USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

FS-1230 | December 2023

Forest Inventory and Analysis

Fiscal Year 2022 Business Report

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Forest Inventory and Analysis

Fiscal Year 2022 Business Report

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James Peak Wilderness, Roosevelt National Forest, CO. USDA Forest Service photo by Elaine Wells.

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Executive Summary

For more than 90 years, the Forest Inventory and Analysis (FIA) program of the Forest Service, an agency of the U.S. Department of Agriculture, has played an integral role in providing information vital to the management and conservation of the Nation's forest resources. In recent years, an increased number of major decisions regarding the Nation's forests have been made with reference to and reliance on FIA findings and forest resource evaluations. Today, FIA provides authoritative data about forest carbon, forest products and services, biomass availability, economic development opportunities, land cover and land use change, incidence of nonnative invasive species, impacts of pests and diseases, and wildfire risk, and to support the sustainable management and conservation of forests, water resources, and biodiversity.

The current FIA strategic plan requires an annual business report that summarizes program activities and progress towards implementing the 2018 Farm Bill direction. This annual business report, the program's 25th, describes program resources, accomplishments, and plans for the coming year. The continued success of FIA is due, in part, to the program's commitment to accountability and transparency in delivering the best value, quality, and array of products in partnership with stakeholders.

Key findings from the fiscal year (FY) 2022 business report include:

Progress on inventory. FIA conducted inventory activity in all 50 States, including Hawaii and Interior Alaska, and completed 12 percent of the forested sample locations in the FIA base grid. FIA crews prioritized measurement of the 2020 and 2021 plot backlog resulting from the impact of the coronavirus (COVID-19) pandemic and other natural disasters. By the end of 2022, 95 percent of all 2020 base grid plots and 80 percent of 2021 base grid plots had been sampled. Crews also measured 63 percent of the 2022 plots. Catchup efforts will continue in FY 2023.

For the third year, inventory efforts continued in the Southwest unit of Interior Alaska where field crews worked by helicopter and raft in roadless areas that had not been inventoried beyond its rivers before. The Southwest unit represents a total forest area sampled of 27 million acres. About 45 percent of the field plots in this unit have been measured to date. After a 2-year pause caused by the COVID-19 pandemic, the National Aeronautics and Space Administration (NASA) was able to resume remote sensing data acquisition using the G-LiHT (Goddard's LiDAR, Hyperspectral & Thermal) Imager to supplement field plot information. G-LiHT imagery was collected over an additional 19 percent of the Southwest unit, focusing on field plots and near field hubs planned for the 2022 and 2023 field seasons. A total of 42 percent of the unit now has G-LiHT coverage.

Funding and partners' support. FIA operations were funded through appropriations at $22.197 million. Under the new budget structure, Congress appropriated $257.6 million for the newly established salary and expense budget line item for the Forest and Rangeland Research account, which includes FIA. In addition to annual program appropriations, FIA received an additional $25 million to help clear the plot backlog caused by natural disasters and the agency's COVID-19 response. Forest Service Research and Development also provided FIA with $176,000 for operations and $1.5 million in information technology (IT) dollars. State agencies, universities, other Forest Service programs, other Federal agencies, and nongovernmental organizations (NGOs) contributed 13 percent of the total available funds—$14.3 million, representing an increase of $2.2 million over the previous year.

Grants and agreements. FIA uses grants and agreements with external partners to achieve high-quality results through expanded capacity and expertise. The FIA Program invested $29.7 million in grants and agreements in FY 2022, an increase of $6.7 million over the previous year. This increase was largely due to the supplemental funding Congress provided to address the plot backlog.

Data availability. Data for all States, Coastal Alaska, and the Tanana Valley and Susitna-Copper units of Interior Alaska were accessible online in FY 2022; however, just 47 percent of States with annual inventories had data available that were less than 2 years old. This was due to two factors. First, some FIA units have been waiting to publish data until after the new volume and biomass equations are released in FY 2023. Second, the FIA Program does not upload data for a given inventory year until all plots in a State have been completed, so the sampling backlog has resulted in further delays. FIA data supplied information for 181 spatial data requests and nearly 630,000 online data requests. FIA staff provided 1,276 consultations; this required an investment of time equivalent to three full-time staff positions.

Reporting and publications. FIA published 143 publications, including 55 core publications (reports specific to a complete survey unit, complete State, national forest, or national reports), and 72 journal articles. This year's published core publications included new 5-year State reports for Maine, Minnesota, Kentucky, Tennessee, Nevada, and Interior Alaska.

Relevant meetings. FIA held 12 user group meetings and 9 management meetings to ensure that the program is providing the highest quality service and meeting its objectives according to the goals stated in the strategic plan and ongoing commitments to partners. This was more than double the number of meetings held in FY 2021.

Personnel. FIA employed the equivalent of 588 full-time employees, 25 more than the previous year. This included 351 Federal employees paid with the FIA portion of agency salary and expense funds and 237 cooperators paid through grants, agreements, and contracts. Cooperators are integral to the efficient delivery of the FIA Program, comprising 40 percent of the total FIA workforce. Seventy percent of employees supported by FIA were employed in data collection and quality assurance, 16 percent in analysis and research, 9 percent in information management, and 5 percent in administration.

National resource use monitoring. The FIA Program uses questionnaires and surveys to gather data on timber products output, harvest utilization, and the characteristics and management objectives of the Nation's private woodland owners. Since FY 2000, FIA has collected such data from 106,444 surveys and questionnaires, including 2,998 in FY 2022. This information, in concert with FIA plot data, is critical to monitoring the sustainability of the Nation's forest resources.

Information technology. In FY 2022, the FIA Program continued to invest in cloud services and application development to facilitate data access and analysis. The program also redesigned the DataMart web interface to create a more efficient and intuitive user experience and replaced the previous version of the EVALIDator web application with an updated web interface and application programming interface (API) that improve performance.

Looking to 2023 and beyond. With the help of congressional funding relief and support from partners, FIA anticipates clearing the backlog of plot sampling needs over the next 2 years. Partnerships are critical to success, so FIA will continue to work with partners and stakeholders to accomplish the program of work and ensure that clients' needs are met. Important goals for FY 2023 and beyond include:

- Prioritize data collection and information production to reduce the backlog. Based on available resources:
  - Complete the remaining FYs 2020 and 2021 plot backlog and 80 percent of the FY 2022 scheduled plots during the FY 2023 field season.
  - Continue annualized inventory across the conterminous United States and Coastal Alaska.
  - Complete field inventory in the Southwest Alaska unit, the third unit of six in Interior Alaska.
  - Continue urban data collection in all partner cities.
  - Publish all 5-year State reports that are currently in final review and layout.
- Given increasing challenges of measuring more remote, roadless units in Interior Alaska, continue exploring possible modifications to the inventory design that improve financial and logistical feasibility while keeping safety a priority.
- Continue working toward achieving annual timber products output survey collection and delivery of data using a sample survey design with a sample size that varies based on the surveyed region. Following the release of 2018 mill data for the South in FY 2020, FIA will release 2018 mill data for the North in early FY 2023 and will release 2019 data by end of FY 2023.
- Continue investing in online applications that improve the delivery of FIA information.
- New updated biomass modeling framework (National Scale Volume and Biomass (NSVB)) will be finalized and included in the National Information Management System (NIMS) and FIA database. The new NSVB models will be implemented in FIA's National DataMart before the end of FY 2023.
- Develop a new search tool that will query, by topic of choice, all FIA publications in one place.
- Work with national users to standardize improved carbon estimation and reporting.
- Continue to respond to the 2018 Farm Bill direction to find efficiencies in the FIA Program through the improved use and integration of advanced remote sensing technologies, with the approach focused on implementing small area estimation techniques.
- Use available authorities to gain efficiencies in the hiring process and fill vacant positions with quality recruits at levels required for successful program delivery.

Introduction

The Forest Inventory and Analysis (FIA) program of the Forest Service, an agency of the U.S. Department of Agriculture (USDA), provides the information needed to assess the status, trends, and sustainability of America's forests. This business report, which summarizes program activities in fiscal year (FY) 2022 (October 1, 2021, through September 30, 2022), gives FIA's customers and partners a snapshot of past activities, current business practices, and future program direction. It is designed to increase our accountability and foster performance-based management of the FIA Program.[1]

The FIA Program has provided authoritative information on the Nation's forest resources since 1930. FIA collects, analyzes, and reports information on the status and trends of America's forests: how much forest exists, where it exists, who owns it, and how it is changing; how trees and other forest vegetation are growing; how much forest has died or been removed; and how harvested trees have been used in recent years. This information can be used in many ways, such as in evaluating wildlife habitat conditions, assessing sustainability of current ecosystem management practices, monitoring forest health, supporting planning and decision-making activities undertaken by public and private enterprises, predicting the effects of climate change, and providing authoritative data to the forest products industry. The FIA Program combines this information with related data on insects, diseases, and other types of forest damage to assess the current health of and potential risks to forests. These data are also used by the Forest Service Research and Development (R&D) Resources Planning Act (RPA) Assessment program to project how forests are likely to appear in 10 to 50 years; various scenarios evaluate whether current forest management practices are sustainable in the long run and assess whether current policies will enable future generations to enjoy the same benefits provided by America's forests today.

As FIA continues to deliver a nationally consistent program, this report remains focused on program accomplishments and challenges while highlighting opportunities created by the joint efforts of the four regional FIA units housed at the Northern Research Station (NRS), the Southern Research Station (SRS), the Rocky Mountain Research Station (RMRS), and the Pacific Northwest Research Station (PNW), in close collaboration with national program leaders in the National Office.

[1] This business report does not include statistical information about the forests of the United States. For this information, contact the appropriate regional or national FIA office listed in appendix A of this report or go to www.fs.usda.gov/research/programs/fia.

Changes From Previous Years' Business Reports

In FY 2022, the FIA Program began work on **standardizing the methods used for gathering and summarizing accomplishment data related to the Nationwide Forest Inventory.** This will allow several key metrics to be calculated from queries on data stored in FIA databases, eliminating inconsistencies in how numbers have been reported over time and across FIA regions. Changes are noted in the relevant tables and include:

- The definition of **forested base grid** plots has been clarified and now includes all plots containing either "accessible forest" or "nonsampled (possibility of forest)" on at least one condition found on the plot. The total number of forested base grid plots (tables 1 and B-1) can now be queried within the FIA database and updated annually for this report. Previously, the number of forested base grid plots was calculated by dividing the total land area (table 1) by the sampling intensity (one plot per 6,000 acres), then multiplying this by the average percentage of land with forest cover (see table B-1 in past business reports).
- The method for calculating the number of forested **base grid plots completed** has been updated to include plots that could not be sampled due to hazardous conditions or denied access. These are now reported in table B-1.
- The number reported for quality assurance (QA) plots sampled is now defined as blind and cold checks completed on forested base grid plots, eliminating some prior inconsistencies in reporting QA plots across FIA regions.

These changes resulted in relatively minor adjustments to the numbers reported in past business reports but will complicate comparisons to historical accomplishment data. Table 4 includes updated numbers for FY 2021 that were calculated using the new methodology to accurately show changes from the previous year.

For the second year, this report presents financial information in two tables: the Federal funds invested in FIA Federal salaries and expenses (S&E) (table B-2a) and a financial statement for operational funds appropriated by Congress directly to FIA (table B-2b). In FY 2021, based on legislative direction in the Further Consolidated Appropriations Act for FY 2020, the Forest Service adopted a new budget structure and changed internal budget policy, direction, and practices. This effort, also known as "budget modernization," changed the way congressionally appropriated funds were allocated to FIA and other Forest Service programs. The new budget structure resulted in some changes in the way FIA can allocate and report on appropriated funding with the transparency expected by partners and stakeholders.

The most significant changes to the agency budget were the elimination of cost pools and the establishment of budget line items for S&E. Previously, cost pools paid with program funds covered fixed operational costs such as business services and infrastructure, workers' compensation programs, and unemployment compensation insurance. Under the new budget structure, FIA operational costs are paid through a new Forest Service operations account rather than with appropriated program funds. Similarly, employee salaries and related expenses (overtime, benefits, travel, training, and awards) are now paid through the S&E budget line items. FIA's S&E budget is included within the agency's Forest and Rangeland Research appropriation without a specific allocation. As a result, the FIA Program is only able to report the funds spent to cover FIA S&E (table B-2a) rather than funds allocated. These changes were intended to improve oversight by ensuring that agency spending is consistent with congressional direction and will help the Forest Service more clearly articulate financial needs and outcomes. The primary impact on this annual business report is that FIA cannot report a total amount of appropriated funding in a way that is fully comparable to prior years.

Operational funds, also called program funds, are used to support grants, agreements, contracts, procurement, and related expenses. As in previous years, FIA is able to report on operational funds appropriated to the program (table B-2b). Reporting of program expenditures also remains unchanged.

Fiscal Year 2022 Program Overview

In FY 2022, the FIA Program completed its 24th year of implementing inventories annually, as outlined in the "Strategic Plan for Forest Inventory and Analysis" (hereafter strategic plan) written in response to the Agricultural Research, Extension, and Education Reform Act of 1998 (Public Law 105–185). FIA operations use a systematic survey sample design with a grid of 6,000-acre hexagons (the base grid) laid over the entire United States with one plot located within each hexagon. The primary goal of the FIA Program's Nationwide Forest Inventory is to measure at least 10 percent of FIA forested base grid plots per year in the Western United States and 15 percent of FIA forested base grid plots per year in the Eastern United States. Table 1 shows the land area, forest area based on the FIA and RPA Assessment definitions, percentage of forest (forest area divided by land area), and the overall distribution of FIA forested base grid plots for the United States, including Puerto Rico, the U.S. Virgin Islands, and U.S. territories and affiliated islands in the Pacific. Interior Alaska, Hawaii, and other islands are sampled on a different schedule due to logistical constraints and not included in the annual sampling targets.

The base program includes annual compilations of the most recent year's information, with full State-level reporting at 5-year intervals. All States have the option to contribute the resources necessary to bring the program up to a full sample intensity of 20 percent per year or to make other value-added contributions such as funding more frequent plot measurements (temporal acceleration) or adding additional sample locations (spatial intensification).

Table 1. Overview of land area, forest area calculated based on the FIA and RPA Assessment definitions of forest,[a] a percentage of land area that is forested based on the FIA definition, and the number of FIA forested base grid plots.

FIA Region	Land area	Forest area (FIA)	Forest area (RPA)	% Forest (FIA)	FIA base grid plots[b] (forested)
	Million acres			*Percent*	*Plots*
Northern	607	183	183	30%	37,636
Southern	533	268	246	50%	52,846
Rocky Mountain	548	153	124	28%	29,318
Pacific Coast (CA, OR, WA)	204	89	83	44%	16,059
Coastal Alaska	39	14	14	36%	2,238
Interior Alaska	327	114	114	35%	4,286
Islands (including Hawaii)	7	3	3	43%	1,386
Total	**2,264**	**824**	**767**	**38%**	**143,769**

FIA = Forest Inventory and Analysis; RPA = Resources Planning Act; CA = California; OR = Oregon; WA = Washington.

Estimates of land and forest area (using both the FIA and RPA Assessment definitions) were taken from "Forest Resources of the United States, 2017: A Technical Document Supporting the Forest Service 2020 RPA Assessment." Forest area estimates from the current FIA database may not match due to the inclusion of more recent inventory data.

[a] The RPA Assessment and FIA definitions of forest differ. The RPA Assessment definition requires at least 10-percent canopy cover by trees at least 5 m (16.5 feet) tall or trees able to reach these thresholds in situ, while the FIA definition includes trees of any height and thus includes woodlands where trees are shorter. Because the FIA definition includes woodlands, estimates of forest area using the FIA definition will be higher in arid to semiarid regions.

[b] The FIA base grid consists of one plot per 6,000 acres in the conterminous United States except for Delaware and Rhode Island, which are sampled at double intensity due to the small land area. Forested base grid plots are defined as plots containing either "accessible forest" or "nonsampled (possibility of forest)" on at least one condition found on the plot.

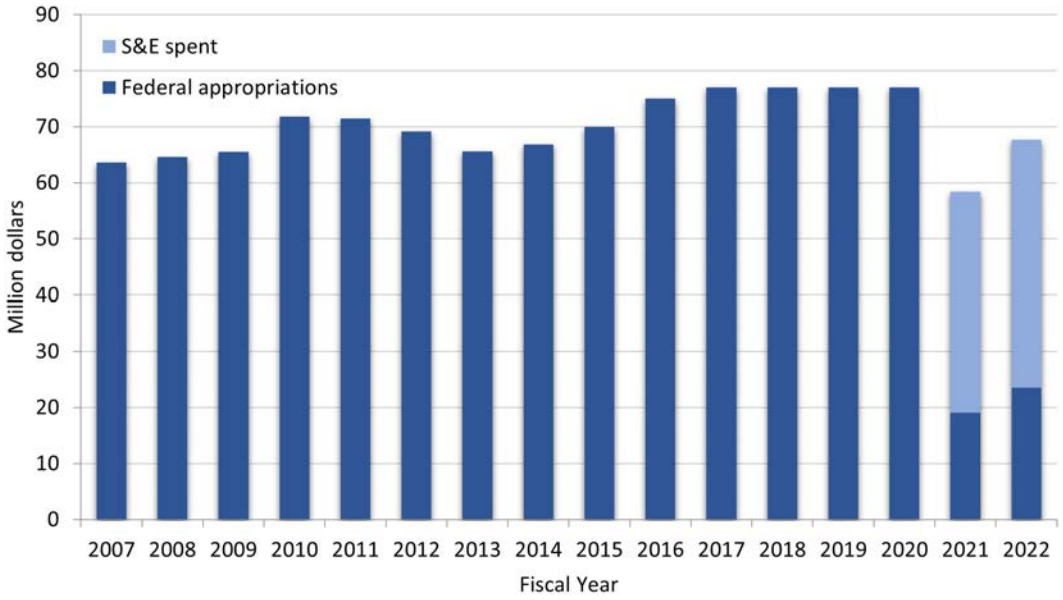
Program Resources

In FY 2022, Congress appropriated $22.197 million for FIA operations. Other funding made available to the program included S&E for FIA staff ($44.05 million), information technology (IT) funding ($1.55 million), and the agency's indirect costs of common business services ($10.4 million in FY 2020, the last year this was tracked). Of the operational funds, congressional direction required that approximately $3.4 million be allocated for specific purposes, with the largest share ($2 million) directed at efforts to refine county and State biomass estimates (i.e., small area estimation). Under the new budget structure, FIA does not receive specific appropriations for S&E or indirect costs, which makes it difficult to estimate the total funding available in a way that is comparable to prior years (figure 1).

Operational funding appropriations in FY 2022 were bolstered by the addition of $25 million in disaster supplemental funding that was provided to support plot, timber products output (TPO), and harvest utilization (HU) data collection catchup in areas affected by fire, hurricanes, or other natural disasters. The disaster supplement is intended to support catchup work over the next 3–4 years. This addition, coupled with partner contributions, brought the total investment in the FIA Program to $108.6 million for FY 2022 (figure 2).

In addition to the $1.55 million in IT funds received from FY 2022 appropriations, FIA also received $1.5 million from other Forest Service R&D IT funds (table B-2b), without which the program would not have been able to meet its IT needs. Partners, including the National Forest System (NFS), contributed $3.1 million to the base program and $11.2 million in added value (table B-4). Value-added contributions fund work such as new research, new measurements, spatial intensification (>1 plot per 6,000 acres) and temporal acceleration (plots sampled more frequently).

Figure 1. FIA appropriated funding level, FYs 2007–2022.



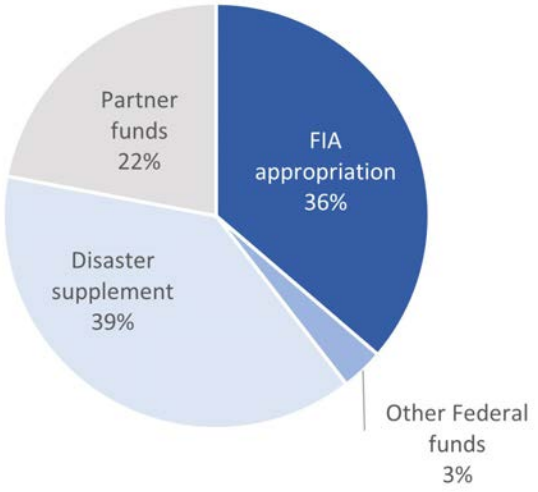
FIA = Forest Inventory and Analysis; FY = fiscal year; S&E = salary and expenses under the new Forest Service budget structure.

Federal appropriations = initial FIA funds added to base + secondary funds added to base. For FYs 2021–2022, this also includes information technology (IT) funding. S&E spent is shown for FYs 2021 and 2022 because S&E were not paid out of FIA's Federal appropriations as in previous years.

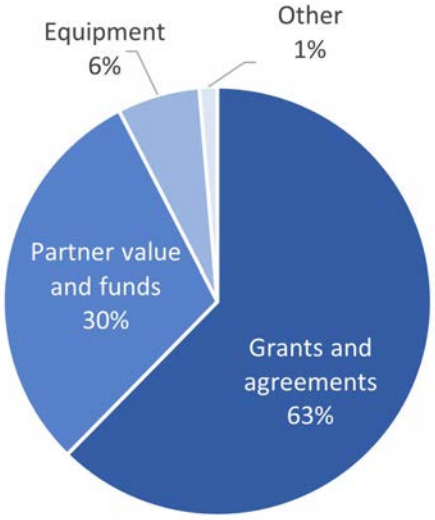
The FY 2021 business report displayed congressional S&E intent rather than S&E spent. Because there was no congressional intent statement for FIA funding in 2022, this number was updated to dollars spent for consistency.

Figure 2. FIA Program total operational funds available (A) and total expenses by category (B), FY 2022. Salary and expenses are not included in the operational budget or expenses.

(A)



(B)



FIA = Forest Inventory and Analysis; FY = fiscal year.

In FY 2022, FIA employed the equivalent of 351 full-time Federal workers (full-time equivalents (FTEs); table B-3a), 19 more than in FY 2021 but still 27 fewer than in FY 2020. Efforts to fill vacant positions have been hindered by ongoing staffing shortages in Human Resources Management, a highly competitive job market, and prohibitively expensive housing in some locations. Cooperators, especially State natural resources agencies, accomplished much of the work done by FIA, contributing an additional 237 full-time employees (table B-3b) for a total FIA workforce of 588 (table B-3c). Cooperator employees made up 40 percent of the total FIA workforce. The majority of the FIA workforce (70 percent) was engaged in data collection (figure 3). Contributions from States remained critical to helping the FIA Program complete its annual fieldwork (table 2).

Figure 3. Federal and State FIA-supported employees by job group, FY 2022.

FIA = Forest Inventory and Analysis; FY = fiscal year.

Investment in Partnerships and Partners' Contributions

In the 1998 Farm Bill, the 2014 Farm Bill, and the 2018 Farm Bill, Congress directed the FIA Program to partner with States and other entities. This is accomplished through grants and agreements to partners that support the FIA program of work. In some cases, partners provide expertise that complements or is not available within FIA; in other cases, they share the workload in data collection, information management, and research in techniques development. Over the last 10 years, FIA has invested over $191.1 million in its partners to implement an efficient inventory. During the same period, partners have contributed $106.9 million to leverage Federal dollars, which has reduced inventory cycles, increased the density of plots, and provided for other annual inventory enhancements.

FIA Investment Through Grants and Agreements. In FY 2022, FIA invested $29.7 million in grants and agreements with partners including State agencies, universities, nongovernmental organizations and companies, other Forest Service programs, and other Federal agencies (figure 4, table B-5). The growing trend of FIA investment in external partnerships over time demonstrates a high reliance on collaborations to efficiently complete program work (figure 5).

Through annual agreements, State agencies received 33 percent of this investment (figure 4). In turn, State agencies leverage FIA's on-the-ground resources to contribute funds and in-kind resources for additional data collection and analysis to meet their local needs (table 2). State fieldwork employees provided through these partnerships made up over one-third of the FIA workforce (figure 3).

Table 2. Annual appropriations received by the FIA Program and allocation of FIA-appropriated and State-contributed funds for fieldwork, FYs 2013–2022.

Category	Fiscal Year									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	Thousand dollars									
Total appropriated funds received	65,567	66,805	70,000	75,000	77,000	77,000	78,000[a]	77,000	57,786	67,637
FIA data collection grants to States	5,338	7,098	5,173	8,428	8,945	9,652	10,633	9,755	11,148	9,742
Number of States recieving grants	16	17	16	18	17	20	18	18	17	17
Average grants to participating States	334	418	323	323	526	482	591	542	656	573
Percent of FIA-received appropriated funding to States for data collection	8%	11%	7%	11%	12%	13%	14%	13%	19%	14%
State contributions for leveraged data collection	3,962	3,919	4,324	5,506	5,205	6,568	5,239	6,809	5,491	2,479
Number of fund-contributing States and U.S. islands	38	36	37	34	36	41	37	41	51	38
Average contribution from States	104	109	117	162	145	151	142	166	108	65

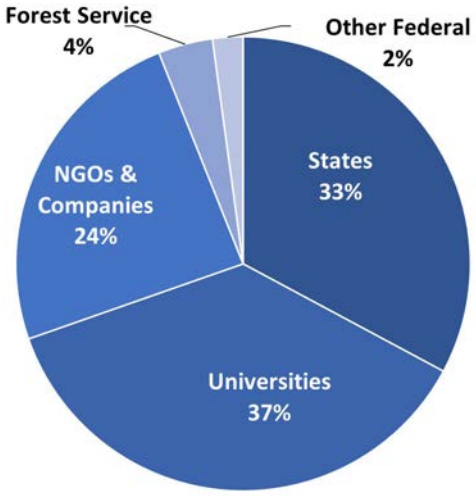
FIA = Forest Inventory and Analysis; FY = fiscal year.

Starting in FY 2021, the indirect costs of operations (former costs pools) were paid through the new Forest Service Operations Treasury Symbol account.

The new salary and expense budget line Items related to Research and Development paid for the staff providing indirect support at the stations. These indirect costs were previously paid with FIA Program funds.

[a] Includes $1 million supplemental appropriation for hurricane relief.

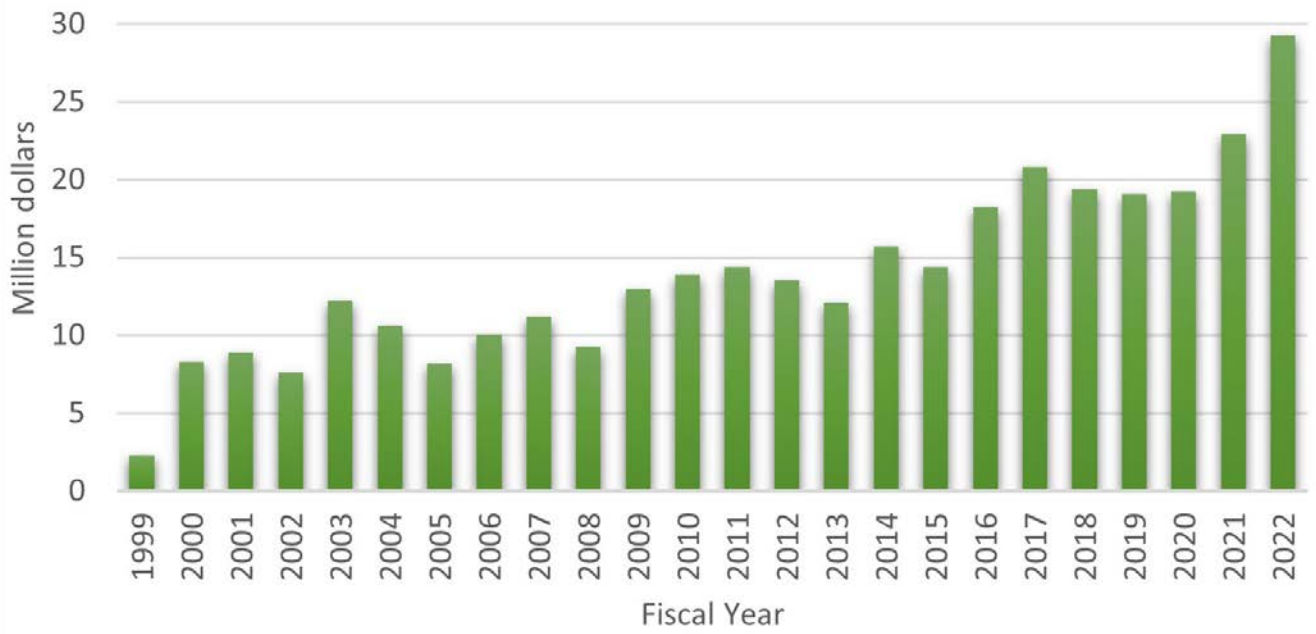
Figure 4. Grants and agreements by recipient group, FY 2022.



Recipient Group	Grant amount ($)	No. of recipients
States	9,741,675	17
Universities	10,918,309	49
NGOs and companies	7,216,324	55
Forest Service	1,151,341	8
Other Federal agencies	640,516	9
Total	**29,668,165**	**138**

FY = fiscal year; NGO = nongovernmental organization.

Figure 5. FIA investment in external partnerships through grants and agreements, 1999–2022.



FIA = Forest Inventory and Analysis.

Partners' Contributions to FIA. At their discretion, partners may contribute the resources needed for FIA to sample the full 20 percent of base grid plots per year (5-year cycle) that is included in the authorizing legislation (1998 Farm Bill). In addition, or as an alternative, partners may choose to contribute resources to enhance the FIA Program, such as intensifying the base FIA sample location grid to support analysis at finer spatial resolutions, funding additional types of measurements on FIA sample locations, or providing analyses or reporting beyond that provided by FIA. The willingness of partners to contribute resources demonstrates the inherent value of the FIA Program as a flexible framework providing information on issues of interest.

Table B-4 lists all partner contributions to the FIA Program in FY 2022. These resources include staff time, vehicle use, office space, equipment, travel costs, and other noncash items that support or add value to the FIA Program. For reporting purposes, contributions are assessed in terms of the cost for Federal FIA staff to provide the same service, which may not necessarily be the same as the actual cost to the partner making the contribution. Overall, partners contributed $3.1 million toward the base program as defined by option B of the FIA strategic plan. Partners also provided another $11.2 million in contributions that add value to the FIA Program for a total of $14.3 million (table 3).

Table 3. FIA grants and agreements to partners and partner contributions by FIA unit, FY 2022.

Unit	Total FIA G&A				Total partner contributions			
	Amount *(dollars)*	Percent	Number	Percent	Amount *(dollars)*	Percent	Number	Percent
Pacific Northwest	4,878,437	17%	20	18%	2,388,711	17%	16	19%
Rocky Mountain	5,120,796	18%	22	20%	637,788	4%	7	8%
Southern	8,683,668	30%	26	23%	2,156,748	15%	11	13%
Northern	7,898,621	27%	37	33%	8,022,374	56%	46	55%
National Office	2,666,712	9%	7	6%	1,097,591	8%	3	4%
Total	**29,248,234**	**100%**	**112**	**100%**	**14,303,212**	**100%**	**83**	**100%**

FIA = Forest Inventory and Analysis; FY = fiscal year; G&A = grants and agreements.
Percentages may not add to totals because of rounding.

Outputs and Products

Table B-1 summarizes funding and performance measures for each of the FIA units. In FY 2022, FIA sampled 13,844 base grid forest plots throughout the 50 States, including Hawaii and the Southwest unit of Interior Alaska (the first unit where all plots are only accessible by air). Nationally, 11 percent of forested base grid plots were completed (table B-1). Spatial intensification and temporal acceleration efforts sampled an additional 4,923 plots. Plot data collection for spatial intensification and temporal acceleration relied on State and contracted crews and was financed by State agencies, Forest Service regions, and other Federal agencies.

In FYs 2020 and 2021, impacts from the coronavirus (COVID-19) pandemic, hazardous conditions and poor air quality induced by catastrophic wildfires, and field staff shortages in all units delayed sampling efforts and made it difficult for the FIA Program to meet its annual data collection and delivery targets. In FY 2022, field crews prioritized measurement of the remaining 2020 and 2021 plots while also working to complete 2022 plots where capacity allowed. The addition of supplemental disaster funding allowed for a large increase in the number of plots sampled (tables 4 and B-1); however, ongoing challenges with hiring Federal employees and limited contracting options in some FIA regions continue to hinder data collection. By the end of 2022, crews had completed 95 percent of the plots scheduled for inventory in 2020, 80 percent of the plots scheduled for 2021, and 63 percent of the plots scheduled for 2022.

The conterminous United States and Coastal Alaska use an annualized[2] survey, and Interior Alaska, Hawaii, and the U.S.-affiliated islands implement a periodic[3] survey. FIA's legislative direction, most recently from the Forest and Rangeland Renewable Resources Research Act of 1978 (PL 95–307, as amended through P.L. 115–334, enacted Dec. 20, 2018), states that the Nation's Trust Territories and Freely Associated States are to be treated as States for research purposes. Since 2000, in compliance with this mandate, periodic inventories have been completed in the Commonwealth of Puerto Rico, U.S. Virgin Islands, Federated States of Micronesia, American Samoa, Guam, the Republic of Palau, the Republic of the Marshall Islands, and the Commonwealth of the Northern Mariana Islands, all of which are exempt from the annualized system.

[2] Annualized inventory measures 10 to 20 percent of all plots in each State each year.

[3] Periodic inventory measures plots once every few years. State-level inventory is based on a full measurement of existing plots.

Table 4. Number and percent change of FIA plots sampled by FIA unit, FYs 2021 and 2022.

	Pacific Northwest			Rocky Mountain			Southern			Northern			Total		
Base grid (forested and possibly forested[a])	2021	2022	Change	2021	2022	Change	2021	2022	Change	2021	2022	Change	2021	2022	Change
Field-sampled	1,667	1,425	**-15%**	1,964	2,958	**51%**	5,551	4,945	**-11%**	4,218	4,516	**7%**	13,400	13,844	**3%**
Nonsampled hazard	54	98	**81%**	14	37	**164%**	55	55	**0%**	13	17	**31%**	136	207	**52%**
Nonsampled denied access[b]	133	100	**-25%**	199	406	**104%**	559	500	**-11%**	865	1,000	**16%**	1,756	2,006	**14%**
Base forest quality assurance plots	66	65	**-2%**	101	202	**100%**	558	429	**-23%**	220	289	**31%**	945	985	**4%**
% field-sampled base grid with QA	4%	5%	**15%**	5%	7%	**33%**	10%	9%	**-14%**	5%	6%	**23%**	7%	7%	**1%**
Additional plots sampled (forested and nonforest)															
Spatial intensification	912	994	**9%**	-	-	-	297	280	**-6%**	1,490	1,519	**2%**	2,699	2,793	**3%**
Temporal acceleration	206	281	-	-	-	-	1,611	1,480	**-8%**	353	369	**5%**	2,170	2,130	**-2%**
Urban plots	31	46	**48%**	-	85	-	188	175	**-7%**	2,272	1,508	**-34%**	2,491	1,814	**-27%**
Special study plots[c]	483	23	**-95%**	-	-	-	33	-	**-100%**	-	-	-	516	23	**-96%**

FIA = Forest Inventory and Analysis; FY = fiscal year; QA = quality assurance.

[a] Plots that are forested or appear to be forested based on a prior field visit or remote sensing data but could not be sampled due to hazardous conditions or denied access are classified as "nonsampled (possibility of forest)."

[b] Landowner permission is required to sample plots on private land; some plots could not be sampled because the landowner denied access.

[c] Special study plots are typically post-disturbance measurements taken after wildfires or hurricanes.
Numbers presented here for FY 2021 may not match the FY 2021 business report because all numbers were updated using consistent database query methods outlined within this business report to allow for accurate comparisons.

FIA measures approximately 550 inventory field plots throughout Hawaii's forests over a 3-year period every 10 years. Field plots are on the islands of Hawai`i, Maui, Moloka`i, Lanai, O`ahu, Kaho`olawe, and Kauai. The second measurement of these field plots began in 2019 and was completed in March 2022, and Hawaii's third inventory measurement is planned for 2029–2031.

The approximately 600 inventory field plots spread across Puerto Rico (mainland Puerto Rico and the islands of Vieques, Culebra, and Mona) and the U.S. Virgin Islands (St. Croix, St. Thomas, and St. John) have been remeasured every 5 years since implementation of the nationalized inventory design there in 2001. Puerto Rico is currently on its seventh inventory, which will be complete in 2024 (two 10-year periodic inventories in 1980 and 1990 preceded the inventories of 2003, 2009, 2014, and 2019[4]). The forests of the U.S. Virgin Islands have been inventoried three times (2004, 2009, and 2014), but the fourth inventory had to be suspended before completion due to the COVID-19 pandemic. Sampling is scheduled to resume in 2024, following completion of Puerto Rico's seventh inventory.

Table B-1 summarizes other key FIA Program accomplishments from FY 2022. Some highlights include:

- FIA staff produced 143 publications, including 55 core reports and 72 peer-reviewed journal articles.
- The number of consultations requested by FIA customers (table B-6) totaled 1,276, an increase of 83 percent over FY 2021, although the total hours spent on consultations decreased somewhat to 6,398.
- FIA processed 629,374 online data retrievals and fulfilled 181 spatial data requests (table B-7).
- FIA held 12 user group meetings and 9 management meetings. National and regional user group meetings provided a mechanism for users and stakeholders to track FIA accomplishments, provide feedback on performance, and present emerging issues and information needs.

Data Availability

The FIA Program mission is to provide continually updated, accurate, and reliable information on the status and trends of the Nation's forest resources. FIA's legislative mandate results in program objectives that include: (1) providing annual access to current and past data for all forested lands sampled as part of the annualized inventory system; (2) producing analytical forest reports for all States on a 5-year cycle; (3) providing information on forest land ownership and the attitudes, behaviors, and other characteristics of America's private forest owners; and (4) delivering data to assess a variety of issues regarding timber resource use.

An interactive map displays current online data availability (this information is also listed in table B-11). The FIA Program strives to provide data no more than 2 years old; at the end of FY 2022, 47 percent of States with annualized inventories met that target, while 47 percent had data that was 3 years old and the remaining 6 percent had data that was 4 years old. The delay in sampling caused by the COVID-19 pandemic also resulted in a delay in data publication to the public FIA database because to ensure an unbiased sample, data cannot be published for a given State until all plots are complete. The FIA Program is working to load the remaining backlog of data in FY 2023.

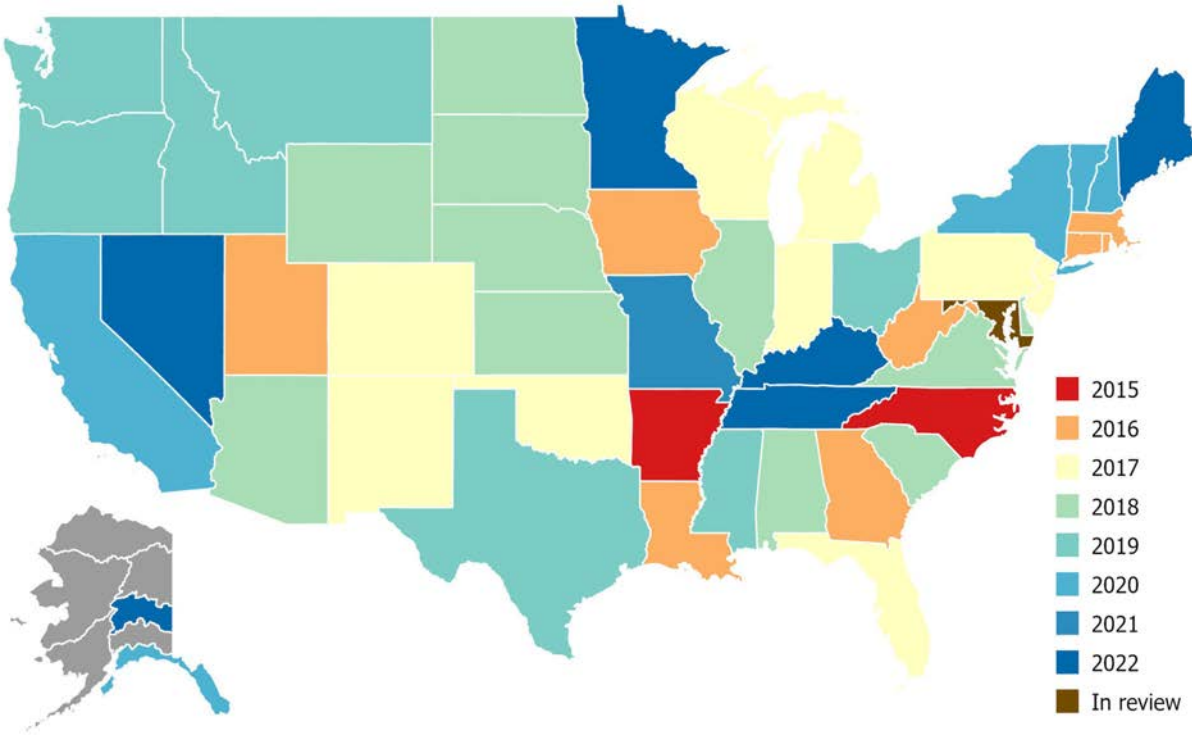
The latest forest inventory data for the Hawaiian Islands is available to the public through a State-specific online inventory database. Data for the Tanana Valley and Susitna-Copper units in Interior Alaska are also available to the public through a Microsoft Access database. Continued improvements to data processing and in the National Information Management System (NIMS) are creating efficiencies across FIA units in the processing of plot data and publishing to the public FIA database (FIADB). The development of Universal NIMS (UNIMS)—the next-generation replacement for NIMS—to internally store and process plot data will accommodate newer sampling protocols and subsequent data, such as from Interior Alaska, urban areas, and special studies, among others. As with NIMS, data from UNIMS will be exported to the FIADB for use by analysts and software tools.

In FY 2022, updated 5-year State reports were published for Maine, Minnesota, Kentucky, Tennessee, Nevada, and the Tanana unit of Interior Alaska (figure 6). In addition, draft versions of interactive reports were made available online for Connecticut, Delaware, Indiana, Iowa, Maine, Massachusetts, Michigan, Pennsylvania, Rhode Island, West Virginia, and Wisconsin. Final versions of these reports were in final layout and awaiting official publication. Table B-11 shows the most recent inventory year included in the 5-year FIA report for each State as well as the year of publication. The FIA Program compiles information on forest and woodland ownership through the National Woodland Owner Survey (NWOS). An interactive online tool, the NWOS Dashboard, allows users to explore the latest forest landowner data and make comparisons across States and regions.

The FIA Program also provides a National Resource Use Monitoring (NRUM) TPO toolkit to deliver estimates of timber products, mill residue, logging residue, residential fuelwood, and other wood removals. The TPO toolkit includes three reporting tools: the TPO Interactive Reporting Tool (currently populated with States and years available in the FIADB with full coverage expected in the coming years), the TPO Data Download, and TPO One-Click factsheets (currently displaying processed data for Northern and Southern States with plans to add States as they get processed in FY 2023).

[4] Puerto Rico's 2019 5-year report is still in preparation; no link is available yet.

Figure 6. Publication year of FIA 5-year State reports, FY 2022.



FIA = Forest Inventory and Analysis; FY = fiscal year.

Publication year of State report does not match the range of data collection dates shown in the publication.

U.S. islands and territories are not shown; the publication years are as follows: Republic of Palau (2007); Commonwealth of the Northern Mariana Islands, Republic of the Marshall Islands, and Federated States of Micronesia (2012); Puerto Rico (2019); Guam, American Samoa, and the U.S. Virgin Islands (2020); Hawaii (in press).

Quality Assurance

The FIA Program collects, analyzes, and publishes tremendous amounts of data annually. A large part of this work consists of designing, implementing, and carrying out procedures to ensure the data can generate unbiased estimates of forest attributes at appropriate spatial scales (States or large landscapes). Toward this end, FIA's QA program employs a framework to promote consistency during all stages of the national core FIA inventory process:

- A national prefield guide and rigorous QA protocols define a nationally consistent process to collect information about FIA plots before field visits. The updated version of the National Prefield Guide 9.2 was released in 2022.
- Up-to-date FIA national field guides ensure consistent core program and core optional data collection.
- A field-level data collection QA guide assists in promoting field QA consistency from across FIA regions.
- FIA's national field data entry program, the Mobile Integrated Data Acquisition System (MIDAS), is integrated into the overall FIA information management structure and provides consistent logic and error checking in the field.
- The UNIMS database and UNIMS Compilation System (UNIMS-CS) will provide additional error checks and consistently calculate and provide access to a variety of derived variables.
- A national R&D QA plan establishes research standards and procedures for all organizational units and personnel within Forest Service R&D.
- FIA's national Band System and structure promote communication across units nationally and across FIA functional areas. The system and structure were revamped in 2021, leading to increased communication and efforts to improve national consistency.

FIA Data Requests and Access

Spatial Data Services

The FIA Spatial Data Services (SDS) team[5] provides customers with the information they need in a way that does not compromise the security of plot locations. Spatial data requests are cataloged as one of four types: spatial, summary, knowledge, or miscellaneous. Spatial requests are those for which FIA spatial data are provided without additional analysis. Summary requests refer to FIA data aggregated for a specific geographic area(s). Knowledge requests are those that require additional spatial data analysis by SDS.

Early in FY 2022, FIA leadership spent more time evaluating spatial data requests prior to approving to ensure the FIA Program is meeting its legal obligations related to confidentiality. Despite this, the SDS team processed 181 requests in FY 2022 (figure 7), down from 257 requests in FY 2021.

FIA enters into formal agreements with clients whose access to confidential FIA data is necessary to execute projects that clearly benefit the FIA Program. FIA confidential data includes plot coordinates, landowners' personally identifiable information, and nonpublic forest product producer information. In FY 2022, the SDS team used Material Transfer Agreements (MTAs) and Memorandums of Agreements (MOAs) as the legally binding agreement instruments to establish a framework for cooperation. Terms and conditions included in these agreements ensure the full protection of FIA confidential data according to current legislation, including the Food Security Act.

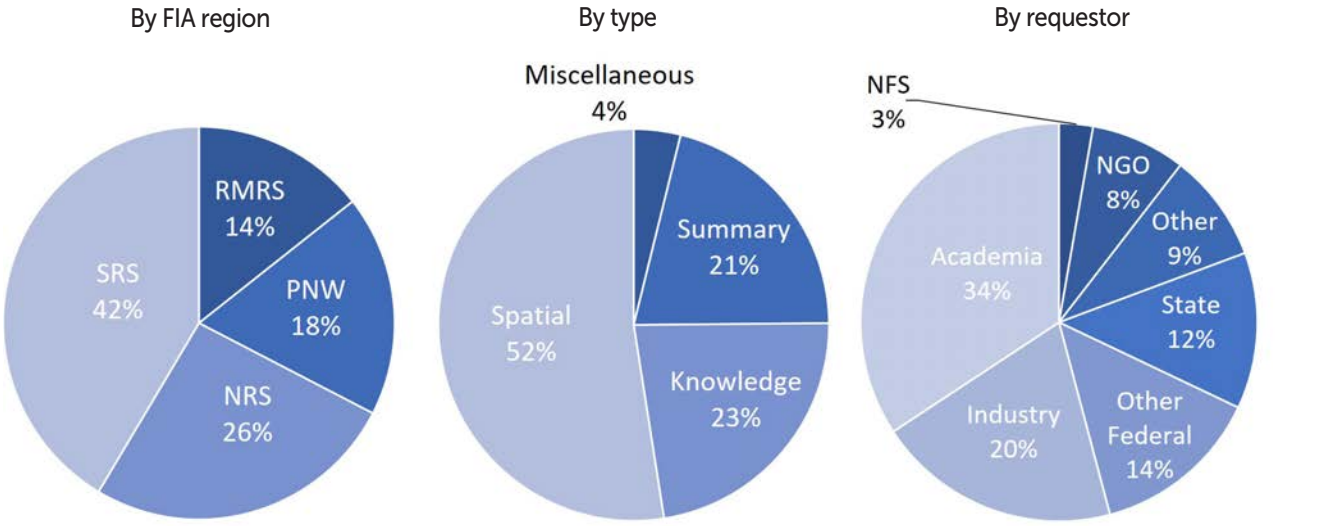
When plot coordinates are shared, the agreed terms prohibit the client from sharing the data with anyone not covered by the agreement, as well as from visiting the plot with the intention of manipulating FIA data or intentionally altering the condition of a plot such that it is not reflective of management conditions in the surrounding area.

Additionally, a Data Security Plan is required to document the transfer, storage, use, and disposal of the shared confidential data. Cooperators who are Federal employees are asked to sign a Letter of Intent that reminds them of their legal obligations regarding confidential data. Non-Federal employees directly hired by the Forest Service, such as contractors, who have a demonstrated need to access confidential FIA data to perform their work duties must sign a nondisclosure agreement.

During FY 2022, FIA entered into national data-sharing agreements (MTAs) with the University of Tennessee, the University of Idaho, the University of Maryland, and the University of Nevada, Las Vegas, and entered into regional agreements with many others. SDS work continued with a variety of partners including: NASA, several U.S. Department of the Interior (DOI) agencies, the Oregon Department of Forestry, the University of Washington and other universities, the Cary Institute of Ecosystem Studies, and the NFS and other non-FIA programs within the Forest Service such as the Geospatial Technology and Applications Center (GTAC), the LANDFIRE Program, the Forest Health Assessment and Applied Sciences Team (FHAAST), and the RPA Assessment Program.

[5] In FY 2022, SDS staff consisted of: Tom Thompson, National SDS team chair; Charles Paulson and John Higham, Northern Research Station; John Chase and Brett Davis, Pacific Northwest Research Station; Chris Toney and Karen Schleeweis, Rocky Mountain Research Station; and Carol Perry, Tracy Roof, and Andres Baeza-Castro, Southern Research Station.

Figure 7. Spatial data requests made to the FIA Spatial Data Services team (total = 181), FY 2022.



FIA = Forest Inventory and Analysis; FY = fiscal year; NFS = National Forest System; NGO = nongovernmental organization; NRS = Northern Research Station; PNW = Pacific Northwest Research Station; RMRS = Rocky Mountain Research Station; SRS = Southern Research Station.

Web Tools and Use

The FIA Program currently supports a variety of tools that provide access to FIA data. These include:

- The EVALIDator web interface, which allows users to generate customized estimates using FIA data. In FY 2022, the previous version of the EVALIDator web application was replaced with the updated API and EVALIDator 2.0 web interface. This change enables better performance and more capabilities while relying on a smaller, more accessible codebase and a continuous deployment pipeline. A team of developers has also been assembled to quickly address bugs and implement changes based on user response.
- EVALIDator API, which allows users to enter hypertext markup language (HTML) to query the FIADB.
- FIA DataMart, which allows users to download FIA data as comma-delimited files (CSV) or as an SQLite database that is readable by the Forest Vegetation Simulator (FVS). In FY 2022, the DataMart web repository received a newly designed interface intended to create a more efficient and intuitive user experience. The file generation script, which runs every weeknight to update the files hosted on DataMart, was also updated to make it easier to maintain and bring it in line with accumulated changes to the FIADB. Lingering issues with file availability due to a faulty permissions structure on the server have more recently been addressed with a server upgrade.
- The NWOS Table Maker and NWOS Dashboard.
- The State Factsheets tool, an interactive dashboard that displays common estimates for each State.
- The TPO toolkit (soon to be relabeled as the NRUM toolkit).
- My City's Trees, an online tool developed in partnership with Texas A&M Forest Service to allow users access to FIA's urban inventory.
- The Design and Analysis Toolkit for Inventory and Monitoring (DATIM), which has been in use since FY 2015 and entered operations and maintenance mode at the end of FY 2022. This indicates that the program is mature with minor issues being addressed in future releases.

FY 2022 saw a large increase in use of the TPO toolkit, which was expanded to include data from additional FIA regions, and a decline in both data downloads and use of EVALIDator (table B-7). The decrease is likely due to some breaks in availability while these tools were being updated. There may also be an ongoing decrease in activity attributable to the effects of the COVID-19 pandemic on research. Records also indicate a drop in requests to the updated EVALIDator API; this is believed to be largely due to intermittent breaks in service and lack of request logging during the initial deployment.

Consultations by FIA Staff

Since the earliest days of the FIA Program, consulting with the public has been a priority. In 1930, "consulting" meant face-to-face interaction with landowners and forestry professionals, or answering handwritten questions received in the mail. While the mechanisms for interactions between customers and FIA representatives may have evolved, the reasons for cooperation remain the same. The amount of information (both data and analyses) made available on the web continues to increase as customers demand more and varied information from FIA data and analyses. Questions pertaining to a single administrative unit (e.g., a single State or national forest) are frequently referred to partners within that administrative unit (e.g., State foresters or NFS analytical staff) who can often provide better context and customer service. When questions span multiple administrative units, FIA staff members assist the customer with finding an answer. FIA staff members do not compete with private-sector consultants; rather, they answer questions about FIA's methods and help customers (including private consultants) use FIA data to answer their own or their clients' questions.

A significant consultation is defined as any dialogue with a customer that requires more than 1 hour of FIA staff time and that is not part of the normal course of business in collecting, analyzing, and reporting FIA information. Historically, consultations have fluctuated slightly from year to year, depending on broader outside interests, while showing regional variations. Since 2006, Federal and State government agencies have consistently remained the program's major clients. Consultations from this group include any internal discussions within other Forest Service programs.

In 2022, FIA customer inquiries increased to 1,276, compared to 696 in 2021 and 1,434 in 2020. The associated number of consultation hours (6,398) was less than the hours in 2021 (8,285). Table B-6 shows the number and hours of significant consultations provided by FIA staff in FY 2022 by responding unit and type of customer. FIA employees also provide assistance to the NFS through a variety of larger partnerships focused on analysis and information delivery.

Jolanda Lake, Okanogan-Wenatchee National Forest, WA. USDA Forest Service Photo by Robin DeMario.

Program Safety

Physical, psychological, and social safety are core values uniting Forest Service employees, contractors, and State partners, both on and off the job. Employees are entitled to a workplace environment where they treat one another with respect, empower one another, model integrity, protect one another, and learn from mistakes. FIA takes these values seriously and makes these commitments whether in the field, in the office, or working remotely.

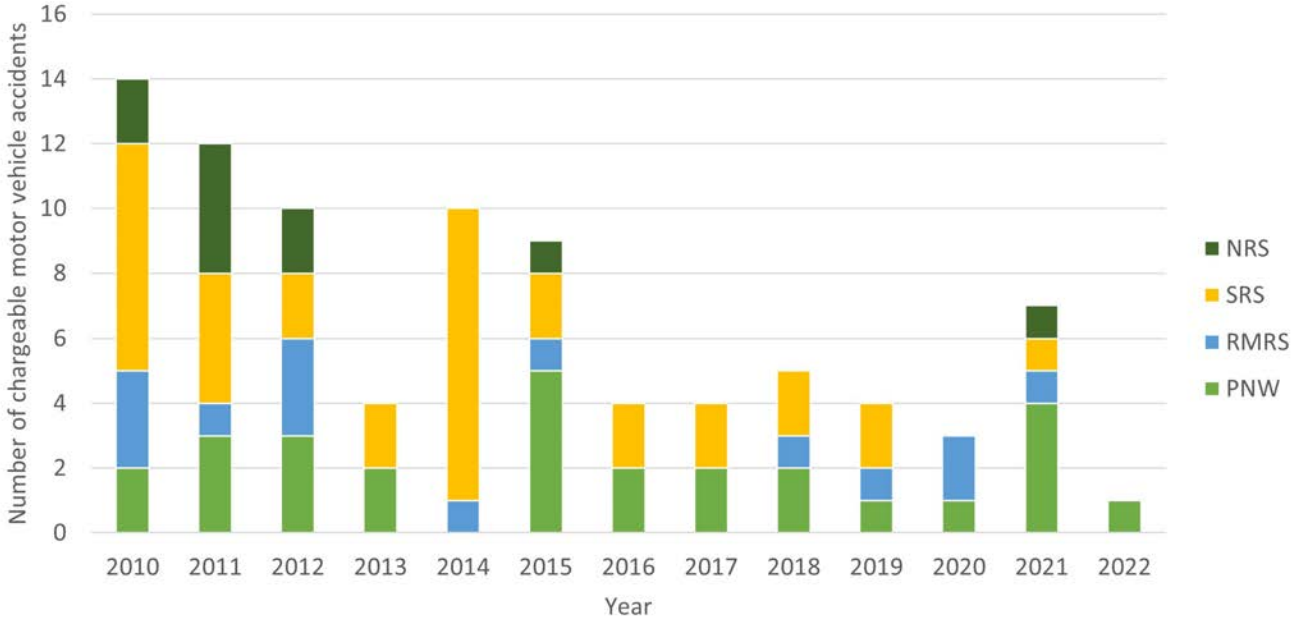
In 2016, the Forest Service began a transition period and cultural reorganization promoting critical thinking and giving voice to safety concerns, inviting a reversal of the lingering hierarchical command that historically characterized the agency. In 2018, the Forest Service introduced organizational changes in the wake of the agency's public reckoning with sexual misconduct, including a revamped harassment-reporting center, changes to investigation procedures, an updated statement of codes and commitments, and the creation of the Work Environment and Performance Office (WEPO) within the Office of the Chief. WEPO's mission is to "improve and sustain a workplace culture where all employees feel safe, valued, respected, and supported."

Along with WEPO's mission, the FIA Program continues to work toward an improved vision of employee well-being and work environment. Program managers, supervisors, and safety teams within FIA units actively monitor and address physical, psychological, and social safety issues and concerns as they emerge through daily engagement, annual staff surveys, and direct reporting.

Job hazard analyses (JHAs) and training for field and office staff are continually reviewed and improved to reduce employees' risk exposure. These JHAs include but are not limited to use of alternative plot access such as watercrafts and aviation, working alone or in hostile environments, urban field safety, lightning hazards, bears, illicit grow sites, road and backcountry travel, psychological safety and harassment, bystander intervention on inappropriate behavior, and check-in/check-out systems for field and office. Office safety focuses on workstation ergonomics; filtering eyewear for computer work; travel safety; active shooter; sexual harassment; bystander intervention; bullying; cybersecurity; preparedness for earthquakes, fires, and other weather disasters; and first-aid training including cardiopulmonary resuscitation and use of an automatic external defibrillator. Field crews are equipped with mobile phones, Garmin inReach® devices, ergonomic data recorders, and satellite phones. Personal protective equipment (PPE) includes hard hats, safety goggles, gloves, safety boots, trekking poles, and aerosol sprays for wild and domesticated animals. International security training is required for all international travelers. In every unit, FIA is committed to reducing employee risk through multiple layers of defense. People are the FIA Program's greatest asset—all take great pride in and responsibility for their own and each other's safety.

The total annual number of vehicle accidents reached a record low of one in FY 2022 despite logging nearly 2 million miles driven (figure 8). The total number of work-related injuries and illnesses increased slightly in FY 2022 but remains low relative to the long-term average (figure 9). Table 5 summarizes the program's safety record for FY 2022.

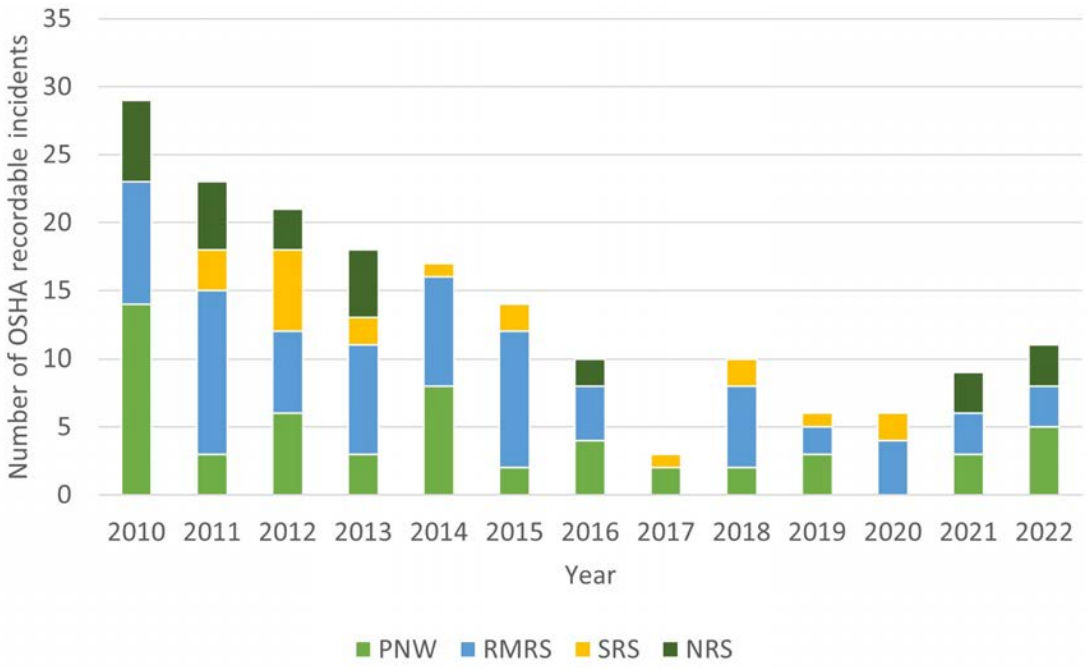
Figure 8. Number of chargeable motor vehicle accidents by FIA unit, FYs 2010–2022.



FIA = Forest Inventory and Analysis; FY = fiscal year; NRS = Northern Research Station; PNW = Pacific Northwest Research Station; RMRS = Rocky Mountain Research Station; SRS = Southern Research Station.

A chargeable motor vehicle accident is any occurrence involving the use of a Government-owned or Government-leased motor vehicle (automobile, truck, or bus) that results in a combined total damage of $1,500 or more. This definition also applies to privately owned vehicles when used for official Government business.

Figure 9. Number of OSHA recordable cases by FIA unit, FYs 2010–2022.



FIA = Forest Inventory and Analysis; FY = fiscal year; NRS = Northern Research Station; OSHA = Occupational Safety and Health Administration; PNW = Pacific Northwest Research Station; RMRS = Rocky Mountain Research Station; SRS = Southern Research Station.

An OSHA-recordable incident is a work-related injury or illness resulting in any of the following: death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid, or loss of consciousness.

Table 5. FIA Program Federal employee estimates for hours worked, miles driven, aircraft hours flown, and safety incidents reported, FY 2022.

Category	FIA Unit					
	PNW	RMRS	SRS	NRS	National Office	Total
Base data						
Federal FTEs[a]	84	100	72	93	2	351
Total estimated hours worked[b]	175,136	208,832	150,384	192,816	3,536	730,704
Total vehicle miles driven	375,484	581,294	427,518	548,857	0	1,933,153
Total flight hours logged	333	10	0	0	0	343
Incidents by class						
OSHA recordable injuries[c]	5	3	0	3	0	11
Chargeable motor vehicle accidents[d]	1	0	0	0	0	1
Aircraft accidents[e]	0	0	0	0	0	0
Aircraft incidents[f]	1	0	0	0	0	1
Safety incident frequency rate						
Recordable injury rate per 100 FTEs	6	3	0	3	0	3
Motor vehicle accidents per million miles driven	3	0	0	0	0	1
Aircraft accidents per 100,000 flight hours	0	0	0	0	0	0

FIA = Forest Inventory and Analysis; FTE = full-time equivalent; FY = fiscal year; NRS = Northern Research Station; OSHA = Occupational Safety and Health Administration; PNW = Pacific Northwest Research Station; RMRS = Rocky Mountain Research Station; SRS = Southern Research Station.

[a] Estimated number of Federal FTEs (based on appendix table B-3a).

[b] Number of Federal employees times 2,080 hours per FTE (based on appendix table B-3a). Note: a small percentage of overtime is not included in estimate.

[c] Work-related injury or illness resulting in any of the following: death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid, or loss of consciousness.

[d] Any occurrence involving the use of a Government-owned or Government-leased motor vehicle (automobile, truck, or bus) that results in a total combined damage of $1,500 or more. This definition also applies to privately owned vehicles when used on official Government business.

[e] Aircraft accidents are those resulting in death or serious injury, or substantial damage to the aircraft.

[f] Aircraft incidents are those affecting, or which could affect, the safety of aircraft operations. (This is a new metric introduced in FY 2020 per safety committee recommendation.)

Program Safety Highlights

Since the COVID-19 pandemic was declared in early 2020, FIA prioritized the safety of crews above established annual program objectives and field data collection targets by adopting additional mitigation measures, field requirements, and travel limitations. Each FIA regional unit embraced a revised set of goals determined primarily by State and regional pandemic status, while also complying with Centers for Disease Control and Prevention (CDC) and Occupational Safety and Health Administration (OSHA) guidance. In summary, some of the common mitigation efforts across all FIA units included:

- Development of regional Deliberative Risk Assessments for conducting field work that mitigates risk to employees and the communities where they work.
- Distribution of CDC-recommended PPE.
- Revision of vehicle-use standards to accommodate one crew member per vehicle to maintain guidelines for social distancing.

Pacific Northwest Research Station

Amid the ongoing pandemic and increasing frequency and extent of wildfires and poor air quality, PNW FIA was successful in completing its planned work while keeping employees safe and well. Data collection teams developed numerous templates and procedures to assess and mitigate risk of exposure to COVID-19 and poor air quality or fire hazard, including:

- Risk assessment worksheets that identified and mitigated risks associated with field work in different States
- A "Go, No-Go" decision-making matrix for each day
- A daily self-check-in form for staff to evaluate their physical and mental health
- A COVID-19 polymerase chain reaction (PCR) testing plan developed in collaboration with public health officials from the State of Alaska

Additionally, extensive efforts were made to research and obtain specialized and additional equipment for staff, in response to near-miss incident reporting and for COVID-19-related needs, including:

- Renting additional equipment and vehicles to allow for socially distanced transportation (one-person, one-car policy) to field plots in collaboration with local Forest Service districts and the General Services Administration.
- Analyzing safety reports (near-miss data), identifying the need for improved head protection, and adopting OSHA-approved climbing-style hard hats, a type of hard hat more suitable for very steep, brushy, rocky terrain.
- Providing ergonomic home-office equipment to staff to facilitate healthier remote work environments.

PNW continued to pilot new Satellite Emergency Notification Devices (SENDs) to explore alternative communication options for staff working in remote areas of Coastal and Interior Alaska. Garmin inReach® SENDs provided substantially improved aviation communication operations including flight following, communicating with dispatch, and two-way communication between crews while both crews were outside of cellular phone reception. Implementing the use of these inReach® SENDs may eventually lead to decreased pack weight if they can ultimately replace other communication devices or global positioning system (GPS) units. All Alaska crew leaders will be provided with these devices for the FY 2023 field season. Likewise, in Oregon, Washington, and California, while many crews were still reliant on SPOT X® devices throughout the FY 2022 field season as their SENDs, several opted to switch over to the inReach®. Because the inReach® was so well received due to overall performance and user preference, the decision was made to transition all crews in these States to this model of SEND in the FY 2023 field season.

Over the past year, PNW FIA continued to implement a safety-buck program to recognize actions promoting health, safety, a positive work environment, and wellness. A new employee resumed management of the program after the previous manager left the agency. Also in the past 12 months, the program safety committee supported an overhaul of the Safety SharePoint site to better organize information and to improve accessibility overall for both office and field-based staff. At the beginning of the field season, over 30 FIA employees from California, Oregon, and Washington attended an in-person wilderness first aid/first responder training, the first in-person gathering attempted by the program since the beginning of the COVID-19 pandemic. Organizing this training required significant planning and implementation of risk mitigation measures in coordination with the training provider. Because of this training, field staff were able to maintain their medical certifications, as required by the USDA.

Rocky Mountain Research Station

RMRS FIA continued to see decreasing accident and injury rates and fewer lost duty and light duty days. The program again experienced fewer serious injuries reported and no serious vehicle accidents. In leading indicators, the program presented multiple safety awards for employees' proactive safety attitudes, behaviors, and actions; shared many learning stories throughout the year; made countless phones calls to employees to maintain a sense of connection; managed multiple in-person employee training opportunities; made multiple leadership field visits; and held regular staff meetings (formal and informal) in which well-being and mental health and the utilization of the new agency resources were discussed. The program also offered an all-day

retirement benefits training to help employees plan now for their futures. The program focused on employees and amidst another challenging year was successful by all accounts.

Initial training for new employees and refresher training for experienced employees are important administrative controls for managing risk, but these have been challenging to navigate in recent years given the increased risk of in-person events during the COVID-19 pandemic. RMRS FIA provided multiple trainings throughout the year including a weeklong virtual training for data collection employees in the spring that included safety, aviation, and wellness-related trainings. Instead of one large centrally located in-person training, the program offered three separate trainings: one northern area training for returning employees, one southern area training for returning employees, and one centrally located training for new employees. While there were a few known COVID-19 exposures, there were no known COVID-19 transmissions due to any in-person training or work. The program also made numerous office position hires and provided individual virtual training sessions throughout the year for these new employees and increased efforts to welcome and connect these new employees with their virtual colleagues.

RMRS FIA continued to encourage employee engagement through the program's safety committee, which met 10 times during FY 2022. The committee explored and implemented multiple employee suggestions for improving safety and efficiency. Some topics researched and implemented include the review of an annual data collection debriefing survey; using fat-tire mountain bikes for plot access; full per diem rate for camping; all-terrain vehicle (ATV) preventative maintenance checklist and assigning preventative maintenance responsibility for shared ATVs; an alternative to door shields for vehicles in some areas; and an update to the aviation safety plan. The safety committee has always been a virtual team and focused on maintaining connections by making time for personal check-ins at every meeting. For the next year, the safety committee will continue to track progress on issues identified in the yearly debriefing, exploring the use of electronic bikes and many more topics.

Southern Research Station

SRS FIA has continued to hold its example of few motor vehicle incidents and reportable injuries. For FY 2022, there were only five vehicle incidents, none of which were chargeable, while driving almost 450,000 miles. This distance is well below the pre-COVID-19 mileage of 700,000 miles. Continued defensive driving courses help maintain safety practices. Only two injuries, neither of which were recordable, occurred during FY 2022. SRS FIA continues to strive to prevent all injuries and manage risk through all phases of work. The recent success is a credit to all the field collection crews and supervisors.

The safety committee has moved to becoming a more virtual team in the COVID-19 and post-COVID-19 periods; however, it hasn't slowed efforts to bring subjects to the forefront. It has continued to update and assist all employees with the latest knowledge available through national and local efforts. The committee continues to author monthly briefings on subjects such as driving, boating safety, and PPE. It will soon begin work to update safety plans and JHAs for the coming year, including the newest COVID-19 mitigation measures.

The program continues to provide necessary PPE to mitigate COVID-19 risk following all prescribed guidelines. N95 masks and COVID-19 test kits are now available to employees at their request. Data collection crews are now traveling with minimal restrictions and beginning to build relationships with State cooperators. The SRS FIA Program has tried to put in place safeguards for everyone's comfort level; every individual needs to determine their degree of risk acceptance when traveling or in day-to-day operations.

Northern Research Station

NRS FIA continues to closely follow agency direction for travel and office capacity regarding the COVID-19 pandemic. N95 masks were provided to staff early in the fiscal year. Field data collection crews are allowed to travel and work in multiperson crews with permission and based on their comfort level.

All SENDs for Federal field employees were upgraded to the newest Garmin inReach Explorer®+. In addition to having the most current satellite connection and communication capabilities, it also includes a weather app that field employees can use to track weather in the area. Recreational GPS devices used for navigation were upgraded to the Garmin GPSMAP® 64sx. Federal and contract field crews were equipped with traffic cones, informational signs, and orange vests for increased visibility when working in populated areas.

The Federal data collection crew continues to maintain safe driving practices, driving 548,857 miles safely with no traffic accidents; only two instances of off-road damage to vehicles were reported. A total of three time-lost recordable injuries and illnesses were reported among Federal employees.

The safety and health committee (composed of field, office, and management staff) continues to ensure staff is current on all safety- and health-related trainings. In addition to monthly meetings, committee members annually review JHA documents to incorporate the changing needs of office and field staff.

FIA Program Accomplishment Highlights

This section provides information on select FIA accomplishments and outcomes throughout the country. Some of these achievements have a nationwide impact, while others are regional but equally important. More detailed information is available from the contact listed with each highlight.

Interactions Among Wildfire, Forest Type, and Landscape Position Are Key Determinants of Boreal Forest Carbon Stocks

Impact: Boreal forest soils contain large stocks of soil carbon that may be sensitive to changes in climate and disturbance. Destabilization of boreal forest soil carbon through changes in inputs, belowground carbon pools, and/or wildfire could accelerate rising atmospheric carbon dioxide (CO_2) concentration. Additionally, increasing frequency of severe fires may be changing the dominant forest types and reshaping aboveground carbon stocks. Although controls on ecosystem carbon pools have received considerable attention, many studies have been limited to locations near the road system, leading to uncertainty in current and future carbon stocks across boreal Alaska. Here, researchers leveraged 545 randomly selected and spatially balanced FIA plots across ~13.5 million ha in Interior Alaska to examine the factors governing soil and live tree carbon pools.

Outcome: Results highlight the nuanced interactions among wildfire, landscape position, and forest type that will play important roles in shaping future boreal ecosystem carbon stocks. Forest type mediated the effects of mean summer air temperature and near-surface permafrost on soil carbon. Meanwhile, forest type, stand age, and aspect were the primary drivers of live tree carbon. Overall, plots with a known history of wildfire during the past 70 years did not have significantly different soil carbon stocks than plots without a known history of fire, likely due to the historical predominance of low-severity fires. Where wildfire likely initiated a transition to deciduous trees (19 percent of plots), live tree and soil carbon pools were reduced by 16 and 20 percent, respectively. Ecosystem carbon likely recovered over time, as maturing deciduous stands rapidly gained carbon in live trees. Deciduous stands without a known fire had comparatively very large live tree carbon stocks, suggesting a significant change in the distribution of ecosystem carbon following severe fire.

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Links:

Cahoon, S.M.P.; Sullivan, P.F.; Gray, A.N. 2022. Interactions among wildfire, forest type and landscape position are key determinants of boreal forest carbon stocks. Journal of Ecology. 110(10): 2475–2492. https://doi.org/10.1111/1365-2745.13963.

Innovative Wood Use Can Enable Carbon-Beneficial Forest Management in California

Impact: This work represents an important first step toward understanding the full breadth of impacts that increased use of mass timber in new construction could have on forests and climate mitigation around the globe. As the need to address climate change grows more urgent, policymakers, businesses, and others are seeking innovative approaches to remove CO_2 emissions from the atmosphere and decarbonize hard-to-abate sectors. Forests can play a role in reducing atmospheric carbon. However, there is disagreement over whether forests are most effective in reducing carbon emissions when left alone versus managed for sustainable harvesting and wood product production. Cross-laminated timber is at the forefront of the mass timber movement, which is enabling designers, engineers, and other stakeholders to build taller wood buildings. The prospect of increased utilization of wood products as a climate solution also raises questions about the impact of increased demand for wood on forest carbon stocks, on forest condition, and on the provision of the many other critical social and environmental benefits that healthy forests can provide. A holistic assessment of the total climate impact of forest product demand across product substitution, carbon storage in materials, current and future forest carbon stock, and forest area and condition is challenging, but it is important to understand the impact of increased mass timber utilization on forests and climate, and therefore also on which safeguards might be necessary to ensure positive outcomes.

Outcome: To assess the potential impacts, both positive and negative, of greater mass timber utilization on forests ecosystems and emissions associated with the built environment, The Nature Conservancy initiated a global mass timber impact assessment (GMTIA), a five-part, highly collaborative research program focused on understanding the potential benefits and risks of increased demand for mass timber products on forests and identifying strategies to

ensure the benefits outweigh the risks. The series of projects has been collaboratively designed to answer pressing questions in the discussion of mass timber impacts, both negative and positive, on carbon sequestration and forest health.

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Links:

Cabiyo, B.; Fried, J.S.; Collins, B.M.; Sanchez, D.L. 2021. Innovative wood use can enable carbon-beneficial forest management in California. Proceedings of the National Academy of Sciences. 118(49): e2019073118. https://doi.org/10.1073/pnas.2019073118.

Optimal Survey Design for Forest Carbon Monitoring in Remote Regions Using Multi-Objective Mathematical Programming

Impact: Cost-effective monitoring of forest carbon resources is critical to the development of national policies and enforcement of international agreements aimed at reducing carbon emissions and mitigating the impacts of climate change. While carbon monitoring systems are often based on national forest inventories utilizing a large sample of field plots, in remote regions, the lack of transportation infrastructure often requires heavier reliance on remote sensing technologies, such as airborne lidar (Light Detection and Ranging). The efficacy of estimating carbon with lidar varies across the various carbon pools within forest ecosystems. Lidar measurements are typically highly correlated with aboveground tree carbon but are less strongly correlated with other carbon pools, such as down woody materials (DWM) and soil. Field measurements are essential to both (1) estimate soil and DWM carbon directly and (2) develop regression models to estimate tree carbon indirectly using lidar. With limited budgets and time, however, many decision makers desire an optimal way to combine field measurements with lidar to minimize standard errors in carbon estimates for the various pools.

Outcome: Using national forest inventories and airborne lidar data from a remote boreal forest region of Interior Alaska, researchers demonstrate the operational feasibility of the method and suggest that it is generalizable to other carbon sampling projects because of its generic mathematical structure. This work introduces a multi-objective binary programming formulation that quantifies the tradeoffs behind the competing objectives of minimizing standard errors for tree carbon, DWM carbon, and soil carbon.

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Links:

Tóth, S.F.; Oken, K.L.; Stawitz, C.C.; Andersen, H.-E. 2022. Optimal survey design for forest carbon monitoring in remote regions using multi-objective mathematical programming. Forests. 13(7): 972. https://doi.org/10.3390/f13070972.

Evaluating Terrestrial Laser Scanning in Southeastern Mixed Hardwood Forests

Impact: Use of terrestrial laser scanning (TLS) to measure tree and stand attributes in forests is increasing in popularity, particularly for mensuration and forest inventory applications that require assessment of tree architecture and size. Although use of this new technology is expanding, access to the equipment and software required to collect and process this type of data is still not widely available to students or forest managers. Once collected, TLS data contain millions of points which require basic programming skills to manipulate and analyze.

Outcome: The FIA Program partnered with the University of Tennessee (UT) to host a training to help raise awareness and access to TLS technology (figure 10). This training held at the UT Arboretum provided students, arboretum staff, FIA field crews, and scientists a hands-on introduction to the collection, processing, and analysis of TLS data for tree size (height and diameter at breast height (DBH)) and stand density estimation (basal area and trees per acre). TLS data were collected and analyzed using various open-source processing scripts and visualization tools to examine potential for using this new technology in multistory hardwood stands. Group discussions centered on identifying potential uses of TLS technology including rapid assessment after hurricanes and other natural disasters, training broad-scale leaf area index (LAI) models, and mapping understory and subcanopy vegetation.

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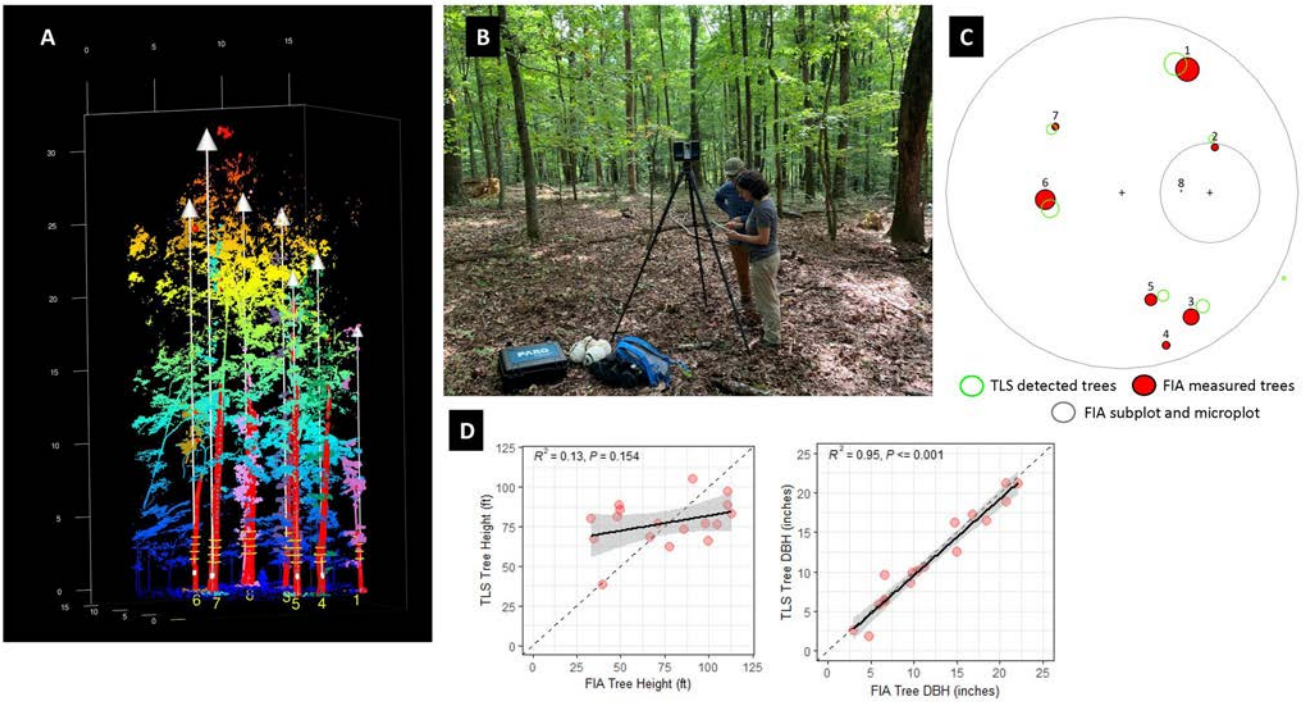
Figure 10. Overview of the University of Tennessee and Forest Service terrestrial laser scanning (TLS) workshop showing (A) the 3D point cloud and probable stem locations on subplot 1, (B) field collection of TLS scans, (C) stem maps comparing TLS and manually detected trees on subplot 1, and (D) accuracy of TLS tree height and DBH estimates versus FIA field-measured trees. USDA Forest Service photo by Todd Schroeder.



DBH = diameter at breast height; FIA = Forest Inventory and Analysis.

Modeling the Growth and Allometric Relationships of Caribbean Tree Species Using Long-Term Permanent Plot Data

Impact: Accurate estimates of tree volume, biomass, and carbon change over time sometimes require prediction of certain tree parameters. For example, reconstructing the broken top of a tree from its DBH depends on understanding the allometric relationships between those two parts of the tree. Projecting growth depends on having annual diameter increment models. These relationships and models have been developed for many species measured by the FIA Program in the temperate and boreal forests in which it operates but much less so in the subtropical forests of the Caribbean. While Caribbean-specific models have been developed for the FIA Program in the past, this two-phase effort draws upon remeasurement data from FIA plots in Puerto Rico and the U.S. Virgin Islands and permanent plots in Jamaica and Trinidad.

Outcome: In this first phase of a larger project, models were fit to the relationships between DBH and total height using Random Forest (RF) and Mixed-Effects Random Forests (MERF) algorithms. Potential variables were ranked by score, submodels sequentially fit, and final variables selected. Then, parametric mixed models with and without environmental variables were finalized. Pseudo R-squared values ranged from 0.81 to 0.30, varying by island, with MERF models showing higher precision. On all islands, very tall tree heights were underpredicted while very short tree heights were overpredicted in Puerto Rico and Trinidad. Models developed without environmental variables could be used in the FIA NIMS to replace the current default models for most Caribbean tree species, improving the accuracy of volume, biomass, carbon, and growth estimates.

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Yang, S-I.; Brandeis, T.J.; Helmer, E.H.; Oatham, M.P.; Heartsill-Scalley, T.; Marcano-Vega, H. 2022. Characterizing height-diameter relationships for Caribbean trees using mixed-effects random forest algorithm. Forest Ecology and Management. 524: 120507. https://doi.org/10.1016/j.foreco.2022.120507.

Using FIA Data to Identify Factors Driving Variability in the Mesophication of Eastern U.S. Forests

Impact: Altered disturbance regimes (particularly fire), historic forest management practices, and climate patterns have resulted in an increase in shade-tolerant tree species associated with wetter conditions throughout the Eastern United States. At the same time, disturbance-adapted, xerophytic species have decreased. These changes in composition have the potential to negatively impact a wide array of ecosystem services. They may decrease the viability of ecologically and economically important species like oaks and decrease forest resiliency to disturbances such as drought. There is also evidence that this replacement of disturbance-adapted species with shade-tolerant, mesic species is a self-reinforcing process, called mesophication (figure 11). The development of effective management practices to address mesophication depends on answering two questions: (1) How does mesophication vary at stand scales and (2) how are the functional conditions of forests (e.g., drought, fire, and shade tolerances) changing?

Outcome: Experts from SRS FIA (Oswalt) and the Center for Forest Restoration and Management (Keyser) partnered to address these research needs utilizing the powerful extent and detail of FIA data. FIA data made it possible to not only address these questions across the entire Eastern United States but to model both the predicted change through time and potential future forest change. Results showed that mesophication was more pronounced in older stands, in stands with more variable diameters, and in wetter sites. However, the method for evaluating shifts and the functional trait examined (e.g., drought versus fire tolerance) sometimes resulted in differing relationships and thus highlights the value of using FIA data to examine complex questions. The results provide evidence that stand-scale conditions impact current and potential future changes in the functional makeup of forests across the Eastern United States but not always in consistent or expected ways.

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Woodbridge, M.; Keyser, T.; Oswalt, C. 2022. Stand and environmental conditions drive functional shifts associated with mesophication in eastern US forests. Frontiers in Forests and Global Change. 5: 991934. https://doi.org/10.3389/ffgc.2022.991934.

Figure 11. A variety of tree species make up the regeneration layer in a Southern Appalachian forest. Understanding how species shift, such as the shift to more mesic species associated with mesophication, helps managers prioritize stands for restoration and make ecologically informed decisions.

USDA Forest Service photo by Margaret Woodbridge.

Global Gridded Biomass Product Based on GEDI Data

Impact: Accurate estimation of aboveground forest biomass stocks is required to assess the impacts of land use changes such as deforestation and subsequent regrowth on concentrations of atmospheric CO_2. FIA provided data and forest sampling expertise for development of the new global gridded biomass product, which was produced using data collected by NASA's Global Ecosystem Dynamics Investigation (GEDI) mission. GEDI collects a global sample of small-footprint waveform lidar data with the purpose of characterizing forest canopy height, canopy vertical structure, and surface elevation, which allows mapping of aboveground biomass density when coupled with plot data collected by FIA.

Outcome: The global 1-km biomass map product and corresponding 1-km estimates of the standard error of the mean are now available for all regions of the world covered by the International Space Station (between latitudes of 51.6 degrees north and 51.6 degrees south). This product represents a globally consistent, transparent, and spatially explicit assessment of forest carbon stocks. GEDI data are now supporting several mapping projects in the United States and elsewhere. The global biomass product can be combined with Landsat data to estimate carbon emissions and sequestration due to land use change and vegetation regrowth.

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Links:

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Forest Disturbance Intensity Maps for Conterminous United States, 1986–2015

Impact: Forest disturbances can have broad impacts on the climate, local environment, and regeneration of the forest ecosystem. The nature and magnitude of such impacts are largely driven by disturbance intensity. The combination of FIA data and Landsat imagery offered a novel way of using FIA remeasurement data to map disturbance magnitude at 30-m resolution from 1986 through 2015. Disturbance intensity was estimated from random forest models using Landsat time series observations as inputs and FIA plot data for model calibration and validation. Models relied on data from FIA plots that had been measured both before and after a disturbance, thus capitalizing on the fact that FIA establishes permanent plots that provide ground truth data for assessing change over time.

Outcome: This map series represents the first annual forest disturbance intensity collection for the conterminous United States, modeled from field remeasurement of individual trees. It allows characterization of disturbance severity, in terms of percentage basal area removal, for the entire country or specific areas of interest, at 30-m resolution. Investigation of trends within this time series shows that disturbance severity has differed considerably among States and U.S. Environmental Protection Agency (EPA) ecoregions and through time. The highest average disturbance intensities by State and EPA ecoregion were observed in the Southeastern United States and along the west coast. The time series also indicates that of all disturbed areas, only about half experienced stand-clearing disturbances, which highlights the importance of considering severity when interpreting forest area disturbance and rates of disturbance.

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Links:

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Aridity Controls Streamflow Response to Forest Disturbance

Impact: Forest disturbance is generally expected to increase runoff and streamflow, but recent studies have shown that this is not always the case. It is important to understand the relationship between disturbance and streamflow because changes in water availability can affect both aquatic ecosystems and downstream users. A combination of FIA data and hydroclimatic data from the National Center for Atmospheric Research allowed quantitative linkage between forest disturbance and streamflow changes in 159 Western U.S. watersheds. While this work found that streamflow often increased following forest disturbance, post-disturbance streamflow decreased in arid watersheds.

Outcome: This work identified exceptions to the expectation that forest cover loss, whether through disturbance or treatment, will lead to increased streamflow. Very dry watersheds are more likely to produce less runoff following forest disturbance—and are also more likely to experience forest disturbance in the first place. Thus, the direction of streamflow response to forest disturbance (increase versus decrease) depends on aridity, defined as potential evapotranspiration relative to precipitation. These findings can inform forest management that seeks to implement silvicultural treatments. Specifically, forest thinning treatments in arid watersheds may not produce increases in water yield.

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Links:

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The 'Hole' Story About Wood Duck Nest Cavities: Forest Inventory Data Reveal Increased Potential Habitat in Northern Minnesota

Impact: Informing wildlife habitat conservation just became a little easier, thanks to new methods for combining local research data with FIA data. Results indicate that potential wood duck habitat in northern Minnesota has increased in recent decades, and the methodology developed here can be used to assess trends across the range of wood ducks and other cavity nesting species.

Outcome: Tree cavities provide nesting habitat for wood ducks, a species prized by both waterfowl hunters and wildlife watchers. But nesting duck hens do not settle for any tree hole; cavity size, height, and condition need to be just right. Artificial nest boxes provide such conditions at some local sites, but natural cavities in forest trees support a large majority of the wood duck population. Forest managers need to know how many suitable nesting cavities are available, and how those numbers are changing over time. But counting cavities over millions of acres is an impossible task. Wildlife researchers from the Minnesota Department of Natural Resources recently reported that probability of suitable nest cavity occurrence is based on three tree characteristics: species, size, and health status. These same tree attributes are measured on every FIA sample plot. Researchers from NRS FIA and Minnesota Department of Natural Resources (James B. Berdeen, Edmund J. Zlonis, and John H. Giudice) teamed up to develop new statistical methods for extrapolating local research findings to strategic scales. Abundance of potentially suitable wood duck nesting cavities increased during recent decades in northern Minnesota, exceeding prior published projections. That is good news for both wood ducks and the forest owners who manage their habitats.

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Links:

Berdeen, J.B.; Nelson, M.D.; Zlonis, E.J.; Giudice, J.H. 2022. Temporal change in abundance of potential nesting cavities for wood ducks (Aix sponsa) in Northern Minnesota, United States. Frontiers in Forests and Global Change. 5: 967060. https://doi.org/10.3389/ffgc.2022.967060.

Shifting Forests and Carbon

Impact: Forest communities change over time and so does the amount of carbon captured, stored, and/or emitted from those forests. Linking forest communities to carbon cycling can improve knowledge about the feedbacks between forest dynamics and climate change.

Outcome: Forest communities—tree species that commonly co-occur—are constantly changing as trees die and new trees replace them. At the same time, carbon moves from the live to the dead carbon pool. A challenge is to determine the amount of carbon being sequestered and stored by these forest communities as they change over time. In this project, NRS scientists and collaborators borrowed an approach from text mining research—an artificial intelligence (AI)-based discipline focused on extracting information from written data—to identify forest communities. Their text mining

algorithm mimics how commonly co-occurring words (species) in sentences (forest inventory plots) form topics (communities). Scientists used over 20,000 remeasurements of around 5,600 FIA plots in the Great Lakes region to evaluate how forest communities change over time. The findings quantified how much carbon was stored in each of six unique forest communities identified by the text mining algorithm. For example, the sugar maple-basswood community had the most live carbon, but the fir-cedar-birch community had the most standing dead carbon. The findings also showed that a combination of both the forest community and the forest structure—the number of different sized trees in the FIA plots—best predicted changes to the carbon pools. These improved knowledge areas can inform forest managers how shifts in their forests' community composition and structure resulting from climate change, human intervention, and other forest stressors may impact their forests' ability to capture and store carbon to further combat climate change.

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Interactive Web Tool Provides Information About the Spread and Potential Impacts of Nonnative Forest Insects and Diseases

Impact: Invasions by nonnative insects and diseases have substantial negative impacts on the structure, composition, and function of forest resources. Understanding how host resources at risk respond in the presence of these forest pests has important implications for the management of native plant communities, invasive plants, and carbon sequestration. Scientists from NRS are providing science-based interactive data visualization tools that allow users to track the ranges of invasive forest pests, quantify trends in host tree species abundance, and compute increases in mortality caused by insect and disease invasions across the United States.

Outcome: Providing science-based interactive data visualizations aids in communicating where and how nonnative forest insects and diseases are contributing to changes in forest resources. To date, the Alien Forest Pest Explorer (AFPE) database includes the geographic distributions of 74 species of forest insects and 15 species of forest pathogens. In addition, the AFPE web tool integrates pest distribution data for 16 of the most damaging pests with forest inventory data from the FIA Program to highlight the status and trends in the health of host resources. This online tool allows users to customize host data retrievals across multiple scales to aid in addressing forest health management and research goals.

Partners: Songlin Fei, Purdue University and USDA Forest Service, Forest Health Protection, FHAAST

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Alien Forest Pest Explorer:
https://mapsweb.lib.purdue.edu/AFPE

Managing the FIA Program Nationally

FIA National Office

The National Office for the FIA Program provides leadership, guidance, coordination, and oversight to FIA field units in strategy and implementing the FIA Program; seeks opportunities to advance the program mission and resources; fosters relationships, transparency, and accountability; coordinates with other Forest Service programs and Federal agencies; seeks input from clients' data needs; and represents FIA in national and international efforts. In collaboration with the field units' leadership, the National Office provides strategic program direction and resource allocation to deliver the program in an efficient and effective way.

Through meetings, presentations, policy papers, briefing papers, budget justifications, and other ways to provide input and engage in national and international efforts, the National Office provides liaison and strategic planning, showcases the value and impact of the program, and guides the allocation of the human and financial resources needed for the implementation of the program. Some of the accomplishments in FY 2022 include:

- Continued leading oversight and implementation of policy changes that provide additional, legally binding protection for confidential information. Since FY 2020, the FIA Program continues to adopt changes to strengthen protections for plot locations, landowners' personally identifiable information, nonpublic business data, and unpublished information. In 2022, FIA entered into 32 new MTAs and 1 new national interagency MOA to protect confidential information when sharing data with partners.
- Worked with agency leadership to allocate and track

additional funding from the Coronavirus Aid, Relief, and Economic Security (CARES) Act, Forest Service R&D funds to support plot backlog resulting from the COVID-19 pandemic and catastrophic wildfires, and targeted FIA funding to universities to work on operationalizing small area estimation techniques, develop national vegetation classification, support national user group and focus group meetings, and support retirees to help on business reports and archiving historical plot measurement data.

- Supported developmental details for six FIA or NFS employees within National Office FIA to provide learning opportunities and experience at national headquarters and to strengthen the FIA workforce.
- Collaborated with NFS Ecosystem Management Coordination Staff to develop a framework for using FIA data to assess old growth and mature forest to respond to Executive Order 14072 of April 22, 2022 (Strengthening the Nation's Forests, Communities, and Local Economies). Supported various data requests related to reforestation, forest disturbances, climate change research, information technology modernization, and artificial intelligence exploration.
- Collaborated with the Society of American Foresters and the National Council for Air and Stream Improvement (NCASI) in organizing two virtual meetings: a national user group focus meeting on carbon in March 2022 and the FIA national user group meeting in April 2022. Both meetings served as a mechanism for FIA partners, users, and research collaborators to present emerging information needs, track the program accomplishments, and provide feedback on performance. The national user group meeting, with 156 virtual registrants, had 3 focus areas: (1) program accomplishments and priorities; (2) forest carbon estimation; and (3) emerging priorities and the FIA Program's contributions. The virtual carbon meeting, with about 140 attendees, also had 3 primary areas of focus: (1) identifying the grand challenges of forest carbon estimation; (2) new and emerging technologies and solutions to address these grand challenges; and (3) the ways in which the diverse range of people interested in forest carbon decision support can form new working relationships to generate associated solutions.
- Provided technical expertise on forest carbon inventories and accounting by reviewing drafted legislation, producing communication products, contributing to an emerging carbon investment program for NFS, estimating the investments needed to support carbon in the FIA Program including greenhouse gas inventories, and collaborating with a temporary Forest Service R&D-funded FIA policy position to (1) provide science leadership to address urgent carbon-related requests and (2) develop a strategy and operational plan to provide field leadership and research capacity to address national needs in coordination with the National Office.
- Demonstrated the transparency and accountability of the program by leading the development of this report, coordinating national reporting teams, soliciting input from partners and data users, and working with the Forest Service Budget Office and unit budget officers to ensure accuracy in the FIA charges and transparency in the financial information reported. Additionally, reported program research and scientific accomplishments to the USDA Technology Transfer Annual Report.
- Provided liaison, technical expertise, and data to the Global Forest Resources Assessment conducted by the Food and Agriculture Organization of the United Nations (FAO) and FAO North American Forest Commission; collaboratively developed an online interactive tool for viewing national data related to multiple resource areas; improved global reporting methods of primary forest through participation in workshops and pilot projects in the boreal region; and provided support to Forest Service International Programs on activities related to the FAO Committee on Forestry and other international issues.

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FIA National Operations Team

FIA has a national operations team that provides operational coordination and support across FIA's core mission. Their major responsibilities include project management, operational planning, IT budget management, liaison to the Forest Service Chief Information Officer (CIO), and oversight of operations QA processes to increase national consistency

Major accomplishments in 2022 include:

- Identified issues related to implementing a nationally consistent program and moved through the change management process to ensure effective and efficient rollout of solutions. Some of these issues included:
  - Bug fixes to the version 9.2 field guide to ensure consistent implementation
  - Addition of growth, removals, and mortality tree status code for better tracking of removals
- Managed FIA software releases, security improvements, and continuous improvements
- Worked toward improved database systems that connect different components of the inventory (e.g., urban, rural, special studies)
- Established a training program for all FIA staff on compliance with Section 508 of the Rehabilitation ACT (i.e., 508 compliance) to ensure electronic and information technology is accessible to people with disabilities
- Worked with collaborators to improve tools, estimates, and management of FIA data

- Worked directly with CIO staff on migrating the national FIA website as it moves to the new Drupal platform
- Continued to implement an annualized, national, urban field data collection certification
- Continued to develop systematic edit checks of data before public release, including MIDAS logic checks in the data collection phase and Universal Information Management System load error checks
- Developed a national system that performs checks and generates individual check-plot results to assist in comparing quality standards nationally
- Worked across FIA regions to identify inconsistencies, find a national resolution, and implement changes in prefield and field manual versions 9.3
- Developed and implemented national data collection staff training standards to ensure consistency
- Assisted with the new national-scale volume and biomass equations to ensure data quality

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The Director's Awards for FIA Excellence

In FY 2022, the following individuals and groups were recognized for:

- Providing and promoting outstanding customer service as part of the FIA Program: Paul Sowers (NRS)
- Advancing the core national FIA Program or expanding the FIA Program to the areas as outlined in the 2014/2018 Farm Bill and the FIA strategic plan: Interior Alaska Reporting Team (Sean Cahoon, Kathryn Baer, and Hans Andersen (PNW))
- Upholding the FIA program's high standards in research, quality assurance and control, and operational efficiency: Brytten Steed (NFS Regions 1 and 4 Forest Health Protection); NRS Archive Team (James Blehm, Mitchell Pennabaker, Brian Gasper, Cassandra Olson, Melissa Powers, Lucretia Stewart, Brian Wall, Jeffrey Wazenegger, Rebecca Christopherson, Scott Hopton, Joseph Kernan, Todd Renninger, and Paul Castillo (NRS))
- Applying FIA research on the ground to improve land stewardship: National Woodland Owner Survey Team (Brett Butler and Jesse Caputo (NRS), and Amanda L. Robillard, Enna N. Sass, and Christopher Sutherland (University of Massachusetts))
- Making a significant research contribution in the inventory and monitoring sciences: Big Data
- Mapping and Analytics Platform (BIGMAP) Team (Christopher Oswalt (SRS); Charles Perry, Barry Wilson, and James Garner (NRS); Chuck Werstak (RMRS); David Bell (PNW); and Eric Aiello, Michael Rich, and Joshua Bixby (CIO))
- The Davita Colker Bryant Award for Outstanding Field Service: Seth Ayotte (PNW) and Benjamin Nurre (NRS)

Interior Alaska Inventory

The purpose of the Interior Alaska survey is to establish a baseline of forest conditions and monitor the status of boreal and arctic forests potentially experiencing rapid change. This work will help complete the base inventory of all forest land within the United States. Given current resources, all field plots across the Interior Alaska units (figure 12) are expected to be surveyed by 2043 (figure 13). Broadly, goals are to:

1. Determine the extent and rates of change in forests at high latitudes.
2. Understand the present and potential future carbon stores and flux of Alaskan forests.
3. Assess the potential for forest products and their role in sustaining rural communities.
4. Leverage partnerships and remote sensing information to develop efficient and cost-effective monitoring strategies.

Objectives

1. Complete a ground measurement of FIA plots across Interior Alaska at one-fifth intensity; 1,491 of an estimated 4,677 forested plots are complete to date.
2. Leverage ground measurements using the NASA G-LiHT imaging platform.
3. Publish data to PNW FIADB website on a unit-by-unit basis; Tanana and Susitna-Copper units are currently available in Microsoft Access databases.
4. Report on data regularly.
5. Continue to explore more efficient, safer, and cost-effective methods of inventorying Interior Alaska.

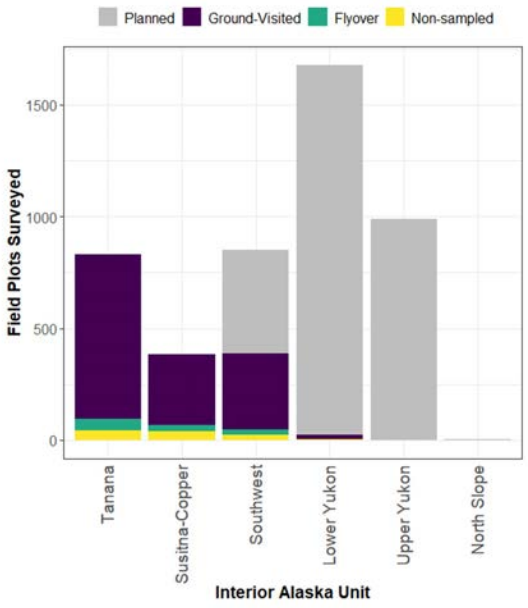
FY 2022 Accomplishments and Milestones

- The Southwest unit, started in 2020, is the first that is completely off the road system, posing substantial logistical challenges. Despite these challenges, field crews have measured tree, forest, and site information on a total of 412 ground plots (approximately 45 percent of the unit), including 149 during the 2022 field season (figure 14). Field crews also measured 24 plots in the Lower Yukon unit in 2022. Field plot collection for the Tanana and Susitna-Copper units has been complete since 2019 and 2020, respectively.
- In 2022, NASA completed G-LiHT data acquisition along strips covering FIA plots over approximately 19 percent of plots in the Southwest unit, for about 42 percent coverage in the unit to date.

Figure 12. FIA units in Interior Alaska.

FIA = Forest Inventory and Analysis.

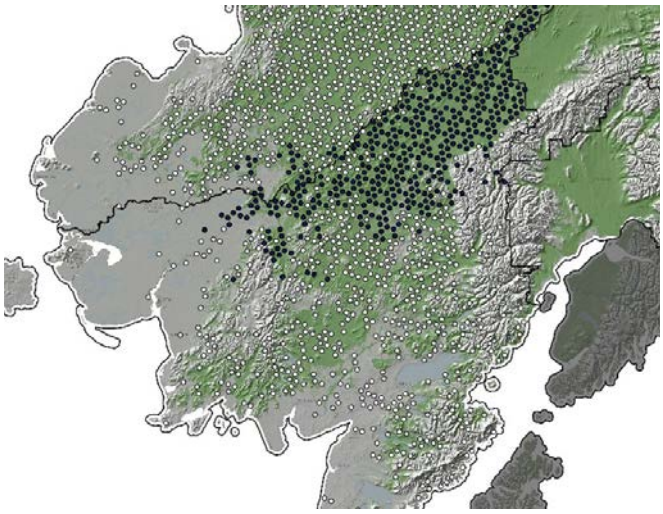
Figure 13. Ongoing field plot progress for Interior Alaska inventory. The Tanana and Susitna-Copper units are field completed, and data are available in FIADB. Flyover plots were visited via helicopter and deemed nonforest (not requiring a field visit).



FIADB = Forest Inventory and Analysis Database.

- The Tanana Data Report, which summarizes the forest resources of the Tanana unit, was published.
- Three publications related to Interior Alaska resource inventory techniques development and improvements were released.
- The Forest Service Interior Alaska data collection coordinator and quality assurance positions were filled.
- The FIA national operations team helped PNW FIA complete an exhaustive, multiyear review of feasible options for redesigning the approach to Interior Alaska data collection to address logistical, safety, and budgetary realities of sampling in remote locations. Based on the preferred option from this review, PNW FIA began a project to assess the feasibility of an annualized study design across the Interior Alaska unit. The feasibility assessment will take 2–3 years and begins with hiring an annualized feasibility project coordinator.

Figure 14. Field-completed (black) and unvisited, anticipated forested (white) FIA field locations in the Southwest and Lower Yukon units of southwestern Alaska. Green is mapped forested area.



FIA = Forest Inventory and Analysis.

Financial Status and Partners

Current funding: $1.8 million (Forest Service) and $261,000 (external sources). Funding was higher in FY 2021, but progress in the more remote roadless areas was slower than expected due to ongoing COVID-19 mitigations and lack of staffing. As a result, some funds carried over and less needed to be added in FY 2022.

FTEs: 4.2 (Forest Service) and 10.3 (external cooperators)

Farm Bill request: $3.7 million per year

Partnerships: Alaska Department of Natural Resources, Division of Forestry; NASA Goddard Space Flight Center; University of Alaska; Alaska Native Science and Engineering Program; Tanana Chiefs Conference; DOI Bureau of Land Management, Alaska Fire Service

FY 2022 Publications and Deliverables

Interior Alaska Database (including data from both the Tanana and Susitna-Copper units): https://www.fs.usda.gov/research/pnw/products/dataandtools/tools/pnw-fiadb-forest-inventory-and-analysis-databases

Cahoon, S.M.P.; Baer, K.C., tech. eds. 2022. Forest resources of the Tanana unit, Alaska: 2018. Gen. Tech. Rep. PNW-1005. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 92 p. https://doi.org/10.2737/PNW-GTR-1005.

The Susitna-Copper unit, which represents an estimated 9 percent of the field plots in Interior Alaska and was field completed in 2019, will be grouped with all or part of the adjacent Southwest unit for reporting purposes.

Other publications:

Andersen, H-K.; Strunk, J; McGaughey, R.J. 2022. Using high-performance global navigation satellite system technology to improve Forest Inventory and Analysis plot coordinates in the Pacific region. Gen. Tech. Rep. PNW-1000. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 38 p. https://doi.org/10.2737/PNW-GTR-1000.

Cahoon, S.M.P.; Baer, K.C., eds. 2022. Forest resources of the Tanana unit, Alaska: 2018. Gen. Tech. Rep. PNW-1005. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 92 p. https://doi.org/10.2737/PNW-GTR-1005.

Cahoon, S.M.P.; Sullivan, P.F.; Gray, A.N. 2022. Interactions among wildfire, forest type and landscape position are key determinants of boreal forest carbon. Journal of Ecology. 110: 2475–2492. https://doi.org/10.1111/1365-2745.13963.

Shoot, C.; Andersen, H.-E.; Moskal, L.M.; Babcock, C.; Cook, B.D.; Morton, D.C. 2021. Classifying forest type in the national forest inventory context with airborne hyperspectral and lidar data. Remote Sensing. 13(10): 1863. https://doi.org/10.3390/rs13101863.

Tóth, S.F.; Oken, K.L.; Stawitz, C.C.; Andersen, H.-E. 2022. Optimal survey design for forest carbon monitoring in remote regions using multi-objective mathematical programming. Forests. 13(7): 972. http://dx.doi.org/10.3390/f13070972.

Small Area Estimation

The purpose of the small area estimation (SAE) research portfolio is to modernize FIA's methods for estimation of forest parameters within spatiotemporal domains spanning sub-State geographies and short time intervals. Early-phase research results are anticipated to support operational estimators and tools for (1) a nationwide, experimental series of annual, county-level forest area and biomass estimates by 2025 and (2) area and biomass change by 2027.

Objectives

1. **Define user needs:** Target attributes and domains, precision and/or accuracy standards, and delivery mechanisms.
2. **Conduct techniques research:** Evaluate new sources of auxiliary information, explore new forms for supporting models, and compare competing estimators and estimates of their precision and/or accuracy.
3. **Develop tools:** Recommend best statistical practices and deliver associated tools to the user community.
4. **National project:** Now called the Partnership for Small Area Estimation (PSAE), we've formed user, science, and development panels composed of FIA scientists as well as representatives from industry, agencies, academia, and other stakeholder groups. PSAE is a strategic, nationally coordinated effort to synthesize historic SAE R&D efforts and to prioritize tasks to achieve objectives 1–3 above.

In FY 2022, a 3-year, $1.36 million cooperative agreement was executed with NCASI Foundation to refine user needs, conduct national SAE research, and develop tools via solicitation of proposals and distribution of research and development subawards. The execution of new and existing agreements and distribution of subawards will enable national coordination on R&D activities. Success of the FIA-NCASI Foundation cooperative agreement will be measured in part by the extent of national coordination achieved, numbers of peer-reviewed journal articles published, and estimation capacity delivery (FIESTA, BIGMAP, r-FIA, RegRake, and other tools).

FY 2022 Accomplishments and Milestones

- **User needs:** To undergo further refinement and synthetization by the user panel at in-person executive meeting
- **Techniques research:**
  - Application of area-level model-based estimation strategies for stand-level inventory
  - Investigating indirect SAE of forest regeneration following fire
  - Evaluating impacts of data transformation on model-assisted estimation
  - Developing a national ownership map and NWOS county-level estimates
  - Application of nearest neighbor techniques in a model-based SAE context
  - Developing county-level volume estimates for Southeastern States and carbon estimates for the United States
  - Eight alternative SAEs for six FIA attributes for the United States
- **Delivery tools:**
  - FIESTA's model-assisted and SAE modules were expanded; demonstration dashboards were developed nationally for ecosubsections, counties, and watersheds; and advances were made in FIESTA-BIGMAP and FIESTA-desktop delivery.
  - Esri accelerated its support of BIGMAP with supplemental access to Amazon Web Services, and the BIGMAP team demonstrated the integration of published SAE methods related to kNN estimation using the R-ArcGIS Bridge.
  - RegRake methodology was demonstrated via a dashboard in South Carolina.

Financial Status and Partners

Historically, SAE-related projects were funded primarily by FIA units and collaborators. Upcoming research will be funded via direct or competitive grants through the NCASI Foundation agreement. Participants include:

- **Forest Service:** NRS, RMRS, SRS, PNW, GTAC, and NFS Regions 1–4. FIA representatives from the four research stations and GTAC are helping to set research and platform development trajectories and conducting R&D activities collaboratively with funding recipients (but are not receiving funding themselves). NFS representatives are providing insights into NFS-specific FIA information needs and associated feedback on R&D proposals.
- **Universities:** Virginia Tech, University of Montana, Harvard University, Missouri State University, Oregon State University, University of Missouri, University of Tennessee, Swarthmore College, Michigan State University, Colby College
- **Industry/other:** RedCastle Resources, Esri, NCASI

FY 2022 Publications and Deliverables

Special journal issue:

Wilson, B.; Coulston, J.; Prisley, S.; Radtke, P., eds. 2023. Small area estimation in forest inventories: new needs, methods, and tools. Frontiers in Forests and Global Change. Lausanne: Frontiers Media SA. 196 p. https://doi.org/10.3389/978-2-83251-647-8.

Articles included in the special issue:

Bell, D.M.; Wilson, B.T.; Werstek, C.E.; Oswalt, C.M. 2022. Examining k-nearest neighbor small area estimation across scales using national forest inventory data. Frontiers in Forests and Global Change. 5: 763422. https://doi.org/10.3389/ffgc.2022.763422.

Cao, Q.; Dettmann, G.T.; Radtke, P.J.; Coulston, J.W.; Derwin, J.; Thomas, V.A.; Burkhart, H.E.; Wynne, R.H. 2022. Increased precision in county-level volume estimates in the United States national forest inventory with area-level small area estimation. Frontiers in Forests and Global Change. 5: 769917. https://doi.org/10.3389/ffgc.2022.769917.

Dettmann, G.T.; Radtke, P.J.; Coulston, J.W.; Green, P.C.; Wilson, B.T.; Moisen, G.G. 2022. Review and synthesis of estimation strategies to meet small area needs in forest inventory. Frontiers in Forests and Global Change. 5: 813569. https://doi.org/10.3389/ffgc.2022.813569.

Ekström, M.; Nilsson, M. 2021. A comparison of model-assisted estimators, with and without data-driven transformations of auxiliary variables, with application to forest inventory. Frontiers in Forests and Global Change. 4: 764495. https://doi.org/10.3389/ffgc.2021.764495.

Frescino, T.S.; White, G.W.; Toney, J.C.; Moisen, G.G. 2022. Small area estimates for national applications: a database to dashboard strategy using FIESTA. Frontiers in Forests and Global Change. 5: 779446. https://doi.org/10.3389/ffgc.2022.779446.

Gaines, G.C., III; Affleck, D.L.R. 2021. Small area estimation of postfire tree density using continuous forest inventory data. Frontiers in Forests and Global Change. 4: 761509. https://doi.org/10.3389/ffgc.2021.761509.

Harris, V.; Caputo, J.; Finley, A.; Butler, B.J.; Bowlick, F.; Catanzaro, P. 2021. Small-area estimation for the USDA Forest Service, National Woodland Owner Survey: creating a fine-scale land cover and ownership layer to support county-level population estimates. Frontiers in Forests and Global Change. 4: 745840. https://doi.org/10.3389/ffgc.2021.745840.

Prisley, S.; Bradley, J.; Clutter, M.; Friedman, S.; Kempka, D.; Rakestraw, J.; Sonne Hall, E. 2021. Needs for small area estimation: perspectives from the US private forest sector. Frontiers in Forests and Global Change. 4: 746739. https://doi.org/10.3389/ffgc.2021.746439.

Schroeder, T.A.; Nagle, N.N.; McCollum, J. 2022. RegRake: a web-based application for custom small area estimation and mapping of forest survey data with regularized raking. Frontiers in Forests and Global Change. 5: 769268. https://doi.org/10.3389/ffgc.2022.769268.

Stanke, H.; Finley, A.O.; Domke, G.M. 2022. Simplifying small area estimation with rFIA: a demonstration of tools and techniques. Frontiers in Forests and Global Change. 5: 745874. https://doi.org/10.3389/ffgc.2022.745874.

Temesgen, H.; Mauro, F.; Hudak, A.T.; Frank, B.; Monleon, V.; Fekety, P.; Palmer, M.; Bryant, T. 2021. Using Fay–Herriot models and variable radius plot data to develop a stand-level inventory and update a prior inventory in the Western Cascades, OR, United States. Frontiers in Forests and Global Change. 4: 745916. https://doi.org/10.3389/ffgc.2021.745916.

White, G.W.; McConville, K.S.; Moisen, G.G.; Frescino, T.S. 2021. Hierarchical Bayesian small area estimation using weakly informative priors in ecologically homogeneous areas of the Interior Western forests. Frontiers in Forests and Global Change. 4: 752911. https://doi.org/10.3389/ffgc.2021.752911.

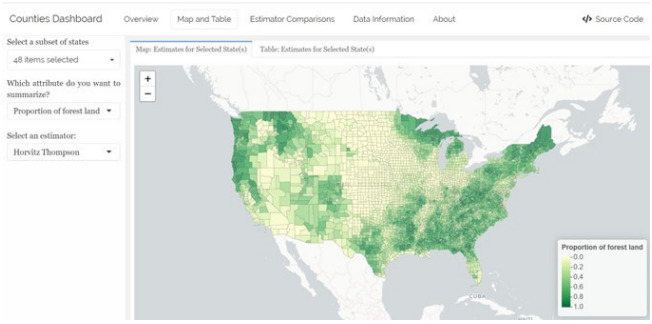
Wiener, S.S.; Bush, R.; Nathanson, A.; Pelz, K.; Palmer, M.; Alexander, M.L.; Anderson, D.; Treasure, E.; Baggs, J.; Sheffield, R. 2021. United States Forest Service use of forest inventory data: examples and needs for small area estimation. Frontiers in Forests and Global Change. 4: 763487. https://doi.org/10.3389/ffgc.2021.763487.

Wojcik, O.C.; Olson, S.D.; Nguyen, P.-H.V.; McConville, K.S.; Moisen, G.G.; Frescino, T.S. 2022. GREGORY: a modified generalized regression estimator approach to estimating forest attributes in the Interior Western US. Frontiers in Forests and Global Change. 4: 763414. https://doi.org/10.3389/ffgc.2021.763414.

Dashboards:

- Precision standards for small area estimators: watersheds (https://mjdvl.shinyapps.io/watersheds/)
- Small area estimates for CONUS: counties (figure 15) (https://fia-dash.shinyapps.io/fiesta-counties/)
- Small area estimates for CONUS: ecosubsections (https://fia-dash.shinyapps.io/fiesta-subsections/)
- Small area estimates for CONUS: watersheds (https://fia-dash.shinyapps.io/fiesta-watersheds/)

Figure 15. Small area estimation dashboard: proportion of forest land by county.



Carbon

The carbon portfolio's mission is to advance the science, monitoring, and reporting of greenhouse gas emissions and removals on land with trees in the United States. This portfolio includes:

- Estimation and accounting compilation systems and tools
- Carbon pool science (including harvested wood products)
- Leveraging FIA remeasurements and auxiliary information for change estimation and attribution across spatial and temporal scales (figure 16)
- Informing carbon management, mitigation, and adaptation activities

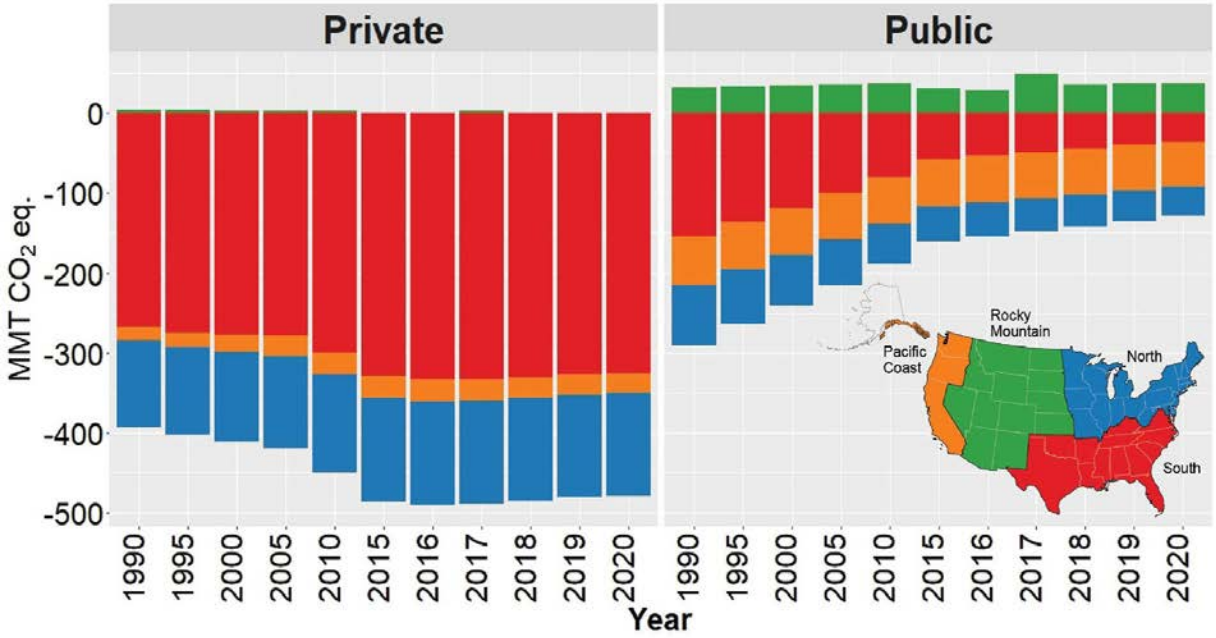
Objectives

1. Increase FIA contributions to the EPA National Inventory Report (NIR) and other reporting instruments and efforts.
2. Develop more spatially and temporally resolved estimates to inform entity, State, and national assessments as well as management, mitigation, and adaption activities.
3. Employ new RPA Assessment projection modeling framework.
4. Be more entrepreneurial—expand partners.
5. Improve collaboration and cooperation between FIA regions, bands, and portfolios to facilitate reporting consistency, reduce redundancies, and ensure regional applicability.

FY 2022 Accomplishments and Milestones

- Contributed the forest land, woodlands, harvested wood products, and urban tree components of the 2022 NIR of greenhouse gas emissions and sinks
- State-level disaggregation included in the 2022 Resource Update (currently in Forest Service review) on FIA contributions to NIR with research datasets
- Contributed to State-level greenhouse gas inventories (California, Oregon, Washington, West Virginia, Vermont, South Carolina, New Hampshire, New York, Maine, Minnesota, and Colorado—and the list is growing)
- Continuing to lead and contribute to U.S. Global Change Research Program reports and reviews (Intergovernmental Panel on Climate Change (IPCC) Assessment Report 6, Working Group III review, Fifth National Climate Assessment (NCA5), Decadal Survey) and Committee on Earth Observation Satellites activities (e.g., global stocktake)
- Leading the land representation of the United States as part of the 2022 NIR in cooperation with the land use and land cover change portfolio
- Leading and contributing to research and applications on nature-based climate solutions
- Disaggregating harvested wood products estimates for States and regions with expected release in 2025
- Produced many refereed publications (10+), invited presentations (10+), and organized sessions in FY 2022 documenting advances (e.g., pool science, estimation, modeling, tool development, and applications of FIA data in carbon science and management)
- Delivered a report on alternative methods, models, and technologies used to estimate forest attributes (e.g., carbon in aboveground biomass) to the California Air Resources Board (CARB)
- Continuing to respond to unprecedented demand for information from the National Office and stakeholders, including work on Executives Orders on reforestation and mature/old growth forest

Figure 16. Carbon stock changes for forest land remaining forest land for the conterminous United States and Coastal Alaska by FIA region and ownership (MMT CO_2 Eq.). (Ownership information was not available for forest land in Interior Alaska, so those lands were excluded from these estimates.)



MMT CO_2 Eq. = million metric tons of carbon dioxide equivalent.

Financial Status and Partners

Current funding and capacity for FIA Program carbon activities: Internal: $1.2+ million (includes Forest Service salaries); external: $2 million+ (NASA, EPA, CARB, States, WO); FTEs: 9 (Forest Service) and 10+ (cooperators)

Stakeholders and partners: University of Minnesota, Colorado State University, Purdue University, Michigan State University, University of Vermont, University of Florida, United Nations Framework Convention on Climate Change, EPA, Council on Environmental Quality, IPCC, U.S. Department of State, NASA, U.S. States, NCASI, NFS, CARB, voluntary carbon registries, and American Forests, among many other nongovernmental organizations, scientists, policymakers, and land managers

FY 2022 Publications and Deliverables

Doraisami, M.; Kish, R.; Paroshy, N.J.; Domke, G.M.; Thomas, S.C.; Martin, A.R. 2022. A global database of woody tissue carbon concentrations. Scientific Data. 9: 284. https://doi.org/10.1038/s41597-022-01396-1.

Fitts, L.A.; Domke, G.M.; Russell, M.B. 2022. Comparing methods that quantify forest disturbances in the United States' national forest inventory. Environmental Monitoring and Assessment. 194: 304. https://doi.org/10.1007/s10661-022-09948-z.

Giebink, C.L.; Domke, G.M.; Fisher, R.A.; Heilman, K.A.; Moore, D.J.P.; DeRose, R.J.; Evans, M.E.K. 2022. The policy and ecology of forest-based climate mitigation: challenges, needs, and opportunities. Plant and Soil. 479: 25–52. https://doi.org/10.1007/s11104-022-05315-6.

Hayes, D.J.; Butman, D.E.; Domke, G.M.; Fisher, J.B.; Neigh, C.S.R.; Welp, L.R. 2022. Boreal forests. In: Poulter, B.; Canadell, G.G.; Hayes, D.J.; Thompson, R.L., eds., Balancing greenhouse gas budgets. Amsterdam: Elsevier: 203–236. Chapter 6. https://doi.org/10.1016/B978-0-12-814952-2.00025-3.

Knott, J.; Domke, G.; Woodall, C.; Walters, B.; Jenkins, M.; Fei, S. 2023. Shifting forests and carbon: linking community composition and aboveground carbon attributes. Ecosystems. 26: 412–427. https://doi.org/10.1007/s10021-022-00765-6.

Nave, L.E.; DeLyser, K.; Domke, G.M.; Holub, S.M.; Janowiak, M.K.; Kittler, B.; Ontl, T.A.; Sprague, E.; Sucre, E.B.; Walters, B.F.; Swanston, C.W. 2022. Disturbance and management effects on forest soil organic carbon stocks in the Pacific Northwest. Ecological Applications. 32(6): e2611. https://doi.org/10.1002/eap.2611.

Nave, L.E.; DeLyser, K.; Domke, G.M.; Holub, S.M.; Janowiak, M.K.; Ontl, T.A.; Sprague, E.; Viau, N.R.; Walters, B.F.; Swanston, C.W. 2022. Soil carbon in the South Atlantic United States: land use change, forest management, and physiographic context. Forest Ecology and Management. 520: 120410. https://doi.org/10.1016/j.foreco.2022.120410.

Quirion, B.R.; Domke, G.M.; Walters, B.F.; Lovett, G.M.; Fargione, J.E.; Greenwood, L.; Serbesoff-King, K.; Randall, J.M.; Fei, S. 2021. Insect and disease disturbances correlate with reduced carbon sequestration in forests of the contiguous United States. Frontiers in Forests and Global Change. 4: 716582. https://doi.org/10.3389/ffgc.2021.716582.

Smith, J.E.; Domke, G.M.; Woodall, C.W. 2022. Predicting downed woody material carbon stocks in forests of the conterminous United States. Science of The Total Environment. 803: 150061. https://doi.org/10.1016/j.scitotenv.2021.150061.

U.S. Department of Agriculture, Office of the Chief Economist. 2022. U.S. Agriculture and Forestry Greenhouse Gas Inventory: 1990–2018. Tech. Bull. No. 1957. Washington, DC. 181 p. https://www.usda.gov/sites/default/files/documents/USDA-GHG-Inventory-1990-2018.pdf.

U.S. Environmental Protection Agency. 2022. Land use, land-use change, and forestry. In: Inventory of U.S. Greenhouse Gas Emissions and Sinks. EPA 430-R-22-003. Washington, DC: 6-1–6-148. Chapter 6. https://www.epa.gov/system/files/documents/2022-04/us-ghg-inventory-2022-chapter-6-land-use-land-use-change-and-forestry.pdf.

Walters, B.F.; Domke, G.M.; Greenfield, E.J.; Smith, J.E.; Nowak, D.J.; Ogle, S.M. 2022. Greenhouse gas emissions and removals from forest land, woodlands, and urban trees in the United States, 1990–2020: estimates and quantitative uncertainty for individual states, regional ownership groups, and National Forest System regions. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2022-0052.

Yu, Y.; Saatchi, S.; Domke, G.M.; Walters, B.; Woodall, C.; Ganguly, S.; Li, S.; Kalia, S.; Park, T.; Nemani, R. 2022. Making the US national forest inventory spatially contiguous and temporally consistent. Environmental Research Letters. 17: 065002. https://doi.org/10.1088/1748-9326/ac6b47.

Land Use and Land Cover Change

The 2014 Farm Bill charged FIA to understand and report changes in land use and land cover (LULC). FIA continuously monitors 326,000 plots across all land types, providing the most complete set of ground-based LULC observations in the world. FIA analysis of LULC focuses on three goals:

1. Help FIA leverage its unique dataset to lead national LULC monitoring.
2. Create a forum for FIA LULC experts to coordinate research within and outside of the program.
3. Maintain communication between LULC researchers and FIA leadership.

Objectives

1. Draw lessons from the now-complete image-based change estimation (ICE) pilot project. A determination has been made that parallel LULC observations on the FIA network at a slightly accelerated schedule do not provide benefits commensurate with involved costs. A paper is in progress that frames lessons learned in the context of international image-based estimation campaigns.
2. Refine a new LULC dashboard that currently delivers plot-based land use estimates at State, county, and survey unit scales. Land cover will be added soon, and development is in progress for change estimation in States where the database supports it.
3. Build a business case for national LULC monitoring. Forthcoming documentation will focus on FIA's incomparable plot information and recent investments in LULC data continuity and display.

FY 2022 Accomplishments and Milestones

- Updated and maintained the FIA Land Resources Explorer dashboard (figure 17)
- Contributed data, funding, and relevant research studies to the Landscape Change Monitoring System (https://data.fs.usda.gov/geodata/rastergateway/LCMS/index.php) and National Land Cover Database Tree Canopy Cover Product (https://data.fs.usda.gov/geodata/rastergateway/treecanopycover/#docref)

Financial Status and Partners

The portfolio currently tracks numerous LULC-related projects funded primarily by their home units and collaborators. Participating organizations:

- **Forest Service:** NRS, RMRS, SRS, PNW, GTAC, NFS
- **Universities:** Oregon State University, University of Maryland
- **Industry/other:** Google, Planet Labs, NASA, NCASI

Figure 17. Landing page for the interactive Land Resources Explorer dashboard.

FY 2022 Publications and Deliverables

Bullock, E.L.; Healey, S.P.; Yang, Z.; Houborg, R.; Gorelick, N.; Tang, X.; Andrianirina, C. 2022. Timeliness in forest change monitoring: a new assessment framework demonstrated using Sentinel-1 and a continuous change detection algorithm. Remote Sensing of Environment. 276: 113043. https://doi.org/10.1016/j.rse.2022.113043.

Davis, R.J.; Bell, D.M.; Gregory, M.J.; Yang, Z.; Gray, A.N.; Healey, S.P.; Stratton, A.E. 2022. Northwest Forest Plan—the first 25 years (1994–2018): status and trends of late-successional and old-growth forests. Gen. Tech. Rep. PNW-1004. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 82 p. https://doi.org/10.2737/PNW-GTR-1004.

Dubayah, R.; Armston, J.; Healey, S.P.; Bruening, J.M.; Patterson, P.L.; Kellner, J.R.; Duncanson, L.; Saarela, S.; Ståhl, G.; Yang, Z.; Tang, H.; Blair, B.; Fatoyinbo, L.; Goetz, S.; Hancock, S.; Hansen, M.; Hofton, M.; Hurtt, G.; Luthcke, S. 2022. GEDI launches a new era of biomass inference from space. Environmental Research Letters. 17(9): 095001. https://doi.org/10.1088/1748-9326/ac8694.

Lu, J.; Huang, C.; Tao, X.; Gong, W.; Schleeweis, K. 2022. Annual forest disturbance intensity mapped using Landsat time series and field inventory data for the conterminous United States (1986–2015). Remote Sensing of Environment. 275: 113003. https://doi.org/10.1016/j.rse.2022.113003.

Rishmawi, K.; Huang, C.; Schleeweis, K.; Zhan, X. 2022. Integration of VIIRS observations with GEDI-Lidar measurements to monitor forest structure dynamics from 2013 to 2020 across the conterminous United States. Remote Sensing. 14: 2320. https://doi.org/10.3390/rs14102320.

Shang, R.; Zhu, Z.; Zhang, J.; Qiu, S.; Yang, Z.; Li, T.; Yang, X. 2022. Near-real-time monitoring of land disturbance with harmonized Landsats 7-8 and Sentinel-2 data. Remote Sensing of Environment. 278: 113073. https://doi.org/10.1016/j.rse.2022.113073.

Strunk, J.L.; Bell, D.M.; Gregory, M.J. 2022. Pushbroom photogrammetric heights enhance state-level forest attribute mapping with Landsat and environmental gradients. Remote Sensing. 14(14): 3433. https://doi.org/10.3390/rs14143433.

Wulder, M.A.; Roy, D.P.; Radeloff, V.C.; Loveland, T.R.; Anderson, M.C.; Johnson, D.M.; Healey, S.; Zhu, Z.; Scambos, T.A.; Pahlevan, N.; Hansen, M.; Gorelick, N.; Crawford, C.J.; Masek, J.G.; Hermosilla, T.; White, J.C.; Belward, A.S.; Schaaf, C.; Woodcock, C.E.; Huntington, J.L.; Cook, B.D. 2022. Fifty years of Landsat science and impacts. Remote Sensing of Environment. 280: 113195. https://doi.org/10.1016/j.rse.2022.113195.

Forest Ecosystem Health Indicators

The purpose of collecting a suite of forest health indicators in FIA inventory is to quantify complex forest ecosystem processes. These indicators include crown condition, tree damage, tree mortality, DWM, vegetation profile, soil quality, lichen communities, nonnative invasive plants, regeneration and browse impacts, and fragmentation. At a minimum, each indicator is assessed on approximately 7 percent of the standard plot grid with a set of national protocols that are "core" to the indicator program. The intensity of implementation varies by FIA region due to budget fluctuation and stakeholder interest.

Objectives

1. Collect and publish health indicator data to FIADB annually from each State and contribute indicator analyses to FIA reports.
2. Provide research, technical assistance, and tool support for health indicator data access and analyses conducted by partners and users.
3. Develop health indicator data with BIGMAP and other online digital tools to help facilitate better access and utility and access for users.
4. Integrate FIA health indicator data with forest health data from State and Federal programs.

FY 2022 Accomplishments and Milestones

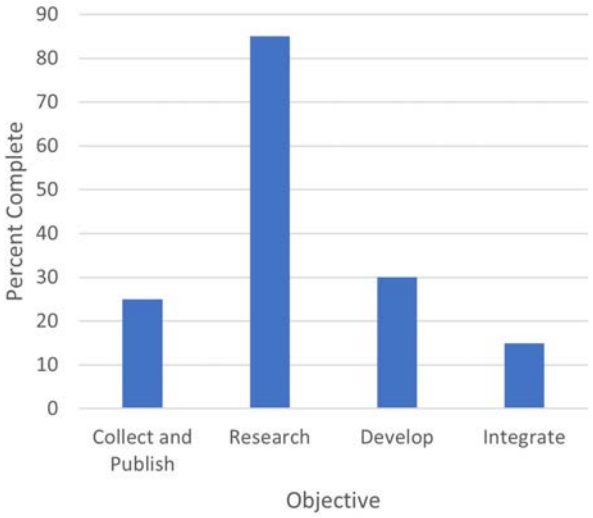
- Caught up on a subset of pandemic-related delays in data collection. Published around 25 percent of health indicator data collected in 2021 to FIADB.
- Continued to conduct meaningful science, engage with important partners such as the NFS and universities, publish data and reports related to forest ecosystem health, and assist users with data access and analysis.
- Deployed and maintained a variety of online tools that provide interactive data visualizations focused on health indicators; many other tools are in development (figure 18).
- Supported an integration team with broad membership to increase communication between FIA and the Forest Health Monitoring Program, improve data alignment and dissemination, and develop integrated services for the public.

Financial Status and Partners

Current funding: The collection of forest health indicators is part of the core function of the national FIA Program; no additional funds are allocated to this task. Some of the publications on this topic resulted from individually funded studies.

Partnerships: State, local, and regional forestry agencies, universities, and many other Forest Service deputy areas, programs, and teams, including NFS, Forest Health Protection, Forest Health Monitoring, and FHAAST

Figure 18. Development status of forest health indicator objectives.



FY 2022 Publications and Deliverables

Barker, J.S.; Gray, A.N.; Fried, J.S. 2022. The effects of crown scorch on post-fire delayed mortality are modified by drought exposure in California (USA). Fire. 5(1): 21. https://doi.org/10.3390/fire5010021.

Berdeen, J.B.; Nelson, M.D.; Zlonis, E.J.; Giudice, J.H. 2022. Temporal change in abundance of potential nesting cavities for wood ducks (Aix sponsa) in Northern Minnesota, United States. Frontiers in Forests and Global Change. 5: 967060. 17 p. https://doi.org/10.3389/ffgc.2022.967060.

Brandeis, T.; Turner, J.; Baeza-Castro, A.-A.; Brown, M.; Lambert, S. 2022. Assessing forest resource damage following natural disasters using national forest inventory plots: a case study of Hurricane Michael. Res. Pap. SRS-65. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 30 p. https://doi.org/10.2737/SRS-RP-65.

Cahoon, S.M.P.; Sullivan, P.F.; Gray, A.N. 2022. Interactions among wildfire, forest type and landscape position are key determinants of boreal forest carbon stocks. Journal of Ecology. 110(10): 2475–2492. https://doi.org/10.1111/1365-2745.13963.

Edgar, C.B.; Westfall, J.A. 2022. Timing and extent of forest disturbance in the Laurentian Mixed Forest. Frontiers in Forests and Global Change. 5: 963796. https://doi.org/10.3389/ffgc.2022.963796.

Evans, M.E.K.; DeRose, R.J.; Klesse, S.; Girardin, M.P.; Heilman, K.A.; Alexander, M.R.; Arsenault, A.; Babst, F.; Bouchard, M.; Cahoon, S.M.P.; Campbell, E.M.; Dietze, M.; Duchesne, L.; Frank, D.C.; Giebink, C.L.; Gómez-Guerrero, A.; Gutiérrez García, G.; Hogg, E.H.; Metsaranta, J.; Ols, C.; Rayback, S.A.; Reid, A.; Ricker, M.; Schaberg, P.G.; Shaw, J.D.; Sullivan, P.F.; Villela GaytÁn, S.A. 2022. Adding tree rings to North America's national forest inventories: an essential tool to guide drawdown of atmospheric CO_2. BioScience. 72(3): 233–246. https://doi.org/10.1093/biosci/biab119.

Harris, L.B.; Woodall, C.W.; D'Amato, A.W. 2022. Increasing the utility of tree regeneration inventories: linking seedling abundance to sapling recruitment. Ecological Indicators. 145: 109654. https://doi.org/10.1016/j.ecolind.2022.109654.

Hessburg, P.F.; Charnley, S.; Gray, A.N.; Spies, T.A.; Peterson, D.W.; Flitcroft, R.L.; Wendel, K.L.; Halofsky, J.E.; White, E.M.; Marshall, J. 2021. Climate and wildfire adaptation of inland Northwest US forests. Frontiers in Ecology and the Environment. 20(1): 40–48. https://doi.org/10.1002/fee.2408.

Jovan, S.; Haldeman, M.; Will-Wolf, S.; Dillman, K.; Geiser, L.; Thompson, J.; Stone, D.; Hollinger, J. 2021. National atlas of epiphytic lichens in forested habitats of the United States. Gen. Tech. Rep. PNW-986. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 96 p. https://www.fs.usda.gov/research/treesearch/63620.

Kondo, M.C.; Zuidema, C.; Moran, H.A.; Jovan, S.; Derrien, M.; Brinkley, W.; De Roos, A.J,; Philip Tabb, L. 2022. Spatial predictors of heavy metal concentrations in epiphytic moss samples in Seattle, WA. Science of The Total Environment. 825: 153801. https://doi.org/10.1016/j.scitotenv.2022.153801.

Kralicek, K.; Barrett, T.M.; Ver Hoef, J.M.; Temesgen, H. 2022. Forests at the fringe: comparing observed change to projected climate change impacts for five tree species in the Pacific Northwest, United States. Frontiers in Forests and Global Change. 5: 966953. https://doi.org/10.3389/ffgc.2022.966953.

Lugo, A.E.; Smith, J.E.; Potter, K.M.; Marcano-Vega, H.; Kurtz, C.M. 2022. The contribution of nonnative tree species to the structure and composition of forests in the conterminous United States in comparison with tropical islands in the Pacific and Caribbean. Gen. Tech. Rep. IITF-54. Río Piedras, PR: U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry. 81 p. https://doi.org/10.2737/IITF-GTR-54.

McCune, B.; Yang, S.; Jovan, S.; Root, H.T. 2022. Climate and epiphytic macrolichen communities in the Four Corners region of the U.S.A. The Bryologist. 125(1): 70–90. https://doi.org/10.1639/0007-2745-125.1.070.

Potter, K.M.; Riitters, K.H.; Guo, Q. 2022. Non-native tree regeneration indicates regional and national risks from current invasions. Frontiers in Forests and Global Change. 5: 966407. https://doi.org/10.3389/ffgc.2022.966407.

Smith, J.E.; Domke, G.M.; Woodall, C.W. 2022. Predicting downed woody material carbon stocks in forests of the conterminous United States. Science of the Total Environment. 803: 150061. https://doi.org/10.1016/j.scitotenv.2021.150061.

Woodall, C.W.; Fraver, S.; Oswalt, S.N.; Goeking, S.A.; Domke, G.M.; Russell, M.B. 2021. Decadal dead wood biomass dynamics of coterminous US forests. Environmental Research Letters. 16(10): 104034. https://doi.org/10.1088/1748-9326/ac29e8.

Woodall, C.W.; Weiskittel, A.R. 2021. Relative density of United States forests has shifted to higher levels over last two decades with important implications for future dynamics. Science Report. 11: 18848. https://doi.org/10.1038/s41598-021-98244-w.

Woodbridge, M.; Keyser, T.; Oswalt, C. 2022. Stand and environmental conditions drive functional shifts associated with mesophication in eastern US forests. Frontiers in Forests and Global Change. 5: 991934. https://doi.org/10.3389/ffgc.2022.991934.

Online tools:

- National FIA Land Resources Explorer
- Northern Research Station Oak Mortality Dashboard
- Northern Research Station Wildland Urban Interface Dashboard
- Alien Forest Pest Explorer

Urban Inventory

The purpose of urban FIA is to implement an annualized inventory of trees in urban settings that provides key data to assess the status and trends of urban trees and forests, including the services they provide, their health, and future risk from insects and disease. The goal is to survey 105 iconic cities, and all Census-defined Urban Areas and Urban Cluster lands outside of cities and not currently in the FIA Nationwide Forest Inventory survey.

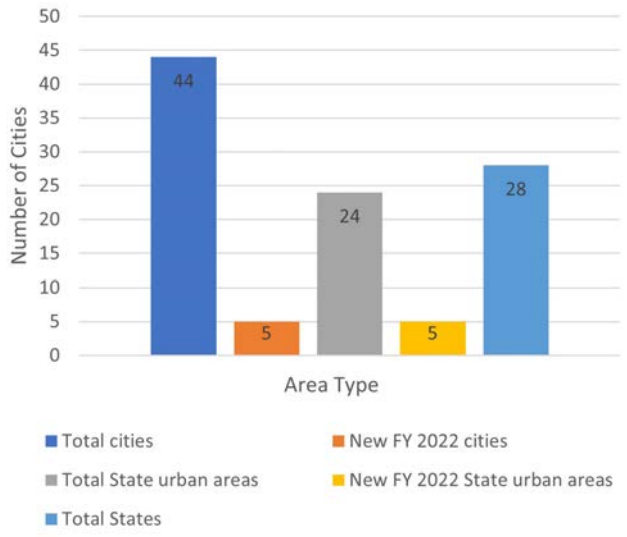
Links:

- Urban FIA Program website and implementation map
- My City's Trees app
- FIA Urban DataMart

Objectives

See figure 19.

Figure 19. Status of implementing urban inventories.



FY = fiscal year.

FY 2022 Accomplishments and Milestones

Data collection:

- Upgraded to Field Guide 9.2
- Developed and conducted virtual and face-to-face national certification training
- Completed all remaining FY 2020/FY 2021 plots that were postponed due to the COVID-19 pandemic
- Began data collection in five new cities and five new States (figure 19)

Information management and data processing:

- Improved workflows with release of Universal Information Management System (UNIMS) database 1.6.0
- Began data processing on all 2022 urban plot projects (figure 20)
- Completed initial exploratory work on urban growth, removal, and mortality (GRM) estimates
- Set up five new city and five new State urban plot projects
- Updated national city-level reporting template tables and figures
- Set up 68 urban sample projects
- Started the approval process for population estimates in Urban EVALIDator

Analysis:

- Continued work on six city-level reports
- Designed standard tables for annual reports

Financial Status and Partners

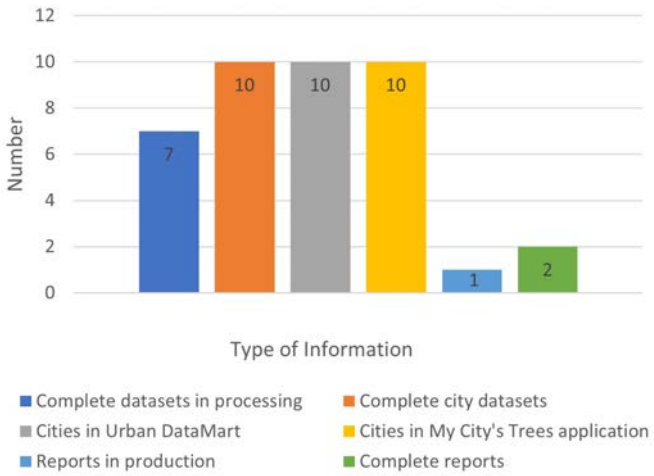
Current funding: Currently funded: $2,961,168; shortfall: $6,663,184; cooperator/added value: $390,913

FTEs: Estimated need for about 78 FTEs spread across multiple business models in each FIA region at full implementation

Farm Bill request: Total estimated cost: $9,624,352

Partnerships: Texas A&M Forest Service; Maine Forest Service; New Jersey Forest Service; Wisconsin Department of Natural Resources; Minnesota Department of Natural Resources; University of New Hampshire; City of Portland, OR; Davey Tree Expert Company; Washington, DC, Urban Forestry Division; Missouri Department of Conservation

Figure 20. Status and availability of urban inventory data and reports urban inventories.



FY 2022 Publications and Deliverables

- Completed a full cycle of data collection for seven cities (Des Moines, IA; Madison and Milwaukee, WI; Baltimore, MD; Minneapolis, MN; Portland, OR; and Providence, RI). Data are currently being processed.
- Added Washington, DC, to the My City's Trees app.
- Added Portland, OR, and Springfield, St. Louis, and Kansas City, MO, to the Urban DataMart.

i-Tree

The mission of i-Tree is to provide a state-of-the-art, peer-reviewed software suite that provides urban and rural forestry analysis and benefits assessment tools. These tools allow people from around the world the ability to assess and quantify the values provided by their local trees and forests, as well as risks to forest health. Since 2006, there have been almost 420,000 users in 149 countries (figure 21). These tools form the foundation for conversations about tree equity and environmental justice. The primary focus of the program is to provide user-supported tools promoting the latest science in support of managing urban forests and the communities that depend on the benefits that these forests provide.

i-Tree software suite: https://www.itreetools.org/

Objectives

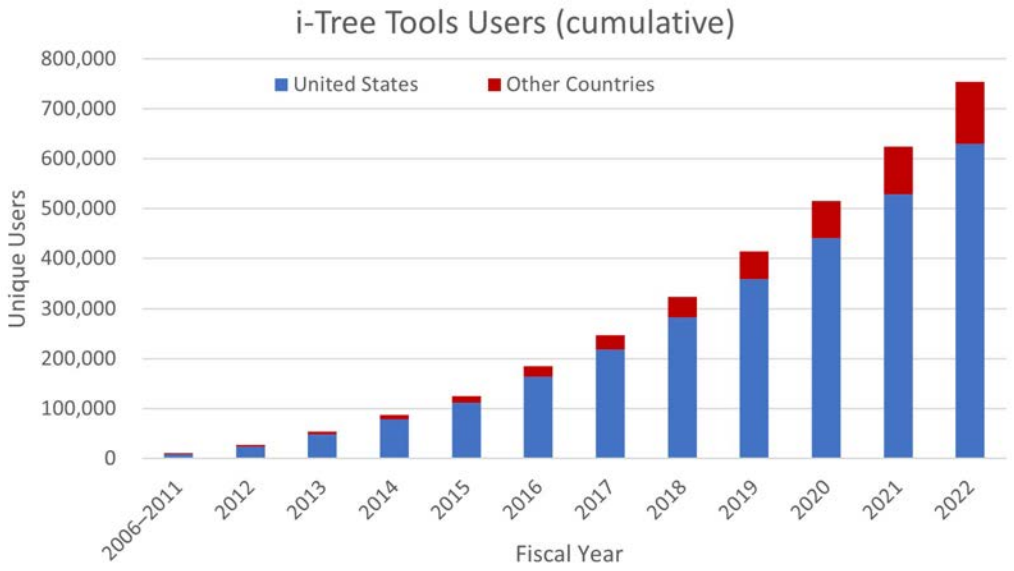
1. **Lead in the delivery of tools** supported by the latest science that will continue to drive, promote, and support the tree equity and environmental justice conversation and associated programs while serving as the international urban forest management standard.
2. **Enhance customer service** by expanding the existing user base at the local level, enabling potential users to advocate for their local urban forests from where they are regardless of their level of familiarity of urban forest science. Tool design, delivery, and output will meet the needs of both new and experienced users.
3. **Provide free user support** and **develop free training** to enhance tool usability for all users regardless of background and experience.

FY 2022 Accomplishments and Milestones

Accomplishments:

- Planned and delivered three International i-Tree Town Hall listening sessions
- Developed and signed a new 5-year memorandum of understanding with the Davey Tree Expert Company, including a signing ceremony with Forest Service Chief Randy Moore
- Released the OurTrees Tool—a quick "go to your phone and get answers about your community" tool for tree canopy assessment
- Consolidated tools to six core Individual Tree and Canopy Assessment tools, ranked from easy to advanced
- Made major performance improvements in i-Tree Eco with the changeover to SQLite, including faster, better installation behavior and the ability to handle much bigger tree inventory datasets (several hundred thousand trees now)
- Made large amounts of back-end improvements on all the web tools for increased performance and stability

Figure 21. Growth in i-Tree tool users over time.



- Helped design and implement a data science camp field day for Washington, DC, high school students in collaboration with local nonprofit organizations

Current projects and next steps:

- Addition of Global Precipitation Model rainfall data to i-Tree Eco to make up for poor weather data at various locations around the globe (with forthcoming release)
- Addition of hydrological tree benefits to i-Tree Eco's Forecast module (with forthcoming release)
- Long-awaited i-Tree Eco Plot Importer (with forthcoming release)
- Landscape performance improvements (with forthcoming release)
- Continued development of a Stormwater Calculator Tool
- Continued development of a National Urban FIA reporting template
- Continued implementation of suggestions from the 2022 i-Tree Town Hall listening sessions
- Expansion of the membership and role of the i-Tree Executive Committee and further development of user feedback loops

Financial Status and Partners

FY 2022 funding: $703,500 (FIA S&E)

Annual operational funds required: $850,000, plus the cost of application science and technical updates. Actual 2022 funding received was $1,524,000 from Forest Service R&D and $100,000 for training from Forest Service State, Private, and Tribal Forestry, Urban and Community Forestry.

Farm Bill request: None

Partnerships: Davey Tree Expert Company, The Arbor Day Foundation, Society of Municipal Arborists, International Society of Arboriculture, Casey Trees, and State University of New York College of Environmental Science and Forestry. In FY 2022, funding support was also provided by the Great Lakes Restoration Initiative and the Korean National Institute of Forest Science.

FY 2022 Publications and Deliverables

Cavender-Bares, J.M.; Nelson, E.; Meireles, J.E.; Lasky, J.R.; MitevaI, D.A.; Nowak, D.J.; Pearse, W.D.; Helmus, M.R.; Zanne, A.E.; Fagan, W.F.; Mihiar, C.; Muller, N.Z.; Kraft, N.J.B.; Polasky, S. 2022. The hidden value of trees: quantifying the ecosystem services of tree lineages and their major threats across the continental US. PLOS Sustainability and Transformation. 1(4): e0000010. https://doi.org/10.1371/journal.pstr.0000010.

Nowak, D., contributing author. 2022. Urban systems and other settlements. In: **Lwasa, S.; Seto, K.C.; Bai, X.; Blanco, H.; Gurney, K.R.; Kılkış, Ş.; Lucon, O.; Murakami, J.; Pan, J.; Sharifi, A.; Yamagata, Y.** IPCC, 2022: Climate change 2022: mitigation of climate change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla et al., eds.]. Cambridge, UK, and New York: Cambridge University Press: 861–952. https://doi.org/10.1017/9781009157926.010.

Lagrosa, J.J.; Zipperer, W.C.; Andreu, M.G. 2022. An ecosystem services-centric land use and land cover classification for a subbasin of the Tampa Bay Watershed. Forests. 13(5): 745. https://doi.org/10.3390/f13050745.

Meléndez-Ackerman, E.J.; Pérez, M.E.; Pou, A.B.; Caballero, E.C.; Cortés, L.; Bonilla-Duarte, S.; Bauer, G.; Martínez Guridy, J.M.; Arendt, W.J.; Nowak, D.J. 2022. A social-ecological approach to studying variation in urban trees and ecosystem services in the National Municipal District of Santo Domingo, Dominican Republic. Frontiers in Sustainable Cities. 3: 764073. https://doi.org/10.3389/frsc.2021.764073.

Nowak, D.J.; Ellis, A.; Greenfield, E.J. 2022. The disparity in tree cover and ecosystem service values among redlining classes in the United States. Landscape and Urban Planning. 221: 104370. https://doi.org/10.1016/j.landurbplan.2022.104370.

Nowak, D.J.; Greenfield, E.J.; Ellis, A. 2022. Projecting urban forest threats across the conterminous United States. Journal of Forestry. 120(6): 676–692. https://doi.org/10.1093/jofore/fvac019.

Ramon, M.; Ribeiro, A.P.; Theophilo, C.Y.S.; Moreira, E.G.; Barbosa de Camargo, P.; Pereira, C.A.B.; Saraiva, E.F.; Tavares, A.R.; Dias, A.G.; Nowak, D.; Ferreira, M.L. 2022. Assessment of four urban forest as environmental indicator of air quality: a study in a Brazilian megacity. Urban Ecosystems. 26: 197–207. https://doi.org/10.1007/s11252-022-01296-7.

National Resource Use Monitoring

The mission of the national resource use monitoring program (formerly known as the timber products monitoring portfolio) is to deliver a nationally consistent program that collects, processes, and reports timber products output (TPO) and harvest utilization (HU) data. The effort includes data related to harvests for industrial products, logging and mill residue, residential fuelwood, and other removals.

The **TPO** surveys gather information from primary wood-processing facilities to quantify the use of roundwood and mill residue by geographic location, tree species, and timber product type.

The **HU** studies collect data at active logging sites to identify the tree species, tree size, and primary product destination of the volume removed, as well as the felled volume left onsite (logging residue).

Objectives

1. **Annual TPO:**
   a. Implement an annual sample design across all participating States (figure 22).
   b. Enhance the national compilation system to adapt to the sample design.
   c. Develop a strategy to improve residential fuelwood estimates.
2. **Data accessibility:**
   a. Develop TPO data and analysis tools to replace the legacy TPO data retrieval system.
   b. Develop a national factsheet series.

FY 2022 Accomplishments and Milestones

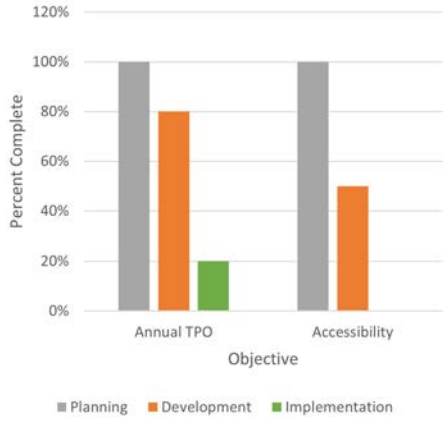
- All FIA regions are collecting mill data on an annual basis using national sample design.
- A tool replacing the legacy TPO data retrieval system is functional and available at TPO Data Reporting Tool.
- A proposal was submitted requesting language indicating confidentiality of FIA's mill survey data in the next Farm Bill.
- Analysis of survey item nonresponse was submitted for publication.

Financial Status and Partners

FTEs: 11.45 (8 SRS, 3 NRS, and 0.45 PNW and RMRS) and 9.5 (external cooperators)

Partnerships: University of Montana, Bureau of Business and Economic Research (joint venture agreement for PNW and RMRS program); University of Massachusetts Amherst (NRS mill data collection); and multiple State forestry agencies across southern and northern regions (assisting with data collection)

Figure 22. Development status of timber products monitoring objectives.



TPO = timber products output.

FY 2022 Publications and Deliverables

Hayes, S.W.; Townsend, L.; Dillon, T.; Morgan, T.A.; Shaw, J.D. 2021. Montana's forest products industry and timber harvest, 2018. Resour. Bull. RMRS-35. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 54 p. https://doi.org/10.2737/RMRS-RB-35.

Marcille, K.C.; Berg, E.C.; Morgan, T.A.; Christensen, G.A. 2021. Alaska's forest products industry and timber harvest, 2015: part 1–4. Resour. Bull. PNW-271. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 45 p. https://www.fs.usda.gov/research/treesearch/63556.

Simmons, E.A.; Marcille, K.C.; Lettman, G.J.; Morgan, T.A.; Smith, D.C.; Rymniak, L.A.; Christensen, G.A. 2021. Oregon's forest products industry and timber harvest 2017 with trends through 2018. Gen. Tech. Rep. PNW- 997. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 63 p. https://www.fs.usda.gov/research/treesearch/63436.

Simmons, E.A.; Berg, E.C.; Morgan, T.A.; Hayes, S.W.; Christensen, G.A. 2022. Logging utilization in Alaska, 2016–2019. Resour. Bull. PNW-272. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 21 p. https://doi.org/10.2737/PNW-RB-272.

Winn, M.F.; Gray, J.A.; Cooper, J.A.; Bentley, J.W. 2022. Southern pulpwood production, 2020. Resour. Bull. SRS-234. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 13 p. https://doi.org/10.2737/SRS-RB-234.

"Timber Product Output and Use" factsheets:

Alabama, 2020 (Resource Update FS-346; https://doi.org/10.2737/FS-RU-346)

Arkansas, 2020 (Resource Update FS-347; https://doi.org/10.2737/FS-RU-347)

Florida, 2020 (Resource Update FS-348; https://doi.org/10.2737/FS-RU-348)

Georgia, 2020 (Resource Update FS-349; https://doi.org/10.2737/FS-RU-349)

Kentucky, 2020 (Resource Update FS-350; https://doi.org/10.2737/FS-RU-350)

Louisiana, 2020 (Resource Update FS-351; https://doi.org/10.2737/FS-RU-351)

Mississippi, 2020 (Resource Update FS-352; https://doi.org/10.2737/FS-RU-352)

North Carolina, 2020 (Resource Update FS-353; https://doi.org/10.2737/FS-RU-353)

Oklahoma, 2020 (Resource Update FS-354; https://doi.org/10.2737/FS-RU-354)

South Carolina, 2020 (Resource Update FS-355; https://doi.org/10.2737/FS-RU-355)

Tennessee, 2020 (Resource Update FS-356; https://doi.org/10.2737/FS-RU-356)

Virginia, 2020 (Resource Update FS-357; https://doi.org/10.2737/FS-RU-357)

Data Delivery: TPO toolkit (https://www.fs.usda.gov/research/programs/nrum) updated with southern 2020 data.

National Woodland Owner Survey

The purpose of the NWOS is to advance the science, monitoring, and reporting of private forest ownerships across the United States by quantifying:

- Who owns the forests of the United States
- Why they own them
- How they have used them in the past
- What they intend to do with them in the future

The NWOS conducts separate surveys or modules for family forest ownerships, corporate forest ownerships, urban landowners, and forest ownerships on U.S. protectorates and territories.

National, regional, and State summaries of family forest (10+ acres) ownership characteristics: https://www.fia.fs.usda.gov/nwos/results

NWOS Dashboard: https://www.fs.usda.gov/research/programs/fianwos#pubs

Objectives

1. **Plan and develop** the NWOS based on stakeholder input.
2. **Implement** all NWOS modules in an effective and efficient manner.
    a. Base: 10,000 contacts per year across the United States.
    b. Corporate: Census of large corporate forest owners once every 5 years.
3. **Distribute** the results of the NWOS through presentations, publications, online tools, and responses to individual stakeholders.

FY 2022 Accomplishments and Milestones

1. **Planning and development:**
    a. Convened national user group meeting
    b. Submitted Office of Management and Budget review package for next iteration
2. **Implementation:**
    a. No landowners contacted due to review process and printing delays; missed landowners will be contacted in FY 2023
    b. Processed data for landowners contacted in FY 2021
3. **Distribution:**
    a. Published reports and online tool for last full iteration of base module
    b. Initial reports from current iterations of the base, urban, and islands modules underway
    c. Wrote numerous journal articles, delivered presentations, and fulfilled stakeholder requests

Financial Status and Partners

Current funding: $650,000 (Forest Service)

FTEs: Two Forest Service and three external cooperators

Farm Bill request: $3.1 million per year (includes full implementation of modules listed above plus urban, islands, Tribal, and public modules)

Selected partnerships: American Forest Foundation, Harvard Forest, NCASI, Society of American Foresters, State forestry agencies, University of Massachusetts Amherst

FY 2022 Publications and Deliverables

Butler, B.J.; Butler, S.M.; Floress, K. 2023. Studies of family forest owners in the USA: a systematic review of literature from 2000 through 2019. Small-scale Forestry. 22: 1–35. https://doi.org/10.1007/s11842-022-09529-5.

Butler, B.J.; Caputo, J.; Henderson, J.D.; Pugh, S.A.; Riitters, K.; Sass, E.M. 2022. An assessment of the sustainability of family forests in the U.S.A. Forest Policy and Economics. 142: 102783. https://doi.org/10.1016/j.forpol.2022.102783.

Butler, B.J.; Caputo, J.; Henderson, J.D.; Pugh, S.; Riitters, K.; Sass, E.M. 2022. Cross-boundary sustainability: assessment across forest ownership categories in the conterminous USA using the Montréal Process Criteria and Indicators framework. Forests. 13(7): 992. https://doi.org/10.3390/f13070992.

Hollins, K.; Chawla, P.; Butler, S.M. 2023. Social marketing works: results from ten years of tools for engaging landowners effectively trainings. Journal of Forestry. 121(1): 84–94. https://doi.org/10.1093/jofore/fvac029.

Sass, E.M.; Caputo, J.; Butler, B.J. 2022. United States family forest owners' awareness of and participation in carbon sequestration programs: initial findings from the USDA Forest Service National Woodland Owner Survey. Forest Science. 68(5–6): 447–451. https://doi.org/10.1093/forsci/fxac026.

Shanafelt, D.W.; Caputo, J.; Abildtrup, J.; Brett, B.J. 2022. If a tree falls in a forest, why do people care? An analysis of private family forest owners' reasons for owning forest in the United States National Woodland Owner Survey. Small-scale Forestry. 22: 303–321. https://doi.org/10.1007/s11842-022-09530-y.

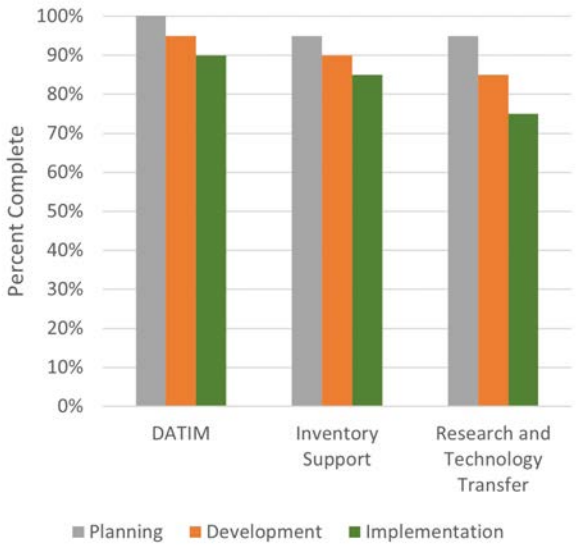
National Inventory and Monitoring Applications Center

The National Inventory and Monitoring Applications Center (NIMAC) is responsible for providing technical assistance on all aspects of forest inventory for FIA, as well as NFS, Federal agencies, State governments, and other countries. Inventory and monitoring goals are accomplished through development of leading-edge forest ecosystem monitoring methods and tools designed for use by land managers across ownerships at landscape to national scales.

Objectives

1. Continue maintenance of DATIM.
2. Provide technical assistance, annual data processing, and analytical tool support for forest inventories conducted by State and Federal agencies.

Figure 23. Development status of NIMAC objectives.



DATIM = Design and Analysis Toolkit for Inventory and Monitoring; NIMAC = National Inventory and Monitoring Applications Center.

3. Conduct research and technology transfer that benefits forest inventory and monitoring efforts around the globe across various spatial scales and diverse ranges of objectives.

FY 2022 Accomplishments and Milestones

- **Design and Analysis Toolkit for Inventory and Monitoring (DATIM):** The National Forest System was unable to continue funding DATIM in FY 2022. FIA continued to fund NIMAC for the ongoing maintenance and further development of DATIM in FY 2022 (figure 23). DATIM allows users to create custom, static analyses that can then be tailored by adding spatial attributes using geographic information system (GIS) software. Those spatial attributes can then be incorporated into analytical queries. In FY 2022, version 17.0 was the most recent release, with subsequent versions already planned for release early in FY 2023. DATIM is publicly available at: www.fs.usda.gov/emc/rig/DATIM/index.shtml.
- **State and Federal agency forest inventory technical assistance:** NIMAC assisted three State-sponsored annual forest inventories (Indiana, Wisconsin, and Missouri) and forest inventory projects on 22 DOI U.S. Fish and Wildlife Service refuges. NIMAC also had representation on the Pennsylvania State forest land Continuous Forest Inventory review/redesign committee.
- **Research:** NIMAC completed a number of forest inventory and monitoring research projects during FY 2022 (see publications below).

Financial Status and Partners

Current funding: $56,000 (external sources)

Partnerships: NFS; U.S. Fish and Wildlife Service; Wisconsin Department of Natural Resources; Indiana Department of Natural Resources; Missouri Department of Conservation; SilvaCarbon; Forest Service International Programs; University of Nevada, Las Vegas; Southern Utah University

FY 2022 Publications and Deliverables

DATIM versions 15.1, 16.0, 16.1, and 17.0 were released during FY 2022.

Dettmann, G.T.; MacFarlane, D.W.; Radtke, P.J.; Weiskittel, A.R.; Affleck, D.L.R.; Poudel, K.P.; Westfall, J. 2022. Testing a generalized leaf mass estimation method for diverse tree species and climates of the continental United States. Ecological Applications. 32(7): e2646. https://doi.org/10.1002/eap.2646.

Edgar, C.B.; Westfall, J.A. 2022. Timing and extent of forest disturbance in the Laurentian Mixed Forest. Frontiers in Forests and Global Change. 5: 963796. https://doi.org/10.3389/ffgc.2022.963796.

Lamb, R.; Hurtt, G.C.; Boudreau, T.J.; Campbell, E.; Sepúlveda Carlo, E.A.; Chu, H.-H.; de Mooy, J.; Dubayah, R.O.; Gonsalves, D.; Guy, M.; Hultman, N.E.; Lehman, S.; Leon, B.; Lister, A.J.; Lynch, C.; Ma, L.; Martin, C.; Robbins, N.; Rudee, A.; Silva, C.E.; Skoglund, C.; Tang, H. 2021. Context and future directions for integrating forest carbon into sub-national climate mitigation planning in the RGGI region of the U.S. Environmental Research Letters. 16: 063001. https://doi.org/10.1088/1748-9326/abe6c2.

Ma, L.; Hurtt, G.; Tang, H.; Lamb, R.; Campbell, E.; Dubayah, R.; Guy, M.; Huang, W.; Lister, A.; Lu, J.; O'Neil-Dunne, J.; Rudee, A.; Shen, Q.; Silva, C. 2021. High-resolution forest carbon modeling for climate mitigation planning over the RGGI region, USA. Environmental Research Letters. 16(4): 045014. https://doi.org/10.1088/1748-9326/abe4f4.

Ma, L.; Hurtt, G.C.; Tang, H.; Lamb, R.; Campbell, E.; Dubayah, R.O.; Guy, M.; Huang, W.; Lu, J.; Rudee, A.; Shen, Q.; Silva, C.E.; Lister, A.J. 2022. Forest aboveground biomass and carbon sequestration potential, northeastern USA. Oak Ridge, TN: Oak Ridge National Laboratory, Distributed Active Archive Center for Biogeochemical Dynamics. https://doi.org/10.3334/ORNLDAAC/1922.

Westfall, J.A.; Coulston, J.W.; Gray, A.N.; Shaw, J.D. 2022. Biomass increases in U.S. forests as FIA implements new tree volume, biomass, and carbon models. Forestry Source. 27(8): 14.

Westfall, J.A. 2022. An estimation method to reduce complete and partial nonresponse bias in forest inventory. European Journal of Forest Research. 141: 901–907. https://doi.org/10.1007/s10342-022-01480-6.

Westfall, J.A.; Coulston, J.W. 2022. Estimating change in annual timber products output using a stratified sampling with certainty design. Environmental and Ecological Statistics. 29(2): 415–431. https://doi.org/10.1007/s10651-022-00533-8.

Westfall, J.A.; Edgar, C.B. 2022. Addressing nonresponse bias in urban forest inventories: an estimation approach. Frontiers in Forests and Global Change. 5: 895969. https://doi.org/10.3389/ffgc.2022.895969.

Westfall, J.A.; Schroeder, T.A.; McCollum J.M.; Patterson, P.L. 2022. A spatial and temporal assessment of nonresponse in the national forest inventory of the U.S. Environmental Monitoring and Assessment. 194: 530. https://doi.org/10.1007/s10661-022-10219-0.

Westfall, J.A.; Wilson, B.T. 2022. Nonresponse bias in change estimation: a national forest inventory example. Forestry 95(3): 301–311. https://doi.org/10.1093/forestry/cpab056.

Zhao, D.; Lynch, T.; Westfall, J.A.; Coulston, J.W. 2022. Additional biomass estimation alternatives: nonlinear two- and three-stage least squares and full information maximum likelihood for slash pine. Canadian Journal of Forest Research. 52(5): 780–793. https://doi.org/10.1139/cjfr-2021-0335.

Digital Engagement

The mission of the digital engagement portfolio is to radically reorient analysis, reporting, and delivery through:

- Deep collaboration with agency and external partners and stakeholders to develop and publish relevant and authoritative data supporting their identified needs
- Analytical and reporting application development relying upon commercial off-the-shelf (COTS) solutions that leverage agency and partner competencies and investments, reduce development times, and increase the potential for collaboration
- Deployment of a secure cloud computing environment providing scalable resources necessary to store, process, and share analyses conducted at national scales

Objectives

1. Place the Analytics and Decision Support (ADS) on a permanent CIO funding line.
2. Continue push for flexible computing, decision-support, and reporting technologies.
3. Leverage cooperating research and development agreement (CRADA) with Esri for content and application production.
4. Set direction and deploy diverse national reporting applications.
5. Develop the next version of the national One-Click reporting application.
6. Drive innovation in national tabling tools.
7. Continue collaboration across portfolios.
8. Update 2018 BIGMAP raster data products.
9. Identify new partners for continued build-out of issue-focused applications.
10. Finalize new blanket purchasing agreement with Esri to support ongoing digital engagement priorities.

FY 2022 Accomplishments and Milestones

- Moved BIGMAP (pilot project) to full production in an FIA- and CIO-managed cloud environment (analytical decision support or ADS) (figure 24)
- Received Director's Award for "Making a Significant Research Contribution in the Inventory and Monitoring Sciences"
- Formally established digital engagement science team in NRS FIA within the Information Management section
- Formally established digital engagement science team in SRS FIA within the Analysis Resources section
- Delivered multiple contributed and invited presentations at the Esri International User Conference
- Delivered high-quality raster products to the Esri Living Atlas of the World—the premiere repository for geospatial data
- Completed multiple digital 5-year State reports
- Aided in identifying and resolving 30+ software bugs in Esri core and Esri Raster Analytics software
- Developed TPO BIGMAP Wood Flow dashboard
- Funded and hired a post-doctoral researcher to work across SRS research work units on BIGMAP and REGEN modeling work
- Developed Small Area Estimation GeoSpatial Toolbox

Note: Some links currently require login credentials, so demonstrations are available upon request.

Figure 24. Status of digital engagement portfolio milestones.

Financial Status and Partners

Current funding: Over $1 million, including $500,000 invested in the BIGMAP environment, $443,000 in universities, and $125,000 in GTAC. These investments continue to support partners and stakeholders, including:

- **FIA analysts**, who improve the technical capacity for raster data processing and reporting
- **Agency stakeholders**, who access the authoritative geospatial raster data for forest planning
- **External partners**, who use high-profile tools supporting sustainability assessments by multinational brands (e.g., Mars, McDonald's) and their forest products supply chains

Additional resources would expand capacity to implement these promising products and the rate of delivery.

FTEs: A total of 11 Forest Service employees, including 5 scientists and 6 technical experts

Partners: Esri, Purdue University, Virginia Tech, The Wilderness Society, Harvard Forest, Locana, Xentity Corporation, Forest Service FHAAST, GTAC, Forest Service Center for Forest Restoration and Management

FY 2022 Publications and Deliverables

Perry, C.H.; Finco, M.V.; Wilson, B.T., eds. 2022. Forest atlas of the United States. FS-1172. Washington, DC: U.S. Department of Agriculture, Forest Service. 54 p. https://www.fs.usda.gov/research/treesearch/64468.

One-Click factsheets:

- 36 annual State factsheets published in SRS and NRS
- 36 sets of annual tables published in SRS and NRS
- 12 annual TPO State factsheets published in SRS and NRS
- 12 sets of TPO annual tables published in SRS and NRS
- Bourbon Barrel Oak Availability tool

- The Mysteries of Bourbon: How Forestry, Mapping Support a Changing Industry (Esri blog post on Bourbon Barrel Oak Availability tool)
- Discover White Oak Suitability with the Bourbon Barrel Oak Availability Tool (ArcGIS blog post on tool use)

Community Engagement

The purpose of the community engagement team is to facilitate efficiency through increased communication, product sharing, and collaboration between units, and to maintain relevancy by showcasing FIA products both internally and externally. Additionally, the team makes concerted efforts to outreach to and recruit diverse candidates for open positions.

Objectives

- Increase internal communication by facilitating information sharing between team members and via newsletters and Microsoft Teams channel.
- Increase external communication by updating the national website, increasing social media presence, and other means.
- Showcase FIA products through social media posts and informational videos.

Ongoing efforts include:

- Continue updates to the FIA Resource Center Microsoft Teams channel to ensure its relevance and usefulness.
- Update content for the national FIA website.
- Continue outreach efforts to underserved communities for diversity recruits.
- Continue to provide and increase social media content reflecting FIA accomplishments (#USDA_FIA).
- Maintain and facilitate contact with station communication shops.
- Update FIA staff and partners on the FIA Program through a newsletter shared internally and on the national website.

FY 2022 Accomplishments and Milestones

- Communicated necessary information regarding updates on the status of upcoming web modernization activities.
- Created an urgent notifications and bulletins alert on the national FIA website to keep users updated on critical changes and upcoming releases.
- Updated several factsheets (using new 508-compliant factsheet template) to provide more timely and relevant information within all factsheets available on the national FIA website.
- Grew and increased use of the FIA Resource Center Microsoft Teams channel.
- Updated the FIA outreach plan (i.e., communication plan) by identifying issues and making suggestions to address those issues.
- Reported on FIA engagement with the public and opportunities for student engagement in the program.
- Provided necessary information internally regarding national issues moving through the change management process.
- Began development of a national glossary of terms for the national FIA website to improve user comprehension.
- Produced a monthly newsletter featuring FIA national portfolios, program news, change management, and community engagement events.

Financial Status and Partners

Current funding and capacity for FIA Program community engagement activities: No program funding is invested in this area or work other than the S&E of the team.

FTEs: The time invested by the eight FIA members of this team is equivalent to one FTE.

Spanning Cultures

FIA engagement with communities is a critical component to program success. FIA crews are based in rural, local, and/or Indigenous communities for months at a time. This requires the program to build critical relationships and draw a connection between data collected and community needs and priorities. The FIA Program has an ongoing citizen science component to help cultivate relationships between Indigenous communities and FIA crews, including FIA, State, and contracted personnel. FIA staff also coordinate with an array of partners to complete fieldwork and host a wide variety of community presentations at events, schools, and community centers, and via webinars.

Objectives

1. **Outreach:** Provide written materials (posters, brochures, flyers) to community members to provide information about FIA and updates on local project work.
2. **Collaborate:** Work closely with Tribal coalitions, Tribes, and Alaska Native Corporations to understand needs, share data, and access lands for field data collection.
3. **Engage:** Increase engagement and communication with Tribes and other Indigenous communities through the activities of a national team consisting of Tribal liaisons from each FIA region.

FY 2022 Accomplishments and Milestones

- National FIA Tribal team continued to collaborate and share across regions including welcoming new Tribal liaisons to NRS and PNW and inviting them to team meetings.
- Developed a plan for updated outreach materials specifically for Indigenous communities and other Tribal entities.
- Developed two sessions of Tribal-related topics for the 2022 FIA Science Stakeholder Meeting, including seven talks that touched on using FIA data to support Tribal management goals, sustainability of culturally important forest products, and timber allotment assessment.
- Continued participating in the NFS Region 9 Tribal Homelands Working Group.
- National Tribal team consisting of Tribal liaisons from each FIA region continued to plan for increased engagement and communication with Tribes and other Indigenous communities. This team also began coordinating with research station Tribal liaisons.
- Delivered summaries of the data collected from plots on Tribal lands to numerous Tribes.
- Led conversations with the RMRS Tribal liaison to discuss opportunities for future recruitment of Tribal members and the development of analysis and reporting products that meet the needs of Tribal foresters.
- Continued partnering with Pacific Islands local governments in six culturally unique jurisdictions, working with diverse staff that speak over nine different languages.
- Continued ongoing partnership with the Tanana Chiefs Conference to implement forest inventory in Interior Alaska.
- Enhanced opportunities for interns and staff throughout the Pacific Islands to build on their knowledge of forest monitoring through a newly implemented joint venture agreement with the Micronesia Conservation Trust.
- Successfully partnered with Tribes across the Nation to grant access to FIA plots on Tribal lands. This included 6 entities in the Pacific Northwest, 20 in the North, 10 in the South, and 23 in the Rocky Mountains.

Financial Status and Partners

Current funding: Core function of national FIA Program, so there is no separate funding. Deliverables listed below may have resulted from individually funded projects.

Partnerships: Tanana Chiefs Conference, Pacific Islands local governments, Northern Tribal Homelands Working Group, Ojibwe Tribes of the Great Lakes, Bad River Tribe, Great Lakes Indian Fish & Wildlife Commission, Micronesia Conservation Trust, and DOI Bureau of Indian Affairs

FY 2023 Anticipated FIA Program Direction

An increase in Federal funding has allowed the FIA Program to make investments in increasing support for the TPO survey and small area estimation techniques and application development, as well as technological investments such as high-precision GPS and increased software development support. Since Forest Service R&D S&E allocations remained unchanged from 2022, much of the funding is being invested into existing and new agreements with States, universities, and other FIA stakeholders.

The FIA Program will continue inventory operations in all 50 States as well as U.S. territories and affiliated islands with focus on continuing efforts to catch up on plot data collection due to delays incurred from the COVID-19 pandemic, natural disasters, hiring of employees, and contracting of plot measurement. FIA will take every advantage it can to use hiring authorities, participate in hiring events, and hire multiple positions (sometimes across more than one FIA unit) through single advertisements. FIA is standardizing position descriptions across FIA units to create efficiencies in hiring and ensure equitable pay across FIA units. It is expanding its outreach to contractors and developing factsheets for becoming a contractor for field data collection. Additionally, FIA field crews, both Federal and State, are traveling between units to complete priority plot measurements. By the end of 2023, all 2020 and 2021 plots and most 2022 field plots are anticipated to be completed.

Other major activities planned for 2023 and beyond include:

- Releasing FIA Tableau Dashboard which provides semiannual reporting of many tables found in the annual FIA Business Report
- Responding to the President's Executive Order 14072 on Strengthening the Nation's Forests, Communities, and Local Economies with data, expertise, and analytics, especially in collaboration with NFS to provide estimates of old growth and mature forest on Federal land
- Continuing to modernize the program's TPO data management, operations, and reporting
- Continuing to develop user-friendly applications with small area estimation techniques that will leverage access to new computing libraries, including nationwide runs at improved speed, automated reporting, and landscape-scale biomass and carbon estimates
- Continuing to populate FIA Urban DataMart and My City's Trees applications as urban data become available
- Modernizing websites
- Increasing accessibility by ensuring FIA products are 508-compliant

Accomplishment of these goals will depend on the continued strong support from partners and their commitment to an efficient and productive FIA, and adequate funding for full program implementation.

Long-Term Strategic Direction

The FIA Program initially intended to implement the "Strategic Plan for Forest Inventory and Analysis" by achieving a base Federal program of sampling 10 percent of forested base plots per year in the West and 15 percent per year in the East by FY 2003. In late 2013, FIA drafted a new strategic plan to update the 2007 plan, in response to the 2014 Farm Bill and its requirements for FIA. This strategic plan was delivered to the agency and USDA in mid-2014, with a final submission delivered to Congress in March 2015. The FIA strategic plan was developed in cooperation with partners and stakeholders and identifies the base program, potential enhancements to the base, priorities for new programs, and areas for increased flexibility in the future. Since the plan is now a decade old, FIA anticipates revising it soon.

Passage of the 2014 Farm Bill and FIA Requirements

On February 7, 2014, Congress passed the Agricultural Act of 2014 (Public Law 113–79), also referred to as the 2014 Farm Bill. Section 8301 of this legislation required the FIA Program to revise its previous strategic plan, approved by Congress in 1999, and submit the new plan to the Committee on Agriculture of the House of Representatives and the Committee on Agriculture, Nutrition, and Forestry of the Senate within 180 days of the passage of the law.

Farm Bill provisions that were addressed in the revised (current) strategic plan:

1. Complete the transition to a fully annualized forest inventory program and include inventory and analysis of Interior Alaska.
2. Implement an annualized inventory of trees in urban settings, including the status and trends of trees and forests, and assessments of their ecosystem services, values, health, and risk from pests and diseases.
3. Report information on renewable biomass supplies and carbon stocks at the local, State, regional, and national levels, including by ownership type.
4. Engage State foresters and other users of FIA information in reevaluating the list of core data variables collected on FIA plots, with an emphasis on demonstrated need.
5. Improve the timeliness of the TPO program and accessibility of the annualized information on that database.
6. Foster greater cooperation among the FIA Program, research station leaders, State foresters, and other users of FIA information.
7. Promote availability of and access to non-Federal resources to improve information analysis and information management.
8. Collaborate with the USDA Natural Resources Conservation Service; NASA; U.S. Department of Commerce, National Oceanic and Atmospheric Administration; and DOI U.S. Geological Survey to integrate remote sensing, spatial analysis techniques, and other new technologies in the FIA Program.
9. Understand and report on changes in land cover and use.
10. Expand existing programs to promote sustainable forest stewardship through increased understanding, in partnership with other Federal agencies, of the more than 10 million private forest owners, their demographics, and the barriers to forest stewardship.
11. Implement procedures to improve the statistical precision of estimates at the sub-State level.

Passage of the 2018 Farm Bill, FIA Requirements, and Ongoing Implementation

On December 11, 2018, Congress passed the 2018 Farm Bill. Section 8632 directed the FIA Program to find efficiencies through the improved use and integration of remote sensing technologies and to partner with States and interested stakeholders.

To comply with congressional direction, FIA scientists continue to investigate and develop promising techniques and applications of remote sensing for improving estimations of forest resources and collaborate with other researchers in the geospatial and remote sensing community. A long-term project called BIGMAP (Big Data, Mapping, and Analytics Platform), entered the full production phase, developed six major digital products, and will deliver FIA PlotMap, a single-plot imputation product that aids users to downscale the FIADB to a 30-m resolution in FY 2024. BIGMAP incorporates the capabilities of Esri Raster Analytics and ArcGIS Enterprise to support the integration of plot data and satellite data in order to add value to the FIA Program.

As the Federal nationwide lidar acquisition program (3D Elevation Program (3DEP), led by U.S. Geological Survey) continues to make progress toward a complete coverage for

all land in the conterminous United States, FIA is supporting lidar collection and exploring how to best incorporate lidar data to improve estimation that has the potential to yield substantial benefits, especially in small area estimation of biomass and carbon. Additionally, the FIA Program seeks to capitalize on these resources along with photogrammetrically derived point clouds including NAIP-3D by extracting lidar point clouds over fuzzed FIA plots to facilitate new and ongoing research to develop tree canopy height products and to meet additional needs for characterizing forest structure, including recovery from disturbance and assessment of trees-out-of-forest conditions.

Since 2016, FIA has supported and advanced a methodology designed to efficiently inventory the boreal forests of Interior Alaska, a region that occupies about 114 million acres. To increase the precision and efficiency of the inventory estimates, as mandated by Congress, the relatively sparse field plot sample (one plot every 30,000 acres rather than one plot every 6,000 acres as in the rest of the FIA base grid) was augmented with strip samples (covering 5 percent of the land area) of remotely sensed data collected from the G-LiHT integrated system. The airborne imaging system comprises several sensors that combine lidar, hyperspectral imaging spectroscopy, thermal imagery, and high-resolution multispectral imagery. G-LiHT allows for the mapping of composition, structure, and function of terrestrial ecosystems at high resolution. This is a significant step toward improving the use and integration of remote sensing technologies in the FIA Program.

FIA continues to prioritize and enhance the collaboration with States, Tribes, Federal agencies, and universities to improve and efficiently provide assessment and analysis of fundamental information for the Nation's forest resources and investments. The Government Performance and Results Act (GPRA) of 1993 directs Federal entities to develop long-term goals and performance measures to monitor progress toward those goals. Although intended for application at the agency level, the GPRA framework also provides an excellent tool for guiding progress for FIA. Table 6 shows key goals, performance measures, and benchmarks for the FIA Program for FYs 2013 through 2022 and targets for a fully implemented program. As discussed above, data collection, publishing of data, and subsequent analysis are behind due to data collection lags during the COVID-19 pandemic.

Table 6. National performance measures of the FIA Program, FYs 2013–2022.

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Target
Goal	**Performance measure**	*Percent*										
Include 100 percent of U.S. forest lands in the FIA sample population	Percentage of Nation's forest land included in the target FIA sample population	100	100	100	100	100	100	100	100	100	100	100
Keep fieldwork current	Percentage of States actively engaged in the annualized inventory program	100	100	100	100	100	100	100	100	100	100	100
Make data accessible to national forest customers	Percentage of national forest land for which FIA data are loaded into NRIS	100	100	100	100	100	100	100	100	100	100	100
Keep analysis current	Percentage of States with FIA State report less than 6 years old	88	90	94	96	96	96	90	94	88	75	100
Keep online data current	Percentage of States with FIA data available online less than 2 years old	92	96	96	96	96	96	88	90	88	45	100
Partners' participation	Partners' financial contributions expressed as percentage of total program funds	10	10	10	12	16	16	13	14	16	13	20

FIA = Forest Inventory and Analysis; FY = fiscal year; NRIS = Natural Resource Information System.

Portage Lake, Chugach National Forest, AK. USDA Forest Service photo by Tyra Olstad.

Conclusions

The FIA Program continues to operate in an era of partnership and collaboration in which Federal and State agencies and other cooperators and stakeholders work together to plan, manage, implement, and continually improve the program. FIA is gathering and disseminating information on a wide array of ecological attributes, while continuing to serve its traditional customers who require timely information on forest resources. FIA is increasing the timeliness of surveys and reporting to provide a continually updated, publicly accessible information base that includes meaningful reports, analyses, and elemental data for others to use. FIA is exploring and leveraging the latest technologies, including remote sensing, to expand the scope of its products and to deliver them more efficiently. As these annual business reports demonstrate, FIA is also openly reporting on financial information, progress, accomplishments, successes, and challenges.

In summary, the FIA Program is committed to working collaboratively with all partners to deliver the best program possible with the available resources. This report is intended to provide a transparent view of the business practices of the FIA Program, to help FIA improve business practices, and to provide information to partners to help improve the program with feedback.

Glossary of Terms Used in Appendixes

- **base Federal FIA Program.** A level of FIA program delivery that includes sampling 10 percent of base grid (Phase 2) plots per year in the Western United States and 15 percent of base grid plots per year in the Eastern United States, with data compiled and made available annually and complete State analyses done every 5 years. A subsample of these plots also provides data on key ecosystem health indicators.
- **base grid plots sampled.** The base grid consists of one sample location per approximately 6,000 acres (Phase 2), and one location per approximately 96,000 acres provides data on key ecosystem health indicators. Some partners chose to intensify beyond the base grid.
- **buy down.** Plots installed at State expense to reach 20-percent implementation level of the base grid. These plots are referred to as "temporal acceleration" plots.
- **core reports.** A class of publications that summarizes forest status and trends for a complete administrative unit, such as a whole State or a national forest. Examples include survey unit reports, State statistical and analytical reports, and national forest reports. Congressionally required 5-year State reports are part of the FIA's core reporting.
- **direct operational expenses.** All expenses directly attributable to the FIA unit incurred as a part of doing FIA business. Excludes indirect business costs (such as rent, telephones, and administrative overhead outside the FIA unit staff) and salary and related expenses. Includes work done for other units as a normal part of FIA business and the following items:
  - **equipment:**
    - **imagery.** Aerial photos and satellite imagery data files.
    - **vehicles.** All vehicle costs, including items such as operating costs, depreciation, and leases.
    - **field equipment.** Measurement tools and equipment, such as data recorders, carried by field crews.
    - **information technology/communications.** Additional computer hardware, software, and communications costs.
    - **other.** Any cost that does not fit into one of the previous equipment categories.
  - **publications.** Costs for laying out, editing, printing, and distributing publications.
  - **grants and agreements.** Cost of cooperative grants, agreements, and contracts that directly support the FIA mission.
  - **office space and utilities.** Charges for rent, lease, or other real estate costs for FIA staff, plus utilities.
  - **other direct expenses.** Any cost that does not fit into one of the previous categories, including office supplies, postage, moving expenses, and other expenses related to delivering the FIA Program.
- **ecosystem indicators.** Data collected on a subset of Phase 2 sample locations measured for a more extended set of ecosystem attributes, including tree crown dieback, soil data, and down woody debris.
- **forest land.** Unless noted, this report uses the FIA definition of forest land. The FIA Program defines forest land as: Land at least 10-percent canopy cover by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10-percent canopy cover with trees and forest areas adjacent to urban and built-up lands. Also included are pinyon-juniper and chaparral areas in the West and afforested areas. The minimum area for classification of forest land is 1 acre and 120 feet wide measured stem to stem from the outermost edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 120 feet wide.

  The Resources Planning Act (RPA) Assessment defines forest land as: Land at least 10-percent canopy cover by trees at least 16.4 m high, or trees able to reach these thresholds in situ, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10-percent canopy cover with trees and forest areas adjacent to urban and built-up lands. The minimum area for classification of forest land is 1 acre and 120 feet wide measured stem to stem from the outermost edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 120 feet wide. This is the definition used for international reporting.
- **FY (end-of-the-year) balance.** Funds reported in the previous fiscal year business report as unspent at the end of that fiscal year and presumably available for use in the current fiscal year.
- **intensification.** Plots installed at the expense of State, National Forest System, or other partner to achieve higher quality estimates for smaller areas or to buy the base Federal sample down to a 5-year cycle.
- **management meetings held.** Number of national or regional management team meetings held by each FIA unit. Each regional management team consists of partners who share in funding and implementing the FIA Program. The team typically consists of representatives from the FIA unit; NFS regional offices; State, Private, and Tribal Forestry offices; and State forestry agencies.

- **NGO (nongovernmental organization).** A class of customers with whom FIA staff members are asked to consult. Includes environmental organizations, professional societies, and other, generally nonprofit, organizations.
- **NIPF (nonindustrial private forest landowners).** Private individuals or organizations that own forest land for purposes other than industrial operations.
- **percentage of forested base grid plots sampled.** Total number of base grid plots sampled divided by the total number of plots in the base grid. Set by Congress, the current target in the East is 15 percent and 10 percent in the West.
- **percentage of full funding.** Total available funds divided by the funding needed to fully implement the base Federal program for a given year's target funding.
- **percentage of region covered by annual FIA.** Sum of forested acres in States currently implementing annual FIA, divided by the total number of forested acres in each FIA region; a measure of the degree to which the FIA region has moved from periodic to annual inventory.
- **publications.** Number of publications per unit, by type of publication, as reported in official agency attainment reports. Publications are among the major outputs of the FIA Program. Types of publications include:
  - **core report.** A report pertaining to reporting inventory results for a complete geographic entity. Includes the following:
    - **national forest report.** A complete analysis for a single national forest.
    - **national report.** A report for the entire Nation, such as the Resources Planning Act Assessment report.
    - **regional report.** A report for a group of States or other contiguous unit larger than a single State, such as a regional assessment.
    - **State resource report.** A complete statistical or analytical summary of the forested resources within a single State.
    - **State timber products output (TPO) report.** A complete analysis of TPO data for a single State.
    - **other.** Publication that does not fit into any of the previous categories, such as an abstract, book, or other government publication.
- **other station publication.** A manuscript published by the Forest Service, for example, a general technical report.
- **peer-reviewed journal article.** An article appearing in a refereed or peer-reviewed journal.
- **proceedings paper.** An article appearing in the proceedings from a meeting or symposium.
- **salary.** Includes direct salary, benefits, and related expenses, broken into the following categories:
  - **administration.** Program manager, project leader, and administrative staff.
  - **data collection/QA.** Staff who interpret photos and high-resolution images to determine forested areas and increase the efficiency of field work; collect, coordinate, or support the collection of field data; and conduct quality assurance (QA) control at least 50 percent of their time.
  - **information management.** Forestry data managers and data compilers with support staff to build data views and analytical data queries.
  - **analysis and research.** Staff who analyze satellite imagery for statistical stratification, analyze collected field data, write publications, and conduct FIA-related research on methods and techniques.
- **significant consultations.** Cases in which an FIA staff person spent at least 1 hour in discussion, analysis, or research to address a specific question or need raised by an external FIA Program customer, and which is not part of the normal course of business in collecting, analyzing, and reporting FIA information.
- **spatial intensification.** Additional plot locations added to increase the number of plots sampled per unit area.
- **temporal acceleration.** Additional plots that are sampled ahead of schedule to reduce the cycle length.
- **total available funds.** Total funds available for delivering the FIA Program, including funds appropriated by Congress for the FIA Program, other funds made available by Forest Service partners, and previous year carryover funds. These funds are a measure of Federal funding for the base Federal program.
- **travel.** Broken into the following categories:
  - **office travel.** Travel costs for all staff except field and QA crews.
  - **field/quality assurance crew travel**. Travel costs for field and QA crews.
- **user group meetings held.** Number of user group meetings sponsored or attended by each FIA unit. A user group meeting is an open meeting in which a complete regional cross section of FIA partners and customers is invited to attend. User group meetings differ from the usual smaller meetings with one or two partners that all FIA units call as a normal course of business.

Appendix A: Contacts

For information about the status and trends of the Nation's forests, please contact the appropriate office below.

Northern FIA Program
Program Manager, FIA
USDA Forest Service
Northern Research Station
1992 Folwell Avenue
☎ 651–649–5191

Rocky Mountain FIA Program
Program Manager, FIA
USDA Forest Service
Rocky Mountain Research Station
4919 S. 1500 W.
Riverdale, UT 84405
☎ 801–625–5464

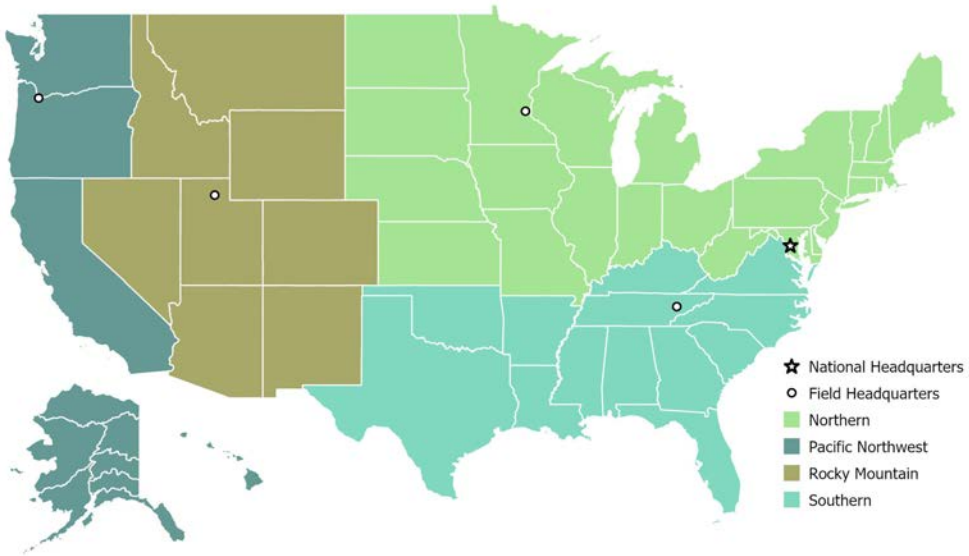
Southern FIA Program
(includes Commonwealth of
Puerto Rico and the U.S. Virgin Islands)
Program Manager, FIA
USDA Forest Service
Southern Research Station
4700 Old Kingston Pike
Knoxville, TN 37919
☎ 865–862–2000

Pacific Northwest FIA Program
Program Manager, RMA (FIA)
USDA Forest Service
Pacific Northwest Research Station
1220 SW 3rd Avenue, Suite 1410
Portland, OR 97204
☎ 971–280–0858

National FIA Program Office
National Program Leader, FIA
USDA Forest Service
201 14th Street, SW
Washington, DC 20250
☎ 703–605–4177

All regional FIA websites and a wealth of statistical and other information are available through the national FIA website at www.fs.usda.gov/research/programs/fia.

Figure A-1. FIA regional units and headquarters.



FIA = Forest Inventory and Analysis.

The Pacific Northwest FIA unit also includes American Samoa, Guam, Republic of Palau, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, and Republic of the Marshall Islands. The Southern FIA unit also includes the Commonwealth of Puerto Rico and the U.S. Virgin Islands.

Appendix B: Additional Data Tables

Table B-1. Performance measures for the FY 2022 FIA Program.

	Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
Total Federal funds directly invested in FIA salary and expenses	$10,273,173	$10,719,111	$10,677,881	$12,001,768	$376,094	$44,048,027
Total Federal funds available for operations	$11,093,964	$9,275,025	$15,022,730	$8,810,248	$6,698,800	$50,900,767
Total FY 2022 appropriated operational funds	$3,874,764	$3,124,062	$7,695,744	$5,295,516	$3,598,800	$23,588,886
Contributions from partners (operations):						
Supporting the 20% FIA Program	$206,538	$259,564	$1,881,083	$763,669	$0	$3,110,854
Value-added contributions	$2,182,173	$378,224	$275,665	$7,258,705	$1,097,591	$11,192,358
Total partner contributions	$2,388,711	$637,788	$2,156,748	$8,022,374	$1,097,591	$14,303,212
Total available operational funds	**$13,482,675**	**$9,912,813**	**$16,816,878**	**$16,722,622**	**$7,796,391**	**$64,731,379**
Base grid (forested and possibly forested[a])						
Total forested base grid plots	**23,012**	**29,318**	**52,846**	**37,636**	-	**142,812**
Field-sampled	1,425	2,958	4,945	4,516	-	13,844
Nonsampled hazard	98	37	55	17	-	207
Nonsampled denied access[b]	100	406	500	1,000	-	2,006
% forested base grid completed[c]	8%	12%	10%	15%	-	11%
Base forest quality assurance plots	65	202	429	289	-	985
% field-sampled base grid with QA	5%	7%	9%	6%	-	7%
Forest plots with one or more health indicators[d]	1,425	2,958	4,945	583	-	9,911
Additional plots sampled (forested and nonforest)						
Spatial intensification	994	0	280	1,519	-	2,793
Temporal acceleration	281	0	1,480	369	-	2,130
Urban plots	46	85	175	1,508	-	1,814
Special Study plots[e]	23	0	0	0	-	23
Number of publications:						
State/island resource reports	0	0	14	14	-	28
State Timber Product Output reports	3	1	13	0	-	17
Regional reports	0	0	0	2	-	2
National reports	0	0	0	3	-	3
5-Year State reports	1	1	2	1	-	5
Subtotal – core reports	4	2	29	20	-	55
Peer-reviewed journal articles	13	19	5	35	-	72
Proceedings articles	0	0	0	1	-	1
Other publications	4	5	4	2	-	15
Subtotal – nonreport publications	17	24	9	38	-	88
Total publications	**21**	**26**	**38**	**58**	-	**143**
Publications per analyst and researcher	1.4	1.6	2.5	2.0	-	1.9
Consulting activities:						
Number of significant consultations	152	591	72	438	23	1,276
Total hours of significant consultations	1,362	1,315	316	2,820	585	6,398
Meetings:						
User group meetings held	0	5	2	5	0	12
Management meetings held	5	0	1	1	2	9

FIA = Forest Inventory and Analysis; FY = fiscal year; QA = quality assurance.

[a] Plots that appear forested based on a prior field visit or remote sensing data but could not be sampled due to hazardous conditions or denied access are classified as "nonsampled (possibility of forest)."

[b] Landowner permission is required to sample plots on private land; some plots could not be sampled because the landowner denied access.

[c] Plots that could not be sampled due to hazardous conditions or denied access are included as completed when calculating this performance metric.

Percent of forested base grid plots completed = (field sampled plots + nonsampled hazard + nonsampled denied access) / total forested base grid plots. For the Pacific Northwest, the percentage was calculated excluding plots in Hawaii and Interior Alaska because those areas have periodic inventories and are not part of the annual sampling target of 10 percent.

[d] Health indicators measured include crown dieback, vegetation diversity and structure, down woody materials, forest soils, and invasive plant species.

[e] Special study plots are typically post-disturbance measurements.

Table B-2a. Federal funds received by the FIA Program to pay for salary and expenses, FY 2022.

	Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
FIA Salary and Expenses (S&E)[a]			*Dollars*			
Salary	**8,994,221**	**10,183,132**	**8,347,832**	**11,706,895**	**362,100**	**39,594,180**
Administration	630,411	803,837	731,201	783,643	362,100	3,311,192
Data collection/QA	4,725,471	6,196,634	4,185,422	5,207,947	0	20,315,474
Information management	1,206,158	970,889	1,102,230	1,234,640	0	4,513,917
Analysis & Research	2,432,181	2,211,772	2,328,979	4,480,665	0	11,453,597
Travel	**749,505**	**535,979**	**1,806,434**	**176,099**	**11,994**	**3,280,011**
Office travel	41,879	49,510	762,730	29,009	11,994	895,122
Field/quality assurance crew travel	707,626	486,469	1,043,704	147,090	0	2,384,889
Other[b]	**529,447**	**0**	**523,615**	**118,774**	**2,000**	**1,173,836**
Total FIA S&E	**10,273,173**	**10,719,111**	**10,677,881**	**12,001,768**	**376,094**	**44,048,027**

FIA = Forest Inventory and Analysis; FY = fiscal year; QA = quality assurance.

[a] Funds made available to pay for S&E charges from FIA staff.

[b] All other expenditures using funds available for S&E, including awards, training, overtime, and boot replacements.

Table B-2b. Financial statement for FIA operational funds, FY 2022.

	Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
Available Federal operational FIA funds			*Dollars*			
Previous year end-of-year balance	22,226	33,082	274,836	55,348	0	385,492
Post-year adjustments[a]	(22,226)	(33,082)	(274,836)	151,684	0	(178,460)
Subtotal pre-year adjustments	**0**	**0**	**0**	**207,032**	**0**	**207,032**
FY 2022 appropriated FIA operational funds						
Initial FIA funds added to base	3,874,764	2,624,062	7,195,744	4,295,516	81,000	18,071,086
Secondary FIA funds added to base[b]	0	0	0	0	953,000	953,000
Congressional directives	0	500,000	500,000	1,000,000	1,010,800	3,010,800
IT funds	0	0	0	0	1,554,000	1,554,000
Subtotal FY22 appropriated operational funds	**3,874,764**	**3,124,062**	**7,695,744**	**5,295,516**	**3,598,800**	**23,588,886**
Other Forest Service R&D funds	0	96,200	80,000	0	0	176,200
Other Forest Service R&D IT funds	0	0	0	0	1,500,000	1,500,000
Other Federal funds[c]	0	38,703	389,946	0	0	428,649
Disaster supplemental (CR)	7,219,200	6,016,060	6,857,040	3,307,700	1,600,000	25,000,000
Subtotal additional Federal funds	**7,219,200**	**6,150,963**	**7,326,986**	**3,307,700**	**3,100,000**	**27,104,849**
Total available Federal operational funds	**11,093,964**	**9,275,025**	**15,022,730**	**8,810,248**	**6,698,800**	**50,900,767**
Direct operational expenses						
Equipment	376,737	586,236	457,806	326,304	1,222,834	2,969,917
Imagery	0	0	71,146	0	25,000	96,146
Vehicles	230,860	445,723	231,488	213,582	0	1,121,653
Field equipment	145,877	106,670	154,720	90,937	192,703	690,907
Information technology/communications	0	8,822	0	9,861	1,005,131	1,023,814
Other	0	25,021	452	11,924	0	37,397
Publications	0	23,932	0	66,219	8,634	98,785
Grants and agreements[d]	4,878,437	5,120,796	8,683,668	7,898,621	3,086,643	29,668,165
Field work/data	3,719,014	3,842,687	6,697,026	2,753,605	-	17,012,332
Information management	0	0	0	0	2,749,931	2,749,931
Research	1,159,423	1,278,109	1,584,946	5,145,016	230,000	9,397,494
Other	0	0	401,696	0	106,712	508,408
Office space and utilities	2,842	12,206	4,191	54,400	0	73,639
Other direct expenses	8,676	440,333	15,320	0	3,312	467,641
Total direct operational expenses	**5,266,692**	**6,183,503**	**9,160,985**	**8,345,544**	**4,321,423**	**33,278,147**
EOY operations balance[e]	5,827,272	3,091,522	5,861,745	464,704	2,377,377	17,622,620
Total FIA Federal operational expense	**11,093,964**	**9,275,025**	**15,022,730**	**8,810,248**	**6,698,800**	**50,900,767**

CR = continuing resolution; EOY = end of year; FIA = Forest Inventory and Analysis; FY = fiscal year; IT = information technology; R&D = Research and Development.

[a] Some bookkeeping is not completed until after the new FY begins, which may affect beginning balances. These adjustments include items such as carryover, return of unused prior year grants, Station adjustments, etc.

[b] Additions to base funding from FIA National Office. This number does not include the congressional allocation for the Small Business Innovation Research (SBIR) program, as that money is not available for FIA operations.

[c] Includes funding from national forests and other Federal agencies.

[d] Grants and agreements include general allocation of grants to basic thematic categories.

[e] The EOY operations balance is higher than average for FY 2022 because some of the disaster supplemental funds will be spent in the following years.

Table B-3a. Federal staffing, in full-time equivalent (FTE) hours, for the FY 2022 FIA Program.

	Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
Administration	3.9	7.0	7.0	6.0	1.7	25.6
Field operations	55.2	62.1	41.2	47.2	0	205.7
Information management	9.4	15.1	9.1	10.0	0	43.6
Analysis and research	15.4	16.2	15.0	29.5	0	76.1
Indirect support[1]	0.3	0.0	0.0	0.0	0	0.3
Total	**84.2**	**100.4**	**72.3**	**92.7**	**1.7**	**351.3**

FIA = Forest Inventory and Analysis; FY = fiscal year.

[1] Indirect support FTEs are research station salaries and expenses charged toward the tracking FIA salary budget code.

Table B-3b. Estimate of cooperator staffing, in full-time equivalent (FTE) hours, funded by FIA grants and agreements for the FY 2022 FIA Program.

	Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
Administration	0.4	1.0	1.9	0.0	0.0	3.3
Field operations	38.0	21.6	120.5	26.0	0.0	206.1
Information management	0.4	0.0	4.3	3.0	0.0	7.7
Analysis and research	8.0	5.0	1.8	5.0	0.0	19.8
Total	**46.8**	**27.6**	**128.5**	**34.0**	**0.0**	**236.9**

FIA = Forest Inventory and Analysis; FY = fiscal year.

Table B-3c. Estimated total federally funded staffing, in full-time equivalent (FTE) hours, for the FY 2022 FIA Program.

	Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
Administration	4.3	8.0	8.9	6.0	1.7	28.9
Field operations	93.2	83.7	161.7	73.2	0	411.8
Information management	9.8	15.1	13.4	13.0	0.0	51.3
Analysis and research	23.4	21.2	16.8	34.5	0.0	95.9
Indirect support[a]	0.3	0.0	0.0	0.0	0.0	0.3
Total	**131.0**	**128.0**	**200.8**	**126.7**	**1.7**	**588.2**

FIA = Forest Inventory and Analysis, FY = fiscal year.

[a] Indirect support FTEs are research station salary and expenses charged toward the tracking FIA salary budget code.

Table B-4. Partner contributions toward implementing FIA in FY 2022.

Unit	Partner	Contributions toward the base program	Contributions that add value
		Dollars	
Rocky Mountain	Forest Service Region 1	81,575	365,576
	Forest Service Region 2, Forest Health Protection	15,945	-
	Forest Service Region 4	1,524	2,648
	Harvard University	-	10,000
	New Mexico State Forestry Division	4,000	-
	University of Montana	153,820	-
	Utah Division of Forestry, Fire, and State Lands	2,700	-
Rocky Mountain total		**259,564**	**378,224**
National Office	Society of American Foresters	-	21,236
	Southern Utah University	-	475,727
	University of Nevada, Las Vegas	-	600,628
National Office total		**-**	**1,097,591**
Northern	Alabama A&M University	-	30,284
	California Air Resources Board	-	150,000
	Colorado State University	-	662,552
	Connecticut Department of Conservation	2,000	-
	Davey Tree Expert Company	-	1,000,000
	Delaware Department of Conservation	4,392	-
	Forest Service Region 9	-	100,000
	Forest Service Research & Development	-	650,000
	Forest Service Resource Planning Act	-	50,000
	Forest Service Rocky Mountain Research Station	-	40,194
	Forest Service State, Private, and Tribal Forestry	67,423	200,000
	Illinois Division of Forestry	19,039	-
	Indiana Department of Natural Resources	27,923	-
	Iowa Department of Natural Resources	15,203	-
	Kansas State Forest Service	16,938	-
	Maine Forest Service	253,847	717,598
	Maryland Department of Natural Resources	20,730	-
	Massachusetts Department of Conservation and Recreation	7,700	-
	Michigan Division of Forest Management	40,200	-
	Michigan State University	-	50,000
	Minnesota Department of Natural Resources	56,279	568,116
	Missouri Department of Conservation	-	18,996
	National Council for Air and Stream Improvement	-	90,000
	National Institute of Forest Science (South Korea)	-	40,120
	Nebraska Department of Forestry, Fish and Wildlife	3,174	-

Table B-4. Partner contributions toward implementing FIA in FY 2022, continued.

Unit	Partner	Contributions toward the base program	Contributions that add value
		Dollars	
Northern (continued)	New Hampshire Department of Resources & Economic Development	19,600	-
	New Jersey Forest Service	20,599	117,234
	New York Department of Environmental Conservation	18,195	-
	North Dakota Forest Service	4,590	-
	Ohio Department of Natural Resources	13,687	-
	Pennsylvania Department of Conservation & Natural Resources	43,083	6,123
	Rhode Island Department of Environmental Management	6,471	6,471
	South Dakota Dept. of Agriculture and Natural Resources	17,225	-
	State University of New York	-	30,000
	Texas A&M University	-	213,610
	University of Florida	-	90,000
	University of Maine	-	253,848
	University of Massachusetts-Amherst	-	11,942
	University of Minnesota	-	82,957
	University of Nevada, Las Vegas	-	600,627
	University of New Hampshire	-	189,034
	U.S. Environmental Protection Agency	-	550,000
	USDA Natural Resources Conservation Service	-	260,000
	Vermont Department of Conservation	8,500	4,000
	West Virginia Division of Forestry	22,271	-
	Wisconsin Department of Natural Resources	54,600	475,000
Northern total		**763,669**	**7,258,705**
Pacific Northwest	Alaska Department of Natural Resources	19,272	-
	CALFIRE	-	986,596
	DOI Bureau of Land Management	-	165,000
	Forest Service Region 6	-	750,000
	Greening Youth Foundation	11,122	-
	Michigan State University	73,882	-
	Micronesia Conservation Trust	55,005	-
	Oregon Department of Forestry	-	9,054
	Oregon State University	-	98,777
	Portland State University	-	60,290
	Sitka Conservation Society	-	3,850
	University of Alaska Anchorage	-	17,876
	University of Hawaii	18,798	-
	University of Kentucky Research Foundation	-	67,500
	University of Montana	28,460	-
	University of Washington	-	23,230
Pacific Northwest total		**206,538**	**2,182,173**

Table B-4. Partner contributions toward implementing FIA in FY 2022, continued.

Unit	Partner	Contributions toward the base program	Contributions that add value
		Dollars	
Southern	Arkansas Forestry Commission	116,568	-
	Florida Forest Service	155,681	-
	Georgia Forestry Commission	183,444	-
	Kentucky Division of Forestry	200,418	-
	North Carolina Forest Service	-	216,991
	Oklahoma Forestry Services	117,556	-
	South Carolina Forestry Commission	122,862	-
	Texas A&M Forest Service	690,801	-
	University of North Carolina at Chapel Hill	66,182	22,674
	University of Tennessee	58,000	36,000
	Virginia Department of Forestry	169,571	-
Southern total		**1,881,083**	**275,665**
Total, all FIA units		**$3,110,854**	**$11,192,358**
Grand total (base program and added value)			**$14,303,212**

DOI = U.S. Department of the Interior; FIA = Forest Inventory and Analysis, FY = fiscal year; USDA = U.S. Department of Agriculture.

Table B-5. Grants and agreements entered into by FIA units, FY 2022.

Unit	Recipient	Purpose	Amount (dollars)
Rocky Mountain	American West Forestry LLC	Field Data Collection	218,679
	Colorado State University	Fire Impacts	169,840
	Colorado State University, Colorado State Forest Service	Field Data Collection	1,839,105
	Forest Service GTAC	FIESTA Development	255,000
	Forest Service R&D Forest and Woodland Ecosystem Program	Soils Analyses	106,410
	Harvard University	Small Area Estimation (Congressionally Directed)	150,000
	Integrated Resource Inventories	Field Data Collection	310,772
	Michigan State University	FIESTA Development	75,003
	National Council for Air and Stream Improvement	Small Area Estimation (Congressionally Directed)	113,500
	New Mexico State University	Soils Analysis Enhancement	160,001
	Oregon State University	Land Use and Land Cover Rapid Assessment Dashboard	32,628
	Paul Chisholm	Field Data Collection	251,680
	Skylight Forestry	Field Data Collection	579,650
	Synergy Staffing Contract	Science Consultations	4,751
	University of Arizona	Increment Core Measurements	50,000
	University of Montana	Nonresponse Mill study	38,000
	University of Montana	Small Area Estimation (Congressionally Directed)	136,500
	University of Montana, Bureau of Business and Economic Research	Timber Products Output	308,000
	University of Montana, Bureau of Business and Economic Research	Wood Utilization Study	46,686
	University of Vermont	National Land Cover Database Tree Canopy Cover	96,200
	Utah State University	Increment Core measurements	50,000
	Wesley Winslow	Field Data Collection	128,391
Rocky Mountain total			**5,120,796**
National Office	Chief Information Office	Cloud services	419,931
	Forest Service GTAC	Land Use and Land Cover ICE analysis and programming	120,000
	Forest Service GTAC	FIESTA development	110,000
	Forest Service GTAC	FIA data viewer and dashboards	30,000
	National Experienced Workforce Solutions	ACES contract (FIA program support)	31,712
	Society of American Foresters	National User Group and Carbon meetings	75,000
	Southern Utah University	508 compliance testing and DATIM support	300,000
	University of Nevada Las Vegas	Data management support	2,000,000
National Office total			**2,666,712**

Table B-5. Grants and agreements entered into by FIA units, FY 2022, continued.

Unit	Recipient	Purpose	Amount (dollars)
Northern	Bradley Angle	Field Data Collection	4,149
	Chandler Johnson	Field Data Collection	191,425
	Colorado State University	Forest Service Urban Forest Inventory, Analysis Assistance	662,553
	Daniel Huberty	Field Data Collection	79,720
	Davey Tree Expert Company	i-Tree: Development, Dissemination and Support	921,895
	Digital Map Products, Inc.	Digital Map Products	2,000
	DJM Ecological Services, Inc.	Field Data Collection	283,920
	DOI National Park Service	Forest Service Lease of National Park Service Office Space	10,000
	Grand Rapids Forestry Science Laboratory	Soil Analysis	74,176
	Hispanic Access Foundation	Resource Assistants Program Cohorts	31,967
	Indiana Department of Natural Resources	Indiana's Statewide Data Collection	92,975
	Joel Fyock	Field Data Collection	8,050
	Lightbox Parent, L.P.	Parcel Data	125,500
	Maine Department of Agriculture, Conservation & Forestry	Maine's Statewide Resource Annualized Forest Resource Inventory	717,599
	Mark Webb	Field Data Collection	161,025
	Michigan State University	Investigating New National Tree Biomass Models for Urban FIA	50,000
	Minnesota Department of Natural Resources	Data Collection and Analytical Reporting	375,258
	National Council for Air and Stream Improvement	Biometrical Research in Support of Entity-Scale Greenhouse Gas Guidelines	90,000
	National Council for Air and Stream Improvement	Small Area Estimation and Assistance Assessment	896,500
	Native Resource Preservation, LLC	Field Data Collection	104,758
	Oak Ridge Associated Universities	ORAU Digital Engagement Products	110,000
	Oak Ridge Associated Universities	ORAU Information Management	300,000
	Oak Ridge Associated Universities	ORAU Carbon Postdoctoral Research Associates	270,000
	Regents of the University of Minnesota	Forest Biometrics Research and Program Support	82,957
	Regents of the University of Minnesota	Marcell Experimental Forest	70,000
	Research Foundation for the State University of New York	Assessing Forests and Their Benefits	30,000
	Reyco Forest Management, LLC	Field Data Collection	96,026
	Ryan Nowak	Field Data Collection	213,643
	South Dakota Department of Agriculture and Natural Resources	South Dakota Statewide Annualized Forest Resource Inventory	31,990
	Strohman Enterprise, Inc.	Continuation of inReach Air Plan	20,500
	Texas A&M University System	FIA Analytical Support	213,610
	Thomas Bergstrom	Field Data Collection	170,891
	University of Florida	Quantifying Changes in Dynamics of U.S. Forests Using FIA Data and Novel Modeling Approaches	350,000
	University of Massachusetts	Family Forest Research Center	571,500

Table B-5. Grants and agreements entered into by FIA units, FY 2022, continued.

Unit	Recipient	Purpose	Amount (dollars)
Northern (continued)	University of Massachusetts	Small Area Estimation and Assistance Assessment	220,000
	University of Massachusetts	National Woodland Owner Survey	65,000
	University System of New Hampshire	Urban Forest Inventory and Analysis (Analytical Assistance)	189,034
	USDA National Agricultural Statistics Service	National Woodland Owner Survey Nonresponse Phone Calls	10,000
Northern total			**7,898,621**
Pacific Northwest	Alaska Department of Natural Resources	Field data collection in Interior Alaska	1,983,369
	Alaska Transportation Contractors	Helicopter Transportation in Alaska	1,232,604
	Department of Interior Acquisition Services	Alaska FIA Aviation Services Agreement	50,000
	FIA Data Collection Plot Contractors	Field Data Collection	270,939
	Greening Youth Foundation, Inc.	Resource Assistants Program Cohorts	43,193
	Michigan State University	Small Area Estimation Methods and Tool Development (Congressionally Directed)	100,000
	Micronesia Conservation Trust	Forest Inventory and Monitoring Network Within Micronesian Communities	120,000
	NASA	Optimizing Inventory Methods and Sampling Design for Carbon Monitoring in Interior Alaska	50,000
	Oregon State University	Collaborative Species and Change Modeling Investigation	50,000
	Oregon State University	Point Cloud-Based Augmentation of Forest Inventory Parameters and Solar Insolation Assessment in Riparian Areas	135,999
	Paul Chisholm	Pacific Northwest Tree Demography Database Development	50,000
	Portland State University	Design and Validation of a Spatially Aware Variant of the BioSum Modeling Framework	159,000
	Sitka Conservation Society	Assessing Forest Conditions Supporting Berry Harvesting, Mushroom Gathering, and Cultural Tree Use in Southeast Alaska	18,909
	University of Alaska Anchorage	Using Tree Rings to Understand Changes in Tree Growth in Interior Alaska	62,289
	University of Hawaii	Sustaining the Capacity for Forest Inventory and Analysis in Hawaii and the Western Pacific Islands	65,000
	University of Kentucky Research Foundation	Techniques for Analysis of Epiphytic Mosses for Source Apportionment of Airborne Pollutants	150,000
	University of Montana	CALFIRE California Logging Utilization	17,000
	University of Montana	Pacific West TPO and Forest Industry Analysis 2021	85,300
	University of Washington	Pilot Study Developing Moss Bioindicators for Mapping Diesel Exhaust	50,000
	University of Washington	Evaluation of Ground-Based Laser Scanning to Support Forest Inventory in Interior Alaska	80,462
	U.S. Department of Energy	Forest Inventory and Analysis Dendroecology Fellowship	104,373
Pacific Northwest total			**4,878,437**

Table B-5. Grants and agreements entered into by FIA units, FY 2022, continued.

Unit	Recipient	Purpose	Amount (dollars)
Southern	Alabama Forestry Commission	Alabama Forest Inventory and Analysis	536,112
	Arkansas Forestry Commission	Arkansas Forest Inventory and Analysis	447,207
	Clemson University	Invasive Plant Fire Behavior Study	39,946
	Florida Department of Agriculture	Florida Forest Inventory and Analysis	467,044
	Forest Service International Institute of Tropical Forestry	Direct Support to FIA Activities	80,000
	Forest Service Region 8	Collection of Annual Tree Seedling Data	30,000
	Georgia Forestry Commission	Georgia Forest Inventory and Analysis	644,584
	Greening Youth Foundation	Resource Assistants Program Cohorts	46,542
	Kentucky Division of Forestry	Kentucky Forest Inventory and Analysis	366,282
	Lurleen B. Wallace Community College	Lurleen B. Wallace Outreach and Education Partnership	401,696
	Mississippi Forestry Commission	Mississippi Forest Inventory and Analysis	557,425
	National Council for Air and Stream Improvement	Small Area Estimation (Congressionally Directed)	350,000
	North Carolina Department of Agriculture and Consumer Services	North Carolina Forest Inventory and Analysis	508,016
	North Carolina State University	Methodology for Rapid Assessment of Hurricane Damage on Primary Forest Industry	80,000
	North Carolina State University	Forest Health Monitoring, Analysis, and Assessment	250,000
	Oak Ridge Institute for Science and Education	ORISE Research Participation Program	240,000
	Oklahoma Department of Agriculture, Food & Forestry	Oklahoma Forest Inventory and Analysis	352,669
	South Carolina Forestry Commission	South Carolina Forest Inventory and Analysis	346,283
	Tennessee Division of Forestry	Tennessee Forest Inventory and Analysis	423,804
	Texas A&M Forest Service	Texas Forest Inventory and Analysis	1,431,684
	University of North Carolina at Chapel Hill	Mapping Forest Aboveground Biomass Loss from Hurricanes	160,000
	University of Tennessee	Improving Small Area Estimation Methods and Tools for Forest Inventories	150,000
	University of Tennessee	Assessing U.S. Roundwood Equivalent Factors	135,000
	University of Tennessee	Rapid Assessment of Hurricane Damage on Primary Forest Industry	20,000
	University of Tennessee	Allometric Functions for Assessing Mangrove Forest Structure Loss After Hurricanes	160,000
	Virginia Department of Forestry	Virginia Forest Inventory and Analysis	459,374
Southern total			**8,683,668**
Grand total			**29,248,234**

ACES = Agriculture Conservation Experienced Services; DATIM = Design and Analysis Toolkit for Inventory and Monitoring; DOI = U.S. Department of the Interior; FIA = Forest Inventory and Analysis; FY = fiscal year; GTAC = Geospatial Technology and Applications Center; ICE = image-based change estimation; NASA = National Aeronautics and Space Administration; NWOS = National Woodland Owner Survey; ORAU = Oak Ridge Associated Universities; ORISE = Oak Ridge Institute for Science and Education; R&D = Research and Development; TPO = timber products output.

Table B-6. Number and hours of significant FIA staff consultations by customer group, FY 2022.

Customer group	Pacific Northwest		Rocky Mountain		Southern		Northern		National Office		Total			
	Number	Hours	Number	Hours	Number	Hours	Number	Hours	Number	Hours	Number	Percent	Hours	Percent
Academic	28	317	24	59	16	139	109	605	6	135	183	14%	1,255	20%
Government	103	952	38	1,069	21	2	180	1,011	6	135	348	27%	3,169	50%
Industry	6	30	4	6	23	117	73	218	5	80	111	9%	451	7%
NGO	11	55	60	7	2	12	68	416	1	110	142	11%	600	9%
NIPF	-	-	450	160	1	2	3	25	-	-	454	36%	187	3%
Media	3	7	7	12	-	-	2	67	-	-	12	1%	86	1%
Other	1	1	8	1	9	44	3	480	5	125	26	2%	651	10%
Total	**152**	**1,362**	**591**	**1,315**	**72**	**316**	**438**	**2,820**	**23**	**585**	**1,276**	**100%**	**6,398**	**100%**

FIA = Forest Inventory and Analysis; FY = fiscal year; NGO = nongovernmental organization; NIPF = nonindustrial private forest landowner.

Table B-7. FIA data access by online tools and Spatial Data Services team requests, FYs 2013–2022.

Number of annual accesses											
Indicator	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total 2013–2022**
Online tools											
DATA downloads	7,383	19,768	66,000	69,025	53,315	195,836	436,119	275,444	331,366	117,252	1,571,508
DATIM	-	-	-	-	37,000	1,605	5,129	4,755	3,768	3,818	56,075
EVALIDator	33,759	35,839	36,532	34,082	38,597	42,625	46,349	46,011	47,120	26,943	387,857
EVALIDator API	-	-	-	75,449	38,313	63,162	3,963,560	1,041,049	515,406	472,014	6,168,953
FIDO	57,567	57,974	47,263	33,293	11,898	4,500	-	-	-	-	212,495
TPO Toolkit	-	69,600	18,544	37,000	1,092	2,652	2,771	2,400	1,400	8,363	143,822
NWOS	4,502	2,994	2,068	1,710	2,517	3,000	2,194	2,431	995	984	23,395
Online accesses total	**103,211**	**186,175**	**170,407**	**250,559**	**182,732**	**313,380**	**4,456,122**	**1,372,090**	**900,055**	**629,374**	**8,564,105**
Spatial data requests											
Academia	143	155	160	162	163	158	82	103	82	62	1,270
State	29	55	91	56	43	61	37	44	30	23	469
NFS	31	32	29	40	37	26	21	24	26	5	271
Other Federal	175	131	136	130	134	105	37	70	41	25	984
NGO	35	31	38	35	38	44	15	22	25	14	297
Industry	41	94	84	54	65	78	30	40	31	36	553
Other	67	88	66	55	59	31	20	21	22	16	445
Spatial data requests total	**521**	**586**	**604**	**532**	**539**	**503**	**242**	**324**	**257**	**181**	**4,289**

API = application programming interface; DATIM = Design and Analysis Toolkit for Inventory and Monitoring; FIA = Forest Inventory and Analysis; FIDO = Forest Inventory Database Online; FY = fiscal year; NFS = National Forest System; NGO = nongovernmental organization; NWOS = National Woodland Owner Survey; TPO = timber products output.

FIDO support was discontinued in FY 2019.

Online data accesses jumped in FY 2019 due to FIA access to data through EVALIDator API for tool development.

Table B-8. Mill, fuelwood, and ownership surveys processed and utilization sites visited, FYs 2013–2022.

Number of annual survey questionnaires or sites												
Survey or site	**Year initiated**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total 2013-2022**
Timber products	1947	1,529	2,503	1,411	2,421	831	2,719	2,682	2,563	2,713	2,858	22,230
Fuelwood[a]	1947	2,360	0	0	0	0	0	0	0	0	0	2,360
Ownership surveys[b]	1978	5,262	0	0	0	5,254	6,407	1,713	3,135	3,105	0	24,876
Utilization sites	1947	189	105	216	162	39	219	132	118	97	140	1,417

FY = fiscal year.

[a] FIA no longer conducts surveys to estimate fuelwood consumption. Industrial fuelwood estimates are part of the timber products output mill surveys. Residential fuelwood estimates are calculated from the U.S. Department of Energy Residential Energy Consumption Survey and the U.S. Census Bureau American Community Survey.

[b] No ownership questionnaires were mailed in 2022 due to review process and supply delays.

Timber products survey numbers from prior years were updated to correct an error in previous reports.

Table B-9. Forest health indicator, year of initiation, and number of plots sampled, FYs 2013–2022.

Indicator	Year initiated	Number of annual samples										Total 2013–2022
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
Crown dieback[a]	1991	2,183	1,341	1,880	2,771	2,976	3,843	2,156	2,736	2,334	1,714	23,934
Lichens[b]	1998	0	98	61	193	197	351	257	-	-	-	1,157
Soils	1999	565	439	487	456	716	426	791	394	836	724	5,834
Vegetation profile	2001	6,703	7,098	6,666	6,757	6,294	7,025	7,000	5,497	6,168	6,661	65,869
DWM	2001	8,271	8,635	8,186	8,459	9,234	9,277	8,188	7,203	7,280	7,360	82,093
Invasive species	2013	8,389	10,402	10,276	10,753	12,045	11,898	11,116	10,256	11,399	11,443	107,977
Mortality[c]	2001	13,859	17,308	16,825	14,606	17,083	16,825	16,116	16,942	16,810	17,523	163,897

FY = fiscal year; DWM = down woody materials.

[a] Lichen data are no longer collected.

[b] Crown dieback numbers from all prior years were updated to correct an error in previous reports.

[c] Number of remeasured annual inventory plots from which tree mortality can be estimated.

Table B-10. Status of FIA surveys in U.S. islands and territories, FY 2022.

Region and area	Land area in inventory (acres)	Forest Area (acres)	Percent forest	Number of major islands	Fiscal year of current inventory cycle end	Fiscal year of inventory available in database[a]	Fiscal year of published report	Number of base field plots	Number of forest health plots	Number of intensified plots	Available online data
Pacific (PNW)											
American Samoa	48,434	43,631	90%	4	2023	2012	2020	76	0	0	Yes
Guam	135,660	63,833	47%	1	2023	2013	2020	66	0	70	Yes
Palau	110,028	90,685	82%	10	2024	2014	2007	56	0	0	Yes
Commonwealth of the Northern Mariana Islands	75,546	51,009	68%	3	2025	2015	2012	37	0	0	Yes
Federated States of Micronesia	161,917	143,466	89%	4	2026	2016	2012	78	0	78	Yes
Marshall Islands	33,182	23,230	70%	10	2028	2018	2012	50	0	20	Yes
Hawaii	4,141,469	1,990,000	48%	8	2022	2022	2023	429	0	82	Yes
Atlantic (SRS)											
Commonwealth of Puerto Rico	2,192,073	1,154,763	53%	4	2024	2019	2019	478	149	0	Yes
U.S. Virgin Islands[b]	82,164	46,967	57%	3	2024	2014	2020	116	59	0	Yes
Total	**6,980,473**	**3,607,584**	**52%**	**47**				**1,386**		**250**	

FIA = Forest Inventory and Analysis; PNW = Pacific Northwest Research Station; SRS = Southern Research Station.

[a] Periodic inventories do not enter data in the FIA database until full cycle is completed. For Hawaii data, check: https://www.fs.usda.gov/research/pnw/products/dataandtools/tools/pnw-fia-hawaii-inventory-database.

[b] The 2019 inventory year for the U.S. Virgin Islands, scheduled to start collecting field data in FY 2020, was delayed due to the COVID-19 pandemic.

Table B-11. State-level summary of land and forest area, years for the most recent available FIA data and 5-year State reports, and length of inventory cycle as of 2022.

Region and State	U.S. Census Bureau land area	Forest land area defined by RPA Assessment	Forest land area defined by FIA	Latest year of data available online	Inventory year of FIA 5-year State report	Publication year of FIA 5-year State report	Cycle Length[a]
	Thousand acres			*Year*			*Years*
Northern	**606,841**	**182,587**	**182,603**				
Connecticut	3,099	1,808	1,808	2020	2012	2016	7
Delaware	1,247	361	361	2020	2013	2018	7
Illinois	35,532	4,980	4,980	2019	2015	2018	7
Indiana	22,929	4,876	4,876	2020	2013	2017	7
Iowa	35,749	2,923	2,923	2021	2013	2016	7
Kansas	52,326	2,527	2,527	2020	2015	2018	7
Maine	19,739	17,579	17,579	2021	2018	2022	5
Maryland	6,252	2,463	2,463	2019	2008	2012	7
Massachusetts	4,992	3,025	3,025	2019	2012	2016	7
Michigan	36,185	20,311	20,311	2019	2014	2017	7
Minnesota	50,961	17,413	17,413	2019	2018	2022	5
Missouri	43,995	15,409	15,409	2021	2018	2021	7
Nebraska	49,167	1,532	1,532	2020	2015	2018	7
New Hampshire	5,730	4,758	4,758	2020	2017	2020	7
New Jersey	4,707	1,990	1,990	2019	2013	2017	5
New York	30,161	18,887	18,887	2019	2017	2020	7
North Dakota	44,161	789	805	2021	2015	2018	7
Ohio	26,151	8,077	8,077	2019	2016	2019	7
Pennsylvania	28,635	16,898	16,898	2020	2014	2017	7
Rhode Island	662	370	370	2020	2012	2016	7
South Dakota	48,519	1,949	1,949	2020	2015	2018	7
Vermont	5,899	4,511	4,511	2020	2017	2020	7
West Virginia	15,384	12,077	12,077	2020	2013	2016	7
Wisconsin	34,661	17,074	17,074	2020	2014	2017	7
Southern	**533,031**	**245,513**	**268,034**				
Alabama	32,413	23,127	23,127	2021	2015	2018	7
Arkansas	33,303	19,040	19,040	2021	2010	2015	5
Florida	34,447	17,253	17,253	2019	2013	2017	7
Georgia	36,809	24,635	24,635	2020	2014	2016	5
Kentucky	25,271	12,442	12,442	2018	2014	2022	7
Louisiana	27,650	14,984	14,984	2018	2013	2016	7
Mississippi	30,031	19,380	19,380	2020	2017	2020	5
North Carolina	31,115	18,829	18,829	2021	2013	2015	7
Oklahoma[b]	43,901	11,911	12,274	2019	2014	2017	7
South Carolina	19,239	12,931	12,931	2020	2016	2018	5

Table B-11. State-level summary of land and forest area, years for the most recent available FIA data and 5-year State reports, and length of inventory cycle as of 2022, continued.

Region and State	U.S. Census Bureau land area	Forest land area defined by RPA Assessment	Forest land area defined by FIA	Latest year of data available online	Inventory year of FIA 5-year State report	Publication year of FIA 5-year State report	Cycle Length[a]
	Thousand acres			*Year*			*Years*
Southern (continued)							
Tennessee	26,390	13,967	13,967	2018	2014	2022	7
Texas[c]	167,188	40,970	63,128	2019	2013	2020	5
Virginia	25,274	16,043	16,043	2020	2016	2018	5
Rocky Mountain	**547,691**	**123,844**	**152,848**				
Arizona	72,700	10,934	18,617	2019	2014	2018	10
Colorado	66,331	20,063	22,804	2019	2013	2017	10
Idaho	52,892	21,386	21,589	2019	2015	2019	10
Montana	93,149	25,517	25,884	2019	2015	2019	10
Nevada	70,260	7,487	10,564	2019	2016	2022	10
New Mexico	77,631	16,619	24,601	2019	2014	2017	10
Utah	52,589	12,087	18,296	2019	2012	2016	10
Wyoming	62,140	9,751	10,493	2019	2015	2018	10
Pacific Northwest	**573,389**	**213,391**	**218,882**				
Alaska, Coast	39,041	14,426	14,426	2019	2013	2020	10
Alaska, Interior[d]	326,575	114,151	114,151	2019	2018	2022	10
California	99,699	31,515	36,768	2019	2015	2020	10
Hawaii[d]	4,110	1,471	1,471	2019	2015	2023	10
Oregon	61,432	29,653	29,726	2019	2015	2019	10
Washington	42,532	22,174	22,339	2019	2016	2019	10
TOTAL	**2,260,953**	**765,334**	**822,366**				

FIA = Forest Inventory and Analysis; RPA = Resources Planning Act.

Note: The RPA and FIA definitions of forest differ. Because the FIA definition includes woodlands, estimates of forest area from the FIA database will be higher in the arid to semiarid regions of the Interior Western United States.

[a] Cycle length is the number of years that it takes to sample all base grid plots in the State. Some States provide supplemental funding to reduce the cycle length to fewer than 10 years in the West and 7 years in the East.

[b] Eastern Oklahoma has a cycle length of 7 years; western Oklahoma has a cycle length of 10 years.

[c] For western Texas, data are available from 2019; for eastern Texas, data are available from 2021. Western Texas has a cycle length of 10 years; eastern Texas has a cycle length of 5 years.

[d] Interior Alaska and Hawaii have periodic inventories; all other States have annualized inventories.

Table B-12. FIA summary statistics and performance measures, FYs 2013–2022.

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Available funds directly invested *(in thousand dollars)*										
S&E funds directly invested in FIA									39,317	44,048
Operational funds									17,621	22,035
IT operational funds									1,500	1,554
Total apropriated funds directly invested in FIA	**65,567**	**66,805**	**70,000**	**75,000**	**77,000**	**77,000**	**77,000**	**77,000**	**58,438**	**67,637**
Other Federal operational funds[a]	2,668	3,077	1,119	910	85	2,666	4,617	3,223	8,035	27,312
Total Federal funds	**68,235**	**69,882**	**71,119**	**75,910**	**77,085**	**79,666**	**81,617**	**80,223**	**66,473**	**94,949**
Partner funds[b]	7,772	7,833	8,972	10,176	10,906	10,883	11,735	12,860	11,426	14,303
Total available funds	**76,007**	**77,715**	**80,091**	**86,086**	**87,991**	**90,549**	**93,352**	**93,083**	**77,899**	**109,252**
% Full Federal appropriated funding[c]	76%	74%	78%	82%	83%	81%	80%	78%	68%	61%
Program expenses and balances *(in thousand dollars)*										
Administration	2,854	3,036	2,703	2,759	3,632	3,532	3,714	3,090	3,098	4,206
Image processing	*589*	*597*	*635*	*761*	*680*	*833*	*981*	-	-	-
Field support	*4,151*	*4,082*	*3,782*	*4,029*	*3,797*	*3,770*	*3,776*	-	-	-
Data collection	*22,559*	*23,590*	*22,807*	*26,888*	*28,404*	*26,952*	*28,610*	-	-	-
Combined field operations[d]	27,299	28,269	27,225	31,678	32,881	31,555	33,366	31,678	35,665	41,621
Information management[d]	5,933	6,737	7,680	7,962	8,743	8,807	7,920	7,872	7,457	8,288
Analysis	*6,695*	*7,058*	*6,907*	*6,800*	*6,534*	*6,575*	*6,453*	-	-	-
Research[c]	*6,690*	*7,072*	*6,111*	*7,084*	*7,054*	*7,050*	*6,680*	-	-	-
Combined analysis and research[d]	13,385	14,131	13,017	13,884	13,588	13,625	13,133	14,254	17,002	20,851
Miscellaneous/other	3,652	3,864	5,025	4,342	2,909	2,933	2,717	2,998	2,865	2,360
Total direct expense	**53,124**	**56,037**	**55,651**	**60,625**	**61,752**	**60,452**	**60,850**	**59,894**	**66,087**	**77,326**
Total indirect expenses[e]	**14,704**	**13,461**	**14,708**	**14,652**	**15,333**	**19,076**	**19,024**	**19,437**	-	-
Indirect rate	22%	20%	21%	20%	20%	24%	23%	24%	-	-
Fire transfer	0	0	449	181	0	0	0	-	-	-
Total EOY balance[f]	407	384	312	452	0	137	1,742	892	385	17,623
Total Federal expense	**68,235**	**69,882**	**71,119**	**75,910**	**77,085**	**79,666**	**81,617**	**80,223**	**66,473**	**94,949**
Other measures										
% States with annual activity	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Annualized States with FIADB 1–2 yrs old	94%	96%	96%	96%	96%	94%	86%	88%	88%	47%
Federal employees	366	366	338	352	341	339	382	379	332	351
Other employees	184	204	185	213	209	220	237	224	232	237
Total employees	550	570	523	565	550	559	618	602	564	588
Base forest plots	21,263	19,789	18,346	14,308	15,543	14,598	14,848	13,502	13,309	142,812
Base QA plots	5,465	2,312	3,083	1,529	2,199	2,171	1,839	1,730	1,233	985
Percent QA plots	11%	5%	7%	11%	11%	15%	12%	13%	9%	1%
All publications	238	234	236	371	206	211	204	239	248	143
Journal publications	90	87	122	122	92	122	112	101	97	72
Percent journal publications	38%	37%	52%	33%	45%	58%	55%	42%	39%	50%
Consultations, number	824	945	1,350	1,289	1,341	1,648	950	1,434	696	1,276
Consultations, hours	8,124	7,987	13,806	7,547	8,781	8,000	7,764	16,735	8,285	6,398
User/management meetings	12	14	13	12	9	14	19	16	10	21
Spatial data requests filled	605	586	604	532	586	503	242	324	257	181
Online accesses	103,211	186,175	170,407	250,559	182,732	310,758	4,456,122	1,372,090	900,055	629,374

Table B-12. FIA summary statistics and performance measures, FYs 2013–2022, continued.

EOY = end of year; FIA = Forest Inventory and Analysis; FIADB = Forest Inventory and Analysis database; FY = fiscal year; IT = information technology; QA = quality assurance; S&E = salary and expense.

[a] Includes return of previous year carryover, return of fire transfers, COVID-19 economic relief, supplemental disaster funding, National Forest System funds, additional Research and Development commitments (including IT contributions managed by FIA in FY 2021 and FY 2022), and funds from other Federal agencies.

[b] Includes partner contributions towards the base program and partner contributions that add value. Cash contributions from the National Forest System and other Federal programs are included under other Federal operational funds rather than under partner funds.

[c] Considering full program implementation funding to achieve 2007 strategic plan for FYs 2007 through 2013 and 2014 (current) strategic plan options A through C for FY 2014 through present. Full funding needed was adjusted for inflation. For FY 2022, appropriated funding received was calculated as the sum of appropriated operational funds and funds invested in S&E. This value is not comparable to prior years.

[d] Includes Federal grants and agreements.

[e] Starting in FY 2021, indirect S&E and rate related to S&E of non-FIA employees tracked with FIA budget code.

[f] Starting in FY 2021, EOY balance is for the appropriated operational funds. It does not include unspent S&E budgeted by the research stations.

Indirect expenses rate jumped in FY 2018 because of the Forest Service approach, adopted that year, to charge costs pools, which are considered an indirect expense rather than a direct expense in this report. Starting in FY 2021, indirect expenses cannot be tracked because, under the new budget structure, indirect costs are no longer charged to the programs.

Online data accesses jumped in FY 2018 due to FIA access to data through EVALIDator API for tool development.

Some Federal partner contributions are included in both the partner funds and total Federal funds categories. Total available funds category is adjusted to avoid duplication.

Some historic numbers have been updated to correct errors discovered during a data review.