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Research Article

Evaluating Recreationists' Awareness and Attitudes Toward Piping Plovers (*Charadrius melodus*) at Lake McConaughy, Nebraska, USA

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Piping plovers (Charadrius melodus) are shorebirds federally protected by the U.S. Endangered Species Act that often nest on beaches in proximity to human recreation. We evaluated whether awareness of piping plovers and their legally protected status and attitudes toward species management varied between groups of recreationists at Lake McConaughy, Keith County, Nebraska, USA. Awareness of piping plovers varied primarily by the respondents' number of annual visits to Lake McConaughy; the respondents' age, sex, or location of primary residence had less influence. Recreationists with increased awareness of piping plovers and their protected status did not have more favorable attitudes toward plovers and recreation restrictions. The more frequently recreationists visited Lake McConaughy, the less receptive they were to alternative management strategies. Piping plover recovery plans should incorporate general and site-specific human dimensions guidance for conservation practitioners. Additional studies are needed to identify approaches to resolve bird-human conflicts.

Keywords *Charadrius melodus*, Endangered Species Act, personal interview surveys, piping plover, recreation

Introduction

Human-wildlife conflicts take many forms (Marshall, White, & Fischer, 2007; Treves, Wallace, Naughton-Treves & Morales, 2006), but occur most often when human interests and wildlife compete for the same resource (e.g., habitat, recreational space). The presence of recreationists at beaches used by nesting shorebirds of conservation concern often result in conflict. Human presence can result in disturbance to incubating adult shorebirds, direct destruction of nests, and death of chicks and adults from vehicular traffic

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and other disturbances (Carney & Sydeman, 1999; McGowan & Simons, 2006; Melvin, Hecht, & Griffin, 1994). These negative impacts may initiate population declines of vulnerable species or exacerbate declines of already imperiled species. Management actions are often implemented to prevent interactions between birds and recreationists and may include enforcement of human exclusion zones or restricting certain forms of recreation, such as all-terrain vehicle use (Glover, Weston, Maguire, Miller, & Christie, 2011; USFWS, 1994; Weston, Dodge, Bunce, Nimmo, & Miller, 2012). In certain areas, the protective measures implemented for birds and other wildlife and the concomitant reduction in recreational opportunities have led to negative attitudes and public debate about how public beaches and other public trust resources should be managed (Harmon, 2014; Panzar, 2013; Steele, 2013). The failure to include stakeholders in species management and decision-making may foment these negative attitudes and impede efforts to protect and recover imperiled populations. Evaluating and understanding patterns and causes of human behavior are important in identifying how to best surmount barriers to species recovery.

Human dimension studies focused on the conservation of birds nesting on beaches also used for human recreation are fairly novel with most conducted only in recent years. Studies have been conducted in Florida (Ormsby & Forsy, 2010) and New Jersey (Burger & Niles, 2013) in the United States and in New Zealand (Bridson, 2000), and Australia (Antos, Weston, & Priest, 2006; Maguire, Rimmer, & Weston 2013; van Polanen Petel & Bunce, 2012; Williams, Weston, Henry, & Maguire, 2009). The unifying theme of these studies is that conservation efforts for birds in public spaces are reliant on human behavioral change. In some cases this behavioral change is required by legislation and compliance is enforceable (e.g., piping plovers in the United States), but in others, behavioral change is requested on a voluntary basis (e.g., hooded plovers, *Thinornis rubricollis*, in Australia). These studies specifically focused on evaluating education campaigns (Ormsby & Forsy, 2010), evaluating awareness and attitudes (Antos et al., 2006; van Polanen Petel & Bunce, 2012), assessing human and bird response to beach closures (Burger & Niles, 2013; Maguire et al., 2013), and assessing dog owner's attitudes and motivations (Bridson, 2000; Jorgensen & Brown, 2014; Williams et al., 2009). The relative rarity of these studies suggests that researchers and managers have only recently recognized the importance of understanding and including the general public and stakeholders in species' protection efforts.

The implementation of protective measures for the federally protected piping plover at publicly owned recreation sites provides an illustration of the importance of human dimensions research. We studied recreationists' awareness of and attitudes toward piping plovers at Lake McConaughy, Nebraska, USA during the breeding seasons of 2013 and 2014. Our objective was to develop a better understanding of recreationists' (a) perspectives toward piping plover protection and (b) opinions of restrictions placed on recreation to protect plovers; ultimately, we hope to improve the decision-making process for human and plover management at Lake McConaughy and elsewhere. Our working hypothesis is that recreationists' demographic characteristics (sex, age, and location of primary residence), previous knowledge of the birds, and frequency of visits to Lake McConaughy will influence their awareness of and attitudes toward piping plovers.

Legal Environment

In the United States, the Endangered Species Act (ESA; 7 U.S.C. § 136, 16 U.S.C. § 1531 et seq.) is intended to protect and recover plant and animal species. The ESA requires federal agencies and others to avoid "take" of listed species and ensure that actions they implement do not jeopardize the continued existence of a listed species. A common outcome of this

requirement is situations where people are required to accommodate the presence and protection of listed species. When these events occur on public property, not all stakeholders affected by the restrictions may have been engaged in the decision-making process. These restrictions, lack of inclusion, and perceived rigidity of the ESA provide limited impetus or opportunity for stakeholders to find compromises between their legitimate activities, including recreation, and species protection.

In 1986, piping plover breeding populations were listed under the ESA as threatened (Atlantic Coast and Great Plains) or endangered (Great Lakes). The current species recovery plans for the Atlantic Coast (USFWS, 1996), Great Lakes (USFWS, 2003), and Great Plains (USFWS, 1988) all provide guidance on how negative impacts to piping plovers caused by humans might be avoided by restricting human activity in breeding and overwintering areas. The recovery plans identify education and increasing awareness as important elements in species protection, and often, education is the preferred management tool used by conservation practitioners (Baruch-Mordo, Breck, Wilson, & Broderick, 2011). Providing educational materials and other information (e.g., signs in species use areas), however, may not be sufficient to modify people's attitudes toward species protection or reduce human behaviors that might further imperil listed species (Jett, 2007). The recovery plans, as currently written, do not suggest consideration of bird-human conflict resolution or increasing species acceptance through modification of social norms, as has been successfully implemented elsewhere (Williams et al., 2009; Zinn, Manfredo, Vaske, & Wittmann, 1998).

Study Species

In North America, piping plovers nest on sandy substrates adjacent to bodies of water along the Atlantic Coast, Great Lakes and in the Great Plains (Elliot-Smith & Haig, 2004). In the Great Plains, which includes Nebraska, plovers breed on midstream river sandbars, sand dunes, alkali lakes and reservoir beaches as well as sand and gravel mines, dredging operations and lakeside beach communities (USFWS, 1988). Piping plovers typically lay four eggs in shallow nests in the sand, incubate the eggs for approximately four weeks and attend the precocial chicks until they fledge at approximately four weeks of age (Elliot-Smith & Haig, 2004); broods are reared in the general vicinity of the nest. Adult plovers, their nests and chicks may be present at breeding areas from mid-April through mid-August. Plovers migrate to the U.S. Atlantic and Gulf coasts and Caribbean islands for the winter. Plovers breed at the same sites from year to year if suitable habitat is present (Elliot-Smith & Haig, 2004).

Study Area

Lake McConaughy, near Ogallala, Keith County, Nebraska, USA (Figure 1), is a human-created reservoir owned and operated by the Central Nebraska Public Power and Irrigation District (CNPPID). Lake McConaughy was formed when Kingsley Dam was constructed in the late 1930s and early 1940s to store and distribute water for irrigation in central Nebraska. A hydroelectric power generating plant was added to Kingsley Dam in the mid-1980s. Lake McConaughy's water level is variable, fluctuating within and between years depending on inflows and outflows. Piping plovers were first observed at Lake McConaughy in 1978 (Rosche, 1994) and the lake is now a major breeding area for the Great Plains population with the number of breeding birds ranging from low 10s to approximately 350 individuals (Elliot-Smith, Haig, & Powers, 2009). The number of nesting birds

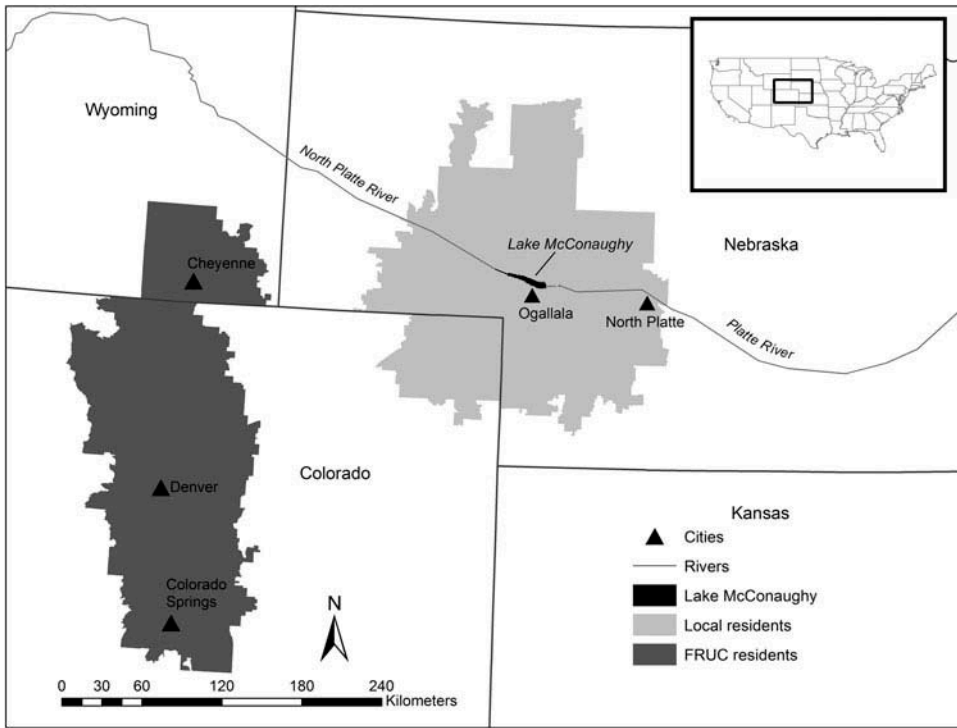


Figure 1. Location of Lake McConaughy in southwestern Nebraska and regions, based on zip codes, that classified local residents and residents of the Front Range Urban Corridor (FRUC).

is dependent on the amount of suitable habitat available to them and that is largely dictated by the water level in the lake; water levels are not regulated to provide nesting areas for plovers. The sandy beaches used by piping plovers as breeding areas at Lake McConaughy are attractive to humans for various types of recreation, including camping, swimming, fishing, boating and picnicking.

Regulatory Environment

Piping plover conservation at Lake McConaughy exists in a complex regulatory and stakeholder environment. The hydroelectric power plant on Kingsley Dam is operated by CNPPID under Federal Energy Regulatory Commission (FERC; Federal Power Act-Ch.12, Title 16, USC) license 1417, issued in 1998 and expiring in 2038 (CNPPID, 2009), with the understanding that the licensed project provide a net benefit to the public. License requirements resulting from consultations between federal and state wildlife regulatory agencies and CNPPID include implementation of a comprehensive management plan for breeding piping plovers to comply with their ESA listing status (CNPPID, 2009). Management actions involve establishing human exclusion zones during the breeding season to prevent interactions between humans and plovers on the beaches and individual nest protection. These exclusion zones are not full beach closures, rather they consist of either large fenced off areas (approximately 40 acres in size) or small fenced off areas surrounding individual nests (approximately 50 by 50 feet) (CNPPID, personal communication). Recreationists

are allowed on the beaches surrounding both types of enclosures. The FERC license also requires CNPPID to provide recreational opportunities for the public, these are to include boating, fishing, camping, and other year round lakeside activities. The public was given the opportunity to provide comments to FERC and CNPPID during the licensing process, but generally are not provided a formal opportunity to comment on annual decision-making regarding beach closures.

A number of other entities and groups have interests in the greater Lake McConaughy area. The Nebraska Game and Parks Commission (NGPC) leases property around Lake McConaughy and manages it as either State Recreation Areas (SRAs) or Wildlife Management Areas (WMAs), concessionaires operate restaurants, convenience stores, boat shops and gas stations, and private individuals own homes or agricultural property around the lake. Recently, more than one million people per year have visited and used the Lake McConaughy area for recreation, mostly during the summer months (NGPC, unpublished data). Visitors to the lake provide a significant source of income to the local community.

Methods

We conducted personal interviews at Lake McConaughy from May 19 to July 15 in 2013 and 2014, a period that corresponds to the peak of the piping plover breeding season. The majority of beach use by recreationists at Lake McConaughy occurs between the last week of May (Memorial Day holiday) and the first week in September (Labor Day holiday) and on weekend days throughout the summer (NGPC, unpublished data), but considerable weekday use does occur. Surveys were conducted during daylight hours on all days of the week to ensure thorough sampling of local and visiting recreationists using the beaches. Two field assistants trained to conduct human dimensions surveys asked recreationists found in the areas used by breeding piping plovers a series of questions to determine their demographic attributes, awareness of and attitudes toward piping plovers, and potential recreation restrictions intended to protect the species. Recreationists in boats, recreational vehicles, or in tents were considered inaccessible and not surveyed. Respondents were chosen randomly from the set of recreationists present on the beach at any time. Not all respondents chose to answer all questions on the survey; very few individuals (<10) solicited for the survey declined to participate.

Basic demographic attributes describing the respondents included sex, age, home zip code (location of primary residence), and number of annual visits to Lake McConaughy. These and other demographic attributes have been associated with differing values and attitudes about natural resources (Vaske, Donnelly, Williams, & Jonker, 2011; Vaske, Jacobs, & Sijtsma, 2011). No information that would allow identification of individuals (names, home address, vehicle license plate numbers) was collected. Awareness was assessed by asking respondents (a) if piping plovers are found at Lake McConaughy and (b) if piping plovers are protected by state and federal endangered species laws. Attitudes were examined by asking questions about plover protection and recreation restrictions. In 2013 and 2014, we asked respondents (a) whether information about piping plovers breeding at Lake McConaughy is adequate, (b) if piping plovers should be protected during the breeding season, and (c) if human recreation should be limited for the protection of nesting piping plovers. In 2014, we additionally asked respondents how receptive they would be to the following changes in recreation opportunities during the birds' 4–5 month-long breeding season if they protected piping plovers (a) a limited number of human free zones on the beach, (b) a limited number of vehicle-free beaches, and (c) entire beach closures. We asked

respondents to rank their responses to questions on a 5-point scale of 1 = *strongly opposed*, 2 = *opposed*, 3 = *neutral*, 4 = *favor*, and 5 = *strongly favor*.

We summarized responses to awareness and attitude questions by demographic attribute (sex, age, number of annual visits, location of principal residence) and whether respondents were aware of piping plovers at Lake McConaughy and their protected status. For residence, we separated respondents into five groups (see Figure 1). We defined “local residents” as those with a home zip code located within an 80 km radius of Lake McConaughy; “FRUC residents” as those with zip codes within the Front Range Urban Corridor (FRUC) that extends from Colorado Springs, Colorado, to Cheyenne, Wyoming; “other Nebraska residents” as those with home zip codes located further than 80 km from Lake McConaughy; “other Colorado residents” as those that are not local (within 80 km) or FRUC residents and “other respondents.” All respondents were 19 years of age or older.

We used demographic attributes to model binary responses (yes or no) to awareness questions using logistic regression in a generalized linear model (Hilbe, 2009). We used demographic attributes and responses to awareness questions (yes or no) to model ordinal responses (ranked 1 to 5) to attitude questions using cumulative logit models (Agresti, 2007). We used ungrouped values for age as a continuous variable in all analyses. Number of visits to Lake McConaughy during the breeding season was used as a continuous variable. We created a set of candidate models using all informative combinations of variables in each analysis. We used Akaike’s Information Criterion (AIC) and model weights (w_i) to select the best-fitting model(s) (Burnham & Anderson, 2002). We used z -statistics to determine whether the maximum likelihood parameter estimates for the top model differed from zero in the analyses. For the cumulative logistic models, we provide parameter estimates which show how the log odds differ for each response value (2–5) compared to the response of 1 for each variable(s) in the best fitting model.

The distribution of responses to the survey questions that were asked during both years of the study was not significantly different between the two years ($p > .05$ for all pairwise comparisons), so those data were combined in analyses. Unless otherwise noted, means are presented $\pm 1 SE$ (Table 1). Models with the lowest AIC value are considered the best fitting and models with $\Delta AIC \leq 2$ are considered to have significant support. All statistical analyses were performed in Program R 3.1.3 (R Development Core Team, 2014).

Results

We surveyed 571 recreationists, 354 in 2013 and 217 in 2014. Of the recreationists surveyed, more males ($n = 323$) than females ($n = 248$) were interviewed; this reflected both the male biased sex ratio of recreationists at the lake and, in mixed groups, usually a male responded to the survey for the group. Respondents ranged in age from 19 to 90 years old. Most respondents ($n = 423$) were 26–59 years of age; this reflected the general age distribution of recreationists found at the lake. Two residence groups comprised most visitors to Lake McConaughy; local residents and FRUC residents. Nearly half of all respondents (48%) were residents of the FRUC, followed by local residents (26%), other Nebraska residents (15%), other Colorado residents (8%) and other (4%). Local residents visited Lake McConaughy more frequently (26.1 trips per year ± 3.0) than other Nebraska residents (15.3 trips per year ± 3.2), other Colorado residents (11.9 trips per year ± 2.0) and FRUC residents (4.1 trips per year ± 0.5) (see Table 1).

Our model selection procedure for the awareness question asking whether piping plovers are found at Lake McConaughy showed the full model including all variables had the lowest AIC value (722.6, Table 2a). A reduced model without the respondent’s

Table 1

Summary of personal interview survey responses. Questions regarding receptiveness to changes in recreation were only asked in 2014 ($n = 217$)

	All respondents combined
# of respondents	571
% of respondent male	56.36%
Mean number of visits annually ($\pm SE$)	11.15 \pm 0.99
Are piping plovers found at Lake McConaughy? (% yes)	60.38%
Are piping plovers protected by state and federal endangered species laws? (% yes)	55.67%
Information provided about piping plovers nesting at Lake McConaughy is adequate	3.23 \pm 0.07
Piping plovers should be protected during the nesting season	4.5 \pm 0.08
Human recreation should be limited for the protection of nesting piping plovers	3.43 \pm 0.06
Receptiveness to changes in recreation	
Limited number of human free zones on the beach	3.69 \pm 0.10
Limited number of vehicle-free beaches	2.36 \pm 0.11
Breeding season beach closure	2.23 \pm 0.10

sex as a variable had a similar AIC value (724.7) and together, these two best fitting models had 87% support by the data. Awareness of piping plovers' presence at Lake McConaughy increased with increasing respondent age, increasing number of yearly visits, sex (males—64%;females—55%) and residence (local—78%; FRUC-55%; other Nebraska—56%; other Colorado—47%; other residences—55%).

Our model selection procedure for the awareness question asking whether piping plovers are protected by state and federal endangered species laws showed the full model including all variables had the lowest AIC value (748.7, [Table 2b](#)). A reduced model without respondent's sex as a variable had a similar AIC value (748.4) and together, the two best models had 84% support by the data. Awareness of piping plovers' legally protected status increased with increasing respondent age, increasing number of visits to Lake McConaughy, and residence (local—69.6%; FRUC—49.3%; other Nebraska (63%; other Colorado—36%; other residences—50%).

Our model selection procedure for the attitude question whether information provided about piping plovers nesting at Lake McConaughy is adequate showed the model that included the binary response (yes or no) to the awareness question whether piping plovers are found at Lake McConaughy had the lowest AIC value (1534.26, [Table 2c](#), [Table 3](#)). A model that included the binary response (yes or no) and respondent age had a similar AIC (1534.33) and together the two best models had 98% support by the data ([Table 4](#)). Respondents who answered yes to the question whether piping plovers are found at Lake McConaughy were 2.53, 3.16, 10.07, and 7.05 times more likely to provide a response of 2, 3, 4, and 5, than providing a response of 1 to the question whether information provided about piping plovers at Lake McConaughy is adequate. Respondents who answered no to the question whether piping plovers are found at Lake McConaughy were 0.39, 0.32, 0.10,

Table 2
 Top three models based on our selection procedure for each awareness
 and attitude question

Model	AIC	Δ AIC	w_i
a) <i>Are piping plovers found at Lake McConaughy?</i>			
Sex + age + region + visits	722.67	0.00	0.64
Age + region + visits	724.73	2.07	0.23
Sex + age + visits	726.92	4.25	0.07
b) <i>Are piping plovers protected by state and federal endangered species laws?</i>			
Sex + age + region + visits	748.74	0.00	0.45
Age + region + visits	748.46	0.29	0.39
Age + visits	752.76	4.30	0.05
c) <i>Information provided about piping plovers nesting at Lake McConaughy is adequate.</i>			
Awareness (plovers found)	1534.26	0.00	0.62
Age + awareness (plovers found)	1,534.33	1.07	0.36
Sex + awareness (plovers found)	1,541.34	7.08	0.02
d) <i>Piping plovers should be protected during the nesting season.</i>			
Null model	1,030.73	0.00	0.35
Awareness (plovers found)	1,030.84	0.11	0.33
Sex + awareness (plovers found)	1,034.79	4.05	0.05
e) <i>Limited human fee zones on the beach.</i>			
Null model	608.39	0.00	0.48
Awareness (plovers protected)	609.90	1.51	0.22
Awareness (plovers found)	611.63	3.24	0.09
f) <i>Beach closure.</i>			
Null model	548.28	0.00	0.44
Visits	549.66	1.38	0.22
Sex	550.52	2.24	0.14
g) <i>Human recreation should be limited for the protection of nesting piping plovers.</i>			
Visits	1,665.64	0.00	0.43
Null model	1,666.22	0.58	0.32
Age	1,669.78	4.14	0.05
h) <i>Vehicle-free beaches.</i>			
Visits	550.18	0.00	0.57
Age + visits	552.16	1.99	0.21
Null model	554.70	4.53	0.06

The variables “awareness (plovers found)” and “awareness (plovers protected)” are responses to awareness questions about whether piping plovers are found at Lake McConaughy and whether they are protected by state and federal endangered species laws.

Table 3

Estimates of maximum-likelihood parameters and the significant deviation from 0 for the best fitting model describing the probability of responses to awareness questions

Parameter	Estimate \pm SE	z-value	$p > Z$
<i>Are piping plovers found at Lake McConaughy?</i>			
Intercept	-1.23 \pm 0.41	-2.96	<.01
Male	0.36 \pm 0.18	2.01	.04
Age	0.02 \pm 0.01	2.93	<.01
Region (local)	1.02 \pm 0.37	2.76	<.01
Visits	0.02 \pm 0.01	2.96	<.01
<i>Are piping plovers protected by state and federal endangered species laws?</i>			
Intercept	-1.55 \pm 0.41	-3.73	<.001
Age	0.02 \pm 0.01	3.23	<.01
Local	1.07 \pm 0.37	2.90	<.01
Other Nebraskans	1.03 \pm 0.39	2.62	<.01
Visits	0.02 \pm 0.01	2.74	<.01

and 0.14 times as likely to provide a response of 2, 3, 4, or 5, than providing a response of 1 to the question whether information provided about piping plovers at Lake McConaughy is adequate. Respondents who were aware of piping plovers felt the information resources provided to them were adequate while those who were unaware of piping plovers felt the information resources were inadequate (see Methods for ranking definitions).

Our model selection procedure for the attitude questions regarding (a) whether piping plovers should be protected during the nesting season (AIC = 1030.73, Table 2d), (b) limited number of human free zones on the beach during the breeding season (AIC = 608.39, Table 2e), and (c) breeding season beach closures (AIC = 548.28, Table 2f), showed the null models (no variables included) had the lowest AIC values. Respondents' demographic characteristics did not influence their attitudes toward piping plover management alternatives.

Our model selection procedure for the attitude question, should human recreation be limited for the protection of nesting piping plovers showed the model that included number of visits to Lake McConaughy had the lowest AIC (1665.64, Table 2g). The null model (no variables included) had a similar AIC (1666.22) and together the two best models had 70% support by the data. For each visit a respondent made to Lake McConaughy they were 0.98, 0.98, 0.99, and 0.99 times more likely to provide a response of 2, 3, 4, and 5, than providing a response of 1 to the question whether human recreation should be limited for the protection of nesting piping plovers. Increasing number of visits to Lake McConaughy during the breeding season was associated with more unfavorable opinions toward restricted human access to beaches.

Our model selection procedure for the attitude question regarding vehicle-free beaches showed the model that included number of visits to Lake McConaughy during the breeding season had the lowest AIC (550.18, Table 2h). The model that included number of visits and respondent age had a similar AIC (552.16) and together the two best models had 88% support by the data. For each visit a respondent made to Lake McConaughy, they were 0.93, 0.98, 0.97, and 0.94 times more likely to provide a response of 2, 3, 4, and 5, than providing

Table 4

Estimates of maximum-likelihood parameters, and the significant deviation from 0, for the model that best describes the probability of responses to attitude questions

Parameter	Estimate \pm SE	z-value	$p > Z$
<i>Information provided about piping plovers nesting at Lake McConaughy is adequate.</i>			
Awareness (plover found*) 1	—	—	—
Awareness (plover found*) 2	0.931 \pm 0.442	2.11	.03
Awareness (plover found*) 3	1.151 \pm 0.272	4.24	>.001
Awareness (plover found*) 4	2.311 \pm 0.347	6.66	>.001
Awareness (plover found*) 5	1.952 \pm 0.231	8.46	>.001
<i>Human recreation should be limited for the protection of nesting piping plovers.</i>			
Visits 1	—	—	—
Visits 2	-0.018 \pm 0.015	-1.199	.231
Visits 3	-0.014 \pm 0.006	-2.479	.013
Visits 4	-0.008 \pm 0.005	-1.473	.141
Visits 5	-0.001 \pm 0.004	-2.211	.027
<i>Vehicle-free beaches</i>			
Visits 1	—	—	—
Visits 2	-0.076 \pm 0.073	-1.037	.299
Visits 3	-0.020 \pm 0.017	-1.192	.233
Visits 4	-0.033 \pm 0.029	-1.160	.246
Visits 5	-0.069 \pm 0.029	-2.345	.019

Note. Parameter estimates show the probabilities that respondents provided an answer of 2, 3, 4, or 5 relative to respondents providing a response to 1 for each incremental increase in the parameter value. *Estimates are for respondents answering “yes” to the question whether piping plovers are found at Lake McConaughy.

a response of 1 to the question of receptiveness to vehicle-free beaches. Increasing the number of visits to Lake McConaughy during the breeding season was associated with more unfavorable opinions toward vehicle-free beaches.

Discussion

Our results indicate that awareness of and attitudes toward piping plovers nesting at Lake McConaughy varied primarily with the number of annual visits to the lake made by the respondent, but their age, sex, and location of primary residence carried some influence. Frequent visitors, local residents and older respondents were more aware of piping plovers and their legally protected status than other respondents. The attitudes of respondents to alternative piping plover management options (limited recreation, vehicle-free beaches, or beach closures) varied only by the number of annual visits made to the lake, they did not vary by respondent age, sex, or location of primary residence. The more frequently a respondent visited Lake McConaughy during the plover breeding season and the more aware they were of the birds' presence, the less likely they were to be supportive of alternative piping plover management techniques. While not directly addressed by our survey questions, casual conversations with recreationists suggested that the more frequently they visited Lake McConaughy, the more they felt plover protection was prioritized over human

interests and consequently, the less receptive they were to alternative management techniques (MBB, JGJ, personal observation). These observations correspond with results from a study (Maguire et al., 2013) that showed that greater frequency of use of a beach where bird protection measures were implemented was associated with a greater sense of inconvenience in beach users. Our results also indicated that respondents with previous knowledge of plovers felt the current educational efforts were adequate, while those without previous knowledge of plovers felt efforts were not adequate (signs, posters, and brochures did not attract their attention and were easily dismissed; MBB, JGJ, personal observation).

As currently written, the three piping plover recovery plans (USFWS, 1988, 1996, 2003) identify education and outreach as vital components of the overall recovery strategy for the species. Increased awareness through education was perceived as effectively improving conservation outcomes, such as increased compliance with exclusion zones and recreation restrictions or increased appreciation of the protected species. However, our results suggest that education and outreach strategies, as currently being implemented by conservation practitioners across the piping plovers' range, are less effective than might be hoped and should be reconsidered. We suggest that management plans should recognize that providing information passively (brochures, signs, posters), which can be useful in some situations, is unlikely to be effective in improving awareness, attitudes and compliance in the majority of situations. Plans should consider a more sophisticated, human-dimensions approach to communication and education that is based on conceptual frameworks regarding how humans receive and process information and how information influences attitudes, behaviors, and social norms (Kollmuss & Agyeman, 2002).

The challenges confronting conservation practitioners charged with protecting piping plovers are complex and, if not effectively managed or resolved, may be barriers to successful conservation. Challenges include various human dimensions issues such as social acceptance of species' protection, the need to avoid bird-human conflicts, and how to best influence specific human behaviors (modification of social norms). Our study underscores the need for recovery and management plans to consider how these sorts of challenges are best addressed since they can affect conservation outcomes (Treves et al., 2006). Broadly incorporating a human dimensions component into endangered species management has been encouraged by a number of authors (see Wallace, Clark, & Reading, 2002 and citations therein). This approach includes engaging stakeholders, understanding stakeholder values and perspectives, considering site-specific, situational nuances and influencing social norms through active education and outreach.

The role of formally engaging stakeholders in management may be a particularly useful tool. Stakeholder involvement in decision-making is important in developing acceptable management alternatives (Gregory & Keeney, 1994). A partnership that engages all stakeholder groups in this way has been successful in resolving conflicts between piping plovers and economic interests in eastern Nebraska (Brown et al., 2011). We suggest this approach is a potentially useful model adaptable for use in other parts of the piping plover's range. It relies on listening to, respecting and accommodating the concerns (within the legal limits of the ESA and other wildlife protection laws) of all stakeholders affected by the presence of nesting piping plovers. Giving stakeholders a "voice" often resolves conflicts before they begin. Failure to engage stakeholders and address their concerns may lead to persistent negative attitudes toward the birds. These negative attitudes can be counter-productive to species' recovery, whether it is through high rates of noncompliance with protection measures or by altering federal and state commitment to species conservation through legislation. While not typically considered to be education and outreach, engaging recreationists and other stakeholders in the decision-making process is educational (for

stakeholders and conservation practitioners alike) and should be included in management planning.

Our study at Lake McConaughy was an initial effort to understand the complex stakeholder environment at one important piping plover breeding site in the Great Plains. Future human dimensions studies of this species should (a) examine additional linkages between recreationists' attitudes, awareness, and behaviors (McCleery, Ditton, Sell, & Lopez, 2006), (b) determine how recreationists' attitudes are formed, (c) evaluate educational and enforcement strategies that influence recreationists' attitudes, behaviors, and compliance with social norms (McCleery et al., 2006), (d) determine relationships between perceived inconvenience and specific types of recreation and recreationists' reasons for visiting sites where species protection measures are implemented, (e) determine what educational materials and delivery mechanisms are most effective, and (f) consider how best to include stakeholders in the decision-making process. This information will be particularly important in situations, like Lake McConaughy, where the success or failure of species management and recovery efforts is dictated more by managers' and regulatory agencies' ability to effectively resolve the human dimensions challenges rather than challenges associated with the biology of the species.

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