Cold Water Milfoil Removal Program

Shawnigan Basin Society

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Shawnigan Basin Society (SBS) with support from the Cowichan Valley Regional District (CVRD) is investigating the feasibility of invasive Eurasian water-milfoil (milfoil) removal during periods of colder water when milfoil is dormant. Removal efforts to date include the use of commercial divers, both surface supply and SCUBA air sources and a variety of different kinds of pumping systems.

This paper describes the results of removal efforts undertaken in Shawnigan Lake on November 20th and 21st 2025. Tests undertaken during this period utilized a diver operated Venturi pumping system with collection of harvested milfoil in custom made burlap bags. This system was designed to facilitate diver collection of milfoil, including roots, without the release of plant fragments.

Background

Eurasian water-milfoil (*Myriophyllum spicatum*) has been established in Shawnigan Lake since the late 1970's (Madrone 2018) and is currently found in most shallow areas of the lake. Milfoil reproduces both vegetatively via fragmentation and subsequent growth of fragments, and via seed production. However, most reproduction occurs through stem fragmentation (Simkovic 2020). Growth is initiated at temperatures exceeding 15 degrees centigrade (Smith and Barko 1990). SBS has been focused on removal during cold water periods to avoid increasing milfoil spread via fragmentation.

Removal Method

SBS has experimented for several years with various pumping systems utilized by professional divers. We have provided a video of these efforts on our website or at the following YouTube location (courtesy of One Drone Services Ltd. – Adrian Fletcher):

Shawnigan Milfoil Removal with Feb and Nov 2025 Updates

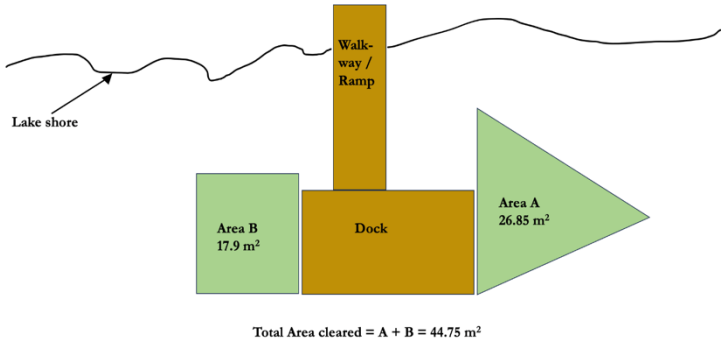
We have tried a number of pumping systems including hydraulic impeller pumps and diaphragm pumps. In our trials this year we used a Venturi pumping system powered by a trash pump that provided approximately 260 gallons of water per minute at a maximum pressure of 37 PSI. This pump produced the required flow in the Venturi system to move the harvested milfoil into the collection bags. The Venturi system was equipped with sufficient buoyancy so that the divers could easily move the intake as they advanced through the milfoil harvesting as they went. Most of the plants and any fragments were entrained in the

flow of the pump and delivered into the collection bags. Any loose fragments were collected with a fine mesh dip net by a surface support person and disposed of in a collection bin.

The first day of removal trials were conducted at the docks located at Lakehouse on Shawnigan. SBS appreciates the support provided by Lakehouse for these trials and for previous removal efforts. The purpose of this first day of trials was to refine the system for Venturi pump removal.

The second day of trials was conducted at the waterfront of a cooperating SBS member. The property was located on the west shore of the West Arm at 2615 Wylde Avenue, Shawnigan Lake BC.

The schematic drawing shows the two areas that were cleared of milfoil. Divers were mobilized from the dock area. The pump and associated Venturi pumping system were set up and the divers systematically worked through the two areas (ie., Area A and Area B) to remove the milfoil growing in these areas.



SHAWNIGAN LAKE – WEST ARM

The bags of milfoil were removed from the pump system when the diver returned to the dock area. Bags were labelled and sealed for subsequent analysis.

On day 1, three bags of milfoil (bags 1 to 3) were retained for analysis. On day 2, bags 4 to 8 were collected and retained for subsequent analysis. All milfoil was allowed to drain for at least 24 hours before being sorted and weighed. Tare weights were determined for containers used in the sorting process. Net weights for milfoil collected per bag were determined.

The percentage of milfoil versus other plants and material were determined for a subset of material collected. Once sorted, plant material and other material were weighed separately to establish the approximate percentage of milfoil in the material collected.

Results of Milfoil Removal Trials

All milfoil collected over the two trial days were collected and analyzed. The detailed results of analysis are provided in Appendix A. A summary of Day 2 trials is provided in Table 1.

Table 1. Results of Milfoil Removal Trials – Day 2

Bag Number	Duration (minutes)	Wet Weight (Kg)	Area (Fugure 1)	Comments
4 and 5	20	3.47	A	Bag 4 failed and material gathered to Bag 5 from the Surface
6	15	2.92	A	Second removal session in this area
7	15	8.48	B	First removal session in area B - system worked as designed
8	15	1.19	B	Second removal session in Area B - diver used a fine meshed net
Total	65	16.06		

Bags 7 and 8 were analyzed for relative composition. The diver collected material from Bag #7 was analyzed for relative composition. It consisted of approximately 71% milfoil by weight, followed by approximately 20% of Robbin's pondweed (*Potamogeton robbinsii*), and approximately 9.4% of 'other unidentifiable plants and debris'. Robbin's pondweed is a common native plant that grows among the milfoil plants and was incidentally harvested along with the milfoil.

Bag 8 had a lower percentage of milfoil (approximately 46% and a corresponding higher percentage of debris as this bag included surface debris gathered while the divers were working.

The results of subsamples to estimate plant composition are provided in Appendix B.

Conclusions

Based on the overall results for Day 2 trials, the rate of removal of material using divers equipped with a Venturi pumping system was approximately 15 kg/hour. Based on the most efficient operation (bag 7) this rate of removal increased to approximately 33.9 kg/hour. The expected composition of material removed is approximately 70% milfoil. Shawnigan Basin Society has conducted previous analyses of diver removal using SCUBA and bags. The % removal of milfoil versus other vegetation and/or debris was similar.

Recommendations

The Venturi pumping system eventually performed as expected. The overall approach could be improved with the following innovations:

1. Extend the pump discharge by a meter or so in order to move the collection bag well past the location of the diver. As the equipment was oriented in these trials, the collection bag was close to the diver during operations. The discharge included sediment associated with the roots on the milfoil, and this eventually created localized turbidity making it difficult for the diver to see.
2. The trash pump employed worked well. It is possible that a higher-pressure pump could induce a greater flow in the Venturi system, which would improve the entrainment of milfoil.
3. It is further recommended that a surface boom with floats and a shallow collection net be used to contain fragments, especially if milfoil removal is done at temperatures above 15 degrees. At these warmer temperatures, the fragments can grow roots and become new plants after settling to the bottom.
4. Significant time was required to set up and demobilize the divers and the equipment. For commercial scale removal, it is recommended that a large enough vessel would be employed to include the pumping system, the diver surface supply system, and a containment boom which could be deployed prior to starting removal activities.

Acknowledgements

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References

Madrone Environmental Services Ltd. 2018. Eurasian Water-Milfoil Management Paln for Shawnigan Lake, BC.

Simkovic, Vicki. 2020. Eurasian Water-Milfoil (*Myriophyllum spicatum*) : Best Management Practices in Ontario. Ontario Invasive Plant Council, Peterborough, Ontario.

Smith, C.S. and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28: 55-64.

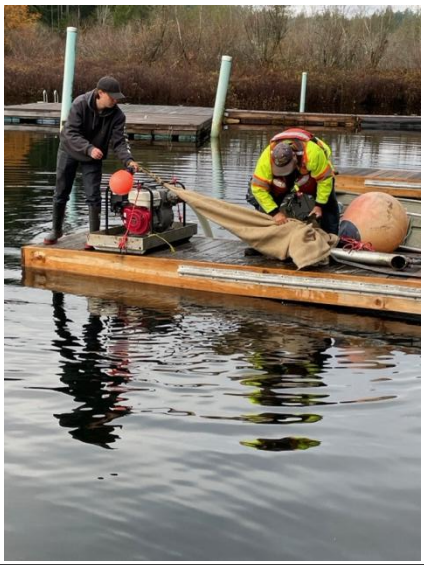

Photo 1. Venturi Pumping System with burlap collection bag

Photo 2. Surface supply diver preparing to enter the water

Photo 3. Establishing wet weight of milfoil collected with Venturi pumping system

Appendix A – Detailed Weights of Materials Collected During Removal Trials

Calculation of milfoil weights

Bag	Description	Tare Wt (FL. OZ)	Tare Wt. (Grams)	Gross Wt (FL OZ)	Gross Wt (Grams)	Net Wt (Grams)	Total Wt. (Grams)	
	DAY 1 - Thursday November 20, 2025							
0	Initial 10 feet by 5 feet bag - elected to go smaller	25.4	726	92.5	2622.4	1896.4	1896.4	
1	First attempt with smaller bag (3X5 feet) - 15 to 20 minutes	15.6	446	73.1	2072.4	1626.4	1626.4	
2	Second attempt - 12 minutes	25.4	726	47.3	1341.0	615.0		
		25.4	726	65.4	1854.1	1128.1		
		25.4	726	94.9	2690.4	1964.4		
		25.4	726	70.2	1990.2	1264.2	4971.6	
3	Third attempt - 25 minutes	25.4	726	55.8	1581.9	855.9		
		25.4	726	72.6	2058.2	1332.2		
		25.4	726	77.7	2202.8	1476.8	3664.9	
	Cumulative Weight Sampled - Day 1						12159.3	or approximately 12.16 kg
	DAY 2 - Friday November 21, 2025							
4 & 5	Bag 4 failed and the material gathered was scooped up and put in Bag 5	25.4	726	102.9	2917.2	2191.2		
			726	70.8	2007.2	1281.2	3472.4	or approximately 3.47 kg
6		25.4	726	107.7	3053.3	2327.3		
		25.4	726	46.6	1321.1	595.1	2922.4	or approximately 2.92 kg
7	This sample was used to calculate % milfoil	329.9	9352.7	629.0	17832.2	8479.5	8479.5	or approximately 8.48 kg
	See Composition Tab for details							
8	This bag was a clean up of the 2nd area	56.4	1598.9	98.3	2786.8	1187.9	1187.9	or approximately 1.19 kg
	See Composition Tab for details							
	Cumulative Weight Sampled - Day 2						16062.2	or approximately 16.06 kg

Appendix B. Calculation of Percent Composition of Selected bags of Plant Material

Calculation of milfoil weights

Bag	Description	Tare Wt (FL. OZ)	Tare Wt. (Grams)	Gross Wt (FL OZ)	Gross Wt (Grams)	Net Wt (Grams)	Total Wt. (Grams)	% of Sample
	DAY 2 - Friday November 21, 2025							
	During analysis of this bag, the vegetative materials collected in the bag were seperated into four categories and weighed seperately							
7	a. milfoil	9.4	266.5	16.3	462.1	195.6		
		9.4	266.5	18.4	521.6	255.2		
		9.4	266.5	22.2	629.4	362.9		
		15.7	445.1	33.8	958.2	513.1		
		15.7	445.1	42.6	1207.7	762.6		
		15.7	445.1	45.5	1289.9	844.8		
		15.7	445.1	46.7	1323.9	878.9		
		15.7	445.1	46.1	1306.9	861.8		
		15.7	445.1	65.0	1842.8	1397.7	6072.6	71.6%
	b. Robbin's pondweed	9.4	266.5	11.1	314.7	48.2		
		9.4	266.5	11.9	337.4	70.9		
		9.4	266.5	11.7	331.7	65.2		
		25.4	720.1	28.8	816.5	96.4		
		25.4	720.1	33.6	952.6	232.5		
		25.4	720.1	33.7	955.4	235.3		
		25.4	720.1	35.6	1009.3	289.2		
		25.4	720.1	36.2	1026.3	306.2		
		25.4	720.1	37.7	1068.8	348.7	1692.5	20.0%
	c. Rysomes or stalks	14.2	402.6	35.8	1014.9	612.4	612.4	7.2%
	d. Other plants	9.4	266.5	9.9	280.7	14.2	14.2	0.2%
	e. Other debris (terrestrial debris)	3.3	93.6	6.4	181.4	87.9	87.9	1.0%
		329.9	9352.7	629.0	17832.2	8479.5	8479.5	100.0%
8	This bag was a clean up of the 2nd area using scuba diving with a fine mesh net. Material collected was seperated into four categories							
	a. milfoil	9.4	266.5	17.5	496.1	229.6		
		9.4	266.5	16.4	464.9	198.5		
		9.4	266.5	13.5	382.7	116.2	544.3	45.8%
	b. Robbin's pondweed	9.4	266.5	13.1	371.4	104.9	104.9	8.8%
	c. stalks (unidentified)	9.4	266.5	14.2	402.6	136.1	136.1	11.5%
	d. Other debris (terrestrial)	9.4	266.5	23.6	669.1	402.6	402.6	33.9%
		56.4	1598.9	98.3	2786.8	1187.9	1187.9	100.0%
	Approximately 1.2 kg of wet weight material analyzed for composition							