Supported by:

Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

Federal Agency for
Nature Conservation

EOCap
4Africa

EOCap4Africa

6c Application: Wetlands and Remote Sensing

Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

DLR

MARTIN-LUTHER-UNIVERSITÄT
HALLE-WITTENBERG

UNIVERSITY OF BOTSWANA

INES Ruhengeri
Institute of Applied Sciences

SCIENTIA SPLENDET ET CONSCIENTIA

EARTH OBSERVATION RESEARCH

Introduction Wetlands

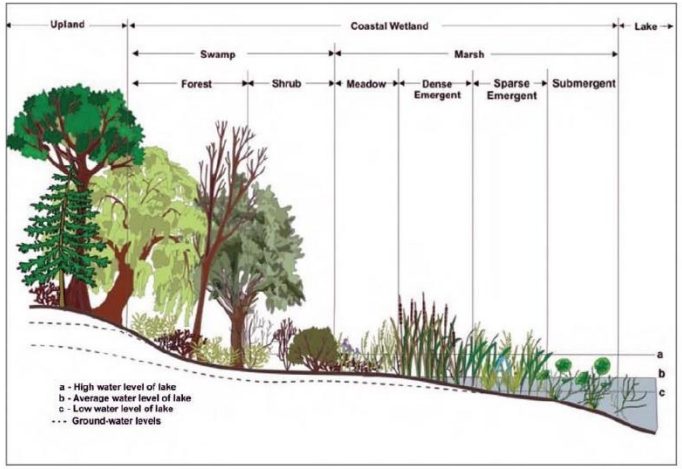
Wetlands - Introduction

- A wetland is a distinct semi-aquatic ecosystem whose groundcovers are flooded or saturated in water, either permanently, or seasonally.
- Wetlands form a transitional zone between waterbodies and dry lands, and are different from other terrestrial or aquatic ecosystems
- They are considered among the most biologically diverse of all ecosystems, serving as habitats to a wide range of aquatic and semi-aquatic plants and animals, with often improved water quality due to plant removal of excess nutrients such as nitrates and phosphorus

Wetlands - Introduction

- Wetlands exist on every continent, except Antarctica
- The water in wetlands is either freshwater, brackish or saltwater
- The main types of wetlands are defined based on the dominant plants and the source of the water. E.g., marshes are wetlands dominated by emergent herbaceous vegetation such as trees and shrubs
- Mangrove forests are wetlands with mangroves, halophytic woody plants that have evolved to tolerate salty water

Wetlands - Introduction



Finlander, 2024

Wetlands come in different sizes and types. Upland vs. wetland vs. lacustrine zones; freshwater swamp forest in Bangladesh; peat bogs are freshwater wetlands that develop in areas with standing water and low soil fertility; a freshwater cattail (*Typha*) marsh that develops with standing water and high soil fertility.

Wetlands - Introduction

- Wetlands contribute to many ecosystem services, e.g., water purification, stabilization of shorelines, storm protection and flood control
- Wetlands can process and condense carbon (carbon fixation), nutrients and water pollutants
- Wetlands can act as a sink or source of carbon, depending on the specific wetland
- They can be a significant source of methane emissions due to anaerobic decomposition

Wetlands - Introduction

Anthropogenic thread of wetlands:

- Humans are disturbing and damaging wetlands in many ways, including oil and gas extraction, building infrastructure, overgrazing of livestock, overfishing, alteration of wetlands including dredging and draining, nutrient pollution, and water pollution

- Wetlands are more threatened by environmental degradation than any other ecosystem on Earth need for assessing wetland ecological health

Wetlands – Definitions and terminology

Technical definitions:

- A simplified definition of a wetland is “an area of land that is usually saturated with water”
- More precisely, wetlands are areas where “water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year”
- Wetlands have unique characteristics: they are generally distinguished from other water bodies or landforms based on their water level and on the types of plants
- Specifically, wetlands are characterized by having a water table that stands at or near the land surface for a long enough period each year to support aquatic plants

Wetlands – Definitions and terminology

A more concise definition:

- Wetlands have also been described as ecotones, providing a transition between dry land and water bodies. Wetlands exist "...at the interface between truly terrestrial ecosystems and aquatic systems, making them inherently different from each other, yet highly dependent on both.“

Wetlands – Definitions and terminology

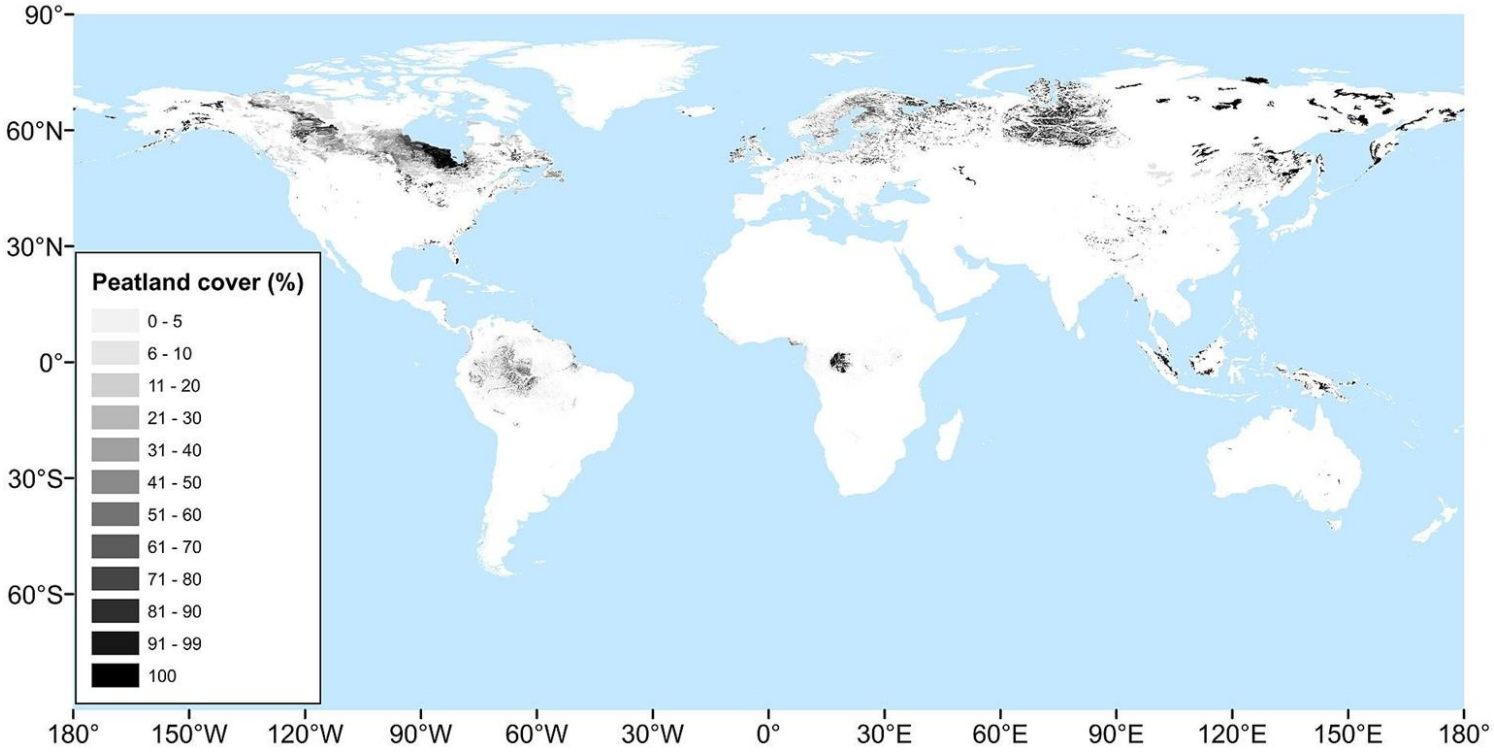
In environmental decision-making, there are subsets of definitions that are agreed upon to make regulatory and policy decisions:

Under the Ramsar international wetland conservation treaty, wetlands are defined as follows:

- Article 1.1: "...wetlands are 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, including areas of marine water the depth of which at low tide does not exceed six meters."
- Article 2.1: "[Wetlands] may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands."
- An ecological definition of a wetland is "an ecosystem that arises when inundation by water produces soils dominated by anaerobic and aerobic processes, which, in turn, forces the biota, particularly rooted plants, to adapt to flooding".

Peatlands

A peatland is a type of wetland whose soil consists of organic matter from decaying plants, forming layers of peat. Peatlands arise because of incomplete decomposition of organic matter, usually litter from vegetation, due to water-logging and subsequent anoxia. Peatlands are unusual landforms that derive mostly from biological rather than physical processes and can take on charcteristic shapes and surface patterning.



PEATMAP: Global peatland distribution. (Xu et al. 2018)

Wetlands

- Wetlands include a variety of habitats, which may be natural or man-made area of water or marsh that can be lotic (standing water) and lentic (running water).
- Many wetlands are transitional zones between upland and aquatic ecosystems, although others are scattered across the landscape in upland depressions that collect water or in zones where groundwater comes to the surface
- Wetlands range from peat bogs to mangrove forests, from freshwater ponds and marshes to flood plain, shallow lakes, brackish water lagoons, estuaries, coastal salt marshes, coral reefs etc.
- Paddy fields and fishponds are man-made and man-managed wetlands

Types of Wetlands

Marine and coastal

Fresh water and inland

Man made

Types of Wetlands

Marine and coastal wetlands


Shallow coastal waters


Mangrove swamps


Rocky marine shore


Estuarine waters


Inter-tidal mud an sand


Brackish water lagoon

Types of Wetlands

Fresh water wetlands

Rivers

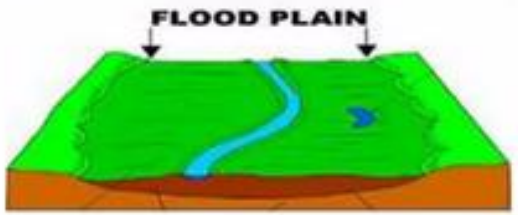
Fresh water lakes

Fresh water Ponds

Spring Oasis

Geothermal wetlands

Marshes



Riverine Flood Plains

Swamps

Types of Wetlands

Man made wetlands


Canals


Water reservoirs / Dams


Fishery ponds


Ponds for water treatment


Rice field


Mining pool

Why are wetlands important?

Wetlands are important because they:

- Improve water quality
- Provide wildlife habitat
- Maintain ecosystem productivity
- Reduce coastal storm damage
- Provide recreational opportunities
- Improve water supply
- Provide opportunities for education

Source: Getty Images

Okavango Delta in Botswana (2025)

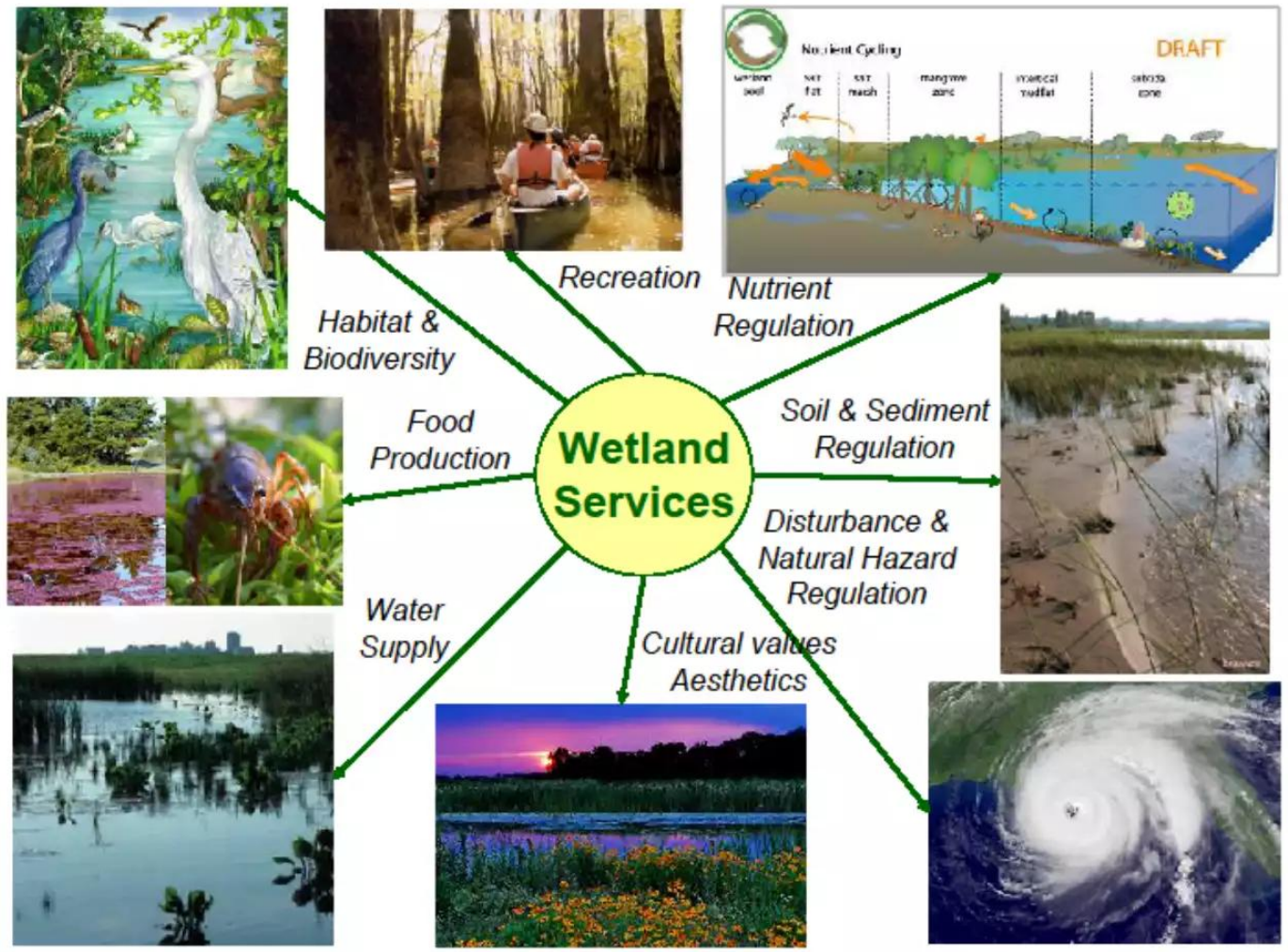
Wetlands and Ecosystem Services

- Wetlands are particularly important providers of all water-related ecosystem services
- Wetlands are productive areas for plant life, animals and agriculture
- Wetlands are the major habitat for most of the world's waterbirds and key habitat for migratory species
- Values of coastal and inland wetland ecosystem services are typically higher than for other ecosystem types
- Wetlands are an important source of food
- Wetlands have high recreational, historical, scientific, and cultural values

Source: Getty Images

Okavango Delta in Botswana (2025)

Wetlands and Ecosystem Services



http://www.epa.gov/wetlands/wetlands-education (2025)

Wetlands are threatened

Human activities can threaten wetlands. The following anthropogenic activities have directly or indirectly affected wetlands:

- Development of agriculture
- Road and railway construction
- Cutting trees and mangroves for human use
- Use of water for irrigation, industrial and domestic use
- Aquatic pollution due to municipality sewage, agricultural practices
- Water pollution from industrial effluents
- Overfishing and non maintenance of fish stock
- Grazing by domestic animals
- Excessive tourism and water sports

Wetlands conservation strategies

- Prevention of loss and restoration of wetlands
- Conservation and collaborative management
- Sustainable use

Supported by:

Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

Federal Agency for
Nature Conservation

EOCap
4Africa

Thank you for your attention!

**Dr. Insa Otte (on behalf of the EOCap4Africa Team)
and colleagues**

insa.otte@uni-wuerzburg.de

References

EPA. (2025). *Wetlands Education for Students and Teachers*. https://www.epa.gov/wetlands/wetlands-education-students-and-teachers

Patra, R. (n.d.). *Wetland*. Retrieved 4 February 2026, from https://de.slideshare.net/slideshow/wetland-249581283/249581283?_gl=1*1o4id04*_gcl_au*MTUwNjE2OTMxNy4xNzM5NjIyMjEw#3

Xu, J., Morris, P., Liu, J., & Holden, J. (2017). *PEATMAP: Refining estimates of global peatland distribution based on a meta-analysis.* University of Leeds. https://doi.org/10.5518/252