Forest Inventory and Analysis

Fiscal Year 2020 Business Report

Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Forest Inventory and Analysis

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Executive Summary

For 90 years, the Forest Inventory and Analysis (FIA) program has played an integral role in providing the 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. Contemporary topics include carbon sequestration, water, recreation, biodiversity, forest products and services, biomass availability, economic development, land-cover and land-use change, nonnative invasive species, pollutant effects, pests and diseases, and wildfire risk.

In 1999 (Farm Bill, Public Law 105–185) and again in 2014 (Farm Bill, Public Law 113–79), Congress directed the Forest Service, an agency of the U.S. Department of Agriculture (USDA), to reevaluate its statewide inventory mission and to transition to survey each State annually rather than periodically, with the exception of Interior Alaska and U.S.-associated islands of the Caribbean and Pacific Ocean. In collaboration with partners, FIA developed strategic plans to fully transition into an annualized inventory and comply with other requirements. The latest FIA Strategic Plan includes a requirement for an annual business report that outlines the status and progress of the national, annual inventory program. In 2018 (Farm Bill, Public Law 115–334), Congress repealed the direction to revise the strategic plan for FIA, as directed in the 2014 Farm Bill, so the content of the existing Strategic Plan remains valid.

This annual business report, the program's 23rd, tells taxpayers, partners, and clients the program results accomplished with the provided financial resources and forecasts the outcomes for the coming year with budgeted financial resources. This relationship with taxpayers, partners, and clients is integral to FIA's continued success because accountability demonstrates our commitment to transparently delivering the best value, quality, and array of products expected by the communities we serve.

In fiscal year (FY) 2020, the program faced unprecedented difficult circumstances caused by the coronavirus (COVID-19) pandemic, hazardous conditions and poor air quality induced by a devastating wildfire season, and staff shortages due to hiring limitations. These challenges directly impacted field operations, especially in the West, and it is anticipated that these impacts will cascade through the program in future plot data collection and subsequent data analysis. In FY 2020, some key findings included in this report are—

Progress on annualized inventory. Despite challenges, FIA conducted inventory activity in all 50 States, including Interior Alaska, and measured about 12 percent of the forest sample locations included in the base FIA grid, compared to 13.5 percent in FY 2019. Except for Interior Alaska and Hawaii, all States, as well as Coastal Alaska, use an annualized survey. The Tanana Valley, the Susitna-Copper unit and the Southwest unit in Interior Alaska, and the Caribbean and Pacific Island inventories are surveyed using a periodic inventory. The total area currently sampled represents about 91 percent of all U.S. forest lands, with Interior Alaska outside the Tanana Valley and the Susitna-Copper unit representing the remaining 9 percent of the Nation's forest area. Inventory efforts started in the Southwest unit of Interior Alaska where inventory crews worked exclusively by helicopter for the first time since inventory began, in roadless areas that had not been inventoried beyond its rivers. Owing to the travel restrictions imposed by COVID-19, NASA delayed Goddard's LiDAR, Hyperspectral and Thermal Imager (G-LiHT) acquisition across the Southwest unit until 2021. The FIA survey of the Southwest unit will increase the total forest area sampled by an estimated 27 million acres.

Funding and partners' support. Annual FIA funding appropriated by Congress remained steady at $77 million. This amount was $21.4 million less than the amount, adjusted for inflation, needed for full program implementation of 2014 Farm Bill options A through C.[1] In addition to annual appropriations, FIA received an additional $0.5 million for COVID mitigation from the Coronavirus Aid, Relief, and Economic Security (CARES) Act at the end of FY 2020 that will be spent and accounted for in FY 2021. State agencies, universities, other Forest Service programs, other Federal agencies, and nongovernmental organizations (NGOs) contributed 14 percent of the total available funds—$12.9 million, representing a one-half million dollar increase over the previous year. About $4.3 million of the partners' fund was directed at intensifying the plot network or buying down plot measurement and reporting cycles to 5 years or less. The remaining $8.6 million were contributions that added value to the FIA program. Forty State agencies and the U.S. Virgin Islands were the largest group of supporters, contributing $3.5 million to the base program and an additional $2.2 million that adds value. About 61 percent of State agency contributions, $4.1 million, were from the Eastern States, reflecting the ownership contrast of Western lands where

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[1]See Long-Term Strategic Direction section for more information on options A through C.

Federal agencies are responsible for a much larger share of the land stewardship activities.

Grants and agreements. FIA leverages partnerships and contracts out critical work to external cooperators when equal quality can be achieved for less cost or additional expertise is needed. About $19.2 million or 21 percent of the available funding was invested in this way in FY 2020, with 36 percent—$7 million—managed by the FIA unit at the Southern Research Station (SRS). Seventeen State agencies and the U.S. Virgin Islands received 50 percent of granted funds. The largest States, Alaska and Texas, were the largest recipients.

Data availability. Data for all States, Coastal Alaska, and the Tanana Valley of Interior Alaska were accessible online in FY 2020. Data for most States were less than 2 years old, except for Kentucky, Tennessee, Louisiana, Florida, Texas, and Hawaii, which were 3 years old. Data collection for the Tanana Valley unit inventory was completed in 2018 and released to the public in 2020 through its own online database. The latest forest inventory data for Hawaii also became available to the public through a user-friendly online database. Published inventories of the Caribbean and Pacific Islands data were 5 years old or more because, in part, they are sampled under a periodic inventory. FIA data supplied information for 324 spatial data requests and almost 1.4 million online data requests. The number of consultations to the FIA team reached 1,434 and required an investment of time equivalent to 8.25 full-time staff positions.

Reporting and publications. FIA published 239 publications, a 17-percent increase from last year, including 107 core publications (reports specific to a complete survey unit, complete State, national forest, or national reports), and 101 journal articles. Of the published core publications, seven were 5-year State reports, analyzing inventory data collected in previous years for the States of New Hampshire, New York, Vermont, Mississippi, Texas, California, and Coastal Alaska; and three were inventory reports for the U.S. Virgin Islands, American Samoa, and Guam. The number of FIA publications per analyst and researcher averaged 2.8 for the entire program.

Quality assurance. FIA field-checked 13 percent of all measured field plots to ensure that FIA databases comprise only the highest quality data. All plots were further checked for consistency when loaded into the FIA database.

Relevant meetings. FIA held 4 user-group meetings and 10 management meetings to ensure that the program is providing the highest quality service and meeting its planned objectives according to the goals stated in the strategic plan and ongoing commitments made to our partners. Of the total 14 meetings, 8 were national and 6 regional.

Personnel. FIA, directly and through cooperators, employed 602 full-time employees, 16 fewer employees than the previous year—13 were cooperators' staff and 3 Federal employees. Cooperators are integral to the efficient delivery of the FIA program, comprising 223.6 full-time employees, or 37 percent of the total workforce. Of the total workforce, 59 percent, or 352.9 employees, were employed in data collection and quality assurance; 19 percent in analysis and research; 10 percent in indirect support from the research stations; 8 percent in information management; and 5 percent in administration.

Nonplot surveys. Although plot-based field surveys provide most FIA data, additional questionnaires and surveys are conducted to report on timber product output (TPO), logging utilization, and the characteristics and management objectives of the Nation's private woodland owners through the National Woodland Owner Survey (NWOS). Since FY 2000, FIA has collected such data from about 97,500 surveys and questionnaires. This information, in concert with FIA plot data, is critical to monitoring the sustainability of the Nation's forest resources.

FIA Strategic Plan. The 2014 Farm Bill requirements addressed in the FIA Strategic Plan include: (1) complete the transition to a fully annualized forest inventory program; (2) implement an annualized inventory of trees in urban settings; (3) report on renewable biomass supplies and carbon stocks; (4) engage State foresters and other users in evaluating core FIA data; (5) improve the timeliness of the TPO program and database; (6) foster greater cooperation among FIA, research station leaders, and State foresters; (7) promote availability of and access to non-Federal resources to improve information management; (8) collaborate with other agencies to integrate remote sensing, spatial analysis techniques, and new technologies into FIA; (9) understand and report on changes in land cover and use; (10) expand existing programs to promote sustainable forest stewardship through increased understanding of the more than 10 million family forest owners; and (11) implement procedures to improve the statistical precision of estimates at the sub-State level.

FIA Direction in 2018 Farm Bill. On December 11, 2018, Congress passed the 2018 Farm Bill. Section 8632 requested the Chief to continue to find efficiencies in the FIA program through the improved use and integration of advanced remote sensing technologies to provide estimates for State- and national-level inventories, where appropriate, and to partner with States and interested stakeholders.

Looking to 2021 and beyond. FIA anticipates another challenging year driven by the ongoing COVID-19 pandemic, continued trends in catastrophic wildfires and climate change, as well as difficult tradeoffs due to ongoing budget constraints. Important goals for FY 2021 and beyond include—

• Complete the remaining FY 2020 plots during the FY 2021 season, which will likely consume the majority of resources

available for FY 2021. Continue annualized inventory of 50 States, with focused attention on the completion of the periodic field inventory in the Southwest Alaska unit, the third unit of six in Interior Alaska. Start data collection in the U.S. Virgin Islands, originally scheduled to start in 2019. Continue urban data collection in all partner cities by completing both the remaining FY 2020 sample and the scheduled FY 2021 sample. Publish the majority of the 19 5-year State reports that are currently in final review and layout.

- Due to budget limitations and the remote logistics and higher costs of measuring roadless units in Interior Alaska, start the design of a safe inventory strategy for Alaska that is financially and logistically feasible. At the current annual funding levels, 150–200 field plots are projected to be accomplished per year while operating in roadless areas, whereas up to 300 plots per year would likely be possible with increasing emphasis on remote sensing integration in both Coastal and Interior Alaska. An inventory design that combines the Coastal and Interior units and leverages partnerships and remote sensing applications to produce model-assisted estimates derived from ancillary remote sensing data would reduce remeasurement intervals and costs, increase safety and sustainability of field operations, and maintain precision and quality of the data.

- Continue our investment in online applications that improve the delivery of FIA information, including the release of:

  ◦ The Landscape Change Monitoring System Data Explorer, an application designed to provide a visualization of Landscape Change products and related geospatial data and to serve as a portal for data downloads.

  ◦ The FIA Geospatial Showcase, a new hub that includes the content from FIA Digital Engagement work, featuring products from the Big Data Mapping and Analytics Platform (BIGMAP). BIGMAP is a cloud-based computing environment designed to store, process, analyze, and deliver FIA content. The platform integrates the capabilities of ESRI Raster Analytics and ArcGIS Enterprise to support the integration of satellite imagery with FIA plot data in order to produce map layers delivered to the public through the Forest Service ArcGIS Online, ESRI Living Atlas, and other open data portals. Some of these layers are expected to become available in FY 2021 and include: tree species distributions, forest type groups, forest carbon pools, and forest stocking, age, and height.

  ◦ The One-Click Timber Products Output (TPO) factsheet, an interactive application to provide annual estimated summaries on industrial and nonindustrial uses of roundwood across the United States. The tool was released in FY 2020 with data available for the South and will populate other States and regions as information becomes available in FY 2021.

  ◦ The TPO Interactive Reporting Tool, an application that allows the review of TPO data summaries for a selected county and year. The tool includes estimates of timber products, logging residue, mill residue, residential fuelwood, and other removals.

  ◦ The National Woodland Owner Survey (NWOS) dashboard, an interactive, online tool that explores the NWOS data by attribute and makes comparisons among States and regions by selected attribute of interest.

- Publish the summary findings from the most recently completed cycle of NWOS data, which included the data collection of 2,772 and 363 responses for the base and urban NWOS modules, respectively.

- Add data for the cities of Kansas City, St. Louis, and Springfield, MO in the FIA Urban DataMart. Publish data on Portland 2018 and San Antonio 2018, already included in DataMart, on the My City's Trees application.

- Publish the printed version of the *Forest Atlas of the United States*.

- Further develop Design and Analysis Toolkit for Inventory and Monitoring (DATIM). New versions are expected quarterly, with version 13.1 scheduled for October 2020. Updates to the User Guide accompany each new release.

- 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.

- Fill vacant positions with quality recruits at levels required for successful program delivery.

For additional details, see FIA program Area Updates for FY 2020.

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) 2020 (October 1, 2019, through September 30, 2020), gives our 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.[2]

The FIA program has been the Nation's continual forest census since 1930. We collect, analyze, and report information on the status and trends of America's forests: how much forest exists, where it exists, who owns it, how it is changing, how the trees and other forest vegetation are growing, how much has died or been removed, and how the 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 and other forest-related investments. The FIA program combines this information with related data on insects, diseases, and other types of forest damage to assess the current health 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 our grandchildren and their grandchildren to enjoy the benefits provided by America's forests as we do today.

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[2]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.fia.fs.fed.us.

Changes From Previous Years' Business Reports

The FIA annual business report quantifies and adapts performance measures that accurately reflect the program's progress and changes toward meeting the goal of an annualized inventory for all 50 States.

As FIA continues to move toward delivering a nationally consistent program, this report remains focused on the 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 Washington Office (WO). While most FIA accomplishments in FY 2020 had a national scope, others remained regional.

This year's report includes changes made to increase national consistency in reported outcomes and performance. A section titled *Program Area Updates* replaces and consolidates previous sections named *Program Features* and *Portfolio Leads Business Plan Updates* into one. The new section details FIA work updates in two parts—the first explains the work, scope, and main partners involved; and the second shows program progress, challenges, and deliverables produced during the fiscal year. The FY 2020 report regroups the categories used to quantify different types of salary and the equivalent number of full-time employees (also called full-time equivalents or FTE) from eight classes to four. The new *field operations* class combines previous classes labeled as *prefield production, field support, data collection*, and *quality assurance*; and the new *analysis and research* class combines previous classes named *research* and *analysis*. This change increases the accuracy of the data, as many employees split their time among multiple FIA teams and task areas to accommodate changing program demands and circumstances over the year. During the COVID-19 pandemic and intense fire season in the West, task-shifting became more common as operations adapted to travel restrictions, new field season schedules, and telework practices.

The FIA program has had a designated budget line within the Forest Service R&D mission area since FY 2017. As a result, indirect costs charged to the FIA program increased due to the new mechanism adopted in FY 2018 to calculate the cost pools that include common business services and infrastructure, and other pooled costs that include Office of Worker's Compensation Programs and Unemployment Compensation Insurance. While cost pools are estimated proportionally to the number of full-time employees (including those holding permanent, temporary, intermittent, and other types of positions within programs in a budget line), other pooled costs are assessed only on permanent employees' direct labor hours. In FY 2020, the FIA program was charged $10,413,491 in national cost pools and other pooled costs, an amount accounted for as the total effective indirect under National Office in table B-2. In FY 2020, FIA funds were used to pay charges for the Information Technology (IT) maintenance costs (formerly labeled Information Resources Decision Board, IRDB), unlike the past 2 years when charges were paid by R&D to help offset the increase of cost pools charged to the program (table B-2). The IRDB fund manages agency-sponsored IT projects.

For the first time, the report presents information about the number of plots sampled for nonnative invasive species using the national protocol adopted by all FIA units in 2013 (table B-9). Nonnative invasive species were recorded on selected FIA plots as early as 1999 in States using regional invasive species protocols—these data are not included in the report.

As a supplement to the FY 2020 Business Report, information related to online FIA data, production and publication dates for 5-year State reports, and links to the reports, as of end of FY 2020, can be explored interactively for each State here.

Due to the unprecedented challenges the program faced in FY 2020, this report includes a section dedicated to these challenges.

Fiscal Year 2020 Program Overview

In FY 2020, the FIA program completed its 19th year of implementing inventories annually, as outlined in the Strategic Plan for Forest Inventory and Monitoring, 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 hexagons, 6,000 acres in size, laid over the entire United States, and one plot located within each hexagon. A subsample of the grid plots may also be measured for a broader set of forest ecosystem indicators. The number of plots with various ecosystem indicators is noted in table B-9.

The primary goal of the FIA program is to measure at least 10 percent of FIA grid plots per year in the Western United States, and 15 percent of FIA grid plots per year in the Eastern United States. Table 1 shows the overall distribution of FIA grid plots for the United States, including Puerto Rico, the U.S. Virgin Islands, and U.S. territories and affiliated islands in the Pacific. These data are for illustrative purposes only and do not include possible additional plots that may be required because of partially forested sample locations, which can increase the number of field-visited plots by 15 to 20 percent.

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 the full sample intensity of 20 percent per year, or to make other value-added contributions such as funding new measurements or additional sample locations. In FY 2020, total appropriated funding was $77 million, $21.4 million below the target level—adjusted for inflation—to complete the transition from the base program to full implementation of plan options A through C, as outlined in the FIA Strategic Plan.[3] The following sections highlight unprecedented challenges, current outputs and products, program resources, and partners' contributions.

Challenges Faced in FY 2020

Fiscal year 2020 was a year marked by USDA Forest Service budget challenges and understaffing, compounded by the impacts of COVID-19 and a historic fire season. Impacted FIA field employees were reassigned to office tasks that supported data quality assurance, analysis, client requests, and research. In regions where State partnerships are used to complete field work, additional challenges were posed by COVID-19's economic impact on individual State revenues, budget shortfalls, and their ability to fill vacant field crew positions.

Flat FIA appropriations, combined with program cost, increases due to Federal salary increases, and payment of IT costs,

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[3]U.S. Department of Agriculture, Forest Service. 2016. Forest Inventory and Analysis Strategic Plan. FS-1079. Washington, DC: U.S. Department of Agriculture, Forest Service. 46 p.

Table 1. Overview of land area, FIADB forest area, RPA Assessment forest area, percentage of forest area, and P2 plots by region in FY 2020.

FIA region	Land area	Forest area (FIADB)	Forest area (RPA)	Forest (FIADB)	FIA grid plots (forest and nonforest)
	Mil. acres	Mil. acres	Mil. acres	Percent	Plots
North	607	182	176	30	102,175
South	533	267	246	50	89,771
Interior West	548	152	131	27	91,844
Pacific Coast (California, Oregon, Washington)	204	88	83	42	34,326
Coastal Alaska	39	14	14	35	5,089
Interior Alaska	327	114	114	35	3,373
Islands (including Hawaii)	7	4	3	53	1,300
Total	**2,264**	**822**	**767**	**33**	**327,877**

FIA = Forest Inventory and Analysis; FIADB = Forest Inventory and Analysis Database; FY = fiscal year; Mil = million; RPA = Resources Planning Act.
Note: RPA Assessment total forest area is 1.7 million acres higher than the data published in the 2017 Forest Resources of the United States report because table 1 includes Puerto Rico, the U.S. Virgin Islands, and U.S. territories and affiliated islands in the Pacific.

Table 2. Number and percent change of FIA plots sampled by unit, FYs 2020 and 2021.

	Pacific Northwest			Rocky Mountain			Southern			Northern			Total		
	2019	2020	Change	2019	2020	Change	2019	2020	Change	2019	2020	Change	2019	2020	Change
Total forest plots	3,243	2,340	-28%	2,553	1,593	-38%	8,063	7,799	-3%	5,838	6,306	8%	19,697	18,038	-8%
Base FIA grid	2,288	1,308	-43%	2,535	1,593	-37%	6,115	6,142	0%	3,948	4,459	13%	14,886	13,502	-9%
Spatial intensification	955	1,032	8%		-		378	398	5%	1,436	1,470	2%	2,769	2,900	5%
Temporal intensification	-	-		18	-	-100%	1,570	1,259	-20%	454	377	-17%	2,042	1,636	-20%
Urban plots	63	47	-25%	28	41	46%	202	181	-10%	1,440	47	-97%	1,733	316	-82%
Special Studies plots	-	-		77	17	-78%	-	124		1,541	-	-100%	1,618	141	-91%
Estimated percent of base grid sampled	14%	8%		12%	8%		15%	15%		13%	15%		13.5%	12.2%	

Note: urban and special study plots include measured forest and nonforest plots.

reduced available operating funds. Hiring limitations led to FIA staff shortages and directly impacted FIA field data collection. There were about 45 vacancies in critical field and support positions across all FIA units. Staff shortages on field operations were further compounded by the impact of the COVID-19 pandemic on travel restrictions and personnel safety, along with hazardous conditions and poor air quality caused by forest fires in some regions. These challenges limited the field plots measured to 50 percent of plan in the West and 90 percent of plan in the East.

Because FIA data are considered mission essential, this allowed data collection partnerships with States and contractors to continue during the pandemic. FIA obtained waivers to the existing Shelter-in-Place and Stay-at-Home orders for field crews from the USDA and the Department of Justice. The various stages of State lockdowns, combined with the unique operational business models and partnerships existing within FIA units, led to different modifications in data collection strategies during the FY 2020 season. FIA units in the South and North mostly relied on State agencies and contractors to collect inventory data. In the West, FIA Federal field crews participated in enterprise risk management, where each employee was empowered to assess personal risk and act accordingly, including shifting to office work related to prefield preparations, postfield data analysis, and research projects. In all units, FIA managers and staff developed Deliberative Risk Assessments for conducting field work that mitigated risk to employees and communities where they worked. Additionally, the program adopted travel restrictions and other measures to ensure the safety of staff and compliance with guidance provided by the Centers for Disease Control and Prevention (CDC) and Occupational Safety and Health Administration (OSHA). For more information on COVID-19-related safety measures, see the section on Program Safety and Annual Highlights.

Outputs and Products

Appropriated funds remained steady at $77 million and partner contributions added $12.9 million (table B-4), allowing the

FIA program to deliver inventory information about the extent and conditions of forests in the United States and to provide customer service to its clients in FY 2020.

Table B-1 shows comparisons across FIA regional units of the funds and the performance estimates of implementing the FIA program. In FY 2020, FIA sampled 13,502 base-grid forest plots throughout the 50 States, including the Tanana Valley and the Susitna-Copper units of Interior Alaska and Coastal Alaska. The estimated percentage of base-grid forest plots sampled for the entire United States dropped from 13.5 percent in FY 2019 to 12.2 percent in FY 2020 (table 2). Spatial and temporal inventory intensification efforts sampled 4,536 forest plots in addition to the base-grid plots measured, increasing the total number of plots sampled by 34 percent. Plot data collection for spatial and temporal intensification was financed by State agencies, Forest Service regions, and other Federal agencies using State and contracted crews.

Due to the COVID-19 pandemic, hazardous conditions and poor air quality induced by catastrophic wildfires and field staff shortages in all units, only 50 percent of all plots scheduled in FY 2020 were measured in the West and 90 percent in the East. Several factors contributed to the higher impact of the pandemic in the West: Western States closed down earlier; plots on a 10-year cycle are farther apart and require more travel, a challenge with no overnight stays allowed; and a limited technical workforce of contractors to supplement FIA data collection efforts. The main limiting factors in Eastern States were travel restrictions and denied access. Urban plots and special study plots were most impacted, especially in the Northern Region where most are located; almost none of the plots scheduled for FY 2020 were measured. Compared to FY 2019 plot activity, FY 2020 saw a significant decrease in the number of base-grid forest plots measured in the West: 43 percent in the Pacific Northwest Region and 37 percent in the Rocky Mountain Region; the national average dropped only 9 percent due to the larger representation of forest plots in the East, a region not as severely impacted by the documented challenges (table 2).

Despite not achieving plot measuring targets, all States successfully implemented some level of data collection in FY 2020. Remarkably, plot data collection started in the southwest unit of Interior Alaska for the first time and could be continued in Hawaii (Maui, Moloka`i, and Kaho`olawe) as part of a 3-year implementation schedule.

The conterminous 48 States and Coastal Alaska use an annualized[4] survey, and Interior Alaska, Hawaii, and the rest of U.S. islands implement a periodic[5] survey (figure 1). FIA's Congressional mandate, most recently from the Forest and Rangeland Renewable Resources Research Act of 1978 (PL

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

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

95–307), 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 and have periodic inventories. In FY 2020, plot data collection took place in Hawaii (Maui, Moloka`i, and Kaho`olawe), as part of a 3-year implementation schedule; no other Pacific islands were planned to be remeasured this year. COVID-19 contributed to further delays for periodic data collection in the U.S. Virgin Islands, originally scheduled to start in FY 2019. No plot remeasurements were scheduled for Puerto Rico in FY 2020 (table B-10).

The virtual work environment during the COVID-19 pandemic contributed to a jump in the total number of FIA publications,

Figure 1. FIA inventory implementation status, FY 2020.
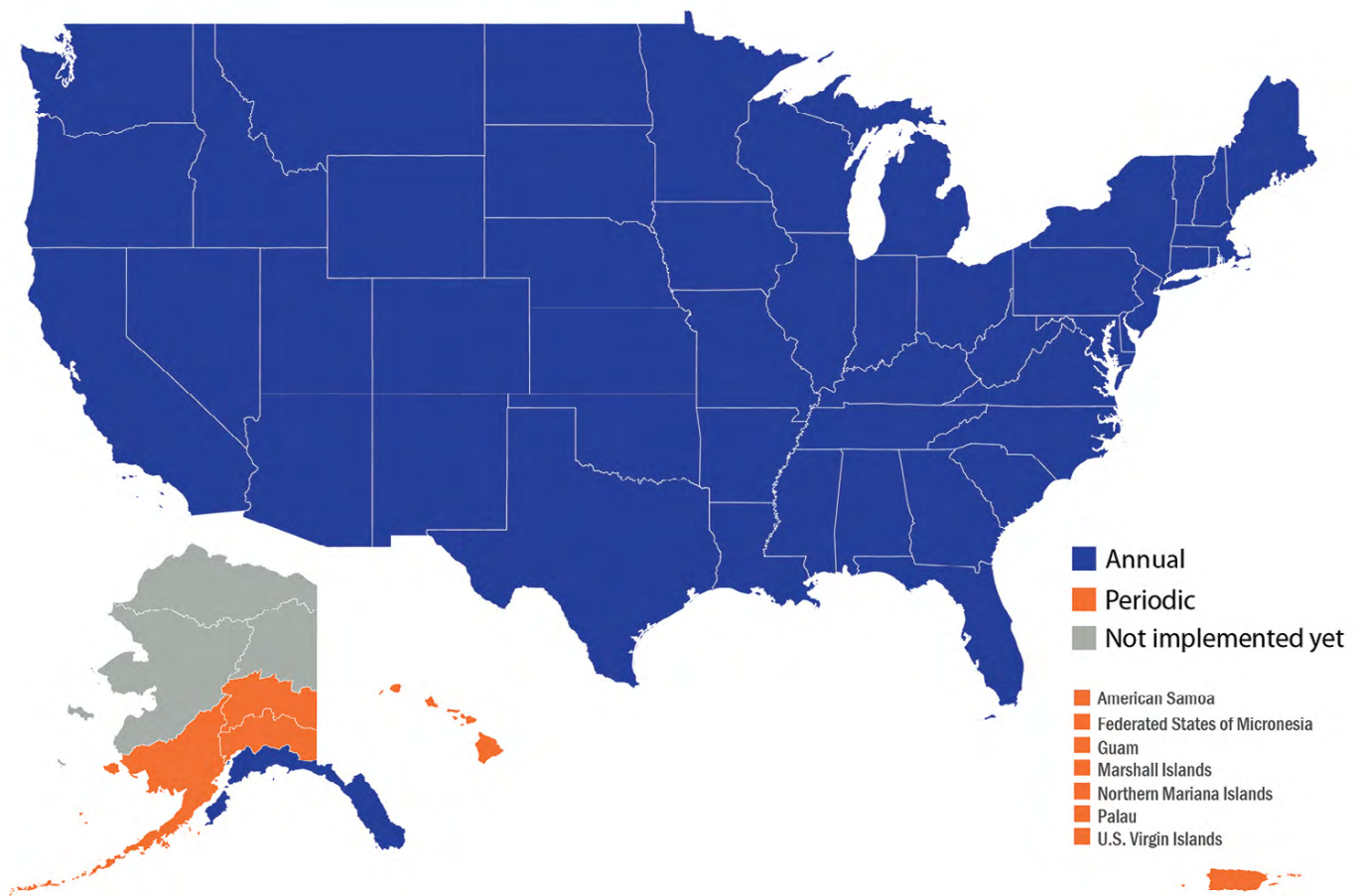
FIA = Forest Inventory and Analysis. FY = fiscal year.

Figure 2. FIA program available funds and expenses by category, FY 2020.

Total Funds Available $93,113,428

- Other federal funds 3%
- Partner funds 14%
- FIA Appropriation 83%

Expenses and EOY Balance

- EOY Balance 1%
- Partner funds expended 14%
- Indirect expenses 21%
- Grants 21%
- Salary 37%
- Travel 1%
- Office space and utilities 2%
- Equipment, publications, and other direct 3%

EOY = end of the year
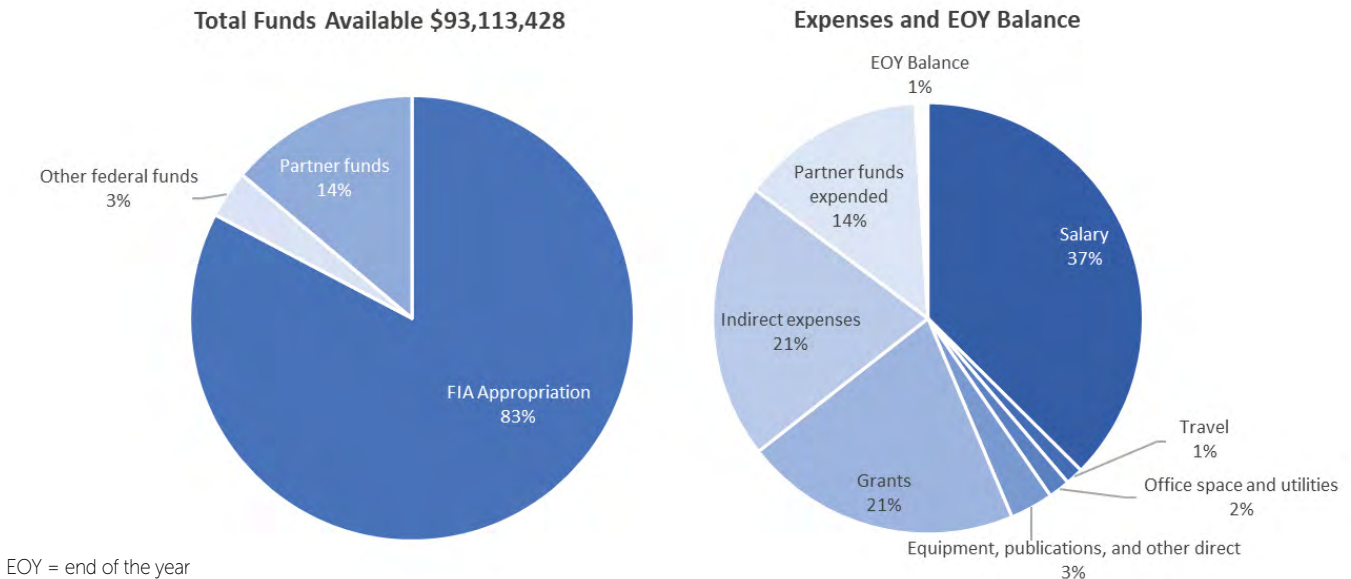
including journal articles, proceedings, and reports—239, representing a 17-percent increase from the previous year. Of these publications, 107 were core publications consisting of reports specific to a complete survey unit, complete State, national forest, or national reports. Core reports include 5-year State reports required by legislation, island resources reports, annual State resources updates, State timber product output reports, and regional and national resources reports. FIA also published 101 articles in peer-reviewed journals and 2 articles in proceedings from scientific meetings and conferences (table B-1).

In FY 2020, the number of consultations requested by FIA customers increased by over 50 percent, reaching 1,434. FIA clients included government, academia, industry, nongovernmental organizations (NGOs), private landowners, and media. These consultations required 16,735 hours of FIA staff time—equivalent to 8.25 full-time staff positions. FIA processed 1.37 million online data retrievals in which FIA customers obtained user-defined tables, data downloads, and maps of interest. Although the number of online data access was highest the previous year, 4.45 million, that peak had resulted from FIA access to data through EVALIDATOR API for tool development. Since 2009, the number of online data access has followed an upward trend, along with improved interactive tools and additional refinements to online user access (table B-1).

Program Resources

Congress appropriated funds for the FIA program in one Forest Service deputy area: Research and Development (R&D). In FY 2020, appropriated funds remained steady at $77 million. FIA received an additional $0.5 million for COVID mitigation from the CARES Act.[6] Because these additional funds were received at the very end of FY 2020, the funds were not included in the financial data of this report and will be accounted for in FY 2021. State agencies, universities, other Forest Service programs, other Federal agencies, and NGOs provided an additional $12.9 million, 14 percent of the total available funds, contributing $4.3 million to the base program and $8.6 million in added value to the program (figure 2 and table B-4). Partner contributions increased by 10 percent, almost $1.2 million more from previous year.

In FY 2020, FIA experienced program cost increases due to mandatory Federal salary and benefit increases totaling $1.8 million, and the FIA funds used to pay for the IT maintenance costs, $2.5 million, funded by R&D in FYs 2018 and 2019. The IRDB approves use of funding for agency-sponsored information technology projects. To help mitigate the total additional costs of $3.3 million, R&D provided FIA with an additional $1.58 million (table B-2). In FY 2021, these fixed-cost increases and IRDB-related costs are planned to be paid with FIA-appropriated funds.

Based on the FIA legislative mandate, Congress directs FIA to make funds available for collaborating with States and other partners to help implement the FIA program. Despite appropriated funds remaining flat since 2017, FIA granted almost $200,000 more in FY 2020 than in the previous year, investing a total of $19.2 million, or 21 percent of the available funds, in partnerships (figure 2 and table B-5). Seventeen State

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[6]Coronavirus Aid, Relief, and Economic Security Act, (PL 116–136).

Table 3. Annual FIA appropriations and allocation of grants to States for data acquisition, 2010–2020.

Category	Fiscal Year										
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
	Thousand Dollars										
Total FIA appropriation	71,817	71,452	69,186	65,567	66,805	70,000	75,000	77,000	77,000	78,000*	**77,000**
FIA data collection grants to States	7,278	8,002	7,475	5,338	7,098	5,173	8,428	8,945	9,652	10,633	**9,755**
Number of States and U.S. islands receiving grants	20	17	18	16	17	16	18	17	20	18	**18**
Average grants to participating States	364	471	415	334	418	323	323	526	482	591	**542**
Percent of appropriated funding granted to States for data collection	10%	11%	11%	8%	11%	7%	11%	12%	13%	14%	**13%**
State contributions for leveraged data collection	5,039	6,192	5,567	3,962	3,919	4,324	5,506	5,205	6,568	5,239	**6,809**
Number of fund-contributing States and U.S. islands	45	40	41	38	36	37	34	36	41	37	**41**
Average contribution from States	112	155	136	104	109	117	162	145	151	142	**166**

FIA= Forest Inventory and Analysis
* Includes $1 million supplemental appropriation for hurricane relief.
Note: FIA funds were granted to 17 States and the Virgin Islands. The Virgin Islands also contributed with FIA funds in addition to 40 States.

agencies and the Virgin Islands received 50 percent of this investment, $9.75 million, through annual agreements (table 3). In turn, State agencies take advantage of FIA's on-the-ground resources, contracted or dedicated, to contribute funds and in-kind resources for additional data collection and analysis to meet their local needs, reaching $6.8 million in FY 2020. Nearly one-third of the entire FIA workforce was State fieldwork employees, provided through these partnerships (figure 4).

Additionally, FIA invested 37 percent of all available funds in Federal salaries; 3 percent in equipment, publications, and other direct expenses; and 2 percent in office space and utilities. Travel expenditures decreased by 60 percent due to COVID-19 travel restrictions and represented 1 percent of available funds (figure 2).

Across FIA regions, cost and productivity figures differ because of the cyclical nature of the inventory system and the differences among field units in operational methods, topography, distance to roads, and access to property. Rates of effective indirect expenses in FIA field units in FY 2019 ranged from 10 to 16 percent (table B-2), reflecting differences in sources of funding and research station indirect expense assessments. Since 2018, the Forest Service increased FIA indirect costs using a new mechanism, called cost pools, based on the number of Federal FIA employees (table B-3). In 2020, the FIA program contribution to cost pools and other pooled costs was $10,413,491, taken off the top to pay for common

business services and infrastructure, telecommunications, utilities, overhead of workers compensation program, and unemployment. FIA also contributed to the maintenance costs of IT with $2,510,800, previously named IRDB costs. Of the $77 million appropriated to the FIA program, $63,609,709 was made available for allocation to FIA units through the corresponding research station.

Figure 3 shows the total appropriated funding for FIA from FY 2007 through FY 2020. Throughout this period, the federally appropriated budget for FIA has been less than the level necessary for full implementation—in FY 2020, around $98.4 million (adjusted for inflation). For more trends on performance measures see table B-12.

In FY 2020, FIA employed the equivalent of 378.6 full-time Federal workers (table B-3a), three less than in FY 2019. Cooperators, especially State natural resources agencies, accomplished much of the work done by FIA, contributing an additional 223.6 full-time employees (13 less than in previous year) for a total FIA workforce of 602.4. Cooperator employees included 178.5 field employees, 9.7 information management specialists, 29.4 analysts and researchers, and 6 administrative specialists (table B-3b). Cooperator employees constitute 37 percent of the total FIA workforce.

Of all Federal and cooperator FIA employees, 59 percent were involved in data collection and field support, 8 percent in

Figure 3. FIA-appropriated funding level, FYs 2007–2020.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■ Funding gap	14.40	16.70	15.82	11.68	13.41	18.15	23.17	23.20	20.11	16.24	16.19	18.46	19.19	21.39
■ Fed. appropriations	63.61	64.64	65.54	71.82	71.45	69.19	65.57	66.81	70.00	75.00	77.00	77.00	78.00	77.00
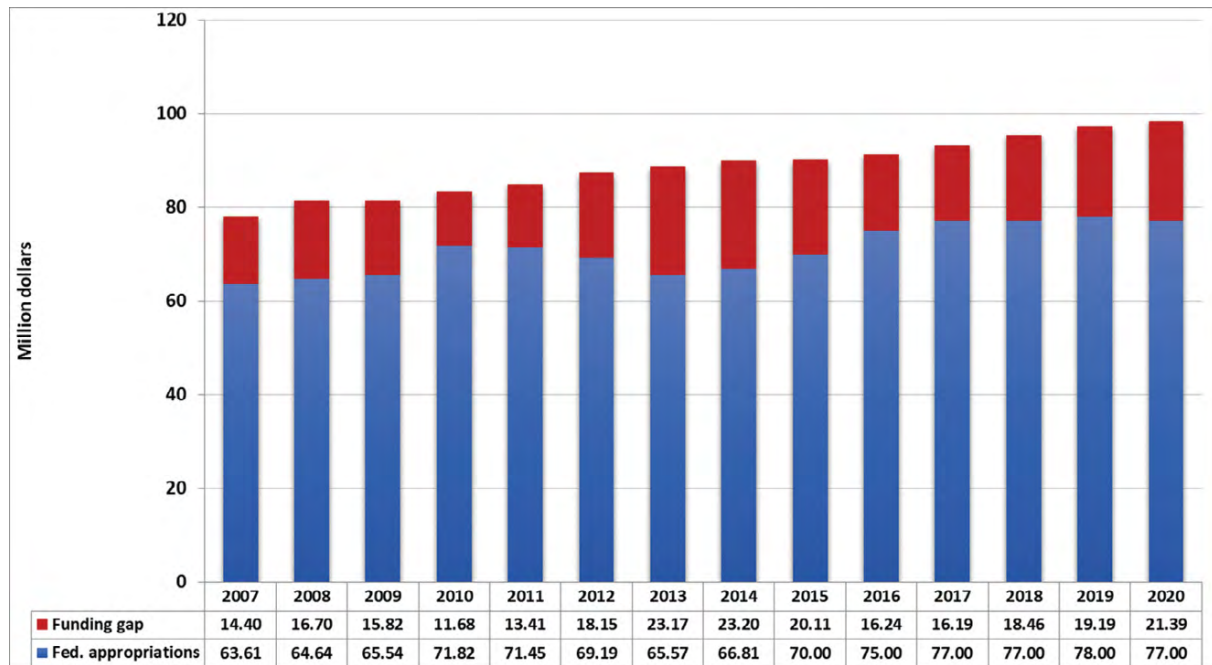
Fed. = Federal; FIA = Forest Inventory and Analysis; FY = fiscal year.
Note: Estimated total annual funding to fully achieve the 2007 Strategic Plan was $78 million. The 2014 Farm Bill required a new Strategic Plan with added items requiring $90 million annually to fully achieve Plan options A through C. Required annual funding levels for full implementation have been adjusted only for inflation each year in this figure and do not include additional costs due to the expansion of the program in some areas. Funding gap is noted in the red segment on bars.

information management, 19 percent in analysis and research, and 5 percent in program management and administration (figure 4). About 9 percent of FIA funds were also used to cover a portion of the administrative costs of R&D staff at research stations who provide support to FIA personnel.

FIA Investment in Partnerships and Partners' Contributions

As indicated by the 2018 Farm Bill, the 2014 Farm Bill, and the 1998 Farm Bill, Congress directed the FIA program to partner with States and other entities. The base Federal commitment is an inventory program that collects data from 10 percent of the sample locations in the Western States (10-year cycle) and 15 percent of the sample locations in the Eastern States (7-year cycle) annually, with comprehensive, analytical reports for all States produced at 5-year intervals. The following discussion summarizes program grants and partners' contributions.

FIA Investment through Grants and Agreements. Each year, FIA units enter into various grants and cooperative agreements with partners to accomplish specialized work in support of the FIA mission. 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,

Figure 4. Federal and State FIA program employees by job group, FY 2020.

FIA-supported employees (602)
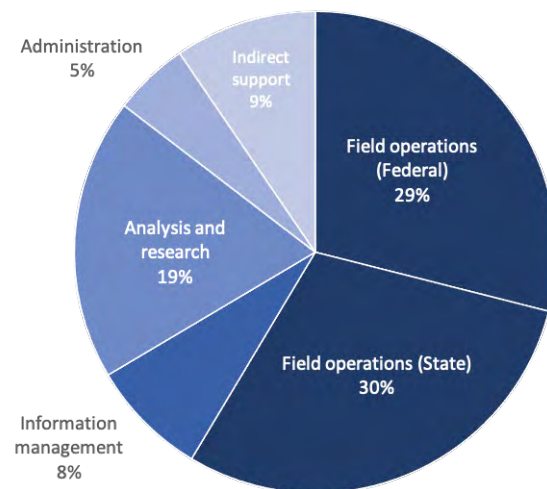
FIA = Forest Inventory and Analysis. FY = fiscal year.

Figure 5. Grants and agreements by recipient group, FY 2020.
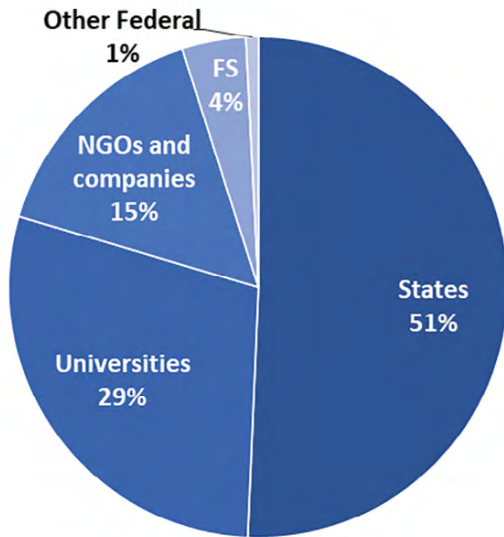
Recipient group	Grant amount ($)	No. of recipients
States + U.S. islands	9,755,408	17+1
Universities	5,560,321	25
NGOs and companies	2,980,140	23
Forest Service	795,122	6
Other Federal agencies	154,406	4
Total	**19,245,398**	**76**

NGOs = nongovernmental organizations.

and research in techniques development. In FY 2020, FIA invested over $19.2 million (almost $200,000 more than previous year) through 105 grants and agreements with partners, including 17 State agencies plus the U.S. Virgin Islands ($9.8 million), 22 universities ($5.6 million), nongovernment partners ($3 million), other Forest Service programs ($800,000), and other Federal agencies ($150,000) (figure 5, table B-5). From the largest recipient group, State governments, the State of Alaska received $2.26 million, which included a $1 million helicopter contract, followed by Texas with $1.4 million, Colorado with $0.8 million, Georgia with $0.77 million, Maine with $0.67 million, and Alabama with $0.55 million (figure 6). The minimal fluctuation of FIA investment in external partnerships from year to year demonstrates the reliance of the program on collaborations to efficiently complete the work.

The use of grants and agreements allows FIA managers to augment the program capacity to collect and analyze data as well as report information to individual States.

Partners' Contributions to FIA. At their discretion, partners may contribute the resources needed to bring the FIA program up to the full 20-percent measurement per year (5-year cycle) that is described in the authorizing legislation (1998 Farm Bill). In addition, or as an alternative, partners may choose to contribute resources to enhance the FIA program from their perspective, such as intensifying the base FIA sample location grid to support analysis at finer spatial resolution, funding additional types of measurements on FIA sample locations, or

Figure 6. Grants and agreements to State partners, in thousand dollars, FY 2020.
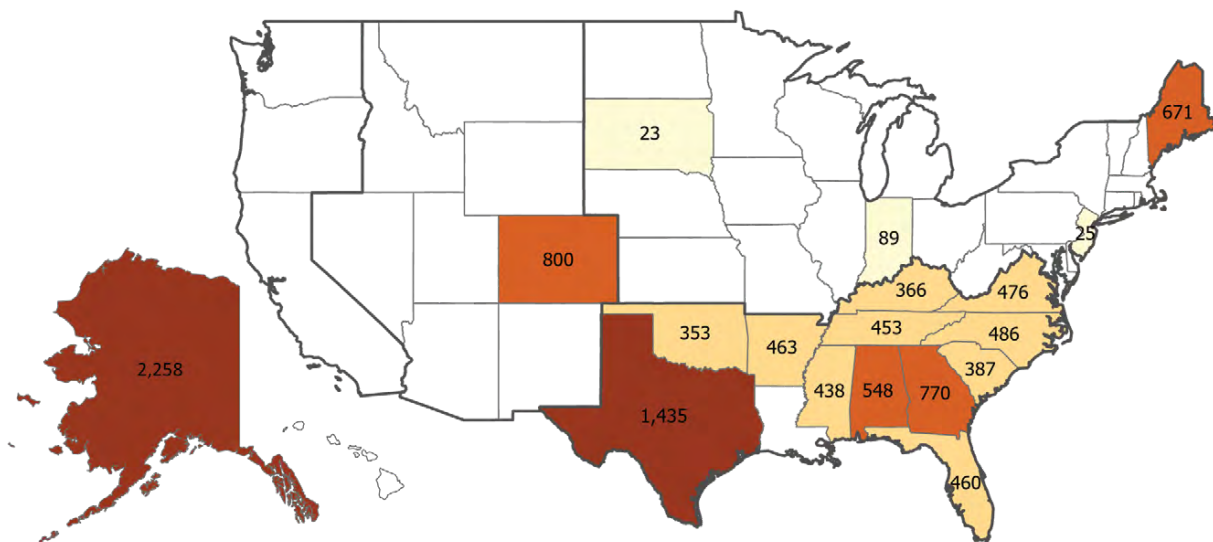
Figure 7. Partner contributions by FIA region and type, FY 2020.

West $5.1 Million

East $7.8 Million

Pacific Northwest

North

Rocky Mountain

South

★ National Headquarters
● Field Headquarters

American Samoa
Federated States of Micronesia
Guam
Marshall Islands
Northern Mariana Islands
Palau
U.S. Virgin Islands

FIA region	Base program ($)	Value added ($)	Total ($)
Pacific Northwest	722,188	3,081,494	3,803,682
Rocky Mountain	209,754	1,073,187	1,282,941
South	2,431,590	378,874	2,810,464
North	938,663	4,054,547	4,993,210
Total	4,302,195	8,588,102	12,890,297

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 to supplement issues of interest.

Table B-4 lists 81 partners that have contributed resources to the FIA program in FY 2020, through 99 different partnerships, either to achieve the 20-percent level of cost-sharing, often expected of agreements, or to add value to FIA in other ways. 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. Contributions are assessed for reporting purposes 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 almost $4.3 million toward the base program as defined by option B of the FIA Strategic Plan, including full 20-percent of target plots measured annually, imagery and photo analysis, and development of core reports. Partners also provided another $8.6 million in contributions that add value to the FIA program (about $1.2 million more than in FY 2019), for a total of $12.9 million. Partner-shared

costs vary by region and the ability of States and other partners to contribute each year. While eastern partners provided over 61 percent of the total FY 2020 contributions, or $7.8 million ($3.4 million toward the program base and $4.4 million in value added), western partners contributed 39 percent, or $5.1 million (almost $1 million toward the base program and $4.1 million in value added) (figure 7).

Forty State agencies and the Virgin Islands contributed $6.8 million to leverage FIA data collection: $3.3 million to base program and an additional $3.5 million to add value (table 3). About 61 percent of State agency contributions, $4.1 million, were from the Eastern States (table B-4). California Department of Forestry and Fire Protection, CAL FIRE, was FIA's largest investor with over $1.5 million for plot intensification, followed by the States of Alaska, Wisconsin, and Texas (figure 8).

As a national program with operations delivered regionally, the distribution of funds granted to partners and the distribution of investments received vary disproportionally among the four FIA units. In 2020, the Southern Research Station (SRS) FIA unit invested the largest amount of funds, 36 percent, mostly in agreements with State agencies

Figure 8. Total State agency contributions to the FIA program, in thousand dollars, FY 2020.

(table 4). The proportionally larger investment in the South results from the large representation of large private forest ownership, the fast forest growth rates, the importance of the forest sector, and a different FIA business model that relies heavily on inventory plot data collected through partnerships with State agencies. The Northern Research Station (NRS) FIA unit managed 24 percent of the granted funds and the largest number of grants and agreements, 34 percent, in part because this unit processed the majority of the national agreements on behalf of the program. The NRS FIA unit also received and managed the largest percent of partner contributions, about 5 million (39 percent) of the total, followed by the Pacific Northwest Research Station

(PNW) FIA unit (30 percent), the SRS FIA unit (22 percent) and the Rocky Mountain Research Station (RMRS) FIA unit (10 percent). The Washington Office (WO) is allocated the internal IT-related funds.

Over the last 10 years, FIA contributed over $167 million to its partners to implement an efficient inventory. During the same period, partners have contributed almost $101 million to leverage Federal dollars, which have reduced inventory cycles, increased the density of plots, and provided for other annual inventory enhancements. Table 5 summarizes FIA grants and partners' contributions by organization group.

Table 4: FIA grants and agreements, and partner contributions by FIA unit, FY 2020.

Unit	Total FIA G&A				Total partner contributions			
	Amount	Percent	Number	Percent	Amount	Percent	Number	Percent
	(dollars)				(dollars)			
PNW	3,309,572	17%	19	18%	3,803,682	30%	18	18%
RMRS	1,853,508	10%	12	11%	1,282,941	10%	9	9%
SRS	6,949,198	36%	28	27%	2,810,464	22%	18	18%
NRS	4,604,775	24%	36	34%	4,993,210	39%	54	55%
WO	2,528,344	13%	10	10%	0	0%	0	0%
Total	**19,245,398**	**100%**	**105**	**100%**	**12,890,297**	**100%**	**99**	**100%**

FIA = Forest Inventory and Analysis; FY = fiscal year; G&A = grants and agreements. NRS = Northern Research Station; PNW = Pacific Northwest Research Station; RMRS = Rocky Mountain Research Station; SRS = Southern Research Station; WO = Washington Office.
Note: Percentages may not add to totals because of rounding.

Table 5. FIA grants and agreements to partners, and partner contributions by organization group, 2011 through 2020 (10 year summary).

Group	Total FIA G&A	Average annual G&A	Percent of G&A	Total partner contributions	Average annual contributions	Percent of contributions
	(dollars)	*(dollars)*		*(dollars)*	*(dollars)*	
States/islands	82,013,586	8,201,359	49%	56,043,850	5,604,385	56%
Universities	44,969,871	4,496,987	27%	8,681,706	868,171	9%
Forest Service	12,399,257	1,239,926	7%	24,789,363	2,478,936	25%
Other Federal	2,269,634	226,963	1.4%	8,760,205	876,021	9%
Other partners	25,315,856	2,531,586	15%	2,417,021	241,702	2%
Total	**166,968,203**	**16,696,820**	**100%**	**100,692,146**	**10,069,215**	**100%**

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

FIA Data Availability

The FIA program mission is to provide continually updated, accurate, and reliable information on the status and trends of the Nation's forested 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 forestland 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.

In an effort to measure how the FIA program satisfies some of these program objectives, we created an interactive app to

Figure 9. Latest year of availability of online FIA data, FY 2020.
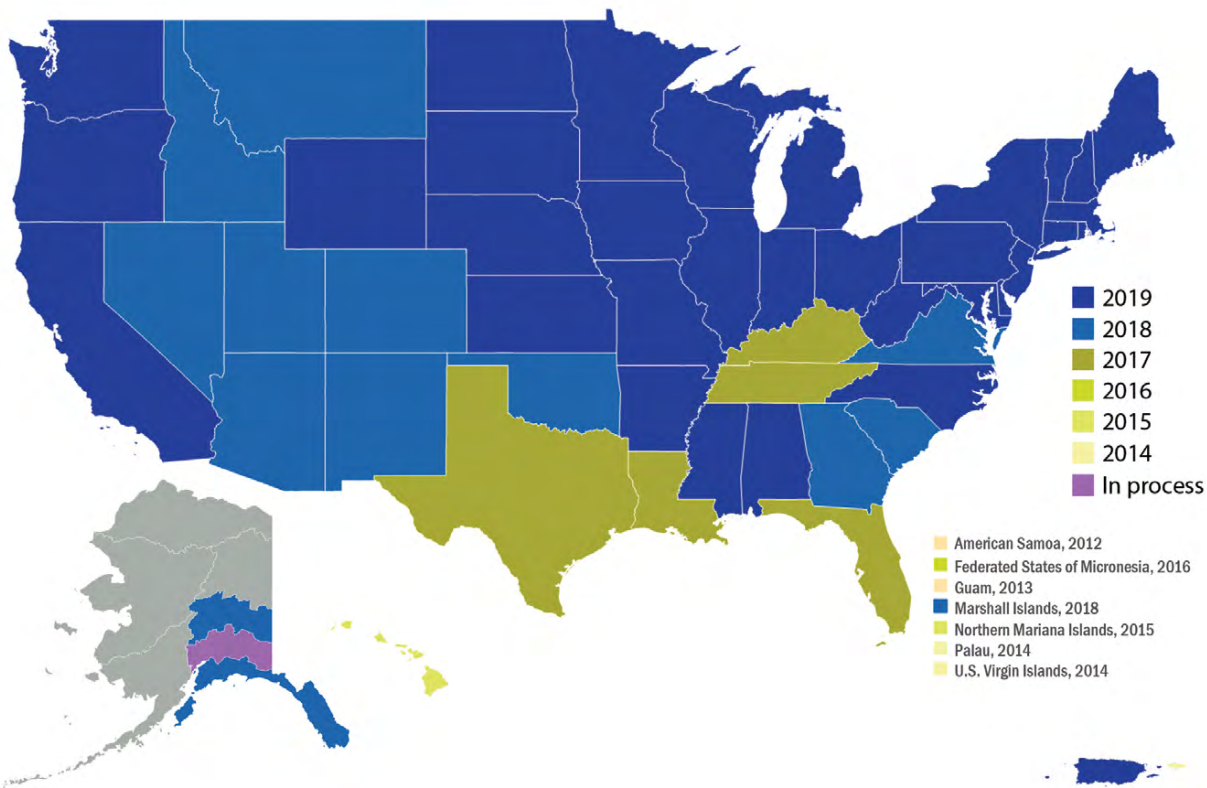
FIA = Forest Inventory and Analysis. FY = fiscal year.
Note: Information related to FIA data available online, production and publication years of 5-year State reports, and links to the reports as of end of FY 2020 can be explored interactively for each State here.

Figure 10. Inventory year of FIA State reports, FY 2020.
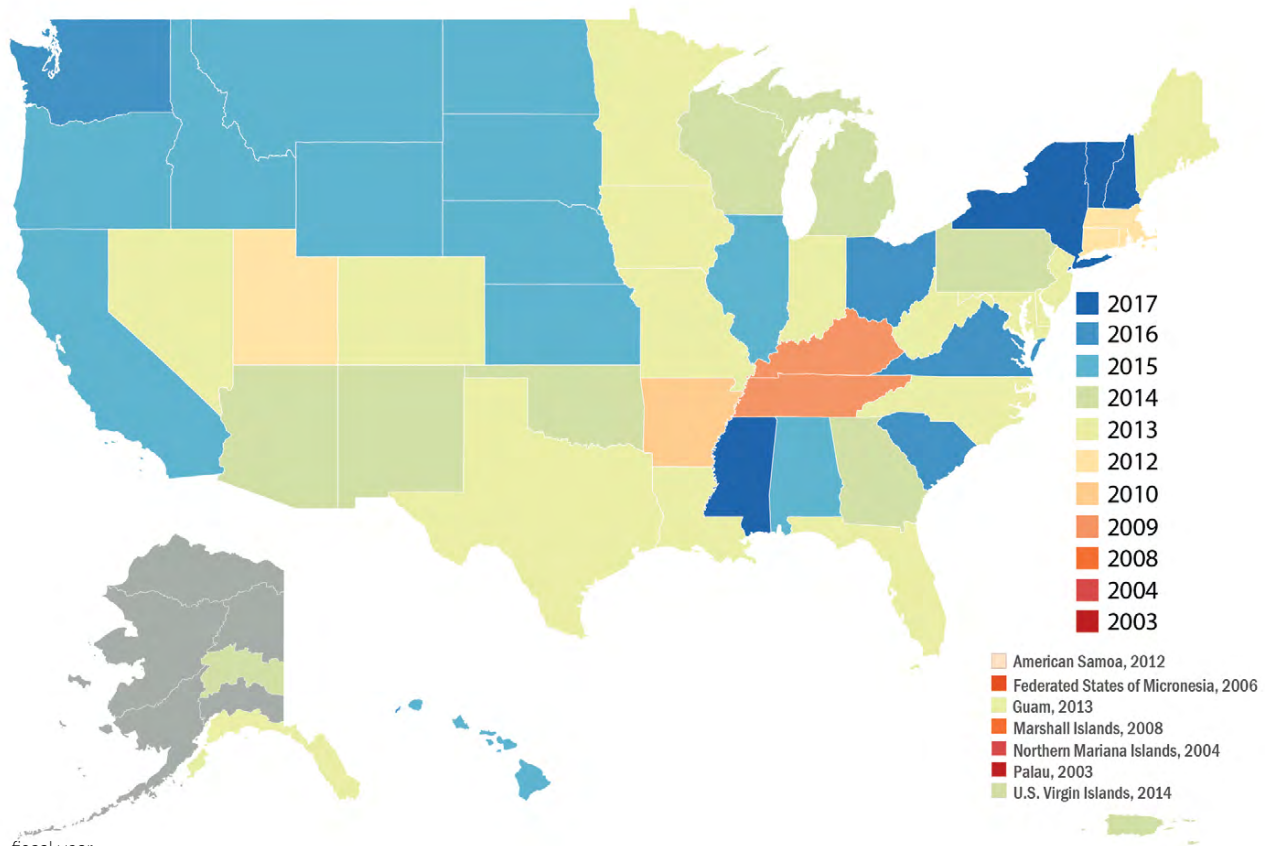
FY = fiscal year.
Note 1: Production year refers to the FY that the publication was created, in most cases matching the last inventory year included in the data.
Note 2: Information related to FIA data available online, production and publication years of 5-year State reports, and links to the reports as of end of FY 2020 can be explored interactively for each State here.

provide FIA data available online, production and publication years of 5-year State reports and links to them, and status of future 5-year State reports, as of end of FY 2020.

Figure 9 shows, for each State, the most recent year for FIA data accessible in our public database as of September 30, 2020—the end of FY 2020. Most of the conterminous States and Coastal Alaska had data less than 2 years old available online, which is the target date for recency of data. Data from Kentucky, Tennessee, Louisiana, Florida, Texas, and Hawaii were 3 years old. Data from the Marshall Islands, the Federated States of Micronesia, and the Northern Mariana Islands dated less than 5 years old, while Guam, American Samoa, Palau, and the U.S. Virgin Islands dated more than 5 years. The latest forest inventory data for the Hawaiian Islands is available to the public through a user-friendly online inventory database. In Interior Alaska, data collection for the second inventory unit, the Susitna-Copper unit, was completed and the third unit, the Southwest unit, was started. Data collection for the Tanana Valley unit inventory was completed in 2018 and released to the public in 2020 through its own Microsoft Access database. Continued improvements to data

processing and in the National Information Management System (NIMS) are paying dividends by enabling FIA to establish a more routine loading schedule. The development of Universal NIMS (UNIMS), the next generation replacement for NIMS to internally store and process plot data, will allow for the flexibility necessary to include newer protocols such as data from Interior Alaska, Hawaii, urban areas, and special studies, among others. Once completed, data from UMINS will be exported to FIA database (FIADB) for use by analysts and software tools as it currently is done by NIMS today.

Figure 10 shows the most recent inventory year included in the 5-year FIA report for each State, which differs from the year of publication (figure 11). Inventory units with report data less than 7 years old are shaded blue or green and include: 42 States, Coastal Alaska, Interior Alaska-Tanana Unit, Puerto Rico, the U.S. Virgin Islands, and Guam. Blue tones correspond with inventory data less than 5 years old. Within the conterminous United States, the oldest data included in a current State report were collected in 2009 in Kentucky and Tennessee, followed by data collected in 2010 in Arkansas.

Figure 11. Publication year of FIA 5-year State reports, FY 2020.
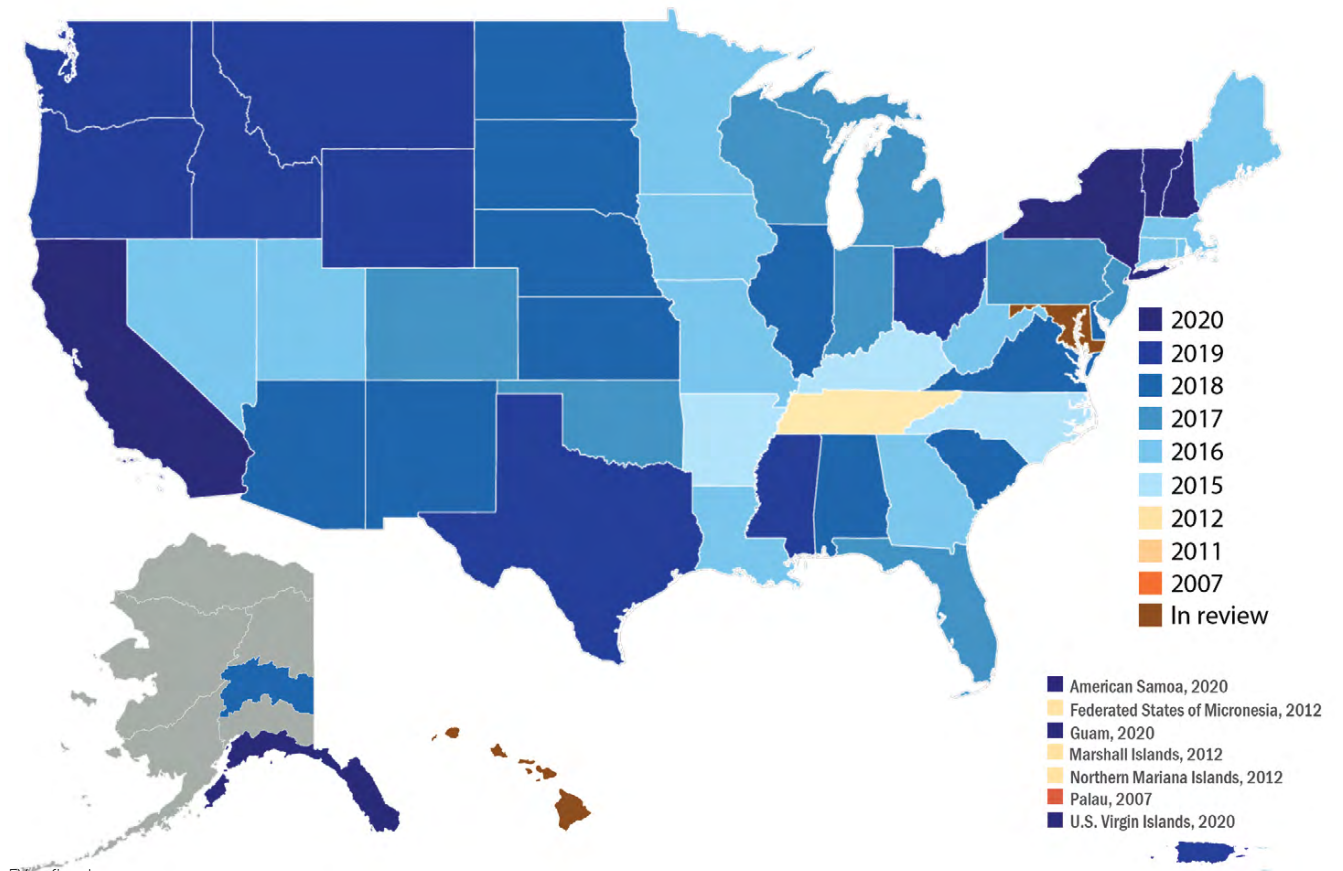
FY = fiscal year.
Note 1: Publication year of State report does not match the dates of data shown in the publication.
Maryland's 5-year State report, produced as a collection of story maps, was created in 2013 but has not yet been published. The last published report for Maryland is 2008.
Note 2: Information related to FIA data available online, production and publication years of 5-year State reports, and links to the reports as of end of FY 2020 can be explored interactively for each State here.

Except for Hawaii, Tennessee, and Maryland, 5-year State reports were published less than 6 years ago, meeting the program objective (figure 11). Maryland's 2013 State report was produced as a series of story maps, yet to be published. American Samoa, Guam, and the Virgin Islands reports were published in FY 2020. Although the goal is not to exceed 10-year cycles outside the conterminous United States, Palau had a longer cycle and was not able to report within this time window.

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 about States and regions.

The FIA program also provides data users with a TPO toolkit to deliver estimated data for timber products, logging residue, mill residue, residential fuelwood, and other wood removals.

The TPO toolkit includes five reporting tools: TPO Interactive Reporting Tool (available only for Oregon, Idaho and Southern States), TPO Data Download, TPO One-Click Fact Sheets (available only for the Southern States), TPO Reporting Tool-Legacy, and the TPO Explorer (coming in FY 2022).

Quality Assurance

The FIA program collects, analyzes, and publishes tremendous amounts of data annually. A large part of our work consists of designing, implementing, and carrying out procedures to ensure the data are unbiased and represent the larger landscape. Toward this end, FIA's Quality Assurance (QA) program employs a framework to promote consistency during all stages of the national core FIA inventory process. The FIA *National Core Prefield Guide* and *National Core Field Guide* document the protocols, ensuring consistent prefield and field data collection for core data items. 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 National Information Management System (NIMS) database and NIMS Compilation System (NIMS-CS) provide additional error checks and consistently calculate and provide access to a variety of derived variables using estimation equations that are described in general technical reports. Each field unit uses a system of post-collection quality assurance checks to inspect data for anomalies. Feedback from users provides an important step in ensuring the quality of the data. We continue to evolve and automate QA throughout our processes.

The National QA Coordinator position had been vacant, but it was filled in June 2020. This position, located at RMRS-FIA, works with the National FIA Program Office and the regional and national band leads (data collection, information management, analysis, and techniques research) to provide direction and coordination for the FIA QA program.

The FIA program promotes process transparency and consistency by extensively documenting methods and procedures, including:

- The FIA *National Prefield Guide 9.1* and rigorous QA protocols define a nationally consistent process to collect information about FIA plots before field visits. The updated version, once posted in 2021, can be accessed at the following link: https://www.fia.fs.fed.us/library/field-guides-methods-proc/index.php)

- Up-to-date FIA *National Core Field Guides*, such as *Field Guide version 9.1*, ensure consistent core program data collection (see https://www.fia.fs.fed.us/library/field-guides-methods-proc/index.php for more details; for urban field procedures see https://www.fia.fs.fed.us/program-features/urban/).

- The field QA Check Procedures Guide assists in promoting field QA consistency from region to region.

- The Forest Inventory and Analysis Database (FIADB) displays standardized output tables and is accompanied by detailed documentation in a recently updated Database Description and User Guide, version 8.0.

- A National R&D QA Plan provides direction to ensure consistency of research standards and procedures and explain review processes. The QA Plan establishes standards and procedures for all organizational units and personnel within Forest Service Research and Development.

- The FIA Quality Assurance Fact Sheet summarizes the processes within the FIA program, from data collection through analysis, which help ensure consistent data and reporting.

Ongoing QA tasks in FY 2020 were aimed at identifying errors and increasing efficiency and consistency in the national inventory, including:

- Continuing to implement an annualized, national, urban field data collection certification.

- Continuing to develop urban field, compiled, and i-Tree data summary reports to share internally and externally for review data prior to public data release.

- Continuing to develop systematic edit checks of data before public release, including MIDAS logic checks completed in the data collection phase and NIMS load error checks.

- Defining rigorous national cold-check field and scoring procedures to allow for equivalent field crew assessments across regions and crew types.

- Developing a national system that performs checks and generates individual check-plot results to assist in comparing quality standards nationally.

- Developing a Master Tree Species list to ensure consistent reporting of tree species across regions, when possible.

- Working across regions and units to identify inconsistencies, come to resolution, and implement changes in prefield and field manual versions 9.1.

- Collaborating, developing, and implementing national data collection staff training standards to ensure consistency, beginning with initial training.

- Continuing to develop well-defined prefield canopy cover measurement training procedures and training material.

- Developing and documenting NIMS tables and NIMS-CS, a consolidated FIA data processing system.

- Working toward improved database systems, the Universal NIMS database (UNIMS), that connect different components of the inventory (e.g., urban, rural, special studies).

FIA Data Requests and Access for FY 2020

Spatial Data Services

The FIA Spatial Data Services (SDS) Team provides services to clients through a virtual Spatial Data Services Center (SDSC), with staff located in all four FIA regions. In FY 2020, SDSC staff consisted of:

- Tom Thompson, National SDS Team Lead, John Chase, and Brett Davis, PNW
- Justin Holgerson and Liz Burrill, NRS, National and Multi-Regional Projects
- Carol Perry and Tracy Roof, SRS
- Chris Toney and Karen Schleeweis, RMRS

FIA enters into formal agreements with clients when requested data and information are confidential or not publicly available. In FY 2020, the use of the Material Transfer Agreements (MTA) and Memorandums of Agreement (MOA) fully replaced the Memorandum of Understanding (MOU) as the legally binding agreement instruments used to establish a framework for cooperation for clients whose access to confidential FIA data was critical to the project and the project clearly benefited FIA. Terms and conditions included in these agreements ensure the full protection of FIA confidential data. When plot coordinates are shared, the agreed terms prohibit the client from visiting the plot for the intention of manipulating FIA data or intentionally leaving the plot in a condition not reflective of management conditions in the surrounding area. The transition from MOUs to MOAs and MTAs put new agreements on hold for a few months at the end of the 2019 fiscal year and into FY 2020. Additionally, Nondisclosure Agreements for Federal employees were replaced with a "Letter of Intent" regarding data confidentiality. Nondisclosure Agreements and Data Security Plans will still be required for non-Federal employees who have a demonstrated need to use confidential FIA data.

During FY 2020, FIA entered into new data-sharing agreements (MTAs) with the University of Maine, the University of Massachusetts, the University of Minnesota, Michigan State University, the University of Washington, and the University of Montana, among others. FIA work continued with a variety of partners, including: NASA, the U.S. Geological Survey, the University of Maine, the University of Maryland, the Cary Institute of Ecosystem Studies, other universities, and other non-FIA programs within the Forest Service. Internal agreements were renewed with the Geospatial Technology and Applications Center (GTAC), the LANDFIRE program, and the Forest Health Assessment and Applied Sciences Team.

Figure 12. Requests made to the FIA Spatial Data Services Center, FY 2020.
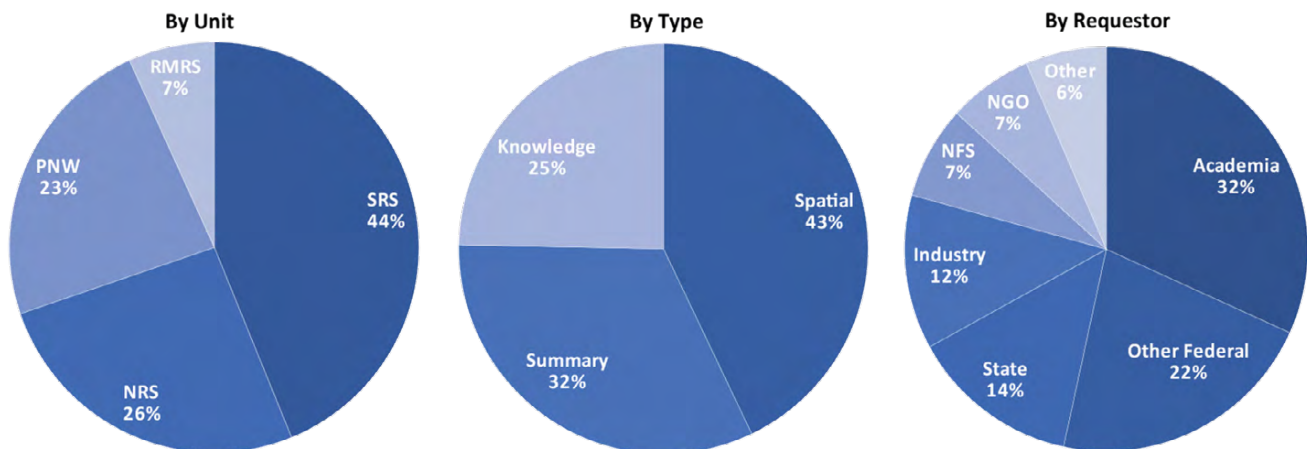
FIA = Forest Inventory and Analysis; NFS = National Forest System; NGO = nongovernmental organization; NRS = Northern Research Station; PNW = Pacific Northwest Research Station; RMRS = Rocky Mountain Research Station; SRS = Southern Research Station.

Table 6. Number of database retrievals using FIA web applications by fiscal year, 2003–2020.

	2003–2009 (Sum)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Number of retrievals	152,647	104,676	132,413	94,027	103,211	186,175	170,407	250,559	182,732	313,380	4,456,122	1,372,090

FIA = Forest Inventory and Analysis; FY = fiscal year; NGO = nongovernmental organization; NIPF = nonindustrial private forest landowner.
Note: These consultations do not include Special Data Services Center requests.

FY 2020 experienced a 33-percent increase in requests for FIA data; 324 requests were processed (figure 12), up from 242 requests in 2019. National or multiregional data requests numbered 30, accounting for 9 percent of all spatial data requests.

Spatial data requests are cataloged as one of three types: spatial, summary, or knowledge. Spatial requests are those where 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 the SDSC. In FY 2020, the percentage of data requests classified as spatial continued to be the category most in demand but decreased to 43 percent, compared to 50 percent reported the previous year (figure 12). Knowledge and summary data requests increased to 32 percent and 25 percent, respectively.

Academia continues to be SDSC's largest client, with 32 percent of all new requests. Federal agencies (excluding the Forest Service) accounted for 22 percent of all requests, followed by States and industry, with 14 and 12 percent respectively. The Forest Service National Forest System (NFS), NGOs, and others accounted for 20 percent.

Although the SRS continues to respond to the largest number of spatial data requests, 44 percent of the total (figure 12), the unit continued to experience a downward trend since FY 2015, when SRS responded to 74 percent of all the data requests.

Web Tools and Use

The FIA program has come a long way since the FIA Data Base Retrieval System (DBRS) was introduced in 1996, allowing the public to query regional FIA data sets in Eastwide/Westwide format. Since then, a variety of web tools have been developed and retired, including the Forest Inventory Mapmaker program, developed in FY 2002 and retired in FY 2009, and the Forest Inventory Data Online (FIDO) tool, developed in FY 2008 and retired in FY 2018, making way for the next generation of data retrieval programs. In FY 2015, a new tool was developed as a partnership between the NFS and FIA, the Design and Analysis Toolkit for Inventory and Monitoring (DATIM). In FY 2020, DATIM had 4,755 retrievals and its version 13.0 was in production by the end of the fiscal year (table B-7). Other currently supported tools that allow access to the FIA data include: EVALIDator; the EVALIDator application programming interface (API), which allows users to enter hypertext markup language (HTML) to query the FIA database (FIADB); the NWOS online Data Access tools; and the TPO toolkit.

Overall, the number of FIA tool users fell in FY 2020 (table 6). The use decrease was mostly due to the changes in how the EVALIDator API is being incorporated into FIA's reporting, and the impact of the COVID-19 pandemic on universities and related research. EVALIDator API reached over a million retrievals in FY 2020 (table B-7). This number peaked at almost 4.5 million in the previous year due to the high number of hits to the EVALIDator API during the development and release of FIA dashboards applications.

Exceptions to this downward trend were the 2,431 queries of the NWOS database, up 11 percent from previous year, and the number of zip files downloaded from FIADB tables, which has steadily increased from almost 20,000 in 2014 to over 275,000 in 2020, peaking at 436,000 in 2019 (table B-7).

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 mechanism 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 National Forest System analytical staff) who can often provide better context and better customer service. When questions span multiple administrative units, FIA staff assist the customer with finding an answer. FIA does not compete with private-sector consultants; rather, we answer questions about our 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 client. Consultations from this group accounted for 72 percent of all consultation time in FY 2020. This would also include any internal discussions within other Forest Service programs.

In 2020, FIA customers' inquiries rose exponentially; the number of consultations increased by 50 percent and the associated number of consultation hours doubled from previous year. FIA specialists collectively addressed 1,434 consultations, which required 16,735 staff hours to complete (table 7)—this number is equal to the number of hours worked annually by 8.25 full-time equivalents, not accounting for leave, holidays, and training. Consultations with government agencies accounted for 53 percent, while other major client groups included academia (19 percent), nongovernmental organizations (10 percent), and industry (9 percent). Table B-6 shows the number of significant consultations provided by FIA staff in FY 2020, ordered by type of customer and responding unit.

Table 7. Number and hours of significant consultations by FIA staff, by customer group, FY 2020.

Customer Group	Number	Percent	Hours	Percent
Academic	274	19%	1,227	7%
Government	763	53%	12,097	72%
Industry	131	9%	511	3%
NGO	150	10%	1,755	10%
NIPF	15	1%	74	0%
Media	30	2%	106	1%
Other	71	5%	965	6%
Total	1,434	100%	16,735	100%

FIA = Forest Inventory and Analysis; FY = fiscal year; NGO = nongovernmental organization; NIPF = nonindustrial private forest landowner.
Note: These consultations do not include Special Data Services Center requests.

FIA Program Accomplishment Highlights for FY 2020

This section provides information on selected 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 respective FIA unit leading the effort, as shown below. (Contact information for each FIA unit also appears in appendix A.)

A Cost-Effective Field Measurement Protocol to Support Lidar-Assisted Carbon Monitoring Programs

Impact: Given the increasing interest in using lidar-based remote sensing to support carbon monitoring systems, including those used for measurement, reporting, and verification requirements for REDD+ (reduced emissions from deforestation and degradation) programs in tropical nations, there is a corresponding need for cost-effective field measurement approaches that support model development and robust assessment of uncertainty in these programs. This research tested and documented an efficient field sampling design and measurement protocol to provide field-based estimates of biomass and carbon stored in trees and coarse woody materials to support complex, multilevel carbon monitoring systems using remote sensing technologies, such as Landsat time series and airborne lidar.

Outcomes: FIA produced a prototype of a "measurable, reportable, verifiable" (MRV) design for cost-effective carbon monitoring using a limited number of FIA field plots integrated with lidar sampling and disturbance information derived from Landsat time series data. The report documents field measurement protocols that are consistent with those of the FIA program and can be used in combination with remote sensing data sources to estimate and model forest carbon and biomass at multiple spatial scales. The approach tested leverages Landsat time series to produce more robust, and less biased, lidar-based biomass and carbon models that can be applied across large areas.

Contacts: Hans Andersen, Hans.andersen@usda.gov

> *Legner, K.; Andersen, H.-E.; Cooke, A.; Cohen, W. 2020. A cost-effective field measurement protocol to support lidar-assisted carbon monitoring programs—implementing a prototype design at six different sites in the United States. Gen. Tech. Rep. PNW-GTR-984. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 66 p.*

https://www.fs.usda.gov/pnw/publications/cost-effective-field-measurement-protocol-support-lidar-assisted-carbon-monitoring-4

A Tutorial in Model-Assisted Estimation With Application to Forest Inventory

Impact: National forest inventories in the United States combine expensive ground plot data with remotely sensed information to improve precision in estimates of forest parameters. A simple post-stratified estimator is often the tool of choice because it is efficient, easy to implement nationally, and intuitive to the many users of inventory data. Because of the increased availability of remotely sensed data with improved spatial, temporal, and thematic grains, the forest inventory community needs a more diverse quiver of statistical estimators.

Outcomes: Focusing on the broad class of model-assisted estimators under the umbrella of generalized regression estimators, FIA provides a tutorial that steps the reader though seven estimators: Horvitz Thompson, ratio, post-stratification, regression, lasso, ridge, and elastic net. How to construct and assess the relative performance of these estimators is illustrated using forest inventory data. The new R package, mase, available on the Comprehensive R Archival Network (https://cran.r-project.org/) provides ready access to each estimator. A decision tree provides guidelines for selecting the best estimator for different forest inventory applications.

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> *McConville, K.S.; Moisen, G.G.; Frescino, T.S. 2020. A tutorial on model-assisted estimation with application to forest inventory. Forests. 11: 244. https://www.fs.fed.us/rm/pubs_journals/2020/rmrs_2020_mcconville_k001.pdf*
>
> *McConville, K.S.; Tang, B.; Zhu, G.; Cheung, S.; Li, S. 2018. Mase: model-assisted survey estimators. https://cran.r-project.org/web/packages/mase*
>
> *McConville, K.S.; Breidt, F.J.; Lee, T.C.M.; Moisen, G.G. 2017. Model-assisted survey regression estimation with the lasso. Journal of Survey Statistics and Methodology. 5: 131–158. https://www.fs.fed.us/rm/pubs_journals/2017/rmrs_2017_mcconville_k001.pdf*

Defining, Analyzing, and Understanding the U.S. Land Base

Impact: Assessing changes of the U.S. forestland area depends on the definitions, methods, and datasets used. Land managers, decision-makers, governments, and other stakeholders need to have authoritative information on forestland area trends and a good understanding of why estimations differ based on the metrics and methods used to produce them.

Outcomes: Land use and land cover provide different ways of understanding forest and rangeland conditions, trends, and future projections. Land use describes the social and economic intent for which land is used, while land cover describes the vegetation, exposed land surfaces, water, and artificial structures covering the land surface at a given time. National analyses of resource trends in the United States rely upon both land-use and land-cover data found in the National Resources Inventory (NRI), the National Land Cover Database (NLCD), the FIA program, and the U.S. Census Bureau. A national team of Forest Service R&D and FIA resource experts and scientists recently analyzed and compared land-use and land-cover estimates in support of the forthcoming 2020 RPA Assessment. For example, comparing trends in land use and land cover over the same decade revealed that changes were broadly similar for both agricultural lands and developed land, but markedly different for forest. These differences are largely attributable to transient changes to and from forest cover, which are not necessarily indicative of a permanent change in forest land use. Using both land-use and land-cover data separately and in combination provides unique and complementary perspectives on land base trends.

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Nelson, M.D.; Riitters, K.H.; Coulston, J.W.; Domke, G.M.; Greenfield, E.J.; Langner, L.L.; Nowak, D.J.; O'Dea, C.B.; Oswalt, S.N.; Reeves, M.C.; Wear, D.N. 2020. Defining the United States land base: a technical document supporting the USDA Forest Service 2020 RPA Assessment. Gen. Tech. Rep. NRS-191. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 70 p.

https://doi.org/10.2737/NRS-GTR-191.

https://www.fs.usda.gov/treesearch/pubs/59691

Who Owns America's Forests? National Woodland Owner Survey Results May Surprise You

Impact: New results from the USDA Forest Service's National Woodland Owner Survey shed light on who owns America's forests, why they own land, what they have done with it in the past, and what they plan to do with it in the future. This information can be used in designing programs and policies that help family forest owners obtain the information and assistance they need to help conserve forests for current and future generations.

Outcomes: There are an estimated 10 million family forest ownerships across the United States; collectively, they own 272 million acres of forest land. This represents one out of every three forested acres in the Nation and is more than any other ownership group. The USDA Forest Service conducts the National Woodland Owner Survey to help shed light on who these people are, why they own land, what they have done with it in the past, and what they plan to do with it in the future. To date, surveys have revealed that the most common reasons for owning family forests relate to the beauty, wildlife habitat, nature protection, and privacy that forests provide. Forest management practices are occurring on many family forests, but written management plans, receiving professional advice, and participation in assistance programs are relatively uncommon. The most common concerns of family forest owners include high property taxes, keeping land intact for future generations, and trespassing. In terms of demographics, the primary decision-makers tend to be older, white males. Because they make decisions that influence the health and existence of one-third of the Nation's forested land, addressing their needs and concerns is important.

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NWOS dashboard https://ffrc.shinyapps.io/NWOSdashboard/

Potential To Increase Carbon Sequestration With Tree Planting

Impact: Almost one-third of Earth's total land area is comprised of forest, which is also the largest terrestrial carbon sink. Using FIA data, conducted research concluded that fully stocking the Nation's understocked forests could increase carbon sequestration by about 20 percent.

Outcomes: This in-depth analysis shows how increasing the number of forest trees might offset carbon emissions in the United States. To mitigate tree loss and offset carbon emissions,

several initiatives are underway to increase tree planting in forests and in landscapes that are not technically defined as forests, such as urban forests. To determine carbon emissions offset from approximately 1.38 trillion trees currently growing in the conterminous United States, researchers examined publicly available data from more than 130,000 forested plots from the national forest inventory conducted by the FIA program. Forests and harvested wood products annually offset the equivalent of more than 14 percent of economy-wide carbon dioxide emissions in the Nation, however, almost 33 million hectares of productive forest land are understocked with trees. Fully stocking all understocked productive forest land with trees could increase carbon sequestration by approximately 20 percent. Current efforts by Federal and State governments and private entities result in an estimated 1.2 billion trees planted on forest land annually, and these trees sequester between 16 and 28 million metric tons of carbon dioxide from the atmosphere per year. These findings suggest that concentrating tree planting on understocked productive forest land may substantially increase carbon sequestration capacity in the United States.

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> ***Domke, G.M.; Oswalt, S.N.; Walters, B.F.; Morin, R.S. 2020.*** *Tree planting has the potential to increase carbon sequestration capacity of forests in the United States. Proceedings of the National Academy of Sciences. Sept. 2020, 202010840.* *https://doi.org/10.1073/pnas.2010840117* *https://www.nrs.fs.fed.us/pubs/60965*

My City's Trees: Delivering Information From Urban FIA Data

Impact: My City's Trees delivers urban FIA data to a broad audience in a user-friendly interface, making the complex database accessible to average users. The information presented in the application provides a basis for strengthening urban forest management and advocacy efforts by empowering city government, nonprofit organizations, and consultants with valuable data that is easy to access and understand. The effort is powered by a partnership between the Forest Service and Texas A&M Forest Service.

Outcomes: My City's Trees is a web application developed several years ago. At the beginning of FY 2020, a major update was released, improving functionality and adding new data. The revamped app has better reporting capability— users are now able to produce a full report or one-page summary for their area in PDF format and share it directly from the application—

and estimates now include breakdowns by diameter class and land use in addition to ownership. Data collected in 2017 for Austin (Texas) and San Diego (California) were added to the application. FIA urban data for other cities will be added in the future.

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> *My City's Trees web application mycitystrees.com.*

Compilation and Analysis of Unit of Measure Conversion Factors Used in TPO Data Processing

Impact: A recently published report by FIA provides a compilation of all roundwood and residue unit of measure conversion factors used by each regional TPO program. These conversion factors are used in TPO data processing to convert mill-reported volumes to various other units of measurement. Until now, a comprehensive list of all conversion factors used in TPO data processing has not been readily available to FIA personnel or its partners. Access to these conversion factors will allow users of FIA TPO data to better understand how reported volumes are determined.

Outcomes: This report provides specific examples that illustrate how conversion factors for each product type and region are applied. To improve upon the consistency and accuracy of conversion factors used in TPO data processing, the report also presents an analysis of expected vs. actual factor variability between and within regions.

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> ***Winn, M.F.; Royer, L.A.; Bentley, J.W.; Piva, R.J.; Morgan, T.A.; Berg, E.C.; Coulston, J.W. 2020.*** *Timber products monitoring: unit of measure conversion factors for roundwood receiving facilities. e-Gen. Tech. Rep. SRS-251. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 148 p.* *https://www.fs.usda.gov/treesearch/pubs/60116*

FIA has 1.7 Million Plots Ready To Use in the Forest Vegetation Simulator

Impact: Scientists and managers use the Forest Vegetation Simulator (FVS) to project forest conditions into the future under a wide range of different management scenarios at scales ranging from single stands to entire States. FVS users can apply a wide variety of treatments to individual stands, such as thinning, planting, prescribed fire, or even wildfire under various weather conditions. This simulator addresses a long-standing demand for FIA plot data in a ready-to-use form because the data conversion process is difficult and time-consuming for the typical FVS user.

Outcomes: By making FIA data available in FVS-ready format and documenting the conversion process, users have access to a consistent and correctly translated inventory dataset. FVS-ready data are delivered via the FIA Data Mart in State-level databases, which also contain the FIA Database tables that have been traditionally been made available. The data are now being used for numerous applications, such as national forest planning, education, scientific analysis, and management of small private forest ownerships.

Contacts: John D. Shaw john.d.shaw@usda.gov

FIA Databases containing FVS-ready data: FIA DataMart FIADB_1.8.0.03 :: SQLliteDB (usda.gov)

Shaw, J. 2019. *Field note: a new conversion of Forest Inventory and Analysis data for use in the Forest Vegetation Simulator. Journal of Forestry 118(3): 307–312.*
https://doi.org/10.1093/jofore/fvz050
https://www.fs.fed.us/rm/pubs_journals/2019/rmrs_2019_shaw_j001.pdf

Shaw, J.D.; Gagnon, A. 2020. *Quick-start guide to Forest Inventory and Analysis data in the Forest Vegetation Simulator. User draft.*
SP-2_FIA_Draft (fs.fed.us).

RMRS Science You Can Use bulletin: https://www.fs.usda.gov/rmrs/sites/default/files/documents/sycu_5_fvs_web.pdf

RMRS Science You Can Use Webinar: Using Forest Inventory and Analysis Data in the Forest Vegetation Simulator | Rocky Mountain Research Station (usda.gov)

Intensifying FIA Inventories To Inform Pacific Coast Climate Goals and Policies and To Manage Forest Carbon Resources

Impact: FIA advanced partnerships across the Pacific Coast to collect FIA data more frequently in California, and at greater spatial intensity in Oregon, given each State's need for improved forest carbon estimates. FIA worked intensively with Washington State to deliver carbon trend science to inform recommendations for Washington's Natural and Working Lands Carbon Sequestration Advisory Group. Leadership in each State directed funding to intensifications, analysis, and/or reporting work for the joint efforts. The greater intensity of plot measurements will improve forest and carbon estimation accuracy and improve estimates of carbon pool dynamics for wildfire, insects, and drought effects. As States consider carbon policy options to combat effects of a changing climate, FIA can help by providing unbiased estimates of current forest carbon stocks and flux.

Outcome: These partnerships have resulted in templates and detailed summary reports co-produced by State agencies and other partners to help inform policy considerations of State legislatures. The State-specific reports have proven invaluable in guiding strategy, decision-making, and overall carbon policy in the dynamic Pacific Coast forests. Additional States have expressed interest in this type of reporting to expand efforts for carbon monitoring in a consistent and unbiased manner.

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Oregon Department of Forestry: Andrew Yost, andrew.yost@oregon.gov
Washington Department of Natural Resources: Dan Siemann, dan.siemann@gmail.com *(no longer at WA DNR)*

FIA's Forest Ecosystem and Harvested Wood Product Carbon accounting efforts:
California https://bof.fire.ca.gov/projects-and-programs/ab-1504/
Oregon https://www.oregon.gov/odf/ForestBenefits/Pages/ForestCarbonStudy.aspx
Washington: in press

FIA Hosts the 2019 FIA Science Stakeholder Meeting

Impact: The Southern Research Station (SRS) FIA program and National Council for Air and Stream Improvement, Inc. (NCASI) hosted nearly 300 scientists, managers, and policy-makers from more than 20 countries and 60 organizations during the 2019 FIA Science Stakeholder Meeting. This meeting, whose theme was "Celebrating Progress, Possibilities, and Partnerships," drew a world-class group of partners, practitioners, and scientists with regional, national, and international inventory and monitoring missions. Maintaining the USDA Forest Service's leadership in this area requires both regular consultation with FIA's users and periodic technical exchange among scientists in fields such as data visualization, statistical inference, and remote-sensing inventory techniques.

Outcomes: The meeting featured more than 190 presentations, 12 plenary speakers, and hands-on sharing of nearly 30 digital products from scientists and partners. In addition, the Forest Service International Programs office helped coordinate a field tour for international colleagues. Jim Hubbard, current USDA Under Secretary of Natural Resources and the Environment, headlined the plenary session. as well as Alex Friend (Deputy Chief for Forest Service R&D), Ken Arney (Forest Service Region 8 Regional Forester), Rob Doudrick (SRS Station Director), David Arnold (Tennessee State Forester), Tom Martin (American Forest Foundation CEO), Healey Hamilton (NatureServe Chief Scientist), Andrew Hait (U.S. Census Bureau), and Songlin Fei (Purdue University).

Contacts: The meeting planning committee was staffed by Christopher M. Oswalt, christopher.oswalt@usda.gov; Bill Burkman, bill.burkman@usda.gov; Tom Brandeis, thomas.j.brandeis@usda.gov; Kerry Dooley, kerry.j.dooley@usda.gov; Sasha Gottlieb, sasha.gottlieb@usda.gov; Moses Jackson, moses.jackson@usda.gov; Jim McKenzie, james.a.mckenzie@usda.gov (retired); Jason Meade, jason.r.meade@usda.gov; Sonja Oswalt, sonja.n.oswalt@usda.gov; Ted Ridley, ted.ridley@usda.gov; Angie Rowe, kimberly.rowe@usda.gov; and Rachel Sheridan, rachel.sheridan@usda.gov
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Brandeis, T.J., comp. 2020. Celebrating progress, possibilities, and partnerships: Proceedings of the 2019 Forest Inventory and Analysis (FIA) Science Stakeholder Meeting. e-Gen. Tech. Rep. SRS-256. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 267 p. https://srs.fs.usda.gov/pubs/60966.

Assessing Interior Alaska Forests— FIA Data for Tanana Valley Available Online

Impact: Alaska's boreal forests span approximately 114 million acres, representing 15 percent of total U.S. forest land. Until the introduction of the FIA program to Interior Alaska FIA 2016, only 16 percent (15 million acres) of the State's forests were consistently inventoried in the coastal region. Although these forests play a significant role in supplying resources to local communities and sustaining global energy, water, and carbon cycles, their remote nature made inventory cost-prohibitive. The Forest Service partnered with local communities and the State of Alaska and leveraged high-tech innovations developed by NASA to pilot a new way of monitoring remote areas.

Outcomes: Data from the first fully completed unit of the Interior Alaska forest inventory, the Tanana Valley unit, are now available online. In the course of inventorying the 33.7 million-acre Tanana Valley, field crews measured more than 800 plots and the results are now at the public's fingertips. The public can access the downloadable database for the Tanana Valley unit, complete with integrated user guides, and over 100 preset queries to generate tables of interest. Additionally, field crews successfully measured just under 400 plots to finish the second Interior Alaska FIA unit, the Susitna-Copper unit, in 2020. Those data will soon be available online.

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The online database and associated documentation can be found here: https://www.fs.usda.gov/pnw/tools/pnw-fia-interior-alaska-database

Additional information about the Interior Alaska inventory project can be found here: https://www.fs.usda.gov/pnw/projects/pnw-fia-interior-alaska-inventory

Estimating Land-Use and Land-Cover (LULC) Change in North-Central Georgia: Can Remote Sensing Observations Augment Traditional Forest Inventory Data?

Impact: Throughout the last three decades, north-central Georgia has experienced significant loss in forest land and tree cover. This study revealed the temporal patterns and thematic transitions associated with this loss by augmenting traditional forest inventory data with remotely sensed observations. The ability of different land-use and land-cover datasets

(based on field, photo, and satellite imagery) was assessed to produce estimates of land-class status as well as detect net and transitional change, alone and in combination with each other.

Outcomes: This study was published as part of a collection of work on estimating change in forests, through the journal *Forests*. It illustrates that, even in a very dynamic part of the country, for FIA to report on land-use and land-cover trends with adequate precision and temporal coherence, at a minimum data would be needed to be collected on all the FIA plots frequently over a long time series and broadly collapsed LULC classes. The paper recommends that FIA harmonize ground, satellite, and aerial observations via a single enhanced plot interpretation process.

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> *Moisen, G.G.; McConville, K.S.; Schroeder, T.A.; Healey, S.; Finco, M.; Frescino, T.S. 2020. Estimating land use and land cover change in north central Georgia: can remote sensing observations augment traditional forest inventory data? Forests. 11(8): 856.* *https://www.fs.fed.us/rm/pubs_journals/2020/rmrs_2020_moisen_g001.pdf*

> *Moisen, G.G.; McConville, K.S., guest eds. 2020. Estimating Change in Forests: Merging Ground- Photo- and Space-based observations. Forests. 11. Special Issue.* *https://www.mdpi.com/journal/forests/special_issues/Estimating_Observations*

Managing the FIA Program Nationally

The National FIA Program Office provides leadership, guidance, and coordination 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, 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 2020 include:

- Worked with agency leadership to obtain additional funding, including COVID response dollars from the CARES Act, R&D funds to support forest carbon research related to the Trillion Trees Initiative, and targeted FIA funding to small-area estimation, DATIM, and National Vegetation Classification development efforts, as well as IT fellows training.

- In collaboration with units, led the development of briefing papers in response to many agency requests, especially related to COVID and budgets.

- Led efforts to conduct and report FIA work by the field units more homogenously across all regions and become a more efficient and accountable national program.

- Consolidated the use of legally binding instruments as the only mechanisms to enter into agreements with partners where confidential information, such as plot location, personally identifiable information, and non-public corporate data, is transferred.

- Collaborated with the Society of American Foresters and the National Council for Air and Stream Improvement in organizing two virtual meetings: a national users group meeting in April 2020, and a Small Area Estimation workshop in late September 2020. 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 users group meeting had four focus areas: (1) remote sensing tools for improving FIA data collection and estimation; (2) improving biomass and carbon estimates; (3) estimating and tracking forest area change, especially post-disturbance; and (4) emerging information needs faced by users. Small-area estimation was such a relevant topic of interest in 2020 that a separate meeting was hosted.

- Organized and facilitated quarterly meetings with the National Management Team (composed of external partners representing all U.S. regions), National Forest System employees, and FIA leadership to report on program progress and received feedback on their perspectives, concerns, and opportunities. Facilitated briefings for internal and external partners and supporters.

- 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 included in this report.

- Provided customer support to data requests and consultations received at the National Office.

- Provided liaison, technical expertise, and data to the Global Forest Resources Assessment (FRA) conducted by the Food and Agriculture Organization of the United Nations (FAO), and FAO North American Forest Commission; improved global reporting methods of primary forest through participation in workshops and pilot projects in the boreal region organized by FAO; provided support to Forest Service International Programs on activities related to the FAO Committee on Forestry (COFO) and other international issues.

In addition to the field units and the National FIA Program Office, FIA has a National Operations Team that provides operational coordination and support to field units. Their major responsibilities include communications, operational planning, IT budget management, liaison to the Forest Service chief information officer (CIO), and oversight of data QA processes to ensure national consistency. The major accomplishments achieved in 2020 include:

- Ensured that FIA's software and hardware met CIO requirements, including software technical approval, 508 compliance, and IT security protocols.

- Worked to ensure IT-related needs were met at every FIA field unit.

- Ensured that FIA scientists and analysts gained the necessary CIO policy exceptions to avoid hindering FIA operations, analysis, and research. For example, technical approval and authority were obtained to continue many of FIA's propriety software used in plot data collection, field safety, data computation, modeling, and estimation, and other non-enterprise software packages.

- Continued the development of DATIM with the release of a tool that grants special roles and data access to NFS partners.

- Completed the FIA data conversion over to the Forest Vegetation Simulator (FIA2FVS).

- Partnered with University of Nevada, Las Vegas, and Southern Utah University who provide important program support in the development of FIA information management tools and 508 testing and compliance.

- Contributed toward achieving national consistency in setting and meeting standards for the assurance of data quality through the development of processes that support change management, decision-making, data management, and content delivery.

- Established a national change management process, which the team oversees while also providing project management services and support, decision-making processes, data management, and content delivery processes.

FIA Program Area Updates for FY 2020

Interior Alaska Inventory

Overview: The forests of Interior Alaska comprise approximately 70 percent of the State's land area and make up nearly 15 percent of total forested land in the United States. Owing to the remoteness and size of interior Alaska, these forests have not been fully surveyed with a forest inventory using standardized, national protocols. Implementing an annualized inventory throughout Alaska's vast and remote boreal forest presents substantial logistical and financial challenges. In 2014, with targeted funding from Congress and additional contributions from R&D, the State of Alaska, and other partners, the FIA program and interested parties agreed to start inventorying Interior Alaska periodically. A pilot study was conducted to gauge feasibility, logistical complexity, and ability to link field samples with advanced remote sensing via partnerships.

Scope: The pilot study led to a plan for the full implementation of FIA protocols throughout Interior Alaska with modifications to scale back the field sample and augment with advanced remote sensing information to allow substantial cost savings. Modifications included: the Interior Alaska region was subdivided into six smaller units, broadly encompassing major watershed boundaries (Tanana, Susitna-Copper, Southwest, Lower Yukon, Upper Yukon, and North Slope units) (figure 13); the field plot sample was reduced to one plot every 30,000 acres (rather than one plot every 6,000 acres); and each inventory unit is to be completed before moving to the next, resulting in a periodic rather than an annualized sample of Interior Alaska. FIA partnered with scientists from NASA to supplement the reduced plot grid sample with cutting-edge airborne-based estimates of forest resources. Using this high-resolution imagery in the estimation phase improves the precision of estimates, going far beyond what would be possible with satellite imagery alone. Goddard Space Flight Center's LiDAR, Hyperspectral and Thermal Imager (G-LiHT) system provided fine-scale (<1 m), multi-spectral observations, which are subsequently used in model-assisted estimates of forest biomass, volume, and carbon.

Partnerships/Users: The diversity of landowners and vastness of the region have resulted in a unique partnership approach to the on-the-ground portion of the inventory. The State of Alaska Division of Forestry manages most of the plot planning, logistical support, and data collection staff, while the Forest Service provides project coordination and quality assurance support. Other project partners include the U.S. Fish and

Figure 13. FIA units in Interior Alaska.

Wildlife Service, National Park Service, University of Alaska Anchorage and Fairbanks, Alaska Native Corporations, and local communities.

Annual Update

Progress: In 2020, FIA completed the report on the Forest Resources of the Tanana Unit, Alaska: 2018; it is expected to be published in 2021. FIA also completed on-the-ground data collection for the Susitna-Copper unit of Interior Alaska. Initial review of the Susitna-Copper unit data is underway for upcoming release. This represents Interior Alaska's second fully completed unit, following the completion of the Tanana unit in 2018. In collaboration with the State of Alaska Division of Forestry, FIA measured 1,269 plots out of the Interior total of an estimated 4,651 forest plots.

The data collection team moved into the Southwest unit in 2020 and worked from aerial access only for the first time since inventory began. Remote hubs this year and in the future will be accessible via air travel alone, primarily helicopter. Limited access to aviation fuel, medical care, internet and phone communication, and/or food and other supplies is creating challenges for costs and maintaining program safety. For example, remote operations hubs this year included the town

of Lake Minchumina, population 11, with access to one ground vehicle, no store, fuel, or healthcare. This is the reality for people living and working in Interior Alaska.

Challenges: Difficult logistics coupled with a field season including COVID-19 hazards delayed and shortened the field season by a month. Precautions included proper testing, quarantine, social distancing, and other safety and wellness actions. Approximately 150 field plots were collected in 2020 as opposed to the nearly 300 plots collected each prior field season in Interior. State of Alaska employees proceeded carefully with field data collection and FIA employees transitioned to remote Quality Assurance support. As a result of COVID-19 travel-related mandates and concerns, NASA delayed G-LiHT acquisition across the remainder of the Southwest unit until 2021. Similarly, interactions with local communities were kept to an absolute minimum, and the Interior FIA Citizen Science project with the University of Alaska Fairbanks and other community engagement activities were cancelled or delayed.

Deliverables: The Tanana unit database was released in April 2020 and is available online.

Small Area Estimation

Overview: There is a growing need for FIA estimates and information over smaller geographic areas (such as sub-State to county spatial scales) and for shorter time periods (such as annually to biennially). But often, the base-program sampling frame, with just one FIA grid plot per 6,000 acres, results in too few plots from which to construct reliable estimates for the small areas or short timeframes using current estimation processes. Motivated by the 2014 Farm Bill language, which called for improving the statistical precision of estimates at the sub-State level, FIA's Small Area Estimation (SAE) portfolio was established in 2017. It began as a loose assemblage of projects already underway in each of the FIA units in collaboration with a variety of partners. The original intent was to track the disjointed projects, foster communication and collaboration among them, and spread awareness that different needs call for different solutions.

Scope: Because "small area" is a term used to describe so many situations, one of the initial challenges facing the SAE portfolio was the lack of consistent language within inventory circles. In statistics, the term "small area" means any domain for which there are too few sample plots from which to make a direct estimate with adequate precision. Historically, FIA has relied on direct estimates, meaning that only plots within the domains of interest are used to construct those estimates. FIA has also relied almost exclusively on design-based inference, which means randomness is introduced by sample selection

and the observations are assumed to be fixed values. Substantial progress has been made in reducing the variances in FIA's direct estimates through post-stratification. Post-stratification is one of many model-assisted methods that can be employed (still under design-based inference) to harness the information available through remotely sensed data. The field of small area estimation requires that FIA methodologies be extended further, to use plots from outside the domains of interest, borrowing strength through these indirect estimators. These methods often require the use of model-based inference, meaning the observations are assumed to be a random realization of some superpopulation. While the terminology may seem tedious, working toward consistent language surrounding estimation issues is an important first step as FIA works to improve and evolve processes.

Partnerships/Users: Since its inception, unifying activities have been accelerating within this portfolio, as well as between portfolios and national projects with overlapping interests. Key partners supporting SAE work include Geospatial Technology Application Center (GTAC), Reed College, Environmental Systems Research Institute (ESRI), Forest Service State and Private Forestry (S&PF), and Oregon State University.

Annual Update

Progress: In 2020, some of the unifying activities laying the groundwork for operational tools were:

- The Society of American Foresters and NCASI held a virtual workshop on SAE focused on understanding and articulating information needs of users. The workshop covered identifying what tools need to do to be most useful, outlining next steps to unify efforts, and identifying applications that will move FIA ahead most quickly. About 116 people registered for the event, which included 14 prerecorded science presentations from researchers across the country, 5 presentations from experts representing different facets of our user community, 4 live demonstrations of tools, and numerous discussions. One of the most relevant recommendations moving forward was to assemble a team of internal and external experts working together to: (1) define small domain precision targets, (2) identify appropriate SAE techniques and auxiliary data, (3) test applicability across a range of ecological and size specifications, and (4) identify cases better suited for project-level solutions.

- We conducted a survey to help understand user needs and expectations for SAE, presented the results to our user community, and collected feedback.

- Scientists from the diverse research groups affiliated with this portfolio gave numerous small-area-related presentations at a variety of scientific and management meetings throughout the year.

- The small area estimation module was enhanced with access to new computing libraries, nationwide runs at improved speed, and automated reporting. User-friendly applications are under development at the GTAC.

- Undergraduate students at Reed College developed prototype dashboards to demonstrate alternative ways to deliver FIA estimates over non-standard domains. For example, estimates for historic fires as well as ecological subsections were pre-processed nationally.

- ESRI accelerated its support of BIGMAP with supplemental access to Amazon Web Services, and the BIGMAP team demonstrated the integration of published SAE methods.

- Funded by S&PF, a project was initiated in the fall of 2020 to develop small area estimates for data related to the FIA National Woodland Owner Survey. Initial efforts are focused on developing GIS products with parcel-level accuracy of ownership categories and size of forest holdings.

- Collaborative work with Oregon State University is underway to evaluate utility of spatial copula models for small area estimation

- The Green Book 2, which is currently under revision following peer review, contains a chapter dedicated to Emerging Alternative Estimators. This includes not only a section summarizing FIA's progress toward SAE but gathers information on other estimation advances (such as model-assisted, model-based, photo-based, and temporally specific) that are not yet operational within the FIA program.

Figure 14. Applied science presentations in the Workshop on Small Area Estimation in FIA.

- **Unifying the Language** Gretchen Moisen
- **FIESTA** Tracey Frescino
- **Big Map** Dave Bell
- **Volume & Biomass with NAIP3D** Phil Radtke, Corey Green
- **Small Area Estimation for TPO** John Coulston
- **Removals** Corey Green, John Coulston
- **Custom EAS Interface** Todd Schroeder, Nicholas Nagle
- **Private Sector Solutions** John Shaw
- **Geostat Methods** Andy Finley
- **International Review** Rich Guldin
- **National Woodland Owner Survey** Brett Butler, Jesse Caputo
- **Post-fire Density,** Dave Affleck, George Gaines
- **Borrowing strength for fires,** Gretchen Moisen
- **SilviaTerra,** Nan Pond

Note: Click on individual presentation to be directed to youtube video.

- We developed an estimation approach that allows for correct annual estimation of disturbance effect on carbon pools (Coulston et al. 2020).

- We applied and tested small area estimation techniques to increase precision or change (removals) estimates.

Challenges: A meeting on small area estimation, originally planned as an in-person event to be held in conjunction with FIA's National User Group Meeting, shifted to a virtual platform due to the pandemic. Though the new environment presented challenges, it also provided opportunities, allowing many more users, scientists, and developers to participate.

Deliverables: FY 2020 publications related to small area estimation in FIA include:

Coulston, J.W.; Edgar, C.B.; Westfall, J.A.; Taylor, M.E. 2020. Estimation of forest disturbance from retrospective observations in a broad-scale inventory. Forests. 11(12): 1298. https://doi.org/10.3390/f11121298.

Green, P. C.; Burkhart, H.E.; Coulston, J.W.; Radtke, P.J. 2019. A novel application of small area estimation in loblolly pine forest inventory. Forestry: An International Journal of Forest Research. 93(3): 444–457. https://www.fs.usda.gov/treesearch/pubs/61546

Green, P. C.; Burkhart, H.E.; Coulston, J.W.; Radtke, P.J.; Thomas, V.A. 2020. Auxiliary information resolution effects on small area estimation in plantation forest inventory. Forestry: An International Journal of Forest Research. 93(5): 685–693. https://www.fs.usda.gov/treesearch/pubs/61530

McConville, K.S.; Moisen, G.G.; Frescino, T.S. 2020. A tutorial in model-assisted estimation with application to forest inventory. Forests. 11(2): 244. https://www.fs.usda.gov/treesearch/pubs/60328

Frescino, T.S.; Moisen, G.G.; Patterson, P.A.; Toney, J.C.; Freeman, E.A. 2020. Demonstrating a progressive FIA through FIESTA: a bridge between science and production. In: Brandeis, T.J., comp. Celebrating progress, possibilities, and partnerships: Proceedings of the 2019 Forest Inventory and Analysis (FIA) Science Stakeholder Meeting. e-Gen. Tech. Rep. SRS-256. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 199. https://www.fs.usda.gov/treesearch/pubs/60966

Rintoul, M.; Maebius, S.; Alvarado, E.; Lloyd-Damnjanovic, A.; Toyohara, M.; McConville, K.; Moisen, G.; Frescino, T. 2020. An alternative post-stratification

scheme to decrease variance of forest attribute estimates in the Interior West. In: Brandeis, T.J., comp. Celebrating progress, possibilities, and partnerships: Proceedings of the 2019 Forest Inventory and Analysis (FIA) Science Stakeholder Meeting. e-Gen. Tech. Rep. SRS-256. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 268. https://www.fs.usda.gov/treesearch/pubs/60966

Stanke, H.; Finley, A.O.; Weed, A.S.; Walters, B.F.; Domke, G.M. 2020. *rFIA: an R package for estimation of forest attributes with the U.S. Forest Inventory and Analysis database. Environmental Modelling & Software. 127: 104664.* https://www.fs.usda.gov/treesearch/pubs/59521

Mauro, F.; Ritchie, M.; Wing, B.; Frank, B.; Monleon, V.; Temesgen, H.; Hudak, A. 2019. *Estimation of changes of forest structural attributes at three different spatial aggregation levels in Northern California using multitemporal LiDAR. Remote Sensing. 11: 923.* https://www.fs.usda.gov/treesearch/pubs/58073

Carbon Accounting and Reporting

Overview: FIA current work on carbon accounting and reporting is guided by the 2014 Farm Bill provision of reporting information on renewable biomass supplies and carbon stocks at the local, State, regional and national levels. One of the FIA goals on carbon accounting has become to advance the science, monitoring, and reporting of greenhouse gas (GHG) emissions and removals on land with trees in the United States. Principally, the FIA program contributes estimates of GHG emissions and removals from forest land, forest land conversions, trees outside of forest (e.g., urban forests, agroecosystems), and harvested wood products in the United States each year and submits these as a component of the National Inventory Report (NIR), which is part of the U.S. commitment to the United Nations Framework Convention on Climate Change. At the national and international scales, in addition to the U.S. NIR, the FIA program also regularly contributes to the USDA GHG Inventory, the U.S. Biennial Report, the Resources Planning Act Assessment, and to the periodic U.S. Forest Sustainability Assessment. The FIA program also contributes to scientific activities such as Intergovernmental Panel on Climate Change efforts, and U.S. Global Change Research Program publications (e.g., Second State of the Carbon Cycle Report, National Climate Assessments).

Scope: The FIA program also contributes to many local, State, national, and international carbon estimation and reporting activities. At the local level, examples include county-level reports of carbon stocks and stock changes as well as contributing to National Forest System plan revisions by providing carbon and disturbance information to highlight management-related impacts of processes such as fire and harvest. State-level carbon summaries are included in 5-year reports and in-depth carbon reports have been developed for California, Oregon, and Washington.

Recent Farm Bills have directly addressed forest carbon stocks with language on reporting on renewable biomass supplies and carbon (C) stocks across scales and by ownership as well as through inclusion of interior Alaska. The bills also call for improving land cover and change detection and refining spatial resolution of estimates.

The FIA program is responding to these calls by continuing to develop and improve methods and models for the estimation of GHG emissions and removals in support of core variables included in the FIA database, research, and reporting. Current research themes include:

- Advancing estimation and accounting compilation systems to improve the spatial and temporal resolution of data and data products.
- Carbon pool science to improve representation of carbon stocks and stock changes within forest ecosystems and transfers between land-use categories.
- Improving resolution of harvested wood products information and estimates.
- Leveraging FIA remeasurements and auxiliary information for change estimation and attribution.

Partnerships/Users: FIA continues to grow the capacity of GHG estimation and accounting by leveraging science and products developed within and outside the FIA program, which will provide policymakers and land managers with information to evaluate the effectiveness of existing land management, carbon, and global change policies and practices and to inform future activities. Major partners include the Forest Service Northern Institute of Applied Climate Science (NIACS), the Forest Service Office of Sustainability and Climate, University of Minnesota Department of Forest Resources, Michigan State University Departments of Forestry and Geography, Purdue University Department of Forestry and Natural Resources, and NASA Jet Propulsion Laboratory.

Annual Update

Progress: During FY 2020, the progress on FIA work on carbon included:
- Improving the 2020 National GHG Inventory Report with data from the new Interior Alaska inventory, used to inform model-based estimates of carbon stocks and changes in Alaska.

- State-level disaggregation of GHG estimates, which was published in the 2020 Resource Update on FIA contributions to 2020 NIR (figure 15).

- Contributed to State-level GHG Inventories (California, Oregon, Washington, and New York).

- Participated in PNW Research Station Carbon Dynamics Workshop with scheduled regional follow-up efforts to include a regional report encompassing California, Oregon, and Washington, and British Columbia (Canada). Substantial proportions of plots could not be completed in 2020 due to COVID, so the follow-up work is delayed into 2022.

- Contributed to U.S. Global Change Research Program reports and reviews (i.e., IPCC Assessment Report 6 review, work on National Climate Assessment 5) including leadership of some products, as well as NASA's Decadal Survey.

- Completed data collection and lab work in support of the FIA biomass model project and progressed work on testing alternative modeling systems to compatibly estimate live tree volume and biomass. Model selection and hand-off to FIA to implement is planned in FY 2021.

- Assumed leadership of the land representation of the United States as part of the 2022 National GHG Inventory Report,

developing new data products in collaboration with the LULC Portfolio in support of the Land Representation.

- Led analyses to provide credible information to USDA, the Office of Science and Technology Policy, the White House, American Forests, and other nongovernmental organizations on the possible size of tree planting efforts on forest land in the United States.

- Started research on disaggregating harvested wood products (HWP) estimates for States. Collaborated with Washington Department of Natural Resources in conducting a harvested wood carbon assessment for the State of Washington. Began the development on a State-level database of HWP input variables.

- Updated the FIA website content on carbon accounting and carbon science.

Challenges: Accessing high-performance computing resources remained an increasing challenge during the pandemic as the Forest Service works remotely. The need for such resources continues to grow. Several options were being tested, including a corporate solution for the future. It is anticipated that pandemic-related disruptions in the field data collection in FY 2020 will have impacts on C reporting in the years ahead.

Figure 15. Estimated 2018 annual emissions and removals from forestland remaining forest, by carbon pool and State (MMT CO$_2$ Eq.).
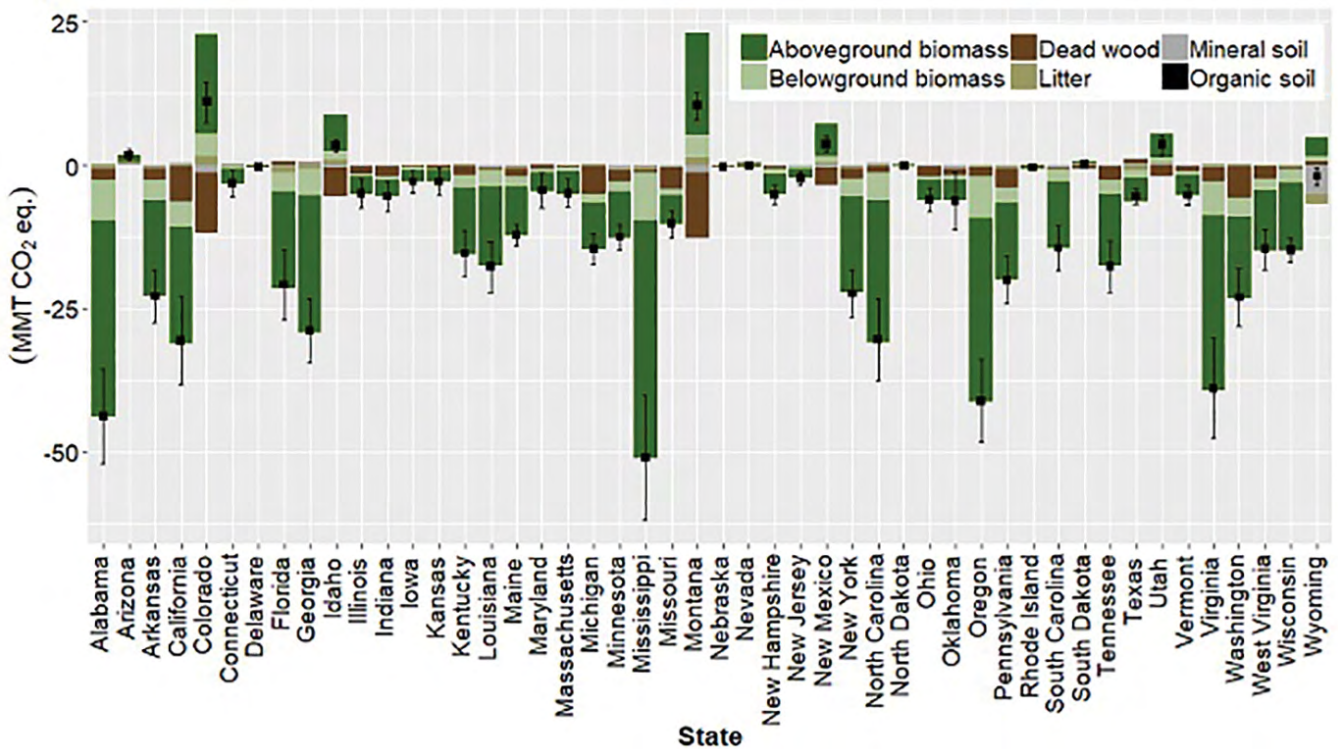
Note: Points and confidence intervals (95 percent) reflect net flux for all carbon pools in each State. Negative estimates indicate net C uptake (i.e., a net removal of C from the atmosphere).

Deliverables: FY 2020 publications related to carbon accounting and reporting include:

Berryman, E.; Hatten, J.; Page-Dumroese, D.; Heckman, K.; D'Amore, D.; Puttere, J.; San Clements, M.; Connolly, S.; Perry, C.H.; Domke, G.M. 2020. Soil carbon. In: Pouyat, R.V.;Page-Dumroese, D.S.; Patel-Weynand, T.; Geiser, L.H., eds. Forest and rangeland soils of the United States under changing conditions: a comprehensive science synthesis. Cham, Switzerland: Springer: 9–31 (Chapter 2).

Birdsey, R.A.; Dugan, A.J.; Healey, S.P.; Dante-Wood, K.; Zhang, F.; Mo, G.; Chen, J.M.; Hernandez, A.J.; Raymond, C.L.; McCarter, J. 2019. Assessment of the influence of disturbance, management activities, and environmental factors on carbon stocks of U.S. national forests. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. https://www.fs.usda.gov/treesearch/pubs/59157

Christensen, G.A.; Gray, A.N.; Kuegler, O.; Yost, A. 2019. Oregon forest ecosystem carbon inventory: 2001–2016. Salem, OR: Oregon Department of Forestry. 343 p. https://www.oregon.gov/ODF/ForestBenefits/Pages/ForestCarbonStudy.aspx.

Christensen, G.A.; Gray, A.N.; Kuegler, O.; Tase, N.A.; Rosenberg, M. 2020. AB 1504 California forest ecosystem and harvested wood product carbon inventory: 2018 reporting period DATA UPDATE. Sacramento, CA: California Department of Forestry and Fire Protection. 435 p. https://bof.fire.ca.gov/projects-and-programs/ab-1504/.

Domke, G.M.; Smith, J.E.; Walters, B.F.; Nichols, M. In review. Forest land category sections of the Land Use, Land Use Change, and Forestry chapter, and Annex. In: U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2018. EPA 430-R-20-002.

Domke, G.M.; Walters, B.F.; Nowak, D.J.; Smith, J.E.; Ogle, S.M.; Coulston, J.W.; Wirth, T.C. 2020. Greenhouse gas emissions and removals from forest land, woodlands, and urban trees in the United States, 1990–2018. Resource Update FS-227. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 5 p. https://www.fs.fed.us/nrs/pubs/ru/ru_fs227.pdf

Guevara, M.; Arroyo, C.; Brunsell, N.; Cruz, C.O.; Domke, G.; Equihua, J.; Etchevers, J.; Hayes, D; Hengl, T.; Ibelles, A.; Johnson, K.; de Jong, B.; Libohova, Z.; Llamas, R.; Nave, L.; Ornelas, J.L.; Paz, F.; Ressl, R.; Schwartz, A.;

Arturo, V.; Wills, S.; Vargas, R. 2020. Soil organic carbon across Mexico and the conterminous United States (1991–2010). Global Biogeochemical Cycles. 34(3).https://www.fs.fed.us/nrs/pubs/jrnl/2020/nrs_2020_guevara_001.pdf

Hudak, A.; Fekety, P.; Kane, V.; Kennedy, R.; Filippelli, S.; Falkowski, M.; Tinkham, W.; Smith, A.; Crookston, N.; Domke, G.M.; Corrao, M.; Bright, B.; Churchill, D.; Gould, P.; McGaughey, R.; Kane, J.; Dong, J. 2020. A carbon monitoring system for mapping regional, annual aboveground biomass across the northwestern U.S. Environmental Research Letters. 15 (2020) 095003 https://doi.org/10.1088/1748-9326/ab93f9

Land-Use/Land-Cover Change

Overview: FIA has long been the Nation's authority on forest land use and tree cover, providing comprehensive information about the status and trends of U.S. forestland in national reports such as the legislated RPA Assessment, and to international bodies such as Food and Agricultural Organization of the United Nations. Although FIA's national sampling grid covers twice as many nonforested as forested plots, the program has not to date been a leader in broader land-use and land-cover assessments, partially due to legislative direction. Adoption of nationally consistent nonforest land-use and land-cover variables around 2012 increased the relevant information collected by FIA. The Strategic Plan written in response to the 2014 Farm Bill included expanded and expedited LULC reporting, targeted at more quickly updating forest estimates due to large-scale disturbances.

The LULC-related work of FIA employees is unified under this portfolio for reporting purposes and, more importantly, to better coordinate initiatives to target FIA LULC assessments. Major projects in this portfolio are the Image-based Change Estimation project (ICE), which uses periodic photointerpretation of FIA plots to support more frequent estimates of LULC change, and the Landscape Change Monitoring System (LCMS), which implements an ensemble of ways to use the Landsat satellite archive to classify and map land-cover change across the country.

Scope: Trends in LULC are traditionally included in FIA State reports, but those analyses are neither nationally consistent nor continuously updated. Furthermore, the recency of FIA's LULC estimates are compromised by its "rolling average" framework, which combines data collected over a span of up to 10 years. Estimates of change may require plot data collected up to twice that amount of time, meaning that "plots alone" assessments may involve considerable latency. Research lines aggregated in this area of work have potential to augment plot-based estimates. Maps of LULC status and change can be combined

in several ways with inventory plots to create statistically defensible estimates at finer temporal and spatial scales.

This area of work has been charged by FIA's Management Team with recommending alternative operational approaches that will improve the depth, currency, and consistency of LULC monitoring in the United States. Proposed alternatives must be accompanied by estimates of cost, and the alternatives must respond to a transparent vision of user needs.

Partnerships/Users: Major collaborators include Boston University, Google, Forest Service Geospatial Technology and Applications Center, NASA, the State University of New York College of Environmental Science and Forestry, Oregon State University, University of Connecticut, University of Maryland, Redcastle Resources, and USGS Earth Resources Observations and Science Center. Other partners, such as Fremont-Winema National Forests, use produced maps in monitoring tree cover lost and assessing the effectiveness of restoration efforts within burned perimeters of large wildfires and other disturbances.

Annual Update

Progress: In FY 2020, LULC work was primarily focused in three areas: plot-based estimation, Image-based Change Estimation (ICE), and FIA LULC mapping.

Plot-based estimation – FIA's land-use (PRESNFCD) and land-cover (LAND_COVER_CLASS_CD) variables have been collected nationally since 2013, meaning that all panels in States on 5–7-year cycles may now be used for LULC estimates. A simple way to visualize LULC status and change is to map the (spatially fuzzed) cover and use class for each plot (figure 16) in addition to plot-level change when remeasurement occurs (figure 17). There is interest in development of an LULC dashboard capable of centralizing updated LULC plot-based estimates from each State. Exploratory conversations between the LULC and Community Engagement portfolios about a dashboard option began in 2020 and will continue in 2021.

Image-based Change Estimation – Although the development of ICE predates the LULC research, ICE is an important LULC project. In FY 2020, ICE data collection was completed for 12 States (all in the Northern Region). Standardized estimates were completed for 3 of these States (Illinois, Missouri, and Connecticut), and a short report (figure 18) was completed for Illinois. NRS-FIA completed more than 65,000 ICE interpretations on base-grid plots in FY 2020. In most years, NRS aims to complete approximately 35,000 plots to keep pace with the release of imagery by the National Agriculture Imagery Program (NAIP). This level of effort is approximately equal to 1.5 FTE.

Figure 16. Land-use class observed for FIA plots measured in 2019, Pennsylvania.
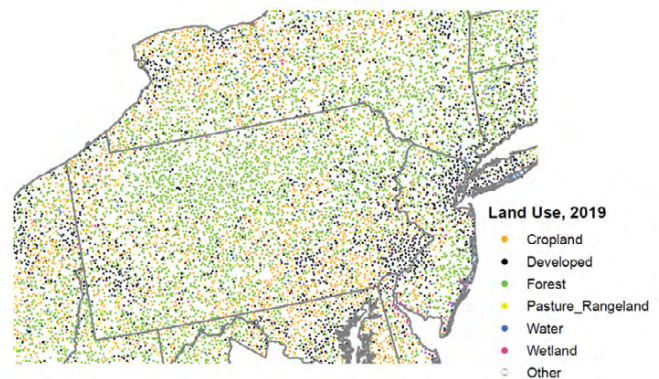
Courtesy of Mark Nelson, NRS FIA.

Figure 17. Forest land-use change between 2019 and previous plot measurement, Northern Region.
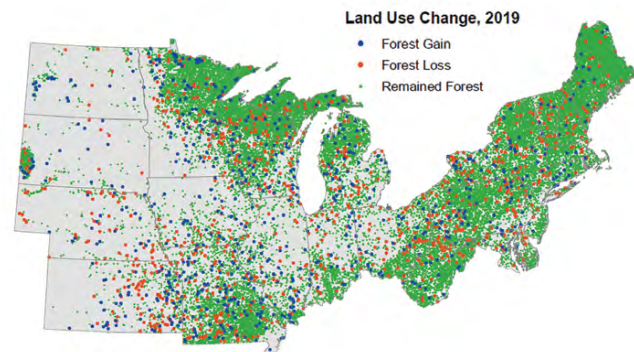
Courtesy of Mark Nelson, NRS FIA.

A comparison of different LULC data collection protocols, shown in figure 19 (McCollum 2019, Moisen et al. 2020), concluded that TimeSync can effectively be combined with FIA plots to augment what we know about disturbance effects (Gray et al. 2019), and showed that rapid image-based alternatives to ICE have potential to improve the precision of change estimates (Lister et al. 2019). Active discussion within this area of research continues to assess how ICE might be improved to best serve FIA's needs.

FIA LULC mapping research – A major application reaching maturity in 2020 was the Landscape Change Monitoring System (LCMS), which has been developed over time with support from IRDB. The LCMS website (figure 20) provides the best-available national-scale maps of forest disturbance and recovery, and also uses FIA research (Cohen et al., 2020) to map both land use and land cover for the country over time.

An FIA collaboration with NASA's SERVIR program provided similar maps for seven countries in East Africa (https://sites. google.com/site/rcmrdservir/home). Schleeweis et al. (2020)

Figure 18. Example of standardized estimates of land-cover and land-use change derived from t Image-based Change Estimation (ICE) observations.
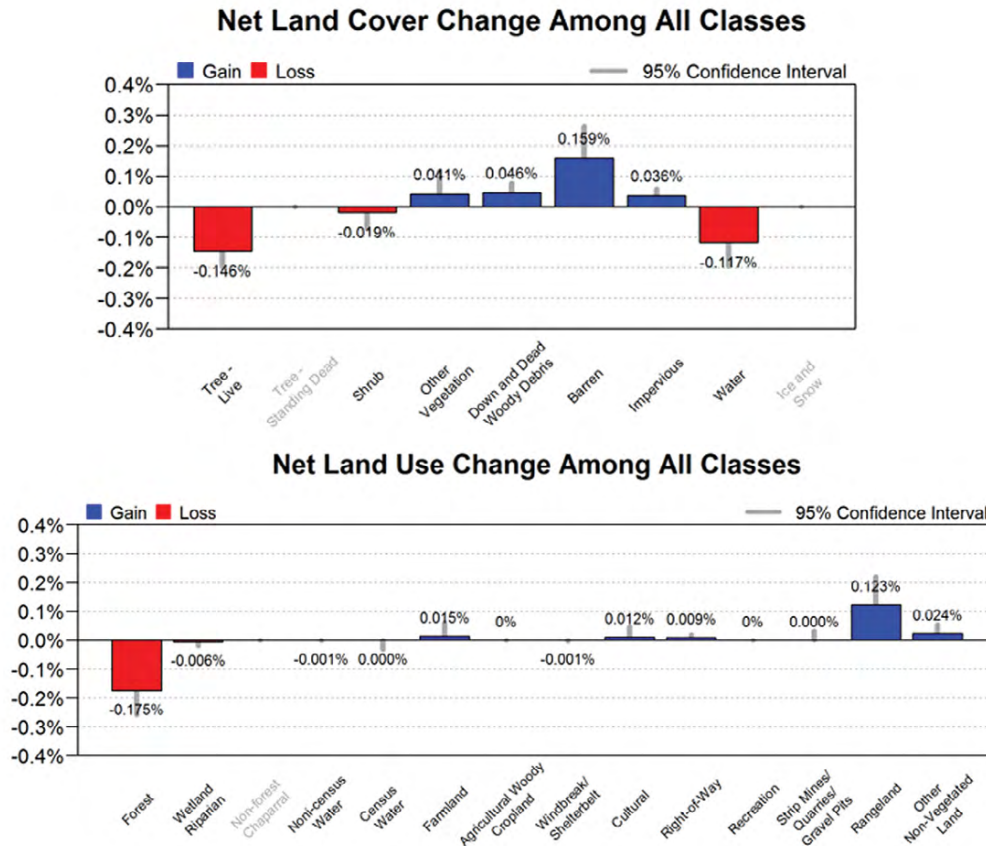
Courtesy of Tracey Frescino, RMRS FIA.   Note: Results for the State of Utah are shown.

Figure 19. Spatial layout of different LULC monitoring frameworks, as compared by Moisen et al., 2020.
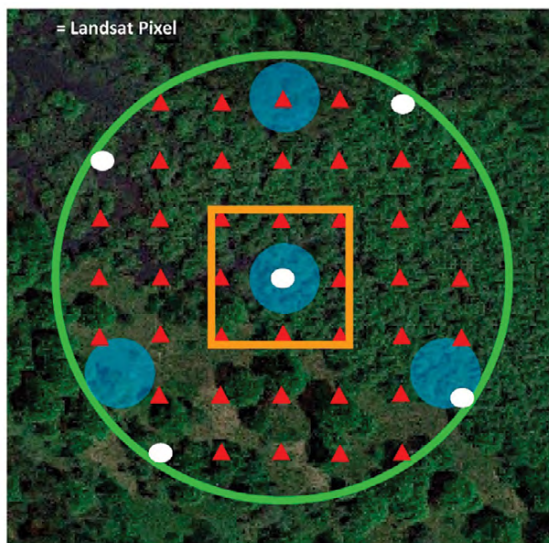
Source: Moisen et al., 2020.
Note: FIA subplots (4) are shown as blue circles, ICE observations are shown as white dots (with red triangles also measured if there is evidence of change), and the focal Landsat pixel used for TimeSync analysis is shown as an orange box.

augmented information in existing national forest disturbance maps by attributing changes to different processes (fire, harvest, etc.). The above maps have strong potential for increasing the efficiency of LULC estimates. In 2021, the portfolio will explore ways to improve estimates by combining plots and maps in collaboration with the Small Area Estimation portfolio.

Challenges: Technical challenges have resulted from changing land cover definitions (between 2013–2018 and 2019). FIA is producing adjusted land-cover estimates that are planned to become available soon. The COVID-19 pandemic impact on field work led to the availability of field crews to help with office work, resulting in an increased photo-interpretations for the ICE program in 2020.

Deliverables: FY 2020 publications related to FIA LULC include:

Cohen, W.B.; Healey, S.P.; Yang, Z.; Zhu, Z.; Gorelick, N. 2020. Diversity of algorithm and spectral band inputs improves Landsat monitoring of forest disturbance. Remote Sensing. 12(10): 1673.

Figure 20. Forest disturbance history of the mid-Atlantic region, as shown by the LCMS app.
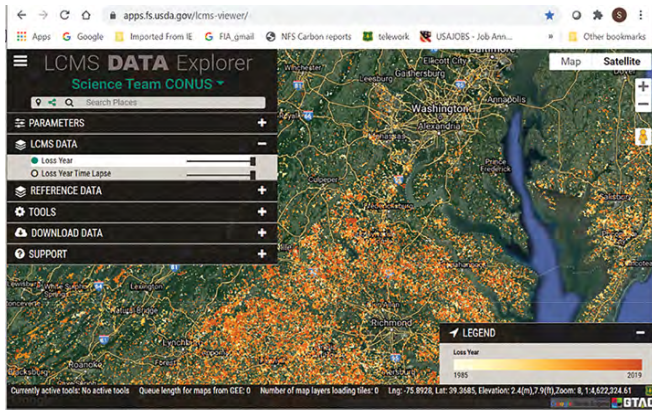
Note: In the LCMS app select "Science Team CONUS" from the dropdown menu to explore shown data.

Gray, A.N.; Cohen, W.B.; Yang, Z.; Pfaff, E. 2019. Integrating TimeSync disturbance detection and repeat forest inventory to predict carbon flux. Forests. 10(11): 984.

Lister, A.; Lister, T.; Weber, T. 2019. Semi-automated sample-based forest degradation monitoring with photointerpretation of high-resolution imagery. Forests. 10(10): 896. https://www.nrs.fs.fed.us/pubs/59035

McCollum, J. 2020. A comparison of land use observations from image-based change estimation and forest inventory and analysis. Celebrating progress, possibilities, and partnerships. Proceedings of the 2019 Forest Inventory and Analysis (FIA) Science Stakeholder Meeting. E-Gen. Tech. Rep. SRS-256. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station: 164–172.

McConville, K.S.; Moisen, G.G.; Frescino, T.S. 2020. A tutorial on model-assisted estimation with application to forest inventory. Forests. 11(2): 244.

Moisen, G.G.; McConville, K.S.; Schroeder, T.A.; Healey, S.P.; Finco, M.V.; Frescino, T.S. 2020. Estimating land use and land cover change in North Central Georgia: bo remote sensing observations augment traditional forest inventory data? Forests. 11(8): 856.

Nagle, N.N.; Schroeder, T.A.; Rose, B. 2019. A regularized raking estimator for small-area mapping from forest inventory surveys. Forests. 10: 1045. doi:10.3390/f10111045.

Schleeweis, K.G.; Moisen, G.G.; Schroeder, T.A.; Toney, C.; Freeman, E.A; Goward, S.N.; Huang, C.; Dungan, J. 2020. U.S. national maps attributing forest change: 1986–2010. Forests. 11(6): 653.

Ecosystem Health Indicators

Overview: The FIA program has a diverse and growing set of customers who are interested in an array of forest attributes that quantify complex forest ecosystem processes across the United States. As a result, FIA includes a suite of forest health indicators in its inventory. Many of these indicators were developed and initially measured by the Forest Health Monitoring (FHM) program in the 1990s. In 1999, they were transferred to FIA and now are a subset of the FIA inventory.

At minimum, each indicator is assessed on approximately 7 percent to 25 percent of the standard plot grid with a set of national protocols that are "core" to the indicator program. The intensity of implementation can vary by region based on budget fluctuation. In addition, indicators can be sampled on all plots (e.g., the Vegetation Profile and Down Woody Materials indicators in the western United States). For more information about indicators or sampling intensity see the Story Map or publication.

Scope: These indicators provide critical information about ecosystem health and aid in understanding the impacts of stressors and other threats to forests:

- Crown Condition
- Tree Damage
- Tree Mortality and Standing Dead Trees
- Lichen Communities
- Down Woody Materials
- Vegetation Profile
- Soil Quality
- Nonnative Invasive Plants
- Regeneration and Browse Impact
- Fragmentation and Landscape Context

Government and academic researchers use these forest health data to identify science needs and direct scarce funds to priority research. Land managers at all levels rely on the data for a strategic look at forest resources and as a basis for strategic-scale forest planning. State forestry and other agencies depend on the data for long-term decision-making and policy formulation.

Scientists and policymakers employ the FIA forest health indicator data about forest soils, down woody materials, and tree biomass to estimate carbon budgets and sequestration. The fire management community identifies areas at highest risk of catastrophic fire and opportunities for preventive treatments using the forest structure, understory vegetation, and down woody debris data. Land managers, equipped with data on

understory vegetation, track nonnative invasive species, assess regeneration security, and quantify the impacts of browsing. This fills critical information gaps for restoring healthy young forest habitat that sets the trajectory for future forests following disturbance. Forest health specialists rely on information about tree condition to quantify the occurrence and impacts of abiotic and biotic forest disturbances. Surveys of lichen communities provide information on human health, air quality, climate, and biodiversity. Indicators of forest fragmentation and urbanization help policymakers understand trends in the spatial distribution of forest land and proximity of forest land to urban development.

Partnerships/Users: Important partners and collaborators involved with the forest health indicators include State, local, and regional forestry agencies, universities, and many other Forest Service programs (Forest Health Protection, Forest Health Monitoring, Forest Health Applications Applied Sciences Team). FIA forest health indicator data and analyses also contribute to a variety of State, national, and global assessments, including many of the Criteria and Indicators of Sustainability for reporting under the Montreal Process. Forest health measurements are key for producing the reports required by the Resources Planning Act (RPA) and are increasingly being used to support regional resource assessments that are a basis for forest planning.

Annual Update

Progress: The FIA program continued to conduct meaningful science, engage with important partners such as National Forest Systems and universities, and publish data, reports, and online tools related to forest ecosystem health. For example, understory vegetation and tree canopy cover data were used as proxies for wildlife habitat and pollution impacts on tree growth and mortality were evaluated.

Challenges: The COVID-19 pandemic and ensuing safety protocols substantially reduced all FIA data collection, including indicators of ecosystem health. However, where plot data were collected, FIA continues to gather information about tree mortality and growth, forest disturbance, understory vegetation, nonnative invasive plants, down woody materials, and soils. Although the delay in field sampling did not have an immediate impact on research, reporting, or data publication, the delayed availability of a complete panel of 2020 data will produce a ripple effect in future years.

Deliverables: FY 2020 publications related to health indicators in FIA include:

Status of shortleaf pine regeneration in Arkansas – *RU FS-278*

Status of white oak advanced regeneration in Arkansas, 2018 – *RU FS-279*

White oak effective density, 2019 – *RU FS-280*

Occurrences of shrubs in PNW – *GTR-980*

Climatic niche limits and community-level vulnerability of obligate symbioses – *Journal of Biogeography. 47: 382-395i*

Lichens as indicators for air pollution in Eastern United States forests – *GTR PNW-GTR-985*

Evaluation of deposition impacts and ozone on tree growth and mortality in California – *Forest Ecology and Management. 465: 118084*

Mapping tall shrub biomass in Alaska – *Remote Sensing of Environment. 245: 111841*

Long-term forest health implications of roadlessness – *Environmental Research Letters. 15: 104023*

Making sense of big data: Putting Forest Inventory and Analysis to work in forest planning – *Science You Can Use Bulletin, Issue 39*

Supporting National Forest System planning with Forest Inventory and Analysis data. – *Journal of Forestry*

Population dynamics of ash following emerald ash borer invasion – *Forest Ecology and Management. 479: 118574 (accepted for publication in FY 2020)*

Forest health data dashboards – *National coarse woody debris dashboard, Emerald ash borer ESRI dashboard, Beech bark disease ESRI dashboard, Hemlock woolly adelgid dashboard, NRS Regeneration dashboard*, *National crown health dashboard*, *National tree damage dashboard*, *NRS invasive plant dashboard*

Urban Inventory

Overview: Since the 2014 Farm Bill direction to assess the necessary resources to implement a nationwide inventory and monitoring of urban forests, FIA has inventoried cities, beginning with Baltimore, MD, and Austin, TX, in 2014, and expanding to 40 cities in 28 States as of 2020. FIA continues to have conversations with additional cities with the plan to add cities in the future as funding allows.

Urban forests are the trees and other vegetation growing along streets and waterways, around buildings, in backyards, and in parks of our cities and towns. They are critical to the function and livability of these human habitats. For the purposes of FIA sampling, urban forests are those areas nested within U.S. Census Urbanized Areas and Clusters (UAUC) and City/Places.

Scope: Urban trees and natural spaces are critical to human health and well-being. A neighborhood's trees moderate air and water pollution, reduce heating and cooling costs, and provide shade and shelter from the hot summer sun. Healthy trees can provide wildlife habitat and improve real estate values. Research shows that trees improve mental health, strengthen social connections, and reduce crime rates. Yet, despite all their benefits and the need to know more about them, urban forests—unlike rural forests—have not previously been covered by a formal continuous inventory system. Once cities complete their first inventory cycle, data can be accessed through FIA Urban DataMart and explored with the My City's Trees application, where users can analyze data and create interactive reports.

As funding and partnership interest allows, FIA plans to continue to add metropolitan areas, with the goal of including all urban forests in the Nation as directed in the FIA Strategic Plan. Once an inventory within a city or urban area within a State is initiated, it will continue to be measured in the future, just as traditional FIA plots are, thus creating a continuous inventory of the Nation's urban forests. Additional information about the program appears in:

- Urban FIA Website
- Urban FIA Briefing Paper
- Urban FIA: Providing Critical Insights About our Nation's Urban Forests
- Journal of Forestry: Strategic National Urban Forest Inventory of the United States

Partners/Users: Texas A&M University, States, and cities across United States.

Annual Update

Progress: *Data collection* – As of 2020, of the 40 cities with Urban FIA implemented, 10 cities have a full data set completed and have started plot remeasurement; 11 are at least 50 percent complete, and the rest have completed less than 50 percent of their first measurement cycle. Collaborative efforts and partnerships are critical to this success because it would not be possible without our contractors, cooperators, and Federal staff. Virtual field data collection training tools have been developed to ensure data collection crews can be certified to collect data without meeting in person. Two tree crown modeling projects focused on improving field data collection efficiencies were completed, with plans to implement results in the field in the fall of 2021. The first involved crown widths and the second involved missing crown foliage.

Reporting – Data review and processing procedures have been developed, reviewed, and improved leading to data certification of 47 urban projects in 2020. Development and testing of the beta version of the Urban EVALIDator application used to

interact with the Urban FIADB was completed. Plans call for an operational version to be released in late 2021. An internal analysis database was developed and released to assist in urban data reporting. Progress continued on the San Diego urban forest report, which is now in review; once complete it will serve as a national reporting template for all future urban FIA reports. Reporting teams started preliminary work on urban forest reports for Chicago, IL; Portland, OR; San Antonio, TX; Washington, DC; and St. Louis, Springfield, and Kansas City, MO.. Three urban forest inventory data requests were completed for the city of Portland, OR.

Challenges: In the face of COVID-19, the safety of field crews and the communities in which they interact took priority, reducing the FY 2020 urban data collection by 83 percent, compared to previous year. Crews sampled about 316 urban plots (table B-1) and an additional 100 were assessed through remote sensing analysis to examine whether they were located in water bodies or in land (table 8). The goal for 2021 is to continue data collection in all cities, completing both the remaining 2020 sample as well as the 2021 sample.

Table 8. Urban FIA plots by State and metro/urban area, FY2020

State	Metro area/urban area*	Plot count
CA	San Diego	26
CO	Denver, Colorado Springs, Front Range, Urban areas	54
CT	Bridgeport, Urban areas	14
DC	Washington DC	4
IA	Des Moines, Urban areas	3
ME	Portland, Urban areas	3
MN	Minneapolis, Urban areas	4
NJ	Trenton, Urban areas	5
NY	Buffalo, NewYork City, Rochester	16
OH	Cleveland	3
OR	Portland	25
PA	Philadelphia, Pittsburgh	5
RI	Providence, Urban areas	2
TX	Austin, Fort Worth, Houston, San Antonio	223
VT	Burlington, Urban areas	9
WI	Madison, Milwaukee, Urban areas	3
WV	Morgantown, Urban areas	1
U.S. VI	U.S. Virgin Islands	16
Total		**416**

Note: Table includes sampled plots and plots assessed through remote sensing analysis such as plots located in water bodies. Totals do not match Table B-1, which only includes sampled plots.

Deliverables: The Urban FIA users guide was updated and the Portland, OR; San Antonio, TX; San Diego, CA; and Washington, DC datasets have been certified and posted on the FIA Urban DataMart, which now supports six cities including Austin and Houston, TX. Three Missouri cities will be added in spring 2021—Kansas City, Springfield, and St. Louis—followed by Chicago, IL. The San Diego 2017 data were published on the My City's Trees application, and Portland 2018 and San Antonio 2018 data are in the final stages of publication and will be added in early 2021.

i-Tree

Overview: i-Tree is a state-of-the-art, peer-reviewed software suite that provides urban and rural forestry analysis and benefits assessment tools worldwide. These tools enable people from across the world 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), with most users, over 360,000, from the United States (figure 22). The five States with highest demand were Texas, Florida, Maryland, California, and Illinois. The number of i-Tree eco-projects processed worldwide as of December 2020 was over 18,000 (figure 23). I-Tree Eco projects require users to collect and enter local tree inventory data for processing.

Scope: i-Tree tools help strengthen forest management and advocacy efforts by quantifying forest structure and the environmental benefits that trees provide. I-Tree Eco is used to assess several ecosystem services and values associated with FIA data collected in urban areas (Urban FIA). I-Tree helps meet the Forest Service mission of sustaining the health, diversity, and productivity of the Nation's forests by providing users an easy means to assess their local forests. It also helps meet FIA's mission by facilitating local forest information so that policymakers, land managers, and nongovernmental groups can have timely and accurate information about the health and productivity of their local forests. I-Tree helps with assessing the changing condition, health, and contribution of forests, improves our ability to quantify forest values, and provides innovative new methods and techniques for synthesis and product delivery.

Partners/Users: i-Tree is a cooperative effort between the USDA Forest Service, Davey Tree Expert Company, The Arbor Day Foundation, Society of Municipal Arborists, International Society of Arboriculture, Casey Trees, and SUNY College of Environmental Science and Forestry. In FY 2020, funding support was also provided by the Great Lakes Restoration Initiative, American Forests, and the Korean Forest Service.

Figure 21. Global i-Tree user distribution, FYs 2006-2020.

Figure 22. i-Tree usage in the United States, FYs 2006-2020.

Annual Update

Progress: In 2020, the number of i-Tree users remained flat at 90,0000. The i-Tree team offered free technical support and answered more than 750 inquiries, equivalent to about 750 hours, over the year. They have also developed short video trainings with 18,700 views last year. Among the i-Tree-related new research conducted and publications developed were projects on:

- Assessing global urban tree cover changes;
- A new tool to assess the effects of riparian trees on stream temperatures;
- Adding new map layers in i-Tree to assess forest risks and benefits nationally;
- Assessing U.S. urban forest potential to produce wood products and its potential value;
- Improving the ability to assess tree cover globally and the associated benefits derived from the tree cover;
- An i-Tree API to allow external user programs to link to i-Tree calculation capabilities;
- Improving capabilities to conduct forest inventories by adding the ability pin tree locations on digital maps;
- Importing existing tree inventories;
- Re-inventorying trees on mobile devices.

Challenges: The largest challenges faced in developing these tools and science relates to coordinating and communicating among the numerous national and international collaborators and users and obtaining funding for the development of new i-Tree features and capabilities. These challenges are overcome through facilitating communication with collaborators and users, listening and responding to issues and ideas, and obtaining external funding.

Deliverables: FY 2020 publications related to i-Tree in FIA include:

> *Abdi, R.; Endreny, T.; Nowak, D. 2020. A model to integrate urban river thermal cooling in river restoration. Journal of Environmental Management. 258: 110023.*
> *https://www.fs.usda.gov/treesearch/pubs/59270*

> *Abdi, R.; Endreny, T.; Nowak, D. 2020. I-Tree cool river: An open source, freeware tool to simulate river water temperature coupled with HEC-RAS. MethodsX. 7(5): 100808.*
> *https://www.fs.usda.gov/treesearch/pubs/61444*

> *Coville, R.; Endreny, T.; Nowak, D.J. 2020. Modeling the impact of urban trees on hydrology. In: Levia, D.; Carlyle-Moses, D.; Iida, S.; Michalzik, B.; Nanko, K.; Tischer, A. eds. Forest-water interactions. Ecological Studies (Analysis*

Figure 23. Distribution of i-Tree eco-projects processed as of December 2020.

i-Tree Eco Submissions, 2020
- International (10,148)
- United States (8,137)
Total: 18,285

and Synthesis), vol 240. Cham, Switzerland: Springer: 459–487. https://www.fs.usda.gov/treesearch/pubs/59517

Morgenroth, J.; Nowak, D.J.; Koeser, A.K. 2020. *DBH distributions in America's urban forests—An overview of structural diversity. Forests. 11: 135.doi:10.3390/ f11020135*
https://www.fs.usda.gov/treesearch/pubs/59336

Nowak, D.J.; Greenfield, E.J. 2020. *Recent changes in global urban tree and impervious cover. Urban Forestry and Urban Greening. 49: 126638.* https://www.fs.usda.gov/ treesearch/pubs/59488

Nowak, D.J.; Greenfield, E.J.; Ash, R. 2019. *Annual biomass loss and potential value of urban tree waste in the United States. Urban Forestry and Urban Greening. 46: 126469.*
https://www.fs.usda.gov/treesearch/pubs/59115

Warnell, K.; Russell, M.; Rhodes, C.; Bagstad, K.J.; Olander, L.P.; Nowak, D.J.; Poudel, R.; Glynn, P.D.; Hass, J.L.; Carter Ingram, J.; Matuszak, J.; Oleson, K.L.L.; Posner, S.M.; Villa, F. 2020. *Testing ecosystem accounting in the United States: A case study for the Southeast. Ecosystem Services. 43: 101099.*
https://www.fs.usda.gov/treesearch/pubs/59916

Westfall, J.A.; Nowak, D.J.; Henning, J.G.; Lister, T.W.; Edgar, C.B.; Majewsky, M.A.; Sonti, N.F. 2020. *Crown width models for woody plant species growing in urban areas of the U.S. Urban Ecosystems. 23(4): 905–917.*
https://www.fs.usda.gov/treesearch/pubs/60534

Forest Products and Utilization

Overview: FIA's Resource Use monitoring aims to capture information to further classify timber harvests, providing data to assess a variety of issues regarding timber resource use. The program includes two data collection efforts—the TPO and the Harvest Utilization studies.

TPO program – The program gathers information though surveys of primary wood processing facilities. These mill surveys provide information to quantify the use of roundwood (whole or chipped logs) by geographic location, tree species, and forest product type. The mill surveys also capture information on mill residue production and management.

Harvest Utilization – These studies involve data collection at active logging sites. Information gathered helps characterize harvested sites by identifying the tree species, size, and primary product destination of volume removed, as well as the amount of fell volume left on site (logging residue).

Scope: The TPO program and the studies on Harvest Utilization allow FIA to report data related to timber harvest for industrial products, logging residue, and mill residue at various geographical levels. Combining these two data sets with other FIA and external data sources, helps generate information on timber harvesting activities and the growth-to-drain ratios. In turn, these production estimates help inform policy and management decisions, estimate sustainability, provide key data to identify timber demand and available primary markets, and assess the economic contributions of timber harvesting and wood products manufacturing, among others. Applications for these data range from wood basket analysis and wood market supply and demand projections, to sustainability and carbon sequestration analyses, among others.

Additional TPO information can be found at https://www.fia. fs.fed.us/program-features/tpo/.

Partners/Users: The TPO program relies on key partnerships with more than 35 State agencies, 5 universities across the Nation, and western Forest Service regions to help gather resource use information and assist in the transition to an annual national survey.

Annual Update

Progress: The TPO program is still transitioning from a census of all primary wood-using facilities, which was carried out periodically but at varying frequencies across the United States, to an annualized mill sample. Additionally, TPO data storage and processing are moving from regional-maintained databases to the FIA database (FIADB). These changes aim to improve the timeliness of TPO and accessibility of the annualized information, in direct response to the 2014 Farm Bill requirements. During FY 2020, the TPO program made considerable progress toward full implementation of the previously mentioned changes. The annualized sample design was implemented across all regions to collected 2019 data. However, other aspects of the program's transition are still at various levels of progress. Table 9 provides a summary of progress toward the annual sample design across each TPO region, using four key milestones: ability to generate a mill sample (sample drawn); transmitting collected data to the national database (data entry); processing data to get population estimates (data processing); and reporting final estimates (data delivery).

One of the programs' major accomplishments in FY 2020, was the release of a new online interactive tool to deliver TPO State-Factsheets for the Southern States. The "TPO one-click Fact Sheets" can be found at https:// public.tableau.com/views/FIATPOOneClickFactsheet/ StateSelection?:showVizHome=no#1. The tool represents the first in a series of online tools currently in development to improve TPO data delivery and access. The application is ready to support data for the entire Nation once those estimates become available.

Table 9. Progress toward adopting an annual sample design for TPO survey during FY 2020.

Region	Number of States	Sample drawn	Data entry	Data processing	Data delivery
Northern	23	Yes	Yes	In progress	No
Southern	12	Yes	Yes	Yes	Through online tools
Western	11	Yes	In progress	No	No

Challenges: Lagged progress shown by Northern and Western regions is due in part to limited programmer resources available to TPO. Additionally, Western program characteristics differ considerably from northern and southern regions, adding complexity to the transition.

In general, delays in the implementation of needed patches and updates to FIADB limits the ability to get TPO data processed timely. TPO progress is also challenged by a lack of participation from a couple of States and an overall decreasing level of mill participation. Data collection for both TPO and Utilization studies was affected by COVID-19. Travel restrictions prevented visits to logging sites and limited TPO data collectors' ability to visits mill to address non-response. Utilization studies' training sessions were also hampered by COVID-19's related travel restrictions (virtual training is not an option for utilization studies).

The program has also experienced delays in publication processing at some research stations, limiting the ability for timely information sharing and engagement with data users.

Deliverables: I program had a total of 14 publications in FY 2020: 12 State-Factsheets that reported results for the 2017 southern TPO survey and two General Technical Reports.

Winn, M.F.; Royer, L.A.; Bentley, J.W.; Piva, R.J.; Morgan, T.A.; Berg, E.C.; Coulston, J.W. 2020. *Timber products monitoring: unit of measure conversion factors for roundwood receiving facilities. e-Gen. Tech. Rep. SRS-251. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 148 p.* https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs251.pdf

Marcille, K.C.; Morgan, T.A.; McIver, C.P.; Christensen, G.A. 2020. *California's forest products industry and timber harvest, 2016. Gen. Tech. Rep. PNW-GTR-994. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 58 p.* https://www.fs.fed.us/pnw/pubs/pnw_gtr994.pdf

USDA Forest Service. 2020. Timber product output and use for Alabama, 2017. Resource Update FS-265. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p. https://www.srs.fs.usda.gov/pubs/ru/ru_fs265.pdf

USDA Forest Service. 2020. Timber product output and use for Arkansas, 2017. Resource Update FS-266. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs266.pdf

USDA Forest Service. 2020. Timber product output and use for Florida, 2018. Resource Update FS-267. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs283.pdf

USDA Forest Service. 2020. Timber product output and use for Georgia, 2017. Resource Update FS-268. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs268.pdf

USDA Forest Service. 2020. Timber product output and use for Kentucky, 2017. Resource Update FS-269. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs269.pdf

USDA Forest Service. 2020. Timber product output and use for Louisiana, 2017. Resource Update FS-270. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs270.pdf

USDA Forest Service. 2020. Timber product output and use for Mississippi, 2017. Resource Update FS-271. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs271.pdf

USDA Forest Service. 2020. Timber product output and use for North Carolina, 2017. Resource Update FS-272. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs272.pdf

USDA Forest Service. 2020. Timber product output and use for Oklahoma, 2018. Resource Update FS-273. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs289.pdf

USDA Forest Service. 2020. Timber product output and use for South Carolina, 2017. Resource Update FS-274. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs274.pdf

USDA Forest Service. 2020. Timber product output and use for Tennessee, 2017. Resource Update FS-275. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs275.pdf

USDA Forest Service. 2020. Timber product output and use for Texas, 2018. Resource Update FS-276. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs292.pdf

USDA Forest Service. 2020. Timber product output and use for Virginia, 2017. Resource Update FS-277. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 2 p.
https://www.srs.fs.usda.gov/pubs/ru/ru_fs277.pdf

National Woodland Owner Survey

Overview: The FIA National Woodland Owner Survey (NWOS; www.fia.fs.fed.us/nwos) provides information on the attitudes, behaviors, and other characteristics of America's private forest owners. This information helps describe the social context that is so important for fully understanding the FIA plot and other forest resource information. An estimated 60 percent of the Nation's forest land, excluding Interior Alaska, is owned by an estimated 10 million private ownerships, including families, individuals, corporations, and other entities. These private lands are often in a matrix of ownership patterns that includes public lands and have landscape-level and cross-boundary impacts related to wildfire, wildlife habitat, and timber supply. Federal and State forestry agencies, universities, nongovernmental organizations, private companies, and others use the findings from the NWOS to increase their understanding of issues related to private landowners and to develop and implement programs, policies, and services that help both the owners and the forest resources.

Scope: The NWOS currently has three modules—Base, Corporate, and Urban—and one module under development—Islands. The Base NWOS is aimed largely at family forest ownerships and is implemented on an annual basis. The Corporate NWOS will be implemented periodically and is aimed at companies that own at least 45,000 acres of forest land across the United States. The Urban NWOS is aimed at residential landowners in urban areas and annual implementation is currently being carried out in Austin, TX, Baltimore, MD, Denver, CO, Portland, OR, St. Louis, MO, and Houston, TX. The NWOS Islands module is similar to the Base NWOS but is being customized for private landowners in the U.S. protectorates and territories, with a pilot study being planned for the U.S. Virgin Islands. All modules collect information on the attitudes (e.g., reasons for owning forest

land), behaviors (e.g., forest management activities), and other characteristics (e.g., size of forest holdings) of private forest ownership. The results are distributed through Forest Service reports, journal articles, online data access tools, and special data summary requests.

Partners/Users: The NWOS partners with universities, State forestry agencies, and Forest Service research units to leverage capacity and impact. Important partners include University of Massachusetts, Forest Service State and Private Forestry, and Michigan State University, among many others.

Annual Update

Progress: The accomplishments of the FY 2020 NWOS efforts include continued data collection, data processing, and preparation of products. Data collection for the Base and Urban NWOS modules included 2,772 and 363 responses, respectively. Estimates from the most recently completed cycle of NWOS data, assigned a nominal date of 2018, were finalized. The initial products summarizing these findings were developed and are in various stages of the publication process with expected releases in FY 2021.

Challenges: COVID-related issues have delayed data processing, data collection, and reporting, but all core activities of the NWOS have continued.

Deliverables: FY 2020 publications related to NWOS in FIA include:

> **Butler, B.J.; Caputo, J.; Robillard, A.L.; Sass, EM.; Sutherland, C.. 2021**. *One size does not fit all: relationships between size of family forest holdings and landowner attitudes and behaviors. Journal of Forestry. 119 (1): 28–44.*
> *https://doi.org/10.1093/jofore/fvaa045.*

> **Butler, B.J.; Caputo, J. 2020.** *Weighting for the USDA Forest Service, National Woodland Owner Survey. Gen. Tech. Rep. NRS-198. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 35 p.*
> *https://doi.org/10.2737/NRS-GTR-198*

An updated forest ownership map for the United States was also developed in FY 2020 and will be released in FY 2021 (https://doi.org/10.2737/RDS-2020-0044) and a summary of the pilot NWOS Corporate module has been submitted to a journal.

National Inventory and Monitoring Applications Center

Overview: The National Inventory and Monitoring Applications Center (NIMAC) is responsible for providing technical assistance on planning, conducting, processing, and analyzing forest inventories to FIA's broad range of customers, which include NFS, other Federal agencies, State governments, and other countries.

Focus: The center efforts focus on three main areas:

Design and Analysis Toolkit for Inventory and Monitoring (DATIM) – The Forest Service National Forest System and FIA continue to fund NIMAC to develop DATIM. The design tool helps identify the range of inventory information needs, sampling designs, and the development of monitoring plans as required by the 2012 Planning Rule. DATIM enables NFS to quickly analyze an enhanced form of FIA data by adding NFS attributes computed using the Forest Vegetation Simulator (FVS). These analyses can be spatially customized using geographic information system (GIS), which can also be used to incorporate map attributes into analytical queries. Ongoing effort is needed to make FIA data from NFS lands accessible to NFS staff for developing data presentations, analyses, and reports that are useful to NFS managers. In October 2020, version 13.1 was released, with subsequent versions already in development. DATIM is publicly available at: www.fs.fed.us/emc/rig/DATIM/index.shtml.

Fish and Wildlife Service Forest Inventory – NIMAC provides assistance to the U.S. Fish and Wildlife Service (FWS) in forest inventory design and implementation, with completed or ongoing inventory work on 15 refuges (Moosehorn, Umbagog, Great Dismal Swamp, Wertheim, Assabet River, Chincoteague, Rhode Island Refuge Complex, Iroquois, Patuxent, Canaan, Oxbow, Mashpee, Aroostook, James River, and Rappahannock River). NIMAC/FWS has developed analytical tools that assist in assuring data quality and produce statistically rigorous estimates for attributes of interest. Reports have been completed for Patuxent, Wertheim, Iroquois, Aroostook, and Mashpee refuges. The results of these assessments are valuable for refuge managers in support of management and policy decision-making. Additional work being considered is the development of a monitoring protocol and an analysis system that provides evaluations of change on remeasured plots.

State Agency and International Technical Assistance – NIMAC has completed forest inventory projects with various State partners, including Kansas Forest Service, Nebraska Forest Service, South Dakota Department of Conservation of Environment and Natural Resources, North Dakota Forest Service (collectively under the Great Plains Initiative), and Massachusetts Department of Conservation and Recreation. Long-term ongoing projects include continuous forest inventories (CFI) on State-owned lands conducted by Missouri Department of Conservation, Indiana Department of Natural Resources, and Wisconsin Department of Natural Resources.

For each CFI, NIMAC assisted in development of the inventory design, field guide preparation, and data recorder software. NIMAC conducts quality assurance checks and processes the data to add attributes such as tree volume and biomass. The State agency receives a customized version of the FIA PC-EVALIDator analytical tool, which allows State analysts to create estimates that address their specific information needs.

Additional Partners/Users: In 2020, NIMAC worked collaboratively with the Forest Service International Programs, who provided funds to continue technology transfer efforts in support of global forestry initiatives, including improvement of national forest inventory systems, remote sensing integration, and training material development and delivery.

Annual Update

Progress: In 2020, NIMAC continued to support the development of the Design and Analysis Toolkit for Inventory and Monitoring (DATIM) via technical assistance and participation on the DATIM Core Team, consisting of NFS and FIA representatives. Enhancements in 2020 included further development in adding FVS attributes to the data, further refinement and added features for the spatial intersection tool, team-sharing capabilities, increased report outputs and options, and improvements in data management processes. In 2021, new versions are expected quarterly with version 13.1 available October 2020. Updates to the User Guide accompany each new release. New capabilities in future versions will be based on guidance from the NFS Advisory Board on desired features and their priority, including adding the functionality for custom estimation units.

NIMAC continued the ongoing forest inventory work for FWS refuges and for State-owned lands in Wisconsin, Indiana, and Missouri. Final development and implementation of the forest database management system (FDMS) for FWS was completed. NIMAC completed data processing and provided an updated PC-EVALIDator tool for the most recent data of continuous forest inventories from Wisconsin, Indiana, and Missouri. Additional related work included updating the Indiana CFI to reflect recent changes in land holdings and significant development of a custom analysis tool for regeneration data compiled by Wisconsin Department of Natural Resources. NIMAC also began participation on a committee reviewing current CFI protocols by Pennsylvania Bureau of Forestry on State lands.

NIMAC continued its technology transfer efforts in support of FIA's work to collaborate on global forestry initiatives, including improvement of national forest inventory systems, remote sensing integration, and development and delivery of training material in partner countries including Peru, El Salvador, Panama, Guatemala, Costa Rica, Mexico, Republic of Congo, and Vietnam. NIMAC staff co-led an international

session at the November 2019 FIA Science Stakeholders Meeting.

Challenges The NIMAC team did not face any significant challenges during FY 2020 other than travel restrictions related to the pandemic. Most of the international events and meetings NIMAC was engaged in either took place virtually or were postponed.

Deliverables: FY 2020 tools and publications related to NIMAC in FIA include:

> *DATIM advances were made available via six new version releases in 2020.*

> *Publication of the FWS document Protocol Framework for Conducting Forest Inventories.*

Digital Engagement

Overview: One definition of success for the FIA program is providing its user community with the data, information, and knowledge products they need to accomplish their diverse objectives. Customer needs and workflows evolve synergistically with our program, and FIA's traditional printed materials and web-based estimation tools are not sufficient to meet current needs. People spend an increasing amount of time in digital media environments, and they seek their news and information within that space. The Digital Engagement strategy improves service in digital environments.

Scope: The Digital Engagement Portfolio (DEP) demonstrates a creative and dynamic approach to technology transfer while facilitating modeling and systems integration. The DEP main goal is to facilitate analysis, reporting, and knowledge delivery within the FIA program through digital delivery.

Partners/Users: To date, the DEP has established multiple collaborative relationships with agency, external partners, and clients to develop and publish relevant and authoritative data supporting their identified needs. The DEP team has developed analytical and reporting applications relying upon cost-saving solutions that leverage agency and partner competencies and investments, reduce development times, and recruit new collaborations. An example is the deployment of a secure cloud computing environment providing scalable resources to store, process, and share analyses conducted at national scales.

Annual Update

Progress: During the 2020 fiscal year, the DEP was very active and achieved the following work:

Cloud computing prototype completed – The Big Data Mapping and Analytics Platform (BIGMAP)—a cooperative effort between FIA, Forest Service Chief Information Office

(CIO), and ESRI—has completed the prototype of a cloud-computing environment and transitioned to a CIO-maintained Analytical and Decision Support (ADS) environment. The ADS will support FIA production and research. Moreover, the ADS can now support geospatial research occurring in numerous other programs within the agency.

Annual State FIA reporting application in production—The FIA One-Click application, using the public Tableau cloud, was deployed for public use and was used to generate more 39 annual factsheets for publication in Treesearch. The One-Click Factsheets are an example of an innovative product that speeds up the dissemination of State-level estimates of forest land to partners and the public while allowing FIA scientists to focus on regional and national products. Once deployed across all 50 States, One-Click production of annual factsheets will save the Forest Service an estimated $100,000 in staff time each year.

Sharing data widely with agency resources and outlets—The team developed new streamlined workflows consistent with the Forest Service Enterprise Data Warehouse (EDW) governance to improve storage and delivery of FIA content.

Hosted Forest Service-ESRI CRADA kickoff and scientific exchange to set priorities for FY 2021—The FIA program signed a Cooperating Research and Development Agreement (CRADA) with ESRI, the world leader in geospatial services, web GIS, and applications. This CRADA will guide significant cooperative research in geospatial cloud-computing with FIA data at the center of all activities.

Deployed multiple dashboards and prototyped 5-year electronic reporting—The success of the FIA program requires diversifying FIA science delivery options through exploration of novel mechanisms. The DEP team is active in publishing science-based dashboards, novel data access points, and dynamic web-based geospatial science stories (see deliverables below).

Received and addressed reviews from the USDA Office of Communications to approve the content of The USDA Forest Service Forest Atlas—The Forest Atlas is scheduled to be published in FY 2021.

DEP team invited to deliver information to the USDA/Forest Service Information Technology Delivery Optimization (ITDO) team, which is assessing R&D IT efforts—The work of the DEP relies heavily on consistent cutting-edge deployment of IT and therefore close collaboration with the USDA and Forest Service CIOs is extremely important.

In FY 2020, the DEP team received several accolades:

- Invitation to offer keynote remarks at Sustainable Packaging Coalition annual meeting.

- Chief's Honor Award for the One-Click and One-Click Timber Product Output applications.

- Deputy Chief's Honor Award for the One-Click and One-Click Timber Product Output applications.

Challenges: The DEP team did not face any significant challenges during FY 2020.

Deliverables: FY 2020 tools and publications related to Digital Engagement in FIA include:

Current Engagement Portfolio
One Click
One Click -Timber Product Output
U.S. Forests at a Glance
Forests in My State -RPA
Southern Data Visualizations
Nonnative Invasive Trees
Northern Data Visualizations

Community Engagement

Overview: Community engagement is a necessary component to the FIA program. The individual mission of the Community Engagement work is to facilitate communication and collaboration between units resulting in efficiencies and product-sharing concerning all aspects of the FIA program; assist in facilitating community engagement projects locally and regionally by acting as a point of contact for information; and increase external communications to share information about the FIA program. The team leading this effort is composed of two representatives from each of the four FIA units.

Scope: The Community Engagement portfolio is designed to further meet the agency, R&D, and FIA mission by maintaining relevancy, continuing to meet client needs, and promoting interest in STEM fields with the objective of recruiting diverse candidates to the FIA program. Targeted communities to engage include NGOs, tribes, State and Federal agencies, universities, municipalities, forest and woodland landowners, and K-12 schools. The Community Engagement efforts also focus on improving national consistency, collaboration, and coordination among FIA units through enhanced engagements and communications. Specific objectives include:

- Discover, organize, and share, among FIA units FIA-produced materials and content, including presentations, recordings, and media products.

- Track and report community engagement projects and activities from each FIA unit (e.g., NatureWatch,

Interpretation and Conservation Education database).

- Facilitate community engagement projects at each unit (e.g., disseminate information concerning funding assistance related to community engagement activities)

- Increase internal and external communications through social media and traditional media outlets.

Annual Update

Progress: For a team focused on increasing communication within the program and improving outreach to the public, 2020 was certainly a year of note. In-person programs and activities, which are so critical for relationship- and community-building, were put on hold. Meetings and certification sessions shifted quickly to virtual events with varying levels of success. The program was forced to think differently about what services to deliver and how. As a result, the program learned and created a larger pool of materials and ideas to work from and is certain to improve both virtual and future in-person activities.

With a program spread across the country, the increased use of virtual platforms led to broader internal communication and collaboration with colleagues. Although unable to visit a co-worker in the office next door, we were easily able and increasingly apt to touch base with a colleague several States away. This resulted in many employees feeling more strongly connected to colleagues and the organization than they have for quite some time.

Challenges: Though tasks and projects were accomplished, they were not without major roadblocks and challenges, including those related to COVID-19. The pandemic also led to an increase in communications via virtual platforms and an increase in well-being checks on team members. In addition to the COVID-19 impact, issues with CIO updates created software and hardware performance problems, making correspondence difficult at times. Lastly, before COVID-19 constraints, agency policy regarding large stakeholder meetings or even smaller conferences, made efficiency difficult as well as prevented flexibility regarding attendees, dates, facilities, and agenda content.

Deliverables: Major accomplishments of the Community Engagement portfolio were mostly associated with increased internal and external communications, these include:

The FIA Community Engagement Newsletter, published monthly, continued to serve as a means to share news and events (live and virtual) across all FIA units.

Increased coordination among regions thanks to multiple efforts, including the development of training and communication tools that were used nationally to increase efficiency and consistency across the program.

Figure 24. Example of an FIA-related social media post with metric on performance.
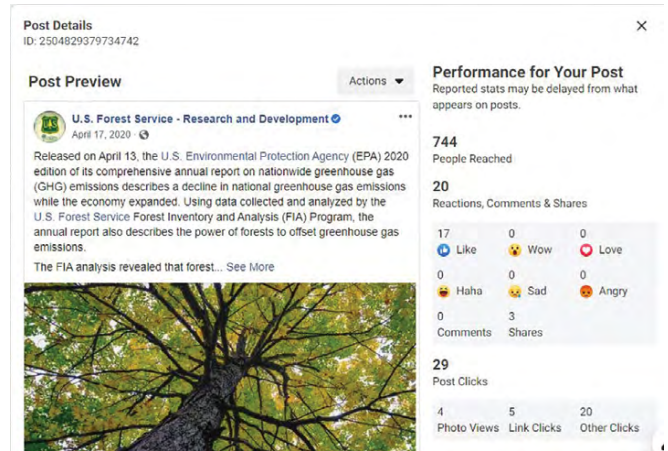
The post used the #USDA_FIA Twitter handle and reached over 744 individuals, assisting in outreach to communities and potentially introducing FIA to new groups.

Multiple virtual field certifications with open invitations to all regions

Development of a Treesearch search engine with the capability of returning FIA-related publications only for internal Forest Service use.

Increased FIA social media presence by creating a specific Twitter handle associated with FIA (#USDA_FIA). Additionally, FIA researchers have reported collaborations based on response to Twitter posts.

Continued work on FIA recruitment video with focused efforts on minority and underserved communities.

Continued work on updating FIA's national website to ensure current content to share the vast array of products and tools available to clients.

2019 FIA Stakeholders Science Meeting in Knoxville, TN, hosted nearly 300 forest scientists, managers, and policymakers from over 20 countries and more than 60 different organizations FIA's partner organization NCASI provided significant help with the meeting themedf "Celebrating Progress, Possibilities, and Partnerships.".

Overall, one of the most notable accomplishments of the FIA Community Engagement portfolio/team continues to be the grassroots involvement of FIA staff committed to the cause and mission of community engagement.

Special Partnerships Spanning Cultures

Overview: Forest Inventory and Analysis community engagement is a critical component of program success. FIA crews are based in rural, local, and/or Native communities for months at a time. The short, intensive period employees live in and depend upon the support of these communities' requires the program to build critical relationships and draw a connection between data collected and community needs and priorities.

Scope: The FIA program has an ongoing Citizen Science component to help cultivate relationships between Native 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, community centers, and via webinar. An additional focus within the program is local hiring and participating in a variety of hiring events and job fairs directed at local students and community members.

Annual Update

Progress: We focused on providing written materials (posters, brochures, flyers) to community members and worked closely with Native and Village Corporations to provide newsletter and social media updates on local project work.

Challenges: Community engagement programs suffered nationwide owing to the 2020 COVID-19 pandemic, beginning with the initial U.S. outbreaks of the virus in December 2019. Citizen Science programs cancelled trainings and events slotted for the summer of 2020 as travel and group-size mandates remained in place for the majority of the field season. Local events in hub communities were also cancelled, owing to major concerns over bringing COVID-19 into remote communities with limited medical facilities.

Deliverables: FY 2020 accomplishments related to special partnerships in FIA included:

Continued participating in the Northern Tribal Homelands Working Group.
Continued leveraging the partnership with Ojibwe Tribes of the Great Lakes to assess the supply and quality of large paper birch within the territories ceded in the treaties of 1836, 1837, 1842, and 1854.

Measured large canoe birch trees to develop a model for these sites, a cooperation with the Great Lakes Indian Fish and Wildlife Commission and Michigan Technological University.

Worked with the Bad River Tribe, MI Tech, The Great Lakes Indian Fish & Wildlife Commission, and Bureau of Indian Affairs on a study of birch planting and growth in Lake States clay.

Organized several southern projects, involving students working with the Job-Corp; ultimately these were cancelled due to COVID-19. Most of the projects related to training, resource management applications, and forest inventory work.

Led conversations with the Rocky Mountain Research Station Tribal Liaison regarding opportunities for future recruitment of tribal members, and the development of analysis and reporting products that meet the needs of tribal foresters.

Delivered summaries of the data collected from plots on tribal lands to numerous tribes.

Continued partnering with Pacific Islands local governments in six culturally unique jurisdictions, working with diverse staff who speak more than nine different languages.

Continued building FIA and local capacity through joint trainings and workshops on the use and collection of the data, while increasing awareness of broadscale changes in local forest ecosystems.

Continued partnerships with local NGOs and universities to enhance our connection with local land managers as they can provide local updates, trainings, and workshops at regional meetings on the inventory information.

Supported the Pacific Island State Foresters by providing data updates and summaries for the 2020 State Forest Action Plan Updates.

Completed the Guam Forest Resources Report, https://www.fs.usda.gov/treesearch/pubs/59433

Hired a joint position with the Pacific Southwest-Institute of Pacific Island Forestry (IPIF) to assist with local management of field data collection in Hawai'i and provide a stronger connection between FIA and research scientists at IPIF.

Delayed in-person data use workshops in Hawai'i due to COVID19 travel challenges and office closures.

Continued ongoing partnership with the Tanana Chiefs Conference and Alaska Native.

Corporations to implement forest inventory in Interior Alaska.

Program Safety

In every way, physical, psychological, and social safety is a [core value](#) uniting Forest Service employees, 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 wilds, the office, or working remotely.

In 2016, Forest Service safety programming began a transition period and cultural reorganization promoting critical thinking and speaking, 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 has evolved the scope of safety and continues to work toward an improved vision of employee well-being and work environment. Program managers and safety teams within FIA units actively monitor and address physical, psychological, and social safety issues and concerns as they emerge, through annual staff surveys and direct reporting.

Table 10. FIA program Federal employee estimates for hours worked, miles driven, aircraft hours flown and safety incidents reported, FY 2020

Category	FIA Unit					Total
	PNW	RMRS	SRS	NRS	WO	
Base data						
Federal FTE equivalents[a]	102	102	80	93	2	**379**
Total estimated hours worked[b]	211,182	211,162	166,795	194,147	4,160	**787,446**
Total vehicle miles driven	205,282	361,189	467,641	545,142	0	**1,579,254**
Total flight hours logged	318	0	0	0	0	**318**
Incidents by class						
OSHA recordable injuries[c]	0	4	2	0	0	**6**
Chargeable motor vehicle accidents[d]	1	2	0	0	0	**3**
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	0.0	3.9	2.5	0	0	**1.6**
Motor vehicle accidents per million miles driven	4.9	5.5	0.0	0	0	**1.9**
Aircraft accidents per 100,000 flight hours	0	0	0	0	0	**0**

[a]Based on appendix B-3 estimated number of Federal employee full-time equivalents (FTE).
[b]Based on appendix B-3 number of Federal employees times 2,080 hours per FTE. 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, serious injury, or the aircraft is substantially damaged.
[f]Aircraft incidents are those affecting, or which could affect, the safety of aircraft operations. (New metric introduced in FY 2020 per safety committee recommendation)
FIA = Forest Inventory and Analysis; FTE = full-time equivalent; NRS = Northern Research Station; OSHA = Occupational Safety and Health Administration; PNW = Pacific Northwest Research Station; RMRS = Rocky Mountain Research Station; SRS = Southern Research Station.

Our Job Hazard Analyses (JHAs) and training for field and office staff are continually reviewed and improved. These include watercraft safety, 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-out/check-in 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, lightning strikes, 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, InReach devices, ergonomic data recorders, and satellite phones. Personal protective equipment includes hard hats, safety goggles, gloves, safety boots, and aerosol sprays for wild and domesticated animals. International security training is required for all international travelers.

Our people are our greatest asset— all take great pride and responsibility for their own and other's safety.

Since 2016, the total annual number of vehicle accidents, has been 5 or fewer (figure 25), reaching a record low of 3 in FY 2020. The total number of work-related injuries and illnesses reported each year has been 10 or fewer for the entire FIA program (figure 26). Table 10 summarizes the program's safety record for FY 2020 with 0 aircraft accidents, 1.6 hours lost due to illness and injury per 100 full-time employees, and 1.9 vehicle accidents per million miles driven.

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 unit embraced a revised set of goals determined primarily by State and regional pandemic status, while also complying with CDC and 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 mitigate risk to employees and the communities where they work.
- Distribution of CDC-recommended personal protective equipment.
- Revision of vehicle-use standards to accommodate one crew member per vehicle, in order to maintain guidelines of social distancing.

Figure 25. Number of chargeable motor vehicle accidents by Unit, FYs 2010-2020.
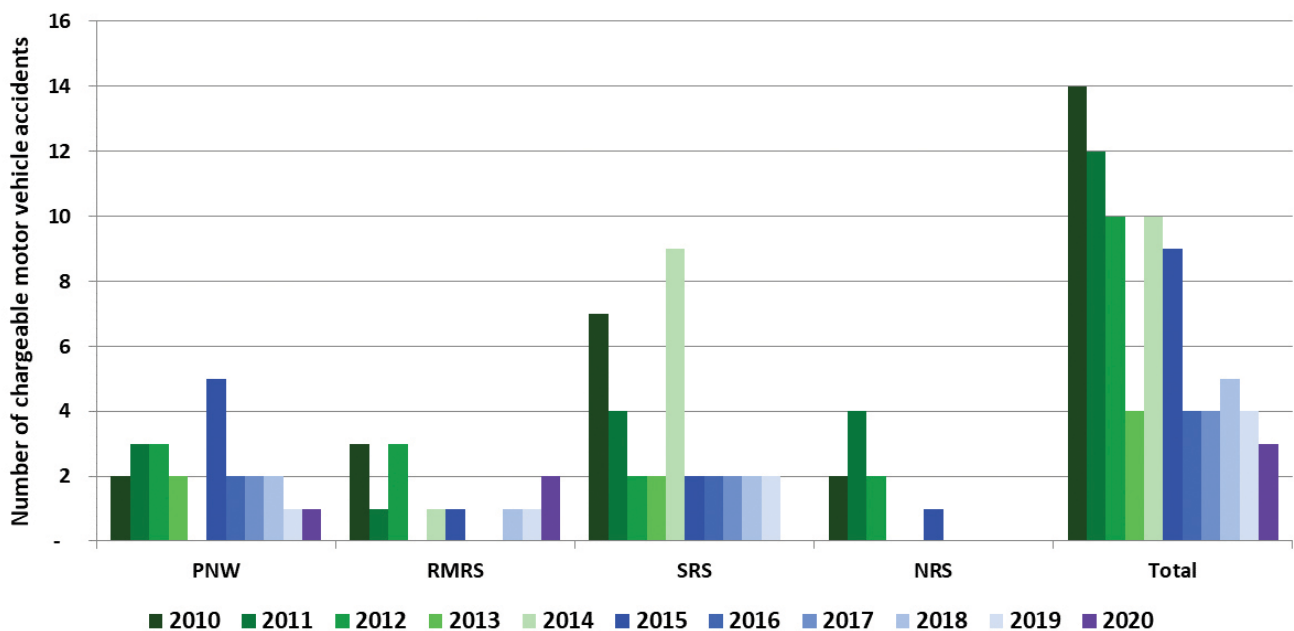
FIA = Forest Inventory and Analysis; FY = fiscal year, NRS = Northern Research Station; PNW = Pacific Northwest Research Station; RMRS = Rocky Mountain Research Station; SRS = Southern Research Station.
Note: A chargeable motor vehicle accident is any occurrence involving the use of a Government-owned 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.

- Prohibition of overnight stays in hotels, only allowing camping as an option for trips longer than one day, which limited the collection of remote plots, especially in the West. An exception was made in Alaska where: crews were isolated before and during the data collection season; COVID-19 testing was used before traveling, complying with State policy; travel operations were shortened to 45 days in one trip and one crew, rather than alternating two crews each week during 80 days; and crew members seriously adopted all mitigation measures included in the Unit's COVID-19 risk assessment. No cases of COVID-19 emerged within the Alaska crews during FY 2020 field season.

Pacific Northwest Research Station

Amid the pandemic, PNW-FIA was successful in completing about half of the scheduled plots. To do this safely, data collection teams developed numerous templates and procedures to assess and mitigate risk of exposure to COVID-19, 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 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 General Service 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 is more suitable for very steep, brushy, rocky terrain.
- Providing ergonomic home-office equipment to staff to facilitate healthier remote work environments.

The unit upgraded safety communication devices for field staff such as satellite phones and SPOT satellite messengers, a device that uses the Globalstar satellite network to provide text messaging and GPS tracking. The unit also piloted new Satellite Emergency Notification Devices (SEND) to explore alternative or additional safety communications for staff working in remote areas, such as Interior Alaska.

Figure 26. Number of OSHA-recordable injuries by Unit, 2010–2020.
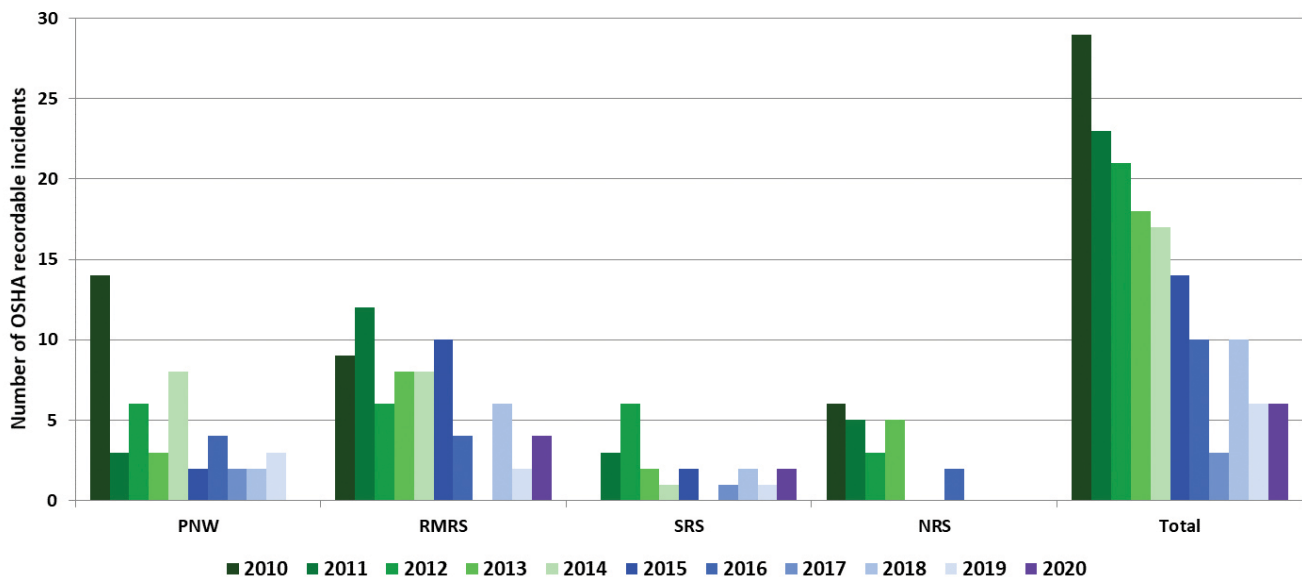
FIA = Forest Inventory and Analysis; FY = fiscal year; NRS = Northern Research Station; OSHA = Occupational Safety and Health Administration; PNW = Pacific Northwest Research Station; RMRS = Rocky Mountain Research Station; SRS = Southern Research Station.
Note: An OSHA recordable incident is a work-related 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.

PNW-FIA also continued the support of a safety-buck program to recognize actions promoting health, safety, positive work environment, and wellness.

Rocky Mountain Research Station

RMRS-FIA navigated the FY 2020 COVID-19 pandemic by adapting the pre-pandemic productivity goals and maintaining a focus on safety throughout the year. Although FY 2020 was different than anyone had ever imagined and planned goals were not completely achieved, the unit was overwhelmingly successful in several ways. RMRS-FIA was able to minimize the risk that our employees would contract COVID19 at work, especially for employees whose family members may be at higher risk of severe illness from COVID19; offer opportunities for employees to maintain or improve their mental health via agency-provided mental health and resilience tools as well as frequent conversations at multiple organizational levels; and offer employees alternative projects to conduct meaningful work, gain new skills, and build relationships across program teams when travel and data collection were not an option. While the program had more government vehicles being used to conduct data collection in FY 2020 than in previous years, there was not an increase in vehicle accidents or associated injuries.

The program safety committee's monthly meetings resulted in several positive accomplishments, including improving the already robust check-out/check-in protocols, addressing hazard trees, sharing safety stories through various outlets, updating the unit aviation safety plan, continuing to explore challenging plot access, and engaging regularly on all pandemic-related challenges.

RMRS-FIA successfully pivoted from a previous reliance on in-person training and engagement to virtual events that allow more employees to take on leadership roles. The program had fully planned and prepared for an in-person, two-week data collection team training for spring 2020 to include safety, aviation, motor vehicle, data collection protocol, and quality assurance. A small team of employees successfully transitioned this training into a robust three-week virtual training for all data collection staff and incorporated the expertise of geographically dispersed office staff that might not have otherwise been able to contribute to field training. Overall, training was found to be effective, with a collateral benefit of increasing program cohesion across teams.

Southern Research Station

SRS-FIA efforts to overcome COVID-19 challenges and operate in a safe environment required a significant time investment. At the beginning of the pandemic, finding safety supplies in a timely manner was strenuous. Staying connected with other safety teams was key to finding effective solutions in a rapidly changing and uncertain environment. Pandemic-related travel restrictions did not significantly affect SRS data collection efforts because these are mostly conducted by State crews in the region.

In FY 2020, the SRS-FIA safety committee began publishing a monthly safety newsletter. Topics were selected to illustrate the program's challenges and accomplishments, and to inform leadership of how the FIA program was addressing safety and operational issues.

The region also experienced a record number of hurricanes in FY 2020. SRS-FIA leadership prioritized safety by minimizing employee exposure during hurricanes— managers spent significant resources to ensure that no crews or staff were located in hurricane paths as each event progressed. Program staff succeeded in maintaining continued phone contact with employees in weather-threatened areas, alleviating concerns from loss of contact during an emergency.

Northern Research Station

The Northern Research Station halted all travel and multi-person field assignments, and office staff transitioned to telework when the COVID-19 pandemic began. Data collection travel assignments were awarded to contractors that had more flexibility to carry out the assignments safely. Purchasing staff worked tirelessly and resourcefully to procure personal protective equipment and disinfectant supplies to help office and field staff work safely during the pandemic. Data collection staff were empowered to work alone in the field on local plots or complete telework projects, depending on their level of comfort.

The data collection crew continues to maintain safe driving practices. Collectively, program employees drove over 545,000 miles safely with no traffic accidents; only two instances of minor cosmetic damage to vehicles were reported.

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 Job Hazard Analysis (JHA) documents to incorporate the changing needs of office and field staff. Early in the COVID-19 pandemic, the Safety and Health Committee created two new Job Hazard Analyses and one Mitigation Strategies document. One JHA addressed general hazards of working during the pandemic while the other addressed specific risks associated with working away from home for extended periods of time. One member of the Safety and Health Committee met regularly with other FIA regional representatives to share coping strategies, concerns, sources of personal protective equipment, and other topics related to COVID-19.

Fiscal Year 2021 Anticipated FIA Program Direction

The FIA program will continue inventory operations in 50 States, with Alaska focused on an annualized survey in Coastal Alaska, and a periodic survey including integration of remote sensing data for efficiency in Interior Alaska (figure 27). FIA partners continually rate "complete the core" as their number one priority, and therefore it remains the number one priority for FIA. This means completing surveys on time, making the data available online, and publishing reports.

The ongoing impacts of COVID-19 and an anticipated difficult forest wildfire season in the West, compounded by current budget and understaffing challenges, will continue to result in a decreasing capacity to meet annual data collection and delivery targets, as well as longer term research needs of NFS and other partners in FY 2021. FIA anticipates additional funds from the CARES Act, between $2.5 and $3 million, to mitigate the impact of COVID-19 in field operations and data delivery. Assuming no travel restrictions and the current budget and staffing levels in FY 2021, FIA is planning to complete 65 percent of FY 2021 base field plots, in addition to completing the majority FY 2020 plots not sampled in FY 2020. FY 2020

western plots located in areas that cannot be cost-effectively measured due to their remote location relative to the majority of the plots scheduled for FY 2021, will be measured in FY 2022. It is estimated that NRS and SRS will be able to complete between 95 percent and 100 percent of the FY 2021 data collection target and western units around 50 percent. Urban plot surveys are anticipated to be back on schedule by the end of 2021, assuming contracting pools are sufficient, and the pandemic allows for operations to be managed safely. Many States are likely to fall 1 to 3 years behind on data delivery.

Operations will continue from remote hubs in the Southwest Unit of Interior Alaska, and data and results will continue to be made available for the first and second units already sampled. The cost of inventory operations in Interior Alaska is expected to be high in remote hubs where access is only by air, and where fuel, medicine, communications, food, and other supplies are limited.

Other major activities planned for 2021 and beyond include: achieving full compliance of State 5-year reports; publishing results from the most recently completed cycle of NWOS

Figure 27. Planned FIA implementation status, FY 2020.
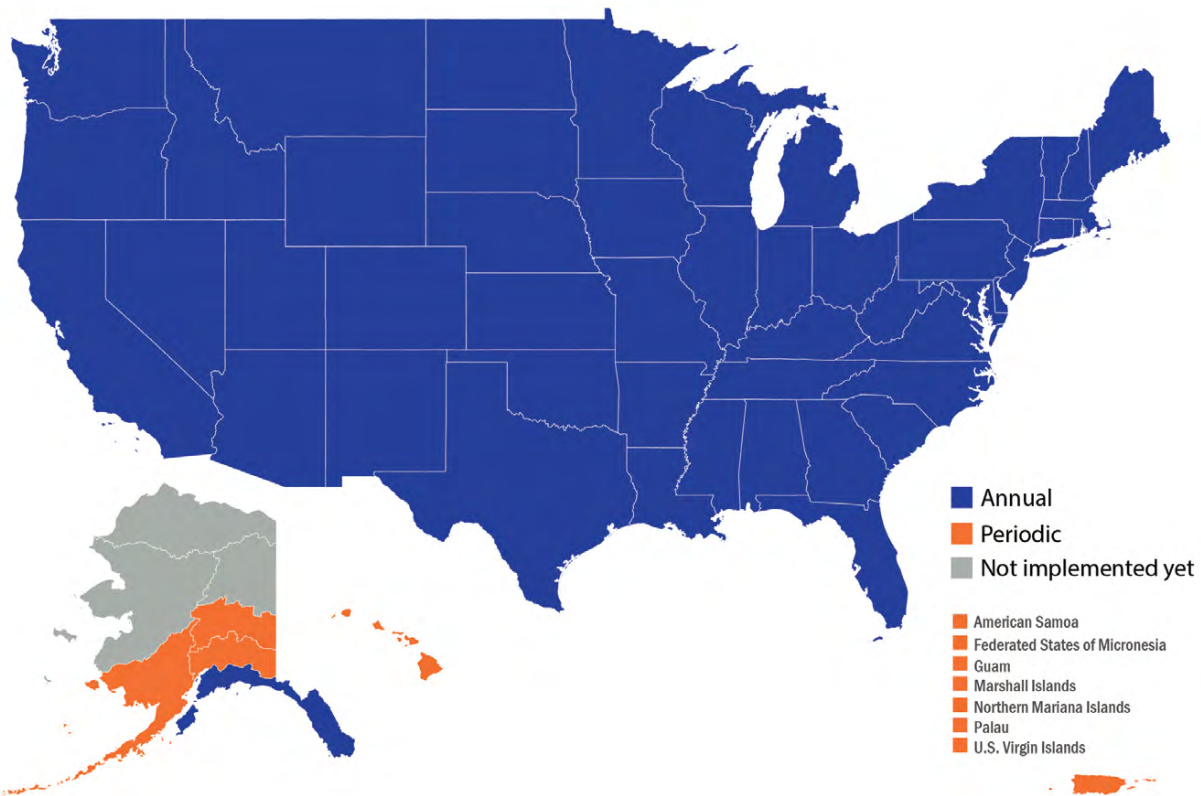
FIA = Forest Inventory and Analysis; FY = fiscal year.

Base and Urban; continuing to modernize the program's TPO operations and reporting through the release of interactive online applications; developing user-friendly applications for small area estimations that will leverage access to new computing libraries, including nationwide runs at improved speed, and automated reporting; further developing DATIM; and populating FIA Urban DataMart and My City's Trees applications as urban data are ready. Accomplishment of these goals will depend on the continued strong support of partners, their commitment to an efficient and productive FIA, and the adequate funding for full program implementation of 2014 Farm Bill options A through C.

In response to the Further Consolidated Appropriations Act for FY 2020, the Forest Service is eliminating cost pools from its budget for FY 2021. For 20 years, cost pools have covered fixed operational costs, such as business services and infrastructure, Office of Worker's Compensation Programs and Unemployment Compensation Insurance. The FIA program has adapted to this new budgeting system in FY 2021. The FIA program will also continue to work through information technology modernization, to comply with agency implementation of the Federal Information Technology Acquisition Results Act.

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 10 percent per year in the West and 15 percent per year in the East by FY 2003. Since then, financial support from partners has enabled FIA to get close to a 20-percent target, remeasuring plots in a 5-year cycle, in some Eastern States. State support has been impacted as Federal budgets fluctuated yet remained essentially flat, at $77 million, since 2017. Impacts in State government budgets have also affected their matching funds and in-kind contributions to the program. Stronger Federal support is needed to continue and expand as partners find exceptional value in leveraging Federal resources to provide improved information and service to their constituents. The program remains underfunded to fully deliver Farm Bill demands and emerging data needs. And this gap has steadily increased since 2017.

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 plan is forward-looking and attempts to balance emerging client demands for new information, tools, and values with necessary decisions on priorities and budget constraints. 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. The plan was delivered to the agency and USDA in mid-2014, with a final submission delivered to Congress in March 2015.

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 Forest Inventory and Analysis 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 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 information from the Forest Inventory and Analysis 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 information from the Forest Inventory and Analysis.

7. Promote availability of and access to non-Federal resources to improve information analysis and information management.

8. Collaborate with the NRCS, National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, and the 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 involving the use of cloud computing and access to massive satellite data archives entered the production phase and will be close to operational in FY 2021. The project, called BIGMAP (Big Data, Mapping, and Analytics Platform), explores the capabilities of ESRI Raster Analytics and ArcGIS Enterprise to support the integration of plot data and auxiliary information in order to add value to the FIA program.

As the ongoing USGS 3DEP program continues to make progress producing coverage for land in the conterminous United States with level-2 resolution LiDAR (Light Detection and Ranging), FIA explores how to best incorporate LiDAR data to produce information that has the potential to yield substantial benefits such as the characterization of vertical forest structure. Additionally, the FIA program seeks to capitalize on these resources along with NAIP-derived and photogrammetrically derived point clouds for nationwide coverage to cooperatively develop tree canopy height products.

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. During FY 2020, the third of the six units of Interior Alaska, the Southwest Unit, was initiated. This is a significant step toward improving the use and integration of remote-sensing technologies in the FIA program.

Table 11. National performance measures of the FIA program by fiscal year, 2013–2020.

Goal	Performance measure	FY2013 level (%)	FY2014 level (%)	FY2015 level (%)	FY2016 level (%)	FY2017 level (%)	FY2018 level (%)	FY2019 level (%)	FY2020 level (%)	Target
Inputs										
Maintain sufficient funding to support the base Federal FIA program[a]	Percentage of total Federal funding necessary for annualized inventory received	85	85	89	82	82	82	84	82	100
Outputs										
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
Keep fieldwork current	Percentage of States actively engaged in the annualized inventory program	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
Outcomes										
Keep analysis current	Percentage of States with FIA State report less than 6 years old	88	90	94	96	96	96	90	94	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	100
Partners' participation	Partners' financial contributions expressed as percentage of total program funds	10	10	10	12	16	16	13	14	20

FY = fiscal year; NRIS = Natural Resource Information System.
[a]Revised percentage based on congressional target of $97.2 million, adjusted for inflation, for 2014–2018 FIA Strategic Plan options A, B, and C in FY 2019.

FIA continues to prioritize and enhance the collaboration with States, Federal agencies and universities to improve and efficiently provide assessment and analysis of fundamental information for the Nation's forest resources and investments.

FIA Backdrop

During its entire 90-year history, FIA has spent a grand total of $1.4 billion from U.S. taxpayers for inventory, monitoring, and assessment of U.S. forest lands. During that time, multi-billions of dollars have been invested by forest industries and tens of thousands of jobs created from logging, primary wood processing, and manufacturing, construction, and retail sales of wood-based products. Since 2000, FIA has invested more than $282 million into partnerships and agreements with States, dozens of universities, nongovernmental organizations, and others to collect data, conduct research, and perform analyses to improve program efficiency and support client information needs. Since 2000, FIA partners have contributed about $181 million to leverage the program to collect and process more data and information to meet local needs. FIA is a proven, cost-efficient partnership program that has consistently delivered significant value added to the taxpayers for more than eight decades. The following summaries outline the range of implementation opportunities provided in the current strategic plan. In the coming year, Congress will review these options, ask questions, and suggest adjustments that will determine its future support for the FIA program.

OPTIONS A and B, Status Quo Option: This option maintains the 7-year East (15 percent), 10-year West (10 percent) paradigm for measurement, and these combined options place the program at the previous strategic plan target funding level.

OPTION C, National Core Option: This option maintains the 7-year East (15 percent), 10-year West (10 percent) paradigm for measuring base plots with improved remote-sensing support plus continuing the timber product output and ownership studies with enhancements and implementation of the urban forest survey.

OPTIONS D and E, Full Farm Bill Option: This option implements the full 5-year (20 percent) measurement program nationally for base plots with improved remote sensing, continued timber product output and ownership studies with enhancements, and all the other items except small-area estimation based on sample intensification.

OPTION F, Leveraged Partner Option: This option is a partner opportunity. Currently States and other partners contribute nearly $11 million annually to intensify data collection, research, and analyses to improve estimates for smaller planning areas. FIA processes, maintains, and distributes the enhanced data and information.

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 at the project level. Table 11 shows our key goals, performance measures, and benchmarks for the FIA program for 2013 through 2020 and targets for a fully implemented program. In FY 2020, 90 percent of all States with annualized inventories had inventory data available online less than 2 years old.

Conclusions

We, the FIA program, continue 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 FIA program. We are gathering and disseminating information on a wide array of ecological attributes, while continuing to serve our traditional customers who require timely information on forest resources. We are increasing the timeliness of our surveys and of our reporting to provide a continually updated, publicly accessible information base that includes meaningful reports, analyses, and elemental data for others to use. We are exploring and leveraging the latest technologies, included remote sensing,

to expand the scope of our products and to deliver them more efficiently. We are also openly reporting on our 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, 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.

■ **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 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), which are included in the "effective indirect expenses" definition. Includes work done for other units as a normal part of FIA business and the following items:

    equipment. Costs for durable goods used for FIA, includes the following:

        computer/telecommunications. Additional computer hardware, software, communications costs.

        imagery. Aerial photos, satellite imagery data files.

        field equipment. Measurement tools and equipment, such as data recorders, carried by field crews.

        other. Any cost that does not fit into one of the previous equipment categories.

    vehicles. All vehicle costs, including items such as operating costs, depreciation, and leases.

■ **grants and agreements.** Cost of cooperative grants and agreements 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 training costs, unemployment, office supplies, postage, awards, moving expenses, and other expenses related to delivering the FIA program.

■ **publications.** Costs for laying out, editing, printing, and distributing publications.

■ **salary.** Includes direct salary and costs, plus benefits charged to the FIA unit, broken into the following categories:

    administration. Program manager, project leader, and administrative staff.

    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.

    field operations. 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.

■ **travel.** Broken into the following categories:

    field/QA travel. Travel costs for field and QA crews.

    office travel. Travel costs for all staff except field and QA crews.

■ **effective indirect expenses.** Include items such as research station management and administrative salaries, operating expenses, research station budget shortfalls, and other items for which the FIA unit is assessed by their research station. Each station has its own means for determining these assessments. Rather than reporting the different rates, we simply calculate the "effective indirect expenses" item by subtraction:

Effective indirect expenses = (total available funds) – (total direct FIA expenses + end of year balance)

■ **effective indirect rate.** Effective indirect expenses divided by total available funds, which is not necessarily the same as the standard station overhead rate; instead this rate reflects the total indirect cost as a fraction of the total funds available to FIA.

■ **ecosystem indicators.** Data collected on a subset of Phase 2 sample locations measured for a more extended set of ecosystem attributes, including tree crown condition, lichen community diversity, soil data, and down woody debris.

■ **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 and Private Forestry offices, and State forestry agencies.

■ **NGO (nongovernmental organization).** A class of customers with whom FIA staff 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 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.

■ **percentage of total 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.

■ **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 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 product 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.

■ **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 our normal course of business in collecting, analyzing, and reporting FIA information.

■ **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.

■ **users group meetings held.** Number of users group meetings sponsored or attended by each FIA unit. A users group meeting is an open meeting in which a complete regional cross-section of FIA partners and customers are invited to attend. Users 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 America's forests, please contact the appropriate office below.

Northern FIA Program Program Manager, FIA USDA Forest Service Northern Research Station 1992 Folwell Avenue St. Paul, MN 55108 ☎ 651–649–5191	**Interior West FIA Program** Program Manager, FIA USDA Forest Service Rocky Mountain Research Station 507 25th Street Ogden, UT 84401 ☎ 801–625–5407
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 620 SW Main St., Suite 502 Portland, OR 97205 ☎ 503–808–2019
National FIA Program Office National Program Leader, FIA USDA Forest Service 201 14th Street, SW Washington, DC 20250 ☎ 703–605–4177	All regional internet home pages and a wealth of statistical and other information are available through the national FIA home page at www.fia.fed.us.

Figure A-1. FIA regions and headquarters
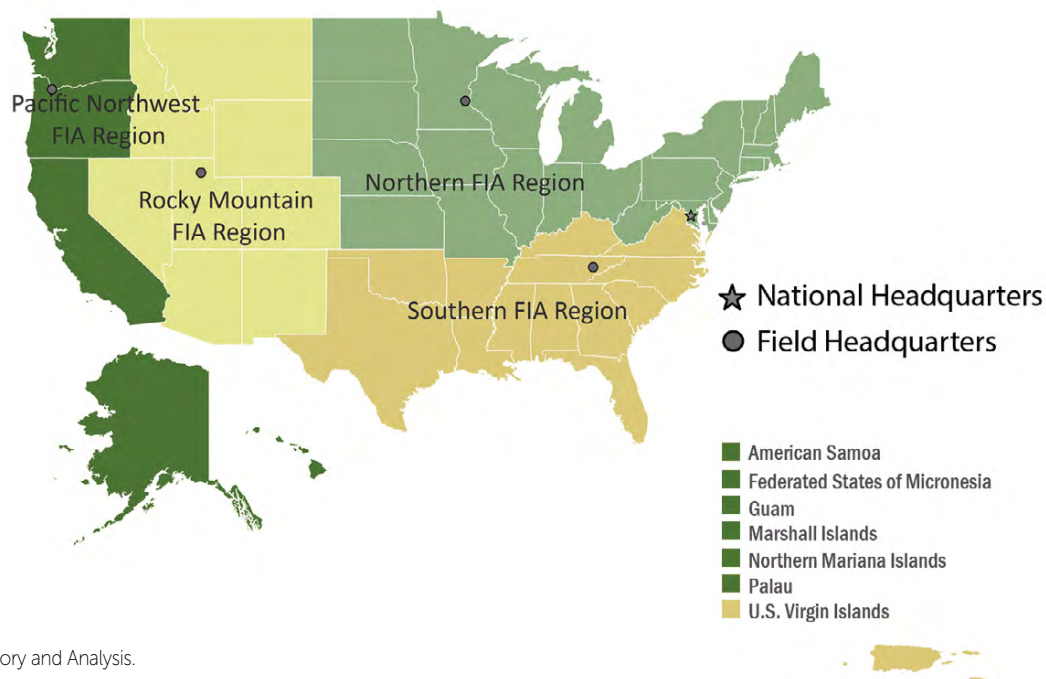
FIA = Forest Inventory and Analysis.

Appendix B: Tables

Table B-1. Performance measures for the FY 2020 FIA program.

	Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
Total available Federal funds	$16,947,249	$14,012,860	$18,613,253	$17,259,477	$13,390,291	$80,223,130
Total appropriated Federal funds	$16,098,455	$13,597,249	$17,177,244	$16,736,761	$13,390,291	$77,000,000
Appropriated as % of 2014 Farm Bill target[a]						78%
Contributions from partners:						
Supporting the 20% FIA program	$722,188	$209,754	$2,431,590	$938,663	$0	$4,302,195
Value-added contributions	$3,081,494	$1,073,187	$348,207	$4,054,547	$0	$8,557,435
Total partner contributions	$3,803,682	$1,282,941	$2,779,797	$4,993,210	$0	$12,859,630
Total all available funds	$20,750,931	$15,295,801	$21,423,717	$22,252,687	$13,390,291	$93,113,428

	Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
Forest plots sampled:						
Base FIA grid	1,308	1,593	6,142	4,459	-	13,502
Spatial intensification	1,032	-	398	1,470	-	2,900
Temporal intensification	-	-	1,259	377	-	1,636
Total forest plots sampled	**2,340**	**1,593**	**7,799**	**6,306**	**-**	**18,038**
Forest plots with one or more health indicators[b]	2,340	1,593	2,479	617	-	7,029
Number of base forest quality assurance plots	148	60	1,147	375	-	1,730
Percent base forest quality assurance plots	11%	4%	19%	8%	-	13%
Urban plots (forested and nonforest)	47	41	181	47	-	316
Special Studies plots (forested and nonforest)	-	17	124	-	-	141
Total base grid plots and percent sampled[c]						
Total base grid plots	43,824	91,282	88,839	101,140		325,085
Average percent of land with forest cover	37%	24%	46%	29%		34%
Estimated percent of base grid sampled	8%	8%	15%	15%		12%
Percentage of States with annual FIA activity[d]	100%	100%	100%	100%		100%
Number of publications:						
National Forest System reports	-	-	-	-	-	-
State/island resource reports	-	-	34	24	-	58
State timber product output reports	-	4	26	1	-	31
Regional reports	-	-	6		-	6
National reports	-	1	2	1	1	5
5-Year State reports	2	-	2	3	-	7
Subtotal – core reports	2	6	70	28	1	107
Peer-reviewed journal articles	16	19	27	39	-	101
Proceedings articles	-	1	-	1	-	2
Other station publications	4	2	8	7	-	21
Other publications	2	1	3	2	-	8
Subtotal – non-report publications	22	23	38	49	-	132
Total publications	**24**	**29**	**108**	**77**	**1**	**239**
Number of publications per federal FTE	0.2	0.3	1.3	0.8	0.5	0.6
Number of publications per analyst and researcher	1.7	1.4	4.2	3.2	-	2.8
Consulting activities:						
Number of significant consultations	219	322	126	685	82	1,434
Total hours of significant consultations	2,419	9,137	629	4,174	377	16,735
Meetings:						
User-group meetings held	1	1	-	1	1	4
Management meetings held	4	-	1	1	4	10

FIA = Forest Inventory and Analysis; FTE = full-time equivalents; FY = fiscal year.
[a]Farm Bill target adjusted for inflation.
[b]Health indicators measured include crown condition, vegetation diversity and structure, down woody material, forest soils, nonnative invasive plant species, and lichen communities.
[c]Includes all plots where trees were measured, except denied access and hazardous plots.
[d]Base-grid targets shown are 20 percent of samples per year as stated in the Farm Bill. Congressional conference notes recommended annual Federal targets of 15 percent in the East and 10 percent in the West. Interior Alaska as well as the Caribbean and Pacific Island inventories are periodic and excluded from the annualized mandate in compliance with Congressional recommendations. The total number of grid plots does not match table 1 because table 1 also includes Puerto Rico, the U.S. Virgin Islands, and U.S. territories and affiliated islands in the Pacific.

Table B-2. Financial statement for the FY 2020 FIA program Federal funds.

		Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
Available funds:				Dollars			
	Previous year end-of-year balance	36,731	111,185	1,137,107	184,847	-	1,469,870
	Post-year adjustments[a]	425,561	(55,082)	(84,192)	(121,410)	-	164,877
	Subtotal adjustments	462,292	56,103	1,052,915	63,437	-	1,634,747
	FY appropriated FIA funds						
	Initial FIA funds added to base	15,714,752	13,388,249	17,177,244	16,636,761	13,340,291	76,257,297
	Secondary FIA funds added to base[b]	383,703	209,000		100,000	50,000	742,703
	Subtotal appropriated FIA funds	16,098,455	13,597,249	17,177,244	16,736,761	13,390,291	77,000,000
	Inter-FIA Unit transfers	50,000	(50,000)			-	-
	Other Forest Service R&D funds	333,002	409,508	383,094	459,279	-	1,584,883
	Special project funding[c]	3,500	-	-	-	-	3,500
	TOTAL AVAILABLE FEDERAL FUNDS	16,947,249	14,012,860	18,613,253	17,259,477	13,390,291	80,223,130
Direct expenses:							
	Salary--	8,233,806	8,379,389	7,897,613	9,937,825	436,676	34,885,308
	Administration	550,835	635,938	722,380	577,977	436,676	2,923,806
	Field operations	4,737,042	4,079,949	3,081,231	4,284,080		16,182,302
	Information management	897,169	1,289,815	911,282	1,545,441		4,643,706
	Analysis and research	2,048,761	2,373,687	3,182,719	3,530,327		11,135,494
	Travel--	525,130	245,492	266,075	179,981	10,947	1,227,625
	Office travel	43,699	25,535	13,649	72,434	10,947	166,264
	Field crew travel	481,431	219,957	252,426	107,547		1,061,361
	Equipment--	426,968	482,283	267,273	452,743	-	1,629,267
	Imagery	-	-		43,426	-	43,426
	Vehicles	199,184	359,259	168,135	170,206	-	896,784
	Field equipment	100,660	55,784	72,138	97,867	-	326,449
	Info. technology/communications	94,181	55,145	27,000	94,010	-	270,336
	Other	32,943	12,095		47,234	-	92,272
	Publications	40,658	10,863	10,000	109,738	833	172,092
	Grants and agreements[d]	3,309,572	1,853,508	6,949,198	4,604,775	2,528,344	19,245,398
	Field work and data collection	2,616,325	1,256,612	6,690,198	2,604,954		13,168,089
	Information management		-		430,043	50,000	480,043
	Analysis and research	693,247	596,896	259,000	1,569,778		3,118,921
	Information Resources Decision Board					2,478,344	2,478,344
	Office space and utilities	457,700	393,128	562,800	93,606	-	1,507,234
	Other direct expenses	1,091,543	135,080				1,226,623
	Total direct expenses	14,085,376	11,499,743	15,952,959	15,378,668	2,976,800	59,893,546
Effective indirect expenses							
	Total effective indirect[e]	2,692,711	2,065,101	2,567,789	1,698,006	10,413,491	19,437,098
	Total effective indirect rate	16%	15%	14%	10%	78%	24%
End of year balance		169,162	448,016	92,505	182,804	-	892,487
TOTAL FEDERAL EXPENSE		16,947,249	14,012,860	18,613,253	17,259,477	13,390,291	80,223,130
	Total effective indirect rate	16%	16%	8%	11%	78%	23%

EOY = end of year; FIA = Forest Inventory and Analysis; FY = fiscal year; 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 and agreements, Station adjustments, etc.

[b]Mid-year additions to base funding from National Office-FIA.

[c]Includes special projects and funding from National Forests and other Federal agencies.

[d]Grants and Agreements include general allocation of grants to basic thematic categories and funds paid to the Forest Service Information Resources Decision Board (IRDB). The IRDB fund manages agency-sponsored information technology projects.

[e]Program-wide charges for cost pools, including the Albuquerque Service Center, and other cost pools, were paid by the National Office and included as program indirect expenses.

Note 1: Table does not include the additional $500,000 FIA received from the Coronavirus Aid, Relief, and Economic Security (CARES) Act at the end of the fiscal year 2020. These funds will be spent in FY 2021.

Note 2: The main cost pools are a function of the number of all FIA program's employees, including those holding permanent, temporary, intermittent, and other types of positions. This cost is estimated using Full Time Equivalents (FTEs) included in Table B-3a. Charges of other cost pools, were calculated as a function of the number of FIA program's permanent employees only, estimated with permanent FTEs.

Note 3: Table reclassifies categories previously reported into new ones. The field operations class combines previous classes labeled as phase 1 production, field support, data collection, and quality assurance. The analysis and research class combines previous classes named research and analysis.

Table B-3a. Federal staffing, in full-time equivalent (FTE) hours, for the FY 2020 FIA program.

	Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
Administration	4.3	5.9	6.8	5.2	2.0	24.2
Field operations	52.7	48.0	32.0	41.7	0	174.4
Information management	7.0	11.9	7.1	11.9	0	37.9
Analysis and research	14.0	20.6	26.0	24.1	0	84.7
Indirect support[a]	23.5	15.1	8.3	10.4	0	57.4
Total	**101.5**	**101.5**	**80.2**	**93.3**	**2.0**	**378.6**

FIA = Forest Inventory and Analysis; FTEs = full-time equivalents; FY = fiscal year.
[a]Indirect support FTEs are salary charges of Forest Service staff that support the FIA program indirectly.

Table B-3b. Estimate of cooperator staffing, in full-time equivalent (FTE) hours, funded by FIA grants and agreements (FTEs) for the FY 2020 FIA program.

	Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
Administration	1.0	0.6	4.4	0.0	0	6.0
Field operations	22.0	20.7	109.8	26.0	0	179
Information management	0.2	1.0	1.5	7.0	0.0	9.7
Analysis and research	5.1	7.0	2.3	15.0	0.0	29.4
Total	**28.3**	**29.3**	**118.0**	**48.0**	**0.3**	**223.6**

FIA = Forest Inventory and Analysis; FTE = full-time equivalents; FY = fiscal year.

Table B-3c. Estimated total federally funded staffing, in full-time equivalent (FTE) hours, for the FY 2020 FIA program.

	Pacific Northwest	Rocky Mountain	Southern	Northern	National Office	Total
Administration	5.3	6.5	11.2	5.2	2.3	30.5
Phase 1 production work	74.7	68.7	141.8	67.7	0	352.9
Information management	7.2	12.9	8.6	18.9	0.0	47.6
Analysis	19.1	27.6	28.3	39.1	0.0	114.1
Indirect support	23.5	15.1	8.3	10.4	0	57.4
Total	**129.8**	**130.8**	**198.2**	**141.3**	**2.3**	**602.4**

FIA = Forest Inventory and Analysis; FTEs = full-time equivalents; FY = fiscal year.

Table B-4. Partner contributions toward implementing FIA in FY 2020.

Unit	Partner	Contributions toward the base program	Contributions that add value
		Dollars	
Rocky Mountain	Colorado State Forest Service	72,723	
	National Aeronautics and Space Administration		554,261
	Nevada Dept of Conservation and Natural Resources	2,673	
	PNW Research Station		70,000
	University of Montana Bureau of Business and Economics Research	113,359	
	USDA Forest Service Region 1		338,926
	USDA Forest Service Region 2	2,900	
	USDA Forest Service Region 4	18,099	
	USDA Forest Service State and Private (LANDFIRE)		110,000
RMRS total		**209,754**	**1,073,187**
National Office			
NO total		-	-
Northern	American Forest		100,000
	American Forest Foundation		155,400
	California Air Resources Board	200,000	
	City of Delta, British Columbia		6,000
	Connecticut Department of Conservation	2,000	
	Conservation Biology Institute		15,068
	Dartmouth University		10,124
	Davey Tree Expert Company		333,487
	Delaware Department of Conservation	4,392	
	Environmental Protection Agency		238,000
	Illinois Division of Forestry	19,039	
	Indiana Department of Natural Resources	26,104	
	Iowa Department of Natural Resources	15,203	
	Kansas State Forest Service	16,938	
	Maine Forest Service	169,195	233,905
	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		5,379
	Minnesota Department of Natural Resources	126,388	285,550
	Missouri Department of Conservation		18,996
	National Aeronautics and Space Administration		144,239
	National Institute for Forest Science (South Korea)		40,120
	Nebraska Department of Forestry, Fish and Wildlife	3,174	
	New Hampshire Department of Resources & Economic Development	19,600	

	New Jersey Forest Service	21,249	137,832
	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
	Plymouth State University		7,053
	Purdue University		43,842
	Rhode Island Department of Environmental Management	6,471	6,471
	South Dakota Department of Forestry & Natural Resource Management	13,554	
	State University of New York		28,328
	Syracuse University		8,250
	Trout Unlimited		68,663
	University of Georgia		12,250
	University of Maine		18,750
	University of Massachusetts-Amherst		166,295
	University of Minnesota		80,085
	University of Minnesota		105,000
	University of Nebraska-Lincoln		3,724
	University of Nevada-Las Vegas		436,101
	University of New Hampshire		24,521
	U.S. Fish and Wildlife Service		24,840
	USDA Forest Service Geospatial Tech and Applications Center		70,000
	USDA Forest Service Region 9		327,922
	USDA Forest Service Research & Development		52,026
	USDA Forest Service Resources Planning Act		50,000
	USDA Forest Service State and Private Forestry	61,800	251,000
	Vermont Department of Conservation	8,500	4,000
	Washington Department of Natural Resources		60,204
	West Virginia Division of Forestry	22,271	
	Wisconsin Department of Natural Resources	54,600	475,000
NRS total		**938,663**	**4,054,547**
Pacific Northwest	Alaska Department of Natural Resources	595,868	
	Alaska Pacific University		9,650
	Alaska Pacific University		9,650
	CalFire-State of California		1,527,450
	Ecotrust		8,358
	Northwest Youth Corps		8,082
	Oregon Department of Forestry		22,000
	Oregon Department of Forestry		376,980
	Oregon Department of Forestry (plot intensification)		39,319
	Portland State University		10,347
	University of Alaska Anchorage		39,701

	University of Hawaii	77,420	
	University of Montana		19,861
	University of Montana		25,620
	University of Montana	48,900	
	University of Washington		15,721
	USDA Forest Service Region 6 (plot intensification, OR and WA)		739,130
	U.S. Department of Interior, Bureau of Land Management (plot intensification, OR)		179,625
	Washington Department of Natural Resources		50,000
PNW total		**722,188**	**3,081,494**
Southern	Alabama Forestry Commission	3,755	
	Alabama Forestry Commission	178,851	
	Arkansas Forestry Commission	154,423	
	Florida Department of Agriculture & Consumer Services	192,551	
	Geological Survey, U.S. Department of Interior		12,600
	Georgia Forestry Commission	275,230	
	Kentucky Division of Forestry	142,678	
	North Carolina Forest Service	165,524	46,133
	Oklahoma Department of Agriculture, Food and Forestry	137,637	
	South Carolina Forestry Commission		152,604
	Texas A&M Forest Service	531,322	
	U.S. Department of Interior Bureau of Indian Affairs, Cherokee Agency		30,000
	USDA Forest Service Region 8 (plot intensification)	450,100	
	U.S. Virgin Islands Department of Agriculture	20,504	
	Virginia Department of Forestry (FIA support)	179,016	37,000
	Virginia Polytechnic Institute and State University (modeling)		16,666
	Virginia Polytechnic Institute and State University (statistical estimation)		25,000
	Virginia Polytechnic Institute and State University (tree canopy)		28,204
SRS total		**$2,431,590**	**$348,207**
Total, all FIA units		**$4,302,195**	**$8,557,435**
Grand total (base program and added value)			**$12,859,630**

FIA = Forest Inventory and Analysis; FY = fiscal year; NO = National Office; NRS = Northern Research Station; PNW = Pacific Northwest Research Station; RMRS = Rocky Mountain Research Station; RPA = Resources Planning Act; SRS = Southern Research Station.

Table B-5. Grants and agreements entered into by FIA units, FY 2020.

Unit	Amount	Recipient	Purpose
Rocky Mountain	18,720	American West Forestry	Annual FIA Implementation
	799,952	Colorado State University	Annual FIA Implementation
	181,440	Integrated Resource inventories	Annual FIA Implementation
	49,500	Kazio, Mike	Annual FIA Implementation
	180,000	Nature Serve	National Vegetation Classification for the Interior West
	36,944	Oregon State University	Carbon assessment for NFS, Disturbance mapping
	123,286	Reed College	Small Area Estimation: development of alternative estimators.
	256,666	University of Montana	Timber Product Output
	207,000	USDA RMRS Forest and Woodlands Ecosystems	Western Soils Analyses
RMRS total	**1,853,508**		
National Office	50,000	Society of American Foresters	Hosting the Timber Products Output meeting and Annual User Group meeting
	1,400,000	University of Nevada Las Vegas	Support to FIA National science delivery tools (MIDAS, DATIM, NOMS and EVALIDator) and data management (NIMS, UNIMS, NWOS, TPO, plot and protocol design, urban forest monitoring, and data storage and publication systems).
	300,000	Southern Utah University	Support on user manuals for BOSS and DATIM applications (508 compliance)
	209,223	ESRI (through FS Chief Information Office)	Support of FIA Digital Engagement
	200,000	FS Chief Information Office	Enterprise Application Development for BOSS
	85,000	FS Geospatial Technology and Applications Center	Imaged based change estimation
	10,303	FS Chief Information Office	FIA software
	273,819	FS Chief Information Office	FIA hardware
NO total	**2,528,344**		
Northern	17,400	Accessability, Inc.	Plot production assembly
	37,193	Angle, Bradley	West Virginia/Maryland pandemic BPA call FY20
	100,000	Board of Regents Nevada System of Higher Education	Research and development support for the FIA national information management system
	80,208	Chestnut Ridge Forestry	New Hampshire data collection plots
	112,425	Chestnut Ridge Forestry	New York data collection plots
	47,999	Chestnut Ridge Forestry	New Jersey data collection plots
	12,089	Chestnut Ridge Forestry	Mid Atlantic data collection plots
	15,068	Conservation Biology Institute, Inc.	Pilot forest inventory and analysis summary data viewer and upgrades to the U.S. Protected Area Database
	333,487	Davey Tree Expert Company	I-Tree: development, dissemination, and support
	27,000	Department of Research Foundation for the State University of New York	Environmental effects of urban forests
	82,104	Digital Map Products Inc	Access to land parcel data
	21,825	Djm Ecological Services Inc	Northern Iowa & SE Minnesota pandemic plots

194,877	DJM Ecological Services Inc.	Michigan summer plots
60,450	DJM Ecological Services Inc.	Massachusetts and Rhode Island data collection plots
87,105	DJM Ecological Services Inc.	Ohio urban data collection plots
59,145	DJM Ecological Services Inc.	Illinois data collection plots
53,785	DJM Ecological Services Inc.	Mid Atlantic data collection plots
96,427	DJM Ecological Services Inc.	Urban Ohio and Pittsburgh data collection plots
70,000	Grand Rapids	Soil analyses
89,984	Huberty, Daniel	Kansas data collection plots
246,422	Huberty, Daniel	Nebraska and Kansas ground truth project
3,174	Huberty, Daniel	New Hampshire data collection plots
89,195	Indiana Department of Natural Resources	Data collection for Indiana's statewide resource inventory
38,600	Johnson Chandler	Michigan data collection plots
79,985	Johnson Chandler	Iowa data collection plots
39,935	Kansas State University	Geospatial agroforestry data products for Kansas
670,598	Maine Agriculture, Conservation & Forestry	Data collection for Maine's statewide inventory for forest inventory and analysis
50,000	Michigan State University	Investigating new national tree biomass models for urban FIA
70,000	Michigan State University	Developing new national tree biomass models for FIA
101,200	Michigan State University	Small domain estimation using strategic-level forest inventory data and auxiliary information
8,000	National Older Worker Career Center, Inc.	ACES agreement for technical services in support of conservation programming
10,000	National Park Service	USDA Forest Service lease of USDOI National Park Service office space
24,976	New Jersey Department of Environmental Protection	FIA analytical science delivery support
33,048	Nowak, Ryan	New York/New Hampshire pandemic data collection of FIA grid plots
2,392	Nowak, Ryan	New York/New Hampshire pandemic data collection of FIA grid plots
79,491	Purdue University	FIA National Woodland Owner Survey support
43,842	Purdue University	Linking forest structure, function, and diversity in support of carbon estimation in the United States
80,067	Regents of The University of Minnesota	Forest biometrics research and program support
85,030	Regents of The University of Minnesota	Improved characterization of land area, ecosystem services, and dynamics across scales
105,000	Regents of The University of Minnesota	Quantifying live-dead wood dynamics using remeasurements from the national forest inventory
22,699	South Dakota Department of Agriculture	Annualized forest resource inventory
30,425	Strohman, Joe	inReach Air Plan, DeLorme
9,925	Strohman, Joe	inReach Air Plan, DeLorme
107,775	Summers, Glen	New York data collection plots
96,750	Texas A&M University System	Analytical support

	40,000	University of Maine System	National forest inventory analysis biomass project for the State of Maine
	313,000	University of Massachusetts	Family forest research center
	306,975	University System of New Hampshire	Urban FIA analytical assistance
	63,125	Webb, Mark	Ohio pandemic data collection plots
	51,875	Webb, Mark	Southern Ohio data collection plots
	102,700	Webb, Mark	West Virginia data collection plots
NRS total	**4,604,775**		
Pacific Northwest	2,257,742	Alaska Department of Natural Resources	Interior Alaska FIA implementation in the Susitna unit
	50,000	Alaska Pacific University	Using advanced remote sensing to estimating woody shrub biomass: a pilot study in the Susitna-Cooper inventory unit of Interior Alaska
	20,000	BLM	Interior Alaska FIA fuel site in Lake Minchumina
	4,300	BLM	Interior Alaska FIA fuel site in Lake Minchumina
	15,000	Department of Interior	FIA program's Hawaii helicopter agreement
	22,000	Department of Interior Acquisition Services	FIA program's Hawaii helicopter agreement
	19,958	Ecotrust	Finding economically feasible forest restoration opportunities in Oregon's Blue Mountains
	83,106	NASA	Interior Alaska FIA G-LiHT collection in the Susitna-Copper unit
	22,283	Northwest Youth Corps	Urban FIA
	30,000	Portland State University	Modeling economic drivers and restoration
	128,423	University of Alaska Anchorage	Using tree rings to understand changes
	25,048	University of Alaska Fairbanks	Analyzing soil samples to understand belowground composition in Interior Alaska
	275,000	University of Hawaii	FIA program of Hawaii's Forests
	150,000	University of Montana	Pacific West timber products output and forest industry analysis
	90,000	University of Montana	Pacific West timber products output and forest industry analysis
	70,000	University of Montana	CalFire California logging utilization
	46,712	University of Washington	Using advanced remote sensing to estimating woody biomass
PNW total	**3,309,572**		
Southern	11,264	Alabama Forestry Commission	Alabama forest inventory and analysis
	536,552	Alabama Forestry Commission	Alabama forest inventory and analysis
	463,267	Arkansas Forestry Commission	Arkansas forest inventory and analysis
	30,000	Auburn University, Purdue University, University of Idaho	Tree seedling data
	460,224	Florida Department of Agriculture	Florida forest inventory and analysis
	770,198	Georgia Forestry Commission	Georgia forest inventory and analysis
	366,282	Kentucky Division of Forestry	Kentucky forest inventory and analysis
	437,925	Mississippi Forestry Commission	Mississippi forest inventory and analysis

	486,232	North Carolina Department of Agriculture and Consumer Services	North Carolina forest inventory and analysis
	19,000	Northern Research Station	Eastern forest environmental threat assessment center
	352,669	Oklahoma Department of Agriculture, Food and Forest	Oklahoma forest inventory and analysis
	387,463	South Carolina Forestry Commission	South Carolina forest inventory and analysis
	429,084	Tennessee Department of Agriculture	Tennessee forest inventory and analysis
	23,760	Tennessee Department of Agriculture	Tennessee forest inventory and analysis
	1,434,964	Texas A&M Forest Service	Texas forest inventory and analysis
	54,000	Virgin Islands Department of Agriculture	Virgin Islands forest inventory and analysis
	476,314	Virginia Department of Forestry	Virginia forest inventory and analysis
	50,000	Virginia Polytechnic Institute and State University	Modeling for national scale biomass estimators
	85,000	Virginia Polytechnic Institute and State University	Using next generation tree canopy cover and forest disturbance data product
	75,000	Virginia Polytechnic Institute and State University	Developing and testing statistical estimation approaches
SRS total	6,949,198		
Grand total	19,245,398		

ACES =Agriculture Conservation Experienced Services; BOSS = Business Operation Support System; BLM = U.S. Department of the Interior, Bureau of Land Management; BPA = Blanket Purchase Agreement; CIO = chief information officer; DATIM = Design and Analysis Toolkit for Inventory and Monitoring; EFETAC = Eastern Forest Environmental Threat Assessment Center; ESRI = Environmental Systems Research Institute; FIA = Forest Inventory and Analysis; FS = USDA Forest Service; FY = fiscal year; G-LiHT = Goddard LiDAR, Hyperspectral and Thermal Imager; GTAC = Geospatial Technology and Applications Center, Forest Service; IITF = International Institute of Tropical Forestry; MIDAS = Mobile Integrated Data Acquisition System; NASA = National Aeronautics and Space Administration; NFS = National Forest System; NIMS = National Information Management System; NO = National Office; NOMS = National Ownership Management System; NRS = Northern Research Station; NWOS = National Woodland Owner Survey; ORISE = Oak Ridge Institute for Science and Education; PNW = Pacific Northwest Research Station; RMRS = Rocky Mountain Research Station; RPA = Resources Planning Act; SE = Southeast; SRS = Southern Research Station; TPO = Timber Products Output; UNIMS = Universal National Information Management System; UNVL = University of Nevada, Las Vegas; USDA = United States Department of Agriculture; USDOI = United States Department of the Interior.

Table B-6. Number and hours of significant consultations by FIA staff by customer group, FY 2020.

Customer group	Pacific Northwest		Rocky Mountain		Southern		Northern		WO		Total			
	Number	Hours	Number	Hours	Number	Hours	Number	Hours	Number	Hours	Number	Percent	Hours	Percent
Academic	23	15	77	699	34	126	135	361	5	27	274	19%	1,227	7%
Government	171	1,936	200	7,075	50	276	316	2,784	26	26	763	53%	12,097	72%
Industry	9	24	11	14	24	112	75	173	12	189	131	9%	511	3%
NGO	10	374	20	801	8	68	87	433	25	79	150	10%	1,755	10%
NIPF	-	-	2	14	2	2	5	10	6	48	15	1%	74	0%
Media	5	68	-	-	1	10	20	25	4	4	30	2%	106	1%
Other	1	2	12	534	7	35	47	390	4	4	71	5%	965	6%
Total	219	2,419	322	9,137	126	629	685	4,174	82	377	1,434	100%	16,735	100%

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

Table B-7. FIA data access by online tools and spatial data center requests, FYs 2009–2020.

Indicator	Number of annual accesses												
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total 2009–2020
Online tools													
DATA downloads	2,014	3,033	1,929	1,512	7,383	19,768	66,000	69,025	53,315	195,836	436,119	275,444	1,131,378
DATIM									37,000	1,605	5,129	4,755	48,489
EVALIDator	3,920	29,000	55,468	34,901	33,759	35,839	36,532	34,082	38,597	42,625	46,349	46,011	437,083
EVALIDator API								75,449	38,313	63,162	3,963,560	1,041,049	5,181,533
FIDO	93,586	70,943	72,946	52,099	57,567	57,974	47,263	33,293	11,898	4,500	-		502,069
National TPO Tool						69,600	18,544	37,000	1,092	2,652	2,771	2,400	134,059
NWOS	6,560	1,700	2,070	5,515	4,502	2,994	2,068	1,710	2,517	3,000	2,194	2,431	37,261
Online accesses total	106,080	104,676	132,413	94,027	103,211	186,175	170,407	250,559	182,732	313,380	4,456,122	1,372,090	7,471,872
Spatial data requests													
Academia	109	114	121	168	143	155	160	162	163	158	82	103	1,638
State	49	47	36	45	29	55	91	56	43	61	37	44	593
NFS	16	32	17	46	31	32	29	40	37	26	21	24	351
Other Federal	105	116	92	169	175	131	136	130	134	105	37	70	1,400
NGO	41	31	23	41	35	31	38	35	38	44	15	22	394
Industry	28	35	34	61	41	94	84	54	65	78	30	40	644
Other	57	48	91	75	67	88	66	55	59	31	20	21	678
Spatial data requests total	405	423	414	605	521	586	604	532	539	503	242	324	5,698

API = Application Program 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 Owners Survey;.
Note 1: FIDO support was discontinued in FY 2019.
Note 2: 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 2000–2020.

Survey or site	Year initiated	Number of annual survey questionnaires or sites												
		2000–2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total 2000–2020
Timber products	1947	17,753	1,727	3,521	1,375	2,675	1,142	2,750	1,341	130	2,359	2,274	2,208	39,255
Fuelwood	1947	2,919	0	0	0	2,360	0	0	0	0	0	0	0	5,279
Ownership surveys	1978	17,281	0	7,960	4,028	5,262	0	0	0	5,254	6,407	1,713	3,135	51,040
Utilization sites	1947	503	66	58	162	189	105	216	162	39	219	132	118	1,969

DWM = Down Woody Material; FY = fiscal year.
Note 1: Ownership survey data included in fiscal years 2018 and 2019 corrects data reported in previous reports.
Note 2: FIA no longer conducts surveys to estimate fuelwood consumption. Industrial fuelwood estimates are part of the TPO 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.
Note 3: This table updates previously reported data for FYs 2018 and 2019.

Table B-9. Forest health indicator, year of initiation, and number of plots sampled FYs 2000–2020.

Indicator	Year initiated	Total 2000–2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total 2000–2020
			Number of annual samples											
Crown condition	1991	9,444	761	0	1,510	5,031	3,813	4,437	5,399	5,723	6,438	4,705	4,572	42,389
Lichens	1998	2,955	167	0	33	0	98	61	193	197	351	257	-	1,357
Soils	1999	6,215	266	2	595	565	439	487	456	716	426	791	394	5,137
Vegetation profile	2001	17,471	2,097	1,624	7,145	6,703	7,098	6,666	6,757	6,294	7,025	7,000	5,497	63,906
Ozone	1994	10,055	1,018	107	-	-	-	-	-	-	-	-	-	1,125
DWM	2001	22,489	1,392	1,414	6,263	8,271	8,635	8,186	8,459	9,234	9,277	8,188	7,203	76,522
Invasive species	2013					8,389	10,402	10,276	10,753	12,045	11,898	11,116	10,256	85,135
Mortality[a]	2001	72,677	15,293	15,858	20,275	13,859	17,308	16,825	14,606	17,083	16,825	16,116	16,942	180,990

FY = fiscal year; DWM = down woody material.

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

Note: In 2013, all FIA units adopted the national invasive species protocol to collect data on nonnative invasive species. Although not included in this table, FIA data collection on nonnative invasive species, using regional protocols, goes back as early as 1999 in some States. This is the first year FIA reports on the number of plots sampling nonnative invasive species using the national protocol.

Table B-10. Status of FIA surveys in U.S. islands and territories in FY 2020.

Region and area	Land area in inventory (Acres)	Forest Area (Acres)	Percent forest	Number of major islands	Year of current inventory	Year of inventory available in database	Year of published report	Number of base field plots	Number of intensified plots	Available online data
Pacific (PNW)										
American Samoa	48,434	43,631	90%	4	2012	2012	2020	28	0	Yes
Guam	135,660	63,833	47%	1	2013	2013	2020	66	70	Yes
Palau	110,028	90,685	82%	10	2014	2014	2007	56	0	Yes
Commonwealth of the Northern Mariana Islands	75,546	51,009	68%	3	2015	2015	2012	37	0	Yes
Federated States of Micronesia	161,917	143,466	89%	4	2016	2016	2012	78	78	Yes
Marshall Islands	33,182	23,230	70%	10	2018	2008	2012	50	20	Yes
Hawaii	4,141,469	1,990,000	48%	8	2015	2015	in progress	554	82	Yes
Atlantic (SRS)										
Commonwealth of Puerto Rico	2,192,327	1,219,178	56%	4	2019	2019	2019	343	61	Yes
U.S. Virgin Islands	82,164	46,967	57%	3	2014	2014	2020	88	25	Yes
Total	6,980,727	3,671,999	53%	47				1,300	336	

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

Note 1: The 2019 inventory year for the U.S. Virgin Islands, scheduled to start collecting field data in FY 2020, was delayed due to COVID-19.

Note 2: Periodic inventories do not enter data in the FIA database until full cycle is completed. For interior Hawaii data check: https://www.fs.usda.gov/pnw/tools/pnw-fia-hawaii-inventory-database

Table B-11. Land and forest area and FIA annualized implementation status by State and region, FY 2020.[a]

Region and State	Bureau of the Census land area	Forest land area defined by 2017 RPA Assessment	Annual inventory entry date	State annualized as of 2019
	Thousand acres		Year	
Northern	**606,841**	**182,587**		**24**
Connecticut	3,099	1,808	2003	Yes
Delaware	1,247	361	2004	Yes
Illinois	35,532	4,980	2001	Yes
Indiana	22,929	4,876	1999	Yes
Iowa	35,749	2,923	1999	Yes
Kansas	52,326	2,527	2001	Yes
Maine	19,739	17,579	1999	Yes
Maryland	6,252	2,463	2004	Yes
Massachusetts	4,992	3,025	2003	Yes
Michigan	36,185	20,311	2000	Yes
Minnesota	50,961	17,413	1999	Yes
Missouri	43,995	15,409	1999	Yes
Nebraska	49,167	1,532	2001	Yes
New Hampshire	5,730	4,758	2002	Yes
New Jersey	4,707	1,990	2004	Yes
New York	30,161	18,887	2002	Yes
North Dakota	44,161	789	2001	Yes
Ohio	26,151	8,077	2001	Yes
Pennsylvania	28,635	16,898	2000	Yes
Rhode Island	662	370	2003	Yes
South Dakota	48,519	1,949	2001	Yes
Vermont	5,899	4,511	2003	Yes
West Virginia	15,384	12,077	2004	Yes
Wisconsin	34,661	17,074	2000	Yes
Southern	**533,031**	**245,513**		**13**
Alabama	32,413	23,127	2001	Yes
Arkansas	33,303	19,040	2000	Yes
Florida	34,447	17,253	2001	Yes
Georgia	36,809	24,635	1998	Yes
Kentucky	25,271	12,442	1999	Yes
Louisiana	27,650	14,984	2000	Yes
Mississippi	30,031	19,380	2007	Yes
North Carolina	31,115	18,829	2003	Yes
Oklahoma	43,901	11,911	2008	Yes

South Carolina	19,239	12,931	1998	Yes
Tennessee	26,390	13,967	1999	Yes
Texas	167,188	40,970	2000	Yes
Virginia	25,274	16,043	1998	Yes
Rocky Mountain	**547,691**	**123,844**		**8**
Arizona	72,700	10,934	2001	Yes
Colorado	66,331	20,063	2002	Yes
Idaho	52,892	21,386	2004	Yes
Montana	93,149	25,517	2003	Yes
Nevada	70,260	7,487	2010	Yes
New Mexico	77,631	16,619	2008	Yes
Utah	52,589	12,087	2000	Yes
Wyoming	62,140	9,751	2010	Yes
Pacific Coastal	**573,389**	**213,391**		**4**
Alaska, Coast	39,041	14,426	2004	Yes
Alaska, Interior	326,575	114,151	2016	Periodic
California	99,699	31,515	2001	Yes
Hawaii	4,110	1,471	2010	Periodic
Oregon	61,432	29,653	2001	Yes
Washington	42,532	22,174	2002	Yes
TOTAL	**2,260,953**	**765,335**		**49**
Forest area performance measure, excluding Interior Alaska				**100%**
Forest area performance measure, including Interior Alaska				**91%**
State activity performance measure, includes all active States				**100%**

FIA = Forest Inventory and Analysis; FIADB = Forest Inventory and Analysis Database; FY = fiscal year; RPA = Resources Planning Act.
[a]Based on area defined as forest in FIADB plus area defined as forest by 2017 RPA Assessment.

Table B-12. FIA summary statistics and performance measures, FYs 2011–2020.

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AVAILABLE PROGRAM FUNDS (in thousand $)										
Apropriated funds	71,452	69,186	65,567	66,805	70,000	75,000	77,000	77,000	78,000*	77,000
Other federal funds[a]	856	528	2,668	3,077	743	304	85	2,377	3,617	3,223
Total federal funds	72,308	69,714	68,235	69,882	69,882	75,304	77,085	79,666	81,617	80,223
Total partner funds[b]	9,109	10,129	7,772	7,833	8,972	10,176	10,906	10,883	11,735	12,860
Total available funds	81,417	79,843	76,007	77,715	77,715	85,480	87,991	90,549	93,351	93,083
% Full federal appropriated funding[c]	86%	81%	76%	74%	78%	82%	83%	81%	80%	78%
PROGRAM EXPENSES AND BALANCES (in thousand $)										
Administration	3,233	2,735	2,854	3,036	2,703	2,759	3,632	3,532	3,714	3,090
Image processing	724	519	589	597	635	761	680	833	981	
Field support	3,917	3,946	4,151	4,082	3,782	4,029	3,797	3,770	3,776	
Data collection	27,057	24,387	22,559	23,590	22,807	26,888	28,369	26,952	28,610	
Combined Field Operations[d]	31,698	28,852	27,299	28,269	27,225	31,678	32,847	31,555	33,366	31,678
Information management[d]	6,794	6,740	5,933	6,737	7,680	7,962	7,599	8,807	7,920	7,872
Analysis	6,105	6,570	6,695	7,058	6,907	6,800	6,534	6,575	6,453	
Research[c]	5,444	6,075	6,690	7,072	6,111	7,084	8,482	7,050	6,680	
Combined Analysis and Research[d]	11,549	12,645	13,385	14,131	13,017	13,884	15,016	13,625	13,133	14,254
Miscellaneous/other	4,417	3,882	3,652	3,864	5,025	4,342	2,909	2,933	2,717	2,998
Total direct expense	57,692	54,854	53,124	56,037	55,651	60,625	62,002	105,633	107,350	59,894
Total Indirect expenses	13,958	14,180	14,704	13,461	14,708	14,652	15,083	16,587	19,076	19,437
Indirect rate	19.5%	20.5%	22.4%	20.2%	21.0%	19.5%	19.6%	24%	23%	24%
Fire Transfer					449	181	-	-	-	-
Total EOY balance	658	680	407	384	312	452	120	137	632	892
Total federal expense	72,308	69,714	68,235	69,882	71,119	75,910	77,205	79,529	80,147	80,223
OTHER MEASURES										
% States with annual activity	100	100	100	100	100	100	100	100	100	100
% States with FIADB 1–2 yrs old	94	94	94	96	96	96	96	94	86	88
Federal employees	397	372	366	366	338	352	341	339	382	379
Other employees	201	203	184	204	185	213	209	220	237	224
Total employees	598	575	550	570	523	565	550	559	618	602
P2 base forest plots	21,233	19,673	21,263	19,789	18,346	14,308	15,543	14,598	14,848	13,502
P2 base QA plots	4,550	4,417	5,465	2,312	3,083	1,529	2,199	2,171	1,839	1,730
Percent QA plots	9%	9%	11%	5%	7%	11%	11%	15%	12%	13%
All publications	204	272	238	234	236	371	206	211	204	239
Journal publications	62	90	90	87	122	122	92	122	112	101
Percent journal publications	30%	33%	38%	37%	52%	33%	45%	58%	55%	42%
Consultations, number	1,753	848	824	945	1,350	1,289	1,341	1,648	950	1,434
Consultations, hours	8,584	8,807	8,124	7,987	13,806	7,547	8,781	8,000	7,764	16,735
User/management meetings	14	15	12	14	13	12	9	14	19	16
Spatial data requests filled	414	605	605	586	604	532	586	503	242	324
Online accesses	132,413	94,027	103,211	186,175	170,407	250,559	182,732	310,758	4,456,122	1,372,090

EOY= end of year; FIA = Forest Inventory and Analysis; FIADB = Forest Inventory and Analysis Database; FY = fiscal year.
[a]Includes return of previous year carryover, return of fire transfers, and additional Forest Service research commitments.
[b]Includes partner contributions toward the base program and partner contributions that add value.
[c]Considering full program implementation funding to achieve 2007 Strategic Plan for FY 2007 through 2013, and 2014 Farm Bill options A through C. Full funding was adjusted for inflation.
[d]Includes Federal grants and agreements.
Note 1: Indirect expenses rate jumped in FY 2018 because of the Forest Service approach, adopted that year, to charge cost pools, which are considered an indirect expense rather than a direct expense in this report.
Note 2: Online data accesses jumped in FY 2019 due to FIA access to data through EVALIDator API for tool development.

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