When Should I Get a Fresh Cut?

A Modeling Approach to Determine the Best Harvesting Method of the Invasive *Hydrilla Verticillata*

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Introduction

Hydrilla verticillata is a submerged aquatic plant originating in Central Africa. (Hydrilla(Hydrilla Verticillata), n.d.). Imported initially to Florida by the aquarium trade, by 1981, it was confirmed to be found in the wild in the Delmarva Peninsula and caught national attention when other infestations were discovered in the Potomac River in Washington D.C.(Hydrilla(Hydrilla Verticillata), n.d.). According to recent U.S. Geological Survey database, *H. verticillata* appears to be found from New England down the east coast, along the southern United States, and west into California and Washington (Kumar et al., 2019).

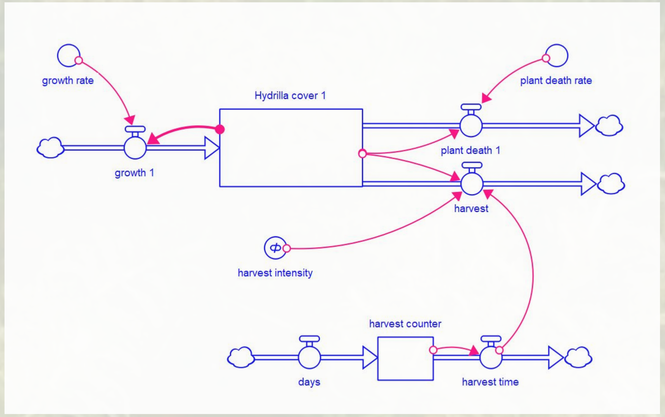
Studies of *H. verticillata* have shown that this aquatic plant can tolerate harsh living conditions; it can grow in water with a wide pH range and has shown the ability to grow in water with salinity levels of 7% and higher (Kumar et al., 2019). in recent years *H. verticillata* has mutated to become tolerant to fluridone-based herbicides (Benoit & Les, 2013). This resilience and adaptability have caught the attention of governments, who have started to implement multiple management strategies to minimize the negative impact *H. verticillata* will have on local economies (Hiatt et al., 2019).

Many management strategies have been developed, some of which are herbicide treatments(Benoit & Les, 2013), the use of grass carps as a form of bioremediation (Stich et al., 2013), and the harvesting of the physical plant (Sabol, 1976). However, *H. verticillata's* physiology and its ability to sprout from small fragments tend to survive different harvesting strategies (Sabol, 1976; Sutton & Portier, 1976; Zuo et al., 2011).

Objective

. This experiment was done to determine how much of *H. verticillata* needs to be harvested and what frequency the harvest needs to happen. In addition, this simulation was done to help determine the best approach to control the population and prevent it from taking over or for complete eradication of the plant.

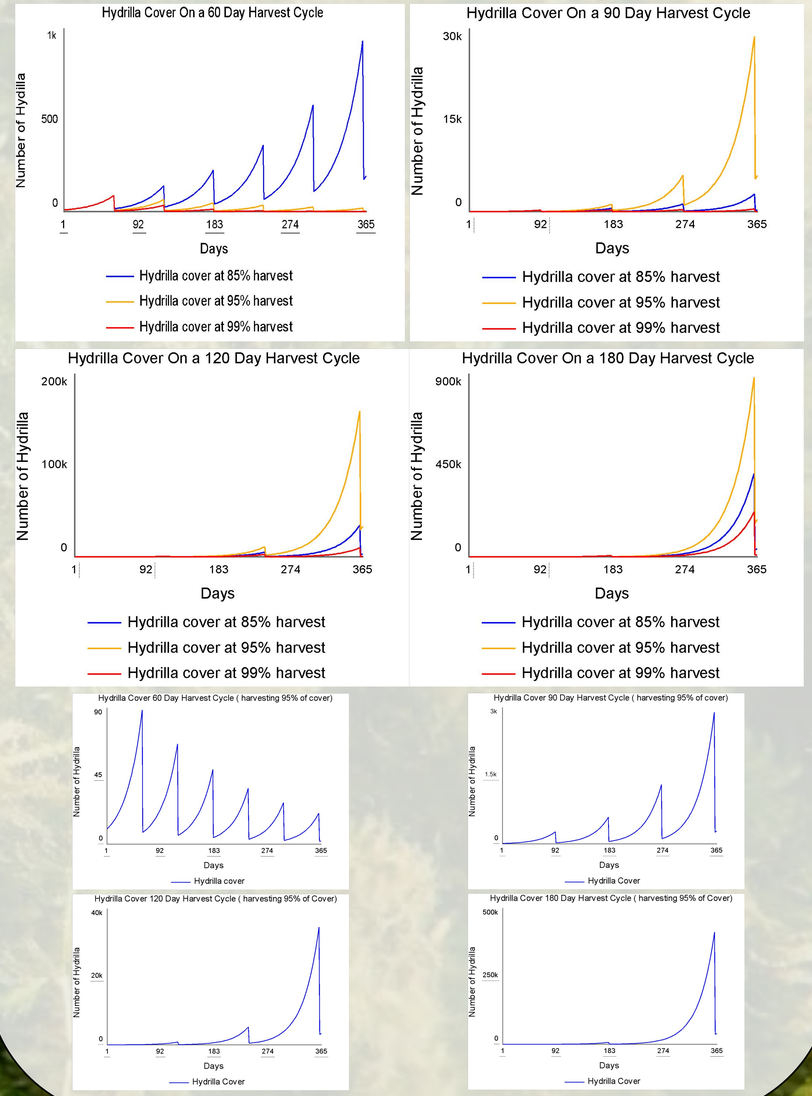
Conceptual model



Modeling Approach

This empirical model can be used to determine how aggressive and at what consistency the harvesting of *H. verticillata* needs to be. These simulations run for 365 days, harvesting the plant at four different frequencies of 60, 90, 120, 180-day cycles. Each cycle ran at different harvesting intensities, consisting of harvesting 85%, 95%, and 99% of visible *H. verticillata* coverage. All simulations ran with an initial population of 10 *H. verticillata* individuals. The decay rate of the plant was set at 0.00793 (d^(-1)). I determined the growth rate by taking the death rate and adding to the integrated growth rate of 0.037 to achieve the new growth rate of 0.045 to achieve a doubling time of 20 days.

Simulation Results



Discussion

When the model was run at harvesting *H. verticillata* at 85%, all harvesting cycles showed an exponential growth pattern with more manageable numbers and more frequent harvesting cycles. When the harvesting simulations were run at 95%, only the 60-day harvesting cycle showed a continual decrease in the *H. verticillata* population. The simulation projected to have two individuals by the end of the year; all other harvesting cycles failed to stunt or control the exponential growth of the plant, even though they did show a significant in the number of individuals left at the end of the 365 days. The final set of simulations were conducted harvesting 99% of the *H. veticillata* during the harvesting events in each harvest cycle. Through the 99% intensity simulations, only the 60-day harvesting cycle showed a significant control and reduction *of H. veticillata*, showing a projected total plant eradication by day 180. The 90-day harvesting cycle at 99% intensity showed potential to control the plant at this harvesting intensity; the 120 and 180-day harvesting cycles failed to reduce *H. verticillata* population enough to be able to be managed by the end of the 365 days. This simulation showed year-round growth from *H. verticillata* to better understand the plants' behavior in future experiments. The model should incorporate dormancy periods and wintering cycles. This model had no stochastic component; previous studies have shown that both the salinity of the water and hurricanes have impacted the growth and spread of *H. verticillata.*

Resources

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