

Report on 2025 Conesus Lake Monitoring Program In-Lake Studies

Distribution, Abundance and Standing Crop of Macrophytes in Eurasian Watermilfoil-Dominated Beds



by

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Report Submitted to
The Livingston County Planning Department
January 15, 2026

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I. Summary

- As part of the watershed monitoring plan we studied the macrophyte community of Conesus Lake primarily to assess the ecological state of five major macrophyte beds monitored since 2000, and to determine if the invasive species Eurasian watermilfoil (*Myriophyllum spicatum*) continues to be dominant.
- The biomass density of all sites was much lower than the long-term averages. Graywood Gully had the highest biomass density at 115 grams/m² but that was only 45% of the average for that site.
- The surface area covered by milfoil was extremely low at Sutton Point and Cottonwood Gully Cove, continuing long term trends which indicate that unique changes are taking place at these sites. The surface area of beds at North Gully Cove, Sand Point, and Graywood were 85-88% of their long-term average.
- Standing crops (Kg dry wt. of milfoil) are the best indicator of the state of the macrophyte beds and the dominance of Eurasian watermilfoil. In 2025, all standing crops were well below long-term averages. The lowest values were 23%, 5.6% and 0.3% of the long-term averages at North Gully Cove, Sutton Point and Cottonwood Cove, respectively. Graywood and Sand Point were at 59% and 37% of their respective averages.
- Plants were nearly absent below depths of 3.5-4 m, compared to growing depths of more than 4-6 m as recently as 1985. We used GPS in coordination with observations by SCUBA divers to map the position of the offshore margin of three milfoil beds. These data will provide a baseline for future comparisons of macrophyte bed distribution.
- A lake-wide qualitative survey showed that while some areas continued to be dominated by Eurasian watermilfoil, native eelgrass (*Vallisneria americana*) has displaced the invasive Eurasian watermilfoil in two beds along the southwest region of the Lake and continues to dominate much of the shallows throughout the lake.
- Our qualitative observations are consistent with the results of a lake-wide rake toss survey of macrophytes completed by Dr. Andrew Brainard and co-workers from the Upstate Freshwater Institute and submitted along with our report. The UFI researchers found that Eurasian watermilfoil continued to be the most frequently encountered macrophyte at depths of 2-3 m in 10 locations throughout the lake.
- While Eurasian watermilfoil continues to dominate the macrophyte community of Conesus Lake, it appears to be on the decline. We discuss possible explanations for this trend. The nearly total loss of milfoil in the Sutton Point and Cottonwood Cove beds is unique. We provide observations indicating that silt-heavy runoff from the Sutton Point watershed and heavy filamentous algal growth at Cottonwood may account for the decline of macrophytes at these sites.

II. Recommendations

- There is an excellent long-term data set on the submerged macrophyte diversity and biomass for Conesus Lake, dating back to work by Herman Forest in the 1960's. These studies have been labor intensive, requiring significant use of SCUBA diving in less-than-ideal conditions. Changing monitoring priorities could make it necessary to reduce the frequency of these studies from the current rotation every fifth year. Rake toss surveys such as the one completed by Upstate Freshwater Institute in 2025 would be an effective monitoring alternative. SCUBA surveys could remain an option when monitoring priorities call for more detailed quantitative analysis.
- The great loss of macrophytes at Sutton Point and Cottonwood Cove in recent years is unique and somewhat troubling. We report seeing heavy siltation in runoff and along the lake bottom near Sutton Point Gully and surmise that siltation may be the reason for the decline of this bed. There was no evidence of heavy siltation in Cottonwood Cove, but we observed very heavy growth of filamentous algae near Cottonwood Gully. Shading and collapse of the macrophytes by filamentous algae could account for the losses seen at this location. It is evident that these two watersheds need special attention. As reported by Beers and Chislock in 2021, it may be that the management practices successfully implemented in the in these two watersheds by the USDA project from 2003-2005 are no longer effective or sufficient.
- The qualitative survey of Conesus Lake carried out in late August showed that nearshore growth of filamentous algae continues to be a major problem, especially in areas such as Sunny Shores, Wilkins Cove, Walkley's Landing/Dacola Shores, North Gully Cove and Cottonwood Cove. Filamentous algae grow rapidly in response to external nutrients. For that reason they are the most useful biological indicators of excess nutrient runoff from the watershed. Watershed management to reduce inputs of nutrients and suspended solids into the lake must remain a priority in our efforts to protect the water quality of Conesus Lake.

III. Introduction

A rich and diverse submerged macrophyte community is important to the ecological balance of lake ecosystems. Macrophytes provide crucial benefits by stabilizing sediments, competing with microalgae and cyanobacteria for nutrients and light, providing a habitat for many plants and small animals, and serving as a nursery ground for many important fish species.

The macrophytes of Conesus Lake has been studied extensively, beginning as early as 1926 when W.C. Muenschner first recognized the richness and diversity of the lake macrophyte community (Muenschner, 1927). Muenschner's initial studies were not supplemented until Geneseo Professor Herman Forest and his co-workers conducted the first thorough quantitative studies in Conesus Lake beginning in the mid 1960's. Forest and colleagues (1971, 1978; Makarewicz and Forest 1986) duplicated Muenschner's transects and sampled extensively throughout the lake, describing a diverse assemblage dominated by some of the very same species listed by Muenschner in 1927. Forest suggested that the proliferation of macrophyte beds around Conesus Lake in the 1960's was due to the invasion and spread of the canopy forming species, Eurasian watermilfoil (*Myriophyllum spicatum*). Construction of the lake perimeter sewer was in part a response to Eurasian watermilfoil overgrowth. Concern about macrophyte overgrowth waned until the late 1990's when Eurasian watermilfoil beds once again formed dense canopies along the lake margin, hindering recreational use of lake waters. This milfoil canopy in turn served as a near-surface "substrate" for the growth of filamentous algae. The great biomass of algae eventually die and decays, releasing foul odors and causing oxygen deficits that could lead to fish kills in shallow water.

Studies by Bosch and colleagues beginning in 1998 established that many of the problem growth areas in Conesus Lake were near the outlets of streams. Shallow stream deltas serve as an ideal habitat for plants, with plenty of light for photosynthesis. Moreover, runoff from streams directly provides the nutrients needed for growth, creating conditions that were especially suitable for the fast growing, opportunistic Eurasian watermilfoil. These observations were the impetus for the USDA Watershed Project, which began in earnest in 2003 with the implementation of agricultural management practices in experimental watersheds. The project continued until 2009 when several papers describing the success

of the work were published in a special issue of *Journal of Great Lakes Research* (Makarewicz *et al.*, 2009). One of the papers focused on the successful reduction of Eurasian watermilfoil growth downstream from the experimental watersheds (Bosch *et al.*, 2009). Overall the project demonstrated that nutrient management in the watershed could reduce plant growth along the lake shore in a time frame of 2-3 years. The Conesus Lake Watershed Management Plan was also written and adopted in 2003 and one of its primary goals was the implementation of watershed nutrient management practices. The management plan also included a list of priority actions that provided the framework for the Conesus Lake Watershed Monitoring Plan, in which a series of monitoring priorities were indicated which included the periodic study of the macrophyte beds that we follow today. Studies of macrophytes as directed by the monitoring plan were completed by Bosch and colleagues in 2009, 2012, 2020 and 2025 as reported in this study. We now have a very valuable recent record of the state of macrophytes in Conesus Lake that spans 28 years (1998-2025) and extends to 58 years if we include the earlier studies by Forest.

For 2025, we report lake wide decreases of Eurasian watermilfoil biomass in our five monitoring locations, with milfoil nearly disappearing in the Sutton Point and Cottonwood Cove study sites along the southwest of the lake. We suggest that the decline in milfoil at Sutton Point Gully is related to increased siltation from high-volume runoff events that have occurred more frequently in recent years (Beers and Chislock, 2021). There was no evidence of heavy siltation in Cottonwood Cove. We suggest that heavy growth of algae over several years may have inhibited the development of the macrophyte bed at this site.

IV. Methods

In July and August 2025 we sampled five macrophyte beds that have been studied by Bosch and Colleagues since 2000. These beds are located on Sutton Point and Cottonwood Gully Cove in the southwest region of the lake, in North Gully Cove to the east and Sand Point to the west along the mid-lake region, and Graywood in the northwest (see **Figure 1**). All of these sites are associated with streams that deliver high loads of nitrogen and phosphorus from the watershed, as shown in studies by Michael Chislock and Colleagues at SUNY Brockport (Beers and Chislock 2021). The dominant macrophyte species at all sites has been Eurasian watermilfoil, which accounted for more than 85% of

the macrophyte biomass at depths of 2-3 m (Bosch et al., 2020). Our goal as part of the 2025 monitoring program was to determine the biomass density, surface area and total standing crop of these five macrophyte beds in 2025 and to compare current trends to the historical record. Sampling was carried out between July 29-August 8, 2025.

The beds were first mapped in late July using GPS to determine their areal coverage. The procedure calls for a snorkeler to track the perimeter of each bed while signaling positions (by slapping the water surface) to a recorder standing on a trailing pontoon boat logging positions as waypoints in a Garmin GPS. At each location mapping was carried out for the whole macrophyte bed and separately for portions of the whole bed where Eurasian watermilfoil made up more than 25% of the visible biomass. Multiple independently surveyed mapping surveys were made for Sand Point Gully (n=2), North Gully Cove (n=2) and Sutton Point to assess the precision of our measurements. ArcGIS software was used to compile waypoints into a shape and to generate an accurate estimate of surface area.

Collections to determine the density (mass/area) of macrophytes were made on July 29 at the Sand Point site, July 31 in North Gully Cove on, August 5 at Graywood, August 7 at Cottonwood Gully and August 21 at Sutton Point (**Figure 1**). SCUBA divers collected triplicate 0.25 m² quadrat samples at four depths along three previously established transects, totaling 36 quadrats per macrophyte bed. The PVC pipe quadrat (with one side removed for ease of positioning) was placed on the lake bottom and all shoot biomass was harvested by hand. The methods used to quantify macrophyte biomass are described in previous technical reports (Bosch *et al.*, 2012) and a more detailed account can be found in the published studies of the U.S.D.A. Watershed Study (Bosch *et al.* 2009). Briefly, samples were sorted to species in the laboratory, blotted dry with paper towels and weighed separately to the nearest 0.1 gram. The dry weight of each species was calculated using previously determined species specific blotted wet weight to dry weight conversions. The standing crop in Kg total weight was calculated by multiplying the average quadrat biomass for the 2-3 m samples dominated by milfoil times the surface area of the milfoil dominated area.

To determine the maximum depth of macrophyte habitation we devised a method that combined the mapping strategy used to determine bed surface area with SCUBA diver

depth measurements. A SCUBA diver would swim along the offshore perimeter of each bed stopping every few meters to obtain a bottom depth reading. At that point the diver would signal a snorkeler at the surface who would then relay the position to a third person holding a Garmin GPS on the trailing boat. The waypoints collected were matched to depth readings and graphed to generate plots showing the trajectory and depth of the offshore perimeter for each bed.

A qualitative survey was conducted to estimate the macrophyte biomass and filamentous algal cover lake wide. The sites sampled were the same that were sampled in 2020 when we first conducted these surveys. For each location we recorded the dominant macrophyte species, qualitative estimates of the biomass density (High, Moderate, Sparse, None) and qualitative estimates of filamentous algal cover. This survey was complementary to a lake wide rake toss survey of macrophyte species composition and abundance carried out by Dr. Andrew Brainard and co-workers from the Upstate Freshwater Institute. The description and analysis of their results is submitted as a stand-alone document along with this report.

V. Results and Discussion

Quadrat Biomass, Surface Area and Standing Crop

Quadrat biomass was consistently low, near 100 mg/m² at depths of 1.5-3 m for the Sant Point, and North Gully sites (**Figure 2, Table1**). At the Graywood site, we found healthy plants with quadrat biomass exceeding 200 mg/m² at 1.5 – 2 m depth. Biomass dropped to 49 mg/ m² at 3 m, and 10 mg/ m² at 4 m. These are depths that in previous years were occupied by very dense growth of Eurasian watermilfoil and coontail (*Ceratophyllum demersum*). There were certainly tall healthy milfoil plants at those depths, just not very many. At depths of 1-4 m, Cottonwood Cove was also historically occupied by a very dense milfoil-dominated bed. However, in 2025 the biomass was very low and, except at the shallowest depths, there was very little watermilfoil (**Figure 2, Table 1**). At Sutton Point watermilfoil was also very sparse and it was present only in one small area along our northern transect.

In contrast to the low quadrat biomass of 2025, the surface areas obtained for three of the beds were very close to the long-term averages (**Figure 3, Table 2**). This was not the case for Cottonwood Cove and Sutton Point, where the macrophyte beds were 8.7% and 6.7% of their past average cover (**Figure 3D-E, Table 2**). It is notable that the 2025 surface areas of the whole beds (**Table 2**) were very similar to the total area covered by milfoil during years of peak growth. For example, the size of the whole North Gully Cove bed in 2025 was 22,444 m² (about 5.5 acres). A look back at the history for this site (**Table 3A**) shows that milfoil alone exceeded the 2025 surface area in 5 of 14 years (2000, 2001, 2004, 2007, 2009).

The strongest indicator of the state of the macrophyte beds and the dominance of Eurasian watermilfoil in Conesus Lake is the standing crop, which combines the average quadrat biomass (**Table 1**) and the surface area dominated by Eurasian watermilfoil (**Table 2**) into one value. Comparing 2025 data to historical average standing crops, Eurasian watermilfoil covered 58.6% and 37.0% of the long-term averages in Graywood and Sand Point and 0.3%, 5.8 % and 23.2% at Cottonwood Cove, Sutton Point and North Gully, respectively (**Figure 4, Table 3**). For these last three beds, the low 2025 standing crops are the continuation of a decline that may have started as far back as 2010.

Caution should be taken in extrapolating our findings from these five study sites to the whole lake, as milfoil populations were thriving in some areas that were not sampled. At Pebble Beach Cove, for example, we noted the return of a very healthy milfoil bed that had all but disappeared in the last 15 years. Milfoil was also abundant in deeper parts of the large bed directly south of Vitale Park near the outlet, and in most of Wilkins Cove, just south of Wilkins Creek. More detailed information on lake-wide trends can be found in the results of the rake toss survey conducted by Dr. Andrew Brainard and Co-workers (submitted with this report). The UFI researchers found that Eurasian watermilfoil was the most frequently encountered macrophyte at moderate to dense abundance in 10 locations throughout the lake. The report goes on to say that “the areas with the greatest abundance of Eurasian watermilfoil were primarily within the intermediate depth zone (2-3 m) and included Eagle Point (East and West), the outlet, Pebble Beach and Wilkins Creek.” Their observation that milfoil is abundant in some parts of the lake substantiates our impressions from a qualitative lake-wide survey of plant growth (**Table 4**).

Overall the results of the 2025 multi-method monitoring show that while Eurasian milfoil populations have generally declined in major areas of Conesus Lake, the species is still dominant in the macrophyte community and in some locations it continues to form very dense assemblages that compromise recreational use of lake waters. Moreover, milfoil and other macrophytes negatively affect water quality by providing an ideal substrate for growth of filamentous algae. In our lake-wide qualitative survey we found that many shoreline areas of the lake were covered by filamentous algae. Notable among these areas of filamentous growth were Wilkins Cove south of Wilkins Creek, North Gully Cove south of North Gully, Walkley's Landing/Dacola Shores near North MacMillan Creek, and parts of the Sunny Shores coastal zone near an unnamed tributary, where we saw the highest algal cover anywhere in the lake.

It is plausible that the general decline in Eurasian watermilfoil/macrophyte biomass might be a result of increasing water column turbidity over time. We know from other monitoring studies that prior to 1980 Conesus Lake were very clear, with average summer Secchi depths of 4.5-5 m and maxima as deep as 7 m. Under these conditions, macrophytes grew abundantly at depths of 4-5 m (**Figure 5A**) and as deep as 7 m. Lake turbidity increased significantly during the 1980's due to higher phytoplankton biomass after the most important phytoplankton consumer, *Daphnia pulex*, was essentially eliminated by the planktivorous invasive alewife (*Alosa pseudoharengus*). By the late 1990's, when Bosch and Colleagues began their studies of macrophytes in Conesus Lake, growth at depths of 4 m and below had declined significantly (**Figure 5B**). The depth of macrophyte growth is limited by light and it is likely that the shallowing/narrowing of the macrophyte growth zone was due to reduced light penetration. The turbidity of lake waters has continued to increase since 2011. This increase is due to regular calcium carbonate precipitation events (known as whittings) that last two to three weeks in July which is a crucial period for macrophyte growth. During the whitening events, the depth of light penetration into the water column may be reduced by as much as 2 m. This may have been the cause of additional shallowing of macrophyte beds as indicated by data from 2025 showing that on average only 2-3% of the plant biomass was found at a depth of 4 m (**Figure 5C**). To document this change more precisely, in 2025 we carried out a targeted SCUBA diver survey to map the position and depth of the outer margin of the macrophyte

beds at three of our study sites. The results showed that on average there was very little growth at 4 m (**Figure 6**). We located a few places where plants grew in deeper waters, but they were the exception.

Whiting events alone cannot explain the loss of milfoil from the Cottonwood Cove and Sutton Point beds, as no other part of the lake shows such a dramatic change. Whatever the cause, it must be site-specific. When we first visited Sutton point on late July 24, the shallow nearshore area normally occupied by the macrophyte bed was fully immersed in silt-laden water. Visibility from the surface was less than 0.5 meters. A month later when we mapped the macrophytes at this site using SCUBA we found that most of the bottom near Sutton Point was covered in very fine silt that was easily agitated. Near the mouth of Sutton Point Gully we observed an area of nearly 1000 m² that was blanketed by a thick layer of mud on which there was no macrophyte growth (see **Figure 3E** map). During the USDA project from 2003-2009, the Sutton Point Gully watershed was an experimental site in which gully plugs were installed and 60% of the cropland was converted to alfalfa, which does not require nitrogen fertilizer. In 2021, Beers and Chislock studied nutrient and sediment loading by Sutton Point Gully documented loads of most nutrients as well as suspended solids that were elevated compared to historical data. The researches =concluded that BMPs in the watershed did not perform during heavy storm events. Cottonwood Gully was another USDA experimental watershed in which numerous BMPs were implemented in 2004-2005. Beers and Chislock found that in 2021 total suspended solids were the greatest since the BMPs had been implemented. We saw no evidence of heavy siltation in Cottonwood Cove, but all the plants remaining at this site were covered by heavy growth of filamentous algae that could shade or even collapse the plants. We conclude from our observations along the lake shore that Sutton Point Gully and Cottonwood Gully watersheds need renewed attention and management to reduce loading of nutrients and sediments that are clearly disrupting normal ecological processes along the shoreline.

VI. Conclusions

We found that Eurasian watermilfoil beds with moderately high biomass persisted in several areas of the lake very much as they had for at least the last 25 years. Specifically, at the Sand Point, North Gully Cove and Graywood long-term study sites, the macrophyte community continued to be dominated by populations of the invasive milfoil. In contrast, at Sutton Point and the Cottonwood Cove we documented the disappearance of what were once thriving macrophyte beds densely populated by Eurasian watermilfoil. We suggest that the growth of macrophytes in Conesus Lake has been limited by light availability as lake waters have become more turbid over the last 50 years. This hypothesis is supported by the fact that macrophytes generally no longer grow at depths where they were once abundant below 3.5-4 m. It may be that biomass production even in the shallows is now light-limited. However, light limitation alone cannot explain the demise of the Sutton Point and Cottonwood Gully macrophyte beds. We propose that heavy siltation during runoff events from Sutton Point Gully and heavy growth of filamentous algae from nutrients delivered by Cottonwood Gully could explain the demise of the two macrophyte beds. If true, this highlights the need for additional research and management to mitigate the loss of nutrients and sediment from these watersheds that seem to be disrupting normal ecological processes downstream in lake habitats.

VII. Acknowledgements

We would like to express our gratitude to a number of people who continue to help us accomplish the goals of the Conesus Lake summer monitoring program: SUNY Geneseo's Biology Department, Dr. Anne Baldwin, Betsy Colón and Sheila McCart of Geneseo's Office of Sponsored Research and Sponsored Programs Administration; Heather Ferrero, Deputy Planning Director and Mary Underhill, Conesus Lake Watershed Manager for the Livingston County Planning Department. This research project was funded by a grant from Finger Lakes -Lake Ontario Watershed Alliance administered by the Department of Environmental Conservation and the Livingston County Planning Department.

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IX. Figures and Tables

Figures

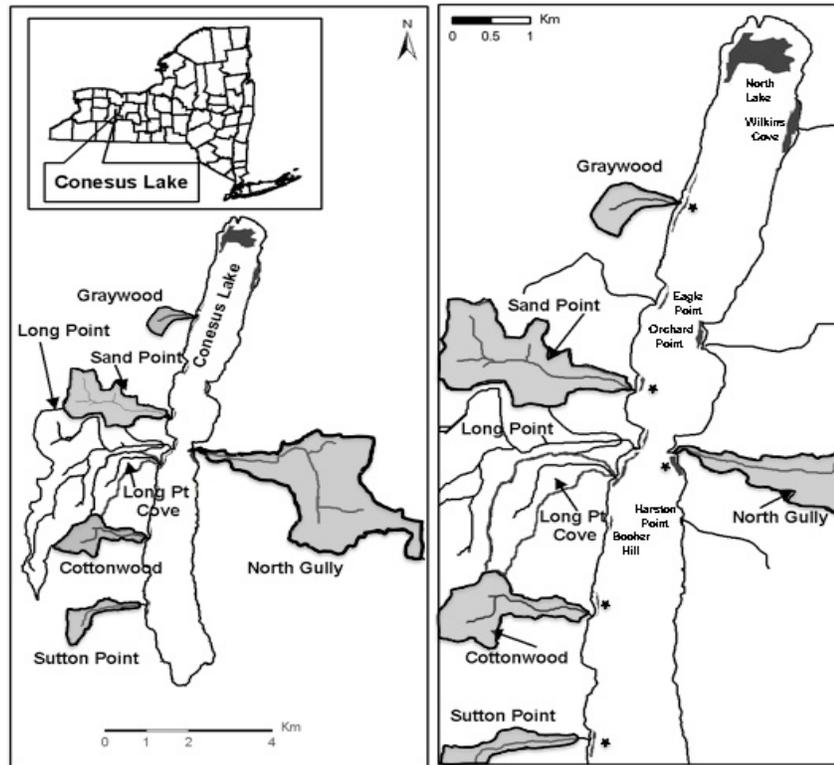


Figure 1. Maps showing some of the largest macrophyte beds and their associated sub-watersheds in their geo-referenced positions. On the right, areas studied in 2025 are identified by a star symbol.

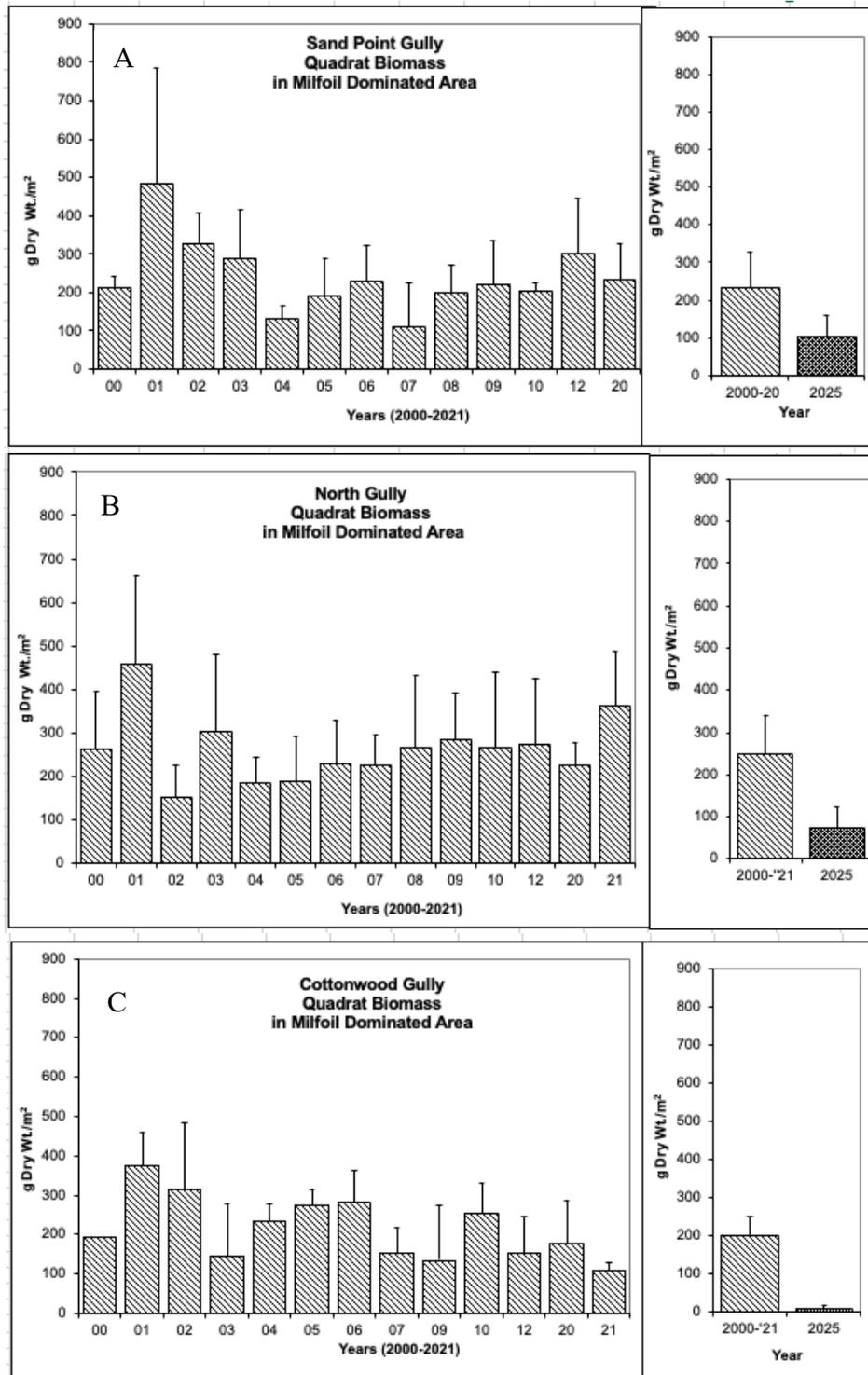


Figure 2. Long term trends in quadrat biomass for representative macrophyte beds showing below average biomass in 2025. (A) Sand Point (B) North Gully Cove; (C) Cottonwood Gully.

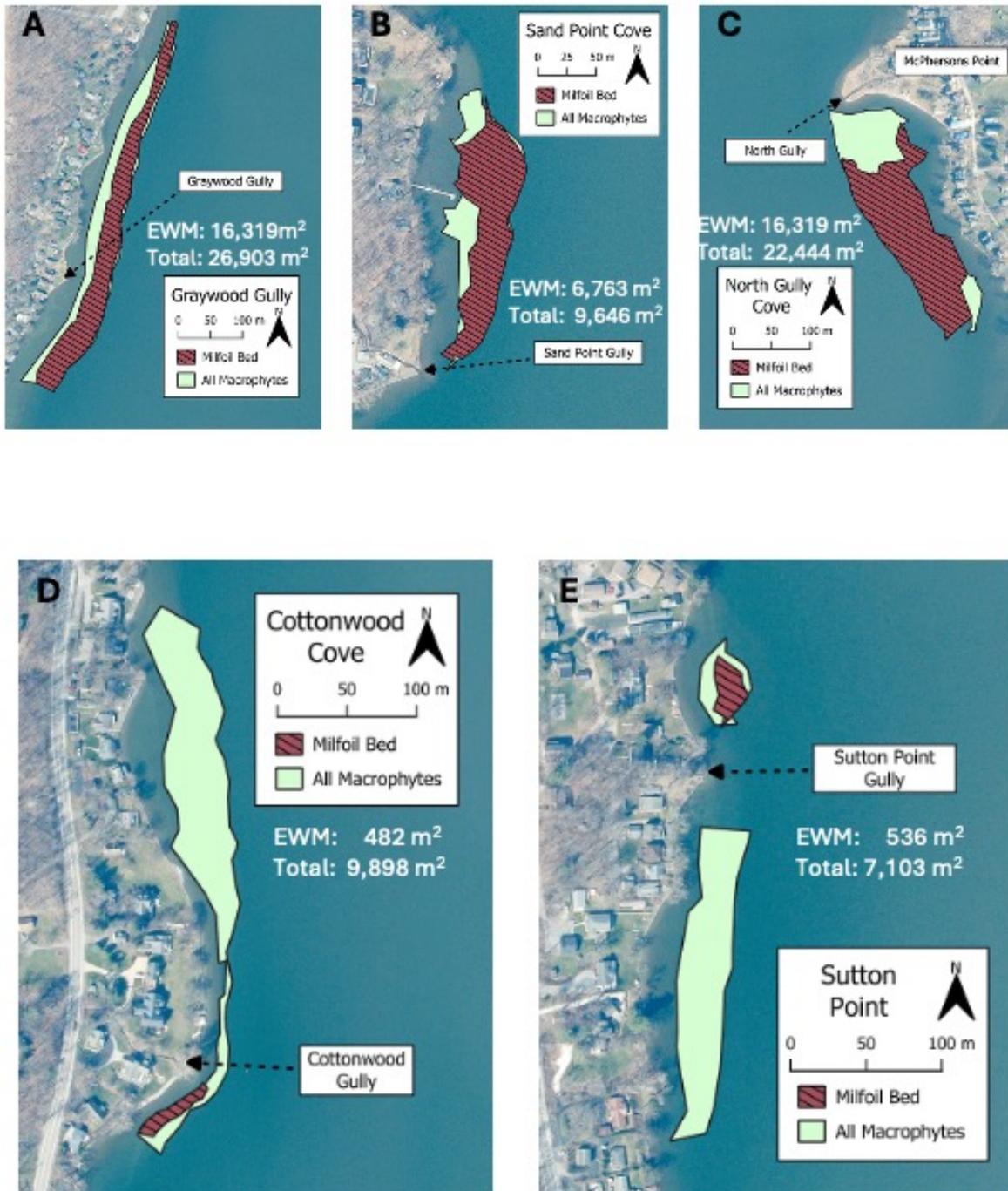


Figure 3. Images showing georeferenced maps of whole macrophyte beds and milfoil dominated regions at Graywood (A), Sand Point (B), North Gully Cove(C), Cottonwood Cove (D) and Sutton Point (E). The surface area of whole beds and regions dominated by milfoil are listed in m² (1 acre = 4,047 m²). The area of no plant growth at Sutton Point was covered with mud, presumably remaining from recent precipitation events.

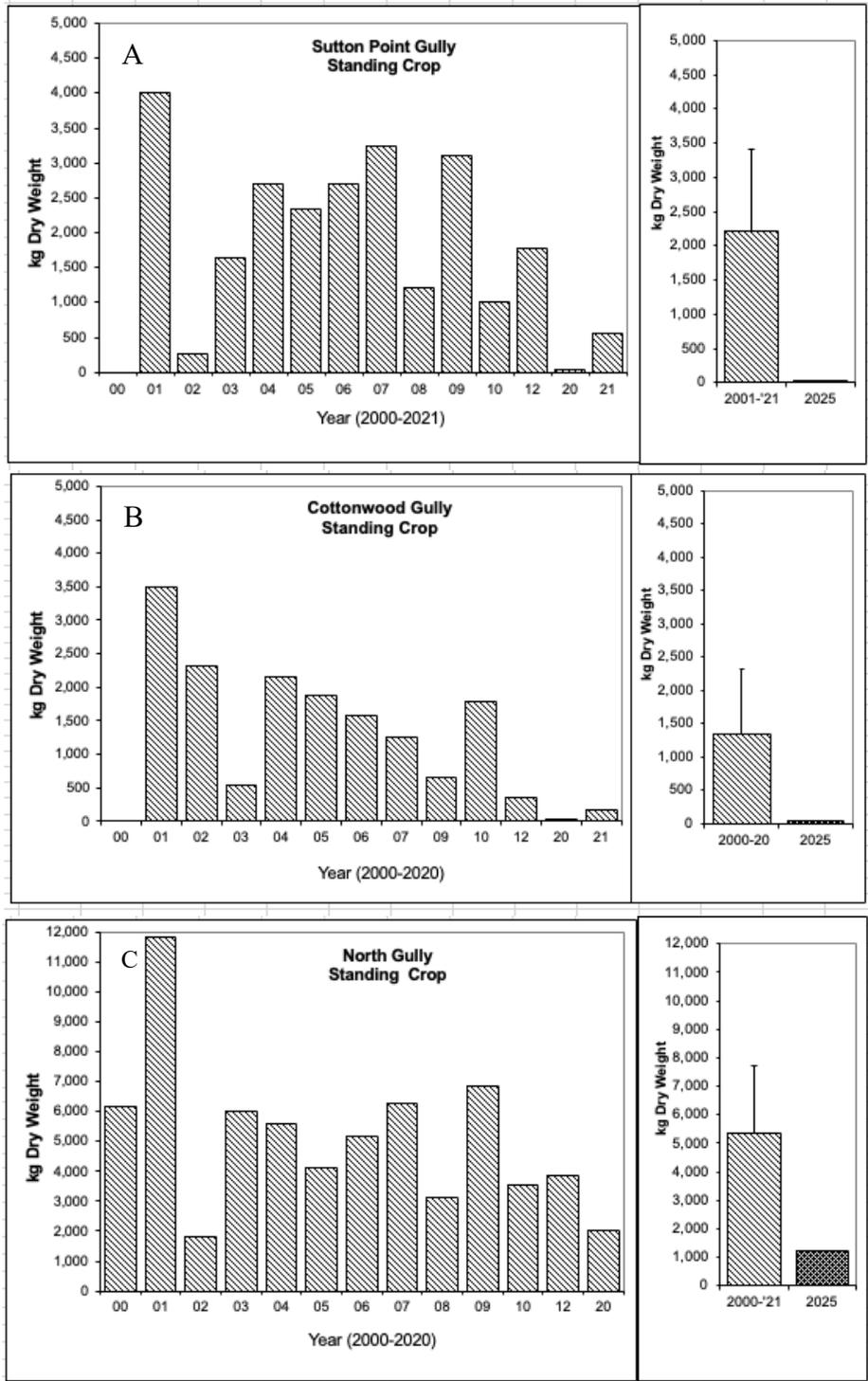


Figure 4. These graphs show historical trends in macrophyte **standing crop** as total kg dry weight of macrophytes for beds showing the greatest declines. Standing crop in 2025 was low for all beds but especially for Sutton Point Gully (A), Cottonwood Gully (B), and North Gully (C), continuing a years-long decline at these three sites.

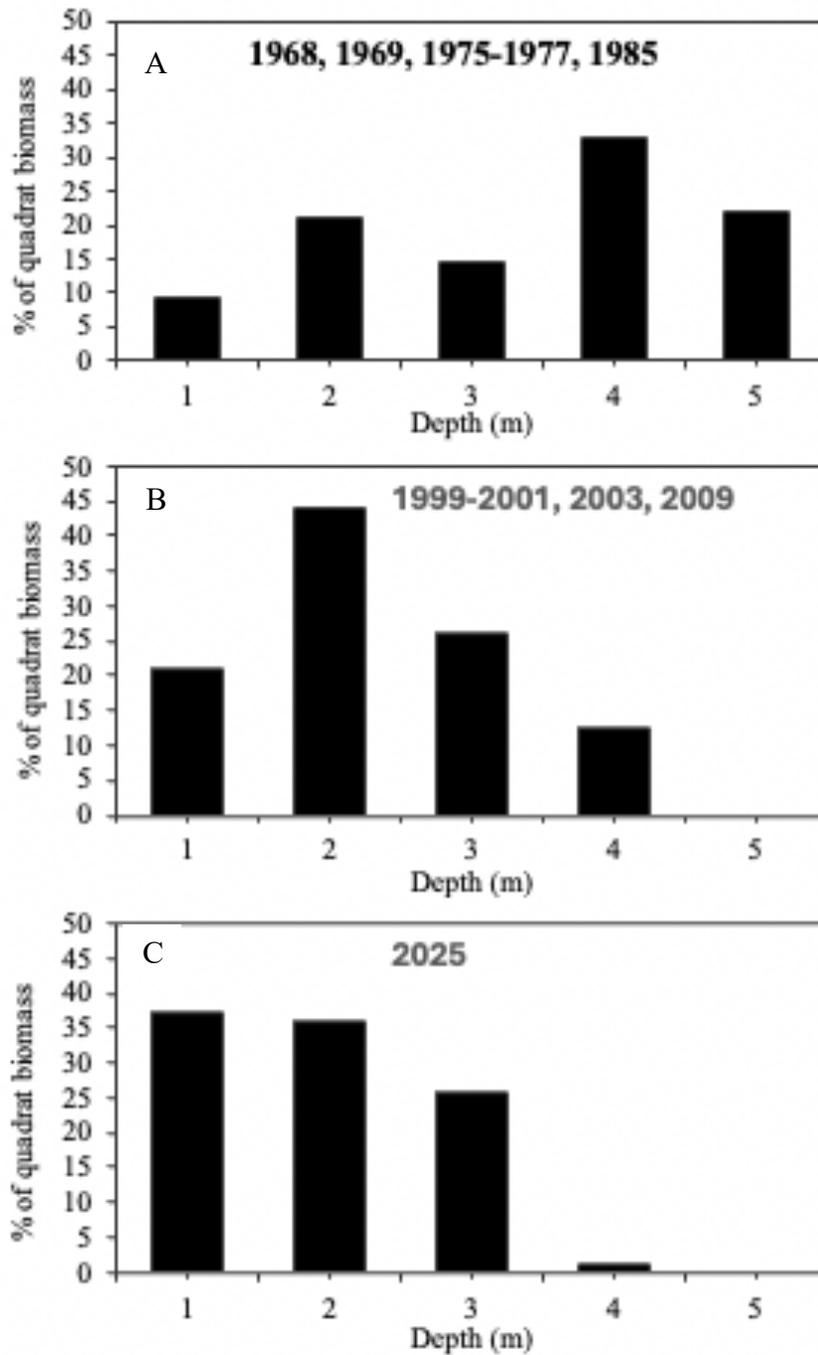


Figure 5. Change in the relative distribution of macrophyte biomass with respect to depth. Data are averages from work by Herman Forest and Colleagues (1968-1985) (A), Bosch and Colleagues (1999-2009) (B), and from the current study (C). This comparison shows that macrophytes once occupied a much wider depth range, living at depths of 5 m and more. The most recent data from 2025 shows that the macrophyte community is restricted to the upper 3-4 meters, with minor exceptions.

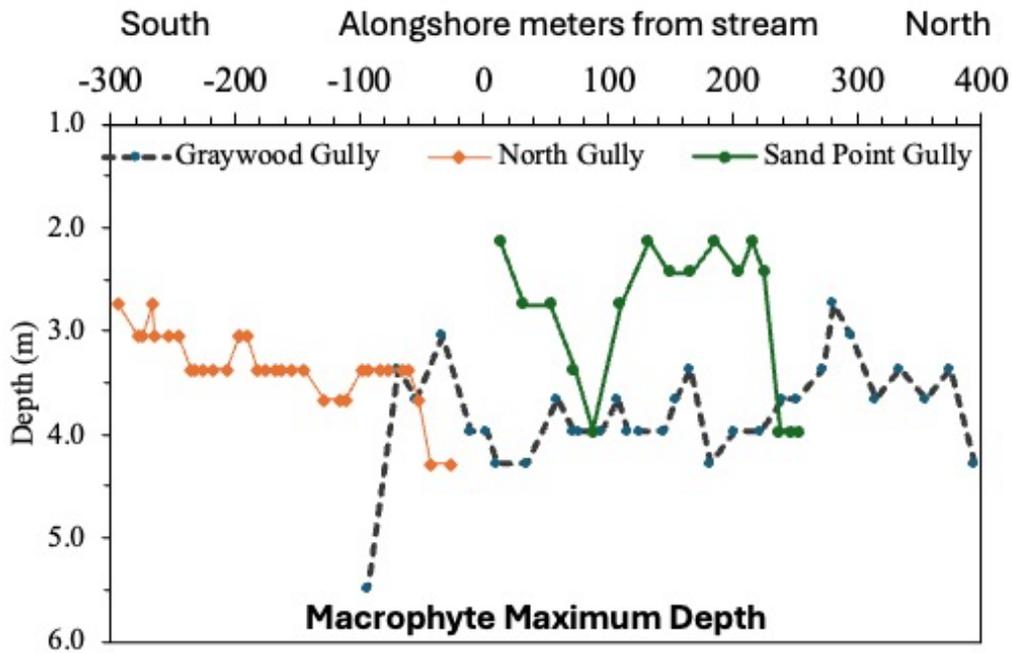


Figure 6. Maximum depth of macrophyte distribution along the offshore margin of several macrophyte beds in 2025. The Graywood Gully bed has a small region of deep growth to 5.5 m by *Ceratophyllum demersum* (coontail), but such deep growth is certainly the exception.

Tables

Table 1. Summary of quadrat biomass data from 2025 SCUBA diver surveys. The values are typically the average of 3 quadrats. Generally, the biomass values are very low, as shown in Figures 4 and 5.

Milfoil Bed Location	Macrophytes grams /m² mean + S.D.	Eur. watermilfoil grams /m² Mean + S.D	Percent Milfoil
Sand Point			
1.5 m	108± 49	93 ± 38	86.1
2 m	111 ± 44	102 ± 41	91.9
3 m	107± 56	107± 56	100.0
4 m	5 ± 5	5 ± 5	100.0
North G. Cove			
1.5 m	71 ± 69	58 ± 66	81.7
2 m	78 ± 2	65 ± 5	83.3
3 m	67 ± 21	28 ± 16	41.8
4 m	0	0	0
Graywood			
1.5 m	254 ± 22	208 ± 33	81.9
2 m	211 ± 6	204 ± 16	96.7
3 m	49 ± 17	27 ± 17	55.1
4 m	10 ± 18	0.2 ± 0.5	2.0
Cottonwood Cove			
1.5 m	39	35 ± 7	91.8
2 m	10 ± 2	0.1 ± 0.3	1.0
3 m	4 ± 3	0.1 ± 0.4	1.8
4 m	0	0	0.0
Sutton Point			
1.5 m	--	--	--
2 m	115	10.6	9.2
3 m	129	0	0.0
4 m	5.8	0	0.0

Table 2. Surface area analysis of milfoil beds showing 2025 data compared to long term averages.

Macrophyte Bed Location	Milfoil Bed Cover (m ²)				Whole Bed Area (m ²)
	Long Term Average	Long Term Range	2025 Avg. ± S.D. & CV	% of Long Term Average	
Graywood Gully	18,604	6,703 - 27,170	16,319	88	26,903
Sand Point Gully	7,653	3,846 - 9,857	6,763 ± 10 <i>n=2 CV= 14.9</i>	88	9,646
North Gully	19,280	8,920 - 30,099	16,563 ± 1,863 <i>n=2 CV=11.2</i>	86	22,444
Cottonwood Gully	5,533	269- 9,387	482	9	9,898
Sutton Point Gully	7,954	343 - 13,802	536 ± 95 <i>n=2 CV=17.8</i>	7	7,103

Table 3A. Historical data on macrophyte biomass, bed surface area, and standing crop for the North Gully Cove and Sand Point Gully macrophyte beds. We use the average dry wt. biomass of Eurasian watermilfoil at 2-3 m to calculate the standing crop.

Location	Year	Average Milfoil Dry Wt. grams . m ²	Surface Area m ²	Standing Crop Kg Dry Wt.
North Gully	2000	262 ± 134	23,192	6,192
	2001	459 ± 202	25,783	11,834
	2002	151 ± 74	12,004	1,813
	2003	304 ± 176	19,760	6,007
	2004	186 ± 57	30,099	5,598
	2005	188 ± 105	21,798	4,098
	2007	225 ± 70	27,850	6,266
	2008	266 ± 167	11,855	3,149
	2009	283 ± 108	24,267	6,874
	2010	265 ± 175	13,325	3,531
	2012	272 ± 153	14,133	3,844
	2020	313 ± 72	8,920	2,792
	2025	72 ± 33	16,653	1,199
	Average	268.6	19,416	5,167

Sand Point Gully	2000	212 ± 29	9,535	2,021
	2001	484 ± 300	9,781	4,730
	2002	325 ± 82	7,354	2,390
	2003	290 ± 126	5,310	1,540
	2004	131 ± 34	8,474	1,110
	2005	191 ± 96	8,349	1,595
	2006	230 ± 92	9,775	2,246
	2007	112 ± 111	9,684	1,084
	2008	201 ± 71	6,022	1,147
	2009	222 ± 111	6,564	1,457
	2010	205 ± 19	4,939	1,012
	2012	301 ± 146	3,846	1,158
	2020	347 ± 120	9,857	3,420
	2025	105 ± 54	6,753	709
	Average	250.1	7,653	1,916

Table 3.B. Historical data of macrophyte biomass at Graywood Gully.

Location	Year	Average Milfoil Dry Wt. grams . m²	Surface Area m²	Standing Crop Kg Dry Wt
Graywood Gully	2000	238	---	---
	2001	412 ± 162	---	---
	2002	193 ± 123	6,703	1,294
	2003	131 ± 79	14,186	1,858
	2004	190 ± 54	26,864	5,104
	2005	230 ± 101	23,988	5,517
	2006	91 ± 37	21,843	1,982
	2007	168 ± 75	27,170	4,572
	2020	233 ± 130	9,780	2,279
	2025	115 ± 125	16,319	1,893
	Average	255.5	18,648	3,229

Table 3 C. Historical data of macrophyte biomass at Sutton Gully and Cottonwood Gully. These are the two sites that show the most pronounced deterioration of macrophyte beds that prior to 2012 were dominated relatively large and dominated by Eurasian Watermilfoil.

Location	Year	Average Milfoil Dry Wt. grams . m ²	Surface Area m ²	Standing Crop Kg Dry Wt.
Sutton Point Gully	2000	184 ± 43	---	---
	2001	467 ± 183	8,592	4,017
	2002	71 ± 40	3,688	262
	2003	138 ± 92	11,819	1631
	2004	227 ± 77	11,909	2,703
	2005	197 ± 90	11,995	2,349
	2006	364 ± 208	7,438	2,707
	2007	295 ± 94	10,973	3,232
	2008	190 ± 106	5,985	1,201
	2009	224 ± 112	13,802	3,099
	2010	135 ± 47	7,390	998
	2012	270 ± 57	6,610	1,785
	2020	210 ± 121	343	72
	2025	11	536	6
	Average	238.4	8,379	2,005
Cottonwood Gully	2000	193 ± 85	---	---
	2001	373 ± 168	9,387	3,501
	2002	316 ± 134	7,360	2,326
	2003	146 ± 43	3,750	548
	2004	234 ± 41	9,205	2,154
	2005	273 ± 81	6,880	1,878
	2006	283 ± 61	5,605	1,589
	2007	155 ± 140	8,100	1,253
	2009	135 ± 78	4,860	657
	2010	252 ± 90	7,077	1783
	2012	154 ± 107	2,283	352
	2020	148 ± 18	269	40
	2025	0.6	482	4.3
		Average	201.6	5,438

Table 4. August 22nd, 2025, lake-wide qualitative survey of macrophyte biomass and filamentous algae cover.

	Location in Lake	GPS Coordinates	Nearest Landmark (e.g. Stream)	Watermilfoil Biomass (High-Moderate-Sparse-None)	Filamentous Cover (High-Mod.-Sparse-None)	Comments
	North Lake					
1A	Sand Point/ Vitale Park 1.5 m	42.832348°N 77.703672°W	Hannas Cr.	1.5 m: Moderate , w/eelgrass	No algae	Directly south of Vitale Park Point
1B	South of Sand Pt. 2-3 m	42.831550°N 77.703618°W	Offshore	2 m transitions to M milfoil; 3 m M more milfoil than eelgrass	No algae	Very clean and dense-moderate milfoil
	Northeast-East Lake					
2A	North of Wilkins Creek	42.825311°N 77.798408°W	Wilkins Creek	2.5 m primarily eelgrass – Sparse to no milfoil	Moderate	Low visibility
2B	Wilkins Cove North	42.823513°N 77.697917°W	South of Wilkins Cr.	2m: Moderate mixed with eelgrass	High algae mostly on milfoil	North end of a large milfoil-dominated bed
2C	Wilkins Cove Central	42.820543°N 77.698761°W	Center of Cove	2m : High milfoil 3m : not visible	High algal cover on milfoil	Most milfoil collapsed due to algal weight
2D	Wilkins Cove South 2m	42.818262°N 77.699116°W	Far South Wilkins Creek	2.5 m: High milfoil	High algal cover on milfoil	Wilkins Creek plume effect
3A	Stella Maris N. of Camp	42.806896°N 77.702998°W	Small Creek to North	Sliver of milfoil before drop-off	Sparse algae	Steep slope
3B	Stella Maris S of Camp	42.832348°N 77.03672°W	Big road pipe	3m: milfoil M 2m: milfoil S , eelgrass present 1m: High eelgrass	1m High on milfoil. Deeper: No algae	South of Camp
4A	Old Orchard Pt.	42.791313°N 77.710787°W	Densmore Gully	2m: Sparse , mainly eelgrass 2.5m: Sparse eelgr. Some milfoil	2m: No algae 2.5m: Moderate on milfoil	Just off stream
4B	McPhersons Cove Center	42.787583°N 77.708475°W	Small pipes culverts	1m: Moderate milfoil transitions offshore to eelgrass	Sparse algae	North of McPhersons Pt.
	East Southeast Lake					
5A	McPhersons Point	42.778048°N 77.715773°W	North Gully	2-3m: High eelgrass Sparse to no milfoil	High algae on milfoil and eelgrass	Just off the stream

5B	North Gully Cove Center	42.776738°N 77.714831°W	North Gully	2-3m High milfoil	High algae	Correspond to dive site
5C	North Gully Cove (South)	42.775797°N 77.713762°W	North Gully	2-3m: High milfoil	High algae	Correspond to dive survey S site
6	Harston Pt. South Gully	42.771735°N 77.714311°W	South Gully	Bed no longer present		Point just by South Gully
6.5	Sunny Shores south of Harston Point	42.769674°N 77.713357°W	Unnamed tributary/ rivulet	1.5m: Sparse milfoil, mostly eelgrass	VERY High	Why high algae?? One large pipe down from road?
7	Walkley's Landing /Dacola Shores	42.726474°N 77.712506°W	North McMillan	Milfoil not obvious, Heavy eelgrass	VERY High	North McMillan plume
	Southwest/West Lake					
8	Maple Beach	42.728951°N 77.719783°W	Southwest Creeks	Sparse milfoil, mainly eelgrass	High	
9A	Sutton Point South	42.740683°N 77.726116°W	Sutton Point Gully	2.5m Sparse milfoil, mainly eelgrass	Sparse algae	Corresponds to Sutton Pt. South Transect
9B	Sutton Point Center	42.741439°N 77.725932°W	At Sutton Pt. Gully	Silted over, no growth	No growth	Stream; Center Transect
9C	Sutton Point North	42.741750°N 77.725703°W	Sutton Point Gully	Small Sparse milfoil patch mostly eelgrass	Moderate to heavy	North transect
10	Long Point Cove	42.778025°N 77.722128°W	LP Cove Gully	2-3m: Sparse to Moderate: patchy milfoil-eelgrass	Moderate south of stream	Near home with wide stairs
	West No. West Lake					
11	Long Point	42.779775°N 77.719622°W	Long Point Gully	1m: Moderate 2-3m: Sparse to none , eelgrass	Moderate	Off Long Point Park just north of LP Gully.
12	Sand Point	42.786946°N 77.720373°W	Sand Point Gully	Heavy	Sparse but past peak	Middle Long-term transect
13	Eagle Point	42.799056°N 77.716640°W	Eagle Point Gully	3m: High ; 2m & shallower eelgrass dominates	Sparse to none	Toward northern section of bed
14	Graywood	42.810342°N 77.714340°W	Graywood Gully	3m: High tall milfoil 2m: mixed milfoil/eelgrass 1m: eelgrass	Past peak but evidence of High algae growth	Transect site nearest Graywood Gully

X. Appendices

Appendix I. Mean and standard deviation of quadrat biomass, milfoil biomass and percent of milfoil in the long-term monitoring sites. All quadrat data are shown as dry weight biomass.

North Gully Cove	Depth (m)	Avg dry wt (g/m ²)	Standard Deviation	Avg dry wt. milfoil (g/m ²)	Standard Deviation	Percent Milfoil
South Transect	1.5	55.8	9.1	55.8	9.0	99.9
	2	92.5	14.7	90.2	10.7	97.5
	3	54.4	44.6	46.9	31.7	86.3
	4	0.0	0.0	0.0	0.0	
Center Transect	1.5	108.1	137.9	90.9	129.0	84.1
	2	100.7	16.7	100.7	16.7	100.0
	3	35.7	17.2	35.7	17.2	100.0
	4	0.0	0.0	0.0	0.0	
North Transect	1.5	48.2	33.9	27.0	18.1	56.1
	2	40.3	18.0	4.0	6.6	9.9
	3	110.0	59.3	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	

Sand Pt. Gully	Depth (m)	Avg dry wt (g/m ²)	Standard Deviation	Avg dry wt milfoil (g/m ²)	Standard Deviation	Percent Milfoil
South Transect	1.5	126.4	122.6	104.8	97.4	82.9
	2	41.4	21.7	25.4	12.0	61.3
	3	48.1	41.6	48.1	41.6	100.0
	4	15.4	8.7	15.4	8.7	100.0
Center Transect	1.5	146.7	28.8	144.5	25.0	98.5
	2	142.2	110.2	132.3	93.6	93.0
	3	127.6	69.2	127.6	69.2	100.0
	4	0.0	0.0	0.0	0.0	
North Transect	1.5	50.3	50.6	30.5	44.5	60.6
	2	148.7	63.6	148.7	63.5	100.0
	3	146.1	148.6	146.1	148.6	100.0
	4	0.0	0.0	0.0	0.0	

Appendix I (continued). Summary tables of macrophyte biomass from each of our study sites.

Graywood Gully	Depth (m)	Avg dry wt (g/m²)	Standard Deviation	Avg dry wt milfoil (g/m²)	Standard Deviation	Percent Milfoil
South Transect	1.5	248.8	81.1	239.2	79.4	96.1
	2	163.0	79.7	150.3	57.8	92.2
	3	21.4	24.3	20.7	23.2	97.0
	4	30.4	31.8	0.5	0.9	1.7
Center Transect	1.5	347.4	112.8	341.1	107.4	98.2
	2	310.7	89.8	310.2	88.9	99.8
	3	40.5	52.5	32.0	42.2	79.0
	4	0.0	0.0	0.0	0.0	
North Transect	1.5	166.5	123.9	42.6	41.7	25.6
	2	159.3	78.8	151.5	65.4	95.1
	3	85.0	22.7	27.7	7.6	32.6
	4	0.0	0.0	0.0	0.0	

Appendix I (continued). Summary tables of macrophyte biomass from each of our study sites.

Cottonwood Gully	Depth (m)	Avg dry wt (g/m ²)	Standard Deviation	Avg dry wt milfoil (g/m ²)	Standard Deviation	Percent Milfoil
South Transect	1	38.6	11.2	35.4	7.4	91.8
	2	8.2	6.4	0.3	0.5	3.20
	3	6.9	5.0	0.4	0.7	5.93
	4	0.0	0.0	0.0	0.0	
Center Transect	1					
	2	6.4	5.8	0.0	0.0	0.00
	3	3.8	1.1	0.0	0.0	0.00
	4	0.0	0.0	0.0	0.0	
North Transect	1					
	2	16.5	9.7	0.0	0.0	0.00
	3	0.0	0.0	0.0	0.0	
	4	0.0	0.0	0.0	0.0	

Sutton Pt. Gully	Depth (m)	Avg dry wt (g/m ²)	Standard Deviation	Avg dry wt. milfoil (g/m ²)	Standard Deviation	Percent Milfoil
South Transect	1.5	nd				
	2	115.0				
	3	128.7				
	4	5.76				
Center Transect		No Bed		nd		
		No Bed		nd		
		No Bed		nd		
		No Bed		nd		
North Transect	1.5	nd		nd		
	2	14.3	10.1	1.1	1.5	7.7
	3	nd		nd		
	4	nd		nd		

Appendix II. GPS coordinates of the macrophyte beds

Bed	N Lat	N Long	S Lat	S Long
Sutton whole bed	-77.725794	42.742621	-77.726291	42.739628
Sutton milfoil	-77.725862	42.742510	-77.725845	42.742082
Cottonwood whole bed	-77.726375	42.760607	-77.726426	42.757074
Cottonwood milfoil	-77.726052	42.757533	-77.726491	42.757189
North Gully whole bed	-77.714763	42.778465	-77.71395	42.775802
North Gully milfoil	-77.714623	42.778296	-77.71395	42.775802
Sand Point whole bed	-77.720208	42.788316	-77.720605	42.786154
Sand Point milfoil	-77.720161	42.788268	-77.720509	42.786226
Graywood whole bed	-77.712891	42.814094	-77.715106	42.808984
Graywood milfoil	-77.712823	42.814089	-77.715149	42.808904