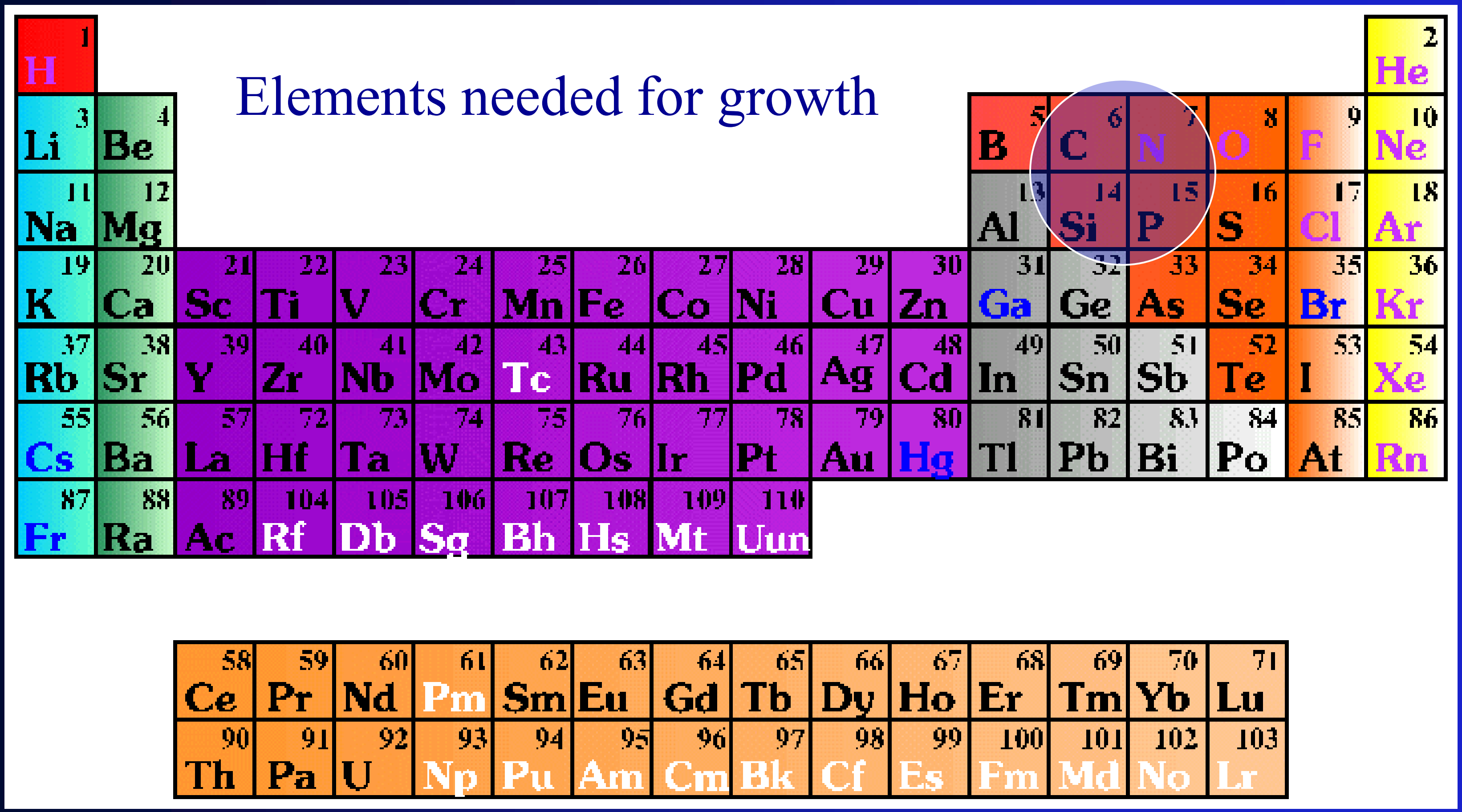
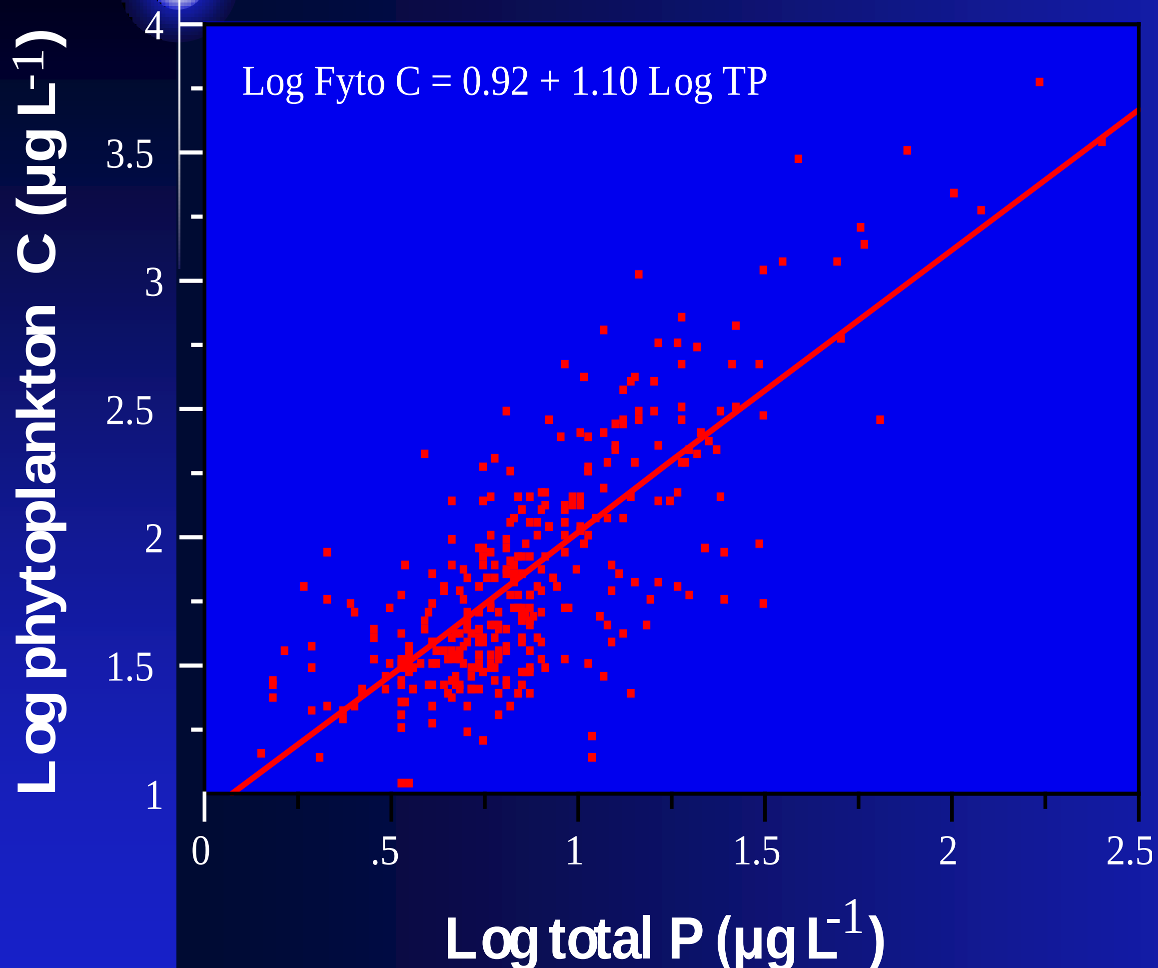
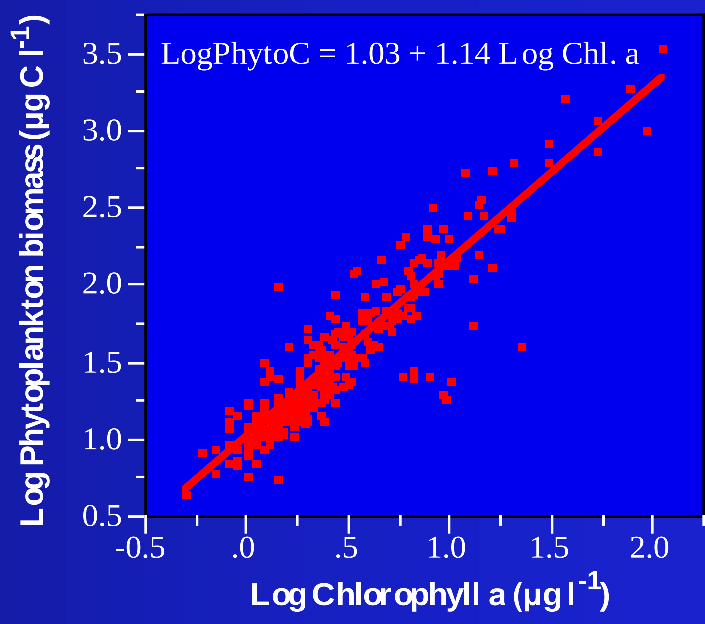
Eutrofiering – 4 nøkkelelementer



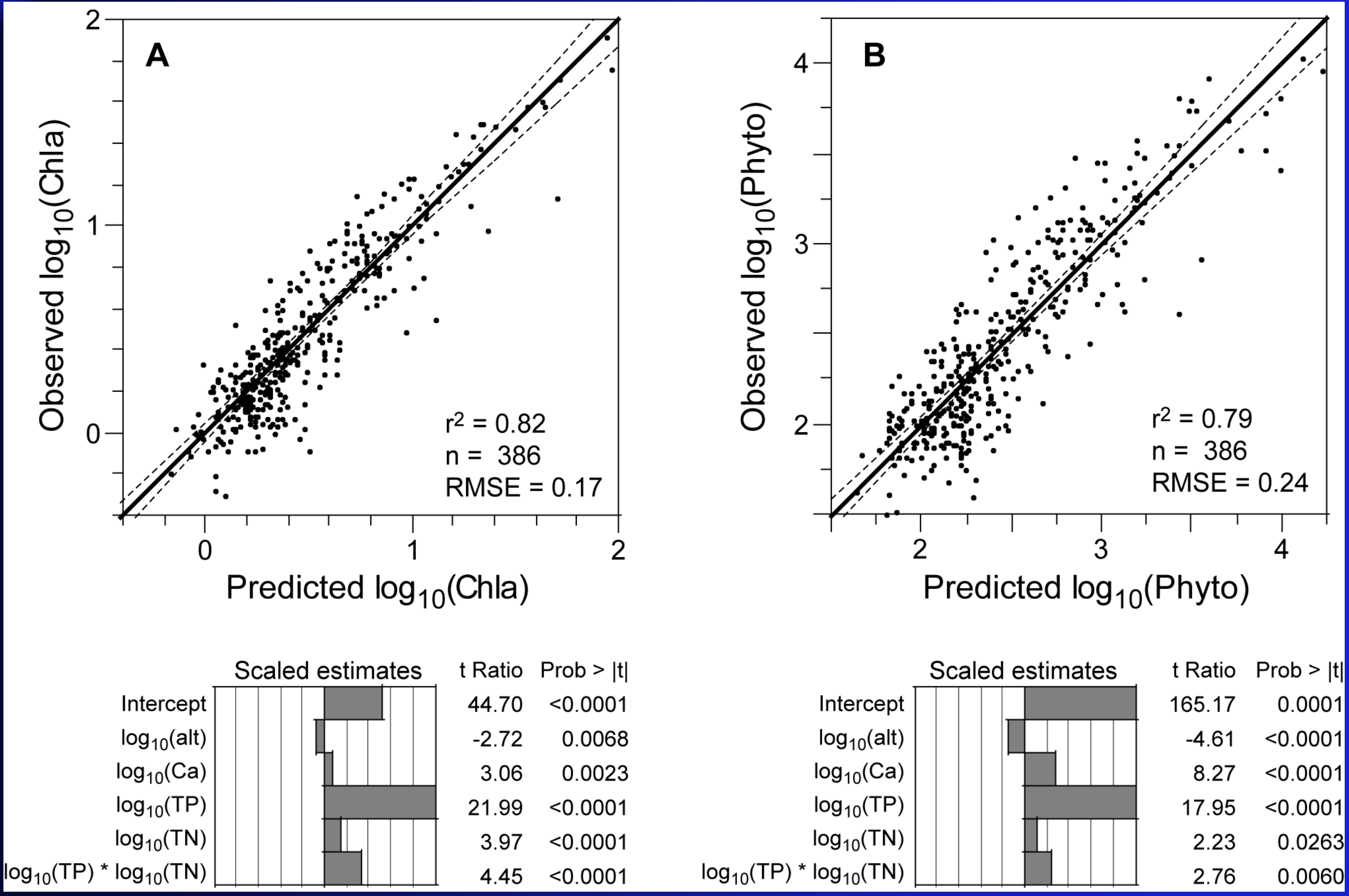
P og alger



Strong correlations at the base of the food web …



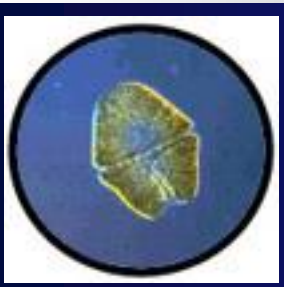
Mest P, men et lite bidrag fra N

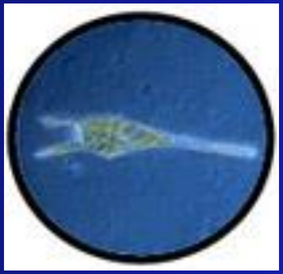


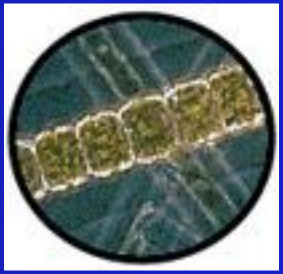
Liebigs minimums prinsipp

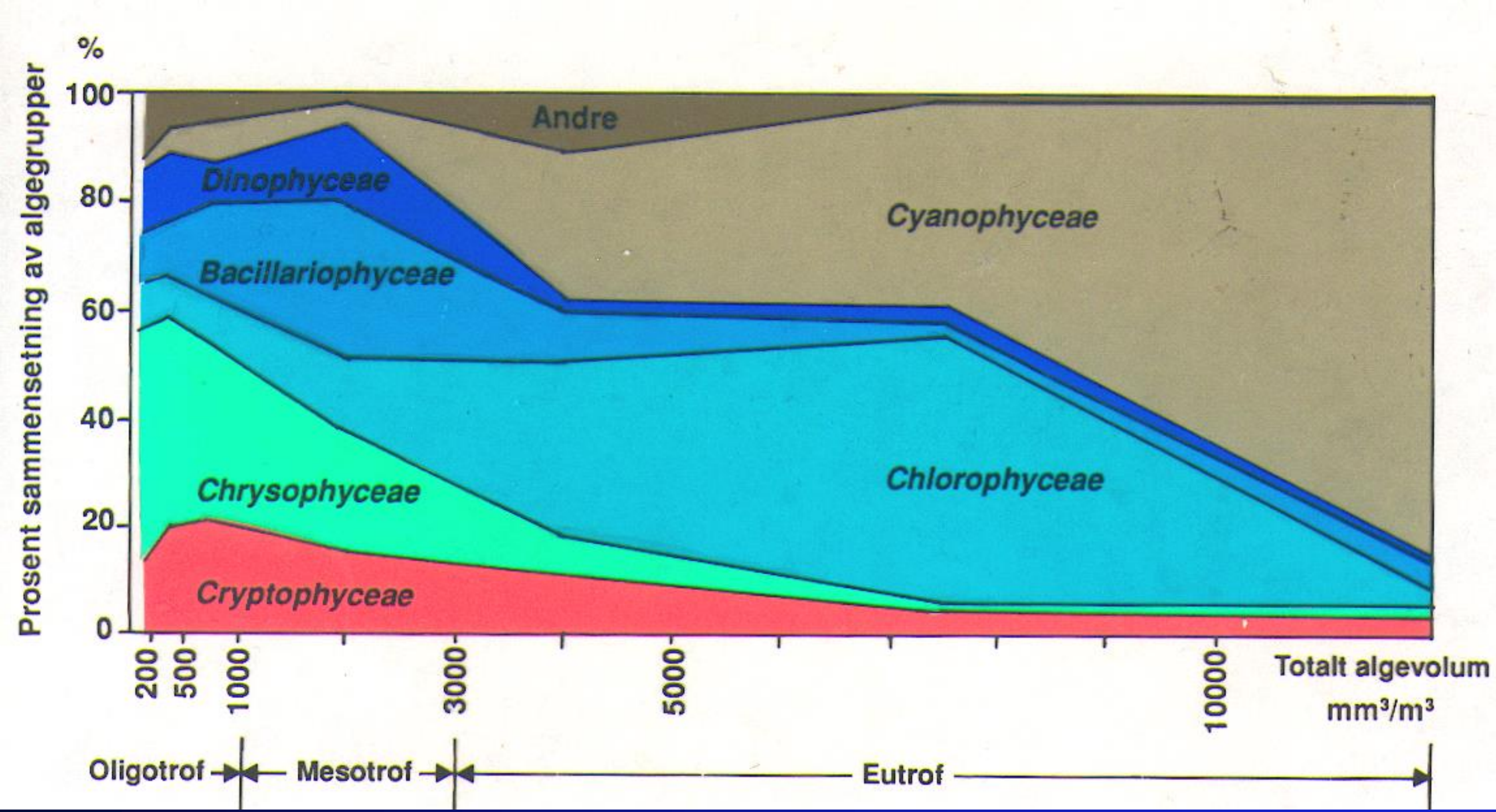
- One principally limiting element
- Often close to co-limitation
- Macro-nutrients vs. micro-nutrients
- Productivity vs standing stock: different elemental demands

Endringer i phytoplankton samfunn, morfologi, beitbarhet og kvalitet



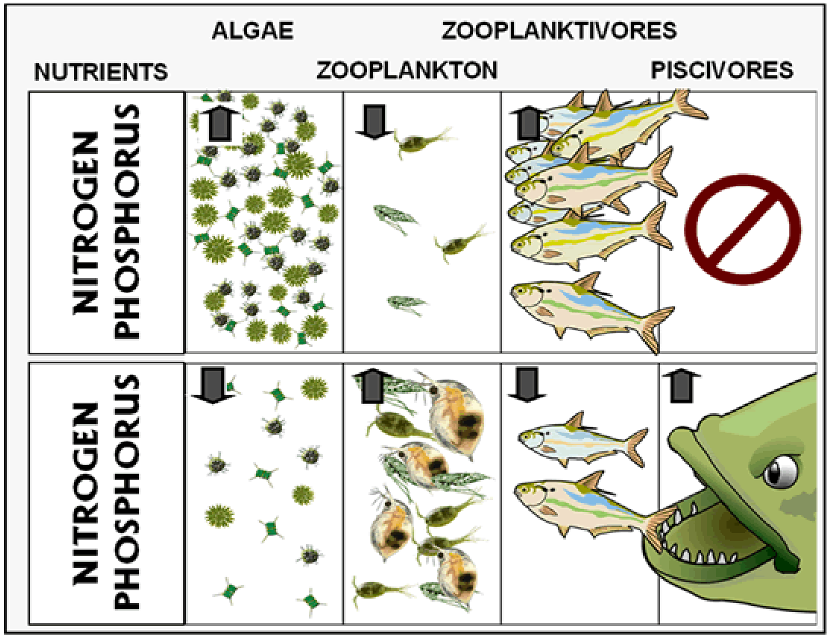


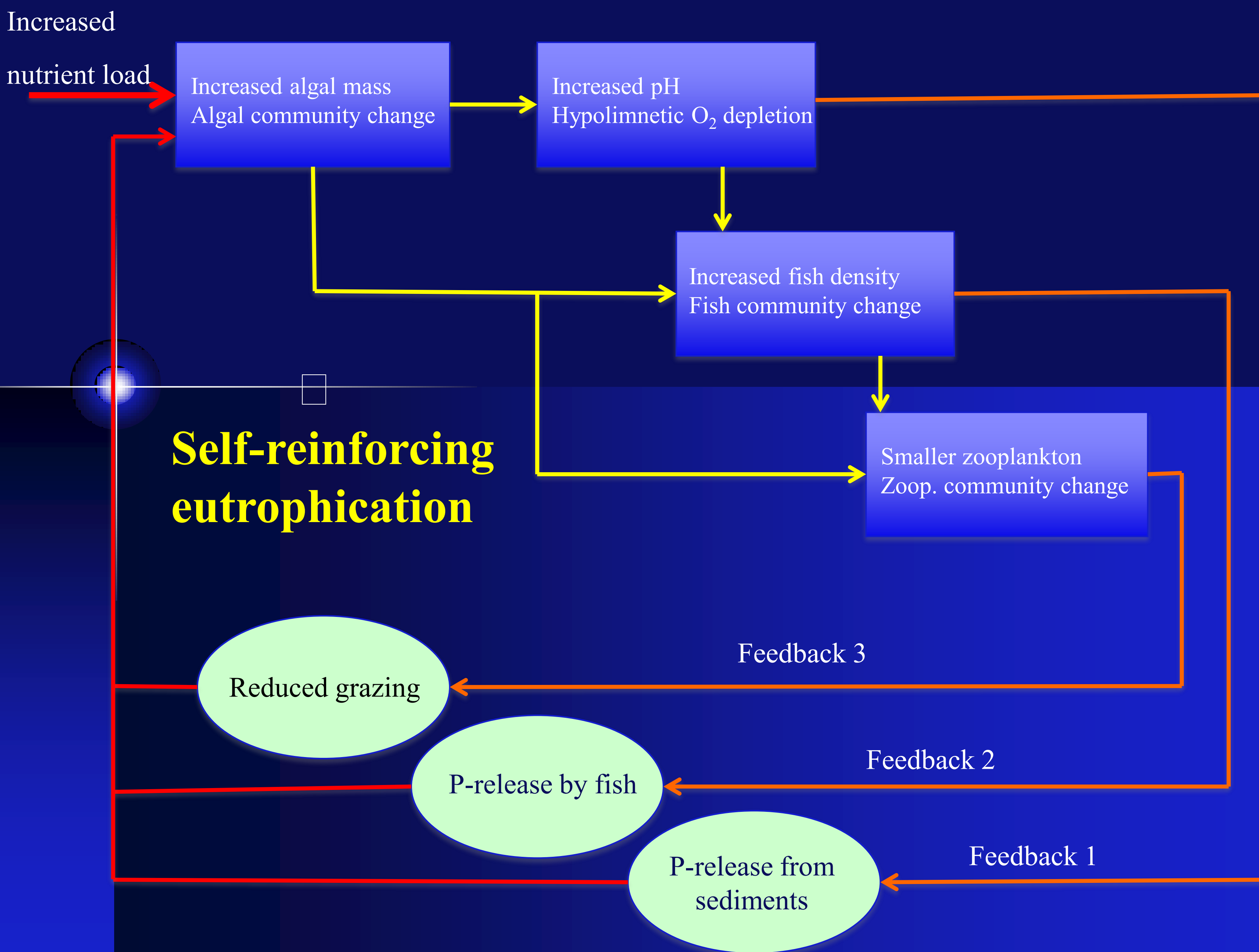




Samfunnsendringer og trofiske kaskader

- Typical shifts from large-bodied to small-bodied species
- Change from large cladocerans (*Daphnia*) to small copepods
- Reduced grazing pressure
- Shift from salmonids to cyprinids
- Importance of top predators and the trophic cascade

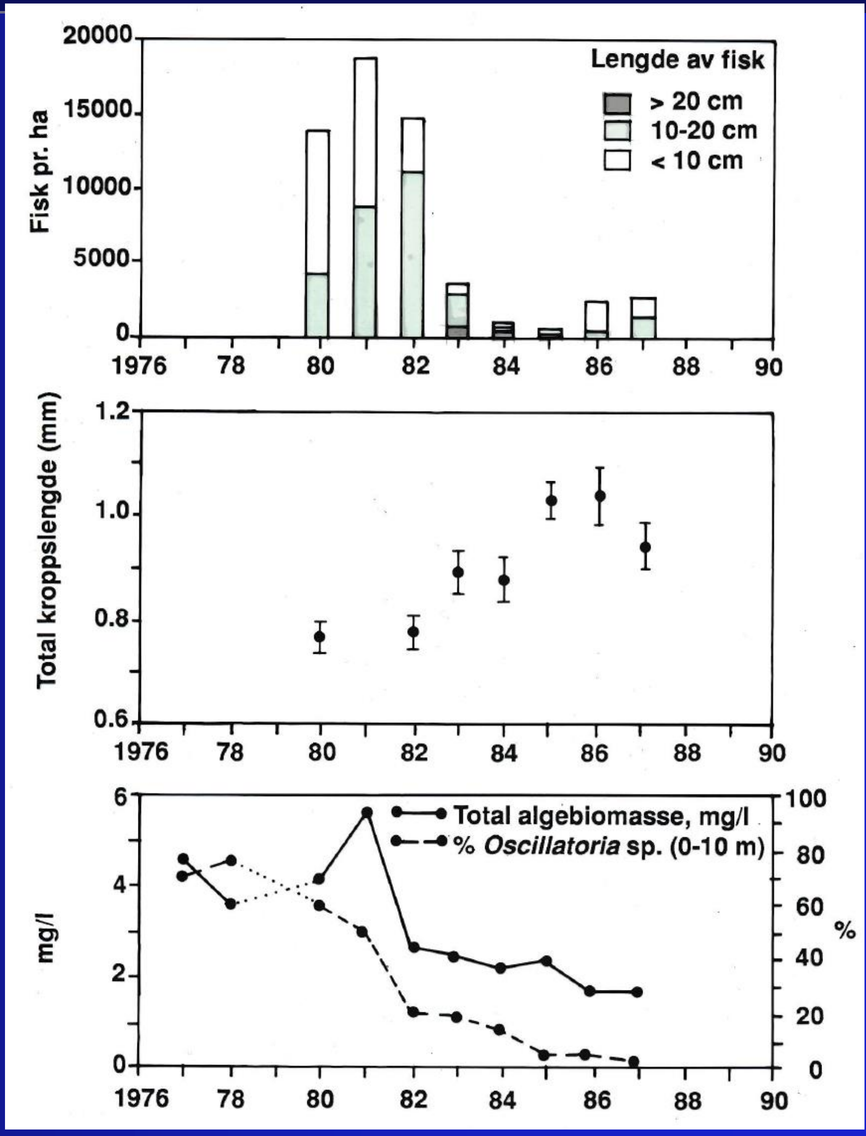




Increased
nutrient load
Increased algal mass
Algal community change
Increased pH
Hypolimnetic O_2 depletion
Increased fish density
Fish community change
Smaller zooplankton
Zoop. community change
Self-reinforcing
eutrophication
Feedback 3
Reduced grazing
Feedback 2
P-release by fish
Feedback 1
P-release from
sediments

Tilfellet Gjersjøen …

- Originally a oligotrophic lake
- Became eutrophic from the -60ies due to increased P-loads
- Sewage plants were built but agricultural runoff continued
- Changes in fish and zooplankton communities, massive cyanobacterial blooms - poor water quality.
- Internal fertilization
- Pike-perch was added in 1980
- Roach vanished, conditions improved – a top-down story?



Hvorfor fungerte kaskaden i Gjersjøen?

- Fosfor (og N) var allerede kraftig redusert
- Mort spilte en avgjørende rolle for å opprettholde den interne P-gjødsling
- Rask og vedvarende effekt av utsetting av gjørs (1981)
- Umiddelbar skremselseffekt som fikk cyprinider til å skifte habitat (til littoral)
- Langvarig effekt ved økt bestand av gjørs
- Gjørsen kom på rett sted til rett tid!

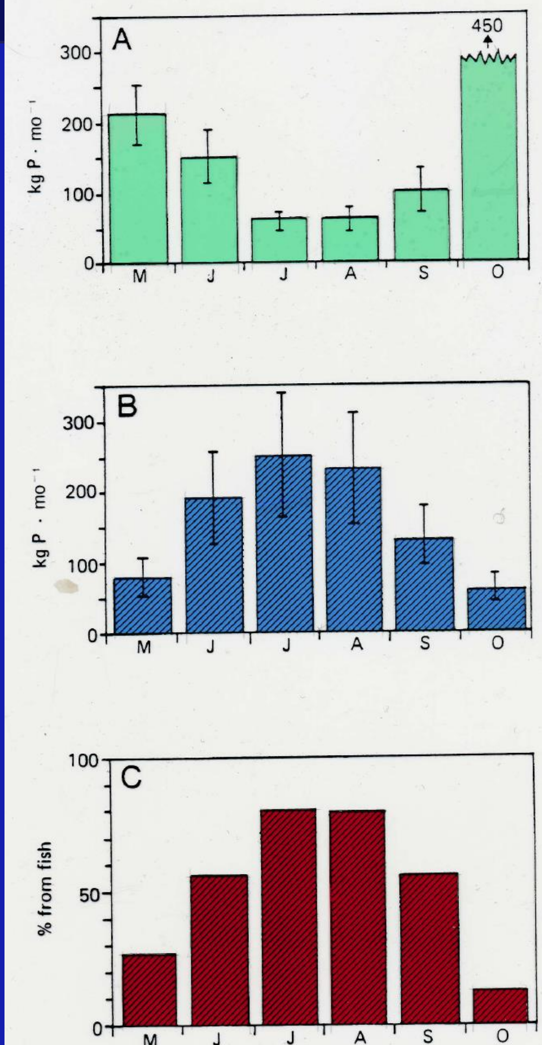


FIG. 4. Total phosphorus supply (kg·mo^{-1}) to Lake Gjersjøen. Standard deviation is shown. (A) Estimated external loading of phosphorus from the tributaries. (B) Total release of phosphorus (SRP) from roach biomass in Lake Gjersjøen. (C) Percentage contribution of phosphorus from fish to Lake Gjersjøen.