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Water Level Manipulation: A Tool For Aquatic Weed Control

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INTRODUCTION

Louisiana has 6.4 million acres of fresh water wetlands with 1.5 million acres in lakes and reservoirs over 1.0 square mile in size (12). The fresh water to land ratio is 1:12 on a statewide basis. There are at least 40 reservoirs 1,000 to 32,000 acres in size excluding Toledo Bend, a joint Louisiana-Texas reservoir of 180,000 acres on the Sabine River. These reservoirs average in depth from 4 to 8 ft (12).

Carver (1) said, "Louisiana's streams are the target of several agencies which propose "work of improvement" for flood control, water storage, and navigation. Approximately 64 new reservoirs on Louisiana streams are planned for construction in the future. The Soil Conservation Service, acting under the authority of PL-566 has watershed projects under construction or in planning stages for most of the major watersheds in the State." With 1.5 million acres presently in lakes and reservoirs over 1.0 square mile in size and 64 new reservoirs in the planning stage, it becomes obvious the importance these waterways have in Louisiana's economy. The shallow water depth of these areas and long growing seasons in Louisiana are conducive to lush growths of aquatic vegetation.

The following information has been garnered from field experience and general observations in managing Louisiana's reservoirs where water level manipulation is an accepted tool for fishery management and aquatic weed control.

PLANT PROBLEMS

Louisiana has a severe aquatic weed problem, primarily submersed and emersed species, in 35 of its reservoirs. Twenty-five reservoirs have management plans designed for improvement of the fisheries, lake renovation, and control of aquatic weeds. Aquatic weed problems in our natural lakes are generally minor, however there are some exceptions. These exceptions are usually traceable to a man-made barrier which tends to stabilize the water body.

Due to the severity of the aquatic weed problems in Louisiana's reservoirs, some type of control practice has been and is being demanded by the public. Practical experiences have shown chemical control not feasible on a statewide basis due to cost and possible effects of annual total water treatments on the aquatic ecosystem; mechanical harvesting has proven to be too expensive and only at best a temporary control which tends to spread the infestation due to the species of aquatics present (most of our problem species spread by fragmentation) (2).

There is an old Limonological idiom that "a lake is born to die." Natural history has shown this to be true, but there are ways to retard the death of a lake as well as to speed the process. Water level stabilization of a natural fluctuation basin tends to speed the ageing process (3).

Nature has for millions of years used a tool for lake management and restoration that until recent years man has ignored—water level manipulation. Man has observed the unstable water levels of nature in natural lakes but has sought water level stabilization in man-made lakes.

WATER LEVEL MANIPULATION

Reservoir management in Louisiana is primarily carried out by water level manipulations. We try to create artificial conditions similar to nature's way of control before man interfered with natural controls. Although scientists have long recognized the beneficial effects that accompany water level changes, only recently have they begun to employ it as a regulatory tool in aquatic plant management, fisheries management, and lake renovation (13).

Well planned water level manipulation has been used to benefit the fisheries in the following ways: increasing total poundage of the standing crop for a period of 3 to 6 years (8), shifting species composition to a more desirable one (5), creating conditions conducive to successful spawning of desirable fishes (especially bass (*Micropterus salmoides* Rafinesque), and crappie (*Pomoxis nigromaculatus* Lesueur) and stimulating the fish to bite (8).

Physical improvement of the water and lake basin is accomplished by: removing nutrient laden water from the bottom during thermal and chemical stratification of the reservoirs by flushing action (6,7,11,14); increasing decomposition of litter buildup on the bottom; allowing decomposition of stumps to drawdown level; snagging and clearing operations; affording an opportunity for bank improvement; checking and maintaining dam and control structures; repairing docks and boat ramps; removing logs that have been stranded on shore; and constructing fish concentration points, especially for bluegill (*Lepomis macrochirus* Rafinesque) and crappie.

Water drawdown and the resulting combination of drying and freezing usually gives effective partial control of submersed and emersed plants. Other types of water level manipulation have been used for control of other aquatics in Louisiana.

Water level manipulation is not an exact science and has to be utilized with caution. Sufficient information for precise management is not available. Basically what we are trying to accomplish is an environment whereby the problem plants cannot survive. Probably the most important aspect is the amount of stress placed on the target plants. The best time to stress the plant is after the roots have utilized their stored energy and just before the plant restores a reserve of energy back into the root system (9).

To be effective, water level manipulation must be carefully planned. It must not be forgotten that each body of water is an entity in itself. Generalizations, even in the same watershed, may not hold true. It is very evident that different weed species react differently in response to manipulation.

Prior consideration of the adverse aspects of a water level manipulation program can help in future management. Many areas will be unaccessible except to only a few who are sturdy of faith and physically capable of overcoming mud, logs, and other restricting barriers. Depending on conditions, waterfowling can be either adversely affected or improved (13). First and second year drawdowns can increase waterhyacinth (*Eichhornia crassipes* (Mart.) Solms) infestations and any fluctuation can increase a submersed or emersed infestation.

Conditions causing low dissolved oxygen should be carefully monitored. We have caused a lake to turnover during drawdown operations. If the dissolved oxygen is not sufficient to safely mix with the strata of low or no dissolved oxygen, conditions that can cause a fish kill may develop. Fish usually move out of shallow areas when the lake level begins dropping; however, in some rare instances fish have been stranded and subsequently killed in holes and puddles. These fish kills have not significantly affected the total fish population.

In changing from a stable to an unstable environment, conditions favorable for the establishment of other plants will be created. Frequent checks should be made for the encroachment of undesirable plants. Two particular plants which we have had problems with are button bush (*Cephalanthus occidentalis* L.) and cypress (*Taxodium distichum* Pinaceae).

A special effort needs to be made to inform the public as to what is going to be done on a lake and why it is being done. A certain amount of adverse public reaction can be expected. In turn the management for the future can be adversely affected for minor or individualistic reasons. If local public sentiment is against the management plan, political involvement can usually be expected.

DRAWDOWN

Water drawdown for control of submersed and emersed aquatic weeds is the only feasible method of control at present in Louisiana's public waters. In a water drawdown we normally recommend a 40 to 70% reduction in surface acreage with 3 to 4 inches of water being removed each 24 hr. The most important factors governing success of water level drawdown are proper timing and extent of drawdown. The many variables of nature must be taken into consideration in drawdown reservoir management planning. The degree of success and length of drawdown time necessary for satisfactory results are determined by temperature, rainfall, and target species for control. The success or failure of a drawdown program can also be greatly affected by time and degree which the lake refills. We normally expect 50 to 95% control of target species in 2 to 3 years.

Varying degrees of control on submersed and emersed vegetation have been maintained on most reservoirs under drawdown management. Generally speaking, fall-winter drawdowns have given us best broad-range control of floating, emersed, and submersed plants in Louisiana. However, the timing should be determined by the target plants creating the problems.

The first recorded water level manipulation in a Louisiana reservoir specifically for aquatic weed control was in 1945. Chicot Lake a 2,000-acre reservoir was "drawndown" over winter. Excellent control was recorded for fanwort (*Cabomba caroliniana* Gray) and watershield (*Brasenia schreberi* Gmelin), but American lotus (*Nelumbo lutea* (Willd.) Pers) was not controlled (4).

"Drawdown" is not a one shot treatment. It will probably have to be carried out on an annual basis in order to maintain control. Chicot Lake has been drawn down annually from 1945 to 1960. Repairs and improvements were made on the basin between 1961 to 1964 and it has been drawn down annually since 1964. Anacoco Lake in Southwest Louisiana has been drawn down annually since 1961 to 1971. Lake Bistineau, Northeast Louisiana was drawndown from 1966 to 1971.

DRAWDOWNS AND WATERHYACINTH

Waterhyacinth infestations in Louisiana waters are under maintenance control, except in the Atchafalaya Basin and a few isolated areas in South Louisiana. Maintenance control in the lakes and reservoirs is hampered by what we call "nursery areas." These are areas where shallow water and dense stands of timber prohibit ground spraying (inaccessible) and aerial applications (thick foliage and possible timber damage from herbicides).

Under certain conditions of drying and freezing during water drawdown, we have obtained excellent control of waterhyacinths in the "nursery areas." In some instances where large floating mats (several hundred acres) were present, the area was dewatered, and after drying, the mats were effectively controlled by burning. Herbicide application of (2,4-dichlorophenoxy)acetic acid (2,4-D) on large mats are effective, but if the mat has formed a floaton, sinkage might not occur. The floaton usually decreases in size temporarily after herbicide application but is regenerated by seed germination and reproduction of daughter plants from a few plants that were not killed. Dewatering the floaton area results in a faster decomposition of the floaton, and after drying, it can be reduced to ash by burning.

Combination of drying and freezing temperatures have been necessary to obtain effective control of stranded waterhyacinths. Those plants which are in as little as one inch of water have not been controlled by short freezing periods. Drying alone has resulted in partial control, however, the combination of drying and freezing is by far a more effective tool than either alone.

It must be remembered that one of the preliminary requirements of seed germination of waterhyacinths is drying (10); therefore, by dewatering the littoral zone, we are enhancing the probability of seed germination. This has happened in some of our drawdown operations. Seed germination, the first year following drawdown operations, can cause the waterhyacinths to be replaced or even exceed the extent of the previous infestation. Usually after 1 or 2 years, the reduction in viable seeds is sufficient to reduce the probability of massive numbers of seeds germinating.

LAMMINAR FLOW

Bayou DeSiard, a 22-mile long bayou which is the potable water supply for the City of Monroe (Ouchita Parish) had a severe infestation of duckweeds (*Lemna, Azolla,* and *Wolffia*). Chemical control was considered, however chemicals available for use in potable water would not control the problem plants. Mechanical control would have been only partially effective. Water level manipulation offered the best potential control method. By using three control structures located at different points on the bayou, a top lamminar flow was created which skimmed the plants from the water surface and deposited them out of the bayou. A problem which had existed for 3 to 4 years was effectively brought under control in 1 year.

INCREASED WATER LEVEL

Floating mats of alligator weed (*Alternanthera philoxeroides* (Mart.) Grisb.) were restricting use of Lake Lac A Nardia located on the batture between the Mississippi River and the levee. The area annually received back water overflow from the Mississippi River. Boats were moved into the lake during an overflow period (water 10 ft above normal pool), and the mats were pushed into a pocket cove and an open field which we knew would be dry during no overflows. The alligator weed in Lac A Nardia was brought under control, and subsequent herbicide applications in the lake have maintained desirable control.

An unexpected side benefit was derived from the operation. The alligator weed rooted and became terrestrial, and our plans were to use herbicides on these rooted plants; however, the area has a high population of white tail deer (*Odocoleus virginianus macrourus* Rafinesque), and these deer utilized the plant to such an extent as to render it no longer a problem. Limited amounts of terrestrial alligator weed are still present on the area; however, it is part of the terrestrial plant system and is a valuable browse for the deer.

It has not been the job of the Louisiana Wildlife and Fisheries to carry on purely scientific investigations of the biology of aquatic weeds. We do realize the basic importance of such investigations but have by necessity been compelled to conduct a practical program, the objective of which has been to provide practical procedures in controlling and where possible eliminating problem plants.

The generalistic biological effects of water level manipulation are basically understood. The specifics of each individual plant species' actions and interactions with other species in stable and unstable impoundments must be understood if we are to make water level manipulation a more exacting tool for management.

I think it is evident from the information herein that documented scientific research is needed in conjunction with this important tool in aquatic weed control. We have recently begun such a project and are trying to measure and establish numerical values for the various parameters.

Looking at the future of aquatic weed control in Louisiana, it becomes obvious that no one tool or technique alone will be totally effective. Integrated management, i.e. water level manipulation, herbicides and biological agents, offers the solution to our problems.

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Water Level Fluctuation And Herbicide Application: An Integrated Control Method For Hydrilla In A Louisiana Reservoir

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ABSTRACT

Water level fluctuation of Sibley Lake in 1973-74 was very effective in controlling all serious aquatic weeds. An integrated control method combining water level fluctuation and herbicide application effectively reduced the hydrilla (*Hydrilla verticillata* Royle) population by 100%. The severe egeria (*Egeria densa* Planch.) problem in the remainder of the lake was reduced by more than 99% using water fluctuation. The rapid refilling and moderate turbidity levels placed additional stress on remaining plants, thereby increasing the degree of control. Results of this project indicate that an integrated method of water fluctuation and herbicide application can effectively control hydrilla in a Louisiana reservoir.

INTRODUCTION

Hydrilla was first discovered in the United States near Miami, Florida in 1960 (2). It has since dispersed over the entire state and into Georgia and Alabama. Hydrilla is found in canals, ditches, pools, lakes, marshes, slow streams, rivers, tidal water areas, and particularly in calcareous sites (7). It grows to depths of 6 to 7 m and commonly produces mats of vegetation so dense that birds and small animals can walk over them (2).

In July 1973, researchers working with a University of Southwestern Louisiana aquatic plant research team brought in samples of what was thought to be egeria. The samples were collected from Spanish Lake, a 502-ha impoundment located near New Iberia, Louisiana. University botanists soon identified the plant as hydrilla. This was the first positive identification of hydrilla in Louisiana.

Specimens of hydrilla were collected from Sibley Lake in Natchitoches, Louisiana by graduate students from Northwestern State University in January 1973. The absence of necessary taxonomic characters, particularly flowers or turions, prevented positive identification until August 1973.

Additional hydrilla infestations were discovered in June 1974, in Lake Theriot and Bayou Terrebonne in southeast Louisiana. Figure 1 depicts known hydrilla infestations in Louisiana.