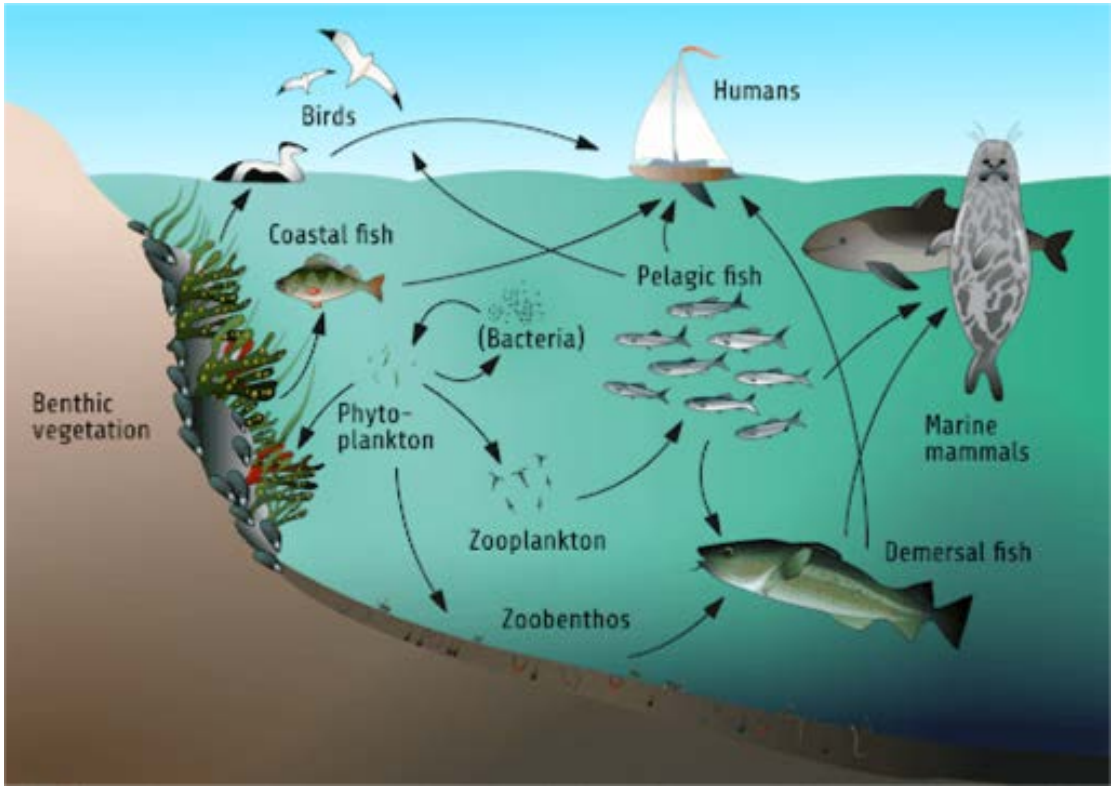
Födovävens allra minsta organismer

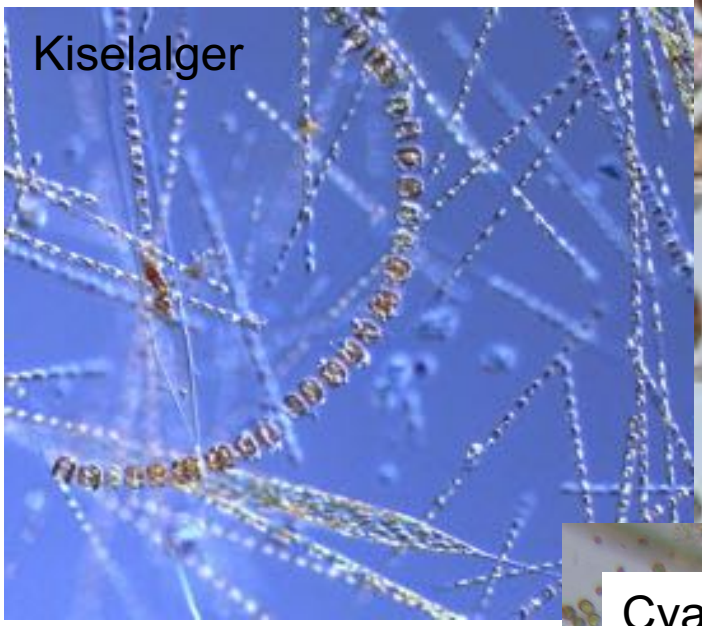


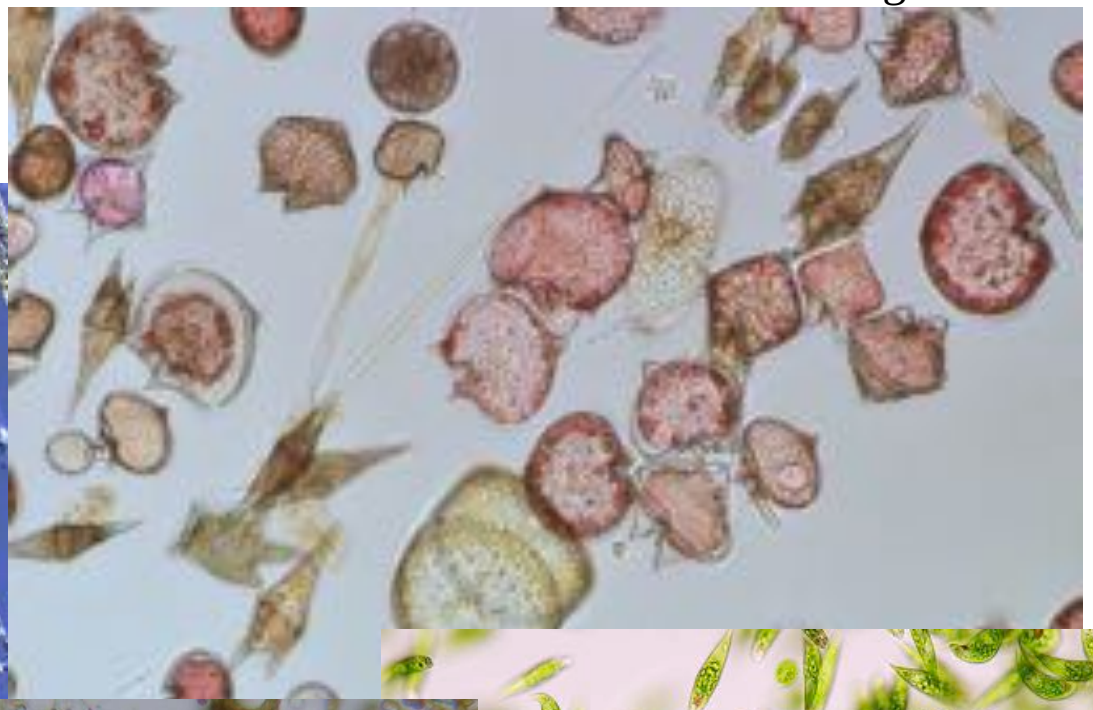
HELCOM

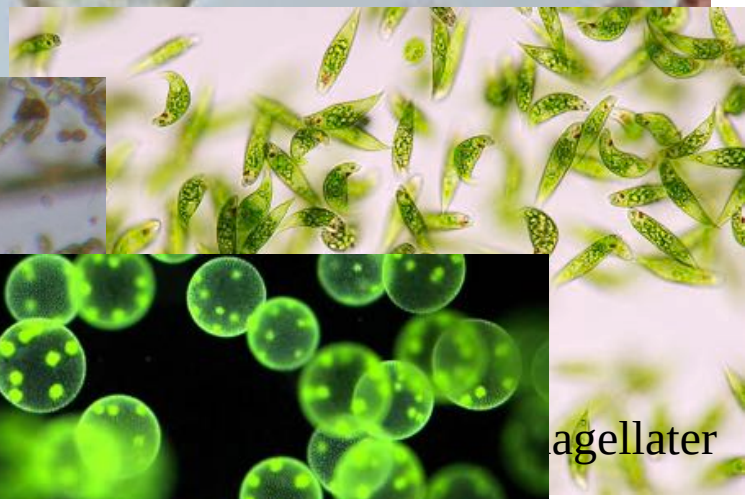
Linnæus University | Centre
Ecology and Evolution in Microbial model Systems

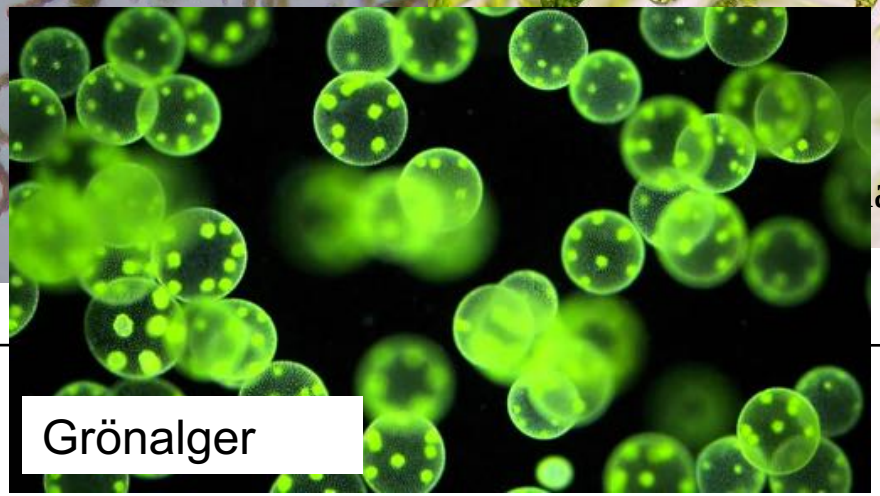
Elin Lindehoff, Docent & Lektor i marin ekologi
elin.lindehoff@lnu.se

Pansarflagellater





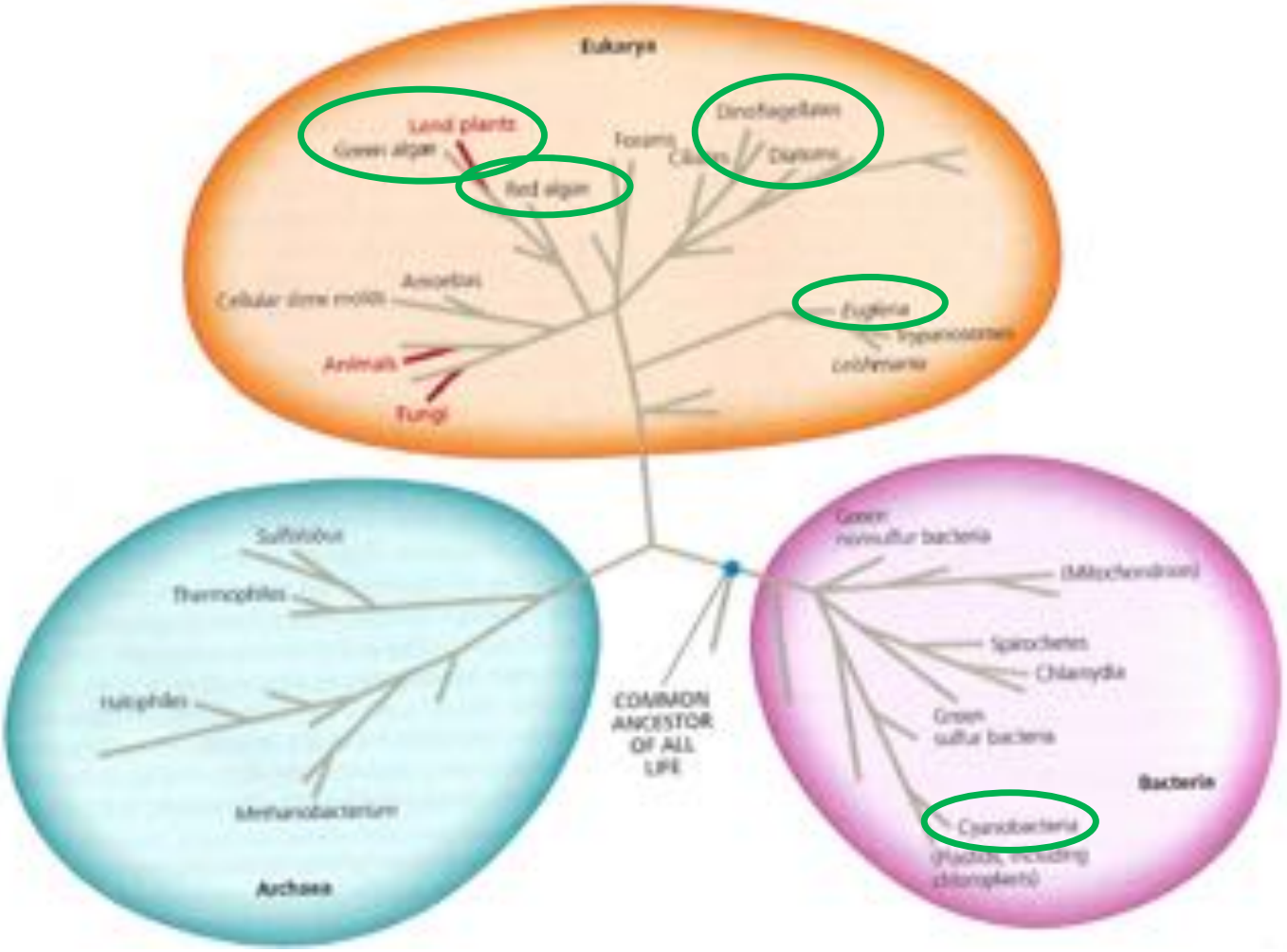




nordicmicroalgae.org

agellater

Livets tre domäner- vart hittar vi växtplankton?

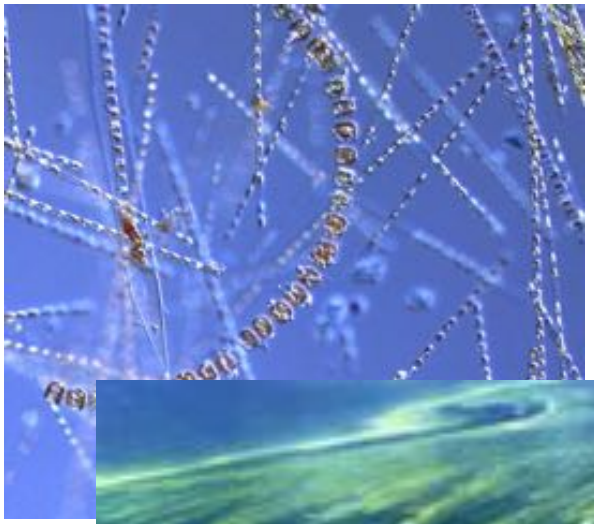


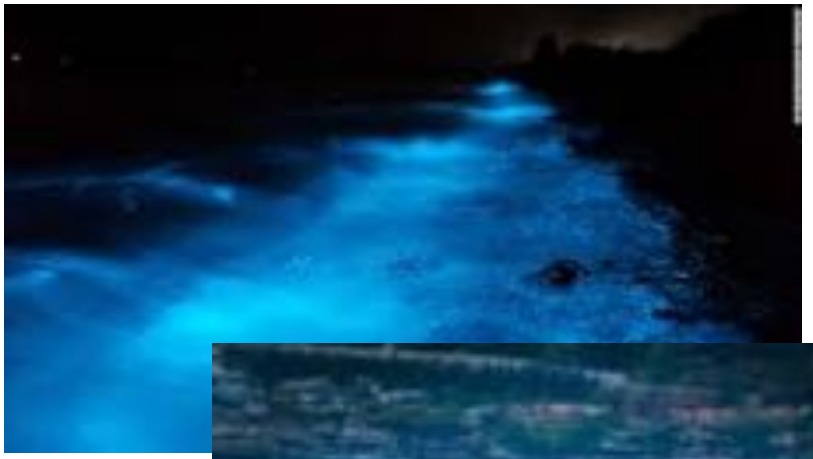
Djurplankton

Plankton chronicles. Link
https://www.youtube.com/playlist?list=PLMwQxJk6f6zGOHMbxhaKwG9CI6Z7_AFDS

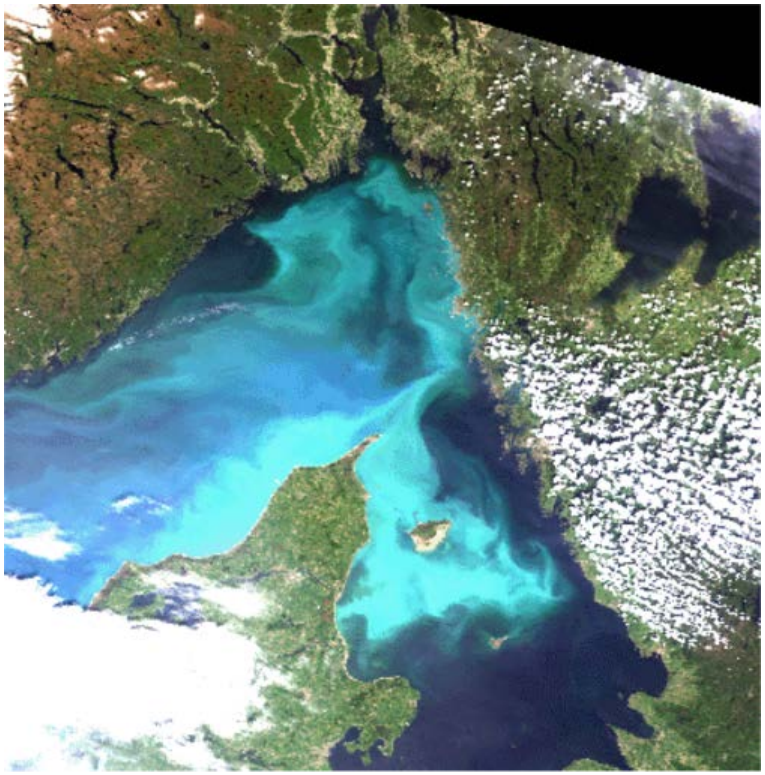
http://kingofwallpapers.com/zooplankton/zooplankton-002.jpg

Blomningar





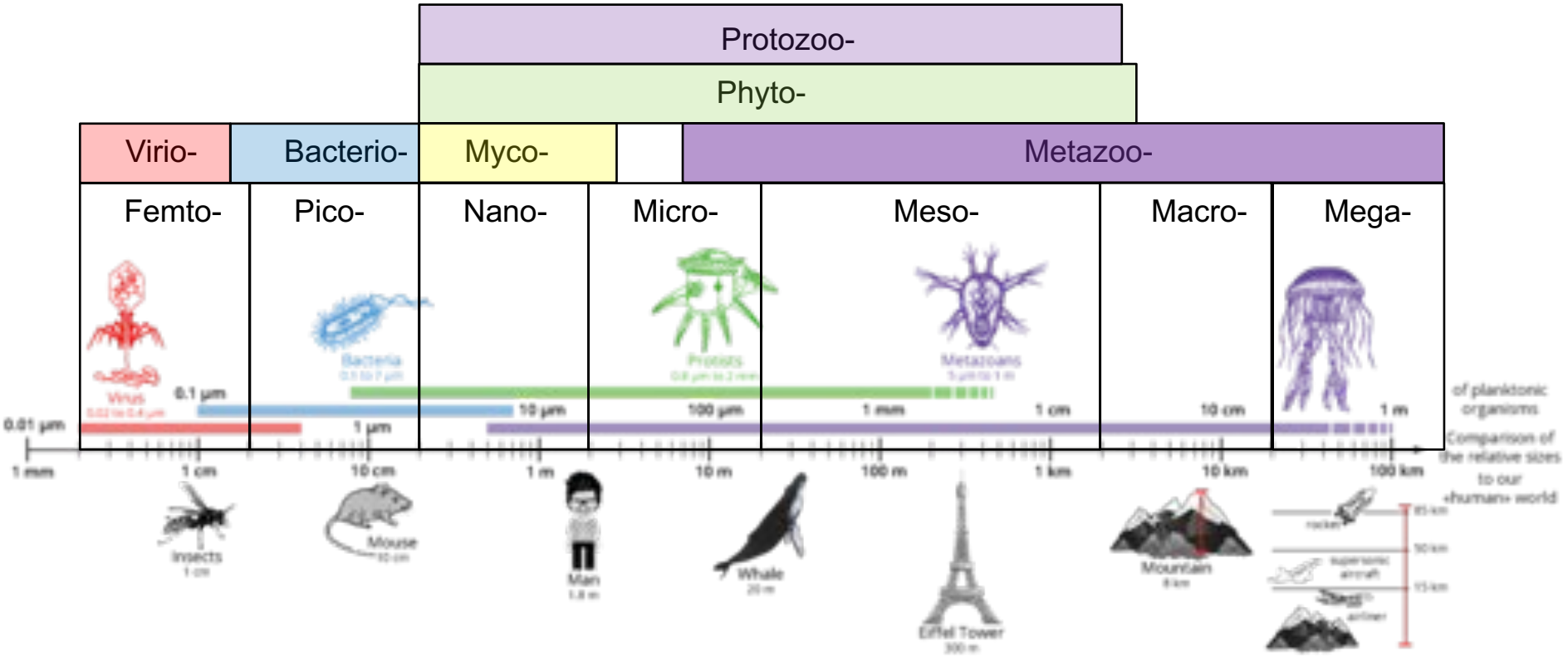
Blomningar



Emiliania huxleyi

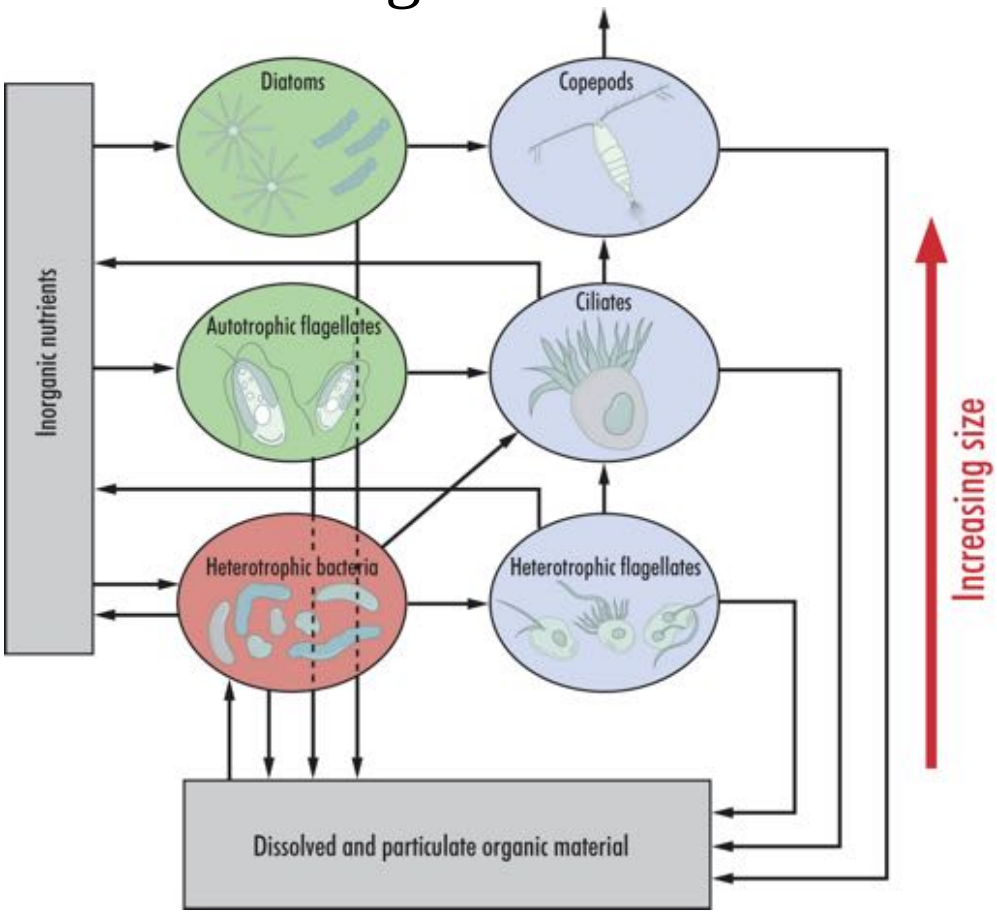
”Coccoliths”=organiska ”fjäll”
Inlagrade med $CaCO_3$, som omger cellen. Signifikant bidrag till att atmosfäriskt CO_2 ”begravs” i marina sediment och djupvatten.

Storleken avgör vem som äter vem
Size matters…



modified from http://planktonplanet.org

Storleken avgör vem-som –äter -vem



Autotrof- fotosyntes
Heterotrof –”äter” organiskt material
Mixotrof- både ock

All varianter kan finnas inom samma släkte

Courtesy U. Tillmann

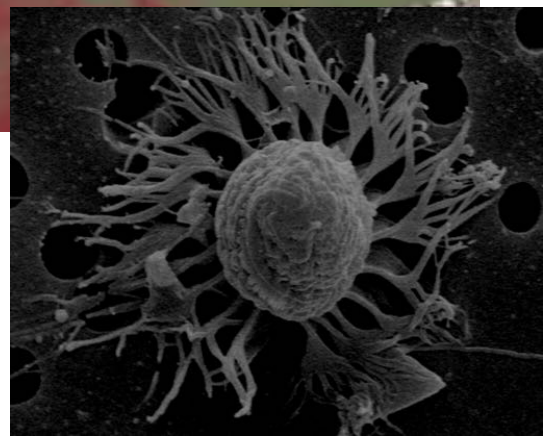
Ett plankton triangel-drama i tre akter

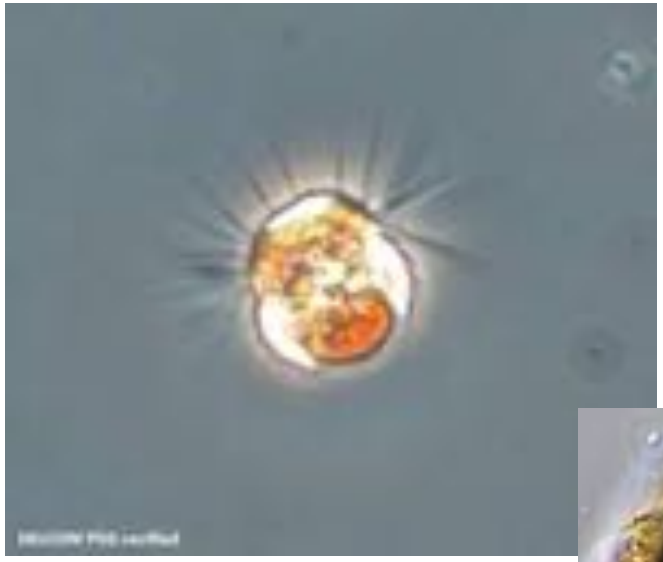
Det var en gång….

Blomning av ciliaten *Mesodinium rubrum*

Ciliaten
Mesodinium rubrum

Mixotrof
Kleptoplastider

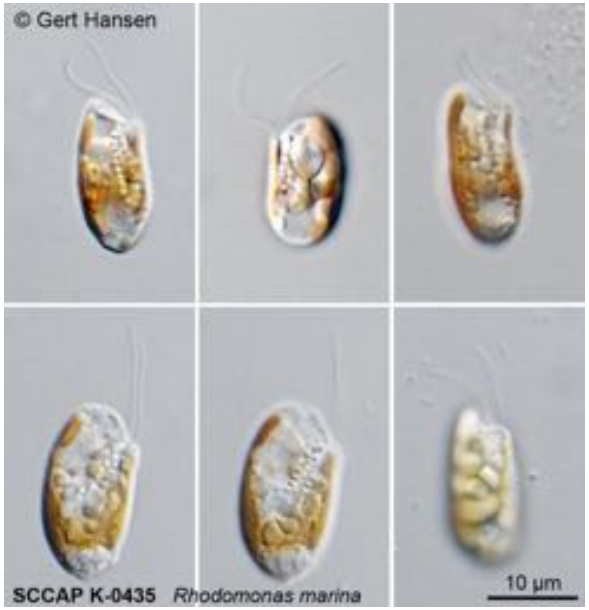




Global spridning, t.ex. Östersjön, Medelhavet, Atlanten, Asien, Antarktis….

Photos: havet.nu; nordicmicroalage.org; stcmop.org; flickr.com

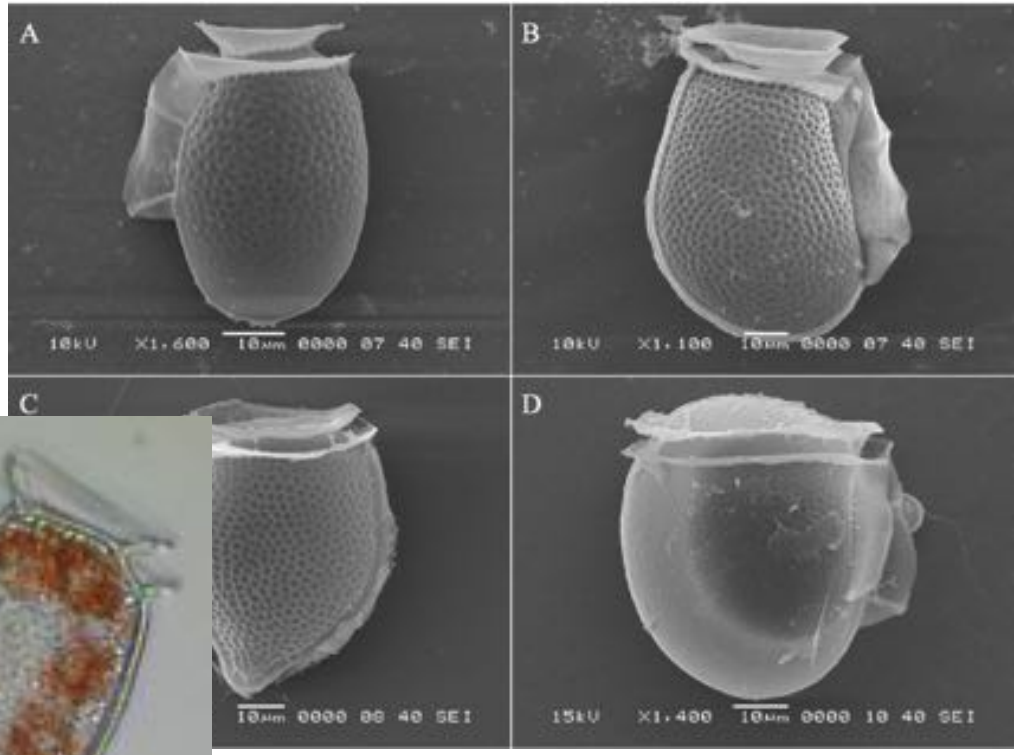
Rekylalgen
Fotoautotrof och bytet



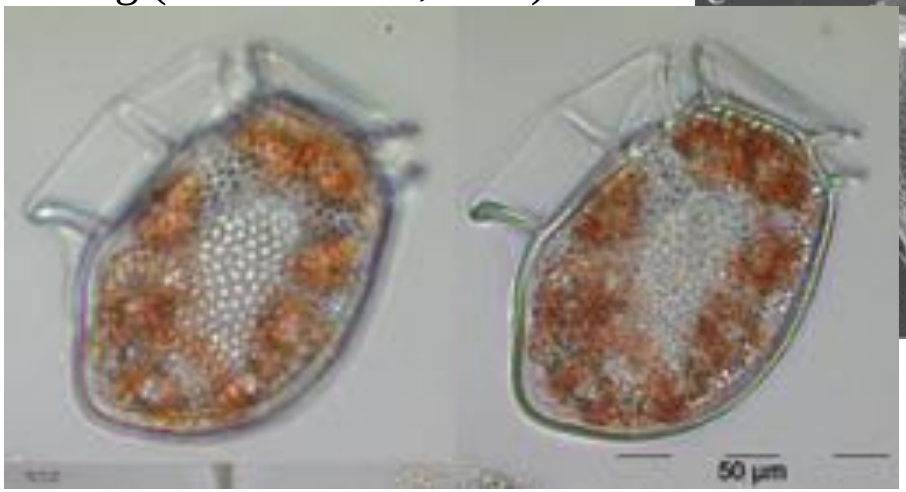
nordicmicroalgae.org

Pansarflagellaten (dinoflagellate) *Dinophysis*

Mixotrof
Kleptoplaster



Olika arter
Red tides – stor spridning, global
Giftig (Okadaic acid, DSP)



Trainer et al. 2013 Marine Drugs

Park et al. 2006 Aquatic Microbial Ecology

Östersjön

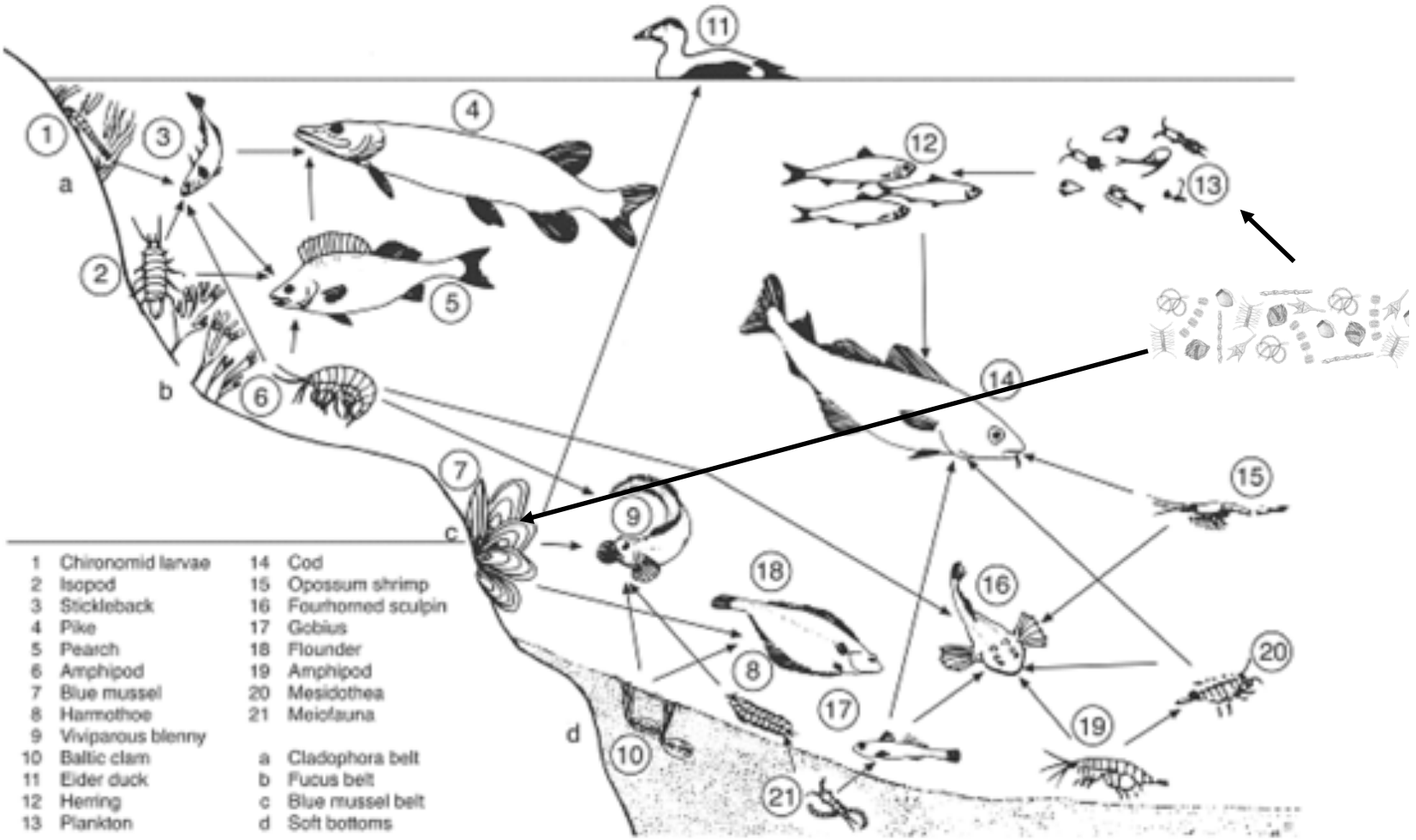
- ett unikt innanhav

Linnæus University | Centre
Ecology and Evolution in Microbial model Systems

Elin Lindehoff, Lektor i marin ekologi
elin.lindehoff@lnu.se

SeaWiFS Project, NASA

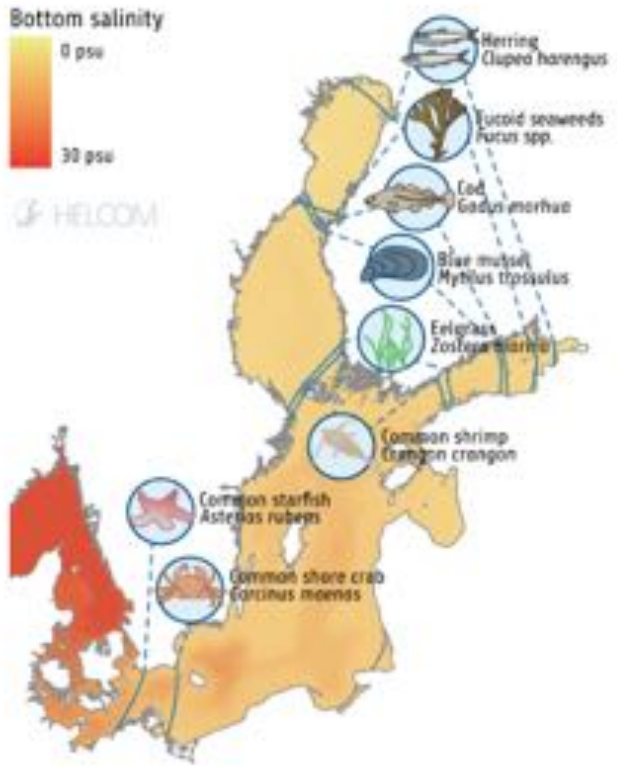
Artfattigt men produktivt och känsligt



Gradient i salthalt…

…från norr till söder

Arter har koloniserat från sött eller salt



Växt- och djurplankton över säsongen

Vårblomning, kiselalger
Thalassiosira baltica, Chaetoceros sp.

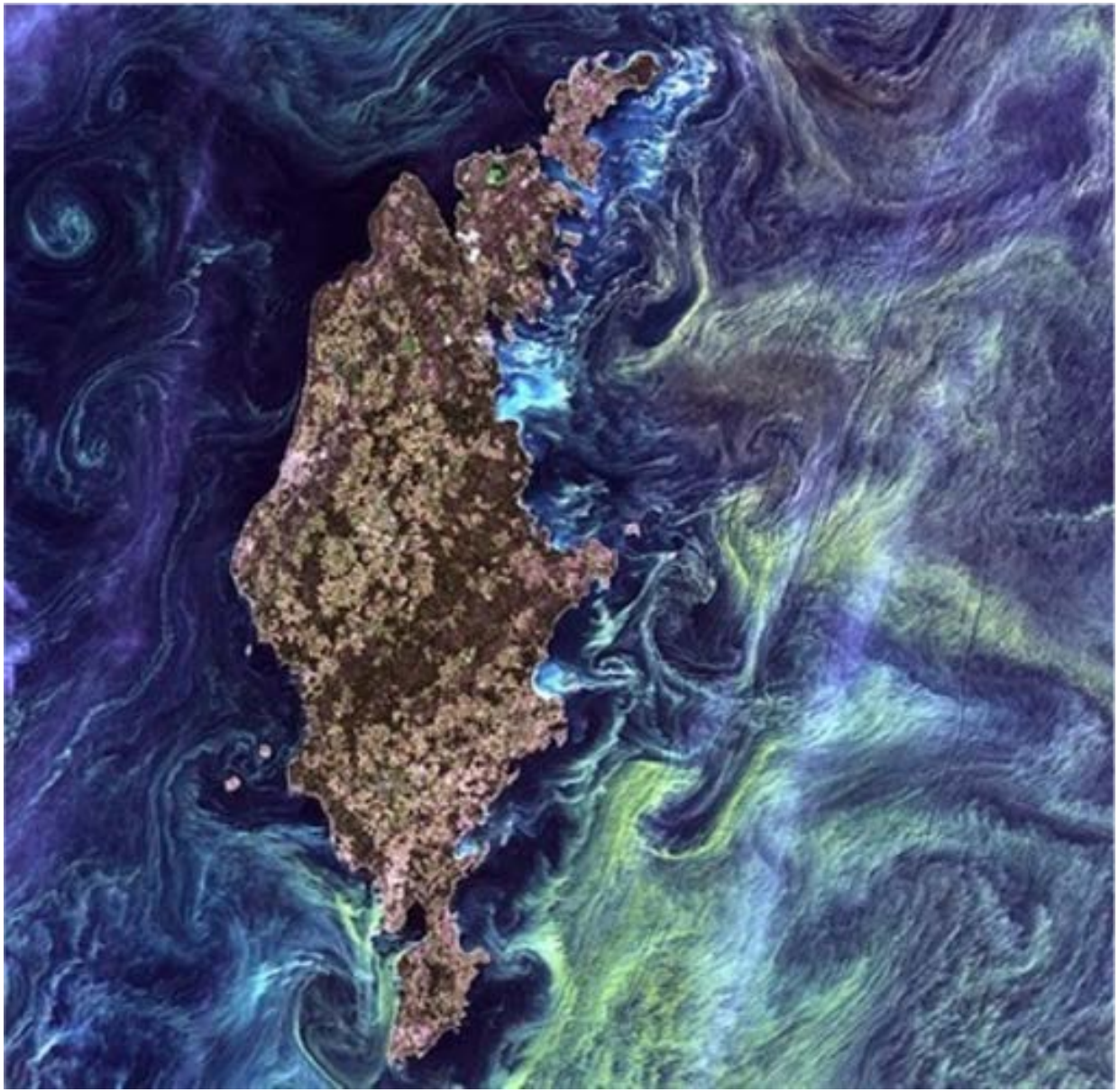
Betare, hopp-hinnkräftor
Acartica sp., Podon sp.

Höstblomning, flagellater
Dinophysis norvegica, Ceratium sp., Alexandtrium tamarense

Sommarblommning, cyanobakterier
Nodularia spumigena

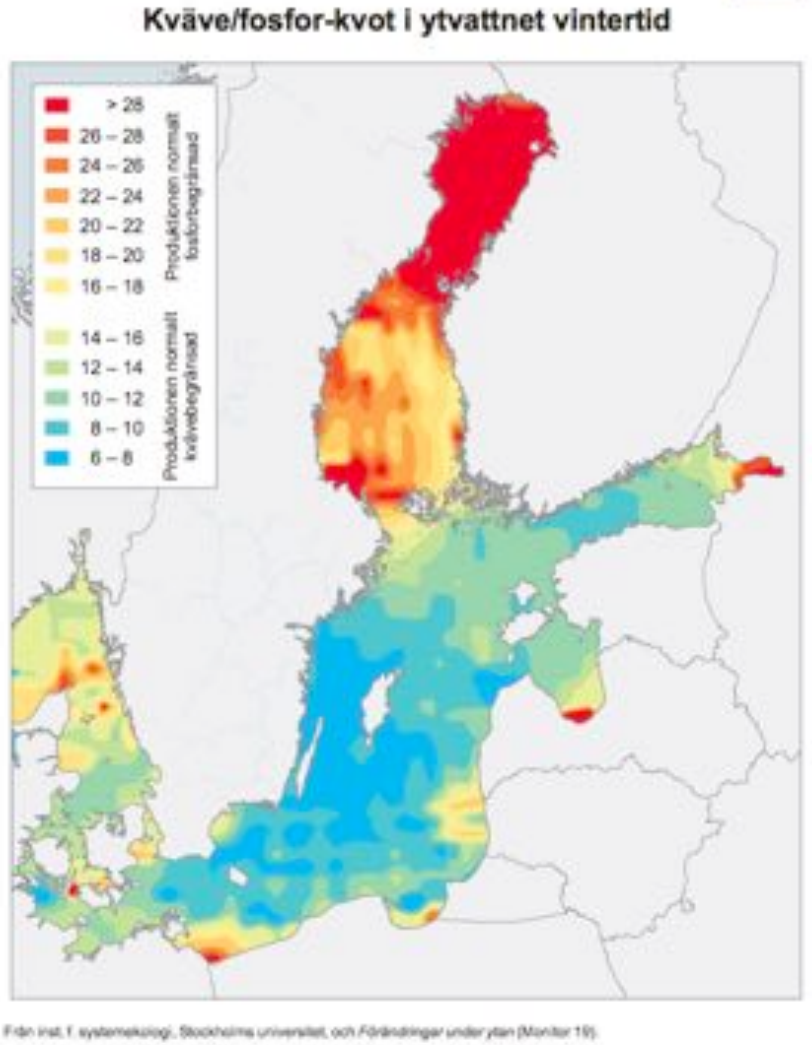
Kaiser et al. 2011
Havet.nu

Linnæus University | Centre
Ecology and Evolution in Microbial model Systems



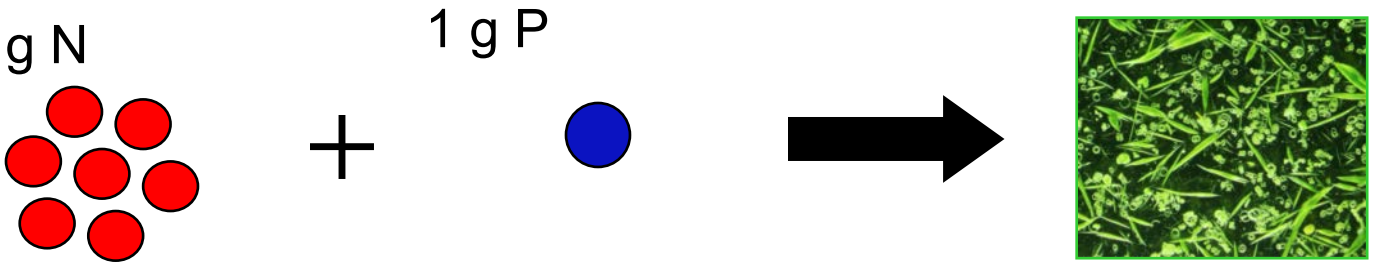
SeaWiFS Project, NASA

Egentliga Östersjön är kvävebegränsad

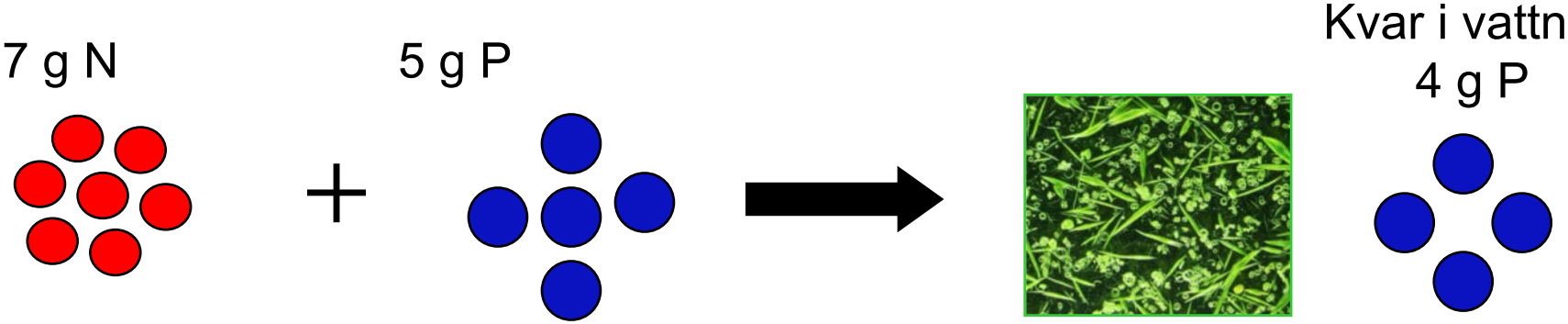


Från inst. f. systemekologi, Stockholms universitet, och *Förändringar under ytan* (Monitor 19).

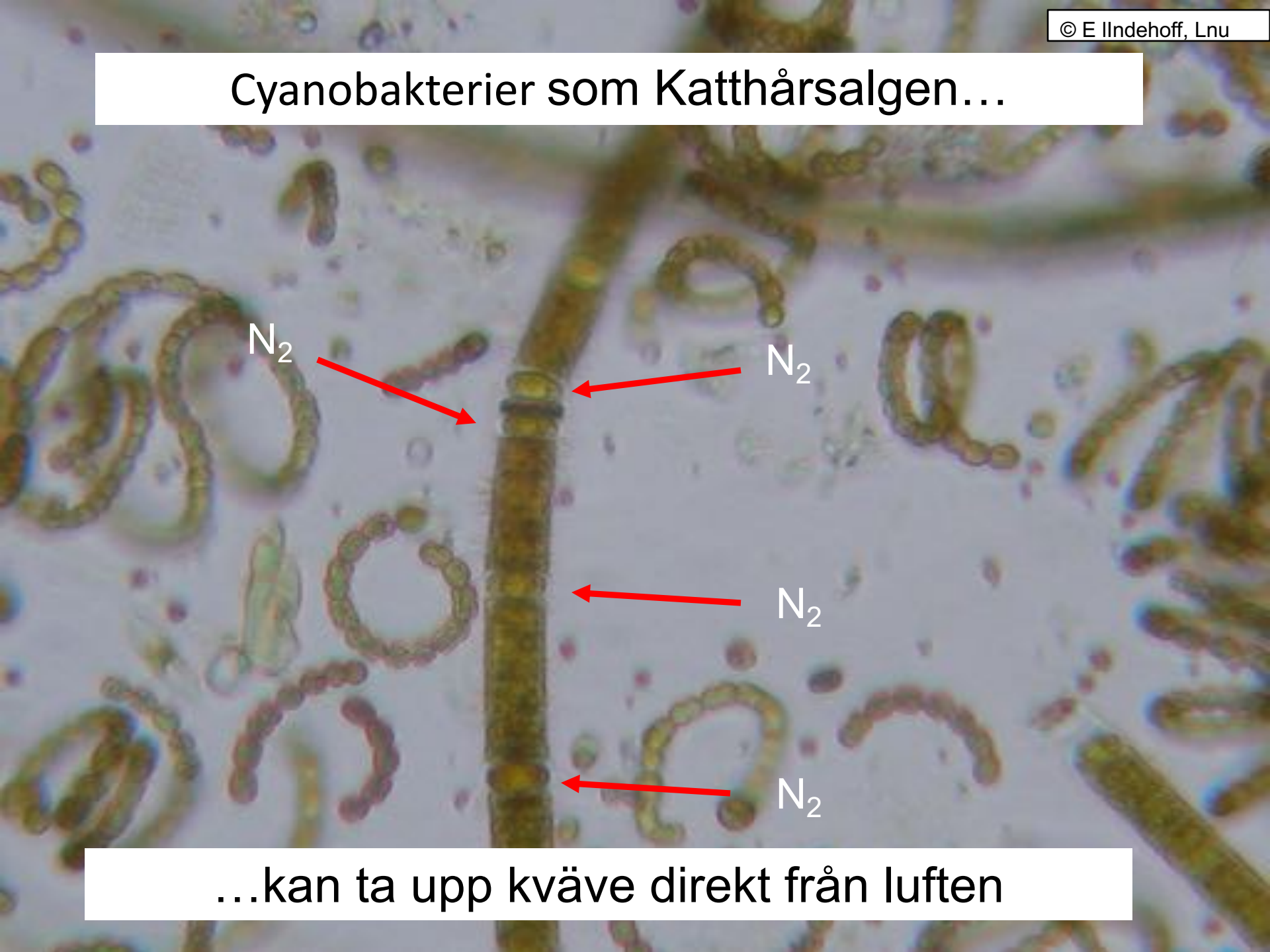
Växtplankton behöver:



I egentliga Östersjön:

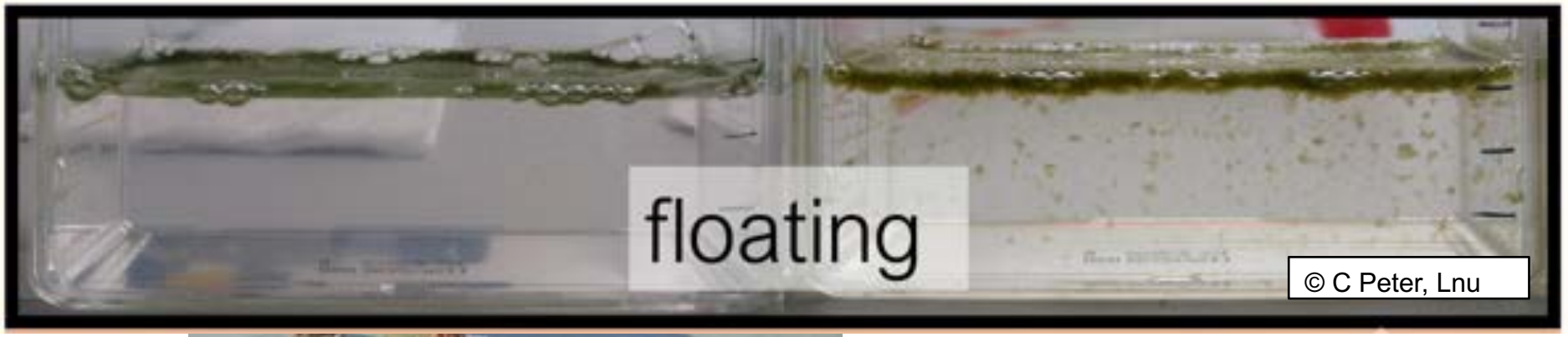


Cyanobakterier som Katthårsalgen…



…kan ta upp kväve direkt från luften

….hur blev det så här?



Linnæus University | Centre
Ecology and Evolution in Microbial model Systems

Elin Lindehoff, Lektor i marin ekologi
elin.lindehoff@lnu.se

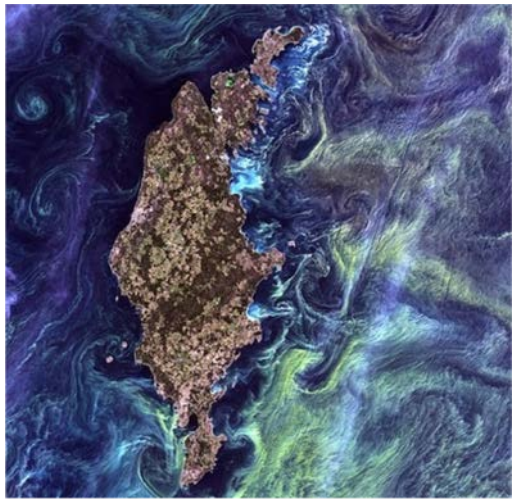
Medeldjup: 56 m
Max djup: 459 m
Brackvattenhav: 1-26 psu

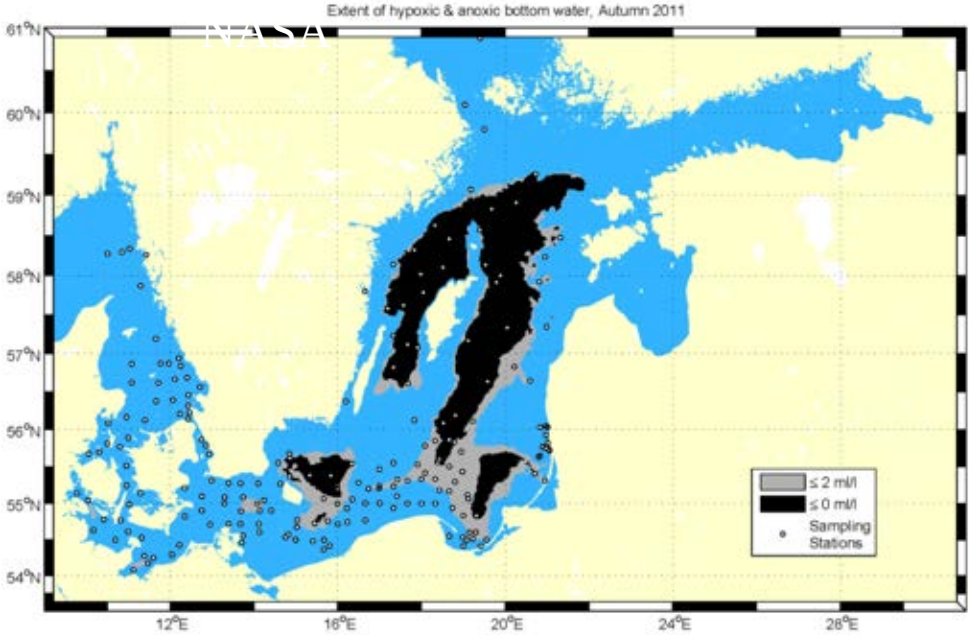
Avrinningsområdet:
14 länder
85 miljoner människor

#1. Övergödning

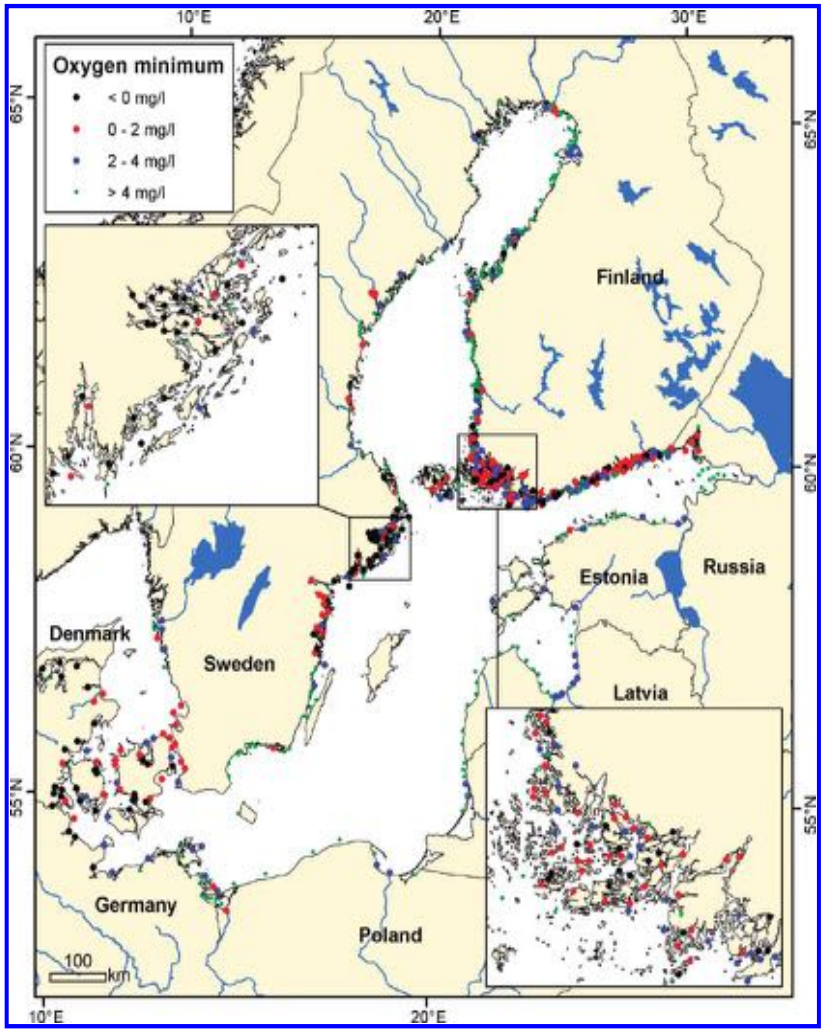
Utsläpp av kväve, fosfor
från mänskliga aktiviteter

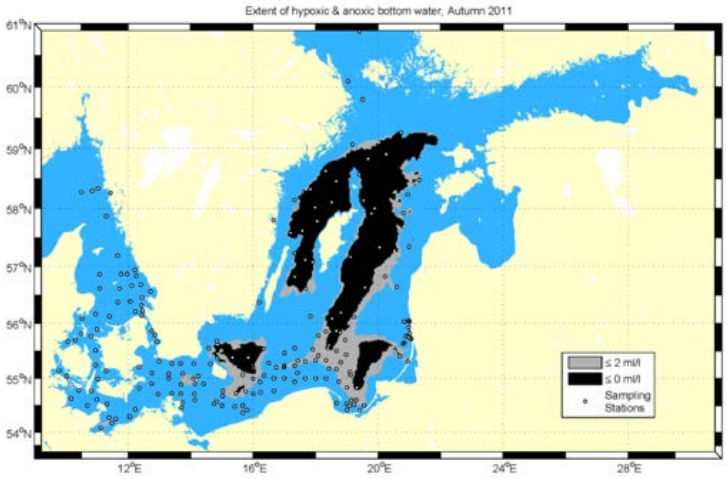
Algblomning
Syrebrist





SMHI



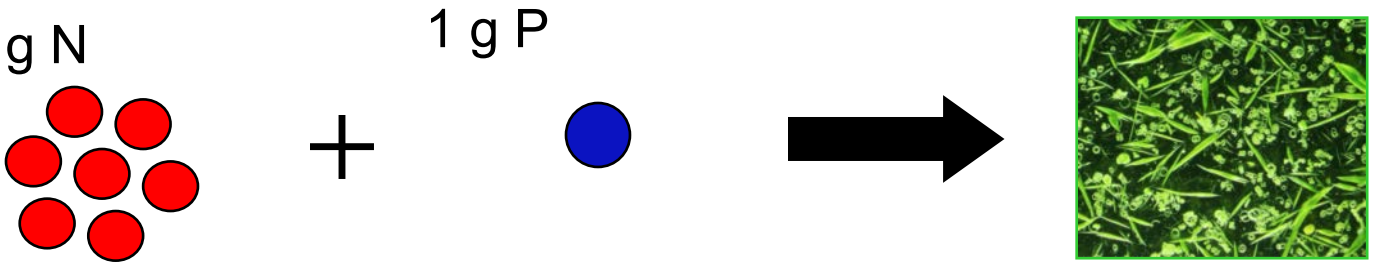


SMHI

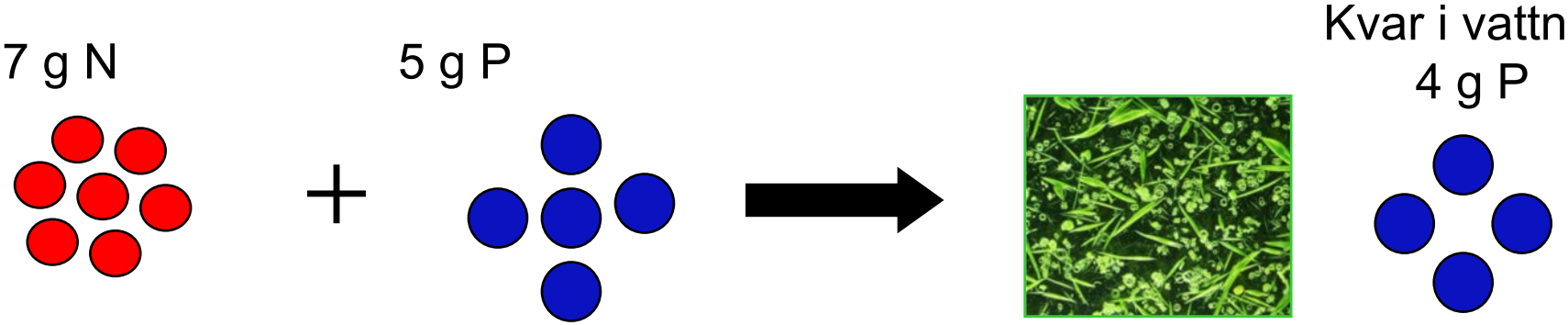
Figure 1. Lowest recorded oxygen concentration at all monitoring locations throughout the period (1955−2009) in the entire Baltic Sea with insets for the Stockholm Archipelago (upper left) and the Finnish Archipelago Sea (lower right). Oxygen concentrations in bottom waters was divided into four categories (<0 mg L^{-1}, 0−2 mg L^{-1}, 2−4 mg L^{-1}, >4 mg L^{-1}). Oxygen concentrations <0 mg L^{-1} are anoxic, 0−2 mg L^{-1} are considered hypoxic by definition, and 2−4 mg L^{-1} are considered oxygen stressed.[26]

Conley, Env. Sci. Tech., 2011

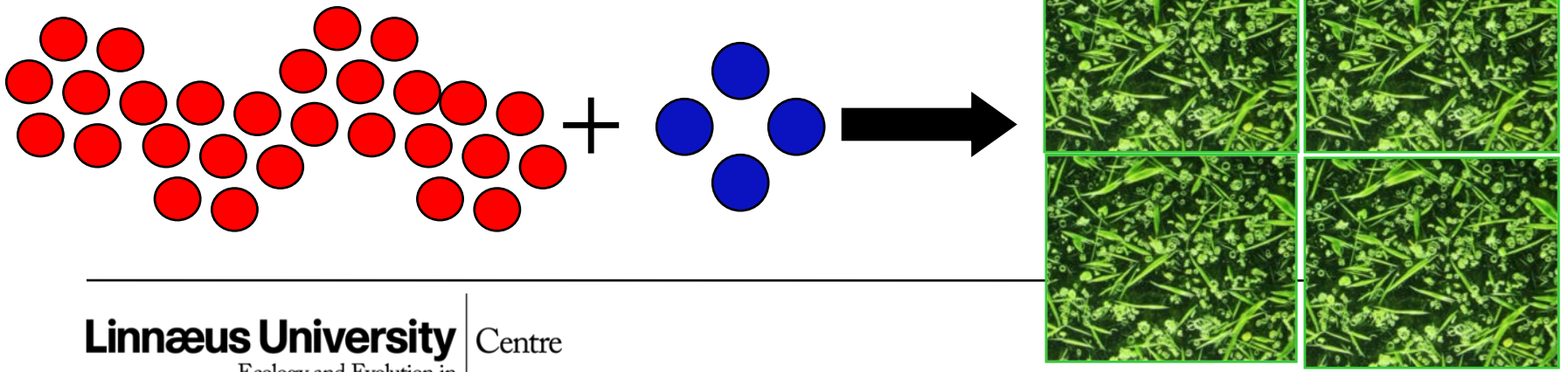
Alger behöver:

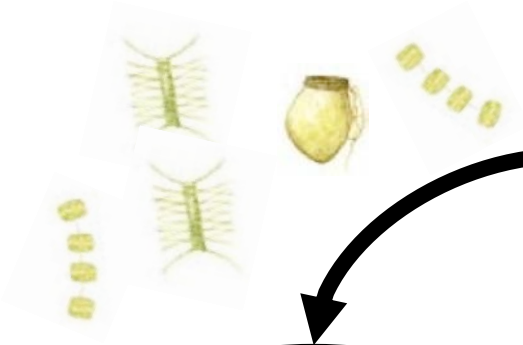


I egentliga Östersjön:

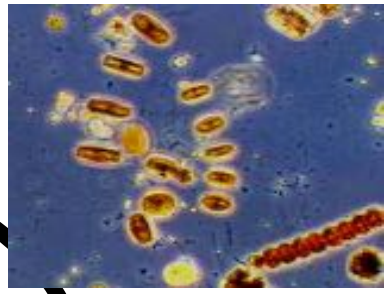


Tillsätter vi kväve får vi alger x 4





Omfattande vårblomning



Höga kväve halter

N_2 fixering

Omfattande blomningar av cyanobakterier

Utsläpp av fosfor

Syrefria bottnar

Östersjöns onda cirkel

Vad ska bort, kväve eller fosfor?

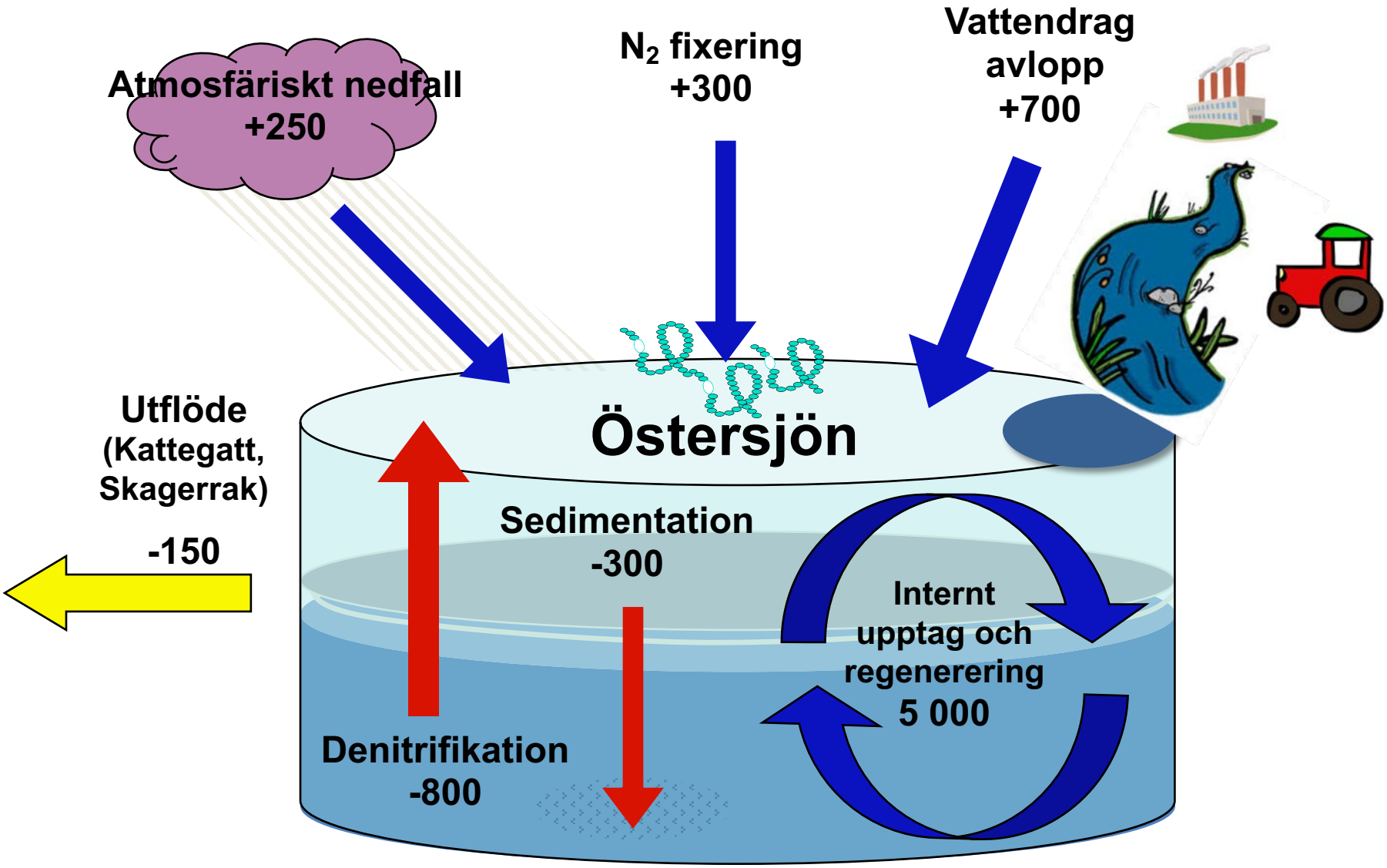
Fosfor

- Cyanobakterier tar ju upp kväve från luften.
- Ändlig resurs

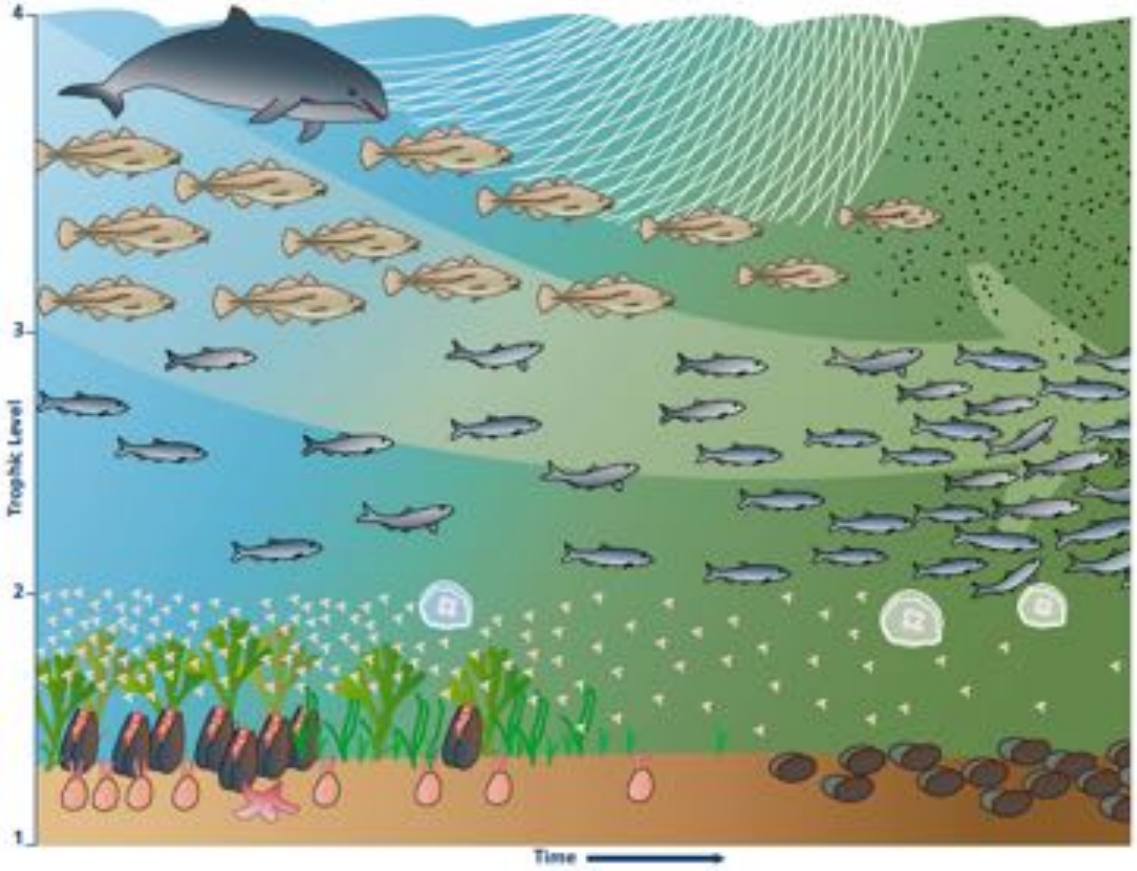
Kväve

- Minskar hela algbiomassan
- Minskar syrefria bottnar
- Minskar fosforutsläpp

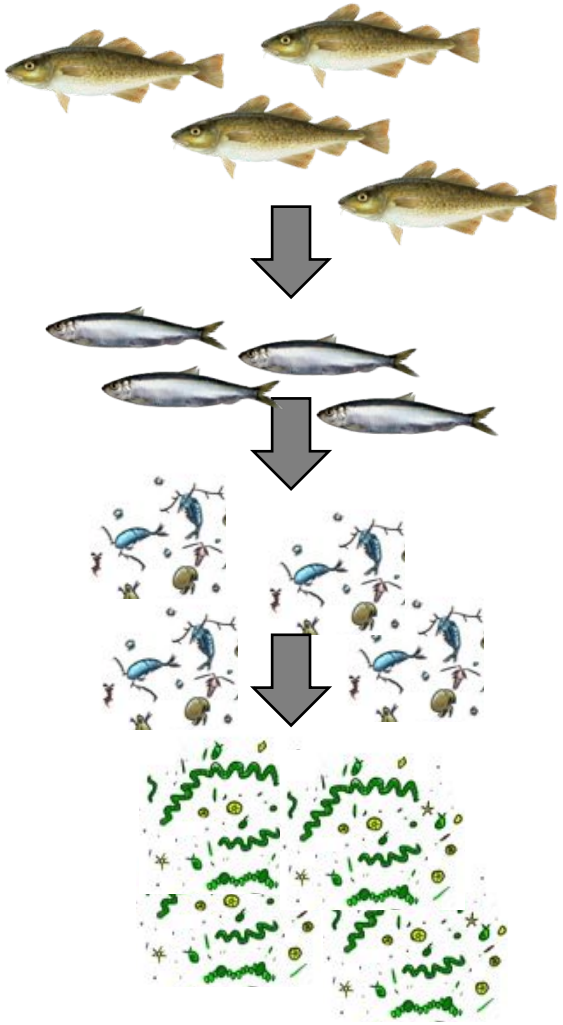
Kvävebudget för Östersjön (1000 Ton/år)

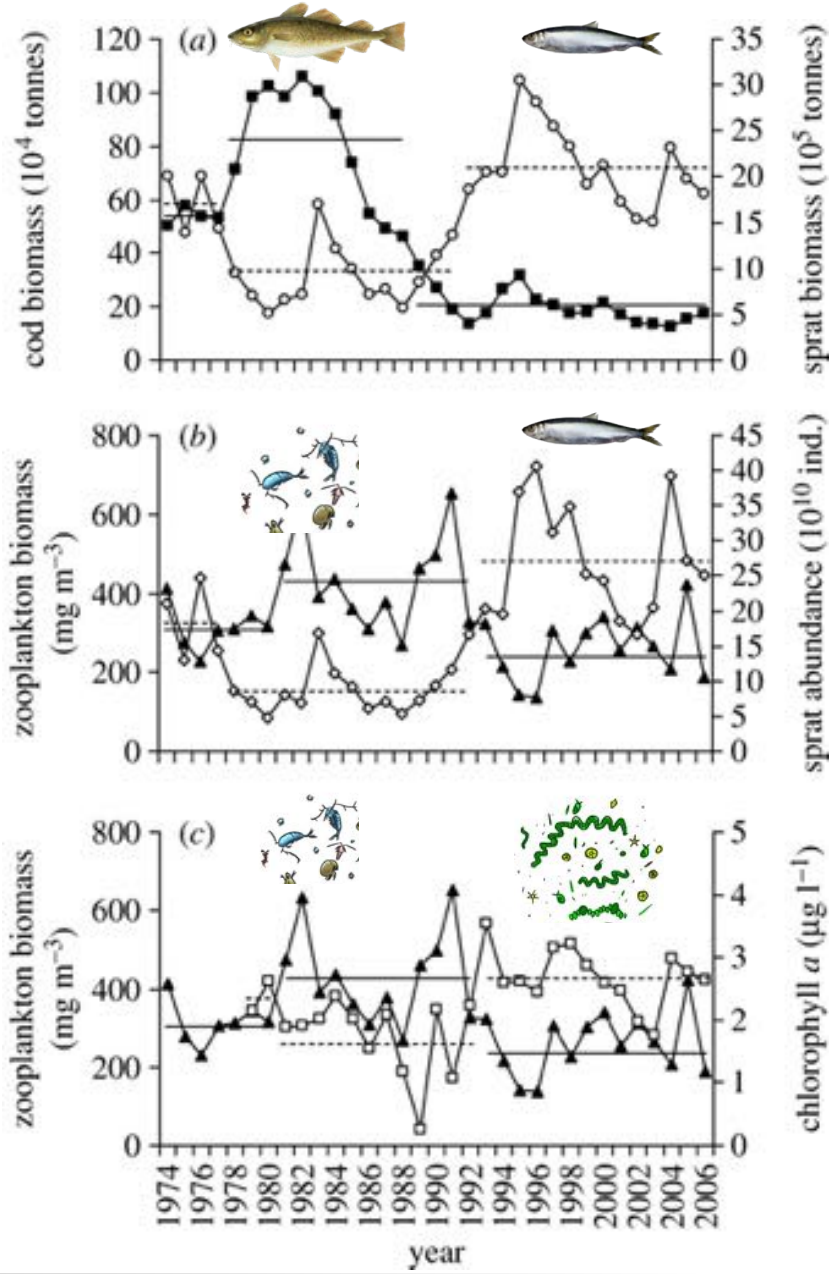


#2. Överfiske



Trofiska interaktioner



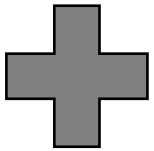


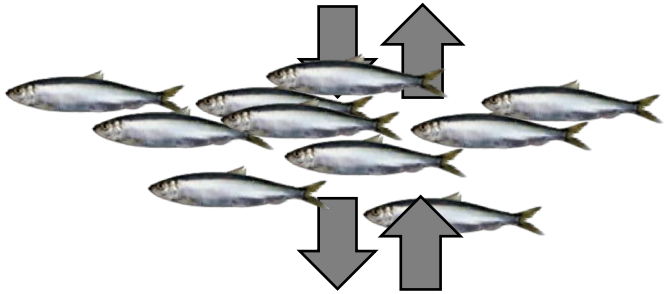
http://www.wardfish.com/wp-content/uploads/2015/08/herring.jpg
http://www.wardfish.com/wp-content/uploads/2015/08/images/certified-species/cod-atlantic

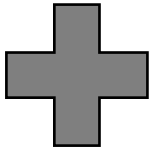
Modified from Casini et al. 2008

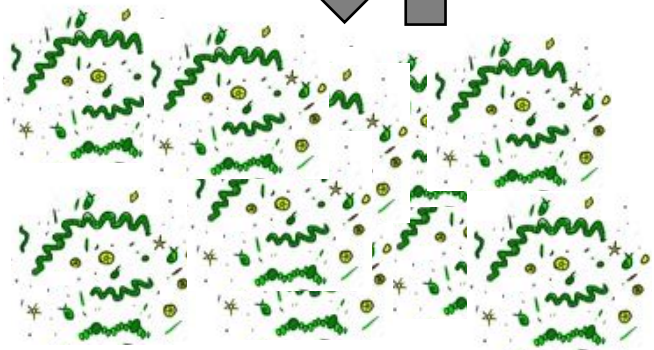
Trofiska interaktioner

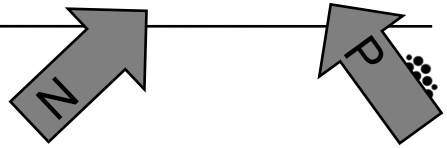
- Störningar (t.ex. Överfiske) kan leda till trofiska kaskader
- Kollaps av torskpopulationen
- “Top-down” och “bottom-up”







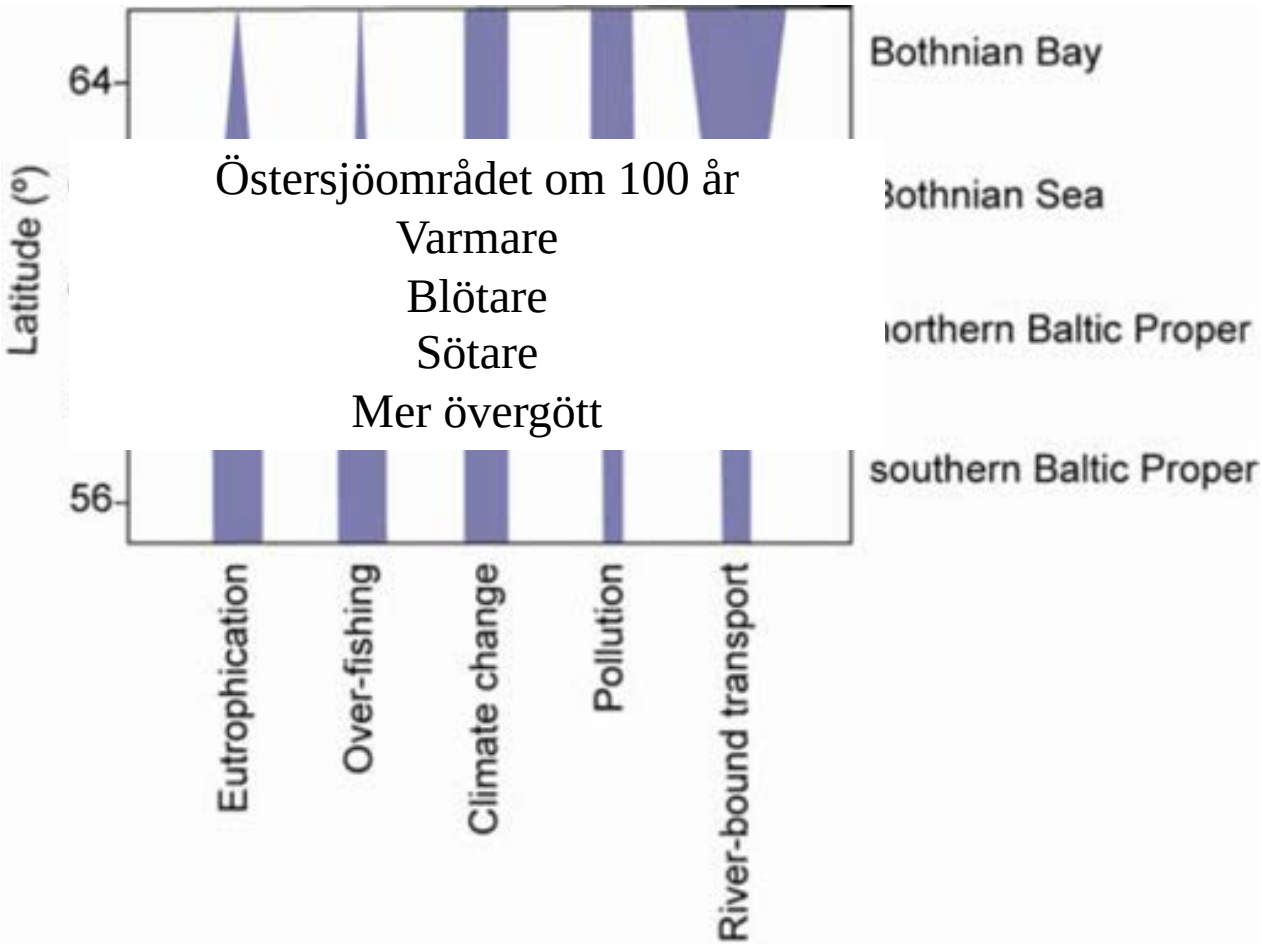




https://www.msc.org/multimedia/images/certified-species/cod-atlantic

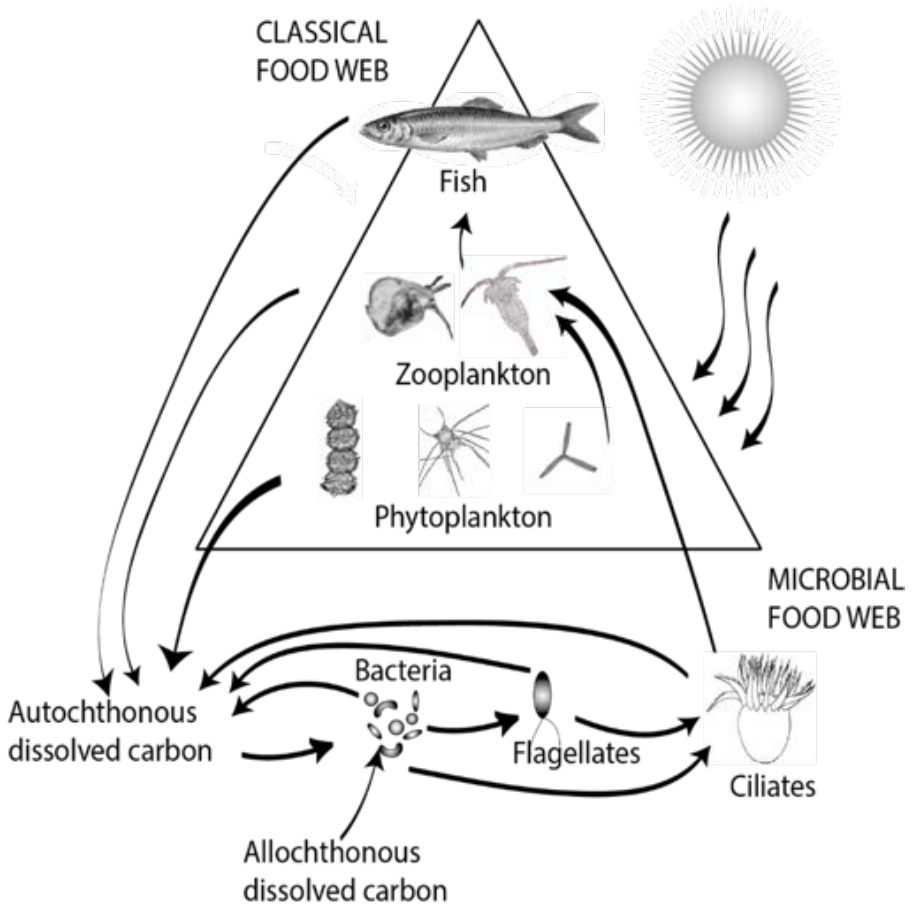
Modified from Casini et al. 2008

Miljöhot- regionala skillnader



Östersjöområdet om 100 år
Varmare
Blötare
Sötare
Mer övergött

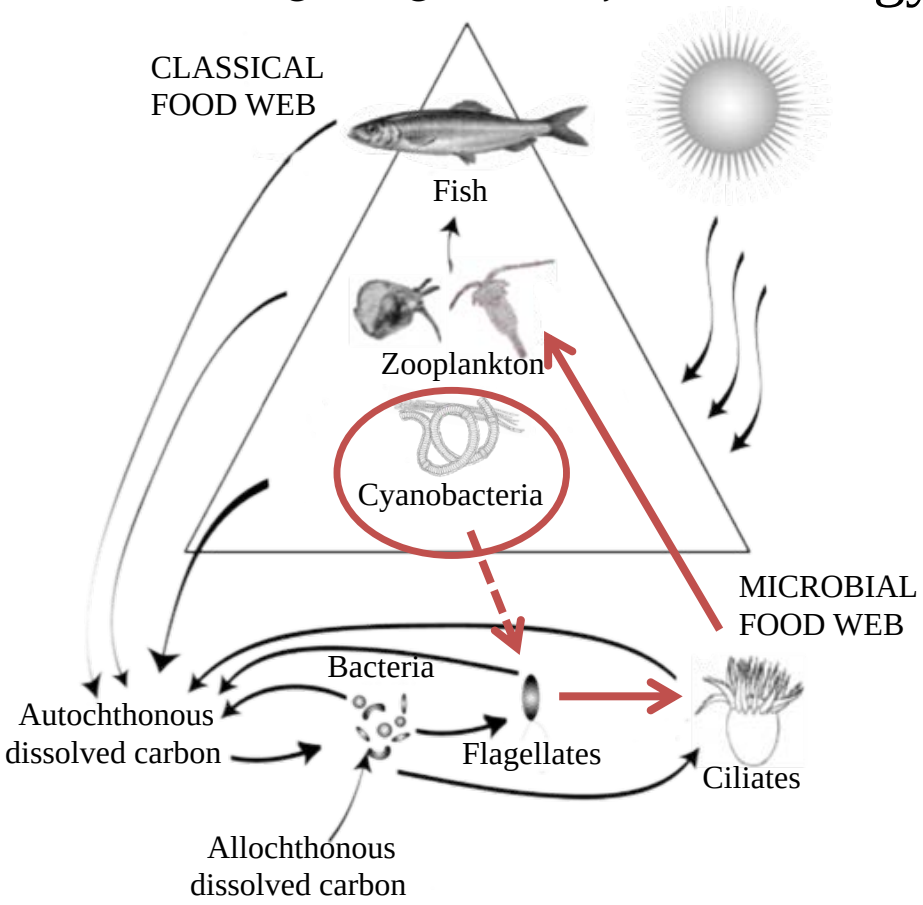
Födovävseffektivitet



- I varje trofiskt steg försvinner upp till 90% av energin
- Underhåll (värme, metabolism, tillväxt) och reproduktion

Födovävseffektivitet:
FWE= Prod top/Prod bas

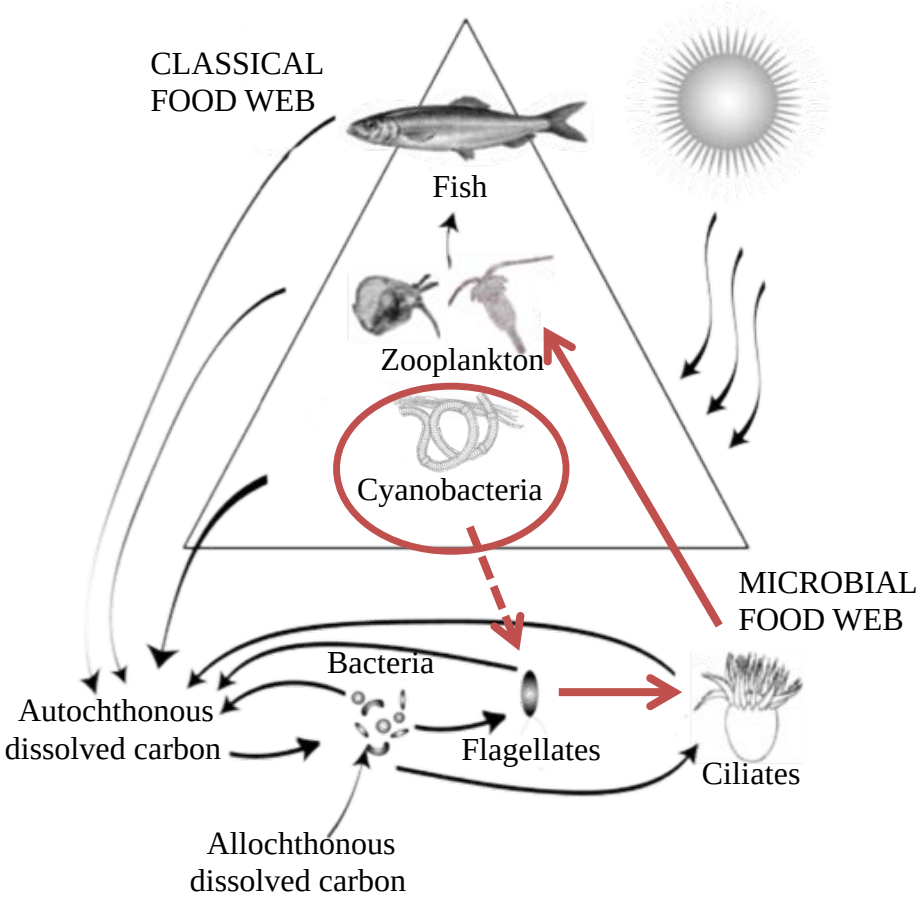
Mer cyanobakterier – gynnas av ökad temperatur



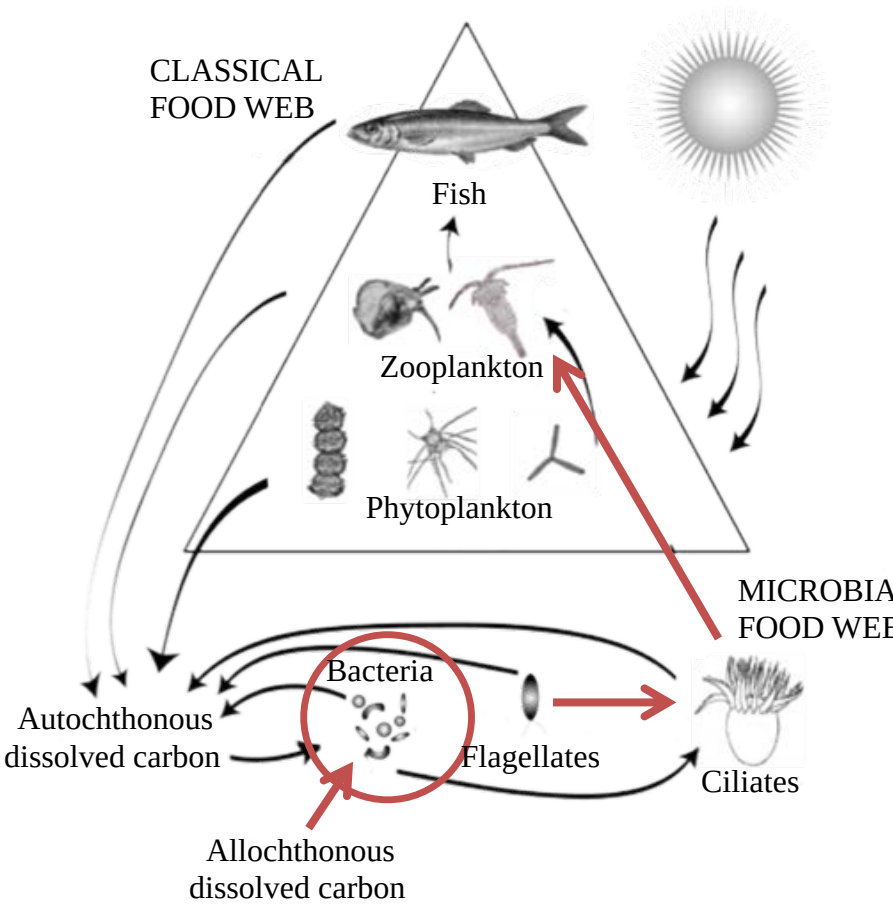
- I varje trofiskt steg försvinner upp till 90% av energin
- Underhåll (värme, metabolism, tillväxt) och reproduktion

Fler trofinivåer = minskad födovävseffektivitet

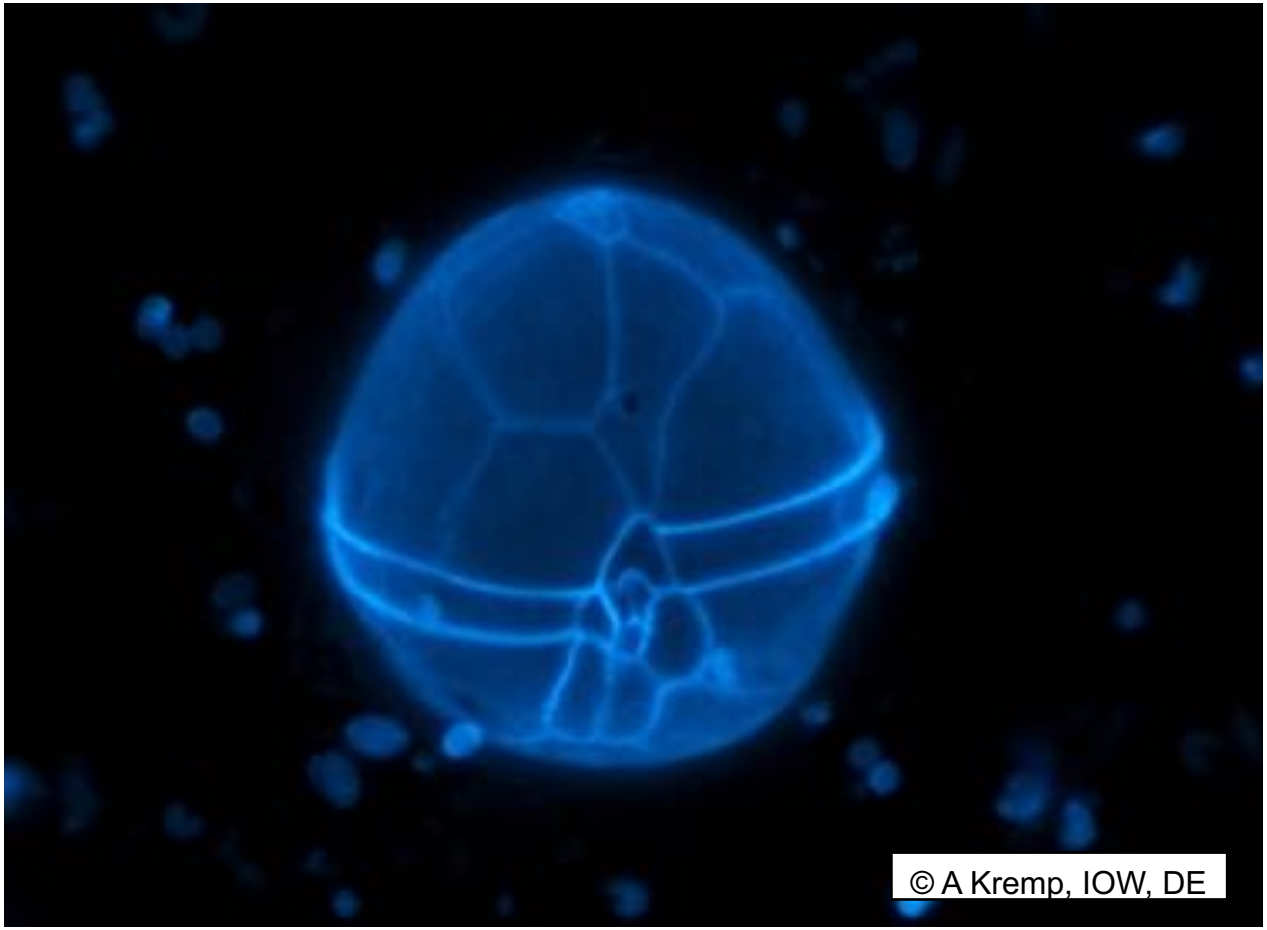
Egentliga Östersjön



Bottniska viken



Andersson et al. 2015, AMBIO



Alexandrium ostenfeldii
Pansarflagellat, Östersjön

Linnæus University | Centre
Ecology and Evolution in Microbial model Systems

Elin Lindehoff, Docent & Lektor i marin ekologi
elin.lindehoff@lnu.se