Assessing Knowledge, Attitudes, and Behavior Toward Charismatic Megafauna: The Case of Dolphins

Erin C. Barney, Joel J. Mintzes, and Chiung-Fen Yen

ABSTRACT: Using concept maps, a Kellert-type (S. R. Kellert, 1985) inventory, and self-report behavioral items, this cross-age study assessed public knowledge, attitudes, and behaviors toward bottlenose dolphins. Results suggest that this important megafaunal species is poorly understood by the public at large, and that negative "utilitarian" attitudes and potentially harmful behaviors are widespread, except among well-educated college students who have benefited by direct instruction. Researchers are encouraged to undertake companion studies on other species.

KEY WORDS: assessment, attitudes, behavior, dolphins, knowledge

Environmental educators and advocates of all stripes have long recognized the value of particularly appealing animal (and plant) species as a mechanism for capturing the imagination and directing public attention toward conservation and preservation of the natural environment. Popular board games, Web sites, newspaper and magazine articles, television shows, films, and even food products (Feldhamer, Whittaker, Monty, & Weickert, 2002) all feature a variety of these "charismatic megafauna." Examples of common species include the bald eagle, giant panda, red wolf, blue whale, eastern grey kangaroo, and the koala. Many of these species are indeed threatened or endangered, whereas others serve the useful purpose of focusing concern and awareness on otherwise less visible but more subtle and far-reaching problems of ecosystem degradation. Informal education programs at many zoos, aquaria, museums, nature centers, botanic gardens and arboreta, national and state parks, and ecotourist attractions feature these organisms, yet very little research has been done to assess these programs or to examine their effects on public knowledge, attitudes, and behavior. This study sought to provide a baseline of information on one species of charismatic megafauna, the bottlenose dolphin, which is the subject of widespread public interest and concern,

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and more recently the center of controversial ecotourist attractions and federal legislative protection efforts. We hope the current study serves as a model and encourages others to begin similar, companion efforts on a diverse range of well-known species (Dimopoulos & Pantis, 2003).

The bottlenose dolphin (Tursiops truncatus) is a cosmopolitan species of marine mammals that is found in every ocean and in many inlets, bays, harbors, estuaries, lagoons, and rivers around the world. Two morphological ecotypes are recognized in the adult: the inshore or coastal type, which apparently migrates seasonally in response to changes in ocean temperature, and the offshore residential type. The home ranges and movement of bottlenose dolphins have been studied through tagging, photoidentification, radio, and satellite telemetry methods. Although dolphins are the most studied cetacean species, much about their natural history and behavior remains unknown. In general, dolphins are opportunistic foragers that feed on a wide variety of fish and invertebrates, and in so doing often become victims of the commercial fishing industry. Recent studies (Waring et al., 1997) suggest that over 20% of U.S. East Coast dolphins show indication of entanglement, net marks, and missing appendages, which are signs of fishing-related incidents. Other studies (Frohoff, 1996; Frohoff & Packard, 1995) reveal a wide range of potentially damaging human–dolphin interactions, interfering with their normal migratory and foraging patterns (i.e., feeding, petting, and boating) that reduce the animals' natural self-protective instincts and increase their aggressive behavior. Only recently have environmental educators (Orams & Hill, 1998) begun studying the effects of programs designed to modify these harmful human–animal interactions.

Knowledge, Attitudes, and Behavior in Environmental Education (EE)

To conservation and environmental educators, affective and behavioral outcomes are often considered as important as cognitive goals (Leeming, Dwyer, & Bracken, 1995). Typically, formal and informal environmental education (EE) programs seek to encourage attitudes and behaviors that are "environmentally responsible," with a view toward conserving natural resources and preserving and protecting the diversity of life forms in a variety of habitats, especially among those species considered endangered or threatened by human activity. Accordingly, the best programs in EE ultimately focus on the wise use of air, water, land, and energy resources, preservation of plants and animals, waste management, and the humane and thoughtful stewardship of the global environmental economy.

A carefully crafted meta-analysis of 128 studies (Hines, Hungerford, & Tomera, 1986/1987) and, subsequently, a strong theoretical synthesis (Kollmuss & Agyeman, 2002) identified a small set of variables that have been shown to correlate repeatedly with proenvironmental behavior. The most powerful of these factors include verbal commitment, locus of control, attitude, personal responsibility, and knowledge, with decreasing correlation coefficients ranging from .49 to .30, respectively. These findings suggest a complex web of interrelated factors that directly and indirectly influence an individual's commitment to proenvironmental action and wise stewardship in the preservation of species diversity. Although personality factors play a role in this commitment, knowledge and attitude appear to be very strong components. Similar findings have been reported by Hungerford and Volk (1990); Hwang, Kim, and Jeng (2000); and Volk and McBeth (1998).

The current study is a follow-up to the Thompson and Mintzes (2002) study that examined relationships between knowledge and attitudes about the marine environment, with emphasis on animal species (i.e., sharks) that have been found at risk of depletion by human activity. In that study, a series of simple, multiple, and canonical correlations showed moderately strong relationships between knowledge structure variables, as revealed in concept maps (Novak & Gowin, 1984), and affective

TABLE 1. Kellert's Attitudinal Dimensions Toward Wildlife and the Environment

Attitude dimension	Description
Aesthetic	Interest in the artistic and symbolic characteristics of animals
Dominionistic	Interest in the mastery and control of animals, as in sporting or other competitive contexts
Ecologistic	Concern for the environment as a system and for interrelationships of wildlife species and the environment
Humanistic	Interest and strong affection for animals, with strong emotional attachment and "love" for them
Moralistic	Concern for the right and wrong treatment of animals, with strong opposition to exploitation or cruelty toward animals
Naturalistic	Interest in direct experience with animals and exploration of nature
Negativistic	Orientation toward an active avoidance of animals as a result of dislike or fear
Neutralistic	Orientation toward a passive avoidance of animals as a result of indifference
Scientific	Interest in the physical attributes and biological functioning of animals
Utilitarian	Concern for the practical and material value of animals; their body parts or habitats, or both

dimensions, as revealed in Kellert's (1996) attitudinal scales (Table 1). The present study furthers the analysis of these important relationships, and extends this analysis into the behavioral domain.

The target of our current attention is public understanding, attitudes, and behaviors concerning dolphins. We have chosen to focus on dolphins for several reasons: (a) because of their emotional appeal: "campaigns to protect big mammals—aptly named 'charismatic megafauna'—enjoy much broader public support than more abstract issues such as climate change" and other environmentally important questions, as suggested by Kollmuss and Agyeman (2002); (b) because efforts to improve the lot of marine mammals depend largely on changing behavior patterns of individual citizens, in comparison to other environmental problems that depend on "powerful others" (i.e., well-funded government agencies, nonprofit organizations, corporations) for their solutions; and (c) the desperate plight of marine mammals is a world-wide phenomenon rather than a local issue, and consequently potential solutions to the problem have wide international applicability and appeal.

Protecting Marine Mammals: Legislation and EE

In contrast to sharks, which generate strongly negative, utilitarian, and moralistic public attitudes, bottlenose dolphins and other marine mammals often elicit positive, aesthetic, and humanistic views (Kellert, 1999). Much of this can be traced to the mass media, especially to television, films, and popular articles in magazines and newspapers. Paradoxically, marine biologists have suggested that these seemingly benign attitudes encourage human–animal interactions that are often profoundly injurious to dolphins. "Loving nature to death" is a phenomenon common to many of these coastal species

(Shackley, 1990), and the problem is compounded by captive dolphin programs that encourage tourists to swim with and feed the animals; some even make the unlikely (and unsubstantiated) claim that the experience is therapeutically beneficial (Cochrane & Callen, 1992). In 1972, the U.S. Congress (and subsequently other legislative bodies around the world) enacted a Marine Mammal Protection Act (MMPA), which sought to regulate the humane treatment of captive animals and harassment of marine mammals in the wild. The 1994 amendments to MMPA and its reauthorization in 2002 define harassment as "any act of pursuit, torment or annoyance which has the potential to injure. . .or disturb a marine mammal in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding or sheltering." Similar legislation in New Zealand and several Australian states has been enacted.

The number of educational programs at aquaria and marine stations is growing. The Dolphin Education Centre, developed at Tangalooma, Moreton Island in eastern Australia (Orams & Hill, 1998), is one exemplary EE program that focuses on reducing the frequency of inappropriate or deliberate touching and petting of captive animals. The Dolphin Education Centre offers visitors library resources, posters, displays, and a small video theater. These resources are supplemented by group briefing sessions and a public address system, which enable staff to speak directly to visitors as they engage in approved feeding sessions. A careful assessment of the program revealed that it has significantly reduced deliberate touching and other behaviors during visits by ecotourists. An in-depth analysis of public understanding, attitudes, and behaviors will provide a baseline of knowledge required to further develop and enhance these and other programs.

Problem

The current study, with respect to dolphins, explores conceptual understanding, attitudes, and behaviors of American elementary, secondary, and college-age students. Specifically, we examined (a) the effects of educational level on knowledge (structure and content), attitude, and harassment behavior; and (b) the effects of knowledge structure and attitude on harassment behavior.

Method

Participants

This study elicited responses of a convenience sample composed of 289 (N = 289) participants enrolled in public schools and a state-supported, public university located in southeastern North Carolina. This region of coastal North Carolina is home to many inshore migrating dolphins; tourism is a major industry, and fishing, boating, and swimming are common pastimes. All participants received course credit for participation in the study. Participants represented the following educational levels:

- Upper elementary school (n = 37), Grade 5 (M = 10 years);
- Junior high school (n = 42), Grade 8 (M = 13 years);
- Senior high school (n = 99), Grade 11 (M = 16 years);
- First-year university (n = 44), students enrolled in general psychology (M = 18–19 years);
- Third-year university (n = 42), students enrolled in marine biology (M = 20–21 years); and
- Graduate (n = 25), students enrolled in the MS program in marine biology (M = 24–25 years).

Third-year university students enrolled in the marine biology course received a 1-hr and 15 min lecture on marine mammals 1 month prior to this study. Remaining participants received no formal

instruction on relevant topics during the time period of this study. Mean combined (verbal and mathematics) SAT scores of students at the university are approximately 1150 (out of a possible 1600).

Concept Maps

Concept maps are two-dimensional, hierarchical, node-link diagrams that depict the most important concepts and relationships within a knowledge domain (Novak, 1998; Novak & Gowin, 1984). For almost 30 years, teachers and educational researchers have used concept maps to assess and evaluate the structural complexity and content validity of students' knowledge frameworks within the natural sciences. Studies in diverse educational settings have revealed that the reliability and validity of concept maps are comparable to the best testing and measurement devices currently available (Shavelson & Ruiz-Primo, 2000). More importantly, concept maps have been shown to be a practical and readily accessible tool that enables teachers to tap into dimensions of conceptual understanding and meaningful learning that are matched only by considerably more elaborate and time-consuming assessment methods, such as clinical interviews and sorting tasks paired with multidimensional analytic techniques (Markham, Mintzes, & Jones, 1994).

Although the concept map has become a widely recognized and commonly used tool in formal elementary, secondary, and even college or university science classrooms, it has found fewer adherents among educators located in zoos, museums, planetaria, aquaria, nature centers, and similar venues. In EE, concept maps have been used by a number of researchers to explore students' understandings of ecosystem structure (Martin, Mintzes, & Clavijo, 2000) and energy flow and biogeochemical cycles (Lin & Hu, 2003), but their enormous potential has yet to be fully embraced by many. In the current study, the concept map was adopted in lieu of the familiar multiple-choice test in order to tap into both the structural or organizational complexity of students' knowledge and its content while avoiding the constraining or convergent qualities of most paper and pencil tests. The idea is to permit students to reveal "what they know" rather than "what they don't know."

We gave participants written and oral directions in the concept mapping procedure (Novak & Gowin, 1984), and they had an opportunity to practice the technique and receive feedback from the instructor. To help them start, we gave the participants six "seed" concept labels (i.e., habitat, fins, behavior, characteristics, uses, humans), and subsequently they constructed a concept map depicting their understanding of dolphins. The participants had up to 1 hr to complete their work.

Kellert's Attitude Scale

Immediately following the concept mapping task, each participant responded to a Likert-type inventory that examined his or her attitudes about dolphins. The methods used in developing, validating, and administering the instrument accorded with the extensive work of Stephen Kellert (1996), of the Yale School of Forestry and Environmental Science, and were consistent with our previous work on sharks (Thompson & Mintzes, 2002).

The initial experimental instrument consisted of six propositions in each of the 10 attitudinal dimensions (Table 1), for a total of 60 items. The items were modeled after previous items written by Kellert (1985) and his colleagues (Kellert & Westervelt, 1983). For purposes of validation, we administered the instrument to a group of 124 students enrolled in a college-level introductory biology course for nonmajors, and subsequently we factor-analyzed their responses using a principal components solution and varimax rotation with Kaiser normalization. After rotation, we retained three factors, and interpreted items possessing factor loadings of .52 or greater. The factors represented in the rotated factor matrix (Table 2) were termed: Humanistic (Factor I), Utilitarian (Factor II), and Ecoscientific (Factor III).

TABLE 2. Factor Structure of the Dolphin Attitude Inventory

	I	II	III
I. Humanistic Attitudinal Factor			
1. Dolphins are graceful.	0.65	0.17	–0.00
2. When I see dolphins in the wild, I feel relaxed and happy.	0.62	0.08	0.10
15. It is impossible for people to love dolphins.	–0.62	–0.06	–0.12
20. I like dolphins.	0.62	0.13	0.16
23. I would stay away from a dolphin in the wild because they are scary.	–0.54	0.01	0.05
24. I would like to swim through a dolphin's underwater world to see what it's like.	0.52	–0.04	0.28
28. I would like to go dolphin-watching on a boat.	0.62	0.04	0.42
29. I would rather see a dolphin in the wild than in captivity.	0.63	0.27	0.08
31. I would have no desire to go out on a boat just to see a dolphin.	–0.67	–0.10	–0.42
35. I am interested in seeing attractive animals like dolphins.	0.60	0.08	0.30
36. Dolphins are not the least bit interesting to me.	–0.66	–0.12	–0.26
37. I am not afraid of dolphins.	0.52	–0.13	0.05
38. Dolphins should be valued because they are beautiful creatures.	0.59	0.08	0.38
43. I would rather read about dolphin biology than see one in the wild.	–0.63	–0.08	0.06
47. I would like to observe dolphins in their natural environment.	0.69	0.10	0.32
51. I am not interested in anything having to do with dolphins.	–0.70	–0.04	–0.27
56. I would not be afraid to touch a dolphin.	0.60	–0.19	0.11
57. I really don't care about dolphins.	–0.69	–0.19	–0.32
58. If I saw a dolphin in the wild, I would not be interested.	–0.65	–0.09	–0.30
II. Utilitarian			
4. Dolphins should not be eliminated from aquaria because they make the aquaria a lot of money.	–0.19	–0.53	–0.14
14. Capturing a dolphin seems like a very exciting and challenging activity.	–0.19	–0.61	–0.19
39. If I saw a dolphin while I was on a boat, I would move the boat closer because dolphins are harmless.	0.23	–0.55	0.01
48. Dolphins should be used to make people happy.	0.05	–0.56	–0.02
53. Movies and television shows, like "Flipper," make good use of dolphins.	–0.10	–0.67	–0.12
54. I admire the people who have the strength and skill to capture dolphins in the wild.	–0.40	–0.55	–0.01
59. Dolphins are important because they entertain us.	–0.24	–0.60	0.03
60. I would love to have a pet dolphin.	–0.02	–0.60	0.07
III. Ecoscientific			
7. I would like to study about the "inner workings" of a dolphin.	–0.06	0.00	0.66
8. I would not go out of my way to see a dolphin.	–0.32	–0.03	–0.61
11. I get bored by scientific talk about dolphins.	–0.28	–0.10	–0.59
21. I would like to learn about dolphin families in class.	0.23	0.04	0.71

(table continues)

TABLE 2. (Continued)

	I	II	III
III. Ecoscientific Factor			
25. I wonder about how dolphins function.	0.14	0.09	0.67
32. I have little interest in learning about how well dolphins smell, hear and see.	–0.36	–0.17	–0.57
33. I would like to watch a mother dolphin giving birth to a calf.	0.14	0.04	0.57
34. Dolphins help make the world a better place.	0.47	0.02	0.53
41. I like to read books about the biology of dolphins.	–0.01	0.08	0.73
45. I enjoy seeing dolphins, but I have little interest in learning about the ocean around them.	–0.36	–0.05	–0.55
50. I am not interested in learning about how dolphins influence the food web.	–0.12	–0.02	–0.56
55. I would like to read about the relationship between dolphins and other sea creatures.	0.25	0.03	0.72
Components Eliminated From Dolphin Attitude Inventory			
3. I believe a person sometimes has to punish a dolphin to get it to do tricks.	–0.48	–0.36	–0.09
5. I have no positive or negative feelings about dolphins.	–0.38	–0.34	–0.17
6. Dolphins deserve legal rights.	0.18	0.17	0.36
9. It is okay to use fishing nets that could kill dolphins.	0.62	0.13	0.16
10. Dolphins should be trained to help fishermen find fish.	–0.14	–0.43	–0.16
12. Keeping dolphins in aquaria is wrong.	–0.23	0.40	0.32
13. I admire a person very much who can train a dolphin to do tricks.	0.04	–0.47	0.08
16. If an aquarium near me had a dolphin exhibit, I would not care.	–0.46	0.21	–0.28
17. Dolphins and people are equally special.	0.13	0.28	0.38
18. If dolphins became extinct, I would feel like I had lost a friend.	0.24	0.07	0.40
19. Keeping dolphins in captivity is cruel, even if they are treated nicely.	–0.01	0.48	0.34
22. Laws against feeding dolphins should be enforced.	–0.02	0.28	0.17
26. When visiting an aquarium, I really like to see the attractive dolphins.	0.48	–0.28	0.17
27. Dolphins would never hurt anyone.	0.24	–0.22	0.22
30. A dolphin trained to do tricks at an aquarium show is a better dolphin than one found in the ocean.	–0.41	–0.44	–0.21
40. It is wrong to cast fishing nets that could possibly trap dolphins.	0.46	0.32	0.12
42. I would not be afraid to feed a dolphin.	0.43	–0.27	0.10
44. Dolphins have feelings just like humans.	0.35	0.23	0.22
46. Strict obedience is necessary from captive dolphins.	–0.38	–0.28	–0.09
49. I would rather study about a group of dolphins than just one dolphin.	0.07	0.02	0.32

Thirty-nine randomized items composed the final instrument. Participants indicated their attitudes by responding to a 5-point Likert-type scale ranging from 1 (*strongly agree*), 2 (*slightly agree*), 3 (*neutral*), 4 (*slightly disagree*), to 5 (*strongly disagree*). For each item within scales, participants in

Factors I and III received a score of 0 (*strongly disagree* or *slightly disagree*), 1 (*neutral*), or 2 (*strongly agree* or *slightly agree*). For scale II, the scoring weights were reversed. Summed scores within each of the subscales were normalized to a range of 0–100.

Behavior

Addended to the attitude inventory was a set of five behavioral items, which queried participants on the extent to which they engaged in several marine conservation activities (i.e., picking up trash on the beach, feeding dolphins, petting dolphins, boating close to dolphins, and throwing trash into the ocean). We recorded their responses on another Likert-type scale ranging from 1 (*very often*), 2 (*often*), 3 (*sometimes*), 4 (*rarely*), to 5 (*never*). For purposes of this study, participants who reported engaging in any one of "feeding," "petting," or "boating close to" dolphins often or very often were classified as harassing; all others were classified as nonharassing.

Analysis

The concept maps were scored for structural complexity (one point for each nonredundant concept, scientifically acceptable relationship, level of hierarchy, branching, and cross-link) and content validity (one point for each of the most common conceptual descriptors), as in Quinn, Mintzes, and Laws (2004). We analyzed differences in knowledge, attitudes, and behaviors as a function of educational level by applying the Kruskal-Wallis and chi-square procedures. Differences in knowledge and attitudinal structure as a function of behavior were analyzed by Wilcoxon two-sample (nonparametric *t*) and chi-square followed by Kruskal-Wallis Highest Significant Differences (HSD) tests.

Results and Discussion

An Exemplary Concept Map

A concept map drawn by a single participant in this study is presented in Figure 1. Although each concept map is unique and idiosyncratic, this particular map is offered as a tangible and representative example depicting common features found in many such maps, and illustrating the salient dimensions of structural complexity and content validity.

Figure 1 depicts a concept map drawn by Sarah, an 11th grade student. Sarah's concept map appears reasonably complex, possessing 19 nonredundant concepts, 18 scientifically acceptable relationships, two levels of hierarchy, four branches, and five cross-links. In comparison to university-level students, Sarah's map is very general in content, possessing few "expert" concepts and propositions. She understands that dolphins are mammals, but she seems to subscribe to a kind of utilitarian and anthropocentric perspective focusing on: the use of dolphins as objects of human entertainment, the symbolic value of dolphins, and captive habitats such as tanks and aquaria. There is no indication that she understands either the ecological or evolutionary significance of dolphins, and little evidence of knowledge concerning their behavioral, structural, and/or functional adaptations, except perhaps that dolphins have "complex brains." Furthermore, there is no indication that she recognizes issues of biodiversity among dolphin species or problems associated with human interventions. On the positive side, Sarah's map reveals few if any explicit misconceptions about dolphins.

Structural Complexity

A summary of the knowledge structure complexity profiles for each structural variable as a function of educational level is given in Table 3. The profiles reveal a general pattern of incremental growth

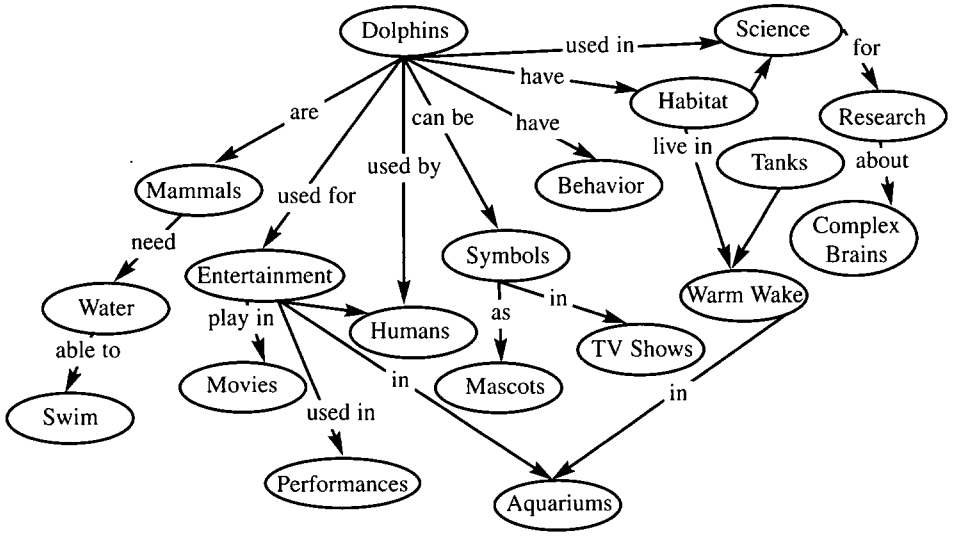

FIGURE 1. Sarah's concept map.

TABLE 3. Knowledge Structure Complexity Profiles

Structural variable	*M* (*SD*) EL	JR	SR	PSY	MBY	GRD	*p*
Concepts	11.2	24.1	19.9	27.5	53.6	49.7	**
	(2.1)	(2.0)	(1.3)	(1.9)	(2.0)	(2.6)	
Relationships	8.3	21.9	17.1	25.6	52.2	48.8	**
	(2.2)	(2.0)	(1.3)	(2.0)	(2.0)	(2.7)	
Hierarchy	1.2	2.5	2.2	3.3	4.1	3.9	**
	(0.2)	(0.2)	(0.1)	(0.2)	(0.2)	(0.2)	
Branching	1.4	5.2	4.2	5.6	12.8	12.6	**
	(0.6)	(0.6)	(0.4)	(0.6)	(0.6)	(0.8)	
Cross-links	0.3	1.1	1.8	1.9	5.8	15.0	**
	(0.6)	(0.6)	(0.4)	(0.5)	(0.5)	(0.7)	

Note. EL = Upper elementary school students; JR = Junior high school students; SR = Senior high school students; PSY = First-year university students enrolled in general psychology; MBY = Third-year university students enrolled in marine biology; GRD = Graduate students enrolled in the MS program in marine biology.
** $p < .01$.

across educational levels, and differences among levels were significant in every instance ($p < .01$). The highest scores were associated with college students; the lowest with elementary school students, and intermediate scores with middle school and high school students. The variances among individuals were relatively small in all cases, suggesting that the concept map provides a reliable mea-sure of structural complexity of knowledge.

Content Validity

Frequency distributions for each of the most common conceptual descriptors by educational level are given in Table 4. Basic descriptors are those depicted in 15% or more of the concept maps drawn by both elementary and junior high school students (i.e., novices) and by undergraduate/graduate students in marine biology (i.e., experts). Advanced descriptors are those depicted in more than 15% of the expert maps but fewer than 15% of the novice maps. We found significant differences among groups in the frequencies of all 22 conceptual descriptors; however, the pattern of differences is more easily interpreted among the 13 advanced descriptors. Among the latter, experts were more likely than novices ($p < .01$) to depict conceptual descriptors concerning reproduction; echolocation; social organization; structural, behavioral, and physiological adaptations; biodiversity; and conservation efforts.

TABLE 4. Inductive Content Analysis

Conceptual descriptor	Frequency						p
	EL	JR	SR	PSY	MBY	GRD	
	Basic (15% or higher)						
Live in ocean	40.0	98.0	60.0	88.9	67.4	79.2	**
Fins, functions (swimming)	45.0	88.4	46.0	35.6	27.9	58.3	**
Have blowholes	0.0	72.1	9.0	28.9	32.6	33.3	**
Entertainment value	7.5	58.1	66.0	63.6	61.9	88.0	**
Live in captivity	0.0	46.5	7.0	0.0	65.0	8.3	**
Educational use (research)	0.0	27.9	12.0	40.0	53.5	82.5	*
Intelligent/smart	7.5	18.6	24.0	35.6	25.6	25.0	**
Mammals	15.0	4.7	41.0	57.8	30.2	79.2	**
Mammal traits (two or more)	2.5	16.3	5.0	22.2	48.8	25.0	**
	Advanced						
Reproductive strategy (k-selection)	0.0	0.0	1.0	6.7	11.6	8.3	**
Conservation efforts	0.0	0.0	1.0	6.7	11.6	8.3	**
Scientific nomenclature	0.0	4.7	2.0	4.4	18.6	12.5	**
Economic value	0.0	9.3	3.0	6.8	21.3	12.0	**
Identification (mark and capture)	0.0	0.0	0.0	0.0	18.6	16.7	**
Adaptations (thermoregulation)	0.0	2.3	0.0	4.4	23.3	25.8	**
Pods	0.0	3.3	5.0	15.6	34.9	20.8	**
Water column (neritic, pelagic)	0.0	0.0	0.0	0.0	16.3	41.7	**
Body form (fusiform)	0.0	0.0	2.0	4.4	41.9	25.0	**
Social organization	0.0	4.7	4.0	2.2	30.2	37.5	**
Predatory behavior	0.0	0.0	0.0	0.0	25.6	62.5	**
Echolocation	0.0	11.7	0.0	2.2	58.1	37.5	**
Reproduction (behavior)	0.0	11.6	7.0	17.8	65.1	45.8	**

Note. EL = Upper elementary school students; JR = Junior high school students; SR = Senior high school students; PSY = First-year university students enrolled in general psychology; MBY = Third-year university students enrolled in marine biology; GRD = Graduate students enrolled in the MS program in marine biology. *$p < .05$. **$p < .01$.

Attitudes

Table 5 summarizes the attitudinal subscale scores of participants by educational level. We found differences ($p < .01$) among groups on all three factors, and mean scores on the Utilitarian (Factor II) subscale were lowest for all participant groups. The most striking pattern is seen in the comparison of the novice and expert participants on the Utilitarian (Factor II) and Ecoscientific (Factor III) subscales. Scores on the Utilitarian subscale were highest among elementary and junior high school students, whereas scores on the Ecoscientific subscale were highest among college-level marine biology students.

Behaviors

Except for graduate students enrolled in the marine biology program, the frequencies of reported harassment behavior (Table 6) appear relatively stable across educational levels, with approximately one third of participants indicating involvement often or very often in feeding, petting, or boating too close to a dolphin. Furthermore, it appears that such behaviors are directly or indirectly related to knowledge about dolphins (Table 7), and that concept maps of nonharassers are structurally more complex (i.e., more tightly integrated and richly descriptive) than those who engage in these interactions. Finally, a series of pairwise comparisons (Table 8) suggest differences in the "attitudinal types" of harassers and nonharassers. Specifically, harassers are much more likely to subscribe to a utilitarian perspective, whereas nonharassers are more likely to adhere to an ecologistic-scientific view.

Limitations, Conclusions, and Implications

This study sought to establish a baseline of descriptive information on public knowledge, attitudes, and behaviors concerning dolphins, and to provide a model for assessing such information concerning other animal groups. It is limited by demographic factors such as locality (i.e., coastal North Carolina), a region rich in migratory and residential marine mammals and a popular area for marine-related pastimes, including fishing, boating, swimming, and surfing. No attempt was made in this study to differentiate between human–dolphin interactions "in the wild" and those occurring in a

TABLE 5. Attitudinal Structure

	M (*SD*)						
Attitudinal factor	EL	JR	SR	PSY	MBY	GRD	*p*
Humanistic	75.7	87.8	81.7	90.1	84.5	76.9	**
	(21.5)	(10.7)	(17.0)	(9.5)	(11.2)	(14.2)	
Utilitarian	45.0	32.8	38.9	52.7	21.9	26.3	**
	(22.1)	(21.3)	(20.2)	(22.3)	(17.1)	(21.6)	
Ecoscientific	62.1	62.9	55.4	59.1	82.9	79.1	**
	(20.2)	(21.5)	(23.0)	(23.8)	(13.6)	(15.8)	

Note. EL = Upper elementary school students; JR = Junior high school students; SR = Senior high school students; PSY = First-year university students enrolled in general psychology; MBY = Third-year university students enrolled in marine biology; GRD = Graduate students enrolled in the MS program in marine biology.
**$p < .01$.

TABLE 6. Frequencies of Reported Harassing Versus Nonharassing Behavior

Behavior	Frequency by educational level**					
	EL	JR	SR	PSY	MBY	GRD
Harassing	36.7	42.5	33.0	20.5	32.0	4.0
Nonharassing	63.3	57.5	67.0	79.5	68.0	96.0

Note. EL = Upper elementary school students; JR = Junior high school students; SR = Senior high school students; PSY = First-year university students enrolled in general psychology; MBY = Third-year university students enrolled in marine biology; GRD = Graduate students enrolled in the MS program in marine biology.
$^{**}p < .01$.

TABLE 7. Knowledge Structure of Harassing Versus Nonharassing Individuals

Behavior	*M* (*SD*)				
	CON	REL	HIE*	BRA	CXL*
Harassing	25.4	22.8	2.4	5.4	2.4
	(15.7)	(17.0)	(1.6)	(4.4)	(5.1)
Nonharassing	29.9	27.8	2.7	6.6	3.7
	(21.1)	(21.5)	(1.4)	(5.8)	(5.0)

Note. CON = Concepts; REL = Relationships; HIE = Hierarchy; BRA = Branching; CXL = Crosslinks.
$^{*}p < .05$.

controlled, legal setting (i.e., Sea world; aquaria). Finally, we based all reported behaviors on participant responses rather than direct observation.

Despite these constraints, we have reported several significant findings. With respect to their knowledge about dolphins, our participants depicted relatively simple concept maps, which grew progressively more sophisticated with increasing age and educational exposure. Many of our novice and expert participants recognized the dolphin's marine habitat, its fins and blowholes, its use in captive, ecotourist attractions and in research environments, its "intelligence," and its status as a mammal. Experts were significantly more likely to depict scientifically acceptable knowledge about reproductive behavior, echolocation, social organization, body form, marine life zones, physiological adaptations, research strategies, and conservation efforts. Furthermore, experts were more likely than novices to subscribe to an environmentally friendly, ecoscientific view of dolphins and less likely to evince a potentially harmful utilitarian view.

In general, these differences in knowledge and attitudes were also reflected in participants' behavior toward dolphins. Our most knowledgeable and environmentally responsible participants were much less likely to engage in disruptive or potentially harmful harassment behavior. For environmental educators and researchers, these findings have several practical implications. Most important, they suggest that significant harassment behavior is related in complex ways to knowledge and attitudes in a predictable manner.

TABLE 8. Frequencies and Pairwise Comparisons of Harassing and Nonharassing Individuals by Attitude Type

Behavior	Frequency by attitude type[a]				
	Hu	Ut[b]	Hu/Ut	Hu/Ec	Ec[b]
Harassing	31.6	50.0	30.6	36.8	15.0
Nonharassing	68.4	50.0	69.4	63.2	85.0

Note. Hu = Humanistic; Ut = Utilitarian; Hu/Ut = Humanistic/Utilitarian; Hu/Ec = Humanistic/Ecoscientific; Ec = Ecoscientific.

[a]For this analysis, participants were classified into one of five "attitudinal types" based on their attitudinal subscale scores (i.e., those who scored above the mean on the humanistic factor but below the mean on utilitarian and ecoscientific factors were labeled Humanistic [Hu], and so forth). The *N*s for each subject group were: Hu (18), Ut (39), Hu/Ut (34), Hu/Ec (38), and Ec (60). [b]Pairwise comparisons by Kruskal-Wallis Highest Significant Differences (HSD) are significant at $p < .05$ for Ut and Ec comparison.

In our view, the results suggest the need for more comprehensive efforts in EE that encompass both informal and formal instruction (Volk & Cheak, 2003). The current study focused on "targeted behaviors" toward dolphins that might be readily and profitably addressed in the informal environment (e.g., in aquaria, marine stations, and aquatic ecotourist centers). These facilities are generally well equipped to handle large numbers of individuals in a relatively relaxed atmosphere, and to encourage specific changes in human–animal interactions. Direct instruction that discourages touching, petting, and feeding of dolphins falls within this domain. In contrast, these facilities are generally not designed to facilitate change in "generic behaviors" or in the conceptual and attitudinal domains that are critical to environmentally responsible stewardship. The formal classroom is the environment for encouraging critical thinking skills and is best reserved for addressing local environmental issues and empowering learners to engage in "pro-environmental action."

Recognizing the principles of "issue ownership" and "action empowerment," Smith-Sebasto and Fortner (1994) have outlined six "indices" of environmental action, which we endorse as appropriate foci for formal classroom instruction. These actions include the educational, civic, financial, legal, persuasive, and physical dimensions of environmental issues. In the context of our concern about dolphins, students who are committed to conservation and protection of this important species might conceivably engage in a variety of useful actions (e.g., reading appropriate research articles and monographs on management of marine mammals, proposing strengthened amendments to the MMPA, boycotting fish canning companies that do not employ net-release devices, writing letters to local newspapers or speaking to advocacy groups, and reporting boating incidents to local law enforcement agencies).

For those involved in the development, delivery, and assessment of educational programs, our findings support those of Dimopoulos and Pantis (2003), who discovered that school, home, and television do not provide information that is of direct value in the conservation and protection of large groups of charismatic megafauna. Although children are interested in diverse animal groups and tend to bond with large conspicuous animals and pets, these attitudes alone do not translate readily into environmentally friendly behavior, nor apparently does instruction that focuses only on knowledge. We suggest that well-financed, carefully crafted, age-appropriate, mass media campaigns targeting specific environmentally friendly behaviors may ultimately contribute more than any other approach.

In closing, we wish to restate that this study focuses on only one of many important and well known megafaunal (and floral) species that have widespread importance in facilitating environmentally friendly attitudes and behaviors, and concerns for ecosystem conservation and protection. We hope that this analysis encourages others to undertake similar studies.

In our view, many environmental educators are particularly well trained and well equipped to design, implement, and assess programmatic efforts that focus on conceptual, attitudinal, and behavioral change. Furthermore, we think that this expertise might be fruitfully employed in large-scale efforts to conserve and protect a wide range of threatened and endangered species. For example, more could be done to encourage public understanding of the bald eagle, the American national symbol, as well as a variety of important charismatic mammals such as the giant panda and the blue whale. To date, "conservation education" efforts of this type have been sporadic, poorly funded, and often directed under the auspices of diverse governmental and nongovernmental agencies. With this article, we invite environmental educators to consider the plight of individual species as worthy subjects of intensive investigation. We would be especially interested in studies that compare and contrast our findings on dolphins to those of other species.

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