View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by UNL | Libraries

University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

US Fish & Wildlife Publications

US Fish & Wildlife Service

2017

Incorporating Human Dimensions Objectives Into Waterfowl Habitat Planning and Delivery

Patrick K. Devers
U.S. Fish and Wildlife Service

Anthony J. Roberts
U.S. Fish and Wildlife Service

Scott Knoche
Morgan State University

Paul I. Padding
U.S. Fish and Wildlife Service

Robert Raftovich
U.S. Fish and Wildlife Service

Follow this and additional works at: https://digitalcommons.unl.edu/usfwspubs

Devers, Patrick K.; Roberts, Anthony J.; Knoche, Scott; Padding, Paul I.; and Raftovich, Robert, "Incorporating Human Dimensions Objectives Into Waterfowl Habitat Planning and Delivery" (2017). *US Fish & Wildlife Publications*. 529.
https://digitalcommons.unl.edu/usfwspubs/529

This Article is brought to you for free and open access by the US Fish & Wildlife Service at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in US Fish & Wildlife Publications by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

Wildlife Society Bulletin 41(3):405–415; 2017; DOI: 10.1002/wsb.791

This document is a U.S. government work and is not subject to copyright in the United States.

Original Article

Incorporating Human Dimensions Objectives Into Waterfowl Habitat Planning and Delivery

PATRICK K. DEVERS,[1] *U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, MD 20708, USA*
ANTHONY J. ROBERTS, *U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, MD 20708, USA*
SCOTT KNOCHE, *Patuxent Environmental and Aquatic Research Laboratory, Morgan State University, St. Leonard MD 20685, USA*
PAUL I. PADDING, *U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, MD 20708, USA*
ROBERT RAFTOVICH, *U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, MD 20708, USA*

ABSTRACT The 2012 revision of the North American Waterfowl Management Plan (NAWMP) explicitly recognized the need to increase recruitment and retention of waterfowl hunters, birdwatchers, and other conservationists to maintain support for wetland conservation. The incorporation of human dimensions objectives within the NAWMP has compelled waterfowl and wetland managers to consider whether and to what extent landscape characteristics such as public land access; the type, amount, and location of wetlands; and site infrastructure will increase support for wetland conservation among user groups. Further, it has forced the waterfowl community to consider the possible trade-offs between managing land to achieve biological versus social objectives. We used publicly available, long-term data sets to illustrate a method of incorporating human dimensions into waterfowl habitat planning and management. We used United States Fish and Wildlife Service waterfowl harvest survey data, United States Geological Survey band encounter data, and Cornell Lab of Ornithology eBird data to summarize travel characteristics of wetland bird enthusiasts (i.e., waterfowl hunters and birdwatchers) in the Atlantic Flyway. Greater than 90% of all trips by wetland bird enthusiasts occurred within their state of residence. We used data from New York, USA, to demonstrate how to construct discrete choice recreation demand models to identify factors that influence site selection and participation. We demonstrate how model outputs, such as the expected change in the number and geographic distribution of recreational trips (i.e., hunting or birdwatching), can be used as an objective metric to evaluate the benefits of alternative habitat acquisition and restoration projects relative to the human dimensions objective of the NAWMP. These data and methods show promise for incorporating human dimensions objectives into habitat delivery and understanding potential trade-offs relative to biological objectives. Published 2017. This article is a U.S. Government work and is in the public domain in the USA.

KEY WORDS Atlantic Flyway, birdwatchers, discrete choice, human dimensions, Joint Ventures, North American Waterfowl Management Plan, participation, site selection, waterfowl hunters.

The 1986 North American Waterfowl Management Plan (NAWMP; U.S. Department of Interior and Environment Canada 1986) was an initiative designed to arrest and reverse the decline of North American waterfowl populations. The explicit objective of the 1986 NAWMP, and subsequent updates, was to achieve specified abundance levels and distribution of North American waterfowl species through regional habitat conservation. In contrast, providing waterfowl-based recreational opportunities (e.g., hunting and birdwatching) was an implicit objective of the 1986 NAWMP and subsequent updates. In 2012, the NAWMP underwent a major revision that reaffirmed these original waterfowl objectives but also explicitly identified the recruitment and retention of waterfowl hunters, birdwatchers, and other supporters to maintain active support for waterfowl and wetland conservation as an objective on par with biological objectives (U.S. Department of the Interior et al. 2012).

The release of the 2012 NAWMP revision compelled the waterfowl habitat management community to re-evaluate its programs, habitat delivery plans, and local-scale management activities in light of this new objective. The NAWMP community's Joint Ventures, researchers, and habitat managers generally have substantial experience with respect to how habitat delivery (e.g., quantity, type, and location) affects waterfowl but have little experience considering how habitat delivery influences the recruitment and retention of wetland bird enthusiasts (i.e., waterfowl hunters and wetland birdwatchers). However, during the course of formal and informal discussions leading to the most recent NAWMP revision, waterfowl biologists and managers hypothesized that participation in birdwatching and hunting may be

Received: 26 May 2016; Accepted: 12 April 2017
Published: 11 August 2017

[1]*E-mail: patrick_devers@fws.gov*

influenced by the characteristics of land parcels, including travel distance (from residence to recreation site), ownership of the site (i.e., public or private), regulations (e.g., open or closed to hunting), site infrastructure (e.g., presence of trails, boat ramps, blinds), and abundance of birds (Jonas et al. 2015). This is not an exhaustive list of potential determining factors but represents commonly held assumptions relating land management to wetland bird enthusiasts (Miller and Hay 1981, Pierce et al. 1996, Brunke and Hunt 2008, Moore et al. 2008). Lack of basic information on wetland bird enthusiasts' selection of sites based on site characteristics, and how participation is affected by changes in those characteristics is a serious yet surmountable challenge to incorporating human dimensions objectives into NAWMP habitat planning and delivery.

Discrete choice modeling is an analytical field that explains and predicts the selection of one alternative from a set of mutually exclusive alternatives, such as purchasing a car or selecting a site for outdoor recreation. With respect to wildlife-based outdoor recreation, big game (Boxall 1995; Schwabe et al. 2001; Knoche and Lupi 2007, 2012) and upland game-bird hunting (Adams et al. 1989, Remington et al. 1996, Knoche and Lupi 2013, Knoche et al. 2015) have been the focus of most discrete choice modeling efforts. Discrete choice modeling offers a promising framework for explaining and predicting recreation participation and site choice for wetland bird enthusiasts, providing results that can inform where, how much, and what kind of land management is needed to achieve the human dimensions objectives of the NAWMP; once obtained, this information can be evaluated concurrently with estimates of how much, where, and what kind of land management is needed to achieve the biological objectives of the NAWMP.

We used several publicly available, long-term data sets and discrete choice modeling to understand how site characteristics affect participation and site choice of wetland bird enthusiasts in the Atlantic Flyway. Further, we provide examples of how these types of results can be used to develop habitat delivery plans and allocate limited funds to maximize participation (i.e., number of hunting or birdwatching trips). Our purpose was not to provide specific recommendations for implementation in the Atlantic Flyway or New York, USA; rather, we sought to demonstrate one potential approach for addressing the new human dimensions aspects of the NAWMP relative to habitat planning and delivery. Our objectives were to 1) introduce and compare data sets that may be useful for exploring site selection and participation of wetland bird enthusiasts; 2) use those data sets to describe overall patterns of travel and site selection at a flyway scale; 3) evaluate multiple factors identified by the NAWMP community that may influence site selection and participation of wetland bird enthusiasts; and 4) illustrate a method for using discrete choice model results of wetland bird-associated recreation in making habitat conservation decisions.

STUDY AREA

The Atlantic Flyway of North America is a migration route that extends from the eastern Arctic Islands and western Greenland south through the United States and into the Caribbean. In the United States, the Atlantic Flyway is bordered by the Atlantic Ocean to the east and the Appalachian Mountains to the west, and includes 17 eastern states from Maine to Florida, including West Virginia. The Atlantic Flyway encompasses a variety of biotic communities including boreal and deciduous forests, forested wetlands, salt marsh, mangrove swamps, and beaches. The Atlantic Flyway is the most densely populated of the 4 North American flyways.

New York State is situated in the northern half of the Atlantic Flyway and covers 141,300 km^2. New York is composed of 7 ecoregions including the Great Lakes, High Allegheny Plateau, Lower New England, the North Atlantic Coast, Northern Appalachian-Boreal Forest, St. Lawrence-Champlain Valley, and Western Allegheny Plateau (New York Department of Environmental Conservation 2017). New York comprises 62 counties and has a population of >19.7 million people (U.S. Census Bureau 2017).

METHODS

Our analysis of waterfowl hunters in the Atlantic Flyway incorporates travel characteristics from 3 data sets: the United States Fish and Wildlife Service's (USFWS) Waterfowl Hunter Diary Survey (hereafter Diary Survey), USFWS's Waterfowl Parts Collection Survey (PCS), and the United States Geological Survey Bird Banding Laboratory's (BBL) waterfowl banding and encounter data (hereafter encounter data). The Diary Survey and PCS were initiated to provide quantitative estimates of the United States waterfowl harvest and hunter activity to support waterfowl harvest management by the USFWS and Flyway Councils. To legally hunt waterfowl in the United States, individuals are required to provide background information regarding their place of residence and previous year's waterfowl hunting activities. The USFWS uses the resulting database to sample waterfowl hunters for participation in the Diary Survey. Hunters selected for the Diary Survey are provided with diary forms and asked to record the date, county, and number of ducks and geese harvested for each of their hunts. The Diary Survey can be used to identify the location of residence (zip code), location of each hunt (county and state), whether the hunter was successful (i.e., harvested ≥1 duck), and how many trips were taken during a given year. Data on hunter age were available for 2013. Unique to this data set of hunter trips is the ability to identify when a trip did not result in any birds harvested by the individual. Unlike other data sets we used, the Diary Survey is unable to identify species harvested to detail finer than group (ducks, geese, sea ducks, or brant [*Branta bernicla*]).

Another sample of waterfowl hunters is asked to take part in the PCS (Martin and Carney 1977, Geissler 1990). Participating hunters submit duck wings and goose tail feathers (from which species, sex, and age can be identified [Carney and Geis 1960, Carney 1992]) from the waterfowl they harvest during the season, along with information about the location (i.e., state and county) of harvest. Thus, the PCS provides data on species composition of the harvested sample, location of harvest (i.e., state and county), and residence (i.e., state and county) of the hunter. However, the PCS does not provide information for trips resulting in no harvest. Sampling designs of the Diary Survey and PCS were designed to prevent a hunter from participating in both surveys simultaneously (R. Raftovich, U.S. Fish and Wildlife Service, personal communication).

Bird banding has occurred in the North America for >100 years, with a coordinated effort by the U.S. government starting in the 1920s. When a banded bird is shot or found dead (hereafter referred to as a band encounter), the finder is encouraged to report the band number to the BBL and receives a certificate that gives information on the history of the banded bird. If the finder provides their zip code of residence and location of collection (at various precisions from 10-min block to exact coordinates), that information can be used as a trip log. Although it is difficult to identify multiple trips in a year by the same individual, band encounter reports provide a more precise location of where the hunting trip occurred than either the Diary Survey or PCS data. A limitation of band encounter data is that these do not provide information on trips during which no banded birds were harvested. This could lead to biased results if banded birds are distributed differently than non-banded birds. Although band encounters may occur more frequently near banding sites (e.g., Henny and Burnham 1976), we are unaware of any published evidence suggesting banded birds have different distribution or movement patterns than non-banded birds.

We used Cornell University Lab of Ornithology eBird data to describe the travel characteristics of birdwatchers in the Atlantic Flyway. The eBird program was launched in 2002 by the Cornell Lab of Ornithology and National Audubon Society and is the most widely used online program for birdwatchers to provide and share data related to bird observations. The eBird data set consists of individual sampling events (i.e., eBird checklists) that document the species observed, abundance, location, and other associated information submitted voluntarily by birdwatchers. To submit checklists, participants must register an account with eBird and may provide information on their home residence (state, county, and zip code) and socio-demographic data (e.g., age, level of education, and employment). Because eBird participants are not a random sample of birdwatchers, it is not possible to make inferences regarding site selection and participation of all birdwatchers. In our results, we make inference only to current eBird users. A complete history and overview of the program can be found on its website (www.ebird.org). We obtained data from eBird including unique observer number; socio-demographics; state, county, and zip code of residence of the user; species observed; and location of each unique trip. For our purposes, we used only trips during which $\geq$1 waterbird was reported. Waterbirds included species from the families Anatidae, Anhingidae, Ardeidae, Gaviidae, Aramidae, Gruidae, Rallidae, or Podicipedidae.

We used data from trips originating and ending in Atlantic Flyway states between 2005 and 2013 for the Diary Survey and PCS. We used band encounter data from 2006 to 2013 because of changes in BBL data entry and processing beginning in 2006. We used eBird data from 2005 to 2014. We analyzed trips during the hunting season or year-round by hunters and birdwatchers, respectively. We removed trips if only brant or sea ducks were reported harvested in the Diary Survey, PCS, or band encounter data. We summarized Diary and PCS data to the county level and calculated trip distances within the county of residence from the center of the zip code of residence to the center of the county of the recreation site. We calculated trip distances using band encounter data from residence (center of zip code) to reported encounter location (10-min block to Universal Transverse Mercator [UTM] coordinates). We calculated trip distances for eBird data from the center of the zip code of residence to the reported location (using the UTM coordinate system). We did not obtain any personally identifiable information.

We used each data set to calculate summary statistics that describe overall travel patterns of Atlantic Flyway wetland bird enthusiasts. We summarized the number of trips and percent of trips within county of residence and state of residence for the Atlantic Flyway states. Summaries provide a comparison among data sets to determine their usefulness for future studies.

We used publicly available data to construct explanatory variables that we hypothesized influenced the recreation participation and site (i.e., county) selection decisions of wetland bird enthusiasts (Table 1). We calculated each individual's travel cost to each potential hunting or birdwatching location using round-trip vehicle operating costs and opportunity cost of time as:

$$TC = 2 \times \left[(M \times c) + \left(\left(\frac{I}{h^w} \right) \times (h^t) \times \left(\frac{1}{3} \right) \right) \right]$$

where TC is the estimated travel cost for a recreation site, M is the miles driven from residence zip code to recreation site, c is the estimated per-mile vehicle operating cost, I is the median household income of zip code of residence, h^w is the number of hours worked annually (assumed to be 2,080), and h^t is the number of hours it takes to drive from an individual's zip code of residence to a recreation site.

The American Automobile Association (AAA) estimate of cost per mile driven in 2013 was \$0.254 (including gas, oil, tires, and depreciation; AAA 2013). In recreation demand literature, the opportunity cost of time is commonly calculated using a fraction of the wage rate. Parsons (2003) noted that a third of the wage rate is a common lower bound in the literature and full wage rate a common upper bound; we used a third of the wage rate. We obtained median household income estimates from the 2006–2010 American Community Survey (U.S. Census Bureau 2015).

We obtained hectares of wetlands basins from the USFWS National Wetlands Inventory (USFWS 2015). We used all wetlands listed in that database, summed over each county. We modeled the influence of a county bordering the Great Lakes or Atlantic Ocean separately. We obtained information on public lands from the Conservation Biology Institute's Protected Areas Database of the United States (Conservation Biology

Table 1. Explanatory variables used to describe site selection and participation of waterfowl hunters and wetland birdwatchers in New York, USA, 2005–2013.

Variable	Metric	Definition	Data source
Travel cost (*TC*)	U.S. dollars (2013)	Constructed using round trip vehicle operating costs and opportunity cost of time. American Automobile Association (2013) estimate of $0.254 per mile driven (which includes gas, oil, tires, and depreciation). Individuals assigned opportunity cost of time by using a third of the median household income of their home zip code, divided by 2,080 to get work hours in a year, and then multiplied by round trip driving time (from zip code of residence to center of county) to get hourly, site, and individual-specific hourly opportunity cost. One-third figure is commonly used in the recreation demand modeling literature.	Estimated
Public land (*l*)	ha	For the hunting model, hectares of land open to public waterfowl hunting in county *i*; for the birding model, hectares of public land in county *i*.	Conservation Biology Institute's Protected Areas Database of the U.S.
Wetlands (*W*)	ha	Total hectares of wetlands in county *i*.	National Wetlands Inventory
Area (*A*)	km^2	Size of county *i*.	U.S. Census Bureau
Great Lakes coast (*O*)	0, 1	Dummy variable indicating if county *i* borders a Great Lake (0 = no, 1 = yes).	U.S. Census Bureau
Atlantic coast (*O′*)	0, 1	Dummy variable indicating if county *i* borders the Atlantic coast (0 = no, 1 = yes).	
Income (*i*)	U.S. dollars (2013)	Median household income in residential zip code *j*.	U.S. Census Bureau
Income^2 (i^2)	U.S. dollars (2013)	Square of median household income in residential zip code *j*. Used to account for possible nonlinear relationship between income and the decision to take a trip.	
Age	Yr	Age of individual.	eBird self-reporting, hunters 2013 calculated
Age^2	Yr	Square of age of individual. Used to account for possible nonlinear relationship between age and the decision to take a trip.	eBird self-reporting
Gender	0, 1	Dummy variable indicating gender of the participant (0 = female, 1 = male).	eBird self-reporting
Education	0, 1	Dummy variable indicating the highest level of education acquired (0 = Bachelor's degree or less, 1 = Masters or Doctoral degree).	eBird self-reporting

Institute 2015). Within this database, individual parcels are assigned an International Union for the Conservation of Nature protected areas category. We eliminated all unassigned areas (often private protected areas) and used the remaining categorized areas to calculate total public land area. We removed categories II (National Parks and protected areas) and III (National Monuments and historic sites) from the data set to calculate total area of huntable public land.

Discrete Choice Models

Discrete choice models have been used extensively to evaluate recreation benefits and support recreation policy-making (Parsons 2003). A type of discrete choice model, the random utility travel cost model, is commonly used when the research objective is to examine the relationship between the choice of a specific recreation site and attributes of that site and substitute sites. This approach allows researchers to evaluate how changes in site attribute levels affect participation, site choice, and economic benefits to outdoor recreationists. Within an outdoor recreation context, the utility (*U*) an individual receives from a particular site (*i*) can be estimated as (Parsons 2003):

$$U_i = \beta_{tc} tc_i + \beta_q q_{i+} \varepsilon_i$$

where tc_i is the travel cost incurred by an individual to visit site i, β_{tc} is the parameter associated with the travel cost variable, q_i is a vector of site attributes for site i, β_q is a vector of parameters associated with site attributes, and ε_i is a random error term.

An individual may also receive utility from choosing not to take a trip on a given choice occasion. The utility associated with the no-trip decision (U_0) is:

$$U_0 = \alpha_0 + \alpha_1 z + \varepsilon_i$$

where α_0 is a constant that represents no-trip utility, z is a vector of individual characteristics that may affect no-trip utility, α_1 is a parameter associated with the individual characteristics, and ε_i is a random error term.

The utility function is assumed to be completely deterministic from the perspective of the outdoor recreationist; the researcher is not aware of all aspects of an individual's utility function, hence the random error term. As such, the choice model is probabilistic, with the probability expression taking on a conditional logit form if the random term has an extreme value distribution:

$$pr(k) = \frac{\exp\left(\beta_{tc}tc_k + \beta_q q_k\right)}{\exp(\alpha_0 + \alpha_1 z) + \sum_{i=1}^{C}\exp\left(\beta_{tc}tc_i + \beta_q q_i\right)}$$

where $pr(k)$ is the probability of visiting site k and C is the number of recreation sites in the choice set. Parameter estimation occurs via maximum likelihood estimation. Calculating changes in seasonal trips as a result of recreation site quality differences proceeds by changing the level of site attribute q_k and extrapolating to the season by multiplying new choice probabilities by the total number of choice occasions (i.e., number of days an individual could take a trip during the season multiplied by the total number of participants during that season). Although alternative discrete choice modeling statistical methods (e.g., nested and mixed logit) provide additional modeling flexibility, we used the conditional logit model to clearly illustrate the application of discrete choice methods to address human dimensions issues. We discuss site attributes with P-values ≤ 0.05, but also provide estimates of effect size to facilitate interpretation.

Because our initial results indicated that trips within the state of residence account for over 90% of all trips, we developed a state-specific case study using random utility models to predict hunter and birdwatcher recreation site choice in New York. We arbitrarily chose New York from all Atlantic Flyway states because it has a variety of wetland types and offers a range of public and huntable lands throughout its counties. We used Diary Survey data to model hunter trips and eBird data to model trips by birdwatchers. Bronx, Kings, Queens, New York, and Richmond counties in New York all represent New York City and are not options for hunters in New York State, so we removed them from our models. We used only in-state trips in our analysis; the number of possible origins and lack of out-of-state data made trips originating in other states difficult to model. We had a more descriptive data set (e.g., age of hunter) available for hunting trips taken during 2013, so we conducted the analysis both for 2013 alone and for all years combined to illustrate the differences in model structure and results.

We used the resulting discrete choice model to predict changes in recreation participation (i.e., number of trips) resulting from hypothetical management actions and thus progress toward achieving the human dimensions objectives of the NAWMP. For example, the model allowed us to estimate the change in both the number and location of waterfowl hunting trips or wetland birdwatching trips that would result from land acquisition for public recreation. The change in the number of waterfowl hunting or wetland birdwatching trips is an objective and transparent metric that has high relevance with respect to the NAWMP goal of recruiting and retaining recreationists who support wetland conservation. We assumed that maximizing the number of trips taken was positively correlated with recruitment and retention of recreationists and their support for conservation efforts (Nord et al. 1998, Theodori et al. 1998, Mehmood et al. 2003). We first used the trip participation model to examine the effect of a 10% loss of wetland basin area in each New York county on the expected percent change in number of trips to each county to obtain a relative index of the value of county-specific habitat protection to wetland bird enthusiasts. We then applied our model to 4 hypothetical North American Wetland Conservation Act (NAWCA) projects in New York based on proposals submitted to the Atlantic Coast Joint Venture (ACJV). We extracted information from each proposal relative to total acreage, publicly accessible acreage (for birdwatching and waterfowl hunting), hectares of wetlands, and location of county (coastal or not) and inserted those changes into the final trip participation model to estimate the expected number of additional trips (waterfowl hunting and birdwatching) each project would generate. We used Monte Carlo simulation ($n = 120$) to estimate the variance and 95% confidence interval for each proposed NAWCA project.

RESULTS

There was an annual average of 19,829 trips taken by 3,285 individual hunters in the Atlantic Flyway sampled by the Diary Survey from 2005 to 2013 (Table 2). The PCS sampled on average 1,457 hunters taking 9,330 successful

Table 2. Descriptive statistics of waterfowl hunters and birdwatchers in Atlantic Flyway states according to 4 data sources: 1) United States Fish and Wildlife Service's Waterfowl Hunter Diary Survey (Diary); 2) United States Fish and Wildlife Service's Waterfowl Parts Collection Survey (PCS); 3) United States Geological Survey band encounter database (band encounters); and 4) Cornell Lab of Ornithology eBird Program data (eBird), 2005–2013.

	Waterfowl hunters			Birdwatchers
Metric	**Diary**	**PCS**	**Band encounters**[a]	**eBird**
Total trips	178,457	83,972	79,933	1,567,062
Total individuals	29,563	13,117		19,410
$\bar{x}$ individuals/yr	3,285	1,457	NA	3,976
$\bar{x}$ total trips/yr	19,829	9,330	NA	93,216
$\bar{x}$ trips/yr/user	6	6	NA	20
Max. trips/yr/user	102	106	NA	624[b]
$\bar{x}$ distance traveled, km	61.4	63.3	55.5[c]	109.4[d]
Max. distance traveled, km	7,758	4,515	8,823	2,602
% of trips in county of residence	52.9	50.2	54.2	52.4
% of trips in state of residence	94.6	92.4	92.5	86.3
Identifies unsuccessful trips	Yes	No	No	No
Identifies species	No	Yes	Yes	Yes
Identifies number of birds	Yes	Yes	No	Yes

[a] Banding data were available for the period 2006–2013.
[b] Users may report multiple stops in the same areas as unique trip logs, resulting in numerous trips per day.
[c] Ten-minute block is the largest geographic area we used from banding data, but some data were more specific.
[d] We used the exact point recorded though there are known issues with reporting bias.

Table 3. Estimated percent of recreational trips taken within county and state of residence by waterfowl hunters and wetland birdwatchers in Atlantic Flyway (AF) states, 2005–2013, as measured by 4 data sources: 1) United States Fish and Wildlife Service Waterfowl Hunter Diary Survey (Diary); 2) United States Fish and Wildlife Service Waterfowl Parts Collection Survey (PCS); 3) United States Geological Survey band encounter database (band encounters); and 4) Cornell Lab of Ornithology eBird Program data (eBird).

	County				State			
State	Diary	PCS	Band encounters	eBird	Diary	PCS	Band encounters	eBird
CT	67.3	58.6	60.0	59.8	96.3	90.2	93.9	87.8
DE	60.1	60.1	69.4	57.4	91.5	92.7	89.2	74.1
FL	39.4	31.2	44.5	60.7	97.1	95.1	95.3	92.9
GA	41.6	40.3	46.8	34.3	95.8	95.7	95.6	66.0
MA	71.4	66.6	67.6	56.0	91.8	88.6	89.9	86.7
MD	42.3	40.6	53.3	37.2	84.1	86.1	86.6	88.2
ME	62.6	54.8	65.5	55.4	89.9	82.7	94.2	85.7
NC	37.8	35.3	50.9	53.9	95.9	93.2	94.3	85.2
NH	71.0	66.2	71.8	44.3	94.7	92.0	93.6	72.0
NJ	52.8	43.9	59.3	53.6	91.2	84.9	90.7	89.7
NY	60.9	56.7	62.7	61.7	95.3	88.1	91.7	89.0
PA	62.3	62.2	60.0	52.1	98.3	97.3	97.0	77.4
RI	59.1	60.1	65.0	63.7	90.2	89.4	87.4	90.1
SC	44.2	41.3	49.6	60.6	94.6	97.2	95.6	94.3
VA	38.0	37.1	40.7	30.6	93.5	94.4	94.3	81.1
VT	62.8	63.1	64.6	64.7	95.5	95.2	93.8	89.6
WV	52.1	58.1	47.8	52.9	89.0	87.7	88.5	78.1
AF	54.4	51.5	57.6	52.9	93.2	91.2	92.5	86.2

trips per year. Band encounter data sampled nearly 80,000 total Atlantic Flyway trips that resulted in the harvest of a banded bird compared to almost 84,000 and >178,000 sampled by the PCS and Diary Survey, respectively. Average hunter trip distance ranged from 50 km to 63 km in the 3 data sets (Table 2). Percent of trips taken within the county of residence ranged from 50% to 54%. Trips within the state of residence accounted for 92–95% of sampled trips from each data source (Table 2), though this varied by state (Table 3). Estimates of average total trips in a year, trips per individual, average distance traveled, and percent of trips within a county or state of residence among the data sources (where applicable) were within 10% of each other, suggesting each data source provided similar information on waterfowl hunter travel characteristics.

Birdwatching trips in the Atlantic Flyway recorded via eBird came from 19,410 people representing over 1.5 million unique trip logs (Table 2). On average, about 4,000 eBird users in Atlantic Flyway states went birdwatching and recorded the trip on eBird annually, though this had a rapidly increasing trend over the survey period. Individuals reported an average of 20 trips per year and traveled an average of just over 100 km. Similar to hunter data, about 52% of reported trips were within the county of the birdwatcher's residence and 86% in the state of residence.

We conducted 3 travel cost analyses examining waterfowl hunter and wetland birdwatcher participation decisions and site choices as a function of wetland user demographics and site characteristics. The analyses included New York waterfowl hunters in 2013, New York waterfowl hunters from 2005 to 2013, and New York eBird users in 2013. In the 2013 New York waterfowl hunter model, recreation site choice was negatively related to travel cost and size of county, and positively related to wetland basin hectares and coastal counties (Table 4). The model using multiple years of data (2005–2013) indicated recreation site choice was negatively related to travel cost and amount of public land, and positively related to wetland basin hectares and Great Lakes counties (Table 4).

In 2013, site selection of New York wetland birdwatchers was positively related to wetland basin hectares and Great Lakes coastal counties and negatively related to travel costs (Table 4). Males were more likely to go birdwatching than females and the decision to go birdwatching exhibited a non-linear relationship relative to age (Table 4). Though statistically significant, the effect size of wetland basin area and public lands on site selection by birdwatchers and waterfowl hunters was small (Table 4).

We predicted the relative change in the number of hunting and birding trips in each county that would result from a 10% loss of wetland basin hectares in each county (Fig. 1). We predicted both groups of users would take fewer trips to counties in the northern portion of New York State. Notably, the Finger Lakes counties did not show a large decrease in trips, and counties just to the northwest of New York City showed moderate reduction in trips by both groups. Examined separately, we predicted the 4 hypothetical NAWCA projects would generate 4.98–43.20 additional hunting trips and 0.25–1.85 additional birdwatching trips by eBird users (Table 5).

DISCUSSION

Our purpose was to call the attention of the NAWMP community, particularly those involved in habitat conservation planning and delivery, to existing data and analytical tools that can be used to investigate relationships between recreationists and land management. The results of such analyses can be used to inform habitat management decisions relative to achieving human dimensions objectives. Our work relied on coarse-scale data, both in terms of site use by

Table 4. Relationship between *a priori* factors and site selection of waterfowl hunters and wetland birdwatchers in New York, USA, derived using random utility models with 3 data sets of recreational site choices in New York, USA: 1) trips reported by eBird users during 2013; 2) trips reported in 2013 by waterfowl hunters, and 3) trips reported between 2005 and 2013 by waterfowl hunters. N/A: not applicable.

	Birdwatchers (2013) $n = 694$		Waterfowl hunters (2013) $n = 270$		Waterfowl hunters (2005–2013) $n = 4,204$	
Factor	$\bar{x}$ (±SE)	*P*	$\bar{x}$ (±SE)	*P*	$\bar{x}$ (±SE)	*P*
Site characteristics						
Travel cost ($)	−0.066 (±0.004)	<0.001	−0.051 (±0.0057)	<0.001	−0.048 (±0.001)	<0.001
Public land (ha)	−1.130e-06 (±1.950e-06)	0.562	−0.000 (±0.0000)	0.135	−0.000 (±4.290e-06)	<0.001
Wetlands (ha)	−0.000 (±0.0001)	0.027	0.000 (±0.0000)	<0.001	0.000 (±5.300e-06)	<0.001
Area (ha)	0.001 (±0.009)	0.466	−0.002 (±0.0008)	0.019	−0.001 (±0.000)	0.057
Atlantic coastal counties (1=yes)	0.169 (±0.179)	0.246	0.687 (±0.2618)	0.009	0.1535 (±0.109)	0.163
Great Lake coastal counties (1=yes)	0.351 (±0.184)	0.057	0.375 (±0.1600)	0.019	0.773 (±0.047)	<0.001
Individual characteristics						
Opt out	6.917 (±0.792)	<0.001	5.360 (±0.9579)	<0.001	N/A	
Income ($/annual)	0.000 (±0.0000)	0.063	−0.000 (0.0000)	0.047	N/A	
Income^2 ($/annual)	8.990e-11 (±8.530e-11)	0.296	1.830e-10 (±1.160e-10)	0.112	N/A	
Age (yr)	−0.091 (±0.0298)	0.002	−0.027 (±0.020)	0.184	N/A	
Age^2 (yr)	0.001 (±0.003)	0.002	−0.000 (±0.000)	0.371	N/A	
Gender (female)	−0.681 (±0.156)	<0.001			N/A	
Education (bachelor's degree or less)	0.202 (±0.1594)	0.206			N/A	

wetland bird enthusiasts and habitat characteristics. Therefore, we urge readers to interpret our results as exploratory and focus on the applicability of these types of data and analytical tools for addressing the new human dimensions objectives of the NAWMP.

The 3 sources of hunting trip data provided similar pictures of waterfowl hunters in the Atlantic Flyway. We chose to focus on Diary Survey data as this source offered a larger sample size than either PCS or band encounters. Our estimate of the average number of waterfowl hunting days per year (6) was less than the national average of 10.7 days (U.S. Department of the Interior et al. 2011). Overall, participation in any type of hunting is lower in the Atlantic Flyway states compared to the national average (U.S. Department of the Interior et al. 2011). Nationally, birdwatchers spent an average of 13 days observing birds away from home (U.S. Department of the Interior et al. 2011) compared to our finding of 20 trips per year for eBird users in the Atlantic Flyway states.

The influence of most of the variables we examined confirmed general hypotheses about site selection by wetland bird enthusiasts. As expected, site selection by wetland bird enthusiasts was negatively correlated with travel cost. Data from each source indicated that greater than half of all waterfowl hunting trips were within a person's county of residence and >90% were within the state of residence. Nationally, 94% of all migratory bird hunters hunted within their state of residence and 11% hunted out of state (U.S. Department of the Interior et al. 2011). In Illinois, USA, 60% of waterfowl hunters reported hunting in their county of residence at least once; 37% hunted only in their county of residence (Anderson et al. 1998). In Alabama, USA, 64% of hunters indicated they traveled <80 km to hunt (Mehmood et al. 2003). Our data suggest birdwatchers participate in their state and county of residence at similar rates to hunters, but they take more trips per year. This is not surprising because birdwatching (unlike hunting) is not restricted to certain dates and seasons. One should compare participation across hunters and birdwatchers with caution, given the differences in these recreational activities and data collection methods. For example, the eBird data contains recorded bird observations, with the assumption that all observations occurred on birdwatching trips. Because these observations may have occurred during an activity not focused specifically on birdwatching, birding trips may be inflated. Finally, the predominance of within-state trips suggests that modeling recreation site choice at the sub-state, particularly county level, within the Atlantic Flyway is appropriate.

As expected, site selection by wetland bird enthusiasts was positively correlated with wetland basin area. Wetland basin area is a variable that could capture multiple aspects of the hunting or birdwatching experience. A wetland is a physical description of a specific trip location, and the amount of filled wetland basins in a county may be related to the probability of harvesting waterfowl or viewing wetland-dependent species. In addition to preferring counties with greater area of wetland basins, wetland bird enthusiasts were more likely to take a trip to a coastal county whether it was a coastal Atlantic Ocean county or coastal Great Lakes county. This is intuitive, given the presumably greater waterfowl hunting and wetland bird viewing opportunities along the coasts. Relationships among functioning wetlands (i.e., area of surface water), waterfowl abundance, and hunter harvest should be explored in future models, perhaps by incorporating indices of local bird abundance such as the Christmas Bird Count and Breeding Bird Survey data.

The negative influence of public land abundance on number of trips in New York was unexpected and we note the small effect size (Table 4). Publicly accessible land has generally been found to be a positive determinant of hunter site selection (e.g., deer hunters [Knoche and Lupi 2012], grouse hunters [Knoche and Lupi 2013], and pheasant hunters (Knoche et al. 2015)]. Previous research with waterfowl hunters has shown that hunters are willing to pay significantly for increased public access (Crookshank 1990) and loss of habitat can have a significant negative effect on

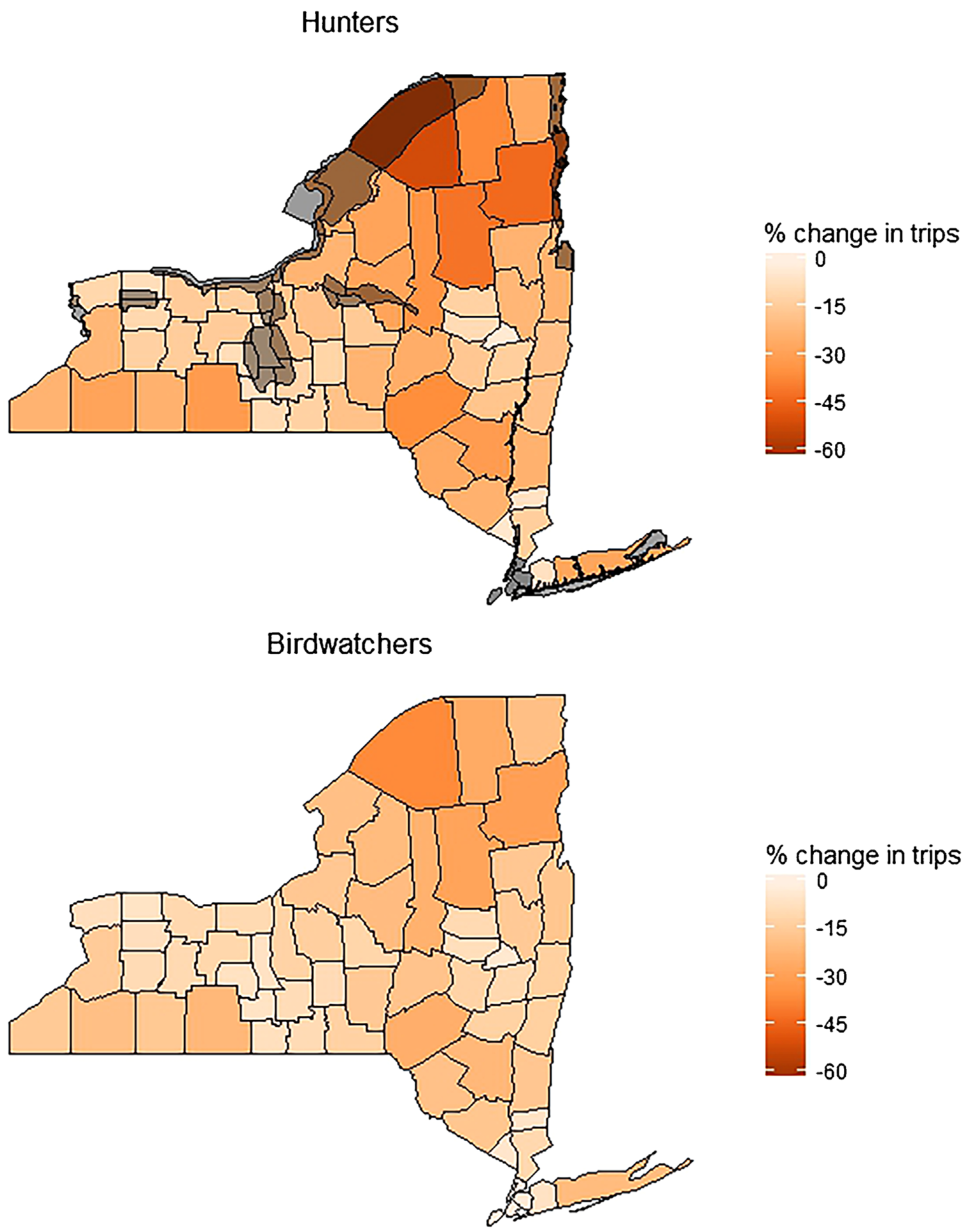

Figure 1. Expected change (%) in the number of waterfowl hunting (top) and wetland birdwatching trips (bottom) by county resulting from a 10% decrease in wetland basin acreage across all counties in New York, USA, 2005–2013. Atlantic Coast Joint Venture waterfowl focal areas are identified by the gray shading.

Table 5. Summary of predicted change in the number of state-wide waterfowl hunting and wetland birdwatching trips in New York, USA, that would be expected to be generated by implementing 4 hypothetical North American Wetlands Conservation Act proposals.

			Size (ha)					
Proposal	**Counties affected**	**Coastal**	**Public lands**	**Wetlands**	**Open to hunting**	**Open to birdwatching**	**$\bar{x}$ (95% CI) seasonal increase in birdwatching trips among eBird users[a]**	**$\bar{x}$ (95% CI) seasonal increase in hunting trips among waterfowl hunters**
1	Genesee	No	440	33	193	440	0.25 (0.08–0.38)	4.98 (2.86–7.30)
2	Livingston, Ontario	No	2,705	221	0	2,240	1.71 (0.55–2.93)	41.17 (24.84–61.29)
3	Lewis	No	76	32	18	32	0.25 (0.07–0.47)	8.08 (4.62–12.98)
4	Oswego, Genesee, Wayne	Great Lakes	1,280	378	653	653	1.85 (0.58–3.44)	43.24 (25.14–62.16)

[a] The estimated increase in birdwatching trips includes only the increase in trips among the eBird sample ($n = 694$). That is, unlike the estimated increase in hunting trips, estimated changes in birdwatching trips are not extrapolated to the population level. Thus, changes in birdwatching trips and hunting trips are not directly comparable. The lack of a scientific survey-based sampling approach for birdwatchers precludes this extrapolation to all birdwatchers in New York.

money spent participating in waterfowl hunting (Miller and Hay 1981). In contrast to New York, Georgia, USA, hunters were positively influenced by amount of public land (A. Roberts, U.S. Fish and Wildlife Service, unpublished data), indicating that access is potentially more important in that state. Similarly, in Ohio, USA, the proportion of a county open to public hunting had a strong influence on local hunting license sales (Karns et al. 2015). It is possible that our analyses did not identify positive preferences for public lands because the public lands data set we used did not fully reflect the specific types and characteristics of public lands used by wetland bird enthusiasts. For example, public land in New York consists mostly of forested acreage such as in Adirondack Park and New York state forests, habitat types that are not attractive to wetland birds (U.S. Geological Survey 2016). Obtaining more precise data on the characteristics associated with public lands has been challenging, and the National Wetland Inventory has known problems with identifying forested wetlands (Kudray and Gale 2000). However, at the state and national scale, waterfowl hunters hunt on private land (97%) more than on public land (77%; Mehmood et al. 2003, U.S. Department of the Interior et al. 2011). Further, 57% of migratory bird hunting days occur on private land (U.S. Department of the Interior et al. 2011). Perhaps a better proxy for public land may be public wetland hectares. Potential for using this variable should be explored at the state scale.

We identified a non-linear relationship between age and the decision to go birdwatching. Initially, increasing age increases the likelihood an individual chooses the no-trip alternative (i.e., not to go birdwatching on a given choice occasion). However, the marginal effect of age on participation decreases with each additional year of age (hence the negative and statistically significant coefficient on the quadratic age variable). This implies that there is an age threshold, beyond which the probability of going birdwatching begins increasing. Time commitments of a growing family and career may reduce recreation participation until work and family obligations diminish later in life. Hay and McConnell (1979) also observed this relationship between income and the likelihood an individual participates in non-consumptive recreation.

Our work demonstrates the potential of using discrete choice models to incorporate human dimensions objectives into wetland habitat conservation planning and management. In the Atlantic Flyway states, most hunting and birdwatching occur within an individual's county of residence; therefore, we recommend future research efforts use finer scale data sets to construct site-specific variables to improve model fit and inference. For example, we used a national database of protected areas that may not adequately represent aspects of public land important to recreationists examined in this research. We suspect states agencies may have more accurate spatial data relative to the distribution and availability of land accessible to the public (e.g., public land or private land accessible through easements), composition of wetlands, recreational regulations (i.e., open or closed to hunting), and presence of infrastructure (e.g., trails, boat launches). Perhaps the most promising state-level data for discrete choice modeling include sign-in information at state parks and wildlife management areas and applications for limited or controlled waterfowl hunting opportunities. Given similar patterns exhibited in these 3 waterfowl hunting data sets (e.g., percent of trips within county and state of residence, distance traveled), we suggest future research efforts consider the application of hierarchical models to integrate these data sets into a common estimation framework and account for the iterative nature of the decision process (Milton 1988, Adamowicz et al. 1990, Swait et al. 2004, Hicks and Schnier 2005). Coupled with more accurate and informative land management data at the state scale, these methods hold great promise for understanding site selection and participation of wetland bird enthusiasts.

Participation in outdoor recreation is influenced by several socio-demographic characteristics including age, gender, and income (Bissell et al. 1998, Johnson et al. 2001, Shores et al. 2007, Baas et al. 2013). Though we found relationships between age and participation with respect to birdwatching, our data contain very limited socio-demographic information, which limited STET hypotheses we could investigate. The USFWS Diary Survey collection methods could be augmented to include data on hunter age and gender, land ownership (i.e., private or public) of the recreational site, and nearest town to help habitat managers target habitat that benefits both wetland birds and recreationists. Waterfowl hunters (Kuentzel and Heberlein 1992, Schroeder et al. 2013) and birdwatchers (McFarlane 1994, Hvenegaard 2002) have a range of commitment and specialization. A more detailed analysis of wetland bird enthusiasts with different species preferences (dabbling *vs.* diving duck hunters, waterfowl *vs.* waterbird watchers) may better inform habitat management at specific sites. We encourage the NAWMP community to build partnerships and cooperative projects with practitioners in the fields of outdoor recreation management, leisure management, and natural resource economics to improve upon our initial efforts by incorporating fine-scale data, testing additional hypotheses, and applying the results to regional and local habitat management decisions.

MANAGEMENT IMPLICATIONS

Jonas et al. (2015) found the allocation of limited land acquisition funds was influenced by the relative importance ascribed to biological versus social objectives. Going forward, the NAWMP community will have to be transparent in regard to the relative importance ascribed to these competing objectives when making habitat conservation and management decisions. Despite the coarseness of our data, we believe our analyses demonstrate the potential of these and similar data and analytical methods for incorporating recreation participation and site selection into habitat planning and delivery under the NAWMP. One advantage of these data sets is that they are readily available at the national scale allowing this approach to be applied across all 4 flyways relatively quickly and economically. The potential application of these data to human dimensions objectives further underscores the usefulness of these monitoring programs and the need to maintain them into the future. We encourage the NAWMP community to establish methods for collecting and maintaining data relative to recreation participation at the site scale (e.g., wildlife management area or National Wildlife Refuge) to complement national data sets.

ACKNOWLEDGMENTS

We thank the Cornell Lab of Ornithology for providing bird observation and socio-demographic data of eBird contributors. We thank the members of the North American Waterfowl Management Plan community that have contributed to the specification of hypotheses relating habitat management to waterfowl hunters and birdwatchers. Two anonymous reviewers, the Associate Editor, and K. Kriese provided valuable comments on earlier drafts of this manuscript. The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

LITERATURE CITED

Adamowicz, W., S. Jennings, and A. Coyne. 1990. A sequential choice model of recreation behavior. Western Journal of Agricultural Economics 15:91–99.

Adams, R. M., O. Bergland, W. N. Musser, S. L. Johnson, and L. M. Musser. 1989. User fees and equity issues in public hunting expenditures: the case of ring-necked pheasant in Oregon. Land Economics 65:376–385

American Automobile Association [AAA]. 2013. Your driving costs. AAA Association Communication, Heathrow, Florida, USA.

Anderson, W. L., R. M. Marshalla, R. M. Whitton, and D. J. Holm. 1998. Illinois waterfowl harvest, hunter activity, and attitudes toward youth waterfowl hunting day, quality hunting, and duck/goose regulations, plus sex/age of hunters, 1996–97 season. Illinois Department of Natural Resources, Publication #95, Springfield, USA.

Baas, J. M., A. Ewert, and D. J. Chavez. 2013. Influence of ethnicity on recreation and natural environment use patterns: managing recreation sites for ethnic and racial diversity. Environmental Management 17:523–529.

Bissell, S. J., M. D. Duda, and K. C. Young. 1998. Recent studies on hunting and fishing participation in the United States. Human Dimensions of Wildlife 3:75–80.

Boxall, P. C. 1995. The economic value of lottery-rationed recreational hunting. Canadian Journal of Agricultural Economics 43:119–131.

Brunke, K. D., and K. M. Hunt. 2008. Mississippi waterfowl hunter expectations, satisfaction, and intentions to hunt in the future. Human Dimensions of Wildlife 13:317–328.

Carney, S. M. 1992. Species, age, and sex identification of ducks using wing plumage. U.S. Fish and Wildlife Service, Washington D.C., USA.

Carney, S. M., and A. D. Geis. 1960. Mallard age and sex determination from wings. Journal of Wildlife Management 24:372–381.

Conservation Biology Institute. 2015. Conservation Biology Institute Protected Areas Database United States. http://consbio.org/products/projects/pad-us-cbi-edition. Accessed 11 Mar 2015.

Crookshank, S. L. 1990. A random utility model of waterfowl hunting. Thesis, University of Delaware, Newark, USA.

Geissler, P. H. 1990. Estimation of confidence intervals for federal waterfowl harvest surveys. Journal of Wildlife Management 54:201–205.

Hay, M. J., and K. E. McConnell. 1979. An analysis of participation in nonconsumptive wildlife recreation. Land Economics 55:460–471.

Henny, C. J., and K. P. Burnham. 1976. A reward band study of mallards to estimate band reporting rates. Journal of Wildlife Management 40:1–14.

Hicks, M. J., and K. Schnier. 2005. Dynamic discrete choice modeling: Monte Carlo analysis. College of William and Mary, Department of Economics Working Paper #18, Williamsburg, Virginia, USA.

Hvenegaard, G. T. 2002. Birder specialization differences in conservation involvement, demographics, and motivations. Human Dimensions of Wildlife 7:21–36.

Johnson, C. Y., J. M. Bowker, and I. K. Cordell. 2001. Outdoor recreation constraints: an examination of race, gender, and rural dwelling. Southern Rural Sociology 17:111–113.

Jonas, D., K. Carrlson, B. Kroh, M. Reddy, K. Schroeder, G. Stoebner, B. Taddicken, M. Vrtiska, P. K. Devers, E. Irwin, and I. Bronson. 2015. Balancing social and ecological objectives at a landscape scale: the Platte River Watershed Case Study. Structured Decision Making Workshop Report. U.S. Fish and Wildlife Service National Conservation Training Center, Shepherdstown, West Virginia, USA.

Karns, G. R., J. T. Bruskotter, and R. J. Gates. 2015. Explaining hunter participation in Ohio: a story of changing land use and new technology. Human Dimensions of Wildlife 20:484–500.

Knoche, S., and F. Lupi. 2007. Valuing deer hunting ecosystem services from farm landscapes. Ecological Economics 64:313–320.

Knoche, S., and F. Lupi. 2012. The economic value of publicly accessible deer hunting lands. Journal of Wildlife Management 76:462–470.

Knoche, S., and F. Lupi. 2013. Economic benefits of publicly accessible land for ruffed grouse hunters. Journal of Wildlife Management 77:1294–1300.

Knoche, S., F. Lupi, and A. Suiter. 2015. Harvesting benefits from habitat restoration: influence of landscape position on economic benefits to pheasant hunters. Ecological Economics 113:97–105.

Kudray, G. M., and M. R. Gale. 2000. Evaluation of National Wetland Inventory maps in a heavily forested region in the Upper Great Lakes. Wetlands 20:581–587.

Kuentzel, W. F., and T. A. Heberlein. 1992. Does specialization affect behavioral choices and quality judgments among hunters? Leisure Sciences 14:211–226.

Martin, E. M., and S. M. Carney. 1977. Population ecology of the mallard. IV. A review of duck hunting regulations, activity, and success, with special reference to the mallard. Resource Publication 130. U.S. Fish and Wildlife Service, Washington D.C., USA.

McFarlane, B. L. 1994. Specialization and motivations of birdwatchers. Wildlife Society Bulletin 22:361–370.

Mehmood, S., D. Zhang, and J. Armstrong. 2003. Factors associated with declining hunting license sales in Alabama. Human Dimensions of Wildlife 8:243–262.

Miller, J. R., and M. J. Hay. 1981. Determinants of hunter participation: duck hunting in the Mississippi Flyway. American Journal of Agricultural Economics 63:677–684.

Milton, J. W. 1988. A nested demand shares model of artificial marine habitat choice by sport anglers. Marine Resource Economics 5:191–213.

Moore, R. L., D. Scott, and A. Moore. 2008. Gender-based differences in birdwatchers' participation and commitment. Human Dimensions of Wildlife 13:89–101.

New York Department of Environmental Conservation. 2017. Habitats of New York State. http://www.dec.ny.gov/animals/9402.html. Accessed 5 Jul 2017.

Nord, M., A. E. Luloff, and J. C. Bridger. 1998. The association of forest recreation with environmentalism. Environment and Behavior 30:1–9.

Parsons, G. R. 2003. The travel cost model. Pages 269–329 *in* P. A. Champ, K. J. Boyle, and T. C. Brown, editors. A primer on nonmarket valuation. Springer Press, New York, New York, USA.

Pierce, C. L., J. K. Ringelman, and M. R. Szymczak. 1996. An investigation of factors affecting waterfowl hunting participation in Colorado. Human Dimensions of Wildlife 1:80–81.

Remington, T. E., M. J. Manfredo, J. J. Vaske, and S. M. DeMasso. 1996. Fee hunting pheasants in Colorado: experimental evidence. Human Dimensions of Wildlife 1:51–59.

Schroeder, S. A., D. C. Fulton, J. S. Lawrence, and S. D. Cordts. 2013. Identity and specialization as a waterfowl hunter. Leisure Sciences 35:218–234.

Schwabe, K. A., P. W. Schuhmann, R. Boyd, and K. Doroodian. 2001. The value of changes in deer season length: an application of the nested multinomial logit model. Environmental and Resource Economics 19:131–147.

Shores, K. A., D. Scott, and M. F. Floyd. 2007. Constraints to outdoor recreation: a multiple hierarchy stratification perspective. Leisure Sciences 29:227–246.

Swait, J., W. Adamowicz, and M. van Bueren. 2004. Choice and temporal welfare impacts: incorporating history into discrete choice models. Journal of Environmental Economics and Management 47:94–116.

Theodori, G. L., A. E. Luloff, and F. K. Willits. 1998. The association of outdoor recreation and environmental concern: reexamining the Dunlap-Heffernan thesis. Rural Sociology 63:94–108.

U.S. Census Bureau. 2015. American Community Survey. http://census.gov/programs–survey/acs/. Accessed 15 Jul 2015.

U.S. Census Bureau. 2017. QuickFacts: New York. https://www.census.gov/quickfacts/NY. Accessed 15 Jul 2017.

U.S. Department of the Interior, Environment Canada, and Secretariat of the Environment and Natural Resources (Mexico). 2012. North American Waterfowl Management Plan 2012: People conserving waterfowl and wetlands. Washington, D.C., USA.

U.S. Department of the Interior, and Environment Canada. 1986. North American Waterfowl Management Plan. Washington, D.C., USA.

U.S. Department of the Interior, U.S. Fish and Wildlife Service, U.S. Department of Commerce, and U.S. Census Bureau. 2011. National survey of fishing, hunting, and wildlife associated recreation. Washington, D.C., USA.

U.S. Fish and Wildlife Service [USFWS]. 2015. National Wetland Inventory homepage. http://www.fws.gov/wetlands/index.html. Accessed 13 Mar 2015.

U.S. Geological Survey. 2016. U.S. Geological survey Land Cover Institute New York land cover page. http://landcover.usgs.gov/newyork.php. Accessed 11 Apr 2016.

Associate Editor: Pearse