Esri News
for Forestry

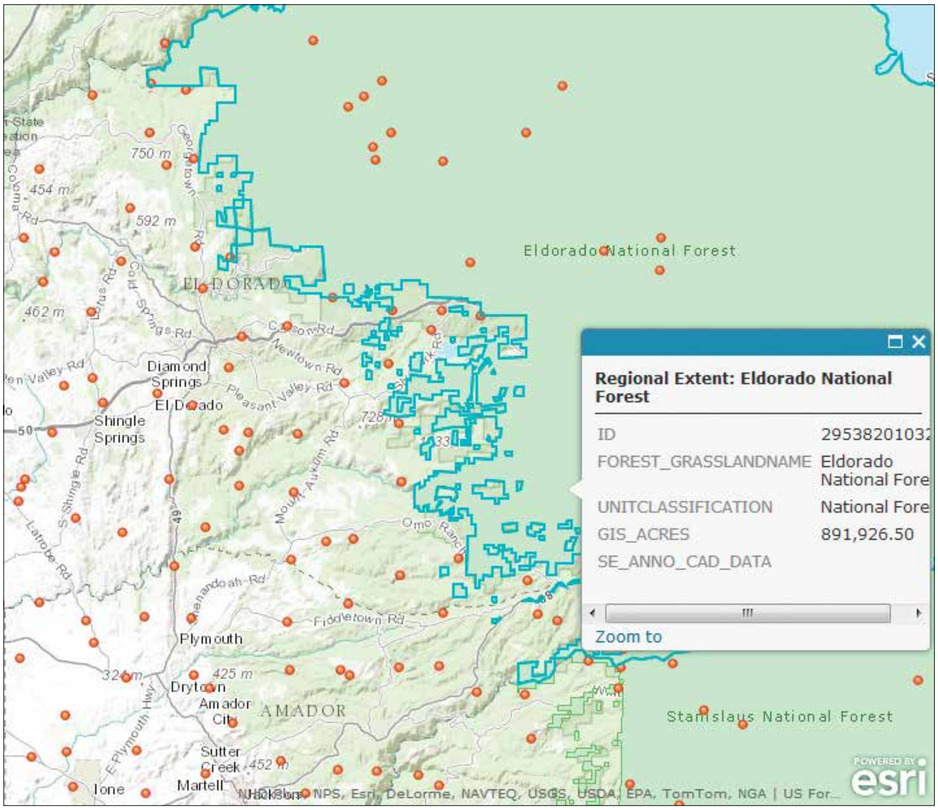
Summer 2014

USFS Platform Helps Investors Find New Business Opportunities

By Barbara Shields, Esri Forestry Writer

From fighting forest fires to making long-range plans for managing national forests, the United States Department of Agriculture US Forest Service (USFS) uses Esri technology to make location-based decisions. Among the many users of the US Forest Service's ArcGIS platform is the Forest Inventory and Analysis (FIA) program. FIA creates the nation's forest inventory and publishes it as GIS data layers. These layers are not only important to agency employees managing the national forests, they are also heavily used by private forest landowners, investors, forestry consultants, and forest industry analysts.

FIA products help USFS employ management strategies and practices that align with the needs of today's forest resource users. Seeing the forest census in GIS helps USFS foresters understand current trends. Forest researchers analyze FIA data layers, such as woody biomass, land cover, grasslands, and canopy density layers, to find new opportunities in the forest for revenue, conservation, and stewardship. Industrial analysts and investors use the FIA layers to evaluate wood supplies and business opportunities.



↑ The US Forest Service Proclaimed Forests and Grasslands data layer can be downloaded from the US Forest Service Forest Inventory and Analysis DataMart, published on ArcGIS Online, and consumed as a GIS web map. (DataMart is at fia.fs.fed.us/tools-data.)

Under the direction of the US Forest Service's research and development team, FIA has been conducting field inventories for nearly 80 years. Its forestry researchers have always used state-of-the-art technology to measure forest status, condition, and trends. Their analysis has been critical to the development and implementation of policies and practices that support sustainable forestry.

Dr. Richard Guldin is the director of quantitative sciences for the USFS research and development team and has led the FIA program since 1996.

"GIS provides context for researchers to explore relationships with the forest ecosystem and the ways these relationships can continue well into the future," Guldin said. "Geospatial tools help the US Forest Service tell the story of America's forests in ways that help

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Use Forest Satellite Data in ArcGIS

Global Forest Watch satellite datasets are now available. An initiative of the World Resources Institute, Global Forest Watch is a dynamic online forest monitoring and alert system that empowers people everywhere to better manage forests. People can use the service to track deforestation throughout the world in near real time.

ArcGIS users can add Global Forest Watch datasets to their GIS forest projects and better analyze indicators of forest change. ArcGIS Online subscribers can access global forest data; add it to a base; and then draw from Esri's massive data collection, such as Landsat, to get a more comprehensive perspective about complex problems.

See the Global Forest Watch platform at www.wri.org. Get a 30-day trial of ArcGIS Online at arcgis.com.

Get Answers at the Esri International User Conference

July 14–18, 2014
San Diego, California
esri.com/UC

↑ Attend the 2014 Esri International User Conference.

If you are thinking about getting GIS, wanting to get more out of the GIS you have, or looking to upgrade your GIS, the Esri International User Conference provides an excellent way to get answers to your *who*, *what*, *where*, *when*, and *why* questions. The many presentations, workshops, and events offered give you the opportunity to design an agenda that suits your specific needs.

People working in forestry and land management will be able to follow forest-specific presentations and hear about real-world GIS deployments, best practices, and applications. Technical sessions from lidar management to web application development are highly popular among IT practitioners. Hands-on workshops facilitated by GIS experts will help attendees hone GIS skills and try out new software. Industry socials and meetings, such as the Esri Forestry Group meeting, will provide a pleasant atmosphere to build professional networks. Hundreds of exhibitors will participate in the EXPO and will be ready to show you range finders, satellite detectors, fire-management GIS platforms, and more. Esri industry experts will also be on hand to talk with you one-on-one and answer your GIS questions.

Save the Date

Esri International User Conference
July 14–18, 2014
San Diego, California, USA
esri.com/UC

International Forestry Students' Symposium
August 6–9, 2014
Vancouver, Canada
www.ifss2014.ca

2014 IUFRO World Congress
October 8–11, 2014
Salt Lake City, Utah, USA
www.iufro2014.com

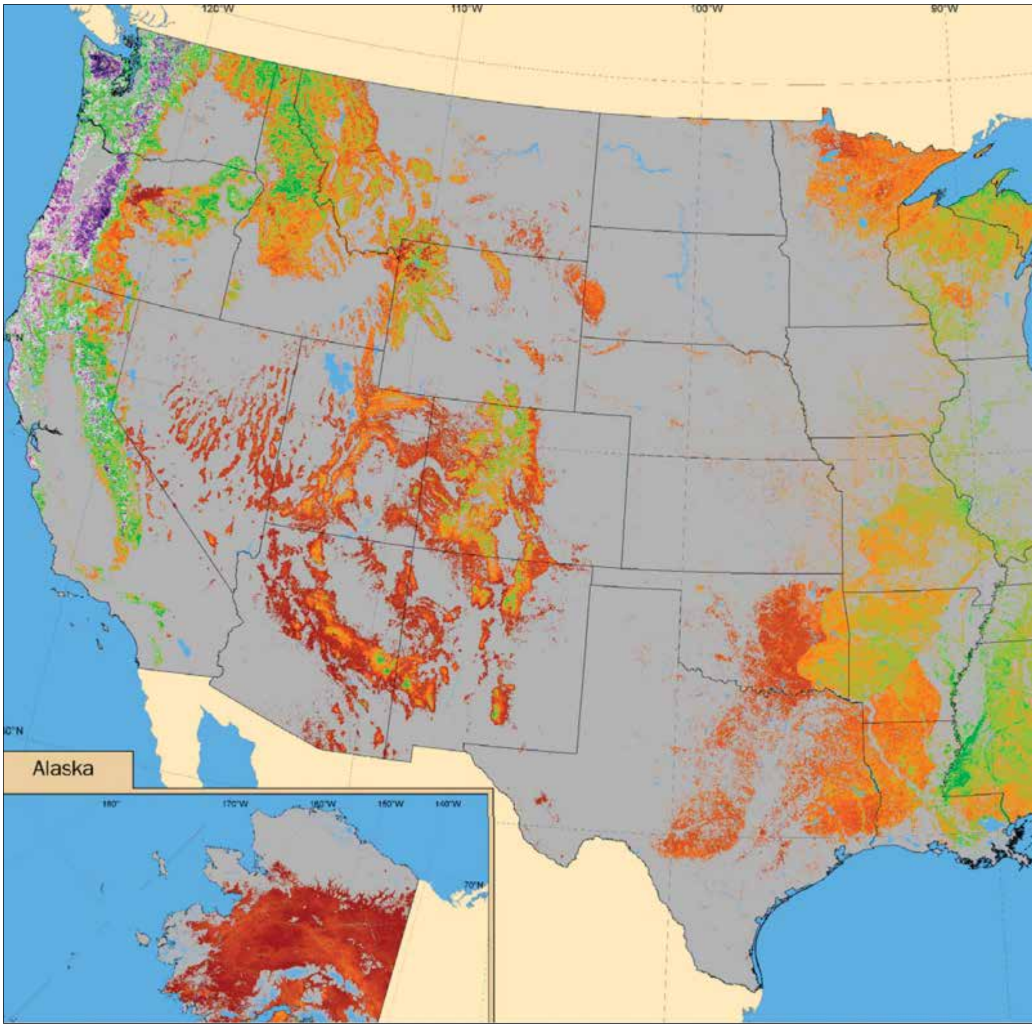
Council of Parties (COP20)
December 1–12, 2014
Lima, Peru
www.cop20.pe

people better see and understand what is happening. FIA geospatial products are available to interested citizens, foresters, and policy makers."

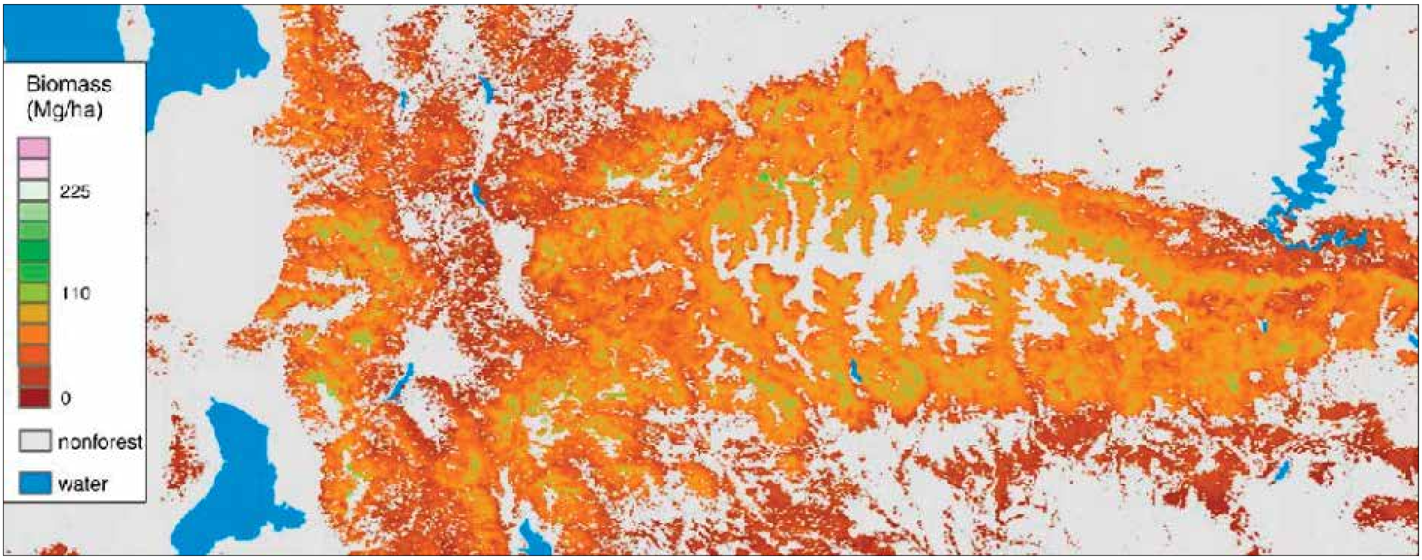
GIS helps researchers employ scientific methodologies to create social data layers, combine them with forest biological and physical information, and produce a broader picture of forest ecosystems. This offers greater insight into how clients and society value and use forests. Social data layers include survey information about the management objectives and interests of private forest landowners. Economic trends can be understood by assessing wood consumption and outputs of the forest products industry.

FIA researchers also use GIS to quantify and visualize biological, physical, and social conditions, which become the foundation for decision making and policy formation. FIA's contextual computing technologies include GIS cloud-based services, multiple platforms, mobile devices, and information products that have been compiled from multiple services.

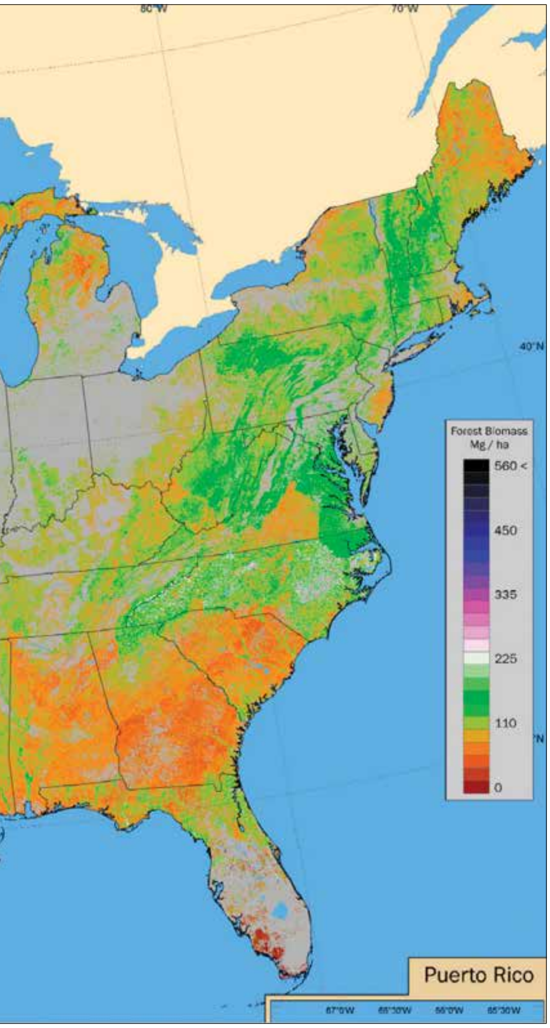
Among its forestry products is an insect and disease risk map portfolio that includes data and maps about the risk and prevalence of two dozen different insects and diseases. Its fire portfolio includes maps that show burn severity in



↑ This map shows the density of aboveground biomass, which includes the dry weight of live trees, stumps, branches, and twigs. (J. A. Black.)



↑ Forest researchers use geospatial statistical models to plot biomass located in the Uinta Mountains, Utah.



↑ Forest researchers rely on forest inventory reports to gain a better understanding of ecosystems. (Laura Kenesic, PhD, USFS.)

pre- and postfire comparisons and ecological dynamics in fire-ridden locations.

Outside organizations, such as large-scale enterprises, also use forest census information. A utility company used the data to locate biomass so it could build a thermal energy generation site. Another company used the census data to see where timber is available for building a large-scale electricity generation facility. Major forest product firms across the United States use FIA data to study supply chain issues and make nine-figure investment decisions about paper machine and boiler rebuilds.

Forest census data is also used by small-scale ventures. For instance, managers for a major distillery were looking for an area where the company could make quality white oak barrel staves. They found just the right site, built a barrel stave sawmill, and created more than 25 jobs in a nearby rural town.

The National Aeronautics and Space Administration (NASA) recently funded the North American Forest Dynamics Project to determine the role of forest dynamics in carbon balance. For this project, FIA used Landsat information to map tree cover change data that characterizes and validates disturbance patterns and recovery rates for forests across the continent.

FIA developers and partners completed a continental United States (CONUS) map product at the 250 m scale and are now working on the project at the 30 m scale level. The map is based on information from more than 300,000 FIA field plots.

The USFS recently launched a raster data service that offers imagery at 30 m resolution to define forest structure. To create a complete view of the land with partial data, FIA analysts used the NN imputation mapping method to build raster data surfaces from its forest inventory data. This method included various approaches for estimating a dataset's missing values by using the known values in that same dataset.

The Forest Atlas of the United States is yet another FIA project. It explores questions about the value of American forests and the challenges that confront them. In addition, FIA is publishing the atlas's data layers as a web service. This content comes from many data providers and includes links to their data repositories such as ArcGIS Online.

Get more FIA information at www.fia.fs.fed.us.

Discovering and Mapping Natural Hazards with Lidar

On February 17, 2011, President Barack Obama declared a major disaster in the state of Oregon due to a severe winter storm that had caused flooding, mudslides, landslides, and debris flows during the previous month. Western Oregon counties—including Clackamas, Clatsop, Crook, Douglas, Lincoln, and Tillamook—were affected. The total public assistance cost estimate is more than $6 million.

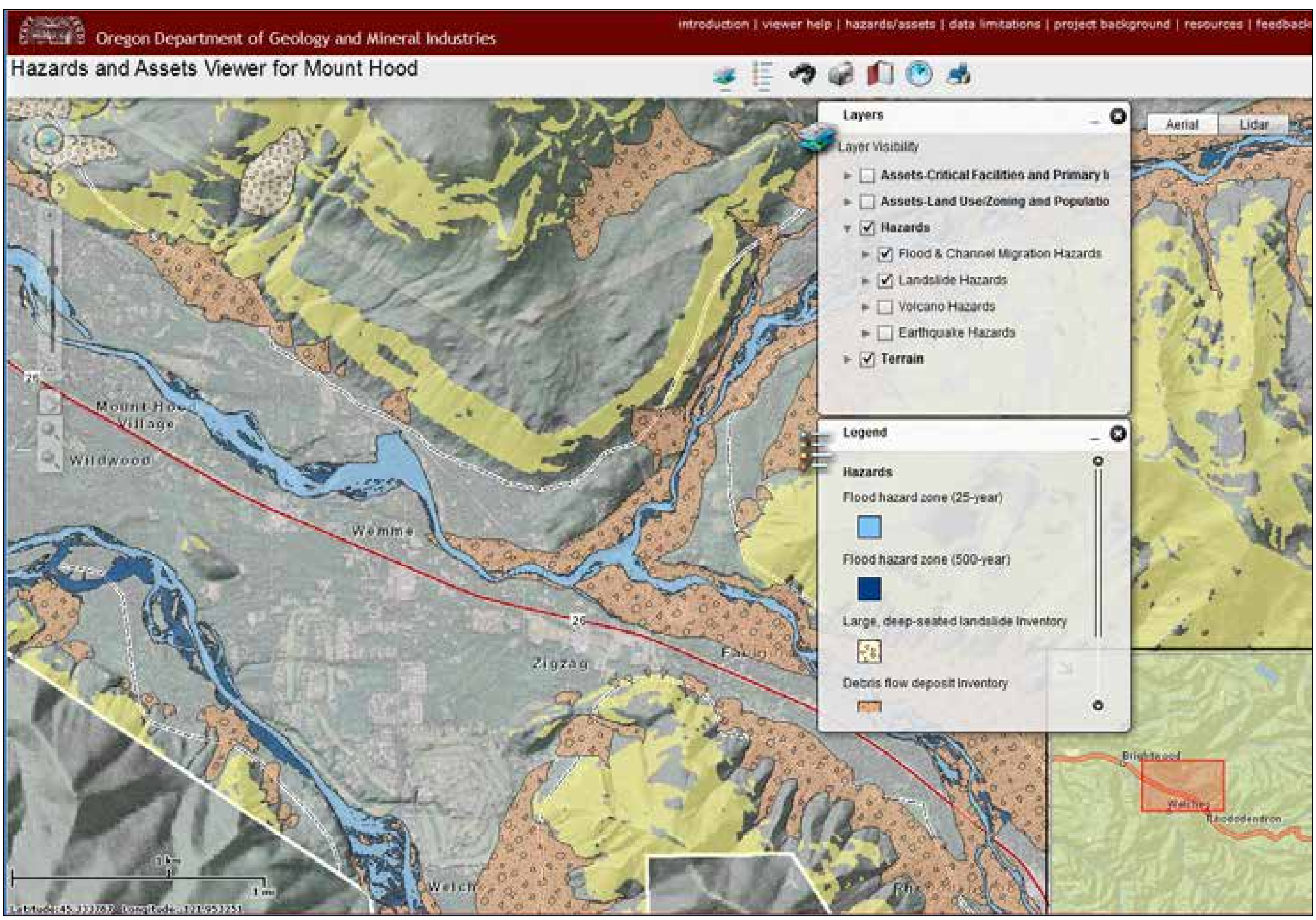
To help mitigate the suffering from events like this and maintain a safe environment for those living in the state, the Oregon Department of Geology and Mineral Industries (DOGAMI) is using light detection and ranging (lidar) data to more accurately find and analyze hazards like landslides and debris flows.

DOGAMI makes this data available to the public using an innovative solution based on Esri's ArcGIS, the standard GIS platform used by the State of Oregon.

Oregon is known for its natural beauty. From cliff-lined beaches to snowcapped mountains, the landscape is an amazing vista formed by millennia of geologic processes. With this beauty comes danger; the earth's movements, which created such breathtaking views, can also be the cause of destruction. Natural hazards such as floods, landslides, earthquakes, coastal erosion, volcanic eruptions, and tsunamis are all possible and have occurred in Oregon over the past century.

Maintaining an accurate inventory of these hazards can be difficult in a region that contains lush tree cover and where cloudy days outnumber sunny ones. Traditionally, aerial photography has been used to create topographic data through stereo pair analysis, but this method cannot always capture the detail needed to identify hazard locations and accurate model inputs.

When DOGAMI staff members first started using lidar, they discovered they weren't even close to mapping the entire landslide hazard inventory of western Oregon. "The technology has proved to be invaluable in improving the accuracy of Oregon's hazard inventories,"



↑ A multihazard map shows Mount Hood's natural hazards and the vulnerability of assets in the area.

says Rachel Lyles, GISP, a project operations manager in the Geologic Survey and Services program at DOGAMI.

Lidar data is used to create bare-earth digital elevation models (DEMs), representations of the earth's surface where all man-made structures and vegetation have been removed. These DEMs are much more accurate than those based on aerial imagery. The detailed topography of lidar-derived DEMs has greatly improved the precision of hazard mapping as well as many other mapping efforts throughout the state.

DOGAMI uses lidar maps as the driver for new projects associated with other natural hazards throughout the state. Oregon's Coos County was first to use flood zone maps with inundation layers that include lidar topography. DOGAMI also used lidar and lidar-derived products to update and correct basemap layers, which greatly improved Digital Flood Insurance Rate Maps (DFIRM) in both detail and readability.

The department published lidar maps to help communities around Mount Hood become more resilient to geologic hazards including volcano, landslide, flood, channel migration, and earthquake. High-resolution lidar proved essential for locating landslides and faults and redelineating flood and volcanic mudflow hazard zones. It has also been critical for mapping assets such as buildings and infrastructure. The accuracy and fine-scale resolutions of the hazard, asset, and risk data make the results more reliable and thus more likely to be useful in risk reduction.

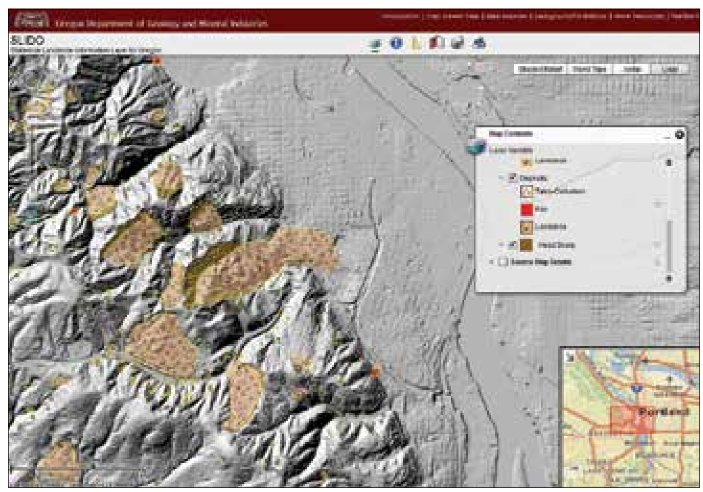
In Oregon, DOGAMI also manages the National Tsunami Hazard Mitigation Program, which has been administered by the National Oceanic and Atmospheric Administration (NOAA) since 1995. DOGAMI's work is designed to help coastal cities, counties, and sites reduce the potential for disastrous tsunami-related consequences by understanding and mitigating this geologic hazard. DOGAMI has developed a new generation of tsunami inundation GIS maps and evacuation brochures. These help residents and visitors prepare for the next earthquake and tsunami.

Lidar data for the Oregon coast was acquired between 2008 and 2009. The onshore lidar has been integrated with offshore and nearshore bathymetry, providing greatly improved topographic inputs for tsunami modeling. With NOAA funding, DOGAMI and Oregon Health and Science University (OHSU) have worked to successfully model tsunami inundation scenarios for the entire Oregon coast. The detailed topography improved model outputs by providing greater definition and inundation accuracy. These improvements have allowed DOGAMI to better educate and inform coastal communities of the risk of tsunami hazards.

Throughout Oregon, local municipalities, state and federal agencies, and tribal communities have been applying lidar topographic data to all aspects of mapping.

"One of the great things that have come from this mass of data is a coming together of users and sharing of ideas," says John English, lidar database coordinator at DOGAMI. "People have found new ways to address geospatial needs. Lidar has changed the way Oregon thinks about mapping."

↑ Lidar data is used to create bare-earth DEM representations that exclude man-made structures and vegetation.



↑ A landslide map includes lidar data and a street map and shows morphological features, land use, and infrastructure.

DOGAMI staff embarked on an ambitious project to make lidar data available and searchable on the web so people could compare and contrast lidar data against aerial photographs, topographic maps, and 10-meter DEMs for their own education. In 2011, DOGAMI began using ArcGIS Viewer for Flex to create an interactive map tool that allows anyone with a web browser to view the lidar data at the 1:9,028 scale. Viewers can navigate using pan and zoom tools, and they can hide and display different data layers, depending on their interests.

The primary data layers available in the viewer are the US

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Topo 24K, which displays USGS 1:24,000-scale quadrangle boundaries, names, and Ohio codes; county and state administrative boundaries; and a contour layer. DOGAMI uses the Ohio code grid system to identify lidar data quadrangles. (The Ohio code grid system splits a 1 × 1 grid block into 64, 7.5-foot quadrangles. Ohio code values are derived from the geographic coordinates of the southeast corner of each block and an assigned grid number, ensuring consistency across the contiguous United States.) The contour layer displays 20-foot contours and labels at the 1:18,056 and 1:9,028 scales.

The lidar data shown in the data viewer is 3-meter resolution, bare-earth hillshade imagery. Users have the option to view the lidar data alone or as a semitransparent layer draped on top of other basemap layers—Esri's aerial, street, and topo basemaps.

One of the most helpful tools for people who are unfamiliar with navigating interactive maps is the overview map. Controls at the top right-hand side of the main map display allow viewers to search for and identify DOGAMI lidar data quadrangles (LDQ). They can show and hide the map legend, draw and measure on the map interface, and find and zoom to an address. The current extent of the data viewer can be printed, as well.

A web map interface helps people search and order LDQ publications and data. Each quadrangle contains a bare-earth DEM, the highest-hit DEM, and a high-intensity TIFF image, all in Esri Grid format. The site is a one-stop shop for purchasing maps, publications, books, and software on the region's geologic information.

DOGAMI has been overseeing the collection of lidar throughout the state since 2008, when Oregon LiDAR Consortium (OLC) was formed. OLC has been the most successful consortium model in the United States, collecting 13.9 million acres of high-density data throughout the Northwest. DOGAMI continues to supervise and coordinate the collection of large swaths of lidar data in Oregon, as designated by the state legislature.

Using a nationwide selection process, DOGAMI has a state price agreement in place with Watershed Sciences Inc. of Corvallis, Oregon, for a predetermined unit cost based on the size of project areas. DOGAMI and consortium partners (which include local, state, federal, and tribal agencies) have combined interests and funding to facilitate Oregon's many lidar data needs. Additionally, DOGAMI uses Esri products to serve more than 33 terabytes of lidar data to the public.

See the lidar data viewer at www.oregongeology.org.

Contributors: Rachel Lyles Smith, project operations manager, Oregon Department of Geology and Mineral Industries, and John English, lidar database coordinator, Oregon Department of Geology and Mineral Industries

Lidar Data Viewer Development: Paul Ferro, GIS analyst and web designer, Oregon Department of Geology and Mineral Industries

← The DOGAMI web service hosts a map that displays new and redelineated flood zones for Coos County, Oregon. Lidar data was used to create new flood zones for the county.

Virginia Locates New Urban Forest Benefits

By Ian Hanou, Richard Thurau, and Brian Beck, Plan-It Geo LLC

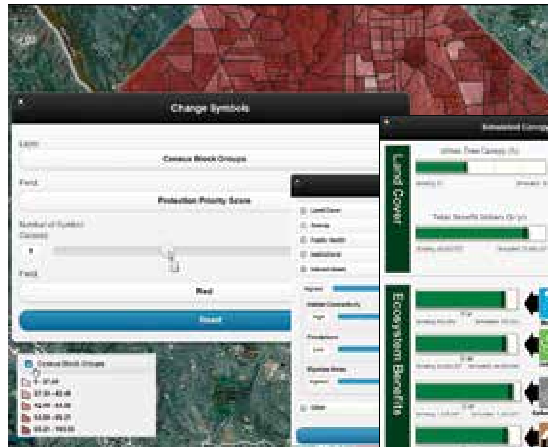
Nearly 30 communities in the state of Virginia have conducted Urban Tree Canopy (UTC) assessments, using aerial imagery to map trees and other land cover to evaluate current resources; prepare for changes from development and disturbance; and plan healthy, sustainable urban forests.

State officials wanted people to be able to use the data, so they asked Plan-It Geo to host a UTC data web mapping application for several Virginia cities. Plan-It Geo launched the Urban Forest (UF) Cloud in ArcGIS Online. UF Cloud provided an accessible, affordable, and configurable platform for deploying a suite of browser-based applications. It meets the needs of Virginia communities, including Lexington, Newport News, Virginia Beach, and Woodstock.

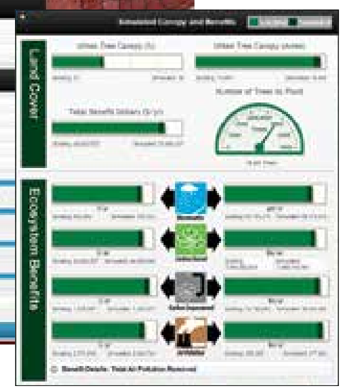
Built on ArcGIS, the service provides urban forest planning, analysis, and tracking tools. This collaborative project involved partners from the Virginia Department of Forestry, Virginia Tech, and funding and support provided by the US Department of Agriculture (USDA) Forest Service. In addition, i-Tree software (itreetools.org) was used to quantify urban forest ecosystem service values using local studies. These values were incorporated into back-end databases and analysis tools.

Numerous data was prepared for the web map including zoning and ownership, census, riparian corridors, floodplains, public facilities, road networks, and growth boundaries. To connect land-use planning with urban forest management, contiguous zoning districts were chosen as the basis for analysis. Based on a statewide survey of UTC planning needs, Plan-It Geo deployed these tools:

- Prioritize Canopy—This tool weights criteria by using slider bars to calculate Priority Planting Scores or Priority Protection Scores for zoning polygons. These are thematically displayed to visualize priority landscapes for restoration.
- Simulate Canopy—Users spatially model gains or losses in UTC to quantify impacts such as tree counts and ecosystem services. Analysis can be either citywide or narrowed to select zoning polygons. A query and filter tool can be used to simulate impact, such as 20 percent tree cover only to residential areas with less than 10 percent UTC.
- Canopy Tracker—Managers map and describe planting or restoration projects, forest losses, or areas for canopy protection.
- Update Metrics—Managers can keep land-cover metrics current and accurate (e.g., remove sports field areas from a zoning polygon to exclude them as possible planting areas).
- Tree Plotter—This is a fully functioning tree inventory application for managing new and established trees and maintenance work history on public and private property.



↑ The Prioritize Canopy tool scores zoning areas for their tree planting or canopy protection potential based on user-defined criteria weighting.



↑ A demonstration of the Simulator tool in a commercial zoning polygon with low tree cover in Newport News, Virginia

- Dashboard—A browser dynamically summarizes tree inventory and canopy data from the tools, providing a snapshot of key statistics and charts/graphs for managers, the public, and elected officials. Dashboard includes a canopy calculator goal-setting tool linked to the spatial data.

Beyond map navigation and search tools, users can change layer symbology (e.g., color zoning polygons by their priority planting score), filter features by field attributes (e.g., location priority riparian restoration areas on public lands), and export data to a desktop file. Additionally, the public can view the map layers through a guest login to see trends in development, canopy distribution and losses, planting events, and trees planted.

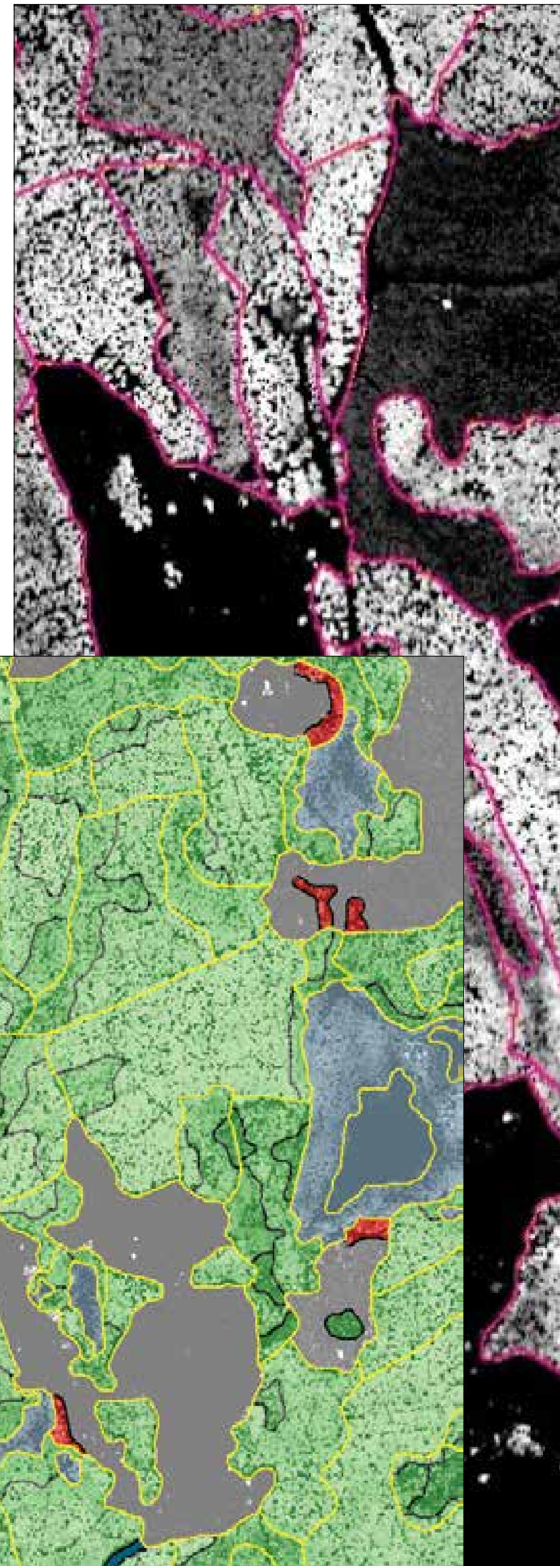
UF Cloud applications are built using Esri's ArcGIS API for JavaScript, jQuery, and HTML5 incorporating data from multiple sources including ArcGIS Online basemaps and clients' ArcGIS for Server and ArcGIS Online accounts.

Find more information about Plan-It Geo at www.planitgeo.com and about Urban Forest Cloud by logging in to pgonline .planitgeo.com/VA/.

Lidar and GIS Improve Forest Operations Management

Bergvik Skog AB Uses Lidar and Esri GIS Services

By Barbara Shields, Esri Writer



Lidar provides fine resolution and very specific measurements for tree and stand characteristics that make forest inventories more exact. By combining lidar with GIS technology, forest managers have a better understanding of their forest and can more accurately plan harvest, thinning, and wood pulp operations.

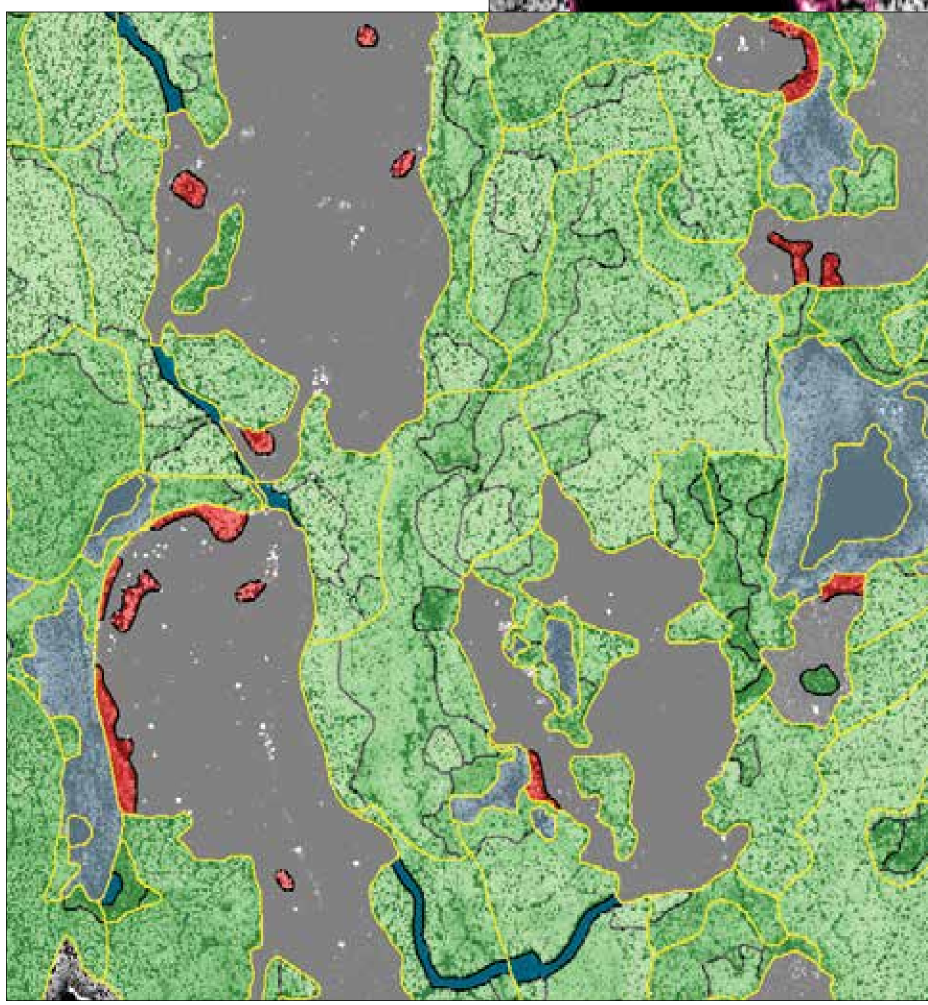
Swedish forest company Bergvik Skog AB uses lidar to measure the characteristics of terrain, canopies, and vertical vegetation and to analyze variability in tree volume, height, and diameter between and within stands. Upon combining lidar-based forest and terrain data with ArcGIS, the forest company automated lidar processing tasks, organized data layers, and produced maps for analysis.

"By using lidar-based forest and terrain data, we get better forest data at a lower cost than previously," Lars Sängstuvall, GIS and forestry analyst at Bergvik Skog AB, said. "Processing and distributing this data requires powerful GIS tools. Solutions help users rapidly and flexibly consume data. In all, acquiring this data has truly been a win-win decision, and Esri tools have been essential in our project."

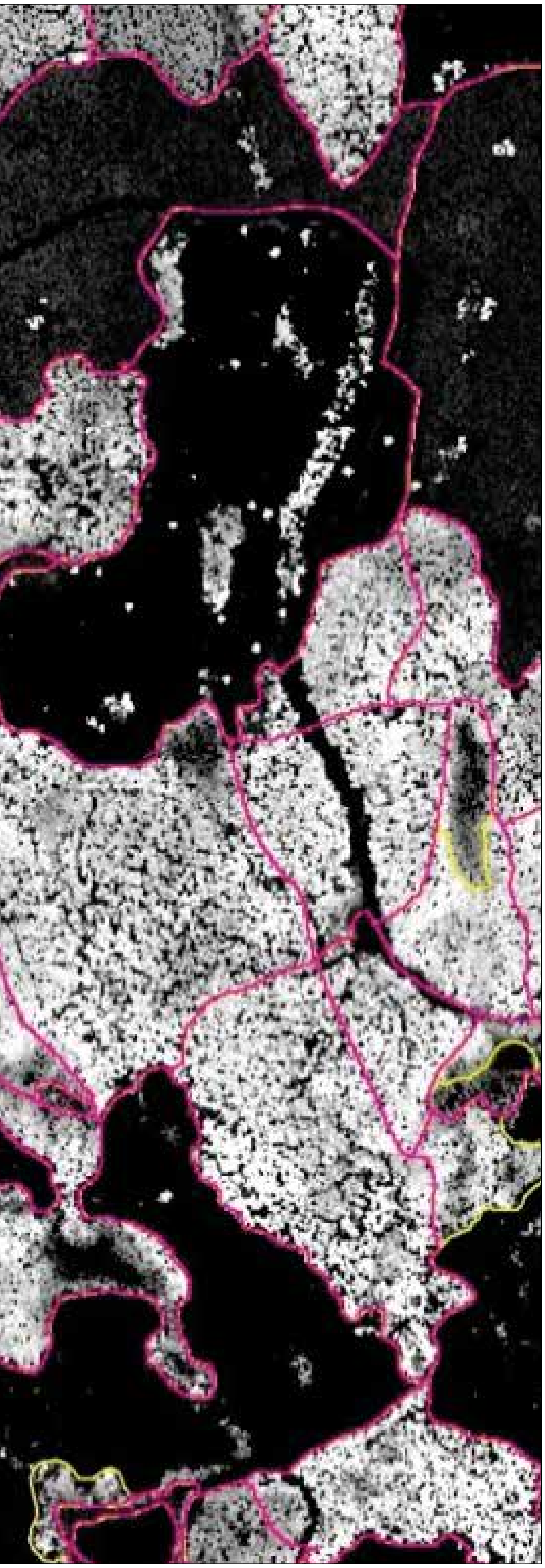
Prior to the implementation, Bergvik Skog AB managers looked for proven inventory registry technology that could replace old, poor, stand-level information with highly accurate and spatially comprehensive information. Their goal was to update the stand inventory database with area-based data. They also wanted staff to use GIS to identify and map dense areas for thinning, regardless of stand delineation.

The company employed the business consultant group COWI to create a geodatabase. COWI used ArcGIS to transform lidar point data into raster files. Bergvik Skog AB stores its stand-level forest information in a GIS database, which includes 245,000 stands.

Bergvik Skog AB administrators listed several returns on the company's lidar and GIS investment. Most importantly, its managers now have a comprehensive and common operational picture of 1.6 million hectares of forest via interactive maps and data layers and models. They also have tools to better



↑ Yellow borders delineate main stands, and gray borders indicate microstands. Within each stand, the microstands are shown with a gray border. The red color shows microstands in the Diff_Larger class, which means that the forest is higher than the stand's normal height. Most of these microstands are nature conservations left after final felling. Volume and other stand data are calculated for all in the Diff_Larger class. The blue indicates areas where heights are too low to be measured. These are usually roads.



↑ A tree height raster, called a DZ, was used as background for stand delineation. The raster is typically shown in monochrome. Black indicates clear-cuts and other areas without forest. Colors become lighter as tree heights increase.

visualize and analyze forest and terrain characteristics. For example, customized spatial analytic tools improve analyses for scheduling where and when to thin forestland and locating the best routes for roads across rugged terrain.

The lidar/GIS deployment increased inventory accuracy. Previous stand inventory standard of error per hectare ranged from 25 to 40 percent root mean square error (RMSE). The new standard of error based on laser data and modeling is 15 percent RMSE.

Lidar is less expensive. Bergvik Skog AB foresters previously had to complete field-based sample-plot inventory after each forest management activity, such as harvesting. The cost of these sample-plot inventories ranged from $5 to $30 per hectare. Comparatively, the lidar data capture costs just $1.5 to $3 per hectare.

The stand inventory is more current. Foresters quickly update the forest database by adding postharvest forest inventory updates to GIS facility as well as felling, road, landownership, and other data. GIS immediately updates forest maps to show these changes.

The updated stand inventory information serves as a base for improved forest and stand-level strategic and tactical planning. Managers use the data for various forest planning activities at the strategic, tactical, and operational levels. They create forest plans, manage operations, calculate values, and more. Foresters easily search data, see it on a map, and bring it into projects.

COWI's forest inventory solution configuration included lidar data; Trimble eCognition software for image analysis, creation, and adaption; an Esri enterprise platform deployed by Esri Sverige AB; and ArboLiDAR technology, developed by Arbonaut Ltd.

The COWI team input airborne laser scanner data into Esri software to create raster files. It then used eCognition to correct the existing stand delineation using lidar vegetation height. The database included legacy and new raster data, as well as vector data for 1.7 million hectares of land, which was described by 3,000 field plots. Models constructed using ArboLiDAR combined plot and lidar data and calculated spatially comprehensive estimates of timber volume, stem count, average heights and diameters, number of trees, and species.

The team delivered the forest data to Bergvik Skog AB in three vector data layers including 15 x 15 m grid cells, microstands, and stands with updated stand borders. In addition, it delivered digital terrain and vegetation height models as raster datasets. COWI replaced most old information in the stand inventory with new stand delineation and mean variables. The new datasets were then deployed with a stand register application called BESK, which designers created to run with Esri software.

Lidar data has made the company's tree registry more accurate, less costly, and easier to use. GIS makes it possible for foresters to access and manage the stand inventory database and calculate and summarize timber volume for different stand levels. They are better equipped to analyze data and plan operations.

About Bergvik Skog AB

Bergvik Skog AB, based in Falun, Sweden, owns 1.9 million hectares of productive forestland, which is 8 percent of all Swedish productive forestland. Its forestry business services include selling harvesting rights, performing internal forest management analyses, addressing environmental forestry issues, and managing operational seedling production. It also controls harvesting, silviculture, and forest management. The annual felling on Bergvik's land is more than six million cubic meters. Get information about Bergvik Skog AB at www.bergvikskog.com.

Learn more about COWI at cowi.com, and discover other GIS applications for foresters at esri.com/forestry.

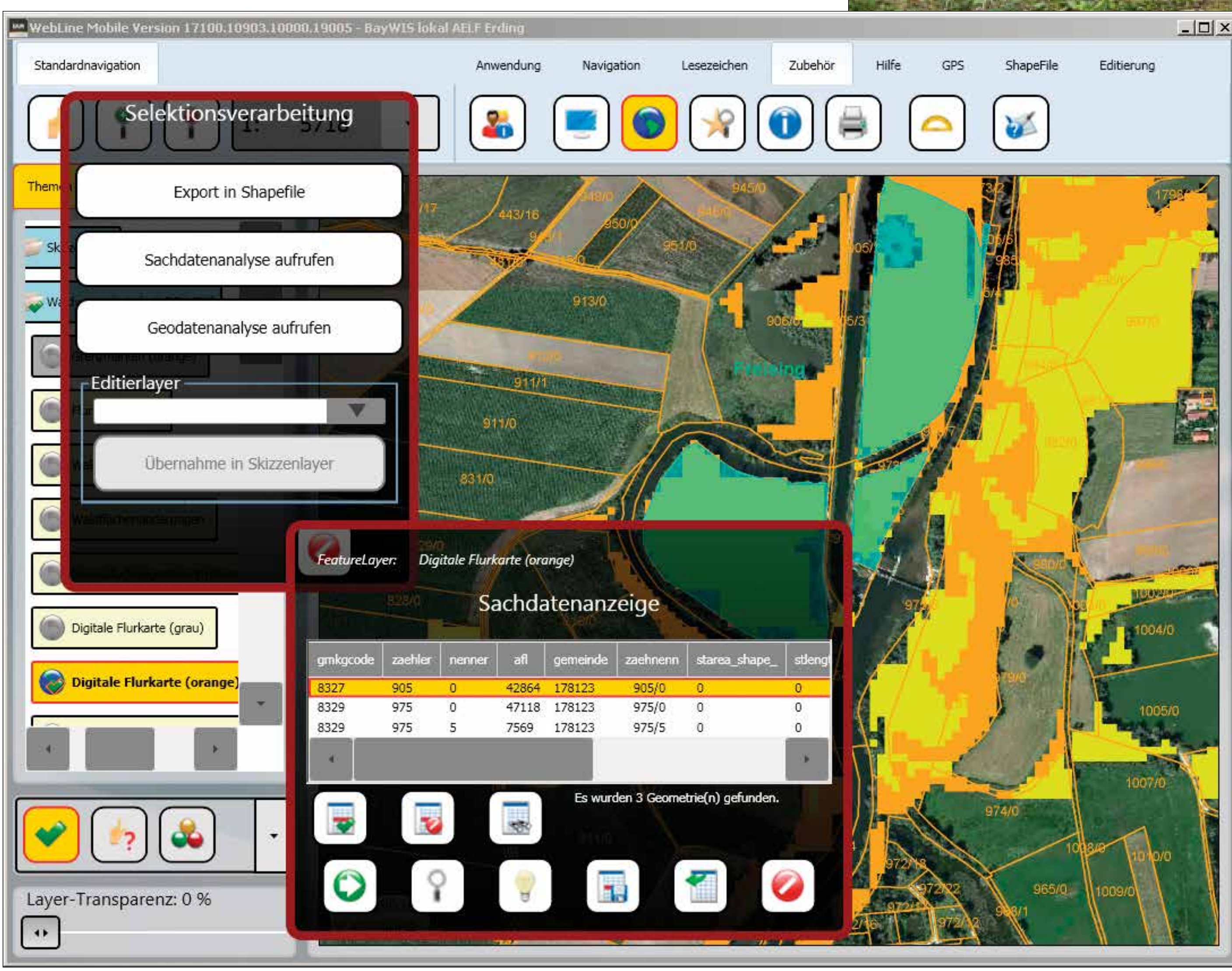
GIS Mobile Apps Improve Bavarian Foresters' Productivity

The Bavarian State Forest Administration is a prime example of how an enterprise GIS can improve productivity. More than 1,200 people use the administration's ArcGIS platform to access and analyze the forest. Administrators, officials, and employees tap into GIS for analysis, workflow, and decision-making support.

To ensure that foresters would actually use the technology, application designers created GIS tools that were not intimidating to nontechnical staff.

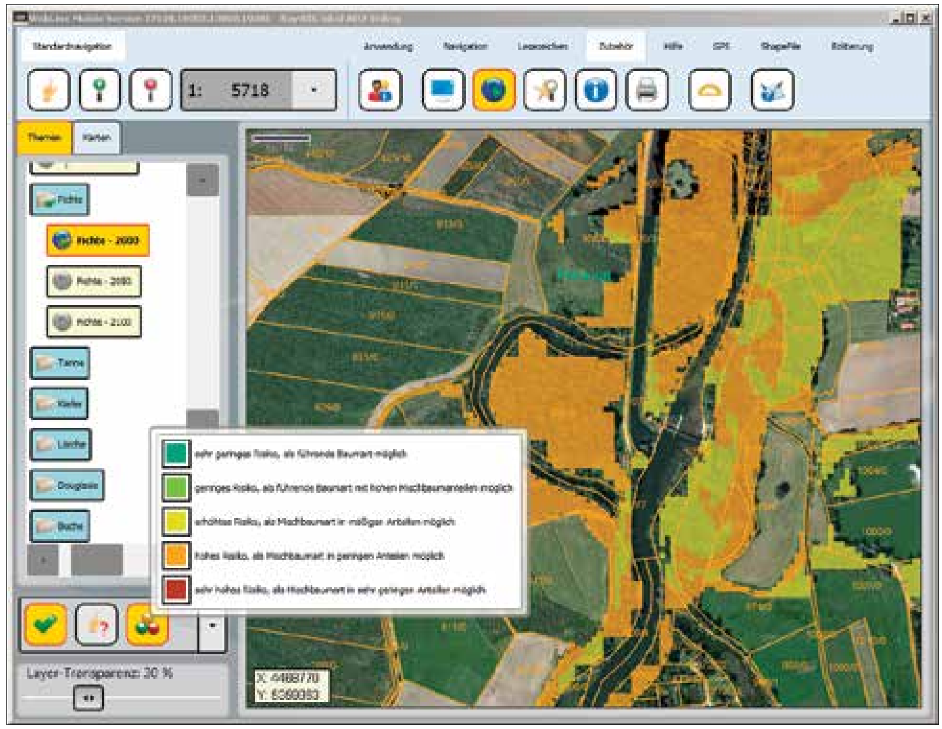
The administration's enterprise GIS, the Bavarian Forest Information System, helps foresters whether they are disconnected while working in the forest or online in the office. A mobile application gives foresters access to data including 90 different themes and 130 layers of information. It supports bidirectional synchronization while using only one user interface.

Because the apps are responsive and easy to use, foresters have adopted GIS and use it for many aspects of their work such as gathering data and analyzing



↑ In the field, the forester is able to take advantage of easy-to-use analysis tools. The forest delineation tool has large buttons and is easily operated by nontechnical personnel like foresters. It has built-in GPS, so the position reference does not need to be added.

↑ Bavarian foresters use GIS to be more productive in the forest.



↑ A basic viewer application makes it easy for users to access data.

↑ In this scene, the user can select specific forests for climate protection, forest overview, nature reserves, and county boundaries information and show it on the map.

change. For instance, they use a change-of-forest area application to monitor newly harvested and planted forests. Foresters use a tool to capture information on a GPS mobile device, and the IT team processes the data for land survey purposes.

Another app is used for surveying wildlife and compares species population to natural habitat. This count is the basis for issuing hunting permits. By using a GIS app specifically designed for counting species, foresters have reduced the time to perform count tasks by 20 to 50 percent.

Geographic information officer Christian Simbeck explained that a goal of the Bavarian State Forest Administration information technology department is to provide foresters with GIS tools that help them achieve their mission, optimize their workflow, and be more productive.

Simbeck advises GIS application developers to take time to understand precisely what users need before developing applications. This includes knowing who will use the application and what level of technological ability they have. Where will they be working with the tool? Locations may be connected in the office, disconnected in the field, or both if the user is mobile. Finally, developers need to understand the step-by-step details of a workflow.

This successful strategy has been proved by the 1,200 employees who use GIS every day.

Learn about ArcGIS for developers at developers.arcgis.com.

GIS App Homes In on State's Gypsy Moth Problem

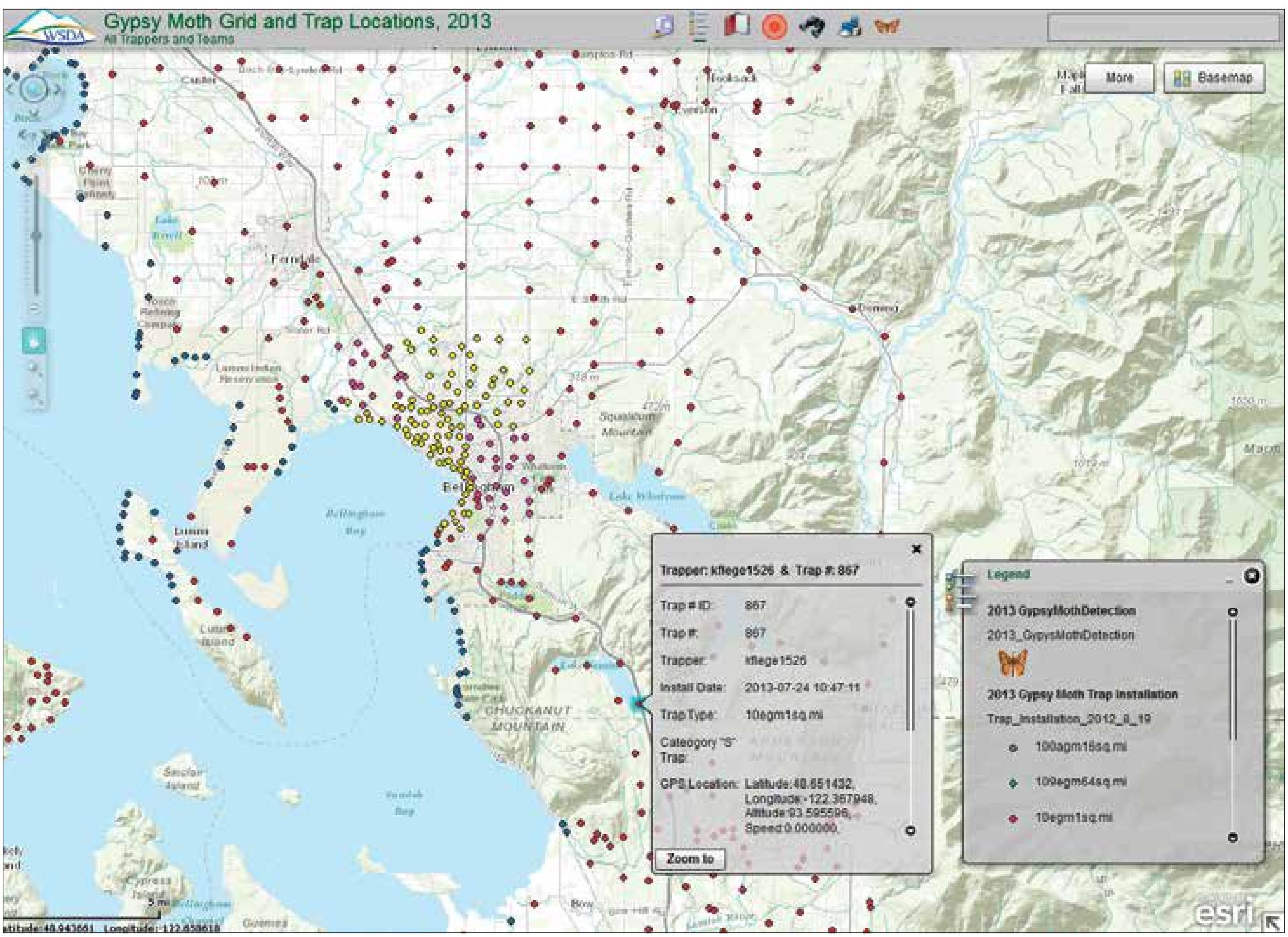
Washington State Department of Agriculture GIS Helps Staff Best Place Traps

The most damaging forest pest ever introduced into North America is the gypsy moth. In 2013, Washington State Department of Agriculture (WSDA) defended its forests from the pest with a trapping program supported by GIS technology including mobile data-capture tools and web applications.

The gypsy moth hitchhikes into the state on ships and vehicles. The United States Department of Agriculture (USDA) used Esri's ArcGIS to create models that showed high-risk sites where gypsy moths were most likely to enter and become established in Washington State. The department also uses a variety of data sources to construct its risk models such as weather conditions, WSDA historical trap and detection data, elevation, and transportation pathways.

Esri and Zerion Software, Inc., worked together to deliver a full end-to-end solution for recording information in the field, processing it on the state's GIS platform and leveraging ArcGIS Online basemaps and data layers for mapping analysis. The solution supports near real-time data collection, management, analysis, and

↑ An adult female gypsy moth stands over her egg mass on a European birch. (Hannes Lemme, Bugwood.org.)



↑ Gypsy moth traps are tracked and mapped for near real-time analysis.

← A US Department of Agriculture worker hangs a trap to check for presence of Asian gypsy moths in Washington State's high-risk areas. She uses a smartphone to transmit trap data to a central server.

mapping. This has reduced WSDA's response time to gypsy moth detection from two hours in 2009 to 15 minutes in 2013.

Zerion's mobile data collection platform, iFormBuilder and iForm app, is a robust, highly customizable tool for capturing relational data with or without a connection. WSDA trappers used iForm on their iPhones, iPads, and iPods to create and transmit more than 103,000 individual records over the span of five months. Forms were created and wirelessly assigned to users from a centralized website. When trappers needed to update their forms with changes or simply save and submit a record, they could do both operations with a simple one-button process.

Trappers hung more than 18,000 traps and created a record for each one including trap data such as trap number, inspector name, GPS coordinates, date, and time. A few weeks later, they would return to inspect the trap, access that record, and input the inspection performed on the trap. The data was more accurate than it had been in previous years using the paper inventory method. Because the mobile app had a standardized drop-down list, automatic time and date stamps, and a limited number of choices, trappers could record data more accurately. The new data collection system reduced data management hours and yearly software costs by more than 40 percent.

Esri developed a tool that streamlined the process of moving the data from the iForm website to WSDA's ArcGIS for Server. It automatically downloaded the desired data directly from the iForm web server. Esri added a drop-down list, which made it easy to create a feature class within the file geodatabase. Trap installation data was downloaded daily and used to create map services on WSDA's ArcGIS for Server. These map services were then used within Esri custom-built Flex applications and in ArcGIS Online. Users could then use the web-based application to access the most current trapping information on the platform.

"The high level of automation and flexibility that the iForm and Esri hybrid system brought to the WSDA pest program has forever changed our standards and expectations of a mobile data collection and management system," Landon Udo, WSDA GIS specialist, said.

The solution made survey processes more efficient. WSDA determined the location and number of traps needed throughout the state by using web-based maps, selecting various data layers such as elevation, and applying USDA raster risk models. It also used high-density grids overlaid on maps of the state's 12 major ports. The dynamic, web-based map interface allowed users to control which layers were visible. WSDA also used the solution to monitor field trappers throughout the season and confirm traps were placed in proper locations and at proper densities.

WSDA uses the same GIS solution to monitor and trap other species such as invasive snails and weeds and Japanese beetles.

Learn more at www.iFormbuilder.com. Explore ArcGIS at arcgis.com.

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