White Paper 1A-
Summary of Major NYS Aquatic Plant Surveys since the mid-1920s

Section 1- Background

New York state is extraordinarily rich in water resources, with nearly 16,000 lakes, ponds and reservoirs each covering a surface area greater than 0.1 acres, and with approximately 7,500 ponded waters with a surface area greater than 6.4 acres (= 0.01 square miles). Many of these lakes are not used by or accessible to the general public, given their remote location relative to transportation corridors and given public agency ownership of the shoreline of these lakes. However, despite the lack of public access to these waterbodies, more than 3000 of these lakes have been surveyed by the state Conservation Department (prior to 1970), the New York State Department of Environmental Conservation (NYSDEC, since the early 1970s), and other government agencies, academic institutions or consultants.

Much of this data was collected to meet specific objectives, such as assessing acidification status, so these datasets are often insufficient to meet other objectives. The associated monitoring program designs also frequently chose candidate monitoring sites that are likewise insufficient to evaluate other objectives. For example, the New York Citizens Statewide Lake Assessment Program (CSLAP) involves lakes with lakefront property associations, and therefore are limited to those lakes and shorelines that can support residential properties (and thus have only limited inclusion of small, high elevation acidic lakes and urban lakes). Likewise, the NYSDEC Lake Classification and Inventory Survey (LCI) usually involves only “public” lakes- those with boat launches or shoreline access across public land- and usually involves larger lakes, thereby under-representing smaller or private lakes. Lakes sampled by the NYSDOH have focused on indicators related to swimming (bacteria) or drinking water quality, and like many lakes sampled by academic institutions or lake associations, these lakes are sampled individually, not collectively as part of larger programs. Even in those lakes sampled as part of larger monitoring programs, aquatic plant communities are generally not systematically surveyed. CSLAP and the LCI, for example, include aquatic plant collections, but for most lakes, evaluation of aquatic plants has been limited to visual surveys for or happenstance observation of invasive or nuisance species. Many of these monitoring efforts, whether part of a larger monitoring program or focused on individual lakes, often do not allocate sufficient time to conduct extensive plant surveys, or do not consistently include samplers with expertise in plant sampling or identification.

Therefore, there are only a limited number of multiple lake monitoring programs that include comprehensive evaluations of aquatic plant communities.

Section 2-New York State Aquatic Plant Survey "Programs"

As noted above, most of the lake water quality monitoring conducted in New York state since the early 1900s have either not included any aquatic plant monitoring, or have not generated data that could be readily compared to aquatic plant information collected at other lakes. In some cases, the water quality monitoring has been conducted on individual waterbodies, not as part of a larger program, and in other cases, aquatic plant monitoring has been sporadic or focused on very specific limited objectives, such as cursory searches for invasive species.

However, there have been a few lake monitoring programs conducted in New York state over the last 100 years that have included a significant focus on aquatic plants and have employed most to all of the elements of the PIRTRAM sampling methodology (as described below). These aquatic plant monitoring programs included both plant-monitoring-only programs and more comprehensive lake monitoring programs with a significant aquatic plant monitoring component:

(1) One time surveys through the New York State Biological Surveys from 1926 to 1938 on more than 300 lakes throughout the state;
(2) 1-2x surveys via the Adirondack Lake Survey Corporation (ALSC) study of more than 1600 lakes in the Adirondack Park and downstate region from 1984 to 1987;
(3) More than 200 PIRTRAM-connected aquatic plant surveys of about 50 individual lakes throughout the state by Racine-Johnson Aquatic Ecologists, Allied Biological Inc (now SOLitude Lake Management), Darrin Freshwater Institute, and the NYSDEC from the mid-1990s to the late-2010s
(4) About 120 surveys through the Adirondack Watershed Institute aquatic plant surveys of about 90 Adirondack lakes

Details about each of these "programs" are provided below.

Section 2.1: The Conservation Department biological surveys **from 1926 to 1938;**

The first statewide lake survey in New York State, the State Conservation Department (the predecessor to the NYSDEC) conducted a biological survey of each of the 17 major drainage basins in New York State from 1926 to 1938, focusing on fisheries resources and stocking. These studies also evaluated lake and stream water quality related to rudimentary water chemistry indicators, invertebrates, plankton, aquatic vegetation, and even aquatic parasites.

The aquatic plant communities were surveyed in more than 300 lakes by Conservation Department biologists. The surveys involved up to 30 biologists in each basin from state, federal, and local governments, academic institutions, and private research organizations. As noted above, many of the survey details have been lost to posterity, despite otherwise well-documented summaries of other water quality and biological survey methods in the 12 part Biological Survey series (http://onlinebooks.library.upenn.edu/webbin/book/lookupname?key=New%20York%20%28State%29%2E%20Conservation%20Department). It appears that plant surveys were conducted in the principal weed areas in lakes, most often between August 15th and Sept 15th. Rakes were used to collect submergent plants. Aquatic plants were identified to species level and quantified using a four point scale- abundant, common, frequent, and rare. As discussed below, it is presumed for this evaluation that these terms were defined in a way that is consistent with contemporary definnitions of these plant abundance terms. However, in some surveys, only the presence of

Table 2.1- Summary of Lakes w/ Aquatic Plant Surveys via NYS Biological Surveys 1926-1938

Basin	*Year*	*#Lakes Surveyed*	*Abundance Categories*	*Range Lake Area (ac)*	*Median Lake Area (ac)*
Allegheny-Chemung basin	1937	22	a, c, f, r, p	<1 - 1529	18
Champlain basin	1929	13	p	2 - 112745	481
Delaware basin	1935	13	a, c, f, r, p	2 - 116	54
Erie-Niagara basin	1932	1	p	NA	859,572
Genesee basin	1926,1937	2	p	337 - 1299	818
Long Island basin	1938	23	a, c, f, r, p	<1 - 92	12
Lower Hudson basin	1934	32	a, c, f, r, p	<1 - 738	62
Mohawk basin	1934	15	a, c, f, r, p	2 - 215	63
Ontario basin	1939	45	a, c, f, r, p	<1 – 2024*	10
Oswegatchie Black basin	1931	49	a, c, f, r, p	2 - 3137	97
Oswego basin	1927	3	p	224 - 17565	17253
Raquette basin	1933	20	a, c, f, r, p	2 - 2185	157
St. Lawrence basin	1930	17	a, c, f, r, p	7 - 1038	134
Susquehanna basin	1935	21	a, c, f, r, p	3 - 1660	42
Upper Hudson basin	1932,1934	41	a, c, f, r, p	<1 - 10088	104
TOTAL	**1926-38**	**304**		**<1 – 859,572**	**54**

*- all Lake Ontario (main lake) sites assumed to be between 200 and 2000 hectares
Abundance categories used in basin surveys: a= abundant, c = common, f = frequent, r = rare, p= present

plants was recorded; the lack of semi-quantitative data in these surveys limits the use of these aquatic plant survey results in conducting abundance-weighted assessments. In addition, given the lack of individual survey sites (or even the areas or survey site densities represented by the survey results), it is not known if species richness calculations are accurate for these lakes. However, given species-level identifications (and the presumption that these identifications are accurate and/or convertible to present taxonomic classifications), species abundance tables and some measures of floristic quality can be generated, and the presence of AIS or protected (RTE = rare, threatened, or endangered) species can be compared to those reported in other surveys.

The basin-specific summaries of the aquatic plant surveys conducted during the Biological Surveys as provided in Table 2.1 show the number and size range of lakes surveyed in each basin. The criteria used to choose the survey lakes cannot be reproduced at this time, but in general, the Biological Surveys were devised to evaluate the condition of the fisheries and associated biological factors for each major drainage basin, including Department stocking policies. The distribution of the lakes by size and geography in most basins suggests an underlying goal to represent an entire cross-section of the basin.

This is apparent from Table 2.1 and Figures 2.1.1 and 2.1.2, which compare the relationship between New York state lakes and those surveyed through the Biological Surveys. The New York state dataset cited here is derived from the NYSDEC Fisheries Index Number database, which summarizes the surface area, location, shoreline length, and designated pond number for nearly 16,000 lakes, ponds and reservoirs greater than 0.1 acre in surface area. Figure 2.1.1 shows that the majority of the New York state lakes are less than 5 acres in size, and the number of lakes in each size category decreases with increasing lake size. The Biological Surveys are comprised of a relatively equal distribution in all ranges of lake sizes, with a slightly larger number of lakes greater than 100 acres in size. Although relatively larger lakes (those great than 100 acres) are far less abundant than smaller lakes overall in New York state, these larger lakes represent a larger portion of lakes sampled through the Biological Survey. These relatively larger lakes most likely represent the majority of lakes heavily used for

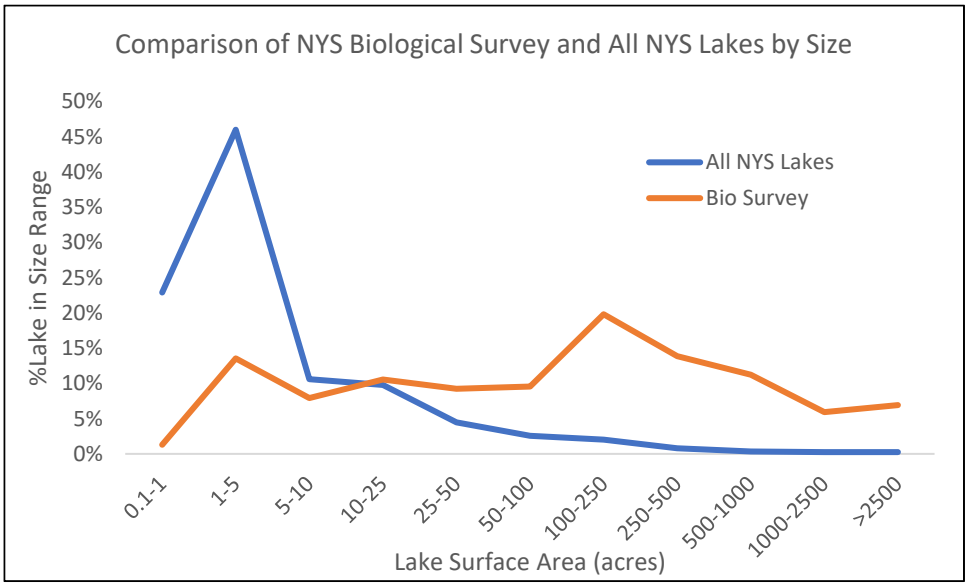


Figure 2.1.1- Size Comparison of All NYS and NYS BioSurvey Lakes

recreation, fish stocking, drinking water, and shoreline property ownership, so placing a greater weight (by increased sampling) on these lakes may result in a greater likelihood of evaluating conditions in the most "important" lakes. However, while the biological assessments of these lakes are extensive, water quality data are very limited, no doubt due to the lack of available analytical tests for many (now traditional) water quality indicators. For most lakes, water quality data are limited to water clarity, oxygen, pH, alkalinity, and some qualitative measure of color and (bottom sample) odor.

Data from these Biological Surveys are generally not available on-line, but many of the Surveys were scanned and converted into PDFs by the University of Michigan (https://afspubs.onlinelibrary.wiley.com/doi/abs/10.1080/03632415.2011.564504).

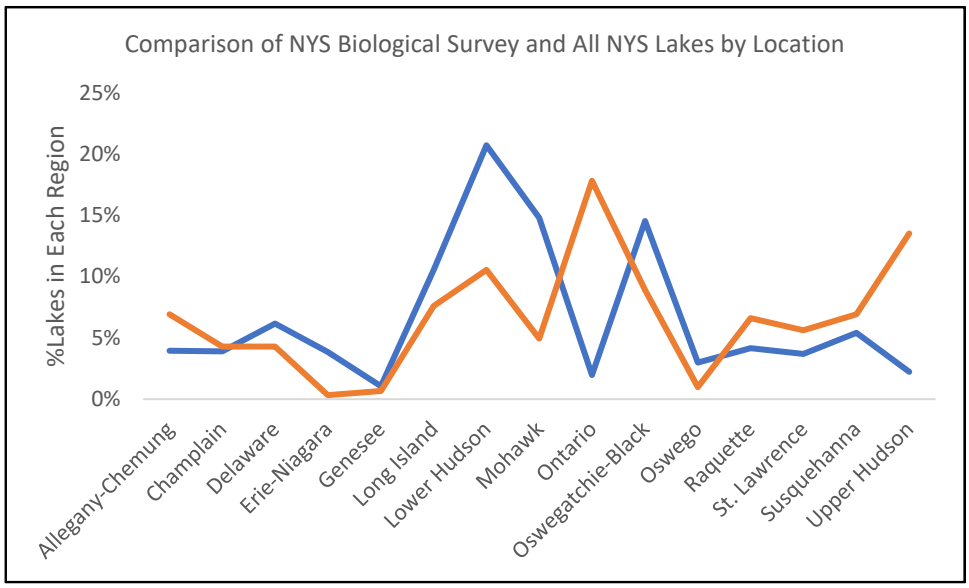
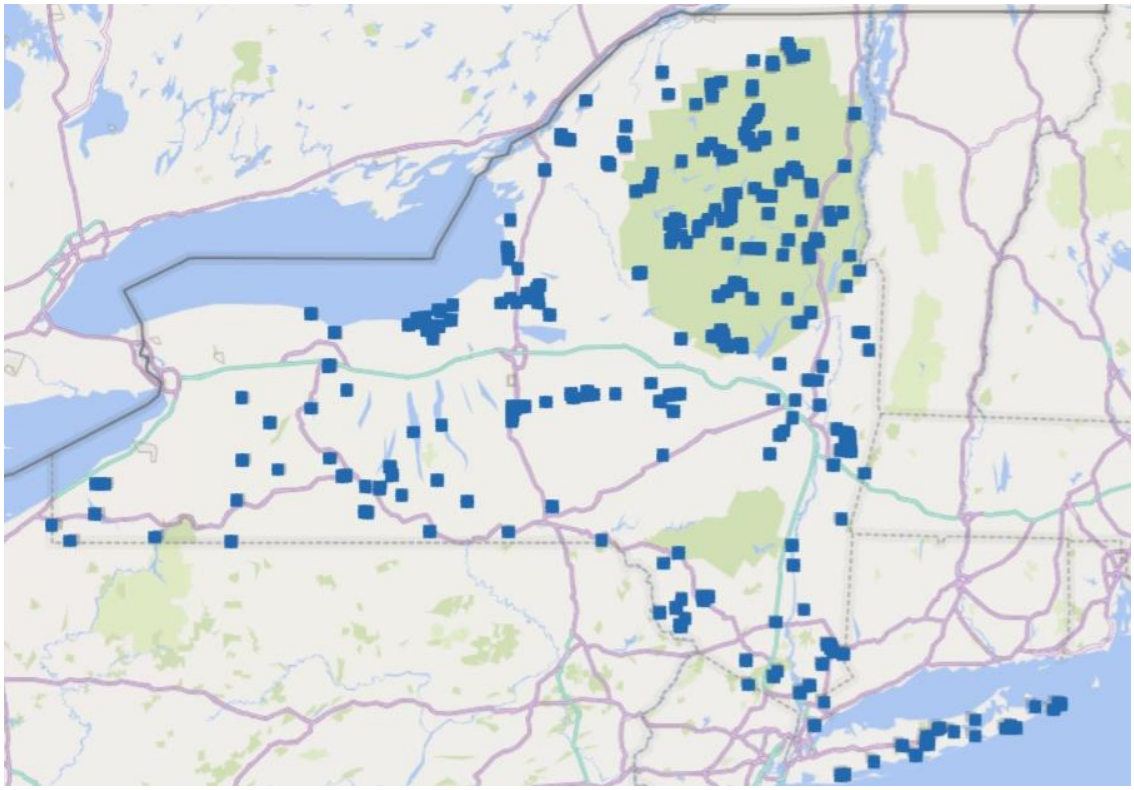


Figure 2.1.2- Geographic Comparison of NYS and Bio Survey Lakes

Figure 2.1.2 shows a geographic comparison of all New York state lakes and those sampled through the Biological Surveys. These data indicate that in most regions (basins) of the state, the percentage of lakes surveyed through the Biological Survey is similar to the overall percentage of lakes associated with those regions, recognizing that in some basins, the very few lakes sampled during the Biological Survey were very large (only Lake Erie in the Erie-Niagara basin, two of the Finger Lakes in the Genesee basin, etc.). The Biological Survey "over-represented" lakes in the (direct drainage to) Lake Ontario basin and Upper Hudson basin, and "under-represented" lakes in the Lower Hudson, Mohawk and Oswegatchie-Black basins. It should be noted that, in general, the earliest surveys usually included fewer lakes.

However, in general, the Biological Survey lakes generally represent a cross-section of New York state lakes in terms of geography (see Figure 2.1.3), and appear to have been explicitly chosen to cover the entire range of New York state lake sizes, with a greater emphasis on moderately to larger lakes than are otherwise represented in the larger New York state lakes dataset. In addition, this emphasis on larger lakes may be more representative of those lakes that are stocked, used extensively for recreation, and lakefront resident properties.

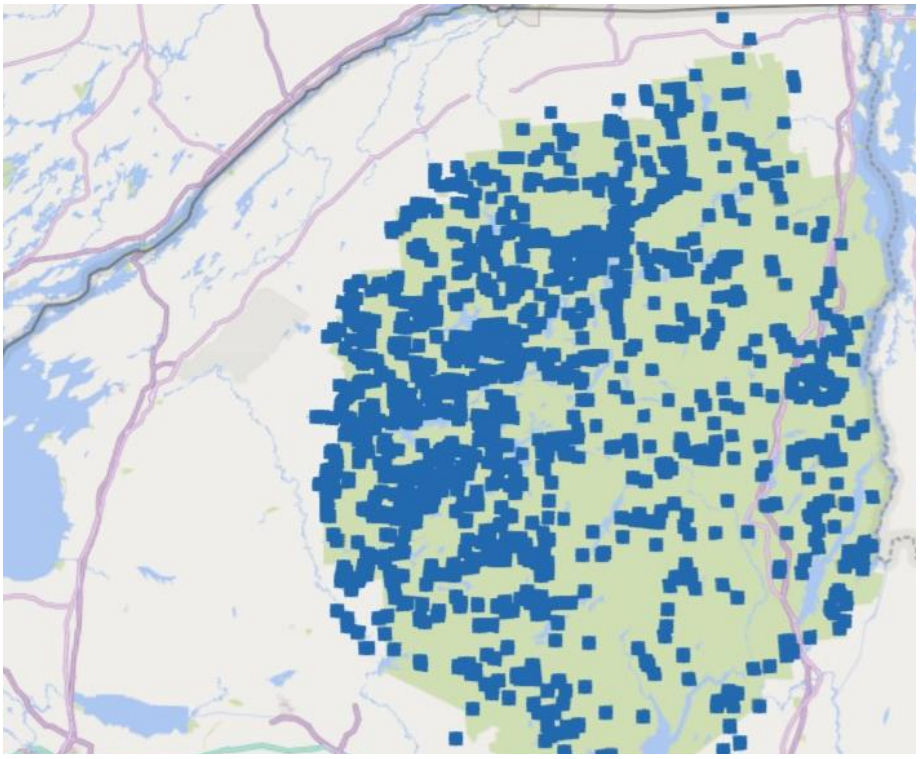
Figure 2.1.3- NYS BioSurvey lakes



With so many lakes surveyed (more than 300), individual lake information for each lake is not provided in this White Paper, and these data are only analyzed in the collective (where appropriate). As discussed in Section 3, the lack of granular survey site data (relative plant abundance information for each plant at each site) and other survey shortcomings also limit the extent to which these data can be used, either on its own or relative to data from other programs. On the other hand, the extensive aquatic plant species identifications in all habitats- submergent, floating and emergent- provided in the NYS BioSurveys were not replicated in other programs cited in this White Paper, highlighting limitations in these other programs.

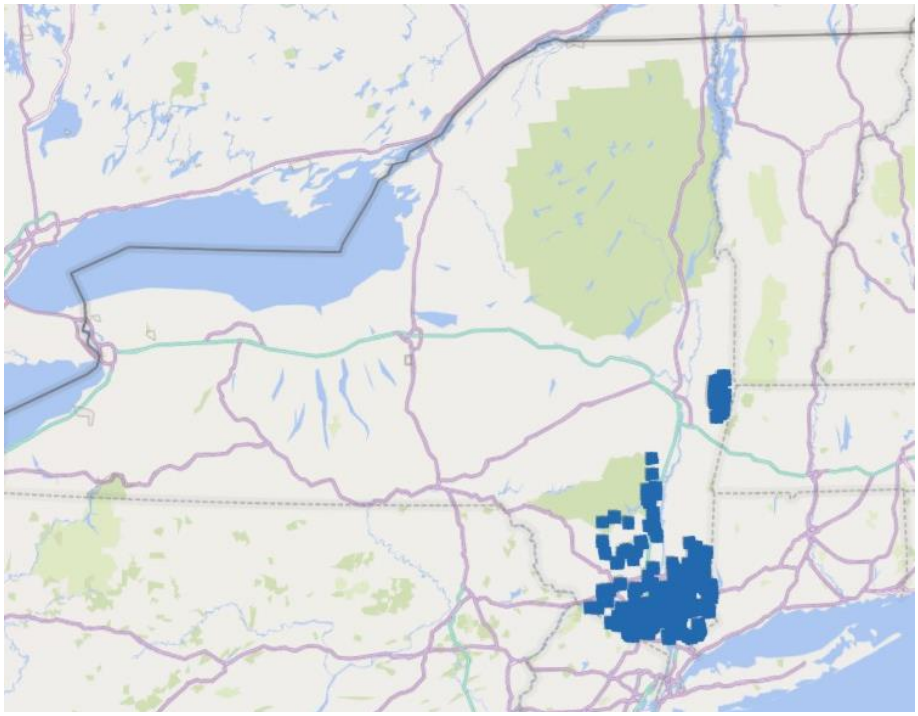
Section 2.2: the Adirondack Lake Survey Corporation acid rain surveys from 1984 to 1987;

Figure 2.2.1- ALSC Adirondack lakes



In response to the lack of information about the impact of acid rain on many lakes in highly vulnerable areas, a cooperative agreement between the Empire State Electric Energy Research Corporation and NYSDEC established the Adirondack Lakes Survey Corporation (ALSC) to determine the extent and magnitude of acidification of Adirondack lakes and ponds. From 1984 to 1987, the not-for-profit organization conducted an extensive baseline survey of nearly 1,500 lakes within the Adirondacks and high-elevation lakes downstate. The ALSC survey was certainly the largest and most extensive monitoring program in the history of the state, but also perhaps the most extensive lake survey conducted in the country. Each lake was

Figure 2.2.2- ALSC Downstate lakes



sampled 1-3x for traditional water quality indicators (except, curiously, for chlorophyll *a*), fish species, phytoplankton, zooplankton, fish collections, and macrophytes, and documentation of lake morphometry, watershed, shoreline and bottom substrate characteristics, and lake bathymetry was also provided for each surveyed lake.

The ALSC aquatic plant surveys included 1305 lakes, ponds, and reservoirs within the Adirondack Park, and another 254 ponded waters located in higher elevation downstate regions, no doubt representing the largest aquatic plant survey dataset ever conducted. The Adirondack region lakes are shown in Figure 2.2.1, and the downstate region lakes are shown in Figure 2.2.2. However, plant communities were NOT evaluated for relative abundance, and individual plant taxa were identified only as present (or by default absent) to genera. Individual survey sites within ALSC lakes were not identified, and therefore survey site densities are not known. This limits the ability of analysts to conduct simple, frequency- or abundance-weighted floristic quality assessments, unless genera-based floristic quality assessments can be developed (see White Papers 1F and 1G, Coefficients of Conservatism and Floristic Quality Indices (FQIs), respectively). This also limits the ability of analysts to determine whether species richness measurements are accurate or reflect limits based on the density or location of survey sites. In some cases, the presence of AIS or RTE species can be determined if the relevant AIS- or RTE-species are the only New York species within an identified genera. One example of this is *Trapa natans* (water chestnut), an invasive plant species and the only (New York) aquatic plant species within the *Trapa* genera. However, since most AIS and RTE are among multiple species found within otherwise native or common genera, the ALSC data have only limited utility in evaluating either AIS or RTE. As with the Biological Surveys discussed above, the lack of individual survey site data for the ALSC precludes an analyst from optimizing survey site selection (number and location of survey sites) for estimating maximum or projected species richness, finding AIS or RTE, or estimating floristic quality (as discussed in White Papers 1D, 1E, and 1F).

The ALSC surveys in the Adirondacks and downstate were devised because "a more standardized, detailed and comprehensive survey was needed to examine the extent and magnitude of acidification of waters in New York State" (http://www.adirondacklakessurvey.org/als.shtml). This resulted in a survey of 1469 lakes in the Adirondacks (of which 1305 were surveyed for aquatic plants) and 254 downstate lakes (all of which were surveyed for aquatic plants). The survey design, particularly lake site selection, was not explicitly intended to assess aquatic plant communities, even in the study area. For example, many of the largest lakes in the Adirondacks and downstate region were not included in the ALSC study, since these were not expected to be acidic or provide sufficient comparisons to those (small and high elevation) lakes subject to cultural acidification in the region. Those aquatic plant survey data that were collected as part of the ALSC were also not subject to the same level of analysis as were the water quality and fisheries data- the primary publication derived from this work was entitled "Adirondack Lakes Survey: An Interpretive Analysis of Fish Communities and Water Chemistry 1984-87". However, these data can provide significant insights to the floristic conditions of significant portions of New York state, particularly since

some survey sites were also included in other aquatic plant surveys discussed in this White Paper. So these data are used, albeit with some precautions, in White Papers 1D and 1E.

The basin-specific summaries of the aquatic plant surveys conducted during the ALSC as shown in Table 2.2.1 show the number and size range of lakes surveyed in each basin in the Adirondack-region (1984-1986) and downstate region (1986-1987). The distribution of the lakes by size and geography in most basins suggests an underlying goal to represent an entire cross-section of the basin, recognizing an upper limit of about 450 acres for the size of surveyed lakes

Table 2.2.1- Summary of Lakes Sampled for Aquatic Plants in the ALSC

Basin	*#Lakes Surveyed*	*%NYS+ Lakes*	*%ALSC+ lakes*	*Range Area (ac)*	*Median Area (ac)*
Champlain basin	245	9%	19%	<1 - 455	10
Lower Hudson basin	252	100%	99%	<1 - 410	15
Mohawk basin	60	34%	5%	2 - 319	14
Oswegatchie Black basin	458	34%	35%	<1 - 462	13
Raquette basin	197	10%	15%	<1 - 708	16
St. Lawrence basin	183	9%	14%	<1 - 436	15
Upper Hudson basin	162*	5%	13%	2 - 373	21
TOTAL	**1559**				

*3 of these southern lakes in this basin were surveyed in the downstate ALSC study
+ relative percentage of lakes in NYS (ALSC "regions" add up to 100% of possible survey sites in the Adirondack and downstate regions; all downstate ALSC lakes are in the Lower Hudson (hence the 100% figure for NYS Lakes)
-Range and Median Area represents statistics for ALSC lakes only, not other lakes in these basins

in most basins. While some of the largest lakes in the Adirondack Park were not included in the ALSC study, likely because these lakes had sufficient buffering capacity and limited susceptibility to acidification to be included in this acid rain study, larger lakes generally represent only a small part of the New York state dataset (Figure 2.2). In fact, as seen in Figure 2.2, lakes above 5 acres are "over-represented" in the ALSC study- a larger portion of lakes in this size range were sampled in the ALSC than would otherwise be expected given the very large number of very small lakes seen throughout the state, including the Adirondacks.

The "typical" (median area) lake in each of the Adirondack regions surveyed for aquatic plants in the ALSC is similar across these regions, with slightly larger lakes in the Upper Hudson River basin (corresponding to the southeastern Adirondacks with relatively large lakes and steep shoreline slopes) and slightly smaller lakes in the Lake Champlain basin (corresponding to shallower slopes and larger sub-drainage basins). These appear to be similar to the lake distribution surveyed in the downstate ALSC study in the Lower Hudson River basin.

Table 2.2.1 suggests that the Mohawk River basin, constituting about 35% of the lakes within the ALSC basins but only 5% of the lakes surveyed for aquatic plants through the ALSC, is undersampled in the ALSC, while several other basins (particularly the Champlain and Upper Hudson basins) were oversampled. However, some of these basins, such as the Mohawk, include only a small portion of the basin within the Adirondack Park (and therefore only lakes in that small portion of the basin were eligible for inclusion in the ALSC), while other basins, such as the Champlain, Raquette, and Upper Hudson, are largely centered within the Adirondack blue line.

Table 2.2.2- ALSC Plant Surveys by Basin- Actual v. Expected Sites

Basin	*#Lakes Surveyed*	*#Lakes in Basin*	*%Basin w/in Adks*	*Expected # Surveys**
Champlain basin	245	617	75%	244
Lower Hudson basin	252	3270	NA	NA
Mohawk basin	60	2339	17%	207
Oswegatchie Black basin	458	2298	29%	352
Raquette basin	197	655	76%	262
St. Lawrence basin	183	584	38%	114
Upper Hudson basin	162*	354	67%	126
TOTAL	**1559**			

*based on the % of lakes in basin within Adirondack Park and 1305 surveys conducted within the Park

Table 2.2.2 shows the percentage of each of the Adirondack-region basins found within the Adirondack Park, and the calculated expected number of aquatic plant surveys based on the relative portion of each basin within the Adirondack Park and the number of lakes within the basin. These calculations assumed that the distribution of lakes within each basin were similar within and outside the Adirondack blue line; this is very likely inaccurate in some basins. However, these assumptions provide an opportunity to evaluate the geographic distribution of lake aquatic plant survey sites and may provide insights about the relative influence of other basin-specific characteristics, such as morphometry, trophic state, dissolved organic matter (color), conductivity and acidification.

Table 2.2.2 shows that Mohawk River and, to a lesser extent, Raquette River basins were under-represented in ALSC plant surveying, and the Oswegatchie-Black Rivers and St. Lawrence River basins were over-represented in these surveys. However, Table 2.2.2 shows many survey sites in each basin and reasonable geographic distribution of sampling sites across the Adirondack Park, particularly when used to compare the ALSC data to those collected in the Biological Surveys of the 1920s-1930s and the Adirondack Watershed Institute (AWI) from the 2010s, as discussed in Section 2.4.

Figure 2.2.3 indicates that the ALSC aquatic plant surveys, in both the Adirondack region (ALSC-A) and downstate region (ALSC-D), are focused on lakes in the 10-25/50 acre range. The Adirondack region includes a slightly larger percentage of smaller (1-5 acre) lakes, and in both the Adirondack and downstate regions, very small (< 1 acre) lakes are generally not surveyed. However, larger lakes (>25 acres) are surveyed in the ALSC in a pattern broadly consistent with the overall distribution of lakes in the state. In other words, the size distribution of ALSC-surveyed lakes skews slightly larger than the larger NYS dataset, but in general follows the size distribution of NYS lakes in lakes larger than about 25 acres. This shift towards larger lakes is more likely to be representative of those lakes with public access, recreational and residential uses, and those subject to aquatic plant management.

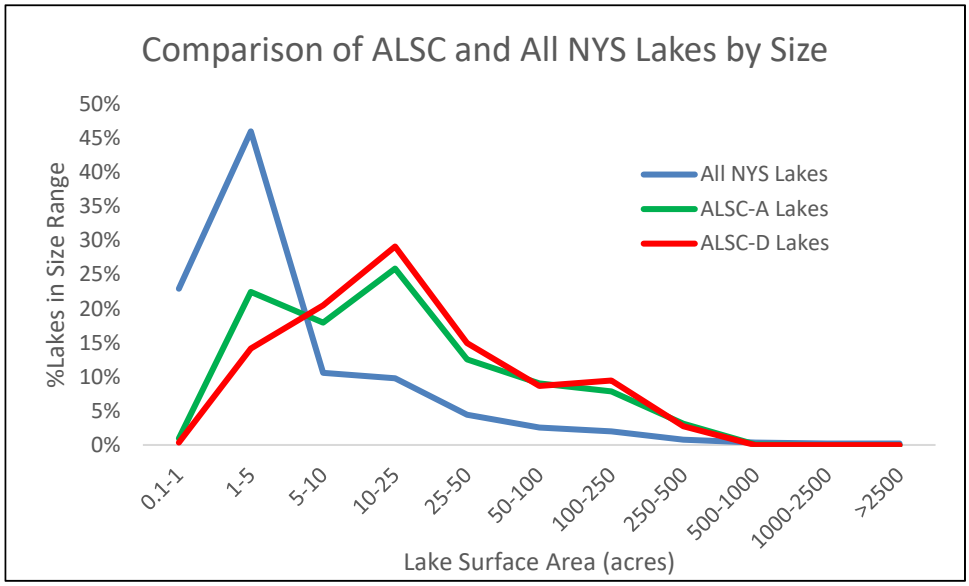


Figure 2.2.3- Size Comparison of NYS and ALSC Lakes

With so many lakes surveyed (more than 1550), individual lake information for each lake is not provided in this White Paper, and these data are only analyzed in the collective (where appropriate).

Section 2.3: PIRTRAM surveys conducted by aquatic plant managers, **generally in support of NYSDEC survey requirements, from the mid-1990s to the mid-2010s.**

From the mid-1990s to the mid-2000s, NYSDEC standardized the requirements for seeking aquatic pesticides permits, by requiring standardized information collection (including development of management and monitoring plans), permit applications, and permit review for those waterbodies deemed by the NYSDEC to be worthy of "enhanced review". These included several hundred waterbodies in New York state identified by one or more NYSDEC divisions as candidates for consistent review and evaluation of permit applications, to both provide consistent guidance to applicants (lake communities, consultants, and pesticide applicators) and to assure that permits were issued "only" for those waterbodies for which applications were closely reviewed and deemed appropriate. The classes of waterbodies included in the enhanced review process included drinking water supplies, waterbodies previously cited on the Division of Water's Priority Waterbody List for excessive aquatic vegetation, waterbodies with regulated wetlands or protected plant or animal species, waterbodies stocked with sports fish, and other high quality regional resources. The aquatic plant survey requirements in the enhanced review program included PIRTRAM (Point-Intercept, Rake Toss, Relative Abundance Method; Madsen 1999, Johnson 2008) surveys at a density of at least 1 site per hectare of littoral zone, and plant identification to species or genus level (depending on the waterbody type and plant habitat). The enhanced review program largely ended by the late 2000s, due to NYSDEC staffing shortages, but by this time, many lake associations and consultants recognized the value of aquatic plant surveys and continued this work to the present day.

This third aquatic plant survey "group" described in this white paper is actually loosely connected sets of aquatic plant surveys conducted by multiple researchers, but sharing common plant survey methodologies that were established in PIRTRAM and adopted by the NYSDEC as part of the Enhanced Review process. All of the surveys in this group used overlay grids to identify potential sampling sites throughout the lake and littoral zone, PIRTRAM sampling protocols for identifying survey sites (withing the overlay grids), collecting samples, and assessing relative abundance, and common plant identification methodologies and nomenclatures used in most New York state aquatic plant surveys. These are discussed further in White Paper 1B.

Since the late 1990s to mid-2000s, more than 200 PIRTRAM aquatic plant surveys have been conducted on more than 50 New York state ponded waters by consultants, agencies, and the public. Most of the surveys yielding comparable results were conducted by the following samplers:

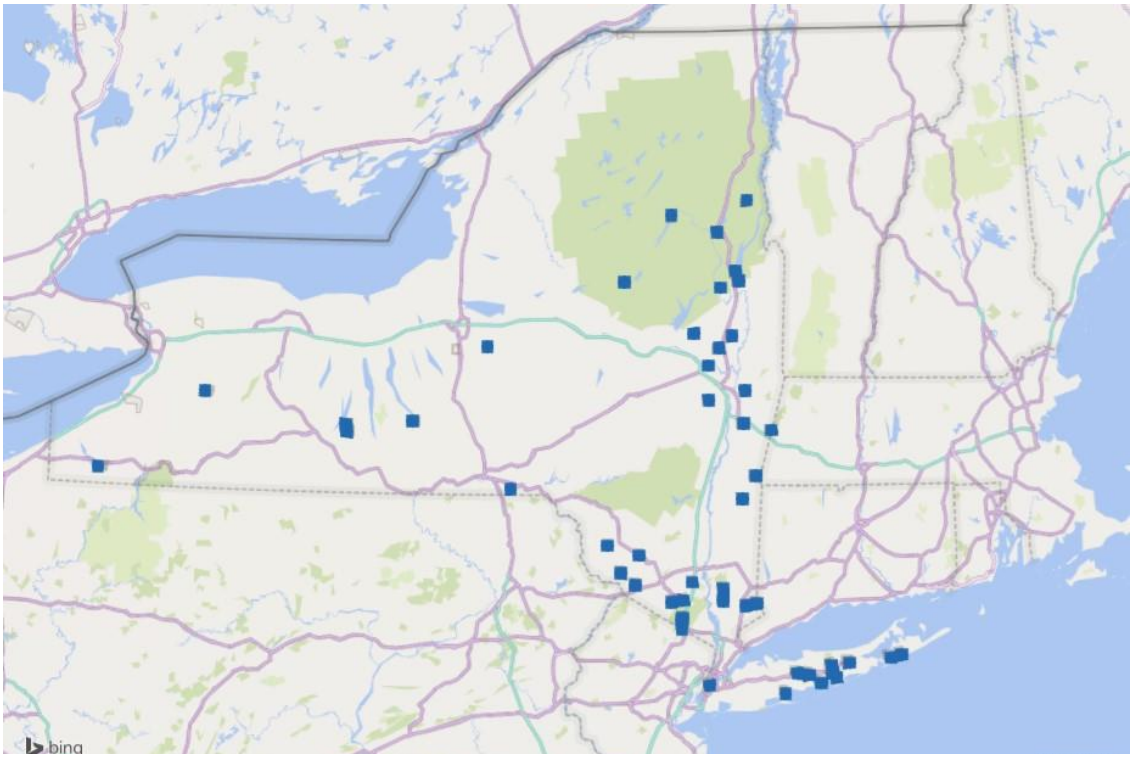
1. NYSDEC- the NYSDEC Division of Water and DEC Region 1 (Long Island) Fisheries staff routinely sampled several small lakes for aquatic plants, initially to build an understanding of impacts from plant management actions on select NYS Lakes, and separately conducted an extensive survey of small ponds in Long Island in the mid-

2000s. All collected plants in these surveys were identified by the NYSDEC Division of Water in Albany.

2. Racine-Johnson Aquatic Ecologists (RJAE) regularly surveyed several very large NYS lakes under contract by the local lake association, starting in the mid-2000s from central to western NYS. These were generally conducted as part of a process for evaluating aquatic herbicides, but usually included both pre- and post-treatment data. These surveys often involved both rake toss and biomass sampling. Aquatic plant identifications were conducted or overseen by RJAE.
3. Darrin Freshwater Institute surveyed several mostly midsized eastern Adirondack lakes, usually as part of a process for evaluating aquatic plant management actions, generally since the late 2000s. Aquatic plant identifications were conducted by DFWI. Many of these surveys initially involved line intercept surveys, but transitioned to point-intercept surveys and otherwise adopted other PIRTRAM methodologies in the same timeframe.
4. Allied Biological Inc. (ABI, now SOLitude Lake Management) conducted aquatic plant surveys in many NYS lakes, ponds and reservoirs throughout the state since the mid-2000s. These surveys were conducted as part of either overall lake management plan development or in support of aquatic plant management evaluation. Aquatic plant samples were identified by ABI/SOLitude.
5. Lake associations. It is likely that many lake associations have conducted aquatic plant surveys since the late 1990s, but the majority of these were either not PIRTRAM surveys or samples were not identified by a plant ID expert. However, several lake associations conducted PIRTRAM surveys, using sample methodologies provided by the NYSDEC, with instructions to gather all plants observed, and with aquatic plants identified by the NYSDEC Division of Water. For the purposes of this evaluation, these are considered to be NYSDEC surveyed lakes.

The distribution of PIRTRAM lakes is shown in Figure 2.3.1. Given the strong similarities among these PIRTRAM-guided plant surveys, the results from these plant surveys can be compiled into a single group and results compared within the group. However, while there were very strong similarities among the plant surveys, there were some differences that should be noted. Many of these differences will be discussed in more detail in the White Paper 1D (Species Richness), White Paper 1E (Individual Plants and Plant Lists), White Paper 1F (Coefficients of Conservatism), and White Paper 1G (Floristic quality).

Figure 2.3.1- PIRTRAM lakes



a. Emergent plants were inconsistently documented (and perhaps observed) within these surveys, with most taxa identified only to genera. This in part reflects the goals of many of these surveys- to evaluate aquatic plant communities in the areas where people recreate (or create navigational channels to support open water recreation), in part reflects the incomplete assessment of shoreline areas with point-intercept survey grids, and in part acknowledges that shoreline vegetation has previously been hand removed in many lakefront properties or otherwise would not be subject to management. Except for those emergent genera in which observed species were growing primarily in a submergent (or immature) state, emergent plants should not be considered in evaluating plant communities WITHIN this compiled group
b. As noted above, some submergent or floating leaf plants are identified only to genera. In some cases, this reflects the lack of multiple individual species within some taxa, but more often reflects both uncertainty in accurate species-level identification of some taxa (such as *Sparganium* and *Nitella*), and lack of readily available taxonomic keys (and associated survey expertise) in identifying some plants (such as water mosses and *Wolffia*). For these lakes, genera level identifications of these plants were considered to be equivalent to species-level identification of most submergent plants, and it is further assumed (perhaps incorrectly) that other species within this genera were not present. As discussed in White Paper 1D, this has implications for comparing species richness in NYS BioSurvey lakes (with detailed and more comprehensive species-level identifications for all habitats) to species richness in PIRTRAM lakes, ultimately resulting in a simplification of the NYS BioSurvey results, as discussed below.

c. Although point-intercept grids generally are widely (and equally) distributed across the littoral zone in all surveyed lakes, and nearly all surveys were whole lake surveys, the density and number of survey sites vary widely within this compiled survey group. Even distribution of these sites is assumed but cannot be guaranteed for some lakes.
d. Relative abundance data were not available for individual survey sites for some of the surveys. In some cases, compilation data (summarizing the number of survey sites with each abundance category for each observed taxa) were provided in the absence of the granular point-intercept data, and in other cases, frequency rather than relative abundance data were available.
e. While it is presumed that all collected plants were properly assigned to specific taxa, it is possible that, given the multiple survey teams involved in this compiled group, some different taxa may have been inadvertently assigned to an incorrect taxa. For example, in most surveys, all white water lilies (and yellow water lilies and bur reeds and spike rushes) were assigned to their own single taxa, but in reality there may have been multiple species observed in the field but mistakenly assumed to represent a single species within the same genera. In general, this consistently occurred with emergent and floating leaf plants and with macroalga. This may also have occurred with naiads, waterweed, narrow leafed pondweeds, and a few other common taxa, but almost certainly did not occur with the milfoils and most pondweeds.
f. As discussed at length in White Paper 1D, accurate plant identifications assume certainty that all characteristic plant traits- intact flowers, leaves, roots, turions, tubers, root systems, etc.- were retained in the plant retrieval, preservation and transport procedures between the collection and identification phases. This represents an on-going challenge in aquatic plant surveys, for reasons discussed in White Papers 1B and 1D, and affects PIRTRAM and all other surveys cited here. However, this may be more of a challenge when multiple survey teams are involved, as is the case with PIRTRAM surveys.

After accounting for these differences between these surveys, it appears that these five distinct survey groups can be evaluated as a single collective entity; this compiled group is referred to here as PIRTRAM survey lakes. These lakes were largely self-chosen; that is, the residents of these lakes contracted with these consultants, were subject to lake association-driven management, or were identified by state or regional DEC staff as high priorities for aquatic plant surveys. The latter may reflect local interest from property owners groups. These connections to lake associations or local resident groups would suggest that the size

distribution of these lakes may be closely aligned with the size distribution of those lakes with lake associations or significant local usage. There is not a comprehensive list of lake associations in the state, but the New York Citizens Statewide Lake Assessment Program (CSLAP) and the NYS Lake Classification and Inventory (LCI) survey are two water quality monitoring programs that represent lake associations and lakes with significant local access and usage, respectively.

Figure 2.3.2- Size Comparison of PIRTRAM, CSLAP/LCI and NYS Lakes

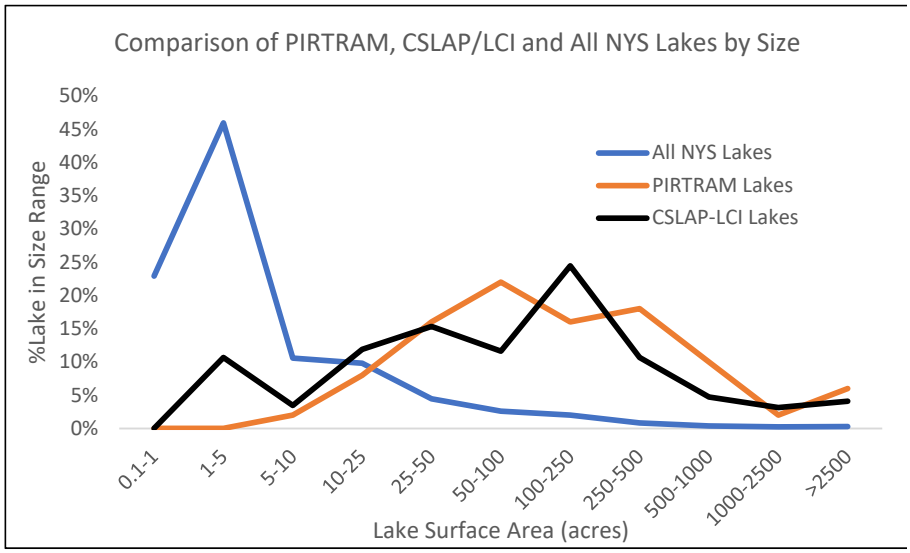


Figure 2.3.3- Spatial Distribution of PIRTRAM and NYS Lakes

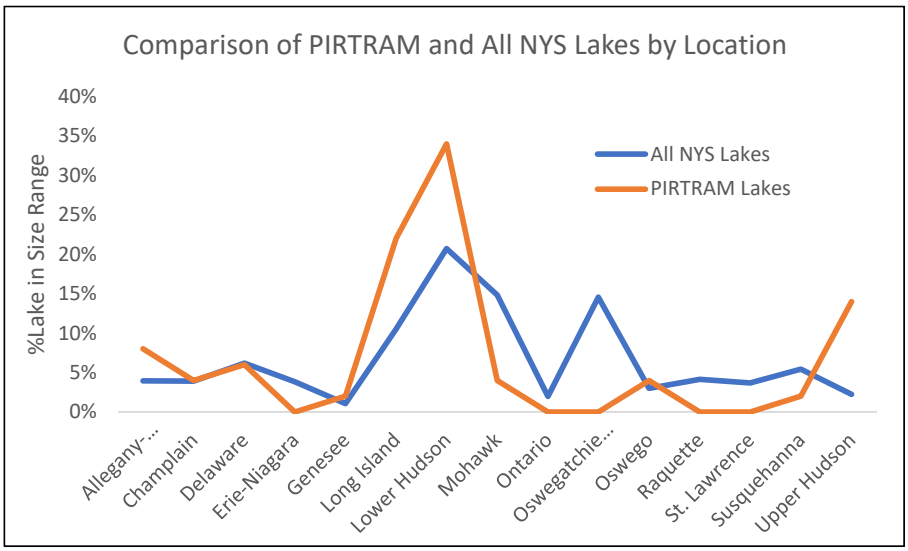


Figure 2.3.2 shows that the typical New York state lake is much smaller than the typical PIRTRAM lake- skewing far more toward the <5 acre size range. The percentage of PIRTRAM lakes in the 50-100 acre and 250-500 acre is larger than in the nearly 1000 lakes sampled through CSLAP or the LCI, and PIRTRAM lakes are slightly less common in the 1-5 acre and 100-250 acre range. However, in general, the size distribution of the 50 PIRTRAM lakes closely matches the size distribution of CSLAP and LCI lakes, suggesting that these PIRTRAM lakes may be

at least spatially representative of lakes with lake associations and significant local usage. This therefore suggests that the PIRTRAM lakes and their associated aquatic plant communities may be indicative of lakes most likely to be subject to aquatic plant management, since this management is usually conducted in actively used lakes by local property owner groups.

Figure 2.3.3 shows the spatial distribution of PIRTRAM lakes across New York state. While there are no PIRTRAM lakes in some of the 17 major drainage basins in New York state, with the exception of fewer-than-expected PIRTRAM lakes in the Oswegatchie-Black Rivers and Mohawk basins, and more-than-expected PIRTRAM lakes in Long Island and the Upper Hudson River basins, the statewide distribution of PIRTRAM lakes generally follows the statewide distribution of all New York state lakes. It is likely that the paucity of lakes in the Oswegatchie-Black and Mohawk basins occurs because these basins fall outside the normal "work range" of the major consultants conducting aquatic plant surveys, and likewise the over-emphasis in the Upper Hudson River and Long Island basins represent those areas where these consultants (or NYSDEC Region 1 staff) are most likely to seek clients or otherwise conduct this work.

Details about each of these lakes are provided in Appendix 2.3.1 and 2.3.2. The floristic condition evaluation in the other White Papers include the analyses of both individual lakes and the compilation of the five groups included in the PIRTRAM aquatic plant surveys.

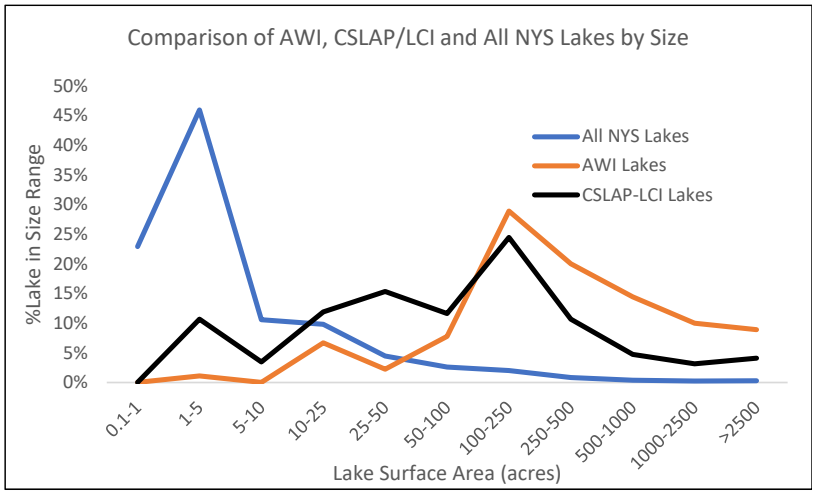
Section 2.4- Aquatic plant surveys conducted by the Adirondack Watershed Institute **from 2012 to 2016**

The Paul Smith's College Adirondack Watershed Institute (AWI) works closely with Protect the Adirondacks and lake associations within the Adirondack Park in support of several environmental monitoring programs. This included the lake water quality monitoring program referred to as the Adirondack Lake Assessment Program (ALAP) involving a combination of volunteer and academic water chemistry monitoring on more than 75 lakes since 1998. ALAP, like most water quality monitoring programs, does not include a significant aquatic plant survey component. However, AWI also partners with lake associations to conduct early detection aquatic plant surveys focusing on finding and documenting AIS infestations within the Park.

AWI aquatic plant surveys started in 2011 and 2012 as one-time surveys primarily in the eastern portion of the Lake Ontario basin (and associated subbasins within the Park) due to geographic requirements from the funding source. Surveys in later years generally excluded very large (>4500 acre) or very small (<5 acre) lakes, even if public access were available. However, lakes within this size range with public or private boat access were prioritized for surveys, particularly if a candidate lake had not been recently surveyed, and surveys were conducted throughout the Adirondack Park.

AWI surveys differ from the other surveys evaluated in this document through the use of both systematic (point-intercept) rake toss surveys and surface evaluations of weed beds in 2012 and 2013, and from surface evaluation of weed beds only in 2014 and 2016. Surveys focused on serpentine searches from deeper to shallower sites within the littoral zone, so while some traditionally-generated overlap grid points would be captured in these surveys, they cannot be considered to be truly comprehensive point-intercept surveys. This sampling strategy resulted in both (rake-toss) point- and areal-assessments of plant communities (frequency and abundance). 60 detailed reports, individual site rake toss and observed beds data were associated with these surveys conducted from 2012 to 2013, and another 57 surveys summarizing results from 2014 and 2016, can be found at

Figure 2.4.1- Size Comparison of AWI, CSLAP/LCI and NYS Lakes



https://www.adkwatershed.org/aquatic-plant-reports-lake.

The 2011 AWI aquatic plant survey results are not available from the AWI website (https://www.adkwatershed.org/aquatic-plant-reports-lake). While the 2015 AWI annual report is available from this website, the individual lake summaries do not include the individual site rake toss and plant bed data indicating the number of plant taxa identified in each lake, but instead includes only the most and least common taxa in each lake. While this allows for a summary of the most and least common taxa accumulated in the individual plant surveys (and therefore could be captured in White Paper 1E), it does not provide the information necessary to estimate the number of taxa on each lake (and therefore could not be captured in White Papers 1D or 1F).

Figure 2.4.2- Spatial Distribution of AWI and NYS Lakes

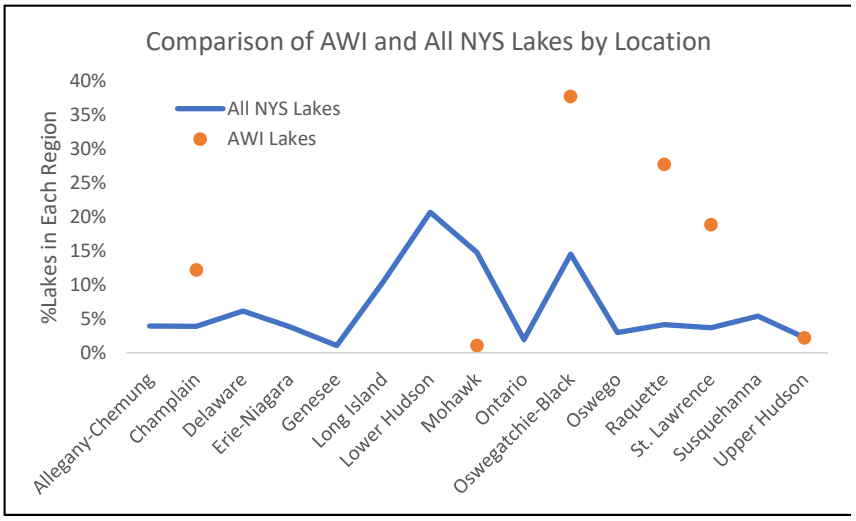
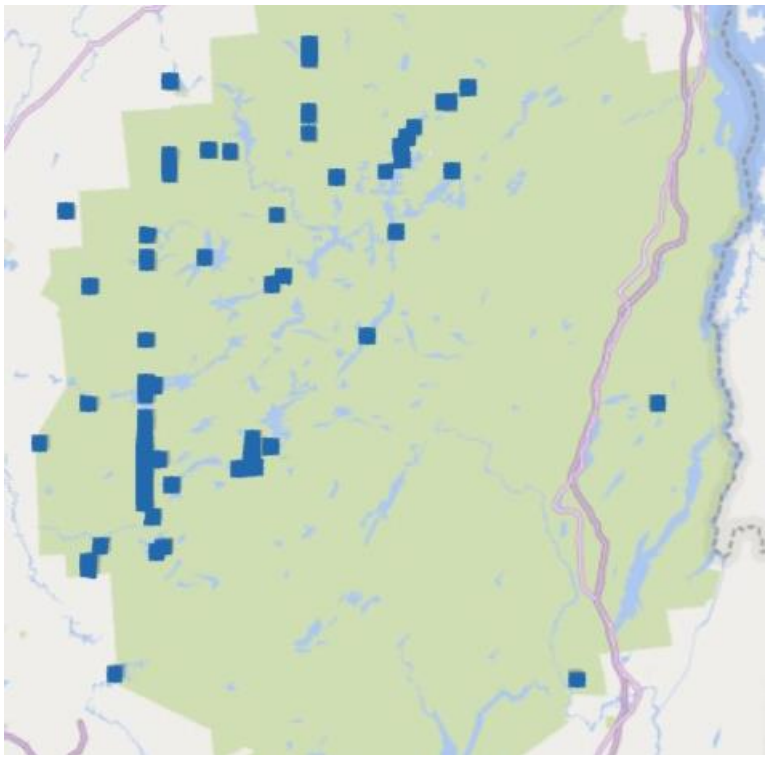


Figure 2.4.1 shows that the typical AWI plant survey lake was much larger than the typical New York state lake, with the largest percentage of survey lakes found in the 100-250 acre (and larger) range. However, the size distribution of the approximately 90 AWI plant survey lakes was similar to the size distribution of the nearly 1000 CSLAP and LCI lakes, roughly similar to the size distribution of the PIRTRAM lakes summarized in Figure 2.3.1. As with the PIRTRAM lakes, this suggests that the AWI plant survey lakes are typical of lakes with extensive public usage and local communities driving decisions about aquatic plant management. And as with the PIRTRAM lakes, this is not coincidental. As noted above, AWI explicitly targeted and conducted aquatic plant surveys on larger lakes with public (or heavily used private) access, with a focus on those with AIS or susceptible to invasion by AIS. Therefore, while the AWI plant survey dataset may not be representative of the typically much smaller lakes that comprise the largest cross section of New York state and especially Adirondack lakes, these data are more typical of occupied and managed lakes in the state and region.

Figure 2.4.3- AWI lakes with aquatic plant surveys



The AWI surveys included only those lakes within the Adirondack Park, given the (appropriate) parochial interests from Adirondack Watershed Institute and Protect the Adirondacks, the survey program sponsors (as seen in Figure 2.4.3). In addition, as noted above, some of the funding sources required surveys to be conducted in specific watersheds within the Park. Figure 2.4.2 shows the geographic distribution of AWI plant survey lakes relative to NYS lakes. Since the AWI surveys only included lakes found within the Adirondack Park, many of the (non-Adirondack) drainage basins shown in Figure 2.4.2 would not include any AWI survey lakes. However, even when the frame of reference for evaluating AWI lake geographic distribution is limited to those basins within the Park, Figure 2.4.2 shows that the western Adirondack Park drainage basins (the Oswegatchie-Black Rivers, Raquette River and St. Lawrence River basins) are over-represented in the AWI surveys. As noted above, this is likely a response to the funding source requirements, most likely due to Environmental Protection Fund monies available to the (eastern) Lake Ontario basin. Likewise, the eastern and southern portions of the Park- the Upper Hudson River, Mohawk River and Lake Champlain basins- are under-represented in the AWI surveys.

It should be noted that, in general, the western Adirondacks are more likely to possess smaller, more dystrophic, and slightly more acidic lakes, due to the underlying geology and relatively flatter terrain. These lakes may support a different aquatic plant community than found in the eastern Adirondacks, which tend to be clear water, larger and slightly more alkaline. The detailed evaluation of the aquatic plant communities within the AWI dataset, as explored in White Paper 1D-Species Richness, will explore this in greater detail. This dataset could also be compared to the ALSC dataset, with a more equitable geographic distribution of lakes within the Park, to see if the AWI lake geographic distribution impacts the ability to extrapolate results from these studies.

Section 3: Summary and Comparison of Aquatic Plant Monitoring Programs

Some aquatic plant monitoring has been conducted as part of many water quality monitoring programs. For example, the Citizens Statewide Lake Assessment Program (CSLAP) encourages samplers to collect and submit for identification aquatic plant specimen either suspected to be invasive species, or taxa not previously documented in the lake, with some instructions for collecting samples for those CSLAP volunteers interested in gaining a greater understanding of aquatic flora. Likewise, the Lake Classification and Inventory (LCI) survey, the other primary (contemporary) NYSDEC lake monitoring program, periodically employs rake tosses, generally via random line intercepts between the launch and sampling sites, to collect and identify plants for supplementing visual observations. As noted above, both programs focus primarily on finding and documenting the presence of invasive species. Other individual lake monitoring programs focus on water quality indicators related to designated uses to be evaluated through the monitoring (such as bacteria testing at swimming beaches or potable water monitoring), or do not include aquatic plant monitoring (such as the Adirondack Lake Assessment Program). Even those monitoring programs that explicitly target aquatic plants, such as the Adirondack Park Invasive Plant Program (APIPP) or Hydrilla Hunt monitoring sponsored by the NYS Federation of Lake Associations (NYSFOLA) and other organizations, have historically focused on unsystematic searches for specific taxa or AIS in general.

Table 3.1: Summary of Historical Aquatic Plant Survey Programs in New York State

Program	Years	# Lakes	Spatial Extent	Siting Method	Plant Collection	Evaluation Abundance	Plant ID	Habitats
BioSurvey	1926-38	305	Unkn	Unkn	Rake toss, visual	Relative abundance	Species	All
ALSC	1984-87	1559	Unkn	Unkn	Unkn	None	Genera	All
PIRTRAM	1997-2019+	50	Entire littoral	Point intercept	Rake toss, visual	Relative abundance or frequency	Species	Mostly floating & submergent
AWI	2012-16	91	Entire littoral	Serpentine search	Rake toss, visual	Relative abundance	Species	Mostly floating & submergent

+ PIRTRAM surveys mostly between 2006 and 2012

However, four monitoring programs have conducted systematic aquatic plant surveys on lakes using common methodologies within each program. These programs differ, in some cases significantly, from the other programs, at least when considering the primary elements of aquatic plant monitoring programs discussed in the Background section of this White Paper and in White Paper 1B. These differences are summarized in detail in Table 3.1.

A few observations about the similarities and differences among the programs.

1. These programs were chosen given significant overlaps in how aquatic plants have been sampled and characterized, and given the large number of lakes surveyed in each of these programs. The largest programs- the state Biological Surveys and the ALSC- include

very large numbers of lakes, with some overlap with the more contemporary programs, but these more historical (older) programs lack some details and common survey methodologies that would afford a direct comparison to these more recent programs. It is unlikely that the details from the historical programs can be resuscitated, particularly given that field logs, standard operating procedures, and/or quality assurance plans were either not developed or have been long lost to posterity.

2. It is presumed that the spatial extent of the NYS Biological Surveys and the ALSC program was roughly similar to those outlined in the PIRTRAM program, with survey sites (visual assessments and/or rake tosses) equally distributed throughout the littoral zone and roughly spaced in increments similar to those employed in contemporary surveys (built from survey sites assigned to overlay grids). Sample site densities are required to evaluate projected species richness and floristic quality (as outlined in White Papers 1D and 1F, respectively), and actual site documentation (individual plants found in each survey site) is required to evaluate site selection optimization (as outlined in White Paper 1C). The latter may also apply to the AWI dataset, since detailed information about individual plants at each survey site is incomplete. However, associated incomplete measures of species richness and uncorrected FQI can be evaluated in all of the program lakes except for the ALSC (for which only plant genera are defined). Long-term changes in plant lists and individual plants can be evaluated using data from all four programs.
3. There is uncertainty about the representation of all habitats in each of the aquatic plant survey programs, particularly for emergent plants that might not be fully captured in programs (like PIRTRAM) that use overlay grids within primarily open water habitats. This might influence evaluation of species richness and floristic quality. To minimize the disparities in the results generated through the programs cited in Table 3.1, only submergent plants and floating leaf plants (and plant species within traditionally "emergent" taxa generally limited to primarily submergent habitats) are used in species richness and floristic quality calculations. In addition, for plants characterized by a single species or genera in the PIRTRAM or AWI surveys (for example, all macroalga are cited in those surveys as *Chara* sp. or *Nitella* sp), NYS BioSurvey results are "corrected" to corral all species within these genera into a single citation, at least when comparing these results to those from more contemporary surveys.
4. The lack of plant species identification in the ALSC program represents a significant problem in comparing results from the ALSC to those from the Biological Survey, PIRTRAM surveys, and AWI surveys. This would strongly influence a comparison of species richness and modified floristic quality uses among these aquatic plant survey programs requires using only plant genera in all of the monitoring programs. The use of plant genera-only data is used only in evaluating plant lists or individual plants, except where noted, as summarized in White Papers 1D, 1E, and 1F.
5. Likewise, the lack of abundance or frequency data in the ALSC program precludes a complete evaluation of floristic quality. Specifically, abundance (or frequency)-weighted floristic quality measures cannot be calculated using the ALSC data. In addition, individual site plant frequency data are not collected consistently in the AWI surveys, or

at all in the NYS BioSurvey lakes, so corrected (modified) FQI evaluations are limited to the PIRTRAM dataset, as summarized in White Papers 1F (Coefficients of Conservatism) and 1G (Floristic Quality).

6. The AWI and ALSC programs are limited to the Adirondack Park and high elevation downstate regions, respectively. The AWI program includes lakes within a size distribution similar to other New York state lakes (such as those sampled in CSLAP and the LCI) that are typical of highly used, potentially managed lakes, broadly consistent with the criteria used to identify project lakes. These AWI lakes generally skew toward the western portion of the Adirondack Park. The ALSC lakes are smaller than most highly used and managed lakes, consistent with the size distribution of lakes more likely to be affected by cultural acidification, but are more closely aligned to the size distribution of all NYS lakes, and spatial distribution of lakes throughout the Park.
7. The NYS Biological Survey and PIRTRAM lakes are also larger than the typical NYS lake, although there is a healthy distribution of smaller lakes in the NYS Biological Survey. It is likely that both datasets are somewhat representative of the most heavily used and managed lakes in the state, broadly consistent with the CSLAP and LCI datasets. The geographic distribution of these lakes appears to be representative of the typical New York state lake.
8. Finally, although each of these programs were conducted in New York state using similar methods for collecting and (most likely) identifying plants, these surveys were conducted over a nearly 100 year period with some differences in the methods outlined in Table 3.1. However, there are enough similarities between, and very large similarities within programs, that at least a cursory comparison of results between and especially within programs can be achieved.

An evaluation of the aquatic plant communities in New York state lakes, as documented in the NYS Biological Survey, ALSC, PIRTRAM and AWI programs, is conducted in the following White Papers:

White Paper 1D- Species Richness: NYS BioSurvey, PIRTRAM and AWI lakes

White Paper 1E- Individual Plants and Plant Lists: all programs

White Paper 1F- Coefficients of Conservatism (C values): NYS BioSurvey, PIRTRAM, and AWI lakes for uncorrected traditional (NY) and modified C values, and PIRTRAM lakes only for corrected modified C values

White Paper 1G- Floristic Quality Indices (FQIs): NYS BioSurvey, PIRTRAM, and AWI lakes for uncorrected traditional (NY) and modified FQI values, and PIRTRAM lakes only for corrected modified FQI values

References:

Adirondack Watershed Institute. 2016. Adirondack aquatic invasive species response team 2016 report. Paul Smiths College, Saranac Lake, New York. https://www.adkwatershed.org/all-publications/category/Aquatic+Plant+Survey

Adirondack Watershed Institute. 2014. Aquatic invasive species early detection team 2014 report. Paul Smiths College, Saranac Lake, New York. https://www.adkwatershed.org/all-publications/category/Aquatic+Plant+Survey

Adirondack Watershed Institute. 2013. Aquatic plant surveys 2013. Paul Smiths College, Saranac Lake, New York. https://www.adkwatershed.org/all-publications/category/Aquatic+Plant+Survey

Adirondack Watershed Institute. 2012. Aquatic plant surveys 2012. Paul Smiths College, Saranac Lake, New York. https://www.adkwatershed.org/all-publications/category/Aquatic+Plant+Survey

Allied Biological, Inc. 2020. Unpublished data

Darrin Freshwater Institute. 2020. Unpublished data

Kishbaugh, S.A. 2020. Unpublished data.

New York State Conservation Department. 1924-1936. A biological survey of the XXX watershed: a supplement to the 19YY annual report. Albany, New York. https://catalog.hathitrust.org/Record/102444321

Racine Johnson Aquatic Ecologists. 2020. Unpublished data.

Appendix 2.3.1: NYS Lakes w/ PIRTRAM Surveys- Background Information

Lake	County	Lake Area (ha)	Littoral Area (ha)	Years	# Years	Surveyor	#Sites
Adirondack Lake	Hamilton	78	39%	2001-2017	17	DEC DOW	29
Artist Lake	Suffolk	12	12	2006	1	DEC DOW	11
Ballston Lake	Saratoga	107	48	2006	1	Lake assn	35
Beaver Dam Lake	Orange	131	42	2012	1	ABI	102
Beaver Lake	Broome?	11	11	2012	1	ABI	52
Big Fresh Pond	Suffolk	34	13	2006	1	DEC DOW	19
Blydenburgh Pond	Suffolk	40	40	2012, 2014	2	DEC R1	27
Cayuga Lake	Tompkins	392	392	2012-2019	8	RJAE	1341
Cazenovia Lake	Madison	471	225^	2008-2019	12	RJAE	304
Central Park Lake	New York	7	7	2007	1	NYC Parks	15
Chautauqua Lake	Chautauqua	5327	2060	2003-2019	14	RJAE	349
Collins Lake	Schenectady	23	5	2006-2007	2	DEC DOW	24
Cranberry Lake	Westchester	41	41	2006, 2009	2	ABI	97
Creamery Pond	Orange	4	4	2008-2013	6	DEC DOW	20
Donahue Pond	Suffolk	17	17	2006-2012	6	ABI	70
Eagle Lake	Essex	172	71#	2008	1	ABI	84
Echo Lake	Sullivan	20	20	2008	1	ABI	65
Galway Lake	Saratoga	212	130	2009	1	DFWI	138
Glen Lake	Warren	131	78	2007, 2009, 2010, 2012	4	ABI	175
Great Patchogue Lake	Suffolk	16	16	2006	1	DEC DOW	10
Guymard Lake	Orange	34	34	2007	1	ABI	70
Hards Pond	Suffolk	12	12	2010-2011	2	DEC R1	18
Java Lake	Wyoming	21	21	2008-2010	3	Lake assn	16
Katonah Lake	Westchester	23	23	2008-2010	3	ABI	18
Kinderhook Lake	Columbia	138	109	2006-2007	2	Lake assn	20
Lake George	multi	11543	2711	2000		DFWI	
Lake Luzerne	Warren	40	24#	2009-2010	3	ABI	95
Lake Oscaleta	Westchester	25	8	2008, 2016, 2018	3	ABI	88
Lake Rippowam	Westchester	12	4&	2008, 2016, 2018	3	ABI	60
Lake Ronkonkoma	Suffolk	92	21^	2009-2012, 2014	5	DEC R1	23
Lake Waccabuc	Westchester	54	19+	2008, 2010-2018	10	ABI	120
Lamoka Lake	Schuyler	294	166*	2000-2019	12	RJAE	166
Little We Wah Lake	Orange	5	5	2012	1	ABI	25
Long Pond	Suffolk	11	11	2006	1	DEC DOW	12
Loon Lake	Warren	221	110	2012		DFWI	?
Lower Yaphank Lake	Suffolk	10	10	2006	1	DEC DOW	11
Mohegan Lake	Westchester	104	104	2008	1	ABI	105
Monroe Mills Pond	Orange?	35	35	2006, 2008-2010	4	ABI	65
Morehouse Lake	Hamilton	43	35	2010	1	DEC DOW	29
Quaker Lake	Allegheny	112	64	2010	1	DEC DOW	30
Robinson Pond	Columbia	47	47	2008-2010	2	ABI	125
Saratoga Lake	Saratoga	1526	657	2007-2012	3	DFWI	241

White Paper 1A-
Summary of Major NYS Aquatic Plant Surveys since the mid-1920s

Lake	County	Lake Area (ha)	Littoral Area (ha)	Years	# Years	Surveyor	#Sites
Snyders Lake	Rensselaer	45	15	1997-2011	15	DEC DOW	47
Southards Pond	Nassau	8	8	2006	1	DEC DOW	10
Stissing Pond	Ulster	29	29	2007	1	ABI	88
Tuxedo Lake	Orange	118	27	2008, 2012	2	ABI	104
Vly Creek Reservoir	Albany	67	35	2012	1	ABI	136
Waneta Lake	Schuyler	317	170[&]	2000-2019	15	RJAE	119
We Wah Lake	Orange	23	23	2012	1	ABI	82
White Lake	Sullivan	113	46	2009	1	ABI	220

Appendix 2.3.2: NYS Lakes w/ PIRTRAM Surveys- Ancillary Information

Lake	Sites / Littoral	Trophic	Ramp Access?	AIS Present?	AIS Most Abundant?	Littoral / Lake Area
Adirondack Lake	0.8	Mesotrophic	yes	no	no	0.5
Artist Lake	0.9	Eutrophic	no	yes	yes	1.0
Ballston Lake	0.7	Eutrophic	no	yes	yes	0.4
Beaver Dam Lake	2.5	Eutrophic	no	yes	yes	0.3
Beaver Lake	4.8	Eutrophic	no	yes	no	1.0
Big Fresh Pond	1.5	Mesotrophic	no	no	no	0.4
Blydenburgh Pond	0.7	Eutrophic	no	yes	yes	1.0
Cayuga Lake	3.4	Mesotrophic	yes	yes	yes	1.0
Cazenovia Lake	1.4	Mesotrophic	yes	yes	no	0.5
Central Park Lake	2.2	Eutrophic	no	yes	yes	1.0
Chautauqua Lake	0.2	Eutrophic	yes	yes	yes	0.4
Collins Lake	5.0	Eutrophic	no	yes	yes	0.2
Cranberry Lake	2.4	Mesotrophic?	no	yes	yes	1.0
Creamery Pond	5.6	Eutrophic	no	yes	yes	0.9
Donahue Pond	3.9	Eutrophic	no	yes	yes	1.0
Eagle Lake	1.2	Oligotrophic	yes	yes	yes	0.4
Echo Lake	3.3	Mesotrophic?	no	no	no	1.0
Galway Lake	1.1	Mesotrophic	no	yes	yes	0.6
Glen Lake	2.3	Oligotrophic	no	yes	no	0.6
Great Patchogue Lake	0.6	Eutrophic	no	yes	yes	1.0
Guymard Lake	2.1	Mesotrophic	no	yes	yes	1.0
Hards Pond	1.5	Eutrophic	no	yes	no	1.0
Java Lake	0.7	Eutrophic	no	yes	no	1.0
Katonah Lake	0.8	Eutrophic	no	yes	yes	1.0
Kinderhook Lake	0.2	Eutrophic	no	yes	yes	0.8
Lake George		Oligotrophic	yes	yes	yes	0.2
Lake Luzerne	4.3	Oligotrophic	yes	yes	no	0.6
Lake Oscaleta	9.4	Mesotrophic	no	yes	yes	0.3
Lake Rippowam	12.9	Mesotrophic	no	yes	yes	0.4
Lake Ronkonkoma	1.1	Eutrophic	yes	yes	yes	0.2
Lake Waccabuc	6.4	Eutrophic	no	yes	yes	0.3
Lamoka Lake	1.1	Eutrophic	yes	yes	yes	0.6
Little We Wah Lake	5.0	Eutrophic	no	yes	yes	1.0
Long Pond	1.0	Eutrophic	no	yes	yes	1.0
Loon Lake		Oligotrophic	no	yes	no	0.5
Lower Yaphank Lake	1.1	Eutrophic	yes	yes	yes	1.0
Mohegan Lake	1.0	Eutrophic	no	yes	yes	1.0
Monroe Mills Pond	1.8	Eutrophic?	no	yes	yes/no	1.0
Morehouse Lake	0.9	Oligotrophic	no	no	no	0.8
Quaker Lake	0.5	Mesotrophic	no	yes	yes	0.6
Robinson Pond	2.7	Eutrophic	no	yes	yes	1.0
Saratoga Lake	0.4	Eutrophic	yes	yes	no	0.4

Appendix 1.2: NYS Lakes w/ PIRTRAM Surveys- Ancillary Information (cont)

Lake	Sites / Littoral	Trophic	Ramp Access?	AIS Present?	AIS Most Abundant?	Littoral / Lake Area
Snyders Lake	3.1	Mesotrophic	no	yes	yes	0.3
Southards Pond	1.3	Eutrophic	no	yes	yes	1.0
Stissing Pond	3.0	Mesotrophic	no	yes	yes	1.0
Tuxedo Lake	3.9	Mesotrophic	no	yes	no	0.2
Vly Creek Reservoir	3.9	Mesotrophic	no	yes	yes	0.5
Waneta Lake	0.7	Eutrophic	yes	yes	yes	0.5
We Wah Lake	3.7	Eutrophic	no	yes	no	1.0
White Lake	4.8	Mesotrophic	yes	yes	yes	0.4