2019 Adirondack Aquatic Invasive Species Surveys

Early Detection Team Report

ADIRONDACK RESEARCH

2019 Adirondack AIS Surveys

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Background Cover image: Long Lake, Oneida County, July 2019.

Executive Summary

Invasive species are any kind of living organism that is not native to an ecosystem and causes some sort of ecological, human health, or socio-economic harm. For over two decades, the Adirondack Park Invasive Plant Program (APIPP) and its partners have documented the distribution and spread of invasive species throughout the jurisdictional boundaries of the Adirondack Partnership for Regional Invasive Species Management (PRISM). In 2019, Adirondack Research, a private research and mapmaking firm constituted APIPP's Adirondack Aquatic Invasive Species (AIS) Early Detection Team. The team surveyed prioritized lakes and ponds in the western Adirondacks and used data collected in the field to produce individualized maps documenting AIS distribution, vegetation biovolume, bottom sediment hardness, and bathymetry. In this report, we address the results of this year's work along with recommendations for continuing and adapting the survey strategy to enhance APIPP's early detection and rapid response capabilities as well as ways to continually improve ongoing efforts to address AIS impacts in the Adirondacks.

Figure 1: Illustration of the survey techniques utilizing a combination of sonar recording and manual rack toss.

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Acknowledgments

APIPP, a program hosted by the Adirondack Chapter of The Nature Conservancy, is one of eight PRISMs in New York State whose mission is to protect the Adirondack region from the negative impacts of invasive species. APIPP contracted Adirondack Research during the 2019 field season to conduct AIS early detection surveys in the western portion of the Adirondack PRISM. Field work, data collection and the compilation of the narrative, maps and materials included in this report were conducted by Janelle Hoh, Mason Fountain, Gabriella Gurney, Sarah LaLumiere, Alessandro Epifanio, and Dr. Ezra Schwartzberg, who constituted APIPP's Adirondack AIS Early Detection Team. Project planning and lake prioritization was conducted by Erin Vennie-Vollrath, APIPP's AIS Project Coordinator. This project was advanced by APIPP, under contract with Adirondack Research, with funding provided by New York State's Environmental Protection Fund as administered by the New York State Department of Environmental Conservation.

Photo 1: Canoe on Horseshoe Lake, St Lawrence Co., NY

Special thank you

Completion of this project would not have been possible without the following members of lake associations, businesses and other agencies: Little Wolf Campground; John Jeffery, Fulton Chain Lakes Association; Cathy and Andy Sayles, Little Long Lake Association; Camp Nazareth; Louanne Cossa, White Lake Association; Mary Lynne Heldmann, Water Watch Co-Chair, Blue Mountain Lake; Curry's Cottages, Blue Mountain Lake; John Burrows, Big Moose Property Owner's Association, and Dunn's Boat Service, Big Moose Lake. We are grateful for their role in protecting many of these important Adirondack lake ecosystems.

Introduction

Since 2002, APIPP has surveyed 410 Adirondack lakes and ponds and found nearly 75% to be free of AIS. Since 2015, APIPP has deployed an AIS Early Detection Team to survey lakes for AIS within the Adirondack PRISM. By deploying an Early Detection Team, new infestations can be quickly recognized, and appropriate management actions taken before significant impacts are observed.

The Early Detection Team's annual AIS surveys rotate through three regions that comprise the Adirondack PRISM. Region 1 (see Figure 2 right) constitutes waterbodies in the Upper Hudson, South Lake Champlain, Sacandaga, and Mohawk watersheds. Region 2, which was visited in 2019, covers the Raquette, Black, Oswegatchie, and Grass watersheds. Region 3 covers North Lake Champlain, AuSable, Saranac, St. Regis, Salmon, Chateaugay, and Great Chazy watersheds. The regions were divided in such a way to balance resources across the ~7 million-acre Adirondack PRISM and increase efficiency in surveying the numerous Adirondack lakes and ponds therein.

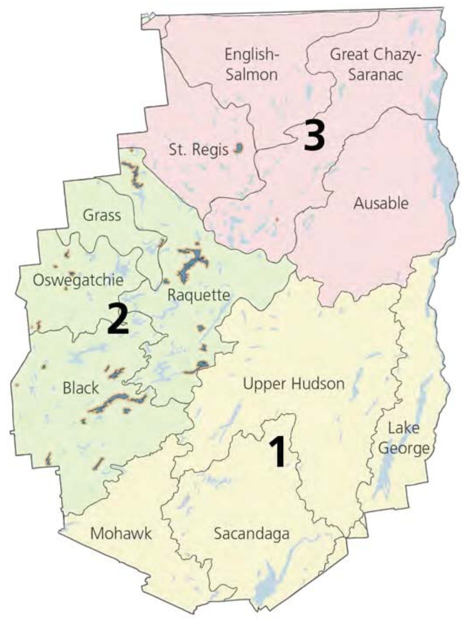


Figure 2: Regions of yearly AIS survey program.

Historically, APIPP's AIS Early Detection Team has performed aquatic vegetation surveys and rapid response management on any new, isolated aquatic invasive plant infestations discovered. In 2018, the Team's output shifted to incorporate new technologies instead of preforming species richness surveys and rapid response management. That said, early detection has always been the primary goal of the Team. Starting in 2018, the Team began using the Lowrance ELITE-7Ti Chartplotter and C-Map BioBase cloud processing and GIS automation platform (www.biobasemaps.com/) to map vegetation biovolume, bottom hardness, and bathymetry as part of standard protocol. As defined by BioBase, biovolume represents the percent of the water column occupied by plant matter at each GPS location. It does not differentiate between plant species. Bottom hardness is determined by using the strength of sonar reflectivity to infer whether the bottom is soft, medium or hard. Generally, sound signals reverberate strongly off hard substrates such as gravel and rocks and weakly off soft substrates such as muck and mud. In the maps presented in this report, the darkest shade of orange is the hardest and the lightest shade of orange is the softest. Images and data captured on the Lowrance ELITE-7Ti Chartplotter were uploaded to the BioBase web interface and then post-processed to create the maps displayed in this report. This information will be used to inform invasive species vulnerability assessments to better prioritize and allocate resources for future early detection surveys.

Objectives

The primary objective of the AIS Early Detection Team was to detect and delineate any new or existing aquatic invasive plant or animal infestations within prioritized lakes. The secondary objective was to deploy the Lowrance ELITE-7Ti system to map the vegetation beds, contour lines, and bottom hardness of a select set of those lakes to gather important baseline data on plant distribution and other physical parameters that influence aquatic species invasion.

Lake Selection and Prioritization

Region 2 lakes and ponds included in the Early Detection Team's 2019 surveys were selected and prioritized by APIPP's AIS Project Coordinator, Erin Vennie-Vollrath, based on existing AIS distribution and monitoring data, the level of public access, and volunteer survey efforts. The abundant waterways in Region 2, and all three regions for that matter, make it challenging to select target waterbodies to survey. Not every lake or pond is selected for survey each three years. The following outlines the parameters used to select and prioritize lakes for survey in 2019. All lakes have either a public access point or some other form of motorized or non-motorized watercraft access.

Lake Selection Criteria	
Priority 1	• has never been monitored for AIS • has only been partially monitored for AIS in the past three years
Priority 2	• has not been professionally monitored in the past three years
Priority 3	• was last professionally monitored for AIS in 2017
Priority 4	• is monitored annually for AIS by volunteers • was last professionally monitored for AIS in 2018

Photo 2: Research Technician Alex delineating beds of invasive milfoils on the tablet-based Arc Collector app.

Photo 3: Variable leaf milfoil in Fifth Lake, Hamilton Co., NY.

Methods

Equipment

Equipment used during this project consisted of two double-sided rakes, a plankton net, two sediment sieves, two Lowrance ELITE-7Ti Chartplotters, two Bluetooth GPS antennas (Garmin GLO), and two iPad 4 minis. Data and observations were recorded on an iPad 4 mini using The Nature Conservancy's Invasive Plant Mobile Monitoring System (IPMMS), an Esri Collector for ArcGIS application. Surveys were completed using console motorboats or canoes, depending on waterbody access. Since the team was accessing multiple waterbodies over the course of each week, specific precautionary measures were taken to guarantee all equipment was decontaminated between waterbodies. Equipment was decontaminated using the Adirondack AIS Prevention Program's free boat wash and decontamination services located throughout the Adirondack Park. The team visited a total of five different decontamination stations, multiple times, over the course of the summer. High pressure and hot water were used to kill any organisms, native or invasive, present on equipment after surveys. The specific equipment that was decontaminated by professional decontamination technicians included: motorboat hulls, trailers, motor lower units and bilges; canoes and paddles; plankton net and detachable PVC sieve and cap end; brass sediment sieves; ropes; and all jars and containers.


Photo 4: Adirondack Research's field vehicle and motor boat used for surveys. Fourth Lake DEC boat launch, Inlet, NY.

Littoral Zone Plant Surveys and Identification

The littoral zone of each lake was surveyed for aquatic plants by the Early Detection Team from shoreline to a depth of about 15 feet, although the littoral zone water depth and distance from shore varied between waterbodies. Some waterbodies were completely comprised of littoral zone; others contained little area that supported plant growth. The team surveyed in a zig-zag search pattern, using visual detection from the surface in combination with the sonar output from the Lowrance unit, to locate plant beds. Once a plant bed was located, rake tosses were conducted to retrieve and identify plants that could not be confirmed through visual detection alone.

All plants retrieved, invasive and native, were identified using the field guides: "Aquatic Plants of the Upper Midwest" by Paul M. Skawinski and/ or "Maine Field Guide to Invasive Aquatic Plants and Their Common Look Alikes" by the Maine Center for Invasive Aquatic Plants and Maine Volunteer Lake Monitoring Program. If an AIS infestation was detected, an occurrence point was marked in its approximate center using the IPMMS. The occurrence feature classifies which species is


Photo 5: A rake covered with variable leaf milfoil from Piercefield Flow, St Lawrence Co., NY.

present and contains unique naming and attribute information for the specific infestation. After an occurrence was entered, the team collected an assessment polygon for the infestation. An assessment polygon was mapped by circumnavigating the exterior boundary of the infestation. The percent cover of the invasive plant was documented for each assessment polygon. Since the polygon is marked with GPS points, changes in acreage and percent cover can be monitored over time.

The most common native plants identified were also recorded and noted for this report. However, complete lists of native plants and their abundance in each lake were not recorded. Much of this information is included in APIPP's 2016 AIS early detection team report, which also conducted work in Region 2 and incorporated native plant species richness surveys.

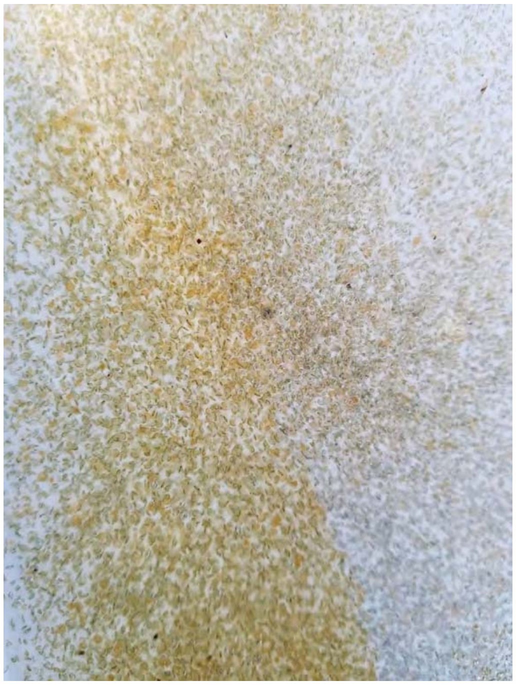


Photo 6: Native zooplankton returned from a plankton tow on Lake Eaton, Hamilton Co., NY.

Animal Surveys and Identification

Two methods were utilized to survey for aquatic animal species. 2mm sediment sieves were used at shorelines with sandy substrates to search for aquatic invasive mollusks, specifically *Corbicula fluminea* (Asian clams). Seven samples were taken at each location using a ray pattern method. In addition to sediment sieves, plankton tows were used to search for aquatic invasive zooplankton using a 500-micron plankton net at the deepest point of the lake. Species of primary concern were: *Bythotrephes longimanus* (spiny waterflea) and *Cercopagis pengoi* (fishhook waterflea). The plankton tow was dropped off the bow of the stationary boat, released to a depth below the thermocline, and then towed for two minutes at a speed of 2mph behind the motorboat or as fast as possible by canoe, allowing the attached line to lie at a 45-degree angle. The net was then retrieved and samples were placed into Nalgene jars or plain white containers for examination in the field. Any samples that were suspected to contain AIS were stored in ethanol and brought back to the Adirondack Research lab for further analysis.

Photo 7: Research Technician Sarah collecting sediment samples to survey for Asian clams. Horseshoe Lake, St Lawrence Co., NY.

Complete Lake Mapping

When conducting plant surveys, the AIS Early Detection Team focused efforts in the littoral zone of each waterbody. In the littoral zone, sunlight can penetrate through to the bottom of the lake, which allows for plant growth. Typically, the littoral zone of a lake is exclusively near shore. However, as advancements are made in underwater mapping and new technologies arrive, it's becoming more apparent that we are all still learning about what lies below the surface of many lakes and ponds. Sunken islands or ridges can arise in seemingly deep water, resulting in potential aquatic plant habitat in unexpected locations of the lake. Covering all acreage of a waterbody lessens that chance of missing a "hidden" area of plant growth.

On lakes or ponds where complete lake mapping/surveys were conducted, the Team generally split the waterbody in half and each team of two paddled or drove from shore to shore in their respective half. To ensure no gaps in coverage occurred, each pass was done about 120 feet apart, which is within the range that BioBase can automatically interpolate lake characteristic parameters. For the purposes of this report, complete lake mapping/surveys refer to this method of data collection from the entire acreage of a lake or pond. Surveys of the littoral zone are still considered "completed," but they do not typically include waterbodies in their entirety.

2016 and 2019 Comparison

APIPP's system of dividing the Adirondack PRISM into three regions and surveying each region on a three-year rotation allows for frequent re-visitation of waterbodies to accommodate early detection and potential rapid response as well as opportunity to conduct assessments of trends over time. Surveys completed in 2016 provide baseline data for Region 2. Upon revisiting in 2019, the team implemented new protocols using different technologies to increase the amount and types of data collected in the field. By using the Lowrance Chartplotter, IPMMS, and the BioBase platform, detailed maps were produced documenting biovolume, bottom substrate hardness, and lake bathymetry for each lake surveyed.

Mapping invasive plant beds using GPS and IPMMS, coupled with biovolume data recorded with BioBase, allowed for accurate delineation of AIS infestations even when located within larger native plant beds.

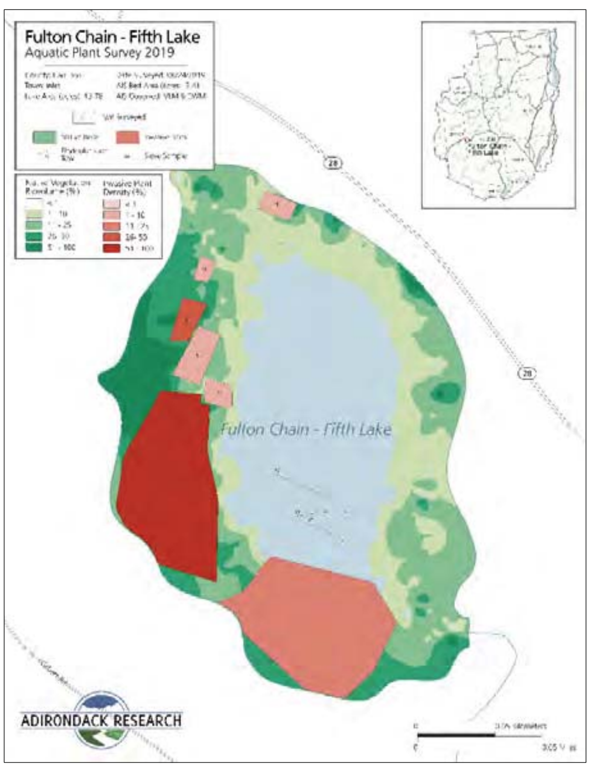
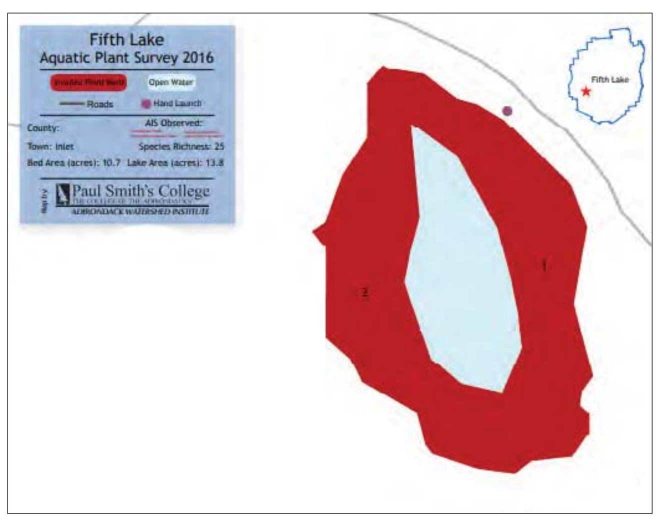


Figure 3: Fifth Lake map from 2019 report (left) and map from the 2016 report (below). 2016 map produced by Paul Smith's College Adirondack Watershed Institute.



Data Management

To ensure all data collected in the field were safely stored, redundant copies were kept at multiple steps throughout the collection process. Following are the steps taken to store and organize data:

Lowrance Chartplotter

1. Data collected on the Lowrance Chartplotter were saved on 32GB memory cards in the field.
2. Memory cards were changed every one to two hours to lessen the amount of data lost if a card became corrupted.
3. At the end of each week, data collected from the Lowrance Chartplotter and stored on memory cards were saved on a computer and backed up on a separate external hard drive.
4. Once backed up, data from the Lowrance Chartplotter were uploaded to the BioBase platform and processed. All processed data were then copied onto Adirondack Research's cloud data storage. Chartplotter data were also backed up (third copy) to cloud storage periodically.

ESRI ArcGIS Collector App – Invasive Plant Mobile Monitoring System (IPMMS)

1. Esri ArcGIS Collector data were backed up on the Esri server weekly. All ArcGIS data were uploaded to Adirondack Research's cloud storage in the middle of the field season, then again at the end of the season.

Paper Collection

1. Lists of native plants identified were recorded on paper and transcribed to digital form weekly.

GIS

1. Post processed GIS data (lake boundaries, invasive plant bed polygons and associated data, point data from Kriging interpolated biovolume, bottom hardness and bathymetry) were stored as GIS shapefiles in vector and raster format, depending on data source.
2. All GIS shapefiles and attribute tables were packaged and submitted to APIPP with this report.

GIS Data Processing

GIS data were exported directly from BioBase and then post processed using a secondary Kriging interpolation. BioBase interpolated data to estimate and plot the geospatial extent of three parameters: vegetation biovolume, bottom hardness and bathymetry. Data was further post-processed (exported in point and grid format) using subsequent interpolation to achieve the rasterized visualizations of these parameters displayed in the maps included in this report. Our interpolation was checked against the visual output available directly from BioBase on their web interface and confirmed that our interpolation methods resulted in identical visualizations of the three parameters mentioned above. These interpolations are stored as raster images in our report and the actual data points that created these images (available from BioBase or from raw sonar files) will need to be further processed if used for GIS-informed risk assessment.

The main uses of this GIS data are to record and track AIS abundance and distribution. Data was also used to create visually appealing lake maps for each of the 46 lakes surveyed. Because AIS presence data were collected using IPMMS, the original shapefiles recorded during each survey are stored in and are accessible through APIPP's GIS database.

Scheduling and Travel

The team of four worked 40-hour weeks, spending the majority of time in the field and the rest in the office planning for the following week and uploading and processing data. To increase efficiency and reduce travel costs, lodging near clusters of lakes to be surveyed were selected each week. Lake survey order for the week was determined by distance to lodging, weather, and scheduling with lake associations.

Photo 8: Research Technician Alex tossing a rake to retrieve plants for identification. Fourth Lake, Hamilton Co., NY.

Photo 9: Research Technician Mason retrieving samples from a plankton tow. Limekiln Lake, Hamilton Co., NY.

Results

Between June 11 and September 5, 46 lakes and ponds were surveyed with the objective of AIS early detection. Of the 46 lakes, 19 were documented to be invaded by at least one AIS. Even though 19 lakes and ponds surveyed contained AIS, all had been documented as invaded prior to 2019. No newly invaded lakes or ponds were discovered by the Early Detection Team in 2019. The most common AIS detected was *Myriophyllum heterophyllum* (variable leaf milfoil), found in 15 lakes and ponds. *Myriophyllum spicatum* (Eurasian watermilfoil) was detected in two lakes and ponds. Two lakes or ponds contained both *Myriophyllum heterophyllum* and *Myriophyllum spicatum*. No invasive mollusk or zooplankton infestations were detected. A total of 299.53 shoreline miles were surveyed. Lakes surveyed ranged in size from 9.44 acres (Clear Pond, Lewis County) to 3543.10 acres (Tupper Lake, Franklin County). Approximately 371.09-acres of beds containing invasive plants were mapped, ranging in size from one plant to 36.14-acres. Across all waterbodies surveyed, 354.5967-acres of *Myriophyllum heterophyllum* were mapped and 16.4981-acres of *Myriophyllum spicatum* were mapped.

Photo 10: Research Technician Sarah on Horseshoe Lake, St Lawrence Co., NY.

Native Vegetation

Below is a list of the common native plant species recorded in each surveyed lake. Comprehensive native plant assessments were not conducted in 2019 since baseline data for Region 2 had already been established in 2016. A more comprehensive list of native plants can be found in APIPP's 2016 report.

	Alpine pondweed	Aquatic moss	Bur reed	Clasping leaf pondweed	Common bladderwort	Common tule	Common waterweed	Dwarf watermilfoil	Eelgrass	Fern pondweed	Floating leaf pondweed	Grass leaved pondweed	Grassy arrowhead	Hairgrass	Large leaf pondweed	Large purple bladderwort	Little floating heart	Mare's tail	Muskgrass	Naiad	Nitella	Northern watermilfoil	Pickerel weed	Pipewort	Quillwort	Ribbon leaf pondweed	Slender watermilfoil	Slender waterweed	Small pondweed	Snail seed pondweed	Spiny hornwort	Swollen bladderwort	Water lobelia	Watershield	White stemmed pondweed	Water water lily	Yellow pond lily
Big Moose Lake									*		*	*	*	*	*		*		*					*		*								*		*	*
Blake Falls Reservoir	*			*							*			*	*						*		*	*		*							*	*		*	
Blue Mountain Lake			*						*		*								*				*	*	*	*							*			*	*
Catamount Pond					*																		*			*								*		*	*
Clear Pond - Lewis County									*														*														*
Clear Pond - St. Lawrence Co.										*											*		*											*		*	*
Eagle Lake				*	*				*	*			*	*		*								*		*								*		*	*
Francis Lake													*			*						*	*	*		*			*					*		*	*
Fulton Chain- Fifth Lake				*							*								*		*						*							*		*	
Fulton Chain- First Lake					*				*	*	*	*			*	*	*		*		*			*					*						*	*	*
Fulton Chain- Fourth Lake	*			*	*		*		*		*		*	*	*	*			*		*			*										*	*	*	*
Fulton Chain- Second Lake					*				*	*		*			*				*		*													*	*		*
Fulton Chain- Seventh Lake									*	*			*													*								*		*	*
Fulton Chain- Sixth Lake									*		*			*			*		*		*			*		*								*		*	*
Fulton Chain- Third Lake				*					*	*						*	*																	*	*	*	
Horseshoe Lake					*				*							*								*										*		*	*
Horseshoe Pond - STLC																							*	*												*	*
Lake Eaton											*					*								*										*		*	*
Limekiln Lake														*																				*		*	*
Little Wolf Lake		*							*	*											*			*													
Long Lake - Oneida Co.			*		*						*			*	*	*					*					*								*		*	*
Long Pond - Lewis County						*							*			*							*	*										*		*	*
Long Pond - St. Lawrence Co.																							*													*	*
Meacham Lake				*			*		*	*	*				*											*								*		*	*
Moody Pond									*					*	*	*	*				*		*											*			*
Nicks Lake									*		*					*					*			*		*								*		*	*
North Lake														*	*							*		*		*								*			*
Oswegatchie River Impoundment			*		*				*				*	*		*					*			*	*	*			*				*	*			
Payne Lake																								*													*
Piercefield Flow		*		*	*		*		*	*	*					*	*				*		*	*		*								*			
Quiver Pond											*					*			*					*										*			*
Rainbow Falls Reservoir			*	*	*				*					*	*	*			*		*		*	*		*							*	*			*
Raquette Pond				*		*	*									*					*		*			*					*	*		*		*	*
Rock Pond					*	*			*				*	*		*				*		*	*	*	*	*								*		*	*
Round Pond																										*								*		*	
Simon Pond				*		*			*					*	*	*	*				*		*			*								*		*	*
South Pond									*		*		*	*		*							*	*		*								*		*	*
Star Lake			*				*					*	*	*	*						*			*				*		*			*	*		*	*
Stark Falls Reservoir			*		*				*		*			*	*					*	*			*		*							*	*		*	*
Streeter Lake									*		*			*		*								*		*								*		*	
Sucker Lake			*		*				*		*	*		*	*						*		*	*										*		*	*
Trout Lake					*								*	*		*				*		*		*	*									*		*	*
Tupper Lake				*		*		*	*				*	*	*	*	*	*		*			*	*		*								*		*	*
Twitchell Lake					*									*		*	*							*										*		*	*
Utowana Lake	*			*	*					*				*	*	*					*		*	*										*		*	*
White Lake			*				*				*		*	*	*						*		*	*		*								*		*	*

Table 1: Native vegetation table for each surveyed lake.

Data and Research Limitations

Project results were affected by various sources of data error, time limitations, and equipment issues. Acknowledging these limitations provide a more prudent analysis of the data and assist with planning for future surveys.

Photo 11: Research Technician Mason with a retrieved rake covered in variable leaf milfoil. Piercefield Flow, St Lawrence Co., NY.

Survey Accessibility

The team used either a canoe or motorboat to complete surveys depending on the accessibility and size of each waterbody. The canoe allowed the team to access lakes with restrictions on motorized usage, whereas the motorboat gave the team opportunity to conduct field work on a sturdier platform. There were limitations associated with each mode of transportation. Lakes and ponds are not always comprised of unobstructed, open water. Many waterbodies surveyed contained downed trees, stumps, rocks, emergent tussocks, mats of floating and submerged plants, or human improvements, such as docks and blocked off swimming areas. These obstacles limited the team's accessibility by both canoe and motorized watercraft. When accessibility was limited, the team maneuvered the vessel as close to the obstacles as possible while ensuring their safety and that of other lake users. When not using canoes, shallow bottom low draft aluminum boats used for this project worked well for these situations, but an outboard motor with electric trim was critical. However, even with this setup some areas were still inaccessible by boat.

As a result of these accessibility limitations, the maps produced for this report may not provide a complete representation of the aquatic vegetation in each lake or pond – especially for shallow areas near shore. Areas unable to be accessed have been identified by hatch marks and labeled "Not Surveyed" in each map's legend.

Technology

Various technologies were deployed over the course of this project to improve survey effectiveness and efficiency. The Esri ArcGIS Collector App and IPMMS ran on an iPad Mini 4 tablet linked via Bluetooth to a Garmin GPS antenna (Garmin GLO). This set-up was used to map invasive plant beds and mark locations of plankton tows and sediment sieves, but spatial accuracy was often limited to around 16 feet due to terrain and insufficient satellite signals. Therefore, spatial data collected over the course of the project is potentially affected by this 16-foot variance. The team did their best to hold the boat stationary and reduce any drifting of the canoe or motorboat while collecting GPS data. Even with this care, the team had difficulty mapping the area of smaller plant beds.

While APIPP's AIS Early Detection Team has been in existence since 2015, the Lowrance Chartplotter and C-Map BioBase platform were new to survey protocol in 2018. During the season, the team identified potential sources of error associated with the Lowrance ELITE-7Ti Chartplotter and BioBase platform. First, when navigating through dense beds of vegetation, the sonar was not able to accurately detect the lake or pond bottom to map sediment hardness, bathymetry, and/ or biovolume. To eliminate this error, surveys focused on bathymetry and bottom hardness should be done in early spring or late fall before or after the growing season. In relation to vegetation, a major limitation of the BioBase platform is that it does not produce accurate vegetation biovolume outputs for areas less than 2.4 feet in depth. This has the potential to impact the thoroughness of maps produced for shallow waterbodies or if water levels are seasonally low. Second, when the transducer is in less than 2 feet of water, the sonar is not able to collect data. This results in data gaps that can only be corrected with visual confirmation and GPS mapping of plant beds. Outputs may show areas of no vegetation because of these limitations. All three of these limitations are also identified by hatch marks and labeled "Not Surveyed" in each map's legend.

Future deployment of the Lowrance Chartplotter, transducer and BioBase platform will likely improve over time as APIPP and its early detection teams become more familiar with the intricacies and limitations of these technologies.

Survey Thoroughness

The zig-zag search pattern used by the team increased the total area surveyed per lake, but it is not the most comprehensive technique to identify every species in a waterbody. Since the main goal of this project was to detect and identify invasive species, documenting overall abundance of native vegetation was not a priority, and therefore, the serpentine search pattern offered the most effective method to meet project goals. With the serpentine search pattern, not every section of water is covered, but the likelihood of missing invasive plant beds is minimized while significantly increasing survey efficiency and reducing cost. There is the possibility that some small invasive plant beds (or single plants) were missed using the serpentine search pattern, but future repeat surveys will help ensure any missed small or isolated infestations will be detected. Survey techniques aside, other factors can influence survey thoroughness including seasonal survey timing, water clarity, or weather conditions. Day to day and year to year changes in survey condition may result in minor variations in documented plant species and abundance.

Photo 12: Watershield, a native plant found in many lakes and ponds.

Recommendations

Adirondack Research provides the following set of recommendations to improve future project effectiveness and techniques used to detect AIS infestations as they relate to informing management decisions.

Crew Size and Training

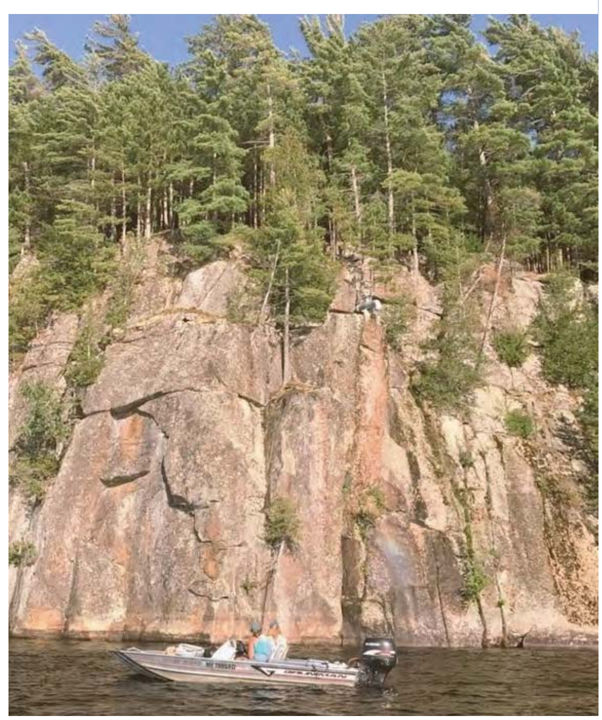
Optimal early detection team size is dependent on the project scope of work. If deploying the BioBase platform to produce detailed lake characteristic maps becomes a higher priority, a larger crew will be necessary, as this component of the survey protocol adds considerably to the time/resources required to survey and map each lake. This especially applies to larger lakes and ponds which have larger surface areas to map. In 2019, the team of four was able to complete serpentine search surveys for AIS on 46 lakes or ponds and collect data to produce complete lake maps for 24 lakes or ponds.

Setup and maintenance of the technology used for this project are vital to collecting accurate, reliable data. Familiarity with the equipment is not a penultimate prerequisite, but it does keep the short field season running smooth. With new technologies comes troubleshooting and periods of trial and error. Understanding intricacies, nuisances, and common issues with the system will prove invaluable in the field.

Technology

In regard to the BioBase platform, the data and maps produced by this technology will be a tremendous asset to lake associations and communities looking to monitor or manage AIS. The data provide detailed waterbody-specific characteristic information with increased accuracy and at reduced cost than top-water or diver-assisted surveys. Utilizing these data to develop geospatial vulnerability models of aquatic invasive plant establishment and spread for individual lakes can help target future early detection surveys and to direct regional AIS spread prevention measures. For example, the bottom hardness data produced may allow for predictions of lake vulnerability to aquatic invasive plants, or even invasive mollusk establishment. Additionally, when analyzed against the biovolume data, improved predictions can be made of where invasive plants are likely to become established and spread. Adirondack Research has already begun this work as an awardee of a Microsoft AI for Earth Grant and is exploring how technology can inform conservation efforts. With study areas across the Adirondack Park, there is leading opportunity to advance a regional vulnerability assessment project with data collected during surveys by the Early Detection Team.

Photo 13: Research Technician Sarah and Crew Leader Janelle on Tupper Lake, Franklin Co., NY.



Yearly Number and Types of Surveys

As with crew size, the annual number of waterbodies surveyed is dependent on the project scope of work. Using the Lowrance Chartplotter to make complete maps of each waterbody, in contrast to only running the system during littoral zone surveys, significantly adds to the time/resources required to survey each lake. Adding additional lakes or ponds to be fully mapped with BioBase will necessitate a larger crew, as well as additional motorboats, sonar units, and subscription-based services. The same will be true with lakes with large acreage, as a minimal speed will need to be maintained to ensure accurate data collection. Since the data collected during this project will have great value in future AIS management and research, we recommend increasing the crew size to 6 to increase the number of littoral and complete BioBase surveys.

The management of aquatic invasive plants pose a challenge for accurately mapping the existing invasive plant beds in a lake. If the survey is conducted after management has occurred, the resulting map does not capture the full extent of the original infestation for that year. All invasive species distribution data and plant bed location maps produced will document only the current conditions in the lake the day the survey was completed. In 2019, the team did not encounter any areas of management in the lakes surveyed.

Conclusions

The 2019 AIS Early Detection Team surveyed 46 lakes and ponds in the western section of the Adirondack PRISM and did not find any new infestations of AIS. Many of the lakes and ponds surveyed in 2019 were previously surveyed in 2016.

The greatest project advancement for the 2019 survey season was the continued incorporation of new technologies introduced in 2018. The BioBase system allowed the team to map aquatic vegetation and lake characteristics in new and compelling ways. This newly acquired data, in combination with the deployment of IPMMS, allowed the early detection team to accurately map invasive plant beds within larger native plant communities. Invasive plant abundance data collected through IPMMS will also allow APIPP to assess trends in infestation expansion or reduction over time. APIPP also now has the opportunity to utilize the BioBase data in combination with AIS distribution data to develop risk/vulnerability assessments for individual lakes.

Moody Pond

Survey Date: August 21, 2019
Last Surveyed: 2018

Lake Description

Moody Pond is 24.9-acres and has 0.90-miles of shoreline. It is located in the town of North Elba, Essex County and lies in the Saranac River watershed. The team launched two canoes off Forest Hill Avenue, across from the Baker Mountain Trailhead.

Aquatic Invasive Plant Presence

Myriophyllum spicatum (Eurasian watermilfoil) was first detected in Moody Pond in 2018. A total of 11 plant beds were mapped.

Native Plant Biota

Comprehensive surveys of all native plants found within the pond were not prioritized in 2019. Native plants detected were: *Brasenia schreberi* (watershield), *Vallisneria americana* (eelgrass), *Potamogeton amplifolius* (large leaf pondweed), *Nitella spp.*, *Utricularia purpurea* (large purple bladderwort), *Nuphar variegata* (yellow pond lily), *Pontederia spp.* (pickerel weed), *Eleocharis spp.* (hairgrass) and *Nymphoides cordata* (little floating heart).

Aquatic Invasive Animal Presence

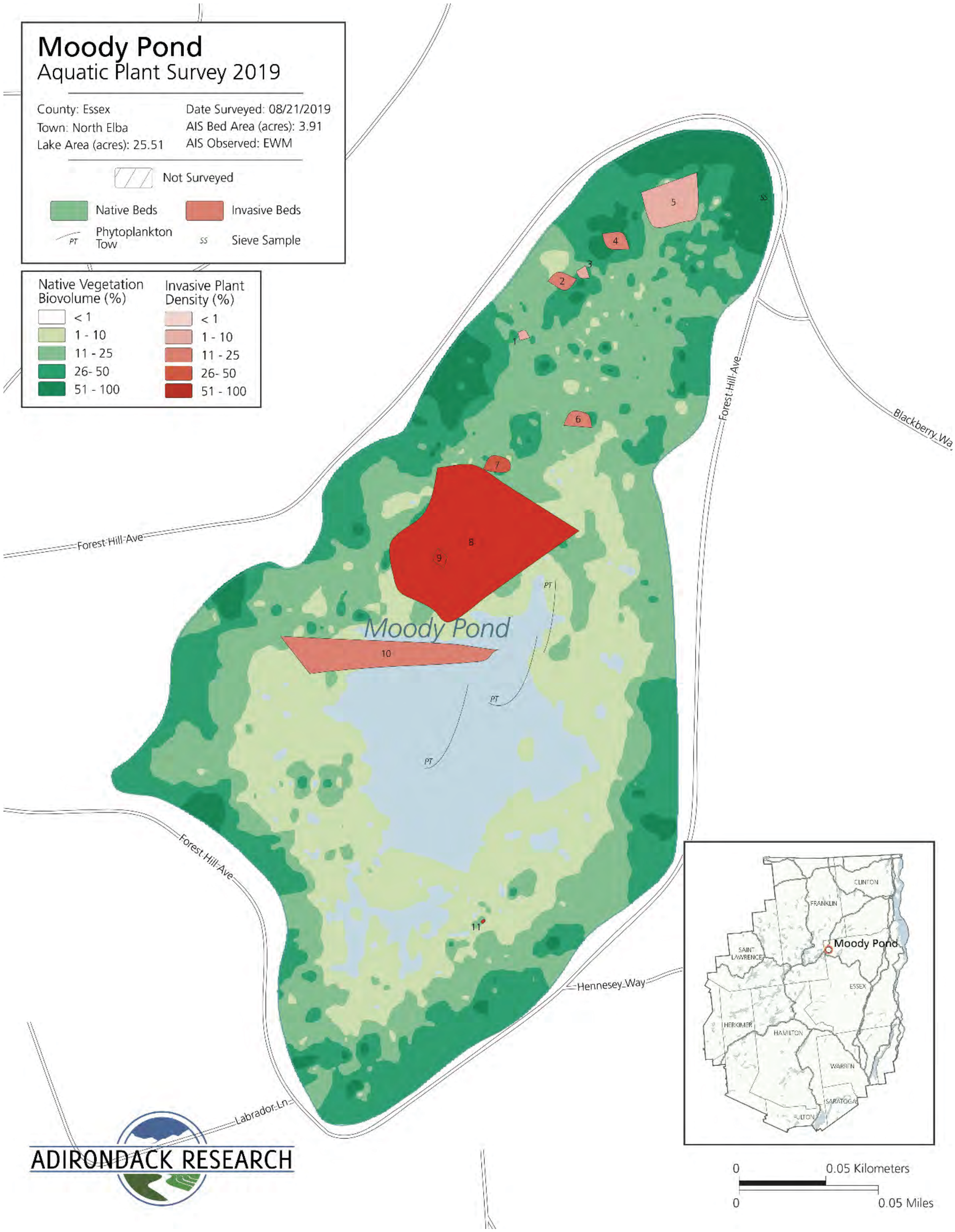
Sediment sieves were taken to determine the presence of *Corbicula fluminea* (Asian clams). None were found. Three plankton tows were also conducted with no invasive zooplankton detected.

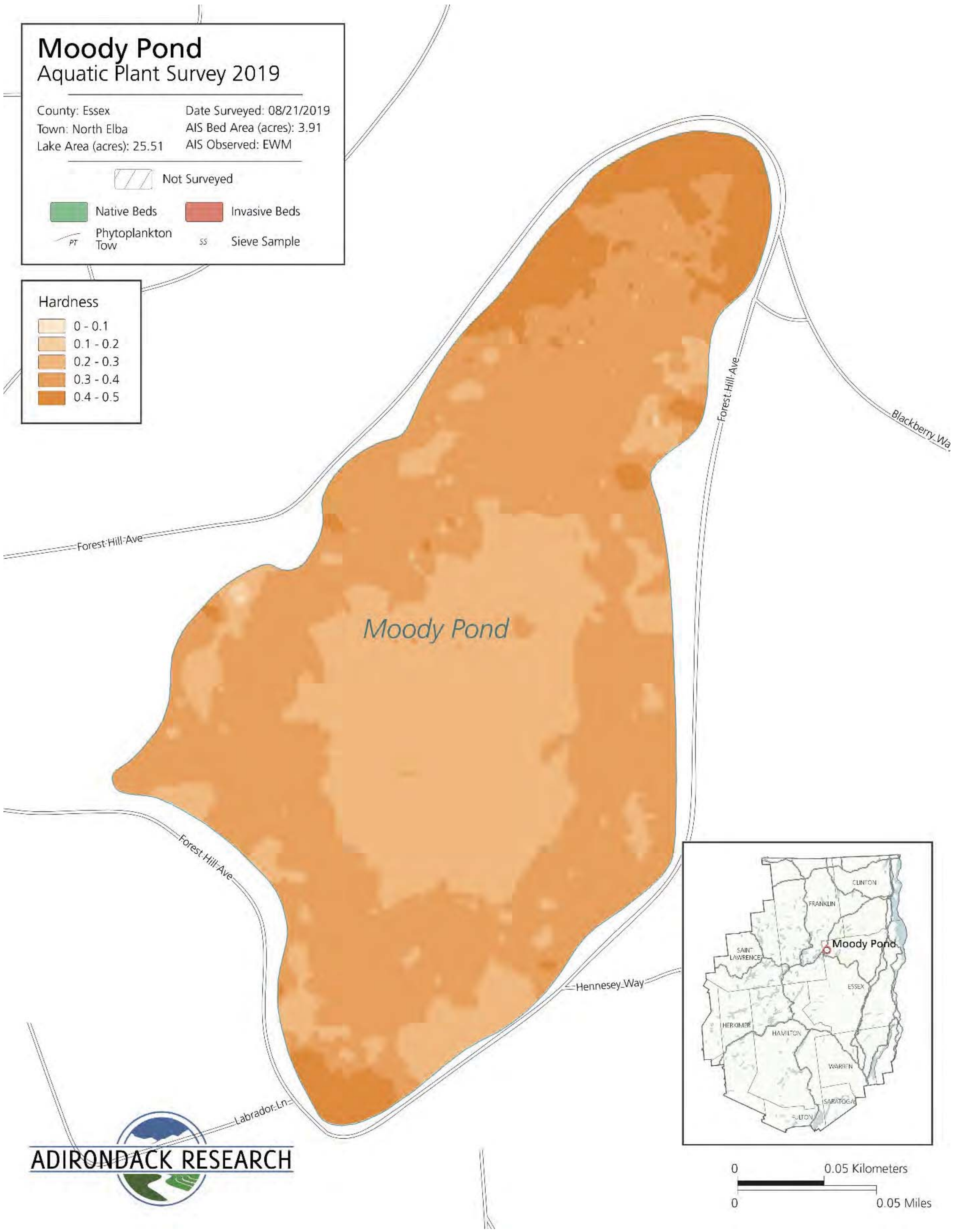
Invasive Species Percent Cover (See map on adjacent page)

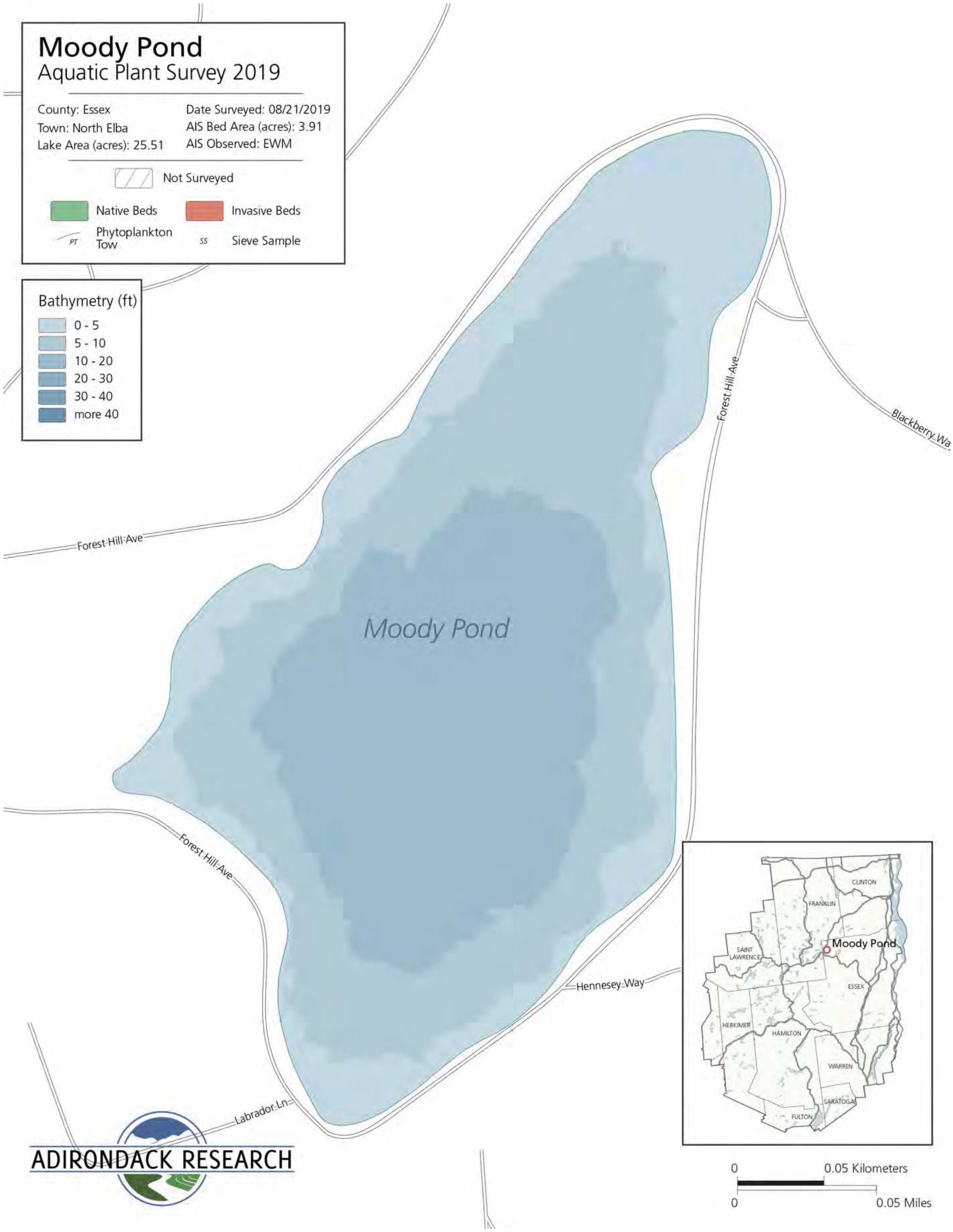
Eurasian Watermilfoil			
Bed	Size (Ac.)	Size (Sq. Ft.)	% Cover
1	.01	561.55	1-10
2	.05	2387.88	11-25
3	.02	799.46	1-10
4	.06	2756.79	11-25
5	.34	14955.80	1-10
6	.06	2470.38	11-25
7	.05	2175.78	26-50
8	2.64	115046.00	51-100

Eurasian Watermilfoil			
Bed	Size (Ac.)	Size (Sq. Ft.)	% Cover
9	.03	1168.21	51-100
10	.63	27393.70	11-25
11	.0005	20.35	51-10

Asian Clam	**Spiny Waterflea**
Present (Y/N)	Present (Y/N)
No	No


Moody Pond
Aquatic Plant Survey 2019
County: Essex
Town: North Elba
Lake Area (acres): 25.51
Date Surveyed: 08/21/2019
AIS Bed Area (acres): 3.91
AIS Observed: EWM
Not Surveyed
Native Beds
Invasive Beds
Phytoplankton Tow
Sieve Sample
Native Vegetation Biovolume (%)
< 1
1 - 10
11 - 25
26- 50
51 - 100
Invasive Plant Density (%)
< 1
1 - 10
11 - 25
26- 50
51 - 100
Moody Pond
Forest Hill Ave
Blackberry Wa
Hennesey Way
Labrador Ln
ADIRONDACK RESEARCH
Moody Pond
0 0.05 Kilometers
0 0.05 Miles


Moody Pond
Aquatic Plant Survey 2019
County: Essex
Town: North Elba
Lake Area (acres): 25.51
Date Surveyed: 08/21/2019
AIS Bed Area (acres): 3.91
AIS Observed: EWM
Not Surveyed
Native Beds
Invasive Beds
Phytoplankton Tow
PT
SS
Sieve Sample
Hardness
0 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
Moody Pond
Forest Hill Ave
Forest Hill Ave
Forest Hill Ave
Blackberry Wa
Hennesey Way
Labrador Ln
CLINTON
FRANKLIN
Moody Pond
SAINT LAWRENCE
ESSEX
HERKIMER
HAMILTON
WARREN
SARATOGA
ADIRONDACK RESEARCH
0
0.05 Kilometers
0
0.05 Miles


Moody Pond
Aquatic Plant Survey 2019
County: Essex
Town: North Elba
Lake Area (acres): 25.51
Date Surveyed: 08/21/2019
AIS Bed Area (acres): 3.91
AIS Observed: EWM
Not Surveyed
Native Beds
Invasive Beds
Phytoplankton Tow
Sieve Sample
Bathymetry (ft)
0 - 5
5 - 10
10 - 20
20 - 30
30 - 40
more 40
Moody Pond
Forest Hill Ave
Forest Hill Ave
Forest Hill Ave
Blackberry Wa
Hennesey Way
Labrador Ln
CLINTON
FRANKLIN
Moody Pond
SAINT LAWRENCE
ESSEX
HERKIMER
HAMILTON
WARREN
SARATOGA
FULTON
0
0.05 Kilometers
0
0.05 Miles
ADIRONDACK RESEARCH