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A Meta-Analysis of Publications Citing USDA Forest Service National Woodland Owner Survey Core Products Through 2021

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Abstract

The National Woodland Owner Survey (NWOS) is implemented by the U.S. Department of Agriculture (USDA), Forest Service, Forest Inventory and Analysis (FIA) program, and is aimed at understanding the social context of the forests of the United States by looking into the attitudes, behaviors, and general characteristics of forest landowners and their land. The surveys cover all types of private forest ownerships, but reporting of results often focuses on families, individuals, trusts, estates, and family partnerships, collectively referred to as family forest ownerships. Survey results are available in published reports and, depending on the iteration, through online data access tools. This paper summarizes citations associated with core NWOS products through 2021. The data show that the products cited most often were those from the 2006 NWOS cycle. The results also show that the most common sources for published documents that cite NWOS findings are the Forest Service and the Journal of Forestry, and that the most common document types are journal articles and reports. Common topics of documents citing core NWOS products include forest policies, such as property taxes and carbon offset programs, invasive plants, forest/woody biomass, and collective action. The results suggest that efforts toward making researchers more aware of published reports associated with more recent NWOS survey findings may encourage citation of newer NWOS findings.

Keywords: private forest owners, family forest owners, Forest Inventory and Analysis (FIA), literature review

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Cover Photograph

White pine, Leverett, MA. USDA Forest Service photo by Brett J. Butler.

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INTRODUCTION

The National Woodland Owner Survey (NWOS) is one of the three major components of the Forest Inventory and Analysis (FIA) program (<https://research.fs.usda.gov/programs/fia>) of the U.S. Department of Agriculture (USDA), Forest Service. The FIA Nationwide Forest Inventory (NFI) generates information focused on the biophysical dimensions of the forests, including forest extent, composition, and structure. The FIA National Resource Use Monitoring (NRUM), which includes the Timber Products Output survey (TPO), generates information focused on the economic dimensions of the forests, specifically the amounts and types of wood harvested and processed. The FIA NWOS, the focus of this report, generates information focused on the social dimensions of the forests with the aim of increasing understanding of the attitudes, behaviors, and general characteristics of private forest ownerships across the United States.

Although the NWOS covers all private forest ownerships across the United States, the reporting of survey results has traditionally focused on the estimated 9.6 million families, individuals, trusts, estates, and family partnerships, collectively referred to as family forest ownerships (Butler et al. 2021a). In total, these ownerships control an estimated 272 million acres, or 39 percent, of forest land across the United States (excluding interior Alaska) (Butler et al. 2021a). The NWOS generates information related to general questions about the land, owner(s), and their ownership; reasons for owning the forest land; the history of the forest land; the uses of the forest land; the recreation that takes place on the forest land; sources of information or assistance for landowners; concerns landowners might have for their forest land; and landowners' plans for their forest land. The results from the NWOS are used to inform and assist in the implementation of policies, programs, and services aimed at private forest owners and to help set the foundation and context for other research on private forest owners.

This report analyzes peer-reviewed journal articles, reports, theses, dissertations, conference proceedings papers, and books that have cited core NWOS products. With the hope of better understanding how NWOS data are used, we present summaries on the number of citations by NWOS product and cycle, where the work is being published, and the topics of those publications. The information presented here can help the NWOS program better understand what draws people to the survey results and contemplate how the program might improve both the survey and access to the results.

What Is the NWOS?

The NWOS is a long-term survey that has evolved over time in frequency, administration, content, and scope. The first national survey was conducted in 1953 by Josephson and McGuire (1958). The survey focused on broad topics, such as the type of private ownership (commercial or otherwise), the location of private forest land in the United States, and the kinds of timber products harvested from those acres. Unlike future iterations of the NWOS, the 1953 report did not provide

information about individual landowners' demographics, attitudes, or behaviors. Although the content of the report was more restricted than the current NWOS, it was the first national report of forest owners in the United States conducted by the Forest Service and is considered the first iteration and progenitor of future iterations of the NWOS.

The second iteration of the NWOS was conducted in 1978 by Birch, Lewis, and Kaiser in conjunction with the USDA Economic Research Service (Birch et al. 1982). The effort gathered information on the 333 million acres of forest owned by the 7.8 million private ownerships in the United States, including information on size of forest holdings and demographics at the national and regional levels.

The third NWOS cycle, and the first done by the FIA program, was conducted in 1993 by Birch (1996a, 1996b; 1997a, 1997b). The survey added state-level results and included information on ownership characteristics, demographics, ownership objectives, timber harvesting, and management practices.

The fourth NWOS cycle was conducted between 2002 and 2006 and is referenced by the terminal year, 2006. Heavily redesigned, the 2006 survey became the foundation for subsequent iterations of the NWOS conducted from 2011 to 2013 and from 2017 to 2018. Annual implementation of the NWOS began in 2019 and uses 5-year survey cycles. Since the 2006 cycle, the methods and content have been quite stable. The information collected includes ownership characteristics, ownership objectives, forest uses, management practices, program participation, recreational activities, landowner assistance, concerns, future uses, and owner demographics. Beginning with the 2013 cycle, the NWOS has been implemented by the Family Forest Research Center (FFRC), a joint venture between the USDA Forest Service, Northern Research Station and the University of Massachusetts Amherst.

During the 2018 cycle, corporate ownerships of large forest holdings (45,000 or more acres) were surveyed separately from other private forest land ownerships, but analogous information on attitudes, behaviors, and other characteristics was collected. To address the unique circumstances associated with large corporate forest ownerships, different sampling, questionnaire, and implementation procedures were developed. A pilot test was conducted in 2018 (Sass et al. 2021), and a full implementation of the large corporate survey is planned for the 2024–2028 NWOS cycle.

Also during the 2018 cycle, implementation of an urban NWOS was initiated. Pilot tests were conducted in Austin (TX) and in the Wisconsin cities of Green Bay, Madison, Milwaukee, and Wausau. Full implementation followed in Austin (TX), Baltimore (MD), Denver (CO), Houston (TX), Portland (OR), and St. Louis (MO). These surveys focused on the attitudes, behaviors, and other characteristics of residential owners of green spaces in these cities. The urban survey was put on hiatus in 2023.

Background on NWOS Citation Analyses

A summary of reports and articles that used FIA NFI data was conducted by Rudis in 2003, but a comparable study for the NWOS has not been conducted. Rudis (2003) found that FIA NFI data were valuable information to many stakeholders and that much of the collected data were fully used, particularly when they were “consistent across spatial and temporal scales important to the geographic region and questions being addressed.” In addition, the report concluded that the data needed to be in formats usable for analysis, be flexible in data management and organization, be able to be reconstructed without bias, and work logically in tandem with other comprehensive data, such as satellite imagery and surveys.

Although not limited to NWOS products, Butler et al. (2022) found 640 peer-reviewed articles that focused on family forest owners in the United States published in 95 sources between 2000 and 2019. The review authors analyzed the topics of the articles, the publications in which the articles appeared, the states and regions the articles focused on, and the articles that were most cited. Their literature review provided the context for this report and was used as a template for the methods and analyses.

Report Overview

The aim of this report is to analyze how NWOS products are being utilized, specifically in a research context. The focus is on literature citations of core NWOS products (Forest Service reports, journal articles, and online data access tools; Table 1) associated with the 1953 cycle through the 2018 cycle. These products have been written for varied audiences, including government officials, researchers, forestry professionals, and others who may be interested in private forest owners. To date, no effort has been made to systematically assess these uses and users.

In this report, we provide data on what NWOS topics, reports, and/or data products are most cited and presumably most useful and valuable to other researchers. Our analysis of citations helps identify whether researchers are aware of and consulting the most up to date NWOS reports and products or are drawing on older sources. The report indicates the journals and other outlets where the results are being cited, and it identifies the types and formats of NWOS products that, based on citations, are of greatest value. The results of the study can inform future iterations of the NWOS, including content development, analyses, and dissemination of findings. The analyses in this report could also inform research topics that the NWOS does not currently address but may be able to address in the future.

Table 1.—Core products, grouped by cycle, from the USDA Forest Service, National Woodland Owner Survey (NWOS), 1953–2018

Cycle, author, publication year	Title	Publisher, product type
NWOS 2018		
Butler and Caputo (2021)	Weighting for the USDA Forest Service, National Woodland Owner Survey	Forest Service GTR ^a
Butler et al. (2021a)	Family forest ownerships of the United States, 2018: results from the USDA Forest Service, National Woodland Owner Survey	Forest Service GTR
Butler et al. (2021b)	One size does not fit all: relationships between size of family forest holdings and landowner attitudes and behaviors	Journal of Forestry
Sass et al. (2021)	Dynamics of large corporate forestland ownerships in the United States	Journal of Forestry
Caputo and Butler (2019)	National Woodland Owner Survey Dashboard (NWOS-DASH)	Forest Service online tool
NWOS 2013		
Butler and Snyder (2017)	National Woodland Owner Survey: family forest ownerships with 1 to 9 acres, 2011–2013	Forest Service RB ^b
Butler et al. (2016a)	USDA Forest Service, National Woodland Owner Survey 2011–2013: design, implementation, and estimation Methods	Forest Service GTR
Butler et al. (2016b)	Family forest ownerships of the United States, 2013: findings from the USDA Forest Service's National Woodland Owner Survey	Journal of Forestry
Butler et al. (2016c)	USDA Forest Service National Woodland Owner Survey: national, regional, and state statistics for family forest and woodland ownerships with 10+ acres, 2011–2013	Forest Service RB
Butler et al. (2018)	NWOS Table Maker Version 2.0	Forest Service online tool
NWOS 2006		
Butler (2008)	Family forest owners of the United States, 2006	Forest Service GTR
Butler et al. (2008)	NWOS Table Maker Version 1.0	Forest Service online tool
Butler and Leatherberry (2004)	America's family forest owners	Journal of Forestry
NWOS 1993		
Birch (1997a)	Private forest-land owners of the southern United States, 1994	Forest Service RB
Birch (1997b)	Private forest-land owners of the western United States, 1994	Forest Service RB
Birch (1996a)	Private forest-land owners of the northern United States, 1994	Forest Service RB
Birch (1996b)	Private forest-land owners of the United States, 1994	Forest Service RB
NWOS 1978		
Birch et al. (1982)	The private forest-land owners of the United States	Forest Service RB
NWOS 1953		
Josephson and McGuire (1958)	Ownership of forest land and timber	Section in Forest Service Resource Report

^a Forest Service General Technical Report

^b Forest Service Resource Bulletin

METHODS

The methods used in this study follow the procedures outlined by Jesson et al. (2011) and the general approach used by Butler et al. (2022) of specifying the scope, the data sources, the inclusion criteria, and the synthesis techniques.

Scope

The study analyzed the sources, topics, and other metadata associated with peer-reviewed journal articles and reports that cited one or more of the core products from the 1953 cycle of the NWOS through the 2018 cycle (Table 1). Core NWOS products were the primary means by which summaries of the results for each iteration were provided. These included Forest Service reports, journal articles, and online data access tools. When available, reports that summarized methods were also included. State-level NWOS summary publications and publications focused on specific topics/analyses were not included in the core products list.

Data Sources

Metadata were gathered for peer-reviewed journal articles, reports, theses, dissertations, conference proceedings papers, and books citing the core NWOS products (Table 1). These documents were identified using the Google Scholar search engine (Google 2022). Google Scholar was selected because it contains a greater breadth of documents than other databases. Separate searches were conducted in October and November 2021 for each of the core NWOS products. First, each core NWOS publication was found in the search engine. Next, all documents identified through the “cited by” feature were retrieved. Core NWOS products that cited another core NWOS product were retained in the results. Birch (1996b), “Private forest-land owners of the United States, 1994,” was not found in Google Scholar; however, many articles that cited other publications by Birch (1996a; 1997a, 1997b) also cited Birch (1996b), allowing us to record citations of that publication.

All documents found were compiled into a spreadsheet categorized by the core NWOS product cited. All files and associated metadata were uploaded into a Zotero citation database (Corporation for Digital Scholarship 2024). The metadata included title, authors, date published, source, and digital object identifier (DOI). Once all documents were uploaded, the data in the citation database were cleaned to ensure the entries were as complete and consistent as possible, with a specific focus on DOIs. For all documents with DOIs, additional metadata, including keywords, were downloaded from the Web of Science citation database (Clarivate Analytics 2021).

Inclusion Criteria

For a document to be included in this study, it needed to cite a core NWOS product (Table 1). A document could be of any type, originate from any country, and have been published any time before the search date. Due to the nature of the primary search engine, Google Scholar, the document types were largely constrained to peer-reviewed journal articles, reports, theses, dissertations, conference proceedings papers, and books.

Synthesis Techniques

Analyses focused on the metadata associated with the documents citing the core NWOS products. General summary statistics included counts of the number of documents published by core NWOS product, NWOS cycle, year, publication source, and document type. If a document cited more than one NWOS product, it was treated as a single document to avoid double counting.

In addition to counting citations per year, citation counts were normalized by publication date year to account for how long a publication has been available. This was calculated as follows:

$$\text{Year-adjusted Citation Count} = \frac{\text{Citation Count}}{(2022+1) - \text{Publication Year}} \quad (1)$$

Common topics of the documents citing the core NWOS products were identified using the Rapid Automatic Keyword Extraction (RAKE) machine learning algorithm (Rose et al. 2010). The input text consisted of titles and keywords. The documents were limited to those found in the Web of Science citation database. The RAKE score is the sum of the ratios of the degrees (number of co-occurrences) and frequencies (counts) of the keywords in each phrase across the entire text:

$$\text{RAKE Score} = \sum_{i=1}^n \frac{\text{deg}(w)}{\text{freq}(w)} \quad (2)$$

where $\text{deg}(w)$ = the number of times keyword w co-occurs with other keywords; and

$\text{freq}(w)$ = the number of times keyword w appears.

These scores were calculated using the UDpipe package in the R statistical environment (Wijffels 2023).

All analyses were conducted in the R statistical environment (R Core Team 2023).

RESULTS AND DISCUSSION

The Google Scholar search identified 1,379 unique articles, reports, theses, dissertations, conference proceedings papers, books, and other document types that cited core NWOS publications. Of these, 637 documents were also found in the Web of Science citation database. The reason for the substantial difference in the number of documents is that many of the documents found in Google Scholar are not from peer-reviewed, indexed sources. For example, graduate theses and dissertations and reports published by governmental or nongovernmental organizations, including many Forest Service publications, are generally not included in the Web of Science citation database but are likely to appear in Google Scholar.

Citations by NWOS Cycle

Looking at the core publications associated with each NWOS cycle, the 2006 NWOS products are the most cited; collectively they account for 65 percent of all citations (n=956 citations) (Fig. 1A). Products associated with this iteration of the NWOS are

still among the most widely cited NWOS products despite the availability of more recent reports. The next most commonly cited cycle is the 1993 NWOS, which has 474 citations or 34 percent of the total number of citations. The 2013 NWOS cycle has four associated core products and a collective 316 citations (21 percent). The 2018 NWOS cycle has five associated products, most of which were not published until 2021. These products have a collective 21 citations. The product of the 1953 iteration, Josephson and McGuire (1958), has the least number of citations (n=11). The year-adjusted citation counts show that the 2006 NWOS cycle is still the most cited (Fig. 1B), but the 2013 NWOS cycle becomes the second most cited, followed by 1993, 2018, and 1953.

Citations by Core Product

Of the core NWOS products (Table 1), Butler and Leatherberry (2004), a peer-reviewed article published in the *Journal of Forestry* that summarizes the preliminary results from the 2006 NWOS cycle, is the most cited (n=466 citations; Fig. 2A). The next most cited (n=440) is Butler (2008), a General Technical Report published by the Forest Service that provided more detailed results (i.e., state- and region-level summaries of all questions) from the same NWOS cycle. In year-adjusted citation counts, these two are still the most cited, but the ranking flips with Butler (2008) having 29.3 citations per year and Butler and Leatherberry (2004) having 24.5 citations per year (Fig. 2B).

The next most cited core products are Birch (1997a), the summary report for the southern United States from the 2003 NWOS cycle, followed by Butler et al. (2016b), the primary report from the 2013 NWOS cycle. Adjusting for publication year, the relative importance of the products from the 2006 and 2013 NWOS cycles flips (Fig. 2B). Decisions to publish separate regional reports, which was done for only the 2003 NWOS cycle, influences the comparisons across publications. Sass et al. (2021) and Josephson and McGuire (1958) have the lowest numbers of citations. The low number of citations for Josephson and McGuire (1958) may be due in part to the report being published as part of a larger book; the book may have been cited rather than the report. Sass et al. (2021), which had yet to have any citations when the citation databases were searched, had only been recently published.

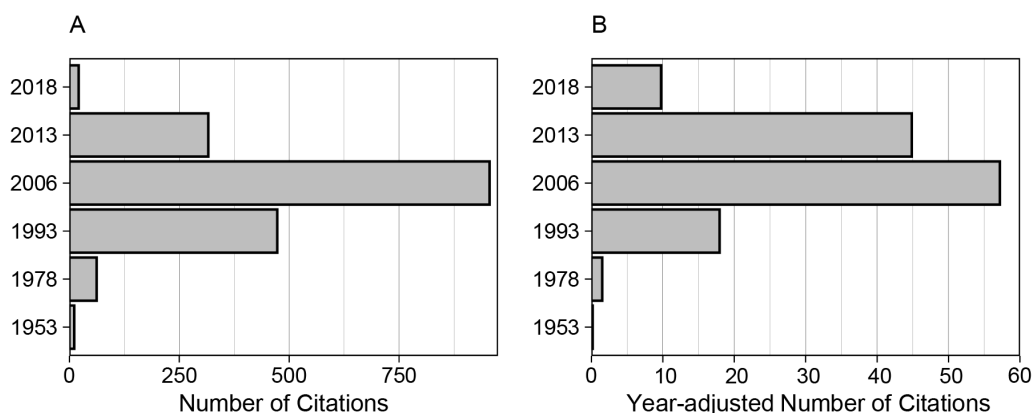


Figure 1.—Number of citations (A) and year-adjusted number of citations (B) of core USDA Forest Service, National Woodland Owner Survey products by survey cycle. Year-adjusted number of citations is calculated as citation count / ((2022 + 1) - publication year).

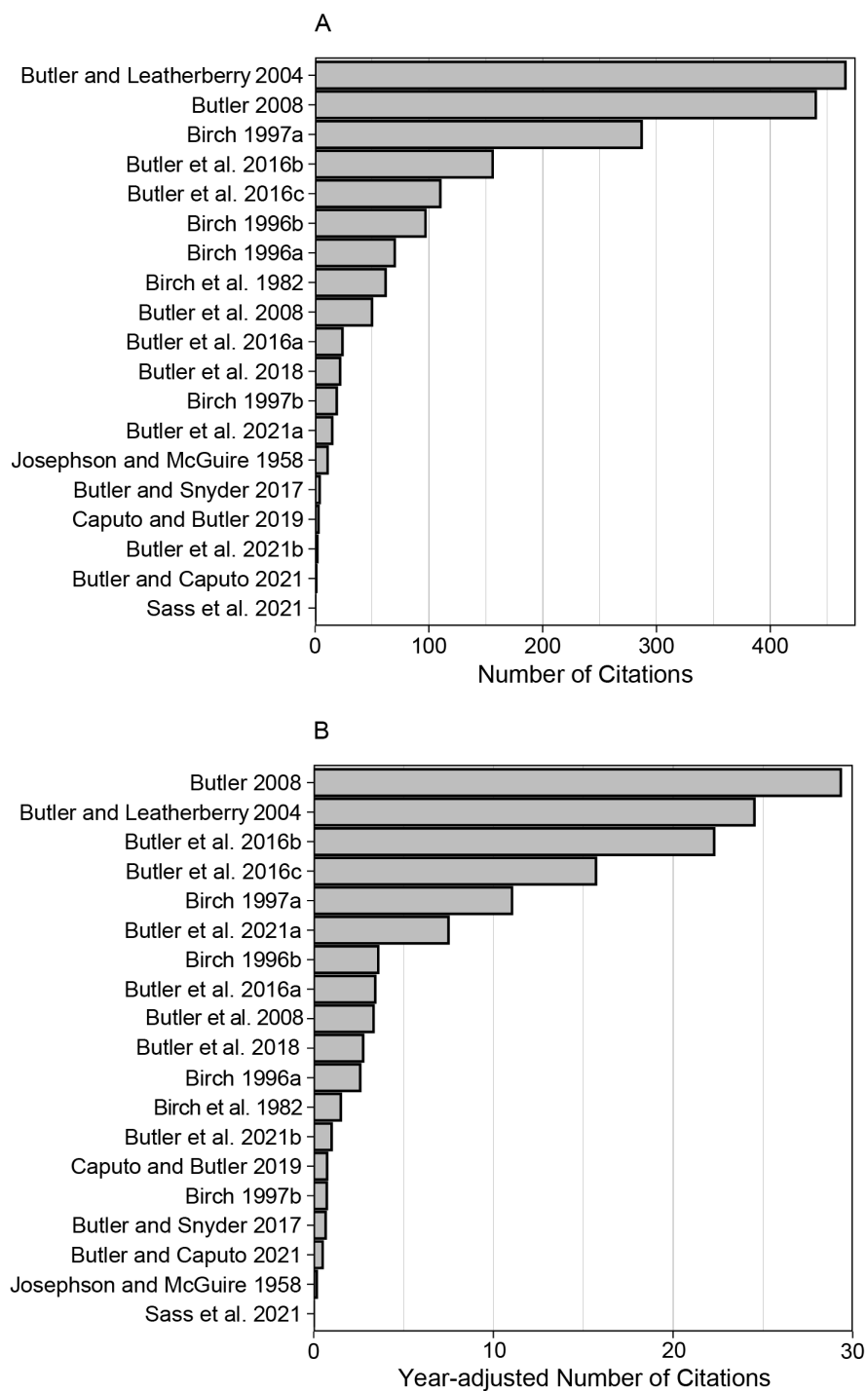


Figure 2.—Number of citations (A) and year-adjusted number of citations (B) of core USDA Forest Service, National Woodland Owner Survey products. Year-adjusted number of citations is calculated as citation count / ((2022 + 1) - publication year).

Citations by Year

Documents citing core NWOS products first appeared in 1983, soon after the publication of Birch et al. (1982). Two additional citations came in 1983 and four more in 1985 (Fig. 3). The low level of citation continued until Birch published four studies in 1996 and 1997, after which citations of core NWOS products increased substantially. The numbers continued to increase until a plateau was reached around 2014. Between 2014 and 2021, a mean of 72 documents cited core NWOS products. The highest number of citations was in 2019 (n=89).

The number of publications citing core NWOS products has a significant, positive correlation ($\rho_{\text{Spearman}} = 0.85$; $p\text{-value} < 0.01$) with the total number of family forest owner articles published each year as reported in Butler et al. (2022). This relationship is logical: If there are more relevant publications, there are more opportunities for citations.

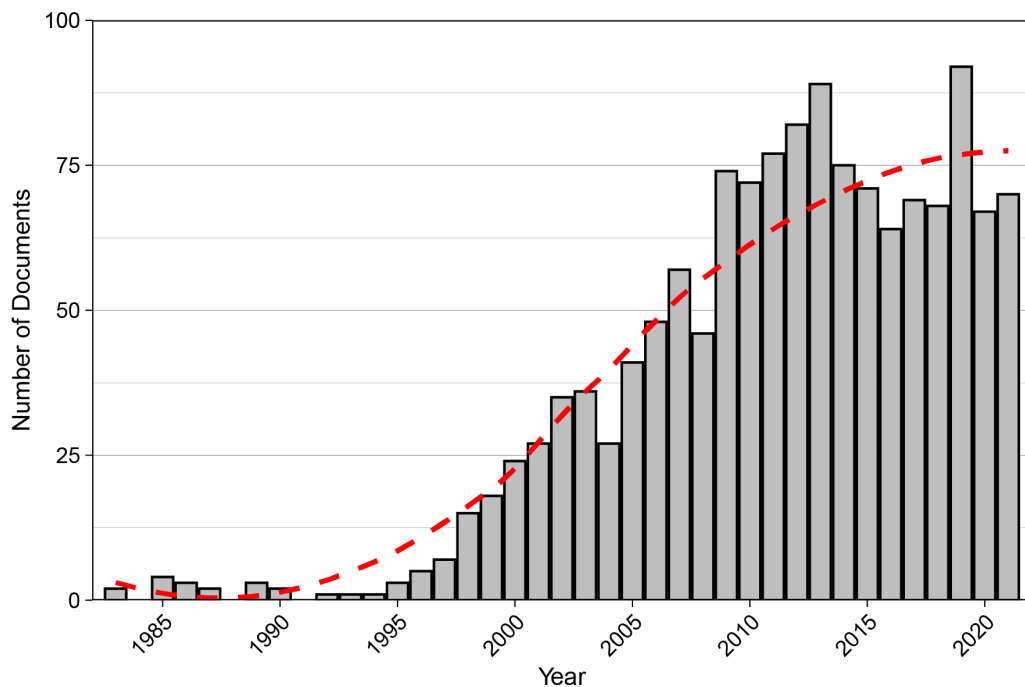


Figure 3.—Number of documents citing core USDA Forest Service, National Woodland Owner Survey products by year.

Publication Sources

Based on the Google Scholar search results, the Forest Service is the most common publisher of documents citing NWOS core products; this publication source includes 267 documents and accounts for 19 percent of the total documents (Fig. 4). The Journal of Forestry is the second most common publication source with 105 documents (8 percent of the total documents). Other relatively common publication sources include the journals Forest Policy and Economics and Small-scale Forestry, which published 48 and 46 documents, respectively. The journals Forest Science, Northern Journal of Applied Forestry, Southern Journal of Applied Forestry, and Western Journal of Applied Forestry merged in 2014; combined they published 86 documents. Other sources with 20 or more publication citing core NWOS products are the journals Landscape and Urban Planning, Forests, Journal of Extension, and the Land Use Policy. An additional 174 sources published documents citing core NWOS products, a large proportion of which published one or two such documents. (Note that articles and reports are included in the source analysis; books, theses, dissertations, and conference papers are excluded.)

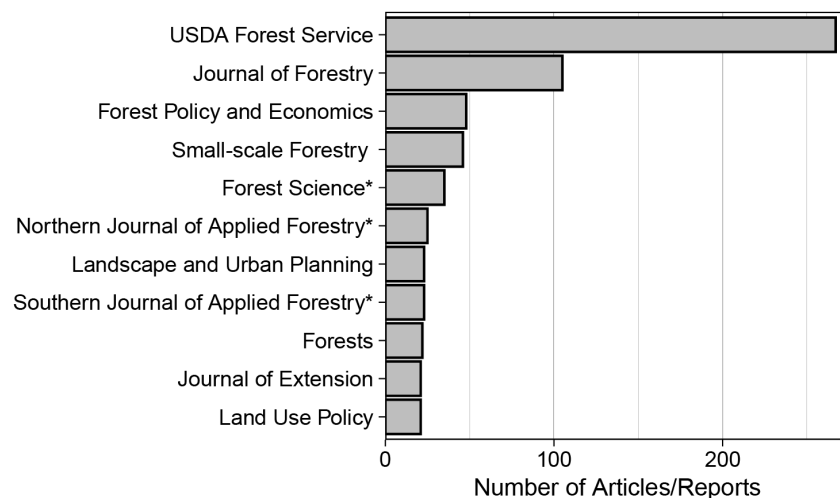


Figure 4.—Number of articles and reports citing core USDA Forest Service, National Woodland Owner Survey products by source. Only sources with 20 or more articles and reports are included in the chart. Publications denoted by an asterisk (*) were merged with Forest Science in 2014.

The publication source of documents containing citations of NWOS core products can indicate where the NWOS data are seen by readers. The Forest Service is the most common publisher, and because its publications are available at no charge we can infer that other forest researchers and any interested readers, including members of the general public, may see these documents; thus the NWOS data published by the Forest Service can potentially reach a larger audience compared to the documents published in academic journals, which have specific target audiences. For example, the stated aim of the Journal of Forestry is to keep “forest management professionals informed about significant developments and ideas in the many facets of forestry” (Society of American Foresters 2022). Thus, the works published in this journal may reach a smaller audience than those published by the Forest Service. The aims and scopes of other journals target other audiences and have varying geographic areas of interest (e.g., regional, national, or international). But an important caveat is the dissemination and outreach channels. While Forest Service publications are available free of charge, they are not consistently indexed or included in citation databases, such as Web of Science, and publicity associated with releases is variable.

Document Types

The types of documents found in Google Scholar citing the NWOS core publications include journal articles, reports, theses, dissertations, conference proceedings papers, sections of books and reports, and books (Fig. 5). Peer-reviewed journal articles are the most common document type, representing over half of the documents (n=748; 54 percent); these were published across 184 journals. The second most common document type is a report (n=177; 13 percent). Many of these are Forest Service General Technical Reports and Resource Bulletins; others are reports from various other sources (e.g., universities). Theses and dissertations add 248 documents (18 percent). Books and miscellaneous documents are the least common types.

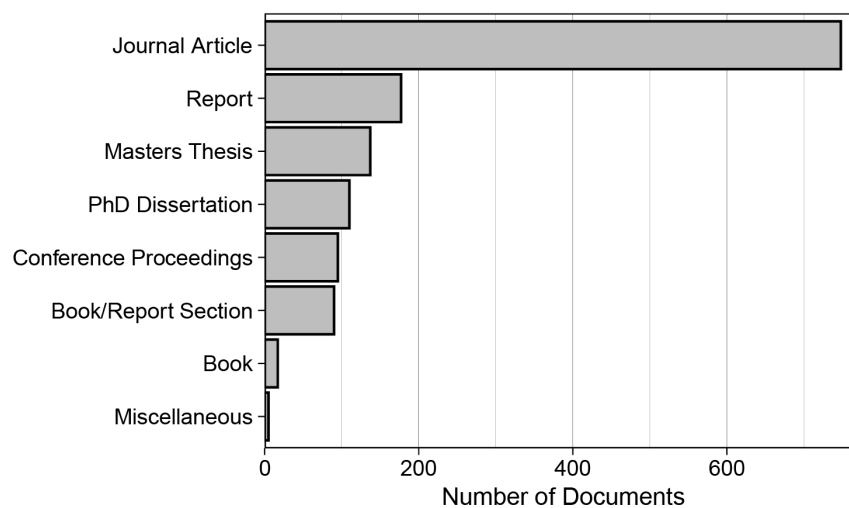


Figure 5.—Number of documents citing core publications of the USDA Forest Service, National Woodland Owner Survey products by document type.

Topics

Topics were assessed based on the titles and keywords associated with the 637 documents that cite core NWOS products found in the Web of Science citation database. The topics identified using the RAKE algorithm can be divided into five broad categories: population of interest, management/conservation practices, landowner characteristics, geographies of interest, and methodological approaches (Fig. 6). The primary populations of interests, as expected, aligned well with those of the core NWOS products, e.g., nonindustrial private, private, and family forest/landowners. Common management/conservation practices and topics included forest policies, such as property taxes and carbon offset programs, invasive plants, forest/woody biomass, and collective action.

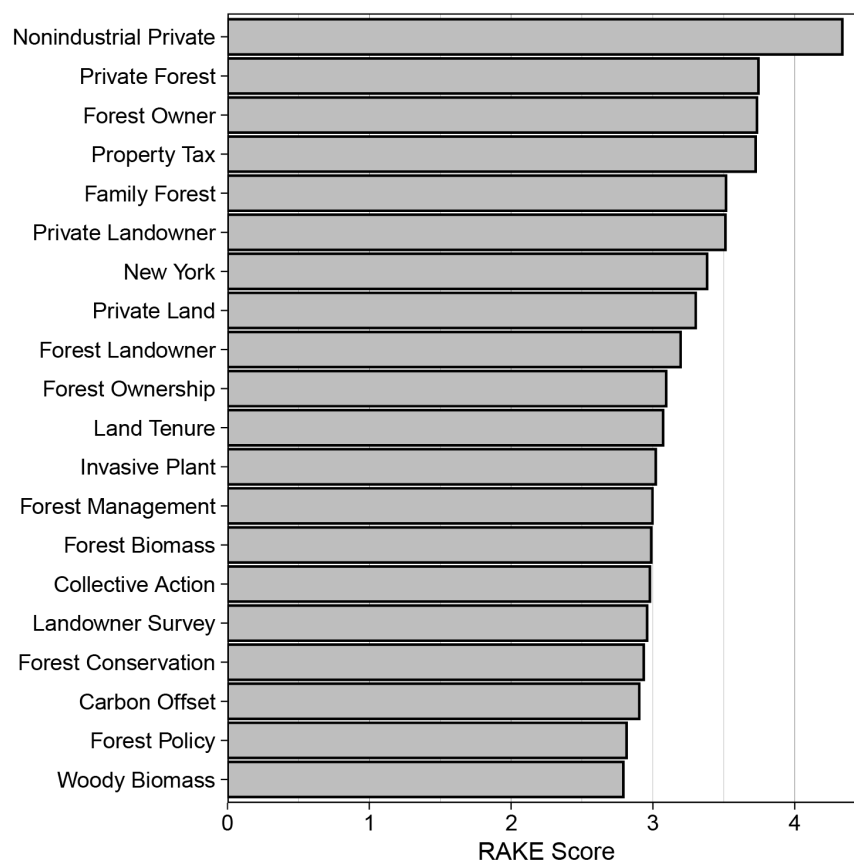


Figure 6.—Top 20 topics, based on titles and keywords, of documents citing core USDA Forest Service, National Woodland Owner Survey products. Only topics with frequencies of at least 5 are included. RAKE score shows the relative importance of each phrase (see Methods for how RAKE score is calculated).

CONCLUSIONS

There are 1,379 citations of the core NWOS products through 2021. The documents that included these citations were largely peer-reviewed journal articles and Forest Service reports focusing on topics related to forest conservation, management, and policy. The products from the 2006 NWOS are the most cited, which may be related to inertia associated with citations of these publications and people not always being aware that there are newer publications. More work to advertise the availability of more recent cycles and associated products would likely increase the citations of these products.

Although most of these analyses relied on results from a robust citation database, Google Scholar, its limits have implications on these analyses. Google Scholar is more comprehensive than other citation databases (e.g., Web of Science), but certain types of documents are often excluded. These include nonacademic work (often called gray literature) and certain types of academic works (e.g., theses, dissertations, and conference papers), which therefore may be underrepresented. These issues were further exacerbated in the analysis that relied on results from the Web of Science citation database, which, like most other citation databases, is largely limited to indexed materials published in peer-reviewed journals. There are also documents that cite statistics from the core NWOS reports without proper attribution, such as those that include NWOS results found in a secondary source and cite the secondary source instead of the primary NWOS source.

Another limit to this study is the exclusion of NWOS products that are not considered core NWOS products. For example, there are state-level two-page summary documents and many reports on specific topics from the NWOS that were not included. A future effort could include a survey of NWOS data users to see whether or how the results are being used in the design and implementation of policies, programs, and services, which may not be captured in the traditional peer-reviewed literature, and how the results can be delivered more effectively.

The results from the NWOS appear to be well distributed among researchers, but there is room for improvement. All results could be digitally linked, making more recent results easier to find. In addition, future research to determine which NWOS products are most useful to various end users could be beneficial. For example, these products might be data that users are able to explore and manipulate themselves (i.e., the online data access tools) or data supplied through reports that users can cite (i.e., the general summary reports). Understanding which products users consult the most could influence how and what information the NWOS provides to potential users, which in turn might increase use.

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