**Wetland**

[](http://en.wikipedia.org/wiki/File:Mangrove_trees_in_Everglades.JPG)

[http://bits.wikimedia.org/static-1.21wmf1/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Mangrove_trees_in_Everglades.JPG)

Mangrove [swamps](http://en.wikipedia.org/wiki/Swamps) are coastal wetlands. This swamp is in the [Florida](http://en.wikipedia.org/wiki/Florida) [Everglades](http://en.wikipedia.org/wiki/Everglades).[[1]](http://en.wikipedia.org/wiki/Wetland#cite_note-dep.state-0)

[](http://en.wikipedia.org/wiki/File:Tourbi%C3%A8re_03_-_Parc_de_Frontenac_-_Juillet_2008.jpg)

[http://bits.wikimedia.org/static-1.21wmf1/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Tourbi%C3%A8re_03_-_Parc_de_Frontenac_-_Juillet_2008.jpg)

[Peat bogs](http://en.wikipedia.org/wiki/Peat_bogs) are freshwater wetlands that develop in areas with standing water and low fertility.

[](http://en.wikipedia.org/wiki/File:Wye_Marsh_panorama1.jpg)

[http://bits.wikimedia.org/static-1.21wmf1/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Wye_Marsh_panorama1.jpg)

[Marshes](http://en.wikipedia.org/wiki/Marsh) develop along the edges of rivers and lakes.

[](http://en.wikipedia.org/wiki/File:Northern_Leopard_Frog_(Lithobates_pipiens).jpg)

[http://bits.wikimedia.org/static-1.21wmf1/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Northern_Leopard_Frog_(Lithobates_pipiens).jpg)

Many species of frogs live in wetlands, while others visit them each year to lay eggs.

[](http://en.wikipedia.org/wiki/File:Snapping_turtle_3_md.jpg)

[http://bits.wikimedia.org/static-1.21wmf1/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Snapping_turtle_3_md.jpg)

Snapping turtles are one of the many kinds of turtles found in wetlands.

A **wetland** is a land area that is [saturated](http://en.wikipedia.org/wiki/Aquifer) with [water](http://en.wikipedia.org/wiki/Water), either permanently or seasonally, such that it takes on the characteristics of a distinct [ecosystem](http://en.wikipedia.org/wiki/Ecosystem).[[2]](http://en.wikipedia.org/wiki/Wetland#cite_note-1) Primarily, the factor that distinguishes wetlands from other land forms or water bodies is the characteristic [vegetation](http://en.wikipedia.org/wiki/Vegetation) that is adapted to its unique soil conditions: Wetlands consist primarily of [hydric soil](http://en.wikipedia.org/wiki/Hydric_soil), which supports [aquatic plants](http://en.wikipedia.org/wiki/Aquatic_plants).[[3]](http://en.wikipedia.org/wiki/Wetland#cite_note-Official_Macquarie_Dictionary-2)[[4]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar-3)

The water found in wetlands can be [saltwater](http://en.wikipedia.org/wiki/Seawater), [freshwater](http://en.wikipedia.org/wiki/Freshwater), or [brackish](http://en.wikipedia.org/wiki/Brackish).[[4]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar-3) Main wetland types include [swamps](http://en.wikipedia.org/wiki/Swamp), [marshes](http://en.wikipedia.org/wiki/Marsh), [bogs](http://en.wikipedia.org/wiki/Bog) and [fens](http://en.wikipedia.org/wiki/Fen).[[5]](http://en.wikipedia.org/wiki/Wetland#cite_note-Keddy2010-4) Sub-types include [mangrove](http://en.wikipedia.org/wiki/Mangrove), [carr](http://en.wikipedia.org/wiki/Carr_(landform)), [pocosin](http://en.wikipedia.org/wiki/Pocosin), and [varzea](http://en.wikipedia.org/wiki/Varzea_forest).

Wetlands play a number of roles in the environment, principally water purification, flood control, and shoreline stability. Wetlands are also considered the most [biologically diverse](http://en.wikipedia.org/wiki/Biodiversity) of all ecosystems, serving as home to a wide range of plant and animal life.[[6]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar_a-5)

Wetlands occur naturally on every continent except [Antarctica](http://en.wikipedia.org/wiki/Antarctica).[[7]](http://en.wikipedia.org/wiki/Wetland#cite_note-water-6) They can also be constructed artificially as a water management tool, which may play a role in the developing field of [water-sensitive urban design](http://en.wikipedia.org/wiki/Water-sensitive_urban_design).

The largest wetlands in the world include the [Amazon River basin](http://en.wikipedia.org/wiki/Amazon_River_basin) and the [West Siberian Plain](http://en.wikipedia.org/wiki/West_Siberian_Plain).[[8]](http://en.wikipedia.org/wiki/Wetland#cite_note-FraserKeddy-7) Another large wetland is the [Pantanal](http://en.wikipedia.org/wiki/Pantanal), which straddles [Brazil](http://en.wikipedia.org/wiki/Brazil), [Bolivia](http://en.wikipedia.org/wiki/Bolivia), and [Paraguay](http://en.wikipedia.org/wiki/Paraguay) in [South America](http://en.wikipedia.org/wiki/South_America).[[9]](http://en.wikipedia.org/wiki/Wetland#cite_note-8)

The UN [Millennium Ecosystem Assessment](http://en.wikipedia.org/wiki/Millennium_Ecosystem_Assessment) determined that environmental degradation is more prominent within wetland systems than any other [ecosystem](http://en.wikipedia.org/wiki/Ecosystem) on [Earth](http://en.wikipedia.org/wiki/Earth). International [conservation](http://en.wikipedia.org/wiki/Conservation_movement) efforts are being used in conjunction with the development of rapid assessment tools to inform people about wetland issues.

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**Definitions**

A patch of land that develops pools of water after a [rain storm](http://en.wikipedia.org/wiki/Rain_storm) would not be considered a "wetland," even though the land is wet. Wetlands have unique characteristics: they are generally distinguished from other [water bodies](http://en.wikipedia.org/wiki/Water_bodies) or [landforms](http://en.wikipedia.org/wiki/Landforms) based on their [water level](http://en.wikipedia.org/wiki/Water_level) and on the types of [plants](http://en.wikipedia.org/wiki/Plant) that thrive within them. Specifically, wetlands are characterized as having a [water table](http://en.wikipedia.org/wiki/Water_table) that stands at or near the [land surface](http://en.wikipedia.org/wiki/Land_surface) for a long enough period each year to support [aquatic plants](http://en.wikipedia.org/wiki/Aquatic_plants).[[10]](http://en.wikipedia.org/wiki/Wetland#cite_note-9)[[11]](http://en.wikipedia.org/wiki/Wetland#cite_note-10)

A more concise definition is a community composed of [hydric soil](http://en.wikipedia.org/wiki/Hydric_soil) and [hydrophytes](http://en.wikipedia.org/wiki/Hydrophytes).[[7]](http://en.wikipedia.org/wiki/Wetland#cite_note-water-6)

Wetlands have also been described as [ecotones](http://en.wikipedia.org/wiki/Ecotone), providing a transition between dry land and water bodies.[[12]](http://en.wikipedia.org/wiki/Wetland#cite_note-11) Mitsch and Gosselink write that wetlands exist "...at the interface between truly [terrestrial](http://en.wikipedia.org/wiki/Terrestrial_ecoregion) ecosystems and [aquatic](http://en.wikipedia.org/wiki/Aquatic_habitat) systems, making them inherently different from each other, yet highly dependent on both."[[13]](http://en.wikipedia.org/wiki/Wetland#cite_note-mitsch2007-12)

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

**Technical definitions**

A wetland is "an ecosystem that arises when inundation by water produces soils dominated by anaerobic processes, which, in turn, forces the biota, particularly rooted plants, to adapt to flooding."[[14]](http://en.wikipedia.org/wiki/Wetland#cite_note-FOOTNOTEKeddy20102-13) There are four main kinds of wetlands -- [marsh](http://en.wikipedia.org/wiki/Marsh), [swamp](http://en.wikipedia.org/wiki/Swamp), [bog](http://en.wikipedia.org/wiki/Bog) and [fen](http://en.wikipedia.org/wiki/Fen). Some experts also recognize wet meadows and aquatic ecosystems as additional wetland types.[[5]](http://en.wikipedia.org/wiki/Wetland#cite_note-Keddy2010-4) The largest wetlands in the world include the swamp forests of the Amazon and the peatlands of Siberia.[[8]](http://en.wikipedia.org/wiki/Wetland#cite_note-FraserKeddy-7)

**Ramsar Convention definition**

Under the [Ramsar international wetland conservation treaty](http://en.wikipedia.org/wiki/Ramsar_Convention), wetlands are defined as follows:[[15]](http://en.wikipedia.org/wiki/Wetland" \l "cite_note-14)

* Article 1.1: "...wetlands are areas of marsh, [fen](http://en.wikipedia.org/wiki/Fen), [peatland](http://en.wikipedia.org/wiki/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 metres."
* Article 2.1: "[Wetlands] may incorporate [riparian](http://en.wikipedia.org/wiki/Riparian) and coastal zones adjacent to the wetlands, and [islands](http://en.wikipedia.org/wiki/Island) or bodies of marine water deeper than six metres at [low tide](http://en.wikipedia.org/wiki/Low_tide) lying within the wetlands."

**Regional definitions**

Although the general definition given above applies around the world, each county and region tends to have its own definition for legal purposes. For example, in the United States, wetlands are defined as "**those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas**".[[16]](http://en.wikipedia.org/wiki/Wetland#cite_note-15) This definition has been used in the enforcement of the [Clean Water Act](http://en.wikipedia.org/wiki/Clean_Water_Act). Some US states, such as [Massachusetts](http://en.wikipedia.org/wiki/Massachusetts) and [New York](http://en.wikipedia.org/wiki/New_York), have separate definitions that may differ from the federal government.

**Ecology**

The most important factor producing wetlands is flooding. The duration of flooding determines whether the resulting wetland has aquatic, marsh or swamp vegetation. Other important factors include fertility, natural disturbance, competition, herbivory, burial and salinity.[[5]](http://en.wikipedia.org/wiki/Wetland#cite_note-Keddy2010-4) When peat accumulates, bogs and swamps arise.

**Characteristics**

Wetlands vary widely due to local and regional differences in [topography](http://en.wikipedia.org/wiki/Topography), [hydrology](http://en.wikipedia.org/wiki/Hydrology), [vegetation](http://en.wikipedia.org/wiki/Vegetation), and other factors, including human involvement. Wetlands can be divided into two main classes: tidal and non-tidal areas.[[7]](http://en.wikipedia.org/wiki/Wetland#cite_note-water-6)

**Hydrology**

Wetland hydrology is associated with the spatial and temporal dispersion, flow, and physiochemical attributes of surface and ground water in its reservoirs. Based on hydrology, wetlands can be categorized as [riverine](http://en.wikipedia.org/wiki/Riverine) (associated with streams), [lacustrine](http://en.wiktionary.org/wiki/lacustrine) (associated with lakes and reservoirs), and [palustrine](http://en.wikipedia.org/wiki/Palustrine) (isolated). Sources of hydrological flows into wetlands are predominately precipitation, surface water, and ground water. Water flows out of wetlands by [evapotranspiration](http://en.wikipedia.org/wiki/Evapotranspiration), [surface runoff](http://en.wikipedia.org/wiki/Surface_runoff), and sub-surface water outflow. Hydrodynamics (the movement of water through and from a wetland) affects hydroperiods (temporal fluctuations in water levels) by controlling the water balance and water storage within a wetland.[[17]](http://en.wikipedia.org/wiki/Wetland#cite_note-16)

Landscape characteristics control wetland hydrology and [hydrochemistry](http://en.wikipedia.org/wiki/Hydrochemistry). The O2 and CO2 concentrations of water depend on temperature and atmospheric pressure. Hydrochemistry within wetlands is determined by the [pH](http://en.wikipedia.org/wiki/PH), [salinity](http://en.wikipedia.org/wiki/Salinity), nutrients, [conductivity](http://en.wikipedia.org/wiki/Electrical_conductivity), soil composition, [hardness](http://en.wikipedia.org/wiki/Water_hardness), and the sources of water. Water chemistry of wetlands varies across landscapes and climatic regions. Wetlands are generally minerotrophic with the exception of bogs.

Bogs receive their water from the [atmosphere](http://en.wikipedia.org/wiki/Atmosphere) and therefore their water has low mineral ionic composition because ground water has a higher concentration of dissolved nutrients and minerals in comparison to precipitation.

The water chemistry of fens ranges from low pH and low minerals to alkaline with high accumulation of [calcium](http://en.wikipedia.org/wiki/Calcium) and [magnesium](http://en.wikipedia.org/wiki/Magnesium) because they acquire their water from precipitation as well as ground water.[[18]](http://en.wikipedia.org/wiki/Wetland#cite_note-17)

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=8)**] Role of salinity**

Salinity has a strong influence on wetland water chemistry, particularly in wetlands along the coast.[[5]](http://en.wikipedia.org/wiki/Wetland#cite_note-Keddy2010-4)[[19]](http://en.wikipedia.org/wiki/Wetland#cite_note-18) In non-riverine wetlands, natural salinity is regulated by interactions between ground and surface water, which may be influenced by human activity.[[20]](http://en.wikipedia.org/wiki/Wetland#cite_note-19)

**Soil**

[Carbon](http://en.wikipedia.org/wiki/Carbon) is the major nutrient cycled within wetlands. Most nutrients, such as [sulfur](http://en.wikipedia.org/wiki/Sulfur), [phosphorus](http://en.wikipedia.org/wiki/Phosphorus), carbon, and [nitrogen](http://en.wikipedia.org/wiki/Nitrogen) are found within the soil of wetlands. [Anaerobic](http://en.wikipedia.org/wiki/Anaerobic_respiration) and [aerobic respiration](http://en.wikipedia.org/wiki/Aerobic_respiration) in the soil influences the nutrient cycling of carbon, hydrogen, oxygen, and nitrogen,[[21]](http://en.wikipedia.org/wiki/Wetland#cite_note-20) and the solubility of phosphorus[[22]](http://en.wikipedia.org/wiki/Wetland#cite_note-21) thus contributing to the chemical variations in its water. Wetlands with low pH and saline conductivity may reflect the presence of acid [sulfates](http://en.wikipedia.org/wiki/Sulfate)[[23]](http://en.wikipedia.org/wiki/Wetland#cite_note-22) and wetlands with average salinity levels can be heavily influenced by [calcium](http://en.wikipedia.org/wiki/Calcium) or [magnesium](http://en.wikipedia.org/wiki/Magnesium). [Biogeochemical processes](http://en.wikipedia.org/wiki/Biogeochemistry) in wetlands are determined by soils with low [redox](http://en.wikipedia.org/wiki/Redox) potential.[[24]](http://en.wikipedia.org/wiki/Wetland#cite_note-23)

**Biota**

The biota of a wetland system includes its vegetation zones and structure as well as animal populations. The most important factor affecting the biota is the duration of flooding.[[5]](http://en.wikipedia.org/wiki/Wetland#cite_note-Keddy2010-4) Other important factors include fertility and salinity. In [fens](http://en.wikipedia.org/wiki/Fen), species are highly dependent on water chemistry. The chemistry of water flowing into wetlands depends on the source of water and the geological material in which it flows through[[25]](http://en.wikipedia.org/wiki/Wetland" \l "cite_note-24) as well as the nutrients discharged from organic matter in the soils and plants at higher elevations in slope wetlands.[[26]](http://en.wikipedia.org/wiki/Wetland#cite_note-25) Biota may vary within a wetland due to season or recent flood regimes.

**Flora**

There are four main groups of hydrophytes that found in wetland systems throughout the world.[[27]](http://en.wikipedia.org/wiki/Wetland#cite_note-26)

[Submerged](http://en.wikipedia.org/wiki/Submerged) water plants. This type of vegetation is found completely underwater. Submerged wetland vegetation can grow in saline and fresh-water conditions. Some species have underwater flowers, while others have long stems to allow the flowers to reach the surface.[[28]](http://en.wikipedia.org/wiki/Wetland#cite_note-27) Submerged species provide a food source for native fauna, habitat for invertrebrates, and also possess filtration capabilities. Examples include [seagrasses](http://en.wikipedia.org/wiki/Seagrasses) and [eelgrass](http://en.wikipedia.org/wiki/Eelgrass).

Floating water plants. Floating vegetation is usually small although it may take up a large surface area in a wetland system. These hydrophytes have small roots and are only found in slow-moving water with rich-nutrient level water Floating aquatic plants are a food resource for avian species. Examples include water lilies [lily pad](http://en.wikipedia.org/wiki/Nymphaeaceae) and [duckweed](http://en.wikipedia.org/wiki/Duckweed).

[Emergent](http://en.wikipedia.org/wiki/Emergent_plant) water plants. Emergent water plants can seen above the surface of the water but whose roots are completely submerged. Many have aerenchyma to transmit oxygen from the atmosphere to their roots.[[29]](http://en.wikipedia.org/wiki/Wetland#cite_note-28) Extensive areas of emergent plants are usually termed [marsh](http://en.wikipedia.org/wiki/Marsh). Examples include cattails ([Typha](http://en.wikipedia.org/wiki/Typha" \o "Typha)) and arrow arum ([Peltandra virginica](http://en.wikipedia.org/wiki/Peltandra_virginica" \o "Peltandra virginica)).

Surrounding [trees](http://en.wikipedia.org/wiki/Tree) and [shrubs](http://en.wikipedia.org/wiki/Shrub). Forested wetlands are generally known as [swamps](http://en.wikipedia.org/wiki/Swamp).[[5]](http://en.wikipedia.org/wiki/Wetland#cite_note-Keddy2010-4) The upper level of these swamps is determined by high water levels, which are negatively affected by dams.[[30]](http://en.wikipedia.org/wiki/Wetland#cite_note-29) Some swamps can be dominated by a single species, such as silver maple swamps around the Great Lakes.[[31]](http://en.wikipedia.org/wiki/Wetland#cite_note-30) Others, like those of the Amazon Basin, have large numbers of different tree species.[[32]](http://en.wikipedia.org/wiki/Wetland#cite_note-31) Examples include cypress ([Taxodium](http://en.wikipedia.org/wiki/Taxodium" \o "Taxodium)) and [mangrove](http://en.wikipedia.org/wiki/Mangrove).

**Fauna**

[Fish](http://en.wikipedia.org/wiki/Fish): Fish are more dependent on wetland ecosystems than any other type of habitat. Every single species of both fresh water and saltwater fish spends part of its life-cycle in a cohiastal wetland[*[citation needed](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed" \o "Wikipedia:Citation needed)*]. 75% of the United States’ commercial fish and shellfish stocks depend solely on estuaries to survive.[[6]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar_a-5) Tropical fish species need mangroves for critical hatchery and nursery grounds and the coral reef system for food.

[Amphibians](http://en.wikipedia.org/wiki/Amphibian): [Frogs](http://en.wikipedia.org/wiki/Frog) are the most crucial amphibian species in wetland systems. Frogs need both terrestrial and aquatic habitats in which to reproduce and feed. While tadpoles control algal populations, adult frogs forage on insects. Frogs are used as an indicator of ecosystem health due to their thin skin which absorbs both nutrient and toxins from the surrounding environment resulting in an above average extinction rate in unfavorable and polluted environmental conditions.[[33]](http://en.wikipedia.org/wiki/Wetland#cite_note-32)

[Reptiles](http://en.wikipedia.org/wiki/Reptile): [Alligators](http://en.wikipedia.org/wiki/Alligator) and [crocodiles](http://en.wikipedia.org/wiki/Crocodile) are two common reptilian species. Alligators are found in fresh water along with the fresh water species of the crocodile. The saltwater crocodile is found in estuaries and mangroves and can be seen in the coastline bordering the [Great Barrier Reef](http://en.wikipedia.org/wiki/Great_Barrier_Reef) in Australia. The Florida [Everglades](http://en.wikipedia.org/wiki/Everglades) is the only place in the world where both crocodiles and alligators co-exist.[[1]](http://en.wikipedia.org/wiki/Wetland#cite_note-dep.state-0) [Snakes](http://en.wikipedia.org/wiki/Snake), [lizards](http://en.wikipedia.org/wiki/Lizard), [goannas](http://en.wikipedia.org/wiki/Goanna), and [turtles](http://en.wikipedia.org/wiki/Turtle) also can be seen throughout wetlands. Snapping turtles are one of the many kinds of turtles found in wetlands.

[Mammals](http://en.wikipedia.org/wiki/Mammals): Multiple small mammals as well as large herbivore and apex species such as the [Florida Panther](http://en.wikipedia.org/wiki/Florida_Panther) live within and around wetlands. The wetland ecosystem attracts mammals due to its prominent seed sources, invertebrate populations, and numbers of small reptiles and amphibians.

[Monotremes](http://en.wikipedia.org/wiki/Monotreme): The [platypus](http://en.wikipedia.org/wiki/Platypus) (*Ornithorhynchus anatinus*) is found in eastern Australia living in freshwater rivers or lakes, and much like the beaver creates dams, create burrows for shelter and protection. The platypus swims through the use of webbed feet. Platypuses feed on insect larvae, worms, or other freshwater insects hunting mainly by night by the use of their bill. They turn up mud on the bottom of the lake or river, and with the help of the electroreceptors located on the bill, unearth insects and freshwater insects. The platypus stores their findings in special pouches behind their bill and consumes its prey upon returning to the surface.[[34]](http://en.wikipedia.org/wiki/Wetland#cite_note-33)

[Insects](http://en.wikipedia.org/wiki/Insects) and [invertebrates](http://en.wikipedia.org/wiki/Invertebrate): These species total more than half of the 100,000 known animal species in wetlands. Insects and invertebrates can be submerged in the water or soil, on the surface, and in the atmosphere.

**Algae**

[Algae](http://en.wikipedia.org/wiki/Algae) are diverse water plants that can vary in size, color, and shape. Algae occur naturally in habitats such as inland lakes, inter-tidal zones, and damp soil and provide a dedicated food source for animals, fish, and invertebrates. There are three main groups of algae:

[Plankton](http://en.wikipedia.org/wiki/Plankton) are algae which are [microscopic](http://en.wikipedia.org/wiki/Microscopic), free-floating algae. This algae is so tiny that on average, if fifty of these microscopic algae were lined up end-to-end, it would only measure one millimetre. Plankton are the basis of the food web and are responsible for [primary production](http://en.wikipedia.org/wiki/Primary_production) in the ocean using photosynthesis to make food. [Filamentous algae](http://en.wikipedia.org/wiki/Filamentous_algae) are long strands of algae cells that form floating mats. [Chara](http://en.wikipedia.org/wiki/Chara_(alga)) and [Nitella](http://en.wikipedia.org/wiki/Nitella) algae are upright algae that look like a submerged plant with roots.[[35]](http://en.wikipedia.org/wiki/Wetland#cite_note-34)

**Biota importance**

Many of the flora and fauna that are part of wetlands are disappearing. As most species are endemic to wetlands, biologists and other scientists routinely census wetland biota to look for threatened populations. The IUCN's global red list[[36]](http://en.wikipedia.org/wiki/Wetland" \l "cite_note-35) can be accessed on the internet to determine if there is any species within a particular wetland system that has been identified as needing assistance to prevent extinction. This is so the animals do not become extinct.

**Climates**

**Temperature**

[](http://en.wikipedia.org/wiki/File:MiddleSpring.JPG)

[http://bits.wikimedia.org/static-1.21wmf1/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:MiddleSpring.JPG)

Wetlands contrast the hot, arid landscape around Middle Spring, [Fish Springs National Wildlife Refuge](http://en.wikipedia.org/wiki/Fish_Springs_National_Wildlife_Refuge), [Utah](http://en.wikipedia.org/wiki/Utah).

Temperatures vary greatly depending on the location of the wetland. Many of the world's wetlands are in temperate zones (midway between the North or South Pole and the equator). In these zones, summers are warm and winters are cold, but temperatures are not extreme. However, wetlands found in the tropic zone, around the equator, are warm year round. Wetlands on the [Arabian Peninsula](http://en.wikipedia.org/wiki/Arabian_Peninsula), for example, can reach 50 °C (122 °F) and would therefore be subject to rapid evaporation. In northeastern [Siberia](http://en.wikipedia.org/wiki/Siberia), which has a polar climate, wetland temperatures can be as low as −50 °C (−58 °F). In a moderate zone, such as the [Gulf of Mexico](http://en.wikipedia.org/wiki/Gulf_of_Mexico), a typical temperature might be 11 °C (51 °F).

**Rainfall**

The amount of rainfall a wetland receives varies widely according to its area. Wetlands in Wales, Scotland, and Western Ireland typically receive about 1500 mm (or 60 in) per year. In some places in Southeast Asia, where heavy rains occur, they can receive up to 10,000 mm (about 200 in). In the northern areas of North America, wetlands exist where as little as 180 mm (7 inches) of rain fall each year.

**Temporal variation:**[[37]](http://en.wikipedia.org/wiki/Wetland" \l "cite_note-36)

* [Perennial](http://en.wikipedia.org/wiki/Perennial) systems
* [Seasonal](http://en.wikipedia.org/wiki/Seasonal) systems
* Episodic (periodic or intermittent) system of the down
* Surface flow may occur in some segments, with subsurface flow in other segments
* [Ephemeral](http://en.wikipedia.org/wiki/Ephemeral) (short-lived) systems
* [Migratory](http://en.wikipedia.org/wiki/Animal_migration) species

**Human-disturbance:**[[38]](http://en.wikipedia.org/wiki/Wetland" \l "cite_note-wetlands-37)

* Encroachment
  + Drainage
  + Development
  + Over-grazing
  + [Mining](http://en.wikipedia.org/wiki/Mining)
  + Unsustainable water use
* Ecosystem Stress
  + [Water Scarcity](http://en.wikipedia.org/wiki/Water_Scarcity)
  + [Endangered](http://en.wikipedia.org/wiki/Endangered) species
  + Disruption of breeding grounds
  + Imbalance in sediment load and nutrient filtration

**Peatswamps of South-east Asia**

In Southeast Asia, peatswamp forests and soils are being drained, burnt, mined, and overgrazed contributing severely to climate change.[[38]](http://en.wikipedia.org/wiki/Wetland#cite_note-wetlands-37) As a result of peat drainage, the organic carbon that was built up over thousands of years and is normally under water, is suddenly exposed to the air. It decomposes and turns into [carbon dioxide](http://en.wikipedia.org/wiki/Carbon_dioxide) (CO2), which is released into the atmosphere. Peat fires cause the same process and in addition create enormous clouds of smoke that cross international borders, such as happen every year in Southeast Asia. Peatlands form only 3% of all the world’s land area, however, their degradation equals 7% of all [fossil fuel](http://en.wikipedia.org/wiki/Fossil_fuel) CO2 emissions.

Through the building of dams, [Wetlands International](http://en.wikipedia.org/wiki/Wetlands_International) is halting the drainage of peatlands in Southeast Asia, hoping to mitigate CO2 emissions. Concurrent wetland restoration techniques include reforestation with native tree species as well as setting up community fire brigades. This sustainable approach can be seen in Central [Kalimantan](http://en.wikipedia.org/wiki/Kalimantan) and [Sumatra](http://en.wikipedia.org/wiki/Sumatra), [Indonesia](http://en.wikipedia.org/wiki/Indonesia).

**Aquaculture**

Concerns are developing over certain aspects of farm fishing, which uses natural waterways to harvest fish for human consumption and pharmaceuticals. This practice has become especially popular within Asia and the South Pacific. Its impact downstream upon much larger water ways has negatively influenced many small island developing states.[[39]](http://en.wikipedia.org/wiki/Wetland#cite_note-38)

**Ecosystem services**

The function of natural wetlands can be classified by their ecosystem benefits. The United Nations Millennium Ecosystem Assessment and Ramsar Convention found wetlands to be of biosphere significance and societal importance in the following areas:

• Flood control • Groundwater replenishment • Shoreline stabilisation and storm protection • Water purification • Reservoirs of biodiversity • Wetland products • Cultural values • Recreation and tourism • Climate change mitigation and adaptation

*The economic worth of the ecosystem services provided to* society by intact, naturally functioning wetlands is frequently much greater than the perceived benefits of converting them to ‘more valuable’ intensive land use – particularly as the profits from unsustainable use often go to relatively few individuals or corporations, rather than being shared by society as a whole*.-Ramsar convention*

*Unless otherwise cited, Ecosystem services is based on the following series of references.*[[6]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar_a-5)

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=21)**] Flood control**

*Major wetland type: floodplain*

**Storage Reservoirs and Flood Protection.** The wetland system of [floodplains](http://en.wikipedia.org/wiki/Floodplains) is formed from major rivers downstream from their headwaters. Notable river systems that produce large spans of floodplain include the [Nile River](http://en.wikipedia.org/wiki/Nile_River) (Africa), [Mississippi River](http://en.wikipedia.org/wiki/Mississippi_River) (USA), [Amazon River](http://en.wikipedia.org/wiki/Amazon_River) (South America), [Yangtze River](http://en.wikipedia.org/wiki/Yangtze_River) (China), [Danube River](http://en.wikipedia.org/wiki/Danube_River) (Central Europe) and [Murray-Darling](http://en.wikipedia.org/wiki/Murray-Darling) River (Australia). "The floodplains of major rivers act as natural storage reservoirs, enabling excess water to spread out over a wide area, which reduces its depth and speed. Wetlands close to the headwaters of streams and rivers can slow down rainwater runoff and spring snowmelt so that it doesn’t run straight off the land into water courses. This can help prevent sudden, damaging floods downstream.”[[6]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar_a-5)

**Human-Impact.** Converting wetlands through drainage and development have contributed to the issue of irregular flood control through forced adaption of water channels to narrower corridors due to loss of wetland area. These new channels must manage the same amount of precipitation causing flood peaks to be [higher or deeper] and floodwaters to travel faster.

Water management engineering developments in the past century have degraded these wetlands through the construction on artificial embankments. These constructions may be classified as dykes, bunds, levees, weirs, barrages and dams but serve the single purpose of concentrating water into a select source or area. Wetland water sources that were once spread slowly over a large, shallow area are pooled into deep, concentrated locations. Loss of wetland floodplains results in more severe and damaging flooding. Catastrophic human impact in the Mississippi River floodplains was seen in death of several hundred individuals during a levee breach in New Orleans caused by Hurricane Katrina. Ecological catastrophic events from human-made embankments have been noticed along the Yangtze River floodplains after the where the middle of the river has become prone to more frequent and damaging flooding including the loss of riparian vegetation, a 30% loss of the vegetation cover throughout the river’s basin, a doubling of the percentage of the land affected by soil erosion, and a reduction in reservoir capacity through siltation build-up in floodplain lakes.[[6]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar_a-5)

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=22)**] Groundwater replenishment**

*Major wetland type: marsh, swamp, & subterranean karst and cave hydrological systems*

The surface water which is the water visibly seen in wetland systems only represents a portion of the overall water cycle which also includes atmospheric water and groundwater. Wetland systems are directly linked to groundwater and a crucial regulator of both the quantity and quality of water found below the ground. Wetland systems that are made of permeable sediments like limestone or occur in areas with highly variable and fluctuating water tables especially have a role in groundwater replenishment or water recharge. Sediments that are porous allow water to filter down through the soil and overlying rock into aquifers which are the source of 95% of the world’s drinking water. Wetlands can also act as recharge areas when the surrounding water table is low and as a discharge zone when it is too high. Karst (cave) systems are a unique example of this system and are a connection of underground rivers influenced by rain and other forms of precipitation. These wetland systems are capable of regulating changes in the water table on upwards of 130 metres (430 ft).

**Human-Impact**. Groundwater is an important source of water for drinking and irrigation of crops. Over 1 billion people in Asia and 65% of the public water sources in Europe source 100% of their water from groundwater. Irrigation is a massive use of groundwater with 80% of the world’s groundwater used for agricultural production.[[6]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar_a-5)

Unsustainable abstraction of groundwater has become a major concern. In the Commonwealth of [Australia](http://en.wikipedia.org/wiki/Australia), water licensing is being implemented to control use of the water in major agricultural regions. On a global scale, groundwater deficits and water scarcity is one of the most pressing concerns facing the 21st century.[[6]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar_a-5)

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=23)**] Shoreline stabilisation and storm protection**

*Wetland type: Mangroves, Coral Reefs, Saltmarsh*

*Main article:* [*Integrated Coastal Zone Management*](http://en.wikipedia.org/wiki/Integrated_Coastal_Zone_Management)

Tidal and inter-tidal wetland systems protect and stabilize coastal zones. Coral reefs provide a protective barrier to coastal shoreline. Mangroves stabilize the coastal zone from the interior and will migrate with the shoreline to remain adjacent to the boundary of the water. The main conservation benefit these systems have against storms and tidal waves is the ability to reduce the speed and height of waves and floodwaters.

*Human-Impact.* The sheer number of people who live and work near the coast is expected to grow immensely over the next 50 years. From an estimated 200 million people that currently live in low-lying coastal regions, the development of urban coastal centers is projected to increase the population by 5 fold within 50 years.[[40]](http://en.wikipedia.org/wiki/Wetland#cite_note-urlUNEP-Home-39) The United Kingdom has begun the concept of managed coastal realignment. This management technique provides shoreline protection through restoration of natural wetlands rather than through applied engineering.

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=24)**] Water purification**

*Wetland Type: Floodplain, Mudflat, Saltmarsh, Mangroves*

**Nutrient Retention.** Wetlands cycle both sediments and nutrients balancing terrestrial and aquatic ecosystems. A natural function of wetland vegetation is the up-take and storage of nutrients found in the surrounding soil and water. These nutrients are retained in the system until the plant dies or is harvested by animals or humans. Wetland vegetation productivity is linked to the climate, wetland type, and nutrient availability. The grasses of fertile floodplains such as the Nile produce the highest yield including plants such as *Arundo donax*(giant reed), *Cyperus papyrus* (papyrus), *Phragmites* (reed) and *Typha* (cattail, bulrush).

**Sediment Traps.** Rainfall run-off is responsible for moving sediment through waterways. These sediments move towards larger and more sizable waterways through a natural process that moves water towards oceans. All types of sediments which may be composed of clay, sand, silt, and rock can be carried into wetland systems through this process. Reedbeds or forests located in wetlands act as physical barriers to slow waterflow and trap sediment.

**Water purification.** Many wetland systems possess biofilters, hydrophytes, and organisms that in addition to nutrient up-take abilities have the capacity to remove toxic substances that have come from pesticides, industrial discharges, and mining activities. The up-take occurs through most parts of the plant including the stems, roots, and leaves . Floating plants can absorb and filter heavy metals. *Eichhornia crassipes* (water hyacinth), *Lemna* (duckweed) and *Azolla* (water fern) store iron and copper commonly found in [wastewater](http://en.wikipedia.org/wiki/Wastewater). Many fast-growing plants rooted in the soils of wetlands such as *Typha* (cattail) and *Phragmites* (reed) also aid in the role of heavy metal up-take. Animals such as the oyster can filter more than 200 liters (53 gallons) of water per day while grazing for food, removing nutrients, suspended sediments, and chemical contaminants in the process.

**Capacity.** The ability of wetland systems to store nutrients and trap sediment is highly efficient and effective but each system has a threshold. An overabundance of nutrient input from fertilizer run-off, sewage effluent, or non-point pollution will cause [eutrophication](http://en.wikipedia.org/wiki/Eutrophication). Upstream erosion from deforestation can overwhelm wetlands making them shrink in size and see dramatic biodiversity loss through excessive sedimentation load. The capacity of wetland vegetation to store heavy metals is affected by waterflow, number of hectares (acres), climate, and type of plant.

**Human-Impact**. Introduced hydrophytes in different wetland systems can have devastating results. The introduction of water hyacinth, a native plant of South America into Lake Victoria in East Africa as well as duckweed into non-native areas of Queensland, Australia, have overtaken entire wetland systems suffocating the ecosystem due to their phenomenal growth rate and ability to float and grow on the surface of the water.

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=25)**] Constructed wetlands**

The function of most natural wetland systems is not to manage to wastewater, however, their high potential for the filtering and the treatment of pollutants has been recognized by environmental engineers that specialize in the area of wastewater treatment. These constructed artificial wetland systems are highly controlled environments that intend to mimic the occurrences of soil, flora, and microorganisms in natural wetlands to aid in treating wastewater effluent. Artificial wetlands provide the ability to experiment with flow regimes, micro-biotic composition, and flora in order to produce the most efficient treatment process. Other advantages are the control of retention times and hydraulic channels.[[41]](http://en.wikipedia.org/wiki/Wetland#cite_note-40) The most important factors of constructed wetlands are the water flow processes combined with plant growth. Constructed wetland systems can be surface flow systems with only free-floating macrophytes, floating-leaved macrophytes, or submerged macrophytes; however, typical free water surface systems are usually constructed with emergent macrophytes.[[42]](http://en.wikipedia.org/wiki/Wetland#cite_note-41) Constructed wetlands can be adapted to treat raw sewage, secondary domestic sludge, enhance water quality of oxidation ponds’ discharge, storm waters, mining waste, and industrial and agricultural waste effluents. The [Urrbrae Wetland](http://en.wikipedia.org/wiki/Urrbrae_Wetland) in Australia was constructed for urban flood control and environmental education. International wastewater management programs can be seen from Kolkata (Calcutta), India to [Arcata](http://en.wikipedia.org/wiki/Arcata), California, USA.[[43]](http://en.wikipedia.org/wiki/Wetland#cite_note-42)

**Kolkata’s constructed wetland.** Kolkata is an example of how constructed wetlands are being utilized in developing countries.

Using the purification capacity of wetlands, the Indian city of Kolkata (Calcutta) has pioneered a system of sewage disposal that is both efficient and environmentally friendly. Built to house one million people, Kolkata is now home to over 10 million, many living in slums. But the 8,000-hectare East Kolkata Wetlands Ramsar Site, a patchwork of tree-fringed canals, vegetable plots, rice paddies and fish ponds – and the 20,000 people that work in them – daily transform one-third of the city’s sewage and most of its domestic refuse into a rich harvest of fish and fresh vegetables. For example, the Mudially Fishermen’s Cooperative Society is a collective of 300 families that lease 70 hectares into which wastewater from the city is released. Through a series of natural treatment processes – including the use of Eichhornia crassipes and other plants for absorbing oil, grease and heavy metals – the Cooperative has turned the area into a thriving fish farm and nature park. In 2005/06, the Cooperative sold fish worth over US$135,000 and shared income of more than US$55,000 among its members.[[6]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar_a-5)[[*not in citation given*](http://en.wikipedia.org/wiki/Wikipedia:Verifiability)]

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=26)**] Reservoirs of biodiversity**

Wetland systems' rich biodiversity is becoming a focal point at International Treaty Conventions and within the [World Wildlife Fund](http://en.wikipedia.org/wiki/World_Wildlife_Fund) organization due to the high number of species present in wetlands, the small global geographic area of wetlands, the number of species which are endemic to wetlands, and the high productivity of wetland systems. Hundred of thousands of animal species, 20,000 of them vertebrates, are living in wetland systems. The discovery rate of fresh water fish is at 200 new species per year.

**Biodiverse river basins.** The Amazon holds 3,000 species of fresh water fish species within the boundaries of its basin whose function it is to disperse the seeds of trees. One of its key species, the Piramutaba catfish, *Brachyplatystoma vaillantii*, migrates more than 3,300 km (2,051 miles) from its nursery grounds near the mouth of the Amazon River to its spawning grounds in Andean tributaries (400 m or 437 yards above sea level) distributing plants seed along the route.

**Productive intertidal zones.** Intertidal mudflats have a similar productivity even while possessing a low number of species. The abundance of invertebrates found within the mud are a food source for migratory waterfowl.

**Critical life-stage habitat.** Mudflats, saltmarshes, mangroves, and seagrass beds contain bother species richness and productivity, and are home to important nursery areas for many commercial fish stocks.

**Genetic Diversity.** Many species in wetland systems are unique due to the long period of time that the ecosystem has been physically isolated from other aquatic sources. The number of endemic species in Lake Baikal in Russia classifies it as a hotspot for biodiversity and one of the most biodiverse wetlands in the entire world.

[**Lake Baikal**](http://en.wikipedia.org/wiki/Lake_Baikal)**.** Evidence from a research study by Mazepova *et al.* suggest that the number of crustacean species endemic to Baikal Lake (>690 species and subspecies) exceeds the number of the same groups of animals inhabiting all the fresh water bodies of Eurasia together. Its 150 species of free-living Platyhelminthes alone is analogous to the entire number in all of Eastern Siberia. The 34 species and subspecies number of Baikal sculpins is more than twice the number of the analogous fauna that inhabits Eurasia. One of most exciting discoveries was made by A.V. Shoshin who registered about 300 species of free-living nematodes using only 6 near-shore sampling localities in the Southern Baikal. "If we will take into consideration, that about 60 % of the animals can be found nowhere else except Baikal, it may be assumed that the lake may be the biodiversity center of the Eurasian continent."[[44]](http://en.wikipedia.org/wiki/Wetland#cite_note-Baikal-43)

**Human Impact.** Biodiversity loss occurs in wetland systems through land use changes, habitat destruction, pollution, exploitation of resources, and invasive species. Vulnerable, threatened, and endangered species number at 17% of waterfowl, 38% of fresh-water dependent mammals, 33% of fresh water fish, 26% of fresh water amphibians, 72% of fresh water turtles, 86% of marine turtles, 43% of crocodilians and 27% of coral reef-building species.

The impact of maintaining biodiversity is seen at the local level through job creation, sustainability, and community productivity. A good example is the Lower Mekong basin which runs through Cambodia, Laos, and Vietnam. Supporting over 55 million people, the sustainability of the region is enhanced through wildlife tours. The US state of Florida has estimated that US$ 1.6 billion was generated in state revenue from recreational activities associated with wildlife. Sustainable harvesting for medicinal remedies found in native wetlands plants in the Caribbean and Australia include the Red Mangrove *Rhizophora mangle* which possesses antibacterial, wound-healing, anti-ulcer effects, and antioxidant properties.[[45]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar_b-44)

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=27)**] Wetland products**

Wetland systems naturally produce an array of vegetation and other ecological products that can harvested for personal and commercial use. The most significant of these is fish which have all or part of their life-cycle occur within a wetland system. Fresh and saltwater fish are the main source of protein for one billion people and comprise 15% of an additional two billion people’s diets. In addition, fish generate a fishing industry that provides 80% of the income and employment to residents in developing countries. Another food staple found in wetland systems is rice, a popular grain that is consumed at the rate of 1/5 of the total global calorie count. In Bangladesh, Cambodia and Vietnam, where rice paddies are predominant on the landscape, rice consumption reach 70%.[[45]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar_b-44)

Food converted to sweeteners and carbohydrates include the sago palm of Asia and Africa (cooking oil), the nipa palm of Asia (sugar, vinegar, alcohol, and fodder) and honey collection from mangroves. More than supplemental dietary intake, this produce sustains entire villages. Coastal Thailand villages earn the key portion of their income from sugar production while the country of Cuba relocates more than 30,000 hives each year to track the seasonal flowering of the mangrove *Avicennia*.

Other mangrove- derived products.

• fuelwood • salt (produced by evaporating seawater) • animal fodder • traditional medicines (e.g. from mangrove bark) • fibers for textiles • dyes and tannins

**Human Impact.** Over-fishing is the major problem for sustainable use of wetlands. The field of aquaculture within the fisheries industries is eliminating mass areas of wetland systems through practices seen such as in the shrimp farming industry's destruction of mangroves. Aquaculture is continuing to develop rapidly throughout the Asia-Pacific region specifically in China with world holdings in Asia equal to 90% of the total number of aquaculture farms and 80% of its global value.[[45]](http://en.wikipedia.org/wiki/Wetland#cite_note-ramsar_b-44) Threats to rice fields mainly stem from inappropriate water management, introduction of invasive alien species, agricultural fertilizers, pesticides, and land use changes. Industrial-scale production of palm oil threatens the biodiversity of wetland ecosystems in parts of south-east Asia, Africa, and other developing countries. Exploitation can occur at the community level as is sometimes seen throughout coastal villages of Southern Thailand where each resident may obtain for themselves every consumable of the mangrove forest (fuelwood, timber, honey, resins, crab, and shellfish) which then becomes threatened through increasing population and continual harvest. Other issues that occur on a global level include an uneven contribution to climate change, point and non-point pollution, and air and water quality issues due to destructive wetland practices.

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=28)**] Wetlands and climate change**

All references within this section were obtained from the following source.[[46]](http://en.wikipedia.org/wiki/Wetland#cite_note-45)

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=29)**] Scientific projections**

“Low water and occasional drying of the wetland bottom during droughts (dry marsh phase) stimulate plant recruitment from a diverse seed bank and increase productivity by mobilizing nutrients. In contrast, high water during deluges (lake marsh phase) causes turnover in plant populations and creates greater interspersion of element cover and open water, but lowers overall productivity. During a cover cycle that ranges from open water to complete vegetation cover, annual net primary productivity may vary 20-fold.”[[47]](http://en.wikipedia.org/wiki/Wetland#cite_note-46)

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=30)**] Mitigation and adaption**

Wetlands perform two important functions in relation to climate change. They have mitigation effects through their ability to [sink carbon](http://en.wikipedia.org/wiki/Carbon_sink), and adaptation effects through their ability to store and regulate water.

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=31)**] Conservation**

*Main article:* [*Wetland conservation*](http://en.wikipedia.org/wiki/Wetland_conservation)

Wetlands have historically been the victim of large draining efforts for [real estate development](http://en.wikipedia.org/wiki/Real_estate_development), or [flooding](http://en.wikipedia.org/wiki/Flooding) for use as recreational [lakes](http://en.wikipedia.org/wiki/Lakes). Since the 1970s, more focus has been put on preserving wetlands for their natural function yet by 1993 half the world's wetlands had been drained.[[48]](http://en.wikipedia.org/wiki/Wetland#cite_note-47) Wetlands provide a valuable flood control function. Wetlands are very effective at filtering and cleaning [water pollution](http://en.wikipedia.org/wiki/Water_pollution),[[49]](http://en.wikipedia.org/wiki/Wetland" \l "cite_note-48) (often from [agricultural runoff](http://en.wikipedia.org/wiki/Agricultural_runoff) from the farms that replaced the wetlands in the first place). To replace these wetland [ecosystem services](http://en.wikipedia.org/wiki/Ecosystem_services) enormous amounts of money had to be spent on [water purification](http://en.wikipedia.org/wiki/Water_purification) plants, along with the remediation measures for controlling floods: dam and levee construction.

In order to produce sustainable wetlands, short-term, private-sector profits need to come secondary to global equity. Decision-makers must valuate wetland type, provided ecosystem service, long-term benefit, and current subsidies inflating valuation on either the private or public sector side. Analysis using the impact of hurricanes versus storm protection features projected wetland valuation at US$33,000/hectare/year.[[50]](http://en.wikipedia.org/wiki/Wetland#cite_note-49)

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=32)**] Balancing wetland conservation with the needs of people**

Wetlands are vital ecosystems that provide livelihoods for the millions of people who live in and around them. The [Millennium Development Goals](http://en.wikipedia.org/wiki/Millennium_Development_Goals) (MDGs) called for different sectors to join forces to secure wetland environments in the context of sustainable development and improving human wellbeing. A three-year project carried out by Wetlands International in partnership with the [International Water Management Institute](http://en.wikipedia.org/wiki/International_Water_Management_Institute) found that it is possible to conserve wetlands while improving the livelihoods of people living among them. Case studies conducted in Malawi and Zambia looked at how [dambos](http://en.wikipedia.org/wiki/Dambo) – wet, grassy valleys or depressions where water seeps to the surface – can be farmed sustainably to improve livelihoods. Mismanaged or overused dambos often become degraded, however, using a knowledge exchange between local farmers and environmental managers, a protocol was developed using soil and water management practices. Project outcomes included a high yield of crops, development of sustainable farming techniques, and adequate water management generating enough water for use as irrigation. Before the project, there were cases where people had died from starvation due to food shortages. By the end of it, many more people had access to enough water to grow vegetables. A key achievement was that villagers had secure food supplies during long, dry months. They also benefited in other ways: nutrition was improved by growing a wider range of crops, and villagers could also invest in health and education by selling produce and saving money.[[51]](http://en.wikipedia.org/wiki/Wetland#cite_note-50)

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=33)**] Ramsar Convention**

*Main article:* [*Ramsar Convention*](http://en.wikipedia.org/wiki/Ramsar_Convention)

*The Convention on Wetlands of International Importance, especially as Waterfowl Habitat*, or Ramsar Convention, is an international [treaty](http://en.wikipedia.org/wiki/Treaty) designed to address global concerns regarding wetland loss and degradation. The primary purposes of the treaty are to list wetlands of international importance and to promote their wise use, with the ultimate goal of preserving the world's wetlands. Methods include restricting access to the majority portion of wetland areas, as well as educating the public to combat the misconception that wetlands are wastelands. The Convention works closely with five International Organisation Partners. These are: [Birdlife International](http://en.wikipedia.org/wiki/Birdlife_International), [IUCN](http://en.wikipedia.org/wiki/IUCN), International Water Management Institute, Wetlands International and [World Wide Fund for Nature](http://en.wikipedia.org/wiki/World_Wide_Fund_for_Nature). The partners provide technical expertise, help conduct or facilitate field studies and provide financial support. The IOPs also participate regularly as observers in all meetings of the Conference of the Parties and the Standing Committee and as full members of the Scientific and Technical Review Panel.

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=34)**] Valuation**

The value of a wetland system to the earth and to humankind is one of the most important valuations that can be computed for [sustainable development](http://en.wikipedia.org/wiki/Sustainable_development). A guideline involving assessing a wetland, keeping inventories of known wetlands, and monitoring the same wetlands over time is the current process that is used to educate environmental decision-makers such as governments on the importance of wetland protection and conservation.

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=35)**] Important considerations**

* Constructed Wetlands take 10–100 years to fully resemble the vegetative composition of a natural wetland.
* Artificial wetlands do not have hydric soil. The soil has very low levels of organic carbon and total nitrogen compared to natural wetland systems.
* Organic matter can be added to degraded natural wetlands to help restore their productivity before the wetland is destroyed.[[52]](http://en.wikipedia.org/wiki/Wetland#cite_note-51)

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=36)**] Assessment**

**Rapid assessment.**

Five steps to assessing a wetland

1. Collect general biodiversity data in order to inventory and prioritize wetland species, communities and ecosystems. Obtain baseline biodiversity information for a given area.
2. Gather information on the status of a focus or target species such as threatened species. Collect data pertaining to the conservation of a specific species.
3. Gain information on the effects of human or natural disturbance (changes) on a given area or species.
4. Gather information that is indicative of the general ecosystem health or condition of a specific wetland ecosystem.
5. Determine the potential for sustainable use of biological resources in a particular wetland ecosystem.

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=37)**] Inventory**

Developing a global inventory of wetlands has proven to be a large and difficult undertaking. Current efforts are based on available data, but both classification and spatial resolution have proven to be inadequate for regional or site-specific environmental management decision-making. It is difficult to identify small, long, and narrow wetlands within the landscape. Many of today’s remote sensing satellites do not have sufficient spatial and spectral resolution to monitor wetland conditions, although multispectral IKONOS and QuickBird data may offer improved spatial resolutions once it is 4 m or higher. Majority of the pixels are just mixtures of several plant species or vegetation types and are difficult to isolate which translates into an inability to classify the vegetation that defines the wetland. Improved remote sensing information, coupled with good knowledge domain on wetlands will facilitate expanded efforts in wetland monitoring and mapping. This will also be extremely important because we expect to see major shifts in species composition due to both anthropogenic land use and natural changes in the environment caused by climate change.

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=38)**] Monitoring**

**Mapping**

A wetland system needs to be monitored over time to in order to assess whether it is functioning at an ecologically sustainable level or whether it is becoming degraded. Degraded wetlands will suffer a loss in water quality, a high number of threatened and endangered species, and poor soil conditions.

Due to the large size of wetlands, mapping is an effective tool to monitor wetlands. There are many remote sensing methods that can be used to map wetlands. Remote-sensing technology permits the acquisition of timely digital data on a repetitive basis. This repeat coverage allows wetlands, as well as the adjacent land-cover and land-use types, to be monitored seasonally and/or annually. Using digital data provides a standardized data-collection procedure and an opportunity for data integration within a [geographic information system](http://en.wikipedia.org/wiki/Geographic_information_system). Traditionally, Landsat 5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper Plus (ETM + ), and the SPOT 4 and 5 satellite systems have been used for this purpose. More recently, however, multispectral IKONOS and QuickBird data, with spatial resolutions of 4 m by 4 m and 2.44 m by 2.44 m, respectively, have been shown to be excellent sources of data when mapping and monitoring smaller wetland habitats and vegetation communities.

For example, Detroit Lakes Wetland Management District assessed area wetlands in Michigan, USA using remote sensing. Through using this technology, satellite images were taken over a large geographic area and extended period. In addition, using this technique was less costly and time-consuming compared to the older method using visual interpretation of [aerial photographs](http://en.wikipedia.org/wiki/Aerial_photographs). In comparison, most aerial photographs also require experienced interpreters to extract information based on structure and texture while the interpretation of remote sensing data only requires analysis of one characteristic (spectral).

However, there are a number of limitations associated with this type of image acquisition. Analysis of wetlands has proved difficult because to obtain the data it is often linked to other purposes such as the analysis of land cover or land use. Practically, many natural wetlands are difficult to monitor as these areas are quite often difficult to access and require exposure to native wildlife and potential endemic disease.

**Further improvements**

Methods to develop a classification system for specific biota of interest could assist with technological advances that will allow for identification at a very high accuracy rate. The issue of the cost and expertise involved in remote sensing technology is still a factor hindering further advancements in image acquisition and data processing. Future improvements in current wetland vegetation mapping could include the use of more recent and better geospatial data when it is available.

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=39)**] List of wetland types**

Wetland types:[[53]](http://en.wikipedia.org/wiki/Wetland" \l "cite_note-52)

* **A—Marine and Coastal Zone wetlands**

1. Marine waters—permanent shallow waters less than six metres deep at low tide; includes sea bays, straits
2. Subtidal aquatic beds; includes kelp beds, seagrasses, tropical marine meadows
3. Coral reefs
4. Rocky marine shores; includes rocky offshore islands, sea cliffs
5. Sand, shingle or pebble beaches; includes sand bars, spits, sandy islets
6. Intertidal mud, sand or salt flats
7. Intertidal marshes; includes saltmarshes, salt meadows, saltings, raised salt marshes, tidal brackish and freshwater marshes
8. Intertidal forested wetlands; includes mangrove swamps, nipa swamps, tidal freshwater swamp forests
9. Brackish to saline lagoons and marshes with one or more relatively narrow connections with the sea
10. Freshwater lagoons and marshes in the coastal zone
11. Non-tidal freshwater forested wetlands

* **B—Inland wetlands**

1. Permanent rivers and streams; includes waterfalls
2. Seasonal and irregular rivers and streams
3. Inland deltas (permanent)
4. Riverine floodplains; includes river flats, flooded river basins, seasonally flooded grassland, savanna and palm savanna
5. Permanent freshwater lakes (> 8 ha); includes large oxbow lakes
6. Seasonal/intermittent freshwater lakes (> 8 ha), floodplain lakes
7. Permanent saline/brackish lakes
8. Seasonal/intermittent saline lakes
9. Permanent freshwater ponds (< 8 ha), marshes and swamps on inorganic soils; with emergent vegetation waterlogged for at least most of the growing season
10. Seasonal/intermittent freshwater ponds and marshes on inorganic soils; includes sloughs, potholes; seasonally flooded meadows, sedge marshes
11. Permanent saline/brackish marshes
12. Seasonal saline marshes
13. Shrub swamps; shrub-dominated freshwater marsh, shrub carr, alder thicket on inorganic soils
14. Freshwater swamp forest; seasonally flooded forest, wooded swamps; on inorganic soils
15. Peatlands; forest, shrub or open bogs
16. Alpine and tundra wetlands; includes alpine meadows, tundra pools, temporary waters from snow melt
17. Freshwater springs, oases and rock pools
18. Geothermal wetlands
19. Inland, subterranean karst wetlands

* **C—Human-made wetlands**

1. Water storage areas; reservoirs, barrages, hydro-electric dams, impoundments (generally > 8 ha)
2. Ponds, including farm ponds, stock ponds, small tanks (generally < 8 ha)
3. Aquaculture ponds; fish ponds, shrimp ponds
4. Salt exploitation; salt pans, salines
5. Excavations; gravel pits, borrow pits, mining pools
6. Wastewater treatment; sewage farms, settling ponds, oxidation basins
7. Irrigated land and irrigation channels; rice fields, canals, ditches
8. Seasonally flooded arable land, farm land

**[**[**edit**](http://en.wikipedia.org/w/index.php?title=Wetland&action=edit&section=40)**] Wetland names**