



# The future of family forests in the USA: Near-term intentions to sell or transfer



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## ARTICLE INFO

### Keywords:

private forest owner  
land use  
land transfer  
multinomial logit  
heterogeneous preferences  
landowner characteristics

## ABSTRACT

Land transfer decisions for family forest owners (FFOs) potentially have large consequences for the critical public benefits these lands provide, but what triggers and influences the decisions are just beginning to be understood. The 2013 USA National Woodland Owner Survey provides an unprecedented set of national data to better understand near-term plans to sell or give away forestland either in its entirety or by subdividing. This study uses multinomial logit analysis to explore whether the likelihood of selling or giving away any or all of forestland within 5 years has some systematic relationship to the FFO, land, and urban-rural characteristics. Understanding what drives respondents' answers to this question provides insight into the characteristics of land and landowners likely associated with land transfer, and potentially where development is likely to occur. The results indicate that FFO, land, and attitudinal characteristics play roles in the plans, but urban-rural characteristics do not. Transfer plans are positively associated with being older, female, having more wooded land, and agreeing that they would sell if offered a reasonable price; transfer plans are negatively associated with high education levels, having a home within 1 mile of the wooded land, and agreement with wanting their wooded land to stay wooded. The marginal effects of the model estimates show that age has one of the greatest impacts on land transfer plans. Results support the need for research coordinating FFO intentions with actual decisions, related to emotional and familial attachments and other life circumstances.

## 1. Introduction

Forests in the USA comprise approximately 331 million hectares, 58% of which are privately owned (Butler et al., 2016c). Of this privately-held land, the majority is owned by families, individuals, trusts, estates, and family partnerships, hereafter referred to as family forest ownerships. Family forest ownerships (FFOs) are the largest of all forestland owner groups in the USA. (Butler et al., 2016a). It is no wonder then that the intentions and plans that these owners have for the future ownership of their land have consequences for the critical public benefits these lands provide, such as clean water and air, carbon sequestration, biodiversity, long-term timber production, and recreation (Kline and Alig, 2005; Millennium Ecosystem Assessment, 2005; Stein et al., 2005).

Decisions regarding these land-based assets are different from other financial assets and decidedly more complex, because of the emotional attachment that can be developed through land ownership (Brown and Raymond, 2007; Creighton et al., 2015; Markowski-Lindsay et al., 2016). The biggest decisions FFOs can make about their forest is when, how, or if they should transfer it to their heirs, and this decision is fraught with a variety of issues (Catanzaro et al., 2014). Life circumstances may trigger

land ownership decisions at any time and may include events such as: family births, deaths, marriages or divorces; job changes; changes in economic or financial circumstances; illnesses; and conversion of nearby forestland (Markowski-Lindsay et al., 2016). Family-related issues also contribute to decisions of when to transfer, including the need to be equal and/or equitable to heirs, family dysfunction, and the inability of families to make decisions of what to do with the land (Catanzaro et al., 2014; Markowski-Lindsay et al., 2016).

Even though uncontrollable situations of life circumstances may trigger land transfer decisions, the role that individual characteristics unique to FFOs play in land transfer decisions are clearly important for using existing policy tools more wisely or targeting outreach to those who would most benefit. However, studies that explore the influence that individual characteristics have on the transfer of forest have been limited.

Two recent regional studies found that individual owner characteristics play a significant role in land transfer decisions. Forest owners in the Catskill and Delaware watersheds of New York indicated that increasing age, retirement status, lower education, lower income, and concerns (e.g., tax burden, need to distribute to family, health, finances) were related to their decision to subdivide versus keeping their

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land intact (Sanborn-Stone and Tyrrell, 2012). A greater number of those who kept their land intact rated protection of the environment, family, timber production, and privacy as more important than those who subdivided their land. Private forest owners in Washington who derive market values from their land (e.g., practicing forestry and having intentions to harvest) indicated that they are more likely to intend to develop their land and anticipate that it would happen sooner than those who enjoy non-market benefits of forest ownership, such as aesthetic or recreation enjoyment (Rozance and Rabotyagov, 2014). By analyzing the individual responses, the authors calculated that roughly 20% of the development would happen within the next 5 years.

A number of other studies focusing on land bequest and inheritance have also shown how individual characteristics factor into land ownership decisions. FFO land bequest decisions in Massachusetts have been discussed as being based on their personal, family and financial goals (Markowski-Lindsay et al., 2016). Non-industrial private forest owners in Virginia holding amenity values for their forest are more likely to bequeath their land to heirs with standing timber (vs. bequeathing it after harvest) (Amacher et al., 2002; Conway et al., 2003).<sup>1</sup> A rare national study indicated that private forest owners who inherited their land are more strongly motivated to have the future intention of passing on their land to their children or heirs than non-inheritors (Majumdar et al., 2009).

Exploring private forest owner values and incorporating the element of time, as was done by Rozance and Rabotyagov (2014), may help policy and outreach be directed at those who would most benefit. As noted by Sanborn-Stone and Tyrrell (2012), effective public policy related to land use, taxes and landowner incentives ought to be informed by what motivates landowners to either keep or sell their land. To be most effective, this understanding of motivations should be current to reflect recent economic circumstances. Understanding who is likely to sell or give away their land in the near-term may provide policy makers, extension professionals, and conservation organizations a foundational understanding of where transfer is likely imminent so as to improve targeting of forest conservation efforts on a nationwide scale.

The 2013 National Woodland Owner Survey (NWOS) provides an unprecedented set of data for the USA to better understand near-term plans to sell or give away forestland either in its entirety or by subdividing. Taking cues from Sanborn-Stone and Tyrrell (2012) and Rozance and Rabotyagov (2014), this study uses national NWOS data to explore whether and how FFO and land characteristics differ with the intention to transfer forestland in the next 5 years. Looking at this issue from a national perspective fills the gap in the existing literature that has mostly been regional. Understanding what drives respondents' intentions on a national scale provides insight into the characteristics of land and landowners likely associated with land transfer. Because ownership transfer of land that results in dividing the land into smaller parcels or properties (i.e., parcelization) is linked to higher probabilities of development (Mundell et al., 2010; Sanborn-Stone and Tyrrell, 2012), understanding these characteristics provides greater information on where this is likely to occur. This study elaborates on previous research by expanding the geographic scope to the entire USA. It also broadens the question from one of development and parcelization to that of plans to sell or give away any or all held forestland.

## 2. Methods

The data in this study derive from the 2013 NWOS, which collected data on ownership characteristics, forest characteristics, reasons for owning, ownership history, forest use, recreation, sources of information, concerns, future intentions, and demographics (Butler et al.,

<sup>1</sup> Non-industrial private forest owners are private forest ownerships who do not own a primary wood processing facility; they include corporations, nongovernmental conservation organizations, associations and clubs, Native American tribes, and families and individuals (Butler et al., 2016c).

2016c). The USA Forest Service's Forest Inventory and Analysis (FIA) unit conducts the NWOS by contacting a sample of private forest ownerships across the USA and asking them to complete a 37-question, self-administered mail-back survey.

The NWOS used an area-based, probability-proportion-to-size sampling design (Dickinson and Butler, 2013); the probability of an owner being sampled depended on the size of their ownership. Each state was overlaid with a grid of hexagons, random sample points within these hexagons were located, and remote sensing and property tax records were used to determine which of the points represented privately-owned forest. Due to this probability-proportional-to-size sample design, the observations were weighted using state-specific and individual owner-specific data: the total estimated area of family forestland held in 4-plus hectare ownerships for each state, the number of responses for each state, and the area owned by each ownership. Surveys were sent to privately-owned forest ownerships. Butler et al. (2016a) provide a detailed discussion of the NWOS survey and estimation methodologies.

In total, 8576 FFOs owning 4 or more hectares responded to the survey, and the overall cooperation rate was 52% (Butler et al., 2016b). To test for nonresponse bias, comparisons were made between responses received in the mail and those who responded from follow-up telephone interviews (Butler et al., 2016b). The telephone interviews reflected 15% of the mail respondents. Of the variables tested, area of forest owned in a state, land tenure, having commercially harvested trees in the previous 5 years, and having received cost-share assistance showed no statistical differences ( $p \geq 0.05$ ). The mail respondents did show a higher propensity to having received forest management advice in the previous 5 years and having received cost-share assistance ( $p < 0.05$ ). Because there was no clear nonresponse bias found, no adjustments were made as was suggested by Butler et al. (2015b).

For purposes of this study, only FFOs holding more than 4 ha are included in the sample. Ownerships of more than 4 ha reflect a large proportion of all forested acres in the USA (roughly 32% or 107 million hectares) Butler et al., 2016b,c). Understanding what influences the decisions of these ownerships is key for targeting or conducting outreach for multiple programmatic efforts (i.e., traditional forest management approaches, current use tax programs and conservation easements) (B. J. Butler et al., 2016c; Hatcher et al., 2013). Of all survey respondents, 4789 reflected 4-plus hectare family forest ownerships and the respondents provided sufficient information (i.e., low enough item nonresponse rates) to be included in the analysis. This paper reflects statistics for these respondents (see Table 1). Questions in the survey were directed at all forested acres owned in a state.

Survey recipients were asked directly about their intentions for transferring ownership of their wooded land within a specified time period. Specifically, respondents were asked to indicate how likely they would be to sell or give away any or all of their wooded land in the next 5 years. Response choices were given on a 5-point Likert scale: Extremely Likely, Likely, Undecided, Unlikely, Extremely Unlikely. This research explores whether the likelihood of selling or giving away any or all of their wooded land within 5 years has some systematic relationships to: FFO and land characteristics; objectives, concerns and attitudes; traditional forestry activities; participation in non-market activities; and urban-rural characteristics of the land.

### 2.1. Explanatory variables

#### 2.1.1. FFO and land characteristics

Numerous 2013 NWOS variables are available to test the association between FFO and land characteristics and likelihood of selling or giving away wooded land. These characteristics include total forest holdings in hectares (i.e., including all parcels owned), owner age, owner income, percent of owner total income derived from wood, whether a primary home or a vacation/cabin or their farm (if applicable) is within one mile of the wooded land, whether the wooded land was inherited, owner gender and owner education (Table 1).

**Table 1**  
Definitions of explanatory variables and sample statistics (n = 4789).

Variable Name	Statistic <sup>a</sup>	Definition
Forest holdings	3.9 (1.5)	Log of hectares of forestland owned, range 1.4–10.3
Age	62.9 (12.0)	Respondent age in years, range 22–99
Income (2013 dollars)	8.5%	Less than \$25,000 (coded as 20)
	23.1%	Between \$25,000 and \$49,999 (coded as 25)
	33.9%	Between \$50,000 and \$99,999 (coded as 50)
	21.5%	Between \$100,000–\$199,999 (coded as 100)
	13.0%	Over \$200,000 (coded as 200)
Income from forest	4.1 (12.5)	Percent of total income, range: 0–100%
Home	59.0%	Home within 1 mile of wooded land; 1 = yes, 0 = no
Cabin	24.6%	Cabin or Vacation home within 1 mile of wooded land, 1 = yes, else 0
Farm	39.0%	Owner's farm within 1 mile of wooded land, 1 = yes, else 0
Inherited	34.3%	Respondent inherited the wooded land, 1 = yes, else 0
Gender	83.5%	Male coded as 1; Female coded as 0
High Education	46.4%	Received Bachelors or Advanced degree, 1 = yes, else 0
Objectives: Ecological	83.2%	1 if answered Important or Very Important to 1 or more of the ecological objective questions, else 0
Objectives: Financial	64.1%	1 if answered Important or Very Important to either one of the financial objective questions, else 0
Objectives: Recreational	67.7%	1 if answered Important or Very Important to either one of the recreation objective questions, else 0
Concerns: Development	43.5%	1 if answered Concerned or Very Concerned about development on nearby lands, else 0
Concerns: Taxes	79.6%	1 if answered Concerned or Very Concerned about high property taxes, else 0
Concerns: Heirs	79.0%	1 if answered Concerned or Very Concerned about keeping land intact for future generations, else 0
Attitude: Would Sell		Agree to sell if offered a reasonable price
	31.0%	Strongly Disagree (coded as 1)
	20.4%	Disagree (coded as 2)
	25.8%	Neutral (coded as 3)
	14.5%	Agree (coded as 4)
Attitude: Keep Land Wooded		Strongly Agree (coded as 5)
		Agrees they want their wooded land to stay wooded
	0.3%	Strongly Disagree (coded as 1)
	0.9%	Disagree (coded as 2)
	11.8%	Neutral (coded as 3)
	27.2%	Agree (coded as 4)
	60.0%	Strongly Agree (coded as 5)
Traditional Forestry Index	1.4 (1.6)	Numeric value between 0 and 6, depending on how many traditional forestry activities participated in
Non-Market Index	1.7 (1.0)	Numeric value between 0 and 3, depending on how many non-market activities participated in
Housing Density	10.8 (20.8)	Number of housing units per km <sup>2</sup> within a Census block group, USA Census 2010
Urban Area Distance	15.0 (13.5)	Distance to nearest urban area in km, USA Census 2010
Forested Proportion	0.61 (0.24)	Proportion of forested land within 5 km of plot, based on NLCD 2011
Forestry Tax Program	84.1%	1 if plot is in a state with a forestry-focused preferential property tax program, else 0 (Butler et al., 2012, 2010)

<sup>a</sup> Statistics provided are the mean (standard deviation) for continuous variables and the frequency percentage for categorical variables.

### 2.1.2. Objectives, concerns and attitudes

It is hypothesized that an FFO's likelihood of selling or giving away their land is related to their ownership objectives, concerns and attitudes about their land, an idea supported by Rozance and Rabotyagov (2014). The link between attitudes and behaviors is well-established in the theory of planned behavior, both within and outside of the forest owner literature (Ajzen, 1991; Collum and Daigle, 2015; Heberlein, 2012; Karppinen, 2005; Silver et al., 2015). The NWOS asks a series of questions about how important various reasons are for owning their forest. Several of these questions were grouped into three categories: ecological, financial, and recreational objectives (Table 1). A respondent was coded as having ecological objectives if they responded "Important" or "Very Important" to any of the following three questions: protect nature or biological diversity; protect water resources, protect or improve wildlife habitat. It is hypothesized that having ecological objectives may be associated with being unlikely to be willing to sell, all else equal.

A respondent was coded as having financial objectives if they responded "Important" or "Very Important" to the following two Likert-scale statements: owning land for land investment or for timber products (such as logs or pulpwood). It is hypothesized that having financial objectives may not be as strongly associated with a likelihood to sell or give away in the next 5 years. FFOs who own their land for timber income may want to hold onto it longer to reap the benefits of the timber income before selling it, while other FFOs may want to sell it while the timber value is high (Amacher et al., 2002; Conway et al., 2003). In areas where timber values are not high, the value of

development may outweigh timber values and the likelihood of selling or giving away may be associated with fluctuating market conditions for the property.

A respondent was coded as having recreational objectives if they responded "Important" or "Very Important" to the following two questions: owning land for recreation (other than hunting) and owning land for hunting. It is hypothesized that having recreational objectives may be associated with being unlikely to be willing to sell, all else equal.

The NWOS asks respondents to rate their level of concern for 16 topics using a 5-point Likert scale. A respondent was coded as having a concern for a topic if they responded "Concern" or "Great Concern." Three concern topics were identified as being related to selling or giving away their land: development of nearby land; high property taxes; and keeping land intact for future generations (Table 1). It is hypothesized that having concerns about nearby development may not be strongly associated with being unlikely to sell or give away their land. Individuals may want to conserve their property in light of the surrounding development, or they may be inspired to sell if the nearby development is raising property values. Concerns about keeping land intact for future generations could go either way because they may or may not be ready to pass on the land in its entirety to heirs. Concerns about high property taxes may be associated with being likely to sell or give land away because of the desire to reduce or remove the tax burden.

The 2013 NWOS asked respondents two attitudinal questions about their land using 5-point Likert scale agreement questions (i.e., Strongly

disagree, disagree, neutral, agree, strongly agree). Respondents were asked whether they agree with the statement “I would sell my land if offered a reasonable price.” Responses were numerically coded where 1 was “strongly disagree” and 5 “strongly agree.” It is hypothesized that greater agreement with selling would be associated with a greater likelihood of selling or giving away their land in the next 5 years. Respondents were similarly asked whether they agree with the statement “I want my wooded land to stay wooded.” Responses were coded similarly. It is hypothesized that, all else equal, greater agreement with wanting their land to stay wooded may be associated with an unwillingness to sell or give away their land in the next 5 years. This hypothesis is based on the assumption that maintaining land under current ownership results in the most certain outcome for the land – that is, the current owner has control over what happens to the land.

### 2.1.3. Traditional forestry activities

Owners who have undertaken traditional forestry activities have invested either their time, money or both in their wooded land. This investment becomes a part of the decision to sell or pass on the land. Traditional forestry is an index variable with a value ranging from 0 to 6, where 0 reflects no traditional activity and 6 reflects engagement in all 6 of the following: has a management plan; has used a cost share program; has green certified any of wooded land; has participated in programs to reduce tax burden; has commercially harvested in past 5 years; and has received advice or information regarding their land in the past 5 years. Respondents are coded with an index number from 0 to 6, based on their past behaviors. Similar to the “financial objectives” variable, it is hypothesized that participating in traditional forestry activities may not be as strongly associated with a likelihood to sell or give away in the next 5 years; FFOs who enjoy the benefits of a program reducing property taxes or of income from commercial harvests may want to hold onto the wooded land longer, or the owner may want to sell it in 5 years if the timber value would be high at that point to reap those financial benefits in the selling price (Amacher et al., 2002; Conway et al., 2003).

### 2.1.4. Participation in non-market activities

FFOs who engage with their land in ways that do not involve an organized market may not be willing to sell or give away their land in the next 5 years because the benefits they receive are not strictly market goods. The literature indicates that those who hold non-market values for forest showed tendencies towards conservation choices (Conway et al., 2003; Farmer et al., 2011; Ma and Kittredge, 2011). Non-market participation is an index variable with a value ranging from 0 to 3, where 0 reflects no participation in non-market activities and 3 reflects participation in all 3 of the following: ever cut or removed trees from land since owning it, for personal use; ever collected non-timber forest products from land since owning it, for personal use; and owner or spouse hunted, hiked, or recreated on land in past 5 years.

### 2.1.5. Urban-rural characteristics

Landowners may also make decisions about the future of their wooded land based on where it is geographically. Similar to Rozance and Rabotyagov (2014), this study associates landowner characteristics and intentions with urban-rural variables. Specifically, this study examines the impact of spatially-defined 2010 Census data on the likelihood of selling or giving away wooded land in the next 5 years: estimated housing density defined as the number of housing units per square mile at the site of each respondents’ wooded land; kilometers distance to the nearest urban area as defined as by the 2010 USA Census (US Census Bureau, 2010). The USA Department of the Interior and USA Geological Survey developed the National Land Cover Database (NLCD) that provides land cover information at the national scale (Homer et al., 2015). This analysis uses data based on 2011 NLCD data describing the proportion of land that is forested within a 1 km radius of the respondents’ forest. It is hypothesized that areas that are more

urbanized to be associated with a higher likelihood of planning to sell or give away land because of higher land value. Finally, this analysis also uses information on whether the owners’ plot exists within a state which has a preferential property tax program which focuses on forestry (Butler et al., 2012, 2010). It is hypothesized that land not in a state with a preferential tax program may be more likely to be associated with plans to sell or give away land for financial reasons.

## 3. Model

This analysis uses the multinomial logit (MNL) framework for categorical data (when responses are options of three or more choices). The MNL simplifies to the binary logit when there are only two choices. The categories may be any type of choice that reflects the preferences of an individual. The MNL provides a set of probabilities for those choice categories given a certain set of respondent characteristics (Ben-Akiva and Lerman, 1991; Greene, 2011).

In the MNL model, if an individual  $i$  chooses an alternative  $j$  from a set of  $J$  choices, the probability of making the choice  $j$  depends on all of the other alternatives. The probability of individual  $i$  making choice  $j$  is represented as (1), under the assumptions that the error term is independently and identically distributed and has a Gumbel distribution (Ben-Akiva and Lerman, 1991; Greene, 2011):

$$\text{Prob}(y_i = j) = \exp(\beta_j x_i) / \sum_j \exp(\beta_j x_i), j = 0, 1, 2, \dots, J \quad (1)$$

The MNL framework allows the analyst to ask how certain characteristics affect the probability of a respondent making one of several alternative decisions. Parameter interpretation is done via comparison with a “reference” outcome. Probabilities for the  $J + 1$  choices for a respondent with characteristics  $x_i$  result from the estimated equations, and the parameters,  $\beta$ , vary for each of the  $J$  alternatives (Greene, 2011).

In this analysis, FFOs are placed into one of three choice categories on the basis of their responses: those who are extremely likely or likely that they would sell or give away any of their wooded land in the next 5 years (*Likely*); those who are undecided (*Undecided*), and those who are extremely unlikely or unlikely to do so (*Unlikely*). With *Likely* as the reference outcome, significant parameter results indicate whether an explanatory variable is more or less associated with one of the other choice categories than the *Likely* choice category. For example, the model might indicate that FFOs with certain characteristics are more *Unlikely* to have plans to sell or give away their wooded land than be *Likely* to make that choice.

## 4. Results

Of the 8460 FFOs owning 4 or more hectares from the 2013 NWOS, 8334 (99%) provided their answer to the question of how likely they would be to sell or give away any of their wooded land in the next 5 years. Approximately 68% of respondents are *Extremely Unlikely* or *Unlikely*, 14% *Undecided*, and 17% *Likely* or *Extremely Likely*. While the majority of respondents are unlikely to some degree, the sample of respondents is large enough to explore whether these categories of responses have some systematic relationship to the forest owner.

The sample comprises 4789 respondents who provided answers to all the explanatory variables tested in the model. Similar to the full sample, 67% of respondents are *Extremely Unlikely* or *Unlikely* to sell or give away their wooded land in the next 5 years, while 15% are *Undecided*, and 18% are *Likely* or *Extremely Likely* (Table 2).

The sample of 4789 own an average of 47.5 ha (standard deviation: 1.5; converted from the mean and standard deviation logarithm statistics of 3.9 and 4.4, respectively) and are 63 years old (standard deviation: 12) on average. Approximately 32% of respondents have an income under \$50,000; 34% have an income between \$50,000 and \$99,999, and 34% have an income over \$100,000. Nearly 84% of the

**Table 2**  
Respondent sample frequency for dependent variable (n = 4789).

How likely is it that you will sell or give away any of your wooded land in the next 5 years?	Number of respondents	Percent of sample
Extremely Unlikely	1994	42%
Unlikely	1195	25%
Undecided	717	15%
Likely	579	12%
Extremely Likely	304	6%
Total	4789	100%

respondents are male and 46% received a Bachelor's degree or higher. Nearly 60% have a home within one mile of their wooded land, 25% have a vacation home or cabin within one mile of their wooded land, and 39% have a farm within one mile of their wooded land. Approximately 34% inherited their wooded land. See Table 1 for sample means/standard deviations of continuous variables and frequencies for categorical variables.

Regarding FFO attitudes, 83% of respondents had ecological objectives for owning their land; that is, they found it important or very important to own their land for protecting nature, biological diversity, water resources, or wildlife habitat. Approximately 64% of respondents had financial objectives for owning their land; they found it important or very important to own their land for land investment or timber products. Nearly 44% had concerns about development on nearby lands, while 80% had concerns about high property taxes and 79% had concerns about keeping their land intact for future generations. Approximately 23% agreed or strongly agreed that they would sell their wooded land if they were offered a reasonable price, while 51% disagreed or strongly disagreed with this statement, 26% neither agreed nor disagreed. Approximately 87% agreed or strongly agreed that they want their wooded land to stay wooded, while only 1% disagreed or strongly disagreed with this statement, 12% neither agreed nor disagreed.

Out of a possible score of 6, respondents, on average, indicated they undertook only 1 type of traditional forestry activity (mean = 1.4, standard deviation = 1.6). Out of a possible score of 3, respondents noted that they participated in approximately 2 non-market activity categories on their land (mean = 1.7, standard deviation = 1.0).

The urban-rural characteristics associated with these respondents indicated mean housing density of 10.7 housing units per km<sup>2</sup> (standard deviation = 20.8); and a mean distance of 15.0 kilometers to the nearest urban area (standard deviation = 13.5). On average, the 5 km surrounding respondents wooded land was approximately 61% forested (standard deviation = 23.9%). Roughly 84% of the land is in a state having a forestry-focused preferential property tax program.

Correlation and multicollinearity tests among variables did not indicate strong levels of correlation. The correlation tests included Pearson, Spearman & Kendall's rank, k-tau, point-biserial, and tetrachoric. The multicollinearity diagnostic Variance Inflation Factor (VIF) was performed on these data and did not indicate multicollinearity. VIFs indicate how "inflated" the variance of each coefficient is compared to what it would be were it to be uncorrelated with any other independent variable (Allison, 1999). VIFs and their reciprocal (i.e., tolerance levels) are produced for each independent variable; tolerance levels below 0.4 are associated with high multicollinearity (Allison, 1999). The lowest tolerance level for variables in this analysis was 0.52 (log of hectares of forest owned); the average tolerance level was 0.8.

4.1. MNL results

The coefficient estimates from the MNL are interpreted in comparison to the reference choice (i.e., likely to sell or give away wooded land in the next 5 years) and are used to understand if an increase or

**Table 3**  
Multinomial logit marginal effects on the likelihood of selling or giving away any or all of your wooded land in the next 5 years.

Independent Variable	Extremely likely or likely	Undecided	Extremely unlikely or unlikely
Forest holdings	2.3%***	-2.4%*	n/s
Age	0.6%***	n/s	-0.6%***
Income	n/s	n/s	n/s
Income from forest	n/s	n/s	n/s
Home	n/s	n/s	4.6%**
Cabin	n/s	5.0%**	n/s
Farm	n/s	n/s	n/s
Inherited	n/s	n/s	n/s
Gender (Male = 1)	-5.4%***	n/s	6.5%**
High Education	n/s	n/s	5.2%**
Objectives: Ecological	n/s	n/s	n/s
Objectives: Financial	n/s	n/s	n/s
Objectives: Recreational	n/s	n/s	n/s
Concerns: Development	n/s	n/s	n/s
Concerns: Taxes	n/s	n/s	n/s
Concerns: Heirs	n/s	n/s	n/s
Attitude: Would Sell	6.9%***	5.8%***	-12.7%***
Attitude: Keep Land	n/s	-4.1%***	5.6%***
Wooded			
Activities: Traditional Forestry	n/s	n/s	n/s
Activities: Non-market	n/s	n/s	n/s
Housing Density	n/s	n/s	n/s
Urban Area Distance	n/s	n/s	n/s
Forested Proportion	n/s	n/s	n/s
Forestry Tax Program	n/s	n/s	n/s

Number of Observations: 4789; pseudo-R<sup>2</sup>: 0.1692.  
p-value: ≤1% = \*\*\*, ≤5% = \*\*, ≤10% = \*, >0% = n/s.

decrease in any explanatory variable has a greater (or lesser) probability of being associated with one choice over another; however, these parameter results do not indicate relative ranking of variables. To understand relative ranking, we report the marginal effects of the model; that is, the percent change in respondent type associated with a 1-unit change in the independent variable (where the "unit" is based on the variable definition). Marginal effects can be used to compare magnitude of effect across the variables and respondent types (Table 3). Model fit, as measured by pseudo-R<sup>2</sup>, is 0.1692; the full reporting of coefficient estimates from the MNL are provided in the Supplementary Materials.

Estimating the likelihood of selling or giving away wooded land in the next 5 years ("near-term transfer plans") against all the explanatory variables indicates that while FFO, land, and attitudinal characteristics play roles, landowner objectives, concerns, activities do not, and neither do variables describing the geographic context of the land (Table 3).

Similar to Rozance and Rabotyagov (2014) and Sanborn-Stone and Tyrrell (2012), transfer plans are associated with being older and having more wooded land; and higher education levels are associated with being less likely to have near-term transfer plans. While the attitudinal measures differed between this study and that of Rozance and Rabotyagov (2014), the result was similar: positive attitudes about their wooded land are less likely to be associated with transfer (or, development plans in the case of Rozance and Rabotyagov).

The specific marginal results imply:

- **Forest Holdings:** The greater the forest holdings (in log of hectares), the more likely to have near-term transfer plans. Increasing forest holdings one percent, the probability of being likely to sell or give away any wooded land in the next 5 years increases by 2.3% and the probability of being undecided about it decreases by 2.4%, but the probability of being unlikely (or very unlikely) to sell remains unchanged.
- **Age:** The older the respondent, the more likely to have near-term transfer plans. Increasing age by one year increases the probability

of being likely to sell or give away wooded land in the next 5 years by 0.6% and decreases the probability of being unlikely by that same percentage.

- **Home:** Having a home within 1 mile of wooded land increases the probability of being unlikely to sell or give away wooded land in the next 5 years by 4.6%.
- **Cabin:** Having a vacation home or cabin within 1 mile of wooded land increases the probability of being undecided about selling or giving away wooded land in the next 5 years by 5.0%.
- **Gender:** Being male is associated with an increased probability of being unlikely to sell or give away wooded land in the next 5 years by 6.5% and decreases the probability of being likely to do so by 5.4%.
- **Higher Education:** Having at least a bachelor's degree is associated with an increased probability of being unlikely to sell or give away wooded land in the next 5 years by 5.2%.
- **Attitude: Would Sell:** The greater the agreement with selling if offered a reasonable price (i.e., moving from “agree” to “strongly agree” or moving from “strongly disagree” to “disagree”) decreases the probability of being unlikely to sell or give away wooded land in the next 5 years by 12.7%, increases the probability of being likely to do so by 6.9%, and increases the probability of being undecided about it by 5.8%.
- **Attitude: Keep Land Wooded:** The greater the agreement with wanting their wooded land to stay wooded is associated with an increased probability of being unlikely to sell or give away wooded land in the next 5 years by 5.6% and a decreased probability of being undecided about the decision by 4.1%. [Rozance and Rabotyagov \(2014\)](#) found those who found aesthetic enjoyment and wildlife as important to be less likely to develop. In this analysis, the *Objectives: ecological* variable includes protecting or improving wildlife habitat, and over 75% of respondents who had these objectives agreed or strongly agreed that they want to keep their wooded land wooded.

Surprisingly, some variables did not show associations with near-term land transfer plans, after accounting for all other variables in the model. Inherited land, income, ownership objectives, concerns, traditional forestry activities, non-market activities, and urban-rural characteristics were all insignificant and had been expected to play some role with the intention to transfer. Similarly, [Rozance and Rabotyagov \(2014\)](#) showed insignificant urban-rural characteristics in their model (distance from a developed parcel and population density). While results from [Rozance and Rabotyagov's development study \(2014\)](#) and [Sanborn-Stone and Tyrrell's subdivision study \(2012\)](#) showed significance in several similar variable categories, interpreting differences between those studies and this research is approached with caution. The likelihood of development ([Rozance and Rabotyagov, 2014](#)) and the actual decision to subdivide ([Sanborn-Stone and Tyrrell, 2012](#)) are different questions to ask of landowners than the intention to transfer land, and they likely involve different factors and characteristics of influence. Nonetheless, it is important to note that these categories of variables are significant factors in other types of land ownership decisions but not in land transfer as described by this NWOS question.

To estimate the validity of the model, an average prediction was calculated and compared with the estimation sample. The model does a relatively good job at predicting the likelihood of having near-term transfer plans for respondents' wooded land. When comparing predictions to the actual responses, the most likely prediction was correct 69% of the time across all response categories.

## 5. Discussion

The results of the analysis are similar to those investigating other forest owner land transfer decisions ([Rozance and Rabotyagov, 2014](#); [Sanborn-Stone and Tyrrell, 2012](#)) by including land and individual-

specific FFO characteristics, and elaborates on them by expanding the geographic scope to the entire USA and broadening the question to that of plans to sell or give away any or all of their forestland. FFO and land characteristics and attitudinal variables influenced near-term transfer plans similar to the way they influenced development and parcelization decisions ([Rozance and Rabotyagov, 2014](#); [Sanborn-Stone and Tyrrell, 2012](#)). Transfer plans are positively associated with being older, female, having more wooded land, and agreeing that they would sell if offered a reasonable price; transfer plans are negatively associated with high education levels, having a home within 1 mile of the wooded land, and agreement with wanting their wooded land to stay wooded.

The marginal effects of the model estimates show insightful results, supporting the idea that individuals' preferences and characteristics matter when considering decisions about forest owners' land ([Butler et al., 2007](#); [Butler et al., 2016d](#); [Sanborn-Stone and Tyrrell, 2012](#)). Attitude towards selling given a reasonable price had a greater absolute impact than attitudes about wanting to keep wooded land wooded. Not only are these high in absolute impact, but are even greater when considering changes from more than one level (e.g., from disagree to agree). For example, FFOs who “agree” with the statement on selling at a reasonable price have a 21% higher probability of being likely to have near-term transfer plans than FFOs who “disagree” with the statement on selling. FFOs who “agree” with the statement that they want their wooded land to stay wooded have a 11% higher probability of being unlikely to have near-term transfer plans than FFOs who “disagree” with the statement.

Landowner characteristics also had significant impacts on the decision. Gender, education and having a vacation home/cabin within one mile of the wooded land had similar absolute impacts, of between 5% and 6%. Landowner age and forest holdings had less of an absolute impact than the other FFO and land characteristics, but these variables are dependent on units. For example, the impact of age appears low at 0.6%, but that marginal effect reflects a 1-year change in age. Consider a 30 year change in age – an FFO in the 70 year age range would have roughly 20% greater likelihood of having plans to sell or give away any or all of their wooded land than an FFO in the 40 year age range.

However, what is most striking about this analysis are the insignificant relationships found with many of the variables. While we cannot know with certainty why these variables are insignificant in the model, here we posit a few potential explanations. The insignificance of the landowner objectives and concerns may have to do with circumstances of the landowner's life and what may occur in the next 5 years of their life. Regardless of why a landowner owns the land or of what concerns the landowner has, the landowner might just not be ready within the next 5 years to transfer the land. It is very possible that many of the landowners have intentions of passing it on in some way, as evidenced by the 79% who have concerns about keeping their land intact for the next generation. The time frame provided in the question may not reflect where they are in the decision process. In addition, a strong sense of place attachment to the land may outweigh other factors of influence ([Jorgensen and Stedman, 2001](#); [Stedman, 2003, 2002](#)). Ecological, financial and recreational ownership objectives and concerns about heirs may not be capturing the deep attachments and personal connections that many FFOs have for their land. Several studies have noted the importance that FFO personal connections with the land have on decisions and intentions related to passing on the land ([Brown and Raymond, 2007](#); [Creighton et al., 2015](#); [Markowski-Lindsay et al., 2016](#)).

The results indicate that the amount of engagement in forestry practices and nonmarket activities has no bearing on near-term transfer plans. This result is counterintuitive to the direction of several existing policies that encourages engagement with the land to “keep forest as forest.” Continuing to invest programmatic funds and energies in promoting forestry practices to woodland owners is not necessarily going to result in a lowered probability of intent to transfer.

The insignificance of the urban-rural characteristics raises several issues of interpretation. Perhaps urban-rural characteristics are insignificant because of the national scope of this study and inability to fully characterize the differences in place-based attributes at that scale.<sup>2</sup> Rozance and Rabotyagov (2014) found significant results, but they conducted a regional study that included not only some similar spatial characteristics (i.e., population density and proximity to a developed parcel), but also variables defining where in the state the parcels were located (i.e., east vs. west). Stein et al. (2005) base their study on GIS models that predict which watersheds are likely to increase their housing density using past and current housing density statistics, past growth patterns, road density and locations of urban areas over a 30-year time frame. While these authors were not testing significance, their approach suggests that past statistics and growth patterns over time may be needed to explain patterns. Further, these authors state challenges in characterizing development because some acres converted to housing may still have substantial tree cover (Stein et al., 2005). While development is distinct from near-term transfer decisions, this challenge may still be relevant for this analysis – indeed the correlation between place specific variables are very low (i.e., forest cover and housing density:  $-0.1$ ; forest cover and distance to urban areas:  $0.2$ ; housing density and distance to urban areas:  $-0.3$ ).

The urban-rural results seem to indicate that it does not matter if the landowner is in a rural or a developing area when it comes to near-term transfer plans. However, what it could indicate is the complex nature of urban-rural characteristics intertwined with current and past life circumstances. What may be missing from this analysis, and indeed from the NWOS survey, are elements describing past decisions made by the respondent about their land and elements of their life that matter to future plans. Respondents in urbanizing or suburban areas may have already responded to the development potential of the land and sold off parcels that were highly valuable in higher density areas; or sold a portion of their land to a non-profit or state or established a conservation easement already, thereby making near-term transfer plans irrelevant. Similarly, respondents might not be ready within the next 5 years to transfer their land, yet they may fully intend on doing so. In either case, looking solely at these spatial statistics alone may be misleading.

The NWOS asked respondents two follow-up questions to the likelihood of selling or giving away any or all of the wooded land owned in next 5 years that provide greater insight to the model results. Specifically, the NWOS asks: *Who will likely receive it?* and *Why are you planning to sell it?* Because respondents can select more than one answer, it is more appropriate to look at the answers to each of these questions individually. Approximately 95% of the estimation sample answered these questions, and the answers were largely related to family, age, and finances:

- *Who will likely receive it?*: Respondents said “my children” 53% of the time. “Other individuals” were the next highest at 36%. Approximately 12% said “I don’t know,” 11% said “Another family member,” followed by “A business” (6%), “Other” (5%), and “Government agency” (4%).
- *Why are you planning to sell it?*: The main reason of why they are planning to sell it or give it away was a write-in answer: “Other” at 34%. The majority of the “Other” category was made up of the following categorizable reasons<sup>3</sup>:

- Death/Age: 45%
- Kids/Next Generation: 13%
- Taxes/Debt: 6%
- Retirement: 5%
- Moving: 4%
- Divorce 1%

Beyond the “Other” category, 30% said “Part of an investment strategy,” 20% said “I am ready to give it away,” 17% said “Too expensive to hold or maintain,” 17% said “I need the money,” 14% were “No longer interested in owning it,” and 5% responded “High market value.”

Although this frequency analysis is not tied directly to the model, it does validate the idea that larger factors are affecting landowners’ decisions.

## 6. Conclusion

Conserving forested lands for clean water, clean air, carbon sinks and a myriad of other public goods has been a major focus of many policies and programs. While the most recent NWOS data indicate that the vast majority of FFOs want to keep their wooded land wooded, other studies indicate that this does not always happen. Alig et al. (2010) indicate that the rate of urbanization on forest has increased in the USA since 1982, and this trend is projected to continue over the next 50 years as the population continues to increase.

Helping to conserve family forests means understanding who is likely to transfer their land, especially in the near-term. It is important to understand how characteristics of the landowners influence decisions. This analysis adds to the developing literature on the supply side of forestland transfer by exploring the association between various ownership characteristics, behaviors and attitudes. Utilizing the 2013 NWOS data, the analysis is able to explore these transfer plans nationwide. Results indicate landowner characteristics and attitudes play a role in plans for near-term land transfer. Attitudinal differences toward selling it at a reasonable price (agree vs disagree) and age differences of roughly a generation or more (30 years or more) show the largest marginal impacts, while gender, education, and having a home or cabin on the land also show significant marginal impacts.

Agencies and organizations can use this type of information to target existing policy and program tools more wisely or for developing outreach materials. For example, the Forest Legacy Program (a conservation program administered by the U.S. Forest Service in partnership with the State lead agencies to encourage the protection of privately owned forest lands through conservation easements or land purchases) could use this information to help identify areas and populations most vulnerable to being transferred. While projects in the Forest Legacy Program are ranked and funded based on their ecological, social and economic values, the rankings could also be weighted, for example, by the likelihood of transfer.

The underlying data of this analysis substantiate the impact of age on the decision to transfer the land and indicate these decisions involve family most of the time. Specifically, this study identifies triggers to act that can occur anytime during a landowner’s lifetime (e.g., death, next generation, debt, retirement, moving, and divorce). Final decisions about the land may be shaped not only by individual landowner desires but also the circumstances that triggers them to act (Markowski-Lindsay et al., 2016). It is important for service foresters, educators, and outreach materials to acknowledge the complex role that these external factors may play in the decision process when interacting with landowners (Markowski-Lindsay et al., 2016; Creighton et al., 2015).

The lack of significance of the urban-rural characteristic is also an important finding. While it highlights the need for more complex modelling to capture the multidimensionality of development pressure and factors influencing land transfer, perhaps most importantly, it reiterates the need to incorporate variables describing the past decisions

<sup>2</sup> To pursue this, population density percentiles were tested, but this had no effect on the model. In addition, road density was considered but excluded because of its correlation with several other variables.

<sup>3</sup> Approximately 26% of the 34% of respondents who had “Other reasons” to give it away, are left uncategorized because it would require some additional interpretation and assumption of the write-in answers. For example, 6% said something to do with estate/estate planning, i.e., “Estate”, “Estate Distribution”, “Estate Planning”, “Estate Plans”, “Estate Settlement”, and “Execution of Estate.”

and life circumstances of the respondent. Transfer plans involve decisions already made intermingled with reasons related to growing old, ill-health, and the need to pass it on to children or the next generation. Clearly these results support the need for more research related to future ownership decisions of forested land because of emotional and familial attachments (Markowski-Lindsay et al., 2016). The lack of spatial or landscape relevance to the intent to transfer suggests that this decision is a complicated one for owners, and that they will not behave homogeneously relative to this question depending on the location of the land. It cannot be assumed that suburban FFOs will act one way with respect to intent, and rural FFOs will act another. What is happening in a family or ownership unit has more influence on future intent than mere location with respect to development. Outreach focused on suburban FFOs will not necessarily be successful, as the intent of owners to transfer depends on other factors. The results of this paper suggest it is more important to focus on certain kinds of people and attitudes, rather than in certain physical spaces prone to suburbanization.

FFO decision-making is complex, often influenced by numerous social, economic, and emotional factors. This study has used new, heretofore unanalyzed, NWOS data combined with FFO and land characteristics, FFO ownership objectives and concerns, new attitudinal questions from that instrument and spatial characteristics to explore the likelihood that FFOs across the USA would have plans to sell or give away any or all of their wooded land in the next 5 years. The consequences of this simple question could have ecosystem service implications for the future when ownership transfer results in parcelization and/or development. Understanding what influences these types of decisions can provide greater information on where these transfers are likely to occur and can help target conservation efforts nationwide.

While asking about plans to sell or transfer some or all of their wooded land is an important question, it is important to note two significant limitations associated with analyzing this NWOS question, in addition to those noted in the results section. First, FFO responses to this question reflect intentions, not actual behavior. FFOs may have an idea of what they would like to do in the next five years, but the plans could change as a result of unexpected life circumstances, such as ill-health, financial woes, or relationship changes such as divorce. Second, FFO responses reflect plans to sell “any or all” of owned wooded land. Clearly, selling all of the wooded land is different from selling a portion of it because selling a portion of it results in parcelization, which has been linked to further fragmentation or development (Mundell et al., 2010; Sanborn-Stone and Tyrrell, 2012). One effect of this lack of specificity in amount of land planned for transfer may be seen in the forest holdings results. The result that greater forest holdings are associated with increased likelihood of near-term transfer plans could derive from the fact that larger tracts can more easily have parcels sold off yet still enable FFOs to retain some land ownership. Ideally, a coordinated national study of FFO plans and decisions including factors that are associated with intentions (as per this study), behavior (such as unexpected life circumstances), and more specificity regarding amount of land being transferred and why could overcome these limitations and help inform policy with regard to land transfer and parcelization.

## Acknowledgements

Funding for this project was provided, in part, by the Research and Development and State and Private Forestry deputy areas of the USDA Forest Service. The authors wish to thank Kristin Floress, Emily Silver Huff, and John Stanovick for their helpful comments and suggestions.

## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.landusepol.2017.10.007>.

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