



*Spraying from an air boat*

## Eradication of Water Chestnut

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**C**OMPLETE extermination of any pest is rarely attempted, because it is usually impossible. Thus most programs aimed at reducing aquatic plant pests are control programs, not eradication programs.

The water chestnut program in New York State is a noteworthy exception. This weed can and should be exterminated, for the uses of waters for recreation are too important to let dense beds of water chestnut interfere.

Some other plant pests have at least some redeeming features. The notorious hyacinth of the deep South has beautiful pink blossoms. The water chestnut is not handsome and its tiny whitish flowers are inconspicuous. Its thorny seeds can puncture a rubber boot. In the fall it turns brown and decays to add more black muck. From June to October it closes waterways with a dense green mat. The old saying, "An ounce of prevention is worth a pound of cure" may be an old chestnut, but is worth repeating again. The spread of this plant in the Mohawk and Hudson area has been a convincing demonstration that this can happen elsewhere.

The actual damage done by water chestnut in this State has been somewhat local but the rate of spread has been alarming and the threat to other waters is real. This is one reason for publicizing the problem and its possible solutions. As indicated in a preceding article (December-January, 1964-65)

by Dr. E. L. Cheatum, Assistant Commissioner, Division of Fish and Game, "highest priority goes to the protection and improvement of fish and wildlife habitat." As shown in that article more funds are allocated to management and development for fish and wildlife than for any other types of program.

Although the water chestnut program, carried on as a joint Federal Aid in Fish and Wildlife Restoration Project (75% D.-J. and P.-R. funds and 25% Conservation Fund) has been costing \$19,000 annually, this is justified by the remedial and preventive work to the aquatic habitat. An evaluation of the annual benefits to fish and wildlife resources of the Mohawk-Hudson area by the elimination of this weed was made by the U.S. Fish and Wildlife Service in 1951, benefits being estimated at \$51,600!

So far the Division of Fish and Game has been the spearhead of the attack to reduce and eventually eliminate water chestnut. Many areas have been cleared up or reduced to where eradication is a matter of only a few more years of continued work. It has been evident that the program, although justified from long-term benefits to the angler, commercial fisherman and duck hunter — is of much wider benefit to other people. Many owners of water front property are damaged when water chestnut closes in so as to prevent use of their boat docks, bathers are discouraged from using

beaches where the thorny seeds of water chestnut are likely to inflict painful injuries and the unsightly decay of countless tons of water chestnut plants every fall adds to the black muck which has unfavorable but complex ecological effects. In many areas water chestnut seems to have created a type of aquatic slum where people do not care to go except perhaps to throw in some unwanted litter.

If we regard the whole problem of getting rid of water chestnut where it now is established and preventing its spread to other waters as merely a fish and game program we will likely fall short of the goal of getting the job done most rapidly and economically. It is the aim of the Division of Fish and Game to give you as much detail as practical about its programs, and this particular one merits considerable thought on your part as to what action you might take. Even if you are from another state you may some day be concerned about water chestnut, for this plant has become a nuisance in waters of several states including Maryland, Massachusetts and Vermont.

Water chestnut (*Trapa natans*) is a plant native to Asia. It is more properly known as water caltrop because the water chestnut of commerce, a familiar ingredient in many Chinese-style delicacies, is not the same thing. (The seeds of *Trapa* are edible but are more relished by muskrats than by people.)



Perhaps the first introduction of this plant in New York State, which was reportedly in 1884 at Collins Lake (near Scotia), was with the idea that it would be useful or ornamental. By 1934 the estimated infestation had grown to about 1,000 to 1,200 acres, mainly in the Mohawk River. By 1952 the Bureau of Game gave the estimated acreage including Mohawk, Hudson and widely scattered separate infestations as about 3,500 acres. The plant had by then reached as far north as Lake Champlain and as far west as Keuka Lake, one of the Finger Lakes.

The first strategy employed by the Bureau of Game (with Federal Aid Pittman-Robertson funds) was mowing with weed cutters, hand-pulling and use of 2, 4-D (ester formulation in fuel oil). In the years from 1949 to 1952, Ralph Smith of the Bureau of Game made a research study of the plant which demonstrated effective methods of eradication. In 1955 a small project was organized under the Bureau of Fish (with assistance of Federal Aid, Dingell-Johnson funds) with the primary objective of halting the spread. This included also some co-operative studies in which John H. Steenis of the U. S. Fish and Wildlife Service worked with us on tests of various chemicals. By 1959 progress in the use of better equipment and spray methods, was made against the large infestations in the Mohawk River and a joint D.-J.—P.-R. project was organized.

This plant is an annual which winters over as seed and anyone might assume that destroying it before seed is set would exterminate it. This is true but not on a basis of just one year, for the plant has an irregular germination, some seeds lying dormant for several years. In some areas where the river current evidently washes away the seeds during floods the plant can be exterminated in a year or two if the seed crop of nearby upstream beds can also be destroyed, but bays and sheltered backwaters where seeds are protected by mud frequently continue to sprout plants for as much as five years during annual destruction of new seed. Fortunately the seeds have no adaption for dispersal and drop locally or it might be impossible to eradicate this plant in a large body of water.

Success in eradication of water chestnut requires use of chemical and manual methods. After trying many herbicides and various formulations including water solutions, oil solutions, emulsions and 2, 4-D pellets, the most effective and economical method yet found is to spray the young plants with undiluted 2, 4-D

amine solution (4 pounds acid equivalent per gallon.) This is a special technique developed for this plant and does not work well on aquatic vegetation generally, which is fortunate, for in destroying water chestnut there would be no object in killing desirable other plants. Another good feature is that fish and other animal life are not affected. The herbicide method is used on large areas. Scattered plants are pulled by hand.

The use of 2, 4-D amine as a herbicide for killing water chestnut is an operation that is very tricky because of the many variables. This is not a direct poison but is a growth regulator. Minor amounts merely stimulate the growth and applying too much would be expensive. Absorption of the proper amount of 2, 4-D by the water chestnut plants causes abnormal growth which is fatal to young plants. A surface spray at rates of one to two gallons per acre of the undiluted herbicide under the proper conditions will kill them at costs (for herbicide alone) of about two to four dollars per acre.

Applying undiluted herbicide as a low pressure spray to the surface leaves of young plants hits them at a vulnerable time when the stored nutrients in the seed have been virtually exhausted in sending up a long shoot to reach the surface. The plant then needs its surface leaves for photosynthesis and growth which in a few weeks would enable it to send out many bushy root

leaves to draw nutrients from the water. Experience in spraying over a season shows that plants become far more resistant after they become older and readily regenerate new surface leaves.

The method of spraying young plants does not build up a high density of 2, 4-D in the water. The best and cheapest results are in shallow, enclosed bays where the effect of dissolved 2, 4-D near the surface is to steep the upper parts of the plant in the herbicide so that plants are frequently killed just by diffusion even when the tops are not hit at all. At the edge of the river channel or in other areas where fresh water sweeps away the dissolved 2, 4-D, effective kills necessitate drenching the leaves much more thoroughly. Tidal action in the many bays along the lower Hudson makes a difficult problem because of fluctuating water levels and the high rate of water change.

Spraying too early is not efficient, for many plants will come up later and spraying too late is to be avoided, if possible. The ideal spraying time is short, only a few weeks, so speed is essential. The use of air boats, one of 65 h.p. and several of the outboard type of up to 9 h.p. has proven invaluable in tackling the difficult job of spraying large acreages within a short working period.

Water chestnut sprayed with 2, 4-D responds in a very characteristic way. The center leaves do not unfold normal-



*Thorny seeds make a nasty puncture*





*A bed in Mohawk River at Crescent Bridge closes in on boat pier*

ly but become elongate in a tight roll extending vertically several inches above the water and causing the plant to flop on its side. The leaves continue to grow but develop very long petioles. As the nutrients become exhausted new leaves may be very tiny. In as little as three weeks the whole upper structure may decay and die. The submerged parts of the plant may persist longer but under ideal conditions will disappear. Conditions are, of course, not always ideal and a second spray may then be needed to effectively prevent a seed crop.

The specifications for a program of hand-pulling or mechanical methods are less rigid but require consideration. The plants can be pulled up when very young as they are then easy to handle. By about mid-August some seed will likely be ripe and dropping from the oldest plants when they are handled. The usual procedure is to check areas twice because there is usually some breakage in pulling plants and new leaves may regenerate. The best rule is to handle the first pulling before August 15th and check areas again several weeks after the initial job. Very late sprouts not reaching the surface before mid-September are probably harmless as they cannot mature seed before the first frost kills them. Late in the season just destroying the tops of plants may be effective, but early in the season the entire plant should be pulled up to prevent new growth. Usually plants are pulled by merely holding on to them, by hand or with a rake, and letting the boat supply the power.

The need for a complete eradication of water chestnut has already been mentioned. This means a thorough mop-up job, hunting down and destroying every plant and doing this until no more plants come up. In fact, it is not fully safe to stop then for in several instances seeds have germinated from

areas where extermination was apparently completed.

One preventive step taken in New York State was the enactment in 1949 of legislation (Section 183 of the Conservation Law) which provides: "No person shall plant, transport, transplant or traffic in plants of the water chestnut or the seeds or nuts thereof nor in any manner cause the spread or growth of such plants." This has probably done some good, but water chestnut has still continued to spread in a way not very well understood. Bait such as crayfish are sometimes packed in water plants obtained on the spot and there is some chance of spread by this method. Along waterways boats probably may carry a few plants.

There is a possibility that birds can transport seeds. Although the large, thorny seeds are not known to be commonly eaten by waterfowl, some seeds are small enough to be swallowed whole and have been reported from wood ducks. As long as there is any water chestnut growing in New York State there are problems, not only of local damage to aquatic resources but of possible spread. The plant has become established in several reservoirs and is not welcomed by water supply authorities.

Formerly the water chestnut eradication program has been carried out as a centralized project, but there are important advantages in developing a regional plan of operation on a state-wide basis. This has been done through co-operation of the Regional Supervisors of Fish and Game. Fortunately, water chestnut has not spread to all of the nine Department regions, but there is need for a state-wide vigilance to spot early infestations when they can be easily eradicated. The need for this was demonstrated by the location last summer of a new infestation scattered

over about 50 acres at the head of Sodus Bay on Lake Ontario. A few more years of growth might have resulted in a difficult eradication job there. It is not easy to find the first few inconspicuous rosettes of water chestnut but this can be done if enough people are interested to learn what the plants look like and to search for them.

The eradication of water chestnut is far from a routine operation. It is something like having a bull by the tail—if you let go you are in for trouble. Even when by continuous work an area of water chestnut has been reduced to scattered plants which seem harmless in June, a look at the same area in August will show large patches of seed-bearing plants which will in a few years close in again. The long period of mopping up operations which is necessary is troublesome and expensive.

Here is an opportunity for locally interested persons to help the operations move faster and more economically. The limited man power of a Departmental project has had and will continue to have difficulty in this type of mopping up operation over a large mileage of water front. Couldn't individuals along the water front or associations such as fish and game clubs, boating associations or others divide up the areas and each take care of local infestations? They can, and it is possible they will. There is food for thought here.

It should be pointed out that local individuals and groups have indeed taken a hand with good results. Collins Lake, in Scotia, for a long time covered with water chestnut, is now a recreational area. An excellent job of clearing out water chestnut was done by the village over a period of years. Mention should also be made of program set up at Stottville, on Stockport Creek, where the village has set up a plan to eradicate water chestnut after several years of spraying had been done by the Conservation Department.

Although the interests of anglers, duck hunters, swimmers, boat operators and owners of waterfront property have been damaged by the introduced water chestnut weed, it has not yet proven possible to get all these interests operating together. The situation really requires a wider interest state-wide in the program and co-operative action of locally interested persons with the Conservation Department's efforts. So far the burden of combatting this plant has been shouldered by the Division of Fish and Game (with the help of Federal Aid in Fish and Wildlife Restoration.) Progress has been made, but ways to move faster are to be desired.