

**Impacts of direct contact and video media on the public perception of the endangered
massasauga rattlesnake (*Sistrurus catenatus*)**

by

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Preface

This study is a continuation of research undertaken by a previous MES graduate student named Fatima Ali, who worked with the Toronto Zoo Adopt-a-Pond program in order to produce a short educational video titled, “Living with Rattlesnakes”. Fatima was interested in examining the video’s potential for creating positive change in the public perception surrounding Ontario’s rattlesnakes. This is because many endangered snakes, and especially venomous ones, suffer from a poor public image that makes conservation measures particularly difficult. Therefore, it is vital to analyze which methods for public outreach work best for: 1) improving the overall perception of these reptiles, and 2) fostering a willingness to protect them. In addition, through collaboration with the Toronto Zoo, it was decided that this research would be expanded to include an analysis into the impact that having direct contact with a live animal has on these two factors.

This study has the potential to answer several important questions. First, if having a live snake present is shown to have a demonstrably positive, persistent effect on public perception, then this could help justify the stress that must be placed on the animal during travel and at the presentations themselves. Conversely, if the video is shown to have an equal or greater impact on perception and willingness to protect, then a case could be made for simply showing the video rather than bringing a live animal - thereby preventing this stress altogether. Also, if the video proves to be successful in improving overall perception and the willingness to protect the snakes, it justifies the funding of similar media projects for other endangered species. Therefore, the ultimate purpose of this study is to provide an analysis of the methodology underlying the rattlesnake workshops that are already being held by the zoo and could provide insights into how to structure them more effectively.

Introduction

A History of Persecution

The interactions between snakes and mammals have existed for at least 100 million years, ever since the first small mammals scurried along the forest floor. According to anthropologist Lynne Isbell, at this time, snakes were likely the primary predators of these small rodent-like mammals and helped drive an evolutionary arms race, as mammals developed ever keener senses of sight and smell. This continued with the evolution of primates, with the development of eyesight better adapted for distinguishing colour and movement, as well as the ability to see in three dimensions - all of which are useful for detecting proximate threats such as snakes (Isbell, 2011). This long evolutionary history has likely contributed to humanity's extreme attitudes towards snakes, and especially ophidiophobia (Isbell, 2011). Further evidence of this innate wariness of snakes was provided in a paper published by Hoehl et al. (2017), that examined the pupil dilation of infants when exposed to images of spiders, snakes, fish, and flowers. They found that infants pupils were significantly more dilated when exposed to spiders and snakes, which the authors concluded was an indication of innate alertness when confronted with these animals. However, they also noted that this does not necessarily imply an innate fear, but rather that our brains are built to identify and react to these animals extremely quickly. This, when coupled with learned cultural messages and negative interactions, can predispose some people to fear snakes later in life.

Negative cultural attitudes towards snakes are evident in many of our customs, folklore, religion, and art. An excellent example of this is the classic portrayal of the temptation of Adam and Eve in the Bible, where Satan takes the form of a serpent. This correlation between

Christianity and a negative portrayal of snakes goes even further, with the Bible mentioning serpents or vipers 80 times, usually as a symbol of evil (Sylenthini & Rajeev, 2020). In most cases, the snake is either killed or something that should be killed. This characterization of snakes extends to the other Abrahamic religions as well (Sylenthini & Rajeev, 2020). However, it is important to note that despite this negative portrayal, there are also many religions, especially in Mesopotamia and Greece, that viewed snakes as symbols of fertility and life (Sylenthini & Rajeev, 2020). Serpents have also long been associated with monsters in folklore across the world, from dragons to sea serpents. This has provided a cultural background predisposed to fearing and persecuting snakes, especially venomous ones.

Stories about snakes and their interactions with humans have continued up until now, with most modern portrayals of snakes being negative in nature. Snakes are often shown as being particularly sly or cunning, such as the hypnotic Kaa in Disney's *Jungle Book* (1967), or monstrous, like the snake in *Anaconda* (1997). However, there has also been a push towards more educational portrayals of snakes in media, particularly from creators like the BBC and National Geographic.

Despite this recent push, there is still a negative stigma surrounding snakes, which is firmly rooted in our evolutionary history, culture, religion, and media. This has all led to increased human persecution of these creatures. For example, in a popular YouTube video created by Mark Rober (<https://www.youtube.com/watch?v=k-Fp7fIAWMA>), he investigated whether drivers would intentionally go out of their way to hit rubber turtles, snakes, and tarantulas, with a rubber leaf as a control. He found that 6% of people would intentionally run these small animals over, with 3.2% hitting the tarantula, 1.8% the snake, and 1% the turtle. This demonstrates how a negative perception of a species can influence human persecution, and thus

impede conservation efforts. However, it is also important to note that about 5.7% of people would stop to try to save these animals, with 4% helping the turtles and 1.7% saving the snakes.

Regardless, it is clear that protecting snakes, and especially venomous ones, is particularly challenging for conservationists, and that they require a fundamental shift in their public image. But how can this be accomplished? In the words of physician Debasish Mridha, “Fear comes from the lack of knowledge and a state of ignorance.”

The Massasauga Rattlesnake

This paper will focus primarily on the massasauga rattlesnake (*Sistrurus catenatus*), a type of pit viper. This information is based almost totally on the Toronto Zoo’s workshop presentation for their workshops. Massasaugas are a rather small, stout-bodied viper, with an average length of 45-75cm, and a weight of approximately 300 to 400 grams. They are Ontario’s only venomous snake and are grey to brownish grey with dark blotches along their back and sides, which are edged in white. The massasauga rattlesnake is an intermediate predator, with a diet consisting mainly of rodents, amphibians, and sometimes other snakes. They are in turn preyed upon by hawks, eagles, and herons.

The preferred habitats of the massasauga rattlesnake are fens, wet meadows, and floodplain forests; however, they are known to migrate upland to drier sites during the summer. In these areas, they prefer open, sunny areas that are intermixed with shade, which allows for ideal thermoregulation. Gestation sites tend to consist of warm table rocks in open areas of forest. To survive the winter, overwintering or hibernation sites are also essential to avoid the lethal freezing temperatures.

The venom of the massasauga is cytotoxic, destroying tissue and causing internal bleeding. It also contains specialized digestive enzymes that disrupt blood flow and prevent blood clotting. While this venom is quite toxic, the amount injected is relatively small compared to other rattlesnakes. The venom is delivered using hinged hollow fangs, and the venom glands are what gives the snake's head its distinctive triangular shape. Like all rattlesnakes, the massasauga rattlesnake utilizes a reflex action to very quickly bite and capture prey, with a strike distance of 18cm or half their body length. However, it is important to note that the antivenom for this species is readily available, and as a result, only two people have died from rattlesnake bite in Ontario in the past 40 years.

When they are first born, rattlesnakes only have a single rattle segment. Each additional rattle is added when the snake sheds its skin, which happens every 2-3 months. This makes the size of the rattle a useful indicator for the age of the snake. Massasaugas mature after 3-5 years and their average lifespan is 18-20 years. Their reproductive behavior involves the males engaging in combat for the right to breed, which occurs in the middle of the summer. However, the females then store the sperm until the following spring when they begin ovulation. After fertilization, the female gives birth to 8-12 young in a neonate capsule, so this species does not lay eggs in the traditional sense like most reptiles, but instead gives birth to live young. The babies then stay with the mother for several days or weeks before dispersing and living on their own.

Massasauga rattlesnakes are thigmophilic creatures, and prefer to remain sheltered or hidden, especially in logs and among leaf litter or rocks. As a result, they are extremely shy, and will try to avoid detection or move away from a threat if they are given the opportunity. To this

end, they rely on their camouflage and the cryptic patterns on their body to avoid being seen, which is useful for both feeding and defense.

The conservation status of the massasauga rattlesnake under the IUCN is Least Concern, as the species' range extends far into the United States, where it is comparatively common. However, the Canadian populations have been listed under COSEWIC as threatened since 1991. This designation was later re-examined in 2012, when the species was separated into two subpopulations, with the Great Lakes/St. Lawrence population listed as threatened and the Carolinian population as endangered. The main threats to this species include habitat loss, habitat degradation and fragmentation, the construction of roads, the draining of wetlands for agriculture, residential development, and the fear and persecution that this species experiences as the result of being a venomous species. Snake fungal disease and climate change have also been identified as potential threats by COSEWIC (<https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/massasauga-2012.html>).

The recovery strategy for this species involves habitat management and protection, habitat restoration, communication and outreach, population management, and research. In particular, the Toronto Zoo is a leading figure in the conservation of the massasauga rattlesnake, contributing through research, education, and a public outreach program. This project is thereby an extension of this program, and, ideally, will aid the recovery efforts of this species.

Project Overview and Similar Research

There have been several studies using different animals that have highlighted the impact that live animals and educational media can have on public perception. In one study by Pearson et al. (2014), the conservation impact of an educational campaign using video presentations at Melbourne Zoo was evaluated to see how it changed public perception of orangutan (*Pongo pygmaeus*) conservation. The results showed significant increases in awareness and attitudes towards orangutans. However, orangutans are already a charismatic species, which may have contributed to this positive impact. Another study by Wunschmann et al. (2017) looked at the impact that exposure to living reptiles and amphibians has on the education and motivation of primary school students. They found that encountering living animals in an education setting is very effective for enhancing a sense of motivation and compassion for the animals involved. While this targeted a different demographic and took place in a zoo setting, its findings are quite interesting, especially since herpetofauna were the focus of the article. There has also been some research done to compare these two educational methods – living animals versus educational videos. In a study looking at student motivation and enjoyment learning about ants, Sammet et al. (2015) found that younger students preferred hands-on activities, while higher level students preferred the videos. However, a combination of the two yielded the best results, with the authors advocating videos as facilitators for hands-on learning experiences. Another comparison by Klingenberg (2014) found that teaching done with living invertebrates achieved knowledge at a significantly higher level than educational videos, with significant higher scores in attitude levels as well. This suggests that using living animals is superior to educational videos, however, the research did not examine the results of using the two methods in combination.

One interesting dynamic that I hadn't considered was the difference between fear and disgust, as it relates to phobias and the perception of snakes in general. This topic was suggested by Kevin Kerr, the Curator for Birds and Invertebrates at the Toronto Zoo, as a potential avenue to explore in this study. It is important to distinguish between fear and disgust in phobias, as the psychological treatments for the two can be quite different. There have been several papers written on the subject, such as Gerdes et al. (2009) and Schonfelder & Bogner (2017). The study by Gerdes et al. explored the difference between fear and disgust as it relates to spiders, and found that fear and disgust were the primary predictors for spider phobias, and that the dangerousness of the animal had no predictive power in this respect. Similarly, the research by Schonfelder & Bogner looked at the interaction between fear/disgust and willingness to protect bees. They found that individual experience of bee stings was the most prevalent reason for expressing fear, though willingness to protect remained high. It was these findings that contributed to the idea to include a short subjective section in the first survey, in order to ascertain what experience, if any, lead to a participant's fear/disgust of snakes. And finally, though these papers focused on invertebrates, it will also be interesting to observe whether these findings hold true for fear of snakes as well, particularly whether perception of dangerous has any impact on the phobia.

Out of all the articles that were found, there were two in particular that most informed this study. These were by Tomazic (2011), and Morgan & Gramann (1989). The 1989 study was particularly interesting because it had a remarkably similar research question regarding the changes in attitude of children to snakes depending on the type of environmental education presented, from mere exposure to modeling to direct contact. They found that the highest attitude scores were found in children that were exposed to a combination of all education types, with the

inclusion of direct contact having the highest impact on attitude scores when looked at on its own. This has interesting implications for this study and helped a great deal when I was formulating my predictions. The paper by Tomazic (2011) was also especially useful, as it too looked at gender and age-related differences in attitudes toward and knowledge of snakes, for school children and pre-service teachers. They found that, while the teachers had better knowledge of, and more positive moralistic attitudes toward snakes, fear of snakes and willingness to pay for snake conservation was not statistically different between the two groups. However, this study was especially helpful because it introduced me to the Snake Attitude Questionnaire, which proved to be invaluable in the design of the surveys for my research. Further details will be provided in the section on Research Design and Methodology. This paper also examined whether the changes they measured were persistent, by re-administering the survey after three months, which I decided to incorporate in this study as well.

To conclude, from what I could find, this study that I am undertaking is one of the few to examine changes in ‘willingness to protect’ in addition to attitude, as well as being the first to focus on one particular species of snake as opposed to snakes in general – and a venomous one at that, which comes packed with a number of misconceptions. It should also be noted that most of these papers focused on the perceptions of children, which are more malleable than those of adults. This is another area where my research is distinct, as the participants will be largely university students. The preliminary evidence behind this study is very intriguing, and it will be useful to analyze and compare the methods for public outreach within the Toronto Zoo’s programs, and especially how they can impact the perception of a venomous reptile – which is something that has not been explored before.

Research Questions and Predictions

There were three primary research questions guiding this study: First (1), did the presentation of the video have a measurable impact on the attitude and ‘willingness to protect’ of the participants? Second (2), did direct contact with a live animal have a measurable impact on the attitude and ‘willingness to protect’ of the participants? And third (3), did a combination of both the video and direct contact have a measurable impact on the attitude and ‘willingness to protect’ of the participants?

For the first question, I hypothesized that there would be no measurable impact, with the prediction that there would be no significant difference between the control and the workshop with just the video shown. For the second question, I hypothesized that there would be a measurable impact, with the prediction that the workshop that includes direct contact with the live animal would show a positive change in both attitude and willingness to protect, when compared to the control. And finally, for the third question I hypothesized that there would be a measurable impact, and I predicted that the workshop that includes both the live animal and the video would show the largest positive change of the three. These predictions were based on the research mentioned previously by Sammet et al. (2015), Klingenberg (2014), and Morgan & Gramann (1989).

Methods and Methodology

In order to explore these questions, it was decided that a series of workshops would be scheduled at the university. This was done in collaboration with the staff at the Toronto Zoo's adopt-a-pond program. These workshops would require several key factors to be a success. First, a sufficient number of participants would be required, and the selection would have to be as non-biased as possible. Second, the workshops themselves would need to be organized. This would consist of the creation of a PowerPoint, consistent scripts, and the presence or absence of the factors under consideration (namely, the live snakes and the video). Next, before and after surveys would need to be drafted to examine any change in attitude towards the snakes because of attending these workshops. Finally, the data from these surveys would need to be analyzed in order to determine correlation and significance among the factors. I will begin by discussing participant selection, and the challenges that were encountered during this process.

Participant Selection

The participants for this study were drawn from Professor Traci Warkentin's winter term ENVS 1000 class at York University. This is a mandatory first year course for Faculty of Environmental and Urban Change students. Since it is a mandatory course and this department is well-known for being highly interdisciplinary, there would thus be a large range of perceptions and opinions from the participants. The workshops were incorporated into the syllabus by Dr. Warkentin, taking place during the tutorials related to the Environmental Education section of the course on February 6th and 7th 2020. However, the students were informed that the project

would have no bearing on their academic progress and was completely optional and voluntary. Therefore, the inclusion and exclusion criteria for the participants were as follows:

Inclusion criteria:

1) Students currently enrolled in ENVS 1000 that have given their consent to participate

Exclusion criteria:

1) Students not currently enrolled in ENVS 1000

2) Students enrolled that have not (or cannot) give consent to participate

3) Students that identify themselves as having severe snake phobias that may experience acute emotional distress from the presentation

A written informed consent form was drafted to provide the participants with some information on the project, benefits, risks, confidentiality, and give them an opportunity to provide consent prior to the presentations, as described in York University's human participants review process. A copy of this form can be found in Appendix A (Page 29). In total, following the conclusion of the workshops, I had 75 completed consent forms and participants, which provided the sample size for this study.

Workshops

After discussion with representatives from the Toronto Zoo's Adopt-a-Pond program, it was decided that we would arrange four different workshop types to explore the guiding questions of this study. The workshops would be structured as follows:

Workshop 1: 35 minute talk with no live animal or video shown (control)

Workshop 2: 35 minute talk with live snake present, no video is shown

Workshop 3: 30 minute talk with the 5 minute video being shown, live snake is absent

Workshop 4: 30 minute talk with the live snake and 5 minute video shown

These workshops had to be coordinated with the Toronto Zoo and the ENV5 1000 tutorial times, with the corresponding teaching assistants giving consent to potentially have the live snake present. As a result, Workshops 1&3 were scheduled for February 6th 2020, and Workshops 2&4 were scheduled for February 7th 2020. It was decided that I would be the primary presenter for all the workshops, to maintain consistency. I also produced a summary of Fatima Ali's video to ensure that the information being presented was consistent across the workshops, and that nothing was being repeated or omitted. This resulted in the creation of four separate PowerPoints, one for each workshop, and two unique presentation scripts depending on whether the video was being shown or not. These scripts can be found in Appendix B (Page 31).

The original plan for the workshops with the live snakes was to have the massasauga placed in a clear tube so that participants would be able to touch its rattle and tail safely. This is the same practice that occurs at the zoo's own workshops. However, due to unforeseen complications, the zoo was unable to accommodate this and instead sent two other non-venomous species for participants to interact with, with the rattlesnake being handled solely by Rick Vos, a representative from the zoo. These two species were the Eastern Rat (*Elaphe*

obsoleta) and the Eastern Fox (*Elaphe gloydi*), both of which are commonly misidentified as massasauga rattlesnakes.

Surveys

Before I began each workshop, a small package of three documents was distributed to the potential participants. This included the written informed consent form, the BEFORE survey, and the AFTER survey. The before survey was to be completed prior to the presentation, and the after survey was to be completed following it, to examine any potential changes in perception and willingness to protect because of attending the workshop. Copies of these surveys can be found in Appendix C (Page 37).

The design of the surveys was guided primarily through reference to the Snake Attitude Questionnaire (SAQ), which was also utilized in the Tomazic (2011) article. The SAQ was developed by Prokop et al. (2009), and consists of 58 statements regarding snakes, separated into six categories: Negativistic, Scientific, Naturalistic, Knowledge, Myths, and Ecological. The statements are also classified based on whether they have a positive or negative wording. The SAQ has been used in numerous studies to evaluate attitudes towards snakes, and Tomazic added one more category that will be vital for this project: Willingness (to protect). The ‘before’ survey included a section with some more subjective questions, such as age, gender, where the participant grew up, and when they were first exposed to snakes. This was included to allow me to make more connections based on the responses. The rest of the survey was statements from the SAQ that were answered based on a five-point Likert scale, to provide a quantifiable analysis. The statements in my surveys focused on the Negativistic section of the SAQ, in

addition to the Willingness section created for Tomazic's paper. I also made sure to rearrange the statements to that there was a combination of positive and negative wording, to ensure that this was not the cause of any unnecessary bias.

Data Analysis

Following the workshops, data from the surveys was compiled on an Excel sheet. To simplify the following data analysis, a number from one to five was given to each point on the Likert scale for positive statements, with 1 for 'Strongly Disagree' and 5 for 'Strongly Agree'. This was reversed for the statements with negative wording. This resulted in a data sheet where, regardless of whether the wording was positive or negative, if there was an increase in the score it indicated an improvement in overall perception.

Once the data was compiled on Excel, it could be manipulated and analyzed in several ways. For the purposes of this study, I decided to investigate how workshop type impacted overall perception, in addition to impacts on Willingness to Protect and Negativistic views separately. Using the bar graph function, I was able to produce a series of graphs with error lines that describe the relationship between workshop type and average before/after scores for each of these. I have also included a table for each of these relationships to clearly show the difference in average scores between the before and after surveys, followed by two tables that report the average difference and standard deviation for each workshop type overall.

Results

Overall Perception

Table 1. Relationship between workshop type and average score before and afterwards, as it relates to overall perception. Also included is the difference between the average scores for each workshop type.

	Average Score (Before)	Average Score (After)	Difference
Workshop 1 (Control)	3.102189781	3.458181818	0.355992037
Workshop 2 (Snake)	3.090909091	3.525	0.434090909
Workshop 3 (Video)	3.212121212	3.757575758	0.545454545
Workshop 4 (Snake + Video)	3.383838384	3.888888889	0.505050505

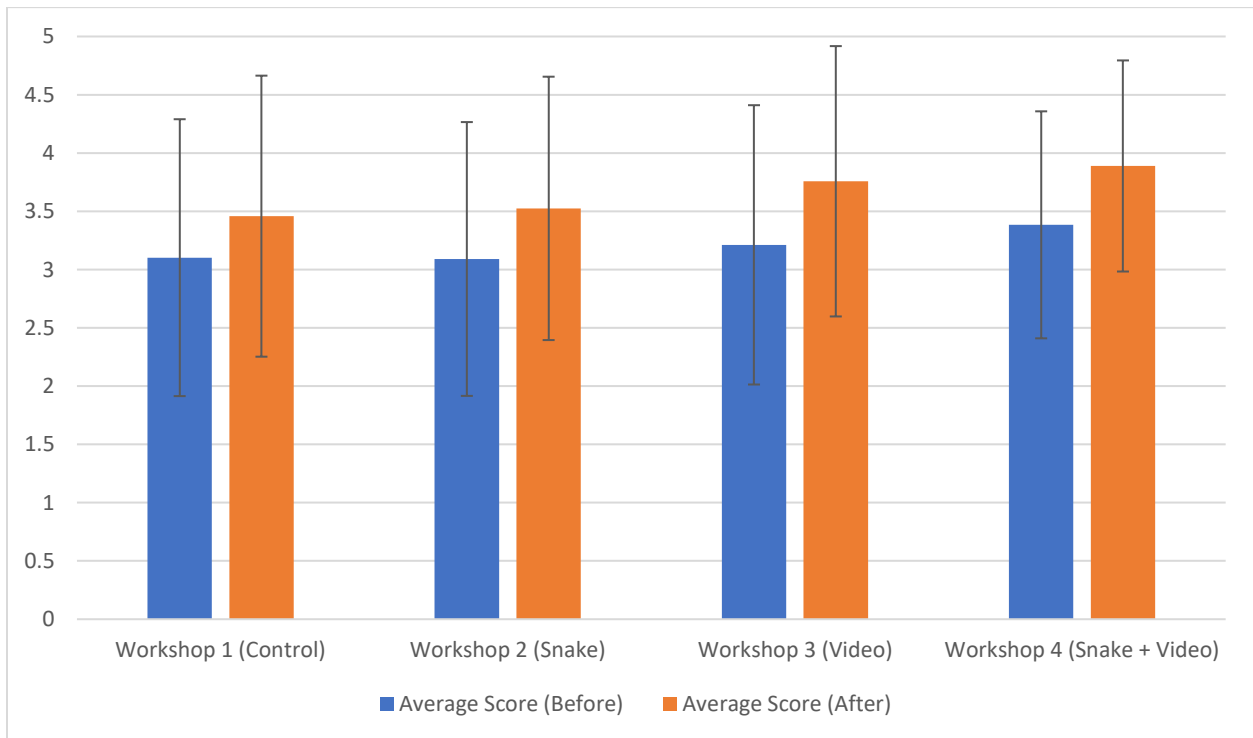


Figure 1. Relationship between workshop type and average score before and afterwards, as it relates to overall perception.

With regards to overall perception, my first hypothesis that there would be no difference between the control and the workshop with only the video (Workshop 3) was refuted. There was indeed a large difference between the two, with the control showing an average increase of ~0.356, and Workshop 3 showing an increase of ~0.545. This indicates that the video had a much larger impact on overall perception than I expected. In fact, it showed the largest difference in perception among the four workshop types for overall perception.

My second hypothesis that there would be a positive change in perception between the control and the workshop showing the live animal (Workshop 2) was supported by the results. However, this difference was much smaller than I predicted (see Table 1).

My third hypothesis that the workshop showing both the video and live animal would have the largest change compared to the control was also refuted. While this showed a larger difference compared to Workshop 2 (see Table 1), the difference was smaller than that of Workshop 3, which only showed the video.

Negativistic Views

Table 2. Relationship between workshop type and average score before and afterwards, as it relates to negativistic views. Also included is the difference between the average scores for each workshop type.

	Average Score (Before)	Average Score (After)	Difference
Workshop 1 (Control)	2.914572864	3.175	0.260427136
Workshop 2 (Snake)	2.86875	3.346875	0.478125
Workshop 3 (Video)	3.03125	3.572916667	0.541666667
Workshop 4 (Snake + Video)	3.201388889	3.736111111	0.534722222

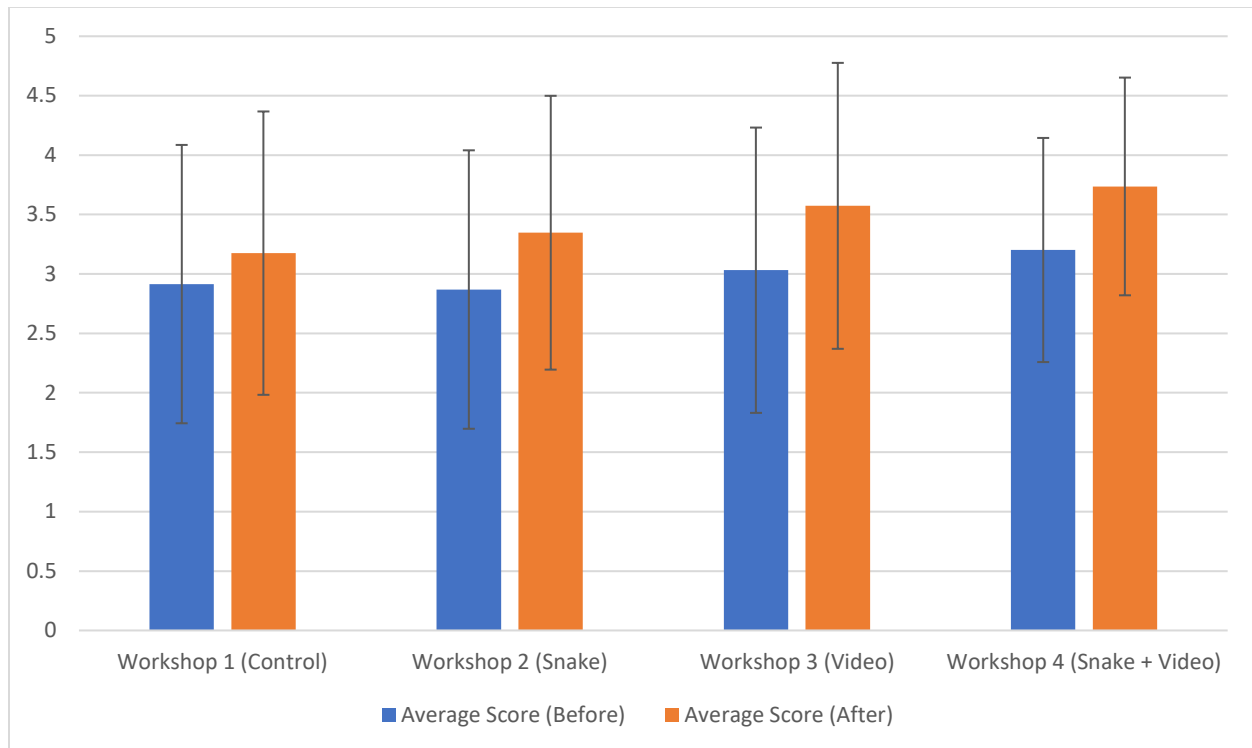


Figure 2. Relationship between workshop type and average score before and afterwards, as it relates to negativistic views.

As I also wanted to look more in depth into the data, I decided to examine both the changes in negativistic views and willingness to protect separately, in addition to overall perception. For negativistic views, my first hypothesis was refuted, similarly to overall perception. There was a large difference between the control and Workshop 3 (see Table 2). Therefore, the video here also had a much greater impact than predicted.

My second hypothesis that there would be a positive change in perception between the control and Workshop 2 was supported by the results. This is similar to the results regarding overall perception, but the difference is much more noticeable here (see Table 2). This indicates

that the inclusion of the live snake had a particular impact on negativistic views of the animals, which is further supported by studies such as those by Tomazic (2011), and Morgan & Gramann (1989).

My third hypothesis that the Workshop 4 would have the largest change compared to the control was also refuted. However, the difference between Workshop 3 and 4 here was much closer (see Table 2). This shows that, even though having the live snake present did not have as big an impact as I expected, it was almost as effective as having the video alone, to improve the negativistic views surrounding venomous snakes.

Willingness to Protect

Table 3. Relationship between workshop type and average score before and afterwards, as it relates to willingness to protect. Also included is the difference between the average scores for each workshop type.

	Average Score (Before)	Average Score (After)	Difference
Workshop 1 (Control)	3.6	4.213333333	0.613333333
Workshop 2 (Snake)	3.683333333	4	0.316666667
Workshop 3 (Video)	3.694444444	4.25	0.555555556
Workshop 4 (Snake + Video)	3.87037037	4.296296296	0.425925926

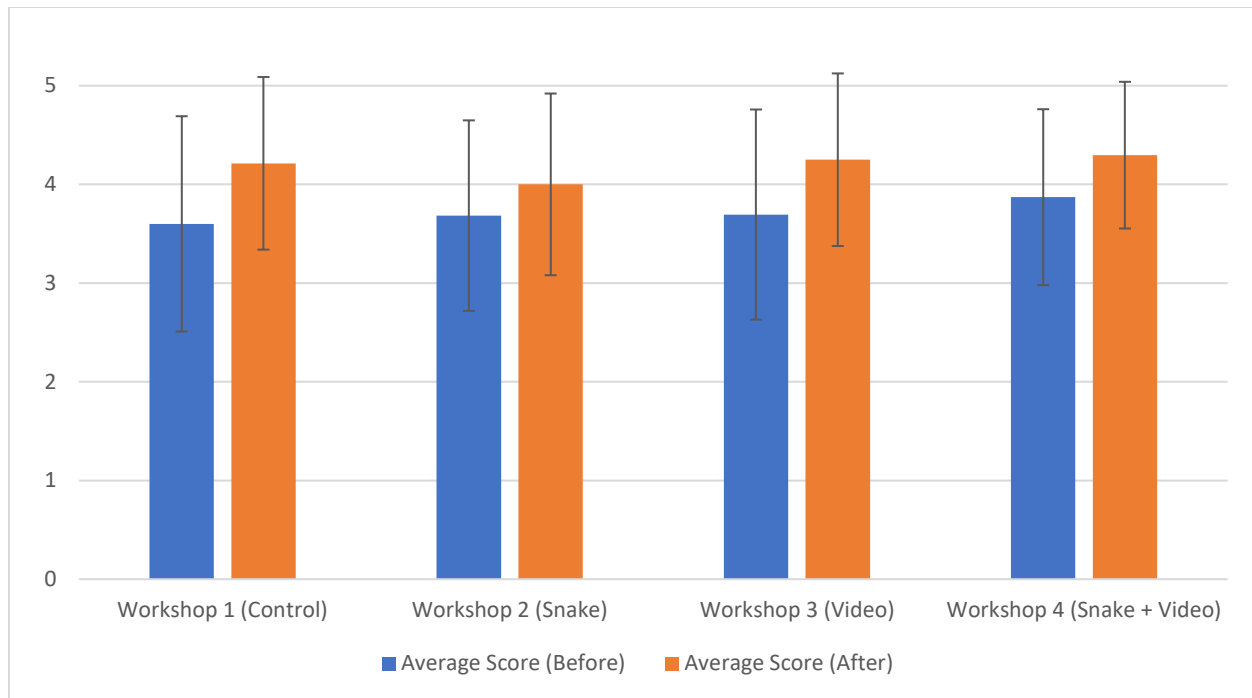


Figure 3. Relationship between workshop type and average score before and afterwards, as it relates to willingness to protect.

With regards to willingness to protect, my first hypothesis was again refuted. However, in this case, the control showed the largest change among all the workshop types at ~ 0.613 . This is the highest change in perception for any workshop type that I looked at and was very surprising. These results imply that, to improve willingness to protect, a presentation with no video or live animal and just a PowerPoint can be just as impactful, if not more, than one that includes them.

My second hypothesis that there would be a positive change in perception between the control and the workshop showing the live animal (Workshop 2) was therefore refuted by the results. Workshop 2 showed the smallest difference in perception among the different workshop types at ~ 0.317 . This indicates that the inclusion of a live animal does not have a significant impact on willingness to protect. This agrees with the findings of Spooner et al. (2021). They

found that, in zoo shows with live animals, conservation action awareness showed weak positive change post-show. This may again be correlated to the ethics surrounding the inclusion of live animals for education purposes, as seeing an animal in captivity does not prioritise natural behaviours and therefore weakens conservation action (Spooner et al. 2021).

My third hypothesis that Workshop 4 would show the largest difference was also refuted. Similar to overall perception, Workshop 3 again showed a larger difference (see Table 3). This has remained consistent throughout the study, with the only difference here being that Workshop 3 was not the most impactful, the control was.

Table 4. Average difference in scores between the before and after surveys for each workshop type.

	Average Difference in Scores
Workshop 1 (Control)	0.409917502
Workshop 2 (Snake)	0.409627525
Workshop 3 (Video)	0.547558923
Workshop 4 (Snake + Video)	0.488566218

Table 5. Average standard deviation scores for each workshop type with respect to the three areas of interest.

	Overall Perception	Negativistic Views	Willingness to Protect	Average
Workshop 1 (Control)	±1.196691597	±1.181674993	±0.982481013	±1.120282534
Workshop 2 (Snake)	±1.152301009	±1.161775386	±0.942967561	±1.085681319
Workshop 3 (Video)	±1.179026572	±1.201743302	±0.969221418	±1.116663764
Workshop 4 (Snake + Video)	±0.939711717	±0.929470249	±0.817093662	±0.895425209
Average	±1.116932724	±1.118665983	±0.927940914	

Reflection and Future Directions

These results have interesting implications, as showing the video alone was more effective than including a live snake in most of these presentations. One possible reason for this is that having the live animal present may portray the image of a “performing animal”, or a creature that is being taken out of its natural habitat for human use (Spooner et al., 2021). For environmental studies students that may be more sensitive to this kind of human use and the ethics underlying them, this could have resulted in giving these workshops a more negative perception.

To conclude, this project was an incredible experience for me. I was able to work closely with the Toronto Zoo in structuring educational workshops to better understand the value of media and live animals in improving the public perception of typically maligned species. However, this was not at all an easy feat. One of the biggest obstacles was ensuring a large sample size. This would not have been possible without Dr. Traci Warkentin, who offered to include my study in her syllabus and tutorial times. This was an incredible help, but also caused a few unavoidable flaws in the design. First, the number of participants between the workshops was not even, which may have skewed some of the results, especially for Workshop 2. Also, the zoo had wanted to host all four workshops on the same day, which was not possible. Finally, this resulted in all participants being Environmental Studies students, which may have introduced some bias into the “willingness to protect” category, as the protection of the natural world is one of the ties that binds our highly interdisciplinary faculty together. Perhaps, more than anything, this project showed me how important compromise is in research. You can’t always create the perfect study under the perfect conditions, especially with qualitative studies like this.

Another aspect of this study that required compromise was the coordination with the Zoo. Initially we had intended to tube the rattlesnake, which would allow participants to touch the snake without harm. This ended up being impossible, as it requires two qualified handlers and only one was available on the days of the workshops. Instead, the Zoo opted to bring two nonvenomous snakes in addition to the rattlesnake, that participants could touch. I think that this could have made a difference in the perception of the rattlesnake, as it was the snake that no one could touch. Another issue was that the Zoo representatives only attended the workshops that required the live animals, would speak and answer questions during the presentation. I feel like this may have given these workshops a greater sense of legitimacy and authority, and it would have been ideal to keep the presenters consistent. However, I see this as just another compromise that had to be made to make the study possible, and I am eternally grateful for all the work and effort on the part of the Zoo staff.

Another unexpected issue that arose was the COVID pandemic, which essentially halted any possible continuation of the research. I had originally intended to have at least one more rep the following semester and had begun arranging it with the Zoo. However, this ultimately proved impossible due to the pandemic, and I was forced to use the data from this one group of workshops. However, I was actually very fortunate that I collected the data when I did, as these workshops took place just before the first lockdowns. This was a great lesson in how unexpected global events can completely shut down some types of research. This also had an impact on my sample size. I finished with a total of 75 participants, which was lower than similar studies such as those by Tomazic (2011) and Morgan & Gramann (1989), which ranged from 121 to almost 600 participants.

Finally, there are also areas where my research design could be improved as well. As I was collating the data and beginning my analysis, I noticed that a Likert scale of 5 may be a bit too shallow to tease out the nuance in people's opinions. I feel like a rank from 0-10 may have been better than the "strongly agree" ranking that I used and would have allowed for more detailed analysis. Ultimately though, this is another example of the compromises that had to be made for the study, as I had structured the questionnaires to be as simple as possible for the participants to fill out. There are many ways that this study could be improved, and I would love to see this research continued in the future, as it addresses very important questions relating to education and the conservation of endangered species.

With regards to future directions, this study provides some very interesting implications. The results were very unexpected, with the video having a larger overall impact than the inclusion of a live animal. Fatima Ali should be proud of her work, as her video is obviously very effective at educating the public and changing their perceptions of this misunderstood reptile. However, while the video alone is more effective at improving overall perception, this study did highlight some differences between improving negativistic views and fostering a willingness to protect. The inclusion of the live snake had a greater overall impact on improving negative views, while the PowerPoint and video were more effective at raising conservation awareness. This provides useful insights into how to structure these workshops going forward, as, according to my findings, the primary goal of the presentation is important to consider. If your target is to improve negativistic views surrounding a species, it is better to include a live animal and other forms of media, like videos. However, if you are focussing on willingness to protect and conservation, then the live animal is not necessary, and it is not worth putting it through the stress of handling. This is important information for the ethical treatment of these

creatures and will help improve existing initiatives that aim to protect Ontario's massasauga rattlesnake.

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Appendix A: Written Informed Consent Form

TITLE OF STUDY

Impacts of direct contact and video media on the public perception of the endangered massasauga rattlesnake

PRINCIPAL INVESTIGATOR

Christopher Lovell

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PURPOSE OF STUDY

You are being asked to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information.

This study is a continuation of research undertaken by a previous MES graduate student named Fatima Ali, who worked with the Toronto Zoo's Adopt-a-Pond program in order to produce a short educational video titled, "Living with Rattlesnakes". Fatima was interested in examining the video's potential for creating positive change in the perception surrounding Ontario's rattlesnakes. This is because many endangered snakes, and especially venomous ones, suffer from a poor public image that makes conservation measures particularly difficult. Therefore, the main purpose of this study is to analyze which methods for public outreach work best for: 1) improving the overall perception of these reptiles, and 2) fostering a willingness to protect them. This research has been reviewed and approved by the FES Human Participants Research Committee on behalf of York University. Collected data will be used as part of my MES Major Research, as well as by the Toronto Zoo to improve the environmental education programs that they offer.

STUDY PROCEDURES

This study will consist of a 30 minute presentation from the Toronto Zoo, which may involve a live snake being present. There will be a short survey to complete before and after the presentation, which should not require more than 3-5 minutes to complete.

RISKS

Some presentations may include the presence of a securely contained venomous snake. All animal handlers are representatives from the Toronto Zoo, with Venomous and Dangerous Reptile Training certification, so risks will be minimal. However, this may cause emotional stress for some participants with snake phobias, so please feel free to terminate your involvement at any time if you feel at all uncomfortable.

Please keep in mind that you may decline to answer any or all questions and you may terminate your involvement at any time if you choose, with absolutely no impact on your academic career.

BENEFITS

There will be no direct benefit to you for your participation in this study. However, we hope that the information obtained from this study may help to inform future environmental education initiatives at the Toronto Zoo, by giving insights into how to most effectively structure public outreach workshops. This study may also help give justification for the stress that animals being used for education are put through, if it can be proved that their presence is having a positive impact on attitudes and perceptions.

CONFIDENTIALITY

Your responses to this survey will be anonymous. Please do not write any identifying information on your survey. In order to ensure confidentiality, the researcher will be assigning code names/numbers for participants that will be used on all research notes and documents. Participant data will be kept confidential except in cases where the researcher is legally obligated to report specific incidents. These incidents include, but may not be limited to, incidents of abuse and suicide risk. Consent forms will be kept for two years following the completion of the study. Raw data will be stored on a secure laptop and destroyed after two years, with the final analysis and report being shared with the Toronto Zoo.

CONTACT INFORMATION

If you have questions at any time about this study, or you experience adverse effects as the result of participating in this study, you may contact the researcher whose contact information is provided on the first page. If you have questions regarding your rights as a research participant, or if problems arise which you do not feel you can discuss with the primary investigator, please contact the Senior Manager & Policy Advisor for the Office of Research Ethics, 5th floor, York Research Tower, York University, at 416-736-5914 or ore@yorku.ca.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. Should you choose to withdraw from the study, all data generated as a consequence of your participation shall be destroyed.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____ Date _____

Investigator's signature _____ Date _____

Appendix B (1): Presentation Script without Video

Hello everyone, my name is Chris Lovell and I'm a graduate student here in the Faculty of Environmental Studies. For my degree, I've been working in collaboration with the Toronto Zoo to perform a study that explores the potential for changing the public perception of massasauga rattlesnakes through direct contact and video media, as well as how we can improve our methods of environmental education. I would like to ask you to take part in this study – you will be greatly assisting my research and contributing to environmental education initiatives well into the future. For this study, I will be giving you a short presentation on Ontario's native massasauga rattlesnake, so keep in mind that there will be images of snakes. If anyone is uncomfortable about this, feel free to terminate your involvement at any time. I have handed you a packet of three sheets of paper stapled together. The first is the consent form, which is two-sided. Here you can learn a little bit more about the study, as well as accessing the confidentiality and contact information. If you are interested in participating, please sign and date the back of the consent form. The second sheet, with its title highlighted in blue, is the "before" questionnaire. Please fill this out now before I start the presentation. Your name at the top is optional, and is more for in case the sheets get separated – you can use your initials if you like. Disregard the third sheet in pink for now, that is to be filled out after the presentation.

So let's begin. The agenda for this presentation will be a brief description of the massasauga rattlesnake's biology, how to identify them, where they are found, some tips for snake safety, and some information on conservation and education initiatives being held by the Toronto Zoo. To start, who here was aware that Ontario was home to a species of rattlesnake?

So, with regards to their biology, let me give you some interesting facts. First let's talk about the rattle. When they are first born, rattlesnakes only have a single rattle segment. Each additional rattle is added every time the snake sheds its skin, which happens every 2-3 months. The rattlesnakes mature after 3-5 years and their average lifespan is 18-20 years.

The massasauga rattlesnake is a type of pit viper, which means it has heat sensing pits that create a thermal image of its prey. This is an evolutionary adaptation for hunting small mammals. They are a rather small, stout-bodied viper, with an average length of 45-75cm. They are also Ontario's only venomous snake, and are grey to brownish grey with dark blotches along their back and sides, which are edged in white.

Their venom is delivered through the use of hinged hollow fangs, and the venom glands are what gives the snake's head its triangular shape. The venom is a type of modified saliva that is used to kill prey and start digestion. Like all rattlesnakes, the massasauga rattlesnake utilizes a reflex action to very quickly bite and capture prey, with a strike distance of 18cm or half their body length. In order to prepare for a strike, the snake anchors its back half first in the distinctive rattlesnake pose.

Their diet consists mainly of rodents, amphibians, and sometimes other snakes.

In terms of identification, one of the easiest ways to do so is to look at the tail. They are the only snake in Ontario that has a rattle on their tail, which makes a sound by shaking the interlocking segments. While other snakes have been known to vibrate their tails, these have no rattle. Massasaugas also have distinctive "raccoon" stripes near their tails.

The rattle and the sound it makes is meant as a warning – but they are always ready to defend themselves. However, the rattle is not always used. Massasaugas are particularly shy snakes, and often prefer to rely

on camouflage to stay undetected. But if they feel suddenly threatened or frightened, they can bite without use of the rattle.

The head of the snake is also quite distinctive. In addition to its triangular shape, they have a vertical pupil and a heat sensing pit below the nostril. This is an incredibly sensitive heat detector, which is able to distinguish differences as small as a tenth of a degree from 18-36 inches away. This provides the snake with a thermal image that is useful for catching prey at night.

It is also important to note that there are a couple of species of look-alike snakes that can be found in Ontario. However, a good rule of thumb to follow is that if the snake is patterned, it is best to keep your distance.

The behavior of the massasauga can also be quite surprising. They are extremely shy creatures, and will try to avoid detection or move away from a threat if they are given the opportunity. To this end, they rely on their camouflage and the cryptic patterns on their body to avoid being seen, which is useful for feeding and for defense.

Here is an example of a massasauga in its preferred habitat. As you can see, or more accurately, as you can't see, the colouration and pattern makes it surprisingly difficult to notice – it just blends right in with the leaves and soil.

Massasaugas are also described as being thigmophilic. This means that they prefer to be sheltered or hidden, especially in things like logs and among leaf litter or rocks.

Their reproductive behavior involves the males engaging in combat for the right to breed, which occurs in the middle of the summer. However, the females then store the sperm until the following spring, which is when they ovulate.

In terms of anatomy, the male snakes can be identified as they have a longer tail, due to the presence of paired copulatory organs called the hemipenes.

After fertilization, the female gives birth to 8-12 young in a neonate capsule, so this species does not lay eggs in the traditional sense like most reptiles, but instead gives birth to live young. The babies then stay with the mom for several days or weeks, until they are ready to strike off on their own. The young have also been observed following female snakes to hibernation sites if they had never been there before.

Now I am going to talk about the conservation of this important species. As a keystone species, massasauga rattlesnakes play a vital role in the ecosystem – fitting into nature like a puzzle piece. Many animals depend on this species for food, such as hawks, eagles, herons, and foxes. It also helps to keep rodent and insect populations in check, which means fewer ticks and reducing the occurrence of Lyme disease. If the massasauga was removed, the ecosystems that we humans rely on would be substantially weakened.

The conservation status of the massasauga rattlesnake under COSEWIC is threatened since 1991. They are also protected under the Species at Risk Act, with the maximum fine for harming a snake or their habitat being \$100,000 and imprisonment for up to 2 years. The Ontario Endangered Species Act has similar penalties, with a maximum fine of \$250,000 and/or a year in jail. The main threats to this species include: habitat loss, habitat degradation and fragmentation, the construction of roads, the draining of wetlands for agriculture, residential development, and the fear and persecution that this species experiences as the result of being a venomous species.

Here you can see a map of the historical range of the snake in Ontario. Unfortunately, the range of these populations has been constantly decreasing since 1984, with the current range looking something like this. There are currently three main populations of massasaugas in the province, around Georgian Bay, Windsor-LaSalle, and Wainfleet Bog.

The northernmost, and largest, population lives around Georgian Bay, where they have to deal with harsh winters and heavy snowfall. In order to survive these challenges, the snakes are known to hibernate in caves for insulation.

The primary threats to this population is residential development, habitat loss, and especially the construction of highways such as the 400 and 69, which has driven even more development within the region.

There is also small population in Windsor-LaSalle, which is the last remnant tall grass prairie in Ontario. This makes it an ideal location for research as this is an incredibly rare ecosystem, and this has been spearheaded by the Ojibway Research Centre.

This population is particularly vulnerable because it is an isolated population that is experiencing a great deal of development pressure. As you can see in this map, the Ojibway Prairie complex is not one continuous ecosystem – it is highly fragmented by roads and development, which casts the future of this population in doubt.

Finally, the last population can be found in Wainfleet Bog on the north coast of Lake Erie. This is Canada's southernmost acid bog, and is home to another isolated population of massasaugas. The main threats to this population are land-use conflicts and management practices. However, there has been some attempt to restore this ecosystem in recent years.

The preferred habitats of the massasauga rattlesnake are fens, wet meadows, and floodplain forests, however, they are known to migrate upland to drier sites during the summer. In these areas, they particularly like open, sunny areas that are intermixed with shaded areas, which allows for ideal thermoregulation. The gestation sites, or areas where the females incubate their young, tend to consist of warm table rocks in open areas of forest. In order to survive our Canadian winters, overwintering or hibernation sites are also essential, in order to avoid lethal freezing temperatures.

Studies using telemetry have also shown that these snakes exhibit site fidelity, which means they return to the same sites throughout their lifetime. As a result, translocation of snakes is not recommended, unless it is within one kilometer.

Now, as can be seen, there is a great deal of overlap between massasauga and human habitation. Therefore, it is important that we learn how to safely share space with this creature. This is similar to all other wildlife that we have cohabitate with, like mammals and plants. This is especially important for rattlesnakes, as in most cases, bites occur as a result of risky and dangerous human behavior. In terms of statistics, males aged 10-29 years are most commonly bitten by rattlesnakes, at 46%, and alcohol is often a factor. However, it is important to note that only two people have ever died from rattlesnake bite in Ontario, with both occurring over 40 years ago when antivenin was rare. By comparison, 6 to 12 people die from lightning strikes each year in Canada.

In order to reduce your chances of accidental snakebite, there is one main rule to follow – give them space and respect if you find yourself in one of the locations where they can be found. Following from this, you should never handle or pose with a rattlesnake, don't pick up freshly killed snakes, keep children at a safe

distance and pets on a leash, don't put your hands into dark places without investigating first, don't walk through heavy brush or tall grass without looking down, and be sure to wear protective footwear.

I will end by talking a little bit about the rattlesnake workshops that are held at the Toronto Zoo. This is an important form of environmental education and public outreach. The Zoo is perfectly suited to act as an intermediary between wildlife and people, allowing them to change perceptions and prejudices surrounding this misunderstood reptile. These workshops consist of a talk by the lead reptile handlers at the zoo, and provide a great deal more information that I was not able to cover here.

So, if you're interested, you should look into attending a Toronto Zoo massasauga rattlesnake workshop for a unique, shared experience. And who knows, you may even be able to touch a live rattlesnake rattle and tell your friends about it!

And this concludes my presentation on the massasauga rattlesnake, a true victim of fear and negative public image. Thank you.

You can now fill out the "after" survey that is highlighted in pink, and I will collect them shortly. Thank you so much for your time and participation.

Appendix B (2): Presentation Script with Video

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The preferred habitats of the massasauga rattlesnake are fens, wet meadows, and floodplain forests, however, they are known to migrate upland to drier sites during the summer. In these areas, they particularly like open, sunny areas that are intermixed with shaded areas, which allows for ideal thermoregulation. The gestation sites, or areas where the females incubate their young, tend to consist of warm table rocks in open areas of forest. In order to survive our Canadian winters, overwintering or hibernation sites are also essential, in order to avoid lethal freezing temperatures.

Studies using telemetry have also shown that these snakes exhibit site fidelity, which means they return to the same sites throughout their lifetime. As a result, translocation of snakes is not recommended, unless it is within one kilometer.

Now, as can be seen, there is a great deal of overlap between massasauga and human habitation. Therefore, it is important that we learn how to safely share space with this creature. This is similar to all other wildlife that we have cohabitate with, like mammals and plants. This is especially important for rattlesnakes, as in most cases, bites occur as a result of risky and dangerous human behavior. In terms of statistics, males aged 10-29 years are most commonly bitten by rattlesnakes, at 46%, and alcohol is often a factor. However, it is important to note that only two people have ever died from rattlesnake bite in Ontario, with both occurring over 40 years ago when antivenin was rare. By comparison, 6 to 12 people die from lightning strikes each year in Canada.

In order to reduce your chances of accidental snakebite, there is one main rule to follow – give them space and respect if you find yourself in one of the locations where they can be found. Following from this, you should never handle or pose with a rattlesnake, don't pick up freshly killed snakes, keep children at a safe distance and pets on a leash, don't put your hands into dark places without investigating first, don't walk through heavy brush or tall grass without looking down, and be sure to wear protective footwear.

I will now play a short video that was made by a previous graduate student named Fatima Ali, in collaboration with the Adopt-a-Pond program at the Toronto Zoo.

And this concludes my presentation on the massasauga rattlesnake, which is a true victim of fear and negative public image. Thank you.

You can now fill out the “after” survey that is highlighted in pink, and I will collect them shortly. Thank you so much for your time and participation.

Appendix C: Before and After Surveys

RATTLESNAKE WORKSHOP QUESTIONNAIRE (BEFORE)

Name _____ Date _____

Gender _____ Where did you grow up? _____

First exposure to snakes? _____

1. I am afraid of rattlesnakes.
Strongly Disagree Disagree Neutral Agree Strongly Agree
2. I would like to encounter some species of rattlesnakes in nature.
Strongly Disagree Disagree Neutral Agree Strongly Agree
3. Rattlesnakes are dangerous animals.
Strongly Disagree Disagree Neutral Agree Strongly Agree
4. I would report it to the authorities if I was aware that someone was destroying rattlesnake habitat.
Strongly Disagree Disagree Neutral Agree Strongly Agree
5. I would rather watch a movie about rattlesnakes than observe them in nature.
Strongly Disagree Disagree Neutral Agree Strongly Agree
6. Rattlesnakes are sympathetic creatures.
Strongly Disagree Disagree Neutral Agree Strongly Agree
7. I would rather avoid places where rattlesnakes are present.
Strongly Disagree Disagree Neutral Agree Strongly Agree
8. I would notify the authorities if I saw someone killing rattlesnakes.
Strongly Disagree Disagree Neutral Agree Strongly Agree
9. I would be hesitant to participate in an expedition to investigate snakes.
Strongly Disagree Disagree Neutral Agree Strongly Agree
10. I would be willing to donate money to protect certain rattlesnake species.
Strongly Disagree Disagree Neutral Agree Strongly Agree
11. Rattlesnakes are disgusting animals.
Strongly Disagree Disagree Neutral Agree Strongly Agree
12. I think most Ontario residents share my opinion of rattlesnakes.
Strongly Disagree Disagree Neutral Agree Strongly Agree

RATTLESNAKE WORKSHOP QUESTIONNAIRE (AFTER)

Name _____

- 1. I am afraid of rattlesnakes.
Strongly Disagree Disagree Neutral Agree Strongly Agree

- 2. I would like to encounter some species of rattlesnakes in nature.
Strongly Disagree Disagree Neutral Agree Strongly Agree

- 3. Rattlesnakes are dangerous animals.
Strongly Disagree Disagree Neutral Agree Strongly Agree

- 4. I would report it to the authorities if I was aware that someone was destroying rattlesnake habitat.
Strongly Disagree Disagree Neutral Agree Strongly Agree

- 5. I would rather watch a movie about rattlesnakes than observe them in nature.
Strongly Disagree Disagree Neutral Agree Strongly Agree

- 6. Rattlesnakes are sympathetic creatures.
Strongly Disagree Disagree Neutral Agree Strongly Agree

- 7. I would rather avoid places where rattlesnakes are present.
Strongly Disagree Disagree Neutral Agree Strongly Agree

- 8. I would notify the authorities if I saw someone killing rattlesnakes.
Strongly Disagree Disagree Neutral Agree Strongly Agree

- 9. I would be hesitant to participate in an expedition to investigate rattlesnakes.
Strongly Disagree Disagree Neutral Agree Strongly Agree

- 10. I would be willing to donate money to protect certain rattlesnake species.
Strongly Disagree Disagree Neutral Agree Strongly Agree

- 11. Rattlesnakes are disgusting animals.
Strongly Disagree Disagree Neutral Agree Strongly Agree

- 12. I think most Ontario residents share my opinion of rattlesnakes.
Strongly Disagree Disagree Neutral Agree Strongly Agree

13. Additional comments (eg. What did you like most or least about the presentation? What are some reasons for your answers, etc.)