Harm van der Geest

- UD Benthische ecologie

H.G.vanderGeest@uva.nl

NIBI conferentie 12 januari 2013

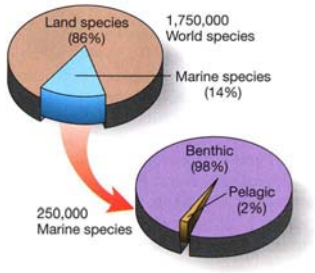


Figure 13–6 Distribution of species on Earth.

Of the 1,750,000 known species on Earth, 86% inhabit land environments and 14% inhabit the ocean. Of the 250,000 known marine species, 98% inhabit the benthic environment and live in or on the ocean floor, while only 2% inhabit the pelagic environment and live within the water column as either plankton or nekton.

lugworm

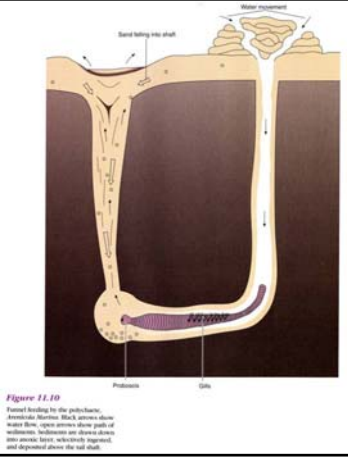


Figure 11.10

Funnel feeding by the polychaete, *Arenicola Marina*. Black arrows show water flow, open arrows show path of sediments. Sediments are drawn down into anoxic layer, selectively ingested, and deposited above the tail shaft.

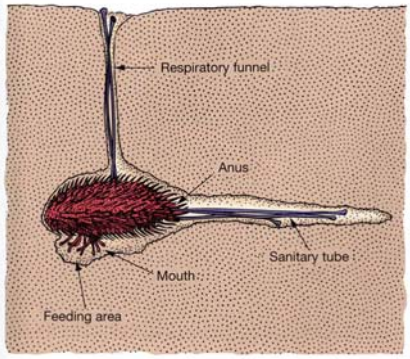
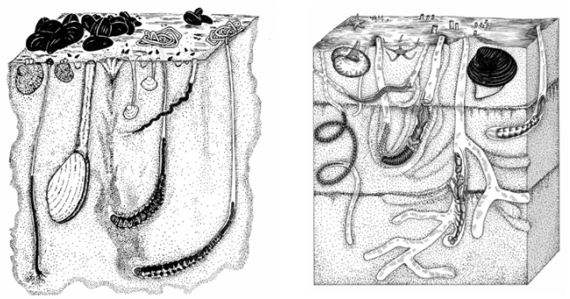


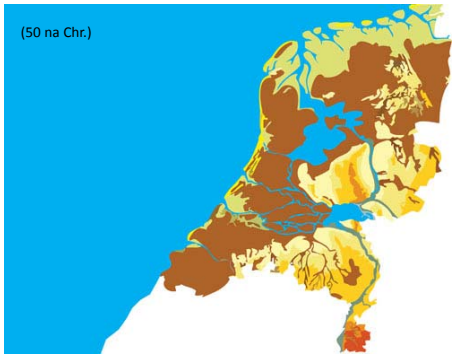
Figure 16–12 Heart urchin.

Feeding and respiratory structures of a heart urchin (*Echinocardium*), which feeds on the film of organic matter that covers sand grains.



Nederland waterland

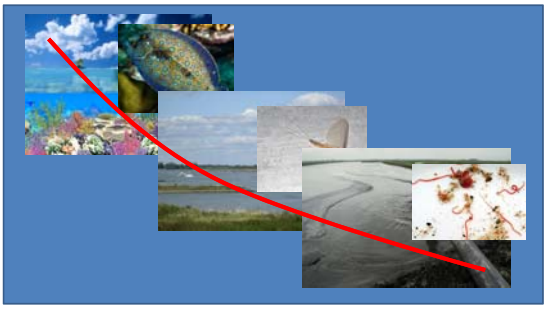
Leven in de delta ...



NEDERLAND LEEFT MET WATERBODEMS

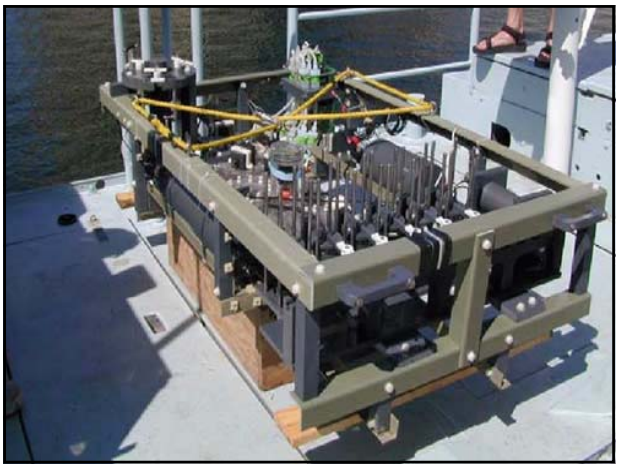
Een land rijk aan water, is een land rijk aan waterbodem
(Kabinetsstandpunt waterbodem, 2005)

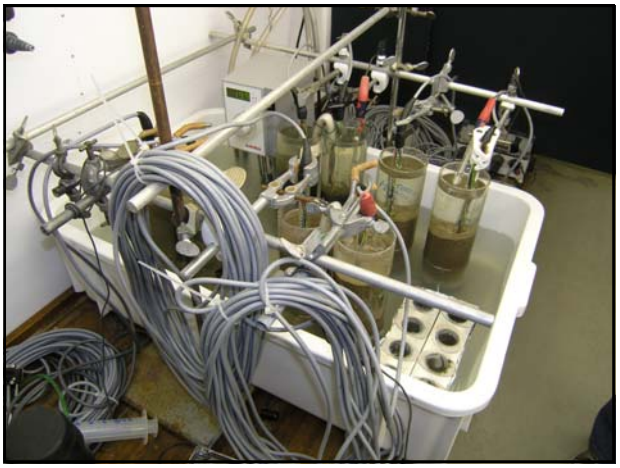
Mijn loopbaan in de benthische ecologie

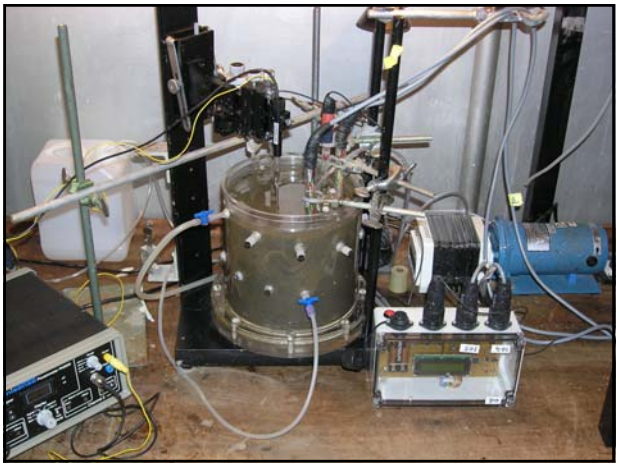


1996 nu


VIKING







Waterbodems van dichtbij...

Vandaag...

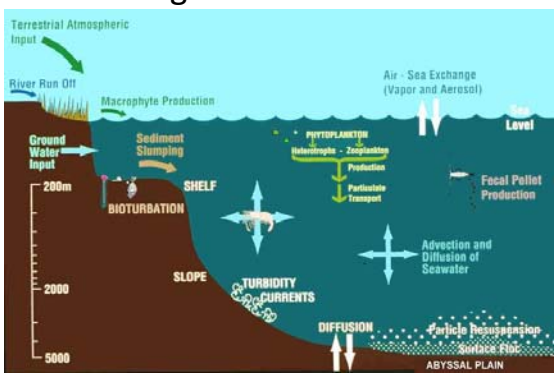
- Processen
- Dynamiek
- Biodiversiteit en landschap
- In de klas

biogeochemische kringloop

www.woorden-boek.nl

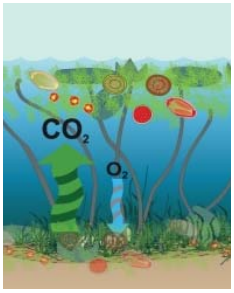
continue stroom van stoffen en energie door de levensgemeenschap heen, die zijn oorsprong vindt in het abiotische milieu en daar weer naar terugvloeit; deze stroom verloopt via de voedselketens.

Organisch materiaal



Afbraak OM

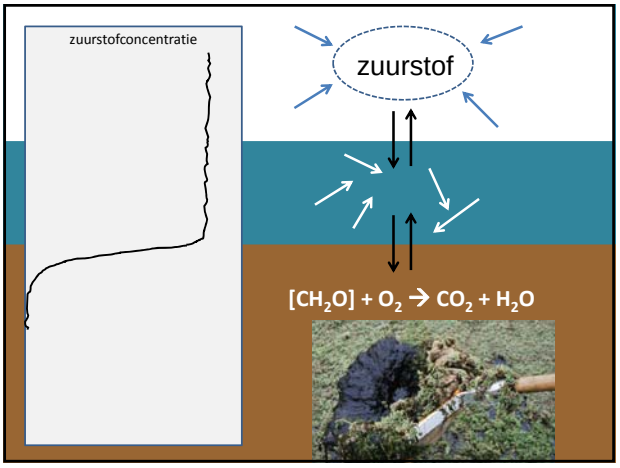
- $[CH_2O] + O_2 \rightarrow CO_2 + H_2O$
- Microbieel proces met zuurstof als electron acceptor



zuurstof


Ook onder water...
http://www.freestuffimages.eu/animals/

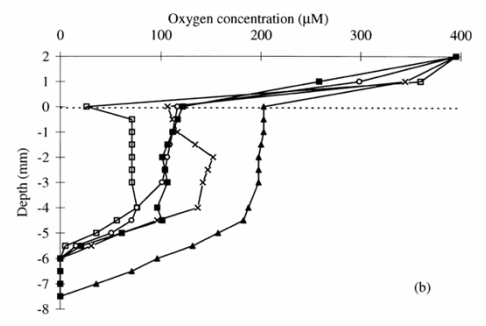

En in de waterbodem.....
http://www.duikenmetbeeld.tv/nieuws/bericht/de-wespkese-put-in-beeld/


zuurstofconcentratie
zuurstof
[CH2O] + O2 → CO2 + H2O

Intermezzo: zuurstof meten

http://www.environmeasure.com/products/2007070731050025vtw_dissolved_oxygen.jpg

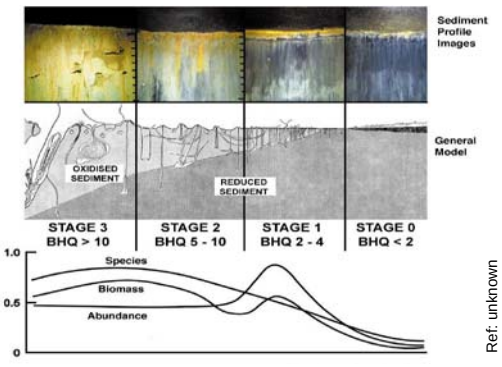
Zuurstof meten in de waterbodem



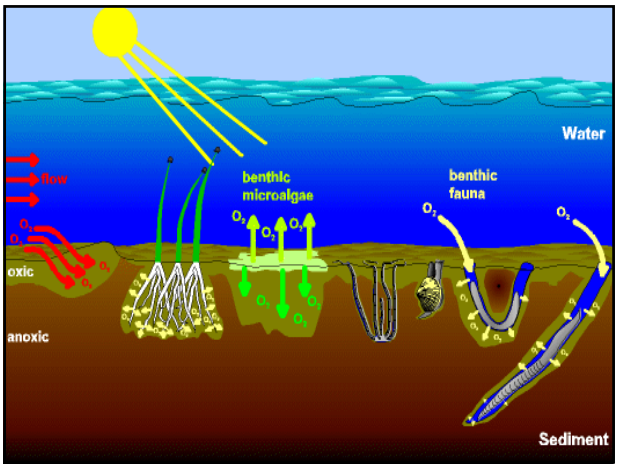
Woodruff et al. Freshwat. Biol. 1999

Alle Nederlandse waterbodems zijn praktisch zuurstofloos

→ **Toename in organische belasting** →



Ref: unknown



Organic matter mineralization

electron acceptors	$\Delta G^{0'}$
Aerobic respiration	
$[CH_2O]^* + O_2 \rightarrow CO_2 + H_2O$	-479
Denitrification	
$5[CH_2O] + 4NO_3^- \rightarrow 4HCO_3^- + 2N_2 + CO_2 + 3H_2O$	-453
Manganese reduction	
$[CH_2O] + 2MnO_2 + H_2O \rightarrow HCO_3^- + 2Mn_2^+ + 3OH^-$	-349
Iron reduction	
$[CH_2O] + 4Fe(OH)_3 \rightarrow HCO_3^- + 4Fe_2^+ + 7OH^- + 3H_2O$	-114
Sulfate reduction	
$2[CH_2O] + SO_4^{2-} \rightarrow 2HCO_3^- + H_2S$	-77
Methanogenesis	
$2[CH_2O] \rightarrow CO_2 + CH_4$	-62

∗Note: [CH2O] is used as a notation for organic material. (c) L. Stal NIOO

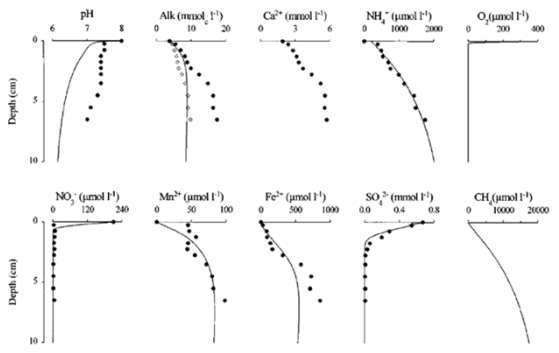


Figure 2. Measured concentrations in the pore water (solid dots) and modelled concentration profiles (lines) at location A (open diamonds represent corrected alkalinity).

Van Den Berg, et al. Biogeochemistry, 2000

Redox potentiaal

- Maat voor de balans tussen alle oxidatie reductie processen in de waterbodem
- In theorie NERNST vergelijking

- In praktijk is niks in evenwicht.....

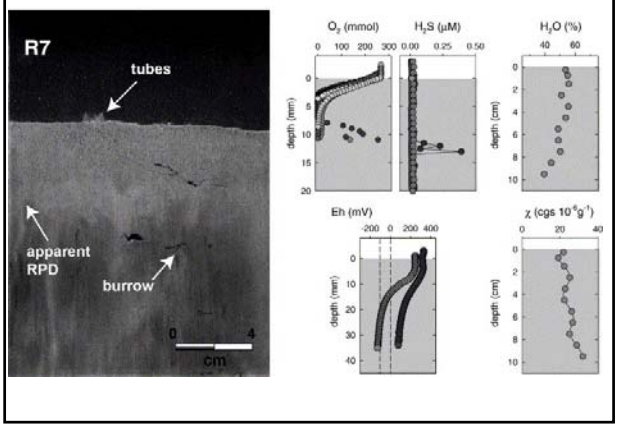
Redox potential

Redox probe

Organic matter mineralization

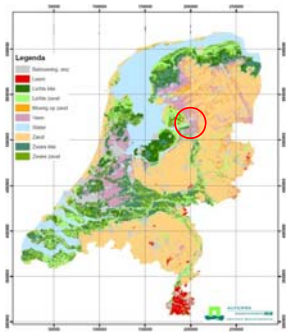
electron acceptors	$\Delta G^{0'}$
Aerobic respiration	
$[CH_2O]^* + O_2 \rightarrow CO_2 + H_2O$	-479
Denitrification	
$5[CH_2O] + 4NO_3^- \rightarrow 4HCO_3^- + 2N_2 + CO_2 + 3H_2O$	-453
Manganese reduction	
$[CH_2O] + 2MnO_2 + H_2O \rightarrow HCO_3^- + 2Mn_2^+ + 3OH^-$	-349
Iron reduction	
$[CH_2O] + 4Fe(OH)_3 \rightarrow HCO_3^- + 4Fe_2^+ + 7OH^- + 3H_2O$	-114
Sulfate reduction	
$2[CH_2O] + SO_4^{2-} \rightarrow 2HCO_3^- + H_2S$	-77
Methanogenesis	
$2[CH_2O] \rightarrow CO_2 + CH_4$	-62

*Note: [CH2O] is used as a notation for organic material.



Meten in de diepte, maar ook in de tijd!

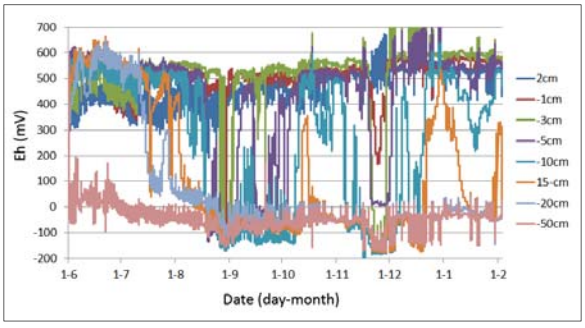
Weerribben-Wieden

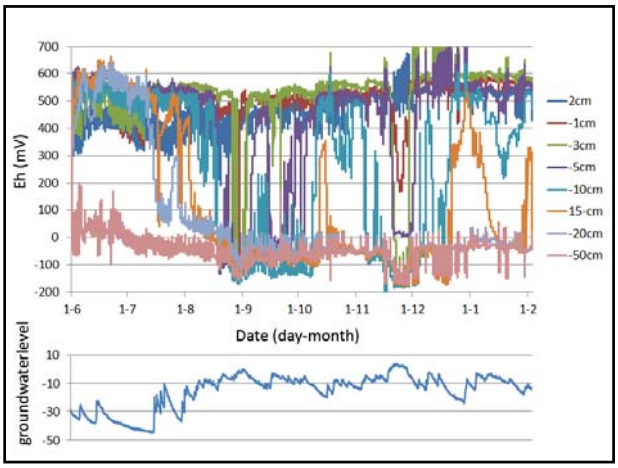


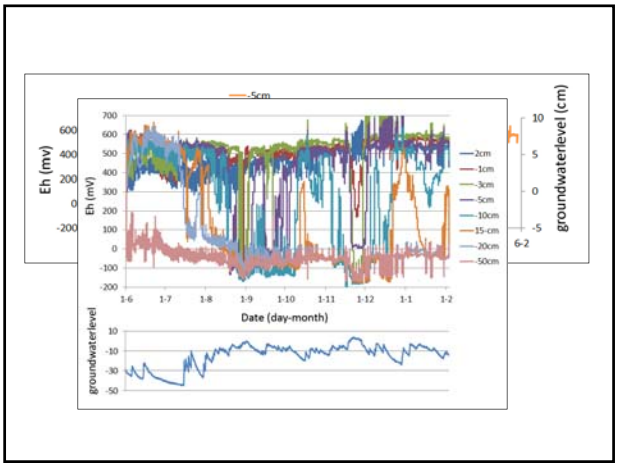
Continuous registration of redox potential profiles

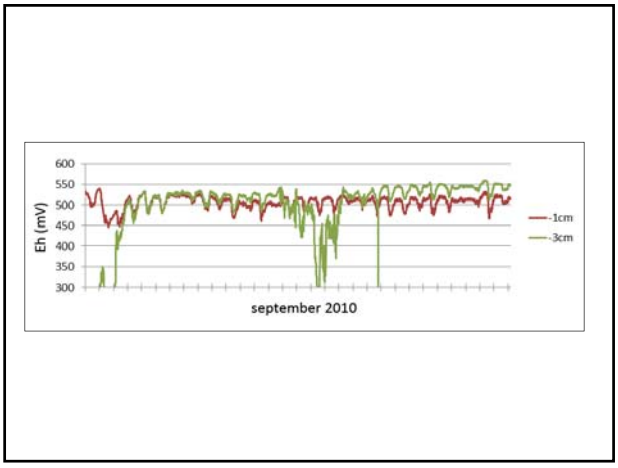
- Hypnos logger
  see poster P25
  CURRENT DEVELOPMENTS IN REDOX POTENTIAL MEASUREMENT TECHNIQUES
  Vorenhout M., van der Geest H.G.

- 8 depths (+2 till -50 cm)
  15 minutes time interval
  8 months

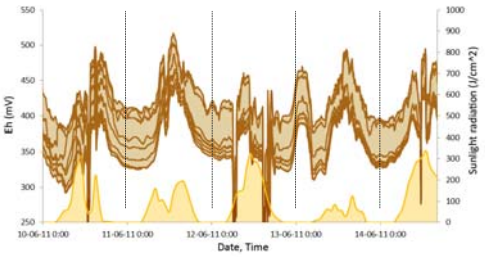


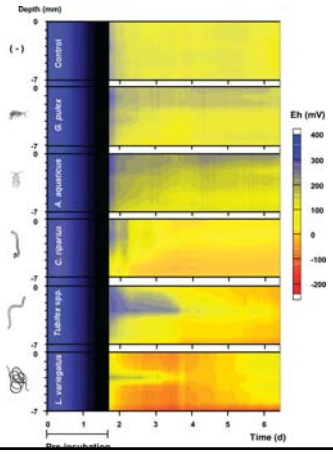

Eh (mV)
700
600
500
400
300
200
100
0
-100
-200
1-6
1-7
1-8
1-9
1-10
1-11
1-12
1-1
1-2
Date (day-month)
2cm
-1cm
-3cm
-5cm
-10cm
15-cm
-20cm
-50cm
groundwaterlevel
10
-10
-30
-50


Eh (mv)
groundwaterlevel (cm)
Date (day-month)
groundwaterlevel
6-2

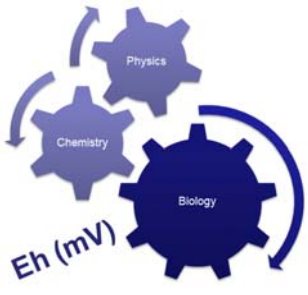

Eh (mV)
600
550
500
450
400
350
300
september 2010
-1cm
-3cm

Day night regime in sediment toplayer

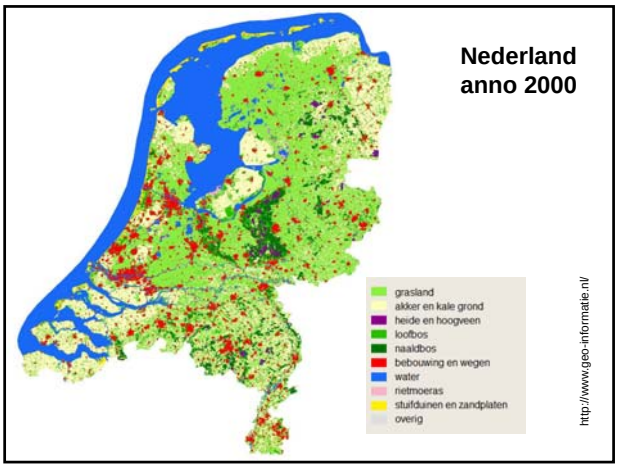




(Hunting et al, 2012)

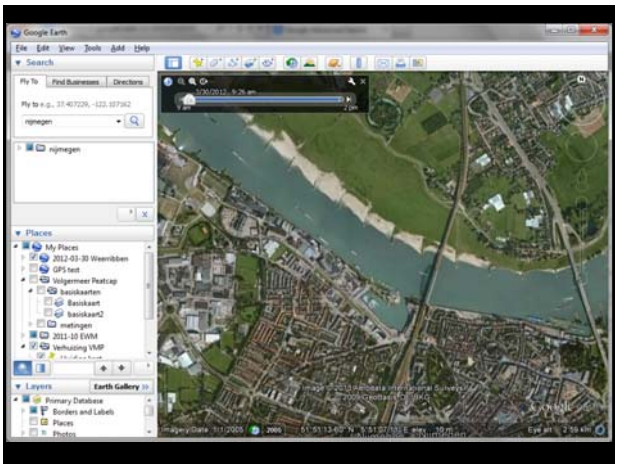


Alle grote kringlopen op aarde


Nederland
anno 2000
grasland
akker en kale grond
heide en hoogveen
loofbos
naaldbos
bebouwing en wegen
water
rietmoeras
stuifduinen en zandplaten
overig
http://www.geo-informatie.nl/


07/08/2011 19:41


NAP

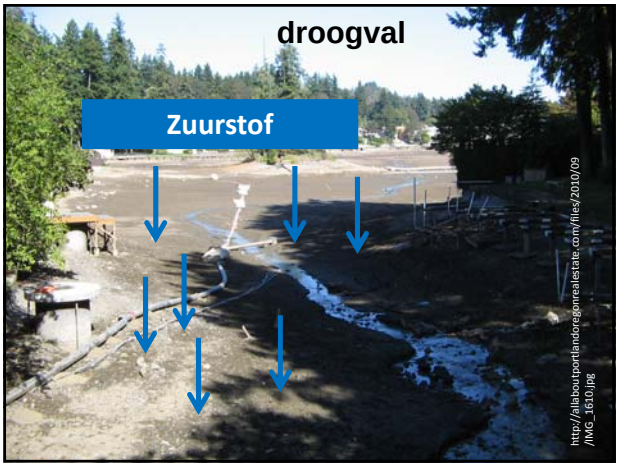


Dynamiek is verdwenen

Slechte waterkwaliteit
Lage biodiversiteit

- Weinig waterplanten
- Troebel water
- Zwevende deeltjes
- Veel voedingsstoffen (stikstof en fosfaat)
- Algen/kroos bloei

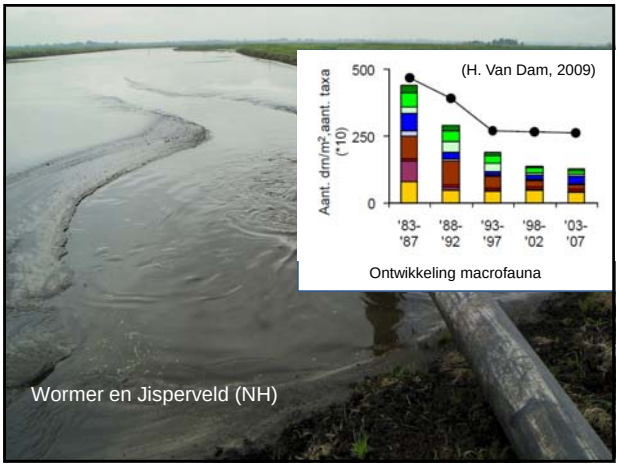
Alle problemen met elkaar verbonden!



Oxidatie van de waterbodem

- Ammonium > nitraat (nitrificatie)
  > stikstofgas (denitrificatie in diepere lagen)
  →atmosfeer
  NETTO VERLIES VAN STIKSTOF
- IJzersulfideverbindingen > IJzer(hydr)oxides + sulfaat
  IJzer(hydr)oxides beschikbaar om fosfaat te binden
  VERMINDERING BESCHIKBAARHEID FOSFAAT

Verbetering van de waterkwaliteit?!

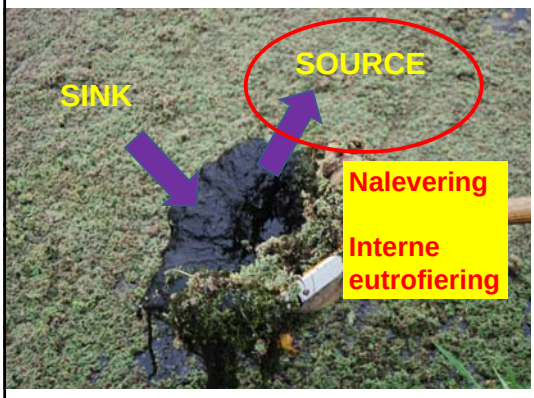


Eutrofiëring

- Overmatige toevoer van nutriënten naar het systeem

Bronnen

- Extern
  - Uitspoeling van meststoffen
  - Inlaat gebiedsvreemd water
  - Depositie
  - .....
- Intern



Laagveen, gebiedsvreemd water, OM afbraak en interne eutrofiering

- In zwakgebufferde veenbodems is afbraak geremd door lage pH en anaerobe condities
- Peilbeheer → Inlaatwater: bicarbonaat + sulfaat

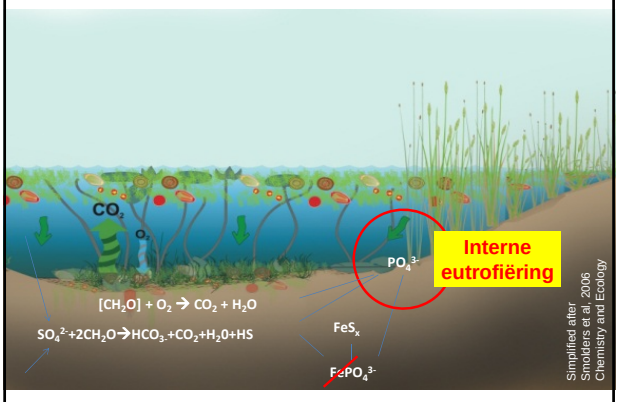
↻ Alkaliteit + electron acceptor → afbraak OM → **vrijkomen van P**

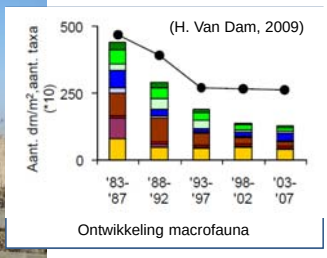
Ref: Smolders et al, 2006 Chem. Ecol

Tegelijkertijd..... P buffering neemt af door

- Meer sulfaattoevoer → sulfide vorming
- Sulfide bindt ijzer
- Minder ijzer(hydr)oxide
- Minder P sorptie
- → Interne eutrofiering

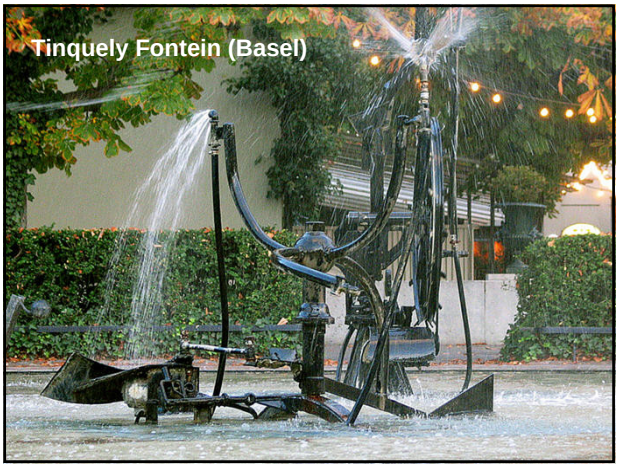
Ref: Smolders et al. 2006 Chem. Ecol



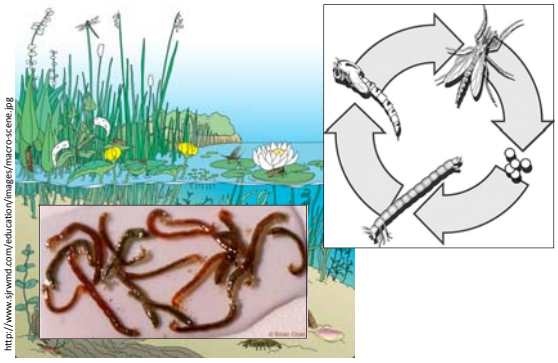


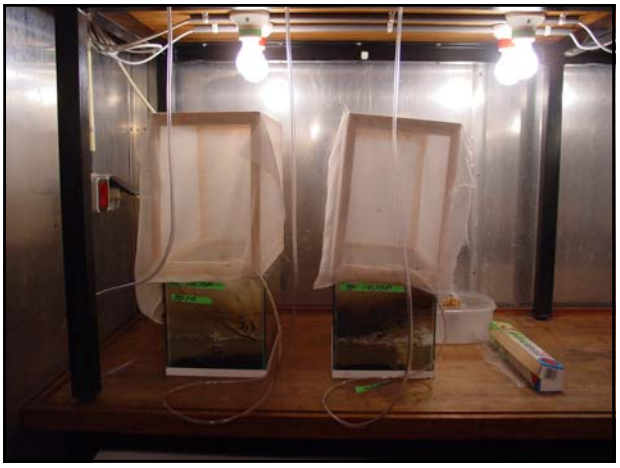
Ontwikkeling macrofauna

(PhD research project Merrin Whatley)



In de klas?

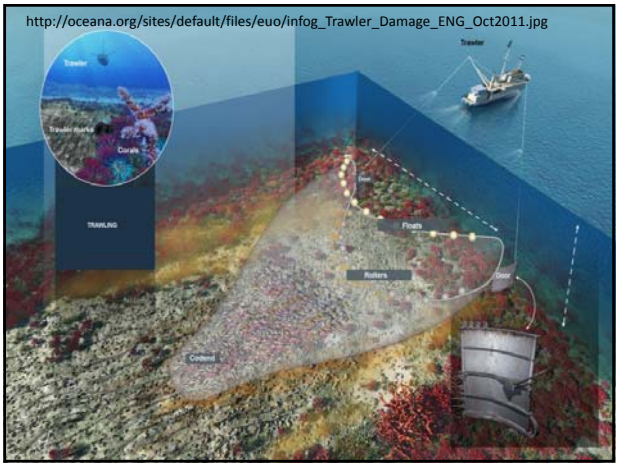

http://www.sjrwmd.com/education/images/macro-scene.jpg

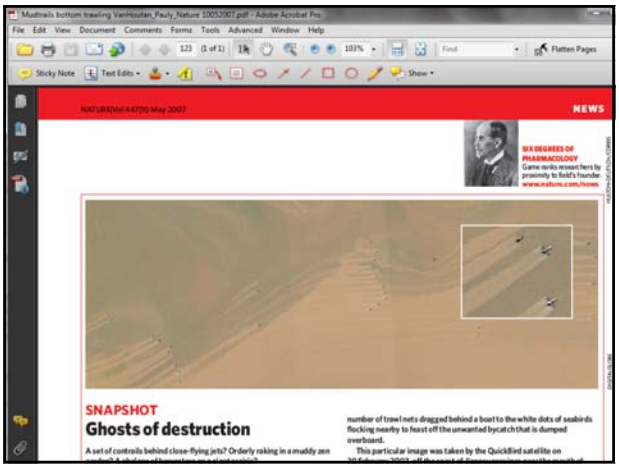


Primaire productie
dag nacht ritmes
verrijking
beesten toevoegen
.....

Toegift

http://oceana.org/sites/default/files/euo/infog_Trawler_Damage_ENG_Oct2011.jpg




NEWS
SIX DEGREES OF PHARMACOLOGY
SNAPSHOT
Ghosts of destruction