

Investigation of a Topical Ointment to
Prevent against the Penetration of
Trichobilharzia ocellata Cercariae Causing
Schistosome Cercarial Dermatitis

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Introduction

Schistosome cercarial dermatitis, also known as “Swimmer’s Itch,” is a serious problem in many freshwater lakes. The reaction was first discovered by William Walter Cort on Douglas Lake in 1928 (Cort, 1950). The cause of the disease is the result of an avian schistosome, usually in the *Trichobilharzia* genus, using a human as an incidental host. An incidental host occurs when a parasite that has evolved to parasitize one particular species, mistakes another species for its host. Often the mistake proves fatal for the parasite, which cannot survive in the body of the wrong host.

Trichobilharzia ocellata is one of the more common species of the avian schistomes that causes schistosome cercarial dermatitis. It is a digenetic trematode that has a very host specific life cycle. It begins its life in the form of an egg that is passed in the feces of its final host, a water fowl. This egg hatches in the lake water, and a miracidium emerges. Using a combination of chemicals, the miracidium is attracted to and infects a snail. In the case of *T. ocellata*, the most common snail species used as an intermediate host is *Stagnicola emarginata*. After the *S. emarginata* is infected, thirty days pass before the snail begins to “shed” cercariae. The cercariae show positive phototaxis. As they swim towards the sunlight, they detect the final host, a water fowl. *T. ocellata* is commonly distributed by the *Mergus merganser* (DEQ, 2005). Upon detecting the fowl, the cercariae will swim directly into the underside of the fowl, and push its way under the skin. Once inside, the cercariae will travel to the intestine, where it will lay eggs and start the cycle over again. It is during the cercarial stage of *T. ocellata* that the incidental exposure takes place. The cercariae can mistake a swimming human for a *M. merganser*, and will burrow its way into some exposed skin. Upon entering the skin, the cercaria will die due to the unexpected foreign body chemistry. As the cercaria decomposes, toxins will be released into the surrounding tissue. These toxins can produce an adverse reaction in some people, causing tiny papules to rise. These papules often will be irritated and inflamed causing an itchy sensation. While one or two papules can cause some slight discomfort, it is important to note that each infected snail “sheds” around one thousand cercariae a day. A swimmer who is unfortunate enough to encounter a large group of cercariae can end up with papules on every inch of exposed

skin. Children are more prone to reacting to the incidental exposure because of their thinner skin, and prolonged time spent playing in the water.

A preventative ointment that could be applied before one enters water known to be inhabited by *T. ocellata* would be highly beneficial to anyone who enjoys water sports. Many studies have been conducted looking into a topical ointment that could potentially provide protection during water activity from the cercariae responsible for schistosome cercarial dermatitis. Currently, there is no commercial product being marketed as a cercariae prevention lotion. Lakeside homeowners often claim homemade remedies, but due to the low level of reaction after exposure, such claims will often go unnoticed or unchecked. The discovery of a preventative ointment would be an extremely lucrative endeavor, as many lakes throughout the world are afflicted by some form of schistosome cercarial dermatitis. Douglas Lake in Pellston, Michigan, is one of these lakes. It is a natural habitat for *T. ocellata*, *M. merganser*, and *S. emarginata*. Using the facilities at the University of Michigan Biological Station (UMBS), located on Douglas Lake, a study was proposed to investigate five lotions and ointments that were thought to possess cercarial preventative qualities.

Materials and Methods

It was imperative to the study that snails that were infected with *T. ocellata* were collected and kept alive. After collecting 1,463 *S. emarginata* from Burt Lake, Munro Lake, Black Lake, Douglas Lake, and Glen Lake, twenty-seven were found to be infected with *T. ocellata*. The snails were kept in specially designed cages that were sunk into the sand right off the beach. The majority of the snails' time was spent in this cage to attempt to keep them in a natural, un-stressful habitat.

When cercariae were needed, the snails were removed from the cages at 7:00am and placed in individual communion cups. Each cup was placed in a tray that holds fifty-five communion cups, and the tray was then inserted into a large "snail shedding tower." Each tower had a large fluorescent light attached to it. The snails were left in the "snail shedding tower" until 12:30pm when the tray was removed. Using a dissecting microscope, each communion cup was checked for cercariae of *T. ocellata*. When the cup with the highest density of cercariae was selected, all the snails were immediately returned to their outdoor cage.

Twenty-six participants were gathered (14 males and 12 females) from around the UMBS community. Each participant signed an informed consent form. The participants' arms were sectioned off into six regions, with three per arm. Starting at the participant's right wrist and working up the arm and down the left arm, each region was numbered one through six. Within each region, a one square inch area was marked off

Five potential topical ointments were randomly applied to each participant's marked off areas, with the left over spot being used as a control spot. The ointments applied to the participants were Safe Sea, Bull Frog SuperBlock, Bull Frog SuperBlock mixed with 100% DEET, Vaseline, and Nexcare Spray Liquid Bandage. Careful attention was paid to which finger was used to apply which ointment to prevent cross contamination.

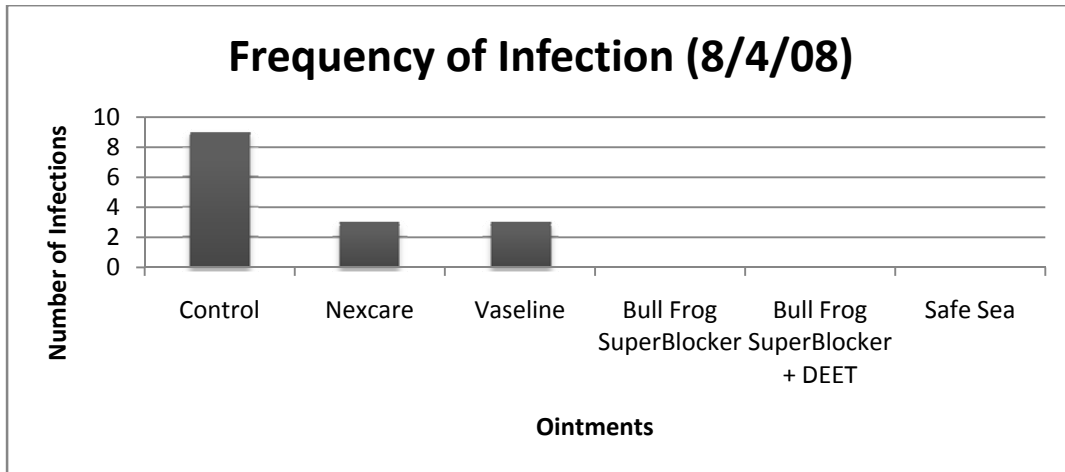
After the ointments were applied to each participant, a single cercaria from the communion cup was pipetted out and placed within each participant's marked off areas. Each participant was then advised to wait until the drop of water containing the cercaria dried. Throughout the next 48 hours, each participant was checked for a response to the exposure.

After the initial trial's data collection was complete, a second trial was run using thirteen participants from the first trial. The second trial was almost an exact replication of the first trial, the only differences being the lower number of participants and the application of two cercariae per marked spot as opposed to a single cercaria.

Results

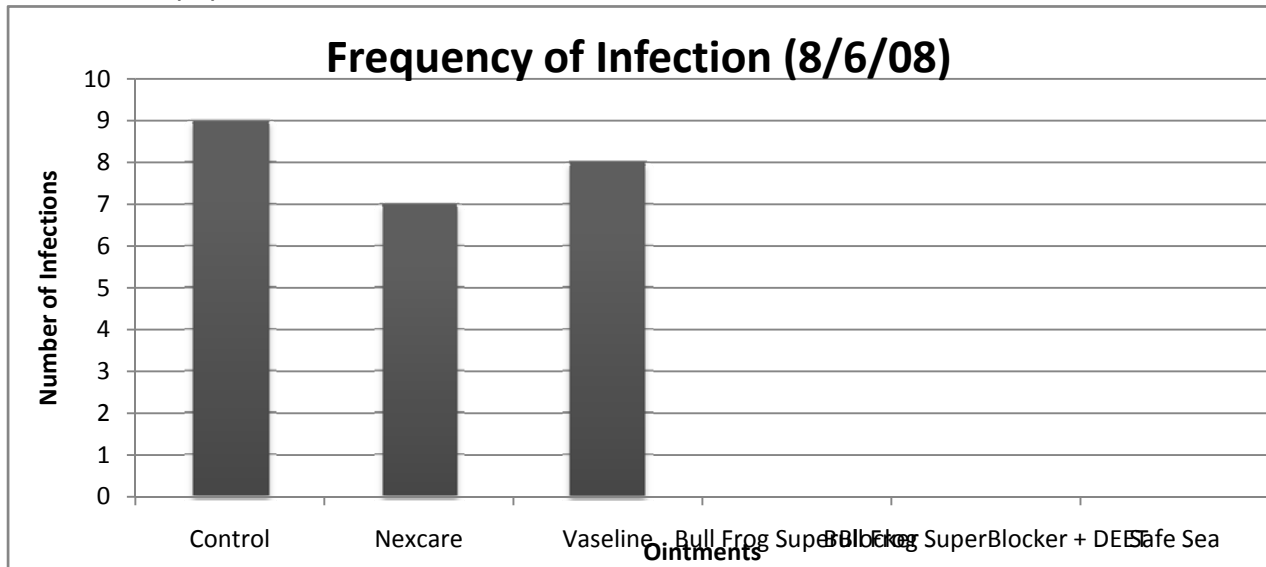
Using the two-by-two contingency chi-squared test, the results show that each of the treatments resulted in p values below .05 when compared to the control for that same day. When compared to the control, the Nexcare Spray Liquid Bandage resulted in a p value that was below .05, the Vaseline resulted in a p value that was below .05, the Safe Sea resulted in a p value that was below .001, the Bull Frog SuperBlock resulted in a p value that was below .001, and the Bull Frog SuperBlock + 100% DEET resulted in a p value that was below .001. The results of the first trial were that ten participants out of twenty-five reacted to being exposed to a single cercaria of *T. ocellata* (Figure 1).

Figure 1: Frequency of Infection of Participants after Being Exposed to a Single Cercaria of *T. ocellata* on 8/4/08



Using the two-by-two contingency chi-squared test, the results show that only 3 of the treatments resulted in p values below .05 when compared to the control for that same day. When compared to the control, the Nexcare Spray Liquid Bandage resulted in a p value that was between 0.5 and 0.1, the Vaseline resulted in a p value that was greater than .05, the Safe Sea resulted in a p value that was below .001, the Bull Frog SuperBlock resulted in a p value that was below .001, and the Bull Frog SuperBlock + 100% DEET resulted in a p value that was below .001. The results of the second trial were that eleven participants out of thirteen reacted to being exposed to two cercariae of *T. ocellata* (Figure 2).

Figure 2: Frequency of Infection of Participants after Being Exposed to Cercariae of *T. ocellata* on 8/6/08



Discussion

As the results show, both the Bullfrog SuperBlock and the Safe Sea seem to have the potential to provide some prevention against *T. ocellata* cercariae. Further studies should

be conducted looking into exactly what chemical(s) sets these two products above the other products in the study. Future application of such knowledge could lead to a preventative lotion against the far deadly human schistomes such as *Schistosoma mansoni*. Safe Sea has been tested as a preventative against *S. mansoni* (Wulff, 2007), but the result were not applicable. Further investigation into the exact chemicals that act as the preventative might lead to a more potent lotion that would work against the human schistomes, not to mention the avian schistomes that cause schistosome cercarial dermatitis.

During this study, several points of interest were noted for future studies. One of these points was how long the cercariae needed to mature before they could penetrate the skin. During a test run of the experiment meant to reveal any potential problems, the cercariae were applied to the participants one hour after they had been shed. It was noticed that not a single participant reacted to the exposure. A future could investigate how long the cercariae need to mature before they are able to penetrate the skin of an incidental host or their avian host.

After examining the reactions of several participants, it was noted that a study focusing on trends in who would react to exposure of a species of *Trichobilharzia* would be highly informative. Some possible trends that were noted during the course of this study were the differences in skin tone variation, phenotypic traits, and between males and females. Pursuing further study of these areas would be highly advisable, as it might lead to a better understanding of how to prevent the exposures.

If the study was replicated, adding a generic brand of suntan lotion would be highly advisable. Both Safe Sea and Bull Frog were brands of suntan lotion that were mentioned to possibly prevent cercariae penetration. The Safe Sea was actually involved in a previous study where the outcome found similar results to this study (Wulff, 2007). Safe Sea is marketed as a combination jelly fish sting preventative and a suntan lotion. Bull Frog Superblock was mentioned to possibly offer protection as a homemade remedy (Blankespoor, 2008). It is a typical suntan lotion that uses titanium dioxide as the UV filter. The results of the study exclude all products except those that are suntan lotions. It is regrettable that a brand of suntan lotion that was not previously mentioned to prevent schistosome cercarial dermatitis was used. Potential product recommendations would be a suntan lotion that contained a different UV filter.

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