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An Assessment of American Indian Forestry Research, Information Needs, and Priorities

Michael J Dockry,[1,*] Serra J. Hoagland,[2] Adrian D Leighton,[3] James R Durglo,[4] and Amit Pradhananga[1]

[1]University of Minnesota, Forest Resources Department, 115 Green Hall, 1530 Cleveland Ave. N., St. Paul, MN 55108 USA (mdockry@umn.edu; prad0047@umn.edu). [2]USDA Forest Service, Rocky Mountain Research Station, 5775 W. HWY 10 Missoula, MT 59808 USA (serra.j.hoagland@usda.gov). [3]Salish Kootenai College, Natural Resources and Forestry, PO Box 70, Pablo MT 59855 USA (adrian_leighton@skc.edu). [4]Intertribal Timber Council, PO Box 641, St Ignatius, MT 59865 USA (jimdurglo@gmail.com).

*Corresponding author email: mdockry@umn.edu

Abstract

Native American and Alaska Native tribes manage millions of acres of land and are leaders in forestry and fire management practices despite inadequate and inequitable funding. Native American tribes are rarely considered as research partners due to historically poor relationships with non-native scientists, tribal mistrust of research, differences between Indigenous values and scientific methods, and low Indigenous representation at research institutions. Understanding tribal research needs is critical to foster successful research partnerships with underserved tribal communities. This study expands on a 2011 tribal research needs assessment with a survey to identify tribal natural resource professionals' research needs, access to research findings, and interest in participating in research. Information needs identified in our survey includes forest health, water quality, culturally significant species, workforce and tribal youth development, cultural importance of water, and invasive species. Additionally, postfire response and valuation, resilience and long-term forestry, protecting and curating tribal data, and Indigenous burning were more important research needs for tribal members than for nontribal members. This study can inform forestry research planning efforts and establish research priorities and collaborations that are aligned with needs identified by tribal natural resource managers.

Study Implications: There is a growing desire to broaden forestry research to support tribal forest management. This study shows that tribal research priorities include forest health, water quality, culturally significant species, workforce development/training, tribal youth development, cultural importance of water, and invasive species. Additionally, postfire response and valuation, resilience and long-term forestry, protecting and curating tribal data, and Indigenous burning were ranked of higher importance by tribal members than nontribal members. This study can inform federal research entities, universities, and natural resource management agencies in planning and establishing research priorities that are aligned with the needs identified by tribal resource managers.

Keywords: Native American, research needs survey, research access, research participation

In the 50 years since the American Indian Movement began, tribes have kept tribal sovereignty and resource protection at the forefront of many large-scale environmental issues (Wilkinson 2005; Estes 2017; Whyte 2017). For Indigenous people and tribal communities, this period also symbolizes a call to improve tribal "information deserts" where active research and scientific partnerships are lacking relative to their land management counterparts (see Rodriguez-Lonebear 2016). However, this situation creates an important opportunity for several reasons. First, the unique sovereign status of federally recognized tribes allows for research and innovation regarding place-based management. Second, the wellbeing of Indigenous communities is often tied to the health of natural resources (see Durkalec et al. 2015) whether on reservation lands, public lands, or lands within tribal ancestral territories. Third, since tribal members and their respective tribal governments are the primary stakeholder group in land management decisions this often fosters an environment where such communities are highly connected to the results of their environmental decision making (Gordon et al. 2013). Finally, tribes manage large land bases, yet tribal communities often lack access to research to support their land management goals. One of the findings of the 3rd Indian Forest Management Assessment Team was that a "lack of coordinated research or research advocacy has led to the tribes being under-serviced by federal and academic research institutions" (Gordon et al. 2013, 137). For all these reasons, it is more imperative than ever to establish and maintain effective and accountable tribal research partnerships.

Numerous studies have shown the importance of including American Indian and Indigenous communities in all phases of the research cycle, from development of questions through results dissemination (Smith 1999; McAvoy et al. 2000; Hurtado et al. 2009; Wilson 2008; Johnson and Larsen 2013; David-Chavez and Gavin 2018; Walter and Suina 2019). Indigenous people are developing their own research efforts that support tribal sovereignty, priorities, and incorporates their own worldviews (Walter and Suina 2019). Non-native research institutions are also beginning to integrate Indigenous perspectives into their research activities. For example, in 2015, the USDA Forest Service published a Tribal Research Engagement Roadmap that developed objectives and strategies for engaging with tribes on research projects (Farley et al. 2015). To facilitate this, the Forest Service designated tribal relations points of contact for each research station within the agency (https://www.fs.usda.gov/research/). Academic journals are also beginning to incorporate Indigenous perspectives by publishing special issues dedicated to topics like tribal forest management (Dockry and Hoagland 2017). To facilitate inclusion of Indigenous perspectives, work is being done to enhance relationships between researchers and tribes (Bengston 2004; Dockry et al. 2018; Lucero and Tamez 2017; Matson et al. 2021).

Incorporating Indigenous perspectives into research is important because there are different perceptions of natural resources between American Indian and non-American Indian people. Despite this importance, there has been limited research exploring these differences. Menominee hunters placed greater value on a wider diversity of plants and nongame animals than Euro-American hunters, indicating the cultural value of whole ecosystems (Ross et al. 2007). In an analysis of American Indian newspapers, Bengston (2004) shows much greater attention to traditional ecological knowledge, spiritual values of forests, environmental justice and racism, and holistic ecosystem management than mainstream newspapers, indicating the values that American Indian communities place on these topics relative to the majority population. Reo and others (2017, 216) found that Indigenous approaches to invasive species and environmental change often focus on "active response strategies" while deemphasizing the impacts of that change. Their study also shows that Indigenous communities in the United States and Canada support partnerships with Indigenous and non-Indigenous neighbors to support and engage in active natural resource projects that address tribal goals, culture, and self-determination. Hatfield and others (2018) show that American Indian elders and traditional knowledge holders express the relationality among species in a way that links environmental change to broader time scales that include socio-political phenomena. Finally, there is a growing data sovereignty movement among Indigenous communities and scholars to maintain control over data and research (Kukutai and Taylor 2016; Rodriguez-Lonebear 2016; Lovett et al. 2019; Tsosie 2019).

The impetus for this research needs assessment primarily stemmed from the Intertribal Timber Council (ITC), a national nonprofit organization established in 1976. The ITC is a consortium of fifty-four American Indian Tribes and Alaska Native Corporations dedicated to improving the management of natural resources of importance to Native American communities. The ITC operates

through a board of directors with appointed delegates from the fifty-four member tribes and Alaska Native Corporations. The ITC is organized into committees and subcommittees. The ITC Research Subcommittee was formed in 2010 to develop recommendations regarding research plans, priorities and initiatives to improve natural resource and fire management, and increase benefits for Indian Country and public lands (Indian Country is a legal term for geopolitical jurisdictions such as Indian Reservations, allotments, and tribal communities, (Legal Information Institute n.d.). In the Research Subcommittee's charter, the first responsibility is to collate and prioritize research needs identified by tribal communities. In addition to assisting the ITC Research Subcommittee in meeting their primary objective, this study may be valuable to natural resource researchers and managers with responsibility to manage lands currently or historically managed by Native Americans. Incorporating tribal knowledge into research and management of forestlands can provide critical insights to sustainable natural resource management in the 21st century.

In 2011, the ITC Research Subcommittee undertook the first systematic survey to understand the needs, priorities, and impediments that tribal forest managers and decision makers faced in developing, accessing, and using research (Beatty and Leighton 2012). The results of this survey identified five priorities for research to support tribal natural resource management: water quality, fish and wildlife management, integration of traditional knowledge with western science, mechanisms to improve knowledge sharing, and invasive species. The survey identified primary impediments to the access and use of research: internet access to research results; a lack of financial and staff resources to apply research results; a lack of financial and staff resources to monitor, evaluate, and report research results; and lack of staff and financial resources to identify applicable research to address local issues. The survey also indicated that there was a lack of convenient access to subject matter experts and published literature. Finally, the survey indicated that there was strong interest by tribes to participate in research activities, especially through establishing research priorities, developing partnerships with research institutions, and securing financial and staff resources to both apply research and conduct monitoring. This article updates and expands on the 2011 tribal research needs assessment (Beatty and Leighton 2012).

Methods

Development of Assessment

The authors convened several face-to-face meetings and discussions with the ITC Research Subcommittee to develop the survey instrument, hereafter known as the survey, to assess tribal natural resource professionals' level of interest in research topics, access to research results, and interest in participating in research. We initiated a pilot survey to review and refine questions over a period of 2 months, which resulted in eight total pilot respondents. Additionally, we received input on the pilot survey from social science survey researchers, those involved in the previous assessment, members of the ITC Research Subcommittee, and ITC leadership. We built our assessment using questions and formatting from Beatty and Leighton (2012). We added a more complete set of demographic questions and specific topics and provided additional opportunities for write-in responses. The survey was created using the Qualtrics online survey platform through the University of Minnesota and consisted of forty-six questions divided into three parts (information needs, information access, and interest in participating in research).

Assessment Dissemination Strategy

Our outreach efforts focused on providing the survey link to natural resource professionals working for the eighty-three tribes identified by the 3rd Indian Forest Management Assessment Team as having "major timberland resources," meaning that their forestlands total over 10,000 ac or have an annual allowable cut of one million board feet or more, and tribes that have reservations with "economically viable timber". (Gordon et al. 2013). The survey was administered electronically but paper copies were available on request. The survey was open for approximately 10 weeks, opening at the ITC Timber Symposium in June 2019 and closing on Aug 15, 2019. The survey was distributed to attendees at the ITC Annual Timber Symposium in paper and electronic formats. In total, approximately two hundred members in attendance at the ITC symposium were notified about the survey and emails were sent to the fifty-four ITC member tribes' natural resources departments. We set up a student call center at Northern Arizona University with the Weyerhaeuser Indigenous Conservation crew July 15 and 16, 2019, to encourage the fifty-four natural resource departments to complete a survey. To encourage individuals to participate, we offered four randomly selected respondents Eighth

Generation blankets (https://eighthgeneration.com/) as an honorarium.

Measurement

Information Needs

The information needs section of the survey included questions about sixty-seven topics, which were grouped into nine broad themes. These thematic groupings were used to be consistent with the previous tribal research needs assessment conducted by Beatty and Leighton (2012). The information needs themes were forest management (ten topics), forest economics and forest products (nine topics), forest protection (five topics), climate adaptation (ten topics), water (six topics), fish and wildlife (five topics), fire (eight topics), social science (six topics), and traditional ecological knowledge integration (seven topics). All the topics were measured on a five-point Likert-type scale from "no new information needed (1)" to "extremely important (5)." The twenty-six survey topics that measured forest management, forest economics and forest products, and fire were used in factor analysis (described in the data analysis subsection below).

Access to Research and Information

Importance of access to research and information was measured using six items on a five-point scale from "not at all important (1)" to "extremely important (5)". Respondents were also asked about access to resource management and scientific information (e.g., online scientific journals, Forest Service General Technical Reports, etc.), the importance and frequency of scientific journal access, and how respondents learn about new research.

Participating in Research Activities

Twelve items were used to measure the importance of participating in research activities. Respondents were also asked whether they have worked with any research partners (e.g., federal agencies, tribal colleges, universities) in the past.

Data Analysis

In addition to descriptive statistics, we conducted data analysis in two steps. First, we conducted an exploratory factor analysis to determine the dimensions or factors of information needs, access to research and information, and participation in research activities. We conducted principal components analysis with varimax rotation to obtain factor loadings. Kaiser-Mayer-Olkin measures of 0.77 (information needs), 0.86 (access to research and information), and 0.82 (participation in research activities) demonstrate that the distribution of values across measures is adequate for conducting factor analysis (Hill 2011).

After identifying factors or dimensions, all items within a factor or dimension were summed and divided by the number of items in the factor to create a summated variable. Thus, each summated variable represents a factor or dimension identified from factor analysis. We used Cronbach's alpha to assess internal consistency of each summated scale (Tavakol and Dennick 2011).

Perceptions about information needs, access to research, and participation in research activities may vary between tribal and nontribal staff and may also change over time. Therefore, we conducted *t*-tests to examine differences between two subgroups: tribal and nontribal staff and between respondents who had worked in forestry for 25 years or less and more than 25 years in the dimensions information needs, access to research and information, and participation in research activities. We used 25 years to divide the sample size into two groups of roughly equal size (the median years worked was 24). We used the IBM Statistical Package for the Social Sciences (SPSS) 25.0 for all statistical analyses.

Inclusion of Indigenous Research Methods

Indigenous research methods are increasingly being used across disciplines and incorporate Indigenous participation, knowledge, and values (Smith 1999; Wilson 2008; Kovach 2010; Walter and Suina 2019). It is critical that Indigenous research involves Indigenous people in knowledge production and that the research supports Indigenous goals (David-Chavez and Gavin 2018). Although this study uses western social science survey methods and statistics, it was conducted by an Indigenous institution and three out of five of the authors, including the lead author, are American Indian tribal members. Thus, this project meets many of the criteria for quantitative Indigenous research outlined by Walter and Suina (2019). Specifically, the survey was designed to understand Indigenous perspectives on natural resource research in an effort to guide future research towards topics of interest to tribal communities. Additionally, the research was conducted in collaboration with the ITC, an intertribal organization that represents tribal perspectives on forest management. The study team included American Indian lead researchers and core members and involved Indigenous youth/students. The survey was piloted

with Indigenous natural resource professionals and the results were reported back to the ITC for their feedback and input into the data analysis. Survey results will be shared with the ITC general membership and potential research collaborators. Thus, Indigenous perspectives informed the development, analysis, and dissemination of the research results.

Results

Survey Respondents

Eighty-six surveys were started and fifty-nine were completed and used in the analysis. Forty-three percent of the survey respondents were members of federally recognized American Indian tribes and 78% were male. A majority (58%) worked for their own American Indian tribe or another American Indian tribe, 12% worked for a federal agency, 12% worked for a college or university, 15% worked for "other" and 4% worked for a nongovernmental organization. Two thirds, 67%, of the survey respondents, described their professional discipline as forestry whereas other disciplines, including wildlife, botany, fire, water/air, and planning, represented no more than 4% each. Using the Forest Service National Forest System regional breakdowns, the largest response rate came from the Southwest region (34%), 20% from the Pacific Northwest region, 14% from the Alaska region, 12% from the Eastern region, 10% from the Intermountain region, 6% from the Southern region, and 4% from the Pacific Southwest region (California). This broadly mirrors locations of tribal forest lands (see Gordon et al. 2013) and suggests that there was not a systematic nonresponse bias.

Information Needs

Ninety-two percent of the survey respondents indicated that getting new information to improve resource management was either very important (46%) or extremely important (46%). There were twenty-nine information needs topics with an overall mean score of 4.0 or higher with the overall top-rated topics being forest health, culturally important species, workforce development and training, tribal youth involvement, water quality, cultural importance of water, input into decision-making from elders or from cultural committee, and invasive species (Table 1.). When asked to prioritize the top three most important information needs, ten topics emerged (listed in order starting from the highest importance): forest health, silviculture, water quality, workforce development/training, fish and wildlife responses to treatments, fuels management, planting/reforestation, planning, growth and yield, and invasive species (Supplementary Table S1).

When looking at the thematic groupings, the most important information needs themes were water, fish and wildlife, and traditional ecological knowledge integration (all topics grouped under each theme had mean scores averaging over 4.0 on a one to five point scale) (Supplementary Material Table S2, Table S3, and Table S4, respectively). Within the theme of water, water quality, the cultural importance of water, and water quantity (e.g., droughts and floods) were the highest rated information needs with mean scores of 4.40, 4.32, and 4.27, respectively. Each of those topics had over 50% of respondents indicating that they were extremely important. For the fish and wildlife theme, information on culturally significant species was rated the highest, with a mean of 4.44 and 51%, indicating that it was extremely important. The highest information needs for traditional ecological knowledge integration were tribal youth involvement, with a 4.40 mean score, and input into decision making from elders or cultural committee, with a 4.31 mean score. None of the topics in the traditional ecological knowledge section had over 50% rated as extremely important; however, 44%–47% of respondents rated the three topics with highest mean scores as extremely important.

Within the theme of forest management, the topics of inventory, planning, silviculture, and GIS were the most important information needs identified by participants (mean score greater than 4.0) closely followed by planting and reforestation, growth and yield, site specific information, and biomass utilization (Supplementary Material Table S5). Information needs for the forest economics and forest products theme did not have any topics with mean scores over 4.0 and ranged from a mean of 3.65 for development of new forest products to 3.11 for certifications like FSC and SFI (Supplementary Material Table S6). The top-rated information needs topics for the forest protection theme were forest health, invasive species, and the Tribal Forest Protection Act/adjacent landowners with means of 4.49, 4.29, and 3.93, respectively (Supplementary Material Table S7). A total of 61% and 47% of respondents indicated that information on forest health and invasive species information was extremely important, respectively. Mean scores for climate change adaptation information needs theme did not exceed 4.0, with early indications of climate change (i.e., phenology) ranking the highest followed

Table 1. Information needs topics scored 4.0 and above. These were the highest mean scores from the 67 topics within the nine broad themes.

Information needs topic	N	Mean*	SD[a]	No new information needed[b]	Slightly important[b]	Moderately important[b]	Very important[b]	Extremely important[b]
Forest health	59	4.49	0.77	1.7	0.0	6.8	30.5	61.0
Culturally significant species	57	4.44	0.63	0.0	0.0	7.0	42.1	50.9
Workforce development/training	57	4.42	0.73	1.8	0.0	3.5	43.9	50.9
Tribal youth involvement	57	4.40	0.62	0.0	0.0	7.0	45.6	47.4
Water quality	58	4.40	0.77	0.0	1.7	12.1	31.0	55.2
Cultural importance of water	57	4.32	0.93	1.8	3.5	10.5	29.8	54.4
Input into decision making from elders or from cultural committee	58	4.31	0.80	1.7	1.7	5.2	46.6	44.8
Invasive species	58	4.29	0.77	0.0	1.7	13.8	37.9	46.6
Water quantity (e.g., floods and droughts)	56	4.27	0.86	0.0	3.6	16.1	30.4	50.0
Fuels management (thinning, piling, under-burning, prescribed burning, biomass removal)	56	4.21	0.95	3.6	3.6	3.6	46.4	42.9
Effects from invasive species	57	4.19	0.74	0.0	1.8	14.0	47.4	36.8
Integrating (TEK) into management	57	4.19	0.97	3.5	1.8	12.3	36.8	45.6
Response to treatments	57	4.18	0.85	0.0	3.5	17.5	36.8	42.1
Effects from climate change	57	4.16	0.73	0.0	1.8	14.0	50.9	33.3
Input into decision making from tribal community	57	4.16	0.82	1.8	1.8	10.5	50.9	35.1
Inventory	55	4.15	0.80	1.8	1.8	9.1	54.5	32.7
First foods/food sovereignty	57	4.12	0.89	1.8	3.5	12.3	45.6	36.8
Federal and state partnerships	57	4.11	0.86	0.0	7.0	10.5	47.4	35.1
Precipitation timing	57	4.09	0.85	0.0	5.3	15.8	43.9	35.1
Indigenous burning	55	4.09	0.87	0.0	5.5	16.4	41.8	36.4
Holistic, balanced management	57	4.09	0.89	1.8	1.8	19.3	40.4	36.8
Drought mitigation	55	4.09	0.93	0.0	7.3	16.4	36.4	40.0
Planning	56	4.05	0.92	1.8	3.6	17.9	41.1	35.7
Groundwater recharge	55	4.05	1.04	1.8	5.5	23.6	23.6	45.5
Silviculture	56	4.04	0.95	3.6	1.8	16.1	44.6	33.9
Threatened and Endangered species	58	4.03	0.72	0.0	0.0	24.1	48.3	27.6
Subsistence harvesting	57	4.02	0.92	3.5	1.8	14.0	50.9	29.8
GIS	56	4.02	0.84	1.8	1.8	17.9	50.0	28.6
Early indicators of changing climate (i.e. phenology)	57	4.00	1.00	3.5	1.8	22.8	35.1	36.8

*Responses based on a 5 point scale from no new information needed (1) to extremely important (5)

[a] SD, standard deviation

[b] Percent

by implementation of climate adaptation projects, adaptation/mitigation planning, and vulnerability assessments (Supplementary Material Table S8).

The top three information needs within the fire theme were wildland fire management, fuels management, and Indigenous burning with mean scores of 4.3, 4.21, and 4.09, respectively (Supplementary Material Table S9). The top-rated topics within the social science theme were workforce development and training, with a mean score of 4.42 and 51% of respondents indicated that it was extremely important (Supplementary Material Table S10). Federal and state partnerships had a mean score of 4.11, followed by policy with a 3.98 mean score.

Factor analysis of the twenty-six survey topics measuring information needs around the forestry-specific themes of forest management, forest economics and forest products, and fire revealed six distinct factors or dimensions, with Cronbach's alpha ranging from 0.77 to 0.88 (Table 2). The six dimensions included innovative markets and approaches, forest operations, postfire response and valuation/merchandising, fire, long term forestry/harvest logistics, and Indigenous burning. One caveat to these findings is that the factor "indigenous burning" consists of only one survey item. An assessment of factor loading for Indigenous burning suggests that it did not fit with any other factors, and thus was distinct from the other identified factors.

The *t*-tests revealed significant differences between tribal and nontribal members in four of six factors of forestry information needs (Table 3). Tribal members reported postfire response and valuation/merchandising, fire, resilience, long term forestry, postdisturbance/harvest logistics, and Indigenous burning as more important information needs than nontribal members.

There were also significant differences between respondents who had worked in forestry for 25 years or less and those who had worked for more than 25 years in dimensions of forestry information needs (Table 3). Respondents who had worked in forestry for 25 years or less reported innovative markets and approaches, postfire response and valuation/merchandising, and Indigenous burning as more important information needs than respondents who had worked in forestry for more than 25 years.

Access to Research and Information

A total of 90% of survey respondents indicated that access to research on the internet was either extremely important or very important. Access to subject matter experts and time to read and study research information was very important or extremely important for 86% and 84% respondents, respectively. Over 50% of respondents indicated that access to research summaries, agency reports, and published scientific publications was very important. A total of 69% of respondents found resource management and scientific information from online scientific journals, 62% from Forest Service General Technical Reports, 48% from ITC meetings and conferences, 45% from SAF publications, and 40% from ITC publications (Table 4). Textbooks, Forest Service Science You Can Use Bulletins, SAF meetings, and libraries were used to access information by 36%, 33%, 26%, and 22% of respondents, respectively (Table 4). Optional write-in answers indicated that information was also accessed through experts, co-workers, regional meetings, and the Joint Fire Science Consortium. Respondents indicated that the most important sources of information were online scientific journals and Forest Service General Technical Reports.

A total of 80% of respondents indicated access to scientific journals was very or extremely important and 14% accessed scientific journals weekly, 50% accessed them monthly, and 23% accessed them a couple of times a year or less. Scientific journals are accessed by between 15% and 22% of respondents when new research is heard about, through regular scanning, when a problem arises, when beginning a new project, and when preparing reports. Only 4% indicated that they access scientific journals when writing grants. A total of 44% of respondents learned about new research by searching the internet themselves, 35% through emailed newsletters, 26% through webinars, and 21% through science synthesis reports (by topical area). Fewer than 20% learned about new research through the ITC or Forest Service blogs and websites and only 5% learned about research through hardcopy newsletters.

Factor analysis of six items measuring access to research and information did not reveal multiple distinct factors. Therefore, we conducted *t*-tests for each item measuring access to research and information. There were no significant differences between tribal and nontribal members or between respondents who had worked in forestry for 25 years or less and those who had worked for more than 25 years in access to research and information.

Participating in Research Activities:

Of all respondents, 59% indicated that protecting tribal data was extremely important and 26% indicated it

Table 2. Factor loadings for dimensions of forestry-specific information needs themes. Six factors (groups) emerge for forestry-specific topics and include: innovative markets and approaches; forest operations; Postfire response and valuation/merchandising; fire; long term forestry/harvest logistics; and Indigenous burning.

Forestry themes	Factor 1: Innovative markets and approaches (α = 0.88)*	Factor 2: Forest operations (α = 0.85)*	Factor 3: Postfire response and valuation/ merchandising (α = 0.86)*	Factor 4: Fire (α = 0.85)*	Factor 5: Long-term forestry/ harvest logistics (α = 0.77)*	Factor 6: Indigenous burning (α = N/A)**
Ecosystem services markets	**0.787**	0.260	0.204	0.090	0.254	0.081
Recreation/tourism	**0.766**	0.054	0.133	0.383	0.032	0.004
Carbon credits and carbon markets	**0.652**	0.084	0.450	0.216	0.052	-0.136
Certifications (SR, FSC, etc.)	**0.641**	0.009	0.270	0.149	0.342	0.197
Non-timber forest products	**0.605**	0.343	0.170	0.155	-0.039	0.178
Marketing strategy/branding	**0.577**	0.361	0.208	0.010	0.430	0.276
Biomass utilization	**0.539**	0.399	0.175	0.481	0.034	-0.148
Inventory	0.006	**0.803**	0.390	-0.010	0.020	0.173
Growth and yield	0.152	**0.777**	0.180	-0.004	0.232	-0.144
Silviculture	0.257	**0.664**	0.335	0.156	0.260	0.298
Site specific information	0.267	**0.644**	-0.040	0.420	0.156	0.029
Planning	0.309	**0.610**	0.044	0.407	0.072	0.286
GIS	0.163	**0.569**	0.008	0.444	0.303	0.067
Salvage logging (fire)	0.287	0.024	**0.760**	0.234	0.224	0.237
Burned Area Emergency Response (BAER)/ Burned Area Rehabilitation (BAR)/ Emergency stabilization	0.330	0.161	**0.734**	0.289	0.061	0.087
Milling infrastructure	0.160	0.378	**0.634**	0.164	0.141	0.086
Appraisal systems	0.446	0.417	**0.610**	0.056	0.267	0.001
Wildland fire management	0.186	0.126	0.229	**0.808**	0.136	0.042
Fuels management (thinning, piling, under-burning, prescribed burning, biomass removal)	0.277	0.200	0.540	**0.598**	-0.076	0.147
Wildland fire prevention	0.203	0.054	0.331	**0.571**	0.326	0.355
Smoke management (human health impacts, emissions, etc.)	0.296	0.126	0.395	**0.558**	0.178	0.159
Liability (for Rx burning	0.129	0.208	0.188	**0.548**	0.406	0.412

Table 2. Continued

Forestry themes	Factor 1: Innovative markets and approaches (α = 0.88)*	Factor 2: Forest operations (α = 0.85)*	Factor 3: Postfire response and valuation/ merchandising (α = 0.86)*	Factor 4: Fire (α = 0.85)*	Factor 5: Long-term forestry/ harvest logistics (α = 0.77)*	Factor 6: Indigenous burning (α = N/A)**
Roads, engineering, transportation, culverts	0.269	0.195	0.035	0.138	**0.836**	0.057
Planting/reforestation	-0.046	0.305	0.407	0.209	**0.642**	0.039
Salvage logging	0.239	0.232	0.486	0.312	**0.496**	-0.242
Indigenous burning	0.082	0.123	0.125	0.167	0.021	**0.879**

*Bold values in each column indicate the forestry themes that group into each factor.
**Factor includes only one item (in bold).

Table 3. Differences in dimensions (factors) of forestry information needs by tribal membership and years worked in forestry.

		Member of a tribe						Years worked in forestry					
		Yes		No				25 year or less		More than 25 years			
Dimensions of information needs	Factor mean	*n*	Mean	*n*	Mean	*t*	*p*	*n*	Mean	*n*	Mean	*t*	*p*
Indigenous burning	4.09	23	4.39	24	3.71	2.846	0.007**	26	4.31	22	3.77	2.167	0.035*
Fire	4.02	23	4.31	26	3.79	2.601	0.012*	27	4.11	23	3.97	0.700	0.487
Forest operations	4.00	22	4.12	26	3.92	0.973	0.335	27	4.02	23	3.98	0.229	0.820
Resilience, long term forestry, post-disturbance/ harvest logistics	3.70	22	4.00	27	3.46	2.633	0.011*	27	3.74	24	3.64	0.460	0.647
Post-fire response and valuation/ merchandising	3.55	22	3.98	26	3.29	2.894	0.006**	26	3.90	23	3.28	2.616	0.012*
Innovative markets and approaches	3.43	23	3.65	27	3.32	1.403	0.167	27	3.78	24	3.16	2.812	0.007**

*$p<0.05$, **$p<0.01$

Table 4. Sources of information survey participants use to support tribal forest management.

	Information sources accessed*	
Information Source	*n*	Percent
Online scientific journals	40	69.0
US Forest Service General Technical Reports (GTRs)	36	62.1
Intertribal Timber Council meetings and conferences	28	48.3
Society of American Foresters publications	26	44.8
Intertribal Timber Council publications	23	39.7
Textbooks	21	36.2
USDA Forest Service Science You Can Use Bulletins	19	32.8
Society of American Foresters meetings and conferences	15	25.9
Libraries	13	22.4

Source: Questions 18 and 19; ITC Information Needs Assessment
*Participants could select multiple options for the access of information.

was very important. A majority of respondents (88%) indicated that developing partnerships with research institutions was very important or extremely important. Half (50%) of respondents said curating tribal data was extremely important. Curating tribal data is related to maintaining tribal data sets and is conceptually related to protecting tribal data. Establishing research priorities was very or extremely important for 84% of respondents and 76% indicated that securing staff and financial resources to apply research results was very or extremely important. A total of 80% of respondents have worked with universities on research in the past, 72% have worked with federal agencies on research, 36% have worked with state agencies, and 32% have worked with nonprofits. Only 16% of respondents indicated that they worked with Tribal Colleges on research. Several respondents indicated in a write-in response that they have never engaged in research activities.

Factor analysis of the twelve survey items measuring participation in research activities revealed three factors: research design and communication, research sovereignty, and research priorities (Table 5).

There were no significant differences between tribal and nontribal members in any of the factors of participation in research activities (Table 6). However, respondents who had worked in forestry for 25 years or less reported research design and communication, research sovereignty, and research priorities as significantly more important than respondents who had worked in forestry for more than 25 years (Table 6).

To further analyze any differences between tribal and nontribal members, we conducted *t*-tests on each item measuring participation in research activities. Although there were no significant differences between tribal and nontribal members at the factor level, this analysis identified significant differences between tribal and nontribal members in two individual items: protecting tribal data and curating tribal data. Tribal respondents reported protecting tribal data (4.74 mean score) and curating tribal data (mean score 4.52) as significantly more important than nontribal respondents (mean scores 4.20 and 4.00, respectively).

Discussion

The vast majority of survey respondents indicated that research information is important for them to do their jobs as natural resource professionals. The top-rated research topics (forest health, water quality, culturally significant species, workforce development/training, tribal youth involvement, cultural importance of water, and invasive species) are all topics that support long-term forest sustainability that goes beyond healthy ecosystems to include healthy cultural connections to those resources and intergenerational continuity. When asked to rate the most important information needs for tribal forestry (Table 1), the priorities were also practical, applied, and support on-the-ground tribal natural resource management (including developing natural resource professionals for future management). This illustrates that tribal values support management of culturally important lands, waters, and people.

When these results are compared to the 2011 research needs survey (Beatty and Leighton 2012), there are many similar findings, including the continued need for research to support tribal natural resource management and the importance of water, fish and wildlife management, cultural knowledge,

Table 5. Factor loadings for dimensions of participation in research activities.

Items	Factor 1: Research design and communication (α = 0.91)*	Factor 2: Research sovereignty (α = 0.81)*	Factor 3: Research priorities*
Interpreting and analyzing data	**0.908**	0.245	0.064
Collecting data	**0.875**	0.220	0.034
Evaluating research studies	**0.700**	0.127	0.602
Presenting research results	**0.693**	0.372	0.324
Designing research studies	**0.657**	0.204	0.564
Protecting tribal data	0.028	**0.842**	0.124
Curating tribal data	0.236	**0.780**	0.178
Securing staff and financial resources to apply research results	0.344	**0.689**	0.130
Developing partnerships with research institutions	0.233	**0.668**	0.097
Finding resources to conduct original research	0.117	**0.573**	0.478
Establishing research priorities	0.049	0.288	**0.874**
Reviewing research studies (including peer review)**	0.617	0.076	0.668

*Bold values in each column indicate the items that group into each factor.
**Item removed due to high factor loading on two factors.

Table 6. Differences in dimensions (factors) of participation in research activities by tribal membership and years worked in forestry.

Dimensions of participation in research activities	Factor mean	Member of a tribe						Years worked in forestry					
		Yes		No				25 years or less		More than 25 years			
		n	Mean	*n*	Mean	*t*	*p*	*n*	Mean	*n*	Mean	*t*	*p*
Research sovereignty	4.16	23	4.38	27	4.06	1.821	0.075	27	4.44	24	3.95	2.979	0.004**
Research priorities	4.07	23	4.04	27	3.76	1.370	0.177	27	4.22	24	3.54	3.652	0.001**
Research design and communication	3.73	23	3.90	27	3.59	1.414	0.164	27	4.07	24	3.38	3.339	0.002**

*$p<0.05$, **$p<0.01$

invasive species, and mechanisms to improve knowledge sharing. Both surveys show participants have an interest in participating in research activities, most especially through establishing research priorities, developing partnerships with research institutions, and securing financial and staff resources to both apply research and conduct monitoring. Our survey differed somewhat from the 2011 survey in that we found a need for improved information for workforce development and youth engagement. Additionally, in 2011 internet access to research results and convenient access to published literature were the first and third rated impediments to research access and use, respectively. Our survey the results show that 90% of respondents indicated that internet access to research results was extremely important or very important and 80% of respondents indicated the same for access to published scientific literature. This suggests that there has been an improvement in access to internet research results and to published scientific literature since 2011. This also implies that it is important to continue to develop strategies to increase access to both internet research and scientific journals.

Our survey results show that topics that improve or support on-the-ground management were highly rated. Broadly, when survey responses are examined within each theme, the highest rated topics are important for on-the-ground management. For example, within the

forest management theme, inventory, planning, silviculture, and GIS were the most important information needs. These are basic components of on-the-ground forest management. In forest protection, forest health and invasive species were highly ranked as was wildland fire management and fuels management for the fire theme. In summary, information needs for tribal forest management seem to focus on the immediate and practical issues that foresters confront in their daily jobs.

Highly ranked policy and social science topics also seem to support on-the-ground management. For example, the Tribal Forest Protection Act and federal and state partnerships were both rated highly. The importance of the Tribal Forest Protection Act is that it is a policy with practical applications for improving forest management across boundaries. It also indicates the extreme importance of land management adjacent to tribal lands. All lands were once tribal lands and tribes typically understand their responsibilities to maintain ecosystems across the landscape irrespective of jurisdiction. It also indicates that the management of adjacent lands can have a profound impact on tribal lands and tribes are looking to mitigate negative forest health impacts (like uncontrolled wildfire and insect or disease outbreaks) emanating off-reservation. The Tribal Forest Protection Act has been in effect for decades and according to respondents in our survey, natural resource professionals still have questions about its impact and implementation.

The cultural aspects of forest management were also ranked highly by survey respondents. The cultural importance of water, Indigenous burning, and workforce development all recognize the importance of culture in forest management and the need to both train youth and to train professionals with the competence and knowledge to understand tribal forest management practices and goals.

Finally, climate change was an important information need but it did not rank as high as some of the practical on-the-ground topics as described above. This could be because there is already a lot of information and work in this area or because climate change is a long-term problem and there are more important information needs for managing current on-the-ground issues. It may also be that climate change is something that permeates many of the information needs prioritized in the survey and was not seen as a stand-alone topic. This is consistent with other studies that show tribal natural resource values are holistic and not reductionist (see Pierotti and Wildcat 2000; Ross et al. 2007; Kimmerer 2013).

Survey responses help make sense of the statistical differences seen in the factor analysis and comparison between tribal and nontribal members and between respondents who worked in forestry for less than 25 years and more than 25 years. For example, tribal members reported that postfire response and valuation, resilience and long-term forestry, and Indigenous burning were more important than nontribal member respondents. This is a gap that has been seen in other research on tribal forestry where nontribal members had different understandings of tribal goals for forest management than tribal members (Gordon et al. 1993; 2003; 2013), although that gap has been closing. In our survey, the practical aspects of responding to fires and maintaining forest value is critical to maintain forest management activities. The long-term nature of Indigenous land tenure also is extremely important to tribal members because their culture, history, and future depends on a resilient forest. Tribes are not going to pack up and move to another area if their lands are poorly managed; tribes live directly with decisions and management outcomes for generations. Finally, there is a lot of literature on Indigenous burning, but the tribal members in our survey rated the research needs of higher importance than nontribal members. Perhaps this is because of the deep connection and knowledge held within Indigenous communities that the tribal members view current literature as limited in relation to that vast knowledge. This could also indicate that tribal members are keying in on differences between Indigenous burning practices and prescribed fire used in modern forestry systems. Additional research into differences between Indigenous burning and prescribed fire treatments is needed for the reintroduction of Indigenous fire-use on the landscape.

Protecting and curating tribal data were also rated more important information needs by tribal members than nontribal members. Data protection and data curation (displaying and/or sharing data) broadly fall under the term "data sovereignty" (Kukutai and Taylor 2016; Walter and Suina 2019). Indigenous people across the country and world are demanding control over their own data (see Harry 2011; Rodriguez-Lonebear 2016; Lovett et al. 2019; Tsosie 2019). This issue is extremely important in forest management but has received less attention than data sovereignty in medical fields. Land and sovereignty are critical aspects of sustainable land management in Indigenous communities (Dockry et al. 2016). The higher rating by tribal members that more information is needed indicates the importance of sovereignty to tribal communities and the future of tribal

natural resources. It can be seen as a pushback against further disposition of tribal assets—in this case, data. Critical questions for researchers to consider in conducting research with tribes include who owns the data, who controls data distribution, how will the data be used, and what happens if the tribe no longer wishes to be a part of a research project? As Smith (1999) highlights, many tribal natural resource professionals have stories about how tribal data has been misused, misinterpreted, or misappropriated. Discussions around data sovereignty and new research on this topic can help support tribal management.

The differences between professionals with more experience than less experience is harder to explain. Professionals with fewer years of experience were more interested in information in new and innovative markets, postfire response and valuation, and Indigenous burning. Additionally, although there was no difference between tribal members and nontribal members, factor analysis for participation in research activities indicates that research sovereignty, defining research priorities, and research design and communication were significantly more important to participants with fewer years of experience. There could be several reasons for these results. First, there may be an overlap between tribal members and respondents who have fewer years of experience. It could also mean that these are new areas of research that will help forestry practitioners in the future. For younger professionals, these topics could be seen as the future of forest management and information is needed to ensure tribal forestry continues. For the more experienced professionals, these topics could be already known to them (e.g., they know a lot about Indigenous burning) or that they already have as much information as they need on these topics to do their jobs today.

We recognize that this assessment has several limitations. The survey respondents represent a relatively low sample size and there is no way to calculate a response rate because the survey link could be used by anyone, and no personally identifiable information was associated with the survey. Although there was a good breakdown of regional responses, there were not enough responses to analyze the data to see whether there were regional differences in research needs. However, since this survey incorporates tribal natural resource research perspectives that are not generally understood outside of tribal communities, it is an important step towards more fully engaging tribes in research activities and developing research that supports their goals. We also recognize that this survey and analysis may generally conflict with holistic Indigenous values and knowledge systems that don't separate and prioritize individual natural resource topics. Further qualitative research would be helpful to develop a more nuanced understanding of tribal research needs, tribal natural resource concerns, and to explore additional topics such as tribal land and sovereignty. However, this research arose from an American Indian institution, included American Indian researchers (including the lead author), and is an important quantitative attempt at summarizing gaps in information and research needs for tribal forest management.

Conclusion

Tribes have thousands of years of place-based knowledge. Their relationship with the environment depends on a rich knowledge of tradition, experiences, and practices. Despite this, tribal research goals, perspectives, and world views have not always been incorporated into natural resource research. This paper describes an Indigenous-led survey of research needs for tribal natural resources and fills an important gap in the literature by identifying topics to support tribal natural resource management goals. Understanding tribal natural resource research needs, access to research information, and perspectives on engagement with research activities will help tribes and researchers find topics and areas of collaboration to solve some of the most important issues in tribal forestry and natural research management. Our survey indicated that tribal research priorities are ones that support long-term forest sustainability and include sociocultural connections. The priorities were also practical and applied and support on-the-ground tribal natural resource management. Our survey indicates that data sovereignty and the presentation of research results are extremely important issues to be attended to when engaging tribes in research activities. We recommend that these results be used as an entry point for researchers and tribes to explore mutual research interests, build long-term relationships, and combine resources to support mutual goals. If researchers work with tribes with respect, honesty, humility, and openness, new research information will be created that will support natural resource management throughout North America.

Supplementary Materials

Supplementary data are available at *Journal of Forestry* online.

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Literature Cited

Beatty, Chris, and Adrian Leighton. 2012. "Intertribal Timber Council Survey of Tribal Research Needs." *The Forestry Chronicle* 88 (5): 565–70.

Bengston, David N. 2004. "Listening to Neglected Voices: American Indian Perspectives on Natural Resource Management." *Journal of Forestry* 102 (1): 48–52.

David-Chavez, Dominique M., and Michael C. Gavin. 2018. "A Global Assessment of Indigenous Community Engagement in Climate Research." *Environmental Research Letters* 13 (12): 123005.

Dockry, Michael J, Katherine Hall, William Van Lopik, and Christopher M Caldwell. 2016. "Sustainable Development Education, Practice, and Research: An Indigenous Model of Sustainable Development at the College of Menominee Nation, Keshena, WI, USA." *Sustainability Science*, 11 (1) 127–138.

Dockry, Michael J., and Serra J. Hoagland. 2017. "Introduction to A Special Issue of the Journal of Forestry—Tribal Forest Management: Innovations for Sustainable Forest Management." *Journal of Forestry*. 115 (5): 339–340.

Dockry, Michael J., Sophia A. Gutterman, and Mae A. Davenport. 2018. "Building Bridges: Perspectives on Partnership and Collaboration from the US Forest Service Tribal Relations Program." *Journal of Forestry* 116 (2): 123–32.

Durkalec, Agata, Chris Furgal, Mark W. Skinner, and Tom Sheldon. 2015. "Climate Change Influences on Environment as a Determinant of Indigenous Health: Relationships to Place, Sea Ice, and Health in an Inuit Community." *Social Science & Medicine* 136: 17–26.

Estes, Nick. 2017. "Fighting for Our Lives: #NoDAPL in Historical Context." *Wicazo Sa Review* 32 (2): 115–22.

Farley, Christopher, Tania Ellersick, and Chalonda Jasper. 2015. "Forest Service Research and Development Tribal Engagement Roadmap." *FS-1043*. Accessed September 23, 2022. https://www.fs.usda.gov/research/docs/tribal-engagement/consultation/roadmap.pdf.

Gordon, John, Joyce Berry, Mike Ferrucci, Jerry Franklin, K. Norman Johnson, Calvin Mukumoto, David Patton, and John Sessions. 2003. "An Assessment of Indian Forests and Forest Management in the United States [IFMAT II]." *Intertribal Timber Council*. https://www.itcnet.org/file_download/29d92288-66ed-44ad-aa3b-17510937842f.

Gordon, John, Jerry Franklin, K.Norman Johnson, David Patton, Jim Sedell, John Sessions, and Ed Williston. 1993. "An Assessment of Indian Forests and Forest Management in the United States [IFMAT I]." *Intertribal Timber Council*. https://www.itcnet.org/file_download/1966ff23-f2df-4df1-914b-52e856950c8e.

Gordon, John, John Sessions, David Cleaves, Vincent Corrao, Adrian Leighton, Larry Mason, Mark Rasmussen, Hal Salwasser, and Mike Sterner. 2013. "Third Indian Forest Management Assessment Team for the Intertribal Timber Council, June 2013. *Assessment of Indian forests and forest management in the United States [IFMAT III]*." https://www.itcnet.org/issues_projects/issues_2/forest_management/assessment.html.

Harry, Debra. 2011. "Biocolonialism and Indigenous Knowledge in United Nations Discourse." *Griffith Law Review* 20 (3): 702–728.

Hatfield, Samantha Chisholm, Elizabeth Marino, Kyle Powys Whyte, Kathie D. Dello, and Philip W. Mote. 2018. "Indian Time: Time, Seasonality, and Culture in Traditional Ecological Knowledge of Climate Change." *Ecological Processes* 7 (1): 1–11.

Hill, Brent Dale. 2011. *The Sequential Kaiser-Meyer-Olkin Procedure as an Alternative for Determining the Number of Factors in Common-Factor Analysis: A Monte Carlo Simulation*. Oklahoma State University.

Hurtado, Sylvia, Nolan L. Cabrera, Monica H. Lin, Lucy Arellano, and Lorelle L. Espinosa. 2009. "Diversifying Science: Underrepresented Student Experiences in Structured Research Programs." *Research in Higher Education* 50 (2): 189–214.

Johnson, Jay T., and Soren C. Larsen. 2013. *Deeper Sense of Place, A: Stories and Journeys of Collaboration in Indigenous Research*. Corvallis, Oregon: Oregon State University Press.

Kimmerer, Robin. 2013. *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*. Minneapolis, Minnesota: Milkweed Editions.

Kovach, Margaret. 2010. *Indigenous Methodologies: Characteristics, Conversations, and Contexts*. Toronto, Canada: University of Toronto Press.

Kukutai, Tahu, and John Taylor. 2016. *Indigenous Data Sovereignty: Toward an Agenda*. Canberra, Australia: Australian National University Press.

Legal Information Institute. 18 U.S. Code § 1151 - Indian Country Defined. n.d. Cornell Law School. Accessed April 26, 2022. https://www.law.cornell.edu/uscode/text/18/1151.

Lovett, Raymond, Vanessa Lee, Tahu Kukutai, Donna Cormack, Stephanie Rainie, and Jennifer Walker. 2019. "Good Data Practices for Indigenous Data Sovereignty and Governance." P. 26–36 in *Good Data*, Angela Daly, S.K. Devitt, and M. Mann (eds.). Institute of Network Cultures, Amsterdam.

Lucero, Stephanie A., and Sonia Tamez. 2017. "Working Together to Implement the Tribal Forest Protection Act of 2004: Partnerships for Today and Tomorrow." *Journal of Forestry* 115 (5): 468–72.

Matson, Laura, G.-H.Crystal Ng, Michael Dockry, Madeline Nyblade, Hannah Jo King, Mark Bellcourt, Jeremy Bloomquist, Perry Bunting, Eric Chapman, and Diana Dalbotten. 2021. "Transforming Research and Relationships through Collaborative Tribal-University Partnerships on Manoomin (Wild Rice)." *Environmental Science & Policy* 115: 108–15.

McAvoy, Leo, Patricia L. Winter, Corliss Wilson Outley, Dan McDonald, and Deborah J. Chavez. 2000. "Conducting Research with Communities of Color." *Society & Natural Resources* 13 (5): 479–88.

Pierotti, Raymond, and Daniel Wildcat. 2000. "Traditional Ecological Knowledge: The Third Alternative (Commentary)." *Ecological Applications* 10 (5): 1333–40.

Reo, Nicholas J., Kyle Whyte, Darren Ranco, Jodi Brandt, Emily Blackmer, and Braden Elliott. 2017. "Invasive Species, Indigenous Stewards, and Vulnerability Discourse." *American Indian Quarterly* 41 (3): 201–23.

Rodriguez-Lonebear, Desi. 2016. "Building a Data Revolution in Indian Country." P. 253–272 in *Indigenous Data Sovereignty: Toward an Agenda*, Tahu Kukutai and J. Taylor (eds.), Australian National University Press, Canberra, Australia.

Ross, Norbert, Doug Medin, and Doug Cox. 2007. "Epistemological Models and Culture Conflict: Menominee and Euro-American Hunters in Wisconsin." *Ethos* 35 (4): 478–515.

Smith, Linda Tuhiwai. 1999. *Decolonizing Methodologies: Research and Indigenous Peoples*. Dunedin, New Zealand: University of Otago Press.

Tavakol, Mohsen, and Reg Dennick. 2011. "Making Sense of Cronbach's Alpha." *International Journal of Medical Education* 2: 53–55.

Tsosie, Rebecca. 2019. "Tribal Data Governance and Informational Privacy: Constructing Indigenous Data Sovereignty." *Montana Law Review* 80 (2): 229–267.

Walter, Maggie, and Michele Suina. 2019. "Indigenous Data, Indigenous Methodologies and Indigenous Data Sovereignty." *International Journal of Social Research Methodology* 22 (3): 233–43.

Whyte, Kyle. 2017. "The Dakota Access Pipeline, Environmental Injustice, and US Colonialism." *Red Ink: An International Journal of Indigenous Literature, Arts, & Humanities*, no. 19.1. Available at SSRN: https://ssrn.com/abstract=2925513.

Wilkinson, Charles F. 2005. *Blood Struggle: The Rise of Modern Indian Nations*. New York: Norton.

Wilson, Shawn. 2008. *Research Is Ceremony: Indigenous Research Methods*. Winnipeg, Manitoba: Fernwood Publishing.