



A Swimmer's Itch Control Program for Crystal Lake

Annual Report

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by

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and

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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.

----- *SPECIALIZING IN EDUCATION AND CONTROL* -----

Executive Summary

Three summers ago, SICON, LLC conducted a complete avian schistosome species assessment on Crystal Lake that included collecting over 10,000 snails from 10 different locations and 2 complete lake-wide bird surveys. In 2016, the overall lake-wide schistosome infection level in *Stagnicola emarginata* snails was 0.79% (for comparison purposes, values < 0.25% are ideal and values > 2.0% are considered epidemic on other lakes). Five common merganser broods (61 ducklings total) were observed on Crystal Lake in 2016.

For the past two summers, Swimmer's Itch Solutions, LLC has partnered with the Crystal Lake & Watershed Association (CLWA) in the implementation of a swimmer's itch control program on Crystal Lake. Using methods that have worked successfully in the past (on Higgins Lake, MI, Glen Lake, MI and on Great Pond Lake, ME), we developed a 2018 program for the CLWA with the following components:

1. trapping and relocating all common merganser broods on Crystal Lake.
2. determining the 2018 lake-wide snail infection level by analyzing a minimum of 2000 snails.
3. determining cercarial densities at 10 different locations on Crystal Lake via qPCR, minimally once in late June/early July and once in late July/early August.
4. collecting adult avian schistosome worms from common merganser pursuant to federal and state scientific collecting permits: USFWS #MB54823B-0 and MI-DNR #SC 1543
5. training two individuals so that by the end of summer 2018 they will be qualified to trap and relocate merganser broods and collect water samples for qPCR analyses from Crystal Lake in 2019.
6. providing one standard common merganser trap (net and supporting equipment) to be shared between CLWA and the Higgins Lake Swimmer's Itch Organization.
7. giving a presentation at the CLWA annual meeting
8. writing a comprehensive final report.

In early spring, Swimmer's Itch Solutions, LLC secured all necessary federal and state permits to conduct this program. During June and July, we trapped and removed all 16 common merganser broods (143 birds in total) that appeared on the lake. Another 3 actively breeding common merganser hens were lethally taken in May under our scientific collecting permit. Collectively, we removed a total of 146 common mergansers from Crystal Lake in 2018.

An analysis of 2112 *Stagnicola* snails from Crystal Lake indicated a lake-wide avian schistosome snail infection level of 0.28%. **This represents a 65% decrease from the summer lake-wide level in 2016.** It is also the same lake-wide snail infection level achieved in Higgins Lake after the first two years of trapping and relocating common merganser broods. Although the number of Crystal Lake swimmer's itch cases reported on our website in 2018 did not significantly change from last year, anecdotal evidence from riparians and data collected from CSA lifeguards suggest that significant reductions in the number and severity of swimmer's itch cases were observed on Crystal Lake in 2018.

Looking ahead to future summers, the CLWA is well positioned to successfully trap and relocate common merganser broods without the need to hire an external contractor. We have equipped the CLWA with a standard common merganser trap (to be shared with the Higgins Lake Swimmer's Itch Organization) and two local individuals have completed the training that is necessary to successfully catch common merganser broods.

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 Crystal Lake (Benzie County, MI).

Swimmer's Itch Solutions, LLC continues to work with the MISIP, which is composed of representatives of 31 lake associations in Michigan dedicated to fighting swimmer's itch. We were also under contract with the Higgins Lake Swimmer's Itch Organization, the Platte Lake Improvement Association, and the Larks Lake Association during the summer of 2018, and 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

Removal of common merganser broods

Accompanying file: CrystalLakeCOMETrapRelocate2018.pdf

Summary of work completed: From June 7 until July 31 we observed 16 common merganser broods (consisting of 143 individual birds) on Crystal Lake. All 16 broods were successfully trapped (Figure 1A), usually within 2 weeks of their appearing on the lake, and safely relocated to a designate location on Hodenpyl Dam Pond or Tippy Dam Pond as described and permitted by Barb Avers (Michigan DNR).

A lake-wide bird survey was conducted on July 31 to ensure that no broods were present on the lake.

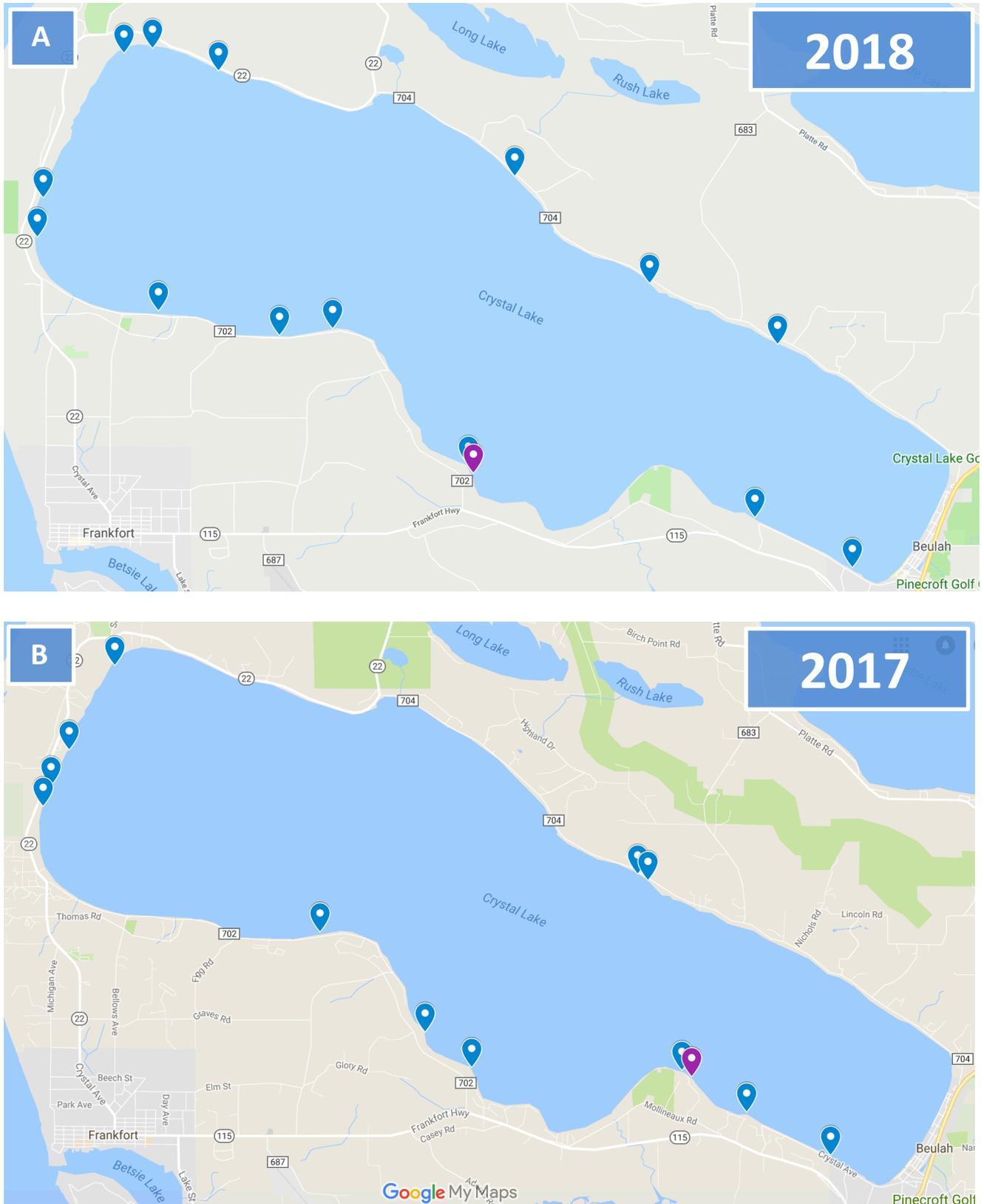


Figure 1. Locations on Crystal Lake (Benzie County, MI) where common merganser broods were trapped in (A) 2018 and (B) 2017, for comparison. Each balloon represents a distinct trapping site (blue = 1 brood tapped; purple = 2 broods trapped).

Assessment Program

Snail infection levels

Accompanying files: CrystalLakeSnailCollectionSites.pdf
 CrystalLakeSnailInfectionLevels2018.pdf

Summary of work completed: In the Swimmer’s Itch Bridge Program of 2016, 10 snail collection sites were strategically chosen around Crystal Lake to give the greatest possible lake-wide coverage. Given that 2016’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. On July 12 and 13, a minimum of 200 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 Crystal Lake.

Table 1. Snail Infection Levels on Crystal Lake in 2016 and 2018. The percentage of *Stagnicola emarginata* snails infected with swimmer’s itch at ten different locations and at 3 different times during the summer of 2016 and once in the summer of 2018. 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 29-July 8, 2016	July 20, 2016	August 2-5, 2016	July 12-13, 2018
River Outlet (L11)	0.58% (173)	1.0% (200)	1.5% (400)	0.0% (199)
Onkeonwe Rd (J11)	0.0% (514)	2.5% (200)	3.0% (400)	0.0% (200)
CBCA (G7)	0.42% (474)	1.0% (200)	0.50% (400)	0.0% (228)
CSA (A6)	2.0% (200)	0.5% (200)	0.75% (400)	0.46% (216)
Marquette Ct (A5)	1.68% (476)	3.5% (200)	0.75% (400)	0.46% (216)
Yacht Club (A3)	0.22% (453)	0.0% (200)	0.75% (400)	0.0% (216)
M6 Hotspot (M6)	0.20% (505)	1.0% (200)	1.25% (400)	1.38% (217)
Nichols Rd (O7)	0.41% (492)	0.0% (200)	0.25% (400)	0.0% (216)
Orchard Hill (R9)	0.0% (445)	0.50% (200)	0.0% (400)	0.0% (204)
Beulah Beach (Q13)	0.63% (480)	0.50% (200)	0.75% (400)	0.5% (200)
Lake-wide	0.52% (4212)	1.05% (2000)	0.95% (4000)	0.28% (2112)

*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.

Because of the variability associated with sample sizes less than 200 snails, the most meaningful and relevant data are the lake-wide infection levels. In 2016, the lake-wide avian schistosome infection level in snails, averaged over the entire summer, was 0.79% (the baseline metric). 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%. Because last summer was the first year of common merganser trapping and relocation, and in an effort to keep swimmer's itch control costs manageable, snail infection level data were not collected in 2017. This summer, 2112 *Stagnicola emarginata* snails were collected during the second week of July, before this year's generation of snails hatched in the lake. An examination of those snails yielded a lake-wide infection level of 0.28%, which happens to be the same percentage that was observed on Higgins Lake during their second summer of a swimmer's itch control program that involved trapping and relocating common merganser broods. Crystal Lake's 0.28% snail infection level represents a 65% decrease from the baseline, pre-control program value in 2016. As is evident from Table 1, most of the 2018 snail infection levels at the ten collection sites on Crystal Lake fell within the ideal or tolerable range.

Observation: *From a snail infection perspective, swimmer's itch is at a tolerable level on Crystal Lake in 2018. At present, there is no known control program or technology that can eliminate or eradicate swimmer's itch from a lake. However, there is still strong potential that snail infection rates could fall further in 2019 as a result of the removal of common merganser broods in 2018.*

Water samples

Accompanying file: CrystalLakeWaterSampleAnalyses2018.pdf

Summary of work completed: Over a two-day period (July 12-13), a total of forty water samples were collected from Crystal Lake for analyses (Four water samples were taken at each of the ten snail collection sites). All samples were subjected to a qPCR protocol that detects all swimmer's itch-causing parasites, and is the test most commonly used to detect total parasite levels. Any positive samples were further analyzed using rhAmp tests that identify which of 4 avian schistosome species are present: *Trichobilharzia stagnicola* (common merganser), *Trichobilharzia physellae* (common merganser and mallard), and unknown schistosome 'AD' (unknown vertebrate host but present in a Glen Lake snail), and *Dendritobilharzia pulverulenta* (known from mallard and Canada goose). All the Crystal Lake samples were positive for *T. stagnicola* and distinctly negative for the other 3 species. Because *T. stagnicola* was easily detected and the other species were negative, it is very likely that other species are not contributing to swimmer's itch outbreaks on Crystal Lake.

All 10 sites contained at least one positive samples, but only four locations had an average parasite count greater than 10 cercariae/ 25 L water (Figure 2). Only Beulah Beach and the M6 hotspot had levels that could be considered to be severe. Counts of *T. stagnicola* on Crystal Lake ranged from 0-369 cercariae/25 L, with a median value of 4.5 cercariae/25 L.

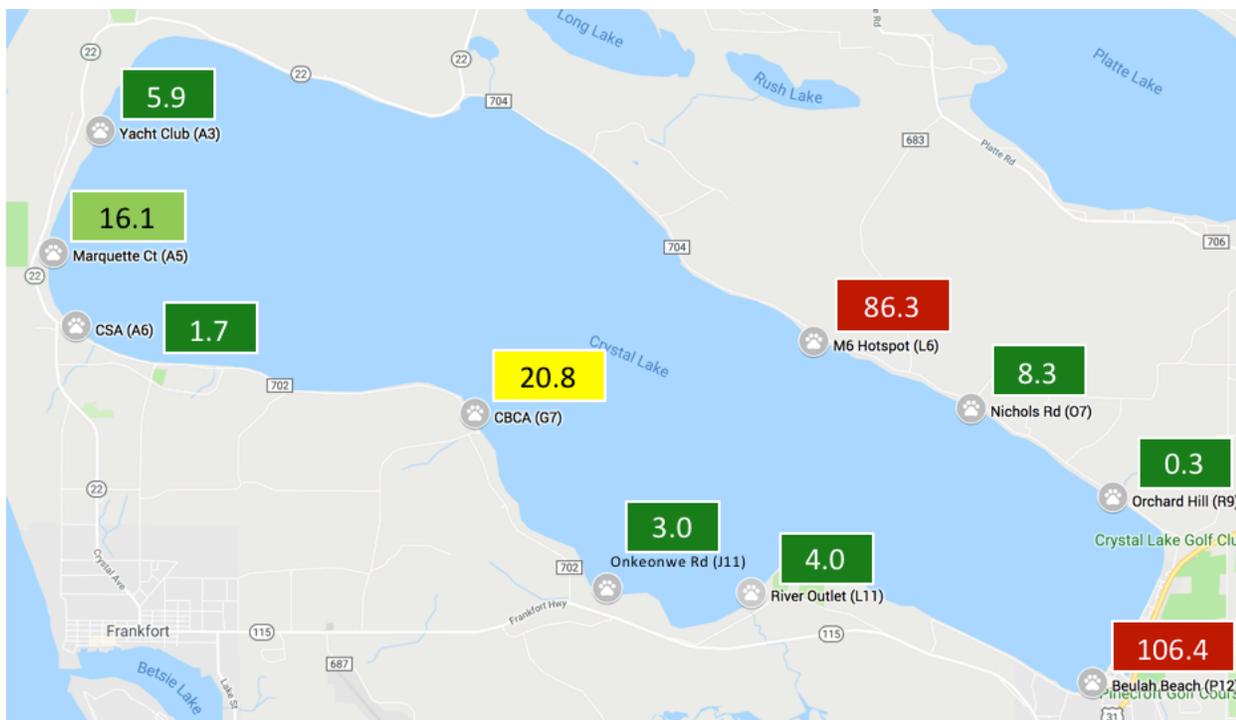


Figure 2. Average number of avian schistosomes/25 mL water in samples taken from Crystal Lake (Benzie County, MI). Analyses were done with *q*PCR; sample size = 4; dates of collection = July 12-13, 2018.

Research Program

Assessment of parasite loads in breeding common merganser hens

Summary of work completed: For several weeks after ice-out, common merganser populations on Crystal 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.

The indiscriminate lethal take of common mergansers is not an effective method of reducing the number of broods on a lake (and therefore the number of swimmer’s itch parasites cycling in a lake). In contrast, limited and targeted lethal take of common mergansers for scientific purposes, if done wisely and judiciously, can provide an added benefit to a swimmer’s itch control program and add to the growing body of swimmer’s itch scientific knowledge. Because hens return annually to lakes where they have successfully reared young, eliminating a breeding common merganser female would have the effect of reducing one brood annually for several years, or at least until her nesting site is discovered by another female.

During the prime egg laying and egg incubation periods, we permanently removed 3 common merganser hens under the authority of our scientific collecting permit. Necropsies of these individuals revealed all 3 birds were lightly infected. The ovaries of all 3 hens contained eggs, at various stages of development, indicating that they were actively breeding on Crystal Lake. Unlike breeding hens that are trapped and relocated with their brood, these three hens will not be returning to breed on Crystal Lake in future years.

Training Program

Training of Crystal Lake & Watershed Association personnel

Accompanying file: CrystalLakeCOMETrapTraining.pdf

Summary of work completed: From May 14 until June 30, Tim Reznick and Tom Thorr participated in approximately 80 collective hours of on-the-job training activities related to trapping common merganser broods. Equipped with a complete trap (net and supporting equipment), they successfully captured a common merganser brood of 8 ducklings on July 3, which was their first attempt at trapping without any assistance from us. Again, without any help from us, they captured 3 additional common merganser broods (23 ducklings total) on July 18 and July 19.

Observation: *Having both hunted and operated boats for most of their adult lives, Tim and Tom have the ideal temperament and expertise to lead future CLWA common merganser trapping programs.*

Educational Activities/Outreach Program

Accompanying files: CLWA2018July21.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 Crystal 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 36 different locations on Crystal Lake in 2018 (Figure 3A), as compared to 34 different locations on Crystal Lake in 2017 (Figure 3B). 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.

Update reports were written upon request from the CLWA board and a comprehensive, informative presentation was given at the 2018 CLWA annual meeting.

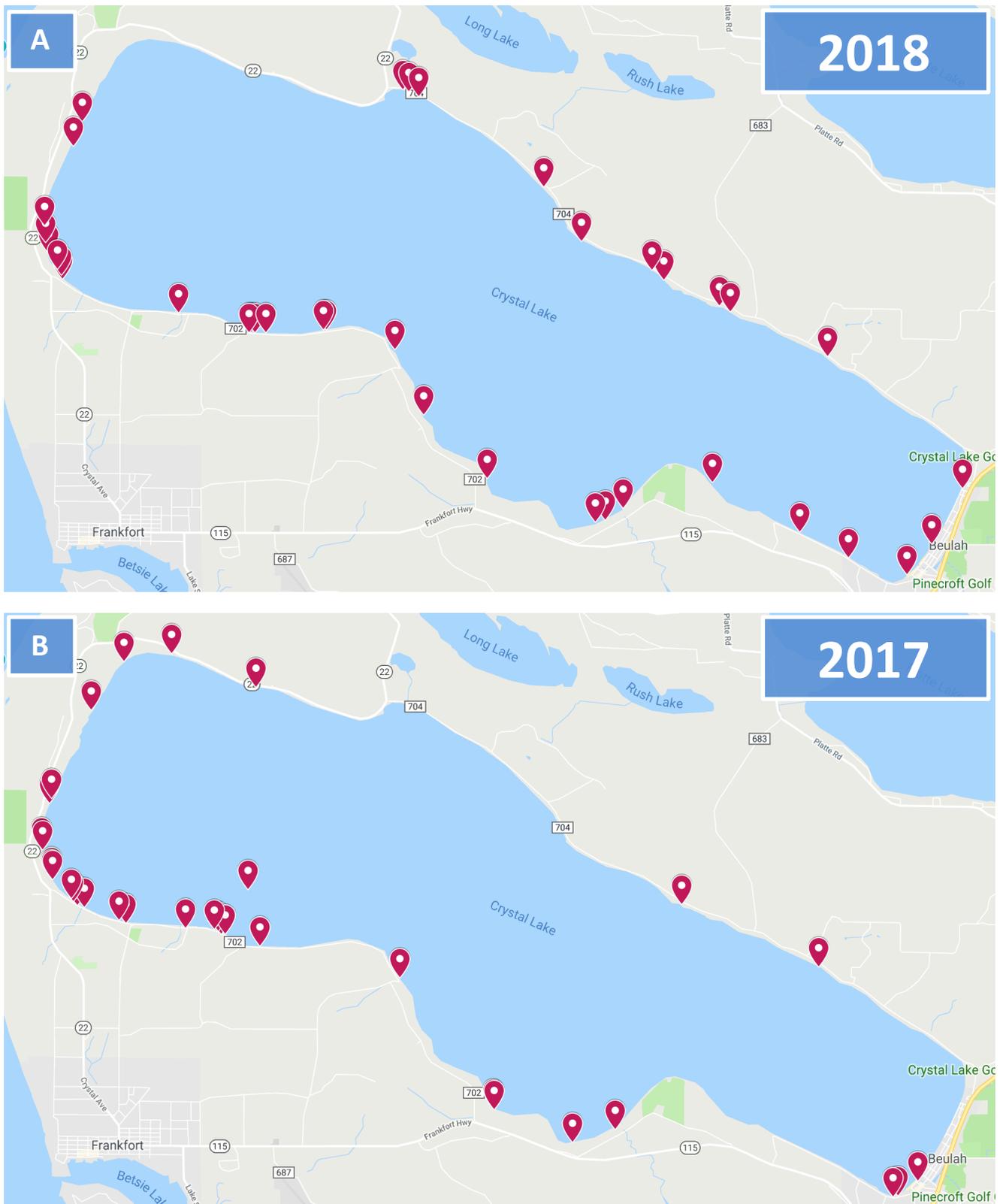


Figure 3. Locations of swimmer’s itch cases on Crystal Lake (Benzie County, MI) that were reported on www.swimmersitchsolutions.com/crystallake from (A) June 1 - August 31, 2018 and (B) June 1 - August 31, 2017, for comparison. Each red balloon represents a distinct location for a swimmer’s itch case report.