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Using Forest Inventory and Analysis Data to Support National Forest Management: Regional Case Studies

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Abstract

Although many forestry practitioners have a general understanding of the Forest Inventory and Analysis (FIA) program and the type of data collected, most non-expert users of FIA reports and basic data are unlikely to be familiar with the breadth of information available and the many potential uses of the data. We present case studies from three USDA Forest Service regions to highlight a variety of applications of FIA data, from informing the forest plan revision process to supplying managers with timely information on important forest attributes at the stand and landscape scales. These examples illustrate the utility of FIA data in meeting managers' information needs, the importance of the linkages between research and management throughout the agency, and the role that the FIA program can play in fostering those collaborations.

Keywords: inventory, monitoring, National Forest System

The National Forest Management Act (P.L. 94–588) sets standards for how the Forest Service manages lands and requires management plans for forests and grasslands as well as regular reports on the status of the nation's forests and rangelands. The 2012 Planning Rule (USDA Forest Service 2012) establishes the planning process and includes a monitoring requirement to detect change and evaluate progress toward reaching plan goals. National Forest (NF) managers and regional staff also have additional information needs at a variety of scales from the project to the region. For example, wildlife biologists may need to know the amount and distribution of a specific habitat type preferred by a species of concern, silviculture staff might be interested in knowing the number of acres in a particular age class or species, and forest health specialists often need to quantify areas at high risk of certain insect and disease threats. Forest-wide data collection to meet these needs is expensive and requires significant staff time.

The Forest Inventory and Analysis program (FIA) of the USDA Forest Service collects data on forest vegetation and related attributes, using a systematic plot design that covers the conterminous United States, Hawaii, parts of Alaska, and some US territories. FIA is part of the USDA Forest Service's Research and Development mission area and is counted as a unit within the US Federal statistical system. FIA data are a rich source of information widely used by managers, researchers (Tinkham et al. 2018), and policymakers because of the consistent data collection protocols, nationwide coverage across all lands (the plot network

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Management and Policy Implications

Forest Inventory and Analysis (FIA) data are used routinely by a wide variety of stakeholders. Many of these users may access the data solely though state-level summary reports and are unaware of the types of data collected and potential applications. National Forest staff require a wide range of information to monitor forest conditions, assess progress toward management goals, and develop long-range management plans. Acquiring forest inventory data is often resource-intensive; FIA data, used alone or in combination with locally or regionally developed tools, can help meet the information needs of managers. We present examples of researchers and managers working together to develop tools and methods to transform FIA data into the information needed to understand if management and monitoring goals are being achieved over time. These case studies illustrate the potential of FIA data to inform forest resource management and planning across all lands, not just those which are federally managed, as well as the value of collaboration between researchers and managers to address a wide range of resource management challenges at a variety of spatial scales.

includes non-forest and privately owned lands, though data may not be collected on all non-forest plots), ability for states and other landowners to consider intensification of the grid of plots, and publicly available datasets. Commonly used data products include: state fact sheets, the National Woodland Owner Survey, Forest Resources of the United States, and state-level summary reports; examples of how FIA data are used to assess the health of the Nation's forests can be found in Morin (2019).

A collection of FIA tools is available (Table 1) to generate an array of standard and custom reports; however, the FIA database has a complex structure, and it can be challenging for non-expert users to construct the database queries needed to obtain information not available in a standard report. Furthermore, natural-resource managers may need to analyze FIA inventory data in ways that are not supported by available FIA tools. In these cases, managers may turn to biometrics or geospatial staff in the regional office, Forest Service Research and Development scientists, or other partners to work together to develop tools and/or approaches to obtain and use the relevant FIA data to meet a specific management need. Some collaborations may be aimed at addressing a specific question at a specific point in time whereas others may be ongoing; these partnerships may also be formal or informal, depending on local and regional needs.

The National Forest System (NFS) is divided into nine regions (Figure 1), each with a staff to support the management of the forests and grasslands in the region. In the sections below identified as case studies, we illustrate the use of FIA data to meet information needs at the forest and regional level for three of these regions: Northern, Pacific Northwest, and Southern. The Northern Region of the NFS encompasses 25 million acres in five states and includes 10 national forests and grasslands. The Pacific Northwest Region manages over 24.7 million acres in Oregon and Washington and includes 17 national forests. The Southern Region, which includes 13 states and Puerto Rico, is responsible for managing 13 million acres containing 14 national forests and a national grassland. These regions also contain many areas with special designations, including Wilderness and roadless areas, National Wild and Scenic Rivers, National Scenic and Historic Trails, National Recreation Areas, National Historic Register sites, National Recreation Trails, National Scenic Areas, and National Volcanic Monuments.

In every region, National Forest personnel balance a variety of management objectives including forest products, recreation, forest health, and wildlife habitat. Many types of data and analyses are required, and FIA data are employed in a variety of ways in order to meet those objectives, from providing summaries of forest characteristics to supplying input data required to calculate metrics, develop geospatial products, or set treatment goals. Our aim is to illustrate the breadth of potential uses of FIA data (beyond standard summary tables) to support land managers rather than to present a comprehensive list of tools or applications. We first describe FIA data and tools, then discuss the potential to intensify the sample, and lastly highlight examples that demonstrate how FIA data are used to meet a range of information needs at the forest and regional level in a consistent and efficient manner.

FIA Data and Tools

Data are collected on FIA's permanent inventory plots located on a systematic grid, with one plot every 6,000 acres of forest land (Bechtold and Patterson 2005). Every year, a subset of plots is measured in

Table 1. General characteristics of FIA tools used to access data (https://www.fia.fs.fed.us/tools-data/index.php) and other tools presented in this paper.

Name	Example attributes	Geographic extent	Difficulty level	Available to public
FIA supported tools				
DATIM	Standard FIA variables; i.e., area, volume, tree number, dead wood	All US*	Moderate	Yes
EVALIDator	Standard FIA variables; i.e., area, volume, tree number, dead wood	All US*	Easy	Yes
FIA Data Mart	Standard FIA variables; state reports, state-level data summaries	All US*	Easy (reports) to difficult (database queries)	Yes
National Woodland Owners Survey Dashboard	Ownership history, demographics, forest use, management	Contiguous US	Easy	Yes
Timber Products Output Reporting Tool	Volume and type of timber harvested and related variables	All US*	Easy to moderate	Yes
Other tools				
FSVeg	Tree species, diameter, height, damage, etc.; fuels data	All US*; NF lands only	Moderate to difficult	No
DecAid	Snag and down dead wood variables: i.e., diameter, cover, height	Pacific Northwest	Easy to moderate	Yes
R1 Estimator Form; R1 Summary Database	Standard FIA variables; FSVeg data	Northern Region NFS	Easy to moderate	No

Note: This is not an exhaustive list; other tools developed by Forest Service regions, Forest Service Research and Development, states, nongovernment organizations, and/or forest management professionals also use FIA data but are not included here. FIA, Forest Inventory and Analysis; NF, National Forest; NFS, National Forest System.
*Data are currently collected for a portion of Alaska; data are also not available for all US territories.

each state, with remeasurement at 5, 7, or 10 years depending on the state (in Northern and Pacific Northwest Regions, the interval is 10 years; in the Southern Region it is 5–7 years). The FIA database structure is complex, with a large number of linked tables that contain many stand-level and tree-level attributes—see Index of Tables and Index of Columns in Burrill et al. (2018). To facilitate analysis, the data can be accessed and summarized in a variety of ways. Standard and customized reports for a range of attributes can be generated using FIA supported tools (Table 1); additionally, FIA data for the regions are loaded into the National Resource Management Field Sampled Vegetation Database, or FSVeg—the NFS vegetation database, USDA Forest Service (2015). Note that FSVeg may only be accessed through the Forest Service computer network. This database warehouses a comprehensive set of data from permanent inventory plots that monitor the effects of treatment at the stand level, as well as site-specific stand exams that include, in addition to tree data, information on down woody material, understory vegetation, etc. Within FSVeg, a user may run reports to summarize tree and stand information, including (but not limited to) volume, cover, trees per acre, area by forest type, and down dead wood.

Both the publicly available FIA and agency FSVeg databases contain large amounts of detailed data; it may be challenging for users to construct queries that efficiently extract and summarize data needed for a particular analysis. This may lead to the development of a secondary layer of tools to meet information needs specific to a region. For example, the Northern Region (also known as R1) addressed the challenge of database complexity by developing regionally specific tools to streamline data retrieval and analysis:

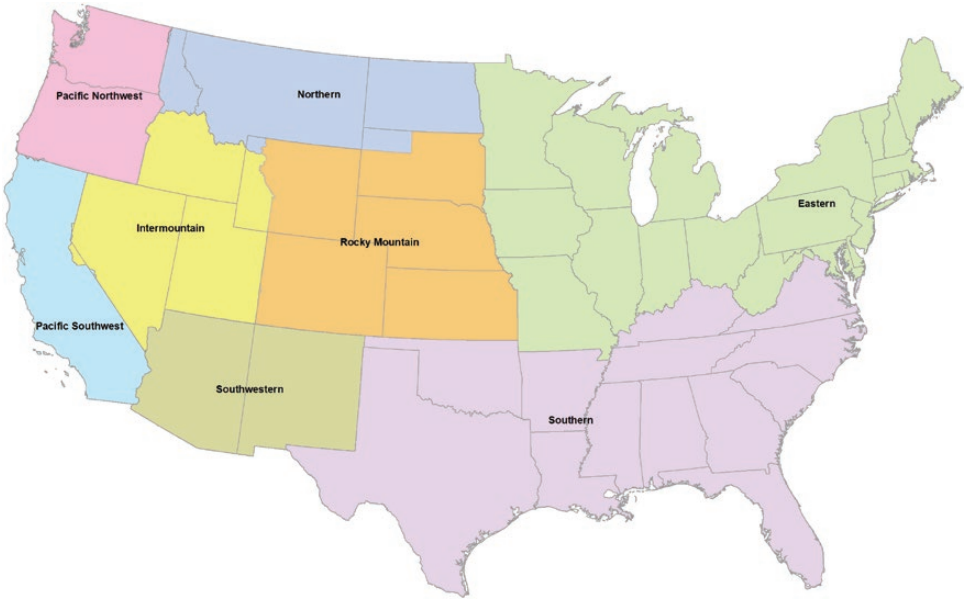

Figure 1. Map of Forest Service National Forest System Regions in the conterminous United States. Not shown: Alaska (which comprises a region), Hawaii (Pacific Southwest), and Puerto Rico (Southern).

- R1 Summary Access Database: a Microsoft Access database that houses a copy of the data in the original FIA database tables for a specified set of inventory data, called an Analysis Dataset (such as the most recent set of FIA inventory data from Northern Region NFS lands). In addition to the FIA tables, regional data also included are:

  - Derived attributes such as: R1 Existing Vegetation Classifications (Barber et al. 2011) for Tree Dominance Type, Tree Size Class, and Vertical Structure; R1 Wildlife Habitat Models such as Goshawk Nest Habitat and Old Growth; and Insect and Disease Hazard Ratings.
  - Associations to spatial datasets commonly used in the Northern Region for broad- to mid-level analysis such as management areas, within and outside wilderness/roadless areas, and landscapes.

In addition to the attributes, the database contains queries and reports built from the tables.

- R1 Estimator Form: a stand-alone program that derives estimates and confidence intervals for data in the R1 Summary Database; creates reports and stores copies of the reports in the R1 Summary Database.

The R1 Summary Database Tools are geared toward regional needs and allow managers to efficiently convert data into information. For example, to facilitate forest planning, geographic areas are delineated within forests; an important step in preparing management plans is characterizing the amount and type of vegetation in these geographic areas, which can be conducted quickly and easily using FIA data via the R1 Summary Database Estimator Form. Any region may create regionally specific tools to meet their needs; the discussion above illustrates the type of product that may be developed. Note that tools to facilitate the use of FIA data are updated over time, and new tools are likely available since this publication.

Intensification of the Grid and Mid-Cycle Remeasurement of Plots

Most national forests use the base FIA plots for analysis; however, some forests and regions have determined that the base FIA plots do not provide enough information to meet analysis needs (recall that the standard grid has one plot every 6,000 acres). This may occur for various reasons; a forest may want to detect change on a finer spatial scale or may need more detailed information on a particular vegetation type or attribute than the standard FIA grid can supply. The sample grid can be intensified to a level specified by the forest or region, providing that resources are available. Note that these intensified grid plots may follow a different inventory protocol and may be similar, but not identical, to FIA plots. In the Northern Region, the Helena–Lewis and Clark NF employed 4× intensification and various analysis areas within the Helena have been intensified up to 48×; additionally, portions of the Flathead, Idaho Panhandle, and Bitterroot NFs have intensified grid data. Forests in other regions also make use of intensified sample grids (see Pacific Northwest example below) as needed to meet information

requirements. Some regions fund the FIA program directly to intensify their sample grids. Datasets collected in direct partnership with the FIA program, with FIA protocols, may be added to the publicly available FIA data.

In the Northern Region, staff have developed tools to assist with: (1) exploring the optimum number of plots to install based on information needs, (2) placing plots within a geographic area of interest in a spatially balanced manner while ensuring that the added plots do not interfere with the base FIA plots, (3) collecting data using Inventory and Monitoring Protocols (NFS protocols used for collecting data), (4) cleaning and loading data into FSVeg, and (5) incorporating intensified grid data with the base FIA data to create an Analysis Dataset (USDA Forest Service 2016). In any region, managers (or researchers) may use the DTIM module of the Design and Analysis Toolkit for Inventory and Monitoring (DATIM) suite of tools (USDA Forest Service 2019) to assess whether available FIA data are sufficient to meet a specified monitoring need or if grid intensification is necessary.

Wildfire, certain insects, and large weather events can quickly cause drastic changes in vegetation conditions. These events can affect large landscapes within a year or two, and these changes may not be adequately characterized if remeasurement occurs at the regularly scheduled time interval. To address this, national forests in affected areas may choose to implement measurements outside the regularly scheduled interval. These mid-cycle measurements provide resource specialists with the information needed to accurately assess the extent and severity of damage and to update plot records to reflect these impacts.

The approach taken varies by location; the Northern Region has developed mid-cycle remeasurement protocols for FIA and intensified grid plots. These protocols use the Inventory and Monitoring Protocols (an enhancement to the FSVeg Common Stand Exam protocols (USDA Forest Service 2016)) to revisit the plots. Tree seedlings/saplings, understory vegetation, and down-woody material are re-inventoried, and these data can be available to employees 4 months after collection. The Custer–Gallatin NF instituted a special remeasurement schedule for FIA plots that have been burned, whereas the Nez Perce–Clearwater NF has remeasured more than 60 FIA plots that burned within a specified 3-year period, allowing managers to assess fire impacts quickly and more accurately. The Helena–Lewis and Clark NF used these protocols to assess mortality of lodgepole and ponderosa pine across diameter classes following a mountain pine beetle outbreak (Figure 2); illustrating the utility of mid-cycle remeasurements and grid intensification. The impact of the outbreak would be challenging to characterize accurately using the standard remeasurement schedule and grid.

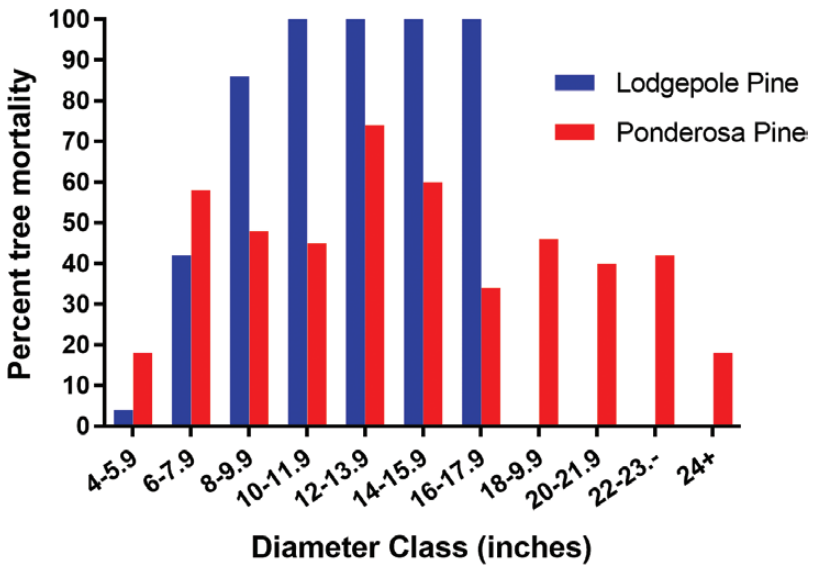

Figure 2. Percentage tree mortality observed from 2006 to 2008 within the Warm Springs Analysis Area, Helena National Forest because of mountain pine beetle (adapted from Randall et al. 2011). Analysis based on remeasured intensified grid plots in the Warm Springs area (48× intensification). Note that this figure is provided as an illustration of the use of intensified grid plots and mid-cycle measurements.

FIA Data in Action: Regional Case Studies

The following examples illustrate some of the ways in which FIA data are used to address the information needs of National Forest and Regional personnel. These examples show a few of the many potential uses of FIA data and are not intended to be a comprehensive summary. Possible applications are wide-ranging and can be explored by contacting Regional, FIA, Research and Development, or university staff.

Land Management Plan Revision in the Northern Region

National Forests must periodically revise their Land Management Plans to meet the National Forest Management Act (P.L. 94–588). Considerable analysis is needed to support the forest plan revision process, including comparing the outcomes of different management alternatives, which helps to determine management goals. In many regions, FIA data are a key component in the plan revision process and are used to understand the current condition of the forest. In the Northern Region, the Idaho Panhandle and Kootenai NF used FIA data when developing their plans, which were completed within the past 5 years. The Nez Perce–Clearwater, Flathead, Helena–Lewis and Clark, and Custer–Gallatin NFs are using FIA data in their current planning efforts. All of the Forests have plan revision staff who are using the R1 Summary Database suite of tools to conduct analyses in support of plan revision. A common type of summary is the percentage of cover (in this example, for the Helena–Lewis and Clark NF) classified by the Northern Region cover types (Figure 3). This information is necessary to determine current conditions and prepare for plan revision. These data, remeasured over time, are also used for assessing progress in moving toward desired conditions.

Another key component of the plan revision process is the assessment of various management alternatives. Forest plans include desired conditions such as the amount of area in certain vegetation types or successional stages. Plan alternatives are evaluated by considering the current condition and comparing how well a proposed alternative will meet the desired future condition. In this example from the Idaho Panhandle NF, FIA inventory data were classified into vegetation dominance types (species with the greatest abundance of canopy cover, basal area, or trees per acre within a given area) as part of the process of assessing how proposed management options could affect the existing vegetation conditions. Western larch and ponderosa pine are currently outside the range of desired conditions, whereas the other forest types are within desired conditions (Figure 4); this information allows managers to identify vegetation types that need to be prioritized for management activities such as harvest, prescribed fire or fire use (use of wildfire to meet forest plan objectives), or planting. The attributes available in the R1 Summary Database for FIA and intensified grid data can be calculated for any stand exam data

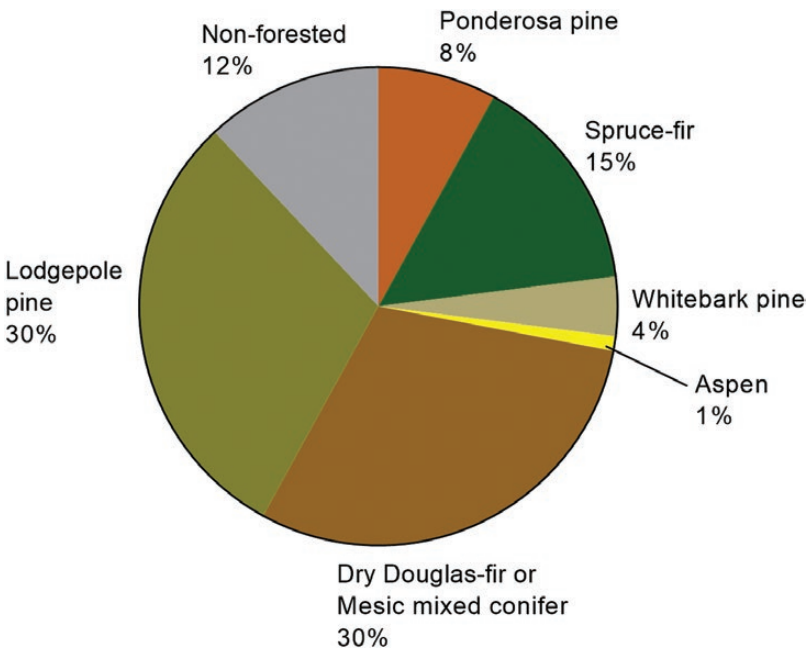

Figure 3. Percentage of area of Helena–Lewis and Clark NF by R1 cover types, from Forest Inventory and Analysis data.

in FSVeg in the R1 Stand Exam Summary Database, allowing resource specialists to quickly understand the current conditions of the stands within an activity area.

Northern Region Broad-Scale Monitoring Strategy

The 2012 Planning Rule requires monitoring movement toward desired conditions for each management unit. Each national forest must monitor progress toward meeting the goals set in the forest plan, and FIA data and regional tools play a critical role in the monitoring task. FIA data are used in the Northern Region (and other regions) to monitor forest plan standards and movement toward desired conditions. Many new forest monitoring plans include forest-level analysis using the Northern Region Broad-scale Monitoring Strategy, and all national forests in the Northern Region use FIA data and the R1 Summary Database to monitor changes in vegetation attributes over time. In this example, FIA data were analyzed to assess whether stands included old-growth characteristics, allowing analysts to estimate the percentage of old-growth habitat in national forests in the region (Table 2).

The Northern Region's Broad-scale Monitoring Strategy makes extensive use of FIA data and the R1 Summary Database. Analyses are implemented over the entire region, by forest, and by Region 1 Potential Vegetation Type Groups (Milburn et al. 2015). Attributes monitored over time include: acres by Northern Region cover types, presence of specific species, acres by tree size class, and percentage of plots with trees of 20.0" diameter at breast height and larger. The use of consistent data collection and analysis protocols throughout the region allows managers to be confident that any changes detected are a result of changes in conditions on the landscape, and not because of differences in protocols or methods between forests.

In the Northern Region, the use of FIA data is facilitated by the development of region-specific tools that enable personnel to carry out a variety of

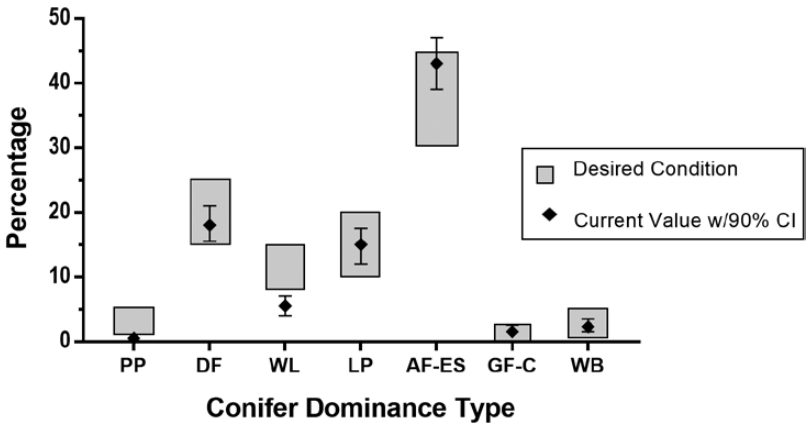

Figure 4. Comparison of existing condition to desired conditions for various proposed plan alternatives. Existing condition is the 90 percent confidence interval of dominance types-based classification of Forest Inventory and Analysis inventory data. PP, ponderosa pine; DF, Douglas-fir; WL, western larch; LP, lodgepole pine; AF-ES, subalpine fir/Engelmann spruce; GF-C, grand fir/western red cedar; WB, whitebark pine.

Table 2. Example of Region 1 estimates of old growth forest area in for the Region and by National Forest.

Unit	Old growth estimate (percent)	90 percent CI lower bound (percent)	90 percent CI upper bound (percent)	Total no. of plots	No. of forested plots
Northern Region	13.7	12.9	14.4	3,883	3,423
Beaverhead-Deerlodge	22.9	20.5	25.4	547	442
Bitterroot	12.8	10.1	15.6	252	226
Idaho Panhandle	11.8	9.8	14.0	413	397
Clearwater	9.4	7.3	11.8	305	300

Note: Forest Inventory and Analysis inventory data are classified as to whether old growth characteristics are met. After Green et al. (1992).

analyses. This is made possible by the R1 Vegetation Analysis Team, which supports the development of analysis tools and the use of FIA inventory data via the R1 Summary Database tools. Although many regions have staff members who support FSVeg, FSVeg Spatial, and other Forest Service corporate tools, the Vegetation Analysis Team's responsibilities also include: developing and maintaining the analysis tools that are not supported nationally, offering training sessions, assisting Northern Region users, and working with Regional Office resource specialists to produce necessary reports.

The use of specialized tools such as those discussed above enables planners, managers, and resource specialists in the Northern Region to use FIA data to support a wide range of planning and monitoring efforts, reducing the need for additional data collection and streamlining the data retrieval and analysis process. It is worth noting that the NFS mission area has been working with FIA to develop a national suite of tools, called DATIM (USDA Forest Service 2019), which incorporates much of the functionality of the Northern Region tools. This will enable all NFS regions and private land managers to use these shared tools to meet their information needs.

Long-Term Wildlife Habitat Monitoring in the Pacific Northwest

In 1994, the Northwest Forest Plan (NWFP; USDA Forest Service 1994) amended forest plans across the range of the Northern spotted owl, which covers around 25 million acres of federal lands in Washington, Oregon, and California (the Pacific Northwest and Southwest Regions). The NWFP stresses monitoring and adaptive management as key elements to maintain a long-term, scientifically based and adaptive plan. Over the past 25 years, the Forest Service and the Bureau of Land Management (BLM) have implemented a NWFP effectiveness monitoring program (Mulder et al. 1999), using FIA as a key data source for monitoring late-successional and old growth forests and associated wildlife habitat components. These landscape scale efforts have produced information products useful for monitoring throughout the region, not just on NWFP forests.

In order to provide more detailed information about the status and trends of forest resources, the Pacific Northwest Region has implemented a 3× spatial intensification of FIA plots across all regionally administered lands outside congressionally designated wilderness areas since the FIA program began annual inventory in 2001; this is carried out as a strong partnership with the USDA Forest Service Pacific Northwest Research Station. Prior to that, both the Pacific Northwest Region and the Oregon BLM had a similar survey known as the current vegetation survey. This long-term dataset has been and continues to be used for monitoring at NWFP, regional, and forest-wide scales. Two key tools have been developed as part of this effort, both of which are publicly available online: Gradient Nearest Neighbor (GNN) maps and the Decayed Wood Advisor (DecAid).

In GNN mapping, FIA field-measured plots are combined with Landsat imagery and other ancillary variables to impute the inventory data across the landscape of interest. GNN maps allow for spatially aware interpretations of the FIA data—taking us from "what vegetation exists" and "how much is there" to "where is it" and "how has it changed." GNN maps are produced by the Landscape Ecology, Modeling, Mapping, and Analysis Lab for the Pacific Northwest Region in partnership with the USDA Forest Service Pacific Northwest Research Station and Oregon State University. The maps are used extensively for NWFP effectiveness monitoring and are integrated with disturbance mapping efforts, for example late-successional and old-growth monitoring (Davis et al. 2015) but are also used for many resource planning efforts such as identifying current levels of snags and down wood within a watershed.

The Decayed Wood Advisor (DecAid) is a planning tool intended to help advise and guide managers as they conserve and manage snags, partially dead trees, and down wood for biodiversity (Mellen-McLean et al. 2017). In the Pacific Northwest, snags and down dead wood are important habitat components for many wildlife species, and staff in the region realized that guidelines for managing this resource needed to be updated to reflect the current state of knowledge. In partnership with the Pacific Northwest Research Station (and with participation from the US Fish and Wildlife Service and other partners), the DecAid tool was developed to address this need. DecAid is publicly available and integrates reference conditions and current status of snags and coarse woody debris from FIA data (i.e., snag diameter, snag density, down dead wood diameter) with literature and other key wildlife habitat syntheses for the Pacific Northwest. After specifying a vegetation condition, users can determine which wildlife species are likely to be associated with specific sizes or amounts of snags or down wood at various statistical levels, determine the sizes or amounts of snags or

down wood needed to meet specified species objectives, and view advice on the roles of insects and pathogens in creation and dynamics of snags and down wood, among other functions. In the Pacific Northwest, DecAid is used by wildlife biologists and ecologists to determine implications of snag and down wood levels on managing for overall forest ecosystem health. Data such as the distribution of down dead wood by size class in mid-successional Westside Lowland Conifer/Hardwood forest plots (Table 3) are easily summarized by DecAid and can serve as a benchmark for managers needing to create specific habitat attributes.

Evaluating Longleaf Pine Ecosystem Condition in the Southern Region

The Southern Region includes the unique longleaf pine ecosystem. This forest type is home to hundreds of bird, reptile, and mammal species, 29 of which are listed as threatened and endangered. The ecological significance and reduction in extent of this ecosystem have made it a priority for conservation and restoration. A key part of those efforts involves developing accurate estimates of the number of acres of existing longleaf pine forests and their condition. Although the FIA database does contain forest type information and a wide array of stand-level variables, these classifications generally do not capture the ecological condition of the stand, because longleaf pine ecosystems possess a distinctive stand structure that is atypical in the region. Additionally, use of the forest type code may omit stands that include longleaf pine but which have been classified into hardwood or other pine types.

Table 3. Distribution of down wood size classes on unharvested mid-successional westside lowland conifer/hardwood forest inventory plots on the west side of the Cascade Mountains, OR ($n = 105$).

Down wood diameter (in.)	Percentage down wood in size class*	Percentage of area with down wood in size class†
5–9.9	24	89
10–19.5	39	88
19.6–39.3	32	64
≥ 39.4	6	18

Note: Data are from DecAid.
*Column total may not equal 100 percent because of rounding. Data are percentage of total down dead wood (pieces) represented by a size class.
†Down wood less than 5 inches in diameter not used in analysis.

Beginning in 2005, a group of stakeholders developed a range-wide conservation plan for longleaf pine, which set restoration goals based on stand condition (Maintain or Improve/Restore; America's Longleaf Regional Working Group 2009). At the time, no techniques were available to classify longleaf pine acreage into condition classes, and a combination of local data and expert judgment was used. To support the conservation plan, an interagency effort developed a set of metrics (NatureServe 2018) to assess the condition of the longleaf pine ecosystem. There are 13 metrics used to categorize stands into one of four condition classes: excellent, good, fair, and poor. Five of the metrics are related to canopy characteristics, four characterize the midstory/shrub layer, and another four describe the ground layer.

FIA data are available to calculate seven of the 13 metrics, although available data are not an exact match to the metrics in all cases. To address this problem, regional staff developed procedures to estimate values for those metrics from existing variables in the FIA database to enable managers to use the assessment protocol developed by NatureServe (NatureServe 2018). A series of macros, which allow tasks to be automated, were developed in Microsoft Access to produce output data files containing the metrics necessary to calculate the scores used to assign condition class. Both stand-level and tree-level FIA data are used; tree-level variables include crown class, compacted crown ratio, and total height. These variables and stand-level data are used to calculate attributes (i.e., tree basal area, crown cover percent, and crown position) required to compute the metrics. Applying the assessment procedure and rating system using current FIA data results in estimates of acres of longleaf pine in each condition class as classified using the NatureServe Dry Mesic Pine Rating (Table 4). Although this analysis is preliminary and requires field validation and additional work to develop methods to more fully incorporate the ground layer metrics, the approach provides a systematic and consistent method to assess the extent and condition of the longleaf pine ecosystem across its range using the latest inventory data, providing managers the information needed to prioritize areas for conservation and restoration.

Final Thoughts

Although FIA data are used by a wide variety of stakeholders including state, federal, and tribal land managers; conservation organizations; researchers; and

Table 4. Estimates of ecosystem condition based on NatureServe Dry Mesic Longleaf Pine Metric Rating using the most recent Forest Inventory and Analysis data.

	Maintain		Improve	Restore	
Owner	Excellent	Good	Fair	Poor	Total
Forest Service	122,224	443,179	546,840	104,826	1,217,069
Other federal	124,351	340,245	334,363	24,974	823,934
State	49,089	357,687	338,996	66,675	811,448
Private	244,326	1,836,752	2,845,295	754,198	5,680,571
Total by condition	539,991	2,977,863	4,065,494	949,674	8,533,022
Total by management	3,517,854		4,065,494	949,674	8,533,022

Note: Data are acres of longleaf pine habitat by condition class throughout the habitat range for all ownerships (includes forested lands in North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas).

policymakers, many of these users are familiar only with summary reports of basic forest attributes. The tools developed by regional staff enable National Forest personnel in the Northern, Pacific Northwest, and Southern Regions to access and analyze a wide range of FIA data products to support their information needs. The examples presented here illustrate some of the ways that national forest staff use FIA data in conjunction with nationally and regionally developed tools and consistent data management and analysis protocols to efficiently meet the ever-growing information needs of forest managers and can serve as models for researchers and managers in partner agencies and organizations, as well as managers of privately owned forests.

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