



Higgins Lake Swimmer's Itch Control and Research 2024 Final Report

Sponsored by Higgins Lake Swimmer's Itch Organization (HLSIO)

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by

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and

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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 the summer of 2015, under the authority of federal and state permits, all common merganser broods were trapped and relocated off Higgins Lake. Not surprisingly, two metrics of the swimmer's itch (SI) problem — snail infection levels and cases of SI (measured by reports to our website) — showed dramatic decreases in all years (2016-2021) following a summer of brood relocation. However, in 2022 and 2023, the common merganser brood relocation program was suspended by MI-DNR because of highly pathogenic avian influenza (HPAI). Fortunately, no common merganser broods appeared on Higgins Lake in 2022.

In 2023, common merganser broods returned, with two broods observed by SIS during bird surveys. Since these broods were not relocated, it was predicted that SI metrics at Higgins Lake would increase in 2024 (see SIS Final Report 2022-2023).

The report below gives the results of all HLSIO-sponsored activities conducted by SIS in 2024. It includes case reporting from our website, results from the water exposure study, and snail infection levels, which are consistent with the predictions made in 2023. In addition, the results of our bird survey(s) are included.

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.

Important Fact to Remember: Given the life cycle of *T. stagnicolae* and the biology of its hosts, infected common merganser broods affect the **following summer's** snail infection levels.

Waterfowl Surveys

Summary of work completed: Waterfowl surveys of the entire shoreline of Higgins Lake were conducted on May 21, 2024 (Figure 1) and again July 23, 2024 (Figure 2).

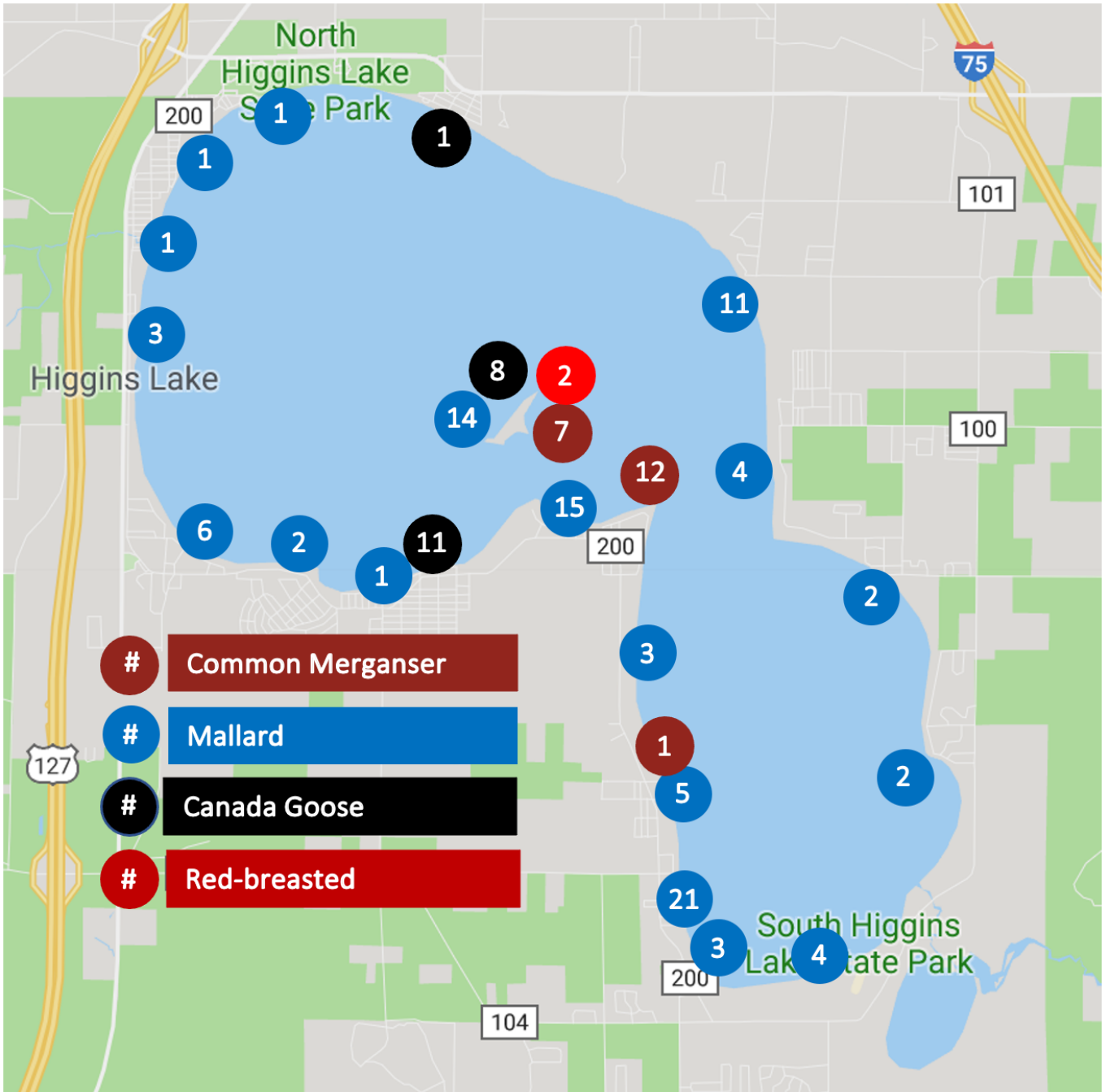


Figure 1. Number of common mergansers, mallards, and Canada geese, and red-breasted mergansers, observed during a May 21, 2024 shoreline survey of Higgins Lake (Roscommon County, MI).

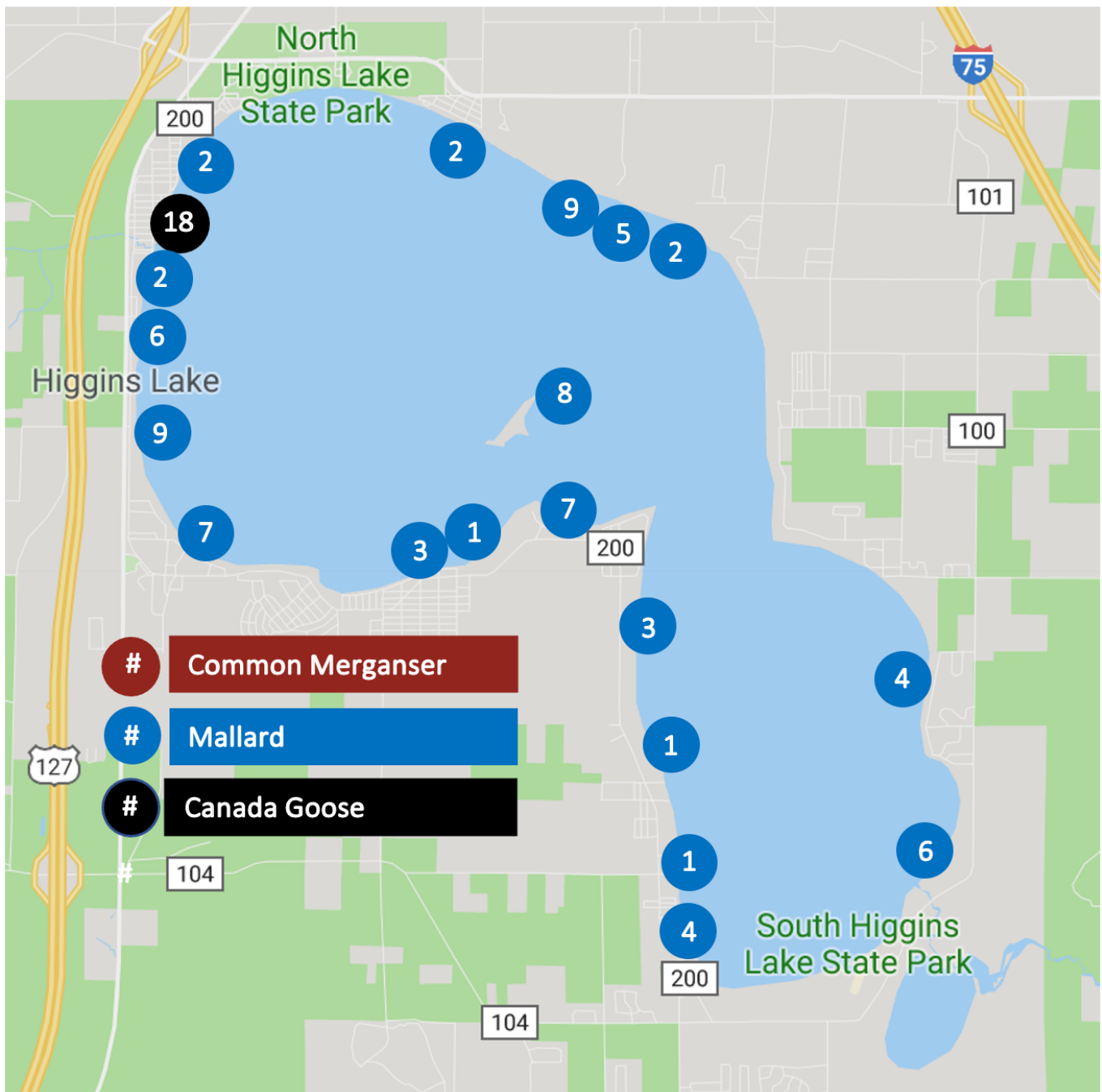


Figure 2. Number of common mergansers, mallards, and Canada geese observed during a July 23, 2024 shoreline survey of Higgins Lake (Roscommon County, MI).

Common Merganser Brood Relocation Activities

Summary of work completed: Only one common merganser brood was observed on Higgins Lake in 2024, and the hen and all 9 of her ducklings (age = 1-2 weeks) were captured and relocated to Lake Huron on June 20, 2024.

Conclusion: Because all common merganser ducklings were relocated well before any avian schistosome infection can become patent, swimmer’s itch case reports in 2025 will most likely decrease.

Snail Infection Survey

Summary of work completed: On June 28, 2024 over 2000 snails were collect at ten different locations on Higgins Lake. Each snail was individually analyzed for avian schistosome infections (Table 1).

With two common merganser broods on the lake for the entirety of last summer, we had anticipated a slight uptick in snail infections in 2024. The absence of such an increase is most likely due to snail infections being so low that a sample size of over 2000 snails yields much more variable results compared to pre-program baseline snail infection levels.

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, 2016, 2017, 2019, 2020, 2022 and 2024. 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 5	Year 6	Year 8	Year 10
Location	2015 July 10-17	2016 July 11-12	2017 July 10-11	2019 July 14-21	2020 July 8	2022 July 11	2024 June 28
Dragonfly House	4.2% (167)	0.0% (200)	0.0% (222)	0.0% (108)	0.0% (120)	0.0% (249)	0.0% (235)
Detroit Point	3.5% (200)	0.0% (200)	0.47% (214)	0.0% (144)	0.0% (220)	0.63% (159)	0.0% (284)
Boat Club	0.5% (200)	0.0% (200)	0.0% (196)	0.0% (5)	0.0% (126)	0.0% (151)	0.0% (2)
Sam-O-Set Park	2.0% (200)	0.5% (200)	0.0% (202)	0.48% (207)	0.0% (177)	0.0% (261)	0.0% (250)
West Boat Launch	5.5% (200)	0.5% (200)	0.48% (210)	0.0% (149)	0.0% (292)	0.0% (153)	0.0% (260)
North State Park	1.9% (155)	0.0% (200)	0.0% (225)	0.0% (199)	0.0% (260)	0.0% (49)	0.0% (300)
Gerrish Twn Park	6.2% (113)	1.0% (200)	0.40% (253)	0.0% (153)	0.0% (240)	0.0% (257)	0.0% (300)
Kelly Beach	2.5% (122)	0.0% (200)	0.0% (208)	0.0% (15)	0.0% (200)	0.0% (298)	0.0% (1)
Almeda Beach	0.5% (200)	1.0% (200)	0.0% (216)	0.0% (238)	0.0% (150)	0.0% (11)	0.0% (244)
South State Park	3.5% (200)	2.0% (200)	0.0% (239)	0.0% (165)	0.0% (278)	0.0% (8)	0.0% (248)
Lake-wide	2.9% (1757)	0.5% (2000)	0.14% (2185)	0.07% (1383)	< 0.05% (2063)	0.06% (1596)	< 0.05% (2124)

*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.

Water Exposure Study

Background: Higgins Lake has conducted a program of trap and relocation of common merganser broods since the summer of 2015. The primary assessment of the program has used snail infection data, which documents a dramatic decline in the percent of snails infected (from ~3% in 2015 to ~0.05% or less in 2019, 2020, and 2022). This means the population of the swimmer's itch parasite has drastically declined, but an important question is how much have swimmer's itch cases declined as a result?

During the 8-year period of the relocation program, our company website has also been open to receive reports of swimmer's itch (SI). The overall trend of this data is also a dramatic decrease (>150 reports in 2015 to only 9 in 2022), but the decrease was not as swift as the snail infection data and even went up slightly some years when snail infection rates were falling or very low. The data arising from a system of self-reporting of SI cases can be difficult to interpret because there is: 1) variability in people's knowledge of the importance of reporting and where to report it; 2) changing motivation for reporting, for example, there may have been more motivation when the problem was more severe (frustration, hope that something could be done) than when the problem had gotten better (cases less severe, fatigue from reporting); and 3) no motivation or mechanism to report when people entered the water and did NOT get swimmer's itch.

With the trap and relocation program suspended in 2022 by the DNR due to avian flu, it was recognized that another method to document SI cases was needed that would be less affected by the issues above. Hence, the 'Higgins Lake water exposure study' was initiated in summer 2022, with a handful of individuals/families that faithfully reported whenever they were in the water and whether any SI cases resulted. Thus, we obtained data on how many SI cases there were on a *per water use basis*. The purposes of gathering such data were to A) provide further documentation for the success of the relocation program, and B) have strong data to compare to future years if common merganser broods appeared and remained on the lake for the summer.

The water exposure study was a success in 2022 and 2023. With two common merganser broods permitted on the lake all summer in 2023, documenting the expected increase was a priority so the water exposure study was continued into 2024. These results are summarized and compared to previous years below.

Recruitment and Training: Participants were again recruited through HLSIO communications. These individuals completed a Google form that asked for basic information like address and contact info (with ability to indicate preference for email or text) as well as choose a 4-digit PIN that would allow them to file reports without having to enter their name and address for each report. An online orientation zoom session was held to give instructions on reporting and to answer any questions. Although initial recruitment in 2023 and 2024 showed promise to enlarge the study, the number of contributors has remained similar from year to year (Table 2). There are five households that have participated all five years with a few households that have participated in one or two years. This means that there were 6 or 7 household locations that were recorded frequently each year, but it is notable that some participants swam in multiple locations in a summer, resulting in 18-19 locations being 'sampled' per year.

Table 2. Participant data in water exposure study, 2022-2024.

Year	Number of sign-ups	Number of contributors*
2022	9	6
2023	13	7
2024	11	7

*The number of contributors who filed more than one report. In 2023, there were 4 individuals who only filed 1 report. Two of these were individuals who signed up later in the study, apparently to report that their families had contracted SI. Based on follow-up communication, they misunderstood the nature of the study. We therefore added these two SI records to the website reports and removed all instances of single reports from the water exposure study data set.

Reporting Forms: The reporting form was identical in 2022, 2023, and 2024: designed to take 1-2 minutes to complete, consisting of the following questions, most of which just required selecting one of a few choices (very little typing):

1. PIN
2. Date of water use
3. Location (Default was home address which could be obtained from the PIN; other choices were common places like the state parks, or the sunken island).
4. How many people were in the water
5. How long people were in the water
6. What time of day people were in the water
7. Whether wind was onshore/offshore (onshore winds can increase likelihood of SI)
8. Whether any precautions against SI were taken (e.g. wore Swimmer’s Itch Guard, wet suite, etc.)
9. How many people got SI
10. Severity of the SI cases
11. Any other details they wished to provide (optional)

Participants also were able to easily ‘correct’ any reports if SI appeared later.

Results: Overall, SI results increased modestly in 2024 (Table 3), as expected from the presence of two broods on the lake in 2023. Given that Crystal Lake SI cases increased from ~1% to over 10% in 2023 (and was about 10% again in 2024) due to having 9 or more broods on the lake, the modest increase on Higgins Lake to 2.34% is not surprising.

Table 3. Summary data from water exposure study, 2022-2024.

Year	Total No. of reports	Number of people in water	Avg. min. in water	Number of SI cases	Percent SI cases	No. of swimming locations	Earliest water use	No. water reports in May & June
2022	182	440	35	4	0.91%	18	6/15	12
2023	233	739	56	11	1.49%	19	5/28	63
2024	199	472	31	11	2.34%	18	5/12	31

Though there is a modest increase in frequency in 2024, most SI cases at Higgins Lake have tended to be quite mild for three straight years, as indicated in Table 4 below.

Table 4. Swimmer’s itch cases at Higgins Lake reported in the water exposure study, 2022-2024.

Date	Location	No. people in water	Time in water	No. of SI cases	Case severity	Wind	Precautions
7/9/22	South side of island	6	31-60 min	2	11-30 papules	Calm	None
7/31/22	N shore, east of B&B marina	1	31-60 min	1	2 papules	Calm	Short wet suit
8/21/22	N shore, east of B&B marina	1	1-2 hr	1	1 papule	Calm	Short wet suit
7/16/23	N shore, east of B&B marina	1	31-60 min	1	1-10 papules	Calm	Short wet suit
7/18/23	N shore, east of B&B marina	1	16-30 min	1	1-10 papules	Light onshore winds	Short wet suit
7/21/23	North State Park	6	31-60 min	2	1-10 papules	Light onshore winds	None
7/25/23	South side of upper basin	7-9	31-60 min	2	11-30 papules	Light onshore winds	Sunscreen
8/3/23	N shore, east of B&B marina	1	31-60 min	1	1-10 papules	Light onshore winds	Short wet suit
8/4/23	North of Flag Point	7-9	31-60 min	1	1-10 papules	Calm	Sunscreen
8/11/23	N shore, east of B&B marina	1	31-60 min	1	1-10 papules	Calm	Short wet suit, sunscreen
9/4/23	South side of upper basin	1	1-15 min	1	1-10 papules	Calm	None
9/5/23	South side of upper basin	1	1-15 min	1	1-10 papules	Calm	None

Table 4, con't.

6/4/24	Near Gerrish Township Park	4	16-30 min	1	11-30 papules	Calm	None
6/20/24	N shore, east of B&B marina	1	31-60 min	1	1-10 papules	Calm	Short wet suit
7/5/24	N shore, east of B&B marina	1	31-60 min	1	1-10 papules	Calm	Short wet suit
7/13/24	N shore, east of B&B marina	1	31-60 min	1	1-10 papules	Calm	Short wet suit
7/14/24	South side of upper basin	1	16-30 min	1	1-10 papules	Light onshore winds	None
7/24/24	West side of lower basin	8	1-2 hours	1	1-10 papules	Strong onshore winds	None
8/1/24	South side of island	1	1-15 min	1	1-10 papules	Calm	None
8/7/24	South side of upper basin	2	1-15 min	2	1-10 papules	Calm	None
8/25/24	N of Cut River	2	31-60 min	2	1-10 papules	Light onshore winds	None

Discussion of water exposure study: As we have stated previously, the Higgins Lake water exposure study is unique because it 1) records SI cases as a rate per water exposure, and 2) it is lakewide. There are no studies in the literature like this one. The only other study we know of has been conducted by the Congregational Summer Assembly (CSA) at Crystal Lake, which is specific to their beach at the southwest end of the lake where many swimmers participate in lessons. The results are comparable: the CSA saw rates of 3-6% before common merganser relocation be reduced to less than 0.5% in 2019 and 2022, and then explode to greater than 10% in 2023 and 2024 as a result of the suspension of the relocation program. At Higgins Lake, SI rates were also very low at 0.9%-1.5%, followed by what appears to be a modest increase in 2024 due to suspension of the relocation program. The modest increase makes sense since there were only two broods on Higgins Lake in 2023. (A modest increase was in fact, our prediction in last year’s final report!). In addition, we speculate that those two broods may not have gotten as quickly infected simply because snail infection levels have been so low on Higgins Lake.

Recommendation: Based on the success of this study, the value of the data generated, and that next year should document a return to relocation levels, **we recommend extending this study into summer 2025.** We do recognize that ‘reporting fatigue’ may be starting to set in. For example, one very faithful participant from all three years stopped reporting for a time (since they weren’t getting SI) and then caught up once they did get a couple cases. A couple of ideas for combatting that fatigue to get one more year of data are 1) giving the option of recording water use on a paper(!) sheet and then scanning and sending it to us, and 2) incorporating a financial incentive for any of this year’s participants who participate in 2025.

Website SI Case Reports

Background: From the beginning of the relocation program, SIS has hosted a website where Higgins Lake residents and visitors can report SI cases. These data are only a rough measure of the SI issue on Higgins Lake because it does not include any reporting of times that individuals used the water *without getting SI*. In addition, the rate of reporting probably varies depending on the prior expectations of the person getting in the water, the severity of the case, and the motivation for reporting. Thus, while a substantial decline in SI reports was seen starting the year following relocation (2016), it did not quite mirror the data from snails or the good reports people were telling us in person. A probable factor is that once people heard that SI risk was being reduced, they expected not to get it, and hence motivation to report was high when they did get it.

In Figure 4 below, the numbers of SI case reports from 2019-2024 are plotted, broken down by case severity (Low = 1-10 papules, Medium = 11-99 papules, High = 100+ papules). While 2021 and 2022 had the fewest reports, 2023 and 2024 appear to be very similar to 2019 and 2020 in terms of total number of reports (30 in 2024, 41 in 2023, 42 in 2020, and 35 in 2019). Case severity appears a little greater in 2023 and 2024, with more medium cases than mild.

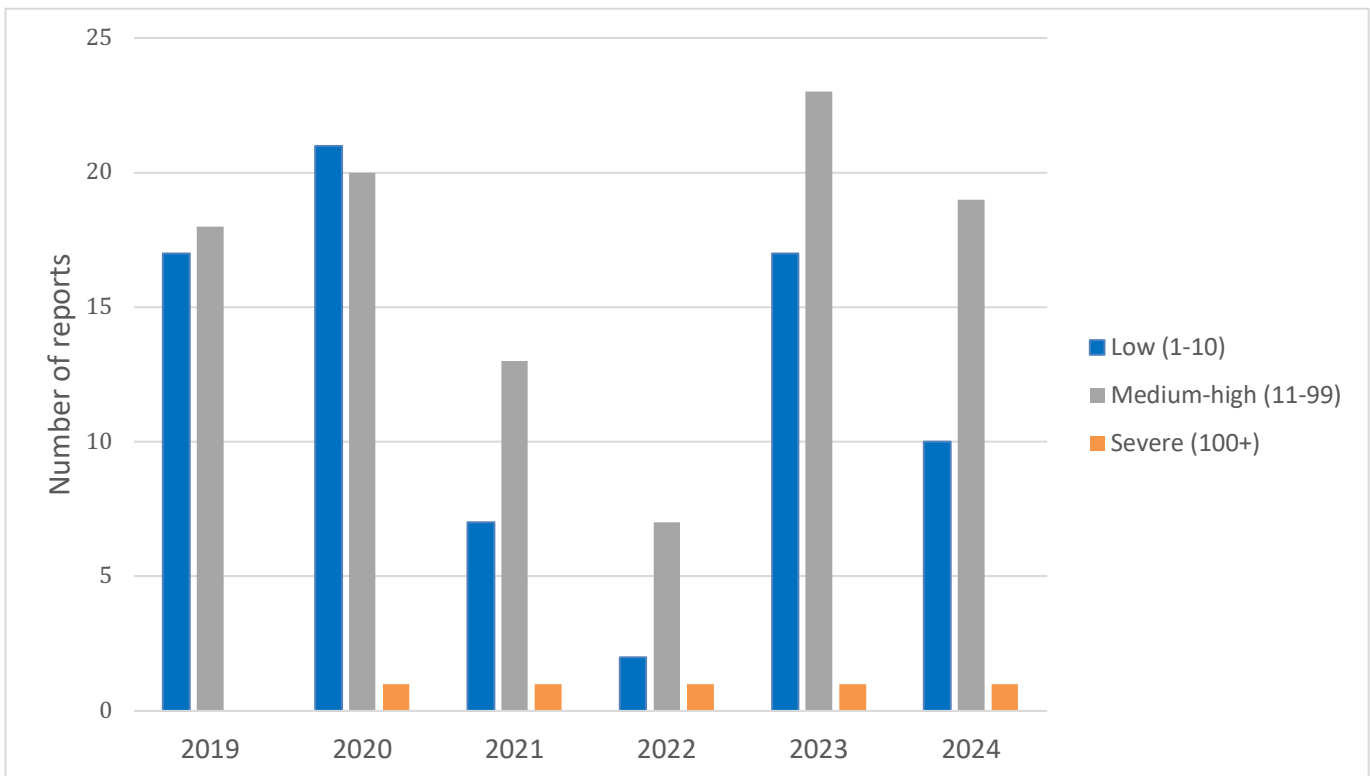


Figure 4. Higgins Lake 2019-2024 SI case reports categorized by severity.

Conclusion: Even with the return of merganser broods in 2023, case numbers reported to our website did not increase in 2024, though there may be a slight shift from mild to moderate severity. Not surprisingly, incidental reporting via website is too variable to detect small increases or decreases.

Worm Development Study

Synopsis: In 2023, HLSIO and SIS identified this project as a priority. Its goal is to know more precisely how quickly the adult worms mature in merganser ducklings. In 2024, the project was continued and we added data to what was collected in 2023, targeting the duckling ages we did not yet have. We were able to obtain enough data to be able to submit a paper for publication. That manuscript was submitted to *Journal of Parasitology* on August 13 and we are waiting to the results of the peer review. The Background and Methods sections below are copied from our 2023 report (though note one bolded sentence in the Methods section). **Skip to the Results to learn what is new.**

Background: Trap and relocation of common merganser broods has been a very successful strategy for controlling swimmer's itch at Higgins Lake and Crystal Lake. This strategy is dependent upon trap and relocation occurring before parasites in the ducklings reach maturity and begin to produce eggs. However, how quickly ducklings first get infected and how quickly the parasites become patent (i.e., shedding eggs through their host's feces) is a research question that is not fully answered.

Based on Harvey Blankespoor and Ronald Reimink's research and statements, we and others have been operating under the assumption that ducklings start shedding large numbers of eggs at the age of 4 weeks. However, we have suspected that ducklings begin shedding parasite eggs earlier, and that it may even be possible that 4 weeks may be the peak or even just past the peak of parasite egg production. The literature has laboratory studies with mallards in which parasite eggs are produced as early as 13-14 days and peak production is 15-22 days. In our control work, Swimmer's Itch Solutions has taken the approach of removing ducklings as early as is possible, at 3 weeks or younger, usually at about two weeks old. We believe that this may be a factor in why our work has been so much more successful at Higgins and Crystal than the work of others at Glen Lake (don't tell them!).

Together with HLSIO, SIS identified this project as being of scientific and practical value to know more precisely how quickly the worms mature. The findings would likely influence the relocation programs, either leading us to relocate broods even earlier, or give us assurance that the timing of our current approach works well.

Study Location and Methods: Since Higgins Lake has not had common merganser broods for the last 3 years, we anticipated that most of our activity would occur on Crystal Lake, where broods have numbered 9 or more each year. This year, Crystal again had 9 broods which gave us a good source of samples, but Higgins Lake had 2 broods, and we were able to obtain some samples from Higgins also. **In 2024, we obtained data from the one brood we relocated from Higgins Lake and added samples from Crystal Lake, Burt Lake, and Glen Lake!**

Fecal samples were taken from common mergansers, with a focus on ducklings, by either getting fresh samples off of docks where they were seen roosting moments before, or by trapping common merganser broods, placing them in cages, and obtaining individual samples from underneath the mats in our cages which prevent samples from getting mixed together. Ducklings were aged by comparing them to the progression of plumage development described in the literature. Plumage was easy to examine for ducklings that were trapped, and for birds on docks it was observable through binoculars by approaching slowly and getting in close range.

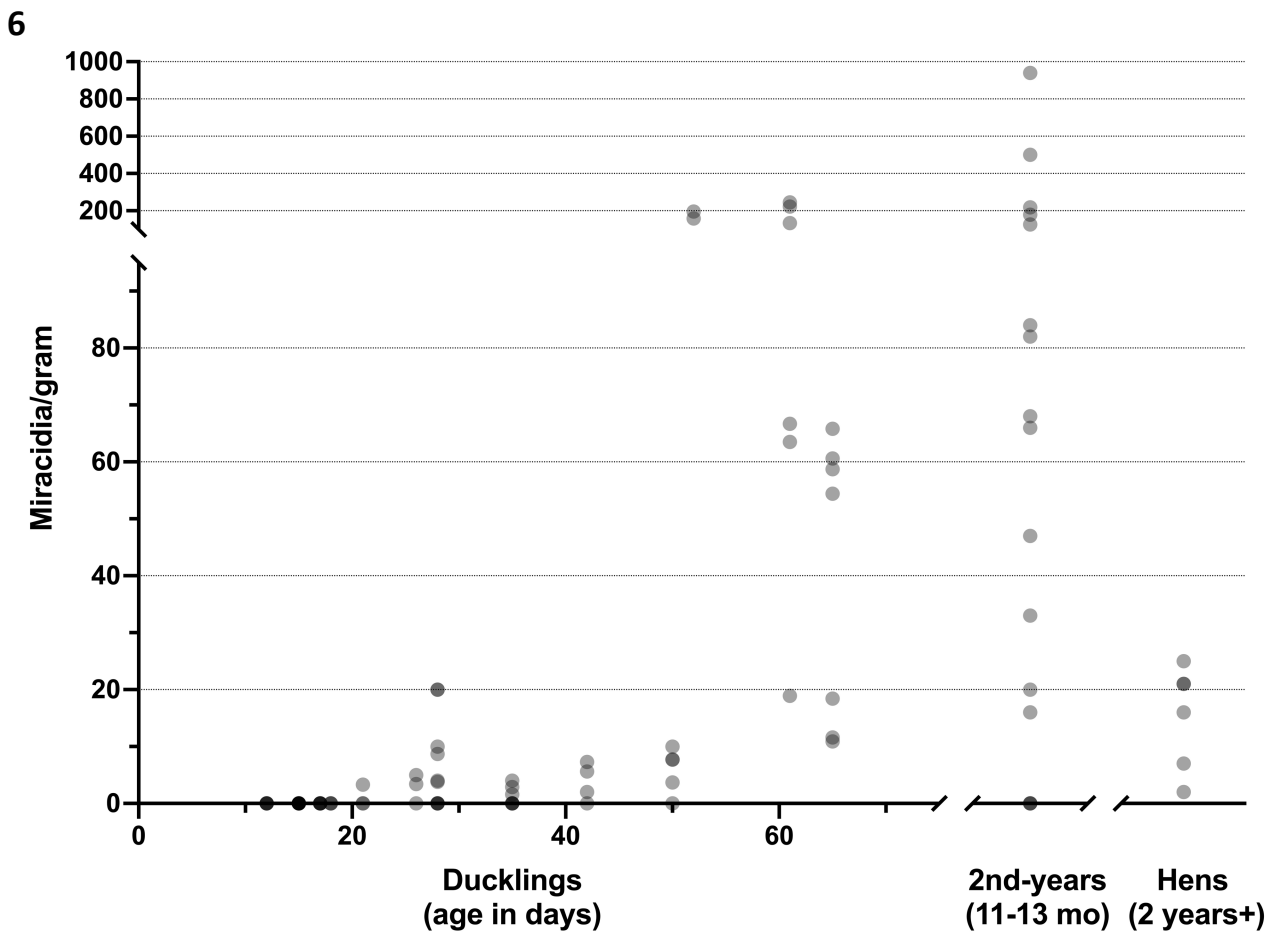
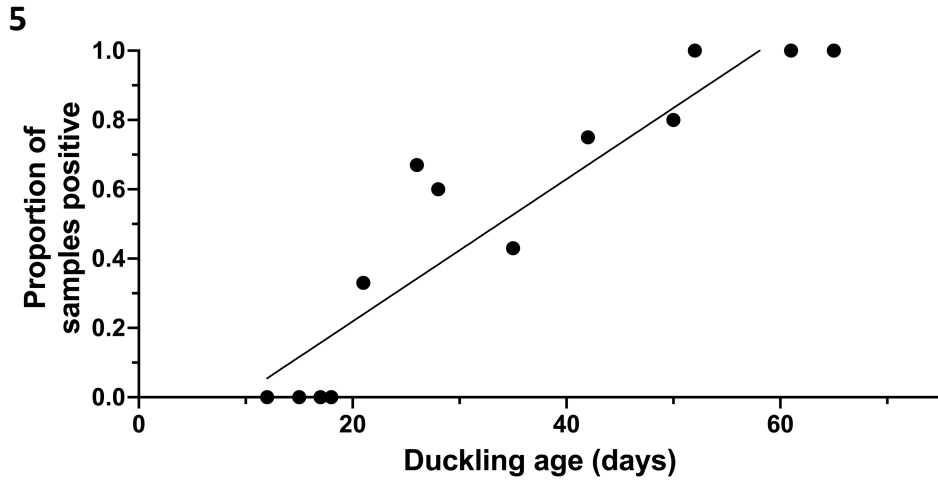
Samples are kept in a cooler or refrigerated until they can be examined. Examination occurs by weighing the sample (or a portion of larger samples) and placing it in a glass petri dish, then diluting and mixing the sample in artificial pond water until the water in the dish is relatively clear (versus cloudy). The samples are then exposed to light for at approximately one hour to make sure all eggs are hatched before being viewed.

The number of parasites in each sample is quantified by examining the sample under a microscope for one minute and all parasites seen are captured and removed by pipette. The one-minute counts are repeated two more times so that there is a total of three counts. These counts are then averaged and divided by the mass of the sample to obtain the number of parasites per gram of feces (parasites/g).

Results: We improved the 2023 count of 61 samples to a total of 97 samples. Of these, 75 were from ducklings that represented 13 different ages (12-65 days). An additional 6 samples were from hens we caught with broods, and 16 were second-year birds (at least 1 year old, but not yet breeding).

We recommend looking at the graph below and reading our paper (sent earlier, but attached again here) for a detailed discussion of the results, but the important findings were:

- 1. As expected, ducklings at the youngest ages (12, 15, 17, and 18 days old) were negative.**
- 2. Ducklings were first found infected at 3 weeks (21 days old), not 4 weeks.**
- 3. The proportion of positive ducklings increases with age (Figure 5).**
- 4. All the oldest ducklings (52, 61, and 65 days old) were positive, and some were shedding very large numbers of parasite eggs, many times higher than younger ducklings and their mother hens.**
- 5. Second-year adults (who don't breed but are present on Higgins and other inland lakes in the summer) can have extremely high parasite egg counts, though there is high variation (3 were negative).** It is interesting that brood relocation has been so successful despite the presence of second-year adults each summer (on Higgins Lake, typically 5-12 individuals). Our paper speculates about reasons why that may be so (with some support from the scientific literature).



Figures 5-6. (5) Proportion of fecal samples positive for *Trichobilharzia* spp. miracidia from common merganser (*Mergus merganser*) ducklings (n=75) of 13 different ages. Each black circle represents an age group. (6) Number of miracidia per gram in fecal samples from common merganser ducklings, second-year individuals (n=16), and brooding hens (n=6). Each gray circle represents one individual, with overlaps producing darker grays.