Reducing Human Disturbance to Atlantic Flyway Shorebirds Using Social Science Methods

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Abstract (Academic)

Human disturbance is a significant threat to shorebirds in North America. Disturbance can result in direct mortality or have long-term impacts on the survival of shorebirds. Land managers employ a variety of management techniques to minimize anthropogenic impacts on shorebirds, but because the Atlantic Flyway is ecologically and recreationally diverse, management can vary among sites. This thesis used social science methods to understand the extent to which human disturbance is managed and how human disturbance is managed. Specifically, we surveyed land managers and biologists in the U.S. and Canada portions of the Atlantic Flyway to examine potential disturbances, types of activities that are restricted, when restrictions occur, the perceived effectiveness of management techniques, public compliance with restrictions, and resource needs of managers. With the findings from this research, agencies and organizations that manage shorebirds can assess where to invest time, effort, and resources to reduce disturbance. We also used a survey of dog walkers to ascertain the benefits and constraints to leashing dogs near shorebirds because dog walking is one of the top-rated potential disturbances to shorebirds. Additionally, we sought to understand the personal and social norms related to dog walking and evaluated if a community-based social marketing (CBSM) approach would be enhanced by the addition of norms. Using a CBSM approach, we provided insights on strategies to promote voluntarily leashing of dogs near shorebirds. Through this thesis, we aimed to bridge the needs of people and the needs of shorebirds, in an effort to produce effective conservation outcomes.

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Abstract (Public)

Shorebird populations have declined in the past four decades. Declines are due in part to human use of coastal areas, which can result in harm to shorebirds. To reduce human impacts on shorebirds and help land managers make decisions about management, this thesis used social science methods. Using a survey of managers, we found that management primarily occurs during the spring and summer and is less frequently during the fall and winter. Of the human activities that could disturb shorebirds, walking dogs off leash is the most commonly regulated. But people are also least commonly compliant with these regulations. Managers believe that the best ways to reduce disturbance to shorebirds included fencing, informal outreach, and signage. More staff and volunteers are also needed to help reduce disturbance. In a subsequent survey of dog walkers, we learned why people leash (or do not leash) dogs near shorebirds. We found that people leash to protect shorebirds, keep dogs safe, control dogs, and keep dogs from bothering people. People choose not to leash because leashing prevents dogs from exercising and socializing, and people believe dogs respond to commands. People who leash dogs generally believe others expect them to leash their dogs near shorebirds. Knowing why people leash or do not leash can help predict leashing behavior and encourage dog walkers to voluntarily leash dogs near shorebirds. This thesis considers the needs of people and the needs of shorebirds as way to achieve effective conservation solution.

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Attributions

Ashley Dayer, my academic advisor and project supervisor, is a co-author of the two manuscripts that comprise this thesis and contributed significantly to the two chapters. She is the PI for both projects in this thesis. She wrote the proposals for the projects and contributed significantly to the study design, interpretation, and editing of the two chapters. Therefore, this thesis is written in the first-person plural voice.

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Introduction

Shorebird populations in North America have declined by approximately 70% since 1973 (North American Bird Conservation Initiative [NABCI], 2016). Declines are due in part to habitat loss and degradation (U.S. Fish and Wildlife Service [USFWS], 2012) as well as an increase in human use of coastal areas, which can reduce the amount of functional habitat available for shorebirds (Foster et al., 2009, Tarr et al., 2010). Due to the increase in human use, human disturbance is a significant threat to shorebirds during all seasons of their annual cycle (Atlantic Flyway Shorebird Initiative [AFSI], 2015; Hunt et al., 2019). According to managers and scientists in the Northeastern United States, human disturbance occurs when a human activity causes an individual or group of shorebirds to alter their breeding, foraging, or roosting activities, which can reduce fitness and survival (Mengak & Dayer, 2020). Using the Delphi technique, managers and scientists co-created a list of human activities that have the greatest potential to cause disturbances to shorebirds: direct harassment, dogs, beach raking, coastal engineering, general beachgoing, events, recreational fishing and shellfishing, motorized watersports, commercial fishing and aquaculture, unmanned aircraft, and wind powered aircraft (Mengak & Dayer, 2020).

Although often unintentional, human activities can cause harm to breeding and non-breeding shorebirds. Disturbance to breeding adult shorebirds can prompt anti-predator behaviors, such as distraction displays to lead predators away from nests. When human activities elicit these responses from adult shorebirds, nest attentiveness is reduced (Verhulst et al., 2001; Hoffmann, 2005; González et al., 2006), leaving eggs and chicks vulnerable to predation and thermal stress (Lord et al., 2001). In addition to indirect impacts, human activities can cause

direct mortality to shorebirds. For example, vehicles can crush shorebirds (Schulte & Simons, 2015) and people walking on the beach can destroy nests (Sabine et al., 2006; 2008). Human activities also impact non-breeding shorebirds by displacing them from important habitats (Tarr et al., 2010), reducing foraging rates (Burger & Gochfeld, 1991; Yasué, 2005), and body mass (Gibson et al., 2018). Land managers use various management techniques to reduce the potentially harmful impacts of human activities on shorebirds. Managers often create closed areas for shorebirds using symbolic fencing, which consists of 1–2 rows of string between posts around shorebird nesting areas (USFWS, 1996; Forys et al., 2016). Regulatory signs are often attached to symbolic fencing to notify the public about legal protections afforded to shorebirds and sanctions for violating rules (Mengak & Dayer, 2019). When physical closures are not feasible, managers restrict human activities by limiting the season, time, or types of activities (USFWS, 1996; Massachusetts Division of Fisheries and Wildlife, 1993). Managers also use outreach programs to educate the public about the impacts of human activities on shorebirds and to increase compliance with regulations and beach closures (Ormsby & Forys, 2010). Education and outreach involving stewards, who are on the beach to interact with beach recreationists, is particularly effective at keeping people out of closed areas (Forys et al., 2011).

Although management techniques can be effective at reducing disturbance, not all techniques are feasible across the Atlantic Flyway, which is a vast network of diverse management sites (Winn et al., 2013). Ecological conditions vary among and within sites, which might cause managers to deviate from recommended guidelines such as buffer distances (Cohen et al., 2010; USFWS, 1996). Furthermore, some land managers have the dual mission of promoting recreation and preserving wildlife (Lafferty et al., 2006), so some sites may have less human activity restrictions than others, depending on site objectives. Given the variety of factors

influencing management at each site, the extent that human disturbance is managed and how it is managed is not well understood. In situations where information gaps exist, social science methods can be used to document and describe the diversity of conservation practices (Bennett et al., 2017). In Chapter 1, we use a social science survey of land managers and biologists intimately familiar with site-level management to understand the state of human disturbance management across the United States and Canada portions of the Atlantic Flyway.

In addition to understanding and describing the processes involved in managing disturbance, social science methods can also be used to inform management actions that reduce human disturbances. One of the top ranked potential human disturbances that shorebirds face is dog walking (Mengak & Dayer, 2020). Dogs have been documented to prey upon shorebird chicks (Lafferty et al., 2006), crush eggs (Weston et al., 2012), disrupt foraging behavior (Lafferty, 2001b), and induce anti-predator behaviors in adults (Burger, 1986), which can deplete energy reserves needed for migration (Navedo et al., 2019). When dogs are present on beaches, shorebirds are less abundant and spend more time alert, relative to resting (Hunt et al., 2019). Shorebirds perceive dogs as predators and have been shown to respond to dogs at a greater distance than humans (Lafferty, 2001b). Reducing the frequency of unleashed dogs could reduce disturbance by making it difficult for dogs to chase birds (Lafferty, 2001a). Social science can also be applied to identify effective ways to successfully achieve goals to change human behavior (Bennett et al., 2017), such as encouraging people to leash dogs to decrease interactions between shorebirds and off-leash dogs. Specifically, community-based social marketing (CBSM) is an approach that can be used to inform and create sustainable behavior change (McKenzie-Mohr, 2011). In Chapter 2, we apply a CBSM approach to inform strategies to promote voluntarily leashing dog near shorebirds, because an assessment of feasible behaviors by Comber

and Dayer (2019) showed that this behavior would have a high impact, high probability of being adopted by dog walkers, and low penetration among dog walkers. Thus, we sought to understand the benefits and constraints to leashing dogs. Together, the two studies in this thesis embrace social science to aim to bridge the needs of people and the needs of shorebirds to produce effective conservation outcomes (Dayer et al., 2020).

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Chapter 1. Understanding the management of human disturbances to shorebirds across the Atlantic Flyway of the U.S. and Canada

Abstract

Human disturbance is one of the most significant threats to shorebird populations. However, there is little information about managers' efforts to reduce disturbances along the Atlantic Flyway. To create an understanding of practices to reduce disturbances, we surveyed land managers along the U.S. and Canada portions of the Atlantic Flyway. We found that general beach going and unleashed dog walking were the most common human disturbance activities at sites in the last five years. Restrictions to potential disturbance activities were most common during the breeding season and were minimal during the non-breeding season. Unleashed dog walking was the most commonly restricted activity; yet, leashed and unleashed dog walking had the lowest levels of public compliance. Managers noted that fencing, informal outreach, and signage are the most effective techniques for encouraging compliance. To continue efforts to reduce disturbance, managers need more staff and volunteers. Our results can guide organizations and agencies to make more informed decisions about where to invest time, effort, and resources to support managers in addressing human disturbance to shorebirds.

Keywords: management; shorebirds; human disturbance; Atlantic Flyway, human dimensions; research-implementation gap

Introduction

Shorebird populations across North America have declined by approximately 70% since 1973 (NABCI, 2016). One of the most serious threats to shorebird populations is human disturbance (AFSI, 2015). Human disturbance to shorebirds has been defined by managers and scientists as a change in shorebird behavior in response to human activities, causing shorebirds to expend energy and ineffectively use key habitats (Mengak & Dayer, 2020). Human disturbance also prevents shorebirds from carrying out components of their annual cycle that would normally occur without human interference (Mengak & Dayer, 2020). Over time, the impacts of human activities may reduce shorebird productivity and survival rates (Mengak & Dayer, 2020). Also, according to managers and scientists, top human disturbances to migrating shorebirds on the Atlantic Flyway of the United States include beach driving, dogs, direct harassment, beach raking, coastal engineering, general beachgoing, events, recreational fishing and shell fishing, motorized watersports, commercial fishing and aquaculture, unmanned aircraft, and wind powered aircraft (Mengak & Dayer, 2020). Because shorebirds experience threats and pressures from human activities during all portions of their annual cycle (NABCI, 2016), understanding the extent that these potential disturbances exist and are managed can allow agencies and organizations to develop more effective strategies to address the threat of human disturbance.

To address human disturbance and the related decline of shorebird species (NABCI, 2016), coastal land managers follow conservation plans, which outline techniques to mitigate disturbances for at-risk, threatened, and endangered shorebird species (e.g., USFWS, 1996, Schulte et al., 2007; Niles et al., 2010). These plans recommend management techniques, or measures that prevent direct and/or indirect harassment and mortality (USFWS, 1996). Management techniques may include conducting outreach and educational programs, protecting

critical shorebird habitats, using law enforcement, and prohibiting or restricting potential disturbance activities (USFWS, 1996; Schulte et al., 2007; Niles et al., 2010). Restrictions can put limitations on the time of day or year or the areas where human activities are allowed. Areas where activities are prohibited are referred to as closures and are designated using signs and symbolic fencing (1–2 rows of lightweight string tied between posts; USFWS, 1996).

Restrictions on activities and site closures are not uniform throughout the year because sites may have at-risk species at certain times of the year, causing managers to use more intensive efforts to fulfill recommendations for at-risk species (USFWS, 1996). Also, some organizations and agencies such as the U.S. Fish and Wildlife Service have experienced major budget and staff reductions (Siemer et al., 2018) so managers might not have the resources needed to implement recommendations throughout the entire year. Furthermore, geographic or ecological conditions can vary among and within sites, causing managers to deviate from recommended guidelines (Cohen et al., 2010). Lastly, some managers have differing abilities to meet recommendations because they have the dual mission of promoting recreation and preserving wildlife (Lafferty et al., 2006). Therefore, managers may need to make compromises on when or where they close beaches to balance their agency or organization's competing goals. Since management recommendations are not always translated into action (known as the research-implementation gap), the extent that activities are restricted and when restrictions occur is not well known (Knight et al., 2008).

Additionally, the effectiveness of various management techniques such as outreach, education, closures, and law enforcement has not been widely studied. Published evaluations of management techniques typically provide insights from a limited geography and/or a limited number of management techniques. Moreover, management techniques often are combined and

are not evaluated independently or in comparison. For example, the breeding success of hooded plover at Mornington Peninsula National Park, Victoria, Australia, was due to the combination of management techniques such as fencing, signage, temporary beach closures, regulation, education, and outreach (Dowling & Weston, 1999). One approach to assess effectiveness is to study shorebird managers' perceptions of management because they are aware of the daily management operations, witness interactions between people and shorebirds, and observe compliance (or lack of compliance) with restrictions on beach activities.

Public compliance can vary by activity, for example, Burger & Niles (2013), showed that compliance with avoiding shorebirds at New Jersey beaches was low for joggers and dog walkers but high among anglers and bird watchers. Although compliance has been studied for some activities, compliance related to emerging issues, such as wind-powered aircraft and unmanned aircraft is not well understood (Mengak & Dayer, 2019). Compliance also can vary based on resource availability and staff capacity. For example, when law enforcement officials are able to respond, they dramatically improve compliance with restrictions (Hatch, 1996) and can be effective in resolving conflict between humans and wildlife (Baruch-Mordo et al., 2011). However, law enforcement officials have noted that because of a lack of funding, they are not always able to pursue violators in the field (Eliason, 2011). Understanding the level of public compliance with various restrictions at a Flyway scale could allow agencies and organizations to ascertain where more research is needed and what efforts are successful.

Enhancing the effectiveness of management or addressing compliance issues may require additional resources; yet, resource needs of managers are not well documented. A site-based assessment of resource needs, the extent of human disturbance activities, efficacy of management, and level of compliance at each location along the Atlantic Flyway would be a

time-consuming effort that might not be practical due to the urgent need for conservation action (AFSI, 2015). Alternatively, information gaps can be reduced relatively quickly and with little resources through expert elicitation (Donlan et al., 2010), which is an approach to systematically consult experts on uncertain issues (Knol et al., 2010). Such social science methods can be valuable for documenting and describing conservation practices and diagnosing the drivers of conservation effectiveness (Bennett et al., 2017; Kidd & Dayer, 2020). We used a survey of land managers and biologists with intimate knowledge of sites along the Atlantic Flyway to determine the current management practices to reduce human disturbance to focal shorebird species (AFSI, 2015). In particular, we elicited knowledge from land managers at sites that are part of Important Bird Areas (IBAs) in the U.S. and Canada portions of the Atlantic Flyway that are known to provide habitat for the focal shorebird species.

Research Questions

This study examined the following questions:

(1) What potential human disturbance activities are present at sites?

(2) To what extent are potential human disturbance activities restricted and sites closed, and when do restrictions and closures occur?

(3) How effective do managers perceive management techniques to be at reducing human disturbance to shorebirds?

(4) How compliant with restrictions on potential human disturbance activities do managers perceive the public to be?

(5) What do managers need in order to better manage human disturbance?

Methods

Survey Sampling Frame

We studied land managers across the Atlantic Flyway from sites within global IBAs, ranging from Atlantic Canada to southern Florida. IBAs are locations deemed by Bird Life International as critical areas for the conservation of various bird species around the world (Bird Life International, 2017). These areas are often broad regions that transcend political boundaries with multiple land management agencies or organizations overseeing different sites within a given IBA. Along the United States portion of the Atlantic Flyway, there are 169 coastal locations with this designation that, according to National Audubon Society (2017), have federally threatened Piping Plovers (*Charadrius melodus*), federally endangered Red Knots (*Calidris canutus*), and/or American Oystercatchers (*Haematopus palliates*), which are a species of concern in the United States. Along the Atlantic Canada portion of the Atlantic Flyway, there are 55 coastal IBAs with global, state, or continental priority that, according to IBA Canada Important Bird Areas (2017), have Piping Plovers (*Charadrius melodus*), Red Knots (*Calidris canutus*), and/or American Oystercatchers (*Haematopus palliates*).

Using information from Bird Life International's Canada and U.S. partner websites (e.g., Bird Studies Canada, Nature Canada, and the National Audubon Society), we created a list of these IBAs and the organizations or agencies that own shorebird habitat within each IBA. After creating this list, we searched organization or agency websites to identify employees who would be most knowledgeable about shorebird management for each listed organization/agency. In cases where we were unable to identify the best contact person, we sent the list to shorebird state coordinators and Audubon coastal bird coordinators and asked for their assistance in identifying the correct contact for those missing organizations or agencies. We also asked them to verify that the list of contacts was accurate and complete. The survey sampling frame for the sites within the

IBAs included federal, state, provincial, municipal, tribal, academic, industry, and NGO land managers and field biologists (hereafter land managers) who were intimately aware of site management (hereafter, land managers) for shorebirds.

Because some IBAs are not managed for shorebirds and/or contacts could not be identified (sites such as sand spoils where ownership was contested by stakeholders and therefore not explicitly managed by any person or organization), 8 of the 169 coastal IBAs in the United States and 6 of the 55 coastal IBAs in Atlantic Canada were not included in this study. Within our database, there were 56 land managers responsible for lands within two or more IBAs. To reduce respondent burden, we randomly selected which site(s) we would ask managers of more than one site to reference for their responses. Sites were randomly selected with a random digit generator. For managers of 2–3 IBAs, only one site was selected; for managers of 4–6 IBAs, two sites were selected; for managers of seven or more IBAs, three sites were selected. Due to this method of random selection, 21 of 55 IBAs in Atlantic Canada and 96 of 169 IBAs in the United States were represented in the sample database for survey invitations. Since some IBAs have multiple jurisdictions, more than one manager was contacted for 69 IBAs. In these cases, the respondents were asked to refer to their management unit within an IBA, rather than to an entire IBA region.

Survey Design

The survey measured characteristics of sites within IBAs, the types of potential human disturbances that have occurred either legally or illegally in the last five years, restrictions related to potential human disturbances, when restrictions occur, managers' perceptions about the effectiveness of management techniques, level of public compliance with restrictions, and the needs of land managers to protect breeding and non-breeding shorebirds from human

disturbances. The human disturbances categories referenced in this survey were selected based on the top human disturbance categories reported by managers and scientists in the Northeastern region of the United States (Mengak & Dayer, 2020). Only survey items (Table 1) used in analyses reported in this manuscript are discussed here.

Survey questions varied in format but were primarily close-ended. In some cases, if the answer choices provided were not relevant to a participant, the participants had the option to select "other," which allowed for text entry. The survey was pilot tested by individuals with experience managing shorebirds but who were not part of the sampling frame. It was also reviewed by the Atlantic Flyway Shorebird Human Activities Committee and members of the Virginia Tech Shorebird Program.

Table 1. Research questions and associated survey items.

	Research Question	Survey Item
RQ1	What potential human disturbance activities are present at sites?	Within the last five years, which human activities have been known to occur at your site(s) either legally or illegally? Select all that apply. General beachgoing, Beach driving, Unleashed dog walking, Leashed dog walking, Events, Motorized watersports, Non-motorized watersports, Commercial fishing, Recreational fishing and shellfishing, Unmanned aircraft, Wind-powered aircraft , Beach raking/scraping, Coastal engineering, Other (please specify)
RQ2	To what extent are potential human disturbance activities restricted and sites closed, and when do restrictions and closures occur?	Activities on the beach may be restricted for the protection of shorebirds during the breeding season (April–June), the migration season (July–November), and/or the winter season (December-March). For each activity, please select the season(s) in which each activity is restricted, if at all restricted at your site(s). General beachgoing, Beach driving, Unleashed dog walking, Leashed dog walking, Events, Motorized watersports, Non-motorized watersports, Commercial fishing, Recreational fishing and shellfishing, Unmanned aircraft, Wind-powered aircraft, Beach raking/scraping, Coastal engineering, Other (please specify) During which months are areas at your site(s) closed for the protection of shorebirds? Please select all that apply. January, February, March, April, May, June, July, August, September, October, November, December, None of the above
RQ3	How effective do managers perceive management techniques to be at reducing human disturbance to shorebirds?	Based on your experience and/or data from your site(s), to what extent are the following practices effective at reducing human disturbances to shorebirds? [response options included: very effective to very ineffective]. Fencing, signs (official postings, interpretive kiosks), informal outreach by staff and volunteers during monitoring, outreach/interpretation efforts, informational materials (brochures, fliers, activity pages), law enforcement, community engagement/stewardship (volunteer dog monitors, education docents, citizen science).
RQ4	How compliant with restrictions on potential human disturbance activities do managers perceive the public to be?	Based on your experience and/or data from your site(s), to what extent do you think the public is compliant with restrictions related to the following activities? [response options included: very compliant to very uncompliant]. General beachgoing, Beach driving, Unleashed dog walking, Leashed dog walking, Events, Motorized watersports, Non-motorized watersports, Commercial fishing, Recreational fishing and shellfishing, Unmanned aircraft, Wind-powered aircraft, Beach raking/scraping, Coastal engineering, Other (please specify)

RQ5	What do managers need in order to better manage human disturbance?	What resources do you think would improve your efforts to reduce potential human disturbances to shorebirds at your site(s)? Select all that apply. More training, More staff, More volunteers, More funding for needs that aren't personnel related, More biological information, More social science information, Other (please specify)

Survey Implementation

We implemented the land manager survey from August – December 2018. Participants who did not respond to the initial request received up to two follow up emails and/or a phone call reminder. We contacted respondents who managed 1–3 IBAs by email and provided them with a link to take an online survey about one of their sites using Qualtrics online survey platform. Land managers who managed four or more IBAs (n = 16), were invited through email to take the survey via phone because they had to answer for two or more IBAs. For managers who chose to take the survey via phone, a time was scheduled, and the survey was administered verbally as the respondent visually followed the survey online to minimize differences in response due to the mode of survey (Dillman, 2014). This approach reduced respondent burden, allowing land managers to take the survey once and note to the researcher which items required a different response for certain sites. The researcher then input one survey for each of these sites. This research was conducted with approval from, and in accordance with, the Virginia Tech Institutional Review Board (Protocol #16–1071).

Survey Analysis

We conducted descriptive statistics analyses using IBM SPSS Statistics for Windows (Version 26). The results are presented with "sites within IBAs" as the unit of analysis except for our analysis of characteristics of participants and non-response bias, which are analyzed with respondent as the unit of analysis. We used chi-square analysis to check for non-response bias, comparing respondents and nonrespondents (binary) on two variables: organization type (e.g., federal, state, NGO, etc.) and the region (Northeast or Southeast) where the individuals' associated IBAs are located. To analyze effectiveness (RQ3), we collapsed the response options so "very effective" and "somewhat effective" are combined as "effective and "very ineffective"

and “somewhat ineffective” are combined as “ineffective.” Similarly, to analyze compliance (RQ4), we collapsed the response options so “very compliant” and “somewhat compliant” are combined as “compliant and “somewhat uncompliant” and “very uncompliant” are combined as “uncompliant.”

Results

Survey Response

We contacted 191 individuals to take the survey. Of those individuals, 37 were not the appropriate contacts for the survey, were not available due to work leave or travel, or worked with someone who co-manages the same site and already took the survey; this group was considered “ineligible.” Subsequently, some ineligible individuals put us in touch with alternative contacts who were available or better suited to take the survey. We emailed the survey to the alternative contacts who were not in the original database (n = 7), which brought the adjusted number of people eligible participants to 161. From the adjusted sample, 110 people took the survey, 51 did not respond or opted out of the survey, making the survey response rate 68.3%. The chi-square analysis showed no significant difference ($p > .05$) among the management type and region of respondents and non-respondents.

Characteristics of Surveyed Participants and Sites Within IBAs

The survey participants (n = 110) were from the following organizational types: federal (n = 35; 31.8%), state/provincial (n = 32; 29.1%), municipal (n = 9; 8.2%), NGO (n = 31; 28.2%), academic (n = 1; 0.90%), and industry (n = 2; 1.8%). Participants managed sites within IBAs in the following states/provinces: Connecticut (n = 2; 1.8%), Delaware (n = 5; 4.5%), Florida (n = 24; 21.8%), Georgia (n = 5; 4.5%), Massachusetts (n = 11; 10.0%), Maryland (n = 3; 2.7%), Maine (n = 1; 0.9%), North Carolina (n = 6; 5.5%), New Jersey (n = 8; 7.3%), New York

(*n* = 11; 10%), Rhode Island (*n* = 2; 1.8%), South Carolina (*n* = 6; 5.5%), Virginia (*n* = 9; 8.2%), New Brunswick (*n* = 6; 5.5%), Newfoundland and Labrador (*n* = 3; 2.7%), Nova Scotia (*n* = 4; 3.6%), Prince Edward Island (*n* = 2; 1.8%), and Quebec (*n* = 2; 1.8%; Figure 1). We focused this study on sites that, according to IBA partner websites, had either Piping Plovers (*Charadrius melodus*), Red Knots (*Calidris canutus*), or American Oystercatchers (*Haematopus palliates*). But through our data collection, we learned that (*n* = 9) 7.1% of the surveyed sites did not have these species. Despite this discrepancy, those nine sites did have focal shorebird species that are of interest to the Atlantic Flyway Shorebird Initiative so we retained them in our analysis. Of the 127 sites, 87.6% had Sanderlings *Calidris alba*; 83.7% had Ruddy Turnstones *Arenaria interpres*; 82% had Greater Yellowlegs *Tringa melanoleuca*; 81.4% had Semipalmated Plovers *Charadrius semipalmatus*; 79.8% had Piping Plovers *Charadrius melodus*; 69% had American Oystercatchers *Haematopus palliates*; 67.4% had Red Knots *Calidris canutus*; 59.7% had Lesser Yellowlegs *Tringa flavipes*; 49.6% had Whimbrels *Numenius hudsonicus*; 31.8% had Wilson's Plovers *Charadrius wilsonia*; 27.9% had Marbled Godwit *Limosa fedoa*; 18.6% had Purple Sandpipers *Calidris maritima*; 14.7% had American Golden Plovers *Pluvialis dominica*; 12.4% had Snowy Plovers *Charadrius nivosus*; and 3.1% had Red-necked Phalaropes *Phalaropus lobatus* on an annual basis at some point during the year. The sites were most commonly characterized as sandy beach habitats (*n* = 108; 88%), followed by intertidal (*n* = 98; 80%), saltmarsh (*n* = 91; 74%), mudflat (*n* = 85; 69%), and estuary habitats (*n* = 66; 54%). Less commonly occurring habitats included rocky beach (*n* = 35; 29%), human-made substrate (*n* = 26; 21%), and mangrove (*n* = 17; 14%).

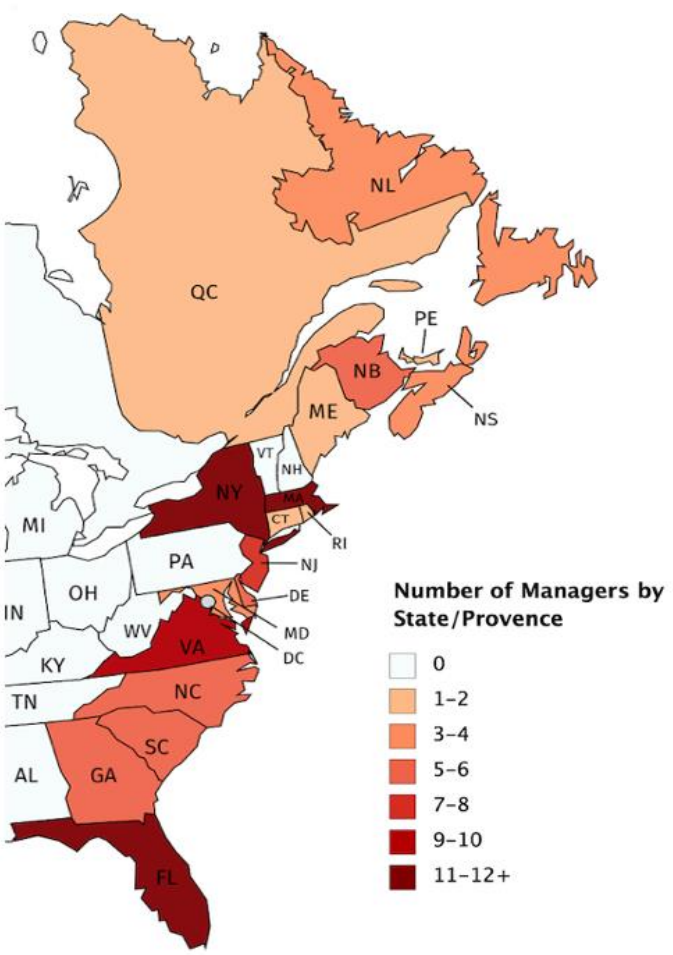

Figure 1. The number of managers that participated in the survey per state/province along the Atlantic Coast of North America.

Potential Human Disturbance Activities at Sites

At 91% of the sites within IBAs, managers reported that general beachgoing was known to occur, either legally or illegally in the last five years, followed by unleashed dog walking at 85% of the sites (Figure 2). Recreational fishing and non-motorized watersports, leashed dog walking, motorized watersports, and beach driving were reported at more than half of the sites. Unmanned aircraft, events, commercial fishing, wind-powered aircraft, and coastal engineering were reported at less than half of the sites. Beach raking/scraping was reported at only 16% of sites.

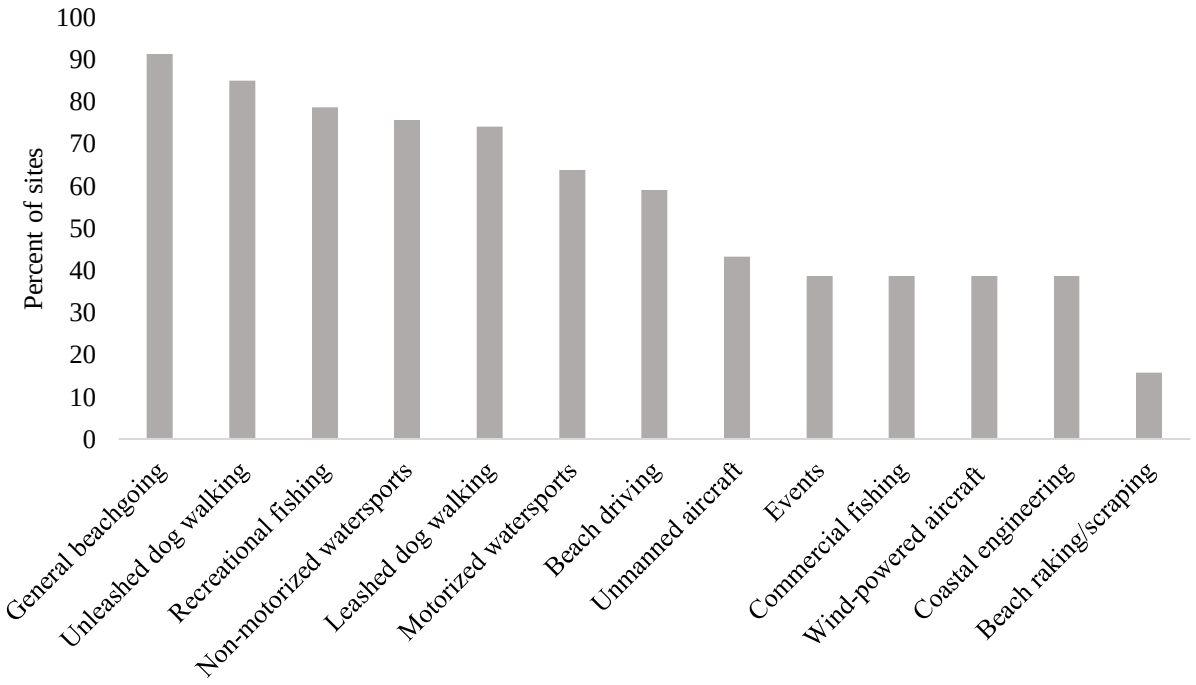

Figure 2. The percent of sites within Important Bird Areas along the U.S. and Canada portions of the Atlantic Flyway where potential human disturbance occurred either legally or illegally in the last five years.

Seasonality of Managing Human Disturbances with Restrictions and Site Closures

Unleashed dog walking was the most commonly restricted activity year-round, followed by beach driving, and leashed dog walking (Figure 3). All other activities were restricted at less than half of the sites throughout the year. Restrictions varied based on the time of year, with most restrictions occurring during the breeding season, followed by migration, and finally winter. Some activities were restricted using full or partial closures, which for this research, we define as sections of beaches or entire beaches where human access is prohibited for the protection of shorebirds. Approximately 78% of the surveyed sites within IBAs had full or partial closures at some point during the year. Closures were most common from April through August; over 60% of sites had some type of closure during these months (Figure 4). Although there were closures at the beginning of the southward migration season (July-November), the percent of sites with closures dropped by more than half after August; only 29% of sites had

closures beginning in September and that declined throughout the migration season. The percent of sites with closures declined even more during the winter season; only 15–20% of sites maintained some type of site closure for the protection of shorebirds during these months.

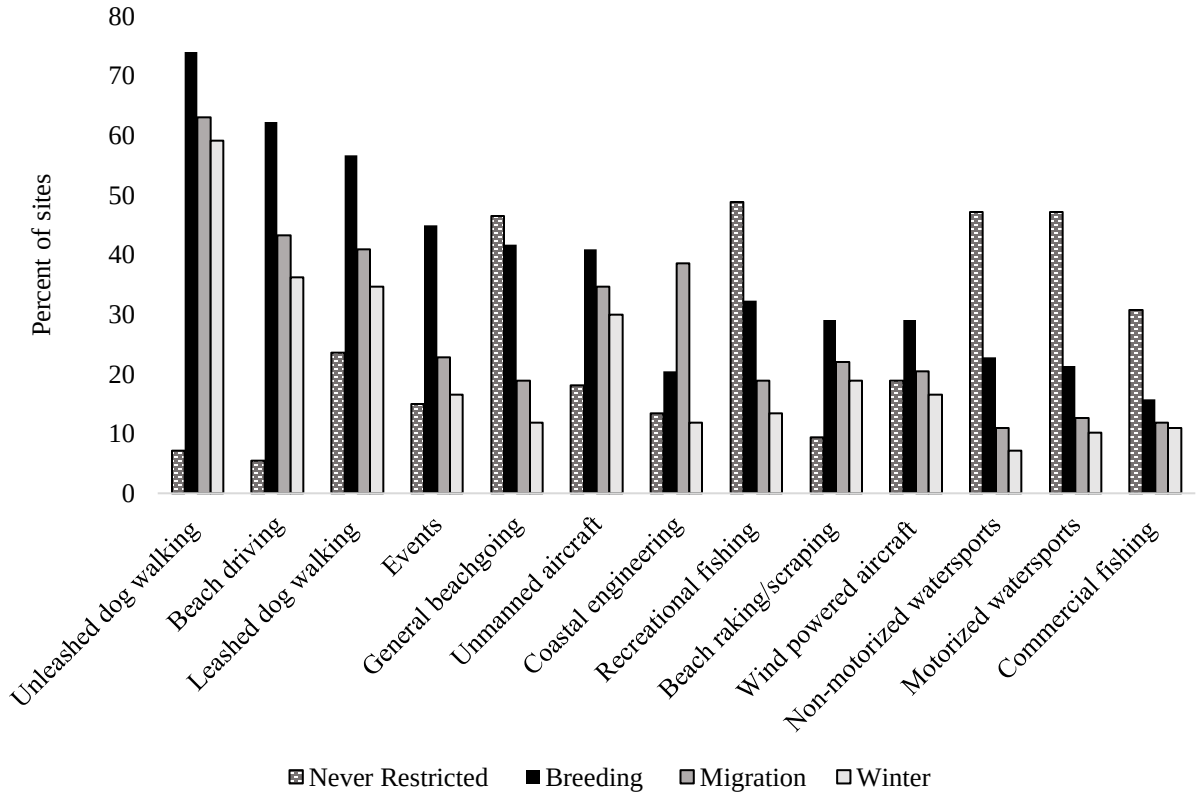

Figure 3**.** The percent of sites within Important Bird Areas along the U.S. and Canada portions of the Atlantic Flyway that have restrictions for potential human disturbances during the breeding, migration, and/or winter seasons.

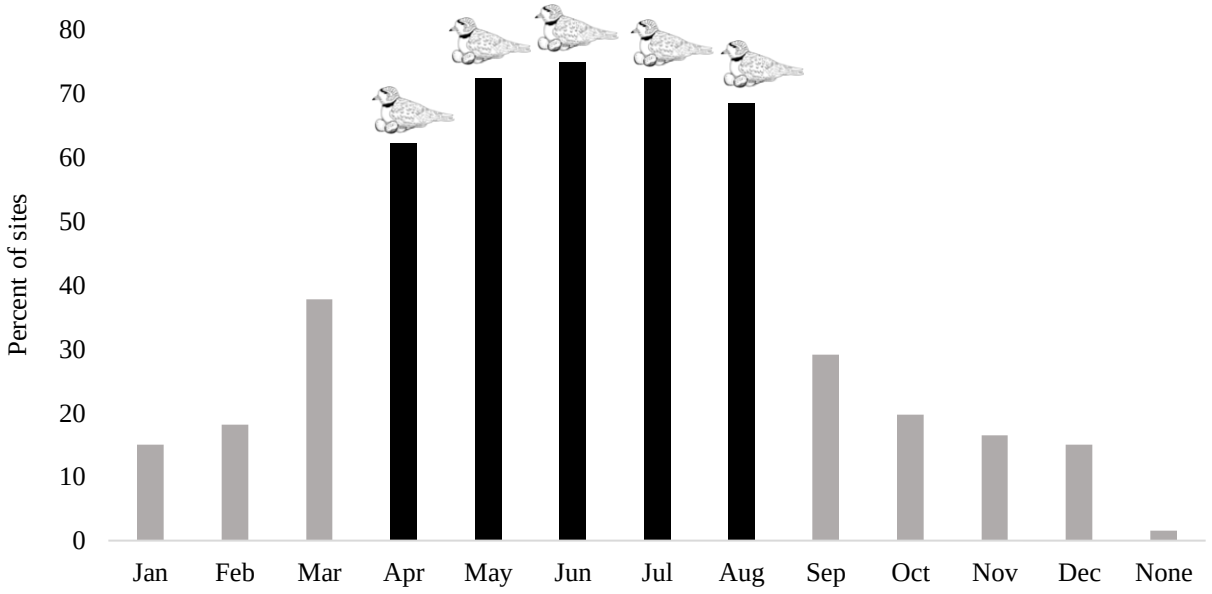

Figure 4. The percent of sites within Important Bird Areas along the U.S. and Canada portions of the Atlantic Flyway that have full or partial closures throughout the year. Months typically considered breeding season at most sites along the Flyway are depicted by black bars and the shorebird icon.

Perceptions of the Effectiveness of Human Disturbance Management

Managers at over 90% of the sites felt that fencing, informal outreach, and signs were effective tools to reduce human disturbance (Figure 5). Managers at over 80% of the sites noted that community engagement and formal outreach efforts were also effective methods for reducing human disturbance. Managers at 75% of the sites rated law enforcement as being effective. In an open-ended section for additional thoughts at the end of the survey, some managers indicated that law enforcement staff are sometimes ineffective because they are not always able to respond to incidents due to the large geographies they cover. Managers perceived informational materials to be the least effective method (50%) for reducing potential human disturbances and also had the greatest frequency of neutral responses (26.7%).

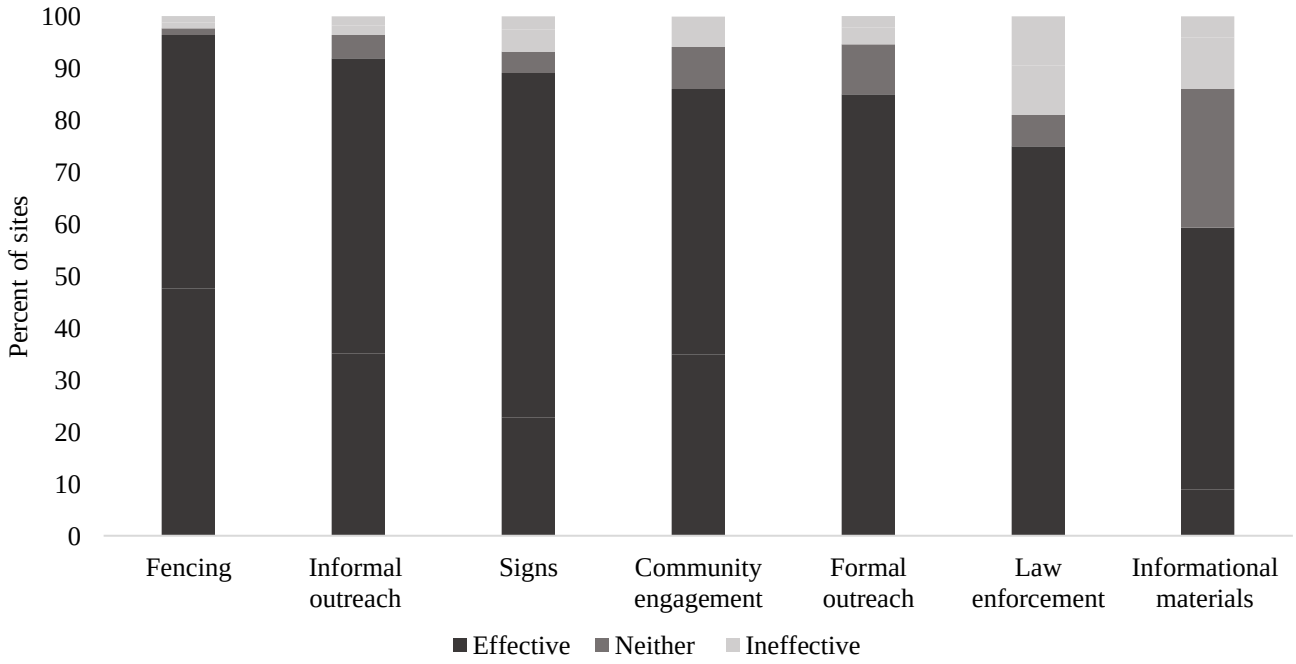

Figure 5. The percent of sites within Important Bird Areas along the U.S. and Canada portions of the Atlantic Flyway where managers report their perceptions about the effectiveness of various management techniques at reducing potential human disturbances to shorebirds.

Perceptions about Public Compliance

Managers at over 80% of sites reported that there is compliance with restrictions related to coastal engineering, events, recreational fishing, and non-motorized watersports (Figure 6). Managers at 60% of site reported compliance with restrictions related to beach raking/scraping, general beachgoing, beach driving, commercial fishing, recreational fishing, and motorized watersports. Managers at approximately half of the sites reported compliance with restrictions on wind-powered aircraft and unmanned aircraft. Compliance with unleashed dog walking and leashed dog walking were believed to be lowest, with less than half of the sites having public compliance according to managers.

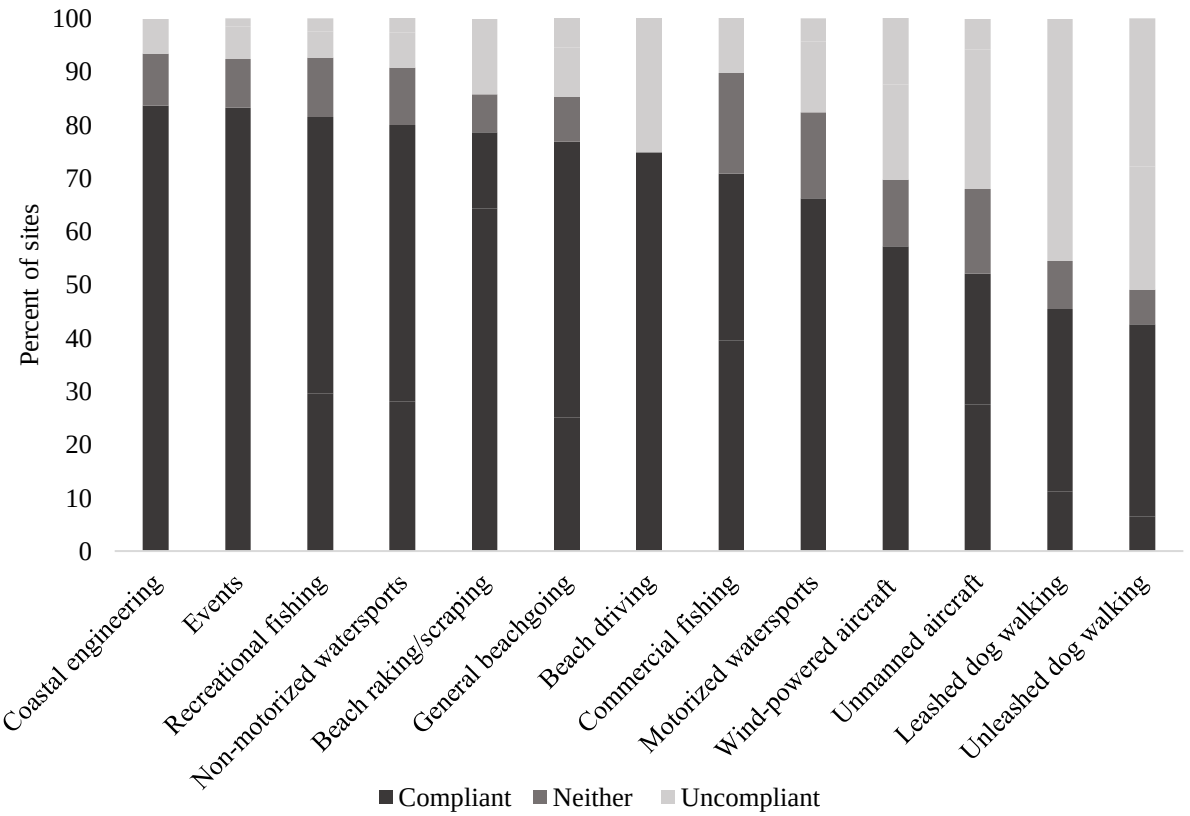

Figure 6. The percent of sites within Important Bird Areas along the U.S. and Canada portions of the Atlantic Flyway where managers perceive public compliance with restrictions relating to potential human disturbances.

Resource Needs

The greatest reported resource needs to improve efforts to reduce potential human disturbances to shorebirds were more staff at 72% of the sites, followed by more volunteers at 61% of the sites (Figure 7). Approximately 35% of managers desired more social science information. Specifically, some managers wrote in the additional comment section that they wanted more social science information related to communicating with the public. Less than 30% of managers reported needing funding for non-personnel related expenses (i.e., signs, vehicles, and other forms of equipment). About 23% of managers reported needing more training at their sites, and just 16% noted needing more biological information.

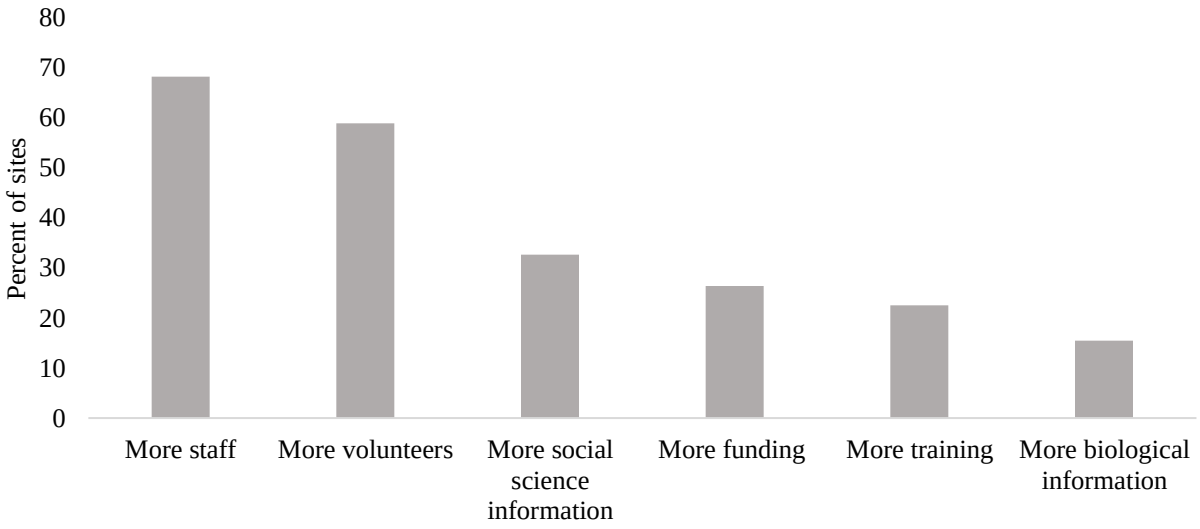

Figure 7. The percent of sites within Important Bird Areas along the U.S. and Canada portions of the Atlantic Flyway where managers believed various resources would improve their efforts to reduce potential human disturbances to shorebirds.

Discussion

Through a survey of land managers and biologists intimately familiar with land management, we found that potential human disturbance activities are widespread across the North American portion of the Atlantic Flyway. In particular, managers most commonly reported general beachgoing, either legally or illegally, occurred in the last five years at their sites. The literature suggests that restricting general beachgoing can provide migrating shorebirds with undisturbed areas to roost and forage (Burger & Niles, 2013) as well as protected areas to breed (Lafferty et al., 2006). However, some managers might not be able to restrict general beachgoing because their sites are designated as recreation areas (Lafferty et al., 2006). Additionally, restricting beach activities can lead to human-human conflict between people who support conservation measures and people who prioritize recreation (Dayer et al., 2017; Dickman, 2010). Therefore, to reduce disturbance from general beachgoing, we suggest that managers promote pro-shorebird conservation behaviors (e.g., community-based social marketing; McKenzie-

Mohr, 2011), such as voluntarily walking around shorebird flocks (Comber & Dayer, 2019) in situations where shorebirds and people use the same areas. Such an approach fosters coexistence of people and shorebirds, while aiming to limit disturbance and conflict (as described in Dayer et al., 2017).

Using voluntary approaches to limit disturbance and conflict throughout the year is especially important because we found that restrictions and closures are minimal during the non-breeding season. Restrictions and closures are currently focused on the breeding season possibly due to recommendations that managers protect shorebird nests during the breeding season (USFWS, 1996). Further, due to the difficulty some managers face in achieving public approval for closures and restrictions, they feel obliged to compromise by only implementing protective measures during the breeding season, when human use is the highest and when shorebirds are likely the most vulnerable (Everly et al., 2020). Seasonal restrictions may also be minimal during the non-breeding season as the impact of disturbance is not always apparent at stop-over sites because migrating shorebirds visit staging areas briefly (Pfister, 1992). However, research shows that disturbance is problematic during migration and can severely impact the ability of shorebirds to gain energy required for migration to their breeding grounds (Burger & Niles, 2014). As such, we encourage organizations and agencies to promote voluntary approaches to reduce disturbance during the non-breeding season. Voluntary approaches can include initiating programs such as "Space to Roost," where beach recreationists are asked to "give shorebirds space" by voluntarily avoiding roosting sites for migratory birds during high tide (Cragg-Fahey, 2020).

Additionally, managers can identify critical habitats for non-breeding shorebirds and establish protected areas using fencing, signage, and informal outreach because those techniques were believed to be effective for reducing disturbance. Biological research often suggests that

fencing or closing parts of beaches to reduce disturbances can provide shorebirds with undisturbed areas to forage, roost, and breed (Ikuta & Blumstein, 2003; Lafferty et al., 2006; Schlacher et al., 2013; Burger & Niles, 2014). Although the literature shows that signs and symbolic fencings are generally effective at minimizing human disturbance, some researchers have documented exceptions where people enter protected areas (Bridson, 2000; Forys et al., 2016). Because signage and fencing are generally useful, but not completely effective, agencies and organizations that rely on signs and fencing to mitigate disturbance could invest efforts into research on communication techniques related to shorebird conservation, specifically research on which messages are most effective and when messages are most effective (Kidd & Dayer, 2020).

Adding to the literature on effectiveness of management techniques, the majority of managers rated law enforcement as being effective for reducing disturbance, but there was less agreement on the effectiveness of enforcement than for other techniques (e.g., fencing, informal outreach, signs) except informational materials. Some managers noted in a write-in section that law enforcement can be ineffective due to their lack of presence and the length of time it takes to respond to an incident. In a study on issues facing conservation law enforcement, wardens noted that lack of funding impacted their ability to pursue violators in the field (Eliason, 2011). However, when law enforcement officials are able to respond, they dramatically improve compliance with restrictions (Hatch, 1996) and can be effective in resolving conflicts between humans and wildlife (Baruch-Mordo et al., 2011). Thus, we recommend organizations and agencies assess if more law enforcement is needed, if it is feasible to provide more law enforcement, or if an alternative approach that does not require law enforcement (e.g., promoting voluntary compliance [Arias, 2015]) is necessary to enhance compliance.

One alternative approach used to promote voluntary compliance is social marketing (Smith et al., 2020). Marketing-based approaches are useful for encouraging voluntary compliance with behaviors that are socially important but may not be germane to an individuals' personal motivations (Brennan & Binney, 2010). Given that our findings show that dog walking has the lowest level of public compliance compared to other disturbance types, we propose that agencies and organizations use a marketing-based approach to encourage pro-shorebird behaviors such as leashing dogs on beaches. A marketing-based approach that capitalizes on norms might be particularly effective for reducing disturbance from dog walking because dog owners respond to the presence of other recreationists rather than the presence of the leash laws (Jorgensen & Bomberger-Brown, 2014).

Our findings also show that staff and volunteers are the greatest resources needed by managers. Therefore, researchers, organizations, and agencies that focus on reducing shorebird disturbance can support managers by providing them with training on how to communicate messages when staff are not present. In-person training sessions or webinars can focus on how to use principles and techniques outlined by Tilden (1957) and Ham (1992) to create interpretive materials such as signs, videos, or displays that communicate messages about reducing disturbance to shorebirds. Webinars or handbooks (e.g., National Audubon Society, 2018) can be provided to managers to help them better recruit, train, and retain volunteers or interns to fill short term staffing needs. Guidance documents (e.g., Giachello, 2007) can also be provided to managers to guide them through the process of creating community-based participatory partnerships so agencies and organizations can garner more assistance from volunteers or academic institutions when staff are limited. Furthermore, partnerships can facilitate

conversation among managers, allowing them to share lessons learned and solicit feedback pertaining to methods for reducing disturbance to shorebirds across the Atlantic Flyway.

Although the Atlantic Flyway is comprised of a diversity of sites with various recreational and ecological objectives, many insights can be gained by assessing human disturbance on a broad scale. For example, understanding the level of public compliance with restrictions on potential disturbances can allow agencies and organizations to evaluate where more research is needed. Additionally, understanding the extent to which activities that may cause disturbance exist and are managed can help organizations and agencies develop effective strategies to address the most prominent human disturbance threats. These insights can be strengthened by conducting an in-depth analysis of observations of human activities and bird presence/absence or behavior (similar to the study conducted by Hunt et al., 2019). Such future research would overcome the potential issue that managers perceptions in this current study may have been influenced by variables such as experience or recent events (Mezias & Starbuck, 2003). Furthermore, future studies could expand on our research by helping organizations and agencies determine if current approaches are accomplishing shorebird conservation goals or if agencies and organizations that support shorebird conservation efforts need to reassess their approaches to management.

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Chapter 2: Understanding Attitudes and Norms of Dog Walkers to Reduce Disturbances to Shorebirds

Abstract

Dog walking can disturb shorebirds. To inform disturbance reduction campaigns, we conducted a survey of dog walkers in Maine, New York and South Carolina to understand beach recreationists' attitudes about the benefits and constraints of voluntarily leashing dogs on beaches and their social and personal norms related to leashing. Common perceived constraints to leashing included perceptions about reducing socialization for dogs, reducing exercise for dogs, and dogs listening to owners' commands. Common perceived benefits to leashing included perceptions about preventing dogs from running into areas for beach-nesting birds, increased safety for dogs, increased control by dog walkers, and keeping dogs away from other people. Benefits, location (i.e., state), and norms were strong predictors of the leashing frequency near beach-nesting birds. We discuss behavior change strategies to leverage social norms, decrease the constraints and increase the benefits of voluntarily leashing dogs near shorebirds.

Keywords: shorebirds; human disturbance; dog walking; leashing; community-based social marketing; social norms; Atlantic Flyway

Introduction

Most dog walkers do not perceive their dogs as a threat to shorebirds (Williams et al., 2009); however, it is well-documented that dogs can have deleterious effects on birds (Banks & Bryant, 2007). Dogs can impact shorebirds by preying upon chicks (Lafferty et al., 2006), crushing eggs (Weston et al., 2012), disrupting foraging behavior (Lafferty, 2001), and inducing anti-predator behaviors such as flight-response (Burger, 1986). Impacts by dogs can cause adult birds to expend vital energy reserves that are necessary for migration (Navedo et al., 2019), and leave eggs and chicks vulnerable to predation and thermal stress (Lord et al., 2001).

Managers often try to minimize canine impacts by fully or partially closing beaches to dog walkers, primarily during breeding season (Comber & Dayer, 2019a), and enforcing buffer distances that prohibit dog walking near shorebird nesting areas (USFWS, 1996; Melvin et al., 1991). Although these restrictions are intended to protect shorebirds from dogs, people are not always receptive to these restrictions and often disregard them (Williams et al., 2009; Jorgensen & Bomberger Brown, 2014). Restrictions can lead to human-human conflict over the management of beaches for shorebirds (Dayer et al., 2017). Conflict over management and reduced compliance may be addressed by information campaigns, but these are often ineffective at changing awareness and attitudes (Jorgensen & Bomberger Brown, 2015), as well as behavior (Schultz, 2011).

Community-based social marketing (CBSM) has emerged as an alternative to information campaigns due to its emphasis on direct communication and community-level initiatives that remove constraints to behavior change (Kennedy, 2010). The CBSM approach consists of five steps: (1) select a behavior to promote; (2) identify perceived barriers (hereafter constraints)[1] and benefits to the behavior; (3) develop a strategy to reduce perceived constraints and increase

benefits; (4) pilot the strategy; and (5) implement and evaluate the strategy. Strategies for CBSM campaigns include social norms (i.e., encouraging people to act in a way that is consistent with their perceptions of other people's expectations), commitment (i.e., asking people to agree to do an action in the future), prompts (i.e., reminding people practice a behavior), incentives (i.e., providing a form of compensation for practicing a behavior), social diffusion (i.e., using trusted sources to encourage a behavior), convenience (i.e. making it easy to do a behavior), and communication (i.e., sharing information about a behavior in an interpretive manner) (McKenzie-Mohr, 2011). The use of such behavior change strategies to simultaneously reduce perceived constraints and increase benefits has been successful at promoting sustainable behavior change in a multitude of environmental contexts (McKenzie-Mohr, 2000).

Whereas to date no studies have applied a CBSM approach to explore how to effectively promote leashing on beaches, some studies (e.g., Bowes et al., 2017; Williams et al., 2009; Westgarth et al., 2010; Guinness et al., 2020) have examined benefits and constraints to leashing dogs on beaches (without necessarily using those terms). This research has typically been conducted through qualitative interviews (e.g., Westgarth et al., 2017), focus groups (e.g., Cutt, et al., 2008), or observational research (e.g., Rezac et al., 2011). Although prior studies provide useful insights through primarily qualitative methods, they are relatively narrow in geographic scope and have limited generalizability of insights.

To understand the benefits and constraints to leashing dogs on beaches for the protection of beach-nesting birds, we used the CBSM framework to study dog walkers in multiple states (New York, Maine, South Carolina) throughout the United States portion of the Atlantic Flyway. For our research, we considered constraints to be situational or personal factors that reduce the probability of engaging in environmental behaviors (Tanner, 1999), whereas benefits referred to

an individual's perceptions regarding positive outcomes associated with the behavior (Schultz, 2014). Survey items that assess benefits and constraints are typically attitudinal items because they measure whether a person feels favorably or unfavorably about a given situation (Ajzen & Fishbein, 1980). The Theory of Reasoned Action has demonstrated that attitudes, along with norms, are useful in informing behavior change campaigns (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). Social norms are informal rules of behavior that are shared by a group of people, and personal norms are a person's expectation of their own behavior (Schwartz 1973, 1977). Norms are not explicitly part of the second step of the CBSM approach (identifying constraints and benefits), but researchers such as Saylor et al. (2011) have included normative items in their benefits and constraint analysis. We compared benefits, constraints, and norms of those who walked dogs on leash and off leash. We also sought to evaluate how benefits and constraints predict the frequency that recreationists leash dogs near beach-nesting birds (Model 1) and then compared the traditional CBSM framework to a model that includes personal and social norms (Model 2; Figure 1). In doing this, we examined if understanding norms should be explicitly added to the second step of CBSM along with identifying constraints and benefits.

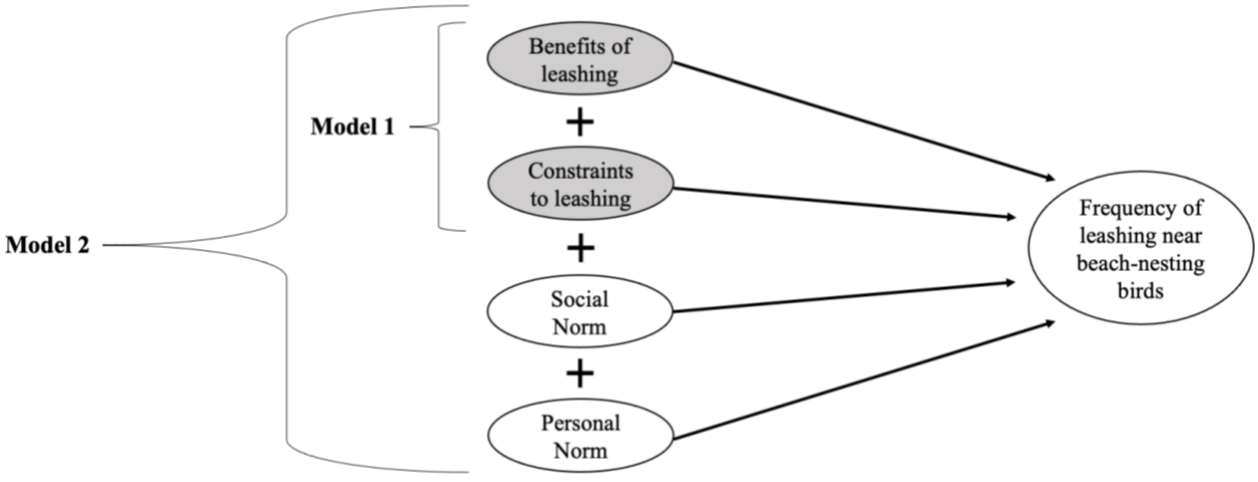

Figure 1. Model 1 included benefits and constraints (shown in grey) as predictors of the frequency that dog walkers leash near beach-nesting birds. Model 2 expanded on model 1 by

including the social and personal norms (shown in white) in addition to benefits and constraints as predictors.

Research Questions

This study examined the following questions:

(1) Do perceptions about benefits and constraints to leashing dogs differ between recreationists who leash dogs and recreationists who do not leash dogs near beach-nesting birds?

(2) Do personal and social norms related to leashing dogs for the protection of shorebirds differ between recreationists who leash dogs and recreationists who do not leash dogs near beach-nesting birds?

(3) Does the addition of personal and social norms to the typical CBSM model of perceptions about benefits and constraints to leashing improve the potential to predict the frequency that recreationists leash dogs near beach-nesting birds?

Methods

We conducted our research along the U.S. portion of the Atlantic Flyway, a well-established bird migration route that links breeding grounds from the Canadian Arctic Archipelago to non-breeding grounds as far as South America's southern tip, Tierra del Fuego (Niles et al., 2008). We selected three states on the Atlantic Flyway (New York, Maine, and South Carolina) due to presence of coastal habitats that support shorebirds during various portions of annual migration, beach habitats that attract recreationists, and leash laws on beaches that allow off-leash dog walking at some point during the year (for characteristics of the leash laws at research sites, see (Comber & Dayer, 2019b). We used historical shorebird habitat and

nesting data (Town of East Hampton Natural Resource Department, 2015; Zitske et al., 2016; McCollough, 2000) and citizen science records from eBird.org to select sites within each state that support the Atlantic Flyway Shorebird Initiative's focal shorebird species (AFSI, 2015). We conducted surveys of dog walkers on approximately six miles of sandy beach habitat in Maine, nine miles of sandy beach habitat in New York, and 11 miles of sandy beach habitat in South Carolina. In Maine, we conducted surveys at Gooch's Beach, Parson's Beach, Goose Rock Beach, and Old Orchard Beach. In South Carolina, we surveyed at Sullivan's Island Beach and Isle of Palms Beach. In New York, we surveyed at Louse Point Beach, Maidstone Park Beach, Beach Lane, Sammy's Beach, Gerard Beach, Indian Wells Beach, Atlantic Avenue Beach, Town Line Beach, Napeague Lane, Main Beach, Wiborg Beach, and Two-Mile Hollow Beach. The number of beaches in New York was greater than the number of beaches in Maine and South Carolina because the length of each beach in New York was smaller compared to the beaches in Maine and South Carolina. During the survey period, some research sites in New York and Maine had symbolic fencing (1–2 rows of lightweight string tied between posts; USFWS, 1996) to designate protected areas for beach-nesting birds, however, symbolic fencing was not present at research sites in South Carolina during the survey period.

Survey Design

We developed an intercept survey to understand the role of constraints and benefits of leashing dogs, social norms, and personal norms in predicting whether dog walkers leash their dogs in areas near beach-nesting birds. We conducted an observational study at Indian Wells Beach in East Hampton, NY for two consecutive days in May 2018 for approximately six hours a day. Two researchers recorded observations from a bench at the beach entrance and we maintained at least 20 feet from beach recreationists to ensure that our presence did not influence

the observed behaviors. To avoid attracting attention to researchers, we recorded observations in notebooks rather than on clipboards with data sheets. We also walked the beach to observe dog walkers near nesting areas out of view from the stationary location. We continued to stay at least 20 feet away from the dog walkers while we walked along the beach to avoid influencing them. During the observational study, we recorded the number of leashed and off-leash dogs that entered the beach, the number of dog walkers that acknowledged or ignored signs relating to dog walking, and changes in leashing activity such as taking leashes off or putting leashes on dogs. Observations were used to develop the intercept questionnaire.

Following the observational study, we conducted a pilot study using 20 interviews with dog walkers for two consecutive days at Indian Wells Beach. We asked participants open-ended questions that addressed: 1) perceived benefits of leashing dogs on beaches; 2) perceived constraints to leashing dogs on beaches; 3) behavioral intentions to leash; and 4) norms about leashing dogs at beaches, among other topics. As participants answered the questions, we recorded their responses on paper. Then we transcribed and qualitatively analyzed the responses from the open-ended interviews to identify appropriate survey response options.

The on-site survey consisted of questions related to constraints and benefits of leashing dogs, dog walkers' social and personal norms, and the frequency that dog walkers leash in areas near beach-nesting birds. Given the responses from the interviews, constraint and benefit questionnaire statements focused primarily on perceived issues for the dogs themselves (e.g., prevents dogs from socializing), rather than dog walkers (e.g., their own exercise priorities). For a full list of the five constraint items and the six benefit items see Table 1. We assessed dog walkers' personal and social norms (Table 1) using questionnaire items adapted from Vining & Ebreo, (1992), which were based on Schwartz (1977). Benefit, constraint, and norm items were

all measured on a 5-point Likert-type scale from "strongly disagree" to "strongly agree." Additionally, we measured demographic data (i.e., residency in relation to beach communities, gender, and birth year of each respondent). The self-reported frequency that dog walkers leash their dogs near beach-nesting birds was also measured on a unipolar (linear) scale from "nearly none of the time" to "nearly all of the time." Participants who did not go near beach-nesting birds (n = 76) or did not know where those areas were (n = 126) were excluded from the analyses for RQ3 (using norms, constraints, and benefits to predict the frequency that recreationists leash dogs) because they were not able to report how frequently they visit areas near beach-nesting birds. In addition to the survey questions, we also determined the leashing status of each dog walker by visual observation (i.e., 0 = leashed and 1 = off-leash), which we used to assign groups of dog walkers when comparing benefits and constraints (RQ1) and norms (RQ2) of recreationists who leash dogs and recreationists who do not leash. Dog walkers who had both leashed and off-leash dogs with them were considered to be in the group of off-leash dog walkers as those dog walkers often commented that they preferred to have their dogs off-leash but needed to leash one or more dogs for certain reasons such as age or aggression.

Before we administered the on-site survey, subject matter experts from the Atlantic Flyway Shorebird Initiative Human Activities Committee who had experience interacting with beach recreationists and social scientists who had experience with conducting surveys reviewed the questionnaire. After review, we implemented the survey with 17 beach recreationists in New York on our first day of survey implementation. We made minor adjustments to the questionnaire wording and length to adjust for issues that arose during this initial implementation.

Data Collection

We implemented the on-site survey from July through October 2018. We generally surveyed from 6:30 to 10:30 a.m. and from 4 to 8 p.m. but adjusted the survey times due to factors such as weather, sunrise/set, level of recreational activity on beaches, and time of day that dogs were allowed at a given beach. Typically, two researchers independently conducted surveys at the same beach. During Labor Day weekend, three researchers independently conducted surveys. Researchers approached beach recreationists who entered the beach entrance with a dog. In cases where there were two or more people in a group, only one person was asked to take the survey. In many cases, the researcher walked with the beach recreationist while administering the survey because dog walkers generally did not want to stop walking their dogs to take the survey.

Before administering the survey, the researcher read the respondent a consent statement informing them of the study's purpose and confidentiality of their responses. The researcher then asked the respondent to provide oral consent stating their agreement to participate in the survey. Verification that a respondent had expressed verbal consent was recorded in the first question of the survey. The researcher also asked the respondent to verify that they were 18 years of age or older. If the respondent was younger than 18, they were ineligible to participate in the survey. Upon receiving consent, the researcher administered the questionnaire verbally to the respondent and recorded responses using an iPad with a Qualtrics application. This research was conducted with approval from, and in accordance with, the Virginia Tech Institutional Review Board (Protocol #16–1071). When the survey was complete, the researcher approached the next closest beach recreationist with a dog and asked them to participate. If there were no dog walkers

nearby, the researcher returned to the beach entrance and waited for the next dog walker to enter the beach.

Data Analysis

We analyzed all research questions (RQ) using IBM SPSS Statistics for Windows (Version 26). For the first research question, comparing benefits and constraints (RQ 1) we used an independent samples t-tests to compare the benefits and constraints of leashing dogs on beaches as perceived by dog walkers with leashed and off-leash dogs. We calculated the effect size using Cohen's D and interpreted .20 as small, .50 as moderate, and .80 as large (Cohen, 1988). Similarly, for RQ 2 (comparing personal and social norms), we used independent samples t-tests to compare the personal and social norms between leashed and off-leash dog walkers. For RQ 3 (using norms, constraints, and benefits to predict the frequency that recreationists leash dogs), we computed the mean value of the six benefits of leashing items for each respondent, and the mean value for the five constraints to leashing items for each respondent. We explored relationships between frequency of leashing near nest sites and independent variables by using Pearson's correlation coefficient (r) to detect bivariate associations. To ensure that we did not have issue with multicollinearity of the independent variables, we used $r = .60$ as a threshold value for elimination (Grazhdani, 2016). We conducted a linear regression analysis of a typical CBSM model using constraints and benefits (independent variables) to predict the frequency with which recreationists leash dogs near beach-nesting birds (dependent variable). To assess whether there was a state effect we treated state as a dummy variable, with New York as the reference category. We conducted another linear regression model (i.e., Model 2) to determine if the addition of norms improved the predictive potential of the CBSM model (i.e., Model 1). We calculated the effect size using partial eta squared and interpreted .01 as small, .06 as moderate,

and .14 as large (Cohen, 1988). Respondents with missing data for the independent and/or dependent variables were excluded from the regression analysis. We verified that assumptions of independent observations, linearity, homoscedasticity, no multicollinearity, and normality of residuals were met for our regression models using a normal P-P plot and computing the Durbin-Watson statistic and VIF values.

Results

Survey Response

We approached 1,020 beach recreationists walking dogs. Of those individuals, 130 declined to participate and 890 people participated ($n_{Leashed} = 356$; $n_{Off\text{-}leash} = 534$), yielding a response rate of 87%. There were 402 respondents from South Carolina, 298 from New York, and 190 from Maine.

Respondent Demographics

Respondents were 41.1% male and 58.9% female. Most (56.1%) were full-time residents, with fewer part-time residents (26.7%) and vacationers (17.2%). Mean age was 51 years old (SD = 14.09) and ranged from 18-84. The number of dogs with a dog walker respondent ranged from one to six with the average being one dog per respondent.

Benefits to Leashing Dogs

Dog walkers with leashed dogs reported that some benefits to leashing were preventing dogs from running into areas for beach-nesting birds, keeping dogs safe, and giving owners control over their dogs. Dog walkers with off-leash dogs felt some benefits to leashing were preventing dogs from bothering other people and preventing dogs from running into areas protected for nesting birds. Participants who had their dogs leashed agreed more strongly, on

average, with all of the perceived benefits statements than participants who had their dogs off-leash. Both groups of participants agreed less strongly that leashes were beneficial for preventing dogs from eating trash on the beach and made it easier to clear up dog waste (Table 1). Effect size for the difference between leashed and off-leash dog walkers was large for the following statements: "leashing keeps my dog safe," "leashing makes it easier to clean up my dog's waste," and "leashing gives me control over my dog." The effect size was between medium and large for the statement "leashing prevents dogs from running into areas for beach-nesting birds," and it was medium for all other benefit statements.

Table 1. Independent samples t-tests of dog walkers' perceived benefits, constraints, and norms related to leashing in South Carolina (n = 402), New York (n = 298), and Maine (n = 190). We compared dog walkers who had dogs leashed (n = 356) and those who had dogs off-leash (n = 534).

	Leash		**Off-Leash**		***t***	***p*-value**	**Cohen's *d***
	M	*SD*	*M*	*SD*			
Benefits[1]							
Prevents my dog from running into areas for beach-nesting birds	4.42	1.00	3.58	1.46	10.15	<.001	.65
Prevents my dog from bothering people	4.27	1.11	3.60	1.41	7.911	<.001	.52
Keeps my dog safe	4.30	1.03	3.19	1.49	13.03	<.001	.83
Gives me control over my dog	4.31	1.00	3.42	1.41	10.94	<.001	.70
Prevents my dog from eating trash on the beach	3.76	1.46	2.90	1.58	8.293	<.001	.56
Makes it easier to clean up dog's waste	3.58	1.53	2.17	1.44	13.83	<.001	.96
Constraints							
Leashing prevents my dog from socializing	2.56	1.50	3.43	1.52	-8.412	<.001	.58
It's not necessary to leash my dog because my dog responds well to my commands	2.59	1.46	3.70	1.36	-11.45	<.001	.80
Leashing prevents my dog from exercising	2.65	1.53	3.58	1.54	-8.910	<.001	.61
My dog pulls on the leash	2.56	1.51	2.53	1.57	0.229	.82	.02

Leashing makes my dog feel threatened	1.84	1.25	2.19	1.44	-3.820	<.001	.26
Social Norm							
My friends and family expect me to leash my dog near beach-nesting birds	3.78	1.26	3.42	1.46	3.856	<.001	.26
Personal Norm							
I would feel guilty if I walked my dog off-leash near beach-nesting birds	4.22	1.22	3.89	1.48	3.600	<.001	.24

[1]All item responses were measured from strongly disagree (1) to strongly agree (5).

Constraints to Leashing Dogs

Dog walkers with off-leash dogs and dog walkers with leashed dogs felt that some constraints to leashing were: leashing being unnecessary because their dogs respond well to their commands, preventing dogs from exercising, and preventing dogs from socializing. Both groups disagreed that leashing was challenging because it makes their dogs feel threatened. Participants who had their dogs off-leash agreed more strongly with all of the constraints to leashing dogs than the participants who had their dogs leashed. The difference between dog walkers with off-leash dogs and dog walkers with leashed dogs was statistically significant ($p < .001$) for all the statements except "my dog pulls on the leash" ($p = .82$). The effect size for the difference between the two groups was small for the statement "leashing makes my dog feel threatened," medium for the statement "leashing prevents my dog from socializing," between medium and large for the statement "leashing prevents my dog from exercising," and large for the statement "it's not necessary to leash my dog because my dog responds well to my commands."

Norms for Leashing Dogs

Means for response items that measured social and personal norms for leashing dogs near beach-nesting birds were lower for dog walkers who had their dogs off-leash than dog walkers

who had their dogs leashed; however, effect sizes for the difference between the two groups were small for both measures (Table 1).

Predictors of Leashing Near Beach-Nesting Birds

There was a moderate positive correlation between the frequency of leashing and social norms (Table 2).There was a weak positive correlation between the frequency of leashing and benefits, and the frequency of leashing and personal norms. There was a weak negative correlation between the frequency of leashing and constraints. Given that the independent variables were not highly correlated with each other (all < .50), we did not eliminate any of them due to multicollinearity concerns (Table 2).

Table 2. Bivariate correlation matrix of the frequency that dog walkers in South Carolina (n = 402), New York (n = 298), and Maine (n = 190) leash and independent variables.

	Frequency of Leashing	Constraints	Benefits	Social norm	Personal norm
Constraints	-0.232**	—	—	—	—
Benefits	0.335**	-0.397**	—	—	—
Social norm	0.403**	-0.177**	0.310**	—	—
Personal norm	0.365**	-0.162**	0.304**	0.483**	—

* $p \leq .05$
** $p \leq .01$

We then conducted multiple linear regression to predict the proportion of time dog walkers leash their dogs near beach-nesting birds (Table 3). Independent variables in model 1 included constraints and benefits of leashing, South Carolina, and Maine (with New York as the reference group). The multiple linear regression for model 1 statistically significantly predicted the frequency of leashing near beach-nesting birds, $F(4,659) = 25.51$, $p < .001$, adj. $R^2 = .129$. In model 1, the benefit scale was the strongest positive predictor of leashing dogs near beach-nesting birds, followed by being surveyed in Maine. The constraint scale had a negative

relationship with leashing. Being surveyed in South Carolina was not a significant predictor of leashing. The effect size was small for the relationship between the frequency of leashing and constraints, Maine, and South Carolina. The effect size was moderate for the relationship between the frequency of leashing and benefits. Model 2 elaborated on model 1 by considering dog walkers' personal and social norms in addition to constraints, benefits, Maine, and South Carolina. The multiple regression for model 2 statistically significantly predicted the frequency of leashing near beach-nesting birds, $F(6,632) = 34.46$, $p < .001$, adj. $R^2 = .239$. The six predictors in model 2 explained 23.9% of the variance, which is greater than model 1 (12.9%). In model 2, the social norm was the strongest predictors of the frequency of leashing near beach-nesting birds. The personal norm was slightly less predictive than social norm but was still greater than the benefits scale and Maine. South Carolina and the constraints scale were not predictive of leashing ($p > .05$). The effect size was small for the relationship between the frequency of leashing and constraints and the frequency of leashing and South Carolina. The effect size was between small and moderate for the relationship between the frequency of leashing and benefits, Maine, social norm, and personal norm.

Table 3. Predictors of the frequency of leashing near beach-nesting birds for dog walkers in South Carolina (n = 402), New York (n = 298), and Maine (n = 190).

	Model 1			*Model 2*		
Variable	B	β	Partial eta squared	B	β	Partial eta squared
Constant	3.094**			1.965**		
Constraints	-0.141*	-0.098*	0.009	-0.105	-0.072	0.005
Benefits	0.390**	0.283**	0.067	0.202**	0.146**	0.019
Maine	0.363**	0.105**	0.010	0.413**	0.118**	0.015
South Carolina	-0.670	-0.021	<0.001	0.031	0.010	<0.001
Social Norm					0.228**	0.045

Personal Norm		0.190**	0.031
Adjusted R^2	0.129	0.239	
F	25.51**	34.456**	

* $p \leq .05$
** $p \leq .01$

Discussion

In this article of dog walkers in Maine, New York, and South Carolina, we show that norms, benefits, and constraints are important considerations for those designing behavior change campaigns related to leashing dogs on beaches. Our findings support the Theory of Reasoned Action, which suggests that attitudes (i.e., benefits and constraints) and norms play a role in behavior change (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). Specifically, we found that constraints and benefits were strong predictors of leashing frequency in model 1. However, constraints were not significant when personal and social norms were added in model 2. Despite constraints not being significant in model 2, perceived constraints to leashing were higher and the perceived benefits to leashing were lower for dog walkers with off-leash dogs than dog walkers with leashed dogs. Thus, our findings corroborate past research on the utility of identifying benefits and constraints to behavior change as part of the CBSM approach (McKenzie-Mohr, 2011). Based on our findings, we provide recommended strategies to increase the benefits and decrease the constraints of leashing dogs. We reflect on the potential efficacy of McKenzie-Mohr's (2011) six strategies for behavior change in CBSM campaigns: norms, commitment, social diffusions, prompts, communication, incentives, and convenience.

Although norms are offered as a behavior change strategy in the third step of CBSM approach, McKenzie-Mohr (2011) does not call for studying norms and the strength of those norms before developing a campaign. Our results suggest that explicitly studying norms to

inform CBSM campaigns could add to the CBSM approach. For example, Saylor et al. (2011) incorporated norms into their analysis of constraints and benefits in a CBSM study and then based recommended strategies for behavior change on the norms of their target audience. The relationship between norms and behavior is demonstrated in a variety of contexts such as alcohol consumption, exercise, health, charitable donations, and conservation (Nyborg et al., 2016). Our study adds to this body of literature by showing that social and personal norms are significant predictors of the frequency that dog walkers leash their dogs near beach-nesting birds. This finding aligns with results by Williams et al., (2009) who found that social norms were the strongest predictors of leashing behavior. Based on our results of the importance of norms, we suspect a norm-based strategy to change leashing behavior would be effective. A norm-based strategy could aim to showcase leashing norms through programs whereby volunteers model responsible dog walking behavior and simultaneously educate other dog walkers about leashing near shorebirds. These volunteers could visually demonstrate normative behavior by outfitting their dogs with leashes or dog vests that state "This dog shares the shore with shorebirds" or another phrase that expresses the meaning of their action to other dog walkers.

A key constraint to leashing near beach-nesting birds is reduced socialization and exercise for dogs, which can be minimized by structural changes that capitalize on convenience. Similarly, other research shows that exercise and socialization are important to dog walkers (Westgarth et al., 2010, 2017; Rezac et al., 2011) and using leashes can limit interactions between dogs (Rezac et al., 2011). To enhance socialization and exercise for dogs, off-leash dog zones can be created at beaches that are not used or lack suitable shorebird nesting habitat. To make dog zones more convenient to use than shorebird zones, parking spaces near dog zones should be available and walking paths should lead to dog zone entrances. Additionally, making

the entrances clearly identifiable using a sign with an icon or graphic image can prompt beach recreationists to remember that dog zones are places where dogs can exercise and socialize.

Incentives can be used to minimize the constraints that dog walkers believe dogs do not need to be leashed because they are obedient and responsive to commands. Williams et al. (2009) postulate that the strong relationship between dogs and their owners likely inhibits owners from recognizing that their dog can have negative behaviors. As such, it is likely that dog walkers' motivations to engage in leashing will be low. Incentives are effective when motivation to engage in behavior change is low (McKenzie-Mohr, 2011). Possible incentives for dog walkers may include dog toys, dog treats, and watering stations.

In addition to constraints, our study uncovered several benefits to leashing that could be emphasized to dog walkers through the strategies outlined by McKenzie-Mohr (2011). In particular, communication can be used to promote the benefit of leashing as a means to prevent dogs from running into areas used by nesting birds. This benefit can be relayed through various communication mediums such as signs, websites, or kiosks displayed at beach entrances, parking lots, pet stores, or veterinary clinics. Rather than posting informational signs, which are not always effective at creating behavior change (Teel et al., 2006), signage can reflect normative messages about leashing. For example, shorebird managers can post signs with photos of actual dog walkers leashing near nesting areas. In the photo, the dog walkers can hold signs that say, "I'm a responsible dog walker, I leash my dog near nesting areas." In addition to reinforcing the norm of being a responsible dog owner, this message also increases the benefit of leashing.

Another benefit to leashing that can be emphasized using commitment is the benefit that leashes prevent dogs from bothering other people and enhance safety for dogs. Bowes et al. (2017) showed that leashes increase control over dogs, and Cutt et al. (2008) noted that leashes

prevent dogs from bothering other people. Given that dog walkers have strong personal norms about leashing near shorebirds and feel positive towards concepts of control and safety, commitment approaches could be used to increase these benefits. Commitment is the act of agreeing to a request to engage in a behavior, which can enhance the potential for a person to follow through with that request (McKenzie-Mohr, 2011). Pledges are a form of commitment by an individual, which leads them to feel internal and societal pressure to act consistently with their promise (Bator & Cialdini, 2000). Pledges can be used to elicit commitment to pro-environmental actions such as leashing dogs on beaches. Commitment through that act of signing a pledge or displaying photos with people holding signs that indicate their pledge, can also enhance people's perception of norms (Mengak et al., 2019). Commitment to leash can be elicited at beach entrances, local veterinarian offices, pet stores, or pet adoption centers. Opportunities to sign pledges could be offered as people purchase beach parking permits or dog walking permits (where required). Pledge campaigns could be initiated when beaches open for the season or during special events.

Lastly, social diffusion can be used to promote leashing as a mechanism to keep dogs safe. Our findings on safety support other studies that show dog walkers feel leashes can provide safety, particularly by reducing the spread of diseases and hostile encounters (Westgarth et al., 2010; Cutt et al., 2008). This benefit can be increased through social diffusion, which focuses on sharing information within a community using a trusted source. In this case, a veterinarian could act a trusted source for information on the health of dogs. Leashing for the protection of dogs can simultaneously reduce the risk of off-leash dog walking near shorebirds.

Finally, our results emphasize that local context needs to be considered when designing a CBSM campaign. Previous research shows that the degree to which a societal group adheres to

social norms and the degree of tolerance for deviation from norms is highly variable from one state to another (Harrington & Gelfand, 2014). Similarly, we found variability in norms related to leashing among the states we studied. For example, Maine was a stronger predictor of the frequency of leashing than New York and South Carolina. This may be because of an incident in Scarborough, Maine, where a piping plover chick was killed by an unleashed dog in 2013 (Reagan, 2014). This situation led to the creation of a new dog walking ordinance for Scarborough beaches, banning dogs on beaches between 9 a.m. and 5 p.m. from April 1st through September 15th (Harry, 2013). The incident also resulted in media coverage, which publicized the controversy between beach recreationists who supported the shorebirds and beach recreationists who supported dog walking (Merrill, 2014). As in this case, it is important for managers to understand the dynamics of a community before implementing a CBSM campaign.

Conclusion

Through surveys of dog walkers, we expanded the understanding of benefits and constraints to voluntarily leashing dogs on beaches and explored variables that predict leashing behavior. In doing so, we added to the limited body of social science research informing how to engage people in activities to promote shorebird conservation (Kidd & Dayer, 2020). In particular, we demonstrated that social and personal norms about walking dogs near beach-nesting birds were strong predictors of leashing behavior near beach-nesting birds, in addition to benefits and constraints. Our findings reinforce the need to identify norms, in addition to benefits and constraints of a selected behavior, as part of the social science research to inform a CBSM campaign. Along with constraints and benefits, an understanding of the personal and social norms of dog walkers on beaches can be used to inform the selection of behavior change

strategies (McKenzie-Mohr, 2011). Based on our findings, we illustrate how commitment, social norms, social diffusions, prompts, communication, incentives, and convenience could be used to design campaigns to reduce disturbance to shorebirds and also foster coexistence between people and shorebirds on beaches.

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Conclusion

One of the greatest threats to shorebirds along the Atlantic Coast is human disturbance. Human disturbance is inextricably tied to the behavior of people, and as such, addressing human disturbance would benefit from the application of social science research (Dayer et al., 2020). Historically shorebird management has been solely guided by the biological sciences (Dayer et al., 2020), but incorporating social science into the framework for decision-making can ensure that conservation actions are based on the best available information (Bennett et al., 2017). Therefore, this thesis used social science methods to understand human disturbance management along the U.S. and Canada portions of the Atlantic Flyway and examined the predictors of a potential disturbance behavior (dog walking) near shorebirds.

Summary of Findings

In chapter one, we used a survey to assess human disturbance management along the United States and Canada portions of the Atlantic Flyway. We examined potential disturbances at sites within Important Bird Areas, types of activities that are restricted, when restrictions occur, the effectiveness of management techniques, public compliance with restrictions, and resource needs of managers. We found that restrictions are most common during the breeding season and are less common during the non-breeding season. We also showed that dog walking was the most commonly restricted activity year-round, but also believed by managers to have the

lowest level of public compliance. Additionally, we found that fencing, informal outreach, and signage were effective techniques for reducing disturbance. Lastly, managers reported that more staff and volunteers are the greatest resource needs for reducing human disturbance.

In chapter two, we used social science methods to understand the perceived benefits and constraints to dog walkers' leashing behavior near shorebirds. We also explored the role of norms as predictors of leashing. Through a survey of dog walkers in Maine, New York, and South Carolina, we learned that common perceived benefits to leashing included preventing dogs from running into areas for beach-nesting birds, increasing safety for dogs, increasing control by dog walkers, and keeping dogs away from other people. We also learned that common perceived constraints included concerns of reduced socialization and exercise for dogs and beliefs that dogs will listen to owners' commands. Finally, we showed that when norms were added to a benefits and constraints predictive model, the ability to predict leashing frequency of individual dog walkers was enhanced.

Scholarly Contributions

This thesis contributes to the limited, yet growing body of literature on social science related to shorebird management. There is a paucity of Flyway-level research about human disturbance management as research generally focuses on localized areas. We used social science methods to reduce knowledge gaps by bringing together the expertise of managers across a vast network of locations. In doing so, we created a regional understanding of human disturbance management that brings attention to the most common obstacles to management and resource needs for management.

This thesis also contributes to the literature on community-based social marketing (CBSM). Although CBSM has been applied in a variety of environmental contexts (Kennedy, 2010), it is underutilized in wildlife conservation (McKenzie-Mohr, 2021). Our research shows that CBSM can be used to disentangle the benefits and constraints of a contentious behavior (i.e., dog walking) that is often fraught with human-human conflict (Dayer et al., 2017). Knowing the benefits and constraints of behaviors can help managers craft strategies to change human behaviors that negatively impacts at-risk species such as shorebirds.

We also show that norms, in addition to benefits and constraints of a selected behavior, can better inform CBSM campaigns. Although some studies (e.g., Saylor et al., 2011) have considered norms in the second step of the CBSM process, it is not explicitly part of the CBSM research prior to creating a campaign. The addition of identifying norms has the potential to improve researchers' ability to predict behavior and can lay the foundation for using norm-based strategies in the third step of CBSM.

Applied Contributions

In this thesis, we used social science methods to describe and document issues faced by shorebird managers. With our findings, organizations and agencies that support shorebird conservation can make more informed decisions about future efforts to enhance management and support managers. We also used social science methods to disentangle the benefits and constraints related to leashing dogs near shorebirds. Using these insights, we offered suggestions for CBSM strategies based on social norms, communication, commitment, prompts, incentives, social diffusion, and convenience. The suggestions outlined in this thesis set the stage for managers and biologist to co-produce strategies during a four-day workshop in December 2020.

The co-produced strategies from the workshop are currently being collated into a guidance document that will offer managers across the Flyway a "menu" of options for reducing human disturbance to shorebirds.

Future Research

This thesis lays the groundwork for further biological and social science research. Studies can examine the biological impacts of disturbance on shorebirds when signs, fencing and informal outreach, are used. Such analyses could examine if managers' perceptions about the most effective management techniques for protecting shorebirds are congruent with biological evidence. Additionally, research on why management techniques are effective and situations in which management techniques are most effective (or least effective) could help managers decide how to optimize resources. This thesis also provides a foundation for designing and implementing a strategy based on the benefits and constraints to leashing. In a future study, strategies can be evaluated to ensure that interventions actually produce behavior change.

Closing

Shorebird populations are declining in North America (NABCI, 2016), in-part due to anthropogenic impacts (USFWS, 1996; 2012). Through the application of social science, this thesis has reduced knowledge gaps and established the basis for future work that considers people as a component of the solution to shorebird conservation, rather than merely a source of disturbance.

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Appendix A. Questionnaire for Land Managers

Default Question Block

We are interested in learning about efforts to reduce human disturbances to shorebirds at the site(s) that you manage within the ${e://Field/IBA%20Site} Important Bird Area (IBA). To view a map of this IBA region that we would like to learn more about, copy and paste this URL into your internet browser: ${e://Field/URL}

This questionnaire should take 20-30 minutes.Your participation in this survey is voluntary, and your identity will be kept confidential. There are no known risks associated with this research.

For questions or concerns about this research, please contact Carolyn Comber at ccomber1@vt.edu or (631)-655-5906. Should you have any questions or concerns about this study's conduct or your rights as a research subject, you may contact the Western Institutional Review Board® (WIRB®) at Help@wirb.com or 1-800-562-4789

Do you consent to participate in this research study?

- ○ Yes
- ○ No

Block 1

We would like to know the names of the site(s) that you manage within the ${e://Field/IBA%20Site} IBA. Please list the sites that you manage below.

The Atlantic Flyway Shorebird Initiative has identified the following fifteen shorebirds as focal species that represent other Atlantic Flyway shorebird species that share similar conservation needs.

Which of the following focal species do you have at your site(s) within the ${e://Field/IBA%20Site} IBA on an annual basis (occurring each year)? Select all that apply.

- [ ] American oystercatcher
- [ ] American golden plover
- [ ] Greater yellowlegs
- [ ] Lesser yellowlegs
- [ ] Marbled godwit
- [ ] Piping plover
- [ ] Purple sandpiper
- [ ] Red knot
- [ ] Red-necked phalarope
- [ ] Ruddy turnstone
- [ ] Sanderling
- [ ] Semipalmated plover
- [ ] Snowy plover
- [ ] Whimbrel
- [ ] Wilson's plover

Block 2

In this survey, we define **human disturbance** as a human activity that causes an individual or group of shorebirds to alter their normal behavior, leading to an additional energy expenditure by the birds. It disrupts or prevents shorebirds from effectively using important habitats and from conducting the activities of their annual cycle that would occur in the absence of humans.

What ***systematic protocols***, if any, are used to monitor potential human disturbances to shorebirds at your site(s) within the ${e://Field/IBA%20Site} IBA? Select all that apply.

- ☐ Atlantic Flyway Disturbance Project (protocol from VT Shorebird Program)
- ☐ Integrated Waterbird Management and Monitoring (IWMM)
- ☐ International Plover Census
- ☐ International Shorebird Survey
- ☐ Agency or organization specific protocols
- ☐ No protocols are used to systematically monitor human disturbances at this site
- ☐ Other (please specify) _____

Are ***incidental observations*** of potential human disturbances to shorebirds recorded at your site(s) within the ${e://Field/IBA%20Site} IBA, (E.g.,visual observation by staff/volunteers, footprints in closed areas, people walking dogs on the beach, etc.)?

- ○ Yes
- ○ No

During which months are potential human disturbances recorded through systematic protocols or through incidental observations at your site(s) within the ${e://Field/IBA%20Site} IBA? Select all that apply.

- ☐ January
- ☐ February
- ☐ March
- ☐ April
- ☐ May
- ☐ June
- ☐ July
- ☐ August
- ☐ September
- ☐ October
- ☐ November
- ☐ December
- ☐ None of the above

Block 3

There are a variety of human activities that may cause disturbance. A range of considerations at the site level determine whether these activities are allowed. Despite best efforts, some human activities that are restricted may still occur at shorebird sites even if they are not permitted. We would like to learn more about the legal and illegal human activities that occur at your sites.

Within the last five years, which human activities have been known to occur at your site(s) either legally or illegally? Select all that apply.

- ☐ **General beachgoing** (walking, running/jogging, beach combing, sunbathing, picnicking, ball playing, frisbee, other beach games, camping, swimming, bike riding)
- ☐ **Beach driving** (4x4, ATV/UTV, beach buggies, ORV, OSV)
- ☐ **Unleashed dog walking**
- ☐ **Leashed dog walking**
- ☐ **Events** (fishing tournaments, festivals, parties, sport competitions, fireworks)
- ☐ **Motorized watersports** (boats, airboats, speedboats, jet-skis)
- ☐ **Non-motorized watersports (**Kayak, canoe, stand up paddleboard, sailboats, kite boarding, kite surfing, wind surfing, skimboarding)
- ☐ **Commercial fishing** (aquaculture, oyster racks, mariculture, horseshoe crab harvest, clamming, worm digging, seaweed harvest)
- ☐ **Recreational fishing and shellfishing** (surf fishing, fishing, shell-fishing, clamming, worm-digging, crabbing, bait collection)
- ☐ **Unmanned aircraft** (drones, UAVs, model aircraft, unmanned remotely operated toys, rocket launches)
- ☐ **Wind-powered aircraft** (paragliding, hang gliding, kite flying, kite skating, sand-yachting or cart sailing)
- ☐ **Beach raking/scraping**
- ☐ **Coastal engineering** (beach nourishment, artificial dune stabilization, construction project)
- ☐ **Other** (please specify) _____

Activities on the beach may be restricted for the protection of shorebirds during the breeding season (April-June), the migration season (July-November), and/or the winter season (December-March). For each activity, please select the season(s) in which each activity is restricted, if at all restricted at your site(s).

	Never restricted	Breeding	Migration	Winter	Not applicable to site(s)
Beach driving	☐	☐	☐	☐	☐
Unleashed dog walking	☐	☐	☐	☐	☐
Leashed dog walking	☐	☐	☐	☐	☐
Beach raking/scraping	☐	☐	☐	☐	☐
Coastal engineering	☐	☐	☐	☐	☐
General beachgoing	☐	☐	☐	☐	☐
Events	☐	☐	☐	☐	☐
Recreational fishing and shellfishing	☐	☐	☐	☐	☐
Motorized watersports	☐	☐	☐	☐	☐
Commercial fishing	☐	☐	☐	☐	☐
Unmanned aircraft	☐	☐	☐	☐	☐
Wind powered aircraft	☐	☐	☐	☐	☐
Non-motorized watersports	☐	☐	☐	☐	☐
Other (please specify)	☐	☐	☐	☐	☐

Block 4

Many factors contribute to public compliance of restricted activities. Compliance might vary from one site to another. We would like to learn about public compliance at your site(s) for the activities listed below. There are no right or wrong answers.

Based on your experience and/or data from your site(s), to what extent do you think the public is compliant with restrictions related to the following activities?

	Very compliant	Somewhat compliant	Neither compliant nor uncompliant	Somewhat uncompliant	Very uncompliant	Not applicable to site(s)
Beach driving	○	○	○	○	○	○
Unleashed dog walking	○	○	○	○	○	○
Leashed dog walking	○	○	○	○	○	○
Beach raking/scraping	○	○	○	○	○	○
Coastal engineering	○	○	○	○	○	○
General beachgoing	○	○	○	○	○	○
Events	○	○	○	○	○	○
Recreational fishing and shellfishing	○	○	○	○	○	○
Motorized watersports	○	○	○	○	○	○
Commercial fishing	○	○	○	○	○	○
Unmanned aircraft	○	○	○	○	○	○
Wind powered aircraft	○	○	○	○	○	○

Non-motorized watersports	○	○	○	○	○	○
Other (please specify)	○	○	○	○	○	○

Block 5

Some sites completely or partially close areas to protect shorebirds from human disturbance. This may occur year-round or seasonally. We would like to learn more about the closed areas, if any, at your site(s).

Do you have closed areas to protect shorebirds from potential human disturbance at your site(s)?

- ○ Yes
- ○ No

During which months are areas at your site(s) closed for the protection of shorebirds? Please select all that apply.

- ☐ January
- ☐ February
- ☐ March
- ☐ April
- ☐ May
- ☐ June
- ☐ July
- ☐ August
- ☐ September
- ☐ October
- ☐ November
- ☐ December
- ☐ None of the above

How are closed areas communicated to beach recreationists at your site(s)? Select all that apply.

- ☐ Fencing
- ☐ Signage
- ☐ Education/outreach by staff or volunteers
- ☐ Other (please specify) _____

Block 6

We would like to learn about your experiences with human disturbance management as well as your thoughts on the resources needed to continue managing human disturbances to shorebirds in the future.

Based on your experience and/or data from your site(s), to what extent are the following practices effective at reducing human disturbances to shorebirds?

	Very effective	Somewhat effective	Neither effective nor ineffective	Somewhat ineffective	Very ineffective	Not applicable to site(s)
Fencing	○	○	○	○	○	○
Signs (official postings, interpretive kiosks)	○	○	○	○	○	○
Informal outreach by staff and volunteers during monitoring	○	○	○	○	○	○
Outreach/interpretation efforts	○	○	○	○	○	○
Informational materials (brochures, fliers, activity pages)	○	○	○	○	○	○
Law enforcement	○	○	○	○	○	○
Community engagement/ stewardship (volunteer dog monitors, education docents, citizen science)	○	○	○	○	○	○

What resources do you think would improve your efforts to reduce potential human disturbances to shorebirds at your site(s)? Select all that apply.

- ☐ More training
- ☐ More staff
- ☐ More volunteers
- ☐ More funding for needs that aren't personnel related
- ☐ More biological information
- ☐ More social science information
- ☐ Other (please specify) _____

Block 7

We would like to know ***your*** thoughts on the following behaviors that visitors to your site could be encouraged to undertake with the goal of reducing disturbance to shorebirds.

In your opinion, if beach recreationists were to undertake the following behaviors, how likely or unlikely would it be for each behavior to minimize actual human disturbance to shorebirds at your site(s)? (Please do not comment based upon the feasibility of each behavior at this time).

	Very likely	Somewhat likely	Neither likely nor unlikely	Somewhat unlikely	Very unlikely	Not applicable to my site(s)
Driving on the wet sand (for breeding season)	○	○	○	○	○	○
Driving on the soft sand/above mean high tide (for migration)	○	○	○	○	○	○
Driving with a spotter in front of vehicles	○	○	○	○	○	○
Lowering vehicle speed near shorebirds	○	○	○	○	○	○
Lowering boat speed near shorebirds	○	○	○	○	○	○
Using boat ramps to launch and pull out boats	○	○	○	○	○	○
Walking or running around a flock of shorebirds, rather than thru	○	○	○	○	○	○
Riding bikes around a flock of shorebirds, rather than thru	○	○	○	○	○	○

Filling in tire ruts	○	○	○	○	○	○
Filling in holes dug in the sand	○	○	○	○	○	○
Leashing dogs on the beach	○	○	○	○	○	○

For what proportion of your sites' beach recreationists are the following behaviors applicable? We define applicability as the behavior is relevant for these individuals. (E.g., "Driving on the wet sand (for breeding season)" would be "applicable" for the proportion of your beach recreationists who drive on the sand in the summer.) Please provide an estimate based on your experience at your site(s).

	Nearly all the recreationists	About 75% of recreationists	About 50% of recreationists	About 25% of recreationists	Nearly none of the recreationists
Driving on the wet sand (for breeding season)	○	○	○	○	○
Driving on the soft sand/above mean high tide (for migration)	○	○	○	○	○
Driving with a spotter in front of vehicles	○	○	○	○	○
Lowering vehicle speed near shorebirds	○	○	○	○	○
Lowering boat speed near shorebirds	○	○	○	○	○
Using boat ramps to launch and pull out boats	○	○	○	○	○
Walking or running around a flock of shorebirds, rather than thru	○	○	○	○	○
Riding bikes around a flock of shorebirds, rather than thru	○	○	○	○	○
Filling in tire ruts	○	○	○	○	○
Filling in holes dug in the sand	○	○	○	○	○
Leashing dogs on the beach	○	○	○	○	○

Block 10

Now we are interested in what proportion of beach recreationists at your site(s) already complete these behaviors. (E.g., What percent of recreationists who bring a dog to the beach keep it on a leash? Or what percent of beach recreationists fill in holes after they dig them in the sand?) Please provide an estimate based on your experience at your site(s).

	Nearly all the recreationists	About 75% of recreationists	About 50% of recreationists	About 25% of recreationists	Nearly none of the the recreationists
Driving on the wet sand (for breeding season)	○	○	○	○	○
Driving on the soft sand/above mean high tide (for migration)	○	○	○	○	○
Driving with a spotter in front of vehicles	○	○	○	○	○
Lowering vehicle speed near shorebirds	○	○	○	○	○
Lowering boat speed near shorebirds	○	○	○	○	○
Using boat ramps to launch and pull out boats	○	○	○	○	○
Walking or running around a flock of shorebirds, rather than thru	○	○	○	○	○
Riding bikes around a flock of shorebirds, rather than thru	○	○	○	○	○

Filling in tire ruts	○	○	○	○	○
Filling in holes dug in the sand	○	○	○	○	○
Leashing dogs on the beach	○	○	○	○	○

Now we are interested in feasibility. Rate how likely or unlikely it would be to encourage beach recreationists to do the following activities at your site(s).

	Very likely	Somewhat likely	Neither likely nor unlikely	Somewhat unlikely	Very unlikely	Not applicable to my site(s)
Driving on the wet sand (for breeding season)	○	○	○	○	○	○
Driving on the soft sand/above mean high tide (for migration)	○	○	○	○	○	○
Driving with a spotter in front of vehicles	○	○	○	○	○	○
Lowering vehicle speed near shorebirds	○	○	○	○	○	○
Lowering boat speed near shorebirds	○	○	○	○	○	○
Using boat ramps to launch and pull out boats	○	○	○	○	○	○
Walking or running around a flock of shorebirds, rather than thru	○	○	○	○	○	○

Riding bikes around a flock of shorebirds, rather than thru	○	○	○	○	○	○
Filling in tire ruts	○	○	○	○	○	○
Filling in holes dug in the sand	○	○	○	○	○	○
Leashing dogs on the beach	○	○	○	○	○	○

Block 8

The Atlantic Flyway Shorebird Initiative has identified the following to be key threats to shorebird conservation. We would like to know what ***you think*** are the greatest threats to shorebird conservation at your site(s).

Reorder the items below by dragging them so that the most threatening item is listed at the top and the least threatening item is listed at the bottom.

Climate change

Coastal engineering (E.g., beach nourishment, dune stabilization, construction project)

Human disturbance

Invasive plant species (E.g., non-native plants that harm humans or the environment)

Predation of shorebirds

Residential and commercial development

Block 9

Lastly, we would like to know some information about your site(s) within the ${e://Field/IBA%20Site} IBA and the people that visit and/or work there.

What is your job title?

We are interested in the number and types of staff/volunteers at your site(s). Please check the boxes for the types of staff that you have and enter the approximate numbers of each type.

- ☐ Full-time biologist
- ☐ Seasonal biologist
- ☐ Seasonal intern/technician
- ☐ Full-time outreach coordinator
- ☐ Seasonal outreach coordinator
- ☐ Full-time law enforcement
- ☐ Seasonal law enforcement
- ☐ Volunteers
- ☐ Other (please specify the position and number of people in the position)

Approximately how many people visit your site(s) annually?

Select the types of shorebird habitat that exist at your site(s). Please select all that apply.

- [ ] Sandy beach
- [ ] Rocky beach
- [ ] Intertidal
- [ ] Mangrove
- [ ] Saltmarsh
- [ ] Mudflat
- [ ] Estuary
- [ ] Human-made substrate (E.g., rock armour, rooftop)

Block 11

Thank you for participating in this survey. The data from this survey will be compiled into a database that will be available to the National Audubon, National Fish and Wildlife Foundation, and other managers or biologists who request information. We would like to know if you are willing to have the information you provided in this survey associated with the names of your sites in this IBA. Such information could aid users of the database in working with managers. You may choose instead to not have the names of your sites associated with your responses. Either way, we will not include the names of any participants in this study in the database or in any other reporting.

- ◯ Yes, my site(s) can be associated with my responses
- ◯ No, I do not want my site(s) associated with my responses

Do you have any additional comments that you would like to add?

Once you click submit, you will not be able to go back and change your responses in the survey. Are you ready to complete the survey by clicking submit?

- ◯ Yes
- ◯ No

Appendix B. Questionnaire for Dog Walkers

VIRGINIA TECH

Default Question Block

We are interested in learning your thoughts and experiences related to dog walking on beaches. This questionnaire should take about five minutes to complete.

Before we begin, do you have experience with walking a dog on the beach in the last year?

- ○ Yes
- ○ No

Are you 18 or older?

- ○ Yes
- ○ No

Block 1

Now I will read you information about the research and ask if you consent to participate.

Your participation in this survey is voluntary, and your identity will be kept confidential.The results of the survey will be published in summary form. Your responses will never be presented in a way that they can be identified.There are no known risks associated with this research.

For questions or concerns about this research, please contact Carolyn Comber at ccomber1@vt.edu or (540) 231-1473. Should you have any questions or concerns about this study's conduct or your rights as a research subject, you may contact the Western Institutional Review Board® (WIRB®) at Help@wirb.com or 1-800-562-4789

Do you consent to participate in this research study?

- ○ Yes
- ○ No

Block 2

First, we would like to know about your visits to Atlantic Coast beaches in the US and Canada.

About how many days in the last year have you visited the beach?

What percent of those days did you have a dog with you?

- ○ Nearly all the time
- ○ About 75% of the time
- ○ About 50% of the time
- ○ About 25% of the time
- ○ None of the time

We know that beach recreationists have diverse perspectives on walking dogs. We would like to learn more about **your** thoughts on leashing or not leashing dogs. There are no right or wrong answers.

In general, on Atlantic coast beaches ***where you have the choice***, how often do you leash your dog(s)?

- ○ Nearly all the time
- ○ About 75% of the time
- ○ About 50% of the time
- ○ About 25% of the time
- ○ Nearly none of the time

More specifically, how often do you leash your dog in the following situations at the beach? Your response options are nearly all the time, about 75% of the time, about 50% of the time, about 25% of the time, or none of the time.

	Nearly all the time	About 75% of the time	About 50% of the time	About 25% of the time	Nearly none of the time	I don't go to those areas	I don't know where those areas are
Areas where there are beach-nesting birds	○	○	○	○	○	○	○
Areas where there are leash laws	○	○	○	○	○	○	○

To what extent do you agree or disagree with the following statements about leashing dogs at the beach? For each statement your response options are strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, or strongly disagree.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
It is challenging to leash my dog because leashing prevents my dog from exercising	○	○	○	○	○
It is challenging to leash my dog because leashing prevents my dog from socializing	○	○	○	○	○
It is challenging to leash my dog because leashing makes my dog feel threatened	○	○	○	○	○
It is challenging to leash my dog because my dog pulls on the leash	○	○	○	○	○
It's not necessary to leash my dog because s/he responds well to my commands	○	○	○	○	○

Leashing is beneficial because it gives me control over my dog	○	○	○	○	○
Leashing is beneficial because it keeps my dog safe	○	○	○	○	○
Leashing is beneficial because it prevents my dog from bothering other people	○	○	○	○	○
Leashing is beneficial because it prevents my dog from eating trash on the beach	○	○	○	○	○
Leashing is beneficial because it makes it easier to clean up my dog's waste	○	○	○	○	○
Leashing is beneficial because it prevents my dog from running into closed areas for beach-nesting birds	○	○	○	○	○

Block 3

Great, thank you for sharing your ideas on that. Next we would like to know about your opinions about dogs near beach-nesting birds. There are many different feelings on this subject and it's OK to have different opinions. There are no right or wrong answers.

To what extent do you agree or disagree with the following statements? For each question your response options are strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, and strongly disagree.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My friends and family expect me to leash my dog near areas where there are beach-nesting birds	○	○	○	○	○
I would feel guilty if I walked my dog off-leash near areas where there are beach-nesting birds	○	○	○	○	○
Dog walking on beaches should be controlled for the protection of beach-nesting birds	○	○	○	○	○
Unleashed dog access at the beach is important to me	○	○	○	○	○

If unleashed, my dog(s) would pose a threat to beach-nesting birds	○	○	○	○	○

When receiving information about beach management, do you trust each of the following sources? Your response options are yes or no

	Yes	No
My local government	○	○
A local dog club	○	○
A pet store	○	○
A non-profit wildlife organization	○	○
A government wildlife agency	○	○

Do you like getting information about beach management in each of the following ways? Your response options are yes or no.

	Yes	No
Social media	○	○
Website	○	○
Newspaper	○	○
Signs	○	○
Email	○	○
Radio	○	○
Television	○	○

Block 4

What is your gender?

- ○ Male
- ○ Female
- ○ Other

In what year were your born?

Which statement best describes you?

- ○ I live year round in a beach community
- ○ I live part-time in a beach community
- ○ I vacation in a beach community

Thank you so much for your time. I really appreciate it.

Survey Code

Number of dogs leashed

Number of dogs unleashed

Did the owner have a leash with them (even if not on the dog)?

- ○ Yes
- ○ No

Beach Code (Ex. GRB, W, OOB)