

Brief Communication - traditional knowledge

Forester Preferences on Revising *Silvics of North America*—a Survey of Registered Foresters in Four States

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Abstract

Silvics of North America (SNA) is a widely used silvicultural manual. However, the last SNA was published in 1990. Therefore, 2,589 registered foresters were surveyed across four US states to answer two broad questions: (1) Should SNA be updated? And (2) would an updated SNA still be a useful tool for forest management? Most respondents indicated that the type and extent of content contained in the previous version of SNA was still desirable today. Aside from updating all sections with recent research findings, expansion was suggested for ecosystem services provided by species. An update to maps provided in SNA, through changes to natural ranges of tree species and other aesthetic improvement, was suggested by most survey respondents. These findings support the conclusion that the SNA would still be an essential source of information if 21st-century issues such as climate change impacts and adaptation measures were included in the update.

Study Implications: There have been major changes in the environment and forest science over the past 30 years, but SNA has not been revised to reflect these changes. The results of this survey indicate that an update to SNA is warranted. The results presented here can serve as a guide for a future update of SNA.

Keywords: *Silvics of North America*, registered foresters, survey

Silvics of North America (SNA) is a significant reference work for forestry and natural resource management fields, last published by the United States Department of Agriculture (USDA) Forest Service in 1990. It is considered an essential resource in understanding the fundamental natural history and potential range of important tree species in North America. The first version of the reference work was published in 1965 and was entitled *Silvics of Forest Trees of the*

United States (Fowells 1965). This publication included the physiological characteristics of 127 tree species. Twenty-five years later, *Silvics of North America* (Burns and Honkala 1990) was published after 10 years of development. This reference work included 200 deciduous and coniferous tree species focusing on those species considered commercially valuable. The species accounts included in the reference work were written by experts employed by the USDA Forest Service and

academic institutions. Generally, each tree species was described by its habitat (i.e., native range, climate, soils and topography, and associated species), life history (i.e., reproduction and early growth, growth and yield, and damaging agents), special uses, and genetic diversity. However, some sections (particularly genetics) were not available for every species. Each species account also included a panchromatic range map describing experts' understanding of its native range. A discussion has begun on a potential update to this reference work, as climate change variability may affect tree and forest structure and function in historically unprecedented ways, even as our understanding of silviculture continues to advance.

The study's objective is to assess the opinions of a subset of stakeholders of *SNA* regarding a potential update to this major work. Additionally, in a broader sense, the survey is designed to provide insight regarding the need for a formally compiled set of literature in the age of Internet search engines. To address these questions, we developed an online survey for registered foresters in four US states. One primary hypothesis was that *SNA* does not need to be updated at this time. Another hypothesis is that if an update of *SNA* is undertaken, the overall structure of tree species accounts within the reference work does not need to be altered. The survey results presented are an effort to inform decision-makers of the need (or lack thereof) of a potential update to *SNA*, and where necessary, to identify areas for enhancement of the reference work.

Methods

An online survey, with questions developed by an independent group of stakeholders, was developed to determine registered foresters' opinions on the potential update to an essential resource of the profession, *SNA*. Stakeholders included USDA Forest Service employees and academics familiar with *SNA*. A list-based sampling frame of email addresses was employed in this survey of specifically named persons. Therefore, we assumed that the target population was synonymous with the sampling frame (American Association for Public Opinion Research 2016). The sampling frame included registered foresters of four US states (Alabama, Michigan, Mississippi, and North Carolina). Email addresses of registered foresters were obtained from freely available lists offered on Internet sites managed by organizations associated with each respective professional registration program. At the time of the study's development, these four states were

the only states offering easily accessible contact information on registered foresters. Some US states do not require the registration of foresters. Still others require registration (e.g., California, Georgia, Mississippi, South Carolina) but do not offer contact information freely over the Internet. We assumed that the lists of registered foresters were accurate and current. Therefore, no response from an eligible sample participant was treated as a nonrespondent (American Association for Public Opinion Research 2016). We also assumed that these registered foresters were somewhat synonymous with a more extensive set of stakeholders (foresters in the U.S.).

The survey was developed using the Survey Monkey (www.surveymonkey.com) platform. It was then offered to 2,589 registered foresters via an email invitation through Survey Monkey. Two reminders were sent to participants before the survey was closed. In addition to questions related to basic demographic information, the survey included questions regarding content within the current version of *SNA*, such as species-level physiological information, known damaging agents, genetic variants, potential growth and yield, and geographic range maps. Generally, the questions focused on gathering opinions regarding the expansion or reduction of existing information, removing information, or adding new information to a potential update of *SNA*. Some questions focused on adding content related to climate change and its impacts on forecasted range distribution and ecosystem services. Survey participants could navigate past questions they did not want to answer. Questions included multiple-choice answers, and skip logic was applied to many of them. Depending on a survey participant's response to a question, through skip logic they might have been directed to an additional set of questions related to their initial response. For example, if a participant responded that tree species-level ecosystem services information should be added to an updated publication, the next question would present a list of ecosystem services that could be added and ask the survey respondent to select those that should be included in an updated version of the reference work. If a participant responded that ecosystem services should not be included in an updated publication, they would be directed to questions about why ecosystem services should not be included. Therefore, survey participants were asked between 30 and 40 questions. Several survey questions included an "other" answer option, which provided participants an open text box to submit an answer not offered in the survey. Of note, this survey was not formatted to

be accessible for navigation for the visually impaired. Although Survey Monkey is compatible with certain screen readers, our survey was not developed to meet these specific guidelines for accessibility.

Results

A total of 331 of the 2,589 registered foresters agreed to participate in the survey. Fourteen additional respondents opened the survey but decided not to participate. Although some of the respondents chose not to answer all questions posed, we obtained a response rate of 13.0% for complete and partial responses to the survey. Although the sampling frames are different, the response rate of foresters to other recent surveys ranged from about 5.0% (Seidl et al. 2016) to 65.0% (Conrad et al. 2017). Although 331 people responded to our survey, the response rate is relatively low. Thus, nonresponse bias can be an issue (Dillman, Smyth, and Christian 2014). Therefore, we compared responses from the first 30 early respondents to the last 30 late respondents (as a proxy for nonrespondents) to determine whether significant differences were evident (Armstrong and Overton 1977). Using one question from the survey (*Prior to this survey, were you aware of the publication SNA?*) to test for nonresponse bias, a Chi-square test of independence with a 95% confidence level was derived ($X^2 = 0.069$, $P = 0.793$), indicating that the two samples were not significantly different.

Demographics

Participants were asked if they were aware of the existence of SNA. Ninety-eight percent of participants responded to this question. Nearly half (46.0%) of registered foresters surveyed indicated that they were aware of the resource. The overwhelming majority of respondents (85.8%) worked in the southern United States. Given that the survey was sent to registered foresters in Alabama, North Carolina, Mississippi, and Michigan, this was not surprising. Nearly 9.0% of respondents worked in the Midwest whereas approximately 4.0% worked in the eastern region of the United States. Many survey participants indicated that they worked for a private company (27.9%) or worked for themselves (21.2%). Additional employers included state/provincial governments (12.9%), consultants (7.1%), timberland investment organizations (4.6%), real estate investment trusts (3.4%), and the US federal government (3.4%). About 12.0% of respondents indicated that they had retired from full-time work in

the forestry profession. Most (84.2%) survey participants classified their primary field of work as forestry, whereas most of the remaining respondents indicated that they worked in fields such as education, law, appraisal, real estate, and several others.

Nearly 45.0% of the survey respondents suggested that they have been employed in their fields for 31 years or more. The remaining respondents had 25 to 30 years (15.8%), 21 to 25 years (9.0%), 16 to 20 years (8.4%), and 11 to 15 years (8.7%) of experience in their field. About 13.3% of the respondents had been working 10 years or less in their respective fields. The majority of respondents (65.3%) indicated that they had obtained at most a bachelor's degree. Nearly 30.0% of the respondents indicated that they had earned a master's degree. Less than 4.0% of the respondents had earned doctorate degrees, and less than 1.0% had only completed high school. Respondents were provided a list of professional organizations and asked to select those where they were members (Table 1). Many respondents indicated that they were members of the Society of American Foresters (71.9%), followed by other organizations not included in the survey's list (40.3%). Other nonlisted organizations included the Association of Consulting Foresters, the Forest Stewards Guild, state-specific forestry associations, and many others.

Tree Species Recognized and Tree Species Accounts

Concerning the species list in the current (1990) version of the SNA, 83.7% of respondents indicated that the current species list should be maintained. Only 12.3% of respondents thought that other tree species should be added to the species list. Of these, about

Table 1. List of professional organizations presented to survey respondents and their responses.

Organization	%	N
American Fisheries Society	0.0	0
American Institute of Hydrology	0.0	0
Canadian Institute of Forestry	0.5	1
Ecological Society of America	1.0	2
Forest Products Society	3.1	6
International Society of Arboriculture	4.6	9
Society of American Foresters	71.9	141
Sierra Club	0.5	1
The Nature Conservancy	3.1	6
The Wildlife Society	2.6	5
Other	40.3	79

60.0% of respondents suggested that invasive tree species be added, about 63.0% suggested that introduced tree species should be added. About 40.0% suggested that species of special concern should be included in an update of the *SNA* (Figure 1). Four percent of the survey respondents felt that some tree species should be removed from the species list, including those that have become less relevant due to changing markets and those made redundant due to changes in taxonomy (Figure 2).

Respondents were asked whether they thought species accounts (life history information) in *SNA* were appropriate in length and level of detail. Approximately 90.0% of respondents indicated that the current species-level information was about the right length. Only about 3.0% of all respondents suggested that the species-level information was too short and should be increased, and about 7.0% suggested that species accounts were too long and could be reduced.

Genetics Information

Respondents were asked about the length of the genetics information available in the current version of *SNA*. Most respondents (71.8%) thought the present level of detail in the genetics section should be maintained and that genetics information should be an optional section for each tree species chapter. About 18.4% of all respondents suggested that the optional genetics sections should be expanded. In comparison, 9.8% of respondents indicated that the length of the genetics section for every species should be reduced where appropriate. When respondents indicated that the genetics section for important species should be expanded, most (71.7%) indicated that genetics-based research history for these species should be included.

Additionally, most (65.2%) of those respondents also suggested that future genetics trends should be incorporated into the genetics section. About half of these respondents indicated that new cultivars should be added to certain tree species' genetics section.

Of respondents that indicated that the genetics section should be reduced, most (57.1%) indicated that it should be reduced to make all tree species life history accounts more consistent (Figure 3). Further, the idea that too much genetic information is confidential or patented or too little genetic information is available for some species was offered as a reason for reducing the genetics section of *SNA*. Given that the genetics section is not found in the life history accounts of every tree species in *SNA*, 50.0% of the respondents suggested that the research history should be reduced. Additionally, of these people, 30.0% and 20.0% suggested content on future trends and new cultivars, respectively, should be reduced.

Damaging Agents

Most respondents (76.1%) suggested that the present level of detail regarding damaging agents should be maintained when updating *SNA*. A smaller portion of respondents (21.1%) indicated that information on damaging agents should be expanded, and only 2.8% indicated that information on damaging agents should be reduced. Of the respondents who indicated information on damaging agents should be expanded, about 61.5% indicated climate change information should be added to damaging agent information, and 38.5% did not think climate change information should be added. Of all respondents, 65.4% indicated that climate variability information

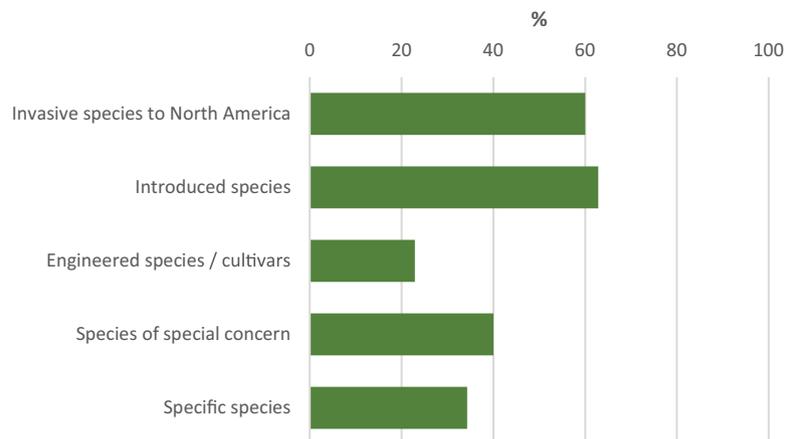


Figure 1. Types of species survey participants indicated should be added to an updated species list of *SNA*.

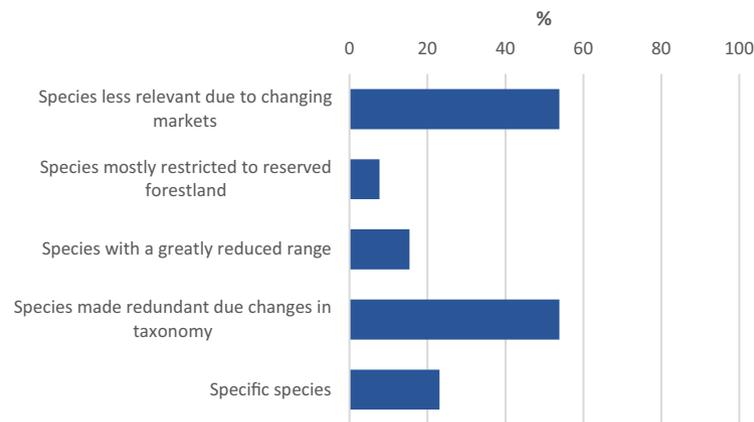


Figure 2. Reasons selected by survey participants to remove species from the species list of *SNA*.

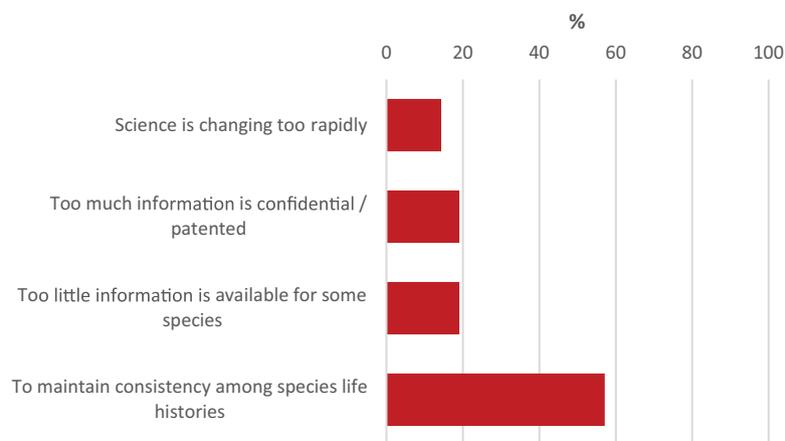


Figure 3. Survey participants responses to why the genetics section should be reduced in an updated *SNA*.

should be expanded compared with 34.6% who thought it should not. Of all respondents that indicated climate variability information should be added, most identified diseases (97.1%) and insects (94.1%) as issues that should be included (Figure 4). Flooding and hurricanes were less important to respondents.

Respondents that indicated information on damaging agents should be expanded were also asked whether information on pollutants should be added. About 46.9% identified pollutants as a topic that should be added, whereas 53.1% did not think pollutants should be added to an update of *SNA*. Of those respondents that indicated that pollutants should be added to an updated publication, most suggested ozone (69.6%) and sulfur oxides (69.6%) as pollutants that should be included, followed by nitrogen oxides (60.9%) and carbon dioxide (56.5%). Of all respondents that indicated that damaging agent information should be expanded, 78.4% suggested that

stress interactions should be added, and 21.6% indicated otherwise. Of all respondents that indicated information on damaging agents should be reduced, 42.9% suggested that conditions are changing too rapidly, and 28.6% suggested that information is limited or too uncertain.

Species Range Maps

In the most recently published version of *SNA*, pan-chromatic species range maps were provided at various scales based on those presented in the *Atlas of United States Trees* (Little, 1971). A majority (78.2%) of survey respondents indicated that these maps should be updated. About 21.0% of respondents indicated that the current maps should be maintained in an update of the reference work, whereas only 0.8% indicated they should be removed. Most respondents indicated that updated maps should be informed using USDA Forest Inventory and Analysis (FIA) data or Canadian National Inventory data (66.8%) or other remote sensing sources

(44.0%) (Figure 5). Of those respondents who indicated the maps could be removed, reasons included (1) species ranges are changing too quickly to maintain accurate maps, or (2) species range maps are too general.

Forecasted Species Range Maps

Opinions were nearly evenly split on whether forecasted range maps should be included in an updated SNA, as 52.5% of responses indicated that forecasted range maps should be included and 47.5% indicated that they should not. Of respondents who indicated that forecasted range maps should be included, 47.0% suggested that forecasted range maps should project changes 20 years into the future, 52.3% preferred 50 years into the future, and 24.2% preferred projections 100 years into the future. Survey respondents were also asked what types of models should be used for forecasting species range maps. Nearly 44.0%

factors (e.g., relative humidity) in their projections compared with 65.0% of respondents indicating that global climate models that estimate climate for a system should be used. Finally, 61.7% of respondents to these questions indicated that uncertainty information should be included when using a single map, and 43.0% indicated that uncertainty information should be included when using multiple maps with varying possible conditions. Of respondents who did not think forecasted species range maps should be included in a revision of SNA, 87.7% indicated that forecasted species range maps were too speculative, 58.8% suggested that these maps include too much uncertainty, and 13.2% indicated that forecasted species range maps include too little information.

Forecasted Species Growth Rates

Not all species life history accounts in the most recent version of SNA include yield tables (estimated timber volume by age and site index). However, survey

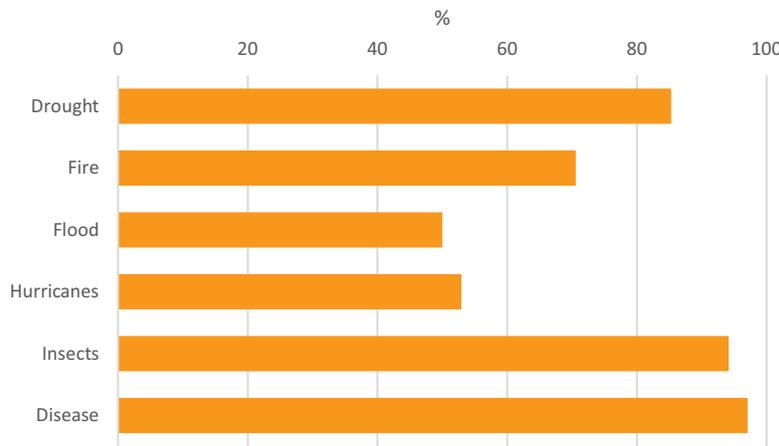


Figure 4. Survey participant responses when asked what climate variability information should be added to an updated SNA.

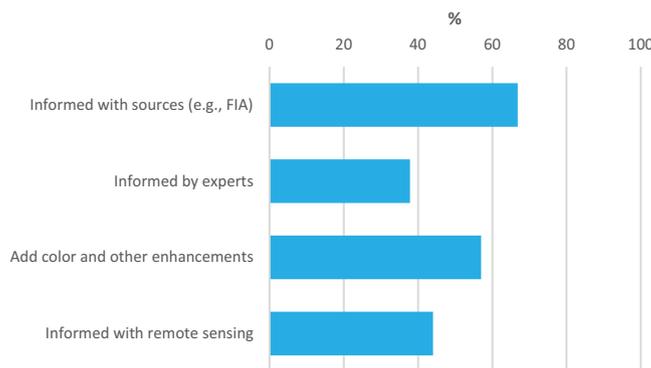


Figure 5. Responses of survey participants when asked how updated maps should be informed in an updated version of SNA.

participants were asked whether forecasted growth rates resulting from climate changes should be included where possible. Most (60.8%) did not think forecasted growth rate information should be included in a revision of this reference work, whereas approximately 39.0% indicated that forecasted growth rates should be included. When asked what time frames would be appropriate for forecasted species growth rates, most suggested that they should be projected 20 or 50 years, 52.6% and 53.6% respectively, into the future and 20.6% suggested 100 years into the future.

Ecosystem Services

Survey participants were provided several examples of ecosystem services associated with forests, including those considered provisioning (e.g., timber, water, food, energy), regulating (e.g., water purification, erosion control, carbon sequestration), cultural (e.g., recreation, heritage), and supporting (e.g., nutrient cycling and photosynthesis). They were asked whether the ecosystem services provided by each tree species should be included in a publication revision. A majority (69.4%)

of respondents indicated that a section on ecosystem services should be added to each species account, and 30.6% did not. Given a list of ecosystem services to potentially add to a revision of *SNA*, of respondents who indicated that ecosystems services should be added, 83.5% identified wildlife and 80.5% identified forest products, including sawtimber and pulpwood, as services to include (Figure 6). Of the respondents that did not think a section on ecosystem services should be added, 59.2% indicated that a discussion of the ecosystem services provided by each tree species includes too much uncertainty. Further, 29.6% of respondents suggested too little information on this subject is available at the tree-species level.

One primary hypothesis was that *SNA* did not need to be updated at this time. The survey suggested that most people felt (1) the tree-species list should not be expanded nor contracted, (2) the content of the species accounts was about the right length, (3) the detail regarding the genetics of tree species (where provided) was about right, and (4) the detail regarding damaging agents to tree species was about right. However, it was

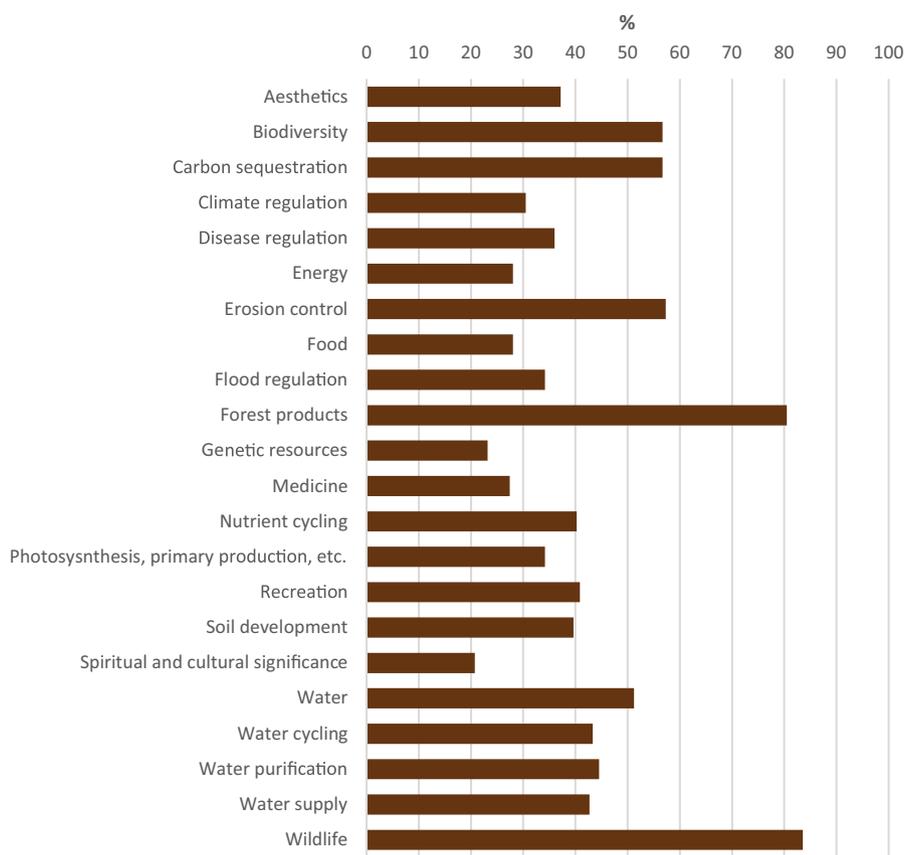


Figure 6. Response of survey participants when provided a list of potential ecosystems services to be added to a revision of *SNA*.

suggested by many respondents that the content needs to be informed by recent research, and that an individual tree-species section on ecosystem services should be more transparent. More importantly, most people felt that the range maps need to be updated, informed by information from other sources, and enhanced with color. People were about evenly divided in opinion on the value of including forecasted range maps (mainly due to perceived uncertainty regarding projected climate change). People were less enthusiastic about including a new section describing potential changes to the growth rates of trees. From these responses by the survey participants, an update to *SNA* seems to be needed. Thus, the first hypothesis we offered might be rejected. The second hypothesis was that if an update of *SNA* was undertaken, the overall structure of tree-species accounts within the reference work does not need to be altered. From the responses we received, this hypothesis can be partially rejected, as survey participants noted that in general, the basic structure of species accounts was about the right length. However, a specific section on ecosystem services provided by trees would be of value.

Discussion

SNA is an important resource that details life history characteristics and native ranges of significant North American trees. *SNA* can be found in print form and through an Internet site hosted by the USDA Forest Service. However, appropriate coverage of important tree species of North America is debatable. A considerable amount of scientific research has been conducted since the mid-1980s when the development of *SNA* was concluding. This information may be of value to land managers and stakeholders interested in the future of North American forests. For example, the publication rate for all science areas is currently over 2.6 million pieces of work per year (White 2019). For research on North American tree species, 50.0%–90.0% of works might have been produced, depending on the bibliographic search engine employed, between 1985 to today (Bettinger et al. 2021). A discussion about a potential update to *SNA*, including the people selected to lead the effort and the resources available to facilitate the effort, is essential. Many of the questions regarding the extent of work necessary to update *SNA* can partially be answered by the stakeholders' responses.

Some of the questions we posed to the sample frame inherently suggest that climate change is occurring and may affect North American trees' geographic range

and growth rate. Although we did not ask this question specifically, with respect to the idea that climate change is occurring, foresters in the southern US generally agree (Boby et al. 2016). There is an even greater belief among forest managers in other countries (Seidl et al. 2016). It is reasonable to suggest that some of the variation we observed in responses to the survey might be attributed to individual value systems or the sample frame's demographics. In our study, most of the respondents identified as foresters, almost half have been working as professionals for over 30 years, and most are members of the Society of American Foresters. In conjunction with education and work experience differences, variations in responses may also be attributed to the shifting baseline syndrome. Shifting baseline syndrome suggests that each generation of people evaluates changes based on a set of baseline conditions that they observed at the beginning of their careers rather than a true baseline (Pauly 1995; Muldrow et al. 2020). This effect can result in inappropriate reference points for evaluating change (Pauly 1995).

These survey results complement recent discussions among the USDA Forest Service and significant stakeholders regarding the need for and extent of a revision to *SNA*. As a major reference work, an undertaking such as this will require significant resources (e.g., the time of experts and administrators, funding, etc.). As a result, those involved should be cautious of pursuing a change only for change's sake. Funding is one of the main challenges to bridging the gap between conceptualizing a reference work and its publication (Nuessel 2012). For efforts such as this, Ralston (2004) suggested that generating enthusiasm for the effort, recruiting authors, dunning authors, and paying attention to other administrative tasks can further burden the process of updating a significant reference work. As of summer 2021, the process for revising *SNA* has begun, and we invite readers of this work to contact us directly, through the email addresses provided at the beginning of the article, to offer constructive comments and suggestions.

Conclusions

Through a survey of registered foresters in four US states, we conclude that an update of *SNA*, a major reference work for forestry and natural resource management fields, is needed. Although most survey respondents suggested that the type and the length of the content in the 1990 version of this reference work are still appropriate today, they also suggested

that each section, particularly damaging agents concerning climate variability, should be updated using more recent scientific investigations. They indicated that an expansion of the ecosystem services at the species level might be necessary. Further, the range maps associated with each tree species were noted by most survey respondents as in need of update. Should an endeavor that focuses on revising this major reference work be initiated, these findings can inform the path forward.

Acknowledgements

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