Testing Floating Benthic Barriers for Control of Fragrant Waterlily (*Nyphaea odorata*) and Eurasian watermilfoil (*Myriophyllum spicatum*) in Christina Lake, BC

Year 1 Summary - 2023



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PROJECT BACKGROUND

Many residents of Christina Lake have raised concerns about the dense infestations of fragrant waterlily *(Nymphaea odorata*) (FL) and requested this invasive plant be removed from Christina Creek to maintain access and to protect environmental values. Residents continue to have concerns with dense infestations of Eurasian watermilfoil *(Myriophyllum spicatum)* (EWM) particularly at the south end of the lake. The Regional District of Kootenay Boundary (RDKB) has been using divers to control infestations of Eurasian watermilfoil (EWM) in the south end, however the dive crew does not have capacity to control all sites, particularly in the south end. The south end experiences very high boat use which in some locations poses a risk to diver safety and the boat traffic results in continual spread of fragments. Considering the work window and budget limitations, the dive crew is not able to provide adequate levels of control in the heavily infested south end of the lake, so the RDKB is exploring alternate control options.

In 2018 the RDKB completed a preliminary investigation into control options for FL and estimated diver crew cost for digging versus cutting over a three to five year period dependant on site size (Stewart 2019). The RDKB does not have access to funding through any local services that could be used for FL and the province has not been able to provide funding to complete any control work on FL until now. With the floating benthic mats available to the public for purchase the RDKB would like to document the process and costs to deploy the barriers and share this information with lake shore residents who would like to secure appropriate authorizations to do control work in front of their property.

This pilot project has been set up to test the feasibility of using floating benthic mats to control dense infestations of fragrant waterlily and also to control Eurasian water-milfoil problems in areas where it is difficult for divers to access or not safe for divers to remove EWM including around marina's and where large dense patches have high levels of boat traffic (south bay). Floating benthic barriers were successfully used for control of EWM in the Kootenay and Columbia system in 2017 by Golder and Associates and the Okanagan Nations Alliance (ONA) on a reduction project.

LIFE HISTORY OF TARGET INVASIVE PLANTS

Fragrant Waterlily (*Nymphaea odorata*):

Fragrant waterlily (Nymphaea odorata) is an aquatic floating leaved perennial plant with white to pink fragrant flowers (Figure 1) . It spreads by rhizomes (Figure 1), seed and detached floating tubers. The roots are anchored by adventitious roots that arise below the leaf bases. The floating leaves have a slit and typically the leaf margins meet or overlap forming a complete circle (Figure 1). The flowers are white to pink with 17 to 43 petals and petal count is a reliable way to distinguish it from other species. There are two subspecies recognized *N. odorata subsp. tuberosa* and *N. odorata subsp. odorata.* Several cultivars have been developed with varying flower colours. Both subspecies and all cultivars are listed as noxious in Washington. This species is not listed as Noxious or Invasive in BC under provincial legislation but is listed for eradication on the regional priority list for the Boundary. This species is reported to be locally problematic with slight value for waterfowl food, high aesthetic value, and no information on the value to invertebrates (Nichols 1986).



Figure 1. Leaf (left), flower from Christina Creek (middle) and tubers with adventitious roots (right).

Eurasian Watermilfoil ((Myriophyllum spicatum)

Eurasian watermilfoil is a perennial aquatic plant with finely dissected leaves spreading by stem fragments and seed. It forms dense mats underwater obstructing water flow and impacting recreation.

It has greater than 24 leaflet pairs on each leaf and a triangle shaped leaf (Figure 2). The native northern watermilfoil has less than 24 but there are hybrids that can be difficult to distinguish. Eurasian watermilfoil is present in shallow areas in Christina Lake with the largest infestations occurring in the shallow areas at the south end of Christina Lake. The RDKB uses a crew of divers to hand pull plants from May to October each year.



Figure 2. Eurasian watermilfoil leaf arrangement. Christina Lake, BC.

PROJECT PRE-PLANNING

The Regional District of Kootenay Boundary (RDKB) submitted at Request for Review with the Department of Fisheries and Oceans (DFO) in February 2023 and discussed the project with provincial Habitat staff. A joint call was completed on March 13, 2023 involving DFO and the Ministry of Water Land and Resource Stewardship to provide details on pilot project and to discuss any concerns since this is not a widely used control method in BC.

The RDKB contacted the Okanagan Nations Alliance resource management staff to see if ONA wanted to be involved as a partner or collaborator, and they initially indicated interest however did not respond further. The RDKB would welcome ONA involvement on any level on this project and will continue communications with ONA.

STUDY PURPOSE AND PROJECT OUTCOMES

Purpose:

1. To pilot use of floating benthic barriers to control fragrant waterlily in Christina Creek and Christina Lake.
2. To determine the number of seasons benthic mats are required to control (kill roots) of fragrant waterlily.
3. To pilot use of floating benthic barriers to control Eurasian watermilfoil in Christina Lake at high boat traffic locations and assess effectiveness.
4. To document the process, costs, and challenges in deploying floating benthic mats for control or EWM and FL and share this information with lake shore owners interested in using this control method around their docks.
5. To use trial outcomes to recommend protocols and procedures to the RDKB for implementing benthic barriers on a larger scale for control of dense patches of EWM in the south end of Christina Lake.

Project Outcomes:

1. To improve effectiveness of the EWM program by adding floating benthic mats as an alternative control option for EWM at high boat traffic areas to improve diver safety at high boat traffic areas.
2. To reduce desirable habitat at project sites for invasive fish (large-mouth bass/northern pike) to maintain or improve native aquatic species diversity.
3. To control the fragrant waterlily patch at the mouth of Christina Creek to improve safety for boat passage through the narrow channel during low water.
4. To provide a step-by-step process to support lake shore owners wanting to use this method to control EWM or FL around their own docks.

STUDY AREA

The pilot project using benthic barriers is being set up in Christina Lake at two sites (the mouth of Christina Creek and in the lake in front of the Christina Lake Community Park) to control fragrant waterlily. The protocol originally planned to include a EWM site, however funding did not allow for purchase of enough barriers in 2023. The locations selected are virtual monocultures of the target invasive plant species so it will not likely impact native aquatic plant species. All locations have silt or sand bottoms.

Native salmonids in the lake and creek include kokanee (*Oncorynchus nerka*), rainbow trout (*Oncorhynchus mykiss*) and mountain whitefish *(Prosopium williamsoni*). Project sites are not near known kokanee shore spawning habitat (red zones). The most recent survey in the area was a project by ONA for pike suppression in 2019 and fish species present in the south bay include: Bass/Sunfish (General), Carp (General), Longnose Sucker, Northern Pikeminnow, Pumpkinseed, Tench, and Yellow Perch. Fortunately, no northern pike were recorded. The pilot protocol appendix contains a list of all fish species records in the south end of Christina Lake and creek based on the provincial fish observation point layer. Westslope (Yellowstone) Cutthroat Trout were recorded in Sutherland Creek which is outside the project sites.

There is no current data on fish spawning in Christina creek but there are suitable gravel/cobble areas in the lower reaches of the creek which may support spawning. The upper portion of the creek is dominated by clay/sand bottom with deep silt accumulations and both bass and sunfish have been observed in the creek (B. Stewart) in the upper portion including proposed project site 1 in the fragrant waterlily patch.

PROJECT SITE AND LOCATION DESCRIPTIONS

Fragrant waterlily Sites 1 and 2.

Site 1: Christina Creek – the fragrant waterlily patch at the mouth of the creek is a series of patches over 100 m stretch and average width of 20 m wide (Figure 3- 5). For this site a series of shorter barriers will be used to enable complete coverage of the odd shaped patch totalling 500 m2. This will also enable removal of some barrier pieces over time to see if there was root survival after one season compared to two seasons.



Figure 3. Location of Site 1 Fragrant waterlily patch at mouth of Christina Creek.



Figure 4. Patch of fragrant waterlily at mouth of Christina Creek (dark green).



Figure 5. View of fragrant waterlily patch surrounded by dense watershield. Photo taken looking NE from mouth of Christina Creek.

Site 2: Christina Lake – Community Park – the fragrant waterlily patch is located in the shallow area on the east side of the lake (Figure 6-7). This site is a relatively small patch surrounded by dense watershield (*Brassneria schreberi*) and has been included in case there are any issues (current, boat use) with using the benthic mats in the creek. The site has a small round patch of fragrant waterlily on a silt substrate with some EWM growing beneath it. It is located approximately 140 m from shore. Patch size is 30 m2.

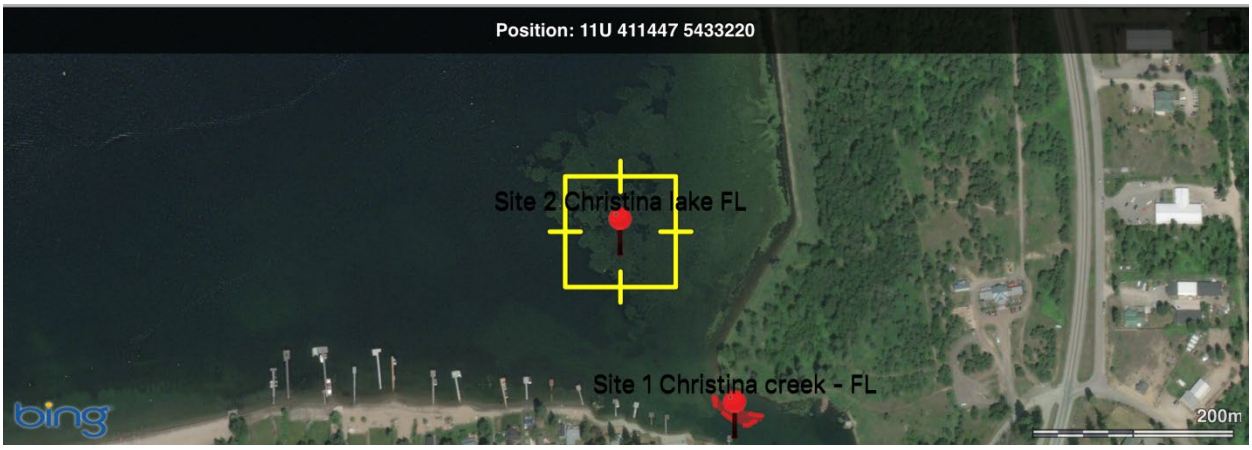


Figure 6. Location of Site 2 Fragrant waterlily patch in Christina Lake west of Christina Lake Community Park.



Figure 7. Location of Site 2 Fragrant waterlily patch in Christina Lake west of Christina Lake Community Park.

STUDY PERIOD

Section 11 Notifications were prepared for sites 2 and 3 in Christina Lake and site 1 in Christina Creek in early spring 2023. The study was originally schedule for May installation however due to high water and turbidity levels installation was delayed until June 19, 2023. The floating barriers at sites 1 and 2 were planned to be in place until the end of the growing season, and a second season if necessary to achieve effective control of the fragrant waterlily. There had been plans to install barriers at Site 3 for control of EWM site but there was not enough project budget to purchase barriers for the third site. The second year of the project is planned for June through September of 2024, but the timing may be adjusted based on timing of water levels drop after freshet.

MATERIALS AND METHODS

Benthic barriers are efficient at killing aquatic plants with small root systems like EWM typically within a few months. In the lower Columbia they found no difference in effectiveness between 9-11 weeks compared to 20 weeks for EWM (Golder and ONA 2018). Since fragrant waterlily has a large tuberous root system it was expected that control will take longer so a season long deployment was planned with a second year of barrier proposed since it would likely be required to kill the roots.

The floating benthic barriers used were lake bottom blankets (URL: https://lakebottomblanket.com/).

INSTALLATION OF THE BARRIERS

The floating benthic barriers were installed on June 19, 2023 at site 1 and 2 (fragrant waterlily). The project budget did not allow for purchase of enough mats for site 3 (EWM). The RDKB dive crew monitored the water levels in the spring and selected this date as having low enough water levels and enough visibility to enable safe installation by divers in Christina Creek (site 1). The installation process was completed by the RDKB milfoil dive crew. The barriers were laid out on a grassy area and the rebar installed in the pockets (Figure 8), then the mats were placed on the front ramp in order of deployment. Three to four barriers could be put on the ramp on the front of the boat comfortably so multiple trips were required for the larger site.



Figure 8. Preparing mats for installation. Date: 2023-06-19.

The installation of two barriers was completed on the smaller site 2 in the lake first. The installation at site 2 (Figure 9) was straight forward and went smoothly. The white side was facing up to increase visibility to boaters and one corner was marked with a buoy. The FL had reached the surface when the barriers were installed so many stems/leaves were not fully covered. As the barriers were installed it became apparent that significant overlap was needed on the sides of the mats which resulted in the outer edge of the patches all the way around not being covered. In future it would be good to purchase 25% more mat length/width than patch size to allow for overlap and billowing. Coverage was better where the mats were dropped a little beyond the edge of the patch and pulled along the bottom a little causing the stems to lay down in the direction of the boat as the barriers sank.

Site 2 received two 12 m (40 ft) barriers side by side, but with the overlap and billowing it was not wide enough or long enough with approximately a 2.0 m strip on three sides and 3 m strip on the fourth side (Figure 10 and 11). At the time of installation only the fragrant waterlily had reached the surface but the watershield had not, so locating the site edges was easy. The mats slowly sink and billow up so do not tightly cover the substrate (Figure 10). The barriers are reported to have very little impact on benthic invertebrates, however no studies have been provided to support the manufacturers claim. The billowing certainly does allow for gas exchange and movement of invertebrates and fish under the barriers.



Figure 9. Installation June 19 at Site 2, 2023 showing first barrier lowly sinking with buoy visible on middle right.



Figure 10. Site 2 August 1, 2023 showing billowing up of the barriers between rebar.

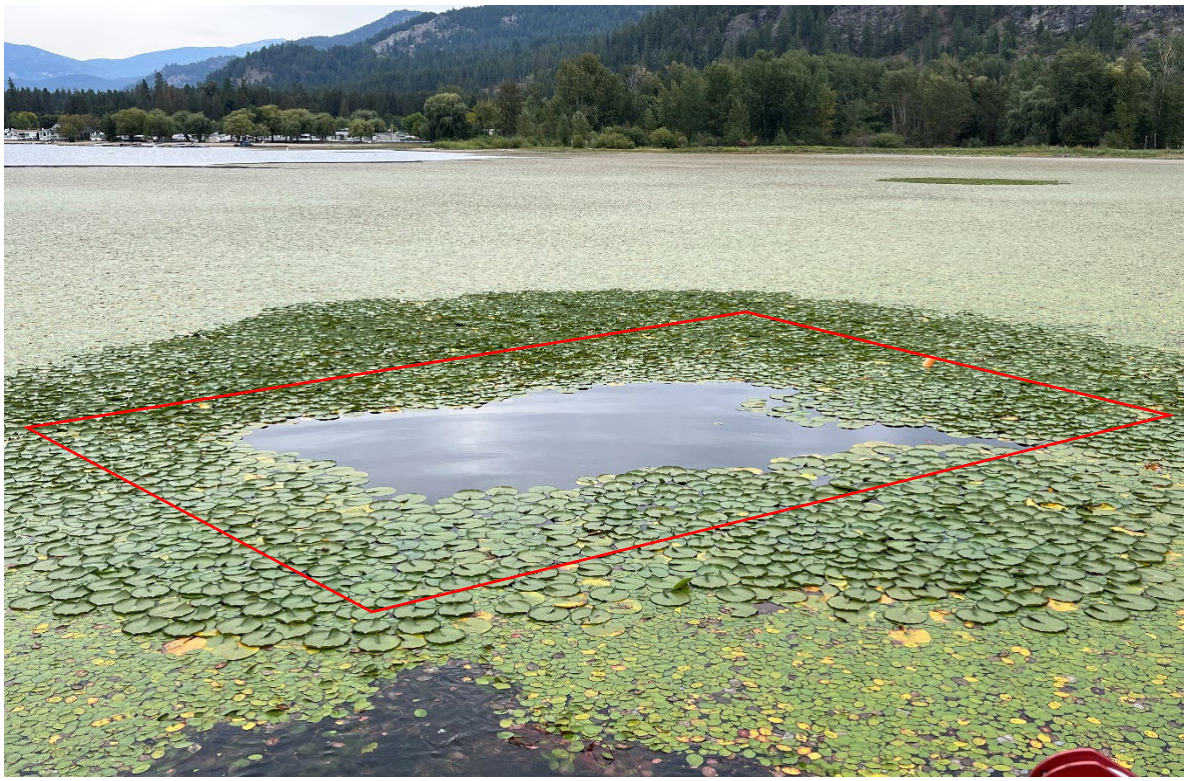


Figure 11. Site 2 September 19, 2023 with leaves from edge growing over top of the barrier as the season progressed. The approximate barrier location shown in red.

Site 1 received nine barriers at 12 m and three at 10 m arranged on the site with 4 long and 3 wide which started at the drop off and were laid in towards shore. The installation was more difficult due to the current and differences in depths. Installation from upstream down worked better than against the current. There were some plants that ended up coming through the overlaps along the length, but crews were able to get all the plants along the short edge under the barriers at the overlap. In July a polygon was recorded around the mats for mapping purposes to get a relatively accurate estimate of area covered and average stem density was recorded however GPS accuracy was not high enough so a calculation based on mat size was done.





Figure 12. Site 1 June 19, 2023. Crew installing first barrier (left) and first seven barriers with buoys visible (lower).

RESULTS AND OBSERVATIONS YEAR 1

The plant health at site 1 and 2 was measured every 6 weeks (August 1, Sept 19) until removal on October 17, 2023. Measurements included root condition: firmness; colouration; presence of fine root hairs; stem length (m); number of stems/leaves, and number of new shoots (attached to roots). The dive crew dug out root pieces at different locations under the barriers during each monitoring pass along with some roots from adjacent untreated areas (control). The materials were measured and photographed to enable tracking change over time.



Figure 13. Site 2 August 1, 2023 – divers sampling roots from under and around barrier. Over the season the surface leaves pushed in over the mats from the untreated edges.

As expected, the number of healthy stems and leaves was reduced under the barriers to zero. Figure 14 shows the stem length for each sample location and treatment by monitoring date. As the season progressed the stems of plants under the barriers decayed and broke off resulting in decline in length over time. The declining water level in the creek as the season progressed affected live stem length but the data did not capture this very well since only one sample was measured and the depth of measurement was not consistent. The substrate at site 1 varies from shallow to deep across the treatment site.

During monitoring in August and September there were more new shoots on the roots at treated sites compared to the control (Figure 15 and 16). This observation that shoots were produced earlier in the season on treated sites is likely a response to stress from the treatment since it did not occur on the control site. The treated locations did not develop as many new shoots by the end of the season as the control. This could be a result of a depleted root reserves under the barriers as the season progressed so less new shoots were produced at the end of the season. The control had no new shoots in the first monitoring in August but had abundant new shoots in September and October monitoring which is likely a normal pattern since many perennial plants develop buds for the following years growth before winter dormancy (Figure 15 and 16). The reduced shoot presence in fall could result in lower density of leaf/stems in year 2 on patches after treatment with barriers for one season. However, those plants could also recover in the spring as new shoots develop or they may have delayed stem/leaf growth because of the partially depleted root reserves.

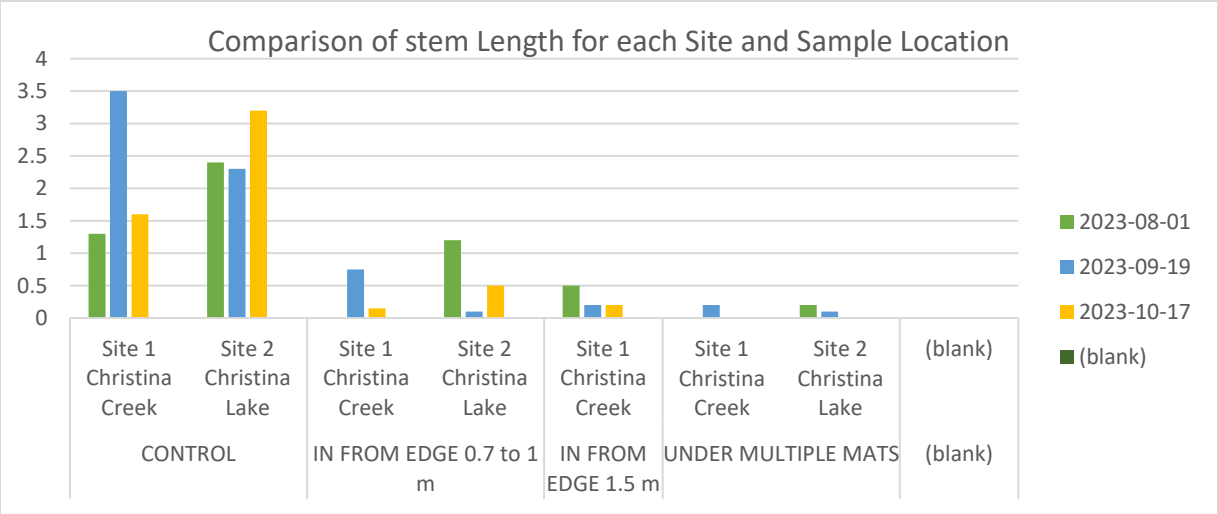


Figure 14. Comparison of stem length for Site 1 and 2 on each monitoring date.

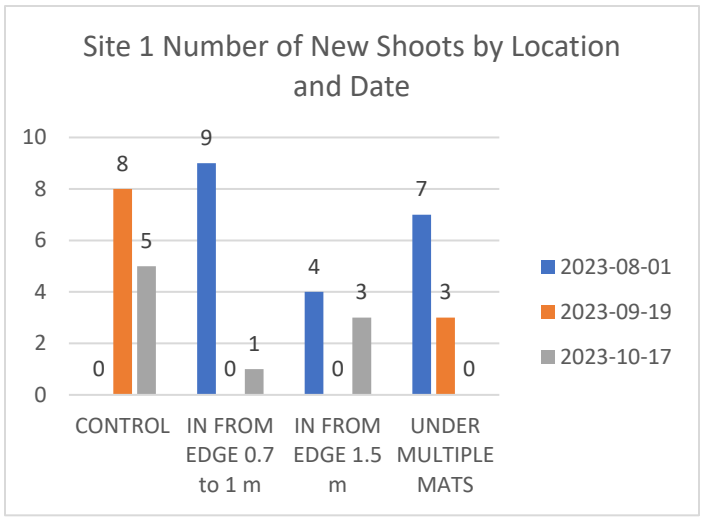


Figure 15. Comparison of number of new shoots on each monitoring date for Site 1

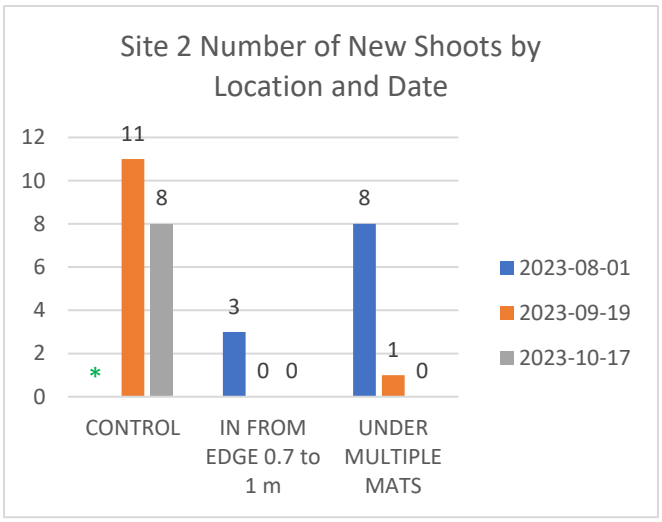


Figure 16. Comparison of number of new shoots on each monitoring date for Site 2.

*unable to find new shoots in dense mass of roots.

When the project began there was no information about how to determine visually when a root was dead so the project recorded the health of the roots based on relative abundance of fine roots, colour of fine roots, colour of root material in cross section, and the firmness of the root. The number of fine roots declined on all treated areas over the season, so abundance of fine root hairs appears to be a reliable indicator of root health. Throughout monitoring the tuberous roots were all firm when squeezed except for a single sample during the final monitoring which felt soft and spongy and appeared to be decaying. This sample was from under multiple layers of barriers (centre of a patch) and likely represents death of that portion of the root. The colour of the cross-section varied by date and location and does not appear to represent root health. The abundance and health of the fine roots appears to be a consistent way to measure health of the root through the season. The control showed healthy abundant to plentiful roots throughout. Under the barriers both sites had declines in fine root relative abundance and over time darkening of the colour suggesting decay and shedding of the fine roots was beginning to occur. During the September and October monitoring samples were found with no fine roots or a few fine roots by the end of the season. Assessing the abundance of roots and colour appears to be a reliable way to indicate root health decline within the season and change in consistency of the tuber from firm to soft and spongy indicates root death.

Based on the monitoring, root health did decline by the end of the season, however only one location was found to have completely decomposed roots (Site 2 under multiple layers far from an edge) indicating actual senescence (death) of that part of the plant. The root systems are connected within a patch, so it is likely the entire root system needs to be starved of resources to completely kill the patch. The variation observed of samples closer to the edge (0.7-1 m from end and 1.5 m from edge) having some fine roots in October still at both sites compared to samples from farther under barriers suggests movement of resources in the from the edge of the root mass may be prolonging survival of roots closer to the edge of the barriers. For year 2 it is very important that the barriers cover the entire root system to the edge, as this will likely result in a quicker death. It is possible this could be as short as a single season since the sample from the centre of the barriers at Site 2 in the lake has completely decayed roots by the end of the season.

Abundance and Healthy of Fine Roots	Site 1 Christina Creek			Site 2 Christina Lake		
	2023-08-01	2023-09-19	2023-10-17	2023-08-01	2023-09-19	2023-10-17
CONTROL						
Abundant	x		x	x	x	x
Plentiful		x				
Few						
None						
IN FROM EDGE 0.7 to 1 m						
Abundant	x			x		
Plentiful		x				
Few			x		x	x
None						
IN FROM EDGE 1.5 m						
Abundant	x					
Plentiful						
Few		x	x			
None						
UNDER MULTIPLE MATS						
Abundant	x			x		
Plentiful					x	
Few						
None		x	x			x[1]

x	*fine roots healthy and white*
x	*fine roots pale*
x	*fine roots brown and unhealthy/decaying*
x	*no fine roots present - all have decayed*
x[1]	*sample spongy/decomposed and dead*

Table 1. *Comparison of fine root abundance and colour by site and location under the barriers during Year 1.*

OBSERVATIONS OF USE BY AQUATIC ANIMAL SPECIES

During installation a painted turtle was briefly entangled in the mass of plant debris wrapped around the boat motor, so the motor was shut off and vegetation removed. The turtle swam off unharmed.

While collecting root samples, the divers reported seeing a few small fish hiding under the mats at Christina Creek site, suggesting that some fish species may utilize the security cover under the barriers while they are in place. The rebar sinks to the bottom while the barrier between rebar pieces billows up off the substrate creating caverns that fish or benthic invertebrates can freely pass through or hide under. The barriers have holes cut in to allow for gas exchange to prevent anoxic conditions under the barriers which is intended to minimize impact to benthic invertebrates and fish. No dead fish were observed or reported in or around the barriers during the project.

When the barriers were removed freshwater sponges were found to be growing on the underside of many of the barriers in Christina Creek (Figure 17). Freshwater sponges are found in many lakes in the area, typically bright green or brown in colour and often covering or attached to wood or other solid surfaces.

No samples were taken of benthic invertebrates to determine population impacts as a result of the barriers since the project monitoring was focussed on potential effectiveness of the floating benthic barriers to control fragrant waterlily.

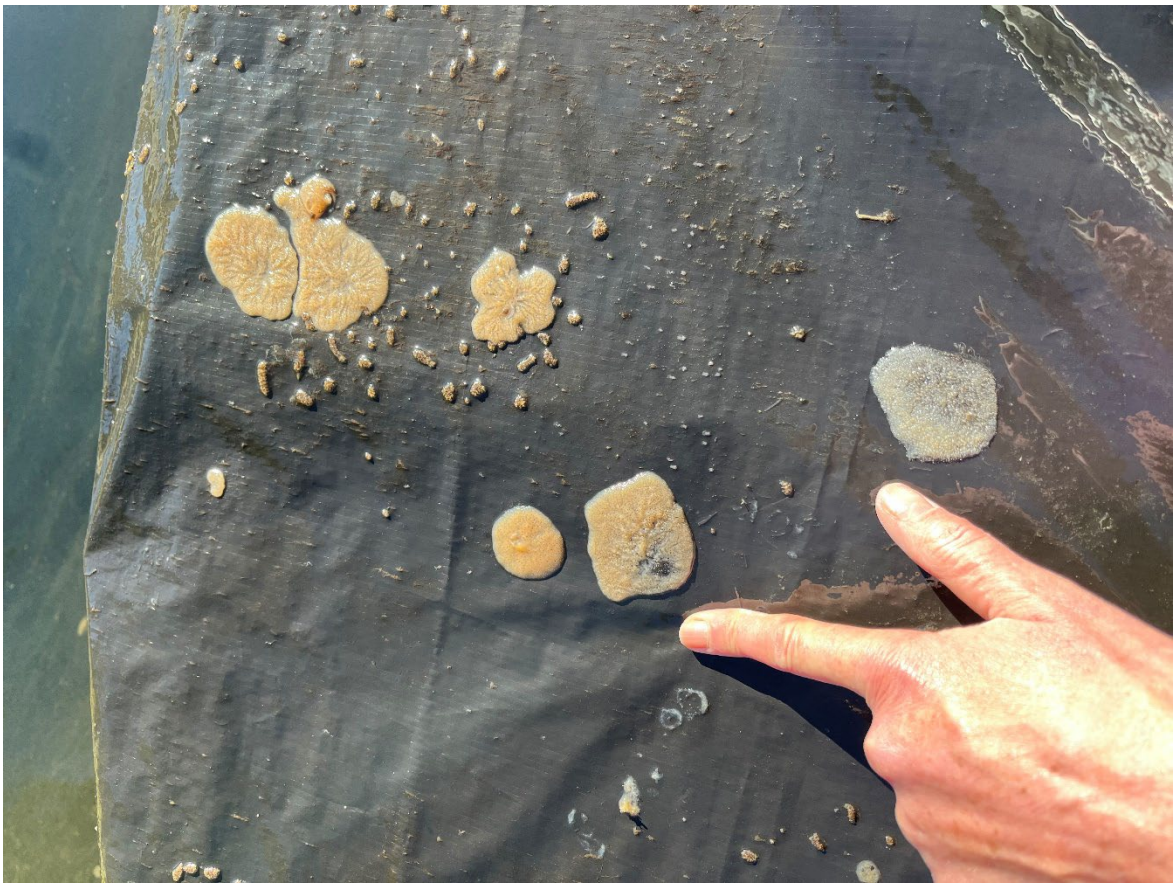


Figure 17. Site 1 October 19, 2023 freshwater sponges visible on the underside of the barriers being removed.

MONITORING COMPARISON PHOTOS FOR EACH MONITORING SESSION BY SITE

Figure 18. Site 1 – August 1, 2023 (Left photo) Plant samples from centre of barrier (left), 0.7 m from edge of barrier (middle) and untreated control outside barriers (right). (Right photo). Closeup of tuberous roots with fine root hairs, rhizomes, pale stems, and new buds.





Figure 19. Site 2 – August 1, 2023- Centre of barrier (left), 0.7 m from edge of barrier (middle) and untreated control outside barriers (right).



Figure 20. Site 1 - September 19, 2023- Plant samples from centre of barrier (left), 1.5 m in from end (middle left), 0.7 m from edge of barrier (middle right) and untreated control outside barriers (right).



Figure 21. Site 2 - September 19, 2023 – Picture on left - Centre of barrier (right), 0.7 m from edge of barrier (middle) and untreated control outside barriers (left). Picture on right -Stressed root with very few root hairs from under the centre of two mats





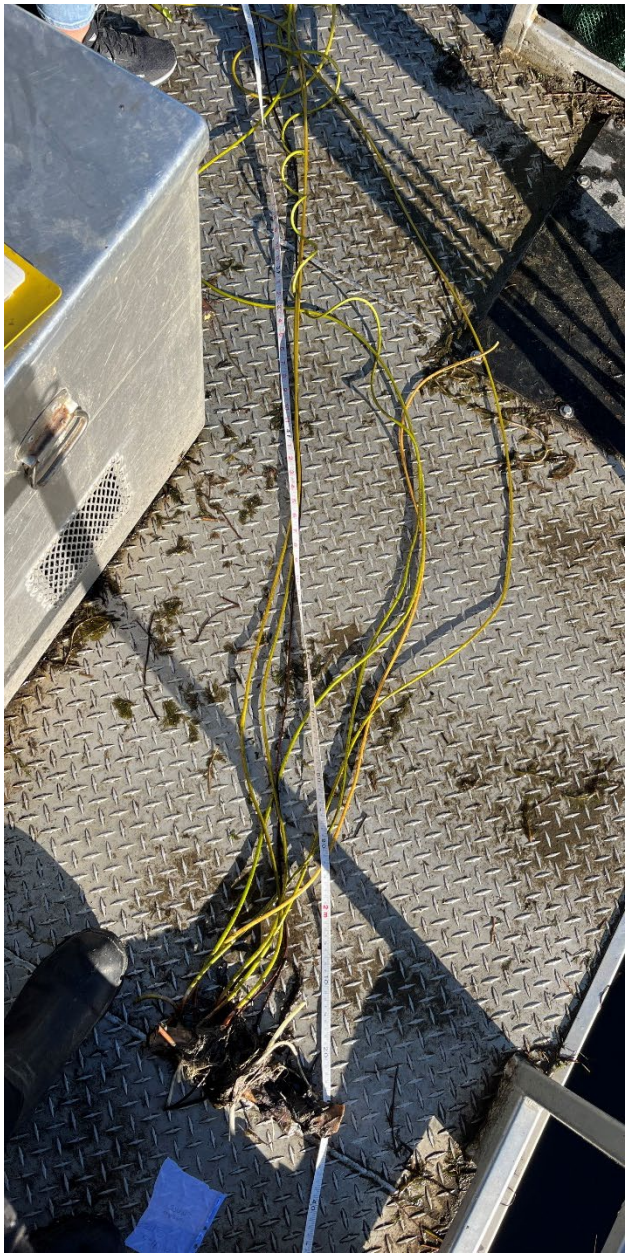
Figure 22. Site 1 – October 17, 2023 - Plant samples 1.0 m from edge of barrier (upper) and untreated control with new leaf growth outside barriers (lower).





Figure 23. Site 2 – October 17, 2023 –root sample (rotten) from 3 m under barrier (left) and suppressed root sample 0.7 m from edge (right) with short, decayed stems. Photo right - healthy untreated stem (control).





OBSERVATIONS RELATED TO INSTALLATION TECHNIQUES

When the barriers were installed, the leaves had already reached the surface. Within six weeks the leaves and stems under the barriers had decayed but the divers observed some stems with leaves along the edge of the barriers growing out to the edge and remaining healthy. These were within 0.3-0.4 m of the edge of the barrier. Ideally the barriers should be installed before the leaves reach the surface to suppress gas exchange to maximize suppression of growth.

Since the barriers require so much overlap on sides and billowed (length-wise) reducing area covered, there was fragrant waterlily left uncovered around all edges of the mats. This likely reduced the effectiveness of the treatment since leaves along the edge or between overlaps reached the surface and would enable gas exchange into portions of the roots along the edge the mats and potentially farther under the mats. In year 2 the installation will need to ensure full coverage out to the edge of the patch so there is less influence from edge effect.

In September the divers observed some stems trying to grow through the small gas exchange holes in the barrier. They also reported a few Eurasian watermilfoil plants starting to grow on the sediment on top of the barriers, likely from floating plant material that had drifted in and rooted.

The removal of the mats did create some localized turbidity due to the sediment buildup on the surface, but the turbidity remained localized to the treatment site and settled before the water flowed downstream. In the lake site the turbidity settled at the site. The operation of the boat motors did result in some turbidity as the boat was used to drag the barriers off the bottom which took quite a bit of force.

SUMMARY AND RECOMMENDATIONS

Year 1 of the project found that the lake bottom barriers installed for one season did control growth of stems and leaves and reduced the number of new shoots in fall. The roots were dead in one location sampled on site 2 and all other treated locations the roots were showing suppressed growth but remained viable after one season under the barrier.

For year 2 the barriers should be re-installed in the same locations but expanded and shifted to prevent any growth on the edge of the patch and to prevent any stalks poking through between the barriers. When the barriers are installed (if the fragrant waterlily has reached the surface) they should be dropped beyond the desired location and then dragged over the plants to lay them down in the direction, so all stems are under the barrier. Alternatively divers could be used to adjust the barriers as they are deployed to ensure they land on the target area. Once the barriers have sank to the bottom they are too heavy for the divers to move unless the boat pulls them to the surface again.

Additional mats should be purchased to ensure full coverage of site 2 and as much of site 1 as possible. For site 2 this would require 2 more 12 m x 3 m barriers (40ftx 10ft). For Site 1 this would require at least another eight 12 m x 3 m (40 ftx10ft) barriers to reach the shore on the north side of the creek.

Installation of the barriers should be timed before the leaves reach the surface to have maximum impact on suppressing gas exchange. If the plant is unable to completed gas exchange to the surface, toxic gases will build up in the roots and likely speed up death and decay.

The monitoring intervals of 6 weeks appeared to work well so should be continued. Timing of removal in the fall should coincide with natural die back of the leaves in untreated areas, unless monitoring indicates root death earlier in the season.

COMMENTS ON EXPANSION OF USE

If a program is undertaken to establish a floating benthic barrier support program with the lakeshore owners there are some environmental concerns that will need to be addressed. To minimize environmental impact from use of the barriers the following should be considered:

1. Barriers should only be used on locations dominated by >75% EWM or FL to minimize impact to native aquatic plant species (macrophytes) that provide significant fisheries habitat value. Areas with more than 25% native macrophytes should be targeted for pulling by the RDKB milfoil dive crew.
2. Do not consider using in locations with known shore spawning habitat (red zones) and high value habitat for other native fish species.
3. Limit locations that landowners can use the barriers to only the areas in front of their property near their dock. Ensure that there is some desirable aquatic plant growth remaining within a reasonable distance of barrier locations so that large areas are not denuded of all vegetation in a single season. This will help to increase passive re-establishment by native macrophytes after removal. Based on observations during the first year, the floating benthic barriers continue to provide some fish habitat value while being used, so have a much lower impact than the aqua thrusters or cutting done by some landowners which denude large areas of all vegetation. These illegal removal activities are occurring particularly at the south end of the lake.
4. Utilize the barriers for as short a period as possible each season. A previous project found complete control of EWM within 9-11 weeks (Golder and ONA 2018). The manufacturer of the floating barriers recommends 6-8 weeks, but no data was provided to back up this claim. When targeting EWM barriers should be removed as soon as the EWM plants have died.
5. The previous study in the Kootenays River in 2017 (Golder and ONA 2018) did not track recolonization levels the following season, however the RDKB Dive Crew Supervisor Phillip Maki advised based on his experience it is likely the EWM will recolonize quickly (later in the season or by following season) unless native macrophytes establish competition. It is possible that native macrophytes with large root systems may survive for short periods under the barriers required to remove the EWM and then recover later in the season. This has occurred with fragrant waterlily as part of this study. This potential should be tested in year 2 at proposed site 3 or another suitable site with a small component of native macrophytes (preferably several species) to observe their response. If this is tested the EWM under the barriers should be monitored weekly after week 6 (minimum period reported to control EWM) and the barriers removed as soon as EWM is dead to maximize potential for native macrophyte survival and recovery.
6. Involving a professional in the notification process and installation process is recommended so landowners understand the value of aquatic plants as fish habitat, role of the plants in lake health, understand the best practices to reduce environmental impact from use of the barriers, and have support to ensure installation and removal cause the least impact. General awareness work should be undertaken with lake shore owners so they better understand the value of maintaining aquatic vegetation to the health of the lake.

7. It is expected that some sites will experience rapid recovery of native aquatic plants following barrier use, particularly on sites with early colonizer species like watershield (*Brasenia schreberi*) growing within or nearby. This species was previously observed to rapidly colonise the shallow silty areas in front of the community park (B. Stewart observation) following removal of some very old benthic barriers. For locations with no native macrophytes where natural recolonization potential by native species is assessed as low, potential to re-establish low growing native macrophytes like Canada waterweed (*Elodea canadensis*) should be explored. This species is reported to be easily cultivated from cuttings and it typically grows as a low growing mat rather than upright. This would be most appropriate for EWM sites where continued presence of tall weeds will cause conflict with boat use (ie. adjacent to high use docks). It is important that any sites where barriers are being considered should be assessed by a professional prior to installation and a multi-year plan developed that includes assessing potential recolonization by native macrophytes.

REFERENCES

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