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Design, Implementation, and Analysis Methods for the National Woodland Owner Survey

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Abstract

The National Woodland Owner Survey (NWOS) is conducted by the USDA Forest Service, Forest Inventory and Analysis program to increase our understanding of private forest-land owners in the United States. The information is intended to help policy makers, resource managers, and others interested in the forest resources of the United States better understand the social context of forests and formulate more informed opinions and decisions. Every year, a different set of approximately 6,500 private forest-land owners from across the country were asked to participate in the NWOS. This document describes the design, implementation, and processing of data for the NWOS from 2002 through 2006. For updates to this report and additional information visit: www.fs.fed.us/woodlandowners.

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Introduction

The USDA Forest Service, Forest Inventory and Analysis (FIA) program instituted the National Woodland Owner Survey (NWOS) in 2001. Three other national surveys of forest-land owners[1] conducted by the USDA Forest Service preceded the NWOS (Josephson and McGuire 1958; Birch et. al 1982; Birch 1996). However, the NWOS differs in that it is more closely aligned with the state-level forest resource inventories conducted by the FIA program. The forest resource inventories collect information related to forest composition, structure, and health. The NWOS is charged with determining: who are the forest-land owners; why are forest lands owned; how are forest lands used; and what are the owners' plans for their forest lands. It is now possible to combine information from the NWOS with information collected during the forest resources inventories to produce contemporaneous information about the resource and the people who own it.

This report provides the background and rationales for studying private forest-land owners, and documents the procedures used to design, implement, and process the data collected by the NWOS. Prerequisites for successful implementation of large-scale surveys, such as the NWOS, are to (Cochran 1977): 1) clearly state the survey's objectives; 2) identify the population of interest; 3) define the data to be collected; 4) determine an appropriate sample size; 5) select and design an appropriate measurement method; 6) assemble the sampling frame; 7) select the sample; 8) collect the data; 9) analyze and summarize the data; and 10) assess the end products to determine how well the objectives were met. This publication describes the sequence of steps used to implement the NWOS.

Background—Why Study Forest-Land Owners?

The genesis of the NWOS is rooted in Congressional acts dating from the 1920s and more recently, the expressed concerns of forestry professionals that information about private forest-land owners was not systematically collected and reported. The U.S. Congress, through the McSweeney-McNary Act of 1928 (Pub. L. 70-466), directed the Secretary of the Department of Agriculture to make and keep current a comprehensive inventory and analysis of the nation's forest resources. To accomplish this mandate, the Forest Service initiated the Forest Survey Program (later renamed Forest Inventory and Analysis) and in the 1930s began collecting, analyzing, and reporting on the status and trends of America's forest resources. The Forest and Rangelands Renewable Resources Planning Act of 1974 (RPA; Pub. L. 93-378) amended the earlier act and directed the Secretary to "make and keep current a comprehensive inventory and analysis of the present and prospective conditions for the renewable resources of the forests and rangelands of the United States." The Forest and Range Land Renewable Resources Act of 1978 (Pub. L. 95-307) supplemented earlier legislation and further instructed the Secretary 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."

Throughout the 20th century, university researchers and extension specialists have conducted forest-land owner surveys (Carpenter and Davis 1984). The scope of most of these studies was a state or group of counties where specific forest-land owners were surveyed using a unique sets of questions. The first nationwide information about private forest-land owners was reported by Josephson and McGuire (1958). In the 1970s, the Northeastern Research Station FIA unit began conducting state level forest-land owner surveys, with the North Central FIA unit following in the 1980s (Table 1). The surveys conducted by FIA were compatible, often using the same survey form; however, they lacked continuity over space and time. In 1978, the USDA Economics, Statistics, and Cooperatives Service surveyed a sample of the nation's owners of rural lands (Lewis 1980). Birch et. al (1982) extracted responses from forest-land owners from the sample and conducted a separate analysis; this was the first in-depth, national report on private forest-land owners in the United States.

[1]Due to differences in perceived definitions, we use the term woodland when communicating with landowners and we use forest land when communicating with forestry professionals. As used in this publications, the terms are synonymous.

Table 1.—State-level forest-land owner surveys conducted by the USDA Forest Service, Forest Inventory and Analysis program from 1972 through 1997

State	Year (Reference)
Connecticut	1975 (Kingsley 1976)
Delaware	1972 (Kingsley and Finley 1975)
Kentucky	1975 (Birch and Powell 1978)
Maine	1982 (Birch 1986)
Maryland	1977 (Kingsley and Birch 1980)
Massachusetts	1975 (Kingsley 1976)
Michigan	1981 (Carpenter and Hansen 1985); 1994 (Leatherberry et al. 1998)
Minnesota	1982 (Carpenter et al. 1986)
New Hampshire	1973 (Kingsley and Birch 1977); 1983 (Birch 1989)
New Jersey	1972 (Kingsley 1975)
New York	1980 (Birch 1983); 1994 (Birch and Butler 2001)
Pennsylvania	1978 (Birch and Dennis 1980)
Ohio	1979 (Birch 1982)
Rhode Island	1975 (Kingsley 1976)
Vermont	1973 (Kingsley and Birch 1977); 1983 (Widmann and Birch 1988)
West Virginia	1975 (Birch and Kingsley 1978)
Wisconsin	1997 (Leatherberry 2001)

The 1978 national survey (Birch et. al 1982), state surveys conducted by the Northeastern and North Central FIA units, and other information, including studies by university researchers, revealed a steady increase in number of forest-land owners. For instance, in 1978 there were an estimated 7.8 million private forest-land owners in the United States. By 1994, the number had increased to 9.9 million owners, yet the area of private forest land remained relatively constant, increasing by only 1 percent (Birch 1996). This change in the ownership situation suggested the need for more comprehensive and contemporaneous information about private forest-land owners.

In 1998, a panel of forestry professionals formally expressed concern about the deficient nature of information on private forest-land owners (FIA Blue Ribbon Panel II 1998). The panel's charge was to review the FIA program and make recommendations to enhance its usefulness. The panel reported, "FIA is uniquely positioned to collect, analyze, and publish information related to national, regional, and local trends in forest ownership, regulation, and social factors affecting forest productivity" (FIA Blue Ribbon Panel II 1998).

Further, the report pointed out that important questions remain about the extent of forest management practices, regulatory implications, and the impact of incentive programs on forest management by private forest-land owners and recommended that FIA implement forest ownership surveys on a recurring basis.

At the dawn of the 21st century, it was apparent that clients of the FIA program needed more comprehensive and timely information about private forest-land owners. The need was predicated on the fact that 57 percent of all forest land in the United States was owned by individuals, families, business (industrial and non-industrial), and other private groups and organizations. Obviously, private forest-land owners will have a significant impact on forest resources in the 21st century and beyond. To ensure that forest resources are utilized and maintained on a sustainable basis, routine and comprehensive studies of private forest-land owners are needed. Such studies are important to detect and quantify changes in ownership patterns and owners' situations, and, hence, facilitate appropriate legislative, administrative, and managerial actions.

In studying forest-land owners and forest ownership, it is useful to frame the concept of ownership around the Jeffersonian notion that ownership of land enhances citizenship and ensures democracy. At a basic level, private ownership of forest land—a valuable resource—is indicative of wealth. Ownership also implies the responsibility of stewardship, both for personal benefit and the public good. Therefore, the forest-land owners can be viewed as conduits through which benefits flow from forest resources. As such, private ownership provides a primary link between the forest and the rest of society. Within bounds defined by society (often through government regulations) and nature, private forest-land owners make basic decisions about the kinds of goods and services produced, the quantities produced, and, for many private goods[2], the direct recipients of the products. Owners' decisions influence such things as the cost of raw materials for producing paper and lumber, the protection of water resources, the reduction of air pollution, and the availability of forest recreation opportunities. To ensure the sustainable flow of these and other goods and services from private forest lands, it is essential to know the opportunities, intentions, and limitations owners face. Understanding ownership and its relation to creating, maintaining, and enhancing wealth, and how that relates to providing services and goods for public consumption is vitally important. The NWOS attempts to provide information that will shed light on forest-land ownership.

Goals and Objectives

The guiding principle of the NWOS is to efficiently provide clients with useful information about private forest-land owners in the United States. Clients of the NWOS range from the interested general public to individual legislators, administrators, resource managers, and researchers. An essential implication of this principle is determining client informational needs. Secondly, it is important to identify information the NWOS can actually provide, given limited resources dictated by funding levels. Both aspects form the basic tenets by which the NWOS operates.

[2]Private goods, such as timber, are consumed by a single end-user; in contrast, public goods, such as clean air, are consumed by all members of society (Samuelson and Nordhaus 1992).

Determining client informational needs started by reviewing the 1978 (Birch et al. 1982) and the 1994 (Birch 1996) national, forest-land owner surveys, and other selected surveys. The reviews were conducted to: 1) identify past informational needs; 2) ensure that the NWOS maintains continuity with previous national surveys, allowing for trend analyses; and 3) learn from the strengths of other surveys while improving on the weaknesses. From the reviews, an extensive list of topics was compiled; the topics represented information frequently sought by natural resource administrators and managers. Through a process best described as brainstorming, and through reviews of relevant current forestry literature, a list of emerging informational needs was developed.

The process of identifying information to be collected by the NWOS involved grouping past and emerging informational topics into thematic groups and then eliminating duplicate themes or redefining the topical area. To ensure that topical areas deemed to be important were indeed relevant to resource managers and policymakers, a steering committee was formed (Appendix IV). The steering committee was charged with, among other assignments, reviewing the list of past information and emerging information needs, and how best to address those needs in a survey. The steering committee included individuals representing partners, cooperators, and clients with a cross-section of disciplines and organizations represented. When it was determined what informational needs the NWOS could address, a set of goals and objectives was established.

The primary goal of the NWOS is to provide policy makers, administrators, mangers, and other interested parties contemporaneous information about private forest-land owners in the United States to facilitate the planning and implementation of forest policies and to support forest sustainability assessments. The steering committee determined this goal will be achieved by accomplishing the following objectives:

- Characterize the land holdings, the ownership and management objectives, and the demographics of private forest-land owners in the states and territories of the United States

- Assess the flows of market and nonmarket goods from private forest lands
- Measure the characteristics of forest-land owners who have participated in federal and state forestry incentive, education, and technical assistance programs
- Quantify the use of forest management practices, including sources of information
- Assess forest-land owners' perceptions of the health of their forest land
- Ascertain the constraints that hinder private forest-land owners from meeting their objectives

These objectives were the basis for the survey instrument used to solicit information from the nation's forest-land owners.

The Populations of Interest

The NWOS has two populations of interest: 1) private forest-land (area) and 2) private forest-land owners in the United States and its territories. These interrelated populations can reveal strikingly different patterns. Whether someone is interested in the area of forest land, the number of forest-land owners, or both, depends on the specific issue being addressed.

A Definition of Forest Land

The NWOS defines forest land as:

Land at least 1 acre in size, at least 120 feet wide, with at least 10 well spaced trees per acre; and land at least 1 acre in size, where trees were removed and trees will grow again (not converted to another use, such as cropland, pasture land, or residential). Forest land does not include Christmas tree farms, orchards, tree nurseries, or land that is mowed for lawn.

This definition was adapted from the one used by the FIA forest resource inventory (Smith et al. 2004). The forest resource inventory definition is very technical and needed to be simplified to make it easier for forest-land owners to understand.

We use the terms forest land and woodland interchangeably.

Forest-Land Owners

Forest-land owners include individuals, groups of individuals, businesses, organizations, and public agencies that own forest land. They are legal entities owning land that is at least 1 acre in size and is, or likely to be, at least 10 percent stocked with trees. Many different subgroups of forest-land owners exist including families, individuals, corporations, unincorporated partnerships, Native American tribes, nonprofit organizations, and various public agencies.

The primary focus of the NWOS is private forest-land owners, especially family and individual owners. Private ownerships are all owners other than federal, state, and local governments. Native American tribal lands are included with other private ownerships. Family and individual owners (often referred to as family forest owners) are defined as individual or joint ownerships that have a legally binding interest in ownership of forest land, including family or individual estates and trusts.

Spatial and Temporal Scales

Spatial scale is defined by the extent and resolution of the data collected. Extent is the total area that is studied and resolution is the smallest unit of area that is studied. The spatial extent of the NWOS is the United States and its territories. Although current efforts are focused on the contiguous United States, future efforts will expand the NWOS to the full spatial extent – all 50 states and the territories (i.e., American Samoa, Commonwealth of the Northern Marianas, Guam, Palau, Puerto Rico, and U.S. Virgin Islands). The spatial resolution will be at least a state, but sub-state level [i.e., FIA survey units (Miles et al. 2001)] estimates will be made where feasible.

The measurement cycle varied from 5 to 10 years depending on the state (see Sample Design section). Data were collected annually from a subset of the sample. For example, if we intend to contact 100 owners in a given state and the measurement cycle is 5 years, this means that 20 of the 100 owners will be contacted each year.

Table 2.—Data collected by the National Woodland Owner Survey

Category	Data collected
Forest land characteristics	
	Acres and number of parcels of forest land owned
	Acres of forest land owned by sub-state region
	Land acquisition and transfer patterns
	Type of ownership
	Part of a farm or ranch
	Part of a primary or secondary residence
Ownership objectives	
	Ownership objectives: open-ended
	Ownership objectives: closed-ended
Forest use	
	Lease and fee-based access
	Conservation easements
	Forest certification
	Participation in cost-share programs
Forest management	
	Primary decision makers
	Harvesting of trees
	Harvesting of non-timber forest products
	Written management plans
	Other activities
Sources of information	
	Sources of advice
	Preferred methods of learning
Concerns and issues	
	Social concerns
	Forest health concerns
Future intentions	
	Future intentions
Demographics*	
	Occupation
	Age
	Education
	Income
	Gender
	Race and ethnicity
	Visual, auditory, and physical impairments

* Only collected from family and individual owners

Data Collected

The data collected by the NWOS can be categorized as follows: 1) forest land characteristics; 2) ownership objectives; 3) forest use; 4) forest management; 5) sources of information; 6) concerns and issues; 7) future intentions; and 8) demographics. The data elements are summarized in Table 2 and the questionnaire is included in Appendix I.

States were the estimation units (see Statistical Estimation Procedures section) and the questionnaire was designed to reference all forest land an owner had in a given state. If an owner had forest land in more than one state, that owner, in theory, could have received questionnaires for the forest land owned in each state and a few owners did. The content of the state-specific questionnaires was similar except for the name of the state, the lists of counties used to delineate sub-state areas, the percentage forest area in the state, and the name of the state forestry agency listed in the question about sources of forestry advice.

The formats of the questions in the NWOS questionnaire include closed-ended, partially closed-ended, open-ended, and rating. Closed-ended questions provide respondents with defined sets of options from which to select a response. Partially closed-ended questions include a defined list followed by an "other" option that allows respondents to specify other answers. In contrast, open-ended questions provide no list of choices from which to select and respondents answer using their own words. For the rating questions, respondents are asked to rate the importance of specific concepts using a 7-point Likert (1967) scale.

Forest Land Characteristics

Acres and parcels of forest land owned—Knowing the amount of forest land owned by each respondent is essential for calculating the number of forest-land owners in an area of interest (see Statistical Estimation Procedures section) and for analyzing the relationships between size of forest-land holdings and forest-land owner characteristics. This information was obtained from Question 1 (Appendix I). The first part of the question asked how many acres of forest land were owned within the state and, separately ascertained, outside the state. The information about the total acres of forest land owned is useful for differentiating between forest-land owners with only a few acres in the state of interest and substantial forest holdings elsewhere, and forest-land owners with only a few acres in the state of interest and no forest land elsewhere. Information about the number of parcels or discrete, unconnected units of forest land was collected to better understand forest land parcelization and consolidation patterns.

Acres of forest land owned by sub-state region—To better understand the distribution of forest-land owners within a state and how different issues or policies may affect them, it is necessary to ascertain where, within a state, forest-land owners' properties are located. Sub-state level information is especially valuable to state natural resources agencies and other organizations that work at the state or sub-state level. To solicit information about forest ownership patterns within a state, a state map depicting sub-state regions, based on the survey units used by the FIA forest inventory (Miles et al. 2001), was provided. Question 2 (Appendix I) listed the counties within the sub-state regions and provided spaces for respondents to indicate the number of acres of forest land owned in each sub-state region.

Land acquisition and transfer patterns—Ownership tenure and land use dynamics are related topics that greatly impact forest resources of the United States. Ownership tenure is the length of time that an owner has owned land and is relevant for policy makers and organizations that deliver or receive goods or services 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.

Information on ownership tenure and land ownership dynamics was gathered through Questions 3 and 4 (Appendix I). Question 3 asked how the forest land was acquired, from whom it was acquired, and when it was first acquired. Question 4 asked about the frequency of forest land transfers, who acquired it, and the occurrence of these transfers in the previous 5 years.

Type of ownership—The type of entity that owns a given parcel of forest land can have a large effect on how the forest land is used. Ownership categories in Question 5 (Appendix I) were selected because of the objectivity of these categories and the relative ease for these categories to be interpreted by respondents and data users.

Forest land as part of a farm or ranch—In many parts of the country, forest land is commonly owned in conjunction with a farm or ranch. It is important to know if forest-land owners are farmers or ranchers 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 of a farm or ranch (U.S. Department of Agriculture 1999), a farm or ranch was defined in the questionnaire as a place where, in most years, $1,000 or more was earned from the sale of crops (other than forest products) or animals. In Question 6 (Appendix I), respondents were asked if they owned a farm or ranch and if an affirmative answer was provided, respondents were instructed to report the number of acres that constituted their farms or ranches.

Forest land as part of a primary or secondary residence—Absentee forest-land owners and an ever-increasing wildland-urban interface are important issues affecting forest resources. It is useful to know if a person lives on the forest land or is an absentee forest-land owner because the two groups tend to behave differently. Question 7 (Appendix I) asked respondents if their primary or secondary (vacation home or cabin) residences were associated with their forest land. As more people buy parcels of forest land 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 parcelization.

Ownership Objectives

Why someone owns forest land is a primary factor affecting how he or she uses it and what society can expect from it. Owner objectives are dynamic, and it is important to understand and monitor the factors that influence owner objectives. To better understand owner objectives and establish a basis for monitoring changes in objectives, Question 8 (Appendix I) asked "What is the main reason you own woodland in (for example) Alabama?," to elicit a response free of prompts. We also asked respondents to rate a list of potential reasons for owning forest land (see Appendix I, Question 9).

Forest Use

Lease and fee-based access—For some forest-land owners, 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 also affect how land is managed. In addition to asking whether a respondents leased or received fees for allowing access to their forest land, information about the activities allowed was also ascertained. Question 10 (Appendix I) asked respondents to indicate for which, if any, activities their forest land was leased. To understand trends in lease activities, a sub-question asked if the respondents had leased any forest land in the previous 5 years.

Conservation easements—Forest-land owners hold land for a variety of reasons. Reasons for owning forest land are ephemeral, often influenced by changes in life circumstance. However, some owners desire a more perpetual use or condition for their land. Conservation easements can be applied to forest land to help ensure an owner's desires for the land are realized. Easements are legal restrictions on a parcel of land that are attached to the land deed, are transferred with the land, and sometimes provide tax benefits. To understand the extent and restrictions of easements on forest lands across the United States, Question 11 (Appendix I) asked respondents about easements on their forest land.

Forest certification—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 track the use of certified management techniques and practices and to gain more insight into who was or was not participating in forest certification programs, Question 12 (Appendix I) asked respondents about their familiarity with forest certification. For those who were familiar with forest certification, they were asked about their current and anticipated participation in a certification program.

Cost-share programs—Some governmental agencies have programs that provide forest-land owners, who meet certain qualifications, with funds to support activities that provide public benefits. Known as cost-share programs, they have been widely applied yet their overall effectiveness is unknown. In particular, agencies know cost-share participants; however, they usually lack information about who is not participating. Asking respondents if they participated in cost-share programs (see Appendix I, Question 13) will allow for the identification of salient characteristics associated with each group. Knowing the differences between those participating and not participating should help agencies improve the effectiveness of their cost-share programs.

Forest Management

Decisionmakers—Forest management decisions have become more complex as greater demands are placed on forests. 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 management decisions is important to ensure the sustainable flow of goods and service from private forest

lands. Question 14 (Appendix I) was used to determine who makes forest management decisions.

Harvesting of trees—Timber from private forest land contributes significantly to the national economy and is a significant source of income for many forest-land owners. Timber products contribute to the well-being of most Americans. Through other sources, information is available on how much wood is removed and processed annually (e.g. Smith et. al 2004). To provide contemporaneous information about private forest-land owners' harvesting behaviors, Question 15 (Appendix I) asked if trees were harvested or removed from the forest land they owned. If respondents indicated that trees were harvested or removed, other questions asked what types of products were removed and the reasons for the removals. To ascertain a temporal context to their answers, respondents were asked if any harvests occurred within the previous 5 years.

The use of professional foresters or other natural resource professionals significantly improves the stumpage price received by forest-land owners (Cubbage 1983) and should improve the quality of the residual stand. Question 15c (Appendix I) asked owners if a professional forester or other natural resource professional planned, marked, or contracted the most recent harvest.

Nontimber forest products—Nontimber forest products are gaining increasing attention across the country as a potentially important source of income for forest-land owners and resources for society. To ascertain how many forest-land owners were harvesting these products, Question 16 (Appendix I) asked respondents what nontimber forest products have been collected from their lands.

Descriptions and regional examples of nontimber forest products were provided. To understand why these products were collected, Question 16b (Appendix I) asked if the nontimber forest products were harvested for sale or gifts/personal use. Another question (Appendix I, Question 16c) asked if nontimber forest products were harvested in the previous 5 years to provide a more temporal context.

Written management plans—A written management plan is one indication that a forest-land owner has contemplated how to manage his or her forest land. In some states, management plans are a prerequisite for participation in certain tax abatement 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. Question 17 (Appendix I) asked respondents if they had a written management or stewardship plan for their forest land.

Other activities—Things owners do with their forest land 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 would have included only silvicultural 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 lands in the United States, Question 18 (Appendix I) asked respondents what activities had occurred on their forest lands.

Sources of Advice and Information

Sources of advice—To meet management objectives, forest-land owners sometimes seek advice from others. There are numerous private forestry consultants and public agencies that provide forest management advice. Although these professionals know their clients, it is 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 professionals' abilities to help implement forest management activities. Increased forest management is beneficial not only to the forest-land owner, but also aids society because it allows the forest land to be used more efficiently. Question 19 (Appendix I) asked respondents from whom they received advice in the previous 5 years.

Preferred methods of learning—It is imperative that the organizations delivering the information know the forest-land owners' preferred ways of learning about forest stewardship. Over the last decade, computers have

transformed how information is delivered. The extent to which forest-land owners have adopted computer technology as a way to learn about forestry management is largely unknown. However, it is likely that as new individuals acquire forest land and as owners adopt computer technology, their preferred way of learning about forestry will also change. Question 20 (Appendix I) asked respondents to rate information/technology transfer methods.

Concerns and Issues

Social concerns—Forest-land owners are continually confronting new regulations and societal encroachment that affect the way they use their land. The challenges imposed by regulations and societal encroachments on private forest land are fairly well known, however not much is known about the concerns owners have for specific regulatory or societal pressures. Question 21 (Appendix I) sought to quantify these concerns.

Forest health concerns—Many things affect the health of forest lands. Knowing owners' concerns about forest health threats is important because this information can assist in developing programs for alleviating those problems. Much is known about the health of forests through information collected by various public agencies (e.g., the USDA Forest Service FIA and Forest Health and Monitoring programs). However, that information may differ significantly from owners' concerns about forest health. It is important that differences are recognized so meaningful progress can be made in sustaining healthy forests. Question 22 (Appendix I) asked respondents to rate their level of concern toward selected biological and health threats to their forest lands.

Future Intentions

Owners' plans for their forest land have significant implications for forest sustainability. Respondents indicated their plans for their forest land in Question 23 (Appendix I).

Demographics

Demographic information was collected in Questions 24 through 30 (Appendix I) to characterize individual and family forest owners. For family owners, the demographic characteristics of the person who made most of the forest use/management decisions were collected. To facilitate the analysis, demographic categories and terms were chosen to correspond with those used by the U.S. Census Bureau (2001) and U.S. Bureau of Labor Statistics (2000).

Age—An owner's age is an important determinant of how the forest land is used. As the owner ages, the probability increases that his or her forest land will be sold or transferred. To limit the intrusiveness of this question, Question 25 (Appendix I) asked respondents to select an age category to which they belonged.

Occupation, Education, and Income—Education, income, and occupation are important determinants of forest-land owner behavior. It is likely that as education and income increase, the objectives of forest-land owners change. Occupation, particularly the degree to which the owner "lives off the land," may influence forest management activities. The diversity of occupations required an open-ended question (Appendix I, Question 24); the responses were later classified according to government standards (U.S. Bureau of Labor Statistics 2000). In addition to occupation, respondents were asked if they were retired. To minimize intrusiveness, Questions 26 and 27 (Appendix I) asked respondents to indicate the levels of education and income using broad categories.

Gender—Males and females may have different attitudes toward their forest land or different preferred methods for managing and learning about their lands. Question 28 (Appendix I) asked respondents to report their gender.

Race and ethnicity—The social goal of equality among races and ethnicities can be partially assessed through knowledge of the distribution of forest-land 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 it. Question 29a (Appendix I) asked respondents if they were Spanish, Hispanic, or Latino. Question 29b (Appendix I) asked to which racial groups they belong.

Long-lasting visual, auditory, and physical impairments—Physical impairments may affect an owner's ability to use or manage forest land. Physical impairments also

may prevent access to information or services that are available to forest-land owners. Question 30 (Appendix I) asked respondents to report severe vision or hearing impairments and any physical conditions that limited their ability to conduct daily activities.

The Survey Instrument

The NWOS used a self-administered questionnaire (Appendix I) as the primary survey instrument. The questionnaire was sent first-class via the U.S. Postal Service and returned to the Forest Service in a pre-paid, pre-addressed return envelope. The mail survey was selected over other methods (i.e., telephone interviews and personal interviews) based on relative advantages, disadvantages, and costs. A mail questionnaire significantly reduces costs, but often comes at the expense of a relatively low response rate. Telephone interviews conducted by the USDA National Agriculture Statistical Service were used to augment response rates.

Developing the Questionnaire

The content, design, and layout of a questionnaire can significantly influence the response rate and the quality of the answers provided (Dillman 2001). Special emphasis was placed on developing questions that elicit accurate information. Study objectives, question wording, and questionnaire format were analyzed to maximize efficiency. The number of questions on the survey was limited to 30 because that number was deemed reasonable to meet the study objectives. Also, 30 questions did not appear to place excessive burden on respondents. To further minimize burden and maximize efficiency, response options were limited to 10 items.

To achieve the survey objectives and to avoid inclusion of extraneous questions, a description, background, and justification were developed for each question (see Data Collected section).

Since the NWOS was primarily a self-administered questionnaire, careful attention was given to wording and flow of the questions. In writing the questions, we tried to use language that someone with the equivalent of an eighth-grade education could understand easily. Explicit instructions were provided for each question. Questions were grouped into sections that solicited similar information (see Data Collected section). Questions were placed in sequences that were logical extensions of previous questions.

The Questionnaire Review Process

A review process was designed to get meaningful feedback on the content and format of the questionnaire from individuals and organizations interested in forest-land owners and forest management. The questionnaire review process involved several steps.

Forest-land owner survey experts reviewed the questionnaire (Appendix I). These reviewers were selected to include people from varying professional backgrounds, affiliations, and geographic areas. All who were asked agreed to participate and each was sent a mission statement, a list of survey objectives, and a draft questionnaire. They were asked to review the questionnaire and provide comments that would improve it. Teleconferences were conducted to facilitate discussion.

Another step in the review process consisted of pretesting the survey instrument. At several forest-land owner conferences and professional meetings, NWOS information was displayed. Individuals interested in the NWOS were asked to complete the questionnaire and their comments were solicited. This approach assessed whether potential respondents would have difficulty answering questions, to determine the amount of time it took to complete the questionnaire, and to garner additional feedback and input. Although a biased sample of the potential respondents, the pretesting provided useful feedback.

Input from state forestry agencies was obtained through coordination with the National Association of State Foresters. The State Foresters were asked to supply contact information for an individual(s) within their agency who could review the questionnaire. After sending copies of the NWOS mission statement and the draft questionnaire, comments were received from 42 state forestry agencies. Additional comments were received from 21 other agencies and organizations.

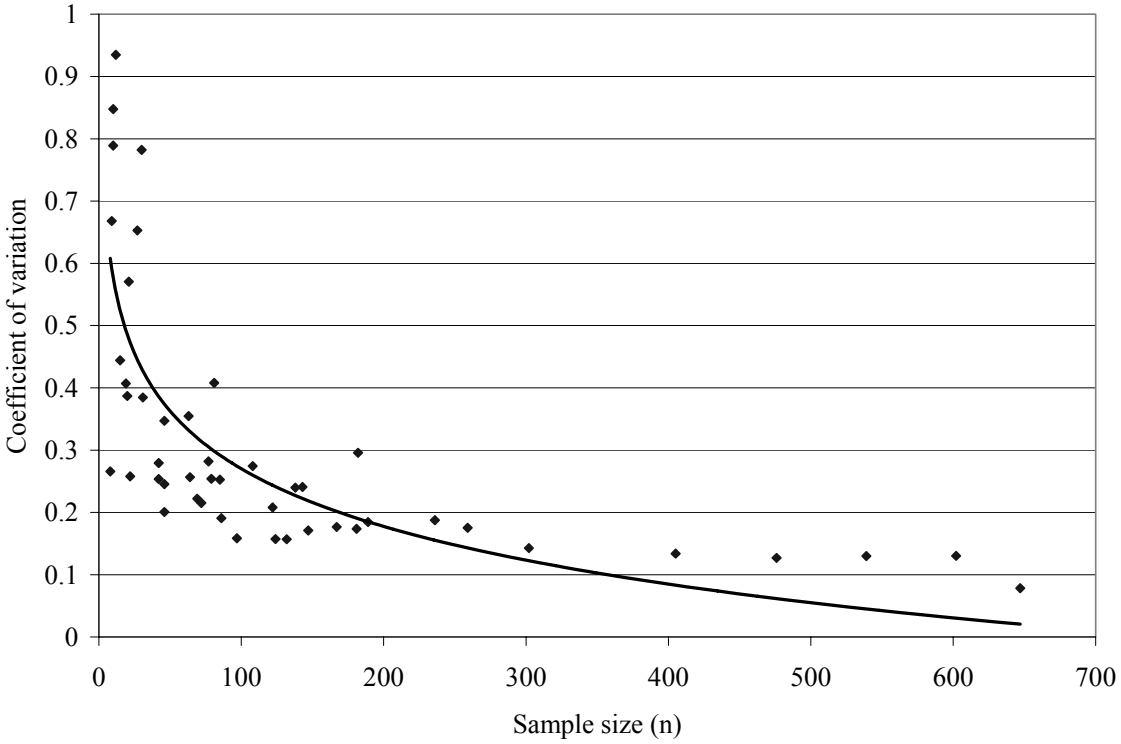

Figure 1.—Relationship between sample size and coefficient of variation for state-level estimates of number of family forest-land owners as calculated from 2002/2003 National Woodland Owner Survey data

At the completion of the review process, another review was initiated, as mandated by the Paperwork Reduction Act of 1995 (Pub. L. 104-13). This process involved review by clearance officers with the U.S. Department of Agriculture and U.S. Department of Agriculture, Forest Service, posting on the federal registry, and a final review by the Office of Management and Budget. As with all federal surveys, the NWOS is approved for 3-year increments and the approval process is repeated as necessary.

Sample Size

Theoretically, sample sizes should be determined by degree of precision desired, willingness to accept an incorrect answer, data variability, and population size (Thompson 1992). Coupled with these statistical considerations, the anticipated response rates and budgetary and other logistical constraints also must be considered.

We used an empirical approach to estimate target sample sizes. The variance associated with the estimated number of private forest-land owners in a state was estimated using results from the 2002/2003 NWOS (Fig. 1) (see Statistical Estimation Procedures section). These data showed that after responses were received from at least 250 respondents, the coefficient of variation approached an asymptote of approximately 0.15. As a result, our goal is to obtain a coefficient of variation for the number of forest-land owners in a state of approximately 0.15. This implies that the standard error of the estimated number of forest-land owners in a state will be equal to no more than 15 percent of the estimated number of forest-land owners. On average, we will aim for sample sizes (completed questionnaires) of at least 250 per state, but the specific state-level target sample sizes will vary depending on population size and variability. The adequacy of the sample size will be assessed as responses are received and adjustments will be made as necessary.

The number of forest-land owners responding to the NWOS in a state—the observed sample size—is a function of the sampling intensity, the percentage of privately owned forest land, number of private forest-land owners (i.e., the number of sample points owned per respondent), and response rates. For the contiguous

United States, one sample point will be established for every 6,000 acres over the course of measurement cycles that will not exceed 7 years in the east and 10 years in the west. Based upon previous research (e.g., Birch 1996) and preliminary results from the NWOS, we anticipate a final response rate of approximately 50 percent after all follow-ups are completed.

In states where the target sample is not achieved, the sampling intensity will be increased until the desired minimum sample size is achieved. The method for implementing this intensification is described in the Sample Design section.

Based upon these considerations and budgetary/logistical constraints, approximately 6,500 private forest-land owners per year are asked to participate in the NWOS.

Sample Design

The accuracy of extrapolating the results of a survey based on a subset of a population is contingent on the selection and implementation of a sampling design. The ability to generalize results is limited to the population, as defined by the sampling frame, implying that all members of the population of interest should have known, non-zero inclusion probabilities.

The NWOS uses two parallel sampling designs—one designed to estimate area of forest land (i.e., acres) and the other to estimate numbers of forest-land owners. For estimating forest land area, a simple random sample design (Thompson 1992) was employed; all acres of private forest land in an estimation unit (e.g., state) had an equal probability of being included in the sample. The probability of a forest-land owner being included in the sample was a function of the amount of forest land owned in the estimation unit. As the owner's forest area approached the inverse of the sampling intensity (i.e., 6,000 ac), the probability of being included in the sample approached one. Stating this another way, if a forest-land owner had at least 6,000 ac of forest land, there was a high probability that he or she was asked to participate in the NWOS and this probability increased as the size of his or her forest holdings increased. This sample design is termed "probability proportional to size."

The Sampling Frame

The same sampling frame was used to estimate area of forest land and number of forest-land owners. The sampling frame for the NWOS is the same that is used for the FIA forest resource inventory (Bechtold and Patterson 2005). The United States was divided into nonoverlapping, 6,000 ac hexagons. Within each hexagon, a sample point was randomly selected. This resulted in a grid of points that, on average, was 3.25 miles apart. Using remotely sensed imagery and/or ground reconnaissance, each point was identified as forest or non-forest. For all forested sampling points, the names and addresses of the forest-land owners were obtained from tax records, other publicly available government records, or the owner. The identified private owners and the land they owned were the basis for estimating attributes of interest.

Annual Implementation

A full survey cycle will take 5 to 10 years to complete in a state. Each year, a random subset (e.g., 10 percent of the contacts in a 10-year state) of the total number of forest-land owners in a state is contacted. This design allows for unbiased estimates to be made on an annual basis. Although the sample size in a given state for a single year may be insufficient to make reliable estimates, the data can be pooled with data from other years or combined with estimates from other states to achieve more robust results.

Survey Intensification

To ensure reliable estimates for each state, it was necessary to increase the sampling intensity in some states (see Sample Size section). If intensification was necessary, the number of forest-land owners contacted was incrementally increased until the desired sample size was achieved. As an example, for a 2x intensification, we overlaid the state with a grid that divided the state into 3,000 ac units. If a sample point from the 1x implementation was located in the grid, that point was used. If no points were located in the cell, a new sampling location was randomly selected. As with the 1x sampling points, the forest status of the 2x points was determined from remotely sensed imagery and for

forested points, the name and address of the owner were determined.

Survey Implementation

The implementation of the NWOS involved assembling the sampling frame, conducting the mail survey, conducting the telephone follow-up survey, and processing the data.

Assembling the Sampling Frame

The people identified by the FIA forest inventory as private forest-land owners formed the sample for the NWOS. The NWOS sample points corresponded to plot center of the FIA inventory plots. To minimize conflict between FIA field crews' access to private forest lands and the NWOS, the NWOS contacts forest-land owners at least 1 year after the field crews completed the forest inventory on an owner's land. For states where current ownership data were not yet available (i.e., the annual inventory process was yet to be initiated), information from the most recently completed periodic inventories was used. To match the sampling intensity of the annual states, only a subset of the private forest-land owners identified in a periodic inventory was contacted in a given year.

The sampling lists included forest-land owners with large and/or multiple holdings, resulting in multiple listings for a single owner. To reduce the burden on these owners, no owner was contacted more than once per survey cycle for each state in which he or she owned forest land. The results from the one survey they completed were assigned to all sample points corresponding to the same owner. In future research, we will assess if this procedure introduces any biases.

Conducting the Mail Survey

Each forest-land owner contacted by the NWOS received up to four mailings. First, a pre-notice (Appendix II) was sent alerting the potential respondents that a questionnaire would be arriving soon. The pre-notice also described the survey—why it is important, why their help is needed, and what they may gain from participating. The forest-land owners then received a questionnaire (Appendix I) with a cover letter that described, in greater detail, the purpose and importance of the survey and a pre-paid, pre-addressed return envelope. A reminder/thank you postcard (Appendix II) was mailed to encourage nonrespondents to respond and to thank those who responded. Finally, a second questionnaire and cover letter with a pre-paid return envelope were sent to forest-land owners who had not responded. For those forest-land owners who did not respond to the mail inquiries and for whom we had telephone numbers, telephone interviews were attempted.

Processing

Completed paper questionnaires (most of our responses) were processed using an automated routine that relied on optical character recognition (OCR) and optical mark recognition (OMR) technology. Paper questionnaires were scanned to produce electronic documents and the digital files were read by software that extracted the data. The software was configured to flag questionable, out of range, and illogical responses. A research staff person reviewed each of these responses to discern the respondent's intent. The verified data were then exported to a database.

Data collected by telephone were entered directly into the database.

All data in the database were checked for duplicate entries, acceptable values, and logic. If a forest-land owner responded to the NWOS more than once, only his or her first response was retained. All values that were flagged as questionable (e.g., out of the normal range) or inconsistent with other answers provided on the questionnaire were examined and, if necessary, changed by research staff. After the data were checked, they were exported to another database.

Data Confidentiality

In accordance with our promise to the forest-land owners whom completed questionnaires and federal law (i.e., Pub. L. 99-198), no data will be released that could be used to identify the individual or group that provided the information. The responses will only be used to make statistically aggregated estimates.

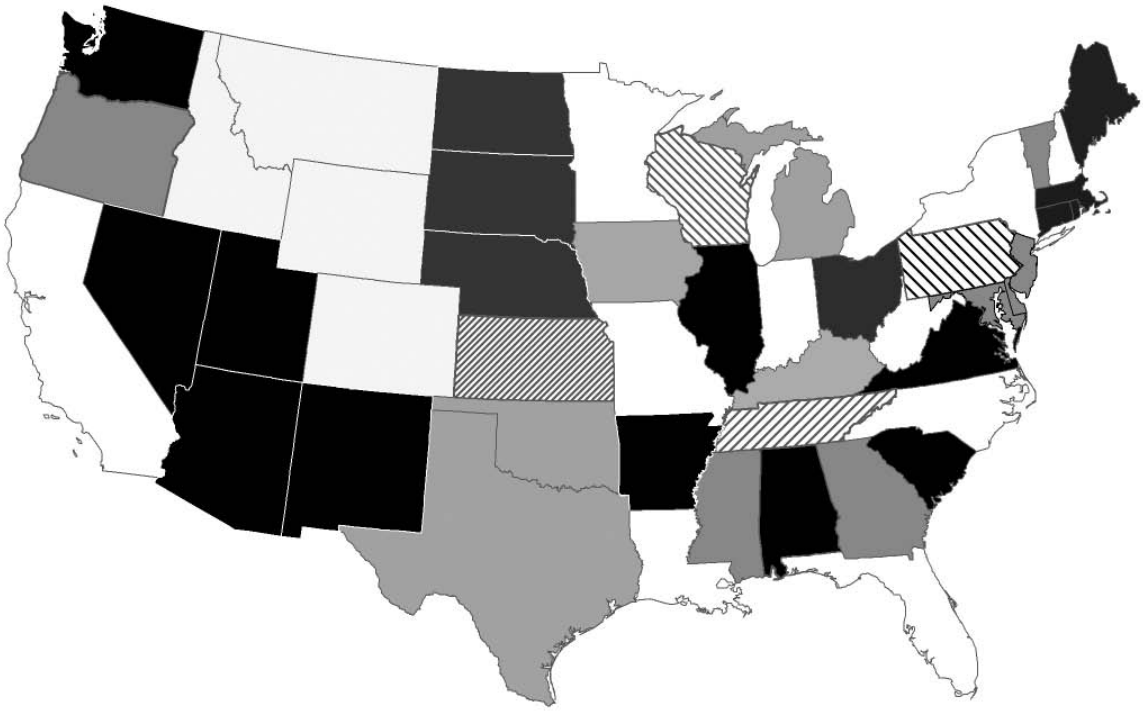

Figure 2.—"Super-states," depicted as contiguous states with identical shading (e.g., Texas and Oklahoma), used by the National Woodland Owner Survey

Statistical Estimation Procedures

Estimates were made of forest land area and number of forest-land owners. Examples of the statistical estimation procedures are included in Appendix III. Due to the sampling design, different procedures were used for estimating areas and owners. Every private, forested acre in an estimation unit had an equal selection probability and simple random sample estimation procedures (e.g., Thompson 1992) were used. The probability of a private forest-land owner being selected was a function of the area of forest land that he or she owned. As such, probability proportional to size estimation procedures (e.g., Horvitz and Thompson 1952) were applicable. These approaches generated the best, linear, unbiased estimates of the statistics of interest. Algorithms for total areas of forest land and numbers of forest-land owners by domain of interest are described below.

The estimation units were states or "super-states." Estimates of the totals and variances were made for each estimation unit and summed to determine totals and variances at broader scales (e.g., regions and the nation). If a state had fewer than 50 private forest-land owners who responded to the NWOS, then it was combined with neighboring states within the region to create a super-state (Fig. 2).

Estimation of Forest Land Area

The population of interest was all private forest land and the sampling unit was 1 acre of forest land. Estimates of total private forest land in an estimation unit were taken from the FIA forest inventory estimates (e.g., Smith et al. 2004).

The area of private forest land within a domain or subset of the population of interest was estimated as the proportion of the forested points that met a specified criteria multiplied by the total private forest land area in the estimation unit. An unbiased estimate of the proportion of the population in the domain is (Lohr 1999):

$$\hat{p}_d = \frac{1}{n_a} \sum_{i=1}^{n_a} y_i \qquad \text{(Eq. 1)}$$

where: n_a = the sample size or number of private, forested sample points in the estimation unit; and

y_i = a binary variable with a value of one indicating inclusion of observation *i* in domain *d*.

An unbiased estimate of the variance of this proportion is:

$$s^2(\hat{p}_d) = \frac{n_a}{n_a - 1}\hat{p}_d(1 - \hat{p}_d) \quad \text{(Eq. 2)}$$

To expand this proportion to a total and estimate the total area of private forest land in the domain of interest, the proportion was multiplied by the estimated area of private forest land in the estimation unit:

$$\hat{A}_d = \hat{A}_f \hat{p}_d \quad \text{(Eq. 3)}$$

where: $\hat{A}_f$ = estimated area of private forest land in the estimation unit.

An unbiased estimate of the variance of this estimate is:

$$\hat{\text{var}}\left(\hat{A}_d\right) = A_f^2\left(\frac{s^2(\hat{p}_d)}{n_a}\right) + \hat{\text{var}}(\hat{A}_f)(\hat{p}_d)^2 \quad \text{(Eq. 4)}$$

The second term in the right-hand side of this equation, $\hat{\text{var}}(\hat{A}_f)(\hat{p}_d)^2$, accounts for the fact that the area of private forest land is an estimate.

Estimation of Number of Forest-Land Owners

The probability of a forest-land owner being contacted to participate in the NWOS, the inclusion probability, was equal to the area of forest land that he or she owned in the estimation unit divided by the total area of forest land in the estimation unit. The Horvitz-Thompson estimator (HTE) (Horvitz and Thompson 1952) provided a method for incorporating the probability proportional to size facet of the sampling design.

Adapting the HTE, an estimate of the number of private forest-land owners within an estimation unit for a domain of interest is:

$$\hat{N}_d = \frac{1}{n_o}\sum_{i=1}^{n_o}\frac{y_i}{\pi_i} = \frac{\hat{A}_f}{n_o}\sum_{i=1}^{n_o}\frac{y_i}{a_i} = \hat{A}_f\sum_{i=1}^{n_o}\frac{y_i}{n_o a_i} \quad \text{(Eq. 5)}$$

where: n_o = number of private forest-land owners in the sample;

y_i = a binary variable with a value of one indicating inclusion of observation i in domain d; and

π_i = the inclusion probability or $a_i / \hat{A}_f$ and $A_f = \sum_{i=1}^{N_o} a_i$.

Variances associated with estimates derived from the HTE are dependent on the joint inclusion probabilities of the sample selected. But these inclusion probabilities are prohibitively difficult to calculate with sample sizes greater than two and are almost always estimated. To estimate variances, we used Grosenbaugh's (1958) approach in which the observations were treated as "n independent replications of a probability proportional to size sample" (Erikson 1995). This approach means the variance can be estimated by:

$$\hat{\text{var}}(\hat{N}_d) = \hat{A}_f^2\frac{1}{n_o(n_o - 1)}\sum_{i=1}^{n_o}\left(\frac{y_i}{a_i} - \left(\sum_{i=1}^{n_o}\frac{y_i}{n_o a_i}\right)\right)^2 + \hat{\text{var}}(\hat{A}_f)\left(\sum_{i=1}^{n_o}\frac{y_i}{n_o a_i}\right)^2 \quad \text{(Eq. 6)}$$

Nonresponse Errors

The methods described above are straightforward ways for estimating areas and numbers of owners and implicitly assume 100 percent response rates or at least that the respondents are an unbiased sample of the forest land and forest-land owners being studied. The presence or magnitude of nonresponse errors and techniques to help mitigate any observed trends (e.g., Biemer et al. 1991, Groves et al. 2002) will be investigated in future research efforts.

Summary

The NWOS is designed to provide information that assists in understanding the role private forest-land owners have in providing goods and services to society. The contributions made by private forest-land owners have long been recognized as important, however, these contributions have not often been fully quantified, at least from a national perspective. The NWOS is the USDA Forest Service's effort to quantify the traits of this group of owners. This publication documents the procedures used to design, implement, and analyze the NWOS in 2002-2006.

The results from the NWOS must be distributed in a variety of formats tailored for specific audiences. Information intended for policy analysts and resource managers will consist of detailed technical documents describing findings and discussing implications. Technical documents detailing the methodological procedures used by the NWOS, such as this report, will be produced for the research community. Effort will be devoted to

developing mechanisms, largely a web-based database retrieval system, which will allow users online access to raw data. The public will be informed of NWOS results through press releases targeted to different locales. Also, information for the general public will be published in a "popular" format, free of technical jargon. The Internet will be a key communication tool, along with the web-based database retrieval system. The NWOS website (www.fs.fed.us/woodlandowners) will serve as a central repository for NWOS data and information.

The first reports of findings will focus on the private forest-land owners at the national and regional (multi-state) levels. As sample sizes increase, the spatial resolution will increase. Subsequent reports will include state- and substate-level details. In addition to increasing the spatial resolution, the spatial extent of the NWOS will increase, eventually expanding to all 50 states and the territories.

We seek to continually improve the NWOS. To this end, at 5-year intervals, in-depth assessments of strengths and weaknesses of the NWOS will be conducted. This publication is intended to document past efforts, provide a foundation for the future, help ensure that the results are objective and repeatable, and the process is transparent. As the procedures described herein are implemented, opportunities to redefine, as well as refine, aspects of the process will be available to clients and others interested in the private forest-land owners of the United States.

For more information
If you would like to learn more about the NWOS or would like to view results, please visit the NWOS website at: www.fs.fed.us/woodlandowners.

Acknowledgments

We sincerely appreciate the nation's forest-land owners' willingness to participate in the NWOS. Obviously, without their participation, the NWOS would not be able to provide the information that is needed to promote sustainable forestry.

We would like to recognize the contributions of the late Thomas Birch. He instituted earlier national surveys of forest-land owners and much of his work is the foundation on which the NWOS is built.

The support of the five FIA units and the field crews that provided the information for contacting the forest-land owners made this study possible and is much appreciated. In particular, Mark Brown and John Winborne provided invaluable assistance.

Invaluable guidance in designing the NWOS was provided by members of the steering committee (Appendix IV), the technical committee (Appendix V), and the numerous other individuals who reviewed the questionnaire.

We thank Mel Baughman, Mark Brown, Denise Wickwer, and Will McWilliams for taking the time to review this document in its entirety. Reviews of the statistical estimation procedures were provided by John Stanovich, Mark Hansen, and Jim Westfall.

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Appendix I – National Woodland Owner Survey Questionnaire

The questionnaires sent to forest-land owners contained these questions, but specific state information was inserted where appropriate (i.e., as indicated by the angled brackets).

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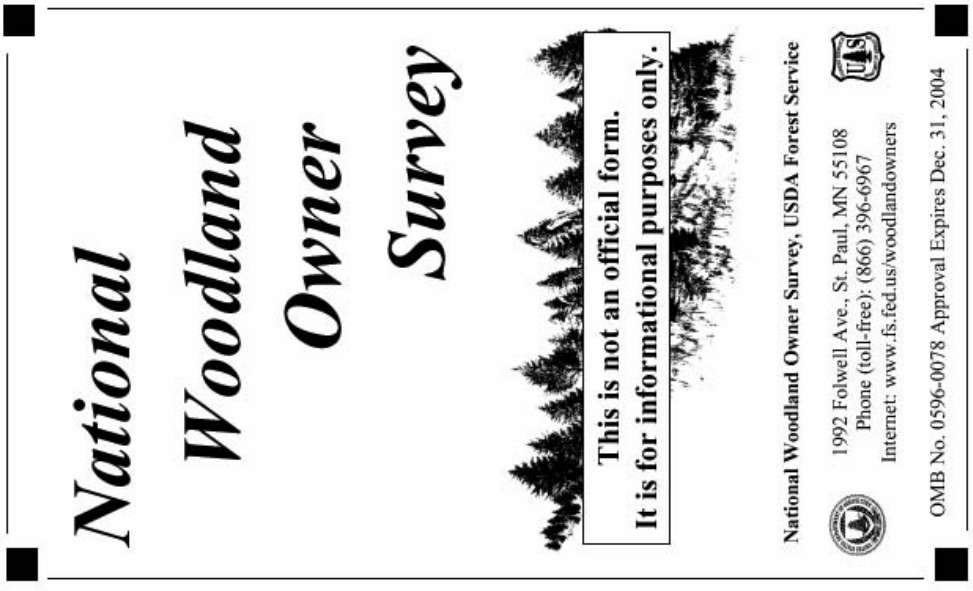
Front cover



Questionnaire page 1

Instructions

- ✓ Please provide answers for all of the woodland that you own in <state>.
- ✓ The owner who makes most of the decisions about your woodland should answer this questionnaire.
- ✓ If this questionnaire is received by a company or other organization, please have a person knowledgeable about the organization's woodlands in <state> answer this questionnaire.
- ✓ If you do not own any woodland in <state>, please return this questionnaire in the postage-paid envelope provided. Thank you!

General Questions about Your Woodland

1. **Woodland** covers <percent woodland>% of <state>.

   Woodland includes:
   - Land at least one (1) acre in size, 120 feet wide, and has at least ten (10) well-spaced trees per acre; and
   - Land at least one (1) acre in size, where trees were removed and trees will grow again (not converted to another use, such as cropland, pasture land, or residential).

   Woodland does *not* include:
   - Christmas tree farms, orchards, or nurseries; or
   - Land that is mowed for lawn.

   a. How many acres of land do you own in <state>?

							Acres of land in <state>

   b. How many acres of woodland do you own in <state>?

							Acres of woodland in <state>

   c. How many unconnected parcels or tracts of woodland do you own in <state>?

   If you own more than 10 or 100 parcels, please estimate to the nearest 10 or 100 parcels.

				Parcels with woodland in <state>

   d. How many acres of woodland do you own outside of <state>?

							Acres of woodland outside of <state>

Questionnaire page 2

2. How many acres of woodland do you own in the following regions of <state>?
   See map below.

<region 1> including <county 1, coubnty 2, ...>.		Acres
<region 2> including <county 3, county 4, ...>		Acres

<state map with sub-state regions>

Questionnaire page 3

3. a. How did you get your woodland in <state>?
*Check **ALL** that apply.*
☐ Bought it
☐ Inherited it
☐ Got it as a gift
☐ Other (please specify): _____

b. From who did you get your woodland?
*Check **ALL** that apply.*
☐ My parents, spouse, or other family members
☐ Other individual(s)
☐ Land investor/developer
☐ A forestry company
☐ A local, state, or federal government agency
☐ Other (please specify): _____

c. In what year did you first get woodland in <state>?
☐☐☐☐ Year ☐ I don't remember

4. a. How many times have you sold or given away woodland in <state>?
*Check only **ONE**.*
☐ Never ➡ **If never,** go to question 5.
☐ Once (1 time)
☐ 2 to 5 times
☐ 6 or more times

b. Who got the woodland that you sold or gave away in <state>?
*Check **ALL** that apply.*
☐ My children or other family members
☐ Other individual(s)
☐ Land investor/developer
☐ A forestry company
☐ A local, state, or federal government agency
☐ Other (please specify): _____

c. Have you sold or given away woodland in <state> in the **last 5 years**?
☐ Yes ☐ No

Questionnaire page 4

5. There are many different types of ownerships that hold woodland. How would you describe the type of ownership in which your <state> woodland is held?
*Check **ALL** that apply.*
☐ Individual or joint ownership
☐ Family partnership or corporation
☐ Business partnership
☐ A corporation that produces forest products
☐ A corporation that does not produce forest products
☐ Forest management company (manage for private clients)
☐ Timber investment management org. (institutional clients)
☐ Nonprofit organization
☐ Club or association
☐ Trust or estate
☐ Other (please specify): _____

6. For the purpose of this survey, a farm or ranch is a place where, in most years, $1,000 or more is earned from the sale of crops (other than forest products) or animals.
Do you own a farm or ranch that is within one (1) mile of any of the woodland that you own in <state>?
☐ Yes ☐ No ➡ **If no,** go to question 7.
↳ **If yes**, how many acres do you farm or ranch?
☐☐☐☐☐☐ acres

7. a. Is your home (primary residence) within one (1) mile of any of the woodland that you own in <state>?
☐ Yes ☐ No ☐ Not Applicable

b. Do you have a vacation home or cabin within one (1) mile of any of the woodland that you own in <state>?
☐ Yes ☐ No ☐ Not Applicable

Your Reasons for Owning Woodland

8. What is the main reason that you own woodland in <state>?
Please write your answer below.

_____

_____

Questionnaire page 5

9. People own woodland for many reasons. How important are the following as reasons for why you own woodland in <state>?
*Mark **ONE** box for **EACH** item.*

	Very Important 1	2	3	4	5	6	Not Important 7
To enjoy beauty or scenery	☐	☐	☐	☐	☐	☐	☐
To protect nature and biologic diversity	☐	☐	☐	☐	☐	☐	☐
For land investment	☐	☐	☐	☐	☐	☐	☐
Part of my home or vacation home	☐	☐	☐	☐	☐	☐	☐
Part of my farm or ranch	☐	☐	☐	☐	☐	☐	☐
For privacy	☐	☐	☐	☐	☐	☐	☐
To pass land on to my children or other heirs	☐	☐	☐	☐	☐	☐	☐
For cultivation/collection of non-timber forest products	☐	☐	☐	☐	☐	☐	☐
For production of firewood or biofuel (energy)	☐	☐	☐	☐	☐	☐	☐
For production of sawlogs, pulp-wood or other timber products	☐	☐	☐	☐	☐	☐	☐
For hunting or fishing	☐	☐	☐	☐	☐	☐	☐
For recreation, other than hunting or fishing	☐	☐	☐	☐	☐	☐	☐
Other (please specify):	☐	☐	☐	☐	☐	☐	☐

_____

_____

Questionnaire page 6

Uses of Your Woodland

10. Have you ever leased or collected money (other than from logging) for allowing people to use the woodland that you own in <state>?

☐ Yes ☐ No ➡ **If no,** go to question 11.

➡ **If yes**, please answer questions **a** *and* **b**.

a. What did they use it for?
*Check **ALL** that apply.*
☐ Hunting
☐ Recreation (other than hunting)
☐ To graze/pasture livestock
☐ Timber production
☐ To cultivate/collect non-timber forest products
☐ Other (please specify): _____

b. Have you leased or collected money for allowing people to use the woodland that you own in <state> in the **last 5 years**?
☐ Yes ☐ No ☐ I don't remember

11. **Conservation easements** are legally binding agreements (sometimes the result of payment to the owner) that restrict land from being used for certain, designated purposes, such as development.

Is there a **conservation easement** on any of the woodland that you own in <state>?

☐ Yes ➡ **If yes,** what types of activities are restricted?
*Check **ALL** that apply.*
☐ Conversion of woodland to another land use
☐ Splitting of woodland into smaller land holdings
☐ Harvesting of trees
☐ Other (please specify): _____

☐ No ➡ **If no,** do you plan to get a conservation easement?
*Check only **ONE**.*
☐ Yes ☐ No
☐ Maybe ☐ Don't know

Questionnaire page 7

12. To encourage good woodland management, groups have created **green certification** programs to recognize woodland owners that comply with a group's standards. Examples include Tree Farm, Green Tag, SmartWood, and the Sustainable Forestry Initiative.

Have you ever heard or read about **green certification** before?

☐ Yes ☐ No ➡ **If no,** go to question 13.

↳ If yes, is any of your woodland in <state> currently green certified?

☐ Yes ➡ **If yes,** go to question 13.

☐ No ➡ **If no,** are you planning to get any of your woodland in <state> green certified?

☐ Yes ☐ No

☐ Maybe ☐ Don't know

13. **Cost-share programs** provide landowners with money to help plant trees or manage their woodland. Examples include the Conservation Reserve Program, Stewardship Incentive Program, and Forestry Incentives Program.

Have you ever used a state or federal sponsored cost-share program to help you manage your woodland in <state>?

☐ Yes ☐ No ➡ **If no,** go to question 14.

↳ **If yes,** have you used a cost-share program to help you manage your woodland in <state>in the **last 5 years**?

☐ Yes ☐ No ☐ I don't remember

Management of Your Woodland

14. Who makes most of the decisions, such as whether or not to harvest trees, for your woodland in <state>?

*Check **ALL** that apply.*

☐ Me and/or my spouse
☐ My childern, parents, or other relatives
☐ My business partner (including associations and clubs)
☐ My land manager or forester
☐ My logging contractor
☐ Other (please specify): _____

Questionnaire page 8

15. Have trees ever been harvested or removed from any of the woodland that you own in <state> since you have owned it?

☐ Yes ☐ No ➡ **If no,** go to question 16.

↳ **If yes,** please answer **a**, **b**, **c**, and **d**.

a. What types of products were harvested?
*Check **ALL** that apply.*

☐ Veneer logs
☐ Sawlogs
☐ Pulpwood
☐ Firewood ➡ _____ Cords per year
☐ Post or poles
☐ Other (please specify): _____

b. Why were trees harvested or removed?
*Check **ALL** that apply.*

☐ To achieve objectives in my management plan
☐ Trees were mature
☐ To clear land for conversion to another use
☐ Needed the money
☐ Needed wood for own use
☐ Price was right
☐ To improve hunting opportunities
☐ To improve scenic and recreational opportunities
☐ To remove trees damaged by a natural catastrophe
☐ To improve quality of remaining trees
☐ Other (please specify): _____

_____

c. During the most recent harvest, did a professional forester help plan, mark, or contract the harvest?

☐ Yes ☐ No ☐ I don't remember

d. Have trees been harvested or removed in the **last 5 years?**

☐ Yes ☐ No ☐ I don't remember

Questionnaire page 9

16. **Non-timber forest products** are products other than logs, pulpwood, firewood, posts, or poles that are collected from woodlands.

Non-timber forest products include:

Edibles such as wild mushrooms, berries, and fiddlehead ferns

Medicinal and dietary supplements such as nettles, Devil's club, and Echinacea

Decorative, floral, or craft products such as conifer boughs, salal, willow, and landscaping transplants

Items of cultural or religious importance such as huckleberries, medicinal plants, and beargrass

Have non-timber forest products been collected from any of the woodland that you own in <state> since you have owned it?

☐ Yes ☐ No ➡ **If no,** go to question 17.

↳ **If yes,** please answer **a**, **b**, and **c**.

a. What types of products were collected?
*Check **ALL** that apply.*
- ☐ Edibles
- ☐ Medicinal and dietary supplements
- ☐ Decorative, floral, or craft products
- ☐ Items of cultural or religious importance
- ☐ Other (please specify): _____

b. Why were these products collected?
*Check **ALL** that apply.*
- ☐ For sale
- ☐ For personal use or gifts

c. Have any of these products been collected in the **last 5 years?**
☐ Yes ☐ No ☐ I don't remember

Questionnaire page 10

17. Do you have a written management or stewardship plan for any of the woodland that you own in <state>?
☐ Yes ☐ No ☐ I don't remember

18. In the last 5 years, have any of the following activities occurred on any of the woodland that you own in <state>?
*Check **ALL** that apply.*
- ☐ Prepared land for new trees - "site prep"
- ☐ Planted trees
- ☐ Reduced fire hazard
- ☐ Applied herbicides, pesticides, or fertilizers
- ☐ Built or performed maintenance on roads or trails
- ☐ Wildlife habitat/fisheries improvement projects
- ☐ Posted land to restrict public access
- ☐ Recreation or hunting by me, my family, or friends
- ☐ Recreation or hunting by the general public with my permission
- ☐ None of the above

Sources of Information

19. In the last 5 years, have you received advice or information about the woodland that you own in <state>?
☐ Yes ☐ No ➡ **If no,** go to question 20.

↳ **If yes**, who did you get advice or information from?
*Check **ALL** that apply.*
- ☐ <state forestry agency> forester
- ☐ Extension forester or other university employee
- ☐ Other state employee
- ☐ Natural Resource Conservation Service, Soil and Water Conservation District or Farm Service Agency employee
- ☐ Private consultant, such as a forester or wildlife biologist
- ☐ A forester from a company that produces forest products
- ☐ Logging contractor
- ☐ Employee of a non-profit group
- ☐ Other forest landowner, neighbor, or friend
- ☐ I don't remember who
- ☐ Other (please specify): _____

Questionnaire page 11

20. There are many different ways to learn about managing woodlands - what to do and how to do it.

How useful would the following ways of learning about managing your woodlands be for you?

*Mark **ONE** box for **EACH** item.*

	Very Useful 1	2	3	4	5	6	Not Useful 7	Don't Know
Publications, books, or pamphlets	☐	☐	☐	☐	☐	☐	☐	☐
Newsletters, magazines, or newspapers	☐	☐	☐	☐	☐	☐	☐	☐
Internet/Web	☐	☐	☐	☐	☐	☐	☐	☐
Conferences, workshops, or video conferences	☐	☐	☐	☐	☐	☐	☐	☐
Video tapes for home viewing	☐	☐	☐	☐	☐	☐	☐	☐
Television or radio programs	☐	☐	☐	☐	☐	☐	☐	☐
Visiting other woodlands or field trips	☐	☐	☐	☐	☐	☐	☐	☐
Talking with a forester or other natural resource professional	☐	☐	☐	☐	☐	☐	☐	☐
Talking with other woodland owners	☐	☐	☐	☐	☐	☐	☐	☐
Talking with a logging contractor	☐	☐	☐	☐	☐	☐	☐	☐
Membership in a land owner organization	☐	☐	☐	☐	☐	☐	☐	☐

Questionnaire page 12

Concerns and Issues

21. Sometimes people are not able to use their woodland as they want. Below are some issues that are affecting some people's ability to use and enjoy their woodland.

Please indicate your level of concern by *marking **ONE** box for **EACH** issue.*

	Great Concern 1	2	3	4	5	6	No Concern 7
Dealing with an endangered species	☐	☐	☐	☐	☐	☐	☐
High property taxes	☐	☐	☐	☐	☐	☐	☐
Keeping land intact for my children or other heirs	☐	☐	☐	☐	☐	☐	☐
Lawsuits	☐	☐	☐	☐	☐	☐	☐
Regulations that restrict harvests	☐	☐	☐	☐	☐	☐	☐
Development of nearby lands	☐	☐	☐	☐	☐	☐	☐
Damage or noise from motorized vehicles	☐	☐	☐	☐	☐	☐	☐
Trespassing or poaching	☐	☐	☐	☐	☐	☐	☐
People stealing my trees	☐	☐	☐	☐	☐	☐	☐
Misuse of woodland, such as vandalism or dumping	☐	☐	☐	☐	☐	☐	☐
Other (please specify):	☐	☐	☐	☐	☐	☐	☐

22. There are many things that can affect the health of woodlands. Below are issues that are affecting the health of some woodlands.

Please indicate your level of concern by *marking **ONE** box for **EACH** issue.*

	Great Concern 1	2	3	4	5	6	No Concern 7
Air and water pollution	☐	☐	☐	☐	☐	☐	☐
Undesirable plants	☐	☐	☐	☐	☐	☐	☐
Domestic animals, such as cattle	☐	☐	☐	☐	☐	☐	☐
Wild animals, such as deer	☐	☐	☐	☐	☐	☐	☐
Fire	☐	☐	☐	☐	☐	☐	☐
Insects or plant diseases	☐	☐	☐	☐	☐	☐	☐
Lack of new trees	☐	☐	☐	☐	☐	☐	☐
Wind or ice storms	☐	☐	☐	☐	☐	☐	☐
Other (please specify):	☐	☐	☐	☐	☐	☐	☐

_____

The Future of Your Woodland

23. What are your plans for your woodland in <state> in the next five (5) years?
*Check **ALL** that apply.*

☐ Leave it as is - no activity
☐ Minimum activity to maintain woodland
☐ Harvest firewood
☐ Harvest sawlogs or pulpwood
☐ Collect non-timber forest products
☐ Sell some or all of my woodland
☐ Give some or all of my woodland to my children or other heirs
☐ Divide all or part of my woodland and sell the subdivisions
☐ Buy more woodland
☐ Convert some or all of my woodland to another use
☐ Convert another land use to woodland
☐ No plans at this time
☐ I don't know
☐ Other (please specify): _____

General Questions About You

Finally we would like to ask a few questions about you. As with the rest of this questionnaire, all of your answers are strictly confidential.

If you are answering this questionnaire on behalf of an organization, please skip the "Questions About You" section and go to the last page of this questionnaire.

24. a. What is your main occupation (if retired, what was your main occupation)?

_____

_____

b. Are you retired?

☐ Yes ☐ No ☐ Semi-retired

25. What is your age?

☐ Under 25 years
☐ 25 to 34 years
☐ 35 to 44 years
☐ 45 to 54 years
☐ 55 to 64 years
☐ 65 to 74 years
☐ 75 years or over

26. What is the highest degree or level of school that you have COMPLETED?
*Check only **ONE**.* If currently enrolled, mark the previous grade or highest degree received.

☐ Less than 12th grade
☐ High school graduate or GED
☐ Some college
☐ Associate or technical degree
☐ Bachelor's degree
☐ Graduate degree

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27. What is your household's annual income?

- ☐ Less than $25,000
- ☐ $25,000 to $49,999
- ☐ $50,000 to $99,999
- ☐ $100,000 to $199,999
- ☐ $200,000 or more

28. What is your sex?

☐ Male ☐ Female

29. a. Are you Spanish/Hispanic/Latino?

- ☐ Yes, I am Spanish/Hispanic/Latino
- ☐ No, I am not Spanish/Hispanic/Latino

b. What is your race?
*Check **ALL** that apply.*

- ☐ American Indian
- ☐ Asian
- ☐ Black or African-American
- ☐ Native Hawaiian or other Pacific Islander
- ☐ White
- ☐ Other (please specify): _____

30. Do you have any of the following long-lasting conditions:

a. Blindness, deafness, or a severe vision or hearing impairment?

☐ Yes ☐ No

b. A condition that substantially limits one or more basic physical activities such as walking, climbing stairs, reaching, lifting, or carrying?

☐ Yes ☐ No

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If there are any additional comments or concerns that you would like to share, please write them below.

Thank you for participating in this survey!
Please return the questionnaire in the postage-paid envelope provided.

Inside back cover

If you would like a copy of the results of this survey, please print your name and address on the back of the return envelope and we will send the results to you.

Back cover

Comments or questions?
Please contact us:

National Woodland Owner Survey
USDA Forest Service
1992 Folwell Ave.
St. Paul, MN 55108

Toll-Free Telephone: (866) 396-6967
Fax: (651) 649-5140
Internet: www.fs.fed.us/woodlandowners

Draft

Version: **4.4**

Form No.: _____

Appendix II – National Woodland Owner Survey Cover Letters and Pre-Notice and Thank You/Reminder Postcards

Pre-notice postcard

Dear Woodland Owner:

Within the next few days you will receive a questionnaire in the mail from the National Woodland Owner Survey. You are one of only a few woodland owners who will receive it. The questionnaire is designed to give you an opportunity to let policy makers, land managers, and public and private service providers know what some of your concerns are. This information will help them better understand and address your needs.

We invite you to participate in the survey by completing the questionnaire when it arrives. Of course, your participation is voluntary and we will treat your answers as strictly confidential. If you have any questions regarding the Survey, please call us toll-free at 1-866-396-6967, visit our website at http://www.fs.fed.us/woodlandowners, or write us at National Woodland Owner Survey, USDA Forest Service, 1992 Folwell Ave, St. Paul, MN 55108.

Dale N. Bosworth, Chief

NATIONAL WOODLAND OWNER SURVEY
USDA FOREST SERVICE
1992 FOLWELL AVENUE
ST. PAUL, MN 55108

FIRST-CLASS MAIL
U.S. POSTAGE PAID
ST. PAUL, MN
PERMIT NO. 680

OFFICIAL BUSINESS

Cover letter that accompanies the first questionnaire

United States Department of Agriculture **Forest Service**

Dear Woodland Owner:

We invite you to participate in the National Woodland Owner Survey being conducted by the United States Department of Agriculture, Forest Service. Your participation in this survey will help policy makers, land managers, and public and private service providers better understand and address your needs and concerns. The results of this survey will be used to help provide services and technical assistance.

You were identified as a woodland owner from public records that indicate that you are among the approximately <insert number> owners of woodland in <insert state>. We will contact only a few of these owners. Because of the limited number of woodland owners contacted, your answers are especially important.

Your participation in this survey is voluntary. Your answers to the questions will be kept confidential and will be combined with those of others. The results will only be used to determine patterns and trends. Completing the questionnaire should take no more than about 15 minutes of your time. A postage-paid return envelope is included for you to return the completed questionnaire to us.

If you would like to receive a copy of the results from the survey, please write your name and address on the back of the envelope that you use to return the completed questionnaire.

We greatly appreciate your valuable assistance.

Dale N. Bosworth, Chief

Reminder/thank you postcard

Dear Woodland Owner:

A week ago we mailed you a questionnaire inviting you to participate in the National Woodland Owner Survey. If you have recently sent the completed questionnaire back we sincerely thank you. You may have intended to complete the questionnaire but perhaps you misplaced it or simply forget about it, so we sent this reminder. Completing the questionnaire is an opportunity for you to provide information that will be used by policy makers, land managers, and public and private service providers to better understand and address things that are important to you and other woodland owners.

We understand that your time is very valuable. However, the 15 minutes or so that it takes to complete the questionnaire will help us to develop more complete and accurate information about woodland owners. If you have any questions regarding the Survey, please call us toll-free at 1-866-396-6967, visit our website at http://www.fs.fed.us/woodlandowners , or write us at National Woodland Owner Survey, USDA Forest Service, 1992 Folwell Ave, St. Paul, MN 55108.

Dale N. Bosworth, Chief

NATIONAL WOODLAND OWNER SURVEY
USDA FOREST SERVICE
1992 FOLWELL AVENUE
ST. PAUL, MN 55108

FIRST-CLASS MAIL
U.S. POSTAGE PAID
ST. PAUL, MN
PERMIT NO. 680

OFFICIAL BUSINESS

Cover letter that accompanies the second questionnaire

United States Department of Agriculture **Forest Service**

Dear Woodland Owner:

Several weeks ago we sent you a questionnaire inviting you to participate in the National Woodland Owner Survey. You may have intended to complete the questionnaire but perhaps you misplaced it or simply forget about it. If you have recently sent the completed questionnaire back we apologize for contacting you again and sincerely thank you. But if you have not completed the questionnaire now may be a good time to do so. For your convenience we have enclosed another copy of the questionnaire with this mailing. It should take about 15 minutes to complete.

Your participation is voluntary, but because of the limited number of woodland owners included in the survey, your answers are especially important. Your answers to the questions will be kept strictly confidential, and will be combined with those of others. The results will be used by policy makers, land managers, and public and private service providers to better understand and address things that are important to you, and other woodland owners.

If you have questions regarding the Survey, please call us toll-free at 1-866-396-6967, visit our website at www.fs.fed.us/woodlandowners, or write us at National Woodland Owner Survey, USDA Forest Service, 1992 Folwell Ave, St. Paul, MN 55108.

Dale N. Bosworth, Chief

Appendix III – Statistical Estimation Examples

Example 1.—Estimation of number of family forest-land owners in Pennsylvania

The question: How many family forest-land owners are there is Pennsylvania?

The (hypothetical) data:

- Estimated area of family forest land in Pennsylvania = $\hat{A}_f$ = 10,000,000 acres
- Variance associated with this estimate = $\text{var}(\hat{A}_f)$ = 4.0 x 10^{10}
- α_i = area of forest land owned by landowner *i*
- There were 50 randomly selected sample points with the following attributes:

Point	Land Use	Owner Class	OwnerID	α_i
1	Forest	Federal	100	450,000
2	Nonforest	-	-	-
3	Forest	Family	109	15,000
4	Forest	Family	118	25
5	Nonforest	-	-	-
6	Nonforest	-	-	-
7	Nonforest	-	-	-
8	Forest	Family	110	10,000
9	Forest	Family	116	100
10	Nonforest	-	-	-
11	Nonforest	-	-	-
12	Forest	Business	105	25,000
13	Nonforest	-	-	-
14	Nonforest	-	-	-
15	Nonforest	-	-	-
16	Forest	Family	108	25,000
17	Forest	Business	106	1,500
18	Forest	Family	111	5,000
19	Forest	Family	119	10
20	Forest	Family	114	500
21	Forest	Family	113	900
22	Forest	Family	121	7
23	Forest	Family	122	3
24	Forest	Business	105	25,000
25	Nonforest	-	-	-
26	Nonforest	-	-	-
27	Nonforest	-	-	-
28	Nonforest	-	-	-
29	Forest	State	103	1,000,000
30	Forest	State	104	500,000
31	Forest	Business	107	40
32	Forest	Local	101	50
33	Forest	State	102	1,500,000
34	Forest	State	103	1,000,000
35	Forest	Family	115	400
36	Nonforest	-	-	-
37	Forest	Family	112	4,500
38	Forest	State	102	1,500,000
39	Forest	Family	117	30
40	Nonforest	-	-	-
41	Nonforest	-	-	-

Point	Land Use	Owner Class	OwnerID	α_i
42	Nonforest	-	-	-
43	Forest	Family	108	25,000
44	Forest	State	102	1,500,000
45	Forest	Family	120	10
46	Nonforest	-	-	-
47	Forest	Family	109	15,000
48	Forest	Family	108	25,000
49	Nonforest	-	-	-
50	Nonforest	-	-	-

Step 1.—Select all sample points that were forested and family-owned

Point	Land Class	Owner Class	Owner	α_i
3	Forest	Family	109	15,000
4	Forest	Family	118	25
8	Forest	Family	110	10,000
9	Forest	Family	116	100
16	Forest	Family	108	25,000
18	Forest	Family	111	5,000
19	Forest	Family	119	10
20	Forest	Family	114	500
21	Forest	Family	113	900
22	Forest	Family	121	7
23	Forest	Family	122	3
35	Forest	Family	115	400
37	Forest	Family	112	4,500
39	Forest	Family	117	30
43	Forest	Family	108	25,000
45	Forest	Family	120	10
47	Forest	Family	109	15,000
48	Forest	Family	108	25,000

Step 2.—Select all unique family forest owners—one record per owner

Owner	α_i
108	25,000
109	15,000
110	10,000
111	5,000
112	4,500
113	900
114	500
115	400
116	100
117	30
118	25
119	10
120	10
121	7
122	3

Step 3.—Calculate sample size

$n_o = 15$

Step 4.—Calculate number of owners

$$\hat{N}_d = \hat{A}_f \sum_{i=1}^{n_o} \frac{y_i}{n_o a_i} = \left(1.0 \times 10^7\right) \sum_{i=1}^{n_o} \frac{1}{n_o a_i}$$

Owner	a_i	$\frac{1}{n_o a_i}$
108	25000	0.000003
109	15000	0.000004
110	10000	0.000007
111	5000	0.000013
112	4500	0.000015
113	900	0.000074
114	500	0.000133
115	400	0.000167
116	100	0.000667
117	30	0.002222
118	25	0.002667
119	10	0.006667
120	10	0.006667
121	7	0.009524
122	3	0.022222
	Sum	0.051051

$$\hat{N}_d = \left(1.0 \times 10^7\right) 0.051051 = 510{,}510$$

Step 5.—Calculate variance the estimated number of family forest owners

$$\hat{\text{var}}(\hat{N}_d) = \hat{A}_f^2 \frac{1}{n_o(n_o - 1)} \sum_{i=1}^{n_o} \left(\frac{y_i}{a_i} - \left(\sum_{i=1}^{n_o} \frac{y_i}{n_o a_i} \right) \right)^2 + \hat{\text{var}}(\hat{A}_f) \left(\sum_{i=1}^{n_o} \frac{y_i}{n_o a_i} \right)^2$$

$$= \left(1.0 \times 10^7\right)^2 \frac{1}{15(15 - 1)} \sum_{i=1}^{n_o} \left(\frac{1}{a_i} - \left(\sum_{i=1}^{n_o} \frac{1}{n_o a_i} \right) \right)^2 + \left(4.0 \times 10^{10}\right) \left(\sum_{i=1}^{n_o} \frac{1}{n_o a_i} \right)^2$$

Owner	α_i	$\frac{1}{a_i}$	$\left[\frac{1}{a_i} - \left(\sum_{i=1}^{n_o} \frac{1}{n_o a_i} \right) \right]^2$
108	25,000	0.00004	0.00260
109	15,000	0.00007	0.00260
110	10,000	0.00010	0.00260
111	5,000	0.00020	0.00259
112	4,500	0.00022	0.00258
113	900	0.00111	0.00249
114	500	0.00200	0.00241
115	400	0.00250	0.00236

Owner	α_i	$\frac{1}{a_i}$	$\left[\frac{1}{a_i} - \left(\sum_{i=1}^{n_o} \frac{1}{n_o a_i}\right)\right]^2$
116	100	0.01000	0.00169
117	30	0.03333	0.00031
118	25	0.04000	0.00012
119	10	0.10000	0.00240
120	10	0.10000	0.00240
121	7	0.14286	0.00843
122	3	0.33333	0.07968
		Sum	0.11525

$$\sum_{i=1}^{n_o}\left(\frac{1}{a_i} - \left(\sum_{i=1}^{n_o}\frac{1}{n_o a_i}\right)\right)^2 = \sum_{i=1}^{n_o}\left(\frac{1}{a_i} - 0.051051\right)^2 = 0.11525$$

$$\left(\sum_{i=1}^{n_o}\frac{1}{n_o a_i}\right)^2 = (0.05105)^2 = 0.00261$$

$$\hat{\text{var}}(\hat{N}_d) = \left(1.0\times10^7\right)^2 \frac{1}{15(15-1)}(0.11525) + \left(4.0\times10^{10}\right)0.00261$$

$$= 5.488\times10^{10} + 1.042\times10^8 = 5.498\times10^{10}$$

$$se\left(\hat{N}_d\right) = \sqrt{\hat{\text{var}}\left(\hat{N}_d\right)} = 234,488$$

The (hypothetical) answer: There were an estimated 510,510 family forest owners in Pennsylvania. The variance associated with this estimate was 5.498 x 10^{10} or a standard error of 234,488.

Example 2.—Estimation of number of family forest-land owners in Pennsylvania who had written forest management plans

The question: How many family forest-land owners in Pennsylvania had written forest management plans?

The (hypothetical) data:

- Estimated area of family forest land in Pennsylvania = $\hat{A}_f$ = 10,000,000 acres
- Variance associated with this estimate = $\text{var}(\hat{A}_f)$ = 4.0 x 10^{10}
- α_i = area of forest land owned by landowner i
- y_i = 1 if forest-land owner i had a written forest management plan and 0 otherwise
- There were 18 randomly selected sample points on family forest land with the following attributes (this a subset of the full complement of sample points listed in example 1):

Point	Land Class	Owner Class	Owner	α_i	y_i
3	Forest	Family	109	15,000	1
4	Forest	Family	118	25	0
8	Forest	Family	110	10,000	1
9	Forest	Family	116	100	0
16	Forest	Family	108	25,000	1
18	Forest	Family	111	5,000	1

19	Forest	Family	119	10	0
20	Forest	Family	114	500	0
21	Forest	Family	113	900	1
22	Forest	Family	121	7	0
23	Forest	Family	122	3	0
35	Forest	Family	115	400	0
37	Forest	Family	112	4,500	0
39	Forest	Family	117	30	1
43	Forest	Family	108	25,000	1
45	Forest	Family	120	10	0
47	Forest	Family	109	15,000	1
48	Forest	Family	108	25,000	1

Step 1.—Select unique owners – one record per owner

Owner	α_i	y_i
108	25,000	1
109	15,000	1
110	10,000	1
111	5,000	1
112	4,500	0
113	900	1
114	500	0
115	400	0
116	100	0
117	30	1
118	25	0
119	10	0
120	10	0
121	7	0
122	3	0

Step 2.—Calculate sample size

$n_o = 15$

Step 3—Calculate number of owners

$$\hat{N}_d = \hat{A}_f \sum_{i=1}^{n_o} \frac{y_i}{n_o a_i} = \left(1.0 \times 10^7\right) \sum_{i=1}^{n_o} \frac{y_i}{n_o a_i}$$

Owner	α_i	y_i	$\frac{y_i}{n_o a_i}$
108	25,000	1	0.000003
109	15000	1	0.000004
110	10000	1	0.000007
111	5000	1	0.000013
112	4500	0	0.000000
113	900	1	0.000074
114	500	0	0.000000
115	400	0	0.000000
116	100	0	0.000000

Owner	α_i	y_i	$\frac{y_i}{n_o a_i}$
117	30	1	0.002222
118	25	0	0.000000
119	10	0	0.000000
120	10	0	0.000000
121	7	0	0.000000
122	3	0	0.000000
		Sum	0.002327

$$\hat{N}_d = \left(1.0\times10^7\right)0.00232 = 23,235$$

Step 4.—Calculate variance the estimated number of family forest owners with written forest management plans

$$\hat{\text{var}}(\hat{N}_d) = \hat{A}_f^{\,2}\frac{1}{n_o(n_o-1)}\sum_{i=1}^{n_o}\left(\frac{y_i}{a_i}-\left(\sum_{i=1}^{n_o}\frac{y_i}{n_o a_i}\right)\right)^2 + \hat{\text{var}}(\hat{A}_f)\left(\sum_{i=1}^{n_o}\frac{y_i}{n_o a_i}\right)^2$$

$$= \left(1.0\times10^7\right)^2\frac{1}{15(15-1)}\sum_{i=1}^{n_o}\left(\frac{y_i}{a_i}-\left(\sum_{i=1}^{n_o}\frac{y_i}{n_o a_i}\right)\right)^2 + \left(4.0\times10^{10}\right)\left(\sum_{i=1}^{n_o}\frac{y_i}{n_o a_i}\right)^2$$

Owner	α_i	y_i	$\frac{y_i}{a_i}$	$\left[\frac{y_i}{a_i}-\left(\sum_{i=1}^{n_o}\frac{y_i}{n_o a_i}\right)\right]^2$
108	25,000	1	0.00004	0.00001
109	15000	1	0.00007	0.00001
110	10000	1	0.00010	0.00000
111	5000	1	0.00020	0.00000
112	4500	0	0.00000	0.00001
113	900	1	0.00111	0.00000
114	500	0	0.00000	0.00001
115	400	0	0.00000	0.00001
116	100	0	0.00000	0.00001
117	30	1	0.03333	0.00096
118	25	0	0.00000	0.00001
119	10	0	0.00000	0.00001
120	10	0	0.00000	0.00001
121	7	0	0.00000	0.00001
122	3	0	0.00000	0.00001
		Sum	Sum	0.00103

$$\sum_{i=1}^{n_o}\left(\frac{y_i}{a_i}-\left(\sum_{i=1}^{n_o}\frac{y_i}{n_o a_i}\right)\right)^2 = \sum_{i=1}^{n_o}\left(\frac{y_i}{a_i}-0.00232\right)^2 = 0.0010$$

$$\left(\sum_{i=1}^{n_o}\frac{y_i}{n_o a_i}\right)^2 = (0.00232)^2 = 5.3982\times10^{-6}$$

$$\hat{\text{var}}(\hat{N}_d) = 1.0\times10^{7}\,\frac{1}{15(15-1)}0.0010 + \left(4.0\times10^{10}\right)\left(5.3982\times10^{-6}\right) = 4.9137\times10^{8}$$

$$se\left(\hat{N}_d\right) = \sqrt{\hat{\text{var}}\left(\hat{N}_d\right)} = 22{,}167$$

The (hypothetical) answer: There were an estimated 23,235 family forest owners in Pennsylvania. The variance associated with this estimate was 4.9137 x 10^8 or a standard error of 22,167.

Example 3.—Estimation of area of family forest land in Pennsylvania owned by people who had written forest management plans

The question: How many acres of family forest are there in Pennsylvania were owned by people with written forest management plans?

The (hypothetical) data:

- Estimated area of family forest land in Pennsylvania = $\hat{A}_f$ = 10,000,000 acres
- Variance associated with this estimate = $\text{var}(\hat{A}_f)$ = 4.0 x 10^{10}
- α_i = area of forest land owned by landowner i
- y_i = 1 if forest-land owner i has a written forest management plan and 0 otherwise
- There were 18 randomly selected sample points on family forest land with the following attributes (this a subset of the full complement of sample points listed in example 1):

Point	Land Class	Owner Class	Owner ID	α_i	y_i
3	Forest	Family	109	15,000	1
4	Forest	Family	118	25	0
8	Forest	Family	110	10,000	1
9	Forest	Family	116	100	0
16	Forest	Family	108	25,000	1
18	Forest	Family	111	5,000	1
19	Forest	Family	119	10	0
20	Forest	Family	114	500	0
21	Forest	Family	113	900	1
22	Forest	Family	121	7	0
23	Forest	Family	122	3	0
35	Forest	Family	115	400	0
37	Forest	Family	112	4,500	0
39	Forest	Family	117	30	1
43	Forest	Family	108	25,000	1
45	Forest	Family	120	10	0
47	Forest	Family	109	15,000	1
48	Forest	Family	108	25,000	1

Step 1.—Calculate sample size

n_a = 18

Step 2.—Calculate area

$$\hat{A}_d = \hat{A}_f \, \hat{p}_d$$

$$\hat{p}_d = \frac{1}{n_a} \sum_{i=1}^{n_a} y_i = \frac{1}{18} \sum_{i=1}^{n_a} y_i = \frac{1}{18} 9 = 0.5$$

$$\hat{A}_d = \left(1.0 \times 10^7\right) 0.5 = 5.0 \times 10^6$$

Step 4.—Calculate variance

$$s^2(\hat{p}_d) = \frac{n_a}{n_a - 1} \hat{p}_d (1 - \hat{p}_d) = \frac{18}{18 - 1} 0.5(1 - 0.5) = 0.26471$$

$$\hat{\text{var}}\left(\hat{A}_d\right) = A_f^2 \left(\frac{s^2\left(\hat{p}_d\right)}{n_a} \right) + \hat{\text{var}}(\hat{A}_f)\left(\hat{p}_d\right)^2$$

$$= \left(1.0 \times 10^7\right)^2 \left(\frac{0.26471}{18} \right) + \left(4.0 \times 10^{10}\right)(0.5)^2$$

$$= \left(1.4706 \times 10^{12}\right) + \left(1.0 \times 10^{10}\right) = 1.4806 \times 10^{12}$$

$$se\left(\hat{A}_d\right) = \sqrt{\hat{\text{var}}\left(\hat{A}_d\right)} = 1,216,794$$

The (hypothetical) answer: An estimated 5 million acres of family forest land in Pennsylvania are owned by people with written forest management plans. The variance associated with this estimate is 1.4806 x 10^{12} or a standard error of 1,216,794.

Appendix IV — Members of the NWOS Steering Committee

Member	Affiliation
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Appendix V — Members of the NWOS Technical Committee

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The National Woodland Owner Survey (NWOS) is conducted by the USDA Forest Service, Forest Inventory and Analysis program to increase our understanding of private forest-land owners in the United States. The information is intended to help policy makers, resource managers, and others interested in the forest resources of the United States better understand the social context of forests and formulate more informed opinions and decisions. Every year, a different set of approximately 6,500 private forest-land owners from across the country were asked to participate in the NWOS. This document describes the design, implementation, and processing of data for the NWOS from 2002 through 2006. For updates to this report and additional information visit: www.fs.fed.us/woodlandowners.

Keywords: Forest Inventory and Analysis; landowner survey; forest-land owners

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