BIOLOGICAL CONTROLS FOR WATERWEEDS

Roy A. Grizzell, Jr. and William W. Neely
Biologists, Soil Conservation Service
Little Rock, Ark. and Walterboro, S.C.

Many waterweeds and certain species of filamentous algae are of major concern to landowners who manage ponds for fish and wildlife. These plants are troublesome because they interfere with fishing, limit the better foods of fish and wild ducks, and cause unbalanced fish populations by providing hiding places for too many small fish.

Animals have been successfully used in other parts of the world to control waterweeds. Allsopp (1960) reports manatees successfully cleared weeds in a canal. Van der Lingen (1960) reported aquatic weeds controlled by Tilapia and by Pekin and Rouen ducks.

All farm ponds contain species of single-celled algae. The microscopic algae are desirable, but the stringy filamentous kinds are not.

Single-filament algae such as Spirogyra grow principally during the cool and colder seasons of the year. This type of algae presents no serious problem unless barnyard manure, hay, tree leaves, or other decaying organic matter is decomposing in the water (Davison, Lawrence and Compton, 1962).

The two more troublesome algae, Pithophora and Cladophora, have branched filaments. Their branched filaments are seen easily when viewed under magnification. When masses of these algae are squeezed dry, they form wads like wet cotton. Both grow principally in summer. Pithophora grows in fresh-water ponds. Cladophora competes with widgeongrass, Ruppia maritima, in brackish water duck ponds. There is no satisfactory chemical control for either.

Presented at 27th North American Wildlife and Natural Resources Conference, Denver, Colorado, March 12-14, 1962.

Pithophora

When Pithophora invades a pond, the water becomes clear because of competition with the phytoplankton for plant nutrients. Fertilization of the pond only hastens the growth. The algae forms a thick blanket across the pond bottom which interferes with bluegill feeding and fishing. Fish production may be reduced 50 percent. Masses of Pithophora also break loose and float to the surface, forming a heavy scum that makes fishing difficult. Even if suitable chemicals were available, treatment would be complicated by the summer stratification of water in the pond. Swingle (1957) reported the possibilities of biological control of Pithophora by means of the Israeli strain of mirror carp, Cyprinus carpio.

From 1957 to 1961 field trials were conducted in Georgia and Arkansas to determine the suitability of Israeli carp to control Pithophora in heavily infested ponds. With Swingle's cooperation, enough carp were obtained to stock the ponds reported here.

Israeli carp were stocked in infested ponds at rates of 55, 61, 64, 100, and 102 per acre. Fish used ranged in size from 2 inches to 14 inches. Periodic checks were made to determine growth rate of fish and the extent to which the algae had either increased or decreased. Table 1 shows the different stocking rates, the original, and final conditions.

Table 1. Stocking Rates, Size of Fish, Original and Final Condition of Algae

Pond	Size (Acres)	Stocking Rate per Acre	Size of Fish (Inches)	Date Original Condition	Date Condition at End of Field Trial
Stone Pond Warren County, Georgia	3	110	3 to 4	12-17-57 Bottom - 90% covered. Surface - 60% covered.	9-26-58 Bottom - No algae present. Surface - No algae present.
Israel Pond Calhoun County, Georgia	1	100	3 to 4	12-17-57 Bottom - 90% covered. Surface - 70% covered.	9-3-59 Bottom - 80% covered. Surface - 50% covered.
Weems Pond Whitfield County, Georgia	3	100	4 to 6	4-2-59 Bottom - 90% covered. Surface - 65% covered.	7-8-60 Bottom - 5% covered. Surface - 1% covered.
Lake Frances, Whitfield County, Georgia	1½	75 25	2 to 6 6 to 12	7-6-59 Bottom - 90% covered. Surface - 25% covered.	7-8-60 Bottom - 5% covered. Surface - 1% covered.
Fish Lake Farms, Jefferson County, Arkansas	Two 1/8 Acre Ponds	64	14	June 1960 Bottom - 100% covered. Surface - 85% covered.	July 1961 Bottom - No algae present. Surface - No algae present.
McGraw Canal, Lincoln County, Arkansas	3	46 15	2 to 4 8	1-28-60 Bottom - 80% covered. Surface - 70% covered.	7- -61 Bottom - No algae present. Surface - No algae present.
Lovett Canal, Lincoln County, Arkansas	3	40 15	5 8	1-28-60 Bottom - 85% covered. Surface - 65% covered.	7- -61 Bottom - 2% covered. Surface - 1% covered.

Good results in reducing or eliminating Pithophora were obtained in six of the seven field trials. The Israel pond had more branched algae than any other observed. The infestation was reduced by 50 percent at one time. Removal of the carp in the pond by fishing and natural losses apparently reduced the number of fish below that necessary to eliminate the algae.

All ponds, except those at Fish Lake Farms, contained other fish, principally largemouth bass, Micropterus salmoides, and bluegills, Lepomis macrochirus. Spawning of Israeli carp was not observed in ponds having bass-bluegill populations. A high percentage of loss of the carp was noted where 12 inch or larger bass were present and the carp stocked were less than 5 inches. In one pond the loss was 75 percent of the original stocking.

On the basis of our experience, we are now recommending a stocking of 5 to 6 inch Israeli carp at the rate of 50 per acre where Pithophora is a pest and bass are present. Where the infestation is especially heavy or fast reduction of the algae is desired more fish per acre will be recommended. Field observations indicate that the larger the fish the faster the reduction.

No recurrence of Pithophora was noted in the Stone Pond two years after it was drained and restocked with bass and bluegills.

Numerous observations were made of the carp actually eating the algae. Examination of 10 stomachs was made. Each stomach was full of algae. We conclude, therefore, that the principal reduction of the plant is by eating. Carp, in feeding along the bottom, also stir up enough sediment to reduce favorable growing conditions for the algae.

Cladophora

A good use for brackish marshes in coastal sections is to dike them into ponds and grow widgeongrass as food for wild ducks. However, some of these widgeongrass ponds become infested with Cladophora. This algae drapes the widgeongrass heavily, either smothering it out or making it unattractive to ducks. Floating masses of Cladophora may cover large portions of the ponds.

The Soil Conservation Service began field trials in 1955 in coastal South Carolina to determine (1) a method for controlling Cladophora and (2) the reason why Cladophora appears in some widgeongrass ponds and not in others, even when ponds are adjacent.

Brays Island Plantation provided a good location for beginning the trials. This plantation had three widgeongrass ponds which had not been bothered with Cladophora the first five years. Then suddenly, they became infested with this algae and were seldom used by ducks. Previously these ponds had good stands of widgeongrass, and were used heavily by wild ducks. Pond 1 ("House Pond") and Pond 2 ("Shop Pond") presented a sanitation problem because of the foul odor of decaying masses of Cladophora near the dwellings. Pond 1 was 27 acres, Pond 2 was 14 acres, and Pond 3 was 18 acres in size.

The first attempt to reduce or eliminate the algae was by drying. The ponds were drained the summer of 1955. They were refilled in early fall and a fair stand of widgeongrass developed before the open duck season, with little Cladophora. It was realized from the outset that this type of management could not be continued over a period of years without exhausting the residual supply of widgeongrass seed.

Drying only temporarily diminished the Cladophora and it was back as heavy as ever the next spring.

A lead on Cladophora control was suggested when the manager of Good Hope Plantation, Ridgeland, South Carolina, requested information on how to kill mullet, Mugil cephalus, in his widgeongrass ponds. He thought that the many large mullet in the ponds might be interfering with the growth of widgeongrass. These widgeongrass ponds were among the oldest in the State (built in 1931) and yet they had never had Cladophora. Could the mullet be the answer?

Queries at Brays Island Plantation revealed that the widgeongrass ponds there had mullet in them up to the year before the Cladophora appeared. An airplane spraying with DDT for mosquito control had killed all the mullet and other fish in the ponds.

Visits were made to several widgeongrass ponds with and without Cladophora infestations. By watching for the jumping and schooling of mullet near the surface, it is relatively easy to determine whether this fish is in a pond in any appreciable numbers. Mullet were detected in the ponds with little or no Cladophora. No mullet were seen in the infested ponds.

It then remained to demonstrate the control of Cladophora by mullet. For these trials, mullet were introduced into Brays Island Ponds 1 and 2 during June 1958 from brackish water creeks adjacent to the ponds via the connecting water control structures. Pond 3 was left without mullet as a control.

The ponds were examined two months later. Although there were many floating masses of Cladophora in the stocked ponds, the infestation

was less than in previous years. By November 1958, the Cladophora had almost disappeared. The previous November there had been almost complete coverage of the ponds with floating masses of algae. On February 12, 1959, no Cladophora was seen in Ponds 1 and 2 and they were being used regularly by wild ducks. The mullet were about 10 inches in length at that time.

The control pond (Pond 3) remained infested with Cladophora. It was, of course, a failure as a wild duck pond during the 1958-59 season.

Field observations and examination of stomach contents of mullet indicate that reduction of the algae is accomplished by eating. The number of mullet per acre required to control Cladophora is unknown. However, since fingerlings are naturally available in adjacent waters, most widgeongrass ponds can be stocked by manipulating the water to let in more mullet.

Duckweeds

The surface of some freshwater ponds becomes covered with duckweeds Lemna, Wolffia, and Spirodela which are detrimental to fish and fishing. These misnamed weeds are not important duck foods - except for wood ducks (Davison and Neely 1959).

Phytoplankton growth is seriously inhibited by the shading effect of these floating plants. Fertilization of such ponds only encourages further growth of the duckweeds.

Duckweeds usually grow in ponds that are in some way protected from prevailing winds. The protection may be from cliffs, embankments, trees, brush, or shrubs surrounding the pond; from large amounts of floating debris; or from submersed waterweeds. If these obstructions are removed, either in whole or in part, wind usually solves the problem

by blowing the duckweeds onto the shore where they die. Chemical and mechanical controls of duckweeds have not been generally successful.

Wild ducks occassionally eat duckweeds. We have no evidence that wild ducks have reduced or eliminated these tiny floating plants. Tame Muscovy ducks were observed eating duckweeds in Georgia in 1956. This species was therefore used in field trials to determine: (1) if reduction could be effected; (2) the number of ducks needed per acre; and (3) length of time necessary to eliminate the weed. Results of treatment are outlined in Table 2.

Table 2. Results of Muscovy Duck Trials to Control Duckweeds in Georgia

Pond	Ducks Stocked	Number	Percentage of Surface Orig. Covered by Duckweed	Percent Reduction of Duckweed and Date
Garvin, Bulloch County 3/4 Acre	June 1, 1958 June 20,1958 Aug. 15,1958	2 2 12 (ducklings)	90	100 April 14, 1959
Broxton, Coffee County 1 Acre	Sept.13,1956	6	85-90	100 August 9, 1957
Sellers, Jeff Davis County 1 Acre	July 19,1959 Sept. 1,1959 Sept.10,1959	3 14 10	95-100	100 October 1, 1959
Gin, Stewart County 3 Acres	Jan. 29,1959	8	95	60 April 8, 1960

Note that on the 3-acre Gin Pond, 8 ducks gave only partial control. As a result of these field trials, six or more Muscovy ducks per acre are recommended. The more per acre, the quicker the control. Other species of ducks have not been tried.

This technique works best on ponds located near human habitation, where predation is not serious. In all cases, to reduce losses from predation, it is recommended that a platform be erected over the water, with the top slightly above the normal water level. For several days after the ducks are placed on the pond, feed should be put on the platform so the ducks will learn to use it.

Submersed Waterweeds

Swingle and Smith (1947) demonstrated the practical eradication of submersed aquatic weeds by enveloping them with filamentous algae, produced by heavy applications of fertilizer in January and February. H. R. Bissland, Soil Conservation Service Biologist, (unpublished report) has shown that in the warmer waters of central Florida and southward, submersed pondweeds can be controlled by year-around fertilization. Cold-water overflow systems designed by the Soil Conservation Service now make both summer and winter fertilization more practical in control of weeds. The systems take cold water from the bottom of ponds and pass it through the dam and downstream, resulting in warmer water in the spring and fall. Controlling submersed vegetation by fertilization is not effective in ponds having extensive shallow water -- less than 18 inches in depth.

Summary

Two genera of algae often are serious problems in Southeastern ponds. Pithophora grows in freshwater fish ponds, and Cladophora in brackish-water duck ponds. No suitable chemical has been found to control either one.

Field trials in Georgia and Arkansas confirm research at Auburn, Alabama that it is practical to establish effective biological reduction of Pithophora in bass-bluegill ponds by using Israeli carp. It was necessary to stock with 5 to 6-inch fish, rather than smaller fingerlings, to prevent largemouth bass from depleting the stocking. Indications are that 50 carp per acre is sufficient.

Field trials in coastal South Carolina proved that Cladophora can be effectively controlled in widgeongrass duck ponds by introducing mullet. Stocking is accomplished by opening the control gates to take water into the ponds on high tides, at seasons when schools of fingerling mullet are observed in adjacent creeks. The fingerling mullet thus come in with the water. The rate of stocking is not known.

Duckweeds occur in farm ponds that are protected too well from wind and wave action. Chemical and mechanical control measures are but temporarily effective. It was found that six or more Muscovy ducks per acre will control duckweeds in ponds. A method of protecting these ducks from predation is described.

Adequate winter and summer fertilization will control submersed waterweeds in ponds not having extensive shallow edges.

LITERATURE CITED

Allsopp, W. H. L.
1960. The Manatee: Ecology, and Use for Weed Control. Nature. London, 188, No. 4752,762. (Fisheries Lab., Dep. Agric., P. O. Box 174, Georgetown, Br. Guiana).

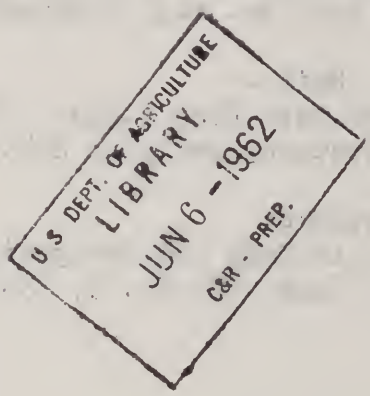
Davison, Verne E. and William W. Neely.
1959. Managing Farm Fields, Wetlands, and Waters for Wild Ducks in the South. U.S. Dept. Agri. Farmers' Bulletin No. 2144.

Davison, Verne E., J. M. Lawrence, and L. V. Compton.
1962. Waterweed Control on Farms and Ranches. U.S. Dept. Agri. Farmers' Bulletin No. 2181.

Swingle, H. S.
1957. Control of Pondweeds by the Use of Herbivorous Fishes. Proceedings 10th An. Mtg. Southern Weed Conf., pp 11-17.

Swingle, H. S. and E. V. Smith.
1947. Management of Farm Fish Ponds. A.P.I. Agricultural Experiment Station, Bulletin 254.

Van der Lingen, I. and others.
1960. Weed Control in Dams and Irrigation Channels. Rhodesia Ag. Jour. 57, No. 5, 353-8.


U S DEPT. OF AGRICULTURE
LIBRARY
JUN 6 - 1962
C&R - PREP.