2018 Cleveland Metroparks Hydrilla Report

Cleveland Metroparks Technical Report 2018/NR-03

Photo by Tim Krynak, Cleveland Metroparks

Dan T. Moore, Debra K. Berry, Bruce G. Rinker
Board of Park Commissioners

Brian M. Zimmerman
Chief Executive Officer

Cleveland Metroparks
4101 Fulton Parkway, Cleveland, Ohio 44144

Appropriate Citation:

Warman, M. and C. Weldon, 2018. 2018 Cleveland Metroparks Hydrilla Report. Cleveland Metroparks Technical Report 2018/NR-03. Division of Natural Resources, Cleveland Metroparks, Cleveland, Ohio.

Contents

Introduction

Hydrilla verticillata is perhaps the most successful invasive aquatic plant in freshwater ecosystems. Hydrilla has been described as the perfect invasive plant because of its ability to thrive in a wide variety of aquatic habitats, grow in very low light conditions in up to thirty feet of water, and its multiple pathways of propagation and reproduction that allow it to persist in the environment for up to a decade (Batcher, 2000; Langeland, 1996). It is one of the most difficult and expensive submersed aquatic weeds to control, requiring multiple applications and multiple years of herbicide treatment (Netherland, Getsinger, & Turner, 1993). It spreads by seeds, stem fragments, tuberous roots in sediment, and vegetative buds (turions) that form and float free in early autumn (Batcher, 2000; Langeland, 1996). Hydrilla is very difficult to detect at low numbers, but because of its rapid growth it can quickly overwhelm a waterbody and form dense, monotypic mats that out-compete native aquatic plants, reduce habitat for wildlife, and can severely impede recreational and other aquatic activities (Batcher, 2000; Langeland, 1996). It is easily spread by boats, humans, waterfowl, and other unsuspecting animals (Langeland, 1996). Hydrilla closely resembles the native aquatic plant *Elodea canadensis*, differing in having finely-toothed leaf margins visible to the naked eye and tuberous roots (Batcher, 2000).

Hydrilla is abundant in the southeastern United States, where it was first introduced several decades ago by the aquarium and aquaculture trades, and is listed as a federal noxious weed (Batcher, 2000; Langeland, 1996) (Figure 1). As of January 7, 2018, *Hydrilla verticillata* is listed as invasive by the state of Ohio (ODA, 2017). Hydrilla rapidly moved up the Atlantic seaboard following its introduction and has been found as isolated occurrences throughout the country (Batcher, 2000; Langeland, 1996) (Figure 1). Recently, hydrilla has begun to move westward, with established populations in and along the Ohio River and occurrences in New York, Pennsylvania, Ohio, and Indiana (Menninger, 2011) (Figure 1). The full extent of its distribution is unknown, as it can be difficult to detect, especially during the initial stages of infestation, and because aquatic species are rarely targeted by invasive plant surveys and control projects.

Hydrilla was first identified in Cleveland Metroparks in July 2011 (Table 1). A single strand of hydrilla was found in the Blue Heron Marsh in Ohio & Erie Canal Reservation by John Mack, then the Chief of Natural Resources. In August 2011, an abundant infestation of hydrilla was found in the Greathouse Wetlands in West Creek Reservation and a small infestation was found in the southern end of Wallace Lake in Mill Stream Run Reservation (Table 1). Park-wide surveys of potential hydrilla habitat, including lakes, ponds, and wetlands, found additional infestations in Sunset Pond and Sanctuary Marsh in North Chagrin Reservation in 2012 and the Wash-Out Wetlands in West Creek Reservation in 2013 (Table 1). The Greathouse Wetlands are suspected to be the source population of hydrilla in Cleveland Metroparks-wetlands plants were transferred from the wetlands to Blue Heron Marsh and Wallace Lake in 2009 and 2010 as part of a habitat enhancement project.

Infestations

Hydrilla infestations in Cleveland Metroparks have all been found in highly accessible areas that experience a great deal of human traffic- including boating, fishing, swimming, birding, educational programs, habitat and fishery management, water-level control, and well-established trails. This points to human activities as the most likely cause of hydrilla introduction in and between these waterbodies. Hydrilla is present in all three major watersheds in Cleveland Metroparks (Figure 2). Maps of each infestation can be found in Appendix A.

Sunset Pond, North Chagrin Reservation

Sunset Pond is a 5.2 acre man-made pond located in North Chagrin Reservation. The pond is a popular location for waterfowl, both local and migratory, and has been utilized as a brood-stock source for game fish by Cleveland Metroparks. A water-control structure is located at its outflow to Sanctuary Marsh. Hydrilla was found in Sunset Pond in 2012, consisting of several strands along the deck behind the North Chagrin Nature Center. More extensive surveys to check for additional hydrilla have been hampered by excessive algae and other nuisance aquatic plant growth throughout the pond.

Sanctuary Marsh, North Chagrin Reservation

Sanctuary Marsh is a 3.7 acre created wetland located in North Chagrin Reservation. It is a popular location for waterfowl, both local and migratory, as well as other wildlife, and is crossed by a boardwalk and ringed by an all-purpose trail. The marsh is used extensively by North Chagrin Nature Center staff for educational programs. It has a water-control structure at its outflow to Buttermilk Creek, a tributary of the Chagrin River. Cleveland Metroparks has regularly conducted boat electrofishing to remove non-native goldfish from the marsh. Hydrilla was found in Sanctuary Marsh in 2012, consisting of substantial mats in the shallow areas around the boardwalk and pond dipping dock.

Blue Heron Marsh, Ohio & Erie Canal Reservation

Blue Heron Marsh consists of two hydrologically connected wetland cells that discharge into the Ohio & Erie Canal. Their water levels can be modified using a water-control structure at one of the outflows to the Canal. Portions of the marsh have a boardwalk and pond dipping dock, which is utilized by CanalWay Visitor Center staff for educational programs. Additionally, a long-term Blanding's turtle study, including the release of head-started turtles and the tracking and trapping of turtles in the marsh, has taken place in the wetlands for several years. A single strand of hydrilla was found in the marsh in 2011 and subsequent surveys found multiple small, sparse patches of hydrilla in the southern wetland cell.

Greathouse Wetlands, West Creek Reservation

The Greathouse Wetlands consist of two hydrologically connected cells that total 1.14 acres. These man-made wetlands were constructed in 2002 and a variety of aquatic plants were purchased from Envirotech Consultants Inc. in Somerset, Ohio and installed. There are two water-control structures- one between the upper and lower cells and one at the lower cell's outflow to West Creek, a tributary of the Cuyahoga River. In addition, a working wetland with a water-control structure at its outflow was created above the Greathouse Wetlands as part of the stormwater management for the Watershed Stewardship Center and discharges into the upper cell. An extensive infestation of hydrilla was found in the upper cell in 2011, while the lower cell had only a few clusters.

Wash-Out Wetlands, West Creek Reservation

The Wash-Out wetlands are composed of 9 hydrologically connected cells that were constructed along a 1,300 foot sewer line wash-out and planted with nursery stock in 2002, totaling 0.44 acres. These wetlands are located in the floodplain of the West Creek valley and are often dry during the growing season. In 2013, cell 7 (cells are numbered 1 through 9 from south to north) was found to have a dense infestation of hydrilla.

Wallace Lake, Mill Stream Run Reservation

Wallace Lake is a former Berea sandstone quarry that was deliberately flooded and turned into a lake in the 1930s. It is 17.6 acres in size, and, while it was formerly 50-60 feet deep in some areas, its current maximum depth is 26 feet due to decades of sedimentation. The lake consists of two deep basins on its north and south ends with a shallow, narrow neck between them. Wallace Lake has a water-level control structure and an outflow into the East Branch Rocky River. During heavy flooding unrestricted flow between the lake and river can occur. The lake is a popular area for fishing, swimming, and boating, and is managed during the growing season for nuisance aquatic vegetation. Hydrilla was found in a small number of patches in the southern basin in 2011, near aquatic vegetation that had been transplanted from the Greathouse Wetlands in 2009 and 2010, and spread rapidly throughout the lake during 2012.

Treatments

Controlling and eradicating hydrilla is a complex and challenging undertaking. Hydrilla is able to thrive in a wide variety of aquatic habitats and each site requires a unique treatment approach that takes into account numerous factors- from water depth and site hydrology to herbicide type and use restrictions (Batcher, 2000; Langeland, 1996). Cleveland Metroparks primary method of hydrilla control is through herbicide treatments. Herbicides are currently the only method of treatment that can completely eliminate an infestation of hydrilla. While other methods, such as mechanical removal and biological control, are management options, they primarily serve to reduce biomass and cannot eliminate hydrilla (Batcher, 2000; Langeland, 1996).

The majority of hydrilla infested waterbodies in Cleveland Metroparks are wetland habitats. Wetlands increase the challenges of treating hydrilla because they have desirable native plant communities that can be negatively affected by herbicides. Additionally, herbicides perform differently in wetlands than other waterbodies because of shallow depths and variable seasonal hydrology. Cleveland Metroparks approach to treating hydrilla continues to evolve as it tests different herbicides, variations in application method, timing, and complimentary management options including water draw-downs and the use of barriers and filters. It also consults with other agencies, manufacturers, vendors, and researchers to stay on top of the best practices available to control hydrilla.

2011 Treatments

3x3 foot test plots of Cutrine Plus (active ingredient copper sulfate) at 0.2 and 0.4 ppm and Reward (active ingredient diquat dibromide) at the standard aquatic surface treatment rates were applied in separate locations in the upper Greathouse Wetland to evaluate their effectiveness on hydrilla. Cutrine Plus at both concentrations exhibited only a moderate control of hydrilla, with no by-kill of other aquatic plants. Although hydrilla is one of only a few vascular plants controlled by copper compounds, Cutrine Plus was not effective enough to be considered a viable long-term control option. Reward, a broad-

spectrum contact herbicide, exhibited better control of hydrilla, but also resulted in extensive damage to non-target native emergent aquatic plants. A filter in the water-control structure at the outflow to West Creek in the lower cell was installed to prevent vegetative fragments and turions from washing out of the wetland complex. All hydrilla that could be located in Wallace Lake, which was limited to the edge of the southern basin among wetland plants transferred in previous years from the Greathouse Wetlands, were spot-treated with Cutrine Plus during the late summer.

2012 Treatments

The Greathouse Wetlands were spot-treated with Cutrine Plus in May and early June. Hydrilla was noted to be dense and abundant in the upper cell and present only in small patches in the lower cell. During the early June treatment it was noted that hydrilla was 50-75% dead in areas treated in May. In late June treatments switched to Reward, as hydrilla was still abundant, particularly in the upper cell. Herbicide application was difficult because of low water levels from planned de-watering and no further treatments were carried out because the wetlands were dry during the remainder of the growing season.

Wallace Lake was spot-treated for hydrilla with Reward in May, where it was limited to the edge of the southern basin and appeared to be greatly reduced from 2011 levels. Although the hydrilla treated in May was gone, new areas of infestation in the southern basin were located in early June and treated with Cutrine Plus. Treatments continued in July with treatments of Cutrine Plus, followed by Reward. Despite the ongoing treatments, hydrilla spread throughout the lake, including into the outflow channel to the East Branch Rocky River at its far northern end. A contractor was hired and initiated whole-lake treatments using SonarAS (fluridone) from mid-July through October. Results of SonarAS treatment were excellent- hydrilla rapidly bleached and died off throughout the entire lake.

2013 Treatments

2013 marked a shift in the treatment approach at the Greathouse Wetlands. The wetlands were de-watered in early spring and a pre-emergent soil treatment of Galleon (penoxsulam) was applied in both cells. The wetlands were then allowed to refill during late spring and early summer and a surface treatment of Galleon was applied. Newly discovered hydrilla in the Wash-Out Wetlands was also treated with a surface water application of Galleon in late summer. Whole-lake fluridone treatments were conducted by a contractor at Wallace Lake from May through September and no vegetative hydrilla was found during the growing season. Sunset Pond had extensive filamentous algae during the growing season and no hydrilla was located, so a single early summer preventive treatment using SonarOne (fluridone) was done. Sanctuary Marsh was treated with SonarOne three times during the summer. While the target concentration in the wetland was maintained, there was significant damage to non-target emergent aquatic plants.

2014 Treatments

The Greathouse Wetlands were treated three times from May-June with Galleon (penoxsulam) and twice from June-August with SonarOne (fluridone). The Wash-Out Wetlands were treated twice from May-June with Galleon and twice from June-August with SonarOne. Due to heavy spring and early summer rains it was extremely difficult to maintain the desired concentrations of herbicide in both wetland complexes and vegetative hydrilla was still found in the upper cell of the Greathouse Wetland in late summer. For the 3rd year, Wallace Lake had contracted whole-lake treatments of fluridone using both

SonarQR and SonarAS from August-October in 6 separate applications. The Blue Heron Marshes were treated for the first time with an application of Galleon in June and SonarOne in August in both wetland cells. Sunset Pond was again choked by filamentous algae and had no hydrilla-specific herbicide treatments. Unlike 2013, a few strands of hydrilla were found growing along the Nature Center deck in the late summer. Sanctuary Marsh was treated with SonarAS three times from June-August, which eliminated the vegetative hydrilla, but again resulted in moderate damage of non-target plants.

2015 Treatments

2015 was the first year all Cleveland Metroparks hydrilla treatments were contracted. Aqua Doc oversaw herbicide applications, treatment monitoring, and residue testing in the six infested waterbodies. Sites were treated with Sonar products (fluridone) from June -October. Fluridone concentrations were maintained at or near target levels in Wallace Lake, Washout Wetlands, Blue Heron Marsh, Sanctuary Marsh, and Sunset Pond throughout the treatment season, though there were some fluxuations due to changes in water level and seasonal drying in shallower sites. Maintaining fluridone concentrations was extremely challenging in the Greathouse Wetlands- levels skyrocketed to over 200 ppb in the final two months of treatment, likely because the wetland complex was nearly dry. It appears that fluridone did not break down as rapidly by photodegradation or general decay from environmental conditions as expected in a shallow wetland habitat. Based on the FasTEST results, fluridone increased in concentration as water levels dropped, instead of evaporating or flushing out. It raises interesting questions and treatment challenges- including fluridone breakdown rates in shallow water habitats, where in the water column the chemicals linger, and if there are differences between types of product (ex: liquid suspensions vs. pellets).

2016 Treatments

For a second year, Cleveland Metroparks contracted all of its hydrilla treatments to Aqua Doc. Sites were treated with Sonar products (fluridone) from May-October, with FasTESTs run roughly every two weeks and bump applications of herbicide applied when needed. 2016 was an unusually dry growing season with minimal rain events. The Greathouse Wetlands continued to be extremely challenging, with highly variable water levels and herbicide concentrations. Disturbingly, despite fluridone concentrations well over 6 ppb throughout the growing season, vegetative hydrilla with new tuber formation was discovered in the upper cell in August during tuber sampling. This raises concerns of herbicide resistance developing and switching to Galleon (penoxsulam) in 2017 is being considered. The Washout Wetlands were only treated once before they dried up in mid-June and remained dry for the rest of the growing season. The dry conditions in this wetland make it difficult to evaluate the efficacy of herbicide treatment on hydrilla. Wallace Lake, Blue Heron Marsh, Sunset Pond, and Sanctuary Marsh all appeared to be responding well to their treatment programs, with no growth of hydrilla observed and fluridone concentrations averaging above 6 ppb. While both Blue Heron Marsh and Sanctuary Marsh experienced variations in water levels, it was not enough to complicate control efforts.

2017 Treatments

Cleveland Metroparks contracted all of its hydrilla treatments to Aqua Doc for a third year. Sites were treated with Sonar products (fluridone) from May-October. FasTESTs for herbicide residue were run roughly every two weeks and bump applications of herbicide were applied when needed. To improve control at the challenging Greathouse and Washout Wetlands, two treatment practices were altered in 2017. First, a less-concentrated granular fluridone formula, Sonar H4C, was used at the Greathouse and

Washout wetlands. This formulation has greater dispersal potential, especially in well-vegetated waterbodies, with a higher pellet count per application. Second, an increased number of FasTESTs were conducted at the Upper Greathouse Wetlands from August – October to ensure uniform herbicide concentrations. Uniform application was achieved and no new vegetative hydrilla was detected in 2017. As in 2016, Sonar AS was used at Wallace Lake and Sonar One was used at Sunset Pond, Sanctuary Marsh, and the Blue Heron Marsh. In 2017, northeast Ohio experienced average rainfall in the spring and a true drought from mid-September until the end of October. Herbicide levels at several sites increased due to evaporation (Table 2). Herbicide treatments were effective in 2017 and the same regime will be used in 2018.

Future Treatments

Future treatment options should consider hydrosoil temperature and a new herbicide. Monoecious hydrilla has been documented to sprout when hydrosoils reach 52^{o}F (Harlan, Davis & Pesacreta, 1985). Fluridone treatments are applied as a "pre-emergent," before hydrosoils reach 52^{o}F so that germinating tubers are immediately exposed to herbicide. In early, 2018, a new selective contact herbicide named ProcellaCOR received USEPA approval. ProcellaCOR degrades quickly in sunlight and may be a good option for rapid hydrilla control if a new infestation is discovered, especially where native vegetation resides. (Netherland, Heilman, Willis & Beets 2016)

Monitoring and Surveillance

Monitoring the effectiveness of herbicide treatments on hydrilla is done several ways in Cleveland Metroparks: visual monitoring, rake tosses, water samples, and tuber sampling. Visual monitoring of infested areas is conducted to track the growth and spread of hydrilla and the effectiveness of treatments. Visual monitoring is regularly carried out by Cleveland Metroparks staff and contractors during the growing season. Visual monitoring is effective in areas where hydrilla is present in well-established populations, but on a larger scale, due to the plants ability to grown in deep, murky water and spread via fragments, it is difficult to detect. Rake tosses may be conducted from the edges of a waterbody or from a boat or kayak. Two hard garden rake heads are fastened together and tossed on a rope into deep, murky waters to aid in hydrilla detection. Water samples are taken during the treatment season and sent to SePro Corporation for FasTESTing, which determines the concentration of herbicide at the ppb level. This ensures that the minimum effective concentration of herbicide is maintained in a waterbody. Depending on the size of the waterbody, one to three FasTEST samples are taken from an assigned site(s) at each waterbody.

Tuber Sampling

Tuber sampling is a common monitoring method in hydrilla control programs. Tuber samplers (Madsen, Wersal, & Woolf, 2007) and sorting screens were constructed in-house by Cleveland Metroparks Building Trades staff. Tuber sampling is used as a measurement of treatment effectiveness- the purpose of treatment is to both kill the vegetative hydrilla during the growing season and prevent the formation of tubers that would sprout into new plants in subsequent years- and determine the size of the tuber banks in infested waterbodies. Tuber sampling was piloted in 2013 and revealed several difficulties, including water depth and substrate composition issues (bedrock, gravel, and heavy clay in many areas), operation

of the samplers (especially establishing a seal to remove sediment cores), and an extremely low density of tubers even from areas where dense, multi-year populations of hydrilla were present.

2014 was the first comprehensive year of tuber sampling. 30-50 substrate cores were taken from each infested waterbody, targeting areas that had the densest amounts of vegetative hydrilla and substrates (clay, silt, and muck) that allowed core retrieval. Each core was screened for tubers using fine-mesh sorting screens. This often took serious effort, as many cores consisted entirely of clay and had to be broken down by hand, and tubers are very similar in size, shape, and color to small pebbles, seeds from a variety of aquatic and riparian/near-shore plants, and random bits of detritus. Sampling was conducted in late August-early September. Although tuber formation is greatest from September-November and sampling is typically conducted in the late fall, this time frame was chosen because of staff availability, to avoid colder water temperatures that would make the process unpleasant, and to avoid complications posed by autumnal leaf fall and vegetation die-back.

Tuber sampling in 2014 took 39 staff hours. A total of 8 tubers were found from the six hydrilla-infested waterbodies in Cleveland Metroparks. This was surprising, as a large tuber bank was anticipated given that many of the areas sampled had had very dense, often multi-year hydrilla populations. However, as 2014 was the first year of sampling and all of the waterbodies have been treated with herbicides for anywhere from 1 to 4 years, it is unknown if this low density of tubers is natural for these populations or evidence that the herbicides have been effective in reducing tuber formation. Only 3 of the 6 waterbodies- Greathouse Wetlands, Blue Heron Marsh, and Sunset Pond- had vegetative hydrilla present and all in relatively low numbers. Even at low densities, a single tuber can develop hundreds of vegetative sprouts that in turn can form thousands of new tubers in a single year, so the 8 tubers found during sampling are significant. Another factor could be where the tuber sampling was conducted- perhaps tubers are more abundant in substrates where the sampler could not get cores, such as gravel or leafpacks. Tuber sampling in 2015 was conducted in mid-late August and took 27.25 staff hours. Tubers were only found in the upper cell of the Greathouse Wetlands, and, unlike previous years, densities were very high. This is also the only area where vegetative hydrilla was seen during sampling activities. This wetland complex continues to be a difficult area to control hydrilla and is the only infestation where the vegetative form of the plant has not been significantly knocked back despite several years of treatment. Tuber sampling in 2016 was conducted in mid-August and took 53 staff hours. Like 2015, tubers and vegetative hydrilla were found only in the upper cell of the Greathouse Wetlands, but tuber densities were very low.

Tuber sampling occurred twice in 2017, in May and September. Sampling efforts in spring and fall took a combined 134.5 staff hours. Spring samples were collected to gather evidence on the timing of tuber sprouting. If an accurate range for tuber sprouting is known, then herbicide treatments can be appropriately timed and unnecessary herbicide applications can be avoided. The 2017 collection protocol called for 50 sediment cores at several locations in each waterbody. An additional 10 cores were collected to boost sampling intensity based on staff availability and timing during the work day. Most cores (776) were collected in May. Fall tuber sampling was cut short due to a drought- low water levels made sifting through cores in the field difficult. Despite an enhanced tuber sampler with quarter-turn valve and foot stand, one location, the outflow at Wallace Lake, was not sampled in 2017. A buildup of submerged, woody debris made navigation hazardous and sediment cores impossible to collect. A single tuber was detected in the Upper Greathouse wetland (Table 3). This tuber detection is unsurprising since vegetative

hydrilla was present in 2016. The overall drop in tuber numbers across infestations is a positive trend (Figure 3).

Surveillance

Due to the widespread and scattered locations of known hydrilla infestations in Cleveland Metroparks, an annual park-wide surveillance of all potential aquatic habitats has been conducted in mid-late summer since 2012 at over 90 sites. Habitats surveyed include lakes, ponds, all wetlands that remain at least partially watered during the growing season, and, beginning in 2014, downstream of known infestations in receiving streams and rivers. This annual surveillance will continue for the foreseeable future, allowing staff to identify and rapidly respond to new infestations. Surveillance is conducted by Natural Resources staff by wading or boat, depending on water depth in crews of 2-5 people. Surveillance identified previously unknown infestations in 2012 (in Sanctuary Marsh) and 2013 (Wash-Out Wetlands). No new infestations have been identified since.

Expanded detection the Cuyahoga River Area of Concern (Figure 4) began in 2017. Staff collaborated with 27 land managers at 65 external properties throughout the AOC. No new infestations of hydrilla were discovered in 2017. However, other AIS of concern were detected: flowering rush (*Butomus umbellatus*), Brazilian waterweed (Egeria densa), water hyacinth (*Eichhornia crassipes*), European frogbit (*Hydrocharis morsus-ranae*), yellow floating heart (*Nymphoides peltata*), water lettuce (*Pistia stratiotes*), and water spangles (*Salvinia minima*). Each occurrence was reported to appropriate land managers and uploaded to national databases- USGS-NAS, GLANSIS, and EDDMapS. An infestation of *E. densa* within Cleveland Metroparks was managed internally and the case was used to refine the Risk Assessment and Action Plan document developed for the hydrilla project.

Rake tosses were conducted where water was too deep or turbid to be surveyed in waders. Rakes were surveyed for species, but not density or weight. Three rake tosses were performed from points along the bank or margin of a waterbody and four tosses were performed from a boat or kayak. Waterbodies were not often uniform and would require the use of multiple survey techniques to adequately search for hydrilla. Efforts were concentrated on areas that have potential vectors of spread present- boat ramps, fishing docks, vegetated shallows, inflows, spots favored by waterfowl, disturbances (dredging, habitat modifications, etc.), and areas with a high degree of public access (trails, beaches, roadways). Publicly accessible waterbodies were prioritized (Table 4).

In 2017, data was captured electronically on Fulcrum, a custom form creation app designed for mobile devices. Fulcrum contains a point map of sites, species lists, and geo-referenced photos. Handheld GPS tracks and acres surveyed are organized on QGIS. Hard copy maps and notes are stored and available at the Rocky River Management Center. Plant vouchers were collected, mounted, and stored at the herbarium at Cleveland Metroparks. Additional vouchers were submitted to the herbarium at the Cleveland Museum of Natural History. Photo vouchers were taken of habitat and species. Non-target species potentially affected by herbicide management of hydrilla were also documented. Results from the first year of expanded surveillance documented no new infestations and supports the early detection and rapid response model for aquatic invasive species control. A complete list of surveyed sites is available in Appendix B & C.

Decontamination

Natural Resources staff instituted a decontamination protocol for vehicles, equipment, and work-wear used in aquatic environments in 2012, after determining that field work activities were likely the primary vector of hydrilla spread in Cleveland Metroparks. Decontamination has numerous benefits and should be part of any field work protocol- not only can it help prevent the spread of invasive species between sites, it can also prevent transmission of many zoonotic diseases. Decontamination stations were set up at Rocky River Management Center, West Creek Maintenance Center and the Watershed Stewardship Center in West Creek. Stations consist of 110 gallon rubber tubs filled with a 2% bleach solution, scrub brushes, and boot picks. Run-off is contained in a catch basin or enters a sanitary sewer system. In 2014, mobile decontamination kits were put together and distributed to Natural Resources staff to be used in the field between sites. In 2015, field decontamination was expanded further with the addition of small spray bottles of bleach that can easily be carried in a field pack and used on minor equipment such as hand tools, nets, and specimen containers. In 2017, field decontamination expanded to include a large tub and backpack sprayers filled with decontamination agent Virkon as a mobile cleaning station. Cleveland Metroparks conducted HACCP training with other local agencies in 2017 including- Cuyahoga County Board of Health, Ohio Geese Control, and Northeast Ohio Regional Sewer District, who have adopted Cleveland Metroparks best practices for decontamination. The protocol in its entirety can be found in Appendix D.

Internal and External Cooperation

Internal Cooperation

Internal cooperation in Cleveland Metroparks has been pivotal in its efforts to institute an effective hydrilla control and eradication program. Natural Resources, Park Management, Site Construction, Outdoor Experiences, and Rangers have collaborated on determining and enforcing appropriate methods to control the spread of hydrilla and ensure information is disseminated to staff. Outdoor Experiences staff have incorporated preventing the spread of hydrilla and other aquatic invasives into many of their programs, ranging from pond-dipping outings to water recreation field trips. The rapid spread of hydrilla in Wallace Lake during the summer of 2012 prompted Cleveland Metroparks to institute recreational restrictions to reduce the risk of movement to other waterbodies. Wallace Lake is a popular place for fishing, swimming, and boating and is used heavily by staff and the public for programs. An internal meeting decided that fishing and all external watercraft would be banned on the lake for the growing season, as those were the activities that posed the greatest risk. Signage was placed around the lake, enforced by the Rangers, and adjacent homeowners and the media were notified. The restrictions were lifted in 2013 and 2014 after internal discussion and will only be reinstituted if vegetative hydrilla is found in the lake. The Invasive Plant Coordinator is working with Site Construction, Park Operations, and other divisions to identify sites that pose a high risk of spreading hydrilla and other invasive plants and to institute protocols for decontaminating large equipment after work is done in those areas.

In 2017, the Natural Resources Division hosted internal partners to further develop practical and effective decontamination techniques across varied job activities. Site Construction, Outdoor Experiences, and Natural Resources divisions participated. As a result, a non-motorized vessel decontamination guide was developed. Outdoor Experiences contacted Natural Resources staff for guidance on decontamination and spread-prevention strategies when working in hydrilla treatment zones. The Hydrilla Project Coordinator presented hydrilla identification information at an Outdoor Experiences in-service for 25

employees and guides to common aquatic invaders were distributed to all nature centers in the Park District. The Natural Resources Division also created a reporting tool for aquatic invasive species in the Northeast Ohio ParkApps for smartphones and tablets. The app can be found by searching the iTunes store for "ParksApp NE Ohio." Internal dialogue will continue in 2018, with leadership from the Invasive Plant Coordinator and Hydrilla Project Coordinator, with the goal to expand internal cooperation and the adoption of best management practices to contractors who work in Cleveland Metroparks .

External Cooperation

Since discovering hydrilla, Cleveland Metroparks has consulted and collaborated with numerous other public agencies, contractors, vendors, and researchers to determine the best approaches to monitoring, treating, and eradicating this highly invasive plant both within its own boundaries and in Great Lakes region. Location and occurrence information for each hydrilla infestation in Cleveland Metroparks is submitted to the Early Detection & Distribution Mapping System (EDDMapS- www.eddmaps.org), the Great Lakes Aquatic Nonindigenous Species Information System (GLANSIS - glansis-noaa) and the USGS Non-indigenous Aquatic Species database (USGS - nas.er.usgs.gov). EDDMapS, GLANSIS, and USGS-NAS are web-based mapping systems for documenting invasive species distribution in the United States and Canada. Participants are able to submit observations, which are verified by experts to ensure accuracy, and view data from across North America. Data is available almost immediately after submission, allowing real-time tracking of invasive species movement and helping facilitate early detection and rapid response programs.

The Park District applied for Great Lake Restoration Initiative funding in 2013 and 2015 to expand hydrilla detection activities outside its reservations and into at-risk areas in Ohio's Lake Erie watershed. The 2013 application did not receive funding. The 2015 application received full funding and the project (GL-00E01923) was initiated in May 2016. Cleveland Metroparks hired a two-year, full time Hydrilla Project Manager to oversee the ongoing treatment, monitoring, and detection activities in the Park District, expand detection efforts to high-risk waterbodies in the Cuyahoga Area of Concern (AOC), and to act as a hub for hydrilla identification and detection training, reporting, and best management practices for Ohio's Lake Erie basin.

In 2017, Cleveland Metroparks offered in-the-field trainings and formal presentations on hydrilla identification and detection. A total of 27 landowners participated in the expanded search and 1025 participants were informed via 33 outreach events. Because of this outreach, two positive hydrilla infestations were reported to Cleveland Metroparks, both from Aqua Doc; a pond in Richfield, Ohio and a private campground in Butler County, Pennsylvania, near another hydrilla infestation in Lake Arthur. The Park District acted as reporter, with permission from landowners, and uploaded the observations to national databases. Both population are under treatment from Aqua Doc. Other AIS were also reported by partners. Lake Metroparks detected and treated a population of *Egeria densa* and shared the results with Cleveland Metroparks. Cuyahoga Soil and Water Conservation District submitted nine locations to Cleveland Metroparks that contained dense, aquatic vegetation stands- one location was visited in 2017 and the remainder will be surveyed in 2018.

Ohio Sea Grant was instrumental in providing educational materials to Cleveland Metroparks. Over 1,000 pieces of literature were distributed by the Hydrilla Project in 2017. Ohio Sea Grant and Ohio Department of Natural Resources supported outreach activities at Cleveland Metroparks E55th Marina. A discounted dock fee (2.5%) was awarded to boaters who participated in an AIS workshop and signed the

Ohio Clean Boater Pledge. The Hydrilla Project Coordinator and ODNR Coastal Management staff delivered general AIS and hydrilla-specific education. Approximately 150 individuals participated in the marina program in 2017. A follow-up survey was issued and was responded to by 70 boaters. The discount program will again be offered at E55th Marina in 2018, with plans to expand to remaining marinas as rates increase.

Marketing and project awareness have come in other forms. The hydrilla project has received press in newsletters from the Rocky River Watershed Council, the Friends of Euclid Creek, and Aqua Doc. Formal presentations were delivered to the Ohio Aquatic Invasive Species Committee, Great Lakes Sea Grant Network, Binational Great Lakes Aquatic Nuisance Species Forum, and the Cuyahoga River Area of Concern Advisory Committee. Park District staff facilitated a field trip for the Great Lakes Sea Grant Network's annual conference and presented a poster for researchers from Wisconsin, Michigan, New York, Minnesota, Illinois, Indiana and Ohio.

Cleveland Metroparks Hydrilla Strike Team facilitated and collaborated with other vegetation sampling efforts in the region. The Park District provided a boat, sonar, and staff time for a joint survey of the Cleveland Harbor with the Nature Conservancy and the Ohio Department of Natural Resources. Species lists and sampling sites were exchanged with the University of Toledo's Lake Erie Center in support of their grass carp habitat study. Lake, Geauga, Portage, and Summit county park districts participated in joint surveys, searched more sites independently, and reported back to Cleveland Metroparks. Eighteen waterbodies were surveyed in the Cuyahoga Valley National Park and a summary report was issued to National Park staff. University of Akron, Cleveland State University, and Baldwin Wallace University partnered with Cleveland Metroparks to receive training and information. Cleveland Metroparks also provided hydrilla identification materials and decontamination supplies (bleach, brushes and tubs) to a private contractor that performs work in the Park District's waterbodies.

To expand reach to the general public, Park District annual reports, best management practices, and herbicide treatment regimes were published digitally. The Crooked River Cooperative Weed Management Area (CWMA) (CRCWMA.org) and Great Lakes Hydrilla Collaborative (HydrillaCollaborative.com) have published all annual reports on Cleveland Metroparks hydrilla management efforts. In 2018 the Cleveland Metroparks website will be updated to feature the hydrilla project with a reporting tool to crowd-source observations.

Costs

Hydrilla is costly to control because of the multi-faceted, long-term approach required to eliminate it. The herbicides needed to effectively treat hydrilla, while at the same time minimizing damage to non-target aquatic plants, are expensive even in small quantities. Completely eradicating hydrilla from a waterbody requires up to a decade of treatment, with a specific concentration of herbicide maintained throughout the growing season (Batcher, 2000; Netherland, Getsinger, & Turner, 1993). Adding to the cost is the fact that each waterbody and infestation are unique and require a tailored treatment approach. Staff time, including mobilization, treatment, monitoring, and surveillance, have increased each year in Cleveland Metroparks as infestations are identified, and expenditures are anticipated to increase annually as herbicide prices rise, waterbodies are added, and treatment strategies evolve. Total treatment costs from 2011-17, comprising herbicide costs (but not staff time or equipment)

and contractor treatments total totals over $133,000 and details of treatment costs are available in Appendix E.

The Ohio Department of Natural Resources (ODNR) has been instrumental in supporting Cleveland Metroparks hydrilla treatment efforts. Through subsidy agreements in 2012, 2013, and 2014 ODNR covered 75% of the costs of contracting whole-lake treatments on Wallace Lake, using GLRI funds granted to the State. From 2015-16, via a subsidy agreement, ODNR funded 75% of all hydrilla treatment costs throughout Cleveland Metroparks. Treatment costs for 2017 were $34,117 for a contract with AquaDoc which covers treatment and monitoring in all six infested waterbodies, which was paid for entirely with Cleveland Metroparks hydrilla GLRI grant.

Hydrilla treatment and monitoring in Cleveland Metroparks is expensive in both herbicides and staff time, but the cost of not controlling this invasive aquatic plant is even greater. If allowed to spread unchecked hydrilla can degrade important aquatic habitat in the Park District's lakes, ponds, wetlands, rivers, and streams. Hydrilla can form dense mats of vegetation, severely limiting recreation including swimming, fishing, and boating. The risk of hydrilla spreading into new areas both within and outside of Cleveland Metroparks is extremely high if aggressive control and monitoring efforts are not instituted and committed to over the long term. As the location of the first known occurrences of hydrilla in the Lake Erie watershed in Ohio, it is incumbent upon Cleveland Metroparks as a conservation agency to proactively and responsibly manage this invasive species to protect the natural resources in both its reservations and the region.

2018 Treatment Plan

Cleveland Metroparks will contract all treatments and monitoring in 2018 to a single contractor, to be solicited by an RFQ in mid-winter and selected based on best and lowest bid standards. Contracting with a single company reduces costs and ensures consistency in treatment methods and effectiveness monitoring. Contractor costs in 2018 will be covered with funding from both the Hydrilla GLRI grant and Cleveland Metroparks operating budget. Wallace Lake and the Greathouse wetlands will undergo a 7th year of contracted, whole-waterbody fluridone treatment. The remaining waterbodies will undergo a 4th year of contracted treatments. 2018 will be the second year of oversight and coordination of hydrilla management efforts by the Hydrilla Project Coordinator. As in 2017, treatments in 2018 will begin in mid-May and end in October. This "pre-emergent" strategy has been successful to date in Cleveland Metroparks. Wader surveys, rake tosses, and boat surveys will continue to be employed on the hunt for hydrilla. Annual surveillance of Cleveland Metroparks will continue and expand into newly acquired properties. GLRI supported, expanded surveys in the Cuyahoga Area of Concern will continue in 2018. Landowners in the Cuyahoga River Area of Concern and the western basin of Lake Erie will be the primary focus of the 2018 outreach efforts.

Works Cited

Batcher, M. S. (2000). Element Stewardship Abstract for Hydrilla verticillata (L.F.) Royle, Hydrilla. Retrieved from The Nature Conservancy Wildlife Invasive Species Team: http://imapinvasives.org/GIST/ESA/esapages/documnts/hydrver.pdf

Harlan SM, Davis GJ, Pesacreta GJ. 1985. Hydrilla in three North Carolina lakes. J. Aquat. Plant Manage. 23:68–71.

Langeland, K. A. (1996). Hydrilla verticillata (L.F.) Royale (Hydrocharitaceae), "The Perfect Aquatic Weed". Castanea(61), 293-304.

Madsen, J. D., Wersal, R. M., & Woolf, T. E. (2007). A New Core Sampler for Estimating Biomass of Submersed Aquatic Macrophytes. J. Aquat. Plant Manage.(61), 31-34.

Menninger, H. (2011). Hydrilla verticillata in the Cayuga Inlet: A science-based review to guide management actions. Cornell University, NY Invasive Species Research Institute, Ithaca.

Netherland, M. D., Getsinger, K. D., & Turner, E. G. (1993). Fluridone Concentration and Exposure Time Requirements for Control of Eurasian Watermilfoil and Hydrilla. J. Aquat. Plant Manage, 31, 189-194.

Netherland, M.D., Heilman, M., Willis, B., & Beets, J. (2016). Efficacy and Selectivity Studies for Aquatic Herbicide - ProcellaCOR. Upper Midwest Invasive Species Conference, Powerpoint Presentation.

Ohio Department of Agriculture (2017), “Invasive Plant Species.” Invasive Plant Species, effective 1/7/18, code 119.03, statutory authority 901.50. Retrieved from the Register of Ohio: http://www.registerofohio.state.oh.us/pdfs/901/5/30/901$5-30-01_PH_FF_N_RU_20171228_1105.pdf

Tables and Figures

Site Name	Size (acres)	Reservation	Watershed	County	Year Found
Sunset Pond	5.20	North Chagrin	Chagrin River	Cuyahoga	2012
Sanctuary Marsh	3.70	North Chagrin	Chagrin River	Cuyahoga	2012
Blue Heron Marsh	2.50	Ohio & Erie Canal	Cuyahoga River	Cuyahoga	2011
Greathouse Wetlands	1.14	West Creek	Cuyahoga River	Cuyahoga	2011
Wash-Out Wetlands	0.44	West Creek	Cuyahoga River	Cuyahoga	2013
Wallace Lake	17.60	Mill Stream Run	Rocky River	Cuyahoga	2011

Table 1. Locations of hydrilla-infested waterbodies in Cleveland Metroparks.

Site	Formula	Avg. Conc. (µg/L)
Wallace Lake	Sonar AS	5.3
Greathouse Upper	Sonar H4C	23
Greathouse Lower	Sonar H4C	28
Washout Wetlands	Sonar H4C	24
Blue Heron Marsh	Sonar One	11.8
Sunset Pond	Sonar One	9.6
Sanctuary Marsh	Sonar One	9.5

Table 2. Average concentrations of fluridone in Cleveland Metroparks sites in 2017. 6 µg/L is the target concentration.

Reservation	Site	Sprouting hydrilla tubers	Non-sprouting hydrilla tubers	Number of core samples
North Chagrin	Sanctuary Marsh	0	0	150
	Sunset Pond	0	0	50
Ohio & Erie Canal	Blue Heron Marsh	0	0	103
West Creek	Greathouse Wetlands-Lower	0	0	100
	Greathouse Wetlands-Upper	0	1	177
	Wash-Out Wetlands	0	0	50
Mill Stream Run	Wallace Lake	0	0	160
Total	**-**	**0**	**1**	**790**

Table 3. Tuber sampling effort in 2017 by location.

Classification	Acres
Total Acres	3732
Acres in Cleveland Metroparks	1420.45
Acres outside Cleveland Metroparks	2311.55
Public Acres	3665.5
Private Acres	66.5

Table 4. Total acreage surveyed in 2017, acres are classified based on ownership and location.

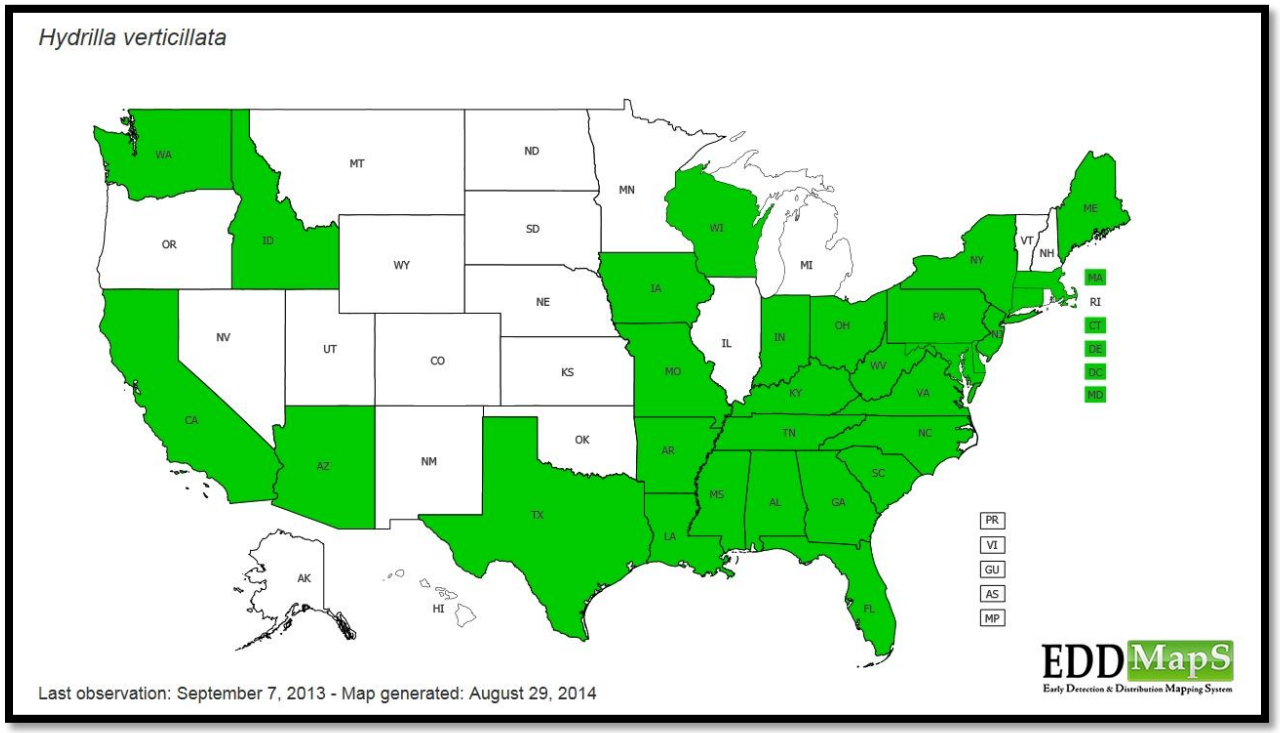


Figure 1. Distribution of hydrilla in the United States

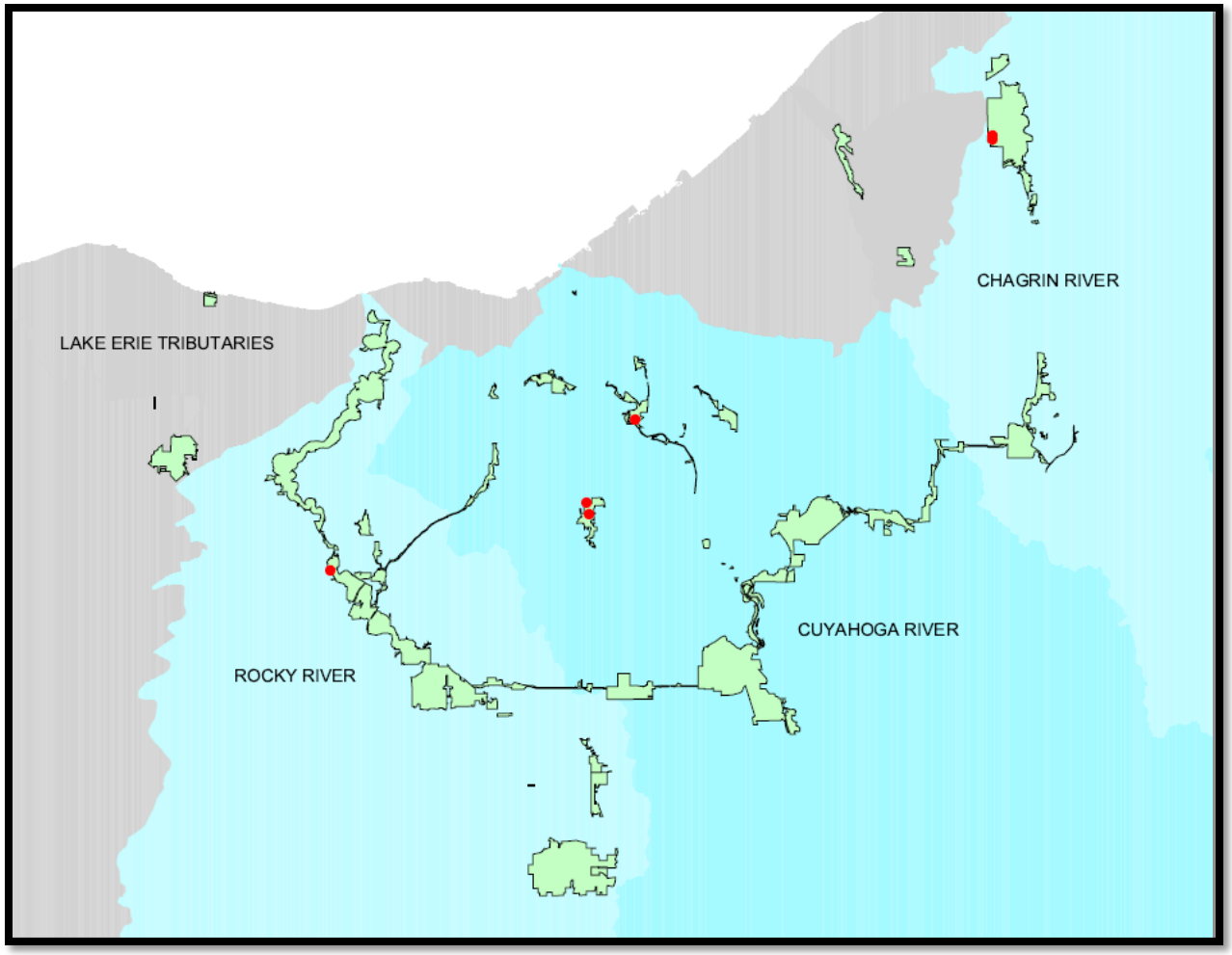


Figure 2. Cleveland Metroparks hydrilla infestations by watershed

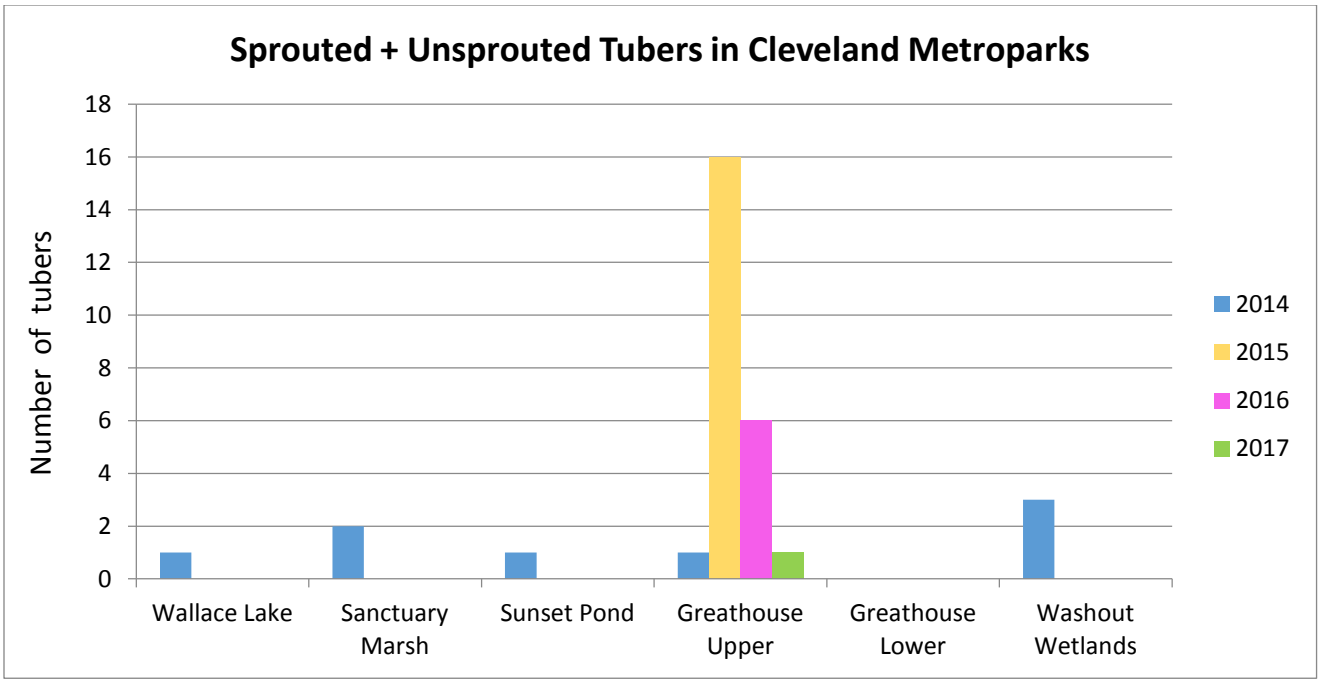


Figure 3. Tubers detected in Cleveland Metroparks sites via tuber sampling by year.

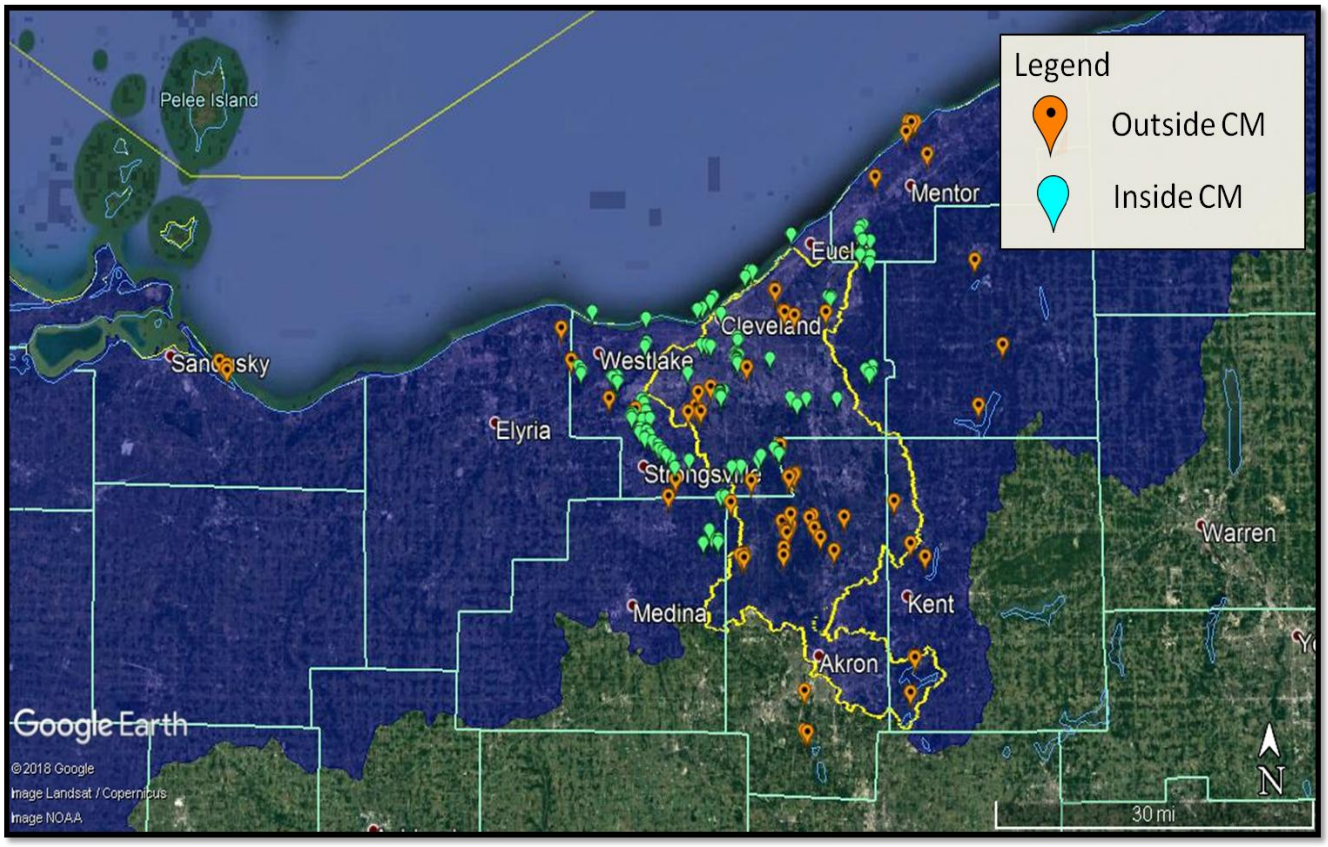


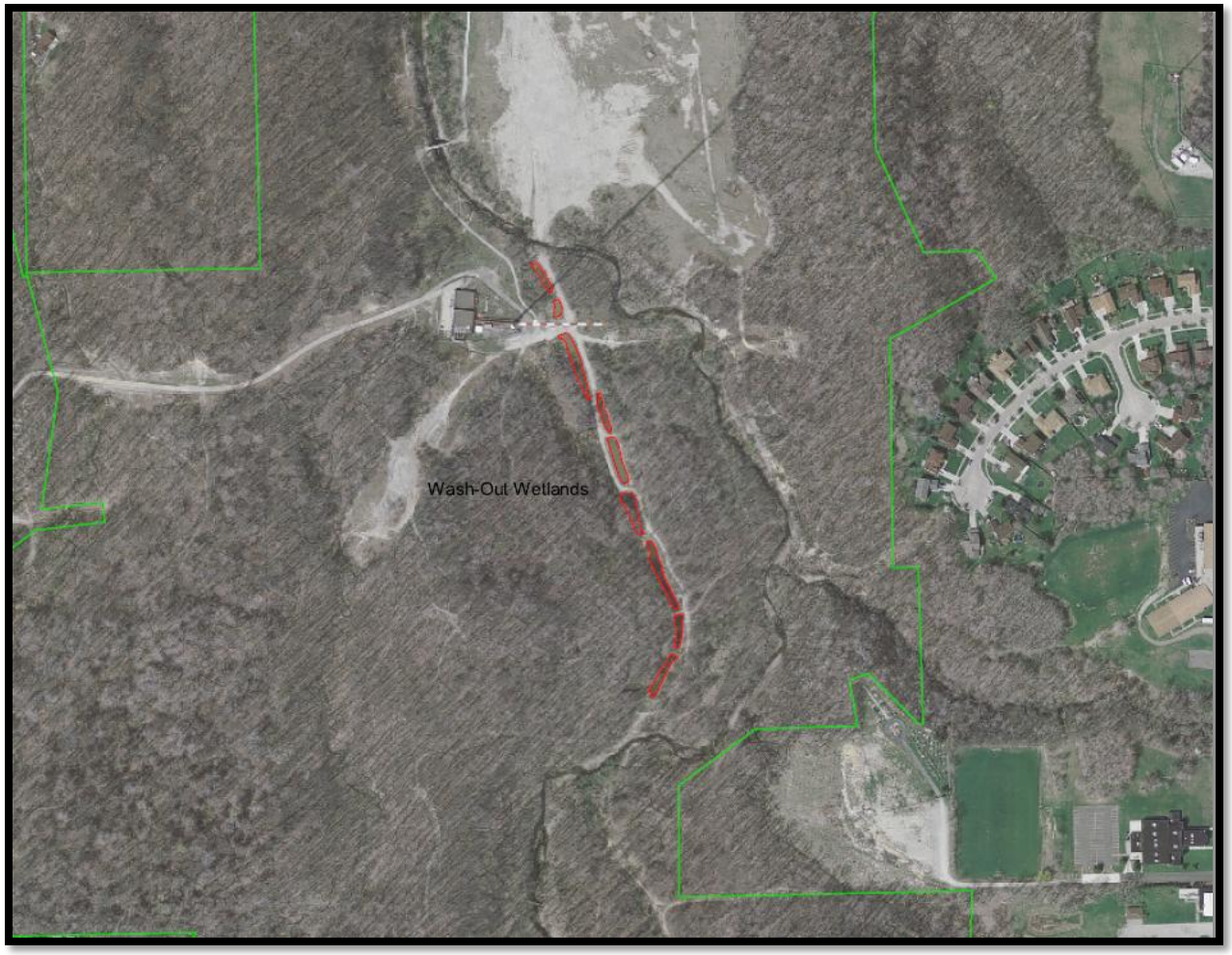
Figure 4. Sites surveyed in 2017 - 104 sites inside Cleveland Metroparks (CM) and 65 sites outside of CM. The Lake Erie Basin is denoted by the dark blue shading, the Cuyahoga River Area of Concern is denoted by the yellow outline.

Appendix A: Cleveland Metroparks Hydrilla Site Maps

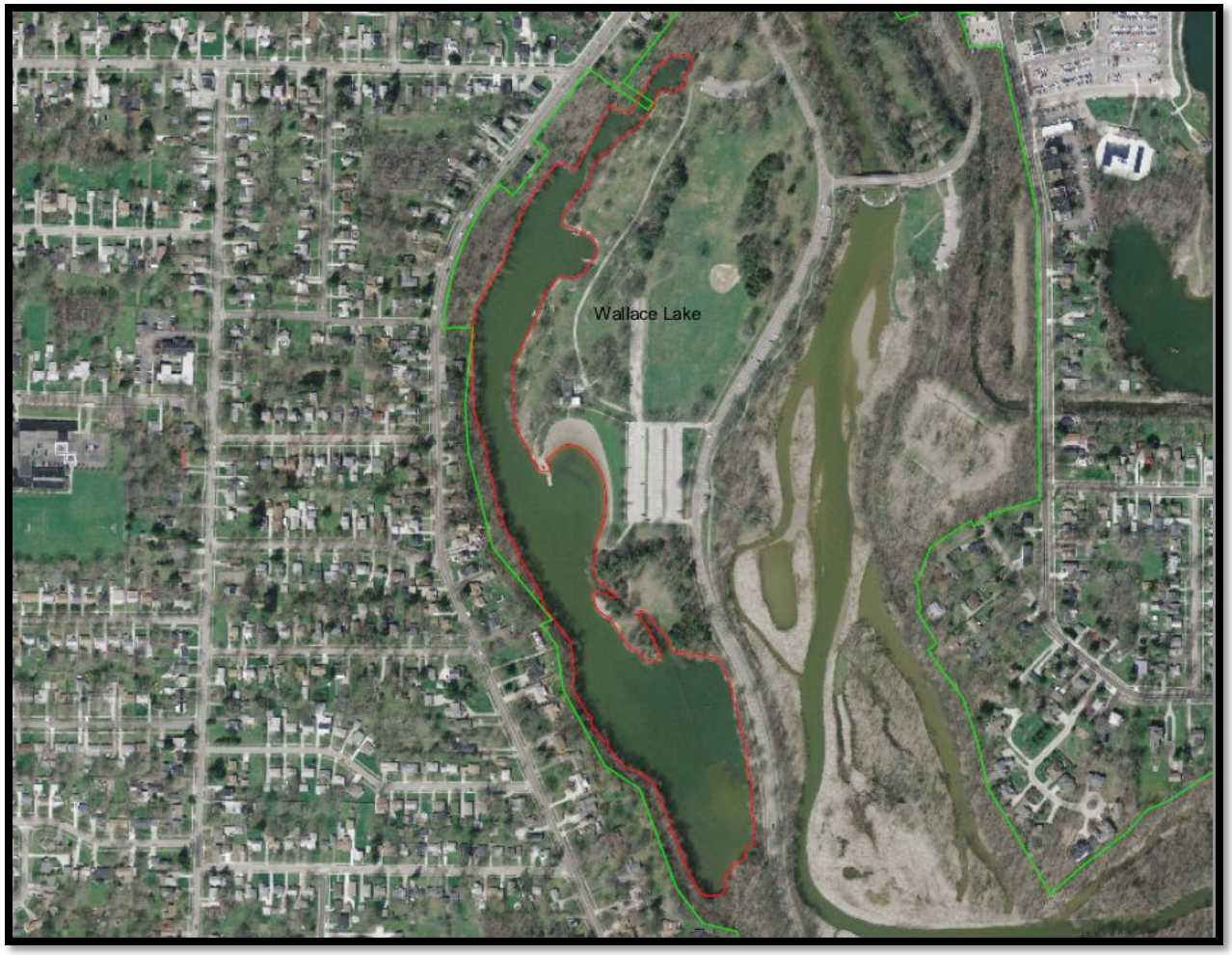
Map 1. Sunset Pond and Sanctuary Marsh in North Chagrin Reservation

Map 2. Blue Heron Marsh in Ohio & Erie Canal Reservation

Map 3. Greathouse Wetlands in West Creek Reservation



Map 4. Wash-Out Wetlands in West Creek Reservation



Map 5. Wallace Lake in Mill Stream Run Reservation

Appendix B: Cleveland Metroparks Annual Surveillance Sites

Reservation	Site/Location	Recommended survey method
Acacia	Northwestern pond	Kayak survey
	Central pond	Kayak survey
	Eastern pond	Kayak survey
Bedford	Circle Emerald ponds (2)	Wader survey
	Shawnee GC ponds (2)	Rake toss
	Gorge Pkwy pond	Wader survey
Big Creek	Apple Ridge/Beech Hill	Wader/kayak
	Lake Isaac	Kayak survey
	Beyer's Pond	Boat survey
	Small ponds around Beyer's	Wader survey
	Fowles Marsh	Wader survey
	Lake Abram wetland complex	Wader/kayak
	Wetland off L2L by Hepburn	Wader survey
	Wetlands off Lake Isaac trail	Wader survey
	Small wetland SE of Lake Abram	Wader survey
	Fern Hill created wetlands	Wader survey
	Eastland dipping pond	Rake toss
Bradley Woods	Bunn's Lake	Wader survey
	Wetland N of White Oak Dr	Wader survey
	Mitigation wetland on E edge	Wader survey
Brecksville	York Rd pond	Rake toss
	Seneca GC ponds (2)	Rake toss
	Sleepy Hollow GC pond	Rake toss
	Mgmt Center ponds (2)	Rake toss
	Chippewa mitigation wetlands	Wader survey
	Riverview N wetlands	Wader/kayak
	Riverview S wetlands	Wader
Brookside & Zoo	Upper created vernal pools	Wader survey
	Goldfish ponds	Wader survey
	Lower created vernal pools	Wader survey
	Waterfowl Lake	Rake toss - borrow boat
Euclid Creek		
Garfield Park	Old boating pond	Wader survey
Hinckley	Hinckley Lake	Boat survey - borrow kayak
	Judges Lake	Kayak survey
	Ledge Lake	Kayak/rake toss
	Wetlands W of Judges	Wader survey
	Upper Ledge pond	Kayak/rake toss

	Brooklyn Exchange ponds (2)	Wader/rake toss
	Beaver Pond east of Judges	Wader survey
	Rising Valley wetland complex	Wader survey
Huntington	Porter creek, mouth	Kayak survey
Lakefront	Edgewater Pier	Rake toss
	Wendy Park	Rake toss/visual
	E 72nd Gordon Park boat ramp	Boat survey/rake toss
	EN Marina	Boat survey/rake toss
	E55th Marina	Boat survey/rake toss
	Wildwood Marina	Rake toss
	Cuyahoga, Scranton Road	Boat survey/rake toss
	Edgewater boat launch	Rake toss
Mill Stream Run	Wallace Lake	Hydrilla found 2011
	Wallace Lake outflow	Hydrilla found 2012
	Baldwin Lake	Kayak/boat
	Handle Rd wetlands	Wader survey
	Whitney Rd wetlands	Wader survey
	Wintergreen ponds (3)	Kayak/rake toss
	Bonnie Park ponds (2)	Wader/rake toss
	Ranger Lake	Kayak/boat
	Strongsville Wildlife Area	Wader survey
	Oxbow opposite SWA	Wader/rake toss
	Wetland pond N of Chalet	Wader survey
	Moose Pond	Rake toss
	Oxbow opposite Royalview	Wader survey
	W130th wetlands	Wader survey
	Drake Rd wetlands	Wader survey
	Swale by mgmt center drive	Wader survey
	EBRR (Wallace to Berea Falls)	Wader survey
North Chagrin	Manakiki GC ponds (3)	Rake toss
	Sunset Pond	Hydrilla found 2012
	Sanctuary Marsh	Hydrilla found 2012
	Strawberry Pond	Rake toss
	Oxbow wetlands	Wader survey
	Dinger's Marsh	Wader/kayak
	Foster's Run mitigation cells	Wader survey
	Wetlands NE of Foster's	Wader survey
	Buttermilk Creek (entire reach)	Boots
	Chagrin River (BC to res edge)	Wader survey
Ohio & Erie Canal	CEI ponds (2)	Kayak survey
	Blue Heron Marsh	Hydrilla found 2011

	Ohio & Erie Canal	Rake toss / visual
Rocky River	Kason Swamp	Wader survey
	Big Met pond	Rake toss
	Wetlands across from POA	Wader survey
	RRNC wetland complex	Wader/kayak
	RRNC old oxbow	Wader survey
	Cedar Point wetlands	Wader survey
	Oxbow Lagoon	Rake toss / kayak
South Chagrin	Shadow Lake	Rake toss
	Mgmt Center ponds (2)	Rake toss
	Squaw Rock pond	Kayak/rake toss
	Sulphur Springs vernal pool	Wader survey
Washington	GC wetlands (4)	Wader survey
West Creek	West Ridgewood wetland	Wader survey
	Greathouse wetlands	Hydrilla found 2011
	Wash-out wetlands	Hydrilla found 2013
	WSC stormwater wetland	Wader survey
	West Creek (WO to res edge)	Wader survey

Appendix C: Survey Sites Outside Cleveland Metroparks

Landowner	Waterbody name	Recommended survey method
Bath Nature Preserve	Bath Creek	Rake toss
	Pond 1	Wader survey
	Pond 2	Wader survey
	Bath Pond	Rake toss
	Garden Pond	Rake toss
Beachwood City Schools	Beachwood high school pond	Rake toss
Brunswick Fraternal Order of Police	Brunswick FOP pond	Rake toss, Wader survey
City of Akron	Lake Rockwell	Boat survey
	LaDue Reservoir	Boat survey
City of Avon	Get Go retention basin	Wader survey
City of Berea	Coe Lake	Boat survey
City of Independence	West creek confluence	Wader survey
City of Mentor	Pond at old Seabrook Nursery	Rake toss
	Mentor Lagoons Marina Boat Channel	Rake toss
City of Parma	Easement behind Busch's funeral home	Wader survey
	Hollenbeck Lake	Boat survey, Rake toss
	Veterans memorial park, Parma	Rake toss
	Ridgewood Lake	Boat survey
City of Shaker Heights	Lower lake	Boat survey
	Horseshoe lake	Boat survey
City of Sherrodsville	Atwood Lake	Point
City of Westlake	Prestwick Crossing retention basin	Rake toss
Cuyahoga Valley National Park	CVNP Beaver Marsh	Rake toss
	Lake Okchanya	Boat survey, Rake toss
	EEC constructed wetland	Wader survey
	Sylvan pond	Rake toss
	Coonrad farm pond	Rake toss
		Rake toss
	Riverview south	Wader survey
	Kendall Lake	Kayak survey, Rake toss
	Lichfield Lake	Boat survey, Rake toss
	Indigo Lake	Kayak survey, Rake toss
	Armington pond	Boat survey, Rake toss
	Horseshoe pond	Boat survey ,Rake toss

	Goosefeather pond	Kayak survey, Rake toss, Wader survey
	Whirligig pond	Rake toss
	Cattail pond	Rake toss
	Meadowedge	Rake toss
	EEC Back pond	Rake toss
	Station Rd Bridge wetlands	Wader survey
	Polar Blast Pond 1	Rake toss
	Polar Blast Pond 2	Rake toss
Geauga County Parks	Lake Kelso	Boat survey, Kayak
	Bass lake	Boat survey, Rake toss
Lake County Metroparks	Chagrin River Park	Wader survey
	Granger pond	Rake toss
Lake County Metroparks / CMNH	Mentor Marsh	Kayak survey
	Becker pond	Wader survey
Lake View Cemetery	Upper Lake View Cemetery Pond	Boat survey, Rake toss
	Wade Pool	Boat survey
Lake view church of god	Lake view church pond	Wader survey
Olmsted Falls Village Park	Parking lot pond	Wader survey
Portage County	Mogadore Reservoir East Side	Boat survey, Rake toss
Portage Lakes	Turkeyfoot Lake	Boat survey, Rake toss
Portage County Park Disrict	Seneca Ponds	Boat survey, Rake toss
	Camp Spelman	Rake toss
Private residence	Jason's pond	Visual vegetation survey
Richfield Heritage Preserve	Dammed pond	Kayak survey, Rake toss
Shaker Lakes Nature Center	Shaker Lakes Nature Center Marsh	Rake toss, Wader survey
State Nature Preserve	Wingfoot Lake	Boat survey, Rake toss
	Pond near Sheldon Marsh	Rake toss
	Sheldon Marsh	Kayak survey, Rake toss, Wader survey
Summit County Metroparks	Mud Lake	Wader survey
	Long Lake	Boat survey
	Brushwood Lake	Boat survey, Rake toss
Wyoga HOA	Lake Wyoga	Boat survey, Rake toss

Appendix D: Cleveland Metroparks Decontamination Protocol

Standard Operating Procedure (SOP) for Foot Based Field Work

For any field work involving foot travel to aquatic sites, including but not limited to wading, the following three prong decontamination approach will apply.

1) *Visual inspection and removal of living and non-living matter from field equipment.* Upon completing field work at an aquatic site, the personnel will observe all equipment and do their best to remove all mud, vegetative matter, and excessive water from field equipment. Dedicated scrub brushes should be included with field equipment for this purpose. Initial cleaning can involve rinsing with water available in the field.

2) *Rinse equipment with clean water.* Upon changing watersheds or before moving to a sensitive habitat the personnel will rinse all field equipment used at the site with clean tap water. For field based rinsing, at least one five gallon container of clean tap water should be included with field equipment for use at the vehicle. For rinsing at the end of the field day, the hot water pressure washer at the car wash bay at the Rocky River Management Center will be used. There will also be locations at Brecksville Garage and West Creek Watershed Stewardship Center for rinsing.

3) *Rinse/soak equipment in 2% bleach solution.* Research into biological decontamination protocols for various other agencies (Ohio DNR, Maine DEP, NYC DEP, and British Columbia Ministry of Environment) reveal that use of household bleach is a cheap, effective, and readily available agent for biological decontamination for a wide range of potentially pathogenic agents. A concentration of 4 oz of bleach for 1 gallon of clean tap water is commonly used and proven effective, and will also be used in this procedure. For travel between subwatersheds, or before moving to a sensitive site, a dedicated backpack sprayer containing 2% bleach solution will be used to saturate all exposed equipment at least 100 feet from the aquatic habitat and allowed to air dry before changing sites. For decontamination at the end of the field day, stations will be available at the Rocky River Management Center car wash bay, Brecksville Garage, and West Creek Watershed Stewardship Center for soaking exposed field equipment in a 2% bleach solution for no less than one minute, and then allowed to air dry overnight before re-use.

Standard Operating Procedure (SOP) for Boat or ATV Based Field Work

For any field work involving use of watercraft, or ATV (including the Argo) at aquatic sites, the following two tiered decontamination approach will apply for decontamination in addition to the aforementioned protocol for other field equipment and clothing.

1) *Visual inspection and removal of living and non-living matter from boat, boat trailer and/or ATV.* Upon completing field work at an aquatic site, the personnel will observe the boat, boat trailer, and/or ATV and do their best to remove all mud, vegetative matter, and excessive water from

field equipment. Dedicated scrub brushes should be included with field equipment for this purpose. Initial cleaning can involve rinsing with water available in the field.

2) *Hose or pressure wash vehicles and trailers with clean tap water.* At the end of the field day, the boat, boat trailer, and/or Argo will be thoroughly cleaned with a hose or pressure washer at a maintenance facility, and all water will be drained from the equipment. All equipment will be allowed to air dry at least overnight before re-use.

Special Circumstances

The protocols outlined are expected to apply to the majority of routine field work, but special circumstances will certainly arise that require specific attention. These will include work in sites with known pathogens or especially sensitive habitats. These circumstances will require situation specific attention, but in many cases the same protocol as already listed will apply with the exception of including a minimum of 15 minute soak in the 2% bleach solution.

Appendix E: Hydrilla Treatment Costs 2011- 2017

2011 Hydrilla Treatment Costs

Location	Reward	Cutrine Plus	Contractor	SonarAS	SonarOne	Galleon	FasTEST*	
Wallace Lake		1.0 gal						
Greathouse	24.0 oz	8.0 oz						
	$16.80	**$22.30**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$39.10**

2012 Hydrilla Treatment Costs

Location	Reward	Cutrine Plus	Contractor**	SonarAS	SonarOne	Galleon	FasTEST*	
Wallace Lake	2.25 gal	8.0 gal	July-Oct					
Greathouse	4.0 gal	5.1 gal						
	$493.85	**$288.18**	**$2,012.00**					**$2,794.02**

2013 Hydrilla Treatment Costs

Location	Reward	Cutrine Plus	Contractor**	SonarAS	SonarOne	Galleon	FasTEST*	
Wallace Lake			May-Oct					
Greathouse						16.3 oz	4	
Wash-Out						0.92 oz	1	
Sunset					5.8 lbs			
Sanctuary					13.76 lbs		1	
			$11,325.00		**$548.46**	**$282.93**	**$664.00**	**$12,820.39**

2014 Hydrilla Treatment Costs

Location	Reward	Cutrine Plus	Contractor**	SonarAS	SonarOne	Galleon	FasTEST	
Wallace Lake			Aug-Oct					
Greathouse					0.94 lbs	5.7 oz	6	
Wash-Out					1.51 lbs	0.6 oz	3	
Sunset								
Sanctuary				21.9 oz			3	
Blue Heron					3.38 lbs	28.0 oz	4	
			$11,500.00	**$210.24**	**$613.02**	**$615.70**	**$1,510.00**	**$14,448.96**

2015 Hydrilla Treatment Costs

Location	Reward	Cutrine Plus	Contractor**	SonarAS	SonarOne	Galleon	FasTEST	
Wallace Lake			May-Oct					
Greathouse			May-Oct					
Wash-Out			May-Oct					
Sunset			May-Oct					
Sanctuary			May-Oct					
Blue Heron			May-Oct					
			$35,575.00					**$35,575.00**

2016 Hydrilla Treatment Costs

Location	Reward	Cutrine Plus	Contractor**	SonarAS	SonarOne	Galleon	FasTEST	
Wallace Lake			May-Oct					
Greathouse			May-Oct					
Wash-Out			May-Oct					
Sunset			May-Oct					
Sanctuary			May-Oct					
Blue Heron			May-Oct					
			$33,475.00					**$33,475.00**

2017 Hydrilla Treatment Costs

Location	Reward	Cutrine Plus	Contractor***	SonarAS	SonarOne	Galleon	FasTEST	
Wallace Lake			May-Oct					
Greathouse			May-Oct					
Wash-Out			May-Oct					
Sunset			May-Oct					
Sanctuary			May-Oct					
Blue Heron			May-Oct					
			$34,117.00					**$34,117.00**
**ODNR covering 75% of contractor costs								
*** GLRI covering 100% of contractor costs								**$133,269.47**