SWIMMER'S ITCH SOLUTIONS

A Swimmer's Itch Control Program for Higgins Lake

Annual Report for Maintenance Year 2

December 15, 2019

by

Curtis L. Blankespoor, Ph.D.
and
Randall De Jong, Ph.D.

* 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

From 2015-17, a three-year Comprehensive Swimmer's Itch Control Program on Higgins Lake **resulted in over a 98% reduction in the lake-wide snail infection level from a pre-program level in 2014**. Last year (2018), the Higgins Lake Swimmer's Itch Organization (HLSIO) transitioned from a comprehensive swimmer's itch control program to a maintenance control program.

In 2019, Swimmer's Itch Solutions, LLC (SIS) partnered with the HLSIO for another year of a swimmer's itch control maintenance program on Higgins Lake whereby SIS was under contract to:

1. trap and relocate all common merganser broods on Higgins Lake in 2019
2. complete the second and final year of a 2-year HLSIO-funded GPS/nest-finding research project which began in 2018
3. conduct a minimum of three waterfowl surveys of the entire Higgins Lake shoreline.
4. give a presentation at the 2019 Higgins Lake Property Owner's Association (HLPOA) annual meeting
5. provide one standard common merganser trap (net and supporting equipment) to be shared between the HLSIO and the Crystal Lake & Watershed Association
6. provide a written, end-of-the-year final report

In early spring, Swimmer's Itch Solutions, LLC secured all necessary federal and state permits to conduct this maintenance program. **During June and July, we trapped and removed 2 common merganser broods (16 birds in total) that appeared on Higgins Lake.** Data from an early August waterfowl survey of the entire shoreline indicated no common merganser broods remained on Higgins Lake.

Although the number of Higgins Lake swimmer's itch cases reported on our website increased slightly from last year's reports, anecdotal evidence from riparians and comments from Higgins Lake Facebook users suggest that the significant reduction we gain in the number and severity of swimmer's itch cases obtained on Higgins Lake in 2017 and 2018 continued to occur in 2019.

Looking ahead to future summers, the HLSIO would be well-served to continue a swimmer's itch maintenance control program on Higgins Lake. Control efforts over the last 5 years have significantly reduced the number common merganser broods on Higgins Lake, and more importantly, the number and severity of swimmer's itch case reports. With case reports minimal, and only 2 common merganser broods appearing on the lake each of the last two summers, future control of swimmer's itch on Higgins Lake can be achieved with a dedicated and vigilant maintenance-level approach.

We share 2 summary conclusions for 2019 and make 3 specific recommendations for 2020.

Summary conclusions

1. Swimmer's Itch Solutions, LLC's swimmer's itch control program has been extremely effective at maintaining the low number and severity of swimmer's itch cases on Higgins Lake in 2019.
2. Our scientific discoveries on Higgins Lake over the past 5 years strongly indicated that the most likely source of the remaining low level of swimmer's itch infection in Higgins Lakes are Second Year (SY) resident adults and spring and fall common merganser migrants ("fly-throughs").

Specific recommendations

1. Continue to promote and manage a "maintenance-level" swimmer's itch control program for the foreseeable future.
2. Continue to support swimmer's itch research projects, particularly ones that have direct application to new and improved swimmer's itch control strategies, including but not limited to:
    a. Banding or putting web tags on all common mergansers captured on Higgins Lake.
    b. Organizing a fall common merganser harassment/hunting program to test whether fall migrants are more heavily infected with avian schistosomes than spring migrants.
    c. Developing new trapping techniques that specifically target resident SY common mergansers.
3. Develop a specific swimmer's itch assessment plan for the summer of 2020 that documents snail infection levels and/or cercarial densities in water samples.

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

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 Larks Lake Association, the Black Lake Preservation Society, and the Elk-Skegemog Lakes Association during the summer of 2019. 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: HigginsLakeBirdSurveys2019.xlsx

Summary of work completed: Waterfowl surveys of the entire shoreline of Higgins Lake were conducted on June 7, June 18, and July 1, 2019. On each of the three surveys, we consistently observed 60-100 mallards and a small group (4-6 individuals) of Second Year (SY) resident adult common mergansers (Figure 1). Dozens of Canada geese were identified on the first two surveys, which occurred before the Higgins Lake Property Owners Association's (HLPOA) initiated their Canada geese removal efforts. No Canada geese were spotted on the July 1 waterfowl survey.

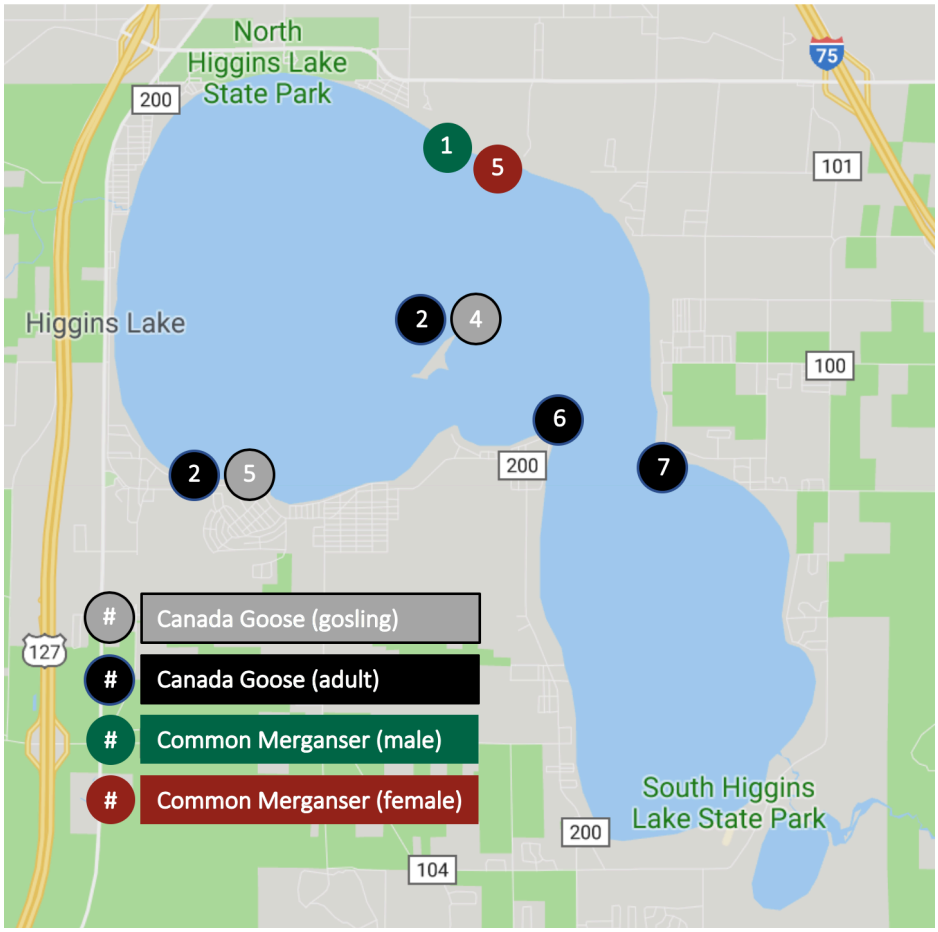

Figure 1. Number of Canada geese and common mergansers observed during a June 18, 2019 shoreline survey of Higgins Lake (Roscommon County, MI).

Removal of common merganser broods
Accompanying file: HigginsLakeCOMETrapRelocate2019.pdf

Summary of work completed: From June 1 until August 15 we observed only two common merganser broods on Higgins Lake. Both broods were successfully trapped (Figure 2), within 2 weeks 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).

Both hens were fitted with a USFWS leg band after capture. Small uniquely numbered web tags were placed on all 14 captured ducklings, bringing the three-year total of ducklings from Higgins Lake equipped with an individually identifiable marking to 85. These web tags will provide a way for us to determine if any of the relocated ducklings return to Higgins Lake to breed in future years.

A fourth waterfowl survey was conducted in early August before our boat was taken off the lake to ensure that all of this year's common merganser broods had been trapped and relocated.

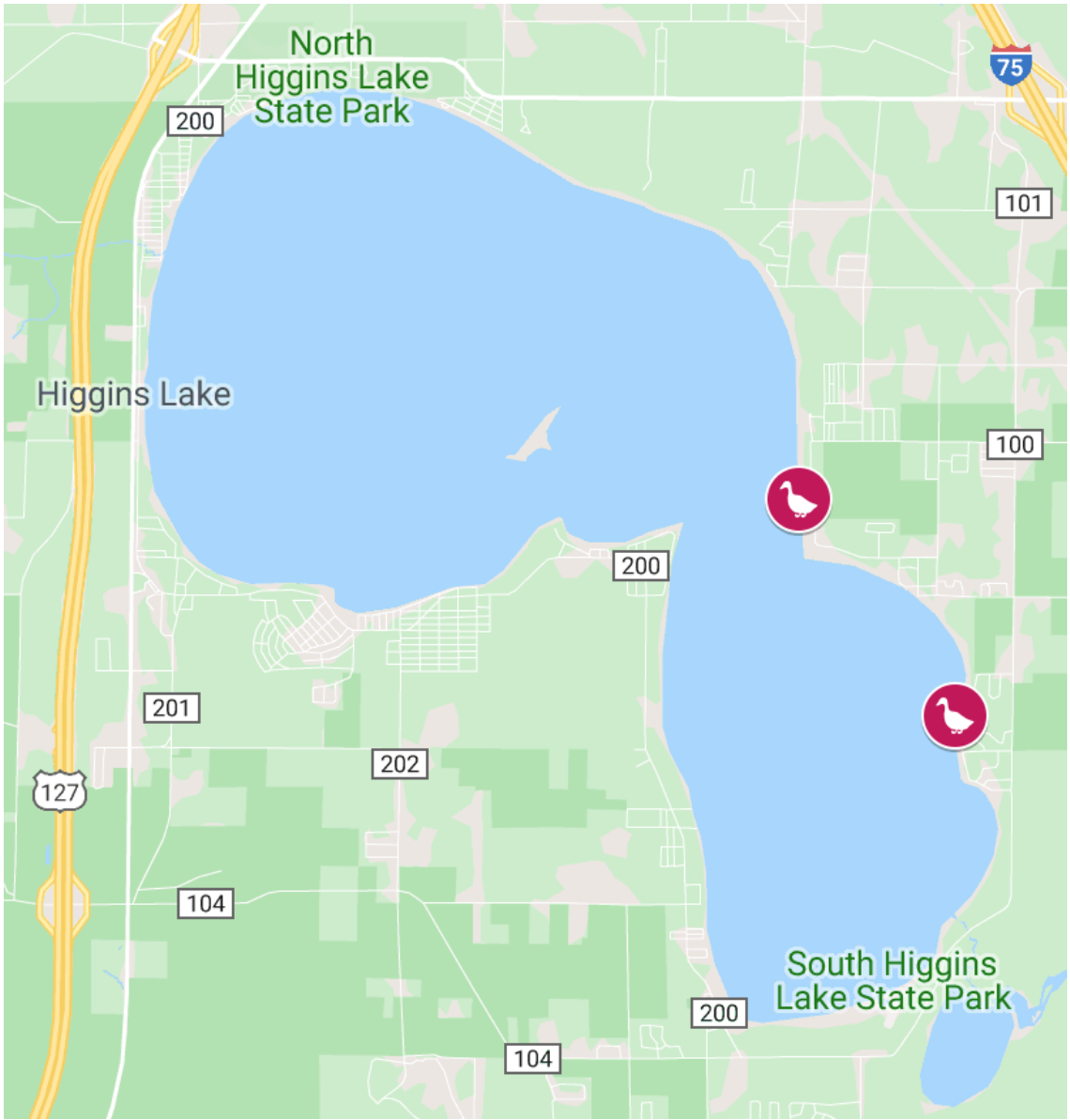

Figure 2. Locations on Higgins Lake (Roscommon County, MI) where common merganser broods were trapped in 2019.

Research Project

Tracking common merganser hens with GPS

Summary of work completed: Common mergansers are a cavity-nesting species and hens typically lay their eggs in trees near a body of water (e.g., pond, lake, river). Mating pairs form almost immediately after ice-out, and hens that have successfully raised a brood in a previous year often show a strong preference to return to the same specific nesting site (as evidenced by the number of hens we recaptured over the past 4 summers). Very little is known about the daily behavior patterns of reproductively active hens.

This summer was the second year of a two-year project using GPS units harnessed on hens to locate common merganser nesting sites. For the last 2 years, we have equipped all the common merganser hens that we have captured (2 in 2018, and 2 more this year) with Lotek GPS PinPoint tags (www.lotek.com). The tags, which have a precision of measurement within $10m^2$, were preprogrammed to record locations at specific times and on specific days. Once a hen wearing one of these tags is recaptured in future years, the data will be collected and analyzed, hopefully allowing us to locate her specific nesting site. To date, we have not had any of the 4 GPS-equipped hens return to Higgins Lake.

The knowledge gained from this project will improve our understanding of common mergansers in northern Michigan. Long-standing assumptions about mating and nesting could be tested and substantiated with data. The new knowledge gained will help the development of more efficient and cost-effective common merganser trapping techniques. Additionally, any active nest sites that are discovered can be destroyed or otherwise rendered unusable for future years.

Educational Activities/Outreach Program

Accompanying files: HLSIO2019July13.pdf

Summary of work completed: On our website (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 26 unique locations on Higgins Lake in 2019 (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 2019 data represent an increase from last year. The most plausible explanation for this increase is the presence this summer of a small group of Second Year (SY) adult common mergansers. No such group of "teenagers" was observed on Higgins Lake in either 2017 or 2018.

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.

Update reports were written upon request from the HLSIO board and a comprehensive, informative presentation was given at the 2019 HLPOA annual meeting.

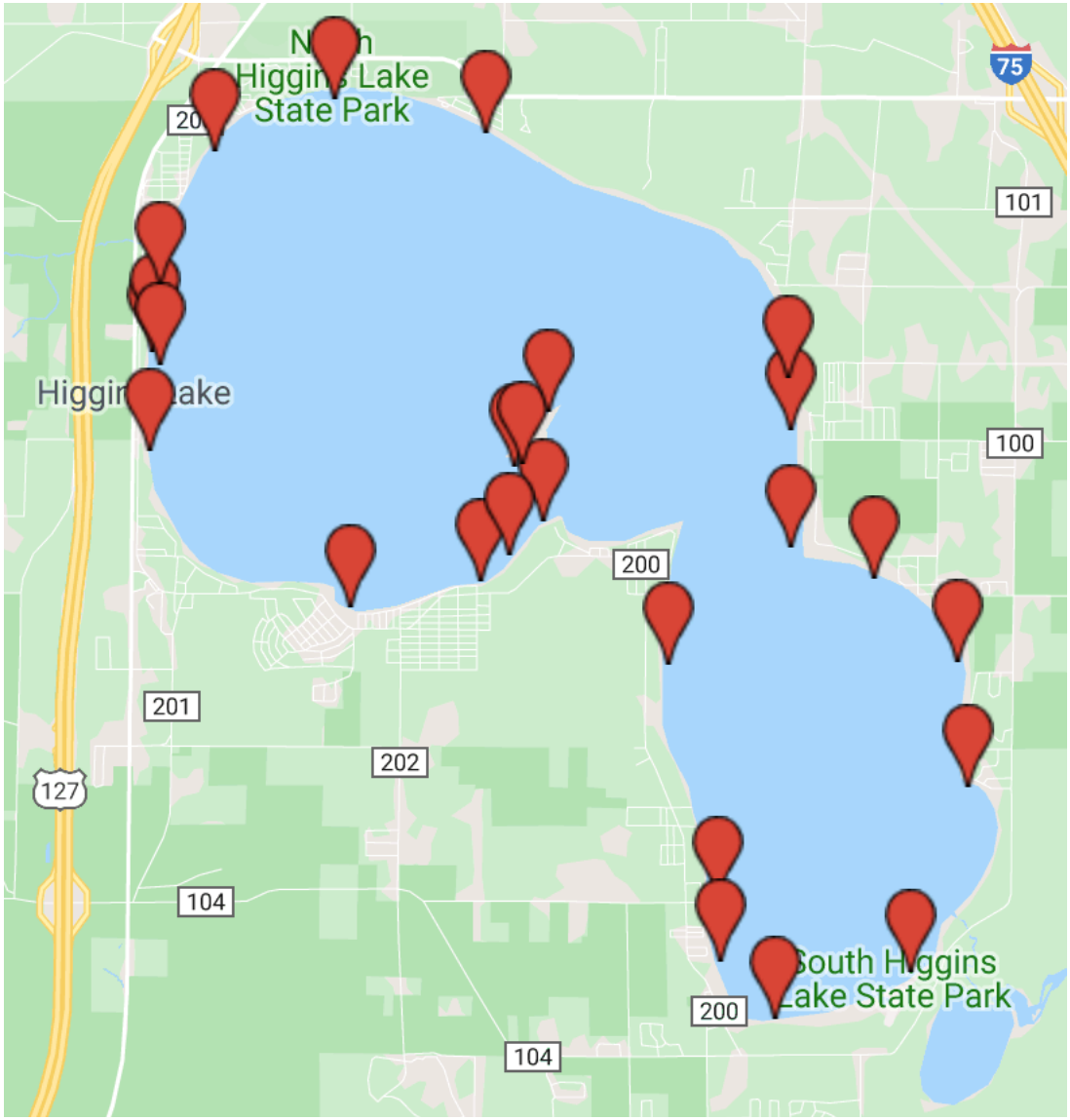

Figure 3. Locations of swimmer's itch cases on Higgins Lake (Roscommon County, MI) that were reported on www.swimmersitchsolutions.com/Higginslake from June 1 - August 31, 2019. Each red balloon represents a distinct location for a swimmer's itch case report.

Two Summary Conclusions

Conclusion #1: *Swimmer's Itch Solutions, LLC's swimmer's itch control program has been extremely effective at maintaining the low number and severity of swimmer's itch cases on Higgins Lake in 2019.*

From 2015-2018, Swimmersitchsolutions, LLC managed a swimmer's itch control program on Higgins Lake that removed 222 common mergansers (including 21 broods) from the lake and reduced the lake-wide avian schistosome snail infection level in *Stagnicola emarginata* by 98% (from 3.01% in 2015 to 0.05% in 2017). This past summer, the HLSIO opted for the more affordable and sustainable maintenance swimmer's itch control program (i.e., one that doesn't require an annual, comprehensive lake-wide assessment of swimmer's itch on Higgins Lake). Only 2 common merganser broods appeared on the lake this summer, and both broods were quickly and successfully trapped and relocated. As expected, this year's anecdotal evidence continued to show most recreational lake users had "itch-free" experiences on Higgins Lake in 2019.

Conclusion #2: *Our scientific discoveries on Higgins Lake over the past 5 years strongly indicated that the most likely source of the remaining low level of swimmer's itch infection in Higgins Lakes are Second Year (SY) resident adults and spring and fall common merganser migrants ("fly-throughs").*

Second year (SY) resident adult common mergansers spend the entire summer on Higgins Lake. Additionally, thousands of migrating birds, during the early spring and late fall, spend short periods of time on the lake. Currently, no control strategies exist that can prevent individuals in these two categories from newly inoculating snails with swimmer's itch causing parasites. Therefore, the most likely source for the persistent, low levels of swimmer's itch infection currently in Higgins Lake are SY resident common mergansers and spring and fall common merganser migrants. It is primarily because of these "uncatchable" birds, that no known control program or technology can completely eliminate or eradicate swimmer's itch from a lake.

Three Specific Recommendations

Recommendation #1: *Continue to promote and manage a "maintenance-level" swimmer's itch control program for the foreseeable future.*

Since 2015, the Higgins Lake community has made a sizable and significant investment in a comprehensive, multi-year swimmer's itch control and research program on their lake. This effort, and specifically the support from the HLSIO, HLPOA, and the Roscommon County Commission have positioned Higgins Lake as the premier leader of a state-wide battle to control swimmer's itch on all Michigan lakes. Now that the "heavy lifting" of swimmer's itch control has been accomplished (i.e., a data-supported reduction on swimmer's itch from an epidemic level to a tolerable, if not ideal, level), it is of paramount importance to continue to support and manage a "maintenance-level" swimmer's itch control program moving forward. The goal of such a program should be to maintain, and possibly even further reduce, the low lake-wide swimmer's itch infection level. Currently, after the first two years of a three-year MI-DNR Common Merganser Control Policy permit given to the HLSIO, the swimmer's itch infection level on Higgins Lake is significantly lower than the qualification requirement threshold for that permit.

Recommendation #2: *Continue to support swimmer's itch research projects, particularly projects that have direct application to new and improved swimmer's itch control strategies, including but not limited to:*

a. *Banding or putting web tags on all common mergansers captured on Higgins Lake.*
b. *Organizing a fall common merganser harassment/hunting program to test whether fall migrants are more heavily infected with avian schistosomes than spring migrants.*
c. *Developing new trapping techniques that specifically target resident AHY common mergansers.*

The recent, dramatic 3-year reduction in the lake-wide avian schistosome snail infection level that Swimmer's Itch Solutions, LLC obtained on Higgins Lake would not have been possible without the scientific knowledge gained from numerous swimmer's itch-related scientific research projects. Most of the scientific research we conduct leads to more effective and financially-sustainable swimmer's itch control strategies. For this reason, such projects need to be supported and incentivized in the years ahead.

One research question that remains unanswered is where relocated ducklings choose to reproduce once they reach sexual maturity. They either return to their natal sites (i.e., where they hatched from eggs), return to the area where they were released after capture (i.e., where they fledged), or to some geographical area unrelated to their experiences as a duckling. For this reason, all captured common mergansers should continue to be banded or equipped with web tags in order to help us answer that important question. Knowing the answer to this question will have significant implications on many future control program decisions (e.g., how far apart do the capture and release sites need to be in order to discourage ducklings from returning to their natal sites to breed?)

Some of the other lake associations in Michigan that trap and relocated common mergansers opted not to band hens or mark ducklings in 2018. Once a brood is captured, the banding itself requires only minimal extra effort, and the potential benefits gained from this research work would have high value for future control efforts. In fact, we strongly suggest that banding hens and web tagging ducklings be a requirement for securing any MISIP funding for common merganser control activities.

From 2015-2017 we've collected necropsy data that show most spring migrant common mergansers on Higgins Lake and Crystal Lake are either uninfected or only lightly infected with avian schistosomes. However, a similar necropsy analysis of common merganser during the fall season has never been undertaken. Given that ducklings, on average, are ten times more heavily infected than adult birds in the summer, and that ducklings represent a significant percentage of the annual fall migrating population (unlike in the spring), one would expect the average avian schistosome load in fall migrants might be significantly higher compared to birds in the spring. Knowing if this indeed is true would increase the value and importance of investing resources in a fall common merganser harassment program. A fall harassment program would also have the added benefits of 1) helping reduce merganser hours on a lake when warmer water temperatures (compared to the spring season) make it more likely that avian schistosomes find and infect *S. emarginata* snails, and 2) having little or no adverse impact on our spring nest locating and summer trap and relocation program.

Determining the extent to which snails are susceptible to naturally acquiring new avian schistosome infections in the fall, when lake water is still relatively warm, is another research project that should be funded as it would further inform future swimmer's itch control strategies.

Recommendation #3: *Develop a specific swimmer's itch assessment plan for the summer of 2020 that documents snail infection levels and/or cercarial densities in water samples.*

With its Michigan DNR-issued common merganser control permit expiring in 2020, the HLSIO will need to provide swimmer's itch assessment data as part of its renewal application to the MI-DNR in 2021. This assessment can be done most efficiently by collecting a large number of *Stagnicola* snails and determining a lake-wide snail avian schistosome infection level, or by collecting numerous water samples and analyzing them with molecular techniques that detect and identify any swimmer's itch-causing parasites. Ideally, conducting both assessment metrics in 2020 would allow the HLSIO the most thorough comparison to pre-control data (i.e., from 2015).