Aquatics

INTRODUCTION:

Aquatics or aquatic ecology is the study of animals and plants in freshwater environments. In addition to the many common aquatic species in this Central New York region, a student of aquatics learns about watersheds, wetlands and the hydrologic cycle. Essential to understanding and appreciating the field of aquatics is a basic knowledge of the physical and chemical properties of water. Water is arguably the most valuable substance on the planet, and is the common name applied to the liquid state of the hydrogen oxygen compound H2O. It covers 70% of the surface of the Earth forming swamps, lakes, rivers, and oceans. Pure water has a blue tint, which may be detected only in layers of considerable depth. It has no taste or odor. Water molecules are strongly attracted to one another through their two hydrogen atoms. At the surface, this attraction produces a tight film over the water (surface tension). A number of organisms live both on the upper and lower sides of this film. Density of water is greatest at 39.2° Fahrenheit (4° Celsius). It becomes less as water warms and, more important, as it cools to freezing at 32° Fahrenheit (0° Celsius), and becomes ice. Ice is a poor heat conductor. Therefore, ice sheets on ponds, lakes and rivers trap heat in the water below. For this reason, only very shallow waterbodies never freeze solid. Water is the only substance that occurs at ordinary temperatures in all three states of matter: solid, liquid, and gas. In its solid state, water is ice, and can be found as glaciers, snow, hail, and frost and ice crystals in clouds. It occurs in the liquid state as water droplets in rain clouds, and on vegetation as dew. Under the influence of gravity, water may accumulate in the openings of hard rock beneath the surface of the earth. This groundwater sustains wells, springs and some streams. As a gas, or water vapor, it occurs as fog, steam, clouds, and humidity. The transparency of water permits enough light to penetrate for plants to carry on photosynthesis and animals to thrive. The depths to which light can penetrate decrease as water contains more suspended materials and becomes turbid (or less clear). Less light means fewer plants can grow, thus attracting less wildlife. Our dependence upon water and competition for it have imperiled and will continue to threaten aquatic environments and the organisms living in them. Good water quality is essential for aquatic life as well as for the human species. Recently, the historical emphasis on political entities, such as counties, towns, villages and cities, has shifted to watersheds. It has been said that one-third of the world¹s population will experience a water shortage crisis in 2025. Wars in the future may well be fought for water rather than for oil!

OBJECTIVES:

• Identify the processes and phases for each part of the water cycle.
• Describe the chemical and physical properties of water and their relation to fresh and saltwater systems.
• Analyze the interaction of competing uses of water for water supply, hydropower, navigation, wildlife, recreation, waste assimilation, irrigation, industry, and others.
• Discuss the methods of conserving water and reducing point and non point source pollution.
• Identify common aquatic organisms through the use of a key.
• Delineate the watershed boundary for a small water body. Explain the different types of aquifers and how each type relates to water quantity and quality.
• Briefly describe the benefits of wetlands, including both function and value.

• Describe the benefits of riparian areas, including both function and value.
• Describe the changes to the aquatic ecosystem based on alteration to the aquatic habitat.
• Know methods used to assess and manage aquatic environments and be able to utilize water quality information to assess the general water quality of a specific body of water. This includes sampling techniques and water quality parameters used to measure point and non-point source pollution.
• Be familiar with major methods and laws used to protect water quality and utilize the information
to make management decisions to improve the quality of water in a given situation.
Source: Canonl Envirothon Objectives Aquatics

OUTLINE:

I. Hydrologic Cycle
- A. Processes: solar radiation, evapotranspiration, condensation, precipitation
- B. Phases: movement and storage of water through atmosphere, terrasphere, biosphere andhydrosphere
- C. Surface Water
- D. Runoff Water
- E. Ground Water

II. Fresh Water: physical and chemical properties

III. Watershed
- A. Definition
- B Streams and Rivers
- C. Lakes
  - 1. oligotrophic, mesotrophic, eutrophic
  - 2. temperature layering/seasonal overturn: epilimnion, thermocline and hypolimnion
- D. Ponds
- E. Ground Water Movement: discharge and recharge
- F. Aquifers: types, relationship to water quality and quantity
- G. Watershed Delineation
- H. Nutrient cycling
  - I. Food Chains/Webs

IV. Freshwater Wetlands
- A. Definition
- B. Soil, Water and Vegetative Characteristics of Swamps, Marshes and Bogs
- C. Functions of Wetlands: benefits and importance
- D. Types of Wetlands
- E, Wetland Remediation

V. Water Quality/Pollution
- A. Affected Water Sources
  - 1. surface water
  - 2. groundwater

B. Sampling Techniques for Assessing Water Quality
    1. macroinvertebrate monitoring
    2. chemical parameter monitoring
C. Pollution Types
    1. point source
        a. definition
        b. examples
    2. nonpoint source
        a. definitions
        b. examples
D. Excessive Nutrient Loading in Streams, Rivers and Lakes
E. Waterbody Polluted Categories: precluded, impaired, stressed and threatened
F. Pollution Prevention and Reduction

VI. Methods For Conserving Water Quantity
A. Reducing Point And Nonpoint Source Pollution

VII. Aquatic Species (fish, amphibians, insects and plants)
A. Identification of Common Regional Species
B. Basic Anatomy and Physiology
C. Life Cycles
D. Aquatic Habitats: surface film, open water, benthic and littoral
E. Impact of Aquatic and Terrestrial Habitat Change on Aquatic Organisms
F. Importance of Aquatic Species
    1. examples
    2. endangered and threatened species
    3. impact of introduced (non-native) species

VIII. Interaction of Competing Uses of Freshwater: wildlife, hydropower, navigation, drinking water, recreation, industry, waste assimilation and irrigation

IX. Main Methods and Legislation For Protecting Surface and Ground Water Quality
A. Watershed Focus
B. Governmental Management of Water Quality in Streams, Rivers, Wetlands and Lakes: monitoring, nutrient loading, sedimentation and flooding
C. Important Legislation
    1. Clean Water Act
    2. Licenses/Permits *Revised: 12/02*

SKILLS:

1. Assess water quality using pH meter, secchi disk, turbidity tube, thermometer, chemical test kits, etc.
2. Identify macroinvertebrates and vertebrates taken from a stream or pond and use them as indicators of water quality.
3. Compare water samples taken from different parts of wetland, stream or pond.
4. Make inferences about species diversity based on water quality tests or measurements.
5. Identify existing nonpoint source management practices in place or make

recommendations for other site-specific best management practices.
6. Use hand lenses and microscopes to identify plankton or algal samples; submerged, emergent or floating plants; and common terrestrial plants (riparian trees & shrubs).
7. Use a topographic map to describe and delineate a water body.

GLOSSARY:

Acid rain: rain containing pollutants that give it a pH of less than 7.0.

Algae: photosynthetic organisms with a onecelled or simple multicellular body plan.

Aqueous: containing or composed largely of water.

Aquifer: a land, gravel or rock formation capable of storing or conveying water below the surface of the land.

Bacteria: unicellular microorganisms of the class Schizomycetes existing as free living organisms or parasites.

Benthos: bottom dwelling or substrateoriented organisms.

Best Management Practices: a practice or combination of practices that provide an effective, practical means of preventing or reducing pollution from non-point sources.

Bioaccumulate: the practice of concentrating a particular substance over time.

Biomonitoring: the use of organisms to assess or monitor environmental conditions.

Biochemical Oxygen Demand (BOD): a measure of the quantity of oxygen used by microorganisms in the aerobic oxidation of organic matter.

Brook: a small stream

Buffer: a vegetated area of grass, shrubs or trees designed to capture and filter runoff from adjoining land uses.

Channelization: the practice of straightening awater course or stream to remove meanders and make the water flow faster. Sometimes concrete is used to line the sides and bottom.

Cobble stone: 2-10 inch size stones where stream life can be found.

Coliform Bacteria: a group of bacteria found in cold and warm blooded animal intestines commonly used as indicators of pathogens.

Cultural Eutrophication: process whereby human activity increases the amount of nutrients entering surface waters.

Culvert: a closed passageway (such as a pipe) under roadways and embankments which drains surface water.

Decomposition: the separating or decaying of organic or chemical matter.

Dendritic: a pattern of stream drainage that resembles the pattern of a tree.

Density of water: Is greatest at 4°(39.2°F).

Dilute and disperse: the practice of discharging a substance into a large body of water that will carry the substance away from its source and reduce its concentration.

Discharge: the flow of surface water in a stream or canal or the outflow of groundwater from a flowing artesian well, ditch or spring.

Discharge pipe: a pipe used to carry wastewater from a factory or other facility into a receiving stream or lake.

Dissolved oxygen: oxygen dissolved in water which is readily available to plants and animals.

Drainage basin: a large watershed usually referring to the combination of several watersheds.

Ecology: the science of the relationships between organisms and their environments.

Ecosystem: an ecological community together with its physical environment, usually considered as a unit.

Ephemeral Stream: a stream that flows only during wet periods or rainstorms.

Epilimnion: topmost layer of water in a lake.

Estuary: an arm of the sea that extends inland to meet the mouth of a river, usually characterized by tidal changes and rich diversity of aquatic life.

Eutrophication: a process in which organic matter accumulates in a body of water until eventually it fills in and becomes dry land.

Fecal coliform: that part of the coliform group of bacteria originating in the intestinal tract of warm blooded animals.

Floodplain: a low area of land, surrounding streams or rivers, which holds the overflow of water during a flood.

Freshwater: water that is not saline or brackish.

Groundwater: water beneath the earth's surface between saturated soil and rock.

Habitat: the area or environment in which an organism lives.

Hardness: a characteristic of water caused by the presence of various salts, calcium, magnesium and iron.

Headwaters: the uppermost reaches of a river or stream.

Hydric soils: soils found in saturated, anaerobic environments usually characterized by gray or mottled appearance, found in wetlands.

Hydrologic cycle: the series of pathways the earth's water may take on its journey from the sea to the atmosphere to the land and ultimately back to the sea.

Hydrologic unit: all land and water within a drainage area.

Hypolimnion: lower layer of water in a lake.

Infiltration: the downward entry of water into the soil.

Instar: the individual insect between two molting events or an organism between egg hatching and the first larval molt.

Intermittent stream: a stream which has an interrupted flow or does not flow continuously.

Larvae: the plural of larva, the first major mobile life stage of an insect or first development following egg hatching.

Lentic: standing water as in a lake.

Limiting factor: something that determines the presence, survival and success of an organism.

Limnology: the study of inland water: ponds, lakes and streams.

Littoral: region of shallow water where light reaches the bottom.

Lotic: running water as in a river.

Macroinvertebrates: an animal without a backbone visible to the naked eye or larger than 0.5 millimeters.

Meander: the circuitous winding or sinuosity of a stream, used to refer to a bend in the river.

Monitoring: to watch and care for a stream on a regular basis.

Nitrate: an important nutrient for building protein in plants and animals.

Nonpoint source pollution (NPS): pollution that originates from many diffuse sources and usually is not regulated, such as runoff from streets that carries with it oil, feces and sediment.

Oligotrophic: a body of fresh water that contains few nutrients and few organisms.

Part per million (ppm): the quantity of one substance contained in one million units of another substance. Equivalent to milligram per liter(mg/l).

Perennial stream: a stream which flows continually.

pH: a symbol used to indicate how acidic orbasic a solution is.

Phosphorus: an important nutrient for life, especially plants and algae.

Plankton: collective word for microscopic organisms that drift around in the upper level of a body of water.

Point source pollution: Pollution that is discharged through a pipe or other conduit and is usually a regulated discharge.

Pollutant: any substance or mixture of substances that defile or contaminate the soil, water or atmosphere.

Pond: a quiet body of water so shallow that rooted plants usually grow completely across it.

Profoudal: region of water below photosynthetic light penetration.

Receiving waters: all distinct bodies of water that receive runoff such as streams, rivers, ponds, lakes and estuaries.

Riffle: a hallow section of a stream where water bubbles over rocks, often found at the bend in a river.

Riparian: relating to the banks of a stream or river.

River: a body of running water of considerable volume usually moving over the earth's surface in a channel or bed.

Run: the straight section in a river between riffles, also refers to fish migration.

Runoff: water, including rain and snow, which is not absorbed into the ground: instead it flows across the land and eventually runs into streams and rivers. Runoff can pick up pollutants from the air and land, carrying them into the stream.

Salt water: water that is saline.

Secchi disk: a simple device for measuring turbidity.

Sediment: soil, sand, and materials washed from land into waterways.

Settling ponds: ponds constructed or used to hold storm water and other runoff where heavy materials can settle and the water can become clear before being discharged.

Stream: a body of running water moving over the earth's surface in a channel or bed.

Stream order: system used to number streams and their tributaries with first order as the headwater stream. When joined by another first order stream the union of two streams becomes a second order stream and so on.

Streambank: the side of a stream.

Subwatershed: a small watershed that is part of a larger watershed such as the watershed of a tributary stream.

Surface water: Water that flows over or is found on the earth's surface.

Thermocline (metalimnion): intermediate (middle) layer of water in a lake.

Total solids: a term used to describe all the matter suspended or dissolved in water.

Tributary: a stream or river that flows into another larger stream or river.

Turbidity: a measure of water cloudiness caused by suspended solids.

Waterfowl: birds that depend on water for habitat i.e. ducks.

Watershed: an area of land that drains into a particular river or body of water usually divided by topography.

Watertable: the upper level of groundwater.

Waterway: a natural or man-made place for water to run through (such as rive, stream, creek, or channel)

Wetland: an area of land that is saturated at least part of the year by water, usually found in depressions, low-lying areas or along floodplains or coastal areas.
Source: New York State Envirothon Web Site