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Kelcie Fredrickson
Augustana College, Rock Island Illinois

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Snake fungal disease in Lake Erie water snakes and its affect on attitude and behavior during treatment

Kelcie Fredrickson

Abstract

Snake fungal disease (SFD) is caused by the fungus *Ophidiomyces ophiodiicola*. Infection occurs when the outer skin is breached, and the organism enters the epidermis. The epidermis becomes necrotic and produces a yellow/brown crust. When the crust breaks off, ulcerations/lesions are formed along the snake's body, head and tail. It has been found that SFD can be treated with a terbinafine nebulization treatment. Ellen Haynes, a PhD student, created a study in which 26 Lake Erie water snakes are separated into treatment and control groups to determine the effectiveness of the nebulization treatment. Through daily observations, this research aimed to compare the snakes in the treatment and control groups by categorizing them by attitude and behavior. The 12 snakes in the treatment group were bright-alert-responsive (BAR) 5% less than the 10 snakes in the control group. The treatment snakes were only BAR 9 of 47 days compared to the control snakes that were BAR 12 of 47 days. This shows that the snakes that are lethargic in nature are more likely to survive.

Introduction

The earliest case of snake fungal disease, or SFD, was discovered in 2000 in southern Illinois and was initially found in rattlesnakes. For the past 18 years, it has been a growing concern in reptile populations due to the widespread morbidity and mortality rates (Allender et al. 2015). Since then, it has been discovered in six different snake families which account for over 30 different species (Hileman et al. 2018). SFD is caused by the fungus *Ophidiomyces ophiodiicola*. This fungus recently split from a complex of fungi called *Chyso sporium* anamorph of *nannizziopsis vriesii* (Lorch et al. 2016). SFD occurs when the snake's outer skin is breached which allows this fungus to enter into the epidermis. Once the fungus is in the epidermis, it only takes days for the infection to worsen. The epidermis becomes necrotic and thickened which produces a yellow/brown crust common to SFD. This crust then breaks off which creates ulcerations along the snake's body, head and tail. Once infected with SFD, snakes begin to exhibit unusual behaviors due to an increase in body temperature (Allender et al. 2016).

It has been previously discovered that SFD can be treated using a Terbinafine nebulization treatment. Terbinafine is an antifungal medication that works by stopping the growth of the targeted fungus. In humans, Terbinafine is taken orally once daily but due to the difficulty of orally feeding medication to snakes, the nebulization method is preferred. To do this, the snakes are transferred to a new tank designed to fill with the Terbinafine fumes to treat their fungal diseases (Kane et al. 2017). Ellen Haynes, one of the Ph.D. students attending the University of Illinois, had created a study which involved 30 Lake Erie water snakes (LEWS) and focuses on SFD and the nebulization treatment. She tested each snake to determine their level of infection and, depending on this level, matched them with a snake that has the same level of infection. To determine the level of infection, TaqMan polymerase chain reactions (qPCR) are run. The pair of snakes is then divided into a control and treatment groups and is randomly selected to be placed in 1 of 4 rounds to be treated daily. The treatment group is treated using the Terbinafine nebulization method. The control group is also placed in a tank to be nebulized, however, this group is treated with a saline solution. Both groups are placed in the nebulization tank and exposed to fumes for 30 minutes. This allows the snakes to go through the same situations and stresses, while allowing sufficient comparisons to occur. Out of 26 total snakes, 13 snakes were undergoing treatment and 13 were in the control group.

During treatment, the snakes being treated for SFD will not likely be as severe as their control counterparts, so the focus of this research is how SFD affects the snake's overall attitude and behavior. The research will be based on the comparison of snakes undergoing treatment versus the control groups. Snakes are classified into two groups during their treatments based on natural behaviors and reactions to human interaction. They can be either: bright-alert-responsive and quiet-alert-responsive. Since SFD causes an increase in body temperature, it can be assumed that their activity levels and natural behaviors will differ depending on whether they are being treated or not. It can be hypothesized that the snakes in the control group will be classified as quiet-alert-responsive more than the snakes in the control group because they will remain hidden in an attempt to cool their body temperature.

Materials & Methods

Once the snakes are placed into groups and rounds, observations will begin to be taken daily. Each day the snakes will be observed and placed in a category of bright-alert-responsive (BAR) or quiet-alert-responsive (QAR). To be classified as BAR, the snake be out in the open and/or reacting to humans being in the room/being handled. To be classified as QAR, the snake will be hiding and/or unresponsive to humans being in the room/being handled. These daily observations will continue for three weeks. This data will include measurements taken for a week prior to the start of treatment and two weeks into treatment.

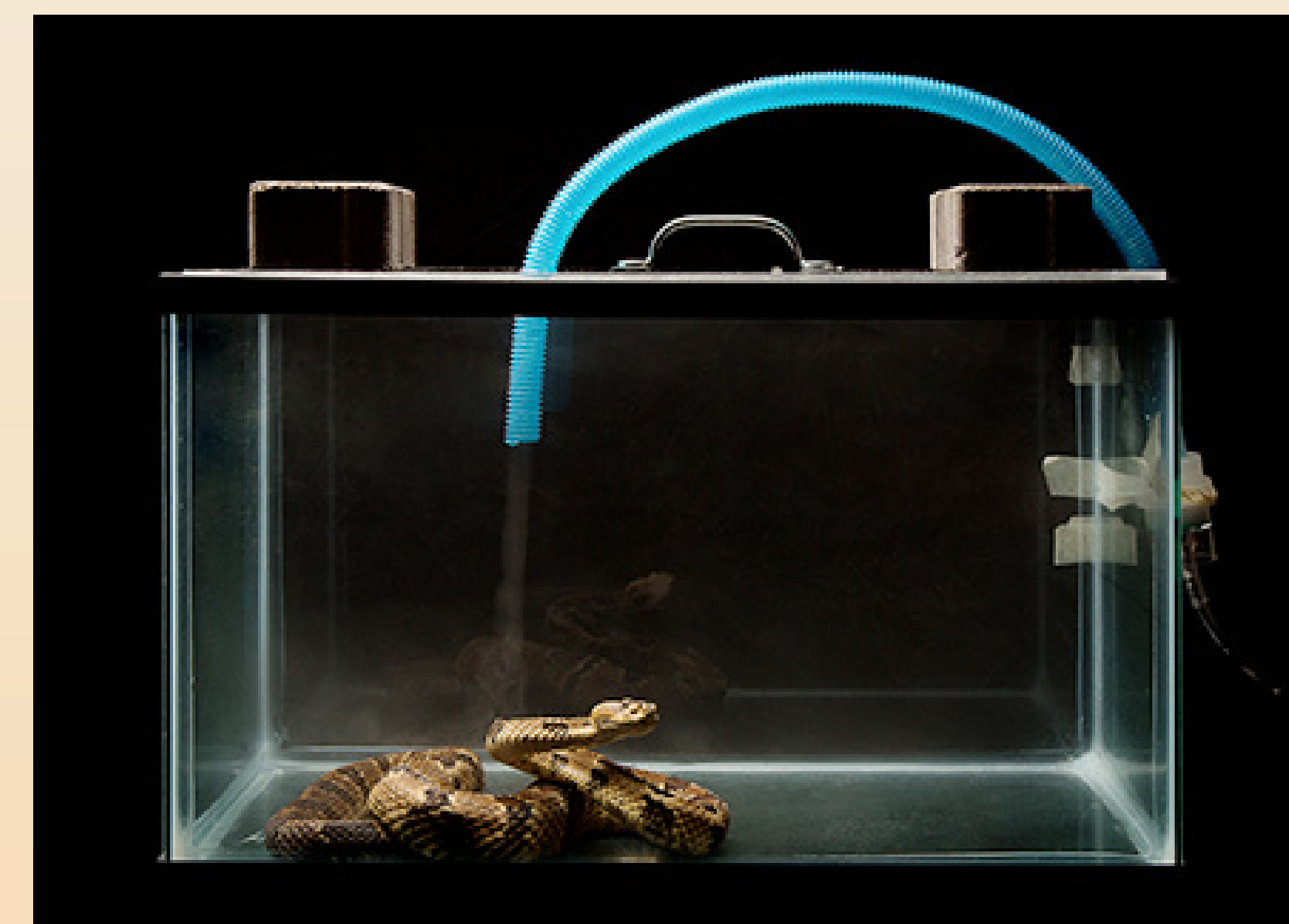


Figure 1: Nebulization treatment tank. The image above shows the nebulization tank during a treatment of a snake with SFD. The fumes will enter the tank through the tube and will be trapped inside to ensure max exposure during the 30-minute treatment period (Yates 2017).

Results

The snakes being treated with terbinafine for SFD were BAR 110 days out of a combined total of 560 days for the 12 snakes. These snakes were BAR only nine days out of 47 during their treatment on average. The snakes undergoing a control treatment of saline were BAR 115 days out of a combined total of 468 for the 10 snakes. These snakes were BAR 12 days out of 47. The control snakes were considered bright-alert-responsive up to 5% more than the treatment snakes.

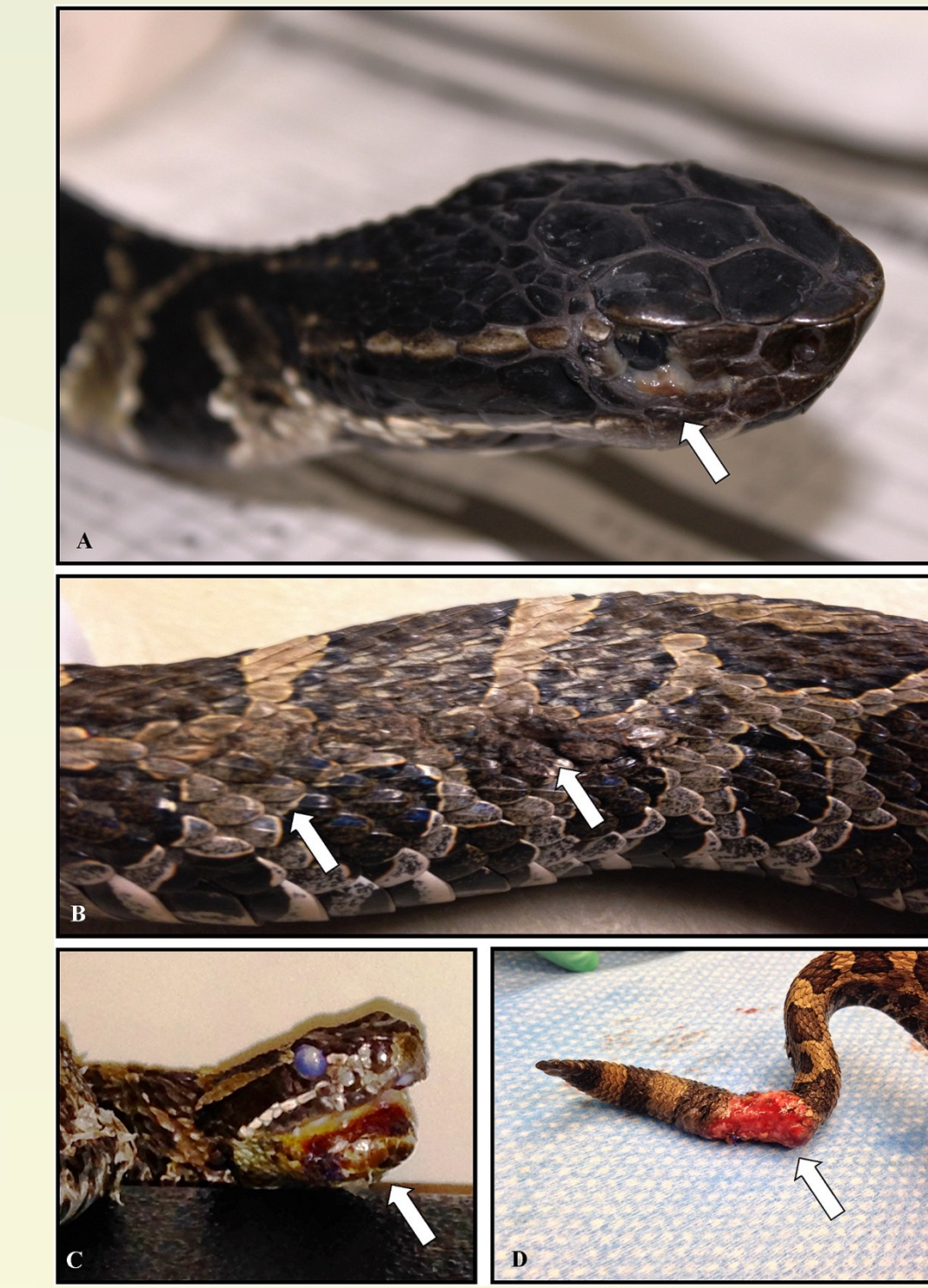


Figure 2: SFD lesions on vipers. A) Active region under the ocular region of a cottonmouth. B) Crusts present under the scales of a massasauga. C & D) Lesions resulting from a more advanced infection present on two massasaugas. Arrows on the images show the location of the lesion (Allender et al. 2015).

Discussion

The results show that the snakes that are suffering without treatment are on average more active and alert than those that are being treated. The snakes in the control group were considered BAR 5% more than the treatment snakes. The snakes acting lethargic are less likely to be suffering, according to the results. Although being active and alert appears healthy in most species, in snakes infected with SFD, this may be a sign of severe illness. This data does not support the hypothesis because it shows that being treated for the fungal infection, makes the snake more QAR. During future data collection and treatments, veterinarians and researchers will be sure to focus on signs of suffering in the snakes that are more active than those that aren't.

During this experiment, complications occurred which may have altered the outcome of the study. One complication is in regard to the number of days each snake was observed. Although, they underwent treatment for the same amount of time, the overall number of days they were observed varies. This makes the average data seem more as an estimation than an exact value. For example, more of the snakes were observed for 47 days than 45 or 46 so the averages round up. Another complication that may have occurred is the number of people doing the observations. Since, multiple people did the daily observations, the criteria for each category may have been different. During the experiment, three snakes died, and one had to be euthanized as a result of the severity of their infections. This lowered the sample size from 26 snakes to 22 with 12 in the treatment group and only 10 in the control group. This alteration of sample size may have altered the overall results, but enough data has been collected for adequate comparison of the two groups.

The site may use these complications and setbacks to alter their observation and recording method. Since the observations may have varied so much, they may add a chart that describes each state, or they may ask for a single person doing the observing to maintain consistency. Overall the setbacks and gains from this experiment will only benefit the lab in the future by forming a more advanced way to record observations for each snake.

Conclusion

SFD has become a growing concern in the past 18 years because the current threat to snakes is unknown. This fungal infection causes significant morbidity and mortality among wild snake populations. In recent years, research has been done on ways to treat SFD and these studies have shown that a terbinafine nebulization treatment is effective. Terbinafine is an antifungal medication that can be nebulized to treat reptiles. Ellen Haynes proposed a research project to determine the effectiveness of the terbinafine treatment by comparing the treatment group to a control group containing snakes with the same level of infection. During her research, daily observations were taken of the snakes to determine if they were BAR or QAR. This data was then compared between the control and treatment group to see the affect SFD has on the snake's attitude and behavior. It was discovered that the snakes in the treatment group were BAR 5% more than the snakes in the treatment group. This disproves the hypothesis but provides valuable data for future studies. This shows that the snake that are more lethargic in nature are healthier and more likely to survive on average. This research can be applied to future studies by turning the researchers attention from the QAR snakes to the BAR snakes for disease severity.

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