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Market and Nonmarket Valuation of North Carolina's Tundra Swans among Hunters, Wildlife Watchers, and the Public

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ABSTRACT Wildlife-related tourism represents an important and growing economic sector for many rural communities and may be inadequately considered during regional planning. Providing robust estimates of wildlife values can help address this challenge. We used both market and nonmarket valuation methods to estimate the value of tundra swans (*Cygnus columbianus*) in North Carolina, USA, and compared tundra swan values among hunters, wildlife watchers, and general public. Wildlife watchers reported the greatest willingness-to-pay (US$35.2/wildlife watcher/yr), followed by hunters (US$30.53/hunter/yr), and residents (US$16.27/resident/yr). We used the Impact Analysis for Planning system software to estimate market values or economic activity associated with tundra swans. Tundra swan hunters spent an average of US$408.34/hunter/year. Depending on assumptions over the substitutability of tundra swan hunting, we estimate that it generates value added of between US$306,155/year and US$920,161/year for the state economy. Wildlife watchers spent an average of US$171.25/wildlife watcher/year. We estimate that this generates value added of between US$14 million/year and US$42.9 million/year for the state economy, again depending on assumptions about whether watching tundra swans would be substituted with other leisure activities in eastern North Carolina or out-of-state. Compared with studies of international nature tourism, we found relatively low leakage rates (i.e., loss of economic benefits outside the study region), suggesting that enhancing opportunities for hunting and wildlife-viewing may be an effective economic development strategy for rural areas in the United States. Presenting both market and nonmarket values provides a more complete picture of the value of wildlife and may facilitate more effective management decisions; therefore, we recommend that both market and nonmarket values be considered to optimize tradeoffs between development and wildlife recreation.

KEY WORDS birding, contingent valuation, *Cygnus columbianus*, economics, markets, nonmarket valuation, tourism, tundra swans, wildlife tourism.

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Wildlife-related tourism represents an important and growing economic sector for many rural communities. Tourism can have a positive effect on rural economies by injecting new dollars into local businesses, supporting the tax base, and creating increased demands for locally available land, labor, and capital (Sims et al. 2004, Phillips et al. 2013). Rural tourism in general, and wildlife-related tourism in particular, has proven to be a powerful component for economic growth by transferring capital, income, and employment from industrial, urban, and developed areas to more rural regions (Lane 1994, Reynolds and Braithwaite 2001). Rural tourism in the United States largely is composed of domestic tourism (Gartner 2004, Aremberri 2005). Most international visitors do not move far from urban areas (Gartner and Lime 2000); thus, international tourism is much less economically important to a developed nation's economy when compared with domestic tourism (Aremberri 2005). Over half of all trips of ≥160 km, originate and end in the same state (U.S. Department of Transportation 2002); therefore, distance and ease of travel are important factors for rural tourists (Oh and Schuett 2010). Unique recreational opportunities also attract tourists and provide rural communities with a competitive advantage in the development of productive tourism businesses (English and Bowker 1996). Further, wildlife tourism can increase rural support for wildlife management and conservation by demonstrating the value of wildlife resources (Ashley and Roe 1998).

Wildlife tourism should be considered in regional planning efforts to avoid damage to rural economies and promote outcomes for stakeholders that reflect their values. Development such as housing, infrastructure, and renewable energy projects can alter landscapes and affect diverse stakeholders including hunters, wildlife watchers, homeowners, developers, and general public. For example, wind-energy developments can negatively affect wildlife populations by altering habitat, altering behavior or displacing species, and causing direct mortality from collisions (Kunz et al. 2007, Kuvlesky et al. 2007). Most wildlife recreation activities take place in rural settings (Knight and Gutzwiller 1995, Reynolds and Braithwaite 2001), so habitat loss or population decline in a rural area dependent on wildlife for tourism may have significant effects on the local economy. Also, local traditions of a rural area may be affected by regional planning. Hunting, in particular, is considered a family tradition and serves as an important way of life for many rural communities (Hayslette et al. 2001, Stedman and Heberlein 2001, Chitwood et al. 2011). Hence, regional planning that considers effects on wildlife may help maintain the viability of hunting and protect socio-cultural values of locals.

Integrating wildlife conservation into regional planning is complex; however, economic impact and cost–benefit analyses are 2 commonly used approaches used in this process. Established market and nonmarket values of wildlife species allows decision-makers to understand tradeoffs inherent to development projects that affect wildlife (Grado et al. 2007, 2011). Economic impact analyses quantify the extent to which an activity affects an economy and how related expenditures benefit services and other businesses (Grado et al. 2011). Economic impact analyses use surveys to determine market expenditures and input–output analyses to assess the contribution of those expenditures to local economic activity, which we term the market value. Market values of wildlife can be assessed by garnering expenditures from a hunting, fishing, or wildlife watching trip from participants (Loden et al. 2004, Grado et al. 2011). These expenses can be used in an input–output analysis to determine total economic impacts, which include direct impacts coming from expenditures made to businesses, indirect impacts coming from supporting business expenditures, and induced impacts coming from expenditures derived from employees of direct and indirect businesses (Grado et al. 2011).

In reality, hunters and wildlife watchers may place substantially more value on wildlife than they have to spend on hunting or wildlife watching trips. These nonmarket values are not reflected in market transactions, so they are often not considered in land use decisions. The nonmarket value of wildlife includes use values (e.g., viewing a species), option values (e.g., maintaining a species for genetic information that may be used in the future), existence values (e.g., satisfaction from knowing a species exists), and bequest values (e.g., knowledge that conserving a species today leaves it for future generations; Loomis and White 1996). Cost–benefit analyses determine net benefits by indicating which of the money flows in economic impact analyses are costs and which are benefits (Taks et al. 2011). Benefits are reflected in willingness-to-pay (WTP), which can be estimated using nonmarket valuation techniques. One common technique for quantifying nonmarket values is the contingent valuation method, which uses surveys to elicit individual preferences for environmental goods, such as species conservation (Arrow et al. 1993, Jakobsson and Dragun 2001, Dalrymple et al. 2012). These methods can quantify both the economic contribution (or market value) and economic value (or WTP) of wildlife species, and thus facilitate their inclusion in a wide range of plans (e.g., county comprehensive plans, Environmental Impact Statements) that rely on monetary values as a common currency for consideration.

We conducted a study focused on documenting the market and nonmarket value of tundra swans (*Cygnus columbianus*) in eastern North Carolina, USA. We investigated whether those who receive use value from an environmental good, such as tundra swan hunting or viewing, will have a greater WTP than those who receive only nonuse value, while controlling for income, education, age, and gender. We hypothesized that income should be positively related to WTP because of previous research (Chen and Jim 2010), and economic theory predicts that WTP for any good or service (holding all else equal) should be positively related to income. Also, we hypothesized that importance of tundra swan conservation should be positively related to WTP because the more important something is to someone, the more they are willing to pay (Loomis and White 1996, Dalrymple et al. 2012). We also evaluated the relationship between gender and WTP as well as age and WTP. Finally, because tourism effects on rural economies often are diluted by leakage of economic benefits back to more wealthy organizations or regions, we evaluated how much of the market value associated with tundra swans was retained in eastern North Carolina and the state as a whole.

STUDY AREA

We defined our eastern North Carolina study area as the 16 counties that provide nearly all (99.4%) of the tundra swan harvest in the state: Hyde, Washington, Currituck, Tyrrell, Beaufort, Pasquotank, Carteret, Pamlico, Chowan, Dare, Halifax, Perquimans, Edgecombe, Bertie, Camden, and Northampton (Fig. 1). The region offers a compelling study area because it provides wintering habitat for an average of 70,000 tundra swans, roughly 68% of the entire eastern population (Roberts and Padding 2017); the first wind-energy development project in the southeastern United States was announced for construction in eastern North Carolina in 2015 (NC East Alliance 2015). Although knowledge gaps remain, a synthesis of available studies suggested that swans and geese may be negatively affected by wind farm development (Kuvlesky et al. 2007, Rees 2012).

METHODS

We conducted 3 surveys: 1 with tundra swan hunters, 1 with wildlife watchers at Mattamuskeet and Pea Island National Wildlife Refuges (NWR), and 1 with residents of North Carolina. We administered an online survey through Qualtrics to 3,000 randomly selected tundra swan hunters during February–March 2015 (n = 1,485). We obtained our sample of hunters from the North Carolina Wildlife Resources Commission's tundra swan hunting permit database. We administered an in-person survey of wildlife watchers in January 2015 (n = 350) and used an intercept survey method to obtain a sample of wildlife watchers (Davis et al. 2012). We gave the questionnaire to every person we saw enter either refuge and had the respondent complete and return it to us while we waited. At Mattamuskeet NWR, we drove the main refuge road and surveyed every person we saw. We spent 10 days at Mattamuskeet NWR and collected 240 surveys. At Pea Island NWR, we surveyed every person that stopped at one of the primary pull-offs along NC Highway 12. We spent 8 days at Pea Island NWR and collected 110 surveys. We administered a mail survey to a sample of 3,000 randomly selected North Carolina residents during February–March 2015 (n = 455). The resident sample was purchased from Survey Sampling International (Shelton, CT, USA) and achieved approximately 76% coverage of North Carolina households using landline phone records, driver license records, and deed records (F. Markowitz, Survey Sampling International, personal communication). Mail survey administration followed Dillman's Tailored Design Method (Dillman 2007), adapted to more closely follow survey administration methods traditionally used by the North Carolina Wildlife Resources Commission. There were 4 mailings that included the first survey packet, second survey packet, reminder postcard, and a final survey packet. Each survey packet included a cover letter that explained the survey, a survey booklet, and a paid return postage envelope. The North Carolina State University Institutional Review Board (IRB #4128) approved this study, and all participants gave their informed consent to participate.

We used pretests and cognitive interviews to identify and correct problems with question comprehension, wording, and skip patterns as well as to finalize bid structures for the contingent valuation questions. We pretested the online hunter questionnaire with a sample of 200 tundra swan hunters and obtained a 45% response rate (n = 90). At the end of the pretest, we asked respondents to indicate any problems they encountered and to suggest improvements. The wildlife watcher questionnaire was pretested in 2 stages at Mattamuskeet NWR (Fig. 1). In February 2014, we interviewed 12 wildlife watchers to collect a list of typical expenses. During October 2014, we administered the questionnaire to 15 wildlife watchers at Mattamuskeet NWR using a cognitive interview format (Desimone and Le Floch 2004). The format involved asking respondents to comment on the current questionnaire and suggest how we could make improvements. The resident questionnaire was pretested via mail with 200 (n = 12) randomly chosen respondents.

The 3 questionnaires used in these surveys were modeled after recent wildlife valuation studies (Grado et al. 2011, Dalrymple et al. 2012). Although we used 3 different questionnaires, they shared several common elements: a question asking the importance of tundra swan conservation, a contingent behavior question asking respondents to rate the likelihood they would take a trip to eastern North Carolina if tundra swans stopped migrating to North Carolina, a contingent valuation question using dichotomous choice with a follow-up bid to determine respondent WTP for tundra swan conservation, and demographic questions assessing gender, age, education, and income. The contingent valuation question presented a hypothetical scenario that a nongovernmental organization was planning on implementing a new program for tundra swan habitat improvement in eastern North Carolina. We asked the respondent if they would be willing to donate a certain amount of money to support this program. We presented respondents with different bid amounts, reflecting the expected range of WTP. The bid for the follow-up question depended on the respondent's answer to the initial question. If the respondent said yes to the initial bid, the follow-up bid would be higher. If the respondent said no to the initial bid, the follow-up bid would be lower (Fig. S1, available online in Supporting Information). The hunter and wildlife watcher questionnaires shared questions asking where the respondent lived, how many people and vehicles were present on their trip, and an expenditure table that requested the amount they spent for specific items (e.g., gas, food, ammunition) and the county where they purchased those items. The wildlife watcher and resident questionnaires also shared a question asking how many times the respondent had seen a tundra swan, a question asking how much they liked or disliked tundra swans, and a demographic question assessing ethnicity. The wildlife watcher questionnaire had a question asking if tundra swans influenced the likelihood of the respondent taking a trip, and a follow-up question asking how much of an influence on a scale of 0–10, where 0 = no influence and 10 = heavy influence. The hunter questionnaire also had a question asking how many days they spent on their most recent trip, and a follow-up question asking of those days, how many were spent actively hunting tundra swans.

To assess hunter and wildlife watcher expenditures, we separated respondent expenses by county to determine how much money was spent in eastern North Carolina. Few tundra swans are known to winter outside of the study area in North Carolina (<1% of harvest occurs outside study area counties; Fig. 1). To determine the percent of expenditures due to tundra swans, we used several questions to obtain an upper bound, which we label "ex-ante," and a lower bound, which we label "ex-post." The ex-ante estimate of the effect of swans on the number of wildlife watching and hunting trips in eastern North Carolina was generated by assuming that all travel currently motivated by swans would shift out of North Carolina if swans no longer existed. In contrast, the ex-post estimate considered other possible adjustments in travel behavior within North Carolina and across species; that is, it is ex-post in the sense of being net of expected behavioral adjustments. For the ex-ante estimate, we used 2 separate questions for hunters and wildlife watchers. For hunters, we calculated the fraction of days they spent actively hunting tundra swans. We then multiplied these fractions by each hunter's expenditures to obtain an ex-ante estimate of the expenditures due to tundra swans. For wildlife watchers, we used the question asking if tundra swans influenced their likelihood of taking a trip, and the follow-up question asking how much of an influence on a scale of 0–10, where 0 = no influence and 10 = heavy influence. The scale was converted to percentages (0 = 0%, 1 = 10%, 2 = 20%, etc.). We multiplied the percentages by each wildlife watcher's expenditures to determine an ex-ante estimate of the expenditures due to tundra swans. For the ex-post estimate, we used the contingent behavior question asking respondents to rate the likelihood they would take a trip to eastern North Carolina if tundra swans stopped migrating to North Carolina. This question was on a scale of least likely (0), no change (5), to most likely (10). Respondents who answered 5–10 on the scale were likely to visit eastern North Carolina even if there were no tundra swans; therefore, we attributed zero percent of their expenditures to tundra swans. We converted other answers to percentages of expenditures due to tundra swans as follows: 0 = 100%, 1 = 80%, 2 = 60%, 3 = 40%, 4 = 20%, and 5–10 = 0%. We then multiplied these percentages by each hunter's and wildlife watcher's expenditures to obtain an ex-post estimate of expenditures due to tundra swans.

For the economic impact analysis of tundra swans in eastern North Carolina, we used the Impact Analysis for Planning (IMPLAN) model to determine direct, indirect, and induced effects. The IMPLAN model determines these effects based on an input–output model with 536 sectors (e.g., tourism, farming). Direct effects are sales, salaries, wages, and jobs created by initial purchases that are retained in the economy. Secondary effects are composed of indirect and induced impacts. Indirect effects are created through purchases made by directly affected businesses in the economy. Induced effects are purchases by employees in sectors that are affected directly and indirectly (Loden et al. 2004). Leakages are local expenditures leaving the region to purchase goods or services elsewhere, or expenditures the region fails to capture (Martin 1987). Indicators of leakage rates were calculated as the difference between total sales and local value added (Loomis and Walsh 1997). We also calculated the Social Accounting Matrix (SAM) multiplier, which is the total effect (i.e., direct, indirect, induced effects) divided by the direct effects (MIG, Inc. 2004). This relationship accounts for social security and income tax leakage, institution savings, and commuting; thus, serving as a barometer of the region's ability to keep dollars that are spent in the economy.

We used 2013 data for all North Carolina counties to represent the economy of interest in IMPLAN. To calculate spending associated with wildlife watchers and hunters, we calculated total expenditures on each item listed on the expenditure table and assigned them to the corresponding economic sector in IMPLAN. We used a regression model to predict mean WTP. We included mean age, mean age squared, and gender (0 = F, 1 = M) in the models. We included education as a binary variable (0 = less than college degree, 1 = college degree or higher) because college was the divider for education level. We also included the importance of tundra swan conservation as a binary variable (0 = of little importance or not at all important; 1 = very important, important, or moderately important) because tundra swan conservation was either important or not important. Respondents identified their annual household income as 1 of 10 categories (1 ≤ \$40,000 to 10 ≥ \$200,000). Each respondent's income was coded as the midpoint of their self-selected income category and reported in units of \$1,000 (e.g., respondents who selected the \$60,000 to \$79,999 income bracket were coded as 69.9995). We then calculated the mean midpoint income and subtracted it from each respondent's midpoint income to obtain respondent income relative to mean income (e.g., 69.9995 − 63.707 = 6.2925), which was included in the model.

We used SAS 9.4 (SAS Institute, Inc., Cary, NC, USA) to fit the model of WTP for tundra swan conservation. Our survey was based on a dichotomous choice with a follow-up bid method; therefore, we obtained interval censored data for each respondent. Instead of observing the exact response from the individual, based on the initial and follow-up bid amounts, we were able to determine an interval for their WTP. For example, if a respondent said yes to an initial bid of US\$50 but no to a follow-up bid of US\$75, WTP was known to lie in the interval between US\$50 and US\$75. Given that our goal was to conduct inference on expected (mean) WTP, we used a normal distribution to model WTP. We considered alternative distributions, such as lognormal, for the WTP because of concerns of potential skewness. However, the relevant quantities under the skewness assumption are the median or other quantiles. Given the nature of the question of interest, the mean is a more relevant quantity leading to the use of a symmetric distribution. We used the LIFEREG procedure in SAS to fit an interval-censored regression model. This model uses χ^2 statistics to test significance of independent variables. If an individual responded "no" to both bids, we knew the response of interest was smaller than the follow-up bid amount but was assumed to be no smaller than 0. If an individual responded "yes" to both bids, we had right-censored data with an unknown upper bound.

We calculated overall nonmarket value for tundra swans in North Carolina by multiplying the population size of residents, hunters, and wildlife watchers by their respective WTP estimates. For tundra swan hunters, we plotted the number of new tundra swan permit applicants for the past 9 years, and fit a regression line to these data. We then used this equation to estimate the total number of tundra swan hunters in the last 25 years. For wildlife watchers, we used visitor data from 5 of the most high-profile tundra swan viewing refuges in eastern North Carolina: Mattamuskeet NWR, Pea Island NWR, Mackay Island NWR, Alligator River NWR, and Pocosin Lakes NWR. Visitor numbers were generated using annual counts by refuge staff and vehicle traffic counters. We obtained a representative sample of visitors at 2 of these refuges, as indicated by both the high compliance rate and by the consistency of our sample with previous research findings that birders tend to be older males with greater levels of education and income (Kerlinger and Brett 1995). We have no reason to believe that visitors to Mattamuskeet NWR and Pea Island NWR were systematically different from visitors to the other refuges. We obtained visitor numbers from November to February, when tundra swans were present, and made the conservative assumption that anyone who visited these sites outside of November to February was not attracted by tundra swans. For residents, we used census data on the number of residents over 18 years old. We compared perceived importance of conserving tundra swans among wildlife watchers, hunters, and residents using analysis of variance followed by a Tukey *post hoc* test.

Using *t*-tests, we compared age, gender, ethnicity, education, and income between the resident sample and North Carolina census population data (U.S. Census Bureau 2013*a*, *b*, *c*). Age, gender, ethnicity, education, and income were different between the sample and population ($P < 0.05$), with the sample being mostly older, white males with greater levels of education and income. To obtain a valid estimate of WTP for the population of residents, we weighted age, gender, ethnicity, education, and income for our sample data based on target population characteristics. We assessed nonresponse bias to the resident survey using results from a follow-up survey of nonrespondents. We randomly selected 200 residents from those who did not respond to the first survey for participation in the nonresponse survey. We called each person 3 times: once during the day, once during the evening, and once over the weekend. We spoke with 57 people and 32 agreed to complete the follow-up survey, which resulted in a 56% compliance rate. We used *t*-tests to compare respondent and nonrespondent data and documented no difference in how much the respondent liked or disliked tundra swans ($t_{355} = -0.19$, $P = 0.85$) or rated importance of tundra swan conservation ($t_{399} = -0.55$, $P = 0.59$).

RESULTS

The tundra swan hunter survey had a 50% response rate. After adjusting for undeliverable addresses, we obtained a 16% response rate for the survey of North Carolina residents. We obtained a compliance rate of 97% for the in-person surveys at both refuges. Hunters ($n = 1,485$) were predominately male (97%), and their mean age was 45 (SD = 14.03; Table 1). The median income was US$90,000. About half of hunters (46%) held a college degree and 19% had a Master's or Doctoral–Professional degree (Table 1). Most tundra swan hunters (87%) lived in North Carolina and 13% lived out of state. Wildlife watchers ($n = 350$) were mostly white (97%) and male (56%), and their mean age was 54 (SD = 15.21; Table 1). Median income was US$90,000. Their education level was high, with 36% having a college degree and 32% a Master's or Doctoral–Professional degree (Table 1). Most wildlife watchers (84%) lived in North Carolina, 15% lived out of state, and 1% lived in another country. Residents ($n = 455$) were mostly white (90%) and male (68%), and their mean age was 60 (SD = 13.83; Table 1). Median income was US$70,000. Nearly a third (29%) of residents held a college degree and 25% held a

Master's or Doctoral/Professional degree (Table 1).

When asked how many times they have seen a tundra swan in their life, wildlife watchers reported seeing tundra swans more often than did residents ($\bar{x}$ = 2.92 vs. 1.28; $t_{643} = -16.33$; $P <$ 0.0001). Almost half of North Carolina residents (49%) stated they have never seen a tundra swan. When asked how much they like or dislike tundra swans, wildlife watchers reported liking tundra swans more than was reported by residents ($\bar{x}$ = 4.73 vs. 3.91; $t_{660} = -16.33$; $P < 0.0001$), who demonstrated indifferent views toward tundra swans (Fig. 2). The importance of conserving tundra swans was given the highest rating by wildlife watchers ($\bar{x}$ = 3.60), followed by hunters ($\bar{x}$ = 3.32), and then residents ($\bar{x}$ = 2.67), with a Tukey test indicating that the ratings were statistically different across all 3 groups ($F_{2,\,2{,}287} = 116.78$; $P < 0.0001$). We asked residents if they would like to travel to view tundra swans in eastern North Carolina, and 38% said yes. When asked why they want to travel to view tundra swans, 76% said they want to see tundra swans, 51% said they want to visit eastern North Carolina, and 25% said the cost is not too expensive.

Status as a hunter or wildlife watcher, income, importance of tundra swan conservation, and age all were significant predictors of WTP (Table 2). Wildlife watchers (US\$35.20) were willing to pay more than hunters for tundra swan conservation (US\$30.53; $\chi^2_1 = 3.96$; P = 0.046), and both wildlife watchers and hunters were willing to pay more than were residents (US\$16.27; $\chi^2_1 = 51.73$; $P < 0.0001$ [vs. wildlife watchers]; $\chi^2_1 = 47.31$; $P < 0.0001$ [vs. hunters]; Fig. 3). The WTP increased with income and perceived importance of tundra swans (Table 2). Coefficients on age and square of age confirm a quadratic relationship, with WTP first increasing and then beginning to decrease at 10.6 years above overall mean age (Table 2). Multiplying mean WTP by the population size shows that hunters had a total WTP of US\$859,816/year, wildlife watchers had a total WTP of US$20,587,997/year, and residents had a total WTP of US$161,788,294/year. Overall, the total WTP for tundra swan conservation among hunters, wildlife watchers, and residents was US$183,236,108/year.

The gross amount of tundra swan–related expenditures made by tundra swan hunters throughout the state was estimated to be between US$416,013/year (ex-post, after behavioral adjustments) and US$1.3 million/year (ex-ante, based on fraction of days actively hunting tundra swan). These estimates are out of total expenditures of US$2.04 million/year or US$408.34/hunter/year for trips that included tundra swan hunting. The gross amount of tundra swan–related expenditures made by tundra swan hunters in eastern North Carolina was estimated to be US$337,940/year ex-post estimate and US$1.2 million/year ex-ante estimate (out of total expenditures of US$1.7 million or US$340.22/hunter/yr). Ex-ante and ex-post estimates of tundra swan–related expenditures for hunters were run through state and eastern North Carolina models in IMPLAN (Table 3). Value added for the state economy by tundra swan hunters was US$306,155/year ex-post estimate and US$920,161/year ex-ante estimate. The SAM multiplier for the total value added to the state was 1.85 and for eastern North Carolina it was 1.50. For every US$1.00 spent on tundra swan hunting, an additional US$0.85 was generated in economic impact return throughout North Carolina and US$0.50 in eastern North Carolina. The state government received an additional US$60,000/year from tundra swan hunting permits, based on an average of 6,000 tundra swan hunting applicants each year. Additional money for the state and federal government was also generated from hunting licenses and duck stamps purchased for tundra swan hunting. The statewide indicator of leakage rate for hunters was 26–28%, and in eastern North Carolina it was 38–40%.

The gross amount of tundra swan–related expenditures made by wildlife watchers visiting Mattamuskeet and Pea Island NWR throughout the state was estimated to be US$16.2million/year ex-post estimate and US$47.2 million/year ex-ante estimate. These estimates were out of total expenditures of US$90.2 million/year or US$171.25/wildlife watcher/year for trips that included tundra swan viewing. The gross amount of tundra swan–related expenditures made by wildlife watchers visiting Mattamuskeet and Pea Island NWR in eastern North Carolina was estimated to be US$15.7 million/year ex-post estimate and US$46.9 million/year ex-ante estimate (out of total expenditures of US$83.2 million or US$157.94/wildlife watcher/yr). Ex-ante and ex-post estimates of tundra swan–related expenditures for wildlife watchers were run through state and eastern North Carolina models in IMPLAN (Table 4). Value added for the state economy by wildlife watchers was US$14 million/year ex-post estimate and US$42.9 million/year ex-ante estimate. The SAM multiplier for the total value added to the state was 1.81 and for eastern North Carolina it was 1.46. For every US$1.00 spent on tundra swan tourism, an additional US$0.81 was generated in economic impact return throughout North Carolina and US$0.46 in eastern North Carolina. The statewide indicator of leakage rate for wildlife watchers was 10–13%, and in eastern North Carolina it was 28–30%.

DISCUSSION

Our finding that wildlife watchers and hunters have a greater WTP than residents may reflect both the tangible benefits that they receive from tundra swans and conservation-oriented attitudes, as previously identified among wildlife recreationists. Cooper et al. (2015) showed that individuals who regularly go birdwatching or hunting are more likely to engage in conservation behaviors than those who do not participate in those activities. Similarly, previous studies revealed that experience with nature is fundamental in influencing pro-environmental behavior

(Scannell and Gifford 2010, Larson et al. 2011, Stevenson et al. 2013). Willingness to pay for species conservation is strongly determined by human attitudes toward the species (Martín-López et al. 2008). The greater WTP for tundra swans by hunters and wildlife watchers also suggests that people are willing to pay more for conserving species from which they perceive a direct benefit (Dalrymple et al. 2012).

Nearly half of residents were indifferent toward tundra swans and their conservation, which highlights the growing disconnect between humans and nature. Previous studies suggested wildlife knowledge and value increases with increased participation in viewing, physical, and consumptive activities (Hinds and Sparks 2008). Tundra swans are a charismatic and unique species in North Carolina, yet almost half of North Carolina residents have never seen a tundra swan. If increasing WTP and conservation awareness is a goal, it is important to identify who in the public is indifferent or interested in the species of interest. Conservation initiatives can be tailored toward the interested public, whereas education can focus on the indifferent public to increase their knowledge and support for conservation (Ballantyne et al. 2011).

Economic multipliers, which measure the total amount of economic activity resulting from additional spending by hunters or wildlife watchers, explain the state's and eastern North Carolina's ability to absorb and use tundra swan–related expenditures. Multiplier size can be related to the size of the region of interest. As geographic size increases, value added increases and less expenditures leak outside the region (Loomis and Walsh 1997). The limited number of hotels and manufacturers (e.g., companies making ammunition or binoculars) in the extremely rural region of eastern North Carolina explains why the state multiplier is larger than the regional multiplier. Multipliers are influenced by the commercial and industrial makeup of an area (Grado et al. 2001, Loden et al. 2004), which causes recreation expenditure multipliers to range from 1.5

to 2.7 in the United States (Loomis and Walsh 1997). Our multipliers were on the low end of this range, indicating that both economies are capturing some tundra swan–related expenditures, but there is room for additional business development to create or capture expenditure activity.

Low indicators of leakage rates associated with our study suggest unique hunting and viewing opportunities can capture high economic value for local, rural communities. Leakage rates for nature-based tourism can be high (e.g., >78% at Bwindi Impenetrable National Park, Uganda, Africa; Sandbrook 2010), which can be attributed to accommodation and service providers owned by nonlocal actors (Akama and Kieti 2007). Lower indicators of leakage rates of our study compared with leakage rates in international contexts, such as Bwindi Impenetrable National Park in Uganda, may be a result of few international tourists. There is sparse literature describing nature-based leakage rates in the United States, which is an important contribution for this paper. Rural tourism in the United States consists mainly of domestic tourism, so expenditures are easier for the economy to capture (Gartner 2004, Aremberri 2005). The low indicator of leakage rates of our study may also be attributed to items, such as lodging and food, being purchased from local businesses. However, we did not include long-term durable goods (e.g., ATVs, binoculars, cameras) in our study, and a large majority of the money generated from these items would leak out of the local economy (Grado et al. 2007). The difference between local and state indicators of leakage rates can be explained by scale. As geographic size increases, value added increases, and there is less leakage. Leakages in larger regions are generally reduced because of a more diverse economy capable of absorbing impacts of direct purchases (Martin 1987). Low indicators of leakage rates associated with our study may reflect the use of local expertise and a significant local consumer base. Wildlife hunting and viewing services benefit from the use of local experience. If hunters and wildlife watchers pay locals for guide services, that money is captured by the local economy, which equates to less leakage, and it benefits local communities. There is also a significant local consumer base for tundra swan hunting and viewing in North Carolina. Most tundra swan hunters and wildlife watchers are residents of North Carolina, so purchases are more likely to be retained by the economy than if wildlife watchers and hunters were from outside of the state.

MANAGEMENT IMPLICATIONS

Our study indicates value of tundra swans far exceeds that of the proposed wind-energy development (US$1.1 million/yr; NC East Alliance 2015) in eastern North Carolina, providing support for using mitigation activities to prevent damage to tundra swan populations, even if mitigation is relatively costly. Our results also indicate “middle age” hunters, wildlife watchers, and average residents spend more for wildlife-related recreation and are willing to pay more than other age cohorts for wildlife conservation. Thus, those hoping to fund wildlife conservation through diverse mechanisms would be most effective when engaging citizens in this age range. Further, tundra swan watchers have much larger consumer surpluses than tundra swan hunters because wildlife watchers were willing to pay the most for tundra swan conservation, but spend less than half as much money as hunters on tundra swan–related recreation. Similarly, wildlife watchers far outnumber hunters and have lower leakage rates, rendering the formers’ activities more economically important despite having similar WTP and expenditures individually (U.S. Department of the Interior and U.S. Department of Commerce 2012). This highlights the importance of developing funding programs focused on wildlife watchers, and nonconsumptive users, many of whom have the largest consumer surpluses associated with wildlife conservation (McFarlane and Boxall 1996).

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SUPPORTING INFORMATION

Additional supporting material may be found in the online version of this article at the publisher's web-site. Supporting material includes questions used to assess respondents' WTP to support tundra swan conservation.

ARTICLE SUMMARY FOR TABLE OF CONTENTS:

We used both market and nonmarket valuation methods to estimate the value of tundra swans (*Cygnus columbianus*) in North Carolina. Wildlife watchers reported the greatest willingness-to-pay, followed by hunters, and residents, and collectively tundra swan related tourists may contribute $44 million/year for the state economy.

FIGURE CAPTIONS

Figure 1. Estimated value of tundra swans as determined by surveys of hunters, wildlife watchers, and general public. The resident survey during 2015 sampled the entire state of North

Carolina, USA; the hunter survey occurred in counties with tundra swans (shaded in grey); and the wildlife watcher survey locations are indicated by stars.

Figure 2. Wildlife watcher (*n* = 350) and resident (*n* = 333) responses to the question "Which of the following best describes your opinion of tundra swans?" in North Carolina, USA, 2015, as reported on surveys to estimate value of tundra swans.

Figure 3. Mean willingness to pay (WTP) per year for wildlife watchers (*n* = 263), hunters (*n* = 1,222), and residents (*n* = 326) in North Carolina, USA, 2015, as reported on surveys to estimate value of tundra swans. All values are presented in US$. Means that share a letter do not differ.

Table 1. Descriptive statistics of hunters, wildlife watchers, and residents surveyed regarding the economic activity relative to tundra swans in North Carolina, USA, 2015.

Variable	Hunters		Wildlife watchers		Residents	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Income (relative to the mean income [subtracted the mean] and reported in $1,000s)	109.17	62.38	95.93	55.96	87.41	59.97
Importance (binary variable, where 0 = of little importance or not at all important; 1 = very important, important, or moderately important)	3.32	0.81	2.67	1.13	3.60	0.69
Age (normalized by the mean age in the sample)	44.53	14.03	54.08	15.47	60.19	14.19

Gender (binary variable, where 0 = female; 1 = male)	0.02	0.15	0.45	0.50	0.33	0.47
Education (binary variable, where 0 = less than a college degree; 1 = college degree or higher)	0.69	0.46	0.74	0.44	0.63	0.48

Table 2. Regression model predicting willingness to pay for tundra swan conservation as reported on surveys of hunters, wildlife watchers, and residents in North Carolina, USA, 2015.

Independent variable	Coeff. [b]	SE
Intercept	−31.18*	5.96
Hunter	20.46*	2.97
Wildlife watcher	26.69*	3.71
Resident[a]	0.00	
Income	0.09*	0.019
Importance	37.59*	5.61
Age	−0.19*	0.07
Age squared	0.009*	0.004
Gender	2.82	3.43
Education	−0.39	2.22
Wildlife watcher × Income	−0.04	0.05
Scale	36.63	1.03

[a] Resident was the omitted category and is represented by the Intercept.

[b] $P < 0.05$.

Table 3. Value added by tundra swan–related expenditures as reported on surveys of hunters within the state and eastern region of North Carolina, USA, 2015. All values are presented in US$.

Hunter value added	State		Eastern	
	Ex-post estimate[a]	Ex-ante estimate[b]	Ex-post estimate	Ex-ante estimate
Direct impact	$166,003	$497,739	$138,828	$472,833
Indirect impact	$69,906	$210,665	$38,919	$128,943
Induced impact	$70,246	$211,757	$31,011	$106,089
Total impact	$306,155	$920,161	$208,758	$707,865

[a] Derived by comparing actual reported travel costs with an estimate of travel costs if tundra swans were no longer in the region (based on how likely respondents were to still take the trip if tundra swans were no longer in the region).

[b] Derived by multiplying actual reported travel costs by the fraction of days actively spent hunting tundra swans.

Table 4. Value added by tundra swan–related expenditures as reported on surveys of wildlife watchers within the state and eastern region of North Carolina, USA, 2015. All values are presented in US$.

Wildlife watcher value added	State		Eastern	
	Ex-post estimate[a]	Ex-ante estimate[b]	Ex-post estimate	Ex-ante estimate

Direct impact	$7,716,124	$23,614,274	$7,514,374	$23,118,496
Indirect impact	$2,942,255	$9,038,854	$1,765,814	$5,443,650
Induced impact	$3,346,137	$10,256,667	$1,697,666	$5,237,300
Total impact	$14,004,516	$42,909,795	$10,977,854	$33,799,446

[a] Derived by comparing actual reported travel costs with an estimate of travel costs if tundra swans were no longer in the region (based on how likely respondents were to still take the trip if tundra swans were no longer in the region).

[b] Derived by multiplying actual reported travel costs by the fraction of days actively spent hunting tundra swans.

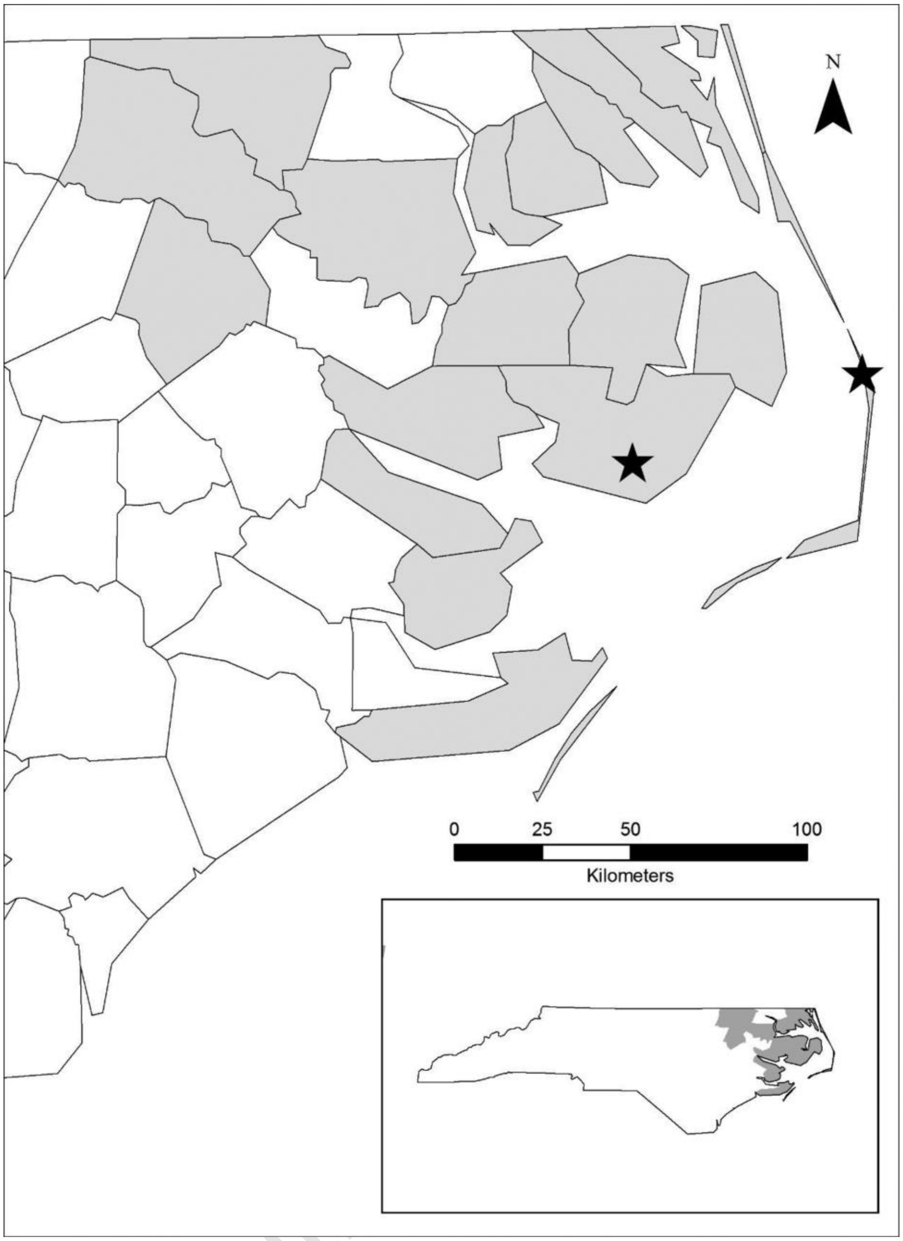

Figure 1

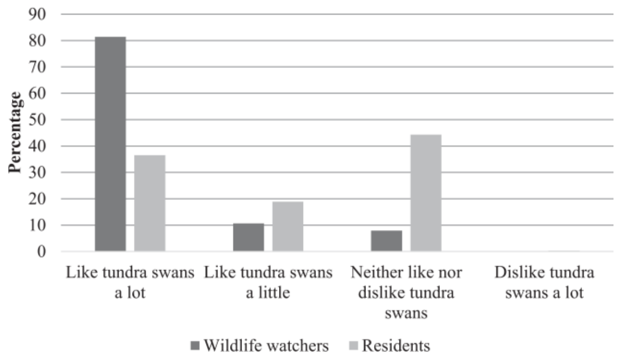

Figure 2

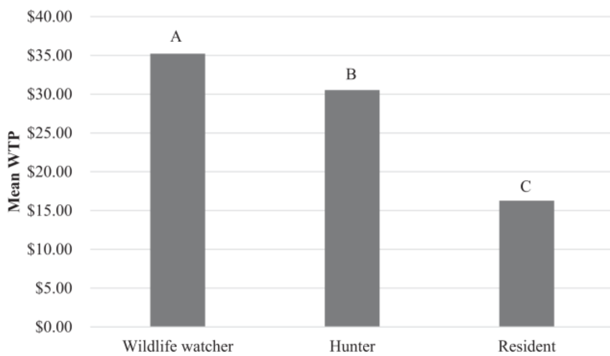

Figure 3