



# A Swimmer's Itch Control Program for Higgins Lake

Annual Report for Maintenance Year 3

November 15, 2020

by

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\* This report was written for the Higgins Lake Swimmer's Itch Organization (HLSIO), a non-profit 501 (c) (3) group tasked with managing and funding a comprehensive swimmer's itch control program on Higgins Lake.

----- *SPECIALIZING IN EDUCATION AND CONTROL* -----

## Executive Summary

In 2020, Swimmer's Itch Solutions, LLC (SIS) partnered with the HLSIO for another year of a swimmer's itch control maintenance program on Higgins Lake. In early spring, SIS secured all necessary federal and state permits to conduct this maintenance program. **Unexpectedly, no common merganser broods appeared on Higgins Lake in 2020.**

Both well-known SI metrics—snail infection level and qPCR analyses of water samples—tell the same story: **Since 2015, Higgins Lake has seen a significant reduction in SI-causing parasites in the lake.** An analysis of 2063 *Stagnicola* snails from Higgins Lake this summer indicated a lake-wide avian schistosome snail infection level of < 0.05%. This represents over a **99% decrease** from the pre-control-program level in July 2015. qPCR analyses of 35 samples from Higgins Lake indicated a very low number of cercariae present in the water.

Based on the results of this assessment, we strongly encourage the HLSIO to continue its common merganser trapping and relocation program as a swimmer's itch control strategy. There is every reason to believe that it alone is responsible for the significantly decreased in SI cases since 2015. It should be noted that Higgins Lake has many migratory waterfowl in the spring and fall, including mergansers, yet their collective contribution to increasing SI-causing parasites in the lake appears to be minor compared to common merganser broods in the summer.

## Introduction

Swimmer's itch, also known as schistosome cercarial dermatitis, is a common problem in many recreational lakes throughout the northern United States and the world. It can be caused by any of over 70 different avian schistosome parasite species that mistakenly penetrate human skin instead of the skin of their natural definitive host. When this happens, the parasite dies at the site of penetration causing an inflammation of the skin and the formation of a papule. Swimmer's itch papules can itch intensely for up to 10 days.

## Brief review of avian schistosome life cycles

All avian schistosome species have a similar two-host life cycle. As adults they live within a definitive host, most commonly a duck; when sexually mature the worms release their eggs, which make their way into the feces of their host. If these feces land in water, eggs of the parasite hatch into larval stages (miracidia), which are infective to an appropriate species of snail (the intermediate host). Upon finding a suitable snail, the miracidium will penetrate the soft tissue and develop within its digestive glands. Over the next 30 days it matures and then produces thousands of cercariae that are released into the water every day, especially during the warm-water summer months. If a cercaria locates the correct vertebrate host species, it penetrates and develops into an adult worm to complete its life cycle. If a cercaria accidentally penetrates human skin, it dies in the skin, and an immune reaction can result, usually causing a raised papule that can itch intensely.

In many northern Michigan lakes, severe outbreaks of swimmer's itch have predominantly and most commonly been attributed to the avian schistosome, *Trichobilharzia stagnicola*. This parasite species typically utilizes the common merganser (*Mergus merganser*) as its definitive host and *Stagnicola emarginata* as its intermediate (snail) host.

## **Off-season Preparation/Research and Development**

**Summary of work completed:** All necessary federal and state permits (US Fish & Wildlife, US Geological Survey, and Michigan DNR) were obtained for work on Higgins Lake (Roscommon County, MI).

Swimmer's Itch Solutions, LLC continues to work with the MISIP, which is composed of representatives of approximately 40 lake associations in Michigan dedicated to fighting swimmer's itch. We were under contract with the Crystal Lake & Watershed Association, the Larks Lake Association, and the Black Lake Preservation Society during the summer of 2020. We also provided technical and other support to the MISIP including sharing control and research results with member lake associations. We continue to work with leading experts in the field of swimmer's itch.

## **Control Program**

### **Waterfowl surveys**

**Accompanying file:** HigginsLakeBirdSurveys2020.xlsx

**Summary of work completed:** Waterfowl surveys of the entire shoreline of Higgins Lake were conducted on June 16, 2020 (Figure 1) and August 18, 2020 (Figure 2). Not surprisingly, several dozens of resident mallards were observed during both surveys. While we didn't see any common mergansers during the first survey, we did find one group of 8 second-year (SY) adult common mergansers on the lake in August. These particular individuals are most likely non-resident birds that are engaging in pre-migratory behavior.

### **Removal of common merganser broods**

**Summary of work completed:** For the past 5 years, Higgins Lake riparians have promptly and accurately reported all common merganser broods on the lake. Nine broods were trapped and relocated in 2015 and that number has been steadily decreasing every year since then (there were only 2 broods in 2019). For the first time in several summers, no common merganser broods were observed on Higgins Lake in 2020. This was confirmed with waterfowl surveys of the entire shoreline (see above).

We are convinced that the removal of the Gerrish Township common merganser nest boxes, first erected in 2017, have played a significant role in the observed decrease in common merganser broods on Higgins Lake. Had Eric Ostergren not spear-headed this removal effort, it's reasonable to assume that a half-dozen (or more) common merganser hens would have produced broods this summer. In another instance of nest site reduction, a confirmed nest that likely produced a brood each year from 2015-2018 was eliminated in July 2018.

Another contributing factor to the 5-year reduction of common merganser broods on Higgins Lake may be that all captured birds (hen and ducklings) are relocated more than 60 miles from their natal site. Many biologists believe that when hatch-year common merganser ducklings mature to breeding age, they return to nest in areas nearby where they fledge. In fact, many waterfowl species exhibit this behavior. Thus, ducklings captured on Higgins Lake and relocated to Tawas City or Cheboygan probably aren't coming back to Higgins to breed. Corroborating evidence for this hypothesis can also be found in the absence of any web tags (put on all captured ducklings over the past 3 years) on Higgins Lake adult common mergansers.

We also want to caution against the expectation next summer of zero common merganser broods on Higgins Lake. The lake is just too large, and the habitat is too ideal for common merganser hens, for a second consecutive brood-free year in 2021.

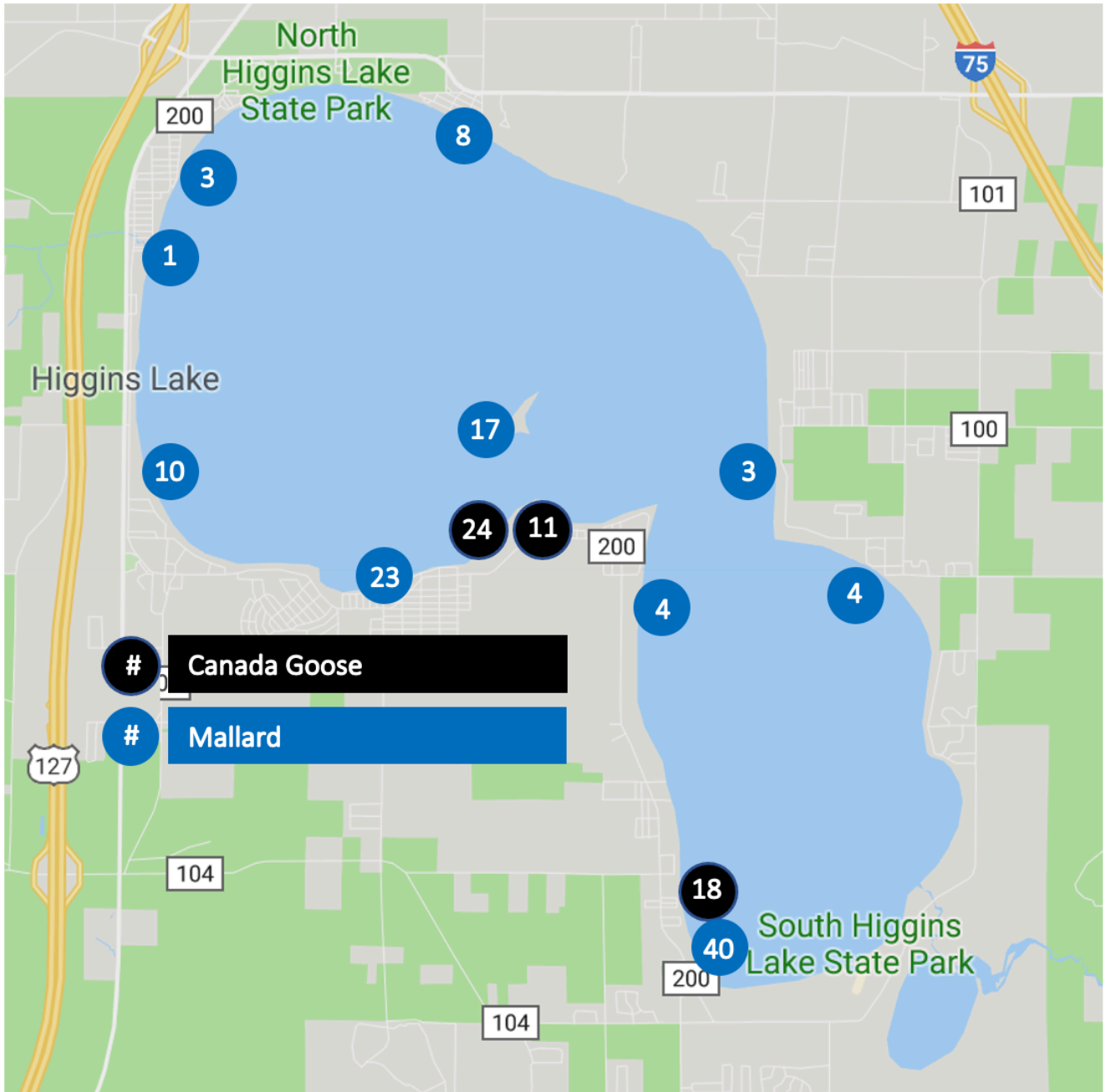


Figure 1. Number of Canada geese and common mergansers observed during a June 16, 2020 shoreline survey of Higgins Lake (Roscommon County, MI).

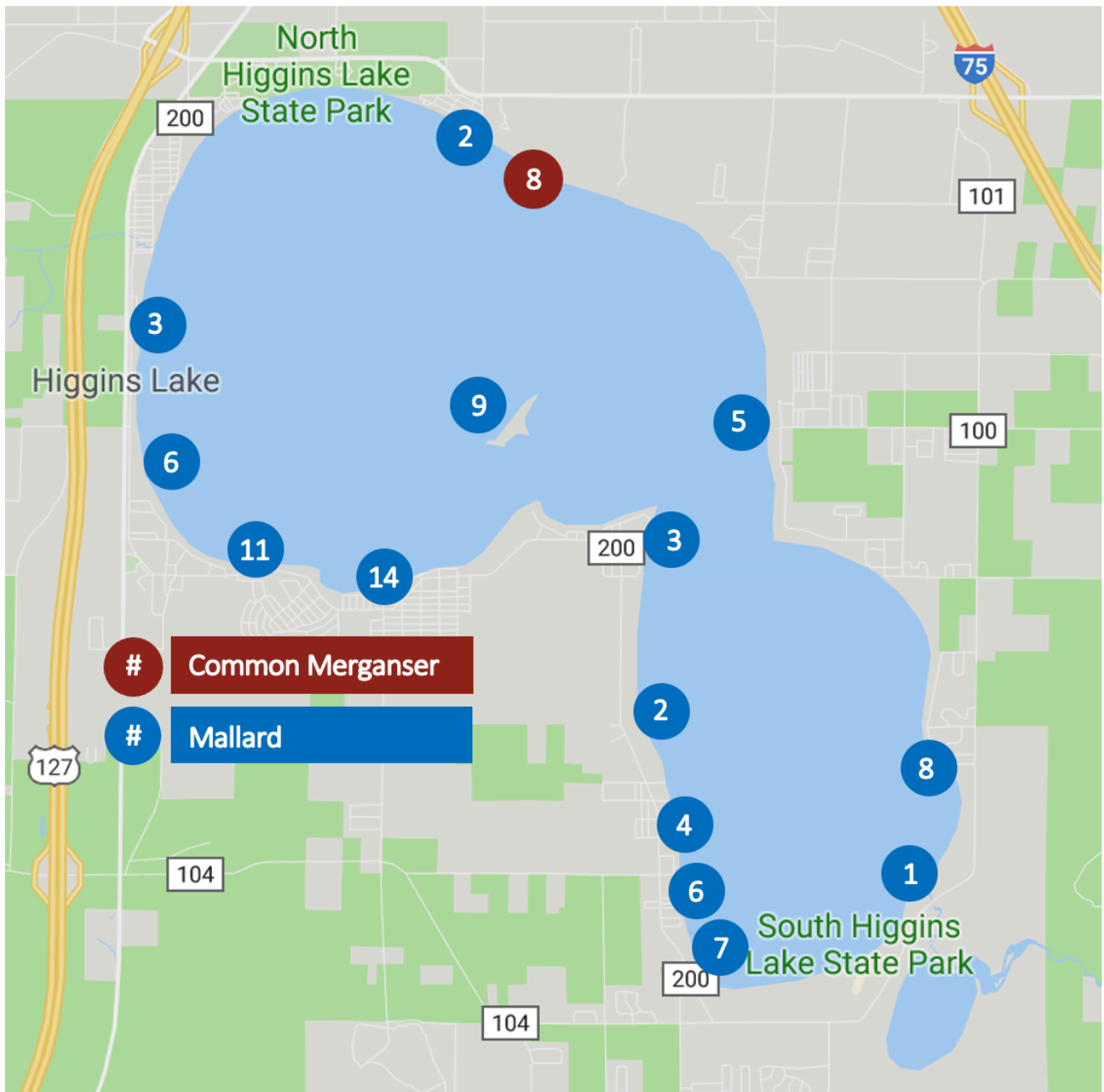


Figure 2. Number of Canada geese and common mergansers observed during a August 18, 2020 shoreline survey of Higgins Lake (Roscommon County, MI).

## Assessment Program

### Snail infection levels

**Accompanying files:** HigginsLakeSnailCollectionSites.pdf  
HigginsLakeSnailInfectionLevels2020.pdf

**Summary of work completed:** In 2015, a comprehensive avian schistosome species assessment was conducted and 10 snail collection sites were strategically chosen around Higgins Lake to give the greatest possible lake-wide coverage. Data from that assessment identified *Trichobilharzia stagnicola* (carried in *Stagnicola emarginata* snails) as the dominant swimmer's itch causing species on Higgins Lake. On July 8, 2020, *S. emarginata* snails were collected from each site and individually shed for avian schistosomes (Table 1).

Given the recent discovery of a novel avian schistosome species carried by *Helisoma* sp. snails and Canada geese, we expanded our 2020 snail collecting protocol to include members of that snail genus. In over 16 person-hours of searching, only 257 *Helisoma* sp. snails were collected, but none were positive for avian schistosomes.

Because of the variability associated with sample sizes less than 200 snails, the most meaningful and relevant data are the lake-wide infection levels. In mid-July 2015, the lake-wide avian schistosome infection level in snails 2.9% (the baseline metric). As a point of reference, the lake-wide snail infection prevalence on Glen Lake (Leelanau County, MI) when swimmer's itch cases were at their worse was a little over 2.0%. This summer, 2063 *Stagnicola emarginata* snails were collected during the first week of July, before this year's generation of snails hatched in the lake. An examination of those snails yielded no avian schistosome infections (i.e., a lake-wide infection level of < 0.05%, which represents over a 99% decrease from the baseline, pre-control program value in 2015). As is evident from Table 1, all of the 2020 snail infection levels at the ten collection sites on Higgins Lake fell within the ideal range.

### Swimmer's Itch Case Reports

**Summary of work completed:** On our website ([www.swimmersitchsolutions.com](http://www.swimmersitchsolutions.com)) we maintained pages solely dedicated to swimmer's itch education, research, and control on Higgins Lake. These pages serve as a centralized repository to report swimmer's itch cases and common merganser nest sites and broods. They also provide important information that facilitates our efforts in providing the most successful comprehensive swimmer's itch control program possible.

Cases of swimmer's itch were reported at 43 unique locations on Higgins Lake in 2020 (Figure 3). We chose to report distinct locations instead of individual cases because it avoids the duplication of data that arises with multiple reports by the same individual or in the same location. While the number of reported swimmer's itch cases is still a very small, the 2020 data represent an increase from last year.

Despite the slight increase in the number of case reports on our website, the anecdotal testimonials from Higgins Lake riparians, and the overwhelmingly positive reviews on various social media platforms, all show the continued success of our control program.

**Conclusion:** *Snail infection levels and case report data both suggest that swimmer's itch is at an ideal level on Higgins Lake in 2020. At present, there is no known control program or technology that can completely eliminate or eradicate swimmer's itch from a lake.*

Table 1. The percentage of *Stagnicola emarginata* snails infected with swimmer’s itch at ten different locations on Higgins Lake (Roscommon County, MI) in 2015-2017, and 2020. Data from July 2015 serve as a pre-program baseline, as the HLSIO initiated swimmer’s itch control efforts in 2015. The number in parenthesis indicates the total number of snails examined. Color of cell indicates infection level. (■ = Ideal (<0.24%), ■ = Tolerable (0.25-0.49%), ■ = Moderate (0.5-0.9%), ■ = Severe (1.0-1.9%), ■ = Epidemic (>2.0%))\*

Control Program	Pre-program Baseline	All Common Merganser Broods Trapped and Relocated (Our program started in 2015)		
	Year 1	Year 2	Year 3	Year 6
Location	2015 July 10-17	2016 July 11-12	2017 July 10-11	2020 July 8
Dragonfly House	4.2% (167)	0.0% (200)	0.0% (222)	0.0% (120)
Detroit Point	3.5% (200)	0.0% (200)	0.47% (214)	0.0% (220)
Boat Club	0.5% (200)	0.0% (200)	0.0% (196)	0.0% (126)
Sam-O-Set Park	2.0% (200)	0.5% (200)	0.0% (202)	0.0% (177)
West Boat Launch	5.5% (200)	0.5% (200)	0.48% (210)	0.0% (292)
North State Park	1.9% (155)	0.0% (200)	0.0% (225)	0.0% (260)
Gerrish Township Park	6.2% (113)	1.0% (200)	0.40% (253)	0.0% (240)
Kelly Beach	2.5% (122)	0.0% (200)	0.0% (208)	0.0% (200)
Almeda Beach	0.5% (200)	1.0% (200)	0.0% (216)	0.0% (150)
South State Park	3.5% (200)	2.0% (200)	0.0% (239)	0.0% (278)
Lake-wide	2.9% (1757)	0.5% (2000)	0.14% (2185)	< 0.05% (2063)

\*While these various levels and categories (ideal, tolerable, moderate, severe, epidemic) might seem arbitrary, they are based on decades of professional experience working on swimmer’s itch on numerous lakes in the USA.

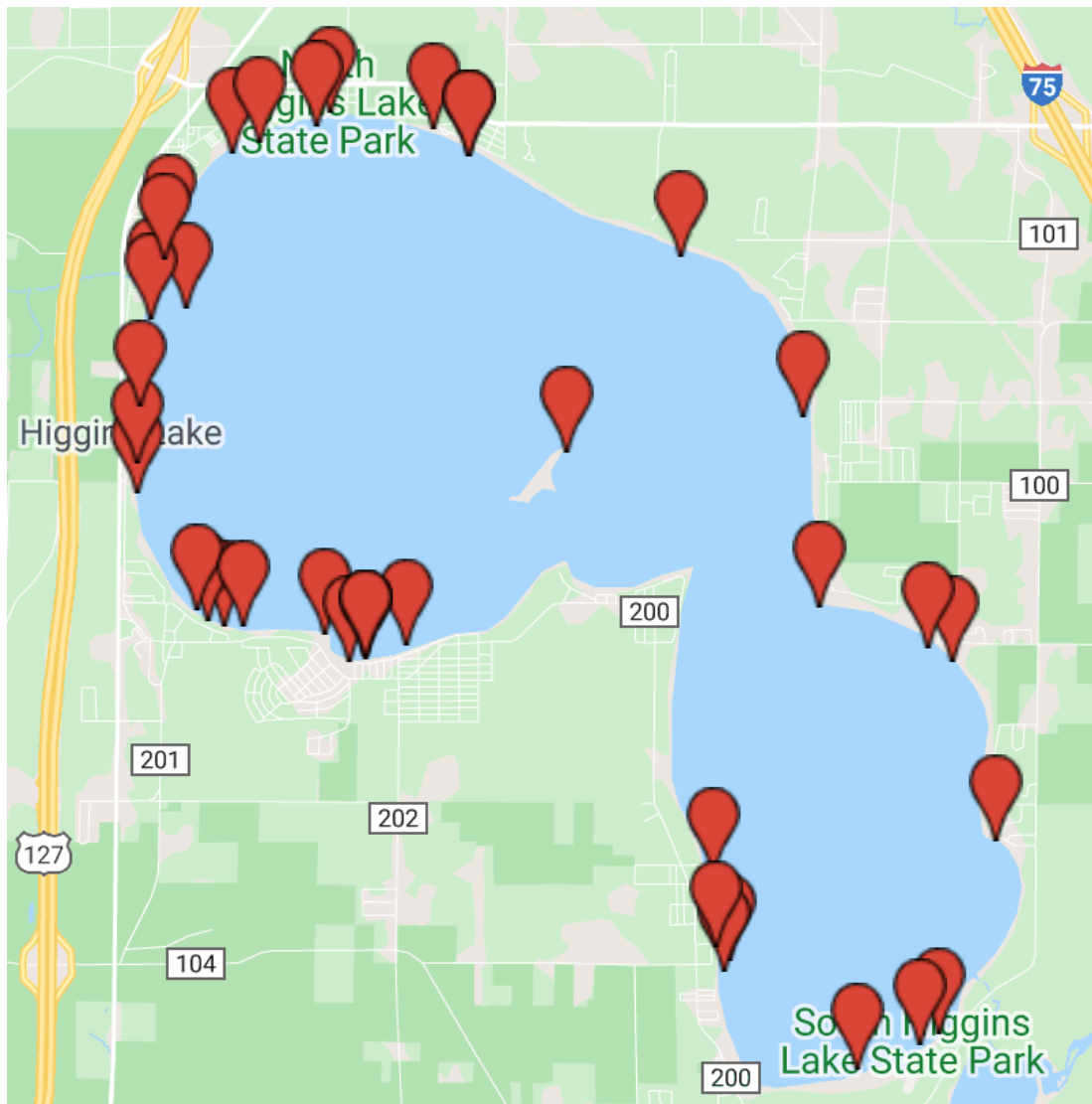


Figure 3. Locations of swimmer's itch cases on Higgins Lake (Roscommon County, MI) that were reported on [www.swimmersitchsolutions.com/Higginslake](http://www.swimmersitchsolutions.com/Higginslake) from May 1 - September 30, 2020. Each red balloon represents a distinct location for a swimmer's itch case report.



## Water samples

**Accompanying file:** HigginsLakeWaterSampleAnalyses2020.pdf

**Summary of work completed:** Higgins Lake personnel collected water samples on four dates: July 13, July 27, August 10, and August 24, 2020, at eight of the 10 snail collection sites (Figure 4). In addition, one of the eight samples was collected from the wrong location on July 13 (Hoffmeyer instead of Hoffman residence). As a remedy, subsequent samplings included both locations, resulting in a total of 35 samples. The 2020 samples were shipped or hand carried to Dr. Randy DeJong's laboratory. In the lab, these samples were filtered onto membranes, which were then sliced in half, with one half of the membrane then used for DNA extraction, and the other half stored at -80°C for later analyses if so desired.

Quantitative PCR (qPCR) was then performed on the 35 samples using the pan-schistosome assay that has been used in the past. This assay detects and quantifies all schistosome DNA in the sample. Five negative controls were run to test for contamination. Following the pan-schistosome assay, all positive samples were subjected to species-specific assays for *Trichobilharzia stagnicolae* (host is common merganser), *T. physellae* (common merganser and mallard), *Anserobilharzia brantae* (Canada goose), and *T. szidati* (mallard), and novel Avian Schistosomatid C (Canada goose). Negative controls were included in these tests also.

Fourteen samples tested positive for cercariae, but the values for estimated number of cercariae were low (Figure 4). The mean number of cercariae in the 35 samples was 0.5 cercariae/25 L. The highest estimate at any one site in 2020 was only 3 cercariae/25 L. All negative controls were negative, indicating that DNA contamination was not an issue. Interestingly, the August 24 samples yielded the highest number of positive sites (6 out of 9). The South State Park was the only site where all four samples tested negative. No site tested positive in all four samplings, though two sites (Sam-O-Set Park, North State Park) tested positive on three dates. Together, these data point to the 'hit or miss' nature of the water sampling via the qPCR technique, and such results are especially expected when snail infection rates and cercariae abundance are low.

All 14 samples positive for the pan-schistosome assay were found to contain *T. stagnicolae* DNA when subjected to the species-specific assays, while one sample also contained detectable *T. physellae* DNA (North State Park, July 27). All water samples were negative for the other species tested, and all negative controls were again negative.

**Conclusion:** *T. stagnicolae* remains the dominant species on Higgins Lake, as it does on many other lakes in northern Michigan.

The qPCR test results are consistent with a decline in schistosomes in the water. Though we caution from interpreting too much from qPCR data since qPCR estimates can be easily influenced by environmental conditions, and since any given sampling can simply miss cercariae in the water on account of being relatively small in volume.

**Summary Conclusion:** Both avian schistosome metrics (snail infection levels and qPCR) strongly suggest the common merganser brood relocation program has, and will continue to, significantly reduced swimmer's itch on Higgins Lake. There is every reason to believe that this program alone is responsible for the significantly decreased in SI cases since 2015.

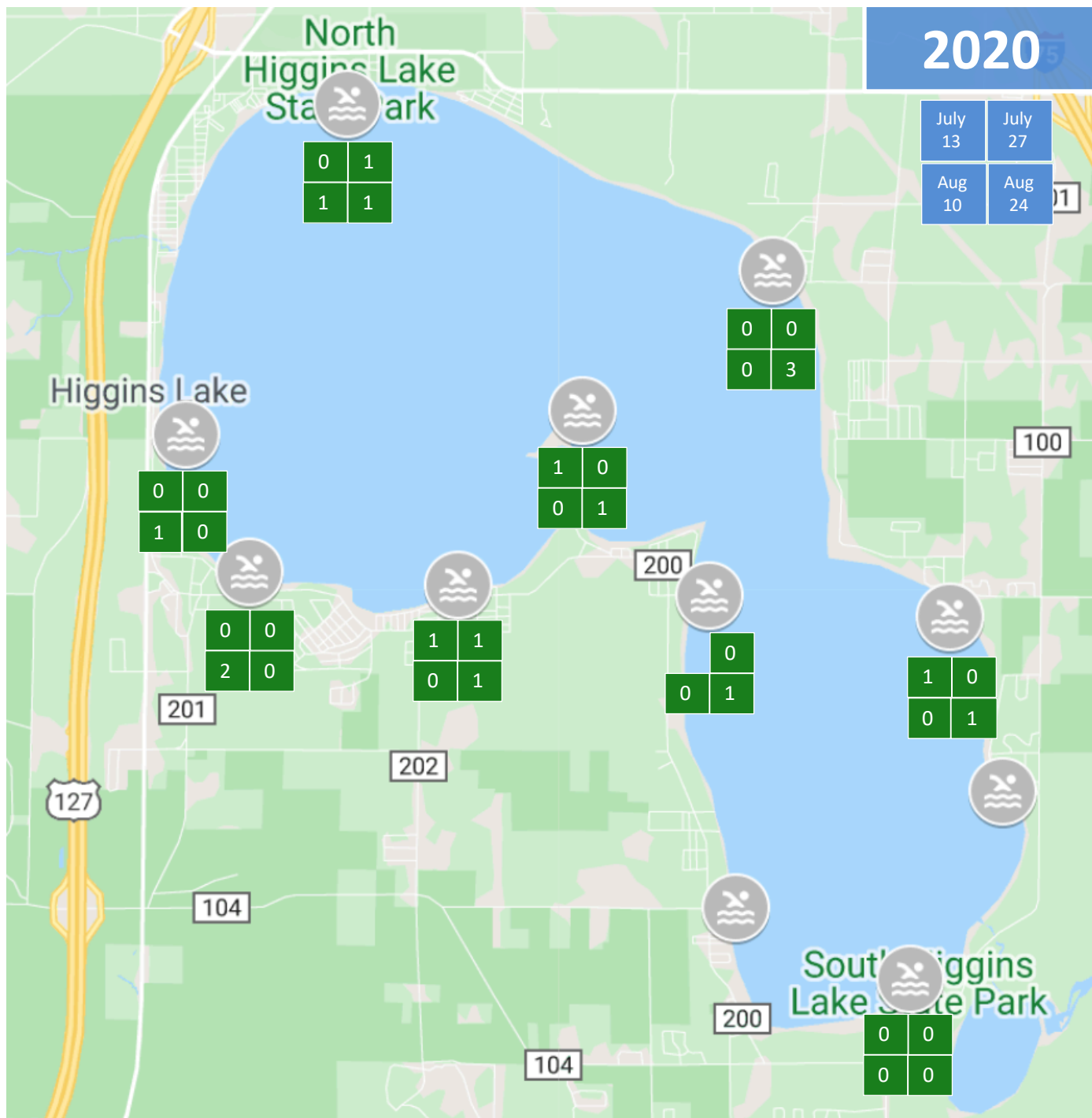


Figure 4. Estimated number of avian schistosome cercariae per 25 mL water in samples taken from Higgins Lake (Roscommon County, MI). Data from different dates are displayed in quadrants at each site: All positive samples subjected to species-specific assays were identified as *Trichobilharzia stagnicola*. Other than the July 27 sample from the North State Park which was also positive for *T. physellae*, all remaining samples were negative for other species tested. Color of cell indicates infection level. (■ = Ideal (<5), ■ = Tolerable (5.0-9.9), ■ = Moderate (10.0-29.9), ■ = Severe (30.0-99.9), ■ = Epidemic (>100)).

### **Recommendations for 2021 and beyond**

Based on the results of our work this summer, we strongly encourage the HLSIO to continue its common merganser trapping and relocation program as a swimmer's itch control strategy. Our data strongly suggest that the program is working. Anecdotal reports from many lake residents over that same time period also strongly support this claim.

We also recommend that the HLSIO continue a yearly assessment/monitoring of swimmer's itch levels on Higgins Lake with the explicit purpose of putting itself in the best possible position for any future common merganser trapping/relocation permit renewals.