
CHAPTER 4

CONDITIONS FOR AQUATIC PLANT GROWTH

Aquatic pesticide applicators manage aquatic vegetation more than any other organism or group of organisms. To manage weeds effectively, the applicator must understand the conditions promoting weed growth. Sunlight and nutrients are two major factors that regulate plant growth. In aquatic habitats, the depth of **light penetration** usually determines the maximum depth at which underwater plants will grow. The amount of available plant **nutrients** roughly determines the amount of vegetation that can be produced. Other important growth factors include **temperature** and, for rooted plants, a **stable substrate** and **protection from wave action**. The potential for a body of water to develop an aquatic weed problem can be estimated by evaluating the availability of each of these growth-regulating factors. These factors characterize shallow water, so many aquatic weed problems are found in shallow areas.

Light

Aquatic plants do not grow in water that is so turbid (murky, muddy) or deep that all light is blocked. They can, however, grow at very low light intensities, even less than one percent of the surface light on a midsummer day.

The **photic zone** is the portion of a body of water in which enough light can penetrate to support aquatic plant growth. The bottom of the photic zone is defined as the depth at which the light intensity is equivalent to one percent of full sunlight. In silty ponds, the photic zone may be only a few inches; in extremely clear bodies of water, the photic zone can extend to a depth of 30 feet or more. The photic zone for most southern Michigan lakes is 10 to 12 feet deep. The shallower the water body, the more likely it is that the photic zone will extend to the bottom sediment, where rooted plants can grow.

Water clarity is also influenced by water *hardness*. Water hardness is a measure of dissolved calcium, magnesium, iron and strontium. Ions of these elements can bind with suspended particles

such as clay and organic matter and cause them to precipitate (settle). Precipitation removes particles that would normally reduce light penetration. *Soft*, acid waters with low calcium and magnesium concentrations are often characterized by suspended organic substances that prevent good light penetration.

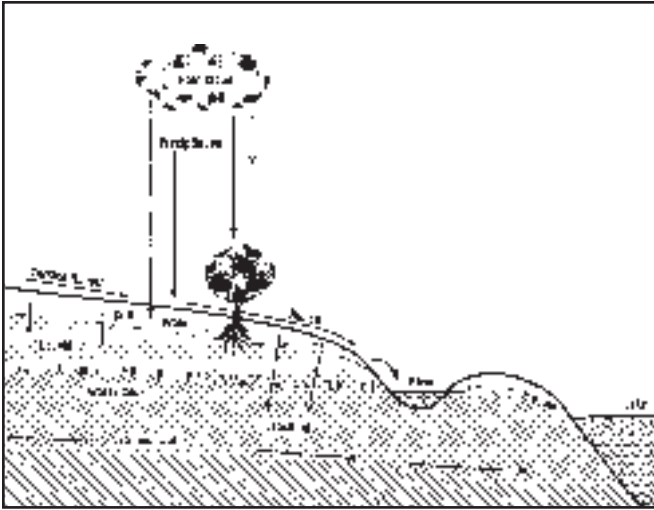
Hardness is usually expressed as parts per million (ppm) of calcium carbonate. Hard waters (hardness values greater than 60 to 75 ppm of CaCO_3) tend to be clearer and therefore weedier than soft waters.

Nutrients

Introduction of unnaturally large amounts of nutrients and sediment into water bodies is a primary factor hastening lake deterioration. Human activities are the primary contributor to lake deterioration by these means. The major nutrient of concern is phosphorus (P), found in most fertilizers (P_2O_5) and organic wastes.

Plants such as **phytoplankton** (free-floating algae), filamentous algae and free-floating flowering plants obtain their nutrients directly from the water. Rooted plants obtain most of their nutrients from the sediments by root uptake. Therefore, both water and sediment nutrient content are important water body characteristics. It is possible to have dense stands of submersed weeds in clear, clean waters that do not have high **water** nutrient content, but do have high **sediment** nutrition.

Nutrients can enter aquatic systems from precipitation (rain), streams, springs, groundwater, and **runoff** (water carrying with it other liquid compounds, water moving soil with contaminants bound to it, or both) from urban and rural areas. The area where these water sources are generated and/or move through is called a **watershed**. In general, the larger the watershed (area draining into a body of water), the greater the amount of nutrients being deposited in a water body with potential to produce more aquatic plants.



Nutrients generated by urban, rural and natural activities enter aquatic areas through many processes.

Runoff is a major contributor to the nutrient enrichment, or “nutrient loading” of surface waters. It is not unusual to see the most prolific weed and algae growths occurring in shallow shoreline areas where sediment loading is greatest. Nutrient contributors from urban watersheds

include sewage effluent (discharge), storm sewer drainage and septic field seepage. Agricultural sources include runoff from fertilized fields, feedlots and nearby pastures. These supplemental nutrients can be used by algae and aquatic plants and encourage excessive plant growth.

As algae and plants die, they fall to the lake bottom and decompose. This decomposed plant matter contributes to the nutrient enrichment of the bottom sediments (**hydrosoil**) and formation of organic substrates called muck. Also, large amounts of decomposing plants can lower the **dissolved oxygen** (D.O.) level in a body of water. Radically lowering the D.O. level can cause fish kills by suffocation. Be aware that the D.O. level may drop dramatically after mechanically cutting aquatic weeds without harvesting, herbicide treatment or seasonal dieback of the aquatic plants.

When aquatic plants are so productive that they begin inhibiting human activities, methods of aquatic weed management are usually considered. Appropriate weed management techniques vary with the weed species, selectivity, cost and the goals of the lake management plan.

Table 4-1. Selected water body characteristics related to the production of rooted plants.

Water Body Characteristic	Rooted Plant Production	
	LOW	HIGH
Average depth	> 15 feet	< 15 feet
Water clarity/light penetration (Secchi disk)	< 3 feet	> 3 feet
Sediments	Sand or highly organic (loose, unconsolidated ooze)	Moderately organic, muck, stable
Dominant fish species	Trout, salmon	Bass, bluegill, pike

Table 4-2. Selected water quality parameters related to the production of phytoplankton.

Water Quality Parameters	Phytoplankton Production	
	LOW	HIGH
Dissolved solids	Low	High
Total phosphorus	0 - 0.01 mg/L	> 0.01 mg/L
Disolved O ₂	Stable	Highly variable
Dominant fish species	Trout, salmon	Bass, bluegill, pike

Temperature

Most aquatic plants grow best in the warm waters of late spring and early summer and reach maximum size in midsummer. Shallow water warms up faster than deeper water and usually exhibits the first visible growth of aquatic plants. Shallow waters provide aquatic plants with long growing periods, even in the northern states where the growing season is normally short.

Temperature is an important factor in determining the life cycle and geographic distribution of aquatic plants. In temperate zones, the onset of cold temperatures and/or the change in photoperiod in the fall causes most aquatic plants to die back to the sediments. Only a few underwater plant types living in deep water can survive the winter under an ice cover as leafy plants. These leafy, winter-surviving plants lose little in **biomass** (volume of living plant material) during these cold periods. Such plants include large-leaf pondweed, Eurasian watermilfoil and elodea. Most aquatic plants emerge from the sediment in the spring from vegetative structures such as tubers (overwintering root structures), turions (overwintering structures made from leaf adaptations), seeds or root crowns.

It is crucial to understand aquatic plant responses to temperature changes so you can predict and identify life stages susceptible to your management technique. With this information, you can target management treatments to the point in the pest's life when it is most easily controlled (vulnerable). For example, curly-leaf

pondweed begins to grow soon after the ice melts. In Michigan, it normally completes its life cycle and collapses before July 4th. Optimum control for curly-leaf pondweed is achieved when the plant is treated after emergence but prior to the onset of turion formation, which occurs in late April to early May.

Substrate

A stable **substrate** (the base on which an organism lives) is required for the attachment of rooted aquatic plants. Sand tends to shift, so it is a poor substrate in flowing waters or along shorelines exposed to strong wind and wave action. In protected areas, sand, as well as silt and clay, interspersed with some organic matter provides an excellent rooting medium for most aquatic plants. Rock and large gravel substrates do not promote the growth of rooted plants because they are nutrient poor.

Runoff and erosion of terrestrial (land) sediments may cause a buildup of sediments along shorelines and at the mouths of inflowing streams.

Shallow areas with gradually sloping bottoms are also prime locations for weed infestations. In contrast, deep water bodies and those with steep sides provide few sites for plant attachment. These characteristics are important to understand when designing and creating ponds and lakes. Considering pest habitat and their management during the design and development stages allows for the incorporation of features that discourage pest invasion.

Chapter 4 – Conditions for Aquatic Plant Growth Review Questions

Write the answers to the following questions, and then check your answers with those in the back of this manual.

- Which is not an important factor for aquatic plant growth?
 - Temperature.
 - A stable substrate.
 - Sunlight and nutrients.
 - Large amounts of wave action.
- The portion of a body of water in which enough light can penetrate to support aquatic plant growth is the _____.
- The bottom of the photic zone is defined as:
 - 30 feet beneath the surface.
 - The depth at which the light intensity is equivalent to one percent of full sunlight.
 - The depth at which the light intensity is equivalent to ten percent of full sunlight.
 - Only a few inches beneath the surface.
- _____ water is often characterized by low calcium and magnesium concentrations and suspended organic substances that prevent good light penetration.
- It is possible to have dense stands of submersed weeds in clear, clean waters that have low water nutrient content, yet have high sediment nutrition. True or False?
- The larger the watershed (area draining into a body of water):
 - The greater the amount of nutrients being deposited in a water body with the potential of producing aquatic plants.
 - The more the amount of nutrients are dispersed, reducing the aquatic plants.
 - The greater the water hardness, reducing the potential of producing more aquatic plants.
 - Both b and c.
- Large amounts of decomposing plants can _____ the dissolved oxygen level in a body of water.
 - Raise.
 - Lower.
 - Have no effect on.
 - Stabilize.
- Which is not a dominant fish species if phytoplankton production is high?
 - Pike.
 - Bass.
 - Bluegill.
 - Trout.
- Temperature is an important factor in determining what characteristics of aquatic plants?
- Why is it necessary to understand aquatic plant responses to temperature changes?
- Which of these statements is false?
 - Sand is a poor substrate in flowing waters or along shorelines.
 - Silt and clay are poor substrates in protected areas because they are nutrient poor.
 - Rock and large gravel substrates do not promote rooted plant growth.
 - Shallow areas with gradually sloping bottoms are prime locations for weed infestations.