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Winter Drawdowns for Aquatic Weed Control and Pond Management

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Pond managers are tasked with creating and maintaining the optimal conditions desired for a pond's use, whether it be fishing, swimming or aesthetics. Because of this, they are encouraged to use all materials and techniques available to them to achieve the desired results. Controlling nuisance aquatic vegetation is frequently a priority for pond managers. Some control methods involve either high effort (raking, hand pulling, benthic barrier installation) or potentially great expense (herbicides, harvesters). Most of these control methods are also used while plants are actively growing during the spring and summer. One often underutilized technique for ponds larger than 1 acre, is the winter drawdown.

A winter drawdown in Arkansas involves draining 2-3 feet of water from a pond in mid-November and allowing spring rains to refill the pond sometime in February. These times are adjusted for ponds in states farther north or south. The goal is to expose 35-50% of the pond bottom, the shallow areas of the pond, to freezing and drying. The percentage of the pond exposed is only an approximation and will require adjustment due to pond topography and shape, and the amount of shallow water. Drawdowns are not recommended for ponds smaller than 1 acre, because it might leave insufficient water to support the fish population. A drawdown during warm months is also not recommended, as heat and low dissolved oxygen can excessively stress fish, and it may enhance the spread of marginal nuisance plant species (such as cattails, alligatorweed, rushes and willows).

Aquatic plants are broadly classified by their growth habitat; floating (rooted and free), emersed or submersed. When aquatic plants (particularly submersed species growing in shallow areas) are exposed during a drawdown, they are more susceptible to control. Exposure can cause plant death by desiccation to the leaves and stems, collapse of the vascular system and root death from freezing and desiccation. Emergent and floating aquatic plants can sometimes be controlled with drawdowns, but this can be species dependent. Table 1 provides the expected impact of a winter drawdown on relative abundance of some aquatic plants the following season.

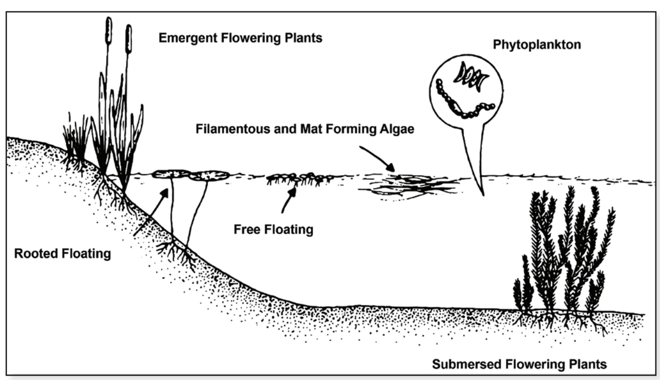

Figure 1. Aquatic plant types. Courtesy of Craig Tucker

During the winter, water freezes into ice at 0°C (32° F), and floats to the top. Water below the ice insulates and often protects submersed plants from freezing damage. Bottom sediments exposed to air during drawdowns are more susceptible to drying and freezing which can negatively impact the reproductive structures of many aquatic plants. Though many aquatic plants reproduce and spread by sexual reproduction (seeds), most rely on vegetative reproduction. Many of these vegetative structures also help aquatic plants survive the winter. It is worth examining these structures and discussing their vulnerability to a winter drawdown.

Rhizomes are large, fleshy, underground stems that grow horizontally just under the soil surface and send up leaves and stems. They are found in plants such as water lily and spatterdock, and act as storage organs for carbohydrates produced by the leaves. After winter dormancy, these carbohydrates are used to produce new leaves in the spring. Many aquatic plants have less substantial, but still important, rhizomes and stolons (above ground horizontal stems) which spread the plant during the summer. The larger and deeper the rhizome is growing, the greater its ability to survive a drawdown.

Figure 2. Lily rhizomes that floated to the surface after a herbicide treatment. Courtesy of John Madsen.

Tubers are another example of a fleshy, carbohydrate storage structure. Tubers are also an underground stem, but without a basal plate and their surface tends to be leathery. Tubers have eyes, or growth nodes, from which the new plants grow. Potatoes are a common terrestrial example of a plant that has tubers. Arrowhead and sago pondweed are two common Arkansas aquatic plants that form tubers.

An aquatic plant-specific overwintering structure, without an exact terrestrial equivalent, is the turion or winter bud. These are modified buds, located at the stem and branch tips, where there would be normal meristematic tissue in the growing season. These are typically produced by the plant as a response to unfavorable growing conditions, such as lowering temperatures or decreasing day length. Once produced, the turions detach from the plant to stay on the pond bottom through the winter or become buried in the sediment. Turions can also sometimes float away to further spread the plant. Like tubers and rhizomes, turions contain carbohydrates and are sometime covered with a protective mucilaginous coat. Turions can be somewhat frost and drought resistant, and buried turions can remain viable for many years. Several of the pondweed species overwinter using turions, as does bladderwort and water milfoil. Hydrilla is likely the most invasive aquatic plant that produces turions.

Figure 3. Aquatic plant tubers. Courtesy of Ryan Wersal.

Some aquatic plants, such as coontail, elodea and water marigold, prepare for winter by growing densely crowded plant tips. These tips have very short internodes, are heavily laden with starch, and physically tougher. They may remain attached to the plant or fall to the pond bottom, and they are better able to withstand winter conditions than typical plant tips.

Seeds produced by sexual reproduction are likely to survive the winter and germinate the following spring. Unlike seeds, rhizomes, tubers, turions and the other overwintering structures described are to varying degrees susceptible to a winter drawdown. Several

Figure 4. Hydrilla turion. Courtesy of Wilfredo Robles.

factors affect the degree to which a drawdown will affect these structures. The length of sediment exposure and the number of days temperatures are below freezing determine the likelihood of rhizome, tuber and turion death. Longer, drier and colder periods of exposure will have a greater impact. In addition, frost heaving of the bottom sediments can uproot weeds and aid in their destruction. Ideally, the sediments should be exposed for at least 6-8 weeks, with temperatures below freezing (0°C/ 32°F) for two weeks or more.

The severity of the winter weather can affect the results of a winter drawdown. A mild winter, especially one with persistent precipitation, may not provide the freezing and/or drying required for plant destruction. Conversely, a cold winter with lots of snow might also lead to disappointing results. Snow is an excellent insulator, so exposed bottom sediments that are constantly covered by snow may not experience the low temperatures required to kill overwintering structures. High levels of groundwater seepage may also reduce or negate the destructive effects on target species by keeping the area moist and unfrozen. In addition, some tubers and/or turions are buried deeply in the bottom sediment, reducing exposure. For example, hydrilla tubers can often be found almost 10 inches below the surface.

A winter drawdown can also be used by pond managers to impact fish populations. As stated earlier, the goal is to drain the pond 2-3 feet and expose 35-50% of the pond bottom. If the pond is 2 acres and the level dropped 3 feet, it is likely that half the water volume has been removed, and the surface area reduced by at least 30%. An environmental change of this level can dramatically alter habitat availability, fish behavior and predator-prey interaction. While a long-term water reduction can lead to undesirable changes in the fishery, short-term drawdowns can provide benefits that few other strategies can easily achieve.

During a drawdown, fish are forced into the deeper areas of the pond as the shallow areas are drained. During this period, fish are more concentrated and predation on small fish can increase substantially. This can be especially true for typical bass/bluegill ponds which often have limited deep habitat. Bluegill are far less able to evade bass predation in open water. A pond referred to as "bluegill-crowded" is one containing bass and an overly abundant population of small bluegill. When a drawdown is performed on a "bluegill-crowded" pond, a shift in the population dynamics often follows. The fishery tends to shift towards fewer individuals, with better condition and fitness. The bass have been given access to a larger number of bluegill to eat, and the surviving bluegill now have reduced competition for food and habitat. A healthier predator/prey balance, along with improvements to shallow habitat (reduction of excessive vegetation, for example), can result in far more satisfying fishing in both the short- and long-term life of the pond. In some cases, pond managers use drawdowns as an annual routine in the management of bass/bluegill populations.

There are additional benefits to a winter drawdown. While the water levels are low and the shoreline is exposed, retaining walls and docks can be repaired, areas where the shoreline is eroded can be filled, and other improvements can be more easily accomplished. When bottom sediments are exposed during a drawdown, the peripheral pond soils get a chance to breathe. The exposed ground dries and contracts, and organic matter dries and oxidizes (composts) more quickly. Shallow areas can become slightly deeper the following season due to this compaction and oxidation, reducing light penetration to the pond bottom and potentially reducing some aquatic plant growth.

Pre-emergent herbicides can fatally interrupt plant growth by preventing seeds from progressing all the way through germination. When applied to bare ground, the registered aquatic herbicides flumioxazin and penoxsulam have been shown to provide pre-emergent weed control. Shallow areas of the pond can be treated with either of these herbicides before the pond refills. Following the label's directions closely increases effectiveness and prevents the applicator from violating the law.

Pond Draining

If at the time the pond was constructed a water control feature was installed, such as an internal or external standpipe, partially draining a water body is relatively easy. Unfortunately, this is not the case for many ponds in Arkansas. It may still be possible to perform a winter drawdown by other means.

The principle of the siphon was depicted on Egyptian reliefs 2,500 years ago. Creating a siphon allows a liquid to flow uphill through a tube by using

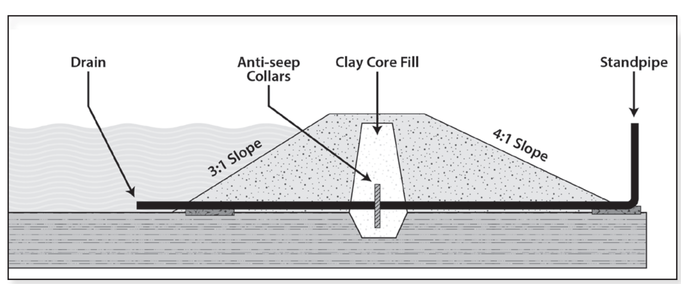

Figure 5. Diagram of example of one type of drain.
Courtesy of Brad Mayhugh.

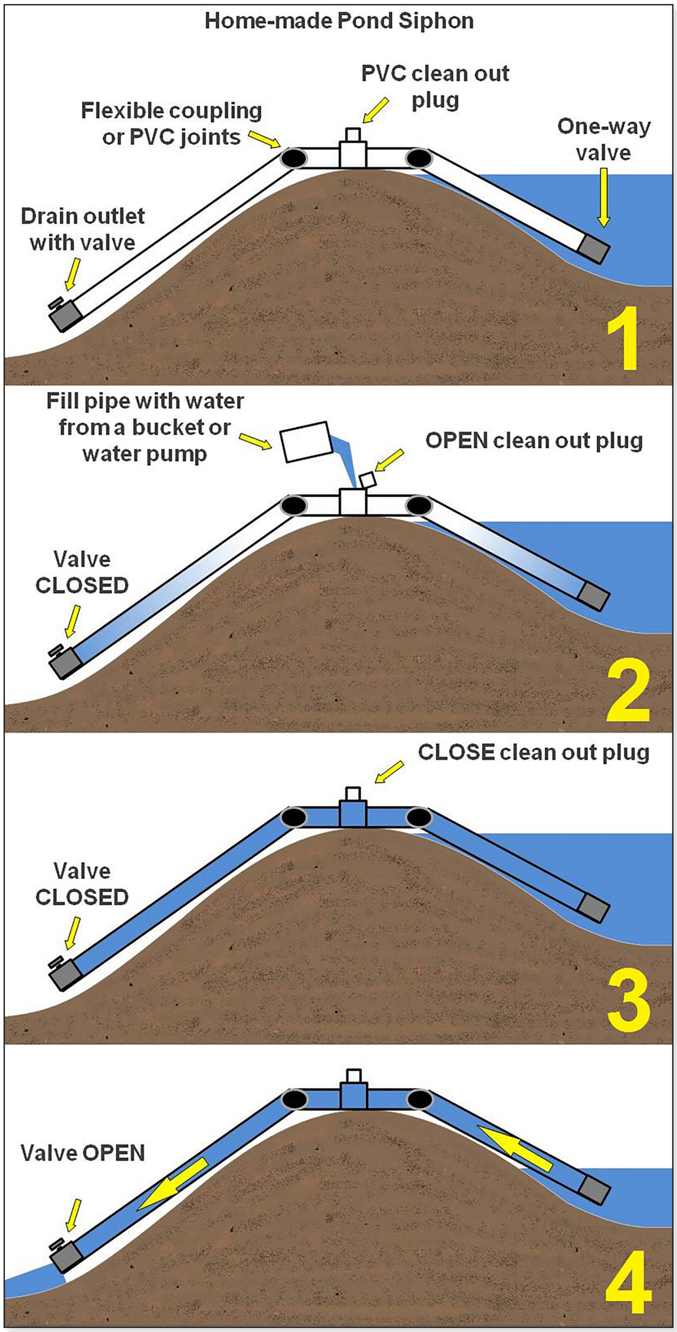

Figure 6. Pond siphon example. Courtesy of Scott Jones.

the force of gravity. In the case of a pond, the water flows through a pipe over the levee to be discharged at a level lower than the pipe intake. Figure 6 provides a detailed description for creating a pond siphon.

The other practical method to reduce water level is by using a pump. Powerful electrical or tractor powered irrigation pumps can be common in the agricultural areas of the Arkansas Delta but might be less common in the hilly areas of the state. There are also smaller gasoline powered trash pumps that could be used for partial pond draining.

Conclusion

A winter drawdown is one tool in the pond manager's toolbox. If the conditions are right, it can effectively control some types of aquatic plants, while having no impact on others. The types and species of plants that are growing in the pond should be correctly identified and considered prior to deciding on a winter drawdown. For some ponds, particularly those classified as "bluegill crowded," a winter drawdown can help restore a healthy predator/prey pond balance. A partial draining can also allow for improvements that would not be possible or easy if the pond were full. Whatever the motivation, a properly performed drawdown can be an effective com-

Figure 7. Water pump. Courtesy of George Selden.

Table 1. Responses of numerous aquatic plants to a winter drawdown. Data was collected from multiple studies resulting in varied response (i.e. both increasing and decreasing results) in many plant species. While the intent is not to confuse, this shows that response from some species to drawdown is uncertain. Some aquatic plants have not been empirically evaluated and therefore do not appear on this list.

Scientific Names	Common Names	Decrease	"No Change"	Increase
Alternanthera philoxeroides	alligator weed			●
Brasenia schreberi	watershield	●	●	
Cabomba caroliniana	fanwort	●		
Callitriche spp.	water starwort	●	●	●
Ceratophyllum demersum	coontail	●	●	●
Chara spp.	muskgrass/chara		●	●
Egeria densa	egeria/Brazilian waterweed/Brazilian elodea	●		
Eichhornia crassipes	water hyacinth	●	●	●
Elatine spp.	waterworts	●	●	

Table 1. continued

Scientific Names	Common Names	Decrease	"No Change"	Increase
Eleocharis acicularis	needle spikerush	●		
Eleocharis spp.	spikerushes	●	●	●
Elodea Canadensis	elodea/Canadian waterweed	●	●	●
Elodea spp.	waterweeds	●		
Glyceria borealis	small floating mannagrass			●
Gratiola neglecta	clammy-hedge hyssop		●	●
Hydrilla verticillata	hydrilla		●	●
Isoetes lacustris	lake quillwort	●		
Juncus spp.	rushes		●	●
Leersia oryzoides	rice cutgrass			●
Lemna minor	duckweed/common duckweed		●	●
Lobelia dortmanna	water lobelia/Dortmann's cardinal flower	●		
Lythrum salicaria	purple loosestrife		●	●
Megalodonta beckii	water marigold/Beck's water marigold			●
Myriophyllum alterniflorum	alternate-leaved watermilfoil	●		
Myriophyllum aquaticum	parrotfeather/parrotfeather watermilfoil	●	●	
Myriophyllum heterophyllum	variable-leaf water-milfoil/two-leaf watermilfoil	●		
Myriophyllum sibiricum	short-spike water-milfoil/northern watermilfoil	●		
Myriophyllum verticillatum	whorled watermilfoil	●		
Najas flexilis	slender naiad/nodding waternymph		●	●
Najas guadalupensis	southern naiad/southern waternymph	●	●	
Najas minor	brittle naiad/brittle waternymph			●
Nelumbo lutea	American lotus		●	
Nelumbo nucifera	sacred lotus		●	
Nitella spp.	stonewort/nitella		●	●
Nuphar advena	spatterdock/cow lily/yellow pond lily	●	●	
Nuphar variegata	varigated yellow pond lily	●	●	
Nymphaea odorata	American white water lily/fragrant water lily	●	●	
Nymphoides cordata	little floating heart		●	●
Nymphoides peltata	yellow floating heart		●	●
Persicaria amphibium	water smartweed/water knotweed		●	●
Phragmites australis	common reed			●
Potamogeton amplifolius	big-leaf pondweed/large-leaf pondweed	●	●	●
Potamogeton crispus	curly-leaf pondweed/curly pondweed	●	●	
Potamogeton diversifolius	water-thread pondweed/diverse-leaf pondweed			●
Potamogeton epihydrus	ribbon-leaf pondweed		●	●
Potamogeton foliosus	leafy pondweed		●	●
Potamogeton gramineus	variable-leaf pondweed/grass-leaf pondweed		●	●
Potamogeton natans	floating pondweed/broad-leaf pondweed	●	●	●
Potamogeton nodosus	long-leaf pondweed		●	
Potamogeton pusillus	small pondweed		●	●
Potamogeton Richardsonii	Richardson's pondweed		●	●
Potamogeton Robbinsii	Robbins' pondweed	●	●	
Potamogeton zosteriformis	flat-stem pondweed		●	●
Ranunculus trichophyllus	thread-leaf crowfoot	●	●	●
Sagittaria graminea	grass-leaf arrowhead/grassy arrowhead	●	●	
Sagittaria latifolia	broad-leaf arrowhead/common arrowhead/duck potato		●	●
Salix interior	sandbar willow			●
Schoenoplectus americanus	chairmaker's bulrush/three square bulrush			●
Schoenoplectus californicus	California bulrush/southern bulrush	●		
Schoenoplectus lacustris	lakeshore bulrush/common clubrush			●
Schoenoplectus tabernaemontani	softstem bulrush			●
Scirpus cyperinus	woolgrass			●
Sium suave	hemloch waterparsnip			●
Sparganium angustifolium	narrow-leaf bur-reed		●	●
Sparganium emersum	European bur-reed/unbranched bur-reed	●	●	
Sparganium hyperboreum	northern bur-reed		●	●
Sparganium natans	small bur-reed	●	●	
Spirodela polyrhiza	giant duckweed/greater duckweed	●		

Table 1. continued next page

Table 1. continued

Scientific Names	Common Names	Decrease	"No Change"	Increase
Stuckenia pectinata	**sago pondweed**		●	●
Trapa natans	**water chestnut**		●	
Typha latifolia	**broadleaf cattail/common cattail**		●	●
Utricularia spp.	**bladderworts**	●	●	
Utricularia vulgaris	**common bladderwort/greater bladderwort**	●		
Vallisneria Americana	**water celery/American eelgrass**	●	●	●
Wolffia columbiana	**watermeal/Columbian watermeal**		●	

Modified from:

Cooke, G. D., E. B. Welch, S. A. Peterson, and S. A. Nichols. 2005. *Restoration and Management of Lakes and Reservoirs*, 3rd Edition. Taylor and Francis, Boca Raton, FL.

Wagner, K. 2020. *Current Knowledge of Drawdown Relevant to Projects in Massachusetts* [White Paper]. Supplement to Mattson et al. 2004. Water Resource Services.

Mattson, M. D., P. J. Godfrey, R. A. Barletta, and A. Aiello. 2004. *Eutrophication and Aquatic Plant Management in Massachusetts. Final Generic Environmental Report*. Edited by K. J. Wagner. Department of Environmental Protection and Department of Conservation and Recreation, EOEA Commonwealth of Massachusetts.

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