

# Predictive Framework of Conservation Ethics for a Marine Youth Adventure Program

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## Abstract

Adolescence is a formative period for developing environmental values, attitudes, and behaviors that persist into adulthood. Research suggests that immersive experiences in nature can foster a conservation ethic (CE) and increase engagement in pro-environmental behaviors. However, as youth spend less time outdoors, structured environmental education (EE) programs play an especially important role in providing these formative experiences. By integrating EE, youth adventure programs create opportunities to develop environmental stewardship through direct engagement with nature and reinforcement of sustainable behaviors. This study examines the impact of the Boy Scouts of America (BSA) Florida Sea Base, a youth adventure program, on CE. Survey data collected in summer 2020 were analyzed using a regression analysis to identify predictors of a higher CE across three Sea Base programs. Significant predictors included biospheric value orientations, environmental awareness, and perceived conservation confidence. Marine STEM participants showed higher conservation confidence but a decline in environmental awareness, suggesting possible overestimation of their understanding of marine issues post-program. These findings highlight the complexity of EE impacts, where increased confidence may not always align with greater environmental awareness. Understanding these dynamics can help design EE programs that foster both confidence and accurate awareness to support long-term sustainability behaviors.

## Keywords

Youth Adventure Programs, Environmental Education, Adventure Tourism, Environmental Values, Environmental Attitudes, Conservation Ethics, Sustainable Behaviors, Environmental Stewardship

## 1. Introduction

Early life experiences play a critical role in shaping environmental values, attitudes, and behaviors. Research suggests that formative interactions with nature during adolescence can foster a lifelong conservation ethic (CE), increasing the likelihood of pro-environmental behaviors in adulthood [1]. CE refers to a pro-environmental attitude that relates to the judicious use, allocation, and protection of natural resources for the purpose of sustainably managing the world's ecosystems and services they provide [2] [3]. In this study, CE refers to a participant's commitment to practice and support low-impact, environmentally responsible behavior in outdoor settings, based on the Boy Scouts of America (BSA) Outdoor Code and Leave No Trace principles.

Positive nature experiences during adolescence have been shown to strengthen pro-environmental attitudes, which in turn influence sustainable behaviors in adulthood [4] [5]. However, as modern lifestyles increasingly limit youth's engagement with the natural world, opportunities to develop these values and attitudes are diminishing [6]. Given that individuals with strong pro-environmental values and attitudes are more likely to adopt sustainable behaviors [7], intentional efforts are necessary to foster these in youth.

Youth adventure programs offer a structured way to reconnect young people with nature through immersive experiences that integrate environmental education (EE) and hands-on outdoor activities. These programs expose participants to ecological systems, promote environmental awareness, and reinforce pro-environmental behaviors [8] [9]. While existing research has demonstrated the effectiveness of EE in adventure-based settings [1] [10] [11], continued understanding is necessary to know how these programs influence CE and shape long-term environmental behaviors in youth adventure programs.

Pro-environmental attitudes like CE shape behavioral intentions [12] and serve as antecedents to pro-environmental behavior [13]-[15]. Realization of these behaviors can contribute to the preservation of natural resources and ecosystem integrity, such as environmentally conscious consumer choices, responsible outdoor recreation (e.g., staying on designated trails, properly extinguishing campfires), and participation in environmental advocacy initiatives [13]-[15]. Since attitudes can influence behavior [16], individuals who develop pro-environmental attitudes like CE are more likely to engage in long-term sustainability practices [17].

Youth adventure programs incorporating EE offer a deliberate opportunity to develop CE in participants through social interactions, increasing time spent in nature, developing outdoor skills, and enhancing ecological knowledge and awareness of environmental issues [8] [18]. When delivered in a positive, engaging, and mentally stimulating manner, these experiences can help cultivate the motivational factors necessary for adopting a CE. In this study, CE was operationalized using the principles of Leave No Trace and BSA Outdoor Code of Ethics, which promote environmentally responsible decision-making and behavior [19] [20]. Given that

youth adventure programs take place in structured natural environments, they are uniquely positioned to expose participants to pro-environmental norms and reinforce attitudes that support sustainability over time [6] [21].

While EE has been widely implemented to foster formative experiences in nature, particularly in outdoor adventure programs focused on youth conservation education [4] [8], further research is necessary to deepen our understanding of how these experiences shape CE. Numerous studies have explored best practices in EE [1] [10] [22] [23], but there remains a need for research examining the specific role of adventure-based EE in developing a CE.

This study addresses this gap by assessing the BSA Florida Sea Base's role in fostering CE among participants, evaluating existing environmental values, and measuring changes in environmental awareness and CE through pre- and post-program surveys. This research also identifies predictors of CE, which is useful to understand, as pro-environmental attitudes like CE are known to predict sustainable behaviors and environmental stewardship [12] [14] [24].

## 2. Materials and Methods

### 2.1. Study Setting

The BSA Sea Base National High Adventure program operates two facilities in the Florida Keys: the main base near Islamorada and the Brinton Environmental Center on Summerland Key [4] [25]. The program is situated within the Florida Keys Reef System (FKRS), the third-largest barrier reef in the world, stretching 220 miles from Biscayne Bay to Key West [26]. The FKRS consists of patch reefs, seagrass beds, mangrove islands, and hardbottom reef habitats, supporting a diverse range of marine life.

This marine environment faces numerous ecological and anthropogenic stressors, including coral disease and bleaching, extreme weather events due to climate change, overharvesting of marine species, nutrient pollution, and physical damage from tourism-related activities such as anchoring and diver impacts [27]. The BSA Sea Base program integrates EE to raise awareness of these marine conservation issues, aiming to foster pro-environmental behavior among youth participants through structured outdoor adventure experiences.

Using a pre- and post-program survey, this study identifies how environmental values, attitudes, and awareness (the latter two influenced from their Sea Base experience) predict a higher CE. Data collection focused on three Florida Sea Base programs: Out Island Adventure, Keys Adventure, Marine STEM Adventure.

### 2.2. Participants and Study Population

The BSA Florida High Adventure Sea Base program serves over 16,000 participants annually (BSA Sea Base High Adventure, 2020), representing the theoretical population for this study [28]. Due to COVID-19 restrictions, program operations in summer 2020 were delayed by two weeks, and attendance was capped at 50% capacity to comply with Monroe County and State of Florida social distancing

mandates [29].

The research population consisted of BSA scouts aged 13 - 18, with 92% identifying as male. Participants traveled to the program from across the United States, and were enrolled in one of three Sea Base programs, each designed to provide distinct environmental and adventure-based experiences. The Marine STEM Adventure program (n = 92) involved hands-on marine science activities, including coral health monitoring, water quality tracking, shark tagging, plant surveying, and underwater robotics, interspersed with outdoor activities such as snorkeling, sailing, and hiking. The Keys Adventure program (n = 109) included a mix of sailing, snorkeling, fishing, and camping, as well as a day trip to Key West. The Out Island Adventure (n = 51) provided participants the opportunity to engage in beach cleanups, fishing, snorkeling, outdoor cooking, and canoeing to a separate island for four days. Each Sea Base adventure lasted 6 days; research on similar EE programs has shown that longer durations, such as 5-day programs, lead to greater retention of environmental awareness and stewardship when compared to shorter 3-day programs [30]. Program groups were structured into six scouts and two adult leaders per crew, forming a “family unit” to adhere to COVID-19 safety regulations.

### 2.3. Survey Procedure

Pre- and post-program surveys were administered onsite to assess changes in environmental awareness and attitudes over the course of the program. Upon arrival at Sea Base, participants were given a verbal and written explanation of the study. Pre-surveys were distributed on the first evening or the morning after arrival, following informed consent procedures. The pre-survey captured demographic data, previous outdoor experience, and environmental value orientations (*i.e.*, biospheric, social-altruistic, and egoistic). The pre-survey questions also asked participants about environmental awareness of issues impacting coral reefs in the Florida Keys (hereafter “environmental awareness”) and CE.

The post-survey was administered on the final night of the program and measured the same variables on environmental awareness, CE, and asked participants their perceived conservation confidence. Each participant was assigned a pseudonym or initials to link pre- and post-survey responses for analysis. To ensure adequate representation across programs during summer 2020, all Marine STEM participants were surveyed (given its smaller group size), while a stratified sampling approach was applied to Keys Adventure and Out Island Adventure participants [31] [32].

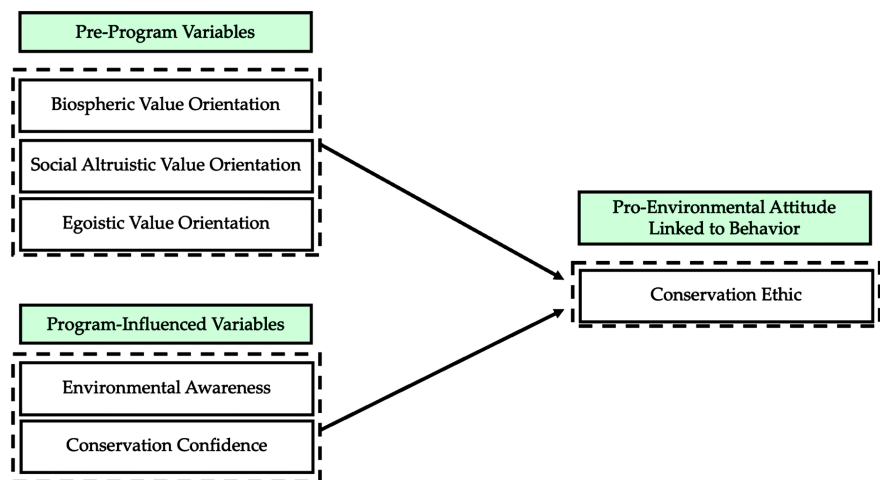
### 2.4. Data Analysis

Survey responses were analyzed using SPSS (Statistical Package for the Social Sciences) to identify significant predictors of CE. A Principal Factor Analysis (PFA) was conducted to distinguish relationships between independent and dependent variables, and reliability tests confirmed the internal consistency of multi-item

survey constructs, which were finally computed by calculating the mean scores of reliable survey items. To compare differences between pre- and post-survey responses, *t*-tests were used, and to compare differences between the three Sea Base programs surveyed, one-way ANOVAs were used to compare mean scores. Finally, a multiple regression analysis was conducted to assess the strength and direction of relationships between independent predictors of CE.

## 2.5. Development of Variable Items in Original Regression Model

To examine the relationships between key variables, this study applied a Predictive Framework of Conservation Ethics (Figure 1), adapted from the Predictive Framework of Personal Responsibility among SCUBA divers [33]. All variables underwent a PFA and reliability test to reveal distinctions between variables and ensure final variables were measuring intended concepts. Variable items with low loadings (<0.40) or strong cross-loadings were removed [34]. To verify the reliability of variable items under their corresponding factor loadings, reliability tests of these items were used to compute new variables; variable items with a low Cronbach's Alpha ( $\alpha < 0.60$ ) were eliminated from further analysis [34].



**Figure 1.** Predictive framework of conservation ethic, adapted from Cottrell and Meisel's (2003) predictive framework of personal responsibility in SCUBA divers.

Based on Cottrell & Meisel's predictive framework [33], our original regression model included a variety of social factors that tested their relationship to CE. For example, sociodemographic factors such as age and education were originally included because these have been cited as predictors of pro-environmental attitudes, although findings were mixed [35] [36]. Outdoor recreation frequency and familiarity were also originally included because the extent of time spent outside can influence emotional connections with the environment, such as place attachment [37]. Scouting experience (*i.e.*, years scouting, scouting rank, and merit badges) was also included, because it aligns with experience in outdoor settings.

Biospheric and social-altruistic environmental value orientations have been as-

sociated with pro-environmental behavior, while egoistic values tend to negatively correlate with pro-environmental attitudes [12] [38] [39], thus were included in the original model as well. Environmental values (*i.e.*, biospheric, social-altruistic, and egoistic) were adapted from an environmental value orientation scale, which consists of 12 variable items [40]. The scale asks participants “the environment’s natural resources should be carefully used, managed, and protected for...” my future, myself, my health, my lifestyle (egoistic), people in my community, my family, all people, future generations (social-altruistic), and marine life, animals, plants, birds (biospheric). The PFA initially suggested a two-factor structure, clustering egoistic and social-altruistic values under a broader anthropocentric orientation. However, these value orientations were kept as three distinct variables in the original framework [40]. Internal reliability confirmed strong internal consistency across all subscales (Cronbach’s Alpha: Biospheric = 0.919, Social-Altruistic = 0.918, Egoistic = 0.901), supporting their validity as separate but related constructs.

Environmental awareness refers to awareness of environmental issues impacting coral reefs in the Florida Keys, which was measured using 11 items asking participants about their awareness of broad impacts to the ecological health of coral reefs in the Florida Keys such as “Global climate change”, and “agriculture/farming”, and “commercial fishing”. Environmental awareness has been identified as a predictor of pro-environmental behavior, although some studies suggest it may be a weak predictor [41]-[43]. The PFA for environmental awareness initially showed a three-factor structure, explaining 58.94% of the variance in environmental awareness perceptions. However, our reliability test resulted in a Cronbach’s alpha of 0.707, indicating acceptable internal consistency across all items, supporting the creation of a single environmental awareness scale. The total variance of this combined scale was 36.25%.

The original model also included perceived conservation confidence, which refers to 4 items that assess participants’ perceptions on how they believe the program influenced their environmental knowledge and awareness, as well as their confidence and motivation to engage with the environment sustainably. The conservation confidence variable was included based on the theory that individuals must first develop a locus of control—encompassing environmental knowledge and confidence to engage in a behavior—before they can be motivated to engage in pro-environmental behavior [44]. PFA results explained 68.68% of the variance. Factor loadings ranged between 0.764 and 0.861, confirming that all items contributed meaningfully to the overall variable. The reliability analysis showed a Cronbach’s alpha of 0.847, indicating high internal consistency.

CE was measured using an eight-item scale derived from the Leave No Trace Principles and the BSA Outdoor Code of Ethics. While attitudes like CE are often examined as an independent variable in environmental attitude studies [2] [3] [14], this study treated CE as a dependent variable to evaluate the social factors that influence its development. The PFA explained 30.87% of the variance for CE. Com-

munalities ranged from 0.506 to 0.743. The reliability analysis showed a Cronbach's alpha of 0.794, demonstrating acceptable internal consistency.

## 2.6. Final Model and Hypotheses (Predictive Framework of CE)

Sociodemographic variables (e.g., age, education, years in scouting, outdoor experience) were excluded from the final model due to a lack of significant relationships with CE. This likely reflects the homogeneity of the study population (*i.e.*, predominantly young, white males with similar scouting backgrounds). Instead, the Predictive Framework of CE included environmental awareness, conservation confidence, and environmental values (biospheric, social-altruistic, and egocentric) as independent variables with CE as the dependent variable. This study tested the following hypotheses, with H<sub>3</sub> referencing the Predictive Framework of CE:

H<sub>1</sub>: Participation in the BSA Florida Sea Base program leads to a significant increase in environmental awareness and CE post-program.

H<sub>2</sub>: Marine STEM participants exhibit significantly higher scores for environmental awareness and conservation confidence compared to participants in the other two programs.

H<sub>3</sub>: Conservation confidence will be the strongest predictor of a CE.

Hypotheses were tested through a paired t-test to evaluate changes in environmental awareness and CE before and after program participation (H<sub>1</sub>), a one-way ANOVA to compare environmental awareness and conservation confidence across program type (H<sub>2</sub>), and a multiple regression analysis to identify the strongest predictor of CE (H<sub>3</sub>).

## 3. Results

This study assessed the influence of the BSA Florida Sea Base program on fostering a CE among youth participants by examining changes in environmental awareness and CE post-program. Predictors of CE were identified, such as environmental values, environmental awareness post-program, and conservation confidence. The analysis was conducted in three stages in order of hypotheses given: (H<sub>1</sub>) paired *t*-tests to assess pre- and post-program differences in key variables, (H<sub>2</sub>) one-way ANOVA to identify significant differences across program types, and (H<sub>3</sub>) regression analysis to determine key predictors of CE.

### 3.1. Paired Sample t-Tests of Environmental Awareness and CE Pre- and Post-Program

For H<sub>1</sub>, paired sample t-tests were conducted to examine changes in environmental awareness and CE from pre- to post-program surveys across all participants, and within each program type (*i.e.*, Keys Adventure, Marine STEM, and Out Island) (**Table 1**). Results for the full sample revealed a statistically significant decrease in environmental awareness, with pre-program scores ( $M = 3.517$ ,  $SD = 0.441$ ) being higher than post-program scores ( $M = 3.406$ ,  $SD = 0.542$ );  $t(246) = 3.260$ ,  $p = 0.001$ . The effect size (Cohen's  $d = 0.532$ ) suggests a moderate decline

in environmental awareness after program participation. Similarly, CE scores also declined, with pre-program scores ( $M = 4.21$ ,  $SD = 0.458$ ) exceeding post-program scores ( $M = 4.13$ ,  $SD = 0.472$ );  $t(250) = 3.339$ ,  $p < 0.001$ . However, the effect size (Cohen's  $d = 0.387$ ) suggests that the decline in CE was smaller in magnitude than the decline in environmental awareness.

**Table 1.** Pairwise  $t$ -tests of CE and environmental awareness before and after participants' sea base experience.

Program Type	Variable	Pre-Survey $M$	Std. Dev	Post-Survey $M$	Std. Dev	$df$	$t$ -value
All	CE	4.21	0.458	4.13	0.472	250	3.339***
Programs n = 247	Environmental Awareness	3.52	0.441	3.41	0.542	246	3.260***
Keys	CE	4.21	0.498	4.16	0.498	107	1.220 ( <i>ns</i> )
Adventure n = 107	Environmental Awareness	3.44	0.418	3.33	0.560	106	1.853 ( <i>ns</i> )
Marine	CE	4.17	0.435	4.11	0.414	90	1.747 ( <i>ns</i> )
STEM n = 88	Environmental Awareness	3.63	0.492	3.50	0.577	87	2.093*
Out Island	CE	4.27	0.409	4.09	0.515	50	3.457***
n = 51	Environmental Awareness	3.49	0.358	3.40	0.423	50	1.923 ( <i>ns</i> )

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ , *ns* = not significant.

Examining changes by program (Table 1), results indicate a decline in environmental awareness was only statistically significant for Marine STEM participants ( $t(87) = 2.093$ ,  $p = 0.039$ ,  $d = 0.585$ ). For CE, a significant decline was observed for Out Island participants ( $t(50) = 3.457$ ,  $p = 0.001$ ,  $d = 0.484$ ), while Keys Adventure and Marine STEM participants did not experience statistically significant shifts in CE scores. These findings indicate that the overall decline in CE was largely driven by Out Island participants, while shifts in environmental awareness were found in Marine STEM.

### 3.2. One-Way ANOVA

For  $H_2$ , a one-way ANOVA was conducted to examine whether there were significant differences in post-program scores of environmental awareness, conservation confidence, and CE among the Marine STEM, Keys Adventure, and Out Island programs (Table 2). Results for post environmental awareness indicated no statistically significant differences across programs,  $F(2, 245) = 2.119$ ,  $p = 0.122$ , suggesting that participants across all three programs reported similar levels of environmental awareness after program completion. Likewise, post CE scores did not significantly differ between programs,  $F(2, 249) = 0.678$ ,  $p = 0.509$ , indicating that participant CE remained consistent regardless of program type.

**Table 2.** One-Way ANOVAs of CE, environmental awareness, and conservation confidence by program type.

Variable	Overall <i>M</i>	Keys Adventure	Marine STEM	Out Island	F-value	df Between Groups	df Within Groups
	n = 252	n = 109	n = 92	n = 51			
CE	4.13	4.17	4.10	4.09	0.678 (ns)	2	249
Environmental Awareness	3.41	3.33	3.49	3.40	2.119 (ns)	2	245
Conservation Confidence	4.31	4.19	4.52 <sup>◊</sup>	4.19	8.365***	2	245

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ , ns = not significant; <sup>◊</sup> = Post-hoc Bonferroni test: Marine STEM's Conservation Confidence score was significantly higher than Keys Adventure (\*\*\*) and Out Island (\*\*).

In contrast, conservation confidence varied significantly across programs,  $F(2, 245) = 8.365$ ,  $p < 0.001$ . Post-hoc Bonferroni tests revealed that participants in the Marine STEM program ( $M = 4.52$ ,  $SD = 0.46$ ) reported significantly higher conservation confidence than those in both the Keys Adventure ( $M = 4.19$ ,  $SD = 0.67$ ,  $p < 0.001$ ) and Out Island programs ( $M = 4.19$ ,  $SD = 0.70$ ,  $p = 0.006$ ). No significant differences were found between the Keys Adventure and Out Island groups ( $p = 1.000$ ). Results suggest while overall post environmental awareness and CE were stable across all groups, the Marine STEM program may have had a stronger impact on participants' conservation confidence compared to the other two programs.

### 3.3. Regression Analysis

For  $H_3$ , the final regression model predicting CE scores across all programs accounted for a significant proportion of variance ( $R^2 = 0.291$ ,  $F(5, 242) = 19.907$ ,  $p < 0.001$ ), indicating that approximately 29.1% of the variance in post-program CE scores was explained by post-survey scores of environmental awareness and conservation confidence, and environmental values (*i.e.*, biospheric, social-altruistic, and ego-centric) (Table 3). The biospheric value orientation was the strongest predictor of CE ( $\beta = 0.360$ ,  $p < 0.001$ ), followed by environmental awareness ( $\beta = 0.176$ ,  $p = 0.002$ ), conservation confidence ( $\beta = 0.170$ ,  $p = 0.003$ ), and the social-altruistic value orientation ( $\beta = 0.247$ ,  $p = 0.007$ ). The egoistic value orientation was negatively associated with CE ( $\beta = -0.227$ ,  $p = 0.010$ ), suggesting an inverse relationship.

When examined separately by program, the predictive strength of these variables varied. The regression model for Keys Adventure explained 25.5% of the variance in CE ( $R^2 = 0.255$ ,  $F(5, 101) = 6.926$ ,  $p < 0.001$ ). In this program, biospheric value orientations ( $\beta = 0.358$ ,  $p < 0.001$ ) were the most significant predictor, while conservation confidence ( $\beta = 0.190$ ,  $p = 0.036$ ) and environmental awareness ( $\beta = 0.191$ ,  $p = 0.038$ ) also had notable contributions to the overall model. For the Ma-

rine STEM program, the model accounted for 32.1% of the variance in CE ( $R^2 = 0.321$ ,  $F(5, 83) = 7.842$ ,  $p < 0.001$ ), with biospheric value orientations ( $\beta = 0.348$ ,  $p = 0.001$ ) and conservation confidence ( $\beta = 0.260$ ,  $p = 0.007$ ) as the strongest predictors. Social-altruistic was not a significant predictor for the Marine STEM model ( $\beta = 0.247$ ,  $p = 0.054$ ). Lastly, for the Out Island program, the model explained the highest proportion of variance in CE ( $R^2 = 0.454$ ,  $F(5, 45) = 7.478$ ,  $p < 0.001$ ). Here, the biospheric value orientation ( $\beta = 0.352$ ,  $p = 0.043$ ) and environmental awareness ( $\beta = 0.267$ ,  $p = 0.024$ ) were the only significant predictors of CE. Interestingly, conservation confidence was not a significant predictor.

**Table 3.** Multiple regression of environmental awareness, conservation confidence, environmental value orientations, and CE.

Variable	Full Model	Keys Adventure	Marine STEM	Out Island
	n = 248	n = 107	n = 89	n = 51
	$\beta$	$\beta$	$\beta$	$\beta$
Environmental Awareness	0.176**	0.191*	0.173 ( <i>ns</i> )	0.267*
Conservation Confidence	0.170**	0.190*	0.260**	0.207 ( <i>ns</i> )
Biospheric Value Orientation	0.360***	0.358***	0.348***	0.352*
Egoistic Value Orientation	-0.227*	-0.157 ( <i>ns</i> )	-0.193 ( <i>ns</i> )	-0.194 ( <i>ns</i> )
Social-Altruistic Value Orientation	0.247**	0.100 ( <i>ns</i> )	0.247 ( <i>ns</i> )	0.285 ( <i>ns</i> )
	$R^2: 0.291$ ***	$R^2: 0.255$ ***	$R^2: 0.321$ ***	$R^2: 0.454$ ***
	F = 19.907	F = 6.926	F = 7.842	F = 7.478

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ , *ns* = not significant.

Overall, these results indicate that while some predictors consistently influenced CE across programs (*i.e.*, biospheric value orientations) other predictors, like conservation confidence and environmental awareness, showed more program-specific effects. The negative association between egoistic value orientations and CE persisted across analyses, reinforcing their inverse relationship.

#### 4. Discussion

Study findings provide key insights into the role of youth adventure programs in fostering CE, a pro-environmental attitude although not all hypotheses were supported. Specifically, H<sub>1</sub> as environmental awareness and CE did not increase post-program, and in some cases declined. H<sub>2</sub> was partially supported: Marine STEM participants reported significantly higher conservation confidence than Keys Adventure and Out Island participants, but post-program environmental awareness and CE did not significantly differ across program types. H<sub>3</sub> was not supported, as conservation confidence was not the strongest predictor of CE in the final model (the biospheric value orientation and environmental awareness were stronger predictors).

Overall, while participants did not exhibit significant increases in environmental awareness or CE post-program, results highlight important predictors of CE, including biospheric and social-altruistic value orientations, environmental awareness, and perceived conservation confidence. Thus, contrary to H<sub>3</sub>, conservation confidence contributed to CE but did not emerge as the dominant predictor once value orientations and environmental awareness were included in the model. The full regression model across all programs showed that biospheric values had the strongest influence on CE, followed by environmental awareness and conservation confidence. Notably, egoistic value orientations negatively correlated with CE, indicating that participants who prioritized self-centered concerns over environmental or collective well-being were less likely to have a higher CE. These findings align with previous research suggesting that pro-environmental behaviors are more closely linked to biospheric and social-altruistic values and negatively relate to egoistic ones [38] [40].

Differences in CE predictors across program types suggest that the structure and content of each adventure program influenced participants' environmental attitudes in distinct ways. This relates to other studies that suggest the type of outdoor recreation participants engage in (e.g., appreciative versus consumptive activities) influence pro-environmental attitudes [45]-[47]. Marine STEM participants exhibited significantly higher conservation confidence, likely due to the program's explicit focus on hands-on marine science activities, a pattern consistent with prior findings that such experiences boost student confidence in environmental actions [48]. The Marine STEM group also exhibited a post-program decline in environmental awareness, potentially due to increased conservation confidence altering their perceptions of environmental issues—an effect observed in findings where overconfidence in self-assessed climate knowledge led to individuals to overlook knowledge gaps and environmental risks [49]. While the program effectively enhanced their confidence in engaging with the marine environment and motivation to engage in sustainable behaviors, this heightened self-assurance may have led to a slight reduction in the perceived severity of environmental threats to coral reefs in the Florida Keys. Similarly, a national survey of Danish students studying sustainability education to become science teachers, found that “self-efficacy and self-assessed knowledge correlate negatively with actual knowledge”, suggesting that participants with inflated confidence may be “subject to an overinflated self-assessment” [50] (p. 215). This pattern may reflect cognitive biases similar to the Dunning-Kruger effect, which is a cognitive bias where individuals with limited competence or knowledge overestimate their ability or understanding [51]. Another study found that low-performing STEM students were consistently more overconfident and less accurate in their predictions than high-performing students [52]. These findings highlight the need for structured EE programs that not only build conservation confidence but also cultivate a deeper, more accurate understanding of environmental threats. Without this balance, participants with limited experience may underestimate the severity and complexity of environ-

mental issues.

Ensuring EE fosters both environmental awareness and conservation confidence is essential for empowering individuals to engage more meaningfully in sustainable behavior and conservation efforts [52]. However, not all outdoor experiences equally reinforce these outcomes. In contrast to the other Sea Base programs, Out Island participants experienced the largest decline in CE scores for example, suggesting that outdoor experiences with fewer structured EE components may be less effective in reinforcing CE. The Out Island program is designed to emphasize participant self-sufficiency and immersion in their outdoor experience. For example, Out Island participants canoe about five miles to Munson Island, live on the island for several days, and prepare their own meals, with the experience centered on team building and self-reliance. In contrast, the Marine STEM program pairs field-based marine science activities (e.g., fish ID while snorkeling, shark and mahi-mahi tagging, and water sampling) with explicit marine science lectures, and requires participants to demonstrate what they have learned through a final presentation on marine ecology and/or conservation. Participants are also required to build and race an underwater remote-operating vehicle (ROV).

Although Out Island participants snorkel, complete a beach clean-up, and learn about local flora and fauna on Big Munson Island, the program provides fewer structured EE opportunities that include explicit instruction and guided reflection on the educational parts of their experience. By comparison, intentionally structured EE activities and reflection of learning experiences (as observed in the Marine STEM program) may be more likely to reinforce conservation norms and more directly inform CE.

Previous research has indicated that EE programs incorporating structured learning experiences are more effective at sustaining long-term environmental awareness and behavioral change compared to programs that rely solely on nature immersion [53]. For instance, studies on a residential EE program found that structured EE components (e.g., guided discussions, reflective exercises, and curriculum-aligned activities) enhanced retention of environmental concepts and sustained conservation attitudes beyond the program experience [30]. These findings emphasize the importance of integrating structured EE components within adventure programs to ensure that participants develop both environmental knowledge and the confidence necessary to translate attitudes into long-term sustainable behaviors.

### **Program Implications**

Sea Base results indicate that program structure can raise conservation confidence without necessarily strengthening (and in some cases potentially reducing) environmental awareness of reef threats in the Florida Keys (*i.e.*, Marine STEM participants reported the highest conservation confidence but showed a post-program decline in environmental awareness, whereas Out Island participants exhibited the largest decline in CE). To foster confidence while maintaining accurate

understanding of environmental issues, we recommend three design actions supported by EE research; each is designed to align participants' confidence with their demonstrated understanding of environmental issues.

First, ensure that each major field experience is paired with guided reflection and explicit application so that the program can complete Kolb's experiential learning cycle rather than relying on the experience alone [54]. Kolb's experiential learning cycle often begins with a concrete experience, followed by reflecting on said experience, drawing conclusions and learning from the experience, and applying the new knowledge in a future action or experiment [54]. For Sea Base, this might look like a structured post-snorkel debrief in which participants identify the primary stressors affecting Florida Keys coral reefs that were discussed during the program (e.g., pollution, physical damage to reefs, bleaching), linking at least one stressor to a specific observation from the snorkel site, and articulating one concrete action they can take during the remainder of their trip (e.g., snorkeling more carefully to avoid touching coral). Second, lessons should be organized around a salient environment issue, not just around facts or data collection. Frenslley *et al.* [55] found that lessons emphasizing real-world environmental issues and relevance to students' lives were associated with higher immediate post-lesson environmental literacy scores. For Sea Base participants, this might look like framing water sampling or reef monitoring around an explicit problem-based question (e.g., "How do water quality conditions increase coral stress in the Florida Keys, and what do today's measurements suggest?"). Third, programs should explicitly teach and provide opportunities to practice feasible, environmentally friendly behaviors through "action knowledge," which teaches participants exactly how to engage in environmentally friendly behaviors [56]. Integrating action knowledge into EE may help instill youths' conviction that their actions can have a meaningful environmental impact [56], and is consistent with models of responsible environmental behavior that emphasize empowerment variables such as locus of control as important predictors of responsible environmental behavior [57]. For Sea Base, this might mean teaching participants "reef stewardship skills", such as maintaining distance to avoid contact with corals or opting for long sleeve rash guards over using sunscreen before snorkeling. Altogether, these design elements can help build conservation confidence while also reinforcing participants' awareness of threats to reefs in the Florida Keys.

## 5. Conclusive Remarks and Implications for Future Research

While this study identifies key factors influencing CE, findings also highlight the complexity of fostering pro-environmental attitudes like CE. The mixed results suggest that while adventure-based EE can support environmental stewardship, simply exposing participants to nature may not sufficiently instill environmental awareness. Future research should explore how program design, duration, and post-program reinforcement efforts (e.g., follow-up activities, continued engage-

ment opportunities) contribute to sustained CE development beyond the immediate program experience. Additionally, given the homogeneity of the study population (predominantly young white males with scouting experience), future studies should examine whether similar findings hold across more diverse participant groups. This study was also conducted during summer 2020 under COVID-19 restrictions, including reduced program capacity and modified operations, which may have influenced program delivery, group dynamics, and participant attitudes in ways not captured by the survey measures. Pandemic-related restrictions may also have altered local use patterns and coastal conditions such as changes in vessel and cruise activity, which can affect nearshore water clarity, turbidity, and animal behavior [58]-[60], which may have influenced what participants observed and how they interpreted reef-related threats. As a result, the observed patterns in environmental awareness, conservation confidence, and CE may partly reflect this unique context. Understanding these dynamics can inform the development of more effective EE programs that not only immerse youth in nature but also actively shape their environmental values, attitudes, and behaviors, fostering a long-term commitment to sustainability and environmental stewardship.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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