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Study of Ecology of Mega-Lentic Ecosystem in India and Abroad: A Review

Avinash Kumar, Anil K Dwivedi

Dept. of Botany, DDU Gorakhpur University, Gorakhpur, Uttar Pradesh, India

ABSTRACT: An aquatic ecosystem is an ecosystem found in and around a body of water, in contrast to land-based terrestrial ecosystems. Aquatic ecosystems contain communities of organisms—aquatic life—that are dependent on each other and on their environment. The two main types of aquatic ecosystems are marine ecosystems and freshwater ecosystems.[1] Freshwater ecosystems may be lentic (slow moving water, including pools, ponds, and lakes); lotic (faster moving water, for example streams and rivers); and wetlands (areas where the soil is saturated or inundated for at least part of the time). Mega-lentic ecosystems are large standing or slow moving pools, ponds and lakes.

KEYWORDS-Ecology, mega-lentic, ecosystem, India, World

I.INTRODUCTION

Freshwater ecosystems are a subset of Earth's aquatic ecosystems. They include lakes, ponds, rivers, streams, springs, bogs, and wetlands.[8] They can be contrasted with marine ecosystems, which have a larger salt content. Freshwater habitats can be classified by different factors, including temperature, light penetration, nutrients, and vegetation. There are three basic types of freshwater ecosystems: Lentic (slow moving water, including pools, ponds, and lakes); mega-lentic are big pools, ponds, and lakes. A lake ecosystem or lacustrine ecosystem includes biotic (living) plants, animals and micro-organisms, as well as abiotic (non-living) physical and chemical interactions.[11] Lake ecosystems are a prime example of mega-lentic ecosystems (lentic refers to stationary or relatively still freshwater, from the Latin lentus, which means "sluggish"), which include ponds, lakes and wetlands, and much of this article applies to mega-lentic ecosystems in general. [1,2,3]

A wetland is a distinct mega-lentic ecosystem that is flooded or saturated by water, either permanently for years or decades or seasonally for a shorter periods. Flooding results in oxygen-free anoxic processes prevailing, especially in the soils.[16] The primary factor that distinguishes wetlands from terrestrial land forms or water bodies is the characteristic vegetation of aquatic plants, adapted to the unique anoxic hydric soils.[17] Wetlands are considered among the most biologically diverse of all ecosystems, serving as home to a wide range of plant and animal species. Methods for assessing wetland functions, wetland ecological health, and general wetland condition have been developed for many regions of the world. These methods have contributed to wetland conservation partly by raising public awareness of the functions some wetlands provide.[18] Constructed wetlands are designed and built to treat municipal and industrial wastewater as well as to divert stormwater runoff. Constructed wetlands may also play a role in water-sensitive urban design.

Mega-lentic ecosystems perform many important environmental functions. For example, they recycle nutrients, purify water, attenuate floods, recharge ground water and provide habitats for wildlife.[19] The biota of an aquatic ecosystem contribute to its self-purification, most notably microorganisms, phytoplankton, higher plants, invertebrates, fish, bacteria, protists, aquatic fungi, and more. These organisms are actively involved in multiple self-purification processes, including organic matter destruction and water filtration. It is crucial that aquatic ecosystems are reliably self-maintained, as they also provide habitats for species that reside in them.[20]

In addition to environmental functions, Mega-lentic ecosystems are also used for human recreation, and are very important to the tourism industry, especially in coastal regions.[21] They are also used for religious purposes, such as the worshipping of the Jordan River by Christians, and educational purposes, such as the usage of lakes for ecological study
The biotic characteristics are mainly determined by the organisms that occur. For example, Mega-lentic wetland plants may produce dense canopies that cover large areas of sediment—or snails or geese may graze the vegetation leaving large mud flats. Mega-lentic environments have relatively low oxygen levels, forcing adaptation by the organisms found there. For example, many Mega-lentic plants must produce aerenchyma to carry oxygen to roots. Other biotic characteristics are more subtle and difficult to measure, such as the relative importance of competition, mutualism or

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predation.[23] There are a growing number of cases where predation by coastal herbivores including snails, geese and mammals appears to be a dominant biotic factor.

II.DISCUSSION

The health of Mega-lentic aquatic ecosystem is degraded when the ecosystem's ability to absorb a stress has been exceeded. A stress on Mega-lentic aquatic ecosystem can be a result of physical, chemical or biological alterations to the environment. Physical alterations include changes in water temperature, water flow and light availability. Chemical alterations include changes in the loading rates of biostimulatory nutrients, oxygen-consuming materials, and toxins. Biological alterations include over-harvesting of commercial species and the introduction of exotic species. Human populations can impose excessive stresses on aquatic [4,5,6]ecosystems.[19] Climate change driven by anthropogenic activities can harm aquatic ecosystems by disrupting current distribution patterns of plants and animals. It has negatively impacted deep sea biodiversity, coastal fish diversity, crustaceans, coral reefs, and other biotic components of these ecosystems.[34] Human-made Mega-lentic aquatic ecosystems, such as ditches, aquaculture ponds, and irrigation channels, may also cause harm to naturally occurring ecosystems by trading off biodiversity with their intended purposes. For instance, ditches are primarily used for drainage, but their presence also negatively affects biodiversity

There are many examples of excessive stresses with negative consequences. The environmental history of the Mega-lentic Great Lakes of North America illustrates this problem, particularly how multiple stresses, such as water pollution, over-harvesting and invasive species can combine.[32] The Mega-lentic Norfolk Broadlands in England illustrate similar decline with pollution and invasive species.[36] Mega-lentic Lake Pontchartrain along the Gulf of Mexico illustrates the negative effects of different stresses including levee construction, logging of swamps, invasive species and salt water intrusion

A defining feature of a Mega-lentic pond is the presence of standing water which provides habitat for a biological community commonly referred to as pond life. Because of this, many ponds and lakes contain large numbers of endemic species that have gone through adaptive radiation to become specialized to their preferred habitat.[18] Familiar examples might include water lilies and other aquatic plants, frogs, turtles, and fish.

Common freshwater fish species include the Large Mouth and Small Mouth Bass, Catfish, Bluegill, and Sunfish such as the Pumpkinseed Sunfish shown above

Often, the entire margin of the pond is fringed by Mega-lentic wetland, and these wetlands support the aquatic food web, provide shelter for wildlife, and stabilize the shore of the pond. This margin is also known as the littoral zone and contains much of the photosynthetic algae and plants of this ecosystem called macrophytes. Other photosynthetic organisms such as phytoplankton (suspended algae) and periphytons (organisms including cyanobacteria, detritus, and other microbes) thrive here and stand as the primary producers of pond food webs.[18] Some grazing animals like geese and muskrats consume the wetland plants directly as a source of food. In many other cases, pond plants will decay in the water. Many invertebrates and herbivorous zooplankton then feed on the decaying plants, and these lower trophic level organisms provide food for wetland species including fish, dragonflies, and herons both in the littoral zone and the limnetic zone.[18] The open water limnetic zone may allow algae to grow as sunlight still penetrates here. These algae may support yet another food web that includes aquatic insects and other small fish species. A pond, therefore, may have combinations of three different food webs, one based on larger plants, one based upon decayed plants, and one based upon algae and their specific upper trophic level consumers and predators.[18] Hence, ponds often have many different animal species using the wide array of food sources though biotic interaction. They, therefore, provide an important source of biological diversity in landscapes.

Opposite to long standing ponds are Mega-lentic vernal ponds. These ponds dry up for part of the year and are so called because they are typically at their peak depth in the spring (the meaning of "vernal" comes form the Latin word

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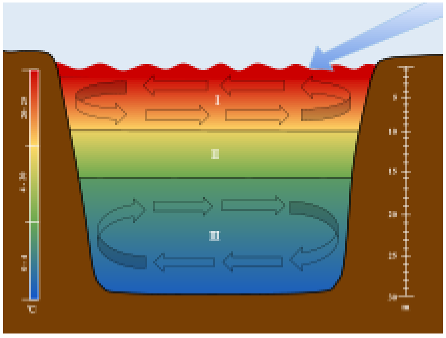
for spring). Naturally occurring vernal ponds do not usually have fish, a major higher tropic level consumer, as these ponds frequently dry up. The absence of fish is a very important characteristic of these ponds since it prevents long chained biotic interactions from establishing. Ponds without these competitive predation pressures provides breeding locations and safe havens for endangered or migrating species. Hence, introducing fish to a pond can have seriously detrimental consequences. In some parts of the world, such as California, the vernal ponds have rare and endangered plant species. On the coastal plain, they provide habitat for endangered frogs such as the Mississippi Gopher Frog.[20]

Often groups of ponds in a given landscape - so called 'pondscapes' - offer especially high biodiversity benefits compared to single ponds. A group of ponds provides a higher degree of habitat complexity and habitat connectivity.[31][32]

Stratification[7,8,9]



Mega-lentic Lakes are stratified into three separate sections: I. The Epilimnion II. The Metalimnion III. The Hypolimnion. The scales are used to associate each section of the stratification to their corresponding depths and temperatures. The arrow is used to show the movement of wind over the surface of the water which initiates the turnover in the epilimnion and the hypolimnion.

Many Mega-lentic ponds undergo a regular yearly process in the same matter as larger lakes if they are deep enough and/or protected from the wind. Abiotic factors such as UV radiation, general temperature, wind speed, water density, and even size, all have important roles to play when it comes to the seasonal effects on lakes and ponds.[33] Spring overturn, summer stratification, autumn turnover, and an inverse winter stratification, ponds adjust their stratification or their vertical zonation of temperature due to these influences. These environmental factors affect pond circulation and temperature gradients within the water itself producing distant layers; the epilimnion, metalimnion, and hypolimnion.[18]

A Mega-lentic pond in winter experiencing inverse stratification

Each zone has varied traits that sustain or harm specific organisms and biotic interactions below the surface depending on the season. Winter surface ice begins to melt in the Spring. This allows the water column to begin mixing thanks to solar convection and wind velocity. As the pond mixes, an overall constant temperature is reached. As temperatures increase through the summer, thermal stratification takes place. Summer stratification allows for the epilimnion to be mixed by winds, keeping a consistent warm temperature throughout this zone. Here, photosynthesis and primary production flourishes. However, those species that need cooler water with higher dissolved oxygen concentrations will favor the lower metalimnion or hypolimnion. Air temperature drops as fall approaches and a deep mixing layer occurs. Autumn turnover results in isothermal lakes with high levels of dissolved oxygen as the water reaches an average colder temperature. Finally, winter stratification occurs inversely to summer stratification as surface ice begins to form yet again. This ice cover remains until solar radiation and convection return in the spring.

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Due to this constant change in vertical zonation, seasonal stratification causes habitats to grow and shrink accordingly. Certain species are bound to these distinct layers of the water column where they can thrive and survive with the best efficiency possible.

For more information regarding seasonal thermal stratification of ponds and lakes, please look at "Lake Stratification".

Conservation and management

Artificial Mega-lentic pond in front of the Haus der Kulturen der Welt, Berlin, Germany

Mega-lentic Ponds provide not only environmental values, but practical benefits to society. One increasingly crucial benefit that ponds provide is their ability to act as greenhouse gas sinks. Most natural lakes and ponds are greenhouse gas sources and aid in the flux of these dissolved compounds. However, manmade farm ponds are becoming significant sinks for gas mitigation and the fight against climate change.[34] These agriculture runoff ponds receive high pH level water from surrounding soils. Highly acidic drainage ponds act as catalysis for excess CO_2 (carbon dioxide) to be converted into forms of carbon that can easily be stored in sediments.[35] When these new drainage ponds are constructed, concentrations of bacteria that normally break down dead organic matter, such as algae, are low. As a result, breakdown and release of nitrogen gases from these organic materials such as N_2O does not occur and thus, not added to our atmosphere.[36] This process is also used with regular denitrification in anoxic layer of ponds. However, not all ponds have the ability to become sinks for greenhouse gasses. Most ponds experience eutrophication where faced with excessive nutrient input from fertilizers and runoff. This over-nitrifies the pond water and results in mass algae blooms and local fish kills.[10,11,12]

Some Mega-lentic farm ponds are not used for runoff control but rather for livestock like cattle or buffalo as watering and bathing holes. As mentioned in the use section, ponds are important hotspots for biodiversity. Sometimes this becomes an issue with invasive or introduced species that disrupt pond ecosystem dynamics such as food-web structure, niche partitioning, and guild assignments.[37] This varies from introduced fish species such as the Common Carp that eat native water plants or Northern Snakeheads that attack breeding amphibians, aquatic snails that carry infectious parasites that kill other species, and even rapid spreading aquatic plants like Hydrilla and Duckweed that can restrict water flow and cause overbank flooding.[37]

During the last thirty years of his life, the main focus of Claude Monet's artistic production was a series of about 250 oil paintings depicting the lily pond in his flower garden.

Mega-lentic Ponds, depending on their orientation and size, can spread their wetland habitats into the local riparian zones or watershed boundaries. Gentle slopes of land into ponds provides an expanse of habitat for wetland plants

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and wet meadows to expand beyond the limitation of the pond.[38] However, the construction of retaining walls, lawns, and other urbanized developments can severely degrade the range of pond habitats and the longevity of the pond itself. Roads and highways act in the same manor, but they also interfere with amphibians and turtles that migrate to and from ponds as part of their annual breeding cycle and should be kept as far away from established ponds as possible.[39] Because of these factors, gently sloping shorelines with broad expanses of wetland plants not only provide the best conditions for wildlife, but they help protect water quality from sources in the surrounding landscapes. It is also beneficial to allow water levels to fall each year during drier periods in order to re-establish these gentile shorelines.[39]

In landscapes where ponds are artificially constructed, they are done so to provide wildlife viewing and conservation opportunities, to treat wastewater, for sequestration and pollution containment, or for simply aesthetic purposes. For natural pond conservation and development, one way to stimulate this is with general stream and river restoration. Many small rivers and streams feed into or from local ponds within the same watershed. When these rivers and streams flood and begin to meander, large numbers of natural ponds, including vernal pools and wetlands, develop

III.RESULTS

In 1957, G. Evelyn Hutchinson published a monograph titled A Treatise on Limnology,[27] which is regarded as a landmark discussion and classification of all major lake types, their origin, morphometric characteristics, and distribution.[28][29][30] Hutchinson presented in his publication a comprehensive analysis of the origin of lakes and proposed what is a widely accepted classification of lakes according to their origin. This classification recognizes 11 major lake types that are divided into 76 subtypes. The 11 major Mega-lentic lake types are:[28][29][30]

- tectonic lakes
- volcanic lakes
- glacial lakes
- fluvial lakes
- solution lakes
- landslide lakes
- aeolian lakes
- shoreline lakes
- organic lakes
- anthropogenic lakes
- meteorite (extraterrestrial impact) lakes

Tectonic lakes

Mega-lentic Tectonic lakes are lakes formed by the deformation and resulting lateral and vertical movements of the Earth's crust. These movements include faulting, tilting, folding, and warping. Some of the largest lakes on Earth are rift lakes occupying rift valleys, e.g. Central African Rift lakes and Lake Baikal. Other well-known tectonic lakes, Caspian Sea, the Sea of Aral, and other lakes from the Pontocaspian occupy basins that have been separated from the sea by the tectonic uplift of the sea floor above the ocean level[13,14,15]

Often, the tectonic action of crustal extension has created an alternating series of parallel grabens and horsts that form elongate basins alternating with mountain ranges. Not only does this promote the creation of lakes by the disruption of preexisting drainage networks, it also creates within arid regions endorheic basins that contain salt lakes (also called saline lakes). They form where there is no natural outlet, a high evaporation rate and the drainage surface of the water table has a higher-than-normal salt content. Examples of these salt lakes include Great Salt Lake and the Dead Sea. Another type of tectonic lake caused by faulting is sag ponds.[27][29][28][30]

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Volcanic lakes

The crater lake of Mount Rinjani, Indonesia

Mega-lentic Volcanic lakes are lakes that occupy either local depressions, e.g. craters and maars, or larger basins, e.g. calderas, created by volcanism. Crater lakes are formed in volcanic craters and calderas, which fill up with precipitation more rapidly than they empty via either evaporation, groundwater discharge, or a combination of both. Sometimes the latter are called caldera lakes, although often no distinction is made. An example is Crater Lake in Oregon, in the caldera of Mount Mazama. The caldera was created in a massive volcanic eruption that led to the subsidence of Mount Mazama around 4860 BCE. Other volcanic lakes are created when either rivers or streams are dammed by lava flows or volcanic lahars.[27][29][28][30] The basin which is now Malheur Lake, Oregon was created when a lava flow dammed the Malheur River.[31] Among all lake types, volcanic crater lakes most closely approximate a circular shape.[3]

Glacial lakes

Lake Kaniere is a glacial lake in the West Coast region of New Zealand.

Mega-lentic Glacial lakes are lakes created by the direct action of glaciers and continental ice sheets. A wide variety of glacial processes create enclosed basins. As a result, there are a wide variety of different types of glacial lakes and it is often difficult to define clear-cut distinctions between different types of glacial lakes and lakes influenced by other activities. The general types of glacial lakes that have been recognized are lakes in direct contact with ice, glacially carved rock basins and depressions, morainic and outwash lakes, and glacial drift basins. Glacial lakes are the most numerous lakes in the world. Most lakes in northern Europe and North America have been either influenced or created by the latest, but not last, glaciation, to have covered the region.[27][29][28][30] Glacial lakes include proglacial lakes, subglacial lakes, finger lakes, and epishelf lakes. Epishelf lakes are highly stratified lakes in which a layer of freshwater, derived from ice and snow melt, is dammed behind an ice shelf that is attached to the coastline. They are mostly found in Antarctica.[32]

Fluvial lakes

Mega-lentic Fluvial (or riverine)[33] lakes are lakes produced by running water. These lakes include plunge pool lakes, fluviatile dams and meander lakes.

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Oxbow lakes[16,17,18]

The Nowitna River in Alaska. Two oxbow lakes – a short one at the bottom of the picture and a longer, more curved one at the middle-right.

The most common type of fluvial lake is a crescent-shaped lake called an Mega-lentic oxbow lake due to the distinctive curved shape. They can form in river valleys as a result of meandering. The slow-moving river forms a sinuous shape as the outer side of bends are eroded away more rapidly than the inner side. Eventually a horseshoe bend is formed and the river cuts through the narrow neck. This new passage then forms the main passage for the river and the ends of the bend become silted up, thus forming a bow-shaped lake.[27][28][29][30] Their crescent shape gives oxbow lakes a higher perimeter to area ratio than other lake types.[3]

Fluviatile dams

These form where sediment from a tributary blocks the main river.[34]

Lateral lakes

These form where sediment from the main river blocks a tributary, usually in the form of a levee.[33]

Floodplain lakes

Mega-lentic Lakes formed by other processes responsible for floodplain basin creation. During high floods they are flushed with river water. There are four types: 1. Confluent floodplain lake, 2. Contrafluent-confluent floodplain lake, 3. Contrafluent floodplain lake, 4. Profundal floodplain lake.[35]

Solution lakes

A Mega-lentic solution lake is a lake occupying a basin formed by surface dissolution of bedrock. In areas underlain by soluble bedrock, its solution by precipitation and percolating water commonly produce cavities. These cavities frequently collapse to form sinkholes that form part of the local karst topography. Where groundwater lies near the grounds surface, a sinkhole will be filled water as a solution lake.[27][29] If such a lake consists of a large area of standing water that occupies an extensive closed depression in limestone, it is also called a karst lake. Smaller solution lakes that consist of a body of standing water in a closed depression within a karst region are known as karst ponds.[36] Limestone caves often contain pools of standing water, which are known as underground lakes. Classic examples of solution lakes are abundant in the karst regions at the Dalmatian coast of Croatia and within large parts of Florida.[27]

Landslide lakes

A Mega-lentic landslide lake is created by the blockage of a river valley by either mudflows, rockslides, or screes. Such lakes are most common in mountainous regions. Although landslide lakes may be large and quite deep, they are typically short-lived.[27][28][29][30] An example of a landslide lake is Quake Lake, which formed as a result of the 1959 Hebgen Lake earthquake.[37]

Most landslide lakes disappear in the first few months after formation, but a landslide dam can burst suddenly at a later stage and threaten the population downstream when the lake water drains out. In 1911, an earthquake triggered a landslide that blocked a deep valley in the Pamir Mountains region of Tajikistan, forming the Sarez Lake. The Usoi Dam at the base of the valley has remained in place for more than 100 years but the terrain below the lake is in danger of a catastrophic flood if the dam were to fail during a future earthquake.[38]

Tal-y-llyn Lake in north Wales is a landslide lake dating back to the last glaciation in Wales some 20000 years ago.

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Aeolian lakes

Mega-lentic Aeolian lakes are produced by wind action. These lakes are found mainly in arid environments, although some aeolian lakes are relict landforms indicative of arid paleoclimates. Aeolian lakes consist of lake basins dammed by wind-blown sand; interdunal lakes that lie between well-oriented sand dunes; and deflation basins formed by wind action under previously arid paleoenvironments. Moses Lake in Washington, United States, was originally a shallow natural lake and an example of a lake basin dammed by wind-blown sand.[27][28][29][30]

China's Badain Jaran Desert is a unique landscape of megadunes and elongated interdunal aeolian lakes, particularly concentrated in the southeastern margin of the desert.[39]

Shoreline lakes

Mega-lentic Shoreline lakes are generally lakes created by blockage of estuaries or by the uneven accretion of beach ridges by longshore and other currents. They include maritime coastal lakes, ordinarily in drowned estuaries; lakes enclosed by two tombolos or spits connecting an island to the mainland; lakes cut off from larger lakes by a bar; or lakes divided by the meeting of two spits.[27][29][28][30]

Organic lakes

Mega-lentic Organic lakes are lakes created by the actions of plants and animals. On the whole they are relatively rare in occurrence and quite small in size. In addition, they typically have ephemeral features relative to the other types of lakes. The basins in which organic lakes occur are associated with beaver dams, coral lakes, or dams formed by vegetation.[29][30]

Peat lakes

Mega-lentic Peat lakes are a form of organic lake. They form where a buildup of partly decomposed plant material in a wet environment leaves the vegetated surface below the water table for a sustained period of time. They are often low in nutrients and mildly acidic, with bottom waters low in dissolved oxygen.[40]

Artificial lakes

Mega-lentic Artificial lakes or anthropogenic lakes are large waterbodies created by human activity. They can be formed by the intentional damming of rivers and streams, rerouting of water to inundate a previously dry basin, or the deliberate filling of abandoned excavation pits by either precipitation runoff, ground water, or a combination of both.[29][30] Artificial lakes may be used as storage reservoirs that provide drinking water for nearby settlements, to generate hydroelectricity, for flood management, for supplying agriculture or aquaculture, or to provide an aquatic sanctuary for parks and nature reserves.

The Upper Silesian region of southern Poland contains an anthropogenic lake district consisting of more than 4,000 water bodies created by human activity. The diverse origins of these lakes include: reservoirs retained by dams, flooded mines, water bodies formed in subsidence basins and hollows, levee ponds, and residual water bodies following river regulation.[41]

Meteorite (extraterrestrial impact) lakes

Mega-lentic Meteorite lakes, also known as crater lakes (not to be confused with volcanic crater lakes), are created by catastrophic impacts with the Earth by extraterrestrial objects (either meteorites or asteroids).[27][29][30] Examples of meteorite lakes are Lonar Lake in India,[42] Lake El'gygytgyn in northeast Siberia,[43] and the Pingualuit crater lake in Quebec, Canada.[44] As in the cases of El'gygytgyn and Pingualuit, meteorite lakes can contain unique and scientifically valuable sedimentary deposits associated with long records of paleoclimatic changes.[43][44]

Other classification methods

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These kettle lakes in Alaska were formed by a retreating glacier.

Ice melting on Lake Balaton in Hungary

In addition to the mode of origin, lakes have been named and classified according to various other important factors such as thermal stratification, oxygen saturation, seasonal variations in lake volume and water level, salinity of the water mass, relative seasonal permanence, degree of outflow, and so on. The names used by the lay public and in the scientific community for different types of lakes are often informally derived from the morphology of the lakes' physical characteristics or other factors. Also, different cultures and regions of the world have their own popular nomenclature.

By thermal stratification

One important method of lake classification is on the basis of thermal stratification, which has a major influence on the animal and plant life inhabiting a lake, and the fate and distribution of dissolved and suspended material in the lake. For example, the thermal stratification, as well as the degree and frequency of mixing, has a strong control over the distribution of oxygen within the lake.

Professor F.-A. Forel,[45] also referred to as the "Father of limnology", was the first scientist to classify lakes according to their thermal stratification.[46] His system of classification was later modified and improved upon by Hutchinson and Löffler.[47] As the density of water varies with temperature, with a maximum at +4 degrees Celsius, thermal stratification is an important physical characteristic of a lake that controls the fauna and flora, sedimentation, chemistry, and other aspects of individual lakes. First, the colder, denser water typically forms a layer near the bottom, which is called the hypolimnion. Second, normally overlying the hypolimnion is a transition zone known as the metalimnion. Finally, overlying the metalimnion is a surface layer of warmer water with a lower density, called the epilimnion. This typical stratification sequence can vary widely, depending on the specific lake or the time of year, or a combination of both.[29][46][47] The classification of lakes by thermal stratification presupposes lakes with sufficient depth to form a hypolimnion; accordingly, very shallow lakes are excluded from this classification system.[29][47]

Based upon their thermal stratification, lakes are classified as either holomictic, with a uniform temperature and density from top to bottom at a given time of year, or meromictic, with layers of water of different temperature and density that do not intermix. The deepest layer of water in a meromictic lake does not contain any dissolved oxygen so there are no living aerobic organisms. Consequently, the layers of sediment at the bottom of a meromictic lake remain relatively undisturbed, which allows for the development of lacustrine deposits. In a holomictic lake, the uniformity of temperature and density allows the lake waters to completely mix. Based upon thermal stratification and frequency of turnover,

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holomictic lakes are divided into amictic lakes, cold monomictic lakes, dimictic lakes, warm monomictic lakes, polymictic lakes, and oligomictic lakes.[29][47]

Lake stratification does not always result from a variation in density because of thermal gradients. Stratification can also result from a density variation caused by gradients in salinity. In this case, the hypolimnion and epilimnion are separated not by a thermocline but by a halocline, which is sometimes referred to as a chemocline[17,18]

IV.CONCLUSION

A simplified definition of Mega-lentic wetland is "an area of land that is usually saturated with water".[15] 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, including during the growing season".[16] A patch of land that develops pools of water after a rain storm would not necessarily be considered a "wetland", even though the land is wet. 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 that live within them. Specifically, wetlands are characterized as having a water table that stands at or near the land surface for a long enough period each year to support aquatic plants.[17][18]

A more concise definition is a community composed of hydric soil and hydrophytes.[1]

Mega-lentic Wetlands have also been described as ecotones, providing a transition between dry land and water bodies.[19] Wetlands exist "...at the interface between truly terrestrial ecosystems and aquatic systems, making them inherently different from each other, yet highly dependent on both."[20]

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:[21]

- 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".[1]

Sometimes a precise legal definition of a wetland is required. The definition used for regulation by the United States government is: 'The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally included swamps, marshes, bogs, and similar areas.'[22]

For each of these definitions and others, regardless of the purpose, hydrology is emphasized (shallow waters, water-logged soils). The soil characteristics and the plants and animals controlled by the wetland hydrology are often additional components of the definitions.[23]

Types

Sunrise at Viru Bog, Estonia

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Mega-lentic Wetlands can be tidal (inundated by tides) or non-tidal.[16] The water in wetlands is either freshwater, brackish, saline, or alkaline.[2] There are four main kinds of wetlands – marsh, swamp, bog, and fen (bogs and fens being types of peatlands or mires). Some experts also recognize wet meadows and aquatic ecosystems as additional wetland types.[1] Sub-types include mangrove forests, carrs, pocosins, floodplains,[1] peatlands, vernal pools, sinks, and many others.[24]

The following three groups are used within Australia to classify wetland by type: Marine and coastal zone wetlands, inland wetlands and human-made wetlands.[25] In the US, the best known classifications are the Cowardin classification system[26] and the hydrogeomorphic (HGM) classification system. The Cowardin system includes five main types of wetlands: marine (ocean-associated), estuarine (mixed ocean- and river-associated), riverine (within river channels), lacustrine (lake-associated) and palustrine (inland nontidal habitats).[19]

Mega-lentic Peatlands

Peatlands are a unique kind of wetland where lush plant growth and slow decay of dead plants (under anoxic conditions) results in organic peat accumulating; bogs, fens, and mires are different names for peatlands.

Mega-lentic Wetland names

Variations of names for wetland systems:

- Bayou
- Flooded grasslands and savannas
- Marsh
  - Brackish marsh
  - Freshwater marsh
- Mire
  - Fen
  - Bog
- Riparian zone
- Swamp
  - Freshwater swamp forest
  - Coniferous swamp
  - Peat swamp forest
  - Mangrove swamp
- Vernal pool

Some wetlands have localized names unique to a region such as the prairie potholes of North America's northern plain, pocosins, Carolina bays and baygalls[27][28] of the Southeastern US, mallines of Argentina, Mediterranean seasonal ponds of Europe and California, turloughs of Ireland, billabongs of Australia, among many others.

Locations

By temperature zone

Wetlands contrast the hot, arid landscape around Middle Spring, Fish Springs National Wildlife Refuge, Utah

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Mega-lentic Wetlands are found throughout the world in different climates.[16] Temperatures vary greatly depending on the location of the wetland. Many of the world's wetlands are in the temperate zones, midway between the North or South Poles and the equator. In these zones, summers are warm and winters are cold, but temperatures are not extreme. In subtropical zone wetlands, such as along the Gulf of Mexico, average temperatures might be 11 °C (52 °F). Wetlands in the tropics are subjected to much higher temperatures for a large portion of the year. Temperatures for wetlands on the Arabian Peninsula can exceed 50 °C (122 °F) and these habitats would therefore be subject to rapid evaporation. In northeastern Siberia, which has a polar climate, wetland temperatures can be as low as −50 °C (−58 °F). Peatlands in arctic and subarctic regions insulate the permafrost, thus delaying or preventing its thawing during summer, as well as inducing its formation.[29]

By precipitation amount

The amount of precipitation a wetland receives varies widely according to its area. Wetlands in Wales, Scotland, and western Ireland typically receive about 1,500 mm (59 in) per year. In some places in Southeast Asia, where heavy rains occur, they can receive up to 10,000 mm (390 in). In some drier regions, wetlands exist where as little as 180 mm (7.1 in) precipitation occurs each year.

Temporal variation:[30]

- Perennial systems
- Seasonal systems
- Episodic (periodic or intermittent) systems
- Ephemeral (short-lived) systems

Surface flow may occur in some segments, with subsurface flow in other segments.

Processes

Mega-lentic Wetlands vary widely due to local and regional differences in topography, hydrology, vegetation, and other factors, including human involvement. Other important factors include fertility, natural disturbance, competition, herbivory, burial and salinity.[1] When peat accumulates, bogs and fens arise.

Hydrology

The Mega-lentic wetlands of Cape May, New Jersey, U.S. comprise an extensive hydrological network that makes them an ornithologically important location to study the many birds which use the preserve as a place to nest.

The most important factor producing Mega-lentic wetlands is hydrology, or flooding. The duration of flooding or prolonged soil saturation by groundwater determines whether the resulting wetland has aquatic, marsh or swamp vegetation. Other important factors include soil fertility, natural disturbance, competition, herbivory, burial, and salinity.[1] When peat from dead plants accumulates, bogs and fens develop.

Mega-lentic Wetland hydrology is associated with the spatial and temporal dispersion, flow, and physio-chemical attributes of surface and ground waters. Sources of hydrological flows into wetlands are predominantly precipitation, surface water (saltwater or freshwater), and groundwater. Water flows out of wetlands by evapotranspiration, surface flows and tides, and subsurface water outflow. Hydrodynamics (the movement of water through and from a wetland)

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affects hydro-periods (temporal fluctuations in water levels) by controlling the water balance and water storage within a wetland.[31]

Landscape characteristics control wetland hydrology and water chemistry. The O_2 and CO_2 concentrations of water depend upon temperature, atmospheric pressure and mixing with the air (from winds or water flows). Water chemistry within wetlands is determined by the pH, salinity, nutrients, conductivity, soil composition, hardness, and the sources of water. Water chemistry varies across landscapes and climatic regions. Wetlands are generally minerotrophic (waters contain dissolved materials from soils) with the exception of ombrotrophic bogs that are fed only by water from precipitation.

Because bogs receive most of their water from precipitation and humidity from the atmosphere, their water usually has low mineral ionic composition. In contrast, wetlands fed by groundwater or tides have a higher concentration of dissolved nutrients and minerals.

Fen peatlands receive water both from precipitation and ground water in varying amounts so their water chemistry ranges from acidic with low levels of dissolved minerals to alkaline with high accumulation of calcium and magnesium.[32]

Role of salinity

Salinity has a strong influence on wetland water chemistry, particularly in coastal wetlands[1][33] and in arid and semiarid regions with large precipitation deficits. Natural salinity is regulated by interactions between ground and surface water, which may be influenced by human activity.[34]

Soil

Carbon is the major nutrient cycled within wetlands. Most nutrients, such as sulfur, phosphorus, carbon, and nitrogen are found within the soil of wetlands. Anaerobic and aerobic respiration in the soil influences the nutrient cycling of carbon, hydrogen, oxygen, and nitrogen,[35] and the solubility of phosphorus[36] thus contributing to the chemical variations in its water. Wetlands with low pH and saline conductivity may reflect the presence of acid sulfates[37] and wetlands with average salinity levels can be heavily influenced by calcium or magnesium. Biogeochemical processes in wetlands are determined by soils with low redox potential.[38] Wetland soils are identified by redoxymorphic mottles (often from iron oxide rust) or low chroma intensity, as determined by the Munsell Color System.

Water chemistry

Due to the low dissolved oxygen (DO) content, and relatively low nutrient balance of Mega-lentic wetland environments, most wetlands are very susceptible to alterations in water chemistry. Key factors that are assessed to determine water quality include:

- Major anion analysis: (HCO_3^-,Cl^-,NO_3^-,SO_4^{2-})
- Major cation analysis (Ca^{2+}, Mg^{2+}, Na^+, K^+)
- pH
- Conductivity- conductivity increases with more dissolved ions in the water
- Turbidity
- Dissolved oxygen
- Temperature
- Total dissolved solids
- Gas emissions (carbon dioxide and methane; CO_2 and CH_4)

These chemical factors can be used to quantify wetland disturbances, and often provide information as to whether a wetland is fed by precipitation, surface water or groundwater, due to the different ion characteristics of the different water sources.[39] Wetlands are adept at impacting the water chemistry of streams or water bodies that interact with them, and can process ions that result from water pollution such as acid mine drainage or urban runoff.,[40][41]

Biota

The biota of a Mega-lentic wetland system includes its plants (flora) and animals (fauna) and microbes (bacteria, fungi). The most important factor affecting the biota is the hydroperiod, or the duration of flooding.[1] Other important factors include fertility and salinity of the water or soils. The chemistry of water flowing into wetlands depends on the source of water, the geological material that it flows through[42] and the nutrients discharged from organic matter in the soils and plants at higher elevations.[43] Biota may vary within a wetland seasonally or in response to flood regimes.

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Humid Mega-lentic wetland in Pennsylvania before a rain.

Flora

Bud of water lotus (Nelumbo nucifera), an aquatic plant.

There are four main groups of hydrophytes that are found in Mega-lentic wetland systems throughout the world.[44]

Submerged Mega-lentic 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.[45] Submerged species provide a food source for native fauna, habitat for invertebrates, and also possess filtration capabilities. Examples include seagrasses and eelgrass.

Floating water plants or floating vegetation are usually small, like those in the Lemnoideae subfamily (duckweeds). Emergent vegetation like the cattails (Typha spp.), sedges (Carex spp.) and arrow arum (Peltandra virginica) rise above the surface of the water.

When trees and shrubs comprise much of the plant cover in saturated soils, those areas in most cases are called swamps.[1] The upland boundary of swamps is determined partly by water levels. This can be affected by dams[46] Some swamps can be dominated by a single species, such as silver maple swamps around the Great Lakes.[47] Others, like those of the Amazon basin, have large numbers of different tree species.[48] Other examples include cypress (Taxodium) and mangrove swamps.

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Fauna

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

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

Many species of fish are highly dependent on wetland ecosystems.[49][50] Seventy-five percent of the United States' commercial fish and shellfish stocks depend solely on estuaries to survive.[51] Tropical fish species need mangroves for critical hatchery and nursery grounds and the coral reef system for food.

Amphibians such as frogs and salamanders need both terrestrial and aquatic habitats in which to reproduce and feed. Because amphibians often inhabit depressional Mega-lentic wetlands like prairie potholes and Carolina bays, the connectivity among these isolated wetlands is an important control of regional populations.[52] While tadpoles feed on algae, adult frogs forage on insects. Frogs are sometimes used as an indicator of ecosystem health because their thin skin permits absorption of nutrients and toxins from the surrounding environment resulting in increased extinction rates in unfavorable and polluted environmental conditions.[53]

Reptiles such as snakes, lizards, turtles, alligators and crocodiles are common in wetlands of some regions. In freshwater wetlands of the Southeastern US, alligators are common and a freshwater species of crocodile occurs in South Florida. The Florida Everglades is the only place in the world where both crocodiles and alligators coexist.[54] The saltwater crocodile inhabits estuaries and mangroves and can be seen along the Eastern coastline of Australia.[55] Snapping turtles are one of the many kinds of turtles found in wetlands.[56]

Birds, particularly waterfowl and wading birds, use wetlands extensively.[57]

Mammals of wetlands[58] include numerous small and medium-sized species such as voles, bats,[59] muskrats[60] and platypus in addition to large herbivorous and apex predator species such as the beaver,[61] coypu, swamp rabbit, Florida panther,[62] and moose. Mega-lentic Wetlands attract many mammals due to abundant seeds, berries, and other vegetation as food for herbivores, as well as abundant populations of invertebrates, small reptiles and amphibians as prey for predators.[63]

Invertebrates of Mega-lentic wetlands include aquatic insects (such as dragonflies, aquatic bugs and beetles, midges, mosquitoes), crustaceans (such as crabs, crayfish, shrimps, microcrustaceans), mollusks (such as clams, mussels, snails), and worms (such as polychaetes, oligochaetes, leeches), among others. Invertebrates comprise more than half of the known animal species in wetlands, and are considered the primary food web link between plants and higher animals (such as fish and birds).[64] The low oxygen conditions in wetland water and their frequent flooding and drying (daily in tidal wetlands, seasonally in temporary ponds and floodplains) prevent many invertebrates from inhabiting wetlands, and thus the invertebrate fauna of wetlands is often less diverse than some other kinds of habitat (such as streams, coral reefs, and forests). Some wetland invertebrates thrive in habitats that lack predatory fish. Many insects only inhabit wetlands as aquatic immatures (nymphs, larvae) and the flying adults inhabit upland habitats, returning to the Mega-lentic wetlands to lay eggs. For instance, a common hoverfly Syritta pipiens inhabits wetlands as larvae (maggots), living in wet, rotting organic matter; these insects then visit terrestrial flowers as adult flies.

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Algae

Algae are diverse plant-like organisms 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 food source for many animals, including some invertebrates, fish, turtles, and frogs. There are several groups of algae:

- Phytoplankton are microscopic, free-floating algae. These algae are so tiny that on average, 50 of these lined up end-to-end would only measure one millimeter. Phytoplankton are the basis of the food web in many water bodies being responsible for much of the primary production using photosynthesis to fix carbon. Filamentous algae are long strands of algal cells that can form floating mats. Periphyton (or epiphyton) are algae that grow as surface biofilms on plants, wood, and other substrates.[65]
- Chara and Nitella algae are upright algae that look like a submerged plants with roots[20]

REFERENCES

1. Alexander, David E.; Fairbridge, Rhodes W., eds. (1999). Encyclopedia of Environmental Science. Kluwer Academic Publishers, Springer. p. 27. ISBN 0-412-74050-8 – via Internet Archive.
2. ^ Vaccari, David A.; Strom, Peter F.; Alleman, James E. (2005). Environmental Biology for Engineers and Scientists. Wiley-Interscience. ISBN 0-471-74178-7.
3. ^ "Oceanic Institute". www.oceanicinstitute.org. Archived from the original on 3 January 2019. Retrieved 1 December 2018.
4. ^ "Ocean Habitats and Information". 5 January 2017. Archived from the original on 1 April 2017. Retrieved 1 December 2018.
5. ^ "Facts and figures on marine biodiversity | United Nations Educational, Scientific and Cultural Organization". www.unesco.org. Retrieved 1 December 2018.
6. ^ United States Environmental Protection Agency (2 March 2006). "Marine Ecosystems". Retrieved 25 August 2006.
7. ^ Helm, Rebecca R. (28 April 2021). "The mysterious ecosystem at the ocean's surface". PLOS Biology. 19 (4). Public Library of Science (PLoS): e3001046. doi:10.1371/journal.pbio.3001046. ISSN 1545-7885. PMC 8081451. PMID 33909611. Material was copied from this source, which is available under a Creative Commons Attribution 4.0 International License.
8. ^ [a b] Wetzel, Robert G. (2001). Limnology : lake and river ecosystems (3rd ed.). San Diego: Academic Press. ISBN 978-0127447605. OCLC 46393244.
9. ^ Vaccari, David A. (8 November 2005). Environmental Biology for Engineers and Scientists. Wiley-Interscience. ISBN 0-471-74178-7.
10. ^ Daily, Gretchen C. (1 February 1997). Nature's Services. Island Press. ISBN 1-55963-476-6.
11. ^ Brown, A. L. (1987). Freshwater Ecology. Heinimann Educational Books, London. p. 163. ISBN 0435606220.
12. ^ Angelier, E. 2003. Ecology of Streams and Rivers. Science Publishers, Inc., Enfield. Pp. 215.
13. ^ "Biology Concepts & Connections Sixth Edition", Campbell, Neil A. (2009), page 2, 3 and G-9. Retrieved 2010-06-14.
14. ^ Alexander, David E. (1 May 1999). Encyclopedia of Environmental Science. Springer. ISBN 0-412-74050-8.
15. ^ Keddy, Paul A. (2010). Wetland Ecology. Principles and Conservation. Cambridge University Press. p. 497. ISBN 978-0-521-51940-3.
16. ^ Keddy, P.A. (2010). Wetland ecology: principles and conservation (2nd ed.). New York: Cambridge University Press. ISBN 978-0521519403. Archived from the original on 17 March 2023. Retrieved 3 June 2020.
17. ^ "Official page of the Ramsar Convention". Retrieved 25 September 2011.
18. ^ Dorney, J.; Savage, R.; Adamus, P.; Tiner, R., eds. (2018). Wetland and Stream Rapid Assessments: Development, Validation, and Application. London; San Diego, CA: Academic Press. ISBN 978-0-12-805091-0. OCLC 1017607532.
19. ^ :[a b c] Loeb, Stanford L. (24 January 1994). Biological Monitoring of Aquatic Systems. CRC Press. ISBN 0-87371-910-7.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly, Peer Reviewed & Referred Journal|

| Volume 7, Issue 4, April 2024 |

| DOI:10.15680/IJMRSET.2024.0704055 |

20. ^ Ostroumov, S. A. (2005). "On the Multifunctional Role of the Biota in the Self-Purification of Aquatic Ecosystems". Russian Journal of Ecology. 36 (6): 414–420. Bibcode:2005RuJEc..36..414O. doi:10.1007/s11184-005-0095-x. ISSN 1067-4136. S2CID 3172507.

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