Supplemental Interim CMT Year 3 Report
Bottom Barriers
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INTRODUCTION

The Control Methods Test (CMT) Year 3 Summer 2024 Interim Special Report was published October 29, 2024 (Anderson 2024) and is available at the Tahoe Keys website link: keysweedsmanagement.org under "Resources" > "Reports". The October 29, 2024 report summarized preliminary results of Year 3 "Group B" (non-herbicide) methods except for Bottom Barriers because these treatments were still in place through early October, 2024, and the post-Bottom Barrier removal monitoring and follow-up treatments were not completed at that time. This supplement to the Year 3 Interim Report summarizes (1) the abundance and species of the aquatic invasive plants (AIP) present before Bottom Barriers were installed and during subsequent weeks post-removal; (2) turbidity monitoring during installation and removal of Bottom Barriers; and (3) macrophyte and nutrient monitoring following post-Bottom Barrier removal. It should be noted that due to unsuccessful maintenance of 75% biomass (AIP abundance) reduction in the Lake Tallac CMT Bottom Barrier sites in Year 2 (2023), no Bottom Barriers were reinstalled in Lake Tallac in 2024 (see Figure 1). Therefore, this report only includes Bottom Barrier deployments and monitoring in the West Lagoon for 2024.

While this supplemental Interim Report highlights the general results of the Bottom Barrier treatments in Year 3, the final CMT Year 3 Efficacy Report will be submitted to Tahoe Regional Planning Agency (TRPA) and Lahontan Regional Water Quality Control Board (Lahontan) in March 2025. The CMT Year 3 Report will provide the context of the Bottom Barrier results including more detailed reporting of the post-removal treatments with the other Group B methods (Diver Assisted Suction Harvesting "DASH", and UV-Spot Treatments).

BOTTOM BARRIER TREATMENT INSTALLATIONS AND REMOVAL

Bottom Barriers were used to cover smaller, specific areas within the larger CMT sites (Figure 1). The intent of these treatments was to determine if the successful reduction in AIP from Year 1 treatments (i.e., efficacy greater than 75% reduction in biovolume or biomass) could be sustained into Year 3. The locations for Bottom Barrier installations were identified on plot maps provided to divers and to monitoring crews. The areas chosen to be covered by the Bottom Barriers were selected to represent the Year 1 Group A treatments as well as a representative presence of AIP species (Eurasian watermilfoil, Curlyleaf Pondweed and Coontail). The areas selected included primarily nearshore (shallow) locations as well as some areas that included deeper water (BB Site 10a and BB Site 8 in Years 2 and 3). In Year 3, only two types of Bottom Barriers were installed: "Lake Bottom Blanket" (Lake Weed Solutions), a partially gas-permeable material, and "BTL-20 Pond Liner", a non-gas permeable material (20 mil thickness). Bottom Barrier materials were cut to fit the selected areas and cut sections were combined as necessary with an overlap. Divers installed the Bottom Barriers and secured them in place with rebar and anchors. The corners of the Bottom Barriers were georeferenced (GPS), and the NE corner was marked with an underwater label. The integrity of the Bottom Barriers was checked bi-weekly and other monitoring crews reported if abnormalities were observed.

The duration of Bottom Barrier installations in 2024 ranged from 113 to 124 days. The Bottom Barriers were in place from about mid-May/early June until early November which encompassed the typical growing season for AIP in the Keys lagoons. In some of the areas where Bottom Barriers were removed, post-removal UV or DASH treatments were used. The primary objective of the post-removal UV and DASH treatments was to control fall-sprouting Curlyleaf Pondweed turions which may have survived under the Bottom Barriers, or turions that may have been transported to the area previously covered by the Barriers. Bottom Barrier Sites 3,8,10 and 26 also received Post-Removal UV or DASH treatments to determine if AIP occurring in previously covered areas could be controlled (Table 1).

For some Bottom Barrier Site The timing and number of Post-Removal UV and DASH "Sequential Group B Treatments" is shown in Table 1.

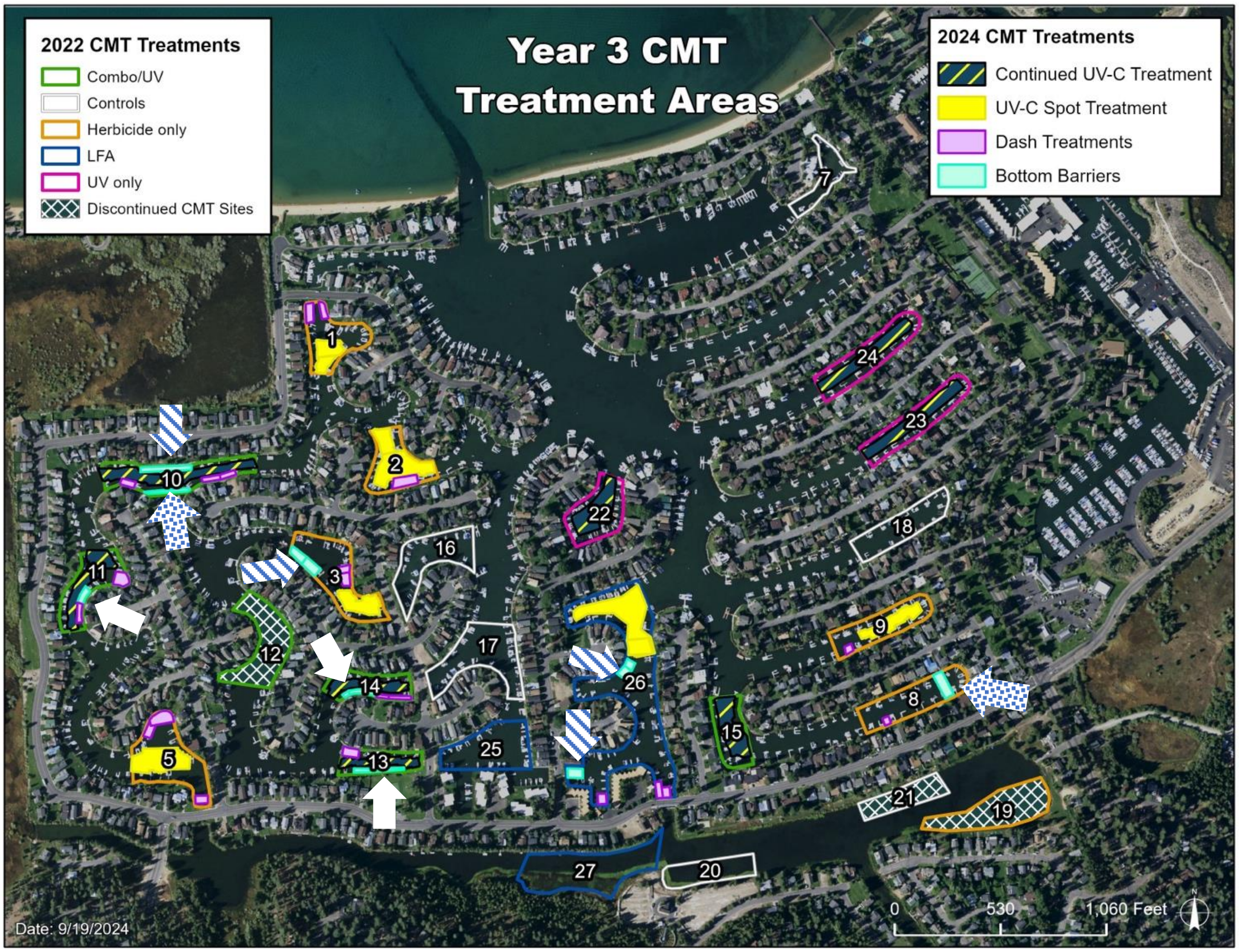


Figure 1. CMT Treatment Sites and Year 3 Group B Bottom Barrier sites: Solid White Arrows show the Bottom Barrier Areas with no Post-Removal Treatments; Stippled Arrows show Post-Removal Bottom Barrier UV treatments; Cross-hatched Arrows show Post-Removal Bottom Barrier UV treatments; Cross-hatched Arrows show Post-Removal Bottom Barrier DASH treatments. (Note: No Bottom Barriers were used in Lake Tallac in 2024.)

Table 1. Summary of CMT Year 3 Bottom Barrier (BB) Installation and Removal: Dates, Duration in Place, Presence of Debris and Plants on Top of Bottom Barriers, "Sequential" Treatment Types and Dates. (Note: Some sites required multiple days for installation or removal of Bottom Barriers.)

Site	Material	Total Sq Ft (mapped)	Installation Date(s)	Removal Date(s)	Number of Days BB's In Place	% Top of BB Covered with Dirt/Debris at Removal Date	% Top of BB Covered with Plant Growth at Removal Date	Post- BB Removal "Sequential Treatment" (Date)
3BBa2024	Pond Liner	7,439	5/20 - **5/22**	9/16 - 9/18	119	25%	0%	**DASH (10/7)**
8BBa2024	Lake Bottom Blanket	6,305	6/12 - 6/13, **6/17**	10/9	114	100%	25%	**UV (10/25)**
10BBa2024	Pond Liner	3,067	**6/6**	9/30, 10/1	117	10%	0%	**UV (10/24)**
10BBb2024	Pond Liner	6,006	6/3 - **6/5**	9/26, 9/30	117	100%	25%	**DASH (10/16)**
11BBa2024	Lake Bottom Blanket	2,358	**6/10**	10/3, 10/7	119	100%	>10%	**No Sequential Treatment**
13BBa2024	Pond Liner	4,022	**6/11**	10/2	113	100%	50%	**No Sequential Treatment**
14BBa2024	Pond Liner	3,018	**5/23**	9/19, 9/23 - 9/24	124	10%	0%	**No Sequential Treatment**
26BBa2024	Pond Liner	3,014	**5/29**	9/23 - 9/24	118	100%	>10%	**DASH (10/9)**
26BBb2024	Lake Bottom Blanket	3,975	**5/28**	9/25	120	100%	50%	**DASH (10/9)**

The detailed areas (polygons) of the Bottom Barrier installations are shown in Figures 2 through 7. Sites 3, 8, 13 and 14 had single areas in which Bottom Barriers were installed. Sites 10 and 26 each had two Bottom Barrier area installations. Sites 8 and 10a (southern BB area) included mid-channel (deep) areas, whereas the other Bottom Barriers were installed in "nearshore" shallow areas. The dots within the Bottom Barrier areas represent a single rake sample taken after removal of the barriers.

Figure 2. Bottom Barrier location in Site 3.

Figure 3. Bottom Barrier locations Site 10.

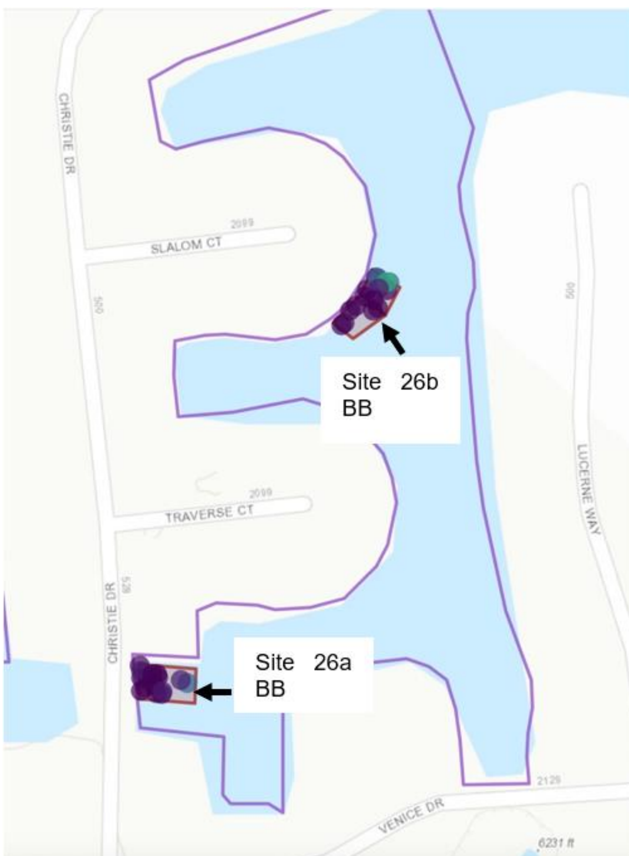


Figure 4. Bottom Barrier locations in Site 26.

Figure 5. Bottom Barrier location in Site 14.

Figure 6. Bottom Barrier location in Site 13.

Figure 7. Bottom Barrier location in Site 8.

BOTTOM BARRIER MACROPHYTE SURVEYS (AIP MONITORING)

The abundance and condition of AIP and native plants in "Pre-"and Post Bottom Barrier Removal were assessed by taking physical rake samples as described in the previous CMT report for 2022 and 2023 and the 2024 CMT Interim Report. Rake samples were taken before barrier installation and after removal of barriers. Due to the relatively small Bottom Barrier areas, and the immediate proximity of the Bottom Barriers to non-covered areas, accurately located rake sampling ensured that samples were taken within the areas to be covered as well as within the areas uncovered when Bottom Barriers were removed. To prevent damage to the Bottom Barriers, rake sampling was not done while the barriers were in place. The rake sample data provides information on the presence and abundance of AIP species as well as the desirable native plants before installations and after removal of Bottom Barriers in fall, 2024. Within 1 to 7 days after a Bottom Barrier was removed, physical rake samples were taken in the uncovered areas. In some areas, additional (sequential) UV or DASH treatments were made as described above. Following the sequential treatments, additional rake surveys were taken to determine the AIP abundance (Rake Fullness, "RF") and species present (Species Relative Abundance, "SRA"). The Bottom Barrier areas were surveyed several times in October and in early November.

It should be noted that the standard number of CMT macrophyte rake samples taken is 30 per (Group A) CMT Site (approximately 30 per acre). Since the Bottom Barrier areas were small compared to the Sites in which they were installed (Figure 1, Figures 2 through 7), the number of rake samples per square foot in each Bottom Barrier area was increased compared with the entire Site and ranged from 5 to10 per Bottom Barrier area. A summary of Bottom Barrier installation and removal turbidity monitoring results is provided in Table 2.

In addition to "focused" rake sampling in each Bottom Barrier area, the standard bi-weekly physical (rake) macrophyte sampling was continued in Year 3 in all CMT sites. Since these "non-Bottom Barrier" rake samples were taken outside the Bottom Barrier area, but within the same Site, the data represent "untreated control" conditions compared to Bottom Barrier areas. The results of macrophyte sampling from the designated CMT untreated "reference" Control Sites 16, 17, 18 serve as full-site control conditions. Therefore, the pre-installation and post-removal macrophyte samples in each specific Bottom Barrier area can be compared with conditions in the site where they were not installed, and with macrophyte sampling in the CMT Untreated Reference Control sites. All Bottom Barrier areas received at least three post-removal macrophyte surveys and most were surveyed at four times. The turbidity was monitored before, during and after barrier installation and removal. Turbidity levels were considered acceptable if turbidity did not exceed 10 percent pre-treatment levels (APAP Amendment 1, Table 11 and MMRP). The pre- and post-removal measurement turbidity values were acceptable and did not require pause in installation or removal of Bottom Barriers (see Table 2).

Table 2. Summary of CMT Year 3 Bottom Barrier Installation and Removal Turbidity

Site	Installation/ Removal	Date	Turbidity Monitoring Pre (Time)	Turbidity Monitoring Pre (Measurement)	Turbidity Monitoring Conclusion of Install/Removal (Time)	Turbidity Monitoring Conclusion of Install/Removal (Measurement)	Turbidity Monitoring 1-hour post (Time)	Turbidity Monitoring 1-hour post (Measurement)	Turbidity Monitoring Conclusion (Time)	Turbidity Monitoring Conclusion (Measurement)
3BBa2024	Installation	5/20/24	8:55	0.93	15:27	0.96	15:45	0.95	8:54	0.97
		5/21/24	8:54	1.02	15:13	0.91	15:18	0.89	15:10	0.91
		5/22/24	8:50	0.94	15:11	0.56	15:16	0.55	8:49	0.79
	Removal	9/16/24	8:30	11.19	16:30	11.40	16:45	0.49	8:30	0.50
		9/17/24	8:30	11.57	16:00	11.62	16:30	11.66	8:30	11.01
		9/18/24	8:30	11.01	8:30	9.15	N/A	N/A	N/A	N/A
8BBa2024	Installation	6/12/24	8:30	0.88	15:45	0.67	16:15	0.70	8:35	0.86
		6/13/24	8:35	0.86	14:32	0.81	15:28	0.84	10:43	0.85
		6/17/24	8:45	1.21	15:15	1.32	16:00	1.29	8:00	1.28
	Removal	10/9/24	8:36	3.25	15:30	3.29	16:30	3.10	11:53	2.95
10BBa2024	Installation	6/6/24	9:37	0.75	15:51	0.74	16:10	0.72	8:41	0.80
	Removal	9/30/24	8:00	2.54	16:00	0.12	16:30	2.60	8:30	2.41
		10/1/24	8:30	2.41	15:30	2.55	16:30	2.61	8:30	2.63
10BBb2024	Installation	6/3/24	8:00	0.67	15:45	0.70	16:15	0.71	8:30	0.66
		6/4/24	8:30	0.66	15:33	0.92	15:51	0.85	8:30	0.70
		6/5/24	8:30	0.70	15:00	0.44	15:44	0.50	8:30	0.75
	Removal	9/30/24	8:03	2.54	13:01	2.52	14:00	2.60	8:30	2.41
11BBa2024	Installation	6/10/24	8:40	0.85	16.35	0.87	17:28	0.86	11:00	0.88
		6/11/24	8:29	1.45	16:00	1.73	16:30	1.70	8:15	1.53
	Removal	10/3/24	8:30	3.60	15:02	3.67	16:00	3.62	8:30	3.40
		10/7/24	8:28	3.46	15:38	3.56	16:14	3.66	12:18	3.80
13BBa2024	Installation	6/11/24	8:29	1.45	16:00	1.73	16:30	1.70	8:15	1.53
	Removal	10/2/24	8:30	3.21	15:30	3.20	16:30	2.96	8:30	3.29
14BBa2024	Installation	5/23/24	8:49	1.53	15:50	1.56	16:23	1.47	13:14	1.44
	Removal	9/19/24	8:30	9.55	16:00	9.00	16:30	9.10	8:30	8.14
		9/23/24	8:30	3.99	11:00	3.90	12:00	4.01	8:30	3.43
		9/24/24	8:30	3.43	15:30	3.52	16:30	3.48	8:30	3.12
26BBa2024	Installation	5/29/24	8:36	1.04	13:25	0.71	13:35	0.62	14:56	0.77
	Removal	9/23/24	11:05	2.51	15:30	2.50	16:30	2.41	8:30	2.35
		9/24/24	8:30	2.35	11:00	2.15	12:00	1.98	8:30	0.68
26BBb2024	Installation	5/28/24	8:30	1.24	16:00	0.75	16:16	0.67	8:00	0.04
	Removal	9/25/24	8:40	1.01	16:00	0.90	16:30	0.99	8:30	0.77

EFFECTIVENESS OF BOTTOM BARRIER TREATMENTS

Barrier Integrity and Anchoring

The ability of the Bottom Barrier materials to control AIP requires good, reliable anchoring and maintenance of the general integrity of the Bottom Barriers. Bottom Barriers were inspected frequently (minimum of every 2 weeks), and the anchoring was adjusted if necessary. Only one Bottom Barrier required maintenance at Site 26 BBa on July 16, 2024 (see Table 1). However, during the removal of Bottom Barriers, divers noted accumulation of debris, and in some instances, plants and plant fragments on the top of the Barriers (see Table 1).

Bottom Barrier Goal: Sustain Reduced AIP Achieved in Year One: 75% Reduction in Biomass and Minimum 3 Feet Vessel Hull Clearance (VHC)

Since the Bottom Barriers remained in place for about four months, any plants, plant seed or Curlyleaf Pondweed turions beneath them would either be dead (and decomposing), or possibly might “recover” once the Bottom Barriers were removed. The multiple post-removal macrophyte surveys were made to determine if plants recovered, or if plants may have moved into the previously covered areas from un-treated areas. Since Coontail has no roots, this plant could easily move within the CMT sites and onto Bottom Barrier areas either while the Bottom Barriers were in place, or after the Bottom Barriers had been removed. Movement of Coontail plants or plant fragments is easily caused by water movement, wind, vessel activity, or by waterfowl feeding activity.

The primary assessment of Barrier effectiveness was Rake Fullness (RF) which is ranking of how much total plant material (all species) was retrieved on each rake sample. The same rake samples were examined for the relative abundance of each species (SRA) and this metric provides the percentage of rake sample represented by each species. This data is useful in determining what species were present before the Bottom Barriers were installed (see “Pre-Install” in the following graphs), and what species if any, were present after the Bottom Barriers were removed. The RF data and sample dates from the macrophyte rake sampling at each Bottom Barrier area are summarized in several bar graphs below. The RF and SRA data within the Bottom Barrier areas were also compared with the RF and SRA data from the CMT Control Sites 16, 17, and 18 in the West Lagoon. (See Figure 1).

The following graphs (Figures 8 through 15) show the average Rake Fullness (RF) for each Bottom Barrier area, and RF from rake samples taken *outside* the Bottom Barrers but within the same CMT Site. The graphs are paired so that the RF changes can be seen easily: Graphs labeled “a” show RF from bi-weekly rake samples throughout the 2024 growing season. Graphs labeled “b” show RF before Bottom Barriers were installed in spring, and after Bottom Barriers were removed in fall. (The “b” graphs show no samples during the time the Bottom Barriers were in place because rake sampling would have displaced or damaged the barrier material). Pre-Bottom Barrier macrophyte rake surveys were done in mid-May to early June depending upon the site. The post-barrier removal rake sample data (RF) are shown as sequence of Post Bottom Barrier Removal dates. The duration (days) of barrier cover is shown for each Bottom Barrier area (see Table 1 and in Figures 9 through 15).

Figure 8 provides RF values for CMT Reference “Control” sites during the 2024 growing season. The comparable dates for the “Post-Bottom Barrier Removal” RF are circled in the Control RF graph. Note that since the Control Sites were surveyed on a bi-weekly interval, these dates did not necessarily coincide exactly with the separate intervals for Bottom Barrier surveys. However, all macrophyte sampling occurred during several weeks in the fall after Bottom Barriers had been removed, and the multiple Control Site sample events (4 to 5 macrophyte monitoring events) provide a reasonable comparison between Bottom Barrier areas and the CMT Control Sites as well as comparisons with non-barrier areas adjacent to the Bottom Barriers. The RF values show that the pre-installation plant abundance was similar to both the CMT Controls, and consistent among the Bottom Barrier areas (see Figure 8 “May/June”, and Figures 9a through15a labeled “Pre-Barrier”). For the Post-Removal period, the Control Sites had an RF of about 20%, which is similar to the RF from the rake samples taken outside the Bottom Barriers (Figures 8 through 15 labeled “a”). However, the post-removal RF was consistently moderately lower, or much lower than in the non-barrier areas, or the CMT Control sites 16,17,18 (Figures 10a through 15a). This suggests that the Bottom Barriers had some residual effectiveness at least during the fall months. However, since overall conditions are poor for growth during fall (short days, low-angle light and cold water), the persistence of efficacy will have to be assessed during the growing season in 2025.

Effectiveness of Post-Removal Sequential UV and DASH Treatments

In limited number of Bottom Barrier areas (Sites 3, 8, 10a,b, 26a,b), UV or DASH "Sequential Treatments" were used following the removal of barriers. This action was taken because in Year 2, rake sampling in areas that had been covered by barriers revealed the presence of AIP within days or weeks after barrier removal. Rake sampling was used before and after the Sequential DASH or UV treatments to determine if these post-removal treatments could control AIP. The sampling data showed that these pos-removal treatments reduced AIP abundance (RF) by <10% to 50% compared with pre-treatment RF values and compared with non-covered areas. (Figures 9, 10, 11, 12, 15). Figures 10 (Site 10) and 11 (Site 11) show presence of AIP in rake samples taken seemingly within a day after complete removal of barriers, though the AIP abundance (RF) is small. The presence of AIP so soon after barrier removal may be explained by the delay from start finish, of 3 to 4 days for complete barrier removal in these sites. This may have resulted in the incursion of AIP from plants adjacent to the barrier areas that were found in rake samples the day after final removal of the barriers.

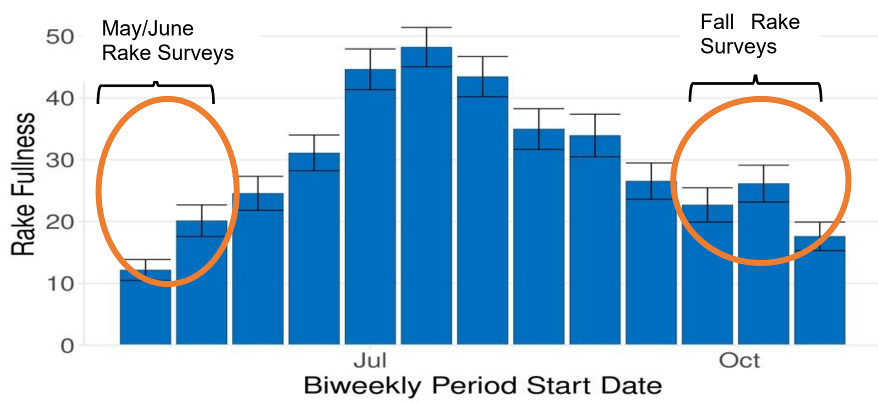


Figure 8. Average Rake Fullness in untreated reference CMT "Control" sites 16,17,18 shoreline areas during 2024 growing season. The circled bars represent dates similar Pre-Barrier and Post-Bottom Barrier removal dates (See following Figures 3 through 9 for comparison).

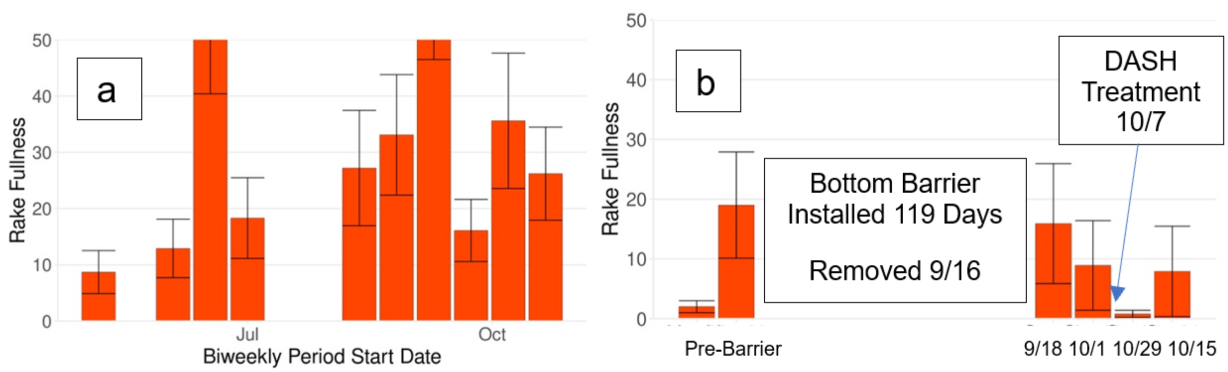


Figure 9. CMT Site 3 Rake Fullness: (a) Rake Samples outside of BB installation; (b) Rake Samples before and after BB installation within BB covered area. (Only BBSite3a Received DASH.)

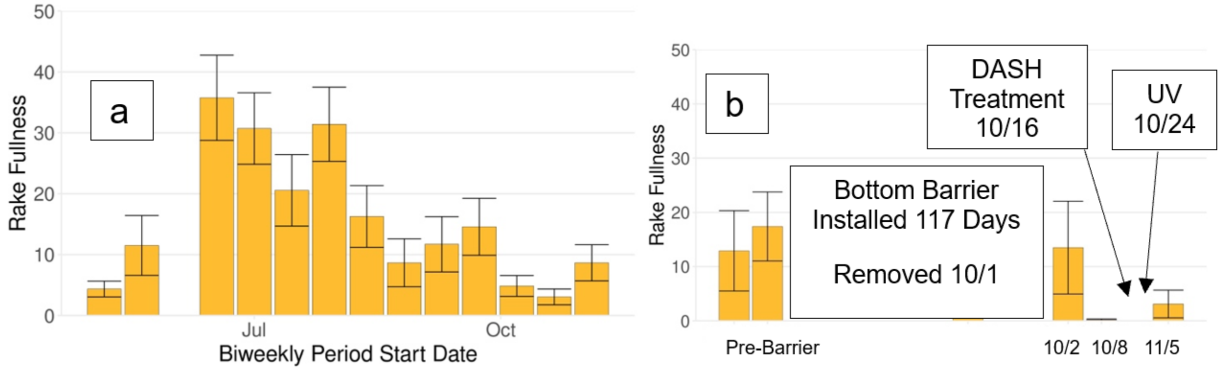


Figure 10. CMT Site 10 Rake Fullness: (a) Rake Samples outside of BB installation; (b) Rake Samples before and after BB installation within BB covered area. Site 10 has two areas: the North area was treated with a Post-removal DASH treatment; the South area was treated by UV. (Only BBSite10b received DASH; BBSite10a received UV).

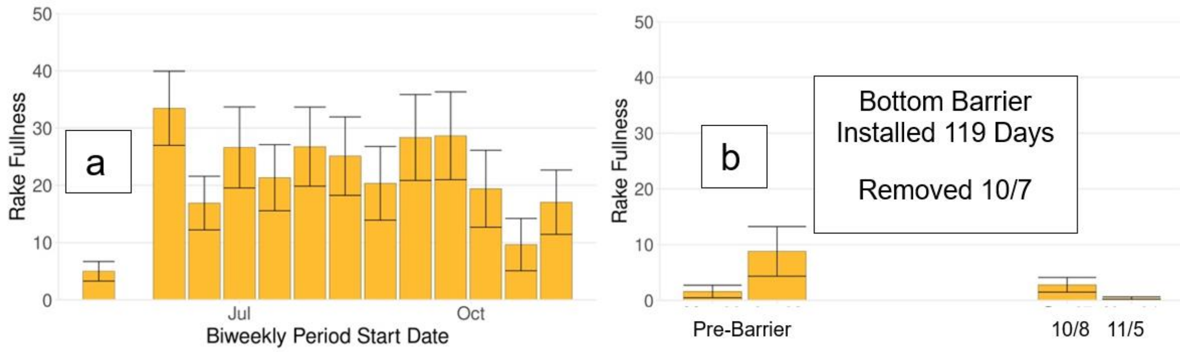


Figure 11. CMT Site 11 Rake Fullness: (a) Rake Samples outside of BB installation; (b) Rake Samples before and after BB installation within BB covered area.

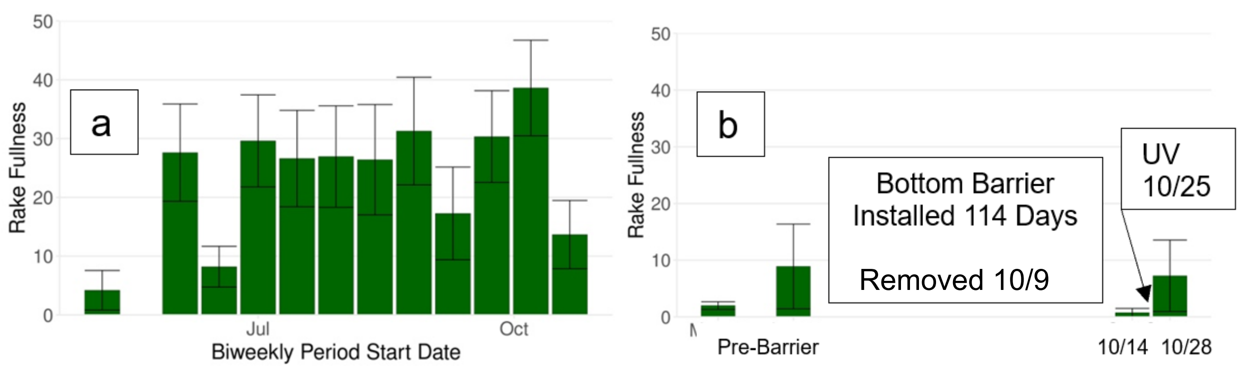


Figure 12. CMT Site 8 Rake Fullness: (a) Rake Samples outside of BB installation; (b) Rake Samples before and after BB installation within BB covered area. Site 8 had a Post-removal UV treatment.

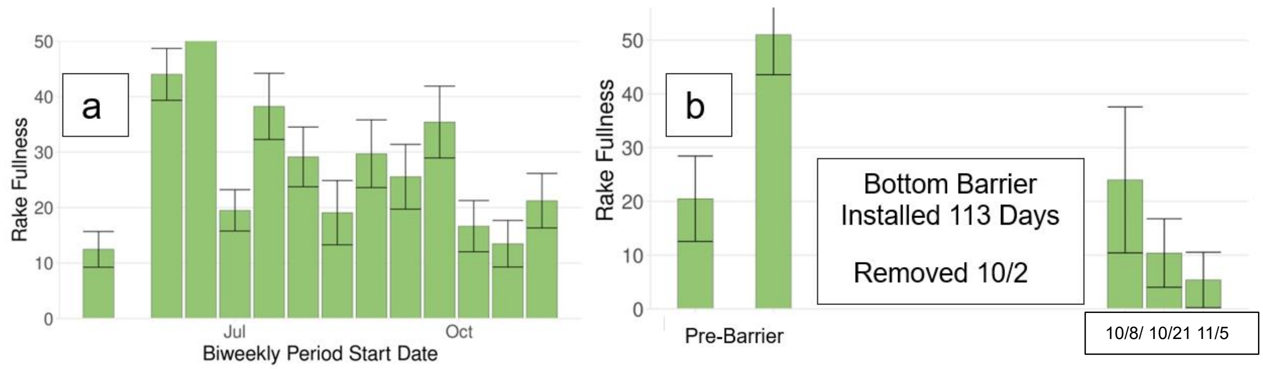


Figure 13. CMT Site 13 Rake Fullness: (a) Rake Samples outside of BB installation; (b) Rake Samples before and after BB installation within BB covered area.

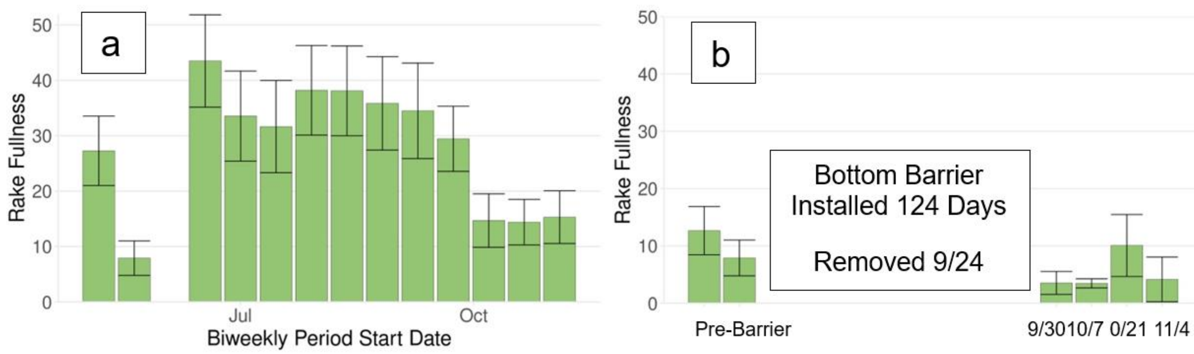


Figure 14. CMT Site14 Rake Fullness: (a) Rake Samples outside of BB installation; (b) Rake Samples before and after BB installation within BB covered area.

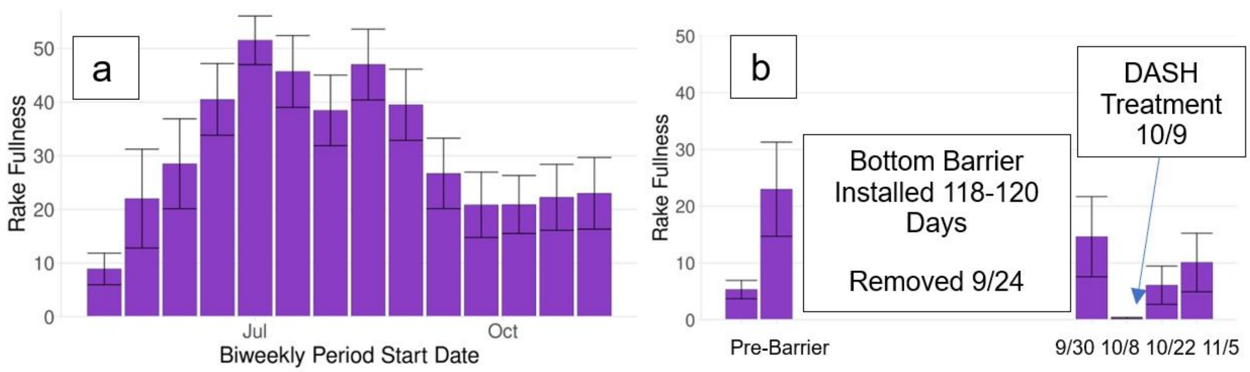


Figure 15. CMT Site 26 Rake Fullness: (a) Rake Samples outside of BB installation; (b) Rake Samples before and after BB installation within BB covered area. After removal of the BB, a single DASH treatment was made to the exposed area on 10/9 to remove sprouted Curlyleaf turions and other AIP. (Both BB Site 26a and 26b received DASH.)

Effects of Bottom Barriers on AIP and Elodea Relative Abundance

Bottom Barrier treatments are expected to suppress populations of aquatic plants beneath the cover regardless of species. However, reinfestation of the covered areas may be affected by different tolerances of plants to no light and anoxic (low dissolved oxygen) conditions allowing some species to re-establish. Reinfestation may also occur by movement of AIP (or fragments and other propagules) from adjacent areas to the previously covered areas. Data from Post-Removal rake samples provides some insight into this problem. The following graphs summarize the “Relative Abundance” of Curlyleaf Pondweed, Eurasian watermilfoil, Coontail and the desirable native plant, *Elodea canadensis*. The Pre-Barrier conditions and Post-Removal conditions are compared in one graph and the adjacent graph shows the seasonal conditions in CMT reference “Control” sites (Figures 16 through 19).

In the following graphs, the Relative Abundance of each species is shown in paired graphs. The left graph (“a”) shows abundance where no Bottom Barrier was deployed (reference “control” areas); the right graph (“b”) shows the abundance before and after removal of the Bottom Barriers. The graph showing the non-Barrier Relative Abundance of Eurasian watermilfoil also indicates the spring and fall sampling periods that coincide with the “Pre-Barrier” and “Post Barrier Removal” macrophyte survey dates. The spring and fall non-Barrier dates are good references as “controls” to compare the Bottom Barrier post-removal data.

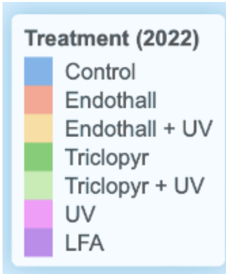
Eurasian watermilfoil was 60 to 90% less abundant in previously covered areas compared to non-Bottom Barrier areas in the weeks after Barrier Removal (Figure 16). Sites 3, 10, and 11 exhibited the most re-infestation by Eurasian watermilfoil, but these sites still had about half the abundance of the non-barrier sites in the fall.

In contrast to Eurasian watermilfoil, Coontail appeared to reinfest the barrier-covered areas quickly once they were removed in sites 8, 13, 14 where it was as abundant as in non-barrier areas. Coontail was least abundant in Sites 3 and 26 post-barrier removal. Generally, Coontail abundance was highly variable probably due to its mobility due to lack of anchoring roots; it could easily move into previous covered areas between macrophyte surveys, and this may explain the variation observed.

Curlyleaf Pondweed exhibited its typical bi-modal abundance with maximum in late June to early July, and the second peak in fall in the non-barrier areas. After removal of the Bottom Barriers, Curlyleaf Pondweed re-emerged with about the same abundance as in the non-barrier areas in the fall. This suggests that turions that were covered in spring survived for about 4 months and sprouted after removal of the Bottom Barriers. There may also have been reinfestation from adjacent areas since the turions could be transported easily into the previously covered areas. However, turion numbers appeared to be reduced compared to non-covered areas (see Turion section below).

The desirable native plant *Elodea canadensis* appeared to be least able to recover from the Bottom Barriers as it was essentially absent in the post-removal samples (Figure 19b). Figure 19a shows that Elodea is sparse in the non-barrier areas ranging from about 1 to 4 % abundance, but the Barriers appear to have reduced its presence almost completely. These results suggests that Bottom Barrier treatments do not provide selective “release” of this important native plant and in fact they are likely to further reduce its low current abundance.

The color Legend for the Relative Abundance Graphs (in percent):



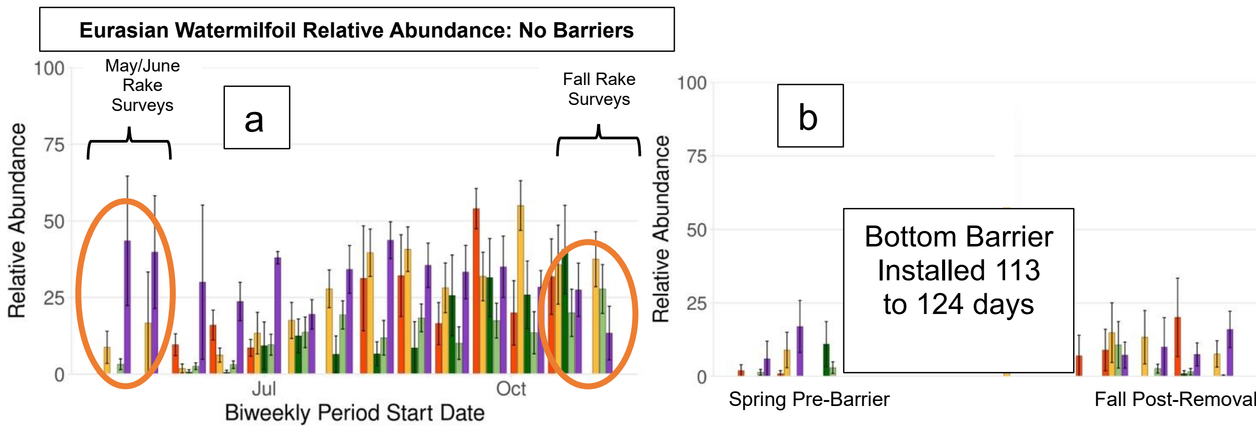


Figure 16. Relative abundance of Eurasian watermilfoil in Bottom Barrier sites: (a) Outside Barrier installations; (b) Pre-installation and after Barrier removal (September-November). The circled bars represent similar Pre-Barrier and Post-Bottom Barrier removal dates.

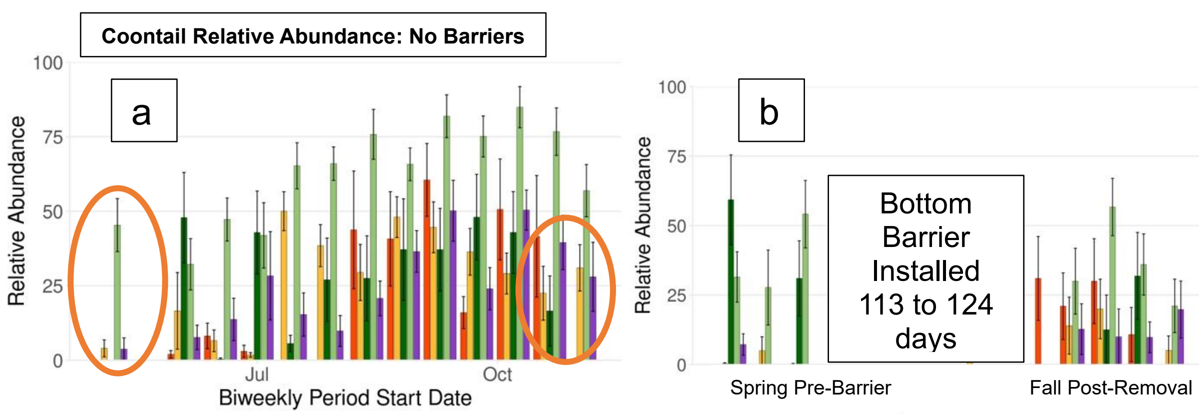


Figure 17. Relative abundance of Coontail in Bottom Barrier sites: (a) Outside Barrier installations; (b) Pre-installation and after Barrier removal (September-November). The circled bars represent similar Pre-Barrier and Post-Bottom Barrier removal dates.

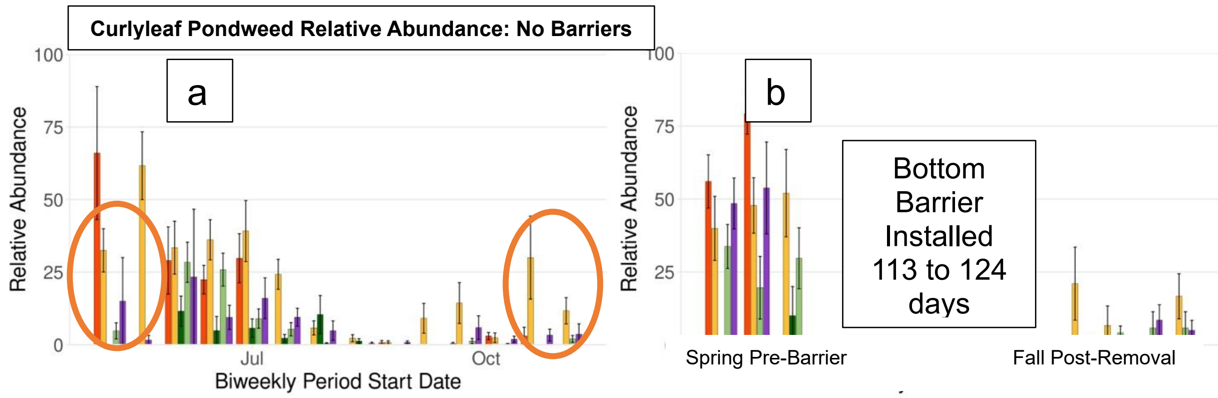


Figure 18. Relative abundance of Curlyleaf Pondweed in Bottom Barrier sites: (a) Outside Barrier installations; (b) Pre-installation and after Barrier removal (September-November). The circled bars represent similar Pre-Barrier and Post-Bottom Barrier removal dates.

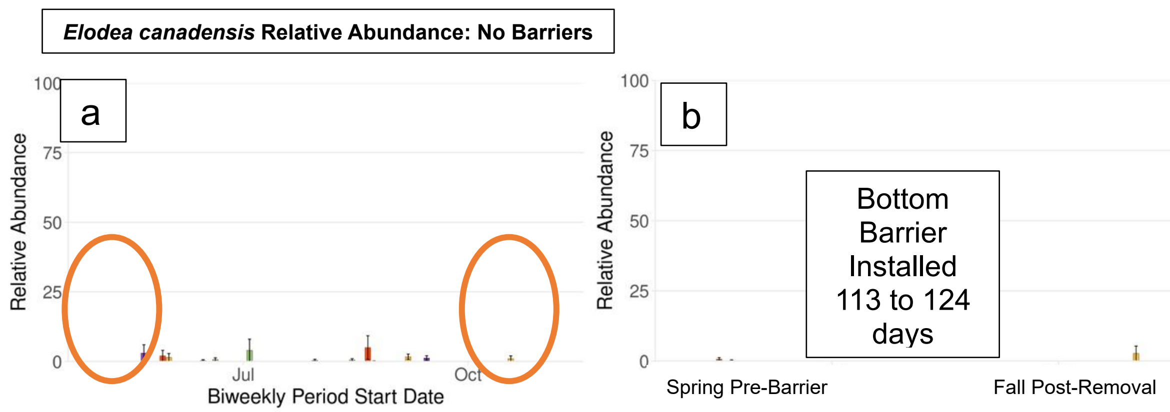


Figure 19. Relative abundance of native *Elodea canadensis* in Bottom Barrier sites: (a) Outside Barrier installations; (b) Pre-installation and after Barrier removal (September-November). The circled bars represent similar Pre-Barrier and Post-Bottom Barrier removal dates.

Effect of Bottom Barriers on Curlyleaf Pondweed turions

Curlyleaf Pondweed is the most aggressively spreading invasive plant in Lake Tahoe, and in the Keys Lagoons due to its ability to produce thousands of “dispersive” turions during the early to mid-summer months. Once formed, the turions can become dispersed while still attached to shoots or when they separate and drift to the bottom. Many, if not most of the turions then sprout in the fall and in this way, they can rapidly expand the Curlyleaf Pondweed population. Bottom Barriers can suppress, or “smother” unsprouted and sprouted turions in the spring. However, once the Bottom Barriers are removed, previously covered turions may sprout, or turions from other locations may re-infest the exposed areas due to movement from wind and the movement of boats, waterfowl, or other disturbances such as weed harvesting.

The effectiveness of the Bottom Barriers in controlling AIP was determined by conducting pre-installation spring rake surveys and follow-up “Post-Removal” rake surveys made after removal of the Bottom Barriers. The Post Removal surveys also retrieved turions that had either been “trapped” beneath the Bottom Barriers, or turions that may have re-infested the area from outside the Bottom Barriers. The number of turions per rake sample provides an assessment of Bottom Barrier effectiveness. The total number of turions per rake sample is shown for untreated reference “Control” sites 16,17,18 in Figure 20. It is clear that turion presence has two peak periods: early to mid-summer and late fall. Turions in late fall are likely unsprouted turions formed in summer or sprouted turions from the current summer or past years. For comparison, Figures 21a and 21b show turions per rake sample in areas initially not covered by Bottom Barriers in spring and the same areas uncovered in fall after barrier removal. Paired figures also show turions per rake sample “outside” the Bottom Barriers.

The data show that in fall, untreated “Control” sites had a maximum occurrence of turions of about 3 to 4 turions per rake; however, there were only 1 to 2 turions per rake sample retrieved after Bottom Barriers were removed in fall. This suggests that even though turions (and Curlyleaf Pondweed) were present a few weeks after the removal of Bottom Barriers, they were less abundant compared to adjacent areas that had not been covered for about 4 months. These results suggest that bottom barriers can reduce the production of turions beneath the covered areas by preventing Curlyleaf Pondweed growth where the barriers are installed; however, turions that were already present and covered by the barriers may survive and sprout when barriers are removed in fall.

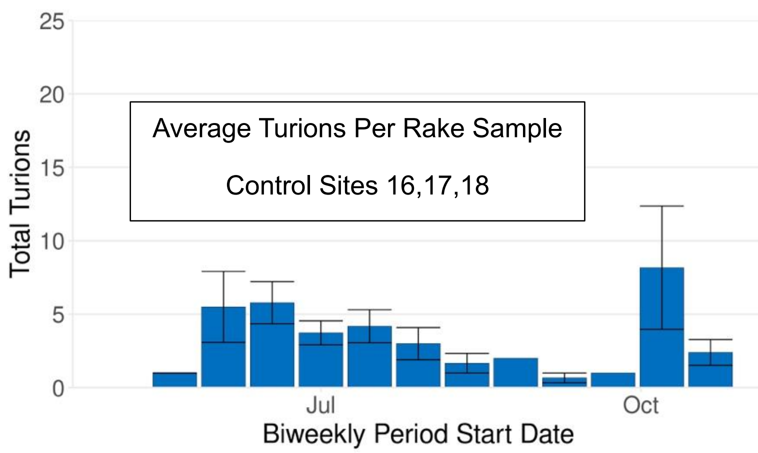
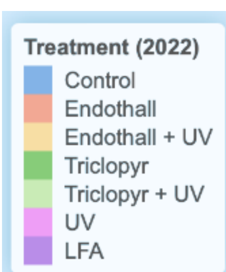


Figure 20. Number of Turions Per Rake Sample in untreated shoreline reference CMT “Control Sites”. Data are from bi-weekly macrophyte surveys in each CMT site (Shoreline samples).

The Color Legend for the following graphs of Curlyleaf Pondweed Turion abundance:



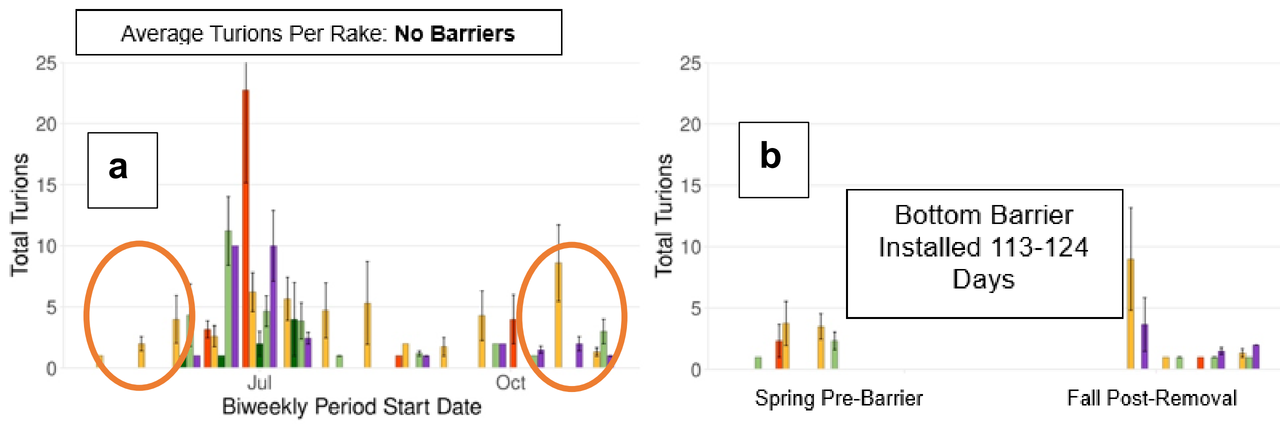


Figure 21. (a) Number of Turions Per Rake Sample in non-barrier areas of the respective Bottom Barrier Sites; (b) Number of Turions Per Rake Sample pre-Barrier installations and in Fall Post-Removal sample areas. The circled bars represent similar Pre-Barrier and Post-Bottom Barrier removal dates.

GENERAL TRENDS IN MACROPHYTE PRESENCE AND ABUNDANCE

From the RF values, it is evident that most Bottom Barrier applications were effective in most areas and sustained low AIP abundance (low RF) during the weeks sampled following the Bottom Barrier removal. Control RF levels were higher than the post-removal RFs in most cases. As in Year 2, the Species Relative Abundance data clearly shows that in most areas, Coontail was the dominant AIP present after Bottom Barriers were removed. Coontail, which has no roots, likely entered the treated areas after the Bottom Barriers were removed. This detailed species-specific data also strongly suggests that Bottom Barriers severely suppress the desirable native species *Elodea canadensis*.

In general, the time period (fall) following the Bottom Barrier removal has slower growth conditions (compared to spring or summer) for aquatic plants due to the decreasing sunlight and cooling temperatures associated with the changing of the seasons. Therefore, it would be normal for biomass (e.g., RF values) to decrease from late September to mid-November. However, Curlyleaf Pondweed typically sprouts during the fall period from turions that were produced in mid-summer. Curlyleaf Pondweed occurrences (regrowth) were noted in the post-barrier removal samples in all Sites.

In contrast to the RFs in Bottom Barrier areas, the RF values for the West Lagoon Control Sites 16, 17, and 18 during the “post-removal” sampling period are much higher (Figure 8). The RF values were also lower following barrier removal compared to adjacent non-barrier areas. The Control Sites in general as well as the LFA sites (e.g., Site 26) had a more diverse representation of AIP, particularly Eurasian watermilfoil as well as an increasing presence of Curlyleaf Pondweed.

Table 3. Summary of CMT Year 3 Bottom Barrier Methods Post-Removal Efficacy[1].

	CMT Site	CMT Year One Treatment Type	Initial Assessment of Successful Control Yes ⬆ Partial ➡ No ⬇	Notes and Limitations
Bottom Barrier (Barrier Type): PL= Pond liner LB=Lake Bottom Blanket				
	3 (PL)	Endothall only	➡	50 to 60% Reduction compared with non-Barrier areas
	8 (LB)	Triclopyr only	⬆	30 to 50 % Reduction compared with non-Barrier areas
	10 (PL)	Endothall combo	➡ ⬆	Post-UV improved reduction compared with non-Barrier areas
	11 (LB)	Endothall combo	⬆	60 to 80 % Reduction compared with non-Barrier areas
	13 (PL)	Triclopyr combo	➡	30 to 50 % Reduction compared with non-Barrier areas
	14 (PL)	Triclopyr combo	➡	30 to 50 % Reduction compared with non-Barrier areas
	26a (PL)	LFA	➡ ⬆	Post-DASH improved Reduction to 60 -80
	26b (LB)	LFA	➡ ⬆	Post-DASH improved Reduction to 75%

[1]Note: This assessment is based on RF Values determined from Rake Samples taken after removal of Bottom Barriers during late September to November 2024 compared with RF values from rake samples taken in non-barrier areas.

SUMMARY AND CONCLUSIONS

Installation, Removal and Maintenance of Bottom Barriers

The two types of Bottom Barrier required divers and top-side assistants to install. The two types were chosen for ease in installation, securing and removal. Only once installation required maintenance (re-anchoring). The turbidity was not adversely affected during installation and removal. The analysis of time and costs per acre will be discussed in the draft Final CMT Report to be released at the end of April 2025.

Efficacy of Bottom Barriers

As in Year 2 of the CMT, while the Bottom Barriers remained intact and in place, these covered areas had no visible plant growth. Due to resource limitations, and even higher water levels in 2024 than in 2023, and the differences in macrophyte growth in the various CMT sites, the timing of installations was also variable (Table 1). The duration of cover was more similar in Year 3 than Year two due to more efficient use of resources and the deletion of Bottom Barriers in Lake Tallac. As in Year 2, the most revealing data on the Bottom Barriers was the post-removal RF, as well as Species Relative Abundance. These metrics provide good assessment of both Pre-installation conditions and Post-removal “reinfestations”. Most of the barrier covered areas sustained low RF for a few weeks after Bottom Barriers were removed. The additional DASH and UV post-removal treatments helped sustain reductions in RF. As in Year 2, Coontail was the most common AIP reappearing after barrier removal. However, Curlyleaf Pondweed turions were also present after removal of Bottom Barriers, but in lower numbers than in non-barrier areas. Another concern is that when Bottom Barriers are removed there is potential for the colonization by sprouting Curlyleaf Pondweed turions. The turions can be dislodged from sediments surrounding the Bottom Barriers. Similarly, if invasive Curlyleaf Pondweed turions (or seed from this plant) survived the covering, these propagules are likely to re-infest the areas covered in 2024. This data also suggests that if Bottom Barriers are small in relationship to the overall AIP infestation, the areas covered will be more susceptible to reinfestation when barriers are removed.

Vessel Hull Clearance

While the Bottom Barriers are in place, the VHC criterion should be met since the Bottom Barriers suppress plant growth well. However, the accumulation of debris and sediments on the Bottom Barriers could easily provide sufficient substrate to support growth of AIP. Since Coontail does not require rooting, it is likely to encroach over Bottom Barriers eventually. This is particularly likely if Bottom Barrier areas are too small, which would leave large, adjacent, non-covered populations of Coontail that could easily re-infest the area from which barriers were removed. When the divers removed the Bottom Barriers, they noted debris on the Bottom Barriers including some with plants (see Table 1). Buildup of debris and incursions of AIP propagules could result in establishment of plants on top of barriers.

Native Plant Impacts

The most striking difference among the re-establishing species was the complete absence of the desirable native plant *Elodea canadensis*. Generally, these results suggest that Bottom Barriers are likely to further reduce the presence of *E. canadensis* which is already a minor constituent of the aquatic plant populations in the Keys. Bottom Barriers are non-selective AIP control methods; they cover and kill desirable native plants as well as targeted AIP. This detrimental outcome for *E. canadensis* was anticipated and noted in the CMT Year 2 Report and appears to be confirmed with the Year 3 results.

Conclusions

The Bottom Barriers effectively excluded AIP from growth beneath them as long as the Bottom Barriers remained anchored and intact. During the time the barriers are in place, the limitations include non-selectivity, reducing macroinvertebrate habitat, and a detrimental impact on desirable native aquatic plants. The addition of post-removal DASH or UV may increase the duration of effective control once Bottom Barriers are removed, but the timing and repetition of the post-removal treatments need to be carefully planned with follow-up monitoring. The potential for incursion of AIP from populations adjacent to bottom barriers suggest that if the covered areas are small, they will be highly susceptible to the re-establishment of AIP once the barriers are removed.

ACKNOWLEDGEMENTS

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