

Article

Cultivating Empathy for Non-Charismatic Intertidal Animals: Assessing the Potential Outcomes of an Empathy-Based Beach Naturalist Program

Cameron Thomas Whitley ^{1,*}, Sarah Brenkert ², Darcie Larson ², Kaitlin Barrailler ¹, Amalie Bramwell ¹, Aowyn Leiper ¹, Cory Houser ¹, Isabella Torres ¹, Katie Combs ¹ and Saul Vizcaino ¹

¹ Department of Sociology, Western Washington University, Bellingham, WA 98225, USA; barraik@wwu.edu (K.B.); amaliebramwell@gmail.com (A.B.); tisabella622@gmail.com (I.T.)

² Seattle Aquarium, Seattle, WA 98101, USA; s.brenkert@seattleaquarium.org (S.B.)

* Correspondence: whitlec@wwu.edu

Simple Summary

Intertidal beaches support a wide range of life that plays a vital role in maintaining healthy coastal ecosystems. Yet, many visitors move through these spaces without fully recognizing how easily they can be damaged. This study examines whether conversations with empathy-trained beach naturalists (ETBN) shape how visitors understand and relate to intertidal marine life. It also considers whether these interactions are associated with differences in how people anticipate behaving during future beach visits. Survey results show that visitors who spoke with an ETBN reported stronger emotional connection and a clearer understanding of intertidal organisms as living beings. They were also more likely to describe specific intended changes in future behavior, such as watching where they step and avoiding disturbances to animals and habitats. Taken together, these findings suggest that ETBN education is associated with deeper public engagement and more conservation-oriented behavioral intentions in shoreline environments.

Abstract

This study examines whether interactions with trained interpreters using empathy-focused messaging through the Seattle Aquarium Beach Naturalist Program are associated with higher levels of empathy toward marine life. Empathy-focused messaging included perspective-taking, relational and anthropomorphic framing, individualization, and narrative storytelling designed to encourage visitors to consider the experiences of intertidal organisms. The study specifically emphasized less charismatic intertidal animals that are less likely to elicit immediate affective engagement, including organisms without readily discernable faces or eyes. Drawing on three summers of survey data (2023–2025) ($n = 263$) from beaches in the Pacific Northwest of the US, we assess affective and cognitive empathy among individuals who did and did not interact with a naturalist during a low-tide event. Respondents completed surveys with Likert and open-ended questions about empathy, what they learned, and how the experience might influence future behavior. Results indicate that encounters with trained interpreters using empathy-focused messaging are associated with increased empathy toward intertidal marine life. Qualitative analysis of open-ended questions further shows that interactions are correlated with heightened awareness, stewardship and protection, animal-centered perspective shifts, and learning and knowledge sharing regarding shoreline ecosystems. These findings suggest that beach naturalist programming with empathy-focused messaging could strengthen both emotional and cognitive engagement with intertidal organisms while fostering more



Academic Editors: Susan P. Bratton and Chi-Ok Oh

Received: 15 August 2026

Revised: 13 October 2026

Accepted: 16 October 2026

Published: 22 October 2026

Copyright: © 2026 by the authors.

Licensee MDPI, Basel, Switzerland.

This article is an open access article distributed under the terms and conditions of the [Creative Commons Attribution \(CC BY\)](https://creativecommons.org/licenses/by/4.0/) license.

conservation-oriented behavior intentions. These results are relevant to scholars of environmental education and human–animal studies, as well as aquariums, parks departments, conservation organizations, and community-based educators seeking to promote more informed, empathetic, and protective engagement among residents and visitors in coastal environments.

Keywords: naturalist; beach naturalist; empathy for animals; marine education; informal science education; interpretive programs; conservation education; interpretation; outreach programs; environmental education

1. Introduction

Biodiversity is central to the functioning of intertidal ecosystems, as diverse assemblages of species sustain ecological processes such as nutrient cycling, primary production, and habitat formation while enhancing resilience to environmental variability [1]. In turn, these biologically rich systems contribute to shoreline stability, support fisheries and other ecosystem services, and play a critical role in sustaining both human and nonhuman communities [2,3]. However, human activities are disrupting shoreline ecosystems at unprecedented rates through development, harvesting, pollution, and recreation [4,5]. Yet, public understanding of ocean systems, biodiversity, and the importance of shoreline ecosystems remains limited [6]. Each year billions of people visit beaches around the world. In the US alone, about 3.4 billion people visit beaches annually [7]. Without proper understanding about intertidal ecosystems, beach visitors may unintentionally contribute to ecological decline. Beach naturalist programs represent one approach to public education, informing audiences about ways individuals can contribute to the protection of intertidal ecosystems. The conservation challenge is therefore not simply whether visitors possess ecological information, but whether brief encounters in these heavily used spaces can encourage them to perceive intertidal organisms as living beings worthy of attention and protection. This challenge may be particularly pronounced for less charismatic intertidal animals that lack the facial features, expressive behaviors, or other characteristics that often facilitate human emotional connection with wildlife.

Naturalist programs emerged in the late nineteenth and early twentieth centuries alongside the expansion of national parks, where early “nature guides” began translating ecological knowledge for public audiences. As these efforts became formalized within conservation and park management, they laid the groundwork for later place-based initiatives, including beach naturalist programs, that similarly aim to educate visitors and reduce human impacts on sensitive intertidal ecosystems [8]. Such interventions often developed through partnerships among marine scientists, conservation organizations, and public agencies [9]. These programs reflect a broader shift toward interdisciplinary informal environmental education and stewardship, grounded in the recognition that public awareness and behavior are critical to reducing human disturbance in sensitive ecosystems [10].

Beaches, as publicly accessible and frequently visited natural environments, represent important sites for informal, free-choice learning, where direct encounters can facilitate environmental understanding [11]. As such, beach naturalist and related coastal environmental education programs have expanded globally as localized strategies to address the growing pressures of tourism, recreation, and resource use on shoreline ecosystems have also increased. These initiatives are based on the premise that knowledge can shift attitudes, and foster pro-environmental behavioral intentions, particularly when participants engage directly with local species and habitats [12,13]. Education-based beach programming may

cultivate a sense of responsibility and long-term stewardship, even if such interventions represent only modest counterweights to broader patterns of coastal overuse and ecological degradation [14,15]. In this sense, beach naturalist programs operate not only as educational encounters, encouraging participants to see shoreline organisms as ecologically significant, but also as subtle interventions aimed at reshaping everyday practices, with the hope that curiosity and care translate into more sustainable interactions with coastal environments.

Although research has demonstrated that environmental interpretation and free-choice learning can shape environmental knowledge, attitudes, and conservation-oriented intentions [10,12,13], less is known about the role of explicitly empathy-oriented interpretation within brief, informal encounters in outdoor coastal settings. Existing research further suggests that empathy toward animals can contribute to conservation attitudes and behavioral intentions [16–18], yet this work has given comparatively less attention to organisms that may be difficult for people to anthropomorphize or relate to emotionally. Intertidal environments provide an especially useful setting in which to examine this question because visitors encounter numerous animals that lack readily recognized faces, eyes, or behaviors commonly associated with charismatic wildlife [19]. Examining empathy-oriented interpretation in this context therefore provides an opportunity to extend research on environmental education beyond knowledge acquisition to consider how interpretive encounters are associated with affective and cognitive relationships with less charismatic nonhuman life.

Although naturalist programs are often perceived as primarily information-focused, interpretation has long emphasized relevance, meaning-making, and emotional connection for audiences. Contemporary initiatives extend this tradition by more intentionally foregrounding affective and perspective-taking strategies in their program design [20–23]. The Seattle Aquarium, for example, has developed programming that not only conveys natural history knowledge, but also invites participants to consider the experiences of intertidal organisms as a way of fostering empathetic concern. A growing body of research suggest that empathy toward animals can play an important role in shaping conservation attitudes and behavior [16–18]. Building on this work, the present study examines whether empathy-oriented communication from beach naturalists enhances empathy for intertidal life and whether engagement with a naturalist is correlated with increased willingness to adopt shoreline protective behaviors.

2. Background

2.1. Historical Foundations of Naturalist Programming

Beach naturalist programs are rooted in a long tradition of natural history and community-based environmental learning. In environmental education vernacular, naturalists are typically understood as individuals who support the conservation of wildlife and facilitate public learning about animals, plants, habitats, and ecological systems [24,25]. Although the term ‘naturalist’ emerged from European scientific traditions in the 17th century, practices of observing, understanding and passing on knowledge of local environments predates this context, particularly within Indigenous knowledge systems [26]. Historically, naturalists were proficient in observing and documenting ecological systems, often developing deep, place-based expertise through journaling, specimen collection, and long-term engagement with specific habitats [24]. These early practices, frequently carried out by amateur and local enthusiasts, laid the groundwork for contemporary naturalists programming by emphasizing close observation, experiential learning, and community involvement. The expansion of formalized environmental education programs in the late twentieth century was closely tied to broader political and cultural shifts, including the

rise of the modern environmental movement and key developments such as the Marine Protection, Research, and Sanctuary Act of 1972 (MPRSA) in the US, also known as the Ocean Dumping Act, which is a federal law regulating the intentional dumping of materials into ocean waters [27,28]. This legislation not only increased funding and protection for marine ecosystems but also helped institutionalize opportunities for public engagement with coastal environments. As marine protected areas expanded and public interest in conservation grew, naturalist-led programs, particularly in coastal and intertidal zones, became increasingly visible mechanisms for translating scientific knowledge to the public.

2.2. Contemporary Beach Naturalist Programming and Research on Interpretive Programming

Contemporary beach naturalist programs build on the naturalist legacy by combining ecological interpretation with public engagement in dynamic shoreline environments. In this context, interpretation refers to communication that helps visitors understand the ecological significance of the organisms and habitats they encounter and connect that understanding to their own experiences and actions. Beach naturalists focus on marine wildlife and intertidal ecology, introducing visitors to local species, their habitats, and responsible ways of interacting with them. Learning often occurs through informal encounters, including guided low-tide exploration, in which dialogue, modeled practices, and shared observation help make shoreline ecology understandable and meaningful to visitors. Although research focused specifically on beach naturalist programs is limited, broader research on environmental interpretation provides insight into their potential impact. Interpretive approaches that are interactive, place-based, and responsive to visitors' interests have been shown to support both engagement and conservation [29].

Together, this literature suggests that interpretive outcomes depend not only on what information is communicated, but also on how interpreters frame that information and establish relational connections between visitors, places, and nonhuman life. This distinction is particularly important for the present study because empathy-oriented interpretation deliberately extends beyond information transmission by encouraging visitors to consider the experiences and perspectives of other animals, many of which have no discernable relational characteristics like faces. More specifically, environmental education has been shown to promote pro-environmental or "green" behaviors, including conservation-oriented decision-making [30], especially when the interpretative framework draws on local contexts and encourages community participation [10,31]. Across the literature, the role of the naturalist is key. Naturalists function not just as sources of knowledge but also as facilitators of social and emotional learning. Their ability to build rapport, convey enthusiasm and adapt to diverse audiences plays a critical role in shaping participant experience [32]. Studies of interpretive professionals highlight that personal connection, storytelling, and approachable communication styles can significantly increase visitor receptivity and retention of information [33]. Specifically, beach naturalists often emphasize not only ecological knowledge, but also respectful and meaningful interactions with marine organisms and their habitats, an approach that aligns with broader calls for more relational and experiential forms of environmental education [10,22]. This is where the use of anthropomorphism and empathy messaging comes in.

2.3. Anthropomorphism in Interpretive Programming

Naturalists and scientists have historically approached anthropomorphism with caution [34,35]. Early Western scientific traditions, particularly those influenced by behaviorism and comparative psychology, discourage attributing human-like emotions or intentions to animals, emphasizing instead parsimonious, mechanistic explanations of behavior [36,37]. This skepticism toward anthropomorphism was further reinforced by concerns that project-

ing human traits onto animals could obscure species-specific behaviors and lead to inaccurate interpretations [35]. As a result, many environmental education practices prioritize factual, descriptive accounts of animal life over affective or relational modes of engagement. However, this avoidance also limits opportunities to foster emotional connections between humans and nonhuman animals, connections that are increasingly recognized as central to conservation outcomes. Recent research suggests that carefully applied, critical or strategic anthropomorphism can enhance empathy toward animals by making their experience more relatable, thereby strengthening concern for their wellbeing and habitats [18,38–40]. These insights echo longstanding Indigenous perspectives encouraging an understanding of human–animal relationships as relational and reciprocal, rather than strictly mechanistic [41,42]. Within environmental education and interpretive contexts, including naturalist-led programs, this shift reflects a growing recognition that knowledge alone is insufficient to motivate pro-environmental behavior, and that engagement, particularly empathy activating engagement, plays a role in shaping conservation attitudes and actions [41–43]. In practice, this can be seen in the ways interpretive programs, including documentaries and guided experiences, sometimes employ narrative or anthropomorphic elements to encourage audiences to identify with individual animals and their struggles. Although the empirical literature on anthropomorphizing marine species remains limited, emerging research suggests that such strategies may play a role in shaping conservation-relevant attitudes and behaviors [44].

Importantly, anthropomorphism and empathy are related but conceptually distinct. Anthropomorphic framing attributes or interprets characteristics of nonhuman organisms through human-relevant terms, whereas empathy involves affective or cognitive engagement with another being's experience. Anthropomorphic framing may provide one pathway to empathy by making unfamiliar organisms more relatable, but empathy can also emerge through cognitive perspective-taking, ecological knowledge, direct observation, and recognition of another organism's needs or capacities. Accordingly, the present study does not treat anthropomorphism as a prerequisite for empathy; rather, we consider anthropomorphic and relational framing as components within a broader set of empathy-oriented interpretive practices.

2.4. Empathy-Based Beach Naturalist Programs

Extending the discussion of the use of anthropomorphism in interpretive programming, the use of empathy-based messaging to foster connections with, and stewardship of, marine environments represent an increasingly important development in environmental education and interpretation. Earlier work in this area largely focused on how environmental education programs shaped participants' awareness, attitudes, and understanding of environmental issues [45]. While previous work has demonstrated value, scholars have increasingly argued that knowledge alone is often insufficient to produce meaningful behavioral change. Instead, affective dimensions, particularly empathy, are now better understood as critical components in cultivating pro-environmental engagement [30,46]. Chawla [47] for example, highlights the importance of early emotional connections with nature, suggesting that experiences which evoke care and concern for nonhuman life can play a formative role in shaping long-term environmental values and behaviors. In this study, we distinguish between affective and cognitive dimensions of empathy. Affective empathy refers to emotional responsiveness toward another being, including concern for or emotional engagement with that being's perceived experience. Cognitive empathy refers to perspective-taking and the capacity to recognize or consider another being's experiences, capacities, or relationship to its environment [48]. Although analytically distinct, these dimensions can operate together: emotional concern may encourage perspective-taking,

while greater understanding of another organism's capacities may make affective engagement more likely. This distinction is particularly relevant for non-charismatic intertidal animals, for which familiar visual cues associated with emotion or agency may be limited.

Within this evolving framework, beach naturalist programs are well positioned to incorporate empathy-based approaches into their interpretive practices. Research suggests that fostering empathy toward nonhuman species can increase individuals' willingness to engage in conservation behavior and support protective policies [38,39]. Similarly, studies in environmental psychology have found that emotional engagement with nature, whether through direct experience or mediated encounters, can strengthen both personal connection and a sense of responsibility toward environmental stewardship [49].

At the same time, the effect of empathy-based programming is not uniform across populations. Social and cultural contexts, including socioeconomic status, geographic location, and culturally mediated understandings of nature, can significantly influence how individuals perceive and relate to marine life [50]. These factors underscore the importance of attending to participant diversity when evaluating the outcomes of environmental education initiatives. Moreover, while empathy is often a critical precursor to compassionate or pro-environmental action, it does not automatically translate into behavior [51]. Empathy operates as part of a broader constellation of cognitive, social, and structural influences that shape environmental decisions-making. Nevertheless, a growing body of work suggests that cultivating empathy remains a promising pathway for strengthening conservation engagement, particularly when combined with opportunities for action and continued learning [30,52]. Despite this potential, relatively little research has examined how empathy can be intentionally fostered within informal learning environments such as aquariums and beach naturalist programs. Expanding this line of inquiry is therefore essential for understanding how affective and cognitive engagement can complement traditional educational approaches and potentially contribute to more effective, inclusive, and sustainable coastal conservation efforts.

2.5. Empathy-Based Beach Naturalist Program Location and Training Characteristics

Washington State in the US maintains some of the longest running traditions of beach naturalist initiatives extending from the far north to the southern shores involving aquariums, universities, cities, clubs, non-profit organizations, citizen scientists, and community members. Our project site selection is a program operated by the Seattle Aquarium in Washington State in the US, which is run across beaches along the Puget Sound. This program is particularly interesting because of its scope of outreach, enduring legacy, and empathy interpretive focus.

Roughly 4.2 million people live along the Puget Sound in the US [53]. This is a complex estuarine system in the Pacific Northwest of the US, characterized by interconnected marine basins, inlets, and channels where freshwater from rivers mixes with saline waters from the Pacific Ocean, supporting diverse ecological communities and extensive human use. This makes this the ideal location to assess the nuances of various programs. The Puget Sound is similar to a class of estuarine systems known as fjord-type or glacially carved estuaries, which are found in several regions of the world including in Norway (Norwegian Fjords), Chile (Patagonian Fjords), Canada (Coastal Fjords of British Columbia), and New Zealand (Fiordland) among others, making the focus and findings of this work applicable to an array of locations.

Within the Puget Sound region, the Seattle Aquarium Beach Naturalist Program consists of staff members and volunteers that provide demonstrative education on beach ecology during low-tide days to visitors at a variety of beaches in King County [54]. The program connects beaches spanning roughly 25 miles of linear shoreline along the

Puget Sound from southern Des Moines Beach Park to Richmond Beach Saltwater Park in the north. The stretch encompasses the entire waterfront of the large urban city of Seattle, Washington, US and neighboring municipalities in King County. The audience of the program is primarily King County residents which encompass 39 cities, roughly 2.34 million people or nearly 30 percent of the entire population of Washington State, US [55]. The program is also frequented by out-of-town and out-of-state visitors. Each year the Seattle Aquarium Beach Naturalist Program engages several thousands of people, although actual numbers are unknown.

The Seattle Aquarium Beach Naturalist Program is unique in that the organization positions the program as a central component of its broader “fostering empathy for wildlife strategic initiative.” As such, staff emphasize empathy-based interpretive practices into the training of beach naturalists (known in the remaining text as empathy-trained beach naturalists or ETBNs). Training materials incorporate structured “empathy best practices” including guidance documents, interpretive signage, and interactive activities designed to help naturalists encourage visitors to consider the lived experiences of intertidal organisms [56]. ETBNs are trained to use relational and perspective-taking language, such as describing habitats as an animal’s home or inviting visitors to imagine environmental disturbances from the organism’s point of view, while modeling low-impact behaviors like gentle touch and careful movement across the shoreline [56]. These approaches are reinforced through multisensory engagement strategies and storytelling techniques that emphasize the agency and vulnerability of even less charismatic species, with program assessments indicating high levels of adoption among volunteers in field settings [56]. Collectively, this training reflects a deliberate pedagogical shift from information transmission toward affective engagement, with the goal of cultivating empathy as a mechanism for promoting pro-conservation attitudes and behaviors among beach visitors.

2.6. Summary and Hypotheses

Taken together, research on environmental interpretation, empathy, and human–animal relationships identifies an important, but understudied intersection. Environmental education research demonstrates the value of interpretive and place-based learning, while research on empathy suggests that affective and cognitive engagement with nonhuman animals can contribute to conservation-oriented attitudes and intentions. Yet, relatively little empirical work has examined these processes together in brief, informal coastal learning encounters, particularly when the animals encountered are species that may not possess the characteristics typically associated with human emotional engagement. This study addresses this gap by examining whether visitors who interact with empathy-trained beach naturalists (ETBNs) report different levels of affective and cognitive empathy toward intertidal animals compared to visitors who do not interact with ETBNs. We further examine whether the two groups differ in how they describe anticipated behavior during future beach visits. Because participation in ETBN interactions was not randomly assigned, the study evaluates associations between ETBN engagement and these outcomes rather than causal effects of the program.

H1. *Visitors who interact with an ETBN will report a stronger affective connection to coastal marine life compared to those who do not engage with an ETBN.*

H2. *Visitors who engage with an ETBN will report higher levels of perspective-taking, reflecting greater cognitive empathy toward marine organisms.*

H3. *Visitors who engage with an ETBN will be more likely to describe intentions to alter their future behavior on the beach in ways that are more attentive to protecting intertidal ecosystems.*

Together, these hypotheses position empathy as a potential outcome from shared interpretive encounters that integrate cognitive, affective, and social forms of learning in coastal environments.

3. Data and Methods

3.1. Selected Locations

Data were collected across three years (2023–2025), with the first year serving to pilot the survey design. Based on the pilot, the survey was shortened and some questions were refined for easier interpretation. During the three years, data were collected from three different public beaches: Olympic Sculpture Park Pocket Beach, Richmond Beach Saltwater Park, and Lincoln Park Beach, along the Puget Sound in Washington, US. The first beach, Olympic Sculpture Park Pocket Beach, is in downtown Seattle off the main pathway along the waterfront and part of a nine-acre park. The beach itself is only a few hundred feet of shoreline. The proximity of this beach to major Seattle tourist attractions means that it attracts lots of out-of-town and out-of-state or out-of-country visitors, including thousands of passengers from the nearby cruise terminal. It does not have any additional amenities, nor does it have a restroom. The second beach, Lincoln Park Beach, is in a neighborhood just south of downtown Seattle. It is part of a 135-acre park with 4.6 acres of shoreline. As a neighborhood beach, it attracts more locals and fewer tourists. This beach has restrooms, playgrounds, grill equipment and picnic tables, and hiking and biking trails. The third beach, Richmond Saltwater Park, is also a neighborhood beach offering picnic shelters, restrooms, a playground and hiking trails. It is part of a 42-acre park with 1300 feet of shoreline, the equivalent of about 3.6 American football fields. These beaches were selected based on their accessibility (e.g., free parking, accessible pathways, and proximity to public transportation), as well as their diversity in physical and ecological features and their distribution across a broad geographical area. Between 2023 and 2025, the program operated on nine to 11 beaches each year (2023: 11 beaches, 2024: 11 beaches, 2025: 9 beaches), during the summer months (May through July or August) and involved 890 staff and volunteers in 2023, 1137 in 2024, and 101 in 2025, with an overall average of four staff and volunteers at each beach program per day of operation. The reduction in naturalists in 2025 reflects updates to the aquarium's approach in program operation.

3.2. Survey Design and Distribution

We created a short, 19-question front and back paper survey. Survey items were adapted from previous measures of affective and cognitive empathy toward animals [18,57]. For the present study, items were modified to assess empathy toward intertidal animals that may be less likely to elicit immediate affective engagement, particularly animals without readily discernible eyes or faces [19]. This adaptation was intentional, rather than focusing primarily on charismatic animals for which emotional identification may occur relatively easily, the instrument was designed to assess whether visitors expressed affective and cognitive empathy toward less anthropomorphically familiar marine life. Each construct was measured using five survey items rated on a seven-point Likert scale ranging from strongly disagree to strongly agree. Two questions in each dimension were reverse coded.

Statements measuring affective empathy highlighted individual's ability to assess how animals might be feeling such as "I often wonder if these animals feel emotions." Cognitive empathy statements were designed to assess relative understanding of animal's abilities and processes, with statements like, "They can respond to things in their environment." The complete items for both constructs are presented in Table 1. The open-ended questions covered a highlight of the day, one thing learned, and if they thought the experience would impact future visits and how. We also collected whether the visitor had a conversation with

a beach naturalist and if they had attended a beach naturalist program in the past. The study used an observational between-group design. The primary comparison was between visitors who interacted with an ETBN during a low-tide event and visitors surveyed during comparable low-tide periods who did not interact with an ETBN. The non-ETBN group was included to provide a comparison for assessing whether empathy scores and anticipated future behaviors differed according to ETBN engagement. Participants were not randomly assigned to these conditions; consequently, the analyses assess group differences and associations rather than causal effects of ETBN interaction. Importantly, both ETBN and comparison-group data were collected during low-tide conditions. Restricting data collection to low-tide periods reduced the likelihood that observed group differences simply reflected differences in tidal accessibility or opportunities to observe exposed intertidal organisms. Nevertheless, other day-level environmental conditions were not experimentally controlled and remain a potential source of variation. Demographic information was not collected to minimize participant burden, preserve the informal and unobtrusive nature of data collection in a public beach setting, and encourage participation in the brief intercept survey.

Table 1. Survey items, means, and significance comparisons based on interaction with an Empathy-trained Beach Naturalist (ETBN) ($n = 263$).

Scales, Cronbach's Alphas and Survey Items	ETBN Mean	No ETBN Mean	Diff. in Means
Affective Empathy Scale (Cronbach's alpha 0.90)	5.31	4.23	1.08 ***
I often wonder if these animals feel emotions.	5.05	4.15	0.90 ***
I usually don't think these animals have feelings (rev).	5.43	4.56	0.87 ***
I try to imagine what it would be like to be one of these animals.	4.82	3.99	0.83 ***
I would not feel upset if I saw someone picking up and moving one of these animals (rev).	6.18	4.46	1.72 ***
I imagine what animals like this are feeling	5.07	4.01	1.06 ***
Cognitive Empathy Scale (Cronbach's alpha 0.84)	6.35	5.30	1.05 ***
These animals can recognize threats.	5.86	4.94	0.92 ***
I don't think picking up and moving one of these animals is harmful (rev).	6.48	4.71	1.77 ***
The lives of these animals are important.	6.64	5.96	0.68 ***
I don't think these animals are really animals (rev).	6.64	5.53	1.11 ***
These animals can respond to things in their environment	6.12	5.33	0.79 ***

$p < 0.001$ ***.

Data were collected on low-tide days with and without ETBNs present. On low-tide days with ETBNs present, ETBNs were instructed to give a green index card to people they had a conversation with and then instructed to inform the visitor that they could receive a \$5 gift card if they completed a survey about their experience. Visitors could self-select to approach a data collector on the beach and participate in the survey. Data collectors tried to approach and follow-up with visitors they saw get green cards to make sure they were aware of the location of data collectors given that two of the three beaches are expansive. If a person asserted that they were interested in the survey, but could not take it immediately due to timing, childcare duties, etc., they were offered a paper with a QR code. Of the 123 surveys from people who interacted with an ETBN, 21 (17.07%) came from responses to QR codes. Data collectors located themselves about ten feet from tidal pools for ease of visibility and accessibility. On days when ETBNs were not present, researchers monitored the beach for people who spent at least five minutes on the shore during low tide. These individuals were then approached to see if they would be willing to take a quick survey about their experience for a \$5 gift card. Data were collected across 19 days (spanning dates

in May through August) involving one to five data collectors at a chosen site for selected days. A total of 263 people completed the survey. Of these, 123 (46.77%) interacted with an ETBN on a beach and day when ETBNs were present. Prior to data collection, the study was reviewed by the Human Research Protections Program Institutional Review Board at the lead author's institution (protocol number WWU/U099/2023).

3.3. Methods

We began by constructing two unidimensional scales to capture affective and cognitive empathy, respectfully, using five survey items developed for each construct. Scale scores were calculated and assessed for internal consistency prior to analysis. We then compared mean levels of affective and cognitive empathy between respondents who interacted with an ETBN and those who did not. All quantitative analyses were conducted using Stata version 16.1 and R version 4.5.3. To complement the quantitative analysis, we conducted an inductive thematic analysis of responses to the open-ended question, "How, if at all, do you think this knowledge [or 'this experience' for participants without an ETBN interaction] will impact you on future visits to the beach?" Responses were initially reviewed to identify recurring patterns in how participants described anticipated future engagement with beach environments. Three researchers participated in an iterative coding process in which preliminary codes were developed, compared, refined, and organized into broader thematic categories. Four substantive themes emerged from this process: heightened awareness, animal-centered perspective shift, learning and sharing knowledge, and stewardship and protection. Responses that did not describe a substantive anticipated change were separately categorized as no perceived impact, nonspecific excitement about future visits, or nonspecific positive statements. Coding and data management were supported by ATLAS.ti 24. To address inter-coder reliability, disagreements among coders were reviewed and discussed until consensus was reached regarding the final coding assignment.

4. Results

4.1. Quantitative Results

To construct the unidimensional measure of affective empathy, the first five survey items were combined into a single scale. Internal consistency was assessed using Cronbach's alpha, indicating strong reliability (Cronbach's alpha = 0.90). In parallel, the five items designed to capture cognitive empathy were aggregated to form a unidimensional scale, with reliability analysis demonstrating good internal consistency (Cronbach's alpha = 0.84).

Using the two scales that were generated, independent-sample t-test were conducted to examine differences in affective and cognitive empathy between beach visitors who spoke with an ETBN on a low-tide day and those who did not. Results indicate that visitors who engaged with an ETBN reported significantly higher levels of affective empathy ($M = 5.31$, $SD = 1.31$, $n = 123$) compared to those who did not ($M = 4.23$, $SD = 1.69$, $n = 142$), $t(263) = 5.72$, $p < 0.001$. The mean difference was 1.08 (95% CI [0.71, 1.45]), with a medium-to-large effect size (Cohen's $d = 0.71$), indicating a substantially meaningful difference in affective empathy between the two groups. Similarly, an independent-samples t-test was conducted to assess differences in cognitive empathy between respondents who engaged with an ETBN and those who did not. Visitors who interacted with an ETBN also reported significantly higher cognitive empathy ($M = 6.35$, $SD = 0.58$, $n = 123$) than visitors who did not interact with an ETBN ($M = 5.30$, $SD = 1.19$, $n = 142$), $t(263) = 8.92$, $p < 0.001$. The mean difference was 1.05 (95% CI [0.82, 1.29]), with a large standardized difference between groups (Cohen's $d = 1.10$). Taken together, these results indicate that interaction with an ETBN during low-tide was associated with elevated levels of affective and cognitive empathy toward marine life. Although the scales are interesting, the individual items

provide some nuance to better understand how people are thinking about coastal marine life on low-tide days when they interact with ETBNs and when they do not.

Visitors who interacted with an ETBN reported significantly higher mean scores across all individual empathy items compared with visitors who did not interact with an ETBN. Differences in mean scores on individual affective empathy items ranged from 0.83 to 1.72, and 0.79 to 1.77 for cognitive empathy items. These numbers are not only significant, but they are conceptually meaningful. For example, on the low end with a 0.79 difference people who interacted with an ETBN and people who did not, people who interacted with an ETBN reported a 12 percent increase in their agreement with the statement that “these animals can respond to things in their environment.” On the higher end, with a 1.77 difference, equating to well over 1-point on a 7-point Likert scale, people who engaged with an ETBN reported a 25.28% increase in agreeing that “picking up and removing one of these animals is harmful” compared to those who did not engage with an ETBN. In Table 1, we not only provide the survey items, but we also report the means for independent survey items and Cronbach alphas for the scales. Collectively, these results provide support for hypotheses one and two. Visitors who interacted with an ETBN reported significantly stronger affective connections to coastal marine life compared to those who did not engage with an ETBN. Similarly, individuals who engaged with an ETBN were correlated with higher levels of perspective taking, indicating potentially greater cognitive empathy toward marine organisms.

4.2. Qualitative Results

To further assess the extent to which engagement with an ETBN shaped visitors anticipated future behaviors, we conducted an inductive thematic analysis of responses to the open-ended question, “How, if at all, do you think this experience will impact you on future visits to the beach?” The coding framework ensured that all responses were systematically categorized, allowing for a clearer comparison between participants who did and did not interact with an ETBN. Consistent with expectations, participants who engaged with a ETBN were more likely to describe specific and meaningful changes in how they would engage with coastal environments, particularly across four thematic domains: heightened awareness, animal-centered perspective shift, learning and sharing knowledge, and stewardship and protection. See Table 2. These qualitative findings provide additional insight to the quantitative results and offer support for the third hypothesis, which stated that visitors who engage with ETBNs will be more likely to articulate greater awareness and be willing to make pro-environmental modifications to future visits.

Table 2. Qualitative themes and associated percents identified from assessing answers to the question about impact on future visits.

	ETBN	No ETBN
Impactful Themes		
Heightened awareness	14.90%	8.30%
Animal-centered perspective shift	6.60%	2.39%
Stewardship and protection	23.10%	5.30%
Learning and sharing knowledge	14.19%	10.60%
No Impact or Non-specific		
No perceived impact	3.30%	22.70%
Non-specific Excitement about Future Visits	9.10%	21.20%
Non-specific Positive Statement	28.90%	29.60%

First, while heightened awareness emerged as a common theme across both groups, its prevalence differed in important ways. Visitors who did not interact with an ETBN

(8.30%) emphasized general attentiveness, such as “pay more attention” or “be more aware of what’s around me,” but typically lacked elaboration. In contrast, 14.90 percent of people who interacted with an ETBN, had awareness-oriented responses and these were more likely to be paired with additional interpretive or behavioral dimensions such as “I’ll look around more and not pick up things,” or “it will totally impact how I engage beaches in the future. I am more aware now of animals being everywhere and what I need to do and not do to protect them when visiting,” suggesting a shift from passive noticing to more engaged observation.

Second, participants who interacted with an ETBN were more likely to express an animal-centered perspective shift, a theme that while less frequent overall, was notably concentrated in this group (6.60% ETBN compared to 2.30% no ETBN). These responses reflected a reorientation in how visitors understood intertidal life, often emphasizing that organisms previously perceived as static, insignificant, or non-living were now recognized as living beings. For example, one respondent noted that learning “what I thought were plants are actually animals” changed how they viewed the shoreline, while another reflected that the beach now felt “more like a neighborhood” of living organisms. Such statements suggest that ETBN facilitated a reframing of the beach from a recreational setting to a dynamic ecological community.

Third, visitors who interacted with an ETBN were more likely to reference learning and sharing knowledge in response to the open-ended question (14.10% ETBN compared to 10.60% no ETBN). These respondents frequently pointed to concrete forms of learning, such as being able to “identify a sea cucumber” or better understand “where to look and what I’m seeing,” and, in some cases, extended this knowledge outward by noting intentions to “teach others about the importance of not harming sea life” or “point things out to my kids.” In contrast, while beach visitors who did not interact with an ETBN occasionally referenced learning, these responses were less specific and rarely linked to sharing information with others.

Most notably, engagement with an ETBN was associated with greater stewardship and protective behavioral intentions for the future (23.10% ETBN compared to 5.30% no ETBN). This theme accounted for a substantially larger share of responses among participants who interacted with an ETBN compared to those who did not. Respondents described concrete, actionable changes in behavior, including “being more mindful of where I step,” “not picking up animals,” and “leaving rocks where they are.” These statements indicate not only greater reported awareness, but also more specific intentions to translate knowledge into future practice. In contrast, stewardship-oriented responses were less frequent and less detailed among those who did not engage with an ETBN.

Other marginal, but important themes emerged. For instance, people who engaged with an ETBN were more specific in their statements about future visits and behavior change, whereas 21.20% of people who did not encounter a beach naturalist simply wrote statements like “I think I’ll come again,” or “I’ll be back” with no substantive connection to conservation or changes to future behavior (9.10% ETBN compared to 21.20% no ETBN). Additionally, about 30 percent of both groups simply referred to the experience as generally “fun” or “enjoyable” with no specifics (28.90% ETBN compared to 29.60% no ETBN). Finally, visitors who did not interact with an ETBN were more likely to say that the experience would not influence future experiences (22.70% no ETBN compared to 3.30% ETBN engagement).

Taken together, these findings provide qualitative support for the third hypothesis by demonstrating that interactions with ETBNs are associated with more substantive and actionable anticipated changes in behavior. In particular, the increased prevalence of stewardship-oriented responses and perspective shifts suggests that these interactions move

visitors beyond general awareness toward more deliberate, informed, and ecologically attentive engagement with intertidal coastal environments.

5. Discussion and Conclusions

This study examined whether engagement with an empathy-trained beach naturalist (ETBN) was associated with higher levels of affective and cognitive empathy toward intertidal animals and greater willingness to adopt shoreline-protective behaviors during future visits to the beach. Across both quantitative and qualitative analyses, the findings consistently indicate that interactions with ETBNs are associated with meaningful differences in how visitors perceive and engage with intertidal ecosystems. Visitors who spoke with a naturalist reported significantly higher levels of both affective and cognitive empathy, and were more likely to describe specific, actionable intentions to modify their behavior in ways that reduce harm to coastal environments.

The magnitude of these differences is noteworthy. The standardized difference between ETBN and non-ETBN visitors was medium to large for affective empathy (Cohen's $d = 0.71$) and large for cognitive empathy (Cohen's $d = 1.10$), suggesting that the observed differences were substantially meaningful rather than simply statistically significant. The larger standardized difference for cognitive empathy may reflect both the characteristics of the measures and the content of brief naturalist encounters. Although Cohen's d was greater for cognitive than affective empathy, the raw mean differences were nearly identical (1.05 and 1.08 points, respectively); lower variability in cognitive scores contributed to the larger standardized difference.

This pattern therefore does not establish that cognitive empathy increased more than affective empathy. Several cognitive items concern recognizing intertidal organisms as animals, understanding their responsiveness to environmental conditions, and identifying harm associated with handling, all of which naturalists can address through explanation and shared observation. Imagining these organisms' emotional experiences may be less immediately accessible, particularly when their expressions and behaviors are unfamiliar to visitors. Smith and colleagues [17] similarly identify difficulties in interpreting distress in wildlife whose nonverbal cues differ from those familiar to humans. However, ecological understanding and emotional engagement may reinforce one another. Schultz [46] found that animal perspective-taking increased biospheric concern, and Berenguer [38] linked induced empathy toward a bird or tree with stronger environmental attitudes and behaviors. Raymond and colleagues [16] also found distinct conservation-related associations for cognitive and affective empathy, although their human-directed measures differ from those used here. Together, this research supports integrating cognitive and affective approaches to interpretation. These results provide support for all three hypotheses and suggest that empathy-oriented interpretive programming can play a measurable role in shaping both attitudes and behavioral intentions in informal coastal learning settings and with less charismatic animals.

The qualitative findings are particularly informative in clarifying how these shifts occur. While many visitors expressed some degree of increased awareness, those who did not interact with an ETBN were more likely to remain at a generic level of attentiveness (e.g., "pay more attention" or "be more aware"). In contrast, visitors who engaged with ETBNs more frequently articulated a progression from awareness to interpretation and action. This included recognizing marine organisms as living beings with ecological significance, as well as identifying specific behaviors to minimize harm, such as avoiding stepping on organisms or disturbing habitat features. These patterns align with prior research suggesting that environmental education is most effective when it integrates cognitive and affective dimensions, rather than relying on information transmission alone [10,30]. The

presence of perspective shifts in the ETBN group also supports arguments that relational and empathetic engagement can deepen how individuals understand nonhuman life, making conservation concerns more personally meaningful [46,47].

An important contribution of these findings concerns the kinds of animals toward which empathy may be cultivated. Much research on human–animal connection focuses on animals possessing characteristics that readily facilitate identification, including recognizable faces, eyes, expressive behaviors, or other features commonly associated with charisma. The present findings extend this conversation by demonstrating that higher affective and cognitive empathy associated with interpretive engagement is also evident in a context populated by less charismatic intertidal organisms. This suggests that empathy-oriented interpretation may be particularly valuable when visitors encounter animals for which emotional connection is not immediately facilitated by familiar morphological or behavior cues. Rather than charisma functioning as a prerequisite for empathetic engagement, relational framing and perspective-taking may provide alternative pathways through which unfamiliar or easily overlooked animals become morally and ecologically salient to visitors.

From a practical standpoint, these findings suggest that beach naturalist programs, particularly those that intentionally incorporate empathy-based approaches, can serve as effective, low-cost interventions for promoting pro-environmental attitudes and behaviors in highly trafficked coastal spaces. Given that over 3 billion people visit beaches annually just in the US [7], even modest shifts in behavior, such as increased care when walking through tide pools or reduced handling of organisms, could have meaningful cumulative effects on shoreline ecosystems. These findings also highlight the importance of how information is delivered. As previous work has shown, the ability of naturalists to engage visitors through dialogue, storytelling, and relational framing is central to program effectiveness [32,33,52]. In this sense, ETBNs function not only as educators, but as social catalysts who help translate abstract ecological knowledge into embodied, place-based practices.

Despite these promising findings, several limitations warrant attention. First, the study relies on self-reported data, including Likert-scale measures of empathy and stated behavioral intentions. Although such measures are common in environmental education research, they do not necessarily correspond to observed behavior. Future studies should incorporate behavior observations or longitudinal designs to assess whether reported intentions persist and translate into practice. Second, the sample is limited to beaches along the Puget Sound, which may restrict the generalizability of the findings to coastal context with different ecological, cultural, or institutional conditions. Third, interaction with ETBNs was not randomly assigned, introducing the possibility of self-selection bias. Visitors who chose to engage may have already held stronger baseline interest in marine life or conservation. The use of a five-dollar incentive may also have influenced decisions to complete the survey. Although the same incentive was offered across study conditions, individuals willing to complete an incentivized survey may differ from the broader population of beach visitors in ways not captured by the study. Additionally, the absence of sociodemographic information limited our ability to account for potential confounding factors, such as age, education, and socioeconomic status, that may be associated with both participation in naturalist interactions and reported empathy. As a result, we cannot determine the extent to which these characteristics contributed to the observed differences between groups. Future research should incorporate sociodemographic measures and more systematic recruitment procedures to better account for potential selection bias and assess whether these associations persist after adjusting for relevant participant characteristics.

Because the survey did not measure baseline empathy prior to the beach experience and participants were not randomly assigned to ETBN interaction, we cannot determine

whether the observed differences resulted from ETBN engagement or reflected preexisting differences between visitors who did and did not interact with naturalists. The findings should therefore be interpreted as associations rather than estimates of program effects. Future research employing pre/post measures, random assignment where feasible, or quasi-experimental design would provide stronger tests of whether empathy-oriented interpretation produces changes in empathy.

A further limitation of this study is the absence of a direct comparison with beach naturalist programs that do not employ an empathy-oriented interpretive approach. Although we attempted to address this gap during the first year of data collection through a pilot design, asking a subset of ETBNs to refrain from using empathy-based language while others continued as usual, this approach proved difficult to implement in practice. Empathy-oriented communication appeared to be deeply embedded in both the training and delivery of the program, making it challenging for ETBNs to suspend this technique. As a result, the comparison lacked consistency and was ultimately not suitable for systematic analysis. Future research should build on these findings by examining how empathy-based interpretive strategies function across different populations and settings, particularly in more diverse or underrepresented communities. Additional work is also needed to better understand how empathy interacts with other factors, such as prior environmental knowledge, social norms, values, and structural constraints, shaping behavior [58], expanding research on informal environmental education in coastal settings remains critical, as these sites can represent key points of accessible contact between humans and vulnerable ecosystems.

In conclusion, this study provides evidence that interaction with empathy-trained beach naturalists (ETBNs) is associated with higher affective and cognitive empathy toward intertidal animals and with more specific conservation-orientation intentions for future beach visits. Importantly, these patterns emerged in a setting where many of the animals encountered lack the facial features, expressive behaviors, and other characteristics that commonly facilitate human emotional identification with wildlife. The findings therefore extend research on empathy and environmental interpretation by suggesting that relational and perspective-taking approaches may provide pathways for engaging visitors with less charismatic and easily overlooked forms of nonhuman life. Although the observational design does not permit causal conclusions, the consistency of the quantitative and qualitative patterns provides a foundation for experimental and longitudinal research testing whether empathy-oriented interpretation can produce lasting changes in how visitors perceive and interact with intertidal animals. More broadly, the study highlights the potential value of designing conservation education for less charismatic animals beyond presenting interpretive biological facts and inclusive of relational connections and shared experiences.

Author Contributions: Conceptualization, C.T.W., S.B., K.B. and D.L.; methodology, C.T.W., S.B. and C.H.; software, C.T.W.; validation, C.T.W., C.H., A.B., A.L., I.T., K.C. and S.V.; formal analysis, C.T.W. and C.H.; resources, C.T.W., S.B. and D.L.; data curation, C.T.W., S.B., D.L. and K.B.; writing—original draft preparation, All participated; writing—review and editing, All participated; supervision, C.T.W., S.B. and D.L.; project administration, C.T.W., S.B. and D.L.; funding acquisition, C.T.W., S.B. and D.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by a National Science Foundation (NSF) Early CAREER grant, grant number 2240023, and support from the Seattle Aquarium.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Human Research Protections Program/Institutional Review Board of Western Washington University (protocol code WWU099/2023 approved 29 June 2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Contact the lead author for data and coding used for this study.

Acknowledgments: The authors would like to thank the beach naturalist who assisted with this study and the undergraduate students who entered survey data.

Conflicts of Interest: Staff members from the Seattle Aquarium were involved in assisting with study design, data collection, and manuscript drafting and editing. Direct funders were not involved in any part of the study.

References

1. Thyrring, J.; Peck, L.S. Global Gradients in Intertidal Species Richness and Functional Groups. *eLife* **2021**, *10*, e64541. [\[CrossRef\]](#)
2. Balke, T.; Vovides, A.G.; Ladd, C.J.; Huxham, M. The Coastal Conservation Narrative Is Shifting from Crisis to Ecosystem Services. *Mar. Biodivers.* **2023**, *53*, 3. [\[CrossRef\]](#)
3. Rodrigues-Filho, J.L.; Macêdo, R.L.; Sarmiento, H.; Pimenta, V.R.; Alonso, C.; Teixeira, C.R.; Pagliosa, P.R.; Netto, S.A.; Santos, N.C.; Daura-Jorge, F.G. From Ecological Functions to Ecosystem Services: Linking Coastal Lagoons Biodiversity with Human Well-Being. *Hydrobiologia* **2023**, *850*, 2611–2653. [\[CrossRef\]](#)
4. Gotama, R.; Baker, D.M.; Guibert, I.; McIlroy, S.E.; Russell, B.D. How a Coastal Megacity Affects Marine Biodiversity and Ecosystem Function: Impacts of Reduced Water Quality and Other Anthropogenic Stressors. *Ecol. Indic.* **2024**, *160*, 111683. [\[CrossRef\]](#)
5. Herbert-Read, J.E.; Thornton, A.; Amon, D.J.; Birchenough, S.N.; Côté, I.M.; Dias, M.P.; Godley, B.J.; Keith, S.A.; McKinley, E.; Peck, L.S. A Global Horizon Scan of Issues Impacting Marine and Coastal Biodiversity Conservation. *Nat. Ecol. Evol.* **2022**, *6*, 1262–1270. [\[CrossRef\]](#)
6. Jefferson, R.; McKinley, E.; Griffin, H.; Nimmo, A.; Fletcher, S. Public Perceptions of the Ocean: Lessons for Marine Conservation from a Global Research Review. *Front. Mar. Sci.* **2021**, *8*, 711245. [\[CrossRef\]](#)
7. Houston, J.R. The Economic Value of America's Beaches. *Shore Beach* **2024**, *92*, 33–43. [\[CrossRef\]](#)
8. Brunelli, M. From Nature Guiding to Nature Interpretation in the United States (1872–1920): The Origins of the Professional Practice of Heritage Interpretation: Between Protection and Education. *Hist. Educ. Child. Lit. HECL VIII 1* **2013**, *2013*, 399–428.
9. Fletcher, S.; Potts, J.S.; Heeps, C.; Pike, K. Public Awareness of Marine Environmental Issues in the UK. *Mar. Policy* **2009**, *33*, 370–375. [\[CrossRef\]](#)
10. Ballantyne, R.; Packer, J. Promoting Environmentally Sustainable Attitudes and Behaviour through Free-choice Learning Experiences: What Is the State of the Game? *Environ. Educ. Res.* **2005**, *11*, 281–295. [\[CrossRef\]](#)
11. Falk, J.; Dierking, L.D. *Lessons Without Limit: How Free-Choice Learning Is Transforming Education*; Bloomsbury Publishing PLC: London, UK, 2002.
12. Hsu, C.-H. Outdoor Environmental Education as a Nature-Based Solution for “Education” and “Environment”: A New Conceptual Framework and Its Pilot Application in a Coastal Community Case Study in Taiwan. *J. Coast. Conserv.* **2025**, *29*, 13. [\[CrossRef\]](#)
13. Hsu, C.-H.; Kang, J.; Yeh, L.-Y.; Chai, L.; Kao, W.-C.; Chen, C.-P.; Hsieh, H.-L.; Lin, H.-J. Evaluating a Community-Based Citizen Science Project: Attitude as a Key Mediator of Behavior Intention Toward Biodiversity Conservation. *Conservation* **2025**, *5*, 17. [\[CrossRef\]](#)
14. Barbaccia, E.; Rodriguez, L.K.; Ovide, B.G.; Gabualdi, M.; Villa, E.; Jahoda, M.; Lanfredi, C.; Rasmussen, M.H.; Traugott, M.; Thalinger, B. Willingness to Engage in Marine Conservation through eDNA-Informed Citizen Science on Whale-Watching Platforms. *Sci. Rep.* **2025**, *15*, 41983. [\[CrossRef\]](#)
15. Mauro, C. Accessible Marine Science: Authentic Lessons and Real-World Stewardship at the Navarre Beach Marine Science Station. *Curr. J. Mar. Educ.* **2025**, *40*, 49–62. [\[CrossRef\]](#)
16. Raymond, C.M.; Eriksson, M.; Korpilo, S.; Carruthers-Jones, J. The Effect of Empathy with Nature and Humans on Conservation Behaviour. *J. Environ. Psychol.* **2025**, *106*, 102710. [\[CrossRef\]](#)
17. Smith, P.; Mann, J.; Marsh, A. Empathy for Wildlife: The Importance of the Individual. *Ambio* **2024**, *53*, 1269–1280. [\[CrossRef\]](#)
18. Whitley, C.T.; Kalof, L.; Urquhart, L.; Tatem, N.; Mair, M.; Ankoudinova, K.; Haight, I.; Meglathery, E.; Worden, M.; Wilkinson, D. Photo Portraiture Enhances Empathy for Birds with Potential Benefits for Conservation and Sustainability. *Sustainability* **2025**, *17*, 8833. [\[CrossRef\]](#)
19. Barrailler, K.; Whitley, C.T.; Brenkert, S.; Jackson, M.; Killebrew, N.; Larson, D. Going with the Flow: Assessing How Zoos and Aquariums Communicate Information About Marine Animals Without Faces (MAWFs). *J. Zool. Bot. Gard.* **2025**, *6*, 33. [\[CrossRef\]](#)
20. Fennell, D.A. Empathy in Animal-Based Tourism Contrasting Constructed Care and Care Ethics at a Captive Wildlife Venue. *Tour. Recreat. Res.* **2024**, *49*, 1222–1237. [\[CrossRef\]](#)

21. Joy, J.J. Exploration of Empathy Integration in Zoological Interpretive Programming at Northwest Trek Wildlife Park. Master's Thesis, Oregon State University, Corvallis, OR, USA, May 2024.
22. Miller, D.N. *Connections of Caring: A Study of Seattle Aquarium Volunteer Beach Naturalists*; Stephen, F., Ed.; Austin State University: Nacogdoches, TX, USA, 2010.
23. Sherman, W.C.; Terry, A.J.; Bowers, A.W. Identifying Indicators, Empathy, and Anthropomorphism in Zoo Visitors' Perceptions of Animal Wellbeing through Qualitative Interviews. *Curator Mus. J.* **2025**, *68*, 141–161. [[CrossRef](#)]
24. Merenlender, A.M.; Crall, A.W.; Drill, S.; Prysby, M.; Ballard, H. Evaluating Environmental Education, Citizen Science, and Stewardship through Naturalist Programs. *Conserv. Biol.* **2016**, *30*, 1255–1265. [[CrossRef](#)]
25. Wilson, E.O. *Naturalist*; Island Press: Princeton, NJ, USA, 2006.
26. Montero Sobrevilla, I. Indigenous Naturalists. In *Worlds of Natural History*; Curry, H.A., Jardine, N., Secord, J.A., Spary, E.G., Eds.; Cambridge University Press & Assessment: Cambridge, UK, 2019; pp. 112–130.
27. Asokan, A. Marine Protected Areas as a Tool for Environmental Justice. *Front. Mar. Sci.* **2024**, *11*, 1478023. [[CrossRef](#)]
28. Kuersteiner, R.L.; Herbach, E.G. In Pursuit of Clean Oceans-A Review of the Marine Protection, Research, and Sanctuaries Act. *St. Clara Law Rev.* **1978**, *18*, 157.
29. Skibins, J.C.; Powell, R.B.; Stern, M.J. Exploring Empirical Support for Interpretation's Best Practices. *J. Interpret. Res.* **2012**, *17*, 25–44. [[CrossRef](#)]
30. Ardoin, N.M.; Bowers, A.W.; Gaillard, E. Environmental Education Outcomes for Conservation: A Systematic Review. *Biol. Conserv.* **2020**, *241*, 108224. [[CrossRef](#)]
31. Kudryavtsev, A.; Stedman, R.C.; Krasny, M.E. Sense of Place in Environmental Education. *Environ. Educ. Res.* **2012**, *18*, 229–250. [[CrossRef](#)]
32. Ben-Ari, E.T. Speaking for Nature: Nature Interpreters Foster Connections between People and the Natural World. *BioScience* **2000**, *50*, 556–562.
33. Powell, R.B.; Ham, S.H. Can Ecotourism Interpretation Really Lead to Pro-Conservation Knowledge, Attitudes and Behaviour? Evidence from the Galapagos Islands. *J. Sustain. Tour.* **2008**, *16*, 467–489. [[CrossRef](#)]
34. Karlsson, F. Critical Anthropomorphism and Animal Ethics. *J. Agric. Environ. Ethics* **2012**, *25*, 707–720. [[CrossRef](#)]
35. Kennedy, J.S. *The New Anthropomorphism*; Cambridge University Press: Cambridge, UK, 1992.
36. Burghardt, G.M. Cognitive Ethology and Critical Anthropomorphism: A Snake with Two Heads and Hognose Snakes That Play Dead. In *Cognitive Ethology*; Psychology Press: East Sussex, UK, 2014; pp. 53–90.
37. Morgan, C.L. *An Introduction to Comparative Psychology*; Walter Scott: London, UK, 1903; Volume 27.
38. Berenguer, J. The Effect of Empathy in Proenvironmental Attitudes and Behaviors. *Environ. Behav.* **2007**, *39*, 269–283. [[CrossRef](#)]
39. Tam, K.-P.; Lee, S.-L.; Chao, M.M. Saving Mr. Nature: Anthropomorphism Enhances Connectedness to and Protectiveness toward Nature. *J. Exp. Soc. Psychol.* **2013**, *49*, 514–521. [[CrossRef](#)]
40. Whitley, C.T. A Picture Is Worth a Thousand Words: Applying Image-Based Learning to Course Design. *Teach. Sociol.* **2013**, *41*, 188–198.
41. Cajete, G. Introduction (From Native Science: Natural Laws of Interdependence). In *Social Theories for the Anthropocene*; Routledge: London, UK, 2025; pp. 99–101.
42. Kimmerer, R.W. *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*; Milkweed Editions: Minneapolis, MN, USA, 2013.
43. Bang, M.; Warren, B.; Rosebery, A.S.; Medin, D. Desettling Expectations in Science Education. *Hum. Dev.* **2013**, *55*, 302–318. [[CrossRef](#)]
44. Zhu, J. The Emotion Toward the Ocean-Designing for Visitors' Empathic Experience in SEALIFE Helsinki Aquarium. Master's Thesis, Aalto University, Espoo, Finland, 2020.
45. Zeppel, H. Education and Conservation Benefits of Marine Wildlife Tours: Developing Free-Choice Learning Experiences. *J. Environ. Educ.* **2008**, *39*, 3–18. [[CrossRef](#)]
46. Schultz, P.W. New Environmental Theories: Empathizing with Nature: The Effects of Perspective Taking on Concern for Environmental Issues. *J. Soc. Issues* **2000**, *56*, 391–406. [[CrossRef](#)]
47. Chawla, L. Growing up Green: Becoming an Agent of Care for the Natural World. *J. Dev. Process.* **2009**, *4*, 6–23.
48. Kalof, L.; Whitley, C.T.; Dietz, T. *Essential Concepts of Animals in Sustainability: An AZ Guide*; Routledge: London, UK, 2026.
49. Kals, E.; Schumacher, D.; Montada, L. Emotional Affinity toward Nature as a Motivational Basis to Protect Nature. *Environ. Behav.* **1999**, *31*, 178–202. [[CrossRef](#)]
50. Lassiter, U.I. *In This Nature: Culture, Place, and Attitudes toward Marine Animals*; University of Southern California: Los Angeles, CA, USA, 2000.
51. Decety, J.; Cowell, J.M. Empathy, Justice, and Moral Behavior. *AJOB Neurosci.* **2015**, *6*, 3–14. [[CrossRef](#)]
52. Blythe, J.; Baird, J.; Bennett, N.; Dale, G.; Nash, K.L.; Pickering, G.; Wabnitz, C.C. Fostering Ocean Empathy through Future Scenarios. *People Nat.* **2021**, *3*, 1284–1296. [[CrossRef](#)]

53. Department of Ecology State of Washington Looking Back and Looking Forward on Our Beach Monitoring Season. Available online: <https://ecology.wa.gov/blog/april-2024/looking-back-and-looking-forward-results-from-the-2023-beach-season-and-proposed-beaches-for-the-20#:~:text=Puget%20Sound%20is%20home%20to%20almost%204.2,popular%20beaches%20across%20Puget%20Sound%20every%20summer> (accessed on 10 March 2026).
54. Seattle Aquarium Beach Naturalist. Available online: <https://www.seattleaquarium.org/explore-the-aquarium/programs/beach-naturalist/> (accessed on 1 March 2026).
55. Washington State Association of Counties King County. Available online: <https://wsac.org/county-spotlights/county-spotlighting/#:~:text=The%20most%20populous%20county%20in%20the%20state,,health%20services,%20leisure,%20hospitality,%20manufacturing,%20and%20education> (accessed on 20 March 2026).
56. Seattle Aquarium Empathy at the Beach. Available online: https://www.seattleaquarium.org/about-us/fostering-empathy-for-wildlife/empathy-cafe/empathy-at-the-beach/?utm_source=chatgpt.com (accessed on 12 March 2026).
57. Whitley, C.T.; Barrailier, K.; Jackson, M.; Bamberger, T.; Burnet, M. Empathy Toward Animals: Documenting Measurement Instruments Used in Research and Practice. *J. Zool. Bot. Gard.* **2026**, *7*, 22. [CrossRef]
58. Kollmuss, A.; Agyeman, J. Mind the Gap: Why Do People Act Environmentally and What Are the Barriers to pro-Environmental Behavior? *Environ. Educ. Res.* **2002**, *8*, 239–260. [CrossRef]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.