Principles of sustainable land use

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International training course
Sustainable Agriculture in Wetlands
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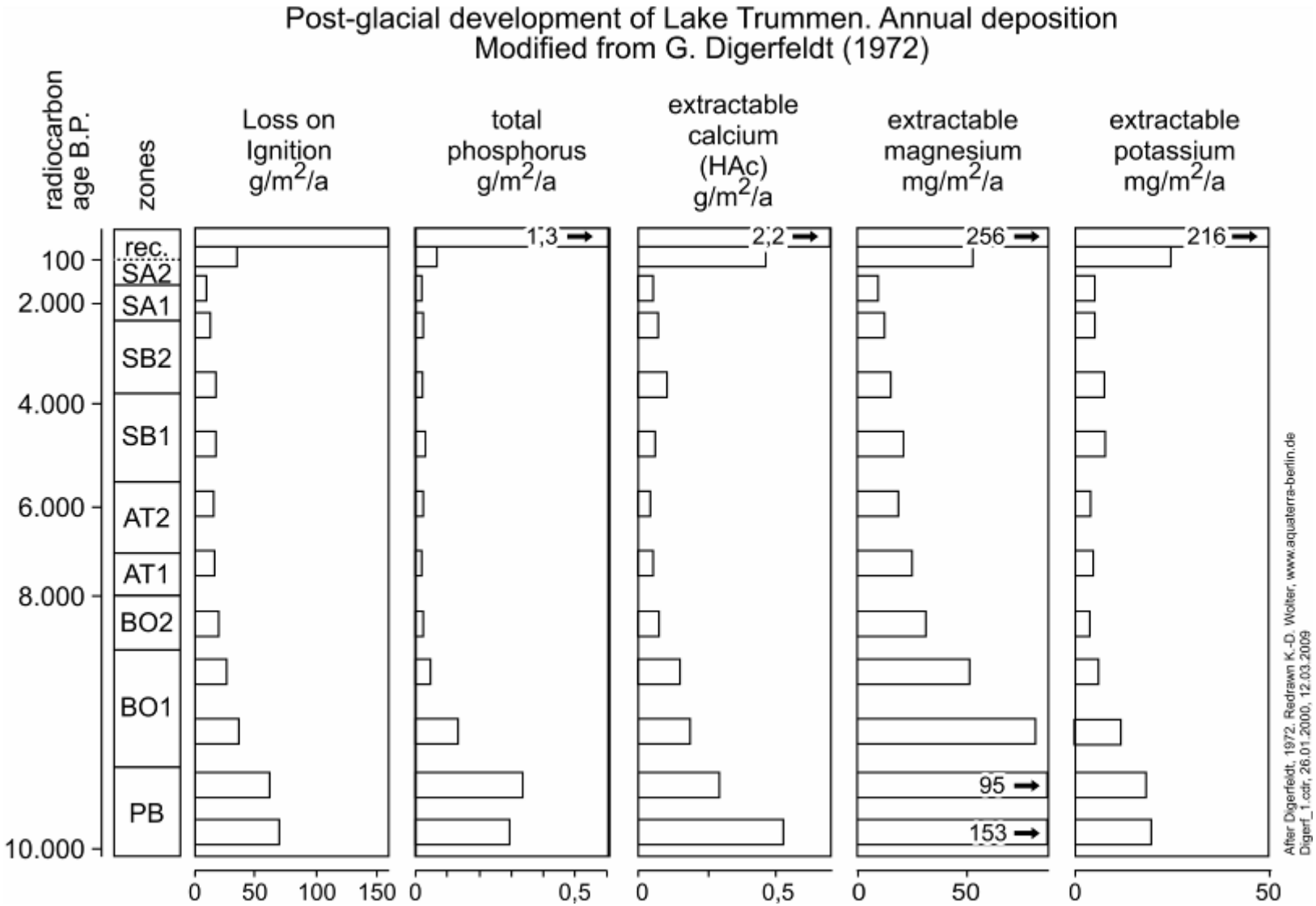
Sustainability - definition

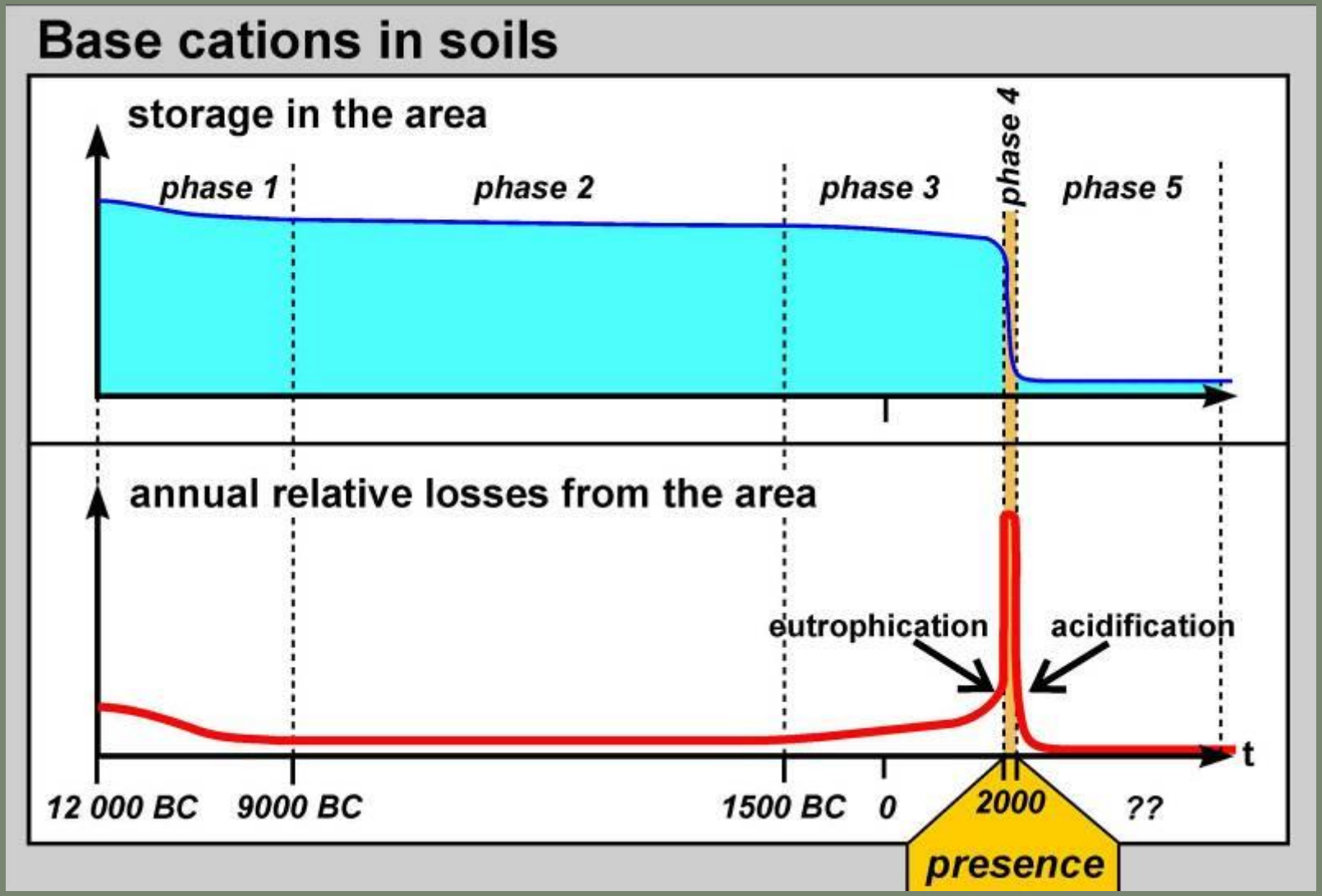
Sustainability is about following practices that we expect will not deplete or destroy critical resources.

For sustainable agricultural and forestry land use the critical resources are fertile soils and water.

Vegetation cover and material flows



Matter losses since the last glaciation



Water and matter cycles – 4 phases of landscape development

Development of agriculture
- destruction of natural vegetation cover
- drainage, lowering of water table
- enhanced mineralisation
- increased water outflow
- losses of dissolved matter
- eutrophication of waters

?? Desertification??

After de-glaciation:
- vegetation and soil develop.
- high soil erosion
- high leaching of matter
- high production of waters
- high sedimentation

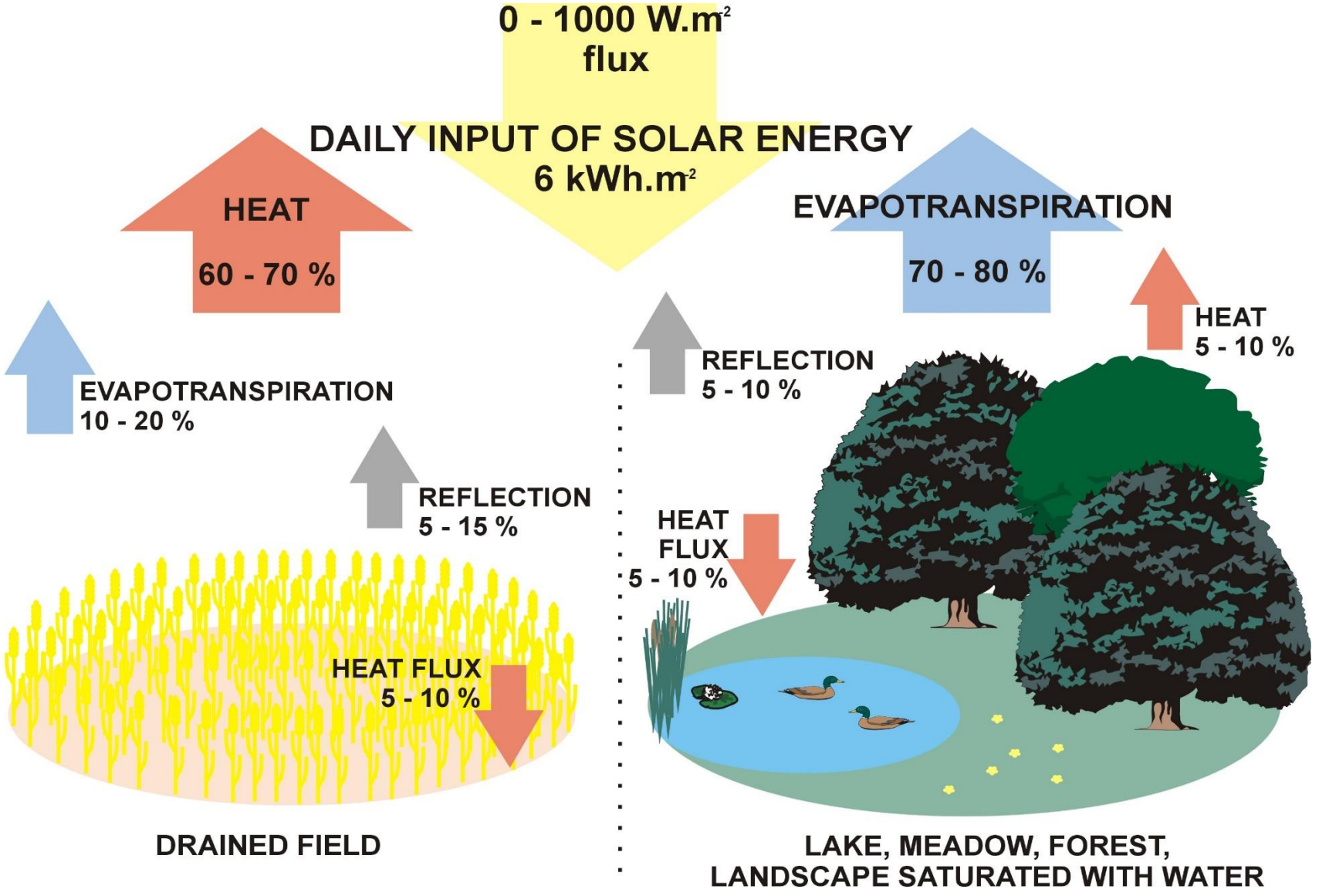
Climax:
- closed matter cycles
- short-circuited water cycle
- minimum losses of water and matter

W. Ripl

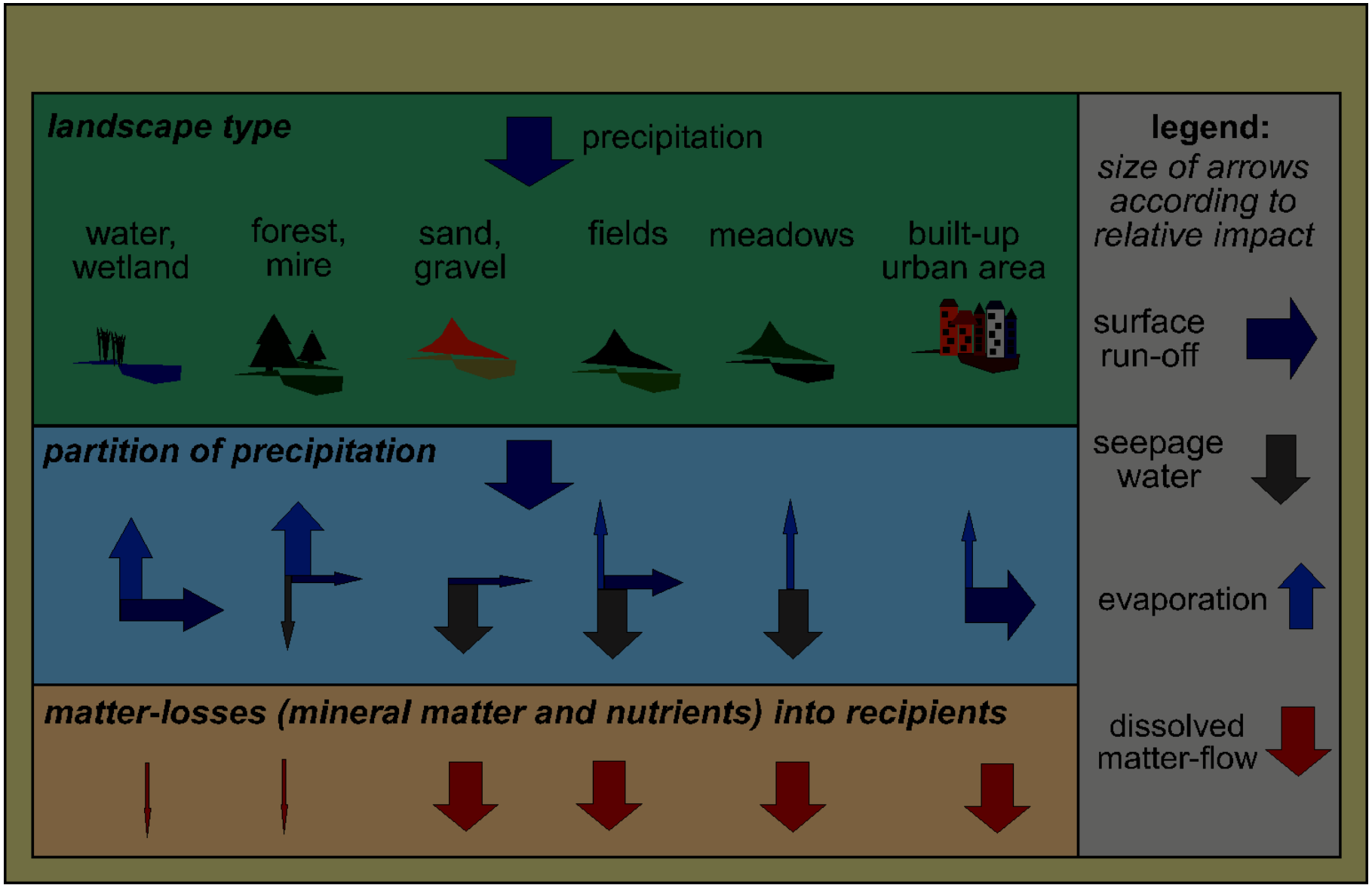
Nature as a dynamic energy-dissipative process

- It controls mechanical and chemical processes close to the soil surface and distributes thereby organisms, it eliminates randomness, minimises material flows, and increases sustainable development
- It controls the atmosphere with respect to its process dynamics, composition and distribution
- It controls temperature- and moisture patterns in space and time
- It structures and distributes processes in the landscape by means of the dynamic medium water

Dissipation of solar energy in ecosystems

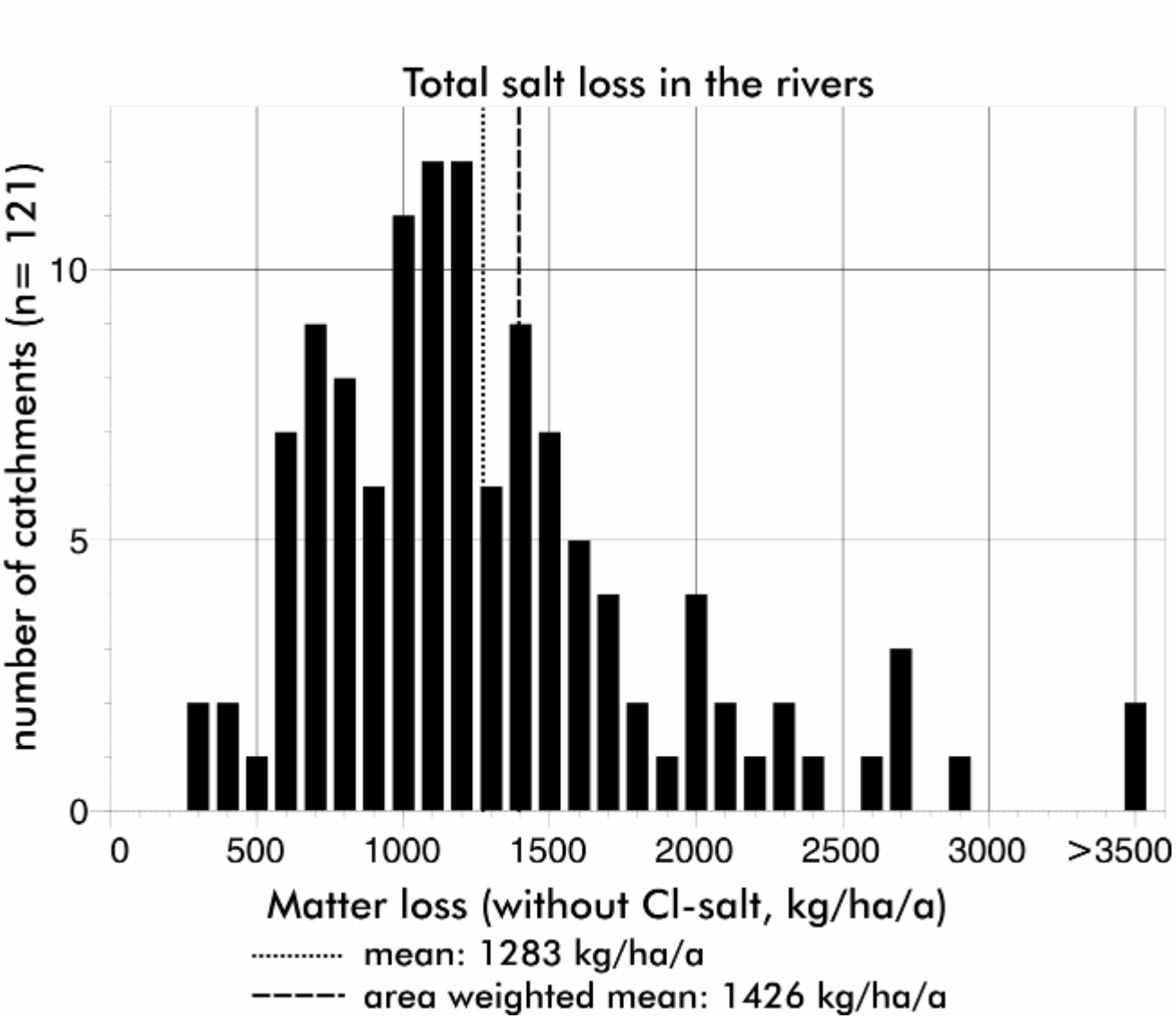


Matter losses in different landscape types



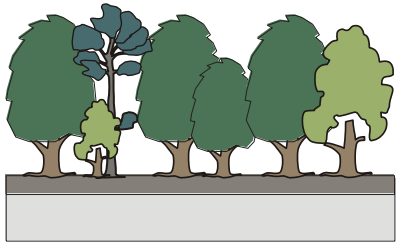
Source: Ripl 1995

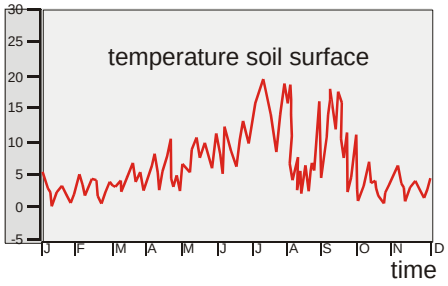
Losses of matter via rivers

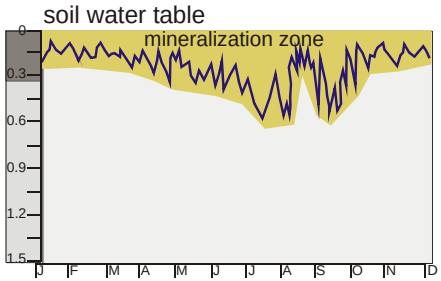


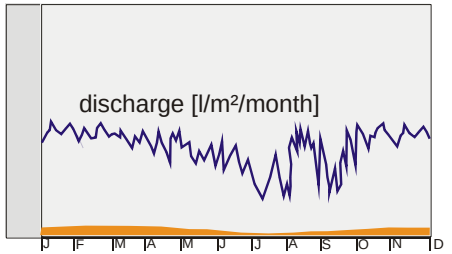
Indicators for sustainable and non-sustainable water cycle and landscapes

Natural ecosystem

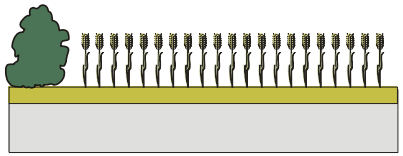


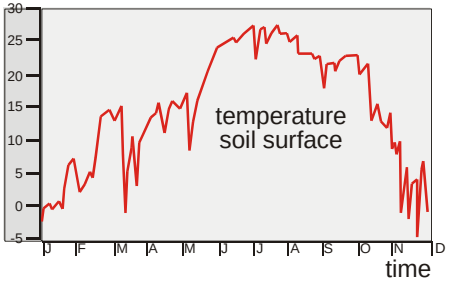


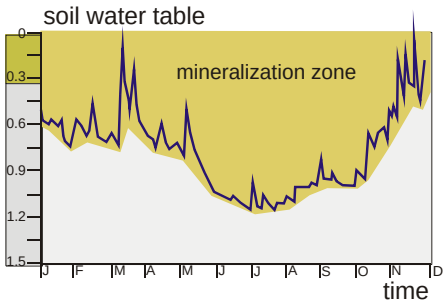


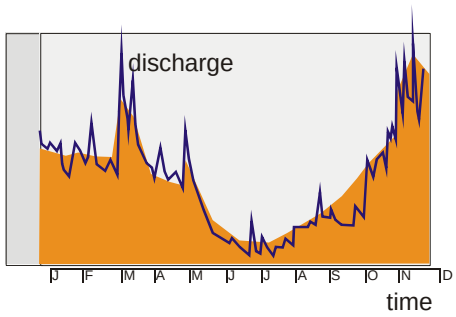


Disturbed ecosystem









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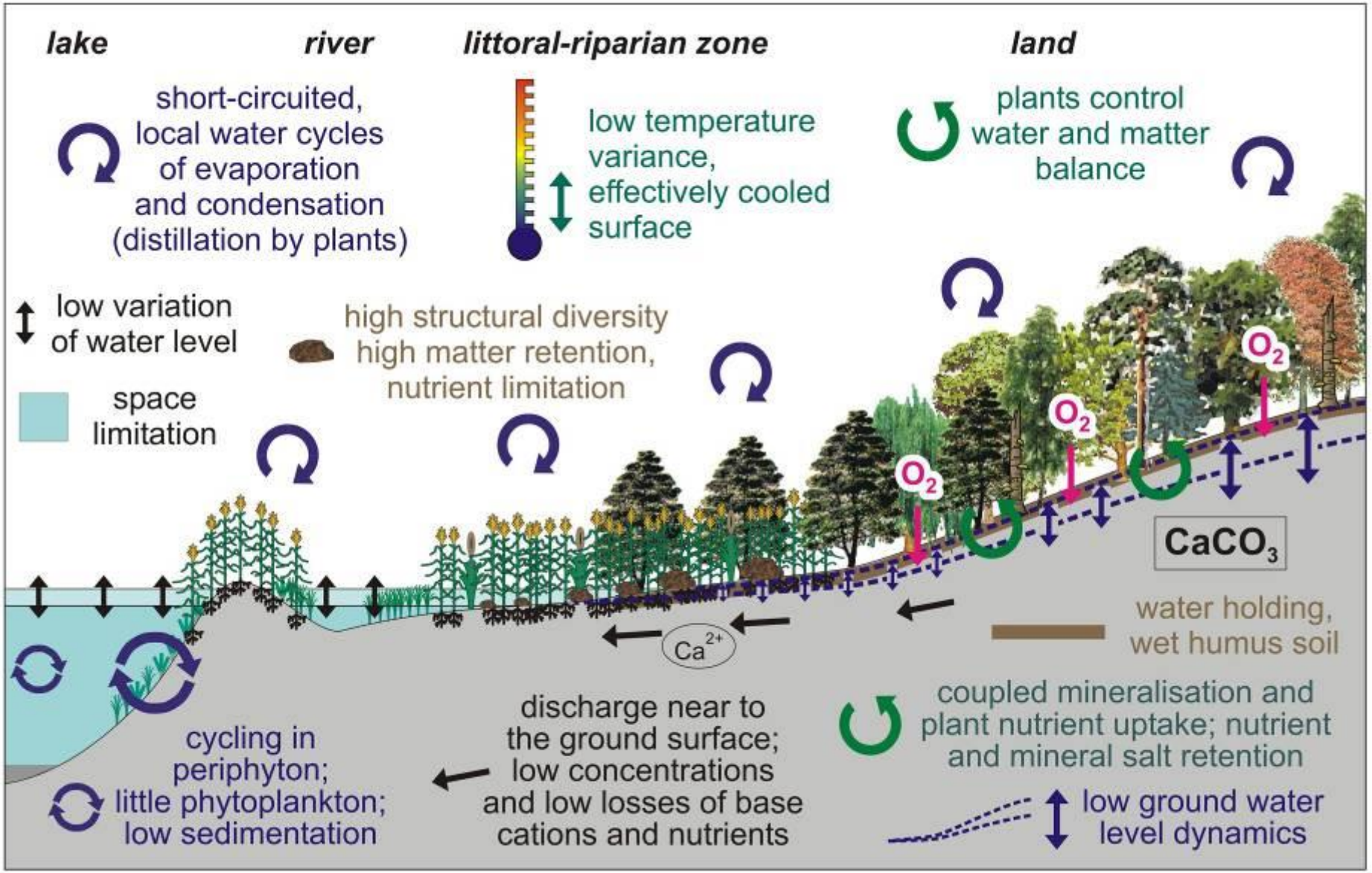
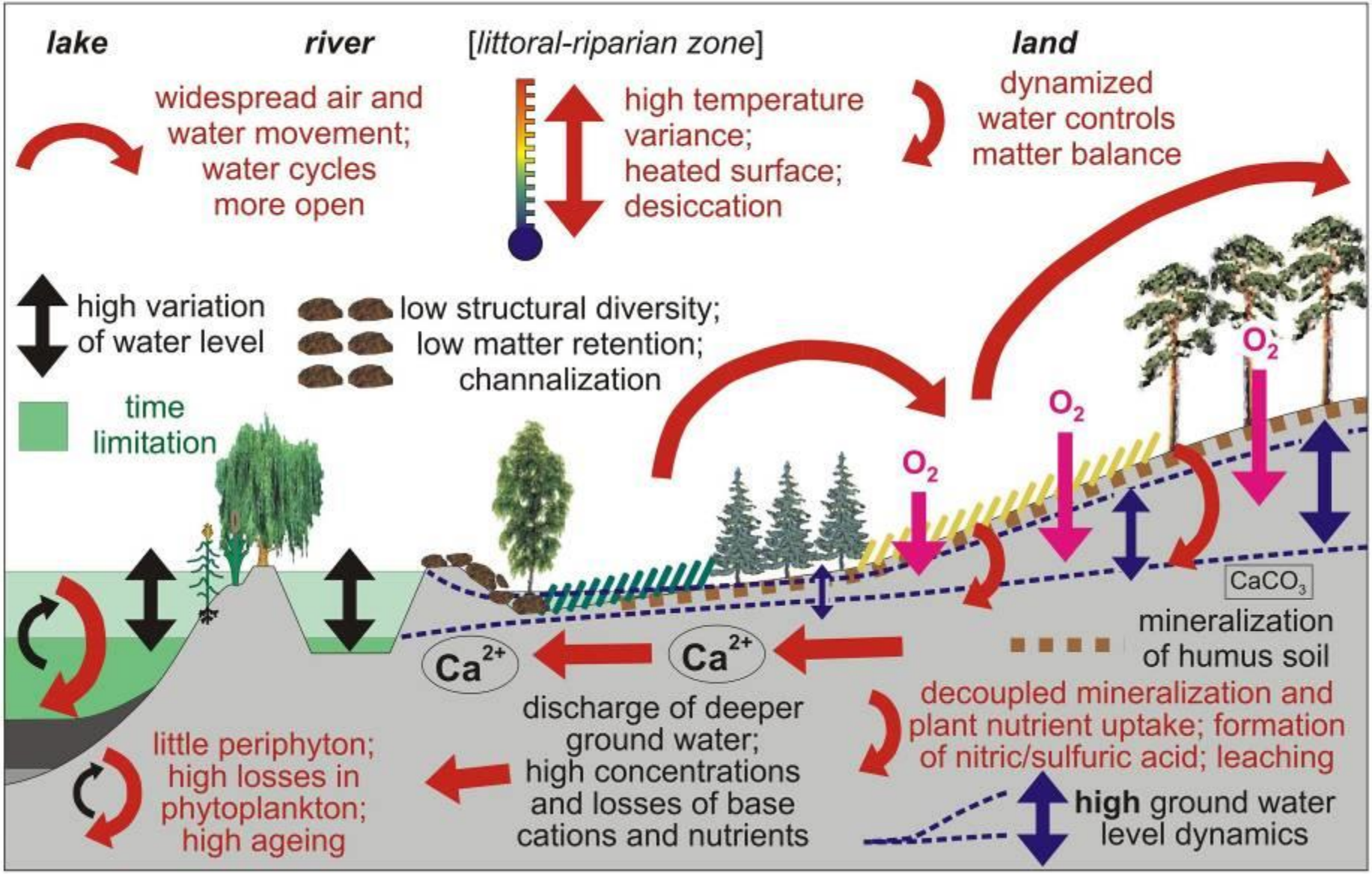
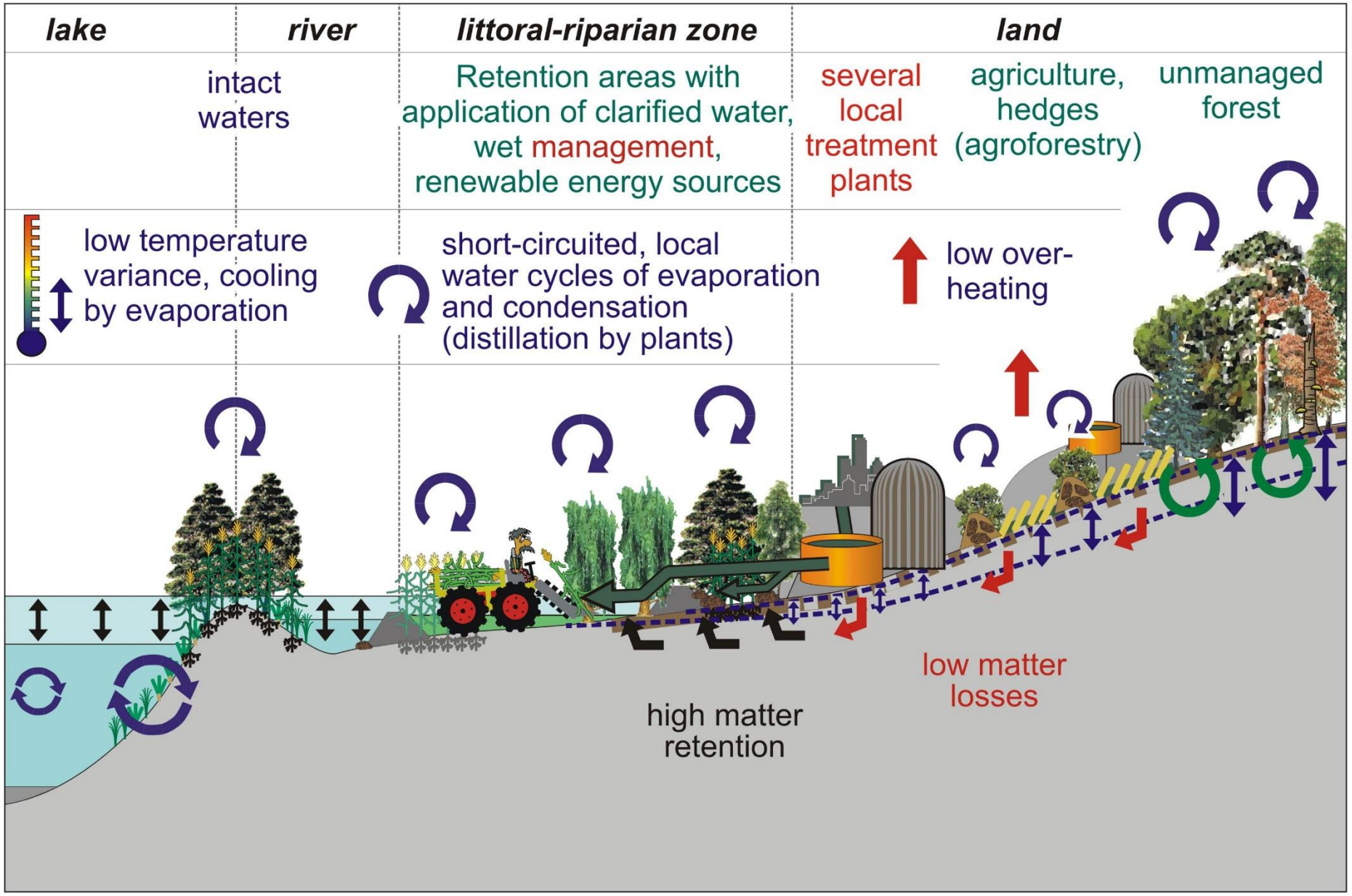
From Ripl et al.


lake
river
littoral-riparian zone
land
short-circuited, local water cycles of evaporation and condensation (distillation by plants)
low temperature variance, effectively cooled surface
plants control water and matter balance
low variation of water level
space limitation
high structural diversity high matter retention, nutrient limitation
O2
O2
O2
CaCO3
water holding, wet humus soil
Ca2+
coupled mineralisation and plant nutrient uptake; nutrient and mineral salt retention
cycling in periphyton; little phytoplankton; low sedimentation
discharge near to the ground surface; low concentrations and low losses of base cations and nutrients
low ground water level dynamics

W. Ripl


lake
river
[littoral-riparian zone]
land
widespread air and water movement; water cycles more open
high temperature variance; heated surface; desiccation
dynamized water controls matter balance
high variation of water level
low structural diversity; low matter retention; channalization
time limitation
O2
O2
O2
CaCO3
mineralization of humus soil
Ca2+
Ca2+
discharge of deeper ground water; high concentrations and losses of base cations and nutrients
decoupled mineralization and plant nutrient uptake; formation of nitric/sulfuric acid; leaching
high ground water level dynamics
little periphyton; high losses in phytoplankton; high ageing

W. Ripl


lake
river
littoral-riparian zone
land
intact waters
Retention areas with application of clarified water, wet management, renewable energy sources
several local treatment plants
agriculture, hedges (agroforestry)
unmanaged forest
low temperature variance, cooling by evaporation
short-circuited, local water cycles of evaporation and condensation (distillation by plants)
low over-heating
low matter losses
high matter retention

Resolution XIII.19. Sustainable Agriculture in Wetlands

Adopted at COP 13 in Dubai (October 2018)

Link to the Text of the Resolution

Definition of the term “agriculture“ - UN FAO

Article I paragraph 1, second sentence of the Constitution of the Food and Agriculture Organization of the United Nations reads: ‘In this Constitution, the term “agriculture” and its derivatives include fisheries, marine products, forestry and primary forestry products.’

Wetland loss

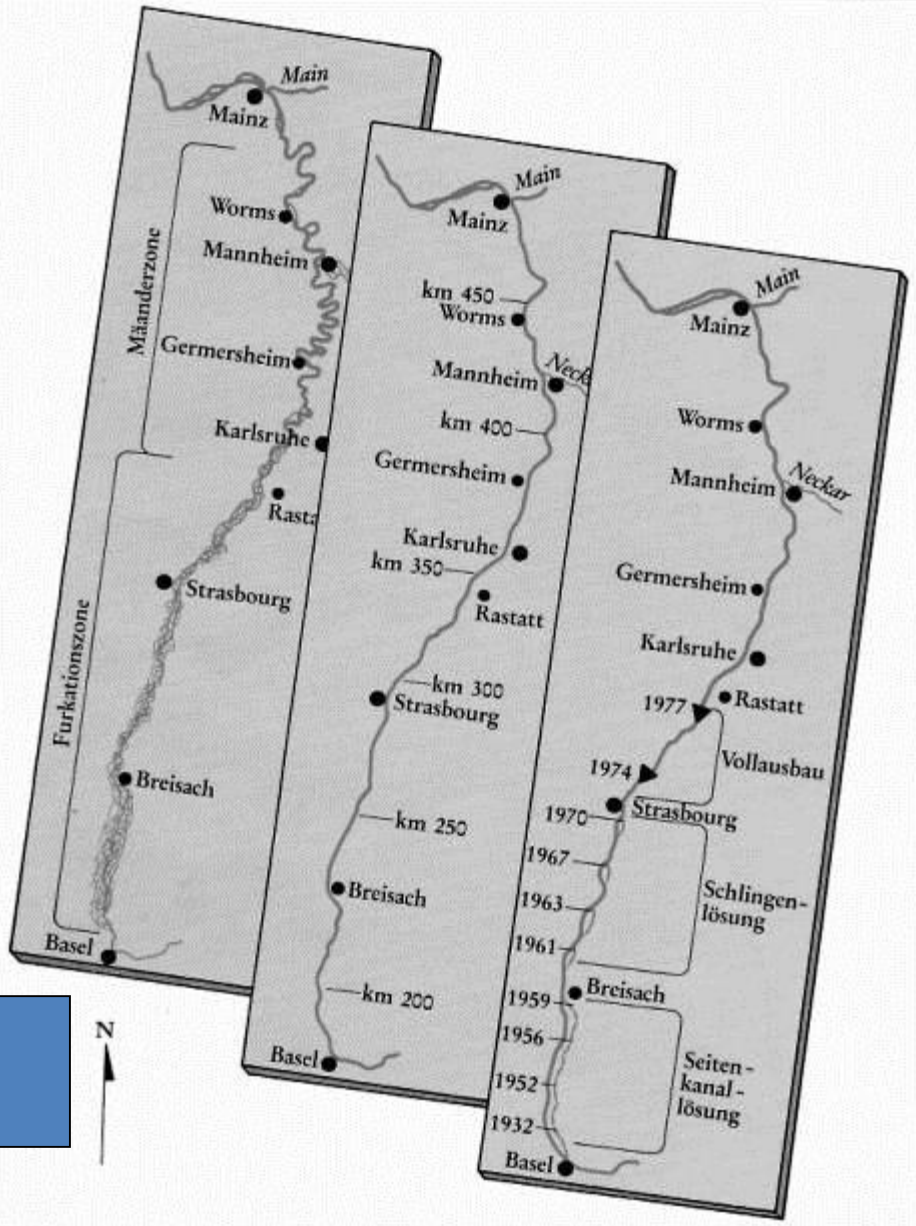
Regulation of the Upper Rhine River

Floodplain loss of 85 %

Günther-Diringer 2003

Peter Birmann

Upper Rhine River, 1817, 1878, 1977
2038 km² → 296 km²



Floodplain loss on the Danube River

Upper Danube	1762 km^2	95 km^2	95 %
Central Danube	8161 km^2	2002 km^2	75 %
Lower Danube	7862 km^2	2200 km^2	72 %
Danube Delta	5402 km^2	3799 km^2	30 %

WWF Auen Institut 1999

Drainage of agricultural land in the Czech Republic

Soil survey (1960-1972)

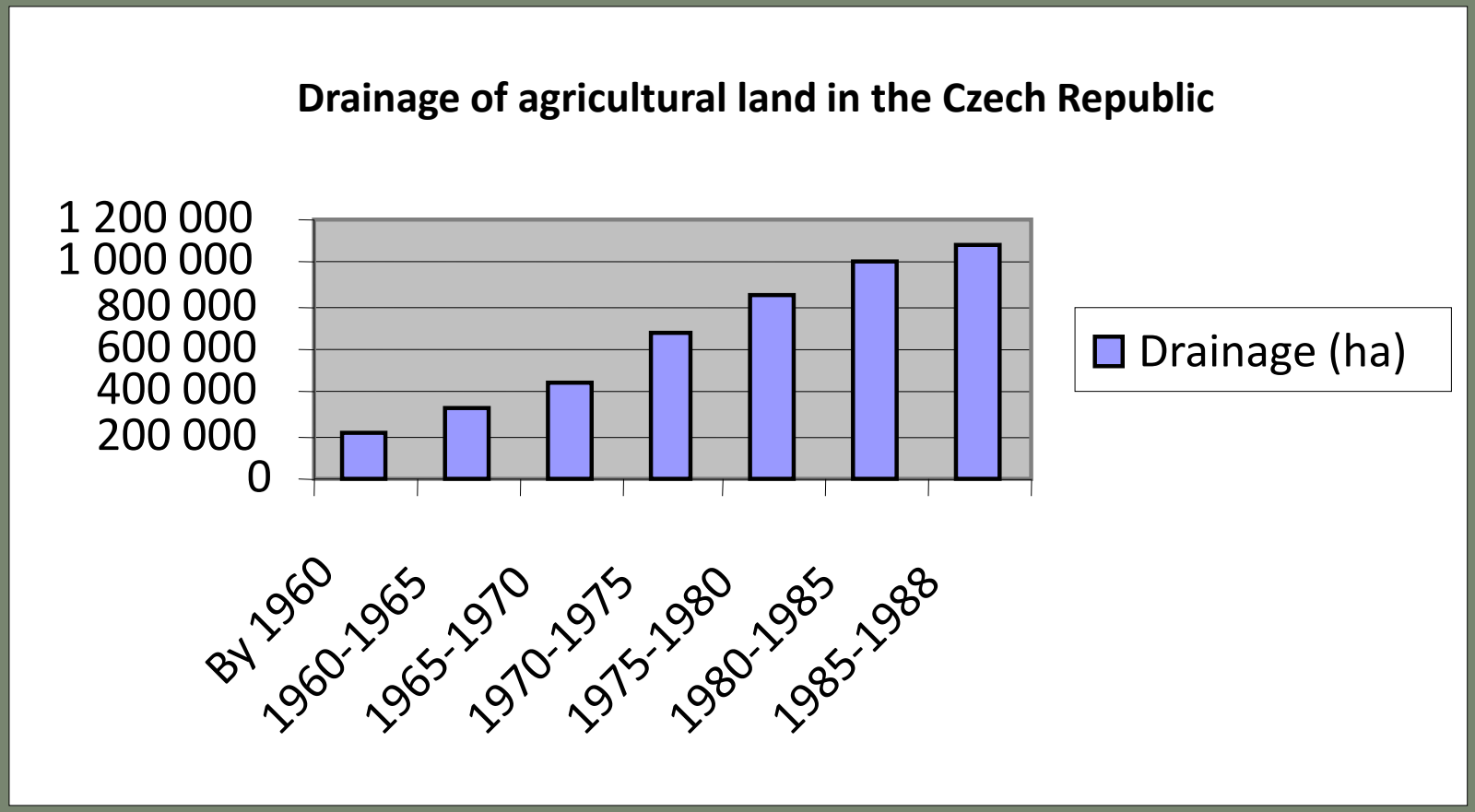
- **waterlogged: 843 781 ha**
(19 % of agricultural land)
- **drained: 1 084 000 ha**
(25,3 % of agricultural land)

Problems that occurred

- **Water erosion**
- **Wind erosion**
- **Soil organic matter degradation**
- **Degradation of soil structure**
  – **soil compaction**
- **Reduced water retention capacity**
- **Transport of nutrients and pollutants to waters**

Source: VÚMOP; photo Jan Vopravil

Wetland destruction and degradation



Springs

Almost 90 % of spring areas were drained in the Czech Republic

Fishponds

16th century 180 000 ha, at present 52 000 ha in the Czech Republic

Reclamation of floodplains for agricultural use = wetland loss

Also small streams were straightened and deepened

Drainage of peatlands for timber production or peat extraction

Impacts of the intensification of agricultural practices on wetlands

Photo by: Jan Pokorný

Eutrophication

Photo by: Sven Björk

Overgrowing by reed and terrestrialization

(Potentially) sustainable uses


Reed harvesting


Floodplain forest – wood production


Fish harvest

Agriculture in wetlands

Lake Mikri Prespa, Greece

LIFE project 2002-2007; 70 ha of wet meadows restored (total area of wet meadows 100 ha). Production of hay and grazing of water buffaloes and cattle

Return of many bird species

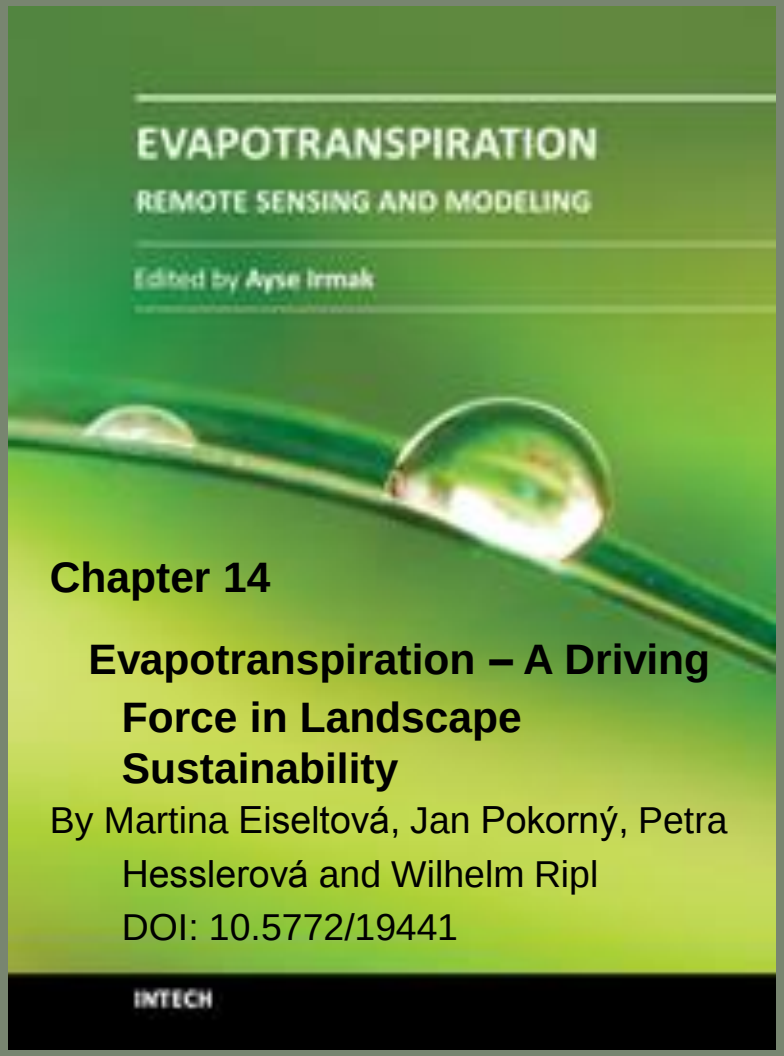
Marais de Saçy, France

Water buffaloes grazing in fen (1000 ha)

- Management of fen, the aim is to protect native flora and fauna

Restoration of degraded floodplain for agriculture
Mulloon Creek – NSW, Australia

Publications



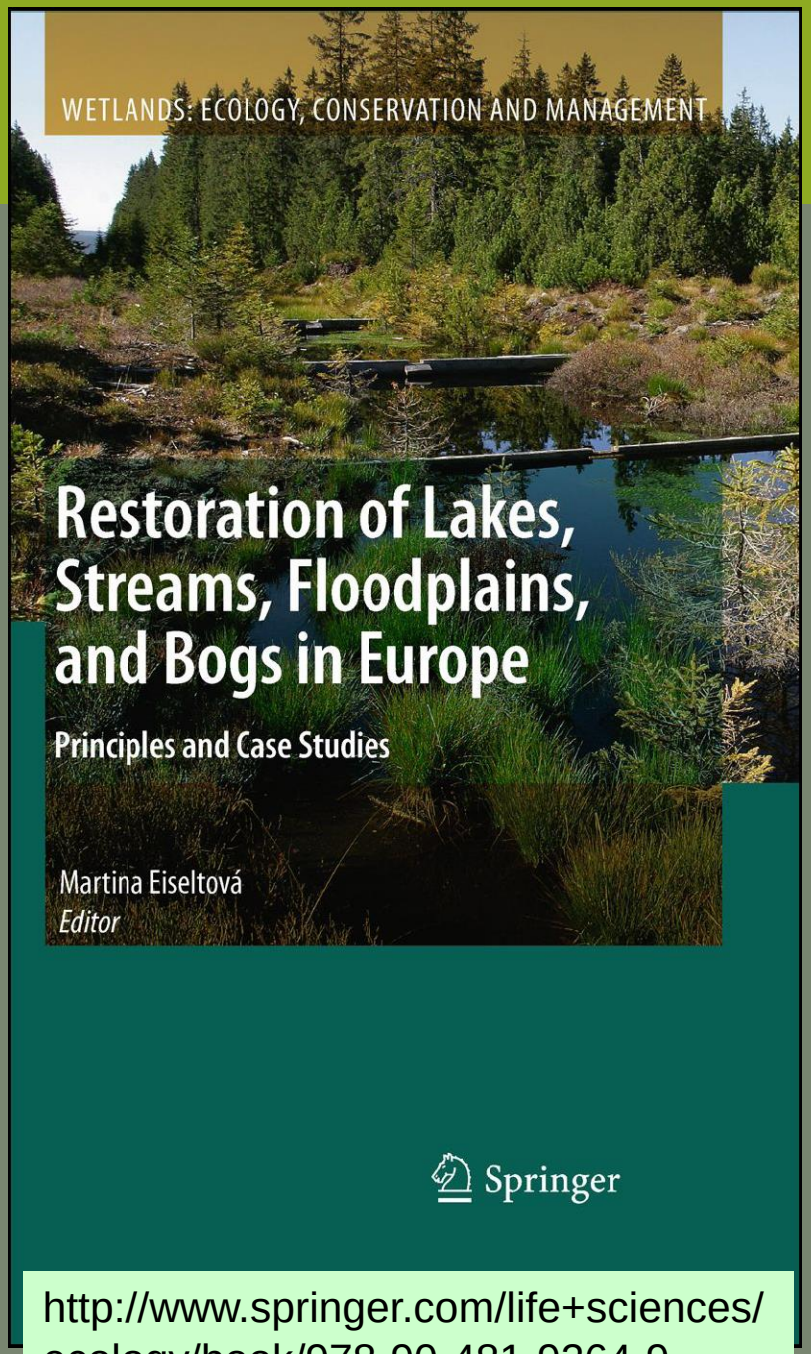
Chapter 14

Evapotranspiration – A Driving Force in Landscape Sustainability

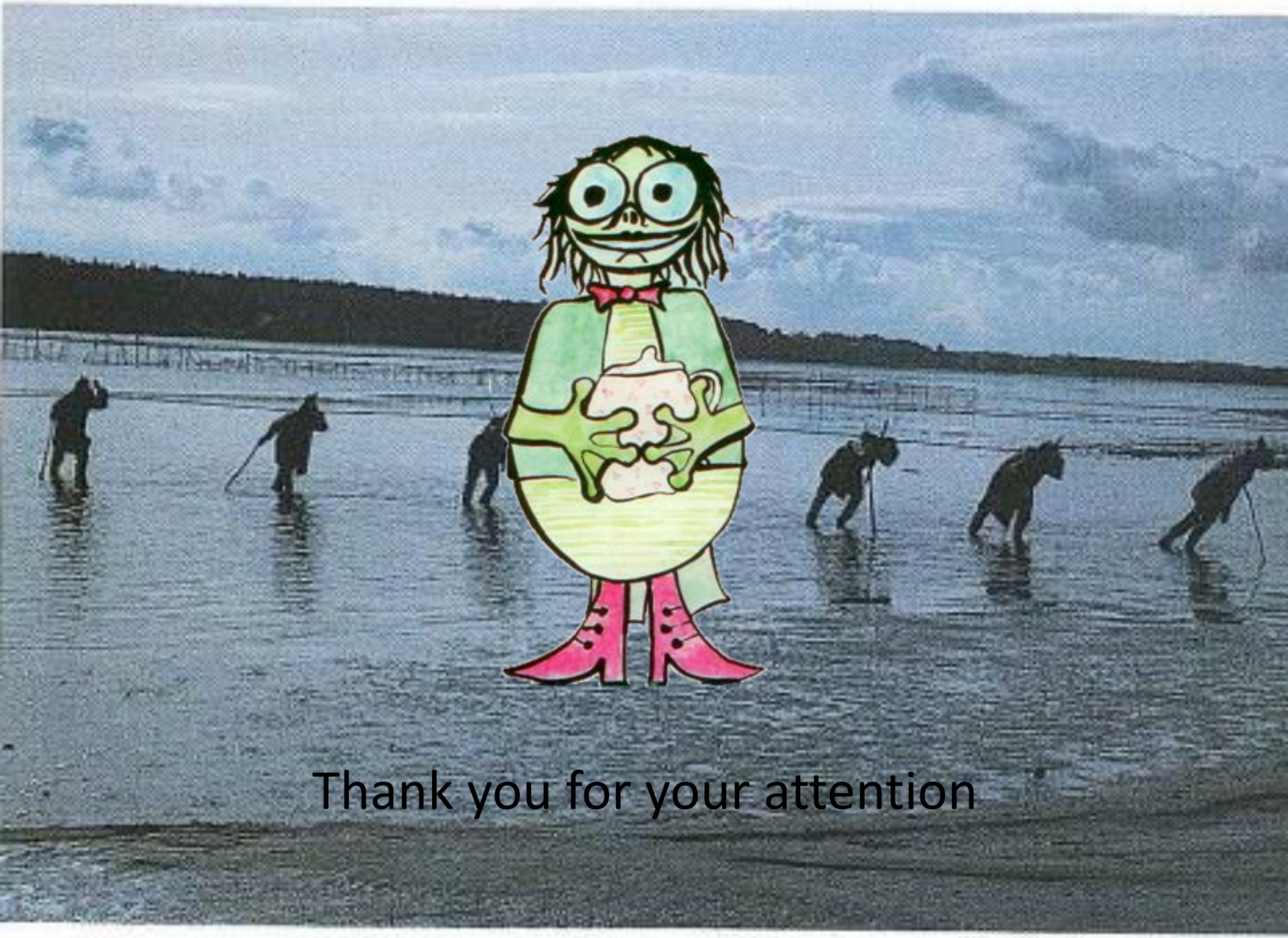
By Martina Eiseltová, Jan Pokorný, Petra Hesslerová and Wilhelm Ripl

DOI: 10.5772/19441

DOI: 10.5772/725



http://www.springer.com/life+sciences/ecology/book/978-90-481-9264-9


Thank you for your attention