SWIMMER'S ITCH SOLUTIONS

A Swimmer's Itch Control Program for Black Lake

Annual Report

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by

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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.

Contractual obligations

For the past three summers, Swimmer's Itch Solutions, LLC (SIS) has partnered with the Black Lake Preservation Society (BLPS) to provide a swimmer's itch control program on Black Lake. In early spring, SIS secured all necessary federal and state permits to continue conducting this control program. The contract stipulated that SIS would:

1. trap and relocate common merganser broods from Black Lake on "a service call" basis at the BLPS's request.
2. determine cercarial densities in Black Lake water samples via *q*PCR (minimum of 12 samples)
3. manage a Black Lake-dedicated webpage from April 1-Sept 15 for reporting common merganser brood sightings and swimmer's itch case reports
4. submit a written summary report no later than October 15, 2021

Work accomplished

Common merganser trapping and relocation efforts

Trapping trips on Black Lake were conducted on six days: June 2, June 9, June 30, July 15, and August 11, August 23. Five common mergansers broods, including all 31 ducklings from those broods, were successfully trapped and relocated to either Cheboygan State Park or Wilderness State Park. Both these relocation sites have been approved for this purpose by the Michigan Department of Natural Resources. Relocating common mergansers to these sites does not spread swimmer's itch, as humans can't get swimmer's itch directly from common mergansers. Moreover, the snail populations

required to sustain the swimmer's itch parasites living in the ducks are absent at both relocation sites.

All trapped hens were fitted with US Fish & Wildlife Service leg bands, and all ducklings were equipped with US Geological Service-approved web tags.

Conclusion: *Year 2 of a swimmer's itch control program based on the trapping and relocation of common merganser broods was very successful as 100% of the ducklings were removed from Black Lake.*

Assessment of swimmer's itch levels

Currently, there are three methods of determining whether the avian schistosome species, *Trichobilharzia stagnicolae,* is cycling in a lake: 1) microscopic examination of a sample population of its snail intermediate host (i.e., "shedding snails"), 2) DNA analyses of lake water samples (i.e., *q*PCR), and 3) microscopic examination/DNA analyses of miracidia in common mergansers fecal samples.

For the initial swimmer's itch assessment conducted in 2019, snails and water samples were collected at different locations around Black Lake (Figure 1). Data obtained in that year serve as a pre-control baseline to which current and future swimmer's itch levels on Black Lake can be compared.

Figure 1. Snail and water collection sites on Black Lake (Cheboygan/Presque Isle Counties, MI)

Avian schistosome cercarial densities

On June 30 and July 14, 2021, we collected water samples from seven of the same locations that were tested in 2019 (Table 1). In our June sampling regimen, we omitted two sites from 2019 (Onaway State Park, and Cain's Creek), and added one (Northwest corner) where we had collected one *Helisoma* snail infected with avian schistosomatid C parasite (whose waterfowl host is Canada goose). On July 14, we added two sample locations where swimmer's itch had recently been reported on the BLPS's *Eyes-on-the-Lake* webpage (East of Onaway State Park, and Hangor Beach on the southwest side).

Quantitative PCR (qPCR) was performed on the samples using the pan-schistosome assay that was used in 2019. 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), and *T. szidati* (mallard), and novel Avian Schistosomatid C (Canada goose). Negative controls were included in these tests also.

The number of cercariae estimated by qPCR for 2021 are displayed and compared to 2019 in the table below (Table 1). In 2021, 5 of 7 locations were positive for cercariae in June, similar to 5 of 8 positive in 2019. The lake-wide average number of cercariae per 25L lake water was lower this year compared to 2019. Out of 9 July samples, only 2 were positive, with an average of 10 cercariae per 25L. 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.

In the results of the species-specific assays, there seems to be a decrease in the frequency of *T. stagnicolae* (common merganser) being detected. At first glance there seems to be a corresponding increase in detection of avian schistosomatid C, but this may be artifact, as the test we are now using for avian schisto C is improved. Again, we would caution against overinterpreting qPCR data, but it is highly likely that the trap and relocation of common merganser broods in 2020 has decreased *T. stagnicolae* levels on Black Lake. Notably, we also detected *T. szidati* at one location in July. This is the first time we have detected it on any lake in northern Michigan. *T. szidati* uses mallards as the duck host and *Lymnaea* sp. as the snail host (and Black Lake has *Lymnaea* sp.). This parasite is well-known to be effective at penetrating human skin and is a common cause of swimmer's itch.

Anecdotal evidence gathered

In July, on a day where we found many people in the water, we were able to stop and ask 4 different families spread over 2 miles on the southwest side of the lake about their swimmer's itch experience in 2021 compared to 2020. We were encouraged to hear from two families that it was significantly better than 2020 and the other two families said they do not normally get it at their location. All 4 families were owners (not renters) and had members who regularly swam throughout the summer. In August, we had the opportunity to talk to 1 more family, and this family also reported a noticeable decrease in swimmer's itch in 2021.

Table 1. Cercarial densities (depicted as numbers) from water samples collected at different locations on Black Lake (Cheboygan/Presque Isle Counties, MI) in 2019 and 2021. Data from 2019 serve as a pre-program baseline, as the BLPS initiated swimmer's itch control efforts in 2020. Color of cell indicates infection level, measured in number of cercariae/25L lake water. (■ = Ideal (<5), ■ = Tolerable (5.0-9.9), ■ = Moderate (10.0-29.9), ■ = Severe (30.0-99.9), ■ = Epidemic (>100)).* Undetermined indicates that qPCR analysis did not identify any of the species for which we have tests. This is most likely due to low amounts of DNA, inhibitory compounds in the sample that prevent qPCR, or an undescribed species/variant in the sample.

	Pre-program Baseline		Current Levels			
Control Program	**Year 0 (2019-Aug 4)**		**Year 2 (2021-June 30)**		**Year 2 (2021-July 15)**	
Location	#	Species Present	#	Species Present	#	Species Present
Onaway State Park	0	N/A				
East of Onaway State Park					4	*T. szidati*
Rainey Beach	0	N/A	0	N/A	0	N/A
State Forest Campground	1	*T. stagnicolae*	28	*T. stagnicolae* Avian Schisto C	0	N/A
Doriva Beach	1	*T. stagnicolae*	0	N/A	0	N/A
Cain's Creek	3	Undetermined				
Northwest Corner			6	Avian Schisto C	94	Avian schisto C
Tribisond Bay	1	Undetermined	7	Avian Schisto C	0	N/A
Pine Grove Beach	>100	*T. stagnicolae*	31	Avian Schisto C	0	N/A
Hangor Beach					0	N/A
Fisher Creek	0	N/A	17	Avian Schisto C	0	N/A
Lake-wide	32	*T. stagnicolae*	13	*T. stagnicolae* Avian Schisto C	10	*T. szidati* Avian Schisto C

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

Noteworthy

As we've made clear in the past, it's impossible to completely eradicate swimmer's itch on any lake. The verified presence of avian schistosomatid C and *T. szidati* means that these parasite species are also cycling on Black Lake, and likely contributing, albeit to a much lesser extent than *T. stagnicolae*, to swimmer's itch cases on Black Lake. Recent evidence we have conducted this year further supports this conclusion.

We continue to believe that the frequency and severity of swimmer's itch cases will continue to decrease as the *T. stagnicolae* levels in Black Lake decrease.

Dedicated webpage

A Black Lake-dedicated webpage (http://www.swimmersitchsolutions.com/blps) was constructed and has been actively managed since April 1, 2021. Although the common merganser breeding season is over for this year, the webpage will remain active until through the month of September.

Recommendations

We offer the following recommendations for swimmer's itch control on Black Lake for 2022 and beyond:

1. Continue to monitor the number and severity of swimmer's itch cases on Black Lake and encourage lake-users to report swimmer's itch cases, whether on our Black Lake-dedicated webpage or the BLPS's *Eyes-on-the-Lake* webpage. Consider conducting a thorough analysis of reported cases to determine if there has been a decrease in 2021 resulting from the 2020 trap and relocation season.
2. Continue being vigilant about trapping and relocating common merganser broods. We greatly appreciate the excellent merganser spotting and reporting by Black Lake residents!