River Water Quality

Section **2e**: Hydrology & Ecology of Running Waters

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Ευρωπαϊκή Ένωση
Ευρωπαϊκό Κοινωνικό Ταμείο

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Hydrology & Ecology of Running Waters

Wetland Hydrology & Biology

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Introduction

- Wetlands are an essential component of the hydrological cycle with substantial role recognized in the WFD
- Wetlands cannot be defined uniformly because of differences in geographical conditions & wetland characteristics
- **General definition**: "*an area of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres*" (Scot *et al*. 1995)

Introduction

- 50% of these remain in “endangered status” due to overexploitation. WFD aims to prevent further deterioration
- Loss of wetlands due to drainage & exploitation as agricultural or urban areas is common feature in Europe& America
- Fed & maintained by rivers, lakes, groundwater => affected by quality & quantity
- Inhabited by plants that can withstand water logging & soils usually different from the surrounding land

Abiotic & Biotic components

A wetland:

- Is relatively permanent feature, part of the ecological succession from water to dry land
- Is characterised by high primary production (PP) to biomass ratios
- Receives increased flow of detritus & allochthonous flow (DOM) of nutrients
- Has slowly decomposing organic matter & peat storing
- Has open mineral cycles & great spatial variations in microhabitats
- Hosts organisms with complex life cycles & short life spans, with complexity related to seasonality

Abiotic & Biotic components

Abiotic

- Very productive ecosystems (3 times of a tropical rainforest, 7000-8000g dry weight/m^2*yr)
- Wetland abiotic environment depends upon the position of the water table (dry, waterlogged & flooded areas)
- Soil moisture determines O_2 levels in soils. Dry soils contain air spaces that get used up after floods & then become anaerobic=>affects organism behaviour & system chemistry => affects microorganisms presence=> nutrient cycles alter
- In anoxic conditions, reducing conditions are created &reduced forms of metals such as Fe^{2+} and Mn^{2+} become more soluble resulting in potentially toxic conditions. Sulphates are also reduced to hydrogen sulphide (H_2S) – highly toxic with distinct “rotten” smell

Abiotic & Biotic components

Abiotic

- Permanently waterlogged soils are often lacking in nitrates because demineralisation of decaying biomass is slowed down=> reduction of nutrient release & denitrification cannot take place
- Marginal wetlands are in relation with the parent water bodies. A riparian wetland merges in with the main river & exchange particulate matter & receives run-off from the land => constant flow of nutrients into the wetland
- Nutrients & minerals are transported to wetlands through rainfall where organisms mediating chemical reactions may immobilise the chemicals

Abiotic & Biotic components

Biotic

The anaerobic conditions that prevail define the biota, since species need special adaptations to survive during the low oxygen-wet season:

- ✓ Animals pass the wet season as dormant seed or other resistant structure
- ✓ Others leave (terrestrial & aquatic life cycles)
- ✓ Plants develop aerenchyma tissues with large air spaces linking the leaves directly with the roots or produce roots which grow upwards into the atmosphere (Mangroves)
- ✓ Aquatic plants excrete oxygen from the roots into the surrounding medium (rhizosphere) where soluble reduced metals become oxidised (less toxic)

- Communities are similar to those of lakes but with detritus (not plankton) as energy source

Abiotic & Biotic components

Biotic

- Wetlands often show some sort of vertical zonation with zones that describe fully terrestrial environments, to others where plants have to overcome anoxia around their roots, & others where there are no plants because of the depth and the light limitation
- In wetlands where bacterial denitrification is abundant, nitrogen is usually the limiting nutrient for plant growth. Can be solved with root nodules of nitrogen fixing bacteria or nitrification in the rhizosphere
- Eutrophic conditions can occur if the wetland neighbours with agricultural land (no nutrient limitation)

Wetlands & Water Quality

- Wetlands are the interface between terrestrial & aquatic systems
- Vital role in removing nutrients by producing biomass that could end in causing eutrophication to the recipient water body
- Denitrification is the most important way of nutrient removal
- Microorganism absorption & deposition removes phosphorus
- Organic matter is decomposed
- Interception & retention of particulate matter by vegetation
- Protect from band erosion & land based sources
- Reduce the impact of storm flows in a river providing extra friction
- Retain water that can be used to recharge the groundwater
- Provide a wide range of natural resources (wood, peat, thatch, rice)
- Host biodiversity & provide habitats & refuges for the wildlife

Current Status of European Wetlands

- Most EU countries are participants in the Ramsar Convention on Wetlands of International Importance, & have a number of wetlands within their boundaries designated under the Convention
- Most EU countries have an inventory of their wetlands
- Management, Restoration & Recreation measures are undertaken (in many of the countries)

Wetlands for wastewater treatment

- Artificial Wetlands are being created for treating domestic and other wastewaters
- The idea was conceived in 1984 (by R.Kickuth) and then used in many countries
- They are easy to construct & maintain, look natural & blend into the landscape
- Take up more space than conventional methods of treatment & need to be isolated from groundwater
- There has to be a porous substratum planted with reeds
- The wastes pass onto the bed & the purified effluent is collected at the end of the bed

  ➢ For a Review of the use of wetlands in wastewater treatment – Cooper & Findlater 1990

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