
Rice Lake, Stearns County (2016-2020)

Monitoring Report for Starry Stonewort Management

Report by the Invasive Species Program - Division of Ecological and Water Resources
Minnesota Department of Natural Resources



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Minnesota Department of Natural Resources

April 29, 2021

Lake Summary

Lake: Rice

County: Stearns

DOW Number: 73019600

Lake Acres: 1513.36

Littoral Acres: 832.55

Project Details

Project Year: 5

Primary Contact: Christine Jurek, Invasive species specialist, Minnesota Department of Natural Resources, Christine.jurek@state.mn.us, 320-223-7847.

Surveyors: Chris Jurek, Courtney Millaway, Ty Riihiluoma, Emelia Hauck Jacobs, Tim Plude and seasonal interns (MN DNR)

Date(s) of Treatment(s): 2016- 2020 (see **Error! Unknown switch argument.**)

Date(s) of Survey(s): 2016- 2020 (see Table 2)

Date of Report: April 29, 2021

Survey Methods: Aquatic Plants: Point Intercept survey; Copper monitoring: YSI 9500 Colorimeter; LaMotte 1200 Colorimeter

Report Details

Jurek C. and E. Hauck Jacobs. 2021. Monitoring report for starry stonewort in Rice Lake, Stearns County (2016- 2020). Minnesota Department of Natural Resources, Division of Ecological and Water Resources, Invasive Species Program, 1035 South Benton Drive, Sauk Rapids, MN 56379. 20 pp.

Summary

This report summarizes starry stonewort monitoring data collected by MN DNR staff between 2016 and 2020. In addition, Steve McComas with Blue Water Science collected invasive taxa data as part of the permit requirements (supplemental reporting documents are available on request).

In late summer of 2016, the DNR identified starry stonewort (*Nitellopsis obtusa*) growth in Rice Lake near the southwest public access during a public water access search effort for invasive species. DNR staff delineated the area and conducted a lake wide meander search of the littoral zone in an effort to determine the extent of the infestation (Figure 1). Starry stonewort was not found elsewhere during the search and appeared to be confined to the vicinity of the southwest public access. A barrier was installed in fall of 2016 around the known extent of infestation in an effort to contain the area for treatment purposes. A suction dredge was first used to remove the biomass and sediment during the fall of 2016. The purpose of using a suction dredge was to attempt to remove any bulbils in the sediment and vegetation. The frequency of starry stonewort decreased from 14% to 7% after the suction dredging. The dredging was followed by two pesticide treatments consisting of Komeen® crystals (chelated copper complex) and Tribune® (diquat dibromide) applied two weeks apart. The objective of the copper treatment was to target starry stonewort that remained after the suction dredge efforts. The frequency of starry stonewort after management was reduced to 0%. The barrier was removed in late fall of 2016.



Figure 1 - Starry stonewort (*Nitellopsis obtusa*) sampled during a rake toss on an early infestation meander survey on Rice Lake, Stearns County (DOW 73019600). Rake toss was located near the southwest public access. Survey conducted on August 31 and September 1 2016.

In 2017, MN DNR evaluated the treatment area to determine how effective management was in the fall of 2016. Unfortunately, starry stonewort was found at 25% of the sampling sites within the fall 2016 treatment area. Therefore, the Rice Lake Association applied for a permit to treat the known area of starry stonewort growth (0.5 acres). The first treatment in 2017 used a combination of chelated granular copper and diquat. Starry stonewort was found after both the first treatment on 17 July 2017 and the second treatment on 4 August 2017. The Rice Lake Association requested an amendment to add two additional treatments in 2017 and conducted two additional treatments on 26 September and 17 October 2017. These two treatments used a combination of Chem one® (granular copper sulfate) and Cutrine Ultra® or Cutrine Plus® (chelated copper). MN DNR had limited staff in 2017 and conducted partial monitoring, while Steve McComas with Blue Water Science conducted pre and post starry stonewort monitoring for the entire duration of the growing season. Monitoring indicated a decline in starry stonewort from 25% (mid-July) to 9% (early October; McComas, 2017). These monitoring requirements were part of the conditions of both the original and amended permit. In 2018, the lake association received a permit for up to four pesticide treatments to manage starry stonewort. After the second copper treatment, the permit was amended to increase the acreage to a total of 3.36 acres (Figure 2). Combination treatments of Chem One (granular copper), Cutrine Ultra (copper), Hydrothol 191 (mono (N,N-dimethylalkylamine) salt of endothall), Komeen crystals (copper complex) and Cutrine Plus (copper) were used in 2018. Hand pulling was also performed on 8 August by Steve McComas, Blue Water Science at all known areas of starry stonewort. In 2018, starry stonewort was reduced from 50% (early July) to 5% (Early September). During 2019, only two treatments were applied on 22 July and 8 August using Hydrothol 191. Finally, three treatments were applied in 2020 using Chem One and Hydrothol 191. After five consecutive years of management, the re-growth of starry stonewort remains an issue, therefore annual repeat spot- treatments are an option for managing starry stonewort.

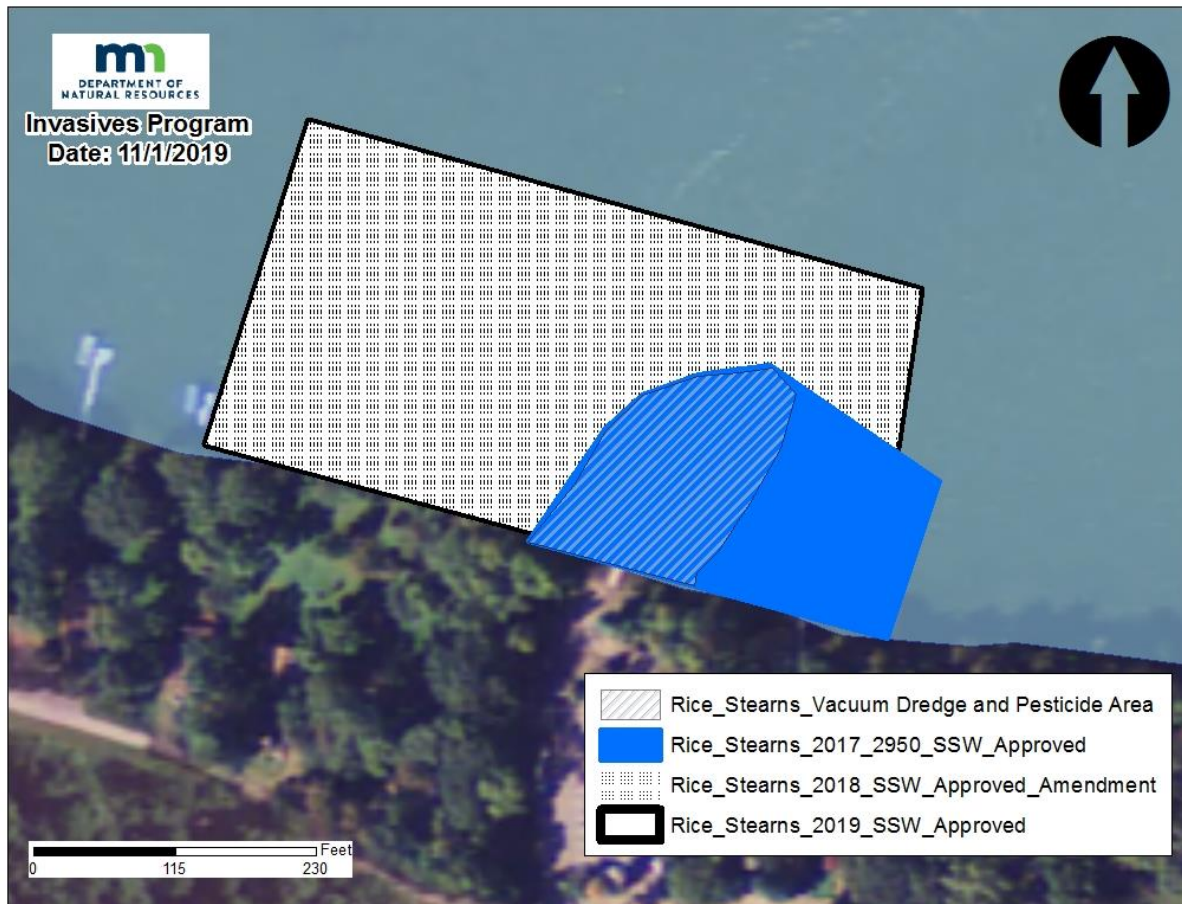


Figure 2 - Starry stonewort management (2016- 2020). Pesticide treatments were conducted annually in Rice Lake, Stearns County (DOW# 73019600) by Professional Lake Management, totaling up to 3.36 acres. The management area expanded from 0.6 to 3.36 acres and management techniques varied among years. The same area was treated in both 2019 and 2020.

Management

Management of starry stonewort has been conducted annually since 2016 (

Table 1). Acreage of treatment has increased from 0.6 acres in 2016 to 3.36 acres in 2018- 2020. A combination of pesticides have been used including Tribune ®, Hydrothol 191 ®, Komeen ® crystals, and Cutrine Plus ® or Cutrine Ultra ®, and Chem One ®.

Table 1 - Starry Stonewort Management Summary. Characteristics and history of pesticide treatments and management activities for Rice Lake, Stearns County (DOW# 73019600), Total acres: 1509.39, Littoral acres: 959, 15% Littoral acres: 143.85.)

Date	Control Method	Total Acres	Pesticide	Dose Rate	Contractor
13-16 Oct 2016	suction dredge	0.6			Aq.Restoration Services
21 Oct 2016	pesticide	0.6	Tribune (diquat) and Komeen crystals (copper complex)	1.67 gallon/ acre ft and 13.54 lbs./acre ft	PLM
17 July 2017	pesticide	0.6	Tribune (diquat) and Komeen crystals (copper complex)	2.00 gallon/acre ft and 15.5 lbs/ acre ft	PLM
4 Aug 2017	pesticide	0.6	Tribune (diquat) and Komeen crystals (copper complex)	1.20 gallons/ acre ft and 15.5 lbs./acre ft	PLM
26 Sept 2017	pesticide	0.6	Chem One (granular copper) and Cutrine Ultra (copper)	3.25 lbs./acre ft and 0.9 gallons/ acre ft	PLM
17 Oct 2017	pesticide	0.6	Chem One (granular copper) and Cutrine Ultra (copper)	5.42 lbs./acre ft and 0.83 gallons/acre ft	PLM
9 July 2018	pesticide	1.0	Chem One (granular copper) and Cutrine Ultra (copper)	5.40 lbs./acre ft and 1.5 gallons/acre ft	PLM
9 Aug 2018	pesticide	1.0	Hydrothol 191 and Cutrine Plus (copper)	0.45 gallons/acre ft and 3.0 gallons/acre ft	PLM
23 Aug 2018	pesticide	3.36	Hydrothol 191 and Kommen crystals (copper complex)	0.45 gallons/acre ft and 3.34 gallons/ acre ft	PLM
8 Oct 2018	pesticide	3.36	Hydrothol 191 and Cutrine Plus (copper)	0.25 gallons/ acre ft and 3.0 gallons/acre ft	PLM
22 July 2019	pesticide	3.36	Hydrothol 191	0.27 gallons/ acre ft	PLM
8 Aug 2019	pesticide	3.36	Hydrothol 191	0.27 gallons/ acre ft	PLM
6 Aug 2020	pesticide	3.36	Chem One and Hydrothol 191	10.42 lbs/acre ft and 0.27 gallons/acre ft	PLM
16 Sept 2020	pesticide	3.36	Chem One and Hydrothol 191	10.42 lbs/acre ft and 0.27 gallons/acre ft	PLM

21 Oct 2020	pesticide	3.36	Chem One and Hydrothol 191	10.42 lbs/acre ft and 0.27 gallons/acre ft	PLM
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Pre- and Post-Treatment Plant Surveys

Methods

In 2016, the population of starry stonewort was delineated and mapped as part of the rapid response effort. Based on the initial delineation of 0.6 acres, a grid of 14 sampling points was set-up to monitor the treatments both pre and post- management. With the expansion of the infested area, a total of 20 points were used for sampling in 2017 and 2018. In 2019, additional sampling points were added to better detect the small population of starry stonewort. The surveys were conducted by MN DNR to evaluate the impacts of copper on both starry stonewort and the native plant communities. These surveys documented the distribution and abundance of all taxa, including starry stonewort. Steve McComas also collected invasive taxa data within the treatment area as part of the permit requirements (data not included in this report). It is important to note that distributions of aquatic plants may vary from year to year due to effects such as differences in weather, as well as the effects from the proposed management.

MN DNR surveyors used a point intercept survey method developed by John Madsen in “Aquatic Plant Control Technical Note MI-02, 1999” and MN DNR protocols to develop the survey. Survey points were placed 39 feet (11.8 meters) apart using a Geographic Information System (GIS). A total of 20 points were sampled in depths of to six feet of water. Plant surveys were conducted by DNR staff using a point intercept grid within the treatment area both pre and post-treatment.

Plant samples were collected by throwing and dragging a double-sided rake along the lake bottom at each point. All plant taxa (submerged, floating-leaf, emergent and free floating) were recorded during the survey. Plant samples were assessed on the boat to determine species and abundance (1: sparse, 2: common/frequent/occasional, 3: abundant/matted and data was recorded using an electronic device. Frequencies of occurrence percentages (i.e. how often a plant species was found in the lake) were calculated based on the littoral zone (the portion of the lake is less than 15 feet in depth).

Results

In 2016, management efforts involved both physical removal (suction dredge) and pesticide (diquat and chelated granular copper). The frequency of starry stonewort was reduced from 14% (pre- suction dredge) to 7% (post- suction dredge; Table 2). Targeting any remaining fragments, a pesticide treatment was applied after the suction dredge. Post- management surveys found no starry stonewort. The combined methods also reduced the submerged native aquatic plant from 93% to 29% (Table 2). Significant changes in native aquatic plants were likely due because the senescence of plant growth during the fall. Even though the management efforts in the fall of 2016 were successful, starry stonewort percent frequency increased to 25% the following July (2017). Management of starry stonewort continued in 2017 with four pesticide treatments to reduce the occurrence and abundance of starry stonewort. Since copper pesticides only cause injury to the algal cells, repeated applications were conducted to reduce the continued growth of starry stonewort. The starry stonewort continued to expand in Rice Lake with numerous pesticide treatments. The survey in July of 2018 indicated an increase of 50% occurrence in the treatment area. However, after an additional four pesticide treatments, the starry stonewort reduced to 5% (Sept 2018). By 2019, the percent of points with starry stonewort had shown reductions from the previous year, with no points with starry stonewort by the end of 2019 (Table 2; Figure 3). No starry stonewort was found at the beginning of 2020, however, one point was found with starry stonewort in September.

Rice Lake has up to 10 submerged native aquatic plants within the treatment area. Overall, impacts to native aquatic plant communities have been documented (Table 3a, 3b). Species that have shown declines with the use of copper have mostly been limited to declines in muskgrass (also a macroalgae that is impacted by copper). During management, declines in native aquatic plants such as Canadian waterweed and water stargrass were documented after applications of a non-selective herbicide (Hydrothall 191). The mean density of submersed native taxa had relatively maintained the same among treatment years (Figure 4), although there were annual reductions in the percent of native aquatic plants (Table 2). Moreover, changes in plant communities between years could also be due to a variety of factors such as differing phenology, seasonal variation or possible impacts from the pesticide treatments. Continued monitoring and management of this site will be helpful to determine if this management technique is effective at reducing and preventing the spread of starry stonewort within the lake, as well as, causing minimal harm to native aquatic plants.

Table 2 - Plant Survey Metrics inside Treatment Area. Summary of metrics for Rice Lake PWA Starry Stonewort Management in Rice Lake, Stearns County (DOW# 73019600). Shaded values were calculated from littoral depth range.

Survey Metrics	11 Oct 2016 (Pre-Dredge)	20 Oct 2016 (Post-Dredge)	4 Nov 2016 (Post- Trt.)	12 July 2017 (Pre-Trt)	25 July 2017 (Post-Trt.)	2 July 2018 (Pre-Trt.)	20 July 2018 (Post-Trt.)	10 Sept 2018 (Post-Trt.)	21 June 2019 (Pre-Trt.)	23 Aug 2019 (Post-Trt.)	7 October 2019 (Post-Trt.)	24 June 2020 (Pre-Trt.)	9 Sep 2020 (Post-Trt.)
Surveyor	MNDNR	MNDNR	MN DNR	MN DNR	MN DNR	MNDNR	MNDNR	MNDNR	MNDNR	MNDNR	MNDNR	MNDNR	MNDNR
Total # Points Sampled	14	14	14	20	20	20	20	20	69	45	45	36	35
Max Depth of Growth (95%) in feet	4.2	4	3.2	5.7	5	4.8	5.7	5.3	6.9	5.2	7.1	3.7	4.1
# of Vegetated Points in Max Depth Range	13	14	8	19	20	18	20	19	65	22	21	32	31
Max Depth of *SSW in feet	3.6	2.8	0	5.8	4.5	4.9	5.5	4.9	4.6	5.1	0	0	1.4
# Points in Littoral (0-15 feet)	14	14	14	20	20	20	20	20	69	45	45	36	35
% Points w/ Submersed Native Taxa	93	79	29	100	95	95	85	55	57	29	18	31	29
Mean Submersed Native Taxa/ Point	1.9	2.3	0.4	2.5	2.5	2.4	2.1	0.7	0.7	0.4	0.2	0.5	0.43
Mean Density of Submersed Native Taxa	1.1	1	1	1.1	1	1	1	1	1	1	1	1	1
# Submersed Native Taxa	6	7	4	8	8	7	8	3	10	6	3	5	7
% Points w/ Starry Stonewort	14	7	0	25	20	50	20	5	4	2	0	0	2
Mean Density of Starry Stonewort	1.0	1.0	0.0	1.0	1.0	0.5	0.2	0.05	1	1	0	0	0.03

*95th percentile calculated based on all vegetated sampling points

** SSW refers to starry stonewort

Taxa refers to groups of submersed aquatic plant species or genera

Monitoring Report for Starry Stonewort Management in Rice Lake, Stearns County (2016- 2020)

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Table 3a. - Plant Frequency Occurrence inside Treatment Area. Percent frequency of occurrence for submersed taxa (most identified to species) in Rice Lake, Stearns County (DOW# 73019600). *denotes invasive aquatic plant/algae.

Taxonomic Name	Common Name	11 Oct 2016 (Pre- Dredge)	20 Oct 2016 (Post- Dredge)	4 Nov 2016 (Post-Trt.)	12 July 2017 (Pre-Trt.)	25 July 2017 (Post-Trt.)	2 July 2018 (Pre-Trt.)	20 July 2018 (Post-Trt.)	10 Sept 2018 (Post-Trt.)
SUBMERSED PLANTS									
<i>Nitellopsis obtusa</i> *	Starry stonewort*	14	7	0	25	20	50	20	5
<i>Potamogeton crispus</i> *	curly-leaf pondweed*	57	86	29	85	75	35	35	70
<i>Ceratophyllum demersum</i>	Coontail	50	50	7	65	65	85	60	55
<i>Chara</i> sp.	Muskgrass	36	29	14	20	0	15	5	0
<i>Elodea canadensis</i>	Canada waterweed	43	57	7	35	45	30	20	0
<i>Heteranthera dubia</i>	Water stargrass	50	50	14	30	15	15	35	0
<i>Najas</i> sp.	Naiad	7	0	0	0	20	0	20	5
<i>Potamogeton richardsonii</i>	Claspingleaf pondweed	0	7	0	10	10	20	20	0
<i>Potamogeton</i> sp.	Narrowleaf pondweed	0	0	0	0	0	65	40	0
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	0	0	0	5	5	0	0	0
<i>Stuckenia pectinata</i>	Sago pondweed	0	7	0	10	5	0	5	0
<i>Vallisneria americana</i>	Water celery	7	21	3	20	25	5	0	5

Table 3b. - Plant Frequency Occurrence inside Treatment Area. Percent frequency of occurrence for submersed taxa (most identified to species) in Rice Lake, Stearns County (DOW# 73019600). *denotes invasive aquatic plant/algae.

Taxonomic Name	Common Name	21 June 2019 (Pre-Trt.)	23 Aug 2019 (Post-Trt.)	7 Oct 2019 (Post- Trt.)	24 June 2020 (Pre-Trt.)	9 Sept 2020 (Post-Trt.)
SUBMERSED PLANTS						
<i>Nitellopsis obtusa</i> *	Starry stonewort*	4	2	0	0	3
<i>Potamogeton crispus</i> *	curly-leaf pondweed*	86	36	40	44	37
<i>Ceratophyllum demersum</i>	Coontail	35	18	2	8	14
<i>Chara</i> sp.	Muskgrass	4	4	2	0	6
<i>Elodea canadensis</i>	Canada waterweed	1	0	0	0	0
<i>Heteranthera dubia</i>	Water stargrass	1	0	0	0	9
<i>Myriophyllum sibiricum</i>	Northern watermilfoil	0	0	0	3	0
<i>Najas</i> sp.	Naiad	0	2	0	0	6
<i>Potamogeton richardsonii</i>	Claspingleaf pondweed	1	0	0	0	0
<i>Potamogeton</i> sp.	Narrowleaf pondweed	16	4	16	22	0
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	1	0	0	3	3
<i>Stuckenia pectinata</i>	Sago pondweed	3	11	0	14	3
<i>Vallisneria americana</i>	Water celery	1	2	0	0	3

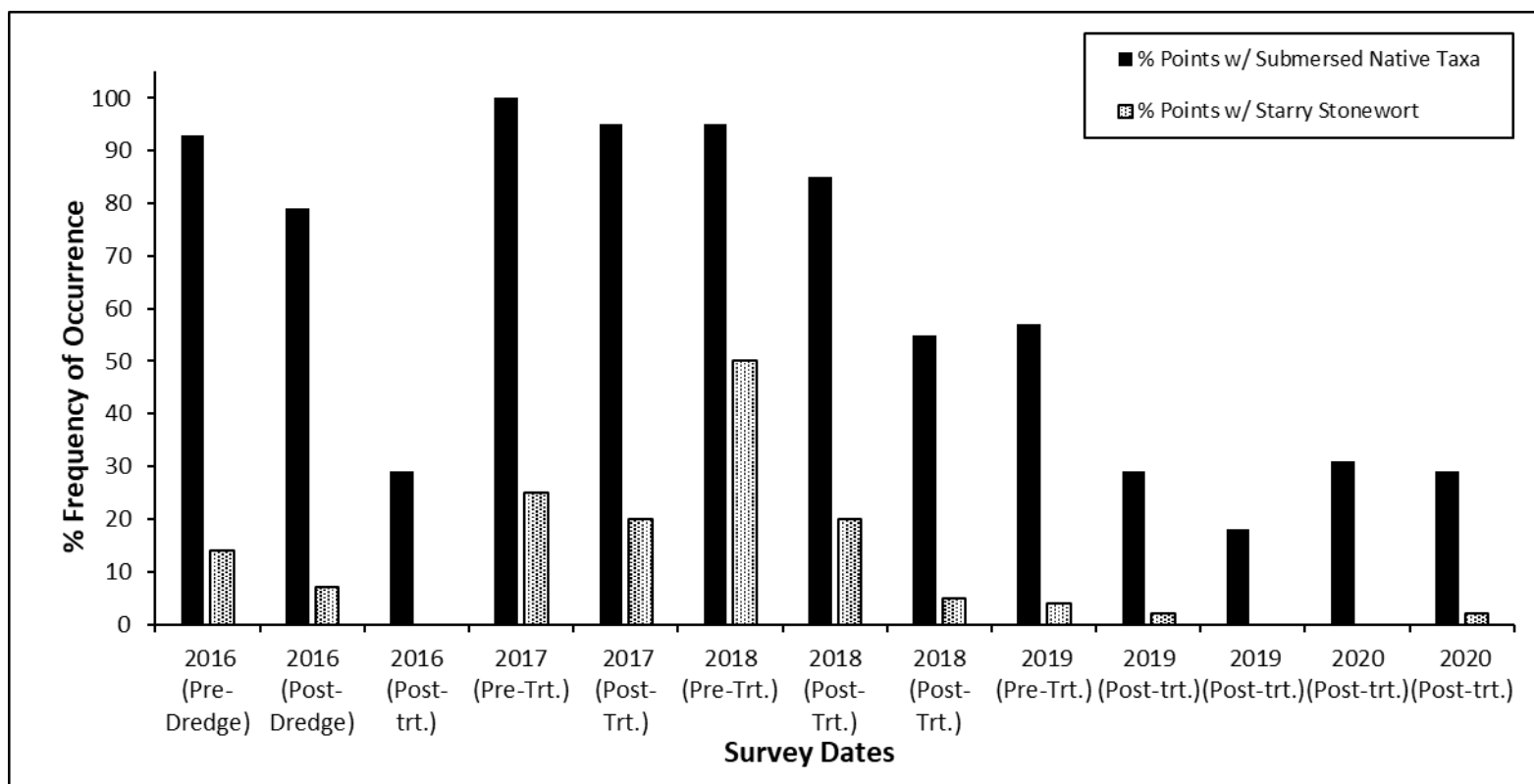


Figure 3- 2016-2020 Plant Frequency of Occurrence inside Treatment Area. Percent frequency of occurrence for submersed native taxa and starry stonewort across treatment dates in Rice Lake, Stearns County (DOW# 73019600).

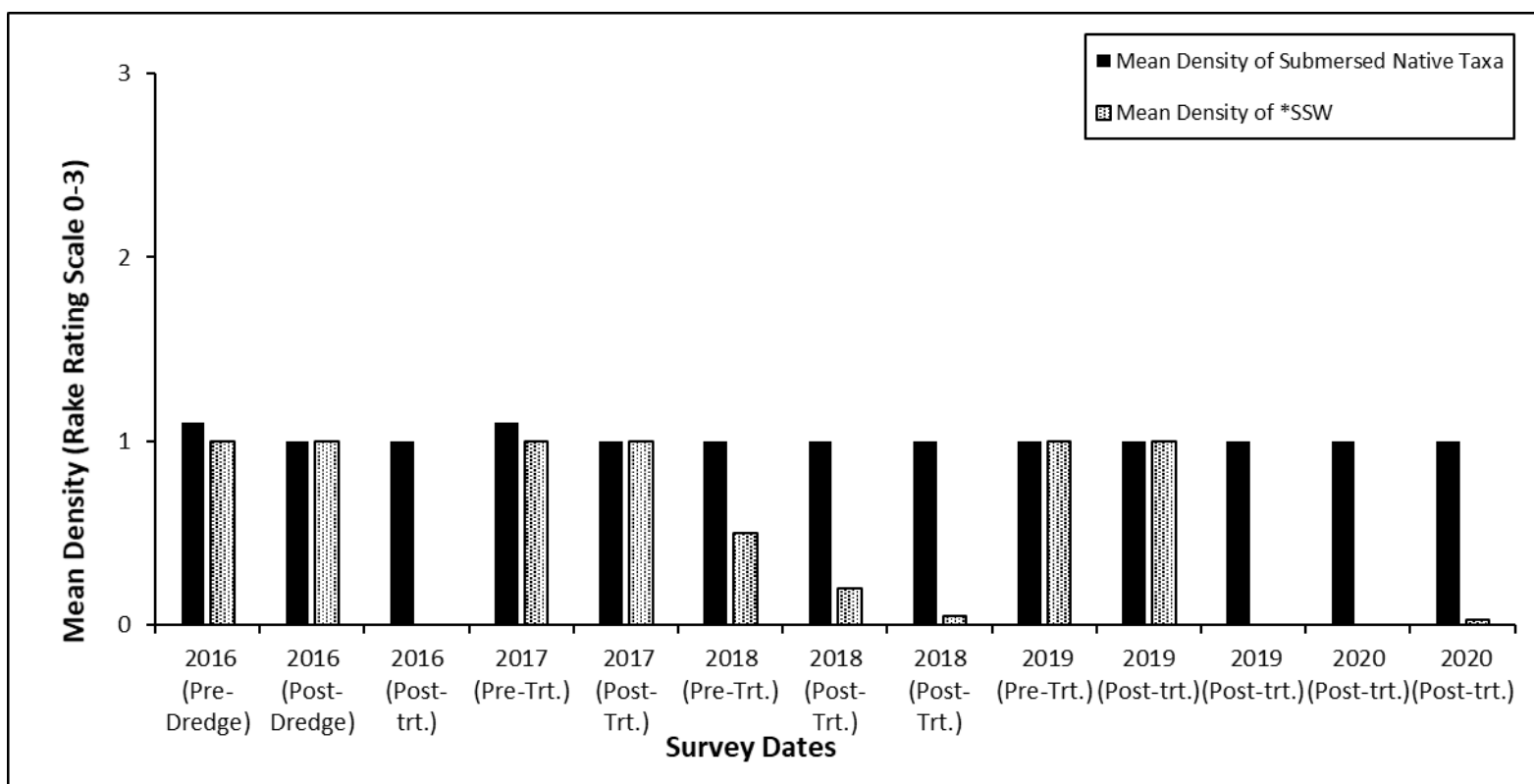


Figure 4 – 2016-2020 Mean Density of Plants inside Treatment Area. Mean density rating (0-3 scale) of for submersed native taxa and starry stonewort across treatment dates in Rice Lake, Stearns County (DOW# 73019600).

Pesticide Concentrations

Copper concentrations were monitored to determine the fate of copper in water. Copper concentrations were obtained in 2016 using a barrier (Figure 5) and in 2018 without a barrier (Figure 6). Copper treatments, surveyors, and sample methods varied by year. Although, copper treatments had a target dose rate of 1 mg/L.

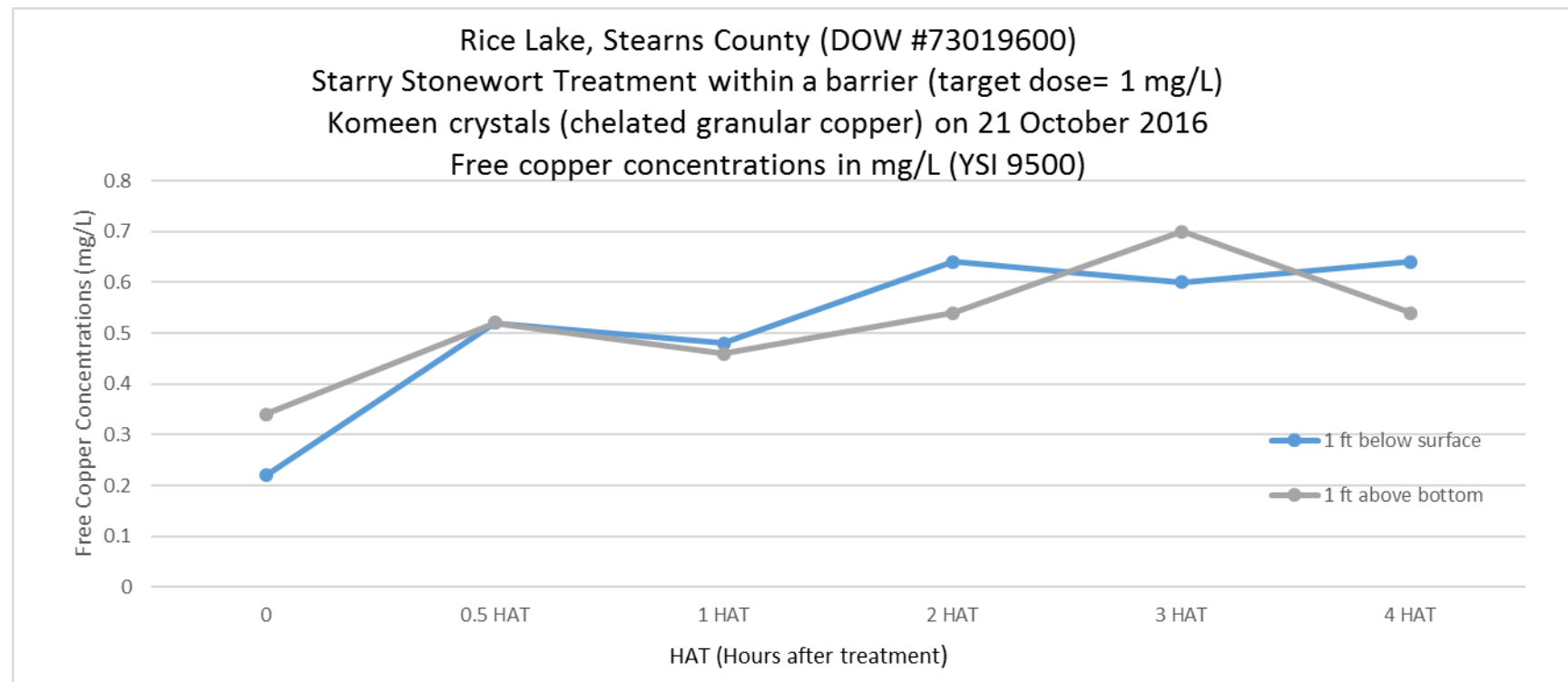


Figure 5 - Post-Treatment copper concentrations (mg/L) for control of starry stonewort in Rice Lake, Stearns County (DOW# 73019600) within a barrier. Target dose rate of 1 mg/L using Komeen[®] crystals (chelated granular copper). Water samples were collected on 21 October 2016 by MN DNR. Samples were collected at up to 4 hours after treatment (HAT) at 12 inches below the surface and 12 inches above the bottom at one sampling site. Method used to analysis copper concentrations was a photometer method using a YSI 9500 Colorimeter that measured free copper concentrations.

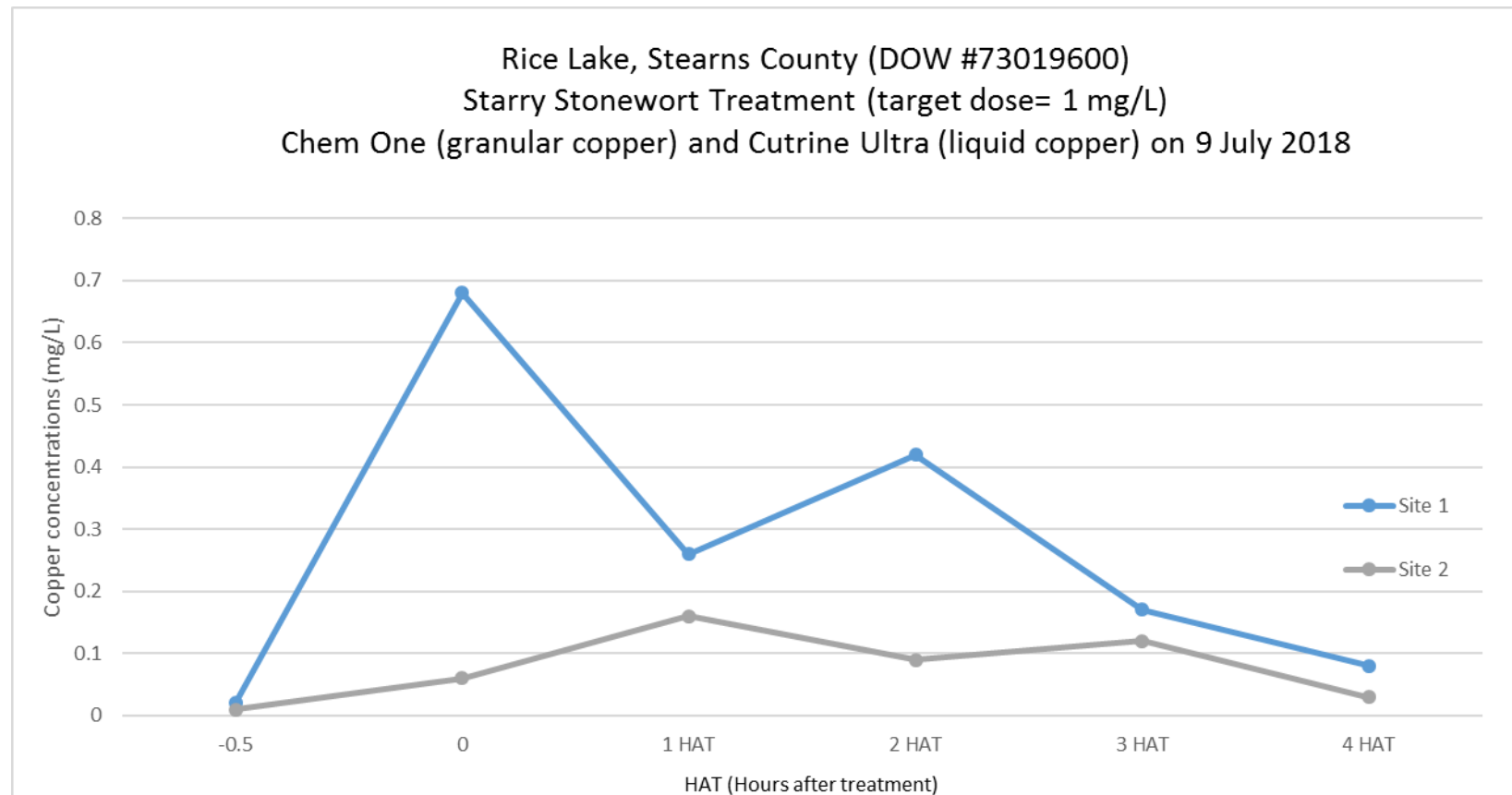


Figure 6 - Post-Treatment copper concentrations (mg/L) for control of starry stonewort in Rice Lake, Stearns County (DOW# 73019600). Water samples were obtained by Rice Lake Association on 9 July 2018 and sent to Freshwater Scientific Services for analysis on 12 July 2018. Samples were collected at up to 12 HAT at two sampling sites. Lab analysis was performed by Freshwater Scientific Services and submitted to MN DNR. Method used to analysis copper concentrations was diethyldithiocarbamate colorimetry with a LaMotte 1200 Colorimeter.

Treatment Area and Survey Activity Map(s)

Management was conducted at the south public water access on Rice Lake in Stearns County. The following maps (Figures 7- 11) display the frequency and abundance of starry stonewort pre and post-treatments and the species richness of native aquatic taxa between 2016 and 2020.

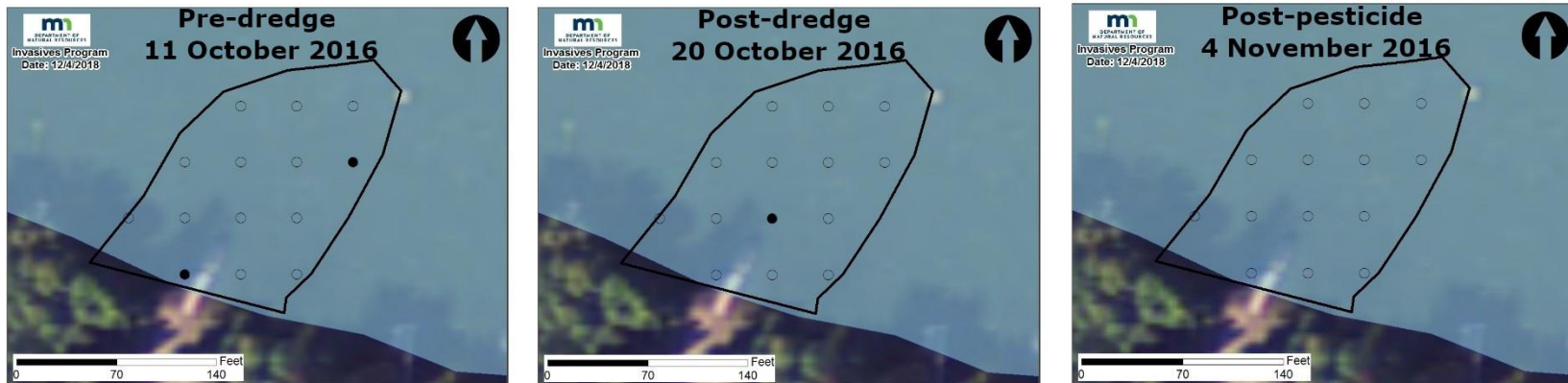


Figure 7 - 2016 Starry stonewort presence and abundance monitoring in Rice Lake, Stearns County (DOW# 73019600). Starry stonewort rake rating as followed: hollow circle= 0 (none), black circle= 1 (sparse), triangle= 2 (scattered), and square= 3 (common).

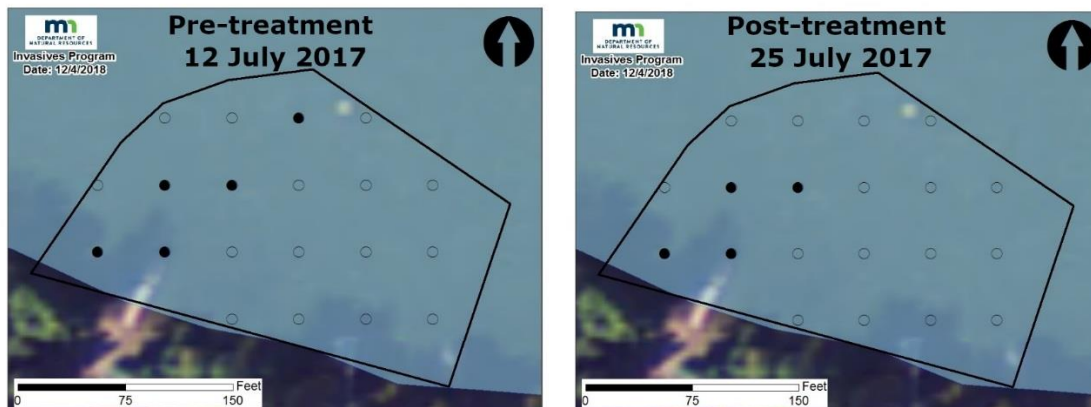


Figure 8 - 2017 Starry stonewort presence and abundance monitoring in Rice Lake, Stearns County (DOW# 73019600). Starry stonewort rake rating as followed: hollow circle= 0 (none), black circle= 1 (sparse), triangle= 2 (scattered), and square= 3 (common).

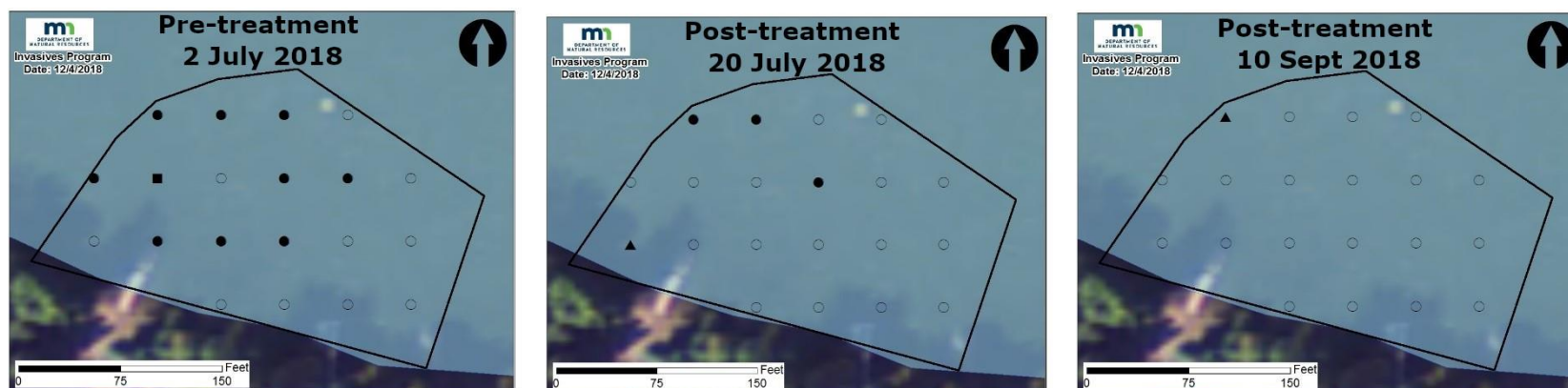


Figure 9 - 2018 Starry stonewort presence and abundance monitoring in Rice Lake, Stearns County (DOW# 73019600). Starry stonewort rake rating as followed: hollow circle= 0 (none), black circle= 1 (sparse), triangle= 2 (scattered), and square= 3 (common).

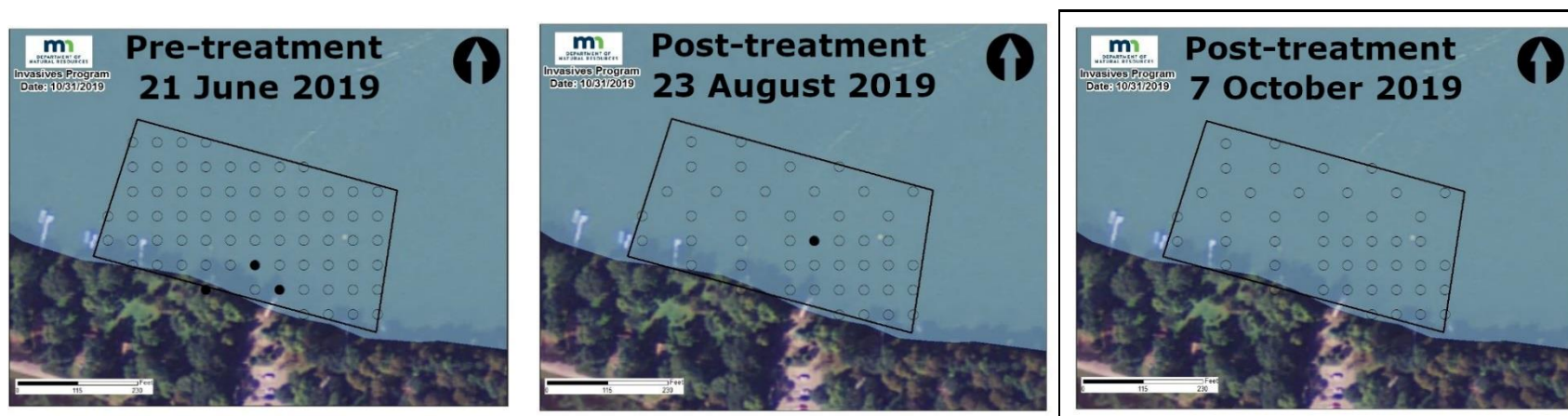


Figure 10 - 2019 Starry stonewort presence and abundance monitoring in Rice Lake, Stearns County (DOW# 73019600). Starry stonewort rake rating as followed: hollow circle= 0 (none), black circle= 1 (sparse), triangle= 2 (scattered), and square= 3 (common).

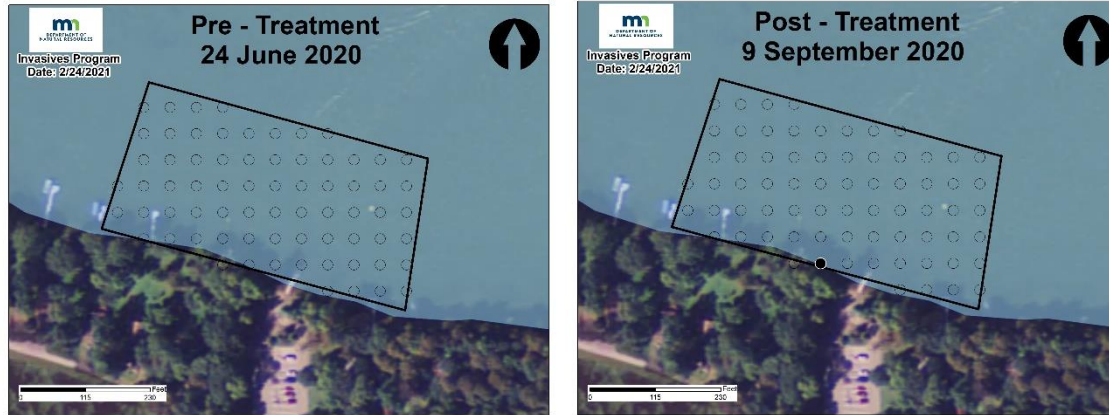


Figure 11 - 2020 Starry stonewort presence and abundance monitoring in Rice Lake, Stearns County (DOW# 73019600). Starry stonewort rake rating as followed: hollow circle= 0 (none), black circle= 1 (sparse), triangle= 2 (scattered), and square= 3 (common).

Conclusion

Based on the numerous pesticide formulations and management techniques that have been implemented in Rice Lake to control starry stonewort, the invasive macroalgae continues to persist. Because of the re-growth of starry stonewort, annual repeat spot-treatments for small populations have been used to provide short-term reduction of the abundance and frequency of occurrence of starry stonewort on an annual basis. Over the four years of management in Rice Lake, there has been a reduction in the frequency of starry stonewort, although impacts have occurred to native aquatic plants. Each year the management techniques, number of treatments and timings of treatment have changed so evaluating success is difficult. Further long-term monitoring is needed to evaluate if a reduction can occur over time.

Copper concentration monitoring following treatments have indicated that the copper algaecides dissipate quickly, especially in small spot treatments. Copper treatments within barriers may provide extended concentration exposure time depending on environmental conditions of the lake. However, most copper treatments, to date, have not met the label requirement of a minimum of three hour contact time. Based on annual meandering surveys conducted by Blue Water science, starry stonewort is limited to the public water access. The management at the public water access has shown to limit spread within the lake since no other locations are known to have starry stonewort. Management also likely reduced matting conditions within the five years of management. It is recommended that monitoring continues at both the management area and lake-wide to determine if management techniques are meeting the goals of limiting the spread within the lake.

Literature Cited

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