Into the Wild – U.S. Consumer Preferences for Residential Landscape Wildlife[1]

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Abstract

A key benefit of botanically diverse landscapes is their ability to attract and support wildlife. Nature relatedness, a term that describes the affective, cognitive, and experiential aspect of human-nature relations, promotes positive well-being and happiness. Wildlife is a broad term which can include insects, reptiles, birds, and mammals. Because markets are typically heterogeneous, consumers are likely to respond differently to landscapes that are wildlife-friendly. The present study used an online survey to explore U.S. consumer preferences for 10 different types of wildlife in landscapes. Participants wanted landscapes that attracted songbirds, butterflies, pollinators, and bees. In general, participants were neutral about attracting gamebirds, deer, and chipmunks. However, they wanted to deter insects, bats, and snakes. Greater native plant knowledge and higher nature relatedness ratings improved the probability of participants wanting to attract all 10 types of wildlife. Demographics impacted preferences with older participants wanting to attract songbirds, butterflies, bees, and pollinators but deter all other types of wildlife. On average, women wanted to attract butterflies but deter game birds, deer, chipmunks, insects, bats, and snakes. Rural residents were more interested in attracting all types of wildlife. People with children wanted to attract gamebirds, deer, and chipmunks to their landscapes.

Index words: native plants, online survey, ordered probit, pollinators.

Significance to the Horticulture Industry

Native plant use in landscapes enriches biodiversity, enhances sustainability, and enriches ecosystem functions including pollinator and wildlife habitats. One key understudied dimension to biodiversity in the landscape literature is wildlife attraction (versus deterrence). Marketing plant benefits can be a powerful motivation to purchase. Nature relatedness promotes positive well-being and happiness. Our objective was to understand consumer preferences for attracting specific types of wildlife and the influence of native plant knowledge and nature relatedness on preferences. Understanding consumer preferences can ground marketing messages and enhance their effectiveness. Greater native plant knowledge and higher nature relatedness ratings improved the probability of participants wanting to attract all 10 types of wildlife. Since study participants wanted landscapes that attracted songbirds, butterflies, pollinators, and bees, we recommend that marketing communications include images and text for plants that entice these types of wildlife. Study participants were neutral about attracting gamebirds, deer, and chipmunks to their landscapes and wanted to deter insects, bats, and snakes, which suggests these entities should be avoided in marketing communication materials.

Introduction

Numerous studies document the tremendous benefits of integrating native plants into the landscape and many consumers perceive native plants as able to deliver those beneficial attributes including attracting and sustaining pollinators (Campbell et al. 2017, Wingall et al. 2019, Wratten et al. 2012) and other wildlife (Goddard et al. 2012, Helfand et al. 2006, Nickerson et al. 2023). In Canada and the United Kingdom, many individuals believe native plants are beautiful as well as beneficial to the economy and nature (Fischer et al. 2014). Over half of the 114 Connecticut landscape and nursery professionals included in the study agreed or strongly agreed that native plants should be favored over noninvasive nonnative plants (Galiardi and Brand 2007). Improved marketing of native plants through their positive influence on pollinators and other wildlife could be beneficial to consumers and the environment.

Pollinator attraction is a key benefit of native plants recognized by many consumers (Campbell et al. 2017, Wingall et al. 2019, Wratten et al. 2012). However, Gillis and Swim (2020) reported that the native plant's aesthetic appeal, not the ecological value, predicted purchasing intentions. Yue et al. (2012) identified a small group of study participants (16%) as "nativists" who were pro-native plants in contrast to 34% who were "invasive plant averse" for non-native plant species and 50% who were described as more "typical" consumers. The more "typical" consumers are those who increase or decrease their plant values depending on other plant characteristics (e.g., color, size, hardiness, height) beyond native and invasiveness. "Typical" consumers perceived native plants similarly to nativists in terms of native plants reducing air pollution and promoting biodiversity indicating some overlap in terms of perceived benefits. However, their values for native plant species were insignificant. In another study, participants preferred a landscape with ~50% native plants over landscapes with 100% or 75% native plants (Peterson 2012). These results were primarily attributed to social norms where participants perceived their neighbors as preferring turf lawns to native plant landscapes. Yue et al. (2011) reported a small ($0.35) premium for plants

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Table 1. Model fit statistics for ordered probit models estimated using a 5-point and 3-point Likert scale dependent variable, by type of wildlife (n = 2011)[z].

	5-point Scale			3-point Scale	
	AIC	BIC		AIC	BIC
Songbird	4430.359	4536.880	>	2275.143	2370.451
Butterfly	4608.513	4715.035	>	2518.399	2613.707
Pollinator	5256.256	5362.777	>	3160.351	3255.660
Bee	5805.802	5912.323	>	3730.965	3826.273
Gamebird	6008.741	6115.262	>	4160.054	4255.362
Deer	6021.657	6128.178	>	4105.269	4200.577
Chipmunk	6129.947	6236.469	>	4139.290	4234.599
Bat	5272.601	5379.123	>	3553.183	3648.492
Insect	5666.141	5772.662	>	3839.167	3934.476
Snake	4225.365	4331.886	>	2635.384	2730.692

[z]Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC) were used to assess model fit for models the dependent variables corresponding to a 5-point or 3-point scale. The lower the AIC and BIC values, the better the model fits the data (Burnham and Anderson 2010, Schwarz 1978).

labeled as noninvasive and native. Helfand et al. (2006) found that participants were responsive to price and willing to pay more for non-conventional landscapes with less turfgrass and more native plants. Yet an inventory of 101 randomly selected suburban home gardens had, on average, 72% non-native plants (Ward and Amatangelo 2018). Nassauer (1995) posited that a person's attitude about native plants is a key driver in the purchase of native plants with the perception of native plants being "messy" and "unattractive" being key deterrents to purchase.

Wildlife attraction and habitat can be a key plant benefit and more botanically diverse landscapes provide a habitat for birds and other wildlife (Helfand et al. 2006). On page 470, Nickerson et al. (2023) operationalized wildlife-friendly plants for consumers and growers as native or introduced "vegetation that attracts and safely supports beneficial insects, birds, and other wildlife." Participants in that study incorrectly used native and wildlife-friendly plants as synonyms. Wildlife-friendly landscape preferences were influenced by personal well-being and a moral responsibility to nature, especially gaining a sense of wonderment for the natural world (Goddard et al. 2012). Kurz and Baudains (2012) found that participants who identified as Australian had a stronger affinity for high (versus low) habitat gardens. The high habitat gardens were rated a seven or higher on a 10-point scale (1=very little provision of habitat, 10=very high provision of habitat) by six expert ecologists. High-habitat gardens included more diverse plant life and reduced/no turf area whereas the low-habitat gardens included turfgrass and more traditional hedgerows. Furthermore, younger and less affluent study participants preferred the high-habitat gardens, but gender had no effect.

Songbirds and pollinators are two of the more positively regarded types of wildlife that might be attracted to botanically diverse landscapes. For example, Rodriguez et al. (2017) reported native plant benefits accrued to birds positively impacted residential preferences. Attracting birds was a key factor for the "modern" cluster that comprised 37% of the sample (Kendal et al. 2012). Goddard et al. (2013) reported that watching or attracting wildlife was important to 41% of their sample and 58% spent time weekly actively watching wildlife with an average of 5.1 wildlife-friendly features in the garden. However, not all wildlife is desirable. Polak et al. (2016) reported that half of the population fears snakes while only three percent meet the diagnostic criteria for a phobia. Additionally, estimates of 25% of the U.S. population have a fear of insects in general (including spiders and bees) was reported (Fukano and Soga 2021).

The benefits to human health for interacting with nature are well-documented. Nature relatedness promotes positive mental health (Dean et al. 2018), well-being (Nisbet et al.

Table 2. Summary statistics of US consumers from an online survey addressing preferences for landscapes that attract or deter wildlife (n = 2011).

Variable	Definition	Mean	SD[z]	US Population
Age	Age in years.	50.425	16.937	38.9[y]
Female	Female=1, otherwise=0	0.606	0.489	50.4% [y]
BSplus	Bachelor's degree or higher=1, otherwise=0	0.439	0.496	34.3% [y]
Suburb	Live in suburb=1, otherwise=0	0.456	0.498	—
Urban	Live in urban area=1, otherwise=0	0.212	0.409	80%[x]
Rural	Live in rural area=1, otherwise=0	0.331	0.471	20% [x]
Adult	Number of adults in household.	2.100	0.949	2.57 persons per household[y]
Child	Number of children <18 in household.	0.689	1.091	—
Income	Income mean in 2022.	82.190	58.039	$75,149[y]
White	White ethnicity=1, otherwise=0	0.779	0.415	75.5%[y]
Black	Black ethnicity=1, otherwise=0	0.098	0.297	13.6%[y]
Other ethnicity	Other ethnicity=1, otherwise=0	0.123	0.115	10.9%[y]
Northeast	Live in Northeast region=1, otherwise=0	0.221	0.415	56.9%[w]
Midwest	Live in Midwest region=1, otherwise=0	0.251	0.433	21.4% [w]
South	Live in South region=1, otherwise=0	0.261	0.439	14.8% [w]
West	Live in West region=1, otherwise=0	0.267	0.443	6.8% [w]
Native Plant Knowledge	1=very unknowledgeable, 5=very knowledgeable	3.549	1.090	—

[z]standard deviation.

[y]U.S. Census Bureau (2023).

[x]U.S. Census Bureau (2022).

[w]Stockingblue (2018).

Table 3. **Nature relatedness scale items used to generate a nature relatedness index to assess US consumer interest in attracting or deterring different types of wildlife to their residential landscapes (n = 2011).**

Definition (1=strongly disagree, 7=strongly agree)	Mean	SD
My ideal vacation spot would be a remote, wilderness area.	4.168	1.967
I always think about how my actions affect the environment.	4.709	1.630
My connection to nature and the environment is part of my spirituality.[z]	4.650	1.747
My relationship to nature is an important part of who I am.[z]	4.931	1.671
I feel very connected to all living things and the earth. [z]	5.049	1.609
Nature Relatedness Index (mean)	**4.877**	**1.538**

[z]Item included in the nature relatedness index (Nisbet and Zelenski, 2013). Items included were determined by Cronbach's alpha. The three items' alpha was 0.906.

2011), and is one mechanism to generate human happiness (Zelenski and Nisbet 2012). Nisbet and Zelenski (2013) developed a nature relatedness scale that has been widely utilized, demonstrating good validity and reliability. Native plant knowledge and nature relatedness questions were included in the analysis due to native plant people engaging in more environmentally sustainable gardening practices (Rihn et al. 2023). As a result, they may have heightened preferences for attracting specific types of wildlife (e.g., pollinators, insects, birds).

We developed the following hypotheses, based upon the literature. With Goddard et al. (2012) findings that wildlife-friendly landscape preferences were influenced partly by personal well-being, researchers hypothesized that a preference for a wildlife-friendly landscape may be positively influenced by a positive nature relatedness score. Researchers hypothesized that in typically diverse markets, consumers may have varying reactions to attracting wildlife to their residential landscapes. We further hypothesized that, based on the literature, songbirds and pollinators would be two of the preferred types of wildlife to attract while snakes and spiders would be two types of wildlife consumers would prefer not to attract.

Materials and Methods

An online survey was hosted in Qualtrics LLC (Provo, UT) to identify how U.S. consumers respond to the wildlife their landscapes may potentially attract or deter. The survey instrument included the informed consent form and screening questions, questions related to past and current native plant purchasing behavior, native plant importance, retail outlets used, native plant preferences, native plant knowledge, and socio-demographics. Additionally, researchers developed a choice experiment with wildlife preferences and a nature relatedness scale (adopted from Nisbet and Zelenski (2013) was employed. Participation lasted approximately 15 minutes and participants were compensated with online points by Qualtrics that they could redeem for different rewards upon completion of the survey. Data collection occurred between October 2023 and January 2024. Participants were screened to ensure they were 18 years old or older, had decision-making power in their landscapes, and lived in a residence where they could change their landscapes (e.g., a house, mobile home, etc.). A total of 2,011 people qualified and participated in the experiment. All procedures and protocols were approved by the University of Tennessee's institution review board (IRB-23-07728-XM).

Participants subjective native plant knowledge was measured using a 5-point Likert scale where 1 equaled not at all knowledgeable and 5 equaled extremely knowledgeable. Five statements were included in the nature relatedness scale, including "My ideal vacation spot would be a remote, wilderness area," "I always think about how my actions affect the environment," "My connection to nature and the environment is part of my spirituality," "My relationship to nature is an important part of who I am," and "I feel very connected to all living things and the earth" (Nisbet and Zelenski 2013). A Cronbach's alpha was used to determine which nature relatedness statements to include in a nature relatedness index (Trochim and Donnelly

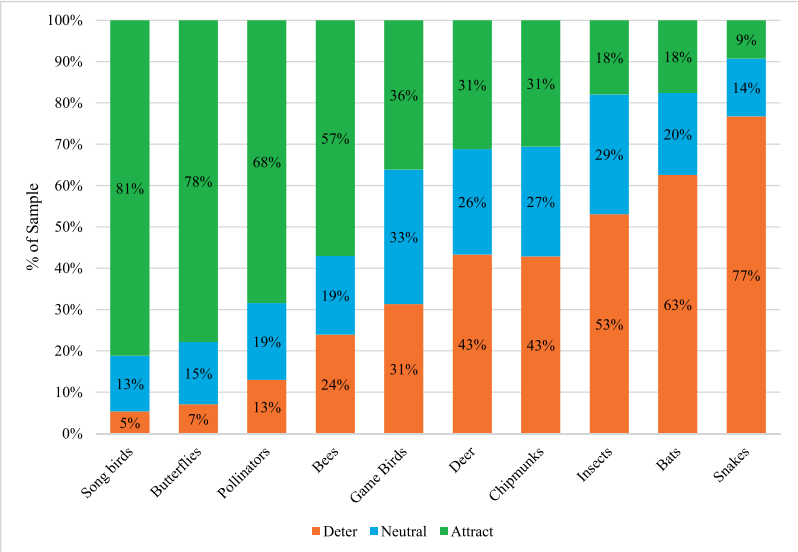

Fig. 1. U.S. consumer preference for landscapes that influence wildlife presence from an online survey (n = 2011).

Table 4. **Ordered probit model estimates for wildlife participants want to attract to residential landscapes from an online U.S. consumer survey (n = 2011).**

	SongBirds		Butterflies		Pollinators (in general)		Bees	
	Coef.	SE[z]	Coef.	SE[z]	Coef.	SE[z]	Coef.	SE[z]
Native Plant Knowledge	0.104	0.034**[y]	0.159	0.033***	0.225	0.031***	0.195	0.029***
Nature Relatedness	0.149	0.024***	0.120	0.022***	0.108	0.021***	0.125	0.021***
Age	0.014	0.002***	0.006	0.002**	0.005	0.002*	0.002	0.002
Female	0.049	0.069	0.150	0.066*	0.010	0.060	−0.176	0.058**
BSplus	−0.072	0.073	−0.104	0.069	0.123	0.064	0.163	0.061**
Suburb	−0.210	0.078**	−0.299	0.077***	−0.311	0.069***	−0.288	0.064***
Urban	−0.321	0.100***	−0.366	0.098***	−0.382	0.087***	−0.357	0.081***
Adult	0.134	0.035***	0.038	0.033	0.035	0.030	−0.025	0.029
Child	0.006	0.034	−0.021	0.033	−0.088	0.031**	−0.055	0.029
Income	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
White	0.006	0.105	0.279	0.088**	0.222	0.087*	0.214	0.082**
Black	−0.112	0.128	−0.221	0.113	−0.223	0.114	−0.114	0.103
Northeast	−0.116	0.095	0.018	0.090	−0.040	0.085	−0.123	0.081
Midwest	0.050	0.093	0.145	0.089	−0.098	0.082	−0.148	0.079
South	0.027	0.096	0.221	0.089*	−0.002	0.084	−0.152	0.078*
Thresholds								
/cut1	0.206	0.221	0.038	0.203	0.302	0.196	0.370	0.184
/cut2	0.987	0.225	0.805	0.206	1.014	0.198	0.948	0.185
Log pseudolikelihood	−1120.5714		−1242.2		−1563.09		−1848.48	
Wald chi2	151.8		185.77		233.03		218.88	
Prob > chi2	0		0		0		0	
Pseudo R2	0.066		0.0746		0.0719		0.0604	

[z]SE indicates standard errors of the regression coefficients.

[y]***, **, * indicate significance at <0.1%, 1%, and 5%, respectively, relative to the base variables (including: non-female, less than a bachelor's degree, rural, other ethnicity, West region).

2006). The three statements "My connection to nature and the environment is part of my spirituality," "My relationship to nature is an important part of who I am," and "I feel very connected to all living things and the earth" resulted in the highest Cronbach's alpha of 0.906 and were averaged to create the index.

Participants indicated whether they wanted their landscapes to attract or deter 10 different types of wildlife using a 5-point Likert scale (1=deter, 3=neutral, 5=attract). The types of wildlife included were those frequently observed on ornamental plant point-of-sale information (e.g., pollinators, butterflies, songbirds) or that are common wildlife found within landscapes and may be considered less desirable (e.g., deer, snakes, insects). The wildlife options were randomized to reduce order bias and included: songbirds, butterflies, pollinators (in general), bees, gamebirds, deer, chipmunks, insects, bats, and snakes.

Given that the wildlife variable is ordinal in nature, ordered probit models and marginal effect estimates were used to assess how native plant knowledge, nature oriented, and demographics influence consumer preferences for different types of wildlife within their residential landscapes. For the analysis, the dependent variable (wildlife attractive) was categorized into three levels, where 1=deter (i.e., they selected 1 or 2 on the original scale), 2=neutral (i.e., selected 3 on the original scale), and 3=attract (i.e., selected 4 or 5 on the original scale). Models were estimated for the 5-point and 3-point levels, and the Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC) indicated better model fit (i.e., values were lower) for the 3-point dependent variable models which were used in the analysis (Table 1, Burnham and Anderson 2010, Schwarz 1978). Independent variables included subjective native plant knowledge, the nature relatedness index, and demographic variables. The significance of the independent variables in the models are relative to the base variables which included non-female for gender, less than a bachelor's degree for education, rural for area of residence, other ethnicity, and West region.

Results and Discussion

Table 2 contains the summary statistics of the sample. The average age of participants was 50 years old, 61% were female, 44% had a bachelor's degree or higher, 46% lived in suburban areas, 21% in urban areas, and 33% in rural areas. The average household consisted of 2 adults and 1 child with a 2022 gross annual income of $82,190. Nearly 78% of the sample were white/Caucasian, 10% were black, and 12% were other ethnicities. Approximately 27% of the sample lived in the West, 26% in the South, 25% in the Midwest, and 22% in the Northeast region. On a 5-point scale, participants indicated they were somewhat knowledgeable about native plants. Compared to the U.S. Census (2022, 2023), the sample was older, had a higher portion of females, higher education obtainment, and a higher portion living in rural areas. The age difference likely is due to Census data including minors (which were not included in the study) and screening questions to target individuals who had landscaping decision-making and residences where they could augment the landscape. Typically, females are the core consumer of gardening-related purchases (Dennis and Behe 2007),

Table 5. Marginal effect estimates based on the ordered probit model results for US consumer preferences for different wildlife they want to attract to their landscapes (n = 2011).

	Song Birds			Butterflies			Pollinators (in general)			Bees		
	Deter (1) dy/dx[z]	Neutral (2) dy/dx	Attract (3) dy/dx	Deter (1) dy/dx	Neutral (2) dy/dx	Attract (3) dy/dx	Deter (1) dy/dx	Neutral (2) dy/dx	Attract (3) dy/dx	Deter (1) dy/dx	Neutral (2) dy/dx	Attract (3) dy/dx
Native Plant Knowledge	−1.1%**[y]	−1.5%**	2.6%**	−2.0%***	−2.3%***	4.3%***	−4.3%***	−3.0%***	7.3%***	−5.5%***	−1.5%***	7.0%***
Nature Relatedness	−1.5%***	−2.2%***	3.7%***	−1.5%***	−1.8%***	3.2%***	−2.1%***	−1.4%***	3.5%***	−3.5%***	−1.0%***	4.5%***
Age	−0.1%***	−0.2%***	0.4%***	−0.1%**	−0.1%**	0.2%**	−0.1%*	−0.1%*	0.2%*			
Female				−1.9%*	−2.2%*	4.0%*				5.0%**	1.4%**	−6.4%**
BSplus										−4.6%**	−1.3%**	5.9%**
Suburb	2.1%**	3.1%**	−5.2%**	3.7%***	4.4%***	−8.1%***	5.9%***	4.1%***	−10.0%***	8.2%***	2.2%***	−10.4%***
Urban	3.2%**	4.7%***	−8.0%***	4.5%***	5.4%***	−9.9%***	7.3%***	5.0%***	−12.3%***	10.1%***	2.8%***	−12.9%***
Adult	−1.4%***	−2.0%***	3.3%***									
Child							1.7%**	1.2%**	−2.8%**			
White				−3.4%**	−4.1%**	7.5%***	−4.2%*	−2.9%*	7.2%*	−6.1%**	−1.7%**	7.7%**
South				−2.7%*	−3.2%*	6.0%*				4.3%*	1.2%	−5.5%*

[z] dy/dx indicates the marginal effect indicating the change from the base variables.

[y] ***, **, * indicate significance at <0.1%, 1%, and 5%, respectively, relative to the base variables (including: non-female, less than a bachelor's degree, rural, other ethnicity, West region). Only significant variables are shown.

which could explain the higher portion of female participants in our study. Lastly, since many residences in urban areas include rentals (e.g., apartments, condos) without landscaping responsibilities, this may explain the higher participation of rural residents. Regarding regional differences, sampling was driven by quotas in each region to ensure somewhat equal distribution across the U.S. instead of population density. Specifically, we wanted to have approximately 25% of the sample from each of the four regions. The screening criteria paired with the quotas may have resulted in slight differences across the regions.

Table 3 shows the nature relatedness scale metrics and index. Participants rated the "I feel very connected to all living things and the earth" statement the highest, followed by "My relationship to nature is an important part of who I am," "I always think about how my actions affect the environment," "My connection to nature and the environment is part of my spirituality," and "My ideal vacation spot would be a remote, wilderness area." Using a Cronbach's alpha measure, the statements were narrowed down to three statements to include in the index, including "My connection to nature and the environment is part of my spirituality," "My relationship to nature is an important part of who I am," and "I feel very connect to all living things and the earth" which had an alpha of 0.906. The native relatedness index mean was 4.877.

Figure 1 is the distribution of the participants' preferences for wildlife in their landscapes in order from the highest portion of wanting to attract that type of wildlife, to the lowest portion wanting to attract that type of wildlife. The majority of the sample wanted to attract songbirds (81% of the sample), followed by butterflies (78%), pollinators (in general, 68%), and bees (57%). Participants displayed equal distribution for gamebirds. Fewer participants wanted to attract deer or chipmunks at 31% each, respectively. Conversely, participants wanted to deter insects (53% selected deter), bats (63%), and snakes (77%). With the exception of gamebirds, participants clearly indicated a preference for attracting or deterring wildlife depending upon the type of wildlife.

The ordered probit model estimates and corresponding marginal effects are in Tables 4-9. Tables 4 and 5 include the ordered probit model estimates and marginal effects for the four types of wildlife participants want to attract: songbirds, butterflies, pollinators, and bees. The probit model estimates show that native plant knowledge and nature relatedness positively impacted participants' probability of wanting to attract all four types of wildlife (Table 4). Age positively impacted probability of attracting songbirds, butterflies, and pollinators. Females wanted to attract butterflies but deter bees. White participants were interested in attracting butterflies, pollinators and bees. Urban and suburban residents were not interested in attracting any of the wildlife relative to rural participants. When considering the marginal effects, if participants were knowledgeable about native plants, they had an increased probability of wanting to attract songbirds (2.6%), butterflies (4.3%), pollinators (7.3%), and bees (7.0%, Table 5). Higher nature relatedness index scores

Table 6. Ordered probit model estimates for neutral wildlife in residential landscapes from an online US consumer survey (n = 2011).

	Gamebirds		Deer		Chipmunks	
	Coef.	SE[z]	Coef.	SE	Coef.	SE
Native Plant Knowledge	0.118	0.028***[y]	0.058	0.028*	0.073	0.028**
Nature Relatedness	0.178	0.020***	0.086	0.020***	0.071	0.020***
Age	−0.006	0.002***	−0.018	0.002***	−0.017	0.002***
Female	−0.383	0.054***	−0.174	0.055**	−0.161	0.054**
BSplus	−0.017	0.058	−0.040	0.059	−0.076	0.058
Suburb	−0.216	0.061***	−0.214	0.062***	−0.137	0.062*
Urban	−0.175	0.081*	−0.090	0.081	0.026	0.081
Adult	−0.004	0.028	0.016	0.028	−0.015	0.028
Child	0.058	0.028*	0.069	0.027*	0.063	0.026*
Income	−0.001	0.001	−0.001	0.001*	−0.001	0.000**
White	0.095	0.079	0.083	0.080	−0.002	0.082
Black	−0.061	0.110	−0.150	0.107	−0.137	0.108
Northeast	−0.100	0.076	−0.128	0.076	0.046	0.076
Midwest	−0.072	0.072	0.025	0.074	−0.021	0.074
South	−0.021	0.073	0.020	0.072	0.032	0.075
Thresholds						
/cut1	0.065	0.178	−0.713	0.177	−0.735	0.176
/cut2	0.986	0.178	0.003	0.176	0.006	0.176
Log pseudolikelihood	−2063.03		−2035.63		−2052.65	
Wald chi2	265.92		234.58		215.27	
Prob > chi2	0		0		0	
Pseudo R2	0.0646		0.0577		0.0527	

[z]SE indicates standard errors of the regression coefficients.

[y]***, **, * indicate significance at <0.1%, 1%, and 5%, respectively, relative to the base variables (including: non-female, less than a bachelor's degree, rural, other ethnicity, West region).

also improved these probabilities at 3.7% for songbirds, 3.2% for butterflies, 3.5% for pollinators, and 4.5% for bees. Older participants had slightly higher probabilities of wanting to attract songbirds, butterflies, and pollinators, but not bees. Females had a 4.0% increased probability of wanting to attract butterflies and a 5.0% increased probability of wanting to deter bees from their landscapes compared to other genders. People with bachelor's degrees or higher were 5.9% more likely to want to attract bees compared to those with lower education levels. Compared to rural residents, suburban and urban residents had decreased probabilities of wanting to attract songbirds, butterflies, pollinators, and bees. The number of adults in the household positively impacted the probability of wanting to attract songbirds. The presence of a child decreased the probability of wanting to attract pollinators by 2.8%. Compared to other ethnicities, white/Caucasian participants had higher probabilities of wanting to attract butterflies (7.5%), pollinators (7.2%), and bees (7.7%). Southern participants were 6.0% more likely to want to attract butterflies than Western participants but -5.5% less likely to want to attract bees. The reduced desire to attract bees may arise from the pervasive fear of bees (Fukano and Soga 2021) or potential allergies.

Tables 6 and 7 present the ordered probit model estimates and marginal effects for the three intermediate wildlife types (gamebirds, deer, chipmunks). Native plant knowledge and nature relatedness index ratings increased participants' probability of wanting to attract all three of these types of wildlife (Tables 6 and 7). Age, female

Table 7. Marginal effects estimates from an ordered probit model on neutral wildlife in residential landscapes from an online US consumer survey (n = 2011).

	Gamebirds			Deer			Chipmunks		
	Deter (1) dy/dx[z]	Neutral (2) dy/dx	Attract (3) dy/dx	Deter (1) dy/dx	Neutral (2) dy/dx	Attract (3) dy/dx	Deter (1) dy/dx	Neutral (2) dy/dx	Attract (3) dy/dx
Native Plant Knowledge	−3.8%***[y]	−0.3%**	4.1%***	−2.1%*	0.2%*	1.9%*	−2.7%**	0.3%*	2.4%**
Nature Relatedness	−5.7%***	−0.4%**	6.1%***	−3.1%***	0.3%***	2.8%***	−2.6%***	0.3%***	2.3%***
Age	0.2%***	0.0%*	−0.2%***	0.7%***	−0.1%***	−0.6%***	0.6%***	−0.1%***	−0.6%***
Female	12.3%***	0.8%**	−13.2%***	6.3%**	−0.6%**	−5.7%**	5.9%**	−0.6%**	−5.2%**
Suburb	7.0%***	0.5%*	−7.4%***	7.8%***	−0.8%**	−7.0%***	5.0%*	−0.5%*	−4.5%*
Urban	5.6%*	0.4%	−6.0%*						
Child	−1.9%*	−0.1%	2.0%*	−2.5%*	0.2%*	2.3%*	−2.3%*	0.2%*	2.1%*
Income				0.0%*	−0.0%*	−0.0%*	0.0%**	−0.0%*	−0.0%**

[z]dy/dx indicates the marginal effect indicating the change from the base variables.

[y]***, **, * indicate significance at <0.1%, 1%, and 5%, respectively, relative to the base variables (including: non-female, less than a bachelor's degree, rural, other ethnicity, West region). Only significant variables are shown.

Table 8. Ordered probit model estimates for less desired wildlife in residential landscapes from an online US consumer survey (n = 2011).

	Insect		Bat		Snake	
	Coef.	SE[z]	Coef.	SE	Coef.	SE
Native Plant Knowledge	0.188	0.029***[y]	0.158	0.030***	0.126	0.034***
Nature Relatedness	0.131	0.021***	0.133	0.021***	0.107	0.024***
Age	−0.008	0.002***	−0.007	0.002***	−0.015	0.002***
Female	−0.162	0.055**	−0.065	0.058	−0.284	0.063***
BSplus	0.152	0.060*	0.056	0.063	0.172	0.068*
Suburb	−0.124	0.062*	−0.156	0.064*	−0.097	0.072
Urban	−0.025	0.080	−0.059	0.082	0.084	0.090
Adult	−0.033	0.029	−0.015	0.029	−0.081	0.033*
Child	0.017	0.028	−0.006	0.029	0.029	0.032
Income	−0.001	0.001	0.000	0.001	0.000	0.001
White	0.064	0.082	0.291	0.086***	0.107	0.092
Black	0.033	0.110	−0.125	0.119	−0.017	0.128
Northeast	−0.022	0.075	0.001	0.079	−0.048	0.087
Midwest	0.056	0.075	0.133	0.078	−0.017	0.088
South	0.008	0.076	−0.019	0.079	−0.077	0.088
Thresholds						
/cut1	0.841	0.186	1.289	0.195	0.762	0.220
/cut2	1.751	0.189	1.944	0.196	1.421	0.219
Log pseudolikelihood	−1902.58		−1759.59		−1300.69	
Wald chi2	207.69		170.82		199.1	
Prob > chi2	0		0		0	
Pseudo R2	0.0573		0.0491		0.0749	

[z]SE indicates standard errors of the regression coefficients.

[y]***, **, * indicate significance at <0.1%, 1%, and 5%, respectively, relative to the base variables (including: non-female, less than a bachelor's degree, rural, other ethnicity, West region).

gender, and suburban residency negatively impacted wanting to attract these types of wildlife (Table 6). Higher incomes decreased wanting to attract deer or chipmunks and living in an urban area decreased participants wanting to attract gamebirds to their landscapes. Having a child in the household improved participants wanting to attract all three types of wildlife. When considering the marginal effect estimates, older participants had a higher probability of wanting to deter gamebirds (0.2%), deer (0.7%), and chipmunks (0.6%) relative to younger participants (Table 7). Females also had higher probabilities of wanting to deter gamebirds (12.3%), deer (6.3%), and chipmunks (5.9%). Suburban residents were less likely to want to attract these types of wildlife when compared to rural residents. Urban residents were 6.0% less likely to want to attract gamebirds than rural residents. People with children had an increased probability of wanting to attract gamebirds (2.0%), deer (2.3%), and chipmunks (2.1%) possibly to delight or entertain their children. As household incomes increased, participants were less likely to want to attract deer or chipmunks to their properties, with potential concerns over landscape plant damage (Russell et al. 2001).

Tables 8 and 9 show the ordered probit model estimates and the significant marginal effects for the three types of wildlife people indicated they want to deter (insects, bats, snakes). Both native plant knowledge and nature relatedness positively impacted the probability of participants

Table 9. Marginal effects estimates from an ordered probit model on wildlife people prefer to deter from their residential landscapes from an online US consumer survey (n = 2011).

	Insect			Bat			Snake		
	Deter (1) dy/dx[z]	Neutral (2) dy/dx	Attract (3) dy/dx	Deter (1) dy/dx	Neutral (2) dy/dx	Attract (3) dy/dx	Deter (1) dy/dx	Neutral (2) dy/dx	Attract (3) dy/dx
Native Plant Knowledge	−6.9%***[y]	2.3%***	4.6%***	−5.6%***	1.8%***	3.8%***	−3.5%***	1.6%***	1.9%***
Nature Relatedness	−4.8%***	1.6%***	3.2%***	−4.7%***	1.5%***	3.2%***	−3.0%***	1.4%***	1.6%***
Age	0.3%***	−0.1%***	−0.2%***	0.2%***	−0.1%***	−0.2%***	0.4%***	−0.2%***	−0.2%***
Female	6.0%**	−2.0%**	−3.9%**	5.5%*	−1.7%*	−3.8%*	7.9%***	−3.6%***	−4.3%***
BSplus	−5.6%*	1.9%*	3.7%*				−4.8%*	2.2%*	2.6%*
Suburb	4.6%*	−1.5%*	−3.0%*						
Adult							2.2%*	−1.0%*	−1.2%*
White				−10.3%***	3.2%***	7.1%***			

[z]dy/dx indicates the marginal effect indicating the change from the base variables.

[y]***, **, * indicate significance at <0.1%, 1%, and 5%, respectively, relative to the base variables (including: non-female, less than a bachelor's degree, rural, other ethnicity, West region). Only significant variables are shown.

wanting to attract these three types of wildlife (Table 8). Older participants wanted to deter all three types of wildlife from their landscapes, females wanted to deter insects and snakes more so than other genders. Suburban residency increased wanting to deter insects and bats relative to rural residency. More adults in the household resulted in wanting to deter snakes from the landscape. Conversely, having a Bachelor's degree or higher increased participants probability of wanting to attract insects and snakes, while white/Caucasian ethnicity improved wanting to attract bats. When considering the marginal effect estimates, native plant knowledge and higher nature relatedness ratings improved participants' probability of wanting to attract all three types of wildlife to their landscapes (Table 9). Age and female negatively impacted the probability of wanting to attract these types of wildlife. Higher education levels improved the probability of wanting to attract insects (3.7%) and snakes (2.6%). Suburban residents were 3.0% less likely to want to attract insects than rural residents. The number of adults in the household decreased the probability of participants wanting to attract snakes by 1.2%. Lastly, white/Caucasian participants were 7.1% more likely to want to attract bats than people of other ethnicities.

In conclusion, native plants have tremendous ecosystem services benefits to humans and the environment. Marketing those benefits can be a powerful motivation for stimulating native plant purchases. Pollinators and songbirds are two of the types of wildlife that can be attracted to landscapes with plants that provide them with sustenance and/or habitat. However, other types of wildlife that might also be attracted to landscapes have received little study. Furthermore, nature relatedness, or feeling connected to the natural world, has been shown to increase human happiness and well-being and high nature relatedness ratings positively impacted participants' desire to attract various types of wildlife to their landscapes.

The first key finding supported existing literature. Many people wanted to attract songbirds (consistent with Rodriguez et al. 2017), butterflies, pollinators in general, and bees (consistent with Campbell et al. 2017, Wingall et al. 2019, Wratten et al. 2012) likely for their ecosystem benefits. Fewer participants wanted to attract deer or chipmunks, likely due to concerns over potential plant damage. Many participants wanted to deter insects, bats, and snakes, likely more from a fear of the organism itself than potential plant damage. Given the diverse nature of many markets, this finding supported our hypothesis.

The second key finding was that if participants were knowledgeable about native plants, they had an increased probability of wanting to attract songbirds, butterflies, pollinators in general, and bees. This finding also supported our hypothesis. An explanation may be that native plant knowledge can foster an appreciation for the interconnectedness of nature, and people with knowledge may be more aware of the vital role pollinators and other wildlife play in plant reproduction and the balance within a healthy ecosystem. Thus, our findings suggest that the connection to the positive attributes of native plants should be emphasized in marketing materials to better connect with potential native plant buyers.

The third key finding showed that a higher nature relatedness index score enhanced the desire to attract songbirds, butterflies, pollinators in general, and bees. This result supported the researchers' hypothesis. We expect that a high nature relatedness score indicates a strong feeling of connection with the natural world, which in turn, can motivate people with this connection to see songbirds, butterflies, pollinators in general, and bees as valuable parts of a healthy ecosystem they want to support. Higher nature relatedness improves happiness and well-being, so promoting these types of wildlife may, in turn, enhance the individual's emotional health.

This study also points out educational opportunities for native plant marketers. A campaign to teach people the benefits of promoting insects (other than butterflies) and bats in the landscape might improve plants sales once consumers understand how these types of wildlife can benefit the ecosystem, and more specifically their own private landscape.

Study limitations include a non-exhaustive list of potential wildlife and not accounting for fears and phobias. The term native plant was not defined for study participants. Their actual native plant knowledge was not assessed. Future research might include these parameters.

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