Forest Policy and Economics 140 (2022) 102747

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Economic contributions of wildlife management areas in North Carolina

William R. Casola [a,*], M. Nils Peterson [a], Erin O. Sills [b], Krishna Pacifici [a], Christopher E. Moorman [b]

[a] Fisheries, Wildlife, and Conservation Biology Program, North Carolina State University, Raleigh, NC 27695. USA
[b] Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27695, USA

ARTICLE INFO

Keywords:
Wildlife management areas
Economic contribution
IMPLAN
Input-output model
Recreation
Hunting

ABSTRACT

Wildlife management areas (WMAs) provide a wide range of ecosystem services. Among these services, hunting and fishing often make the most obvious contribution to local and state economies through the expenditures of the hunters and anglers. However, the total economic contributions of WMAs also include other forms of recreation that are generally less visible, unlicensed, and less well understood. Quantifying the size of the economic contribution from all recreationists can inform decisions about investment in and management of public lands. To this end, we estimated the direct, indirect, and induced economic contributions of recreation on protected land managed by the state of North Carolina (NC) primarily for hunting, fishing, and wildlife conservation (hereafter WMAs). We collected data on visitation and conducted in-person intercept surveys at 9 WMAs to estimate the number of visits and expenditures per visit for people engaged in activities that required licenses (e.g., hunting) and activities that did not (e.g., hiking and bird watching). We estimated annual visitation on the 9 study WMAs, accounting for differences in location, hunting season, day of the week, and weather. We then predicted annual visitation at all 94 WMAs in NC using a predictive regression model. Most visitors did not engage in any licensed activities, and those visitors spent more per trip on average ($119.83) and had greater variability in expenses than visitors engaged in licensed activities ($84.19). We used the estimates of total annual visits, expenditures per visit, and the distribution of those expenditures across sectors to calculate the economic contribution of recreation on each of the 9 study WMAs and on the entire WMA system in NC. Recreation was responsible for approximately 2200 jobs, $84 million USD in annual labor income, and $140 million USD in value added annually in NC. The majority of this contribution was due to visits made by users not engage in licensed uses of WMAs, as those users were more numerous, spent more per trip, and were more likely to visit WMAs in peri-urban areas with more economic linkages than rural areas.

1. Introduction

Although state and national parks are widely accepted as valuable to recreationists and local economies, less is known about the economic contributions of public lands set aside for wildlife conservation. Value provided by public land stems from ecosystem services, including watershed and climate regulation, improved aesthetics, and recreational opportunities (Irwin and Bockstael, 2001). The value of these services is increasingly recognized, particularly in association with iconic protected areas such as national parks (Caudill and Carver, 2019; Cullinane and Koontz, 2020; Hjerpe and Kim, 2007). The establishment and persistence of protected areas are supported by general consensus about their economic benefits and contributions (Cullinane and Koontz, 2020; Rosenberger et al., 2017). Historically, protected areas were created to preserve areas of great natural beauty, often with no local consultation and even with expulsion of local people (Negi and Nautiya1, 2003). Today however, local consultation is common and often required. Consultation and collaboration with local stakeholders occur to ensure that protected areas are designed and managed to provide local benefits and that local communities are educated about those benefits (Arni and Khairil, 2013; Force and Forester, 2002; National Park Service, 2007). However, in the US, local consultation and collaboration are often not required for states to protect land for wildlife conservation. Consequentially, the value of public land protected as wildlife conservation areas has received less attention (Black, 2018).

Wildlife conservation areas, which are classified as IUCN type IV Habitat/Species Management Areas and often referred to as wildlife management areas (WMAs), are established and managed to protect

* Corresponding author.
E-mail address: wrcasola@ncsu.edu (W.R. Casola).

https://doi.org/10.1016/j.forpol.2022.102747
Received 1 September 2021; Received in revised form 31 March 2022; Accepted 14 April 2022

particular species or habitats. In the US, they typically allow both regulated hunting, trapping, and fishing, and other recreational activities. However, only the former activities are licensed. This creates a critical need to understand how WMAs support other types of recreation and how that affects their contributions to local economies.

Understanding the economic contributions of wildlife management areas is critical for management agencies facing resource allocation questions from local and state governments (Liu et al., 2013; Payton and Ottensmann, 2015; Poudyal et al., 2020). Local and state governments often focus on the implications of a new WMA for local property tax revenues, which can be easily quantified and therefore made salient to the decision-making process (Corn, 2015). This approach, however, may paint an artificially negative view of WMAs by ignoring the potential economic contributions of visitors to that recreation area, because they are more challenging to quantify (Dasgupta, 2021). Such contributions include local economic activity, sales tax generation, and employment. Management agencies need to understand these contributions when confronted with bills attempting to offset presumed losses in property taxes due to the existence of nontaxable public lands within the jurisdictional boundaries of the local governments. For example, proposed North Carolina Senate Bill 111 (2019–2020) and Chapter 69, Title 31 of the United States Code mandate payments to local governments to help offset losses in property taxes due to the existence of nontaxable public lands within their boundaries. This type of legislation, however, may be flawed if the protected areas generate other types of offsetting tax revenue such as sales taxes collected by county and municipal governments. This may be especially true with WMAs, because substitutes, other public land that allows hunting, are rarely available in one area.

The need to understand the economic contributions of WMAs is highlighted by the fact that public recreation contributes to local economies in drastically different ways depending on the types of users, the scale of visitation, the types and locations of expenditures, and the structure of local economies (Chen et al., 2003; Frew et al., 2018; Gioglio et al., 2019; Grado et al., 2007; Hjerpe and Kim, 2007; Poudyal et al., 2020). Unlike many other forms of public land, WMAs engage users participating in hunting, fishing, and trapping. These users are conventionally distinguished as consumptive users (Organ and Fritzell, 2000). Users participating in other activities, such as hiking, boating, and bird watching, are conventionally distinguished as non-consumptive users (Duffus and Dearden, 1990). This distinction is useful because it differentiates between recreational users required to support state wildlife management agencies through license fees and excise taxes on their equipment, and groups that are not typically required to do so. However, this alignment is not perfect, because some activities that typically do not require licenses are in fact consumptive (e.g., mushroom collecting, berry picking), and all groups affect resources (e.g., crowding, trail damage, litter). Thus, we label all users participating in hunting, angling, and trapping as 'licensed users', and all others who are not participating in hunting, angling, and trapping (e.g., hikers, birders, bikers, campers, horseback riders, and geocachers) as 'non-licensed users.' Recreation on WMAs is often comprised of a mix of licensed and non-licensed users, with licensed users making up a significant portion of all visitors to public lands that allow both uses (Knight and Gutzwiller, 1995; Reynolds and Braithwaite, 2001). This distinction between licensed and non-licensed users is important in terms of economic contributions because these users incur different expenses during each visit. Other important factors influencing the economic contributions of WMAs include the geographic location of spending (i.e., rural or urban, level of commercial and industrial development), the type of goods (durable or consumable) or services purchased, and what economic sector to which the goods or services belong (English and Bowker, 1996; Grado et al., 2011; Hjerpe and Kim, 2007; Phillips et al., 2013).

Previous studies analyzing the spending patterns and subsequent economic contributions of licensed and non-licensed users suggest spending between the 2 groups is highly variable and driven by the user's primary activity. For example, white-water rafters on the Middle Fork of the Salmon River (Idaho) spent about $2900 per rafter per trip (in 1993), compared to resident waterfowl hunters in Mississippi who spent an average of $905 per hunter per trip (in 2006, English and Bowker, 1996; Santos et al., 2016). However, few studies included or compared the economic contributions of both licensed and non-licensed users on the same public land or at the same time. A notable exception is the estimation of the economic contributions of all users, licensed and non-licensed, who visit National Wildlife Refuges (Carver and Caudill, 2007; Caudill and Carver, 2019). These studies used expenditure data from the National Survey of Fishing, Hunting, & Wildlife-Associated Recreation, rather than expenditure data from wildlife refuge visitors. Most visitors to wildlife refuges participated in non-licensed activities, and these non-licensed users were responsible for the overwhelming majority of the economic contributions (Carver and Caudill, 2007; Caudill and Carver, 2019). Poudyal et al. (2020) built upon this research specifically investigating the contributions of licensed users recreating on Tennessee WMAs. These studies adopted aggregate perspectives, estimating economic contribution values at a national, regional, or state level. Hence, there is need to understand the individual spending habits of licensed and non-licensed users, as well as the geographic distribution of their spending. Breaking user spending into geographic categories relevant to policy making (e.g., in county, in state, and out of state spending) is critical given governance at different geographic levels may shape long-term pressure to expand, disband, or tax recreation areas. Such a breakdown also allows for estimation of the economic contribution to counties where WMAs are located.

Additional research exploring how WMAs contribute to local and regional economies is essential for multiple reasons. Landscapes protected for wildlife conservation represent one of the largest areas of public land globally, and one of the fastest growing segment of public land (UNEP-WCMC, 2018). Wildlife management areas may also attract housing development on their periphery (Peterson et al., 2013; Radeloff et al., 2010) and affect nearby property values (Black, 2018; Casola et al., 2021). Research valuing land protected for wildlife tend to use landscape level valuations for ecosystem services (Noe et al., 2017), and these valuation studies lag behind those focused on other forms of protected land in domains related to impacts on local property values (Liu et al., 2013) and tourism, and how both contribute to local tax bases and economies (Caudill and Carver, 2019; Poudyal et al., 2020). Also, unlike national or state parks, WMAs in the US often lack records of visitation (e.g., due to entrance fees that generate counts of visitors), thus quantifying their contributions to local and regional economies has proven more difficult. Further, recreation on WMAs is expected to increase (Cordell, 2008; White et al., 2016), thus expanding the potential economic contributions of these properties. These increases in nature-based recreation are expected to primarily occur among wildlife recreation groups participating in non-licensed activities (e.g., hikers, birders), even on properties originally established to support hunting, fishing, and trapping (Balmford et al., 2009; Ziesler, 2020). Hence, documentation of the individual expenditure profiles of both licensed and non-licensed users and the geographic distribution of their spending is critical because the total economic contribution depends on the joint distribution of different types of visitors and different characteristics of local economies.

We evaluated the economic contribution of diverse user groups on public WMAs in North Carolina and employed methodological innovations for counting users and estimating their expenses. We adopted the standard approach to estimate economic contributions (i.e., via input-output matrices and economic multipliers); however, we collected data from a more diverse set of users, compared individual expenditure profiles for users engaged in both licensed and non-licensed activities, calculated economic contributions to local jurisdictions (counties) where WMAs are located, and compared results across multiple WMAs in urban and rural landscapes. This approach also allowed us to estimate the spatial distribution of spending attributed to users in both groups.

We minimized recall bias in our expenditure data by eliciting information on expenditures for the current trip through intercept surveys conducted at the recreation sites, following the lead of other studies (Frew et al., 2018; Grado et al., 2001). We introduced a modeling approach to estimate total number of visits based on observational data, thus eliminating recall bias and incorporating factors that influence visitation outside of an individual visitor's control.

1.1. Study area

North Carolina has an extensive system of public access WMAs, known locally as 'game lands.' These WMAs serve a variety of licensed (hunters, anglers, and trappers) and non-licensed users (hikers, birders, bikers, campers, horseback riders, geocachers and many others). The North Carolina Wildlife Resources Commission (WRC) manages all of these lands but some are owned by other public and private partners. These public and private partners voluntarily enroll their properties into the system and provide public access in return for a nominal per acre payment from the WRC (approximately $0.17 per acre). In total, the system encompasses approximately 94 properties, covering approximately 845,000 ha, of which about 216,000 ha are owned by the WRC, 506,000 ha are owned by the US Forest Service, and 123,000 ha are owned by other public and private entities (e.g., Duke Energy, US Army Corps of Engineers, The Nature Conservancy). WMAs in NC are primarily forested; however, the WRC actively manages small portions of these properties to promote early successional plant communities, wetland conditions, and agricultural crops. These non-forested portions of WMAs promote structural diversity and hunting opportunities. The WRC also practices active forest management on properties they own (e.g., logging, prescribed fire). Annual cost of management for these properties is approximately $8 million (approx. $9.48/ha), funded primarily through hunting/fishing license sales and federal matching dollars provided by the Federal Aid in Wildlife Restoration program.

2. Methods

The economic contributions of recreational users are a direct result of visitor expenditures and can cascade through local and regional economies, resulting in economic contributions across numerous economic sectors. The standard approach to quantifying the full contributions of an economic activity, such as recreation on public lands, is to track how they multiply via an input-output matrix that represents the structure of the local economy. This approach is used by federal agencies, such as the US Forest Service, the US National Park Service and the US Fish & Wildlife Service, which annually or semi-annually estimate the economic contributions of recreation on their properties (Caudill and Carver, 2019; Cullinane and Koontz, 2020). In addition to the input-output matrix, this methodology requires data on the full profile of expenditures by visitors to public lands, including what goods and services are purchased and where. These purchases are then distributed across retail margins, value added in the local economy, and "leakages," or purchases from other regions (Grado et al., 2011; IMPLAN Group LLC., 2020; Santos et al., 2016). Visitation and expenditure data for these analyses are typically obtained from mail-in or online surveys, requiring users to recall estimates of previous trip expenses and their number of annual visits (Grado et al., 2011; Poudyal et al., 2020); however, this raises the issue of recall bias and the accuracy of estimated expenditure data for the "average" trip and the number of trips taken per year. This is worrisome as research has suggested estimates of trip expenditures and estimates of the number of trips per year tend to increase as time since last trip increases (Fisher et al., 1991); therefore the most accurate estimates are likely reported during or immediately following the trip in question.

In our study, we estimated total visitation based on sight census counts (on 319 days, research technicians tallied every user observed, what activity they were participating in, and a count of unattended vehicles). We modeled how visits varied across days, and we expanded to total annual visits across all WMAs by modeling how visitation varied with the characteristics of the WMA.

2.1. Sampling

Nine WMAs in North Carolina (NC) were purposively selected to include a range of sizes, locations (region and urban proximity), amenities, and user group diversity (Fig. 1). We also ensured representation from each geographic region in NC (mountains, piedmont, and coastal plain). At each of these WMAs, we conducted intercept surveys with visitors to obtain data on expenditures by licensed and non-licensed users. Beginning at sunrise, we administered questionnaires to every willing person at major access points, along external boundary roads and internal WMA roads, and at WMA amenities (e.g., trail heads, hunting blinds, parking lots, camping areas, boating access areas, public fishing access areas). Because hunters do not routinely enter WMAs through centralized access points, it was important we intercept them, as well as other visitors, in a wide variety of locations, both inside the WMA and along external boundary roads. The survey was conducted between Sept. 2017 and May 2019, covering 2 full years of all NC hunting seasons and the summer of 2018. We deliberately focused efforts to survey all opening days of hunting seasons and randomly selected Saturdays, Sundays, and weekdays during hunting and non-hunting months. In addition to the questionnaire, we collected observational data to model total annual visits. Among the 9 properties, respondents completed 1943 survey packets across 328 survey days. Survey compliance rate was high (60% of users who were asked agreed to complete a survey), and recapture rate was minimal (7% of users who were asked had already completed a survey within the past year). Respondents were only allowed to complete one questionnaire per year during the survey period. The North Carolina State University Institutional Review Board approved this study (IRB#11690).

2.2. Questionnaire development

We pre-tested the original questionnaire using in-person intercept surveying at 4 WMAs ($N = 53$) during the summer of 2017. During pretest data collection, researchers explained each question and took detailed notes, which were then used to correct issues with question wording, comprehension, and skip patterns. In the final questionnaire, all respondents were asked to indicate the primary activity they were participating in, all other activities they were participating in during their trip (hunting, trapping, fishing, hiking/walking, camping, bird-watching, biking, boating-motorized, canoeing/kayaking, horseback riding, shooting range, field trials – hunting dog competitions, other), and the proportion of their trip dedicated to recreating on WMAs. This was elicited by asking "How much influence did your game land visit have on your decision to travel today" (scale 0–10; 0 = no influence, 10 = The game land visit was the only reason I traveled today). Respondents were asked about their trip expenses in 10 categories (Gasoline, Rental Vehicles, Airfare, Restaurants or Take-out Meals, Groceries or Snacks, Other Food, Lodging, Entrance Fees, Entertainment, and Other Products or Services) and each category corresponded to a unique economic sector (Table A). Other products and services included ammunition for hunting, bait for fishing, other outdoor gear or clothing, and camping supplies. This category may include some durable goods, even if purchased prior to their trip, as long as the products and services were purchased specifically for the trip in progress. We avoided double counting this subset of durable goods by only allowing respondents to complete one questionnaire per year during the survey period. Respondents traveling in groups were instructed to only list expenses they personally incurred (e.g., for respondents who carpooled, only the driver listed gas expenses unless they split the cost of gas among all travelers). Along with each expense, they reported the county (or state if outside NC) where the good or service was purchased. We asked respondents to

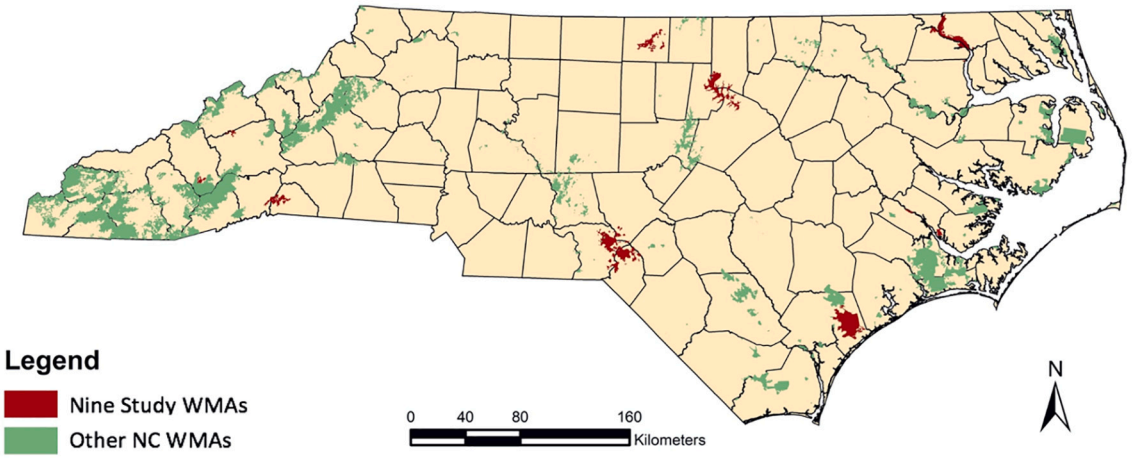

Fig. 1. Wildlife management areas (WMAs) in North Carolina managed by the Wildlife Resources Commission and the select 9 study WMAs.

indicate their age, sex (male or female), highest education level achieved (1 < high school, 2 = high school/GED, 3 = vocational or trade school, 4 = associates degree, 5 = bachelor's degree, 6 = graduate or professional degree), annual household income before taxes (1 < $25,000; 2 = $25,000–$50,000; 3 = $50,001–$75,000; 4 = $75,001–100,000; 5 = $100,001–$125,000; 6 = $125,001–$150,000; 7 > $150,001), and the number of people in each of four categories (adult male, adult female, youth male, youth female) who were traveling in their vehicle.

Activity options on the questionnaire were nonexclusive, meaning one person may have indicated they were participating in multiple activities during a single trip. Respondents who reported participating in a single activity were assigned to the corresponding licensed or non-licensed user group. Participants who reported hunting or fishing were assigned to the licensed group, regardless of primary activity, because they were participating in an activity that required a license. Participants who reported multiple non-hunting or fishing activities were assigned to the non-licensed group. We were unable to parse out specific non-licensed users because many non-licensed activities are non-exclusive, meaning it was common for a non-licensed user to participate in multiple activities during a single WMA trip (e.g., hiking and birding, camping and kayaking). Additionally, the focal unit of this activity breakdown is a single trip, meaning in a given year, someone who holds a hunting license can take both licensed trips (e.g., trips where they are hunting) and non-licensed trips (e.g., trips where they are hiking).

2.3. Analysis

We began by calculating total daily visits from the observational counts collected at all 9 study WMAs. We incorporated unattended vehicle counts into total daily visits by calculating the average number of people per vehicle and adjusting the unattended vehicle counts using the average (1.84 people per vehicle) as a conversion factor. The converted vehicle counts were then added to the count of observed users, providing an estimate of total daily visits. Next, we estimated the number of annual visits to each WMA using a 2-step process; first, we modeled annual visits at the 9 study WMAs and second, we expanded these estimates to all WMAs in NC using a predictive regression model. This approach provided predicted values of visitation at all WMAs based on the observational data collected at the 9 WMAs. We first constructed the best fitting model for the 9 WMAs with total daily visits as the response variable. Total daily visits was modeled as a function of year (2017, 2018, 2019; categorical), opening day of a hunting season (indicator variable), average daily temperature (continuous), hunting season (deer, small game, turkey, no-hunting; categorical), and day type (Saturday, Sunday, weekday; categorical). Hunting seasons were grouped into non-overlapping blocks and represented by the most popular target species; for example, white-tailed deer season includes all fall overlapping seasons (e.g., deer, mourning dove, waterfowl, black bear). Opening days of each specific season within these season blocks were accounted for in the model. We used a quasi-Poisson regression model because it accounted for observed overdispersion in the data while maintaining a proportional variance-mean relationship (Ver Hoef and Boveng, 2007). This modeling approach was important because we were interested in getting visitation estimates that are adjusted by the effects of days with heavy visitation. The model returned estimates for the average number of visits on each day type, during each season (e.g., Saturdays during turkey season, weekdays during deer season), and explained 58% of the total deviance (Table B). To estimate what type of users were making these visits, we pooled survey data from all 9 WMAs and calculated the proportion of visits from licensed and non-licensed users on each day type, during each season. We then annualized these estimates by multiplying the average number of visits on each day type, during each season by the number of occurrences of each day type within each season. This provided an annual estimate of use at each of the 9 study WMAs by licensed and non-licensed users.

We used the annual visitation estimates from the initial model to make predictions at all 94 WMAs in NC. We built a separate predictive regression model with the goal of estimating annual visitation as a function of specific WMA characteristics. We constructed the best fitting model for the annual visitation estimates at the 9 WMAs with total annual visits as the response variable. The independent variables in this model were specific WMA characteristics that could impact the total number of annual visits an individual property received. These characteristics included WMA acreage (square root transformed to account for diminishing returns to size; continuous), county population density (continuous), regional demand index (high, medium, low; categorical), and amenity score (range 0–6; continuous). Regional demand index was determined through expert judgement, informed by regional demand trends, WMA specific hunter and non-hunter demand levels as reported by the WRC, and expert feedback provided by regional WMA staff. We calculated amenity score as the count of amenities available at a particular WMA from a possible total of 6: formal trail system, informal trail system, boating access areas, public fishing access areas, improved parking lots, and designated camping areas. Overdispersion in the data and the need to maintain a proportional variance-mean relationship resulted in the use of a quasi-Poisson regression model (Ver Hoef and Boveng, 2007). This modeling approach was important because we were interested in getting visitation estimates that are adjusted by the effects of heavily visited WMAs. The model used to predict annual visitation at all 94 WMAs in NC explained 98% of the total deviance (Table C).

Predictions were made by entering WMA characteristics for each of the remaining 85 WMAs into the aforementioned annual visitation model. For example, Jordan WMA was not one of the 9 study WMAs, therefore we predicted annual visitation at Jordan WMA by entering acreage = 40,807, amenity score = 6, county population density = 711, and regional demand index = medium into the visitation model. We calculated 95% prediction intervals for annual visitation estimates at all 94 WMAs to account for additional uncertainty associated with prediction errors. We elicited expert feedback from the WRC to confirm face validity of these estimates.

We collected trip expenditure data from all respondents to estimate the economic contribution of WMA visits (i.e., gross economic contributions, as opposed to net economic impacts). 'Trip' refers to a single day visit to a WMA. This definition was chosen because WMA visits are typically made by in-state residents. Camping is prohibited on 67 of the 94 WMAs in NC and only limited camping opportunities exist during select hunting seasons on the remaining WMAs. Additionally, our expenditure and activity data support this definition (less than 5% of trips involved lodging expenses or participation in camping). WMA visitors reported the county in which the expense was incurred, the proportion of their trip dedicated to visiting the WMA, and demographic information. We broke expenditures into 2 geographic categories, (1) within county expenditures (i.e., expenditures incurred within the same county(s) as the WMA visited), and (2) within state expenditures (i.e., expenditures incurred within NC but outside of the WMA's county(s)). Out of state expenditures were reported but not included in this analysis as they represented an extremely low percentage of overall expenditures (Table 1). We calculated the average expenditure across both geographic categories and within each economic sector for licensed and non-licensed user groups and then adjusted these averages using the proportion of the trip dedicated to recreating on WMAs.

We used the 2018 Impact Analysis for Planning (IMPLAN) software, along with the expenditure data, to estimate the direct, indirect, and induced effects of licensed and unlicensed recreation on: (1) each of the 9 study WMAs, and (2) the entire NC WMA system as a whole. IMPLAN employs an input-output model across 546 economic sectors to estimate these effects. Direct effects are the sales, income, jobs, and taxes, directly attributed to WMA related expenditures and retained within a region's economy. Indirect effects refer to the income and employment impacts resulting from business to business commerce generated as a result of direct expenditures. Induced effects are the result of household spending by employees whose employment is a result of direct and indirect sales. Direct, indirect, and induced effects are estimated across a number of categories including employment, labor income, value added, and state and federal taxes. The employment column represents all jobs created as a result of WMA related spending, whereas the labor income column includes all salaries and wages resulting from WMA related spending. The value-added column is the difference between the output and intermediate outputs and may be thought of as the contribution to state gross domestic product (GDP). Federal, state, and local tax columns include the total of income, sales, and property taxes collected as a result of WMA related spending. Because we wanted to estimate the contribution to both the county and the state for each of the 9 study WMAs, we used multi-regional input-output (MRIO) analysis to account for direct effects in both geographic locations. We calculated Social Accounting Matrix (SAM) multipliers, which is the total effect (direct, indirect, and induced) divided by the direct effects. SAM multipliers allow for the estimation of a region's ability to retain sales dollars spent within the region's economy, while also accounting for social security, tax, institutional savings, and commuting leakages. The benefit of a MIRO analyses is that the associated SAM multipliers capture leakages to the linked regions (i.e. leakages between a county and the rest of the state) that would otherwise be lost in a single region analysis. We calculated the statewide leakage rate as the fraction of total expenditures across the entire NC WMA system that were not directly converted into value added to the NC economy (Loomis and Walsh, 1997). We employed a single-region IMPLAN model to estimate the economic contribution of the entire WMA system (all 94 WMAs) to NC's economy. Expenditure amounts are in 2018 dollars (the year of collection) and economic contribution totals are in 2020 dollars.

Out of 1943 surveys collected at the 9 study WMAs, approximately 25% (547) lacked sufficient data to estimate trip expenses. We compared these incomplete responses to the rest using descriptive statistics and *t*-tests. Age, sex, and median income were the same for both groups ($p > .05$), but non-respondents were less likely to have a college degree ($p < .001$). There was no difference in total spending per visit between people with and without college degrees among the 75% of respondents who provided complete responses ($t = 1.07$, $p = .14$). Thus, partial data appears to reflect time constraints, comprehension issues, or privacy concerns more than a systematic bias, although the latter is a possibility.

3. Results

We obtained trip expenditures data from 1396 visitors, including 673 engaged primarily in hunting, 219 engaged primarily in fishing, and 504 engaged only in activities that did not require licenses. Most (59%) respondents had a college education (Associates degree or higher) and the median annual household income was $50,001– $75,000. Licensed users were primarily male (95%) with a mean age of 42 (SD = 14.83). Non-licensed users were primarily male (69%) with a mean age of 49 (SD = 16.83). Of the 504 non-licensed users, the most popular non-licensed activities were hiking (45%), kayaking (36%), other activities (22%), birding (18%), non-hunting field trials participants (observers, dog handlers, other non-hunting participants; 13%), horseback riding (10%), camping (9%), biking (7%) and motorized boating (5%). The most popular "other" activities listed by respondents were climbing, swimming, nature photography, and dog training/walking. Almost half (45%) of non-licensed users reported participating in multiple activities during a single visit. The high degree of overlap among non-licensed activities was a driving factor in grouping them together into a single user group of non-licensed users.

Non-licensed users spent the most per trip overall and in association with WMA specific activities, and made a greater proportion of the trip expenditures locally than licensed groups. Specifically, average trip expenditures for non-licensed users ($119.83; 95% CI = $93.09–$146.56) were 42% greater than hunters ($84.48; 95% CI = $61.67–$107.30) and 44% greater than anglers ($83.30; 95% CI = $63.37–$103.23) per trip (Table 1). Variance in spending was high among non-licensed users. Non-hunting users participating in field trials spent the most per trip, averaging $284.88 (95% CI = $197.70–$372.05) per trip,

Table 1
Expenditure summary statistics, including 95% confidence intervals, for licensed and non-licensed users on North Carolina wildlife management areas (WMA). Collected between 2017 and 2019.

User Group	Mean Spending Per Trip	Mean Spending Attributed to WMA	Location of Spending Attributed to WMA		
			Within County	Within NC[a]	Outside NC
Hunters	$84.48 ($61.67–$107.30)	$73.76 ($53.84–$93.67)	77.1%	22.4%	0.5%
Anglers	$83.30 ($63.37–$103.23)	$61.98 ($47.15–$76.80)	79.5%	18.4%	2.1%
Non-licensed	$119.83 ($93.09–$146.56)	$95.98 ($74.57–$117.39)	85.4%	10.5%	4.1%

[a] Expenditures incurred within NC but outside of the county(s) containing the WMA visited.

followed by horseback riders ($174.98; CI = $116.47–$233.49), bikers ($167.59; CI = $0–$349.16), campers ($161.89; CI = $93.27–$230.50), birders ($144.31; CI = $63.50–$225.12), motorized boaters ($125.69; CI = $45.28–$206.10), kayakers/canoers ($108.59; CI = $57.24–$159.93), hikers ($100.48; CI = $63.50–$137.45), and users participating in other activities ($93.71; CI = $56.05–$131.36). The trend of non-licensed users spending more persisted after accounting for the proportion of spending attributed to the WMA, although all groups attributed between 74 and 87% of their total trip expenses directly to the WMA visit itself (Table 1). Average trip expenditures specifically attributed to their WMA visit were $95.98 (95% CI = $74.57–$117.39) for non-licensed users, $73.76 for hunters (CI = $53.84–$93.67) and $61.98 for anglers ($47.15–$76.80) per trip (Table 1). The proportion of overall spending in local counties was greater for non-licensed users (85.4%) than for hunters (77.1%) or anglers (79.5%). This magnified effects of differential spending with non-licensed users spending 66% more than anglers and 44% more than hunters locally (Table 1). Spending among licensed and non-licensed users also varied across expenditure category. Lodging constituted a larger percent of trip expenses for anglers (22%) and non-licensed users (16%) than for hunters (2% of trip expenses). Hunters spent more ($33.27/trip) than non-licensed users ($21.21/trip) and anglers ($9.90/trip) in the "other" category in NC. Other included expenses related to ammunition for hunting, bait for fishing, other outdoor gear or clothing, and camping supplies. Hunters and anglers spent the same amount in NC ($8.53; Hunters 95% CI = $6.11–$11.51, Anglers CI = $3.24–$15.27) on restaurants or takeout during a single trip, which was about 34% less than the average non-licensed user ($12.89; CI = $7.57–$20.71). To strengthen face validity of these estimates, we compared average trip expenditures for hunters and anglers with average trip expenditures in the 2016 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, and average trip expenditures for non-licensed users with the average trip expenditures for daily visitors in the 2020 National Park Visitor Spending Effects report. Our estimates and those of the aforementioned reports were similar and within the 95% confidence intervals of our average trip expenditures estimates when adjusted for inflation. The 2016 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation reported an average trip expense of about $50/person/day for hunters and about $47/person/day for anglers and the 2020 National Park Visitor Spending Effects report estimated average trip expenditures of $91.62/person/day for non-local daily visitors and $138.23/person/day among all visitors.

We estimated approximately 202,937 annual visits to the 9 study WMAs, with gross expenditures estimated at $17,064,497 (Table 2). IMPLAN MRIO estimates at these 9 game lands indicated visitor expenditures translated into approximately 217 jobs in NC, and over $7 million in labor income. Value added to the state economy by WMA users at these 9 locations exceeded $11.5 million annually and contributed approximately $3.2 million in federal, state, and local tax revenue (Table D). Across the 9 WMAs, approximately 20% of visits were from hunters, 19% from anglers, and 61% from non-licensed users. Transitioning to the estimates for the entire WMA system, we estimated approximately 2,180,211 (95% Prediction Interval = 843,965–6,270,624) visits to NC WMAs in 2018 (Table 2). To assess face validity, we compared our estimate of annual hunting trips to all 94 WMAs (436,042 trips) with the estimated North Carolina share of total public land hunting trips based on the South Atlantic estimates in the 2016 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. The South Atlantic estimate is approximate 2.2 million visits over an 8 state plus Washington DC area. North Carolina's portion is between 353,000 (based on share of public land acreage) and 618,000 visits (based on share of hunting licenses sold), aligning well with our estimate. The 2018 gross expenditures made within NC as a result of WMA visits was estimated to be $179,521,258 (PI = $69,492,546 – $516,326,656), of which approximately $32,003,654 (PI = $12,388,692 – $92,047,457) may be attributed to hunters, $25,137,564 (PI = $9,730,241 – $72,295,278) may be attributed to anglers, and $122,380,040 (PI = $47,373,612 – $351,983,920) may be attributed to non-licensed users (Table 2). These expenses translated into approximately 2202 jobs in NC, resulting in over $84 million in labor income (Table 3). Value added to the state economy by WMA users exceeded $140 million in 2018. For comparison, travel and tourism within NC in 2018 accounted for approximately 230,000 jobs and $6.34 billion in annual labor income (U.S. Travel Association, 2018). Economic contribution estimates are based on category specific SAM multipliers (Table 3). The SAM multiplier for employment was 1.59, indicating that for every job created as a result of WMA related spending, an additional 0.59 jobs were created elsewhere in the state's economy. The SAM multiplier for labor income and value added in NC was 1.97 and 1.99, respectively. This suggests that for every dollar spent visiting WMAs, an additional $0.99 in economic contribution is generated elsewhere in the state's economy. WMA related spending contributed over $18 million in federal tax revenues and over $18.5 million in state and local tax revenues. The SAM multiplier for federal (1.94) and state and local tax (1.54) revenues indicated that for every tax dollar generated as a result of WMA spending, an additional $0.94 in federal tax revenue and an additional 54 cents in state and local tax revenue is generated elsewhere in the state's economy (Table 3). The out of state leakage rate was 22% for the entire WMA system, and the out of county leakage rate at the 9 study WMAs varied between 21 and 45%. Out of county leakage rates tended to decrease as county population density increased ($r = -0.79$; $R^2 = 0.63$).

4. Discussion

The North Carolina state economy is capturing much of the spending attributed to WMAs, as indicated by low leakage rates and large SAM multipliers in our study. The estimated statewide leakage rate (22%) and

Table 2
Predicted annual visitation to select North Carolina WMAs and total predicted annual expenditures for licensed and non-licensed users.

Wildlife Management Area	Predicted Annual Visits				Predicted Annual NC Expenditures
	Hunters	Anglers	Non-licensed	Total	
Green River	1559	4886	62,999	69,444	$6,208,323
Cold Mountain	4347	10,147	15,451	29,945	$2,356,665
Sandy Mush	3888	283	6342	10,513	$886,150
Sandhills	2458	2320	9520	14,298	$1,197,258
R. Wayne Bailey Caswell	3387	5326	5591	14,304	$1,086,296
Butner – Falls of the Neuse	5655	3862	16,589	26,106	$2,175,994
Holly Shelter	3888	2886	10,945	17,719	$1,467,695
Neuse River	1622	1747	4833	8202	$669,813
Chowan Swamp	2987	2224	7195	12,406	$1,016,304
All NC WMAs	436,042	414,240	1,329,929	2,180,211	$179,517,266

Annual visitation predictions based on data collected between 2017 and 2019.

Table 3
Economic contributions, including direct, indirect, and induced effects, from all WMA related spending by user type to the North Carolina economy.

User Group	Impact	Jobs	Labor Income	Value Added	Federal Tax	State/Local Tax
All Users Combined	Direct Effect	1383	$42,549,379	$70,269,215	$9,368,032	$12,034,556
	Indirect Effect	458	$24,530,271	$38,957,013	$5,125,942	$3,625,126
	Induced Effect	361	$16,926,039	$30,842,994	$3,659,417	$2,882,916
	Total Effect	2202	$84,005,689	$140,069,221	$18,153,390	$18,542,597
	SAM Multiplier[a]	1.59	1.97	1.99	1.94	1.54
Hunters	Direct Effect	232	$6,398,779	$10,484,729	$1,425,894	$2,161,078
	Indirect Effect	74	$3,967,688	$6,366,712	$833,250	$605,856
	Induced Effect	56	$2,619,470	$4,773,097	$566,326	$446,131
	Total Effect	362	$12,985,937	$21,624,538	$2,825,470	$3,213,065
	SAM Multiplier	1.56	2.03	2.06	1.98	1.49
Anglers	Direct Effect	184	$5,841,848	$10,275,435	$1,314,695	$1,948,605
	Indirect Effect	67	$3,599,014	$5,675,539	$753,864	$550,392
	Induced Effect	51	$2,382,572	$4,341,478	$515,110	$405,792
	Total Effect	302	$11,823,434	$20,292,452	$2,583,669	$2,904,790
	SAM Multiplier	1.64	2.02	1.97	1.97	1.49
Non-licensed	Direct Effect	967	$30,308,751	$49,509,051	$6,627,442	$7,924,872
	Indirect Effect	317	$16,963,569	$26,914,761	$3,538,828	$2,468,877
	Induced Effect	254	$11,923,997	$21,728,419	$2,577,981	$2,030,992
	Total Effect	1537	$59,196,317	$98,152,231	$12,744,251	$12,424,742
	SAM Multiplier	1.59	1.95	1.98	1.92	1.57

Dollar values represent 2020 estimates.
[a] Social Accounting Matrix (SAM) multipliers are the total effect (direct, indirect and induced) divided by the direct effects.

value added SAM multiplier (1.99) were more desirable than leakage rates and multipliers reported in other recreation/tourism studies, including those focused on statewide waterfowl hunting and international nature-based tourism (Grado et al., 2011; Hjerpe and Kim, 2007; Sandbrook, 2010) and slightly more desirable than, but relatively consistent with, studies focused on wildlife based recreation in the southeastern US (Frew et al., 2018; Poudyal et al., 2020). The lower leakage rate and higher SAM multipliers in our study may be a result of (1) large proportion of visitors from in-state, and (2) recreation activities that are organized by the visitors themselves. Regional visitation limits the amount of expenditures incurred on long distance travel (e.g., airfare, rental vehicles.), and self-administered nature-based recreation limits expenditures captured by recreation concessionaires and guides with bases outside local areas (English and Bowker, 1996; Hjerpe and Kim, 2007; Martin, 1987; Sandbrook, 2010). On average, long distance travel and guide services were low expenditure categories among surveyed WMA users, thus contributing to low leakage rates observed for overall WMA expenditures. The WMA users spent most on gasoline, food, and lodging, some of which are easily captured by the local economy, and spent relatively little on durable goods (e.g., guns, kayaks, bikes, binoculars) that are rarely produced or sold locally. However, leakage rates and SAM multipliers did vary among the WMAs, with the lowest out of county leakage rates and highest multipliers observed at more urban WMAs. These differences may be explained by urban areas having more diversified economies which are able to locally capture more of the dollars spent by recreational users (Martin, 1987). Because WMAs are less vulnerable to economic leakage often attributed to long distance travel, durable goods, and guide services, they likely generate less expenditures benefiting economies distant from the WMA being used compared to other types of recreation areas.

Differences in spending among user groups on WMAs appear to reflect structural differences in activities. The WMA users, in aggregate, demonstrated high levels of local spending, but non-licensed users spent more overall, and more locally. Licensed users, specifically hunters, may have different visitation schedules than many non-licensed users. For example, they may arrive on WMAs before sunrise or depart after sunset and thus may prefer shorter travel times. These preferences may create constraints to local spending, for example, lower amounts of fuel required, fewer restaurant stops, and no need for overnight lodging. These hypotheses align well with our results, which indicated licensed users spent about 34% less than the average non-licensed user on restaurants or takeout during a single trip. Non-licensed users do not face these same distance-based constraints; however, they may prefer to visit on non-hunting days (e.g., Sunday in NC; Boston and Herr, 2020) or during non-hunting months. Non-licensed users also participated in more activities per WMA trip, which may increase overall spending and total time spent at the WMA. Another factor driving the spending differences between licensed and non-licensed users and low leakage rates observed in our study is urban proximity. Urban proximity contributed to the results in 4 possible ways, (1) licensed users are less likely to live and recreate in urban areas (Larson et al., 2014), (2) urban settings with diverse economies may have more opportunities for spending than rural economies (Martin, 1987), (3) urban residents have greater incomes which are known to correlate positively with willingness to pay (Chen and Jim, 2010; Frew et al., 2018), and (4) urban settings have greater commercial and industrial development, thus increasing the ability of local economies to capture spending (Grado et al., 2011). Future studies may benefit from the collection of fine scale data on where respondents live (e.g., zip code or municipality), possibly paired with census data, helping to further uncover drivers of spatial patterns in visitor spending (Chakraborty and Keith, 2000). Structural differences in activities among user groups may help explain licensed users spending less locally than non-licensed users.

We showed that non-licensed users were responsible for more visits and spent more per visit on average than licensed users, although licensed users also paid fees for their licenses. Non-licensed users spent more per trip, spent a greater proportion locally per trip, and took the majority of trips to WMAs. Therefore, non-licensed users are the means to the majority of the value added, employment and tax benefits that local and state economies receive from WMAs. However, licensed users provided a majority of funding for WMA land acquisition and maintenance through license sales, matching federal funding, and excise taxes on guns and ammunition (Jacobson et al., 2010; Price Tack et al., 2018). Our analysis did not include fees for annual hunting, fishing, or trapping licenses, because those are annual expenses rather than trip expenses. However, these fees support land management and jobs within state wildlife agencies, which further expands the overall impact from licensed WMA users.

Monetization of non-licensed users to help support wildlife conservation and public land management presents an important and difficult challenge for wildlife conservation (Duda et al., 2021). Recent funding efforts have been successful in expanding the financial resource base for state fish and wildlife agencies (i.e., The Blue Ribbon Panel on Sustaining America's Diverse Fish & Wildlife Resources with the Recovering

America's Wildlife Act). However, this legislation failed to address the issue that non-licensed users are consistently absent from these efforts to expand funding. Users in both groups agree with expanding funding and are willing to contribute (Lee Jenni, 2020). Non-licensed users already provide a critical contribution by making WMAs an economic benefit for both residents and state and local governments, and their expenses can be further leveraged to help state and federal wildlife management agencies. Monetization options include special access passes, requiring all users to obtain fishing/hunting licenses, or even an excise tax on outdoor gear such as binoculars and tents. We acknowledge implementing new funding mechanisms is difficult, but states like Colorado and Virginia have been successful at the state level. Colorado requires all visitor to state WMAs to purchase a WMA access pass or a state fishing or hunting license, and Virginia requires all visitors to state WMAs to purchase an access permit unless they already own a hunting or fishing license. Future work should evaluate public support and economic contribution of such funding mechanisms, and how these funding mechanisms may impact the expenditure profile of both licensed and non-licensed users.

5. Conclusion

Our study indicated that investment in WMAs that attract more daily visits – for licensed or unlicensed activities – may increase the overall economic contribution of WMAs, and may result in positive contributions to employment, income, and tax revenues for local and state governments. These benefits are produced by diverse users, engaged in both licensed and non-licensed activities, across the urban-rural gradient, and may result from new spending or a transfer in local spending. Our results indicate that WMAs make a large annual contribution to the state economy relative to annual maintenance costs borne by state management agencies. Further, the returns seem likely to grow as participation in nature-based recreation grows rapidly throughout the world, especially activities currently not licensed (Balmford et al., 2009; Ziesler, 2020). Spending attributed to WMAs is readily captured and retained within local economies, especially in urban communities, and to a lesser degree in rural communities. WMA related spending in rural communities may be especially important to these communities as rural decline and other global social challenges impact rural economies (Goetz et al., 2018; McCleery et al., 2014). Finally, we find that protected areas designed to provide hunting and fishing opportunities are attracting non-consumptive users, whose expenses constitute the majority of recreation driven benefits to local economies. Future research assessing the viability of cheaper data collection methods (e.g., virtual visitor surveys, constituent database surveys) and novel technology (e.g., cell phone location data, georeferenced social media posts) may help advance visitation and economic contribution studies by improving visitation and expenditure estimates while minimizing recall bias.

Funding

This work was supported by the North Carolina Wildlife Resources Commission [Cooperative Agreement DELM-0001].

Declaration of Competing Interest

William Casola reports financial support was provided by North Carolina Wildlife Resources Commission.

Appendix materials

Table A
Wildlife management area user's expenditures by IMPLAN sector.

Questionnaire Category	Economic Sector	Sector Number
Gas	Refined Petroleum Products	3154
Rental Vehicle	Automotive Equipment Rental	3450
Airfare	Air Transportation Services	3414
Restaurant or Take-Out Meal	Full-Service Restaurant Services	3509
Groceries or Snacks	Other Snack Foods	3098
Other Food	All Other Food Products	3103
Lodging	Hotels and Motel Services Including Casinos	3507
Entrance Fees	Other Products and Services of State Government Enterprises	3531
Entertainment	Other Amusement and Recreation	3504
Other products or services (e.g., ammunition for hunting, bait for fishing, other outdoor gear or clothing, camping supplies)	Retail Services – Sporting Goods, Hobby, Musical Instruments, and Book Stores	3410

Table B
Model parameters for the quasi-Poisson model used to predict daily visitation at 9 study wildlife management areas (WMA) in North Carolina.

Parameter	Estimate	Std. Error	t - value
(Intercept)	3.90***	0.33	11.91
Day of Week: Sunday	0.31[a]	0.16	1.92
Day of Week: Weekdays	−0.14	0.16	−0.90
Year: 2018	1.05***	0.19	5.680
Year: 2019	0.21	0.25	0.823
Opening Day of Hunting Season	0.69***	0.15	4.638
Avg. Temperature	−0.01**	0.005	−2.947
Season: No Hunting	1.03***	0.17	5.963
Season: Spring Non-turkey	0.08	0.21	0.383
Season: Spring Turkey	0.52**	0.17	3.055
WMA: Caswell	−0.63**	0.20	−3.187
WMA: Chowan Swamp	−0.75***	0.21	−3.526
WMA: Cold Mtn	0.04	0.20	0.197

(continued on next page)

Table B (*continued*)

Parameter	Estimate	Std. Error	t - value
WMA: Green River	0.91***	0.15	5.901
WMA: Holly Shelter	−0.36*	0.17	−2.085
WMA: Neuse River	−1.12***	0.22	−5.057
WMA: Sandhills	−0.57**	0.20	−2.791
WMA: Sandy Mush	−0.98***	0.26	−3.739

Parameters include characteristics impacting daily visitation at each WMA.
Note: The reference level is Saturday during the 2017 Deer Season at Butner-Falls Game land.
[a] $p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

Table C
Model parameters for the quasi-Poisson model used to predict annual visitation at all 94 wildlife management areas (WMA) in North Carolina.

Parameter	Estimate	Std. Error	t - value
(Intercept)	5.97***	0.35	17.02
sqrt(Acres)	0.003[a]	0.001	2.84
Amenity Score	0.53**	0.06	8.28
Regional Demand Index – Medium	0.34	0.16	2.14
Regional Demand Index – High	2.01***	0.15	13.28
Population Density	0.0005	0.0002	2.17

Parameters include characteristics of each WMA and their surrounding county.
Note: Regional Demand Index – Low is the regression reference level.
[a] $p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

Table D
Total annual economic contributions of wildlife management area (WMA) related spending at the 9 study WMAs to the North Carolina economy.

WMA	Employment	Labor Income	Value Added	Federal Tax	State/Local Tax
Green River	84	$2,765,780	$4,423,220	$585,360	$647,284
Cold Mountain	31	$911,511	$1,519,908	$204,722	$245,830
Sandy Mush	10	$378,931	$624,670	$79,040	$88,756
Sandhills	15	$491,038	$843,954	$106,237	$127,150
R. Wayne Bailey Caswell	13	$385,662	$596,203	$85,130	$84,058
Butner – Falls of the Neuse	25	$1,013,964	$1,711,773	$205,407	$222,346
Holly Shelter	18	$518,426	$840,927	$110,372	$112,037
Neuse River	8	$240,203	$422,308	$48,515	$68,096
Chowan Swamp	13	$339,526	$569,450	$73,852	$100,906

References

Arni, A.G., Khairil, W.A., 2013. Promoting collaboration between local community and park management towards sustainable outdoor recreation. Procedia Soc. Behav. Sci. 91, 57–65. https://doi.org/10.1016/j.sbspro.2013.08.401.

Balmford, A., Beresford, J., Green, J., Naidoo, R., Walpole, M., Manica, A., 2009. A global perspective on trends in nature-based tourism. PLoS Biol. 7, e1000144 https://doi.org/10.1371/journal.pbio.1000144.

Black, K.J., 2018. Wide open spaces: estimating the willingness to pay for adjacent preserved open space. Reg. Sci. Urban Econ. 71, 110–121. https://doi.org/10.1016/j.regsciurbeco.2018.06.001.

Boston, B., Herr, V., 2020. Sunday Hunting on Game Land Final Report. Atlanta, GA.

Carver, E., Caudill, J., 2007. Banking on Nature 2006: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation. Washington, DC.

Casola, W.R., Peterson, M.N., Wu, Y., Sills, E.O., Pease, B.S., Pacifici, K., 2021. Measuring the value of public hunting land using a hedonic approach. Hum. Dimens. Wildl. https://doi.org/10.1080/10871209.2021.1953196.

Caudill, J., Carver, E., 2019. Banking on Nature 2017: The Economic Contributions of National Wildlife Refuge Recreational Visitation to Local Communities. Falls Church, Virginia.

Chakraborty, K., Keith, J.E., 2000. Estimating the recreation demand and economic value of mountain biking in Moab, Utah: an application of count data models. J. Environ. Plan. Manag. 43, 461–469. https://doi.org/10.1080/713676570.

Chen, W.Y., Jim, C.Y., 2010. Resident motivations and willingness-to-pay for urban biodiversity conservation in Guangzhou (China). Environ. Manag. 45, 1052–1064. https://doi.org/10.1007/s00267-010-9478-2.

Chen, R.J., Hunt, K.M., Ditton, R.B., 2003. Estimating the economic impacts of a trophy largemouth bass fishery: issues and applications. N. Am. J. Fish Manag. 23, 835–844. https://doi.org/10.1577/M02-014.

Cordell, H.K., 2008. The latest on trends in nature-based outdoor recreation. For. Hist. Today 4–10.

Corn, M.L., 2015. Congressional Research Service PILT (Payments in Lieu of Taxes): Somewhat Simplified.

Cullinane, T.C., Koontz, L., 2020. 2019 National Park Visitor Spending Effects: Economic Contributions to Local Communities, States, and the Nation. Fort Collins, CO.

Dasgupta, P., 2021. The Economics of Biodiversity: The Dasgupta Review. HM Treasury, London.

Duda, M.D., Beppler, T., Austen, D.J., Organ, J.F., 2021. The precarious position of wildlife conservation funding in the United States. Hum. Dimens. Wildl. 1–9. https://doi.org/10.1080/10871209.2021.1904307.

Duffus, D.A., Dearden, P., 1990. Non-consumptive wildlife-oriented recreation: a conceptual framework. Biol. Conserv. 53, 213–231. https://doi.org/10.1016/0006-3207(90)90087-6.

English, D.B.K., Bowker, J.M., 1996. Economic impacts of guided whitewater rafting: a study of five rivers. J. Am. Water Resour. Assoc. 32, 1319–1328. https://doi.org/10.1111/j.1752-1688.1996.tb03500.x.

Fisher, W.L., Grambsch, A.E., Eisenhower, D.L., Morganstein, D.R., 1991. Length of recalll period and accuracy of estimates from the national survey of fishing, hunting, and wildlife-associated recreation. Am. Fish. Soc. Symp. 12, 367–374.

Force, J.E., Forester, D.J., 2002. Public involvement in national park service land management issues. Soc. Sci. Res. Rev. 3, 1–28.

Frew, K.N., Peterson, M.N., Sills, E., Moorman, C.E., Bondell, H., Fuller, J.C., Howell, D. L., 2018. Market and nonmarket valuation of North Carolina's tundra swans among hunters, wildlife watchers, and the public. Wildl. Soc. Bull. 42, 478–487. https://doi.org/10.1002/wsb.915.

Gioglio, R., Sohngen, B., Haab, T., Bruskotter, J., 2019. Economic Valuation of Natural Areas in Ohio.

Goetz, S.J., Partridge, M.D., Stephens, H.M., 2018. The economic status of rural america in the president trump era and beyond. Appl. Econ. Perspect. Policy 40, 97–118. https://doi.org/10.1093/aepp/ppx061.

Grado, S.C., Kaminski, R.M., Munn, I.A., Tullos, T.A., 2001. Economic impacts of waterfowl hunting on public lands and at private lodges in the Mississippi delta. Wildl. Soc. Bull. 29, 846–855.

Grado, S.C., Hunt, K.M., Whiteside, M.W., 2007. Economic impacts of white-tailed deer hunting in Mississippi. Proc. Annu. Conf. Southeast. Assoc. Fish Wildl. Agencies 61, 59–67.

Grado, S.C., Hunt, K.M., Hutt, C.P., Santos, X.T., Kaminski, R.M., 2011. Economic impacts of waterfowl hunting in Mississippi derived from a state-based mail survey. Hum. Dimens. Wildl. 16, 100–113. https://doi.org/10.1080/10871209.2011.551175.

Hjerpe, E.E., Kim, Y.-S., 2007. Regional economic impacts of Grand Canyon river runners. J. Environ. Manag. 85, 137–149. https://doi.org/10.1016/j.jenvman.2006.08.012.

IMPLAN Group LLC, 2020. IMPLAN.

Irwin, E.G., Bockstael, N.E., 2001. The problem of identifying land use spillovers: measuring the effects of open space on residential property values. Am. J. Agric. Econ. 83, 698–704.

Jacobson, C.A., Organ, J.F., Decker, D.J., Batcheller, G.R., Carpenter, L., 2010. A conservation institution for the 21st century: implications for state wildlife agencies. J. Wildl. Manag. 74, 203–209. https://doi.org/10.2193/2008-485.

Knight, R.L., Gutzwiller, K.J., 1995. Wildlife and Recreationists: Coexistence through Management and Research. Island Press, Washington, DC, USA.

Larson, L.R., Stedman, R.C., Decker, D.J., Siemer, W.F., Baumer, M.S., 2014. Exploring the social habitat for hunting: toward a comprehensive framework for understanding hunter recruitment and retention. Hum. Dimens. Wildl. 19, 105–122. https://doi.org/10.1080/10871209.2014.850126.

Lee Jenni, G.D., 2020. A Qualitative Approach to Understanding Environmental Planning and Education. North Carolina State University.

Liu, X., Taylor, L.O., Hamilton, T.L., Grigelis, P.E., 2013. Amenity values of proximity to National Wildlife Refuges: an analysis of urban residential property values. Ecol. Econ. 94, 37–43. https://doi.org/10.1016/j.ecolecon.2013.06.011.

Loomis, J.B., Walsh, R.G., 1997. Recreation Economic Decisions: Comparing Benefits and Costs. Venture Publishing, State College, PA, USA.

Martin, L.R.G., 1987. Economic impact analysis of a sport fishery on Lake Ontario: an appraisal of method. Trans. Am. Fish. Soc. 116, 461–468. https://doi.org/10.1577/1548-8659(1987)116<461:EIAOAS>2.0.CO;2.

McCleery, R.A., Moorman, C.E., Peterson, M.N., 2014. Urban Wildlife Conservation. Springer US.

National Park Service, 2007. Director's Order #75A: Civic Engagement and Public Involvement.

Negi, C.S., Nautiya1, S., 2003. Indigenous peoples, biological diversity and protected area management — policy framework towards resolving conflicts. Int. J. Sustain. Dev. World Ecol. 10, 169–179. https://doi.org/10.1080/13504500309469795.

Noe, R.R., Keeler, B.L., Kilgore, M.A., Taff, S.J., Polasky, S., 2017. Mainstreaming ecosystem services in state-level conservation planning: progress and future needs. Ecol. Soc. 22, art4. https://doi.org/10.5751/ES-09581-220404.

Organ, J.F., Fritzell, E.K., 2000. Trends in consumptive recreation and the wildlife profession. Wildl. Soc. Bull. 28, 780–787.

Payton, S.B., Ottensmann, J.R., 2015. The implicit price of urban public parks and greenways: a spatial-contextual approach. J. Environ. Plan. Manag. 58, 495–512. https://doi.org/10.1080/09640568.2013.864619.

Peterson, M.N., Peterson, T.R., Liu, J., 2013. The Housing Bomb: Why our Addiction to Houses Is Destroying the Environment and Threatening our Society. Johns Hopkins University Press.

Phillips, W.J., Wolfe, K., Hodur, N., Leistritz, F.L., 2013. Tourist word of mouth and revisit intentions to rural tourism destinations: a case of North Dakota, USA. Int. J. Tour. Res. 15, 93–104. https://doi.org/10.1002/jtr.879.

Poudyal, N.C., Watkins, C., Joshi, O., 2020. Economic contribution of wildlife management areas to local and state economies. Hum. Dimens. Wildl. 25, 291–295. https://doi.org/10.1080/10871209.2020.1716114.

Price Tack, J.L., McGowan, C.P., Ditchkoff, S.S., Morse, W.C., Robinson, O.J., 2018. Managing the vanishing North American hunter: a novel framework to address declines in hunters and hunter-generated conservation funds. Hum. Dimens. Wildl. 23, 515–532. https://doi.org/10.1080/10871209.2018.1499155.

Radeloff, V.C., Stewart, S.I., Hawbaker, T.J., Gimmi, U., Pidgeon, A.M., Flather, C.H., Hammer, R.B., Helmers, D.P., 2010. Housing growth in and near United States protected areas limits their conservation value. Proc. Natl. Acad. Sci. 107, 940–945. https://doi.org/10.1073/pnas.0911131107.

Reynolds, P.C., Braithwaite, D., 2001. Towards a conceptual framework for wildlife tourism. Tour. Manag. 22 (1), 31–42. https://doi.org/10.1016/S0261-5177(00)00018-2.

Rosenberger, R.S., White, E.M., Kline, J.D., Cvitanovich, C., 2017. Recreation economic values for estimating outdoor recreation economic benefits from the National Forest System. https://doi.org/10.2737/PNW-GTR-957.

Sandbrook, C.G., 2010. Local economic impact of different forms of nature-based tourism. Conserv. Lett. 3, 21–28. https://doi.org/10.1111/j.1755-263X.2009.00085.x.

Santos, X.T., Grado, S.C., Hunt, K.M., 2016. Assessing the economic impact of waterfowl hunting in Mississippi. Int. J. Soc. Econ. 43, 86–103. https://doi.org/10.1108/IJSE-04-2014-0068.

U.S. Travel Association, 2018. The 2018 Economic Impact of Domestic Travel on North Carolina Counties.

UNEP-WCMC, 2018. 2018 United Nations List of Protected Areas. Supplement on protected area management effectiveness. Cambridge, UK.

Ver Hoef, J.M., Boveng, P.L., 2007. Quasi-poisson vs. negative binomial regression: how should we model overdispersed count data? Ecology 88, 2766–2772. https://doi.org/10.1890/07-0043.1.

White, E., Bowker, J.M., Askew, A.E., Langner, L.L., Arnold, J.R., English, D.B.K., 2016. Federal outdoor recreation trends: effects on economic opportunities. Portland, OR. https://doi.org/10.2737/PNW-GTR-945.

Ziesler, P.S., 2020. Statistical Abstract: 2019. Natural Resource Data Series. NPS/NRSS/EQD/NRDS—2020/1272. Fort Collins, Colorado.