Spring 2019

Do Different Methods of Communication Impact Undergraduate Student's Knowledge, Attitudes, & Beliefs Towards White-Nose Syndrome in Little Brown Bats

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DO DIFFERENT METHODS OF COMMUNICATION IMPACT UNDERGRADUATE STUDENTS' KNOWLEDGE, ATTITUDES, AND BELIEFS TOWARDS WHITE-NOSE SYNDROME IN LITTLE BROWN BATS?

by

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A Thesis Submitted in Partial
Fulfillment of the Requirements for a
Degree with Honors
(Wildlife Ecology)

The Honors College

University of Maine

May 2019

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ABSTRACT

White-nose syndrome (WNS) is a deadly fungal disease that has killed millions of hibernating bats since its introduction to North America in 2006. The little brown bat (*Myotis lucifugus*), once widespread across the US, has been the most severely impacted with some colonies experiencing a 99% decline. Scientists believe changing people's behavior is the key to bat conservation as the fungus is spread primarily by humans transferring the fungus between bat colonies. Outreach is a common method used to affect behavioral change in people, but not all outreach methods are equally effective. The purpose of this study was to investigate if different methods of media communication, video and written-text, impacted undergraduate student's attitudes toward, beliefs toward, conservation behaviors concerning, and their knowledge toward little brown bats and WNS. Data were collected using an online survey distributed to undergraduate students at the University of Maine (n = 233). Participants were asked a set of questions before the treatment (pre-test), given either text or video outreach material, and then asked the same questions (post-test). Overall, there were no significant differences between the text and video as outreach methods in their effects on the four cognitions. There were significant changes in the four cognitions within the each treatment. Both text and video treatments positively and significantly impacted attitudes toward, beliefs toward, conservation behaviors concerning, and their knowledge toward little brown bats and WNS. These significant changes between the pre- and post-test within treatments, illustrate the impact outreach has on cognitions that support conservation.

ACKNOWLEDGEMENTS

I would like to thank the Charlie Slavin Research Grant from the Honors College at the University of Maine for their financial contribution to this study. Thank you to my Honor's thesis committee members for their support and guidance throughout this thesis.

I want to thank my advisor, Dr. Carly Sponarski, for her contribution and support of this thesis. She has devoted countless hours to my study and has provided invaluable guidance and advice. I could not have asked for a better advisor for my Honor's thesis.

Lastly, I would like to thank my parents for their constant encouragement and confidence in me to reach my goals. I would not be where I am today without them.

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INTRODUCTION

White-nose syndrome (WNS) has had devasting impacts on North American hibernating bat populations (Fenton, 2012). Since the discovery of this fungal disease in the US in 2006, it has killed millions of bats (Willis et al., 2011). Scientists estimated that over 5.5 million bats died between 2006 and 2011 (Hayes, 2012). Such high fatalities across a number of North American bat species have made WNS "one of the fastest declines of wild mammal populations ever observed" (Willis et al., 2011, pp. 364). WNS is not native to North America, and is believed to have been introduced to North America from Europe by contaminated clothing and/or gear used by recreational cavers (Warnecke et al., 2012). The European source of WNS observed in North America is supported by the discovery of a related fugus in Europe. Warnecke et al. (2012) found that North American bats were susceptible to both the North American version and the European versions of the fungus. Unlike North American bats, European bats have not experienced widespread mortality from the disease despite the fact that the European version causes mortality faster in North American bats than the North American version (Raloff, 2012; Warnecke et al., 2012). This discrepancy in mortality suggests that European bats have developed resistance mechanisms from co-evolution with the disease (Warnecke et al., 2012).

WNS is caused by a fungus called *Pseudogymnoascus destructans* (P.d.). This fungus infects the skin around the nose and wings of the bat, typically exhibiting fuzzy white fungus around these areas, hence the name of the disease. Lorch et al. (2011) discovered that the fungus is spread to other bats through contact with infected bats or

contaminated surfaces. Lorch et al. (2013) found that P.d. can survive in caves and other hibernacula sites without hosts for several years. Disease transmission of WNS is not species specific and spreads between bat specifies indiscriminately. Transmission is not density-dependent meaning it has the same impact regardless of colony size (Langwig, Frick, Bried, Hicks, Kunz, & Kilpatrick, 2012). WNS directly affects bats during the winter months when they are in torpor, a state of low body temperatures, metabolic rates, and heart rate. During torpor, their immune system is repressed in order to decrease metabolic energy costs (Frick, Puechmaille & Willis, 2016; Meteyer, Barber, & Mandl, 2012). Once infected, bats experience more frequent arousal from torpor resulting in a rapid depletion of fat reserves necessary for winter survival (Warnecke et al., 2012).

The little brown bat (*Myotis lucifugus*), populations once widespread across the USA, has been the most severely impacted by WNS (Frick, Puechmaille, & Willis, 2016). Previous studies have estimated that, in WNS-infected areas, there has been a 99% decline in little brown bat colonies whereas, before WNS was introduced to North America, the little brown bat population was increasing (Maslo, Valen, Gumbs, & Frick, 2015; Frick, Puechmaille, & Willis, 2016). Population declines are worrisome, not only for species conservation but also the ecological and economic impact these declines in bat populations will have on the environment as bats are major controllers of insect populations (Kingston, 2016). Boyles, Cryan, McCracken, and Kunz (2011) estimated that bat mortality in WNS-infected areas has resulted in roughly 1320 metric tons of insects not being consumed each year which could result in $3.7 billion in agricultural losses. Presently, bats and their role as natural pest controllers has been estimated to be worth about $22.9 billion a year to the agricultural industry (Boyles et al., 2011).

Current WNS conservation and management methods by federal and state government agencies concentrate on preventing the further spread of the disease (Frick, Puechmaille, & Willis, 2016). The National Response Plan by the U.S. Fish and Wildlife Service (2011) outlined 6 components, each with its own working group, which are (a) communications and outreach, (b) data and technical information management, (c) diagnostics, disease management, (e) epidemiology and ecological research, (f) disease surveillance, and (g) conservation and recovery. The goals of the National Response Plan's communication and outreach working group is to focus on distributing research and information on WNS and bats to researchers, management partners and the public (National Response Plan, 2011). While outreach about the importance of bats to humans and ecosystems is mentioned in the goals of the National Response Plan, it is brief and does not go into detail about which methods or messages people should use in order to create effective outreach programs and/or materials.

Despite the growing amount of information coming from research on bats and WNS, there are still knowledge gaps scientists are trying to fill. Foley, Clifford, Castle, Cryan, and Ostfeld (2011) state many aspects of bat species-specific ecology and life histories have significant knowledge gaps including roost site location, foraging and roosting behaviors, carrying capacities of populations, and age-specific rates of survival and reproduction. This information is important because of a need to understand why certain species are impacted by WNS more than others, provide best practices when searching for bat colonies, and give insight on life history features that may help bats recover and/or hinder recovery. Foley et al. (2011) also mentions that there is little data on long-term abundance of bat populations. This lack of knowledge impacts the ability of

conservationists to make good management decisions to protect bats from contracting WNS and also highlights the disinterest the public community has historically held in regard to bats and bat research. While scientists are trying to fill these knowledge gaps, it is critical that outreach methods are designed to effectively communicate the aspects of WNS and bat ecology to people as we are a vector of the spread of this fungus. In order to influence behavioral change in people, it is important to understand if different communication methods affect people differently. The best mechanism for communication will support increased awareness in human populations and hopefully lead to minimization of further spread of the fungus.

Theoretical Framework

Scientists believe that changing people's behavior is the key to bat conservation (Kingston, 2016; Musila, Prokop, & Gichuki, 2018). In order to accomplish changes in human behavior, we need to better understand the cognitive factors (e.g. attitudes and beliefs) influencing human behavior.

The cognitive hierarchy is one such framework that supports a better understanding how different cognitions influence behavior (Vaske & Manfredo, 2012). The cognitive hierarchy is depicted as an inverted triangle (Figure 1) with hard to change, stable cognitions, such as values, at the bottom and relatively easier to change cognitions, such as behaviors, at the top (Miller, Jorgenson, Nickerson, & Pitas, 2018). Values are an individual's beliefs about what is right and wrong (Kingston, 2016). People tend to have very few values and the values they do have are resistant to change. Values influence wildlife value orientations (WVO), a basic belief. WVOs refer to an individual's beliefs about what is right and wrong in relation to wildlife (Zinn, Manfredo, & Barro, 2002).

WVOs fall along a spectrum with domination at one end and mutualism at the other end (Teel & Manfredo, 2009). Individuals with domination WVO have a utilitarian view of wildlife and believe that human well-being is more important than wildlife (Teel & Manfredo, 2009). Individuals with mutualistic WVO believe that the well-being of wildlife is equal to human well-being (Teel & Manfredo, 2009).

WVOs influence an individual's attitudes, which are the positive or negative thoughts and feelings an individual has about an object (Kingston, 2016). Unlike WVOs, attitudes are relatively more numerous and susceptible to change (Kingston, 2016). Attitudes directly and indirectly influence behavior and can be used to predict behavioral intentions (Vaske & Manfredo, 2012. Major factors influencing attitudes towards wildlife are a species attractiveness, similarity towards humans, and its potential threat to humans (Gunnthorsdottir, 2001; Kingston, 2016). Two major aspects of attitudes are the evaluative (e.g. positive or negative assessment) and cognitive (e.g. beliefs related to attitude object) (Vaske & Manfredo, 2012).

At the same level in the hierarchy as attitudes are beliefs, which are what an individual thinks to be true, regardless of if they are correct (Vaske & Manfredo, 2012). In a study by Draheim, Rockwood, Guagnano, and Parsons (2011) about the impact of information on beliefs and attitudes toward coyotes, belief statements included "the D.C. metro area coyote population should be protected and preserved" and "the D.C. metro area coyote population should be completely eliminated". Neither of the statements are objective facts but simply what an individual think to be right.

Beliefs and attitudes directly influence someone's behavioral intention. Behavioral intentions are an individual's belief about how they would act in a certain

situation (Manfredo, 2008). Behavior is influenced by behavioral intentions and can be defined as an action related to an attitude object (Ajzen & Fishbein, 1980). Behaviors are comprised of four elements which are the action, target, context, and time (Ajzen & Fishbein, 1980). The target is the object at which the action was directed towards (Ajzen & Fishbein, 1980). Context refers to the circumstances and situation while time refers to the specific occasion of when the behavior (Ajzen & Fishbein, 1980). If the goal of outreach for WNS is to change people's behavior, then the cognitive hierarchy indicates that several human cognitions need to be understood and targeted when it comes to the influencing human behavior in regard to WNS management. The cognitive hierarchy provides a framework to choose the cognitions I would examine, attitudes, beliefs and behavioral intention, that could affect people's perceptions about WNS in little brown bats.

Previous research has shown that people, on average, tend to have negative beliefs and attitudes towards bats. People's attitudes towards bats are commonly negative due to bats' perceived unattractiveness, the dissimilarity between them and humans such as being nocturnal and having wings, and their association with diseases like rabies (Kingston, 2016; Prokop, Fancovicova, & Kubjatko, 2009). A study by Prokop, Fancovicova, and Kubiatko (2009) found that a large number of Slovakian undergraduate students had a fear of bats. This fear was influenced by a perception of diseases and negative representation in media are driving factors for current negative attitudes toward bats (Prokop, Fancovicova, & Kubiatko, 2009).

Other studies have indicated knowledge as an essential driver for changing people's attitudes towards unpopular species, such as bats, with an increase in knowledge

resulting in more positive attitudes (Reimer, Mase, Mulvaney, Mullendor, Preyy-Hill, & Prokopy, 2014). In a study conducted by Reimer et al. (2014), they examined the relationship between knowledge and attitudes. They found that providing a small amount of information to participants made their attitudes significantly more positive toward the eastern hellbender. Prokop, Fancovicova, and Kubiatko (2009) found that the level of knowledge undergraduate students in Slovakia had significant impacts on their attitudes towards bats with increased levels of knowledge resulting in more positive attitudes.

Outreach Methods

Outreach utilizes information to affect change. In wildlife conservation, there are many different outreach methods that people can used to increase knowledge and make attitudes more positive, although not all methods are equally effective (Stern, Ardoin, & Powell, 2017). One outreach method that is becoming increasingly more popular is conservation-related educational videos (Leeds et al., 2017). Videos are partly popular because they can be distributed easily to many audiences across a variety of platforms (Leeds et al., 2017). However, researchers question whether videos are as effective as an outreach tool compared to other methods such as text (Merkt, Weigand, Heier, & Schwan, 2011). A study by Leeds et al. (2017) found that after viewing a film on great apes, participants had increased positive attitudes toward great apes and increased knowledge on threats and ways to help protect great apes near their communities. These findings show promise in the utility of videos as a conservation outreach tool in affecting human cognitions.

Text based conservation messages is a traditional method and includes articles, signs, and displays. Participants in a study by van Polanen Petel and Bunce (2012)

reported that text-based media (i.e. newspapers and beach signage) were among the most frequently used sources for shorebird information. Previous research has shown that text can impact people's attitudes and knowledge (Reimer et al., 2014). Reimer et al. (2014), mentioned above, found that providing a few sentences of information (in the form of a caption) on the eastern hellbender supported more positive attitudes of participants who were unfamiliar with the species. Participants in a study by Landay and Bridge (1982) found that text information on wall panels significantly increased museum visitor's knowledge. However, this study also found that video and panels or just videos were more effective than panels alone (Landay & Bridge, 1982). These mix of results in the research described indicate the need for more studies on the effectiveness of videos and text. To my knowledge, there are no studies on how effective videos compared to text are for uncharismatic species, such as the little brown bat.

The purpose of this study was to investigate how different methods of communication, video and written-text, impact undergraduate student's attitudes towards, beliefs towards, conservation behaviors concerning, and knowledge about WNS in little brown bats. Research questions for this study are

1. What attitudes, beliefs, and knowledge do undergraduate students at the University of Maine have related to WNS and little brown bats?
2. Is there a difference in prior experience, prior knowledge, and level of self-assessed knowledge between demographic variables (sex, year in college, town, and major)?

3. Did the video or text treatment impact undergraduate student's attitudes toward, beliefs toward, conservation behaviors concerning, and their knowledge toward little brown bats and WNS?
4. Is there a difference between video and text communication methods in the impact on undergraduate student's attitudes toward, beliefs toward, conservation behaviors concerning, and their knowledge toward little brown bats and WNS?

METHODS

Sampling Protocol

Data were collected during the fall semester of 2018 from undergraduate students at the University of Maine in Orono, ME. In order to ask undergraduate students to participate, I asked twenty-eight professors if they would be willing to distribute my questionnaire to their classes. Fourteen of the professors agreed to distribute my invitation to participate email. In order to increase participation, I also visited many of the participating classes and announced my study to the class.

The questionnaire was distributed to undergraduates through emails using two methods: (a) emailed directly to potential participants from the principal researcher, (b) invitation email forwarded from the course's professor to their class or (c) professors would post the invitation email as an announcement on their course site (e.g. Blackboard). A total of 1,112 students were contacted to participate from 15 classes. The questionnaire was distributed using the Dillman method: (a) the first electronic invited students to participate and included a link to the survey on Qualtrics; (b) two weeks later, the second electronic contact, sent in the original method of distribution (e.g. email, post, etc.), was sent to remind students to participate (APPENDIX A). Students were asked to only complete the survey once, however the survey was anonymous so there was no way to guarantee this. Three hundred one students participated in the survey and 233 completed surveys could be used for analysis. The response rate was 20.1% (233/1,112). Due to the method of data collection, the ability to do a nonresponse bias check was limited.

Participants completed a set of pre-test questions, given either the video or text treatment (treatment was randomized) and the complete a set of post-test questions (identical to pre-test). Institutional Review Board (IRB) for the Protection of Human Subjects approval was obtained for the method and instrument used in this study, application number 2018-08-12 (APPENDIX B)

Questionnaire Design

The questionnaire was published to Qualtrics, an online survey platform. The questionnaire comprised of a variety of question types including yes/no, true/false, and 5-point Likert-like scale questions. The question topics included: (a) previous experience with bats and WNS; (b) attitudes towards little brown bats; (c) beliefs towards little brown bats and WNS (d) conservation behaviors concerning WNS and bat conservation; and (e) knowledge of WNS and little brown bats (APPENDIX C).

The previous experience with bats and WNS section included 3 questions. Previous experience questions asked (a) have you ever seen a bat in the wild (b) have you had a negative experience with bats, and (c) had you heard of white-nose syndrome. Answer choices for these questions were yes, no, and not sure. These questions are from the "Bats in New York: What do Albany County residents think?" survey (Center for Conservation Social Science, 2018).

The attitudes toward little brown bats section included 7 questions and were used from the "Bats in New York: What do Albany County residents think?" survey (Center for Conservation Social Science, 2018). Attitudinal questions asked participants to rate how much they agree or disagree that little brown bats are generally: (a) harmless, (b) worthless, (c) vulnerable, (d) attractive, (e) frightening, (f) beneficial, and (g) interesting.

Answer choices consisted of (a) strongly disagree (-2), (b) slightly disagree (-1), (c) neither (0), (d) slightly agree (+1), and (e) strongly agree (+2).

The belief section toward little brown bats, WNS, and conservation behaviors was comprised of 5 questions. The 5 questions concerning beliefs towards little brown bats and 2 questions concerning WNS. Response categories for beliefs about little brown bats were on a 5-point Likert-like scale ranging from -2 to +2 and consisted of (-2) strongly disagree, (-1) slightly disagree, (0) neither, (-1) slightly agree, and (+2) strongly agree. Belief questions towards little brown bats were created by modifying questions from Miller, Freimund, Metcalf, and Nickerson's (2018) study.

Conservation behavioral intentions were broken into two categories: (a) conservation effort (4 items) and (b) person behavioral intention (5 items). All 9 of these questions were on a 5-point Likert-like scale ranging from -2 strongly disagree to +2 strongly agree (same as beliefs) and based off of questions from the bat survey from the Center for Conservation Social Science (2018).

The section on knowledge of WNS and little brown bat consisted of 10 questions: (a) 3 questions asked about little brown bats, (b) 4 questions asking about WNS, and (c) 3 questions asking how knowledgeable participants felt about bat in Maine, WNS, and rabies. Answer choices for knowledge questions on little brown bats and WNS consisted of (a) true, (b) false, and (c) not sure. For self-assessed level of knowledge on bats in Maine, WNS, and rabies, answer choices were on a scale from (a) not at all knowledgeable, (b) slightly knowledgeable, (c) knowledgeable, (d) highly knowledgeable, and (e) extremely knowledgeable. Knowledge questions were created based on the video from Untamed Science (2017) and the survey from the Bats in New

York: What do Albany County residents think? survey by the Center for Conservation Social Science at Cornell University (2018).

Demographic variables included were sex, year in school and major. Sex had three categories: (a) female, (b) male, and (c) prefer not to say. Year in school had five categories: (a) first year, (b) sophomore, (c) junior, (d) senior, and (e) 5th year or more. There were 75 majors for respondents to choose from and, in order to analyze the data, the majors were collapsed into 2 groups, conservation related (i.e., environmental sciences; environmental horticulture; forestry; marine sciences; parks, recreation, and tourism; sustainable agriculture; wildlife ecology) and non-conservation related (i.e., animal and veterinary sciences; biology; finance; kinesiology and physical education; nursing; undecided; zoology).

Communication Material

The video used in this study for the video treatment was created by Untamed Science (2017) and is available on YouTube. Untamed Science is an organization whose mission is to make science fun and more accessible to the general public by creating accessible articles and videos about various aspects of science (www. Untamedscience.com). The YouTube video was embedded into the survey to allow participants to view it directly in Qualtrics while completing the survey. The text information was created from the video's script with some modifications to make it better suited for reading during text treatment and included a citation for the Untamed Science video. (APPENDIX D)

Data Analysis

A chi-square test was used to detect differences in mean response for prior experience and demographic variables. An Independent *t*-test was used to detect differences in mean response in prior knowledge and level of self-assessed knowledge for demographic variables of sex, and major. A One-way Analysis of Variance (ANOVA) was used to detect differences in mean responses for prior knowledge and level of self-assessed knowledge for year in college.

Within each treatment (i.e. video and text), differences in pre- and post-test variables, including attitudes toward, beliefs toward, conservation behaviors concerning and level of knowledge about little brown bats and WNS were analyzed using a paired *t*-test. To compare difference between treatment (i.e., between video and text), the mean differences between the pre- and post-test responses were calculated and an Independent *t*-test was used to test for differences between the two treatments.

RESULTS

Sample Description

The sample was composed of 86 males and 143 females, with 4 participants choosing prefer not to say, for a total of 233 useable respondents. Of the 233 surveys used for analysis, 28.4% were first year (n=67), 32.6% were sophomore (n=77), 19.1% were junior (n=45), 14.8% were senior (n=35) and 3.8% were fifth year or more (n=9). There were 141 students in conservation related majors (i.e., environmental sciences; environmental horticulture; forestry; marine sciences; parks, recreation, and tourism; sustainable agriculture; wildlife ecology) and 90 students in non-conservation related majors (all other majors available at the University of Maine). Courses surveyed were: Conservation Anthropology (ANT 250); Economic Anthropology (ANT 466); Zoonoses and Animal Health (AVS 477); Entomology (BIO 326); Invertebrate Biology (BIO 353); Fundamental of Chemistry (BMB 207); Public Speaking (CMJ 103); Communication and the Environment (CMJ 107); Civilizations III (HON 211); Geomatics, Coordinate Geometry, and GPS (SFR 208); Environment and Society (SFR 220); Forest Recreation Management (SFR 228); Recreation Site Planning and Management (SFR 434); Introduction to Marine Policy (SMS 230); and Ecology (WLE 200).

Prior Experience

Prior experience was measured using two binary questions: (a) Have you seen a bat in the wild? and (b) Have you had a negative experience with bat? There were no significant differences between the demographic variables, sex (seen a bat: $\chi^2 = 5.67$; $p > 0.05$ and negative experience ($\chi^2 = 0.81$; $p > 0.05$) and year in college (seen a bat: $\chi^2 =$

1.18*; p* > 0.05 and negative experience: (χ^2 = 1.19*; p* > 0.05) for both prior experience variables. There was a significant difference between major type and having seen a bat in the wild (χ^2 = 15.21*; p* = <0.001), with conservation related majors seeing bats in the wild more, but no significant difference with previous negative experience with bats (χ^2 = 3.59*; p* > 0.05).

Prior Knowledge, and Self-assessed Level of Knowledge

For the prior knowledge summed index and prior sex-assessed level of knowledge, there were no significant differences between the sexes (*p* > 0.05; Table 1).

For years in college, there were no significant differences in prior knowledge. In regard to differences in self-assessed levels of knowledge 2 out of 3 questions were significantly different. These questions were self-assessed level of knowledge of bats in Maine (*F* = 2.17 *p* = 0.03) and WNS (*F* = 3.08 *p* = 0.02; Table 2). First years, sophomores, and juniors significantly differed with 5th year or more in terms of levels of self-assessed knowledge for bats in Maine (*p* = 0.03), while first years and juniors differed with 5th year or more for WNS (*p* = 0.02) with 5th years or more reporting a higher level of self-assessed knowledge for both questions (Table 2). There was no significant difference in prior knowledge and self-assessed levels of knowledge of rabies in year in college (*p* >.17; Table 2).

See Appendix for Table

For differences in conservation and non-conservation related majors, conservation related majors had, on average, a higher level of knowledge of bats and WNS than non-conservation related majors *(t* = 1.07; *p* < 0.001; Table 3). For self-assessed level of knowledge about WNS, conservation majors had, on average, higher self-assessed levels

of knowledge ($t = 5.04$; $p < 0.001$) whereas there was no significant difference between conservation and non-conservation majors in their self-assessed knowledge levels in bat presence in Maine and rabies ($p > 0.05$; Table 3).

See Appendix for Table

Pre-Test Attitudes, Beliefs, and Knowledge

Undergraduate students at the University of Maine answered positivity to the seven attitudinal questions (Table 4). On average, University of Maine undergraduate students answered between slightly and strongly agree that little brown bats are generally harmless, vulnerable, attractive, beneficial, and interesting. The only questions with an average negative response, slightly disagree to strongly disagree, were little brown bats are generally worthless, and frightening.

Undergraduate students also answered positively to the belief questions. In general, students answered between slightly agree and strongly agree that little brown bats are important to the ecosystem, little brown bats are beneficial to humans, they liked knowing they existed and that these bats had the right to exist. The only question that had an on average negative response, slightly disagree to strongly disagree, was "little brown bats are dangerous to humans" with a mean of 1.14. (Table 4).

Undergraduate students had a relatively high level of prior knowledge (sum $M = 4.46$) (Table 4). The knowledge question, 'insect eating bats provide important pest control service to the agricultural industry in the US', had the highest mean of 0.86 (1.00 would mean everyone got it right) followed by the question, 'white-nose syndrome is a major threat to bats in the US' which had a mean of 0.75. The question, 'little brown bats populations have significantly declined', had a mean of 0.73. The question with the

lowest mean was ‘white-nose syndrome kills bats by causing them to use up all their fat reserves which they need to survive winter’ which had a mean of 0.47.

See Appendix for Table

Differences in Video Treatment

Attitudes

Within the video treatment, there were significant differences between the pre- and post-test responses for 5 of 7 attitude questions (Table 5). The questions with significant differences were participants thought little brown bats were generally: (a) more vulnerable (pre-test M = 1.17 and post-test M = 1.08; t-value = -6.91; p = <0.001), (b) more attractive (pre-test M = 0.42 and post-test M = 0.72; t-value = -4.13; p = <0.001), (c) less frightening (pre-test M = -0.96 and post-test M = -1.23; t-value = 3.48; p = 0.001), (d) more beneficial (pre-test M = 1.21 and post-test M = 1.70; t-value = -6.54; p = <0.001), and (e) more interesting (pre-test M = 1.44 and post-test M = 1.62; t-value = -2.80; p = 0.006) than they had prior to the video treatment. Overall, the mean attitudinal change were more favorable attitudes towards little brown bats.

See Appendix for Table

Beliefs

There were significant differences between the pre- and post-test responses for 3 of the 5 belief questions (Table 6). The questions with significant differences were: (a) little brown bats are important to the ecosystem (pre-test M = 1.50 and post-test M = 1.70; t-value = -3.11; p = 0.002), (b) little brown bats are beneficial to humans (pre-test M = 0.93 and post-test M = 1.60; t-value = -8.29; p = <0.001), and (c) I like knowing little brown bats exists (pre-test M = 1.46 and post-test M = 1.63; t-value = -3.00; p =

0.003). There was no significant difference between the pre- and post-test for (a) little brown bats are dangerous to humans and (b) little brown bats have the right to exits ($p >$ 0.05). The overall change for the three significantly different questions between the pre- and post-test was that respondents had more favorable beliefs about little brown bats.

See Appendix for Table

Conservation Behaviors

Conservation behavior questions were broken into two main questions: (a) belief questions about conservation efforts and (b) person behavioral intent questions. There were significant differences for 2 of the 4 conservation effort questions (Table 7). The questions with significant differences were: (a) I believe management efforts should aim to increase little brown bat populations (pre-test M = 1.31 and post-test M = 1.55; t-value = -3.15; p = 0.002), and (b) I believe government funding should be spent to protect little brown bats (pre-test M = 1.12 and post-test M = 1.46; t-value = -4.94; p =<0.001). There was no significant change in respondents' beliefs concerning conservation efforts regarding that they could do anything to help in bat conservation and that through cooperation, people will be able to conserve bats in Maine. Although the average responses for both questions in the pre- and post-test was positive between slightly and strongly agree.

For the conservation behaviors concerning personal behavioral intention all 5 questions were significantly different ($p <$ 0.001; Table 7). Generally people agreed more positive intent to perform these behaviors in that they would be more likely to: (a) seek out information about bat conservation (pre-test M = 0.57 and post-test M = 0.84; t-value = -4.34; p = <0.001), (b) share information about bat conservation with others (pre-test M

= 0.57 and post-test M = 0.87; t-value = -4.99; p = <0.001), (c) join or support a bat conservation group (pre-test M = -0.33 and post-test M = 0.04; t-value = -5.78; p = <0.001), (d) help monitor bats (pre-test M = -0.03 and post-test M = 0.30; t-value = -5.61; p = <0.001), and (e) contact legislators to request their support for funding to study white-nose syndrome (pre-test M = -0.35 and post-test M = -0.05; t-value = -4.37; p = <0.001). Overall for the video treatment respondents, participants were more likely to support conservation efforts and do conservation behaviors.

See Appendix for Table

Knowledge

There was a significant difference in the sum differences of pre- and post-test knowledge questions with the post-test knowledge sum difference being higher than the pre-test (Table 8). This shows a higher number of knowledge questions being correct after viewing the video treatment.

See Appendix for Table

Overall, these results support the third research question of whether the video treatment would impact undergraduate student's attitudes toward, beliefs about, and knowledge of little brown bats and WNS.

Differences in Text Treatment

Attitudes

Within the text treatment, there were significant differences in pre- and post-test responses for 4 of the 7 attitude questions (Table 9). The questions with significant differences were participants thought little brown bats were generally: (a) more vulnerable (pre-test M = 0.85 and post-test M = 1.32; t-value = -4.98; p = <0.001), (b)

more attractive (pre-test M = 0.26 and post-test M = 0.40; t-value = -2.10; p = 0.04), (c) less frightening (pre-test M = -0.82 and post-test M = -1.22; t-value = 5.44; p = <0.001), and (d) more beneficial (pre-test M = 1.15 and post-test M = 1.47; t-value = -4.29; p = <0.001). For these significantly different questions, the mean attitudinal change were more favorable attitudes towards little brown bats.

See Appendix for Table

Beliefs

There were significant differences in pre- and post-test responses for 4 of 5 belief questions (Table 10). The questions with significant differences showed a net positive change and were: (a) little brown bats are important to the ecosystem (pre-test M = 1.38 and post-test M = 1.59; t-value = -2.83; p = 0.006), (b) little brown bats are dangerous to humans (pre-test M = -1.01 and post-test M = -1.20; t-value = 2.02; p = 0.05), (c) little brown bats are beneficial to humans (pre-test M = 0.76 and post-test M = 1.30; t-value = -6.72; p = <0.001), and (d) I like knowing little brown bats exist (pre-test M = 1.14 and post-test M = 1.38; t-value = -2.72; p = 0.008). There was no significant difference between the pre- and post-test for '…little brown bats have the right to exist' (p > 0.05). The overall change for the four significantly different questions between the pre- and post-test was that respondents had more favorable beliefs about little brown bats.

See Appendix for Table

Conservation Behaviors

For the conservation behavior questions related to belief about conservation efforts, there were significant differences in pre- and post-test responses for 2 of 4 conservation behavior questions (Table 11). The questions with significant differences

were: (a) I believe management efforts should aim to increase little brown bat populations (pre-test $M = 1.20$ and post-test $M = 1.38$; t-value = -2.55; $p = 0.01$), and (b) I believe government funding should be spent to increase little brown bat populations (pre-test $M = 1.02$ and post-test $M = 1.26$; t-value = -3.34; $p = 0.001$). There was no significant change in respondents' beliefs concerning conservation efforts regarding that they could do anything to help in bat conservation and that through cooperation, people will be able to conserve bats in Maine. Although the average responses for both questions in the pre- and post-test was positive between slight and strongly agree.

For the conservation behaviors concerning personal behavioral intention, 4 of the 5 questions were significantly different ($p < 0.05$) (Table 11). Generally people agreed more positively that they would be more likely to: (a) seek out information about bat conservation (pre-test $M = 0.36$ and post-test $M = 0.68$; t-value = -4.56; $p = <0.001$), (b) share information about bat conservation with others (pre-test $M = 0.47$ and post-test $M = 0.78$; t-value = -3.99; $p = <0.001$), (c) join or support a bat conservation group (pre-test $M = -0.19$ and post-test $M = 0.08$; t-value = -3.43; $p = 0.001$), and (d) help monitor bats (pre-test $M = 0.07$ and post-test $M = 0.25$; t-value = -2.55; $p = 0.01$). The overall trend for these questions were for more favorable conservation behavior intents for bat conservation.

See Appendix for Table

Knowledge

There was a significant difference in the sum differences of pre- and post-test knowledge questions with the post-test knowledge sum difference being higher than the

pre-test (Table 12). This shows a higher number of knowledge questions being correct after viewing the text treatment.

See Appendix for Table

These results answer the third research question of whether the text treatment would impact undergraduate student's attitudes toward, beliefs about, and knowledge of little brown bats and WNS.

Differences Between Video and Text Treatment

There were no significant differences between video and text for any of the mean difference between the pre- and post-test variables tested (attitudes towards, beliefs toward, conservation behaviors toward and knowledge about little brown bats).

See Appendix for Tables

DISCUSSION

This study examined the impact of two communication methods, video and text, had on undergraduate students' attitudes towards, beliefs towards, conservation behaviors concerning and knowledge about WNS and little brown bats. Prior to experiencing one of the two treatments, undergraduate students had, on average, positive attitudes, beliefs, and knowledge regarding little brown bats and WNS which was unexpected as bats are generally disliked by people due to their association with diseases (Kingston, 2016).

Effects within Treatment

Knowledge was included in this study because previous research has found a link between knowledge levels and attitudes. For example, a previous study by Reimer et al. (2013) found that the more knowledge an individual had about a species, especially an uncharismatic species, there was a higher likelihood they possessed more positive attitudes and beliefs were toward the species. A study on bats in the Great Smoky Mountains Nation Park also found that increasing individual's knowledge of bats increases their overall positive attitudes towards them (Fagan, Willcox, & Willcox, 2018). Draheim, Rockwood, Guagnano, and Parsons (2011) found providing information on coyotes to students resulted in students having more favorable attitudes and beliefs towards coyotes. Similar results were found in this study in the differences between pre- and post-test responses within each treatment. These findings illustrate the importance of knowledge in shaping peoples' attitudes and beliefs towards bats and highlights the importance of effective information transmission to the public.

Past research has found that participants tend to have more positive attitudes towards a species after learning about the species rarity (Reimer et al., 2013). Both treatment types emphasized the decline bat populations, including the little brown bat, have experienced due to WNS. Learning about the severity of WNS and the increasing rarity of little brown bats likely contributed to the positive changes in mean attitudinal and belief post-test responses. Based on the cognitive hierarchy, attitudes and beliefs affect an individual's behavior and, based on the results of this study, outreach on little brown bats and their threats positively change attitudes towards, beliefs towards, and behavioral intentions regarding little brown bats and bat conservation. Thus, it can be inferred that including information about the rarity of little brown bats due to WNS can support attitudinal and belief changes in the public and potentially change people's behaviors.

When comparing the results for within treatments, not all the same questions were significantly different between the pre- and post-test for video and text. For example, unlike the video treatment, participants did not find little brown bats more interesting after they had read the text treatment. A study by Choi and Johnson (2010) comparing video and text-based instruction found that master students paid more attention to the video than the text. Choi and Johnson (2010) suggested that the video was more memorable than text because it included both audio and visual components. The differences between media types and the lack of increased interest in little brown bats of text-treatment respondents suggest there could be a significant difference between video and text methods, at least regarding people's interest in a species. A person's interest in a subject is connected to how much they value the subject, with a higher interest resulting

in a higher value for the subject (Prokop et al., 2015). Due to the limits of this study (i.e., sample size and type), it is worthwhile to explore the effectiveness of text versus video when communicating about conservation issues such as WNS.

Neither the video or text treatment significantly increased participants attitudes toward the degree of perceived harmfulness of little brown bats. The lack of significant change in the attitudinal variable, harmless, may be due to the lack of information on diseases, such as rabies, that bats are known to be able to transfer to humans and it would be interesting to see if in a future study. Including information on disease could impact how people judge bats as harmful. There was also no significant change in participants attitudes toward the worth of little brown bat in either treatment despite a significant positive change in participants attitudes toward little brown bats being beneficial. This may be because, although the benefits of bats to humans were discussed in both treatments, it was not discussed in much detail. Including more information on how bats are beneficial to humans may impact people's perception of their worth, although there could be other factors influencing it.

There were significant positive changes in post-test responses for conservation effort and personal behavioral intent regarding bat conservation for the video and text treatment. In both treatments, participants felt that management efforts should be focused on increasing little brown bat populations and for government funding to be used to help protect little brown bats suggesting that the treatments were effective in creating a positive change in how participant's attitudes and beliefs towards, and how they feel about little brown bats. Fagan, Willcox, and Willcox (2018) found that people's attitudes towards bats significantly impacted people's support for bat conservation and

management. This study showed that outreach on little brown bats was able to positively change participant's attitudes and beliefs towards them and, due to this, changed how much they supported bat conservation and management. Based on this, this study indicates that outreach can impact people's support for bat conservation and management.

Both treatments also observed a significant difference in participants personal behavioral intentions for seeking out and sharing information about bat conservation, joining or supporting a bat conservation group, and helping to monitor bats. This result suggests that both outreach treatments made an impact in the level of interest participants had for helping bats and bat conservation. There was also a significant positive difference in the video treatment for personal behavioral intention of contacting legislators to ask for support for funding to research WNS, but this was not observed in the post-test text treatment respondents. A study comparing video and text with behavioral intentions observed participants who have viewed a video tend to have more environmentally favorable behavioral intentions (Perrin, 2011) which could explain why the video-treatment had more significant changes on personal behavioral intent than the text-treatment. This same study also found that, regardless of how the messages are conveyed (i.e. video or text-based), messages that were more emotionally stirring were more likely to lead to favorable environmental behavioral intentions (Perrin, 2011). Since both treatments has similar, if not the same, messages regarding little brown bats and WNS, they would both invoke the same level of emotions and thus is the reason why significant changes in participant's conservation behavior effort and intention in both treatments.

Difference between Video and Text Treatments

Based on the findings, there was no evidence that either video or text treatment has a greater impact on attitudes, beliefs, conservation behaviors concerning and knowledge of little brown bats and WNS. However, as mentioned above, the content of the message may have more impact on an individual's attitudes and beliefs than the method the message was communicated (Perrin, 2011). The lack of significant differences between the two treatments may highlight a need for outreach in general on little brown bats and WNS.

Limitations of Study

One of the limitations to this study was the sample size which consisted of a relatively small number of undergraduate students at the University of Maine. The respondents in this study represent a small subset of undergraduate students at the University of Maine, and an even smaller subset of undergraduate students in WNS-affected areas. Due to this, this study cannot make any inferences on the general public's attitudes toward, beliefs toward, conservation behavioral intention toward or knowledge about little brown bats and WNS as well as how video and text may differ in impact for the public.

Another limitation was the inclusion of only video and text as treatment methods. It is possible that another method of communication, such as a podcast or live speaker, could have significant differences from other forms of communication (e.g. videos, etc.). Related to this, the message content used in both treatments was not looked at in much detail in this study. Message content has been found to impact attitudes, beliefs, and behavioral intentions (Perrin, 2011). The primary focus on choosing and creating the

video and text treatments was that they conveyed certain key take-home messages (e.g. bats are beneficial to humans, WNS is killing bats, etc.) but other aspects of message context, such as message framing (e.g. negatively or positively framed) and persuasiveness, were not considered when evaluating the impact of each treatment.

Conclusions/Further Research

This study contributes to the growing research on conservation outreach methods. Although this study was not able to find a difference in the impact and effectiveness between video and text as outreach methods, the results highlighted the need for outreach on little brown bats and WNS using either type of communication methods. The results from this study support findings in other studies regarding the importance of information on changing peoples' attitudes and beliefs toward unfamiliar, uncharismatic, and generally disliked species such as the little brown bat (Reimer et al., 2014; Prokop et al. 2009). Based on this study, conservation outreach materials and programs aiming to positively change peoples' attitudes and beliefs towards little brown bats should include general information on them as well as information on their decline due to WNS and how they are beneficial to humans. It may also be beneficial to include what people can do to help bat conservation and information on disease transmission.

Further research on outreach methods, and attitudes and beliefs towards disliked species, is needed to better understand the impacts outreach has on the public. Future studies on outreach for little brown bats should examine if and how message content may impact attitudes and beliefs especially in regard to what information is presented (e.g. including or excluding information on bat-transmitted diseases) and how it is framed. Future studies should examine how outreach on little brown bats may impact outdoor

recreationalists, such as cavers, specifically because of their role in the spread of WNS. Future studies should also include a wider variety of outreach methods and a larger sample size that better represents the general public.

REFERENCES

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting behavior*. Englewood Cliffs N.J.: Prentice-Hall.

Boyles, J. G., Cryan, P. M., McCracken, G. F., & Kunz, T. H. (2011). Economic importance of bats in agriculture. *Science*, 332(6025), 41-42.

Center for Conservation Social Science. (2018). Bats in New York: What do Albany county residents think?, Cornell University.

Choi, H. J., & Johnson, S. D. (2010). The effect of context-based video instruction on learning and motivation in online courses. *The American Journal of Distance Education*, 19(4), 215-227.

Draheim, M. M., Rockwood, L. L., Guagnano, G., & Parsons, E. C. M. (2011). The impact of information on student's beliefs and attitudes toward coyotes. *Human Dimensions of Wildlife*, 16(1), 67-72.

Fagan, K. E., Willcox, E. V., & Willcox, A. S. (2018). Public attitudes toward the presence and management of bats roosting in building in Great Smoky Mountains National Park, Southeastern United States. *Biological Conservation,* 220, 132-139.

Fenton, M. B. (2012). Bats and white-nose syndrome. *Proceedings of the National Academy of Sciences of the United States of American*, 109(18), 6794-6795.

Foley, J., Clifford, D., Castle, K., Cryan, P., & Ostfeld, R.S. (2011). Investigating and managing the rapid emergence of white-nose syndrome, a novel, fatal, infectious disease of hibernating bats. *Conservation Biology*, 25(2), 223-231.

Frick, W. F., Puechmaille, S. J., & Willis, C. K. R. (2016). White-nose syndrome in bats. In C. C. Voigt & T. Kingston (Eds.), *Bats in the Anthropocene: Conservation of bats in a changing world* (pp. 245-262). New York, NY: Springer.

Gunnthorsdottir, A. (2001). Physical attractiveness of an animal species as a decision factor for its preservation. *Anthrozoös*, 14(4), 204-215.

Hayes, M. A. (2012). The Geomyces fungi: Ecology and distribution. *BioScience*, 62(9), 819-823.

Kingston, T. (2016). Cute, creepy, or crispy – how values, attitudes, and norms shape human behavior toward bats. In C. C. Voigt & T. Kingston (Eds.), *Bats in the Anthropocene: Conservation of bats in a changing world* (pp. 571-595). New York, NY: Springer.

Landay, J., & Bridge, R. G. (1982). Video vs. wall panel display: An experiment in museum learning. *Curator*, 25(1), 41-56.

Langwig, K. E., Frick, W. F., Bried, J. T., Hicks, A. C., Kunz, T. H., & Kilpatrick, A. M. (2012). Sociality, density-dependence and microclimates determine the persistence of populations suffering from a novel fungal disease, white-nose syndrome. *Ecology Letters*, 15, 1050-1057.

Leeds, A., Lukas, K. E., Kendall, C. J., Slavin, M. A., Ross, E. A., Robbins, M. M.,…Bergl, R. A. (2017). Evaluating the effect of a year-long film focused environmental education program on Ugandan student knowledge of and attitudes toward great apes. *American Journal of Primatology*, 79, 1-9.

Lorch, J. M., Meteyer, C. U., Behr, M. J., Boyles, J. G., Cryan, P. M., Hicks, A. C.,…Blehert, D. S. (2011). Experimental infection of bats with Geomyces destructans causes white-nose syndrome. *Nature*, 480, 376-379.

Lorch, J. M., Muller, L. K., Russell, R. E., O'Connor, M., Lindner, D. L., & Blehert, D. S. (2013). Distribution and environmental persistence of the causative agent of white-nose syndrome, *Geomyces destructans*, in bat hibernacula of the eastern United States. *Applied and Environmental Microbiology*, 79(4), 1293-1301.

Manfredo, M. J. (2008). *Who cares about wildlife?*. New York, NY: Springer.

Maslo, B., Valen, M., Gumbs, J. F., & Frick, W. F. (2015). Conservation implications of ameliorating survival of little brown bats with white-nose syndrome. *Ecological Applications*, 25(7), 1832-1840.

Merkt, M., Weigand, S., Heier, A., & Schwan, S. (2011). Learning with videos vs. learning with print: The role of interactive features. *Learning and Instruction*, 21, 687-704.

Meteyer, C. U., Barber, D., & Mandl, J. N. (2012). Pathology in euthermic bats with white nose syndrome suggests a natural manifestation of immune reconstitution inflammatory syndrome. *Virulenc*e, 3(7), 583-588.

Miller, Z. D., Freimund, W., Metcalf, E. C., & Nickerson, N. (2018). Targeting your audience: Wildlife value orientations and the relevance of messages about bear safety. *Human Dimensions of Wildlife*, 23(3), 213-226. doi:10.1080/10871209.2017.1409371

Miller, Z. D., Jorgenson, J., Nickerson, N. P., & Pitas, N. A. (2018). A cognitive hierarchy approach to understanding fee increases in the national parks of the United States. *Journal of Outdoor Recreation and Tourism*, 22, 18-25.

U.S. Fish and Wildlife Service. (2011). *A national plan for assisting states, federal agencies, and tribes in managing white-nose syndrome in bats*. Washington: Federal Information & News Dispatch, Inc.

Perrin, J. L. (2011). Emotional responses to environmental messages and future behavioral intentions. *Applied Environmental Education & Communication*, 10(3), 146-157. doi:10.1080/1533015X.2011.603612

van Polanen Petel, T., & Bunce, A. (2012). Understanding beach users' behavior, awareness, and attitudes to shorebird conservation in central Queensland: Tools for effective shorebird conservation. *Coastal Management*, 40(5), 501-509. doi:10.1080/08920753.2012.709464

Prokop, P., Fančovičová, J., & Kubiatko, M. (2009). Vampires are still alive: Slovakian students' attitudes toward bats. *Anthrozoös*, 22(1), 19-30. doi:10.2752/175303708X390446s

Raloff, J. (2012). Europe bat pest more potent. *Science News*, 181(10), 9.

Reimer, A., Mase, A., Mulvaney, K., Mullendore, N., Perry-Hill, R., & Prokopy, L. (2014). The impact of information and familiarity on public attitudes toward the eastern hellbender. *Animal Conservation*, 17(3), 235-243. doi:10.1111/acv.12085

Stern, M. J., Ardoin, N. M., & Powell, R. B. (2017). Exploring the effectiveness of outreach strategies in conservation projects: The case of the Audubon Toyota TogetherGreen program. *Society & Natural Resources*, 30(1), 95-111. doi:10.1080/08941920.2016.1164266

Teel, T. L., & Manfredo, M. J. (2010). Understanding the diversity of public interests in wildlife conservation. *Conservation Biology*, 24(1), 128-139. doi:10.1111/j.1523-1739.2009.01374.x

Untamed Science. (2017). White-nosed syndrome in bats. Retrieved from http://www.untamedscience.com/biology/ecology/ecology-articles/white-nose-syndrome-bats/

Vaske, J. J., & Donnelly, M. P. (1999). A value-attitude-behavior model predicting wildland preservation voting intentions. *Society & Natural Resources, 12*(6), 523-537. doi: 10.1080/089419299279425

Vaske, J. J. & Manfredo, M. J. (2012). Social psychological considerations in wildlife management. In D. J. Decker, S. J. Riley, & W. F. Siemer (Eds.) *Human dimensions of wildlife management* (pp. 43-57). Baltimore, M. D.: The Johns Hopkins University Press.

Warnecke, L., Turner, J. M., Bollinger, T. K., Lorch, J. M., Misra, V., Cryan, P. M.,…Willis, C. K. R. (2012). Inoculation of bats with European Geomyces destructans supports the novel pathogen hypothesis for the origin of white-nose syndrome. *Proceedings of the National Academy of Sciences of the United States of America*, 109(18), 6999-7003. doi:10.1073/pnas.1200374109

Willis, C. K., Menzies, A. K., Boyles, J. G., & Wojciechowski, M. S. (2011). Evaporative water loss is a plausible explanation for mortality of bats from white-nose syndrome. *Integrative and Comparative Biology*, 51, 364-373.

Zinn, H. C., Manfredo, M. J., & Barro, S. C. (2002). Patterns of wildlife value orientations in hunters' families. *Human Dimensions of Wildlife*, 7(3), 147-162. doi:10.1080/10871200260293324

TABLES

Table 1. Differences between sex and student's prior experience, prior knowledge, and self-assessed level of knowledge using an Independent t-test.

	Male	Female	*t*-value	*p*-value[3]
Prior Knowledge[1]				
Sum of all binary pretest knowledge questions	4.47	4.45	-0.05	0.96
Self-assessed Level of Knowledge[2]				
Bats in Maine	1.99	2.05	0.47	0.64
White-nose syndrome	1.73	1.78	0.35	0.73
Rabies	2.51	2.71	1.67	0.10

[1] The response categories consisted of true, false, and not sure for each knowledge question.
[2] Each question is on a 5-point Likert-like scale from 1 not at all knowledgeable to 5 extremely knowledgeable.
[3] Equal variance can be assumed for all tests.
[*] Equal variance cannot be assumed ($p > 0.05$) and Tahame post-hoc test was used.

Table 2. Differences between years in college and student's prior knowledge, and self-assessed level of knowledge using a one-way ANOVA.

	n	1st Year	Sophomore	Junior	Senior	5th Year Plus	F-value	*p*-value [3]	Eta
***Prior Knowledge*[1]**									
Sum of all binary pretest knowledge questions	232	1.05	4.49	4.44	4.94	5.33	1.42	0.23	.16
***Self-assessed Level of Knowledge*[2]**									
Bats in Maine	233	1.91 [a]	2.01 [a]	2.00 [a]	2.06[ab]	3.00 [b]	2.71	0.03	.21
White-nose syndrome	233	1.63 [a]	1.78 [ab]	1.64 [a]	1.91 [ab]	2.67 [b]	3.08	0.02	.23
Rabies	233	2.67	2.64	2.44	2.71	3.22	1.61	0.17	.17

[a,b,c] The letter superscripts denote significant differences between means based on the Bonferroni post-hoc test.
[1] This is a summed index where the original 7 knowledge questions were coded as 1 = correct and 0 = incorrect.
[2] Each question is on a 5-point Likert-like scale from 1 not at all knowledgeable to 5 extremely knowledgeable.
[3] Equal variance can be assumed and Bonferroni post-hoc test was used to test differences between groups.

Table 3. Differences between major, organized into non-conservation related majors and conservation related majors, and student's prior knowledge, and self-assessed level of knowledge using an Independent *t*-test.

	Non-conservation related majors	Conservation related majors	*t*-value	*p*-value[3]
Prior Knowledge[1]				
Sum of all binary pretest knowledge questions	3.78	4.91	1.07	<0.001
Self-assessed Level of Knowledge[2]				
Bats in Maine	1.96	2.06	3.58	0.43
White-nose syndrome	1.51	1.92	5.14	<0.001*
Rabies	2.64	2.62	0.25	0.87

[1] The response categories consisted of true, false, and not sure for each knowledge question.
[2] Each question is on a 5-point Likert-like scale from 1 not at all knowledgeable to 5 extremely knowledgeable.
[3] Equal variance can be assumed unless specified with an * then equal variance cannot be assumed ($p > 0.05$).

Table 4. Pre-test attitudes, beliefs, and sum knowledge questions for undergraduate students.

	Pre-Test (*M*)
How much do you agree with the following …[1]	
… Little brown bats are important to the ecosystem	1.44
… Little brown bats are dangerous to humans	-1.14
… Little brown bats are beneficial to humans	0.85
… I like knowing little brown bats exist	1.30
… Little brown bats have the right to exist	1.79
In general, do you think of little brown bats as…[1]	
Harmless	1.04
Worthless	-1.58
Vulnerable	0.92
Attractive	0.33
Frightening	-0.88
Beneficial	1.18
Interesting	1.34
Sum Knowledge Index[2]	
Sum differences of pre-test and post-test knowledge	4.46

[1] Questions were on a 5-point Likert-like scale from -2 strongly disagree to +2 strongly agree.
[2] This is a summed index where the original 7 knowledge questions were coded as 1 = correct and 0 = incorrect.

Table 5. Differences between pre- and post-test video treatment on attitudes toward little brown bats using a paired *t*-test.

In general, do you think of little brown bats as…[1]	Pre-test (*M*)	Post-test (*M*)	*t*-value	*p*-value[2]
Harmless	1.17	1.08	0.74	0.46
Worthless	-1.63	-1.73	1.92	0.06
Vulnerable	0.99	1.54	-6.91	<0.001
Attractive	0.42	0.72	-4.13	<0.001
Frightening	-0.96	-1.23	3.48	0.001
Beneficial	1.21	1.70	-6.54	<0.001
Interesting	1.44	1.62	-2.80	0.006

[1] Questions were on a 5-point Likert-like scale from -2 strongly disagree to +2 strongly agree.
[2] Equal variance can be assumed.

Table 6. Differences between pre- and post-test video treatment on beliefs toward little brown bats using a paired *t*-test.

How much do you agree with the following …[1]	Pre-test (*M*)	Post-Test (*M*)	*t*-value	*p*-value[2]
… Little brown bats are important to the ecosystem	1.50	1.70	-3.11	0.002
… Little brown bats are dangerous to humans	-1.26	-1.26	<0.001	1.00
… Little brown bats are beneficial to humans	0.93	1.60	-8.29	<0.001
… I like knowing little brown bats exist	1.46	1.63	-3.00	0.003
… Little brown bats have the right to exist	1.84	1.82	0.10	0.47

[1] Questions were on a 5-point Likert-like scale from -2 strongly disagree to +2 strongly agree.
[2] Equal variance can be assumed.

Table 7. Differences between pre- and post-test video treatment on conservation behaviors related to bats and white-nose syndrome using a paired *t*-test.

Conservation Behavior Questions[1]	Pre-test (*M*)	Post-test (*M*)	*t*-value	*p*-value[2]
How much do you agree with the following…				
There are things I can do to help with bat conservation	1.28	1.30	-0.36	0.72
I believe that by working together people will be able to conserve bats in Maine	1.50	1.57	-0.91	0.36
I believe management efforts should aim to increase little brown bat populations	1.31	1.55	-3.15	0.002
I believe government funding should be spent to protect little brown bats	1.12	1.46	-4.94	<0.001
How likely are you to do the following…				
Seek out information about bat conservation	0.57	0.84	-4.34	<0.001
Share information about bat conservation with others	0.57	0.87	-4.99	<0.001
Join or support a bat conservation group	-.033	0.04	-5.78	<0.001
Help to monitor bats	-0.03	0.30	-5.61	<0.001
Contact legislators to request their support for funding to study white-nose syndrome	-0.35	-0.05	-4.37	<0.001

[1] Questions were on a 5-point Likert-like scale from -2 strongly disagree to +2 strongly agree.
[2] Equal variance can be assumed.

Table 8. Differences between pre- and post-test video treatment on the sum knowledge index about little brown bats and white-nose syndrome using a paired *t*-test.

Sum Knowledge Index[1]	Pre-test (*M*)	Post-test (*M*)	*t*-value	*p*-value[2]
Sum differences of pre-test and post-test knowledge	4.76	6.24	-8.84	<0.001

[1] This is a summed index where the original 7 knowledge questions were coded as 1 = correct and 0 = incorrect.
[2] Equal variance can be assumed.

Table 9. Differences between pre- and post-test text treatment on attitudes toward little brown bats using a paired *t*-test.

In general, do you think of little brown bats as…[1]	Pre-test (*M*)	Post-test (*M*)	*t*-value	*p*-value[2]
Harmless	0.94	1.04	-1.18	0.24
Worthless	-1.55	-1.69	1.81	0.07
Vulnerable	0.85	1.32	-4.98	<0.001
Attractive	0.26	0.40	-2.10	0.04
Frightening	-0.82	-1.22	5.44	<0.001
Beneficial	1.15	1.47	-4.29	<0.001
Interesting	1.25	1.37	-1.77	0.08

[1] Questions were on a 5-point Likert-like scale from -2 strongly disagree to +2 strongly agree.
[2] Equal variance can be assumed.

Table 10. Differences between pre- and post-test text treatment on beliefs toward little brown bats using a paired *t*-test.

How much do you agree with the following…[1]	Pre-test (*M*)	Post-test (*M*)	*t*-value	*p*-value[2]
…Little brown bats are important to the ecosystem	1.38	1.59	-2.83	0.006
…Little brown bats are dangerous to humans	-1.01	-1.20	2.02	0.05
…Little brown bats are beneficial to humans	0.76	1.30	-6.72	<0.001
…I like knowing little brown bats exist	1.14	1.38	-2.72	0.008
…Little brown bats have the right to exist	1.74	1.66	1.41	0.16

[1] Questions were on a 5-point Likert-like scale from -2 strongly disagree to +2 strongly agree.
[2] Equal variance can be assumed.

Table 11. Differences between pre- and post-test text treatment on conservation behaviors related to bats and white-nose syndrome using a paired *t*-test.

Conservation Behaviors[1]	Pre-test (*M*)	Post-test (*M*)	*t*-value	*p*-value[2]
How much do you agree with the following…				
There are things I can do to help with bat conservation	1.04	1.16	-1.89	0.06
I believe that by working together people will be able to conserve bats in Maine	1.33	1.41	-1.12	0.27
I believe management efforts should aim to increase little brown bat populations	1.20	1.38	-2.55	0.01
I believe government funding should be spent to protect little brown bats	1.02	1.26	-3.34	0.001
How likely are you to do the following…				
Seek out information about bat conservation	0.36	0.68	-4.56	<0.001
Share information about bat conservation with others	0.47	0.78	-3.99	<0.001
Join or support a bat conservation group	-0.19	0.08	-3.43	0.001
Help to monitor bats	0.07	0.25	-2.55	0.01
Contact legislators to request their support for funding to study white-nose syndrome	-0.20	-0.09	-1.60	0.11

[1] Questions were on a 5-point Likert-like scale from -2 strongly disagree to +2 strongly agree.
[2] Two-tailed significance

Table 12. Differences between pre- and post-test text treatment on sum knowledge index about little brown bats and white-nose syndrome using a paired *t*-test.

Sum Knowledge Index[1]	Pre-test (*M*)	Post-test (*M*)	*t*-value	*p*-value[2]
Sum differences of pre-test and post-test knowledge	4.19	6.03	-8.29	<0.001

[1] This is a summed index where the original 7 knowledge questions were coded as 1 = correct and 0 = incorrect.
[2] Equal variance can be assumed.

Table 13. Mean differences between video and text treatments of attitudes toward little brown bat responses respectively using an independent *t*-test.

In general, do you think of little brown bats as…[1]	Video (*M*)	Text (*M*)	*t*-value	*p*-value[2]
Harmless	-0.09	0.10	1.96	0.19
Worthless	-0.11	-0.14	3.40	0.73
Vulnerable	0.55	0.48	2.06	0.58
Attractive	0.29	0.14	3.98	0.11
Frightening	-0.27	-0.40	0.11	0.23
Beneficial	0.49	0.32	0.75	0.13
Interesting	0.17	0.12	0.03	0.56

[1] Questions were on a 5-point Likert-like scale from -2 strongly disagree to +2 strongly agree.
[2] Variance can be assumed equal.

Table 14. Mean differences between video and text treatments of beliefs toward little brown bat responses respectively using an independent *t*-test.

How much do you agree with the following…[1]	Video (*M*)	Text (*M*)	*t*-value	*p*-value[2]
Little brown bats are important to the ecosystem	0.20	0.21	0.24	0.89
Little brown bats are dangerous to humans	0.00	-0.19	2.62	0.13
Little brown bats are beneficial to humans	0.67	0.54	0.11	0.25
I like knowing little brown bats exist	0.17	0.24	7.61	0.48
Little brown bats have the right to exist	-0.03	-0.08	4.28	0.44

[1] Questions were on a 5-point Likert-like scale from -2 strongly disagree to 2 strongly agree.
[2] Variance can be assumed equal.

Table 15. Mean differences between video and text treatments of sum knowledge index about little brown bats and white-nose syndrome responses respectively using an independent *t*-test.

	Video (*M*)	Text (*M*)	*t*-value	*p*-value[2]
Sum differences of pre- and post-test knowledge	1.47	1.86	5.49	0.16

[1] State the response categories for the two questions.
[2]Variance can be assumed equal.

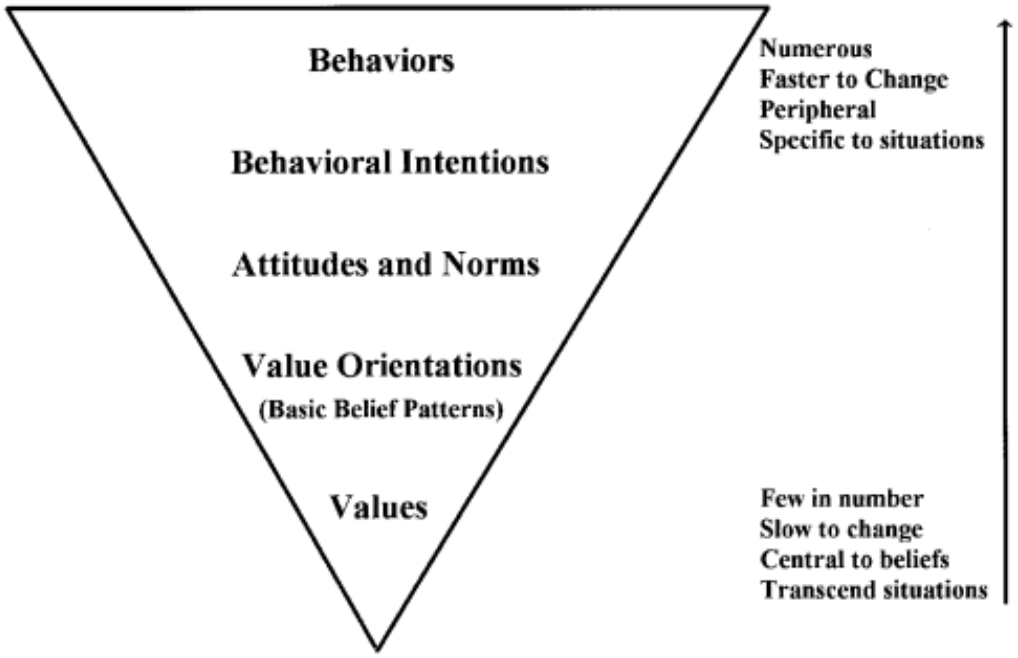
Table 16. Mean differences between video and text treatments of conservation behaviors related to bats and white-nose syndrome responses respectively using an independent t-test.

Conservation Behaviors[1]	Video (*M*)	Text (*M*)	*t*-value	*p*-value[2]
How much do you agree with the following…				
There are things I can do to help with bat conservation	0.03	0.12	0.12	0.33
I believe that by working together people will be able to conserve bats in Maine	0.06	0.08	1.49	0.87
I believe management efforts should aim to increase little brown bat populations	0.23	0.19	0.006	0.66
I believe government funding should be spent to protect little brown bats	0.34	0.24	0.23	3.11
How likely are you to do the following…				
Seek out information about bat conservation	0.27	0.32	1.13	0.61
Share information about bat conservation with others	0.30	0.31	3.49	0.90
Join or support a bat conservation group	0.37	0.26	0.002	0.28
Help to monitor bats	0.32	0.18	0.006	0.13
Contact legislators to request their support for funding to study white-nose syndrome	0.30	0.11	2.90	0.06

[1] Questions were on a 5-point Likert-like scale from -2 strongly disagree to +2 strongly agree.
[2]Variance can be assumed equal.

FIGURES

Figure 1. The structure of the cognitive hierarchy from Vaske & Donnelly (1999).



APPENDICES

APPENDIX A

Sample Recruitment Scripts

Email to Professors

Hello,

My name is Kiley Davan and I was/am in your [course name] (if applicable). I am a senior in the Honors College and Wildlife Ecology program. I am currently working on my honors thesis and I am examining differences in media communication platforms and people's attitudes towards white-nose syndrome (WNS) in bats, specifically how video vs. text impact undergraduate students' attitudes. Examining the differences in media platform effectiveness could help conservation organizations create more effective outreach programs relating to WNS. This research is significant as there are minimal studies examining people's attitudes towards bats and people's attitudes towards bats on white-nose syndrome.

I am emailing you today because I am wondering if you would be willing to have your undergraduate students participate in my project by distributing my survey to your class. If you're willing to have your class participate the survey can be sent out in three ways:

An email that you can forward to your class(es), or
A link and directions that you can post to a class webpage (such as Blackboard)

Participation would also include sending another email to your class two weeks after the initial invitation to remind students to complete the survey. I will send you a reminder email at that time.

Participation in the voluntary survey should take about 15-20 minutes and is anonymous. There is a raffle that students can enter to win one of five $10.00 Amazon gift cards after completing the survey or if you are interested, you could giving extra credit to students who participate, this option is completely up to you.

Thank you for your time. Please let me know if you are willing to distribute my survey and/or have any questions or concerns.

Sincerely,
Kiley Davan

Email/Instructions to Students

Hello,

My name is Kiley Davan and I am a senior in the Honors College and Wildlife Ecology program here at UMaine. For my honors thesis, I am examining how different forms of communication platforms influence undergraduate student's attitudes towards white-nose syndrome (WNS) in bats. Understanding these differences are important because this could support the design of effective conservation messaging in the future.

I am wondering if you would be willing to participate in an anonymous and voluntary survey. The survey involves answering some questions, viewing a short video (~5 minutes) or reading a blurb, and then answering some of the same questions you answered before watching or reading the material presented. This survey may take about 15-20 minutes to complete. At the end of the survey you can enter to **WIN** 1 of 5 **$10.00 Amazon gift cards**.

This survey can only be completed once and you must be 18 years or older to participate. You may choose to stop participating at any time. If you choose to participate, you will be asked to answer questions related to your beliefs and attitudes toward bats.

If you are interested in participating, you can access the survey through the link below. Thank you for your time.

Start Survey Here [Link to Survey]

Sincerely
Kiley Davan

Reminder to Participate

Hello,

I am emailing to remind you to participate in my survey. If you have already participated, thank you so much. And if you have not, I would greatly appreciate it if you could take the time to complete my survey, see link below. The survey will close in 2 weeks (insert date). I really appreciate your support and I am very interested to hear from you.

Start Survey Here:

Sincerely,
Kiley Davan

APPENDIX B

IRB Application Cover Page

APPLICATION COVER PAGE

- ***KEEP THIS PAGE AS ONE PAGE – DO NOT CHANGE MARGINS/FONTS!!!!!!!!!***
- ***PLEASE SUBMIT THIS PAGE AS WORD DOCUMENT***

APPLICATION FOR APPROVAL OF RESEARCH WITH HUMAN SUBJECTS
Protection of Human Subjects Review Board, 400 Corbett Hall

(Type inside gray areas)
PRINCIPAL INVESTIGATOR: Kiley Davan **EMAIL:** Kiley.m.davan@maine.edu

FACULTY SPONSOR: Carly Sponarski **EMAIL:** carlycs@maine.edu
(Required if PI is a student):
TITLE OF PROJECT: How different methods of communication impact people's attitudes towards White-nose syndrome in bats
START DATE: September 13, 2018 **PI DEPARTMENT:** Wildlife, Fisheries, and Conservation Biology
FUNDING AGENCY (if any): N/A

STATUS OF PI: FACULTY/STAFF/GRADUATE/UNDERGRADUATE U (F,S,G,U)

1. **If PI is a student, is this research to be performed:**

   ☒ for an honors thesis/senior thesis/capstone? ☐ for a master's thesis?
   ☐ for a doctoral dissertation? ☐ for a course project?
   ☐ other (specify)

2. **Does this application modify a previously approved project? N (Y/N). If yes, please give assigned number (if known) of previously approved project:**

3. **Is an expedited review requested? Y (Y/N).**

Submitting the application indicates the principal investigator's agreement to abide by the responsibilities outlined in Section I.E. of the Policies and Procedures for the Protection of Human Subjects.

Faculty Sponsors are responsible for oversight of research conducted by their students. The Faculty Sponsor ensures that he/she has read the application and that the conduct of such research will be in accordance with the University of Maine's Policies and Procedures for the Protection of Human Subjects of Research. REMINDER: if the principal investigator is an undergraduate student, the Faculty Sponsor MUST submit the application to the IRB.

Email this cover page and complete application to UMRIC@maine.edu

****

FOR IRB USE ONLY **Application # 2018-08-12** **Review (F/E): E Expedited Category:**
ACTION TAKEN:

☒ **Judged Exempt; category 2 Modifications required? Yes Accepted (date) 9/13/2018**
☐ **Approved as submitted. Date of next review: by Degree of Risk:**
☐ **Approved pending modifications. Date of next review: by Degree of Risk:**
Modifications accepted (date):
☐ **Not approved (see attached statement)**
☐ **Judged not research with human subjects**

FINAL APPROVAL TO BEGIN **9/13/2018**
Date

01/2017

APPENDIX C

Informed Consent

You are invited to participate in a research project being conducted by Kiley Davan, an undergraduate student in the Wildlife Ecology program, and Dr. Carly Sponarski, a faculty member in the Department of Wildlife, Fisheries, and Conservation Biology at the University of Maine. The goal of this project is to see if different forms of communication have an impact on people's attitudes towards bats, specifically Little Brown bats, and which method has the greatest positive impact. You must be at least 18 years of age to participate.

What will you be asked to do?

If you decide to participate in this survey, you will be asked to fill out the following online questionnaire about your beliefs and attitudes related to bats. You will be asked to complete a pre-survey, view either a short video or reading, and complete a post-survey. It may take approximately 20 minutes to complete the survey.

Risks

Risk to participants is minimal.

Benefits

Benefits for participating in this study include the knowledge and further understanding gained through this research about people's attitudes towards bats and white-nose syndrome, and which method is most effective for public outreach on these subjects. There are no direct benefits to you.

Confidentiality

Precautions will be taken to insure that your confidentiality is maintained. Names and email addresses will not be associated to your survey answers in any way. If you choose to participate in the raffle, you will be directed to a separate page. Data will be kept on a password protected computer and kept indefinitely.

Voluntary

Participation is voluntary. If you choose to participate in this study, you may stop at any time. You may skip any questions you do not wish to answer. Submission of survey implies consent to participate in this study.

Compensation

Compensation for participating will be possibly winning one of the five $10.00 Amazon gift cards in the raffle.

Contact Information

If you have any questions, please contact Kiley Davan at kiley.m.davan@maine.edu. You may also reach the faculty advisor on this study at carly.cs@maine.edu. If you have any questions about your rights as a research participant, please contact the Office of Research Compliance, University of Maine, 207/581-1498 or 207/581-2657 (or e-mail umric@maine.edu).

APPENDIX D

Sample Questionnaire

Pre-test

Section A: In this section, we are going to ask you questions about your knowledge of bats.

We would like to know about your knowledge and experience with bats before you start the survey.

	Yes	No	Not Sure
Did you know bats live in Maine?	○	○	○
Have you seen a bat in the wild?	○	○	○
Have you had a negative experience with bats?	○	○	○
Had you ever heard of white-nose syndrome?	○	○	○

Section B: In this section we are going to ask you questions about your general beliefs about wildlife.

To what extent do you disagree or agree with each of the following statements?

	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree
We should strive for a world where humans and wildlife can live side by side without fear.	○	○	○	○	○
The needs of humans should take priority over wildlife protection.	○	○	○	○	○
I view all living things as part of one big family.	○	○	○	○	○
Wildlife are like my family and I want to protect them.	○	○	○	○	○
Humans should manage wildlife populations so that humans benefit.	○	○	○	○	○
I feel a strong emotional bond with animals.	○	○	○	○	○
Wildlife is on earth primarily for people's benefit.	○	○	○	○	○
Wildlife is only valuable if it produces human benefits.	○	○	○	○	○

Section C: In this section, we are going to ask you beliefs about little brown bats.

To what extent do you disagree or agree with each of the following?

	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree
Little brown bats are important to the ecosystem.	○	○	○	○	○
Little brown bats are dangerous to humans.	○	○	○	○	○
Little brown bats are beneficial to humans.	○	○	○	○	○
I like knowing that little brown bats exist.	○	○	○	○	○
Little brown bats have the right to exist.	○	○	○	○	○

In general, do you think of little brown bats as:

	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree
Harmless	○	○	○	○	○
Worthless	○	○	○	○	○
Vulnerable	○	○	○	○	○
Attractive	○	○	○	○	○
Frightening	○	○	○	○	○
Beneficial	○	○	○	○	○
Interesting	○	○	○	○	○

How knowledgeable are you about the following?

	Not at All Knowledgeable	Somewhat Knowledgeable	Knowledgeable	Highly Knowledgeable	Extremely knowledgeable
Bats that live in Maine	○	○	○	○	○
White-nose syndrome	○	○	○	○	○
Rabies	○	○	○	○	○

How likely do you believe that bats in Maine will get white-nose syndrome?

- o Not at All Likely
- o Somewhat Likely
- o Likely
- o Highly Likely
- o Extremely Likely

How severe do you believe the consequences of bats getting white-nose syndrome to be?

- o Not at All Severe
- o Somewhat Severe
- o Severe
- o Highly Severe
- o Extremely Severe

Section D: In the following section, you will be asked questions on your knowledge of bats, specifically little brown bats.

The following are true and false statements about little brown bats. Please answer to the best of your ability.

	True	False	Not Sure
Little brown bats hibernate in caves during winter.	o	o	o
Little brown bat populations have significantly declined.	o	o	o
Insect eating bats provide important pest control services to the agricultural industry in the US.	o	o	o
White-nose syndrome is a major threat to bats in the United States.	o	o	o
White-nosed syndrome is caused by a fungus.	o	o	o
When people visit caves, they may spread white-nose syndrome in bats without knowing it.	o	o	o
White nose syndrome kills bats by causing them to use up all of their fat reserves which they need to survive winter.	o	o	o

Section E: In the following section, you will be asked questions about management and awareness relating to bats.

To what extent do you disagree or agree with each of the following?

	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree
There are things I can do to help with bat conservation.	○	○	○	○	○
I believe that by working together people will be able to conserve bats in Maine.	○	○	○	○	○
I believe management efforts should aim to increase little brown bat populations.	○	○	○	○	○
I believe government funding should be spent to protect little brown bats.	○	○	○	○	○

How likely are you to do the following in the future?

	Extremely Unlikely	Unlikely	Neither	Likely	Extremely Likely
Seek out information about bat conservation.	○	○	○	○	○
Share information about bat conservation with others.	○	○	○	○	○
Join or support a bat conservation group.	○	○	○	○	○
Help to monitor bats.	○	○	○	○	○
Contact legislators to request their support for funding to study white-nose syndrome.	○	○	○	○	○

[INSERT VIDEO OR TEXT TREATMENT HERE]

Post-test

Section F: In this section, you will be asked about how you feel your knowledge has changed.

How knowledgeable about the following do you feel now?

	Not at All Knowledgeable	Somewhat Knowledgeable	Knowledgeable	Highly Knowledgeable	Extremely knowledgeable
Bats that live in Maine	○	○	○	○	○
White-nose syndrome	○	○	○	○	○
Rabies	○	○	○	○	○

Section G: In this section, we are going to ask you beliefs about little brown bats.

To what extent do you disagree or agree with each of the following?

	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree
Little brown bats are important to the ecosystem.	○	○	○	○	○
Little brown bats are dangerous to humans.	○	○	○	○	○
Little brown bats are beneficial to humans.	○	○	○	○	○
I like knowing that little brown bats exist.	○	○	○	○	○
Little brown bats have the right to exist.	○	○	○	○	○

In general, do you think of little brown bats as:

	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree
Harmless	○	○	○	○	○
Worthless	○	○	○	○	○
Vulnerable	○	○	○	○	○
Attractive	○	○	○	○	○
Frightening	○	○	○	○	○
Beneficial	○	○	○	○	○
Interesting	○	○	○	○	○

Section H: In the following section, you will be asked questions again on your knowledge of bats, specifically little brown bats.

The following are true and false statements about little brown bats. Please answer to the best of your ability.

	True	False	Not Sure
Little brown bats hibernate in caves during winter.	○	○	○
Little brown bat populations have significantly declined.	○	○	○
Insect eating bats provide important pest control services to the agricultural industry in the US.	○	○	○
White-nose syndrome is a major threat to bats in the United States.	○	○	○
White-nosed syndrome is caused by a fungus.	○	○	○
When people visit caves, they may spread white-nose syndrome in bats without knowing it.	○	○	○
White nose syndrome kills bats by causing them to use up all of their fat reserves which they need to survive winter.	○	○	○

Section I: In the following section, you will be asked questions about management and awareness relating to bats.

To what extent do you disagree or agree with each of the following?

	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree
There are things I can do to help with bat conservation.	○	○	○	○	○
I believe that by working together people will be able to conserve bats in Maine.	○	○	○	○	○
I believe management efforts should aim to increase little brown bat populations.	○	○	○	○	○
I believe government funding should be spent to protect little brown bats.	○	○	○	○	○

How likely are you to do the following in the future?

	Extremely Unlikely	Unlikely	Neither	Likely	Extremely Likely
Seek out information about bat conservation.	○	○	○	○	○
Share information about bat conservation with others.	○	○	○	○	○
Join or support a bat conservation group.	○	○	○	○	○
Help to monitor bats.	○	○	○	○	○
Contact legislators to request their support for funding to study white-nose syndrome.	○	○	○	○	○

Section J: In this section we are going to ask questions to get to know you.

Are you an undergraduate student at the University of Maine in Orono, Maine?

- ○ Yes
- ○ No

What is your major?
Accounting - Animal and Veterinary Sciences - Anthropology - Army ROTC - Art Education - Art History - Athletic Training -Biochemistry - Bioengineering - Biology - Botany - Chemical Engineering - Chemistry - Child Development and Family Relations - Civil and Environmental Engineering - Communications - Communication Sciences and Disorder - Computer Engineering - Computer Science - Construction Engineering Technology – Earth and Climate Sciences - Economics - Ecology and Environmental Sciences – Electrical Engineering Technology - Elementary Education - Engineering Physics - English - Environmental Horticulture - Finance - Financial Economics - Food Science and Human Nutrition - Forest Operations, Bioproducts, and Bioengineering - Forestry - French - History - Human Dimensions of Climate Change - International Affairs - Journalism - Kinesiology and Physical Education - Management - Marine Sciences - Marketing - Mass Communication - Mathematics - Mechanical Engineering - Mechanical Engineering Technology - Medical Laboratory Sciences – Microbiology Molecular and Cellular Biology - Music - Music Education - Music Performance - New Media - Nursing - Parks, Recreation, and Tourism - Philosophy - Physics and Astronomy - Political Science - Pre-Business - Pre-Engineering - Psychology - Romance Languages - Secondary Education - Social Work - Sociology - Spanish - Studio Art - Survey Engineering Technology - Sustainable Agriculture- Theatre - Undecided/Explorations - University Studies - Women's, Gender, and Sexuality Studies - Wildlife Ecology - Zoology

What year are you in?

- 1st Year
- Sophomore
- Junior
- Senior
- 5th Year or More

Please enter the course code from the class that sent you this survey to complete:

_____

Please enter the Professor's name from the class that sent you this survey to complete:

_____

Are you male or female?

- Female
- Male
- Prefer Not To Say

Which of the following best describes where you are from?

- Town/city with many neighbors
- Outside town with scattered neighbors
- Rural area with few neighbors

Are you from the state of Maine?

- Yes
- No

Raffle Would you like to enter your email in a raffle for a chance to win 1 of 5 $10 Amazon gift cards?

- Yes
- No

Thank you for participating in my survey. We really appreciate you taking the time and sharing your opinions. If you have any questions, please contact Kiley Davan (kiley.m.davan@maine.edu) or Dr. Carly Sponarski (carlycs@maine.edu).

APPENDIX E

Communication Treatments

Text Treatment

White-nose Syndrome in Bats
Untamed Science

In North America, large numbers of hibernating bats are dying due to a disease called white-nose syndrome (WNS). The disease is caused by a fungus, *Pseudogymnoascus destructans* (PD). PD often appears as white, fuzzy patches on the nose and wings of bats. WNS causes bats to be more active in the winter instead of hibernating. This increase in activity level results in a loss of their winter fat reserves. Without these fat reserves, the bats are unable to survive the winter. When a population of bats become infected in a cave, often less than 10% of bats survive.

WNS was first observed in central New York in 2006. It is believed to have been brought over from Europe by a person who had visited an infected cave in Europe, picked up the spores of the fungus on their clothing or cave gear, and then visited the cave in central New York. The fungus thrives in cold, dark habitats and quickly spread to other caves. As of 2018, twelve years since it was discovered, WNS has been detected in 33 US states and 7 Canadian provinces. And in the last decade, the fungus has killed over 5.7 million bats.

There are currently 7 species of bats known to have WNS in the US which are the Little brown bat, the Big brown bat, the Tri-colored bat, the Northern long-eared bat, the Gray bat, the Indiana bat, and the Eastern small-footed bat. The Little brown bat was once the most common bat in the northeastern United States but due to the spread of WNS, this species are now endangered and extinct in many regions. Five other bat species, the Eastern red bat, the Southeastern bat, the Silver-haired bat, the Rafinesque's bat, and the Virginia big-eared bat, have been found to have the fungus but don't seem to show symptoms of the disease. It is possible that these bat species may be resistant to the disease.

Scientists are racing to learn more about the disease and to help us make informed management decisions about decreasing infection rates of bats and the spread of the fungus. Dr. Susan Loeb and Pallavi Sirajuddin, researchers at Clemson University, are monitoring bats in the Blue Ridge Mountains in order to get a better understanding about WNS. To do this, they are attaching temperature sensitive radio transmitters to the bats to measure their body temperature and how long they are awake. Sirajuddin will compare the results of bats with WNS to bats without WNS. At the cave they are studying, they found 321 bats in 2015 but, in 2017, there were only 34 bats and many of them have the disease.

Researchers are also developing ways to detect WNS before bats show any signs of symptoms, such as through early detection devices. One such device is called an electronic nose (e-nose) device. Every species of bat has a unique smell associated with

them, and this smell changes once a bat becomes infected with WNS. The e-nose would use these unique smells to determine whether or not a population of bats has been infected.

Even with so many researchers searching for solutions, bats are still dying at alarming rates. This could could negatively impact the environment and humans because bats are important to the environment. They pollinate flowers, disperse seeds, and manage insect populations. The natural pest control bats provide is critical to the US agricultural industry which values bats at 22.7 billion dollars annually. Without bats, the agricultural industry would have to spend more money for extra treatments of pesticides to make up for all the insects the bats weren't eating.

Although there is no solution yet, scientists are continuing to research WNS and are working to help mitigate its effects.

Source: Untamed Science. (2017). White-nosed Syndrome in Bats. http://www.untamedscience.com/biology/ecology/ecology-articles/white-nose-syndrome-bats/

Video Treatment

Untamed Science. (2017). White-nosed Syndrome in Bats. http://www.untamedscience.com/biology/ecology/ecology-articles/white-nose-syndrome-bats/

AUTHOR'S BIOGRAPHY

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