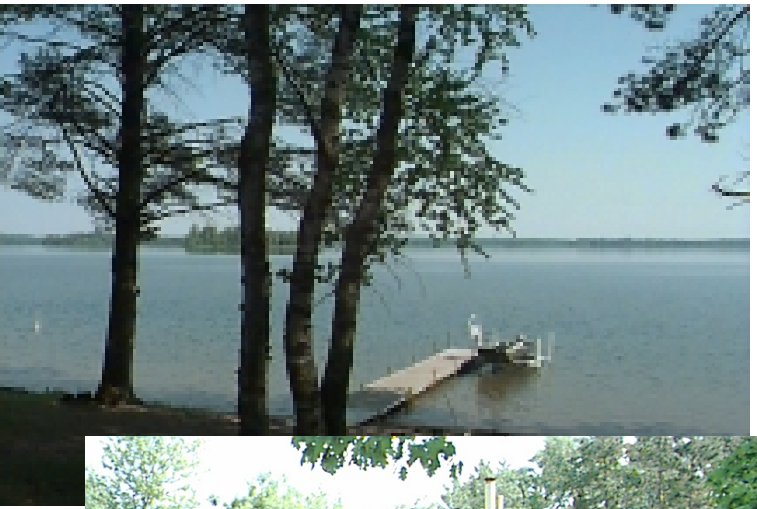
Phytoplankton physiological characteristics



$$dO_2/dt = GPP_{pelagic} + GPP_{benthic} - R_{pelagic} - R_{benthic} + F_{atm} + A$$

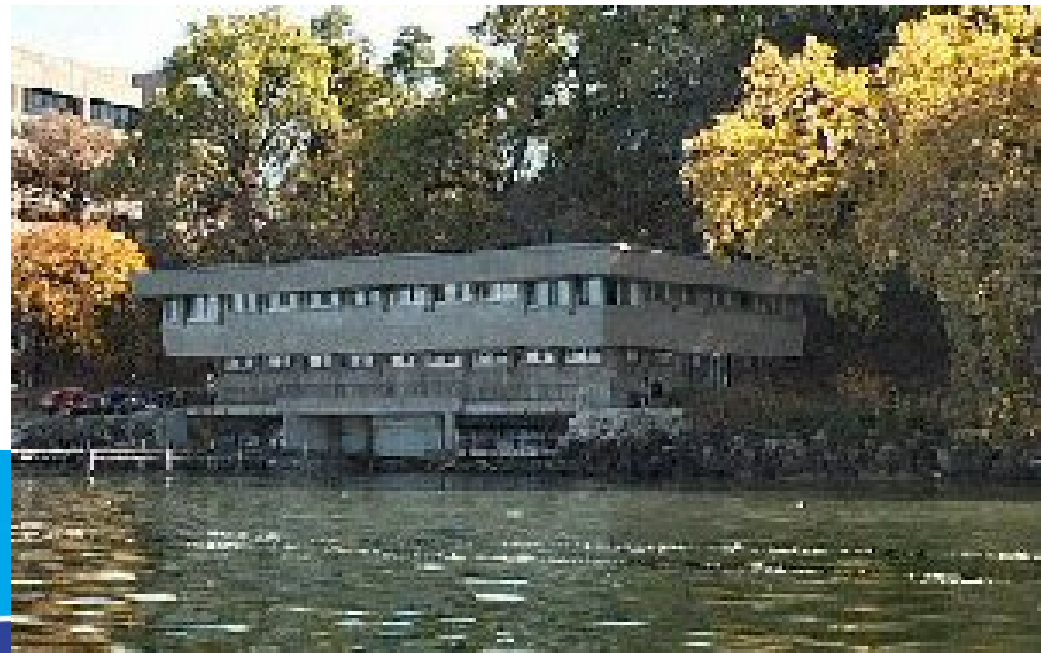
THE UNIVERSITY of WISCONSIN MADISON

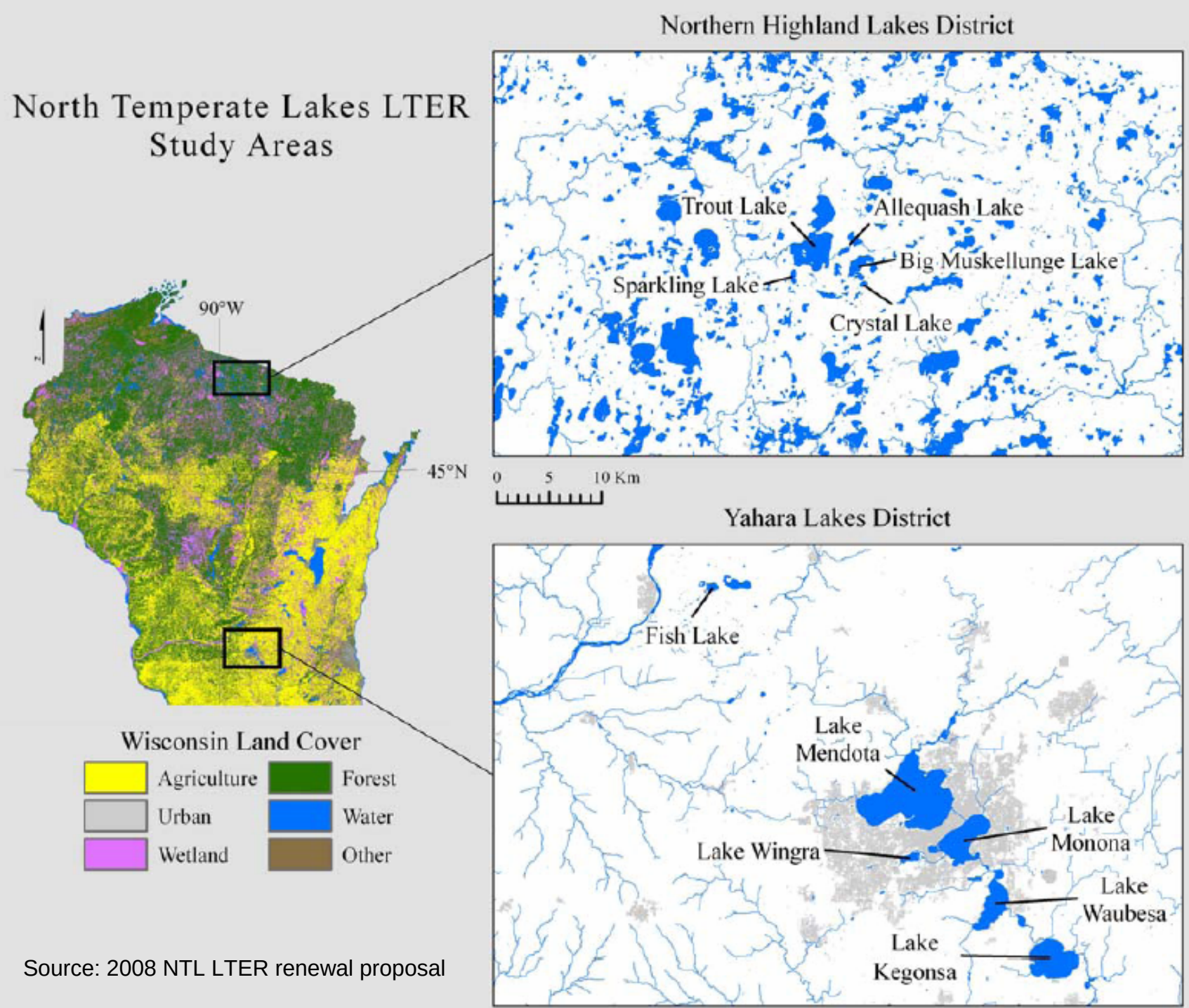
University of Wisconsin
Center for Limnology



Trout Lake Station

Hasler Laboratory for Limnology





Source: 2008 NTL LTER renewal proposal

the lake district…

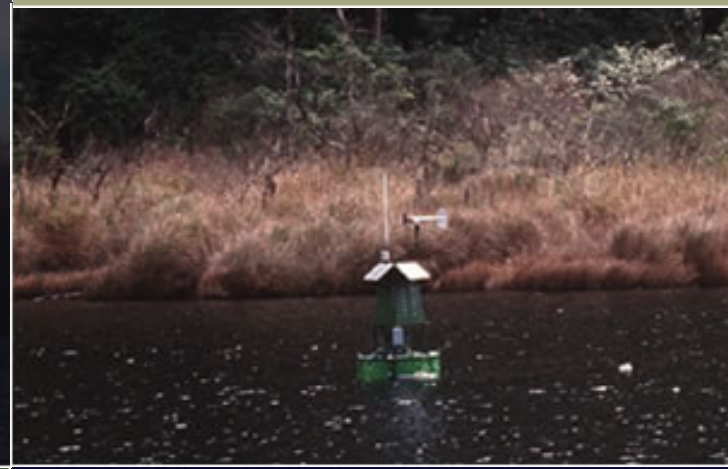
Image by Google Earth

Global Lake Ecological *Observatory Network*

Grassroots network of limnologists, information technology experts, and engineers who have a common goal of building a scalable, persistent network of lake ecology observatories.

for more information, visit ABOUT GLEON

for more information, visit GLEON NEWS



GLEON

for more information, visit GLEON EVENTS

NSF

Gordon and Betty MOORE FOUNDATION

3 Networks

Lake observatories


New Zealand

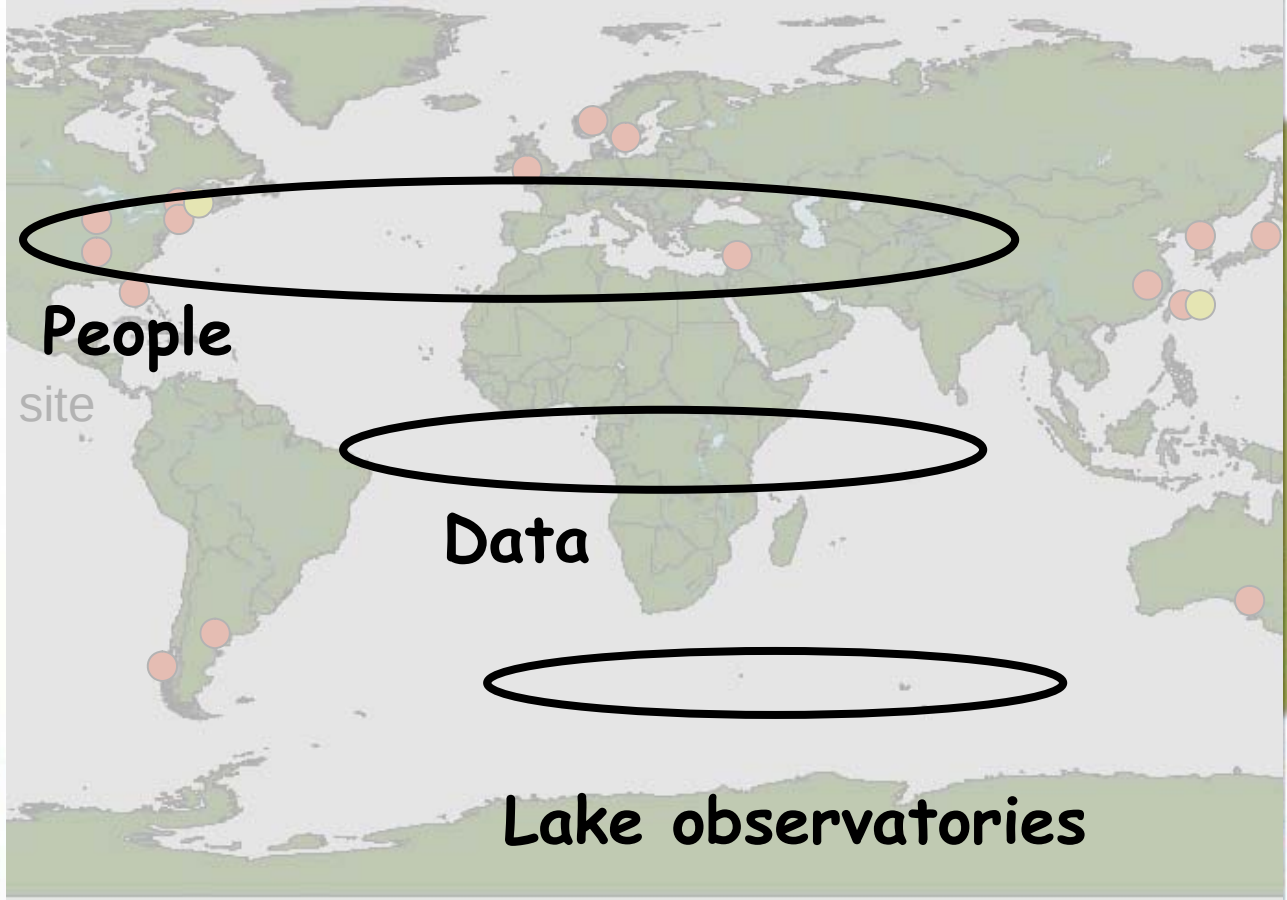

Wisconsin


Finland


Israel


Sweden


Taiwan



1. 19 countries participating
2. More than 120 scientists
3. Most sites are developing

Scientists

ICE WaRM

- Share expertise in ecosystem measurements and modeling
- Obtain ecosystem estimates of metabolism in the Coorong
- Share the Coorong story with a broader audience

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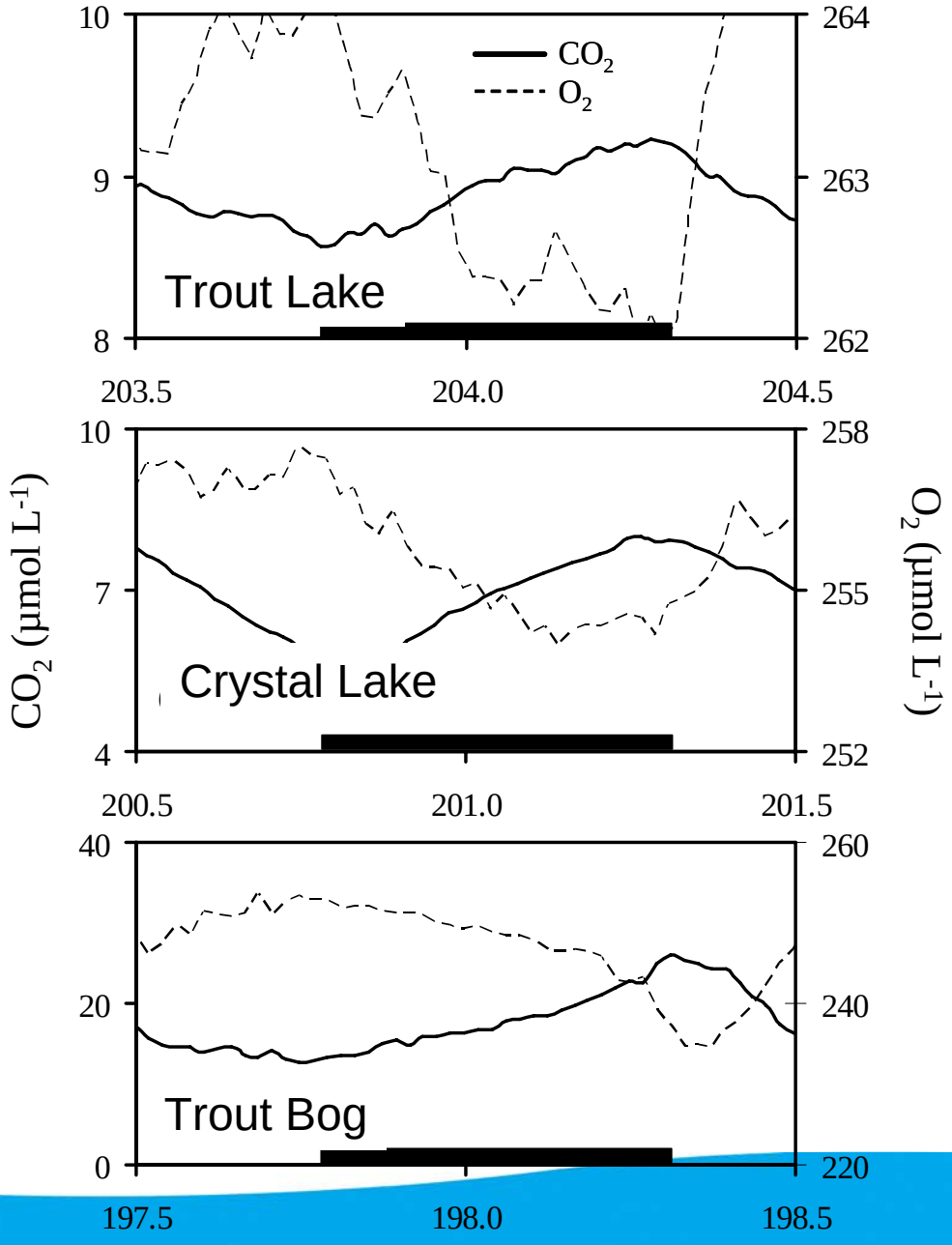
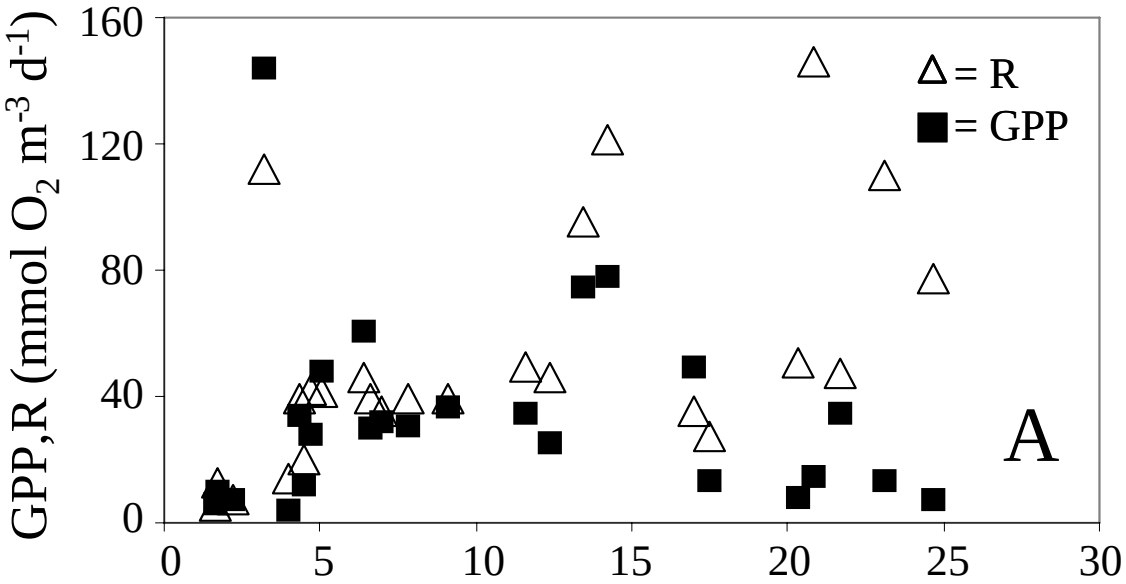
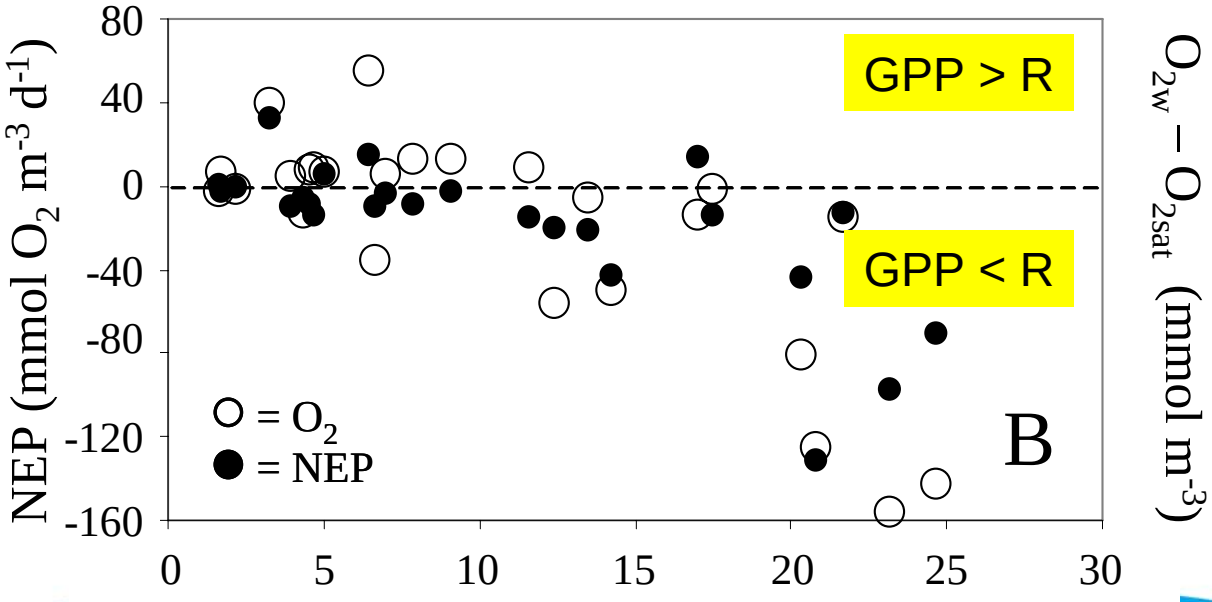


$$dO_2/dt = GPP - R + F_{atm} + A$$

(Odum 1956)

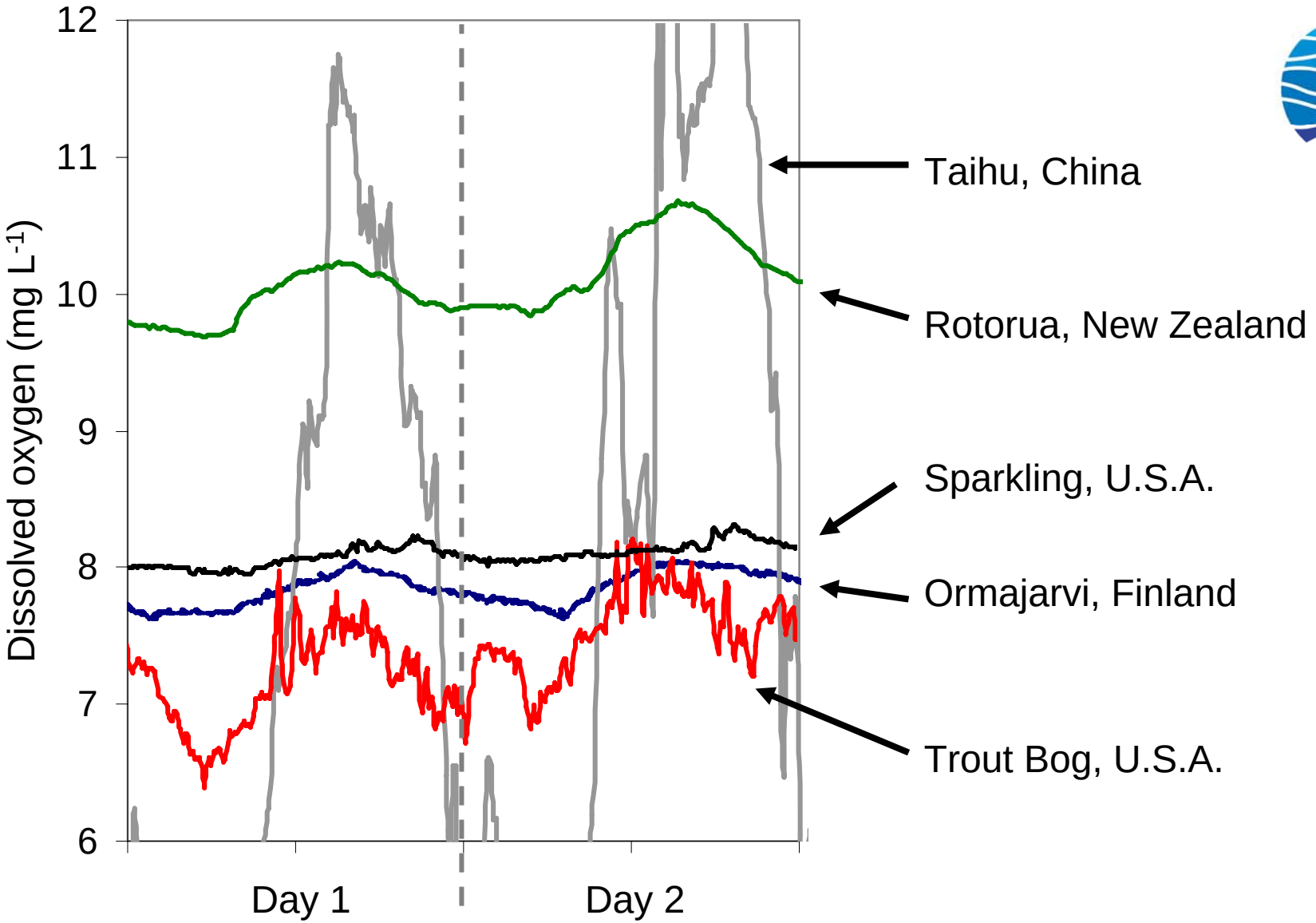
Hanson et al. 2006

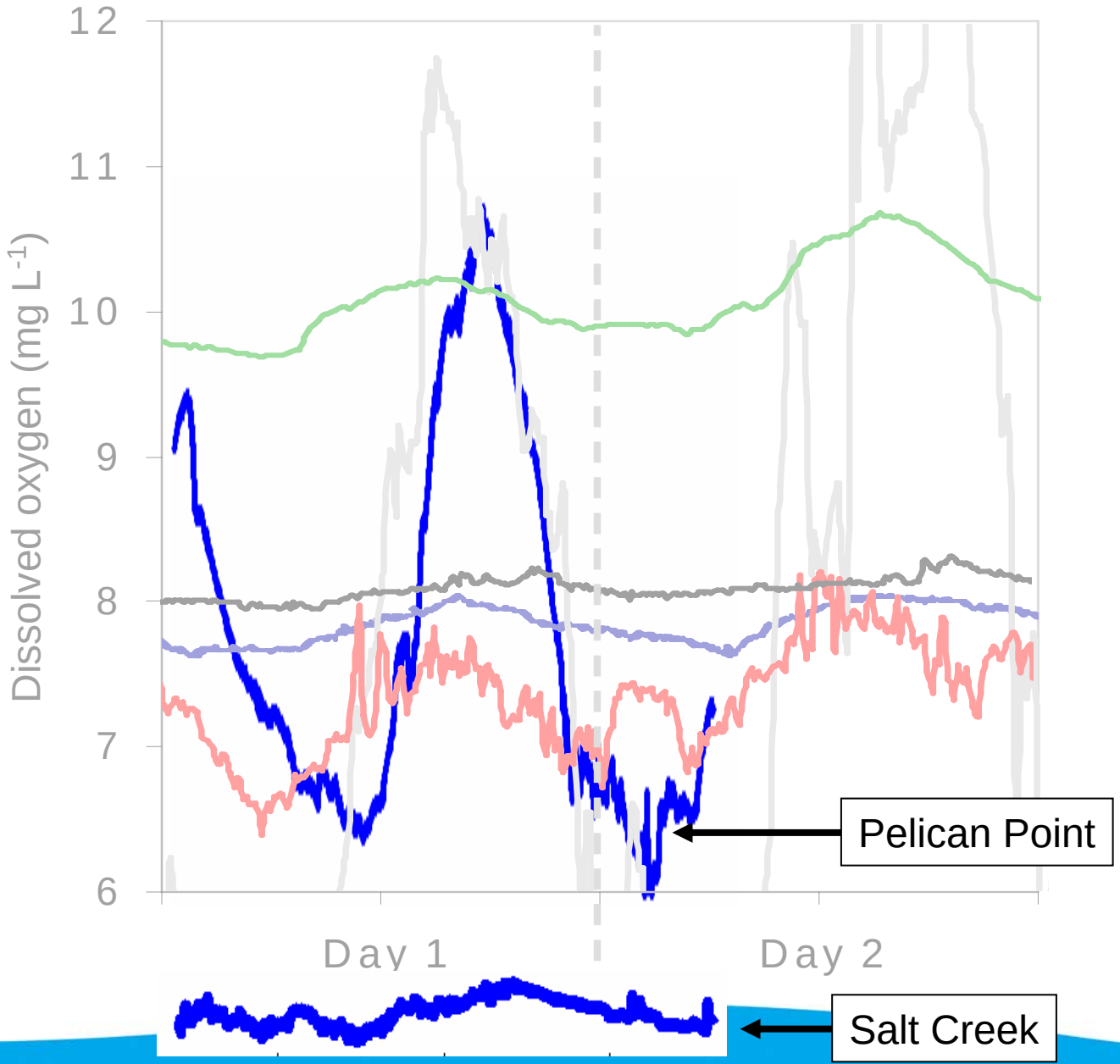


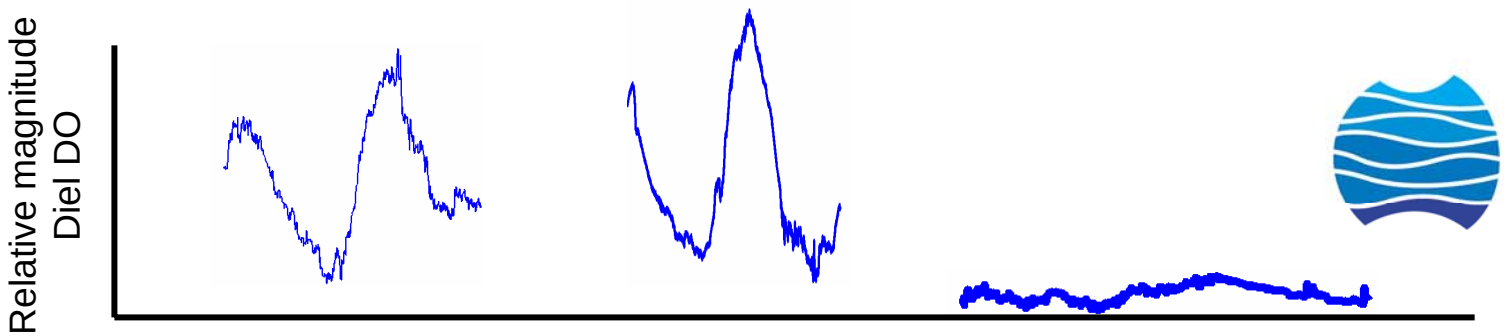


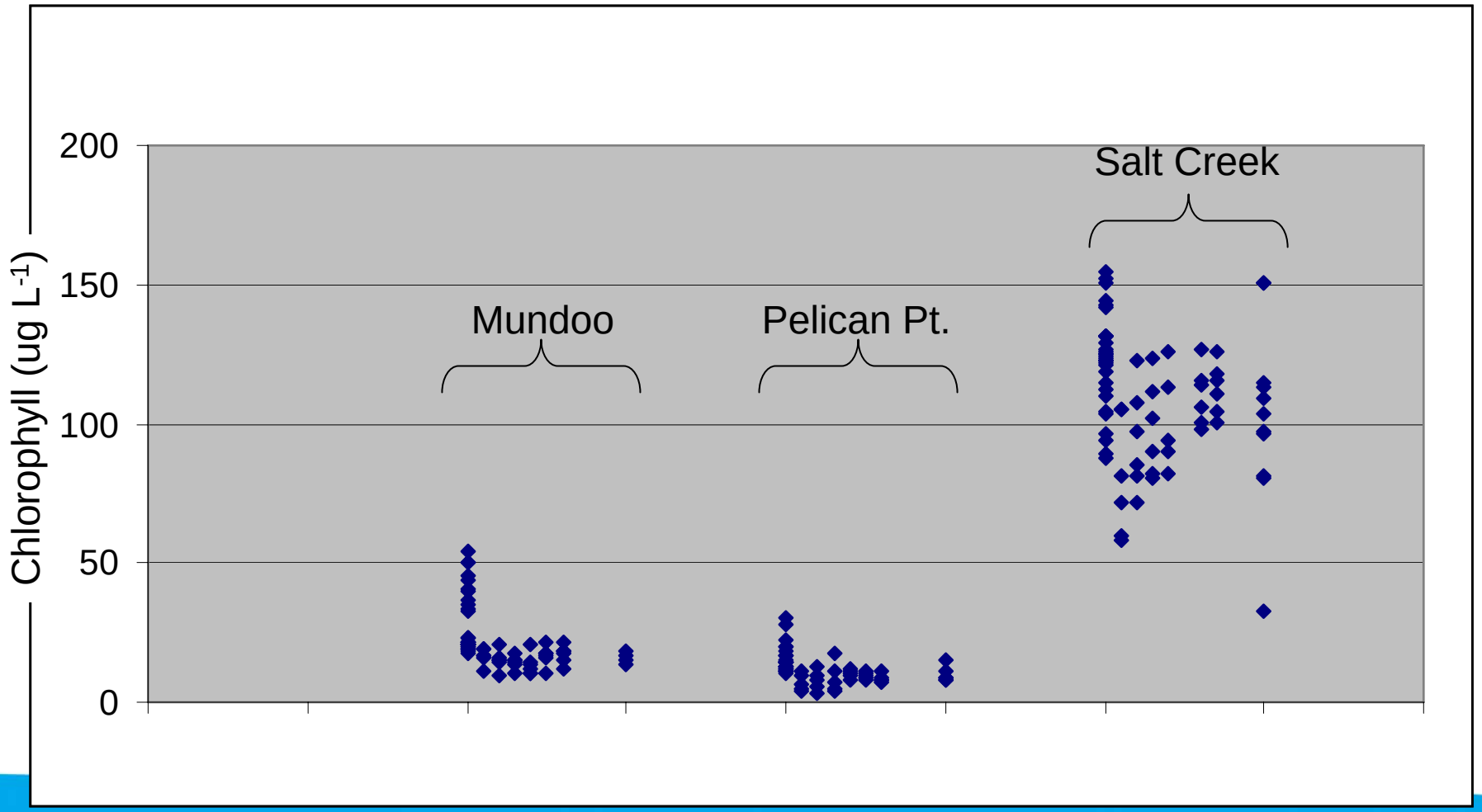
DOC (mg L^{-1})

Hanson et al. 2003


12
11
10
9
8
7
6
Dissolved oxygen (mg L-1)
Day 1
Day 2
Taihu, China
Rotorua, New Zealand
Sparkling, U.S.A.
Ormajarvi, Finland
Trout Bog, U.S.A.

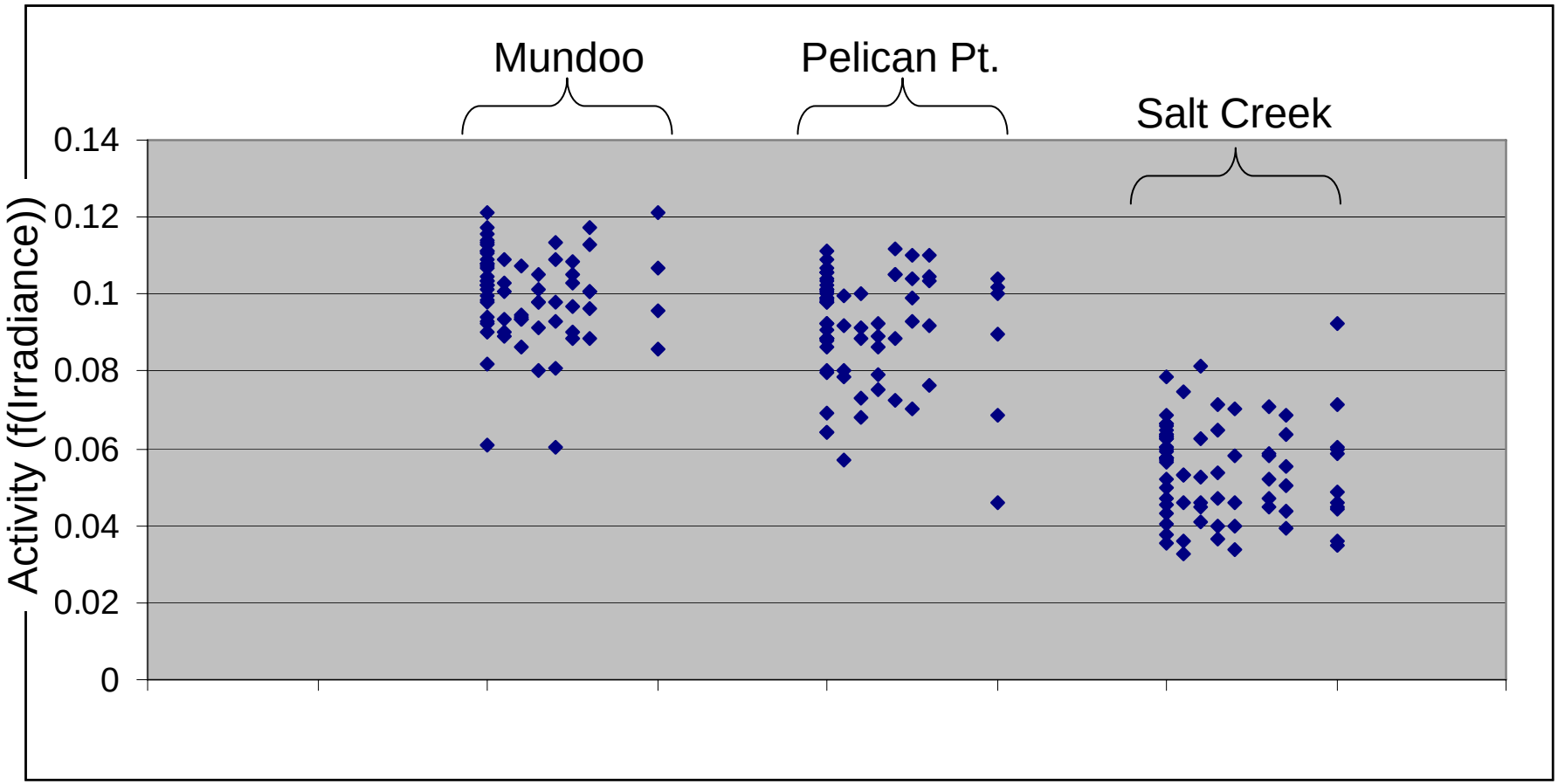

12
11
10
9
8
7
6
Dissolved oxygen (mg L-1)
Day 1
Day 2
Pelican Point
Salt Creek





2007Coorong.mdb => Results.xls

Production capacity of algae as a function of irradiance



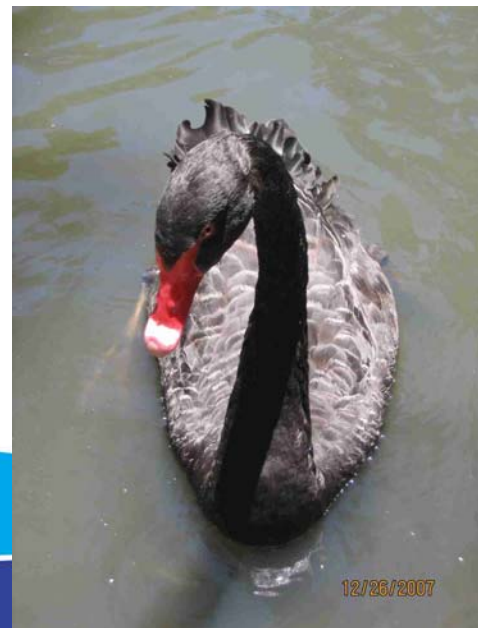
2007Coorong.mdb => Results.xls

Can we piece-together all three components (algal biomass and response to light, dissolved oxygen) to predict primary production?

“Prediction is very hard,

especially about the future.”

- Yogi Berra



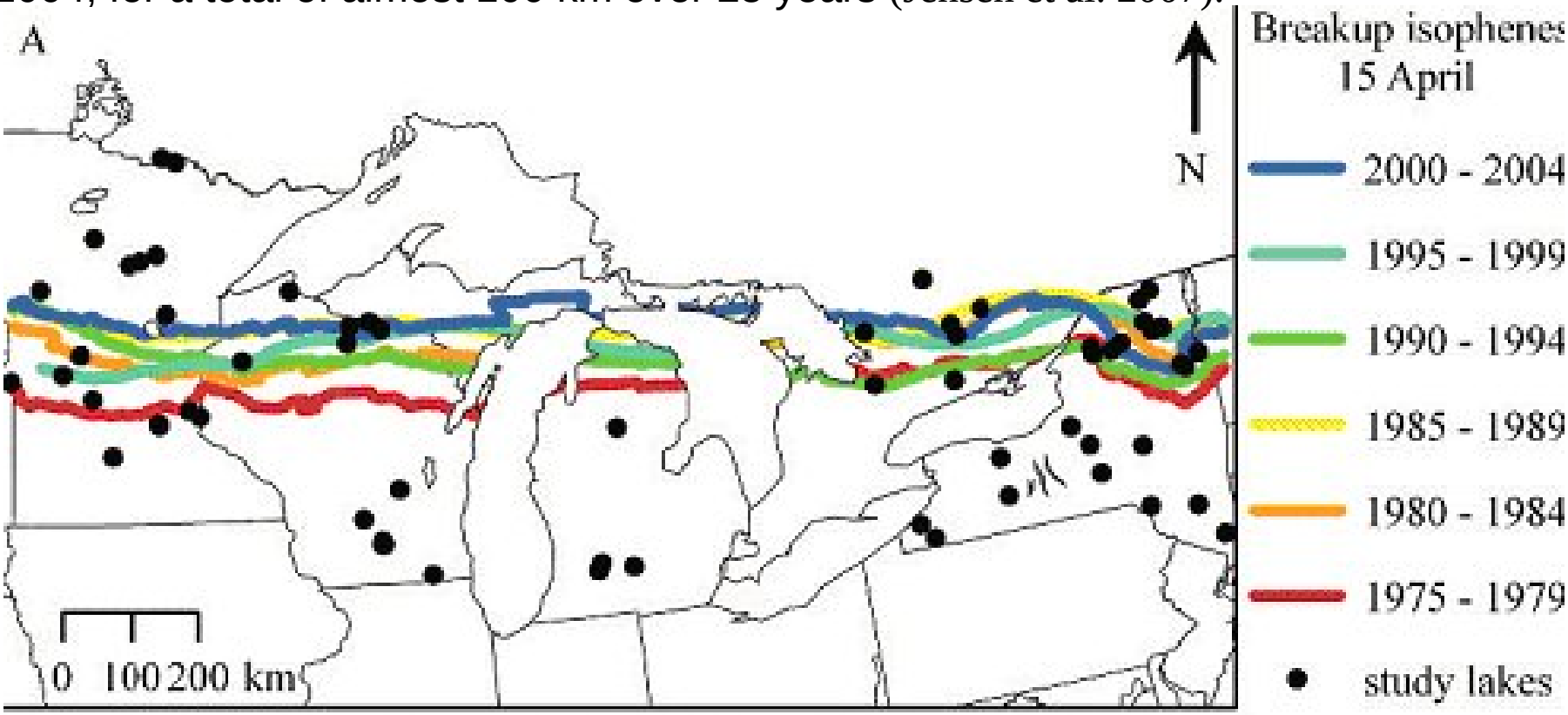
Why?

1. Multiple drivers for observations
2. Relationships are scale dependent
3. Measurement, parameter, and model uncertainties can be high

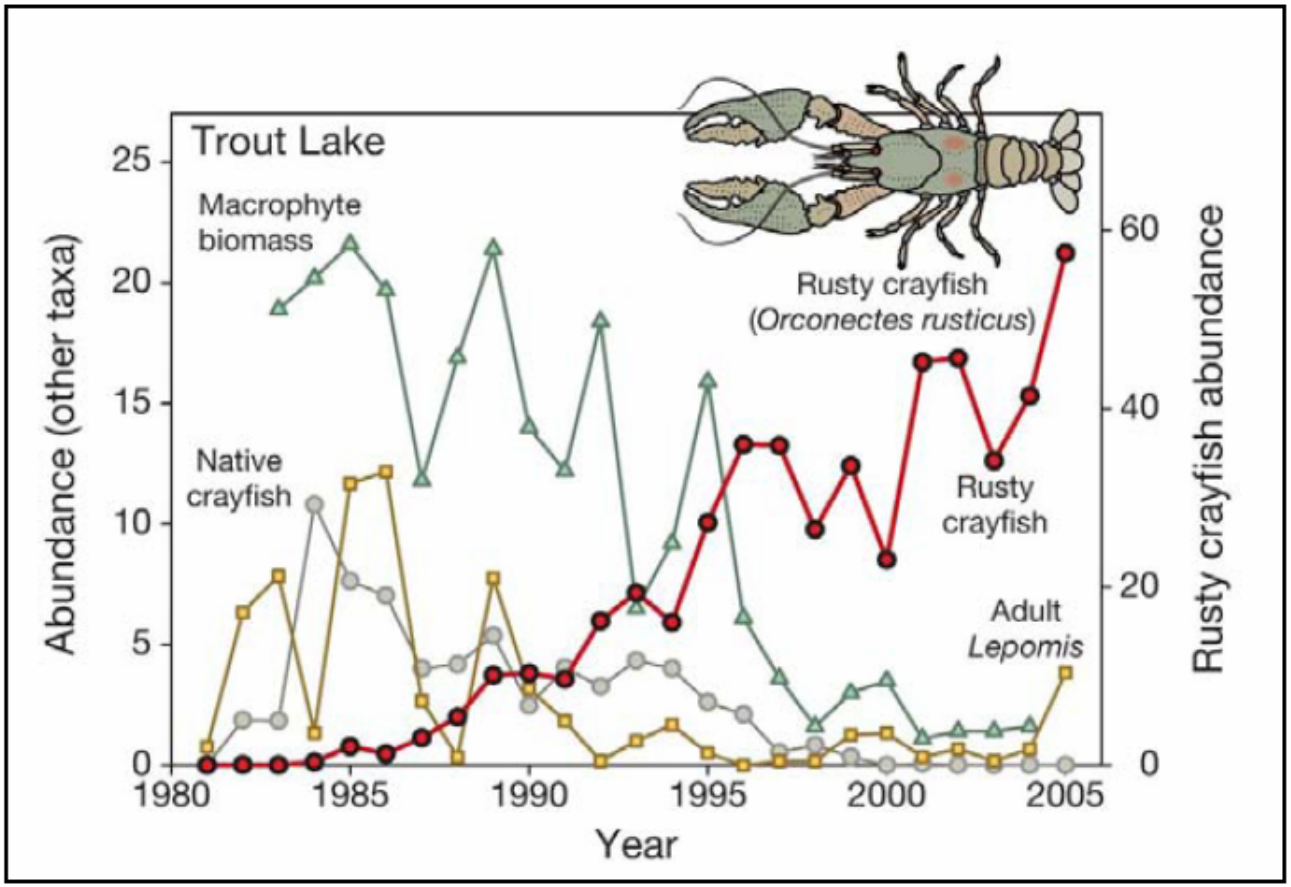
Climate Change

Lakes that thaw on April 15th (tax day).

Isolines move northward 3.8 kilometers per year from 1975 to 2004, for a total of almost 100 km over 25 years (Jensen et al. 2007).

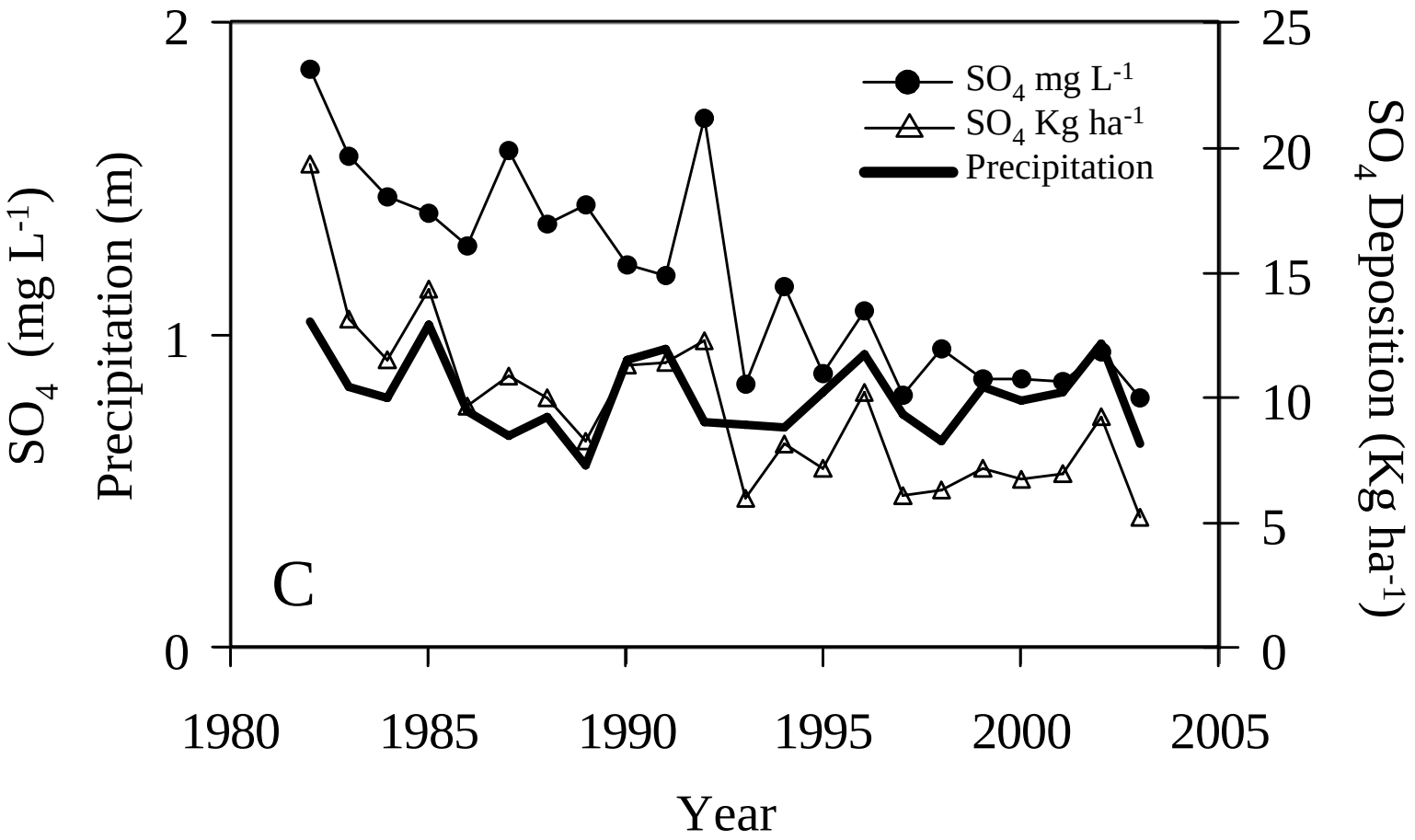


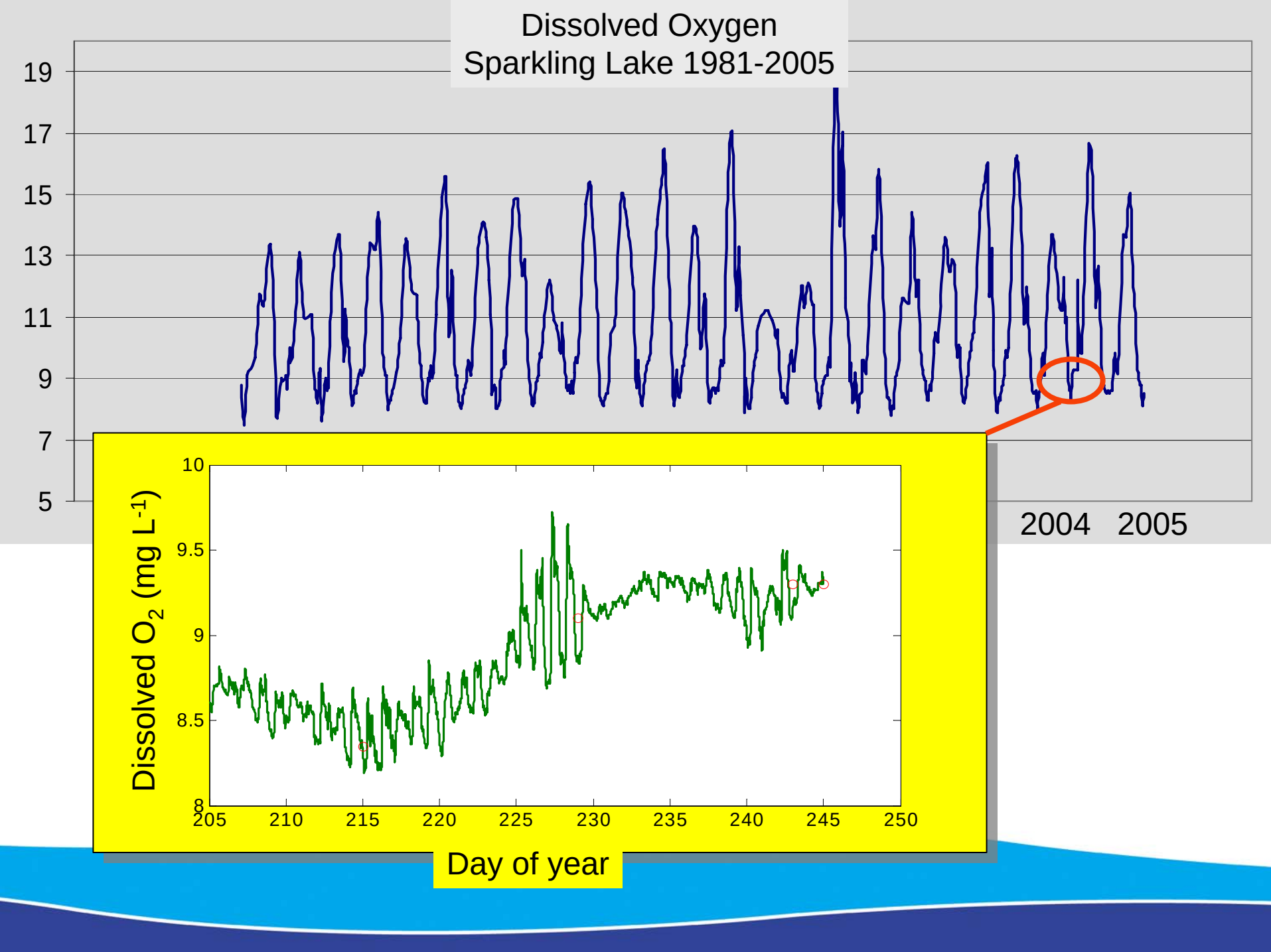
Invasive Species



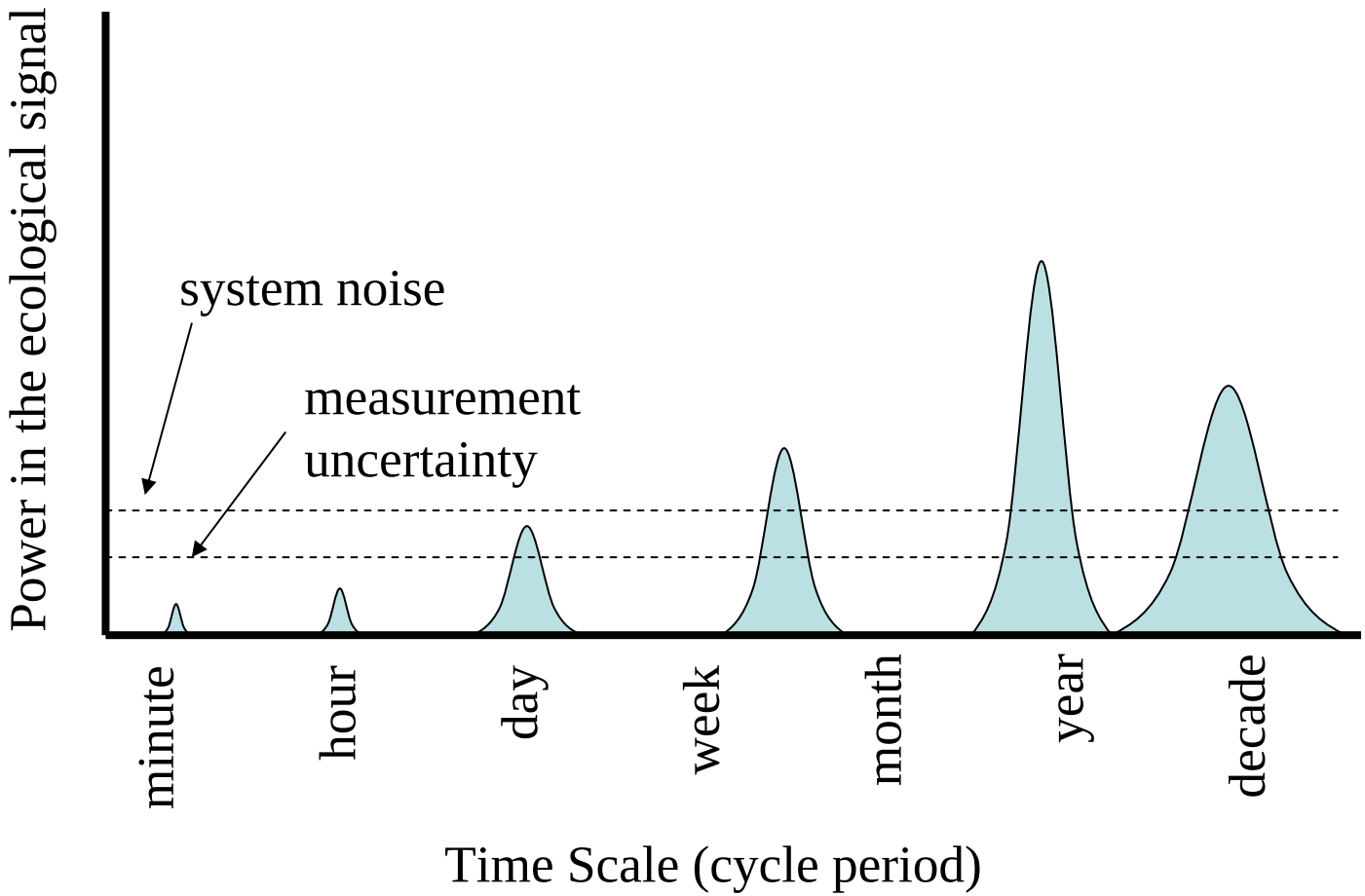
Caption for Figure 3:
The invasion of Trout Lake by rusty crayfish was associated with declines of macrophyte biomass, sunfish (*Lepomis* spp.) and native crayfish.

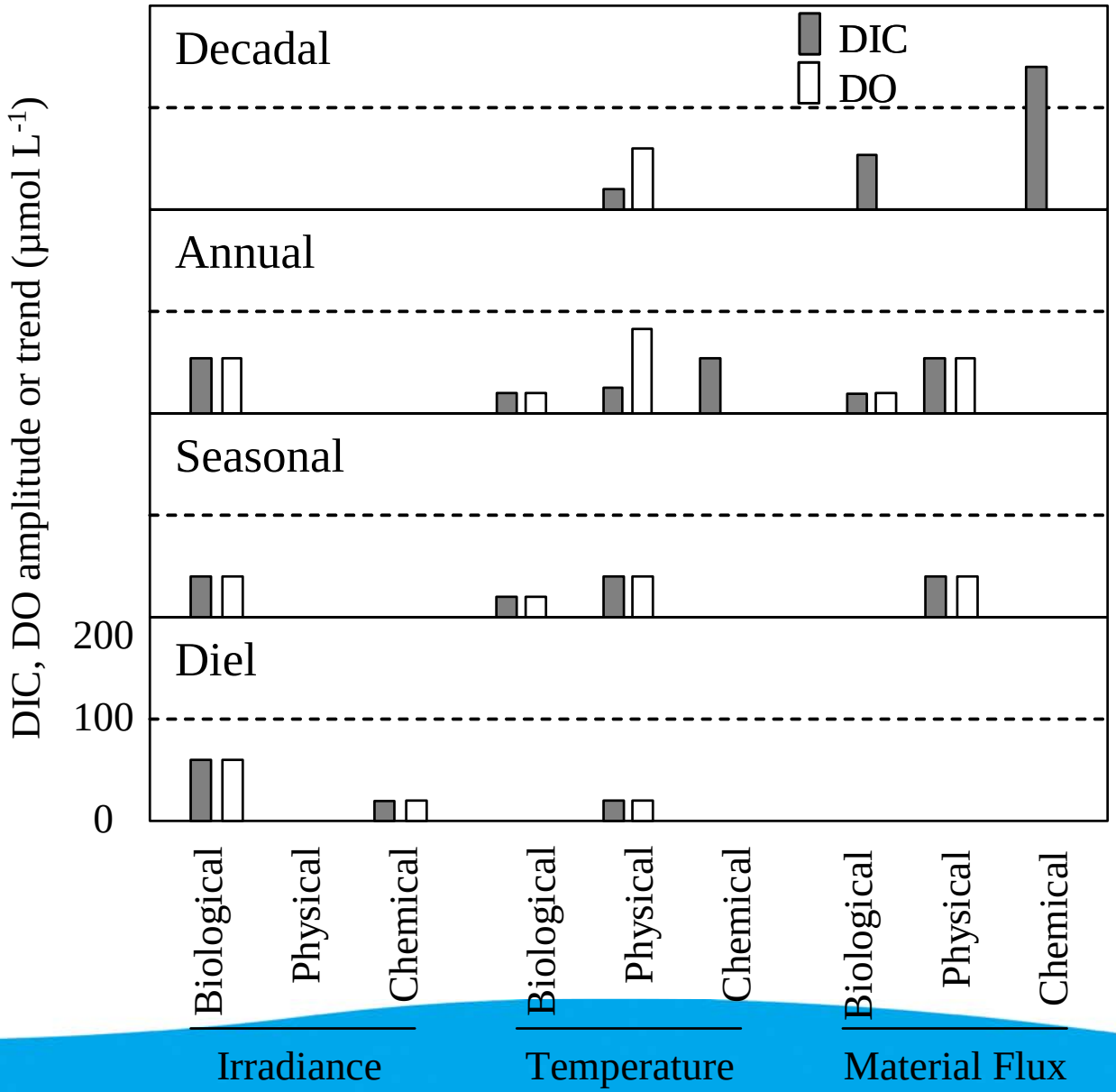
Source: 2008 NTL LTER renewal proposal


2
1
0
25
20
15
10
5
0
1980
1985
1990
1995
2000
2005
Year
SO4 (mg L-1)
Precipitation (m)
SO4 Deposition (Kg ha-1)
SO4 mg L-1
SO4 Kg ha-1
Precipitation
C


Dissolved Oxygen
Sparkling Lake 1981-2005
19
17
15
13
11
9
7
5
2004
2005
Dissolved O_2 (mg L^{-1})
10
9.5
9
8.5
8
205
210
215
220
225
230
235
240
245
250
Day of year

Domains of Control



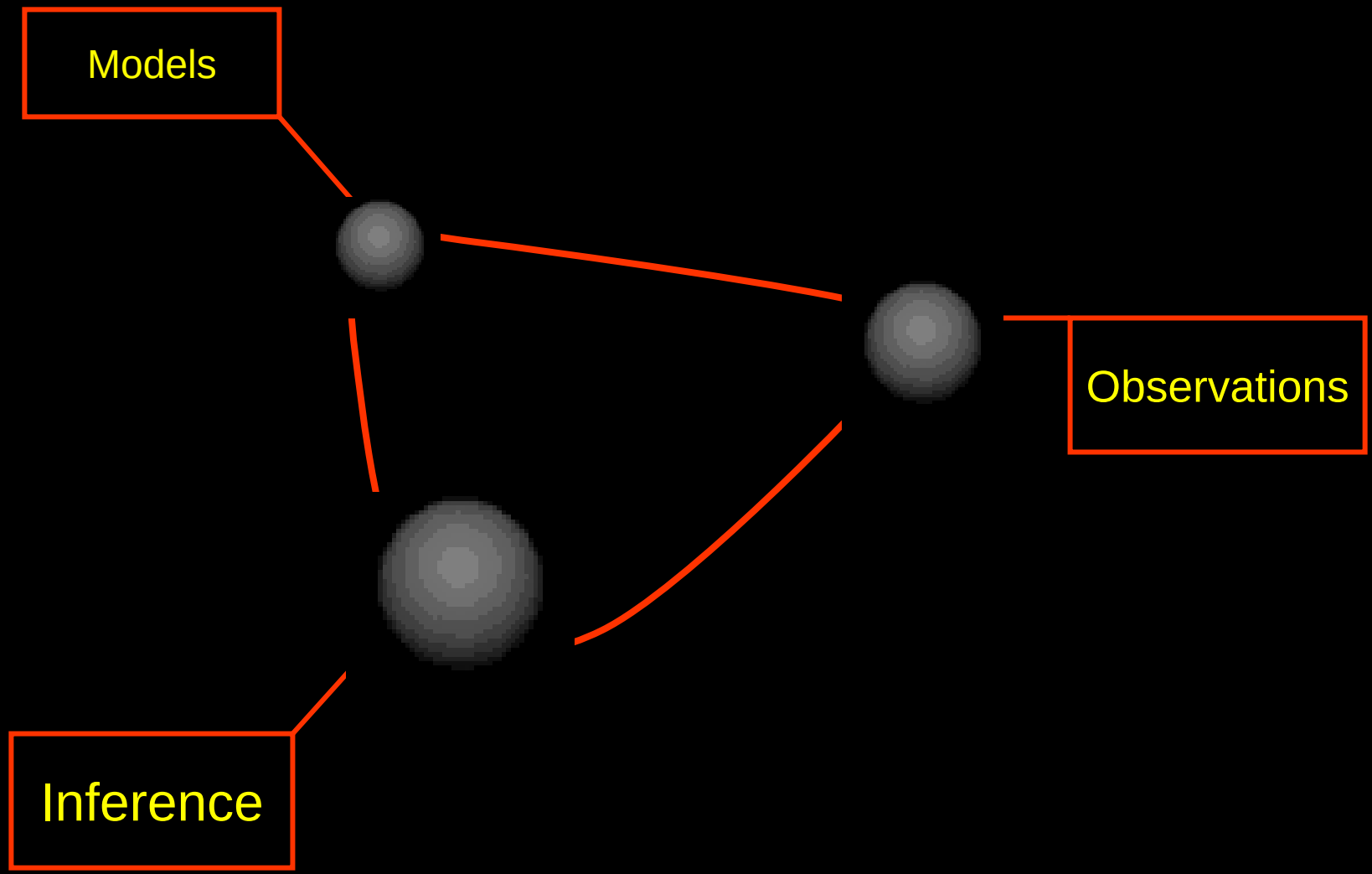


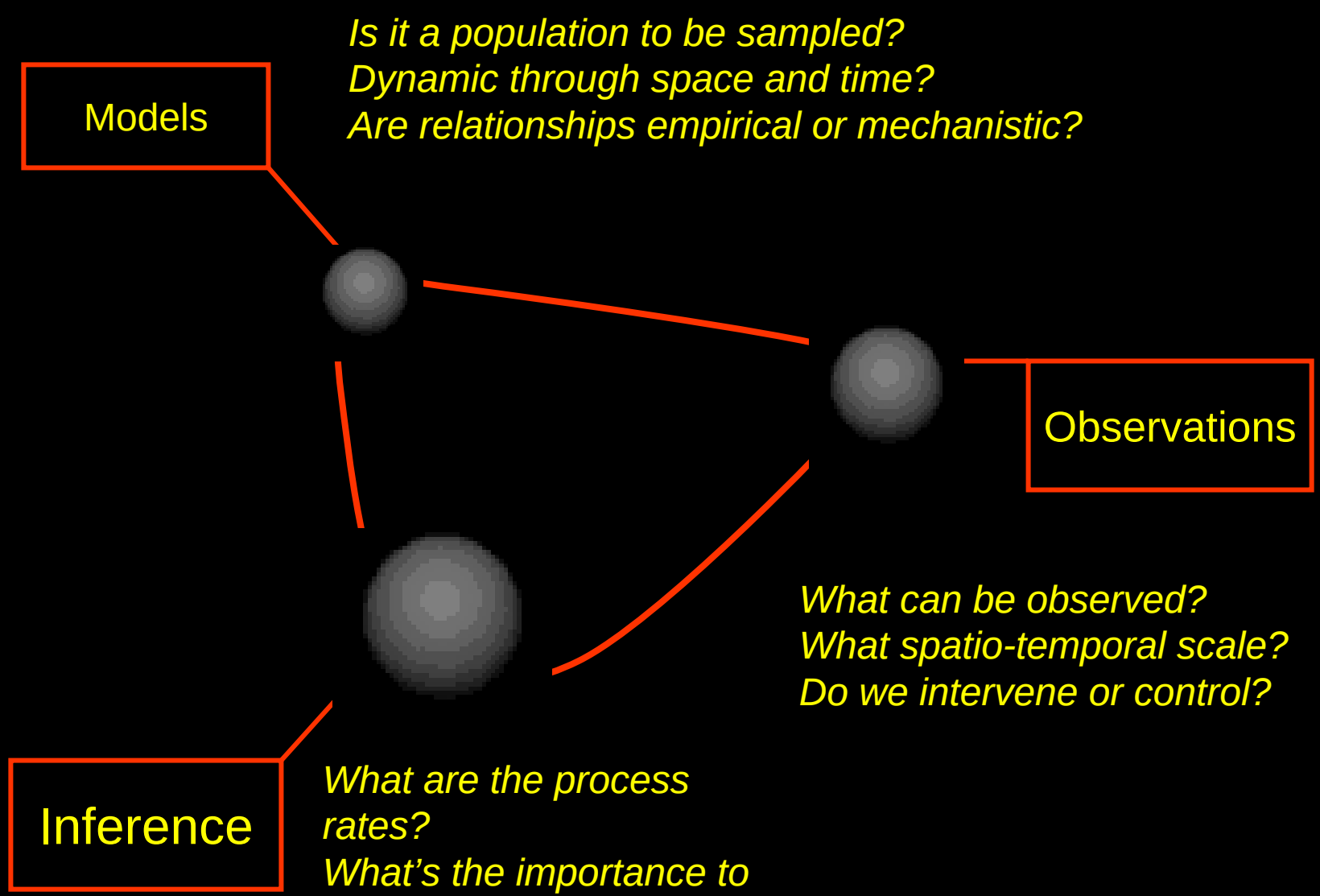
Hanson et al. 2006

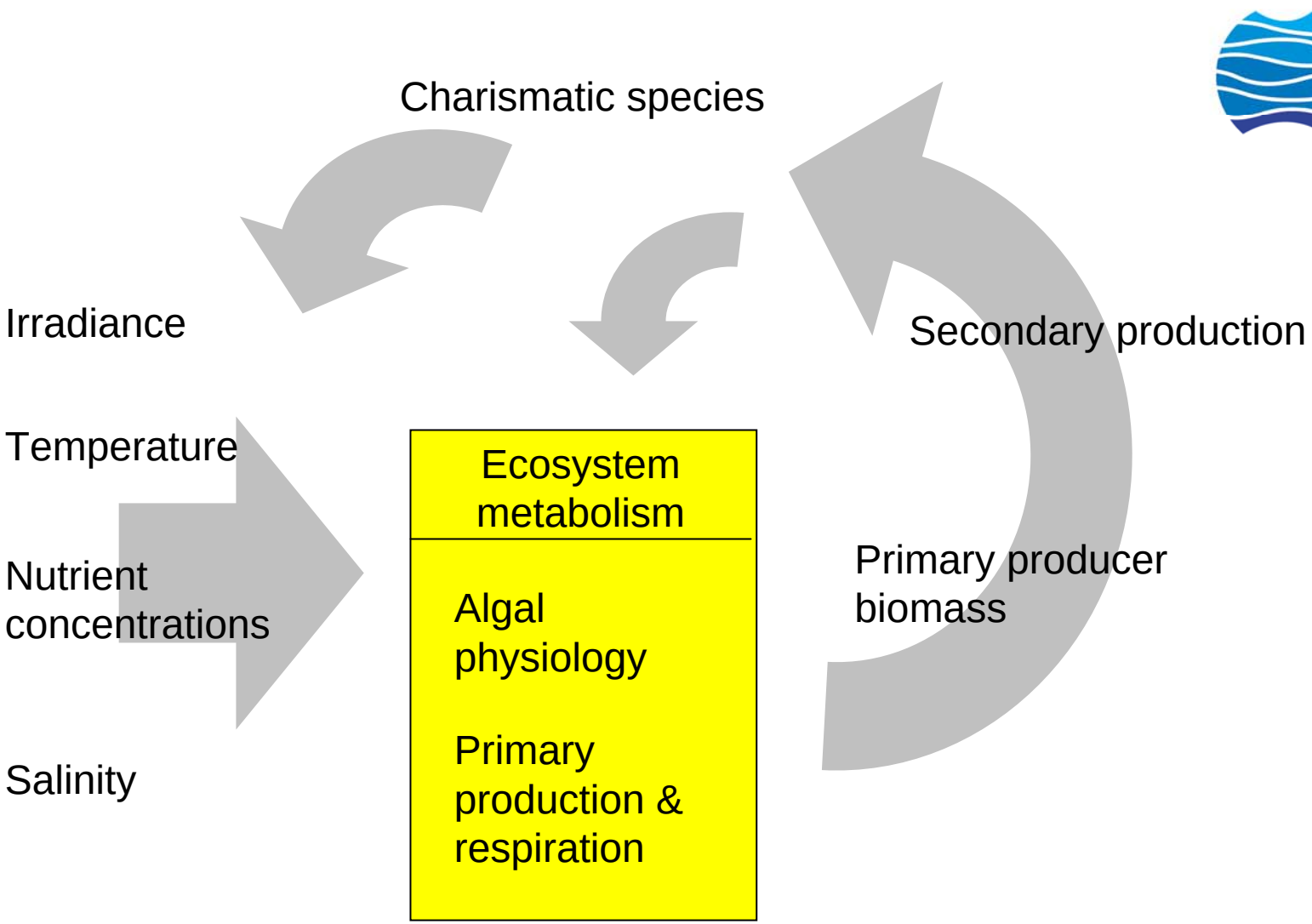
1. Sampling frequency, duration and precision influences our interpretation of a variable.

2. Even in a simple system, inference is scale dependent and can be difficult.

3. By extracting information at multiple scales, we make better use of information content in the data.


Models
Observations
Inference


Models
Is it a population to be sampled?
Dynamic through space and time?
Are relationships empirical or mechanistic?
Observations
What can be observed?
What spatio-temporal scale?
Do we intervene or control?
Inference
What are the process rates?
What's the importance to the larger story?


Charismatic species
Irradiance
Temperature
Nutrient concentrations
Salinity
Ecosystem metabolism
Algal physiology
Primary production & respiration
Secondary production
Primary producer biomass

Summary

- Ecosystem state change in the Coorong has shifted primary producers
- Productivity is low in the south basin and high in the north basin
- Physical/chemical habitat has profound affects on all trophic levels
- Models of alternative futures will help inform management action

Acknowledgements

- ICE WaRM
- University of Adelaide
  - Justin Brookes
  - Kane Aldridge
  - Brian Deegan
  - George Ganf
  - Abigail Goodman
- CSIRO
  - Rod Oliver
  - Zyg Lorenz

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Thank you!