OHIO STATE UNIVERSITY EXTENSION

Your Pond Update

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Autumn 2017- It's Not Just "Seaweed"! Aquatic Vegetation to Benefit Water Quality and Fisheries

Collecting the pond-management handbooks issued by various state management agencies and Extension services is an odd hobby of mine. Almost universally, they acknowledge the benefit of aquatic vegetation to ponds and lakes: "All pond animals depend on aquatic plants, either directly or indirectly" (Austin et al. 1996); "Aquatic plants are a beneficial and necessary part of…lakes and ponds" (IDNR 2001); "Aquatic plants benefit fish populations…" (Prather 2004); "Because of…many benefits, some aquatic plant growth is always desirable" (Lembi 2009); "Under normal circumstances, [aquatic plants] are beneficial to the pond ecosystem in many ways" (Swistock et al. 2011); etc. *ad infinitum*. Still, pond and lake owners willing to tolerate the presence of aquatic plants are surprisingly few: "[Fish] will benefit from more vegetation than anglers will typically tolerate" (Gabelhouse et al. 2004). A short list of some benefits that aquatic plants can provide to water quality and fisheries:

- Dissolved oxygen: Whenever the sun is shining on plants or algae, they are using the process of photosynthesis to manufacture sugar for their own energy. A byproduct of photosynthesis is oxygen. Vascular plants provide a more stable source of dissolved oxygen to the water than the seasonally cyclic nature of planktonic algae can.

- Fish cover and wildlife habitat: Good habitat for shoreline-loving (i.e., littoral) fishes like Largemouth Bass (*Micropterus salmoides*) and Bluegill (*Lepomis macrochirus*) tends to be texturally diverse, "lumpy," with plenty of spaces between habitat types, "rough" edges, etc. Vegetation provides places both for prey fish to hide (regarding small Ohio ponds, that's usually Bluegill) and from which ambush predators can conduct their predatory business (usually Largemouth Bass in ponds). (More diverse fisheries are possible and more likely in managed lakes, especially with the diversity of habitat provided by diverse stands of vegetation.) In so doing, the right coverage of aquatic plants provides cover that helps to balance the predator–prey interactions that shape the fishery.

- Aesthetics: Wetland and aquatic plants look cool, especially those with showy flowers.

- Habitat for macroinvertebrates: When I think of little aquatic bugs in a pond or small lake, I think of free food to promote the growth of fish.

- Substrate for beneficial bacteria: The smooth surface of a pond or lake's clayey bottom provides area for the colonization of beneficial bacteria (i.e., the stuff that helps break down organic muck and drives the nitrogen cycle in a benign direction). Increasing that surface area by introducing the "bumpiness" of aquatic plants also increases the area available for such colonization.

- Stabilization of substrate: Putting roots into a pond or lake's substrate and covering that substrate with the fibers of plant stems makes the shearing energy of wind and waves less able to stir up muddy water.

- Long-term nutrient storage: A lake or pond has a nutrient regime that drives its productivity; i.e., your aquatic site is going to grow some green stuff whether you want it to or not. Any nutrients that fuel the growth of vascular plants are no longer available to fuel the growth of organisms that are considered a serious nuisance to small managed waters; i.e., rooted plants provide beneficial competition against filamentous green algae, duckweeds/watermeal, and the harmful algal bloom organisms (i.e., blue-green algae or cyanobacteria; Fig. 1). (These latter two bullet points are nicely detailed by the work of Dutch scientist Marten Scheffer: e.g., Scheffer 1998; Scheffer and van Nes 2007; etc.)

Figure 1. The complete absence of aquatic plants from ponds reduces beneficial competition for nutrients and increases the likelihood of harmful algal blooms (Eugene Braig 2015).

However, there are some potential disadvantages to tolerating plants in a pond or small, managed lake.

- Seasonal die-offs: Many aquatic plants have limited growing seasons. If you have a group of plant species that tends to die back in the late summer, you'll need to mitigate that with later-growing plants to maintain benefit throughout the growing season.

- Excessive coverage can contribute to wide oxygen fluctuations: As we've discussed, oxygen is a byproduct of photosynthesis conducted under the light of day. However, when the sun goes down (or even under prolonged, heavy cloudiness) photosynthesis stops or slows. Respiration continues in the dark, and plants become net consumers of oxygen. A moderate coverage of plants buffered by a substantial volume of water leads to a healthy daily cycle, with oxygen increasing throughout the day and decreasing within tolerable levels throughout the dark of night. Excessive coverage within a small volume of shallow water will find oxygen (and pH) at high concentrations throughout the day, but will create a very high oxygen demand at night, possibly leading to stressfully low oxygen concentrations as dawn approaches and possibly even inducing minor fish kills on localized scale.

- Excessive coverage can reduce the growth of fish: The right amount of hiding space balances the interaction of predator and prey. Too much and the prey fish come to be too good at hiding; not enough of them come to be eaten by predators, they begin to overpopulate, compete excessively among themselves, and stunt (their growth slows to the point that they never achieve desirable size). Too many hiding places and the predatory fish have trouble finding or maneuvering to take a meal; their growth slows as well. Too much coverage leads to too many—and thus universally small—fish. Excessive coverage also makes habitat too uniform, filling in those all-important spaces between and eliminating habitat's "rough" edges.

- Maintaining the right coverage is likely to take a commitment of active, informed management effort. This is perhaps the biggest deterrent to tolerating plants in a pond or small lake with a managed fishery; you have to know something about what's growing there and commit to keeping that growth beneficial to the site's intended function. In addition, managing aquatic plants to a limited, beneficial coverage is increasingly difficult with increasing smallness and shallowness of smaller ponds.

How can I maintain a healthy coverage?

Published recommendations vary regarding the amount of coverage by plants to benefit a fishery. Depending on your goals, approx. 5%–20% coverage of a site's area is probably a good starting point, higher within that range if striving for a balanced fishery and lower if trying to enhance the growth of either predator or prey species. Some cite as high as 40% providing definite benefit for fisheries (IDNR 2001), and that may be the case for some sites. Other ponds or lakes may see reduced fish growth with 40% coverage. If fish are present, but quality fishing isn't important to your site, 40% coverage is almost certainly not problematic. If no fish are present (i.e., if maintaining dissolved oxygen throughout summer nights is not a concern), even higher coverages can be tolerated (this latter case may be relevant to stormwater-management basins or wetlands managed as wildlife habitat). However much coverage you tolerate, remember that scattered diverse clumps will benefit habitat better than a single uniform mass of "weed bed."

The more vascular plants you can tolerate, the greater the beneficial competition against nuisance organisms and greater benefit to water clarity. However, daily fluctuations of dissolved oxygen and pH will be wider with increasing plant coverage, potentially stressing aerobic organisms like fishes. A tradeoff.

Maintaining a healthy coverage begins with good pond design. If planning to build a pond, the bulk of the shoreline should be constructed with a 3:1 slope into the water (every 3 feet out from shore adding an additional foot of depth: e.g., see Austin et al. 1996; USDA 1997; IDNR 2001). (Gentler slopes can be used for swimming areas, etc.) The pond should also be built with appropriate depth: perhaps 25% or more of the area to 8 feet or deeper for much of Ohio; to 12 feet or deeper along the north of the state (Austin et al. 1996). This combination of depth and slope helps limit the area where plants can receive sufficient sunlight to take root and flourish to a relatively narrow—and thus more easily managed—nearshore area.

Aquatic plants seem to manage to colonize almost any new pond given time. Sometimes, the initial colonization is by undesirable species; be vigilant to manage against undesirables and thus facilitate colonization by more desirable things. You may want to resort to harvesting native aquatic plants from nearby wet places, although that is associated with some risk of transplanting unseen and undesirable "hitchhiking" organisms. Certainly be careful to not transplant any endangered (see http://naturepreserves.ohiodnr.gov/rareplants) or invasive species.

Unfortunately, while you may find an abundance of showy waterlily-like plants for sale, there are very few nurseries or water gardens that are likely to stock native submerged species. Entering key words like "native aquatic plants for sale" and "Ohio" into an internet search engine (like Google) might reveal some hidden gems. Still, have some savvy that you're not buying a potential invasive intended to enhance captive aquariums (like Brazilian "elodea" or waterweed [*Egeria densa*]).

If you find aquatic plants have gotten out of hand in any given season, consider applying a dye early in the following year to help limit growth next season. Dyes, of course, are most useful to smaller pond sites with appropriate depth and with relatively high retention times for water. Dyes should not be used in ponds that serve as domestic water supplies.

Also, consider spot treatments with granular formulae of aquatic herbicides to keep vegetation restricted to desired areas. If you do opt for herbicide use, as always, only consider herbicides specifically labeled for aquatic applications, select a product most likely to be effective on the problem plant, and very strictly adhere to all label guidelines, giving special attention to any listed use restrictions for treated waters (see Lynch [2009] for general herbicide guidance, and please contact me if you'd like to discuss any available newer products).

Begin on your pond or lake by developing some idea for where you'd like to tolerate aquatic plants. Areas that support in-water recreation (e.g., swimming or boat traffic) are often identified as places to exclude vegetation. Stands of aquatic plants near (but not covering) known fish-nesting sites can enhance their appeal in providing easy access to good nursery habitat. Begin to think about the areas where you may want aquatic vegetation to establish. Be willing to manage against vegetation where it's unwanted or if coverages become excessive.

There is likely some species of aquatic plant that is good at colonizing most wet substrate types. Exceptions may be solid bedrock and hard, compacted clays. That said, getting desirable species to establish before nuisance species take hold can prove a challenge. The state of Missouri published a decent introductory primer on establishing aquatic plants (MDC 2015) that I'm happy to share upon request.

What plants are good?

If you'd like to begin exploiting/exploring aquatic plants to benefit water quality and fisheries, I usually recommend that you keep two key concepts in mind: 1. that the plant species present be diverse and 2. that tolerated species be native (Fig. 2). Diversifying coverage is likely to diversify habitat types, but is also more likely to maintain benefit throughout the growing season. Thus, e.g., as your native pondweeds (*Potamogeton* spp.) are dying back in late summer, they can be replaced by native waterweed (*Elodea canadensis*), etc.

Figure 2. A modest coverage by diverse native plants, like emergent bulrushes and submerged pondweeds, can enhance pond/lake water quality and fish habitat (Eugene Braig 2016).

If a species is well established here and not native to Ohio, it's quite possible that that's because it's an aggressive colonizer and thus potentially invasive. Invasive species may choke out other species and form dense monotypic stands. A good example is invasive curly-leaf pondweed (*P. crispus*). If it takes over your pond or lake and then completely dies off in the late summer (as pondweeds do), you've lost the benefit of its presence. Then, as the dead vegetation is decomposing, it's creating a high demand for dissolved oxygen that becomes a liability. I recommend that you consult a more comprehensive regional field guide (e.g., Chadde 2002) and draw upon local expertise (e.g., your county Extension or Soil and Water Conservation office or—well—me) to help identify potential invasive or nuisance species.

An early Extension Fact Sheet (Lynch 2006) provided a brief list of aquatic plant species that are common to Ohio ponds and discussed the benefits and disadvantages of several general groups. I have expanded on that list here (Table 1). Also, IDNR (2001) provided a substantial listing of emergent species only and assessed their likelihood of providing quality wildlife habitat or becoming a nuisance. Here are a few more personal thoughts that I often relay to Extension clients by e-mail.

Table 1. Some herbaceous aquatic plants that are common to Ohio ponds and small lakes. The use of common names can be variable across references, especially for something so rarely discussed as aquatic plants; scientific names will be much more consistently applied, and thus are also listed here. Note that, with the potential to encounter around 1,000 species of plants in or near the water in Ohio alone, this list only touches on a few very common things and is not remotely comprehensive. Consult relevant field guides for more detail (e.g., Chadde 2002).

Aquatic plant (scientific name)	**Growth form**	**Native status**
Filamentous green algae (division Chlorophyta)	Submerged (algae)	Mixed[1]
Muskgrasses and stoneworts (esp. *Chara* spp. and *Nitella* spp.)	Submerged (macroalgae)	Mixed[1]
Canadian waterweed (*Elodea canadensis*)	Submerged	Native
American eelgrass (*Valisneria americana*)	Submerged	Native
Slender naiad (*Najas flexilis*)	Submerged	Native
Brittle naiad (*N. minor*)	Submerged	Invasive
Large-leaf pondweed (*Potamogeton amplifolius*)[2]	Submerged[3]	Native
Curly-leaf pondweed (*P. crispus*)[2]	Submerged	Invasive
Variable-leaf pondweed (*P. diversifolius*)[2]	Submerged[3]	Native
Illinois pondweed (*P. illinoensis*)[2]	Submerged[3]	Native
Floating pondweed (*P. natans*)[2]	Submerged[3]	Native
Long-leaf pondweed (*P. nodosus*)[2]	Submerged[3]	Native
Small pondweed (*P. pusillus*)[2]	Submerged	Native
Richardson's pondweed (*P. richardsonii*)[2]	Submerged	Native
Sago pondweed (*Stuckenia pectinata*)[2]	Submerged	Native
Coontail (*Ceratophyllum demersum*)	Submerged	Native
Eurasian watermilfoil (*Myriophyllum spicatum*)	Submerged	Invasive
Duckweeds and watermeal (family Lemnaceae)	Free-floating	Native
Water-shield (*Brasenia schreberi*)	Floating-leaved[4]	Native
American lotus (*Nelumbo lutea*)[5]	Floating-leaved[4]	Native
Spatterdock (*Nuphar advena*)[5]	Floating-leaved[4]	Native
White waterlily (*Nymphaea odorata*)[5]	Floating-leaved[4]	Native
Horsetails or scouring rushes (*Equisetum* spp.)	Emergent	Native
Sedges (esp. *Carex* spp. and *Cyperus* spp.)	Emergent	Native
Spikerushes (*Eleocharis* spp.)	Emergent	Native
Bulrushes (*Schoenoplectus* spp. and *Scirpus* spp.)	Emergent	Native
Rushes (*Juncus* spp.)	Emergent	Native
Reed canary grass (*Phalaris arundinacea*)	Emergent	Invasive[6]
Common reed (*Phragmites australis*)	Emergent	Invasive[6]
American water plantain (*Alisma subcordatum*)[5]	Emergent	Native
Arrowheads (*Sagittaria* spp.)[5]	Emergent	Native
Pale-yellow iris (*Iris pseudacorus*)[5]	Emergent	Invasive
Blue flag (*I. versicolor*)[5]	Emergent	Native
Pickerelweed (*Pontederia cordata*)[5]	Emergent	Native
Bur-reeds (*Sparganium* spp.)	Emergent	Native
Narrowleaf cattail (*Typha angustifolia*)	Emergent	Invasive
Broadleaf cattail (*T. latifolia*)	Emergent	Native
Hybrid cattail (*T. x glauca*)	Emergent	Invasive
Swamp milkweed (*Asclepias incarnata*)[5]	Emergent	Native
Purple loosestrife (*Lythrum salicaria*)[5]	Emergent	Invasive
Swamp rose mallow (*Hibiscus moscheutos*)[5]	Emergent	Native
Waterprimroses or seedboxes (*Ludwigia* spp.)[7]	Emergent	Native[8]
Smartweeds and docks (family Polygonaceae)[7]	Emergent	Native[8]

Footnotes to Table 1:

1 Most of the algae encountered in Ohio will be native species, even if they sometimes grow to nuisance coverages.

2 While plants are almost entirely submerged, the pondweeds do grow emergent flower spikes in season.

3 Many pondweed species have two different forms of leaf on the same plant: both submerged (often narrow or even threadlike) and floating (usually rather broad).

4 Some references also describe plants with underwater roots and generally floating leaves and flowers as "emergent."

5 Many emergent and floating plants display showy, colorful, and very attractive flowers in season.

6 There are native strains/subspecies of these common shoreline grasses, but the invasive forms are most commonly encountered.

7 These common shoreline plants often have rather plastic growth forms, appearing as typical emergent plants where rooted on shore, but often sending more flaccid, vine-like stems into (and under) shallow water.

8 Most you're likely to encounter in Ohio will be natives, but there are a few potential invasive species among these plants.

But first, a few easy vocabulary terms:

- *Emergent* describes those plants rooted along shorelines or in shallow water with stiff stems growing into the air (like grasses and cattails).
- *Floating-leaved* describes those plants that root in shallow- to moderate-depth water with leaves and flowers floating on the water's surface (like waterlilies).
- *Submerged* describes plants with more flaccid stems that grow mostly or entirely underwater.

Don't tolerate potentially invasive, non-native plants. While common to Ohio, the plants that I describe as "invasive" (Table 1) should probably be actively excluded from managed ponds and lakes. Newly invading or recently expanding invasive species to avoid (not yet common to Ohio and thus not listed in Table 1) are submerged *Hydrilla* or waterthyme (*Hydrilla verticillata*) and Brazilian "elodea" or waterweed, floating-leaved yellow floating-heart (*Nymphoides peltata)* and European frogbit (*Hydrocharis morsus-ranae*), and the plant-like macroalga starry stonewort *(Nitellopsis obtusa*). This list of potential invasives is nowhere close to comprehensive. Please ask a professional if you see something growing and aren't certain if you want to tolerate it on your pond or lake.

Many species that I describe as "floating-leaved" (Table 1) will rather assertively (although often rather slowly compared to some other plants) spread in extensive shallows. They can easily come to nuisance coverages in small, shallow ponds. If you have substantial expanses of deep water, deep enough where waterlily-like plants aren't likely to colonize, those species can provide a valuable diversity of habitat to shallow nearshore areas. Watershield (*Brasenia schreberi*) is the floating-leaved species listed here that is perhaps less likely to form such expansive stands. Also, tiny and free-floating duckweeds (family Lemnaceae) are common to marshes and the quiet backwaters of lakes (and not at all problematic there), but they can quickly come to nuisance coverages (crashing oxygen production) on small, still ponds.

Some of the emergent species with beautiful, showy flowers rarely come to nuisance coverages and may be a good choice for their aesthetics as well: consider pickerelweed (*Pontederia cordata*), native arrowheads (*Sagittaria* spp.), water plantain (*Alisma subcordatum*), and blue flag (*Iris versicolor*). Sedges and bulrushes (family Cyperaceae) also help to enhance shoreline habitat and have a great, marshy aesthetic (even without the showy flowers). If you happen to be extremely ambitious, you can also consider cattails (*Typha* spp.), and they will be excellent for producing large biomass and consuming excess nutrient loads. However, cattails are aggressive colonizers and will require continuous management to keep them in check on suitable habitat. If you decide to tolerate cattails, you are likely committing to a lifetime of active management. (Frankly, most pond owners thus decide to simply exclude all cattails. Managers of lake-size sites are more likely to have diverse shoreline habitat, some of which may be unsuitable to cattails, and thus to be able to successfully tolerate some cattail colonies.) If you do allow some cattails, keep them away from earthen dams where they may attract burrowing muskrats.

Almost ubiquitous to wild wet places, cattails deserve a bit more attention. There are two species of cattails in the region—native broadleaf cattail (*T. latifolia*) and invasive narrowleaf cattail (*T. angustifolia*)—and they freely hybridize

(as *T. x glauca*). Even if you tolerate a stand of natives, receiving a bit of pollen from any of the invasive species nearby will effectively breed your native cattails out of existence in relatively few generations. Still, the two species and hybrid function pretty much identically on the landscape. All said, some wetland grant programs expect management plans to exclude or remove all cattails because of the likelihood of eventual hybridization with the invasive.

Summation

Develop some kind of plan. Know where it might be necessary to exclude aquatic plants and where you might benefit from tolerating some coverage. Manage for diversity of aquatic plants and manage against potentially invasive or nuisance species. Be willing to take management actions to enhance or restrict coverage as necessary.

Maintain vegetative cover to attain your goals for the site and its fishery. A thumbnail: Remember, (so long as it's not so great as to cause nighttime oxygen stress) greater coverages tend to enhance water clarity/quality and fish survival; more modest coverages tend to increase fish predation and enhance fish growth. Spaces between stands of aquatic plants are as valuable as the stands themselves. Observe trends on your own site over time, keeping written notes if possible. Every site represents a bit of a trial-and-error balancing act, so don't shy away from seeking the advice of professionals.

…And always feel free to drop me a line if I can help. My job is service to you, pond and lake owners and managers, and I kinda like my job.

References

Austin, M., H. Devine, L. Goedde, M. Greenlee, T. Hall, L. Johnson, and P. Moser. 1996, 2015. Ohio pond management handbook: a guide to managing ponds for fishing and attracting wildlife. Ohio Department of Natural Resources, Division of Wildlife, Publication 5432 (R0815), Columbus, OH.

Chadde, S. W. 2002. A Great Lakes wetland flora: a complete guide to the aquatic and wetland plants of the upper Midwest, 2nd ed. PocketFlora Press, Laurium, Michigan.

Gabelhouse, D. W., R. L. Hager, and H. E. Klaassen (R. Schultz, rev.). 2004. Producing fish and wildlife from Kansas ponds, 4th edition. Kansas Department of Wildlife and Parks. Pratt, KS.

IDNR (Illinois Department of Natural Resources). 2001. Aquatic plants: their identification and management. IDNR, Fishery Bulletin No.4, Springfield, IL.

Lembi, C. A. 2009. Identifying and managing aquatic vegetation, publication APM-3-W. Botany and Plant Pathology, Purdue University Extension, West Lafayette, IN.

Lynch, W. E. Jr. 2006. Benefits and disadvantages of aquatic plants in ponds, Extension fact sheet A-17-06. School of Environment and Natural Resources, Ohio State University Extension, Columbus, OH.

Lynch, W. E. Jr. 2009. Chemical control of aquatic plants in ponds, Extension fact sheet A-4-09. School of Environment and Natural Resources, Ohio State University Extension, Columbus, OH.

MDC (Missouri Department of Conservation). 2015. How to establish aquatic plants in your pond, publication FIS004. MDC, Jefferson City, MO

Prather, K. editor. 2004. A management guide for ponds and small lakes in Kentucky, 3rd edition. Kentucky Department of Fish and Wildlife Resources, Frankfort, KY.

Scheffer, M. 1998. Ecology of shallow lakes. Chapman & Hall, London.

Scheffer, M., and E. H. van Nes. 2007. Shallow lakes theory revisited: various alternative regimes driven by climate, nutrients, depth and lake size. Hydrobiologia 584:455–466.

Swistock, B. R., R. W. Soderberg, H. Blanchet, and W. E. Sharpe. 2011. Management of fish ponds in Pennsylvania. Penn State Cooperative Extension, UH137, University Park, PA.

USDA (US Department of Agriculture). 1997. Ponds—Planning, Design, Construction: Agriculture Handbook 590. USDA Natural Resources Conservation Service, Washington DC.