Say “Oui” to Weevils

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Introduction

- Eurasian watermilfoil is one of the most invasive aquatic species in North America [1].
- It reproduces rapidly and forms dense mats/monocultures.
- Multiple reproduction modes include flowers, runners, and fragmentation.
- It gets caught in boat propellers (has negative recreation effects) and blocks out light to other organisms beneath it (has negative ecological effects).

Objective

- Previous control methods include hand pulling, mowing (mechanical harvesting), laying mats (benthic mats) and herbicides [2].
- Weevils may be used as a more environmentally friendly biological control to reduce the population of Eurasian watermilfoil [2].
- Weevils are native to Upstate NY and are mifoil specialists (only eat milfoil and prefer invasive watermilfoils).
- Use math models to predict the lacks most efficient/suitable for weevil augmentation (sustaining populations of weevils).

Methods

- 6 data points were collected: lake area, buffer zone, Secchi depth, phosphorus, latitude, and max depth. These were determined for four Indian River Lakes.
- 2 data points used as variables: the number of weevils added and the treatment frequency.
- We input the 8 data points into a mathematical model to predict the biological probability of success of weevil populations at reducing Eurasian Watermilfoil [2].

Results

Lake Name	Latitude	Area (ha)	Max Depth (m)	Buffer (km)	[P], ug/L	Secchi depth (SD)
Moon	44	93.44	6.10	1.30	23.25	1.90
Butterfield	44	409.00	15.24	4.95	12.95	3.73
Grass	44	128.00	17.00	1.47	11.39	2.42
Hickory	44	210.00	9.14	1.75	36.47	1.27

Table 1: **Data collected** on 4 lakes in Indian River area (all these lakes are heavily infested with the invasive Eurasian Watermilfoil). Each data point is the mean/average.

Adult Weevils & and a single stem of Eurasian Watermilfoil
https://www.cbc.ca/news/canada/sudbury/weevils-milfoil-sudbury-1.3685225

Close-up of adult weevils eating the milfoil leaves
https://www.maisrc.umn.edu/milfoil-weevil

Weevils lay eggs in the stem and the larvae eat/mine the plant material
https://www.invasive.org/browse/detail.cfm?imgnum=0002007

Thick mat of Eurasion watermilfoil blocking light penetration on Hickory Lake (Photo Credit: H.Neaves)

Eurasian watermilfoil: the arch enemy of local lakes. Math to the rescue!

C. Eggleston recording Secchi Depth (Photo Credit: A. Inserra)

Google satellite image of Moon Lake. The red shows the buffer (the suitable overwintering habitat for weevils)

Multi stakeholder partnerships:
Clarkson University, Indian River High School and local lake resident volunteers

Augmentation Frequency	Number of Weevils	Moon Lake Success Probability	Butterfield Lake Success Probability	Grass Lake Success Probability	Hickory Lake Success Probability
1	5,000	**0.1**	0.0	0.0	0.0
1	10,000	**0.2**	0.0	0.0	0.1
1	15,000	**0.2**	0.2	0.1	0.1
2	5,000	1.0	1.0	1.0	1.0
2	10,000	1.0	1.0	1.0	1.0
2	15,000	1.0	1.0	1.0	1.0
3	5,000	1.0	1.0	1.0	1.0
3	10,000	1.0	1.0	1.0	1.0
3	15,000	1.0	1.0	1.0	1.0

Table: Biological Success Predictions. 10 to 100 percent success for all augmentations studied on Moon Lake (other lakes less successful).

Conclusions/Discussion

- The results showed us that Moon lake was the best candidate for the weevils (10 -20 % successful at lowest augmentation strategy). The smaller area size, shallower water, and higher levels of phosphorus could be contributing factors to a better chance of weevil success at reducing Eurasian Watermilfoil on Moon Lake.
- Success on all lakes were first predicted with 2 augmentations of 5000 weevils.
- More augmentations should be studied to find the “best/optimal” one: The least amount of weevils that will do the job!

References

[1] Ecology of Eurasian Watermilfoil. *Journal of Plant Management (*Smith and Barko).
[2] A Machine-Learning Approach to Predict Biocontrol Success of Invasive Eurasian Watermilfoil Reduction. In review, *Ecological Applications* (Antoniou et al.).

How does this research help others?

SUSTAINABLE DEVELOPMENT GOALS

8 DECENT WORK AND ECONOMIC GROWTH — Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

14 LIFE BELOW WATER — Conserve and sustainably use the oceans, seas and marine resources for sustainable development

15 LIFE ON LAND — Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

17 PARTNERSHIPS FOR THE GOALS — Strengthen the means of implementation and revitalize the global partnership for sustainable development

Multi-stakeholder partnerships and voluntary commitments.
https://sdgs.un.org/goals/goal8

Take a picture to download the **summary** with more information on **UN SDG, Weevils and Eurasian milfoil!**

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