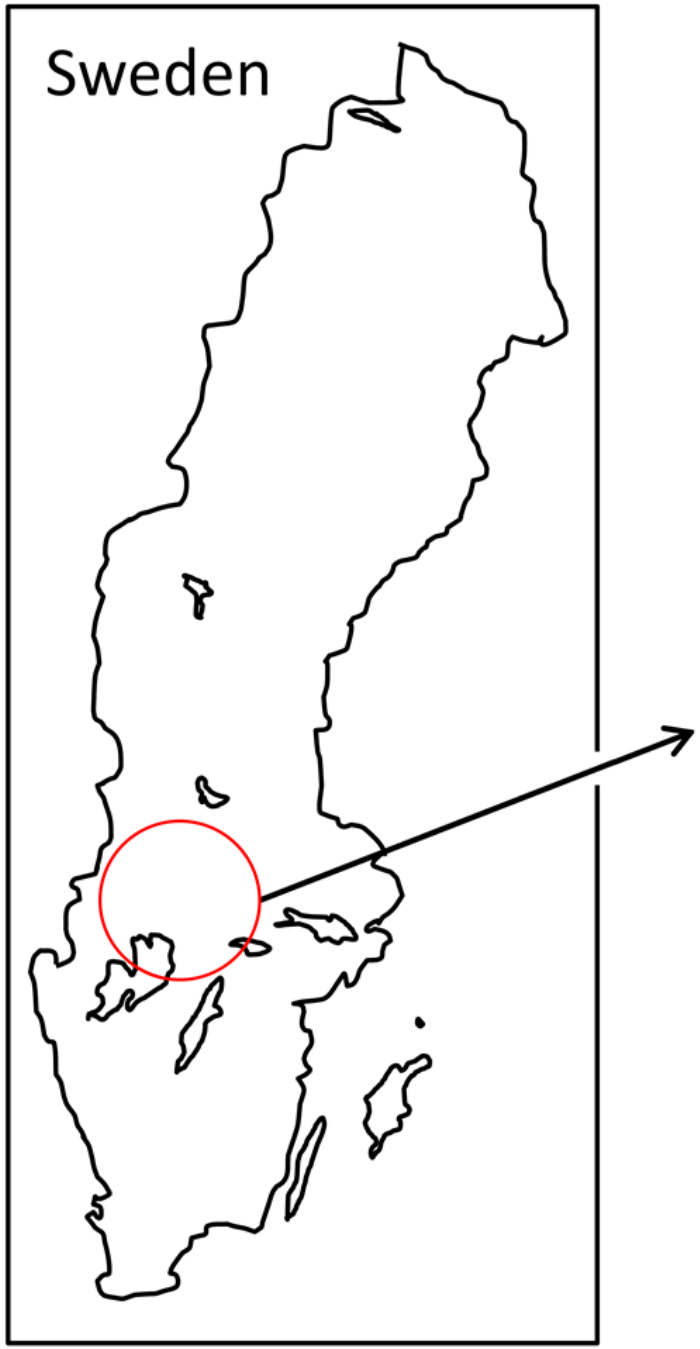
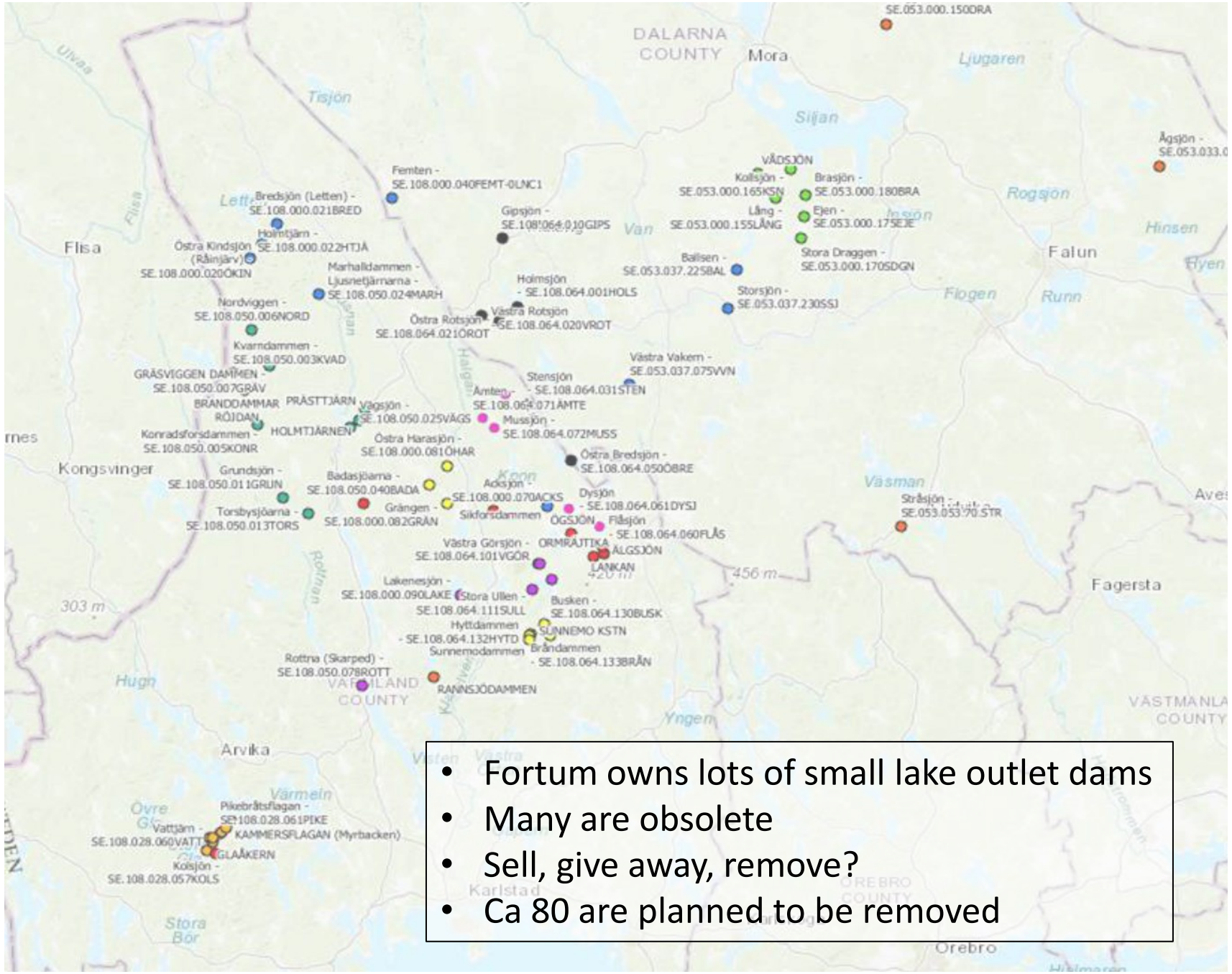
Removal of lake outlet dams in Sweden

Johan Watz, Eva Bergman, Olle Calles, Lutz Eckstein,
Miguel Gómez, Anders Nilsson

FREE FLOW

Outlet of Lake Kollsjön





- Fortum owns lots of small lake outlet dams
- Many are obsolete
- Sell, give away, remove?
- Ca 80 are planned to be removed

Before

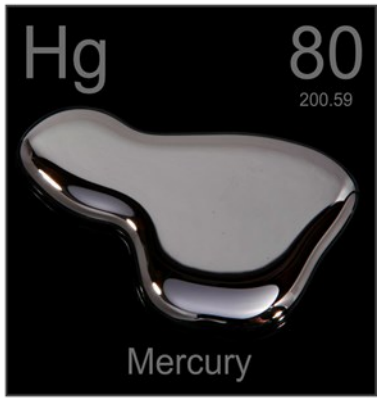
Photos: Axel Emanuelsson, Norconsult

1. Effects on trophic levels
    a) Nutrients
    b) Plankton
    c) Aquatic plants
    d) Fish

Focus of this presentaion

2. Migration of large predatory fish
3. Mercury dynamics



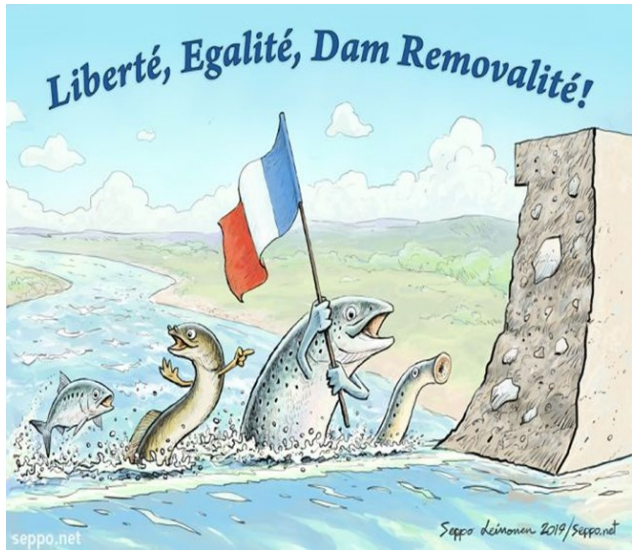



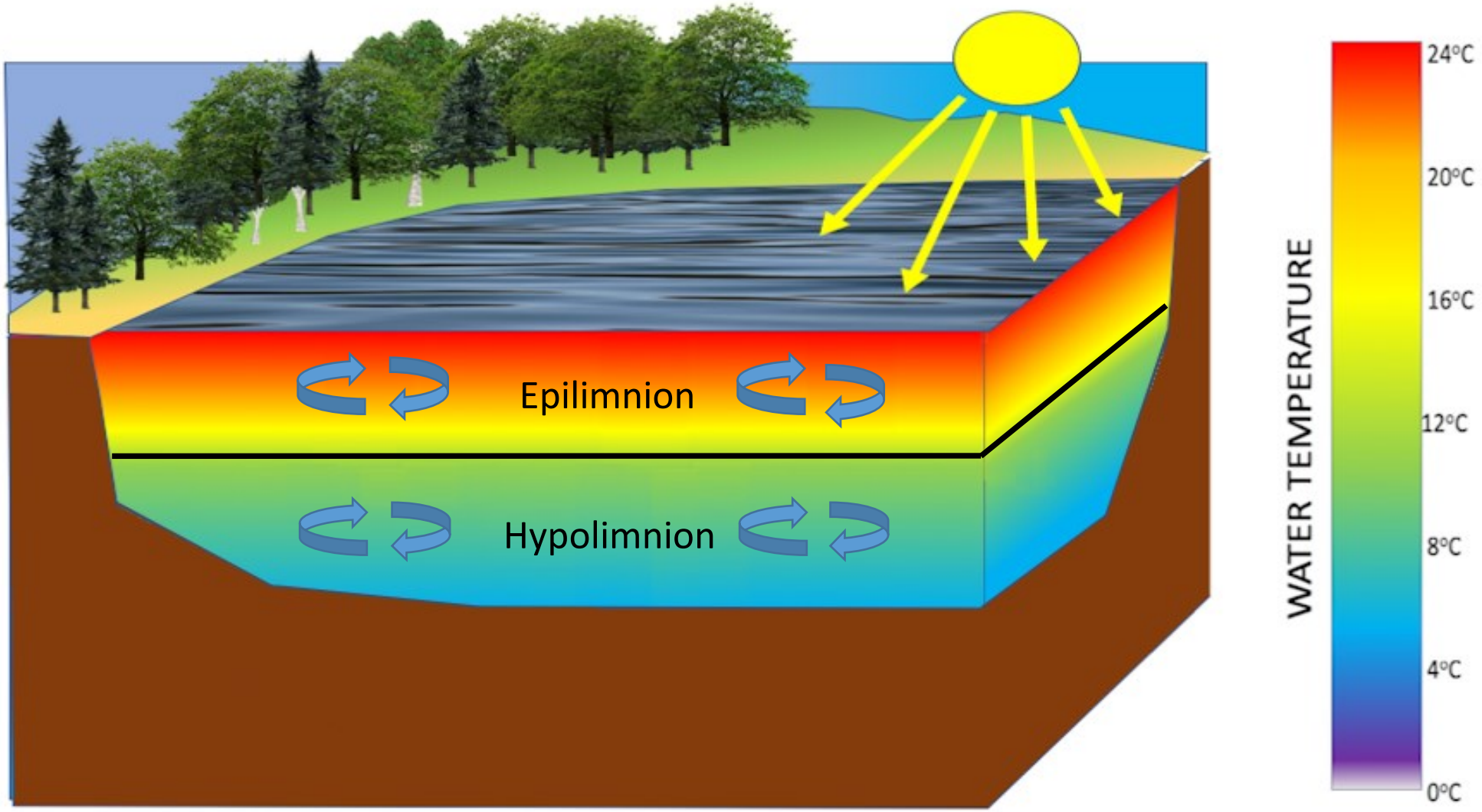
1. Sampling from 30 lakes
2. Historical data (from NORS - gill netting surveys)

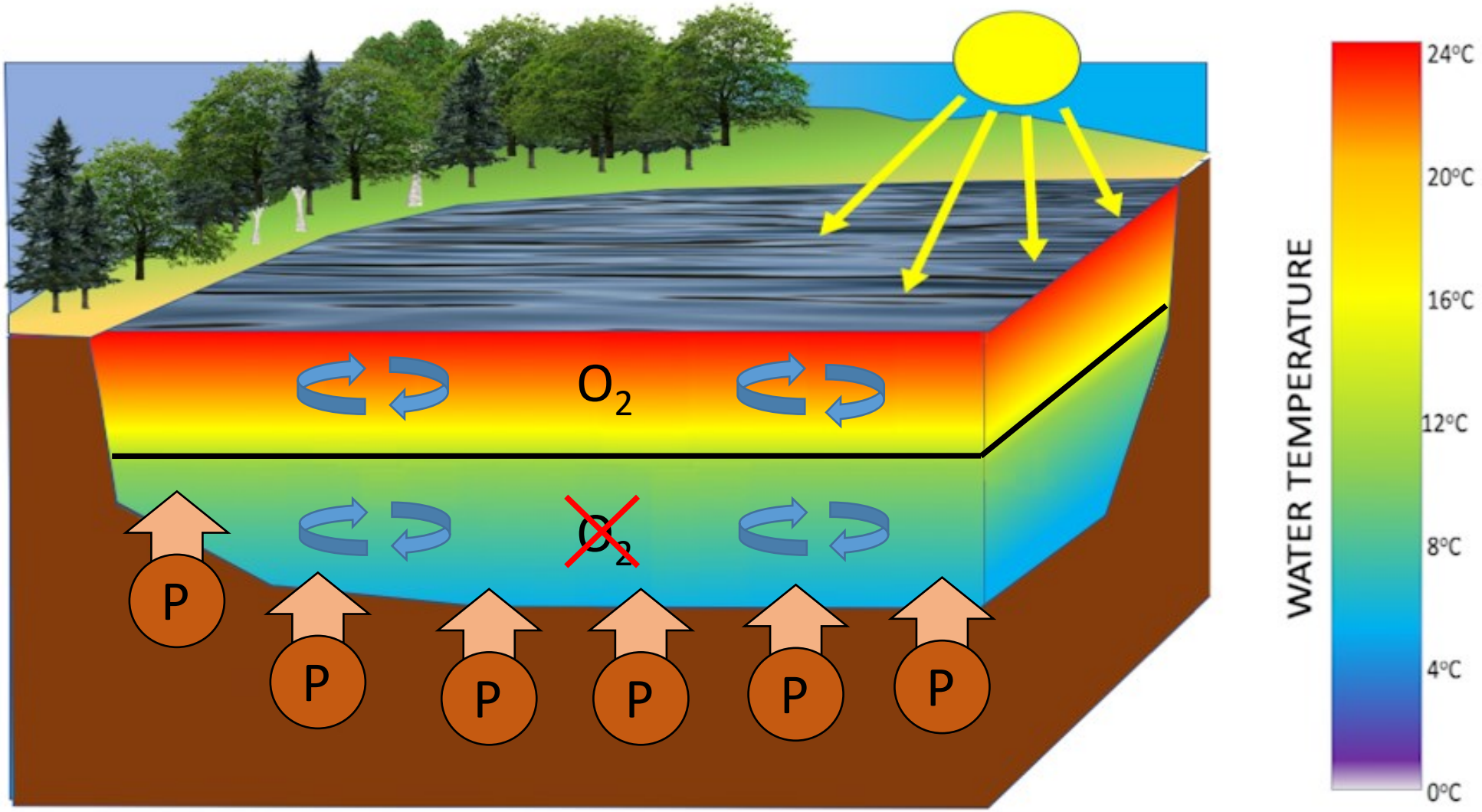
a. Before and after data (+ controls)
b. Time sequence data (after removal)

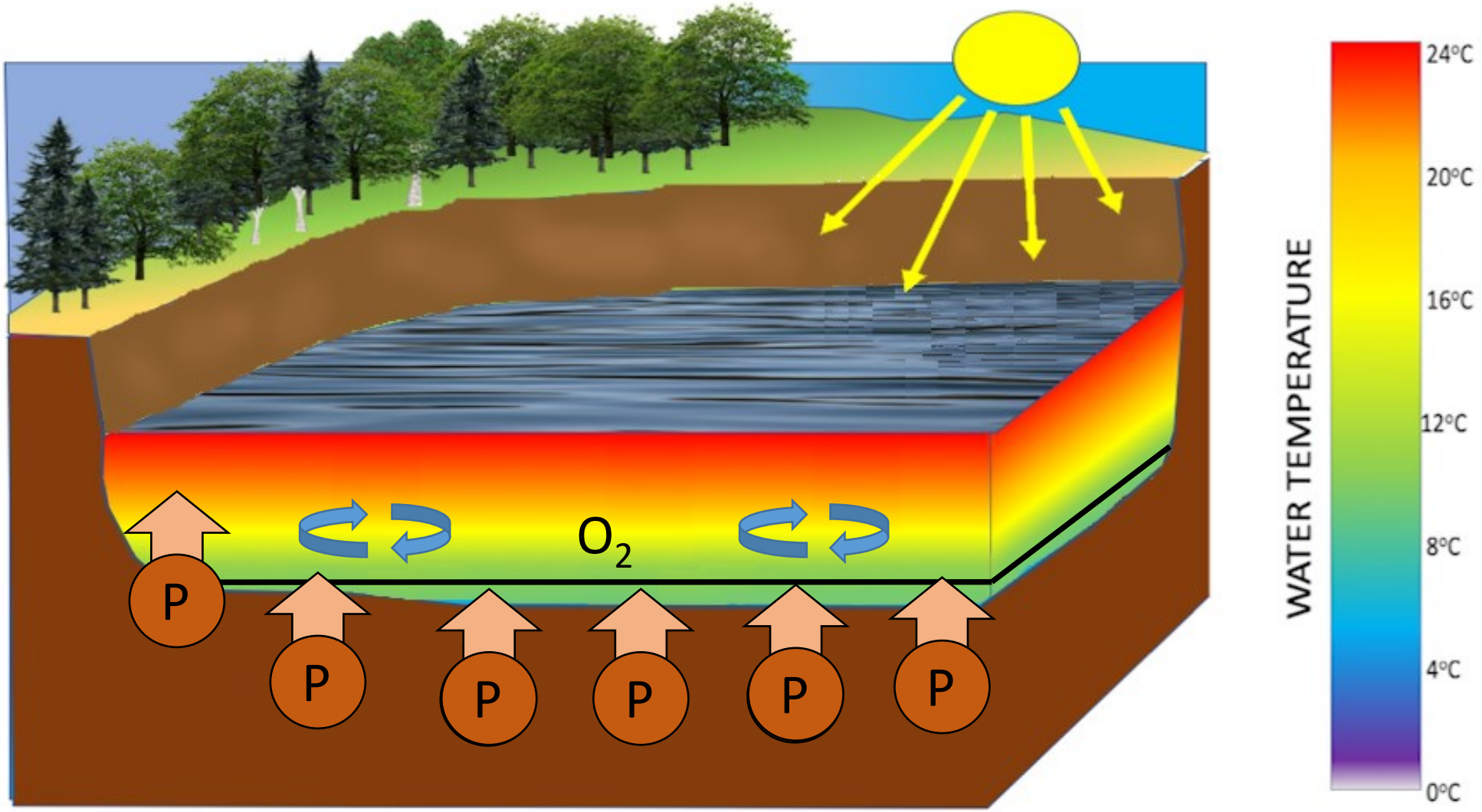
- Analysis in progress
- Results on P-tot, plankton and fish

1. Lowered water levels
2. Increased longitudinal connectivity



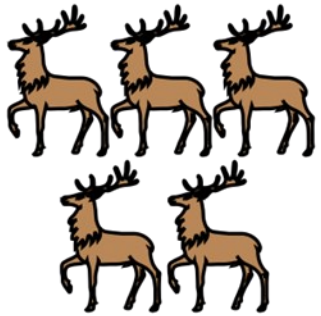
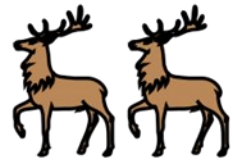

Epilimnion
Hypolimnion
WATER TEMPERATURE
24°C
20°C
16°C
12°C
8°C
4°C
0°C


O_2
O_2
P
P
P
P
P
P
WATER TEMPERATURE
24°C
20°C
16°C
12°C
8°C
4°C
0°C

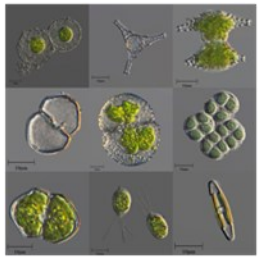


Reduced internal P loading
Bottom-up effect of dam removal?

Trophic Cascade

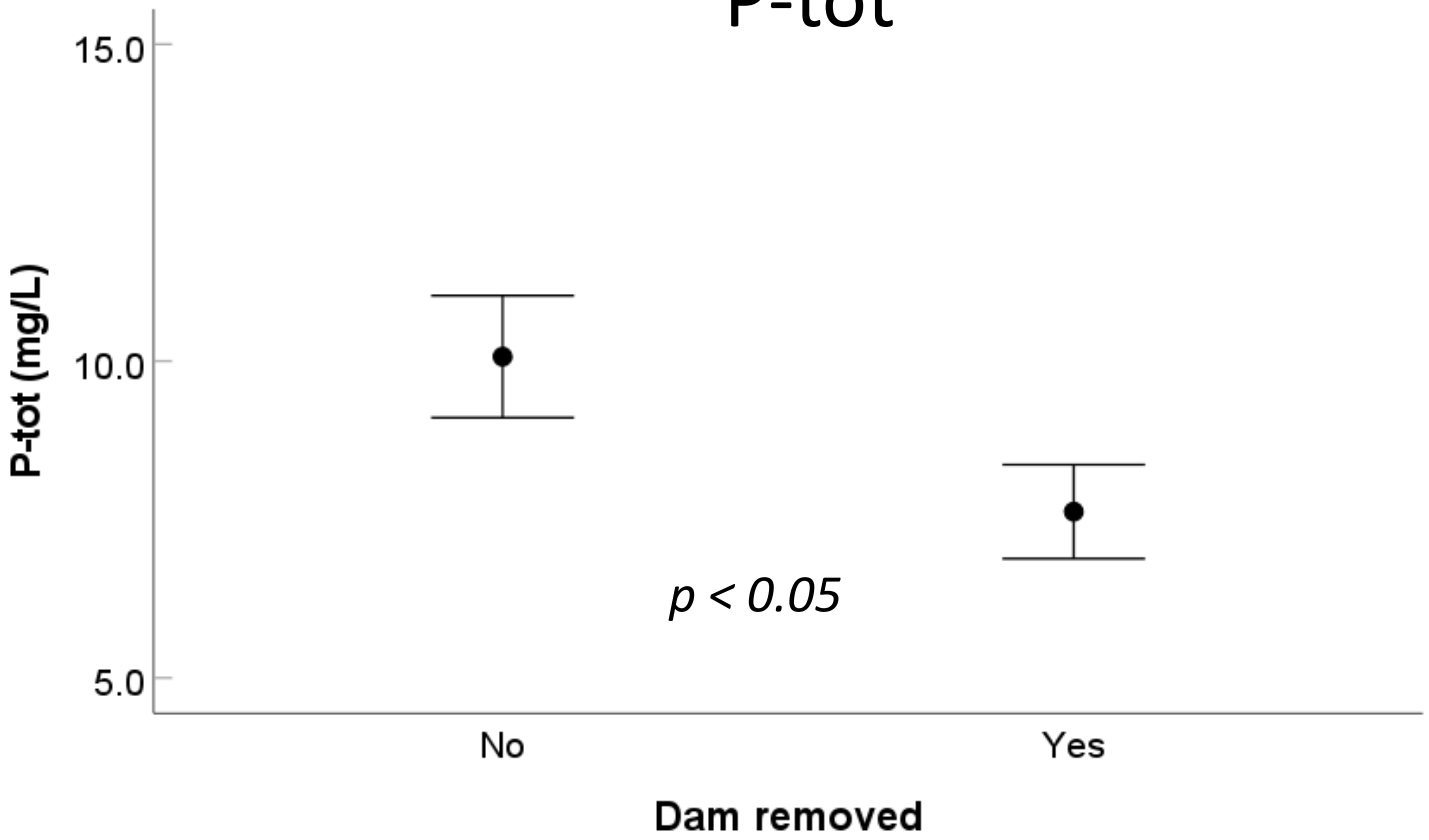
Level 3		
Level 2		
Level 1		

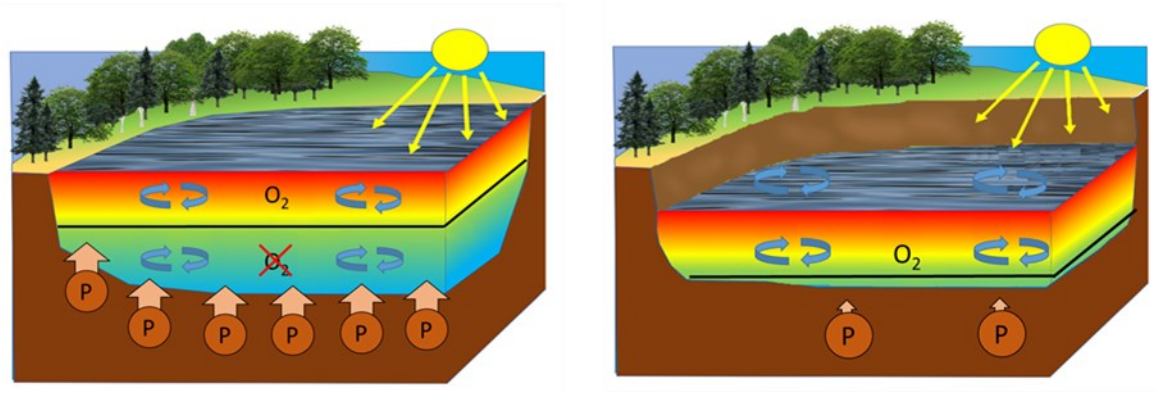
l connectivity
predatory fish
wn effect of
removal?



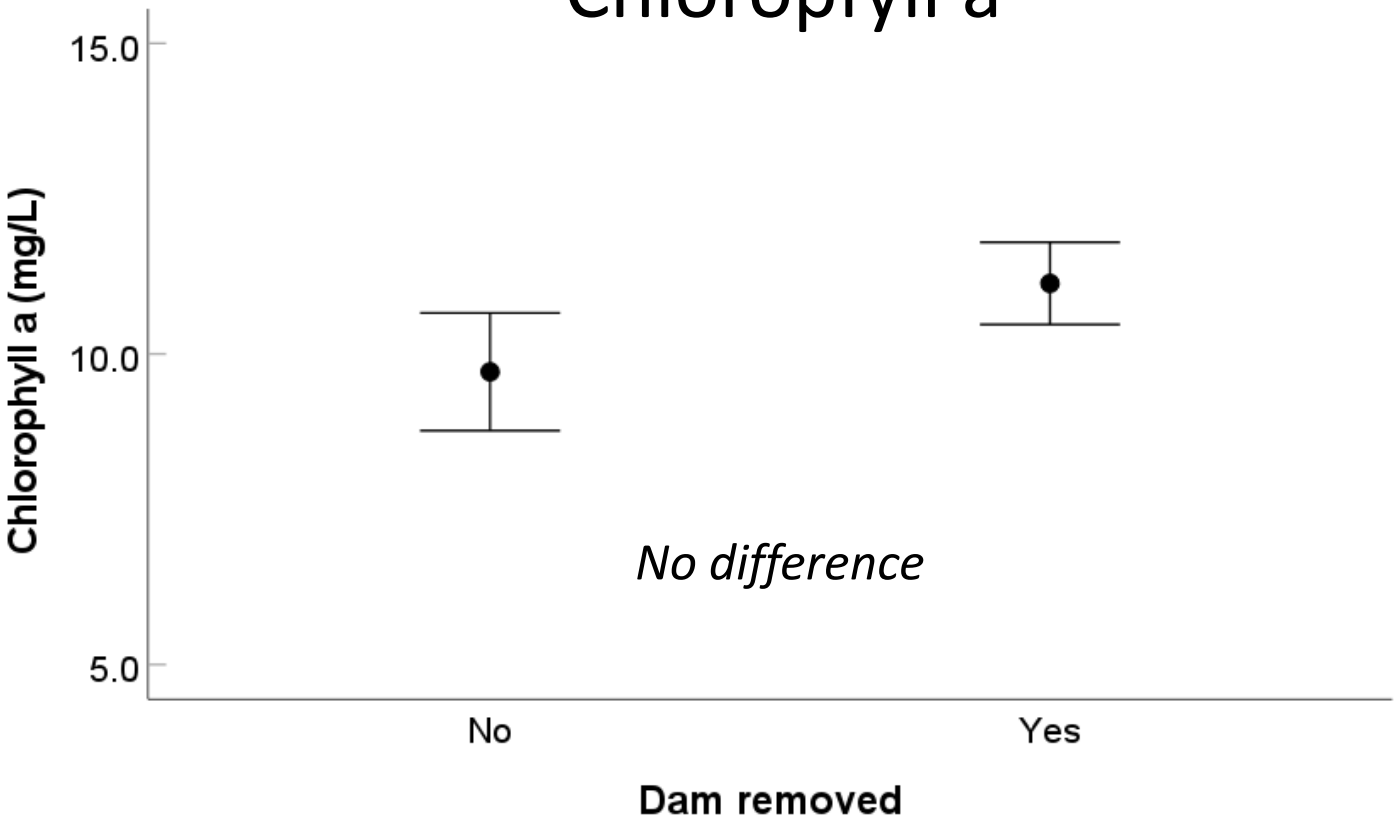

VOLVO
EC250EL
VOLVO

P-tot

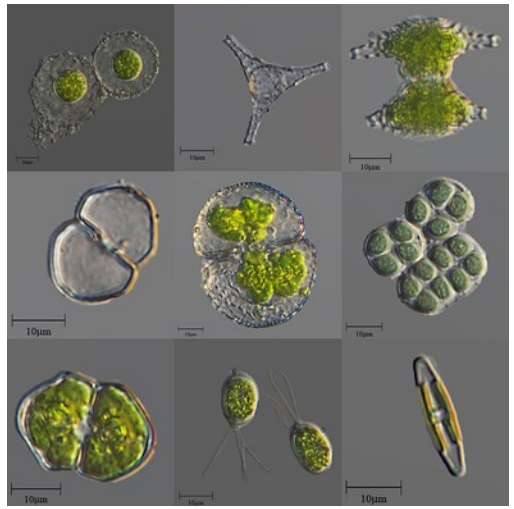


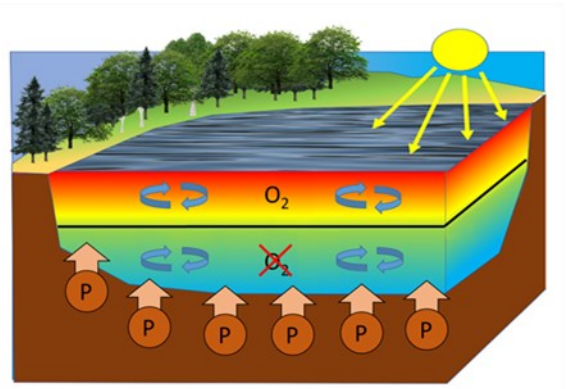


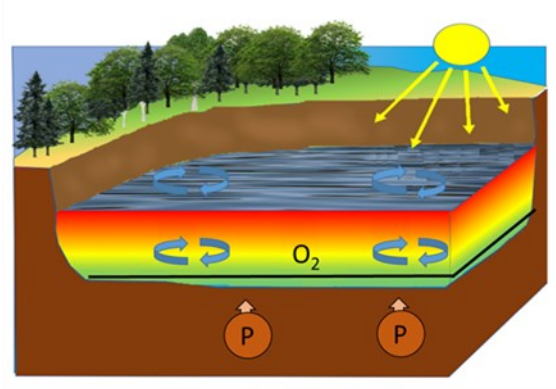
Chloropfyll a



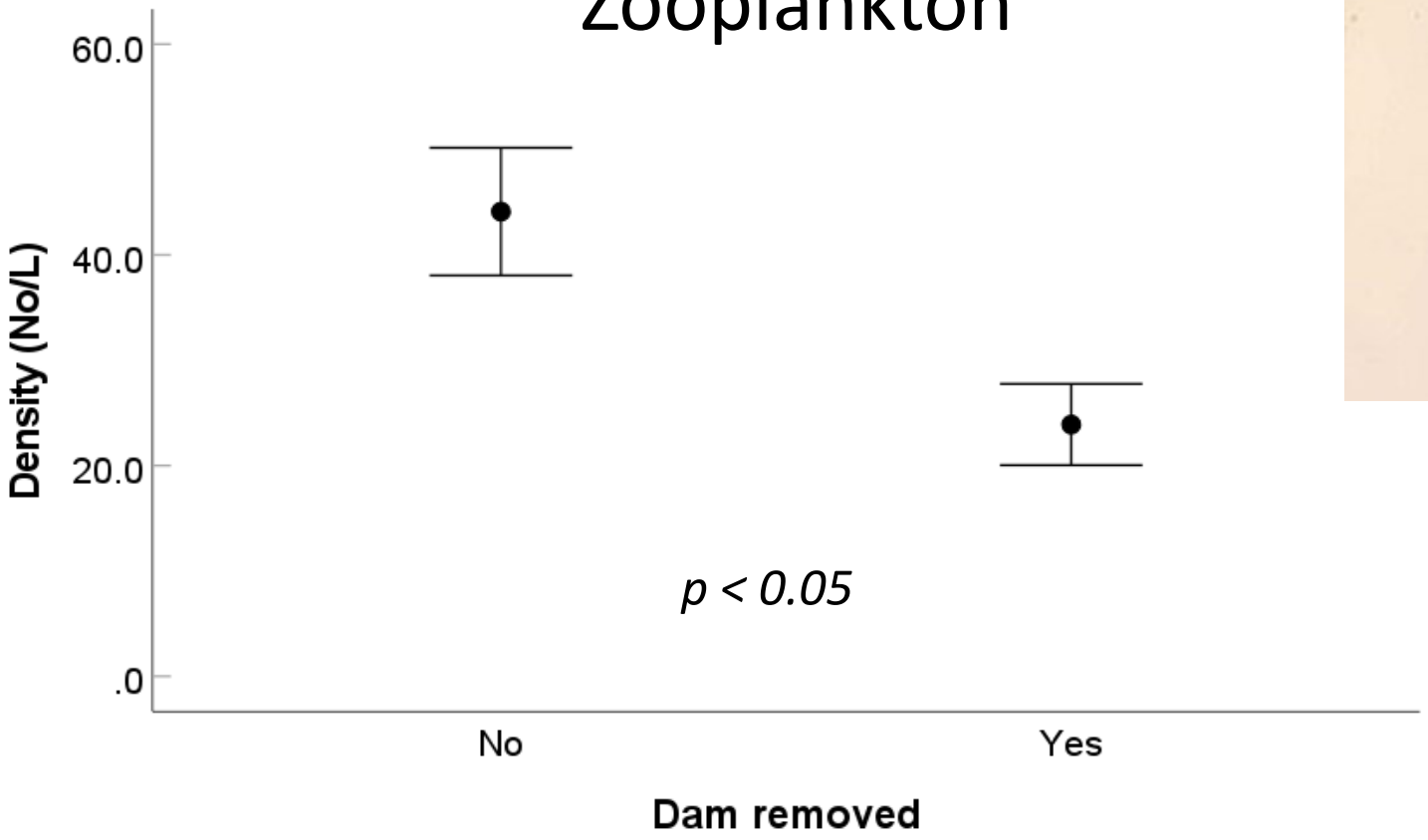
No difference



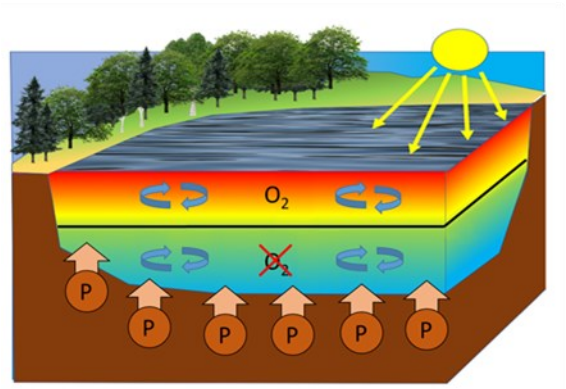


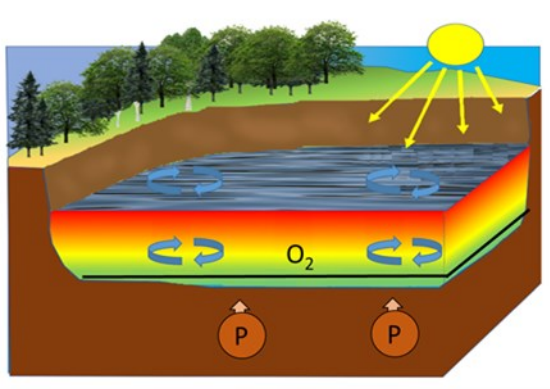


Zooplankton

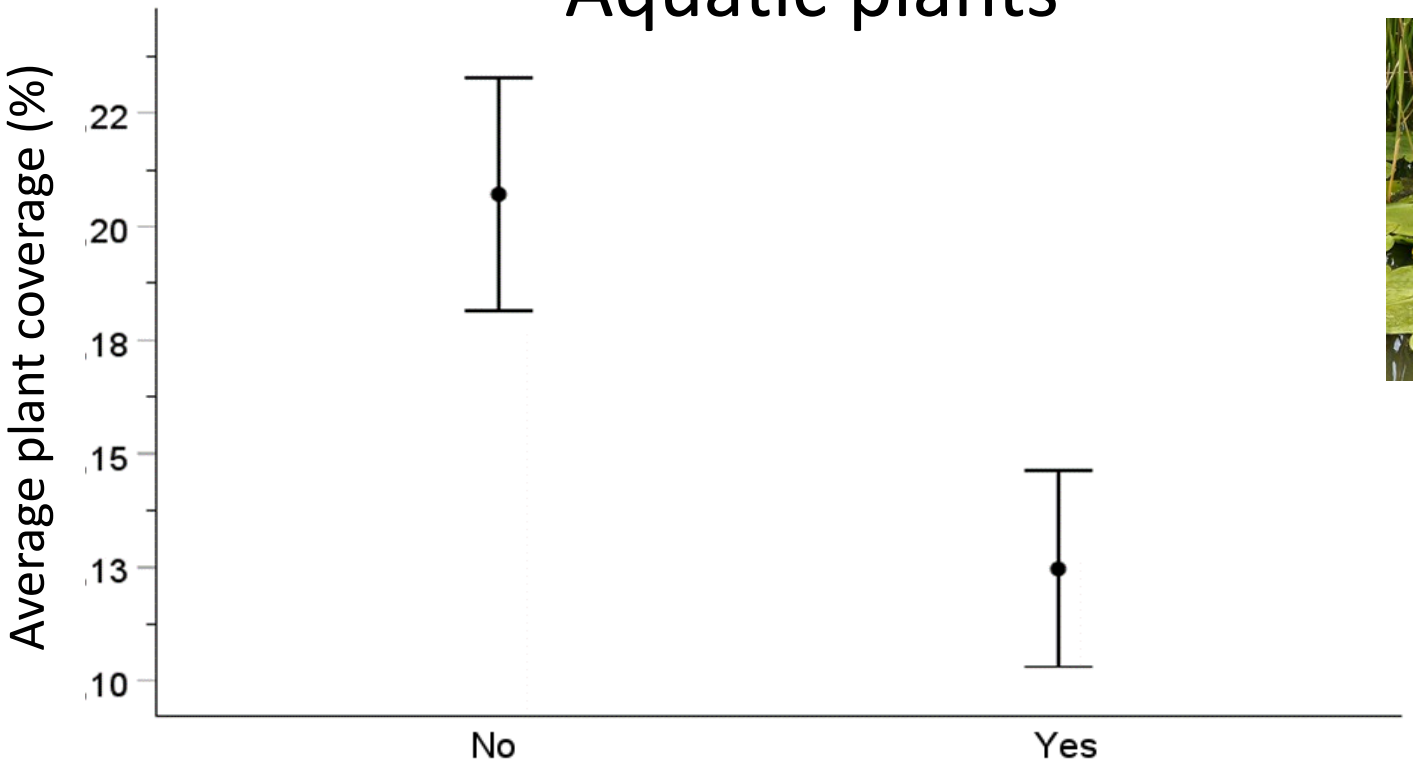


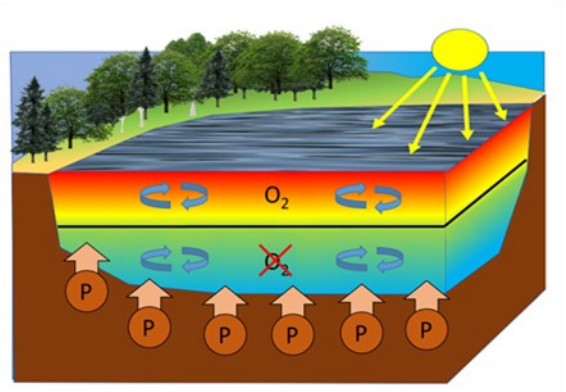
$p < 0.05$

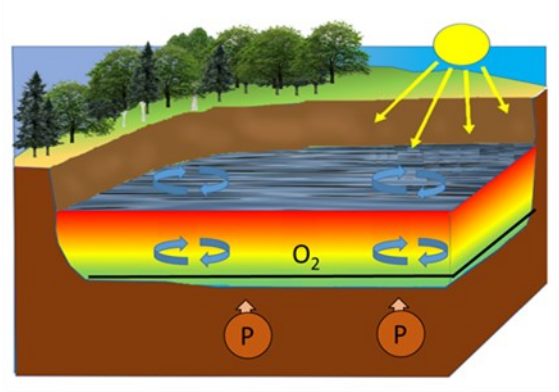




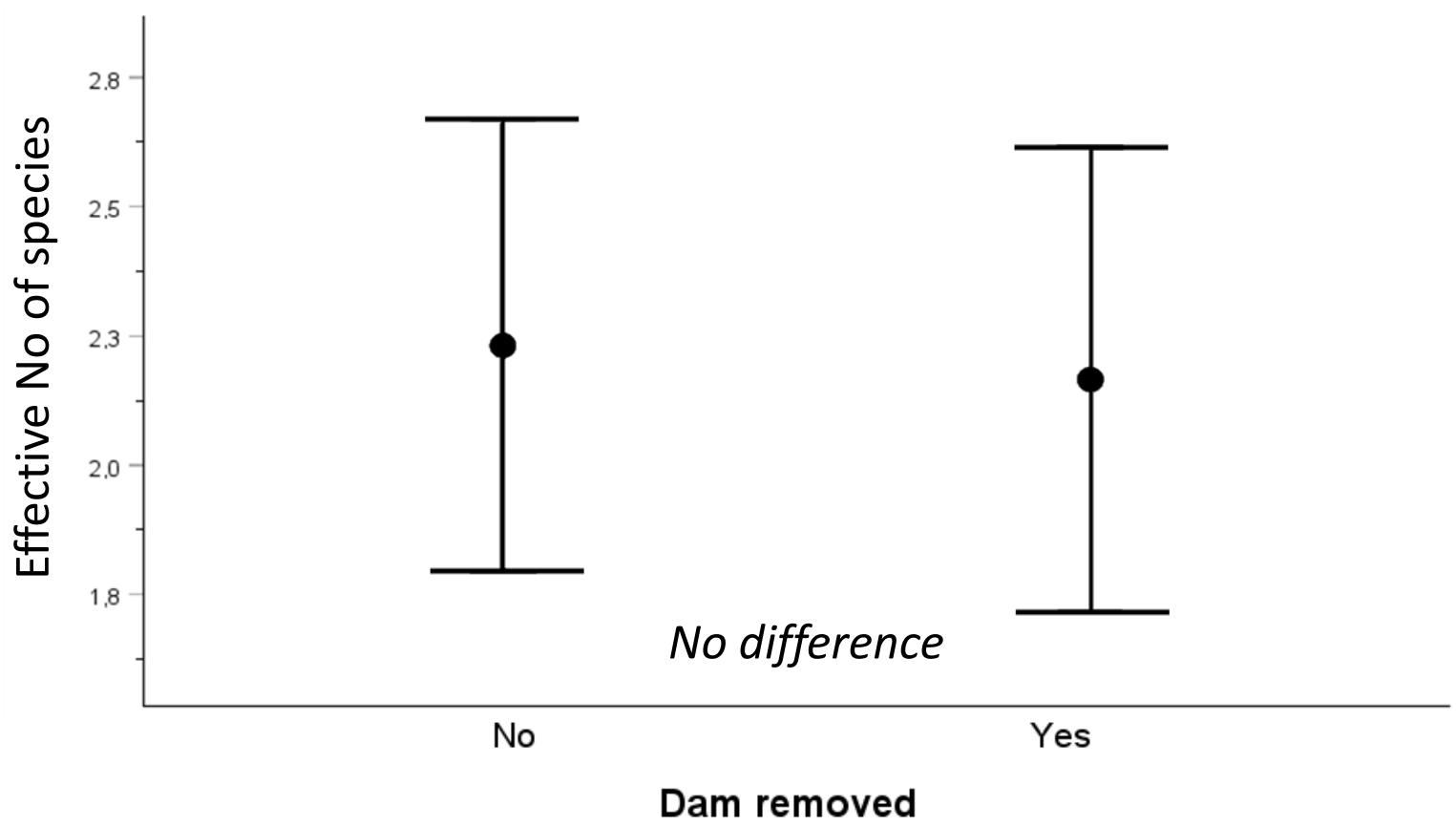
Aquatic plants





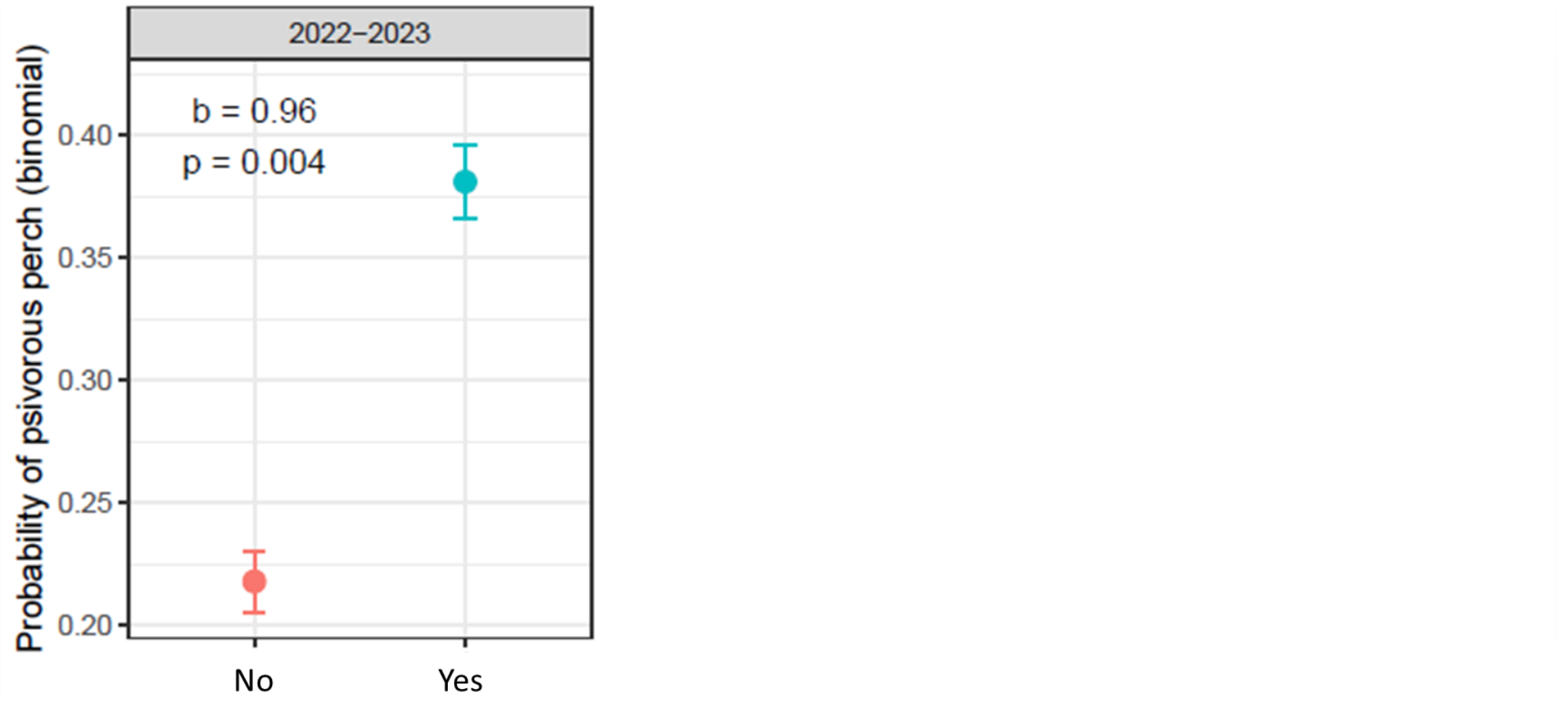


Fish diversity



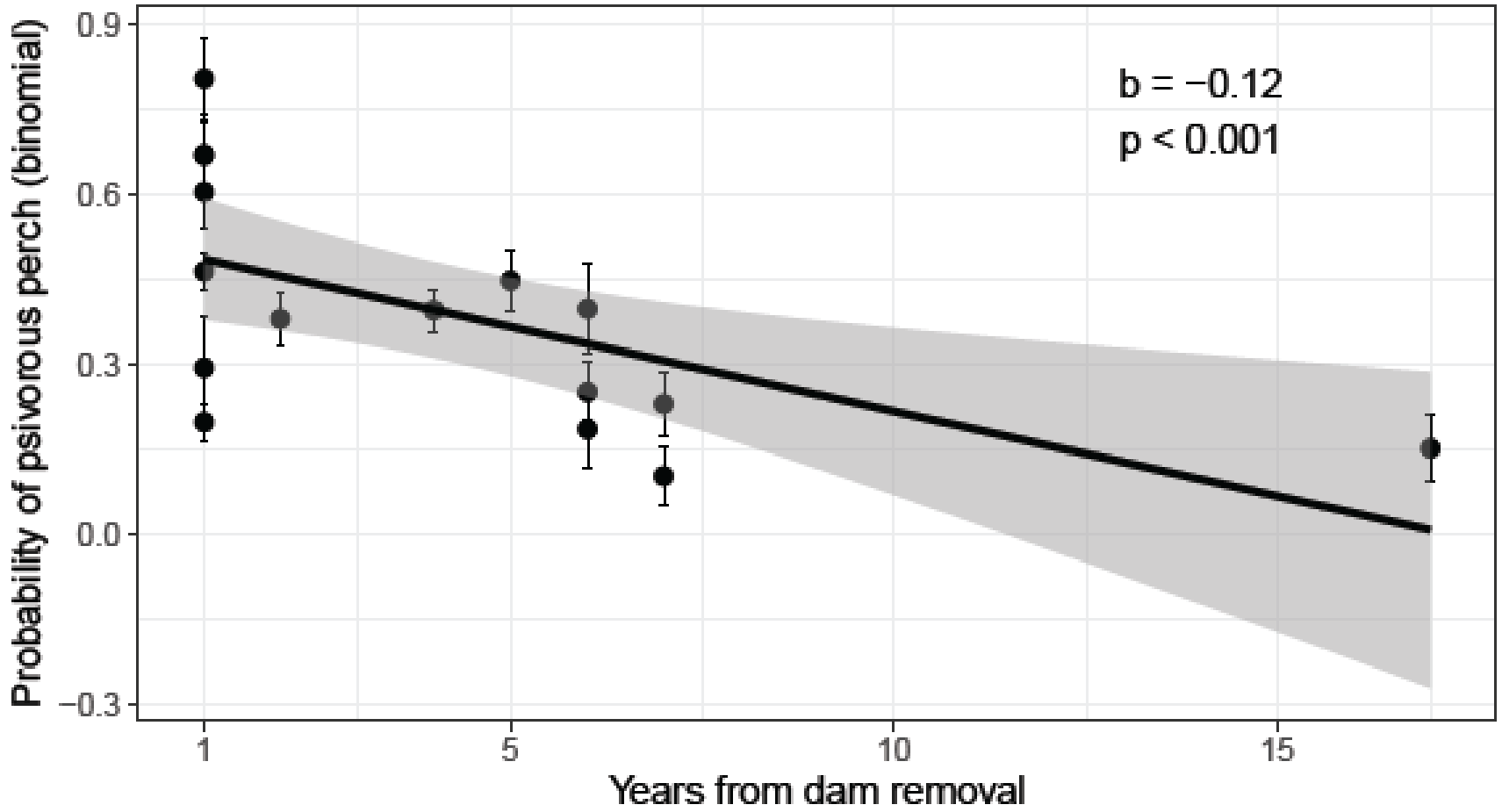
Effective No of species = e ^ Shannon index

Insectivorous vs piscivorous perch



Dam removal

Insectivorous vs piscivorous perch



Removal of lake outlet dams
in central Sweden

- Reduced P-tot conc.
- Reduced density of zooplankton
- Reduced coverage of aquatic plants (temporarily)
- Increased proportion of piscivorous perch (temporarily?)

Further analysis

- Plant community
- Biomass of piscivorous fish
- Demography of species other than perch
- Acoustic telemetry of pike (before-during-after removal)
- Mercury bioaccumulation in pike

Amanda Odénius Hedman

Andreas Wahlberg

Niclas Carlsson

Emil Nordström

Johanna Ekman

Energimyndigheten

fortum

Karlstads Universitet

Lunds Universitet

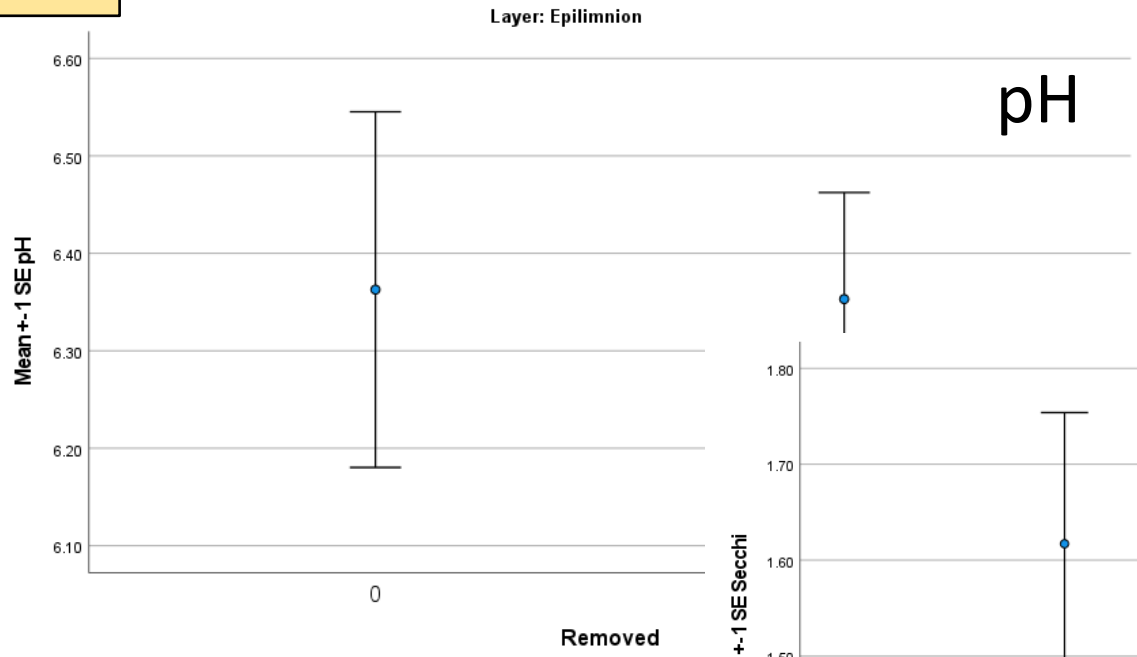
Länsstyrelsen Värmland

Thank you for listening!

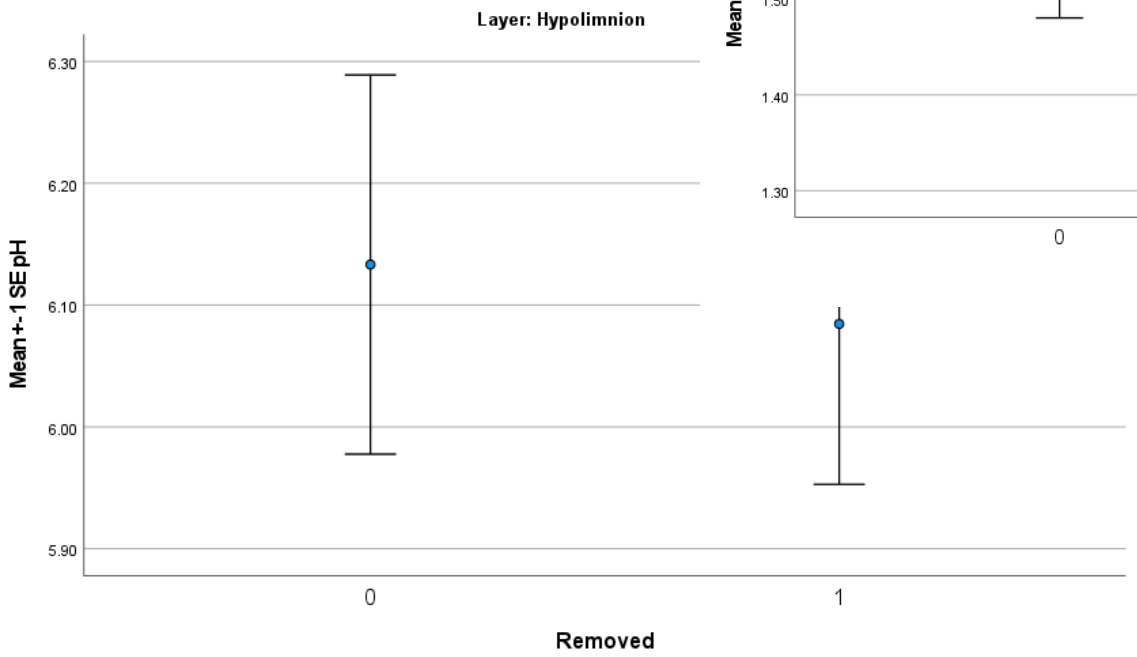
ARK

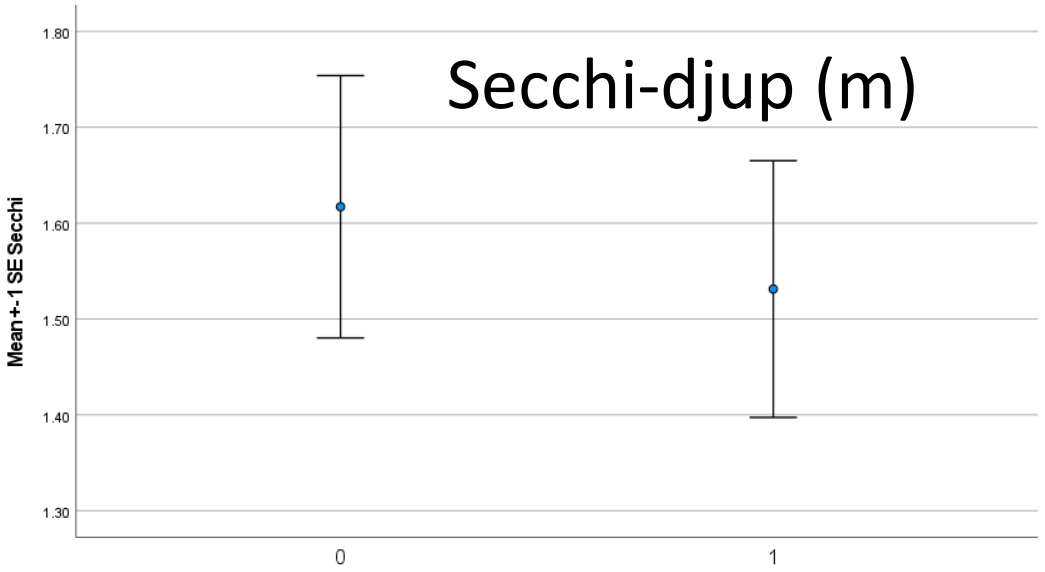
FREE FLOW

EXTRA

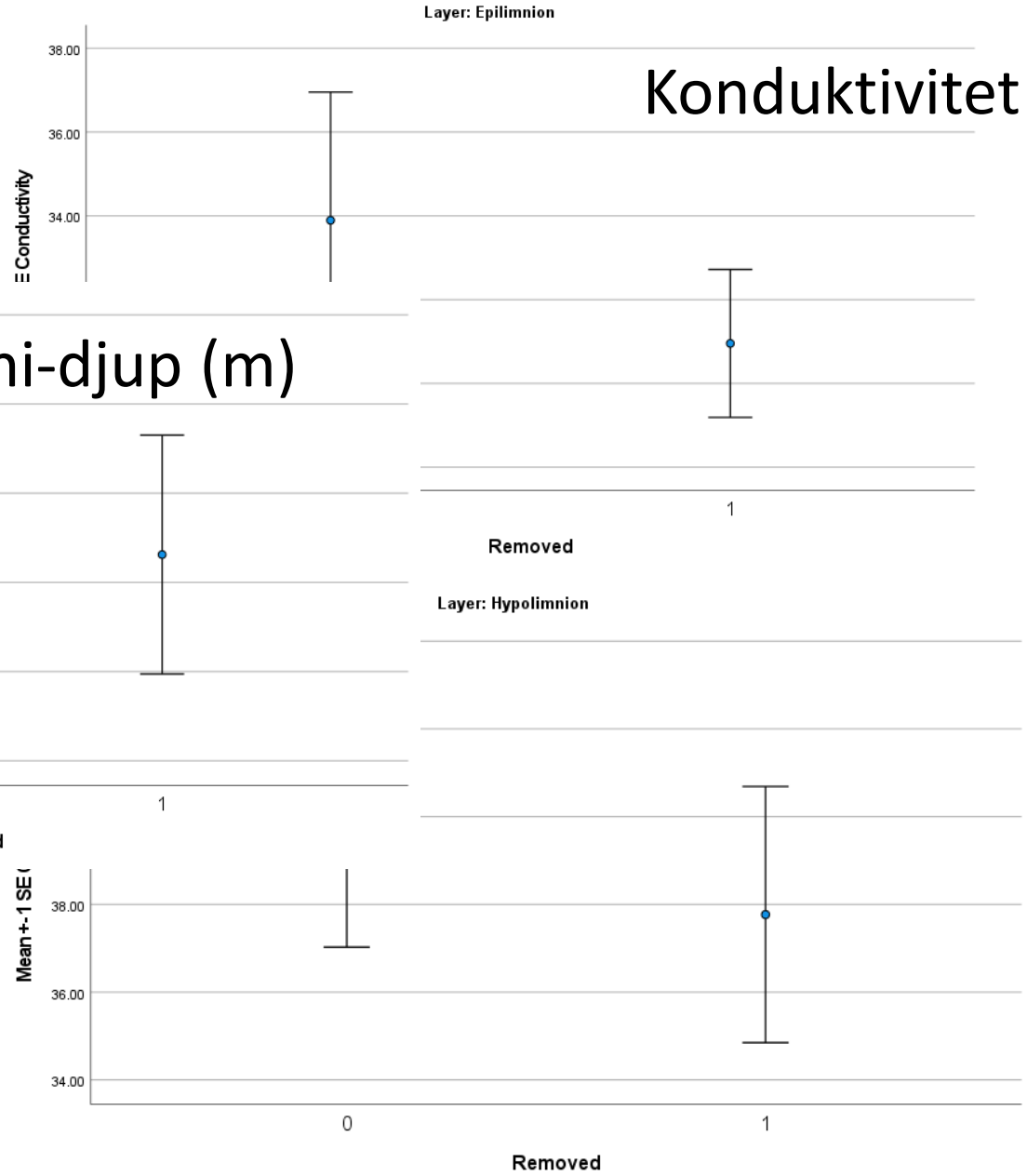


pH



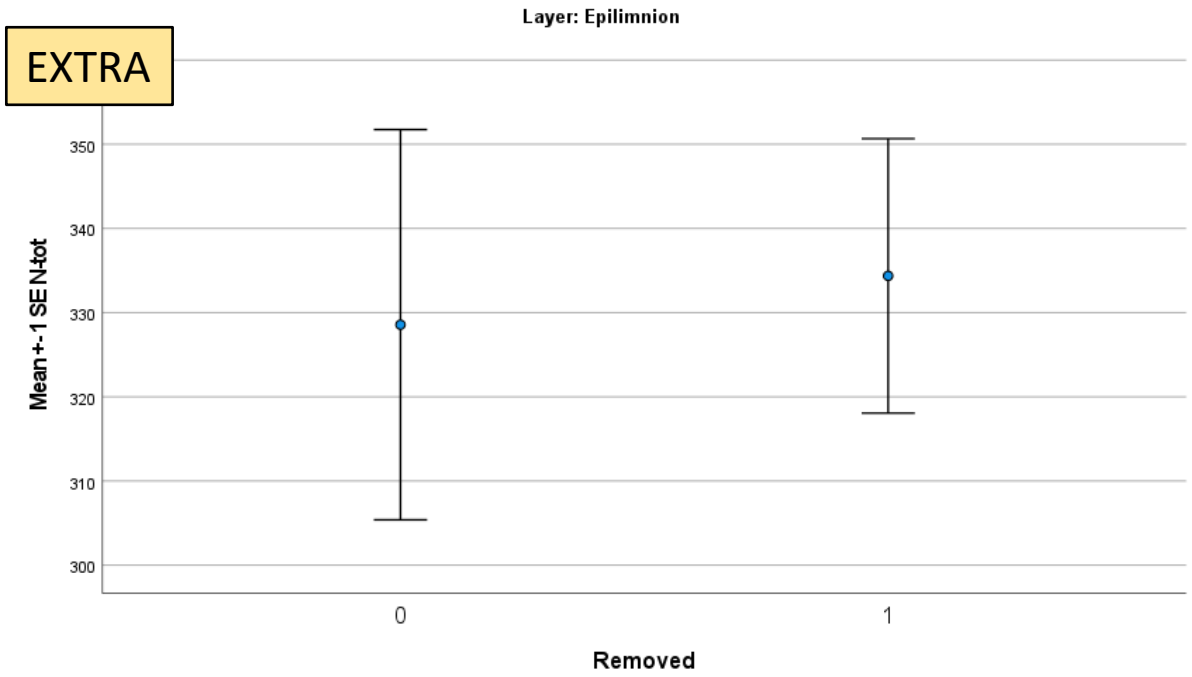


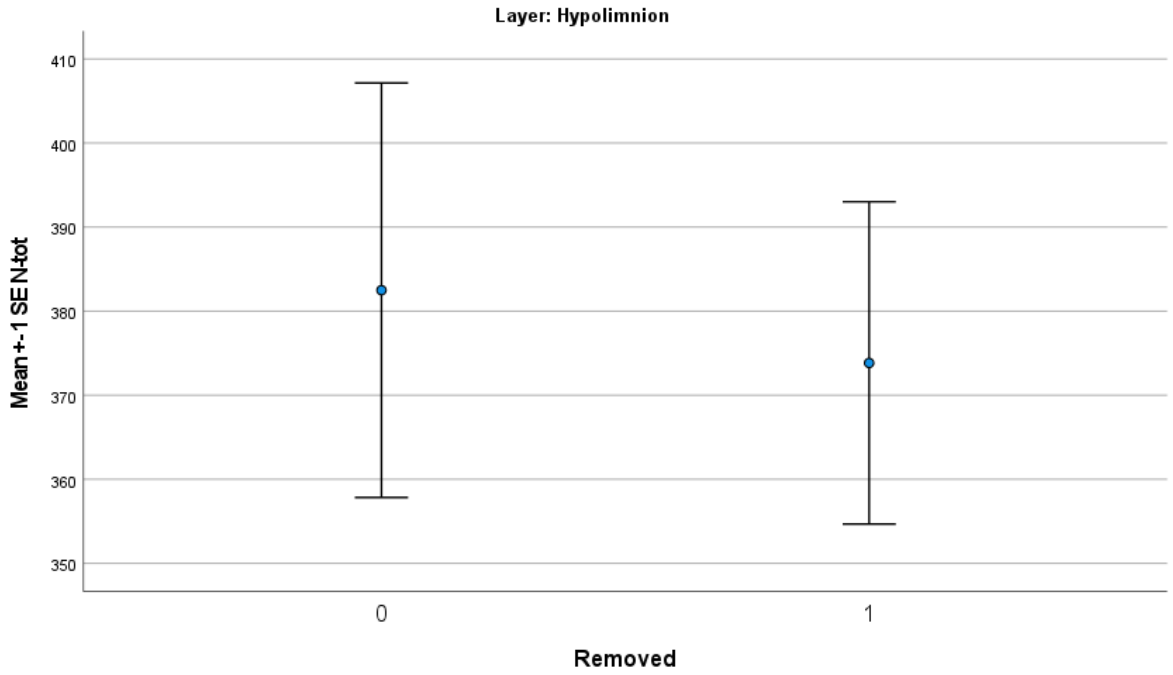
Secchi-djup (m)



Konduktivitet

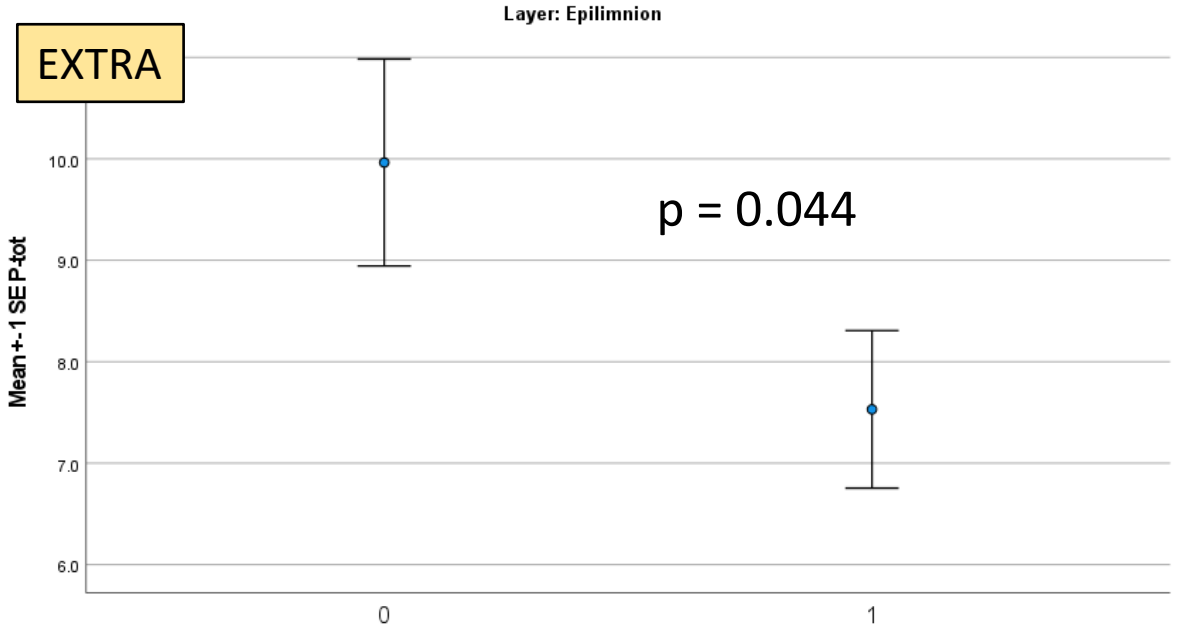
EXTRA



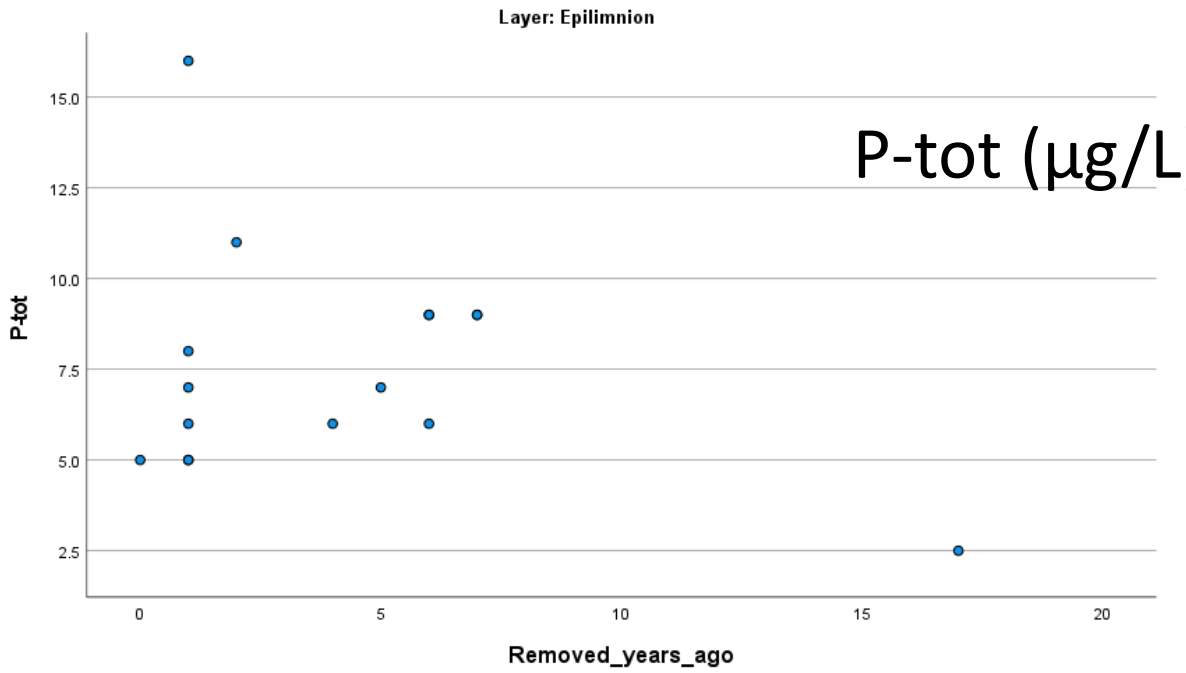


N-tot (µg/L)

EXTRA

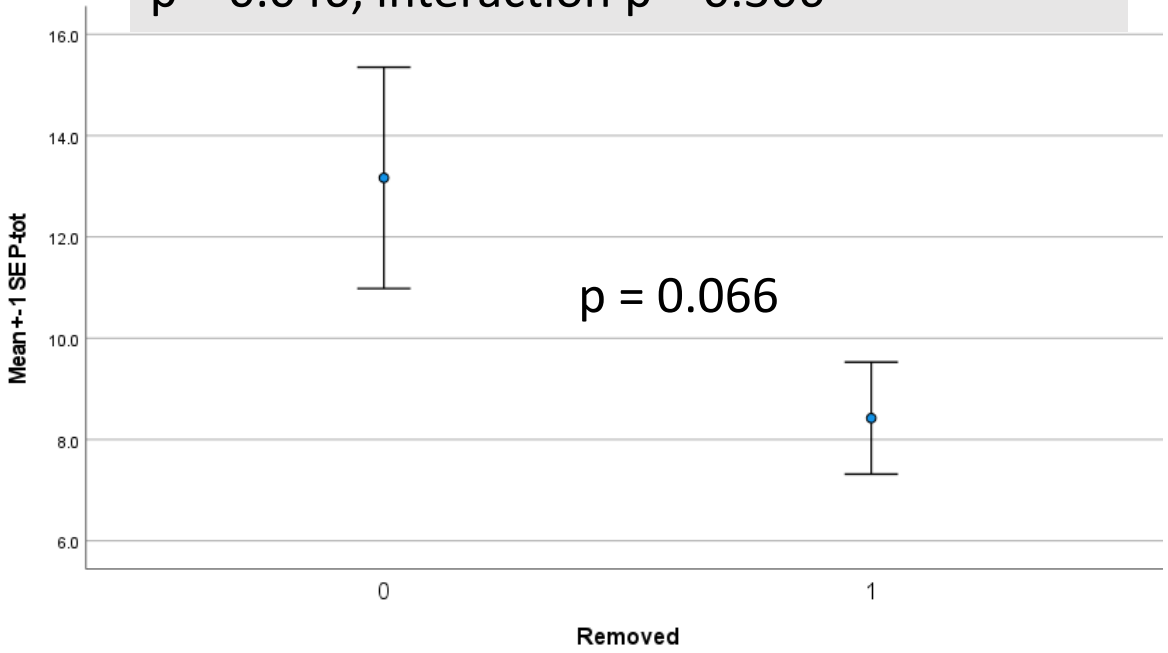


p = 0.044



P-tot (µg/L)

Large model: dam removal p = 0.028; layer p = 0.046; interaction p = 0.306



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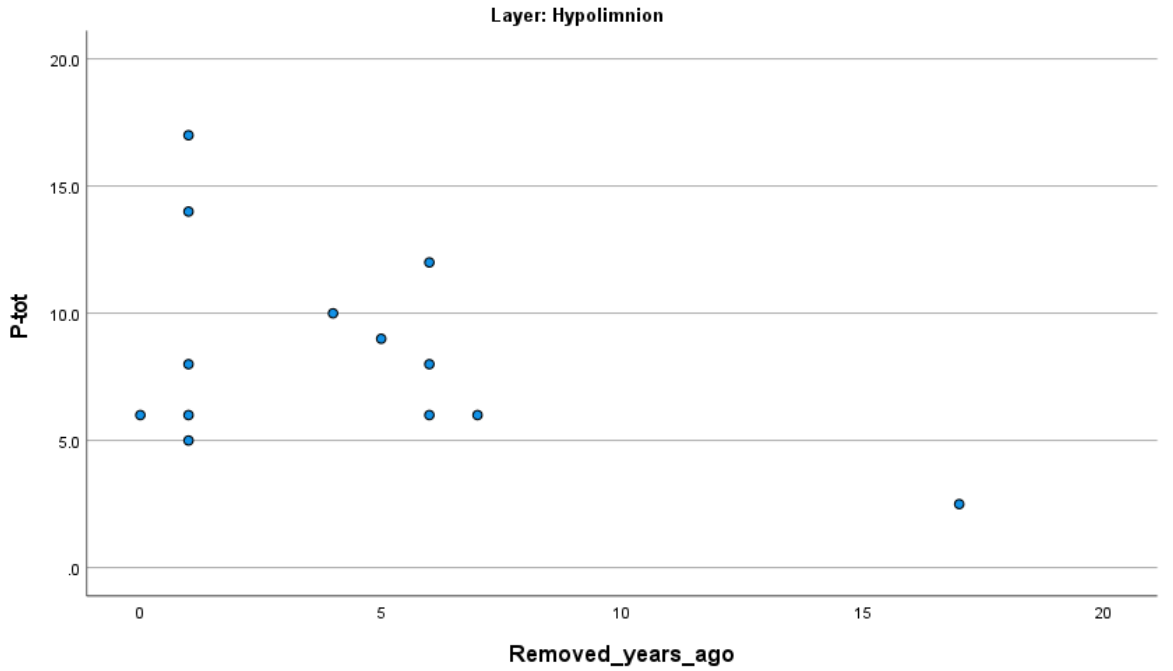

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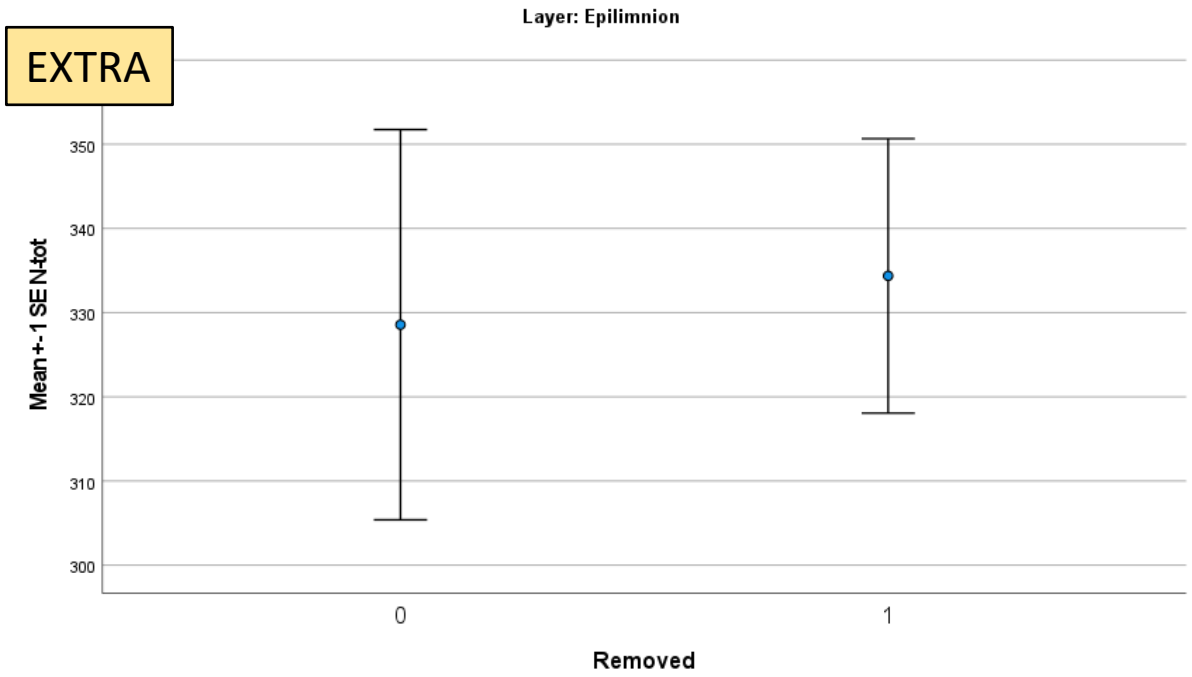
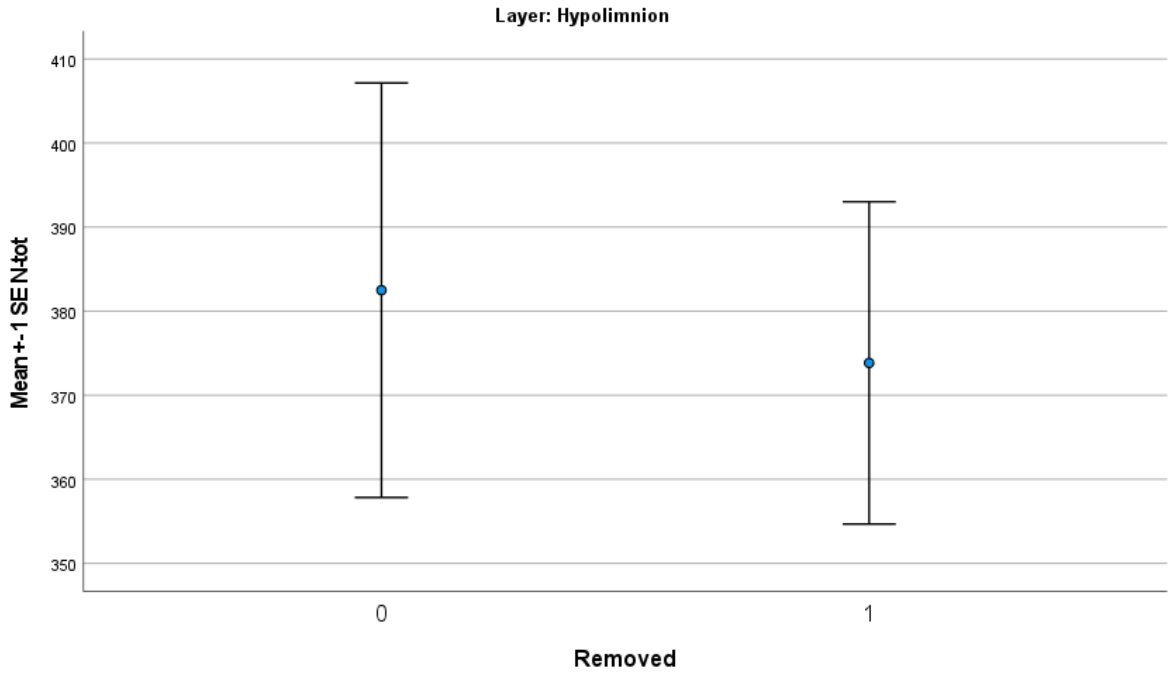
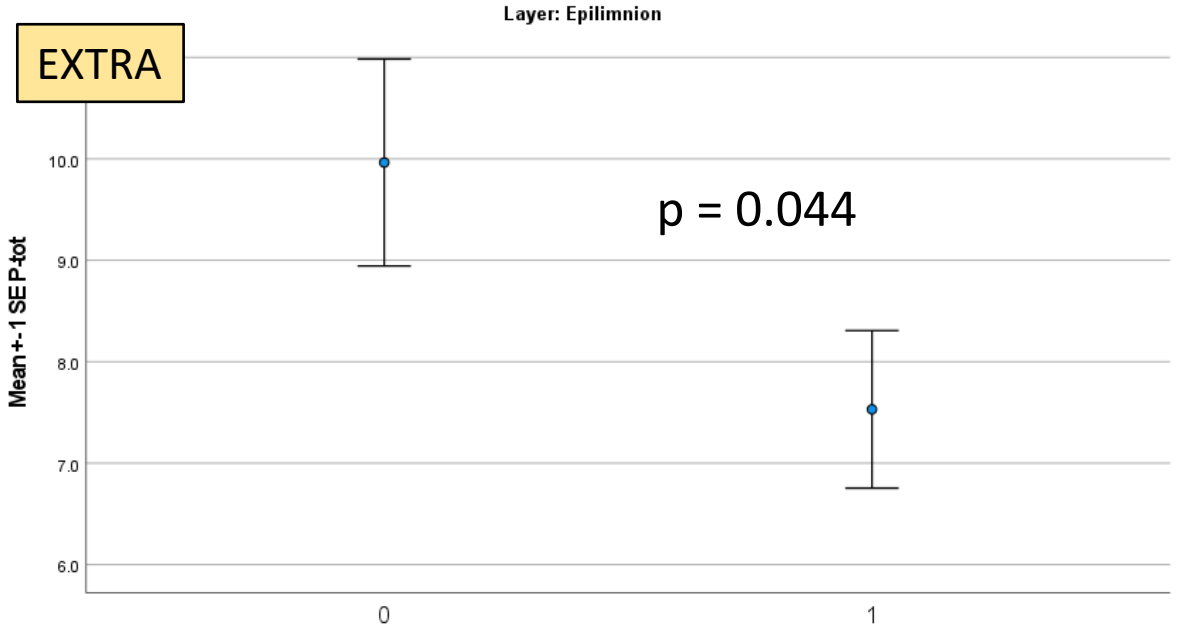


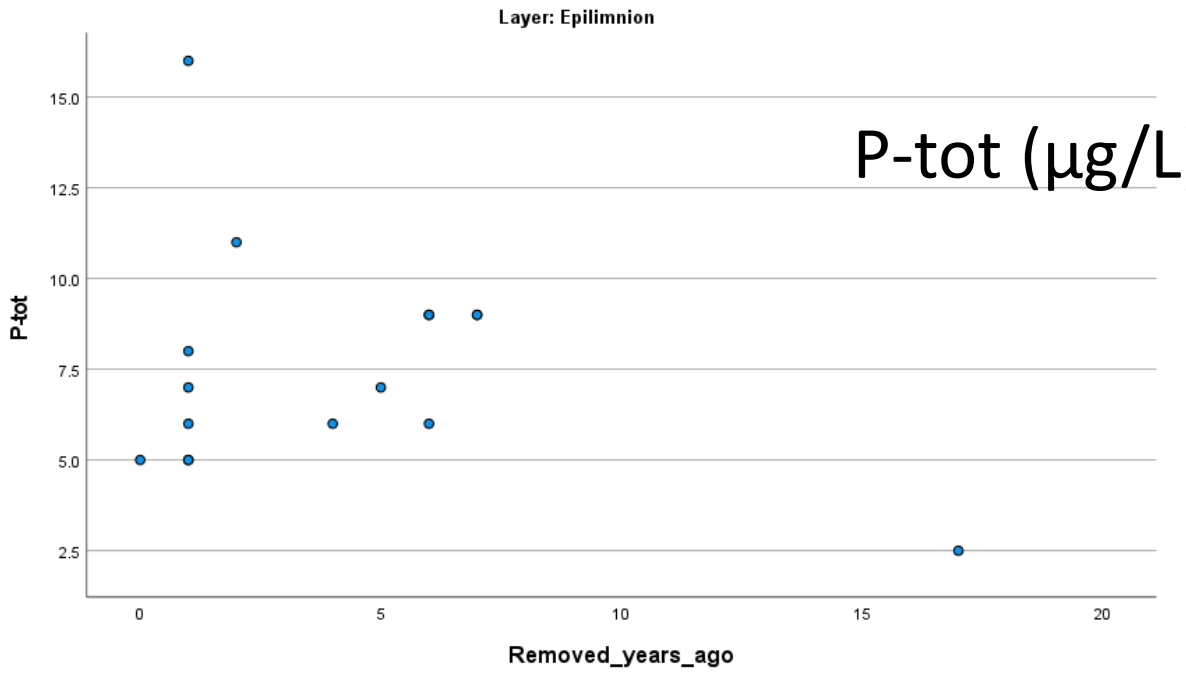


N-tot (µg/L)

EXTRA

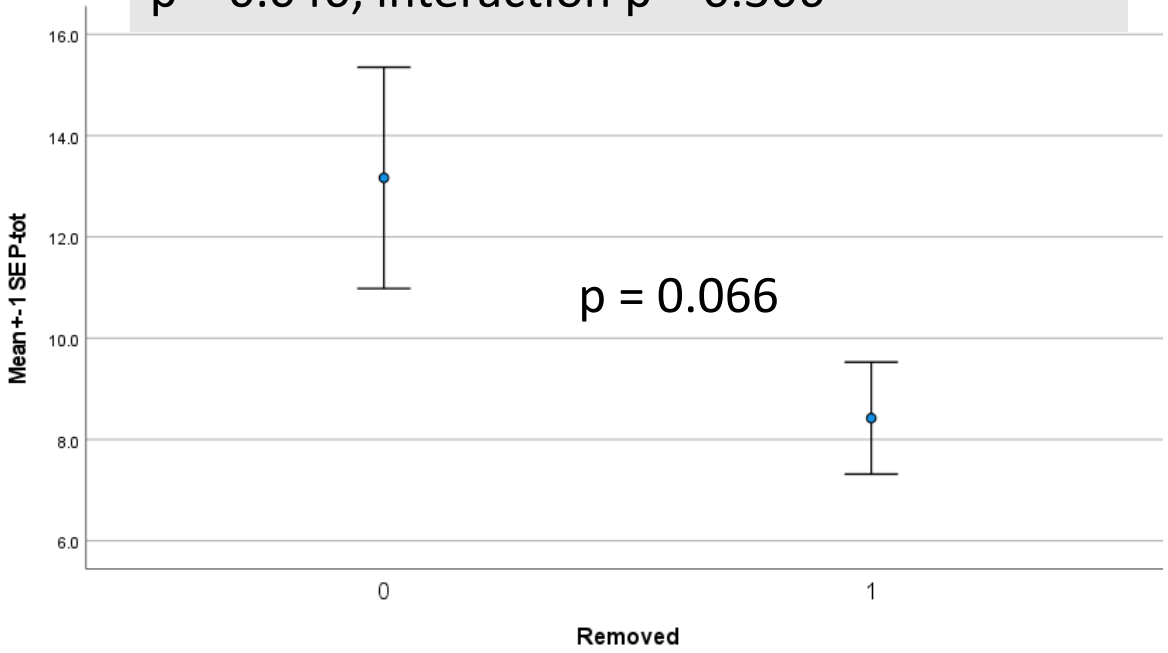


p = 0.044

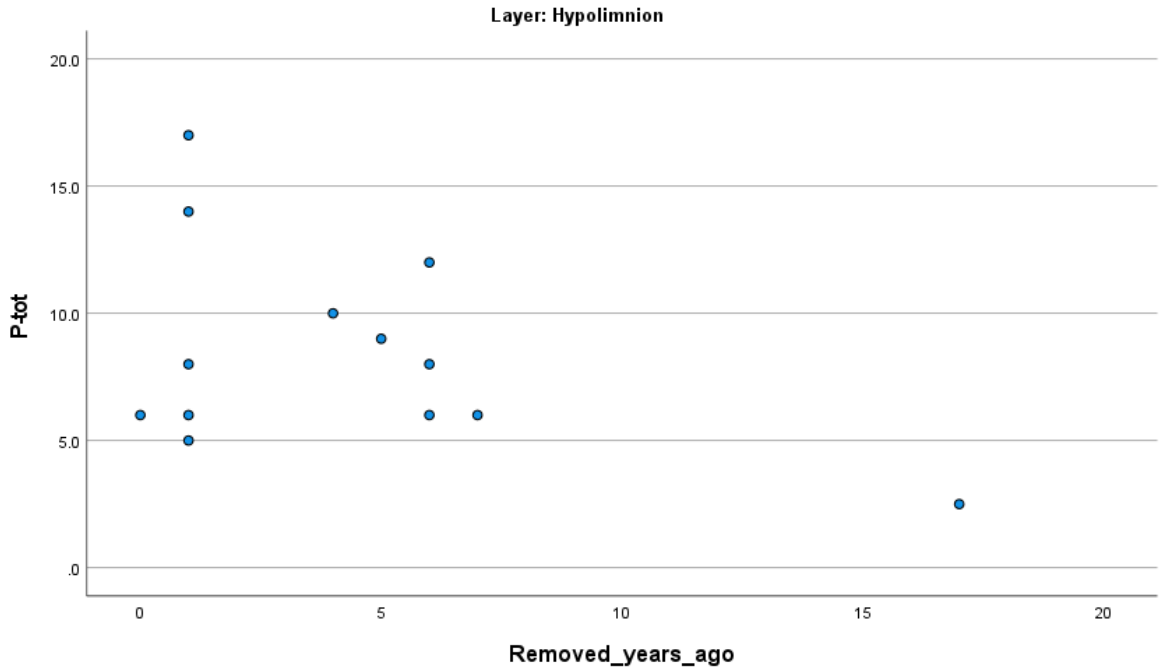


P-tot (µg/L)

Large model: dam removal p = 0.028; layer p = 0.046; interaction p = 0.306



p = 0.066



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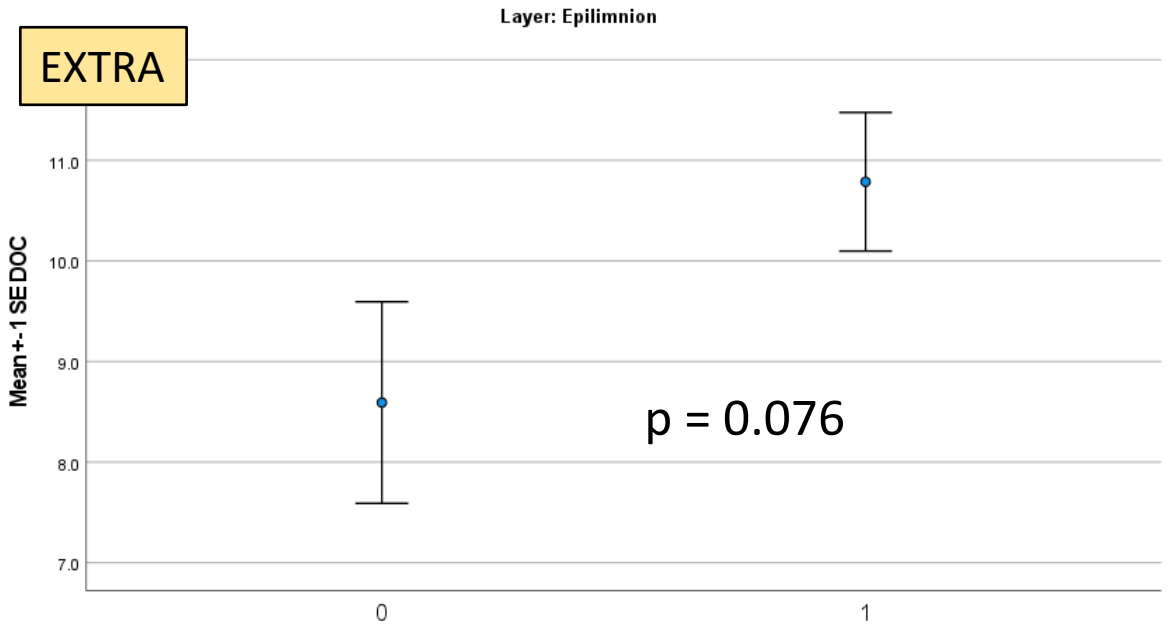
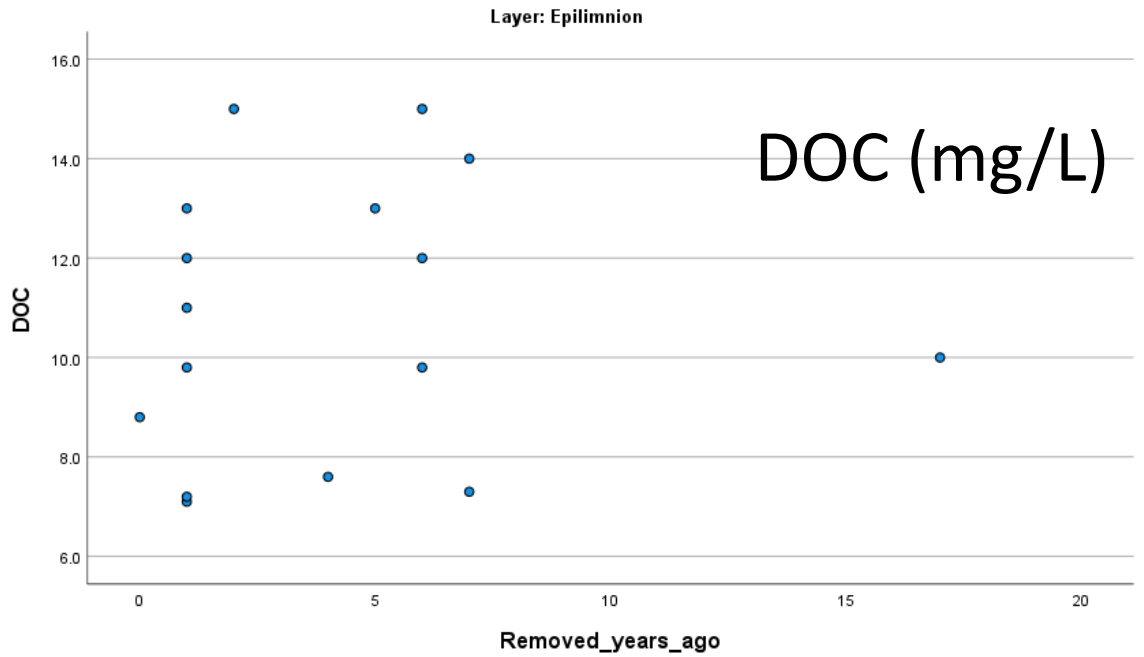
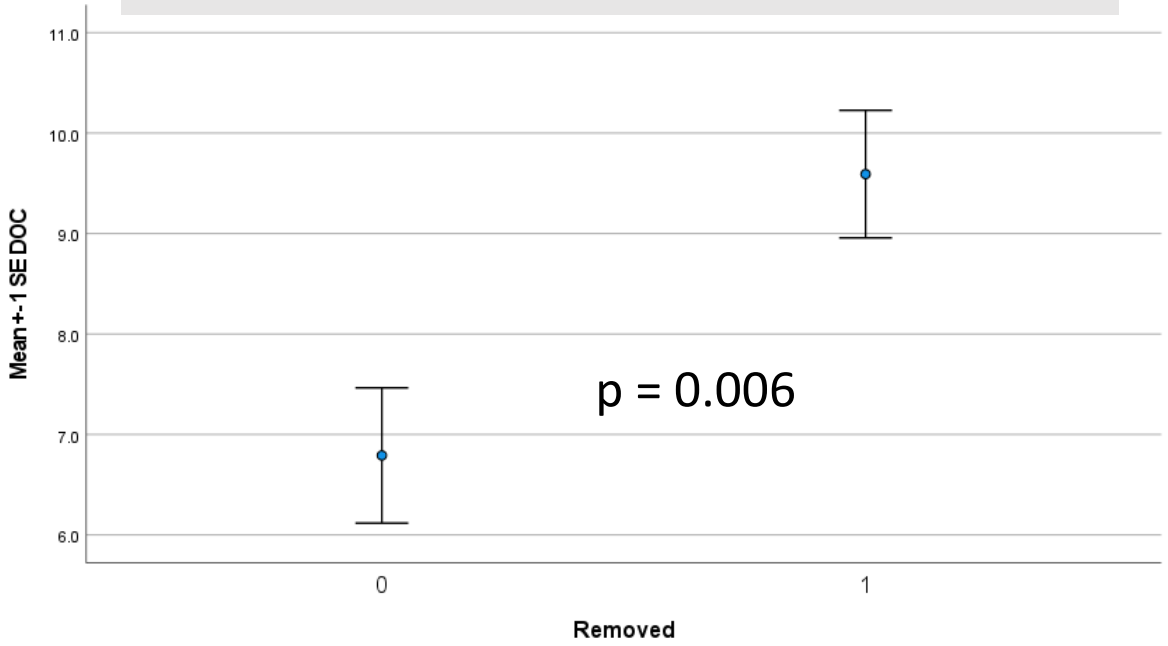
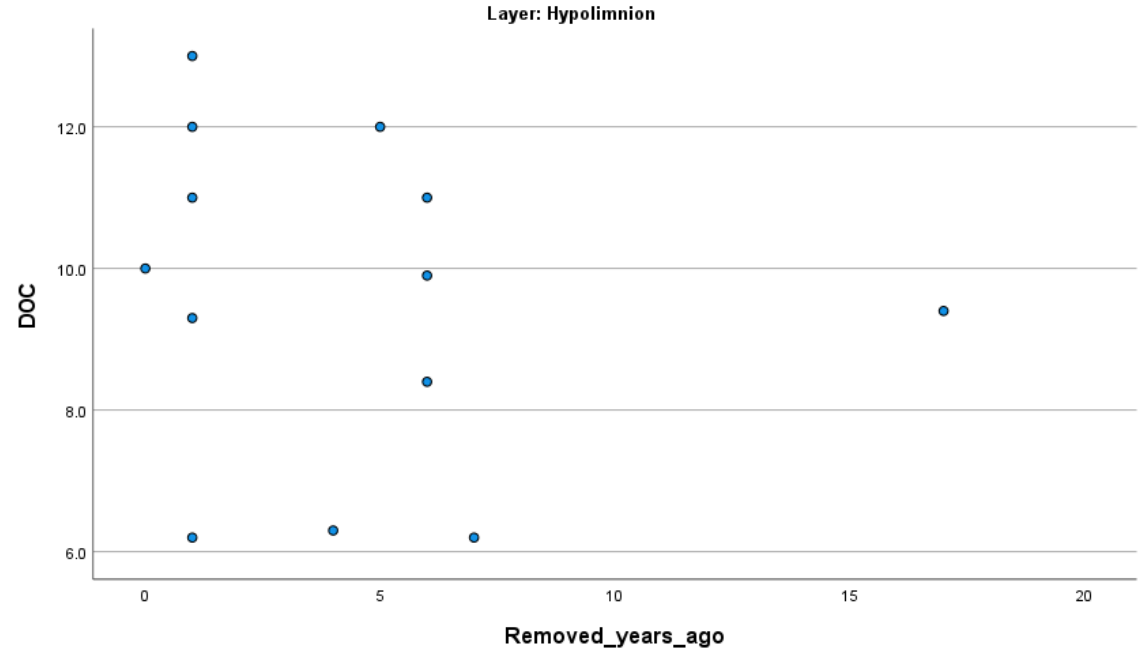




DOC (mg/L)

Large model: dam removal p = 0.084; layer p = 0.018; interaction p = 0.949





EXTRA

INSLAGET
Karlstads universitets intranät

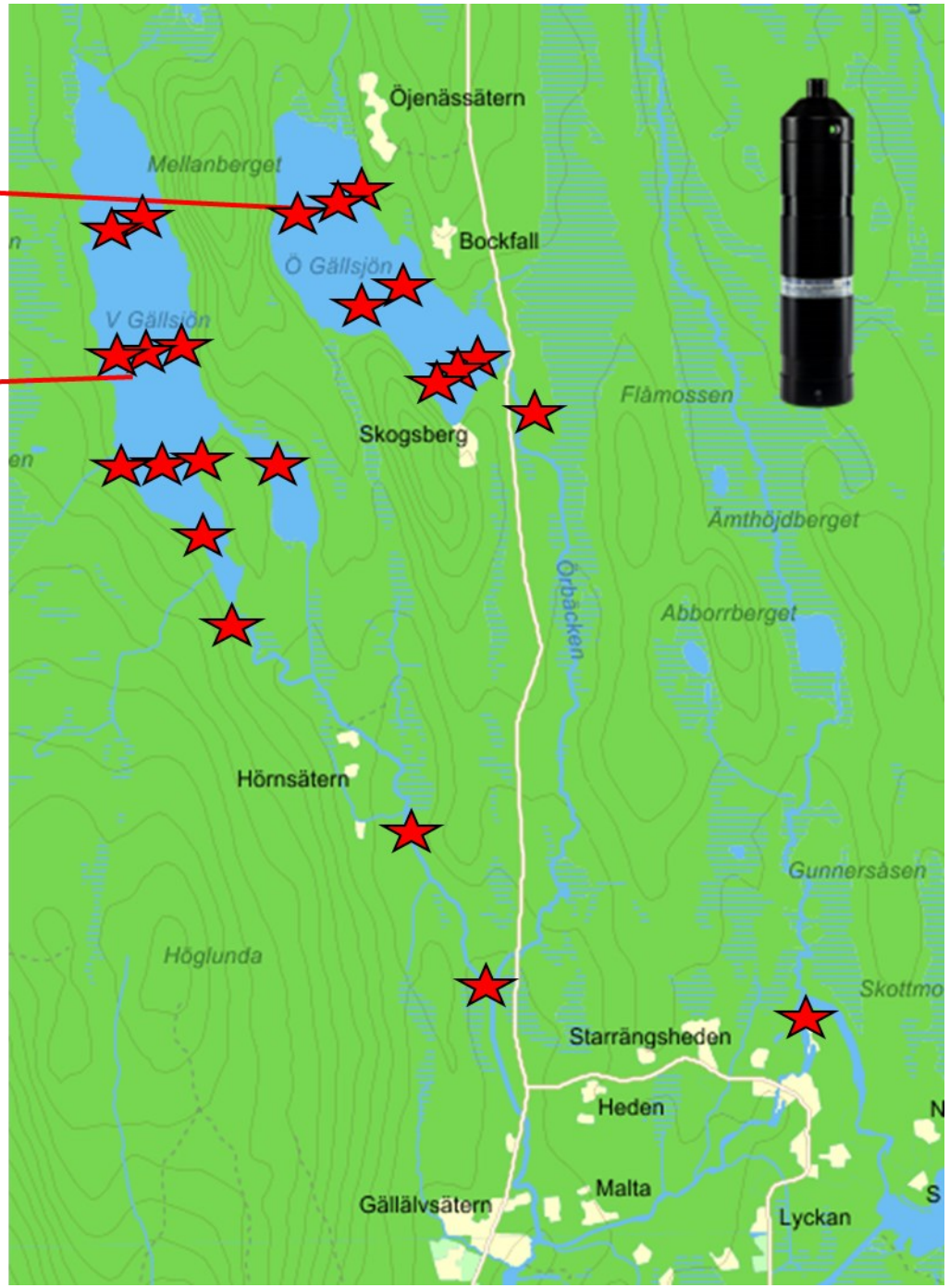
En samarbetsinsats mellan fors...

En samarbetsinsats mellan forskare och Sportfiskeakademin

Forskning om hur vi kan bevara ekosystem är avgörande för att uppnå en hållbar framtid. Ett spännande projekt, finansierat av Energimyndigheten (HåVa) och utfört i samarbete med Fortum, undersöker ekosystemeffekterna av dammutrivningar i inlandsvatten. I en delstudie inom detta projekt har forskare samarbetat med Sportfiskegymnasiet i Forshaga för att fånga och märka gäddor med akustiska sändare.

14 tagged pike

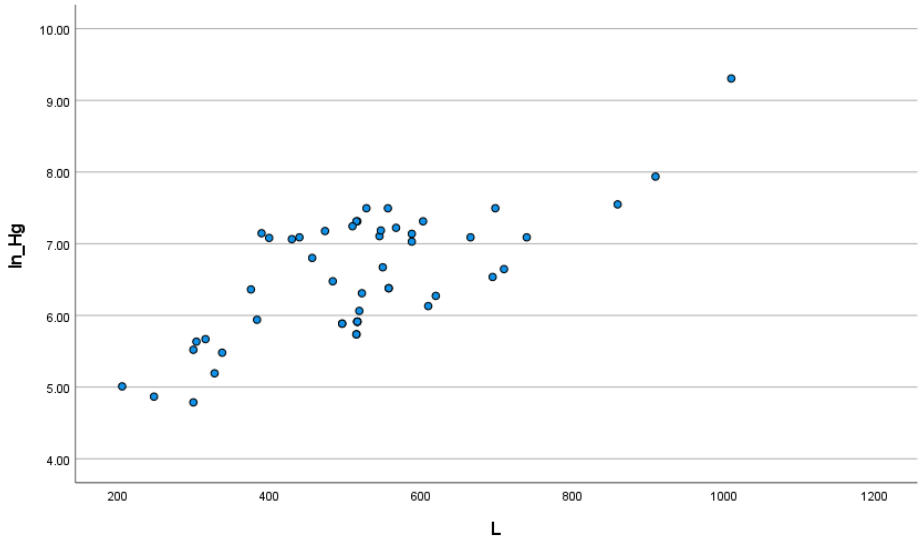
30 tagged pike

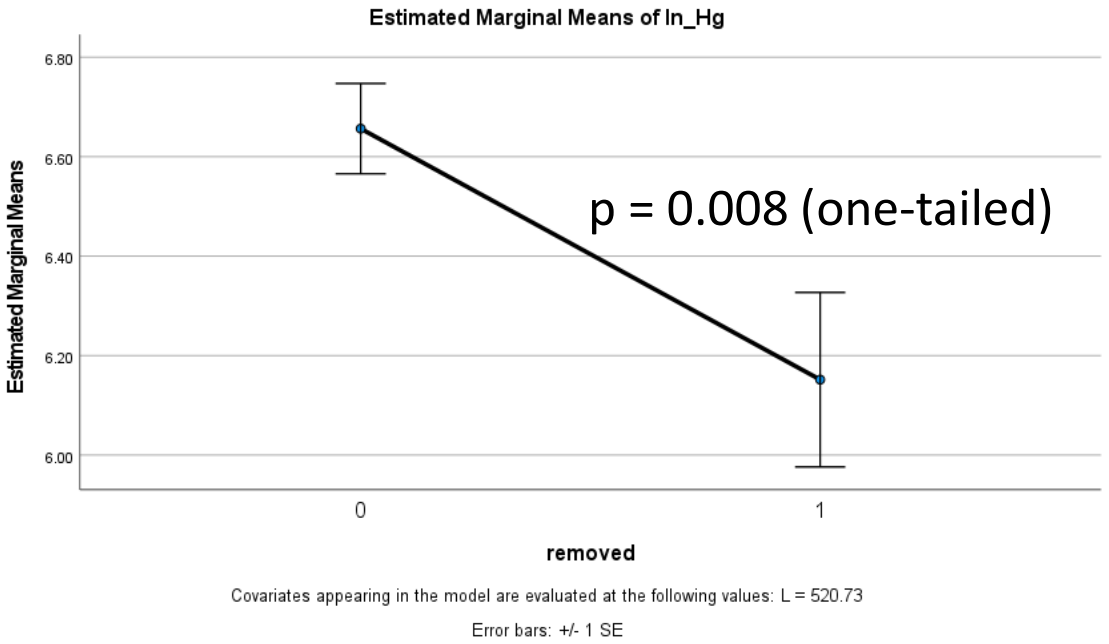



EXTRA

EXTRA

Hg-tot, pike (+ some historical data)



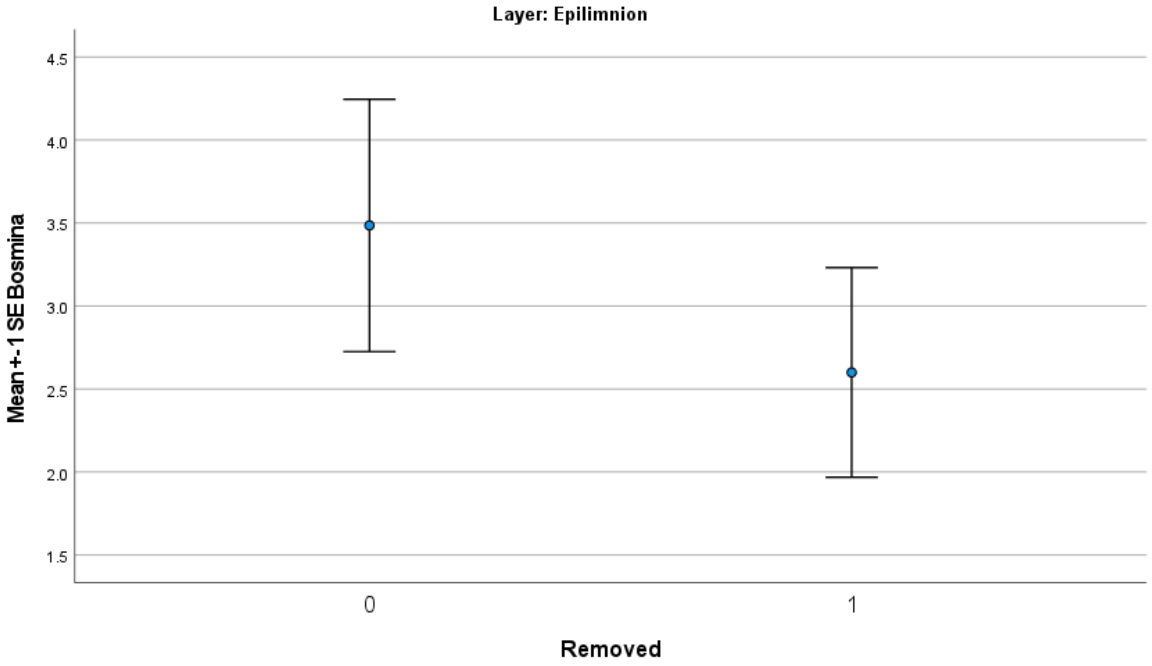


Pseudoreplicated!

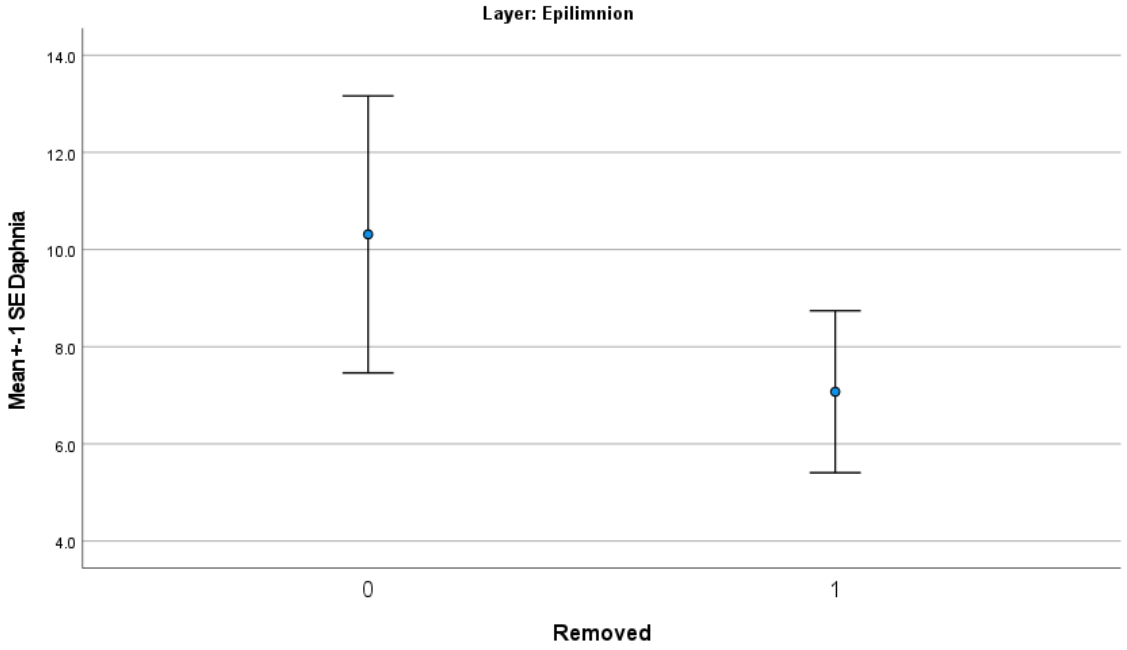
And sampling year not considered.

EXTRA

Bosmina



Daphnia



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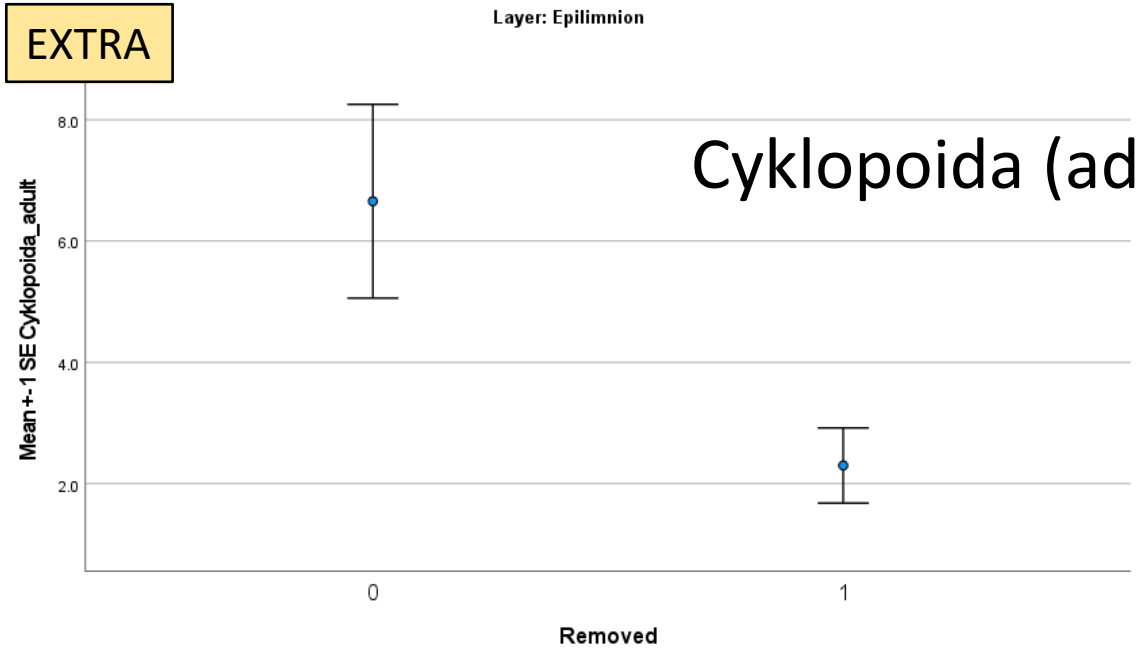
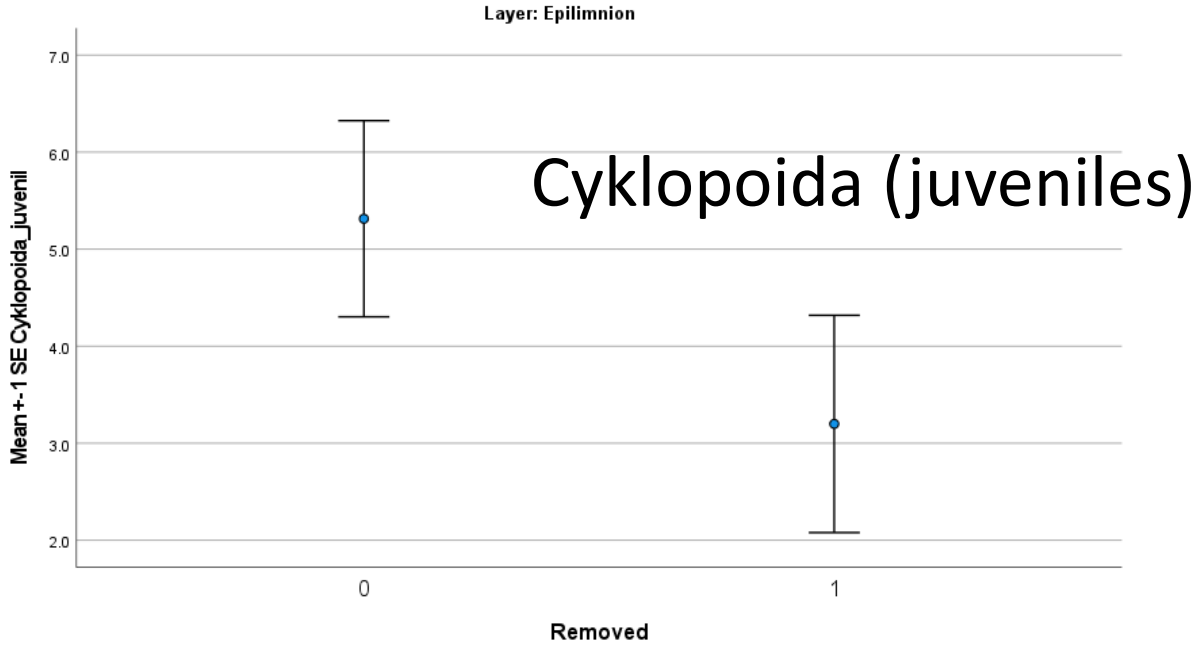
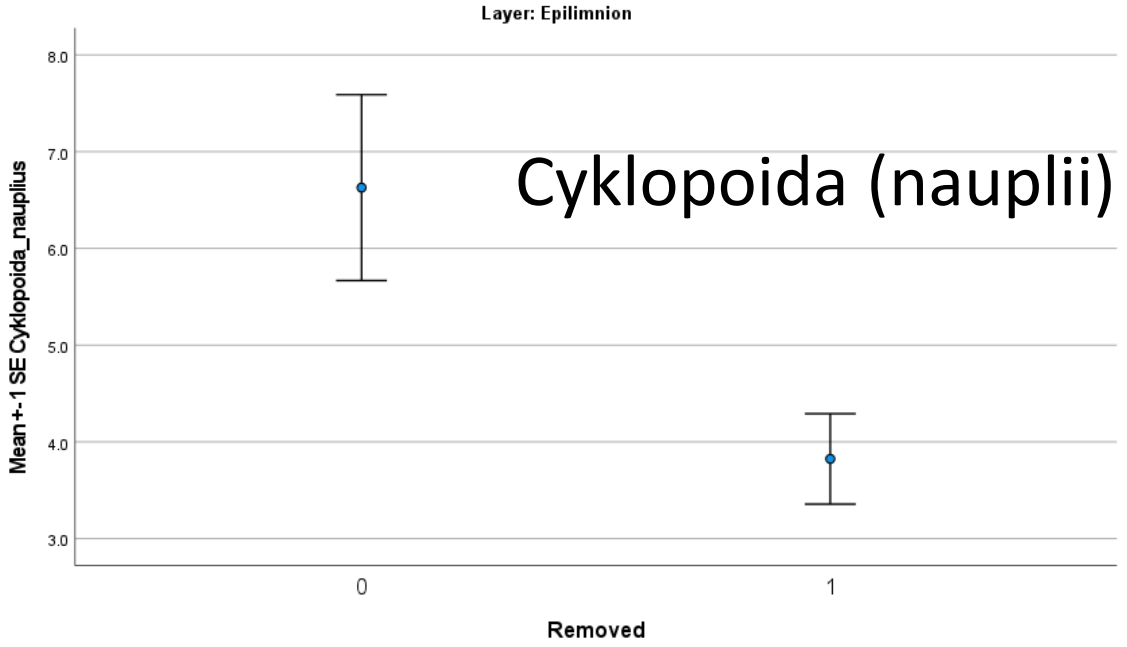


Cyklopoida (adults)

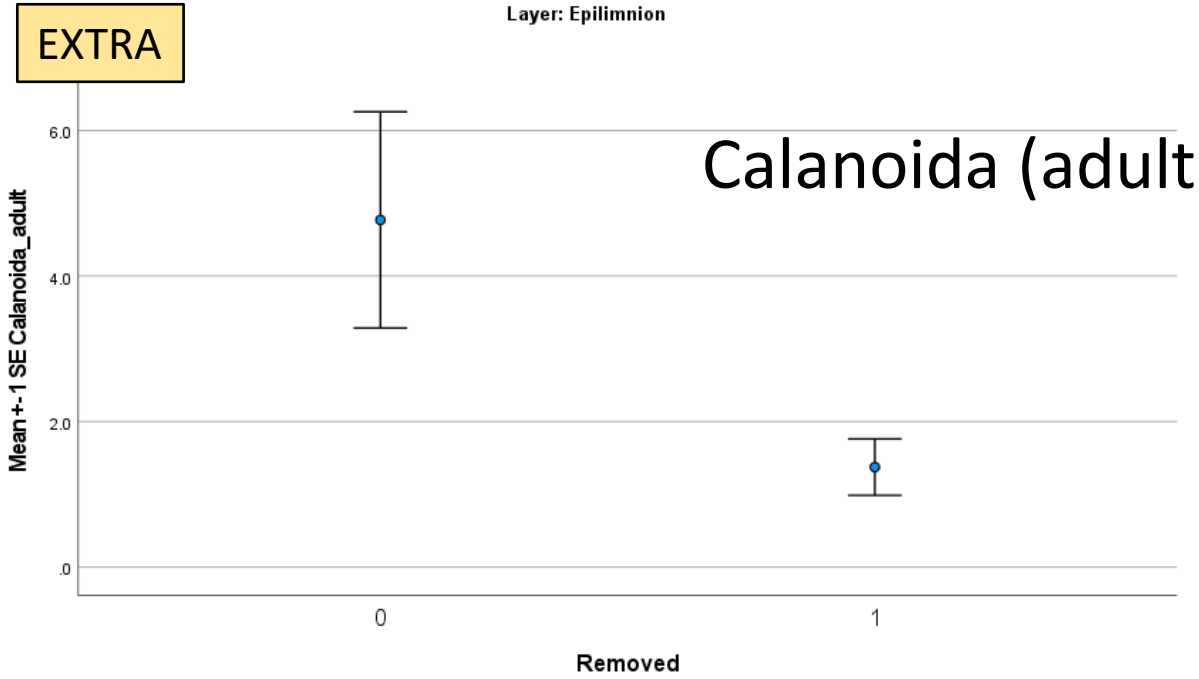


Cyklopoida (juveniles)

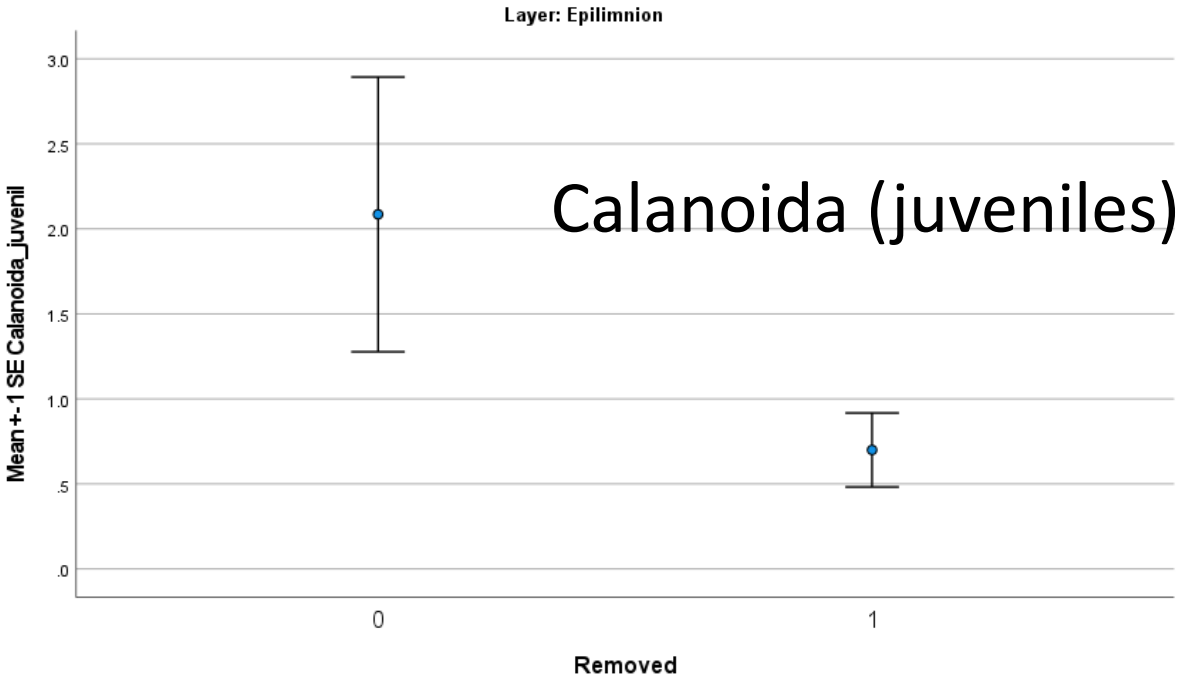


Cyklopoida (nauplii)

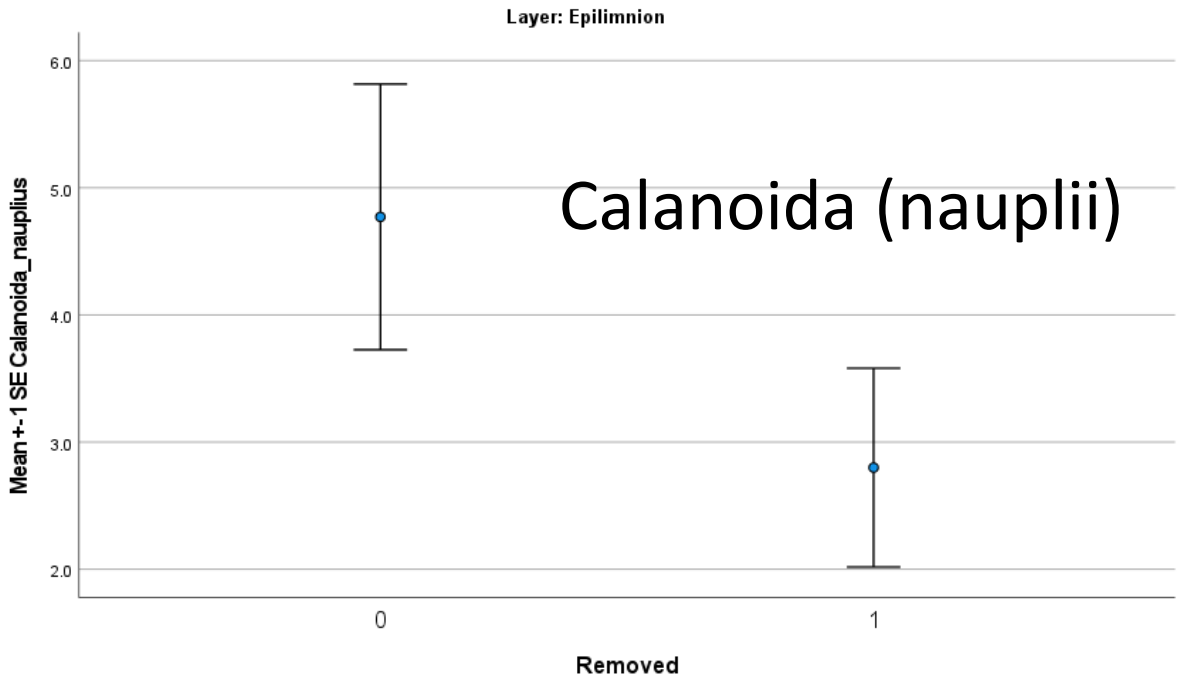
EXTRA



Calanoida (adults)



Calanoida (juveniles)



Calanoida (nauplii)