SWIMMER'S ITCH SOLUTIONS

An Assessment of Swimmer's Itch Control on Crystal Lake After 5 Years of Trapping and Relocating Common Merganser Broods

Report

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by

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*This report was written for the Crystal Lake & Watershed Association (CLWA), a non-profit 501 (c) (3) group of concerned citizens committed to protecting the beauty and water quality of Crystal Lake and its surrounding environment. The CLWA engages in monitoring, education, and advocacy on behalf of the broad community for whom Crystal Lake is a vital economic, recreational, and aesthetic resource.

Executive Summary

Six summers ago (2016) the CLWA contracted with SICON, LLC to collect extensive swimmer's itch (SI) baseline data. In the summer of 2017, under the authority of federal and state permits, all common merganser broods were trapped and relocated off Crystal Lake. Two local individuals have taken over the trapping program, and all common merganser broods have been relocated off Crystal Lake the last four summers. This summer, the CLWA contracted with Swimmer's Itch Solutions, LLC to assess the effectiveness of the common merganser trapping and relocation program on SI control.

Both well-known SI metrics—snail infection level and qPCR analyses of water samples—tell the same story: **Since 2016, Crystal Lake has seen a significant reduction in SI-causing parasites in the lake**. An analysis of 2211 *Stagnicola* snails from Crystal Lake in 2020 indicated a lake-wide avian schistosome snail infection level of 0.045%. This represents a **99% decrease** from the pre-control-program level in July 2016.

Based on the results of this assessment, we strongly encourage the CLWA 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 2016. It should be noted that Crystal has many migratory waterfowl in the spring and fall, including mergansers, yet their contribution to 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.

Snail Infection Levels

Summary of work completed: Because a thorough assessment of snail infection levels was conducted last summer (see our 2020 Final Report), no snails were collect from Crystal Lake in 2021.

Water Samples

Summary of work completed: On July 18 and August 3, 2021 water samples were collected from Crystal Lake by Crystal Lake personnel. Ten sites, which match those used in 2018, 2019, and 2020 were sampled on July 18, while one site (River Outlet) was evidently omitted on August 3 due to a locked gate (per Dave Wynne). The preserved 2021 samples were delivered to Dr. Randy DeJong on September 6, 2021. In a Calvin University laboratory, these samples were filtered onto membranes and then used for DNA extraction.

Quantitative PCR (qPCR) was then performed on the 19 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* (waterfowl host is common merganser), *T. physellae* (common merganser and mallard), *Anserobilharzia brantae* (Canada goose), *T. szidati* (mallard), and novel avian schistosome C (Canada goose) that uses *Helisoma* snails. Negative controls were included in these tests also.

Estimated numbers of cercariae for 2021 are displayed on the second map below (Figure 1b), while the first map allows the comparison of values from 2018 and 2019 (Figure 1a). Ten samples tested positive for cercariae, which is the same number as 2020. However, there were three samples in August that were greater than 10 cercariae per 25L, notably higher than any samples in 2020. In addition, the median number of cercariae per 25L increased slightly in 2021 (Table 1). The number of negative sites in 2021 showed a somewhat different pattern by month (5 in July and 4 in September) than previous years (2020, 2 in July and 8 in August; 2019, 2 in July and 5 in September). The highest estimate from any one sample in 2021 was 114 cercariae per 25 L. All negative controls were negative, indicating that DNA contamination was not an issue.

Of the 10 samples positive for the pan-schistosome assay, most (7) were found to contain only *T. stagnicolae* DNA, while one was found to contain *T. stagnicolae* and *T. physellae*, one *T. physellae* only, and one sample could not be determined (too little DNA). All previous samples from Crystal Lake (in years 2018-2020) have had been positive for only *T. stagnicolae*, so it is interesting that two samples in 2021 were positive for *T. physellae.* In addition, these two samples were at opposites sides of the lake (Nichols Road and CBCA, August samples) and were the two highest estimates for cercariae per 25L. This parasite is carried by both mallards and common mergansers and uses a different snail host species (*Physa* sp.). While this snail species is present on Crystal Lake, it's not commonly or easily found. Nonetheless, this is something to monitor closely over the next couple of summers.

We were not surprised to have all 10 samples be negative for novel avian schistosomatid C (Canada goose), since *Helisoma* snails were very rare in our 2020 snail survey. 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 Crystal Lake, as it does on many other lakes in northern Michigan.*

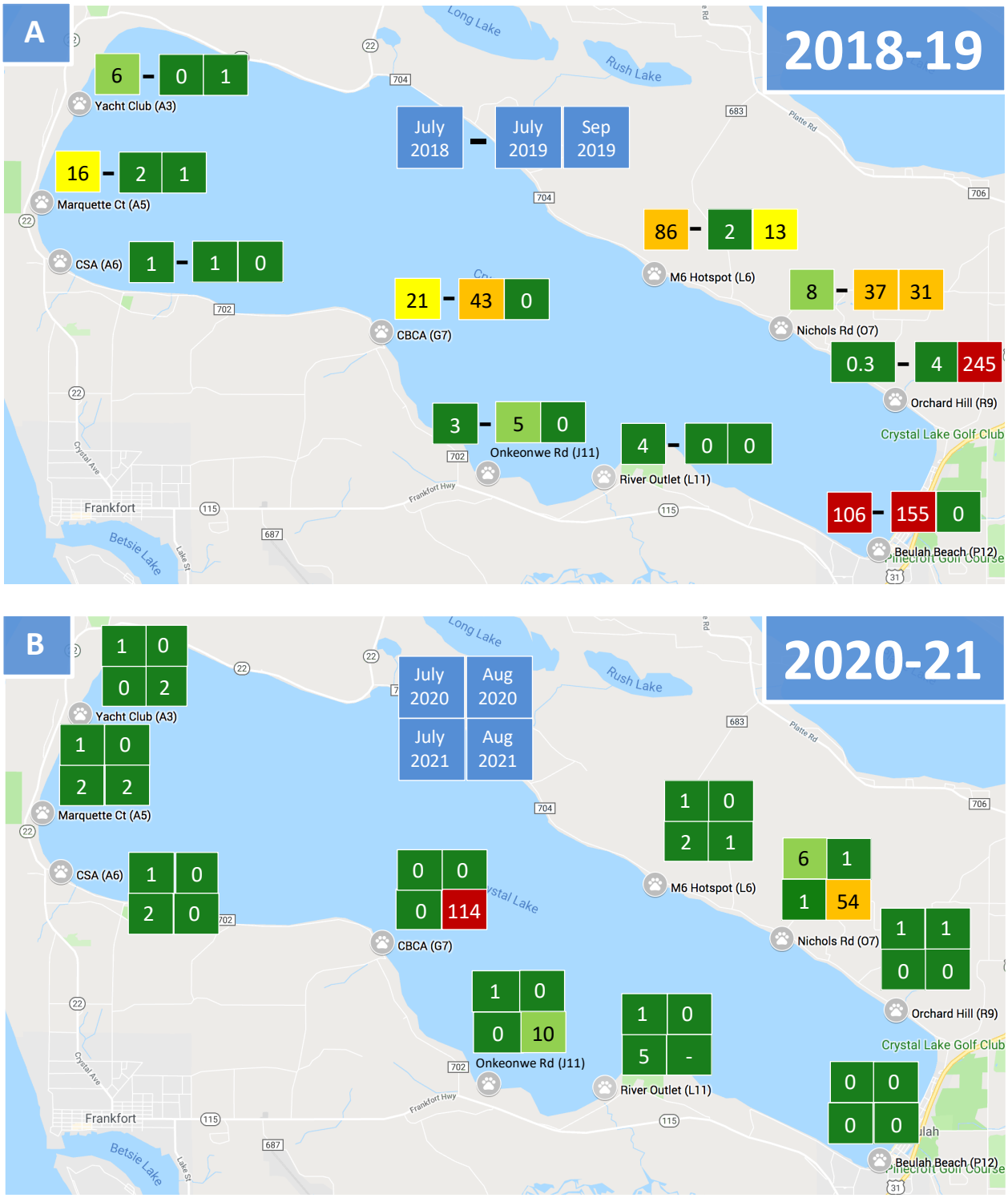

Figure 1. Estimated number of avian schistosome cercariae per 25 L of water in samples taken from Crystal Lake (Benzie County, MI) in 2018-2019 (Figure 1a) and 2020-2021 (Figure 1b). Data from different dates are displayed according to the legends. Color of cell indicates infection level. (= Ideal (0-5), = Tolerable (6-10), = Moderate (11-30), = Severe (31-100), = Epidemic (>100)

Table 1. A four-year comparison of qPCR analyses of water samples taken from Crystal Lake (Benzie County, MI).

Year	Number of samples positive	Number of samples above 10 cercariae / 25L	Estimated cercariae (range)	Estimated cercariae (median)
2018	10 of 10	4 of 10	1 – 106	4.5
2019	13 of 20	6 of 20	0 – 245	1.6
2020	10 of 20	0 of 20	0 – 6	0.5
2021	11 of 19	3 of 19	0 – 114	1.3

Looking further at trends at sites around the lake over four years of data, there are a few things to note. First, the Nichols Road site has been positive in every sample (7 total) with 3 readings over 30 and Marquette Court has been positive 6 out of 7 times, though with lower cercariae estimates. Second, Beulah Beach had very high cercarial estimates the first two samples, and has been negative since. However, we know Beulah Beach has had swimmer's itch cases in 2021 and in previous years, reminding us again that each qPCR sample is but a 'snapshot'. All other sites have been positive 3-5 times out of 7. Combining the samples each year, and comparing year over year results gives us the best picture. Even then, our feeling is that qPCR data should be viewed as supplemental to, rather than a replacement for, snail infection prevalence and swimmer's itch case reports.

The qPCR results for 2021 show a bit of an uptick in number of positive samples and the estimated number of cercariae. However, we caution against overinterpreting qPCR data, as the number of samples analyzed is usually small, and represent point-in-time 'snapshots' of the cercariae in the water at the time and day of sampling. Moreover, it is well known that qPCR results are influenced by environmental conditions. A lot of variation is seen and expected from sample to sample. Nonetheless, our 2021 results suggest that continued vigilance is warranted.

Summary Conclusion: *Both avian schistosome metrics (snail infection levels from 2020 and qPCR in 2020-21) strongly suggest the common merganser brood relocation program has significantly reduced the T. stagnicolae population on Crystal Lake. There is every reason to believe that this program alone is responsible for the significantly decrease in SI cases since 2017.*

Recommendations:

Based on the results of this assessment, we strongly encourage the CLWA to continue its common merganser trapping and relocation program as a swimmer's itch control strategy. Our data in 2020 (snail and qPCR) and in 2021 (qPCR), combined with the Congregational Summer Assembly's swimmer data in 2018 and 2019, strongly suggest that the program is working. Anecdotal reports from many lake residents over that same time period also strongly support this claim.

However, we are a bit concerned with an increase in swimmer's itch case reports, the uptick in qPCR counts, and the delayed trapping of early broods in both 2020 and 2021. We believe that removing broods on Higgins and Crystal before they are 2 weeks of age has enhanced our success. In fact, we have obtained data the last two years from multiple ducklings and broods that show that common merganser ducklings can be passing parasite eggs at least as young as 13 days (this is also consistent with the

scientific literature). We propose that SIS be responsible for trapping and relocating all common merganser broods until a defined date in June, perhaps the last day of Tim and Tom's school year. This will give the trap and relocation program at Crystal Lake the best chance for continued success and further protect the reputation of trap and relocate.

We also recommend that the CLWA continue a yearly assessment/monitoring of swimmer's itch levels on Crystal Lake with the explicit purpose of putting itself in the best possible position for any future common merganser trapping/relocation permit renewals. We recommend a snail assessment in 2022 or 2023, and if CLWA wishes, continued qPCR monitoring.