Aquatic Plant Management for Fish and Wildlife

Habitat Extension Bulletin No. 21

There are numerous species of aquatic plants in a wide diversity of shapes and sizes. Similarly, a range of opinion exists on what constitutes an aquatic plant.

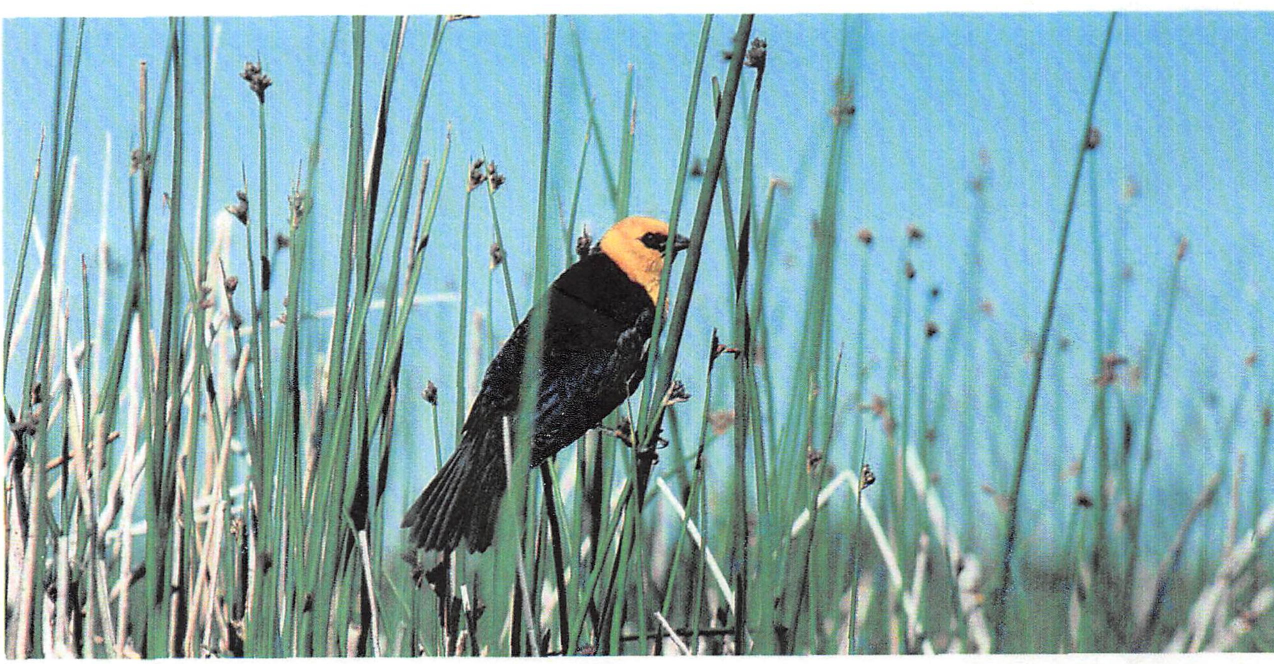
Any puddle of water persisting for a month starts to turn green from microscopic algae. If a body of water remains for a year, higher forms of algae, submerged vascular plants, and emergent shore-line plants may appear. This procession is natural and beneficial to aquatic ecosystems. This bulletin provides information about the benefits of aquatic plants and ways to manage aquatic plants to achieve results that benefit the human user, fish, and wildlife alike.

Benefits of Aquatic Plants

Through photosynthesis, aquatic plants convert the sun's energy into oxygen and carbohydrates, a process called primary production. Many invertebrates and some vertebrates feed directly on aquatic plants and are, therefore, known as primary consumers. Other animals eat primary consumers and are called secondary consumers. The progression proceeds through several more levels, each made possible originally by the nutrition and life-sustaining oxygen of aquatic vegetation.

Fish derive many benefits from the presence of aquatic vegetation. Some species feed on plants, but in North America, it is more common for fish, such as the fathead minnow and gizzard shad, to eat microscopic algae. Aquatic plants are used for shelter by many fish species. Experienced anglers know that "weed beds" are good places to catch fish. Also, insects and other invertebrates which fish feed upon use aquatic vegetation for attachment, shelter, and food. Some fish species, including northern pike and yellow perch, spawn on plants.

Waterbirds consume aquatic plants, though



yellow-headed blackbird in marsh habitat

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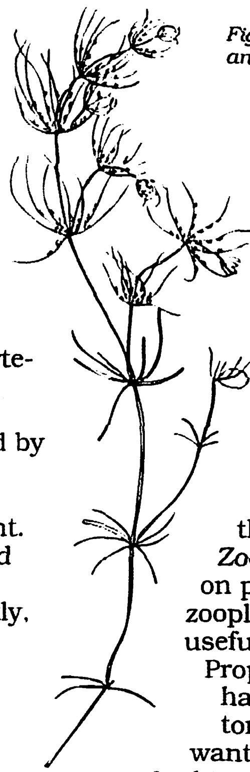


Figure 1. Chara (after Matsumura and Harrington 1955).

only the seeds contribute much energy. During periods of high protein need, such as for egg laying and molting, waterfowl rely heavily on small aquatic animals (insects and shrimp). Aquatic vegetation, which is so important for invertebrates, is indirectly related to waterfowl production at these critical times. Nesting and shelter of waterfowl are also enhanced by aquatic vegetation.

Other wildlife would not live in and around ponds if aquatic plants were absent. Frogs, turtles, snakes, some songbirds and raptors, muskrats, mink, and many other animals all derive food, directly or indirectly, and shelter from aquatic plants.

Besides being a food source and place for shelter, aquatic vegetation can also save a pond from ruin caused by the siltation and turbidity of shoreline erosion. Stands of submergent and emergent vegetation in shallow water can subdue the erosive force of waves.

Despite these many benefits of aquatic plants to wildlife, pond owners commonly view aquatic plants as a nuisance. Instead of eliminating all aquatic plants, effective pond management involves determining and maintaining optimum amounts of vegetation.

Kinds of Aquatic Plants and Their Value to Fish and Wildlife

Algae

Algae constitute a group of plants ranging from single-celled plankton to complex plants. Technically, they have no leaves or flowers. Three categories of algae are recognized: planktonic, filamentous, and macrophytic.

Planktonic Algae

The microscopic algae living in the water column are called phytoplankton. This group of plants, at high density, gives water a green color, which is sometimes called a "bloom." Planktonic algae quickly find their way into an impoundment; there is no need to introduce them.

Because of the small size of planktonic algae, few fish species are able to feed upon them. Yet phytoplankton are critical to any aquatic system for a number of reasons. Phytoplankton produce most of the oxygen in an aquatic ecosystem. *Zooplankton* (microscopic animals) feed on phytoplankton, and fish then consume zooplankton. Also, phytoplankton can be a useful tool for managing higher plants. Properly timed applications of fertilizers have been used to increase phytoplankton numbers, thereby shading out unwanted, rooted plants. On the negative side, planktonic algae use oxygen for respiration at night, when no oxygen is being produced. This can deplete oxygen levels to a point where fish die. A specific group of planktonic algae known as blue-green algae can cause taste and odor problems in water and fish.

Filamentous Algae

Filamentous algae are long green threads, or filaments. These algae often form mats that look like slimy cotton. Filamentous algae are considered a nuisance more often than any other plant group. Fish have a hard time swimming through the filaments; in fact, one species, known as fish net algae, resembles a fish net that entangles small fish. Young waterbirds, such as coots and ducks, can drown after becoming entangled in filamentous algae. From a human viewpoint, pond aesthetics, swimming, boating, and fishing are compromised when too much filamentous algae is present. On the positive side, a few fish species, such as golden shiners, use filamen-

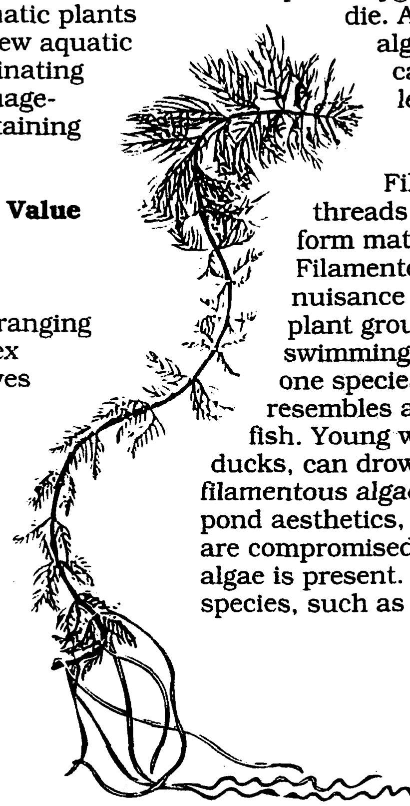


Figure 2. Ceratophyllum (after Matsumura and Harrington 1955).

tous algae as spawning substrate. Also, coots and gadwall ducks eat some species of filamentous algae. In general, this group of aquatic plants requires management to avoid user conflicts.

Macrophytic Algae

Macrophytic, or advanced, algae resemble rooted, vascular plants. However, these algae have no roots or vascular bundles. *Chara* is the most common plant in this group. It can be confused with the vascular plants called *Ceratophyllum* (coontail) and *Myriophyllum* (water milfoil), and it is important to accurately identify *Chara* if a herbicide is to be used because vascular plant herbicides are ineffective on algae. Unlike these other plants, *Chara* has no roots and flowers (Figure 1), and has a skunk– like odor from which its common name, musk–grass, is derived. Coontail and water milfoil may have a musty, pond odor but not a skunk odor. The leaves of coontail have a horned appearance (Figure 2), and the leaves of water milfoil are feather-like (Figure 3).

The major wildlife benefit of macrophytic algae is shelter. Fish and many invertebrates live in and around plants of this group. Some species of fish spawn on macrophytic algae, and this group of plants is particularly important as a food source for waterfowl. Muskrats and 22 species of ducks are known to feed on macrophytic algae. Macrophytic algae seldom grow more than three feet tall, impacting water sports only in shallow water.

Macrophytes

Macrophytes have flowers, true leaves, and roots. It is useful to split macrophytes into three groups: free-floating, submergent, and emergent.

Free-Floating Macrophytes

Free-floating plants in North America are represented by tiny plants known collectively as duckweeds, or sometimes, watermeal. These plants range in size from a pin head to a match head. They grow only in still water, and dense growths (several inches thick) often indicate high phosphorous levels in water. These plants can flower, but most of their propagation is through self-replication.

These free-floating macrophytes are important to a number of wildlife species. Fish derive shelter from duckweeds, and waterfowl and muskrats eat them. Sometimes duckweeds become so abundant on the surface that submerged plants can not get enough sunlight to grow.

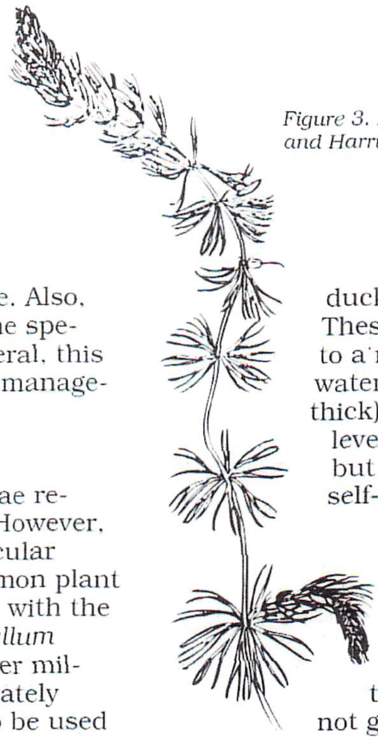


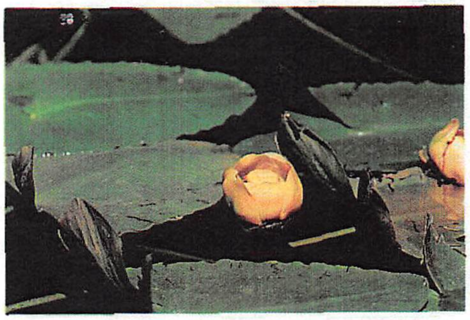
Figure 3. Myriophyllum (after Matsumura and Harrington 1955).

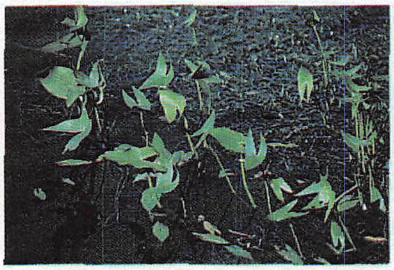
Submergent Macrophytes

Plants in this group grow from the bottom to the surface, and consequently some of the leaves may float (e.g., water lilies). However, because of their attachment to the pond bottom, submergent plants should not be confused with free-floating plants.

Fish, insects, and other invertebrates use submergent vegetation for shelter. Dense growths of these plants are referred to as "weed beds" by anglers. Submergent plants are also extremely important to waterfowl. Most produce seeds above water, and some produce edible tubers. The true pondweeds (*Potamogeton*), wildcelery (*Vallisneria*), and coontail are examples of submergent plants valuable to waterfowl. Some submergent plant species, such as water lilies

water lilies





arrowhead

(*Nymphaea*), spatterdock (*Nuphar*), water buttercup (*Ranunculus*), and American elodea (*Elodea*), are used as ornamentals in aquariums and backyard ponds.

Most submergent plants grow densely in shallow water. They reduce wave action, thereby slowing bank erosion. However, because of their dense growth, submergent plants sometimes hinder swimming, boating, and fishing.

Emergent Macrophytes

Emergent plants grow from the shallow bottom of a pond up through the water to a considerable distance into the air. If the water level recedes, plants in this category usually survive. Common emergent plants are cattails (*Typha*), arrowhead (*Sagittaria*) rushes (*Scirpus*), spikerushes (*Eleocharis*), sedges (*Carex*), and smartweed (*Polygonum*). Two grasses are commonly found in the wet conditions adjacent to ponds in the inter-mountain region: saltgrass (*Distichlis*) and wild millet (*Echinochloa*).

cattails

Only very young fish utilize emergent vegetation for shelter due to shallow water conditions. However, this kind of vegetation produces many insects, and consequently fish benefit indirectly. Similarly, frogs and snakes seek shelter and food produced in emergent vegetation. Waterfowl and other birds nest, find shelter, and eat parts of emergent plants as well as insects produced there. Muskrat and mink make use of food and shelter available in emergent vegetation. Because the plants and much of the wildlife utilizing them are visible, emergent plants add considerably to pond aesthetics. Emergents grow along shorelines, thus reducing bank erosion. Without some management of emergent plants, they can grow too dense and become nearly impenetrable.

Manipulation of Aquatic Plants

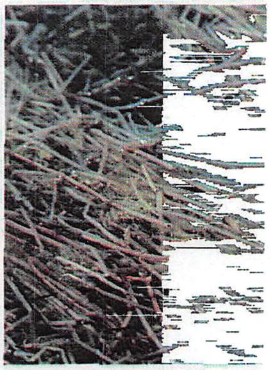
Natural ponds and wetlands have gradually established plant and animal life over thousands of years. However, modern land use practices, such as grazing, tilling the surrounding land, drainage, and fire suppression, can impact natural processes. Constructed ponds and wetlands have not been shaped by the forces of time but are also subject to the effects of land use practices. Thoughtful management is essential if these relatively fragile ecosystems are to be supported and preserved.

There are several key concepts to keep in mind when trying to manipulate aquatic plants. Moderation should be a guiding principle. Too little vegetation can be as detrimental to a system as too much. Also interspersion, or "edge effect," adds greatly to the wildlife value of the habitat as does species diversity.

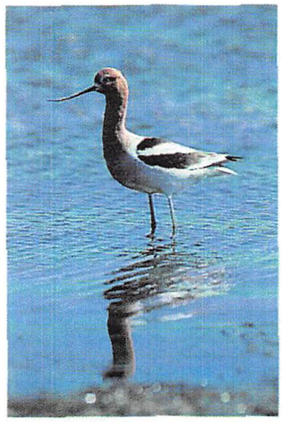
Water Depth

Farm pond construction guides generally suggest digging one–fourth to one–third of the pond area at least 10 feet deep to insure winter survival of fish. For human safety, pond bank slope should be no steeper than 3:1 until the water reaches a depth of five feet.

Since the presence and diversity of plants are related to water depth, it makes sense to vary water depth. Areas of deep water do not need to be located in the center of the pond. A shallow area in the middle of a pond will encourage growth of a "weed bed" and may provide great fishing. An island adds "edge" and duck/goose nesting sites. Shorelines need not descend at a uniform 3:1 slope. They can be less steep in



places, or they can undulate. However, large areas of shallow water, which may promote excessive plant growth, should be avoided.



American avocet

Water Level Control

In addition to designing a pond with different water depths, manipulation of water depth to provide flooding and drying can be a powerful management tool. These measures have strong impacts on plant growth. To fluctuate water levels with proper timing, it is desirable to have access to a flow of at least one-half cubic feet per second (cfs) and to have a water control structure with dam boards. For waterfowl and other shoreline inhabitants, it may be desirable to construct a series of dikes to cover more area with shallow water. A single dike requires more depth to cover the same area.

With intentional lowering of water levels, it is possible to create waterfowl feeding areas by planting smartweed, barnyard grass, or proso millet. This must be done during normal spring planting times. In the fall, gradually flood the seeded area no deeper than 10 to 15 inches. If the water is deeper than this, dabbling ducks cannot reach the seeds on the bottom. The nutritional value of seeds does not deteriorate from long soaking.

If unwanted vegetation has been mowed or disked during lower water levels, the plant parts will decompose and produce abundant invertebrates when re-flooded. Try to flood that area shortly before waterfowl nesting season (early April) that nests will not be flooded, but high numbers of invertebrates will be available in shallow water for newly hatched ducklings.

Substrate

Aquatic plants grow best in fertile soils. Unless four to six inches of topsoil are provided along the shoreline of gravel pit ponds, few emergent plants will grow. The location of growth can be controlled by the placement of fertile soil. For example, to create swimming beaches, plant growth can be discouraged through a process called "blanketing," spreading a sheet of plastic over an area and covering it with sand. Sand is a rather sterile substrate and the plastic will prevent roots from reaching fertile pond soil. This process also can be used to intersperse vegetation in ponds.

leopard frog

Shading

In the southeastern U.S., fertilization of pond waters to promote phytoplankton growth is recommended. By encouraging algae blooms that reduce sunlight penetration through the water column, submerged plants can be reduced or eliminated. It is important to maintain consistent numbers of algae through the summer because if the bloom is lost and rooted vascular plants have started growing, fertilizing will only accelerate vascular plant growth. This technique has been used with very poor success in the western U.S. and is not recommended for this region.

Plantings

As mentioned earlier, aquatic vegetation will find its way into water bodies. It may be desirable, however, to speed the process by planting specific aquatic species, which ensures that valuable species are present.

When plant seeds are available, they can be scattered over appropriate areas. Some aquatic plants develop from tubers which can be transplanted while other aquatic plants spread from plant pieces.

To avoid noxious, exotic plants like purple loosestrife (*Lythrum solicaria*), hydrilla (*Hydrilla verticillata*), and Eurasion water milfoil (*Myriophyllum spicatum*), positively identify the plant species you transplant. If you are unsure, seek identification assistance from the Wyoming Game and Fish Department, Cooperative Extension Service, or the Weed and Pest District of muskrat

the Natural Resource Conservation Service (NRCS), formerly the Soil Conservation Service.

areas can be mowed prior to seed formation and again about a month later. Fall mowing is also useful but results are shorter lived. Willow and cottonwood saplings, up to three inches in diameter, can be effectively controlled by disking. Prescribed burning of dry cattails will damage their root system and impede re-growth. Cattails also can be killed by raising the water level three and one-half to four feet during the growing season. Similarly, if willow and cottonwood seedlings are flooded to cover all above ground growth, they will die. Keep in mind the guiding principles of moderation and interspersion when controlling cattails, willows, or cottonwoods using these measures.

Control of Nuisance Vegatation

Despite the best plans and management efforts, aquatic plant communities often progress toward greater densities and dominant species. Control measures may be necessary to maintain productivity and usefulness. No single control is appropriate for all situations. Biological control is preferred when possible; herbicides should be used with extreme care. In some situations, integration of mechanical, chemical, and biological control measures may offer the best solution.

Mechanical Control

Mechanical control is perhaps a poor term for a catch-all category of disrupting or killing plants from a physical standpoint. Drying, flooding, cutting, and burning are common mechanical control measures.

If submerged vegetation has become a problem, a fall draw-down to dry unwanted plants will set back their growth the next year. If plant roots freeze over winter, their regrowth will be further reduced. Before implementing a fall draw-down, be certain that adequate water levels remain in the impoundment to avoid a winter fish kill.

Submerged vegetation can be cut and removed, but will often grow back like a lawn. Fragments left in the water may further distribute some plant species and make the problem worse. This approach is probably most suited to targeted areas of an impoundment.

Cattails sometimes become too dense around the edge of a pond, hindering access. Dense willow (*Salix*) and cottonwood (*Populus*) growth can present similar problems. Dried cattail

Mechanical measures are labor intensive, and the results are short-lived. With the possible exception of prescribed burning, mechanical means are not likely to be overdone because workers will grow weary before excessive effort has been expended. Because of the temporary impact, mechanical control techniques are unlikely to cause long-term damage.

Chemical Control

Various herbicides have been found to be effective in killing aquatic plants. Unfortunately, treatment of submerged vegetation is presently an "all or nothing" proposition. There are suggestions of treating half a pond at full dose, but experience has shown that if the wind blows sometime within several days of treatment, the entire pond will be treated at half a dose. With foliar (direct) application on emergent plants, it is easier to apply herbicides to small areas and achieve desired results. Aerial spraying should be avoided; it covers too much area and may impact non-target vegetation.

When considering herbicides, take the following precautions. Check state laws regarding application procedures and rates before treatment. Only a licensed applicator should apply herbicides; this assures that the person knows what herbicides have been approved for aquatic use and how to apply them safely. Do not consider unapproved chemicals even if they are cheaper. Finally, be aware that oxygen depletion in the water can endanger fish communities and is a common occurrence following herbicide application. Dead plants cannot carry out photosynthesis to produce oxygen, and bacterial decomposition of dead plants puts a heavy demand on existing oxygen resources.

The table below lists herbicides found to be effective in the intermountain U.S. Use higher dosages in hard waters and an agriculture "sticker" for emergent plants with waxy leaves. Because tender, growing plants are more susceptible to herbicides, do not expect satisfactory results after August.

When herbicides work, they are fast and thorough. For these reasons they are popular. However, complete elimination does not fall within the guidelines of moderation. Also, herbicides are very expensive, and results last only one to three years in most cases.

Biological Control

With present-day environmental concerns regarding chemicals, biological control of aquatic vegetation is receiving more attention. While there is still much to learn in this area, one thing is clear: biological control takes patience. One to three years may be necessary before desired changes are seen.

Crayfish, fish, and muskrats are examples of biological control tools. The principal food of crayfish is aquatic vegetation. *Orconectes causeyi* is a non-burrowing crayfish found in the western U.S. that effectively reduces aquatic vegetation. However, largemouth bass (*Microptuerus salmoides*) reduce crayfish numbers, so where they are present, vegetation may reach undesirable levels. A close relative, *O. rusticus*, the rusty crayfish, has been devastating to desirable aquatic vegetation in northern Wisconsin and should not be introduced. It is likely that in the absence of predators, most native crayfish will control submerged aquatic vegetation, thus making exotic introductions unnecessary.

Grass carp (*Ctenopharyngodon idellus*) are a north-temperate species from China that has great potential for biological control of submerged vegetation, but the common name has aroused emotions. Grass carp are legal in only a few states, and many of those, including Wyoming, require a permit. Stocked grass carp must be sterile (triploid) fish. Contact the Wyoming Game and Fish Department regarding stocking

CHEMICALS TO CONTROL AQUATIC VEGETATION

Phytoplankton	
Copper sulphate	3/4 to 1 lb per surface acre
Aquazine	1 ppm
Filamentous algae	
Copper sulphate	5 to 6 lb per acre-foot
Cutrine Granular	spot treatment for Chara
Cutrine plus	0.6 - 1.2 gal per acre-foot
Aquazine	1 to 2 ppm
Submerged aquatic vascular plants	
Aquathol K	0.3 - 2.6 gal per acre-foot
Diquat	1/4 to 3 ppm
Sonar	15-20 lb per surface acre
Emergent	
Dalapon	foliar spray
Rodeo	foliar spray
2, 4-D	foliar spray

permits and requirements.

The major problem with grass carp involves identifying stocking rates to achieve reduction rather than elimination of submerged aquatic plants. Grass carp are voracious eaters their second and third year of life. In later years, they eat much less. Stocking rates of 10 to 25 grass carp per surface acre should effectively reduce aquatic vegetation. Five additional grass carp per surface acre should be stocked every three to five years thereafter. Some knowledge of the existing fish community is needed to select the proper size of grass carp to stock. When large-mouth bass or other predators are present in moderate to high numbers, eight inch or larger grass carp should be stocked. When predators are not present, smaller, less expensive fish are satisfactory. A grass carp stocking model has been developed at Colorado State University, which makes adjustments for water temperature, types and amount of vegetation, level of control desired, and several other factors. This information is available from the Wyoming Game and Fish Department.

The literature on marshes recommends keeping common carp (*Cyprinus carpio*) out of wetlands. While they remove aquatic vegetation, their numbers cannot be controlled. Moderation is not possible with common carp which spawn prolifically in vegetated waters. Their use for plant reduction is not recommended.

Tilapia (*Tilapia*) are tropical herbivorous fish and require permits prior to introduction. Because they are native to warm climates, they cannot survive at water temperatures below 50° F. Any pond or wetland that freezes over will not support tilapia year-round. Consequently, tilapia must be over-wintered indoors and released in the spring. This is not practical for most pond owners.

For emergent vegetation, muskrats (*Ondatra zibethica*) are a possible biological control. Muskrats will open marsh land, cutting a considerable amount of vegetation to construct huts. An added benefit is that these huts serve as waterfowl loafing and nesting sites. To encourage muskrats to build huts (rather than bank dens), provide stable water levels and place a bale of hay on top of two other bales of hay in water for a start. Muskrats eat many of the same plants as waterfowl; if muskrats flourish, it may become necessary to control their numbers by trapping.

Summary

Aquatic plant management is an important aspect of many impoundments. The emphasis here has been on the concept of managing for optimum levels of vegetation, rather than elimination. Aquatic vegetation provides food for many species of wildlife, and enhances aesthetics of most ponds and lakes. Many kinds of vegetation management/control can be accomplished by most pond owners with a little thought and planning. Keep in mind that expertise is available from state and federal agencies such as the Wyoming Game and Fish Department and the NRCS. Related to this, always remember to check various federal and state laws prior to implementing management practices such as herbicide application or grass carp stocking.

For More Information

The proper management of aquatic plants is a complex procedure. Because the science of managing aquatic plants is rapidly evolving, we recommend contacting the Wyoming Game and Fish Department for advice before beginning any management project.

Illustrations drawn after Matsumara, Y. and Harrington, H. D. 1955. The True Aquatic Vascular Plants of Colorado. Colorado Agricultural Experiment Station, Technical Bulletin #57, Colorado A & M, Fort Collins, CO.

Written by Stephen A. Flickinger, Colorado State University, and James R. Satterfield, Jr., Colorado Division of Wildlife, through the Wyoming Cooperative Fish and Wildlife Research Unit.

This publication is one in a series of habitat extension bulletins produced by the Wyoming Game and Fish Department. Call 1-800-842-1934 for additional information or assistance.