A Long Range Look At

AQUATIC PLANT MANAGEMENT

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THE MAGNITUDE and nature of the problem of troublesome aquatic plants in the United States is extensively documented and generally well known. There is no need to repeat this information; if no problem existed we would have no real reason to be here.

This presentation is a summation of my personal views and it is not to be construed as the official stand of the Waterways Experiment Station of the Corps of Engineers.

My purpose is to suggest that the problem is so large and so complex that there is no single solution to it, and that instead of a panacea, we need an arsenal. It has seemed to me that many of the people concerned with aquatic plant management, both research and operational types, have been guilty of tunnel vision; they have selected a small part of the puzzle, declared it to be *the* essential part, and worked on it without regard to its relation to the big picture. To be sure, it is essential that scientific specialization continues. But I believe it to be equally true that someone must attend to the whole mosaic, so that the tessera of special products may be fitted together. In effect, I am proposing the development of an integrated system for managing aquatic plants.

I prefer to think in terms of "aquatic plant management" rather than "aquatic weed control." It has become obvious that "the problem" is concerned with *managing* a complex system and not just *controlling* one facet of it. The term "management" is also more compatible with the thinking behind the new name for this Society. What we must have is a logical, but possibly rather complex, methodology by which the entire aquatic ecosystem is managed for the benefit of nature and a highly complex and changing society. The system will almost surely be multifaceted, consisting of an entire arsenal of techniques and hardware, any combination of which can be called upon for attacking a given problem.

The Situation

In past years when aquatic plants were just beginning to be problems in the nation's waterways, people responsible for their control thought in terms of total eradication. It has taken some years and considerable frustration to realize that any aquatic plant that is successful enough to become a national problem is here to stay. Why is this so? Because they almost all have very large ecological amplitudes, i.e. they flourish in a wide variety of situations. The water hyacinth, for example, grows in the tropics, subtropics, and temperate zones. It grows along exposed lake banks, under cypress trees, in shallow ditches, in large open reservoirs, in narrow canals and broad streams, in small shallow depressions with very little water, and, indeed, in wet soil where there is no standing water. It grows in coastal lagoons with saline water, in open sewers, and in pristine brooks, and on and on *ad infinitum.* I have even seen them grow in distilled water for a surprising length of time.

There are at least two major implications here. One is that the plants are now an integral part of

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**The author, botanist with the United States Army Engineer Waterways Experiment Station, Vicksburg, Miss., presented this article at the Hyacinth Control Society convention, July, 1974.*

the aquatic ecosystem and play an essential role in it. The fact that the plants now play an essential role in the biosystems suggests that in many places, we would not *want* to eradicate them, even if we could. Indeed, whether a plant is "good" or "bad" is entirely a matter of who is doing the defining. One land owner may like water hyacinths around his boat dock and another may not — in one case they are good and the other bad. Introduction of the human factor complicates the situation drastically. Each individual and group tends to see the aquatic plants in terms of its own viewpoint. The result is that landowners, environmental groups, fishermen, water skiers, the EPA, and so on, express the problem and the acceptable solution in different ways.

The second implication is that methods to control growth and proliferation must enable us to reach effectively into every nook and cranny of the aquatic world; into broad lakes, swift streams, drainage ditches, navigation canals, cypress swamps, reed marshes, and so on. Further, we must be able to reach into these places and kill or suppress the target plant, but *only* the target plant. A technique that kills water hyacinths in a drainage canal, but that also kills the soybeans in the fields alongside, is clearly unacceptable.

The situation, then, is a complex of factors about aquatic plants and about the nature of the problems they pose to society. From this, it is clear that an aquatic plant management capability must be one that can be applied with precision and selectivity. Each situation will dictate how precise and how selective each operation must be.

The Problem

The situation discussed above demonstrates that an effective aquatic plant management system must meet three general requirements.

First, the control method must be fitted to the situation. At first glance this often seems to be easy, but in practice, many subtleties intrude. For example, Blue Lake, Mississippi, is choked with alligatorweed, so let us introduce the Agasicles beetle to suppress the plants. But it turns out that there is a difficulty. The lake is surrounded by cotton fields, and the insecticides used to suppress the bollworm and bollweevil also eliminate the Agasicles. The cotton farmers are not going to lose their crop to save a few funny bugs on alligatorweed in a lake they mostly wish wasn't there to begin with. So let us spray the alligatorweed with a herbicide — but let's make sure that it doesn't drift over into the cotton fields — a practical impossibility. What is left? Perhaps a slow-release herbicide in the water. Perhaps mechanical harvesting. Perhaps a fungus that is immune to insecticides, but is specific to alligatorweed. Perhaps some combination of these.

In parts of Louisiana water hyacinths grow among the cypress trees, choke narrow and tortuous bayous, and cover the nearby open lakes in huge masses. Let us assume that the situation is such that herbicides may be safely sprayed on them. A rig mounted on an airboat is effective in open lakes and bayous, but how do we get the herbicide to the plants amid the closely spaced trees? Clearly another kind of operational platform is required. The point is that the control method must fit the geographical, ecological, and social situation, and it is utterly unrealistic to assume that one weapon will deal with all possible eventualities.

The second general requirement is that the control methods must be economical. To be sure, there is obviously a direct relation between the criticality of the problem and the amount of money that may be spent to eliminate the problem. Nevertheless, the lower the cost, the happier we all will be. Thus, a technically effective method may be ineffective in practice because no one is willing to foot the bill.

The scientific community is often guilty of forgetting the sordid fact that somebody has to pay for each operation. But we all sometimes forget that economics is not based on the same considerations in all places. Thus it is that a candidate control method may be tried in one situation and rejected because it is too costly. The method is then all too often automatically removed from consideration for other situations. And that may be a mistake. In the next county is a lake used for recreation; the people concerned with it might well be willing to pay a high price for a control method that would keep the water free without deleterious or undesirable side effects. But the method used in, for example, Lake Loiza, Puerto Rico, is rejected because it is "too expensive." We have thrown the baby out with the bath water.

The point is the cost is relative. Thus, it may be concluded that our arsenal of weapons can include systems that range widely in cost of operation.

The third general requirement is that control methods must be timely. A method, however effective at killing aquatic plants, that cannot be cranked up until after a boat in Jacksonville harbor has been swept from its mooring by a flood of water hyacinths is not really acceptable.

The argument here is that an effective and economical aquatic plant management system must incorporate procedures for applying the various plant-killing or plant-growth suppression methods at the optimum time and place. All too often the plant control agencies do not learn of the existence of a problem until a telephone call from a frantic citizen apprises them that the bridge to his house is about to be swept away by legions of water hyacinths. At this point in time, the population explosion has already occurred, so the control agency is faced with the prospect of dealing with the worst possible situation.

The nagging fact is that those legions were once upon a time only a handful of juvenile plants. If they could have been attacked at that time, the population explosion would not have occurred, and the crisis would never have arisen. And all of this might have been achieved by a couple of hours of effort and a few grams of herbicide, or a few gallons of fuel to run a mechanical harvester, or whatever. The difficulty is that there is no effective method of finding potential centers of population explosions or of monitoring the growth of populations. The result is that our control agencies are forced to await the onslaughts of the mature armies, instead of strangling the babies in their cradles. The latter would clearly be cheaper.

The point is that we need an effective intelligence service, so that our available arsenal of control methods can be deployed with maximum effort.

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Bill Rushing's concept of aquatic plant management involves a whole arsenal of control methods including (above) chemical application from an airboat, (top, right) mechanical harvesting and (bottom right) biological controls such as the herbivorous white amur.

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The Solution

This, of course, is a misnomer. Clearly, there is at this time no way of spelling out the details of an effective and economical aquatic plant management system. It is, however, possible to describe its general characteristics in qualitative terms. It is my hope that, by so doing, we will indentify gaps in the research programs that are being conducted, and at the same time provide a general framework into which existing work may be fitted. The effectiveness of too many potentially useful control methods is still too uncertain, so, at this time, we should not set priorities.

First, we need an arsenal of control methods. There are two segments to this need. Of primary importance is the need for the largest possible number of ways of affecting the plants themselves. Some obvious possibilities include:

Controlled-release herbicides — These look especially promising for situations in which water exchange is slow, such as in many canals and lakes.

Growth regulators—These offer the possibility of suppressing the formation of stolons on water hyacinths, for example.

Mechanical plant removal — All mechanical methods have proven to be very expensive, but there is mounting evidence that the costs could be dramatically reduced by careful engineering. And it should not be forgotten that there may be special situations in which only mechanical removal will be acceptable.

Biological agents — Much attention has been and is being devoted to these methods. But one wonders if enough imagination has been applied. Would it be possible to develop strains of fungii, bacteria, or viruses that would have useful properties, for example? Note that I did not say "find" them; I am proposing that we might be able to create them. Recent work on the development of the sterile monosex white amur hybrid is a case in point.

Radiation — While the experiments so far conducted suggest that the CO_2 laser is relatively ineffective, it should be remembered that only one wavelength has actually been tried. Perhaps among the infinity of others is a combination that will unzip the DNA molecule. The Navy has recently developed a method for creating very short-duration electromagnetic pulses of the order of 10 megawatts; one wonders what the effect on the highly complex molecules included in the plant's metabolic cycle might be.

As discussed earlier, a plant control method is useless if it cannot be brought to the plants. At the moment, our arsenal of platforms consists mainly of three kinds of vehicles: conventional boats, airboats, and helicopters. Each has advantages and disadvantages, and there are places where none can reach. In view of this, there may well be a place for air-cushion vehicles and Archimedes screw vehicles.

There is certainly a place for improved spray methods that are more effective, uniform, and controllable than some of the fire-hose methods that are often used today.

This raises the flag of economics. A lot of money is spent and will be spent on aquatic plant control. This suggests that there is a market for devices specifically engineered for aquatic plant control use. So let us devote more dedicated engineering effort to such mundane things as the configuration of spray nozzles, hull designs for boats, and so on.

Further, the comprehensive management system must include an information-gathering capability, so that the deployment of control resources can be optimized. Three things seem to be worthy of consideration:

Remote sensing — Could we develop a capability, perhaps using earth satellites or regularly scheduled high-altitude aircraft flights, for detecting aquatic plant populations at an early state of development — perhaps using automated identification techniques to keep down costs and improve response time?

Monitoring instruments — Could we place sensing instruments in critical places, and telemeter their responses to an operations center?

Growth prediction — Could we develop mathematical prediction methods that would tell us where and when a potentially dangerous population of aquatic plants will appear? We surely could, if we spent some effort on understanding the basic physiological processes of our target plants.

Finally, the management system must include a public information capability, so that the public can be informed both as to the nature and magnitude of the problems, and also as to the specific steps being taken to counter them.

Conclusion

I have only touched the surface of the multitude of areas we need to consider in the development of a long-range capability for operational management of aquatic plants. The crux of the whole matter is that the *entire* situation must be considered. When we consider the problem as a system, I think that we must conclude that we must develop a multifaceted arsenal of techniques and materials for aquatic plant management. □