Aqua Link, Inc.
Pond, Lake & Stream Management & Supplies

March 11, 2020

Walker Lake Landowners Association
Shohola Township
Pike County, Pennsylvania

Re: Walker Lake
Aquatic Macrophyte Survey Final Report
ALI Project No. 1577-15

Dear Board Members:

Aqua Link was retained by the Walker Lake Landowners Association (hereinafter referred to as the Association) to perform a follow-up aquatic macrophyte (vascular plant) survey of Walker Lake early in the 2019 growing season. Located off Twin Lakes Road in Shohola Township, Pennsylvania, Walker Lake has a surface area of approximately 110 acres.

The purpose of this aquatic plant survey was to document the different aquatic plant species (native and non-native) and their respective densities throughout the entire lake basin in 2019 as compared to the previous macrophyte surveys performed by Aqua Link during the 2017 and 2018 seasons. Native aquatic plants are an integral component of balanced lake ecosystems and provide important aquatic habitats for numerous aquatic organisms including fish. In contrast, non-native, invasive aquatic plants can upset this delicate balance and outcompete native species, which are often less problematic. Once established, the control or eradication of non-native, invasive aquatic plants can be very expensive, therefore the early detection of non-native, invasive aquatic plants is an essential component of lake management plans.

Of particular interest in Walker Lake is the extent of bladderwort (*Utricularia sp.*) throughout the lake. This native aquatic plant can grow very dense and therefore has the potential for significantly affecting various lake uses. Bladderwort is a submerged, free-floating aquatic plant that lacks true roots.

This document represents the final report for the aquatic macrophyte survey, performed by Aqua Link in May 2019. Section 1 of this report discusses our study design, all methods used to collect field data, and how these data were analyzed. Section 2 represents the results of the aquatic plant survey. Section 3 provides a trend analysis comparing the 2017, 2018, and 2019 plant data. Section 4 discusses our conclusions and our recommendations to control nuisance, problematic aquatic vegetation and to further protect the lake in terms of water quality.

P.O. Box 605, Doylestown, PA 18901-0605
Phone: 215.230.9325 • • • Fax: 215.230.9326 • • • Website: www.aqualinkinc.com

1. Study Design, Field Methods & Data Analysis

Study Design & Field Methods

Aqua Link performed the third aquatic macrophyte (aquatic plant) survey of Walker Lake on May 21, 2019 to determine changes in the macrophyte community following plant treatments performed during the 2018 season. The aquatic plant survey was performed by a 2-man field crew using a 16-ft boat equipped with an outboard motor and Lowrance water depth chart plotter (fathometer or water depth sounder).

For this study, aquatic vegetation (floating leaved and submerged) was sampled at 31 different locations throughout the lake along predetermined transects. These locations were the same lake locations that were sampled during the previous surveys. The locations of all sampling points were determined using a Garmin GPS unit (Montana 680t model) for this aquatic plant survey.

At each lake sampling point, the aquatic plant community was observed and documented. Aquatic plants at the lake surface in reach of the boat were collected by hand for field identification. Next, submerged aquatic vegetation was sampled using an aquatic rake. The aquatic rake was lowered to the lake bottom and dragged a distance of approximately 1 meter (3.3 feet) on each side of the boat. Collected aquatic plants were sorted in the boat and identified. In addition, Aqua Link recorded the relative densities (low, moderate, and high) of all aquatic plants that were collected at each of the sampling locations. Aqua Link also retained representative specimens of all vegetation collected during the macrophyte survey. All retained plant specimens were packaged and transported back to our laboratory. All identification of collected plant specimens were then verified by a second Aqua Link professional lake manager.

For this report, a more in-depth analysis can be found in Section 3, comparing the macrophyte species of concern, primarily bladderwort, from 2017 through 2019. Other species of potential concern include floating aquatic vegetation like watershield and yellow water lily. However, both of these species are not considered a nuisance or threat at this time in the lake at their respective densities. Other macrophyte species that were identified in the 2019 survey are not considered a threat to the health of the lake or recreational activities and are considered beneficial to the aquatic ecosystem at their respective densities.

Data Analysis

Aqua Link initially developed an aquatic plant survey database for this project using Microsoft Excel in 2017. All newly acquired plant data (e.g. plant identifications, relative densities and GPS locations) for 2019 were entered into the existing database for analysis. GPS

data and Google Earth mapping software were used to develop aquatic macrophyte coverage maps for the 2017, 2018, and 2019 study years.

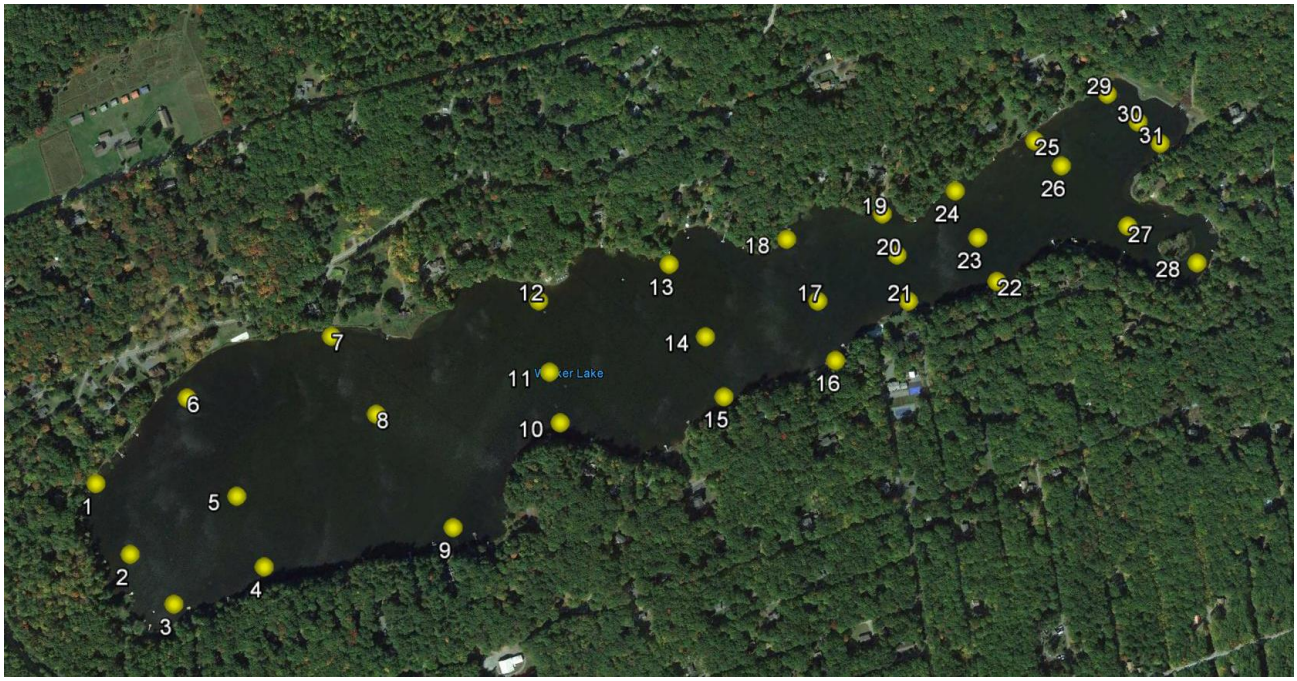


Figure 1 Aquatic Plant Sampling Locations at Walker Lake

2. Aquatic Macrophyte Survey Results

Aqua Link performed a macrophyte (aquatic plant) survey of Walker Lake on May 21, 2019. The study design, methods, and data analysis for this aquatic macrophyte survey were previously discussed in Section 1. All field data collected as part of this survey are presented in Attachment A of this report.

A total of 31 individual points were sampled at Walker Lake in 2019. A total of eight (8) different aquatic macrophyte species were identified during the May 2019 survey (Table 1). The vegetation type for each identified specimen is also provided in Table 1. Macrophyte types were designated as submerged aquatic vegetation (SAV), macro-algae (MA), floating aquatic vegetation (FAV), or emergent aquatic vegetation (EAV). Refer to Attachment B for background information on the aquatic vegetation species that were collected for the 2017 through 2019 study dates.

Like the previous surveys, the most prevalent species found in Walker Lake in 2019 were muskgrass (*Chara sp.*) and bladderwort (U*tricularia sp.*). Muskgrass was found in 20 of the 31 sampling locations in low to moderate density while bladderwort was found in 14 of the 31 sample locations in low density. Water moss (*Fontinalis antipyretica)* was the next most prevalent species found, existing at 5 of the 31 sampling locations in low to moderate density. All other species were found in three or less sampling locations and existed predominantly in low densities with the exception of watershield (*Brasenia schreberi)* which was found at three locations in low to moderate density.

Table 1 Aquatic Plants in Walker Lake in 2019

Common Name	*Scientific Name*	*Plant Type*
Bladderwort	***Utricularia sp.***	**SAV**
Muskgrass	***Chara sp.***	**MA**
Giant Hairgrass	***Eleocharis montevidensis***	**SAV**
Water Shield	***Brasenia schreberi***	**FAV**
Yellow Water Lilly	***Nuphar lutea***	**FAV**
Leafy Pondweed	***Potomogetan foliosis***	**SAV**
Springtape	***Sagittaria kurziana***	**SAV**
Water Moss	***Fontinalis antipyretica***	**SAV**

In 2019, eight different species of macrophytes were found, the same amount of species that were found in 2018 and three less than the eleven different species found in 2017. In 2019 there was a slight re-emergence of yellow water lily and watershield. In 2018, the survey was conducted on May 3 which is early in the growing season and some of the floating vegetation had likely not reached the surface yet. This year, the survey was conducted later in the season on May 21 which may have allowed for plants to emerge before the survey was conducted. Another change for 2019 is the emergence of a new plant, giant hairgrass (*Eleocharis montevidensis),* which was found at just one sampling location in low density. This plant is native to North America and currently does not restrict any recreation uses in Walker Lake. In fact, this plant can serve as habitat for fish and other aquatic organisms, making it beneficial.

With the exception of springtape and baby tears, all aquatic plants identified during the 2017 through 2019 aquatic plant surveys and other site visits were considered native. In all three surveys, springtape was not considered problematic, but should continue to be monitored. Similarly, baby tears was not problematic when observed during a lake monitoring event in 2016, but monitoring should continue to prevent potential spread of this species. In 2017, the aquatic plants that impacted desirable lake uses to some degree for lakeside property owners and

lake users were bladderwort, watershield, white water lily and yellow water lily. Bladderwort is a submerged aquatic plant that adversely impacts fishing, boating, swimming and aesthetics when densities are considered moderate to high. Watershield and water lilies are floating leaved aquatic plants that at moderate to high densities can impair boating, swimming and fishing. At the time of this macrophyte survey for 2019, bladderwort, yellow water lily, and watershield were present in the lake, but in densities not yet deemed problematic to lake health or recreation. However, if these plants were left untreated in 2019, these plants would have likely limited some recreational uses of the lake. This is especially true of bladderwort.

Figure 1 shows all of the sampling point locations used by Aqua Link during the 2017 – 2019 aquatic plant surveys. Figures 2 and 3 depict the distribution of bladderwort in 2018 and 2019. In 2018, bladderwort was observed at 20 sampling locations and this plant was only found at 14 sampling locations in 2019. Figures 4 and 5 present the distribution of floating leaved aquatic vegetation (FAV) in 2018 and 2019.

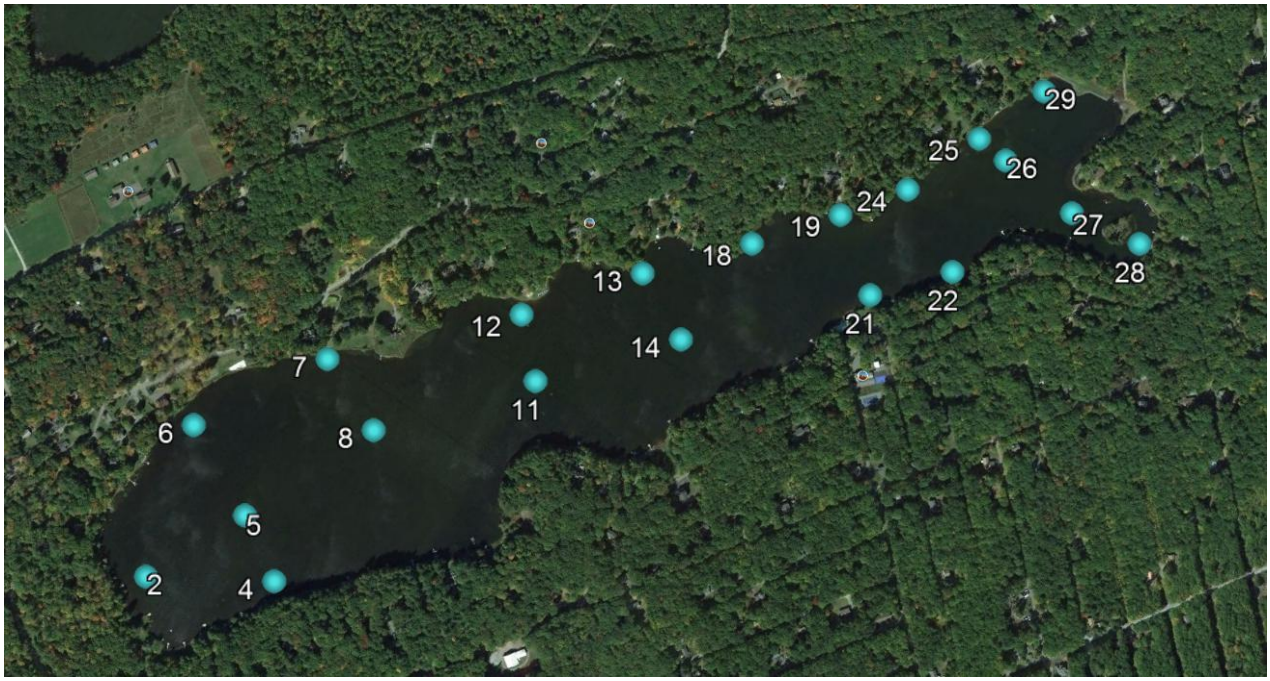


Figure 2 Bladderwort Distribution in Walker Lake in 2018

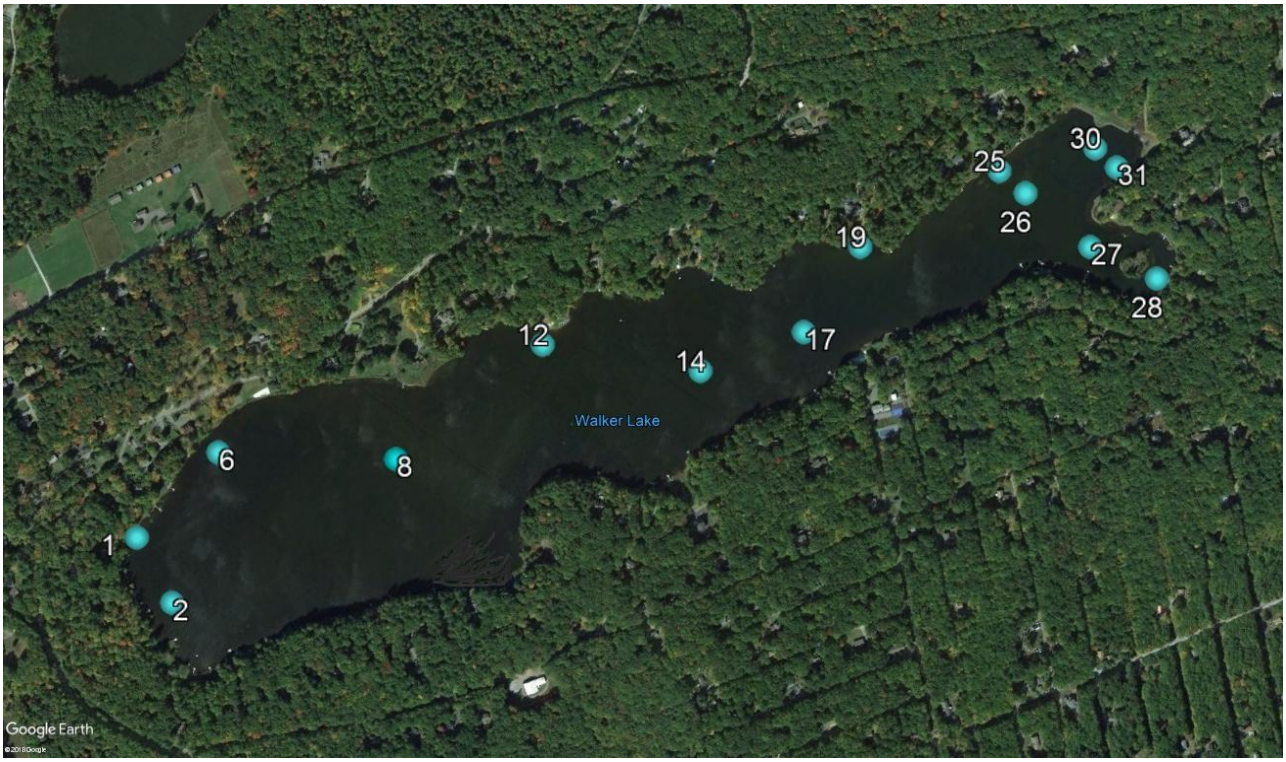


Figure 3 Bladderwort Distribution in Walker Lake in 2019

Figure 4 Floating Aquatic Vegetation Distribution in Walker Lake 2018

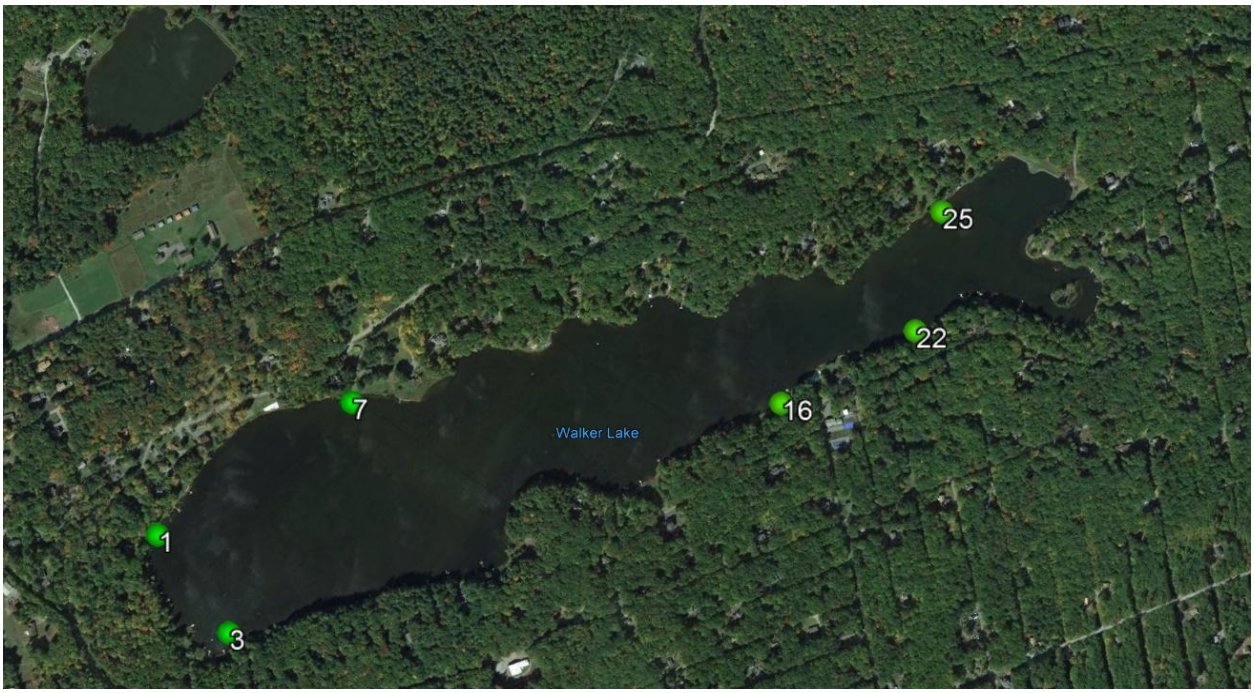


Figure 5 Floating Aquatic Vegetation Distribution in Walker Lake 2019

In 2018, no floating aquatic vegetation was found compared to 2019, where floating aquatic vegetation was found in 6 of 31 sampling locations. Although there were more plants present at the time of the survey in 2019 than 2018, floating aquatic vegetation treatments performed on the lake in 2018 can still be considered highly successful. In 2019, the study was conducted at a later date than 2018 which allowed for more plants to emerge before the study date. All floating aquatic vegetation in the lake is considered under control at this time.

In 2019, bladderwort was found at 14 of the 31 sampling locations in Walker Lake and at low density for each sampling location (Figure 3). Bladderwort is a carnivorous plant common to Pennsylvania. It is most common in the northeast region of the state in water bodies that exhibit an acidic pH (below 7), a low alkalinity (soft water) and cold average water temperatures. Bladderwort is a submerged, free-floating aquatic plant that lacks true roots. Due to this anatomical feature, nutrients are not obtained via the lake sediment, but rather from the water column. Nutrient uptake via the water column is supplemented with captured microorganisms such as zooplankton, insects, and juvenile crustaceans. Utricles (i.e. small bladders) located at the base of the leaves capture the aforementioned prey. Tiny hair like projections at the opening of the bladder are sensitive to the motion of prey; when stimulated these hairs cause the bladder to suck in water and the passing organism. The bladder is then quickly closed, and the prey is digested.

Bladderwort is a perennial plant that reproduces via seed production, turions (i.e. buds), and fragmentation. A yellow flower protrudes from the water's surface, receives pollen from an insect, then drops a seed. Seeds and turions (buds) lie dormant through the fall and winter season. In the spring, water temperature and sunlight penetration trigger the inflation and subsequent floatation of buds and seeds to the water surface, where a new plant begins to grow. Aside from seeds and buds, fragmentation also results in reproduction. Small leaves, stems, or roots that are broken off begin to sprout and grow into a new plant. Anatomically, bladderwort has finely-divided, branched, submerged leaves, and produces irregular yellow snapdragon-like flowers. Bladderwort provides food and cover for fish. It is especially valuable due to its ability to grow in acidic water bodies with loose sediment where few other aquatic plants will grow.

Muskgrass was the most prevalent species found in Walker Lake in 2019, being found at 20 of the 31 survey locations in subsequent densities ranging from low to moderate. This species is not classified as a vascular plant, but a macro-algae. This classification is due to the lack of a vascular system (i.e. root system) that is characteristic of plants. Instead, macro-algae consist of filaments (i.e. chains) of single cells which function independently of one another. Macro-algae do not have roots; instead they have rhizoids (root like appendages that attach to substrate). Muskgrass has stems which are ridged and often encrusted with calcium carbonate, feeling rough and crusty to the touch. When crushed it has a garlic or skunk like odor. Muskgrass has two modes of reproduction which are vegetative or sexual. Muskgrass is a source of food for waterfowl, and home to many invertebrates. This macro-alga also provides excellent habitat for all sizes of fish. While muskgrass is usually considered beneficial, there are circumstances in which its excessive growth becomes a nuisance.

Water moss (*Fontinalis antipyretica)* was found at 5 of the 31 locations surveyed in subsequent densities ranging from low to moderate. Water moss is generally not considered to be a nuisance plant and provides many benefits to aquatic ecosystems. Water moss tends to grow in large clumps or mats which provide excellent shelter for fish and egg fry. Water moss also serves as habitat for a wide variety of invertebrates including mayfly, caddisfly, and stonefly larvae.

One notable addition to the list in 2019 is giant hairgrass (*Eleocharis montevidensis*) which was found at just one sampling location and in low density. This plant is widespread throughout the United States and is found in a variety of habitats including lakes. This plant can grow in dense stands and grow up to half a meter tall. Due to the rocky bottom in Walker Lake, it is unlikely that this plant will become widespread as it favors sandy bottoms. In controlled densities this plant can be considered beneficial as it provides excellent habitat for crustaceans, macro invertebrates, and both small and large fish.

At lower frequencies and densities two other species of aquatic vegetation were collected. The collected species were leafy pondweed and springtape. Leafy pondweed is native while springtape is not. However, both of these species provide valuable benefits to aquatic ecosystems. It should be noted that baby tears was once again not detected throughout this survey and the entire 2019 growing season. This plant was only observed one season during a water quality monitoring event in 2016. Refer to Attachment B for background information on all aquatic plant species that were collected in the 2017 through 2019 surveys.

3. Trend Analysis

When comparing the 2019 macrophyte data to the data collected in 2017 - 2018, several trends were noticed. First, it should be noted that the dates for all three surveys are different. The first survey in 2017 was conducted on June 6th. By this time, most submerged plant species are observable and much of the floating aquatic vegetation has reached the surface. In 2018, the survey was conducted much earlier in the growing season on May 3rd. The reason for this was to conduct the survey and perform the first plant treatment earlier in the 2018 season due to large quantities of vegetation observed in 2017. Because of the timing of this survey, much of the existing floating vegetation in the lake had not yet reached the surface but did so later in the growing season. In 2019, the survey was conducted on May 21st. While still somewhat early in the season for floating vegetation, some floating aquatic vegetation was reaching the surface of the lake. It should be noted that later in the 2019 season, more floating aquatic vegetation was present than there was at the time of the survey. The reasoning behind the survey date differences from 2017 – 2019, was Aqua Link's revised pesticide treatment program during this time period. Due to the density of bladderwort observed in 2017, the initial treatment was applied earlier in the growing season to reduce the decomposition of treated plant biomass especially in 2018 and to a lesser degree in 2019. To avoid skewed macrophyte data due to pesticide application, the 2017 – 2019 macrophyte surveys were completed prior to the first treatments.

When comparing the data for the three surveys, it is important to take into consideration the life cycle of each species of plant. For example, some species of submerged aquatic plants like bladderwort reach maturity earlier and are more observable earlier in the season than many species of floating vegetation. Floating vegetation like lilies and watershield mature later and stands of these vegetation types grow larger and denser as the growing season progresses. Because of this, the date of the study has significant impact on the types of plants that will be observed. This can explain why in 2018 there was no floating aquatic vegetation present at the time of the study. Although treatments for floating aquatic vegetation in 2017 were successful and undoubtedly reduced the total volume of plants in 2018, the most likely reason for the absence of plants during the time of the study in 2018 was timing. In 2019, watershield and yellow water lily were able to be observed at the time of the study date of May 21st. By this time in the growing season, some plants have reached the surface. However, it is important to note the absence of white water lily in 2019. This is more likely due to successful treatments in 2018 that reduced or eliminated white water lily in the sampling locations of the lake for the 2019 season. This trend highlights the importance of considering both treatment success and timing of the study when conducting plant surveys.

In 2019, bladderwort (Figure 3) was found in 14 out of 31 stations or 45% of sampling locations in Walker Lake as compared to 20 out of the 31 sampling locations or 65% in 2018 (Figure 2). Since the first survey in 2017, bladderwort has been reduced in both frequency and

density. In 2017, bladderwort was found in 27 out of the 31 sampling locations or 87% in 2017 of locations in densities ranging from low to high. In 2018, bladderwort was found in 20 of 31 locations with densities ranging from low to moderate. Finally, in 2019 we observed bladderwort in just 14 of 31 locations and all at low density. This indicates that submerged aquatic plant treatments continue to be successful at controlling and reducing the bladderwort population in the lake. It is also important to consider that the timing of when the plant surveys are conducted is less of a factor for the presence of bladderwort as mature plants are able to be observed early on in the growing season.

Although the timing of each survey has been different, the overall results of the study and what is observed throughout the entire growing season has been consistent. Each year there has been a reduction in frequency and density for both submerged and floating aquatic vegetation, highlighting ongoing success of plant treatments performed by Aqua Link Inc.

4. Conclusions & Recommendations

Based upon our May 2019 survey, eight (8) different aquatic plants were observed throughout Walker Lake. Of these plants, five (5) are classified as submerged aquatic vegetation (SAV) and one (1) as macro-algae (MA). One new plant, giant hairgrass, is considered submerged aquatic vegetation (SAV). Watershield and yellow water lily are floating aquatic vegetation (FAV). All aquatic plants identified with the exceptions of springtape and baby tears are native to Pennsylvania. Springtape is a submerged aquatic plant which is native to Florida. Baby tears is a submerged plant that can reach the surface and it is native to the southern United States as well as central and South America.

Based on the findings of the May 2019 macrophyte survey, the aquatic macrophyte community in Walker Lake continues to be diverse and healthy. The aquatic plant of most concern is bladderwort. Other plants that should remain closely monitored are springtape and baby tears. Baby tears is also a non-native submerged aquatic plant that was not observed during this survey, but was seen in part of Aqua Link's 2016 lake monitoring activities only. It should be noted that springtape and baby tears are not considered problematic at this time.

Bladderwort is a native, highly beneficial plant but can be a nuisance to recreational activities and threaten lake diversity when the population goes unchecked. From an ecological point of view, the amount of bladderwort present is highly beneficial to aquatic organisms, namely fish. Juvenile fish use this vegetation in the early stages of their development to avoid predation and successfully grow to larger sizes. These areas are very important to a fish community because without them, small fish will be vulnerable to excessive predation. At this time, the bladderwort population is under control and is not considered to be highly problematic for recreational activities like swimming and boating. However, it is highly recommended that treatments for bladderwort continue as the population can increase rapidly if the population is not controlled.

Based upon the above, Aqua Link offers the following recommendations to the Association to improve and protect the water quality and aquatic habitats of Walker Lake:

1. Most of the isolated stands of macrophytes (rooted aquatic plants) found in Walker Lake should be allowed to propagate and spread. Macrophytes provide habitat for aquatic organisms including fish and compete with phytoplankton (microscopic free-floating algae) for nutrients. Therefore, it is expected that increased quantities of macrophytes will further improve the water clarity of Walker Lake. Early treatment, usually early to mid-May, is again strongly recommended for bladderwort control. A follow-up treatment should occur near the end of June through July, depending on the speed of regrowth, to treat any regrowth or additional locations not targeted in the initial treatment. Floating leaved plants such as lilies and watershield should continue to be treated in minimal areas affecting water recreation or boat traffic. Some stands of lilies should be left untreated as they provide excellent habitat for fish and other aquatic organisms.

2. Aquatic weed harvesting and the stocking of triploid grass carp are not recommended for Walker Lake. These techniques have the potential for spreading the growth of aquatic plants via fragmentation. This includes all types of aquatic weed harvesting such as manual raking/cutting or the use of commercial weed harvesting equipment. In addition, grass carp are highly unpredictable when stocked in lakes greater than 10 acres in surface area. These fish may feed primarily on native plant species as opposed to the target plant species.

3. Aquatic macrophyte surveys should be performed annually or at least on some routine basis. The purpose of these surveys is to continually monitor the lake for the spread of non-native plants that have been already identified in the lake (e.g. springtape and baby tears) and the invasion of other non-native aquatic plants. These surveys also will be used to assess the ongoing effectiveness of the aquatic herbicide treatment program.

4. An updated bathymetric (water contour) map of the lake should be developed. This map should show water depth contours throughout the entire lake basin. Bathymetric maps are very useful tools for both lake managers and lake users. A bathymetric map provides critical information to lake managers such as lake volume, mean (average) water depth, maximum water depth, and aquatic habitats (e.g. shallow spawning areas, nurseries for young and juvenile fish, rock piles, sunken timber, submerged islands, points). These maps are also

very useful to lake managers when installing artificial fish habitat structures or reefs for fisheries improvement projects. In addition, these maps can be reproduced and provided to Association members and other lake users as an aide for fishing and navigation purposes.

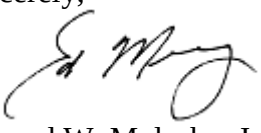
5. The Association should continue collecting baseline water quality data in 2020. Newly acquired water quality data should be analyzed and compared to those data in the existing 2016 - 2019 database.

6. Fishery surveys should continue to be performed annually in Walker Lake. Newly acquired fisheries data should be analyzed and compared to those data in the existing 2016, 2017, and 2019 database.

Many of the above recommendations will require a high level of technical expertise and, therefore, likely require the professional services of a qualified environmental consultant. Aqua Link is an environmental consulting firm, specializing in lake management and restoration, and is uniquely qualified to assist the Association in implementing all of the recommendations offered in this report. In addition, the implementation of some of the recommendations may be eligible for state and federal funding. Aqua Link is highly experienced and knowledgeable in various grant programs and preparing grant applications in order to obtain state and federal funding. Over the past 21 years, Aqua Link has assisted agencies, organizations and associations in securing funds for their projects.

If you have any questions or need assistance in implementing any of the recommendations offered in this report, please call me. Thank you for allowing Aqua Link to assist you in properly managing your lake.

Sincerely,



Edward W. Molesky, Jr., CLM
President

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Attachments A & B

1577-15 Walker Lake 2019 Macrophyte Survey Report.docx

ATTACHMENT A

Aquatic Plant Survey Field Data

Walker Lake **Macrophyte Survey** **Plant ID and Density (Low, Medium, or High)** **Prepared by Aqua Link, Inc.**
ALI Customer No. 1577-15
5/21/2019

Plant Common Names

WayPoint	Latitude	Longitude	Bladderwort	Watershield	Yellow Water Lily	Water Moss	Muskgrass	Leafy Pondweed	Springtape	Giant Hairgrass			
1	41.41177	74.92229	low	low		low							
2	41.41135	74.92102	low										
3	41.41123	74.91986		med			low						
4	41.41237	74.91908					low						
5	41.41285	74.92026				low							
6	41.41341	74.92204	low										
7	41.41526	74.92082		med			med						
8	41.41487	74.91933	low			med							
9	41.41439	74.91701				med	low						
10	41.41635	74.91678					med						
11	41.41677	74.91750					med						
12	41.41774	74.91846	low				med	low		low			
13	41.41888	74.91714					med						
14	41.41846	74.91582	low										
15	41.41801	74.91489					low						
16	41.41933	74.91382			low		low						
17	41.41978	74.91473	low										
18	41.42013	74.91586					low						
19	41.42121	74.91486	low			low			low				
20	41.42092	74.91419											
21	41.42056	74.91352					med						
22	41.42151	74.91256			low		low						
23	41.42192	74.91332											
24	41.42206	74.91415					low		low				
25	41.42324	74.91366	low		low		med		low				
26	41.42322	74.91302	low										
27	41.42318	74.91145	low				low						
28	41.72341	74.91010	low				low						
29	41.42434	74.91322					med						
30	41.42432	74.91250	low				low						
31	41.42429	74.91196	low				low						
Count			14	3	3	5	20	1	3	1	0	0	0

Key to Plant Species

Common Name	Scientific Name	Common Name	Scientific Name
Bladderwort	*Utricularia sp.*	Leafy Pondweed	*Potamogeton foliosus*
Watershield	*Brasenia schreberi*	Giant Hairgrass	*Eleocharis montevidensis*
Yellow Water Lily	*Nuphar lutea*	Springtape	*Sagittaria kurziana*
Water Moss	*Fontinalis antipyretica*		
Muskgrass	*Chara sp.*		

ATTACHMENT B

Aquatic Plant Descriptions & Pictures

Bladderwort

Utricularia spp.

Alternate names—hooded watermilfoil, pop-weed

Description—A fairly common aquatic plant in Pennsylvania, bladderwort lacks true roots and often floats freely beneath the water surface. It has characteristic tiny oval bladders near the bases of finely divided leaves. It is usually found in cold ponds with acidic and soft water most prevalent in northeastern Pennsylvania. Reproduction is by winter buds. Emergent flowers are typically yellow or purple but may range to white and green. Bladderwort is especially interesting because it is carnivorous, digesting organisms such as insect larvae and zooplankton that are sucked into a trap door on each bladder. The bladders have hairs that the tiny organisms trigger as they swim.

Value—Bladderwort provides food and cover for fish. It is especially valuable because it is able to grow in acidic ponds with loose sediment where few other aquatic plants will grow.

Coontail

Ceratophyllum spp.

Alternate name -hornwort

This plant can become more of a nuisance when you are trying to control it physically or mechanically because it reproduces quickly through fragmentation.

Description - The dark olive-green leaves of coontail are whorled around the stem. Each leaflet is forked with toothed edges. The leaflets are more densely crowded around the tip of the stem, giving the appearance of a raccoon tail. The purplish green flowers form where the leaf attaches to the stem and remain submerged. The plant may be anchored to the bottom or, more likely, free-floating beneath the surface. Coontail prefers ponds with hard water, although one species can be found more commonly in softer, acidic waters. Coontail can tolerate low light conditions in deep water. Plants have been described as having a very coarse or "plastic" feeling. Coontail spreads by seeds and by fragmentation.

Value - Coontail foliage is a favorite of many species of waterfowl and muskrats in Pennsylvania. It is also home to many invertebrates such as snails, crustaceans, and insect larvae, thus providing a great source of food for fish. Coontail inhibits the growth of blue-green algae on its stems by secreting sulfur-based toxins.

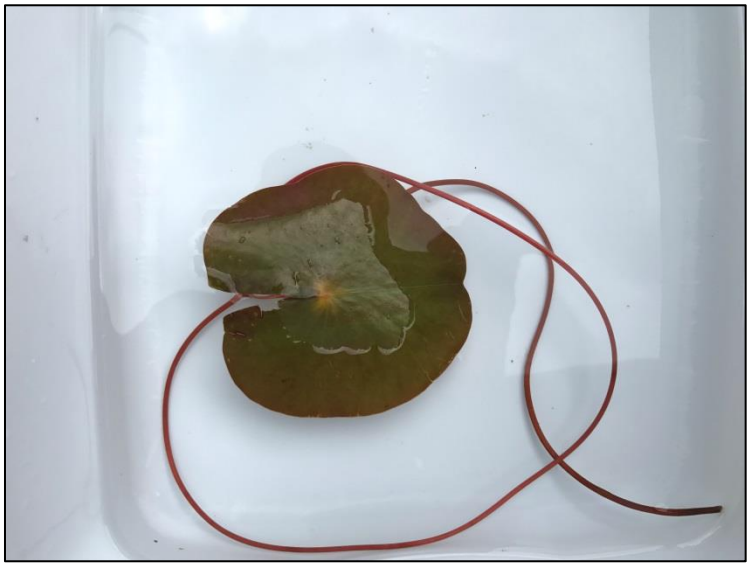
Water Lily, White

Nymphaea spp.

Alternate name - fragrant water lily

Description -Floating round leaves grow up to twelve inches across, are split to the stem in a V shape at the center, and are often purple underneath. Flowers of native water lilies are large, showy, and white, and have a sweet smell. Water lilies bearing other colored flowers are nonnative, tropical plants often sold for backyard water gardens. Flowers remain open from morning until shortly after midday. Commonly planted as an ornamental, this plant reproduces by rootstocks and seeds. It prefers to grow in quiet water less than six feet deep.

Value - This plant's beautiful appearance and its flowers make it a commonly used item in aquascapes. In addition, water lily creates excellent habitat for fish as it attracts small and large fish and their prey (insects, frogs, etc.). Despite this benefit, however, water lily's tangled stems make fishing very difficult. Waterfowl eat parts of the plant, as do a variety of wildlife, including deer. Water lily is also a favorite of honeybees.



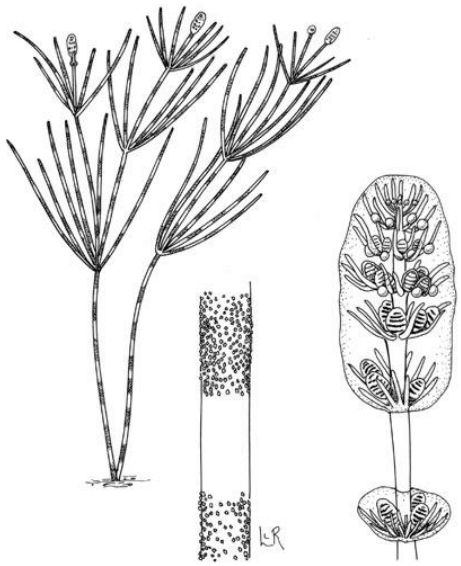
Stonewort

Nitella spp.

Description – Nitella is classified as a macro algae, meaning it is a non-microscopic algae that can be seen with the naked eye. It has smooth stems and branches, lacking encrustation. Branches are arranged in whorls around the main stem. It is most common in soft water, especially in the Northeastern region of Pennsylvania. This plant is usually considered beneficial to the aquatic ecosystem.

Value – Waterfowl feed on Nitella. It is also home to microscopic algae and invertebrates that are eaten by small fish. It is also a great source of habitat for fish.

Common look-alike – Chara



Watershield

Brasenia schreberi

Alternate names—dollar bonnet, dollar tag, water target

Description—Floating leaves are oval to elliptical (football shaped) and have an elastic stem that attaches at their centers. Leaves are green on top and purple underneath and grow two to five inches in length. A gelatinous coating on stems and the undersides of leaves protects them from herbivores. Flowers are dull red to purple. Plants prefer acidic and soft-water ponds and reproduce by rootstocks and seeds. Watershield can quickly take over a pond surface and severely limit recreational uses. Plants can grow in water up to six feet deep.

Value—Watershield offers good cover and habitat for fish, but the stems make fishing difficult. The leaves make a great landing spot for insects.

Yellow Water Lily

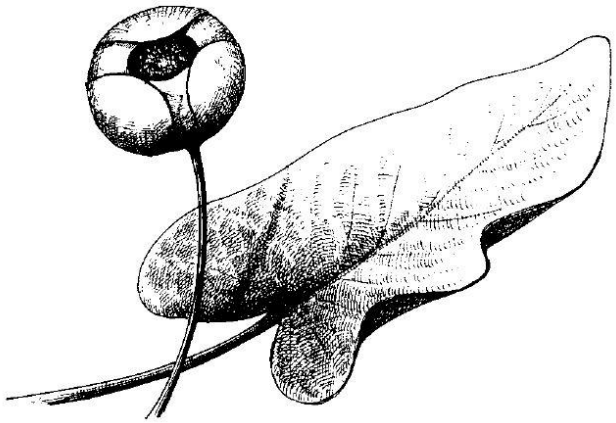
Nuphar lutea

Alternate names—yellow pond lily, cow lily, bullhead pond lily

Description—Spatterdock is common to Pennsylvania ponds, especially acidic, soft-water ponds in northern regions. It has large, twelve-inch leaves that are round to heart shaped, with a distinct midrib. Most leaves extend above the water. Flowers are large and yellowish outside and reddish inside. Spatterdock tolerates fluctuating water levels and reproduces by rootstocks and seeds.

Value—Spatterdock is an excellent plant from a wildlife and fisheries perspective. It supports a high density of fish and insect life below the water surface, providing good food and cover for fish. Large bass can often be found cruising through spatterdock looking for small fish and insects. Spatterdock is also a food source for many animals and plants.

Common look-alike—water lily



Common Water Moss

Fontinalis antipyretica

Alternate names—antifever fontinalis moss, greater water-moss

Description—*Fontinalis antipyretica* has branched, trailing stems that are triangular in cross-section and may be as long as 60 cm (24 in). The leaves are quite stiff and are arranged in three overlapping rows. Each leaf is lance-shaped or egg-shaped, with a keel and a sharp point, some 4 to 9 mm (0.16 to 0.35 in) long. There are no flowers but minute spores are sometimes produced in smooth sporangia (capsules) between 2 and 2.6 mm (0.08 and 0.10 in) long.

Value—*Fontinalis antipyretica* grows in large clumps and mats and provides refuge for fish eggs and fry. Numerous invertebrates shelter among the fronds; Chironomid larvae hide in the bases of the leaves and mayfly, caddisfly and stonefly larvae cling to the fronds, and in fast-flowing water black fly larvae are often present. Diatoms and other microscopic algae grow epiphytically on the fronds.

Chara

Chara spp.

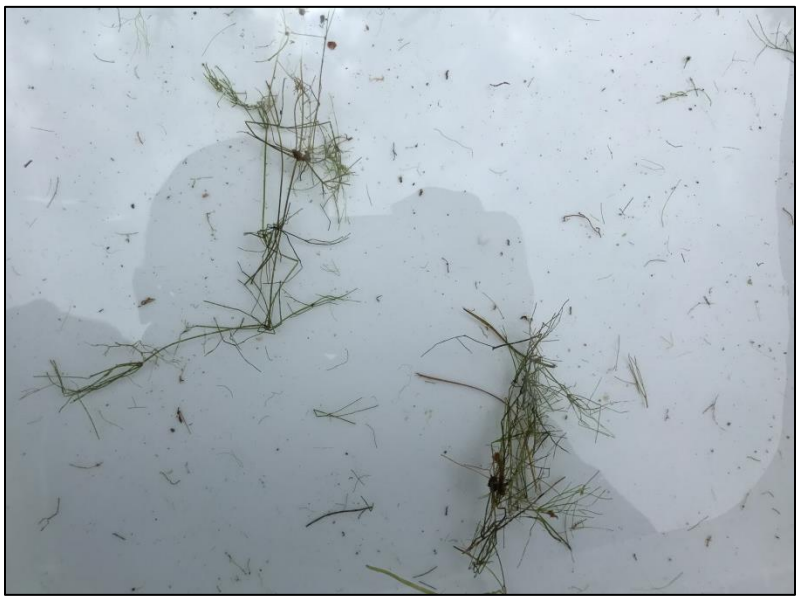
Alternate names—stoneworts, muskgrass, brittlewort, candelabra plant

This macro algae can become more of a nuisance when you are trying to control it physically or mechanically because it reproduces quickly through fragmentation.

Description—Chara is classified as algae despite looking very much like a rooted aquatic plant. It may also be classified as macro algae, non-microscopic algae that can be easily seen with the naked eye. Around the stem are whorls of six to eight "leaves," which are often encrusted with calcium carbonate. Chara grows in dense mats and feels grainy or crunchy to the touch and when crushed. It produces a musty garlic or skunk like odor. It prefers soft sediment and is usually found in hard-water ponds in limestone areas of Pennsylvania.

Value—Chara is an excellent food source for many species of waterfowl and various fish species. It is home to many micro- and macroinvertebrates and provides good cover for small fish. Salamanders and newts lay eggs in Chara beds. Generally considered a beneficial plant, Chara can become a nuisance especially in shallow ponds in hard-water regions of the state.

Common look-alike—Nitella



Pondweed, Leafy

Potamogeton foliosus

Description—Leafy pondweed has narrow (about 1⁄16 inch wide), grasslike leaves. The sides of each leaf are generally parallel but form a pointed tip. There are no floating leaves. Leafy pondweed grows in many pond environments but is common in deep sediments in shallow portions of a pond, typically to a depth of four feet. Plants can grow very dense and may interfere with swimming, fishing, and boating.

Value—Leafy pondweed provides a large amount of plant material that supplies immense quantities of invertebrate food for young fish. The fruit is also eaten by many waterfowl species.

Elodea

Elodea canadensis

Alternate names—waterweed, native *Elodea*, Canadian waterweed

This plant can become more of a nuisance when you are trying to control it physically or mechanically because it reproduces quickly through fragmentation.

Description—Elodea is one of the most common plants in Pennsylvania ponds. It has densely whorled, dark-green leaves. The leaves usually occur in whorls of two to three that become more crowded toward the top of the stem. The dense tops can produce very thick growth near the water surface. This plant is typically rooted but can survive and grow as floating fragments. Elodea may act more like an evergreen and survive throughout the winter on a pond bottom. The flowers have three petals and are green or white. Plants reproduce from fragments.

Value—Elodea is commonly used as an aquarium plant. Its thick stems provide cover for young fish and are home to many invertebrates that serve as a food source. The stems are also fed upon by muskrats and waterfowl. As long as it does not grow too abundantly, elodea is one of the most beneficial pond plants for its value as habitat and wildlife food, especially since it often remains green during the winter. This plant is an excellent oxygenator.

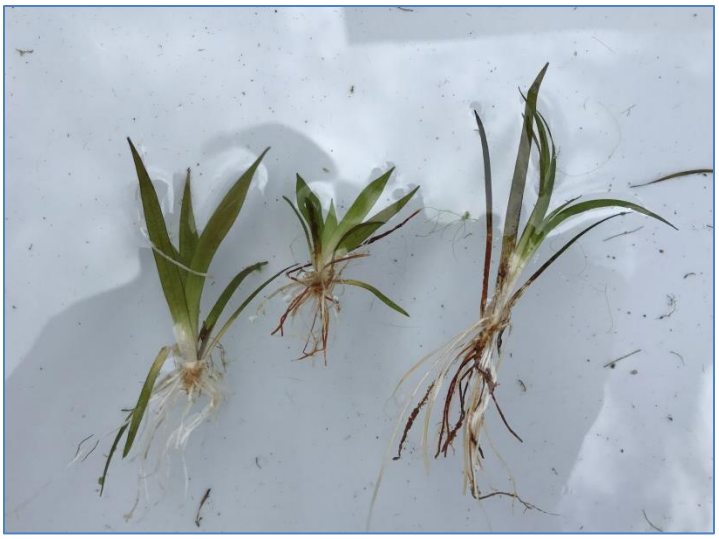
Common look-alikes—Brazilian elodea, hydrilla, Egeria

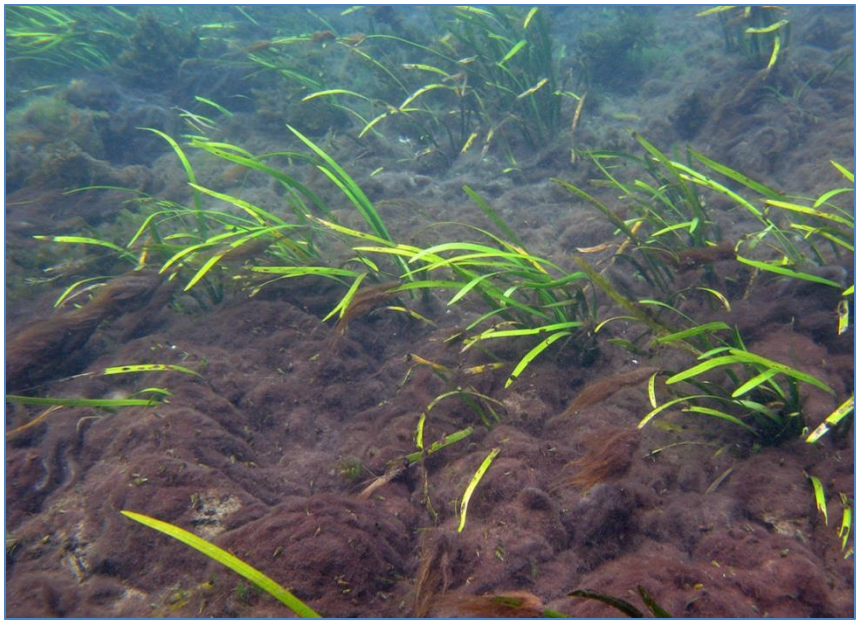
Spring Tape

Sagittaria kurziana

Description – Spring tape is a submerged, rooted plant. The leaves have pointed tips and 3-5 parallel ridges that run vertically down the leaf. The leaves range from less than an inch to 3 feet long. This plant is native to central and northern Florida, but is popular in the aquarium trade. In shallow lotic systems (flowing water) the plant will drape over the water's surface, creating a canopy to the life underneath. This plant is beneficial to an aquatic ecosystem due to its ability to create such habitat for adult and juvenile fish, crustaceans, and macro-invertebrates.

Common look alike – This plant is often confused with *Vallisneria Americana* (tapegrass). In fact the two can be easily distinguished by one obvious trait: spring tape has pointed leaf tips while tapegrass has rounded leaf tips.





Giant Hairgrass

Eleocharis montevidensis

Description – Eleocharis montevidensis is a species of spikesedge known by the common name sand spikerush. It is a widespread coastal plant native to the Americas. It grows in moist, sandy spots in many habitat types, including lakes, riverbanks, wet meadows, and springs. Eleocharis montevidensis is a rhizomatous perennial herb forming tufts or mats of erect, firm stems up to half a meter tall. The narrow grasslike leaves are dark purplish or reddish brown at the bases, becoming lighter in color toward the tips, and drying to a thin, papery texture. The inflorescence is an oval-shaped spikelet appearing at the tip of the stem. It is under a centimeter long and made up of several flowers covered in brownish bracts. This plant is beneficial to aquatic ecosystems as it provides habitat for a variety of aquatic organisms.

Literature Cited

Penn State University. 2009. A Field Guide to Common Aquatic Plants of Pennsylvania. Penn State's College of Agricultural Sciences.

"Eleocharis Montevidensis." *Wikipedia*, Wikimedia Foundation, 2 May 2019, en. Wikipedia.org/wiki/Eleocharis_montevidensis.