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Sustaining America's Aquatic Biodiversity

Aquatic Habitats: Homes for Aquatic Animals

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Natural aquatic habitats include ponds, lakes, rivers, streams, springs, estuaries, bays, and various types of wetlands. Some of these habitats are shallow and others deep, some are cold-water and others warm-water, some are freshwater and others saltwater, and some have high oxygen levels and others little oxygen.

Aquatic habitats can be classified as:

- non-flowing waters like lakes and ponds,
- slowly-flowing waters like marshes and swamps, and
- flowing waters like rivers and streams.

A pond is a small (usually less than ten surface acres in size), shallow depression in the earth filled with water from rain or snow-melt runoff, springs, or groundwater. Ponds can lose water through seepage, evaporation, or transpiration (plant respiration).

Because ponds are shallow in depth, sunlight penetration into the pond encourages abundant growth of bottom-rooted plants such as pondweed and milfoil, and floating-leaf plants like water lily and duckweed. Ponds often are fringed with emergent bulrushes and cattails. Water temperature in ponds is similar from top to bottom. Dissolved oxygen levels may vary greatly over a 24-hour day. Ponds are rich in plants and algae that serve as the foundation of the food chain for insects, fish, and other forms of wildlife.

A lake is larger and deeper than a pond. Lakes can range in size from small (ten surface acres) to large (the Great Lakes: Erie, Michigan, Huron, Ontario, and Superior). Three areas in the United States with abundant lakes are:

- the glacier-formed Great Lakes and those in Minnesota, Wisconsin, and Michigan;
- the limestone sinkhole lakes in Florida; and
- the mountain lakes in the West.

Lakes are too deep for water plants to grow except around the shoreline. Water temperature "layering" occurs as cooler (denser) water sinks to the bottom in the summer. Dissolved oxygen "layering" also occurs as oxygen-poor waters are found on the bottom in summer. Lakes provide abundant fish and wildlife habitats.

Wetlands (marshes, swamps, bayous, and bogs) generally are shallow, low-lying areas (near the water table) with fluctuating water levels. The soils are wet most of the year and they support an abundance of aquatic plants.

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Wetlands once were considered "useless" lands to be used only as dumpsites or drained, ditched, and dredged for farming and building sites. Today we know that wetlands are valuable lands that support a rich biodiversity of waterfowl, songbirds, turtles, frogs, fish, and other wildlife. They act as natural sponges, absorbing rain water and preventing floods.

Marshes are "grassy" wetlands dominated by cattails, bulrushes, pondweeds, and floating-leaf plants like the water lily. They can vary in size from a small wet meadow to thousands of acres like the Everglades in Florida. Lakeside and riverside marshes slow soil sediment runoff and protect water quality. Wildlife and fish nest and rear their young in these important nursery areas.

Salt marshes occur along our coastal areas. They are dominated by salt-tolerant plants like cord grass and are greatly influenced by tides. Among our most productive wildlife habitats, salt marshes are important feeding and nursery areas for fish, shellfish, crabs, and waterfowl.

Swamps are "woody" wetlands dominated in the North by trees like willows, alders, and maples, while in the South bald cypress, tupelo gum, and oaks dominate. Swamps often are wet part of the year and dry the remainder of the year. If they remain wet too long, the trees may die, and most swamps have standing dead trees.

Many bottomland hardwood swamps occur along big rivers like the Mississippi River and are important for flood control because they slow downstream peak flows. They provide valuable nesting and resting places for waterfowl and other wildlife. Wood ducks, for example, nest in dead, hollow trees in swamps.

Springs are areas where groundwater flows upward to the surface. They may range in size from tiny seep holes with only enough water to form a small puddle to large spring streams flowing at a rate of 1,000 gallons per minute.

Spring flows are dependent on enough rainwater filtering into the soil and rock in an area and filling up the underground aquifer. Springs' continuous flows of clear, cool, high-quality water year-round provides habitat and refuge for many unique aquatic animals, especially during hot weather or droughts.

Moist soil and lush vegetation along stream banks (called riparian areas) offer food, shelter, and water for songbirds and many other forms of wildlife. They are important travel corridors for most wildlife moving from one area to another.

Rivers and streams are flowing water systems contained within a channel bounded by uplands.

Flow: Much of the annual flow in streams and rivers is provided by groundwater (natural spring seeps) that, in turn, is replenished by rainwater. Because water seeps slowly through the soil, the surface water flowing in streams can represent rainwater that fell days, weeks, or even months before. This regular, continuous seepage of groundwater that keeps streams flowing is called base flow, low flow, or minimum flow.

Water velocity is regulated by gravity (steepness of the slope), friction (roughness of the bottom and banks), and water depth.

Pools and Riffles: Natural streams are composed of two dominant habitat types: pools and riffles. A pool is an area of deep, slow water; a riffle is an area of shallow swift water. Pools and riffles are important to fish and aquatic life. Pools provide cover, shelter, and resting areas for sport fish. Riffles aerate the water, harbor most of the insect life, and are used by fish as primary feeding and spawning sites.

Good sport-fish streams display an alternating pattern of pools and riffles. Pools and riffles generally occur at a distance of five to seven times the width of a stream. For example, in a stream 10 feet wide, a pool or riffle usually will occur every 50 to 70 feet. An equal amount of both habitats (a pool-riffle ratio of 1:1) is considered optimum for sport fish.

The **streambed** is the foundation of the stream and its banks. Many stream characteristics (channel shape, width, depth, and fish community) will vary markedly depending on streambed materials.

Streambeds are composed of a variety of materials, collectively called bottom sediments. Bottom sediments range in size from large boulders and rocks, through gravel (1/4 to 3 inches in diameter) to fine sand, silt, and clay particles. Of these, gravel-sized and larger particles are most important to sport fish. Nearly all stream fish require clean gravel to spawn and larger cobbles or boulders for resting and cover. The smaller, fine bottom materials (silt and clay) generally are unsuitable for spawning sites because they smother eggs and young fish.

Aquatic plants and animals are inseparable from their habitat, the nonliving (physical and chemical) part of their environment. Plants and animals are dependent on the nonliving habitat to satisfy their basic needs for food, shelter, and moisture. Many endangered aquatic species depend on wetlands for survival.

Aquatic ecosystems consist of living organisms together with their nonliving habitat. Although the ecosystem concept is a useful one, the exact definition is somewhat arbitrary. For example, an ecosystem can range in size from a small water droplet to the vast oceanic ecosystem, and the upper, lower, and horizontal boundaries are often not well established.

Similarly, the temporal aspects of ecosystems are often fuzzy. For example, a vernal (spring) pond is a temporary wetland filled with rainwater, and is transformed from an aquatic ecosystem into a terrestrial one when it dries up during the summer. An intermittent stream is one that sometimes is full of water and at other times dry.

Ecosystems are not always self-sustaining. For example, fish and other aquatic animals in streams depend on leaves and insects falling from terrestrial (land) ecosystems as energy sources. Just as no single life form (species) is sufficient unto itself, neither is any one ecosystem. Ecosystems and their plant and animal life are not independent from one another in time, space, or energy.

The four basic parts of any ecosystem, whether aquatic or terrestrial, are:

- abiotic (nonliving) substances (mainly inorganic and organic compounds),
- producers (largely green plants),
- consumers (animals), and
- decomposers (bacteria and fungi).

Plants, animals, decomposers, and organics are interdependent with one another.

The major differences between aquatic (water) and terrestrial (land) ecosystems are:

Moisture is the major limiting factor on land. All terrestrial life is continually confronted with the problem of dehydration. In contrast, moisture is readily available in aquatic ecosystems.

Temperature variations are extreme in the air of terrestrial ecosystems. In aquatic ecosystems, water serves as a buffer; that is, it both gives up and absorbs heat slowly, moderating extreme temperature changes.

Essential gases (dissolved oxygen and carbon dioxide) are more abundant/available in terrestrial ecosystems. Atmospheric gases are remarkably constant in terrestrial ecosystems due to the rapid circulation of air. In contrast, oxygen and carbon dioxide are major limiting factors to aquatic life.

Structural support is considerably greater in aquatic ecosystems. Air, in contrast to water, offers very little solid support. Strong skeletons have evolved in land plants and animals to compensate for the lack of a supportive environment.

Nutrient source and availability is different for aquatic systems than land systems. Soil, not air, is the major source of nutrients in terrestrial systems. In aquatic systems, nutrients are dissolved in water. Nutrients generally are more available in aquatic than terrestrial systems.

Few geographic barriers inhibit the free movement of organisms in aquatic systems. Aquatic ecosystems are more continuous than terrestrial ecosystems. Except for temperature, salinity, and depth barriers, aquatic animals move freely.

Aquatic ecosystems provide us with enormous benefits at little cost. They:

- provide critical fish and wildlife habitats serving as spawning and nursery areas for fish like bass and nesting and feeding areas for waterfowl like geese,
- improve our water quality by filtering out sediment and toxins,
- act as natural sponges that absorb flood waters, collecting and storing excess water, preventing floods, and
- produce a rich variety of natural products such as fish and shellfish, cranberries and wild rice, ducks and geese, and timber.

Wetlands provide outdoor recreational opportunities for boating, fishing, photography, nature observation, and scenic beauty.

Aquatic Habitat Websites

- Pond Management: http://www.cnr.vt.edu/extension/fiw/fisheries/streamsrivers/index.html

- American rivers: http://www.amrivers.org/

- *Landowner's Guide to Managing Streams in the Eastern United States*, Virginia Cooperative Extension publication 420-141: http://www.ext.vt.edu/pubs/forestry/420-141/420-141.html

- Vernal pools: http://www.state.nj.us/dep/fgw/ensp/vernalpool.htm, http://www.vernalpool.org/vernal_1.htm and http://www.uri.edu/cels/nrs/paton/

- Endangered rivers: http://www.amrivers.org/mostendangered2002/default.htm http://www.nationalgeographic.com/geographyaction/rivers/ and http://www.nationalgeographic.com/earthpulse/columbia/index_flash.html

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