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ORIGINAL RESEARCH

Does Absence Make the Heart Grow *Less* Fond? Spatial Proximity Partially Predicts Family Forest Landowner Engagement

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Abstract

Families constitute the largest forest ownership group in the United States. Previous research has suggested that absenteeism influences how families perceive, use, and manage their land. The extent to which prior findings are sensitive to different definitions of absenteeism is unclear, however. In this paper, the distance between landowners' residences and their forest land was calculated in order to compare different measures of absenteeism in terms of their statistical relationships with management and engagement activities. Data from the National Woodland Owner Survey were used to establish six binary definitions of an absentee owner based on fixed distances between landowners and their land. Bivariate tests were run to determine whether there were significant differences across these definitions between resident and absentee owners in terms of eighteen management and engagement variables. For more than half of these variables, whether differences between the two groups were statistically significant or not depended on the chosen threshold. Logistic regression models were also used to predict the likelihood of a subset of four dependent variables based on the absolute value of the distance landowners live from their land. Three of these models—for invasive species removal, leasing land, and emotional attachment—had sufficient goodness of fit and a statistically significant distance parameter.

Keywords Family forest landowners · Absentee landowners · Nonindustrial private forest landowner (NIPF) · Forest management · Resident landowner · Landowner engagement

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Introduction

Families, individuals, and trusts holding 10 or more acres of forested land who do not reside within one mile of their forested land account for approximately 48% of family forest land in the US (123 million acres) (Butler et al. 2021). This "absentee" owner acreage, as currently predominantly defined in the literature, represents approximately 1.42 million ownerships (Butler et al. 2021). A comparison of the last two survey cycles of the National Woodland Ownership Survey (Butler et al. 2016, 2021) shows an increase in forestland under absentee ownership between 2011 and 2018 from 117 to 123 million acres (from 44 to 48% of family forest land). Given the number of absentee owners and thus the impact that their behaviors may have on forested landscapes, there is interest among the research and extension communities in understanding their attitudes and behaviors (e.g., Kuhns et al. 1998; Petrzelka et al. 2013; Snyder et al. 2020). It is thus important to determine whether absentee ownership impacts forestland ownership goals, attitudes, behaviors, or information networks. If so, are there unique outreach, programming, or incentive strategies that would better assist absentee owners in engaging with their forestland, achieving desired ownership goals, and maximizing the private and public benefits that can be produced from forest land? Absentee ownership of rural lands is not just an issue of concern in the U.S.; international scholars have also examined trends in and implications of absentee ownership, including in Finland (e.g., Laakkonen et al. 2019; Juutinen et al. 2020), Sweden (e.g., Bergstén and Keskitalo 2019), Australia (Kam et al. 2020), Japan (e.g., Oono et al. 2020), South Korea (e.g., Shin and Yeo-Chang 2019), and Europe (Wiersum et al. 2005).

A common contention that has been raised about absentee forest landowners is that they are unengaged, inactive or disinterested in managing or maintaining their land (e.g., Kendra and Hull 2005; Petrzelka, et al. 2013; Crowley et al. 2019). A number of hypotheses have been raised to explain why absentee owners may be less engaged forest landowners, including greater expenses and time needed to manage their lands (e.g., Frey et al. 2019), little knowledge or experience with forest management or lack of forestry information networks (e.g., Crowley et al. 2019), and greater detachment or psychological distance from the concept of being a forest owner (e.g., Huff et al. 2017). In meta-analyses of family forest landowner behaviors and intentions, closer proximity to one's wooded land has been found to be positively related to harvesting (Silver et al. 2015) and implementation of other silvicultural treatments (Beach et al. 2005), while having an inconsistent relationship to a broader suite of forest landowner actions and activities (Floress et al. 2019). While consistent relationships between absenteeism and forest management behaviors haven't been confirmed in the literature, negative relationships between absentee owner status and land management activities have been more common than positive ones. For example, absenteeism has been found to reduce the likelihood of commercial harvesting (e.g., Vokoun et al. 2006; Hendee and Flint 2013; Sagor and Becker 2014), woody biomass removal (Young et al. 2015), reforestation (Sagor and Becker 2014), hazardous fuels

reduction (Fischer 2011), collective action for wildfire risk reduction (Charnley et al. 2020), invasive species treatment or control (Sagor and Becker 2014; Snyder et al. 2020), and wildlife habitat management (Joshi and Arano 2009; Sagor and Becker 2014). On the other hand, absenteeism has been found in some research to have a positive association with participation in landowner assistance and other government-sponsored incentive programs (e.g., Janota and Broussard 2008), including enrollment in a state-level forest property tax program (Fortney et al. 2011; Snyder et al. 2020), as well as landowner intentions to enroll their wooded land in a public hunter access program (Kilgore et al. 2008) or to sell forest carbon credits (Miller et al. 2012).

As was recognized by Petrzelka et al. (2013) and Snyder et al. (2020), there has been inconsistency in the way in which absenteeism has been defined and operationalized in the research literature. Almost all studies have used a definition that relies, at least conceptually, on the spatial proximity between a landowner and his or her land. Most studies have utilized a binary definition based on whether a landowner lives more than some pre-defined distance from their forestland. The threshold that was adopted in these studies ranged from one mile (Butler et al. 2021), to 50 miles (Conway et al. 2003; Vokoun et al. 2006; Becker et al. 2013; Khanal et al. 2020), to 75 miles (Sagor and Becker 2014), to 200 miles (Helman et al. 2020), to those who live in a different county than their forestland (Fortney et al. 2011). Bagdon and Kilgore (2013) and Crowley et al. (2019) identified absentee owners as those with a mailing address different than their parcel address. In all these cases, however, the choice of threshold or binary criterion was largely instrumental and largely without theoretical backing. Less frequently, research has addressed absentee ownership through the inclusion of a continuous variable representing the distance one resides from their wooded land (e.g., Potter-Witter 2005; Joshi and Arano 2009). This latter approach is valuable in that it does not assume that landowners exist in a binary state as *either* resident *or* absentee owners, an assumption that is problematic not only because of the lack of guidance on which threshold to adopt but because the binary resident/absentee dichotomy itself may be an unfounded construct. Even less commonly, measures of distance or proximity other than spatial proximity, such as temporal proximity, are used. For example, Romm et al. (1987) defined absenteeism as spending two weeks or less on one's forested property.

We suggest that this lack of consistency in how absentee owners have been defined has obscured our ability to clearly understand whether absenteeism influences factors and attributes such as landowner attitudes, behaviors and intentions. We are not aware of any research that has conducted a comparative analysis using multiple definitions of absenteeism to examine whether relationships between absenteeism and forest landowner behaviors, attitudes or intentions are sensitive to the way in which an absentee owner is defined. The purpose of our research is to address this information gap through a national, comparative analysis using multiple definitions of absenteeism to examine how the way in which absentee ownership is defined influences our understanding of absentee owner behavior. Having a better understanding of whether relationships between absenteeism and behaviors are sensitive to different definitions can improve interpretation of the existing absentee owner literature, provide guidance on more consistent operationalization of

absenteeism in future research, and provide insight into whether and how absentee forest owners differ from resident landowners.

In this paper, we used data from the USDA Forest Service, National Woodland Owner Survey (NWOS) (Butler et al. 2021) to explore differences between resident and absentee family forest landowners across a suite of both binary and continuous measures of absenteeism, defined in terms of spatial proximity (i.e., distance). We expected to find that (a) choice of distance threshold to use in a binary definition of absenteeism will influence conclusions about differences between resident and absentee landowners in different ways, and (b) that active, engaged management (i.e., *personal* engagement) will be less likely as the spatial distance between landowners and their land increases—whether that distance is measured using binary or continuous measures.

Methods

The data used here come from the 2018 cycle of the USDA Forest Service, Forest Inventory and Analysis Program (FIA) National Woodland Owner Survey (NWOS). The NWOS is USDA's official source of information on private forest ownerships in the United States and their objectives, goals, actions, and future intentions. The 2018 data cycle was completed in 2017–2018 and resulted in 9,524 complete surveys (family forest ownerships with 1 + acres), with an overall cooperation rate of 39.7% (Butler et al. 2021). The NWOS uses a spatially-explicit sample methodology, in which a hexagonal grid is established across the entire area of the USA and a single point is randomly located within each grid cell. The land use at each point is determined and, if found to be forested, the ownership of the land at that point is surveyed. The size of the grid cells (and consequently, the sampling intensity) is determined for each state based on a target sample size of 250 responses per state. Item non-response in the NWOS is addressed through a multiple imputation approach, in which five imputed values are derived for each missing variable on each survey. Across all variables in the NWOS, a mean of 3.7% of values were imputed in the 2017–2018 cycle (Butler et al. 2021). For more information on the NWOS methodology, including sampling and non-response assessment, see Butler et al. (2021).

As covariates, we selected 18 items from the NWOS: a single item identifying whether landowners had a management plan, nine items identifying whether or not specific management actions were taken in the past 5 years, five items identifying programmatic activities, one item identifying whether landowners leased their woodlands, one item identifying whether landowners planned on transferring their land in the next 5 years, and two items regarding landowners' knowledge and emotional connection to their woodlands (Table 1). Fifteen began as binary variables. Three began as Likert-scale items that were dichotomized based on whether respondents selected one of the two highest choices (i.e., likely/extremely likely or agree/agree strongly). These 18 variables were selected based on expert knowledge, the family forest landowner literature (e.g., Floress et al. 2019; Butler et al. 2021), and our prior research, as being variables that are

Table 1 Eighteen binary variables pertaining to elements of landowner personal engagement, including management actions, program participation, and landowner attributes (1 = yes, 2 = no)

Variable	Landowner…
MAN_PLAN	… has a management plan
ACT_CUT_SALE	… harvested wood for sale in the previous 5 years
ACT_CUT_PERS	… harvested wood for personal use in the previous 5 years
ACT_NTFP	… harvested non-timber wood products in the previous 5 years
ACT_INVA	… managed invasive species in the previous 5 years
ACT_INS	… managed insects or disease in the previous 5 years
ACT_ROAD	… built roads in the previous 5 years
ACT_TRAIL	… built trails in the previous 5 years
ACT_WILD	… managed for wildlife in the previous 5 years
CERT	… enrolled land in green certification program
TAX	… enrolled land in preferred tax program
2 EASE	… has a conservation easement
COST_5YR	… enrolled land in cost-share programs in the previous 5 years
CARBON	… enrolled land in a carbon sequestration program
LEASE	… leased forestland (for uses other than logging)
TRAN_FUT_B2	… is likely to transfer land in the next 5 years (answered 'likely' or 'extremely likely' on a 5-point Likert scale)
KNOW_WOOD_B2	…agrees that they know their land well (answered 'agree' or 'strongly agree' on a 5-point Likert scale)
EMO_WOOD_B2	…agrees that they have a strong emotional connection to their land (answered 'agree' or 'strongly agree' on a 5-point Likert scale)

From the National Woodland Owner Survey (Butler et al. 2021)

important from an outreach and extension perspective and as being behaviors or attributes that have been found or hypothesized to be influenced by absenteeism.

Our primary variable of interest was the straight-line distance between an ownership's mailing address and the FIA sample point falling on their forested land. In the case where an ownership had two or more sample points on their land, we calculated the mean distance between each point and the landowners' address. The spatial coordinates of the sample points were known a priori; those associated with the landowner address were determined by geocoding the mailing address where the original survey instrument was sent. Geocoding was done using ArcMap's *ArcGIS World Geocoding System* tool (ESRI 2019). We included only those addresses that were recognized by the geocoder at the address or street level; addresses that could be resolved to a zip code, city center, or post office were dropped. All raw NWOS data; including survey responses, sample points, and geocoded mailing addresses; were accessed only by authorized users, remained on protected USDA servers and/or encrypted media, and was handled using standard USDA protocols for controlled unclassified information (CUI) and personal identifiable information (PII).

Ownerships may consist of one or more individual owners. The NWOS questionnaire packet contains instructions that "the owner who makes most of the decisions" (i.e., the primary owner) should respond to the survey. The associated mailing address, ultimately derived from property tax records, is similarly assumed to correspond to the household of the primary owner. Survey questions refer to the entirety of an ownership's forest holdings in a state, not individual parcels.

Two sets of analyses were conducted. In the first, a series of six binary definitions of absentee ownership were established based on a set of fixed distances between landowners and their forested land (1, 10, 15, 25, 50, and 100 miles). These distances were selected to span the range of definitions used in the past literature. For each definition, landowners who lived within the threshold were identified as residents and those who did not were identified as absentee owners. For each of the 18 covariates and six definitions, a bivariate (X^2) test (i.e., 2×2 contingency analysis) was run to see if there was a significant difference between resident and absentee landowners (108 unique tests). Despite the large number of tests, we intentionally did not apply a multiple test correction because we are not interested in the *experimentwise error rate (EER)*, i.e., the probability of making at least one Type 1 error across a battery of tests being considered *simultaneously* (see, e.g., Bender and Lange 2001). Instead, we are interested in understanding how the results of a single, *hypothetical* test would differ across all possible permutations of definition and covariate (i.e., each combination of threshold and action/attribute). The EER is therefore not relevant.

In the second analysis, we fit four binomial generalized linear models (GLMs), i.e., logistic regression models, predicting a subset of four selected variables from the bivariate analysis: commercial harvest, invasive species management, leasing land, and whether landowners have a strong emotional attachment to their land (Table 1). These variables—a subset of the variables used in the bivariate analysis—were selected based on having been shown or hypothesized to be influenced by absenteeism (see above). Independent variables include the absolute value of the distance that landowners' live from their land, the number of years landowners' have owned their land (i.e., tenure), and total size of holdings. Distance and size-of-holdings were log transformed. Similar to the dependent variables, these variables have been shown in previous research (Silver et al. 2015; Floress et al. 2019) or have been theorized (e.g., Huff et al. 2017) to be predictive of many landowner behaviors. Hosmer–Lemeshow and Tjur's coefficient of discrimination (Tjur 2009) were calculated as measures of goodness-of-fit. For all analyses, except where otherwise noted, we interpreted the significance of the results using an α level of 0.05. Other than the initial geocoding, all analysis was done using R (R Core Team 2019) and full code is available in Supplement 1.

Results

A valid distance between a landowner and his/her forest was obtained for 82.8% of our sample (n = 7,886), after excluding those respondents whose addresses were not recognized as point or street addresses. Of the final sample, 176 response records

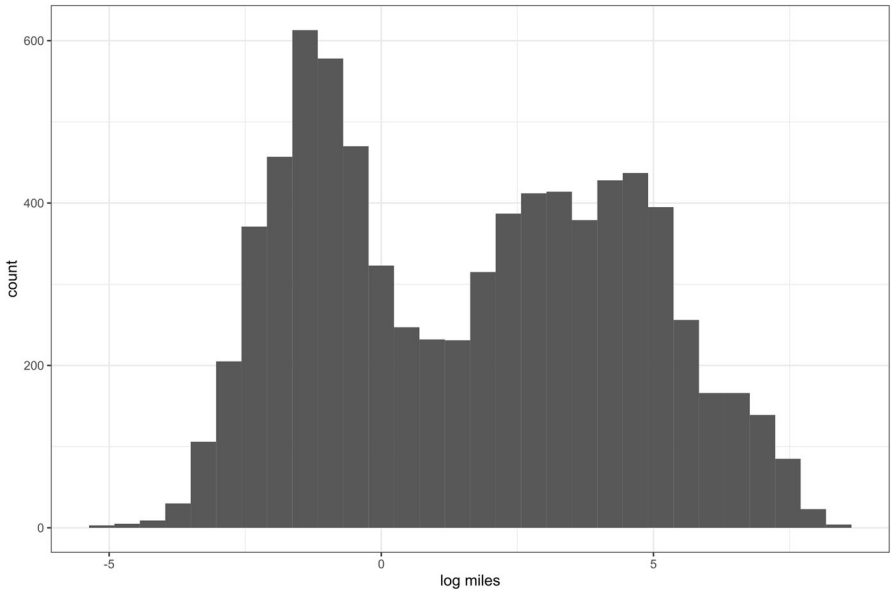

Fig. 1 Distribution of the distance between family forest landowners and their forest land in the United States. N = 7886. Mean = 103.6 miles; median = 5.6 miles)

were associated with more than one sample point. The mean distance between landowners and their land was 103.6 miles and the distribution was distinctly bimodal (median = 5.6 miles) (see Fig. 1).

Bivariate (X^2) tests

As the defining threshold increased across the six definitions (from 1 to 100 miles), fewer and fewer landowners were classified as absentee (see Fig. 2). Even with the 100-miles definition, though, the absentee group still had a sample size of more than 1,500 (19.1%).

The choice of which distance criterion to use to differentiate resident and absentee owners made a substantial difference in determining whether differences between the two groups were statistically significant in terms of the 18 selected dependent variables. At an α level of 0.05, statistical significance was affected by the chosen distance for 13 of the 18 variables. In other words, only five variables were either universally significant or not significant across all six definitions, whereas all other variables were significant at some distances and not significant at others. At an α level of 0.10, significance was affected for 12 of the 18 variables (see Table 2).

Five of the 18 variables were significant regardless of definition (at $\alpha = 0.05$). Three of these variables (cutting wood for personal use, gathering non-timber forest products, and having a high knowledge of one's wooded land) were

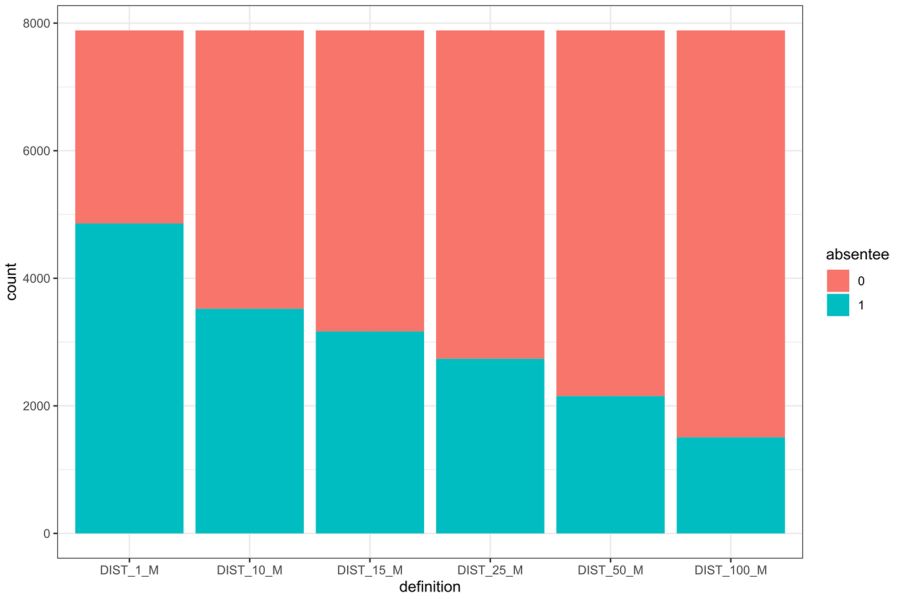

Fig. 2 Sample size, absentee versus resident landowners, by definition of 'absentee landowner'. Data from National Woodland Owner Survey (NWOS). 0 = 'resident owner'; 1 = 'absentee owner'

consistently more likely for resident landowners. The other two (building roads, leasing land) were always significantly more likely for absentee landowners.

The other 13 variables differed in their significance depending on the definition adopted. Furthermore, there was no strong or consistent pattern as to where significance differed. Most commonly, variables were significant where the distance threshold was low and became insignificant as the threshold was increased (having a management plan, building trails, green certification, easements, cost-share programs, carbon programs, or transferring land in the next 5 years). Some variables, however, were only significant at the high end of the spectrum (managing invasive species, tax programs) or were significant only at the poles (cutting wood products for sale, removing unwanted insects, improving wildlife habitat, or having a strong emotional connection with one's woodland). In most cases, the relative differences between resident and absentee ownerships tended to be consistent across definitions (even when statistical significance changed), but not always. For example, significantly more absentee landowners have cut timber for sale when a threshold of 1 mile was adopted, whereas cutting was more common among residents with thresholds of 25, 50, or 100 miles. Similar cases were found for green certification, tax programs, easements, cost-share programs, or having a strong emotional connection with one's woodland.

Table 2 Results of bivariate (X^2) tests testing whether 18 attributes differed between resident and absentee U.S. family forest landowners, using 6 different definitions

Variable	Statistic	DIST_1_M	DIST_10_M	DIST_15_M	DIST_25_M	DIST_50_M	DIST_100_M
MAN_PLAN	prop-res	0.173	0.192	0.196	0.203	0.209	0.213
	prop-abs	0.244	0.247	0.247	0.242	0.236	0.230
	chi-squared	55.148	35.063	27.944	15.921	6.702	1.997
	p value	<0.001**	<0.001**	<0.001**	<0.001**	0.010**	0.158
ACT_CUT_SALE	prop-res	0.222	0.259	0.265	0.271	0.271	0.269
	prop-abs	0.280	0.256	0.247	0.232	0.222	0.208
	chi-squared	32.156	0.056	3.169	14.608	19.807	23.101
	p value	<0.001**	0.813	0.075*	<0.001**	<0.001**	<0.001**
ACT_CUT_PERS	prop-res	0.468	0.436	0.425	0.413	0.401	0.392
	prop-abs	0.287	0.258	0.254	0.249	0.238	0.208
	chi-squared	267.832	267.659	240.060	208.627	179.611	178.437
	p value	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**
ACT_NTFP	prop-res	0.264	0.243	0.237	0.233	0.226	0.221
	prop-abs	0.163	0.151	0.150	0.142	0.137	0.120
	chi-squared	116.888	102.613	88.783	91.398	77.876	77.727
	p value	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**
ACT_INVA	prop-res	0.281	0.279	0.281	0.286	0.288	0.287
	prop-abs	0.275	0.276	0.273	0.262	0.250	0.236
	chi-squared	0.303	0.056	0.510	4.962	10.668	15.913
	p value	0.582	0.812	0.475	0.026**	0.001**	<0.001**
ACT_INS	prop-res	0.092	0.084	0.085	0.085	0.087	0.087
	prop-abs	0.077	0.081	0.081	0.079	0.072	0.066
	chi-squared	5.318	0.142	0.346	0.984	4.860	6.422
	p value	0.021**	0.706	0.556	0.321	0.027**	0.011**

Table 2 (continued)

Variable	Statistic	DIST_1_M	DIST_10_M	DIST_15_M	DIST_25_M	DIST_50_M	DIST_100_M
ACT_ROAD	prop-res	0.129	0.153	0.156	0.167	0.175	0.185
	prop-abs	0.233	0.243	0.249	0.243	0.242	0.228
	chi-squared	130.071	101.777	103.256	65.761	43.834	13.941
	p value	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**
ACT_TRAIL	prop-res	0.274	0.263	0.263	0.262	0.262	0.265
	prop-abs	0.253	0.258	0.258	0.258	0.257	0.242
	chi-squared	4.001	0.276	0.190	0.171	0.217	3.179
	p value	0.045**	0.599	0.663	0.679	0.641	0.075*
ACT_WILD	prop-res	0.272	0.290	0.293	0.301	0.308	0.313
	prop-abs	0.326	0.325	0.323	0.314	0.299	0.273
	chi-squared	25.176	10.876	7.735	1.450	0.503	9.049
	p value	<0.001**	0.001**	0.005**	0.228	0.478	0.003**
CERT	prop-res	0.035	0.040	0.042	0.044	0.046	0.047
	prop-abs	0.052	0.052	0.050	0.047	0.043	0.037
	chi-squared	12.335	6.312	2.453	0.268	0.365	2.589
	p value	<0.001**	0.012**	0.117	0.605	0.546	0.108
TAX	prop-res	0.232	0.236	0.242	0.246	0.248	0.249
	prop-abs	0.243	0.243	0.234	0.225	0.215	0.198
	chi-squared	1.259	0.483	0.558	4.126	9.089	16.956
	p value	0.262	0.487	0.455	0.042**	0.003**	<0.001**

Table 2 (continued)

Variable	Statistic	DIST_1_M	DIST_10_M	DIST_15_M	DIST_25_M	DIST_50_M	DIST_100_M
EASE	prop-res	0.056	0.060	0.059	0.061	0.063	0.065
	prop-abs	0.067	0.066	0.068	0.066	0.063	0.055
	chi-squared	4.214	0.948	2.523	0.883	0.001	1.698
	p value	0.040**	0.330	0.112	0.347	0.970	0.193
COST_5YR	prop-res	0.065	0.091	0.094	0.100	0.103	0.105
	prop-abs	0.126	0.117	0.115	0.107	0.101	0.090
	chi-squared	72.674	14.876	8.778	0.871	0.031	3.156
	p value	<0.001**	<0.001**	0.003**	0.351	0.861	0.076*
CARBON	prop-res	0.001	0.002	0.002	0.002	0.003	0.003
	prop-abs	0.006	0.007	0.007	0.008	0.007	0.007
	chi-squared	10.812	7.418	8.622	13.540	4.622	3.471
	p value	0.001**	0.006**	0.003**	<0.001**	0.032**	0.062*
LEASE	prop-res	0.096	0.134	0.142	0.154	0.163	0.172
	prop-abs	0.248	0.259	0.261	0.256	0.260	0.264
	chi-squared	276.241	198.516	172.810	121.207	95.247	67.009
	p value	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**
TRAN_FUT_B2	prop-res	0.137	0.150	0.153	0.157	0.162	0.163
	prop-abs	0.182	0.183	0.182	0.180	0.173	0.173
	chi-squared	27.806	15.218	11.422	6.549	1.434	0.753
	p value	<0.001**	<0.001**	0.001**	0.010**	0.231	0.386

Table 2 (continued)

Variable	Statistic	DIST_1_M	DIST_10_M	DIST_15_M	DIST_25_M	DIST_50_M	DIST_100_M
KNOW_WOOD_B2	prop-res	0.862	0.854	0.854	0.855	0.852	0.849
	prop-abs	0.807	0.796	0.790	0.779	0.766	0.740
	chi-squared	39.125	46.282	55.543	70.408	79.644	100.791
	p value	< 0.001**	< 0.001**	< 0.001**	< 0.001**	< 0.001**	< 0.001**
EMO_WOOD_B2	prop-res	0.779	0.766	0.765	0.763	0.766	0.769
	prop-abs	0.754	0.761	0.763	0.765	0.758	0.743
	chi-squared	6.078	0.226	0.026	0.012	0.440	4.348
	p value	0.014**	0.635	0.873	0.912	0.507	0.037**

Prop-res and Prop-abs refer respectively to the proportion of resident and absentee landowners who answered 'yes' to each attribute. ** *p* value < 0.05, * *p* value < 0.10

Table 3 Results of three binomial generalized linear regression models, predicting three landowner engagement variables (invasive species management, leasing land, and having a strong emotional connection to one's forest land) based on how far U.S. family forest landowners live from their forested land (log miles), land tenure (years), and total forested size-of-holdings (log acres)

	Estimate	Standard error	z value	*p* value
Invasive species management[a]				
(Intercept)	−1.590	0.080	−19.943	< 0.001**
Log (distance)	−0.069	0.010	−7.000	< 0.001**
Tenure	−0.010	0.002	−5.719	< 0.001**
Log (size-of-holdings)	0.211	0.015	13.656	< 0.001**
Leasing forest land[b]				
(Intercept)	−4.688	0.125	−37.457	< 0.001**
Log (distance)	0.090	0.012	7.258	< 0.001**
Tenure	0.006	0.002	2.997	0.003**
Log (size-of-holdings)	0.568	0.021	27.388	< 0.001**
Having an emotional connection to one's land[c]				
(Intercept)	0.343	0.078	4.386	< 0.001**
Log (distance)	−0.042	0.010	−4.405	< 0.001**
Tenure	0.007	0.002	4.081	< 0.001**
Log (size-of-holdings)	0.163	0.016	10.225	< 0.001**

**p value < 0.05, *p value < 0.10

[a]Hosmer–Lemeshow test: p value = 0.822; Tjur statistic: 0.03

[b]Hosmer–Lemeshow test: p value = 0.263; Tjur statistic: 0.17

[c]Hosmer–Lemeshow test: p value = 0.139; Tjur statistic: 0.02

Regression models

Three of the four models demonstrated adequate model fit according to the Hosmer–Lemeshow test (Table 3). The model predicting commercial forest harvest, on the other hand, produced a significant test statistic ($p < 0.001$), suggesting poor fit. All models had variance inflation factors (VIFs) less than two for all predictor variables, suggesting the absence of problematic multicollinearity. For the three models with adequate fit, leasing forest was significantly more likely with increased distance (the odds ratio was 1.09 for the logged variable), whereas invasive species management and having an emotional connection were significantly less likely (odds ratios were 0.93 and 0.96, respectively, Table 3). Size-of-holdings had a positive relationship to all three variables, as did tenure for both the leasing and emotional connection variables. On the other hand, there was a negative relationship between land tenure and invasive species management. There was a substantial difference in the values of the Tjur statistic between the leasing model, with a Tjur statistic value of 0.17, and the other two models, with Tjur statistics less than 0.03. The latter have more unresolved error. Model coefficients, error terms, and goodness-of-fit statistics for all models are included in Supplement 1.

Discussion

The results of these analyses show that—where absenteeism is defined using a binary measure—the choice of threshold largely determines whether differences between absentee and resident landowners will be found to be statistically significant. Five of the variables tested remained significant across all definitions; furthermore, for these variables, the relative frequency of the associated attribute between residents and absentee owners remained consistent as well (i.e., the attribute was relatively more frequent for one group across all definitions). In these cases, the broad conclusions one might draw about the relative differences between residents and absentee owners would not change regardless of definition. Cutting wood for personal use, harvesting non-timber wood products, and knowing one's woodland well were always significantly more likely for resident owners, providing support for the idea that distance is related to a decline in family forest landowners' personal engagement with the land. On the other hand, leasing woodland or building roads were consistently more likely for *absentee* owners. In the case of leasing land, this is also supportive of the idea that personal engagement is less likely with greater distance. In the case of building roads, the connection is less clear, but we might speculate that a less engaged owner might have built roads in order to facilitate leasing or perhaps in preparation for future development or sale. For the other 13 variables in our analysis, the statistical significance—and sometimes the relative frequency—changed as the definition of absentee owner changed. This is a problematic conclusion given the common usage of the resident/absentee dichotomy and the inconsistent adoption of definitions in the FFO literature. Furthermore, even where *broad* conclusions remained consistent across definitions, *specific* conclusions sometimes varied substantially. For example, leasing land to others is less common among resident landowners than absentee landowners across all six definitions, but the proportion of residents that lease ranges from 9.6% with the 1-mile definition to 17.2% with the 100-mile definition (see Table 2).

Why might significance change with definition? To the extent that significance is more likely with smaller thresholds than higher thresholds, there are several reasons. One is purely statistical: the data are relatively more unbalanced as the threshold increases. In other words, the farther a landowner must live in order to be classified as absentee, the fewer absentee owners remain in the dataset (see Fig. 2). This reduces the statistical power to find a significant relationship. Another possible reason is that the resident/absentee dichotomy is a *valid construct* and shorter distances quite simply are better proxies for the true, underlying phenomenon. However, the pattern of greater significance at the low end of the threshold spectrum is not consistent across variables and evidence for a single threshold relevant to all attributes is slim. More likely, there is simply substantial variation among individual landowners above and beyond their spatial proximity to their land, and this variation means that the randomness associated with individual landowners being classed in the two groups for each definition is driving semi-random changes in significance.

Data constraints and survey conventions are likely going to ensure that binary measures of absenteeism remain quite common in the research literature. In that

case, which definition should a researcher use? Unfortunately, our analysis—although it highlights that the choice of definition will affect research findings—does not provide us the means to advocate for any one definition. It remains largely arbitrary. One argument for short distances (particularly 1-mile) is that they are more common in the literature, and, to the extent that standardization promotes ease of comparison, this may actually be one of the better reasons for choosing this definition (although other definitions, e.g., 50-miles, are also quite common). A more semantic argument would be that short distances are closer to a literal definition of resident, in which the landowner lives *directly* on their forested parcel. In that case, using the parcel address itself to determine residency (e.g., Bagdon and Kilgore 2013; Crowley et al. 2019) may be the most sound approach. At the opposite end of the spectrum, definitions based on very large distances (Fortney et al. 2011 as an extreme case) are probably capturing something very different from 'absenteeism' as it is commonly understood. Statistical significance is also (slightly) more common at the low end of the threshold spectrum. Although this is not in and of itself a reason to adopt a short distance, it does suggest that a binary definition based on a short distance may be capturing a real phenomenon. The bimodal distribution that we find for distance (see Fig. 1) offers another tantalizing possibility; perhaps we are seeing what is in actuality two different populations, a resident population which is normally distributed around a mean of ~0.4 miles and an absentee population which is normally distributed around a mean of ~55 miles. If true, this would offer a measure of support for the underlying resident/absentee construct itself as well as providing evidence that the appropriate distance to use as a defining threshold is a short one. At the end of the day, however, the appropriate definition to adopt for a given analysis may depend on the context and the questions being asked. Some phenomena may split quite naturally at short distances and others at longer distances. This becomes a particularly convincing perspective, if one believes that the underlying dichotomy is no more than a utilitarian construct aimed at simplifying the analysis of complex and continuous variables (i.e., distance in its multiple forms).

Where data availability makes it possible, the use of a continuous measure of absenteeism seems to be an alternative with a lot of advantages. It is relatively more free from assumptions—in that it still tests the effect of spatial proximity without assuming a binary construct dividing landowners into resident and absentee groups. This construct—although instrumentally useful and commonly applied—does not appear to be (as yet) backed up theoretically. The use of continuous measures of absenteeism in predictive models furthermore allows one to estimate the unit impact of distance on the attribute of interest. In the current analysis, and in common with earlier research, we found that living further away from one's land was associated with reduced likelihood of invasive species management (Sagor and Becker 2014; Snyder et al. 2020). We found a similar relationship between distance and landowners' having a strong emotional connection to their land; this connection was more likely when landowners live on or near their land. In the case of leasing land, we found the opposite relationship—that land lease becomes more likely as landowners live further from their land. All three of these are consistent with the overall hypothesis that *personal* engagement declines with distance.

Interestingly, we found that the fundamental relationship between distance and leasing of forest land held across all six binary definitions *as well as* the regression model. In these cases, a hypothetical researcher using the same dataset would have drawn the same broad conclusions regardless of whether he/she adopted a regression or bivariate approach, and, in the latter case, regardless of the distance threshold that was adopted. For the three other variables that were included in both analyses (commercial harvest, emotional connection, and invasive species management), we found mixed and inconclusive results between the bivariate models and the regression models, as well as within the bivariate models themselves, leading to a situation where the conclusions of a hypothetical researcher using the same dataset would have varied substantially depending on the measures and methods that he/she chose.

Aside from the question of how to measure absenteeism, a larger question may be: is absenteeism a useful or informative variable to understand family forest landowner behaviors and attitudes—at least when based on spatial distance? As this analysis shows, absenteeism is only very mildly associated with landowner attributes. In three of our regression models, model fit was adequate and the distance parameter was statistically significant, but unresolved error was high and the value of the resulting Tjur statistic was modest (in the case of the leasing model) or poor. Effect sizes were also not particularly large. Given the challenge of representing the vast complexity inherent in human decision making in terms of a small, concrete set of measurable predictive variables, this contribution should not be dismissed out of hand. Regardless of how strongly or weakly associated with other variables it might be, however, absenteeism—at least when defined in terms of spatial distance—might not be the variable that we are most interested in most of the time. To the extent that it functions as a proxy for engagement, we might be better served by attempting to include direct measures of engagement in our models. Further, to the extent that we are directly interested in *proximity*, spatial proximity might not be the measure that matters most. Psychological distance (Liberman et al. 2007; Huff et al. 2017), travel time to one's wooded land, or time spent on land (Romm et al. 1987), might be more meaningful measures of proximity. However, these are metrics in need of further empirical study in the FFO literature.

There are several potential weaknesses of our approach worth consideration. One relates to the potential for temporal scale mismatch inherent in the structure of the NWOS questions. The measurement of distance between survey respondents and their forests is based on the mailing address at *the time of survey completion*, whereas several of the questions pertaining to land use activities explicitly refer to the *5-year period prior to survey completion*. Therefore, landowners who had moved during that 5-year period, may have engaged in some of these activities when they lived either closer or further away from their woods. This undoubtedly introduces some error into our analyses, but we believe this error to be largely non-problematical, for two reasons. One, it is unlikely that more than a minority of landowners moved their primary address during such a small time-frame, limiting the magnitude of the effect (although this is strictly speaking unknown). Also, we cannot identify any likely mechanism that would result in this error being *biased* in either direction, in other words, it seems probable that landowners who moved are just as likely to have moved further away from their land as closer. A related

issue is the error originating from ownerships owning two or more parcels and/or ownerships containing individual owners living at two or more addresses. In both cases, the distance between an ownership's forest land and at least one active owner (although not necessarily the *primary* owner) may in actuality be closer than our methodology would estimate. In other words, the distance we calculated is more accurately described as a *maximum distance* between owners and their forest land. This semantic distinction is unlikely to change the overall conclusions that how we define and operationalize absenteeism in large part determines the conclusions we draw about its importance and effect. Furthermore, dropping these owners from the dataset would reduce the representativeness of our sample, as we are interested in the entire family forest owner population—not only the subset of single owner, single parcel ownerships.

Another consideration is that we framed our bivariate analyses as hypothetical and fully independent across each permutation of covariate and definitions, and, as such, did not adjust for multiple hypothesis tests (see "Methods"). An alternative means of framing our analysis would be to consider each definition (i.e., distance threshold) as defining an independent, hypothetical case, with the 18 variables constituting a non-independent set of tests within each case. To demonstrate this alternative framing, we reanalyzed the bivariate analyses using the conservative Bonferroni adjustment procedure (Quinn and Keough 2002) on the 18 tests within each of the six definitions. This resulted in 19 fewer individual tests being found significant at the α level of 0.05, out of the 70 tests that were originally found to be significant at this alpha level (see Table 2). In addition, after making the conservative adjustment, four variables (whether or not landowners managed insects/disease, had easements, had a strong emotional connection to their land, or built/maintained trails) were shown to be statistically insignificant across *all* definitions of absenteeism (see Supplement 1). However, this still left nine variables for which the choice of definition was instrumental in determining significance and interpreting results, leaving the broader conclusions essentially unchanged.

Conclusions

Our results suggest that whether family forest landowners live near or far from their land does matter for some, but not all, attributes and behaviors. Analyses based on dichotomous measures of absenteeism, regardless of the definition chosen, suggest that resident landowners (or landowners who live closer to their land) are more likely to cut wood for personal use, harvest non-timber forest products, and agree that they know their land well as compared to landowners who live farther away; they are less likely to build roads and lease their land to others. Regression models using continuous measures suggest that invasive species management and having an emotional connection to one's forest land are more likely when one lives near or on their land, whereas leasing is more likely as one lives farther away.

For most variables, however, we found that different measures and definitions of absenteeism resulted in markedly different conclusions. Where bivariate definitions are preferred or necessary (i.e., where continuous data are unavailable), we are

unable to conclude that there is any statistical or theoretical reason to prefer one definition over another. That being said, short distances (and particularly 1-mile) have the advantages of being most common in the literature (i.e., they are closest to being a standard) and are most consistent with the literal definition and common understanding of the term *resident*. Where data allow for the distance between a landowner and their land to be measured as a continuous variable, we feel this approach to have a number of advantages in terms of analysis and interpretation. Continuous measures are also not predicated on a dichotomy between resident and absentee, a construct that is (as far as the authors can tell) without theoretical foundations. The logistic models in the current analysis provides qualified support for the general conclusions of previous research, that personal engagement (and therefore, behaviors and activities associated with personal engagement) are less likely as the distance between landowners and their land increases.

In terms of our original research expectations, we found that (a) when using binary definitions of absenteeism, the arbitrary choice of definition does in fact influence strongly what conclusions are drawn and whether those conclusions are found to be statistically significant, and (b) across all analyses, landowners' personal engagement with their forests *on average* declines with distance and among absentee owners (when using binary measures) relative to resident owners, with the important caveat that the strength of this conclusion depends to some extent on which binary definitions are adopted and which variables are being examined.

Future research could explore the causal and theoretical relationships between family forest landowner engagement and proximity, as well as whether it is spatial proximity that is most relevant, as opposed to temporal proximity or psychological distance. Research is also needed to explore what, if anything, could be done to temper these effects if our underlying interest in the topic of absenteeism is to determine how better to assist and incentivize absentee landowners to be actively engaged with their land.

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Declarations

Conflict of interest We have no funding or competing interests to declare.

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