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Research Article

Diverse University Students Across the United States Reveal Promising Pathways to Hunter Recruitment and Retention

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ABSTRACT Declining participation in hunting, especially among young adult hunters, affects the ability of state and federal agencies to achieve goals for wildlife management and decreases revenue for conservation. For wildlife agencies hoping to engage diverse audiences in hunter recruitment, retention, and reactivation (R3) efforts, university settings provide unique advantages: they contain millions of young adults who are developmentally primed to explore new activities, and they cultivate a social atmosphere where new identities can flourish. From 2018 to 2020, we surveyed 17,203 undergraduate students at public universities across 22 states in the United States to explore R3 potential on college campuses and assess key demographic, social, and cognitive correlates of past and intended future hunting behavior. After weighting to account for demographic differences between our sample and the larger student population, we found 29% of students across all states had hunted in the past. Students with previous hunting experience were likely to be white, male, from rural areas or hunting families, and pursuing degrees related to natural resources. When we grouped students into 1 of 4 categories with respect to hunting (i.e., non-hunters [50%], potential hunters [22%], active hunters [26%], and lapsed hunters [3%]), comparisons revealed differences based on demographic attributes, beliefs, attitudes, and behaviors. Compared to active hunters, potential hunters were more likely to be females or racial and ethnic minorities, and less likely to experience social support for hunting. Potential hunters valued game meat and altruistic reasons for hunting, but they faced unique constraints due to lack of hunting knowledge and skills. Findings provide insights for marketing and programming designed to achieve R3 objectives with a focus on university students. © 2021 The Wildlife Society.

KEY WORDS college students, constraints, hunting, motivations, R3, segmentation, wildlife values.

Hunting is a key aspect of North American culture (Reiger 2001, Mahoney and Jackson 2013) that provides economic benefits to rural communities (Frew et al. 2018), helps wildlife agencies achieve ecological management goals (Heffelfinger et al. 2013), and forms the backbone of the wildlife conservation funding system in North America (Loveridge et al. 2006, Serfass et al. 2018). Despite these benefits, since the 1980s the number of annual license holders in the United States has decreased by approximately 2 million (U.S. Fish and Wildlife Service [USFWS] 2020) and the number of active hunters has declined by approximately 30% (USFWS 2018). The decline has been greater among generations of young adults born since 1980 (Enck et al. 2000, Winkler and Warnke 2013). Today, <5% of the population in the United States hunts in any given year (USFWS 2020). Peterson et al. (2011) attributed this decline to shifts in social structures and priorities resulting in diminishing social support for hunting. Specific factors affecting hunter recruitment include competing demands for time and money, lack of accessible mentors, urbanization, land ownership changes that affect hunting access, negative media coverage, and a growing disconnect between humans and nature (Winkler and Warnke 2013, Larson et al. 2014, Kellert et al. 2017). Regardless of the causal factors, declining hunter numbers affect the capacity of wildlife management agencies to achieve their missions and goals (Mockrin et al. 2012, Larson et al. 2014).

To slow declining participation in hunting, state wildlife agencies and many conservation organizations focused on game species are increasingly emphasizing hunter recruitment, retention, and reactivation (R3) efforts (Responsive Management and National Shooting Sports Foundation [NSSF] 2017, Ringelman et al. 2020). Despite a growing emphasis on R3, however, its efficacy remains questionable (Seng et al. 2007, Larson et al. 2013). Misunderstanding of unique subpopulations of potential hunters and overreliance on conventional marketing tactics have limited recruitment from outside existing hunting communities (Ryan and Shaw 2011, Responsive Management and NSSF 2017). Although traditional hunters—typically white men from rural backgrounds (Decker et al. 1984, Stedman and Heberlein 2001, Larson et al. 2014)—comprise the majority of the hunting community, hunters initiated from these backgrounds are no longer sufficient to offset declines in hunting participation (Winkler and Warnke 2013, Price Tack et al. 2018). Countering declines in hunting participation requires wildlife management agencies to move beyond the white, masculine conceptualization of hunting and identify R3 strategies that work for a more diverse population of potential hunters (Lee et al. 2014).

Non-traditional path hunters (NTPHs) are individuals who enter the hunting community as adults, have limited hunting experience, have little or no familial or social support for hunting, and are part of an underrepresented group within the hunting community (Quartuch et al. 2017). Thus NTPHs tend to be women, individuals who are black, indigenous, or people of color (BIPOC), residents of urban areas, or people from non-agricultural backgrounds (Quartuch et al. 2017). Some NTPHs may be locavores interested in consuming food (i.e., game meat) they consider ethically grown or locally harvested (Tidball et al. 2013, Stedman et al. 2017). Others may be motivated

to hunt for conservation or civic-oriented reasons, such as improving ecosystem health or controlling wildlife damage (Decker et al. 2015). In many cases, the motivations and constraints of NTPHs mirror those of traditional hunters (Peterson et al. 2009, Decker et al. 2015). Social support and relationships are key to recruiting and retaining hunters (Byrne and Dunfee 2018), and may be particularly important for NTPHs. But finding and fostering social support for hunting among diverse and geographically dispersed NTPHs remains a major R3 challenge (Larson et al. 2014).

Undergraduate students at universities across the United States are potential NTPHs who are relatively easy to locate and access. About 40% of young adults in the United States aged 18–24 years currently attend some type of college or university, and that number has increased steadily since 1980 (National Center for Education Statistics 2019). Of about 20 million undergraduate students, 55% identify as female, 47% identify as BIPOC, and most are from urban areas (U.S. Census Bureau 2018). Most college and university students are in an age group prone to adopting new activities (i.e., emerging adulthood). Emerging adulthood is distinguished by relative independence from traditional social roles and expectations, with an emphasis on role exploration, boundary testing, risk-taking, and self-identification (Arnett 2000, Hartmann and Swartz 2006). Although emerging adults may lack financial resources that limit adoption of expensive activities, they have freedom from the supervisions that constrain adolescents and are not fully burdened by the responsibilities associated with adulthood (Johnson and Goldman 2011). Colleges and universities present students with a unique social setting that facilitates exploration of new ideas and behaviors without perceived consequences or commitment (Arnett 2007, Ravert 2009). As emerging adults, students are primed to experiment with new leisure activities they may adopt long-term (Luyckx et al. 2006, Larson et al. 2017). This period also affords opportunities for retaining or reactivating individuals whose hunting participation may wane or lapse during the college years. In short, college students may be naturally inclined to explore new activities such as hunting, and the social atmosphere on university campuses can help nurture non-traditional pathways into hunting. College-focused R3 programs are therefore increasing in popularity (Stayton et al. 2017, Ringelman et al. 2020).

Hunter recruitment, retention, and reactivation efforts will not resonate with every student on a diverse campus. Market segmentation, an approach widely used in other disciplines (Dolnicar 2002) that is gaining traction in the conservation field (Metcalf et al. 2019), could help R3 program managers assess which groups of students have the highest potential of being recruited and retained and through what mechanisms. Studies have used market segmentation to place hunters into particular subgroups based on hunting experience preferences (Miller 2003, Needham and Vaske 2013), harvest preferences (Floyd and Gramann 1994, Ward et al. 2008), hunting motivations (Gigliotti 2000), and license purchasing behavior (Hinrichs et al. 2020). Limited empirical research has compared groups of hunters and non-hunters to identify strategies for recruiting new types of hunters.

Our descriptive study used data collected from students at 22 public universities across the United States to investigate

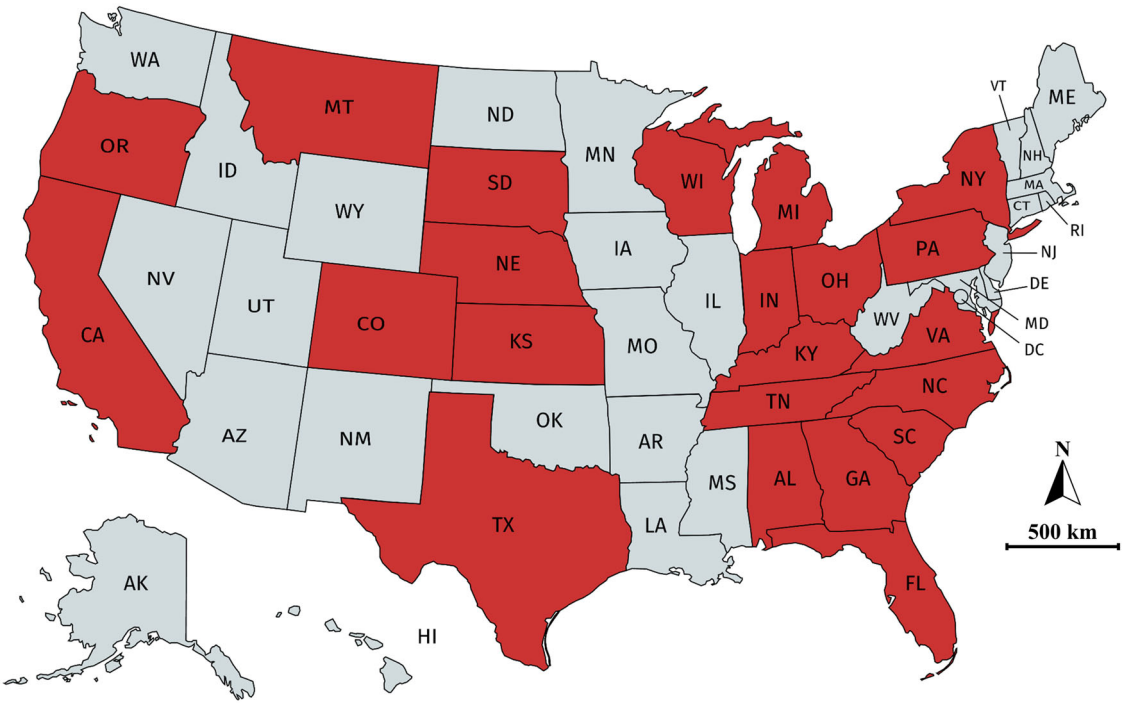

Figure 1. States (in red) containing the 22 large public universities across the United States that participated in the student survey effort from 2018–2020.

hunting participation rates among college students, factors associated with past hunting participation, likelihood of hunting in the future, and factors associated with future hunting participation. To better understand future hunting participation and provide R3 insights, we investigated differences in socio-demographic attributes, social support, and hunting-related beliefs, motivations, and constraints among 4 groups of college students: non-hunters, potential hunters, active hunters, and lapsed hunters.

STUDY AREAS

From 2018–2020, we worked with university researchers at 22 public universities in 22 states (Table S1, available online in Supporting Information) to conduct a web-based survey of undergraduate students in all USFWS regions across the United States (Fig. 1). Most schools were land-grant universities, which often feature majors and courses related to wildlife and natural resources that might attract traditional and non-traditional path hunters.

METHODS

Data Collection

At 20 of these universities we sampled, researchers sent a web survey link (Qualtrics, Provo, UT, USA) to a random sample of undergraduate students (typically 5,000 in the sample frame but ranging from 3,000 to 16,000) provided by university administrators (Table S2, available online in Supporting Information). In the 2 cases where a university-wide random sample was not possible, we worked with colleges within the university to obtain a random sample of participants across a variety of majors. We used an adapted version of the Dillman et al. (2014) approach to administer the questionnaire. This method included 2 email contacts at approximately weekly intervals, followed by a shorter survey of non-respondents (featuring a subset of identical items) to check for potential response bias. The survey process involving human subjects was approved by the North Carolina State University Institutional Review Board (Protocol 12676) prior to implementation.

Survey Instrument

Our questionnaire was developed by researchers at North Carolina State University with written and verbal input from collaborators across participating institutions and R3 staff from state agency partners (Table S1). The instrument was designed to describe and assess university students' beliefs, attitudes, and behaviors with respect to hunters and hunting. Most constructs were based on theoretical frameworks commonly employed in outdoor recreation and leisure research.

We measured past hunting experience by asking participants "have you ever hunted before?" with response options of "yes" (1), "I have accompanied someone hunting but did not personally hunt" (0.5), or "no" (0). If students answered "yes" or that they have accompanied someone, we asked additional questions about how old they were for their first hunting experience and how many times they hunted in the past year.

We measured future hunting participation by asking participants "how likely are you to hunt in the future?" with response options of "I will definitely not hunt" (1), "I will probably not hunt" (2), "Not sure" (3), "I will probably hunt" (4), or "I will definitely hunt" (5). If a participant answered 3 or higher, we asked a question regarding how often they predicted they would hunt in the future, with the response options of "Might try it once" (1), "Rarely (once every few years)" (2), or "Regularly (at least once per year)" (3).

We measured social support for hunting by asking participants to indicate who in their lives hunts (e.g., parent, sibling, other relative). We then grouped responses into 3 categories: immediate family (parents and siblings), extended family and friends (all other hunting connections), and no social support. Patterns of socialization into hunting help to create social norms, or unwritten rules about how to think and behave, that ultimately influence hunting participation (Hrubes et al. 2003, Stedman and Heberlein 2009, Larson et al. 2014).

We measured beliefs about hunters and hunting in several ways. First, we asked participants if they approved of "legal, regulated hunting" on a scale from "strongly disapprove" (1) to "strongly approve" (5) following the approach used in previous studies (Responsive Management and NSSF 2017). We also asked participants whether they "disapproved" (1), were "neutral" (2), or "approved" (3) of hunting for 9 different reasons such as engaging in sport or recreation, being close to nature, or obtaining local, free-range meat. We adapted potential reasons for hunting from previous studies (Decker et al. 2015, Quartuch et al. 2017, Responsive Management and NSSF 2017). We also asked participants to rank their level of agreement with 9 statements about hunters and hunting on a scale from "strongly disagree" (1) to "strongly agree" (5), including items such as "hunting is a safe activity," "hunters behave responsibly and follow hunting laws," and "hunters financially contribute to wildlife conservation."

We assessed motivations to hunt using items from previous studies that matched the approval items referenced above and covered a wide range of possible motivations (Decker et al. 2015, Responsive Management and NSSF 2017). These included hunting for meat, hunting to obtain a trophy (i.e., animal body parts that can later be displayed), and hunting for egoistic (i.e., hunting for personal benefit) and altruistic reasons (i.e., hunting to contribute to conservation and society) described in the broader motivations literature (Batson et al. 2002). Participants indicated if they, personally, would consider hunting for each purpose with response options of "no" (1), "maybe" (2), or "yes" (3).

We investigated constraints to hunting using items from previous studies to identify a range of potential hunting constraints (Metcalf et al. 2015, Responsive Management and NSSF 2017). We listed 20 potential constraints designed to cover a range of intra-personal, interpersonal, and structural (or contextual) constraints frequently identified in the recreation literature (Stodolska et al. 2019). All items

were rated on a scale from "not at all" a barrier (1) to "very much" a barrier (4).

We assessed wildlife value orientations, or basic beliefs about wildlife, in 2 ways. Using items from existing scales, we used 4 items to measure wildlife-specific value orientations across the dominionistic to mutualistic spectrum (Teel and Manfredo 2010, Manfredo et al. 2020). We assessed broader conservation caring using 4 items that focused on personal perceived importance of wildlife conservation (Skibins and Powell 2013). Each of these items was rated on a scale from "strongly disagree" (1) to "strongly agree" (5) with a midpoint of "neither" (3).

In addition to these predictors of behavior, we explored key demographic correlates of hunting participation that help to define NTPHs (Quartuch et al. 2017). These attributes included information about participants' gender identity (choices included male, female, or not listed), race and ethnicity (choices included White, Hispanic or Latino, Black or African American, Asian, American Indian, Middle Eastern or North African, Native Hawaiian or Pacific Islander, other), college major (grouped into 6 categories, later coded as agriculture or natural resource majors vs. other majors), and the population size of the area where a participant grew up (e.g., urban vs. rural based on population density). We measured respondents' participation in other non-consumptive outdoor recreation activities during the past year with a checklist including adventure sports, bird watching, camping, canoeing or kayaking, hiking, and wildlife viewing or photography. We created an outdoor recreation index by summing these activities, with scores ranging from 0 (no participation) to 6 (very high levels of participation).

On the shorter survey checking for non-response bias, we used only 1 item to measure each of the key themes (8 items total). Vayer (2020) and supplemental tables (Tables S3–S8, available online in Supporting Information) provide more details about the survey instrument.

Data Analysis

Prior to analysis, we filtered out survey responses that were <33% complete (the key questions about past and future hunting participation appeared a third of the way through the survey) and removed respondents who were not undergraduate students within the 18–34-year age range. This resulted in the removal of 13% of all surveys that were started. We used Stata version 16.1 (StataCorp, College Station, TX, USA) and SPSS Statistics version 25 (IBM, Armonk, NY, USA) for all analyses. We first used principal component factor analysis (PCF) with an orthogonal rotation to reduce multiple items into larger thematic constructs (Acock 2016). We calculated mean composite scores for each core construct (e.g., motivations, constraints, value orientations) or sub-dimensions that appeared in subsequent analyses. We used Cronbach's alpha to assess the reliability of these scales (Vaske 2019). Prior to interpreting frequencies, we conducted post-stratification weighting based on enrollment and student demographic data provided by the National Center of Education Statistics (2019). Following suggestions outlined by Vaske (2019), we developed normalized multiplicative weights for each case (i.e., respondent) based on their school enrollment, their gender identity (male vs. female), and their race and ethnicity (white vs. BIPOC; Table S2). These weights helped us account for potential sampling bias and develop more precise predictions during analyzes using the Stata fweight procedure. Sample sizes for each analysis varied because of missing data on approximately 10% of surveys.

To assess which factors influence hunting participation by university students, we examined the weighted estimate of past hunting participation. We then fit a blocked logistic regression model to examine the relative influence of various factors on past hunting participation. The dependent variable represented membership in 1 of 2 clusters: no previous hunting participation, including respondents who had accompanied someone on a hunt (0), and previous hunting participation (1). We added independent variables sequentially to the model in blocks, beginning with demographic variables followed by value orientations, beliefs about hunters and hunting, and social support for hunting. We assessed the contributions of each block to the overall predictive power of the model using change in Akaike's Information Criterion (AIC), block χ^2, model classification accuracy, and change in Nagelkerke R^2. After comparing the effects of each block, we assessed the significance of specific predictor variables in the full model using parameter estimates and odds ratios (OR). To examine the sensitivity of our analysis, we tested both weighted and unweighted models and found no significant differences. We therefore reported unweighted model results.

To assess predictors of future hunting behavior, we developed 4 future hunting clusters of respondents based on a combination of past hunting experience and likelihood of future hunting. Non-hunters were individuals who had not hunted in the past and expressed no interest in future hunting (responses of 1 or 2 on the future hunting scale). Potential hunters were individuals who had not hunted in the past but expressed possible interest in future hunting (responses of 3 to 5). Active hunters were individuals who hunted in the past and expressed strong interest in future hunting (responses of 4 or 5), plus those who indicated they were not sure about future hunting (3) but said they might still hunt rarely or regularly. Lapsed hunters were individuals who hunted in the past but indicated they had no interest in hunting in the future (responses of 1 or 2), plus those who were not sure (3) but said they might only try hunting once. We used chi-square tests (for categorical variables) and analysis of variance (ANOVA) tests (for continuous variables) with weighted data to compare each groups' socio-demographic attributes and beliefs about wildlife and hunting. When the assumption of unequal variances was violated, we used Welch's ANOVA with Games-Howell *post hoc* tests to determine differences between future hunting subgroups. We assessed effect size using Cramer's V (for chi-square tests) and eta (for ANOVA), applying cutoff criteria for small, medium, and large effect sizes outlined by Vaske (2019). To further

Table 1. Variables used in data analysis, with unweighted means ($\bar{x}$) and standard deviations (SD) for single items and aggregated scales based on entire sample of university students across 22 universities in the United States, 2018–2020 ($n = 17{,}203$).

Variable	Definition	$\bar{x}$	SD	Items	Cronbach's α
Race	Dummy variable: 1 if white, 0 if BIPOC[a] or mixed race	0.75	0.43	1	
Gender	Dummy variable: 1 if male-identifying, 0 if female-identifying or gender non-conforming	0.43	0.49	1	
Major	Dummy variable: 1 if majoring in field related to agriculture (Ag) or natural resources (NR), 0 if not Ag/NR field	0.20	0.40	1	
Hometown	Dummy variable: 0 if urban (>50,000), 1 if rural (<50,000)	0.51	0.50	1	
Outdoor recreation score	Index: sum of 6 items, higher score means more participation	2.85	1.74	1	
Wildlife value orientation: mutualistic	Scale: 1 = strongly disagree to 5 = strongly agree	3.68	0.88	2	0.651
Wildlife value orientation: dominionistic	Scale: 1 = strongly disagree to 5 = strongly agree	2.96	0.95	2	0.596
Conservation caring score	Scale: 1 = strongly disagree to 5 = strongly agree	4.07	0.67	4	0.799
Overall approval	Scale: 1 = strongly disapprove to 5 = strongly approve	3.72	1.23	1	
Approval: altruistic	Scale: 1 = disapprove to 3 = approve	2.62	0.59	2	0.823
Approval: egoistic	Scale: 1 = disapprove to 3 = approve	2.21	0.73	5	0.938
Approval: meat	Scale: 1 = disapprove to 3 = approve	2.55	0.70	1	
Approval: trophy	Scale: 1 = disapprove to 3 = approve	1.58	0.78	1	
Beliefs about hunters and hunting	Scale: 1 = strongly disagree to 5 = strongly agree	3.42	0.91	9	0.938
Motivation: altruistic	Scale: 1 = no to 3 = yes	2.02	0.86	2	0.940
Motivation: meat	Scale: 1 = no to 3 = yes	2.01	0.90	1	
Motivation: egoistic	Scale: 1 = no to 3 = yes	1.84	0.80	5	0.930
Motivation: trophy	Scale: 1 = no to 3 = yes	1.39	0.71	1	
Constraints: other activities	Scale: 1 = not at all to 4 = very much	3.11	1.09	1	
Constraints: morals and comfort	Scale: 1 = not at all to 4 = very much	2.22	1.09	4	0.908
Constraints: skills and knowledge	Scale: 1 = not at all to 4 = very much	2.22	1.08	6	0.935
Constraints: logistical	Scale: 1 = not at all to 4 = very much	1.93	0.78	6	0.805
Constraints: judgment and experiential	Scale: 1 = not at all to 4 = very much	1.29	0.56	3	0.735
Social support: immediate	Dummy variable: 1 if ≥1 immediate family member hunts, 0 if they do not	0.39	0.48	1	
Social support: extended	Dummy variable: 1 if ≥1 extended family member or friend hunts, 0 if they do not	0.27	0.44	1	

[a] BIPOC refers to individuals who are black, indigenous, or people of color.

explore differences for key variables among the future hunting groups, we tested a multinomial logistic regression model comparing the 4 groups with non-hunters as the reference category. Results of this multivariate analysis supported patterns observed in the bivariate analysis. To facilitate interpretation, we described differences among future hunting groups based on bivariate comparisons.

RESULTS

The overall survey response rate was 14.2% (ranging from 6.1% to 31.5% among universities), yielding a total effective sample size of 17,203 across all institutions (Table S2 provides a breakdown by university). After data weighting, the sample included 65% of respondents identifying as white, 47% identifying as male, 47% from rural hometowns or cities smaller than 50,000 residents, and 17% majoring in subjects related to agriculture or natural resources (Table 1). These ratios roughly align with the national averages of students at public universities across the United States (U.S. Census Bureau 2018).

We also collected 6,585 questionnaires from students who did not respond to the initial survey invitations. Our χ^2-based nonresponse check revealed relatively minor differences between full survey respondents and these non-respondents. Based on weighted averages across all schools, a smaller percentage of non-respondents had hunted in the past (23% vs. 29%). A smaller percentage of non-respondents indicated they would definitely hunt in the future (15% vs. 29%), though more said they might hunt in the future (32% vs. 27%). A larger percentage of non-respondents were male (47% vs. 41%). The effect sizes for all of these differences were small (Cramer's $V < 0.05$). We observed the biggest difference for college major, with non-respondents less likely to report agriculture or natural resource majors (12% vs. 17%, Cramer's $V = 0.09$). All other variables, including conservation caring and approval of hunting, were nearly identical across both groups.

Survey Scales and Constructs

The PCF analysis for hunting approval items identified 4 categories (Table S3): egoistic motivations focused on personal reasons for hunting such as spending time with friends and family and connecting with nature (5 items, Cronbach's $\alpha = 0.938$), altruistic motivations focused on community benefits of hunting such as controlling wildlife damaging ecosystems or causing problems for people (2 items, $\alpha = 0.823$), hunting to obtain meat (1 item), and hunting to obtain a trophy (1 item). The PCF analysis for beliefs about hunters and hunting identified 1 overarching factor (9 items, Cronbach's $\alpha = 0.936$; Table S4).

The PCF analysis for motivations to hunt yielded 4 categories identical to the approval items (Table S5): egoistic motivations (5 items, Cronbach's $\alpha = 0.939$), altruistic motivations (2 items, $\alpha = 0.946$), hunting to obtain meat (1 item), and hunting to obtain a trophy (1 item). The PCF analysis for hunting constraints revealed 5 categories

(Table S6): individual constraints focused on morality and comfort such as a reluctance to kill an animal and a personal discomfort around firearms (4 items, Cronbach's $\alpha = 0.908$); skills and knowledge constraints such as lacking the knowledge and skills to prepare game meat and properly store equipment and firearms (6 items, $\alpha = 0.935$); logistical constraints such as uncertainty about where to hunt and not having anyone to hunt with (6 items, $\alpha = 0.805$); judgment and experience constraints such as feeling discouraged by negative experiences in the outdoors and feeling uncomfortable because of a lack of diversity in hunting (3 items, $\alpha = 0.735$); and an alternative activities constraint of "I would rather do other activities" (1 item).

The PCF analysis for the 4 wildlife value orientation items identified 2 factors (Table S7) that aligned with previous research (Teel and Manfredo 2010): mutualistic wildlife value orientations (2 items, Cronbach's $\alpha = 0.647$) and dominionistic wildlife value orientations (2 items, $\alpha = 0.592$). The PCF analysis for the 4 conservation caring items identified 1 overarching factor including statements about the importance of wildlife conservation and willingness to voluntarily spend money on conservation (Cronbach's $\alpha = 0.799$; Table S8).

Past Hunting Experience

The weighted estimates revealed 29% of respondents (±0.7% for 95% CI) reported previous hunting experience and an additional 11% (±0.5%) had accompanied a hunter in the field. But 33% (±0.7%) of respondents who had hunted in the past had not been hunting in the last 12 months. About 59% (±0.7%) of respondents approved or strongly approved of legal, regulated hunting.

Results of the full blocked logistic regression supported a strong relationship between predictors and past hunting participation ($\chi^2_{18} = 9{,}543.7$, $P < 0.001$, Nagelkerke pseudo $R^2 = 0.659$). The overall rate of correct classification in the model was 87%, surpassing the proportional by chance accuracy rate cutoff criterion of 59%. Iterative incorporation of blocks in the model suggested that past participation in hunting was most strongly associated with demographic variables and beliefs about hunters or hunting, followed by social support and value orientations (Table 2).

Social support for hunting among immediate family members was the single strongest predictor of past hunting participation (OR = 12.47), and support from an extended network of family and friends (OR = 1.44) was also important (Table 3). Among the variables in the demographic block, all but region were statistically significant. Students who were male (OR = 4.06), white (OR = 1.40), agriculture or natural resource majors (OR = 1.48), and

Table 3. Parameter estimation (β) and odds ratios (OR) from a full hierarchical logistic regression model predicting past hunting participation of university students across 22 universities in the United States, 2018–2020 ($n = 15{,}109$). The unweighted percentage of students responding "Yes, I've hunted in the past" was 31%. Cragg-Uhler (Nagelkerke) $R^2 = 0.659$, classification accuracy = 86.8%, $\chi^2_{18} = 9{,}543.7$, $P < 0.001$.

Variables	$\bar{x}$	β	SE	OR
Constant		−9.709	0.306	
Region (reference = Midwest)	0.34			
Northeast	0.13	−0.268	0.091	0.765**
Southeast	0.30	0.063	0.067	1.065
West	0.23	0.069	0.073	1.071
Race or ethnicity (reference = BIPOC[a] or mixed race)	0.25			
White	0.75	0.337	0.077	1.400***
Gender (reference = female or non-conforming)	0.57			
Male	0.43	1.402	0.060	4.064***
College major (reference = not Ag/NR)	0.81			
Agriculture (Ag) or natural resources (NR)	0.19	0.390	0.069	1.476***
Childhood location (reference = urban)	0.51			
Rural	0.49	0.340	0.055	1.404***
Wildlife value orientation: mutualistic[b]	3.68	−0.080	0.036	0.923*
Wildlife value orientation: dominionistic[b]	2.95	−0.051	0.033	0.950
Conservation caring[b]	4.08	0.262	0.048	1.300***
Overall approval[c]	3.73	0.245	0.034	1.278***
Approval: egoism[d]	2.22	0.220	0.065	1.245**
Approval: altruism[d]	2.62	−0.108	0.070	0.897
Approval: meat[d]	2.56	−0.079	0.066	0.924
Approval: trophy[d]	1.58	0.563	0.040	1.756***
Beliefs and attitudes about hunters and hunting[b]	3.42	1.087	0.059	2.960***
Social support (reference = no support)	0.34			
Extended support	0.27	0.363	0.084	1.438***
Immediate family support	0.39	2.523	0.075	12.465***

*, **, *** denote statistically significant odds ratios (OR) at $\alpha = 0.05$, 0.01, and 0.001, respectively.
[a] BIPOC refers to individuals who are black, indigenous, or people of color.
[b] Scale: 1 = strongly disagree to 5 = strongly agree.
[c] Scale: 1 = strongly disapprove to 5 = strongly approve.
[d] Scale: 1 = disapprove to 3 = approve.

Table 2. Relative predictive power of distinct variable blocks in a hierarchal logistic regression model predicting past hunting participation among university students across 22 universities in the United States, 2018–2020 ($n = 15{,}109$).

Logistic regression variable block	Δ R^2 [a]	Accuracy[b]	AIC[c]	χ^2	df	*P*
Demographics	0.292	74.8%	15,227.8	3,518.8	7	<0.001
Value orientations	+0.047	76.8%	14,582.7	651.1	3	<0.001
Beliefs about hunting	+0.222	83.6%	11,089.8	3,504.9	6	<0.001
Social support	+0.098	86.8%	9,225.0	1,868.8	2	<0.001
Full model	0.659	86.8%	9,225.0	9,543.7	18	<0.001

[a] Refers to Nagelkere pseudo-R^2; + denotes change in R^2.
[b] Refers to model classification accuracy rate.
[c] Akaike's Information Criterion.

from rural areas (OR = 1.40) were more likely to report previous hunting participation (Table 3). Among variables in the beliefs block, positive beliefs about hunters and hunting (OR = 2.96), overall approval of hunting (OR = 1.28), and approval for egoistic (OR = 1.25) and trophy-seeking reasons (OR = 1.76) were all positively associated with past hunting participation. Approval of hunting for altruistic reasons (civic or conservation purposes) and to obtain local, ethically sourced meat did not significantly predict past hunting participation. Of the variables in the value orientation block, conservation caring scores (OR = 1.30) were positively associated with, and mutualistic value orientations were negatively associated with (OR = 0.92), past hunting participation (Table 3).

Future Hunting Participation

Our weighted estimates revealed that 19% (±0.6% for 95% CI) of respondents in our sample reported they would definitely hunt in the future and 27% (±0.7%) reported they might hunt in the future. Integrating responses from the past hunting question, we placed students into 4 different groups: 50% (±0.7%) of all students were non-hunters, 22% (±0.6%) were potential hunters, 26% (±0.7%) were active hunters, and 3% (±0.2%) were lapsed hunters. Among potential hunters, 36% of respondents indicated they might try it once, 49% reported they might hunt rarely, and 15% indicated they intended to hunt regularly. About 76% of active hunters intended to hunt regularly in the future. Membership in the 4 groups varied based on socio-demographic attributes and social support (Fig. 2) and hunting-related beliefs, motivations, and constraints (Fig. 3).

Most BIPOC (64%) and female (66%) respondents were non-hunters, though both groups were well represented in the potential hunter group (23% and 19%, respectively; Table S9, available online in Supporting Information). Most students from urban hometowns (56%) and majors other than agriculture or natural resources (53%) were non-hunters, although some were potential hunters (20% and 21%, respectively). Whereas 74% of students who lacked social support were in the non-hunter category, only 5% were in the active hunter category. Nearly 20% of students without any social support were in the potential hunting group (Table S9).

When we examined distributions of students within each future hunting subgroup, active hunters primarily were white (84%), male (74%), and from rural hometowns (62%; Fig. 2; Table S9). About 81% of active hunters had immediate family who hunted, and only 7% reported no social support for hunting. Potential hunters were more diverse than current hunters: 38% of potential hunters were BIPOC or mixed race, 47% were female, 79% were not agriculture or natural resource majors, 43% were from urban hometowns, and 74% did not have immediate family members who hunt. Lapsed hunters were mostly from rural hometowns, white, male, and enrolled in disciplines outside the natural resources. Lapsed hunters were similar to active hunters with respect to these characteristics, but similarities ended with social support; 53% of lapsed hunters reported having immediate familial support compared to 81% of active hunters. Non-hunters, the largest group of students, were 55% white, 72% female, and mostly majoring in disciplines outside of agriculture or natural resources. These students were more frequently from urban areas and lacked

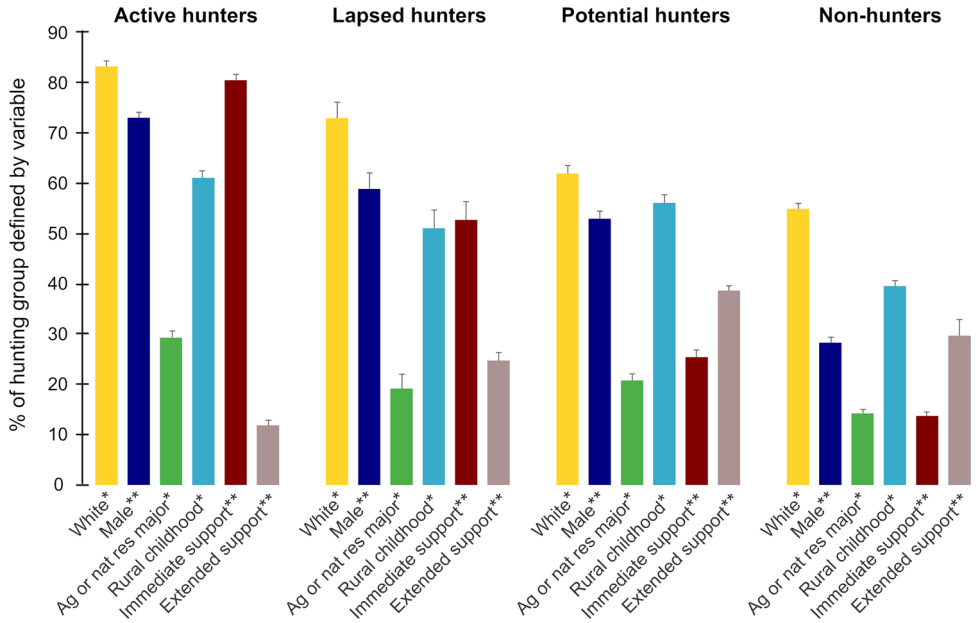

Figure 2. Demographic attributes of college students across 22 universities in the United States, 2018–2020, assigned to 4 future hunting groups based on survey responses: non-hunters ($n = 7{,}820$, 50% of sample), potential hunters ($n = 3{,}572$, 22% of sample), active hunters ($n = 4{,}421$, 26% of sample), and lapsed hunters ($n = 718$, 3% of sample). Distribution represents weighted percentage of students within each hunting group (with 95% CI) defined by race or ethnicity (% white), gender (% male), major (% agriculture or natural resource major), childhood location (% rural), and social support for hunting (% immediate family and % extended family and friends). Weights accounted for enrollment, gender, and race ratios across schools and were rounded to nearest integers in chi-square analysis. All chi-square tests are significant at $P < 0.001$. Effect size denoted as * = small (0.1), ** = medium (0.3), and *** = large (0.5).

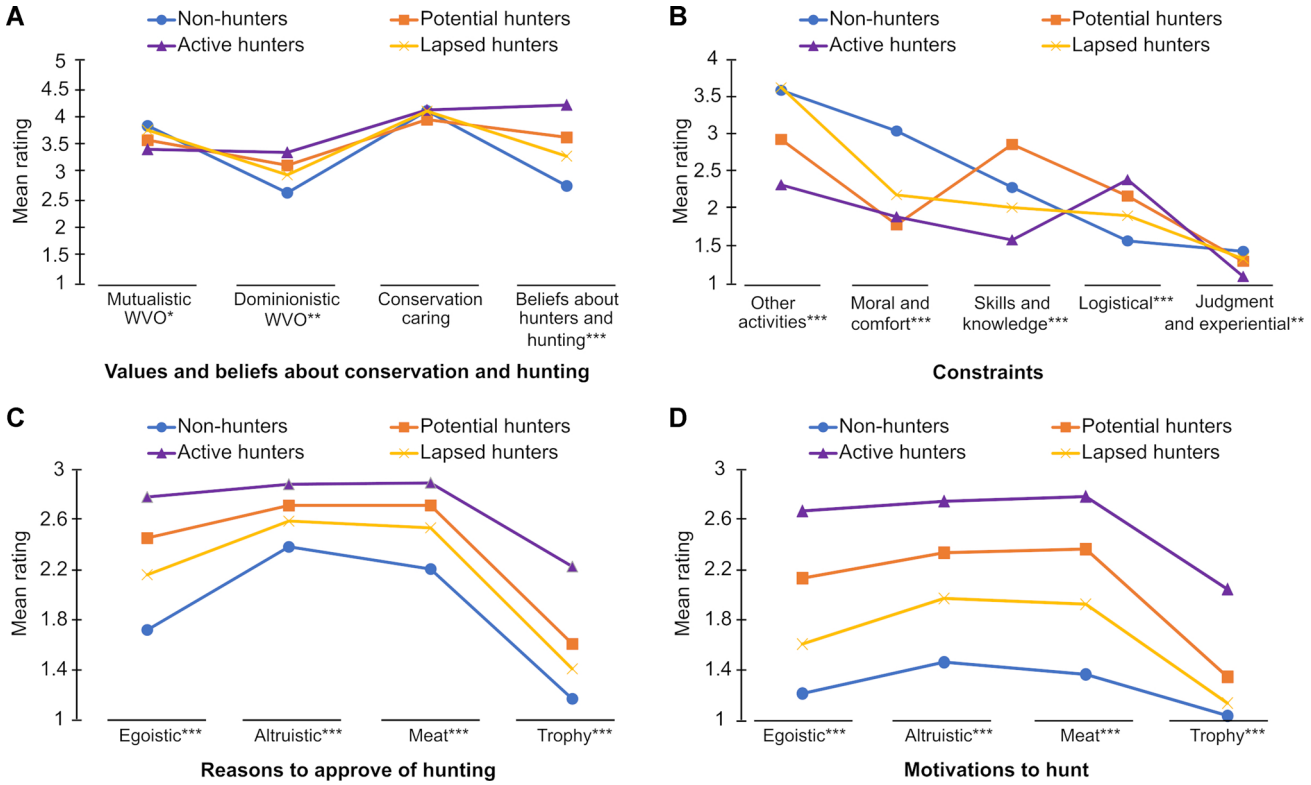

Figure 3. Comparison of mean ratings among future hunting groups of college students across 22 universities in the United States, 2018–2020, based on A) wildlife value orientations (WVO) and beliefs about conservation and hunting, B) constraints to hunting, C) reasons to approve of hunting, and D) motivations to hunt. All variables represent aggregate scales. Value and belief variables were rated on a scale from 1 = strongly disagree to 5 = strongly agree. Constraints were rated on a scale from 1 = not at all to 4 = very much a barrier. Approval items were rated on a scale from 1 = disapprove to 3 = approve. Motivations were rated on a scale from 1 = no, I would not hunt for this purpose to 3 = yes, I would hunt for this purpose. Effect size denoted as * = small (0.1), ** = medium (0.3), and *** = large (0.5).

social support for hunting (Fig. 2; Table S9). We also observed differences between future hunting groups with respect to other outdoor recreation activities, with non-hunters participating in fewer non-consumptive outdoor recreation activities ($\bar{x} = 2.39$) than potential hunters ($\bar{x} = 2.76$) and active hunters ($\bar{x} = 3.23$; Table S10, available online in Supporting Information).

We found differences with large effect sizes between the 4 respondent groups based on their hunting-related beliefs, motivations, and constraints (Fig. 3; Table S10). Active hunters had the most positive beliefs about hunters and hunting, followed by potential hunters, lapsed hunters, and non-hunters (Fig. 3A). Conservation caring and wildlife value orientation scores were similar across all groups, although dominionistic value orientations were slightly higher among active and potential hunters (Fig. 3A). The constraint most frequently cited among non-hunters, potential hunters, and lapsed hunters was "I would rather do other activities," but non-hunters and lapsed hunters ranked this constraint as more important than other groups (Fig. 3B). Non-hunters ranked moral constraints higher than the other groups, and active hunters ranked logistical constraints higher than the other groups. Knowledge-related constraints were prominent for potential hunters. Approval of hunting for different purposes varied among the 4 groups, with potential and active hunters ranking altruistic, egoistic, and harvest-oriented reasons for hunting as more acceptable than non-hunters and lapsed hunters. All 4 groups generally viewed altruistic and harvest-oriented reasons for hunting positively (Fig. 3C). Potential and active hunters ranked altruistic, egoistic, and harvest-oriented reasons for hunting as more important than non-hunters and lapsed hunters, though altruistic motivations were rated as most important within the 2 non-hunting groups (Fig. 3D). The multinomial logistic regression analysis of future hunting correlates highlighted similar patterns, supporting key group attributes described above (Table S11, available online in Supporting Information).

DISCUSSION

This study suggests university students represent a promising target for R3 efforts. The percentage of students who engaged in hunting in the past (29%) is higher than national, self-reported estimates of past hunting participation among all adults in the United States (23%; Manfredo et al. 2018). The proportion of university students who say they are active hunters (26%) is higher than the general population's annual purchase rate for hunting licenses (5%; USFWS 2020). Additionally, a substantial percentage of university students without previous hunting experience (22%) would consider hunting in the future, higher than national estimates of future interest in hunting among the

general public (16%; Manfredo et al. 2018). These numbers show there are many active—and perhaps even more prospective—hunters on diverse college campuses around the United States. A better understanding of university students and the factors influencing their relationship with hunting could inform future R3 research and programming.

Our results confirmed the persistence of traditional pathways into hunting and the important role of social support in the outdoor recreation adoption model (Byrne and Dunfee 2018). We found that traditional hunter characteristics (e.g., rural hometown, male, white, social support from immediate family) were strongly associated with past and future hunting participation, a pattern that has been observed in other studies (Brown et al. 2000, Stedman and Heberlein 2009, Larson et al. 2014). Although social support from extended family (i.e., grandparents, aunts, uncles, other relatives) and friends was important for university students, social support from immediate family (i.e., mother, father, siblings) was among the strongest correlates of past and future hunting participation. Family relationships that focus on hunting across generations cultivate positive connections and access to the activity from an early age (O'Leary et al. 1987), influencing identity adoption and recreation participation later in life (Heberlein and Thomson 1996, Stedman and Heberlein 2009). The cultural contexts and social habitats that support hunting behaviors have always been key to R3 (Larson et al. 2014), and they may be especially important on university campuses where access to prototypical rural hunting settings is limited.

About half of potential hunters were in non-traditional hunter demographic categories (i.e., female, racial minority, ethnic minority, urban), and they reported different pathways into hunting than more traditional participants. Potential hunters rarely enjoyed the social support from immediate family members that was familiar to active hunters; however, many potential hunters did acknowledge support from friends and extended family. These indirect connections to hunting may be a fruitful avenue for NTPH-focused R3 efforts, providing a unique pool of mentors and social support for hunting that is largely absent among students and young adults drawn to hunting later in life (Quartuch et al. 2017, Ringelman et al. 2020). As hunting participation among NTPHs, especially women (Heberlein et al. 2008, Metcalf et al. 2015), continues to increase, understanding and nurturing their unique pathways into hunting will be critical (Quartuch et al. 2017).

A desire to engage in other activities instead of hunting was the largest constraint to hunting among all groups except active hunters, perhaps not surprising because university students are exposed to a wide range of activity choices across campus (Ravert 2009). Potential hunters identified lack of skills and knowledge as the second largest constraint to participation. This is promising for managers and agencies who can directly address skill and knowledge deficiencies through strategic programming (Ringelman et al. 2020, Vayer 2020). Patterns in reported constraints also highlight the influence of growing public discourse about the morality of hunting (Fischer et al. 2013). Like non-hunters, lapsed hunters reported preferences for other activities and moral and comfort barriers as major constraints to participation. State wildlife agencies might struggle to address constraints faced by non-hunters and lapsed hunters because these tend to be intrapersonal constraints that students navigate on their own (Kocak 2017).

Unlike other groups, active hunters indicated logistical constraints (e.g., losing access to hunting land, lacking free time to hunt) were their primary reasons for not hunting. Moving away from familiar areas to attend college was a common issue for active hunters. Other studies report similar results, with active hunters likely to indicate structural constraints (Wright et al. 2001, Barro and Manfredo 1996, Metcalf et al. 2015). Our findings support the assertion that constraints are hierarchical (Crawford et al. 1991, Wright et al. 2001), with new constraints emerging and growing in importance as engagement with an activity increases. For example, logistical constraints to hunting may be irrelevant to students who lack interest and motivation and are unable to negotiate moral and comfort barriers. Similarly, students who lack the financial resources to hunt may not cite cost as a constraint because they only learn about costs after negotiating moral and comfort barriers. These results suggest that an R3 initiative will not effectively recruit or retain every student; a variety of approaches are needed to help diverse subgroups of students negotiate specific types of constraints (Raymore 2002).

Procurement of ethically and locally sourced meat was the most important hunting motivation for all groups of respondents. Game meat harvest has been recognized as a prominent reason for hunting (Duda et al. 2010), and may be particularly important for NTPHs hoping to access local, free range meat (Tidball et al. 2013, Stedman et al. 2017). For potential hunters in our sample, the 2 strongest motivations to hunt were to obtain game meat and to support conservation (e.g., controlling overabundant wildlife populations for the benefit of ecosystems). Results suggest R3 efforts that capitalize on altruistic reasons for hunting could be popular among urban dwellers and young adults (Decker et al. 2015, Byrd et al. 2017). Egoistic motivations for hunting such as being closer to nature and relaxing or escaping from everyday life were popular among active hunters, slightly less important among potential hunters, and minimally important to lapsed hunters and non-hunters. Hunting for trophies, on the other hand, was strongly opposed by every group except active hunters, reflecting ethical concerns documented in the general population (Gunn 2001). Overall, our results indicate that all groups of students, including non-hunters, might be willing to support or perhaps even engage in hunting focused on game meat harvest or altruistic goals. Other studies have revealed similar trends regarding hunting motivations (Larson et al. 2014) and public support for hunting (Decker et al. 2015, Byrd et al. 2017), which might influence the way managers communicate about hunting and attempt to recruit NTPHs.

Efforts to create and expand R3 efforts at universities could have conservation benefits that extend beyond increased hunting participation. University students reported less support for hunting (59%) than adults in the American public (70–80%; Duda et al. 2010, Responsive Management 2017), providing room to bolster support for hunting via strategic, university-focused messaging and programming. Because positive beliefs about hunting lead to more consistent participation and presumably more political and social support for hunting, it is critical to frame hunting in a way that resonates with a diverse public (Larson et al. 2014, Byrd et al. 2017, Manfredo et al. 2018). Positive beliefs are often associated with familial role models who reinforce the value of hunting, yet this familial support is absent for many university students. The campus environment provides alternative support mechanisms (e.g., student organizations) that influence identity development during the period of emerging adulthood (Arnett 2000, Nelson and Barry 2005). Positive social interactions with peers who are active and potential hunters could affect the way students think and act with respect to hunting (Johnson and Goldman 2011). These interactions might persuade some non-hunters to become hunting advocates, leading to more support for hunting and conservation-related policies (Stedman and Decker 1996). This potential is underscored by the fact that our respondents, whether or not they hunted, generally reported pro-conservation attitudes and mutualistic wildlife value orientations. Such patterns may reflect a broader shift in wildlife value orientations among young adults, mirroring trends reported in the larger population across the United States (Manfredo et al. 2016, 2020).

Trends revealed in our study also present opportunities for wildlife management agencies (Manfredo et al. 2016). Stronger emphasis on the conservation implications of hunting might attract new groups inspired by pro-conservation motivations (Larson et al. 2014, Stayton et al. 2017). Emphasis on connections between conservation and hunting might also help to alleviate perceived conflicts among hunters, environmental advocates, and the general population (Knezevic 2009). These beliefs and values suggest strong interest in conservation among diverse university students that might translate into future support for innovative conservation funding strategies (Serfass et al. 2018). Leveraging common ground could help to create a more cohesive and sustainable base of support among hunters and non-hunters, ultimately advancing wildlife agency missions, policies, and conservation goals (Blascovich and Metcalf 2019).

Limitations

Although many of our binary demographic predictor variables were strong correlates of hunting participation, future research could investigate nuanced differences within demographic subgroups to assist wildlife agencies with marketing and recruitment methods. This might include examination of potential variation among BIPOC subpopulations (Shinew et al. 2006), in addition to interactions among different demographic groups (e.g., women from urban areas, Latinx students who are not natural resource majors). Such interactions may be particularly important when considering constraints to hunting participation (Shores et al. 2007, Rushing et al. 2019). Our quantitative approach enabled us to cover a wide geographic area and study a range of possible hunting behaviors and correlates, but a qualitative approach would deepen understanding of students' broader engagement with hunting and potentially reveal mechanisms behind some of the observed patterns. The self-reported nature of past hunting and intended future hunting behaviors is another limitation of our study. Although self-reported behavior and behavioral intent are widely viewed as effective measures of overt behavior (Ajzen and Driver 1992), particularly in hunting studies (Hrubes et al. 2003, Larson et al. 2014), there is potential for social desirability bias in responses.

Our sample was large and geographically diverse, but the study included only large public universities and most were land grant institutions with a longstanding emphasis on agriculture and natural resource management. Our sampling frame may be biased in unknown ways because it did not represent students at all types of institutions (e.g., private schools, smaller public schools, community colleges). Furthermore, our decision to focus on 18–34-year-old students at large institutions excluded non-traditional undergraduates (e.g., older adults pursuing college degrees), and our low response rate to the online survey across most schools raises questions about potential response bias. But our non-response check suggested the survey was representative of the student population at the 22 universities we surveyed, both demographically and behaviorally (with respect to hunting participation). Our use of post-stratification weighting based on student enrollment and demographic data allowed us to account for potential sampling bias and develop more precise estimates. But non-response checks and population proportion-based *post hoc* weighting do not fully eliminate response bias in online surveys (Vaske et al. 2011), and it is not clear how our sample of university students compares to other populations of young adults.

MANAGEMENT IMPLICATIONS

Our study demonstrated interest in hunting among diverse university students, highlighting the growing importance of non-traditional pathways into hunting and revealing unique subgroups (i.e., market segments) of hunters and non-hunters that could assist with R3 programming on university campuses. For R3 program managers interested in recruitment at universities, the potential hunter subgroup of students is an ideal target. This group was large, amenable to hunting, and far more diverse than other subgroups (with the exception of non-hunters). To effectively connect with NTPHs in the potential hunter group and foster a more inclusive hunting community, agencies need messages and communication strategies that resonate with diverse populations. This might include development of peer support networks to fill existing gaps in social support for hunting

and creation of R3 spaces where non-traditional (e.g., female, BIPOC) voices are welcomed and amplified. An enhanced emphasis on game meat harvest and conservation connections are motivating factors for many students and offer ways to attract and retain potential NTPHs. These strategies could help new hunters from non-traditional backgrounds overcome skill and knowledge deficits and find the support needed for sustained hunting participation. To enhance retention and reactivation, more information and resources are needed to help university students who hunt (or would like to hunt) overcome structural and logistical constraint. Possible solutions include offering information about local hunting opportunities, providing transportation to improve access to game lands, facilitating hunting equipment storage for students, and fostering peer networks of active hunters (possibly using digital platforms that are frequently used by students) to reinforce social support. Using these approaches, wildlife agencies can collaborate with university partners to develop more effective tools and strategies as they seek to reverse declines in hunting participation and change the contemporary face of hunting in the United States.

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