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Family Forest Ownerships of the United States, 2018: Results from the USDA Forest Service, National Woodland Owner Survey

A Technical Document Supporting the USDA Forest Service 2020 RPA Assessment

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Abstract

The National Woodland Owner Survey (NWOS) is conducted by the U.S. Department of Agriculture Forest Service, Forest Inventory and Analysis program, in order to collect information on the attitudes, behaviors, and other characteristics of America's private forest ownerships. This report provides documentation and results from the 2017-2018 iteration of the NWOS, which is referenced by the terminal year, 2018. The particular focus of the results in this report is family forest ownerships with 10+ acres of forest land; other groups of forest ownerships will be the focus of separate reports. A brief history and background of the NWOS are provided along with a synopsis of the survey implementation and estimation procedures. Selected results are presented and full sets of summary tables, by geography and four domains of interest, are provided in the accompanying supplemental materials (appendix 1). The geographies include states, regions, and the nation with summary tables provided where minimum sample sizes were obtained. The domains of interest used in the supplemental summary tables are family forest ownerships with holding sizes of 1+, 10+, 100+, and 1,000+ acres of forest land. Each set of summary tables includes information on forest area by ownership category, survey cooperation rates, and summaries of the responses to questions asked on the survey. The report concludes with a discussion of data interpretation, data limitations, and how to compare results with previous iterations of the NWOS.

Family forest ownerships control 39 percent of the forest land in the United States, excluding interior Alaska. An estimated 93 percent of the family forest land is in holdings of 10 or more acres of forest land, but an estimated 62 percent of the family forest ownerships have holdings between 1 and 9 acres of forest land. The results highlighted in this report are for family forest ownerships with 10+ acres of forest land at the national level. This group includes an estimated 3.7 million ownerships who collectively own 253 million acres of forest land; 34 percent of the U.S. forest land, excluding interior Alaska. The most common reasons for owning family forests are "To enjoy beauty or scenery," "To protect or improve wildlife habitat," "To protect nature or biological diversity," and "For privacy." Forest management practices are occurring on many family forests, but written management plans, receiving professional advice in the previous 5 years, and participating in assistance programs are relatively uncommon. Family forest owners' most common concerns include "High property taxes," "Keeping land intact for future generations," and "Trespassing or poaching." In terms of demographics, a large percentage of the primary decision-makers are older, white males.

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INTRODUCTION

The National Woodland Owner Survey (NWOS) is implemented by the U.S. Department of Agriculture (USDA) Forest Service's Forest Inventory and Analysis (FIA) program in order to provide information on: who owns America's forests, why they own them, what they have done with them in the past, and what they plan to do with them in the future. The FIA program has three major components: the plot-based forest inventory (www.fia.fs.fed.us); the Timber Products Output Survey (www.fia.fs.fed.us/program-features/tpo); and the NWOS (www.fia.fs.fed.us/nwos). Collectively, these three components provide a comprehensive view of the nation's forests in terms of biophysical as well as economic and social dimensions. The legislative authority for FIA, including the NWOS, is provided in the Forest and Rangeland Renewable Resources Research Act of 1978 (PL 95-307 § 3) and the Agricultural Research, Extension, and Education Reform Act of 1998 (PL 105-185 § 253).

The NWOS currently has three components: base (or rural), large corporate, and urban. Additional components (e.g., tribal and islands) are planned for the future (Table 1). This report provides results from the base NWOS and, in particular, results for families, individuals, trusts, estates, and family partnerships that own forest land, collectively referred to as family forest ownerships (see below for a fuller definition). Data collection for this iteration of the NWOS was conducted in 2017 and 2018 and is referred to by its terminal date, 2018. Summary tables are provided in appendix 1 of this report for family forest ownerships at the state, regional, and national levels for ownerships with 1 or more acres (1+), 10 or more acres (10+), 100 or more acres (100+), and 1,000 or more acres (1000+) of forest land, as sample sizes allow. In addition to providing these tables, this report provides a brief background of the NWOS, summaries of survey implementation and estimation procedures, a presentation of selected findings, and guidance on interpreting the results. The results presented in this report focus on family forest ownerships with 10+ acres of forest land at the national level. Additional information, including results from previous iterations of the base NWOS and other NWOS components, is available on the NWOS website: www.fia.fs.fed.us/nwos.

History of the NWOS

The USDA Forest Service has been providing information on America's private forest ownerships for over 60 years (Figure 1). The first, national-level statistics on private forest ownerships in the United States were provided by Josephson and McGuire (1958). They reported on the distribution of forest land

Table 1.—Current and potential future components of the National Woodland Owner Survey program

Component	Target population	Status/notes
Base/rural	Private forest ownerships in U.S. states, excluding large corporate forest ownerships	Fully implemented. The focus of this report.
Large corporate	Corporate forest ownerships with at least 45,000 acres of forest land in U.S. states	Pilot test completed
Urban	Private, residential landowners within Census defined urban areas in U.S. states	Implemented in selected cities across the United States
Islands	Private forest ownerships in U.S. affiliated protectorates and territories	Pilot testing initiated
Tribal	Tribal and other forest ownerships within Federally recognized Tribal reservation boundaries	Potential future component

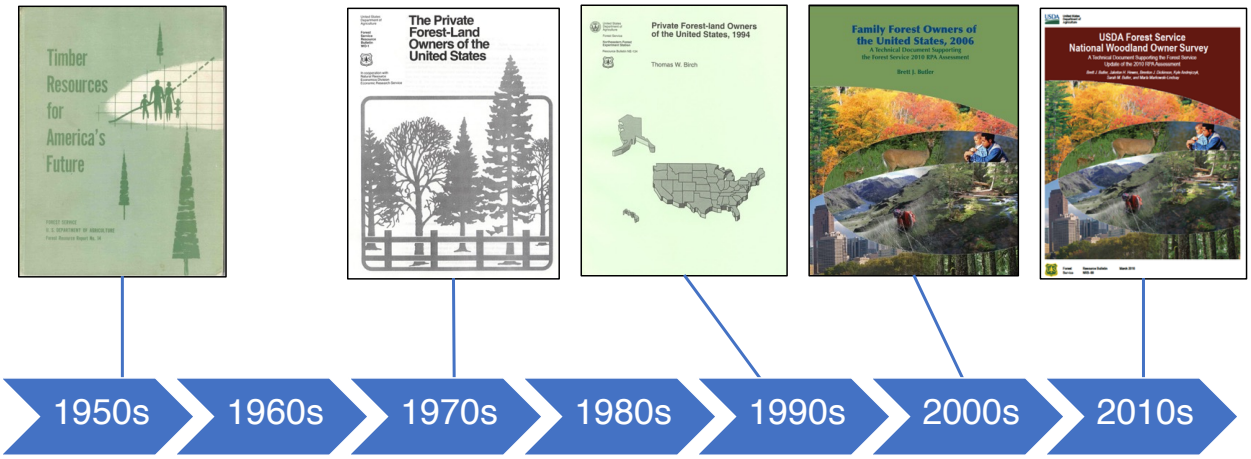


Figure 1.—Timeline of major reports associated with the USDA Forest Service, National Woodland Owner Survey, 1958–2016.

by ownership category and information on size of forest holdings, stand size distributions, and forest productivity with special attention given to farmers and industrial owners. The next national report was based on data collected in 1978 (Birch et al. 1982). As an adjunct to a landowner survey being conducted by the USDA Economic Research Service, the Birch et al. report provided limited information including summaries of size of forest holdings, general information about the ownership (e.g., legal structure, land tenure, acquisition source), and owner demographics. In 1993, the first national survey was conducted by the USDA Forest Service, FIA program (Birch 1996c). It included information on size of forest holdings, land tenure, ownership objectives, management practices, and demographics. This was the first report to provide state-level results for the entire nation (Birch 1996a, 1996b, 1997). Subsequent national-level surveys were completed in 2006 (Butler 2008), 2013 (Butler et al. 2016), and, as reported here, 2018. The content of the 2006, 2013, and 2018 iterations built on the content of the 1993 NWOS, but went into greater depth regarding ownership characteristics, ownership history, uses of the forest land, forest management, participation in programs and policies, recreation activities, sources of information, and demographics. The sampling methodology, questions asked, and estimation procedures used limit comparisons to results of earlier iterations of the NWOS. The questions and methods have been largely standardized since the 2006 iteration.

Population of Interest: Family Forest Ownerships

Although the NWOS covers all private forest ownerships, this report focuses on family forest ownerships with 10+ acres of forest land as was the focus of Butler et al. (2016). In total (including ownerships with 1+ acres of forest land), there are an estimated 9.6 million family forest ownerships in the United States[1] that collectively control 272 million acres of forest land. Ownerships with 10+ acres of forest land represent 38 percent of these ownerships and 93 percent of these acres. Ownerships with 1 to 9 acres of forest land tend to have holdings that are challenging to manage using traditional forestry approaches and often do not qualify for forestry assistance programs; this group will be the focus of a separate report, as was previously done (Butler and Snyder 2017).

As a part of the FIA program, the NWOS adheres to the USDA Forest Service definitions of forest land and family ownerships. Forest land is defined as "land that has at least 10 percent crown cover by live

[1] Results in this report exclude interior Alaska, due to sampling limitations.

tally trees of any size or has had at least 10 percent canopy cover of live tally species in the past, based on the presence of stumps, snags, or other evidence. To qualify, the area must be at least 1.0 acre in size and 120.0 feet wide" (USDA Forest Service 2016). Additional details on the forest land definition are available in the FIA glossary (USDA Forest Service 2016) and the FIA field manual (USDA Forest Service 2019). Some other reports, such as the "Forest Resources of the United States, 2017" (Oswalt et al. 2019), have adopted a forest land definition defined by the United Nations, Food and Agriculture Organization (2012) and consequently acreage values may differ. See Oswalt et al. (2019) for a discussion of specific differences.

The term family ownership is shorthand for the FIA ownership category defined as "Individual and family, including trusts, estates, and family partnerships" (Burrill et al. 2018, USDA Forest Service 2019). Combining the two definitions, a family forest ownership is a family, individual, trust, estate, or family partnerships that owns at least 1 acre of land with tree cover of at least 10 percent, and the land is not used for other purposes, such as lawn, that would impede natural processes.

The terms forest land and woodland are used interchangeably within the NWOS program; the specific term selected depends on the audience. The term "forest land" is used when speaking predominantly to technical experts, such as the target audience of this report. The terms "wooded land" or "woodland" is used when talking with landowners as, based on previous research (Andrejczyk et al. 2016), these terms better correspond to most landowners' perceptions of the technical definition of forest land. The 2018 NWOS questionnaire (appendix 2) uses the term wooded land and provides a lay version of the technical definition.

SURVEY PROCESS

All components of the NWOS go through the same five steps: needs assessment, design/testing, implementation, estimation, and products/results (Figure 2), with the research cycle repeated for each subsequent iteration. These steps provide the basic outline for this report.

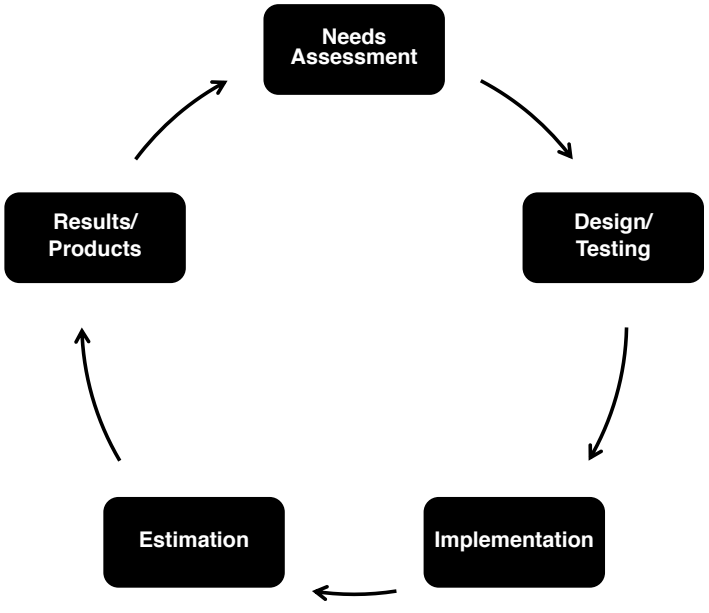


Figure 2.—The design, implementation, and estimation research cycle of the National Woodland Owner Survey.

NEEDS ASSESSMENT

The needs assessment, or scoping, for the 2018 NWOS started with a review of the authorizing legislation and all other high level guidance. As with the larger FIA program, the authorization and general guidance comes from the Forest and Rangeland Renewable Resources Research Act of 1978 (PL 95-307 § 3) and the Agricultural Research, Extension, and Education Reform Act of 1998 (PL 105-185 § 253). Additional guidance for the NWOS comes from periodic Blue Ribbon panels, stakeholder meetings, and other feedback from data users.

As with all federally sponsored surveys, the NWOS is subject to the Paperwork Reduction Act (PL 96-511). This entails: providing the documentation for the justification, methods, and burden placed on the public, along with a list of the questions to be asked; review of the materials by experts; and, ultimately, review by the Office of Management Budget (OMB). In addition, the NWOS is classified as "Influential Scientific Information" and adheres to the relevant review and dissemination procedures.

The 2018 NWOS was implemented by the Family Forest Research Center (www.familyforestresearchcenter.org), a joint venture between the Northern Research Station of the USDA Forest Service and the University of Massachusetts Amherst (UMass), Department of Environmental Conservation. This arrangement means that the NWOS is also subject to the UMass Human Subjects protocols, including review by the UMass Internal Review Board (IRB; www.umass.edu/research/compliance/human-subjects-irb). The IRB reviews the survey methods and questions being asked with a focus on ensuring that people are not being coerced to participate and there are no threats to human welfare.

The needs assessments are timed to coincide with the NWOS 5-year data collection cycles (see Sampling), i.e., the needs, scope, methods, and products are thoroughly reviewed every 5 years. This helps to ensure consistency within each cycle/iteration. In assessing the needs, one focus has been on consistency of questions asked and implementation methods across iterations to maximize comparability and facilitate analyses of changes over time.

DESIGN AND TESTING

The survey methods and questionnaire content were direct results of the needs assessments. The questionnaire content from previous surveys was modified to adapt to new topics (e.g., carbon markets) and adjusted to improve how data were collected. That being said, the methods and questionnaire were kept as constant as feasible to maximize comparability across iterations.

Survey methods and questions were based on existing scientific literature and were thoroughly tested before implementation. Testing of questions involved two stages: pretesting and pilot testing. Pretesting involved cognitive interviews (Willis 2005) conducted with landowners to ensure the questions are understandable, there are no missing items, and the target concepts match with the respondents' conceptions (e.g., what does it mean to a landowner to own land "to enjoy beauty or scenery"?). In addition, more detailed information on the responses (e.g., details on what was involved in specific activities) was also captured. Cognitive interviews were conducted until no new information is captured, a total of 11 interviews with randomly selected forest owners were conducted, and the instrument was deemed reliable. For the 2018 NWOS, the cognitive interviews showed no substantial issues. The biggest issues were related to skip patterns (i.e., a respondent being asked to skip a sub-part of a question given their response to a previous part of the question), and questions were adjusted accordingly.

After the questionnaire was finalized, we conducted a pilot test consisting of a full implementation (see Implementation section) involving approximately 100 private forest ownerships. This allowed for

verification of implementation methods and examination of how owners were responding. There was some additional indication of errors associated with skip patterns. All questions with skip patterns were further assessed and skip patterns were removed or modified where feasible. Otherwise, the pilot testing showed the implementation methods were working as designed.

IMPLEMENTATION

The NWOS implementation can be divided into the following steps: sampling, land owner contact, data entry, and logic checks, which then facilitate the generation of estimates (Figure 3). This section provides an overview of each step. Additional information is available in Butler and Caputo (in press) and Butler et al. (in review).

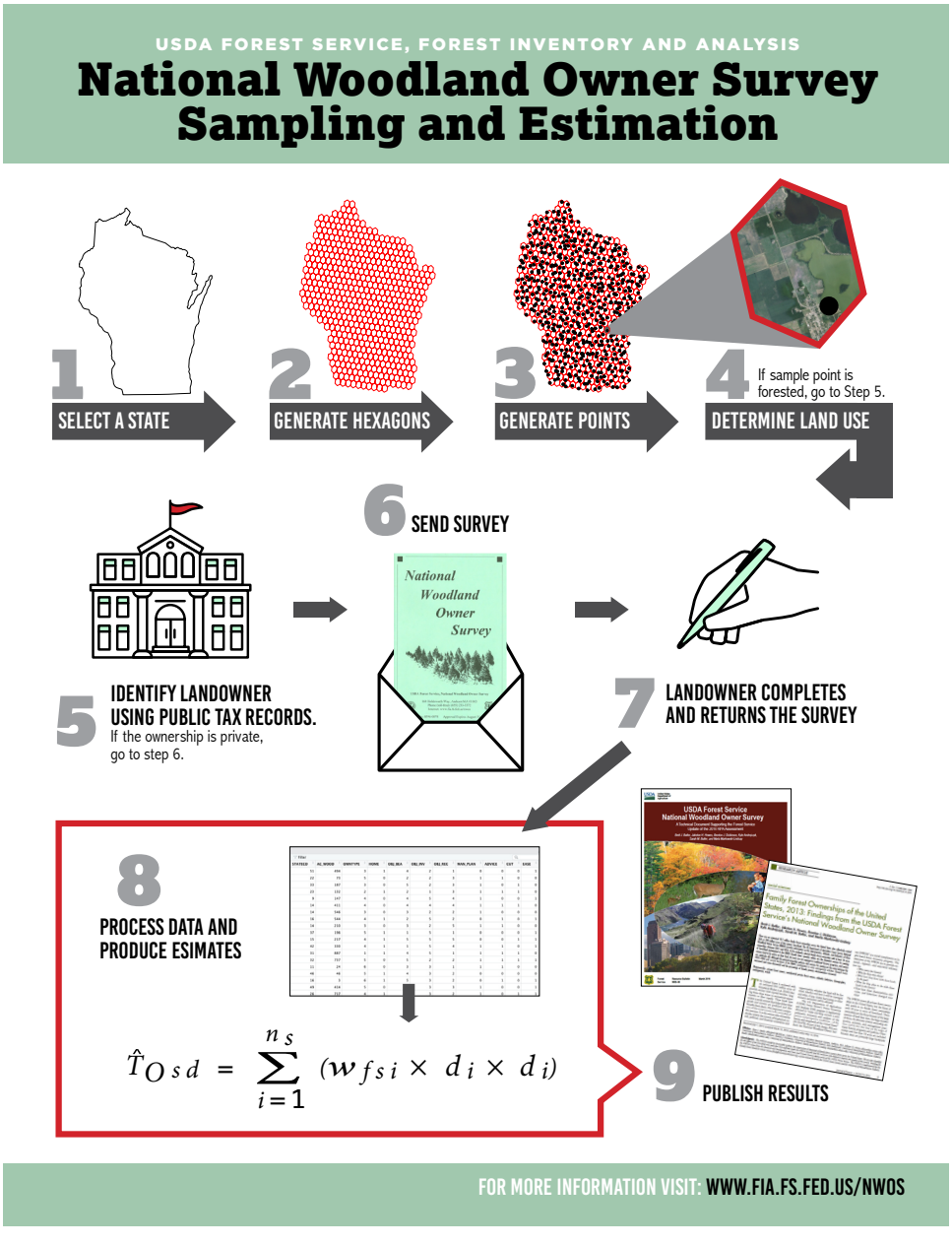


Figure 3.—Steps involved in the sampling and estimation for the National Woodland Owner Survey.

Sampling

The first step in the implementing the 2018 NWOS was to generate the sample, i.e., the list of landowners who were contacted. The NWOS sample design is a derivative of the FIA sample design (Bechtold and Patterson 2005) and can be summarized as an area-based sample design with inclusion probabilities proportional to size of holdings. The initial sample is drawn from the FIA plots and the sample is subsequently augmented to reach the target sample sizes. All sampling is done on a state-by-state basis.[2] The basic FIA sampling protocol involves: dividing a state into hexagons of approximately 6,000 acres; randomly locating a sample point in each hexagon; using remote sensing and previous inventory information to identify potentially forested sample points; obtaining land ownership information from property tax records or other sources; and finally, where permission is granted, visiting the potentially forested points to determine land use and, if forested, collecting the inventory data. Non-forest points are part of the sample and are not replaced.

The NWOS augmentation largely followed these same steps except high-resolution aerial photography was used to make the land use determination and no site visits were performed. The field-visited, base FIA points were used as training sets for the photo interpreters. Augmentation occurs by repeating the basic sampling procedure with a decreased hexagon size, with these smaller hexagons nested within the base hexagons in a fully tessellated manner. The size of the hexagons for augmentation were a function of the target sample sizes. FIA base sample points were intersected with the augmented hexagons and new, augmentation points were randomly located in "empty" hexagons. The family forest ownerships identified through the base FIA points and augmentation process formed the sample for the NWOS results presented in this report.

The target number of respondents for the 2018 NWOS was 250 family forest ownerships per state. This number was based on examination of coefficients of variation for estimates of total acreage and numbers of family forest ownerships, coupled with desired error rates and logistical and financial constraints (Butler and Caputo, in press). The coefficients of variation reach the desired error rates at around 250 respondents, but they substantially stabilized once a sample size of 100 was reached, especially for estimates of family forest ownerships with 10+ acres of forest land. This is similar to the findings of Stanovick et al. (2002). Consequently, tables are published for states and regions that reach the threshold of 100 respondents for specified domains of interest.

Given that not all ownerships contacted will respond, more than 250 ownerships need to be contacted in order to reach the target number of respondents. The target number of contacts was equal to the target number of respondents divided by the expected response rate based on previous iterations of the NWOS. For example, if the response rate was 40 percent, then 625 ownerships would need to be contacted to obtain 250 respondents (250 / 0.4 = 625).

The target cycle length for the NWOS is 5 years, i.e., a full data collection cycle is completed every 5 years and associated results are published. The 2018 NWOS was implemented over 2 years, 2017 and 2018. Subsequent iterations of the NWOS will be implemented on an annual basis with 20 percent of the sample respondents, randomly distributed across each state, asked to participate each year. To minimize burden on owners, no ownership will be asked to respond more than once per 5-year cycle for each state in which they own forest land, regardless of the number of sample points on their land in a state in a given cycle.

[2] Following the precedent of the FIA forest inventory, Alaska, Oklahoma, and Texas are divided into sub-state areas, each of which, for sampling and estimation purposes, is treated as a separate state.

Landowner Contacts

The 2018 NWOS used the Tailored Designed Method (Dillman et al. 2014) for implementing the survey. This involved up to four waves of contacts for each potential respondent: a pre-notice postcard, a first questionnaire packet, a reminder/thank you postcard, and a second questionnaire packet. The basic timing for each wave was as follows:

> **Day 1:** The pre-notice postcard was mailed. This postcard let potential respondents know that a survey would soon be arriving and provided some basic background information.
>
> **Day 7:** The first questionnaire packet was mailed. This packet contained the questionnaire along with a cover letter explaining the purpose of the survey and the importance of their response, and a postage-paid envelope to return the completed survey.
>
> **Day 12:** The third mailing, a thank you/reminder postcard, was sent.
>
> **Day 28:** The final mailing was a replacement questionnaire packet which included a second survey, a return envelope, a modified cover letter, and an insert indicating the survey could be completed online and that a Spanish language version was available.

A toll-free phone number, postal address, email address, and the URL for the NWOS website was included in each mailing. Copies of the postcards and cover letters are provided in appendix 3 of this report.

Ownerships that did not respond to the mailings were put into the nonresponse pool. If a phone number was available, the USDA National Agricultural Statistics Service (with whom we contracted) attempted to collect a subset of the information via telephone interviews. As many nonrespondents as possible were contacted within the budget constraints. A post-hoc power analysis indicated approximately 1,000 completed nonresponse interviews would be sufficient to evaluate nonresponse biases and this number was reached (see below). Results from these interviews were only used for nonresponse assessment purposes, they were not used for generating population estimates.

Data Entry and Verification

Once surveys were returned, they were logged into a database. Questionnaires were then scanned and data were extracted using optical character/mark recognition software. All data were subsequently verified by a person to ensure the responses were recorded correctly. The data were then uploaded to a database.

Quality control checks were performed on a randomly selected 20 percent of the questionnaires. All responses on each selected questionnaire were compared to the database records. These checks indicated a verifier error rate of less than 0.1 percent, most of which were minor errors associated with the typing-in of open response answers. Where identified, the errors were corrected.

Range and Logic Checks

The next step was to run the data through a series of range and logic check procedures. First, all open-ended questions including "Other (please specify)" fields were manually inspected to identify if responses provided additional information that allowed filling in of skipped questions or adjusting of the raw responses in non-skipped questions. For example, a respondent may have not answered a question about harvesting timber but may have provided the same information in a text or comment field, allowing us to correct the omission. This procedure resulted in changes to 0.2 percent of the questions.

Next, data were checked for errors associated with value ranges, skip-patterns, and between-question inconsistencies. Range errors resulted from response values being outside logical bounds and were

most commonly associated with inaccurate scanning of handwriting in open response answers. Skip-pattern errors resulted from a respondent answering questions they should have skipped, based on their answers to root questions or not answering questions they should have. Between-question errors arose when a respondent's answer to one question was not logically consistent with the answer to another question. Where possible, errors were fixed based on reviews of the questionnaires for potential errors associated with handwriting and consideration of responses to other questions. Errors which could not be unambiguously resolved were handled by setting the ambiguous values to null (i.e., item nonresponse). The range and logic error rate (the percentage of questions that generated one or more errors) was 0.9 percent.

ESTIMATION

Estimating population totals and other population-level parameters associated with the 2018 NWOS involved analyzing item and unit nonresponse patterns, adjusting for unit nonresponse, imputing missing items, generating weights, and calculating the population-level estimates and associated variances (Figure 4). The estimates were generated in terms of acreages and ownerships. The inputs used to generate estimates included the sample data, survey data, land area per state, and FIA forest inventory based estimates of forest area by ownership category. Data were stored in a database as described in Caputo and Butler (2021).

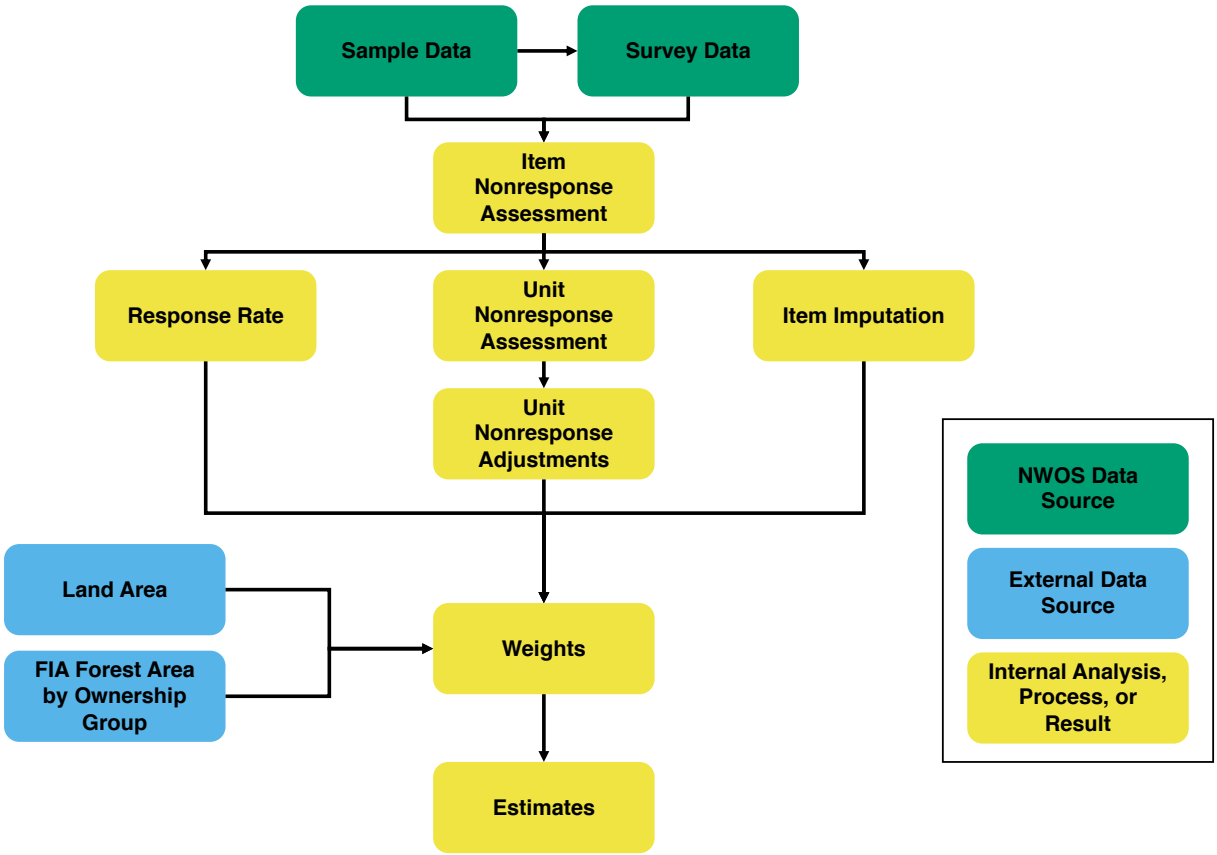


Figure 4.—Data sources and steps associated with generating population estimates for the National Woodland Owner Survey.

Item Nonresponse Assessment

Missingness is an issue that is confronted in virtually all surveys. Missingness can be analyzed at the unit level (i.e., a person who received a survey fails to respond at all), the respondent level (i.e., the respondent only completes a subset of the questions), or the question level (i.e., the percentage of valid responses to a specific question). Depending on the reasons for nonresponse, the missingness can lead to biases in estimates. Unit nonresponse is addressed in a later section of this report. This section addresses respondent and question missingness which are specific types of item missingness. The item nonresponse assessment, in addition to looking at patterns of item nonresponse, was used to set the level of completeness needed to include a response in the analysis and not be classified as unit nonresponse.

Question missingness is the percentage of the qualifying respondents who did not answer a specific question. Qualifying respondents were those who saw a specific question and were not instructed to skip it due to answers to earlier questions in the questionnaire. Respondent missingness is the percentage of qualifying questions not answered for each respondent. Qualifying questions were those that were seen by respondents and were not skipped due to answers to previous questions.

There were 22 "check group" questions on the 2018 NWOS questionnaire where respondents were asked to "check all that apply" and the responses were recorded as separate binary variables in the database. To avoid overcounting these questions/variables in the missingness assessment, each check bank question was collapsed to a single variable indicating whether they checked one or more of the options, including "none of the above," or failed to check any option (i.e., item nonresponse). After collapsing these variables, there were a total of 98 questions or variables.

The one question requiring a response on the 2018 NWOS was acres of woodland owned (`AC_WOOD`[3]). This variable was deemed required because it was used directly in the estimation weights (see Weights) and the conservative approach of not imputing this key variable was taken. A total of 453 returned questionnaires (4 percent) were missing this variable, were recoded as unit nonresponse, and were dropped from subsequent analyses.

To balance the number of responses retained and the amount of data imputed, a response missingness threshold must be selected. Response missingness ranged from 0 to 98 percent with a mean of 7 percent (median = 3 percent) (Figure 5). Looking to maximize the number of responses retained and minimize the amount of data imputed, a threshold of 25 percent was selected; records with missingness of greater than this percentage were recoded as "Nonresponse - excessive missingness" and dropped from further analyses. This resulted in the removal of 498 records (5 percent) due to excessive missingness.

Excluding size of forest holdings (`AC_WOOD`), which had no missing values because it was a required variable, question missingness ranged from less than 1 percent to 94 percent with an average of 6 percent (median = 3 percent) (Figure 6). Two questions, "Concern – other" (`CNC_OTH`) and "Reason for owning – other" (`OBJ_OTH`), had missingness values of greater than 75 percent. These questions were intended to capture issues not listed in the concerns and reasons for owning lists and to be assessed in a qualitative manner. The missingness associated with them supports not generating quantitative summary statistics for these variables and these variables were excluded from the summary tables.

Three additional questions, "NTFP – reason (check group)" (`NTFP_WHY_CG`), "Management plan - implementation" (`MAN_PLAN_IMPLEMENT`), and "Management plan - writer" (`MAN_PLAN_WRITER`), had missingness values greater than 10 percent (Figure 6). These variables were retained in the summary

[3] A monospace font is used to help differentiate database variable names and other computer related terms. Variable names are indicated in the annotated questionnaire (`NWOS_6_0_ANNOTATED.pdf` included in appendix 2) and the metadata for the NWOS database (Caputo and Butler 2021).

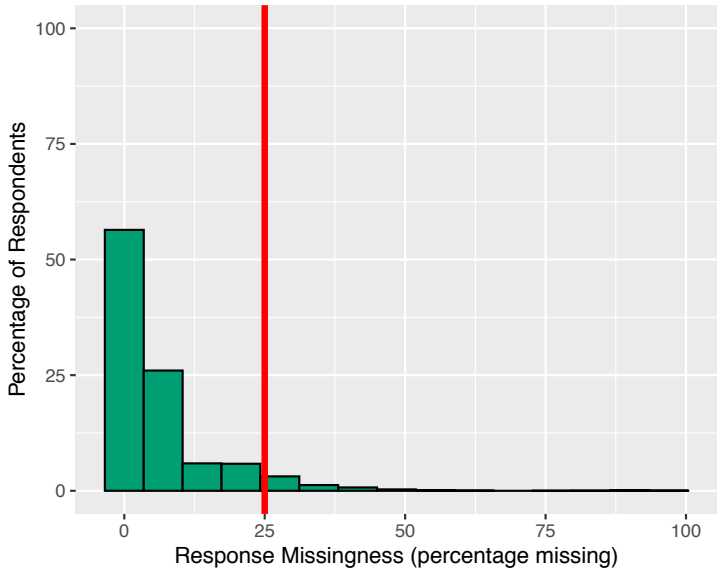


Figure 5.—Response missingness for the 2018 National Woodland Owner Survey. The red vertical line represents 25 percent missingness, the threshold used to identify responses with excessive missingness.

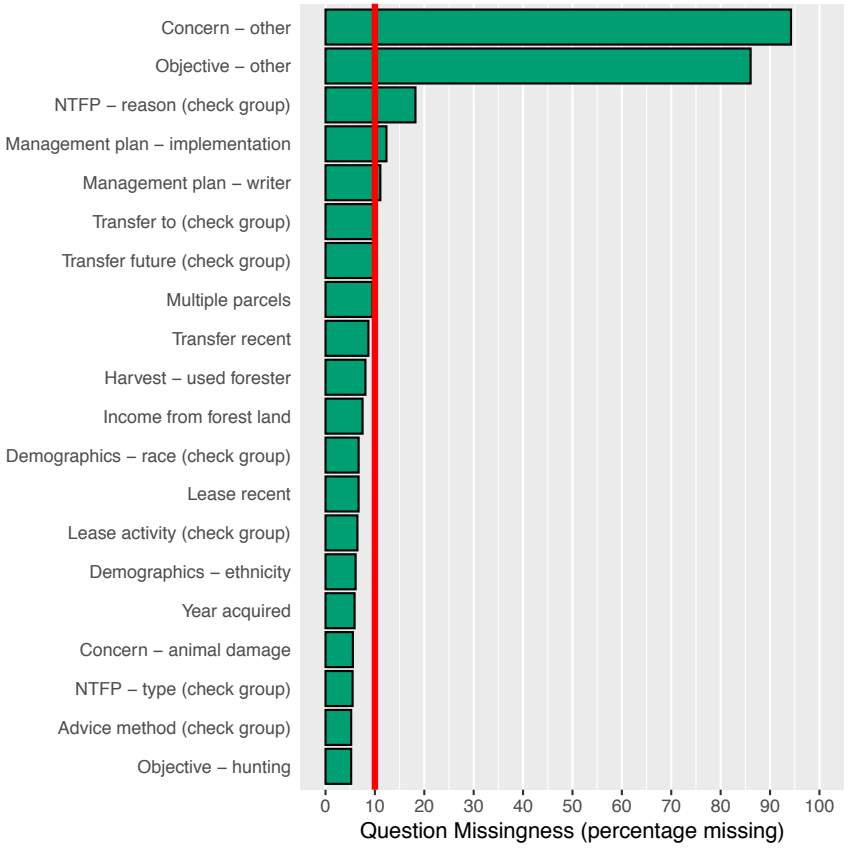


Figure 6.—Question missingness rates for the 2018 National Woodland Owner Survey. Only the 20 of the 98 questions with missingness of at least 5 percent are shown. The red vertical line represents 10 percent missingness. "Check groups" denotes questions where respondents were asked to check one or more items; for nonresponse purposes, all of the responses for a given question were collapsed into a single variable.

tables, but this missingness should be considered in interpreting the results. All of these variables were associated with skip patterns. Although skip patterns were dramatically reduced between the 2013 and 2018 iterations of the NWOS, further reductions may be warranted.

After the item nonresponse assessment, a final check of the raw data was done to ensure that the entire sample was accounted for, i.e., all ownerships were attributed to one, and only one, stratum and all were linked to a single, valid (i.e., sufficiently complete) survey or else attributed with the appropriate nonresponse code. In the rare circumstances where multiple questionnaires were returned by the same ownership, the first returned questionnaire was retained. In addition to completeness, some surveys were invalidated because the reported acreage was determined to be implausible given the number of sample points associated with the ownership (e.g., 10 acres of forest land and three sample points), which was likely due to sample frame issues.

Cooperation Rate

For the 2018 NWOS, there were a total of 35,123 family forest ownerships in the sample (Table US-2 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). Of this sample, 11,130 had no or insufficient ownership/address information; most of these were associated with augmented sample points with holes, which appeared to be largely random, in the data source layer used to identify ownerships. Of the remaining 23,993 sample points, 9,518 were sufficiently complete responses (i.e., missingness ≤ 25 percent), 1,153 were partial responses (which were subsequently dropped), and 13,322 were nonresponses. This yields a cooperation rate of 40 percent (9,518 / 23,993). The cooperation rates varied substantially across the United States ranging from over 60 percent in Alaska, North Dakota, Nevada, and South Dakota to less than 30 percent in Connecticut, Hawaii, and Nebraska (Figure 7).

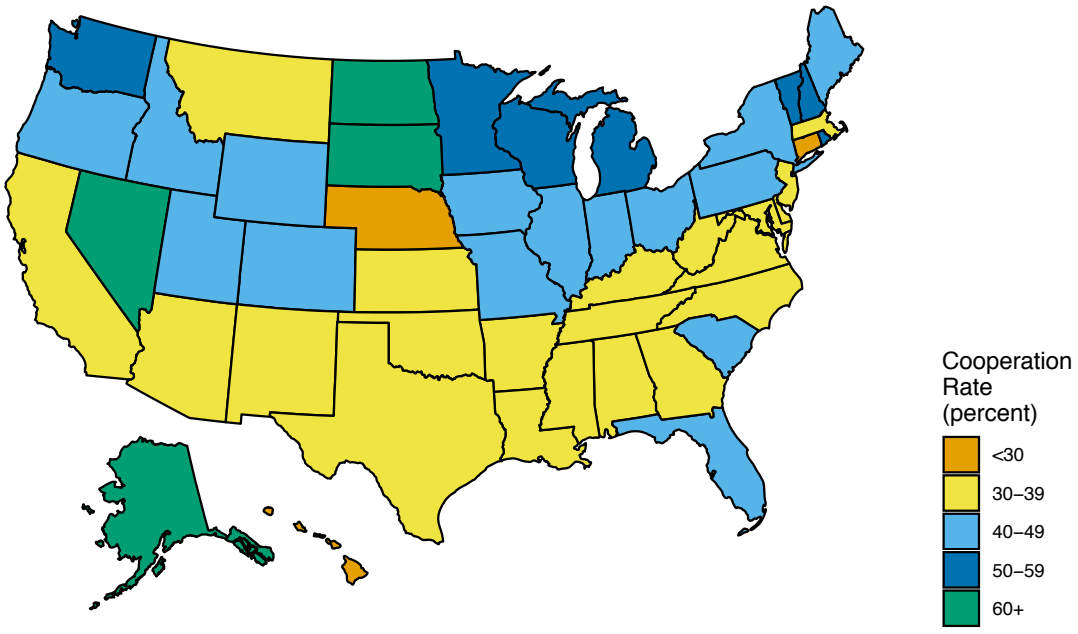


Figure 7.—Family forest ownership cooperation rates for the 2018 National Woodland Owner Survey.

Item Imputation

Imputing missing values is a common technique used for many surveys and is fast becoming a standard. This was used for the first time with the NWOS for the 2018 iteration. Missing values were imputed using multivariate imputation by chained equations (mice). This approach builds separate models for each variable and then uses these models to predict missing values (van Buuren 2018). The specific modeling method selected was random forests (Breiman 2001), an approach that can be used for numeric and categorical variables, has few statistical assumptions, and is a robust predictor. Five imputations were generated, a number that van Buuren (2018) and Rubin (1987) suggest is sufficient for datasets that have relatively low missingness and the missingness patterns do not create issues with convergence of the imputation models. These assumptions are true for the 2018 NWOS. The number of imputations also needs to be weighed against the additional data processing time. Imputation was implemented using the mice package in the R statistical environment (van Buuren and Groothuis-Oudshoorn 2011).

On average, 4 percent (median = 3 percent) of the values for a given variable were imputed. This ranged from 0 percent for size of forest holdings (`AC_WOOD`) to over 10 percent for "NTFP – reason (check group)" (`NTFP_WHY_CG`), "Management plan - implementation" (`MAN_PLAN_IMPLEMENT`), and "Management plan - writer" (`MAN_PLAN_WRITER`).

The goodness-of-fit of the imputation results can be assessed using "convergence" plots and by comparing observed to imputed values (van Buuren 2018). Convergence plots show the means and standard deviations for the imputed values by iteration; patterns of convergence across iterations suggest problems with the imputation models. Based on the convergence plots for the 2018 NWOS (see appendix 4, `NWOS_IMPUTATION_CONVERGENCE_PLOTS.pdf`), the imputation models behaved well. Comparing the imputed values to the observed values for numeric (Figure 8) and categorical variables (Figure 9), the imputation results appear to behave satisfactorily. The categorical variables shown in Figure 9 were selected to represent variables from each section of the questionnaire; the imputed values for the variables not displayed showed comparable patterns. The imputed values represent the median values and outliers reasonably well. There is a tendency for some imputed variables to be biased towards the median (or modal) values of the observed data. This is a common issue with many models of categorical variables and is the preferable direction of a bias for imputed values.

The procedure for logic checking imputed values was similar to that done on the observed data described above, with a few key differences. The primary difference being that if an error was detected between an imputed and observed variable, the value for the observed value always took precedence and the imputed value was changed accordingly. Errors that could not be resolved unambiguously were addressed by setting values to the modal or mean value for that variable, i.e., imputation to the mode/mean. The error rate for imputed values was 0.3 percent.

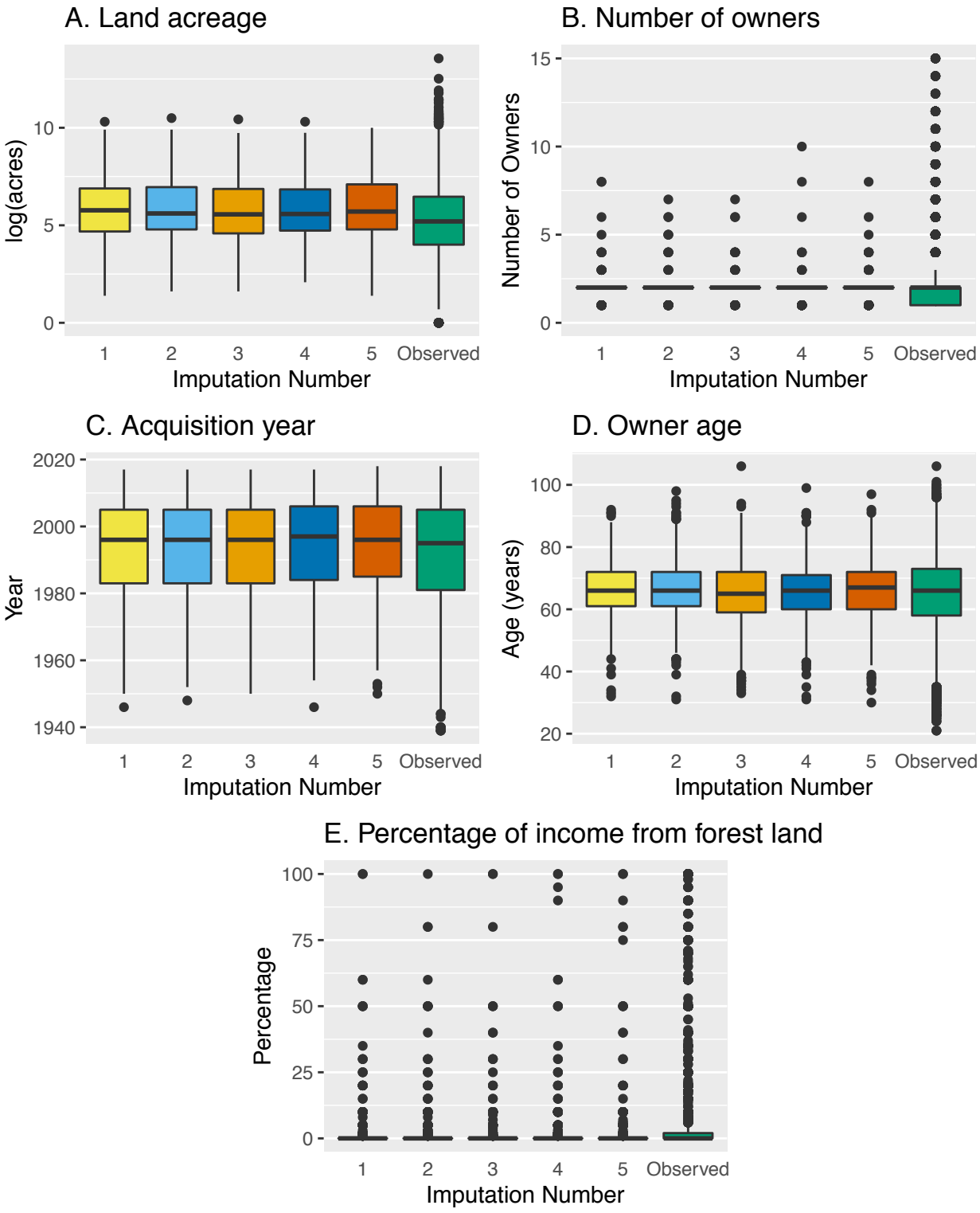


Figure 8.—Comparisons of five iterations of imputed values and observed values for numerical variables for the 2018 National Woodland Owner Survey.

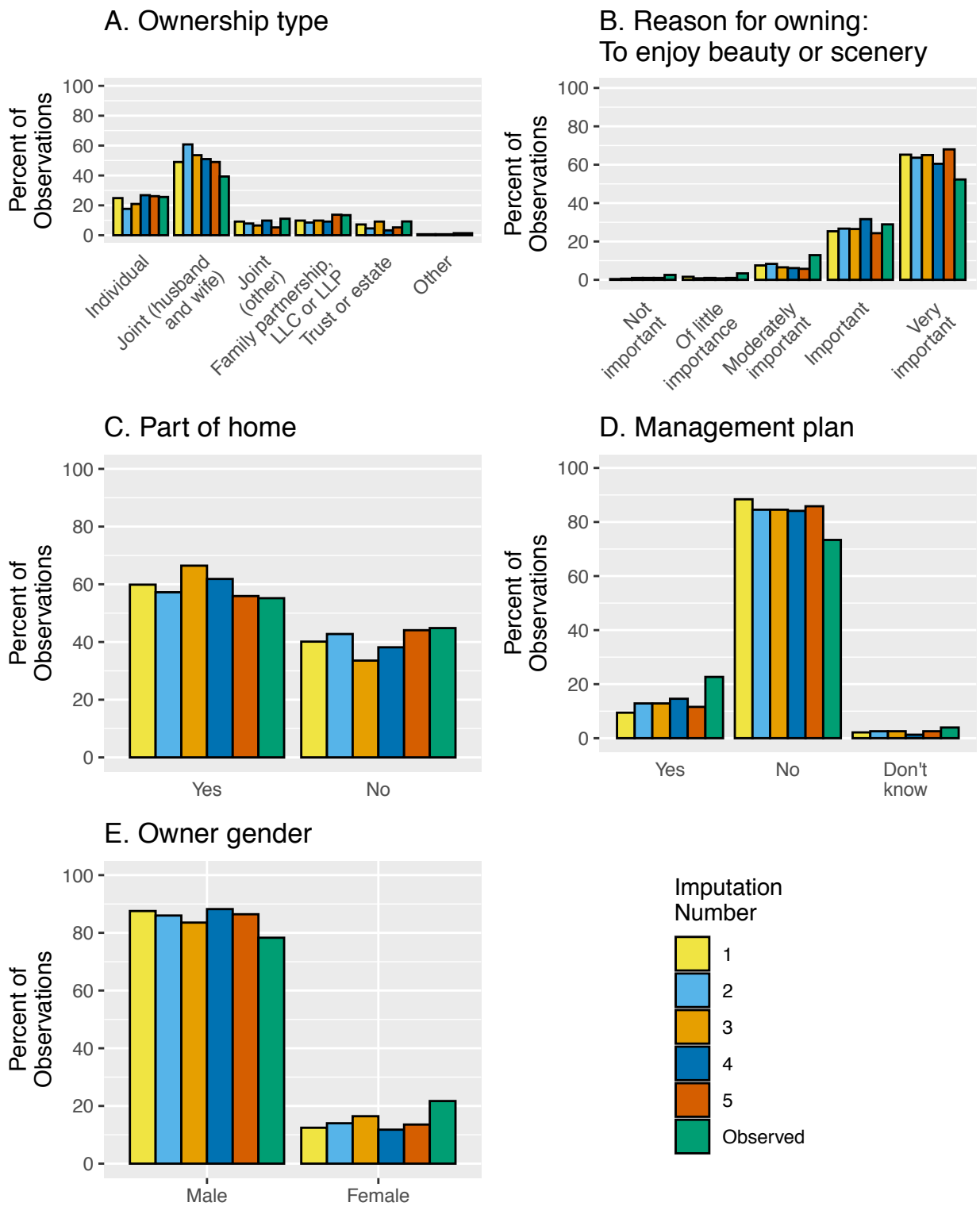


Figure 9.—Comparisons of five iterations of imputed values and observed values for selected categorical variables for the 2018 National Woodland Owner Survey.

Unit Nonresponse Assessment

Unit nonresponse was assessed using two approaches: comparing mail versus telephone respondents and comparing values for auxiliary data between respondents and nonrespondents. The ancillary data, being tied to all sample points, can be used to adjust weights (see Weights).

Telephone nonresponse assessment

Telephone calls were made to nonrespondents who were asked to answer a subset of the survey questions; 1,048 interviews were completed. The telephone responses were compared to the mail responses, with imputed values being dropped. Online surveys were excluded from the comparisons due to their low sample size (n = 207). There were 125 variables that were gathered in both the phone and mail surveys; this count includes each item from check bank questions as a separate item. Variables were compared using chi-squared and Mann-Whitney U tests for categorical and continuous variables, respectively. Likert-scale questions were condensed into binary variables, with the top two categories (e.g., "Very important" and "Important") recoded as 1 and other categories (e.g., "Moderately important", "Of little importance", "Not important", and "Not applicable") recoded as 0. To control for multiple comparisons, the method proposed by Holm (1979) was used to adjust p-values, with a base (uncorrected) threshold of used as the cutoff for significance. Effect sizes were calculated using Cohen's *d* (Cohen 2009).

Of the 125 variables tested, 76 (61 percent) did not significantly differ (p-value > 0.05) between the mail and telephone respondents (appendix 4, `TELEPHONE_NONRESPONSE_SUMMARY.pdf`). Of the 48 variables that did significantly differ, 14 differed with a negligible effect size ($|d| < 0.2$), 13 differed with a small effect size ($0.2 \leq |d| < 0.5$), 2 differed with a medium effect size ($0.5 \leq |d| < 0.8$), and no variables differed with a large effect size ($|d| \geq 0.8$). Effect size could not be determined for two questions: owner education and ownership type. The 2018 NWOS appears to capture a representative sample of landowners in most regards, with nonrespondents being slightly less active on their land and less sure of future plans.

Unit nonresponse assessment

Propensity scoring (Brick 2013), based on state-level random forests models (Buskirk and Kolenikov 2015), was used to predict response propensities and these values were in turn used to adjust weights. The predictor variables in the model were: data origin, Census tract-level population density (U.S. Census Bureau 2010), ecoregion (Bailey 2016), and parcel size (Core Logic, Inc. 2019). All four variables were measured at the sample point and, if an ownership had more than one sample point, the values were aggregated using the mean, mode, or total (sum) for population density, ecoregion, and parcel size, respectively. Data origin was a binary variable indicating whether an ownership had at least one sample point that was part of the FIA plot-based, forest inventory or whether all associated sample points were part of the augmented sample.

The relative importance of the predictor variables and the Tjur goodness-of-fit statistic (Tjur 2009) for each model are included in appendix 4 (`UNIT_NONRESPONSE_MODEL_RESULTS.pdf`). The relative importance of variables varied by state, but in general, origin was the most important predictor variable followed by the other three variables, which were approximately equal in importance. For the six states where the Tjur statistic for the response propensity model was less than 0.01, all respondents in the stratum were assigned a unit nonresponse adjustment of 1.0, i.e., no adjustments were made.

The probability of each ownership responding was predicted using the relevant state-level model. The inverse of the response probabilities were calculated and normalized so the total acreage in a stratum did not change. The normalized, inverse response probabilities (unit nonresponse adjustments) were used to adjust the weights as described below.

Weights

To produce population-level estimates, the sample design needs to be incorporated into the estimators; to mitigate potential nonresponse biases, appropriate adjustments need to be applied. The 2018 NWOS estimation approach followed the weighting methodology outlined by Valiant et al. (2013). Details on the approaches are provided in Butler and Caputo (in press), but an overview is provided here. In addition, a package for the R statistical environment used to generate the weights and estimates is available (Butler and Caputo 2019).

The NWOS uses an area-based sample design that results in inclusion probabilities that are proportional to size of forest holdings, i.e., the greater the acreage owned, the greater the probability of being selected. Weights were calculated separately for each state and stratum (e.g., family forest); subscripts for state and stratum are dropped below to simplify notation. The inclusion probability for a family forest ownership is equal to the area of forest land owned in a state divided by the sampling intensity, which is the area of family forest land in the state divided by the number of sample points in the stratum (Eq. 1). The design-based weight is the inverse of the inclusion probability multiplied by the number of sample points owned (Eq. 2). For the point estimates, the area of family forest land was set to the FIA forest inventory estimates to harmonize estimates across the FIA program. Both sets of estimates are valid, but the plot-based, forest inventory estimates are published more frequently and are tied to other forest resource estimates.

$$\pi_i = \frac{a_i}{A_F/n_F} = \frac{a_i n_F}{A_F} \quad [1]$$

$$\omega_i' = \frac{1}{\pi_i} p_i \quad [2]$$

Where

π_i = selection probability for family forest ownership *i*,
a_i = area of forest land owned by family forest ownership *i*,
$A_F = \frac{n_F}{n} \times A$= area of family forest land,
A = land area in state,
n_F = number of family forest ownership sample points,
n = total number of sample points in state,
ω_i' = design-based weight for family forest ownership *i*, and
p_i = number of sample points family forest owned by ownership *i*.

To account for response rates and potential nonresponse biases, the weights were adjusted by multiplying the design-based weights by the inverse of the response rate (Eq. 3) and unit nonresponse adjustments (Eq. 4). The adjusted weights were then multiplied by the sum of the design-base weights divided by the sum of the adjust weights (Eq. 5) so that the area totals did not change.

$$\omega_i'' = \omega_i' \times \frac{1}{RR} \quad [3]$$

$$\omega_i''' = \omega_i'' \times nr\_adj_i \quad [4]$$

$$\omega_i = \omega_i''' \times \frac{\sum(\omega_i' \times a_i)}{\sum(\omega_i''' \times a_i)} \quad [5]$$

Where

ω_i'' = response rate adjusted weight for family forest ownership *i*,
RR = response rate,
ω_i''' = nonresponse adjusted weight for family forest ownership *i*,
nr_adj_i = nonresponse adjustment for family forest ownership *i*,
ω_i = final weight for family forest ownership *i*, and
other variables are defined as above.

Estimates

Estimates were generated for totals and proportions, in terms of both acreages and ownerships, for all questions asked on the NWOS questionnaire. Means and medians were calculated for continuous variables in terms of ownerships (e.g., the mean size of forest holding per ownership). Total number of owners was also calculated. All estimates used the weights described above to account for the sample design and adjust, as necessary, for nonresponse biases. Totals were the products of the weights and binary variables which indicated whether respondents were in the domain of interest (e.g., 10+ acres of forest land) and provided the relevant response to the question of interest (e.g., "Had a written forest management plan") (Eq. 6). To generate acreage estimates, the area of forest land owned by each ownership was incorporated into Equation 6 (Eq. 7). Other statistics, such as means, were estimated using variants of the total equations as described in Butler and Caputo (in press). In addition to the point estimates, variances need to be calculated in order to quantify the reliability of the estimates. Variance estimation followed the bootstrapping approach outlined by Efron and Tibshirani (1986) based on 1,000 replicates; details are provided in Butler and Caputo (in press). Point and variance estimates were combined across the multiple imputations using the rules outlined in van Buuren (2018) and Rubin (1987).

$$\hat{T}_O = \sum \omega_i d_i y_i \quad [6]$$

$$\hat{T}_A = \sum \omega_i d_i y_i a_i \quad [7]$$

Where

$\hat{T}_O$ = total number of family forest ownerships in the domain of interest for the given attribute,
$\hat{T}_A$ = total area family forest land in the domain of interest for the given attribute,
d_i = binary variable indicating inclusion of ownership *i* in domain of the interest,
y_i = binary variable indicating the presence of a specific attribute for ownership *i*, ownership *i*, and other variables are defined as above.

Product

The core products from the 2018 NWOS will eventually iclude brief summaries, a tool for custom data retrievals and data visualization, documentation, and summary tables, all of which will be available via the NWOS website: www.fia.fs.fed.us/nwos. The core summary tables are included in the appendix 1 accompanying this report. For these tables the population of interest is family forest ownerships. National, regional, and subregional summary tables are provided for four domains of interest: family forest ownership with 1+, 10+, 100+, and 1,000+ acres of forest land. States included in each region and subregion were based on the Renewable Resource Planning Act Assessment (RPA) regions and subregions (Oswalt et al. 2019) with the exception, due to the relative distribution of private forests, that the RPA Rocky Mountain and Pacific Coast regions are combined into one region, the West, with subregions being Rocky Mountain and Pacific Coast for the NWOS reporting. The states included in each region and subregion are listed at the beginning of each set of regional/subregional NWOS tables and are displayed in Figure 10. Data for interior Alaska are missing from the national summary tables and relevant regional and subregional tables due to an inadequate sampling frame for that part of the state.

State-level summary tables are provided for family forest ownerships for two domains of interest: 10+ and 100+ acres of forest land, as sample sizes allow (Figure 11). State-level sample sizes in the 1+ and 1,000+ acres of forest land categories were too small to provide reliable state-level estimates.

Each set of summary tables consists of 30 tables. The first table in each set provides a summary of the estimated area of forest land by ownership category for the geography of interest; these forest area estimates are derived from the FIA plot-based forest inventory. The second table provides a summary of the 2018 NWOS cooperation rates and sample sizes for family forest ownerships in the geography of interest; these numbers are for all family forest ownerships (i.e., 1+ acres of forest land) regardless of domain interest because size of forest holdings is not known for nonrespondents and hence cooperation rates can only be calculated for the full stratum. The third table provides estimates of the total acreage, total number of ownerships, and sample size for the specific geography, stratum, and domain of interest. Summary tables 4 through 30 provide results of the questions asked on the 2018 NWOS for the specific geography, stratum, and domain of interest; statistics in these tables are provided in terms of total acres, total ownerships, percentage of acres, and percentage of ownerships along with sample sizes (i.e., number of respondents). Accompanying each total and percentage estimate is an estimate of the associated standard error, which provides an indication of the reliability of each value. Where applicable, summaries of continuous variables (e.g., means and medians) are included in table footnotes.

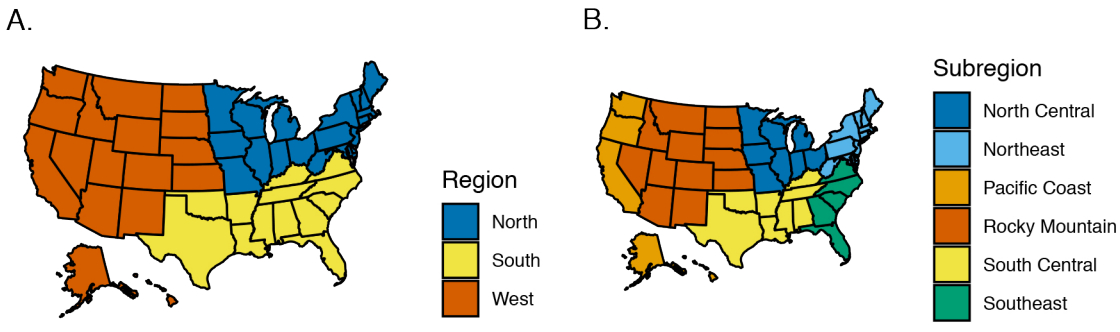
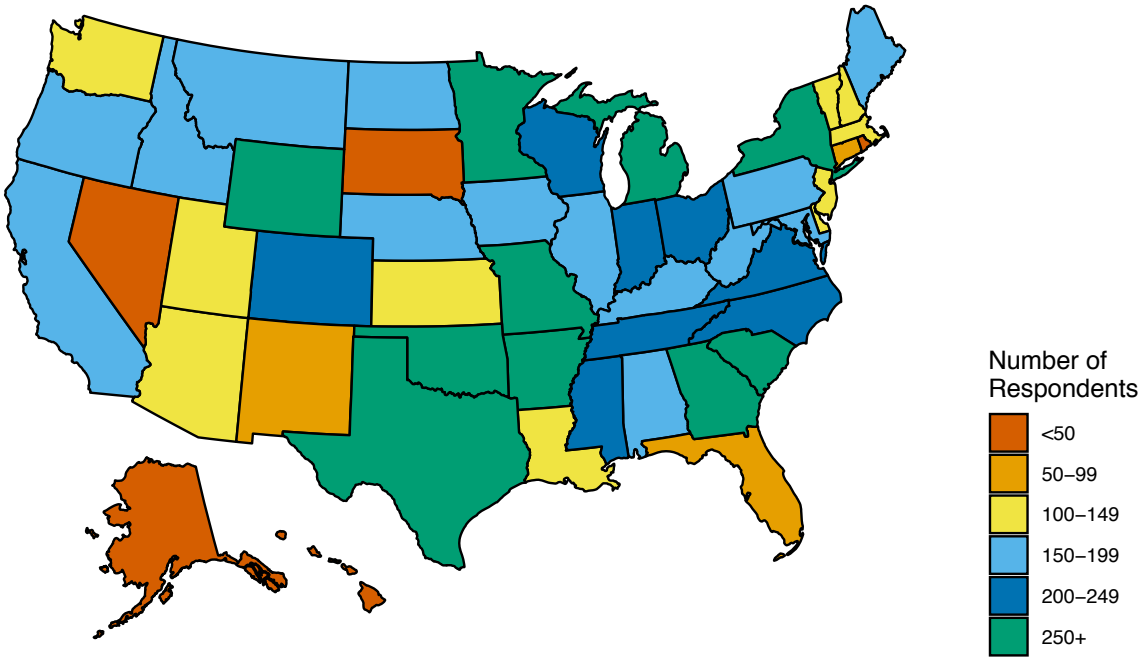


Figure 10.—Regions (A) and subregions (B) used for reporting for the 2018 National Woodland Owner Survey.

A.



B.

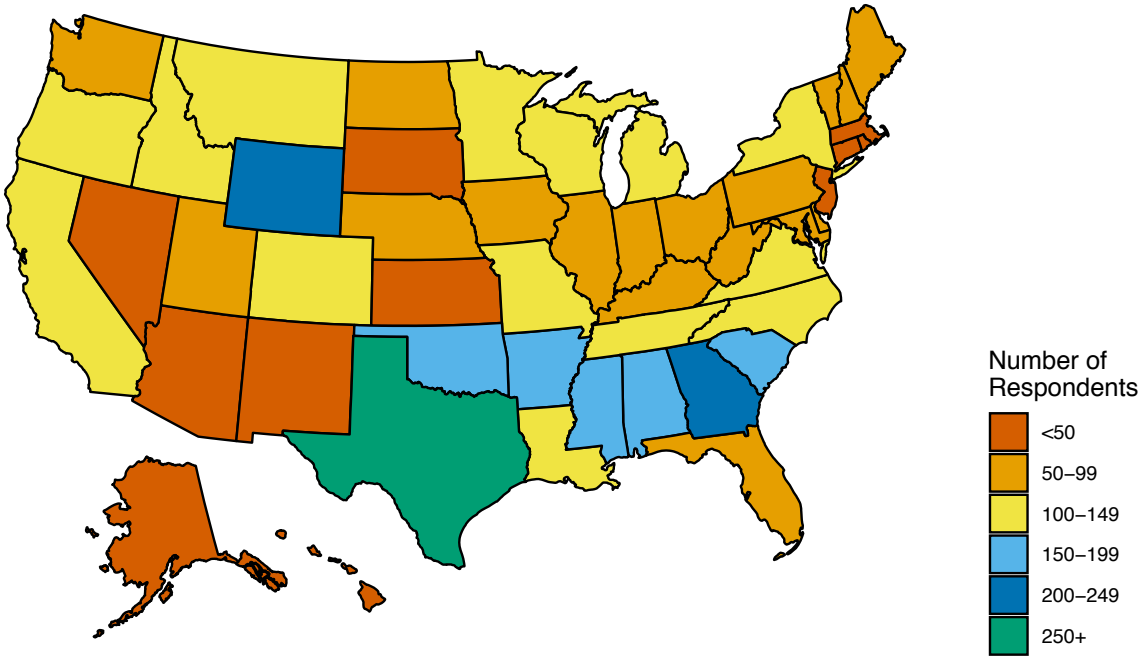


Figure 11.—Number of family forest ownership respondents with (A) 10+ and (B) 100+ acres of forest land for the USDA Forest Service, National Woodland Owner Survey, 2018.

RESULTS

This section provides selected national-level results from the 2018 NWOS. Unless noted otherwise, these results are for family forest ownerships with 10+ acres (`TENPLUS`) of forest land. These results are based on responses from 8,639 family forest ownerships with 10+ acres of forest land in U.S. states (excluding interior Alaska) (Table US-3 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). The NWOS sample design is incorporated to provide estimates in terms of acres and ownerships, totals and proportions, and associated sampling errors. The overall cooperation rate was 40 percent (Table US-2 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`) and there were no large nonresponse biases detected (see Unit Nonresponse Assessment). State-level cooperation rates and sample sizes are provided in Table 3 (page 40).

Forest Ownership Distribution

One of the most basic statistics about forests is area by ownership category (see Sidebar 1 for definitions). Private ownerships control 60 percent of the forest land in the United States, excluding interior Alaska (Table US-1 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). Of this private acreage, there are an estimated 272 million acres of family forest land. This family forest acreage accounts for 39 percent of forest land in the United States, a higher percentage than any other ownership category (Figure 12). State-level forest areas by ownership category are summarized in Table 4 (page 42).

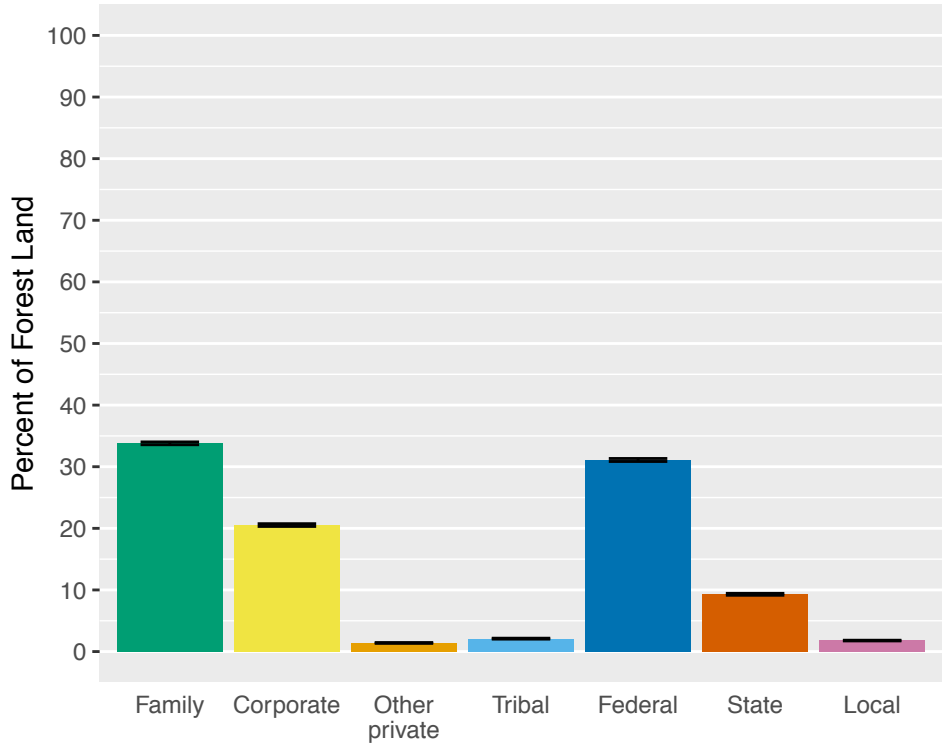


Figure 12.—Percentage of forest land by ownership category, United States, 2018. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE]).

Category	Definition	Example	FIA database values (OWNCD; Burrill et al. 2018).
Family	Individuals, families, trusts, estates, and family partnerships	Mr. and Mrs. Smith	45
Corporate	Private corporations, including Native Corporations in Alaska and private universities	Weyerhaeuser	41
Other private	Non-governmental conservation/ natural resources organizations and unincorporated partnerships, associations, and clubs	The Nature Conservancy	42, 43
Tribal	Native American and other ownerships within reservation boundaries	Navajo Nation	44
Federal	National Forests, Grasslands, Prairies, and other Forest Service, National Parks, Bureau of Land Management, Fish and Wildlife Service Refuges, Department of Defense, Department of Energy, and other Federal	USDA Forest Service	11, 12, 13, 21, 22, 23, 24, 25
State	State, including state public universities	Wisconsin Department of Natural Resources	31
Local	County, municipal, and other local, including water authorities, and other non-Federal public	St. Louis County	32, 33

Sidebar 1.—Definitions and examples of ownership categories adapted from USDA Forest Service, FIA definitions (USDA Forest Service 2019).

Family forest land is not evenly distributed across the United States (Figure 13). While private ownerships, and in particular family forest ownerships, dominate much of the eastern United States, public forest ownerships, and in particular federal ownerships, dominate much of the West. The area of family forest land ranges from less than 1 million acres in Hawaii, Rhode Island, Nevada, Delaware, North Dakota, South Dakota, New Jersey, Wyoming, and Connecticut to over 10 million acres in Texas, Georgia, Alabama, Mississippi, Missouri, North Carolina, and New York (Figure 14A). In percentage terms, family forest land ranges from less than 10 percent in Nevada, Alaska, Idaho, Arizona, Wyoming, Utah, and Hawaii to over 70 percent in Kansas, Iowa, Nebraska, Illinois, Missouri, Indiana, and Kentucky (Figure 14B).

Size of Forest Holdings

The size of family forest holdings ranges from 1 acre (the minimum acreage according to the FIA definition of forest land) to many thousands of acres. The statistics, especially totals, may look very different depending on the minimum acreage used to define the domain of interest. The four minima used in the tables accompanying this report are 1, 10, 100, and 1,000 acres of forest land. In terms of acreage, 93 percent of the family forest land is part of ownerships with forest holdings of 10 or more acres of forest land (Figure 15). In terms of ownerships, 62 percent of the family forest ownerships have holdings of between 1 and 9 acres of forest land. Table 1 provides a summary of these domains

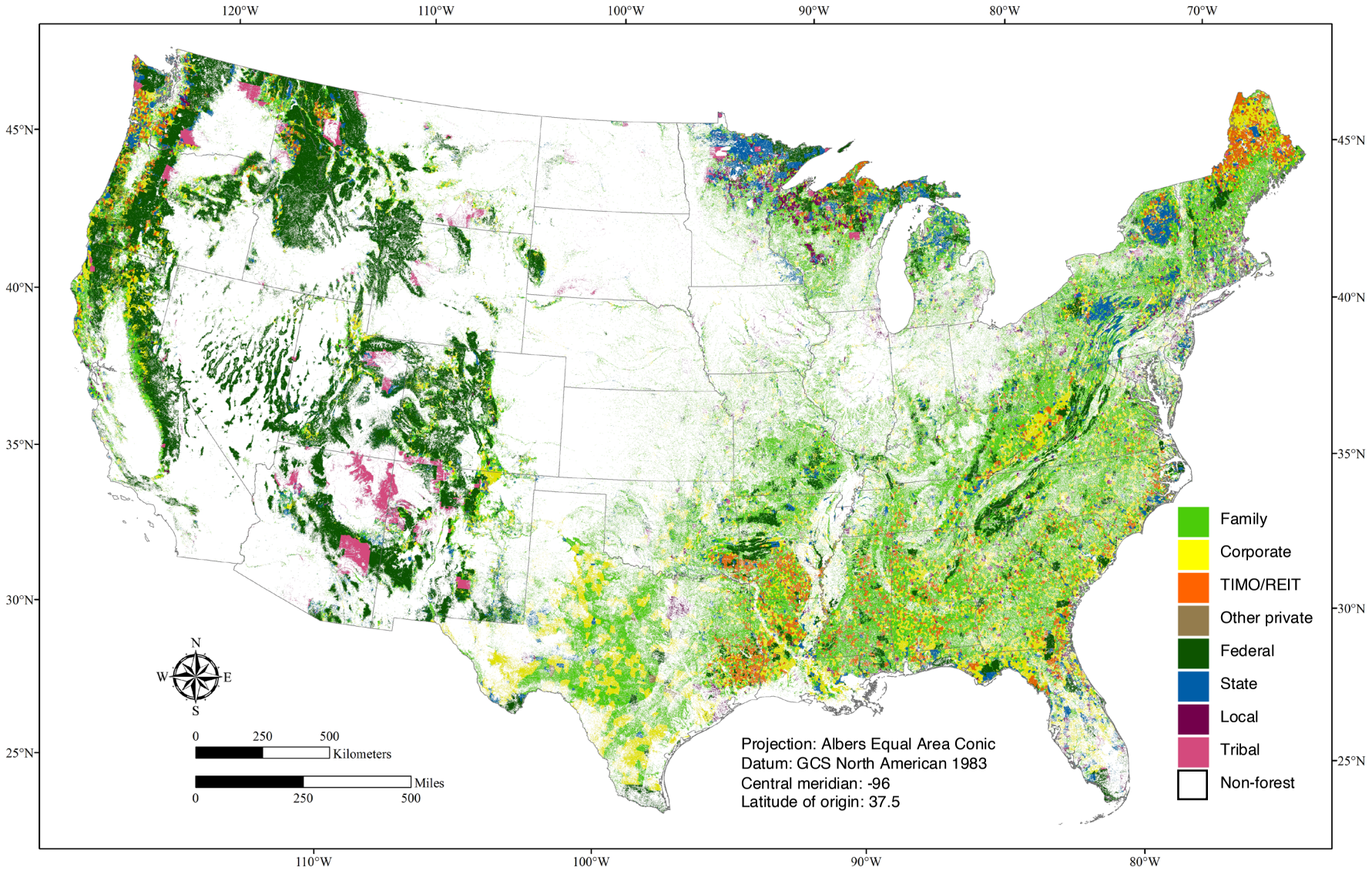
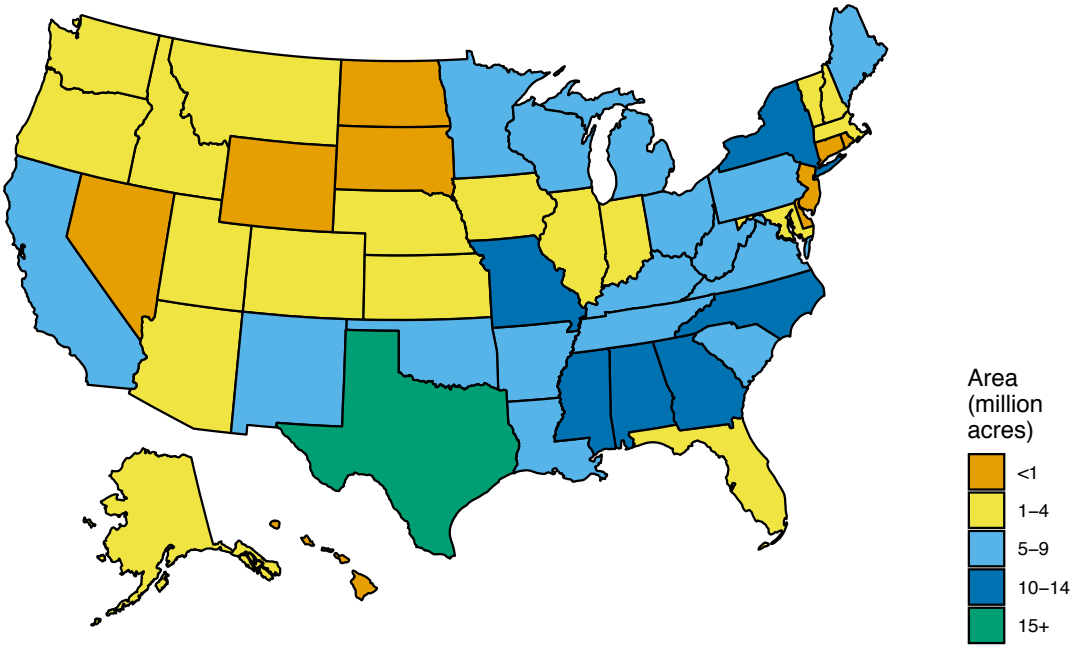


Figure 13.—Forest ownership, United States, 2017 (Sass et al. 2020). The underlying data for this map were collected between 2012 and 2017.

A.



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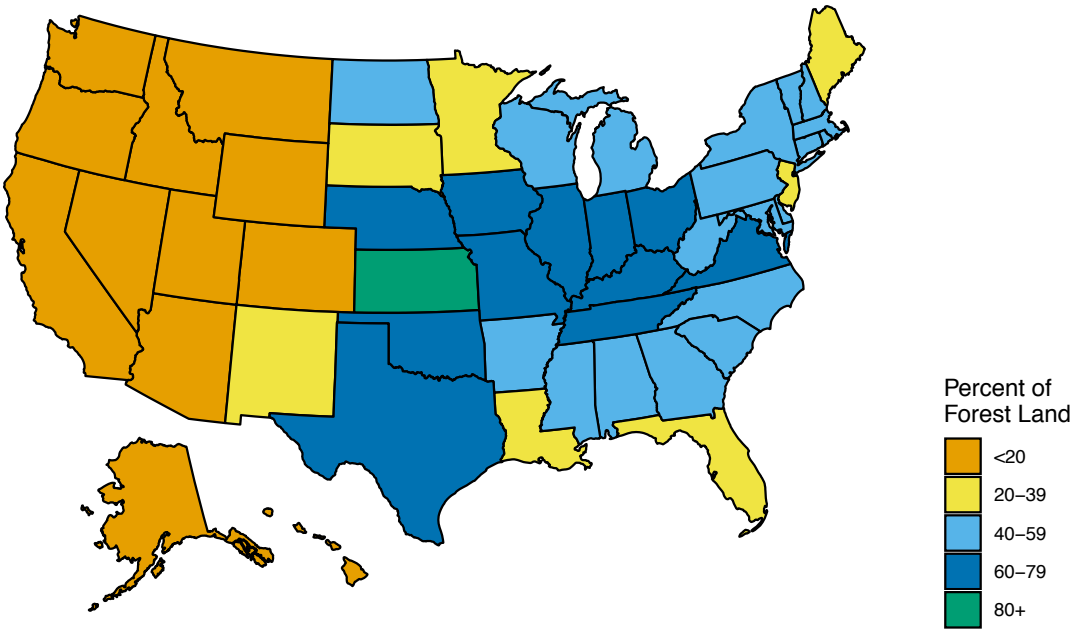

Figure 14.—(A) Family forest acreage and (B) percentage of forest land owned by family forest ownerships by state, United States, 2018.

in terms of numbers of acres, ownerships, and owners. For family forest ownerships with 10+ acres of forest land, there are an estimated 253 million acres of forest land in the U.S. (Table US-3 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). These acres are spread across an estimated 3.7 million family forest ownerships (Table 2; Table US-3 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`), but the distribution is not even with a relatively high percentage of the acres owned by relatively few of the ownerships (Figure 15). The number of owners (i.e., individuals) associated with a single ownership varies from one to over 1,000, but averages 2 (median = 2), and the estimated total number of owners is 7.5 million (Table 2, Table US-5 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). State-level estimates of family forest acreage and ownerships (10+ acres of forest land) are summarized in Table 5 (page 44).

Table 2.—Estimated acres of family forest land, numbers of family forest ownerships, and numbers of family forest owners by minimum size of forest holdings, United States, 2018. Values in parentheses are standard errors.

Minimum size of forest holdings (acres)	Acres	Ownerships	Owners
	millions		
1+	271.9 (1.6)	9.6 (0.2)	18.1 (0.4)
10+	253.3 (1.6)	3.7 (0.04)	7.5 (0.1)
100+	157.7 (1.4)	0.5 (0.01)	1.3 (0.03)
1000+	49.5 (0.8)	0.02 (0.00)	0.08 (0.00)

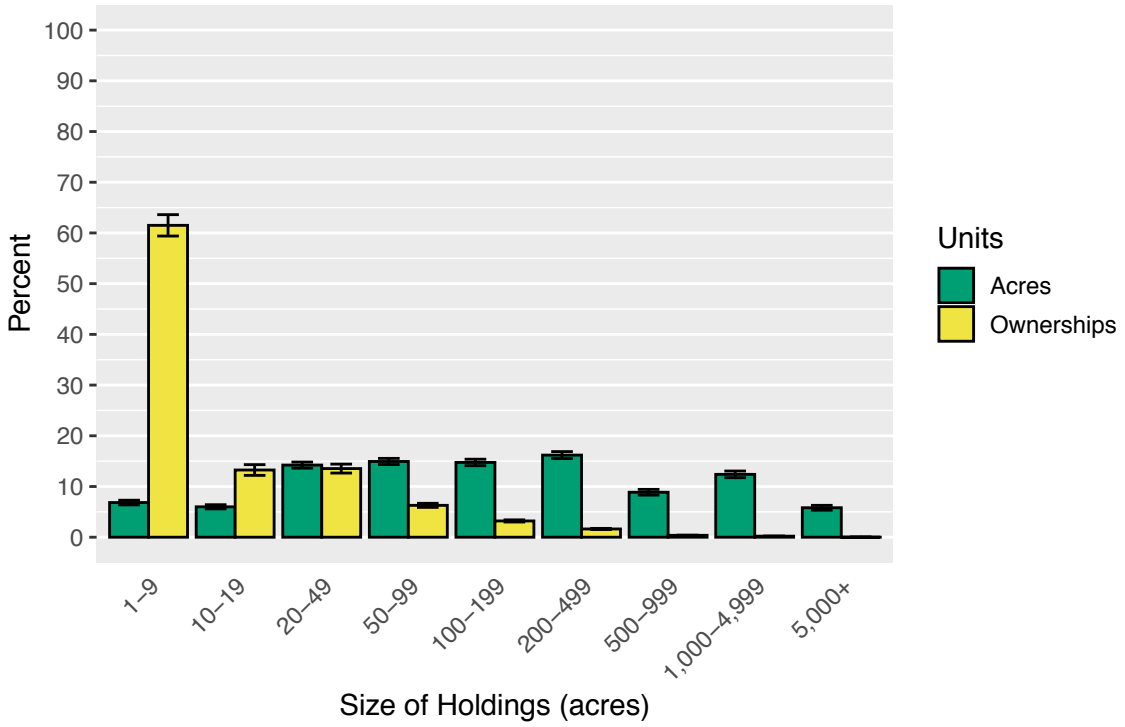

Figure 15.—Estimated percentage of family forest acres and ownerships by size of forest holdings, United States, 2018. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE]).

Part of Home or Farm

A key characteristic of family forest land is whether it is associated with an owner's home and/or farm. An estimated 52 percent of the family forest land, owned by an estimated 62 percent of the family forest ownerships, have the primary residence of the owner within 1 mile of their forest land (Figure 16; Table US-6 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). Or looking at the corollary, an estimated 48 percent of the family forest land, owned by an estimated 38 percent of the family forest ownerships, have the primary residence of the owner at least 1 mile away from their forest land and can be considered absentee ownerships. An estimated 41 percent of the family forest land, owned by an estimated 30 percent of the family forest ownerships, is associated with an owner's farm that is within 1 mile of their forest land (Figure 16; Table US-6 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). These percentages are not mutually exclusive—some owners have both their home and a farm in close proximity to their forest land.

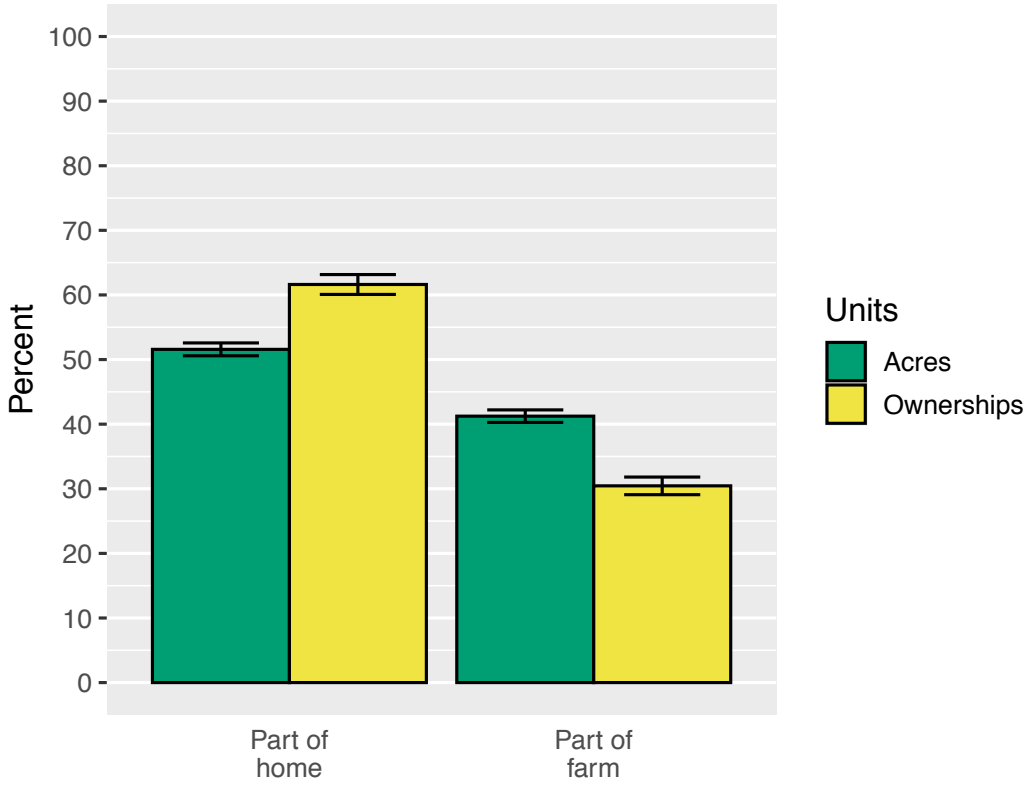

Figure 16.—Estimated percentage of family forest acres and ownerships (10+ acres of forest land) by home and farm status, United States, 2018. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE]).

Reasons for Owning

There are many reasons that people own forest land. The 2018 NWOS asked respondents to rate the importance of 13 potential reasons for owning forest land on a five-point Likert scale that ranged from "Very Important" to "Not Important." The vast majority of family forest land is owned for multiple reasons (Table US-7 in appendix 1, NWOS_2018_FFO_TENPLUS_US.pdf). In terms of acreage, the three most commonly cited reasons for owning forest land are: "To enjoy beauty or scenery," "To protect or improve wildlife habitat," and "To protect nature or biological diversity" (Figure 17). In terms of numbers of ownerships, the most common reasons are: "To enjoy beauty or scenery," "For privacy," and "To protect or improve wildlife habitat" (Figure 17).

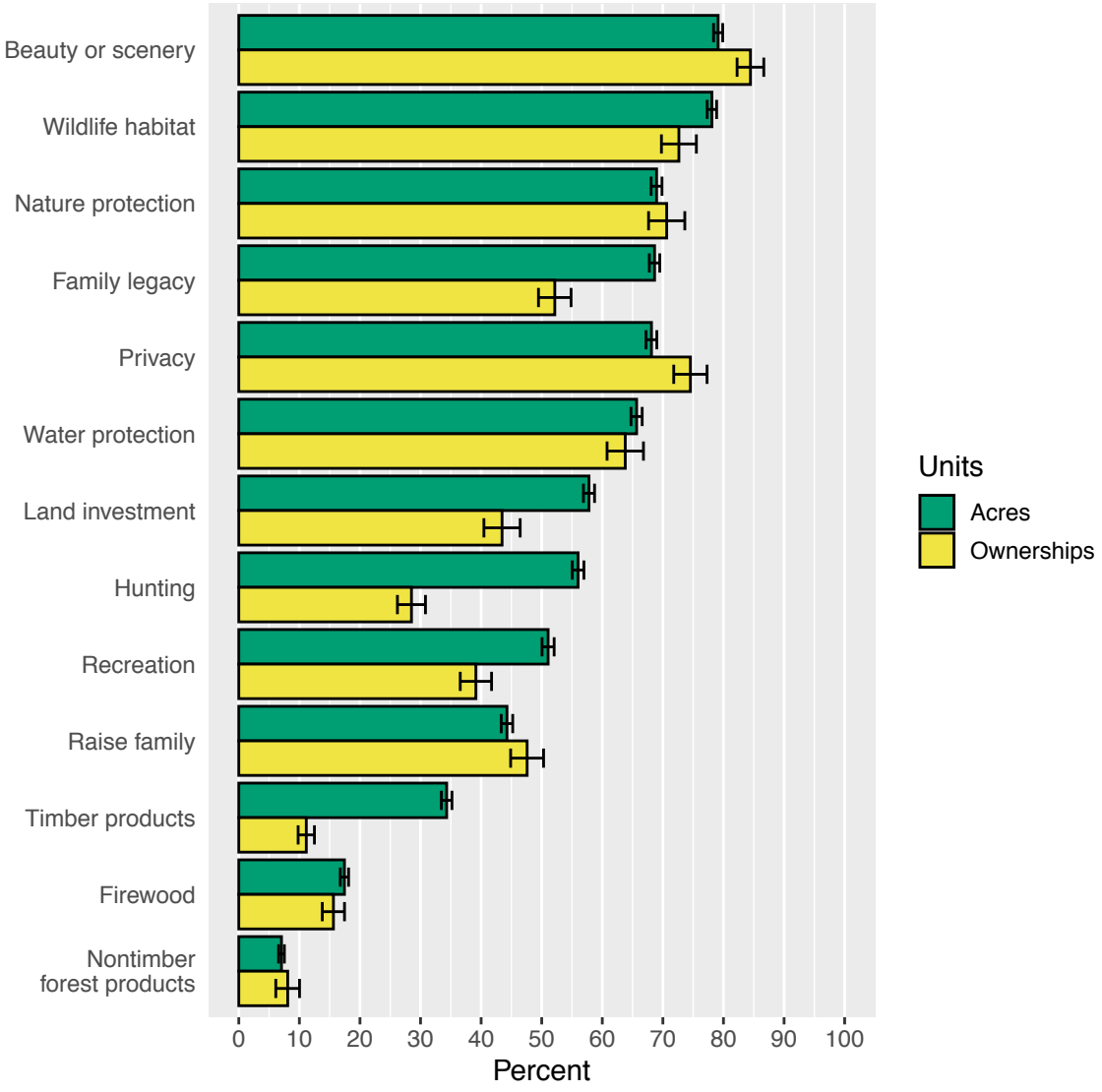

Figure 17.—Estimated percentage of family forest acres and ownerships (10+ acres of forest land) by reasons for owning forest land, United States, 2018. Values include ownerships who rated reasons as important or very important on a 5-point Likert scale. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE].

Recreation

Recreation occurs on the vast majority of family forest land; an estimated 94 percent of the family forest land, owned by 88 percent of family forest ownerships, had someone recreating on it in the previous 5 years. The people most commonly recreating are the owners, their spouses, friends, children, and other family members (Figure 18A; Table US-22 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). The most common forms of recreation are hunting and hiking or walking (Figure 18B; Table US-22 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`).

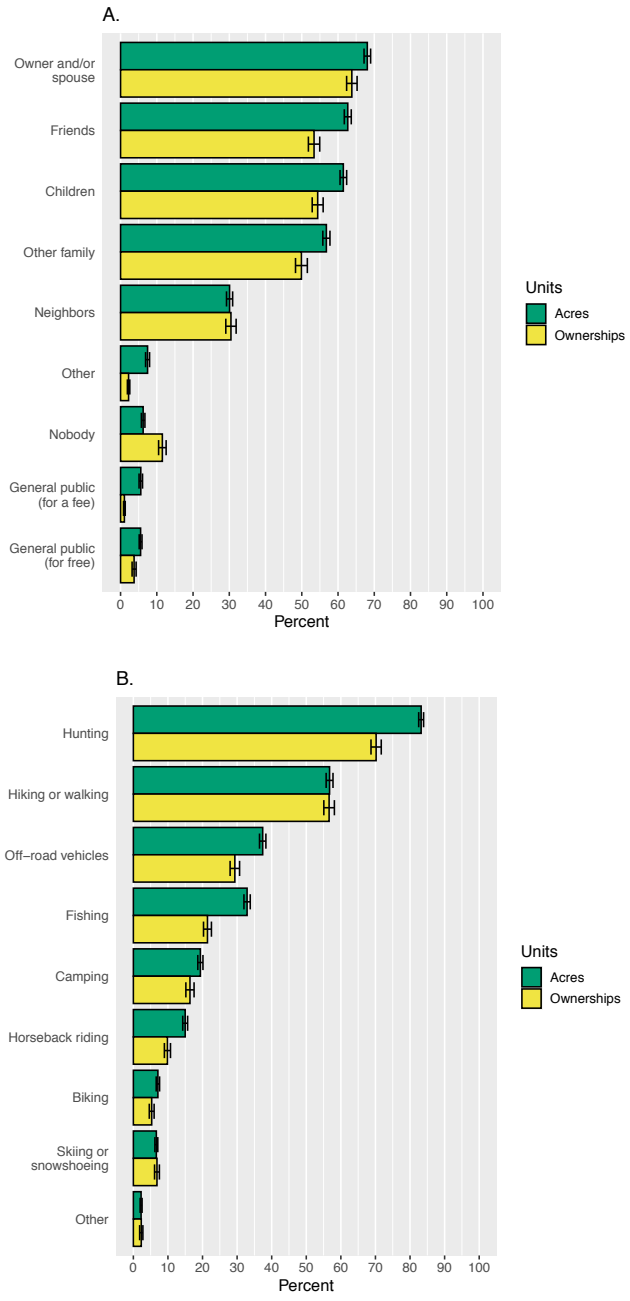

Figure 18.—Estimated percentage of family forest acres and ownerships (10+ acres of forest land) by (A) who and (B) how they recreated, United States, 2018. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE])

Management Activities

Of the management activities queried by the NWOS, the most common in the previous 5 years are: "Improved wildlife habitat," "Cut and/or removed trees for own use," "Cut and/or removed trees for sale," "Eliminated or removed invasive plants," and "Trail construction or maintenance" (Figure 19; Table US-14 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). Many ownerships have participated in one or more of these activities. An estimated 15 percent of the family forest land, owned by 25 percent of the family forest ownerships, had *none* of the queried activities occurring on their forest land. It is worth noting that many of these activities have different time horizons, e.g., wildlife habitat improvements may occur more frequently than commercial timber harvests.

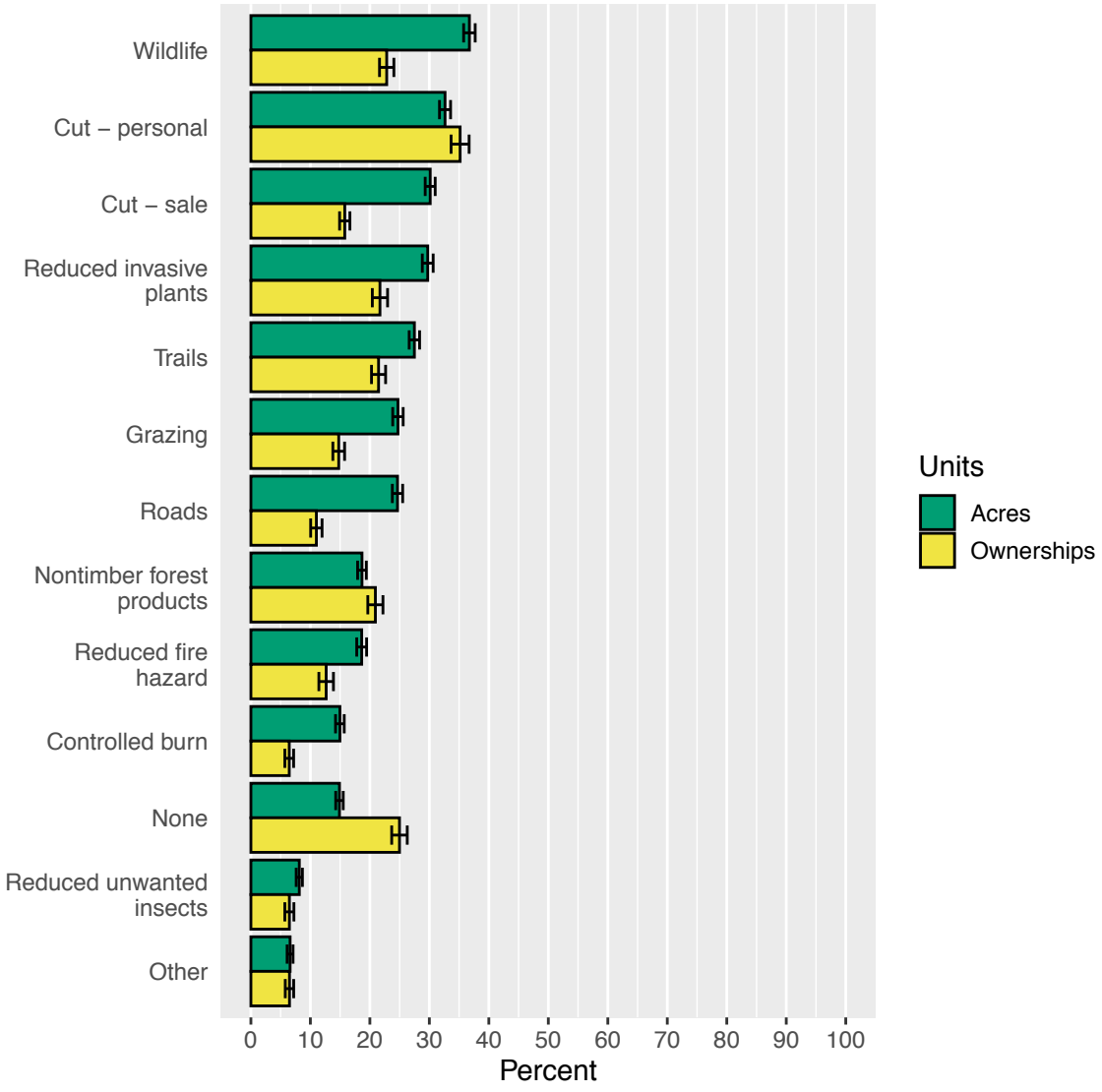

Figure 19.—Estimated percentage of family forest acres and ownerships (10+ acres of forest land) by management activities in the previous 5 years, United States, 2018. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE]).

In general, the percentages of family forest ownerships that plan to do these activities in the next 5 years is equal to or greater than the percentages in the previous 5 years (Table US-15 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). In particular, owners intend to improve wildlife habitat, eliminate or reduce invasive plants, cut trees for sale, cut trees for personal use, and construct or maintain trails (Figure 20). The most common future activities are the same as the past, but the order is slightly different.

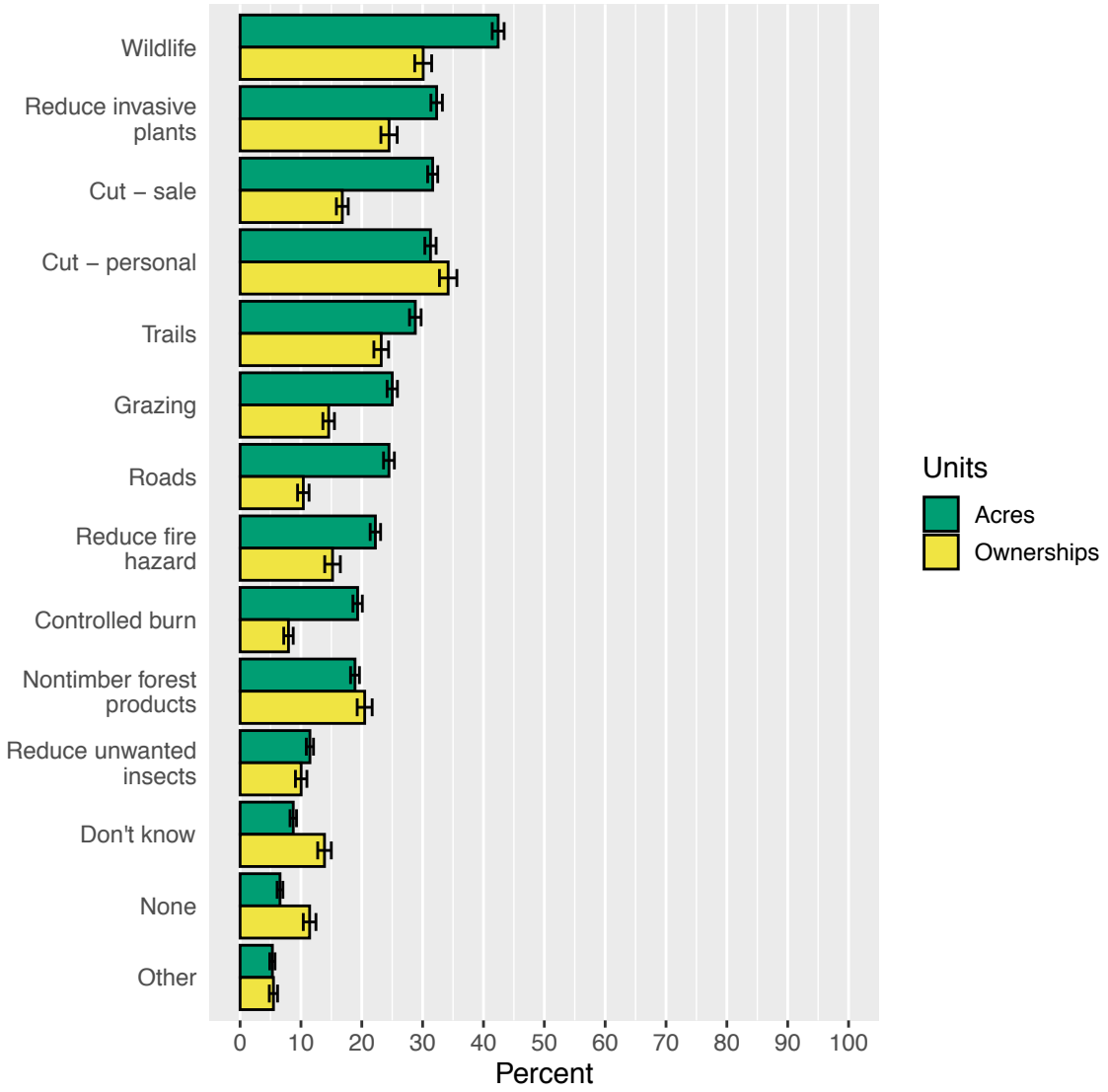

Figure 20.—Estimated percentage of family forest acres and ownerships (10+ acres of forest land) by intended management activities in the next 5 years, United States, 2018. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE]).

Management Plans and Advice

Multiple tools and approaches have been designed to help landowners meet their needs; two traditional ones are written forest management plans and receiving advice. An estimated 24 percent of the family forest land, owned by an estimated 11 percent of the family forest ownerships, is owned by people who

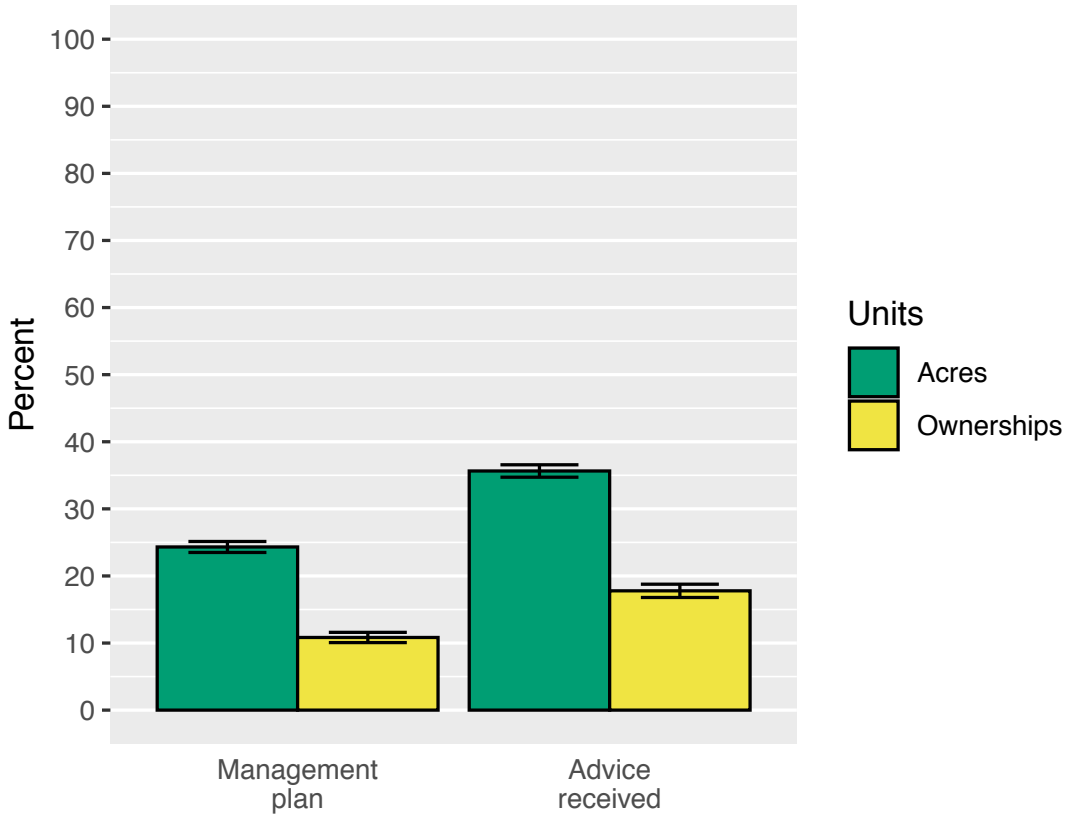

Figure 21.—Estimated percentage of family forest acres and ownerships (10+ acres of forest land) that have written management plans and have received advice, United States, 2018. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE]).

have written forest management plans (Figure 21; Table US-11 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). The percentages for those who have received advice are higher; an estimated 36 percent of the family forest land, owned by an estimated 18 percent of the family forest ownerships, have received some type of advice in the previous 5 years (Figure 21; Table US-24 in appendix 1, `NWOS_2018_FFO_TENPLUS_US`). The advice sources on the questionnaire include both professionals (e.g., consulting foresters) and non-professionals (e.g., other landowners).

Most family forest ownerships have not received advice in the previous 5 years, but only 19 percent of the family forest land, owned by 26 percent of the family forest ownerships, is owned by people who state they do not want any information about their forest land (Figure 22; Table US-25 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). The most popular advice topics are timber management, wildlife management, land transfer, invasive plants, and unwanted insects or diseases. Written materials and talking to an expert are the most commonly cited methods by which owners want to receive information.

Programs and Policies

There are many programs and policies that have been designed to help increase and ensure sustainable forest management, but most family forest ownerships have low levels of familiarity with them and are not participating in them (Tables US-16, US-17, US-18, US-19, US-20 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). The program with the highest participation rate is property tax programs; 26 percent of the family forest land, owned by an estimated 17 percent of the family forest ownerships,

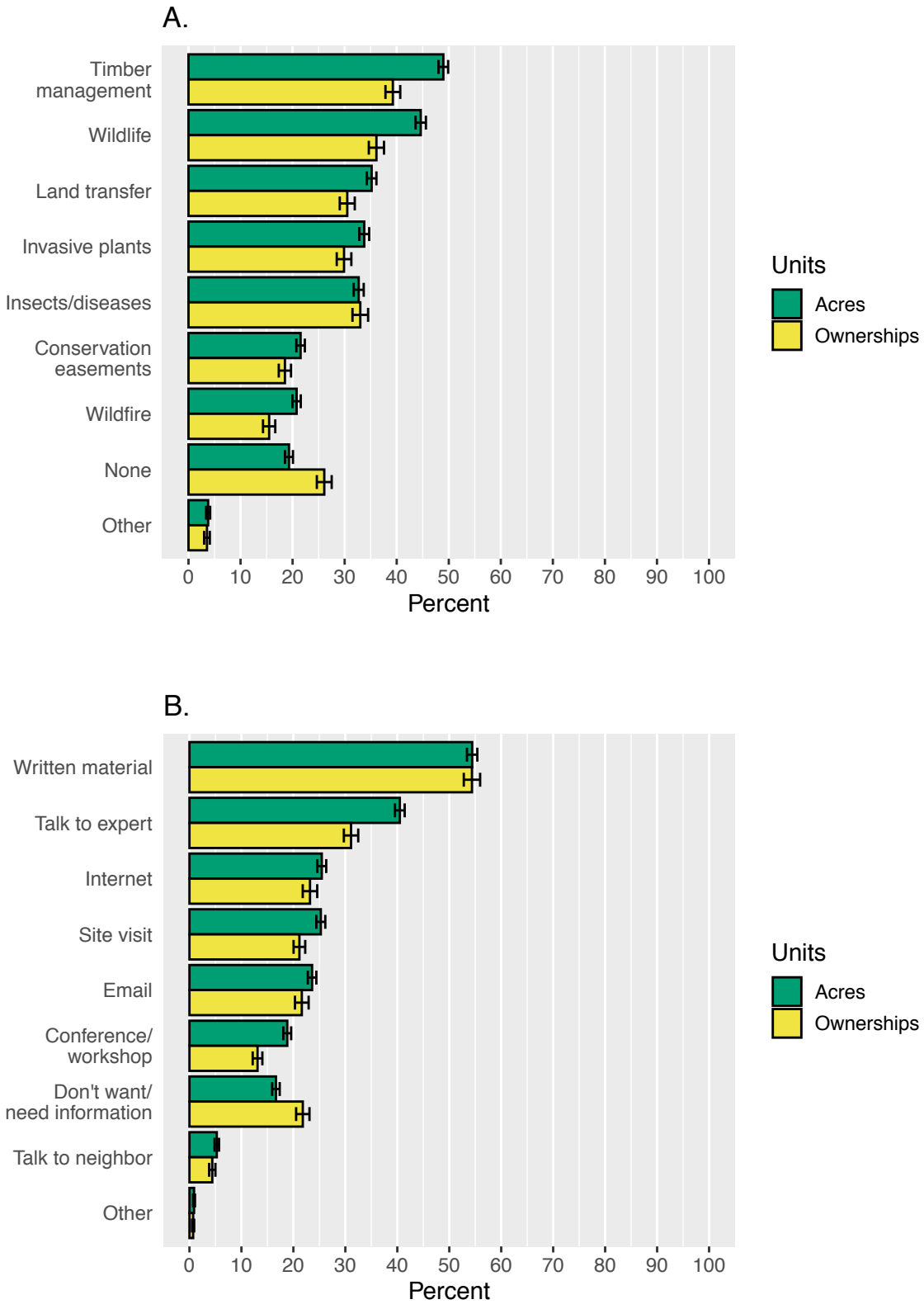

Figure 22.—Estimated percentage of family forest acres and ownerships (10+ acres of forest land) by preferred advice (A) topics and (B) methods, United States, 2018. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE]).

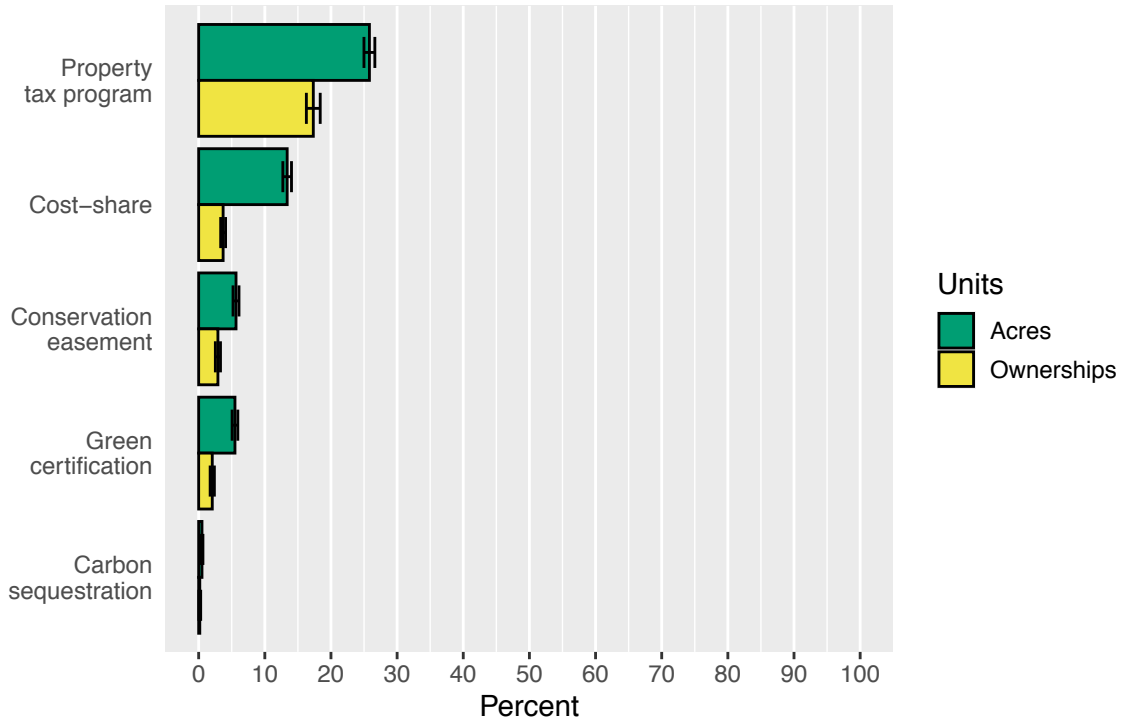

Figure 23.—Estimated percentage of family forest acres and ownerships (10+ acres of forest land) by program participation, United States, 2018. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE]).

is owned by people who have participated in forest property tax programs (Figure 23). The next most common program is cost-share. An estimated 13 percent of the family forest land, owned by an estimated 4 percent of family forest ownerships, is owned by people who have participated in cost-share programs in the previous 5 years. The other programs asked about in the NWOS—conservation easements, green certification, and carbon sequestration—have participation rates of less than 10 percent (in terms of both acres and ownerships).

Concerns

Many issues may be concerns for family forest owners. Of the 16 issues asked about in the 2018 NWOS, 75 percent or more of the family forest land is owned by people who rated one or more of the following as concerns or great concerns: "High property taxes," "Keeping land intact for future generations," and "Trespassing or poaching" (Figure 24; Table US-26 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`).

Demographics

Demographics help us better understand who landowners are, as well as provide insights into the fate of the land and help to ensure programs are being equitably administered. Demographic information collected on the NWOS includes age, gender, education, ethnicity, and race (Table US-29 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). In addition, the NWOS ascertains what percentage of an owner's annual income is derived from their forest land (Table US-30 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). The demographics correspond to the owner who is the self-reported, primary

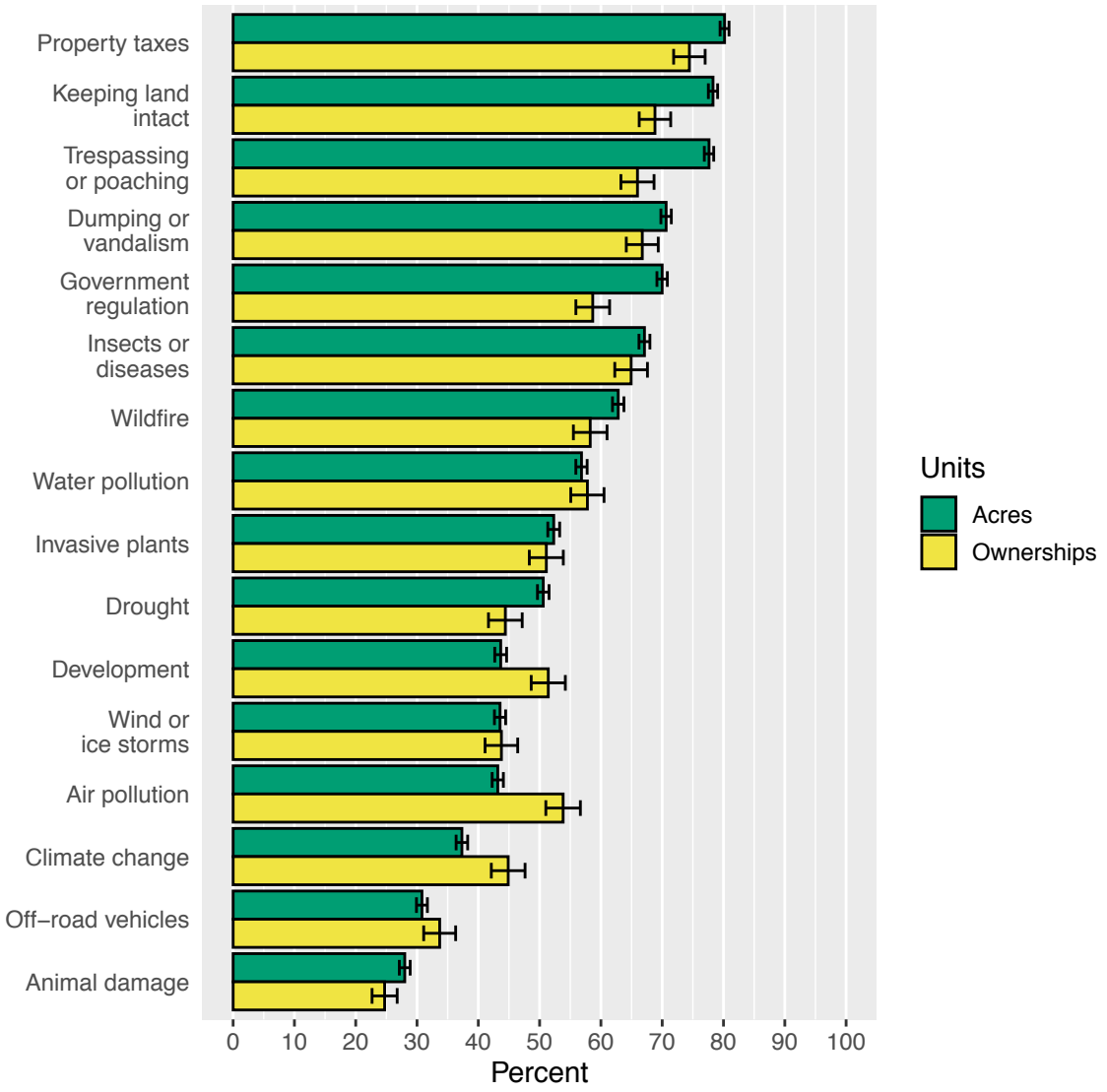

Figure 24.—Estimated percentage of family forest acres and ownerships (10+ acres of forest land) by concerns, United States, 2018. Values include ownerships who rated reasons as important or very important on a 5-point Likert scale. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE]).

decision-maker for the land, but it should be recalled that many of these ownerships include more than one person. The average age is 65 years (median = 65 years), 76 percent are male, 42 percent have a college degree, and 97 percent are white (Table US-29 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). Annual income derived from their forest land ranges the full gamut from 0 to 100 percent, but the average is 1 percent (median = 0 percent).

In terms of age, an estimated 20 percent of the family forest ownerships, which control 23 percent of the family forest acres, have primary decision-makers that are 75 years of age or older (Figure 25; Table US-30 in appendix 1, `NWOS_2018_FFO_TENPLUS_US.pdf`). An additional 32 percent of the ownerships, and 34 percent of the acreage, have primary decision-makers that are 65 to 74 years of age. These statistics suggest a relatively large proportion of the family forest will transfer hands in the not too distant future.

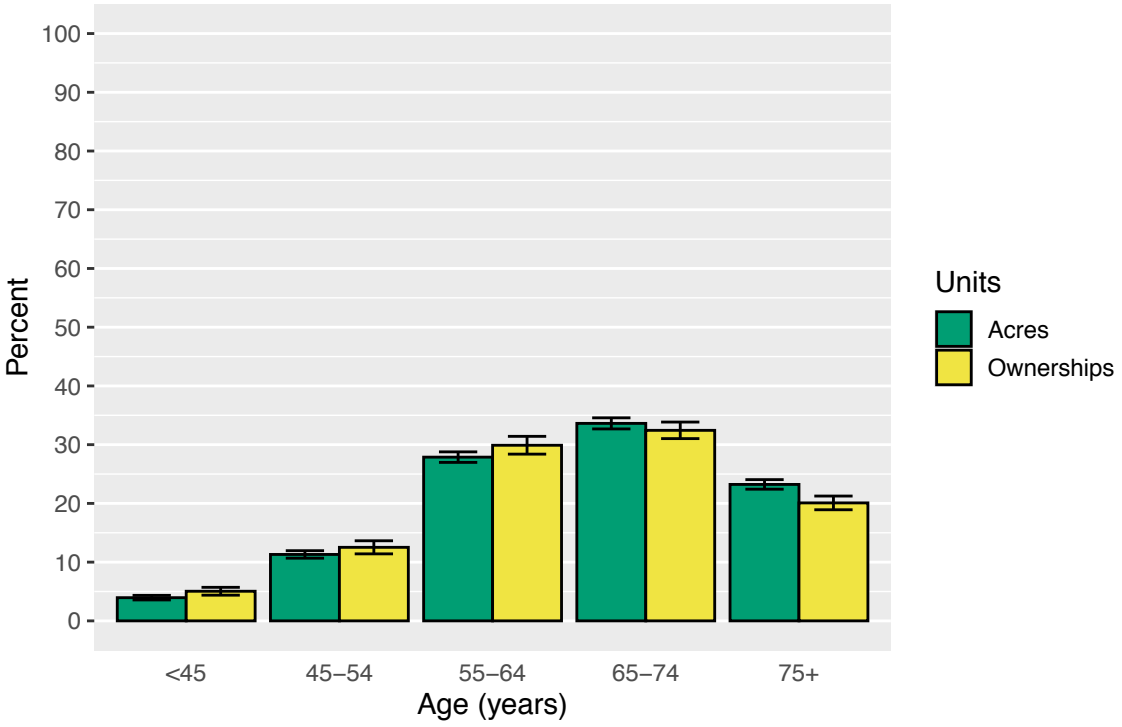

Figure 25.—Estimated percentage of family forest acres and ownerships (10+ acres of forest land) by age of primary decision-maker, United States, 2018. Error bars represent 95 percent confidence intervals (i.e., 1.96 × standard error [SE]).

CONCLUSIONS

The results above are a subset of the many statistics collected as part of the 2018 NWOS. Full sets of tabular summaries by geography (including by state) and for different domains of interest (i.e., family forest ownerships with 1+, 10+, 100+, and 1,000+ acres of forest land) are included in appendix 1 accompanying this report. Tools to further explore the results, cross-tabulations and data visualization(s) are available at: www.fia.fs.fed.us/nwos/results.

In interpreting the results, it is important to recognize the constraints of the underlying data. Since the NWOS results are based on a sample of ownerships, one key element in interpreting the results are the standard errors (SEs) provided in the tables. These values help to quantify the reliability of the associated estimates. If a standard error for an estimate is higher than desired, it is possible that it may be reduced if the sample size is increased (e.g., looking across larger geographic areas) or by looking at expanded domains of interest. Due to the NWOS sample design with inclusion probabilities that are a function of size of holdings, the standard errors associated with ownerships of smaller holdings (e.g., 1 to 9 acres of forest land) are particularly large and so the estimates for ownerships with 10+ acres of forest land tend to have smaller standard errors.

It is also important to recognize that there are important subgroups or segments of family forest ownerships. This report highlights results for family forest ownerships with10+ acres of forest land. Depending on one's needs, there are many ways the data could be segmented, such as looking at just the active timber harvesters or minority landowners. Tools are being created to facilitate these analyses and specific segments will be the focus of future research efforts.

Another important caveat in interpreting the NWOS results is that the "intensity" of activities on an ownership's land are not captured. For example, respondents are asked to indicate if they have harvested trees, but they are not asked about the number of acres or volumes harvested. The results provide estimates of the number of acres owned by people who have harvested trees, but this does not imply that all of the acres were harvested. Ancillary data (including FIA plot-based forest inventory data) and additional surveys are required to answer questions regarding intensity of timber harvesting and other activities.

Examination of trends across time is a goal of the NWOS program. However, these comparisons need to be made carefully in order to account for differences in questions asked, sample designs, and changes to estimation procedures. To account for these issues, data from the 2006 and 2013 iterations of the NWOS are being reprocessed and will be available on the NWOS website (www.fia.fs.fed.us/nwos/results). Guidance for conducting statistical tests across time and geographies is provided in Butler and Caputo (in press). Additional results from the NWOS, including results from the Urban and Corporate components, are also available on the NWOS website.

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TABLES

Table 3.—Sample size and cooperation rate for family forest ownerships[a] by state for the National Woodland Owner Survey, United States[b], 2018.

Region/state	Sample size	No/insufficient contact information	Nonresponses	"Partial responses"	"Complete responses"	"Cooperation rate[c]"
	number					*percent*
North						
Connecticut	705	259	331	16	99	22.2
Delaware	565	86	298	14	167	34.9
Illinois	648	277	172	15	184	49.6
Indiana	714	148	277	30	259	45.8
Iowa	509	128	177	24	180	47.2
Maine	547	87	250	23	187	40.7
Maryland	669	151	296	20	202	39.0
Massachusetts	616	125	306	17	168	34.2
Michigan	697	208	191	14	284	58.1
Minnesota	653	142	210	23	278	54.4
Missouri	852	157	358	35	302	43.5
NewHampshire	540	302	102	8	128	53.8
NewJersey	740	240	303	27	170	34.0
NewYork	798	210	275	27	286	48.6
Ohio	784	156	346	27	255	40.6
Pennsylvania	594	156	215	15	208	47.5
Rhode Island	701	680	7	2	12	57.1
Vermont	577	377	79	6	115	57.5
West Virginia	763	290	266	18	189	40.0
Wisconsin	484	77	155	24	228	56.0
North total	13,156	4,256	4,614	385	3,901	43.8
South						
Alabama	650	68	354	26	202	34.7
Arkansas	971	185	472	40	274	34.9
Florida	314	69	126	17	102	41.6
Georgia	967	113	497	38	319	37.4
Kentucky	943	350	378	34	181	30.5
Louisiana	608	214	231	20	143	36.3
Mississippi	829	125	419	49	236	33.5
North Carolina	784	83	402	37	262	37.4
Oklahoma	1,293	346	618	41	288	30.4
South Carolina	747	79	361	27	280	41.9
Tennessee	821	119	456	26	220	31.3
Texas	1,823	347	927	59	490	33.2
Virginia	728	78	389	25	236	36.3
South total	11,478	2,176	5,630	439	3,233	34.8

Table 3. (continued)

Region/state	Sample size	No/insufficient contact information	Nonresponses	"Partial responses"	"Complete responses"	"Cooperation rate[c]"
West						
Alaska[b]	529	486	1	3	39	90.7
Arizona	1,588	1,141	278	34	135	30.2
California	724	267	267	12	178	38.9
Colorado	722	132	307	25	258	43.7
Hawaii	228	74	98	11	45	29.2
Idaho	560	147	207	20	186	45.0
Kansas	671	259	261	16	135	32.8
Montana	494	65	242	34	153	35.7
Nebraska	739	154	372	40	173	29.6
Nevada	186	141	10	3	32	71.1
New Mexico	358	160	121	11	66	33.3
North Dakota	970	755	20	21	174	80.9
Oregon	532	155	185	20	172	45.6
South Dakota	238	174	13	10	41	64.1
Utah	445	125	168	20	132	41.3
Washington	530	197	153	12	168	50.5
Wyoming	974	265	375	37	297	41.9
West total[b]	10,488	4,697	3,078	329	2,384	41.2
United States[b]	35,122	11,129	13,322	1,153	9,518	39.7

[a] These numbers are for all family forest ownerships with 1+ acres of forest land.
[b] Excluding interior Alaska
[c] Cooperation Rate = $\frac{\text{CompleteResponses}}{\text{CompleteResponses+PartialResponses+Nonresponses}}$

Note: Data may not add to totals due to rounding

Table 4.—Estimated area of forest land by ownership category by state, United States, 2018. Numbers in parentheses are standard errors.

Region/state	All Ownerships	Private			
		Total	Family	Corporate	Other private
	millions				
North					
Connecticut	1.8 (0.0)	1.3 (0.0)	0.9 (0.1)	0.3 (0.0)	0.1 (0.0)
Delaware	0.4 (0.0)	0.3 (0.0)	0.2 (0.0)	0.1 (0.0)	0.0 (0.0)
Illinois	5.0 (0.1)	4.2 (0.1)	3.7 (0.1)	0.4 (0.0)	0.1 (0.0)
Indiana	4.9 (0.1)	4.1 (0.1)	3.6 (0.1)	0.4 (0.0)	0.1 (0.0)
Iowa	2.9 (0.1)	2.5 (0.1)	2.3 (0.1)	0.2 (0.0)	0.1 (0.0)
Maine	17.5 (0.1)	15.6 (0.1)	5.2 (0.1)	10.0 (0.1)	0.4 (0.0)
Maryland	2.4 (0.1)	1.8 (0.1)	1.3 (0.1)	0.4 (0.0)	0.1 (0.0)
Massachusetts	3.0 (0.0)	1.9 (0.1)	1.3 (0.1)	0.3 (0.0)	0.2 (0.0)
Michigan	20.3 (0.1)	12.5 (0.1)	8.8 (0.1)	3.0 (0.1)	0.7 (0.1)
Minnesota	17.6 (0.1)	7.2 (0.1)	5.9 (0.1)	1.2 (0.1)	0.1 (0.0)
Missouri	15.4 (0.1)	12.6 (0.1)	11.3 (0.1)	1.1 (0.1)	0.2 (0.0)
New Hampshire	4.7 (0.0)	3.4 (0.1)	2.3 (0.1)	0.8 (0.1)	0.3 (0.0)
New Jersey	2.0 (0.0)	0.9 (0.0)	0.5 (0.0)	0.3 (0.0)	0.1 (0.0)
New York	18.7 (0.1)	13.8 (0.1)	10.3 (0.2)	2.9 (0.1)	0.6 (0.1)
Ohio	7.9 (0.1)	6.7 (0.1)	5.5 (0.1)	1.0 (0.1)	0.2 (0.0)
Pennsylvania	16.8 (0.1)	11.7 (0.1)	8.6 (0.1)	2.4 (0.1)	0.7 (0.1)
Rhode Island	0.4 (0.0)	0.3 (0.0)	0.2 (0.0)	0.1 (0.0)	0.0 (0.0)
Vermont	4.5 (0.0)	3.5 (0.0)	2.7 (0.1)	0.7 (0.1)	0.1 (0.0)
West Virginia	12.0 (0.1)	10.4 (0.1)	6.1 (0.1)	4.1 (0.1)	0.1 (0.0)
Wisconsin	17.0 (0.1)	11.4 (0.1)	9.7 (0.1)	1.5 (0.1)	0.3 (0.0)
North total	175.0 (0.3)	125.8 (0.3)	90.2 (0.4)	31.1 (0.3)	4.5 (0.2)
South					
Alabama	23.1 (0.1)	21.5 (0.1)	13.1 (0.2)	8.3 (0.2)	0.1 (0.0)
Arkansas	18.9 (0.1)	15.2 (0.1)	8.6 (0.1)	5.7 (0.1)	0.9 (0.1)
Florida	17.1 (0.1)	10.8 (0.2)	3.8 (0.1)	6.9 (0.2)	0.1 (0.0)
Georgia	24.5 (0.1)	21.8 (0.2)	13.3 (0.2)	8.2 (0.2)	0.4 (0.0)
Kentucky	12.4 (0.1)	10.9 (0.1)	8.8 (0.1)	2.0 (0.1)	0.1 (0.0)
Louisiana	15.0 (0.1)	13.0 (0.1)	5.4 (0.1)	7.5 (0.2)	0.2 (0.0)
Mississippi	19.3 (0.1)	17.1 (0.1)	11.4 (0.2)	5.0 (0.1)	0.8 (0.1)
North Carolina	18.8 (0.1)	15.5 (0.1)	10.5 (0.2)	4.7 (0.1)	0.3 (0.0)
Oklahoma	12.2 (0.3)	10.5 (0.3)	7.7 (0.2)	2.6 (0.1)	0.2 (0.0)
South Carolina	12.9 (0.1)	11.2 (0.1)	6.7 (0.1)	4.3 (0.1)	0.2 (0.0)
Tennessee	13.9 (0.1)	11.6 (0.1)	9.2 (0.1)	2.4 (0.1)	0.1 (0.0)
Texas	61.9 (0.6)	57.9 (0.6)	39.3 (0.5)	16.8 (0.3)	1.8 (0.1)
Virginia	16.1 (0.1)	13.2 (0.1)	9.7 (0.1)	3.3 (0.1)	0.2 (0.0)
South total	266.0 (0.8)	230.5 (0.8)	147.6 (0.7)	77.6 (0.6)	5.2 (0.2)
West					
Alaska[a]	12.0 (0.1)	1.7 (0.1)	0.1 (0.0)	1.6 (0.1)	0.0 (0.0)
Arizona	19.8 (0.2)	1.7 (0.1)	1.1 (0.1)	0.5 (0.1)	0.1 (0.0)
California	31.7 (0.2)	12.0 (0.2)	6.2 (0.2)	5.3 (0.1)	0.5 (0.1)
Colorado	23.3 (0.2)	5.0 (0.1)	3.8 (0.1)	1.2 (0.1)	0.1 (0.0)
Hawaii	1.5 (0.1)	0.6 (0.1)	0.1 (0.0)	0.4 (0.0)	0.1 (0.0)
Idaho	22.0 (0.1)	2.9 (0.1)	1.3 (0.1)	1.6 (0.1)	0.0 (0.0)
Kansas	2.5 (0.1)	2.3 (0.1)	2.1 (0.1)	0.2 (0.0)	0.0 (0.0)
Montana	26.0 (0.2)	5.8 (0.2)	2.9 (0.1)	2.7 (0.1)	0.3 (0.0)
Nebraska	1.5 (0.1)	1.3 (0.1)	1.1 (0.1)	0.1 (0.0)	0.0 (0.0)
Nevada	11.1 (0.1)	0.3 (0.0)	0.2 (0.0)	0.1 (0.0)	0.0 (0.0)
New Mexico	27.4 (0.2)	8.4 (0.2)	6.2 (0.2)	1.9 (0.1)	0.2 (0.0)
North Dakota	0.8 (0.0)	0.5 (0.0)	0.5 (0.0)	0.0 (0.0)	0.0 (0.0)
Oregon	29.6 (0.1)	10.1 (0.1)	3.4 (0.1)	6.6 (0.1)	0.1 (0.0)
South Dakota	2.0 (0.1)	0.6 (0.0)	0.5 (0.0)	0.1 (0.0)	0.0 (0.0)
Utah	18.9 (0.2)	2.2 (0.1)	1.3 (0.1)	0.9 (0.1)	0.1 (0.0)
Washington	22.1 (0.1)	7.5 (0.1)	2.5 (0.1)	4.8 (0.1)	0.2 (0.0)
Wyoming	10.6 (0.1)	1.2 (0.1)	0.7 (0.1)	0.5 (0.1)	0.0 (0.0)
West total[a]	262.6 (0.6)	64.2 (0.4)	34.0 (0.4)	28.6 (0.3)	1.7 (0.1)
United States[a]	703.7 (1.0)	420.5 (1.0)	271.9 (0.9)	137.3 (0.8)	11.4 (0.3)

[a]Excluding interior Alaska
Note: Data may not add to totals due to rounding

Table 4. (continued)

Region/state	Tribal	Public			
		Total	Federal	State	Local
	millions				
North					
Connecticut	0.0 (0.0)	0.5 (0.0)	0.0 (0.0)	0.3 (0.0)	0.2 (0.0)
Delaware	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)
Illinois	0.0 (0.0)	0.8 (0.0)	0.4 (0.0)	0.2 (0.0)	0.2 (0.0)
Indiana	0.0 (0.0)	0.8 (0.0)	0.4 (0.0)	0.3 (0.0)	0.1 (0.0)
Iowa	0.0 (0.0)	0.4 (0.0)	0.1 (0.0)	0.2 (0.0)	0.1 (0.0)
Maine	0.2 (0.0)	1.7 (0.1)	0.3 (0.0)	1.2 (0.0)	0.2 (0.0)
Maryland	0.0 (0.0)	0.7 (0.0)	0.1 (0.0)	0.4 (0.0)	0.2 (0.0)
Massachusetts	0.0 (0.0)	1.1 (0.0)	0.1 (0.0)	0.6 (0.0)	0.4 (0.0)
Michigan	0.0 (0.0)	7.8 (0.1)	3.1 (0.0)	4.2 (0.1)	0.5 (0.1)
Minnesota	0.7 (0.0)	9.7 (0.1)	2.9 (0.0)	4.2 (0.1)	2.6 (0.1)
Missouri	0.0 (0.0)	2.8 (0.0)	1.9 (0.0)	0.8 (0.0)	0.1 (0.0)
New Hampshire	0.0 (0.0)	1.3 (0.0)	0.9 (0.0)	0.2 (0.0)	0.3 (0.0)
New Jersey	0.0 (0.0)	1.0 (0.0)	0.1 (0.0)	0.6 (0.0)	0.3 (0.0)
New York	0.0 (0.0)	4.9 (0.1)	0.2 (0.0)	4.1 (0.1)	0.7 (0.1)
Ohio	0.0 (0.0)	1.2 (0.0)	0.4 (0.0)	0.5 (0.0)	0.3 (0.0)
Pennsylvania	0.0 (0.0)	5.1 (0.1)	0.6 (0.0)	3.9 (0.1)	0.6 (0.1)
Rhode Island	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)
Vermont	0.0 (0.0)	1.0 (0.0)	0.5 (0.0)	0.4 (0.0)	0.1 (0.0)
West Virginia	0.0 (0.0)	1.6 (0.0)	1.2 (0.0)	0.3 (0.0)	0.1 (0.0)
Wisconsin	0.4 (0.0)	5.2 (0.0)	1.6 (0.0)	1.2 (0.0)	2.4 (0.1)
North total	1.4 (0.1)	47.8 (0.2)	14.7 (0.1)	23.8 (0.2)	9.3 (0.2)
South					
Alabama	0.0 (0.0)	1.6 (0.1)	0.9 (0.0)	0.5 (0.1)	0.2 (0.0)
Arkansas	0.0 (0.0)	3.7 (0.1)	3.2 (0.1)	0.4 (0.0)	0.1 (0.0)
Florida	0.1 (0.0)	6.2 (0.1)	2.7 (0.1)	2.9 (0.1)	0.6 (0.1)
Georgia	0.0 (0.0)	2.7 (0.1)	1.8 (0.1)	0.5 (0.1)	0.4 (0.0)
Kentucky	0.0 (0.0)	1.5 (0.1)	1.2 (0.1)	0.2 (0.0)	0.1 (0.0)
Louisiana	0.0 (0.0)	2.0 (0.1)	1.1 (0.1)	0.6 (0.1)	0.3 (0.0)
Mississippi	0.0 (0.0)	2.2 (0.1)	1.7 (0.1)	0.2 (0.0)	0.3 (0.0)
North Carolina	0.0 (0.0)	3.2 (0.1)	2.1 (0.1)	0.8 (0.1)	0.3 (0.0)
Oklahoma	0.2 (0.0)	1.4 (0.1)	0.9 (0.1)	0.4 (0.1)	0.1 (0.0)
South Carolina	0.0 (0.0)	1.7 (0.1)	1.0 (0.0)	0.4 (0.0)	0.2 (0.0)
Tennessee	0.0 (0.0)	2.3 (0.1)	1.4 (0.0)	0.8 (0.1)	0.1 (0.0)
Texas	0.0 (0.0)	4.0 (0.2)	1.7 (0.1)	1.7 (0.1)	0.6 (0.1)
Virginia	0.0 (0.0)	2.8 (0.1)	2.2 (0.1)	0.3 (0.0)	0.3 (0.0)
South total	0.3 (0.0)	35.2 (0.3)	21.8 (0.2)	9.9 (0.2)	3.4 (0.1)
West					
Alaska[a]	0.1 (0.0)	10.2 (0.1)	8.8 (0.1)	1.2 (0.1)	0.2 (0.0)
Arizona	5.9 (0.1)	12.1 (0.2)	10.1 (0.2)	2.0 (0.1)	0.1 (0.0)
California	0.3 (0.0)	19.4 (0.2)	18.4 (0.1)	0.7 (0.0)	0.4 (0.0)
Colorado	0.5 (0.1)	17.7 (0.2)	17.0 (0.2)	0.6 (0.1)	0.1 (0.0)
Hawaii	0.0 (0.0)	0.9 (0.0)	0.2 (0.0)	0.7 (0.0)	0.0 (0.0)
Idaho	0.1 (0.0)	18.9 (0.2)	17.7 (0.2)	1.3 (0.1)	0.0 (0.0)
Kansas	0.0 (0.0)	0.2 (0.0)	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)
Montana	1.1 (0.1)	19.0 (0.2)	18.0 (0.2)	1.1 (0.1)	0.0 (0.0)
Nebraska	0.0 (0.0)	0.2 (0.0)	0.1 (0.0)	0.1 (0.0)	0.0 (0.0)
Nevada	0.1 (0.0)	10.7 (0.1)	10.7 (0.1)	0.0 (0.0)	0.0 (0.0)
New Mexico	3.7 (0.1)	15.3 (0.2)	12.6 (0.2)	2.7 (0.1)	0.0 (0.0)
North Dakota	0.1 (0.0)	0.3 (0.0)	0.2 (0.0)	0.1 (0.0)	0.0 (0.0)
Oregon	0.5 (0.1)	19.0 (0.1)	17.8 (0.1)	1.0 (0.0)	0.2 (0.0)
South Dakota	0.2 (0.0)	1.1 (0.0)	1.0 (0.0)	0.1 (0.0)	0.0 (0.0)
Utah	0.6 (0.1)	16.1 (0.2)	14.5 (0.2)	1.5 (0.1)	0.1 (0.0)
Washington	1.9 (0.1)	12.7 (0.1)	9.7 (0.1)	2.5 (0.1)	0.5 (0.1)
Wyoming	0.3 (0.0)	9.2 (0.1)	8.8 (0.1)	0.4 (0.0)	0.0 (0.0)
West total[a]	15.4 (0.2)	183.1 (0.6)	165.6 (0.5)	15.8 (0.3)	1.7 (0.1)
United States[a]	17.1 (0.3)	266.1 (0.7)	202.1 (0.6)	49.6 (0.4)	14.4 (0.2)

[a]Excluding interior Alaska
Note: Data may not add to totals due to rounding

Table 5.—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by state, United States, 2018. Numbers in parentheses are standard errors.

Region/state	Area (acres)	Ownership
	millions	*thousands*
North		
Connecticut	0.40 (0.05)	14.0 (2.0)
Delaware	0.16 (0.01)	3.6 (0.2)
Illinois	3.57 (0.12)	81.5 (4.4)
Indiana	3.27 (0.11)	83.2 (3.9)
Iowa	2.01 (0.07)	41.5 (2.0)
Maine	4.66 (0.15)	74.6 (4.0)
Maryland	1.05 (0.04)	25.2 (1.5)
Massachusetts	0.88 (0.04)	21.0 (1.4)
Michigan	8.12 (0.24)	181.6 (8.0)
Minnesota	5.38 (0.17)	101.5 (4.9)
Missouri	10.79 (0.28)	176.2 (7.1)
NewHampshire	1.84 (0.09)	32.4 (2.7)
NewJersey	0.33 (0.02)	11.1 (0.9)
New York	9.28 (0.26)	187.3 (8.4)
Ohio	4.66 (0.14)	115.4 (5.2)
Pennsylvania	7.50 (0.25)	163.2 (8.0)
Rhode Island	0.12 (0.03)	4.7 (1.5)
Vermont	2.54 (0.11)	40.7 (3.1)
West Virginia	5.69 (0.22)	96.0 (6.6)
Wisconsin	9.00 (0.27)	153.3 (6.7)
North total	81.27 (0.73)	1,608.1 (20.9)
South		
Alabama	12.87 (0.38)	139.2 (8.3)
Arkansas	8.24 (0.25)	104.1 (6.2)
Florida	3.24 (0.18)	61.3 (6.5)
Georgia	12.92 (0.33)	130.9 (6.8)
Kentucky	8.00 (0.28)	135.7 (7.9)
Louisiana	5.18 (0.22)	47.4 (4.3)
Mississippi	11.11 (0.34)	120.4 (7.1)
North Carolina	9.49 (0.28)	178.8 (9.3)
Oklahoma	7.50 (0.18)	88.4 (4.6)
South Carolina	6.26 (0.18)	64.3 (3.3)
Tennessee	8.49 (0.33)	192.7 (12.2)
Texas	38.03 (0.84)	259.9 (12.1)
Virginia	9.11 (0.27)	138.6 (7.6)
South total	140.45 (1.26)	1,661.8 (27.9)

Table 5. (continued)

Region/state	Area (acres)	Ownership
	millions	*thousands*
West		
Alaska[a]	0.06 (0.25)	1.5 (10.2)
Arizona	0.98 (0.21)	18.3 (5.9)
California	5.79 (0.30)	75.1 (8.6)
Colorado	3.47 (0.14)	48.9 (4.1)
Hawaii	0.09 (0.01)	1.1 (0.4)
Idaho	1.16 (0.12)	15.7 (3.2)
Kansas	1.87 (0.09)	48.4 (3.3)
Montana	2.89 (0.14)	28.9 (3.5)
Nebraska	1.08 (0.05)	20.4 (1.7)
Nevada	0.16 (0.08)	2.5 (2.2)
New Mexico	6.09 (0.21)	51.9 (4.4)
North Dakota	0.43 (0.02)	6.5 (0.7)
Oregon	3.02 (0.19)	32.1 (4.5)
South Dakota	0.43 (0.06)	6.1 (2.0)
Utah	1.28 (0.11)	13.6 (2.9)
Washington	2.13 (0.14)	49.4 (5.3)
Wyoming	0.67 (0.05)	4.9 (1.1)
West total[a]	31.60 (0.62)	425.3 (19.3)
United States[a]	253.32 (1.62)	3,695.2 (41.6)

[a]Excluding interior Alaska
Note: Data may not add to totals due to rounding

LIST OF SUPPLEMENTAL MATERIALS

The following materials are available at https://doi.org/10.2737/NRS-GTR-199.

Appendix 1

Appendix 1 is composed of four folders that segregate the tables by domain (1+, 10+, 100+, 1000+ acres of forest land). Within each domain folder are separate sets of 30 summary tables for the nation, regions, subregions, and states where the number of survey responses received meets or exceeds the minimum sample size of 100 (see Table 3, page 40). All tables are in pdf format.

Summary Tables for the Nation, Regions, Subregions, and States Found in Appendix 1

- **ONEPLUS: Family forest ownerships with 1+ acres of forest land**
  - NWOS_2018_FFO_ONEPLUS_NORTH.pdf
  - NWOS_2018_FFO_ONEPLUS_NORTHCENTRAL.pdf
  - NWOS_2018_FFO_ONEPLUS_NORTHEAST.pdf
  - NWOS_2018_FFO_ONEPLUS_PACIFICCOAST.pdf
  - NWOS_2018_FFO_ONEPLUS_ROCKYMOUNTAIN.pdf
  - NWOS_2018_FFO_ONEPLUS_SOUTH.pdf
  - NWOS_2018_FFO_ONEPLUS_SOUTHCENTRAL.pdf
  - NWOS_2018_FFO_ONEPLUS_SOUTHEAST.pdf
  - NWOS_2018_FFO_ONEPLUS_US.pdf
  - NWOS_2018_FFO_ONEPLUS_WEST.pdf
- **TENPLUS: Family forest ownerships with 10+ acres of forest land**
  - NWOS_2018_FFO_TENPLUS_AL.pdf
  - NWOS_2018_FFO_TENPLUS_AR.pdf
  - NWOS_2018_FFO_TENPLUS_AZ.pdf
  - NWOS_2018_FFO_TENPLUS_CA.pdf
  - NWOS_2018_FFO_TENPLUS_CO.pdf
  - NWOS_2018_FFO_TENPLUS_DE.pdf
  - NWOS_2018_FFO_TENPLUS_GA.pdf
  - NWOS_2018_FFO_TENPLUS_IA.pdf
  - NWOS_2018_FFO_TENPLUS_ID.pdf
  - NWOS_2018_FFO_TENPLUS_IL.pdf

- NWOS_2018_FFO_TENPLUS_IN.pdf
- NWOS_2018_FFO_TENPLUS_KS.pdf
- NWOS_2018_FFO_TENPLUS_KY.pdf
- NWOS_2018_FFO_TENPLUS_LA.pdf
- NWOS_2018_FFO_TENPLUS_MA.pdf
- NWOS_2018_FFO_TENPLUS_MD.pdf
- NWOS_2018_FFO_TENPLUS_ME.pdf
- NWOS_2018_FFO_TENPLUS_MI.pdf
- NWOS_2018_FFO_TENPLUS_MN.pdf
- NWOS_2018_FFO_TENPLUS_MO.pdf
- NWOS_2018_FFO_TENPLUS_MS.pdf
- NWOS_2018_FFO_TENPLUS_MT.pdf
- NWOS_2018_FFO_TENPLUS_NC.pdf
- NWOS_2018_FFO_TENPLUS_ND.pdf
- NWOS_2018_FFO_TENPLUS_NE.pdf
- NWOS_2018_FFO_TENPLUS_NH.pdf
- NWOS_2018_FFO_TENPLUS_NJ.pdf
- NWOS_2018_FFO_TENPLUS_NORTH.pdf
- NWOS_2018_FFO_TENPLUS_NORTHCENTRAL.pdf
- NWOS_2018_FFO_TENPLUS_NORTHEAST.pdf
- NWOS_2018_FFO_TENPLUS_NY.pdf
- NWOS_2018_FFO_TENPLUS_OH.pdf
- NWOS_2018_FFO_TENPLUS_OK.pdf
- NWOS_2018_FFO_TENPLUS_OR.pdf
- NWOS_2018_FFO_TENPLUS_PA.pdf
- NWOS_2018_FFO_TENPLUS_PACIFICCOAST.pdf
- NWOS_2018_FFO_TENPLUS_ROCKYMOUNTAIN.pdf
- NWOS_2018_FFO_TENPLUS_SC.pdf
- NWOS_2018_FFO_TENPLUS_SOUTH.pdf
- NWOS_2018_FFO_TENPLUS_SOUTHCENTRAL.pdf

- NWOS_2018_FFO_TENPLUS_SOUTHEAST.pdf
- NWOS_2018_FFO_TENPLUS_TN.pdf
- NWOS_2018_FFO_TENPLUS_TX.pdf
- NWOS_2018_FFO_TENPLUS_US.pdf
- NWOS_2018_FFO_TENPLUS_UT.pdf
- NWOS_2018_FFO_TENPLUS_VA.pdf
- NWOS_2018_FFO_TENPLUS_VT.pdf
- NWOS_2018_FFO_TENPLUS_WA.pdf
- NWOS_2018_FFO_TENPLUS_WEST.pdf
- NWOS_2018_FFO_TENPLUS_WI.pdf
- NWOS_2018_FFO_TENPLUS_WV.pdf
- NWOS_2018_FFO_TENPLUS_WY.pdf

• HUNDREDPLUS: Family forest ownerships with 100+ acres of forest land

- NWOS_2018_FFO_HUNDREDPLUS_AL.pdf
- NWOS_2018_FFO_HUNDREDPLUS_AR.pdf
- NWOS_2018_FFO_HUNDREDPLUS_CA.pdf
- NWOS_2018_FFO_HUNDREDPLUS_CO.pdf
- NWOS_2018_FFO_HUNDREDPLUS_GA.pdf
- NWOS_2018_FFO_HUNDREDPLUS_ID.pdf
- NWOS_2018_FFO_HUNDREDPLUS_LA.pdf
- NWOS_2018_FFO_HUNDREDPLUS_MI.pdf
- NWOS_2018_FFO_HUNDREDPLUS_MN.pdf
- NWOS_2018_FFO_HUNDREDPLUS_MO.pdf
- NWOS_2018_FFO_HUNDREDPLUS_MS.pdf
- NWOS_2018_FFO_HUNDREDPLUS_MT.pdf
- NWOS_2018_FFO_HUNDREDPLUS_NC.pdf
- NWOS_2018_FFO_HUNDREDPLUS_NORTH.pdf
- NWOS_2018_FFO_HUNDREDPLUS_NORTHCENTRAL.pdf
- NWOS_2018_FFO_HUNDREDPLUS_NORTHEAST.pdf
- NWOS_2018_FFO_HUNDREDPLUS_NY.pdf

- NWOS_2018_FFO_HUNDREDPLUS_OK.pdf
- NWOS_2018_FFO_HUNDREDPLUS_OR.pdf
- NWOS_2018_FFO_HUNDREDPLUS_PACIFICCOAST.pdf
- NWOS_2018_FFO_HUNDREDPLUS_ROCKYMOUNTAIN.pdf
- NWOS_2018_FFO_HUNDREDPLUS_SC.pdf
- NWOS_2018_FFO_HUNDREDPLUS_SOUTH.pdf
- NWOS_2018_FFO_HUNDREDPLUS_SOUTHCENTRAL.pdf
- NWOS_2018_FFO_HUNDREDPLUS_SOUTHEAST.pdf
- NWOS_2018_FFO_HUNDREDPLUS_TN.pdf
- NWOS_2018_FFO_HUNDREDPLUS_TX.pdf
- NWOS_2018_FFO_HUNDREDPLUS_US.pdf
- NWOS_2018_FFO_HUNDREDPLUS_VA.pdf
- NWOS_2018_FFO_HUNDREDPLUS_WEST.pdf
- NWOS_2018_FFO_HUNDREDPLUS_WI.pdf
- NWOS_2018_FFO_HUNDREDPLUS_WY.pdf

- **THOUSANDPLUS: Family forest ownerships with 1,000+ acres of forest land**
  - NWOS_2018_FFO_THOUSANDPLUS_NORTH.pdf
  - NWOS_2018_FFO_THOUSANDPLUS_PACIFICCOAST.pdf
  - NWOS_2018_FFO_THOUSANDPLUS_ROCKYMOUNTAIN.pdf
  - NWOS_2018_FFO_THOUSANDPLUS_SOUTH.pdf
  - NWOS_2018_FFO_THOUSANDPLUS_SOUTHCENTRAL.pdf
  - NWOS_2018_FFO_THOUSANDPLUS_SOUTHEAST.pdf
  - NWOS_2018_FFO_THOUSANDPLUS_US.pdf
  - NWOS_2018_FFO_THOUSANDPLUS_WEST.pdf

Listed below are the titles of tables summarizing forest area by ownership category, sample size and cooperation rate, and responses to the 2018 National Woodland Owner Survey. These table titles are for the entire United States, denoted by the "US" preceding the table number; analogous tables are available for regions, subregions, and states as listed above.

- Table US-1 (2018)—Estimated area of forest land by ownership category, United States, 2018
- Table US-2 (2018; FFO)—Sample size and cooperation rate for family forest ownerships for the USDA Forest Service, National Woodland Owner Survey, United States, 2018

- Table US-3 (2018; FFO 10+)—Total estimated area and estimated number of family forest ownerships (10+ acres of forest land), United States, 2018
- Table US-4 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by size of land and forest holdings and whether they own multiple forested parcels, United States, 2018
- Table US-5 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by ownership type and number of owners, United States, 2018
- Table US-6 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by whether they have a primary residence, cabin or secondary residence, or farm is within 1 mile of their forest land, United States, 2018
- Table US-7 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by reason for owning, United States, 2018
- Table US-8 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by acquisition type, source, and land tenure, United States, 2018
- Table US-9 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by land transfer, United States, 2018
- Table US-10 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by forest management decisionmaker, United States, 2018
- Table US-11 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by management plan familiarity and status, United States, 2018
- Table US-12 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by timber harvesting status, products harvested, reasons for harvesting, and use of a forester, United States, 2018
- Table US-13 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by types of nontimber forest products harvested and reasons for harvesting, United States, 2018
- Table US-14 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by past (previous 5 years) management activities, United States, 2018
- Table US-15 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by future (next 5 years) management activities, United States, 2018
- Table US-16 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by familiarity with and participation in green certification programs, United States, 2018
- Table US-17 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by familiarity with and participation in property tax programs, United States, 2018
- Table US-18 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by familiarity with and current and future participation in conservation easements, United States, 2018

- Table US-19 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by familiarity with and participation in cost-share programs, United States, 2018
- Table US-20 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by familiarity with and participation in carbon sequestration programs, United States, 2018
- Table US-21 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by past and future participation in leasing and leasing activities, United States, 2018
- Table US-22 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by who has recreated and recreation activities, United States, 2018
- Table US-23 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by land posting status, United States, 2018
- Table US-24 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by advice received, methods, and sources, United States, 2018
- Table US-25 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by preferred assistance topics, methods, and programs/policies, United States, 2018
- Table US-26 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by landowner concerns, United States, 2018
- Table US-27 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by likelihood of transfer and transfer recipient, United States, 2018
- Table US-28 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by conservation attitudes, United States, 2018
- Table US-29 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by landowner demographics, United States, 2018
- Table US-30 (2018; FFO 10+)—Estimated area and estimated number of family forest ownerships (10+ acres of forest land) by income from forest land for primary owner, United States, 2018

Appendix 2

Survey Instrument

- `NWOS_6_0_ANNOTATED.pdf`: An annotated version of the survey instrument used for the 2018 NWOS. Annotations correspond to the values in the NWOS Database (Caputo and Butler 2021) and are references in various sections of this report. While this version is for Alabama, the version used for other states are nearly identical with the exceptions of changes to the state names, area of forest land in a state, region-specific examples of non-timber forest products, and the state-specific tax program listed. Copies of all state survey instruments are available at: www.fia.fs.fed.us/nwos/quest.

Appendix 3

Mailing Materials

- `NWOS 2018 POSTCARD 1.pdf`: Pre-notice postcard.
- `NWOS 2018 COVER LETTER 1.pdf`: Cover letter accompanying first questionnaire packet.
- `NWOS 2018 POSTCARD 2.pdf`: Thank you/reminder postcard.
- `NWOS 2018 COVER LETTER 2.pdf`: Cover letter accompanying second questionnaire packet.

Appendix 4

Nonresponse Assessment Results

- `NWOS_IMPUTATION_CONVERGENCE_PLOTS.pdf`: Convergence plots used as model diagnostics for item imputation for the 2018 National Woodland Owner Survey.
- `TELEPHONE_NONRESPONSE_SUMMARY.pdf:` Comparisons between phone and mail respondents for all variables tested for the 2018 National Woodland Owner Survey.
- `UNIT_NONRESPONSE_MODEL_RESULTS.pdf`: Coefficients and goodness of fit statistics for state-level, unit nonresponse models for the 2018 National Woodland Owner Survey.

Butler, Brett J.; Butler, Sarah M.; Caputo, Jesse; Dias, Jacqueline; Robillard, Amanda; Sass, Emma M. 2021. **Family forest ownerships of the United States, 2018: results from the USDA Forest Service, National Woodland Owner Survey.** Gen. Tech. Rep. NRS-199. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 52 p. [plus 4 appendixes] https://doi.org/10.2737/NRS-GTR-199.

The National Woodland Owner Survey (NWOS) is conducted by the U.S. Department of Agriculture Forest Service, Forest Inventory and Analysis program, to collect information on the attitudes, behaviors, and other characteristics of America's private forest ownerships. This report provides documentation and results from the 2017-2018 iteration of the NWOS, which is referenced by the terminal year, 2018. The particular focus of the results in this report is family forest ownerships with 10+ acres of forest land; other groups of forest ownerships will be the focus of separate reports. A brief history and background of the NWOS are provided along with a synopsis of the survey implementation and estimation procedures. Selected results are presented and full sets of summary tables, by geography and four domains of interest, are provided in the accompanying supplemental materials. The geographies include states, regions, and the nation with summary tables provided where minimum sample sizes were obtained. The domains of interest used in the supplemental summary tables are family forest ownerships with holding sizes of 1+, 10+, 100+, and 1,000+ acres of forest land. The report concludes with a discussion of data interpretation, data limitations, and how to compare results with previous iterations of the NWOS.

KEY WORDS: Family forest owners, private forest owners, attitudes, behaviors, demographics, forest inventory and analysis