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A Comprehensive Swimmer's Itch Control Program for Higgins Lake

Annual Report for Year 2*

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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.

Executive Summary

In January of 2015, SICON (Swimmer's Itch Control), LLC* reached agreement with the Higgins Lake Swimmer's Itch Organization (HLSIO) to conduct a three-year science-based program to significantly reduce swimmer's itch in Higgins Lake. This effort is part of a multi-lake pilot program in Michigan that was designed to help confirm that the results of the prior SICON LLC program on Glen Lake could be replicated.

The work completed in 2016 represents Year 2 of the comprehensive science-based program that focused on actions to significantly reduce swimmer's itch on Higgins Lake from both measured and reported epidemic levels. The program included the following components: 1) locating and eliminating common merganser nesting sites to prevent fledging success, 2) conducting 14 extensive lake-wide bird surveys to further assess the effectiveness of Gerrish Township's spring harassment program 3) trapping and relocating any common merganser broods that appeared on the lake, 4) an objective assessment metric (i.e., snail infection percentages), 5) an education component including weekly summer meetings with members of the Higgins Lake community at SICON LLC's Dragonfly House headquarters and laboratory, 6) a joint research project with Dr. Patrick Hanington from the University of Alberta, Canada, exploring the possibility of using new molecular techniques to accurately quantify the number of cercariae in a water sample, and 7) a Swimmer's Itch seminar held at the Dragonfly House and presentation at the Michigan Swimmer's Itch Partnership (MSIP) Meeting at Roscommon High School on June 22 that brought together leading experts from across the United States and Canada.

During common merganser breeding season (April-May), we identified 6 candidate nesting sites, 2 located in Lyon Township where the birds were not harassed or lethally taken, and 4 in Gerrish Township where the birds were harassed almost daily with pyrotechnics. We were able to confirm that both candidate sites in Lyon Township were active common merganser nests, but could not do so for any of the candidate sites in Gerrish Township.

Throughout June and July SICON LLC trapped and removed 6 common merganser broods (47 birds in total) that appeared on Higgins Lake. Five of the 6 broods were captured in Gerrish Township. Another wounded common merganser male was lethally taken under our scientific collecting permit. Thus, we removed a total of 48 common mergansers from Higgins Lake in 2016. The 48 birds removed in 2016, combined with the 97 common mergansers that we trapped and relocated or lethally removed in 2015, represents a 2-year total of 145 birds taken off Higgins Lake by SICON, LLC. Particularly noteworthy is the fact that all 145 birds were removed from the lake after the Gerrish Township program of harassment and lethal take had been completed in the spring.

In the summer of 2015, an extensive analysis of over 10,000 swimmer's itch-carrying snails established a pre-program, summer lake-wide baseline avian schistosome infection level of 3.01%. A similar analysis in 2016 revealed a summer lake-wide snail infection level of 0.28%. **In only the second year of SICON, LLC's comprehensive swimmer's itch control program on Higgins Lake we reduced the snail infection level on Higgins Lake by 90%.**

We share 5 key summary conclusions for 2016 and make 5 specific recommendations for 2017.

*SICON, LLC was reconstituted from SiCon, LLC. after the retirement of Dr. Harvey Blankespoor.

Five Summary Conclusions

Conclusion #1: *SICON, LLC's comprehensive swimmer's itch control program has been very effective and has significantly reduced the snail infection level by 90%.*

Over the past two years SICON, LLC removed 145 common mergansers (15 broods) from Higgins Lake and reduced the lake-wide *Stagnicola* snail infection level by 90% (3.01% in 2015 to 0.28% in 2016). These results replicate those from our comprehensive swimmer's itch control program conducted successfully on Glen Lake in the 1990s. A key component of our program focuses on preventing common merganser broods from spending the entire summer on the lake because it's the flightless ducklings, with their very high individual parasite infection levels (most likely due to immature immune systems), that are primarily responsible for increasing the number of swimmer's itch causing parasites to cycle in a lake.

Conclusion #2: *SICON, LLC's comprehensive swimmer's itch control program could have been more efficient and identified more natural nesting sites had Gerrish Township not insisted that their harassment and lethal take program be conducted in the early spring, concurrently with our program.*

The timing of the Gerrish Township program interfered with the SICON, LLC program. It makes intuitive sense that common merganser nest sites are much easier to locate and broods are much easier to capture in the absence of a harassment and lethal take bird control program.

Conclusion #3: *Gerrish Township's harassment and lethal program was not effective in reducing the number of nesting common mergansers on Higgins Lake or in reducing the infection level of snails that cause swimmer's itch.*

Not only have spring harassment programs been proven ineffective on other northern Michigan lakes (e.g., Glen Lake and Crystal Lake), but Gerrish Township's combined program of harassment and lethal take did not prevent common mergansers from nesting and rearing broods on Higgins Lake. In fact, when compared to last year's numbers, the Gerrish Township program increased the total number of nests and broods on Higgins Lake in 2016. Despite all of Gerrish Township's efforts, 15 common merganser broods (133 ducklings total) still appeared on the lake over the past two summers. Those ducklings are more than enough to seed the entire lake with hundreds of thousands of avian schistosome eggs and keep snail infection levels, and more importantly swimmer's itch cases, at epidemic levels. While the Gerrish Township program did reduce the world's population of common mergansers by 50 adults, detailed necropsies of the birds lethally taken under their permit showed half were males, most were non-resident birds, and nearly all were either not infected with the swimmer's itch parasite or only lightly infected.

Furthermore, a closer examination of the snail data we collected in 2016 provides additional evidence that the Gerrish Township program was ineffective at reducing parasite infection levels. The snail infection levels at the sites located in Gerrish Township, where their program was exclusively focused, are actually slightly higher than the sites in Lyon Township where no lethal and harassment program occurred and to where Northpoint Fisheries claim the common mergansers were driven (referred to by Northpoint Fisheries as "Zone 4: Higgins Lake Refuge").

Finally, if the Gerrish Township program had not been conducted at all, the adult, early spring mergansers they harassed and shot would not have meaningfully contributed to the lake-wide snail infection level. Analyses of the depredated individuals showed all but one either was not infected or showed very low infection levels. In addition, snail susceptibility to avian schistosome infection is very low in the spring, and most common mergansers leave the lake in mid-May once breeding is over. Finally, SICON, LLC would still have removed all of the broods from the lake before they reached the age (4-6 weeks old) when they could start contributing to snail infection levels.

Conclusion #4: *Captured and relocated common merganser ducklings did not return to Higgins Lake*

In order to obtain federal and state permit to trap and relocate common mergansers, SICON, LLC had to extensively study the fate of trapped and relocated individuals. Over the past 30 years we have marked hundreds of ducklings and have never observed a marked duckling return to the lake where it was captured. We have also documented that the mortality of translocated common merganser ducklings is extremely low. Despite not being permitted to band common merganser ducklings, SICON, LLC can conclusively challenge the notion that relocated ducklings return to Higgins Lake.

Conclusion #5: *Misinformation about the science of swimmer's itch, including its causes and solutions, abounds. Educational and outreach activities must continue to be an essential part of any effective lake-wide swimmer's itch control program.*

In addition to providing relevant and helpful information about swimmer's itch on our website (www.swimmersitchcontrol.com), SICON, LLC also hosted weekly open houses at our laboratory and summer residence. Two different local news stations (9&10 News and NBC25) and a local newspaper (*The Resorter*) ran stories on our comprehensive and successful swimmer's itch control program on Higgins Lake.

We hosted an international swimmer's itch conference and participated in the Michigan Swimmer's Itch Partnership (MSIP) Conference on June 22. SICON, LLC also provided two update reports to the HLSIO and we gave a comprehensive, informative presentation on our program at the HLPOA annual meeting.

Five Specific Recommendations for 2017

Recommendation #1: *Transition into a less costly Comprehensive Swimmer's Itch Control Maintenance Program, which focuses on merganser brood removal and decreases the amount of time SICON, LLC is committed to conduct research and assessment activities on Higgins Lake*

Rationale: Two of our major objectives have been achieved: 1) our data validate that we significantly reduced the lake-wide swimmer's itch infection level on Higgins Lake, and 2) we replicated SICON, LLC's previous success on Glen Lake decades ago. Lake-wide snail infections levels are currently low enough to begin a transition to a lower cost, planned maintenance program on Higgins Lake. The goal of such a program will be to maintain, and hopefully further reduce, the current low lake-wide snail and swimmer's itch infection level. The specific components of a comprehensive maintenance program will need to be developed and will greatly depend on whether Gerrish Township intends to conduct their competing harassment and lethal program.

Recommendation #2: *Remove all known common merganser nesting sites, including the nest boxes that were erected on Higgins Lake by Gerrish Township to attract breeding females.*

Rationale: We believe the data strongly support our claim that the nest boxes erected by Gerrish Township increased the number of common merganser broods on Higgins Lake in 2016. Effective swimmer's itch control programs need to reduce the number of "merganser hours" on a lake in order to reduce the number of larval parasites that infect *S. emarginata* snails.

Recommendation #3: *Remove or permanently seal the two confirmed common merganser nesting sites in Lyon Township.*

Rationale: We believe that nesting sites are the limiting factor that determine the number of common mergansers that breed on a lake. Eliminating confirmed common merganser nesting sites may provide a long-term benefit by reducing the number of "merganser hours" on a lake for more than just 1 summer (see the last sentence in the Rationale for Recommendation #2).

Recommendation #4: *Retime the spring merganser harassment program to late summer/early fall to test whether it can help reduce merganser hours on the lake at a time of year when snails are more susceptible to avian schistosome infection.*

Rationale: Harassment programs share a common weakness in that they only chase birds away temporarily, with individuals most often flying to other sections of the same lake. The data indicate that the Gerrish Township harassment program has been ineffective at reducing the number of nests on Higgins Lake, especially when nest boxes are placed near the lake to attract common mergansers. We believe a retimed program to late summer/fall could potentially help reduce merganser hours on the lake particularly at a time when warmer water temperatures make it more likely that avian schistosomes find and infect *S. emarginata* snails. More importantly, a late summer/fall harassment program likely would have little or no adverse impact on our spring nest locating and summer trap and relocation program. The effectiveness of fall harassment, however, has never been scientifically analyzed. In concert with other MSIP

member lakes, a robust late summer/fall harassment research protocol could be implemented in 2017 to determine its value for reducing swimmer's itch.

Recommendation #5: *Transfer the responsibility for swimmer's itch research on further improving swimmer's itch control programs, lake infection assessment metrics, preventive lotions, and other swimmer's itch projects to the Michigan Swimmer's Itch Partnership (MSIP).*

Rationale: For both 2015 and 2016, voluntary donations and grants to the HLSIO were responsible for funding 100% of SICON, LLC's comprehensive swimmer's itch control program, which included research, educational, and control activities. Several other northern Michigan lakes have benefited from the advances made in our research activities. The MSIP, in conjunction with the Leelanau Center for Education (LCE), is being structured to become the medium and long term organization to lead in swimmer's itch research related to control programs, preventive lotions and general research with a long term goal of eradicating swimmer's itch. MSIP and SICON, LLC have been working with leading experts in the USA and Canada, including Dr. Tom Raffel from Oakland University and Dr. Patrick Hanington from the University of Alberta, Canada. LCE will begin fundraising to support these efforts.

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 the cercaria locates the correct vertebrate host species, it penetrates and develops into an adult worm to complete its life cycle.

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

Objective: To be fully prepared to implement and manage Year 2 of a three-year comprehensive swimmer's itch control program on Higgins Lake.

Summary of work completed: All end-of-the-year summary reports required for the continuation of our federal (US Fish & Wildlife; US Geological Survey) and state (Michigan DNR) permits were completed and filed by December 31, 2015.

We have been working closely with the Higgins Lake Property Owner's Association (HLPOA), Higgins Lake Swimmer's Itch Organization (HLSIO) and the Michigan Swimmer's Itch Partnership (MSIP) to encourage state legislators to allocate public funds to battle swimmer's itch. On December 8, 2015, we accompanied representatives of the HLPOA and MSIP to a meeting with Senator Dave Hildenbrand's staff to present a request for state funds to be appropriated for swimmer's itch control. Governor Snyder signed Michigan's new state budget that includes $250,000 earmarked for swimmer's itch control in 2017. Funds will be distributed to the Leelanau Center for Education (LCE) in the near future. The MSIP will work closely with the LCE to distribute those funds to lake associations consistent with the appropriation language.

New and improved methods for trapping all ages of common mergansers were also explored, and a modified drive trap, one that is both easier to use and to manufacture, was assembled.

SICON, LLC continued to work with the MSIP, which is composed of representatives of 24 lake associations in Michigan dedicated to fighting swimmer's itch. SICON, LLC worked on Crystal Lake, Lime Lake and Lake Leelanau during the summer of 2016 and provided technical and other support for the MSIP including sharing its control and research results with member lake associations. SICON, LLC continues to work with leading experts in the field of swimmer's itch in the USA and Canada.

Bird Control Program

Objective 1: To determine the location of common merganser nesting sites on/near Higgins Lake.

Data file: HigginsLakeSICONMap.pdf
HigginsLakeBirdSurveys2016.xlsx
MarlLakeBirdSurveys2016.xlsx
CommonMerganserNest1.mp4
CommonMerganserNest2.mp4

Summary of work completed: Last year a detailed species assessment revealed that only two avian schistosome species were cycling on Higgins Lake, both of which utilize the common merganser as their definitive host (Canada geese and mallards are not carrying the swimmer's itch parasites on Higgins Lake). For this reason, we focused our bird research and control program on common mergansers.

Breeding common mergansers begin to pair up immediately after ice-out. When nest prospecting and nesting, common mergansers exhibit persistent and stereotypic behaviors. Although it takes hours of careful observations, often very early in the morning, these behaviors can lead to the discovery of nesting sites. We identified 6 candidate nest sites (2 in Lyon Township and 4 in Gerrish Township), but were only able to confirm the Lyon Township sites as viable nests (in quadrant A5 and B11). We were unable to confirm the 4 candidate nest sites in Gerrish Township because we were no longer able to observe those stereotypic behaviors of nesting common merganser hens because of the constant and continued interference from the harassment activities of Gerrish Township's alternate swimmer's itch control program.

We informed both property owners that we found a common merganser nest on their property and were told by one owner of his future plans to remove the tree. We understand that efforts will be made to seal the other nest site with permission of the property owner and we will assist in that effort.

Observation: *Our ability to locate nesting sites for common mergansers is severely compromised by any spring common merganser harassment/lethal program.*

For several weeks after ice-out, common merganser populations on Higgins Lake include both resident birds (i.e., individuals that will spend the summer on the lake) and non-resident birds (i.e., individuals that stay a few days on the lake while they are still migrating north), with the latter usually outnumbering the former. This trend steadily declines until late-May when all the

breeding males leave the lake and only the resident population remains. Fourteen complete lake bird surveys, conducted from April 20 to June 6, support these data.

We also observed a high degree of variation in the number of common mergansers on Higgins Lake, ranging from a low of 1 individual bird on May 27 to a high of 56 birds on April 20. Although some of this variation can be explained by the presence of the ephemeral non-resident birds, an additional factor is clearly the Northpoint Fisheries spring program which included harassment and lethal take activities. Evidence supporting this claim can be found by comparing the results of bird surveys that we conducted within 6 hours of each other. On the morning of April 27, in the middle of Northpoint Fisheries spring program, we observed 22 birds on the lake, but that number increased to 38 individuals that same afternoon. Conversely, on May 24, two days after Northpoint's program was completed, morning and afternoon counts of common mergansers on Higgins Lake were 17 and 16 birds, respectively.

Additionally, we observed tremendous variation in common merganser counts on Marl Lake during the period from April 25-May 11. SICON's frequent inspections of Marl Lake showed it was used as a temporary refuge by common mergansers harassed by the Gerrish Township program. The close proximity of Marl Lake to Higgins Lake and the ease of travel between lakes once harassment ended for the day supports our contention that the Gerrish Township harassment program is not effective at achieving its stated goals.

Observation: *With a limited number of birds that can be lethally taken on a permit, it's senseless to shoot breeding males or any bird that cannot be positively identified as a resident.*

Objective 2: To further reduce the number of avian schistosome eggs deposited in Higgins Lake.

Data file: HigginsLakeBirdRemoval2016.pdf

Summary of work completed: From June 13 until July 18 we observed 6 common merganser broods on Higgins Lake. Two females and 45 ducklings were successfully trapped, often within a week of their appearance on the lake, and safely relocated to a designate location on Lake Huron as described and permitted by Barb Avers (Michigan DNR). One brood (7 birds) was captured in Lyon Township (quadrant A5) and five broods (40 birds) were captured in Gerrish Township (quadrants H1, H1, M10, Q14, and Q18). An additional survey was conducted at the end of July to ensure that no more broods were present on the lake.

Additionally, we used lethal force (i.e., shotgun) to remove 1 adult male common merganser that had been previously injured.

Observation: *Using either trap/relocation or lethal take, 48 common mergansers were removed from Higgins Lake in 2016*

Assessment of Snail Infection Level

Objective 1: To determine the avian schistosome infection level in snails on Higgins Lake in 2016.

Data files: HigginsLakeSnailSites.pdf
HigginsLakeSnailCollections2016.pdf

Summary of work completed: Last year 10 snail collection sites were strategically chosen around Higgins Lake to give the greatest possible lake-wide coverage (see HigginsLakeSnailSites.pdf). Given that last year's avian schistosome species assessment identified *Trichobilharzia stagnicola* as the dominant swimmer's itch causing species on Higgins Lake, only *Stagnicola emarginata* snails, its intermediate host, were examined this summer. At five different times, from early June to late July, a minimum of 170 snails were collected from each of the 10 sites and individually shed for avian schistosomes (Table 1). Collectively, these data provide an annual assessment of the avian schistosome infection level on Higgins Lake.

Table 1. Snail Infection Levels on Higgins Lake in 2016. The percentage of *Stagnicola emarginata* snails infected with swimmer's itch at ten different locations and at 5 different times during the summer (data from June 17 and June 29 were combined in order to more easily compare snail infection levels to the 2015 data) 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%))*

Location	June 9-10	June 17-29	July 11-12	July 20-24
Dragonfly House	0.0% (200)	0.25% (400)	0.0% (200)	0.0% (250)
Detroit Point	0.0% (200)	1.1% (366)	0.0% (200)	0.5% (200)
Yacht Club	0.0% (200)	0.0% (322)	0.0% (200)	0.0% (200)
Sam-O-Set Park	0.5% (191)	0.25% (400)	0.5% (200)	0.0% (200)
West Boat Launch	0.0% (200)	0.0% (381)	0.5% (200)	0.0% (170)
North State Park	0.0% (200)	0.25% (400)	0.0% (200)	0.0% (200)
Gerrish Township Park	1.0% (200)	0.0% (400)	1.0% (200)	0.0% (250)
Kelly Beach	0.0% (200)	0.25% (400)	0.0% (200)	0.0% (181)
Almeda Beach	0.5% (200)	0.8% (400)	1.0% (200)	0.5% (200)
South State Park	0.0% (241)	0.0% (396)	2.0% (200)	0.5% (200)
Lake-wide	0.2% (2032)	0.3% (3865)	0.5% (2000)	0.1% (2051)

*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.

Consistent with last year's data, the trend towards infection levels increasing from early June to early July is most likely a result of water temperatures increasing over that time period. Because of the variability associated with sample sizes less than 200 snails, the most meaningful and relevant data are the lake-wide infection levels. 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%. It is evident from Table 1 that the lake-wide snail infection levels on Higgins Lake this summer are more within the acceptable range.

Observation: *From only a snail infection level perspective, swimmer's itch is at an acceptable level on Higgins Lake in 2016. At present, there is no known control program or technology that can eliminate or eradicate swimmer's itch from a lake.*

Objective 2: To determine the feasibility of using an additional, or even alternative, diagnostic metric to snail infection levels for accurately assessing reductions in parasite loads on Higgins Lake.

Data files: Will be sent as an addendum to this report.

Summary of work completed: While snail infection level is currently the best diagnostic metric for assessing parasite load, we continue to collaborate with Dr. Patrick Hanington (University of Alberta) and other scientists in an attempt to find alternative, and perhaps less costly, methods. We tested one such method, which involves quantitatively assessing the number of avian schistosome cercariae in the water via a technique called quantitative polymerase chain reaction (*q*PCR). Every time we collected snails, we also collected water samples. Twenty-five (25) 1L water samples were passed through a 20µm mesh plankton tow and the resultant 50ml sample preserved in 100% ethanol. All samples, alone with ones taken at 4 other MSIP member lakes, have been sent to Dr. Hanington for *q*PCR analysis and cercarial count determination. We hope to correlate our snail infection levels (whole-lake and site-specific) with the cercarial counts to determine if *q*PCR analyses of water sample accurately reflect snail infection level analyses as a quantitative metric of parasite load.

We expect results from the *q*PCR analyses to be completed by the end the year. Those data, once received and reviewed, will be sent as an addendum to this report.

Educational Activities/Outreach Program

Objective: To be a helpful resource for those in the Higgins Lake community who desire to learn more about what an effective comprehensive swimmer's itch control program entails.

Data files: 9&10NewsStory.mp4
NBC25NewsStory.mp4

Summary of work completed: Weekly open houses were offered at the Dragonfly House (our laboratory and summer residence) every Monday evening, including the Memorial Day and 4th of July holidays, from 6-8pm from May 30-July 25. Just as we did last year, we printed and made available at those open houses 100 snail field identification cards.

On our website (www.swimmersitchcontrol.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.

The geographic distribution of swimmer's itch cases in 2016 reported on our website is almost cosmopolitan over the entirety of the lake (Figure 1).

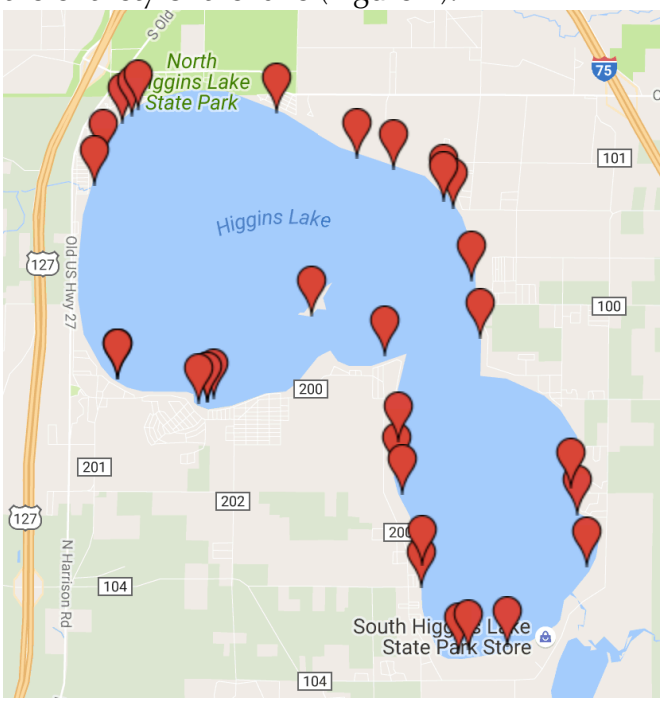

Figure 1. Geographic locations of swimmer's itch cases reported on www.swimmersitchcontrol.com/higginslake from June 1 - July 31, 2016. Each red balloon represents 1 website report (the number of individuals in each report varied from 1 to 7) of swimmer's itch.

Two different local news stations (9&10 News and NBC25) visited and conducted interviews for their respective evening news broadcast. Both broadcasts were very positive and complimentary of SICON, LLC's efforts to significantly reduce the occurrence of swimmer's itch on Higgins Lake. Additionally, Cheryl Holladay spent considerable time interviewing our team and wrote several articles that appeared in the *The Resorter*.

We hosted a swimmer's itch workshop at the Dragonfly House with top scientists from Michigan, Canada, New Mexico and Washington DC and participated, along with those experts, in the day-long Michigan Swimmer's Itch Partnership (MSIP) Conference at Roscommon High School on June 22.

Update reports were written upon request from the HLSIO and a comprehensive, informative presentation was given at the HLPOA annual meeting.

Observation: *Misinformation about swimmer's itch abounds. Educational and outreach activities must be an essential part of any effective lake-wide swimmer's itch control program.*

Program Assessment Questions

Question 1: How effective is SICON, LLC's Comprehensive Swimmer's Itch Control Program?

Data files: HigginsLakeSnailInfectionLevels2015.pdf
HigginsLakeSIReports2015.pdf

Summary of work completed: Because snails overwinter with avian schistosome infections, any swimmer's itch control efforts that focus on breaking the parasite's cycle at the level of the definitive host will only begin to see tangible results in the second year of the program. Thus, last year's data on snail infection levels and swimmer's itch reported cases provide a pre-program baseline for comparison purposes.

In 2015 we collected over 10,000 snails from 10 different sites across the lake. Our objective analysis showed the overall, summer lake-wide snail infection level was slightly over 3.0% (see HigginsLakeSnailInfectionLevels2015.pdf). While that might seem like a low number, throughout more than 5 decades of working on swimmer's itch control and research on many lakes in Michigan, we've found that a snail infection level over 2% translates to a swimmer's itch problem that can be considered epidemic. The overall lake-wide snail infection level for 2016 is 0.28%. That's a 90% reduction and a very dramatic decrease! The magnitude of this decrease can be seen visually by comparing Table 1 above with last year's snail infection data (see HigginsLakeSnailInfectionLevels2015.pdf). We produced similar snail infection level reductions when we trapped and removed common merganser broods on Glen Lake (2.1% down to 0.3%), which is why we expected similar results based on our program for Higgins Lake.

Corroborating evidence that our comprehensive, science-based, control program is having significant success can be found by comparing this year's anecdotal reports of swimmer's itch (see Figure 1 above) to those in 2015 (see HigginsLakeSIReports2015.pdf). Not only is the number of reported cases down dramatically across the entire lake but the average severity of each case (i.e., the number of papules) is also considerable less in 2016 compared to last year.

Observation: *SICON, LLC's Comprehensive Swimmer's Itch Control Program has been very successful in reducing the number of swimmer's itch cases on Higgins Lake.*

Question 2: How effective is the Gerrish Township's swimmer's itch control program?

Summary of work completed: Gerrish Township was once again required by their permit to turn over mergansers they killed to SICON, LLC for analysis. And, once again, the analyses showed Northpoint Fisheries killed as many males as females. Not only that, all but one of the adult common mergansers they killed in early spring were either not infected or lightly infected. Our unpublished data over many decades of conducting research on swimmer's itch show that snail shedding and infection is minimal in the early spring, cold water. These results again demonstrate that an early spring harassment and lethal program provides no material benefit in reducing swimmer's itch on Higgins Lake.

Working with common mergansers over the past 30 years, SICON, LLC has never witnessed an increase in the number of common merganser broods on any lake once trapping and relocation efforts began. Last year we trapped all common merganser broods on Higgins Lake following the Gerrish Township program (total 9 broods). This summer we trapped and removed 6 broods. With the use of nest boxes, Northpointe Fisheries recently claimed they were able to effectively eliminate 7 common merganser broods from Higgins Lake this spring. Thus, a total of 13 common merganser broods came off Higgins Lake in 2016, which directly contradicts Northpointe Fisheries' claim that their activities have not attracted more common mergansers to the lake. Increasing the total number of common merganser broods (and therefore, common merganser hours) on Higgins Lake is certainly not the desired direction to go if the ultimate goal is a lower-cost swimmer's itch maintenance program that will effectively keep the number of swimmer's itch cases on Higgins Lake at a much lower level into the foreseeable future.

Further evidence of the ineffectiveness of the Gerrish Township swimmer's itch control program can be found upon closer examination of the snail infection levels on Higgins Lake. Three of the collection sites are located in Lyon Township and the remaining 7 are in Gerrish Township. SICON, LLC's program removed broods in both townships, but the Northpoint Fisheries early spring harassment and lethal program was restricted to only areas within Gerrish Township. If the Northpoint program had any added effect at reducing snail infection levels over our program, then it's reasonable to expect the reduction in snail infection levels in 2016 should be greater in the 7 Gerrish Township collection sites. But the opposite was observed: the reduction in snail infection levels were greater in the 3 snail collection sites in Lyon Township when compared to the 7 Gerrish Township collection sites.

Observation: *Compared to last year, the Gerrish Township program attracted more common merganser broods to Higgins Lake in 2016. It also hindered us from locating more common merganser nests, made trapping more difficult, and slowed progress towards a long-term, less costly swimmer's itch long term maintenance program.*

Question 3: Other lake associations have common merganser spring harassment programs. How effective are their programs?

Representatives from Glen Lake and Crystal Lake participated in the MSIP swimmer's itch conference on June 22, 2016 at Roscommon High School. Twenty-four total Michigan lake associations are now participating in MSIP. Both associations reported on the effectiveness of their harassment activities in preventing common mergansers from breeding on their respective lake. For a number of years following the successful SICON, LLC program, Glen Lake, which is about one quarter the size of Higgins Lake, was able to keep the number of common merganser broods hatching on the lake to a minimum (i.e., 1-2 broods) using harassment. However, the number of broods began to increase recently despite their aggressive harassment program. In 2015, the number of broods hatching on Glen Lake increased to 3. This spring, Glen Lake spent twice as much money and effort with their extensive and thorough spring harassment program even adding a second boat. Rob Karner, the biologist for Glen Lake, supervised the harassment program. Rob reported that as of June 22, the number of common merganser broods had more than doubled to 8 broods this summer.

Without a SICON, LLC program to remove those common merganser broods, Glen Lake will likely see a dramatic increase in swimmer's itch next year. Glen Lake has already agreed to work with SICON, LLC, beginning in 2017.

Joel Buzzell from Crystal Lake reported on their riparian-conducted harassment efforts. A recent count of mergansers on Crystal Lake found 78 common mergansers (including 5 broods) following their riparian harassment program (somewhat less than the 97 left on Higgins Lake by Northpoint Fisheries after their lethal and harassment program last year). Results of snail raking experiments they conducted last year showed inconclusive results. Joel was not very optimistic about the benefit of raking snails for controlling swimmer's itch and was unsure if they will do snail raking again next year. Regardless, Crystal Lake will continue to work with SICON, LLC in 2017 and they have agreed to delay any harassment program until after SICON, LLC has completed its capture and relocation program.

Observation: *Evidence from multiple lakes in 2016 showed spring harassment programs are ineffective in preventing common mergansers from nesting and rearing broods.*

A Review of Last Year's Recommendations

In last year's annual report we presented the following 4 specific recommendations for 2016 and future years:

1. Convince all outside agencies, including individual riparians, to suspend (or work in coordination with SICON) their perceived control activities so that the efficacy of the SICON program can improve.
2. Coordinate the efforts of the HLSIO with the Michigan Swimmer's Itch Partnership (MSIP).
3. Centralize the work on Higgins Lake, and possibly other lakes in the MSIP, by creating one comprehensive website.
4. Institute a late summer/early fall merganser harassment/control program.

Some progress was made with the first recommendation, but Gerrish Township continued to "go at it alone" with their spring harassment and lethal take program in 2016. Additionally, some riparians are applying copper sulfate along their beachfront property. It continues to be our hope that all swimmer's itch control activities work in a coordinated and synergic manner. This would give the greatest chance for an effective, long-term solution to the swimmer's itch problem on Higgins Lake.

Gerrish Township also insisted on maintaining its own swimmer's itch reporting webpage, a decision that directly interferes with the spirit of recommendation 3.

The HLPOA and HLSIO were the driving forces behind the formation of the MSIP (recommendation 2 above), and it was the coordination of those groups that played an essential role in convincing the Michigan Legislature to approve a very sizable appropriation ($250,000) in next year's state budget to address the problem swimmer's itch is becoming in Michigan.

To our knowledge no progress was made on recommendation 4.