3.2 Developing a Lake Management Plan

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Introduction

Invasive aquatic plants are a major problem for the management of water resources in the United States. Nonnative invasive species cause most of the nuisance problems in larger waterways and often produce widespread dense beds that obstruct navigation, recreation, fishing and swimming and interfere with hydropower generation. In addition, dense nuisance plants increase the likelihood of flooding and aid in the spread of insect-borne diseases. Invasive plants also reduce both water quality and property values for shoreline owners.

Invasive species have a negative impact on the ecological properties of the water resource. They may degrade water quality and reduce species diversity while suppressing the growth of desirable native plants. Invasive species may alter the predator/prey relationship between game fish and their forage base, which results in higher populations of small game fish. Invasive species may also change ecosystem services of water resources by altering nutrient cycling patterns and sedimentation rates and by increasing internal loading of nutrients.

The most troublesome invasive plants that cause problems in the United States and recommendations for managing them are discussed in Section 2 of this manual. These exotic weeds are most likely to cause the greatest concerns, but many other native and nonnative species can cause problems as well, particularly in small areas or in ponds.

Development of a management plan

Water resource managers need to have an aquatic plant management plan for long-term management, even in bodies of water that have not yet been invaded by these exotic species. An effective aquatic plant management plan should establish protocols to prevent the introduction of nuisance plants, provide an early detection and rapid response program for the waterbody so new introductions can be managed quickly at minimal cost and aid in identifying problems at an early stage. The plan should also assist in identifying resources and stakeholders so that coalitions can be built to aid in the management of problem species. The planning process should include information that is already available and identify gaps in knowledge where more information is needed. An effective management plan will help water resource managers communicate the need for management of invasive species and provide a rationale or approach for management. A comprehensive aquatic plant management plan should have eight components: prevention, problem assessment, project management, monitoring, education, management goals, site-specific management and evaluation.

Prevention

The focus of a prevention program is education and quarantine combined with proactive management of new infestations [early detection and rapid response (EDRR)]. Most invasive aquatic plants are introduced to a water body as a result of human activity and introductions most often occur when invasive plants are transported on boats, watercraft and boat trailers. Prevention activities can include signage at boat launches and marinas and other educational programs. Successful prevention programs utilize federal and state legislation, enforcement, educational programs in broadcast and print media and volunteer monitoring programs. An early detection and rapid response program should be employed in conjunction with prevention efforts to control new infestations at an early stage. Proactively controlling new infestations before they develop into large populations of exotic plants is both technically easier and less expensive, which results in major cost savings in the long run. The eradication of small populations is much more likely than eradication of large established populations. Early detection and rapid response is a critical component of an exotic species prevention program and is emphasized by federal agencies involved in invasive species management.

Problem assessment

Problem assessment should focus on identifying a problem in a given waterbody and collecting information about the problem. This information can then be used to formulate specific problem statements that define the cause of the problem. Problem assessment is the process of both acquiring objective information about the problem, such as maps and data on plant distribution, and identifying groups or stakeholders that should have input into formulating the problem statement. Problem assessments should also identify the causes of the problem and should increase the understanding of the water resource by reviewing information that is already available and highlighting areas where additional information is needed. A specific problem statement should be developed using the resources identified during problem assessment to aid in refining the concerns of users and the nature of the nuisance problem.

Project management

Project management is often a neglected aspect of managing invasive plants, particularly when volunteers manage the project. Successful projects are the result of good planning and management of assets, which include financial resources, partnerships, volunteers and other personnel. Detailed records of expenses must be maintained, particularly if the project is funded by government entities. In addition, a thorough evaluation of success of the program should include expenditures of both time and labor.

Monitoring

A monitoring program should include not only an assessment of the distribution of the target plant species, but also a program to monitor other biological communities (including desirable native plant communities) in the water body. Water quality parameters should be recorded on a regular basis to determine whether long-term changes have taken place in the water body and to assess whether management activities have had a positive or negative effect on other aspects of the water resource. Monitoring should also include baseline data collection (as outlined in the problem assessment section above), compliance monitoring involving a permit and assessments of management impacts to the environment at large. Successful monitoring programs often include a "citizen" monitoring component. For instance, citizen monitors have assessed water quality in many water bodies for several decades using techniques as simple as measuring water clarity using a Secchi disk (see page 2). The largest volunteer network in the US is The Secchi Dip-In (https://www.nalms.org/secchidipin/), though many states also have a statewide volunteer network (e.g., Florida LakeWatch; http://lakewatch.ifas.ufl.edu).

Education and outreach

Education and outreach should be initiated at the beginning of the program and should continue throughout the project. Education initially consists of familiarizing the project group with the problem and possible solutions, which helps to build a consensus regarding the solution. As the program progresses, education efforts should be extended to include the public (in addition to stakeholders in the lake association) and to inform them of the problem, possible solutions and what actions the program is taking to address the problem. It is important to provide as much information as possible to the public and to be forthright and open about management activities. A public web page devoted to the management program can be a very successful tool but the project group should utilize local media outlets, such as newspapers and radio, as well. Also, if your project is successful, share your success with others through homeowners associations, state environmental agencies or your local county cooperative extension service.

Plant information and methods

The development of a program to monitor invasive plants requires a list of invasive, nonnative, native, endangered and threatened plant species in the waterbody, maps marked with the locations of species of concern or species targeted for management, locations of nuisance growth and bathymetric maps. Quantitative plant data (sampling for plant distribution or abundance using a recognized sampling protocol) should be used for assessment, monitoring and evaluation as often as possible. Quantitative data are more desirable than qualitative data (subjective assessments such as "a big population" or "heavily infested") because:

- Quantitative data are objective and provide hard evidence regarding the distribution and abundance of plants, whereas subjective surveys are based on opinion rather than fact
- Quantitative data allow for rigorous statistical evaluation of plant trends in assessment, monitoring and evaluation
- Quantitative data and surveys may eliminate costly but ineffective techniques in a given management approach
- Quantitative data allow individuals other than the observer to evaluate the data and to develop their own conclusions based on assessment, monitoring and evaluation data

Plant quantification techniques vary in their purpose, scale and intensity (see table below). Cover techniques include both point and line intercept methods. These techniques yield the most information regarding species diversity and distribution and can reveal small changes in plant community composition. The best method for measuring plant abundance remains biomass measurement but this is time-intensive and usually reserved to evaluate the effectiveness of management activities. Hydroacoustic surveys measure submersed plant canopies while the plants are still underwater and are excellent for assessing the underwater distribution and abundance of submersed plants; however, this technique is unable to discriminate among species. Visual remote sensing techniques, whether from aircraft or satellite, have also been widely used to map topped-out submersed plants or floating and emergent plants.

Aquatic Plant Quantification Techniques

Technique	Information produced
Cover techniques: point intercept	Species composition and distribution (whole-lake)
Cover techniques: line intercept	Species composition and distribution (study plot)
Abundance techniques: biomass	Species composition and abundance
Hydroacoustic techniques: SAVEWS	Distribution and abundance (no discrimination among species)
Remote sensing: satellite, aircraft	Distribution (plants near the surface only, no discrimination among species)

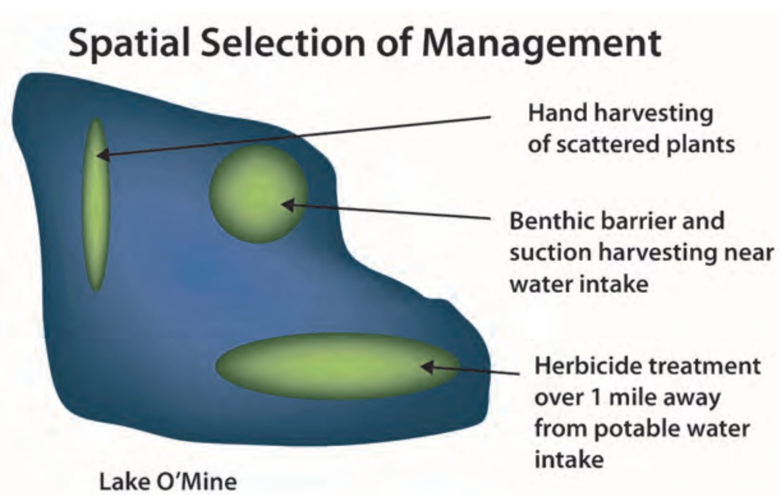
Management goals

Specific management goals that are reasonable and testable should be formulated as part of the management plan. This set of goals provides the milestones that can be used to determine whether the management program is successful. If specific management goals are not established, stakeholders may dispute whether management efforts have been successful since they may lack a clear understanding of the expectations of the management program (Section 3.1). Goals should be as specific as possible, including indicating areas that have a higher management priority.

Providing stakeholders with a specific set of goals will allow them to evaluate quantitative data to determine whether management goals have been met. For instance, if vegetation obstructs recreational use of the waterbody, a goal of “unobstructed navigation” is vague and may result in unending management. If, however, the goal is to maintain navigation channels in navigable condition 90% of the time, then the success of the management program can be measured, tested and compared to the specific goal. Once plant management goals are developed, methods to achieve the goals should be implemented using techniques that are acceptable to stakeholders and regulatory agencies based on environmental, economic and efficiency standards. Management techniques will vary based on conditions within the water body and frequently change over time; this is referred to as site-specific management.

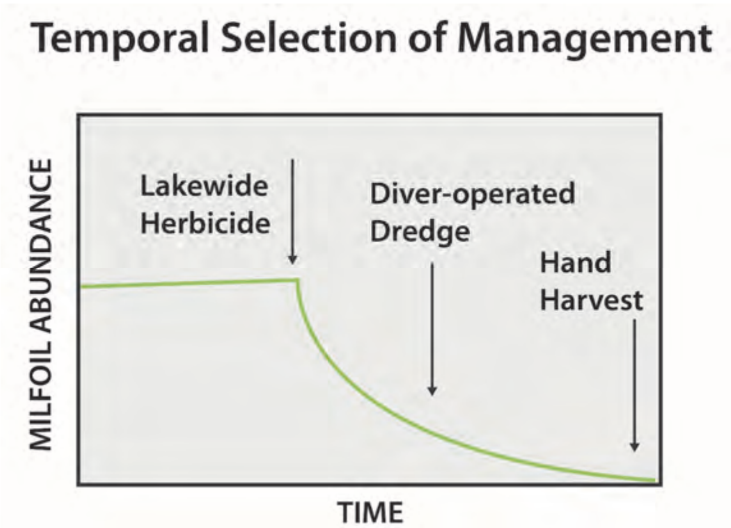
Site-specific management

Site-specific management utilizes management techniques that are selected based on their technical merits and are suited to the needs of a particular location at a particular point in time. Techniques should be selected based on the priority of the site, environmental and regulatory constraints of the site and the potential of the technique to control plants under the site’s particular conditions.



Spatial selection criteria include the identity of the target weed species, the density of the weed, the size of the infested area, water flow characteristics, other uses of the area and potential conflicts between water use and restrictions associated with selected management techniques. For example, consider an area of nuisance growth that is close to a drinking or irrigation water intake. The primary use of the water (i.e., drinking or irrigation) may preclude the use of herbicides that cannot be applied to waters used for drinking or irrigation; therefore, the most appropriate control method for this area might be the use of a benthic barrier and suction harvesting. Consider another site that is more than a mile from the same intake. Weeds at this site could be controlled with herbicides without restrictions on other uses (provided the label specifies use of the herbicide in the area). Perhaps you have an area that is colonized mainly by scattered plants instead of dense stands. If the goal is to eradicate the plant from the water body and you have volunteers at your disposal, hand pulling may be the best method to prevent the formation of dense beds of the weeds.

Management techniques may change over time based on the success (or failure) of the management program. For example, consider Long Lake in Washington State, a small body of water that was dominated by Eurasian watermilfoil (Section 2.3) throughout more than 90% of the littoral zone. A whole-lake treatment of fluridone was applied to Long Lake, which reduced the biomass of the weeds by more than 90%. Small remaining beds in the second year were managed with diver-operated suction harvesting, benthic barriers or spot treatment with contact herbicides. By the third or fourth year, routine surveys found only sporadic Eurasian watermilfoil fragments, which were removed by hand harvesting. Similar treatment programs have been successful in other water bodies as well, which demonstrates that it is appropriate to alter management techniques as weed control requirements change over time. A wide variety of aquatic plant management techniques may be employed and include physical (Section 3.4), mechanical (Section 3.5), biological (Section 3.6) and chemical (Section 3.7.1) control methods. Regardless of method, all techniques should be selected based on their technical merits, as limited by economic and environmental thresholds.



Evaluation

Evaluation of management techniques and programs is typically lacking, even in large-scale management programs. A quantitative assessment should be made to determine the effectiveness of weed management activities, identify environmental impacts (both positive and negative) of management activities, provide the economic cost per acre of management and address stakeholder satisfaction.

Summary

It is critically important to develop a management plan to effectively prevent and control invasive aquatic plants in water resources. Planning should be a continuous process that is ongoing and evolves based on past successes and failures. A comprehensive plan should educate the public about invasive species so they can identify and exclude weeds from uninfested areas. Aquatic plant management programs should also provide a concise assessment of the problem, outline methods and techniques that will be employed to control the weed and clearly define the goals of the program. Mechanisms for monitoring and evaluation should be developed as well and information gathered during these efforts should be used to implement site-specific management and to optimize management efforts. The planning process helps to prepare for the unexpected in weed management, but resource managers should expect the plan to change as stakeholders provide input and management activities commence.

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Page 121: Nuisance growth near a water intake; John Madsen, USDA ARS, Davis, CA
Page 122: Long Lake herbicide treatment; John Madsen, USDA ARS, Davis, CA