Wetland Biogeography

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Abstract

Wetlands are a unique ecosystem adapted to conditions of saturated soils that connect upland and deep-water ecosystems. Wetlands cover about 5 to 8% of the Earth's surface, but are disproportionately important in providing unique habitats for large numbers of plant and animal species, storing immense amounts of carbon, and providing ecosystem services such as flood mitigation, water quality improvement and coastal protection. Despite the great benefits of wetlands, they have been heavily impacted by human land use with approximately 50% of wetlands either drained, degraded or filled in for purposes such as agriculture, mosquito control, forestry, or settlement. Wetlands can be difficult to categorize with some ambiguity in terms used, however they are generally divided into three groups: coastal wetlands (including saltwater marshes, tidal freshwater marshes and mangrove swamps), freshwater marshes and swamps, and peatlands (including bogs and fens).

Main Text:

Wetlands are regions that are frequently inundated or saturated for extended periods of time such that they are a distinct ecosystem – separate from the upland and deep-water water systems that they connect. As wetlands form an ecotone between terrestrial and aquatic systems, they provide unique habitats for diverse flora and fauna and many important ecosystem services including flood mitigation of rivers and streams, protection of clean water, buffering of coastlines from high energy waves (such as from typhoons or tsunamis), and habitat for a great diversity of plant and animal species. These ecosystem services have lead wetlands to be termed the 'kidneys of the landscape' as they receive both water and waste from upstream natural and human sources (Mitsch et al. 2007). When compared to adjacent terrestrial and aquatic systems, wetlands are generally amongst the most productive ecosystems on the planet (though not all are highly productive, for e.g. peatlands and cypress swamps have low productivity). Wetlands commonly have anoxic soils which slows the decomposition of organic matter. This slow decomposition over time leads wetlands to storing an immense amount of carbon in their soils. Decomposition of this carbon produces proportionately more methane, a potent greenhouse gas, during respiration than upland systems, making wetlands the largest natural source of methane.

Many different definitions of wetlands exist for scientific, legal, and management purposes but they generally share three common criteria. One, wetlands have the presence of water at the soil surface, or within the root zone, either continuously or for extended periods of time. Two, wetlands have unique soil conditions that differ from adjacent uplands, commonly containing hydric soils (soils that have anoxic conditions). Lastly, wetland vegetation and biota are adapted to wet conditions while flooding-intolerant biota are absent.

Globally, wetlands cover about 7 to 10 million km^2 (about 5 to 8% of the land surface). [Figure 1 near here] Wetlands are found predominantly in boreal and tropical regions with lesser amounts in temperate latitudes. [Fig 2 near here] The general controls on wetland occurrence are climate and

geomorphology. While many cultures evolved in concert with wetlands (for e.g. the Babylonians, Egyptians, and Aztecs all delivered water via wetlands), and indeed paddies used in rice cultivation are a form of domestic wetlands, regions with high human-impact have lost about 50% of their wetlands. Wetlands are generally less impacted by humans in sparsely populated areas, but have suffered up to complete removal in densely-populated areas. Wetland destruction has occurred for a variety of purposes; some examples include filling-in for residential or industrial developments; peat mining; drainage for agriculture, mosquito control or forestry; and indirect effects through the construction of dams.

Wetlands are often divided into three main categories: i) coastal wetlands, which include salt marshes, tidal freshwater marshes, and mangrove swamps, ii) peatlands, and iii) freshwater swamps and marshes. As the physical and biotic characteristics of these classifications grade between each other, characterizing a wetland in practice can be somewhat arbitrary with the same term used for different systems in different regions.

Coastal wetlands constitute a relatively small fraction of total global wetlands (ca. 5 to 10%). Salt marshes occur primarily in high latitudes while mangrove swamps become dominant in tropical latitudes. Some characteristic salt marshes occur in the Mediterranean Sea, a famous example being the Camarague in the Rhone River delta. San Francisco Bay also has salt marshes (now over 95% destroyed). Mangrove swamps occur in the Florida Everglades and the extensive Sine Saloum Delta in Senegal. Coastal wetlands are heavily influenced by two primary factors: salinity of the water and the energy provided by tidal forces. Tidal energy influences processes such as gas exchange, sediment deposition, fluxes of mineral and organic matter, and removal of toxins while salinity creates unique habitats for organisms that are able to withstand the stress of salinity ranges from freshwater (yet still influenced by tidal forces) to approaching that of seawater. Wetland plant adaptations to saline conditions includes exclusion and excretion of salt, pneumatophores, production of viviparous seedlings, and prop roots.

Peatlands, also termed moors and muskegs, are the most common wetland type globally, covering some 2.4 to 4.1 million km^2, primarily in the humid northern boreal regions. Peatlands include fens and bogs as part of a succession in which fens can transition to bogs over time. Bogs commonly have low nutrient availability with no significant water source besides rainwater. Bogs typically have peat deposits dominated by acid-loving vegetation such as mosses and can be forested or open. The Pocosins of the Carolinas is an example of an evergreen shrub bog. Fen-dominated peatlands are characterized by a flow-through water source and are covered by sedges, reeds, and grasses. There is an extensive body of research conducted on peatlands, especially in the extensive peatland complexes of the Hudson's Bay Lowlands, Canada and the West Siberian Lowlands, Russia.

Freshwater marshes and swamps are typically differentiated based upon the dominant vegetation type such as: marshes (herbaceous plants), swamps (woody vegetation; trees or shrubs), sedge or wet meadows (shallow marshes), and wet prairies (intermediate between a marsh and a meadow), amongst other sub-categories. Freshwater swamps cover approximately 1.1 million km^2 globally and vary from almost continually inundated to only sporadically. Few tree species can exist in continually saturated soils, however some exceptions exist such as the tupelo/gum (*Nyssa* spp.) and cypress (*Taxodium* spp.) prevalent in the swamps of the southeastern United States. The Great Dismal Swamp (S.E. Virginia and N.E. North Carolina, USA) is an example of a predominantly bald cypress-gum swamp. Freshwater marshes do not have extensive peat deposits like peatlands, but have a shallow-water regime and soft-stalked emergent aquatic plants. The Mesopotamian marshlands of southern Iraq and Iran were originally a large freshwater marsh complex but have been heavily damaged by human land use.

SEE ALSO: Soils of wet and hydric landscapes; Wetlands hydrology; Ecosystem services

References

Mitsch, William J. and James G. Gosselink. Wetlands. 4th Ed. Hoboken, New Jersey: John Wiley and Sons, 2007

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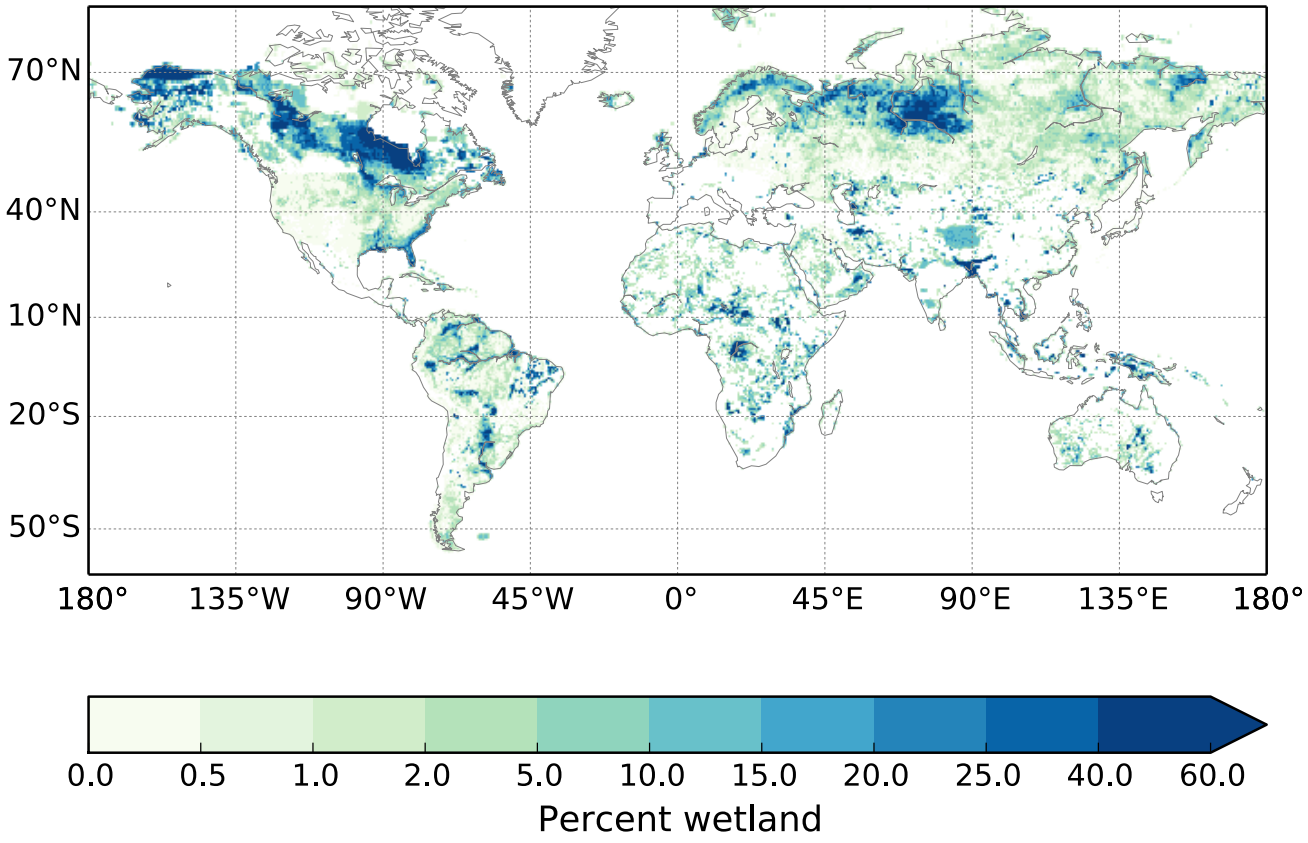
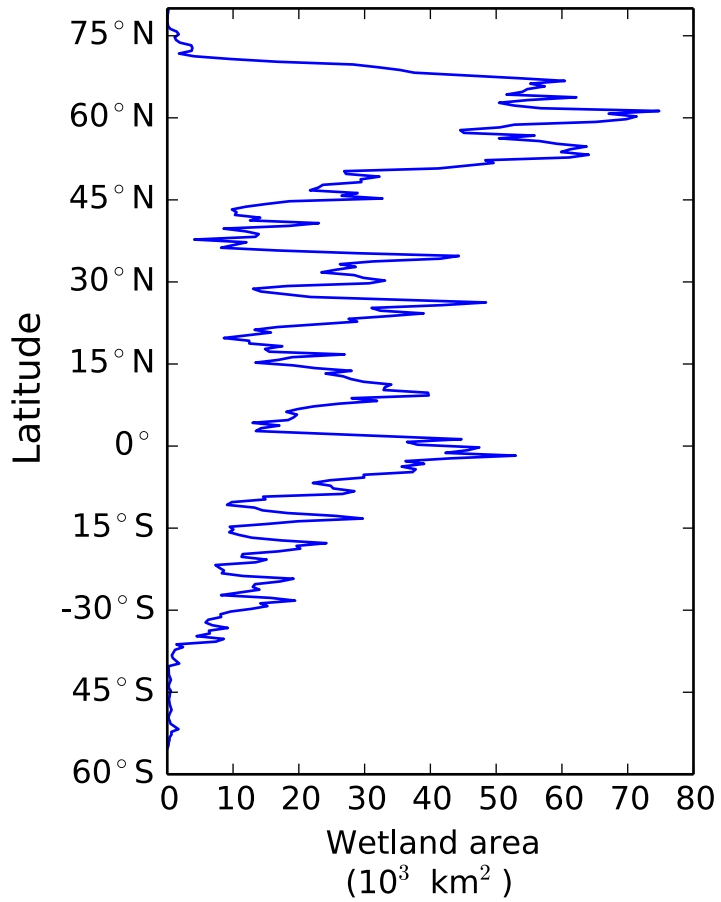
Further Reading:

Mitsch, William J., James G. Gosselink, Christopher J. Anderson, and Li Zhang. Wetland Ecosystems. Hoboken, New Jersey: John Wiley and Sons, 2009




75° N
60° N
45° N
30° N
15° N
0°
15° S
-30° S
45° S
60° S
Latitude
0
10
20
30
40
50
60
70
80
Wetland area
(10^3 km^2)