Received: 3 February 2021 | Revised: 9 July 2021 | Accepted: 4 August 2021

DOI: 10.1111/csp2.522

CONTRIBUTED PAPER

Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access

WILEY

Understanding landowner decisions regarding access to private land for conservation research

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Funding information
Global Change Center; National Fish and Wildlife Foundation, Grant/Award Number: 0407.17.058676; National Science Foundation, Grant/Award Number: IOS-17555055; Southeastern Association of Fish and Wildlife Agencies, Grant/Award Number: 2017-2020-VTECH

Abstract

Private land comprises over half the land mass of the United States—dominating certain ecosystems and hosting large numbers of threatened and endangered species. Understanding privately owned properties is thus critically important to conservation, yet these lands remain understudied by conservation biologists. A key factor in this lack of research is the difficulty of gaining permission to access private lands. However, there has been almost no empirical work to offer guidance for natural scientists on this issue. Using a combination of mail surveys and interviews, we undertook one of the first empirical studies of landowner decisions regarding access to their private property for research, and we identified the primary drivers and deterrents. We found that natural scientists may have more success gaining access if the landowners are interested in learning about the research taking place, if they have previously allowed research on their property, if they have positive attitudes toward conservation, and if they have larger properties. We also found that many landowners allowed research out of a desire to be helpful. Conversely, landowners are less likely to allow research if they are concerned that doing so will restrict free use of their property. Landowner age, education, trust in science, and attitude toward the subject of study were not significant predictors of landowner decisions. By considering our findings when requesting access to properties and engaging with landowners during research, scientists can improve their chances of accessing properties, enhance landowner satisfaction with the experience, and increase the likelihood that landowners will be amenable to future requests to conduct research on their land.

KEYWORDS

access, attitudes, hellbender, helpfulness, private lands, survey, trust in science

1 | INTRODUCTION

Over half the land mass of the United States is privately owned (USGS GAP, 2020), yet private lands, and the habitats and species they contain, remain understudied (Hilty & Merenlender, 2003; Martin, Blossey, & Ellis, 2012; Metzger, Bunce, van Eupen, & Mirtl, 2010; Norton, 2001). Problematically, findings from research on public and

private lands do not always align. For example, studies of the Northern Spotted Owl (*Strix occidentalis*) conducted on public lands have found different habitat and prey preferences than those conducted on private lands (Hilty & Merenlender, 2003), with implications for management. Additionally, public and private lands tend to dominate different habitats (Joppa & Pfaff, 2009; Scott et al., 2001). This means that some species, and in some cases almost entire ecosystems (e.g., temperate grasslands [Olson et al., 2001; USGS GAP, 2020]), are largely under private control and may be poorly understood as a result (e.g., NABCI, 2013). This is particularly concerning given the large portion of at-risk species that depend on privately owned habitat (US GAO, 1995).

The lack of research on private lands is largely due to the added difficulties that come with working on private property (Ciuzio et al., 2013; Hilty & Merenlender, 2003). A fundamental challenge is gaining permission to access private lands for research (Hargiss & Dekeyser, 2014). Understanding why landowners allow, or decline to allow, use of their property can help scientists gain access. Additionally, understanding why landowners allow research can help scientists foster a positive experience for participating landowners. Unfortunately, there is limited empirical guidance to help natural scientists navigating this challenge. The literature that does exist highlights the value of contacting landowners face-to-face or over the phone to request access, having someone with prior landowner connections on the team, making sure the study is palatable to landowners (e.g., not requiring long and frequent visits), sharing research with landowners, and being respectful of landowner properties (Dreitz & Knopf, 2007; Hargiss & Dekeyser, 2014; Hazell, 2004; Hilty & Merenlender, 2003; Lesser, 2001). However, these insights are almost entirely anecdotal or based on expert opinion (excluding Lesser, 2001), and they do not consider the landowners' own perspectives on why they allow research to take place.

Research on participation in conservation activities more generally, such as government- or NGO-sponsored land management programs, may also provide some insight as to why landowners allow conservation research on their property. Studies of participation in conservation activities suggest that landowners are more likely to participate if, among other traits, they have positive attitudes toward the conservation activity and previous experience with it, have positive attitudes toward the environment, are trusting of the conservation community, are interested in learning new management practices, have larger properties, and have high levels of formal education (Prokopy et al., 2019; Ranjan, Church, Floress, & Prokopy, 2019). Given the similar goals of conservation activities and conservation research, these findings may also pertain to allowing conservation research.

An important distinction between allowing research and participating in conservation activities is that allowing research may require more frequent access to the property by outside entities and less active engagement on the part of the landowner. These aspects of allowing research are more similar to allowing outside access for other activities, such as hunting. The literature regarding why landowners allow outside hunting access to their properties identifies several of the same predictors as the conservation activity literature (Brown, Decker, & Kelley, 1984; Guynn & Schmidt, 1984). However, it also suggests that landowner concerns that allowing hunting access would restrict free use of the property is a critical factor in landowner decisions (Hussain et al., 2007). Perceived restrictions on use of one's own property may also be important in determining whether landowners allow research access.

In this study, we focused on landowners' decisions to allow study of eastern hellbenders (*Cryptobranchus alleganiensis alleganiensis*) on their property. Hellbenders are large, aquatic salamanders that are suffering from declining populations (Wheeler, Prosen, Mathis, & Wilkinson, 2003). Much remains to be learned about their ecology and behavior, but the streams in which hellbenders are found often flow through private property, making their in situ study dependent on landowner cooperation (Nickerson & Mays, 1973; USGS GAP, 2020). Unfortunately, private landowners have traditionally had negative attitudes toward hellbenders (Nickerson & Mays, 1973), which may further complicate requests for access. Such a scenario is not uncommon for species of conservation concern (e.g., large carnivores [Muhly & Musiani, 2009]).

Using both survey and interview techniques, we investigated the factors influencing landowner decisions regarding property access for conservation research. Based on findings from previous research, we focused the survey on assessing landowners' (a) attitudes toward hellbenders, (b) attitudes toward conservation on their property, (c) trust in science, (d) previous experience allowing science on their property, (e) beliefs about research restricting property use, (f) interest in learning about the research taking place on their property, (g) property characteristics, and (h) demographics. We then used the interviews to add depth to our survey results and explore some additional possible predictors of landowner decisions about research access.

2 | METHODS

2.1 | Study site

Our research focused on the communities surrounding Copper Creek, a degraded waterway which runs through Scott and Russell counties in southwestern Virginia

(Martin, 2019). The creek has been identified as a watershed of high conservation value due to the large number of threatened and endangered species that live there (VDGIF, 2015). However, the watershed is almost entirely privately-owned, meaning that, as is the case for many watersheds (USGS GAP, 2020), landowners play an important role in stream research and management. The stream bank is under private control and landowners have the right to "reasonable use" of water resources on their property for agricultural or other purposes (Scott v. Burwell's Bay Improvement Association, 2011).

Residents of Scott and Russell Counties are primarily white, over the age of 65, educated to the completion of high school or receipt of a general equivalency diploma (GED—proof of high-school-level knowledge achieved through testing), and have a median income that is about two-third the national median (U.S. Census Bureau, 2019). These characteristics make the population a useful study group for understanding landowner decisions about allowing research on private property, as the majority of private land owners in the United States are of this demographic (USDA NASS, 2019). Additionally, previous studies suggest that individuals with lower levels of education and lower incomes are less likely to participate in conservation activities (Baumgart-Getz et al., 2012; Prokopy et al., 2008). For this reason, it may be particularly valuable to understand this group's decisions about allowing conservation research.

2.2 | Survey

In the fall of 2018, we administered a survey to all landowners over the age of 18 with property that abutted Copper Creek or one of its tributaries ($N = 885$). We requested that the survey be completed by "the primary decision maker in the household" in an effort to ensure that responses accurately reflected the decisions that households would make about allowing conservation scientists to access their properties. Our sample included 732 households with mailing addresses in Virginia, and 153 households with out-of-state addresses. The contact information used to reach landowners was drawn from the tax parcel records for Scott and Russell counties.

We mailed the initial, six-page, two-sided survey booklet (see supplementary material) between October and November 2018. As per the total design method (Dillman et al., 2014), the initial survey was followed by a reminder postcard 1–2 weeks later. For those who had yet to respond, a second complete survey was mailed 2–6 weeks after the postcard (this range in mailing dates is the result of printing delays and strategic avoidance of holidays). At least 1 month following the second full survey mailing, we sent a one-page, two-sided nonresponse survey to those who had yet to respond. This survey contained a subset of questions from the full survey and was used to check for significant differences between those who responded to the initial survey (respondents) and those who did not (nonrespondents).

The landowner characteristics we focused on in our survey were drawn from previous research about landowners allowing conservation activities or hunting on their property, and we assessed landowner attitudes toward hellbenders. Prior to distribution, the survey was reviewed by other social scientists at Virginia Tech, biologists with expertise in private lands research, and conservation professionals working in the Copper Creek area. It was also pretested with five landowners in another watershed. All statistical analyses were performed using R 3.6.2.

To assess landowner attitudes toward science and conservation on their property, we used a series of four semantic differential items for each ("item" is used in place of "question" because not all items are interrogatives). We analyzed each set of four items for internal consistency using Cronbach's alpha in the umx package (Bates, Neale, & Maes, 2019). We then averaged scores across items to create a single mean score for each attitude.

To assess landowner trust in science, we used Stern and Coleman's (2015) trust ecology framework which breaks trust into four types: rational trust (based on expected outcomes), procedural trust (based on rules and processes ensuring honesty), affinitive trust (based on affinity for the trustee), and dispositional trust (inherent levels of trusting). We assessed the first three of these aspects using two, 5-point, Likert-scale questions for each aspect. We assessed dispositional trust through a single item. We then performed confirmatory factor analysis using R's Lavaan package (Rosseel, 2012). We found very high levels of correlation among all items and were not able to distinguish the different facets of trust. Because of this, we used the umx package's Cronbach's alpha function (Bates et al., 2019) to test for internal consistency between items, and then averaged across all items to create a single score for trust in science.

We used a single yes/no item to determine whether landowners had previous experience allowing research on their property, a single Likert-scale item to determine landowner interest in learning about the research taking place on their property, and a single Likert-scale item to assess their level of concern that allowing research would restrict free use of their property. Property characteristics and demographics were assessed through open ended and multiple-choice questions.

At the conclusion of the survey, we asked landowners "Are you willing to be contacted by Virginia Tech to discuss research on your property?" We used a logistic regression with a binomial distribution (Dobson & Barnett, 2018) to assess the extent to which the landowner responses to other survey questions predicted their response to this question. We assessed significance using analysis of variance employing the "car" package in R (Fox & Weisberg, 2019).

2.3 | Interviews

Following the survey, we conducted semistructured, in-person interviews with a subset of the respondents. Participants were only contacted for an interview if they had agreed in the survey to be contacted to discuss research on their property. Contacts were also limited to landowners who provided their phone number and responded affirmatively to a survey question about whether they had a creek on their property. This resulted in a total of 108 individuals who were eligible for contact.

We attempted to contact landowners by phone no more than four times and left only one voicemail before considering them no longer available for the project. Upon making contact with a landowner, we asked if they would be willing to participate in one of two research projects. If the creek on their property was suitable for supporting hellbender populations, we asked the landowners if they would be interested in allowing scientists to install underwater concrete shelters (as in Button et al., 2020) for hellbenders on their property as part of a research project. If their property was not suitable for hellbenders, we asked landowners if they would be interested in participating in a citizen science project where they would collect water quality data to inform research on hellbenders.

Of the 108 individuals we attempted to contact, 45 were unreachable, seven were no longer interested in participating, four agreed to participate but we were unable to arrange an interview, and 15 were ineligible for participation due to other causes (e.g., the property was owned by a corporation, the landowner was unwell, etc.). This left us with 37 willing interviewees. Ten of these individuals were interviewed about a citizen science project and twenty-seven were interviewed about allowing hellbender research.

During the interviews, we asked landowners open-ended questions about their property, their experience living in the Copper Creek area, their trust in science, their experience with science, why they agreed to allow research on their property, and what would make them hesitate to allow research. These questions added nuance to our understanding of what drives landowner decisions. All interviews were conducted face-to-face on the landowners' properties except one, which was conducted over the phone with a landowner who lived out of state and was unable to meet in person. Given the large amount of information that was gained from the surveys, we were able to limit our question list to 16 questions. The lead author conducted all interviews accompanied by an assistant who took notes on interviewee responses. All but one of the interviews were also recorded. In this one case, the landowner asked not to be recorded, so the assistant's notes were used instead of a transcribed recording.

The lead author transcribed landowner interviews using inqScribe, and coded the transcripts using MaxQDA. As is often the practice in social science research (e.g., Haywood et al., 2016), the lead author coded all interviews. She was well-positioned to do so, having been present for all interviews and understanding the context for the comments made by landowners. All interviews went through two rounds of inductive coding. During the first round, the lead author identified and clarified codes as she read through the transcripts. In the second round, she clarified codes and reanalyzed all transcripts. She also deductively coded interviews using the trust ecology framework. To do this, she coded landowner responses as indicating trust, lack of trust, or distrust of science, and then categorized quotes as procedural, affinitive, rational, or dispositional.

3 | RESULTS

3.1 | Survey respondents

We received a 26% response rate to our full survey ($n = 230$). Respondents were primarily male (71%), with a mean age of 65. Forty-eight percent of respondents indicated high school completion or a GED was their highest level of education, making this the most common response. The age and education levels of respondents were representative of the area as a whole (U.S. Census Bureau, 2019). Seventy-one of our respondents (30.8%) were absentee landowners who did not currently live on their property in the Copper Creek area.

3.2 | Nonresponse survey

Fifty-one of the six hundred and fifty five nonresponse surveys we distributed were returned, for a 7.1% response rate. Wilcoxon test comparisons revealed that the respondents to the nonresponse survey were older ($x_{\text{survey}} = 64.9$, $x_{\text{noresponse}} = 69.9$, $r = .201$, $p = .001$), had less positive

TABLE 1 Average responses (where applicable) and percent respondents giving each response for the predictor variables included in the model

Predictor variable	Survey item(s)	Possible responses	Percent total respondents or mean value	Percent respondents agreeing to contact or mean value	Percent respondents declining contact or mean value
Interest in learning about the research taking place	I would enjoy learning about the research taking place on my property	Strongly disagree	5.405	2.985	8.642
		Disagree	3.604	0.746	8.642
		Neither agree nor disagree	26.126	11.940	46.914
		Agree	33.333	39.552	25.926
		Strongly agree	31.531	44.776	9.877
Previous experience with research	Have you ever allowed research to take place on property you own (in Scott and/or Russell County or elsewhere)?	Yes	23.556	35.821	6.098
		No	76.444	64.179	93.90
Fear of restrictions	Allowing research on my property would lead to restrictions in what I can do with my property	Strongly disagree	16.300	25.000	3.614
		Disagree	13.216	16.912	6.024
		Neither agree nor disagree	36.564	30.147	44.578
		Agree	21.586	22.059	22.892
		Strongly agree	12.335	5.882	22.892
Attitudes toward conservation on property	I would describe conserving nature on my property as: important... unimportant beneficial... harmful interesting... uninteresting	Attitudes were rated from 1 to 5. Scores closer to one represent more positive attitudes while scores closer to five represent more negative attitudes	Mean: 1.771	Mean: 2.102	Mean: 1.563
Size of property[a]	Approximately how many acres of property do you (or your spouse) own or rent in Scott and/or Russell County, Virginia?	Open response	Mean: 113.848	Mean: 68.568	Mean: 143.455
Education	What is the highest level of education you have attained?	Less than high school/GED	8.929	3.676	16.049
		High school diploma/GED	47.768	47.794	50.617
		Associates degree	19.642	22.794	13.580
		Undergraduate degree	12.946	13.971	9.877
		Graduate or professional degree	10.714	11.765	9.877

(Continues)

TABLE 1 (Continued)

Predictor variable	Survey item(s)	Possible responses	Percent total respondents or mean value	Percent respondents agreeing to contact or mean value	Percent respondents declining contact or mean value
Attitudes toward hellbenders	I would describe hellbenders as disgusting... appealing good... bad harmful... beneficial interesting... uninteresting	Attitudes were rated from 1 to 5. Scores closer to one represent more positive attitudes while scores closer to five represent more negative attitudes.	Mean: 2.679	Mean: 0.343	Mean: 2.588
Age	What year were you born? (subtracted from survey year to calculate age)	Open response	Mean: 64.884	Mean: 65.513	Mean: 64.227
Trust in science	Average score based on six Likert-scale questions	Scores closer to five are more trusting while scores closer to one are less trusting	Mean: 3.668	Mean: 3.487	Mean: 3.767

[a]The median property size was 59 acres for those agreeing to be contacted, 40 for those declining, and 50 acres overall.

attitudes toward conservation ($x_{survey} = 1.644$, $x_{nonresponse} = 2.090$, $r = .147$, $p = .021$), and were less interested in learning about the research taking place on their property ($x_{survey} = 3.823$, $x_{nonresponse} = 3.340$, $r = .154$, $p = .011$) than those who responded to the full survey. The practical importance of these differences is likely to have been small. Differences in age of 65 versus 70 years may not represent meaningful differences in life experience and the other two factors differed by less than a half point on the Likert scale.

3.3 | Regression analysis

We found satisfactory internal consistency in our measures of landowner attitudes toward conservation ($\alpha = .725$), but dropped one reverse-coded item due to its very low correlation with the remaining items (correlation $= -0.081$, revised $\alpha = .907$). Although the internal consistency in our hellbender attitude scores was somewhat low ($\alpha = .665$), no items were recommended for removal. Our trust items had good internal consistency ($\alpha = .801$). Landowners were, on average, fairly neutral in their trust in science, had fairly positive attitudes toward conservation, and had neutral attitudes toward hellbenders (Table 1).

The property size of survey respondents ranged from less than an acre to 4,000 acres. The 4,000-acre property was an outlier, but the removal of this property had no effect on the outcome of our model, so it was included in the regression.

From our logistic regression model, we found that landowners were more likely to agree to be contacted regarding research on their property if they were more interested in learning about the research taking place ($p < .001$), if they had previously allowed research on their property ($p = .001$), if they had more positive attitudes toward conservation on their property ($p = .032$), and if they had larger properties ($p = .043$). Concerns that participating in research would restrict landowner use of their property had a significantly negative correlation with agreeing to be contacted for participation ($p = .001$). We did not find a significant effect of trust in science, education, age, or attitudes toward hellbenders on landowner willingness to be contacted (in all cases $p \geq .185$; Table 2). McFadden's pseudo r^2 for the model was .254.

4 | INTERVIEW RESPONDENTS

Interviewees had an average age of 65, were primarily male (67%), and owned an average of 89 (median of 67) acres of land. Although most interviews ($n = 30$) were conducted with single individuals, five interviews were conducted with husband and wife pairs, and two

were conducted with mother and adult son pairs. The interviews lasted between 8 and 54 min with an average of 22 min. According to Wilcoxon test comparisons, those who refused the interview or who were unavailable were not significantly different from those who consented to the interview on any of the parameters included in our regression model (in all cases $p \geq .098$). We also had similar coding results between interviews with landowners who were asked to participate in the citizen science project and interviews with landowners who were asked to allow research. For this reason, we do not distinguish between them in our results.

5 | INTERVIEW INSIGHTS

When asked why they were allowing research on their property, many landowners stated an interest in learning about the research—a finding which corroborates our survey results. For example, one landowner said "I think it's always... interesting to know what's here, what you're studying...and what you do..." Also in line with the survey, many of the landowners who were willing to participate in research expressed positive attitudes toward nature and conservation.

Although our survey did not show trust to be a significant predictor of landowner decisions about allowing research, our interviews suggested that landowners' have complicated levels of trust in science. Many landowners stated that they were trusting of science overall, but they had specific aspects of science, such as climate change, of which they were distrustful. The highly politicized nature of most of these distrusted aspects suggests that cultural affiliation might have an important role in determining trust (Gauchat, 2012). Relatedly, the importance of the source of scientific information also came up numerous times. For example, one landowner said "I've got(ten) less trusting. And I think a lot of that is due to the media...I don't trust media no more. And I think we can all agree that they lie to us and they feed us what we want to hear."

The most common aspects of trust that landowners discussed from the trust ecology framework were dispositional and rational trust. Only landowners who described themselves as trusting of science discussed procedural trust of the scientific process and affinitive trust of scientists. These aspects of trust were often the result of past experiences. For example, one landowner said, "I know in order to do things [scientists] go over and above and beyond to what most average people would even imagine... I saw that with (*name redacted*) and her group." This reference to prior interactions with another research team suggests that experiences with scientists and science can be important in shaping landowner trust.

We explored the importance of past experience further by asking landowners whether they had allowed research on their property previously. Several landowners stated that they had, and even more had friends or family members who had done so. These landowners generally had neutral or positive attitudes toward the experience, although few could express the exact details of the study. As one landowner said of a past experience, "I told [the scientist] sure [you can go in the creek] but now what they were doing I'm not sure...they never did come back, so I don't know what they figured." The most common complaint landowners had about past research was when scientists did not ask for permission prior to entering the property.

When asked if they had interacted with scientists working on their property, many landowners said they had not. However, this lack of interaction was not necessarily due to lack of interest. As one landowner explained of his interactions with scientists, "I might go visit them on the four-wheeler and take them something to drink or something, but no I don't...stay with them. I think I'm just bothering them." Relatedly, many landowners self-consciously described themselves as not having any experience with the sciences. For example, one landowner said "I ain't—I don't have none...pretty much all I've ever done is welded ... as far as having anything to do with science I— (nervous laugh)."

Finally, many landowners also expressed a personal norm, or internalized value, of being helpful as a motivation for allowing research. For example, when asked why he was allowing research, one landowner said, "you know, I got that thing about the survey, and I thought yeah that's okay. That would be awesome to help them out." The importance of helpfulness may, in part, have been primed by how we phrased our requests for participation. In both the survey and our phone contact requesting an interview, we specifically asked landowners for their help, as suggested by Dillman et al.'s (2014) guide to survey technique.

In addition to asking landowners why they were allowing research, we also asked landowners to consider what, if anything, would make them hesitate to allow research on their property. The most common response to this question was that landowners would be concerned if the research were somehow destructive to their property. Concerns about research being destructive were followed closely by concerns about the research interfering with the landowner's free use of their property or their lifestyle while the research was taking place. For example, one landowner said "Just if it, you know, impeded our use of the property. That'd be about my only concern." This finding mirrored that of our survey. The concerns landowners expressed about limitations to use

TABLE 2 Regression table for the best model predicting landowner consent to be contacted regarding research

Predictor variable	*B*[a]	*SE*	Wald χ^2	Odds ratio	*p*
Interest in learning about research	1.012	0.237	22.777	2.750	<.001***
Previous experience allowing research	1.835	0.635	10.736	6.266	.001***
Concerns about restrictions	−0.588	0.195	10.116	0.556	.001***
Attitudes toward conservation on property	−0.440	0.206	4.578	0.644	.032*
Size of property	0.003	0.002	4.105	1.003	.043*
Bachelor's or higher	0.516	0.394	1.724	1.675	.189
Attitudes toward hellbenders	0.332	0.278	1.432	1.393	.231
Age	−0.019	0.018	1.052	0.981	.305
Trust in science	−0.173	0.380	0.208	0.841	.648

[a]Beta values are presented on the logit scale.
[b]We tested the effect of education using both the 5-point scale (Table 1) and the 2-point scale shown here (including "bachelor's degree or higher" and "associates degree or lower"). Although we do not show the fine scale results here, they also did not show that education had a significant effect on landowner decisions (Unpublished data).

of their property were focused on the presence of scientists interrupting planned activities (e.g., making it unsafe to hunt, disturbing visiting relatives). No landowners mentioned concerns about the potential land use restrictions emerging from discovery of threatened or endangered species on their property during research.

6 | DISCUSSION

Understanding landowner decisions about allowing conservation research on their property has the potential to facilitate private lands research and improve landowner and scientist experiences. Our study represents one of only a very small number of empirical investigations of this topic, and it is the only study to incorporate landowners' own perspectives on why they allow research.

Since there has been limited empirical study of why landowners allow access to their properties for research, we drew from research into why landowners participate in conservation activities or allow hunting on their property to design our study. We found that, while there are some similarities across the three behaviors, allowing research on their properties can not necessarily be predicted by all of the same factors as the other two behaviors. Similar to findings regarding participation in conservation activities (Prokopy et al., 2019; Ranjan et al., 2019), we found that landowners were more likely to allow research on their property if they were interested in the research taking place, had previously allowed research, had larger properties, and had more positive attitudes toward conservation. However, we did not find a significant role of trust or formal education level in determining whether landowners allowed research. In alignment with the hunting literature (Hussain et al., 2007), we found that the greatest deterrent to landowners allowing research was a concern that research would interfere with their property use. One of the unique predictors of landowner participation in research was landowners' motivation to allow research out of a desire to be helpful. We may have found this unique result because, in comparison to participation in conservation activities which often have clearly identifiable outcomes for the landowner, allowing research may have less tangible benefits to the landowner and may therefore rely on different motivations. Our results provide several key considerations for scientists hoping to gain access to private lands for research.

6.1 | Avoid parachute science

"Parachute science" is a concept commonly used in the context of international research describing when foreign scientists "parachute" in to a country, collect data, and leave without providing anything of lasting benefit to the local populations (Barber et al., 2014). However, this concept is also applicable in the context of more local research. The results of both our interviews and surveys suggest that teaching landowners about the research taking place on their property is a clear way that scientists can give back to landowners. An interest in learning about the research taking place on their property was a primary reason why landowners allowed the research to take place, yet our study suggests that scientists often do not clearly share their study results with landowners.

We recommend that scientists share their research before (e.g., provide a clear explanation of their study plans), during (e.g., invite landowners to join them in the field), and after (e.g., provide reports of results) the field

study. Even if the landowner is hesitant or seemingly uninterested in engaging, scientists may still want to keep the door open for communication. Standoffishness may be due to the landowner's lack of confidence in their scientific knowledge or a concern about wasting the scientist's time rather than a genuine lack of interest, as we heard from landowners in our interviews.

In addition to helping the landowner get more out of the research, engaging landowners may benefit the scientist as well. As has been identified in several previous papers (e.g., Hazell, 2004; Oliver et al., 2012), engaging with landowners provides a chance to tap into local ecological knowledge which can benefit the study. It also can build trust and support for the research by providing scientists with the opportunity to demonstrate characteristics of trustworthiness such as ability, benevolence, and integrity (Lutter, Dayer, Heggenstaller, & Larkin, 2018; Stern, 2018). Engaging landowners can also strengthen the additional types of trust that were less salient for landowners without experience working with scientists, such as procedural or affinative trust.

6.2 | Focus on helpfulness

In addition to an interest in learning, our interview results show that landowners who allow research on their property often have a personal norm, or a sense of moral obligation, for being helpful. Combined with landowner interest in learning, this desire to be helpful suggests that allowing research may be considered a prosocial behavior (a behavior intended to benefit individuals other than the self, such as volunteering (Batson & Powell, 2003)). Increasing understanding (learning) and acting on values (helpfulness) are among Clary and Snyder's (1999) six motivations for volunteering. Although we did not investigate the other motivations in this study, they may warrant attention in future research.

Scientists seeking access to private lands may benefit from emphasizing that landowners will be helping out by allowing access to their property. This technique is already widely adopted in social science survey research, which has found that emphasizing the need for help improves response rates (Mowen & Cialdini, 2016; Dillman et al., 2014). Additionally, the importance of helpfulness indicates that offering incentives to landowners in exchange for allowing access to their land is inadvisable, as this can ultimately discourage prosocial motivation and reduce landowner participation (Batson & Powell, 2003; Deci, Ryan, & Koestner, 1999; Frey & Jegen, 2001). Instead, scientists can emphasize that they personally appreciate the landowner's help.

6.3 | Consider landowner attitudes

We found that landowner attitudes toward science, nature, and conservation played an important role in landowners allowing research on their property. Although attitudes alone do not necessarily predict behaviors (Fishbein & Ajzen, 2011), they are an important component of what determines human actions. If scientists are able to get a sense of landowner attitudes toward science, nature, and conservation (e.g., through surveys or guided conversations), they may be able to frame their requests such that they speak to landowner attitudes. This knowledge could also be learned through contacts with other scientists working in the area, collaboration with social scientists, or connections with local extension offices.

6.4 | Build landowner trust

Our survey results did not show a significant role of trust in predicting landowner decisions regarding allowing research. However, trust is often difficult to measure (Stern & Coleman, 2015), and our interviews suggested that landowners had nuanced trust that varied depending on the aspect of science which may have made us less likely to find a significant result. Previous research suggests that trust is generally highly predictive of behavior (Stern & Baird, 2015) and it has been shown to be important in other private land use decisions (Lutter et al., 2018; Ranjan et al., 2019), so it is likely still important to consider the role of trust when reaching out to landowners.

Many landowners spoke of past experiences with scientists as informing their levels of trust, and affinitive and procedural trust were only mentioned by landowners who had previously worked with scientists. Additionally, trust building with one landowner may increase trust among other landowners as well (Stern, 2018). The value of past experiences emphasizes the importance of scientists paying careful attention to the impressions they are making with landowners, as these interactions can have lasting effects. Scientists should take care not to damage landowner trust, but, if they accidentally do so, trust may be regained through apology, acceptance of responsibility, and rapid, subsequent displays of competence. It may also be helpful to develop procedures to prevent repeated mistakes and share them with landowners (Stern, 2018).

6.5 | Respect landowners' property use

One of the most important predictors of landowners declining research on their property was concern that

allowing research would restrict use of their property or cause the landowner to lose control of how his/her land is managed. Many scientists already seek to minimize the disturbance their studies cause, but the prominence of this concern in driving landowners' decisions heightens its importance. Given the variation in land use across properties and the lack of first-hand land management (e.g., farming) experience by some scientists, it could be useful to discuss study design with landowners in the planning stages of projects to ensure they will be compatible with land use. Additionally, when requesting permission for access, scientists should explicitly and honestly discuss what, if any, limitations in property use may result from allowing the research as well as any physical changes that may be made to the property and how they will be mitigated. Landowners in our study did not express concern about the discovery of threatened or endangered species on their property, but this is a known concern among some landowners (e.g., Kishida, 2001; Lueck & Michael, 2003). Explicitly explaining what, if any, actions will be taken upon discovery of a listed species can also be an important way to ensure landowners make an informed decision about allowing research on their property.

6.6 | Conclusions

An overarching theme in our research was the lasting impact that scientists can have in their interactions with landowners. Many landowners who agreed to allow our hellbender research had previously allowed research on their property or mentioned that friends or family members had done so, indicating that past experiences of the individual and their peers are important in landowner decisions.

By considering the drivers of decision-making by landowners when requesting access to private lands, scientists can improve their chances of gaining access, and they can begin to address the disparity in conservation research (Hilty & Merenlender, 2003) between private and public lands. By continuing to keep these drivers in mind throughout the research project, scientists can help ensure that their research benefits themselves, the landowners, and future scientists seeking access for years to come.

ACKNOWLEDGMENTS

Thank you to the landowners who participated in this research project. The National Fish and Wildlife Foundation, a fellowship from the Global Change Center at Virginia Tech, the National Science Foundation, and the U.S. Fish and Wildlife Service/Southeastern Association of Fish and Wildlife Agencies provided financial support for this work. Virginia Tech's Open Access Subvention Fund covered the cost of publication. The authors appreciate feedback from P. Angermeier and M. Stern as well as assistance from J. D. Kleopfer and M. Pinder and B. Beaty. J. Groffen, H. Davie, S. Beers, M. Lee, and E. Bennick assisted with data collection.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Rebecca S. M. O'Brien: Conceptualization; methodology; project administration; formal analysis; investigation; data curation; and writing-original draft. **Ashley A. Dayer**: Conceptualization; methodology; writing-review and editing; supervision; and funding acquisition. **William A. Hopkins**: Writing-review and editing; supervision; funding acquisition; and project administration.

DATA AVAILABILITY STATEMENT

Due to confidentiality requirements, the data used for this manuscript are unavailable for public access.

ETHICS STATEMENT

This article is the authors' original work reflecting their own research and analysis honestly and completely. The paper appropriately credits the contributions of authors and co-researchers as well as properly citing sources. All authors have been actively involved in the work leading to this paper and take responsibility for its content. Our research was reviewed and approved by the Virginia Tech Institutional Review Board (IRB #18-444).

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REFERENCES

Bates, T. C., Neale, M. C., & Maes, H. H. (2019). umx: A library for structural equation and twin modelling in R. *Twin Research and Human Genetics*, *22*, 27–41.

Batson, C. D., & Powell, A. (2003). Altruism and prosocial behavior. In T. Millon, M. Lerner, & I. Weiner (Eds.), *Handbook of psychology* (pp. 463–484). Hoboken, NJ: John Wiley & Sons.

Barber, P. H., Ablan-Lagman, M. A., Ambariyanto, Berlinck, R. G. S., Cahyani, D., Crandall, E. D., ... Willette, D. A. (2014). Advancing biodiversity research in developing countries: The need for changing paradigms. *Bulletin of Marine Science*, *90*, 187–210.

Baumgart-Getz, A., Prokopy, L., & Floress, K. (2012). Why farmers adopt best management practice in the United States: A meta-analysis of the adoption literature. *Journal of*

Environmental Management, *96*, 17–25. https://doi.org/10.1016/j.jenvman.2011.10.006

Brown, T. L., Decker, D. J., & Kelley, J. W. (1984). Access to private lands for hunting in New York: 1963-1980. *Wildlife Society Bulletin*, *12*, 344–349 Retrieved from https://www.jstor.org/stable/3781106

Button, S. T., Hallagan, J. J., Bodinof Jachowski, C. M., Case, B. F., Groffen, J., & Hopkins, W. (2020). Weathering the storm: Improving the availability and stability of artificial shelters for hellbender salamanders. *River Research and Applications*, *36*, 1944–1953.

Ciuzio, E., Hohman, W. L., Martin, B., Smith, M. D., Stephens, S., Strong, A. M., & VerCauteren, T. (2013). Opportunities and challenges to implementing bird conservation on private lands. *Wildlife Society Bulletin*, *37*, 267–277.

Clary, E. G., & Snyder, M. (1999). The motivations to volunteer: Theoretical and practical considerations. *Current Directions in Psychological Science*, *8*, 156–159.

Deci, E. L., Ryan, R. M., & Koestner, R. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, *125*, 627–668.

Dobson, A. J., & Barnett, A. G. (2018). *An introduction to generalized linear models*. CRC press.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method*. John Wiley & Sons.

Dreitz, V. J., & Knopf, F. L. (2007). Mountain plovers and the politics of research on private lands. *Bioscience*, *57*, 681–687.

Fox, J., & Weisberg, S. (2019). *An R companion to applied regression, third edition*. Thousand Oaks, CA: Sage.

Fishbein, M., & Ajzen, I. (2011). *Predicting and changing behavior: The reasoned action approach*. Taylor & Francis.

Frey, B. S., & Jegen, R. (2001). Motivation crowding theory. *Journal of Economic Surveys*, *15*, 589–611.

Gauchat, G. (2012). Politicization of science in the public sphere: A study of public trust in the United States, 1974 to 2010. *American Sociological Review*, *77*, 167–187.

Guynn, D. E., & Schmidt, J. L. (1984). Managing deer hunters on private lands in Colorado. *Wildlife Society Bulletin*, *12*, 12–19.

Hargiss, C. L. M., & Dekeyser, E. S. (2014). The challenges of conducting environmental research on privately owned land. *Environmental Monitoring and Assessment*, *186*, 979–985.

Hazell, D. (2004). Ecological research on private land: Lessons from the farm. *Pacific Conservation Biology*, *10*, 164–172.

Haywood, B. K., Parrish, J. K., & Dolliver, J. (2016). Place-based and data-rich citizen science as a precursor for conservation action. *Conservation Biology*, *30*, 476–486.

Hilty, J., & Merenlender, A. M. (2003). Studying biodiversity on private lands. *Conservation Biology*, *17*, 132–137.

Hussain, A., Munn, I. A., Grado, S. C., West, B. C., Jones, W. D., & Jones, J. (2007). Willingness to provide fee-access hunting. *Forest Science*, *53*, 493–506.

Joppa, L., & Pfaff, A. (2009). High and far: Biases in the location of protected areas. *PLoS One*, *4*, 1–6.

Kishida, D. (2001). Safe Harbor agreements under the Endangered Species Act: are they right for Hawaii? *University of Hawaii Law Review*, *23*, 507–553.

Lesser, V. M. (2001). Applying survey research methods to account for denied access to research sites on private property. *Wetlands*, *21*, 639–647.

Lueck, D., & Michael, J. A. (2003). Preemptive habitat destruction under the endangered species act. *Journal of Law and Economics*, *46*, 27–60.

Lutter, S. H., Dayer, A., Heggenstaller, E., & Larkin, J. L. (2018). Effects of biological monitoring and results outreach on private landowner conservation management. *PLoS One*, *13*, 1–15.

Martin, L. J., Blossey, B., & Ellis, E. (2012). Mapping where ecologists work: Biases in the global distribution of terrestrial ecological observations. *Frontiers in Ecology and the Environment*, *10*, 195–201.

Martin, Z. (2019). Relating fine sediment dynamics and best management practices (BMPs) to instream habitat conditions for priority fishes and mussels in the Copper Creek watershed.

Metzger, M. J., Bunce, R. G. H., van Eupen, M., & Mirtl, M. (2010). An assessment of long term ecosystem research activities across European socio-ecological gradients. *Journal of Environmental Management*, *91*, 1357–1365. https://doi.org/10.1016/j.jenvman.2010.02.017

Mowen, J. C., & Cialdini, R. B. (2016). On implementing the door-in-the-face compliance technique in a business. *Journal of Marketing Research*, *17*, 253–258.

Muhly, T. B., & Musiani, M. (2009). Livestock depredation by wolves and the ranching economy in the northwestern U.S. *Ecological Economics*, *68*, 2439–2450. https://doi.org/10.1016/j.ecolecon.2009.04.008

Nickerson, M. A., & Mays, C. E. (1973). *The Hellbenders: North American "giant salamanders"*. Milwaukee, WI: Milwaukee Public Museum.

Norton, D. A. (2001). Is the amount and focus of ecological research in New Zealand sufficient to sustain indigenous biodiversity on private land? *New Zealand Journal of Ecology*, *25*, 77–82.

North American Bird Conservation Initiative (NABCI), U.S. committee. (2013). *The state of the Birds 2013 report on private lands*. (Vol. 48, pp. 1–48). Washington, DC: U.S. Department of Interior.

Oliver, D. M., Fish, R. D., Winter, M., Hodgson, C. J., Heathwaite, A. L., & Chadwick, D. R. (2012). Valuing local knowledge as a source of expert data: Farmer engagement and the design of decision support systems. *Environmental Modelling and Software*, *36*, 76–85. https://doi.org/10.1016/j.envsoft.2011.09.013

Olson, D. M. (2001). Terrestrial ecoregions of the world: A new map of life on earth: A new global map of terrestrial ecoregions provides an innovative tool for conserving biodiversity. *BioScience*, *51*, 933–938. https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2

Prokopy, L., Floress, K., Arbuckle, J. G., Church, S. P., Eanes, F. R., Gao, Y., ... Singh, A. S. (2019). Adoption of agricultural conservation practices in the United States: Evidence from 35 years of quantitative literature. *Journal of Soil and Water Conservation*, *74*, 520–534.

Prokopy, L., Floress, K., Klotthor-Weinkauf, D., & Baumgart-Getz, A. (2008). Determinants of agricultural best management practice adoption: Evidence from the literature. *Journal of Soil and Water Conservation*, *63*, 300–311. Available from http://www.jswconline.org/cgi/doi/10.2489/jswc.63.5.300

Ranjan, P., Church, S. P., Floress, K., & Prokopy, L. (2019). Synthesizing conservation motivations and barriers: What have we learned from qualitative studies of farmers' behaviors in the United States? *Society and Natural Resources*, *32*, 1171–1199.

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, *48*, 1–36.

Scott v. Burwell's Bay Improvement Association. (2001). Scott v. Burwell's Bay Improvement Association, 281 Va. 704, 708 S. E.2d 858 (Va. 2011).

Scott, J. M., Davis, F. W., McGhie, R. G., Wright, R. G., Groves, C., & Estes, J. (2001). Nature reserves: Do they capture the full range of America's biological diversity? *Ecological Applications*, *11*, 999–1007.

Stern, M. J. (2018). *Social science theory for environmental sustainability: A practical guide*. Oxford, England: Oxford University Press.

Stern, M. J., & Baird, T. D. (2015). Trust ecology and the resilience of natural resource management institutions. *Ecology and Society*, *20*, 14.

Stern, M. J., & Coleman, K. J. (2015). The multidimensionality of trust: Applications in collaborative natural resource management. *Society and Natural Resources*, *28*, 117–132.

Wheeler, B. A., Prosen, E., Mathis, A., & Wilkinson, R. F. (2003). Population declines of a long-lived salamander: A 20 +-year study of hellbenders, *Cryptobranchus alleganiensis*. *Biological Conservation*, *109*, 151–156.

U.S. Government Accounting Office (US GAO) (1995). *Species protection on nonfederal lands*. Washington, DC: US GAO.

U.S. census bureau (2019). QuickFacts United States. Available from https://www.census.gov/quickfacts/fact/table/US/AGE775219 (accessed August 2, 2020).

U.S. Geological Survey (USGS) Gap Analysis Project (GAP) (2020). Protected Areas Database of the United States (PAD-US) 2.1: U.S. Geological Survey data release. https://doi.org/10.5066/P92QM3NT

U.S. Department of Agriculture (USDA) NASS (2019). 2017 Census of agriculture report: United States summary and state data. AC-17-A-51. *Geography Area Series*, *51*. Washington, DC: United States Department of Agriculture.

Virginia Department of Game and Inland Fisheries (VDGIF), (2015). Henrico, VA: Virginia's 2015 Wildlife Action Plan.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: O'Brien, R. S. M., Dayer, A. A., & Hopkins, W. A. (2021). Understanding landowner decisions regarding access to private land for conservation research. *Conservation Science and Practice*, *3*(11), e522. https://doi.org/10.1111/csp2.522