



Exploring the relevance of the multidimensionality of wildlife recreationists to conservation behaviors: A case study in Virginia

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Abstract

Wildlife recreationists' participation in conservation behaviors could provide key support to the conservation efforts of state fish and wildlife agencies. However, little is known about how identifying with multiple forms of wildlife recreation (i.e., hunters, anglers, birders, wildlife viewers) may influence participation in conservation behaviors, specifically for supporting state fish and wildlife agencies and their conservation goals. Using a mixed-mode survey of Virginia wildlife recreationists, we explored the hypothesized relationship between individuals' participation in conservation behaviors and their identification with multiple forms of consumptive and nonconsumptive wildlife recreation. We found wildlife recreation identity is multidimensional, with many individuals identifying with consumptive and nonconsumptive identities simultaneously. Further, consumptive-only recreationists (i.e., hunters and/or anglers) participated in conservation behaviors less often than nonconsumptive-only recreationists (i.e., birders and/or wildlife viewers) and recreationists with both consumptive and nonconsumptive identities were less likely to support a state fish and wildlife agency in the future. Our findings underscore the importance of all types of wildlife recreationists, especially those with intersecting identities, as state fish and wildlife agencies work to advance conservation. Hence, developing multi-faceted engagement strategies may enhance support for state fish and wildlife agencies among their growing wildlife recreation constituency.

KEYWORDS

anglers, birders, conservation behavior, hunters, recreation identity, state fish and wildlife agencies, wildlife recreation, wildlife viewers

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1 | INTRODUCTION

The relationship between wildlife recreation and participation in conservation has significant implications for the success of state fish and wildlife agencies (hereafter, “wildlife agencies”) and their conservation efforts (Teisl & O'Brien, 2003). Wildlife agencies currently work to conserve fish, wildlife, and their habitats, while also managing wildlife recreation activities (Association of Fish and Wildlife Agencies [AFWA] & Wildlife Management Institute [WMI], 2019; Decker et al., 2015). The success of wildlife agency conservation efforts depends largely on public support via volunteering, funding, and advocacy (AFWA & WMI, 2019). Wildlife recreationists (i.e., hunters, anglers, birders, and other wildlife viewers) represent a key constituency interested in supporting and advancing conservation. Indeed, wildlife recreationists participate in a variety of conservation behaviors beneficial to wildlife agencies, including improving habitat, contributing to citizen science, and advocating for policy (Cooper et al., 2015; Shipley et al., 2019; Wood et al., 2011). While past research has tied recreationists' conservation participation to factors such as values toward wildlife and level of environmental concern (e.g., Poortinga et al., 2004; Steg & Flek, 2009), there is a paucity in the literature regarding the role of recreation identity in conservation behavior. Further, much of current recreation management is divided into serving specific recreation identities, however, research indicates recreationists may identify with multiple identities, which in turn may influence their conservation participation (e.g., Cooper et al., 2015). Concomitantly, little research has focused on asking if established patterns of conservation behaviors translate to supporting wildlife agencies in their conservation efforts.

A growing body of research has highlighted the relationship between past participation in wildlife recreation activities and conservation behaviors (Bennett et al., 2018; Larson et al., 2015). Conservation behaviors are defined as actions that contribute to protection or responsible use of the environment in pursuit of environmental and/or social outcomes (Bennett et al., 2018; Larson et al., 2015). Cooper et al. (2015) found that all domains of conservation behaviors are linked to participation in and identification with hunting and birding. Other studies have reached similar conclusions, focusing specifically on financial support for conservation (e.g., birders purchasing the Migratory Bird Hunting and Conservation Stamp, Shipley et al. 2019) and lifestyle behaviors, such as recycling (e.g., Landon, Kyle, Riper, Schuett, and Park, 2018). However, wildlife recreationists participation in the full range of conservation has received little attention in the context of wildlife agencies.

Furthermore, despite research that suggests future intended participation may not always align with past patterns of involvement (Floress et al., 2018), potential discrepancies between individuals' past and intended conservation behaviors remain poorly understood. Thus, expanding research of recreationists' past and future participation in a variety of conservation behaviors would provide an important evidence base for wildlife agencies seeking to expand support for their conservation efforts.

As demonstrated in prior research, accurately categorizing the identities of social groups, like recreationists, may help better understand and predict their values, attitudes, and behaviors (Lute et al., 2014; Schroeder et al., 2021). However, much of the past research, engagement, and management of wildlife recreationists has followed a broad dichotomy of recreation identity, categorizing recreationists as either consumptive (i.e., those that remove organisms from their habitats) or nonconsumptive (i.e., those that do not actively remove organisms from their habitats; Boyle & Samson, 1985; Grooms & Urbanek, 2018). While approaching wildlife recreation identity in this way has provided some insight into the recreation-conservation relationship (e.g., Daigle et al., 2002; Duffus & Dearden, 1990), those relationships may break down if those who participate in a combination of consumptive and nonconsumptive activities deviate from the expected norms of the wildlife recreation identities they align with (e.g., a hunter sitting in a tree stand and only birdwatching, an angler practicing catch-and-release and/or fish viewing). For example, a notable exception to the binary recreation identity framework is work by Cooper et al. (2015) that explored the behaviors of people who identify with and participate in both hunting and birding. They highlighted the additive effect that multiple recreation identities and participation can have on conservation behaviors, finding individuals who identified with and participated in both hunting and birding were more active in conservation compared to hunters or birders alone. However, Cooper et al. (2015) did not explicitly identify other common recreationists in their sampling scheme that wildlife agencies interact with, such as wildlife viewers and anglers, meaning those recreation identities may further affect conservation participation. Thus, research into the intersection of wildlife recreation identities across wildlife agencies' full constituencies of recreationists could aid in advancing engagement in agency conservation efforts.

The purpose of the present study was to examine how wildlife recreationists' intersecting identities as hunters, anglers, birders, and/or other wildlife viewers relate to their engagement in behaviors that may benefit the conservation efforts of wildlife agencies. We investigated the intersection of wildlife recreation identities by developing

a typology of wildlife recreationists' strength of identity as a hunter, angler, birder, and/or other wildlife viewer. We used this typology to explore how wildlife recreationists' identities relate to (1) their past participation in a variety of conservation behaviors; and (2) their likelihood to support their state wildlife agency in the future through those same conservation behaviors. This research was guided by the following questions:

1. How do wildlife recreation identities as a hunter, angler, birder, or other wildlife viewer intersect? How do resultant intersecting wildlife recreation types compare in their wildlife recreation activity participation and socio-demographics?

We expected, as in Cooper et al., (2015), there would be some distinguishing recreation identities aligning with past classification schemes (e.g., consumptive and non-consumptive), as well ones where recreation identities would intersect (e.g., identify with both consumptive and nonconsumptive identities). We also expected recreationists would have greater participation within the activities aligning with their identities (e.g., hunters participating more in hunting), and would align with past findings of sociodemographic factors related to certain recreationists (e.g., greater education level in activities like birding; Adams et al., 1997).

2. How do intersecting wildlife recreation types compare in their past participation in conservation behaviors, and their likelihood to participate in conservation to support a wildlife agency?

We expected broad participation in conservation behaviors across the recreation identities, with patterns following previous research highlighting nonconsumptive recreationists' interests in citizen science (McFarlane 1996; Wood et al., 2011) and consumptive recreationists' participation in conservation funding (Heffelfinger et al., 2013). We also expected differences in future likelihood to participate in conservation to support a wildlife agency, with consumptive recreationists being more likely to support a wildlife agency.

3. To what extent do intersecting wildlife recreation identities predict past participation in conservation behaviors, and the likelihood to participate in conservation to support a wildlife agency?

We expected that the relationship between recreation identities and participation in conservation behaviors, both past and future likelihood, would track with the number of intersecting identities. For example, as with

Hunter-Birders in Cooper et al., (2015), we expected recreationists who identified with multiple components of consumptive and nonconsumptive identities would be more strongly related to increased conservation participation.

2 | METHODS

2.1 | Research context

This research study was one component of a larger social science project conducted in conjunction with a participatory planning process that developed a 10-year Wildlife Viewing Plan for the state of Virginia (DWR, 2021). The primary purpose of the Wildlife Viewing Plan is to aid DWR in engaging more wildlife viewers in addition to the constituents they currently serve, including through their conservation activities. The agency is also guided by a mission to conserve and manage wildlife populations and habitat; connect people to Virginia's outdoors through wildlife-related activities; and protect people and property by promoting safe outdoor experiences. Thus, insight into who participates in conservation, and how they do so, aligns with and supports these three aspects of the agency's mission.

2.2 | Survey development

We developed a mixed-method survey that included open- and closed-ended survey items that explored (among other topics): the extent to which respondents identified with four groups of wildlife recreationists (i.e., birders, wildlife viewers, hunters, and anglers); their participation in specific wildlife recreation activities; and their past and future intended participation in conservation behaviors. For this study, we distinguished birders from other wildlife viewers, given past research demonstrates birders may differ from other wildlife viewers in terms of importance placed on viewing specific species, their desired end-goals for their recreational pursuits, and resources used (Cole & Scott, 1999). For more information on measurement and analysis, see section 2.4 "Measurement and analysis". All research activities were approved by and conducted in compliance with the requirements of the Virginia Tech Institutional Review Board (Protocol #17-754).

We pre-tested the survey instrument and conducted follow-up interviews with wildlife recreationists in Virginia ($n = 15$) to gather feedback on the survey regarding item saliency, clarity, survey logistics, and to ensure the survey could be completed in a timely manner. The

survey was also pilot tested with undergraduate students in the Human Dimensions of Fisheries and Wildlife course at Virginia Tech ($n = 72$). The survey was also reviewed by members of DWR staff, contributors to the Wildlife Viewing Plan, and other conservation and social science professionals ($n = 25$).

2.3 | Survey administration

For survey administration, we contracted with the Cornell Survey Research Institute to purchase a random sample of 13,000 residential mail addresses (acquired through a vendor using U.S. Postal Service records), which included owners and renters for Virginia households. In line with the development of DWR's Wildlife Viewing Plan (DWR, 2021) and to ensure adequate response rates for each of our four target recreationist types, we based our target sample size (~ 200 – 300) on prior estimated proportions of each recreation activity within Virginia (United States Department of Interior [USDOI], 2018), the expected percentage of the Virginia public who participate in wildlife viewing, and the expected response rates of wildlife recreationists in Manfredo et al.'s (2018) Wildlife Values study in Virginia. This sample design assumed a $\pm 5\%$ sampling error and 95 confidence interval for our estimates of wildlife viewers in Virginia (Vaske, 2008).

From November 4, 2019, to January 13, 2020, we administered surveys using a modified Dillman approach, consisting of an initial invitation and up to two reminders (Dillman et al., 2010; Dillman et al., 2014). We used a mixed-mode implementation, including push-to-web postcards and a mail survey. We initially mailed a push-to-web postcard, which contained a unique, 6-character alphanumeric code for each participant and both a URL and QR code to access the survey instrument online via Qualtrics. Given initially low response rates ($< 2.0\%$ response rate), the first reminder mailing sent to nonrespondents included a full invitation letter, printed version of the survey instrument, and a postage-paid return envelope. The final reminder for nonparticipants consisted of a push-to-web postcard that invited participants to complete either the online survey or the mail survey they previously received.

To test for nonresponse bias, we conducted a short follow-up survey for nonrespondents. The follow-up survey instrument included questions exploring nonrespondents' recreation self-identity and participation, participation in conservation behaviors, sociodemographic characteristics, and several other questions included in the broader survey. On February 18, 2020, we sent a 1-page, printed version of the follow-up survey to

TABLE 1 Definitions of wildlife recreation activities provided to survey participants in the self-identity survey item. Respondents were asked to what extent each kind of wildlife recreation activity described them, on a scale of “very like me” (1) to “very unlike me” (5)

Recreation identities	Description
Birder	Someone who intentionally observes, feeds, or collects data specifically about birds, including birding, birdwatching, and feeding birds.
Wildlife viewer	Someone who intentionally observes, photographs, feeds, or collects data about wildlife (other than birds), or visits parks and natural areas because of wildlife.
Hunter	Someone who participates in hunting or trapping, with a license or exempt from a license, using any legal method to harvest wildlife.
Angler	Someone who participates in fishing, in either freshwater or saltwater areas, to harvest and/or catch-and-release fish.

4000 randomly selected addresses of nonrespondents and completed the nonresponse survey on May 5, 2020.

2.4 | Measurement and analysis

Using package `poLCA` (Linzer & Lewis, 2011) in R (2020), we ran a latent class analysis (LCA) to develop a typology of wildlife recreation identities, based on participant responses to a recreation self-identity survey questions with four Likert-items, one per recreation identity (Table 1). To develop our LCA models, we initially used a separate sample of wildlife recreationists, from the broader Wildlife Viewing Plan, (DWR, 2021) based on databases of individuals with prior affiliation to DWR (e.g., part of the agency's hunting and fishing license database, recipients of the agency's wildlife viewing e-newsletter, or participants in a birding citizen science project). Using the DWR-affiliated sample ($n = 2610$) allowed us some level of analysis and model validation via comparing the average number of days and years individuals in resulting LCA classes had participated in the separate recreation activities (e.g., we expected LCA classes with a hunter component to have spent more days and years hunting). The selected model from this analysis was then applied to our sample of Virginia residents.

Latent class analysis is a maximum likelihood-based approach that organizes respondents into empirically derived latent classes. Compared to other segmentation

analyses, this approach is useful in its ability to incorporate and describe uncertainty to identify the most probable classes of respondents (Ehrlich et al., 2017; Scarpa et al., 2011). Model selection criterion can then be used to compare different empirically derived numbers of classes among respondents. To determine which model best fit the data, we used differences in the Bayesian Information Criterion (Δ BIC), given its efficacy for dealing with false positives (Ehrlich et al., 2017; Hagenaars & Halman, 1989). We tested a range of models that hypothesized 2–10 latent classes. Given restrictions in LCA, respondents who left any portion of the self-identification question unanswered were not included in the models (e.g., responded only for hunting and birding but not the other recreation types).

To measure participation in conservation, the survey instrument included five conservation behaviors, with definitions and examples drawn from research by Larson et al. (2015) and Cooper et al. (2015), and insights from exploratory focus groups we conducted as part of the broader social science project (Grooms, Dayer, and Peele, 2019). Conservation behaviors included: informing or teaching others about wildlife; improving wildlife habitat on public or private lands; advocating or voting related to wildlife conservation; collecting data on wildlife or habitat to contribute to science or management; and contributing to fundraising efforts for wildlife conservation.

We explored past participation in the conservation behaviors generally and future likelihood to participate in conservation behaviors to support DWR specifically. To measure past conservation behaviors, we asked survey respondents to fill in how many days within the past 12 months they had voluntarily participated in each behavior. To measure future conservation behaviors to support DWR, we asked respondents to rate how likely they would be to contribute to DWR via the five conservation behaviors on a scale of 1 = very likely to 5 = very unlikely. The future conservation behaviors survey item was only asked of respondents who had interacted with DWR programs or services within the past 5 years, as a result of survey skip logic. Using SPSS (Version 27.0), we ran one-way ANOVAs with Tukey or Tamhane post-hoc tests (whether normality assumption tests were met) to compare how past participation in the five conservation behaviors and future participation in the same conservation behaviors to support DWR differed among the LCA classes.

We developed logistic regression models to examine factors predicting past participation in conservation behaviors, and likelihood to participate in conservation to support DWR. To isolate the effects of our LCA wildlife recreation types on general and future DWR

conservation behaviors, we controlled for age, gender, and education by including them in our models, as in Cooper et al. (2015). We used consumptive-only recreationists (hunters and/or anglers; see Results Section 3.3) as a reference group, given the historic focus wildlife agencies have placed on this group, and the desire of DWR (among other wildlife agencies) to improve engagement with wildlife viewers and other wildlife recreation constituents. To facilitate logistic regression models, we transformed past participation in conservation behaviors into a binary variable, with 0 = no participation and 1 = ≥ 1 day(s) participating in the conservation behavior. We also transformed future participation in conservation behaviors into a binary variable, with 0 = unlikely to participate (very unlikely – neither likely nor unlikely), and 1 = likely to participate (somewhat likely – very likely). We examined specific comparisons between the recreation types using odds ratios.

3 | RESULTS

3.1 | Survey response

After reviewing and cleaning the data to remove blank surveys and missing data, we received a total of 1016 surveys (response rate = 7.7%). The majority of respondents were white (93.5%), non-Hispanic/Latinx (96.6%), male (55.1%), had a Bachelor's degree or higher educational attainment (62.7%), and were above the age of 60 (54.7%). Income levels varied among individuals, with the largest percentage earning \geq \$100,000 a year (35.5%). Survey respondents represented all four of our base wildlife recreation activities. Of respondents who identified (i.e., responded as “very like me” or “somewhat like me”) with a wildlife recreation activity, 26.3% identified as hunters, 50.6% as anglers, 63.2% as birders, and 77.8% as wildlife viewers. Additionally, 21.3% of survey respondents had not participated in wildlife recreation in Virginia (i.e., nonwildlife recreationists) and were not included in analyses.

3.2 | Nonresponse check

We compared our 1016 respondents to 111 nonrespondents (2.8% response rate with one mailing). There were no statistically significant differences in the proportion of respondents compared to nonrespondents identifying as birders, viewers, or hunters, and no difference in gender distribution. Nonrespondents identified less strongly, on average, as anglers compared to respondents (nonrespondents = 2.59, respondents = 2.98; $t[101.9] = 2.19$,

TABLE 2 Log-likelihood, Bayesian Information Criterion (BIC), and Δ BIC values used to assess model fit among latent class models comparing 2–10 hypothesized classes

Number of classes	Log likelihood	BIC	Δ BIC
4	-10,754.9	22,029.8	0.00
5	-10,701.4	22,054.7	24.9
6	-10,649.2	22,082.1	52.3
7	-10,624.9	22,165.5	135.6
8	-10,594.0	22,235.7	205.8
3	-10,928.4	22,244.8	215.0
9	-10,568.9	22,317.4	287.5
10	-10,555.9	22,423.5	293.6
2	-11,215.6	22,687.3	657.5

Note: Models are organized by descending Δ BIC values.

$p = .031$, Cohen's $d = 0.233$). Additionally, nonrespondents were slightly older than respondents by ~ 3 years ($t [1007] = -2.93$, $p = 0.003$, Cohen's $d = -0.30$), with a smaller proportion earning a mean annual income of $\geq \$125,000$ ($\chi^2 [1, N = 934] = 0.13$, $p = .013$, $\Phi = 0.13$), or having a Bachelor's degree or higher level of education ($\chi^2 [1, N = 1049] = 21.1$, $p = .004$, $\Phi = 0.14$).

3.3 | LCA recreation types

Based on the lowest Δ BIC (Table 2), four latent classes (hereafter, "recreation types") were identified and named based on the combination of recreation activities with which individuals in that class were most likely to strongly identify. These recreation types were consumptive-only, nonconsumptive-only, consumptive-viewing, and comprehensive recreationists (Table 3). The four recreation types varied in terms of the mean number of days within the past year and mean number of years they had participated in each recreation activity, and their socio-demographic characteristics (Table 4).

Consumptive-viewing recreationists were, on average, 5 years younger than nonconsumptive-only recreationists (Table 4). The majority of consumptive-only, consumptive-viewing, and comprehensive recreationists were male ($>65\%$ for all types), while the majority of nonconsumptive-only were female (64% female vs. 36% male). Over half of individuals in all recreation types had a Bachelor's degree or higher educational attainment, with nonconsumptive-only having the most formal education (83.4% holding a Bachelor's degree or higher).

Comprehensive recreationists had the highest mean number of days within the past year, and the highest number of years spent participating in birding or wildlife

viewing of any LCA recreation type. Consumptive-only recreationists spent a similar number of days within the past year hunting and angling compared to comprehensive and consumptive-viewing recreationists, and had spent fewer years angling than comprehensive recreationists. Further, there was still some participation, on average, by each LCA recreation type in each base recreation identity.

3.4 | Participation in conservation behaviors

Comprehensive recreationists had the greatest percentage of individuals who had participated in all five conservation behaviors within the past year (Table 5). Consumptive-only recreationists had the lowest participation rates among the LCA recreation types for all five conservation behaviors, notably responding as having spent no days within the past year collecting wildlife data. Of the other two LCA recreation types, a greater percentage of nonconsumptive-only recreationists had participated in improving wildlife habitat, collecting wildlife data, and contributing to fundraising compared to consumptive-viewing recreationists.

Considering future conservation behaviors to support DWR, comprehensive recreationists again had the greatest percentage of individuals who were likely to participate in each of the five conservation behaviors. Consumptive-viewing recreationists generally had the next highest percentage of future participation, with the exception of advocacy or voting. Further, consumptive-viewing and nonconsumptive-only recreationists had similar levels of future participation in conservation behaviors, generally being within 5% of one another. Consumptive-only recreationists again had the lowest percentage of individuals likely to participate in conservation behaviors among the LCA recreation types (Table 5). For all conservation behaviors, a greater percentage of individuals in each LCA recreation type were likely to participate in the future to support DWR, compared to their past behavior, generally.

3.5 | Conservation behavior participation predictive models

Being classified as any of the other three LCA recreation types was strongly associated with greater past participation in four of the five conservation behaviors (Figure 1, standard errors in Table S1). Because none of the consumptive-only recreationists in our sample collected wildlife data within the past year, we were unable to

TABLE 3 Wildlife recreation types, total number of respondents per type, and descriptions, based on latent class analysis (LCA) analysis of recreationists' self-identity responses

LCA recreation types	N	% of sample	Description
Consumptive-only	104	12.8%	Identify as hunters and anglers; do not identify as birders and wildlife viewers.
Nonconsumptive-only	352	43.6%	Identify as birders and wildlife viewers; do not identify as hunters or anglers.
Consumptive-viewing	270	33.5%	Identify as hunters, anglers, and wildlife viewers; do not have a directional identity for birders.
Comprehensive	81	10.0%	Identify as birders, wildlife viewers, hunters, and anglers.

TABLE 4 Mean number of days within the past 12 months and mean number of years spent participating in hunting, angling, birding, and wildlife viewing, and socio-demographic variables for each latent class analysis (LCA) recreation type

Variables	Consumptive-only	Nonconsumptive-only	Consumptive-viewing	Comprehensive
Days participating				
Hunting	5.46 ^a	0.46 ^b	10.8 ^a	11.3 ^a
Angling	11.1 ^a	2.40 ^b	16.2 ^a	23.1 ^a
Birding	3.14 ^a	127.3 ^b	43.7 ^c	191.3 ^d
Wildlife viewing	16.5 ^a	104.9 ^b	69.1 ^c	173.4 ^d
Years involved				
Hunting	13.6 ^a	1.21 ^b	18.4 ^a	20.1 ^a
Angling	23.8 ^a	6.19 ^b	31.1 ^{ac}	34.1 ^c
Birding	2.67 ^a	22.2 ^b	15.9 ^c	32.5 ^d
Wildlife viewing	7.75 ^a	28.0 ^b	29.6 ^b	38.6 ^c
Socio-demographics				
Age	58.3 ^{ab}	60.4 ^b	56.1 ^a	59.9 ^{ab}
Gender (% male)	70.1%	36.2%	77.9%	66.7%
Education (% with ≥ Bachelor's degree)	63.3%	83.4%	61.5%	62.8%

Note: Numbers with different superscripts within rows denote significant differences in means based on 1-way ANOVA comparisons at $\alpha = .05$ within each recreation activity. Chi-square analysis of gender and education showed both demographics differed significantly among the four LCA recreation types.

create a model for this conservation behavior. Further, classification as a comprehensive recreationist was strongly related to past participation in the four conservation behavior models we could run: informing or teaching others (odds ratio [OR] = 5.95, $p < .001$), improving habitat (OR = 16.7, $p < .001$), advocating or voting (OR = 2.64, $p = .020$), and contributing to fundraising (OR = 2.85, $p = .009$) (See Table S1). Additionally, consumptive-viewing recreationists were more likely to participate in informing others (OR = 2.85, $p = .025$), and improving habitat (OR = 5.98, $p < .001$), while nonconsumptive-only recreationists engaged in improving habitat (OR = 5.76, $p < .001$), and contributing to fundraising (OR = 2.05, $p = .034$). Hosmer-Lemeshow Goodness-of-Fit tests showed good fit for models

predicting future participation in all five conservation behaviors (Table S2).

Relative to the consumptive-only recreationists, being classified as any of the other three LCA recreation types was not related to future participation in informing or teaching, advocating or voting, or contributing to fundraising to support DWR. Of the LCA recreation types and conservation behaviors, only being classified as a comprehensive recreationist was strongly and positively related to future participation in improving habitat (OR = 7.98, $p = .014$) and collecting data (OR = 5.73, $p = .027$) to support DWR. Notably, the odds ratios for comprehensive recreationists' future participation in improving habitat were lower than what was measured in the past participation model. Although Hosmer-

TABLE 5 Percent of individuals in each latent class analysis (LCA) recreation type (1) that have participated in each conservation behavior within the past 12 months, and (2) were likely to participate in each conservation behavior within the next 12 months to contribute to the work of Department of Wildlife Resources (DWR)

Conservation behaviors	Consumptive -only	Nonconsumptive -only	Consumptive- viewing	Comprehensive
Past conservation behaviors (n = 691)				
Informing or teaching others	7.0%	13.4%	19.3%	30.6%
Improving wildlife habitat	11.6%	39.7%	37.7%	61.1%
Advocating or voting	15.1%	23.0%	19.7%	30.6%
Collecting data on wildlife or habitat	0.00%	5.60%	7.00%	11.1%
Contributing to fundraising	16.3%	34.4%	25.0%	36.1%
Future conservation behaviors to support DWR (n = 257–263)				
Informing or teaching others	25.0%	28.6%	39.8%	55.6%
Improving wildlife habitat	25.0%	64.9%	65.6%	78.4%
Advocating or voting	31.3%	57.5%	54.7%	67.6%
Collecting data on wildlife or habitat	17.6%	45.9%	52.0%	69.4%
Contributing to fundraising	18.8%	46.4%	49.5%	52.8%

Lemeshow Goodness-of-Fit tests showed good fit for models predicting future participation in all five conservation behaviors to support DWR, pseudo- R^2 values for each model did not exceed 0.10 (Table S2).

4 | DISCUSSION

Understanding recreationists' interests in conservation behaviors specifically related to wildlife agencies can help wildlife agencies achieve their conservation goals (AFWA & WMI, 2019). By developing a wildlife recreation typology based on recreation self-identity, we found wildlife recreation is multidimensional, with many individuals identifying with, and being classified as both consumptive and nonconsumptive activities. Recreationists who identified with both consumptive and nonconsumptive recreation identities (i.e., comprehensive recreationists), participated in conservation behaviors more than any of the other three LCA recreation types, and were the only recreation type (relative to consumptive-only recreationists) significantly related to future participation in conservation behaviors to support DWR. Further, consumptive-only recreationists (i.e., hunters and/or anglers) had the lowest participation in conservation behaviors, for both past participation and future DWR support.

Our exploration of hunters, anglers, birders, and wildlife viewers found extensive intersections among the identities. Of our four LCA recreation types, two types (consumptive-only and nonconsumptive-only) tracked onto the traditional consumptive versus nonconsumptive

dichotomy used in past research (e.g., Boyle & Samson, 1985; Burgin & Hardiman, 2015). The additional two wildlife recreation types (consumptive-viewing and comprehensive recreationists) supported findings from earlier research that consumptive-nonconsumptive identity dichotomies overlook the complexity of wildlife recreation identities, and the effect of multiple identities on recreation participation (Connelly et al., 1985; Cooper et al., 2015). This intersection in wildlife recreation identities for over 40% of the recreationists in our sample has important implications for future research and management actions dependent on engaging wildlife recreation communities. For example, by using an intersecting identity approach to recreation, agencies may be able to better understand how to engage different groups in conservation via creating identity salient communication (e.g., Lute et al., 2014), or studying how other concepts like wildlife values or attitudes differ among identities and influence behavior (e.g., Schroeder et al., 2021).

Wildlife agencies have traditionally depended on consumptive-only recreationists as key conservation contributors (Tack et al., 2018); yet our data suggests wildlife agencies may find more conservation gains (e.g., greater funds donated or increased participation in restoration projects), by engaging wildlife recreationists with nonconsumptive or intersecting identities. Of our LCA recreation types, those with a viewing and/or birding identity component (i.e., nonconsumptive-only, consumptive-viewing, and comprehensive recreationists) were more involved in all conservation behaviors than consumptive-only recreationists. One reason for relatively lower conservation involvement by consumptive-only recreationists may be related to

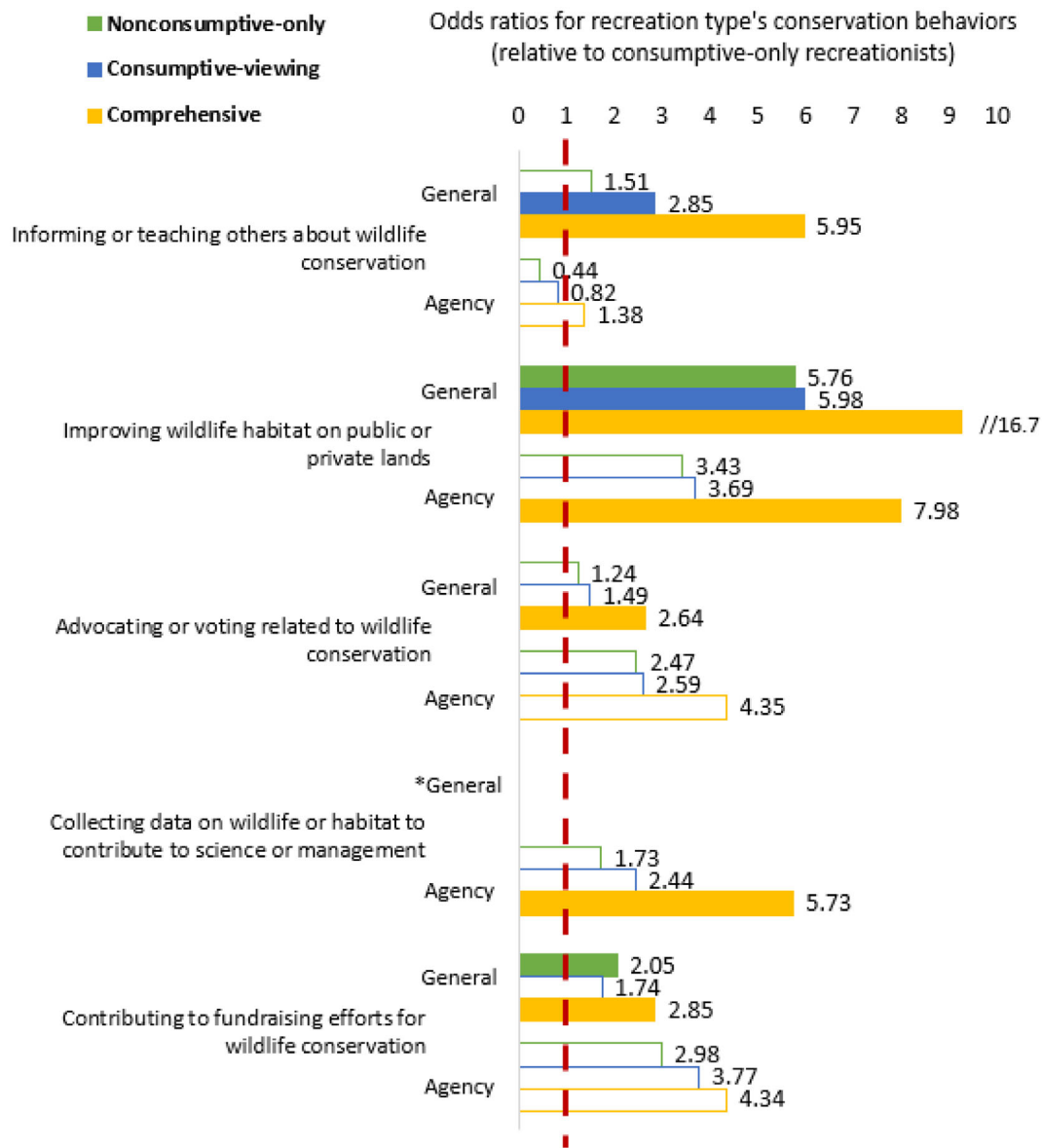


FIGURE 1 Odds ratios (OR) from binary logistic regression models examining factors predicting latent class analysis (LCA) wildlife recreation types' (1) past participation in each conservation behavior within the past 12 months (General), and (2) future likelihood to participate in each conservation behavior within the next 12 months to contribute to the work of Department of Wildlife Resources (DWR) (Agency), relative to consumptive-only recreationists. Variables with filled bars were significant predictors for each conservation behavior model, and bars not filled in were not significant predictors at $\alpha = 0.05$. Asterisks (*) indicate models where our reference group = 0, resulting in an overfit of the model.

those recreationists growing accustomed to their passive conservation contributions via excise taxes and license purchases. These conservation funding mechanisms have been available for almost a century (Jacobson et al., 2007), funding wildlife and habitat management efforts without requiring active involvement by hunters and anglers. Conversely, recreationists beyond hunters and anglers have lacked similar, passive support mechanisms for agency conservation efforts (AFWA & WMI, 2019). Hence, recreation types with a nonconsumptive identity component may have recognized the lack of comparable conservation

support mechanisms for their activities, motivating their participation in other conservation behaviors. Another explanation for differing levels of conservation participation could be related to geographical differences in activity access. For example, hunters' recreational pursuits are typically limited to a set number of days per year, depending on species they hunt, and to lands managed for hunting or fishing (Schroeder et al., 2017). Conversely, birders or other wildlife viewers can participate in their activities during most of the year, with far less restriction on time and location. Recreation types with a nonconsumptive

component may then have higher engagement in conservation given greater opportunities for recreation involvement. For consumptive-viewing and comprehensive recreationists, the addition of a nonconsumptive identity component may have brought additional direct experiences with nature and further dependence on natural resources to continue their recreational pursuits, which are shown to facilitate conservation behavior involvement (Nisbet et al., 2009). Future research could explore the effect of direct nature experiences, particularly if the addition of specific recreation identities is related to increased interactions with wildlife.

Our results align with those of Cooper et al. (2015), and demonstrate the additive effect of wildlife recreation identities on conservation behavior. Indeed, comprehensive recreationists were more likely to have engaged in conservation behaviors than individuals who identified with only one type of recreation. As explored in past research (Kellert 2017; Nisbet et al., 2009), greater exposure to and experience with wildlife may be key to developing positive, long-term interest in conservation. Moreover, we expanded Cooper et al.'s (2015) framework to explicitly include anglers and wildlife viewers, two groups with demonstrated conservation interests (Griffin et al., 2016; Landon et al., 2018). While the addition of anglers and wildlife viewers did not result in their own unique recreation type, our results highlight how they intersect with other wildlife recreation identities, and that they are distinct from birder and wildlife viewers. Further their addition to Cooper et al.'s (2015) birder-hunter framework may have captured important recreation identities who experience further meaningful interactions with natural resources. These findings not only provide further support for the relationship between recreation and conservation, but also underscore the value for wildlife agency conservation efforts targeting intersecting recreation activities.

Considering past conservation behavior participation, habitat improvement was the only behavior for which all three LCA recreation types (relative to consumptive-only recreationists) were significantly related to participation. Thus, developing resources and opportunities that simultaneously engage recreationists of all types in habitat improvement may be an area where wildlife agencies can enhance their conservation and outreach goals. Additionally, nonconsumptive-only recreationists were more likely to contribute to fundraising efforts, as were consumptive-viewing recreationists to informing and teaching others. These findings align with previous research suggesting the growing influence nonconsumptive recreationists have on conservation, especially in the fields of conservation education and communication

(Kudryavtsev et al., 2012) and funding (Shipley et al., 2019). With these findings in mind, wildlife agencies like DWR could further enhance conservation involvement by demonstrating the multifaceted benefits of the agency's current conservation programs and goals.

Despite prominent differences in the past conservation behaviors of the four LCA recreation types, comprehensive recreationists were the only LCA recreation type (relative to consumptive-only recreationists), statistically likely to participate in future conservation behaviors, specifically in improving habitat and collecting data. These results may be connected to the timeliness and visibility of their contributions, relative to the other conservation behaviors. For example, planting pollinator habitat or submitting data into an online portal both produce immediate, tangible evidence of conservation contributions (e.g., new habitat or a growing online database). Comparatively, behaviors such as informing and teaching, advocacy, and fundraising all require substantial resource investment by recreationists, and may take much longer for impacts to be seen/publicized (Larson et al., 2015). Data from the broader social science project in which this research was conducted further supports this idea, with wildlife recreationists describing their desire for tangible benefits and outcomes of their contributions to DWR (DWR, 2021; Grooms, Dayer, and Peele, 2019). Given comprehensive recreationists' connection to improving habitat and collecting data, our research suggests these behaviors may be productive areas to focus on as agencies like DWR work to engage recreationists in their future conservation goals.

Although our findings on future conservation support have promising implications for future agency conservation efforts, prior research demonstrating behavioral intention does not guarantee behavior must also be considered (Floress et al., 2018; Nikou & Economides, 2017). For example, a wildlife recreationist may have the intention to participate in a given conservation behavior to support a wildlife agency, but may not be presented the opportunity or resources to do so (Klößner, 2013). A strategy for agencies like DWR to bridge this gap could be to work with partner organizations to coordinate and maximize the accessibility of their conservation programs (DWR, 2021). The DWR already partners with organizations such as the Virginia Society of Ornithology, and expanding these partnerships to other recreation-specific groups (e.g., the Virginia Angler's Club) may increase opportunities for recreationists to carry out conservation behaviors. Further, to capitalize on the high likelihood of future conservation participation we measured, wildlife agencies may develop interpretive messaging and outreach to highlight where recreationists' future help and

contributions could be directed (Roberts et al., 2021). Wildlife agencies could also cross-train volunteers within recreation groups to build familiarity in the wildlife agency, which can produce actionable knowledge about what their future conservation participation can contribute to wildlife agencies (Stern, Briske, and Meadow, 2021).

4.1 | Limitations

There are several limitations to this study. First, our wildlife viewer definition included collecting data about wildlife as a viewing activity. Considering collecting data was also one of our target conservation behaviors, its inclusion in our wildlife viewer identity may have influenced viewer's responses regarding their participation in collecting data. We used the wildlife viewer definition implemented by USDO, 2018 and supplemented it with focus group responses from the broader DWR Wildlife Viewing Plan project (Grooms, Rutter, Barnes, Peele, and Dayer, 2020), which indicated that citizen science data collection was integral to viewing activities for many viewers. In retrospect, it may have been more appropriate to stay with the base definition from USDO, 2018, which did not include citizen science. Further, while we controlled for age in our logistic regression models, the average age for all of our wildlife recreation types was 55. Past research has explored the role of age in wildlife recreation participation (e.g., Sánchez-Rivero et al., 2020), noting a bias toward older individuals. Future research may approach this issue through targeting sampling efforts at youth outdoor events. Additionally, both our survey and single-mailing nonresponse bias check had relatively low response rates. Mail survey response rates are in decline across natural resources surveys (Stedman et al., 2019). Specifically, other state-wide studies of the general public (e.g., Manfredo et al., 2018) related to wildlife topics experienced similarly low response rates. Future approaches to surveying recreation groups may thus benefit from different survey administration methods, such as drop off-pick up surveys, to improve their response rates (Allred & Davis, 2011). Finally, as aforementioned, survey respondents tend to overestimate their future participation in activities (Floress et al., 2018) so it is unclear if our findings reflect differences between intention and behavior, or differences between general and agency-specific conservation behaviors, especially considering the survey instrument only presented the DWR conservation survey items to respondents who indicated past interactions with the agency. Lacking a future, agency-specific conservation behavior component also

meant we were unable to fully estimate the difference in effect between general and agency-specific conservation behaviors. Future research could include future participation measures related to general and agency-specific conservation behaviors.

4.2 | Implications

Results of this study suggest that as wildlife agencies in Virginia, as well as potentially in other states, work to advance their conservation missions, wildlife recreationists can help them achieve success. Harnessing the capacity of wildlife recreationists beyond those with consumptive-only interests when developing conservation engagement strategies can help agencies reach their conservation goals. For example, agencies might engage consumptive-viewing recreationists by encouraging hunters to collect wildlife observations while sitting in a hunting blind. Furthermore, projects to create pollinator habitat on public lands could also engage comprehensive recreationists in species monitoring of pollinators and game species using the same or overlapping habitats. Even for agencies that still consider hunters and anglers as a primary focus of their conservation efforts, our findings suggest that expanding conservation opportunities to hunters and anglers with intersecting, nonconsumptive identities could further the conservation successes of wildlife agencies. This could include wildlife agencies utilizing their existing databases of hunters and anglers as sources for volunteers in future habitat improvement and advocacy projects, and other agency conservation programs.

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DATA AVAILABILITY STATEMENT

Due to the possible sensitivity of human subjects' data, and in compliance with Protocol #17-754 approved by the Virginia Tech Institutional Review Board, focus group transcriptions and raw survey data are only accessible to project investigators.

ETHICS STATEMENT

All research activities were approved by and conducted in compliance with the requirements of the Virginia Tech Institutional Review Board (Protocol #17-754). The survey described in this report was organized and implemented by Virginia Tech University and was not conducted on behalf of the U.S. Geological Survey. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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