

## ARTICLES

### EFFECT OF EDUCATION PROGRAMS ON THE KNOWLEDGE AND ATTITUDES ABOUT SNAKES IN SAN ISIDRO DE UPALA, COSTA RICA

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**Abstract:** We interviewed 30 people in San Isidro de Upala, Costa Rica, to reveal their knowledge and attitudes about snakes. We found that many people hated and feared snakes because they assumed incorrectly that many or all snakes in the area were venomous. We then administered an education program designed to improve people's knowledge and attitudes about snakes. The program included information on the biology, identification, and ecological importance of snakes. We also explained how to safely respond to snake encounters. Before-and-after comparisons of responses to questionnaires measuring knowledge and attitudes showed that education programs made people more knowledgeable about snakes. Increased knowledge has been linked to positive attitudes. If people have positive attitudes towards snakes, they will be less likely to kill them; therefore helping to preserve the biodiversity of Costa Rica.

#### Introduction

Snakes are important in many ecosystems. They are not only top predators, but also prey. They are also important for medicinal purposes, rodent control, and protein sources in some regions (Christoffel 2007). Despite their importance, snake populations are declining globally in response to habitat degradation, intentional killing, biocides, and trade (Dodd 1987).

There is a great need for snake conservation and research, especially in areas with high biodiversity. One such area is Costa Rica, which is one of the most biologically diverse countries for its size (Vaughan 2003). Many areas with high levels of biodiversity are often developing countries whose people fear snakes. If we are to save snakes and biodiversity, we must learn to change attitudes so that snakes and other wildlife are viewed as important. (Morgan and Gramann 1989).

One of the goals of environmental education (EE) is to change attitudes and increase knowledge about wildlife. Environmental education has been successful in rural Costa Rica with other groups of animals. Vaughan et al. (2003) found that after a one-month scarlet macaw EE program, elementary students did 71% better on post-program knowledge surveys and had more positive attitudes towards macaws. They also passed on some of their "macaw knowledge" to their parents.

It is challenging to educate people about snakes because many fear them. Snakes were the fifth most disliked group of animals in one study (Kellert and Berry 1979). Because of this fear, many people know little about snakes and often perpetuate inaccurate myths. This lack of knowledge is dangerous for both people and snakes because frightened people make irrational decisions that often result in snake death and/or an increased risk of a snake bite (Christoffel

2007). Irrational snake persecution confounds conservation efforts. Even in some relatively undisturbed natural areas snake numbers and diversity may be depressed because local people kill snakes.

A number of social scientists have sought to explain the fear of snakes, or ophidiophobia (Christoffel 2007). It has been hypothesized that the fear of snakes is learned more easily than the fear of other things (Ohman and Mineka 2003). Others have linked the fear of snakes to negative stories from the media and to the fears passed on from parents (Murray and Foote 1979). Ophidiophobia has also been linked to folklore and religion, which commonly vilify snakes (Nissenson and Jonas 1995).

The few EE studies with snakes have found that the more experience people have with snakes, the less they fear them (Murray and Foote 1979). Morgan and Gramann (1989) evaluated different methods of snake EE and found that informational slide shows significantly improved snake knowledge. Rebecca Christoffel (2007) studied attitudes about venomous and non-venomous snakes in Michigan (MI) and Minnesota (MN). She found that an individual's sex and knowledge of snakes explained much of the observed variation in attitudes toward snakes. She also found that people knew little about local snakes. After exposure to EE programs, participants had more knowledge and positive attitudes towards snakes than non-participants.

Despite Costa Rica's high diversity of snakes and great need for snake conservation, we could not find a single EE program that focused on snakes in that country. Therefore, we developed and administered a snake EE program in rural Costa Rica. The goals of this study were to describe people's attitudes and knowledge about snakes and to determine if an EE program could improve knowledge, understanding, and tolerance in a small rural community in Costa Rica.

## Methods

We performed our study in the town of San Isidro de Upala, Costa Rica. San Isidro is located in the northwest corner of the Alajuela province, in a valley formerly composed of tropical rainforest. It is now a mixture of agriculture land interspersed with secondary rainforest. The population is about 150 people, and the area is rural. One of us (AG) spent 3.5 months with a family in the area while completing research in 2008.

Because of the coherence of Rebecca Christoffel's methodology (Christoffel 2007) and her helpfulness and cooperation, we decided to use the same general format for this study. We used semi-structured oral interviews to learn the baseline knowledge and attitudes of community members. Based on what we learned from those interviews, we created a snake EE program aimed at increasing knowledge and positive attitudes towards snakes.

We performed 30 oral interviews to gather baseline data. Interviewees included six subjects in the 5–15 age group (2 female and 4 male), four in the 16–29 age group (3 female and 1 male), and 20 in the 30+ age group (6 female and 14 male). Because 93% of our subjects were between the ages of 18 and 40, we chose not to analyze the results according to age group.

The oral interviews consisted of open-ended questions designed to reveal people's attitudes about snakes as well as experiences they have had. For the first part of the interview, we asked questions about overall attitudes and experiences with snakes (a complete list of the oral interview questions is listed in Table 1).

We showed subjects photographs of common snakes of the region and asked them to identify the snakes as well as whether the snakes were venomous or not. We also asked questions about the importance of snakes in the environment and if they had encountered snakes in the media. Media is defined as newspapers, books, television, movies, or magazines.

In the final part of the interviews, we used an eleven-point scales (on a scale of 0–10) to assess responses to photographs of certain snake species. On the fear scale a zero meant that the interviewee would be terrified seeing a picture of the snake. A ten meant they had no fear and would touch a snake. On the preference scale, zero meant despising snakes (having "the only good one is a dead one" philosophy) while a ten meant liking a snake enough to have it as a pet. Fives on either scale meant having neutral attitudes. We noted snake anecdotes and myths interviewees volunteered during the interviews. At the end of each interview, we asked if any subjects were interested in attending an education program about snakes.

Each interview was translated and interpreted for subjects by Jose Emilio Oporta Morales. At the beginning of each interview, we explained that participation in the study was voluntary and that the identities of interviewees would remain confidential. We also explained the objectives of the study as well as how we would use and disseminate results. Before the interview, each subject was required to sign a consent form signifying that they agreed to participate and allowed us to use resulting data.

We performed the interviews in either our host family's

home, our subject's home, or at school for our subjects in the 5–15 age-group. We offered no monetary compensation to participants; however, we did give them candies as a thank you gesture. We tried to complete each oral interview in isolation. We did this to eliminate bias due to non-participants voicing their opinions or subjects changing their answers in the presence of non-participants. We realized early that isolation was not possible in many places because we were entering a family's home and could not enforce our rules in their household. Sometimes, we had to perform multiple interviews at the same time due to time constraints and the need to interview key demographic groups. For example, we did this when we went to the elementary school to interview 5–15 year olds. In this multiple interview setting, it was necessary to omit the snake identification data.

After analyzing the results of the oral interviews, we then devised an education program catered to the needs of the community. The education program was held as a seminar at our host family's home and lasted about an hour. Jose Emilio Oporta Morales once again served as our translator.

At the start of the program, we administered a 15-minute initial questionnaire consisting of 17 objective, multiple choice, and translated questions that would be covered in the program (Table 4). The subjects signed a consent form before starting the program. For subjects under 18, we required a parental signature as well. If subjects could not read, we read the questionnaire aloud. To measure the impact of the program through retention rates, we re-administered the same 15-minute pre-program questionnaire immediately after the education program.

In the program, we focused on debunking prevalent myths about snakes. We also spent a significant amount of time teaching local snake identification as well as natural history information. Additionally, we explained the benefits of having snakes around as well as their role in the environment. We informed subjects how to react to snake bites and encounters and created an informational handout reiterating this information. At the end of our time in Costa Rica, we donated a bi-lingual field guide of the snakes of Costa Rica by Alejandro Solórzano (Solórzano 2005) and a snake hook to the San Isidro community center.

Other environmental education studies (Eagles and Demare 1999, Vaughan et. al 2003) have shown the importance of running programs over a long period of time and incorporating them into formal education. However, given our brief time in Costa Rica and lack of access to the school system, we were unable to run the education program over a long time period.

We analyzed the interview data by categorizing open-ended answers as either positive or negative and then looked for patterns across demographic groups. We also categorized the preference and fear scale questions as positive, neutral, or negative based on the numerical answer (0–3 being negative, 4–6 being neutral, and 7–10 being positive). For the identification questions, we looked for trends in correct answers. Additionally, we used the chi squared test to determine if there were differences in correct answers between men and women. Expected values were calculated by creating a 2x2 contingency table with sex of interviewee defining the rows and "correctness" defining the columns. The expected value for each cell was

Table 1. Oral interview questions asked during this study.

Question
1. How old are you?
2. Where do you live?
3. How long have you lived there, and/or where did you spend most of your childhood?
4. What is your highest level of education?
5. What is your name?
6. What do you think the name of this snake is (for each picture); Used: a) Boa Constrictor ( <i>Boa constrictor</i> ), b) Stripebelly False Coral ( <i>Erythrolamprus mimus</i> ), c) Common Cat-eyed Snake ( <i>Leptodeira annulata</i> ), d) Brown Vine Snake ( <i>Oxybelis aeneus</i> ), e) Common Snail Eater ( <i>Sibon nebulatus</i> ), f) Tiger Rat Snake ( <i>Spilotes pullatus</i> ), g) Allen's Coral Snake ( <i>Micrurus alleni</i> ), h) Fer-de-lance ( <i>Bothrops asper</i> ), i) Bushmaster ( <i>Lachesis stenophrys</i> )
7. Is this snake venomous (for each picture: a-h)?
8. Have you ever touched a snake? If so what type?
9. What are the most common snakes you see?
10. Where are snakes when you see them?
11. What are snakes doing when you see them?
12. How do you feel about snakes in general?
13. Have you ever killed a snake; if so, why?
14. Have you ever read or seen any books, magazine articles, newspaper articles, movies, or television shows about snakes?
15. Do you remember what the media was like; were snakes portrayed as good or bad?
16. Do you think the portrayal was accurate?
17. Do you think that snakes are important to you; to the environment?
18. Describe the pros and cons of having snakes on your property; w/in 5 km of your property but not on it?
19. Would you rate these snake pictures (Boa, Common Cat-eyed, Brown Vine Snake, Tiger Rat Snake, and Fer-de-lance) on a like/dislike scale of 0-10?
20. Would you rate these snake pictures (same species as above) on a fear scale of 0-10?
21. Would you be willing to attend an education program about snakes?

calculated by multiplying the cell row total by its column total and then dividing that product by the grand total of the contingency table. We considered a chi square statistic significant if it yielded a  $p$ -value of 0.05 or less and denoted each significant  $p$ -value with a "\*" in the resulting tables. Chi square and  $p$ -values for each identification question are reported in Table 2. We included answers of "I don't know" and "do not recognize" in the incorrect category.

We also analyzed the pre- and post-program questionnaires using the chi squared test to determine if there were any significant differences in correct answers between men and women and between pre- and post-program questionnaires. The expected values were calculated the same way they were calculated in Table 2. Again, questions with  $p$ -values less than 0.05 were considered significant. Chi square and  $p$ -values for each questionnaire question are reported in Table 4. We also categorized questions based on the proportions answered correctly. Mostly correct consisted of questions with greater than 65% of subjects answering correctly, intermediate consisted of questions with 35–64% correct, and mostly incorrect consisted of questions with less than 35% correct. We also compared pre- and post-program answers per individual to determine if they answered better or worse as well as collectively to see how many subjects answered better or worse. For each question with a numerical answer, we noted whether the subjects overestimated or underestimated the correct answer.

## Results

### Oral Interviews

Thirty subjects completed oral interviews before the education program.

Questions 1–5: Questions 1–5 were simply demographic questions. Interviewees included six subjects in the 5–15 age group (2 female and 4 male), four in the 16–29 age group (3 female and 1 male), 20 in the 30+ age group (6 female and 14 male). None of the interviewees had finished high school, five had some high school education, eleven finished primary school, ten had some primary school education, and four had no education at all.

Question 6 and 7: For these identification questions, only 26 interviewees responded. The four interviewees that did not respond were children that we interviewed at the elementary school. We considered an answer correct if the interviewee answered with a name that either our translator or we recognized. We considered an answer to be incorrect if neither our translator nor we recognized the name or they didn't know the name. The responses can be seen in Table 2. Answers are only analyzed as a whole and by sex because there were no significant differences in answers from other demographic groups. The most commonly misidentified snakes (by both common name and whether or not the species is considered venomous) were the False Coral Snake, Common Cat-eyed Snake, and Common Snail Eater. Most subjects knew the Boa Constrictor and Allen's Coral Snake (by name and venom). They also knew that the Fer-de-lance and Bushmaster were venomous. There was a significant difference in correct answers to the Fer-de-lance identification question with males answering more correctly than females. There was also a significant difference between males and females in correct responses to the question of whether or not the Bushmaster is venomous with males answering more correctly than females.

Table 2. Analysis of answers by interviewees to oral interview questions 6 and 7.

Snake to be identified	Proportion Answering Correctly to Common Name					Proportion Answering Correctly if Snake Was Venomous				
	Total	M	F	Chi <sup>2</sup> Value	P-Value	Total	M	F	Chi <sup>2</sup> Value	P-Value
a) Boa Constrictor	21/26	15/17	6/9	1.762	0.184	20/26	15/17	5/9	3.540	0.060
b) Stripebelly False Coral	0/26	0/17	0/9	0.000	1.000	2/26	2/17	0/9	1.147	0.284
c) Cat-eyed Snake	0/26	0/17	0/9	0.000	1.000	7/26	4/17	3/9	0.287	0.592
d) Brown Vine Snake	13/26	9/17	4/9	0.064	0.800	13/26	11/17	5/9	0.197	0.657
e) Common Snail Eater	0/26	0/17	0/9	0.000	1.000	5/26	4/17	1/9	0.584	0.445
f) Tiger Rat Snake	15/26	9/17	6/9	0.454	0.500	17/26	13/17	4/9	2.667	0.102
g) Allen's Coral snake	24/26	16/17	8/9	0.227	0.634	23/26	14/17	9/9	1.795	0.180
h) Fer-de-lance	14/26	11/17	3/9	4.406	0.036*	20/26	14/17	6/9	0.816	0.366
i) Bushmaster	5/26	5/17	0/9	3.277	0.070	19/26	16/17	3/9	11.051	0.001*

\* denotes significance at the alpha = 0.05 level

Question 8: Fourteen interviewees said that they had touched a snake (some reported touching multiple species), 15 said that they had not, and one did not answer. Of the interviewees that had touched a non-venomous snake, most people touched Boa Constrictors (7 people), Vine Snakes (2 people), and Tiger Rat Snakes (2 people). Four interviewees also said that they had touched a venomous Fer-de-lance.

Question 9-11: The most common snakes that interviewees reported seeing were Fer-de-lances (21 people), Boa Constrictors (16 people), Parrot Snakes of the genus *Leptophis* (9 people), and Tiger Rat Snakes (9 people). For those that had seen snakes, most interviewees reported seeing snakes on the farm (11 people), on the road (10 people), in the house (10 people), and in the forest (9 people). When interviewees saw snakes, the snakes were usually sitting still (8 people), biting or in strike position (5 people), or simply moving away from the interviewee (4 people).

Question 12-13: Approximately two-thirds of interviewees, 21 people, stated that they felt afraid of snakes. Of these, two said that their fear depended on whether or not the snake was venomous, and one said fear depended on the size of the snake. Twenty three interviewees stated that they had killed snakes and six said they had not. Of the interviewees that had killed snakes, six stated that they only killed venomous snakes; one said he only killed little snakes, and one said he only killed big ones. Most people reported killing snakes to avoid bites (10 people) or because they were scared (6 people).

Question 14-16: Ten people reported watching snake programs on television, nine reported never seeing any media coverage about snakes, eight reported seeing movies about

snakes, and two read snake books. The snake programs seen on television were on the National Geographic Channel and Discovery Channel. The programs were about Fer-de-lances, Cobras, and Rattlesnakes. Of the snake movies, six interviewees reported seeing the movie "Anaconda" while one saw a western movie featuring a snake. Nine interviewees said that the snakes were portrayed negatively in the media, eight said that they were neutral, and only one said that snakes were portrayed in a positive manner. Thirteen interviewees (45%) stated that they believed the media portrayed the snakes accurately.

Question 17: Nineteen interviewees said that snakes were important to them personally, while seven said that they were not. Nineteen people also said that snakes were important to the environment, four said they were not important, and three people were unsure. The top reasons why snakes were considered personally important to interviewees included pest control (10 people), medicinal purposes (4 people), or to keep the food chain in balance (4 people). The main reason snakes were not important to people is that they bite and kill people (4 people). Similarly, the top reasons why snakes were considered important to the environment included pest control (8 people) and to keep the food chain in balance (8 people), even if snakes were not personally important to interviewees. Snakes were considered unimportant to the environment because they bite and kill people (1 person), have absolutely no place on Earth (1 person), and because they reproduce rapidly (1 person).

Question 18: The most commonly stated advantage for having snakes on interviewee's property was pest control (12 people). The most common disadvantages for snakes on interviewee's property included snakes being dangerous to people (16 people) and snakes being dangerous to

Table 3. Analysis of answers by interviewees to oral interview questions 19 and 20.

Snake	Positive Feeling		Neutral Feeling		Negative Feeling	
	Fear Scale	Preference Scale	Fear Scale	Preference Scale	Fear Scale	Preference Scale
Boa Constrictor	17/30	13/30	5/30	10/30	8/30	7/30
Cat-eyed Snake	10/29	8/29	8/29	7/29	11/29	14/29
Brown Vine Snake	14/29	11/29	8/29	6/29	7/29	12/29
Tiger Rat Snake	15/30	14/30	3/30	7/30	12/30	9/30
Fer-de-lance	7/30	8/30	5/30	3/30	18/30	19/30

farm animals (5 people). The most common advantage for tolerating snakes within 5 kilometers of interviewee's property included pest control (7 people). The most common disadvantages for tolerating snakes within 5 kilometers of interviewee's property included snakes being dangerous to people (15 people), and snakes being dangerous to farm animals (6 people).

Question 19 and 20: The number of responses in each category can be seen in Table 3. Many interviewees felt unfearful towards Boa Constrictors (57%) and Tiger Rat Snakes (50%), while 60% of interviewees felt fearful towards the Fer-de-lance. In the preference scale, many interviewees liked Tiger Rat Snakes and Boa Constrictors (47% and 43%, respectively), while many disliked the Fer-de-lance (63%) and Common Cat-eyed Snake (47%).

Question 21: Most interviewees, 28/29, said that they would be willing to attend an education program about snakes.

#### Pre- and Post-Program Questionnaires

Overall, 15 subjects completed the pre-program survey, and 12 subjects completed the post-program survey. Of the subjects who completed the pre-program questionnaire four were female, and 11 were male. In the post-program survey, three subjects were female, and nine were male. It was necessary to list the results as percentages so that we could compare the answers between pre- and post-education programs due to different numbers of subjects completing each questionnaire. We removed non-answers from the equation because subjects could have forgotten to answer questions

In the pre-program questionnaire, answers to questions 5, 7, 10, 13, 14, 15, and 17 were mostly correct. Answers to questions 2 and 16 were intermediate. Answers to questions 1, 3, 4, 6, 9, and 11 were mostly incorrect, and answers to question 8 were all incorrect (Table 4). Greater than 50% of subjects underestimated the correct answer in questions 1, 2, 3 and 8.

In the post-program questionnaire, answers to questions 5 and 14 were all correct. Answers to questions 7, 9, 10, 15, 16, and 17 were mostly correct. Answers to questions 1, 2, 3, 6, 11, and 13 were intermediate, and answers to question 4 were mostly incorrect. In the post-program questionnaire, all twelve subjects still answered question 8 incorrectly (Table 4). More than 50% of subjects underestimated the correct answer in questions 1, 2, 3 and 8. More than 50% of subjects overestimated the correct answer in question 4.

Question 12 was a qualitative question without a correct answer. This question was aimed at gauging people's attitudes before and after the education program. In the pre-program questionnaire, 27% of subjects answered that they feared snakes, 8% were neutral, 47% reported no fear whatsoever, and 20% did not respond. In the post-program questionnaire, 33% of subjects were afraid, 8% were neutral, 42% had no fear, and 17% did not answer. Subjects improved their answers in all post-program questions except 7, 8, 10, 13, and 15. There were no significant differences in correct answers between the sexes. However, the difference between pre- and post-program answers in questions 5, 9, and 11 was statistically significant (Table 4).

## Discussion

### Oral Interviews

The data from the oral interviews indicate that interviewees only had moderate knowledge of both local snake identification and venomosity, with the majority (over 50%) of interviewees knowing the correct identification and venomosity of four and five (out of nine) species respectively. All of the interviewees misidentified the False Coral Snake, Common Cat-eyed Snake, and Common Snail Eater. Interviewees also misidentified whether or not these species' were venomous more than other species. This is unfortunate because they are all non-venomous snakes. Therefore, they are probably killed more than others because the majority of people who said they killed snakes tried to only kill venomous ones.

There were significant differences between male and females in the answers to two identification questions. Males were better than females at identifying the Fer-de-lance and knowing whether or not Bushmasters were venomous (Table 2). Perhaps this difference occurred because women do not work in snake habitats as much as men do in Costa Rica, and therefore do not encounter snakes as much. Women were also proportionately more scared than men for all five snake species shown on the fear scale. Women may not be able to identify these snakes as well as men because they are more scared of them. However, the opposite may be true as well: women may be more fearful of these snakes than men because they cannot identify them (either by species or venomosity).

Most people (21/26) were afraid of snakes in general, but some said that it depended on their size and if they were venomous. Of all the snakes shown, the greatest number of people felt negatively and fearful towards the venomous Fer-de-lance. Interviewees also said that the Fer-de-lance was the most commonly seen snake in the area.

Of people who have seen snakes in the media, half said that snakes were portrayed negatively. Of the remaining people who saw snakes in the media, most said the snakes were portrayed as neutral and the program was educational. However, the educational or neutral programs that interviewees saw were about venomous or dangerous snakes.

Although most people are afraid of snakes in San Isidro de Upala, it is difficult to determine the cause of this fear from this study alone. However, the oral interviews give valuable insights into the cause of snake fear in this community. Snakes may be feared in this region because venomous snakes are the most commonly seen snakes. However, people may simply believe that they see venomous snakes more than others because they are scared. Because snakes are commonly maligned in the media, and dangerous and venomous snakes are often shown in educational programs, people may develop the fear of snakes due to the media. Further research must be done to reach a conclusion.

Fear aside, the vast majority of people said that snakes were important to them personally and to the environment. They felt this way due to snakes' importance for pest control and because of their intrinsic value in the environment. Additionally, all but one interviewee expressed interest in attending an education program.

Table 4: Analysis of responses by interviewees to pre- and post-program questionnaires. M = male; F = female.

Question	Proportion Responding		Proportion Answering Correctly				Pre-Program Proportion Answering Correctly				Post-Program Proportion Answering Correctly			
	Pre	Post	Pre	Post	Chi <sup>2</sup> Value	P-Value	M	F	Chi <sup>2</sup> Value	P-Value	M	F	Chi <sup>2</sup> Value	P-Value
1. How many snake species are in Costa Rica?	15/15	11/12	4/15	6/11	2.084	0.145	2/11	2/4	1.519	0.218	3/8	3/3	3.438	0.06
2. How many venomous snake species occur in Costa Rica?	15/15	12/12	6/15	5/12	0.008	0.929	3/11	3/4	2.784	0.095	3/9	2/3	1.029	0.310
3. How many snake species occur around Upala?	15/15	12/12	3/15	5/12	1.501	0.221	3/11	0/4	1.364	0.243	3/9	2/3	1.029	0.310
4. How many venomous (can kill people) snake species occur near Upala?	15/15	12/12	2/15	4/12	1.543	0.214	2/11	0/4	0.839	0.360	3/9	1/3	0.000	1.000
5. When are Boa Constrictors venomous?	15/15	12/12	10/15	12/12	4.909	0.027*	6/11	4/4	2.727	0.099	9/9	3/3	0.000	1.000
6. What are some large threats to snake populations in Costa Rica?	13/15	12/12	5/13	7/12	0.987	0.320	3/9	2/4	0.325	0.569	4/9	3/3	2.857	0.091
7. When are most snakes in this area active?	15/15	12/12	12/15	9/12	0.096	0.757	9/11	3/4	0.085	0.771	7/9	2/3	0.148	0.700
8. On average, how many people are bitten by venomous snakes each year?	15/15	12/12	0/15	0/12	0.000	1.000	0/11	0/4	0.000	1.000	0/9	0/3	0.000	1.000
9. Of the people that are bitten, how many of these people, on average, die each year?	15/15	12/12	4/15	9/12	6.238	0.013*	3/11	1/4	0.008	0.929	7/9	2/3	0.148	0.700
10. What type of people are most commonly bitten by venomous snakes?	15/15	12/12	14/15	10/12	0.675	0.411	10/11	4/4	0.390	0.532	7/9	3/3	0.800	0.371
11. If you are bitten by a venomous snake, the most important thing to do is?	14/15	12/12	1/14	7/12	7.949	0.005	0/10	1/4	2.692	0.101	4/9	3/3	2.857	0.091
12. On a scale of 1–5 (1 being phobic and 5 being no fear whatsoever) how scared are you of snakes as a group?	12/15	10/12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13. As a whole, snake populations in Costa Rica are declining? (True or False)	12/15	11/12	11/12	7/11	2.650	0.104	8/9	3/3	1.010	0.315	6/8	1/3	1.637	0.201
14. Snakes always live together? (True or False)	15/15	12/12	14/15	12/12	0.831	0.362	10/11	4/4	0.390	0.532	9/9	3/3	0.000	1.000
15. Rattlesnakes occur in the region? (True or False)	15/15	12/12	13/15	10/12	0.059	0.808	9/11	4/4	0.839	0.360	7/9	3/3	0.800	0.371
16. Snakes with triangular shaped heads and slit pupils are always venomous? (True or False)	15/15	12/12	9/15	10/12	1.741	0.187	7/11	2/4	0.227	0.634	7/9	3/3	0.800	0.371
17. Bushmasters like to live near people and commonly consume livestock? (True or False)	14/15	11/12	10/14	9/11	0.365	0.546	8/11	2/3	0.042	0.838	7/8	2/3	0.637	0.425

\* denotes significance at the alpha = 0.05 level

There were a few problems in the oral interview question content and format. Using a picture of a snake may not have provided a fair representation of baseline knowledge. Judging snake knowledge by common name is problematic as well, due to our limited knowledge of the Spanish language as well as multiple common names for snakes.

There was also a potential problem in the administration of the interview. Although we tried to keep each interview private, we performed many interviews in homes where other family members liked to express their opinions during the interview. We also had to perform some group interviews in the interest of time. Having others commenting during interviews may have biased our interviewees' answers.

#### Education Program and Pre- and Post-Program Questionnaires

Overall, the proportion of subjects with correct answers increased in 11 questions from pre- to post-program questionnaires. Subjects also performed significantly better on questions 5, 9, and 11 (Table 4). Therefore, the subjects did learn and retain some knowledge from the education program. Given the information, it is difficult to predict why subjects answered these three questions better than others. Two of these question's answers are non numeric, and therefore easier to remember, but question 9 does have a numeric answer.

Subjects did worse on four questions in the post-program questionnaire, and remained unchanged for one question. The question that remained the same was question 8, and everyone answered this question incorrectly. Again it is difficult to say why no one answered this question correctly because it is a straightforward question with a numeric answer. We may have poorly presented the answer to that question in our education program.

We used question 12 to gauge subject's attitudes before and after the program. In this case, we used fear to measure the attitude change. From these results, it would appear that people became more fearful of snakes with the percentage of people reporting ophidiophobia increasing by 5%. However 5% does not represent a significant change. Therefore, attitudes, as measured in this questionnaire, did not seem to change much over the course of the education program. This was also the question with the most non-responses. Subjects may not have understood what the question was asking of them. It should be noted that only one question of the survey is directly aimed at discovering attitudes. It may not be valid to analyze a change in attitudes with only one question dedicated to this purpose.

A general problem with our education program was that fewer people attended the program than said they would in the oral interviews. Additionally, fewer women attended than men. It is difficult for the results to truly represent the community at large with such a small sample size. Fewer people completed the post-program questionnaire than the pre-program questionnaire. We are unsure whether people simply did not want to fill out the questionnaire again, or they did not stay for the whole program.

### Conclusions

Although we gained many insights from this study, there is still much to learn. It would be useful to go back in six months and measure retention rates using the same questionnaire without a refresher program. It would also be interesting to do pre- and post-education program censuses of snakes around San Isidro de Upala. This study could determine if education programs not only improve knowledge and attitudes, but also translate into an increase in snake numbers. However, the post-program censuses would have to be done over years to take into account lag time in snake reproduction.

With Costa Rica becoming such a technologically modern country, television and movies are important parts of family life. The media might consider changing their portrayal of snakes, especially in programs on "scientific" television channels. Instead of focusing on dangerous and venomous snakes (that represent a small fraction of the total snakes), they should instead focus on common snakes and ones with interesting traits.

Although most interviewees had some education (at least up to 6th grade), no interviewee said they learned about snakes in school. Schools, especially those in rural areas, need to teach their students not to fear the natural world around them. They also need to teach them to respect snakes as well as all plants and animals, especially in a fragile and diverse tropical rainforest ecosystem like Costa Rica.

Fortunately, this change in the school system is already

beginning in richer areas and cities, but not in poor rural areas where the need is greatest. For students to gain knowledge about snakes and the natural world, they must attend school as well. Areas like San Isidro are trying to increase attendance in rural areas by offering secondary school at night so that students are able to help their family by working during the day and going to school at night.

With much of this community's snake knowledge coming from media, religion (Catholicism), and myths learned over their entire lives, it is difficult to change their viewpoints with one education program. This study shows a glimpse of the snake knowledge and attitudes of the small Costa Rican town of San Isidro de Upala. It also shows that an education program based on the specific needs of a community can foster an increase in knowledge about snakes. However, there is still a significant amount of snake human dimensions and education research to do, not only in San Isidro, but also in Costa Rica and the rest of the world. Factual snake information needs to be presented at an early age and from all angles (religion, school, media, and family to name a few) if it is to have a positive, lasting effect on individuals and communities.

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