PERCEPTIONS OF CONSERVATION EDUCATORS ON PROGRAM EFFECTIVENESS:

A MIXED METHODS STUDY

By

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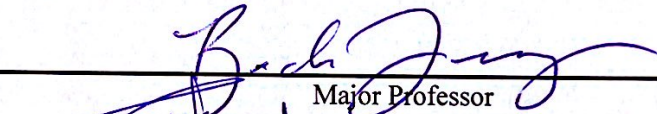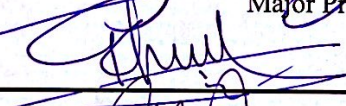for the degree of

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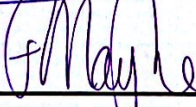PERCEPTIONS OF CONSERVATION EDUCATORS ON PROGRAM EFFECTIVENESS:
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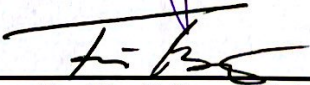
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Acknowledgments

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I. Introduction

Since the Industrial Revolution, humans have had, and continue to have, an increasing impact on the environment. Humans have exploited Earth's resources, altered its natural systems, and decreased species biodiversity (Goudie, 2018). As these impacts intensify, there is increasing pressure to mitigate or reduce environmental harm. Efforts to reduce harm and promote environmental sustainability are widespread and take a variety of forms. One strategy to reduce environmental impacts is increasing environmental education initiatives. Scholars have identified environmental education as a means to influence behaviors that promote environmental sustainability and conservation (Bickford et al., 2012). Yet, emphasis on environmental education is relatively recent in the scope of human development.

In 1990, the United States created the National Environmental Education Act (NEEA). The NEEA stated that the federal government has a responsibility to "support development of curricula, special projects, and other activities, to increase understanding of the natural and built environment and improve awareness of environmental problems" (United States, 1990, p. 1). The act also created the Office of Environmental Education within the US Environmental Protection Agency (EPA). The Office of Environmental Education notes that important components of environmental education include knowledge and understanding of environmental challenges, attitudes of concern, and participation in activities to help resolve such challenges (EPA, 2022).

Globally, there is an increasing emphasis on expanding environmental education as well. The United Nations is taking an increasing role in promoting education across its member countries. For example, the United Nations Commission on Sustainable

Development (CSD) defines 17 Sustainable Development Goals (SDGs) to address an array of environmental, social, and economic challenges. SDG number 4 is quality education, defined as the goal to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (UN, 2022, p. 1). In support of the SDGs, the United Nations Educational, Scientific and Cultural Organization (UNESCO) created the Education for Sustainable Development (ESD for 2030). ESD for 2030 provides a 10-year global framework that aims to increase the knowledge of learners surrounding issues such as climate change, sustainable resource use, and biodiversity loss. This framework supports the expansion of educational activities and facilities while monitoring the extent to which education is helping to reach environmental goals (UNESCO, 2023). As of 2023, 50 countries have committed to preparing educational initiatives that include a range of education practices to increase environmental knowledge.

The growing awareness and scale of environmental education have underscored its value as a useful mechanism to help alleviate many environmental issues. Education has been identified as a top factor contributing to people's willingness to engage in environmentally positive conservation behaviors (Li, Wang, & Cui, 2022). Yet, research suggests that environmental education research rarely incorporates the evaluation of programs when assessing the success of institutions, such as zoos and aquariums (Ardoin, Bowers, & Gaillard, 2020). There is also a lack of research in assessing the successes and barriers of species-specific educational programs and their influence on pro-conservation behaviors (Ardoin, Bowers, & Gaillard, 2020).

Research has also identified unique difficulties in implementing environmental education such as a lack of incentives for researchers to evaluate programs, weak valuation

of environmental resources, and a lack of connection to the environment in urban settings (Cooke et al., 2013). Other researchers have identified that providing guests to conservation facilities with information is not a sufficient way to increase their knowledge to the point where it influences their behavior (Torlay, 2020). Research is needed to better understand these barriers and explore how environmental educators overcome them to contribute to knowledge, behavior changes, and overall conservation goals.

Conservation of species and ecosystems has become a greater focus of environmental education initiatives in recent times, as the rate of extinction and habitat degradation continues to accelerate (McGovern et al. 2020; Moloney et al. 2020). A focus on species-specific education can contribute to overall ecosystem health and widespread conservation outcomes (Thompson & Rog, 2019). As such, an understanding of what makes for successful conservation education programs is essential in contributing to species and overall ecosystem conservation goals.

The purpose of this research is to explore the perceptions of environmental educators on the effectiveness and impact of their educational programs to promote behavior change toward species-specific conservation. Specifically, this research relies on the perceptions of sea turtle conservation educators across the United States to report on education on a wide spatial scale. We examine education strategies used, how educators define their program success, and identify barriers to this success to better understand the impact of conservation education programs on participants.

Objectives

The objectives of this research were to examine educators' perceptions of their environmental education programming. Our specific research goals were to: 1) explore the education strategies used to promote species-specific conservation, 2) to report on the barriers to implementing successful education programs, and 3) understand how educators define the success of their education programs in contributing to conservation goals. To achieve these objectives, we conducted a mixed-methods study using surveys and interviews to elucidate areas of strengths, weaknesses, opportunities, and threats in sea turtle conservation education programming as well as investigate educators' definition of success.

II. Literature Review

The focus of this research is to understand how species-specific conservation educators perceive the factors that contribute to program effectiveness. There are many different approaches to environmental education as a means to improve awareness and promote participation in activities to help reduce environmental harm. Common practices used to educate the public on environmental issues include formal school curricula, outreach programs, and institutions, such as zoos and aquariums. This study is limited by the current literature that exists assessing these education practices, especially in the marine environment. Within the literature on environmental education, three broad categories emerged. These categories were: the ability of education to improve knowledge in formal school settings; the contribution environmental education has on influencing positive behavior changes; the way knowledge can pass from children to other members of their

household, such as parents. This literature review synthesizes the current research on environmental education programs and their effectiveness.

<u>Increase in environmental knowledge in formal school settings</u>

Extensive literature exists showing different approaches to increasing environmental education and their successes in improving knowledge. One common strategy for increasing environmental education starts with the development and implementation of curriculum in public schools. Public schools have the unique ability to employ long-term education initiatives. A systematic literature review completed in 2017 analyzed 25 years of literature regarding environmental education programs in kindergarten through 12th grade (K-12). The review analyzed over one hundred articles and reported that almost all the studies conducted between 1994 and 2013 showed positive impacts on the knowledge, attitudes, and skills of students as a result of education (Thomas et al., 2019). Research identifies changing knowledge as a key step toward environmental change and can be accomplished through a variety of K-12 programs. A long-term plan to reduce energy at a public high school found the use of role models, uniform curriculum, school culture, and communication as key strategies in influencing the knowledge of students (Schelly et al., 2012). While extensive research within the public school system exists, there has been a lack of investigation of other non-formal learning environments and institutions (Ntona et al., 2023). Research suggests that practical hands-on interactions outside of the school environment have the power to enhance student learning outcomes (Damerell, Howe, & Milner-Gulland, 2013). Non-formal learning environments provide opportunities to implement those strategies in a greater capacity than formal school settings.

<u>Changing behaviors in non-formal education settings</u>

        Informal education facilities such as national parks, zoos, aquariums, and conservation centers are increasingly emphasizing environmental education as one of their primary functions. An analysis of zoos and aquariums accredited by organizations such as Association of Zoos and Aquariums showed that an increasing number of facilities that once emphasized specimens and collections have shifted their goals to focus on education. Of these accredited institutions, nearly 97% of them emphasize education in their mission statements (Moss, 2013). Education in these non-formal settings has evolved not only in quantity but also in its messaging; with an increasing focus on conservation threats and how to help conserve species and ecosystems (Mellish et al., 2019). Institutions such as these have the unique ability to provide more interactive educational programs through animal viewings and interactions that many formal education settings such as schools may lack. Torlay (2020) shows that interactive and direct experiences are more beneficial in encouraging conservation behavior compared to presentations. One example of an interactive approach is attending performances, such as dolphin shows. In a 2013 study analyzing the knowledge gained by audience members, Miller et al. found that participants in dolphin shows demonstrated increased short-term knowledge and, three months after the experience, claimed to be more likely to engage in conservation behaviors. This shows that programs such as this may be effective in increasing environmental knowledge and contributing to positive environmental change. Eco-tourism is another interactive strategy that increases environmental knowledge. A study completed in Malaysia demonstrated that visitors to local marine parks were more likely to engage in pro-environmental behaviors if they had higher levels of knowledge (Abdullah et al., 2020). Researchers here identify the need for environmental education to maintain not only an important component of Malaysia's

economy but also the biodiversity and protection of the country's marine parks. Another study of a long-term educational environmental initiative conducted by Arnold et al. (2009) interviewed students who considered themselves to be "ecologically minded" on what experiences as children they believed contributed to them having a positive mindset about the environment and sustainability. Of the formative experiences identified, the most common included experiences in nature, experiences with animals, and relationships with teachers. This study demonstrates the impact educational experiences have on students and their environmental attitudes. With the modern expansion of virtual programming, education can take nontraditional routes to influence behavior. A study on the effectiveness of social media in influencing sustainable habits was conducted among a group of young adults in Qatar. Following a social media campaign, 49% of participants identified that they had learned more about sustainability, and at least 25% of them adopted a new behavior that promoted a sustainable lifestyle (Al-Mulla, Ari, & Koc, 2022).

Knowledge transmission in non-formal education settings

Non-formal learning settings can improve the environmental knowledge of students with effective programming. Another study suggests that investing in youth environmental education can increase the knowledge of adults and other community members even if they do not participate in programming. Long-term interactive programming may have some power to influence behavior in both children and adults. Damerell et al. (2013) completed a controlled trial to assess the ability of children to influence the knowledge and attitudes of their parents. The researchers built upon an earlier study that showed parents had a 38% increase in knowledge about scarlett macaws following the enrollment of their children in a month-long course (Vaughan, 2003). To further demonstrate the effect children's education

has on their parents' perceived knowledge, 15 wildlife clubs participated in wetland activities over one year. Researchers administered questionnaires to students and parents to test their knowledge of wetland systems prior to joining the camp and following completion of the activities. The results showed that parents who had students who talked about their experiences had significantly higher post-program knowledge than those who did not (Damerell, Howe, & Milner-Gulland, 2013). The study also revealed that these parents and children who had increased knowledge of watershed systems also showed more water conservation practices in their homes. This result indicates a link between increased knowledge and increased behaviors that contribute to environmental sustainability. However, despite the increasing prevalence of conservation education initiatives and existing case studies, research into the factors that contribute to effective educational programming is still in the beginning stages (Mellish et al., 2019).

Evaluation of the successes and barriers environmental education programs experience is needed to ensure they are effectively contributing to their goals, such as species conservation. Understanding such barriers helps to identify gaps between environmental concerns and actions that lead to behavior changes (Anderson & Jacobson, 2018). Research that does exist can reveal some barriers to programming. Some of these barriers identified are the fact that not all groups have access to non-formal institutions such as zoos, aquariums, and species conservation centers due to factors including income level and distribution of such facilities (Craig et al., 2016). Additional barriers to environmental education via policy, funding, and institutional limits also exist, which reduce the effectiveness of short-term environmental education programs. A study conducted by Counsell et al. (2020) surveyed 445 students from seven schools on their pre- and post-

program knowledge following a visit to a zoo. Their results showed a 60.5% increase in knowledge but only a 24% increase in their knowledge of pro-conservation behaviors based on a zoo visit alone. The relative lack of increase in knowledge about behaviors due to a zoo visit further reinforces Torlay's conclusions that simply providing information may not be enough to sufficiently cause changes. Further analysis of non-formal educational programming is necessary to identify additional barriers and successes of these programs.

Research on the factors that contribute to successful programming is essential to ensure quality education that contributes to increases in knowledge and pro-conservation behavior. The development of successful species-specific education programs can not only contribute to the conservation of species of concern but overall ecosystem conservation and health.

III. Materials and Methods

For our research purposes, we focused on a taxonomic group of concern: sea turtles (*Chlemioidea)*. There are six species of sea turtle in the United States, all are classified as endangered, and three of the six are considered critically endangered (IUCN, 2022). Due to their widespread range throughout the United States, there is an extensive network of conservation centers dedicated to conducting sea turtle rehabilitation, with many of the facilities also emphasizing education about the species as a primary goal. Several threats to these species can be mediated through education, such as threats due to habitat loss, increased human interactions, pollution, and harvesting of adults and eggs. Sea turtles are also charismatic megafauna- large animals with high public appeal. The use of charismatic megafauna such as sea turtles is an effective strategy for increasing public awareness, funding, and contributing the ecosystem conservation as a whole (Thomas-Walters et al.,

2021; Thompson & Rog, 2019). The widespread distribution of sea turtles, the numerous threats that can be mediated through education, and its status as a well-known and charismatic species make it an excellent candidate for use in conservation education programming.

Site and Participant Selection

We conducted a web search of sea turtle and marine conservation centers in the United States, resulting in 36 centers with education as one of their primary goals and who actively employ educational programming either at their location or within their community. We began our web search with a review of the 42 centers authorized by the National Oceanic and Atmospheric Association (as of 2019) to rehabilitate the species Several of these facilities actively participate in rescue and rehabilitation, but do not participate in education initiatives as revealed through their websites and were therefore excluded from this study. We then expanded the search to include other marine conservation centers that engage in educational programming, even if they were not authorized for rehabilitation. The 36 centers we selected for recruitment actively promote the education of sea turtles through community outreach, visits to their centers, or the creation of educational materials. The centers we selected also named at least one education coordinator on their staff. We contacted these 36 centers via email and requested participation in the study by their education coordinators. For this study, we defined education coordinators or educators as a term referring to formal personnel responsible for the design or implementation of educational programs at these facilities. These personnel held roles that included, but were not limited to, education director, environmental educator, education specialist, and naturalist, and excluded positions such as docent or volunteer. We considered educational programming to be activities such as

community events, presentations, curriculum distribution, hosting visitors, visiting schools, and other on and offsite events. Bernard (2018) notes that a relatively small number of knowledgeable people, eight, is sufficient in uncovering core themes in studies involving qualitative data; therefore, a low population of potential participants as well as a low response rate would still be sufficient in providing us with the necessary information to address our research objectives. Participants' anonymity was ensured throughout the data collection, storage, and analysis. Survey responses did not record identifying information such as name or location, interview notes were stored electronically behind two-factor authentication, and interview recordings were transcribed by an independent third party who also ensure anonymity.

Research design

To understand the impact of education on species-specific conservation, we developed a mixed methods study design. First, we created a survey that was distributed to participants who engaged in species-specific conservation programs to assess their perceptions of the strengths, weaknesses, opportunities, and threats of these programs (Appendix C). Next, we conducted semi-structured interviews with the educators who participated in the initial survey. In order to reduce bias, we created our interview questions before administering our surveys. Finally, we used the results of our first survey to create a second survey. The purpose of the second survey was to determine what educators perceived as the single most important factor to consider when designing and implementing successful educational programming. We engaged a mixed methods concurrent triangulation strategy as developed by Creswell (2017). Triangulation of at least two methods, in this case, quantitative and qualitative methods, is used when a single method is considered to be

inadequate for answering a research problem (Morse, 1991). The use of quantitative survey data alone would have likely been inadequate for gaining a comprehensive understanding of educators' perspectives (Creswell, 2014). Our strategy was concurrent because quantitative and qualitative data were collected at the same time and the findings from both phases were compared and integrated. Using a combination of qualitative and quantitative data enabled us to build upon our initial dataset and use qualitative analysis to further expand and explain out initial quantitative data to better identify the most salient aspects of conservation education (Figure 1). The Texas Christian University Institutional Review Board approved the research design in October of 2023 under study number 2023-261 and determined that the study presented no more than minimal risk to human subjects (Appendix A).
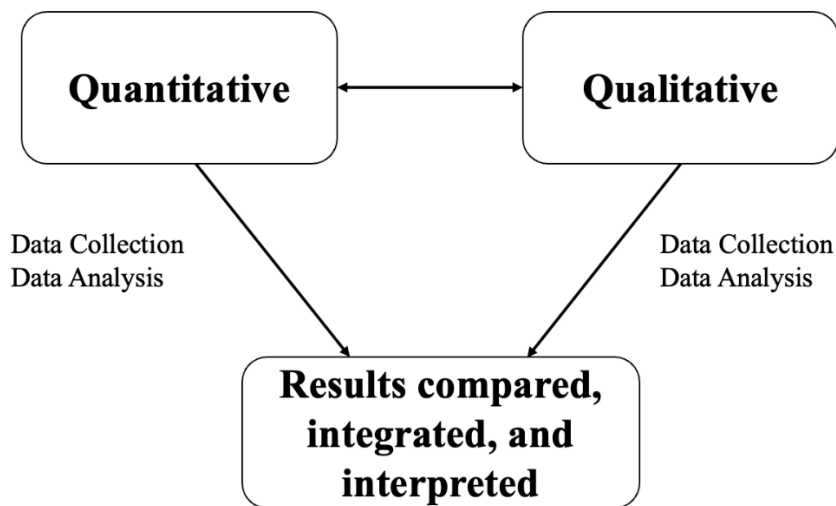
Figure 1: A visual diagram of the mixed methods triangulation strategy used in this study. Triangulation of the quantitative and qualitative data increased our understanding of the perceptions of educators. Diagram modified from Atif et al., (2013).

The quantitative stage relied on the use of surveys. The objectives of these surveys were to assess the perceived strengths, weaknesses, opportunities, and threats (SWOT) facing conservation education through a SWOT integrated with the Analytic Hierarchy Process (AHP) analysis. The qualitative stage of data collection relied on semi-structured interviews of educators to expand on their experiences in the field. The qualitative interview data was analyzed via thematic analysis, relying on various coding strategies to create higher-order themes following procedures described by Braun and Clarke (2021). The entire analysis of the quantitative and qualitative datasets was merged to characterize the perceptions of conservation educators (Figure 2). The details of each stage of the study are outlined in the following sections.

| Stage | Data | Operations and Analyses | Results |

Quantitative
- Strengths
- Weaknesses
- Opportunities
- Threats

Consistency Measures and Relative Priority Rank → Creation of 2nd survey to identify the single most important factor → Analytical Hierarchy Process (AHP)

Qualitative
- Types of education strategies used
- Educators' perceptions of the success of their educational programs
- Educators' perceptions of barriers to effective environmental education

Qualitative Content Analysis → Inductive coding / Deductive coding / Values coding → Theme creation

What makes for effective environmental education programs

Figure 2: Flowchart describing research methods, data type, operations and analyses, and results broken up by stage of the research process.

<u>SWOT Analysis</u>

Strengths, weaknesses, opportunities, and threats (SWOT) analysis was originally developed nearly 70 years ago by Harvard professors Smith and Christensen as a means to analyze business operations (Balamuralikrishna & Dugger, 1995). Since the initial development of the SWOT model, it has gained popularity in a variety of fields such as marketing (Rutsaert et al., 2014), healthcare (Pery & Isworo, 2018), business management (Ho, Xu, & Dey, 2010), and agriculture (Benzaghta et al., 2021; Sahoo et al., 2018). SWOT analysis allows organizations to evaluate their activities in terms of internal aspects (strengths and weaknesses) as well as external factors (opportunities and threats) (Benzaghta et al., 2021; Bull et al., 2016). The strengths and opportunities are categorized as positive effects and the weaknesses and threats are considered negative effects (Darshini, Dwivedi, & Glenk, 2013). Understanding these factors can help program managers improve their practices in many ways such as taking advantage of opportunities, avoiding threats, and reducing weaknesses.

The SWOT analysis is gaining applicability in the education sector, including use by many universities when evaluating their programs (Helms & Nixon, 2010). A literature search using the term "SWOT and education" produced over 40,000 results published in the last 10 years. In the realm of science education, SWOT is gaining utility as well. A SWOT analysis was employed by researchers in India to evaluate veterinary and animal science education to inform policy and create plans for the future (Sasidhar & Reddy, 2012). SWOT models are useful in revealing the perceptions of individuals, in this case, educators, which are used to inform decision-making. The SWOT findings can also be integrated with quantitative techniques such as an AHP to structure the SWOT factors hierarchically and

compare the factors systematically (Kharel et al., 2018). The SWOT-AHP, a multi-criteria

decision-making tool, quantify qualitative data identified through a SWOT analysis.

Therefore, SWOT-AHP aids decision-making by ranking the identified internal or positive

factors (i.e., strengths and opportunities) against the external or negative factors (i.e.,

weaknesses and threats).

In AHP, SWOT factors are compared in a pairwise fashion to identify which of the

factors has a higher impact. In this technique, a relative priority value is assigned to each

factor (Saaty, 1977). This is determined using the use of a pairwise comparison matrix as

developed by Saaty. In the pairwise comparisons, relative priorities are expressed as

$$A = \begin{pmatrix} 1 & 2 & 4 & 3 \\ 1/3 & 1 & 3 & 2 \\ 1/4 & 1/3 & 1 & 1 \\ 1/4 & 1/3 & 1 & 1 \end{pmatrix}$$

After the comparisons, a consistency index (CI) is determined to measure the consistency of

the responses using the eigenvalue (λ_{max}) for the sample size of n:

$$CI = \frac{\lambda_{max-n}}{n-1}$$

A consistency ratio (CR) which checks for overall consistency and ensures the reliability of

the decision-making process, is estimated using the formula:

$$CR = \frac{CI}{RI}$$

Where RI is a random CI obtained from the randomly generated reciprocal matrix using the scale 1/9, 1/8, …., 1, … 8, 9 (Kharel et al., 2018). The CR value should be kept <10% and else the subjective judgment should be reevaluated to avoid irrational judgment of participants (Saaty, 1977). We chose a SWOT-AHP analysis because it is effective in providing a systematic assessment of the various factors at play in creating and implementing effective conservation education programs.

SWOT Factor Identification

We conducted an extensive literature search to identify SWOT factors related to conservation education. Key words used for this literature search included terms such as "strengths of environmental education" "SWOT analysis of outdoor education" "weaknesses of environmental education" etc. Literature results produced showed existing SWOT analysis of environmental education programs, but only produced one species-specific education SWOT analysis, and was not based in the United States (Gal, 2023). Other factors were adapted based on SWOT analysis of formal education programs, such as curriculum designs. We compiled an initial list of factors and distributed the list to a group of five experts (Appendix B) We identified experts within our university community as well as educators from non-formal institutions, such as local zoos, who did not participate in this study. These experts had extensive experience in the fields of environmental education or qualitative research and provided insights and feedback on the first round of factors. We then narrowed down and altered the factors according to the feedback we received from the experts. This resulted in a list of five literature-based, expert-informed factors in each SWOT category (Table 1).

Table 1: Table of SWOT factors identified and confirmed by experts in the field of species conservation used to create our first survey.

Strengths (internal)	Weaknesses (internal)
S1. Ability to freely create or enhance species-focused educational materials and content	W1. Lack of resources dedicated to education (e.g., time, money, space)
S2. Availability and promotion of research programs	W2. Difficulty measuring effectiveness of education programs and activities
S3. Activities that engage the community in hands-on conservation and create public awareness	W3. Lack of personnel with educational expertise
S4. Creating / Fostering an emotional connection with species	W4. Ineffective adult education programs and activities
S5. Adequate personnel with educational expertise	W5. Oversimplification of complex ecological issues
Opportunities (external)	**Threats (external)**
O1. Use of virtual programming and social media to increase public outreach and engagement	T1. Short term experiences (such as visiting the facility once) may not be sufficient to influence conservation behavior

O2. Partnership with local schools to provide students with age-appropriate educational programs and activities to promote conservation behavior

T2. Vulnerable to changes in funding patterns or economic downturns (funding sources uncertain)

O3. Providing the local community with programs and activities to promote conservation behavior

T3. Climate change and other large-scale environmental threats to sea turtles

O4. Engaging nonlocal community (tourists) with programs and activities to promote conservation behavior

T4. Lack of evidence to demonstrate that education is an effective tool in achieving conservation goals

O5. Influencing legislation related to environmental protection and species conservation

T5. Opposition from industries, groups, or political entities whose activities threaten sea turtles

Survey Instrument

We used the online survey platform Qualtrics (Qualtrics, Provo, UT.) to determine educators' perceptions of the identified SWOT factors. In our initial survey, we asked the respondents to evaluate the relative importance of different SWOT factors in each category when compared against one another. This was done by asking respondents to rank each of the five pairings of the four factors in each SWOT category using a numerical value of 1-9 on a Likert scale where 1 = "equal," 3 = "moderately important," 5= "important," 7=" very

important", and 9="extremely important". Respondents used their own experiences, expertise, and background to inform their choices. For example, respondents were asked to make a pairwise comparison in the strengths category between "*Ability to freely create or enhance species-focused educational materials and content*" and "*availability and promotion of research programs*" and determine if one of them was more important, or equally as important as the other (Appendix C). The Likert scale values allowed us to calculate factor priority scores to reveal the educators' perceptions of factors.

The survey also asked participants if they were interested in participating in a phone interview. Respondents were directed to a separate page where they could leave their contact information for a second survey and indicate their willingness to participate in an interview. The use of a separate page ensured that identifying information such as name and phone number were not associated with survey responses.

Following participation in a phone interview (when applicable), participants were sent a link to a second survey. In cases where participants chose not to participate in a phone interview, they were sent the link to the second survey following their completion of the initial survey.

The second survey asked respondents to make pairwise comparisons between the top-ranked SWOT factors identified in each category via the results of the first survey (Table 2). These results can be used to evaluate the relative importance and influence of different SWOT categories for conservation educators.

<u>Interviews</u>

This study used semi-structured interviews of 10 participants who chose to be interviewed from the initial survey. The interview protocol included demographic and background questions as well as questions that fell under three topic domains that aligned with the research objectives (Appendix D). These topic domains were 1) types of education strategies used, 2) educator's perceptions of program success, and 3) perceived barriers to success. This structure allowed the researchers to organize the interview around relevant topic domains with a set of probing questions to maintain consistency for comparison across interviews. The interviews lasted between 30 and 50 minutes. Nine interviews were audio recorded and transcribed word for word. One participant asked not to be recorded. During their interview, we took handwritten notes. The audio recordings were transcribed by the third-party transcription service *GoTranscript* (GoTranscript Inc., 2023). We ensured anonymity throughout the process. The transcriptions and interview notes were analyzed using thematic analysis to identify, evaluate, and produce themes from the interview corpus (Rasmitadila et al., 2020).

<u>Data Analysis</u>

We conducted a thematic analysis of the interviews informed by the research objectives. Initially, we used the identified SWOT factors to inform theme development. We conducted our coding using Atlas.ti version 23.2.1 (ATLAS.ti Scientific Software Development GmbH, 2023) The interviews were analyzed thematically based on a six-step process outlined by Braun and Clarke (2006) and discussed below (Figure 3).
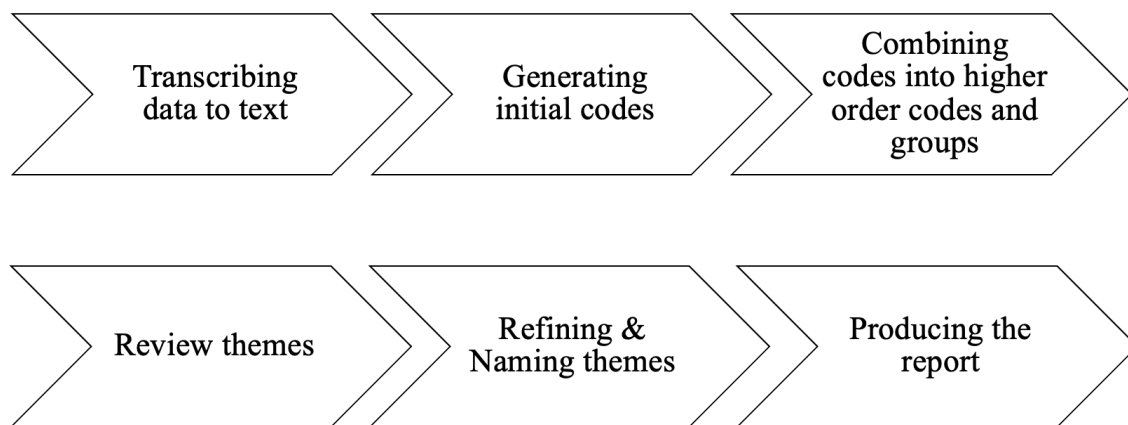
Figure 3: Thematic analysis steps as described by Braun and Clarke (2006).

Thematic analysis is a method for identifying, analyzing, and reporting patterns (themes) within the data (Nowell et al., 2017). The method consists of an initial read of the interview data. This allowed us to become familiar with the interview content. We then generated codes, categories, and higher-order themes from the interview data that reflected recurring patterns of meaning relative to our research objectives. Our initial coding relied on a deductive coding approach in which we looked for data that aligned with the highest-rated SWOT factors from each category revealed in the first round of surveys (Table 8). For example, we initially coded for data relating to different types of education strategies, barriers, and limitations, existing evaluations, and aspects that make educational programs successful. For the second round of coding, we used an inductive approach where we read the transcripts again, assigning codes to information that did not align with the SWOT factors or the research objectives to reveal other important information. We also used a values coding method, which allowed us to categorize data as it related to the attitudes, beliefs, and values of participants as it related to their program's greatest successes and limitations (Lester, Cho, & Lochmiller, 2020). To ensure coding reliability, a codebook was created

using pre-identified terms before the coding process began and was reviewed throughout the data analysis stage. Following a review of our themes, we generated a final report on our findings.

We took steps to ensure reliability and validity during the research project. The interview guide was designed using existing literature and was reviewed by a panel of five experts before distribution who were not involved in the research participation. Four reviewers were environmental education experts, and one has experience conducting surveys. During the data collection and analysis, the researchers met regularly to discuss responses and coding, adding to the validity of the study (Patton, 2014). This step helped overcome the potential bias of the researchers through the facilitation of cross-checking participants' responses and assigned codes (Anney, 2014).

IV: Results and Findings

SWOT-AHP Results

We conducted quantitative analysis of the survey data using the SWOT-AHP techniques which resulted in individual priority scores for each factor as well as consistency ratings among responses. The analysis of our first survey resulted in high levels of agreement about the top factor within each SWOT category. Participants showed a high level of agreement concerning the top factor in that category. The highest level of agreement from participants was about the top opportunity of sea turtle conservation education. We saw the most variation in responses in the strengths category. Our second survey produced a low measure of consistency, indicating a high degree of disagreement among participants about the single most important factor to consider when designing successful education programs.

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In the following sections, we present detailed results of our surveys and the results of the SWOT-AHP analysis.

SWOT Survey I Results

Our initial survey was sent to 36 potential participants and yielded 15 total responses, 13 of which were complete. This resulted in a 41.7% response rate and a 36.1% completion rate. The surveys that were not completed were not included in the analysis nor contacted for an interview. Of the 13 completed surveys, 10 respondents chose to participate in a phone interview. Two declined and one did not leave their contact information. The participants represented different non-profits, conservation organizations, and other facilities that emphasize education as one of their primary goals. Four participants held the role of Director of Education, four held the role of education coordinator or manager, and five held other roles related to education and outreach.

The results of our first survey were based on the 13 completed survey responses we received. Thirteen responses are adequate for this study because the SWOT-AHP does not require a large sample for statistical best fit (Kharel et al., 2018). We calculated consistency indexes (CI), random indexes (RI) and consistency ratios (CR) for each of the four SWOT factors in the first survey based on the overall CI and RI. (Tables 3-6). The random index value was 1.12, which is the random index for a matrix of five choices as given by Saaty (Saaty, 1989). The CI for strengths category was 0.047, the CI for the weaknesses category was 0.011, the CI for the opportunities category was 0.009, and the CI for the threats category was 0.029. We found that the CRs of the participants were all well within the accepted values (CR<10%) for each SWOT category (Tables 3-6).

The CR indicates the agreement among educators about critical issues. A lower CR value indicates more consistency or uniformity among responses and higher scores indicate greater diversity or disagreement among participants on the importance of the SWOT factor being examined. The strengths category received the highest CR score of CR=4.2% (Table 3). This score represents that there was most disagreement among participants about the top strength of conservation education. The weaknesses category received a CR of 1.0% (Table 4). The opportunities category received the lowest CR score of CR=0.8% (Table 5), which indicates the highest agreement among experts regarding opportunities for conservation education. The threats category received a CR score of 2.6% (Table 6).

Table 2: Relative priority rank, consistency index (CI) for each of the strength factors, and the overall random index for a matrix of 5 (RI) and CR (blue) for the strengths category.

Consistency Measures				
Factor	Priority Rank	λ_{max} (CI)	Overall RI	Overall CR
S1	12.6%	5.19	1.12	4.2%
S2	8.6%	5.08		
S3	31.7%	5.24		
S4	26.6%	5.24		
S5	20.6%	5.20		
		(0.047)		

Table 3: Relative priority rank, consistency index (CI) for each of the weakness factors, and the overall random index for a matrix of 5 (RI) and CR (blue) for the weaknesses category.

Consistency Measures				
Factor	Priority Rank	λ_{max} (CI)	Overall RI	Overall CR
W1	34.3%	5.08	1.12	1.0%
W2	16.0%	5.04		
W3	21.9%	5.05		
W4	14.8%	5.04		
W5	13.1%	5.02		
		(0.011)		

Table 4:Relative priority rank, consistency index (CI) for each of the opportunity factors and the overall random index for a matrix of 5 (RI) and CR (blue) for the opportunities category.

Consistency Measures				
Factor	Priority Rank	λ_{max} (CI)	Overall RI	Overall CR
O1	7.8%	5.02	1.12	0.8%
O2	23.3%	5.03		
O3	27.3%	5.05		
O4	19.4%	5.03		
O5	22.2%	5.04		
		(0.009)		

Table 5: Relative priority rank, consistency index (CI) for each of the threat factors, and the overall random index for a matrix of 5 (RI) and CR (blue) for the threats category.

Consistency Measures				
Factor	Priority Rank	λ_{max} (CI)	Overall RI	Overall CR
T1	10.6%	5.07	1.12	2.6%
T2	18.3%	5.15		
T3	31.7%	5.12		
T4	14.1%	5.10		
T5	25.3%	5.13		
		(0.029)		

Table 6: Consistency ratio (CR) of expert responses as calculated from the results of the pairwise comparison of SWOT factors in two different surveys.

Survey Round	SWOT Factors	CR
I	Strengths	4.2
	Weaknesses	1.0
	Opportunities	0.8
	Threats	2.6
II	Ranking of the highly ranked factors from I[a]	4.0

[a]In the second survey, educators were asked to make a pairwise comparison of the SWOT factors that were ranked the highest in the first round of the survey. CR <10 is considered acceptable

We also calculated factor priority scores (F_p) based on the results of our first survey (Table 7). The different priority scores given to individual SWOT factors by the educators show differences in the perceived importance of each SWOT factor. A higher priority score indicates a higher importance placed on that factor by the participants. The priority scores indicate that the strength "*Activities that engage the community in hands-on conservation and create public awareness*" (31.7%) and the weakness "*Lack of resources dedicated to education (e.g., time, money, space)*" (34.3%) were considered the most important internal factors to consider when creating and implementing effective environmental education programs. An analysis of the priority scores of the external factors indicates that "*Providing*

the local community with programs and activities to promote conservation behavior"

(27.3%) was the most important opportunity to consider and that "*Climate change and other*

large-scale environmental threats to species" (31.7%) was considered the greatest threat

among educators to the success of their programming (Table 8). Perception maps were

created to visually demonstrate how participants perceived the different SWOT factors

(Figure 4). Blue lines show how responses about the internal factors were distributed towards

the top strength and weakness. Red lines show how responses about the external factors were

distributed towards the top opportunity and threat of successful education programs.

Table 7: Priority scores given to different SWOT factors and categories by the

educators

SWOT Categories	Factor Priority (F_p)
Strengths	
S1. Ability to freely create or enhance species-focused educational materials and content	12.6%
S2. Availability and promotion of research programs	8.6%
S3. Activities that engage the community in hands-on conservation and create public awareness	**31.7%**
S4. Creating / Fostering an emotional connection with species	26.6%
S5. Adequate personnel with educational expertise	20.6%
Weaknesses	
W1: Lack of resources dedicated to education (e.g., time, money, space)	**34.3%**

W2: Difficulty measuring effectiveness of education programs and activities | 16.0%

W3: Lack of personnel with educational expertise | 21.9%

W4: Ineffective adult education programs and activities | 14.8%

W5: Oversimplification of complex ecological issues | 13.1%

Opportunities

O1: Use of virtual programming and social media to increase public outreach and engagement | 7.8%

O2: Partnership with local schools to provide students with age-appropriate educational programs and activities to promote conservation behavior | 23.3%

O3: Providing the local community with programs and activities to promote conservation behavior | **27.3%**

O4: Engaging nonlocal community (tourists) with programs and activities to promote conservation behavior | 19.4%

O5: Influencing legislation related to environmental protection and species conservation | 22.2%

Threats

T1: Short term experiences (such as visiting the facility once) may not be sufficient to influence conservation behavior | 10.6%

T2: Vulnerable to changes in funding patterns or economic downturns (funding sources uncertain) | 18.3%

T3: Climate change and other large-scale environmental threats to species	**31.7%**	
T4: Lack of evidence to demonstrate that education is an effective tool in achieving conservation goals	14.1%	
T5: Opposition from industries, groups, or political entities whose activities threaten species	25.3%	

Bold values indicate the highest factor priority scores for each category

Table 8: The highest-ranked strength, weakness, opportunity, and threat factors based on the first SWOT-AHP analysis

	Factors with the Highest Priority Score
Strength	Activities that engage the community in hands-on conservation and create public awareness
Weakness	Lack of resources dedicated to education (e.g., time, money, space)
Opportunity	Providing the local community with programs and activities to promote conservation behavior
Threat	Climate change and other large-scale environmental threats to species
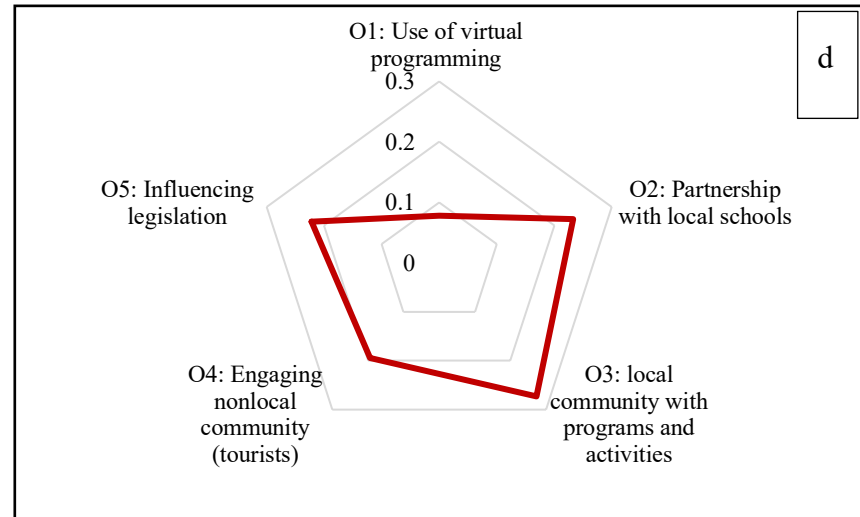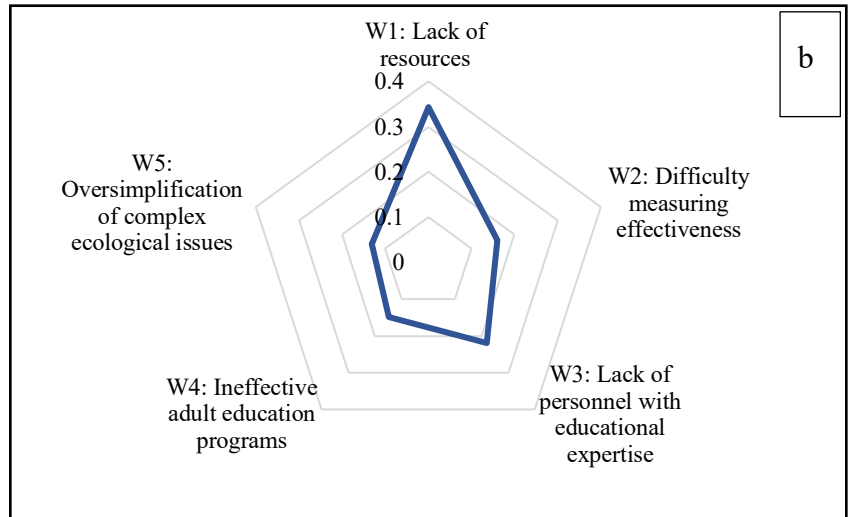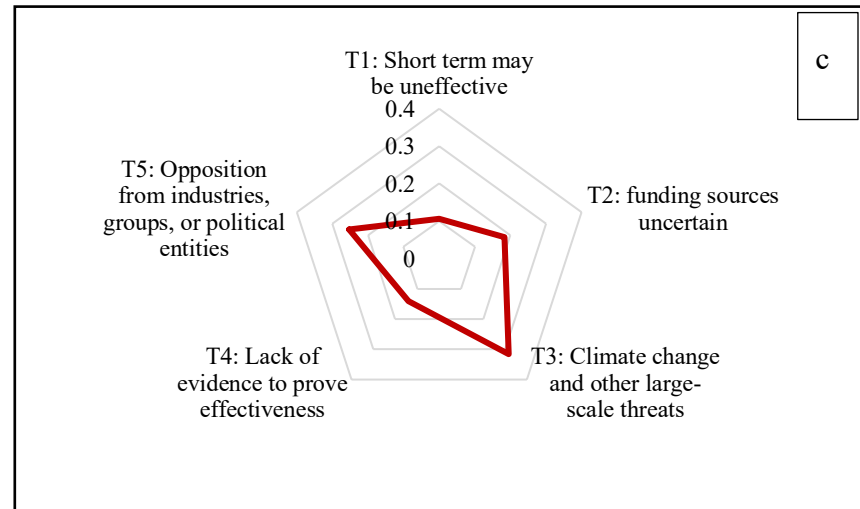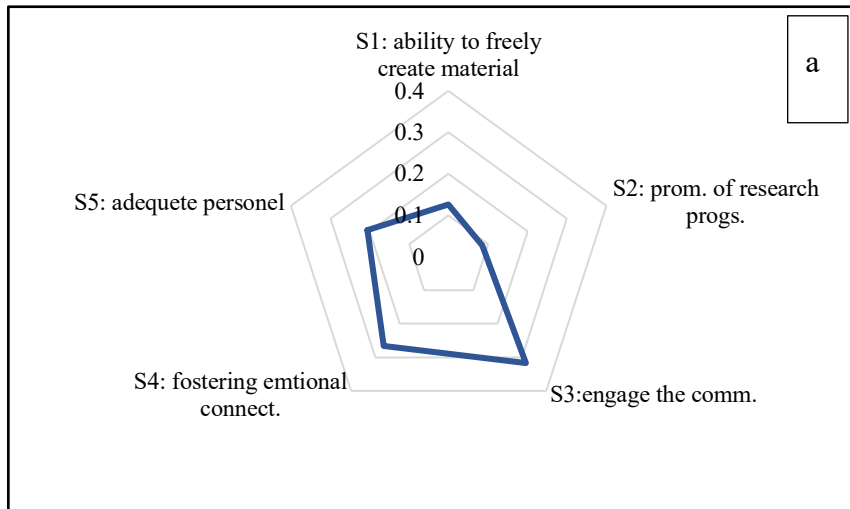
Figure 4: Perception maps of environmental educators showing how responses were skewed towards the top factor in each category: (a) strengths, (b) weaknesses, (c) opportunities, and (d) threats

SWOT Survey II -AHP Results

Our second survey was sent to 12 out of 13 participants of the first survey who left their contact information. Of the 12 surveys we sent, 12 respondents completed them, indicating a 100% response rate. We calculated the geometric means of each factor to measure the respondents' perceived importance of each of these factors (Appendix E). We measured the judgmental consistency of each expert's opinion through the use of consistency ratios (CR). We calculated the priority ranks, CI, RI, and overall CR for the second survey responses. To calculate the CR, the consistency index (CI) is divided by the random index (RI) for the same order matrix. Typically, a CR value of 10% or less is considered desirable for n=5 (the number of the intensity of importance), 9% or less for n=4, and 5% or less for n=3 factors (Saaty, 1989).

The strengths category received the highest priority score of 40% and the weaknesses category the received the lowest priority score of 17%. There was a high level of judgmental consistency among the survey participants in terms of selecting the most important single SWOT factor. The CR value of 4.0% was well within the desirable range of 10% or less (Table 9).

Table 9:Relative priority rank, consistency index (CI), random index (RI), and

consistency ratio (CR) for SWOT factors (Survey Part II)

Consistency Measures				
Factor	Priority Rank	CI	RI	CR
S	40.0%	4.14	0.9	4.0%
W	14.0%	4.04		
O	29.0%	4.16		
T	17.0%	4.09		
		0.036		

When the CR is within the acceptable value of 10%, it indicates a high level of agreement among educators. Therefore, we are able to make a consensus about what our participants perceived as the most important single factor when creating and implementing successful education programs (Saaty, 1989). In the case of our study, respondents agreed that the strength "activities that engage the community in hands-on conservation and create public awareness" as the most important single factor to consider.

Interview Findings

From our initial survey, 12 respondents indicated their desire to participate in a phone interview. The interviews were conducted, and a thematic analysis was carried out for the 12 interviews. The first part of the thematic analysis resulted in 989 lines of data consisting of 503 quotations arranged into 75 initial codes (Appendix F). The most frequent codes included conversations about education barriers, funding, evaluation, differences between short- and long-term programming, emotional connection of species, and diversity. Next, we organized the 75 initial codes into six higher-order code groups (Table 10). Finally, we used

these higher-order code groups to develop three primary themes related to educators'
perceptions of successful environmental education programming. In the following sections, I
will outline our initial codes and how I used them to create the higher order codes and
themes.

**Table 10: Overview of the six most common higher-order categories reported across our
interviews. Percentages indicate the percentage of interviews where the category was
applied.**

Code groups	Number of instances	Percentage of interviews (%)
Education Strategies	98	90
Long-term versus Short-term programs	45	100
Components of Successful Education Programs	132	100
Education Barriers	144	100
Empowerment	47	100
Community Building and Ownership	94	100

The three themes are: 1) the unique strengths of short-term programming, 2)
empowering individuals and communities to contribute to conservation through the
development of a STEM identity, and 3) collaboration with communities to develop
ownership over educational programs. These themes are informed by the higher-order code
groups; however, some higher-order code groups were integrated across multiple themes. As
such, the following sections present interview findings that led to the creation of each higher-

order code group. We follow this with an explanation of how and what codes from each higher-order code group were integrated into the formation of our three themes.

Higher-order codes
<u>Education Strategies</u>

The first higher-order code we created was education strategies. This higher-order code appeared 98 times and in 90% of interviews. Some of the initial codes that were used to create this code included codes that referred to different education strategies, such as "in the field", "in the classroom", "field trip", "interactive", and "reducing fears about nature". The most common initial code of "in the field" was seen 20 times throughout the interviews. The code for interactive education strategies was the second most common initial code, appearing at least one time in each interview.

Interview participants reported several types of education strategies and a variety of programs used at their facilities. The most reported education strategies included collaboration with schools to administer in-class interactive experiences at schools and field trips to the conservation sites. When discussing school programs, interviewees described strategies that included physically going into schools and classrooms to provide educational lessons and equipping teachers with lesson plans and additional materials to continue these lessons after they leave. These included presentations, shows, sponsoring clubs, afterschool programs, and lesson development within schools. One participant described that this "brings the environment into the classroom" while another reflected that "[We] come to your school, we're still in the classroom setting, but we're doing something fun. This might be your first experience of that kind." Another interviewee described the role schools have in continuing conservation-focused messaging by explaining, "Connecting whatever was happening [here]

back to their classroom studies so that it didn't just connect at the end of the magical experience, and then they never think about it again." School programs are also beneficial to reaching audiences and demographics that may not be able to access these facilities. For example, one participant noted, "One [program we do is] where they [educators] actually go into the schools. It's for any kids that might not be able to make it out to [the facility]. It's after school, so it's targeting more traditional schools."

On-site at these conservation facilities, participants cited several strategies to engage youth and students in educational programming. Most participants (six out of 10) indicated that field trips were the most popular program for students. Another participant spoke more broadly, stating that their most popular programs included "Anything where it didn't feel like school,". Most participants noted that field trips provided students with opportunities for interactive and "hands-on" experiences. Because of this, participants also said that interactive experiences were one of the most important things to provide when designing and implementing effective education programs. Participants developed this idea further by adding "We are interactive with our field trips too. It's not just 'here's admission to the center, have fun.' We set up interactive education stations." Interview participants emphasized the necessity of interactive and hands-on activities in 100% of the interviews we conducted.

Throughout our analysis, we developed two codes for interactive and hands-on educational experiences. These two codes resulted in 31 lines of data and were present across all 10 interviews. The frequency of these codes across interviews emphasizes the importance and necessity of interactive and hands-on strategies when delivering environmental educational content either onsite or at schools. One participant said, "We have to have real

hands-on learning." Another stated "People really like experiential programs" and "It's still learning, but it doesn't feel like it to them." When one participant was asked about which of their programs, they believed to be the most successful, they shared, "When we are actually able to get kids out in the environment and actually get them participating in hands-on science." Examples of interactive and hands-on programs mentioned by participants throughout the interviews included mock sea turtle rescues, collecting water and sediment samples, marine debris collections, dissections, and going out on boats and kayaks to see turtles. Educators also indicated that these hands-on and interactive programs provide students with unique experiences they may not have otherwise had. Moreover, many educators shared that they have experienced participants in their hands-on programming change their negative associations and relationships with nature. One described many of their participants as "nature-phobic, they don't want to be outside or be around these natural elements if they don't have to." The same educator then shared how participation in hands-on programming affects students. This facility takes students out into the water on canoes or kayaks to receive educational programming while immersed in nature. Students learn about the importance of ecosystem health and conservation as they kayak through the ocean and local waterways. This interactive, hands-on learning experience has resulted in the program participants sharing how they are "actually seeing that students are demonstrating a less fearful approach to nature and the environment. They're more willing to spend time outside or they're more willing to be in and around the water." Another educator spoke on the success of hands-on programs, stating "Our outcomes also demonstrate long-term wise that when our participants go through those action-oriented programs, the conservation outcomes

are actually greater and those are what people often remember six or even seven weeks or even six months after the program itself."

Long-term versus Short-term programs

The second higher-order code we created was the code for long-term versus short-term programs. This higher-order code was applied in 100% of our interviews. This higher order code was created through the use of various initial codes that related to educators' perceptions of the differences between these program lengths. Some of the initial codes that were used to create this code included "long-term barriers", "long-term successes", "multi-touch", "short-term", "participants have fun" and "stimulate curiosity". The code "multi-touch" was used by our educators in our interviews to describe programs where the same group of participants engaged in programming multiple times. The most common initial code of "long-term" was seen 32 times throughout the interviews. The code for long-term successes was the second most common initial code, appearing 13 times across the 12 interviews.

In the interview, we asked participants if they (or their facility) engaged in any long-term programming and how they view these programs against short-term programs. For our analysis, "long-term" and "multi-touch" were synonymous, based on how educators used the terms to describe to similar longer-term programs. Most of the multi-touch programs described by participants in their interviews centered around meeting with the same students from the same classroom/school multiple times throughout the school year, primarily through after school programs. The second most common way facilities reported multi-touch programs was through homeschool partnerships. One educator described long-term programming within the schools as "[w]hen we go offsite to those locations and be able to

work with those kids for an hour, and we see them multiple times throughout the school year." Another facility shared details of a yearlong program in which homeschool students develop and execute their own research projects as well as participate in outreach to teach the public about the results of their projects. Most participants indicated that long-term programming had a lasting effect on students and made them more likely to engage in pro-conservation behaviors. For instance, one participant stated, "I think some of these long-term classes and projects where we're seeing kids over and over and really empowering them and making them feel like they're a part of something, to me, these are the ones that I see the greatest changes[...] to me, those seem very effective." Another shared, "the more contact points, the more they [the students] change their behavior and that is core to what we do".

When discussing their perceptions of long- versus short-term learning effectiveness, most participants did share the view that short-term programs may not sufficiently increase knowledge, nor willingness to engage in conservation behavior. One participant shared, "When we're talking about true conservation or sustainability or getting people to adopt a different mindset or a perception towards something, one-off programs aren't going to do anything. Multi-touch programs are critical when we're looking at those types of things." Another shared, "I am a firm believer that one-off programs do nothing other than have a good time."

When asked why they thought there was a limited number of long-term programs despite their perceived effectiveness, participants most often credited a lack of space, funding, and personnel as the highest contributing factors. Other participants cited a lack of willingness to participate in programming multiple times by the local community, describing how their facility and offerings compete with other available recreational activities. For

example, families may prioritize when choosing how to spend their free time. One participant, who chose not to be recorded, shared how they feel their education programs compete against other activities families have to participate in, such as sports games, band performances, and other events. They described how this may contribute to a limited number of repeat visitors. Many participants shared that they believed there was a lack of long-term programs across the industry but remained optimistic that short-term programs could still contribute to conservation goals.

When discussing barriers to long-term programming, participants referred to the use of short-term programming as a way to overcome some of these barriers while contributing to conservation goals. Participants discussed how short-term programming can be effective in stimulating curiosity, creating positive associations with the environment, and contributing to overall program success. One participant discussed how they believe fun is an indicator of successful education programs, "I would say that I think success of an education program, and this is really the bare minimum, but I just think a participant has a great time." They go on to say, "if they learn something even better, but if they had a great time, then they're always going to have a positive association with that topic and that's success to me."

Components of Successful Education Programs

The next higher-order code we created was components of successful education programs. This higher-order code appeared 132 times and in 100% of interviews. Some of the initial codes that were used to create this code included initial codes about what educators perceived as the most important to developing successful programs. Some of these initial codes included "perceptions of educators", "important", "most successful", "requirements", "diversity" and "emotional connection of species". The most common initial codes for

diversity of programs, audiences, and educators appeared 46 times throughout the interviews. The second most common code for emotional connection appeared 29 times across interviews.

In the interviews we asked participants how they would describe the success of their educational programs. If they described them as successful, we asked them to explain why they believed that to be true. Most participants suggested that at least some of their programs were highly successful. Participants shared that the formation of emotional connections with species contributes to overall program success. One participant shared "People love turtles. It's very easy to get people to come and actually see us." Another shared the same feeling, "Sea turtles are charismatic animals. People love them. Being able to get up close and personal with a sea turtle resident or sea turtle patient, the kids eat it up. They love it."

The advantage of forming emotional connections with species was described by educators as two-fold: it not only gets people excited about conservation but also helps contribute to positive relationships with nature, particularly in populations who have not had these positive experiences. A participant illustrated this advantage,

"For me, it's more of creating that experience and that positive interaction with these animals and making science fun […] we'd love to have more engagement with animals…I really do think we need to continue to push environmental education and make sure that it is easily accessible to students because in a lot of areas, we are the first experience that those children are getting with that animal. We are that first positive experience."

Another educator, who chose not to be recorded, shared that the more emotionally engaging the programs are, the more likely participants are to return for more education programs in the future.

One participant did raise concerns about relying too heavily on the emotional connection of species. They suggested that it can detract from reaching conservation goals, stating

> "There's always a danger…the problem is the awesomeness and beauty of the animal in the room, it's a charismatic player. If the students see the charismatic player, they can oftentimes forget the message…Sometimes the charismaticness of the thing that you bring in or the activity you provide can sometimes even take away or detract from the point."

They also added that even if participants only remember the cool animal, it can contribute to their overall willingness to participate in species conservation, saying "They will at least remember that, and that experience will stay with them and maybe later on in life, it can find a slot in their brain that connects to bigger picture thinking."

Another aspect of education that participants believed contributed to their success was the diversity of programs and audiences. When discussing programs, there was a variety of field trip, homeschool, intern, volunteer, outreach, and virtual programs described. Participants later went on to discuss the importance of diversifying audiences. One participant said, "We have to diversify who our audience really is in order for us to be successful from a conservation standpoint." While many of the facilities have several

programs for school-age children, most agreed that having a diverse audience was essential to their success.

One participant emphasized that the success of their annual beach cleanup was because it attracted a diverse group of people. They stated,

"I think [Name of Event] is our most popular event because it appeals to everyone. It's not just school-age students. [Name of Event] allows the entire family to come and participate together as a unit in doing something good for the environment… We are not just about field trips for school-aged children, we cover all the ages."

Another described reaching a diverse audience as one of their primary goals. This participant said, "Being able to do science simulations with the youngins, being able to do lectures for lifelong learners. That's the primary goal as far as the organization is concerned." However, reaching a diverse audience can be difficult. One participant noted

"I think some of the biggest barriers that we face is reaching outside the typical audience… we've been putting a lot of consorted effort into diversifying who our audience is and who our participants are and so really reaching students that might not traditional think of marine science as a career for them."

Participants also suggested that there is a need for diverse personnel and educators to administer lessons. They reflected on the low salary of educators and naturalists (nature educators) and how this contributes to a lack of diversity in professionals, explaining how

this makes the position primarily accessible to professionals who have the freedom to spend a short amount of time in an educator position. One participant described the role of an educator as, "It's almost gap year like employment, because they [educators] don't make enough money to live." They expanded on how college graduates who do not have this freedom, or graduates who have a responsibility to provide for more than just themselves, cannot often take roles as naturalists. They shared how the financial and freedom constraints contribute to a lack of diversity within the environmental education field. They stated,

> "It's often the white college graduates who have the freedom and family and financial support to essentially throw a couple of years away as a naturalist. You have a reduction of diversity in the naturalist population. If you go to any conference of naturalists, 95% will be middle to upper class white college graduates, very few Hispanic and very few Black naturalists."

Another participant shared how having a diverse group of educators to deliver content is important for underrepresented communities and communities of color to see scientists and educators who "look like them" participating in conservation. Increasing diversity of the educators was described as essential in getting participants excited and engaged in programming, as well as allowing them to see where they fit in the world of conservation. This concept of diversity also contributed to participants' development of their STEM identity, which was used to develop one of our main themes and is explained in more in the later sections.

Education Barriers

The next higher-order code we created was education barriers. This higher-order code appeared 144 times and in 100% of interviews. Some of the initial codes that were used to create this higher order code included initial codes such as "barriers", "funding", "buses", "evaluation" and "accessibility". The most common initial code of barriers was seen 64 times throughout the interviews. The code for "funding" was the second most common initial code, appearing 49 times across interviews.

Throughout the interviews, participants shared barriers to implementing and expanding successful environmental education programs. Barriers reported by participants included funding, evaluation difficulties, personnel shortages, state standard limitations, political constraints, lack of infrastructure, and accessibility. The most common barrier reported was funding, which participants discussed 49 times throughout the interviews. When asked what they believed was the largest barrier they faced, funding was mentioned first in nine out of 10 interviews. One participant stated, "There's just no money to do it." Another said, "It's always financial." Most of the educators we interviewed worked for non-profit organizations. Their statuses as non-profit entities contribute to difficulty in securing funding for education. One participant stated, "I think probably our number one barrier is that we're a non-profit organization, so all our funding either comes from generated revenue or grants or donations." Another educator shared their perspective on how their non-profit status and the need to generate funding limited their ability to dedicate time to effective education programming. They said,

"The thing we have to constantly go up against is that we have to have the money to do that. We're a completely independent non-profit. We receive no financial support from any government entity of any kind. Whatever we bring the front gate [admission sales] is what we have to support our operations. There are things that I would love to do that I can't do or there are things that I would love to not have to do like summer camp but in order for me to run my field trip programs we have to do summer camp because that's what pays for our school groups...we have to pay for it in some capacity and there's just very limited external funding that is interested in funding education programs for schools."

When facilities did not have large revenue-generating programs such as summer camps, they reported resorting to charging schools for their participation, stating, "There is just a real cost that we incur to bring kids to us… We had to charge the schools."

Participants often described the lack of funding as existing due to the absence of verifiable evidence that their education programming is successful. One participant expanded on this point, saying,

"Sometimes it [lack of funding] makes it a little difficult for us to implement a new program when we're not sure of the results or how well it will be received because that's money being put into that program, invested in that program that could potentially not be a success. I also think there's a perception out there that why would you need to do it?... There are people that I work with day-to-day who would be like

‘That’s stupid. Why would I spend money on that?’ That’s probably one of the biggest

barriers.”

Another shared, “For students to go to an outdoor education program, it’s expensive…school

districts don’t carve out money out of their budgets for this, because I believe they still don’t

see it as a high enough value.”

Another participant identified that a lack of funding for research and evaluation also

led to a lack of funding to implement education saying that

“The biggest barrier that exists, the only way education in any capacity is ever

funded, appreciated, or respected is when you can demonstrate legitimate long-term

outcomes. That’s where it becomes very challenging sometimes to be able to

demonstrate the validity of your methods or your program to show that ‘Hey, we’re

actually the reason why this happened.’ The assessment and evaluation piece is really

critical, but there needs to be a bigger investment and research across the board.”

Some participants shared that they have teams and employees who are dedicated to finding

and applying for grants to fund their programs. Facilities that did not have the resources

needed to apply for grants or pursue other funding opportunities often reported personnel

shortages as a barrier to receiving funding and implementing more education programs.

Participants also reported that a lack of personnel led to fewer people available and willing to

administer educational programming.

Moreover, participants emphasized how important employees were to their success, showing that without an adequate number of employees, they would struggle to create and deliver impactful content. One participant shared that they believed their programs were successful because of their staff, saying "People make it really successful, and the way the programs are put together, it's never just one person putting it together. People work as a team and pull things together." Another shared, "I know a lot of research facilities don't have a dedicated education staff. I think that we're lucky that we do have that." Several participants also indicated that they relied heavily on volunteers to assist in administering their education programs. These participants credited robust volunteer populations for success in their program administration. One participant stated, "We couldn't do half the stuff we do without the volunteers."

Despite the importance and value of volunteers, educators in our study indicated that the COVID-19 pandemic impacted their volunteer numbers. One participant, in particular, shared their experience with shifting volunteer populations and demographics following the COVID-19 pandemic. They said that their post-pandemic volunteer pool did not rebound to the same per-pandemic numbers. They shared that they were not sure what the driving force behind this was, but that low volunteer numbers are negatively impacting their facility's capacity to engage in educational programming.

Political constraints were also mentioned briefly in a few interviews. Most notably, participants referred to local, state, and national politics as barriers when discussing the lack of funding and perceived negative attitudes toward environmental education. However, the impacts of climate change and other wide scale environmental phenomena as a barrier to educational programming were only mentioned once throughout the interviews.

Finally, accessibility was the last barrier reported by participants. Most participants referred to their remote locations on the coast and the need for transportation to access them as a barrier, particularly in reaching underserved communities. Participants discussed the costs associated with travel and with bussing groups to their sites, particularly among Title I and low-income schools and populations. Bussing groups was mentioned in seven of 10 interviews both from an availability standpoint and a financial one. One participant, underscoring the problem with bussing, stated "bussing is a huge hurdle. Bussing is very difficult to get a hold of right now and it's very difficult to pay for if you can get a hold of it." Another said, "They have all this red tape behind getting buses to come out. I think it's a matter of getting the students here. Getting them actually out into the environment could be a barrier depending on where they're coming from." Additionally, many participants reported that grant funds were being used for bussing and transportation. One participant said,

> "We actually fund bussing for field trips so that we can bring them here, so that they
> can experience that. We just have to find grants to fund that, but I think that is huge
> because when those students (underrepresented) come out here, I think it is so much
> more meaningful than a kid who's come every year on a field trip since they were in
> kindergarten."

Several educators also described the development and popularity of their virtual programming as a way to reach communities and participants who cannot physically make it

to their onsite programming. One participant described, "Our programs are great, but there's a lot of kids that are never going to be able to get out here."

Empowerment

The next higher-order code we created was empowerment. This higher-order code appeared 47 times and in 100% of interviews. Some of the initial codes that were used to create this higher order code included initial codes such as "underserved communities," "meet them where they are," "STEM identity," and "making choices." The most common initial code of underserved communities was seen 17 times throughout the interviews. The code for STEM identity appeared 11 times across interviews.

When asked about what goals educators had for their programs, many emphasized developing a STEM identity in their participants as one of their top investments. Participants referred to the development or contribution to a participants' STEM identity as one of the most important markers of successful programming, sometimes being considered more important than any knowledge gains. Empowerment and STEM identity were both discussed as not only an important outcome of educational programming, but also essential during the creation of programs. One participant shared,

> "We are heavily invested with [name of the facility] in developing an increasing
> STEM identity. We come at it from two different perspectives, and so one of the big
> things that we really push for is how do we take STEM identity and how do we teach
> them through conservation as a lens. How are we able to teach engineering practice
> using conservation? We have a big push on conservation technology and integrating

different technological pieces to our applied conservation efforts as well as to our research efforts, and we integrate that into all our programming as well."

Others shared that "all of our programs are being realigned and retooled in a way to enhance our local communities, particularly our youth, on their environmental science identity." One participant shared how their use of interactive and hands-on programming allows participants and students to develop their STEM identity, and how she defined this as a characteristic of successful education programming when she shared, "They walk away with a positive experience with nature or with an animal, or with science, and that positive experience is going to help develop their STEM identity [...] they're always going to have a positive association with that topic and that's success to me." Developing STEM identities was described as a tool to empower individuals and as a crucial component that can have long-term effects on students. One participant stated, "Really teaching students that might not traditionally think of marine science as a career for them" and "You don't know which student or which participant, or which person coming through is going to be that marine biologist that solves your major oceanic problem we may be having."

The idea of instilling the belief in individuals that they have the power to make a difference was mentioned in 100% of our interviews as well. When asked about what an interviewee believed made education programs successful, they responded, "It is very important to... make sure the kids were constantly seeing how everything they did impacted the world they lived in, and what were choices they were making and how would it affect it?" When asked, what you would describe as your overall goal for your education programming? one participant shared "Our biggest goal is that they feel like they're empowered to make a

difference just by making small changes in their daily living." Another shared "Really, our goal is we want them to be scientifically literate, but also environmentally literate to make better decisions as an everyday consumer." Another participant responded that her biggest hope through education is "that youth, and not just kids, not just our school group, but the younger generation would be compelled to do things differently than what the older generations have done, and see that those changes, no matter how small, do make a difference." The empowerment theme was discussed from the standpoint of empowering both local participants and individuals who may live far from the marine environment. They shared,

> "The things, the decisions and the choices we make hundreds of miles from the ocean can impact the quality of life for these animals out here in the ocean". Education is essential in empowering individuals to make these pro-conservation behavior choices. "It really does start with education, if they don't know it, then they can't make the choices."

Community building and ownership

Our last higher-order code we created was community building and ownership. This higher-order code appeared 94 times and in 100% of interviews. Some of the initial codes that were used to create this higher order code included initial codes such as "community building," "ownership," and "meet them where they are". The most common initial codes of

community building and "ownership" both appears 22 times. The code for "meet them where they are" was the second most common initial code, appearing 11 times across interviews.

Throughout our interviews, many educators emphasized the role of the local communities. They described the need to tailor education to the issues that are important to the local communities, as well as allowing space for the local community to take ownership of their learning while contributing to overall community building. "The most successful conservation education or environmental education programs are built in collaboration with the local audiences that they're serving, and I think that has to be there." One described that "we meet them where they are, we find out what their interests are, and then we design programming around that rather than coming in with a preexisting lesson and being like 'You're going to be excited about sea slugs' We come in and find out what's relevant to them. They might not see water. They might not ever go to the beach." Others described that lessons and programs must be relative to the world that the community lives in. "Successful conservation starts with educating people to appreciate and understand the world they live in." Participants also discussed the responsibility they believe they hold as educators to be aware of this, and to involve local community needs. One participant shared their view on this responsibility to include the local community by sharing,

> "I just hope we as educators and as scientists and as conservationists recognize that that looks differently for everybody. A lot of us were raised in this world of like, 'I love the ocean, I love the world, and conservation is the only way it is.' Some people weren't raised that way and going in with a really open mind and non-judgey mind and understanding where people are starting from and building up from there".

Another shared "Also just involved them (the local community). I think when you involve audiences, you get a lot more buy-in in the activities and the conservation efforts"

Another participant shared this belief,

"We have to see more of an emphasis on participatory education and that the audiences that we're serving take ownership and that they have actual say in the design of these programs. We need to get away from the mindset of this is the problem that I see so this is what I'm going to tell this community how to fix that problem or how to be involved or here's what we are going to do. That doesn't work and we know it doesn't work."

In addition to emphasizing the need for community ownership over their education, interview participants also shared the unique ability that education can have in building and connecting local communities. The code "community building" was applied 24 times throughout the 10 interviews. Many of the participants described that educational programming acts as a vehicle to provide opportunities for the local community to come together and work towards a common goal. This included trash clean-ups, outreach festivals, volunteer opportunities, and citizen science initiatives. Educators described the ability their programs have to help local communities "feel a part of something bigger." One educator described how "We really foster that we're all in this together. We're going to learn science, we're a science community, and we've got each other's back." Reflecting on these programs,

one shared "Whether it's a cleanup or whatever it might be because, to me, that's where the big challenge is going to happen. A lot of these kids, especially if they've not come out a lot, they might not realize that they're part of the marine science community. Making them feel like they're part of something and that what they do matter is my philosophy." When asked about what role they hope education can play in the future, one respondent shared,

> "I really hope that through education, that they can understand that what they do matters but also that they are part of a community. When we stand together as a community, we can really make positive change. That's one of my biggest goals with all of my programs is not only do I want the individual to have fun and the individual to learn, but I also want to give them things in the community that they can be a part of."

Most of our interviews shared this belief that their presence and programming are having a positive impact on both the environment and the community.

Theme creation

We integrated higher-order codes into three themes: 1) The unique strengths of short-term programming 2) Empowering individuals to contribute to conservation, and 3) Community developing ownership over their education. These themes were informed by our six higher order codes. Each of these six higher order codes were created by combining several of our initial codes.

The first theme of unique strengths of short-term programming refers to the perspective educators held about how they make short-term or one-off program experiences successful. This theme was informed by the higher codes of education strategies, education barriers, long-term versus short-term programming, and components of successful education programs (Figure 5).

Initial codes

Higher order codes

Theme

Initial codes	Higher order codes	Theme
Emotional connection		
Diversity of educators	Components of successful education programs	
Reducing fears about nature	Education strategies	The unique strengths of short-term programming
Participants have fun	Education barriers	
Stimulate curiosity	Long-term versus short-term programming	
Long-term barriers		

Figure 5: A visual web of how we used our initial codes (left) to create a series of higher order codes (center) that led to our overall theme creation of empowering individuals.

Our next theme was empowering individuals to contribute to conservation. This theme was informed by the higher codes of empowerment, education strategies, and components of successful education programs (Figure 6).
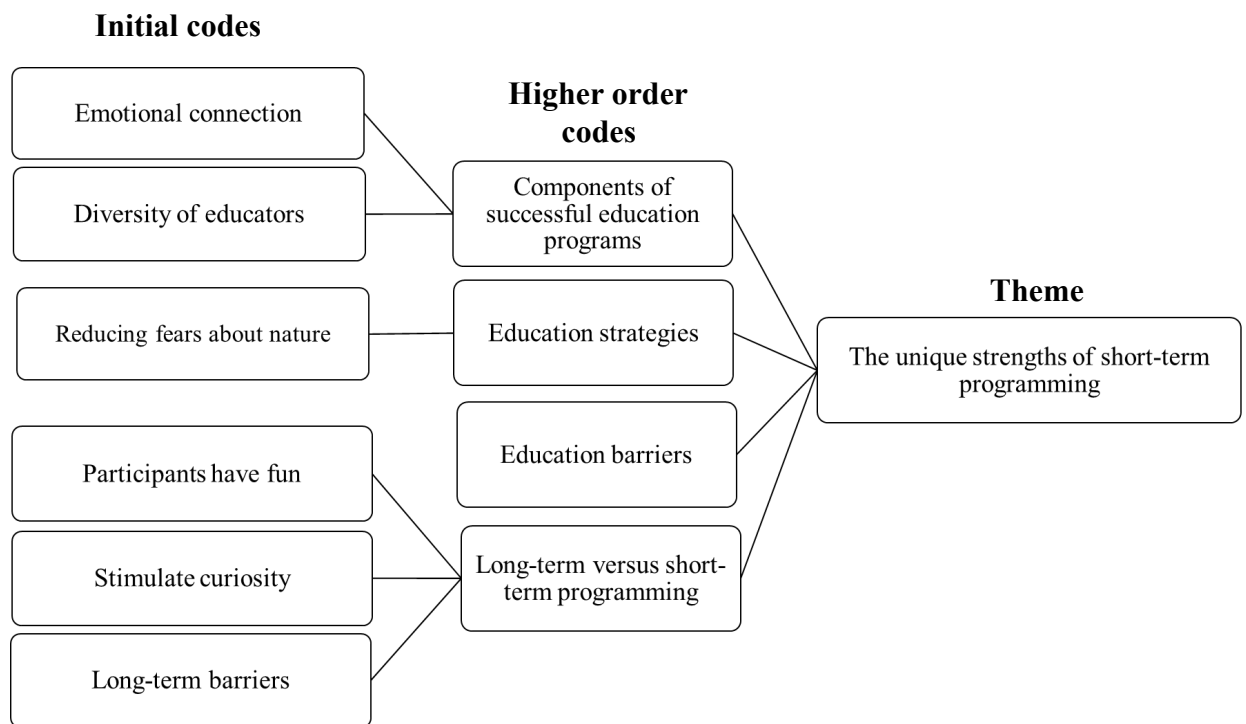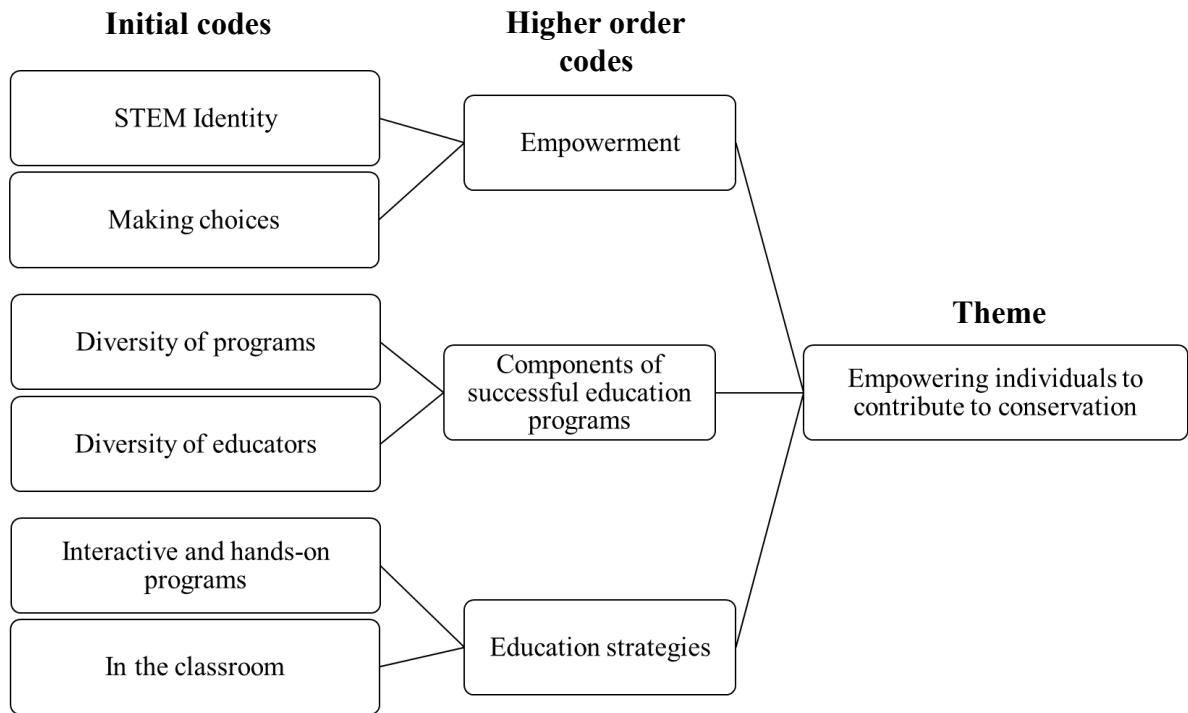

Figure 6: A visual web of how we used our initial codes (left) to create a series of higher order codes (center) that led to our overall theme creation of empowering individuals.

Our final theme regarding educators' perceptions of what factors contribute to successful programs was the importance of the local community developing ownership over their education. This theme was informed by the higher codes of education barriers, components of successful education programs, and community building and ownership (Figure 7).

Initial codes

Tailoring lessons

Community building

Meet them where they are

Diversity of audiences

Community working together

Higher order codes

Community building and ownership

Education barriers

Components of successful education programs

Theme

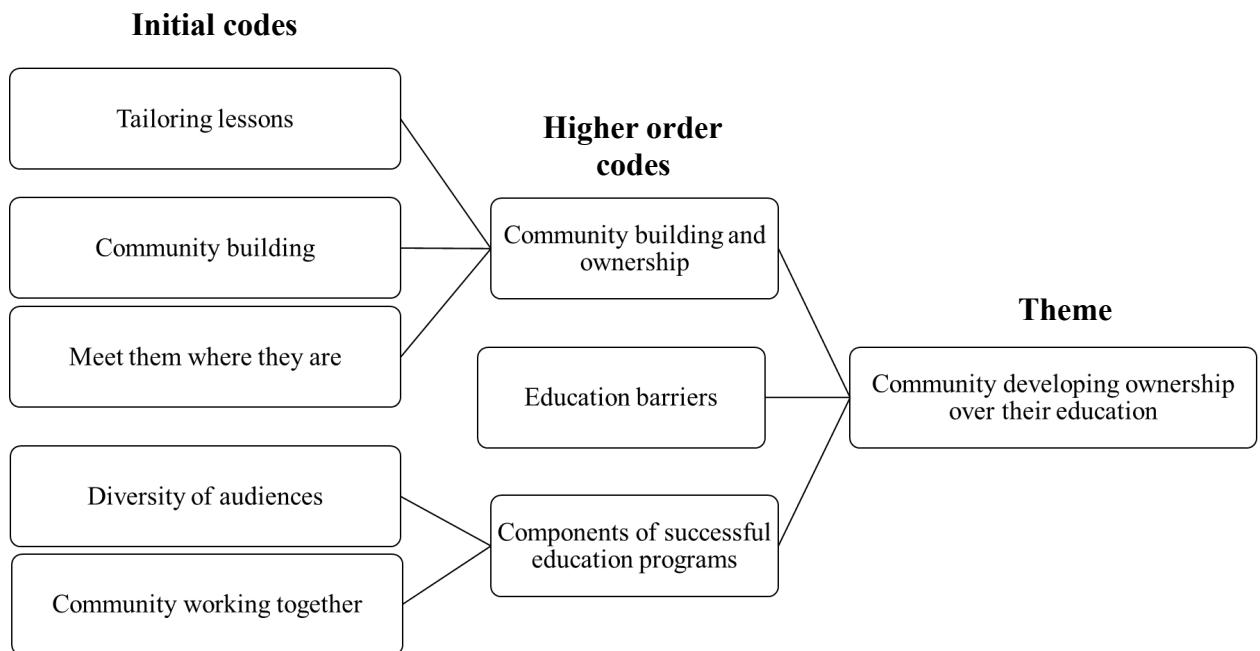Community developing ownership over their education

Figure 7: A visual web of how we used our initial codes (left) to create a series of higher order codes (center) that led to our overall theme creation of community ownership.

V. Discussion

This study analyzed and reported on environmental educators' perceptions of what makes educational programs effective at contributing to conservation goals. Specifically, we analyzed environmental educators' beliefs about what were the specific strengths, weaknesses, opportunities, and threats facing environmental education programs. We also explored their views of long- versus short-term educational programming, their perceptions of what makes educational programs effective, and the barriers that, in their view, prevent them from being effective in achieving conservation goals. The results and findings showed that there was a high degree of consistency and agreement among participants, not only on the individual SWOT factors, but also on their perceptions of what makes for a successful and effective program. In the interviews, participants also shared the importance of not only contributing to education and conservation goals but in fostering community ownership and community building through education. Expert opinion is key to developing educational programs, and opinions from educators actively working in the field of environmental and conservation education are important because of their unique role in implementing such programs. In the following sections, we situate our results and findings with the existing environmental education literature and discuss implications of the study.

SWOT Results Discussion

Our study revealed a high level of agreement among participants about the top factor in each SWOT category, which was strengthened by our interview findings. Three out of the four top factors aligned and integrated cohesively with our interview findings and aided the formation of our three primary themes (Figure 8). For example, the top strength was activities that engage the community in hands-on conservation and create public awareness.

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This result is supported from the interview findings, as evident from our codes and the frequency with which participants spoke about engaging the community as a factor of overall program success. Educators place high importance on engaging the community because it increases positive conservation outcomes at the local level. This importance of community engagement is corroborated by existing research that emphasizes the fact that conservation actions are influenced by complex social value systems (Taylor, 2000). Existing research recommends that to achieve maximum conservation actions, managers must collaborate with communities (Martin et al., 2016). The importance of engaging and collaborating with the community is also present in the IUCN framework for collaborative management which promotes a partnership between organizations and local communities (IUCN, 1996, Sec. 1.42). Engaging the community in hands-on conservation actions strengthens the effectiveness of environment education programs in contributing to overall conservation goals.

To effectively engage the community and influence conservation behaviors, education centers must provide ample opportunities for the community to participate in programs. The top opportunity identified through the SWOT analysis confirms the importance of creating opportunities for the community to be involved. Our interview findings further validated the importance of providing diverse programs for community involvement. There are several strategies that were identified in our interviews that educators use to involve the community. Participants emphasized that involving a diverse group of people from different locations, backgrounds, and age groups is essential to program success. The perceived importance of community involvement is discussed in the following sections.
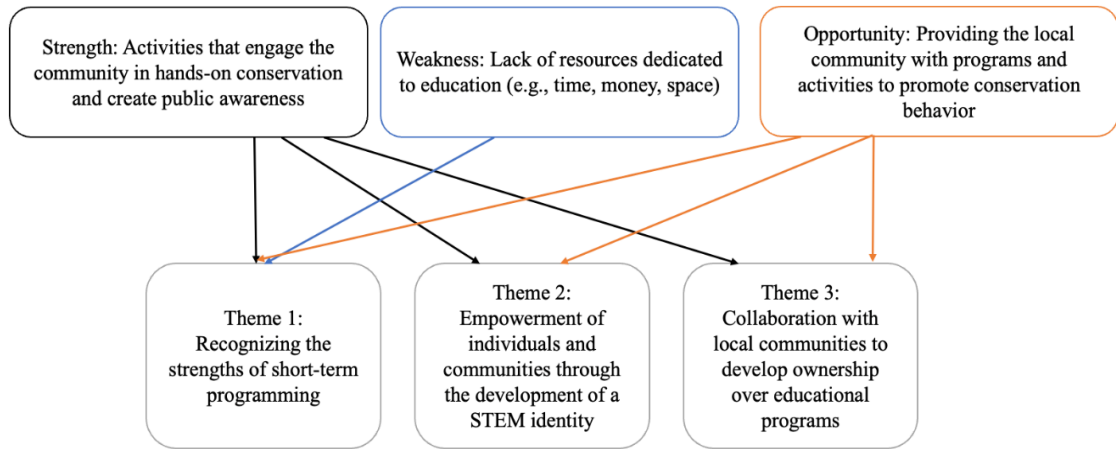
Figure 8: A web showing how three of our top identified SWOT factors were triangulated with our qualitative data and contributed to our overall themes.

The most identified threat factor was "climate change and other large scale environmental events that threaten sea turtles." However, the threat of climate change and other large-scale events was not mentioned a single time throughout the interviews. The need for education programs as a means to promote conservation of sea turtles exists due to environmental events that threated sea turtle survival. As climate change and other large scale environmental events continue to accelerate, educational programs may not be effective in protecting and conserving species as these threats are too broad to be mitigated through education alone. This perception is supported by other research that explores the threats to species education as well. A previous SWOT analysis of a species focused education program found that educators of a program that aimed to conserve the Lesser kestrel species identified these threats. In that study, educators explained that they feared that their program may be shut down or discontinued as a result of the lack of success in increasing the kestrel population (Gal, 2023). Climate change and other environmental threats may harm populations beyond the scope of what can be accomplished through education. A lack of

success in contributing to conserving and protecting species against such events through education may lead to programs being discontinued, as educators have expressed in previous studies as well as through our survey results. Despite this threat, educators in our study expressed optimism about how educating participants about sea turtles has the power to contribute to broader conservation actions that can benefit entire ecosystems as a whole. Further, climate change does not seem to impact education centers on a direct day to day basis, the way other threats and limitations such as changes in funding do. Educators' optimism in contributing to larger conservation goals through species-focused programming, as well as the lack of day to day impact can explain why educators did not express concerns about such larger threats during the interviews.

This discrepancy between the SWOT and the interview responses demonstrates the importance of triangulation of methods, such as qualitative interviews coupled with a quantitative survey, such as the SWOT-AHP analysis employed here. Without the qualitative data, we may have incorrectly assumed that the threat of climate change was considered an important consideration of educators when designing and implementing successful education. However, after comparing our data, it seems as though this is not a factor that conservation educators worry about when designing successful programs.

Our AHP revealed a high level of judgmental consistency among what educators perceive as the top factor of successful education. The top factor identified was the strength of engaging the community with hands-on conservation activities. The survey findings align with perceptions of educators revealed in the interviews that hands-on experiences and collaborating with the community are essential to program success. Research on what makes for successful STEM education in formal school curriculum identifies that teamwork and

collaboration need to be emphasized during the creation of programs (Margot & Kettler, 2019). The findings of our SWOT suggests that educators agree that the component of engaging the community in opportunities for them to work together towards a common goal should not only be emphasized in formal curriculum development, but in informal institutions as well to increase program success. This belief was further explored through our interviews and contributed to the formation of several of our themes. The following sections discuss the creation of our themes based on the integration of our SWOT-AHP results and interview findings.

Theme 1: Recognizing the importance of short-term programming

Our initial literature review revealed that short-term programming is less effective in contributing to conservation goals as compared to long-term programming (Counsell, 2020). While many of our research participants acknowledged this sentiment, they revealed that using short-term programming is essential to developing successful programs. Research participants in our study shared the belief that short-term education programming, such as a single field trip, may not be sufficient in influencing conservation behavior. Studies exist on this topic reinforce their perspective that knowledge retention and willingness to change behaviors are enhanced with longer-duration programs (Collins et al., 2020). Interview participants agreed with this view, but revealed a number of barriers they face when trying to design and implement long-term programs, such as the fact that long-term programs often require more resources than short-term or one-off programs.

Indeed, research participants credited a lack of resources as the most significant weakness of environmental education programs in the survey. They further expanded on this during the interviews, with nearly 100% of participants sharing that a lack of finances and

infrastructure was their biggest barrier in expanding their education, as well as the most contributing factor as to why they could not administer more long-term programs. Therefore, perceptions on the way that even short-term programming contributes to willingness to continue learning about conservation beyond the initial experience is significant in demonstrating the importance of all types of educational programming.

Some of our participants shared that they are overcoming barriers to long-term programs by recognizing the impact single experiences can have on students' willingness to continue learning or ability to make connections to conservation down the line. Prior research supports this perspective, that one-off programs can increase the likelihood that education participants will continue to learn about conservation following their visit to (Schilbert & Scheersoi, 2023). Thus, the benefits of short-term programming are an important consideration when accounting for the excess resources needed to administer long-term programs.

In addition to increasing willingness for continued learning, even short-term experiences in nature can foster positive experiences with nature, which is associated with increased willingness to adopt pro-conservation behaviors (Pirchio et al., 2021). This is especially important when considering low-income and underrepresented communities, who, as reported by research participants, may never, or seldom have, the chance to come out to the facilities in person. Educators described creative ways to bring education to low-income and underrepresented communities through school visits and virtual programming, but both of these strategies contribute to excluding these populations from direct nature interactions.

Interestingly, a single educational experience outdoors is linked to increased engagement in subsequent, indoor lessons on the same topic (Kuo, Browning, & Penner,

2018). Therefore, a single nature-based educational experience, such as those provided by the conservation facilities in this research, has the potential to increase student engagement when they return to the classroom. A single outdoor experience coupled with school partnership programs such as lesson plans for teachers provided by such facilities can help increase educational program duration and result pro-conservation behaviors while reducing dependency on identified barriers such as high cost and physical infrastructure. This strategy is especially important for low-income and underrepresented groups who often face the most hurdles in physically reaching such conservation facilities (reported by interview participants) by increasing the impact of a single visit on their learning as opposed to multiple interactions. These interactions with nature provided by conservation education centers contribute to individuals' abilities to develop meaningful relationships with the environment, further contributing to their willingness to engage in pro-conservation behaviors (Harris et al., 2023).

Widespread barriers such as funding and infrastructure were often reported as out of the control of educators. When educators face barriers that are out of their control, they should focus on improving the quality of the programs within their capacity, even if they are short-term or single event programs. Our study revealed two important themes when discussing what factors increase the success of educational programs, even short-term ones. Short-term programs can be just as successful as longer-term and more resource consumptive experiences by focusing on empowering individuals through the development of STEM identities, as well as working with local communities to establish ownership over their educational programming.

Theme 2: Empowering Individuals and Communities-STEM Identity

The results of our initial SWOT survey showed that the top opportunity identified by educators was providing the local community with programs and activities to promote conservation behavior. The concept of empowering participants to engage in these conservation behaviors was shared among all interview participants as crucial to programmatic success. This suggests that environmental educators value engagement with the local community as a way to enhance conservation behavior. Indeed, education has been identified as effective in influencing people's willingness to engage in environmentally positive conservation behaviors (Li, Wang, & Cui, 2022). However, the way educators conduct their programs is important to influence behavior change. For example, narratives shared by the participants emphasized the need to ensure that in order for programs to be effective in influencing behavior changes, they need to provide opportunities for empowerment. More specifically, programs need to provide opportunities for participants feel empowered to make a difference, to realize that their choices matter, and to understand that they can contribute to larger conservation goals through behavior changes. Incorporating aspects of human psychology such as these into program design has been gaining application in the sciences using Behavior Centered Design (Sulliven-Wiley, et al., 2023). The knowledge-attitude-behavior (KAB) model is one of the oldest models often used to explain an individual's environmental behavior (Hungerford & Volk, 1990). Hungerford and Volk identify three categories of variables that contribute most to environmentally positive behavior, one of which is empowerment (1990). Our findings support the KAB model by demonstrating the impact empowerment has on creating education programs that are successful in contributing to conservation goals. However, the extent to which creating a

sense of empowerment has on achieving conservation outcomes require further exploration. The use of evaluation tools such as pre- and post-program surveys or other assessments of behaviors should be used to validate program success in influencing conservation behaviors. Educators should be trained and sensitive to the needs of the audiences they are serving through their programming in order to best understand how to foster a sense of empowerment in program participants.

Throughout our study, nearly all participants emphasized the goal of contributing to conservation by influencing people to make behavior changes. Their responses all mirrored nearly the same approach to encouraging these behavior changes- through the empowerment of individuals to realize their capacity to contribute to real conservation. Two main approaches to empowering participants were revealed during our study. The first approach was through the use of hands-on and action-oriented lessons and programming. From the survey, participants identified "activities that engage the community in hands-on conservation and create public awareness" as the top strength of conservation education. The interviews mirrored these results as educators described how the use of action was often considered the most important aspect of effective environmental education programs. This is supported by existing research exploring the use of action knowledge. Otto and Pensini (2017) reported that providing action knowledge by teaching children how to actively engage in environmentally friendly behaviors, such as recycling, may be effective in instilling the belief that they can have a meaningful environmental impact, and make them more likely to participate in behavior changes. The perspective of educators revealed in this study expands on the existing research about pro-environmental behaviors. Many of the research participants reported on the behavior changes they witnessed in their local community as

well as the direct program participants that they believe are a direct result of the unique hands-on education they provide.

The second most widely shared method of increasing the empowerment of the participants to make real change consisted of educators focusing on diversifying audiences and personnel and developing STEM identity. Research has supported this emphasis on the importance of empowerment and the development of a STEM identity. The Center for the Advancement of Informal Science Education defines someone with a STEM identity as someone who "think(s) about themselves as science learners and develop an identity as someone who knows about uses and sometimes contributes to science" (Bell et al., 2018, p. 1). Extensive research exists analyzing the importance of STEM identity in formal classroom settings, with a particular focus on the retention of STEM students through undergraduate degrees as well as those who will go on to choose careers in the STEM field (Stewart, 2021). Few studies have documented the links between experiences with outdoor education and the development of science identity in terms of species conservation, particularly in the marine environment, and how this can contribute to changing behaviors (Harris et al., 2023). Despite a lack of published studies, the findings of our study suggest the importance of fostering STEM identity when developing effective conservation education programs. Marine conservation educators in our study consider the development of STEM identity to be one of the most important factors in contributing to participants' willingness to participate in conservation behaviors. Literature supports their perspectives by emphasizing the use of identity shifts to encourage pro-environmental behavior following educational programming (McGuire, 2015). A focus on STEM identity should be expanded from an undergraduate career perspective to include informal education settings as well. Informal educators, such as

our study participants, are beginning to notice the importance of these identify shifts, and widespread training and adoption of practices to encourage STEM identities should be implemented in the environmental education field to increase conservation outcomes and contribute to overall empowerment of individuals. Our study revealed that educators perceive empowerment of individuals and the development of their identity as members of the science community as one of the defining features of success.

Moreover, educators in our study credited a diverse array of programs, tailored to fit the specific needs of the target communities, in contributing to developing STEM identity and a feeling of empowerment. Research participants also shared their techniques to educate on all aspects of STEM, such as technology and engineering, through a conservation approach. This finding suggests that opportunities to participate in educational programming at conservation centers such as those in our study may also help increase conservation knowledge, and empower participants to take pro-conservation actions, as reported by our interview participants. Conservation educators should take steps to ensure that programs work to best target specific community needs in order to best empower them through the development of their STEM identity. Fostering a sense of empowerment will not only contribute to overall environmentally positive attitudes and actions but will improve the impact of overall species conservation outcomes.

Theme 3: Collaboration with communities to develop ownership over educational programs

The second category described by the KAB model emphasizes the role of ownership in contributing to environmentally friendly behaviors (Hungerford & Volk, 1990). Our third theme was the theme of collaboration with communities to develop ownership over their educational programming, which builds on this model to specifically apply to pro-

conservation behaviors. Our study revealed that engaging with the community and providing the local community with educational programs is considered by educators to be the top strength and opportunity of conservation education. This is supported by a growing body of research surrounding community engagement that emphasizes the role of local communities' involvement as a critical part of program development (Mthembu, 2023). Community engagement has been described by the World Health Organization (WHO) as a process that allows community members to be involved in defining issues that are important to them and to make decisions about things that affect their lives. They expand on this definition to include working with groups of people affected to address issues affecting their well-being and to identify solutions that encourage change (World Health Organization, 2023). This concept is most often applied in healthcare settings but is beginning to take hold as a guiding principle for other research and planning areas as well (Irish et al., 2022). During the interviews, participants emphasized the need to empower and involve the local communities they are serving as well as the importance of making lessons relevant to them. By tailoring conservation education lessons to specific communities, education centers may increase the ability and the likelihood that these communities will engage in pro-conservation behaviors (Adabanya et al., 2023). Effectively tailoring these lessons not only increases the capacity to contribute to conservation but also allows for positive effects on community building by bringing together community members to work together towards a common goal (Schiavo, 2021). Participants described events such as trash clean-ups, festivals, pop-up booths, and more as strategies to engage all members of the community. These mostly no cost events were also described as some of the most popular events according to the educators. Community events that effectively engage a wide range of participants increase social

interaction, a sense of place and belonging, and community participation in initiatives such as conservation and social sustainability (Stevenson, 2022). Our research suggests that in order to be more successful in contributing to conservation outcomes, education facilities should offer opportunities for all members of the community to be engaged, despite factors such as age and program cost. Our findings also suggest that providing opportunities for community involvement in conservation can contribute to overall community building and sense of place.

In addition to participation in community events, research shows that experiences outdoors, such as those provided through conservation education programs can also contribute to a sense of place or attachment. Our findings show that conservation education center have the unique ability to develop programs that fulfill both community involvement and provide positive experiences outdoors. An increased sense of place is associated with increased pro-environmental behaviors (Kudryavtsev, Krasny, & Stedman, 2012). Therefore, successful conservation education programs should emphasize the practice of involving the communities they serve. Our results demonstrate how the involvement of these communities increase the power of education in influencing behavior, compared to relying on facility created programming. Yet, while the research participants in our study heavily discussed their perspectives on the importance of making lessons relevant to the communities they serve, none of them discussed the processes they use to determine what is relevant to them, a critical step in the theory of community empowerment.

Conservation education programs should emphasize and develop a methodological strategy for implementing the needs of the communities they serve and making lessons and

experiences relative to them to have the greatest impact on pro-conservation behavior changes.

VI. Conclusions

Few studies have explored the perceptions of environmental educators on the effectiveness of their education programs. This study examined the perceptions of educators in the field of marine conservation education about the aspects that make their programs successful. Specifically, we explored the education strategies used to promote species-specific conservation, documented the barriers to implementing successful education programs, and examined how educators define the success of their education programs in contributing to conservation goals. The results of the SWOT-AHP analysis showed that educators had a high level of agreement on what factors influence the effectiveness of conservation education programs. Educators agreed that the primary strength of conservation education was community engagement to create public awareness and that the biggest weakness for conservation education was a lack of resources for conservation programs. They also agreed that the primary opportunity for conservation education was providing the local community with opportunities to participate in conservation behavior and that the biggest threat to conservation education was climate change and other environmental problems. Overall, educators agreed that the most salient factor influencing conservation education and its effectiveness was community engagement. Community engagement allows educators to increase positive conservation outcomes. Thus, to be effective, conservation education programs should continue to create hands-on activities that promote community engagement to increase public awareness of the importance of species conservation.

Our interviews revealed information about the types of education strategies that are being used throughout marine education facilities in the United States, the perceptions of educators about their education programs, as well as the most common barriers to effective education programs. Educators are using a broad range of education strategies to promote species conservation. These strategies included field trips, hands-on activities, in-the-field activities, community outreach, and virtual programming. Contrary to the literature, educators said that short-term programs are effective at promoting species conservation behavior because they can reduce participants' fears about nature and increase their likeliness to continue to learn about species conservation. Educators also said that the primary barriers they face were funding, accessibility, and full-time educator personnel.

From these interviews coupled with the results of the SWOT-AHP analysis, we identified key themes that are essential to the success of conservation education programs. These themes were 1) recognizing the importance of short-term programming, 2) empowering individuals through the development of their STEM identities, and 3) working with local communities to develop ownership over their education. In particular, our findings suggest that educators value short-term programming as a way to effectively convey educational messages that yield significant outcomes. Additionally, our findings show that educators emphasize the importance of empowering individuals and communities through the development of their STEM identities, as well as the necessity of collaborative efforts with communities to establish ownership over education programs. These findings provide important insights into the effectiveness of environmental education programming.

Through our analysis, we also identified potential areas for future research that will continue to improve conservation education programs. Participants spoke about the need to

diversify not only their audiences but their educators. Diversification of educators helps

contribute to the development of STEM identities by empowering participants to be able to

picture themselves as members of the science community. Further, employing educators from

diverse backgrounds may help inform educational programs by sharing different perspectives

on what issues are important to different groups. When discussing barriers to creating

education that is effective in influencing pro-conservation behavior, research participants

often cited a lack of people to administer the programs. Most of the facilities included in this

research were non-profit organizations that relied on the dependence of volunteers to assist

their educational efforts. One participant shared how their once robust volunteer population

did not rebound following the COVID-19 pandemic. The lack of volunteers compared to

what they once had was described as greatly limiting their ability to expand their educational

programming. They shared that they did not know what the driving force behind this was.

Because volunteers are so critical to the success of conservation education programs, future

research could assess how volunteer populations have been affected post the COVID-19

pandemic, as well as motivations to volunteer with such organizations.

One of the major themes derived from our research respondents was the need to

empower and build communities that these programs serve. Future studies could flip our

view and focus on the perceptions of the participants of these programs, assessing how they

view their sense of empowerment and belonging as a result of these conservation education

initiatives. This could better inform educators on what issues and needs the communities they

serve have and contribute to more effective education moving forward. An expansion of this

study could focus on measuring how the participants' perception of their empowerment

through education contributes to their capacity and willingness to engage in pro-conservation behaviors.

The largest barrier identified among participants through both the interviews and the SWOT analysis was a lack of resources, particularly funding. When asked about evaluations, most educators shared that they only formally evaluated programs when it was mandated by grant funding guidelines. Educators shared the belief that evaluation is difficult but is likely the only way to obtain more funding through evidence that their programs are effective. The most commonly reported way that educators reported assessing their programs was through the use of pre-and post-surveys. Future research should investigate methods for long-term measuring of participants' change in behaviors or attitudes as a result of education programs. This research can inform uniform practices for evaluating programs, which can contribute to ease in receiving both legislative and financial support.

The findings of our study revealed important information about the perceptions of environmental educators and contribute to a growing body of research on environmental education. Our study also demonstrates the need for more effective and inclusive environmental education. Taken together, the findings have the potential to directly benefit environmental educators, increase the effectiveness of programs, contribute to species-specific conservation goals, and improve communities. These factors are especially important to consider when developing short-term programs to increase their success while reducing dependency on resources needed for long-term programs. Incorporating these aspects into conservation education can protect species and ecosystems of concern, promote the well-being of communities, and contribute to large education initiatives such as those outlined by the United Nations Sustainable Development Goals and UN Education for Sustainable Development plan.

Appendix A: Letter of Approval from TCU's IRB

TCU OFFICE OF RESEARCH COMPLIANCE &
INSTITUTIONAL REVIEW BOARD

Date: October 12, 2023

Study Number: IRB#2023-261

Study Title: Conservation education managers' perceptions of short- and long-term learning effectiveness

Principal Investigator: Brendan Lavy

Co-Principal Investigator: Camden Butterworth

Primary Contact: Brendan Lavy

IRB Determination: Approved

Determination Date: October 12, 2023

Administrative Check-In Date: --

Dear Brendan Lavy:

The above-referenced human subjects research study was reviewed by the TCU Institutional Review Board (IRB) Chair and/or IRB Chair's designee(s) and approved on October 12, 2023. It was determined that this study presents no more than minimal risk to human subjects in that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests. The study was determined to meet the criteria for expedited review under:

6. Collection of data from voice, video, digital, or image recordings made for research purposes.

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. [45 CFR 46.101(b)(2)](#) and (b)(1531-1544). This listing refers only to research that is not exempt.)

In accordance with this approval, the specific conditions the IRB Chair/Chair's designee approved for the conduct of this research are listed below.

● The study meets the criteria for approval as outlined in §45 CFR 46.111.

● The consent procedures provide subjects with the required elements of informed consent as outlined in §45 CFR 46.116.

● The study meets the criteria to waive the requirement to obtain a signed consent form in accordance with §45 CFR 46.117.

This approval is based on the degree of risk and will require an Administrative Check-In on **--.**

Copies of the stamped, IRB-approved study [consent documents and recruitment materials] can be accessed in Cayuse and downloaded for use.

This approval is limited to the activities described in the approved Cayuse Human Ethics study and extends to the performance of these activities at each respective site identified in the study. The research must be conducted in accordance with the IRB-approved study. If applicable, informed consent must be obtained and documented using only the current IRB-approved stamped documents.

This approval does not constitute funding or other institutional required approvals. Should the study involve other review committees, such as the Institutional Biosafety Committee (IBC), it is the Principal Investigator's responsibility to ensure that all required approvals are in place prior to conducting research involving human subjects or their related specimens.

Please note the following Principal Investigator responsibilities:

● It is the Principal Investigator's responsibility to submit for Administrative Check-In, via a Renewal Submission in Cayuse Human Ethics, at least one month prior to -- in order to continue study activities beyond that date. Please note, failure to submit an administrative check-in may result in a processing hold being placed on all submissions from the Principal Investigator.

● It is the Principal Investigator's responsibility to submit any proposed changes to study activities, via a Modification Submission in Cayuse Human Ethics, for IRB review and approval prior to being implemented.

● It is the Principal Investigator's responsibility to promptly notify the IRB of any reportable events (adverse events/ protocol deviations/ unanticipated problems/ subject complaints/ other) that occur during the research, including any breach in confidentiality or data security that places participants or others at a greater risk of harm. Notify the IRB via an Incident Submission in Cayuse Human Ethics.

Cayuse Human Ethics studies must be closed when all activities involving human subjects are completed, including interaction/intervention with participants or analysis of identifiable data. If the principal investigator leaves the University prior to the expiration of the study, the study must be closed or transferred to another eligible TCU PI. Student-led studies must be closed before graduation. Closure of student-led studies which remain open after graduation are the responsibility of the faculty advisor.

The TCU Institutional Review Board operates under a Federal wide Assurance approved by the

DHHS Office for Human Research Protections, FWA000022286. Our DHHS IRB Registration

Number is IRB000002653.

Should you have any questions, please do not hesitate to contact us. Please contact Research

Compliance at IRBSubmit@tcu.edu or (817) 257-5070, if you need any additional information.

Best regards,

Office of Research Compliance (Pardo et al.)

Texas Christian University

IRBSubmit@tcu.edu | TCU ORC

Appendix B*: Initial SWOT Factors from the literature

Strengths	Weaknesses
- Ability to freely create species focused educational content[1]. - Ability to create scientific research programs[2]. - Activities than engage the community in hands-on conservation and create public awareness[2]. - Opportunities to attract funding from individuals or groups interested in the species. - Educational expertise within the organization[2] - Opportunity to engage children[2]. - Fostering a strong emotional connection with a specific species, which encourages conservation behavior[1] - Other:	- Conducting ongoing evaluations of programs and acticvies[2] - Lack of resources (time, money, space, etc.)[2,3] - Difficulty of measuring effectiveness of education activities[2] - Lack of educational expertise within the organization[2] - Difficulty engaging adults[2] - Risk of oversimplification of complex ecological issues[3] - Failures to address broader environmental concerns - Other:
Opportunities	**Threats**
- Utilizing virtual programming and social media to increase reach and engagement[2] - Opportunities to collaborate with academic institutions (such as Universities) for research and advocacy - Involving local communities (such as local groups or schools) in stewardship and citizen science[2] - Allowing individuals to get involved in conservation action[2] - Influencing policy[2] - Engaging tourists[3] - other:	- Short term experiences (such as visiting the facility 1 time) are not sufficient enough to tangibly influence knowledge or attitudes[1] - Difficulty students have in getting into conversations with relatives and peers about topics learned[1] - Vulnerable to changes in funding patterns or economic downturns[2] - Climate change and other large-scale environmental threats could exacerbate challenges facing sea turtles - Lack of "powerful, accessible evidence to demonstrate that education is an effective tool in achieving resource management or conservation goals" (p.108)[2,3] - Opposition from industries, groups, or political entities whose activities threaten sea turtles

	- Time investment- asking educators to spend summers and weekends implementing educational programming to visitors[4] - Other:

References:

1. Adwin Bosschaart, Joop van der Schee & Wilmad Kuiper (2016) Designing a flood-risk education program in the Netherlands, The Journal of Environmental Education, 47:4, 271-286, DOI:10.1080/00958964.2015.1130013

2. Nicole M. Ardoin & Joe E. Heimlich (2013) Views From the Field: Conservation Educators' and Practitioners' Perceptions of Education as a Strategy for Achieving Conservation Outcomes, The Journal of Environmental Education, 44:2, 97-115, DOI: 10.1080/00958964.2012.700963

3. Ririhena, SW Strategy for Biodiversity Conservation Efforts in Wasur National Park of Merauke in Merauke Regency

4. Gal, A. Strengths, weaknesses, opportunities and threats: a SWOT analysis of a long-term outdoor environmental education program in Israel. *Journal of Outdoor and Environmental Education* (2023). https://doi.org/10.1007/s42322-023-00125-5

Appendix C*:* SWOT Survey Protocol Part I

Pre-Interview Questionnaire:

A. Consent to Participate

B. SWOT Round 1 Survey-Perceptions concerning conservation education
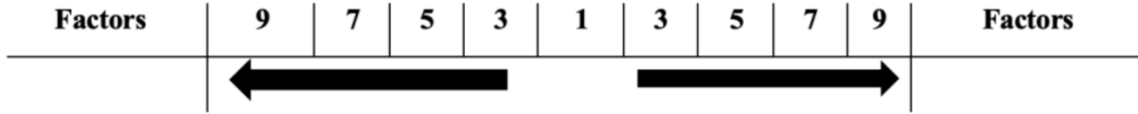
Perceptions concerning conservation education

Please utilize the table below to compare different attributes associated with sea turtle
conservation.

Strengths (internal)	Weaknesses (internal)
S1. Ability to freely create or enhance species-focused educational materials and content	W1. Lack of resources dedicated to education (e.g., time, money, space)
S2. Availability and promotion of research programs	W2. Difficulty measuring effectiveness of education programs and activities
S3. Activities that engage the community in hands-on conservation and create public awareness	W3. Lack of personnel with educational expertise
S4. Creating / Fostering an emotional connection with species	W4. Ineffective adult education programs and activities
S5. Adequate personnel with educational expertise	W5. Oversimplification of complex ecological issues

Opportunities (external)	Threats (external)
O1. Use of virtual programming and social media to increase public outreach and engagement	T1. Short term experiences (such as visiting the facility once) may not be sufficient to influence conservation behavior
O2. Partnership with local schools to provide students with age-appropriate educational programs and activities to promote conservation behavior	T2. Vulnerable to changes in funding patterns or economic downturns (funding sources uncertain)
O3. Providing the local community with programs and activities to promote conservation behavior	T3. Climate change and other large-scale environmental threats to sea turtles
O4. Engaging nonlocal community (tourists) with programs and activities to promote conservation behavior	T4. Lack of evidence to demonstrate that education is an effective tool in achieving conservation goals
O5. Influencing legislation related to environmental protection and species conservation	T5. Opposition from industries, groups, or political entities whose activities threaten sea turtles

Strengths

Please carry out a pairwise comparison of the following set of factors that are likely to be considered a __strength__ of sea turtle conservation. Please mark the factor you think is more important than the other. For example, compare the factor "Availability to freely create or enhance special-focused educational materials and content" with "Availability and promotion of research programs" and mark the option in the direction that accurately reflects the degree of your opinion. Please note there is no 'right' or 'wrong' answer; we are simply interested in your opinion.

Factors	9	7	5	3	1	3	5	7	9	Factors
			←				→			

1=Equally important; 3=Moderately more important; 5=More important; 7=Very important; 9=Extremely important

	9 7 5 3 1 3 5 7 9	
S1. Ability to freely create or enhance species-focused educational materials and content	○ ○ ○ ○ ○ ○ ○ ○ ○	S2. Availability and promotion of research programs
S1. Ability to freely create or enhance species-focused educational materials and content	○ ○ ○ ○ ○ ○ ○ ○ ○	S3. Activities that engage the community in hands-on conservation and create public awareness
S1. Ability to freely create or enhance species-focused educational materials and content	○ ○ ○ ○ ○ ○ ○ ○ ○	S4. Creating / Fostering an emotional connection with species
S1. Ability to freely create or enhance species-focused educational materials and content	○ ○ ○ ○ ○ ○ ○ ○ ○	S5. Adequate personnel with educational expertise
S2. Availability and promotion of research programs	○ ○ ○ ○ ○ ○ ○ ○ ○	S3. Activities that engage the community in hands-on conservation and create public awareness
S2. Availability and promotion of research programs	○ ○ ○ ○ ○ ○ ○ ○ ○	S4. Creating / Fostering an emotional connection with species
S2. Availability and promotion of research programs	○ ○ ○ ○ ○ ○ ○ ○ ○	S5. Adequate personnel with educational expertise
S3. Activities that engage the community in hands-on conservation and create public awareness	○ ○ ○ ○ ○ ○ ○ ○ ○	S4. Creating / Fostering an emotional connection with species
S3. Activities that engage the community in hands-on conservation and create public awareness	○ ○ ○ ○ ○ ○ ○ ○ ○	S5. Adequate personnel with educational expertise
S4. Creating / Fostering an emotional connection with species	○ ○ ○ ○ ○ ○ ○ ○ ○	S5. Adequate personnel with educational expertise

Weaknesses

Please carry out a pairwise comparison of the following set of factors that are likely to be considered a __weakness__ of sea turtle conservation. Please mark the factor you think is more important than the other. For example, compare the factor "Lack of resources dedicated to education (e.g., time, money, space)" with "Difficulty measuring effectiveness of education programs and activities" and mark the option in the direction that accurately reflects the degree of your opinion. Please note there is no 'right' or 'wrong' answer; we are simply interested in your opinion.
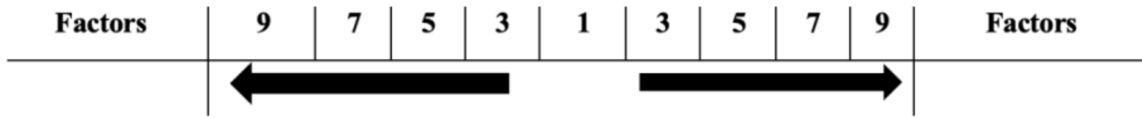
Factors	9	7	5	3	1	3	5	7	9	Factors
			←				→			

1=Equally important; 3=Moderately more important; 5=More important; 7=Very important; 9=Extremely important

	9 7 5 3 1 3 5 7 9	
W1. Lack of resources dedicated to education (e.g., time, money, space)	○ ○ ○ ○ ○ ○ ○ ○ ○	W2. Difficulty measuring effectiveness of education programs and activities
W1. Lack of resources dedicated to education (e.g., time, money, space)	○ ○ ○ ○ ○ ○ ○ ○ ○	W3. Lack of personnel with educational expertise
W1. Lack of resources dedicated to education (e.g., time, money, space)	○ ○ ○ ○ ○ ○ ○ ○ ○	W4. Ineffective adult education programs and activities
W1. Lack of resources dedicated to education (e.g., time, money, space)	○ ○ ○ ○ ○ ○ ○ ○ ○	W5. Oversimplification of complex ecological issues
W2. Difficulty measuring effectiveness of education programs and activities	○ ○ ○ ○ ○ ○ ○ ○ ○	W3. Lack of personnel with educational expertise
W2. Difficulty measuring effectiveness of education programs and activities	○ ○ ○ ○ ○ ○ ○ ○ ○	W4. Ineffective adult education programs and activities
W2. Difficulty measuring effectiveness of education programs and activities	○ ○ ○ ○ ○ ○ ○ ○ ○	W5. Oversimplification of complex ecological issues
W3. Lack of personnel with educational expertise	○ ○ ○ ○ ○ ○ ○ ○ ○	W4. Ineffective adult education programs and activities
W3. Lack of personnel with educational expertise	○ ○ ○ ○ ○ ○ ○ ○ ○	W5. Oversimplification of complex ecological issues
W4. Ineffective adult education programs and activities	○ ○ ○ ○ ○ ○ ○ ○ ○	W5. Oversimplification of complex ecological issues

Opportunities

Please carry out a pairwise comparison of the following set of factors that are likely to be considered an **opportunity** of sea turtle conservation. Please mark the factor you think is more important than the other. For example, compare the factor "Lack of resources dedicated to education (e.g., time, money, space)" with "Difficulty measuring effectiveness of education programs and activities" and mark the option in the direction that accurately reflects the degree of your opinion. Please note there is no 'right' or 'wrong' answer; we are simply interested in your opinion.

Factors	9	7	5	3	1	3	5	7	9	Factors
←							→			

1=Equally important; 3=Moderately more important; 5=More important; 7=Very important; 9=Extremely important

9 7 5 3 1 3 5 7 9

O1. Use of virtual programming and social media to increase public outreach and engagement	○ ○ ○ ○ ○ ○ ○ ○ ○	O2. Partnership with local schools to provide students with age-appropriate educational programs and activities to promote conservation behavior
O1. Use of virtual programming and social media to increase public outreach and engagement	○ ○ ○ ○ ○ ○ ○ ○ ○	O3. Providing the local community with programs and activities to promote conservation behavior
O1. Use of virtual programming and social media to increase public outreach and engagement	○ ○ ○ ○ ○ ○ ○ ○ ○	O4. Engaging nonlocal community (tourists) with programs and activities to promote conservation behavior
O1. Use of virtual programming and social media to increase public outreach and engagement	○ ○ ○ ○ ○ ○ ○ ○ ○	O5. Influencing legislation related to environmental protection and species conservation
O2. Partnership with local schools to provide students with age-appropriate educational programs and activities to promote conservation behavior	○ ○ ○ ○ ○ ○ ○ ○ ○	O3. Providing the local community with programs and activities to promote conservation behavior
O2. Partnership with local schools to provide students with age-appropriate educational programs and activities to promote conservation behavior	○ ○ ○ ○ ○ ○ ○ ○ ○	O4. Engaging nonlocal community (tourists) with programs and activities to promote conservation behavior
O2. Partnership with local schools to provide students with age-appropriate educational programs and activities to promote conservation behavior	○ ○ ○ ○ ○ ○ ○ ○ ○	O5. Influencing legislation related to environmental protection and species conservation
O3. Providing the local community with programs and activities to promote conservation behavior	○ ○ ○ ○ ○ ○ ○ ○ ○	O4. Engaging nonlocal community (tourists) with programs and activities to promote conservation behavior
O3. Providing the local community with programs and activities to promote conservation behavior	○ ○ ○ ○ ○ ○ ○ ○ ○	O5. Influencing legislation related to environmental protection and species conservation
O4. Engaging nonlocal community (tourists) with programs and activities to promote conservation behavior	○ ○ ○ ○ ○ ○ ○ ○ ○	O5. Influencing legislation related to environmental protection and species conservation

Threats

Please carry out a pairwise comparison of the following set of factors that are likely to be considered a **threat** of sea turtle conservation. Please mark the factor you think is more important than the other. For example, compare the factor "Lack of resources dedicated to education (e.g., time, money, space)" with "Difficulty measuring effectiveness of education programs and activities" and mark the option in the direction that accurately reflects the degree of your opinion. Please note there is no 'right' or 'wrong' answer; we are simply interested in your opinion.
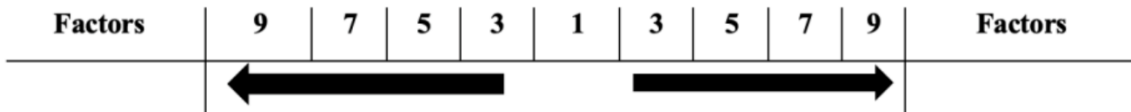
Factors	9	7	5	3	1	3	5	7	9	Factors
←							→			

1=Equally important; 3=Moderately more important; 5=More important; 7=Very important; 9=Extremely important

9 7 5 3 1 3 5 7 9

T1. Short term experiences (such as visiting the facility once) may not be sufficient to influence conservation behavior	○ ○ ○ ○ ○ ○ ○ ○ ○	T2. Vulnerable to changes in funding patterns or economic downturns (funding sources uncertain)
T1. Short term experiences (such as visiting the facility once) may not be sufficient to influence conservation behavior	○ ○ ○ ○ ○ ○ ○ ○ ○	T3. Climate change and other large-scale environmental threats to sea turtles
T1. Short term experiences (such as visiting the facility once) may not be sufficient to influence conservation behavior	○ ○ ○ ○ ○ ○ ○ ○ ○	T4. Lack of evidence to demonstrate that education is an effective tool in achieving conservation goals
T1. Short term experiences (such as visiting the facility once) may not be sufficient to influence conservation behavior	○ ○ ○ ○ ○ ○ ○ ○ ○	T5. Opposition from industries, groups, or political entities whose activities threaten sea turtles
T2. Vulnerable to changes in funding patterns or economic downturns (funding sources uncertain)	○ ○ ○ ○ ○ ○ ○ ○ ○	T3. Climate change and other large-scale environmental threats to sea turtles
T2. Vulnerable to changes in funding patterns or economic downturns (funding sources uncertain)	○ ○ ○ ○ ○ ○ ○ ○ ○	T4. Lack of evidence to demonstrate that education is an effective tool in achieving conservation goals
T2. Vulnerable to changes in funding patterns or economic downturns (funding sources uncertain)	○ ○ ○ ○ ○ ○ ○ ○ ○	T5. Opposition from industries, groups, or political entities whose activities threaten sea turtles
T3. Climate change and other large-scale environmental threats to sea turtles	○ ○ ○ ○ ○ ○ ○ ○ ○	T4. Lack of evidence to demonstrate that education is an effective tool in achieving conservation goals
T3. Climate change and other large-scale environmental threats to sea turtles	○ ○ ○ ○ ○ ○ ○ ○ ○	T5. Opposition from industries, groups, or political entities whose activities threaten sea turtles
T4. Lack of evidence to demonstrate that education is an effective tool in achieving conservation goals	○ ○ ○ ○ ○ ○ ○ ○ ○	T5. Opposition from industries, groups, or political entities whose activities threaten sea turtles

What is your job title?

○ Education manager

○ Education coordinator

○ Director of Education

○ Educator

○ Other (please specify):

[   ]

What is your level of education?

○ High school graduate

○ Undergraduate degree (associates, bachelor's)

○ Graduate Degree

○ Post-graduate Degree

○ Certification

How many years of experience do you have in conservation or environmental education?

○ 0-3 years

○ 4-7 years

○ 8-10 years

○ 10+ years

Approximately how many people (students, visitors, etc.) does your facility serve each calendar year?

[   ]

How would you classify the majority of patrons who participate in educational programming at your facility?

○ Adults (18+)

○ Children via school programming (ex: field trips)

○ Mixed ages (families)

○ Other (Please specify):

[   ]

How many employees (including volunteers) at your facility are primarily responsible for educational programming as part of their jobs? (best approximation accepted)

[   ]

Reminder that this is a 3-part study. The next portion of the survey asks you to leave your contact information. Your name and contact information will not be linked to your survey responses.

Part 2: Interview via phone (Appendix C)

Part 3: Follow-up survey for comparison of ranked SWOT factors

SWOT Survey Part II

Recently, Texas Christian University researchers completed a survey to understand perceptions concerning sea turtle conservation. Based on the responses, the highest ranked strength, weakness, opportunity, and threat factors are:

Strength: Activities that engage the community in hands-on conservation and create public awareness
Weakness: Lack of resources dedicated to education (e.g., time, money, space)
Opportunity: Providing the local community with programs and activities to promote conservation behavior
Threat: Climate change and other large-scale environmental threats to sea turtles

Now, we ask that you make additional comparisons for each highest-ranked factor. As an example, from the first row below, please compare the strength factor "*Activities that engage the community in hands-on conservation and create public awareness*" with the weakness factor "*Lack of resources dedicated to education (e.g., time, money, space)*" and mark in the direction that accurately reflects your opinion. Accordingly, please complete all six rows below. Please note there is no right or wrong answer; we are interested in your opinion.

Factors	**9**	**7**	**5**	**3**	**1**	**3**	**5**	**7**	**9**	**Factors**

1=Equally important; 3=Moderately more important; 5=More important; 7=Very important; 9=Extremely important

	9	7	5	3	1	3	5	7	9	
S: Activities that engage the community in hands-on conservation and create public awareness	○	○	○	○	○	○	○	○	○	W: Lack of resources dedicated to education (e.g., time, money, space)
S: Activities that engage the community in hands-on conservation and create public awareness	○	○	○	○	○	○	○	○	○	O: Providing the local community with programs and activities to promote conservation behavior
S: Activities that engage the community in hands-on conservation and create public awareness	○	○	○	○	○	○	○	○	○	T: Climate change and other large-scale environmental threats to species
W: Lack of resources dedicated to education (e.g., time, money, space)	○	○	○	○	○	○	○	○	○	O: Providing the local community with programs and activities to promote conservation behavior
W: Lack of resources dedicated to education (e.g., time, money, space)	○	○	○	○	○	○	○	○	○	T: Climate change and other large-scale environmental threats to species
O: Providing the local community with programs and activities to promote conservation behavior	○	○	○	○	○	○	○	○	○	T: Climate change and other large-scale environmental threats to species

Experiences and Perceptions of an Environmental Educator

Interview Protocol

Campus: Texas Christian University
Department: Environmental and Sustainability Sciences
Interviewee: Name / Facility:

Interviewer: Dr. Brendan Lavy and Graduate Research Assistant Camden Butterworth

Date:
Start time:
End time:

Notes:

Interview Sections Utilized, Degree of Fidelity to Protocol (Check if Used/Applicable):
_____ Pre-Interview
        Degree of conformity to Protocol ___%

_____ Demographic/background questions
        Degree of conformity to Protocol ___%

_____ Topic Domain I: Types of education strategies used
        Degree of conformity to Protocol ___%

_____ Topic Doman II: Educator's Perceptions of Programs
        Degree of conformity to Protocol ___%

_____ Topic Domain III: Perceived barriers to success
        Degree of conformity to Protocol ___%

_____ Conclusions
        Degree of conformity to Protocol ___%

_____ Follow Up/ Thank You Email
        Degree of conformity to Protocol ___%

_____ Documents collected:

_____ Post interview comments/concerns/Irregularities:

_____ Length of interview:

Pre-Interview:
 A. **Introductory narrative**: purpose of the study, length of interview, follow-up survey, thank you for participation, etc.
 B. **Welcome Script:** Welcome and thank you for your participation. I am ….
 C. **Informed consent**: Review informed consent, ability to skip questions, etc.
 D. **Other permissions:** To facilitate documentation and analysis, may we digitally record this interview. Reminder of part 3 of this survey and permission to be contacted after the interview to access part 3.
 E. **Interview Overview:** Our interview will not exceed 45 minutes in length. We will begin with demographic questions and then cover 3 topics, including educations strategies used by participants, their perceptions of the programs, and perceived barriers to achieving education goals
 F. **Introduction/Rationale:** The research study will investigate the perceptions of environmental educators on their experiences, goals, and barriers to achieving their goals. You have been asked to participate in this study because your experiences will demonstrate different perspectives of species-specific educators.
 G. **Goals & Expectations:** The results of this research study will enable us to better understand what strategies are being used in the filed of environmental education and allow us to report on perceived successes and barriers that exist in using education to achieve conservation goals.

Demographic/background questions:
 1. Can you tell me about your role at your organization?
[Follow Up Probes: Do you have a team, primary responsibilities, day to day operations]

 2. How long have you been working in this field?
[Follow Up Probes: previous employment, any relevant research, years in this position]

 3. What is your highest level of study?
[Follow Up Probes: certifications]

Topic Domain I: Types of education strategies used
 1. What goals do you have for your educational programs?

 2. Can you describe the main education programs your facility uses?
[Follow Up Probes]: do you use long term programs? Outreach outside the facility]

 3. What materials or programs are most popular? Why do you think so?

Topic Doman II: Educator's perceptions of programs
      1. In your opinion, what kinds of EE programs are best run or most successful?

      2. Do you believe there is a limited number of long-term education programs?
[Follow Up Probes]: If yes, why? If no, why?

      3. How would you describe the success of your education programs at your center?
      4. Have you seen any positive changes in the community that you believe are a result of your educational programming?

      5. Have you received any feedback from participants in your programs that you can share with me?

      6. Have you ever formally evaluated your programs for effectiveness?
[Follow Up Probes: outside evaluations, internal assessments, surveys]

Topic Domain III: Perceived barriers to success
      1. What are the major barriers to incorporating education into your organization's conservation work?
[Follow Up Probes: how do you mitigate these barriers]

      2. How do you hope these conditions/ barriers change in the future?
[Follow Up Probes: Can education help with this?]

Conclusions:

Before we conclude this interview, is there anything else you would like to share about your experiences as a conservation educator?

Post Interview Comments and/or Observations:

Appendix E- Pairwise Comparison calculations for SWOT surveys

Survey Part I

Table 1: SWOT factors and their weighted geometric mean of importance perceive by survey respondents.

	Extremely Important	Very Important	More Important	Moderately More Important	Equal	Moderately More Important	More Important	Very Important	Extremely Important		
Weight →	9.00	7.00	5.00	3.00	1.00	0.33	0.20	0.14	0.11	**Total Responses ↓**	**Geometric Mean ↓**
					Strengths						
S1:S2	2	2	3	3	1	0	0	2	0	13	2.62
S1:S3	0	0	1	1	1	2	2	3	3	13	0.31
S1:S4	0	0	0	3	1	2	0	4	3	13	0.36
S1:S5	0	0	1	3	2	0	2	3	2	13	0.52
S2:S3	1	0	0	2	2	1	2	3	2	13	0.46
S2:S4	0	0	0	2	1	1	2	4	3	13	0.28
S2:S5	0	0	0	2	3	2	1	2	3	13	0.39
S3:S4	1	1	3	3	2	0	1	2	0	13	1.68
S3:S5	2	1	0	3	4	2	0	0	1	13	1.50
S4:S5	2	1	1	2	3	2	1	0	1	13	1.38
					Weaknesses						
W1:W2	0	3	4	3	1	1	1	0	0	13	2.69
W1:W3	0	1	1	3	5	2	0	1	0	13	1.23
W1:W4	0	1	3	5	2	0	1	1	0	13	1.95
W1:W5	0	5	3	3	0	1	0	1	0	13	3.12
W2:W3	0	1	1	1	5	2	1	2	0	13	0.79
W2:W4	0	1	0	4	5	1	1	1	0		1.14
W2:W5	1	0	1	4	4	2	0	0	1	13	1.34

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W3:W4	0	2	1	2	6	1	0	1	0	13	1.43
W3:W5	0	1	4	1	4	1	2	0	0	13	1.49
W4:W5	0	1	1	2	5	1	3	0	0	13	0.99
						Opportunities					
O1:O2	0	0	0	1	4	2	0	4	2	13	0.36
O1:O3	0	0	0	1	2	2	3	4	1	13	0.29
O1:O4	0	0	0	1	3	2	2	4	1	13	0.33
O1:O5	0	0	1	0	4	1	3	3	1	13	0.39
O2:O3	0	2	0	0	9	0	2	0	0	13	1.05
O2:O4	1	0	2	1	6	0	1	1	1	13	1.06
O2:O5	0	1	1	1	8	0	0	1	1	13	1.04
O3:O4	1	0	3	2	6	0	1	0	0	13	1.80
O3:O5	0	1	0	4	6	0	1	0	1	13	1.22
O4:O5	0	0	1	4	2	2	3	0	1	13	0.78
						Threats					
T1:T2	0	0	0	1	4	1	5	1	1	13	0.39
T1:T3	0	0	1	1	3	2	2	1	3	13	0.42
T1:T4	0	1	1	3	4	1	2	0	1	13	1.03
T1:T5	0	0	1	0	3	1	3	2	3	13	0.32
T2:T3	0	1	1	1	3	1	1	1	4	13	0.51
T2:T4	2	0	1	0	6	1	1	1	1	13	0.94
T2:T5	0	0	3	1	4	1	0	2	2	13	0.77
T3:T4	3	1	3	1	2	1	0	2	0	13	2.07
T3:T5	4	0	1	1	4	0	1	2	0	13	1.59
T4:T5	1	0	0	1	4	2	1	2	2	13	0.51

Table 2: Pairwise comparison matrix for strength factors and the associated normalized

matrix

Pairwise Comparison Matrix							Normalized/Standardized Matrix					
	S1	S2	S3	S4	S5			S1	S2	S3	S4	S5
S1	1.00	2.62	0.31	0.36	0.52		S1	0.11	0.22	0.10	0.09	0.11
S2	0.38	1.00	0.46	0.28	0.39		S2	0.04	0.08	0.15	0.07	0.08
S3	3.20	2.18	1.00	1.68	1.50		S3	0.34	0.18	0.33	0.42	0.31
S4	2.78	3.56	0.59	1.00	1.38		S4	0.30	0.30	0.20	0.25	0.29
S5	1.93	2.54	0.67	0.73	1.00		S5	0.21	0.21	0.22	0.18	0.21
SUM	9.29	11.90	3.03	4.05	4.78		SUM	1.00	1.00	1.00	1.00	1.00

Table 3. Table 2. Pairwise comparison matrix for weakness factors and the associated

normalized matrix

Pairwise Comparison Matrix							Normalized/Standardized Matrix					
	W1	W2	W3	W4	W5			W1	W2	W3	W4	W5
W1	1.00	2.69	1.23	1.95	3.12		W1	0.33	0.41	0.28	0.30	0.39
W2	0.37	1.00	0.79	1.14	1.34		W2	0.12	0.15	0.18	0.17	0.17
W3	0.81	1.26	1.00	1.43	1.49		W3	0.27	0.19	0.23	0.22	0.19
W4	0.51	0.88	0.70	1.00	0.99		W4	0.17	0.13	0.16	0.15	0.12
W5	0.32	0.75	0.67	1.01	1.00		W5	0.11	0.11	0.15	0.16	0.13
SUM	3.02	6.58	4.39	6.54	7.94		SUM	1.00	1.00	1.00	1.00	1.00

Table 4. Table 2. Pairwise comparison matrix for opportunities factors and the associated

normalized matrix

Pairwise Comparison Matrix							Normalized/Standardized Matrix					
	O1	O2	O3	O4	O5			O1	O2	O3	O4	O5
O1	1.00	0.36	0.29	0.33	0.39		O1	0.08	0.09	0.08	0.06	0.09
O2	2.78	1.00	1.05	1.06	1.04		O2	0.22	0.24	0.28	0.19	0.24
O3	3.40	0.95	1.00	1.80	1.22		O3	0.27	0.23	0.27	0.33	0.27
O4	3.00	0.94	0.56	1.00	0.78		O4	0.24	0.22	0.15	0.18	0.18
O5	2.59	0.96	0.82	1.28	1.00		O5	0.20	0.23	0.22	0.23	0.23
SUM	12.77	4.21	3.73	5.47	4.42		SUM	1.00	1.00	1.00	1.00	1.00

Table 5. Table 2. Pairwise comparison matrix for threat factors and the associated normalized

matrix

Pairwise Comparison Matrix							Normalized/Standardized Matrix					
	T1	T2	T3	T4	T5			T1	T2	T3	T4	T5
T1	1.00	0.39	0.42	1.03	0.32		T1	0.10	0.07	0.14	0.15	0.08
T2	2.55	1.00	0.51	0.94	0.77		T2	0.25	0.17	0.17	0.13	0.18
T3	2.38	1.97	1.00	2.07	1.59		T3	0.24	0.34	0.33	0.30	0.38
T4	0.97	1.07	0.48	1.00	0.51		T4	0.10	0.19	0.16	0.14	0.12
T5	3.12	1.30	0.63	1.97	1.00		T5	0.31	0.23	0.21	0.28	0.24
SUM	10.03	5.73	3.04	7.00	4.18		SUM	1.00	1.00	1.00	1.00	1.00

Table 6. Highly rated SWOT factors and their weighted geometric mean of importance perceived by survey respondents (Survey Part II)

Weight	Extremely Important	Very Important	More Important	Moderately More Important	Equal	Moderately More Important	More Important	Very Important	Extremely Important	Total	Geometric Mean
	9.00	7.00	5.00	3.00	1.00	0.33	0.20	0.14	0.11		
	1	2	3	4	5	6	7	8	9		
S:W	6	0	0	1	3	1	1	0	0	12	2.62
S:O	1	0	2	2	7	0	0	0	0	12	1.89
S:T	1	0	5	1	3	0	2	0	0	12	1.97
W:O	0	0	0	1	3	2	0	0	6	12	0.30
W:T	1	1	0	5	0	0	3	1	1	12	1.06
O:T	0	5	1	1	0	2	2	0	1	12	1.49

Table 7. Pairwise comparison matrix for strength factors and the associated normalized

matrix

Pairwise Comparison Matrix						Normalized/Standardized Matrix				
	S	W	O	T			S	W	O	T
S	1.00	2.62	1.89	1.97		S	0.41	0.33	0.49	0.36
W	0.38	1.00	0.30	1.06		W	0.16	0.13	0.08	0.19
O	0.53	3.29	1.00	1.49		O	0.22	0.42	0.26	0.27
T	0.51	0.95	0.67	1.00		T	0.21	0.12	0.17	0.18
Sum	2.42	7.86	3.86	5.52		SUM	1.00	1.00	1.00	1.00

Appendix E*: Interview Codes and Frequencies by Interview

Code	Interview Number										Totals
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Totals**
● **strategies** Gr=93	17	2	6	13	5	9	13	7	10	11	93
● **Barriers** Gr=64	18	4	2	6	2	4	6	6	9	7	64
● **funding** Gr=49	9	8	2	11	1	4	4	0	1	9	49
● **Evaluation** Gr=44	12	7	5	3	0	4	5	2	5	1	44
● **Long-term** Gr=32	9	3	6	0	3	7	0	0	1	3	32

○ **Emotional connection of species** **Gr=29**	4	5	1	0	5	0	9	2	2	1	29
○ **Empower** **Gr=25**	0	0	3	0	1	6	6	5	4	0	25
● **Perceptions** **Gr=25**	6	3	2	5	1	0	4	4	0	0	25
○ **Diversity** **Gr=23**	4	1	8	0	0	1	1	2	4	2	23
○ **Community Building** **Gr=22**	1	0	1	1	0	11	1	0	2	5	22
○ **Community Ownership** **Gr=22**	3	1	6	1	0	2	1	5	1	2	22
● **funding: limitations** **Gr=22**	7	6	1	5	0	1	1	0	0	1	22

● **education strategies: In the field** **Gr=20**	6	1	1	6	1	1	0	3	0	1	20
○ **Diversity: diverse audience** **Gr=18**	2	0	8	0	0	1	1	0	4	2	18
● **Education Barriers: personnel shortage** **Gr=17**	3	4	1	1	1	1	1	1	1	3	17
● **Perceptions of Educators: important** **Gr=17**	5	2	1	1	1	0	4	3	0	0	17
○ **Underserved communities** **Gr=17**	0	0	2	3	0	4	3	0	0	5	17
● **Evaluation: purpose** **Gr=15**	4	5	1	1	0	0	2	0	2	0	15
● **funding: sources** **Gr=15**	1	2	0	3	0	2	2	0	0	5	15

● **Education Barriers: standards** Gr=14	9	0	0	2	0	0	0	3	0	0	14
● **education strategies: in the classroom** Gr=14	4	0	0	2	3	0	2	3	0	0	14
● **Evaluation: strategies** Gr=14	5	1	2	2	0	1	1	0	2	0	14
● **education strategies: technical skills** Gr=13	4	0	0	1	0	1	1	2	2	2	13
○ **Long-term: successes** Gr=13	3	1	1	0	3	3	0	0	1	1	13
● **Positive Changes** Gr=13	3	3	1	0	0	0	1	0	2	3	13
○ **Short-term** Gr=13	3	0	2	3	0	0	1	4	0	0	13

● **education strategies: field trip** **Gr=12**	2	0	2	2	0	1	3	0	2	0	12
○ **education strategies: interactive** **Gr=12**	0	0	0	0	0	0	3	1	4	4	12
● **Long-term: Multi-touch** **Gr=12**	5	0	4	0	0	3	0	0	0	0	12
● **Education Barriers: infrastructure** **Gr=11**	2	0	0	0	0	0	3	0	5	1	11
● **education strategies: unique experiences** **Gr=11**	0	0	0	3	0	0	4	0	1	3	11
○ **Meet them where they are** **Gr=11**	0	0	4	0	1	2	2	1	1	0	11
● **STEM identity** **Gr=11**	2	1	3	0	0	2	0	0	1	2	11

● **education strategies: career oriented** **Gr=10**	1	1	0	0	2	1	0	0	1	4	10
● **Evaluation: difficulty** **Gr=10**	2	1	2	0	0	1	2	2	0	0	10
○ **Relationships with nature** **Gr=10**	1	1	0	0	0	0	2	4	0	2	10
○ **volunteers** **Gr=10**	0	0	0	0	1	1	1	0	2	5	10
○ **Education Barriers: politics** **Gr=9**	0	0	0	0	1	0	0	2	4	2	9
● **Evaluation: outcomes** **Gr=9**	2	0	1	0	0	2	1	0	2	1	9
○ **Short-term: just for fun** **Gr=9**	1	0	2	3	0	0	1	2	0	0	9

○ **accessibility** **Gr=8**	2	0	1	0	0	1	2	0	1	1	8
○ **COVID-19** **Gr=8**	0	0	1	0	0	1	1	0	0	5	8
○ **Decision making** **Gr=8**	2	0	0	0	0	0	0	4	2	0	8
● **Education Barriers: busses** **Gr=8**	3	0	1	0	0	2	1	0	0	1	8
○ **Long-term: barriers** **Gr=8**	1	2	1	0	0	2	0	0	0	2	8
○ **Outreach** **Gr=8**	1	0	1	0	1	2	2	1	0	0	8
● **State standards** **Gr=8**	6	1	0	1	0	0	0	0	0	0	8

● **State standards: integration** **Gr=8**	6	1	0	1	0	0	0	0	0	0	8
● **STEM integration** **Gr=8**	4	0	1	0	0	1	0	2	0	0	8
○ **Stewards** **Gr=8**	0	0	1	0	0	1	2	2	1	1	8
○ **choices they make** **Gr=7**	1	0	0	0	0	0	1	5	0	0	7
● **education strategies: Fun** **Gr=7**	1	0	0	1	0	2	2	1	0	0	7
● **funding: Opportunities** **Gr=7**	1	0	1	0	0	2	0	0	1	2	7
○ **Short-term: unsuccessful** **Gr=7**	3	0	1	0	0	0	1	2	0	0	7

● **Education Barriers: Proving success** Gr=6	2	0	0	3	0	0	1	0	0	0	6
● **education strategies: homeschooling** Gr=6	0	0	2	0	0	3	0	0	1	0	6
● **funding: non-profit** Gr=6	1	0	0	2	1	0	1	0	0	1	6
● **Perceptions of Educators: Most successful** Gr=6	1	0	2	1	0	0	2	0	0	0	6
○ **Behavior Changes** Gr=5	1	0	0	0	1	3	0	0	0	0	5
● **Diversity: Diverse programs** Gr=5	2	0	0	0	0	0	1	2	0	0	5
● **education strategies: place-based education** Gr=5	1	0	1	2	1	0	0	0	0	0	5

○ **interns** **Gr=5**	0	0	0	0	0	2	1	0	0	2	5
● **Perceptions of Educators: requirements** **Gr=5**	0	1	0	3	0	0	0	1	0	0	5
● **education strategies: Virtual Programming** **Gr=4**	0	0	1	0	0	1	1	0	0	1	4
● **funding: needs** **Gr=4**	1	2	0	1	0	0	0	0	0	0	4
○ **Title I** **Gr=4**	1	0	0	2	0	0	1	0	0	0	4
○ **stimulating curiosity** **Gr=3**	0	0	0	2	0	1	0	0	0	0	3
○ **individual meanings** **Gr=2**	1	0	0	0	0	1	0	0	0	0	2

○ **Knowledge transmission** Gr=2	0	0	0	0	0	0	1	0	1	0	2
○ **Diversity: Diverse personal** Gr=1	0	1	0	0	0	0	0	0	0	0	1
● **Education Barriers: feeling like they cannot make a difference** Gr=1	0	0	0	0	0	1	0	0	0	0	1
○ **ocean empathy** Gr=1	0	0	0	0	0	0	0	0	1	0	1
Totals	202	71	96	97	36	102	113	84	84	104	989

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Vita

Personal Background

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Education

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Experience

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Awards

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Abstract

PERCEPTIONS OF CONSERVATION EDUCATORS ON PROGRAM EFFECTIVENESS:
A MIXED METHODS STUDY

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Environmental education is gaining recognition as a critical strategy to reduce environmental harm. Education has been identified as a top factor contributing to people's willingness to engage in environmentally positive conservation behaviors. Non-formal learning institutions such as zoos and aquariums can create and engage learners in species-specific education programming. Species-specific education programs can generate high public appeal and contribute to overall environmental conservation outcomes. This research assesses the perceptions of educators at non-formal institutions about their conservation education programs and reveals three key themes when designing and implementing successful education. These themes were 1) recognizing the importance of short-term programming, 2) empowering individuals through the development of their STEM identities, and 3) collaborating with local communities to develop ownership over their education. The results contribute to a growing body of research on effective environmental education and help promote species conservation and community wellbeing while contributing to larger education goals.