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Eurasian Watermilfoil *(Myriophyllum spicatum L.)*

A Report for the Ministry of the Environment

Introduction

Eurasian watermilfoil, a perennial aquatic plant found in forty-four states and three Canadian provinces (Blossey, 2003), is quickly becoming one of Ontario's most demanding non-native species. The plant is indigenous in Europe, North Africa, and Asia. The exact date of its entry into North American waters is unclear. Accounts of its arrival provide dates ranging from the late 1800's to the 1940's. It is generally thought that the plant arrived here through a ship's ballast or through release from aquariums.

Adaptation Abilities

Characterized by its feather-like leaves and reddish pink stem tips, Eurasian watermilfoil grows in ponds, lakes, and rivers. The plant is rooted to the water's bottom and grows upward towards the surface where it forms a dense canopy of winding stems and leaves. The leaves of the Eurasian watermilfoil are arranged in whorls around the stem. It is an extremely hardy plant and can thrive in a variety of environments, allowing for easy adaptation from location to location. It will grow in depths ranging from 0.5 to 10 metres deep and tolerates a wide range of pH and water temperature levels. Its only requirement is a high amount of sunlight, however it has been known to survive under light ice cover (The western aquatic).

In addition to its hardiness, the Eurasian watermilfoil has reproductive features that allow for easy adaptation. It reproduces rapidly, primarily through stem fragmentation and underground runners. In effect, even a small portion of the Eurasian

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watermilfoil's stem left free-floating can take root and form a whole new colony. In this way, fragments of the plant stuck to boat propellers could easily be displaced to another location, resulting in a new colony forming. It is this ability that allows for Eurasian watermilfoil's rapid spread.

Factors at Risk

Eurasian watermilfoil affects a variety of factors, both biotic and abiotic, when introduced to an environment.

Abiotic:

The most apparent problems to the human population are the limits it puts on our ability to enjoy recreational activities. Swimming, boating and fishing are all impacted by the presence of watermilfoil. Likewise, it makes our beaches and waterfront properties less appealing to the eye. Watermilfoil has also been identified as a culprit in clogging intake pipes to power generation plants and ruining irrigation processes. It can also obstruct dams, resulting occasionally in floods and increased water levels.

Eurasian watermilfoil has an effect on levels within the water. Temperatures in shallow water inhabited by watermilfoil have been recorded as increasing by as much as 10 degrees Celsius. It also raises pH levels, and lowers oxygen levels.

Biotic:

Eurasian watermilfoil also affects biotic factors in its environment. The dense canopy it forms at the surface of the water is a perfect breeding ground for mosquitoes. Open water area is diminished, making less room for fish to spawn and for the growth of young fish. In addition, watermilfoil is an aggressive competitor against native species of plants. Its growth period is much earlier than

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many native plants, so that by the time they are ready to grow, all sunlight is blocked out by the watermilfoil cover, making it impossible for them to flourish. The lowered population of native plants has a direct effect on the food web of the environment. Because of the lack of native plants, waterfowl lose a lot of their main food sources. In addition, large fish have a harder time catching smaller fish, which will often use the watermilfoil as a protective barrier.

Possible Impact on Humans and Environment

Immediate	Long-term
• inability to partake in recreational activities • clogging of pipes, boat propellers • increase in water levels	• decreased water front realty values • economic downfall for power generation plants • loss of aquatic vegetation due to temperature drop, pH increase • increase in Ontario's mosquito population, encouraging spread of West Nile Virus • declining fish populations due to lack of spawning area • disappearance of native plant species • diminished waterfowl population • increase in small fish population

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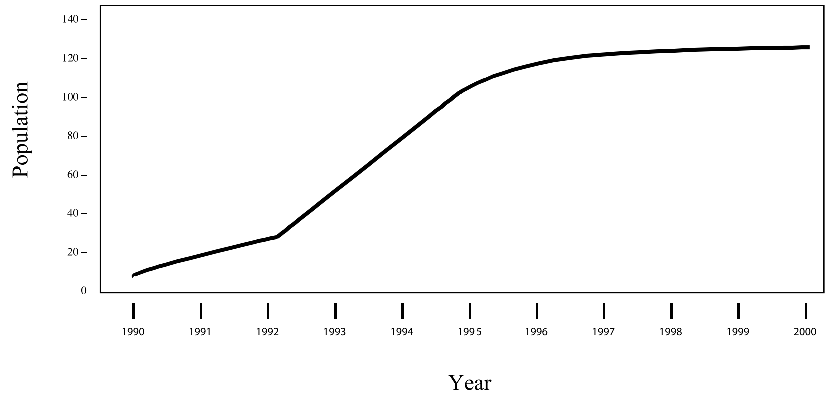
Predictions for the Future

Current population data for Eurasian watermilfoil is not readily available to the public. However, based on knowledge of the plant itself, conclusions about its population trends can be made. A graph of population data for Eurasian watermilfoil in a small lake would most likely look like this:

Population of Eurasian Watermilfoil in Lake X



This graph, resembling the sigmoid population growth model, indicates a period of steady growth in the Eurasian watermilfoil population of Lake X. Eventually, the watermilfoil would run out of space to grow in, reaching the lake's carrying capacity. By this time, however, native species and animals in the environment would have already been affected by the invasion.

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It is reasonable to assume that, given its durability and reproductive frequency, Eurasian watermilfoil could easily choke out entire bodies of water in the future, rendering it unusable for recreation and economic endeavours.

Control Methods

Research has been, and continues to be done, on ways to control the Eurasian watermilfoil population. Effectiveness varies from method to method. There are four major types of watermilfoil control. They are:

Chemical Control (Herbicides)

Herbicides are often used to destroy Eurasian watermilfoil colonies. The most popular herbicides are 2, 4-D and fluridone. While they have proven quite effective in both labs and the field, both chemicals have negative effects. The main problem with these herbicides is that they aren't specifically targeted at Eurasian watermilfoil. Instead, by using them, native plants may also be killed. Likewise, some cases of use have resulted in fish kills and water contamination. A herbicide that holds more promise in combating Eurasian watermilfoil is triclopyr. It is more desirable for a variety of reasons. It requires a short contact time of only 18 to 48 hours and targets watermilfoil specifically, reducing the chance of negative side effects (The western aquatic).

Mechanical Control

Mechanical control methods are commonly used, but may be expensive. Rotovation is one mechanical method. Underwater tiller blades periodically churn up sediment and watermilfoil roots, making it impossible for them to secure themselves to the water bottom. The roots usually end up floating to the surface of the water, where they are collected to inhibit stem fragmentation.

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Another type of mechanical control is harvesting. Eurasian watermilfoil is usually cut five feet below the surface, allowing for an open water area in which fish are free to spawn and boats can easily travel (The western aquatic). However, this method is impractical because of the watermilfoil's rapid growth rate. Harvesting must take place two to three times per season, and doesn't totally remove the colony. If anything, harvesting is a temporary solution.

Physical Control

There are a variety of methods in which Eurasian watermilfoil can be physically controlled, the most obvious of these being hand-pulling. This process, however, would be very labour intensive and not incredibly effective. A better way of control would be "matting". Matting involves cutting out the sunlight source of the watermilfoil. This is done quite literally by placing an opaque material on either the surface of the water or on the water's bottom. Water level drawdown is yet another method. Levels of water are intentionally reduced in order to kill off watermilfoil populations. This option is mostly undesirable.

Biological Control

The most promising of all the control methods is biological control. Intensive research continues to be done in this area. Three major sources of biological control have been identified. They are:

1. Insects

The milfoil weevil, an insect native to North America, was discovered to eat watermilfoil almost exclusively. In fact, the weevil relies on the watermilfoil for much of its life cycle. Adult weevils lay their eggs on the milfoil stems. Once the eggs hatch, larvae make their way down the stem, eating the cortex as they go

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along. As a result, plant growth is suppressed and the Eurasian watermilfoil's biomass is significantly decreased. The effectiveness of the milfoil weevil varies from location to location, but its presence shows a direct correlation to a decrease in Eurasian watermilfoil population (Newman).

2. Grass Carp

The grass carp has been determined to eat Eurasian watermilfoil as a natural part of its diet. Despite this fact, research has shown that Grass carp only eat Eurasian watermilfoil as a last resort, when no native plants are available.

3. Plant Pathogens

Plant pathogens, such as the fungus mycoleptodiscus terretris, have been proven to reduce the Eurasian watermilfoil biomass in laboratory tests. However, field tests have been less than effective. Research continues on the use of plant pathogens to control Eurasian watermilfoil populations.

Recommended Course of Action

The nature of the Eurasian watermilfoil infestation requires immediate attention and action towards control methods. The first step to take is making the public aware of the problem. Encourage boaters to check their propellers for watermilfoil fragments after removing them from a body of water so as to prevent spread from site to site. Also, discourage the dumping of bait pails in uninfected bodies of water. By enlisting the public's help and support, Eurasian watermilfoil control will move towards proactive action, instead of reactive.

However, in order to fight the already existent populations, herbicide use is most practical, specifically triclopyr. Its short contact time and specific targeting of Eurasian watermilfoil make it the obvious choice of the current proven methods.

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Research should continue to take place on biological control methods, specifically the milfoil weevil and its potential to control watermilfoil population. The ideal choice of course would be to introduce weevils to infested environments, as it is both economically feasible and more natural than chemical control. Before this can take place, more information needs to be made available on the weevil's potential impact once introduced, as well as its actual ability to consistently decrease watermilfoil populations.

Conclusion

Without immediate action, Eurasian watermilfoil populations will reach uncontrollable numbers. Entire aquatic ecosystems will be devastated by the watermilfoil's negative impact, and the human population of Ontario will suffer a loss to recreation abilities and economic possibilities. Hopefully in future years, research will take place and interim control measures will be used to control the population of Eurasian watermilfoil.

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Teacher's Notes

Knowledge/Understanding

- The student demonstrates a high degree of understanding of how the invading species has adapted. He or she links a number of adaptations to the success of the watermilfoil (e.g., "watermilfoil is an aggressive competitor against native species of plants. Its growth period is much earlier than many native plants, so that by the time they are ready to grow, all sunlight is blocked out by the watermilfoil cover").

Inquiry

- The student analyses the actual or potential problem with a high degree of effectiveness. He or she considers both abiotic and biotic factors (e.g., "Watermilfoil has also been identified as a culprit in clogging intake pipes"; "large fish have a harder time catching smaller fish, which will often use the watermilfoil as a protective barrier").
- The student predicts the future impact of the invading species with considerable effectiveness. He or she recognizes the absence of population data for this invading species, and makes an appropriate prediction of the population trend for an individual lake, but not for the province as a whole. The student indicates several long-term impacts in the table, and further states that "watermilfoil could easily choke out entire bodies of water in the future, rendering it unusable for recreation and economic endeavours."

Communication

- The student communicates information in graph/chart/table format with a high degree of clarity. Despite the lack of population data, he or she includes a graph that clearly predicts a population trend "resembling the sigmoid population growth model" and showing the watermilfoil "reaching the lake's carrying capacity". The graph is titled and well labelled.
- The student communicates ideas and information with a high degree of clarity. The report is organized into suitable sections and flows well. The appropriate use of scientific terminology is evident throughout (e.g., carrying capacity, sigmoid), and all specific terms are explained (e.g., matting, rotovation).

Making Connections

– The student recommends and justifies a highly effective course of action. He or she researches and discusses four control methods (i.e., chemical, mechanical, physical, and biological). The student recommends chemical control in the short term, more research on biological control in the longer term, and public education "to prevent spread from site to site". He or she provides a clear justification for the recommendation.

Comments

This work is representative of a low level-4 performance. The student demonstrates a high degree of achievement of the expectations in the Knowledge/Understanding, Communication, and Making Connections categories of knowledge and skills. The student also demonstrates a high degree of achievement with respect to one criterion in the Inquiry category. However, with respect to the other criterion in the Inquiry category, the student demonstrates only a considerable degree of achievement – i.e., achievement that is more characteristic of level 3.

Next Steps

In order to improve his or her performance, the student needs to:

- predict the population trend for the province as a whole.