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Conservation

Croton Hydrilla Control Project

2018 ANNUAL UPDATE

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Andrew M. Cuomo, Governor | Basil Seggos, Commissioner



**CROTON HYDRILLA CONTROL PROJECT
2018 ANNUAL UPDATE**

Division of Lands and Forests
Bureau of Invasive Species and Ecosystem Health

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List of Acronyms

CFS	Cubic Feet per Second (1 cfs = 1.858 million gallons per day)
DEC	New York State Department of Environmental Conservation
DLF	DEC Division of Lands and Forests
NYCDEP	New York City Department of Environmental Protection
DOH	New York State Department of Health
EPA	United States Environmental Protection Agency
PPB	Parts per Billion (1 ppb = 1 microgram per liter)
PRISM	Partnership for Regional Invasive Species Management
SAV	Submerged Aquatic Vegetation

Year in Review

Through the ongoing work of the New York State Department of Environmental Conservation's (DEC) Division of Lands and Forests (DLF) and its partners, the Croton Hydrilla Control Project successfully completed the second year (2018) of a five-year treatment project. *Hydrilla verticillata*, an aquatic plant from Asia, is one of the most difficult aquatic invasive species to control and eradicate in the United States. Hydrilla is easily spread by its fragments, turions, and tubers. Turions are overwintering buds found where leaves attach to stems. Tubers are potato-like reproductive structures that form on the roots of the plant each fall and allow hydrilla to store energy and regenerate the following spring. Infestations can have negative impacts on recreation, tourism, and aquatic ecosystems. If the Croton River hydrilla infestation reaches the Hudson River, the tide could potentially spread it along 153 miles of estuary to connecting tributaries and beyond.



Figure 1: Healthy hydrilla in Croton River in 2016 (top), and damaged, chlorotic hydrilla following the second treatment season in 2018 (bottom).

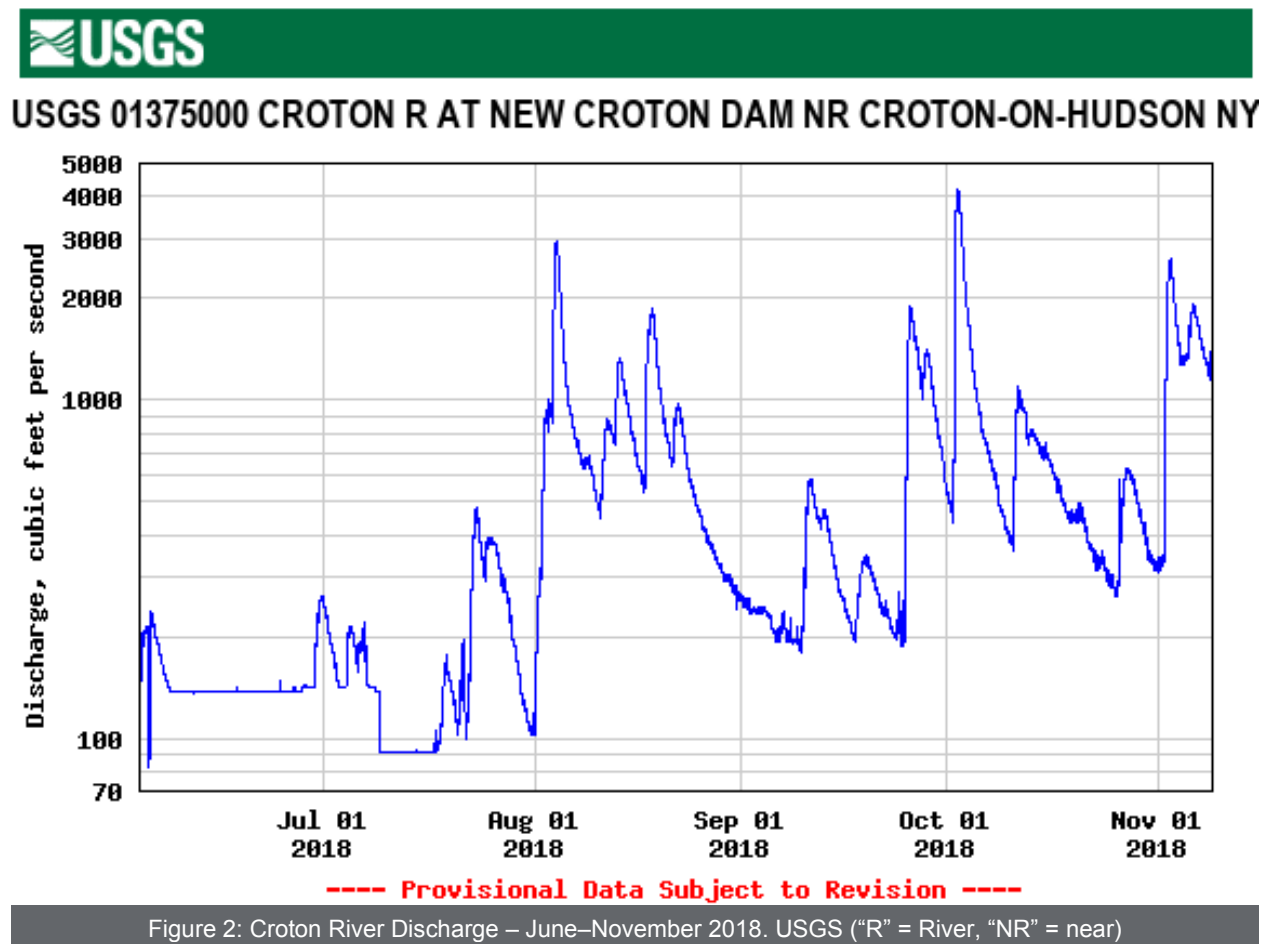
2018 Highlights

- 471 points on the Croton River were surveyed for submerged aquatic vegetation (SAV) in 2018, and hydrilla was present at 18% of the survey points (down from 34% in 2017, and 87% in 2016).
- Hydrilla plants occurred in trace and sparse abundance in 2018. No moderately dense or dense populations were observed.
- During treatment, hydrilla plants showed significant signs of injury and impacts to plant fitness.
- Hydrilla tuber density in the Croton River decreased by 83.6% from 2017 to 2018 in sites sampled.
- No non-target impacts on water celery, a native plant of concern, were observed.
- Twice-weekly drinking water sampling revealed fluridone levels well below USEPA and NYSDOH maximum levels.
- 1,458 points were sampled for SAV at 29 high-priority sites along the lower Hudson River Estuary and no hydrilla was present.
- 3,764 points were sampled for SAV at 18 sites along the upper Hudson River Estuary and no hydrilla was present.

2018 Challenges

Record Rainfall

Sustained and record rainfall amounts caused treatment shutdowns throughout the 2018 season. A Pesticide Discharge Management Plan (PDMP) was developed as an operational protocol as part of the State Pollutant Discharge Elimination System (SPDES) permit. In 2018, the PDMP for this project targeted treatment in waters flowing at a rate less than 500 cubic feet per second (cfs) in an effort to ensure fluridone concentrations would remain within the target range of 2.0-4.0 parts per billion (ppb). Discharge (the volume of water in the Croton River) results from a combination of controlled bottom releases (using doors at the base of the New Croton Dam) and water spilling over the top of the Dam. Discharge is measured at the United States Geological Survey (USGS) Hydrological Station 01375000 (located along the Croton River, 1,000 feet downstream of the New Croton Dam). Discharge regularly measured above 500 cfs during the 2018 treatment season including during intense storms in August and October (Figure 2). In total, 55 treatment shutdown days occurred during the 2018 treatment season due to storms. The longest shutdown period occurred following storms during August and lasted 14 consecutive days.



Water Temperature

While high flows were the dominant trend during the 2018 treatment season, low flows impacted the first month of treatment in June. Because little rainfall occurred during this month, there was little spill from the New Croton Dam.

Without warm rainwater spilling from the surface of the reservoir, cold water enters the Croton River solely through controlled bottom release. Therefore, the water temperature in the Croton River during the first month of treatment (June) was below 50 degrees Fahrenheit. Hydrilla germination from tubers is not typical under 50 degrees Fahrenheit, and so hydrilla growth was limited in the upper portion of the Croton River during this time. The lower third of the Croton River is tidally influenced and river temperatures were warm enough in that section to germinate hydrilla tubers during June 2018.

Didymo

A bloom of didymo (*Didymosphenia germinata*), also known as “rock snot,” occurred in the Croton River during the spring and summer of 2018. While didymo has been found in the West Branch of the Croton River in the past, the extent and magnitude of the 2018 bloom was unprecedented. Didymo was also found in Indian Brook, which is a tributary to the Croton River and located upstream of the fluridone treatment. Didymo is a microscopic algae (diatom) that can form thick brown mats on stream bottoms (Figure 3). Didymo blooms typically occur in cool, clear, nutrient-poor water. It is possible that the thick growing mats impacted the early 2018 hydrilla growth by limiting the amount of sunlight reaching the bottom of the river. The didymo bloom was scoured away during intense rainfall in July and August 2018.



Figure 3: Didymo at Croton Gorge Park (left) and Silver Lake Beach (right), 2018.

Partnerships

In 2018, the Croton River Hydrilla Control Project relied on strong working relationships and collaborative efforts with a variety of organizations and groups. While DEC serves as the lead agency for this project, Village of Croton-on-Hudson staff, specifically those in the village's Water Department, were vital to the success of monitoring efforts.

Outreach

Outreach plays a significant role in the project by addressing concerns about recreation, drinking water, and the spread of invasive species.

A public meeting detailing plans for 2018 season operations was held on May 23, 2018, at the village municipal building in Croton-on-Hudson.

Throughout the 2018 season, several organizations, including the Hudson River Sloop Clearwater and the Lower Hudson Partnership for Regional Invasive Species Management (LH PRISM) provided outreach and education about this treatment project in an effort to reduce the risk of spreading hydrilla into the Hudson River. Additionally, during monthly New York State Hydrilla Task Force calls led by DLF's Bureau of Invasive Species and Ecosystem Health, project staff shared information with other New York regions and neighboring states combating hydrilla.

Webpage

DEC's hydrilla webpage (www.dec.ny.gov/animals/104790.html) provides information on this prohibited invasive plant, while a separate webpage discusses the Croton Hydrilla Treatment Project (www.dec.ny.gov/animals/106386.html). These webpages are frequently accessed by people from New York State and around the world. People visited the hydrilla webpage 2,299 times and the project page 714 times during 2018. Drinking water was monitored throughout the project for fluridone levels, and results were made available to the public on DEC's Water Sample Analysis webpage (www.dec.ny.gov/animals/110624.html), which was visited 335 times in 2018.

Looking Forward

Despite many weather-related challenges, the treatment of hydrilla in the Croton River was successful in 2018. The Croton River Hydrilla Control Project Five-Year Management Plan continues to provide the framework for decision-making and adaptive management strategies. We will continue to build upon past experience with each year of treatment. We will continue to communicate regularly with the New York City Department of Environmental Protection (NYCDEP) regarding the necessary treatment of the source of the hydrilla infestation in the New Croton Reservoir.

Table of Contents

List of Acronyms	ii
Year in Review	iii
2018 Highlights	iii
2018 Challenges	iv
• Record Rainfall	iv
• Water Temperature	v
• Didymo	v
Partnerships	vi
Outreach	vi
Webpage	vi
Looking Forward	vi
Introduction	1
About Hydrilla	1
The Croton River Hydrilla Control Project	1
2018 Permitting	2
2018 Field Season Activities	2
Herbicide Treatments	2
Water Quality Sampling	3
Submerged Aquatic Vegetation Surveys	5
• 2018 SAV Findings	9
• Aerial Drone SAV Mapping	9
• Hudson River SAV Surveys	9
Plant Tissue Sampling	11
Hydrilla Tuber Monitoring	12
Macroinvertebrate Sampling	13
Water Sample Analysis	13
Hydrilla Fact Sheet and ID	13
Outreach & Partnerships	13
Conclusion	14
Sources	15
Appendix A: Helpful Links	16

Tables and Figures

Table 1. 2018 Croton River Macrophytes	9
Table 2. 2018 Hudson River High-Priority Sites for Hydrilla	10
Table 3. 2018 Upper Hudson River Estuary SAV Sites.	11
Figure 1: Hydrilla Appearance before and after 2018 Treatment.....	iii
Figure 2: Croton River Discharge June–November 2018	iv
Figure 3: Didymo in the Croton River 2018.....	v
Figure 4: <i>Hydrilla verticillata</i>	1
Figure 5: Fluridone Injection Units	2
Figure 6: 2018 Drinking Water Analysis for Fluridone.	4
Figure 7: 2018 Croton River Total Phosphorus	4
Figure 8: 2018 Distribution System Water Analysis for Fluridone.	5
Figure 9: 2016–2018 Percent Hydrilla Abundance Croton River: Black Rock Park	6
Figure 10: 2016–2018 Percent Hydrilla Abundance Croton River: Silver Lake Beach.....	6
Figure 11: 2016–2018 Percent Hydrilla Abundance Croton River: River Islands	7
Figure 12: 2016–2018 Percent Hydrilla Abundance Croton River: Lower Portion.....	7
Figure 13: 2016–2018 Percent Hydrilla Abundance Croton River: Lower Coves.....	8
Figure 14: 2016–2018 Percent Hydrilla Abundance Croton River: Wetland Bay	8
Figure 15. 2016–2018 Croton River Hydrilla Tuber Density	12

Introduction

About Hydrilla

Hydrilla, or “water thyme” (*Hydrilla verticillata*), is a vascular aquatic plant from Asia that is one of the most difficult invasive species to control and eradicate in the United States. Infestations can have negative impacts on recreation, tourism, and aquatic ecosystems. Hydrilla has been a popular aquarium plant for many years; however, it is now listed by the federal government as a “noxious weed.” New York State law prohibits possession of hydrilla with the intent to sell, import, purchase, transport, introduce, or propagate it under 6 *New York Codes, Rules and Regulations Part 575 Prohibited and Regulated Invasive Species*.

In New York State, hydrilla is a perennial plant that emerges in late spring to early summer and grows along the bottom of wetlands, rivers, streams, lakes, and ponds. Its monoecious form (containing both male and female organs on the same plant) is capable of overwintering in New York State. Hydrilla can grow up to an inch per day, producing dense mats of vegetation that extend from the river bottom to the surface of the water. The dense mats displace the native plants that provide the food, water, and shelter for native aquatic wildlife.

To propagate, hydrilla can produce seeds, green buds called turions, and tubers that grow in the sediment at the end of the roots and store energy. New populations of hydrilla can sprout from seeds, turions, and tubers, as well as from plant fragments that easily break off of the plant. These extremely effective dispersal methods make manual control of hydrilla extremely difficult in New York State.



Figure 4: *Hydrilla verticillata*

The Croton River Hydrilla Control Project

DLF has been monitoring the hydrilla infestation since its discovery in the Croton River in October 2013. Control and eradication methods in the Croton River are based on an adaptive management strategy outlined in the Croton River Hydrilla Control Project Five-Year Management Plan. A link to the Five-Year Plan can be found in Appendix A: Helpful Links. This annual update outlines the accomplishments of the treatment project in 2018 (Year 2).

2018 Permitting

DLF's Invasive Species Coordination Section obtained the following permits in order to operate during the 2018 treatment season:

- Article 15 Aquatic Pesticide Permit AV-3-17-505, issued 5/23/2018¹ (Expired 10/31/18)
- Article 24 Freshwater Wetlands Permit, issued 6/29/17 (Expires 12/31/2021)
- Special Local Needs Permit for Sonar® Genesis from New York State Department of Health (DOH), issued 04/15/2017 (Expires 12/31/2021)
- SPDES General Permit GP-0-16-005, Acknowledgement of NOI, issued 5/19/2017 (Expires 10/31/2021)
- Westchester County Land Use Permit, issued 5/9/2018 (Expires 12/31/2021)
- NYCDEP Temporary Land Use Permit, issued 6/29/2017 (Expires 6/28/2022)

2018 Field Season Activities

Herbicide Treatments

The 2018 herbicide treatment involved injecting the aquatic herbicide fluridone (tradename: Sonar® Genesis [EPA Reg. No. 67690-54]) into the Croton River at a concentration of 2.0–4.0 parts per billion (ppb) for 60–120 days. Information about the efficacy of low-dose fluridone treatments of infested flowing waters can be found in the Croton River Hydrilla Control Project Five-Year Management Plan. Links to the plan and the NYS Special Local Needs Label for Sonar® Genesis can be found in Appendix A: Helpful Links. Sonar® Genesis is a liquid herbicide (active ingredient: fluridone) that was applied to the river via subsurface injection from remote-controlled (via cell phone) injection systems placed at two locations on the Croton River.

The first injection site was located just below New Croton Dam and a second injection site was located near the concrete dam at Black Rock Park. Injection locations were selected in order to maximize treatment coverage and ensure product mixing (that the herbicide mixed

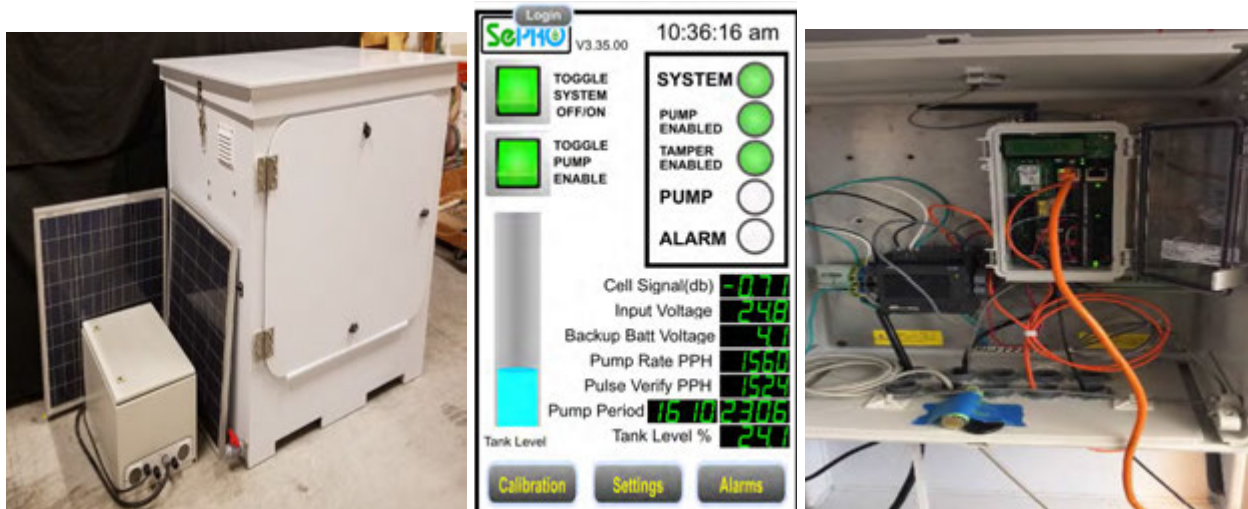


Figure 5: A fluridone injection unit (left), unit control dashboard (center), and cellular control device (right). SePRO

¹ DEC Aquatic Pesticide Permit AV-3-8-505 initially issued 05/11/18. Revised version issued 05/23/18.

with the water). Staff from SÖLitude Lake Management and SePRO Corporation installed, calibrated, and maintained the units. A licensed pesticide applicator from SÖLitude Lake Management filled and refilled the injection unit tanks. The actual dosage and duration of the application were determined daily by flow rates in the river using discharge measurements from the USGS Hydrologic Station 01375000 (located just below the New Croton Dam), as well as the observed efficacy and label requirements of Sonar® Genesis. Pump rates were calculated daily and controlled by accessing a dashboard using a cellular device or laptop computer. Unit operation was conducted by SÖLitude Lake Management-licensed applicators and SePRO staff.

Prior to the beginning of treatment, permanent, weatherproof, bilingual signs with information about the fluridone treatment were installed in compliance with the Article 15 Aquatic Pesticide Permit at the following public access locations:

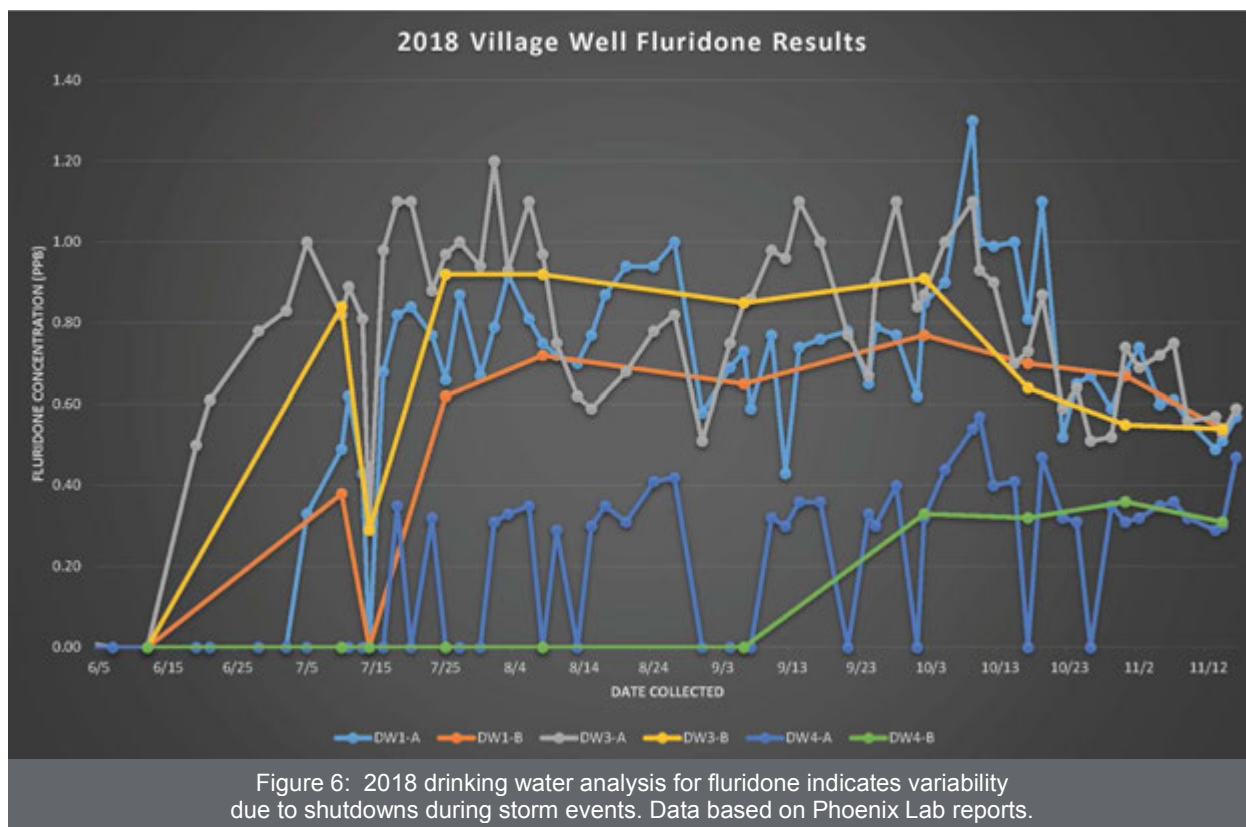
- Croton Gorge Park – 18 “No Public Access” posters
- Black Rock Park – 4 “No Public Access” posters and 10 “No Irrigation” posters
- Silver Lake Beach – 6 “No Irrigation” posters
- Croton Gorge Unique Area – 7 “No Irrigation” posters
- Public Park at Paradise Island – 4 “No Irrigation” posters
- Echo Boat Launch – 1 “No Irrigation” poster

Treatment began on June 5, 2018 and ended on November 3, 2018. The herbicide Sonar® Genesis was applied for a total of 98.35 days (high flow rates caused 55 days of shutdown). The Croton Dam injector averaged 5.28 gallons per day (a rate of 2.5 ppb) for a total of 519 gallons. The Black Rock Park injector averaged 2.14 gallons per day (a rate of 0.8 ppb) for a total of 210.3 gallons (SÖLitude 2018).

Water Quality Sampling

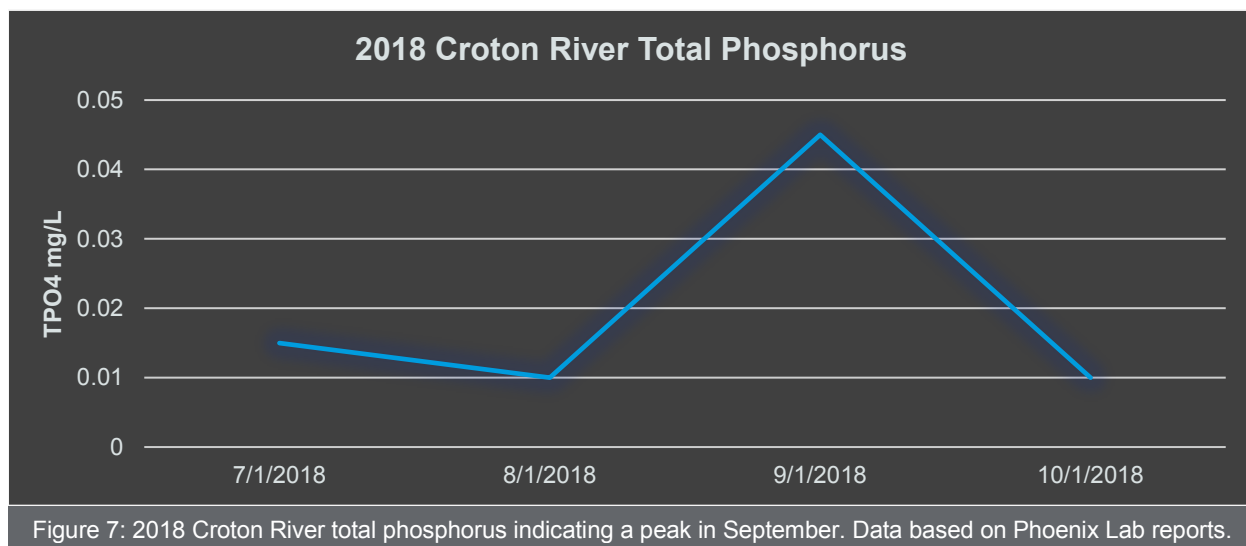
Drinking water samples were collected throughout the 2018 field season by SÖLitude Lake Management and the Village of Croton-on-Hudson Water Department. Drinking water (from wells) and finished water (water that is released to the public from the Village of Croton-on-Hudson’s distribution system) were collected and analyzed. Samples were collected from three village wells (DW 1, DW 3, and DW 4) and two distribution sites (Upper North Highland Pump House [UNH-1] and the Village of Croton-on Hudson Municipal Building [MB-1]). All water samples were analyzed for fluridone concentration by Phoenix Labs in Manchester, Connecticut, to a 0.3 ppb detection limit. Initially, one sample was collected from each sampling location twice a week. Every other week, two samples (A and B) were taken from each sampling location to test for variation among samples.

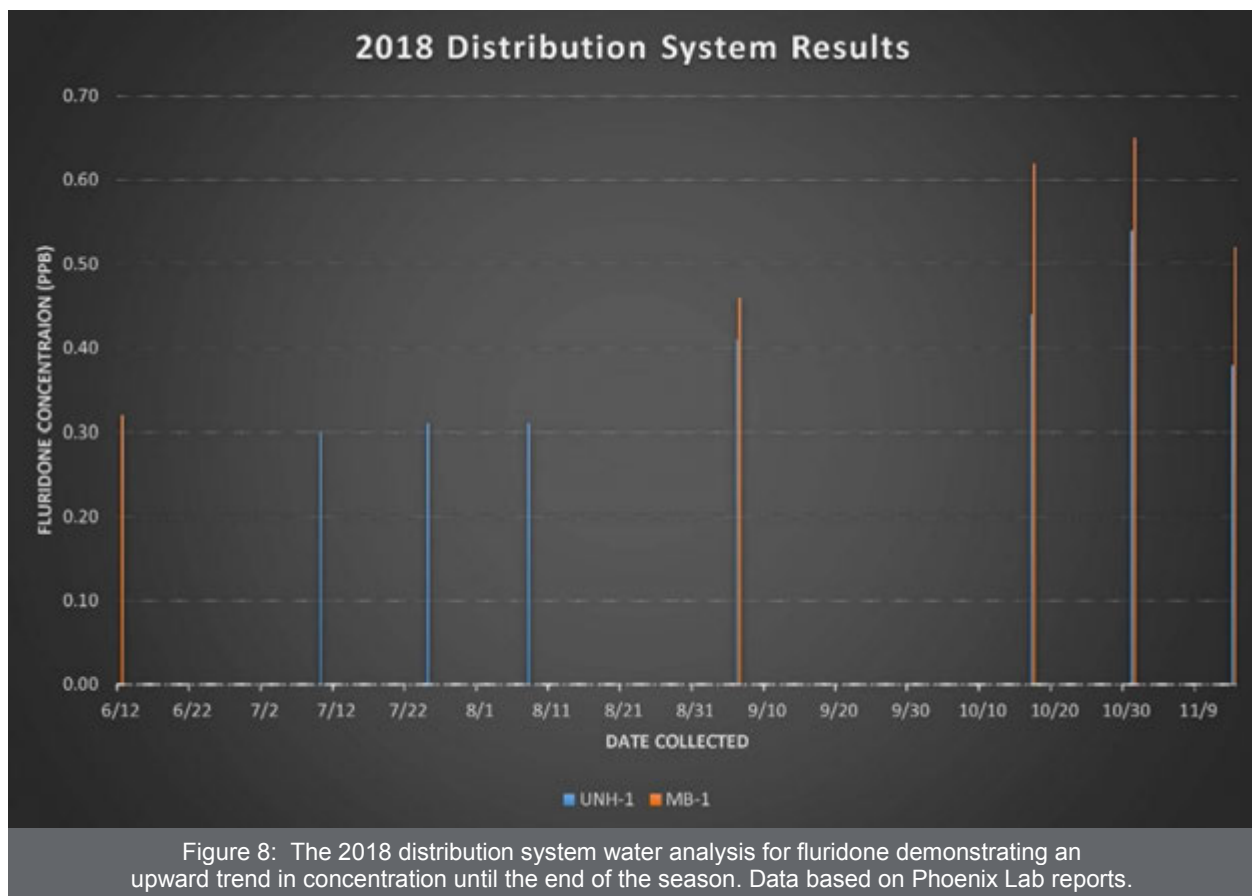
Drinking water sampling began on June 7, 2018, and was conducted twice per week until fluridone levels exceeded 1.0 ppb in drinking water well #3 (DW3) on July 5, 2018. Beginning July 10, 2018, water sampling was conducted three times per week until November 27, 2018, when fluridone concentrations dropped below 1.0 ppb at all water sampling locations. Sampling was then conducted weekly until two consecutive samples with readings of “non-detect” were found at all water sample locations (this occurred January 23, 2019). The highest fluridone concentration during the 2018 treatment season was 1.3 ppb, well under the 4.0 ppb limit set by this project. Phoenix Lab reports containing sampling results from the finished water and drinking water were posted to the Croton Hydrilla Project’s Water Sample Analysis Results Page on the DEC website (<http://www.dec.ny.gov/animals/110624.html>). Figure 6: 2018 Village Well Fluridone Results and Figure 8: 2018 Distribution System (Finished Water) Results display the fluridone concentrations throughout the 2018 treatment season. Graphs were generated using data from the Phoenix Lab reports.



Additionally, river water samples were collected weekly by SŌlitude Lake Management at five sites along the Croton River (CR 1, CR 1.5, CR 2, CR 3, and CR 4) and were analyzed for fluridone by SePRO Research Lab in Whitaker, North Carolina using the FasTEST method to an accuracy of 1.0 ppb. FasTEST sampling concluded for the season on November 14, 2018, following the end of treatment and all river site samples reporting non-detect for fluridone.

In addition to sampling for fluridone, SŌlitude collected water samples on July 2, 2018; August 1, 2018; September 19, 2018; and October 17, 2018, to test total phosphorous (TPO4). Figure 7: 2018 Croton River Total Phosphorus contains TPO4 data based on Phoenix Lab reports.





Submerged Aquatic Vegetation Surveys

During the 2018 field season, biologists with SÖLititude Lake Management conducted point-intercept (Madsen 1999) aquatic plant surveys at 471 points within the Croton River. Surveys were conducted post-treatment of hydrilla at the same sample points utilized in the 2016 and 2017 SAV surveys. Results were compared to post-treatment data from 2017. Originally, the Croton Hydrilla Control Five-Year Plan called for pre- and post-treatment aquatic plant surveys to be conducted by the contractor. However, because the treatment is proposed for such an early seasonal start (May) when many aquatic plants are either unidentifiable or have not yet emerged, the fall survey from each year will serve as the pre-treatment survey for the following season.

Sample points were GPS-referenced and two 10-meter weed-rake tosses were conducted at each point. Samples from each rake toss were identified to species when possible and percent

cover was estimated (Doyle 2017). An abundance mean of hydrilla was calculated for each site by assigning one of five semi-quantitative densities:

- No Plants (empty rake)
- Trace (one or two stems per weed rake)
- Sparse (3 to 10 stems)
- Medium (more than 10 stems)
- Dense (entire weed rake full of stems)

Significant decreases in the number of sites with hydrilla and the overall abundance of hydrilla at each site were observed following treatment in 2018. The vast majority of hydrilla plants showed signs of herbicide injury, although some showed signs of recovery following treatment shutdowns. Figures 8, 9, 10, 11, 12, and 13 show the declines in percent abundance for each section of the Croton River surveyed in 2018.

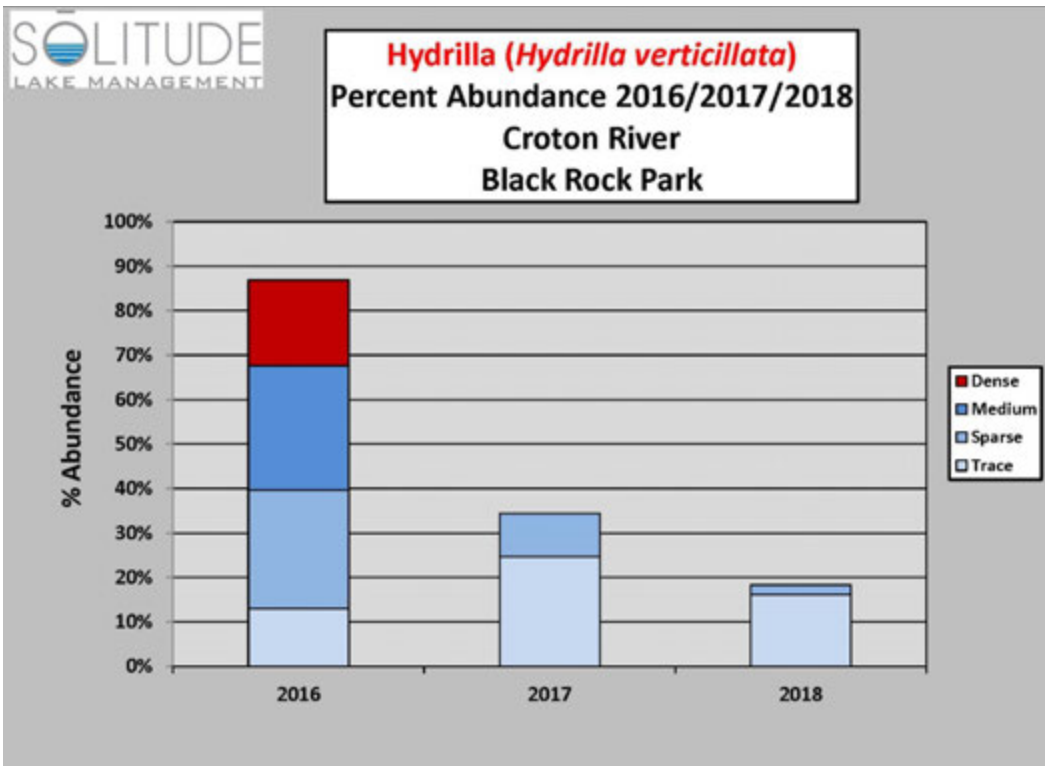


Figure 9: 2016 to 2018 Percent Abundance – Croton River: Black Rock Park

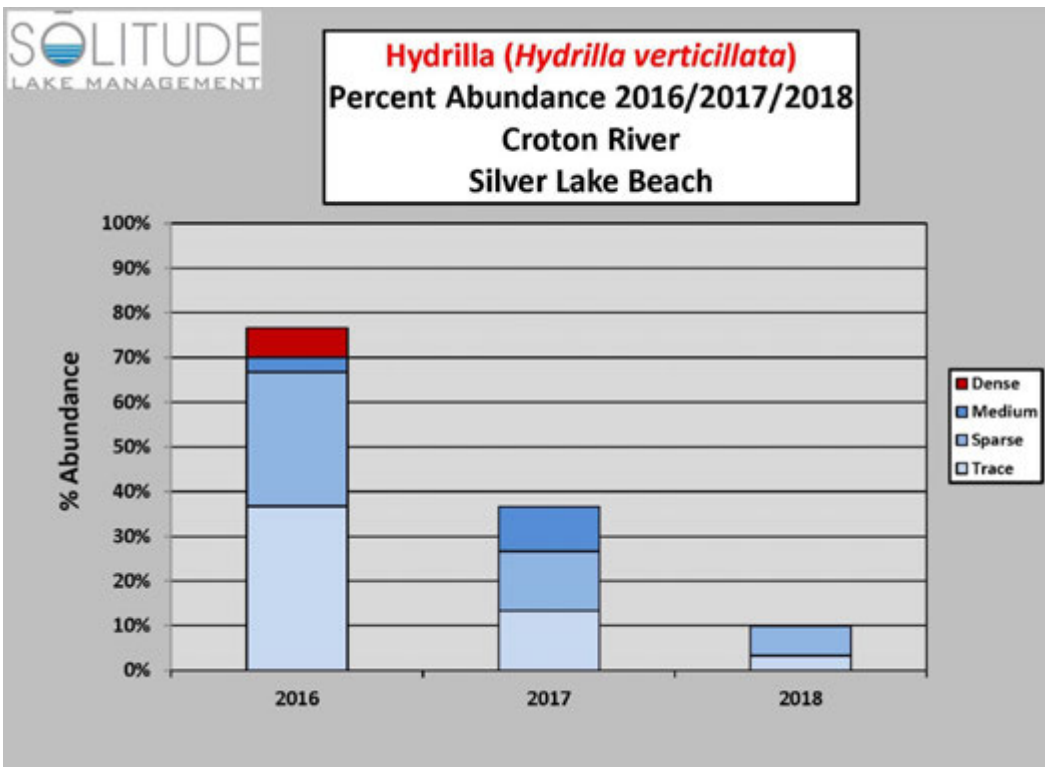


Figure 10: 2016 to 2018 Percent Abundance – Croton River: Silver Lake Beach

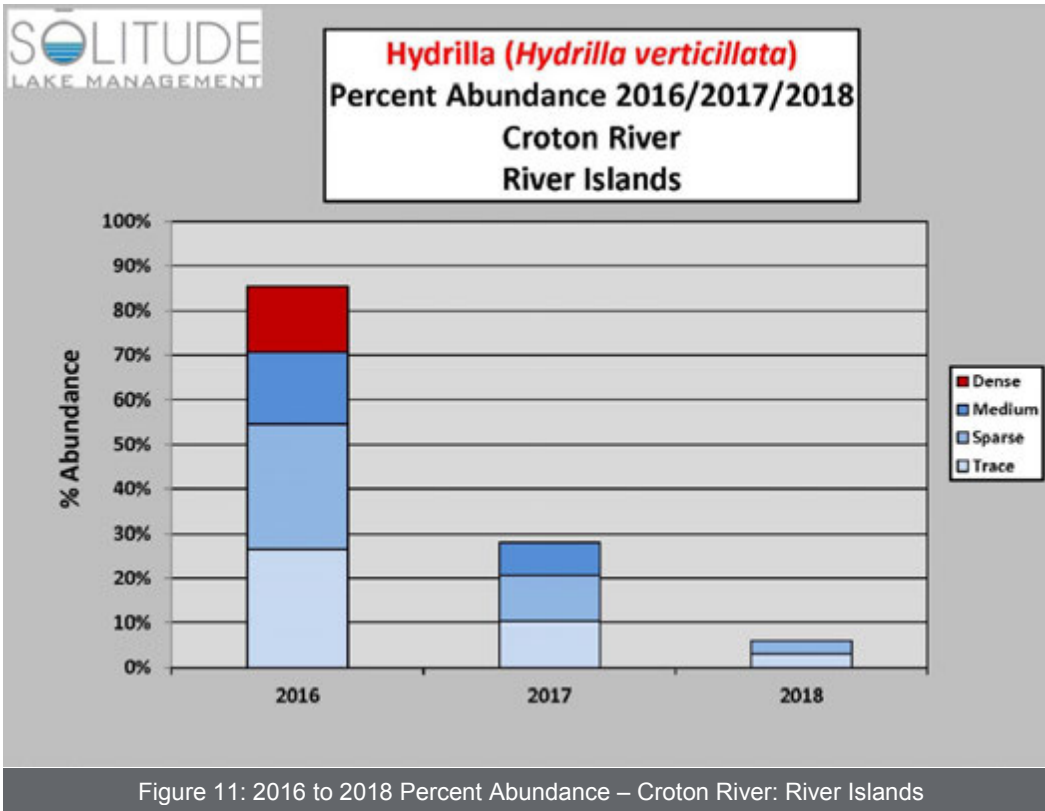


Figure 11: 2016 to 2018 Percent Abundance – Croton River: River Islands

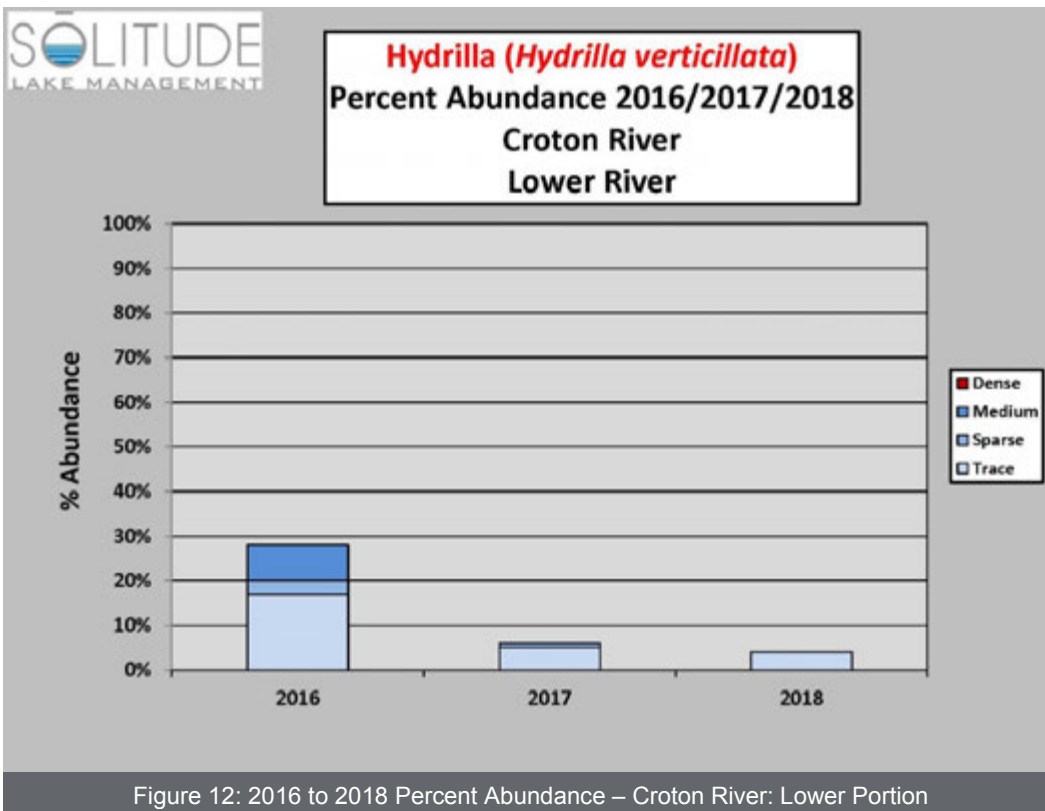


Figure 12: 2016 to 2018 Percent Abundance – Croton River: Lower Portion

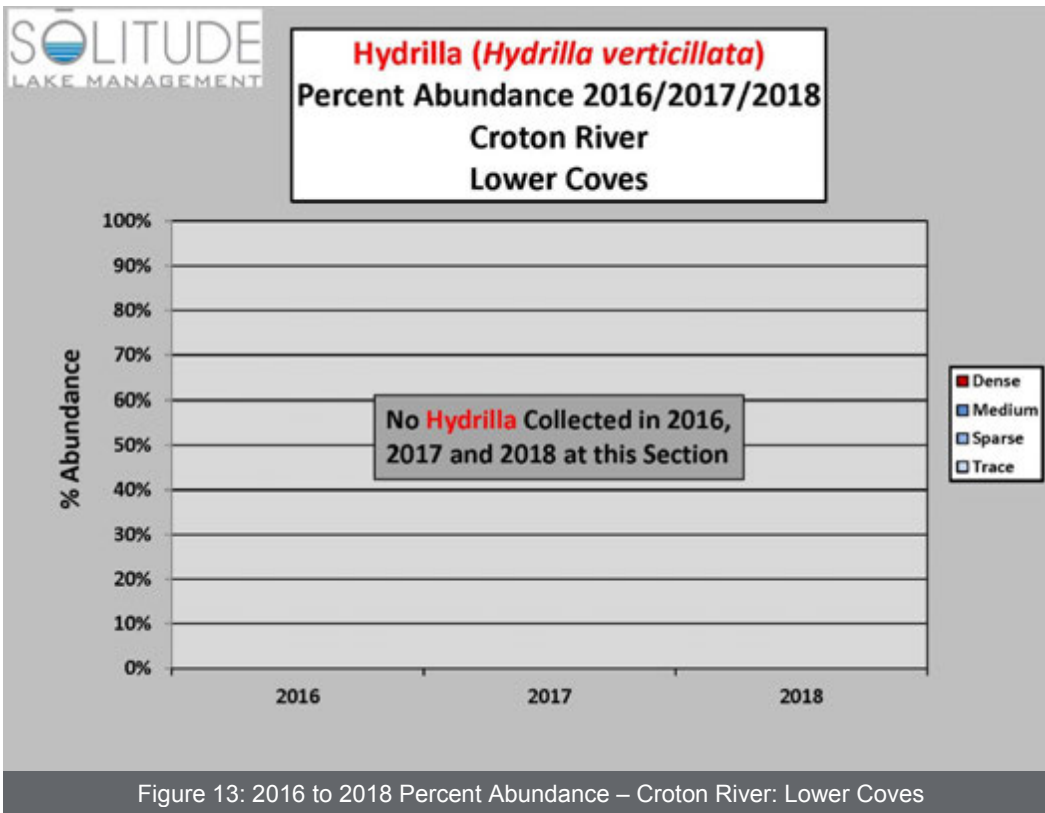


Figure 13: 2016 to 2018 Percent Abundance – Croton River: Lower Coves

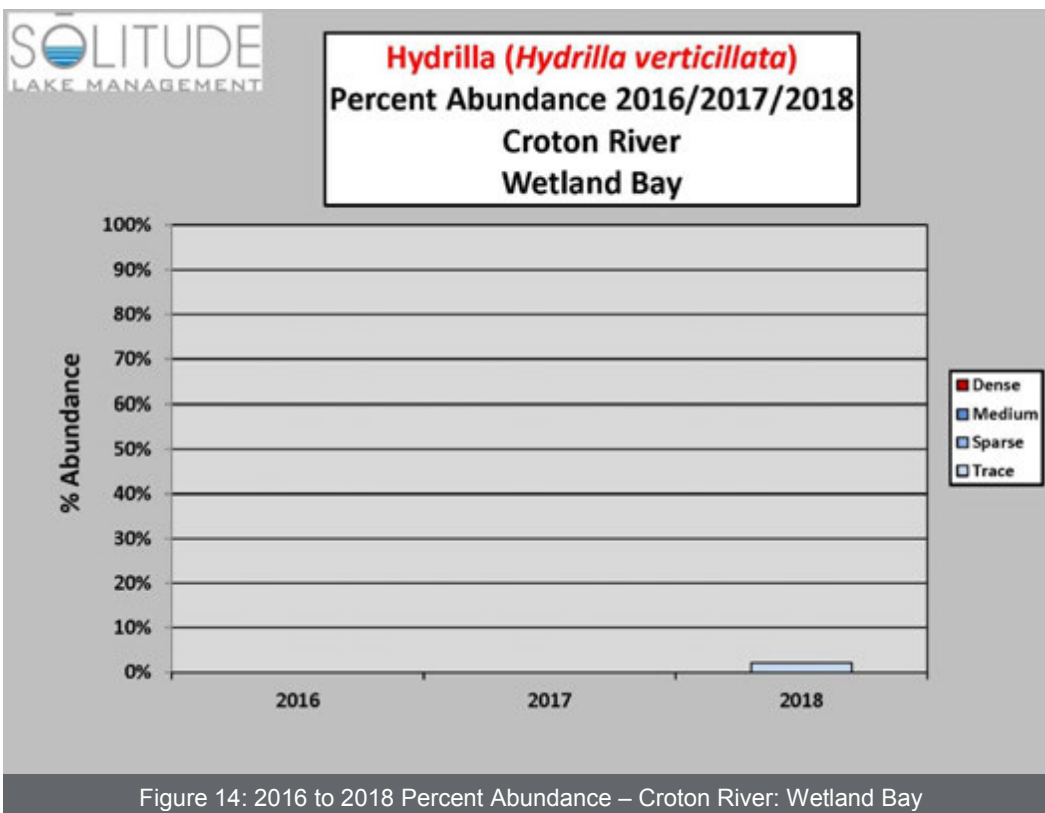


Figure 14: 2016 to 2018 Percent Abundance – Croton River: Wetland Bay

2018 SAV Findings

During the 2018 SAV surveys, biologists with SÖLitude Lake Management identified all visible aquatic plants (macrophytes) to species when possible and calculated percent abundance for each site. Table 1: 2018 Croton River Macrophytes contains the list of macrophytes that were identified and their status.

Table 1: 2018 Croton River Macrophytes at Priority Sites		
Common Name	Latin Name	Status
Hydrilla	<i>Hydrilla verticillata</i>	aggressive, exotic, invasive
Eurasian Water Milfoil	<i>Myriophyllum spicatum</i>	aggressive, exotic, invasive
Heart Pondweed	<i>Potamogeton perfoliatus</i>	native
Coontail	<i>Ceratophyllum demersum</i>	native
Long-leaf Pondweed	<i>Potamogeton nodosus</i>	native
Sago Pondweed	<i>Stuckenia pectinate</i>	native
Common Waterweed	<i>Elodea canadensis</i>	native
Water Stargrass	<i>Heteranthera dubia</i>	native
Muskgrass	<i>Chara sp.</i>	native
Leafy Pondweed	<i>Potamogeton foliosus</i>	native
Small Duckweed	<i>Lemna minor</i>	native
Spikerush	<i>Eleocharis sp.</i>	native
Horned Pondweed	<i>Zannichellia palustris</i>	native
Giant Arrowhead	<i>Sagittaria montevidensis</i>	native, rare
Water Moss	<i>Fontinalis sp.</i>	native
Common Watermeal	<i>Wolffia columbiana</i>	native

Table 1. 2018 Croton River Macrophytes at Priority Sites. SÖLitude Lake Management

Aerial Drone SAV Mapping

Portions of the Croton River are inaccessible for traditional SAV-survey methods. On June 7, 2018, SÖLitude Lake Management conducted a drone survey in a remote portion of the Croton River, from south of the New Croton Dam to the northern portion of Black Rock Park, and just south of Silver Lake Beach. Results were difficult to interpret due to several environmental conditions, including turbidity, increased flow rates, water depth, and the presence of didymo (SÖLitude 2018).

Hudson River SAV Surveys

Between August 20, 2018, and October 4, 2018, biologists from SÖLitude Lake Management surveyed 29 high-priority sites along the Hudson River with habitat characteristics suitable for hydrilla (based on bathymetry, suitable SAV habitat, prior SAV abundance, and proximity to the Croton River system). Site information is organized by river mile in Table 2: 2018 Hudson River High-Priority Sites for Hydrilla Monitoring.

SÖLitude Lake Management took a total of 1,458 GPS-referenced points at a total of 29 sites and surveyed each point for SAV utilizing two 10-meter weed-rake tosses. Samples from each rake toss were identified to species when possible and percent cover was estimated. No hydrilla was observed at any of the Hudson River high-priority sites during the 2018 survey.

Table 2: 2018 Hudson River High-Priority Sites for Hydrilla Monitoring			
Site Name	River Mile	Size (Acres)	Points
Devries Park	25	9.0	45
Kemeys Cove	31	12	30
Croton Bay	34	639	78
Half Moon Bay	35	76.7	66
Cedar Pond & Clark Park	37	29.0	58
Graff Audubon Marsh	37	4.0	26
Oscawana Park	37	19.0	45
George's Island Park	39	31	60
Lents Cove	43	39	57
Dickey Brook	43	5.7	20
Annsville Creek	44	144.5	83
Iona Marsh	45	152	69
Popolopen Creek	46	13	35
Manitou Marsh South	46	47.0	31
Manitou Marsh North	47	16.0	25
Constitution Marsh	52	358	88
Foundry Cove Bay	53	6.7	12
Foundry Cove	53	41.5	64
Cold Spring Park	54	8.0	34
Moodna Creek Bay	57	49	68
Fishkill Creek	59	41.7	47
Balmville Marsh	64	13.0	30
Wappingers Creek	67	94.3	50
Poughkeepsie Yacht Club	83	39	40
Black Creek Preserve	83	36	48
Mills-Norrie State Park	84	28	50
Vanderburgh Cove	87	98.6	42
Sleightsburg Park	90	224.0	100
Kingston Point Marsh	91	31	29

Table 2. 2018 Hudson River High-Priority Sites for Hydrilla Monitoring. SOLitude Lake Management

In addition to the 29 high-priority sampling sites that are within close proximity to the Croton River infestation, a new set of surveys was conducted in 2018 in the upper Hudson River Estuary by Northeast Aquatic Research, LLC. Once again, habitat characteristics suitable for hydrilla (based on bathymetry, suitable SAV habitat, and prior SAV abundance) were used to select sample sites.

Northeast Aquatic Research, LLC surveyed a total of 3,764 points at 18 sites as an early-detection effort. Each point was surveyed utilizing a single three-meter weed-rake toss. Samples from each rake toss were identified to species when possible and percent cover was estimated. No hydrilla was observed at any of the sites along the upper Hudson River Estuary during the 2018 survey.

Table 3: 2018 Upper Hudson River Estuary SAV Survey Sites			
Site Name	River Mile	Grid (m)	Total Number of Points Mapped (Total Number Accessible/Surveyed)
Middle Ground Flats	116–117	50	218 (190)
North Bay	118	50	85 (53)
Tivoli Bay	99–100	50	317 (288)
Esopus Flats	101–102	50	208 (181)
Rondout Creek	90–91	50	367 (310)
mouth of Moodna Creek	58	50	76 (53)
mouth of Cossackie Creek	127–128	30	163 (147)
Rattlesnake Island	126–127	30	90 (74)
Coeymans Creek	134	20	49 (36)
inlet north of Paarda Hook	139	20	86 (73)
Schodack Creek	129–135	50	661 (656)
Stockport Creek	121–124	50	530 (327)
Little Nutten Hook and Newton Hook	124–126	50	127 (58)
Inbocht Bay and Duck Cove	107–111	50	856 (777)
Ramshorn Livingston	112–113	50	66 (55)
creek south of Shad Island	136	20	355 (194)
Rogers Island	114–115	50	234 (221)
Hannacroix Creek	133	20	83 (71)
Table 3. 2018 Upper Hudson River Estuary SAV Survey Sites. Northeast Aquatic Research, LLC			

Plant Tissue Sampling

On June 5, 2018 (prior to treatment), SŌLitide Lake Management collected native wild celery (*Vallisneria spiralis*) from five GPS-referenced locations in the Croton River and sent the samples to the University of Maryland Center for Environmental Science for DNA biotyping and propagation studies.

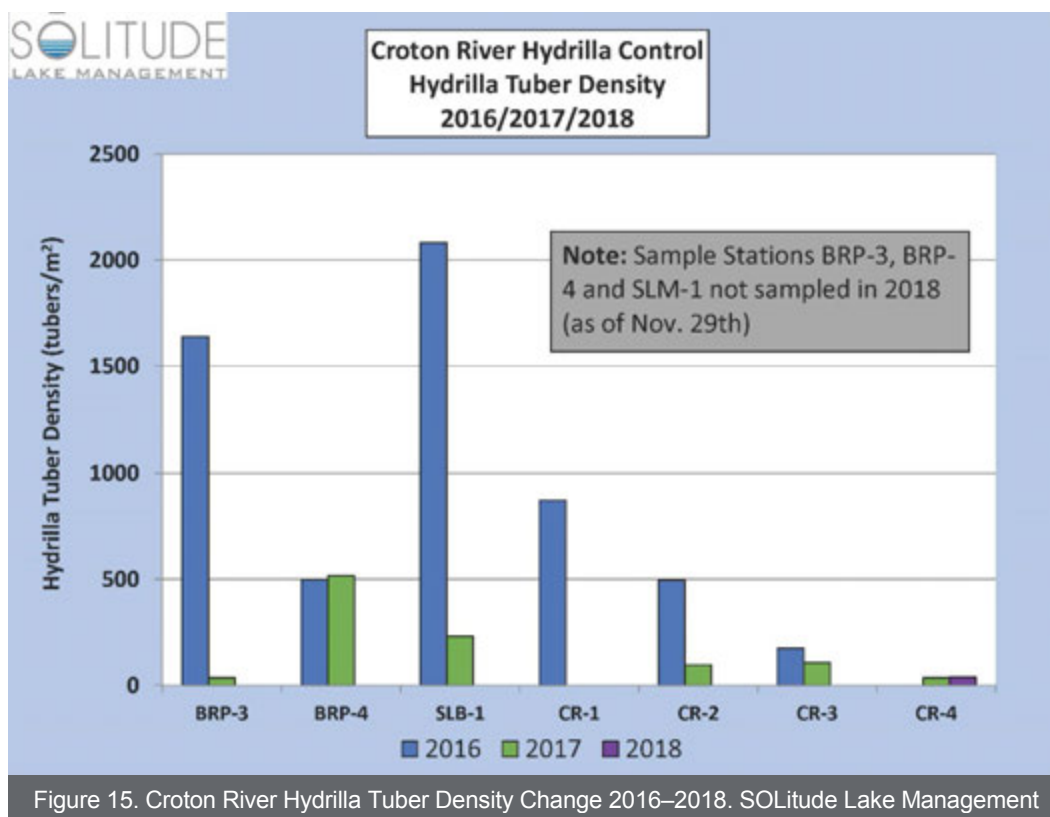
On June 5, 2018, SŌLitide Lake Management also collected plant tissue samples from five species including hydrilla at five GPS-referenced points and sent them to the University of Georgia to be tested for the presence of an epiphytic blue-green algae (*Aetokthona hydrillicola*). *A. hydrillicola*, which is linked to avian vacuolar myelinopathy (AVM), has been found to grow on the undersides of hydrilla leaves and can move through the food chain from waterfowl to raptors. No *A. hydrillicola* was found in the samples collected in 2018.

Hydrilla Tuber Monitoring

On November 13, 2018, SOLitude Lake Management conducted hydrilla tuber monitoring in the Croton River north and south of Paradise Island at four stations (CR 1, CR 2, CR 3, CR 4). Tubers were collected via airboat using a modified post-hole digger. Tuber density was calculated and expressed in tubers/m² (meters squared). Due to high flow conditions, tuber sites were not accessible at Black Rock Park (two stations: BRP 3, BRP 4) or Silver Lake Beach (one station: SLB-1). SOLitude biologists plan to sample these three remaining sites during the spring of 2019.

Figure 14 shows tuber density change from 2016–2018 in the Croton River. No tubers were found at CR 1, CR 2, or CR 3. The steady

decrease in tuber density is evidence that the fluridone treatment has significantly reduced the fitness of the hydrilla and that most plants were not able to form tubers during the 2017 or 2018 growing seasons. The tubers that were able to form were extremely stunted compared to untreated plants and may have had reduced or no viability due to treatment. As hydrilla abundance has been reduced via treatment, monitoring efforts have increased. In 2017, 3–6 cores were collected per site, while in 2018, 15 cores were collected per site. Hydrilla tubers can persist in the sediment and remain viable for a minimum of six years (Nawrocki 2016). Exhausting the tuber bank in order to prevent infestation is a critical part of this treatment project.



Macroinvertebrate Sampling

On May 9, 2018, biologists from SUNY Oneonta collected macroinvertebrates from four sites on the Croton River. Two of the sites were located within the project treatment area (downstream of the New Croton Dam), one control site was located upstream of the New Croton Reservoir, and the last control site was located upstream of the treatment area in Indian Brook (a tributary to the Croton River).

Only the sampling upstream of the New Croton Reservoir was unhindered by the extensive didymo bloom. Below the New Croton Dam, the heavy matting of long-stalk didymo appeared to decrease the number of all large-bodied macroinvertebrates. A fourfold decrease in both chironomids (midges) and simuliids (black flies) were observed, concurrent with a 20- to 100-fold increase in daphnids (small waterfleas) and cyclopoid copepods (small freshwater crustaceans) relative to survey data from 2017 (Coney et al. 2018). Results of the 2018 study were inconclusive due to the didymo bloom (Coney et al. 2018).

Water Sample Analysis

Water samples results were made available to the public in the full lab reports posted to DEC's website (www.dec.ny.gov/animals/110624.html) and summarized in the biweekly status reports to partners.

Hydrilla Fact Sheet and ID

DLF and its partners use DLF's hydrilla fact sheet, ID sheet, and ID card to educate the public about hydrilla in New York. These outreach materials help people learn how to identify hydrilla, tell it apart from look-alikes, and report potential locations to DLF so we can help control it. Links to these outreach documents are available on the hydrilla page of our website: www.dec.ny.gov/animals/104790.html. Paper copies can be requested by contacting DLF's Invasive Species Coordination Section at isinfo@dec.ny.gov.

Outreach & Partnerships

The Croton River Hydrilla Control Project has cultivated strong working relationships with a variety of environmental organizations and municipalities. Program staff have provided partner agencies with an initial training on hydrilla identification, infestation case studies, potential control methods, and an overview of Croton River Hydrilla Control protocols and data collection. DLF sent status updates to key partners regularly via an email listserv, and held conference calls regularly with partners in other infested regions of New York State.

In 2018, the following partner agencies conducted outreach or shared data in conjunction with the Croton River Hydrilla Control Project:

- Lower Hudson PRISM
- Hudson River Sloop Clearwater
- SUNY Oneonta

The following partner agencies assisted with program operation:

- Village of Croton-on-Hudson Water Department
- New York City Department of Environmental Protection (NYCDEP)
- DEC Region 3 Fisheries Unit
- DEC Region 3 Department of Materials Management

Conclusion

Fluridone treatment continues to decrease the abundance and fitness of hydrilla plants in the Croton River. The presence of hydrilla decreased significantly between 2017 and 2018 and no dense or moderately dense sites were observed during 2018 SAV surveys. All plants found during treatment showed signs of herbicide injury. Despite a variety of environmental conditions that interrupted consecutive treatment days, treatment was effective during 2018. Tuber and turion production were significantly reduced from pre-treatment levels. We will continue to rely on adaptive management strategies and close cooperation with our partners managing the New Croton Reservoir infestation in order to reduce the threats that hydrilla poses to our environment.

Sources

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Doyle, C. 2018. "2018 Delineation of Hydrilla and other Submerged Aquatic Vegetation (SAV) in the Croton River." Unpublished data.

Madsen, J. D. 1999. "Point and Line Intercept Methods for Aquatic Plant Management." APCRP

Technical Notes Collection (TN APCRP-M1-02), US Army Engineer Research and Development Center, Vicksburg, MS. p 1–16.

Nawrocki, J. L., R. Richardson, and S. T. Hoyle. 2016. "Monoecious Hydrilla Tuber Dynamics following Various Management Regimes on Four North Carolina Reservoirs." *Journal of Aquatic Plant Management*, 54: p. 12–19.

SOLitude Lake Management. 2017. "Croton River 2017 Treatment Final Report." Unpublished data.

Appendix A: Helpful Links

DEC Hydrilla Webpage

<https://www.dec.ny.gov/animals/104790.html>

DEC Croton Hydrilla Control Project Webpage
and Five-Year Management Plan

<https://www.dec.ny.gov/animals/106386.html>

DEC Croton Hydrilla Project's Water Sample
Analysis Results Webpage

<https://www.dec.ny.gov/animals/106386.html>

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