Anthropogenic Dynamics

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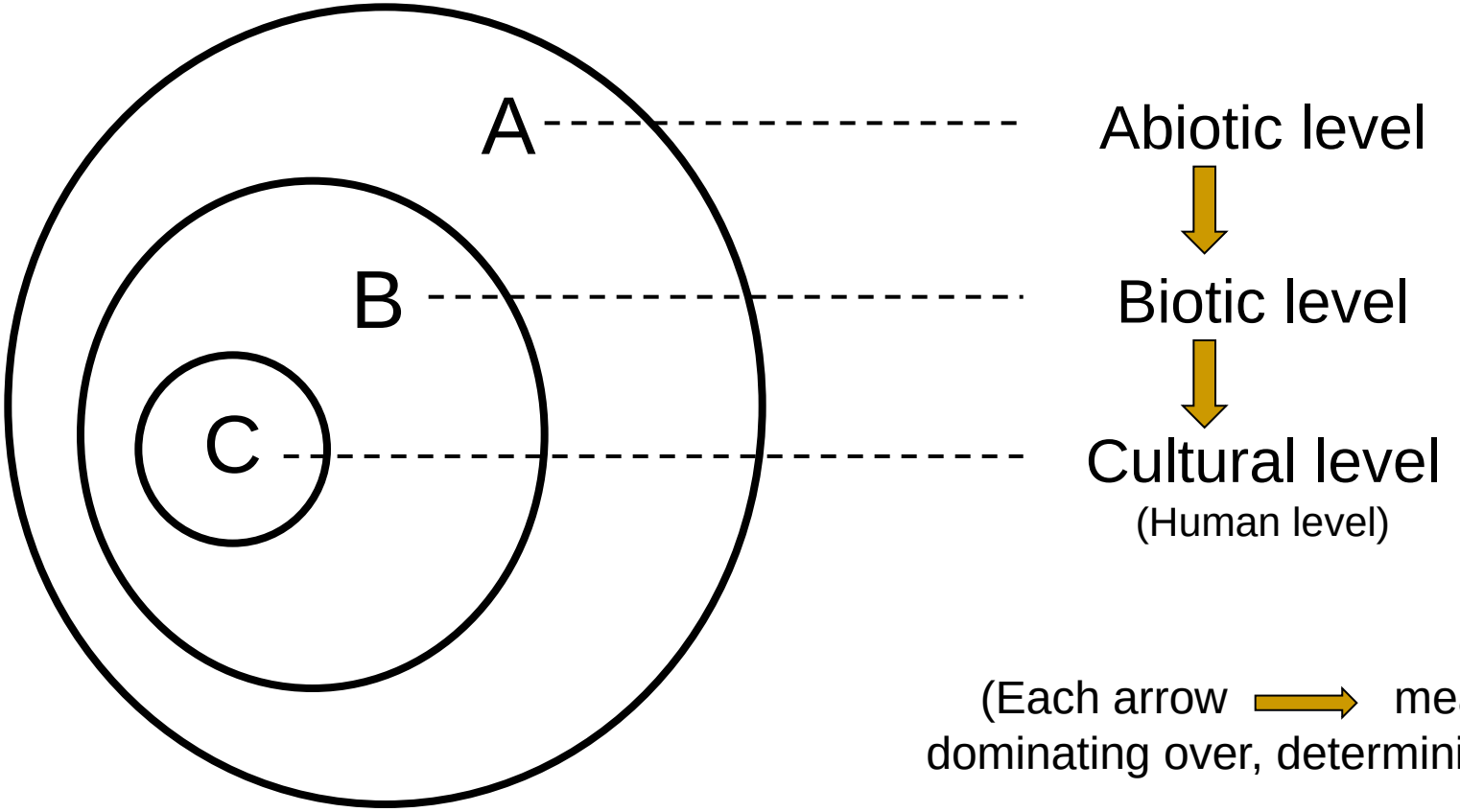
International Master in Architecture. Theme 4.

Course Environmental Sustainability.

HUMAN ACTIVITIES DEPEND ON AN INTACT BIOTIC AND ABIOTIC LEVEL.

VAN LEEUWEN (1979) EN SCHROEVERS (1982)



(Each arrow ⟹ means: dominating over, determining for)

Cosmosphere (A) ⟹ *atmosphere (A)* ⟹ *hydrosphere(A)* ⟹ *lithosphere (A)* ⟹ *biosphere (B)* ⟹ *noosphere (C)*

Ecological conditions: dominant or weak ?

- Some abiotic conditions are **strong, dominant, aggressive.** Other abiotic environmental conditions are **weak.**

  silence < noise

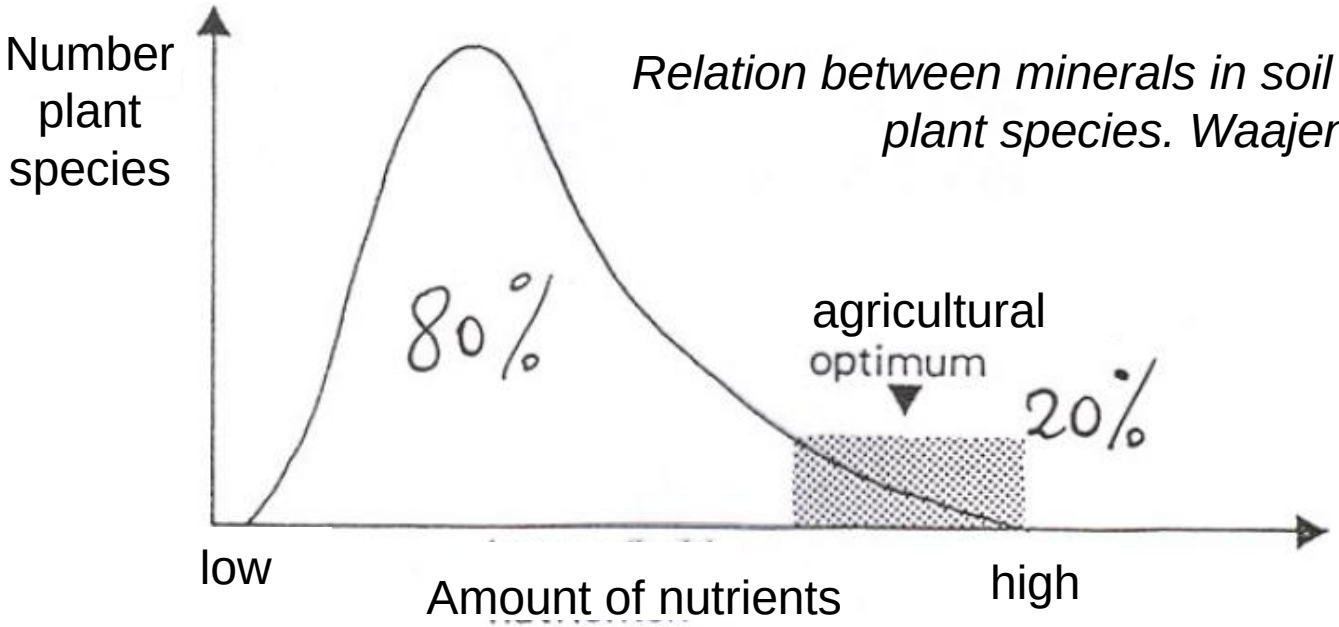
  clean < dirty

  quiet < dynamic

  fresh water < salt water

  …

  low dynamic < high dynamic



Relation between minerals in soil and the number of plant species. Waajen, 1985

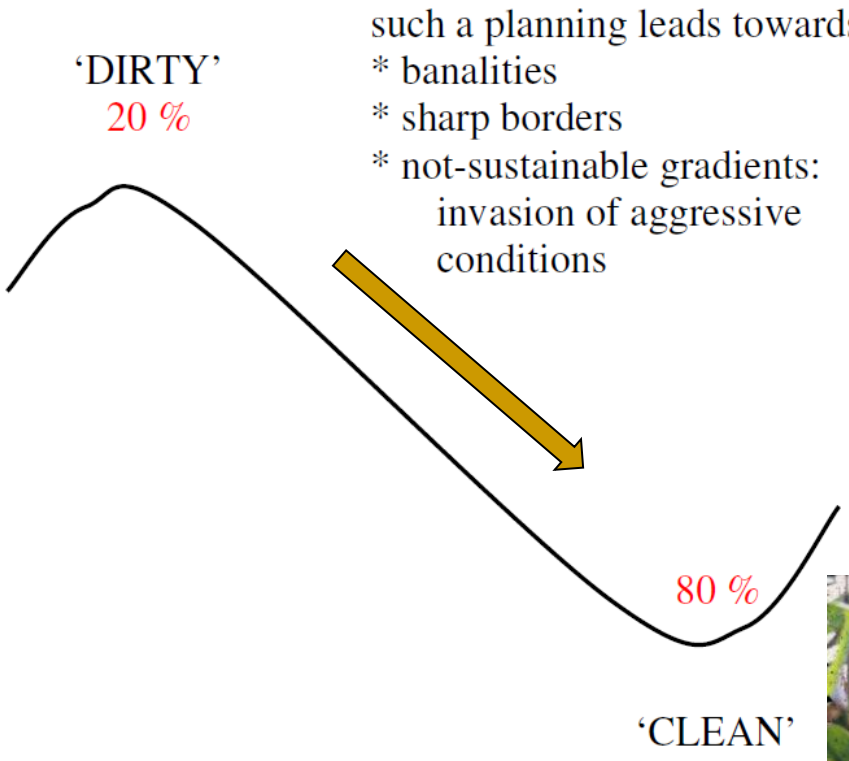
Verband tussen het voedselaanbod en het aantal plantensoorten, Bron: Waajen, 1985

- In habitats characterised by **weak abiotic conditions** (clean, silent, fresh water, few nutrients (= oligotrophic), …), a lot of different species can grow : 80 % of the indigenous plant species. Biodiversity is high.

- In habitats characterized by a lot of **dominant, aggressive abiotic conditions** (dirty, salt, high dynamic, a lot of nutrients (eutrophic),….), very few species can grow: 20 %. Biodiversity is low. Those species will occur in very large populations with a big biomass: very few species but very high densities and a lot of individuals will occur.
- Examples: coastal ecosystems salt mud flats and marshes (Zwin, Saeftinghe, ...) but also cities.

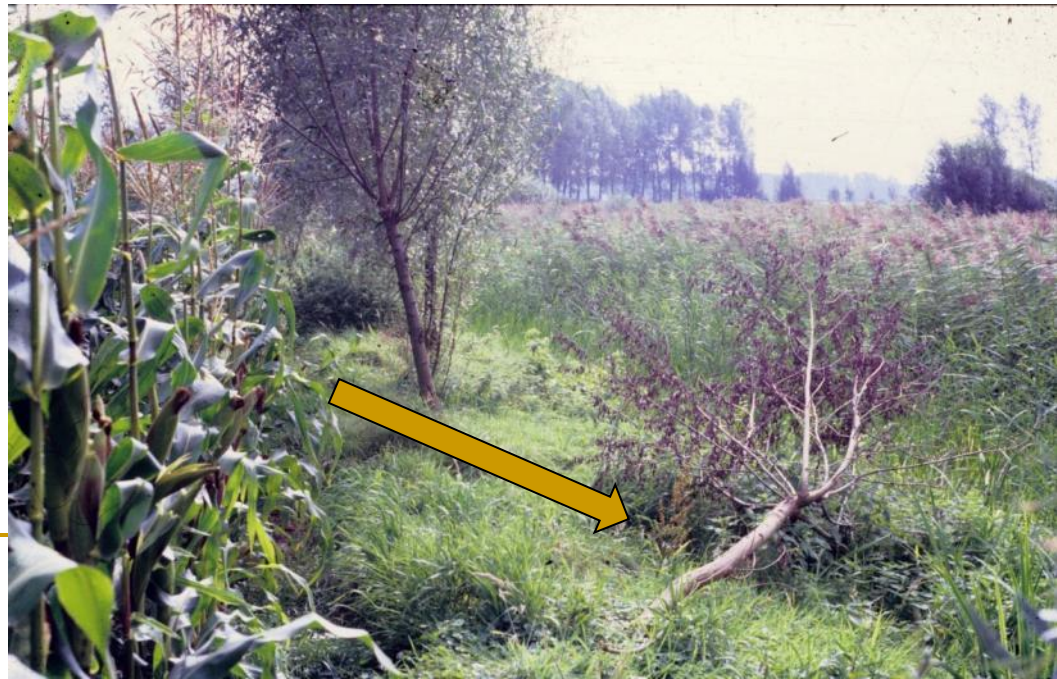
  e.g.: Rats, doves, Stinging Nettle (*Urtica dioica*), English Daisy (*Bellis perennis*), Canada thistle (*Cirsium arvense*), Dandelion (*Taraxacum officinale*), …

Anthropogenic dynamics. Situation to avoid by design.

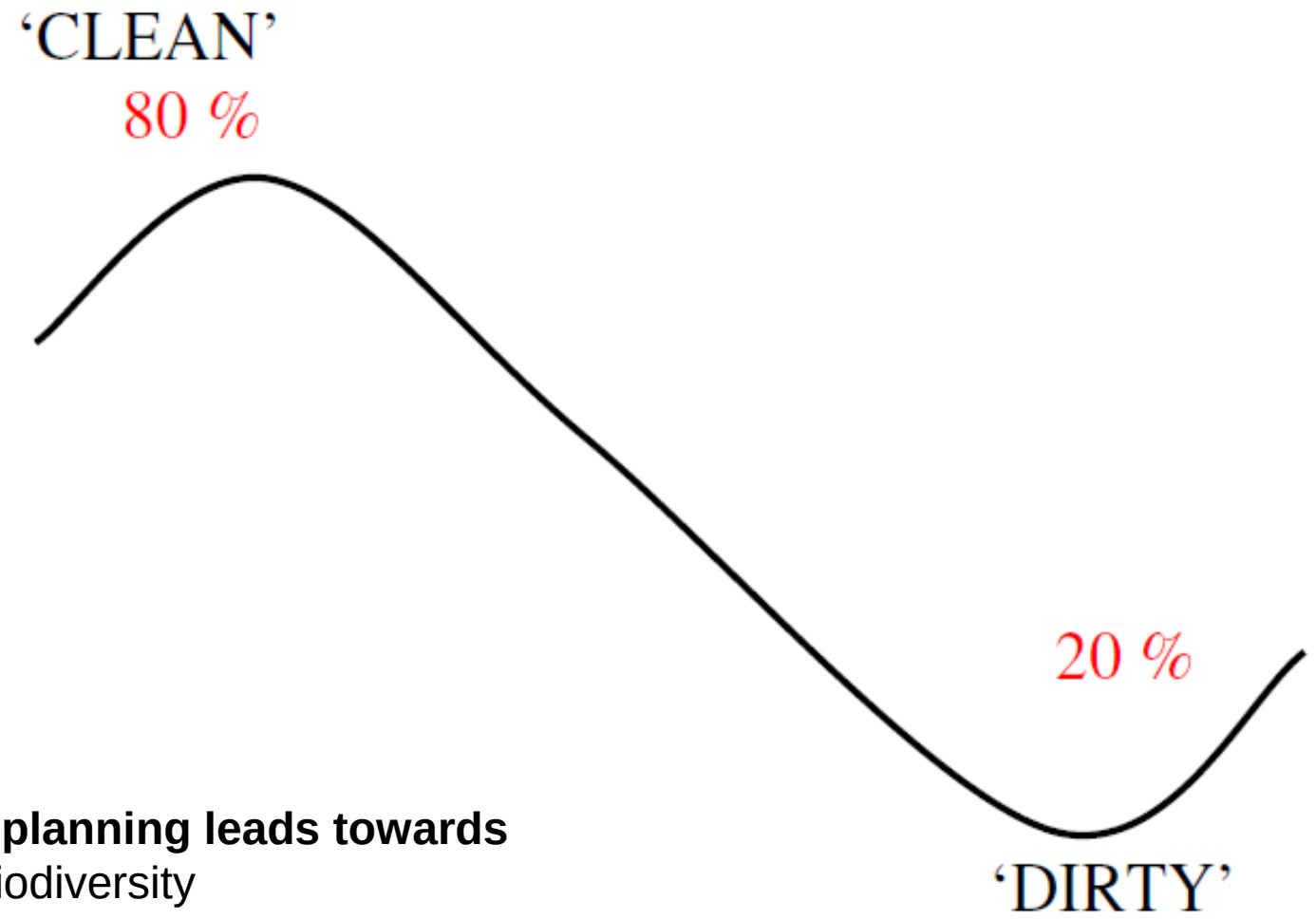


Avoid the situation of aggressive ecological conditions on a higher place (such as slopes, river springs, …) in landscapes.
Those aggressive conditions will spread and overrule lower situated weaker conditions. Biodiversity will decrease for sure.

Saeleghemkreek Meerdonk (O-Vl, B.)



Anthropogenic dynamics. Situation to create by design.

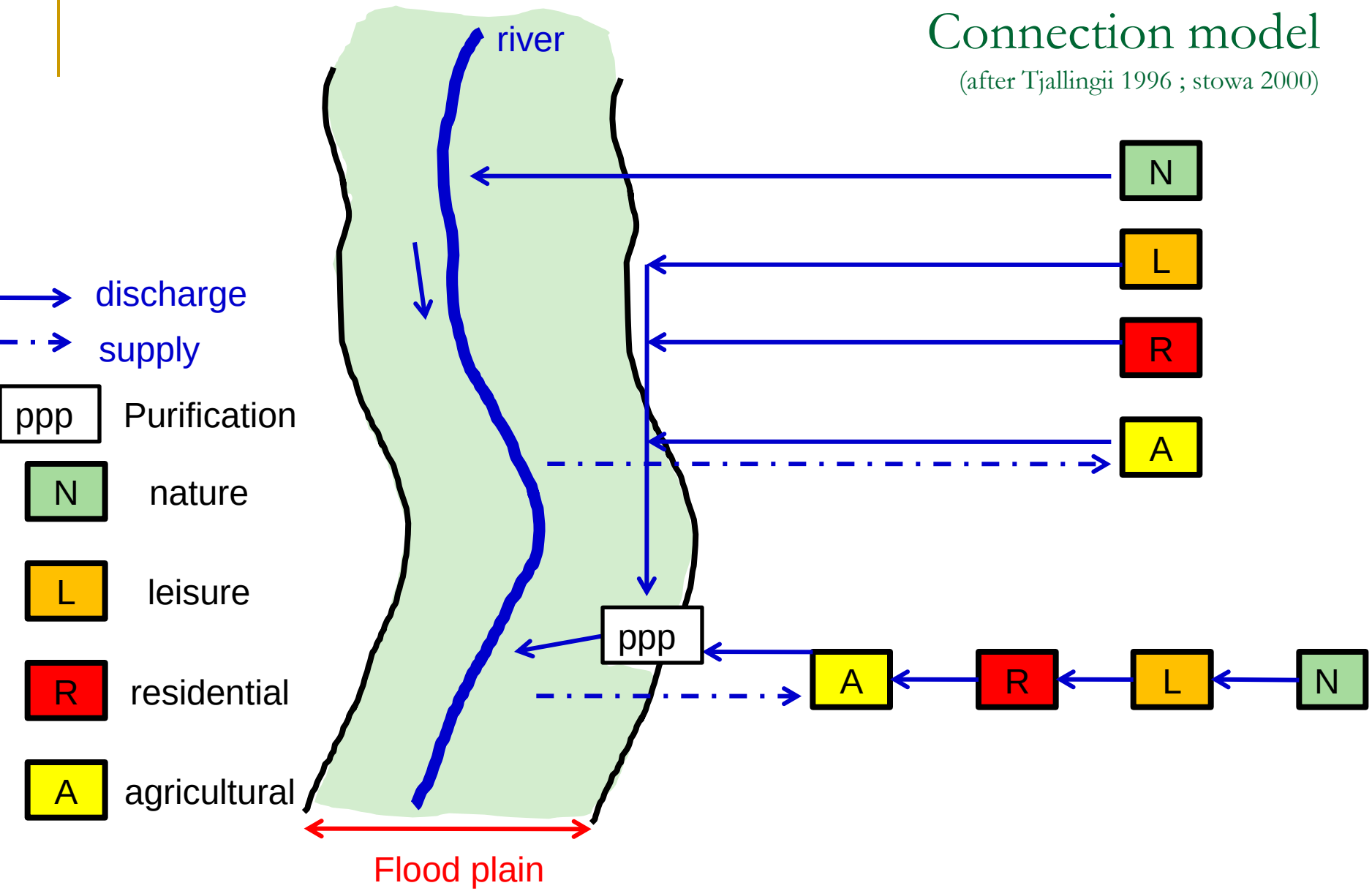


Such a planning leads towards

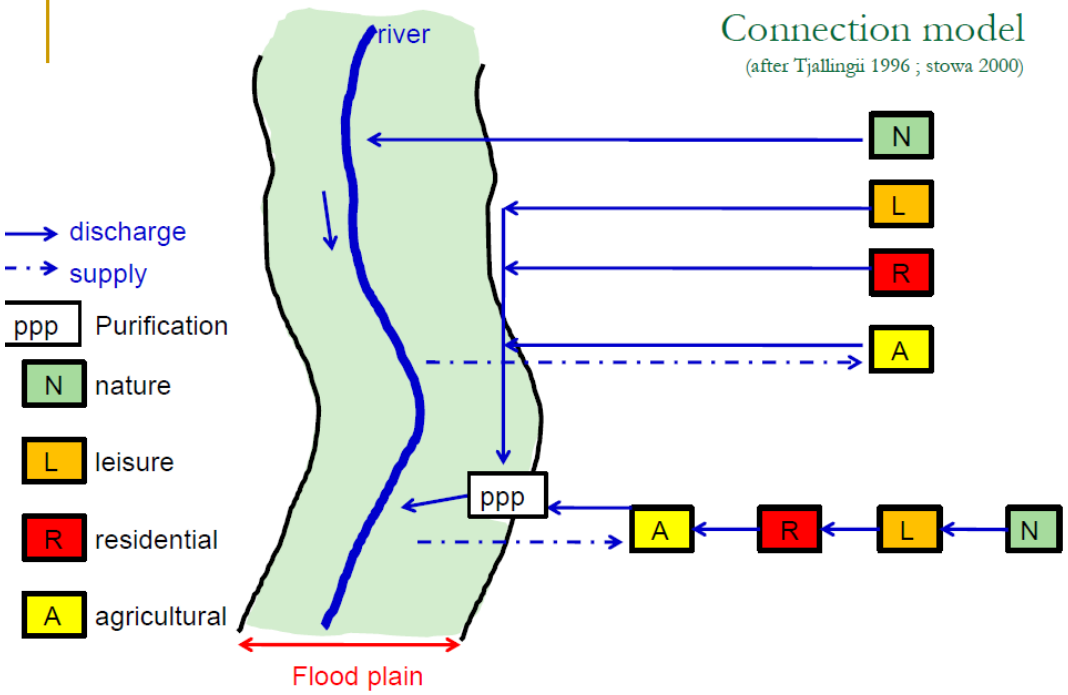
* high biodiversity
* sustainable gradients
* increasing differentiation

Connection model

(after Tjallingii 1996 ; stowa 2000)



The connection model suggests an ecologically sound water-chain between rural and urban regions.



This connection model can be used to design a sustainable regional water system. In this connection model the underlying ecological principle is to create a stable gradient by allowing water to **flow from clean (in low-dynamic surroundings) to polluted (in high-dynamic surroundings)**, from nutrient-poor to nutrient-rich conditions. There are two possibilities: a series connection and a parallel connection (because 'dirty' dominates over 'clean'). See lesson for examples.

STOWA. STICHTING TOEGEPAST ONDERZOEK WATERBEHEER. 2001. Levende stadswateren: werken aan water in de stad. STOWA, ill. ISBN 90 5773 096 3. www.stowa.nl

ANTHROPOGENIC DYNAMICS.

examples

- Concentrate waste, debris, nutrients, ... at the deepest point of a site, instead of spreading everywhere → *trivialization*
- Concentrate disturbance in landscapes: bundle Infrastructure. That's better than disturbing a little everywhere because then the most sensitive species will die everywhere → *trivialization*
- Do not start cleaning up the dirtiest, filthiest black points, but make a priority of keeping clean areas clean. Otherwise, the dirty areas will get a little cleaner but clean areas also a little filler → *trivialization*
- Keep manure surplus concentrated in some areas and search for a solution on site, instead of using the 'manure bank' to spread the manure all over the country, creating a little surplus everywhere → *trivialization*

Examples on a large landscape scale: river system management

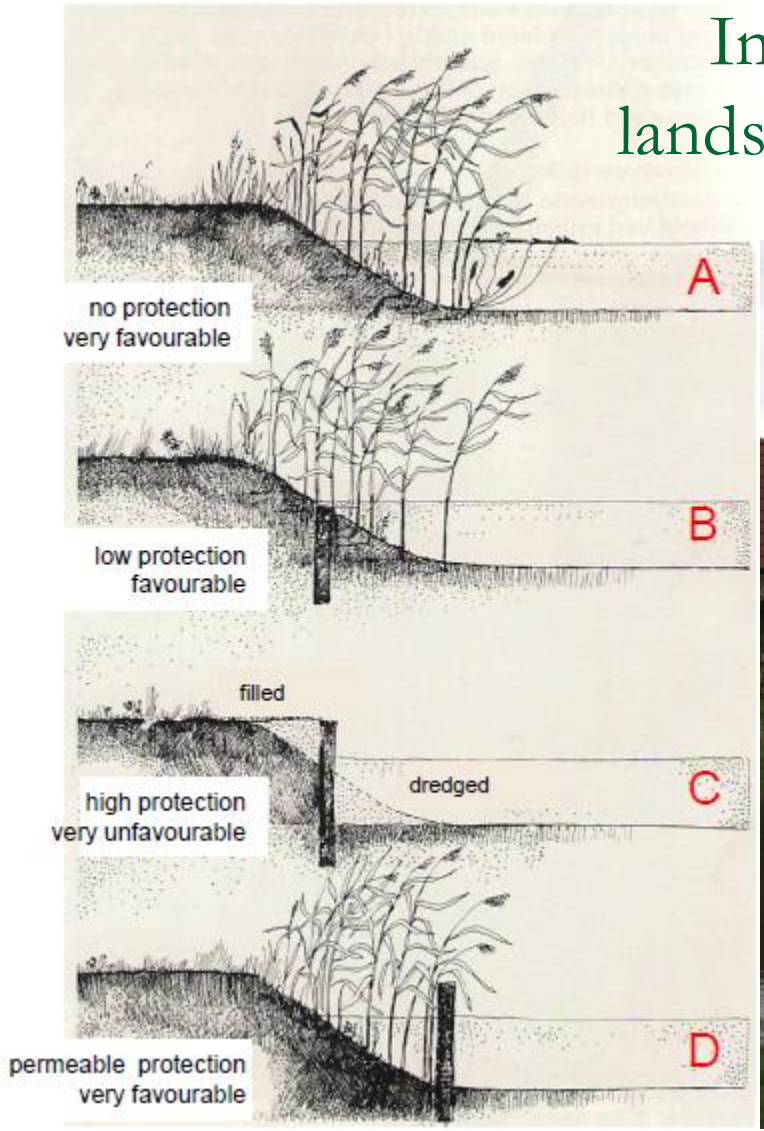
- Environmental assessment report for a factory
- Layout of a dirty water remediation plan

See lecture for details.

Small scale applications: In (urban) gardens design, dry oligotrophic sand is put on top ....

De kleine Aarde (Boxtel, NL)

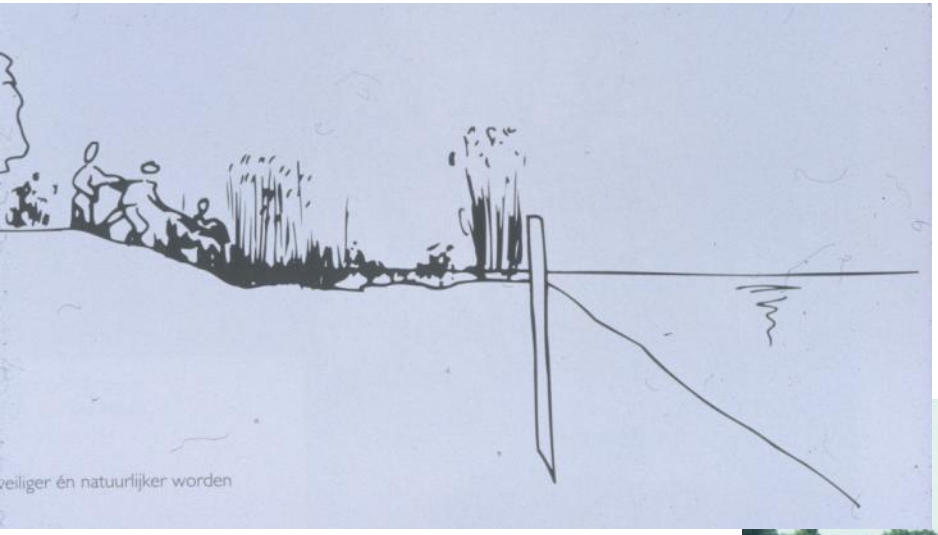
...and the wet, eutrophic clay is put down... Importance of gentle gradients in (urban) landscapes for biodiversity (and for safety of children)



Some camp shedding methods enable rich nature (B and D).

Culemborg (NL), ecoquarter EVALanxmeer Natural camp shedding provides rich nature, also within residential areas

Nature friendly permeable bank protection (Kromme Rijnproject, Utrecht (NL))



Nature friendly permeable bank protection (Kromme Rijnproject, Utrecht (NL))

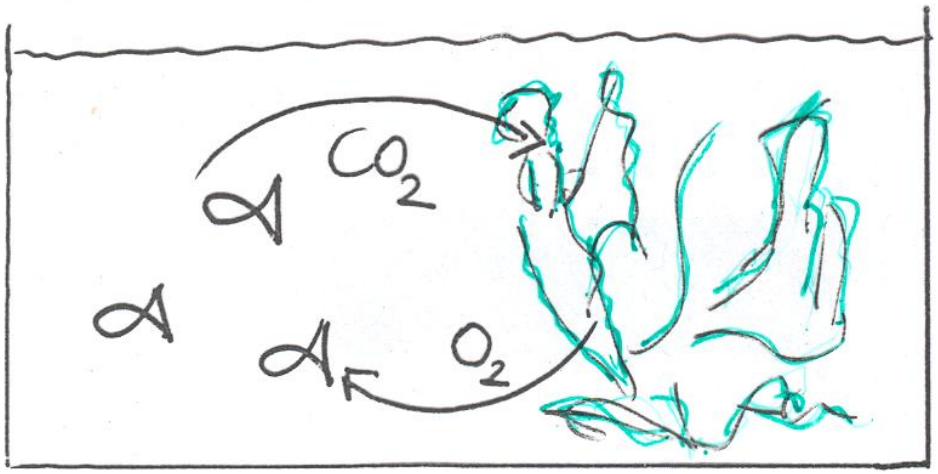
A missed opportunity.
Sharp, abrupt boundaries: little biodiversity and moreover unsafe for children.

Houten (NL)

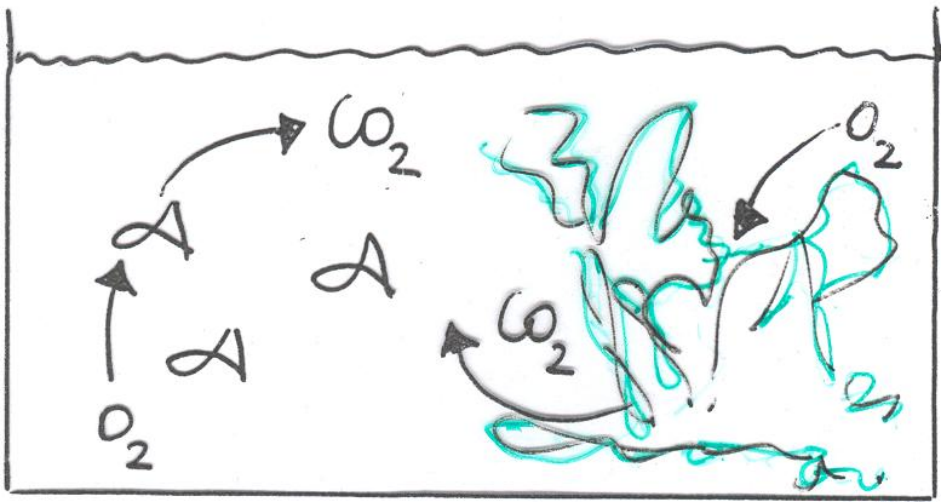
ANTHROPOGENIC DYNAMICS

EXAMPLE: EFFECTS OF EUTROPHICATION.

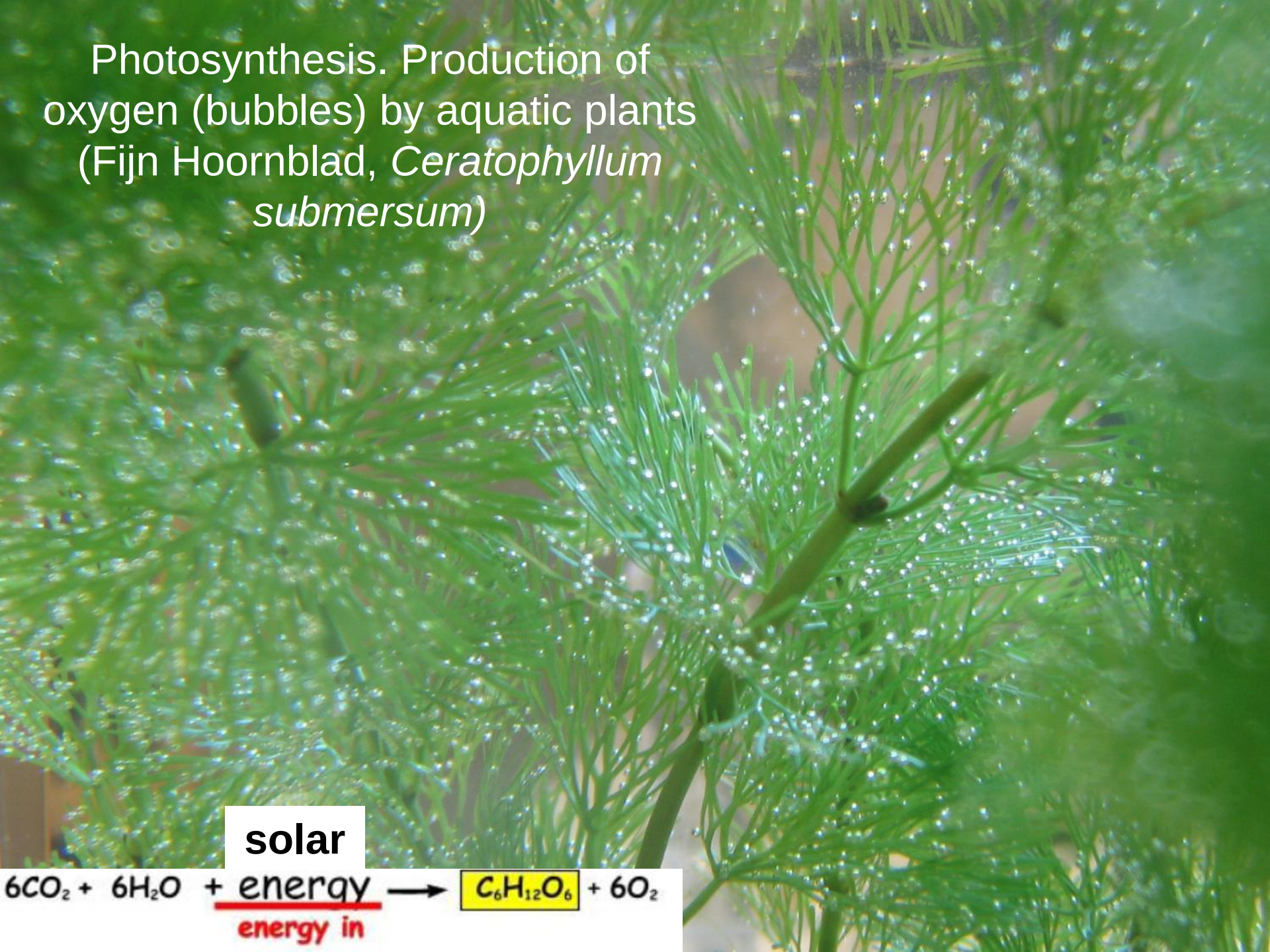
Day: plants (algae) produce O_2
animals consume O_2



Night: *all* organisms consume O_2



Photosynthesis. Production of oxygen (bubbles) by aquatic plants (Fijn Hoornblad, *Ceratophyllum submersum)*

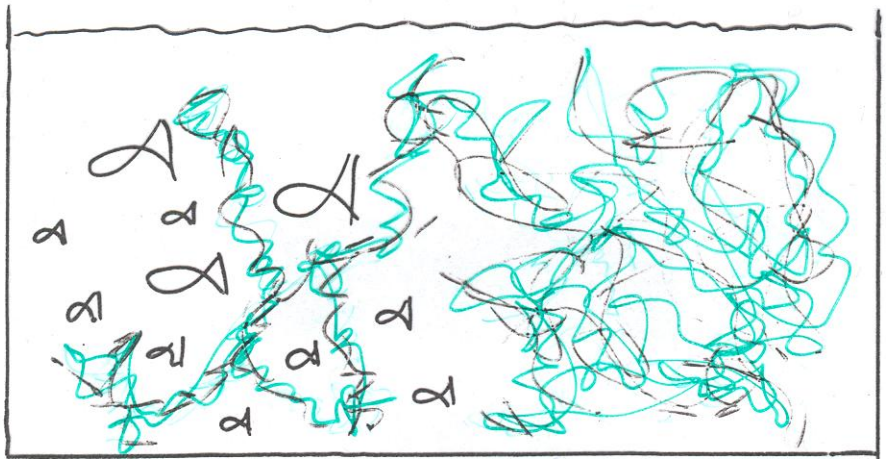


The pike (**snoek**, *Esox lucius)* is getting tricky in eutrophic water. On the contrary, The carp bream (**brasem**, *Abramis brama)* feels fit.

http://www.digischool.nl/bi/onderwaterbiologie/html/biologie/zoetwate/snoek.htm

http://www.ravon.nl/Soorten/Vissen/Brasem/tabid/153/Default.aspx

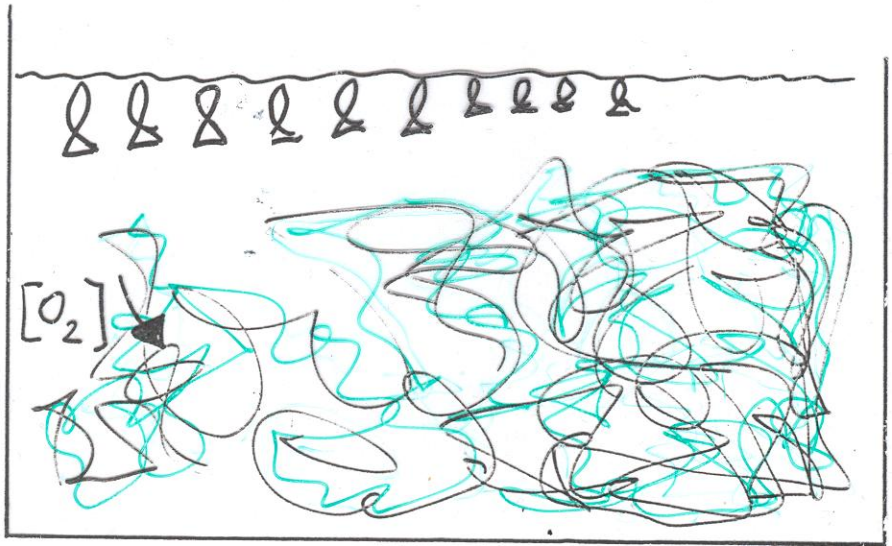
Minerals → phosphates, Nitrates



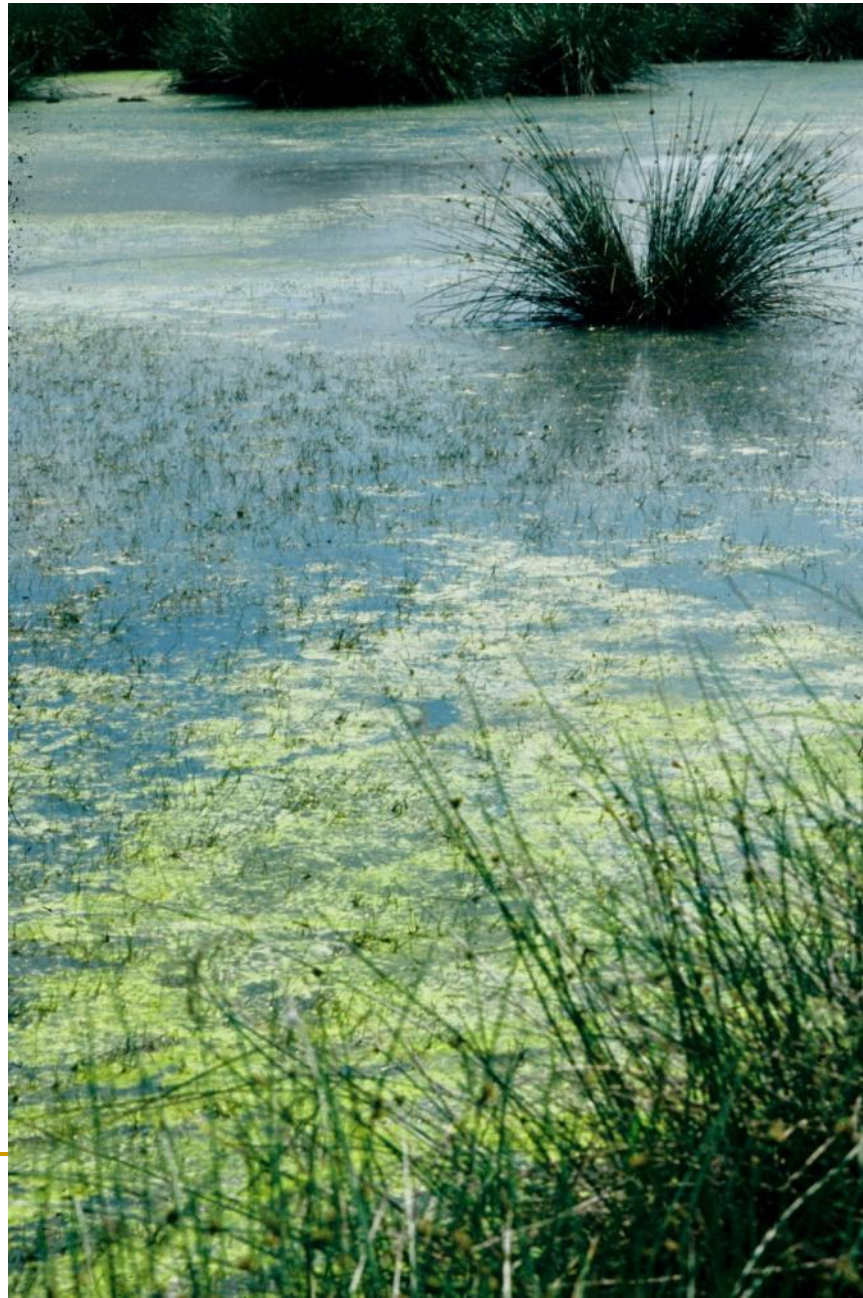
Day: After fertilization: more algae and more animals of a few tolerant species, which massively expand, the water becomes pea soup green

Night: *all* organisms consume O_2

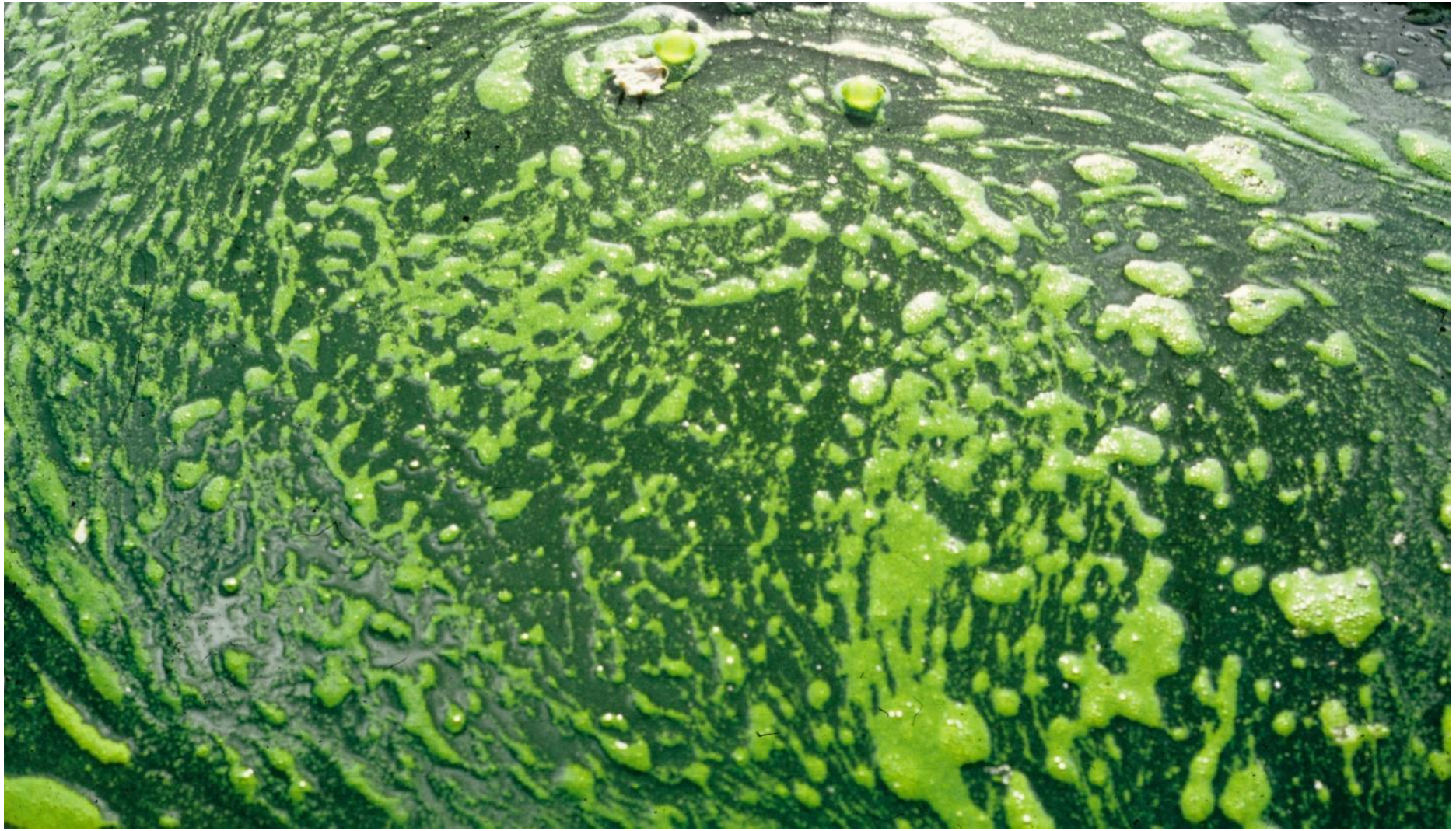
➡ anaerobic (faster in hot water)



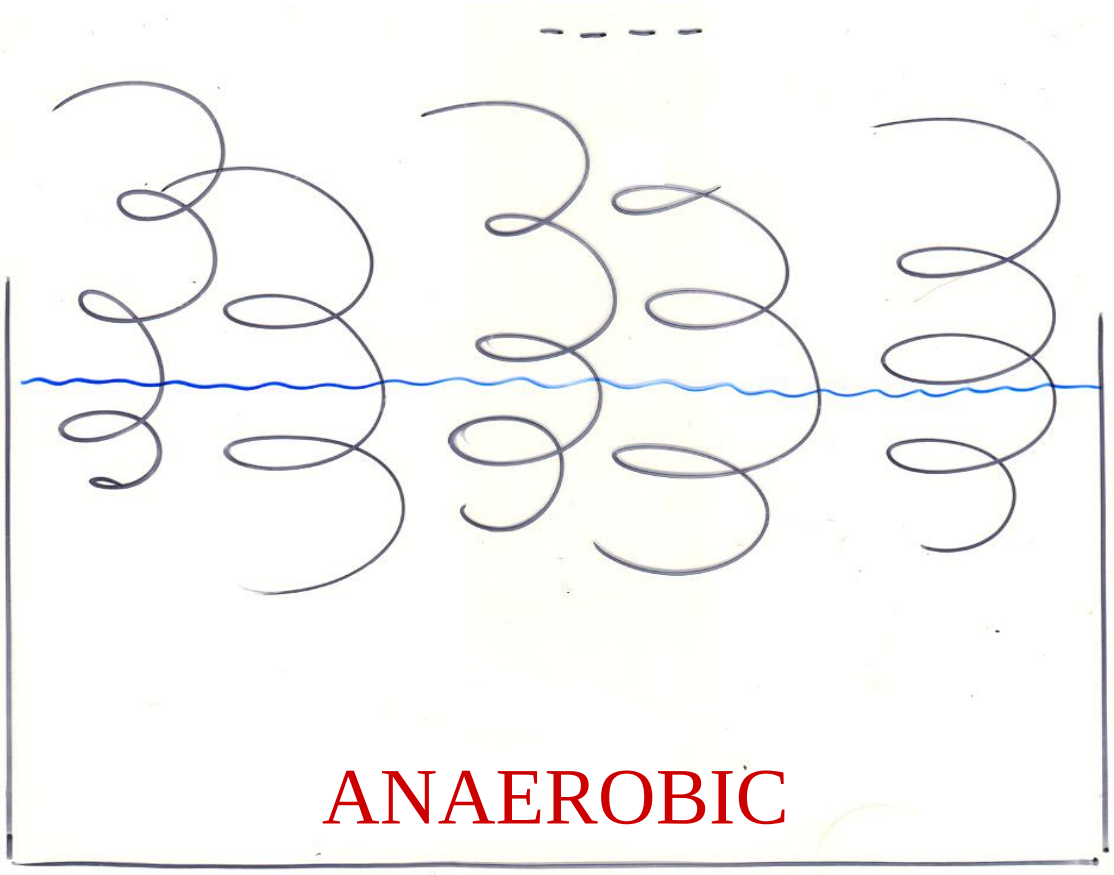
Excessive algae growth due to fertilization (= eutrophication)



Eutrophication: algae bloom.



CH_4 , H_2S *SMELL*



O_2-free ➡ anaerobic digestion by bacteria and other micro-organisms leads to odor. Risk of growth of *Clostridium botulinum* that causes botulism (mortality of waterfowl). Risk is greatest in the summer semester.

Risks for human health of too many nitrates in food and drinking water

- *EU-nitratenrichtlijn (1975):* *EU Nitrates Directive*

Max.-waarde: 50 mg NO^-_3 / liter (=11.3 mg nitraatstikstof per liter)

Streefwaarde: < 25 mg NO^-_3 / liter (=5.6 mg nitraatstikstof per liter)

(in 62 mg nitraat(14+3x16) zit 14 mg N, dus in 50 mg …)

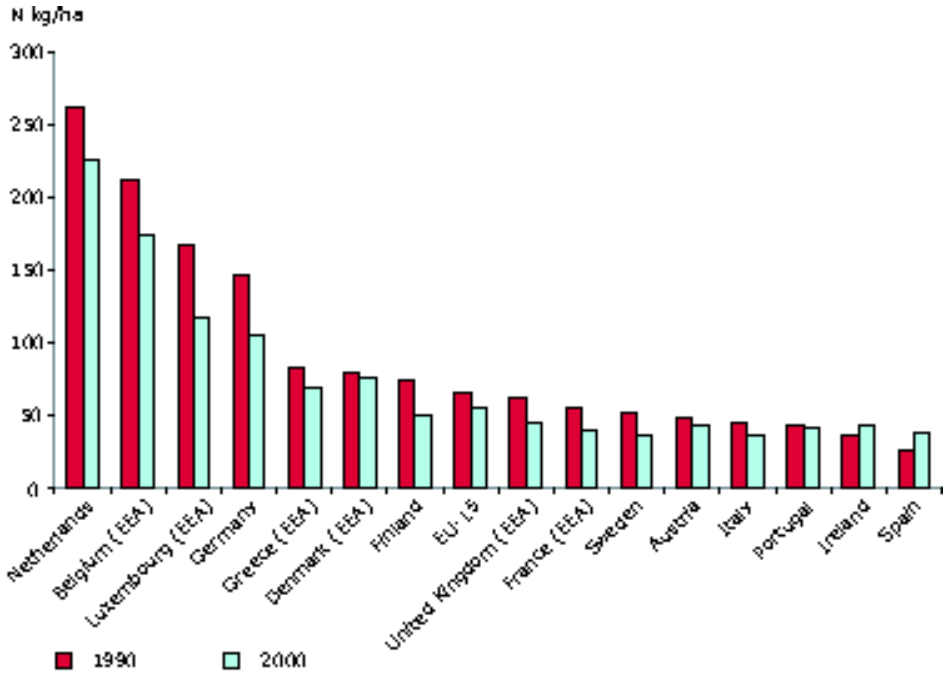
- *WHO-norm:*

A.D.I. van 3.65 mg NO^-_3 / dag, kg (baby's !)
(let op: totaalwaarde, dus ook groenten, enz.)

- *Risico's:*

anaerobic reduction of nitrates (NO^-_3) to nitrites (NO^-_2)

Blauwziekte (=methemoglobinemie)
Kanker: er wordt een causaal verband vermoed via nitrieten, nitrosaminen en -amiden)



http://www.eea.europa.eu

At EU-15 level the gross nitrogen balance in 2000 was calculated to be 55 kg/ha, which is 16% lower than the balance estimate in 1990, which was 66 kg/ha. In 2000 the gross nitrogen balance ranged from 37 kg/ha (Italy) to 226 kg/ha (the Netherlands). All national gross nitrogen balances show a decline in estimates of the gross nitrogen balance (kg/ha) between 1990 and 2000, apart from Ireland (22% increase) and Spain (47% increase). The following Member States showed organic fertiliser application rates greater than the threshold of 170 kg/ha specified by the Nitrates Directive in 2000: the Netherlands (206 kg/ha) and Belgium (204 kg/ha).

Algae bloom in France: no swimming allowed

Pas de baignade, les étangs d'Apigné ont le bloom

La pellicule d'algues contient des bactéries. La preuve? Lorsqu'elle est en nombre, l'eau peut prendre une coloration verte ou bleue. C'est le cas aux étangs d'Apigné depuis le 3 juillet. Du coup, la baignade y est interdite.

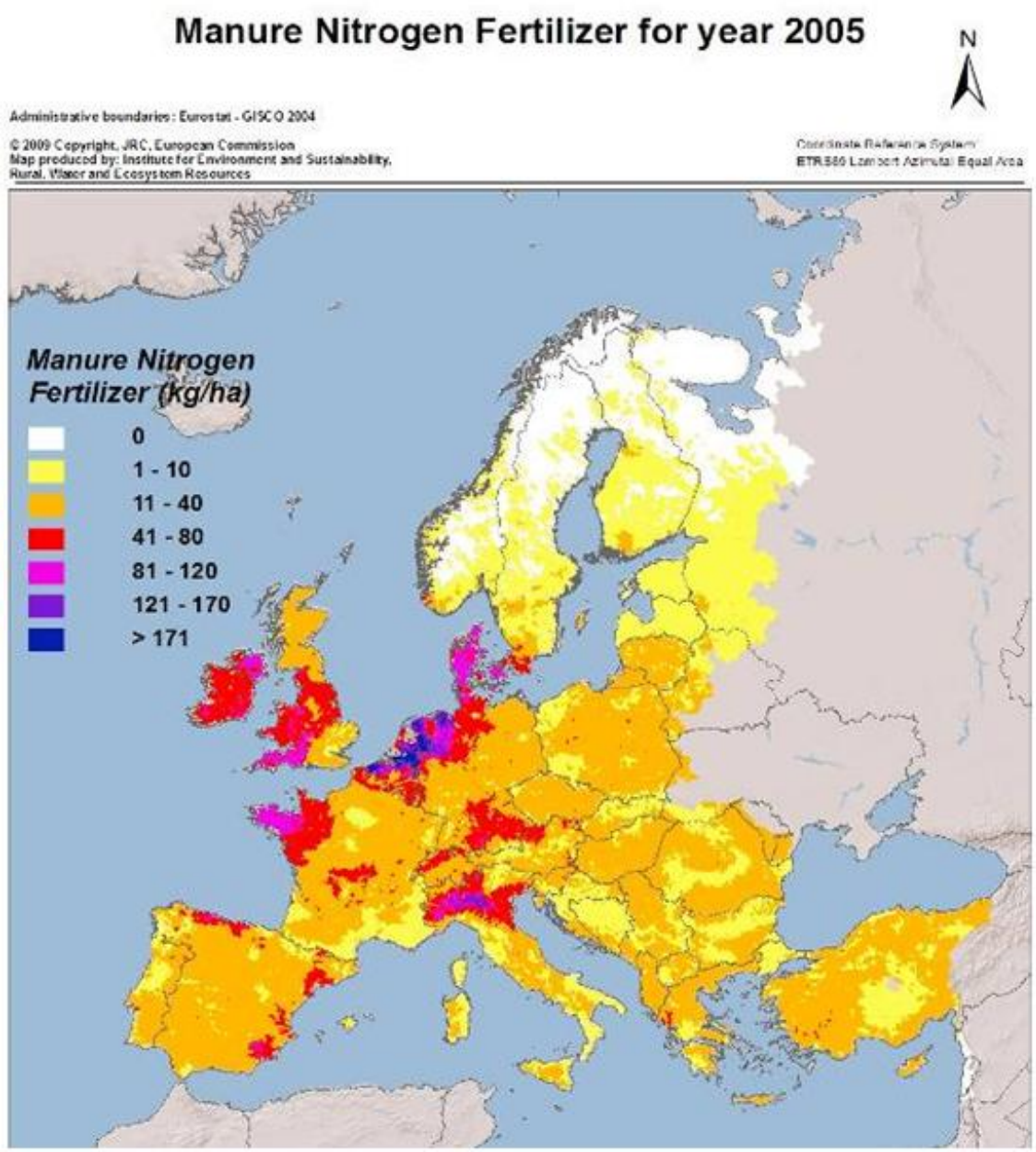
http://www.rennes.maville.com/actu

Algae bloom in Qingdao (China), the city which hosted the sailing part of the Beijing 2008 Olympics. Chinese authorities, trying to solve the problem

http://seawayblog.blogspot.com/2008/07/qingdao-and-algae-bloom.html

EUROPEAN COMMISSION
Joint Research Centre

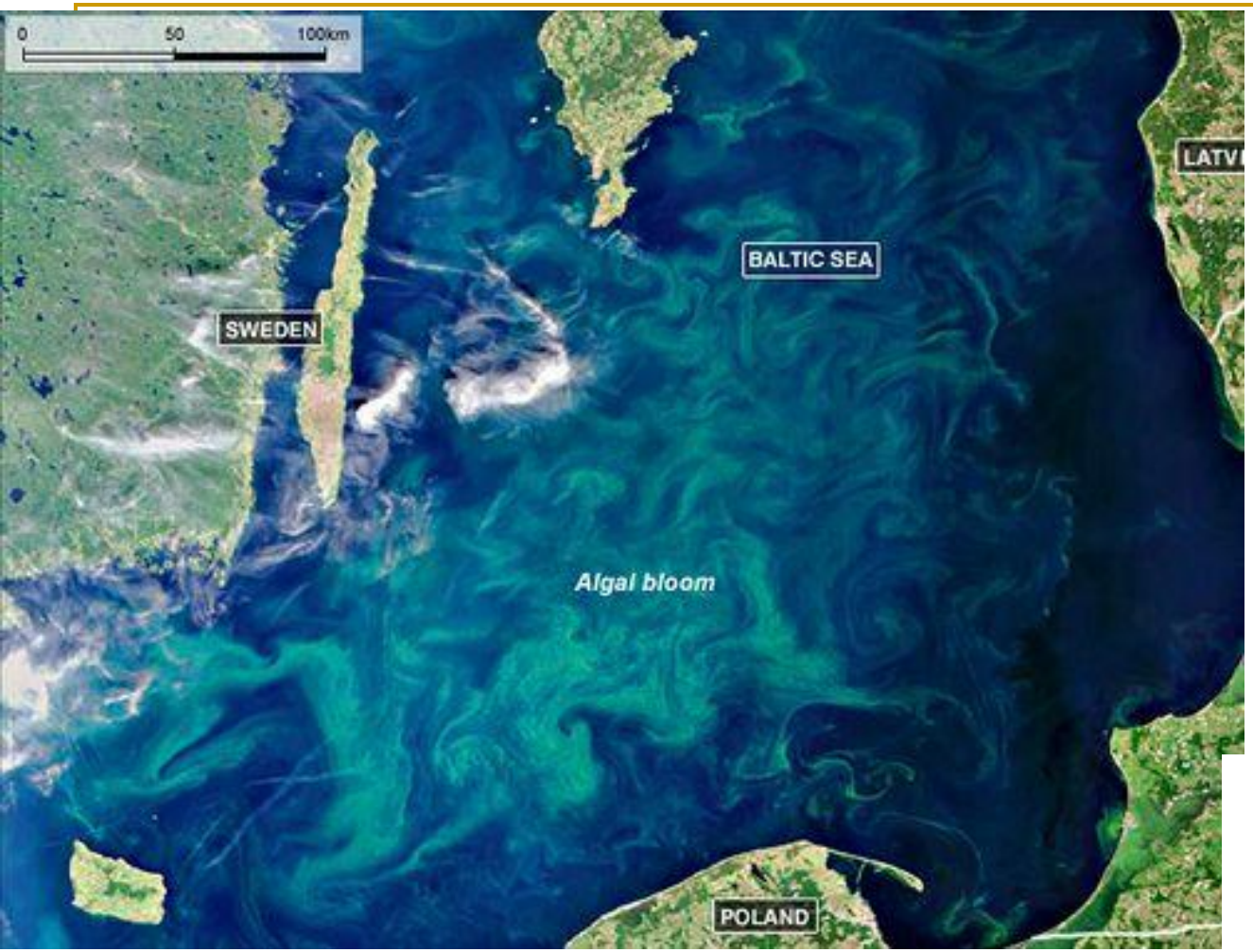
ies



The North Sea is processing the largest volume eutrophying pollution, but thanks to *the strong tides*, North Sea water is regularly replaced from the ocean.

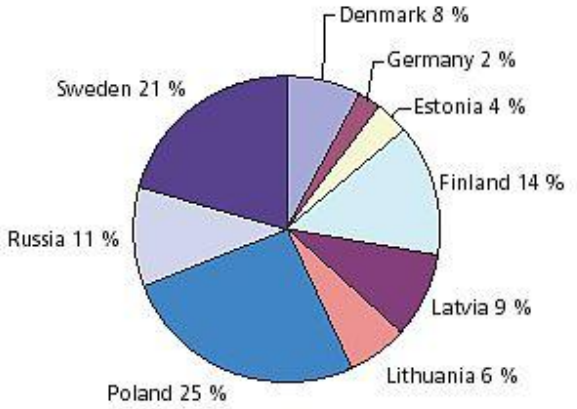
The Mediterranean and the Baltic Sea are most vulnerable to eutrophication, due *to the lack of tides* (Gibraltar, the Kattegat-Skaggerrak). The Mediterranean sea is also warm, which causes major problems, in particular for the Adriatic sea (The river Po!)

http://epp.eurostat.ec.europa.eu



This Envisat image captures blue-green algae blooms filling the Baltic Sea, which is roughly 1600 km long, 190 km wide and has a surface area of about 377 000 sq km. 11 July 2010

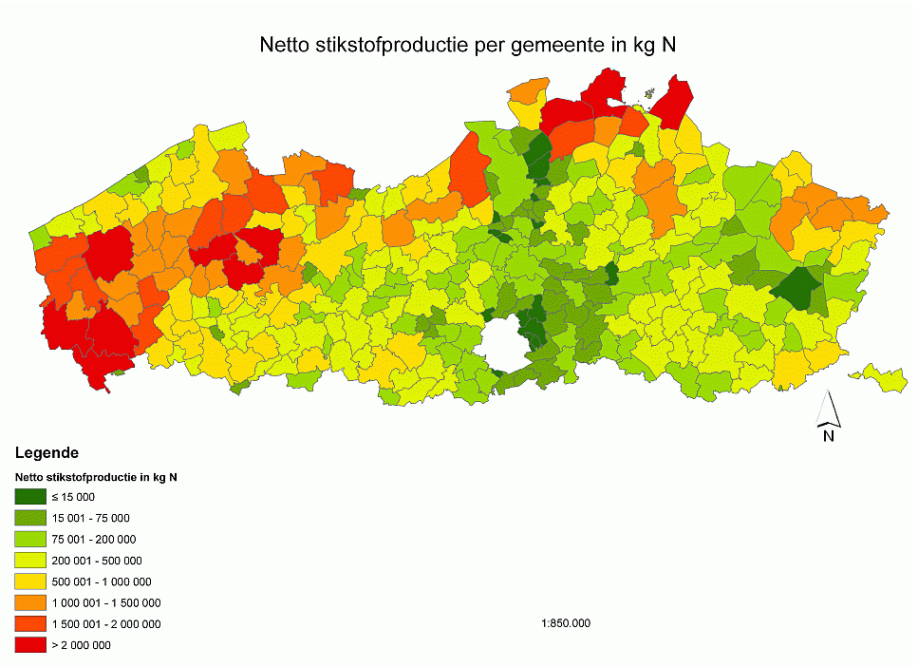
Proportion of waterborne inputs of nitrogen into the Baltic Sea by HELCOM countries in 2000. These inputs include inputs from natural background sources as well as anthropogenic sources

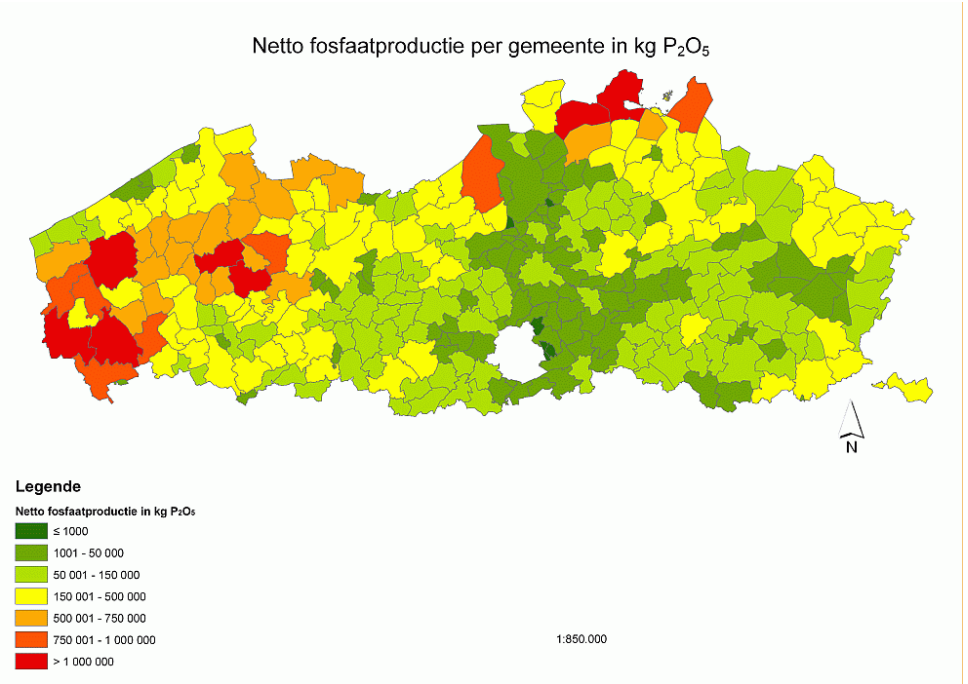


http://www.dailygalaxy.com ; http://onorbit.com/node/2368

http://www.helcom.fi/environment2/eutrophication

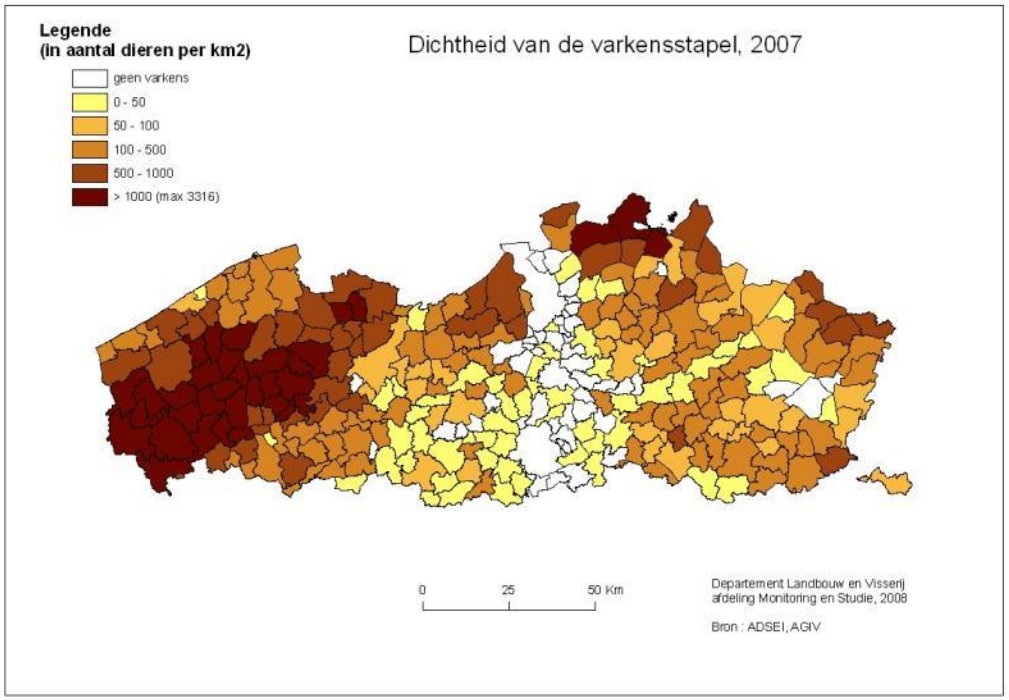
One major reason is the intensive livestock in Flanders



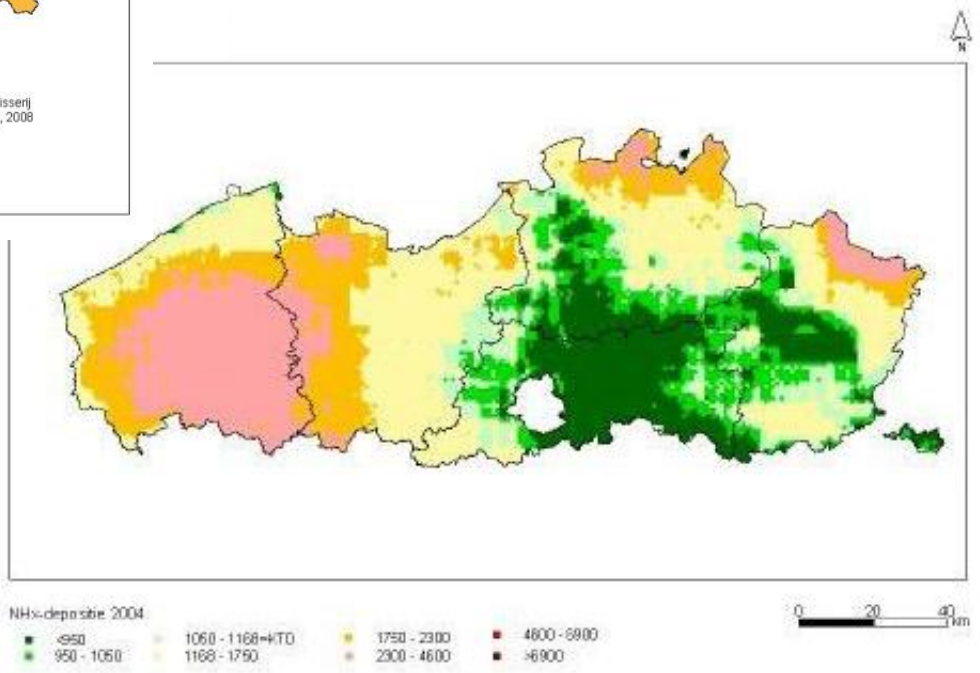


Nitrogen and phosphate production by town in 2007 (VLM, 2008)

One major reason is the intensive livestock in Flanders



Pig population in Flanders (VLM, 2008)



NH_3 deposition in Flanders (VMM, 2005)

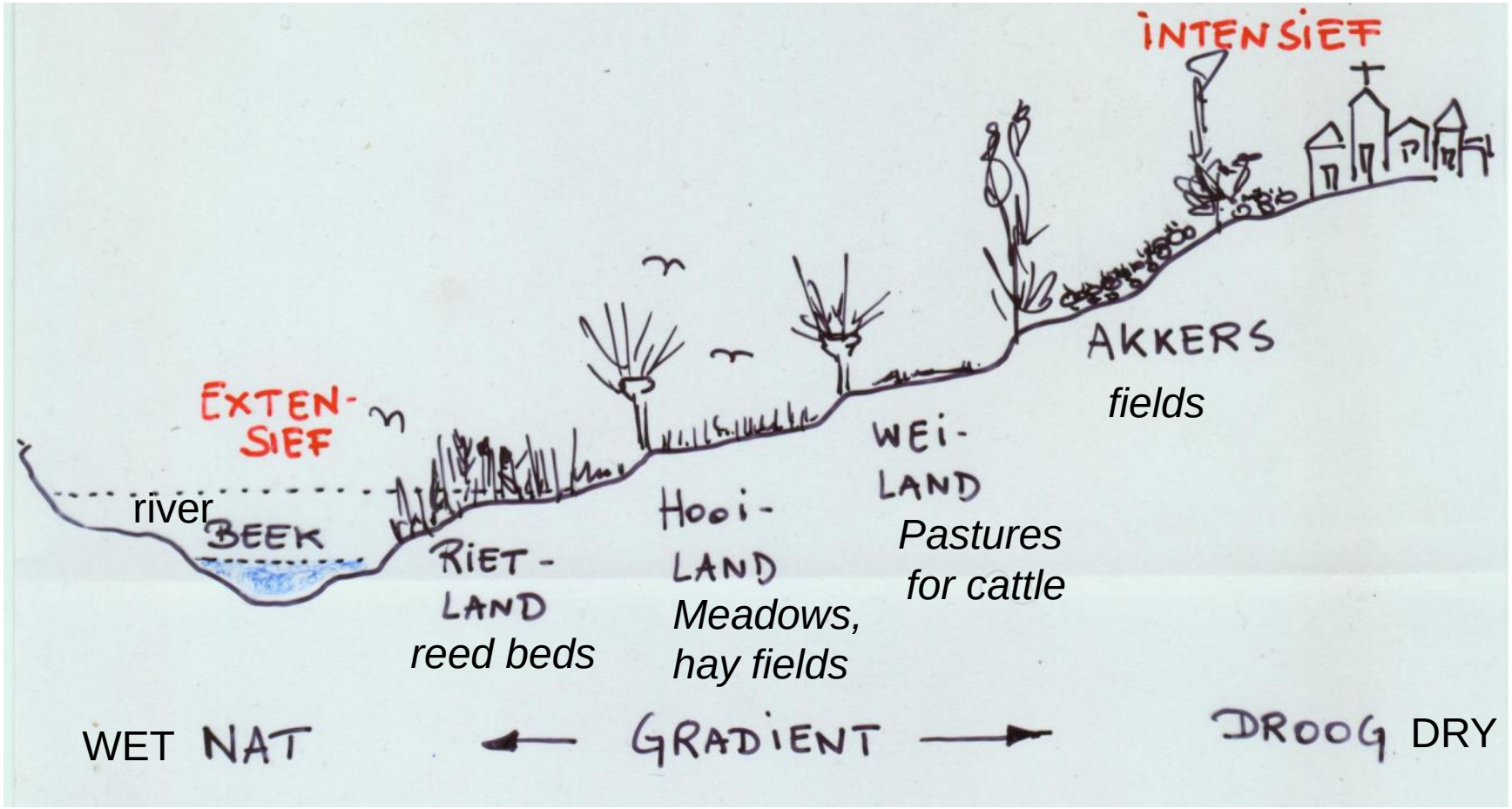
Anthropogenic dynamics.

Under what conditions can human activities be reconciled with the preservation of biodiversity?

The GRADIENT- concept (space)

- Is a gradual, slow transition from one extreme to another extreme abiotic condition : high - low, dry - wet, sandy - clay, open – closed , oligotrophic – eutrophic, ….
- Is a **spatial** concept

The Relation Theory (VAN LEEUWEN, 1966)



A huge spatial variation (landscape diversity, biodiversity) is connected with temporal constantness in human activities.

In fact, people added an extra gradient to the existing abiotic gradients in the landscape: from extensive to intensive occupations

Relation theory of VAN LEEUWEN (1966): time is dominant over space.

- Pattern (spatial) is determined by processes (temporal).
- Ecological sound green management (process) is the cause of a huge spatial diversity with a huge biodiversity (pattern) .
- So urban and rural planning of blue green areas (space) only leads towards high diversity, when the appropriate (ecological) management is applied (time).

- **<u>Earlier</u>**: Very different occupations from one place to another place (depending on the water levels, topography, fertility, etc. ....), but each year the same activities on the same place at about the same moment (depending on rhythm of seasons).

Such a constancy in the processes (time) provides a biodiverse pattern.

- **<u>Today</u>**: Always something else is done, different occupations from one year to another year (depending on market prices, subsidies, etc ....). At the same place, activities quickly change over time.

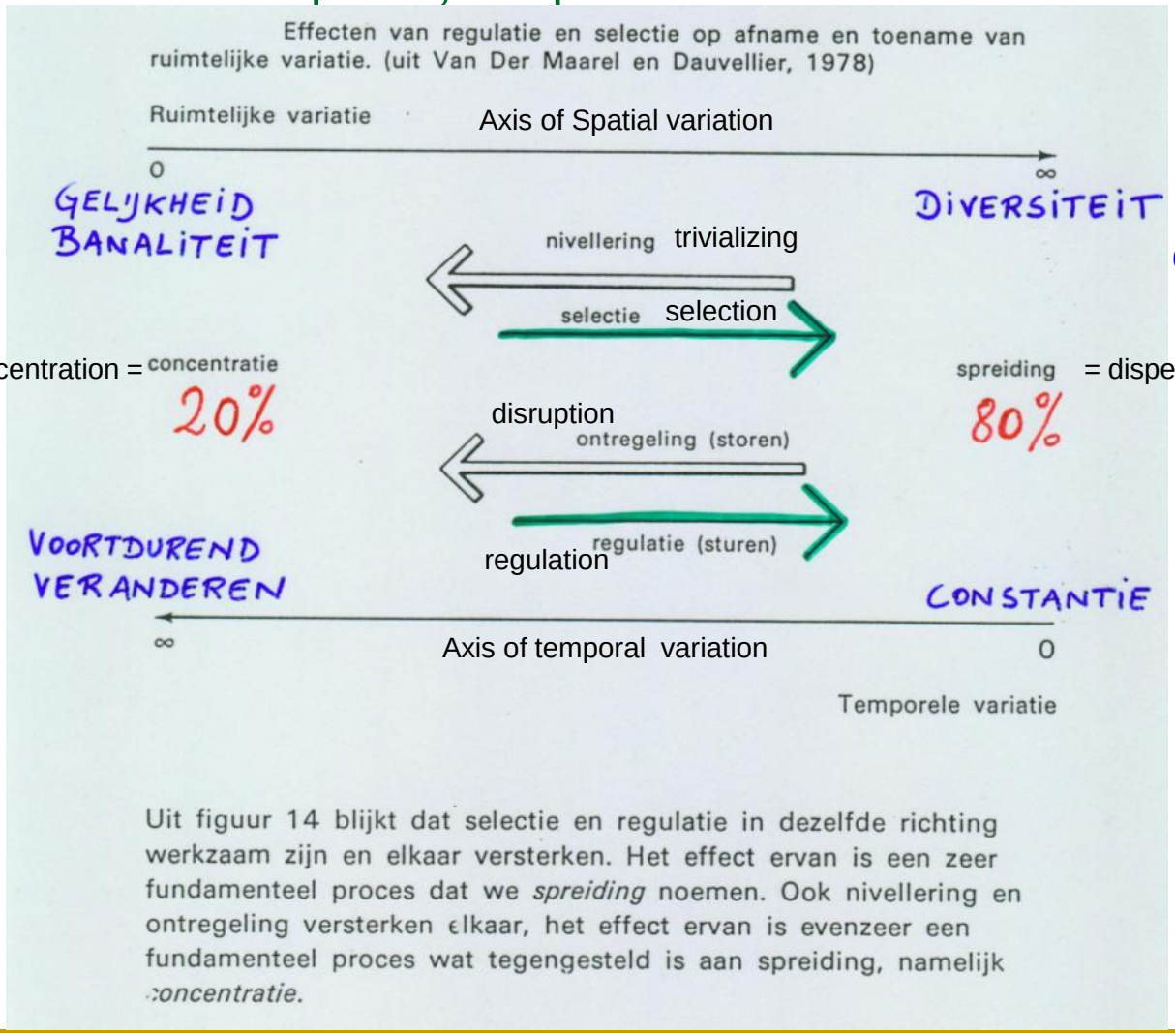
Such ongoing changes in processes lead to banality and trivialization in landscapes

Relation theory (VAN LEEUWEN, 1966)

Time dominates space, so process is dominant to pattern

Equality in space, monotony, general, common

Variety in space, heterogeneity, diversity, particular, unique



Variety in time, disturbance, instability, changes

Constancy in time, permanence, stability, remaining the same

Relation theory (VAN LEEUWEN, 1966)

- Thus **disruption** of processes (*ontregelen*) is preceding **trivializing** (*nivelleren*) of landscapes and of biodiversity. The consequence is **concentration** and **convergence**: few species, few vegetation types. **Instability**.
- **Selection** (*selecteren*) without first **regulating** (*reguleren*) the management processes is meaningless. Selection and regulation work in the same direction of **dispersion** and **divergence**: many species, different vegetation types. **Stability**.

RELATION THEORY (VAN LEEUWEN, 1966) versus SPATIAL PLANNING: summary

- Urban and rural planning (pattern planning) without temporal planning (process planning) has little sense,

because :

- A pattern is always the result of a process (time dominates space).

- So make sure that a spatial plan can (also financially) be reconciled with a management plan (= process), that is proposing for all the planning areas maintainable (in the time) and sustainable, ecologically sound management tools. Only then a bio-diverse pattern will follow from this management.

- So propose green management modes (= processes) that are (financially) viable. E.g grazing, periodic flooding, ... (See lecture)
- Connect with local traditional (agricultural) management (see historical geography)
- Provide resources, people, legislation, etc.

- So ecological sound landscape management is the cause of a great spatial diversity.
- Using the appropriate ecological management techniques (processes) is leading towards a great diversity. (haying to minimize nutrients, grazing cattle, reintroducing flooding,…).

Extensive grazing along the river Rhine Millingerwaard (NL)

Extensive grazing as a (cheap) management tool.

Heckrunderen
(http://www.wildernis.eu/NL/?l1=83.Begrazing)

Red deers (edelherten) in the Oostvaardersplassen

http://www.ark.eu/ark/ark-voor-u/advies-over-natuurontwikkeling/oostvaarderswold

Wisenten *(Bison bonasus, Europese bison)* grazing and pruning
National Park Zuid-Kennemerland (NL) http://www.ark.eu/ark/ark-voor-u/begrazingsbeheer

Gent (B): applying extensive grazing (with sheep)of river banks in the city centre as a cheap management tool.

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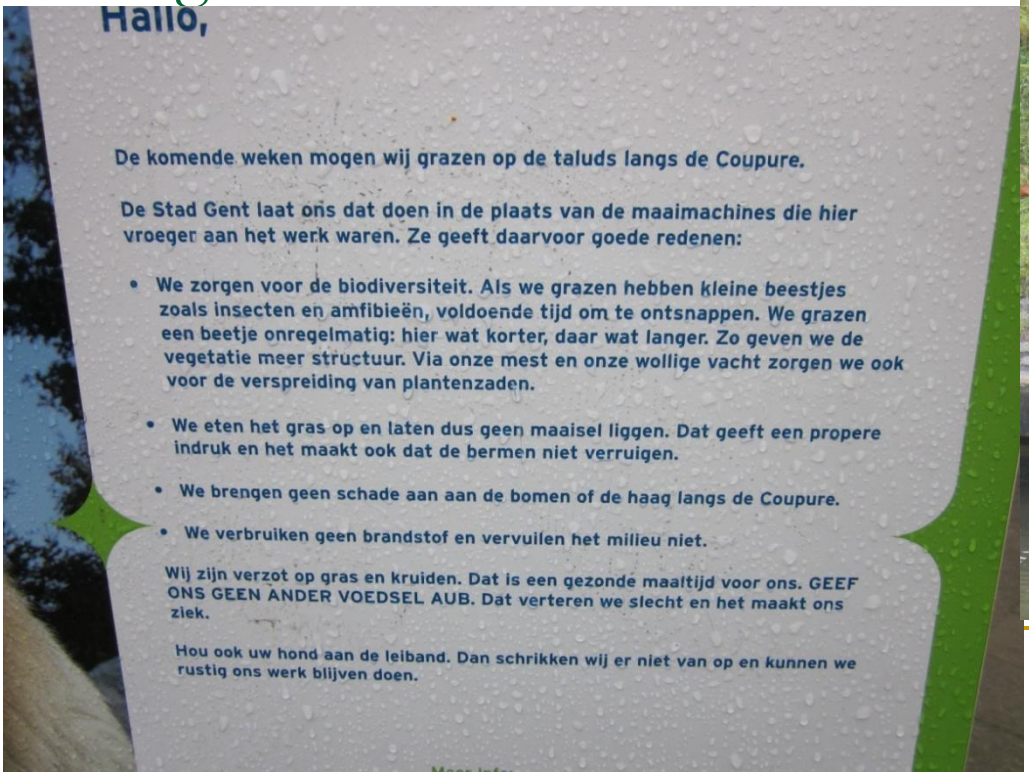


Delft (NL): changing towards ecological ***urban river bank management***. The lawn management is still very intensive. The Blue Heron *(Ardea herodias)* needs not only a correct **pattern** (gradient) but also a correct **process** (ecological management)

Too intensive (mowing) management (*process*) leads to sharp borders and low biodiversity (*pattern*)

Hingene (B)

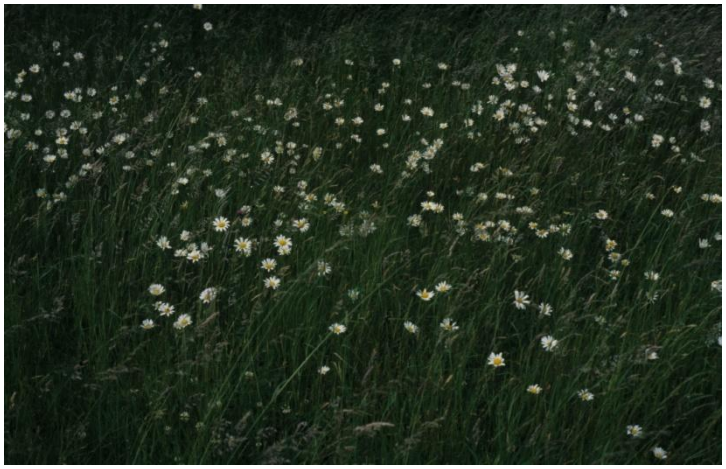
These insights are applied to the management of roadsides, Wallonië (B.),
Extensive and late haying increases biodiversity

Ecological green management in city park Aalst (B.)

Bosorchis (Dactylorhiza fuchsii)

A growing area of the lawns are maintained, using ecological principles. Haying once or twice a year decreases the amount of minerals such as nitrogen and phosphorus. As a consequence rare orchid species occur again in this urban city park.

Shifting towards ecological green management, enhancing biodiversity
Heks (Limburg, B.)



A compromise was found: intensive lawn management along the paths, (cheaper) ecological sound grassland management elsewhere.

Also in small (city)gardens, nature value increases enormously, when those ecological principles are applied.

De Klinge (B)

Sint-Gillis Waas, B (with an ecological swimming pond)

High water levels forced people to extensive activities.

Hayfields

The seventh month (July) was once the hay month in Western Europe.
By then the spring flowers produced seeds and all the young birds fledged.

'*Wetlands with high significance for biodiversity*' for some people, for others '*worthless swamps*'.

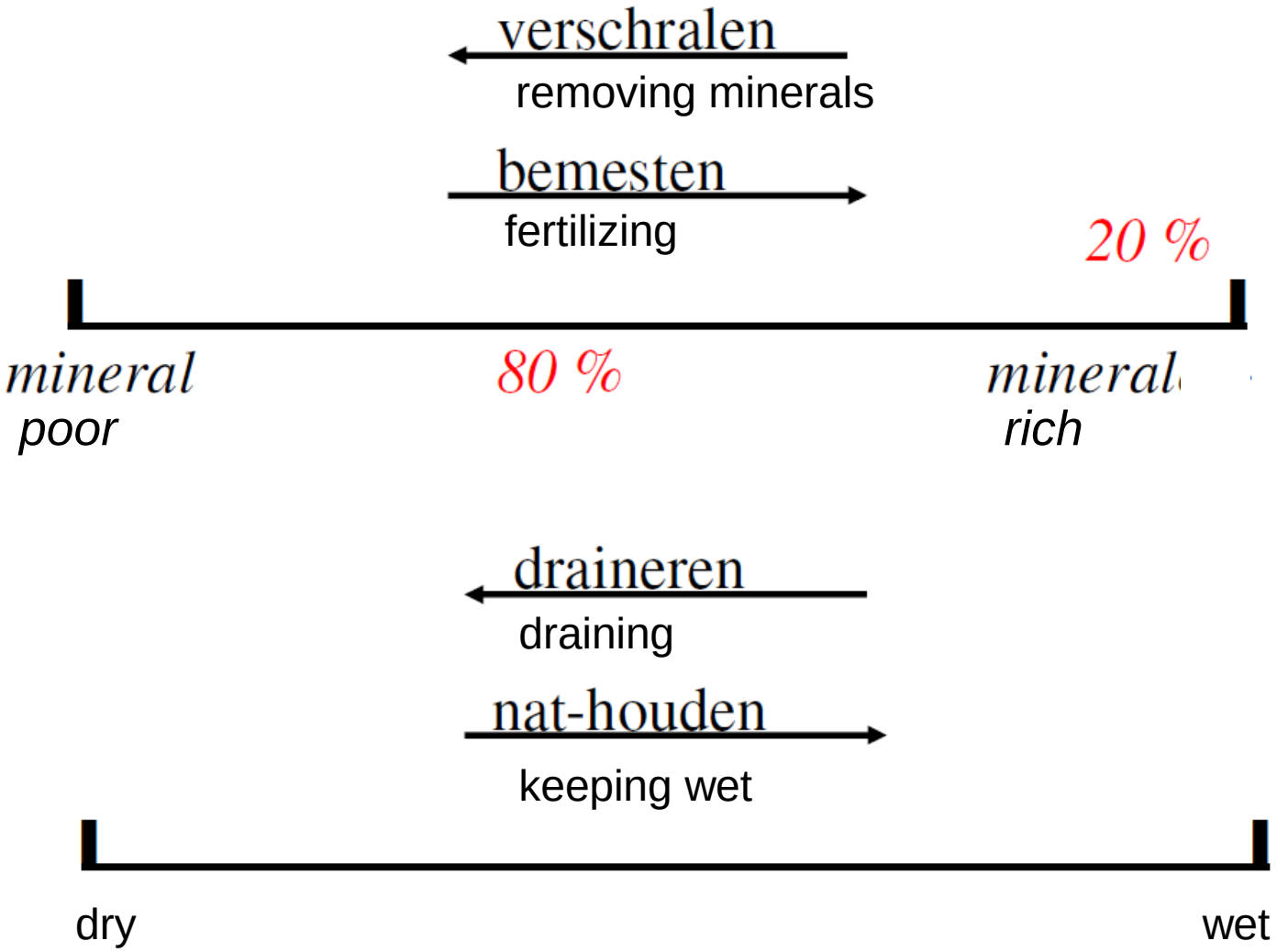
Haying as a management tool

Haying removes nutrients, a poorer soil is attractive for a lot of species such as this orchid species (e.g. :*Dactylorhiza majalis*).

Drainage for intensive agriculture.

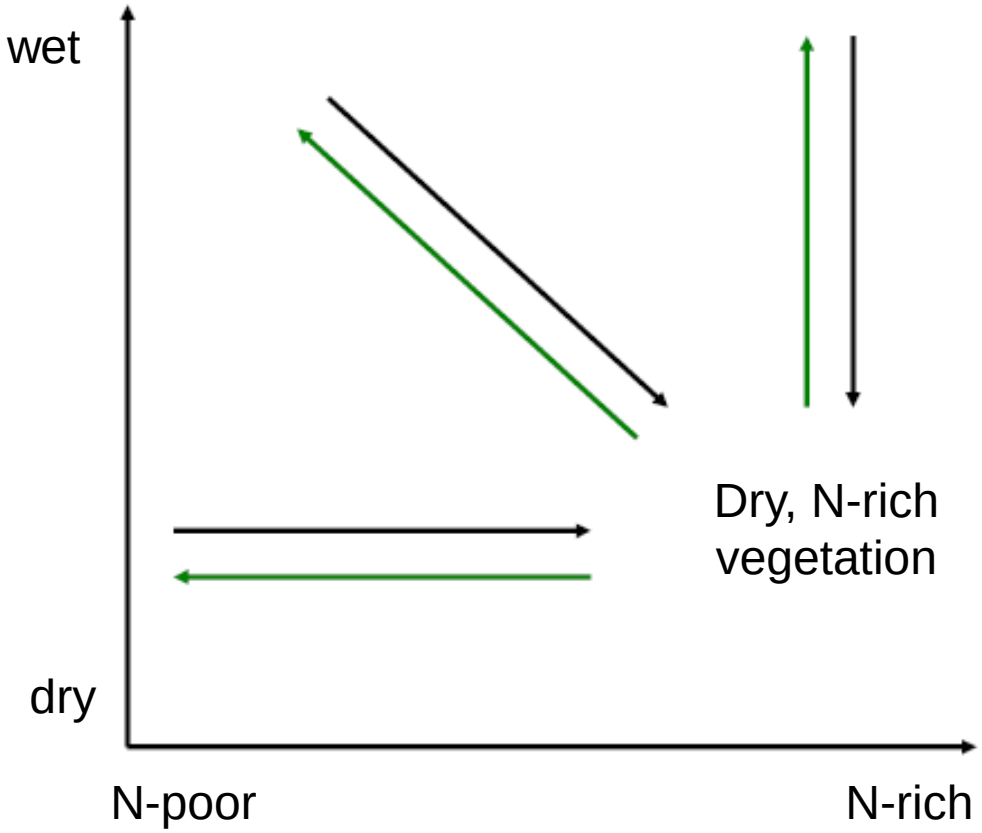
Drainage is accelerating mineralization processes and more minerals are released into the soil which become **drier** and **richer in nitrogen**.

ANTHROPOGENIC DYNAMICS: Features and Terminology



ANTHROPOGENIC DYNAMICS.

Culture technology versus nature technology



culture technology

Draining and fertilizing

Convergent: banalities

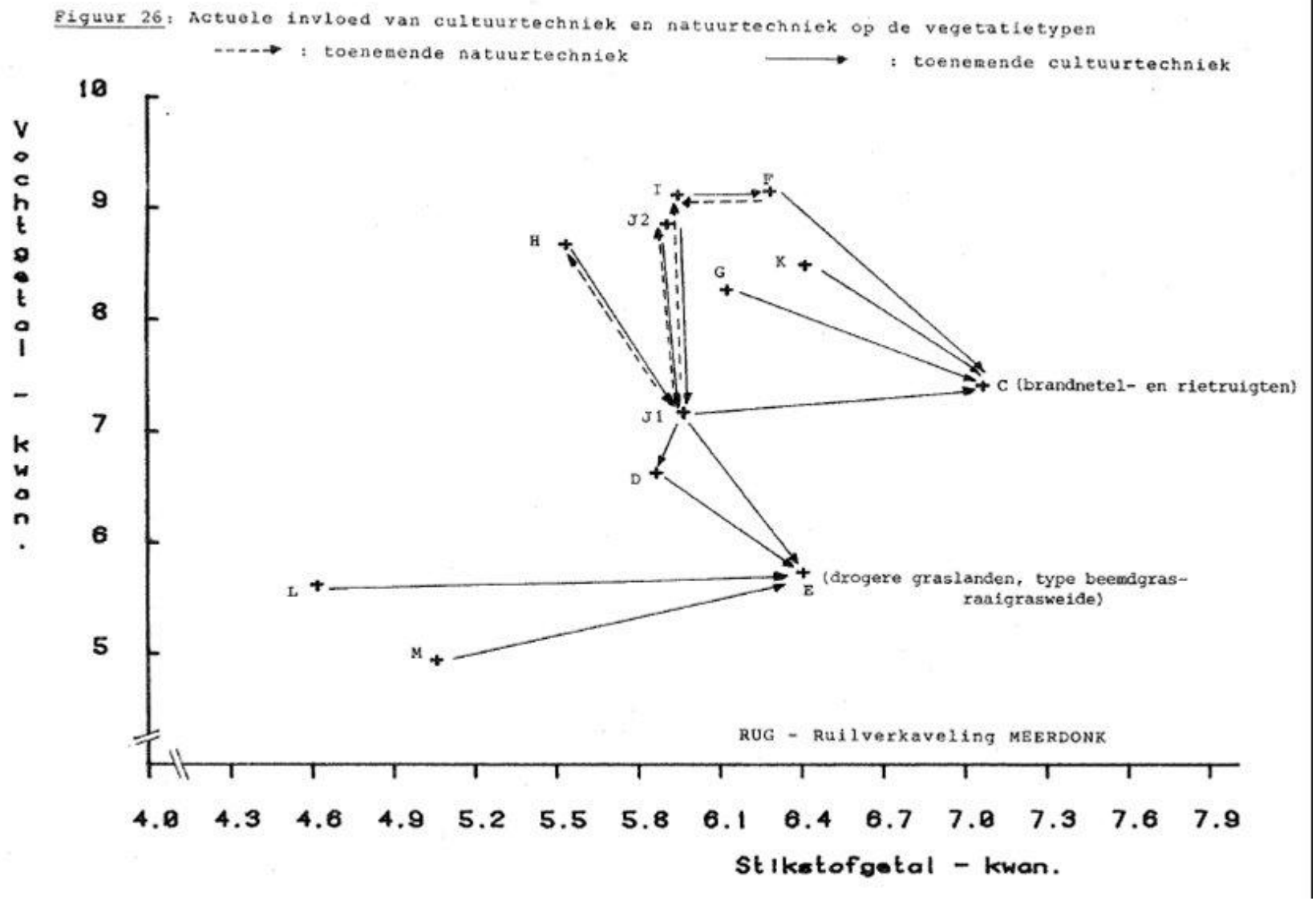
nature technology

Keeping wet and removing minerals

divergent: diversities

Meerdonk (B): Water level is too low (after land consolidation), which causes severe desiccation of the nature reserve, upstream.

Culture technology versus nature technology.



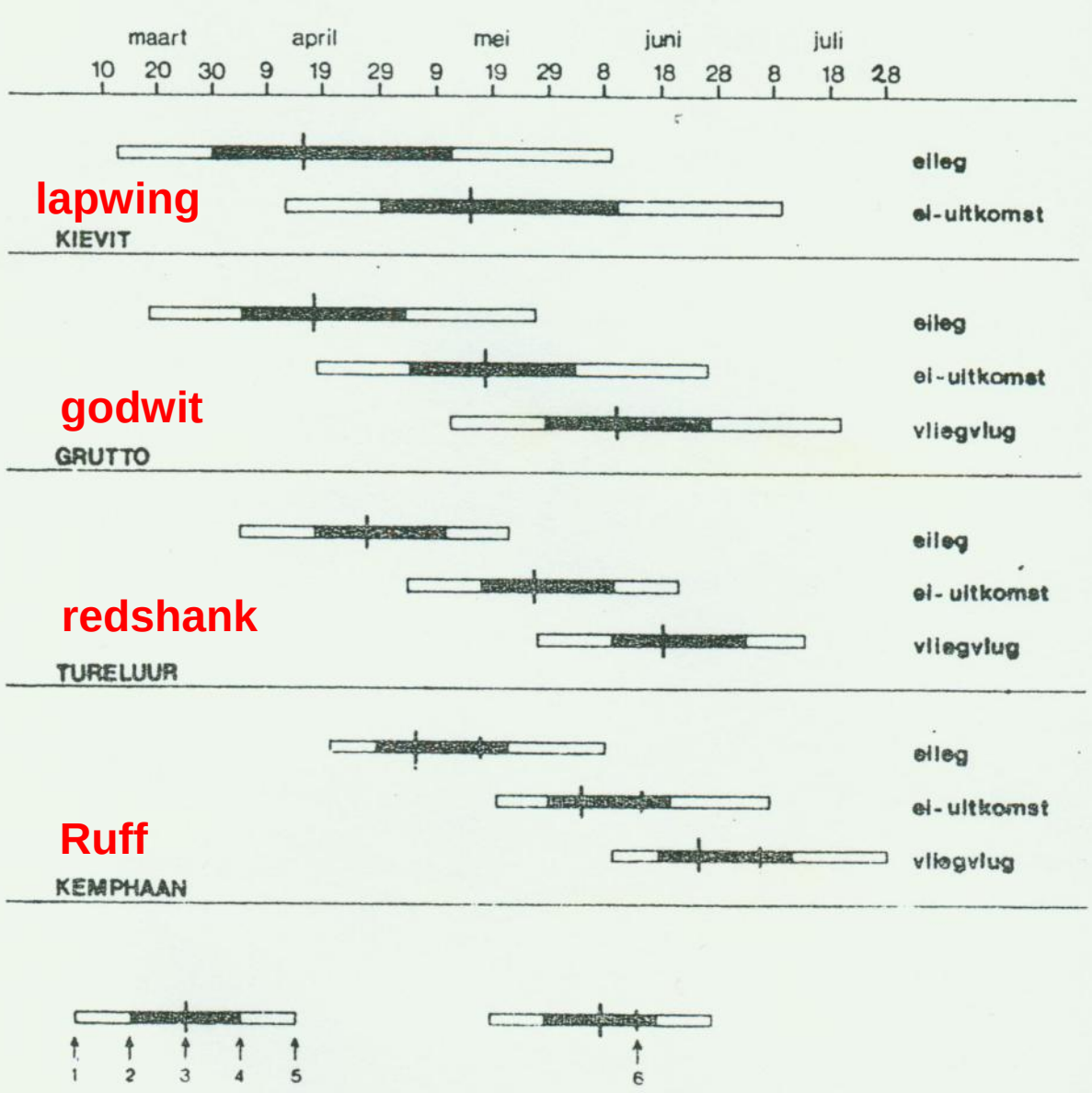
Impact on vegetation in the nature reserve 'the Salegemkreek "in Meerdonk (B) (from Rombaut, 1982).

Example: impact of intensification on farmland birds.

The **pheasant (fazant)** (l) and **lapwing (kievit)** (r) are relatively unaffected by desiccation and eutrophication

But ground-nesting **godwits (grutto)** (l) and certainly **Ruff (kemphaan)** (r) are highly endangered

An earlier hay date causes problems for late-nesting meadow birds such as **redshank (tureluur)** and **godwit (grutto)**.
For the early breeding species **lapwing (kievit)** this is an advantage.



Figuur 31 (uit BEINTEMA & MUSKENS)

Fenologie van weidevogels in de broedtijd.
1 = eerste datum, 2 = 10%, 3 = 50% (mediaan), 4 = 90%, 5 = laatste datum. Kemphaan: 6 = 90% met weglating van buitendijkse (= vroege) broedsels (10% en 50% blijven nu ook).

- Not only the environmental conditions themselves are affected, but also the land use (process) changes: the grass haying (cutting) time is forced.
- Previously, the month of July was the hay month. Today there is often in May or even late April, a first hay cut : intensification.
- This leaves the ground breeding bird species injured.

Meerdonk (B). The intact creeks landscape before land consolidation took place. In the slow gradient from wet to dry land, the farmers land use was adapted to the conditions

After land consolidation: extensive grasslands, meadows and pastures disappeared, intensive agriculture appeared: land use (process) is strongly intensified.
Eutrophication and desiccation increased.

Meerdonk (B): the nature reserve is poisoned, dried, and mineral rich.

Result: nitrophilous species such as nettle (*Urtica dioica)* extend en masse, to the annoyance of the farmers who take action with herbicides.

Heure-en Famenne (B). Sign: pasture with protected plants

It would therefore be quite possible that this sign stays longer here, than the plants themselves, if the curator has no impact on the adjacent land, to avoid **negative horizontal relationships**

So horizontal ecological relations are very important for an ecologically sound urban and rural planning (see theme 8).