WETLAND ECOLOGY

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OUTLINE

1. EXAMPLES AND DEFINITION
2. WHY IMPORTANT ?
3. FUNCTIONING AND SPECIAL FEATURES
4. HYDROLOGY
5. SOILS
6. PHYSICO-CHEMICAL CONDITIONS
7. VEGETATION
8. TYPES OF WETLANDS (TERMINOLOGY)
9. PROTECTION AND RESTORATION

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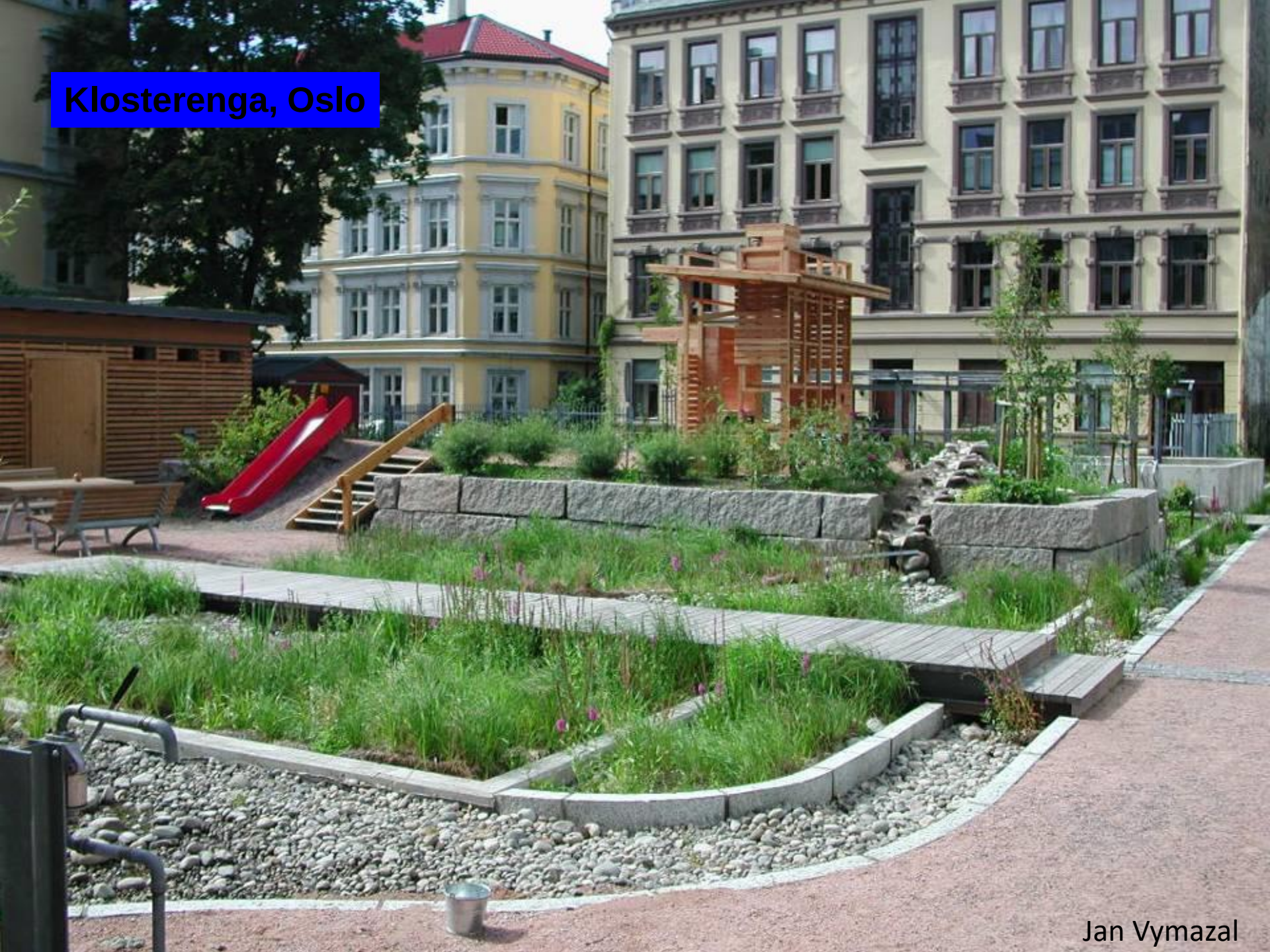
Klosterenga, Oslo
Jan Vymazal

Constructed wetland Žitenice

Jan Vymazal

A WETLAND IS A SHALLOW, SEASONALLY OR PERMANENTLY WATERLOGGED OR FLOODED AREA WHICH NORMALLY SUPPORTS HYDROPHYTIC VEGETATION

Denny, 1995

All areas of marsh, fen, peatland, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish, or salt.”

The convention set a depth of 20 feet (6 m) as the limit for any water body to be included in the term wetland.

Ramsar convention, 1971

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- accumulation of peat, later transformed to coal – in tropical wetlands
- first peatlands: 300-360 million years ago (carboniferous period)
- coal accumulated also later in Permian, Triassic and Jurasic periods

IMPORTANCE OF WETLANDS

- **HABITATS**
- **EFFECT ON CLIMATE (LOCAL AND GLOBAL)** - CARBON SINK (IN HISTORY COAL, OIL, GAS, PEAT FORMATION)
- **EFFECT ON WATER QUALITY**
- **SOURCE OF WATER, PEAT, TIMBER, FOOD (RICE, FISHES, WATERFOWL ETC.)**
- **GOOD FOR REPRODUCTION**

USE BY HUMAN

- AGRICULTURE (RICE PADDIES, FLOODPLAINES)
- FISHING
- HUNTING (WATERFOWLS)
- WATER USE FOR DRINKING OR IRRIGATION
- SOURCE OF PEAT (BURNING, HORTICULTURE)
- WOOD (TIMBER) AND BIOMASS PRODUCTION
- WATER PURIFICATION (CONSTRUCTED WETLANDS)
- RECREATION

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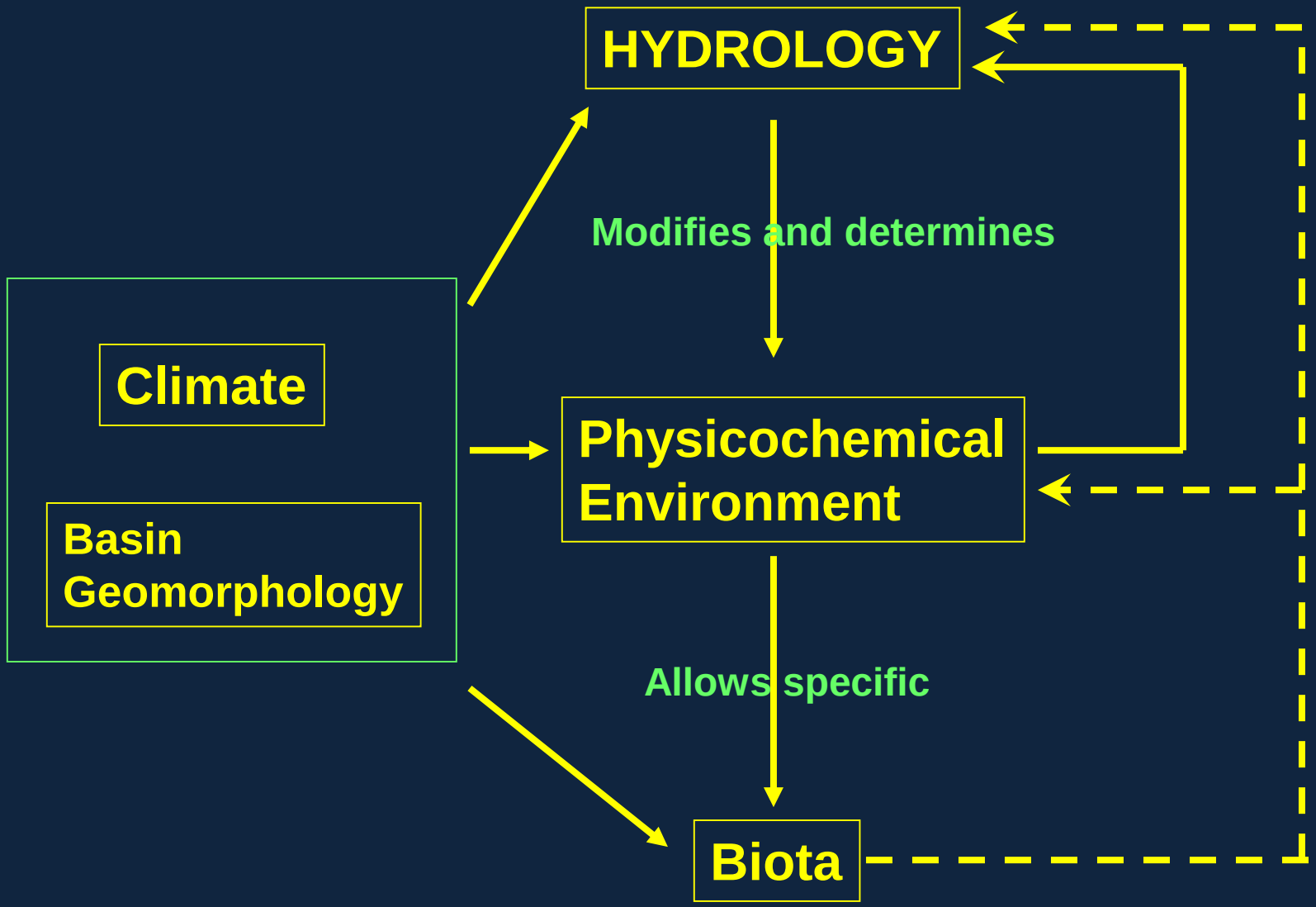
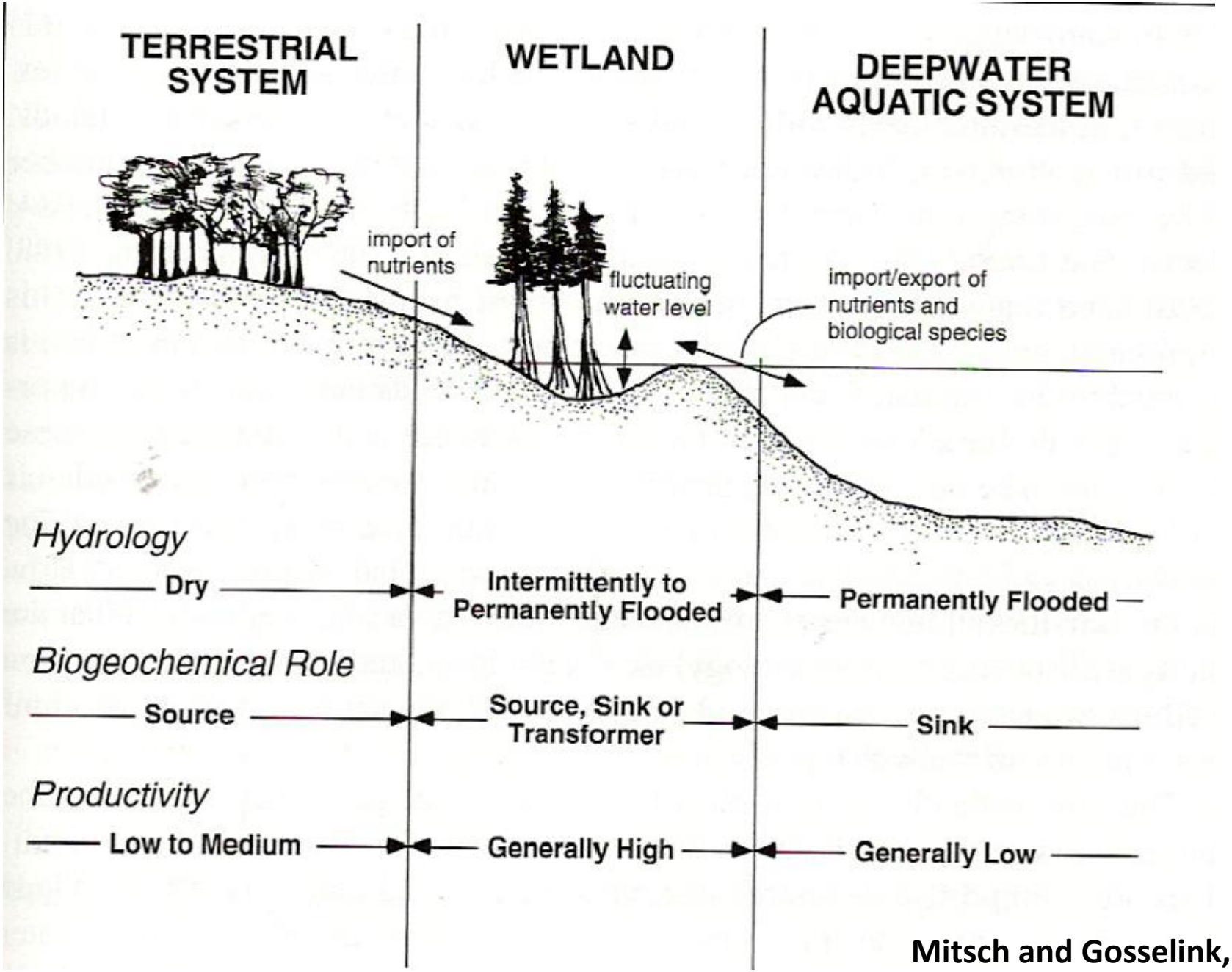


Mitsch and Gosselink, 2000

WETLANDS CONSTRUCTED BY BEAVERS – ECOSYSTEM ENGINEERS (NORTHERN AMERICA – 200 000 KM^2 IN PAST)

Wetlands, Peter D. Moore



Mitsch and Gosselink, 2000

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A SIMPLE WATER BALANCE EQUATION :

$$\mathbf{S = Q + R + G_i - O - ET - G_o \pm T} \quad (m^3\ year^{-1})$$

- S = net change in storage
- Q = surface flow, including wastewater or stormwater inflow,
- R = contribution from rainfall
- Gi = groundwater inflow
- O = surface outflow
- ET= loss due to evapotranspiration
- Go = groundwater outflow
- T = tidal inflow (+) or outflow (-)

- <u>water input should be at least the same as loss due to evapotranspiration</u>

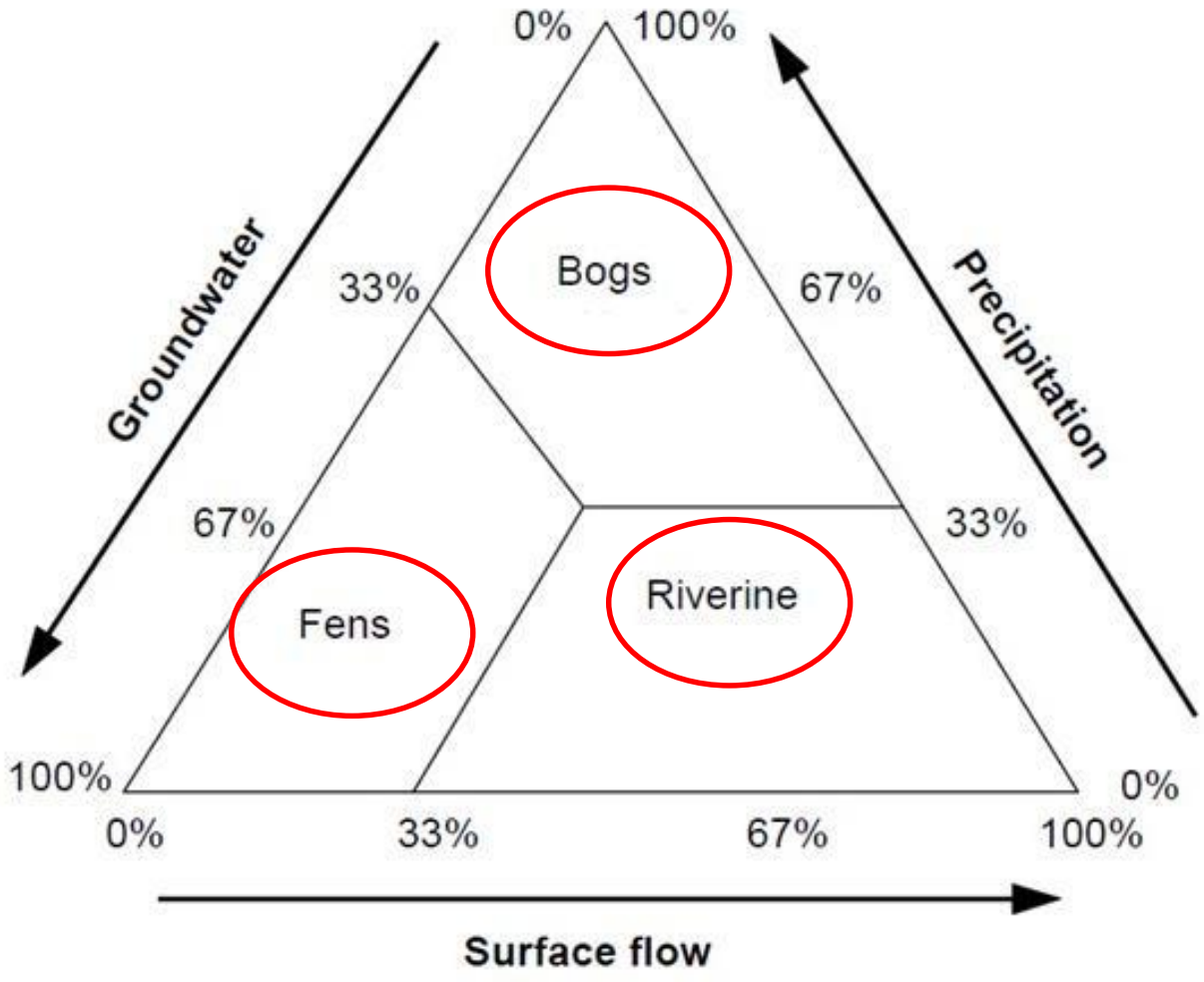
- TURNOVER OR RESIDENCE TIME (DETENTION TIME FOR CW):

$$\mathbf{t = V / Q} \qquad \text{(day)}$$

V ... average volume of water stored in wetland (m^3)

Q ... total inflow rate ($m^3\ day^{-1}$)

HYDROLOGY



Wetlands, Peter D. Moore

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ORGANIC SOILS (HISTOSOLS)

- CONTAIN MORE THAN 12 % OF TOTAL C IN THE UPPER 1 M LAYER
- PEAT (PEATLANDS)

Waterlogged mineral soils

- part or the whole soil profile is saturated for a sufficient period of time to create distinctive gley horizons
- sandy, loamy, or clay
- Increase in organic matter accumulation in surface horizon
- Mottled zone (gley horizon) where iron and manganese accumulate
- Permanently reduced zone (gray color or bluish-green color)

SOILS

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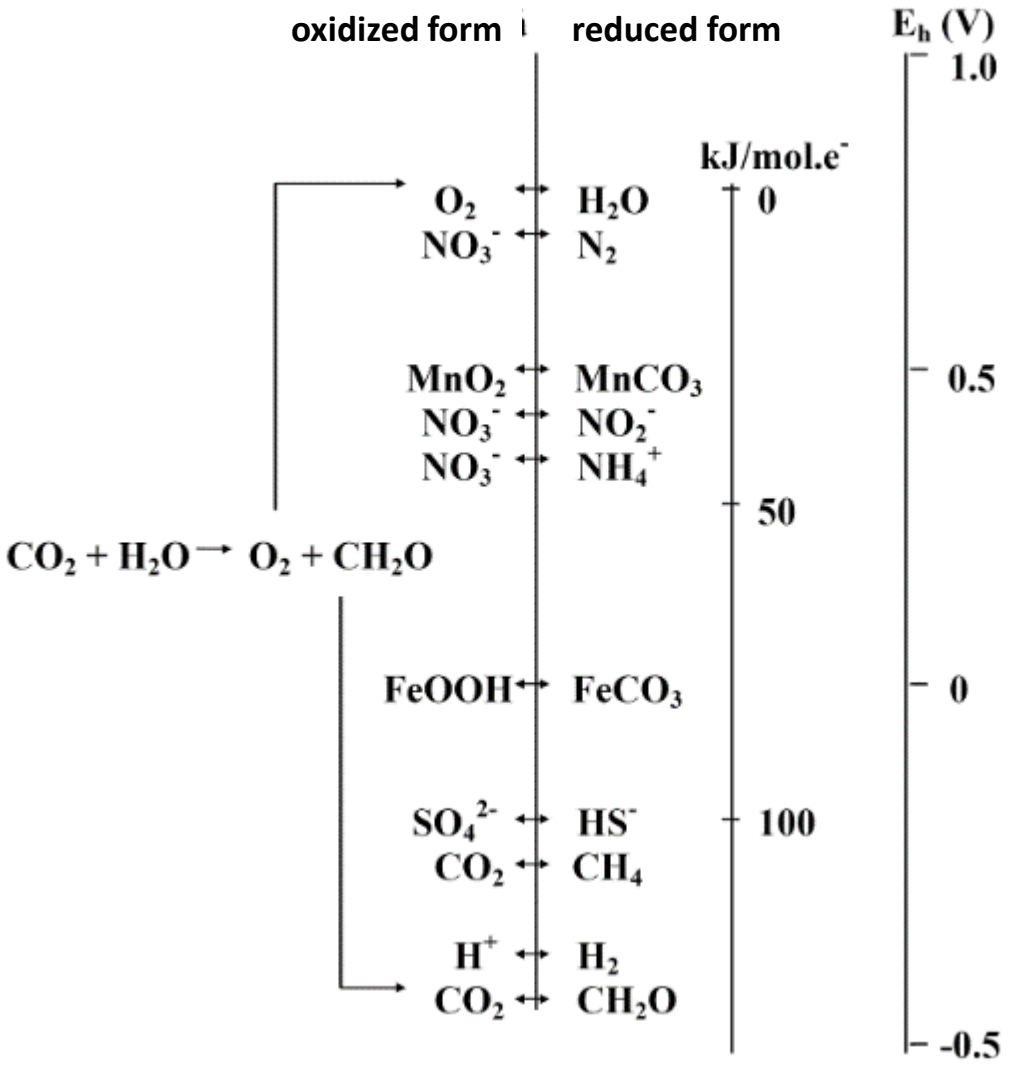
Oxidation reduction potential (redox potential)

- **oxidation-reduction (redox) potential E^o – tendency of substance undergoing oxidation to give up electrons and substance undergoing reduction to gain electrons**
- Nernst equation
- units: V or mV (volts, milivolts), sometimes log E is used (pE)

MEASUREMENT OF REDOX POTENTIAL IN SOIL

- platinum electrodes
- reference electrodes (silverchloride, calomel)
- dataloggers....

REDOX PAIRS AND THEIR REDOX POTENTIAL



Fenchel and Finlay. Ecology and Evolution in Anoxic Worlds. 1996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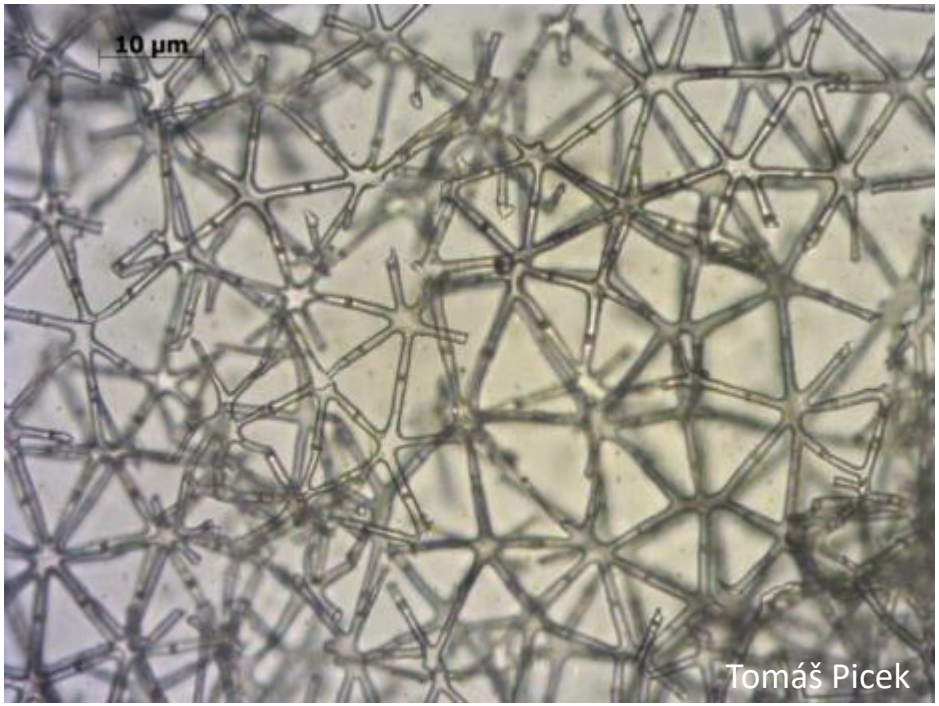
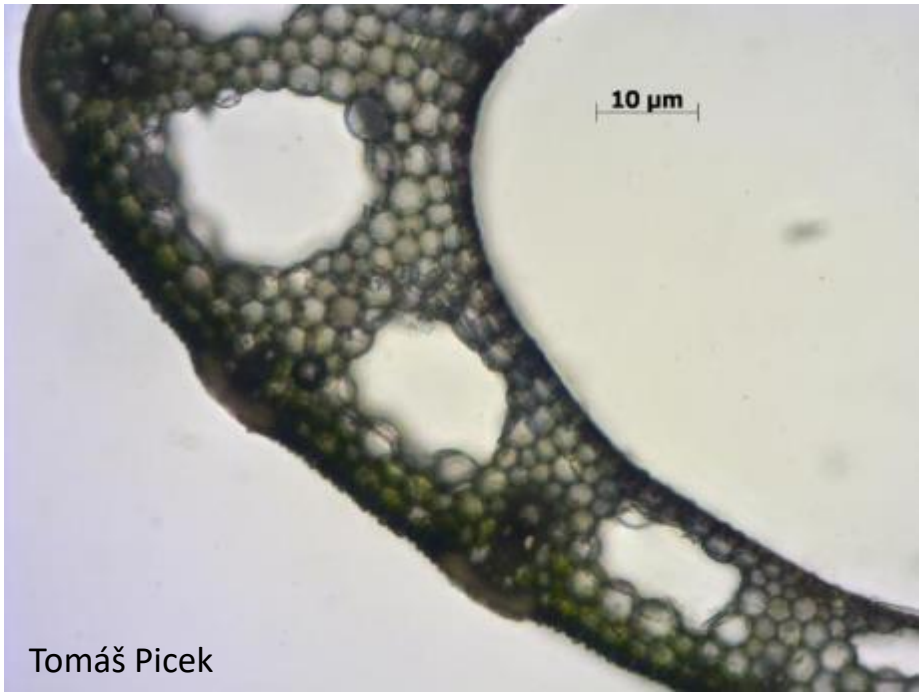
SPECIAL PLANTS
SPECIAL ADAPTATIONS
AERENCHYMA





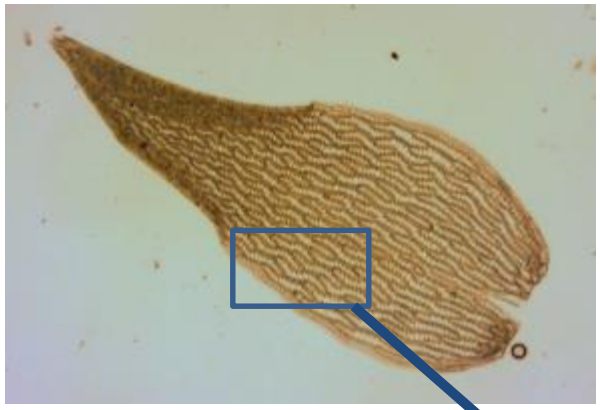
CARNIVOROUS PLANTS

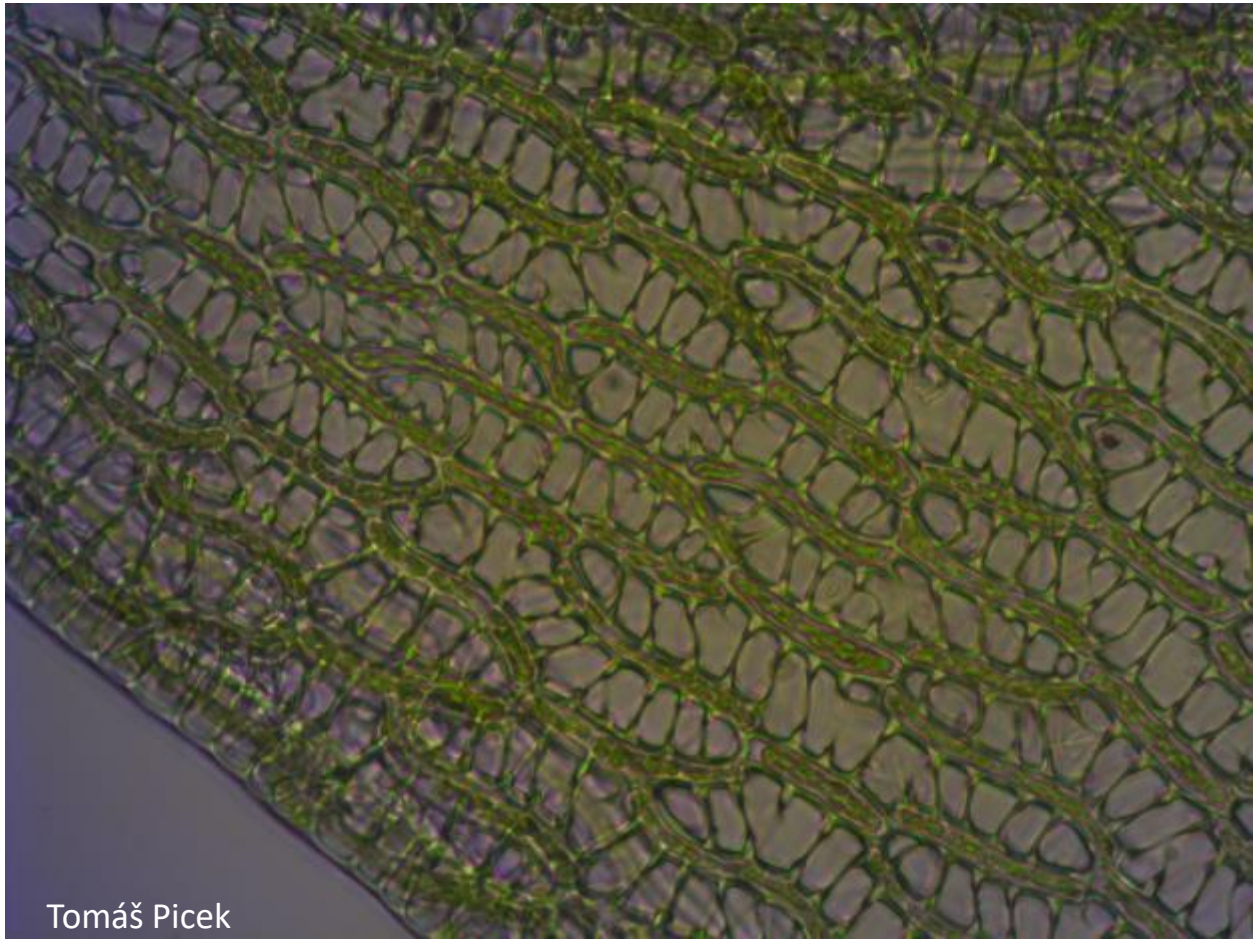
Drosera rotundifolia

Drosera anglica

Sphagnum attributes

- Water storage in hyaline cells
- Cation exchange ability
- Low nutrient demands
- Organic metabolites prevent decay
- No herbivory

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WETLAND TYPES

SIX BASIC TYPES :

- SWAMP
- MARSH
- BOG
- FEN
- WET MEADOW
- SHALLOW WATER

P.A. Keddy Wetland Ecology (2004)

Swamp

- WETLAND DOMINATED BY TREES ROOTED IN HYDRIC SOIL, BUT NOT IN PEAT

- TREES - DIFFICULT TO GERMINATE IN WATERLOGGED CONDITINIOS
- RESULT OF SUCCESSION – AFTER HERBACEOUS PLANTS
- TUSSOCKS
- IN TEMPERATE ZONE – VERY OFTEN TREE IN SWAMPS ALDER (*ALNUS GLUTINOSA)* OR *(ALNUS INCANA)*

Marsh

- wetland dominated by herbaceous plants, usually emergent through water, rooted in hydric soil, not in peat

- reed – Phragmites Australis – temperate zone
- salt marshes – Spartina spp
- Cyperus Papyrus – tropics

Bog

- wetland dominated by Sphagnum moss, sedges *(Carex)*, Ericaceous shrubs *(Calluna, Vaccinium, Ledum)* or evergreen trees *(Pinus, Picea)* rooted in deep peat


bog, Bohemian forest, Czech Republic
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bog, Finland
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Fen

- WETLAND DOMINATED BY SEDGES AND GRASSES ROOTED IN SHALLOW PEAT

Wet meadows

- wetland dominated by herbaceous plants rooted in occasonally flooded soils (periodic flooding)

wet meadows, Třeboň, Czech Republic

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SHALLOW WATER

- WETLAND DOMINATED BY TRULY AQUATIC PLANTS GROWING IN AND COVERED BY AT LEAST 25 CM OF WATER (LITTORAL OF LAKES, RIVER BAYS)

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Threats for wetlands

- DRAINAGE
- FILLING
- HYDROLOGIC MODIFICATIONS
- PEAT MINING
- MINERAL AND WATER EXTRACTION
- WATER POLLUTION (NUTRIENTS - EUTROPHICATION, TOXIC COMPOUNDS)
- CLIMATE CHANGE

Wetlands Protection

- 1971, Ramsar, Iran, 18 countries signed the convention
- 168 contracting countries recently
- number of Ramsar sites in the whole world: 2189
- the total area of all Ramsar sites: 208 000 000 hectares
- http://www.ramsar.org/

- The Convention is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their **Wetlands of International Importance** and to plan for the "wise use", or sustainable use, of all of the wetlands in their territories.

- The Convention's mission is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world".