The Three Lakes Council

2023 Aquatic Macrophyte Surveys at Three Lakes, Lewisburg, NY

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2023 Aquatic Macrophyte Surveys at Three Lakes: Lake Waccabuc

The Three Lakes Council

Introduction

In 2023, the Three Lakes Council contracted SŌLitude Lake Management (SŌLitude) to map the aquatic plant growth and communities within Lake Waccabuc in Lewisboro, NY. The target species that biologists most notably look for is invasive Brazilian waterweed (*Egeria densa*) also referred to as Brazilian Elodea. The discovery of invasive Brazilian Elodea in Lake Waccabuc was first documented in 2008. In response to this initial discovery, an intensive Diver-Assisted Suction Harvesting (DASH) program was implemented to remove the nuisance macrophyte. **Regrowth of Brazilian elodea has not been documented in the Three Lakes system since 2010.** Aquatic macrophyte surveys have been performed on an almost yearly basis at Lake Waccabuc since 2008 and is now surveyed on a bi-annual basis. The other two basins, Lakes Oscaleta and Rippowan, are surveyed on a bi-annual basis as well but alternate with the Lake Waccabuc survey. Monitoring the potential infestations of nonnative plant growth is the goal for all three lakes. Brazilian elodea has not been documented in these waterbodies. During 2023, only Lake Waccabuc was surveyed. This report includes the following components: aquatic macrophyte abundance, distribution and discussion from 2023 survey results. Maps from the aquatic macrophyte survey and aquatic macrophyte library are included in the appendix of this report.

Summary of Findings

- Invasive Eurasian water milfoil (*Myriophyllum spicatum*) continues to be the most dominant macrophyte within Lake Waccabuc.
- **No invasive Brazilian elodea (*Egeria densa*), curly leaf pondweed (*Potamogeton crispus*), water chestnut (*Trapa natans*), or brittle naiad (*Najas minor*) were found**.
    - Brazilian elodea has not been documented since 2010, and water chestnut has not been documented since 2014.
    - Curly leaf pondweed was documented in 2019 but has not been observed since.
    - Brittle naiad was last documented in 2021 but not in 2023.
- Overall, there were seven submersed macrophytes that were present during the 2023 survey.
- In total, eight floating macrophyte species were observed through the 2023 survey.
- **Two non-native macrophytes were documented during the 2023 survey: Eurasian water milfoil and purple loosestrife (*Lythrum salicaria*).**

- White water lily (*Nymphaea adorata*) continues to be the dominant floating-leaf macrophyte within Lake Waccabuc.
- Macrophyte diversity increase slightly from 2021, after remaining consistent since 2010. This lake continues to maintain high diversity compared to other lakes in the region.

Methodology

Point Intercept Submersed Aquatic Plant Mapping

The Point Intercept Method (PIM) for sampling macrophytes is designed to determine the extent of submersed aquatic plant growth within an area of concern. This method was developed by the US Army Corps of Engineers and modified by Cornell University (Kishbaugh, Lord and Johnson, 2006). The total number of sample points is typically based on the total acreage of a waterbody with one point surveyed per acre. In Lake Waccabuc, plant growth is found mostly in the littoral zone which is the area along the shorelines and various coves where sunlight can reach to the sediment. The point-intercept locations within the lake are restricted to this area. Points were determined by a 40-m grid data layer placed over an orthophoto bathymetric map of the lake and logged during the 2010 survey using a GPS unit with sub-foot accuracy.

The PIM vegetation survey at Lake Waccabuc was performed on August 10th, 2023. The 120 sites sampled are the same points determined in 2010 and revisited annually since then. During every survey, each predetermined georeferenced point was accessed by boat. At Lake Waccabuc, **three rake tosses** were executed at each site, as with the previous surveys, for enhanced detection of target species and other macrophytes. The tosses were conducted from opposite sides of the boat and were labeled and recorded A, B, and C respectively (Table 1). The real-time GPS coordinates of the sample location were recorded using a Trimble Geo 7X, a handheld GNSS system.

Biologists collected the following data from each rake toss: overall abundance of floating and submersed macrophyte growth, relative abundance of each species, and any other pertinent field notes regarding the sample location. The abundance scale defined by this methodology was used to categorize the observed macrophyte growth for each rake toss (Table 1). Visual depictions of this scale are shown in Figures 1 and 2. Any macrophyte specimen requiring further identification was collected and placed in a resealable bag and labeled with the sample location. Regionally appropriate taxonomic keys were used for the identification of all species.

Table 1: PIM Descriptions

Abundance	Description
Z: Zero	No plants on rake.
T: Trace	Fingerful on rake.
S: Sparse	Handful on rake.
M: Medium	Rake-ful of plants.
D: Dense	Difficult to bring into boat.

The overall and relative abundance values from the three rake tosses were translated into a numeric value before further data analysis: 0 for no plants, 1 for trace, 2 for sparse, 3 for medium, and 4 for dense plants. For example: if toss A was Dense (4), toss B was Sparse (2), and toss C was Medium (3) for the same macrophyte, the average abundance would be Medium (3). Raw abundance data with mean calculations can be found in the appendix of this report.

Figure 1: Submersed Aquatic Plant Densities

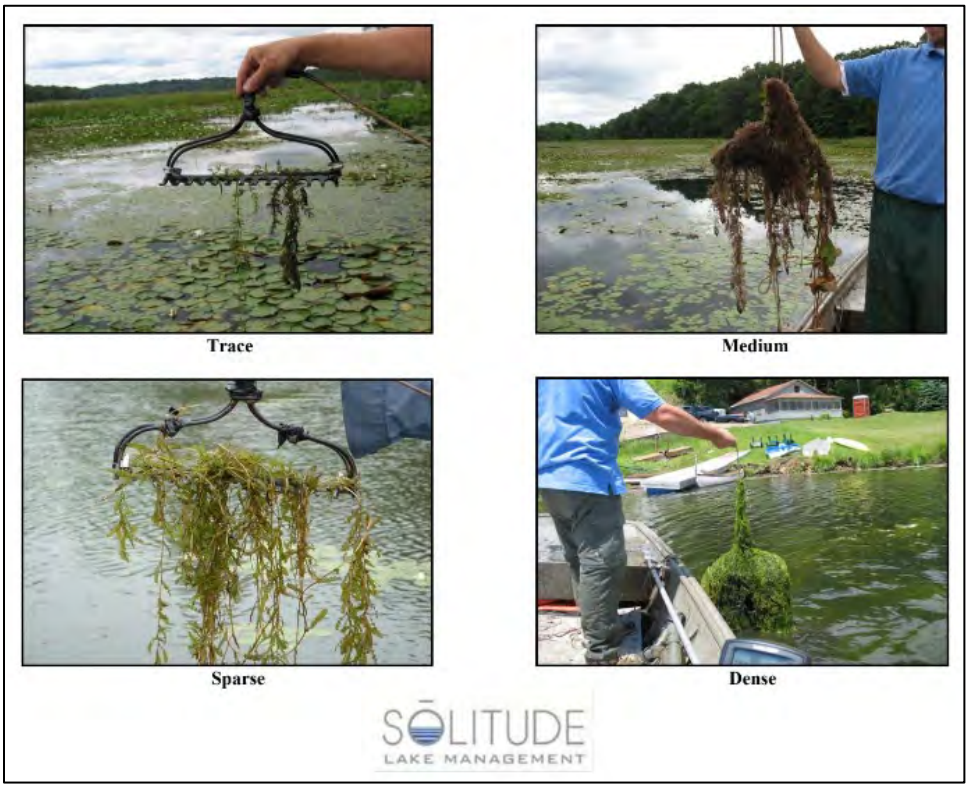
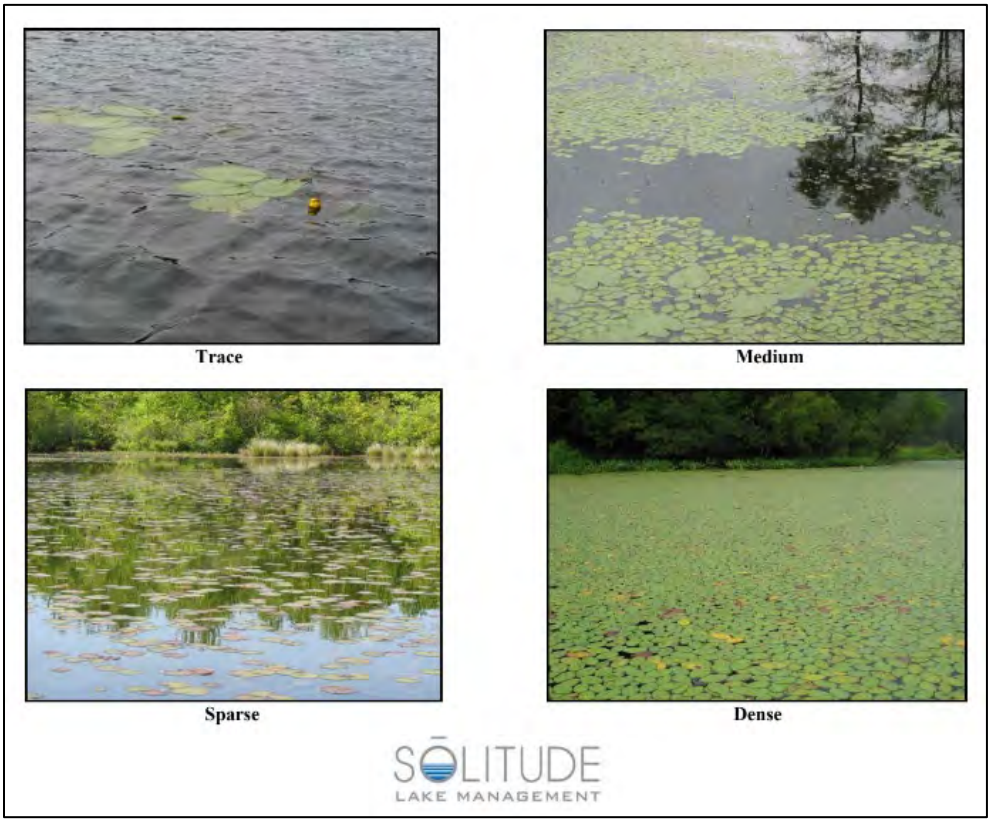


Figure 2: Floating Aquatic Plant Densities



Lake Waccabuc

Macrophyte Abundance and Distribution Results

Table 2 provides the presence data of all observed plant species from 2017 to 2023 as well as the percent abundance change from 2021 to 2023. Table 3 displays the historical presence data of each aquatic plant species observed from 2008 to 2016. Graphs displaying the abundance and distribution from year to year for each macrophyte are in the Appendix.

Table 2: Lake Waccabuc Macrophyte Results (2017-2023) and Percent Abundance Change (2021-2023)

Common Name	Scientific Name	Type	2017	2018	2019	2021	2023	% Change
Arrowhead	*Sagittaria sp.*	**E**	X	X	X	X	X	-63.6%
Bassweed	*Potamogeton amplifolius*	**S**	X	X	X	X	X	-64.0%
Benthic Filamentous Algae	-	**S**	X	X	X	X	X	-28.8%
Brazilian Elodea	*Egeria densa*	**S**						0.0%
Brittle Naiad	*Najas minor*	**S**	X	X	X	X		-100.0%
Common Waterweed	*Elodea canadensis*	**S**	X	X	X		X	+100.0+
Coontail	*Ceratophyllum demersum*	**S**	X	X	X	X	X	-39.0%
Creeping Bladderwort	*Utricularia gibba*	**FF**	X	X	X			0.0%
Curly-leaf Pondweed	*Potamogeton crispus*	**S**	X		X			0.0%
Dwarf Watermilfoil	*Myriophyllum tenellum*	**S**	X	X	X	X		-100.0%
Eurasian Watermilfoil	*Myriophyllum spicatum*	**S**	X	X	X	X	X	+4.5%
Flat-stem Pondweed	*Potamogeton zosteriformis*	**S**						0.0%
Floating Bur-reed	*Sparganium fluctuans**	**E/F**	X	X	X	X		-100.0%
Floating Filamentous Algae	-	**FF**	X	X	X		X	+100.0%
Great Duckweed	*Spirodela polyrhiza*	**FF**		X	X	X	X	-90.0%
Leafy Pondweed	*Potamogeton foliosus*	**S**	X	X	X	X		-100.0%
Quillwort	*Isoetes sp.*	**S**	X					0.0%
Ribbon-leaf Pondweed	*Potamogeton epihydrus*	**S**	X	X	X			0.0%
Robbin's Pondweed	*Potamogeton robbinsii*	**S**	X			X	X	+366.7%
Slender Naiad	*Najas flexilis*	**S**	X					0.0%
Small Bladderwort	*Utricularia minor*	**S**					X	+100.0%
Small Duckweed	*Lemna minor*	**FF**	X	X	X			0.0%
Spatterdock	*Nuphar variegata*	**F**	X	X	X	X	X	-38.7%
Spiral-fruited Pondweed	*Potamogeton spirillus*	**S**			X			0.0%
Pickerelweed	*Pontederia cordata*	**E**					X	+100.0%
Pondweed Species	*Potamogeton sp.**	**S**	X	X				0.0%
Purple Loosestrife	*Lythrum salicaria*	**E**					X	+100.0%
Water Chestnut	*Trapa natans*	**F**						0.0%
Watermeal	*Wolffia columbiana*	**FF**		X	X			0.0%
Water Stargrass	*Zosterella dubia*	**S**	X	X	X			0.0%
Watermoss	*Fontinalis sp.**	**S**						0.0%
Watershield	*Brasenia schreberi*	**F**	X	X	X	X	X	-2.7%
White Water Lily	*Nymphaea odorata*	**F**	X	X	X	X	X	+3.8%

In Tables 2 and 3, the Type column is a quick classification of the macrophyte: "E" classifies an emergent, "F" is a rooted floating species, "FF" is free-floating, and "S" is a rooted submerged species. Red entries indicate invasive species and Green entries indicate algae species.

Table 3: Lake Waccabuc Macrophyte Results (2008-2016)

Common Name	Scientific Name	Type	2008	2010	2011	2012	2013	2014	2015	2016
Arrowhead	*Sagittaria sp.*	**E**	X	X	X	X	X	X	X	X
Bassweed	*Potamogeton amplifolius*	**S**	X	X	X	X	X	X	X	X
Benthic Filamentous Algae	-	**S**	X	X	X	X	X	X	X	X
Brazilian Elodea	*Egeria densa*	**S**	X	X						
Brittle Naiad	*Najas minor*	**S**		X	X		X	X	X	X
Common Waterweed	*Elodea canadensis*	**S**	X	X	X	X	X	X	X	X
Coontail	*Ceratophyllum demersum*	**S**	X	X	X	X	X	X	X	X
Creeping Bladderwort	*Utricularia gibba*	**FF**	X	X	X	X	X	X	X	X
Curly-leaf Pondweed	*Potamogeton crispus*	**S**	X		X		X	X	X	X
Dwarf Watermilfoil	*Myriophyllum tenellum*	**S**	X	X	X	X	X	X	X	X
Eurasian Watermilfoil	*Myriophyllum spicatum*	**S**	X	X	X	X	X	X	X	X
Flat-stem Pondweed	*Potamogeton zosteriformis*	**S**	X							
Floating Bur-reed	*Sparganium fluctuans**	**E/F**							X	
Floating Filamentous Algae	-	**FF**	X	X	X	X	X	X	X	X
Great Duckweed	*Spirodela polyrhiza*	**FF**				X	X	X	X	X
Leafy Pondweed	*Potamogeton foliosus*	**S**	X	X	X	X	X	X	X	X
Quillwort	*Isoetes sp.*	**S**								
Ribbon-leaf Pondweed	*Potamogeton epihydrus*	**S**		X	X	X	X	X	X	X
Robbin's Pondweed	*Potamogeton robbinsii*	**S**	X	X	X	X	X	X	X	X
Slender Naiad	*Najas flexilis*	**S**			X					
Small Duckweed	*Lemna minor*	**FF**		X		X	X	X	X	X
Spatterdock	*Nuphar variegata*	**F**	X	X	X	X	X	X	X	X
Spiral-fruited Pondweed	*Potamogeton spirillus*	**S**	X	X	X	X	X			
Pondweed Species	*Potamogeton sp.**	**S**						X	X	X
Water Chestnut	*Trapa natans*	**F**						X		
Watermeal	*Wolffia columbiana*	**FF**				X			X	X
Water Stargrass	*Zosterella dubia*	**S**		X	X	X	X	X	X	X
Watermoss	*Fontinalis sp.**	**S**				X	X			
Watershield	*Brasenia schreberi*	**F**	X	X	X	X	X	X	X	X
White Water Lily	*Nymphaea odorata*	**F**	X	X	X	X	X	X	X	X

Macrophyte Abundance and Distribution Discussion

Two invasive macrophytes were present during the 2023 survey: purple loosestrife and Eurasian watermilfoil. Throughout the survey history of Lake Waccabuc, a total of six different invasive aquatic plants have been identified within the basin. **Brazilian elodea has not been documented since 2010 and water chestnut was only documented in 2014.** Since then, no water chestnut has been observed again in Lake Waccabuc.

In 2023, only 117 sites of the 120 were accessible as points one (1) through three (3) were too shallow and overgrown with plants. Submersed vegetation was recorded at 94 sites which is 80% of the littoral zone within the basin. Overall, seven different submersed aquatic plants (including benthic filamentous algae) were observed. Dense amounts of submersed plants were documented at 26 (or 28%) of the sites surveyed, while medium abundances were observed at 14 (or 15%) sites. Sparse amounts of submersed aquatic vegetation were present at 23 (or 24%) sites, while trace abundances accounted for 31 sites (or 33%).

During the 2023 vegetation survey at Lake Waccabuc, eight floating macrophyte species were observed. A total of 65 (or 56%) sampling sites supported floating macrophyte growth. Dense amounts of floating aquatic plants were recorded at 19 (or 29%) sites, while medium abundance was observed at 12 (or 18%) sites. Sparse amounts of floating plants were observed at nine (or 14%) sampling sites, while trace amounts accounted for 25 (or 38%) of sites within the littoral zone. The Appendix contains additional information on each individual plant species.

The dominant submersed macrophyte in 2023 was the highly invasive plant, Eurasian water milfoil. This species was observed at 92 (or 79%) sampling sites within the littoral zone which is a 4.5% increase when compared to 2021. Trace abundances were present at 34 (or 37%) of the sites surveyed. Sparse populations were recorded at 26 (or 28%) of the sites surveyed. Medium amounts were observed at 14 (15%) sites, while 18 (or 20%) were considered dense. Heavier abundances were located primarily in the eastern cove, near the outlet. Overall, Eurasian water milfoil varied in abundance throughout the basin.

The dominant floating macrophyte was white water lilies at 54 (or 46%) of the sites surveyed. When compared to the survey data from 2021, this lily species increased in abundance by 3.8%. Out of the 54 sites that supported white water lily populations, 14 sites were considered nuisance in abundance. Dense amounts were observed at eight (or 15%) sites and medium abundances were present at six (or 11%) sites. At non-nuisance levels, sparse abundances of white water lily were recorded at nine (or 17%) sites and trace abundances were observed at 31 (or 57%) sites. White water lily patches were scattered throughout the littoral zone of Lake Waccabuc. However, the densest populations were observed in the eastern cove.

Although not a true macrophyte, benthic filamentous algae were the third most observed aquatic species within Lake Waccabuc in 2023. Benthic filamentous algae were recorded at 42 (or 36%) sampling sites, which is a 28.8% decrease from 2021. At nuisance levels, the algae were documented in dense patches at nine (or 21%) sites and medium abundance at five (or 12%) sites. At non-nuisance levels, benthic filamentous algae were recorded in sparse abundance at eight (or 19%) sites and trace abundance at 20 (or 48%) sites. The densest populations of the filamentous algae were observed within the eastern cove and northern cove with a few trace patches scattered around the western shorelines.

Watershield, often mixed in with other lily species, was observed at 36 (or 31%) sites at various abundances which is a 2.7% decrease when compared to 2021. Only one (or 3%) sampling site supported dense amounts of growth while four (or 11%) sites supported medium levels of growth. Watershield was observed in sparse amounts at six (or 17%) sites and trace amounts at 25 (or 69%) sites. The majority of the watershield patches were observed within the eastern and southeastern coves. However, one dense patch of the macrophyte was observed along the northwestern shoreline.

Floating filamentous algae returned to Lake Waccabuc after it was last documented in 2019. The filamentous algae were observed at 30 (or 26%) sampling sites within the basin. Floating filamentous algae were documented in dense abundance at three (or 10%) sites while medium abundance was documented at four (or 13%) sites. Sparse amounts of the floating patches were recorded at seven (or 23%) sites while trace amounts were recorded at 16 (or 53%) sites. Most of the observed floating filamentous algae was documented along the western shorelines as well as the eastern and northern coves.

Coontail remains present within Lake Waccabuc as it was documented at 25 (or 21%) sampling sites, which is a 39.0% decrease from 2021. No dense patches of coontail were observed during the 2023 vegetation survey. However, medium patches were recorded at two (or 8%) sampling sites. Sparse abundance was only observed at one (or 4%) site while trace abundances were observed at 22 (or 88%) sites. The majority of the coontail populations were concentrated in the eastern and southeastern coves. Only a few trace patches were observed along the southern shoreline, northeastern cove, and island shoreline.

Spatterdock was observed at 19 (or 16%) sampling sites this year, which is a 38.7% decrease from 2021. Nuisance levels were observed in dense abundances at seven (or 37%) sites and medium abundances at two (or 11%) sites. Sparse amounts were recorded at three (or 16%) sites and trace abundances occurred at seven (or 37%) sites. Spatterdock was present throughout the eastern end of the lake mixed in with other lily species, as well as in the southern and northern coves.

Robbin’s pondweed continues to thrive in Lake Waccabuc as it was documented at 14 (or 12%) sampling sites, which is a 366.7% increase from 2021. This native macrophyte was only observed in non-nuisance levels of abundance. Robbin’s pondweed was recorded in sparse amounts at

only one (or 7%) sampling site and trace amounts at 13 (or 93%) sampling sites. This pondweed species was mostly observed within the northeastern and southeastern coves with the sparse patch located along the southwestern shoreline.

A native macrophyte that was documented for the first time in Lake Waccabuc in 2023 was pickerelweed. This emergent plant was recorded at 12 (or 10%) sampling sites along the shorelines of the basin. Out of the 12 documented sites, only one (or 8%) was observed at medium abundance. The other 11 (or 92%) sites were observed at trace levels of abundance. Most of the pickerelweed patches were recorded in the eastern cove with a few trace patches scattered along the western shorelines.

Bassweed populations decreased significantly in 2023 as the macrophyte was only observed at nine (or 8%) sampling sites. This is a 64.0% decrease when compared to the survey results from 2021. All nine sites were observed at trace abundance within Lake Waccabuc. Most of the macrophyte was observed within the eastern cove with a few patches observed along the northeastern and southeastern shorelines.

Other species that were observed at 3% abundance or less in 2023 include: common waterweed, small bladderwort, arrowhead, great duckweed, and invasive purple loosestrife. The purple loosestrife was observed in the eastern cove at the opening of the Lake Waccabuc outlet. Aquatic species that were observed in 2021 but not in 2023 include: invasive brittle naiad, dwarf watermilfoil, floating bur-reed, and leafy pondweed.

Recommendations

In 2024, we highly recommend a repetition of the SAV mapping within Lake Waccabuc. However, based on an ongoing rotational SAV mapping schedule for the Three Lakes Council, both Lake Rippowam and Lake Oscaleta will be surveyed in 2024. Monitoring continues to be important for examining and quantifying the abundance and distribution of both non-native and native macrophytes throughout the three basins. Based on 2023 SAV mapping, one to two days of vegetation monitoring is recommended at Lake Waccabuc for the 2025 season. Additionally, Lake Oscaleta and Lake Rippowam will require two to three days of vegetation monitoring during the 2024 season.

The point-intercept methodology continues to work well in monitoring and quantifying the growth of aquatic macrophytes in Lake Waccabuc. If Brazilian elodea or water chestnut should re-infest Lake Waccabuc, the point-intercept survey is ideal to direct short- or long-term management efforts in a cost-effective manner.

It is possible that other infestations could appear or may not be within the boundaries of the survey and non-native growth can be overlooked, especially when an infestation is small or intermittent. The Three Lakes Council should consider the implementation of an additional diver survey in the North Cove specifically for Brazilian elodea. The Eurasian water milfoil population of Lake Waccabuc continues to be stable and local management via hand-pulling can reduce impacts to recreational activity in the short-term. However, chemical treatment of target areas is recommended for more effective and long-term control.

As always, SŌLitude Lake Management would like to use this space to thank you for allowing us to be of service to the Three Lakes Council. We look forward to working with you in the 2024 season.

Sincerely,

Vicky Thiel

Vicky Thiel
Aquatic Biologist

SŌLITUDE
LAKE MANAGEMENT

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Appendix

Macrophyte Photo Library and Description

Lake Waccabuc Year Abundance Graphs

Lake Waccabuc Raw Data and GPS Coordinates

Lake Waccabuc Abundance Table

Species Specific Maps

AQUATIC MACROPHYTE PICTURE LIBRARY WITH SUMMARIES

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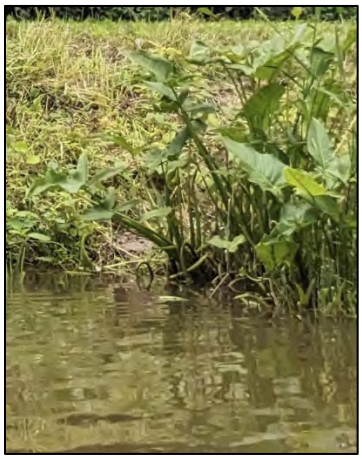
Arrowhead (*Sagittara* sp.)



Arrowhead Native: Arrowhead has emergent leaves, and usually inhabits shallow waters at pond or lake edges, or along sluggish streams. It can tolerate a wide variety of sediment types and pH ranges. Arrowhead is very suitable for constructed wetland development due to its tolerance of habitats, and ability to act as a nutrient sink for phosphorous. Typical arrowhead reproduction is via rhizomes and tubers although seed production is possible if conditions are ideal. Arrowhead has high wildlife value, providing high-energy food sources for waterfowl, muskrats, and beavers. Arrowhead beds provide suitable shelter and forage opportunities for juvenile fish as well.

Bassweed (*Potamogeton amplifolius*)

Large-leaf pondweed, Musky weed

Bassweed Native: Bassweed has robust stems that originate from black-scaled rhizomes. The submersed leaves of bass weed are among the broadest in the region. The submersed leaves are arched and slightly folded, attached to stems via stalks, and possess many (25-37 veins). Floating leaves are produced on long stalks (8-30 cm). Stipules are large, free, and taper to a sharp point. Flowers, and later in the season fruit are densely packed onto a spike. Bass weed prefers soft sediments in water one to 4 meters deep. This plant is sensitive to increased turbidity and has difficulty recovering from top-cutting from such devices as boat propellers and aquatic plant harvesters. As its name implies, the broad leaves of this submersed plant provide abundant shade, shelter, and foraging opportunities for fish. The high number of nutlets produced per plant makes it an excellent waterfowl food source.

Brazilian Elodea (*Egeria densa*)

Egeria, Anacharis, Brazilian waterweed

Brazilian Elodea Invasive: Brazilian elodea is an aggressive exotic invasive submersed plant that originated from South America. It was introduced via the aquarium hobby trade and is a top selling plant used as an oxygenator. The stems can be several meters long, and the strap-like leaves are situated in whorls of three to six, but usually four. The leaves are finely serrated and are tightly packed together near the end of the stem. Brazilian elodea can be rooted or free floating, and due to its highly branching nature, can quickly reach nuisance densities and crowd out or block light penetration for desirable native submersed plants. Although it can be confused with *Hydrilla*, another invasive submersed plant, its lack of tuber production and leaf structure differentiates it. Although it can produce white flowers, it reproduces vegetatively in the United States. Waterfowl consume Brazilian elodea, and fish and invertebrates use the stems for refuge and habitat.

Brittle Naiad (*Najas minor*)

Brittle water nymph, European naiad

Brittle Naiad Invasive: Brittle naiad is a submersed annual that flowers in August to October. It resembles other naiads, except its leaves are highly toothed with 6-15 spinules on each side of the leaf, visible without the aid of magnification. The leaves are opposite, simple, thread-like, and usually lime-green in color, often with a “brittle” feel to them. Brittle naiad fruits are narrow, slightly curved, and marked with 10-18 longitudinal ribs, resembling a ladder. Brittle Naiad was introduced from Europe in the early 1900’s and can be found in most of the northeastern states. Brittle naiad prefers sandy and gravel substrates but can tolerate a wide range of bottom types. It is tolerant of turbid and eutrophic conditions. Waterfowl graze on the fruit.

Common Watermeal (*Wolffia columbiana*)

Common Watermeal Native: Common watermeal appears as pale green globes of vegetative matter without roots, stems, or true leaves. It is one of the world's smallest flowering plants, but flowers are rarely found and require magnification to see. Watermeal usually reproduces by budding. Watermeal is typically found on the surface of a basin and is often intermingled with other duckweed species. This free-floating macrophyte drifts with the water's current or wind. Therefore, it grows independent of water depth, clarity, or sediment type. In the fall it produces winter buds that sink to the bottom. In the spring, the buds become buoyant and float to the surface. Waterfowl, fish, and muskrats all include watermeal in their diets.

Common Waterweed (*Elodea canadensis*)

Elodea

Common Waterweed Native: Common waterweed has slender stems that can reach a meter in length, and a shallow root system. The stem is adorned with lance-like leaves that are attached directly to the stalk that tend to congregate near the stem tip. The leaves are populated by a variety of aquatic invertebrates. Male and female flowers occur on separate plants, but it can also reproduce via stem fragmentation. Since common waterweed is disease resistant, and tolerant to low-light conditions, it can reach nuisance levels, creating dense mats that can obstruct fish movement, and the operation of boat motors.

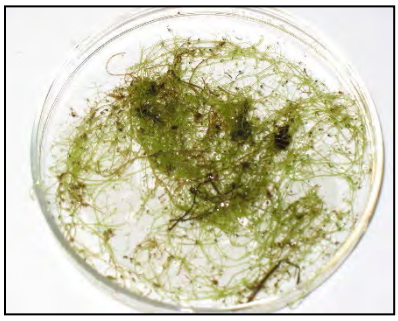
Coontail (*Ceratophyllum demersum*)

Hornwort

Coontail Native: Coontail has long trailing stems that lack true roots, although it can become loosely anchored to sediment by modified leaves. The leaves are stiff and arranged in whorls of 5-12 at each node. Each leaf is forked once or twice and has teeth along the margins. The whorls of leaves are spaced closer at the end of the stem, creating a raccoon tail appearance. Coontail is tolerant of low light conditions, and since it is not rooted, it can drift into different depth zones. Coontail can also tolerate cool water and can over winter as a green plant under the ice. Typically, it reproduces via fragmentation. Bushy stems of coontail provide valuable habitat for invertebrates and fish (especially during winter), and the leaves are grazed on by waterfowl.

Creeping Bladderwort (*Utricularia gibba*)

Humped bladderwort, cone-spur bladderwort



Creeping Bladderwort Native**:** Creeping bladderwort is a small (usually less than 10 cm long), delicate, free-floating stem. It often forms tangled mats in quiet shallow waters, often associated with bogs, or stranded on soil. It is sometimes mistaken for algae. It has short side branches that fork once or twice, a defining characteristic. Small bladders, used to capture live prey, are situated on these side branches. Small yellow snap-dragon-like flowers are produced on a short stalk. Mats of creeping bladderwort offer limited cover and foraging opportunities for fish.

Curly-Leaf Pondweed (*Potamogeton crispus*)

Curly-Leaf Pondweed Invasive: Curly-leaf pondweed has spaghetti-like stems that often reach the surface by mid-June. Its submersed leaves are oblong and attached directly to the stem in an alternate pattern. The margins of the leaves are wavy and finely serrated, hence its name. No floating leaves are produced. Curly-leaf pondweed can tolerate turbid water conditions better than most other macrophytes. In late summer, curly-leaf pondweed enters its summer dormancy stage. It naturally dies off (often creating a sudden loss of habitat and releasing nutrients into the water to fuel algae growth) and produces vegetative buds called turions. These turions germinate when the water gets cooler in the autumn and give way to a winter growth form that allows it to thrive under ice and snow cover, providing habitat for fish and invertebrates.

Dwarf Water Milfoil (*Myriophyllum tenellum*)

Dwarf Water Milfoil Native: Dwarf milfoil, which does not look anything like other milfoil species, has slender unbranched stems ranging from 2 cm to 15 cm in height. The leaves are reduced to scales or “bumps”. If the tips rise out of the water, they can produce pale flowers and nut-like fruits. The toothpick-like stems arise from rhizomes in a chain. Dwarf milfoil is often small and overlooked, preferring sandy bottoms in waters up to four meters deep. Dwarf water milfoil provides suitable spawning habitat for panfish and adequate shelter for small invertebrates. The rhizome networks also help stabilize bottom sediments.

Eurasian Water Milfoil (*Myriophyllum spicatum*)

Asian Water Milfoil

Eurasian Watermilfoil Invasive: Eurasian water milfoil has long (2 meters or more) spaghetti-like stems that grow from submerged rhizomes. The stems often branch repeatedly at the water's surface creating a canopy that can crowd out other vegetation and obstruct recreation and navigation. The leaves are arranged in whorls of 4 to 5 and spread out along the stem. The leaves are divided like a feather, resembling the bones on a fish spine. Eurasian watermilfoil is an exotic originating in Europe and Asia, but its range now includes most of the United States. This macrophyte can grow in cool water and low light conditions gives it an early season advantage over other native submersed plants. In addition to reproducing via fruit production, it can also reproduce via fragmentation. Waterfowl graze on Eurasian watermilfoil, and its vegetation provides habitat for invertebrates. However, studies have determined mixed beds of pondweeds and wild celery can support more diverse invertebrate populations.

Filamentous Algae

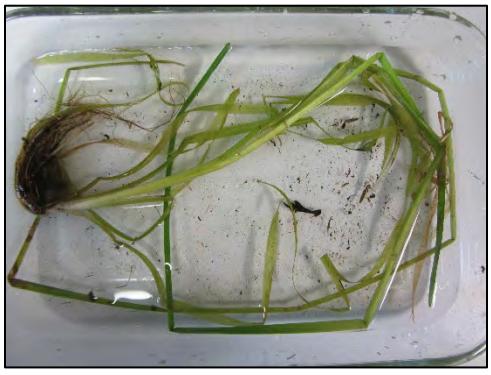
Floating Filamentous Algae, Benthic Filamentous Algae

Filamentous Algae: Filamentous algae is a chain or series of similar algae cells arranged in an end to end manner. Benthic filamentous algae is attached to a hard substrate, such as logs, rocks, a lake bottom, or even other aquatic plants. When growing in heavy densities, benthic filamentous algae can appear as brown or green mats of vegetation that can reach the surface. When large pieces break off the bottom substrate, they become floating filamentous algae patches. Benthic filamentous algae can comprise an entire range of morphologies, but flagellated taxa are far less common.

Flat-stem Pondweed (*Potamogeton zosteriformis*)

Flat-stem Pondweed Native: Flat-stem pondweed is freely branched, emerging from a delicate rhizome system. The stems are strongly flattened with an angled appearance. The long leaves are stiff and linear with a prominent midvein, and numerous fine parallel veins. This prominent midvein distinguishes this pondweed from water stargrass. The stipules are firm and free situated in the leaf axils. Flat-stem pondweed lacks floating leaves. Flat-stem pondweed inhabits a variety of water depths from shallow water to water several meters deep. It prefers soft sediment types. Although it produces nut-like fruits, it over winters primarily by rhizomes and winter buds. It can be a locally important food source to fauna, such as waterfowl, muskrat, deer, beaver, and moose. It also provides suitable habitat and food for fish and aquatic invertebrates.

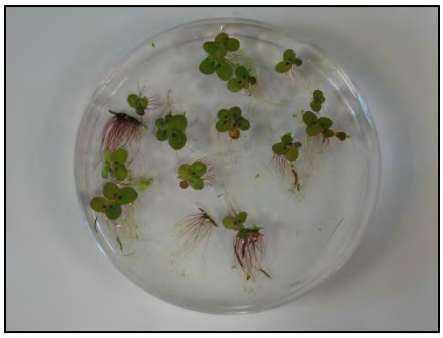
Floating Bur-reed (*Sparganium sp.*)



Floating Bur-reed Native: Floating bur-reed is an aquatic perennial that grows along rhizomes in static or slow-moving water. The leaves are limp, strap-shaped, float on the water's surface, often growing in the direction of any flow. At maturity (July-September), the floating bur-reed produces an emergent flowering spike that supports a few white flowers with an appearance of small, fluffy cotton balls. From the flowers, floating bur-reed produces spiky fruits (seed heads) that are primarily dispersed by water. The fruits are water-repellent and can remain floating for several months. Various species of bur-reed display the floating leaves.

Great Duckweed (*Spirodela polyrhiza)*

Large Duckweed



Great Duckweed Native: Great duckweed is the largest of the duckweeds, but it is still very small compared to other aquatic macrophytes. It has simple flattened fronds with irregular oval shapes, often up to 1 cm in length and 2.5 to 8.0 mm long. The frond surface is usually green with a conspicuous purple dot. The underside of the frond is magenta with a cluster of 5-12 roots that dangle into the water. Although great duckweed produces flowers, it usually reproduces via budding, and like other duckweeds, it is capable of rapid growth. It often occurs with other duckweeds, and since it is free floating, it can be moved via the wind or water currents. It derives its nutrients from the water column and often occurs in eutrophic systems. It's an excellent food source for waterfowl, muskrats, and fish. The dense mats also offer shade and cover for fish.

Leafy Pondweed (*Potamogeton foliosus*)

Leafy Pondweed Native: Leafy pondweed has freely branched stems that hold slender submersed leaves that become slightly narrower as they approach the stem. The leaf contains 3-5 veins and often tapers to a point. No floating leaves are produced. It produces early season fruits in tight clusters on short stalks in the leaf axils. These early season fruits are often the first grazed upon by waterfowl during the season. Muskrat, beaver, deer and even moose also graze on the fruit. It inhabits a wide range of habitats, but usually prefers shallow water. It has a high tolerance for eutrophic conditions, allowing it to even colonize secondary water treatment ponds.

Pickerelweed (*Pontederia cordata*)

Pickerelweed Native: Pickerelweed is a native emergent plant that inhabits lake margins and sluggish stream from ankle deep to several meters deep. It has glossy heart-shaped leaves that originate from a sprawling rhizome. The leaf blade is adorned with numerous parallel veins. The flower spike is crammed with small blue flowers, a distinguishing characteristic. Pickerelweed is very common in the Northeast. Reproduction is by rhizome spread and late season seed dispersal. The flowering stalk plays host to a myriad of insect species, while the seeds are often consumed by waterfowl. The rhizomes and stems offer shade and habitat for fish. Another ecological benefit of pickerelweed is shoreline stabilization and established beds help to dampen wave action.

Purple Loosestrife (*Lythrum salicaria*)

Purple Loosestrife Invasive: Purple Loosestrife is an invasive emergent plant that originates in Europe and temperate regions of Asia. It was first introduced to the eastern United States in the early 1800's and now ranges from the East to Midwest U.S. with some western locations. Purple Loosestrife has angled stems that emerge from a woody rootstalk. The leaves are lance-shaped, have fine hairs on their surface, and are attached directly to the stem. The leaves can be arranged in opposite pairs, whorls of three, or spiraled around the stem. At the end of the stem, clusters of magenta flowers are produced in leaf axils in a terminal spike. Each flower has 5-7 narrow petals that are wrinkled with a tissue paper consistency. Purple Loosestrife has very little value to local wildlife. The roots are woody, and the seeds are low in nutrition. However, the flowers produce nectar that attracts honeybees and other insects.

Quillwort (*Isoetes sp.*)

Quillwort Native: Quillwort is a low growing, submersed aquatic plant with many leaves forming from a basal structure called a corm. The size of the hollow leaves depends on the species. This macrophyte is known as a lycopod and does not have 'true' rhizomes or seeds. Instead, quillwort has pseudo-rhizomes and megaspores. The megaspores act like seeds and are found in the expanded bases of each leaf; the megaspores are the primary method for species identification of quillwort genus.

Ribbon-Leaf Pondweed (*Potamogeton epihydrus*)

Ribbon-leaf Pondweed Native: Ribbon-leaf pondweed has flattened stems and two types of leaves. The submersed leaves are alternate on the stem, lack a leaf stalk, and are long tape-like in shape. Each leaf, which can reach lengths up to 2 meters long, has a prominent stripe of pale green hollow cells flanking the midvein, and 5 to 13 other veins. Stipules are not fused to the leaf. Floating leaves are egg or ellipse-shaped and supported by a leaf stalk about as long as the leaf itself. Fruiting stalks are located at the top of the stem and packed with flattened disk-shaped fruits. It is typically found growing in low alkalinity environments, and in a variety of substrates. Seeds are highly sought after by all manner of waterfowl.

Robbins Pondweed (*Potamogeton robbinsii*)

Fern Pondweed

Robbins Pondweed Native: Robbins pondweed has robust stems that emerge from spreading rhizomes. The leaves are strongly ranked creating a fern-like appearance most clearly seen while still submerged. Its distinct closely spaced fern-like leaves give it a unique appearance among the pondweeds of the Mid-Atlantic region. Each leaf is firm and linear, with a base that wraps around the stem. At the stem it has ear-like lobes fused with a fibrous stipule. No floating leaves are produced. Robbins pondweed thrives in deeper water, and under some circumstances, it can over winter green. Robbins pondweed creates suitable invertebrate habitat and cover for lie-in-wait predaceous fish, such as pickerel and pike.

Slender Naiad (*Najas flexilis*)

Bushy Pondweed

Slender Naiad Native: Slender naiad has fine-branched stems that can taper to lengths of one meter, originating from delicate rootstalks. Plant shape varies; sometimes compact and bushy, other times long and slender, depending on growing conditions. The leaves are short (1-4 cm long) and finely serrated, tapering to a point. It is found in a variety of habitats and can colonize sandy or gravelly substrates. If conditions are ideal, it can reach nuisance densities. It is a true annual, and dies off in the fall, relying on seed dispersal to return the next year. It is an important food source for waterfowl.

Small Bladderwort (*Utricularia minor*)

Small Bladderwort Native: Small bladderwort is a free-floating aquatic perennial herb. The stems are both floating and creeping usually no more than 75 cm long. The stem is densely lined with leaves bearing the bladders. The bladders are used to capture prey, such as protozoa, zooplankton, and even small insect larvae. The leaves are linear, flat, and bristle-tipped, generally three parted at the base and forked 1 to 3 times. Small yellow snap dragon-like flowers are produced. Since it is free floating, and it derives nutrients from captured prey, it can inhabit low nutrient waters. It is not limited to substrate type, water clarity, or water depth, due to its lack of roots, but it is at the mercy of wind or water currents.

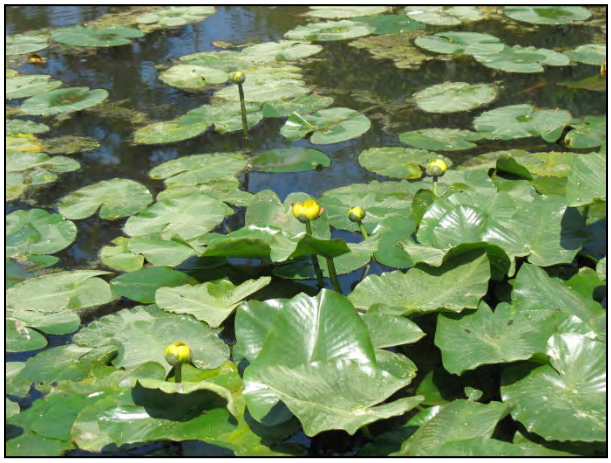
Small Duckweed (*Lemna minor*)

Water Lentil, Lesser Duckweed

Small Duckweed Native: Small duckweed is a free-floating plant, with round to oval-shaped leaf bodies typically referred to as fronds. The fronds are small (typically less than 0.5 cm in diameter), and it can occur in large densities that can create a dense mat on the water's surface. Each frond contains three faint nerves, a single root (a characteristic used to distinguish it from other duckweeds), and no stem. Although it can produce flowers, it usually reproduces via budding at a tremendous rate. Its population can double in three to five days. Since it is free floating, it drifts with the wind or water current, and is often found intermixed with other duckweeds. Since it's not attached to the sediment, it derives nutrients directly from the water, and is often associated with eutrophic conditions. It over winters by producing turions late in the season. Small duckweed is extremely nutritious and can provide up to 90% of the dietary needs for waterfowl. It is also consumed by muskrat, beaver, and fish. The dense mats of free-floating macrophytes can inhibit mosquito breeding.

Spatterdock (*Nuphar variegata*)

Yellow Pond Lily, Bullhead Pond Lily



Spatterdock Native: Spatterdock leaf stalks emerge directly from a submerged fleshy rhizome. Spatterdock has heart-shaped leaves with a prominent notch. Depending on the habitat, these leaves can be held aloft via erect stems. A distinguishing characteristic of spatterdock is the leaf stalk, which bears a winged margin. Flowering occurs in the summer and the flowers open during the day and close at night. Spatterdock typically inhabits quiet water less than two meters deep with a soft substrate, such as ponds, shallow lakes, and slow-moving streams. The leaves offer shade and protection for fish, and the leaves, stems, and flowers are grazed upon by muskrats, beavers, and occasionally deer.

Spiral-Fruited Pondweed (*Potamogeton spirillus*)

Spiral-fruited Pondweed Native: Spiral-fruited pondweed has slender stems that originate from a delicate, spreading rhizome. The stems tend to be compact and have numerous branches. Submersed leaves are linear with a curved appearance. Floating leaves are delicate, ellipse-shaped and range from 7 to 35 mm long and two to 13 mm wide. Stipules are fused to the leaf blade for more than half of their length. Nut-like fruits are produced on stalks of varies lengths. Shorter stalks tend to be on lower axils with fruit arranged in a compact head, while longer stalks tend to appear on upper axils, with fruit arranged in a cylindrical head. The fruit itself is a flattened disc with a sharply toothed margin. Its smooth sides appear like a tightly coiled embryo, a distinguishing characteristic. Spiral-fruited pondweed prefers shallow water with sandy substrate but can inhabit a wide range of bottom substrates. It serves as an important stabilizer and cover for fish fry and invertebrates.

Water Chestnut (*Trapa natans*)

Water nut

Water Chestnut Invasive: Water chestnut is native to both Europe and Asia. The macrophyte was first observed in the United States in the late 1800's in Massachusetts. Water chestnut has two types of leaves, submerged and floating rosettes. The submersed leaves are delicate, opposite and contain numerous adventitious roots. Floating leaves are strongly toothed triangular leaves displayed in a rosette fashion, supported by long petioles with spongy inflated bladders for buoyancy. These petioles can reach lengths of up to 16 feet. Water chestnut prefers to inhabit nutrient-rich slow-moving waters in lakes, ponds, or streams. Although water chestnut can reproduce via fragmented rosettes, the plant produces numerous single-seeded horned nuts armed with sharp half-inch barbs. After maturation, these nuts fall off the plant and over winter, producing 10-15 new rosettes the following season. These nuts can inflict painful wounds to swimmers if stepped on. Studies have shown a water chestnut can lie dormant on a lake bottom for up to 12 years, and still germinate. Water chestnut is a poor source of food for waterfowl. High densities of water chestnut can inhibit boating and fishing.

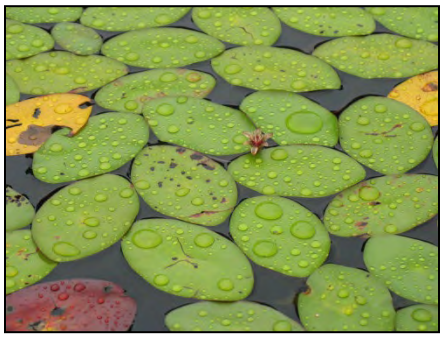
Water Stargrass (*Zosterella dubia*)

Water Stargrass Native: Water stargrass has slender free-branched stems that originate from rhizomes. The leaves are narrow and alternate, attaching directly to the stem. Leaves can be up to 15 cm long, and lack a prominent midvein, a distinguishing characteristic. Water stargrass can inhabit a wide range of water depths and sediment types and can tolerate reduced clarity environments. Yellow star-shaped flowers are produced by midsummer, but reproduction is usually via over wintering rhizomes. Water stargrass is a locally important waterfowl food source and provides suitable cover and foraging for fish.

Watermoss (*Fontinalis* sp.)

Watermoss Native: Watermosses are submerged mosses that are attached to rocks, trees, logs, and other hard substrates by false rootlets located at the base of their stems. The stems are dark green to brown, and about one foot long. The leaves share a similar color to the stems and are usually ovate with fine-toothed margins. Watermoss is utilized by aquatic invertebrates as well as a breeding site for small fish. Water moss rarely reaches nuisance levels.

Watershield (*Brasenia schreberi*)

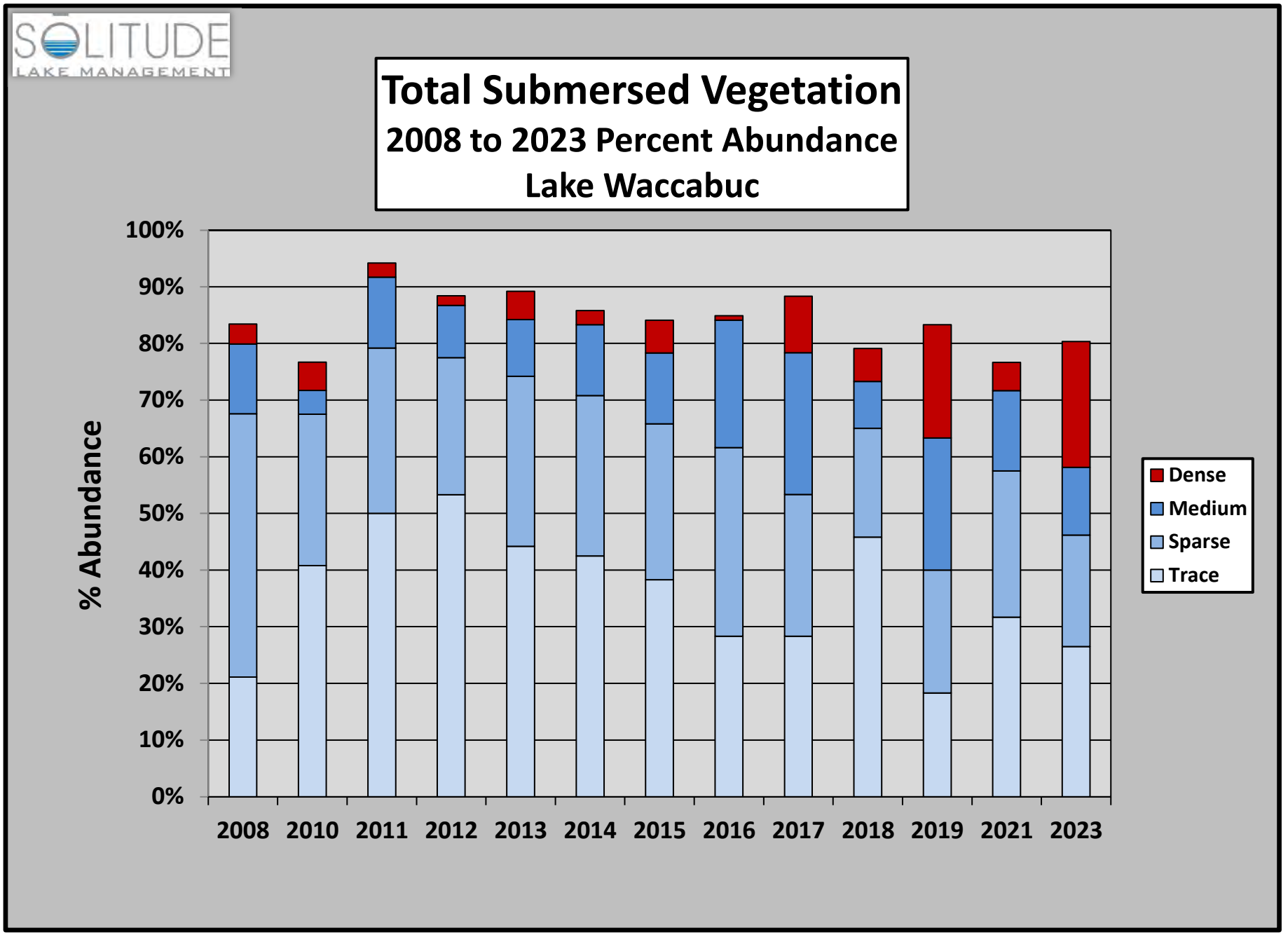


Watershield Native: Watershield is a floating-leaf aquatic plant similar to water lilies. Its stem and leaves are elastic and are attached to a rooted rhizome that acts as an anchor and source of stored nutrients. The leaf stalks are attached to the middle of the leaf, creating a bull's eye effect, hence its name water target. The leaves are green on the upper surface, and purple underneath. Maroon to purple flowers peak above the water's surface on short, stout stalks. Watershield is usually coated with a clear gelatinous slime on the stem and underside of the leaves. Watershield prefers soft-water lakes and ponds in sediments containing decomposing organic matter. The whole plant is consumed by waterfowl, and the floating leaves provide shade and cover for fish.

White Water Lily (*Nymphaea* odorata)

Fragrant Water Lily

White Water Lily Native: White water lily leaf stalks emerge directly from a submerged fleshy rhizome. White water lilies have round floating leaves. Flowering occurs during the summer, and the flowers open during the day, and close during the night. Water lilies typically inhabit quiet water less than two meters deep, such as ponds, shallow lakes, and slow-moving streams. The leaves offer shade and protection for fish, and the leaves, stems, and flowers are grazed upon by muskrats, beavers, and occasionally deer.


SOLITUDE
LAKE MANAGEMENT
Total Submersed Vegetation
2008 to 2023 Percent Abundance
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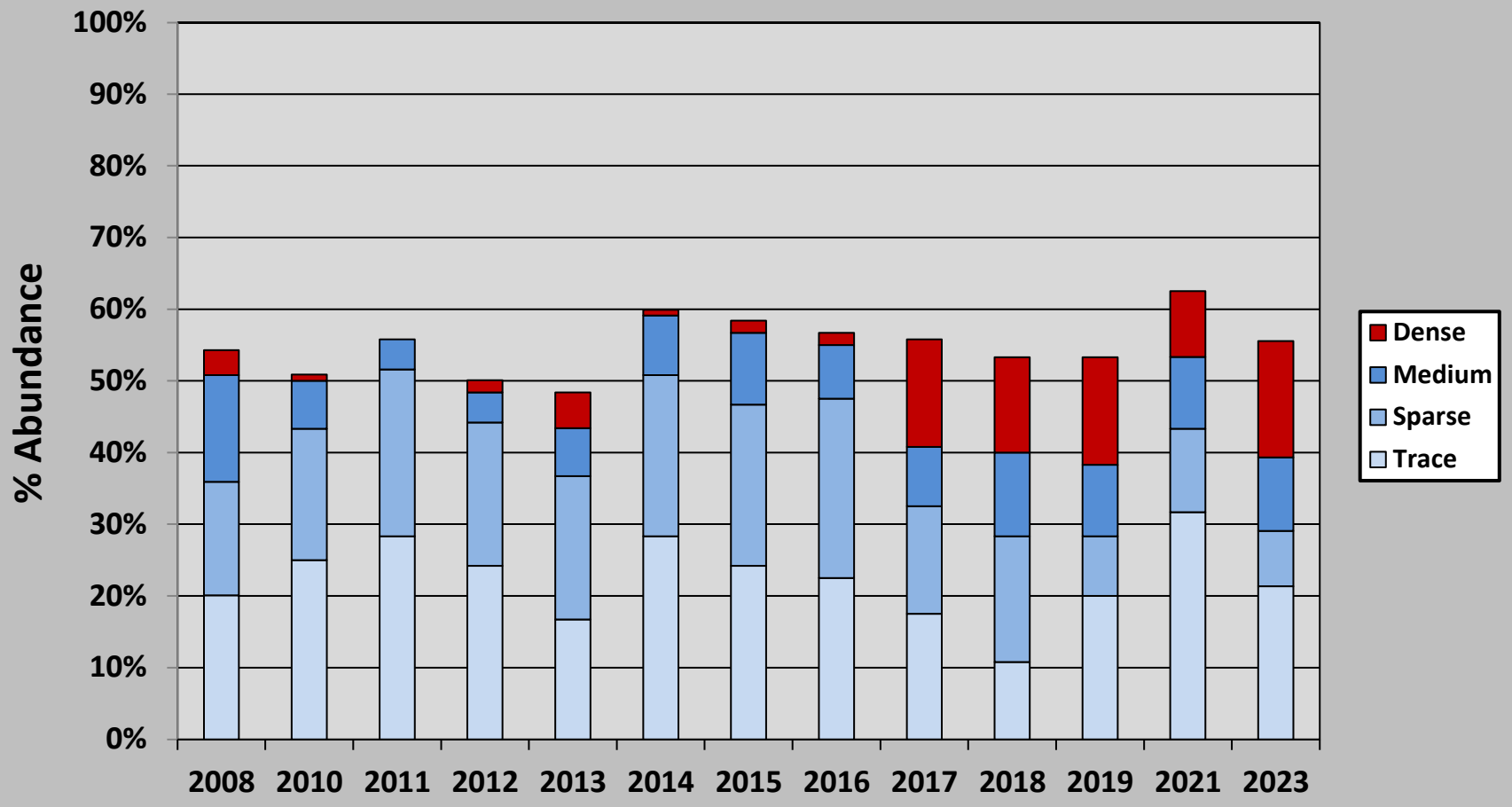
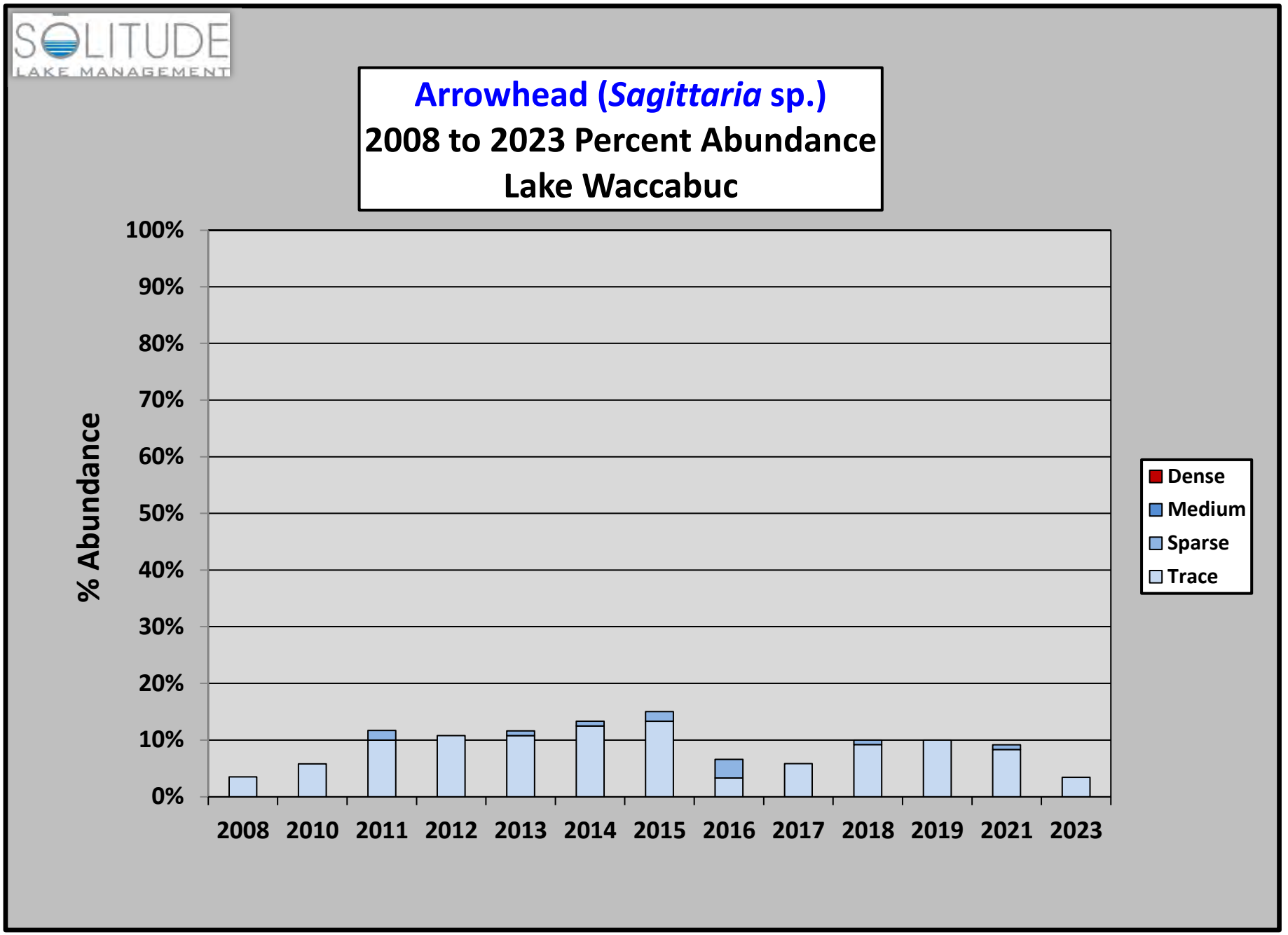
SOLITUDE LAKE MANAGEMENT

Total Floating Vegetation
2008 to 2023 Percent Abundance
Lake Waccabuc




SOLITUDE
LAKE MANAGEMENT
Arrowhead (Sagittaria sp.)
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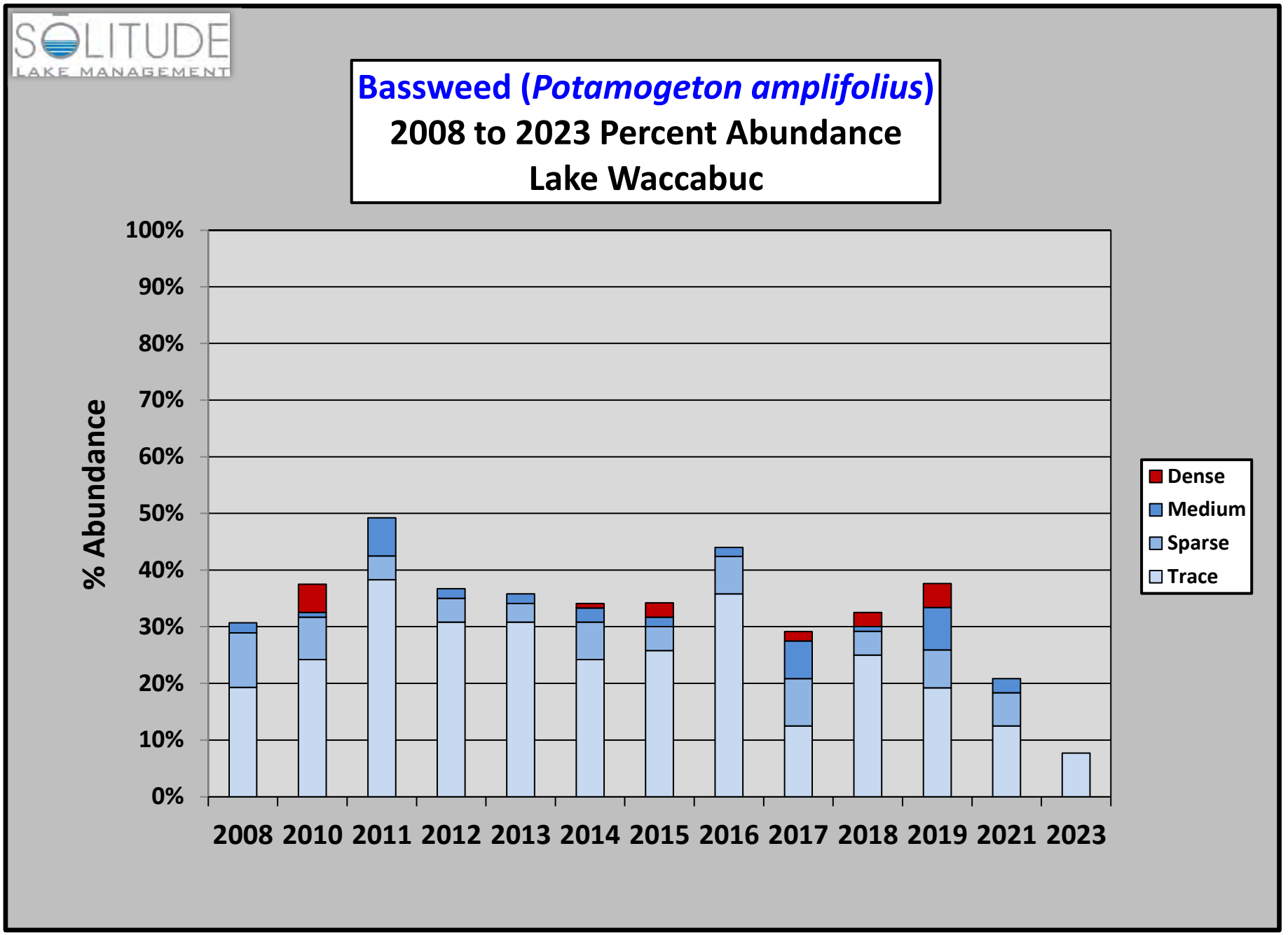
SOLITUDE
LAKE MANAGEMENT
Bassweed (Potamogeton amplifolius)
2008 to 2023 Percent Abundance
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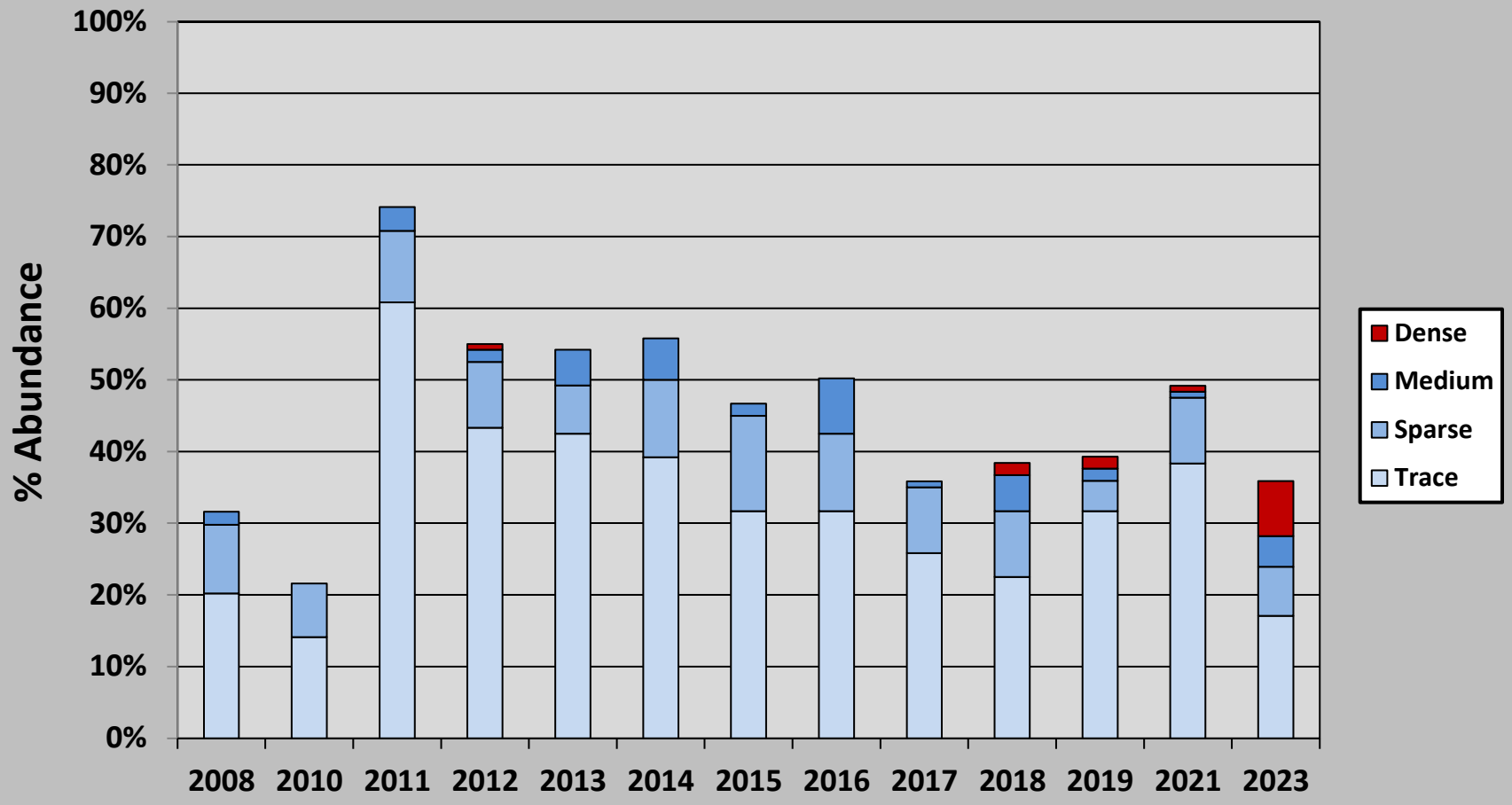
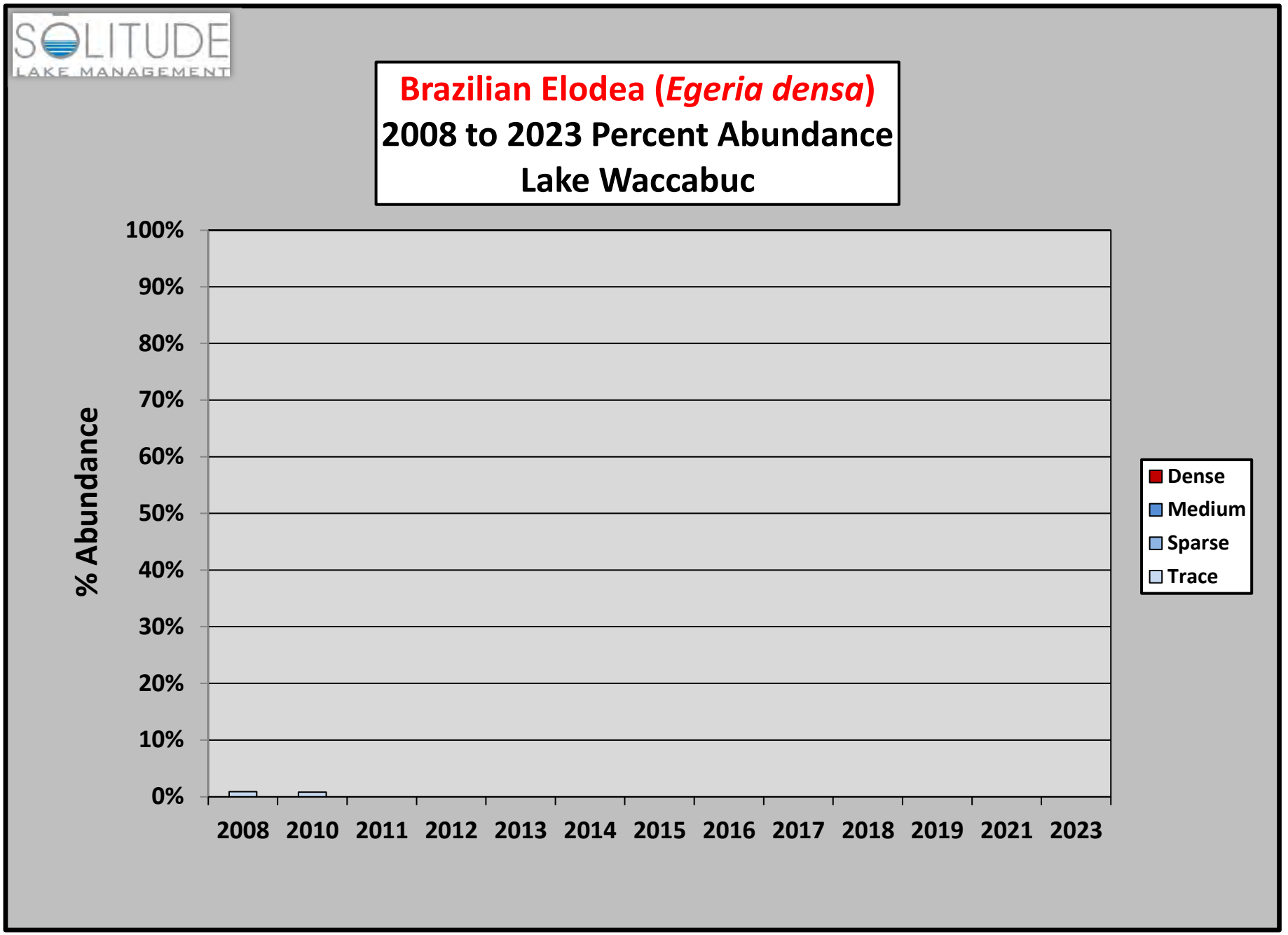
SOLITUDE LAKE MANAGEMENT

Benthic Filamentous Algae
2008 to 2023 Percent Abundance
Lake Waccabuc




SOLITUDE
LAKE MANAGEMENT
Brazilian Elodea (*Egeria densa*)
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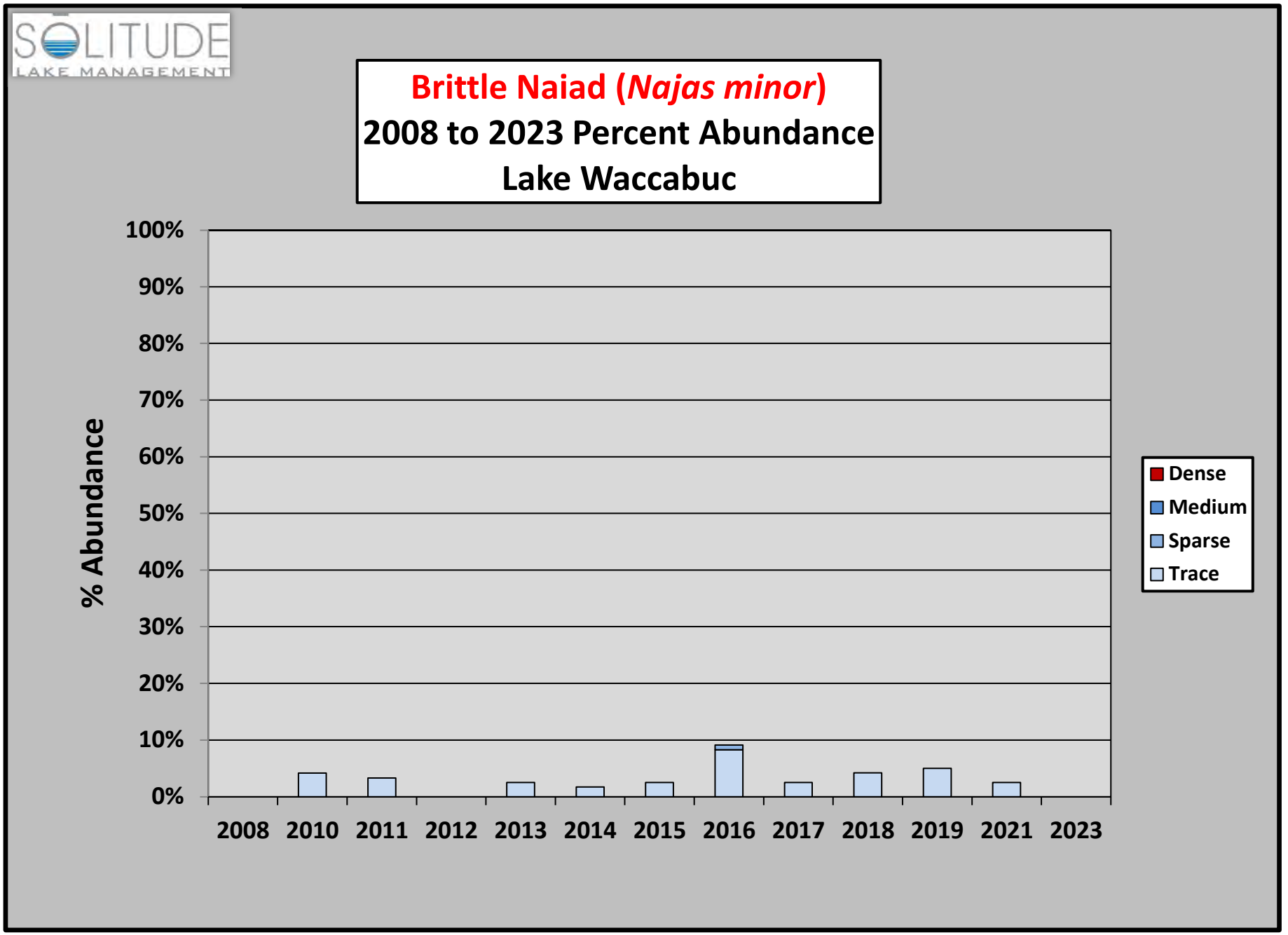
SOLITUDE
LAKE MANAGEMENT
Brittle Naiad (Najas minor)
2008 to 2023 Percent Abundance
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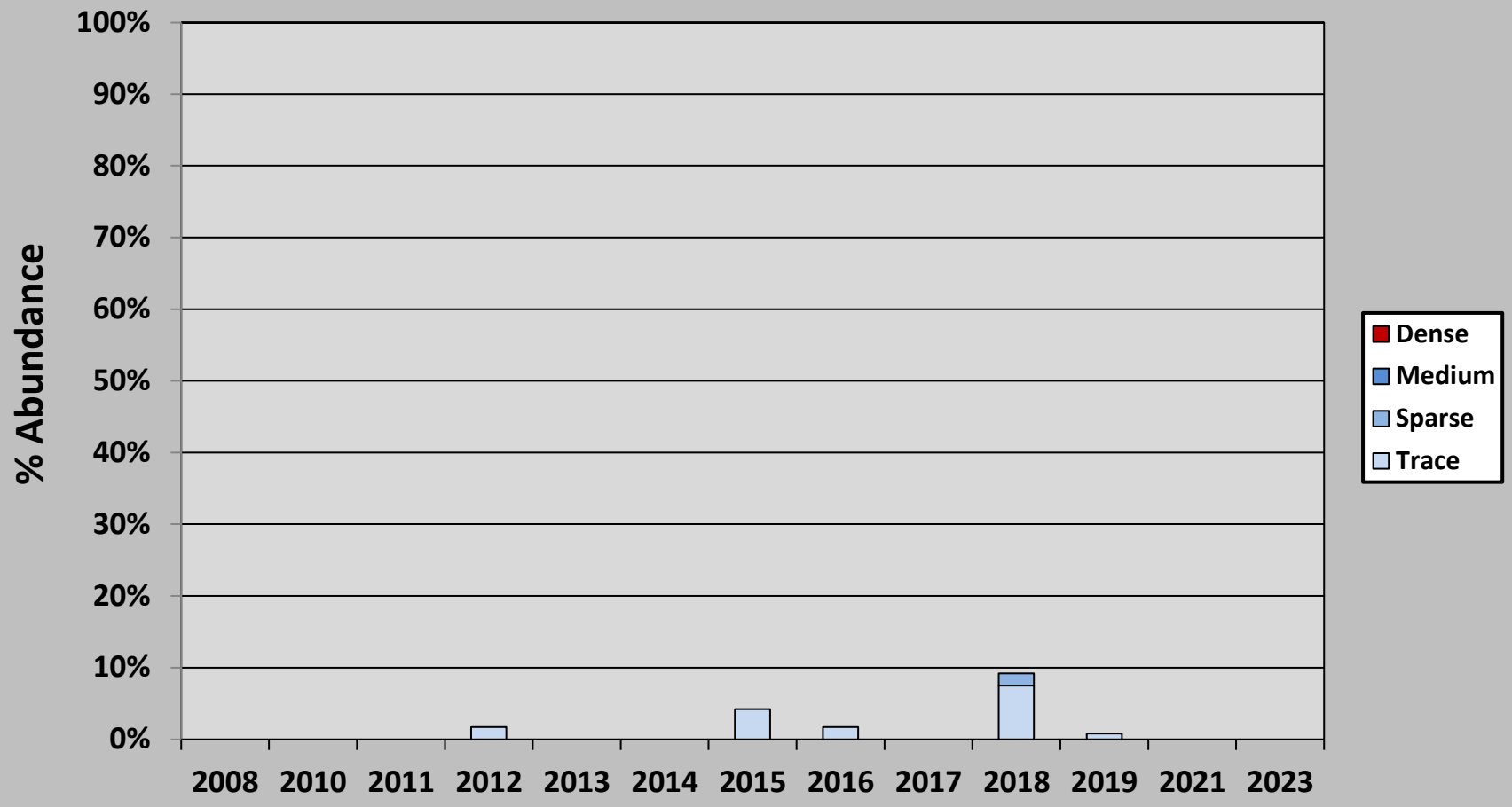
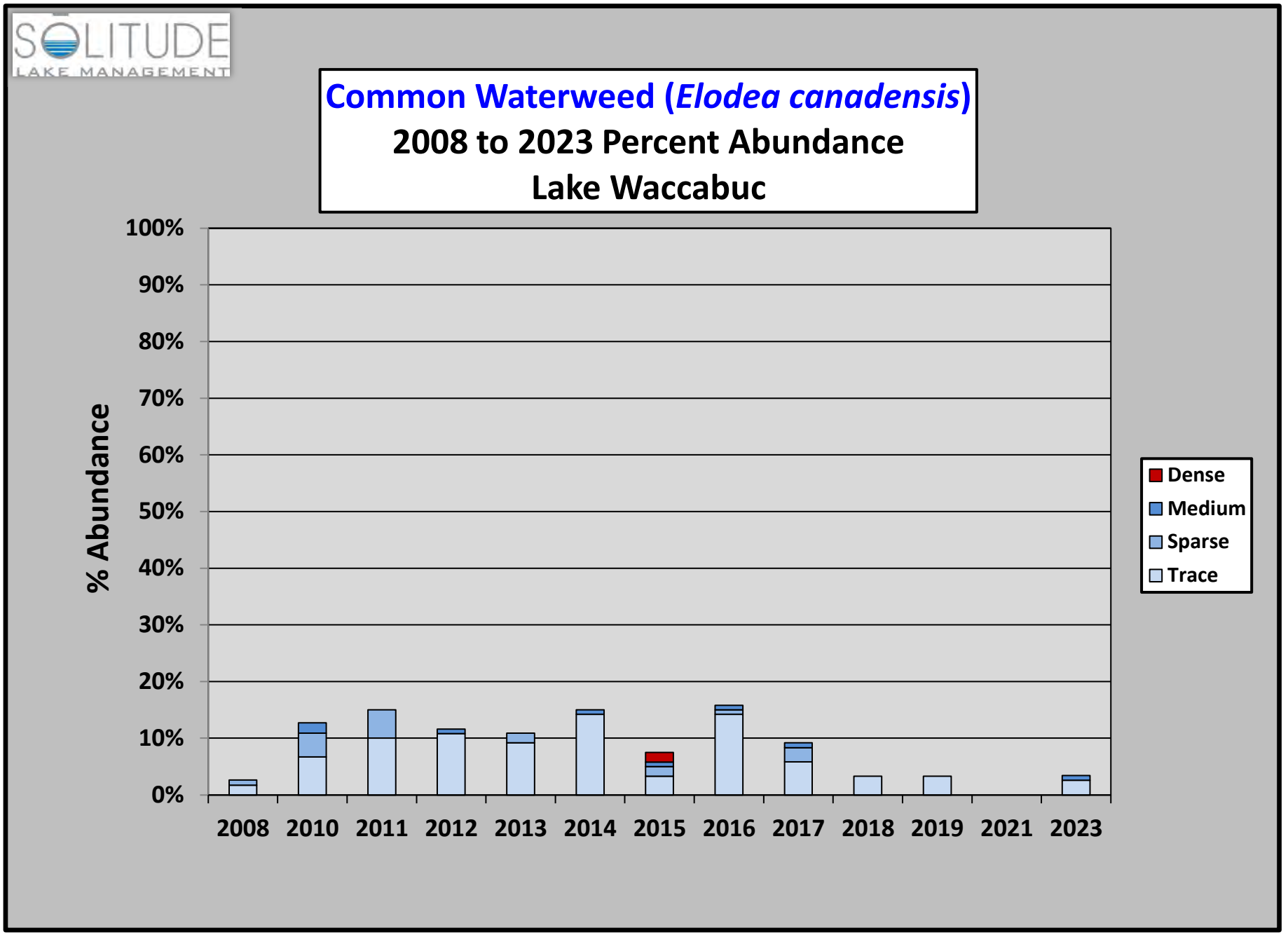
SOLITUDE LAKE MANAGEMENT

Common Watermeal (*Wolffia columbiana*)
2008 to 2023 Percent Abundance
Lake Waccabuc




SOLITUDE
LAKE MANAGEMENT
Common Waterweed (Elodea canadensis)
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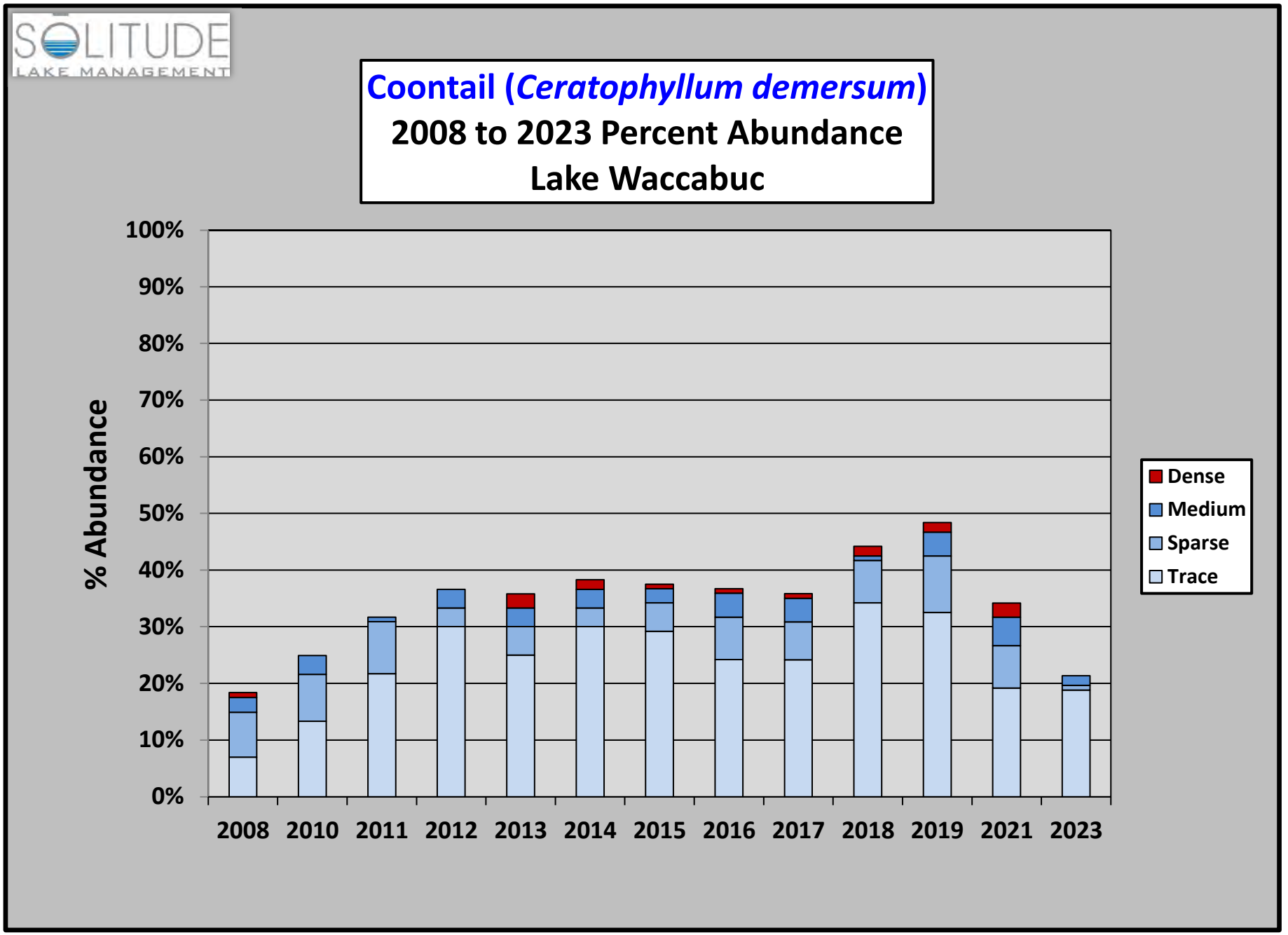
Coontail (*Ceratophyllum demersum*)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
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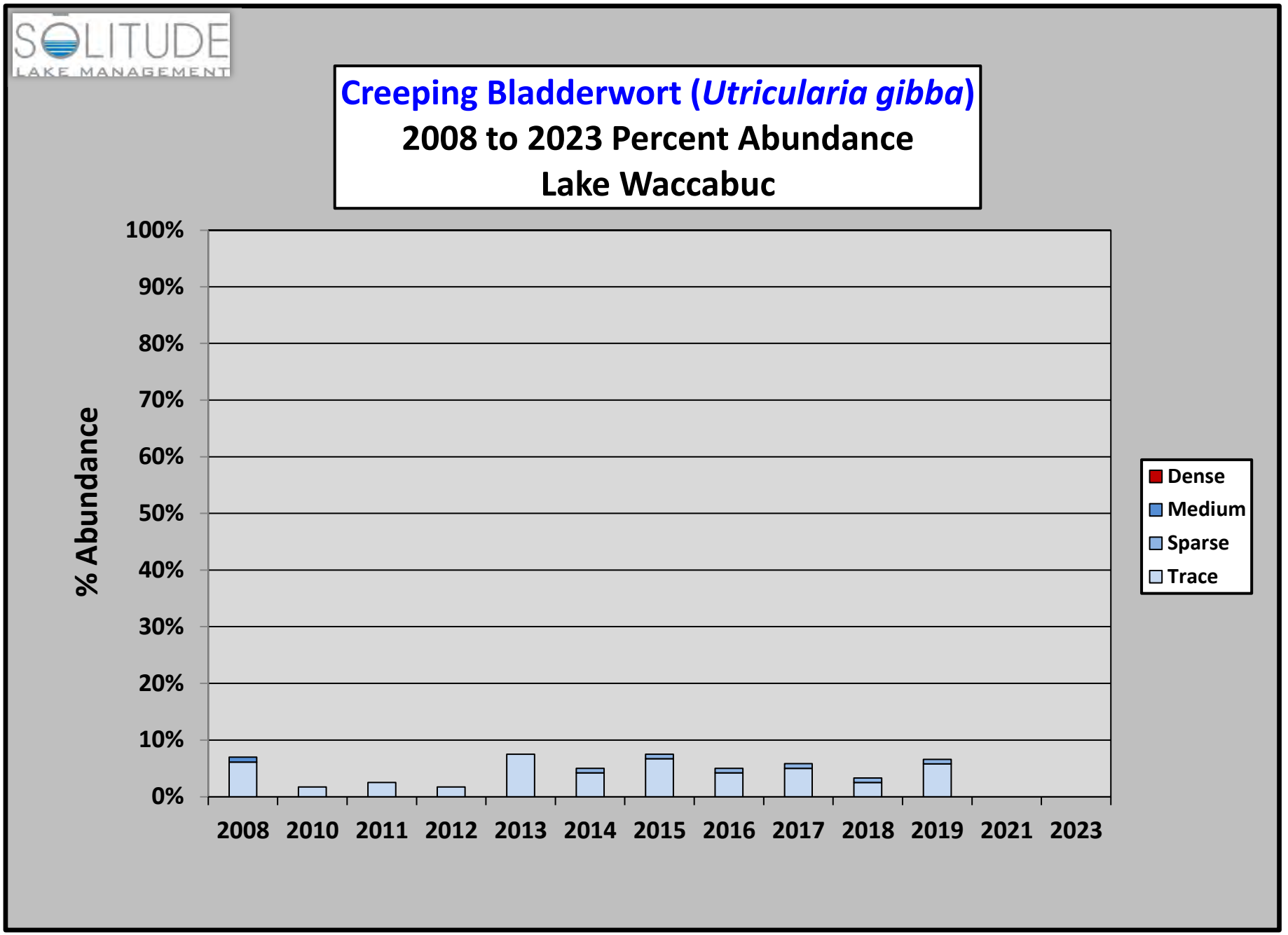
SOLITUDE
LAKE MANAGEMENT
Creeping Bladderwort (*Utricularia gibba*)
2008 to 2023 Percent Abundance
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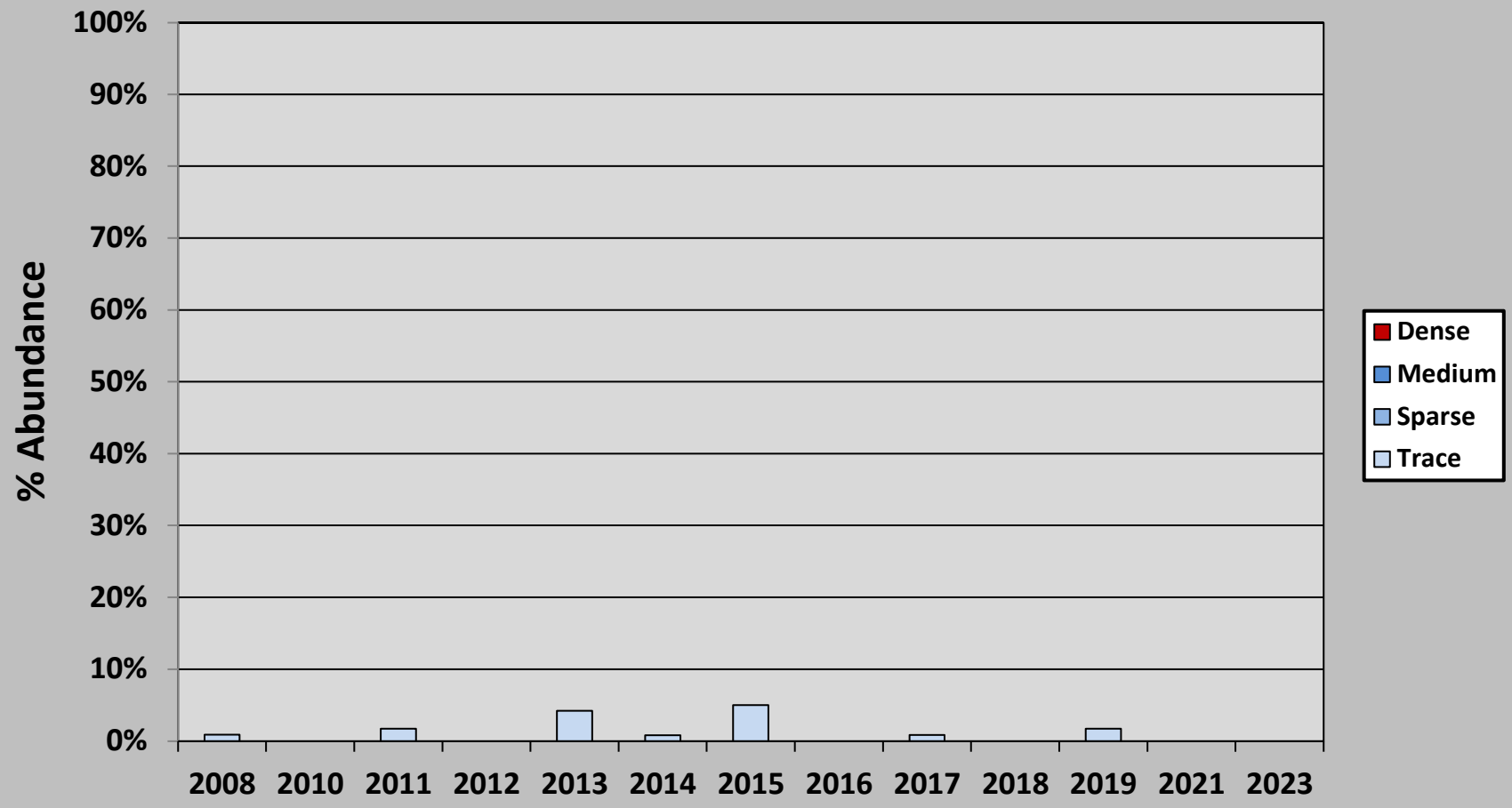
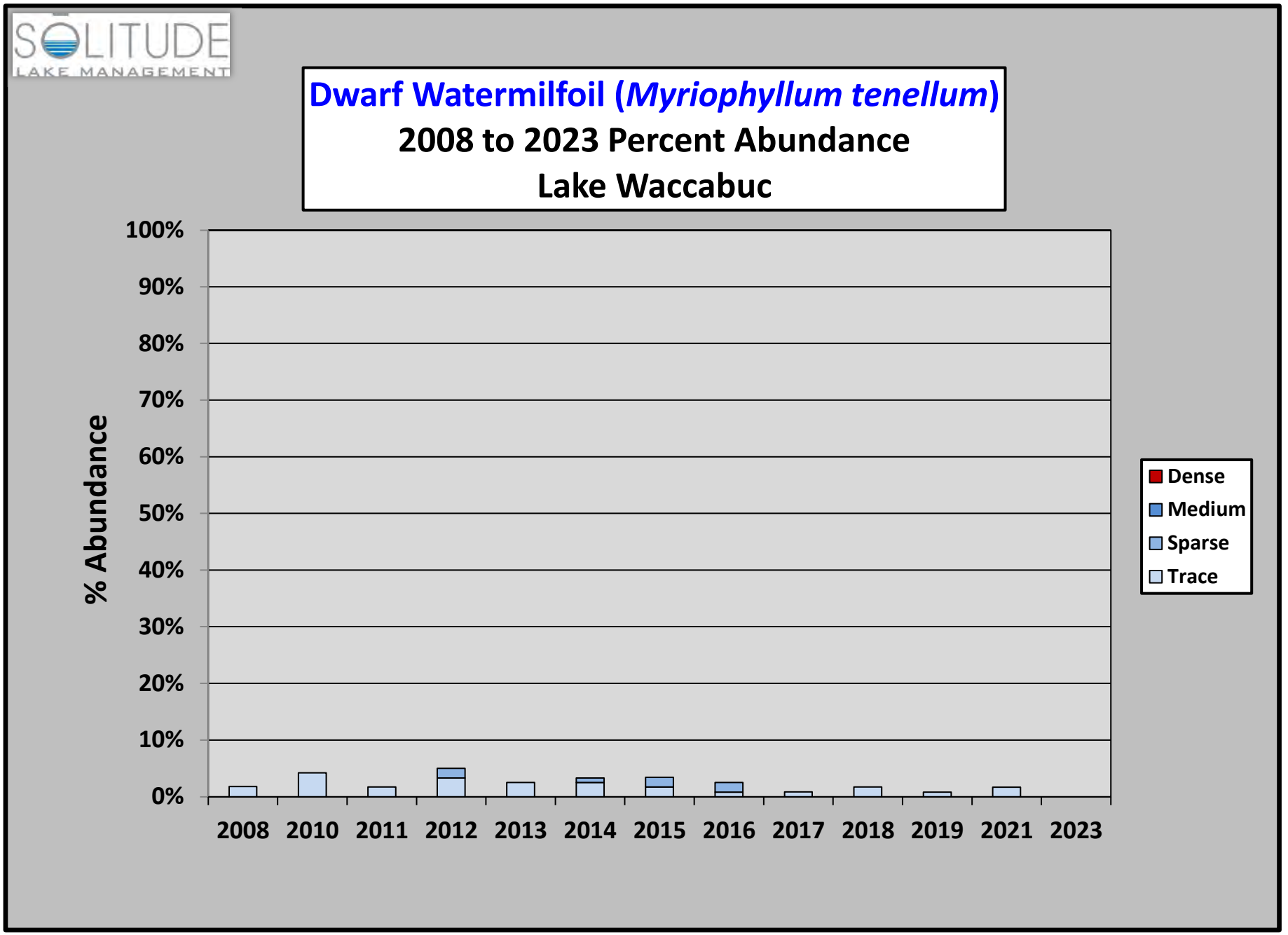
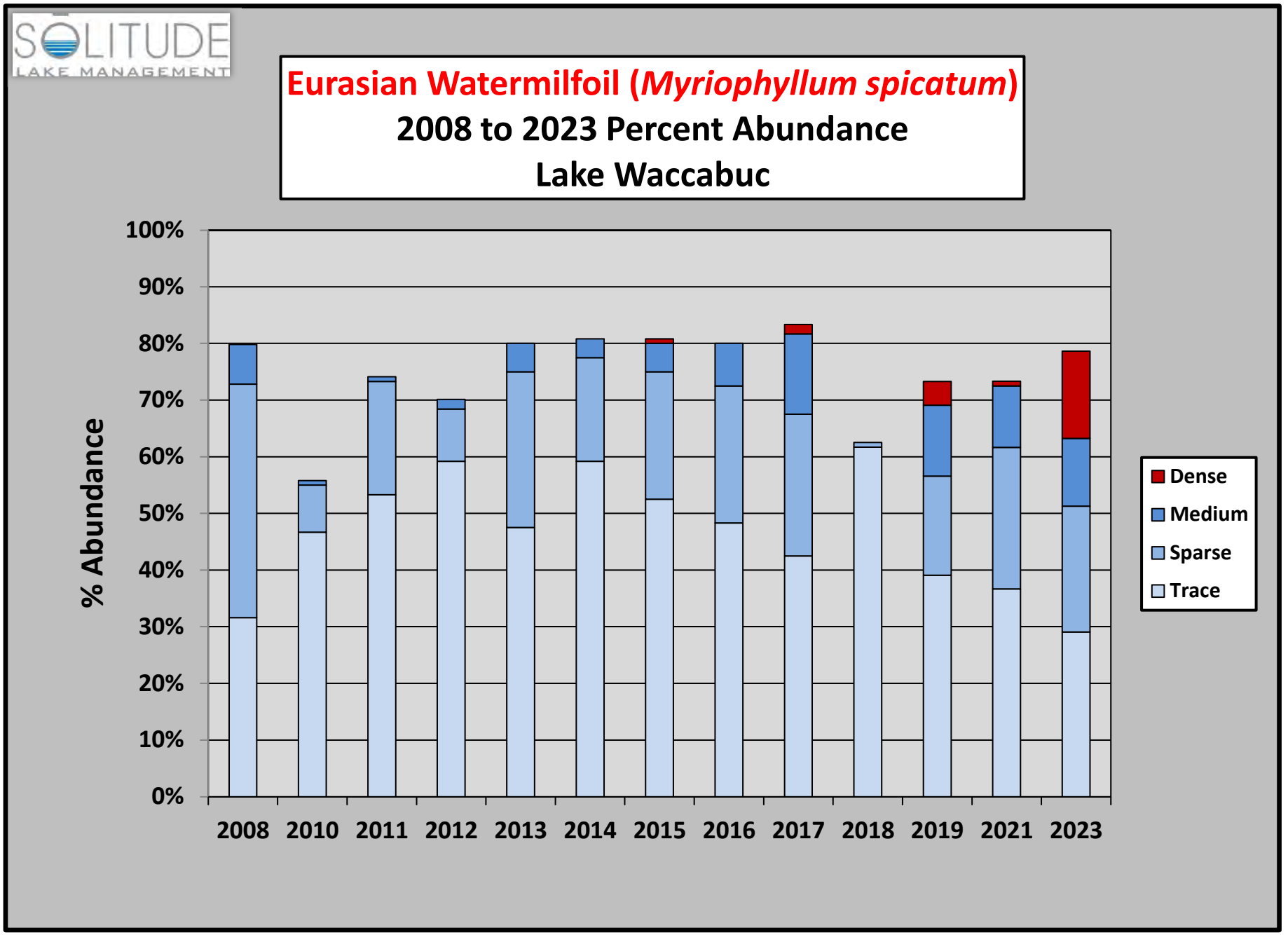
SOLITUDE LAKE MANAGEMENT

Curly-Leaf Pondweed (*Potamogeton crispus*)
2008 to 2023 Percent Abundance
Lake Waccabuc




SOLITUDE
LAKE MANAGEMENT
Dwarf Watermilfoil (*Myriophyllum tenellum*)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2008
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2021
2023
Dense
Medium
Sparse
Trace

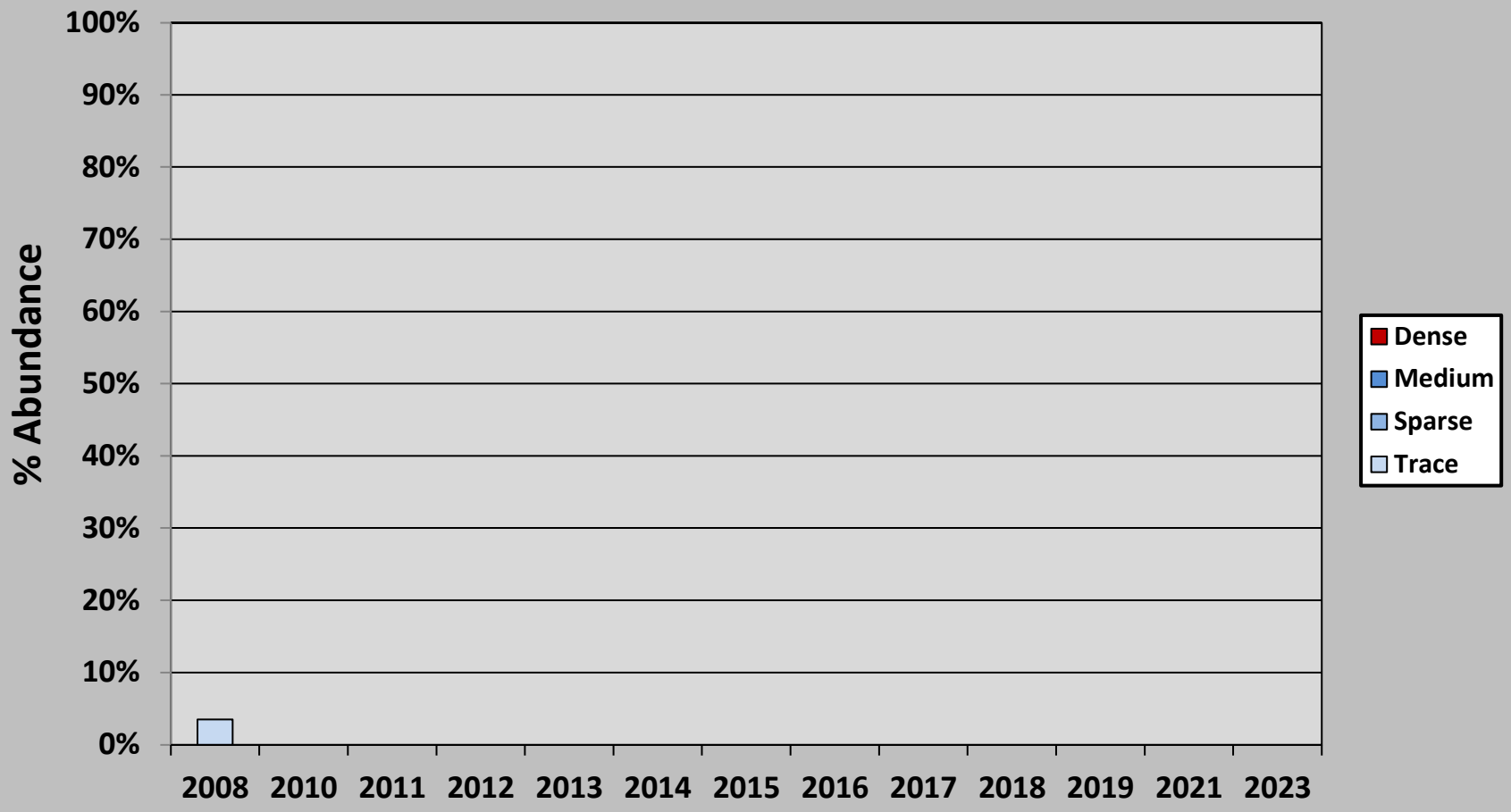

SOLITUDE
LAKE MANAGEMENT
Eurasian Watermilfoil (Myriophyllum spicatum)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2008
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2021
2023
Dense
Medium
Sparse
Trace

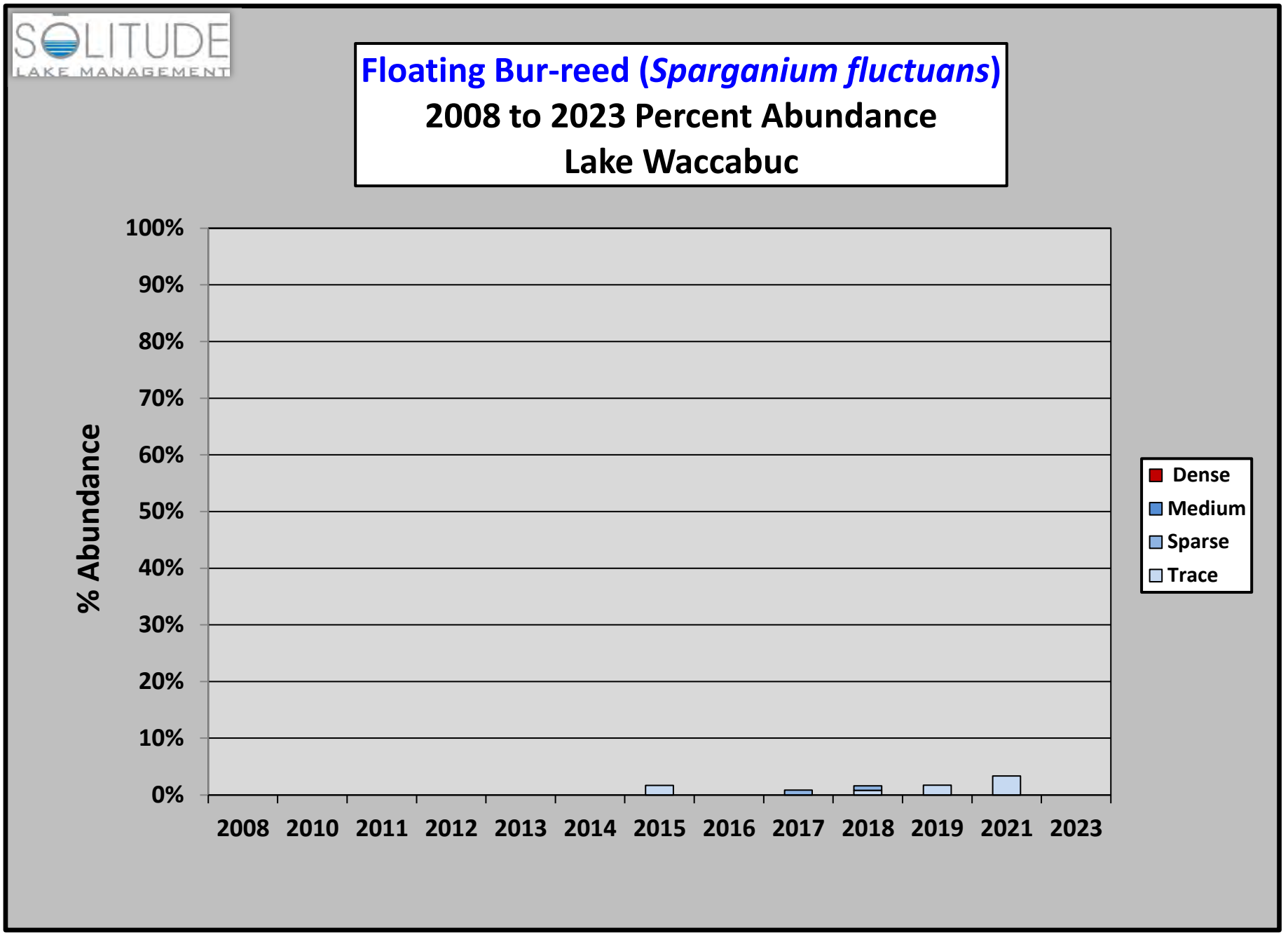
SOLITUDE LAKE MANAGEMENT

Flat-Stem Pondweed (*Potamogeton zosteriformis*)

2008 to 2023 Percent Abundance

Lake Waccabuc




SOLITUDE
LAKE MANAGEMENT
Floating Bur-reed (Sparganium fluctuans)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2008
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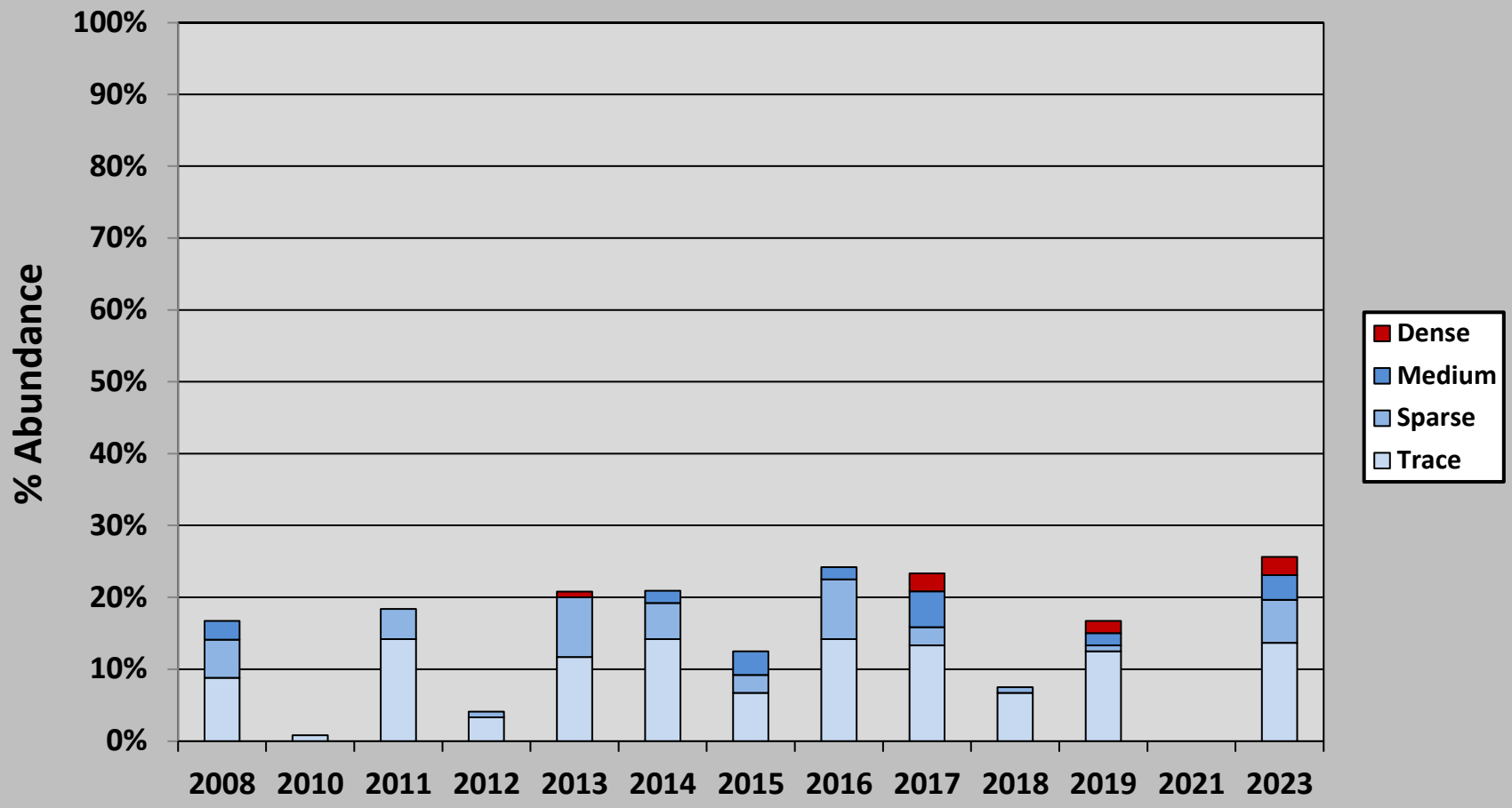
2021
2023
Dense
Medium
Sparse
Trace

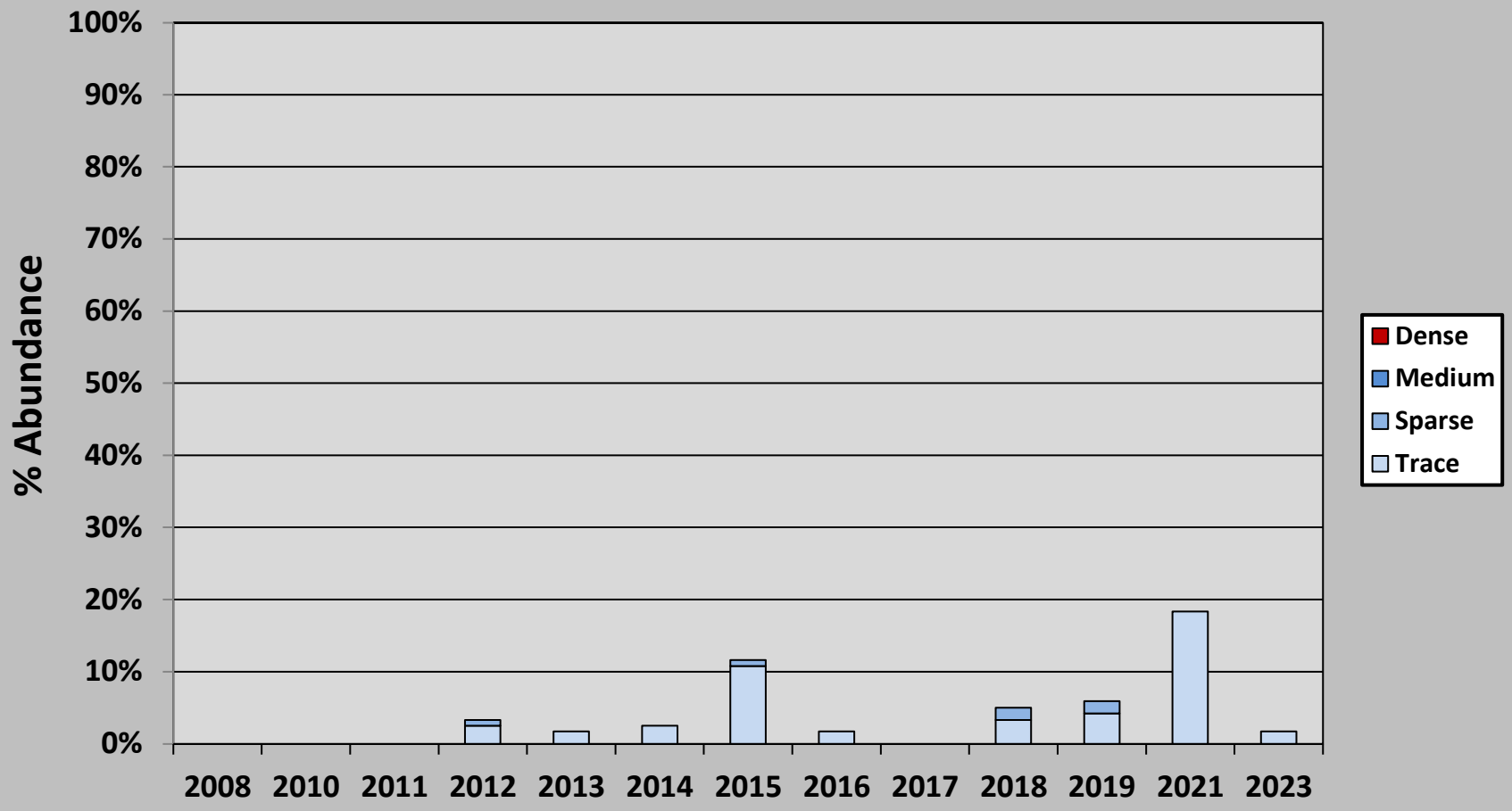
SOLITUDE LAKE MANAGEMENT

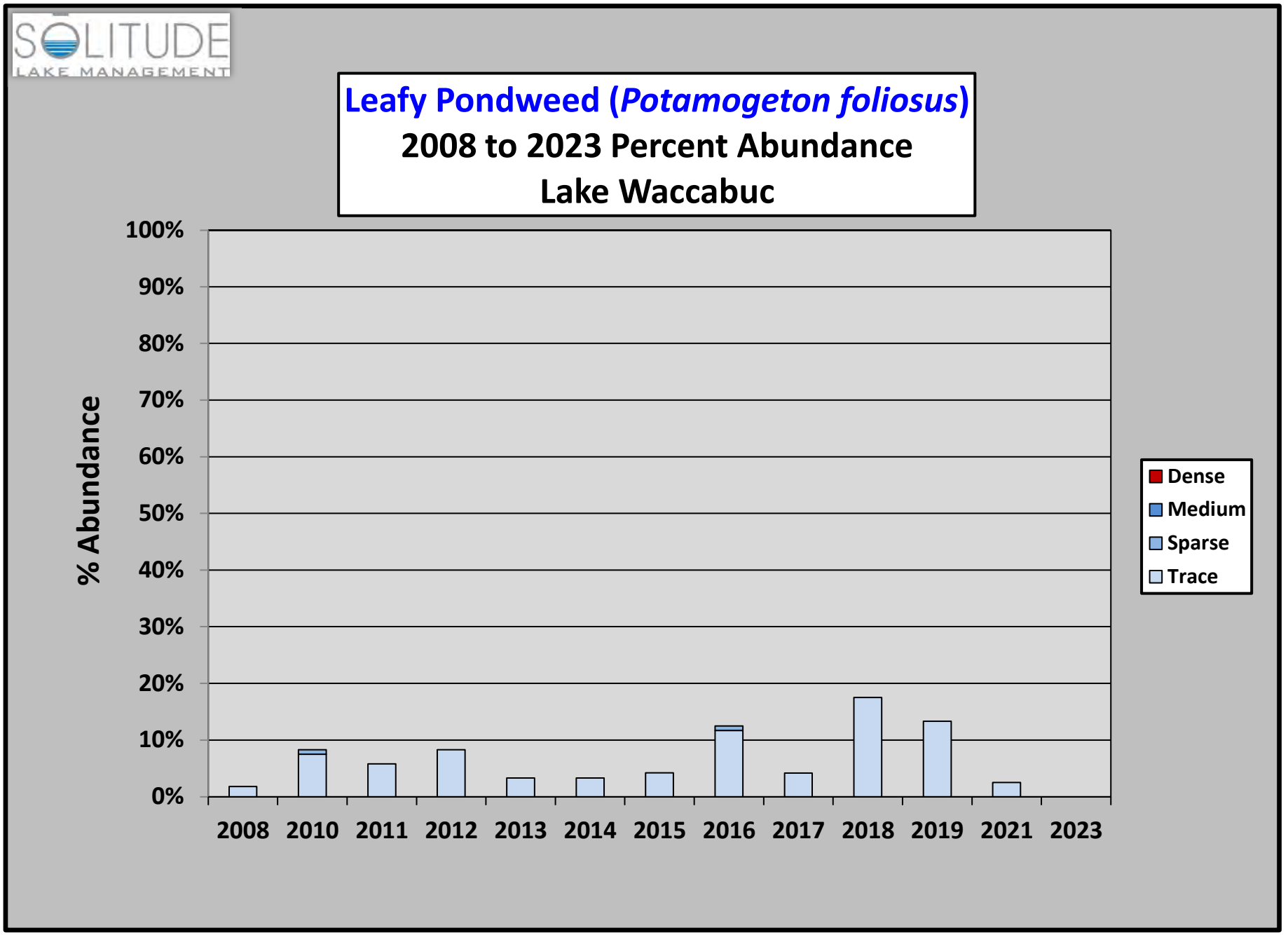
Floating Filamentous Algae
2008 to 2023 Percent Abundance
Lake Waccabuc



SOLITUDE LAKE MANAGEMENT

Great Duckweed (*Spirodela polyrhiza*)
2008 to 2023 Percent Abundance
Lake Waccabuc




SOLITUDE
LAKE MANAGEMENT
Leafy Pondweed (Potamogeton foliosus)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
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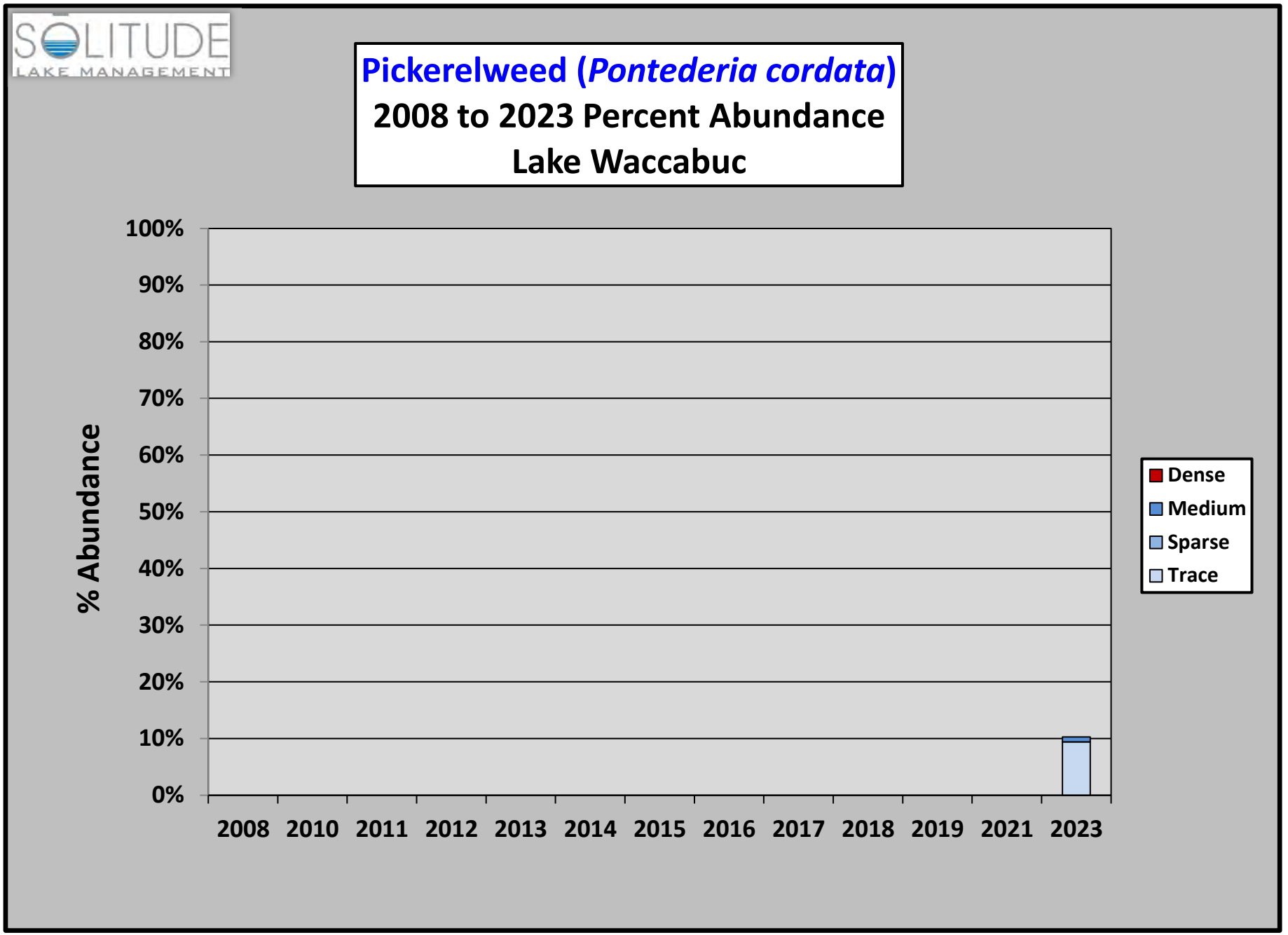
2021
2023
Dense
Medium
Sparse
Trace


SOLITUDE
LAKE MANAGEMENT
Pickerelweed (Pontederia cordata)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
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2023
Dense
Medium
Sparse
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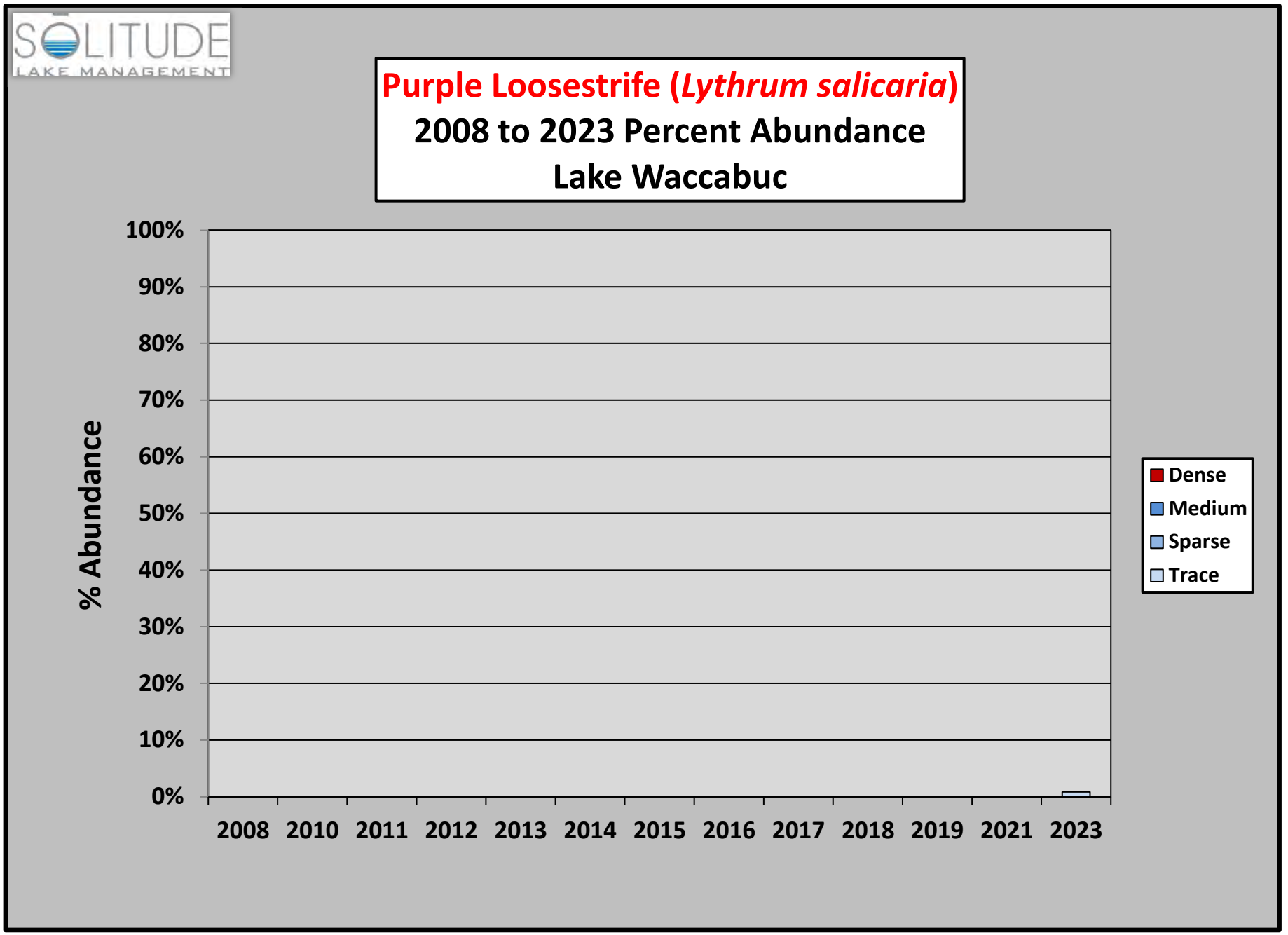
SOLITUDE
LAKE MANAGEMENT
Purple Loosestrife (Lythrum salicaria)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2008
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Sparse
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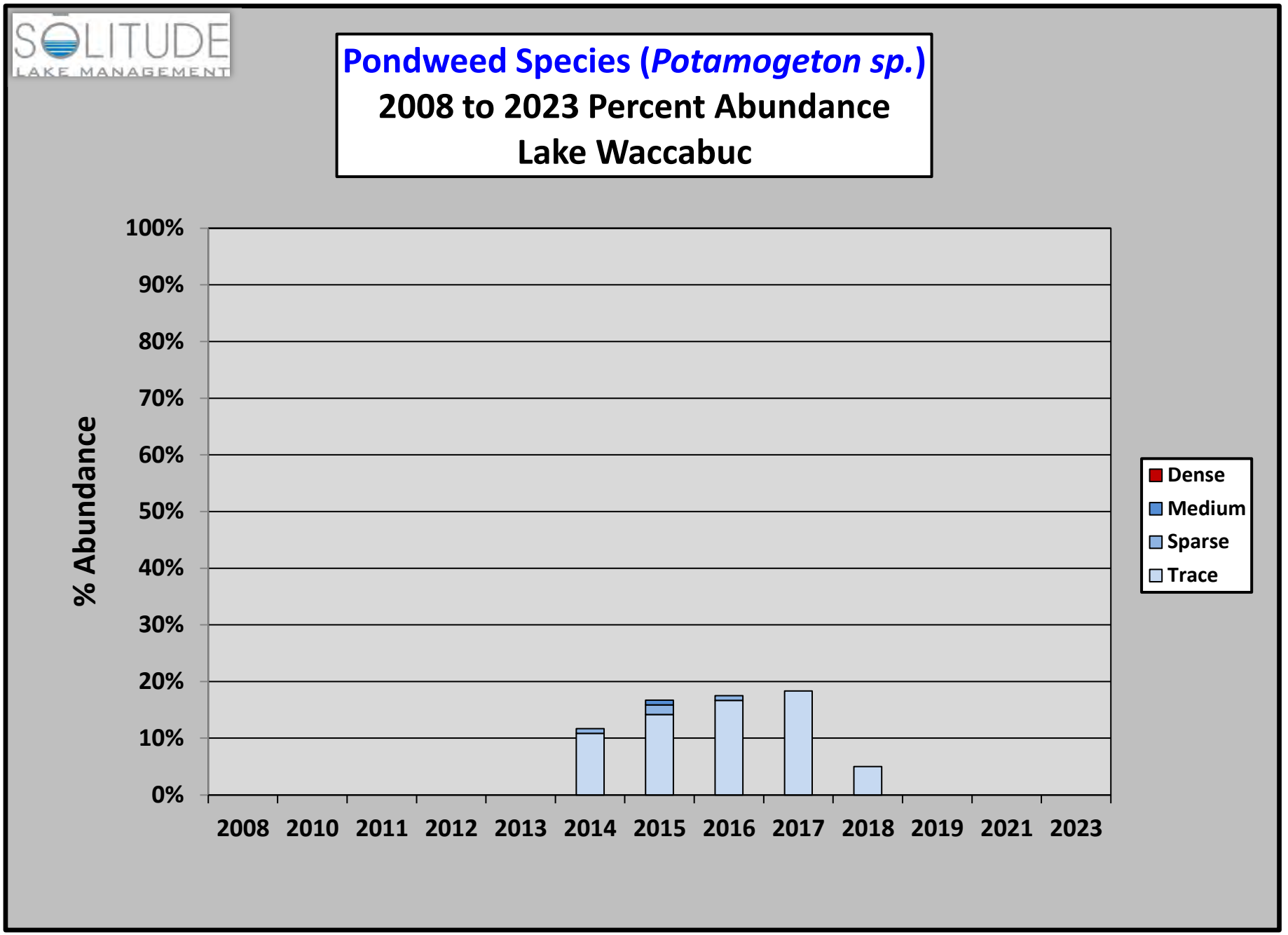
SOLITUDE
LAKE MANAGEMENT
Pondweed Species (Potamogeton sp.)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
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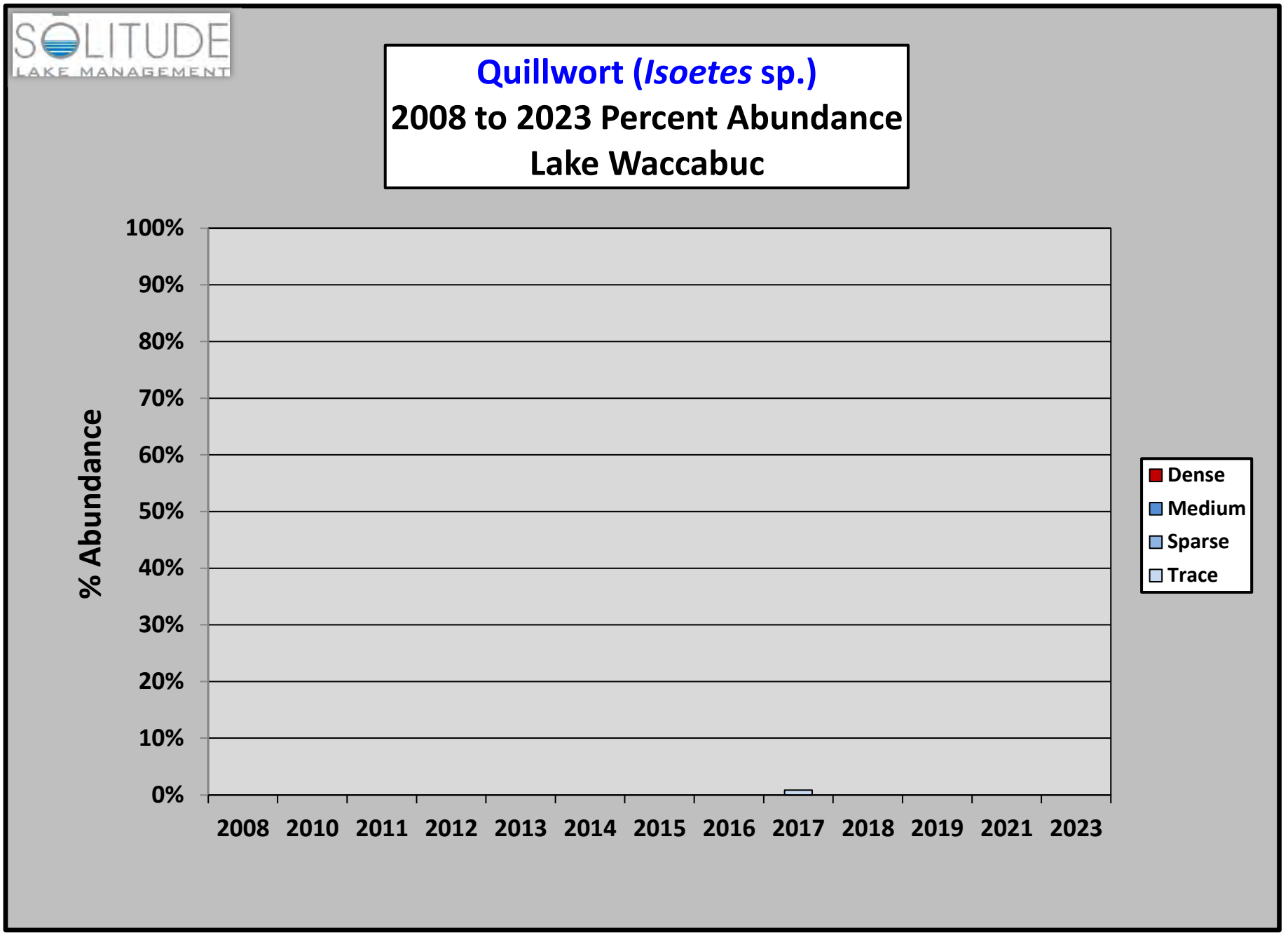
SOLITUDE
LAKE MANAGEMENT
Quillwort (Isoetes sp.)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
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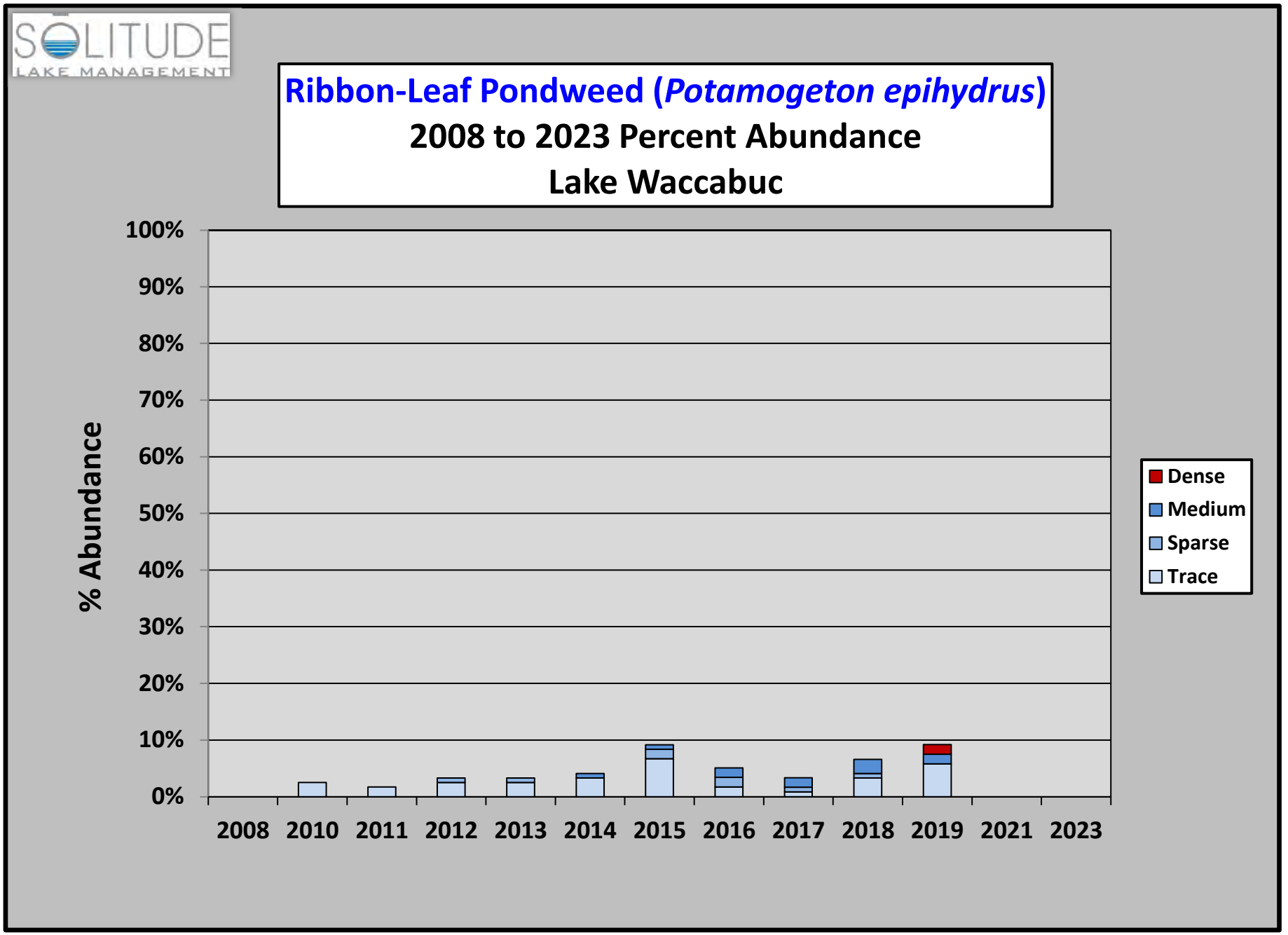
2023
Dense
Medium
Sparse
Trace


SOLITUDE
LAKE MANAGEMENT
Ribbon-Leaf Pondweed (Potamogeton epihydrus)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
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70%
60%
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40%
30%
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10%
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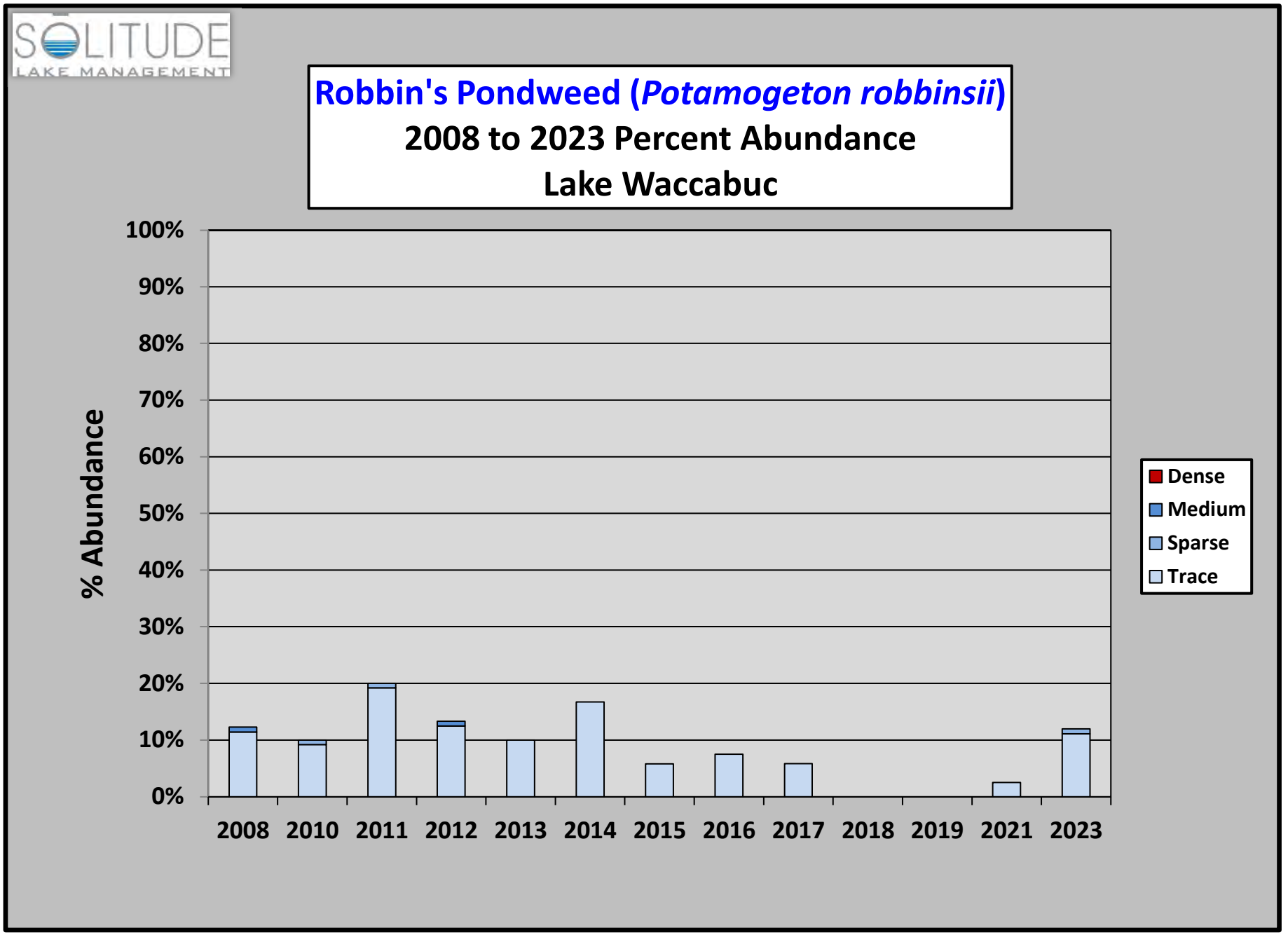
2023
Dense
Medium
Sparse
Trace


SOLITUDE
LAKE MANAGEMENT
Robbin's Pondweed (Potamogeton robbinsii)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
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2023
Dense
Medium
Sparse
Trace

SOLITUDE LAKE MANAGEMENT

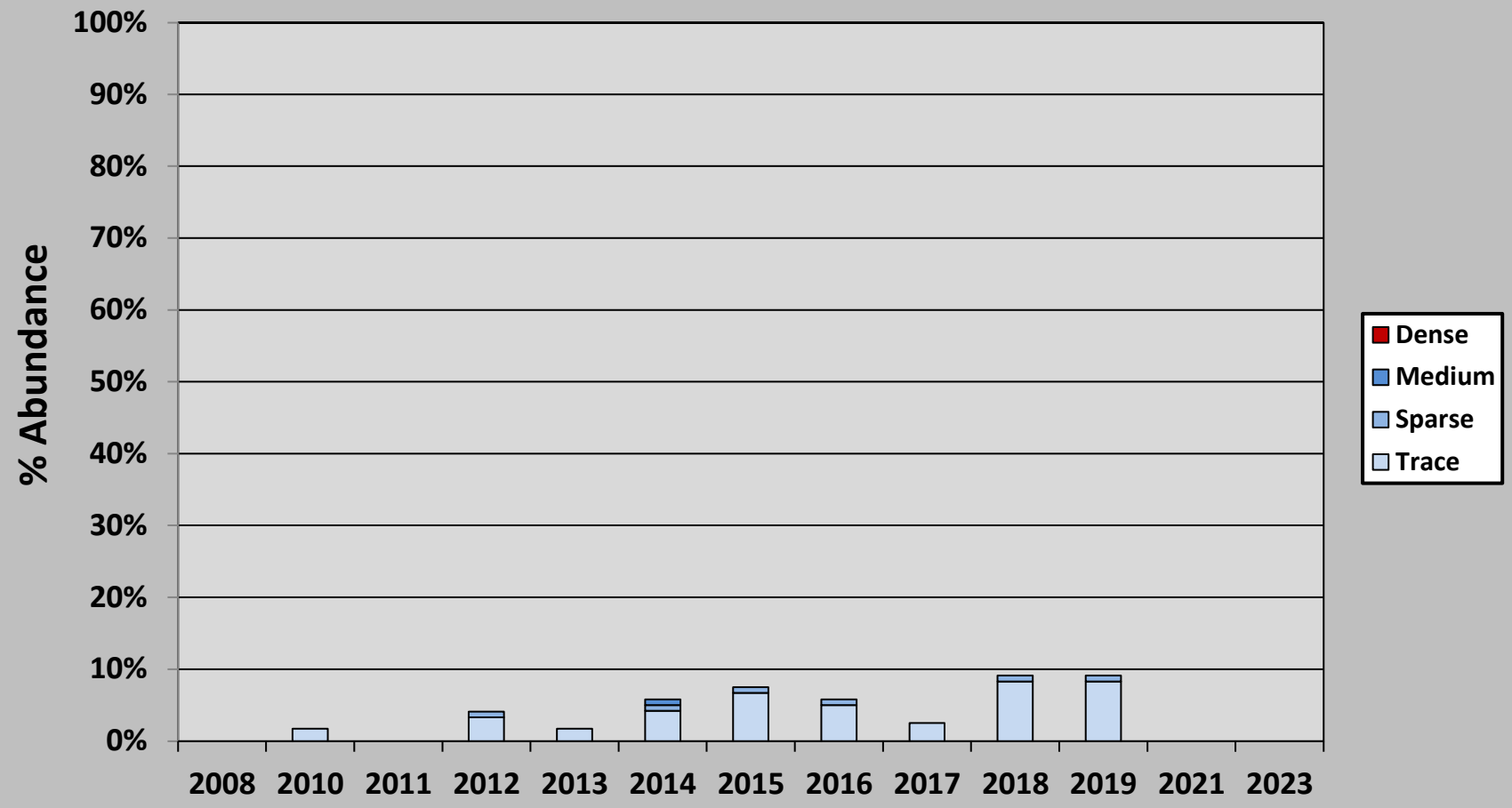
Slender Naiad (*Najas flexilis*)
2008 to 2023 Percent Abundance
Lake Waccabuc

SOLITUDE LAKE MANAGEMENT

Small Bladderwort (*Utricularia minor*)
2008 to 2023 Percent Abundance
Lake Waccabuc

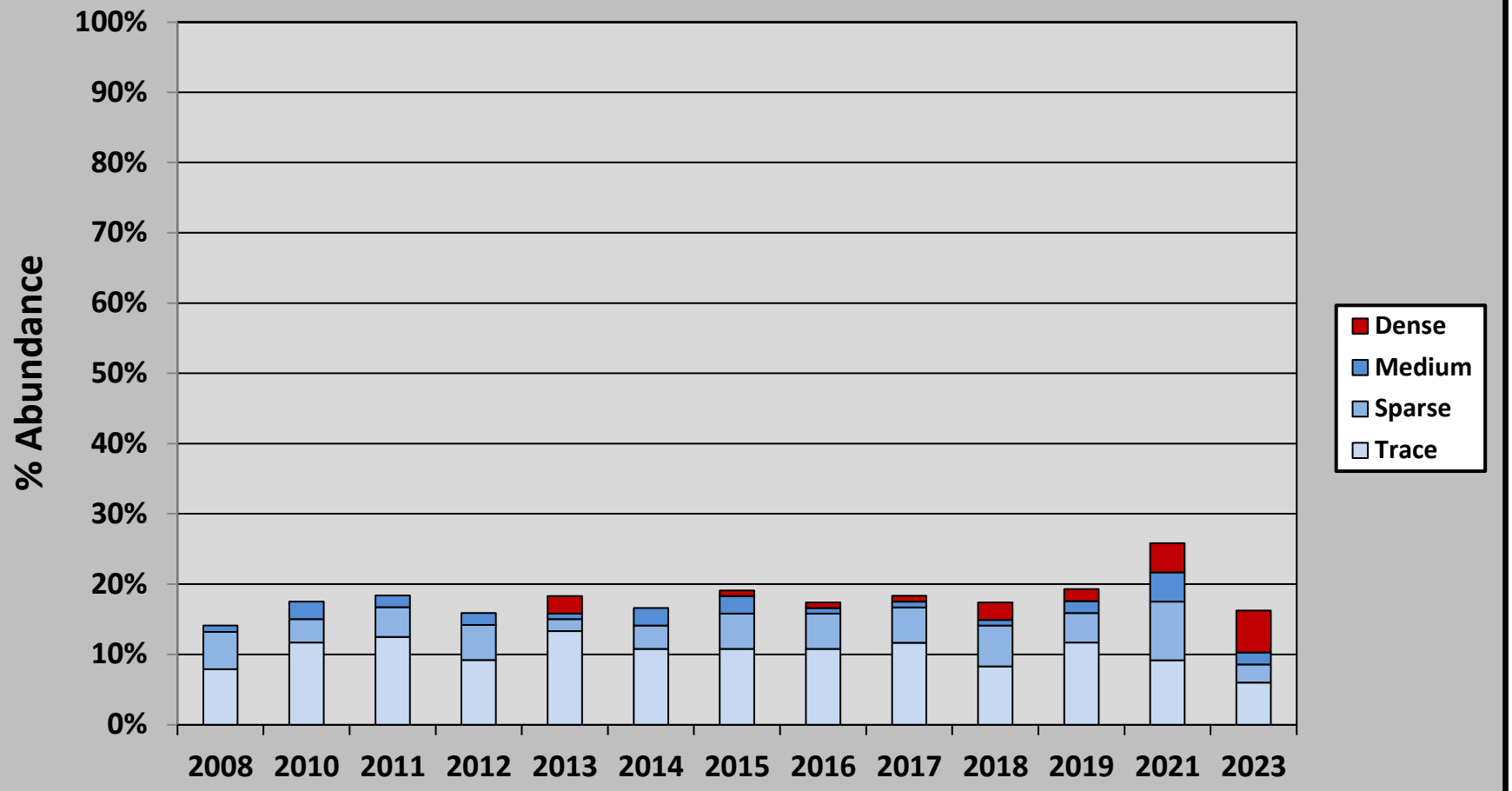
SOLITUDE LAKE MANAGEMENT

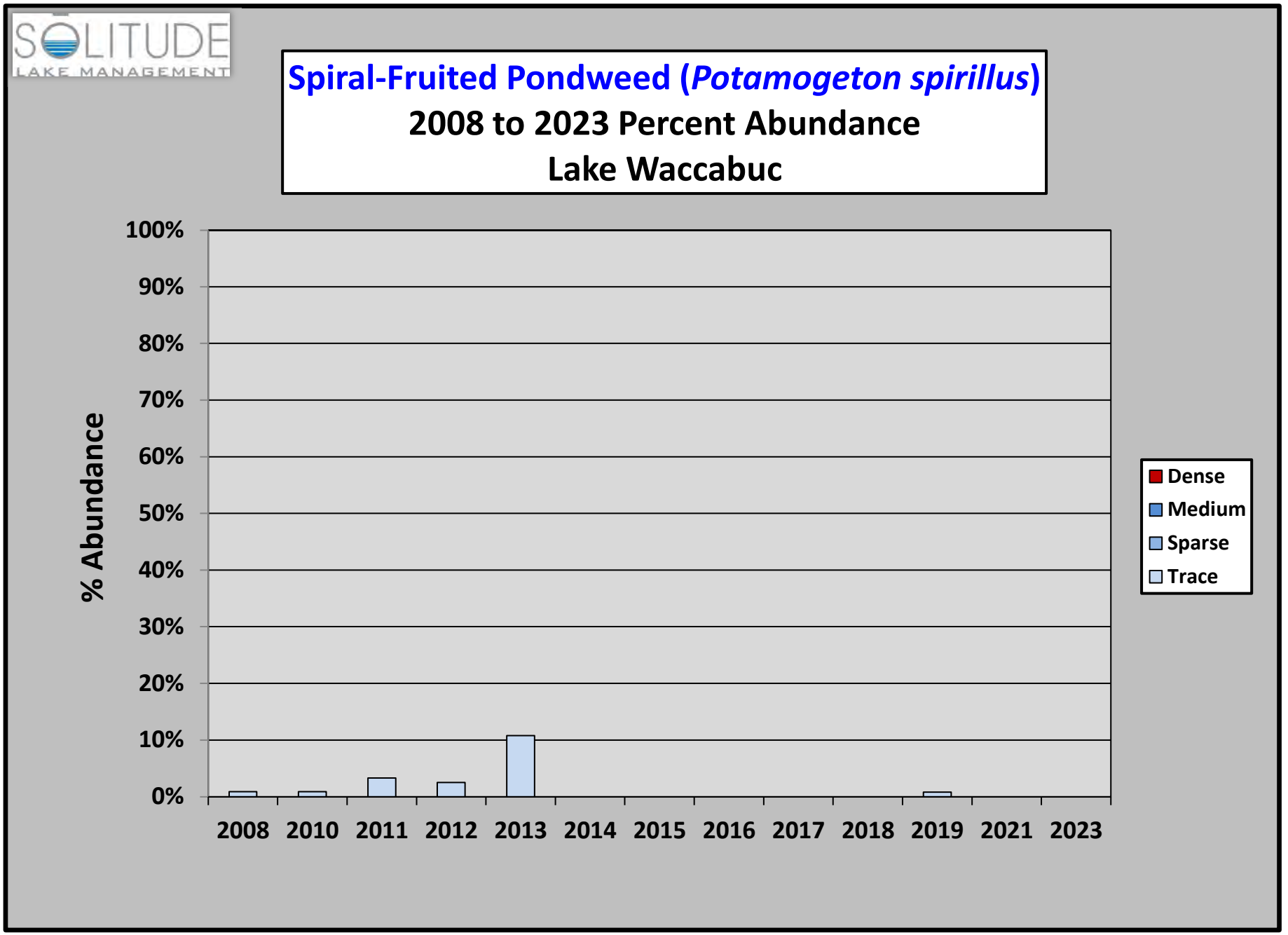
Small Duckweed (*Lemna minor*)
2008 to 2023 Percent Abundance
Lake Waccabuc



SOLITUDE LAKE MANAGEMENT

Spatterdock (*Nuphar variegata*)
2008 to 2023 Percent Abundance
Lake Waccabuc




SOLITUDE
LAKE MANAGEMENT
Spiral-Fruited Pondweed (Potamogeton spirillus)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
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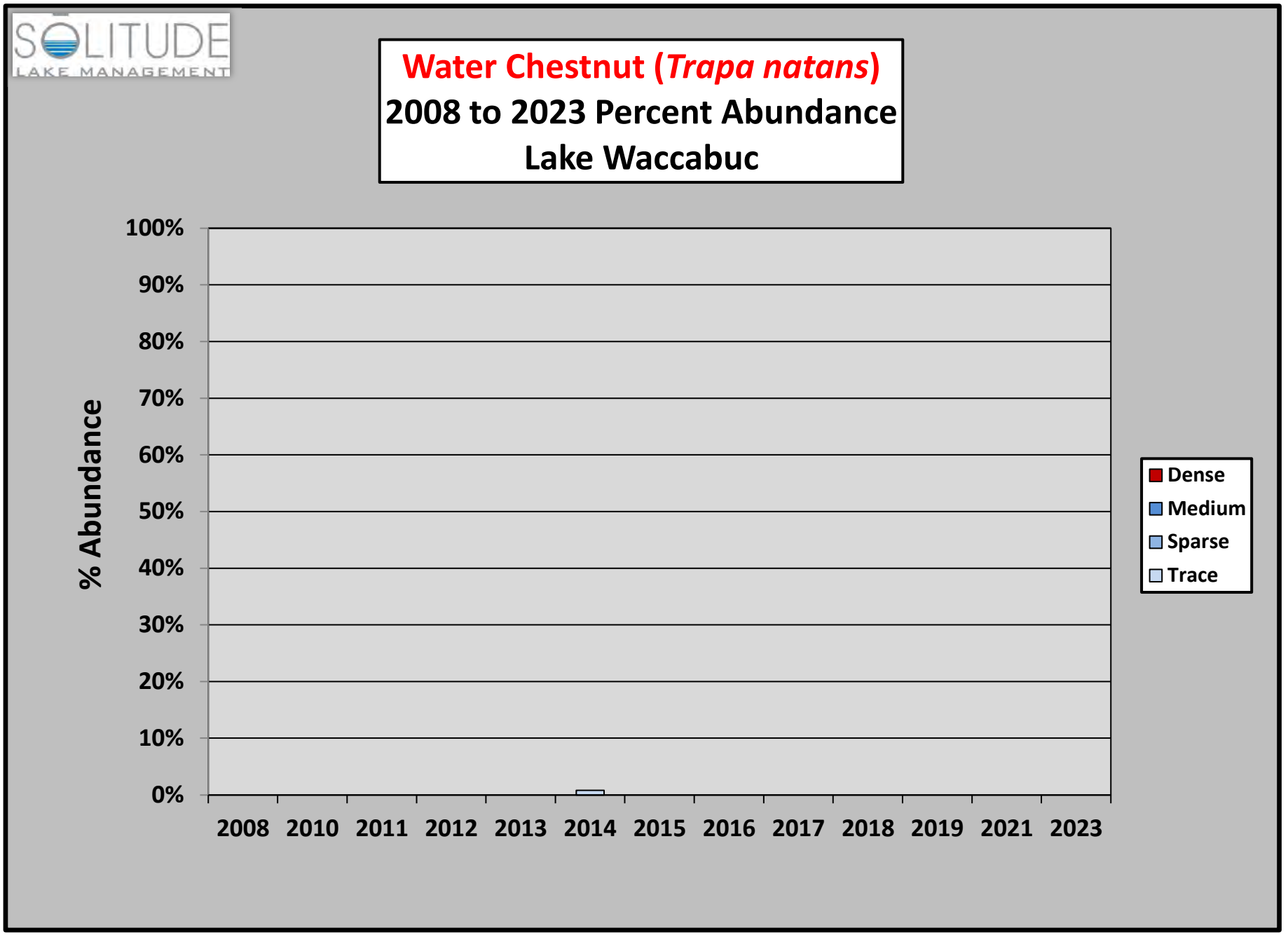
2023
Dense
Medium
Sparse
Trace


SOLITUDE
LAKE MANAGEMENT
Water Chestnut (*Trapa natans*)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2008
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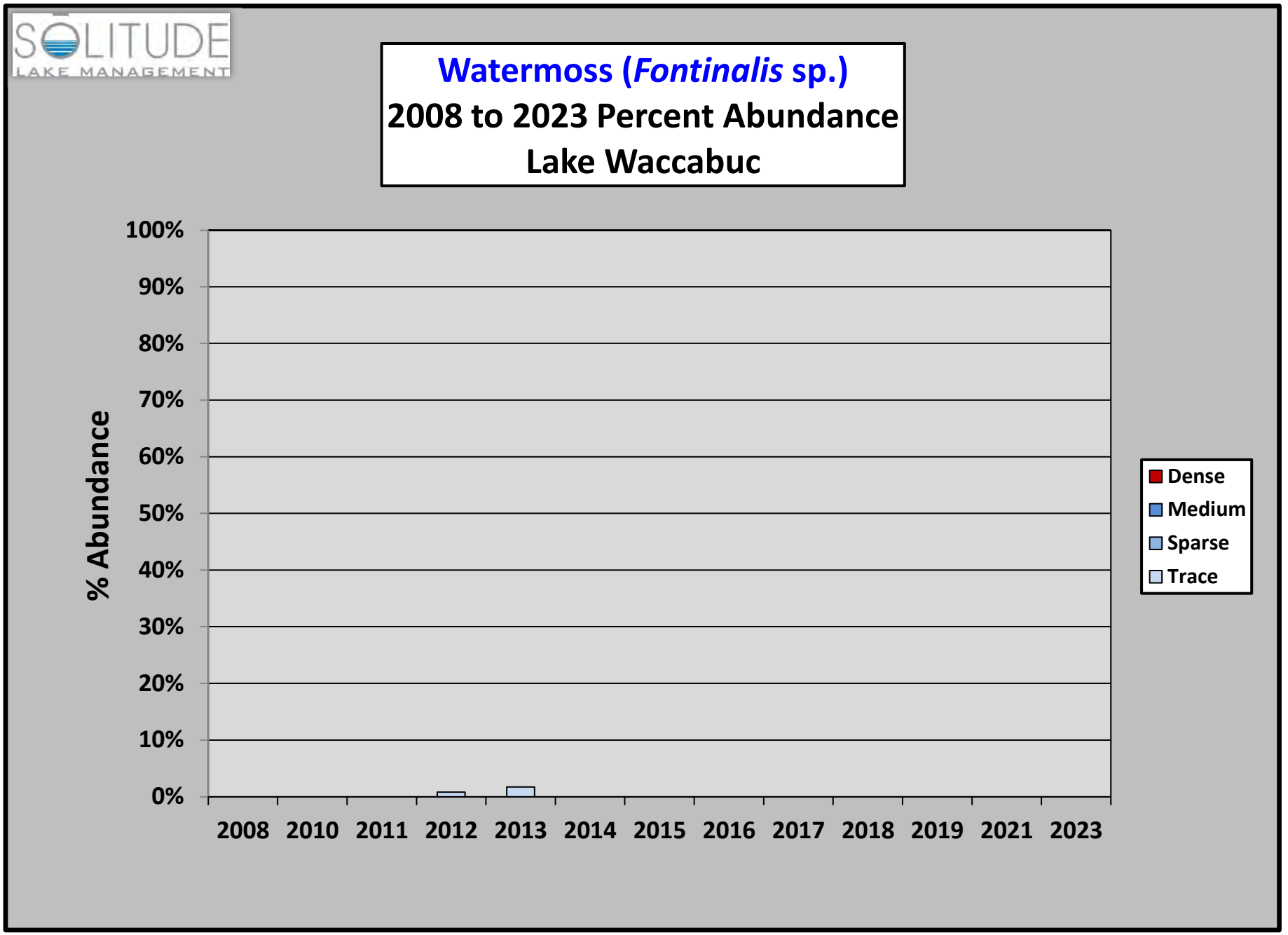
2021
2023
Dense
Medium
Sparse
Trace


SOLITUDE
LAKE MANAGEMENT
Watermoss (Fontinalis sp.)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2008
2010
2011
2012
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2014
2015
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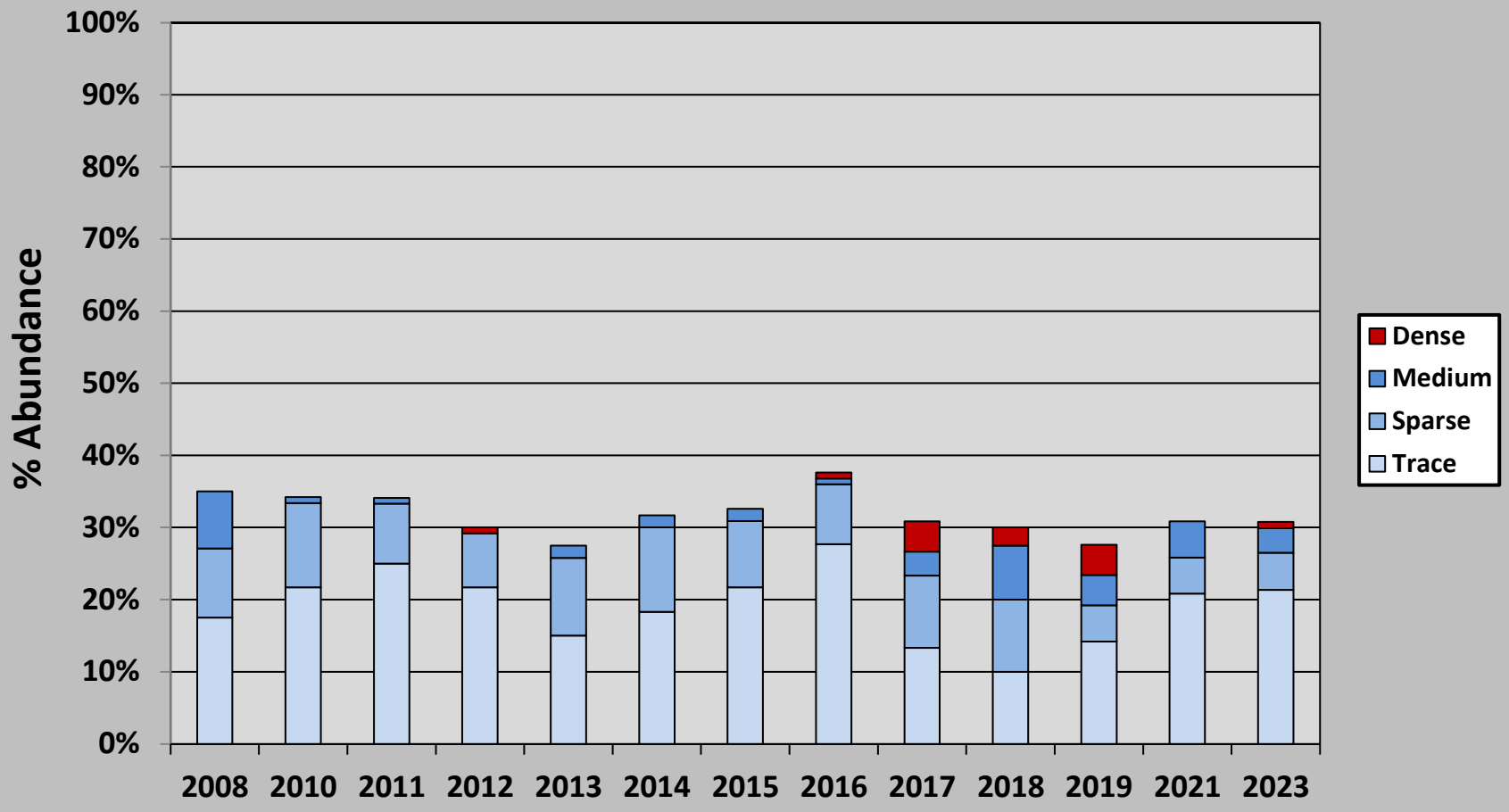
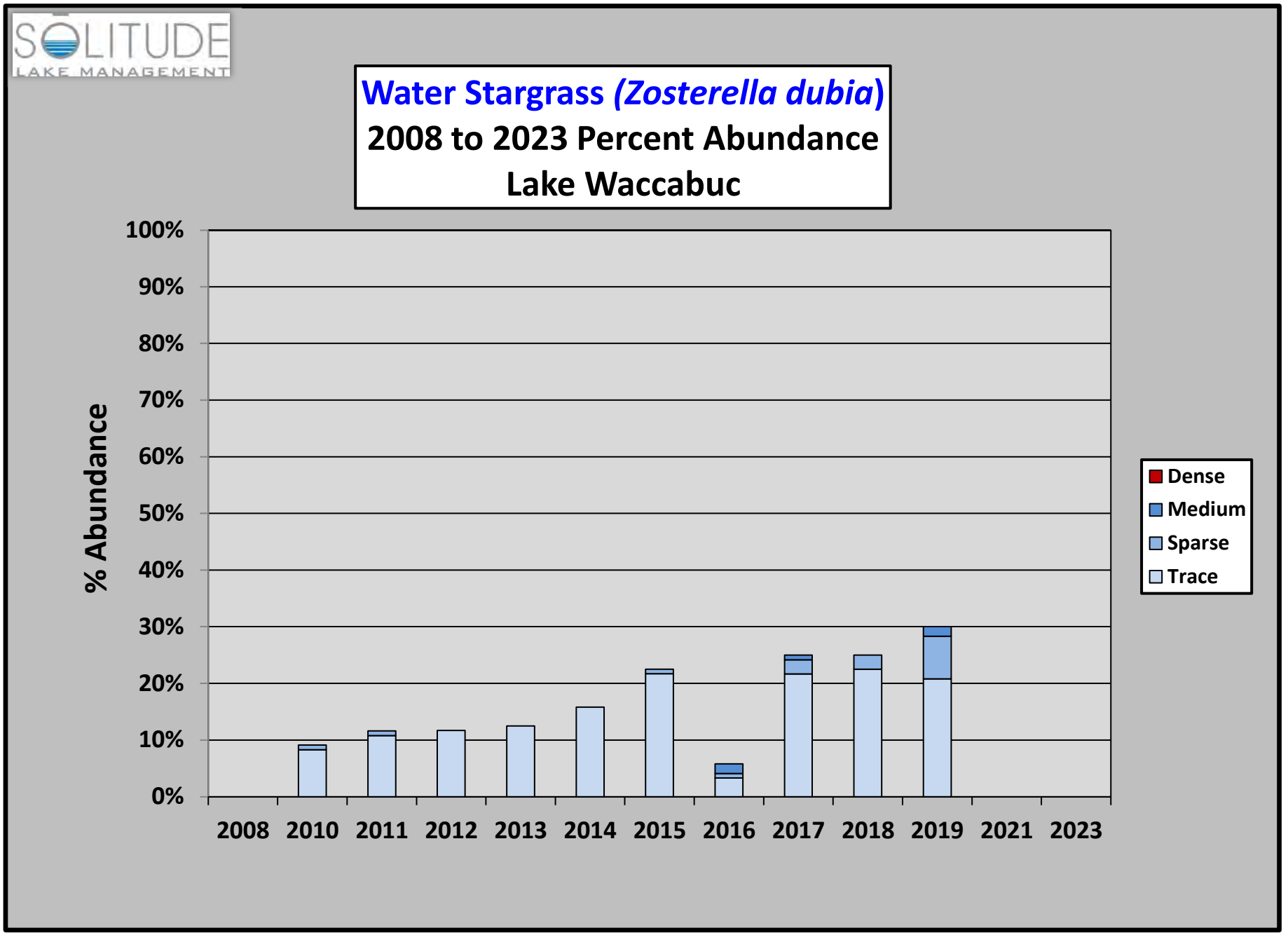
2017
2018
2019
2021
2023
Dense
Medium
Sparse
Trace

SOLITUDE LAKE MANAGEMENT

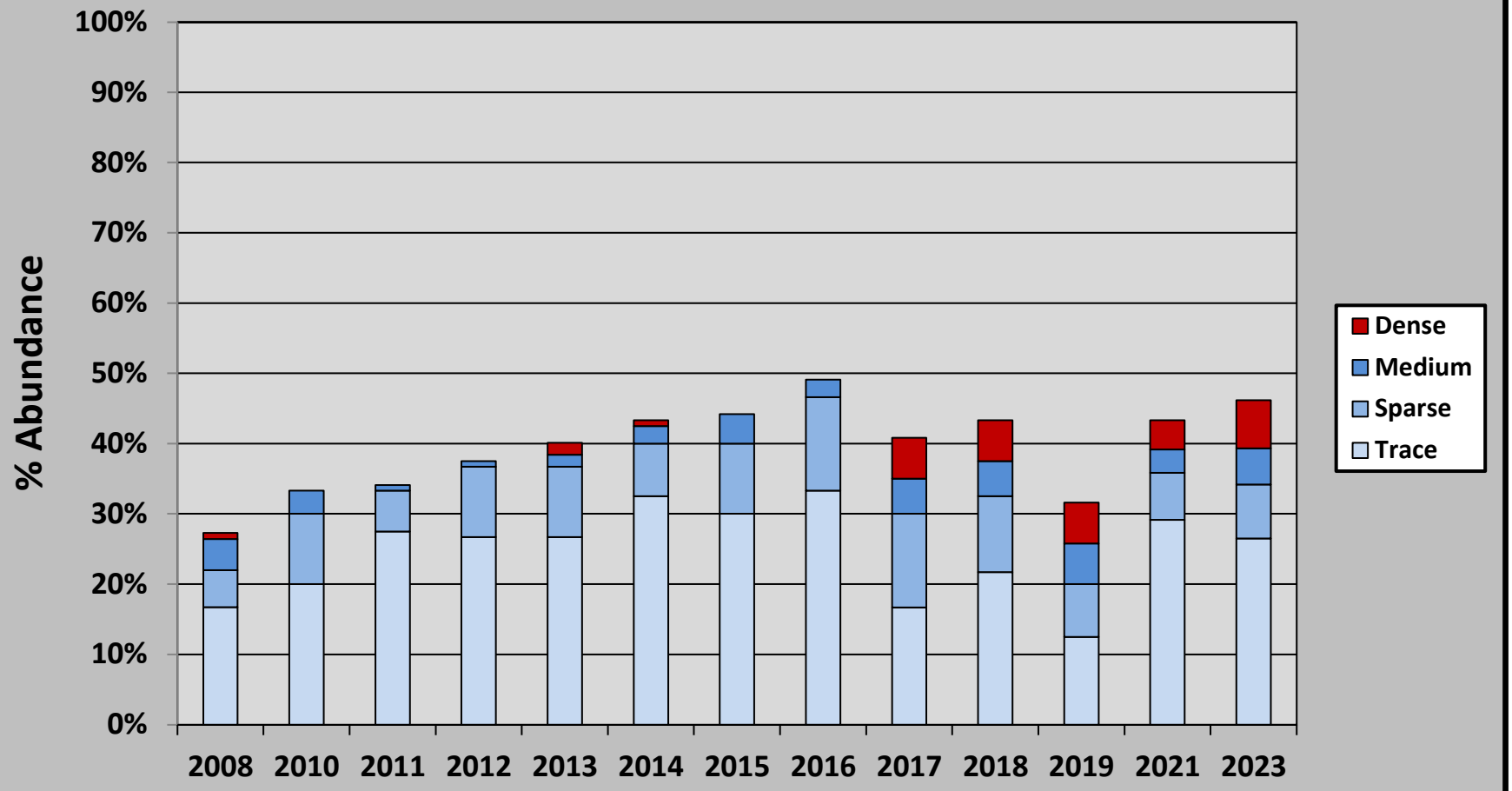
Watershield (*Brasenia schreberi*)
2008 to 2023 Percent Abundance
Lake Waccabuc




SOLITUDE
LAKE MANAGEMENT
Water Stargrass (Zosterella dubia)
2008 to 2023 Percent Abundance
Lake Waccabuc
% Abundance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2008
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2021
2023
Dense
Medium
Sparse
Trace

SOLITUDE LAKE MANAGEMENT

White Water Lily (*Nymphaea odorata*)
2008 to 2023 Percent Abundance
Lake Waccabuc



Lake Waccabuc
Aquatic Vegetation Survey
August 10, 2023

STATION	SAMPLE	LATITUDE (NAD83)	LONGITUDE (NAD83)	Depth (ft)	Total Submersed Vegetation	Total Floating Vegetation	Arrowhead	Bass Weed	Benthic Filamentous Algae	Common Waterweed	Coontail	Eurasian Water Milfoil	Floating Filamentous Algae	Great Duckweed	Pickerelweed	Purple Loosestrife	Robbins Pondweed	Small Bladderwort	Spatterdock	Water Shield	White Water Lily
1	A																				
1	B																				
1	C																				
1	M	41.297713°	-73.571637°	Innaccessible																	
2	A																				
2	B																				
2	C																				
2	M	41.297818°	-73.572004°	Innaccessible																	
3	A																				
3	B																				
3	C																				
3	M	41.297919°	-73.572367°	Innaccessible																	
4	A			1.5	S	D			S			T	T		T	T			D		S
4	B				M	D			M			S							D		S
4	C				S	D			S			S							D		S
4	M	41.298002°	-73.572754°	2	S	D			S			S	T		T	T			D		S
5	A			2	S	D			S			T	T		D				D	T	M
5	B				S	D			S			T	T		M				D	T	M
5	C				S	D			S						S				D	T	M
5	M	41.297913°	-73.573074°	2	S	D			S			T	T		M				D	T	M
6	A			3	S	D			D		T	S	D						D	T	S
6	B				D	D			D		T	M	S						M	T	T
6	C				D	D			D		T	S							M		T
6	M	41.29764°	-73.573063°	3	M	D			D		T	S	S						M	T	T
7	A			2.5	M	D			M		T	S	T						D		S
7	B				M	D			M			M	T						D		S
7	C				M	D			M			S	T						D		S
7	M	41.297719°	-73.572773°	3	M	D			M		T	S	T						D		S
8	A			2.5	D	D		T	D	D	D	S							T	D	D
8	B				D	M		T	D	M	D	M								M	M
8	C				D	S		T	D	M	T	M			T					S	S
8	M	41.297345°	-73.573038°	3	D	M		T	D	M	M	M			T				T	M	M
9	A			2.5	D	T		T	D	T	T	D					T	T		T	
9	B				D				D	T		D					T				
9	C				D				D	T	T	D									
9	M	41.297125°	-73.573167°	3	D	T		T	D	T	T	D					T	T		T	
10	A			2	M	D		T	M	T	T	T	T		T			T	T	S	D
10	B				S	D		T	S		S									S	D
10	C				S	D		T	S		T	T	T							S	D
10	M	41.297062°	-73.573482°	2	S	D		T	S	T	T	T	T		T			T	T	S	D
11	A			2.5	M	D		T	M	T	S	T			T			T	T	S	D
11	B				M	D			M		S							T		M	D
11	C				M	D			M	T	S	T						T		S	D
11	M	41.297419°	-73.573428°	3	M	D		T	M	T	S	T			T			T	T	S	D
12	A			5	D	D			D		T	T	M						D	T	T
12	B				T	M			T		T	S	S						M	T	T
12	C				T	M			T			T	M						T		
12	M	41.297692°	-73.573421°	5	S	M			S		T	T	M						M	T	T
13	A			3.5	S	D			T			S							D	T	S
13	B				T	D			T			T							D		T
13	C				S	D			T			S							D		S
13	M	41.297941°	-73.573496°	4	S	D			T			S							D	T	S
14	A			3	S	D			S		T	S							D		M
14	B				M	D			S			M							D		S
14	C				S	D			S		T	S							D		M
14	M	41.298244°	-73.573469°	3	S	D			S		T	S							D		M
15	A			2	M	D			T		T	M	T						D	T	S
15	B				M	M			T		T	M	T						M	S	M
15	C				M	D			T		T	M	T						D	T	S
15	M	41.298473°	-73.573792°	2	M	D			T		T	M	T						D	T	S
16	A			2.5	D	D			M			D							D	T	S
16	B				M				M			M									
16	C				M				M			S									
16	M	41.298191°	-73.573794°	3	M	T			M			M							T	T	T
17	A			5	D	M			M		T	D	M								
17	B				D	M			M		T	D	M								
17	C				D	M			M			D	M								
17	M	41.297884°	-73.573825°	5	D	M			M		T	D	M								
18	A			5	S							S									
18	B				D				M			D									
18	C				D				S			D									
18	M	41.297623°	-73.573768°	5	M				S			M									

Lake Waccabuc
Aquatic Vegetation Survey
August 10, 2023

STATION	SAMPLE	LATITUDE (NAD83)	LONGITUDE (NAD83)	Depth (ft)	Total Submersed Vegetation	Total Floating Vegetation	Arrowhead	Bass Weed	Benthic Filamentous Algae	Common Waterweed	Coontail	Eurasian Water Milfoil	Floating Filamentous Algae	Great Duckweed	Pickerelweed	Purple Loosestrife	Robbins Pondweed	Small Bladderwort	Spatterdock	Water Shield	White Water Lily
19	A			7	D							D									
19	B				D							D								T	
19	C				D							D									
19	M	41.297417°	-73.573808°	7	D							D								T	
20	A			3	D	M					T	D							S	T	M
20	B				D	M		T				D							T	M	
20	C				D	S		T				D								S	
20	M	41.297134°	-73.573708°	3	D	M		T			T	D							T	S	T
21	A			7.5	D							D									
21	B				D						T	D									
21	C				D							D									
21	M	41.297058°	-73.57418°	8	D						T	D									
22	A			11.5																	
22	B																				
22	C																				
22	M	41.297448°	-73.574157°	12																	
23	A			12																	
23	B				T				T			T									
23	C				T				T			T									
23	M	41.297696°	-73.574235°	12	T				T			T									
24	A			10	T						T	T									
24	B				S				S			T									
24	C				T				T			T									
24	M	41.297922°	-73.574122°	10	T				T		T	T									
25	A			4.5	D				D			S									
25	B				D				D			M									
25	C				D				D			S									
25	M	41.298234°	-73.574188°	5	D				D			S									
26	A			3	M	M			T			M	M								S
26	B				D	M			M			D									M
26	C				D	S			D			M	T								S
26	M	41.298519°	-73.574167°	3	D	M			M			M	T								S
27	A			3	D	S			D			S	S	T							T
27	B				D	S			D			M	S	T							T
27	C				D	S			D			S	S	T							T
27	M	41.29852°	-73.574638°	3	D	S			D			S	S	T							T
28	A			13	T	T			T					T							
28	B				T				T												
28	C				T				T												
28	M	41.298181°	-73.574559°	13	T	T			T					T							
29	A			3.5	D	T			S		T	D								T	T
29	B				M							M									
29	C				M	T			T			M									T
29	M	41.296966°	-73.574516°	4	M	T			T		T	M								T	T
30	A			5	D						T	D									
30	B				D						D	M									
30	C				D						D	M									
30	M	41.297039°	-73.575209°	5	D						M	M									
31	A			3.5	D	T					T	D									T
31	B				D						T	D									
31	C				D						T	D									
31	M	41.296835°	-73.57609°	4	D	T					T	D									T
32	A			4.5	D						T	D									
32	B				D							D									
32	C				D			T			T	D					T				
32	M	41.296643°	-73.576377°	5	D			T			T	D					T				
33	A			4.5	T							T					T				
33	B				T							T									
33	C				T							T									
33	M	41.296586°	-73.576756°	5	T							T					T				
34	A			11																	
34	B																				
34	C																				
34	M	41.296564°	-73.577181°	11																	
35	A			18																	
35	B																				
35	C																				
35	M	41.296606°	-73.577476°	18																	
36	A			4	S	M						S							S	M	
36	B				M	M						M							M	M	
36	C				S	M						S							S	M	
36	M	41.296282°	-73.5775°	4	S	M						S							S	M	

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STATION	SAMPLE	LATITUDE (NAD83)	LONGITUDE (NAD83)	Depth (ft)	Total Submersed Vegetation	Total Floating Vegetation	Arrowhead	Bass Weed	Benthic Filamentous Algae	Common Waterweed	Coontail	Eurasian Water Milfoil	Floating Filamentous Algae	Great Duckweed	Pickerelweed	Purple Loosestrife	Robbins Pondweed	Small Bladderwort	Spatterdock	Water Shield	White Water Lily
37	A			4.5	M	S					T	M							S	S	T
37	B				S	M						S							M	M	
37	C				M	M						M							S	M	
37	M	41.296255°	-73.57714°	5	M	M					T	M							S	M	T
38	A			4	M	T						M					T			T	T
38	B				M							M									
38	C				M	T						M								T	
38	M	41.296273°	-73.576709°	4	M	T						M					T			T	T
39	A			3	M	D					T	M					T			T	D
39	B				M	D					T	S								T	D
39	C				S	D					T	S					T			T	D
39	M	41.295993°	-73.576724°	3	M	D					T	S					T			T	D
40	A			3	M	M						M					T			M	T
40	B				M	S						M								S	
40	C				M	M						M					T			M	T
40	M	41.296055°	-73.577133°	3	M	M						M					T			M	T
41	A			3	T	S					T	T								T	S
41	B					S															S
41	C				T							T									
41	M	41.295762°	-73.577017°	3	T	T					T	T								T	T
42	A			3.5	T	S					T	T					T		S	T	T
42	B				M	M						M							M		
42	C				S	S						S					T		S		T
42	M	41.296053°	-73.577429°	4	S	S					T	S					T		S	T	T
43	A			2.5																	
43	B																				
43	C																				
43	M	41.29636°	-73.577875°	3																	
44	A			12		T													T		
44	B																				
44	C																				
44	M	41.296536°	-73.578542°	12		T													T		
45	A			4	T							T									
45	B																				
45	C																				
45	M	41.296478°	-73.579316°	4	T							T									
46	A			3																	
46	B																				
46	C																				
46	M	41.296412°	-73.580224°	3																	
47	A			4.5	T							T									
47	B				T							T									
47	C				T							T									
47	M	41.296542°	-73.581069°	5	T							T									
48	A			4.5																	
48	B																				
48	C																				
48	M	41.296511°	-73.581778°	5																	
49	A			3.5																	
49	B																				
49	C																				
49	M	41.296582°	-73.582606°	4																	
50	A			4.5	T	T	T					T								T	
50	B				T							T									
50	C				T	T	T					T								T	
50	M	41.296417°	-73.583399°	5	T	T	T					T								T	
51	A			3	T	T	T					T					T				
51	B				T							T									
51	C				T							T									
51	M	41.296244°	-73.584188°	3	T	T	T					T					T				
52	A			3	D	M					M	D					T				M
52	B				D	M						D									M
52	C				D	M						D									M
52	M	41.295979°	-73.585063°	3	D	M					T	D					T				M
53	A			8	T							T									
53	B				S							S									
53	C				T							T									
53	M	41.296512°	-73.586169°	8	T							T									
54	A			6	D	S			T			D								T	S
54	B				M	M						M									M
54	C				M	M						M									M
54	M	41.29675°	-73.586787°	6	M	M			T			M								T	M

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STATION	SAMPLE	LATITUDE (NAD83)	LONGITUDE (NAD83)	Depth (ft)	Total Submersed Vegetation	Total Floating Vegetation	Arrowhead	Bass Weed	Benthic Filamentous Algae	Common Waterweed	Coontail	Eurasian Water Milfoil	Floating Filamentous Algae	Great Duckweed	Pickerelweed	Purple Loosestrife	Robbins Pondweed	Small Bladderwort	Spatterdock	Water Shield	White Water Lily
55	A			6	S	T						S									T
55	B				M							M									
55	C				S							S									
55	M	41.296857°	-73.587467°	6	S	T						S									T
56	A			9																	
56	B																				
56	C																				
56	M	41.296934°	-73.58833°	9																	
57	A			6	D	S			T			D								T	S
57	B				D	S						D									S
57	C				D	S			T			D									S
57	M	41.296765°	-73.589146°	6	D	S			T			D								T	S
58	A			12																	
58	B																				
58	C																				
58	M	41.296541°	-73.589935°	12																	
59	A			7	T	S						T									S
59	B					S															S
59	C					S															S
59	M	41.296349°	-73.590817°	7	T	S						T									S
60	A			3.5	T	T											T			T	
60	B				S												S				
60	C				S												S				
60	M	41.29645°	-73.591649°	4	S	T											S			T	
61	A			8	T							T									
61	B																				
61	C																				
61	M	41.296376°	-73.592372°	8	T							T									
62	A			5.5	D	S			T			D	S							T	T
62	B				D	S			T			D	S								
62	C				D	S			T			D	S							T	
62	M	41.296266°	-73.593276°	6	D	S			T			D	S							T	T
63	A			6	D	S			T			D	S							T	T
63	B				M	S						M	S								T
63	C				D	S			T			D	S								T
63	M	41.296041°	-73.594035°	6	D	S			T			D	S							T	T
64	A			6.5	D	M			T			D	M		T					T	T
64	B				M	M			T			M	M							T	T
64	C				D	M			T			D	M							T	T
64	M	41.295827°	-73.594979°	7	D	M			T			D	M		T					T	T
65	A			1																	
65	B																				
65	C																				
65	M	41.296354°	-73.595653°	1																	
66	A			7	S	M						S	M		T					S	S
66	B				M	M						M	M		T					S	S
66	C				S	M						S	M		T					S	T
66	M	41.296976°	-73.595741°	7	S	M						S	M		T					S	S
67	A			8	D	D			T			D	S								D
67	B				D	D			T			D	S								D
67	C				D	D			T			D	S								D
67	M	41.297297°	-73.594999°	8	D	D			T			D	S								D
68	A			3.5	D	D						D	T							D	T
68	B				M	D						M								D	S
68	C				D	D						D								D	S
68	M	41.297631°	-73.594181°	4	D	D						D	T							D	S
69	A			5	S	S						S	S		T					S	T
69	B				M	S						M	T							S	S
69	C				S	S						S	S		T					S	T
69	M	41.298366°	-73.593558°	5	S	S						S	S		T					S	T
70	A			5	D	D						D	D		T						D
70	B				M	D						M	M								D
70	C				D	D						D	D		T						D
70	M	41.298618°	-73.593°	5	D	D						D	D		T						D
71	A			4.5	S	T			T			S	T		T					T	T
71	B				S	T			T			S	T								T
71	C				S	T			T			S	T		T					T	T
71	M	41.29857°	-73.592166°	5	S	T			T			S	T		T					T	T
72	A			9.5	M	D			T			M	D		T					T	M
72	B				M	D			T			M	D		T						M
72	C				M	D			T			M	D		T						M
72	M	41.298898°	-73.591659°	10	M	D			T			M	D		T					T	M

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STATION	SAMPLE	LATITUDE (NAD83)	LONGITUDE (NAD83)	Depth (ft)	Total Submersed Vegetation	Total Floating Vegetation	Arrowhead	Bass Weed	Benthic Filamentous Algae	Common Waterweed	Coontail	Eurasian Water Milfoil	Floating Filamentous Algae	Great Duckweed	Pickerelweed	Purple Loosestrife	Robbins Pondweed	Small Bladderwort	Spatterdock	Water Shield	White Water Lily
73	A			4.5	T	T			T			T									T
73	B				S	T			T			S									
73	C				T	T			T			T									
73	M	41.298934°	-73.590831°	5	T	T			T			T									T
74	A			20																	
74	B																				
74	C																				
74	M	41.298483°	-73.59016°	20																	
75	A			4	T							T									
75	B																				
75	C				T							T									
75	M	41.298625°	-73.589103°	4	T							T									
76	A			5	S	T			T			S	T								T
76	B				S	S						S									S
76	C				S	T						S									T
76	M	41.298849°	-73.588326°	5	S	T			T			S	T								T
77	A			9	T							T									
77	B																				
77	C																				
77	M	41.299055°	-73.587559°	9	T							T									
78	A			14																	
78	B																				
78	C																				
78	M	41.299327°	-73.586625°	14																	
79	A			3.5																	
79	B																				
79	C																				
79	M	41.299522°	-73.585825°	4																	
80	A			13																	
80	B																				
80	C																				
80	M	41.299551°	-73.585034°	13																	
81	A			11																	
81	B																				
81	C																				
81	M	41.29984°	-73.584129°	11																	
82	A			6	S							S									
82	B				S							S									
82	C				S							S									
82	M	41.299143°	-73.583351°	6	S							S									
83	A			6	S			T	T		T	S									
83	B				M							M									
83	C				S						T	S									
83	M	41.299347°	-73.582934°	6	S			T	T		T	S									
84	A			9	S	D						S	T								D
84	B				M	M						M	T								M
84	C				S	D						S	T								D
84	M	41.299375°	-73.582604°	9	S	D						S	T								D
85	A			6	T	T						T									T
85	B																				
85	C				T	T						T									T
85	M	41.299073°	-73.58251°	6	T	T						T									T
86	A			6	M	T						M	T								T
86	B				S	T						S	T								
86	C				M	T						M	T								T
86	M	41.298926°	-73.582887°	6	M	T						M	T								T
87	A			6.5	T							T									
87	B																				
87	C				T							T									
87	M	41.298883°	-73.583351°	7	T							T									
88	A			24																	
88	B																				
88	C																				
88	M	41.300246°	-73.583392°	24																	
89	A			18																	
89	B																				
89	C																				
89	M	41.300647°	-73.582293°	18																	
90	A			4																	
90	B																				
90	C																				
90	M	41.300876°	-73.581731°	4																	

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STATION	SAMPLE	LATITUDE (NAD83)	LONGITUDE (NAD83)	Depth (ft)	Total Submersed Vegetation	Total Floating Vegetation	Arrowhead	Bass Weed	Benthic Filamentous Algae	Common Waterweed	Coontail	Eurasian Water Milfoil	Floating Filamentous Algae	Great Duckweed	Pickerelweed	Purple Loosestrife	Robbins Pondweed	Small Bladderwort	Spatterdock	Water Shield	White Water Lily
91	A			10	T							T									
91	B																				
91	C				T							T									
91	M	41.301002°	-73.581321°	10	T							T									
92	A			8																	
92	B																				
92	C																				
92	M	41.301026°	-73.581062°	8																	
93	A			4	D	D			D			M	D								T
93	B				D	M			D			M	M								
93	C				D	D			D			M	D								
93	M	41.300993°	-73.580658°	4	D	D			D			M	D								T
94	A			2.5	D	T			D			S	T								
94	B				M	T			M			M	T								
94	C				D	T			D			S	T								
94	M	41.300914°	-73.580279°	3	D	T			D			S	T								
95	A			1.5	D	S			D			S	S								T
95	B				D	S			D			M	S								T
95	C				D	S			D			S	S								T
95	M	41.300743°	-73.580272°	2	D	S			D			S	S								T
96	A			1.5	D	T			S			D	T								T
96	B				D				S			D									
96	C				D				S			D									
96	M	41.300518°	-73.580674°	2	D	T			S			D	T								T
97	A			3.5	D	T			S			D	T								
97	B				D				S			D									
97	C				D				S			D									
97	M	41.300782°	-73.580769°	4	D	T			S			D	T								
98	A			2.5	T	D						T	T								D
98	B					D															D
98	C					D															D
98	M	41.300204°	-73.581088°	3	T	D						T	T								D
99	A			6.5	T							T									
99	B																				
99	C																				
99	M	41.300485°	-73.581057°	7	T							T									
100	A			13.5																	
100	B																				
100	C																				
100	M	41.300814°	-73.581077°	14																	
101	A			19																	
101	B																				
101	C																				
101	M	41.300772°	-73.581508°	19																	
102	A			22																	
102	B																				
102	C																				
102	M	41.300546°	-73.581475°	22																	
103	A			3	S	D			T			S			T				T	T	D
103	B				M	D						M								S	D
103	C				S	D						S								T	D
103	M	41.300214°	-73.581383°	3	S	D			T			S			T				T	T	D
104	A			10	S	T						S	T								T
104	B				M	T						M	T								
104	C				S	T						S	T								
104	M	41.299838°	-73.581605°	10	S	T						S	T								T
105	A			15	T							T									
105	B																				
105	C																				
105	M	41.299473°	-73.581707°	15	T							T									
106	A			11.5	T	T						T									T
106	B				T							T									
106	C				T							T									
106	M	41.299371°	-73.581071°	12	T	T						T									T
107	A			10	T							T									
107	B																				
107	C				T							T									
107	M	41.299203°	-73.580142°	10	T							T									
108	A			14	T							T									
108	B																				
108	C				T							T									
108	M	41.29929°	-73.579378°	14	T							T									

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109	A			8	T	T	T					T								T	T
109	B				S	S						S								T	S
109	C				T	T						T								T	T
109	M	41.29928°	-73.578785°	8	T	T	T					T								T	T
110	A			2	S	S						S					T			S	T
110	B				M	S						M								S	
110	C				S	S						S								S	
110	M	41.299198°	-73.578561°	2	S	S						S					T			S	T
111	A			2	T				T			T					T				
111	B																				
111	C				T				T												
111	M	41.299005°	-73.578469°	2	T				T			T					T				
112	A			2	T			T				T					T				
112	B				T							T									
112	C				T							T									
112	M	41.298784°	-73.57864°	2	T			T				T					T				
113	A			5.5	S						T	S					T				
113	B				S							S									
113	C				S							S									
113	M	41.299112°	-73.578739°	6	S						T	S					T				
114	A			4	S				T		T	S									
114	B				M							M									
114	C				S							S									
114	M	41.298589°	-73.578812°	4	S				T		T	S									
115	A			2	T							T									
115	B																				
115	C																				
115	M	41.298193°	-73.57897°	2	T							T									
116	A			9.5	T							T									
116	B																				
116	C				T							T									
116	M	41.298049°	-73.578477°	10	T							T									
117	A			18	T	T	T					T									
117	B																				
117	C				T							T									
117	M	41.298274°	-73.577818°	18	T	T	T					T									
118	A			14	T							T									
118	B																				
118	C				T							T									
118	M	41.298222°	-73.576921°	14	T							T									
119	A			2.5	S	T		T				S								T	T
119	B				M	S		S				M									S
119	C				S	T		T				S									T
119	M	41.298329°	-73.576048°	3	S	T		T				S								T	T
120	A			5	D	D			D			D							D		T
120	B				D	D			D			D							D		
120	C				D	D			D			D							D		
120	M	41.298473°	-73.575102°	5	D	D			D			D							D		T

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Aquatic Macrophyte Abundance Distribution
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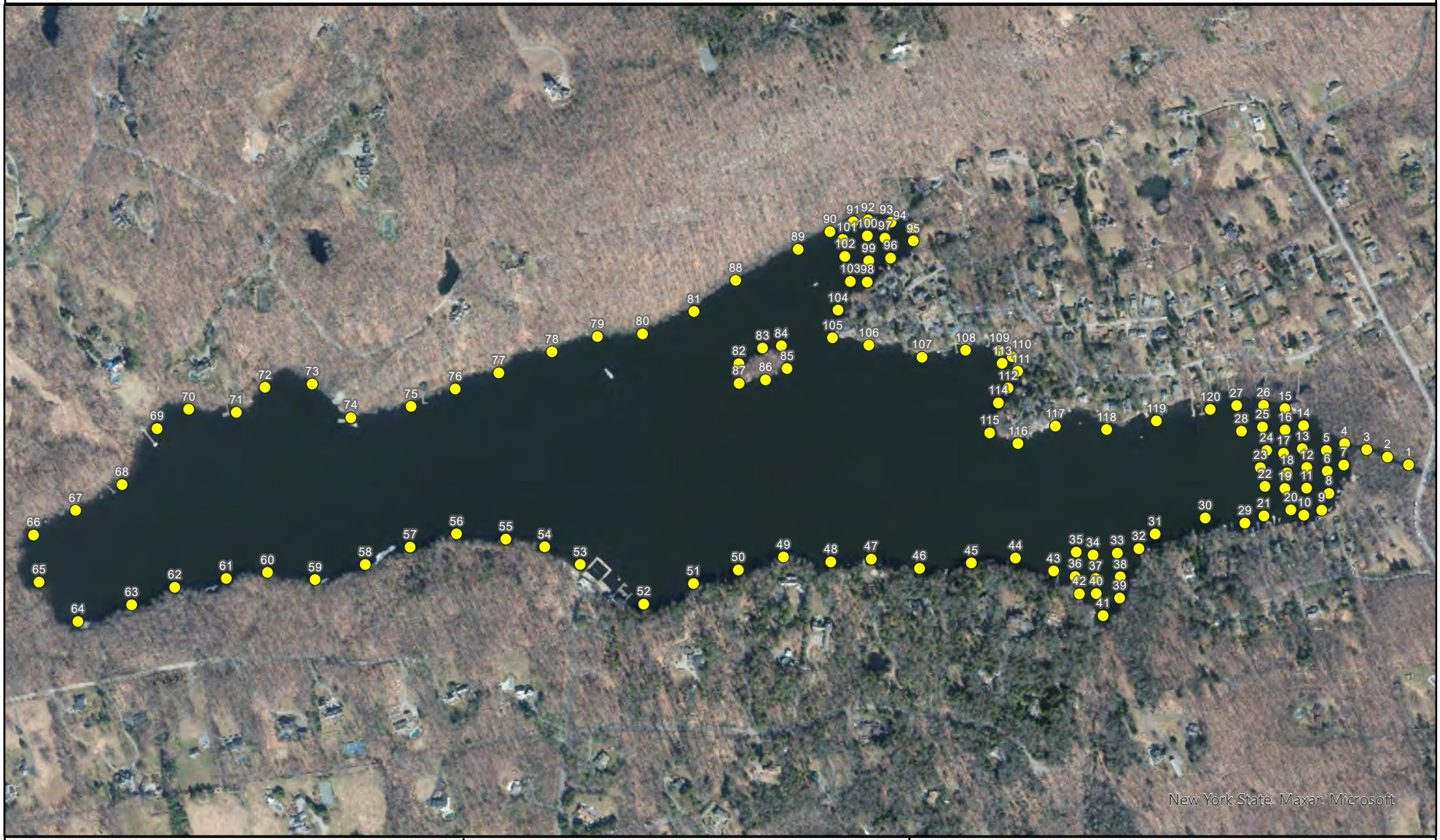
Aquatic Macrophyte	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
TOTAL SITES	117									
Total Submersed Vegetation	94	80%	31	33%	23	24%	14	15%	26	28%
Eurasian Water Milfoil	92	79%	34	37%	26	28%	14	15%	18	20%
Benthic Filamentous Algae	42	36%	20	48%	8	19%	5	12%	9	21%
Coontail	25	21%	22	88%	1	4%	2	8%	0	0%
Robbins Pondweed	14	12%	13	93%	1	7%	0	0%	0	0%
Bass Weed	9	8%	9	100%	0	0%	0	0%	0	0%
Common Waterweed	4	3%	3	75%	0	0%	1	25%	0	0%
Small Bladderwort	3	3%	3	100%	0	0%	0	0%	0	0%
Total Floating Vegetation	65	56%	25	38%	9	14%	12	18%	19	29%
White Water Lily	54	46%	31	57%	9	17%	6	11%	8	15%
Water Shield	36	31%	25	69%	6	17%	4	11%	1	3%
Floating Filamentous Algae	30	26%	16	53%	7	23%	4	13%	3	10%
Spatterdock	19	16%	7	37%	3	16%	2	11%	7	37%
Pickerelweed	12	10%	11	92%	0	0%	1	8%	0	0%
Arrowhead	4	3%	4	100%	0	0%	0	0%	0	0%
Great Duckweed	2	2%	2	100%	0	0%	0	0%	0	0%
Purple Loosestrife	1	1%	1	100%	0	0%	0	0%	0	0%

SAMPLE POINT LOCATION

SOLITUDE LAKE MANAGEMENT



LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed,
3 inaccessible

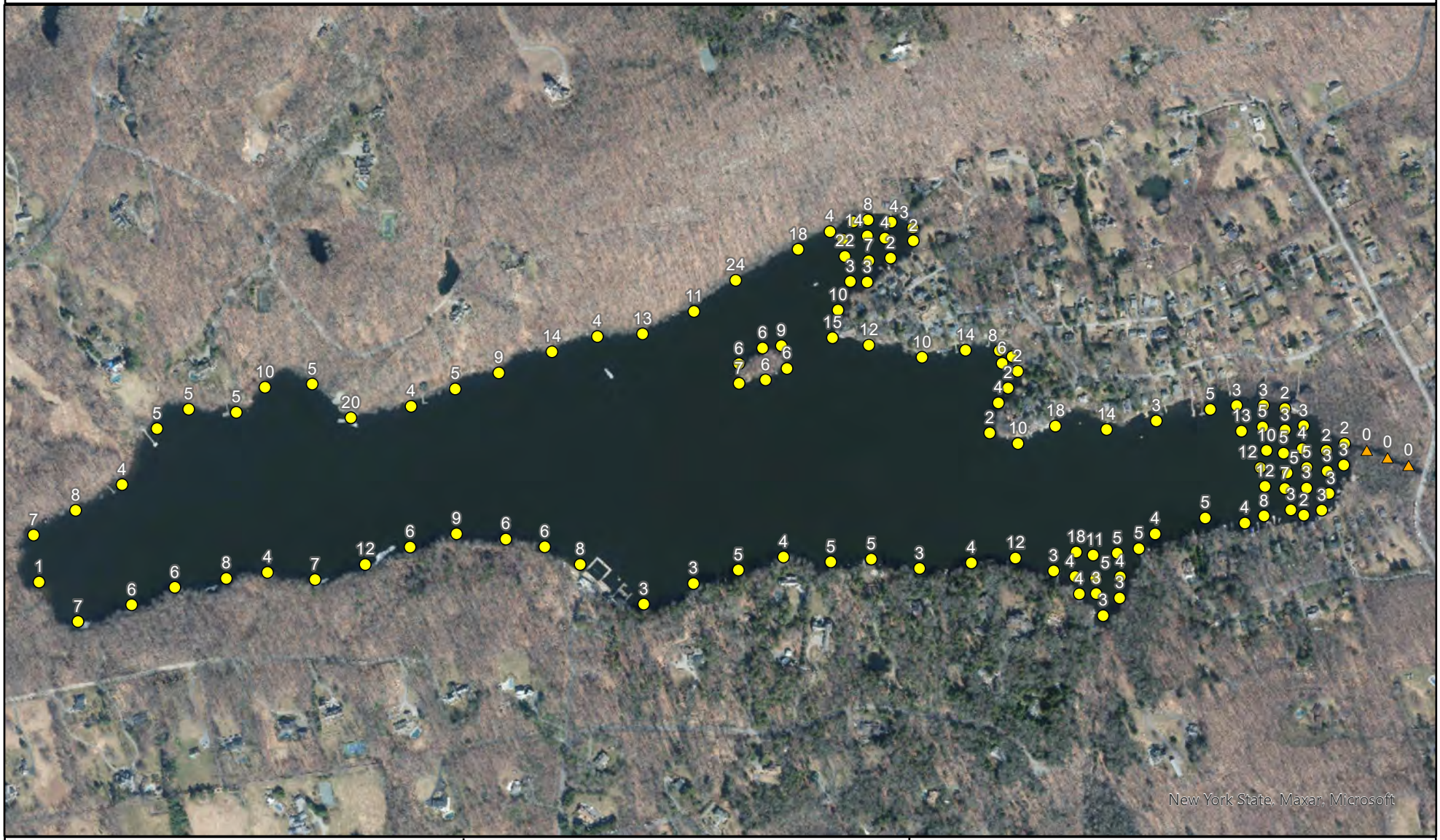
Sample Point

N

0 900 1,800 Feet

WATER DEPTH

SOLITUDE LAKE MANAGEMENT



LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 120

▲ Not accessible

● Water Depth in Feet

N

0 900 1,800 Feet

TOTAL SUBMERSED VEGETATION

SOLITUDE LAKE MANAGEMENT

LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density

- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

Abundance	Sites	Percent
Total	94	80%
Trace	31	33%
Sparse	23	24%
Medium	14	15%
Dense	26	28%

0 750 1,500 Feet

TOTAL FLOATING VEGETATION

SOLITUDE LAKE MANAGEMENT

LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 120, 117 surveyed, 3 inaccessible

Plant Density

- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

Abundance	Sites	Percent
Total	65	56%
Trace	25	38%
Sparse	9	14%
Medium	12	18%
Dense	19	29%

0 750 1,500 Feet

ARROWHEAD *(Sagittaria sp.)* DISTRIBUTION

SOLITUDE LAKE MANAGEMENT

LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density
- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

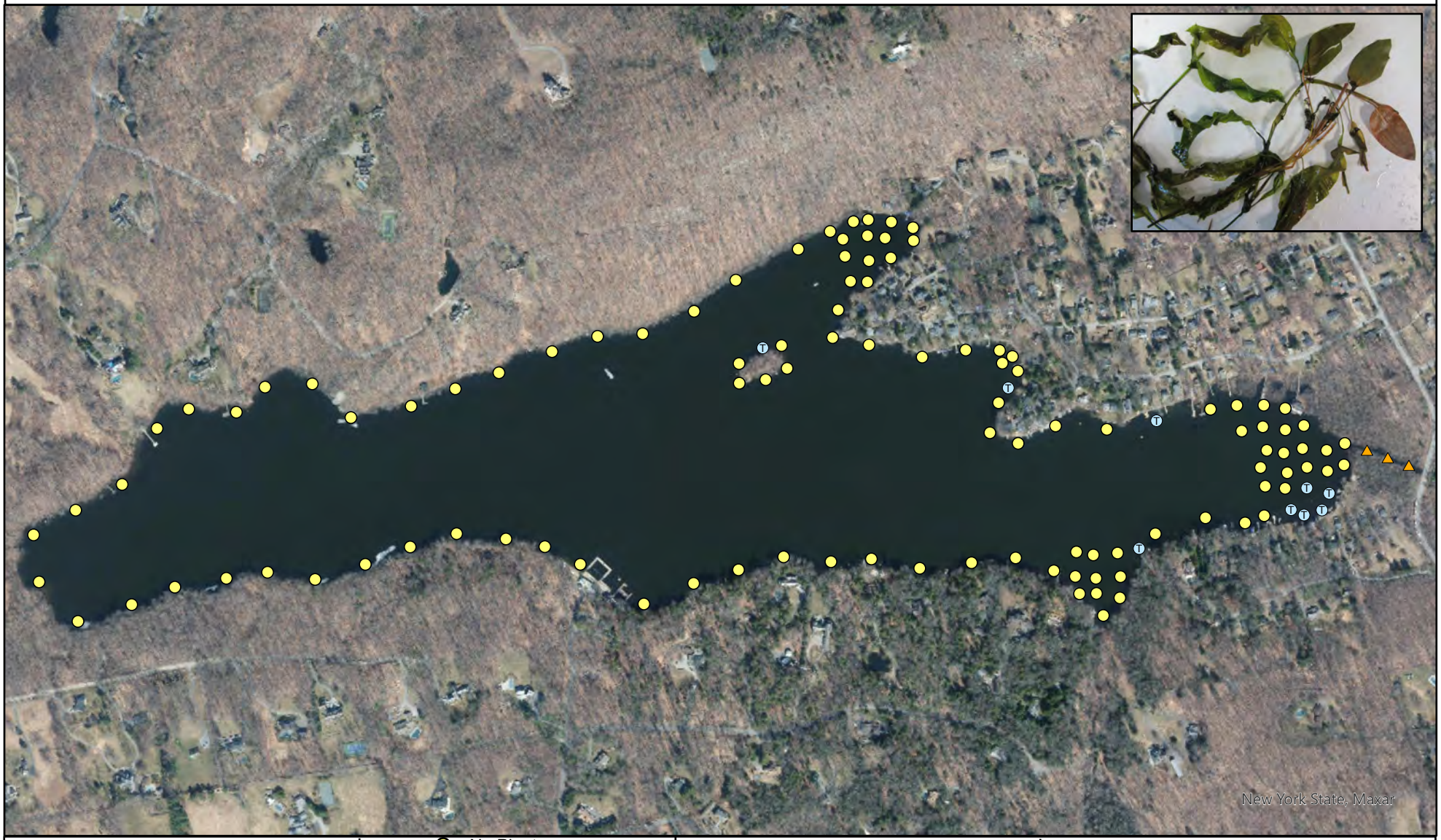
Abundance	Sites	Percent
Total	4	3%
Trace	4	100%
Sparse	0	0%
Medium	0	0%
Dense	0	0%

N

0 650 1,300 Feet

BASSWEED *(Potamogeton amplifolius)*
DISTRIBUTION

SOLITUDE LAKE MANAGEMENT



LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density
- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

Abundance	Sites	Percent
Total	9	8%
Trace	9	100%
Sparse	0	0%
Medium	0	0%
Dense	0	0%

N

0 650 1,300 Feet

BENTHIC FILAMENTOUS ALGAE DISTRIBUTION

SOLITUDE LAKE MANAGEMENT

LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 120, 117 surveyed, 3 inaccessible

Plant Density

- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

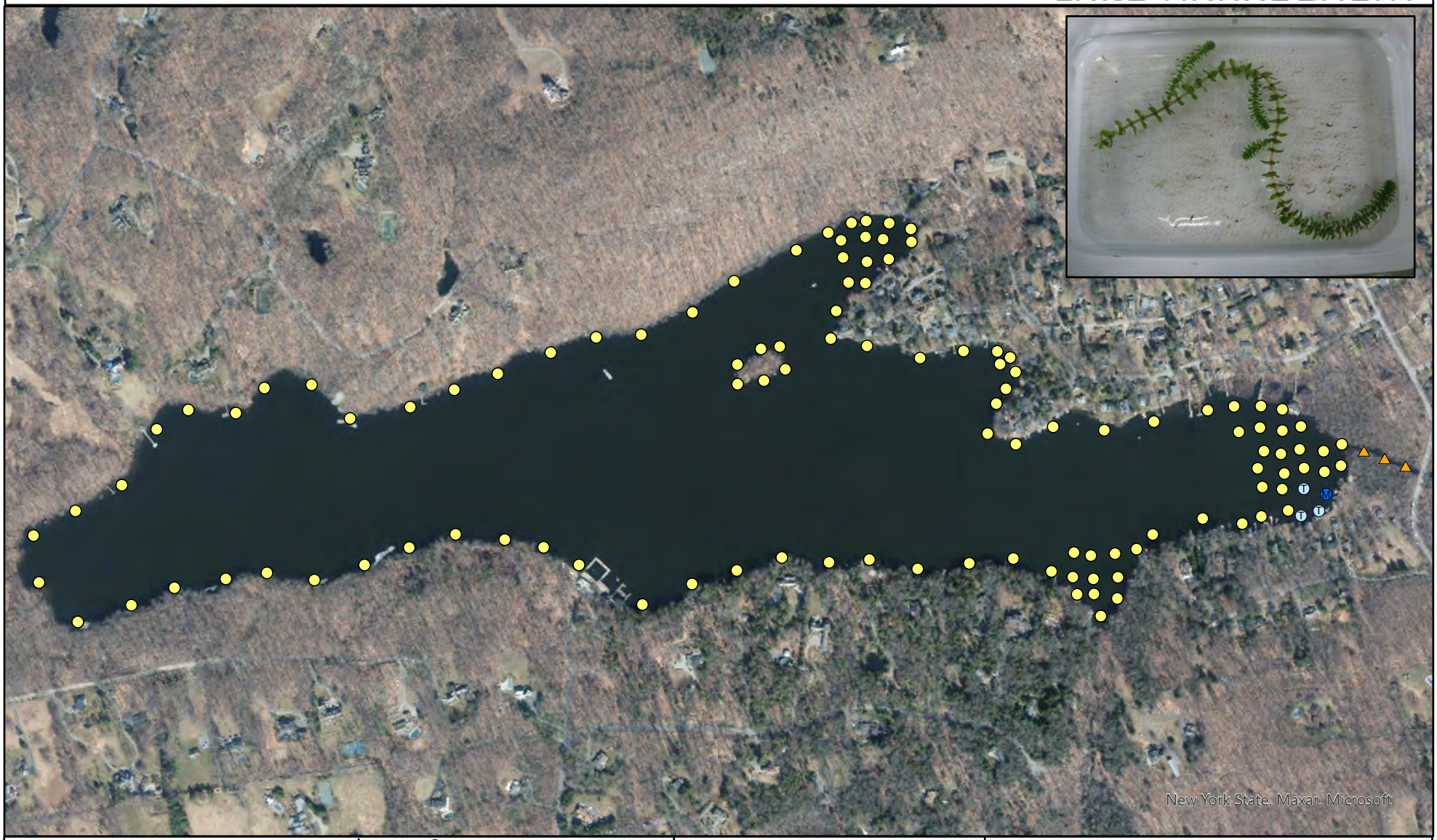
Abundance	Sites	Percent
Total	42	36%
Trace	20	48%
Sparse	8	19%
Medium	5	12%
Dense	9	21%

N

0 750 1,500 Feet

COMMON WATERWEED *(Elodea canadensis)* DISTRIBUTION

SOLITUDE LAKE MANAGEMENT



LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 120, 117 surveyed, 3 inaccessible

Plant Density

- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

Abundance	Sites	Percent
Total	4	3%
Trace	3	75%
Sparse	0	0%
Medium	1	25%
Dense	0	0%

0 750 1,500 Feet

COONTAIL *(Ceratophyllum demersum)*
DISTRIBUTION

SOLITUDE LAKE MANAGEMENT

LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density
- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

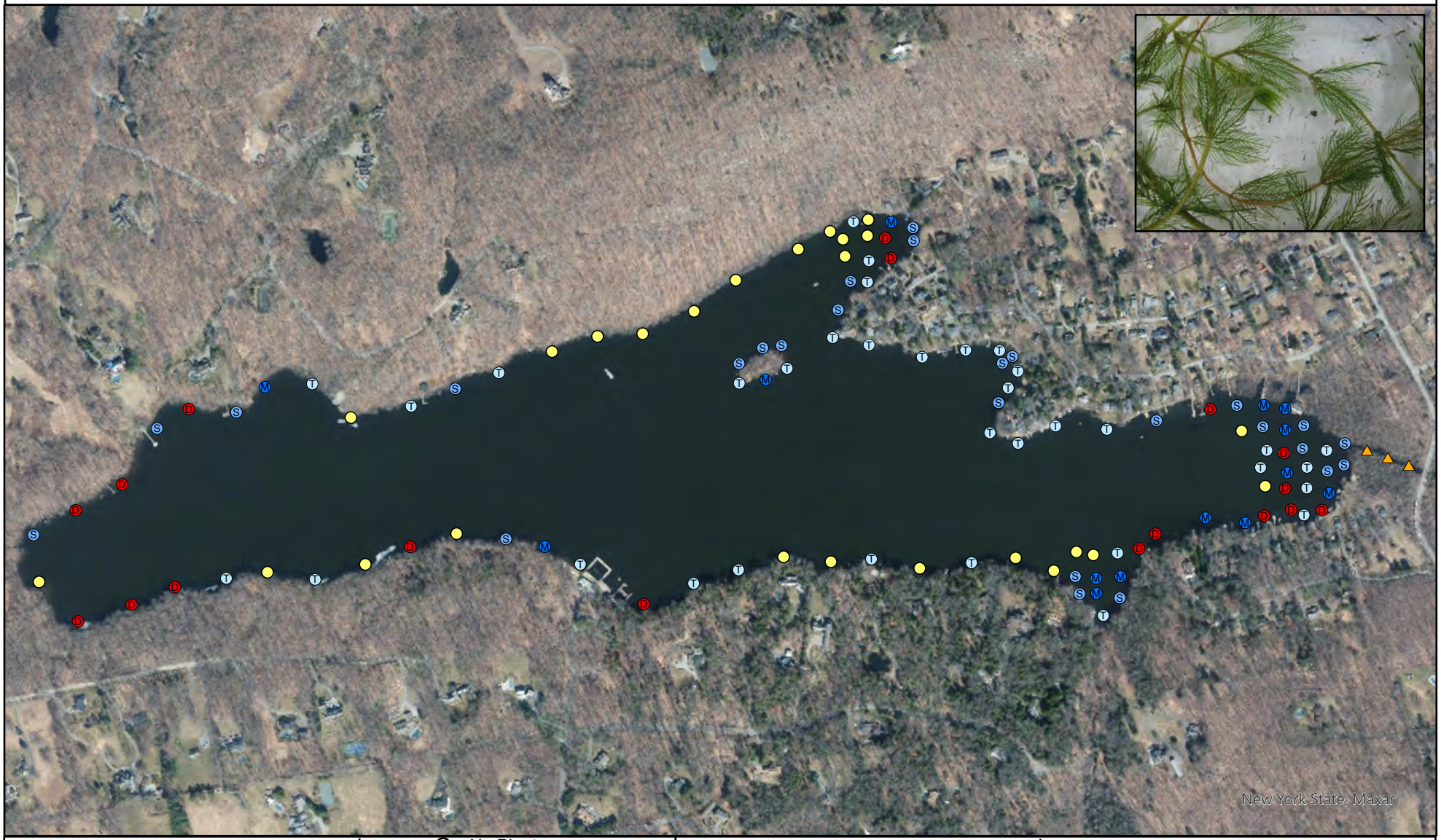
Abundance	Sites	Percent
Total	25	21%
Trace	22	88%
Sparse	1	4%
Medium	2	8%
Dense	0	0%

N

0 650 1,300 Feet

EURASIAN WATERMILFOIL *(Myriophyllum spicatum)* DISTRIBUTION

SOLITUDE LAKE MANAGEMENT



LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density
- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

Abundance	Sites	Percent
Total	92	79%
Trace	34	37%
Sparse	26	28%
Medium	14	15%
Dense	18	20%

N

0 650 1,300 Feet

FLOATING FILAMENTOUS ALGAE DISTRIBUTION

SOLITUDE LAKE MANAGEMENT

LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 120, 117 surveyed, 3 inaccessible

Plant Density

- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

Abundance	Sites	Percent
Total	30	26%
Trace	16	53%
Sparse	7	23%
Medium	4	13%
Dense	3	10%

0 750 1,500 Feet

GREATER DUCKWEED *(Spirodela polyrrhiza)* DISTRIBUTION

SOLITUDE LAKE MANAGEMENT

LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density
- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

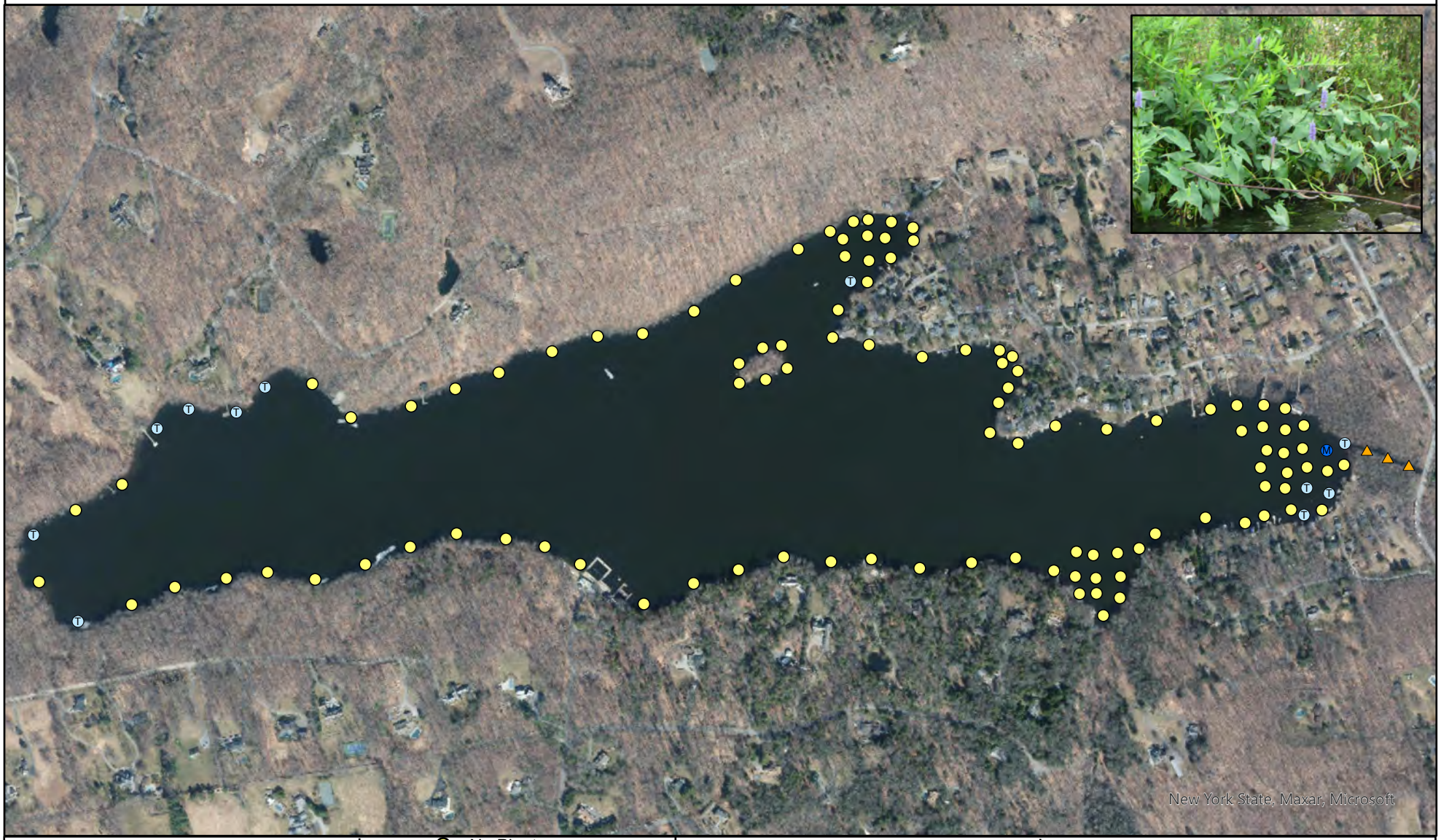
Percent Distribution

Abundance	Sites	Percent
Total	2	2%
Trace	2	100%
Sparse	0	0%
Medium	0	0%
Dense	0	0%

0 650 1,300 Feet

PICKERELWEED *(Pontederia cordata)*
DISTRIBUTION

SOLITUDE LAKE MANAGEMENT



LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density
- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

Abundance	Sites	Percent
Total	12	10%
Trace	11	92%
Sparse	0	0%
Medium	1	8%
Dense	0	0%

N

0 650 1,300 Feet

PURPLE LOOSESTRIFE *(Lythrum salicaria)* DISTRIBUTION

SOLITUDE LAKE MANAGEMENT

LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density

- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

Abundance	Sites	Percent
Total	1	1%
Trace	1	100%
Sparse	0	0%
Medium	0	0%
Dense	0	0%

N

0 650 1,300 Feet

ROBBINS' PONDWEED *(Potamogeton robbinsii)* DISTRIBUTION

SOLITUDE LAKE MANAGEMENT

LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density
- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

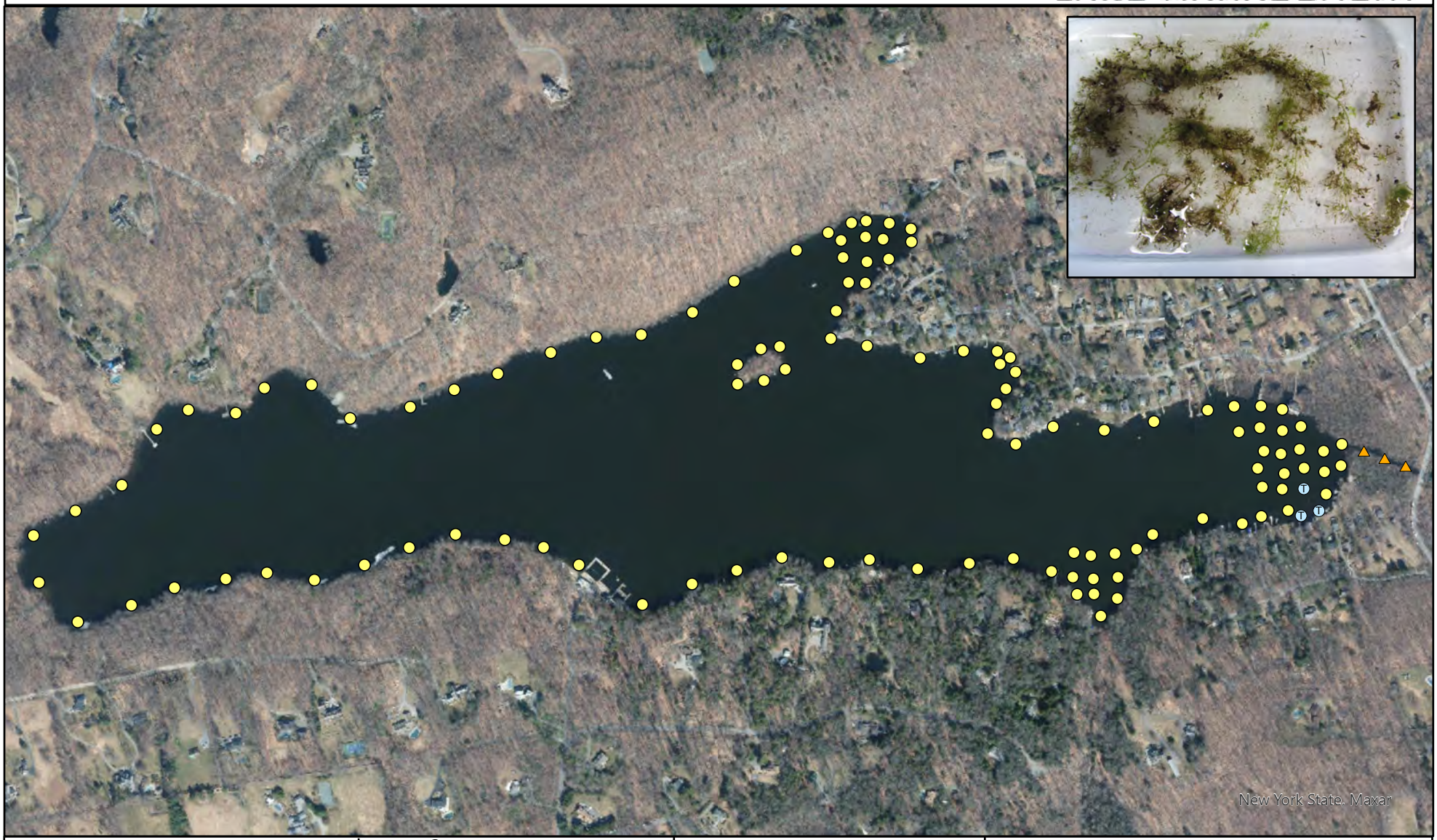
Abundance	Sites	Percent
Total	14	12%
Trace	13	93%
Sparse	1	7%
Medium	0	0%
Dense	0	0%

N

0 650 1,300 Feet

SMALL BLADDERWORT *(Utricularia minor)* DISTRIBUTION

SOLITUDE LAKE MANAGEMENT



LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 120, 117 surveyed, 3 inaccessible

Plant Density

- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

Abundance	Sites	Percent
Total	3	3%
Trace	3	100%
Sparse	0	0%
Medium	0	0%
Dense	0	0%

N

0 750 1,500 Feet

SPATTERDOCK *(Nuphar variegata)* DISTRIBUTION

SOLITUDE LAKE MANAGEMENT

LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density
- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

Abundance	Sites	Percent
Total	19	16%
Trace	7	37%
Sparse	3	16%
Medium	2	11%
Dense	7	37%

N

0 650 1,300 Feet

WATERSHIELD *(Brasenia schreberi)* DISTRIBUTION

SOLITUDE LAKE MANAGEMENT

LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density

- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

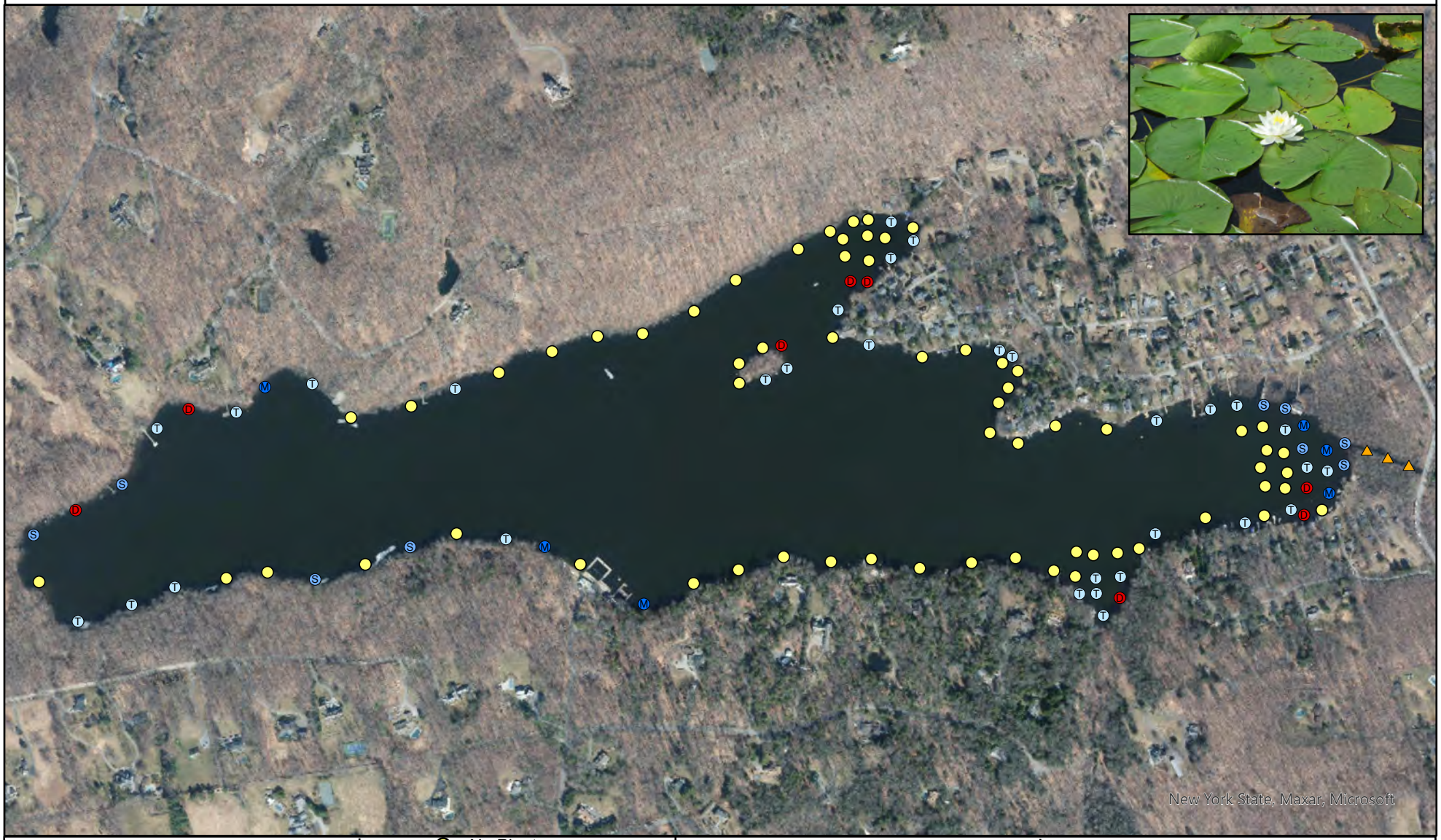
Abundance	Sites	Percent
Total	36	31%
Trace	25	69%
Sparse	6	17%
Medium	4	11%
Dense	1	3%

N

0 650 1,300 Feet

WHITE WATERLILY *(Nymphaea odorata)* DISTRIBUTION

SOLITUDE LAKE MANAGEMENT



LAKE WACCABUC
Aquatic Vegetation Survey
August 10, 2023

Sampling Stations: 117 surveyed, 3 inaccessible

Plant Density
- No Plants
- Trace Plants
- Sparse Plants
- Medium Plants
- Dense Plants
- Not accessible

Percent Distribution

Abundance	Sites	Percent
Total	54	46%
Trace	31	57%
Sparse	9	17%
Medium	6	11%
Dense	8	15%

N

0 650 1,300 Feet