Using Phoslock® to control cyanobacteria in a shallow eutrophic Scottish Reservoir: ecological responses across multiple trophic levels

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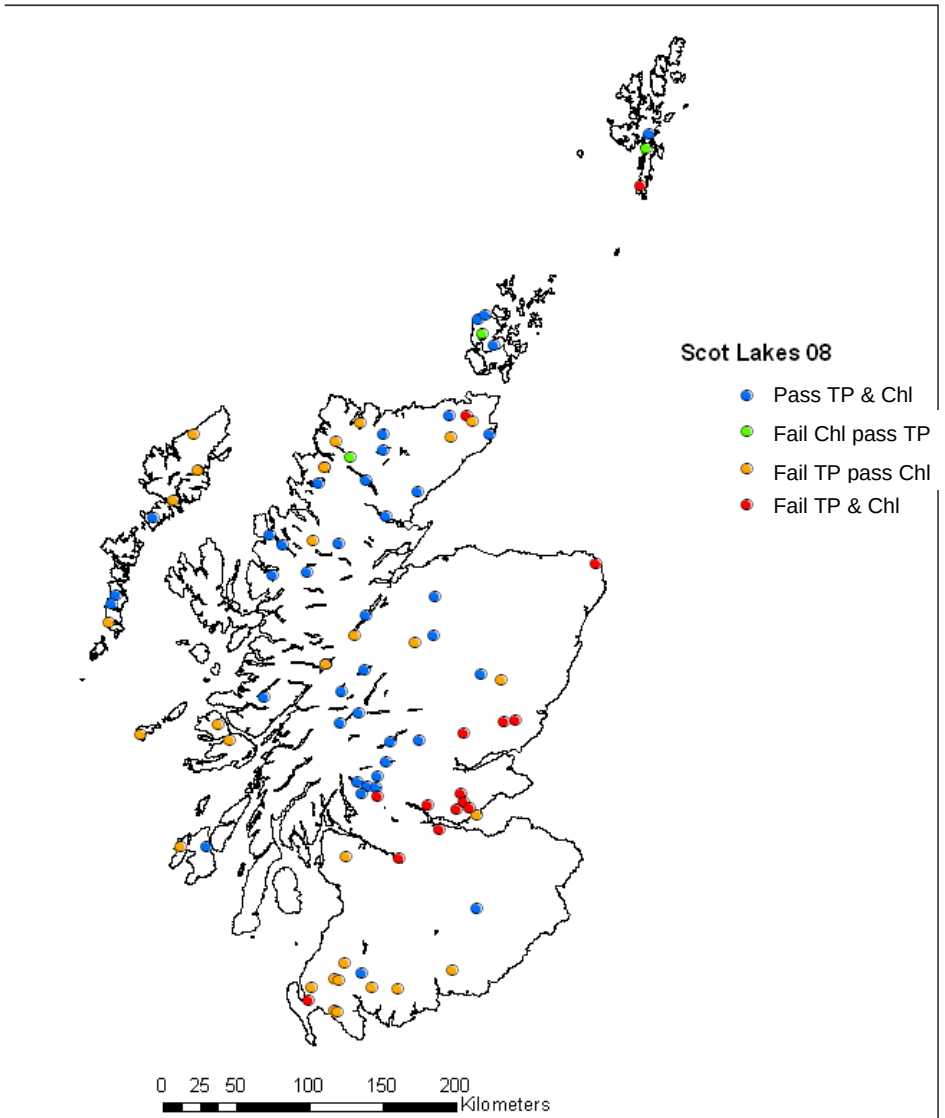
Loch Leven - 2007

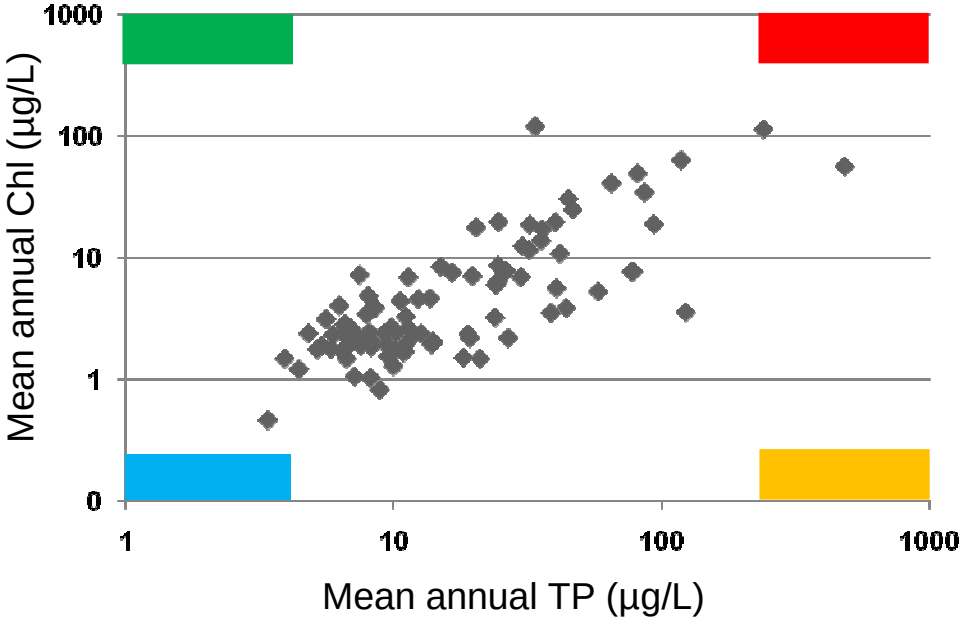
We did all the hard work……

Talk outline

- **Introduction**
- **The tale of a very important little bucket!**
- **Assessing the ecological responses following Phoslock® application**

The national scale - 2008





Pass TP; Pass Chl - 45 %

Pass TP; Fail Chl - 2 %

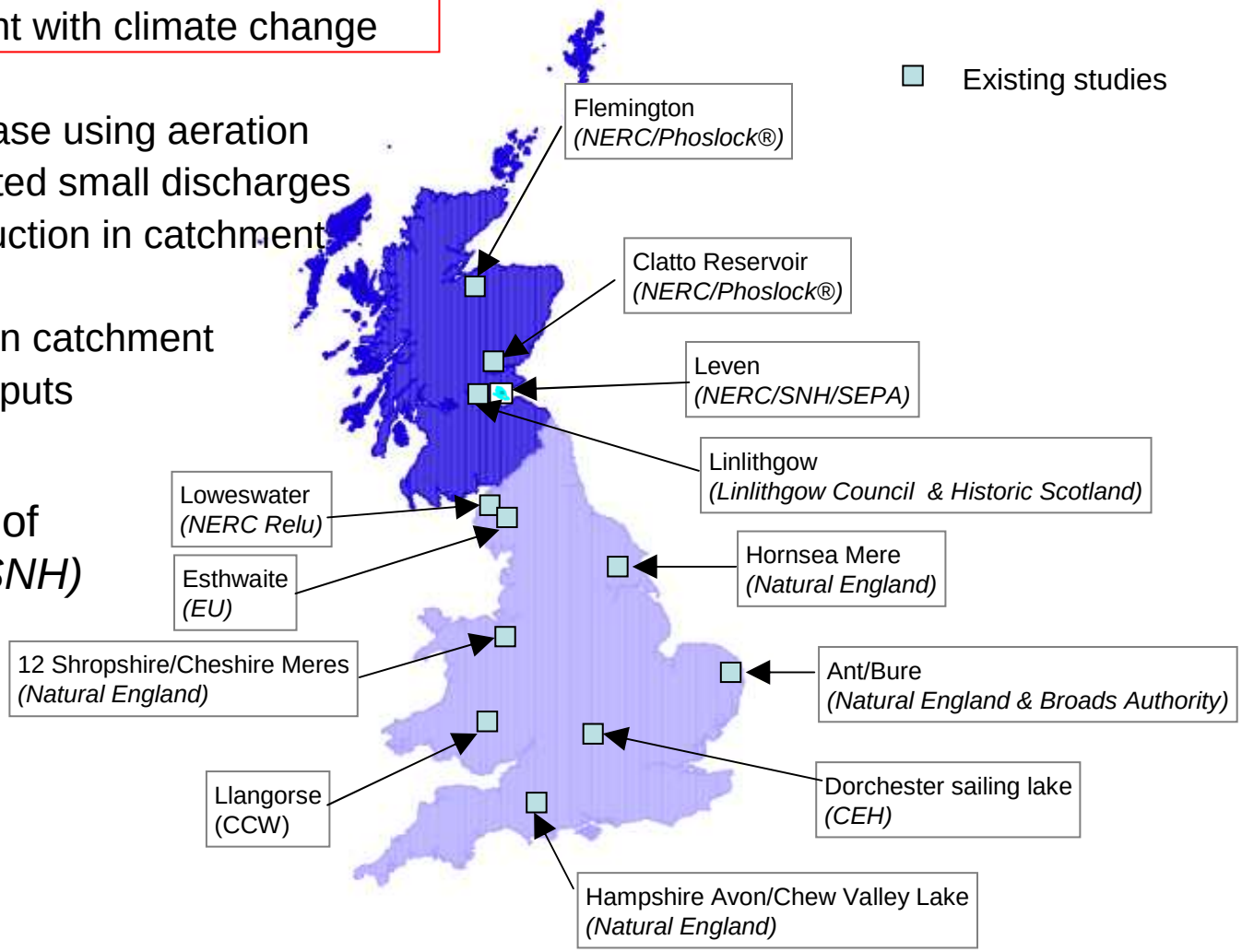
Fail TP; Pass Chl - 35 %

Fail TP; Fail Chl - 18 %

Current CEH Lake restoration projects

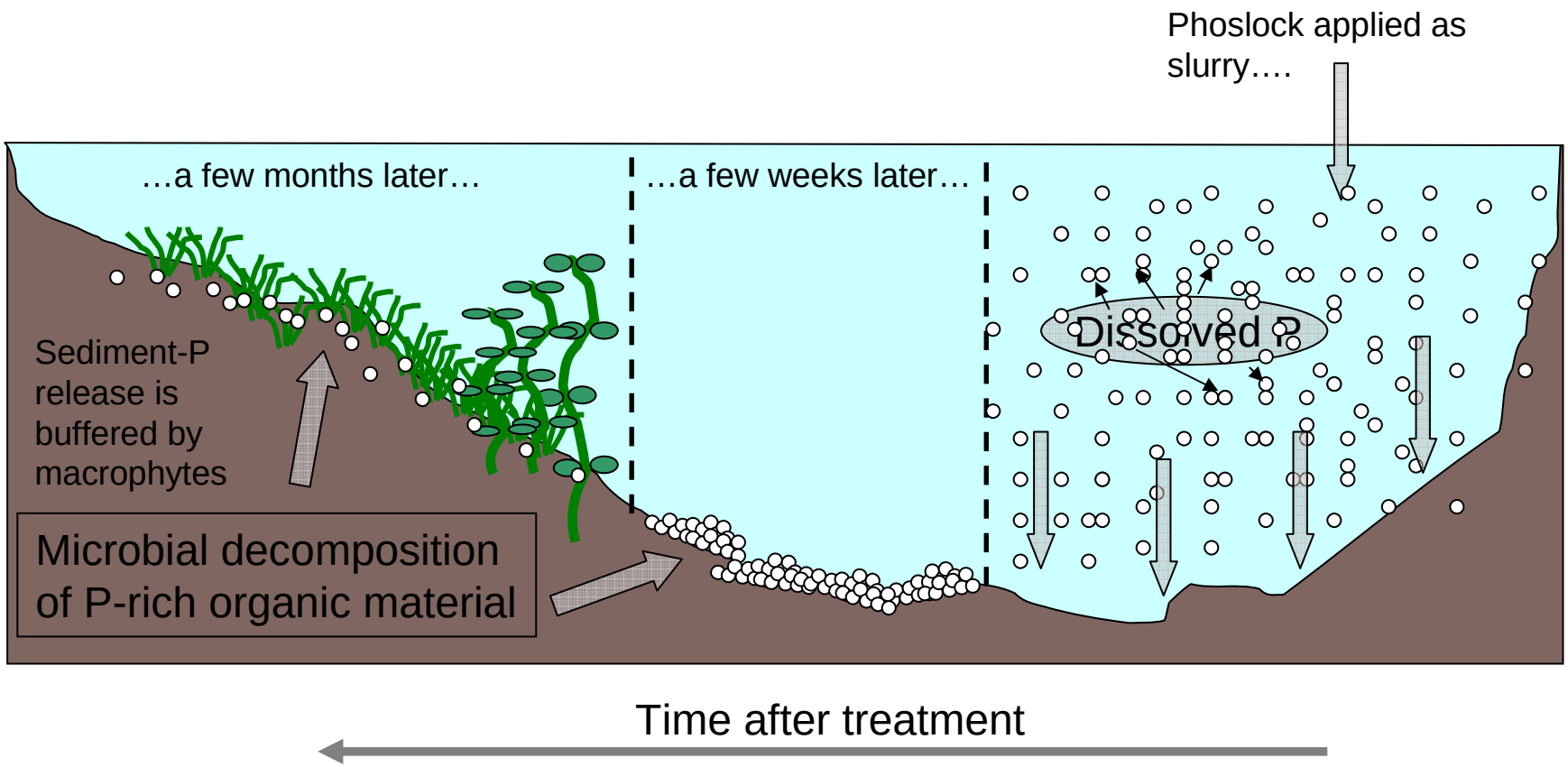
- Control of sediment P release using P-capping
- Managed flushing to speed up recovery
- Interactions of management with climate change
- Biomanipulation
- Control of sediment P release using aeration
- Identification of un-consented small discharges
- Industrial point source reduction in catchment
- Control of pesticide use
- Control of diffuse sources in catchment
- Reduction of agricultural inputs

+ site condition survey of
~ 140 Scottish lochs *(SNH)*



> 6,000 lakes in GB have eutrophication problems

The Phoslock® story…..



…..perhaps a little simplistic?

Shutting down the phosphorus pump

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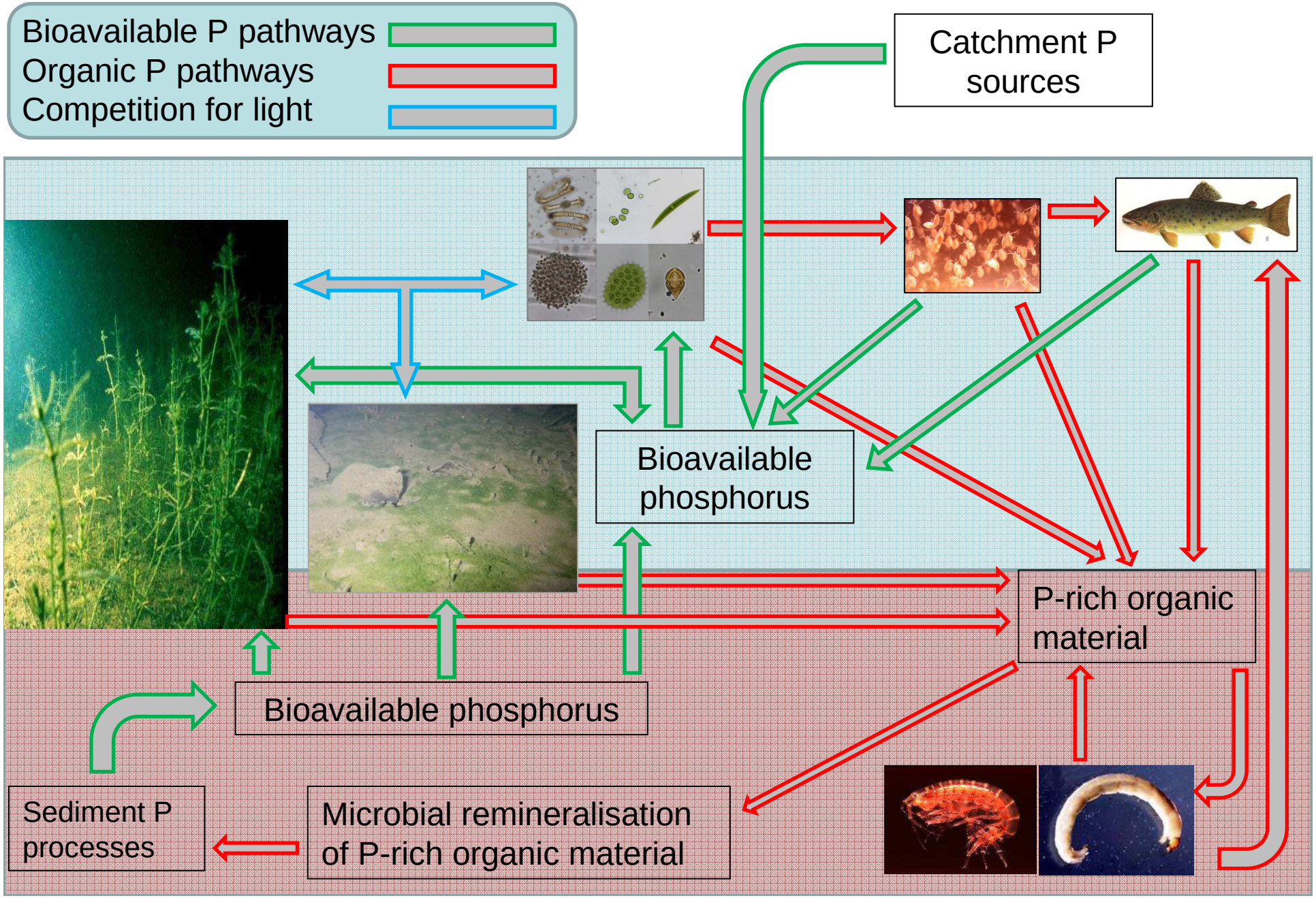

Shutting down the phosphorus pump

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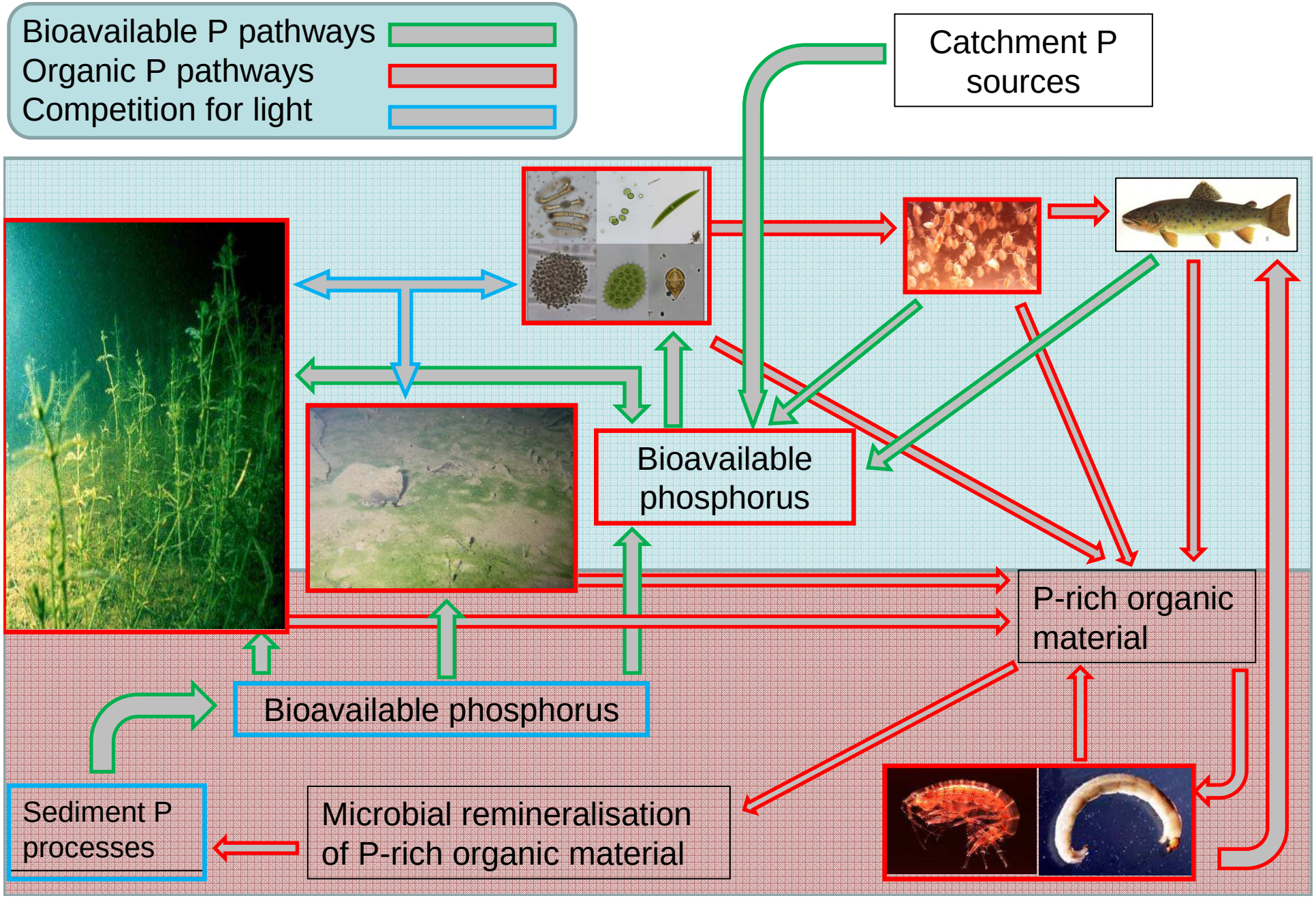

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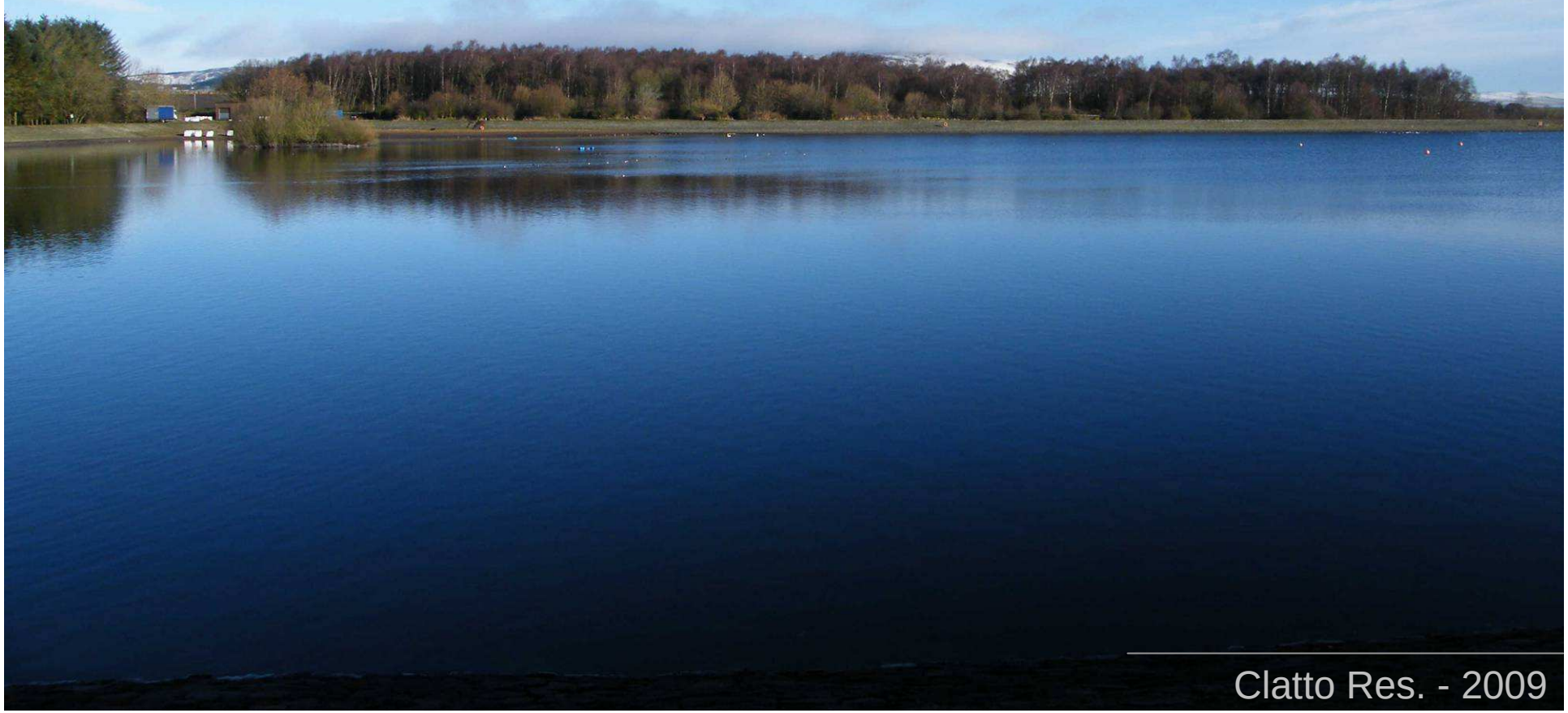
- **Introduction**
- **The tale of a very important little bucket!**
- **Assessing the ecological responses following Phoslock® application**



Clatto Reservoir

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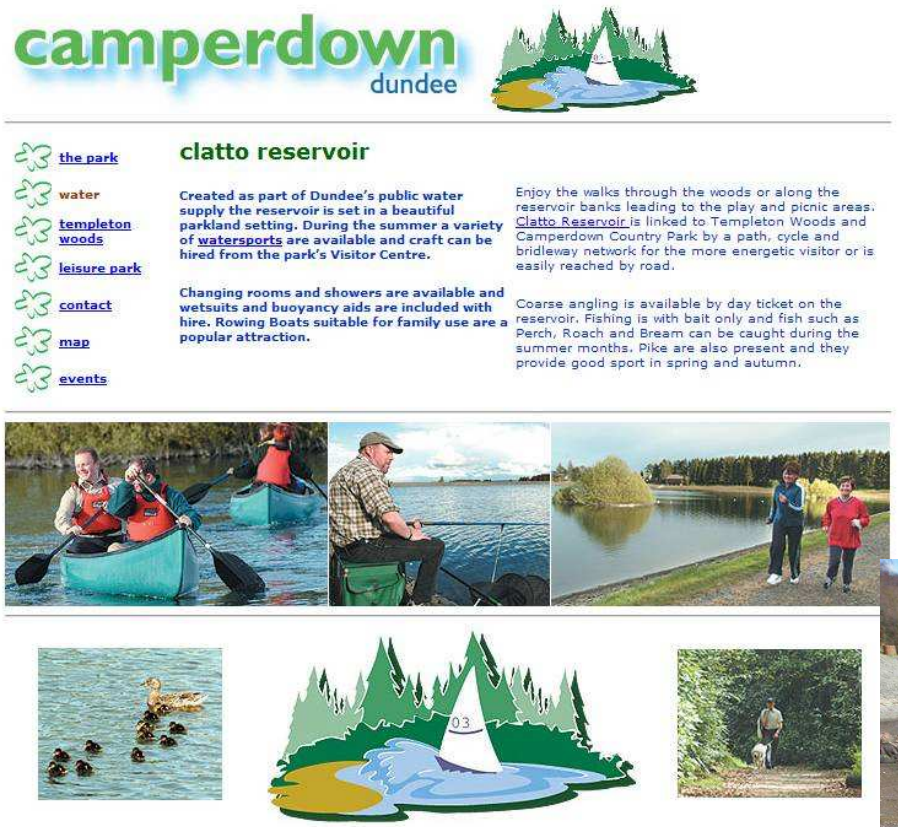
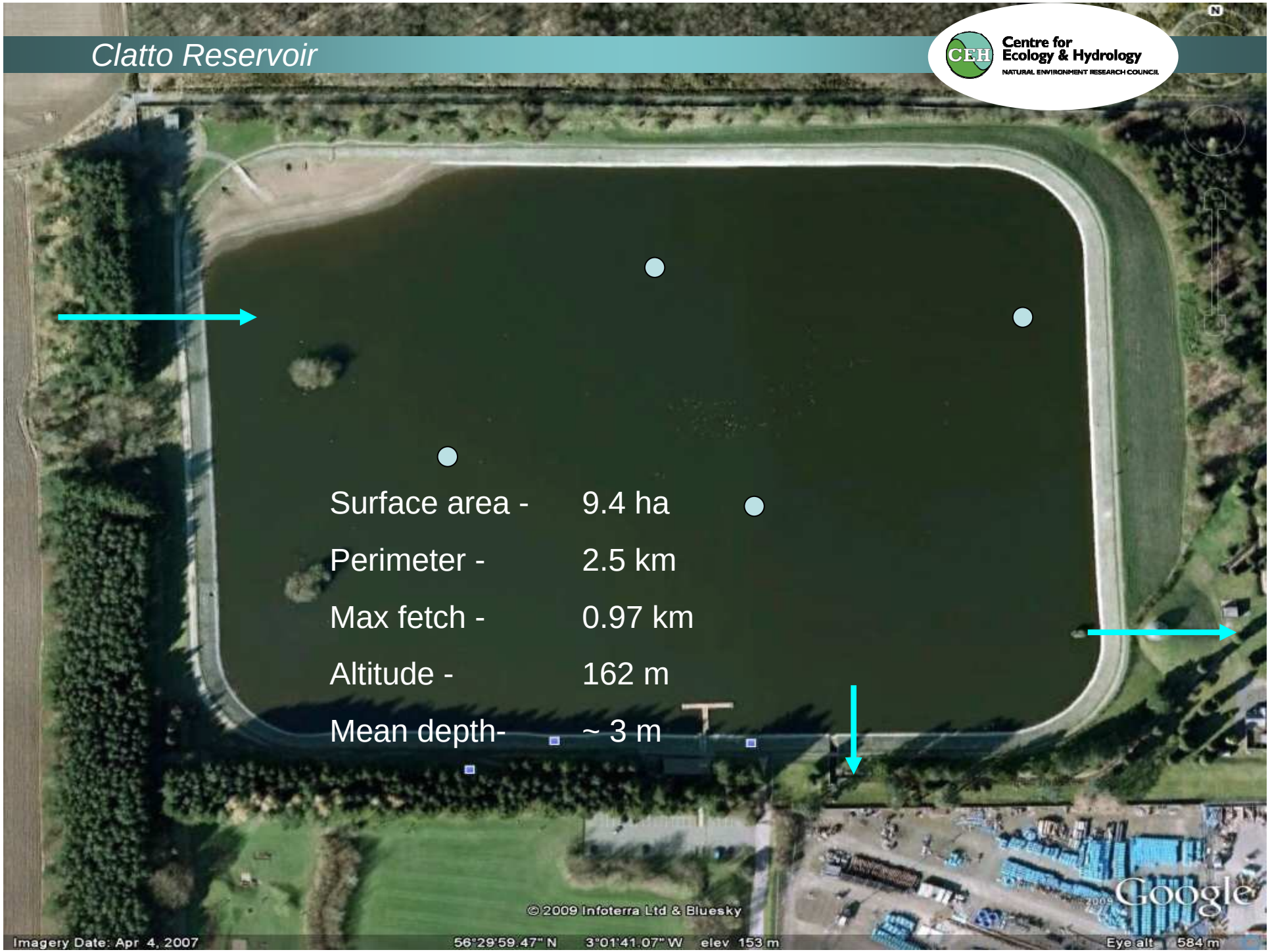
Clatto Reservoir



experiment with straw addition

Clatto Reservoir



Clatto Reservoir- restoration objectives

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Set management objectives:

(1) To reduce blue green algal numbers to below 20,000 cells/ml

(2) To reduce TP concentrations to below 35 µg/L over summer

Dundee City Council — CHANGING FOR THE FUTURE — www.dundeecity.gov.uk

PHOSLOCK® — Phoslock Water Solutions Ltd.

SEPA
Scottish Environment Protection Agency

Our Ref: CAR/S/1034491

Dundee City Council
Ancrum Outdoor Education Centre
10 Ancrum Road
DUNDEE
DD2 2HZ

If telephoning ask for:
John Shabashow

10 February 2009

FAO Earle Wilson

Dear Sirs

WATER ENVIRONMENT (CONTROLLED ACTIVITIES)(SCOTLAND) REGULATIONS 2005
APPLICATION FOR AUTHORISING AN ACTIVITY
APPLICATION ID: CAR/S/1034491
APPLICANT: DUNDEE CITY COUNCIL
LOCATION: CLATTO COUNTRY PARK, STRATHMARTINE, DUNDEE

Further to the application for authorising an activity received on 23 January 2009, the Scottish Environment Protection Agency has considered the application and has decided to grant an authorisation subject to conditions. I enclose authorisation number **CAR/S/1034491.** The authorisation is subject to the conditions in the attached schedule of conditions. Failure to comply with any of these conditions is an offence under the above Regulations.

Under section 46 of the above Regulations, there is a right of appeal against the terms or conditions of the enclosed authorisation. Notice of any appeal including a statement of the grounds of appeal must be given in writing to the Scottish Ministers within 3 months of the date of this authorisation. The Regulations also require that a copy of the appeal should be forwarded to SEPA. The bringing of an appeal will not suspend the operation of the said condition or conditions.

"100 g Phoslock® will remove 1 g PO_4-P"

Total water column P –	27.7 kg P
Releasable sediment P –	180 kg P
Phoslock® dose –	20.8 tonnes (24 t)

Environment agencies treating Clatto as a trial application

Phoslock application – 3rd - 5th March 2009

Shutting down the phosphorus pump

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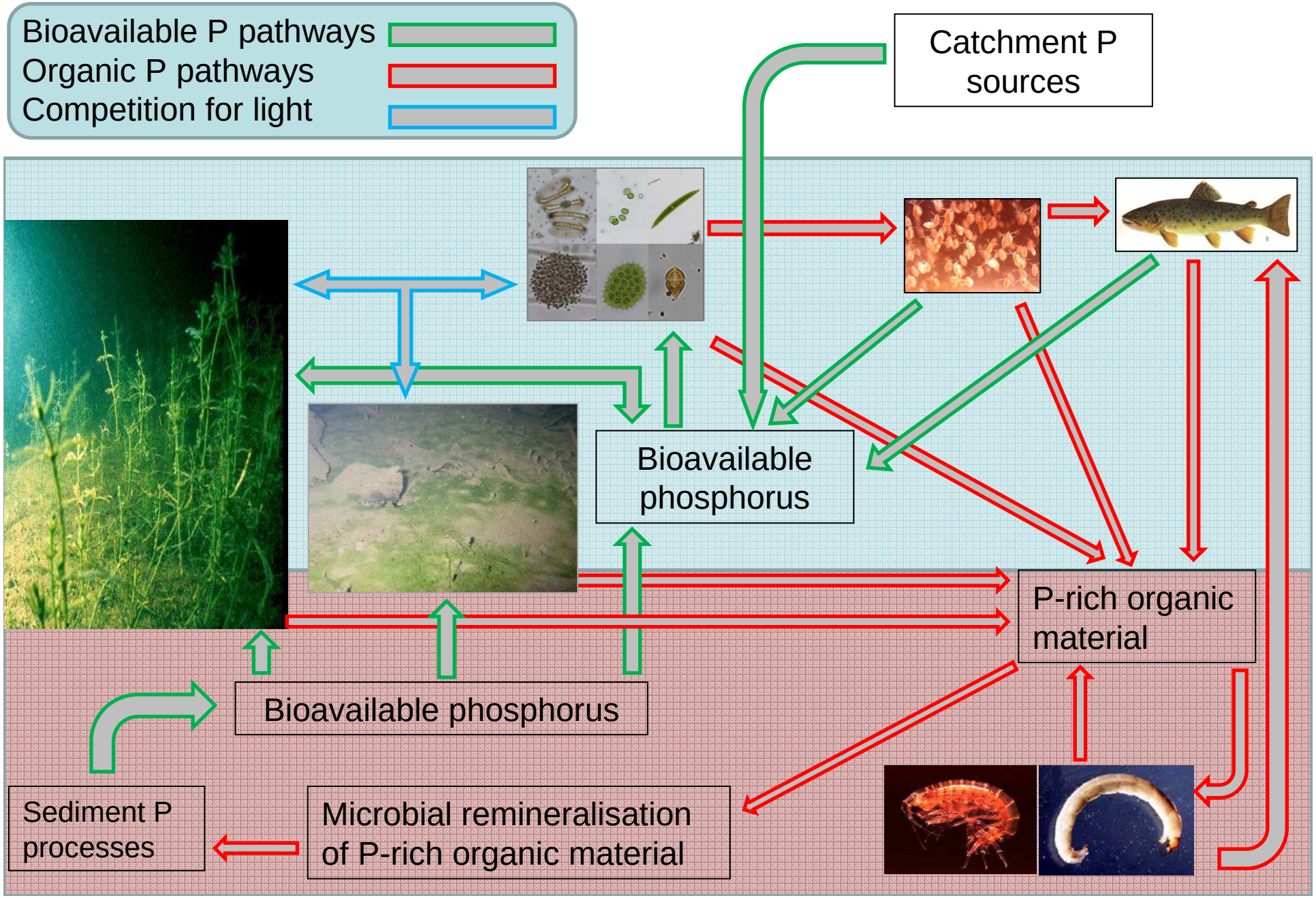
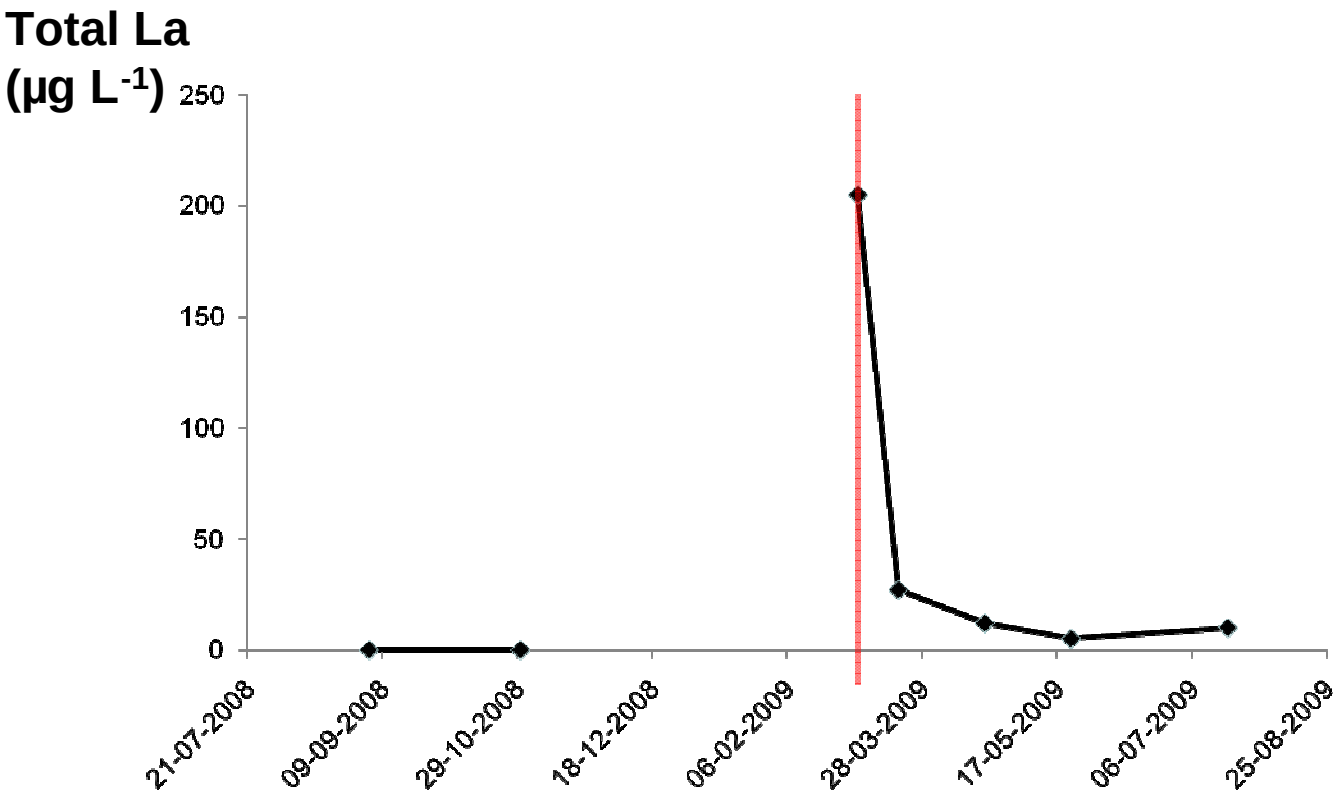
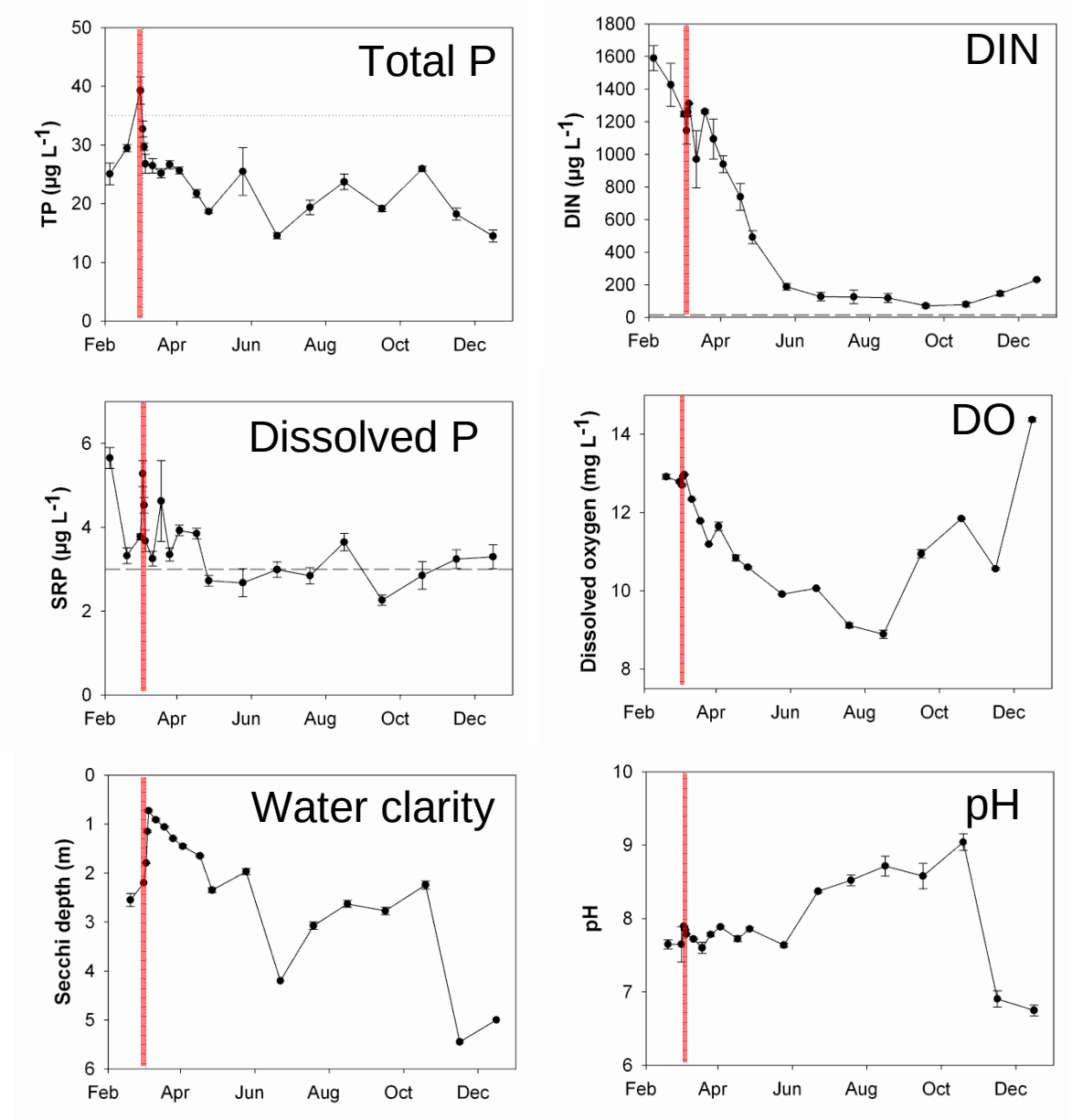


Total lanthanum in the water column

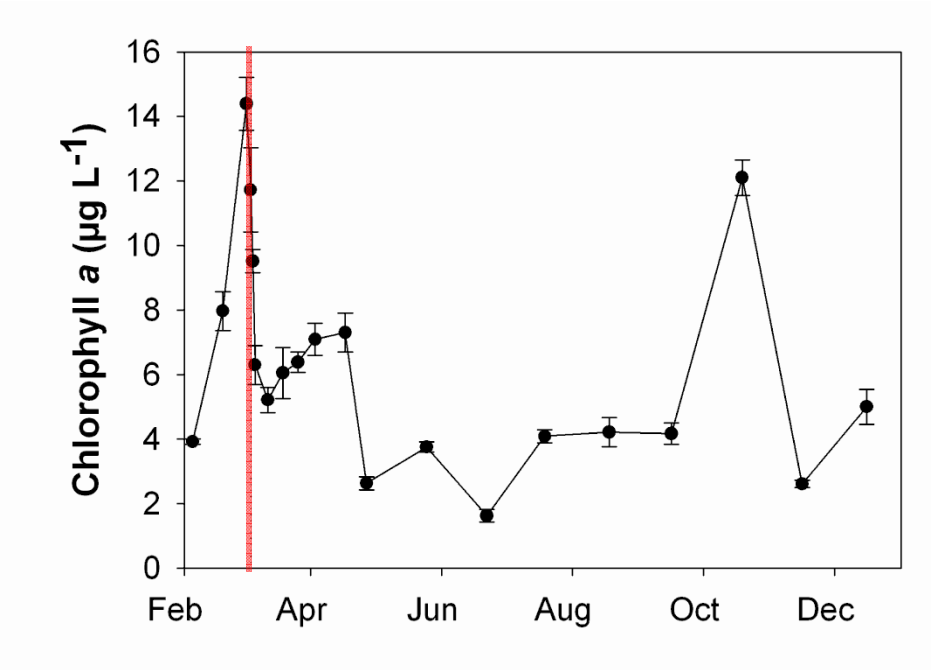


Clatto Reservoir; Interim Report. Groves, 2009.
http://www.phoslock.eu/?subject=en-clatto

Physicochemical responses in the water column



Phytoplankton responses



Blue-green algal response

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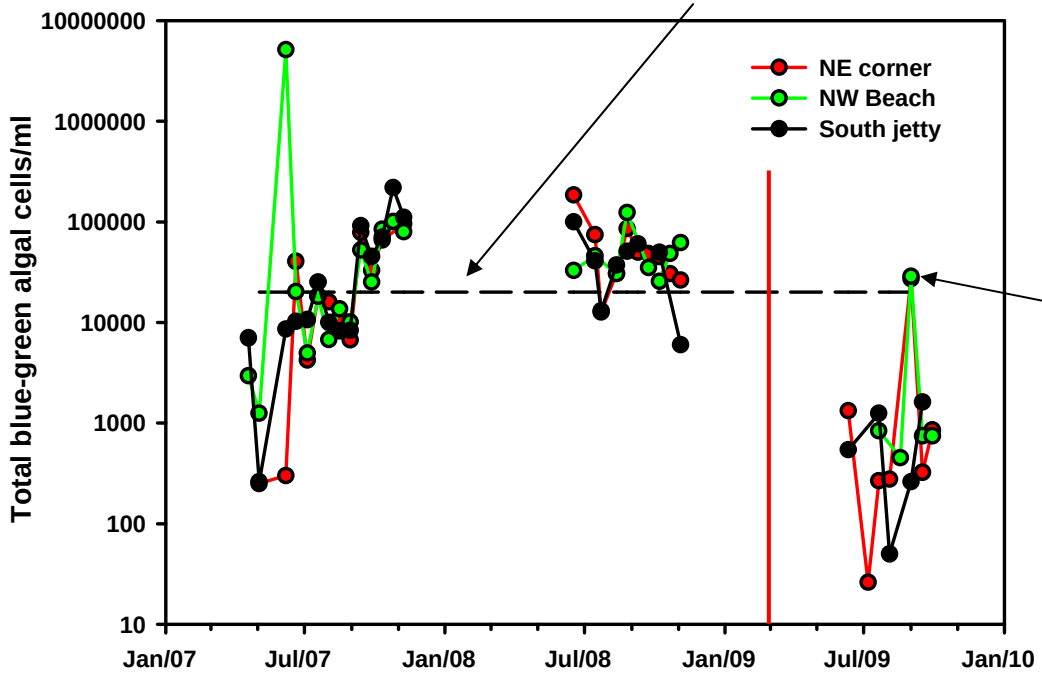
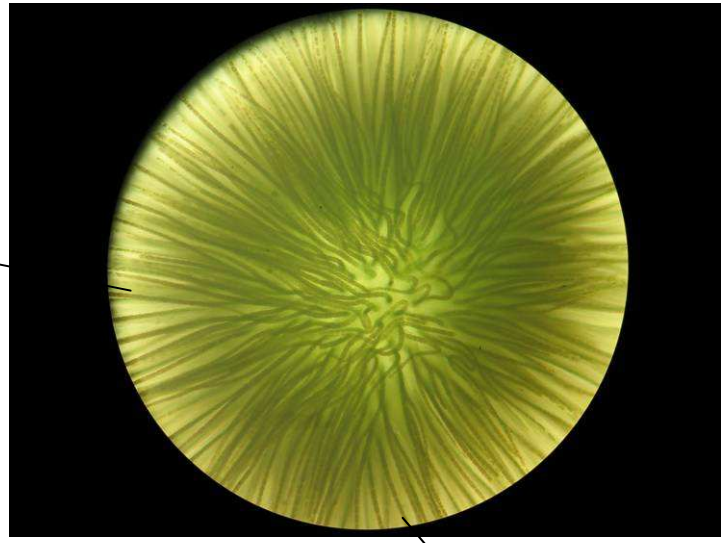
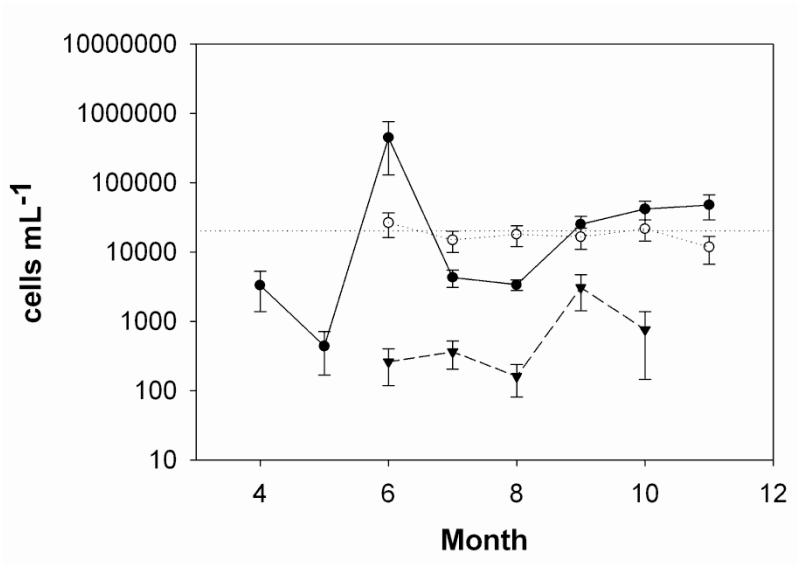
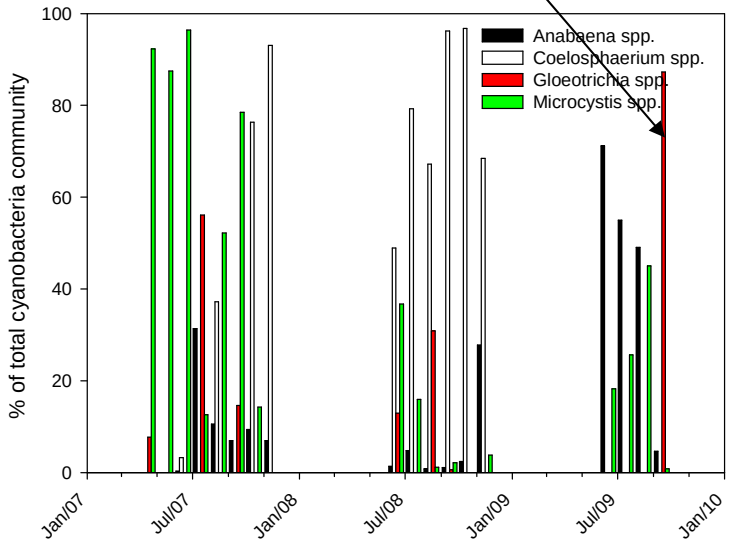
WHO guidelines (20,000 cells/ml)

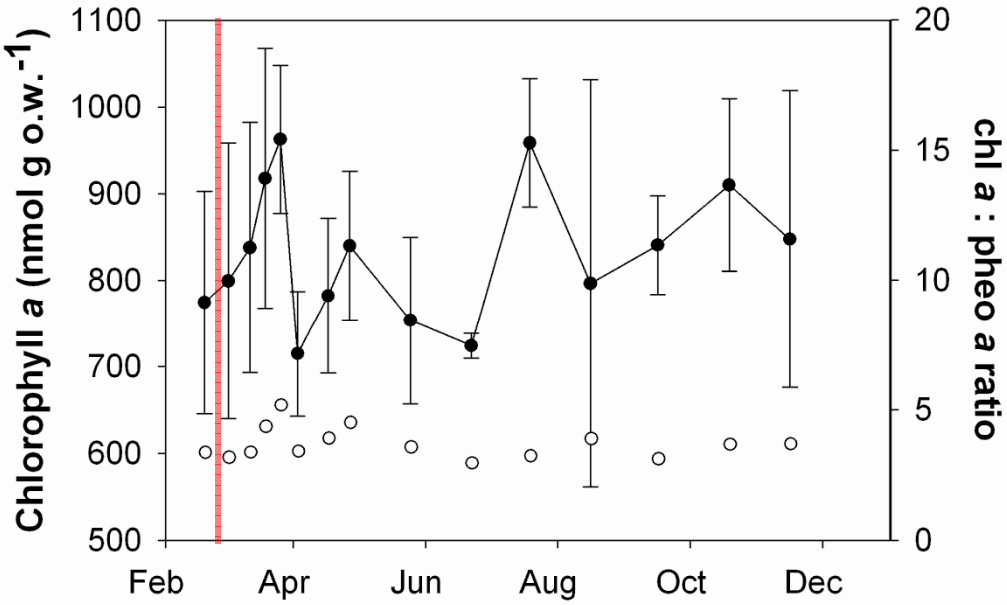




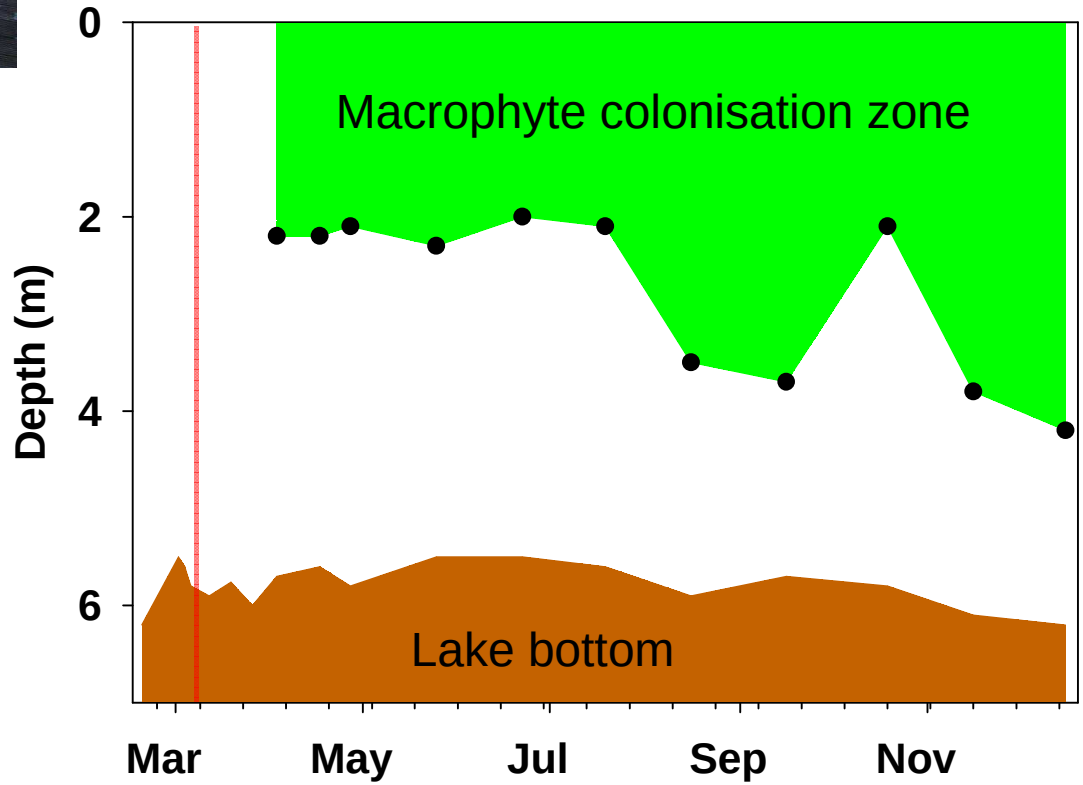




Benthic algal response



Macrophyte response



Macroinvertebrate response

Hydra oligactis Pallas 1766 ; 27th April 2009- Clatto Res.

Macroinvertebrate response

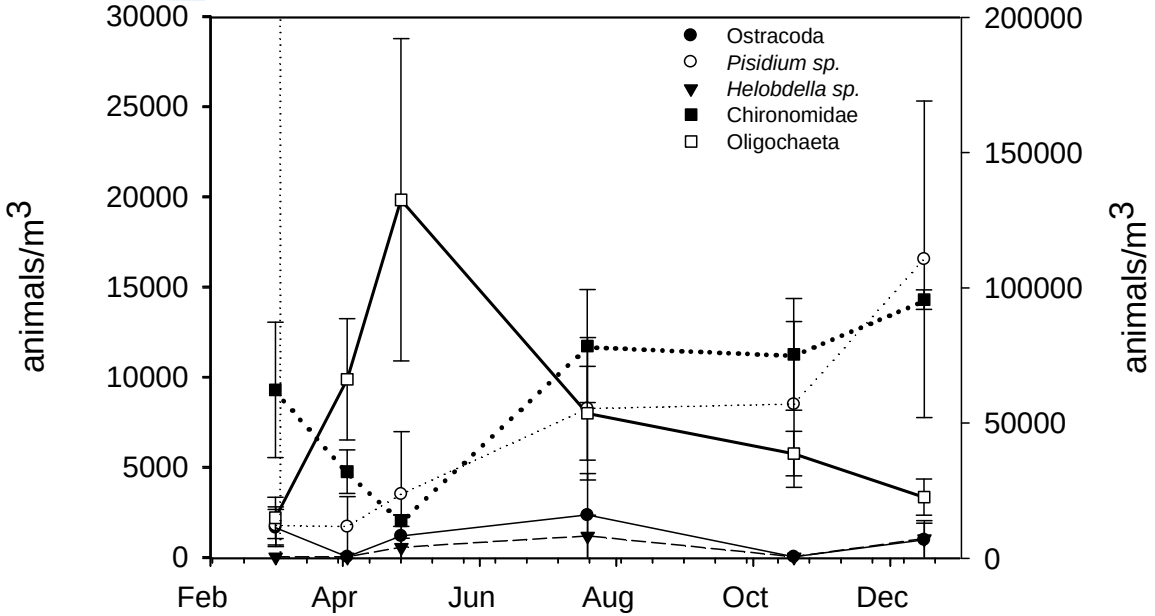
Seed shrimp - Ostracoda

Pea-mussel – *Pisidium sp.*

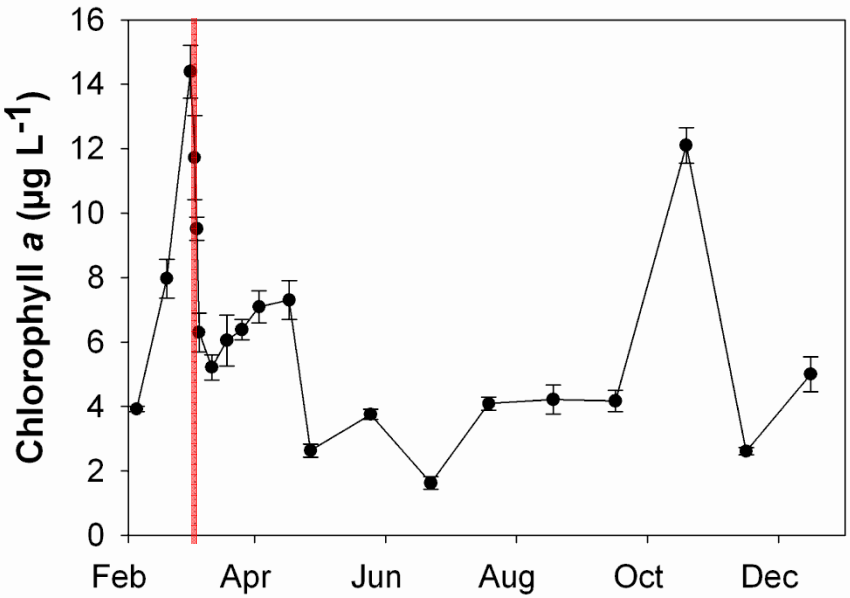
Leech – *Helobdella sp.*

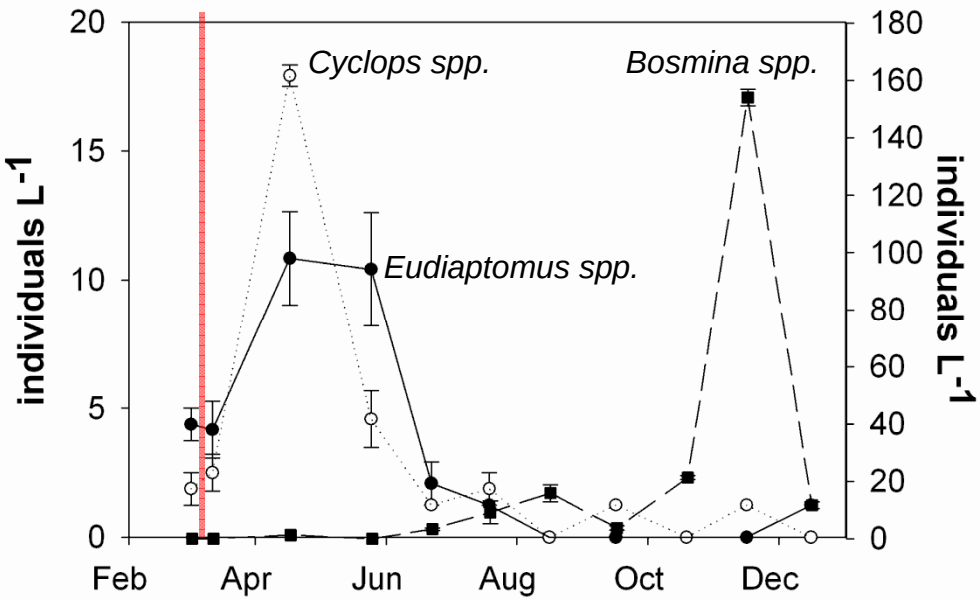
Non-biting midge larvae - Chironomidae

True worm - Oligochaeta

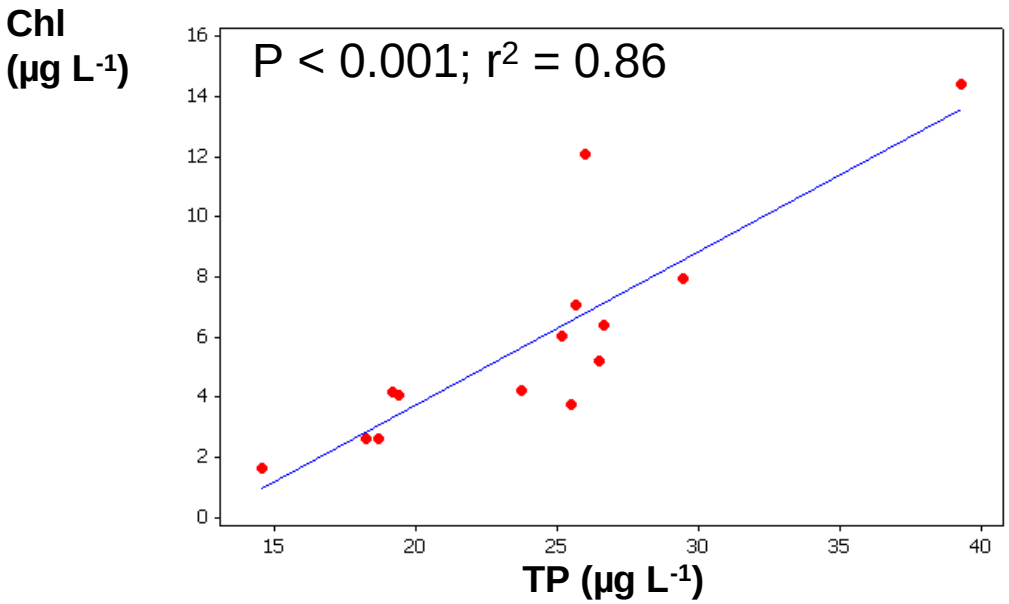


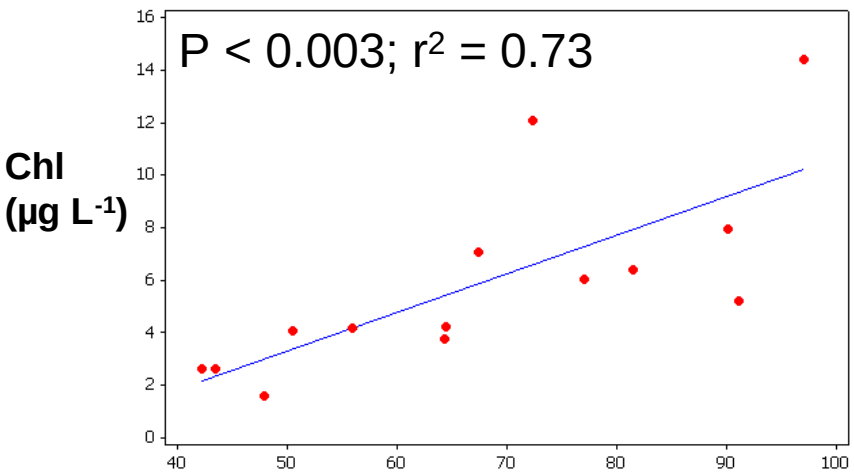
Crustacean zooplankton response

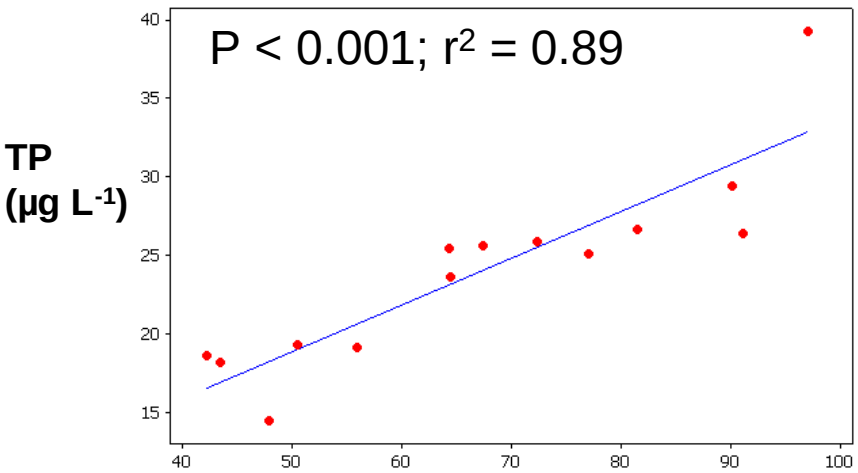




Wind direction as a driver of sediment P release?







Westerly wind frequency (% previous week)

Summary

- TP concentrations did not exceed 35 µg L^{-1}
- Cyanobacterial abundance did not exceed 20,000 cells per ml
- Phytoplankton biomass appeared to be P limited and remained below 12 µg L^{-1}
- Benthic algal biomass did not increase with water clarity
- The macrophyte community responded positively with water clarity
- The macroinvertebrate community showed a mixed response
- The zooplankton community was driven by the phytoplankton
- Wind mixing may confound the effects of Phoslock® in shallow water bodies