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USDA Forest Service National Woodland Owner Survey, 2011-2013: Design, Implementation, and Estimation Methods

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Abstract

The National Woodland Owner Survey (NWOS) is conducted by the U.S. Forest Service, Forest Inventory and Analysis program to increase the understanding of the attitudes, behaviors, and demographics of private forest and woodland ownerships across the United States. The information is intended to help policy makers, resource managers, educators, service providers, and others interested in the forest and woodland resources of the United States better understand the social context of these lands in order to facilitate more informed opinions and decisions. This report describes the design, implementation, and estimation methods for the NWOS implemented from 2011 through 2013. The NWOS is concerned with three non-overlapping populations of interest: family, corporate, and other private. To simplify the discussion, the focus of this report is on family forest and woodland ownerships, but identical methods were used for the other populations of interest. Results from this research are being published separately. For additional information visit: www.fia.fs.fed.us/nwos. See also [dx.doi.org/10.2737/NRS-GTR-157](https://doi.org/10.2737/NRS-GTR-157).

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DOCUMENT OVERVIEW

The U.S. Forest Service, Forest Inventory and Analysis (FIA) program conducts the National Woodland Owner Survey (NWOS; www.fia.fs.fed.us/nwos) to provide national, regional, and state-level information on who owns the forests and woodlands¹, why they own them, what they have done with these lands in the past, what they plan to do with these lands in the future, and how their characteristics, attitudes, and behaviors have changed over time. Iterations were conducted in 1953 (Josephson and McGuire 1958), 1978 (Birch et al. 1982), 1993 (Birch 1996), and 2002-2006 (Butler 2008). The fifth iteration of the NWOS, documented here, was conducted from 2011 through 2013 by the Family Forest Research Center, a joint venture of the U.S. Forest Service and the University of Massachusetts Amherst.

This report documents the procedures used to design, implement, and generate estimates from the data collected by the U.S. Forest Service, National Woodland Owner Survey (NWOS) during the 2011-2013 iteration of the survey. An analogous document published for the 2002-2006 NWOS (Butler et al. 2005) provides additional background on the NWOS. The organization of the current document follows the workflow of the NWOS as depicted in Figure 1. First the background of the NWOS and the general planning process steps are described. Then the methods used to generate the sample of respondents asked to participate in the NWOS are defined including sampling design, sampling frame, sample size determination, and sample intensification. Next the basic survey instrument is detailed, and comparisons are made with the survey instrument used in the previous iteration of the NWOS. Methods used to implement the NWOS with mail, phone, and online approaches are outlined and data processing, quality assurance, data confidentiality, and database design are described. The next topic covered is procedures used to generate population-level estimates that incorporate the NWOS sampling design by using questionnaire responses. Finally, the NWOS products and general analytical approaches are briefly described. Key terms are defined in the glossary at the end of this report.

¹The phrase “forest and woodland” is used throughout this report to be consistent with the terminology used in Oswald et al. (2014) and Butler et al. (2016). See the glossary for definitions of terms used in this report.

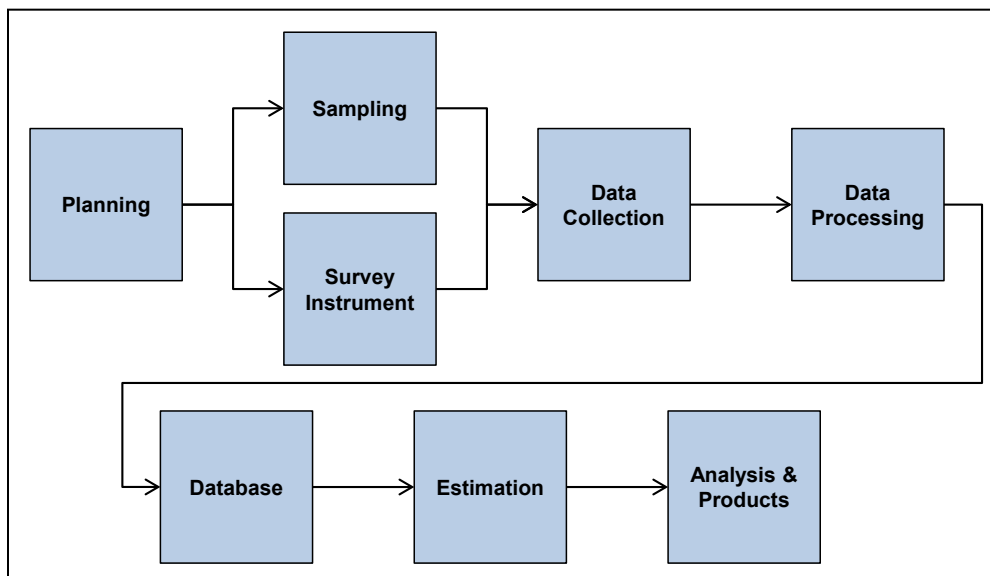


Figure 1.—Steps in the implementation of the U.S. Forest Service, National Woodland Owner Survey.

BACKGROUND AND PLANNING

Goals and Objectives

The legislative authority for conducting the NWOS as part of the Forest Inventory and Analysis program comes from the Forest and Rangeland Renewable Resources Research Act of 1978 (RRA 1978). This act instructs the Secretary of the U.S. Department of Agriculture to “obtain, analyze, develop, demonstrate, and disseminate scientific information about protecting, managing, and utilizing forest and rangeland renewable resources in rural, suburban, and urban areas.” As such, the U.S. Forest Service has established the NWOS as the social complement to the biophysical inventory conducted by the FIA program. While most of FIA is concerned with monitoring the number, species, health, and related attributes of the trees of the nation’s forest and woodland resource (Bechtold and Patterson 2005), the NWOS is concerned with understanding the social context within which the forests and woodlands exist, or more precisely the ownerships of these resources. The NWOS collects data on three groups of private forest and woodland ownerships: family, corporate, and other private. While family forest and woodland ownerships are the focus of many of the NWOS products (Butler et al. 2016) and are the population of interest discussed here, identical methods were used to collect data for corporate and other private forest and woodland ownerships.

The objectives of the NWOS are to address questions related to:

- Who owns America’s forests and woodlands?
- Why do they own these lands?
- What have they done with these lands in the past?
- What do they plan to do with these lands in the future?
- How have characteristics, attitudes, and behaviors changed over time?

The goal is to obtain statistically reliable estimates of population parameters that answer these questions for the nation and all U.S. states, territories, and protectorates. Estimates for territories and protectorates have not yet been obtained, but it is hoped this shortcoming will be addressed in the next iteration of the NWOS.

Monitoring trends in forest ownership characteristics is as equally important to the NWOS mission as is generating snapshot estimates of landowner statistics. Previous iterations of the NWOS were conducted in 1953 (Josephson and McGuire 1958), 1978 (Birch et al. 1982), 1993 (Birch 1996), and 2002–2006 (Butler 2008). Due to differences in data collected, data collection protocols, and estimation procedures, there are limitations when making comparisons between surveys, especially the earliest surveys. The 2002–2006 and the current 2011–2013 iterations represent the first time that the same data collection protocols were used. Eighty-six percent of the 2011–2013 variables have analogous variables that were collected in the 2002–2006 NWOS, and a detailed discussion of comparability is provided. Because estimation procedures have been updated, the 2002–2006 data were reprocessed using the new procedures to avoid any differences due to data processing when comparing between the two iterations.

The Institutional Approval Process

As with all research that includes human subjects, approval of the methods used for the NWOS was required. Because the NWOS is implemented by the Family Forest Research Center (<http://familyforestresearchcenter.org>), a joint venture between the U.S. Forest Service and the University of Massachusetts Amherst, both federal- and university-level approvals were required. The process for federal approval is outlined in the Paperwork Reduction Act (PRA 1995) and is administered by the Office of Management and Budget (OMB). The university approval process is administered by the university's Internal Review Board (IRB; <https://www.umass.edu/research/compliance/human-subjects-irb>).

The Paperwork Reduction Act requires that all projects that collect information from 10 or more private citizens, businesses, or other nonfederal entities obtain approval from OMB prior to implementing the survey. As stated in the preamble of the bill, the overall intent of the Paperwork Reduction Act is "to have Federal agencies become more responsible and publicly accountable for reducing the burden of Federal paperwork on the public" (PRA 1995). The submission package was assembled by the NWOS staff and involved reviews by outside experts and clearance officers within the Department of Agriculture and the Forest Service, posting on the federal registry, and a final review by OMB. The NWOS was approved under OMB Information Collection Number 0596-0078 for a 3-year period (September 1, 2010 to August 31, 2013), the maximum allowed under the OMB guidelines.

The University of Massachusetts Internal Review Board process is administered in accordance with the Federal Policy on the Protection of Human Subjects (DHHS Policy 45 CFR 46, FDA policy 21 CFR Parts 50 and 56). The IRB, composed of university faculty with survey expertise, reviews all research involving human subjects. For the IRB process, the NWOS staff prepared the requisite forms, which were reviewed and approved by the IRB.

SAMPLING: DESIGN, FRAME, SIZE, AND INTENSIFICATION

To extrapolate the results of a survey of a subset of a population of interest to the whole population of interest, a probability-based sampling design is often employed. This means that all members of the population of interest have non-zero inclusion probabilities, i.e., all members of the population have some known, calculable probability of being included in the sample (Cochran 1977). This section discusses all aspects of the sampling associated with the 2011-2013 NWOS, including: a description of the overall sampling design; details on the sampling frame, the list from which respondents are selected; the rationale for the target sample sizes; and why, where, and how the sample was intensified. More detailed discussions of the sampling strategy are provided in Dickinson and Butler (2013) and Dickinson et al. (2015).

Sampling Design

The NWOS is built upon the sampling framework used for the plot-based FIA forest resource monitoring (Bechtold and Patterson 2005). The sampling procedure involves a hexagonal tessellation of the population from which a random sample point is selected within each hexagon (Fig. 2). A grid of 5,937-acre hexagons was randomly placed over the United States, giving a spatial sampling intensity of roughly one sample point per 6,000 acres. The grid cell size was reduced in some small states, such as Rhode Island and Delaware, to obtain estimates with reliabilities more comparable to other, larger states. Rather than taking the hexagon centers as the primary sampling units as is done in a purely systematic design, sample points were randomly offset to “satellite locations” within each hexagon. The random offset was accomplished by randomly selecting azimuth and distance from the hexagon center. Sampling was systematic through time, with plots on a 5- to 7-year sampling rotation in the eastern United States and 10-year rotation in the western United States (Fig. 2).

The FIA primary sampling units, which are zero-dimensional points (Bechtold and Patterson 2005), were used to draw the NWOS sample. Analysis of the NWOS data differs from the FIA forest resource analyses because even though the sampling units for the NWOS are based on the FIA primary sampling units, ownerships are measured as opposed to the plots used for the forest resource analyses. Because multiple sample points can fall on the same ownership—especially for large and/or multiple-parcel ownerships—NWOS selection of ownerships is with-replacement (Jessen 1978, Lohr 1999). The hexagonal tessellation means an ownership can be selected as many times as the number of hexagons it occupies, but no more, because only one point is selected from each hexagon. As in any with-replacement design, attribute information from an ownership is used in estimation as many times as the ownership is selected.

Ownerships are selected with probability proportional to size because points on the ground have equal probabilities of selection, and the greater the area of forest and woodland owned, the greater the probability of being included in the sample. Unequal probability sampling provides an advantage when there is wide variation among the units (Lohr 1999), though sometimes it is just inherently part of the sampling process.

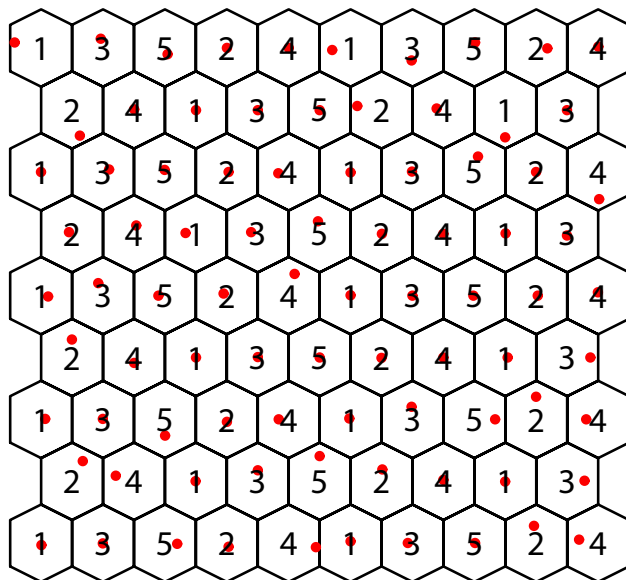


Figure 2.—Schematic diagram of the hexagonally tessellated, random sampling design used by the U.S. Forest Service, Forest Inventory and Analysis program to monitor forest resources (Bechtold and Patterson 2005). Each hexagon contains one randomly selected sample point (•). The numbers represent a 5-year inventory cycle and indicate the year the hexagon will be sampled. For example, sample points in the hexagons labeled “1” would be sampled the first year, sample points in the “2” hexagons the second year, and so on, with sampling cycling back to the points in the “1” hexagons starting the sixth year.

The critical terms to define in relationship to the NWOS sampling design are: population, stratum, and domain of interest. In this report, slightly different terminology from that used by Bechtold and Patterson (2005) in describing the FIA sampling design is used in order to be more consistent with the broader sampling literature (e.g., Lohr 1999). The population sampled by the NWOS is the same population sampled as part of the FIA forest resource inventory: all U.S. land. However, populations of interest are subsets of this full sampling frame. Furthermore, only ownerships associated with private forests are measured for NWOS attribute values. Family, corporate, and other private forest and woodland ownerships are the three populations of interest, and taken together, they represent all private forest and woodland ownerships. To simplify discussions in this report, population of interest refers to family forest and woodland ownerships unless noted otherwise. Identical procedures were used for the other populations of interest.

The NWOS was administered with varying sampling intensities by stratum. Strata were states for the 2011-2013 iteration of the NWOS in contrast to the 2002-2006 iteration when strata were substate estimation units (Butler et al. 2005). Stratification by state is done for several reasons. First, expected cross-state differences in parameters should make stratification more efficient in terms of variance estimation. Second, states themselves are often domains of interest. Finally, a certain degree of precision is desired for each state, meaning disproportionate stratification is needed (Kish 1965, Lohr 1999, Som 1973).

Domain of interest refers to a particular subset of a population of interest, either within or across strata. For example, a domain of interest could be family forest and woodland ownerships with a written forest management plan.

Sampling Frame

Remote sensing and ground-truthing determined land use at each sample point generated from the approach outlined in the Sampling Design section. Forest is defined by FIA as “land at least 120 feet (37 meters) wide and at least 1 acre (0.4 hectare) in size with at least 10 percent cover (or equivalent stocking) by live trees including land that formerly had such tree cover and that will be naturally or artificially regenerated” (Oswalt et al. 2014: 31) and as further defined in the FIA field manual (U.S. Forest Service 2010). Ownership for forested sample plots was determined from publicly available property tax records and was designated as 1 of 16 ownership categories (Table 1). Private ownerships were then contacted and invited to participate in the NWOS.

An ownership is a legal entity that includes one or more owners, and so an individual owner can be part of more than one ownership. As stated in the questionnaire instructions, respondents were asked to respond for all of the forest and woodland they owned in a state. If an ownership had forest land in multiple states, they might be asked to complete separate surveys for each state within which they own forest and woodland. However, less than one percent of ownerships in the sample had sample points in more than one state. No ownership was contacted more than once per cycle for each state within which they owned forest and woodland. Because the unit of interest was an ownership, an individual could be asked to complete separate questionnaires if they were part of more than one ownership.

All qualified names and addresses were standardized (e.g., first name then last name) following the U.S. Postal Service addressing standards. This information was then entered into a master table, and a series of filters were applied to identify ownerships that were listed more than once.

Table 1.—Ownership categories used by the U.S. Forest Service, Forest Inventory and Analysis program (U.S. Forest Service 2012). Numbers in parentheses represent the values recorded in the FIA database (Woudenberg et al. 2010).

Ownership Group	Ownership Class
Forest Service (10)	National Forest (11)
	National Grassland and/or Prairie (12)
	Other Forest Service land (13)
Other Federal (20)	National Park Service (21)
	Bureau of Land Management (22)
	Fish and Wildlife Service (23)
	Departments of Defense/Energy (24)
	Other Federal (25)
State and Local Government (30)	State including state public universities (31)
	Local (county, municipality, etc.) including water authorities (32)
	Other non-Federal public (33)
Private (40)	Corporate, including native corporations in Alaska and private universities (41)
	Nongovernmental conservation /natural resources organizations. Examples include Nature Conservancy, National Trust for Private Lands, Pacific Forest Trust, and Boy Scouts of America (42)
	Unincorporated partnerships/associations /clubs. Examples include hunting clubs that own, not lease property; recreation associations; 4H clubs; and churches (43)
	Native American (Indian) – within reservation boundaries (44)
	Individual and family, including trusts, estates, and family partnerships (45)

Sample Size

The target sample size per strata (i.e., state) was empirically determined by examining the coefficient of variation for estimates of the number of private ownerships for each state using the 2002-2006 data (Butler 2008). The coefficient of variation is a means for looking at variation across estimates from populations of different sizes (Cochran 1977) and is calculated as:

$$c_v = \frac{\hat{\sigma}}{\hat{t}}$$

Where

c_v = coefficient of variation,

$\hat{\sigma}$ = estimate of the standard error for the estimate of the total, and

\hat{t} = estimate of the total.

Based on this analysis, an inflection point occurred around a sample size of 250, and the coefficient of variation began to approach an asymptote of approximately 0.15 (Fig. 3).

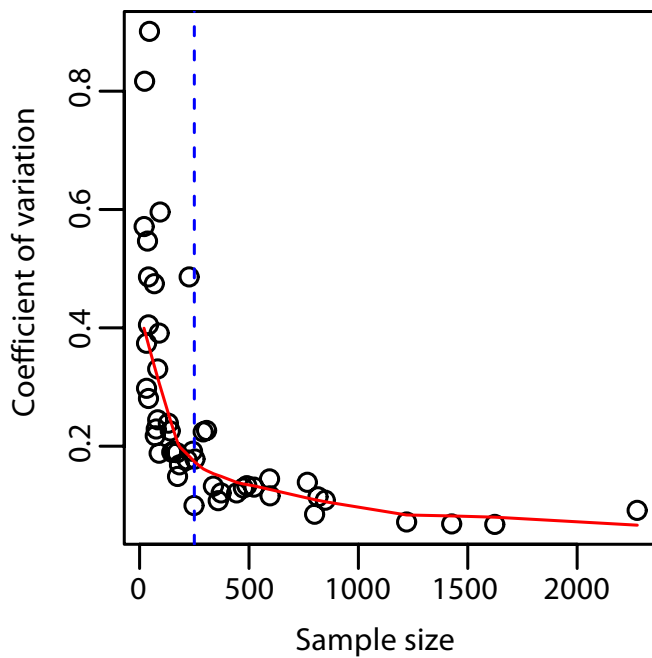


Figure 3.—Relationship between sample size and coefficient of variation for the total number of forest and woodland ownerships by state for the 2002-2006 U.S. Forest Service, National Woodland Owner Survey (Butler 2008).

A much smaller rate of decrease in the coefficient of variation after this point indicated a much lower marginal benefit. As a result, the goal of the 2011-2013 NWOS was to obtain a minimum of 250 responses per state with an associated coefficient of variation of no more than 0.15. In states where the target sample was not achieved through the base sample, efforts were made to increase the sampling intensity (see Sample Intensification section).

The number of forest and woodland ownerships responding to the NWOS in a state—the effective sample size—is a function of the sampling intensity, the percentage of forest and woodland that is privately owned, the number of sample points owned per respondent, and cooperation rates. Cooperation rates are calculated as:

$$\text{Cooperation Rate} = \frac{\text{Responses}}{\text{Sent} - \text{Undeliverables}} \times 100$$

Where

Responses = number of completed and partially completed surveys returned,

Sent = total number of surveys mailed, and

Undeliverables = number of surveys returned as undeliverable.

Often the term response rate is incorrectly used in the literature, when it is actually cooperation rate that is being reported. According to AAPOR (2015), response rate should, at a minimum, include in the denominator those in the sample who were not contacted (e.g., those with bad addresses).

For the contiguous United States, the base sample is one sample point for every 6,000 acres collected over the course of the full measurement cycle that does not exceed 7 years in the East and 10 years in the West. The cooperation rate for the 2002-2006 NWOS was 51.3 percent (Butler 2008). Based upon these considerations, budgetary and logistical constraints, and the fact that the 5-year cycle was compressed to 3 years, approximately 9,000 private forest and woodland ownerships per year were asked to participate in the NWOS from 2011 through 2013.

The goal is to complete a full cycle of the NWOS once every 5 years with 20 percent of the potential respondents, equally distributed across the United States, contacted each year. This would better reflect how the sample is collected (i.e., as part of the base FIA program), allowing for finer temporal trends to be discerned and a better distribution of the workload. Due to various logistic constraints, the idealized timing has not yet been reached, but hopefully will be in the future.

Sample Intensification

In states where the base sample did not reach the minimum sample size, an intensified sample was collected if the requisite data were available (i.e., ownership information was available in a GIS format). This intensification was conducted in Connecticut, Delaware, Hawaii, Massachusetts, Maryland, Montana, New Jersey, and Rhode Island. Sampling procedures used for the base sample were replicated as closely as possible for the intensified sample, with a goal of eliciting a total of 250 respondents per state, including the base NWOS sample. In Connecticut and Maryland, external funding enabled even greater intensification, resulting in sample sizes larger than 250.

Using information from the base sample, including percentage of private forest and woodland ownership and cooperation rates, appropriately sized hexagons were created, and points were randomly generated for all hexagons where an NWOS sample point did not already exist. Newly generated points were intersected with a subset of federal and state land identified in the Protected Areas Database geospatial layer (PAD-US 1.1) (CBI 2010). For points determined not to be on federal or state ownerships, aerial photography was used to determine whether the points were forested or wooded. For the forested or wooded points, ownership information was collected from available geospatial data, and points determined to be private forest and woodland ownerships were added to the sample.

SURVEY INSTRUMENT

This section details the general approach taken for designing the survey instrument and discusses the specific data elements collected. Differences among the current and previous survey instruments are discussed in addition to minor differences in questionnaires across versions and states.

Because the only information available for all potential respondents was name and mailing address (see Sampling Frame section above), the primary survey instrument was a mail-based paper booklet ([App. 1](#)). This booklet contained a total of 37 questions, with many having one or more subparts. The survey instrument length was limited to minimize burden on respondents. Study objectives, including comparability with previous studies, and input from experts influenced the selection of questions that were included.

A Web-based version of the survey instrument was created and coded by using hypertext markup language (HTML). This online survey instrument contained all of the same questions as the paper survey, and the wording and formatting mimicking that of the paper version as much as possible. To increase comparability with the paper version, no logic checks were built into the online version.

To test for nonresponse bias and provide additional data, a phone survey instrument containing a subset of the questions on the paper survey instrument was administered to a subset of the nonrespondents ([App. 2](#)). Only a subset of questions (22 percent) was used in order to minimize interview time, and only a subset of nonrespondents was contacted due to limited phone number availability and financial constraints.

As described above, states were the strata or estimation units, and the survey instrument was designed to reference all forest and woodland an ownership had in a given state. If an ownership had forest or woodland in more than one state, that ownership could receive a survey from each state, and a few owners did receive surveys for multiple states. The content of the state-specific survey instruments is documented in the Survey Instrument Versions section below.

Survey Pretesting

The wording, content, design, and layout of a survey instrument can significantly influence the response rate and the quality of the answers provided (Dillman et al. 2009). Pretesting via focus groups was used to develop questions that elicited accurate information. In writing the questions, the goal was to use language that someone with the equivalent of an eighth-grade education could easily understand. In addition, efforts were made to use words common to private forest owners rather than technical, forestry terms. For example, the term forest was not used in the survey instrument because it has a different connotation to owners and forestry professionals. Instead the phrase “wooded land” was used throughout the survey.

Pretesting of the survey instrument, in accordance with the OMB approval process, involved focus groups with private forest and woodland owners from across the United States. Focus groups were held in New Mexico, Maine, North Carolina, Missouri, and California in the fall of 2010 and in Hawaii in the fall of 2011. Recruiters were asked to invite owners who represented a range of sizes of forest and woodland holdings in order to negate any effects of size of forest holdings on the testing. In each state, two focus groups were conducted at one location (one midday and one evening session), with 6 to 12 landowners participating in each session. Landowners were asked some general questions about their land and then asked to complete sections of the survey instrument. After each section was completed, a group discussion was facilitated to highlight anything that might have been misunderstood, and participants were probed for deeper meanings on their responses. Questions were examined for readability, word choice, and efficacy in eliciting responses, and adjustments were made as deemed appropriate. An example of the focus group topic guide is included in [App. 3](#).

Survey Questions

The formats of the questions in the NWOS survey instrument include closed-ended, partially closed-ended, and open-ended (Dillman et al. 2009). Closed-ended questions provide respondents with defined sets of options from which to select responses and included rating questions where respondents were asked to rate concepts using a 5-point Likert scale (Likert 1967). Partially closed-ended questions include a defined list followed by an “other” option that allows respondents to specify additional responses. Open-ended questions allow the respondent to fill in a blank response area using their own words.

Questions were grouped into sections that solicited similar information and were placed in sequences that were intended to be logical extensions of previous sections and questions.

Table 2 outlines the questions and data collected, and more detailed descriptions and justifications for each question are provided below. A copy of the survey instrument is available in [Appendix 1](#), and the question numbers listed below refer to this instrument. The Database section of this report details the coding used for each question.

Table 2.—Data collected by the 2011-2013 U.S. Forest Service, National Woodland Owner Survey

Category	Data collected	Question number(s)
Forest ownership characteristics	Form of ownership	1
	Number of owners	2
Forest and woodland characteristics	Acres and number of parcels of forest and woodland owned	3
	Part of a primary or secondary residence	4 & 5
	Part of a farm or ranch	6
Ownership objectives	Ownership objectives	7
Ownership history	Land acquisition and transfer patterns	8 & 9
Forest use and management	Primary decisionmaker	10
	Written management plans	11
Forest use	Harvesting of trees	12
	Harvesting of nontimber forest products	13
	Past activities	14
	Future activities	15
	Lease and fee-based access	16
Conservation program participation	Cost-share programs	17
	Forest certification	18
	Property tax programs	19
	Sale of development rights	20
Recreation	Recreation activities	21
	Forest and woodland access	22
Sources of information	Sources of advice	23 & 24
	Preferred methods of learning	25
Concerns and issues	Social and forest and woodland health concerns	26
Future intentions	Likelihood of selling forest and woodland	27 & 28
Demographics	Occupation	29 & 30
	Age	31
	Gender	32
	Education	33
	Race and ethnicity	34 & 35
	Income	36 & 37

Forest ownership characteristics

Form of ownership (Question 1)—The type of entity that owns a given parcel of forest or woodland can have a large effect on how the land is used. Ownership categories in Question 1 were selected because of the objectivity of these categories and the relative ease by which they can be interpreted by respondents and data users.

Number of owners (Question 2)—An ownership is a legal entity and can be composed of one to many hundreds of individual owners. The number of people who are a part of the ownership has implications for how the land is used and how it will pass to future generations of owners. As stated in the survey instrument instructions, if the owner was part of more than one ownership, they were to respond for the ownership listed on the survey envelope address.

Forest and woodland characteristics

Acres and parcels of forest and woodland owned (Question 3)—Knowing the amount of forest and woodland owned by each ownership is essential for extrapolating the responses to population-level estimates and for analyzing the relationships between size of holdings and other characteristics. The question began by ascertaining the total acres of land owned. This was done to help owners differentiate between all land and forest/woodland. In addition, this information can be used to calculate what percentage of an ownership's holdings is forested/wooded versus other land uses. The next parts of the question asked how many acres of forest and woodland were owned within the state. A lay definition of forest and woodland was provided on the survey instrument. Information about the number of parcels or discrete, unconnected units of forest and woodland was collected to better understand forest and woodland parcellation and consolidation patterns.

Forest and woodland as part of a primary or secondary residence (Questions 4 and 5)—Absentee forest and woodland ownership and an ever-increasing wildland-urban interface are important issues affecting forest and woodland resources. It is useful to know if a person lives on the forest and woodland or is an absentee owner because the two groups may behave differently. Questions 4 and 5 asked respondents if their primary or secondary (vacation home or cabin) residences, respectively, were associated (i.e., within one mile) with their forest/woodland. As more people buy parcels of forest and woodland and move into the woods, the land base for more traditional uses, such as timber harvesting, often diminishes (e.g., Wear et al. 1999). This phenomenon is also related to parcellation.

Forest and woodland as part of a farm or ranch (Question 6)—In many parts of the country, forest and woodland is commonly owned in conjunction with a farm or ranch. It is important to know if forest and woodland owners also own farms or ranchs in order to understand the communication networks they use, the types of programs that might be most appealing, and the potential opportunities and constraints they face. Adopting the U.S. Census of Agriculture definition, a farm or ranch was defined in the survey instrument as a place where, in most years, \$1,000 or more was earned from the sale of crops (other than forest products) or animals (NASS 2014). In Question 6, respondents were asked if they owned a farm or ranch and if it was within a mile of their forest/woodland.

Ownership objectives

Ownership objectives (Question 7)—Forest and woodland owners own their land for various reasons. Knowing why owners have their land is important for understanding their attitudes

and behaviors. Reasons for owning land include both amenity and financial objectives. Question 7 sought to understand reasons for owning forest and woodland by asking respondents to rate 16 potential reasons for owning land using a five-point Likert scale.

Ownership history

Land acquisition and transfer patterns (Questions 8 and 9)—Ownership tenure and land use dynamics are related topics that can greatly impact forest resources. Ownership tenure is the length of time that an ownership has owned land and is relevant for policy makers and organizations that deliver services or receive goods from private forests. Knowing how often land is bought and sold and the types of groups participating in these transactions provides additional insight into land-use dynamics. Question 8 asked how the forest and woodland was acquired, from whom it was acquired, and when it was first acquired. Question 9 asked about the frequency of forest and woodland transfers, who acquired it, and the occurrence of these transfers in the previous 5 years.

Forest use and management

Primary decisionmaker (Question 10)—Forest and woodland management decisions have become more complex as greater demands are placed on the land. To meet management challenges, some owners rely on professional managers, others have formed cooperatives, and still others make decisions on their own. Understanding trends in who makes forest and woodland management decisions is important to ensure the sustainable flow of goods and services from private forests and woodlands.

Written management plans (Question 11)—A written management plan is one indication that a forest and woodland owner has contemplated how to manage his or her land. In some states, management plans are a prerequisite for participation in certain preferential property tax programs. Having a management plan often is used as an indicator in sustainability assessments and is generally a requirement for getting forest land green certified. For those respondents indicating they had a written forest management plan, subparts of this question asked if they had implemented it and who prepared it. For those respondents indicating they did not have a management plan, a subpart of this question asked them to select from a list of potential reasons why not.

Forest use

Harvesting of trees (Question 12)—Timber from private land contributes significantly to the national economy and can be a significant source of income for forest and woodland owners. Through other sources, information is available on how much wood is removed and processed annually (e.g., Oswald et al. 2014). To provide contemporaneous information about harvesting behaviors of private forest and woodland ownerships, this question used a matrix format to ask what types of products (firewood, logs, chips, or unwanted trees) were harvested and why (personal use, sale, or other). If the respondent indicated that trees were harvested or removed, subparts of the question asked if they used a professional forester or a certified logger for any of the harvests.

Harvesting of nontimber forest products (Question 13)—Nontimber forest products are gaining increasing attention as a potentially important source of income for forest and woodland owners and as a resource for society. To ascertain how many forest and woodland owners were harvesting these products, this question used a matrix to ask respondents what types, if any, of

Table 3.—Examples of regional nontimber forest products (NTFPs) provided on the 2011-2013 U.S. Forest Service, National Woodland Owner Survey

Category	Region			
	North	South	West	Hawaii
Edibles	Berries, maple syrup	Berries, mushrooms	Mushrooms, berries	Pepeiao, guava
Medicinals	Ginseng, St. John's wort	Ginseng, saw palmetto	Nettles, Echinacea	Māmaki, noni
Landscaping	Transplants	Pine straw, transplants	Transplants	Hāpu'u, palāpalai
Decorative	Boughs, birch bark	Boughs, moss	Conifer boughs, salal	Maile, 'ōhi'a lehua, ti

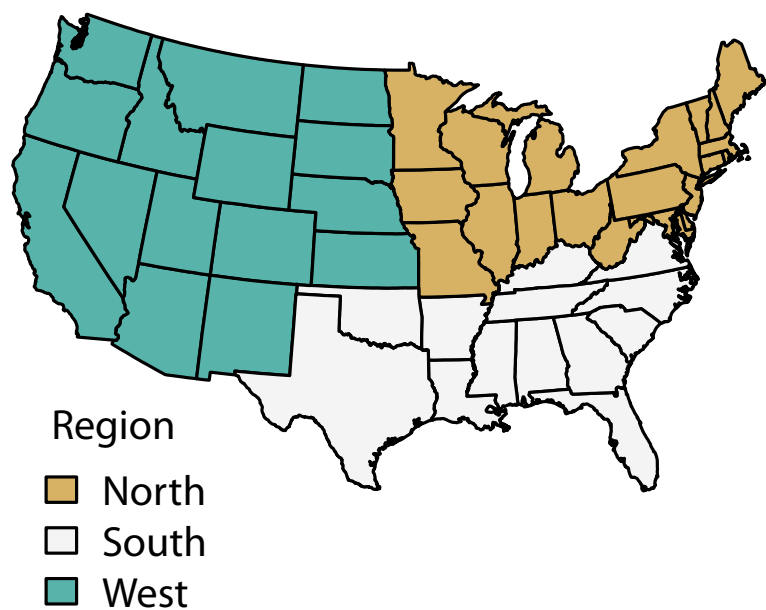


Figure 4.—Regions used by the 2011-2013 U.S. Forest Service, National Woodland Owner Survey for specifying nontimber forest product (NTFP) examples. Alaska was included in the western region and Hawaii was treated separately.

nontimber forest products have been collected from their lands and why these products were collected (personal use or sale). Regionally relevant examples of the four types of nontimber forest products (edibles, medicinals, decorative, and landscaping) were included (Table 3; Fig. 4).

Past activities (Question 14)—Things owners do with their forest and woodland are suggestive of the types of goods and services they intend to produce from that land. For instance, owners' actions affect the ability of the forest to sequester carbon, produce timber, and protect wildlife. Traditionally, management included only limited treatments, such as planting new trees following a harvest, but the proliferation of nontimber ownership objectives has greatly increased the range of management activities implemented. To quantify what types of management activities are being applied to the private forest and woodlands across the

United States., this question asked respondents to indicate which of the following activities had occurred on their forest or woodland in the previous 5 years: cut and/or removed trees for sale; cut and/or removed trees for own use; collected nontimber forest products; reduced fire hazard; controlled burn/prescribed fire; eliminated or reduced invasive plants; eliminated or reduced unwanted insects or diseases; road construction or maintenance; trail construction or maintenance; improved wildlife habitat; or livestock grazing.

Future activities (Question 15)—Owners' plans for their forest and woodland have significant implications for forest sustainability. Using a 5-point Likert scale ranging from extremely likely to extremely unlikely, this question asked respondents to indicate how likely it was that the following activities would happen on their forest or woodland in the next 5 years: cut and/or remove trees for sale; cut and/or remove trees for own use; collect nontimber forest products; reduce fire hazard; controlled burn/prescribed fire; eliminate or reduce invasive species; eliminate or reduce unwanted insects or diseases; road construction or maintenance; trail construction or maintenance; improve wildlife habitat; or livestock grazing. This is the same list of activities used in Question 14 with the verb tenses changed where appropriate.

Lease and fee-based access (Question 16)—For some forest and woodland ownerships, receiving fees for allowing others to access their land is an important source of income and represents a significant service provided to society. These arrangements can also affect how land is managed. In addition to asking whether a respondent leased or received fees for allowing access to their forest or woodland, information about the specific activities allowed was also ascertained. This question asked respondents to indicate for which, if any, activities their forest or woodland was leased. To understand trends in lease activities, a subquestion asked if the respondents had leased any forest or woodland in the previous 5 years.

Conservation program participation

Cost-share programs (Question 17)—Some government agencies have programs that provide forest and woodland ownerships that meet certain qualifications with funds to support activities that generate public benefits. Known as cost-share programs, they have been widely applied, yet their overall effectiveness is not well understood. In particular, agencies know cost-share participants; however, they usually lack information about who is not participating. Asking respondents if they participated in a cost-share program allows for the identification of salient characteristics associated with each group. Knowing the differences between those participating and not participating can help agencies improve the effectiveness of their programs.

Forest certification (Question 18)—There is a growing worldwide movement for certifying that forests are sustainably managed. Numerous organizations have established criteria that quantify indicators of sustainable management. To gain more insight into who was and was not participating in forest certification programs, this question asked respondents about their familiarity with forest certification and current and anticipated participation.

Property tax programs (Question 19)—Some state and local governments have programs that defer, reduce, or eliminate property taxes for forest and woodland owners. The property tax programs differ by state. This question asked respondents about their familiarity with their state's tax program and if they were enrolled in it.

Sale of development rights (Question 20)—Forest and woodland owners have land for a variety of reasons. Reasons for owning can change over time, often influenced by changes in life circumstances. In a conservation easement, development rights can be sold or given away by a landowner to protect the character of the land. To understand the extent of private forest and woodland ownerships selling development rights across the United States, this question asked respondents about their familiarity with this concept, whether any of their land was enrolled, and, if not, how likely they were to enroll their land in it in the next 5 years.

Recreation

Recreation activities (Question 21)—Recreation is one of the most common reasons people cite for owning forest and woodland, and as such warranted a question apart from Question 14. This question asked respondents who, if anyone, had recreated on their land in the past 5 years, and if so, how they recreated.

Forest and woodland access (Question 22)—Forest and woodland owners sometimes restrict access to their land by the general public. Land is posted to restrict access by trespassers, hunters, drivers of motorized vehicles, or other members of the public. This question asked respondents if their forest or woodland was posted to restrict access, and if so, what activities were restricted.

Sources of information

Sources of advice (Questions 23 and 24)—To meet ownership and management objectives, forest and woodland owners sometimes seek advice from others. There are numerous private forestry consultants and public agencies that provide forest and woodland management advice. Although these professionals know their clients, it is also important for them to know something about those who do not use their services. Knowing the potential market and striving to meet the needs of that market will increase the ability of professionals to help forest and woodland owners meet their needs. This question asked respondents from whom, if anyone, they received advice in the previous 5 years. To gauge a landowner's interest in receiving advice about management, transferring land to the next generation, development rights, cost-sharing, tax programs, and timber markets, respondents were asked how helpful advice on these topics would be to them.

Preferred methods of learning (Question 25)—It is important that organizations delivering information to private forest and woodland ownerships know their preferred ways of learning about forest and woodland stewardship. Over the last decade, computers have transformed how information is delivered, but many landowners still rely on other methods, such as talking with a professional forester and written materials. This question asked respondents to rate information/technology transfer methods.

Concerns and issues

Social and forest and woodland health concerns (Question 26)—Forest and woodland ownerships are continually confronting new regulations, societal encroachment, and forest and woodland health issues that affect the way they use their land. Knowing owners' concerns about these issues is important because this information can assist in developing programs for alleviating those problems. This question sought to quantify these concerns by asking respondents to indicate their level of concern for a number of topics affecting forests and woodlands.

Future intentions

Likelihood of selling forest and woodland (Questions 27 and 28)—Owners' plans for selling or otherwise giving away their forest or woodland have significant implications for forest and woodland sustainability. It is at this point of transfer that land use changes are most likely to occur, and ownership objectives and uses can change dramatically. In Question 27, respondents indicated how likely they were to sell or pass on their land in the next 5 years, and if they were likely or very likely to do so, who was likely to receive it and their reason(s) for transferring the land. In order to further gauge landowners' intentions for the future of their land, Question 28 asked respondents to rate, from strongly agree to strongly disagree, the following two statements: (1) I want my wooded land to stay wooded, and (2) I would sell my land if I was offered a reasonable price.

Demographics

The final section of the survey instrument asked about landowners' demographic characteristics. This information is an important determinant of forest and woodland owner behaviors and is important for understanding other phenomenon, such as the likelihood of transferring land due to old age. Space for up to two owners who were a part of the ownership to provide demographic information was included, and 67 percent of the family and individual owners responding to the 2011-2013 NWOS indicated they had two or more owners. To facilitate comparison with other data sources, demographic categories and terms were chosen to correspond with those used by the U.S. Census Bureau (2012) and the U.S. Bureau of Labor Statistics (2010). Owners of businesses and other organizations were instructed to skip this section.

Occupation (Questions 29 and 30)—Occupation can be an indicator of how owners view their land. For example, are they a natural resource professional or a farmer? Respondents were asked if they were retired. The diversity of occupations required an open-ended question, and the responses were later classified according to categories defined by the U.S. Bureau of Labor Statistics (2010).

Age (Question 31)—An owner's age can be an important determinant of how the forest and woodland is used. As the age of an owner increases, the probability increases that his or her land will be sold or transferred in the near future. Respondents were asked to write in their age.

Gender (Question 32)—Males and females may have different attitudes toward their forest and woodland or different preferred methods for managing and learning about their lands, so respondents were asked to indicate their gender.

Education (Question 33)—Education can influence what owners know about their land, their familiarity with programs, and their willingness to participate. Question 33 asked respondents to indicate their level of education within broad categories.

Race and ethnicity (Questions 34 and 35)—The social goal of equality among races and ethnicities can be partially assessed through knowledge of the distribution of forest and woodland owners among these groups. This information is particularly important for agencies that are statutorily required to report this information, but lack any meaningful source for this data. These questions asked respondents if they were of Hispanic or Latino origin and to which racial groups they belonged. The categories and wording came from the precedent established by the U.S. Census Bureau (2012).

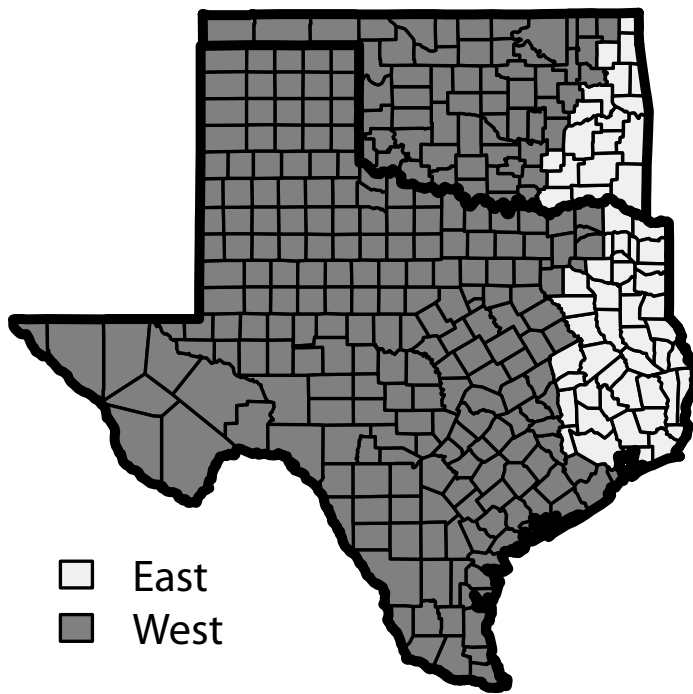


Figure 5.—Counties defined as western and eastern Texas and Oklahoma in the implementation of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey.

Income (Questions 36 and 37)—It is likely that as income increases, the objectives of forest and woodland owners change. To minimize intrusiveness, Question 36 asked respondents to indicate the levels of income using broad categories. Question 37 asked respondents to indicate what percentage of their income was derived from their forest and woodland.

Survey Instrument Versions

2011-2013 version

The NWOS survey instrument, with the exceptions noted here, was the same across states. The primary differences among state survey instruments included the state name listed in questions, the percentage of forest and woodland cover within the state listed in the definition, nontimber forest products examples (Table 3), and tax program names. The other difference was for survey instruments distributed to private forest and woodland ownerships in western Texas and western Oklahoma (Fig. 5). These survey instruments were modified to clarify the intention to include all wooded land and rangeland that had the required number of trees per acre.

The base surveys mailed to private forest and woodland ownerships in 2011, 2012, and 2013 were virtually identical apart from a few minor grammatical corrections. The only substantive difference between version 5.0, used primarily in 2011, and version 5.1, used primarily in 2012 and 2013, was a correction in one option in the recreation question (Question 21b). Skiing or snowmobiling was changed to skiing or snowshoeing to avoid mixing passive and mechanized recreation.

2011-2013 version vs. 2002-2006 version

To maximize the potential for trend analyses, efforts were made to minimize changes to the survey instruments used in the 2002-2006 and 2011-2013 iterations of the NWOS. Identical wording was used for most questions, but some questions were changed, dropped, or added.

Questions, subquestions, and options were dropped if they were deemed to be confusing, onerous, or not well used. Questions, subquestions, and options were added to cover topics that were either missed in the previous iteration or that had more recently emerged as important issues.

Changes were made to clarify some issues that were not always well understood. In the 2011-2013 iteration, the term “wooded land” was used instead of the term “woodland” used in the 2002-2006 iteration. It was found through focus group testing that the new terminology resonated more consistently with respondents. To overcome some confusion with the earlier iteration of the NWOS, the following instructions were added to the survey instrument:

- “If you are part of more than one group that owns wooded land, please respond for the group that is listed on the outside of the envelope.”
- “If the company listed on the envelope is a subsidiary of a larger company, please respond for the larger, parent company.”
- “Write on the cover ‘No Land Owned’” was added to the instructions outlining what to do if no wooded land is owned.
- Differences between survey instrument versions need to be considered when interpreting changes between survey iterations; however, these differences are not expected to have substantive impacts on the comparisons.

A summary of the main differences in the wording of questions for the two survey iterations is available in Table 4. The actual 2011-2013 NWOS survey instrument is included in [Appendix 1](#) of this report and the 2002-2006 NWOS survey instrument is available in Appendix I of Butler et al. (2005). The only complete question dropped between iterations was a long question asking about distribution of forest and woodland by substate areas. Due to changes in estimation procedures, this information is no longer required. All of the Likert rating questions were switched from 7-point to 5-point scales so points can be labeled as is recommended in the current best practices (Marsden and Wright 2010).

Table 4.—Comparisons between the 2011-2013 (version 5.1) and 2002-2006 (version 4.5) versions of the U.S. Forest Service, National Woodland Owner Survey

Question number ^a		Description	Comparison notes
Version 5.1	Version 4.5		
1	5	Acres by ownership category	Categories were simplified, especially for corporations. Switched from “check all that apply” to “check only one”.
2	--	Number of owners	
3	1	Size of forest and woodland and number of parcels owned	Subquestion of wooded land outside of State of interest was dropped. The number of parcels subquestion was separated into two subquestions.
4	7	Primary residence	
5	7	Vacation home	
6	6	Farm	Added “not applicable” option. Dropped subquestion on farm acreage.
7	9	Reasons for owning	Converted from a 7-point to a 5-point Likert scale and all options were labeled with words. Added objectives related to: water resources and raising a family. Split home and vacation home objectives.
8	3	Land acquisition	Added more detail on family relationships. Dropped the “don’t know” option for acquisition year.
9	4	Land transfer	Added more detail on family relationships. Dropped the don’t know option for acquisition year.
10	14	Decisionmaker	Added more detail on family relationships and dropped logging contractor.
11	17	Management plans	Added subquestions on whether plan was implemented, who prepared the plan, and reasons for no plan. Don’t know option was dropped.
12	15	Timber harvesting (simplified)	Converted to a matrix format. Added options for wood chips and unwanted trees. Dropped veneer logs and pulpwood. Added subquestion on certified logger. Dropped reason for cutting.
13	16	Nontimber forest products	Converted to matrix format.
14	18	Recent forest activities	Added controlled burn, invasive species, and livestock grazing. Dropped planted trees and chemical use. Separated road and trails. Recreation and posted converted to separate questions.
15	23	Future forestry activities	Switched to a likelihood rating. Dropped convert land, buy more land, leave as is, minimum activities, no plans, and don’t know. Sell and give away converted to separate questions.
16	10	Leases	Added land conservation, carbon sequestration, water supply, and wildlife. Dropped timber production and nontimber forest products.
17	13	Cost-share programs	Converted familiarity from yes/no to rating. Added subquestion on recency. Dropped specification of programs.

continued

Table 4.—continued

Question number ^a		Description	Comparison notes
Version 5.1	Version 4.5		
18	12	Green certification programs	Converted familiarity from yes/no to rating. Dropped subquestion on future intentions for certification.
19	--	Property tax program	
20	11	Easements	Used phrase sell development rights instead of conservation easement. Converted familiarity from yes/no to rating. Dropped subquestion on what was eased.
21	18	Recreation	Added information on who recreated and the types of recreation activities.
22	18	Posting	Added subquestion on what activities are restricted.
23	19	Advice received	Added subquestion on advice topic and method of receiving advice.
24	--	Advice desired	
25	20	Preferred methods to receive advice	Converted to a check all that apply.
26	21/22	Concerns	Converted from a 7-point to a 5-point Likert scale and all options were labeled with words. Added climate change. Separated air and water pollution. Dropped endangered species, lawsuits, regulations, timber theft. Changed unwanted plants to invasive plant species.
27	23	Future selling/giving away land	Added subquestion on who will receive it and why they are planning to dispose of it.
28	--	Conservation attitudes	
29	24	Demographics - retired	Asked for up to two owners in version 5.1.
30	24	Demographics - occupation	Asked for up to two owners in version 5.1.
31	25	Demographics - age	Asked for up to two owners in version 5.1. Asked as a continuous variable in version 5.1.
32	28	Demographics - gender	Asked for up to two owners in version 5.1.
33	26	Demographics - education	Asked for up to two owners in version 5.1. Changed graduate degree to advanced degree.
34	29	Demographics – ethnicity	Asked for up to two owners in version 5.1.
35	29	Demographics - race	Asked for up to two owners in version 5.1.
36	27	Demographics - income	
37	--	Income from forest and woodland	

^a 5.1 is representative of the versions of the survey used in the 2011-2013 iteration of the NWOS; 4.5 is representative of the versions of the survey used in the 2002-2006 iteration of the NWOS.

DATA COLLECTION

The primary data collection method was a self-administered, mail-back survey instrument. An online version of the survey instrument was also available. Telephone interviews, using a subset of the questions from the mail survey instrument, were conducted to facilitate the nonresponse bias assessment and to increase the number of responses. The mail survey was selected as the primary contact method because name and address was the only information available for all ownerships in the sample. This section describes the methods used to implement all three modes. Copies of the mail, online, and phone survey instruments are included in the [Appendixes](#).

Mail Survey

The implementation of the mail portion of the NWOS used methods adapted from the Tailored Design Method developed by Dillman et al. (2009). Each forest and woodland ownership contacted by the NWOS received up to four mailings. First, a prenotice postcard ([App. 4](#)) was sent alerting the potential respondents that a survey instrument would be arriving soon. The prenotice postcard briefly described the survey, outlining why it was important, why their help was needed, and what they may gain from participating. Three to five business days later, the potential respondents received a survey instrument ([App. 1](#)), prepaid business reply return envelope, and a cover letter ([App. 4](#)) that described in detail the purpose and importance of the survey. Seven to ten business days after the survey instrument was sent, a reminder/thank you postcard ([App. 4](#)) was mailed to thank those who responded and to encourage nonrespondents to reply. Finally, 12-15 days after the reminder/thank you postcard was mailed, a second survey instrument and cover letter ([App. 4](#)) with a prepaid business reply envelope were sent to ownerships that had not responded. All mail was sent first-class via the U.S. Postal Service.

Responses to the mailings were monitored as they were returned. Tracking numbers displayed on the back of the survey instruments were used to track who responded and help ensure they were not unnecessarily contacted again. Approximately 7 percent of mailings were returned by the Post Office and marked as undeliverable due to a bad address or because the person had moved or was deceased. Bad addresses were corrected where possible or new addresses were obtained and materials were mailed again. In the case of deceased owners, the new owner was contacted if mailing information was available. Otherwise the correspondence was recorded as undeliverable. If a respondent did not own forest or woodland, they were asked to indicate this on the survey instrument and return it so their record could be updated.

The mail survey instrument was designed using special software (TeleForm [Verity Inc. 2010]) to allow electronic data capture in order to increase data quality and data entry efficiency. Returned paper survey instruments (most of the responses) were scanned, and the software used optical character recognition (OCR) and optical mark recognition (OMR) technology to capture the data. The software was configured to flag all data entries that were indecipherable or otherwise indeterminate. A member of the research staff reviewed all entries to verify the data which were then exported and subjected to the processing steps described below.

Online Survey

Forest and woodland ownerships that received a copy of the mail-back survey instrument were alerted to the option of completing the survey online. A bright piece of paper included in the mailing contained relevant information for accessing the online survey.

Phone Survey

For forest and woodland ownerships that had not responded to the mail or online surveys and for whom telephone numbers were available, telephone interviews were attempted. Due to a combination of budgetary constraints and low phone number availability, the number of attempted follow-up interviews of nonrespondents was: 1,688 in 2011 (19 percent of nonrespondents), 411 in 2012 (21 percent of nonrespondents), and 958 in 2013 (33 percent of nonrespondents). Landowners were contacted by employees of the U.S. Department of Agriculture, National Agricultural Statistical Service during July and August of 2011, 2012, and 2013, and they were asked the subset of the mail survey questions listed in [Appendix 2](#). Data collected by telephone were recoded to match the coding of the mail survey instrument.

Quality Assurance

For each year that the NWOS was conducted, quality assurance (QA) procedures were implemented to determine the error rates from the survey verification process. A minimum of two mail survey instruments per state per year were randomly selected, and all entries in the physical survey instruments were compared to the corresponding field values in the electronic files. For every error that was found, a correction was made to the electronic recording of that survey. If error patterns were detected, this information was passed on to data entry personnel, and data were reprocessed as necessary.

Error rates ranged from 0.13 percent to 0.29 percent across the 3 years (Table 5). There were two basic types of errors—errors in text coding and those in numerical coding. In 2011, 21.4 percent of the errors were text-based while 78.6 percent of the errors were numerical (Table 6). The QA analysis of the 2012 surveys indicated that text-based errors appeared to be more than simple, random errors. Specifically, many of the text errors seemed to derive from fingers being on the wrong keys, as opposed to simple misspellings. These errors were recorded as text errors. In addition, in several instances errors were detected in multipart questions where the correct coding was present but was not coded under the correct field name. These errors were as if one of the fields of the multipart question was missing resulting in the remainder of the data being skewed. These errors were recorded as numerical coding errors. In 2012, 13.6 percent of the errors were text-based, and 86.4 percent of the errors were numerical (Table 6). The QA analysis of the 2013 surveys had simple text and numerical coding errors similar to that of 2011. It should be noted, however, that in a few isolated instances, many text errors were recorded for surveys from respondents who wrote a lot of text on their survey. In these cases, the text was not coded and was counted as an error, resulting in more text errors than in previous years with 28.1 percent of the errors being text-related, and 71.9 percent of the errors being numerical (Table 6).

Table 5.—Quality assurance error rates for the 2011-2013 U.S. Forest Service, National Woodland Owner Survey

	Year		
	2011	2012	2013
Number of surveys error checked	150	81	79
Number of fields checked per survey ^a	283	281	283
Total number of errors found	56	66	64
Error rate (percent)	0.13	0.29	0.28

^aIncludes responses to “others” and all text fields.

Table 6.—Number of quality assurance errors by error types for the 2011-2013 U.S. Forest Service, National Woodland Owner Survey

	Year			Total
	2011	2012	2013	
Text Errors (percent of total)	12 (21.4)	9 (13.6)	18 (28.1)	39 (21.0)
Numerical errors (percent of total)	44 (78.6)	57 (86.4)	46 (71.9)	147 (79.0)
Total number of errors	56	66	64	186

DATA PROCESSING

Once the data were electronically captured, a series of steps were performed to drop blank and other erroneous records, generate additional variables, recode skipped questions and item nonresponses, validate text entries, run logic checks, and verify data ranges. This section describes these steps.

The original data files from the mail, online, and phone surveys were archived in read-only files, and working copies of each file were created. All manipulations were made on these working files (i.e., the original, raw files were never manipulated). Apart from the review of the text entries, all data processing was done using scripts implemented in the R computing environment (R Development Core Team 2012). All data changes were recorded in a log file to allow for review and documentation. The final “cleaned” version of the file was then imported into the database.

Dropping Records

The initial data files contained records that were blank, duplicates, or had other errors forcing them to be dropped from the data set (Fig. 6). Records with null sample point counts, a variable needed for data estimation, were dropped. Some records were dropped because FIA changed the plot designation from forest to nonforest, and hence the sample point should not have been included.

Less than 2 percent of the records were dropped due to duplicates (70 records), invalid state assignments (46 records), and other miscellaneous reasons (78 records). Owners who responded multiple times were identified via the response tracking system, and only the earliest response was used and the other record(s) was dropped. Because the eastern and

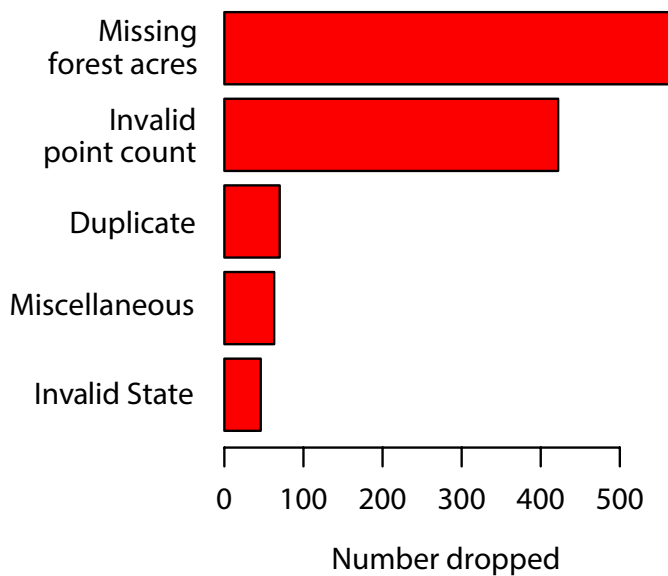


Figure 6.—Number of records dropped during the processing of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey, by reason.

western portions of Oklahoma and Texas were processed separately, it was necessary to identify where ownerships were located in these states. Where this was not feasible, the record was dropped. Other reasons for dropping records included the respondents being a public ownership or evidence that the intended recipient did not complete the survey.

Generating and Importing New Variables

A number of additional variables are required in the database that are not taken directly from the survey instrument. Most of these variables are administrative in nature, such as assigning state codes, but some variables are imported by linking to data from other sources. The administrative variables added were:

- Survey mode (mail, online, or phone)
- Survey instrument version
- State code
- Control number – a unique identifier for each record in a table

Specific codes for these and all other variables are listed in the Database section below.

FIA Plot Variables

The base NWOS sample points align with the FIA plot sample points making it easy to append FIA plot variables to NWOS data files. For sample points that were part of an intensification, some variables were not available, so these variables were collected separately. The variables appended to the NWOS files were:

- Owner class
- Forest industry code
- Point/plot count

Point count is the number of sample points that fall on an ownership's forest and woodland and include both the base and intensified samples. The validity of the sample point counts was assessed by comparing the expected number of sample points to the observed number of sample points from the sampling frame. Expected point counts were calculated by taking the number of acres of forest and woodland owned and dividing it by the sampling intensity for the state. For example, if a family forest and woodland ownership reported owning 100 acres of forest and woodland and the sampling intensity was 1 sample point per 10,000 acres of family forest and woodland, the expected sample point count is $100/10,000 = 0.001$ or rounding up, no more than 1.

When large discrepancies were observed, the record was examined to see if any corrections needed to be made. Observed point counts substantially lower than expected point counts were typically associated with a subsidiary not responding for all of the land owned by a parent company, as they were asked to do. In these instances, the point count for a record was adjusted to what would be expected based on the acreage reported and the sampling intensity for that state. Observed point counts that were substantially higher than the expected point counts were typically caused by surveys being received by the wrong ownership (e.g., errors in mailing addresses or postal delivery). Where this was determined to be the case, the records were dropped.

In the FIA database (FIADB) private land ownerships are classified using the following owner class code (OWNCD) values (Woudenberg et al. 2010):

- Corporate (FIADB OWNCD variable value = 41)
- Nongovernmental conservation/natural resources organization (OWNCD = 42)
- Unincorporated local partnership/association/club (OWNCD = 43)
- Native American (Indian) (OWNCD = 44)
- Individual [and family] (OWNCD = 45)

However, this information is sometimes missing or incorrect. In the NWOS database, a new variable (OWNER_CLASS_ADJ) was created. When assigning this variable, information including the name associated with the ownership, how the respondent identified their form of ownership in the survey, and the original FIA OWNCD classification were taken into account. There were 1,116 instances (9.8 percent of records) where the FIA OWNCD did not agree with the survey response, and the OWNER_CLASS_ADJ values were coded to be consistent with the survey responses and ownership information.

Forest Industry code (FORINDCD), an FIA field variable (condition-level) indicating whether or not a respondent owns a primary processing mill (Woudenberg et al. 2010), was also checked during this process. If a respondent reported owning less than 1,000 acres of forest and woodland and the variable indicated they owned a mill, the record was investigated and adjusted if needed. If FORINDCD was blank and the respondent reported owning less than 1,000 acres of forest and woodland, the variable was coded as no mill owned. If FORINDCD was blank and the respondent reported owning more than 1,000 acres of forest and woodland, records were examined to determine the proper classification.

Recoding Item Nonresponse and Skip Patterns

A respondent may not answer a specific question or subpart of a question for various reasons. To maximize the interpretation of missing values, the following codes were used to designate different reasons for nonresponse:

- 1 Respondent opted not to answer a specific question; true item nonresponse.
- 2 Respondent was instructed to skip the question or subquestion due to their response to a previous question. For instance, in part A of a multi-part question, a respondent may be instructed to complete parts B and C if they answered “yes” to part A. For those who answered “no” to part A, parts B and C are recoded as a skip pattern and are given a value of -2.
- 3 Question was not asked in a specific version of the survey. For instance, the mail survey asked respondents if they had transferred any of their forest or woodland to another person in the past, while the phone survey did not. Therefore, all variables dealing with this question of land transfers were recoded to -3 for all phone survey responses.

Text Entries

All text entries were reviewed. Several questions on the survey were semi-closed and offered an “other” option where the respondent could write in their own answer. Text entries were reviewed to make sure the respondent should not have checked off one of the pre-existing choices. If this was the case, the datum was changed to reflect what the respondent wrote. However, if what the respondent wrote did not fit into one of the pre-existing answers, the datum was left unchanged.

Logic Checks

Logic checks were performed to ensure internal consistency within a respondent’s responses, mostly within multipart questions. If the intent of the respondent could be positively discerned, the data were changed accordingly. If the intent could not be definitively discerned, the variable was recoded as item nonresponse (-1). The logic checking system flags records which were then each scrutinized to see if changes were needed. For example, if part A of a two-part question says “if you answered ‘yes’ please answer part B,” and the respondent answered “no” but still completed part B, then a logical error warning was generated and the responses were scrutinized and changes made as deemed appropriate.

Range Checks

The values for all entries were compared with the valid values as defined in the database documentation. When values were not within the acceptable ranges or sets of values, warning flags were generated and the records were examined. Where feasible, the values were adjusted, otherwise they were recoded as missing due to item nonresponse (-1). For example, if a respondent wrote she acquired her land in 92, a warning flag was generated and the value was recoded as 1992.

DATABASE

The NWOS database is a relational database that resides on the Forest Service servers protected by a firewall and other security measures. The tables within the database contain information on all aspects of the NWOS, ranging from the sampling frame to response tracking to survey responses. Much of these data are considered sensitive but not classified, and FIA is mandated under the Food Security Act (FSA 1985) to protect the identity of those individuals and groups to whom the information pertains. Limited data is shared with cooperators and is done so under very controlled circumstances specified through formal agreements and only for projects that further the NWOS mission. The only information that would potentially be shared is contained in the QUEST and FOREST_AREA tables. Names and descriptions of the variables contained in these tables are outlined below following the format used in the Forest Inventory and Analysis database documentation (Woudenberg et al. 2010).

QUEST Table

The QUEST table contains the individual responses to the survey, but no personally identifiable information. There are three data types present in the QUEST table: continuous, categorical (discrete), and text. The majority of the variables are categorical. The general coding for these variables are listed in Table 7. A description of variables in the QUEST table, along with specific variable coding, is included in [Appendix 5](#).

FOREST_AREA Table

The FOREST_AREA table includes estimates for acres of forest and woodland by state and ownership category and their accompanying variances, which are a required input for transforming data from the NWOS respondents to population-level estimates of numbers of forest and woodland ownerships and area of forest and woodland (Table 8 and [App. 6](#)). Forest and woodland area estimates were determined from the Forest Inventory and Analysis plot-based inventory data (Bechtold and Patterson 2005) taken from the cycle that best corresponded to the 2011-2013 NWOS data collection. The plot inventory years varied by state but tended to be from 2009 to 2013 in the East and from 2004 to 2013 in the West (Table 9). No recent results from completed FIA inventory cycles were available for Hawaii and interior Alaska, so areas of forest and woodland by ownership category for these states were taken from the data underlying the “Forest Resources of the United States, 2007” (Smith et al. 2009).

Table 7.—General coding used for categorical variables in the QUEST table for the 2011-2013 U.S. Forest Service, National Woodland Owner Survey. See Appendix 5 for coding for specific variables.

Value	Code
1	Yes
0	No
8	Not applicable
9	Don't know
-1	Item nonresponse
-2	Skipped due to skip pattern
-3	Question/subquestion not asked

Table 8.—Variables included in the FOREST_AREA table of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey database

Identifying number	Column name	Descriptive name	Data type ^a
1	CN	Sequence number	CONT
2	STATECD_NWOS	NWOS state code	CAT
3	NWOS_YEAR	NWOS year	CONT
4	OWNER_CAT	Ownership category	CAT
6	AREA	Forest area	CONT
5	VAR_AREA	Variance of forest area	CONT

^aData types: CONT=continuous; CAT=categorical.

Table 9.—Inventory years for FIA plot data used to make estimates for the 2002-2006 and 2011-2013 iterations of the U.S. Forest Service, National Woodland Owner Survey (NWOS), by state

State	NWOS Iteration (years)		State	NWOS Iteration (years)	
	2002-2006	2011-2013		2002-2006	2011-2013
Alabama	2001-2006	2006-2013	Nebraska	2002-2006	2009-2013
Alaska	2004	2004-2012	Nevada	2004-2005	2004-2013
Arizona	2001-2008	2004-2013	New Hampshire	2002-2006	2009-2013
Arkansas	2000-2006	2007-2013	New Jersey	2004-2006	2009-2013
California	2001-2010	2004-2013	New Mexico	2005-2013	2005-2013
Colorado	2002-2008	2004-2013	New York	2002-2006	2009-2013
Connecticut	2003-2006	2009-2013	North Carolina	2002-2006	2003-2013
Delaware	2004-2006	2009-2013	North Dakota	2002-2006	2009-2013
Florida	2002-2004	2009-2013	Ohio	2001-2006	2009-2013
Georgia	1998-2006	2005-2013	Oklahoma (East)	2008-2010	2008-2013
Hawaii	-- ^a	1985	Oklahoma (West)	-- ^a	2008-2013
Idaho	2004-2008	2004-2012	Oregon	2001-2010	2004-2013
Illinois	2002-2006	2009-2013	Pennsylvania	2002-2006	2009-2013
Indiana	2002-2006	2009-2013	Rhode Island	2003-2006	2009-2013
Iowa	2002-2006	2009-2013	South Carolina	2002-2006	2007-2013
Kansas	2002-2006	2009-2013	South Dakota	2002-2006	2009-2013
Kentucky	2000-2006	2005-2012	Tennessee	2000-2006	2005-2012
Louisiana	2001-2008	2001-2013	Texas(East)	2001-2006	2009-2013
Maine	2002-2006	2009-2013	Texas (West)	2004-2011	2004-2011
Maryland	2004-2006	2009-2013	Utah	2000-2008	2003-2012
Massachusetts	2003-2006	2009-2013	Vermont	2003-2006	2009-2013
Michigan	2002-2006	2009-2013	Virginia	1998-2006	2008-2012
Minnesota	2002-2006	2009-2013	Washington	2002-2011	2004-2013
Mississippi	2006-2006	2006-2013	West Virginia	2004-2006	2009-2013
Missouri	2002-2006	2009-2013	Wisconsin	2002-2006	2009-2013
Montana	2003-2008	2003-2012	Wyoming	2011-2012	2011-2012

^aNo data.

In order to make as accurate comparisons as possible between the 2002–2006 and 2011–2013 iterations of the NWOS, 2002–2006 data were recalculated using consistent methods. Newer NWOS methods calculate state-level estimates, while previous estimates were made at the substate, survey unit level. Additionally, FIA plot data used to calculate forest and woodland area estimates for inventory years that better matched the 2002–2006 NWOS data collection time period became available after the 2002–2006 NWOS results were published. The plot inventory data used for the 2002–2006 NWOS varied by state but tended to be from 2002 to 2006 in the East and 2002 to 2008 in the West (Table 9). For Hawaii and interior Alaska, the estimates were again taken from the data used in Smith et al. (2009). The statistical approach for calculating the forest and woodland area estimates and associated variances is documented in Bechtold and Patterson (2005).

ESTIMATION

Analysis of the NWOS data can involve many different approaches. Here the approach taken to generate population-level estimates in terms of ownerships and forest and woodland area is discussed. Other analyses may rely on different summary statistics, such as means, or use modeling approaches, such as logistic regression. Dickinson et al. (2016) discuss some additional approaches and provide the theoretical justification for the estimators. It is important that all analyses take into account the sampling design (as described above) in order to make valid inferences to the population of interest, e.g., family forest and woodland ownerships.

Differences exist in the estimation procedures used for the 2011–2013 NWOS (described here and in Dickinson et al. 2016 and Dickinson and Butler 2013), those used for the 2002–2006 NWOS (described in Butler et al. 2005), and earlier iterations of FIA ownership surveys. The “dual-sampling” paradigm implicit in the earlier iterations of the NWOS (Birch 1996, Birch et al. 1982, Butler et al. 2016, Kingsley and Finley 1975) assumes a whole acre of forest or woodland is sampled at each point and an ownership is sampled at each point. This is not theoretically correct as the primary sampling units are zero-dimensional points (Bechtold and Patterson 2005). The only attributes recorded by FIA field crews that are used for the NWOS are the land use, ownership class, and for private forest and woodland points, name and address of the owner. With the exception of forest and woodland area estimates, all other attributes used in NWOS analyses are obtained from the survey, which applies not only to the forest and woodland where the point is, but to all forest and woodland in the state associated with the ownership. The dual-sampling paradigm, though theoretically inaccurate, does not lead to invalid point estimators because the probability proportional to size point estimators simplify to simple random sample estimators when per-acre estimates are calculated (Dickinson and Butler 2013). The bigger problem lies in variance estimation. Issues with the previous NWOS estimators are discussed in more detail in Dickinson and Butler (2013).

Population Estimates

The unit of analysis for NWOS estimation depends on the needs of the data user. If the data user is more interested in land or trees than in ownerships, area-based summaries and analyses are likely more useful. Where the focus is on the people who own the trees, ownership-based summaries and analyses are likely more useful. And in many circumstances, both should be examined. Presented here are the ownership- and area-based total estimators and their associated variance estimators for categorical variables, the dominant NWOS variable type.

Procedures for combining estimates across strata, as well as for estimating means, quantiles, and proportions for both categorical and continuous variables, are described in Dickinson et al. (2016). Dickinson et al. (2016) provide the theoretical derivations of the estimators, which were then adjusted in order to accommodate the reality of the sample (e.g., survey nonresponse). Example calculations using the equations presented here are in [Appendix 7](#).

Ownership-based totals

The total estimator applicable to the NWOS sampling design is commonly called the Hansen-Hurwitz estimator (Brewer and Hanif 1983, Lohr 1999, Thompson 1992). It is the average of each individual estimate of the population total, which is the attribute value divided by the observation's probability of selection. The population total can be represented as (see equation 100 in Dickinson et al. 2016):

$$\hat{N}_{hd} = \frac{\hat{A}_{FIA}}{n_h} \times \sum_{i=1}^{n_h} \frac{d_i}{a_i} = \hat{A}_{FIA} \times \bar{x} \quad (1)$$

Where

\hat{N}_{hd} = number of forest and woodland ownerships in stratum h and domain d ,
 \hat{A}_{FIA} = area of forest and woodland in the stratum, derived from FIA data,
 n_h = number of sample points owned by survey respondents in the stratum,
 d_i = an indicator taking the value of 1 if ownership i is in domain d and 0 otherwise,
 a_i = area of forest and woodland owned by ownership i , and
 $\bar{x} = \sum_{i=1}^{n_h} \frac{d_i}{a_i} / n_h$.

The variance of this statistic can be estimated by:

$$\widehat{var}(\hat{N}_{hd}) = \hat{A}_{FIA}^2 \times \widehat{var}(\bar{x}) + \bar{x}^2 \times \widehat{var}(\hat{A}_{FIA}) \quad (2)$$

Where

$\widehat{var}(\bar{x}) = \frac{\sum_{i=1}^{n_h} (x_i - \bar{x})^2}{n_h(n_h - 1)}$ and
 $\widehat{var}(\hat{A}_{FIA})$ = estimated variance of the forest area estimates derived from the FIA plot data calculated following the procedures outlined in Bechtold and Patterson (2005).

Ideally, a covariance term would be included in equation 2, but it cannot be estimated with the available data (Dickinson et al. 2016).

Acre-based totals

The number of forest and woodland acres within a given stratum and domain of interest can be estimated by:

$$\hat{A}_{hd} = \frac{\hat{A}_{FIA}}{n_h} \times \sum_{i=1}^{n_h} d_i = \hat{A}_{FIA} \times \bar{x}_{hd}^a \quad (3)$$

Where

\hat{A}_{hd} = area of forest and woodland in stratum h and domain d , and
 $\bar{x}_{hd}^a = \frac{1}{n_h} \times \sum_{i=1}^{n_h} d_i$ and is equivalent to the sample proportion of points associated with responding ownerships which are in the domain of interest.

The estimator of the variance is:

$$\widehat{var}(\hat{A}_{hd}) = \hat{A}_{FLA}^2 \times \widehat{var}(\bar{x}_{hd}^a) + \bar{x}_{hd}^a{}^2 \times \widehat{var}(\hat{A}_{FLA}) \quad (4)$$

Where

$$\widehat{var}(\bar{x}_{hd}^a) = \frac{\sum_{i=1}^{n_h} (x_i - \bar{x}_{hd}^a)^2}{n_h(n_h - 1)}$$

And again, ideally, a covariance term would be included, but it is not estimable with the available data (Dickinson et al. 2016).

Nonresponse error

When not all people in the sample respond and the characteristics of interest for respondents and nonrespondents are different, nonresponse error arises and will impact estimates. This error is notoriously difficult to detect, and if found, it is difficult to rectify (Groves et al. 2002). In addition to assessing nonresponse bias, efforts were made to maximize response rates by using the four contact method (see Data Collection section) advocated by Dillman et al. (2009).

Unit or survey nonresponse occurs when a person asked to respond to a survey does not respond. The degree to which this causes a bias in the results depends on whether the characteristics of the respondents are substantially different than those of the nonrespondents. The first approach for minimizing this error is to maximize cooperation rates. To minimize nondeliverable errors, names and addresses for the NWOS were standardized, and current mailing addresses were obtained using the U.S. Postal Service’s Coding Accuracy Support System (CASS) and FASTforward systems. Overall, the rate of undeliverable addresses was 8 percent.

The overall cooperation rate for the 2011–2013 NWOS was 52 percent. Note that cooperation rates differ from response rates in that undeliverables are negated from the denominator of the cooperation rate calculation (AAPOR 2015), and many studies use the term “response rate” when they really mean cooperation rate. Across the states included in the estimation, the cooperation rates for family forest and woodland ownerships ranged from a low of 37 percent in Hawaii to a high of 64 percent in Michigan (Butler et al. 2016) (Fig. 7). Some regional differences occurred, with response rates generally higher in the North and lower in the South.

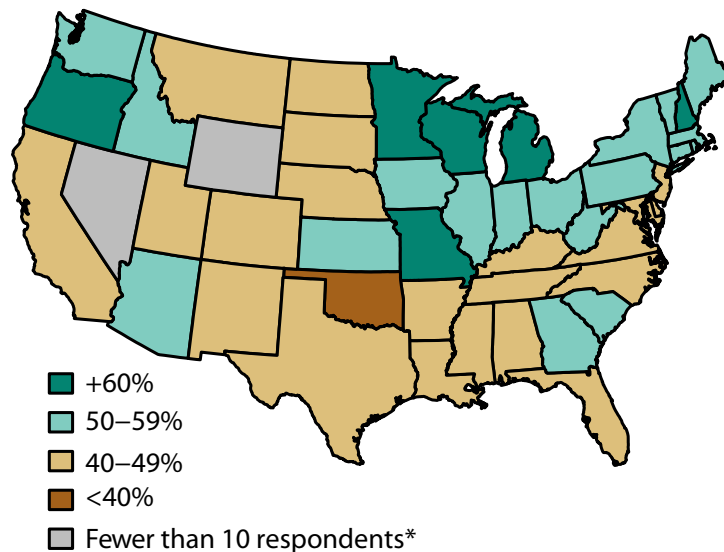


Figure 7.—Cooperation rates for family forest and woodland ownerships (1+ acre) for the 2011–2013 U.S. Forest Service, National Woodland Owner Survey, by state (Butler et al. 2016). The cooperation rate for Hawaii was 37 percent. In Alaska there were fewer than 10 respondents with forest or woodland. *Estimates were not calculated for states with fewer than 10 respondents.

Nonresponse bias assessment and mitigation is notoriously difficult and fraught with problems as all methods of mitigation rely upon untestable assumptions (Sarndal et al. 1992). Methods for mitigating unit nonresponse usually consist of weighting the respondents' values in some way, but choosing the weights can be very difficult (Groves et al. 2002, Lohr 1999, Sarndal et al. 1992).

Ideally, a model of unit nonresponse could be developed and used to compensate for any detectable nonresponse bias using ancillary data or the results from the NWOS telephone survey data. Unfortunately, resources were not available to conduct a thorough investigation of nonresponse bias and viable methods for dealing with it. Therefore, the estimators presented assume no nonresponse bias.

While a strict nonresponse bias assessment was not possible, a qualitative assessment could be conducted. A strict assessment would evaluate how the nonresponse influenced estimates of key population parameters. Instead, comparisons were made between mail and phone respondents. The variables examined were area of forest and woodland owned in a state (AC_WOOD), land tenure (TENURE = QUEST_YEAR - ACQ_YEAR), having commercially harvested trees in the previous 5 years (ACT_CUT_SALE), having a written forest management plan, (MAN_PLAN), having received forest management advice in the previous 5 years (ADVICE), and having received cost-share assistance (COST). Demographic variables, such as age, could not be tested as they were not asked on the phone version of the survey. Family forest and woodland ownerships with 10+ acres are a primary focus of many NWOS analyses and reports (e.g., Butler et al. 2016), so the nonresponse bias assessment focused on this population and domain of interest. For continuous variables, graphical comparisons were made using box plots, and Kolmogorov-Smirnov (Conover 1971) and Wilcoxon rank sum (Hollander and Wolfe 1973) tests were used to test for statistically significant differences. For categorical variables, graphical comparisons were made using bar plots, and X^2 tests (Agresti 2007) were used to test for statistically significant differences. All analyses were conducted in the R computing environment (R Development Core Team 2012).

Four of the six variables tested, AC_WOOD (Fig. 8), TENURE (Fig. 9), ACT_CUT_SALE (Fig. 10), and COST (Fig. 11), showed no statistically significant differences ($p \geq 0.05$) between

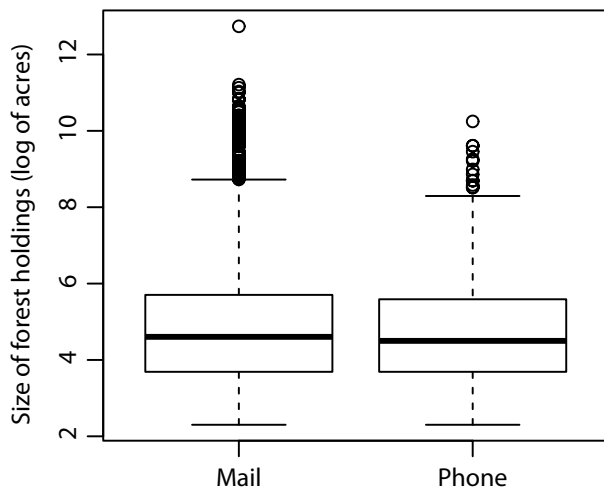


Figure 8.—Comparison of size of forest and woodland holdings between mail and phone respondents for family forest and woodland ownerships (10+ acres) of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey.

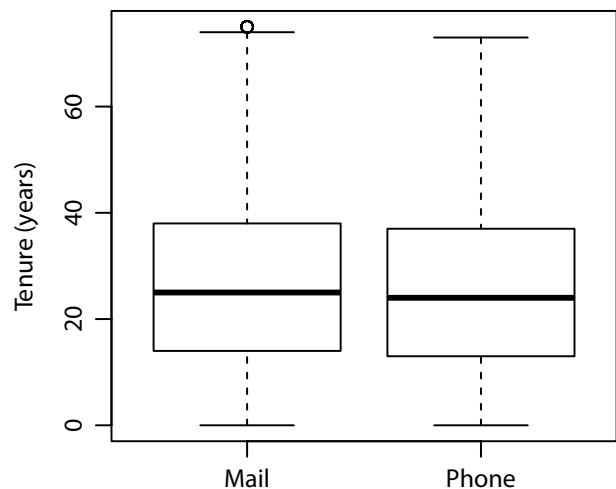


Figure 9.—Comparison of land tenure between mail and phone respondents for family forest and woodland ownerships (10+ acres) of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey.

the mail and phone respondents. The other two variables, MAN_PLAN (Fig. 12) and ADVICE (Fig. 13), did show significant differences ($p < 0.05$). In both cases, the percentages were higher for the mail respondents. There appears to be a higher propensity for those who have a written management plan or have received forest management advice to complete an NWOS survey. This is logical (i.e., they are more attuned to the forestry community) and suggests there may be an upward bias in the estimates of these variables. With no means for fully testing nonresponse bias, mixed results (mostly supporting no bias) from the qualitative analysis, and no means for correcting bias, no corrections were made to the data, but these findings should be considered when interpreting the results.

The second type of nonresponse manifests in surveys that are returned but contain missing values for one or more questions. This is called item nonresponse. Item nonresponse rates for the 2011-2013 NWOS family forest and woodland ownerships with 10+ acres varied from 0 to 60

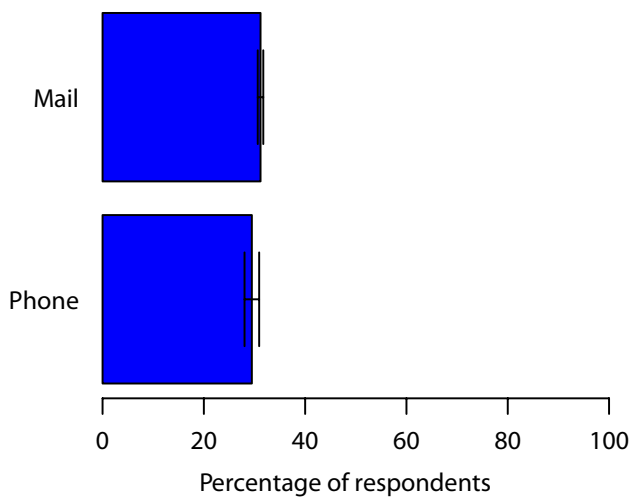


Figure 10.—Comparison of commercial timber harvesting in the preceding 5 years between mail and phone respondents for family forest and woodland ownerships (10+ acres) of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey.

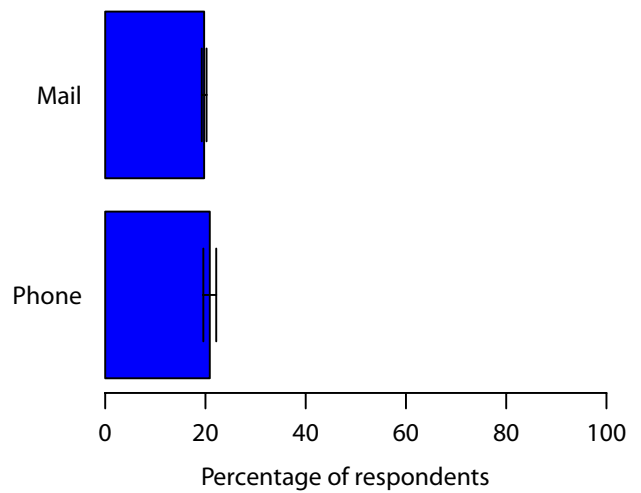


Figure 11.—Comparison of cost-share participation between mail and phone respondents for family forest and woodland ownerships (10+ acres) of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey.

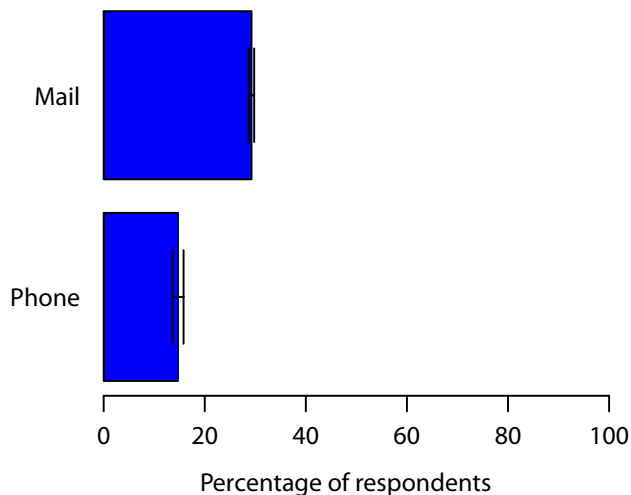


Figure 12.—Comparison of written forest management plan rates between mail and phone respondents for family forest and woodland ownerships (10+ acres) of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey.

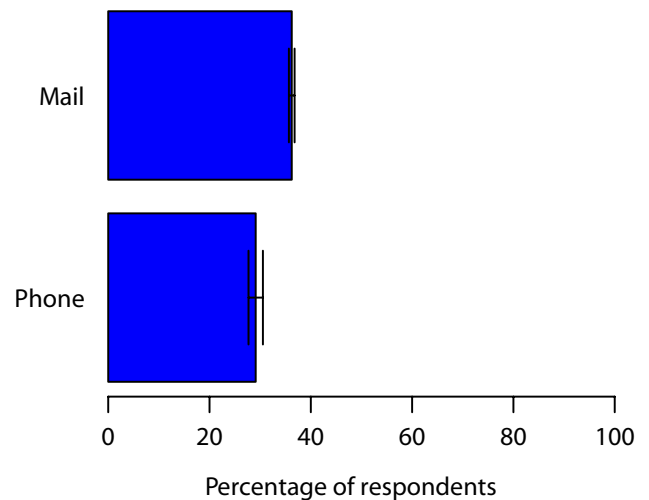


Figure 13.—Comparison of forest management advice rates between mail and phone respondents for family forest and woodland ownerships (10+ acres) of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey.

percent with a median rate of 5 percent (Table 10). The “other” options were excluded from this analysis because most respondents viewed those as optional if the question did not apply to them. Questions that asked about why a respondent did or did not do something and questions that had complex formats (e.g., multiple skips or a matrix format) tended to have the greatest item nonresponse rates. Questions with high item nonresponse rates, such as demographics for the second owner, the number of children or other family members who are likely to receive the land, reasons for not having a management plan, and having ever cut or removed trees for personal use, should be interpreted with caution. The content and formatting of these questions with high item nonresponse rates will be reconsidered for future iterations of the NWOS.

Methods for mitigating item nonresponse usually involve imputation techniques (Groves et al. 2002), but many studies take a naïve approach and assume that those who responded are representative of those who did not respond. Currently, the naïve approach to item nonresponse is the only feasible option for the NWOS. This approach potentially biases the NWOS estimates, but to what degree is unknown, as testing for item nonresponse bias is beyond the resources of NWOS at this time.

Table 10.—Item nonresponse rates for questions asked as part of the 2011-2013 U.S. Forest, National Woodland Owner Survey. Statistics are for family forest and woodland ownerships with 10+ acres.

Question number	Description	Item nonresponse rate
		<i>Percent</i>
1	Form of ownership	1.27
2	Number of owners	5.76
3.1	Acres of land owned	0.43
3.2	Acres of wooded land owned	-- ^a
3.3	Multiple parcels	1.06
3.3.1	Number of parcels	4.90
4	Primary residence	0.25
5	Secondary residence	0.56
6	Farm or ranch	0.64
6.1	Farm or ranch near forest	1.91
7.1	Ownership reason beauty or scenery	2.99
7.2	Ownership reason nature protection	4.15
7.3	Ownership reason water protection	4.39
7.4	Ownership reason wildlife habitat protection	5.11
7.5	Ownership reason land investment	3.46
7.6	Ownership reason part of home or primary residence	3.93
7.7	Ownership reason part of my cabin or vacation home site	5.77
7.8	Ownership reason part of my farm or ranch	5.95
7.9	Ownership reason privacy	4.65
7.1	Ownership reason raise family	5.25
7.11	Ownership reason to pass land on to children or other heirs	2.49
7.12	Ownership reason firewood	4.66
7.13	Ownership reason timber production	3.09
7.14	Ownership reason nontimber forest products	4.48
7.15	Ownership reason hunting	3.53
7.16	Ownership reason recreation	4.93
8.1	Acquisition method	1.11
8.2	Acquisition source	4.40
8.3	Acquisition year	6.37
9.1	Land transfer	5.10

continued

Table 10.—continued

Question number	Description	Item nonresponse rate
		<i>Percent</i>
9.2	Land transferred to	10.28
9.3	Land transferred in preceding five years	8.27
10.1	Management decisionmaker	2.16
11	Management plan	2.43
11.1	Management plan implementation	21.41
11.2	Management plan writer	12.84
11.3.1	Reason for not having a management plan	52.88
12.1.1a	Cut logs	18.26
12.1.2a	Cut firewood	17.22
12.1.3a	Cut wood chips	39.01
12.1.4a	Cut unwanted trees	28.59
12.2	Forester used	10.19
12.3	Certified logger used	11.36
13.1.1	Edible nontimber forest products collected	4.96
13.2.1	Medicinal nontimber forest products collected	9.21
13.3.1	Landscaping nontimber forest products collected	7.45
13.4.1	Decorative nontimber forest products collected	8.08
14.1	Activities	3.07
15.1	Future - cut for sale	5.43
15.2	Future - cut for personal	7.98
15.3	Future - collect nontimber forest products	11.86
15.4	Future - reduce fire hazards	11.54
15.5	Future - controlled burn	11.54
15.6	Future - mitigate invasive species	10.03
15.7	Future - mitigate unwanted insects	11.91
15.8	Future - road construction or maintenance	10.34
15.9	Future - trail construction or maintenance	10.00
15.1	Future - improve wildlife habitat	7.90
15.11	Future - livestock grazing	10.63
16	Leased land	1.30
16.1.1	Lease activity	0.60
16.2	Leased in preceding five years	9.17
17.1	Familiarity with cost-share programs	1.49
17.2	Cost share participation	1.89
17.2.1	Cost share participation in the preceding five years	10.03
18.1	Respondent's familiarity with certification programs	1.40
18.2	Certified land	4.82
18.3	Certified land in preceding five years	8.00
19.1	Familiarity with tax abatement programs	1.27
19.2	Land enrolled in tax program	2.45
20.1	Familiarity with easements and development rights	1.37
20.2	Land or development rights sold or given away	1.54
20.3	Likelihood of selling or giving away development rights in the next five years	3.43
21.1.1	Who recreates on land	3.88
21.2.1	Recreation activities	3.26
22	Posted land	1.96
22.2.1	Posted restrictions	4.41
23	Advice received in the preceding five years	1.45
23.1.1	Advice topic	6.03

continued

Table 10.—continued

Question number	Description	Item nonresponse rate
		<i>Percent</i>
23.2.1	Advice method	7.77
23.3.1	Advice source	4.85
24.1	Advice on woodland management	4.74
24.2	Advice on how to transfer land to the next generation	5.98
24.3	Advice on selling or giving away development rights	7.09
24.4	Advice on cost-sharing for woodland management	6.61
24.5	Advice on more favorable tax policies	5.36
24.6	Advice on stronger timber markets	7.68
25.1	Advice type	3.09
26.1	Landowner concern - air pollution	5.07
26.2	Landowner concern - damage or noise from off-road vehicles	5.40
26.3	Landowner concern - damage from animals	5.11
26.4	Landowner concern - development of nearby lands	5.54
26.5	Landowner concern - drought or lack of water	4.53
26.6	Landowner concern - global climate change	5.14
26.7	Landowner concern - high property taxes	2.62
26.8	Landowner concern - invasive plant species	4.44
26.9	Landowner concern - keeping land intact for future generations	2.68
26.1	Landowner concern - misuse of wooded land, such as vandalism or dumping	3.21
26.11	Landowner concern - trespassing or poaching	2.72
26.12	Landowner concern - unwanted insects or diseases	4.31
26.13	Landowner concern - water pollution	4.31
26.14	Landowner concern - wildfire	3.90
26.15	Landowner concern - wind or ice storm	4.37
27	Respondent's likelihood of selling or giving away land in the next five years	1.43
27.1.1	Intended recipient	10.66
27.1.1.1	Number of children	25.70
27.1.2.1	Number of family members	57.00
27.2.1	Transfer reason	15.99
28.1	Intend wooded land to stay wooded	2.52
28.2	Intend to sell land if offered a reasonable price	4.12
29.1	Retirement status - owner 1	5.96
29.2	Retirement status - owner 2	32.13
30.1	Occupation - owner 1	36.65
30.2	Occupation - owner 2	60.11
31.1	Age – owner 1	7.17
31.2	Age – owner 2	32.84
32.1	Gender – owner 1	6.39
32.2	Gender – owner 2	32.48
33.1	Education – owner 1	6.27
33.2	Education – owner 2	32.02
34.1	Ethnicity – owner 1	7.77
34.2	Ethnicity – owner 2	33.45
35.1.1	Race - owner 1	9.63
35.2.1	Race – owner 2	31.77
36	Annual household income	16.95
37	Income from wood	11.84

^aNo value is shown because to be included in this table necessitated a response from respondents indicating they had a family forest and woodland ownership with at least 10+ acres. The item nonresponse rate for this question, including all respondents for family forest and woodland ownerships of any size, was 4.83 percent.

ANALYSIS AND PRODUCTS

Although states are the basic strata, it is possible to make estimates for other geographies. Scaling-up to multi-state regions is simply a matter of summarizing the statistics over the broader areas. For geographic areas that do not conform to state boundaries, estimates are possible, but there are important caveats. For example, if substate level estimates are desired, the location of the sample points can be used to identify respondents in the geographic area. Although it is known a respondent has acreage in the area of interest, it is not possible to determine if the respondent only owns forest and woodland in the specified area of interest. The area-based estimates will not be biased, but estimates of number of ownerships could be biased. A sufficient sample size is required in any substate geographic area to ensure confidentiality of the respondent and that the statistics are reliable. Ideally, each geography of interest would have at least 100 respondents.

In analyzing NWOS data, the difference between all forest and woodland holdings in a state and specific forested/woodland parcels may be important to some analyses. If the ownership has only one parcel, then this point is moot. Keeping with the precedent set by previous iterations, the 2011-2013 NWOS asked respondents to respond for all forest and woodland holdings in a state that are part of their ownership, not a specific parcel. While it is possible to ask them to respond to a specific parcel (e.g., their largest or newest parcel), it is not logistically possible to convey to them exactly where the point(s) lie. Asking them to respond only to a specific parcel that is not associated with the sample point would create a sampling bias. The problem with not associating the responses with a specific parcel is that it is uncertain if the behaviors and characteristics (e.g., written management plan and timber harvesting) overlap. Interpretation of results must therefore account for this difference, or analyses can be limited to ownerships with single parcels. This latter approach assumes that all behaviors and characteristics are consistent across a parcel, an equally uncertain assumption. Analyses (e.g., Kilgore et al. 2015) have shown no significant differences between ownerships with single versus multiple parcels, but this should nonetheless be considered by those using the NWOS data for modeling purposes.

A standard approach should be taken when conducting special analyses using the NWOS data. This begins with univariate analyses then progresses to bivariate analyses, and finally, if appropriate, multivariate analyses. The univariate analyses look at each variable independently and are useful for examining the basic distributions and determining if transformations or recoding are necessary. The bivariate analyses look at relationships between key pairs of variables and are useful for building and interpreting multivariate analyses. The multivariate analyses allow for examination of higher-level relationships, but building these models is more complicated and interpretation of the results is more complex. In each step, it is imperative to recognize the data types (e.g., categorical or continuous) and use approaches that are appropriate for each type (e.g., X^2 analyses for comparisons between pairs of categorical variables). Other important issues to consider are:

- What is the domain of interest?
- How should the data be weighted to incorporate the sampling design?
- How should missing data (e.g., -3, -2, and -1 values) be handled?
- In calculating percentages, how should item nonresponse be handled?
- How should skip patterns be handled?

- How do potential sources of error (e.g., nonresponse) influence interpretation of results?
- What are the proper statistical models given the questions of interest and the underlying data?

The results from the NWOS will be shared through multiple outlets. This report documents the methods used to design, implement, and generate estimates from the 2011-2013 NWOS. Tables and two-page summaries of the results will be available through subsequent publications, which can be accessed at the NWOS website (www.fia.fs.fed.us/nwos). The tables will summarize each of the questions asked on the survey and will provide population-level estimates of ownerships and area by state, region, and for the nation. The initial tables will focus on family forest and woodland ownerships with 10+ acres of forest and woodland holdings. Subsequent summaries will examine other ownership types and ownerships with forest and woodland holdings of less than 10 acres. Customization of the domains of interest and cross-tabulations will be available via the NWOS Online Table Maker program (<http://apps.fs.fed.us/fia/nwos/tablemaker.jsp>). General and scientific reports will be published using the latest NWOS results, and the first publication will document the general findings. Subsequent publications will focus on specific topics. Publications will be made available through a variety of outlets ranging from peer-reviewed journals aimed at scientific audiences to brochures aimed at more general audiences. In addition, presentations will be made at scientific and other meetings to further share the results. On a limited and highly controlled basis, the raw survey results (with no personally identifiable information appended) can be made available to researchers. Individuals interested in this access should contact the lead author of this report or another member of the NWOS staff.

It is the intent of FIA to implement the NWOS on a continual basis, and planning for the next iteration of the NWOS has begun. Monitoring trends in the attitudes and behaviors of America's private forest and woodland ownerships will continue, with hopes of increasing sample sizes in those states where the targets were not met, including U.S. territories and protectorates. NWOS will work with interested parties to further increase the sampling intensities in selected areas and address state-specific issues.

GLOSSARY

area-based—analyses where the units of analysis are area of forest and woodland, reported in terms of acres. This is in contrast to ownership-based analyses.

domain—a subset of a population of interest for which separate estimates are desired. These subsets are not known before sampling, and thus the number of respondents in the domain is a random variable (Lohr 1999). For example, family forest and woodland ownerships with a management plan compose a domain of interest.

forest land—defined by the Renewable Resource Planning Act Assessment as “land at least 120 feet (37 meters) wide and at least 1 acre (0.4 hectare) in size with at least 10 percent cover (or equivalent stocking) by live trees including land that formerly had such tree cover and that will be naturally or artificially regenerated” (Oswalt et al. 2014: 31). For the purposes of the NWOS, forest and woodland are combined.

owner—an individual who is a part of an ownership.

ownership—legal entity that is made up of one or more owners including individuals, groups of individuals, businesses, organizations, and public agencies that have legal rights and obligations for a given resource. Many different subgroups of forest and woodland ownerships exist including families and individuals, corporations, unincorporated partnerships, Native American tribes, nonprofit organizations, and various public agencies. In the case of the NWOS, the resource of interest is forest and woodland.

item nonresponse—when a survey is returned, but one or more questions are not filled out, or have otherwise unusable responses.

ownership-based—analyses where the units of analysis are ownerships. This is in contrast to area-based analyses.

population (of interest)—the larger group to which inferences are desired (Lohr 1999). For example, the population of interest may be family forest and woodland ownerships.

strata—subgroups of the population of interest from which a sample is drawn (Lohr 1999). For the NWOS, strata are states. Different states have different sampling intensities and so estimation is done separately. Procedures are given for aggregating stratum estimates.

woodland—defined by the Renewable Resource Planning Act Assessment as “land at least 120 feet (37 meters) wide and at least 1 acre (0.4 hectares) in size with sparse trees capable of achieving 16.4 feet (5 meters) in height with a tree canopy cover of 5 to 10 percent combined with shrubs a least 6 feet (2 meters) in height to achieve an overall cover of greater than 10 percent of woody vegetation” (Oswalt et al. 2014: 35). For the purposes of the NWOS, forest and woodland are combined.

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APPENDIXES

The following appendixes can be accessed at: dx.doi.org/10.2737/NRS-GTR-157.

Appendix 1: U.S. Forest Service, National Woodland Owner Survey, Version 5.1

Appendix 2: Text Used in the Phone Version of the U.S. Forest Service, National Woodland Owner Survey, Version 5.1

Appendix 3: Focus Group Guide Used in Pretesting The U.S. Forest Service, National Woodland Owner Survey

Appendix 4: Postcards and Cover Letters Used as Part of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey

Appendix 5: Descriptions of Variables and Coding Values in the Quest Table of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey Database

Appendix 6: Descriptions of Variables and Coding Values in the Forest_area Table of the 2011-2013 U.S. Forest Service, National Woodland Owner Survey Database

Appendix 7: Example of Estimation Calculations for the 2011-2013 U.S. Forest Service, National Woodland Owner Survey

Butler, Brett J.; Dickinson, Brenton J.; Hewes, Jaketon H.; Butler, Sarah M.; Andrejczyk, Kyle; Markowski-Lindsay, Marla. 2016. **USDA Forest Service National Woodland Owner Survey, 2011-2013: design, implementation, and estimation methods.** Gen. Tech. Rep. NRS-157. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 43 p.

The National Woodland Owner Survey (NWOS) is conducted by the U.S. Forest Service, Forest Inventory and Analysis program to increase the understanding of the attitudes, behaviors, and demographics of private forest and woodland ownerships across the United States. The information is intended to help policy makers, resource managers, educators, service providers, and others interested in the forest and woodland resources of the United States better understand the social context of these lands in order to facilitate more informed opinions and decisions. This report describes the design, implementation, and analysis of data for the NWOS implemented from 2011 through 2013. The NWOS is concerned with three non-overlapping populations of interest: family, corporate, and other private. To simplify the discussion, the focus of this report is on family forest and woodland ownerships, but identical methods were used for the other populations of interest. Results from this research are being published separately. For additional information visit: www.fia.fs.fed.us/nwos. See also dx.doi.org/10.2737/NRS-GTR-157.

KEY WORDS: family forest owners, private forest owners, nonindustrial private forest owners, sampling design, survey, statistical estimation

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