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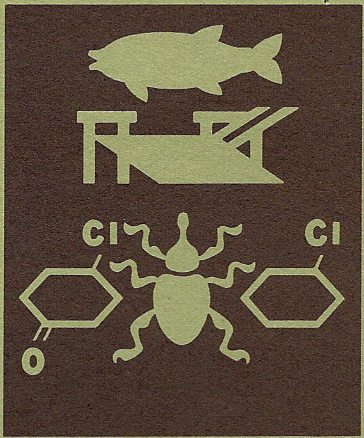

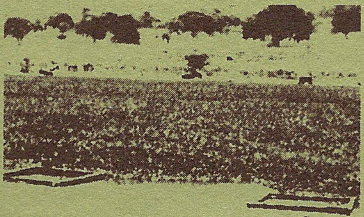

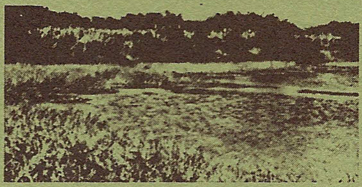

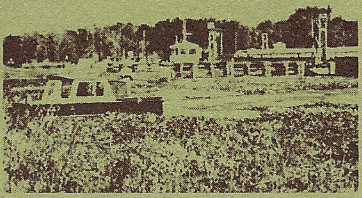

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AQUATIC PLANT CONTROL RESEARCH PROGRAM

Information Exchange Bulletin

EURASIAN WATERMILFOIL A GROWING PLANT MENACE IN NORTH AMERICA

BY DANA R. SANDERS, SR.

INTRODUCTION

Some species of aquatic plants have been a problem in the United States since the last quarter of the 19th century. Exotic species such as the waterhyacinth and alligatorweed began creating serious problems in the southeastern states by 1900. A more recent widespread aquatic plant problem occurring not only in the United States but also in Canada is Eurasian watermilfoil (Figure 1).

ORIGIN AND INTRODUCTION INTO NORTH AMERICA

Eurasian watermilfoil (*Myriophyllum spicatum* L.) was introduced into North America during the early part of the 19th century. It is native to Europe and western Asia, but has readily adapted and spread to cooler climates around the world in both hemispheres (Figure 2). In addition to Europe, Canada, and the United States, it has become a problem in southern Africa and Zambia.

In the United States, Eurasian watermilfoil was present in New Jersey lakes prior to 1900, in Chesapeake Bay in 1902, the Tennessee Valley Authority (TVA) system in 1960, Lake Seminole, Georgia, in 1962, Currituck Sound prior to 1967, Robert S. Kerr Reservoir, Oklahoma, in 1972, and more recently in Lake Washington in the city of Seattle, Washington. Every geographical region of the continental United States has some degree of infestation of Eurasian watermilfoil (Figure 3). It occurs in the Canadian province of British Columbia, where its inevitable southward spread further threatens the Columbia River system and irrigation projects of the western United States. Eurasian watermilfoil is sometimes confused with another species of milfoil, viz. *Myriophyllum exalbescens*, but with close examination of the foliage structure and flowers one can easily differentiate the two closely related species.

REPRODUCTION AND GROWTH

Eurasian watermilfoil produces viable seeds in almost all areas of its current distribution, and even though seeds retain viability after freezing, the seeds have not been observed in the natural environment. The most common known method of reproduction is from stem fragments that are carried by currents, boats, boat trailers, or, possibly, waterfowl from one area to another. The plant produces rhizomes and stolons, which serve as a source of plant tissue that overwinters and causes reinfestation unless they are completely removed or killed.

Figure 1. Morphology of Eurasian watermilfoil.

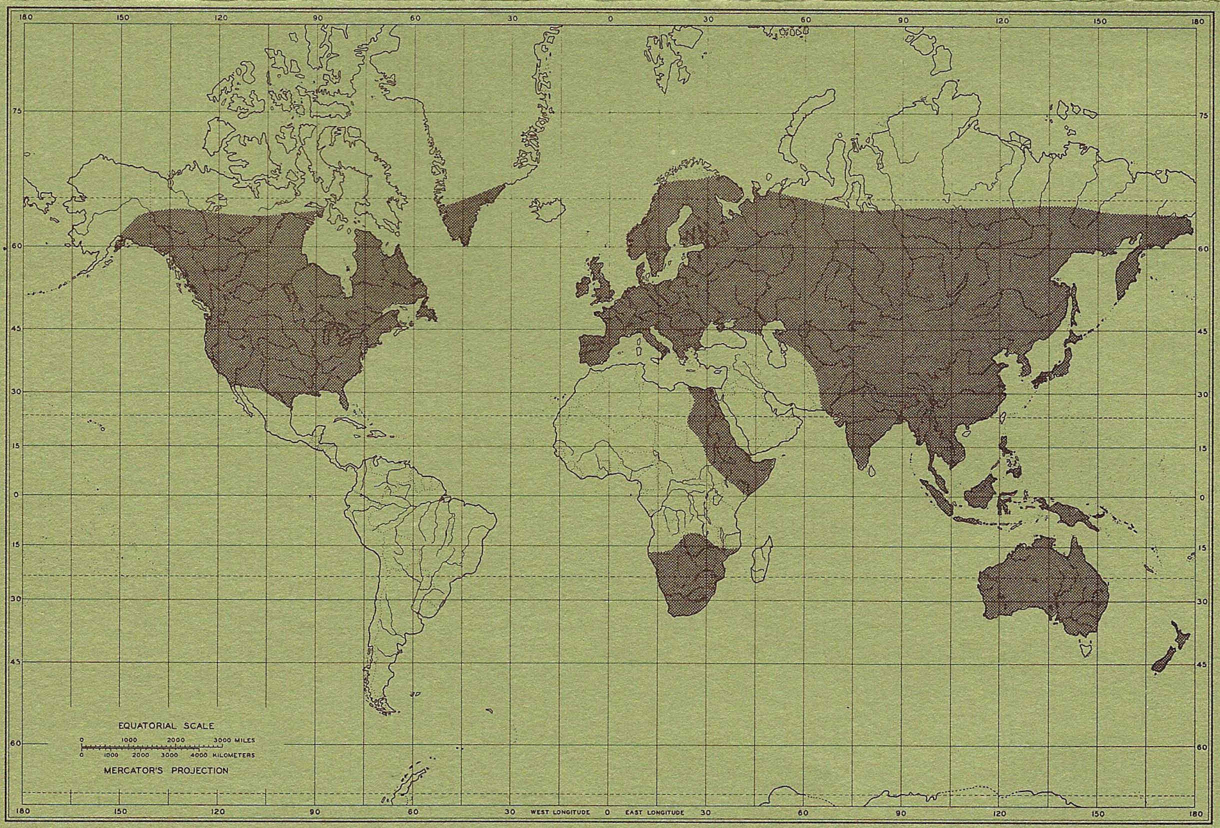

Figure 2. Worldwide distribution of Eurasian watermilfoil.

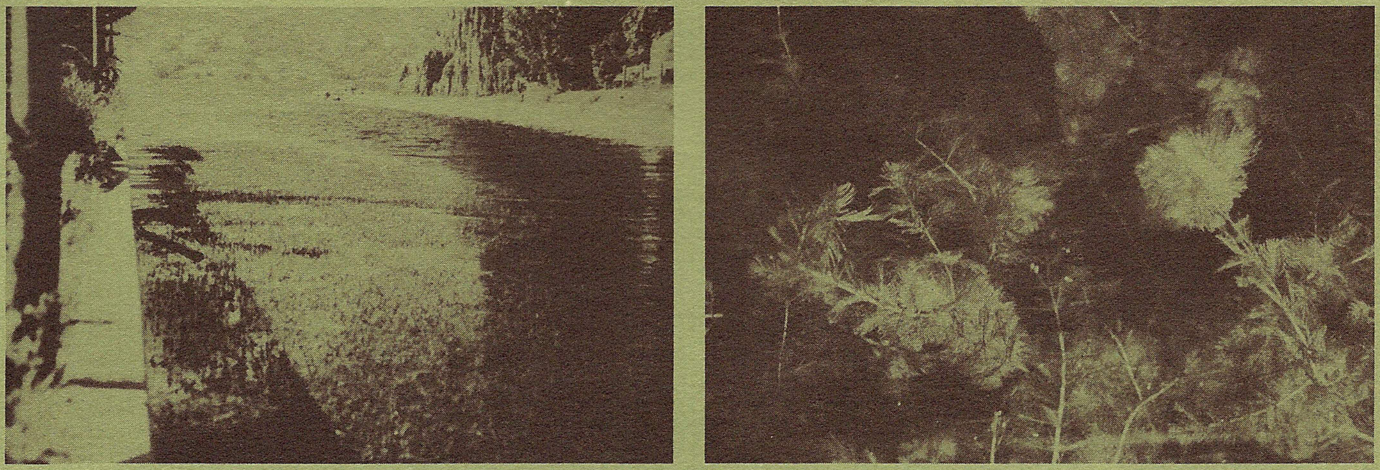

Figure 3. Infestation and closeup of Eurasian watermilfoil

Stem tips of Eurasian watermilfoil undergo a natural process known as autofragmentation. In this process, the tips break away from the main portion of the plant, float to another area, eventually lose buoyancy, and fall to the bottom where developing roots establish themselves in the hydrosoil. This process usually occurs in the spring or fall, but in some climates can occur continually throughout the year.

The surface area spread of Eurasian watermilfoil in a body of water is very rapid. In the TVA system, it spread from 2000 acres in two reservoirs in 1962 to 8000 acres in seven reservoirs in 1975 to 25,000 acres in eight reservoirs in 1979. In Lake Seminole the acreage increased from 1 acre to 800 acres in 15 years, and in the Robert S. Kerr Reservoir, it increased from 2 acres to 1200 acres in 6 years. At the peak of the Chesapeake Bay infestation, more than 200,000 acres of Eurasian watermilfoil were present, and an estimated 60,000 to 75,000 acres of the 98,000 acres of Currituck Sound are still infested.

Light penetration through the water column is a major factor that contributes to or limits the growth of watermilfoil in any particular body of water. In a relatively turbid body of water, the spread of this rooted plant will be restricted, but may occur to depths of 25 ft or more in the clearer waters of the Pacific Northwest. A second factor important in the distribution of this plant is salinity. While it can flourish in brackish waters (up to 15 parts per thousand salt content), growth becomes inhibited at higher salt concentrations. Calcium is a third factor necessary for the growth of Eurasian watermilfoil. In conditions containing less than 20 mg of calcium carbonate, it will not survive.

The Eurasian watermilfoil plant has a 90 to 95 percent water content, and it can produce more than one to two tons, dry weight, of vegetation per acre, most of which is found in the upper 2 to 3 ft of the water column, when the growth reaches the surface and produces the dense mat.

As Eurasian watermilfoil reaches problem proportions, fishing in shallow waters is usually the first activity denied to the water body user. Fishing becomes difficult to impossible. Fish populations can become stunted when excessive Eurasian watermilfoil growth occurs. Gradually, as the problem spreads, boat traffic to and from launching areas is restricted, and recreational activities, such as swimming and water skiing, are affected.

CONTROL

Because of the existence of Eurasian watermilfoil as a rapidly growing problem throughout a wide range of environmental conditions across the United States and Canada, many Federal, state, and local agencies are currently engaged in concerted efforts to reduce the problem. Some agencies, through research, are investigating new approaches for treating the problem, while other agencies are primarily engaged in operational control activities. Still other agencies, such as the U. S. Army Corps of Engineers, are actively involved in both types of activities. Regardless of the nature of these activities, control methods usually fit into one of four major categories: mechanical, biological, chemical, and environmental management.

Mechanical

At the present time, mechanical control is being used in many areas for the treatment of Eurasian watermilfoil. Several types of mechanical systems have been investigated, ranging from a modular system that, in effect, harvests the plant material to cutters and rototillers (Figure 4) that leave the destroyed material in the water. In some cases conventional dredges and draglines have also been employed to remove the plants. Various types of barriers and containment devices have been used to simply confine the plant in an attempt to reduce the overall rate of spread.

As with any control method, mechanical control has both advantages and disadvantages. Improperly applied, it can even contribute to the existing problem. Some of the advantages are that

- It provides immediate relief.
- No foreign substances are added to the aquatic ecosystem.
- Excess nutrients in the plant tissue are removed during harvesting operations.

Some of the disadvantages are that

- Generally, most systems have an overall low rate of removal, thus controlling large areas can be very time consuming.
- On a per-acre basis, costs can be high as $1000 for total harvesting operations.
- Fragmentation resulting from cutting can contribute to the spread of the problem.

The U. S. Army Corps of Engineers is currently conducting a major research program in an effort to solve the problems through the design of more efficient systems and their subsequent proper application.

Biological

Although initially expensive to research and develop, biological control agents require only minor operational expenditures once in use. Current Eurasian watermilfoil biological control efforts are being focused on the investigation of several insects, plant pathogens, and herbivorous fish that will control this problem species.

Insects are discovered as a result of searches conducted in the United States and abroad. Most problem aquatic plants are exotic species that are imported into the United States from their native habitats. In their native habitat these plants are not a problem due to the presence of natural enemies that keep them under control. Very seldom, if ever, do these natural enemies survive the importation to another country, and the plants then flourish, unchecked.

To date, two insects have been found on Eurasian watermilfoil in the United States and are currently under evaluation. These are a weevil that feeds on the flowers and above-water portions of the plant and a moth that feeds on the underwater leaves and stems of the plant.

Although searches are being conducted to find plant pathogens and disease organisms that would place an additional stress on watermilfoil growth, none have been found. A sudden decline in the growth of approximately 200,000 acres of watermilfoil in Chesapeake Bay was thought to be the result of one or more disease organisms. However, subsequent investigations failed to relate the effect to any known cause, including the identity of any disease organisms.

The white amur, a herbivorous fish, is presently being used in Arkansas and Florida for control of submersed aquatic plants. It appears that the white amur will be of importance as a control agent for Eurasian watermilfoil in the future. Some ongoing research will have to be completed, however, before it is widely available.

At the present time, there are no biological control agents available to the general public for control of Eurasian watermilfoil.

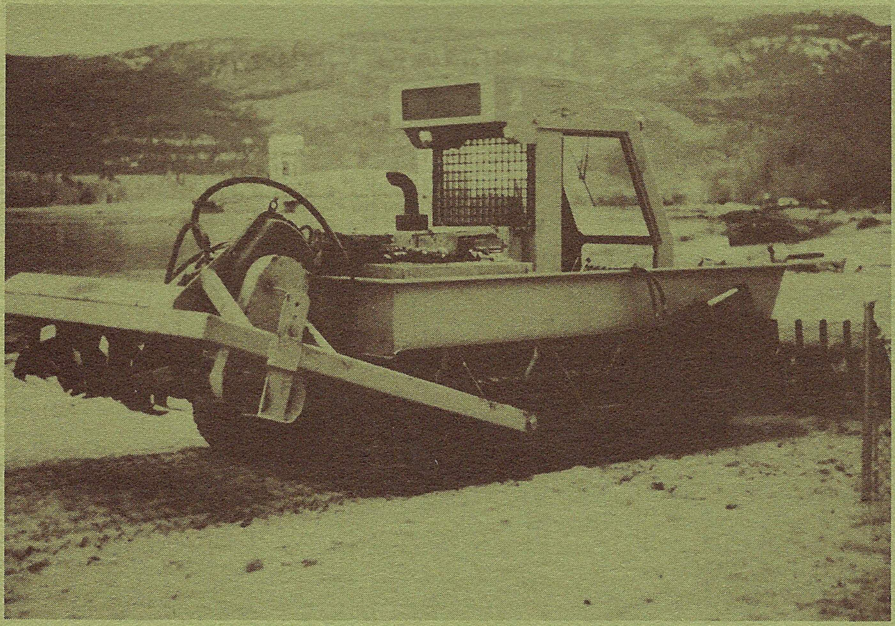

Figure 4. Rototiller used in mechanical control

Chemical

To date, the majority of control efforts for Eurasian watermilfoil have been through the use of chemical herbicides (Figure 5). Herbicide selection, proper application, and timing of application are all very important considerations in the use of herbicides. Federal and state laws govern the use of herbicides in aquatic systems.

Herbicides used for control of Eurasian watermilfoil generally cost $2 to $5 per pound. Depending upon the application technique employed, the depth of the water, and the herbicide used, the cost of treating a problem area can vary from $60 per acre (2 ft deep) to $250 per acre in deeper water for the chemicals only. Additional costs are incurred for manpower and equipment.

With the exception of a few problem areas that lend themselves to the use of mechanical control methods, the use of herbicides offers the only economical, predictable method of controlling Eurasian watermilfoil at the present time. Should the use of these herbicides be completely discontinued, Eurasian watermilfoil would continue to spread throughout the waterways of the United States at an even more rapid rate.

Environmental Management

Environmental management involves altering the aquatic environment in such a manner as to effect a desired level of aquatic plant control. Although several methods have been considered, only two methods, water level fluctuation and shading, appear to be feasible for operational level control of Eurasian watermilfoil.

Water level fluctuation, or drawdown, has been a common practice in fisheries management but has only recently been used specifically for aquatic plant control. The timing of water level fluctuation must be coordinated with other uses of the water body such as recreation, navigation, and power production. Where drawdown is a viable alternative, it should be used as a control method.

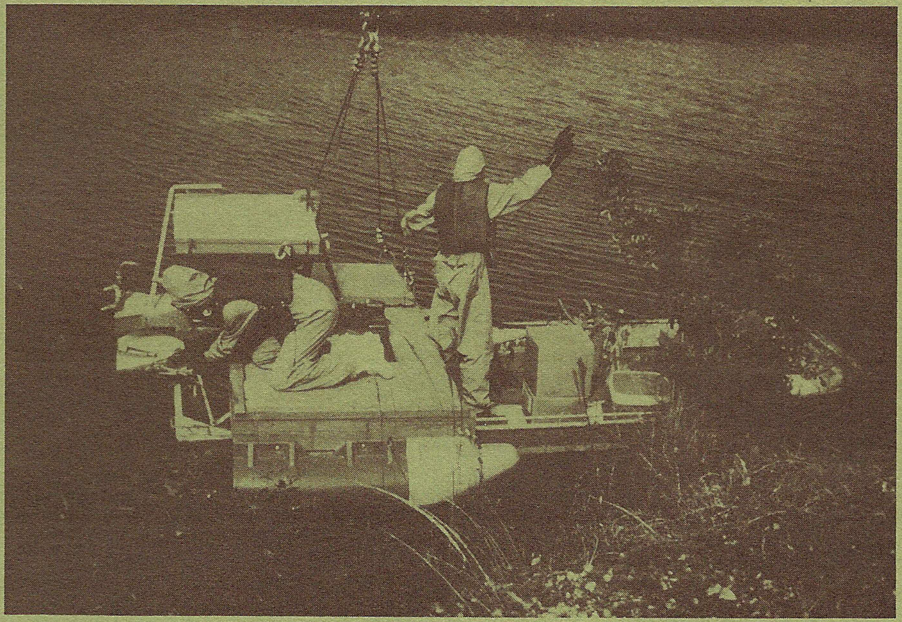

Figure 5. Boat used in applying granular chemical herbicide

A new fiberglass shading material has been developed that can be installed underwater on top of growths of Eurasian watermilfoil. This material restricts the available incoming light and inhibits the plant's growth. The exact effect in terms of degree of control and cost of application have not yet been determined; however, tests are presently under way.

Integrated Control

Integrated control of aquatic plants involves the use of two or more different methods at the same place and time.

An example would be the use of chemicals following an initial control effort using mechanical methods. Mechanical control methods are very costly, especially when attempts are made to cut and remove the plant material in deeper and deeper depths. The same holds true with chemical methods. It is known that for most submersed aquatic plants, approximately 85 to 90 percent of the plant biomass (weight) is concentrated in the upper 2 to 3 ft of the water column. This upper 2 to 3 ft can be harvested in a fairly economical manner, but the plants would regrow to the surface in just a few weeks. To prevent this regrowth, the remaining plant material could be treated with a herbicide. As only 10 to 15 percent of the original biomass remains, much less chemical could be used than if using chemicals alone. The overall effect of this combination would be more control for a longer time. This may be extended even further if the herbicide used is in a timed-release form.

Another example of an integrated approach is the use of drawdown techniques where the problem areas are exposed by lowering the water level, and the exposed areas are treated with herbicides to prevent regrowth after reflooding.

Both of these methods are continually being evaluated for control of other submersed problem plants; however, operational use of these techniques need not be delayed for completion of the tests.

ACKNOWLEDGEMENTS

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This bulletin is published in accordance with Army Regulation 310-2. It has been prepared and distributed as one of the information dissemination functions of the Environmental Laboratory of the Waterways Experiment Station. It is principally intended to be a forum whereby information pertaining to and resulting from the Corps of Engineers' nationwide Aquatic Plant Control Research Program (APCRP) can be rapidly and widely disseminated to Corps District and Division offices as well as other Federal agencies, State agencies, universities, research institutes, corporations, and individuals. Contributions are solicited and will be considered for publication so long as they are relevant to the management of aquatic plants as set forth in the objectives of the APCRP, which are, in general, to provide tools and techniques for the control of problem aquatic plant infestations in the Nation's waterways. These management methods must be effective, economical, and environmentally compatible. This bulletin will be issued on an irregular basis as dictated by the quantity and importance of information to be disseminated. Communications are welcomed and should be addressed to the Environmental Laboratory, ATTN: J. L. Decell, U. S. Army Engineer Waterways Experiment Station, P. O. Box 631, Vicksburg, Miss. 39180, or call 601-636-3111, Ext. 3494.

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