Creating Value from America's Forest Census

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"Science you can use"

Bottom Line Up Front

- Opportunities are emerging to broaden the information available for analyses—“contextual computing”

- A suite of new information products are emerging from Forest Service Research & Development’s FIA Program that offer promise for expanding the types of geospatial analyses that can be conducted

- The success of these ventures depends on harnessing the opportunities for
  - **Cloud-based computing**
  - **Using multiple platforms/mobile devices**
  - **Integrating information products from multiple sources**

What’s Contextual Computing?

- During my professional lifetime, I’ve experienced major shifts in technology supporting forestry

Mainframe Computing | Personal Computing | Mobile Computing | Contextual Computing | ??? Computing

- **Contextual computing** is analysis in the context of a user’s location and situation—***PUSH*** not ***PULL***

What’s Contextual Computing?

Mainframe Computing | Personal Computing | Mobile Computing | Contextual Computing | ??? Computing

Here Today?

- What might contextual computing mean for forestry geospatial applications?

- Here’s what I think contextual computing will mean:
  - ü Bigger and better electronic “team rooms”
  - ü New information products
  - ü Create new insights into context of how clients & society value & use forests and related natural resources
  - ü Integrates “social” with biological/physical to create “ecological”

Benefits of Contextual Computing?

- Bigger and better electronic “team rooms”
  - **Empower who can enter the “room” to use information**
  - **Enable others to bring their own information, add information from others, & leave information behind when they log off**
  - **New data governance practices.**

- New information products
  - **Composite data layers & displays—consolidated federal, state, NGO data**
  - **Blended information--photos “pinned” to data layers Users/visitors to be the “eyes” of resource managers & other users**
  - **Consistent information across devices & systems (e.g., Android, IOS, ArcGIS)**

Benefits of Contextual Computing

- Create new insights into context of how clients & society value & use forests and related natural resources
  - Shared sentiments, expertise, desire, intentions—via social media
  - Better clarity about who, what, when, where, why and how forest values & uses add to quality-of-life.
- Integrates “social” information with bio/physical information to create broader “ecological” information
  - Geospatial analysis started with biological & physical information; now social information adds value
  - Now, we are seeing people as part of the ecosystem

What does this mean for geospatial analyses?

- Biological & physical data layers will continue to be important—the root of forest geospatial analyses

- New ways are needed to make sense of social information & transform it into information usable with biological & physical data in geospatial analyses
  - **Much social information is "unstructured" so ways are needed to analyze it & link it to more structured forest geospatial info**
  - **Technologies & analytics needed to deliver & comb through social information in "near real time" to identify the nuggets useful for geospatial analyses important to land managers**

Transition to Second Segment

- A suite of new information products are emerging from Forest Service Research & Development's FIA Program that offer promise for expanding the types of geospatial analyses that can be conducted

Forest Inventory & Analysis (FIA)

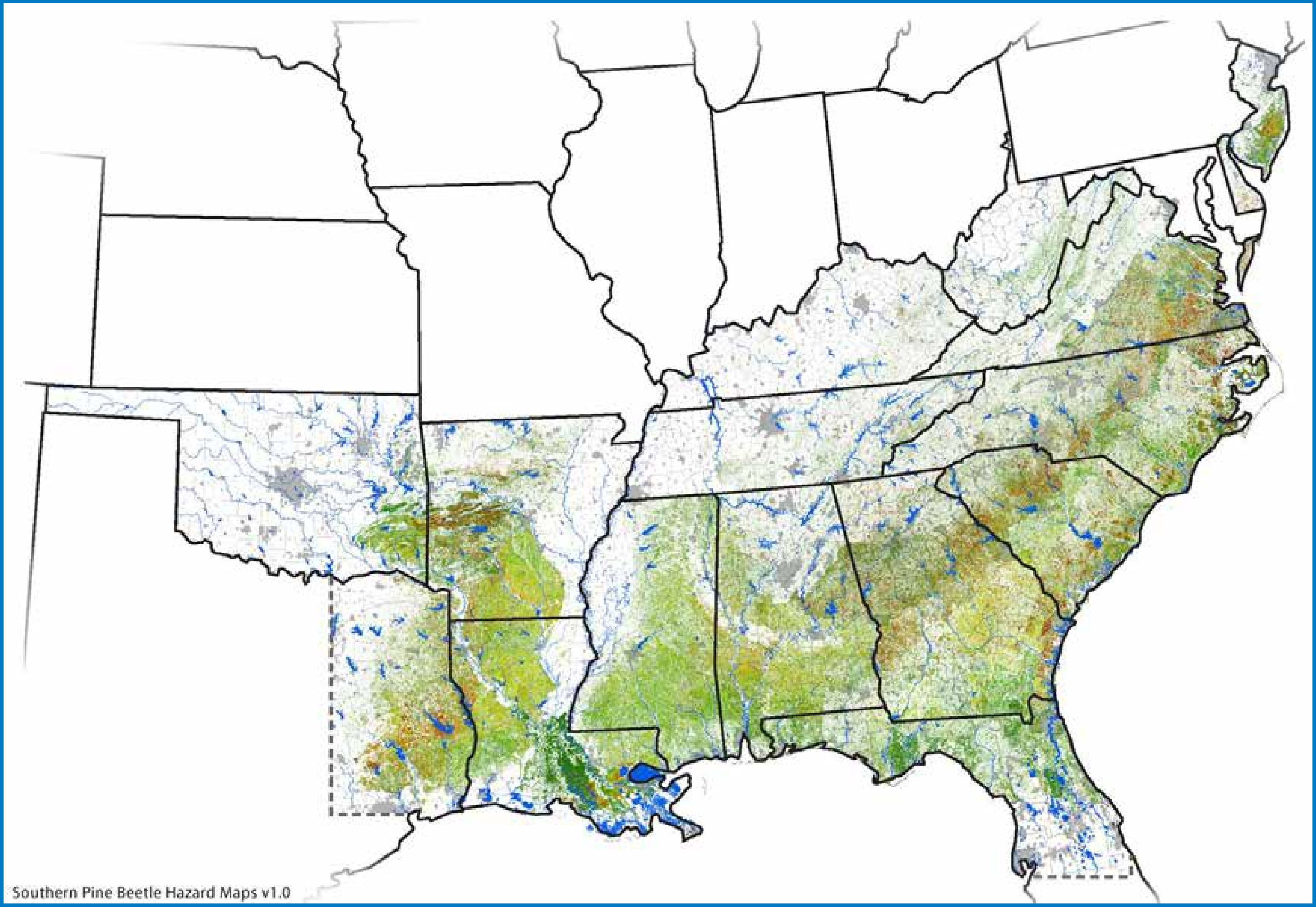
- The Nation's forest census; a leading program globally
- Covers 800 million acres of public and private forest land
  - **Alaska to Puerto Rico, Maine to Guam**
  - **Urban to remote wild lands/wilderness**
- Data collection since the 1930s; approaching 80^{th} anniversary
- Combines remote sensing information; biological/physical measurements in the field; imputation modeling, estimation, & analyses in the office; surveys of private forest landowner values & preferences; surveys of industrial firms' wood usage
- Reports at multiple spatial scales; state, region, national
- Broad range of information users: agencies, firms, NGOs, investors; consultants; academics

New FIA-Based Information Products

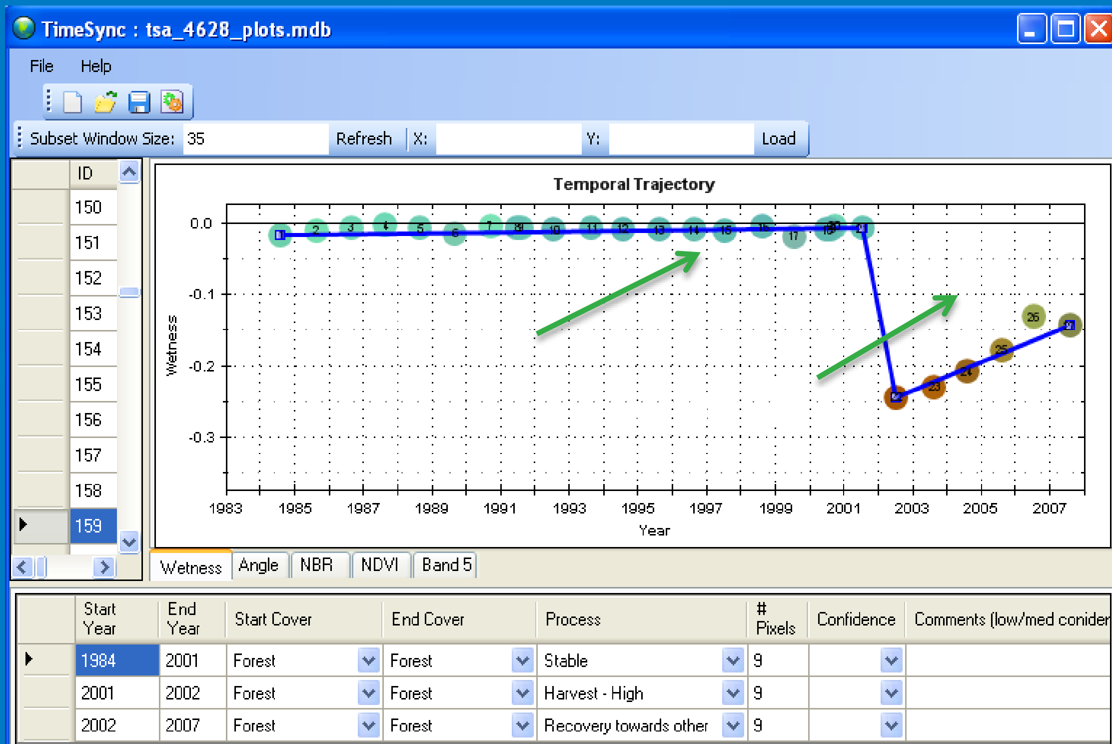
- Moving from reports to portfolio of information products
- Shifting from tables of information by categories/clusters to data layers
- Innovations the past decade, based on FIA information:
  - **Forest Insect & Disease Risk Maps**
  - **Forest cover change detection & biomass maps**
  - **Monitoring Trends in Burn Severity (MTBS)**
  - **LANDFIRE database**

Insect & Disease Risk Maps

- Southern Pine Beetle Hazard Map (Red/High to Green/Low)

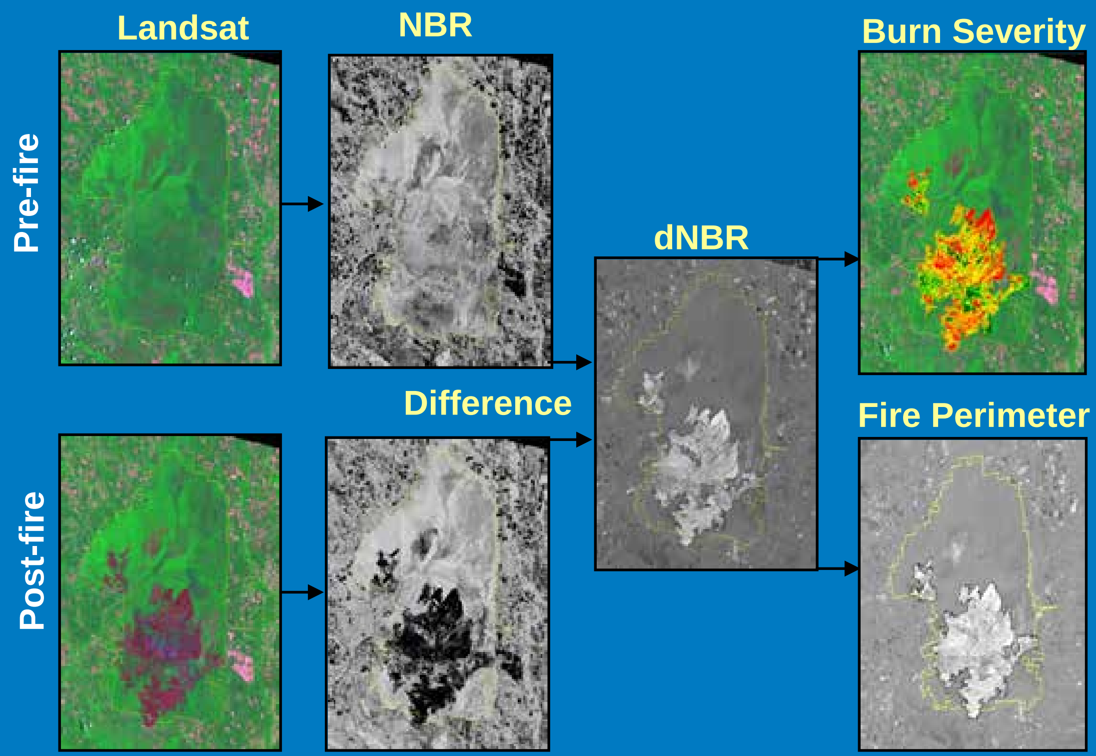


Monitoring Tree Cover Change with Landsat



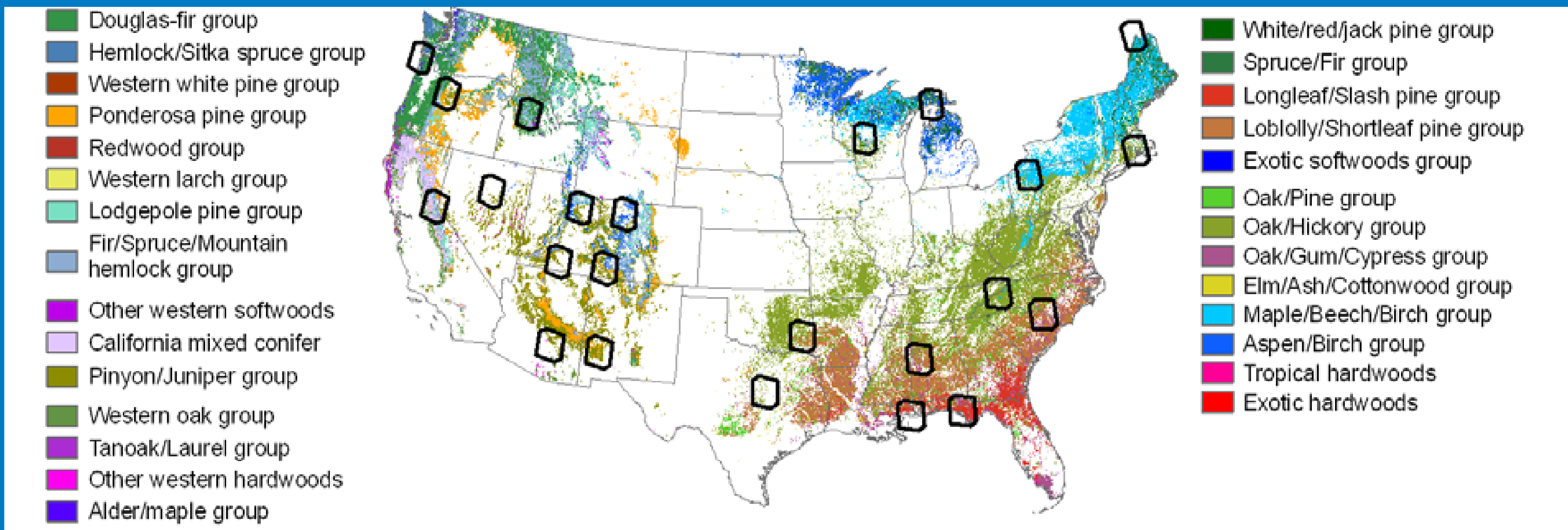
Monitoring Trends in Burn Severity

- MTBS characterizes burn severity on all large fires in CONUS, AK, HI, PR
  - **All ownerships**
  - **Historical (since 1984)**
  - **Landsat-based, 30m resolution**
- Jointly implemented by FS (Remote Sensing Applications Ctr) and USGS (EROS)
- Interagency sponsorship by Wildland Fire Leadership Council



North American Forest Dynamics Project

- NASA funded project designed to characterize disturbance patterns and recovery rates of forests across the continent.
- Goal: Determine the role of forest dynamics in North American carbon balance
- Uses FIA data for validation and training



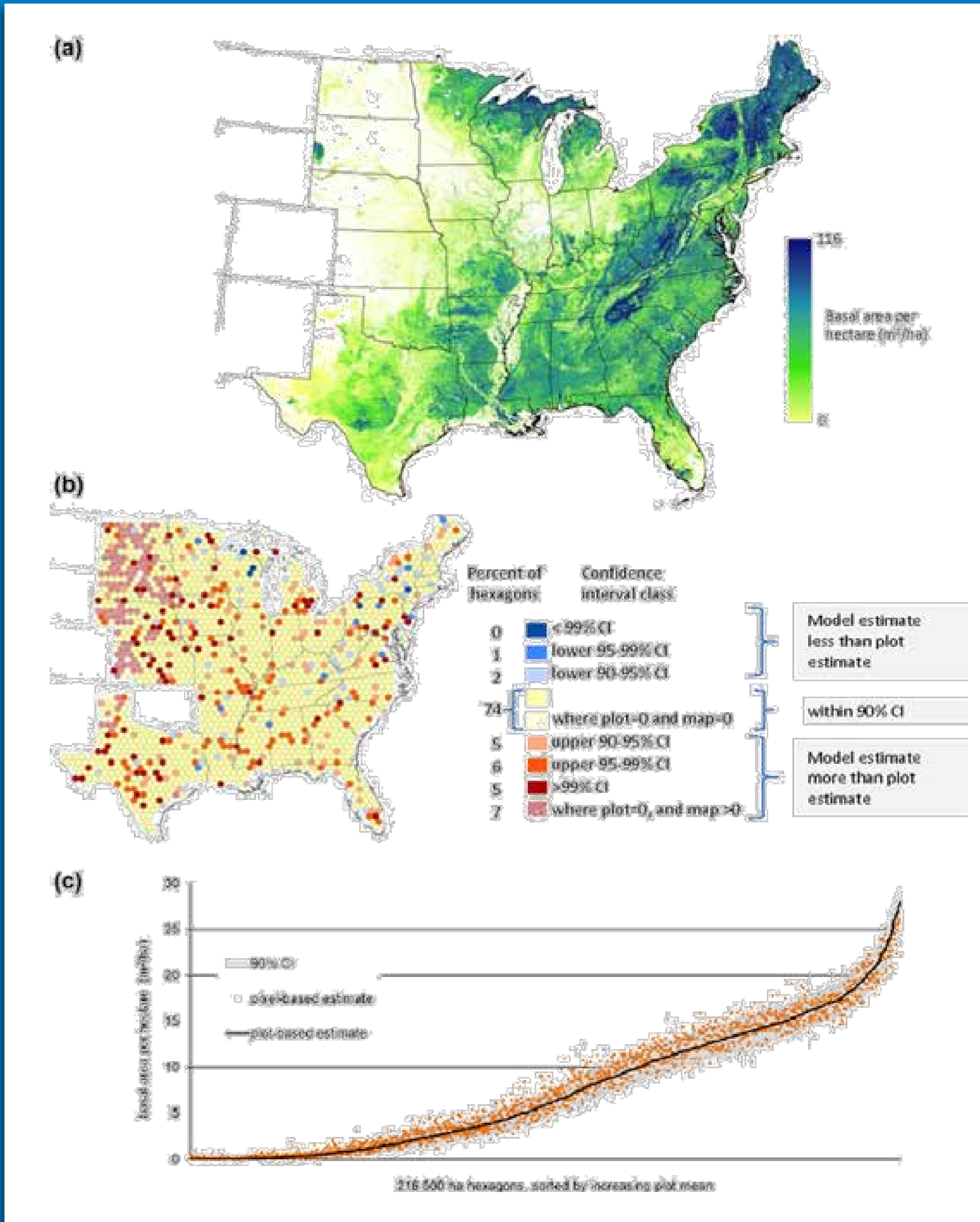
Forthcoming Information Products

- We are also hard at work on several new information products that are just nearing completion
  - **A 30-m resolution raster data surface describing forest composition and structure using nearest neighbor imputation from FIA plot data (NN data surface), across all forests of the lower 48 states.**
  - **FIAtlas**

What is a Nearest Neighbor surface?

- Imputation is a method for filling in missing values in a dataset, from known values in that same dataset.
- NN imputation *mapping* is a method for building raster data surfaces from forest inventory data *(Eskelson 2009).*
- The family of imputation mapping methods includes:
  - **k-NN *(Tomppo 1991), McRoberts et.al. (2002)***
  - **MSN *(Moeur and Stage 1995)***
  - **GNN *(Ohmann et. al. 2002)***
  - **RFNN *(Crookston and Finley 2008)***
- FIA developers & partners have completed CONUS mapping at the 250m scale and are now working at the 30m scale, based on known information from 300,000+ FIA field plots

Nearest Neighbor Analysis Examples



- Feasibility demonstrated
  - **Regional-scale projects *(e.g., Pierce et al., 2009, Ohmann et al. 2011)*.**
  - **National pilot project *(Nationwide Forest Imputation Study, Grossmann et al., 2009)*.**
  - **Related nationwide projects:**
    - **National Land Cover Dataset's Canopy layer update (*Coulston et al. 2012*).**
    - **250-m resolution nationwide NN data surfaces *(Wilson et al., 2012)*.**
    - **Landfire's Tree-list layer *(Drury and Hernyk 2011)***
    - **North American Forest Dynamics project (NAFD, *Goward et al., 2008*).**
    - **Monitoring Trends in Burn Severity (Eidenshink et.al, 2007)**


FOREST ATLAS
OF THE UNITED STATES
The United States has a tremendous forest resource—more than 750 million acres of native and planted forests managed by public and private landowners for forest products, recreation, wilderness, wildlife habitat, and many other purposes. Over the past 150 years, basic surveys of United States forests have evolved into a rigorous inventory program that we can use to share information about the value of these forests and the challenges that confront them. In the Forest Atlas of the United States, we explore these questions and many more:
Where do forests grow and why?
What disturbances affect forests?
How do people benefit from forests?
How might U.S. forests respond to climate change?
What wildlife depends on forests for habitat?
How might people affect the future of forests?
USDA

What Shapes the Forest?

Forests change constantly. Disturbances shape forests by the way they kill or damage trees, what they leave behind, and how forests recover. Change may result from the subtle, slow, and continuous processes of natural growth and death of vegetation. Alternatively, changes may be caused by disturbance events that vary in terms of their magnitude, frequency, and spatial pattern. The magnitude of an event relates to how much of the forest canopy has been removed. Major disturbances remove or kill all the existing trees, while minor disturbances leave many trees alive. The frequency of disturbance varies widely by event type. Volcanoes erupt, expand, and erode over thousands or millions of years; major rivers flood several times a century; devastating hurricanes hit land every decade or so; and hundreds of lightning strikes start fires every year. Different disturbances result in diverse spatial patterns—from scattered individual trees killed by disease, to clumps and patches of trees killed by fire, to large expanses of forest converted to suburbs. The combination of magnitude, frequency and pattern dictate how disturbance events shape forests and how forests respond.

Natural disturbances (such as fire, wind, flooding, insects, diseases, and invasion of non-native species) are an integral part of the life cycle of forests. Dry forest conditions, plentiful fuel, high winds, and an ignition source can lead to large fires. Old trees weakened by lengthy drought may be more susceptible to insect and disease outbreaks. People may

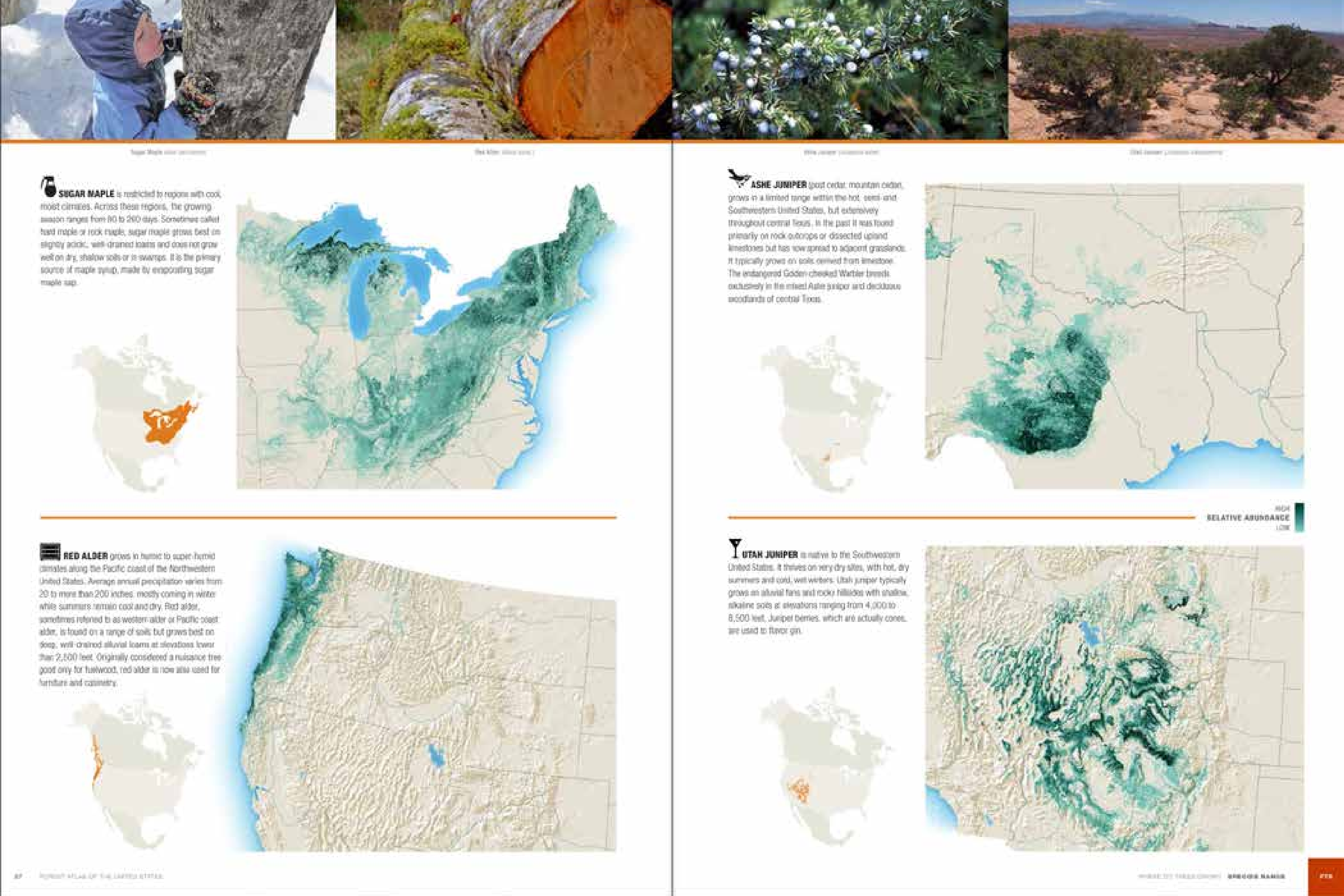
play a role in "natural" disturbances by providing triggers, the unattended campfire or transport of an invasive species, or by lengthening natural disturbance cycles such as fire. Natural disturbance patterns are often cyclical and some forests may return to their pre-disturbance composition after a period of time.

Compared to natural disturbances, anthropogenic disturbances driven by human needs (such as timber harvesting, prescribed burning, and land clearing) often occur more frequently, require a different set of conditions, and yield different consequences for forests. Harvesting and prescribed fire designed to mimic natural disturbances can enhance natural processes of vegetation recovery. Land development permanently changes the way land is used.

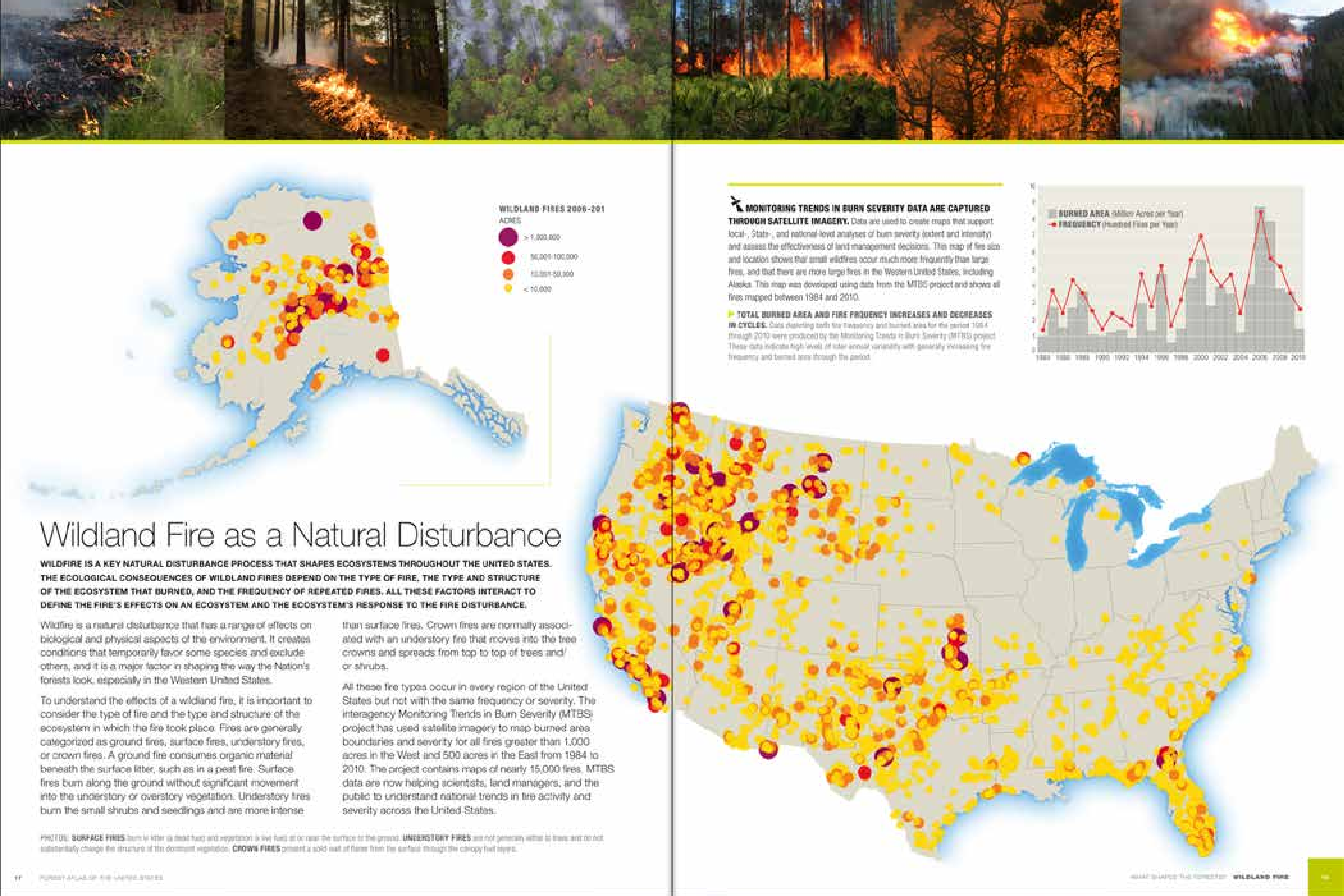
Regardless of cause, there is a dynamic interplay between disturbance and re-growth, with both occuring at the same time over large landscapes, and recurring at the same place over time.

VOLCANIC ERUPTIONS AND FOREST SUCCESSION. Volcanoes can devastate forested landscapes. Many dead trees may be left behind. Increased sunlight encourages site colonization by hardy plants. Soon even trees are reestablished on the landscape. After many decades, the forest looks much as it did before the eruption.

Elements:
Introductory context with compelling imagery



Elements:
Polygon and raster maps at various scales



Elements:
Dot maps & ancillary graphics

Providing Quality Timber Products While Sustaining Our Forests

BEFORE WOOD PRODUCTS CAN BE MANUFACTURED, TREES MUST BE HARVESTED FROM FORESTS AND THE TIMBER MUST BE TRANSPORTED TO MANUFACTURING FACILITIES. TIMBER RESOURCES AND HARVESTING OPERATIONS EXIST THROUGHOUT THE UNITED STATES, BUT ONLY A SMALL PROPORTION OF FORESTS ARE HARVESTED INTENSIVELY. CUTTING TREES FOR WOOD PRODUCTS CAN BE ACCOMPLISHED SUSTAINABLY TO MAINTAIN RENEWABLE AND RESILIENT FORESTS THAT REGENERATE INTO THE FUTURE.

Harvesting timber (i.e., cutting trees) for wood products is an important piece of forest management and what shapes the forest. By selectively removing both live and dead trees from the forest, forest managers are better able to predict forest attributes and shape forests to meet the needs of current and future generations. Plant, animal, and human populations depend on forests for resources such as clean water, shelter, and food.

Timber harvest occurs all across the nation and in other countries. Because wood products are used all over the world, timber is often harvested and processed in one place, while the products may be used thousands of miles away.

Trees are a renewable resource because they grow back after being harvested. Amongst a host of forest management goals and objectives, sustaining our forests includes carefully managing them so the sum of harvest and mortality levels does not exceed growth—this helps maintain the timber resource and ensures that harvested forests are enabled to regrow into the next forest.

TIMBER HARVEST BY OWNERSHIP IN THE PACIFIC NORTHWEST.

TIMBER HARVEST LEVELS AS A FRACTION OF ANNUAL GROWTH.

TIMBER HARVEST AS A FRACTION OF LIVE VOLUME.

WOOD MOVEMENT IN THE UPPER MIDWEST. Timber is often processed and used far from where it was harvested. The depiction of timber flow in the Upper Midwest illustrates the movement of logs to mills. Clearly, timber is moving all over the region, and some logs are even shipped overseas. Similar patterns exist in other parts of the country. This movement results from the complexity of wood product markets that connect landowners, loggers, mills, and consumers.

PHOTOS: TIMBER PRODUCTS FROM FOREST TO MARKETPLACE.

Elements:
Choropleth maps & novel representations

Forest Industries Keep America Working

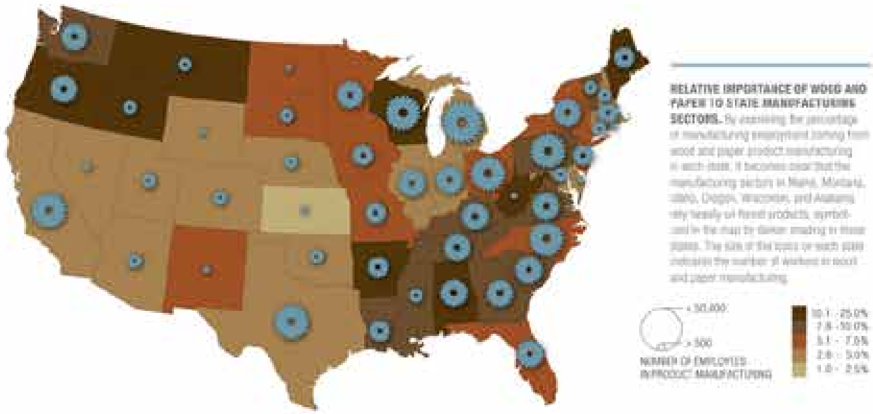
FOREST INDUSTRIES ARE A MAJOR CONTRIBUTOR TO OUR ECONOMY, BY PROVIDING JOBS FROM THE FORESTS TO THE SHOWROOMS. THE EMPLOYMENT IMPACT OF THE INDUSTRY IS EVIDENT THROUGHOUT THE NATION, THOUGH DIFFERENT REGIONS OF THE COUNTRY RELY ON DIFFERENT COMPONENTS OF THE INDUSTRY TO VARYING EXTENTS. FROM SOFTWOOD LUMBER AND PLYWOOD PRODUCTION IN THE WEST TO HARDWOOD MANUFACTURING IN THE EAST, THE FOREST INDUSTRY PROVIDES EMPLOYMENT IN MANY WAYS.

The forest industry is comprised of many different occupations, from natural resource professionals working in the field, to production workers in mills and factories, to statistics and financial experts working in office settings. Forestry and logging workers study the timber resource and deliver raw materials to wood products facilities, while wood and paper mill employees work in the manufacturing sector. The common thread between these jobs is the resource they are ultimately tied to—trees harvested from the Nation's forests.

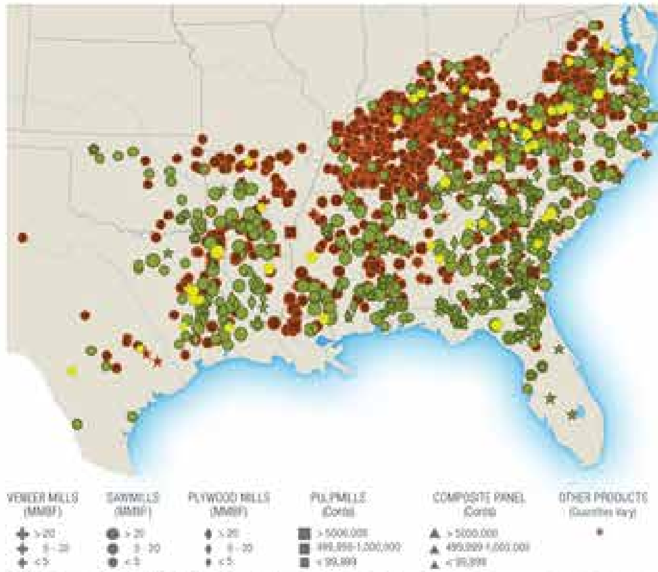
For the purpose of measuring employment in the industry through time, the forest industry is defined as the sum of employment in forestry and logging, wood product manufacturing, and paper manufacturing. This is a somewhat narrow definition of the industry, as it does not include forestry support personnel or those working in furniture manufacturing. Also, these figures only include private employees, so the state and federal government employees that work in forestry and wood products are not included.

Analyzing the percentage of manufacturing employment that is comprised of wood and paper manufacturing jobs is one way to highlight the importance of the forest industry to manufacturing activities on a state-by-state basis. Though wood and paper employment in Maine and Montana may be small compared to more populous states with larger forest industries, the industry is very significant in terms of contribution to the states' manufacturing sectors.

While the forest products industry remains an integral part of the nation's economy and vital to many local economies, the industry was particularly hard hit by the dramatic downturn in the housing sector and the associated "Great Recession" of 2007-2009. The 75 percent drop in housing starts from 2005 to 2009 had a major impact on the forest industry throughout the country, culminating in a loss of over 350,000 forest industry jobs. However, a modest recovery in housing and improving economic indicators suggest that forest industries may be positioned for a sustained recovery with a rebound in forest industry employment.

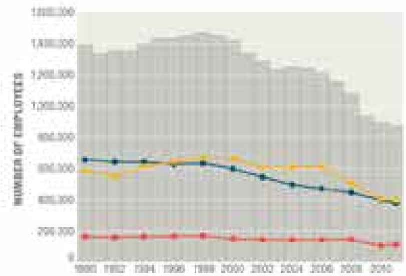


RELATIVE IMPORTANCE OF WOOD AND PAPER TO STATE MANUFACTURING SECTORS. By examining the percentage of manufacturing employment coming from wood and paper product manufacturing in each state, it becomes clear that the manufacturing sectors in Maine, Montana, Idaho, Oregon, Wisconsin, and Alabama rely heavily on forest products, symbolized in the map by darker shading in those states. The size of the icons on each state indicates the number of workers in wood and paper manufacturing.



PRIMARY WOOD USING MILLS OF THE SOUTHERN UNITED STATES, 2009. Mills that process timber to make wood products are a major source of employment for forest industry workers in the South. Both hardwood and softwood mills are prevalent throughout the southern states, with a few mills that process both hardwoods and softwoods. This map shows the location, type, and size of various mills in the region.

MMBF. Millions of Board Feet of Timber. Softwood and hardwoods are sold by the board foot. **The Cord.** Pulpwood is usually sold by the cord or by weight.



FOREST PRODUCTS INDUSTRY EMPLOYMENT, 1990–2011. The United States forest products industry, defined as the three sectors including forestry and logging, wood product manufacturing, and paper manufacturing, employed over 1.2 million workers annually from 1990 through 2006. With the onset of a collapse in U.S. housing markets and an official recession from 2007 - 2009, employment in the industry dropped precipitously and was under one million workers during 2009 through 2011. However, significant improvements in housing markets during 2011 and 2012 generated optimism for industry stakeholders going forward.

- FORESTRY AND LOGGING
- WOOD PRODUCT MANUFACTURING
- PAPER MANUFACTURING
- TOTAL

PHOTOS: **MANY JOBS ARE PERFORMED TO BRING WOOD PRODUCTS FROM FORESTS TO CONSUMERS.** A sawyer cuts a tree that has been selected for harvest and helicopter ...

Elements:
Proportional symbol maps & regional insets

America's Private Forest Owners

PRIVATE FOREST OWNERS CONTROL 56 PERCENT OF THE FOREST LAND IN THE CONTIGUOUS U.S. THIS GROUP INCLUDES MORE THAN 11 MILLION FAMILIES, INDIVIDUALS, CORPORATIONS, TRIBES, AND OTHER PRIVATE GROUPS. THE VALUES AND OBJECTIVES OF THESE OWNERS, WITHIN THE CONSTRAINTS AND OPPORTUNITIES THEIR FORESTS PROVIDE, DETERMINE WHAT CAN AND WILL BE DONE ON THEIR LAND.

Most private forest land (62 percent) is owned by an estimated 10 million families, individuals, trusts, estates, and other groups who are collectively referred to as family forest owners. There are four major "types" of family forest owners:

(1) 49 percent of owners who seek to establish a woodland retreat with high amenity values;

(2) 28 percent who own the land to meet multiple aesthetic, recreational, and financial objectives;

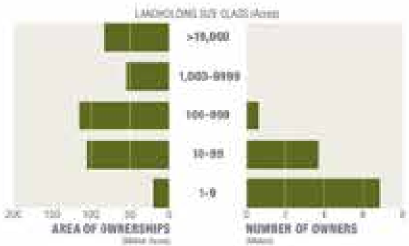
(3) 5 percent of owners who are focused primarily on the financial gains they can earn from their land; and

(4) the remaining 18 percent of owners who do not have strong objectives for their property.

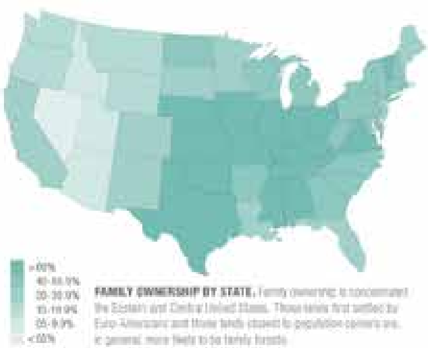
Corporations own 33 percent of private forest land. This group includes multi-national, regional, and local companies. Forestry is the primary objective for some of these owners, but others are energy companies or own it for other reasons, such as buffers around manufacturing plants. Two newer types of corporations are timber investment management organizations (TIMOs) and real estate investment trusts (REITs). Timber production is still a primary ownership objective, but these companies do not own primary wood processing facilities. TIMOs manage land on behalf of institutional investors and others groups/individuals of large net worth; REITs are an alternative legal structure offering tax advantages, with additional constraints.

The remaining 5 percent of U.S. private forest land is owned by Native American tribes; non-governmental organizations; and clubs, associations, and partnerships. This percentage is not enormous at the national scale, but these owners do control substantial forest acreage in some areas, such as Arizona and central Washington.

The cumulative decisions of private owners determine which private lands remain forested; what, if any, forest management occurs; and what goods and services are provided. Private forests can be a valuable public benefit. It is the owners who are the critical link between forests and society and who influence the future of our forests.



AREA AND NUMBER OF PRIVATE FOREST OWNERSHIPS BY SIZE.

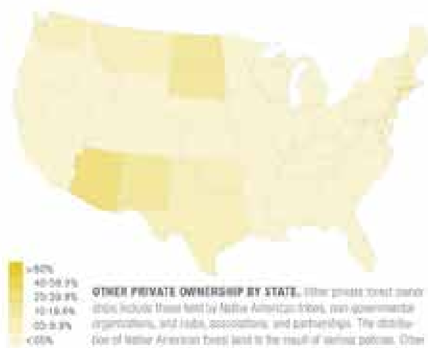


FAMILY OWNERSHIP BY STATE.

PHOTOS: PRIVATE FOREST OWNERS ARE A DIVERSE GROUP WITH A WIDE VARIETY OF OBJECTIVES.

DISTRIBUTION OF PRIVATE FOREST OWNERSHIP

CORPORATE OWNERSHIP BY STATE.



OTHER PRIVATE OWNERSHIP BY STATE.

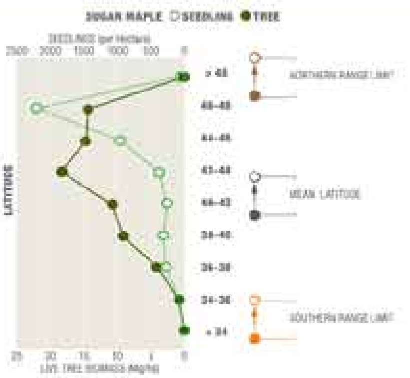
OUR FORESTS FUTURE

Elements:
Image storylines to give the maps a human face

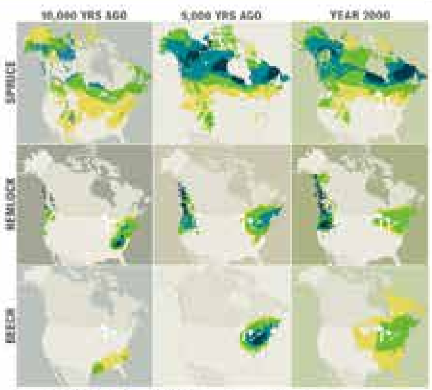
Forests on the Move

GLOBAL CLIMATE CHANGE WILL INFLUENCE THE DISTRIBUTION OF TREE SPECIES. JUST AS PAST GLACIATION AND WARMING EVENTS CAUSED CHANGES IN THE DISTRIBUTION AND ABUNDANCE OF FORESTS, THE UNPRECEDENTED AND RAPID CHANGE IN CLIMATE EXPECTED FOR THE 21ST CENTURY HAS THE POTENTIAL TO EXERT TRANSFORMATIVE PRESSURES ON FOREST ECOSYSTEMS. IT IS IMPORTANT THAT WE UNDERSTAND HOW TREES MAY ADAPT TO THESE CHANGES, AND A CRITICAL COMPONENT OF ADAPTION WILL BE SPECIES MIGRATION.

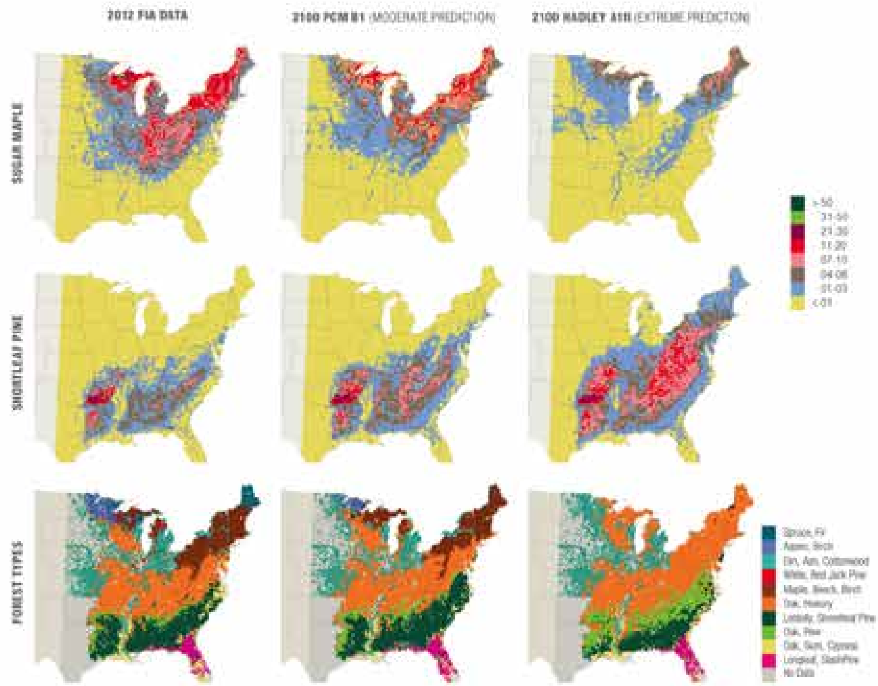
When considering species migration, we begin with an understanding of why species occur where they do. How do climate, soil, and landscape characteristics create suitable habitats for different tree species? While generalist species respond to broad climate conditions, species with narrow ranges are constrained by very specific site characteristics. Understanding these associations, we use predictions from climate models to examine how today's suitable habitats may change in the future; these models assess whether or not species will likely continue to thrive in a region based on these habitat characteristics. Tree species with projected declines in suitable habitat will likely face greater stress in the new conditions and may have reduced reproductive capacity or be less able to respond to other stressors. Species with projected increases in suitable habitat will likely be in a better position to grow and reproduce. Finally, we must consider how a species might respond to habitat changes, especially if newly suitable habitat does not occur near where it presently exists and colonization across the landscape will be required. Because trees can live for decades and many years pass before they begin to reproduce, there will be a lag time between when the location of suitable habitat changes and when the shift in distribution occurs. In some cases, there is already evidence of a disconnect between the centers of distributions of mature trees and seedlings of the same species. In other cases we are yet to see such shifts at species range edges, making it important to monitor how these changes unfold as climate changes continue. In the end, it is difficult to predict the timing and direction of range shifts, but computer models and multi-layered approaches integrating climate predictions, disturbance patterns, and habitat needs allow us to evaluate forest vulnerabilities to climate change.



HOW DO TREE SPECIES MIGRATE? Adult trees can't migrate like animals, finding and occupying newly suitable habitats. But tree seedlings may colonize locations beyond the range of mature trees. For example, sugar maple seedlings (left, dotted line) occur further north than mature sugar maples (left, solid line). The centers of distributions may shift as well (right).



EVIDENCE FROM PAST MOVEMENTS. We understand the ways tree species have moved around the landscape by studying the distribution of ancient pollen trapped in soil. The stratification of pollen in different layers gives us an indication if a species was present on the landscape and allows us to see how trees recolonized North America after the last glaciation.



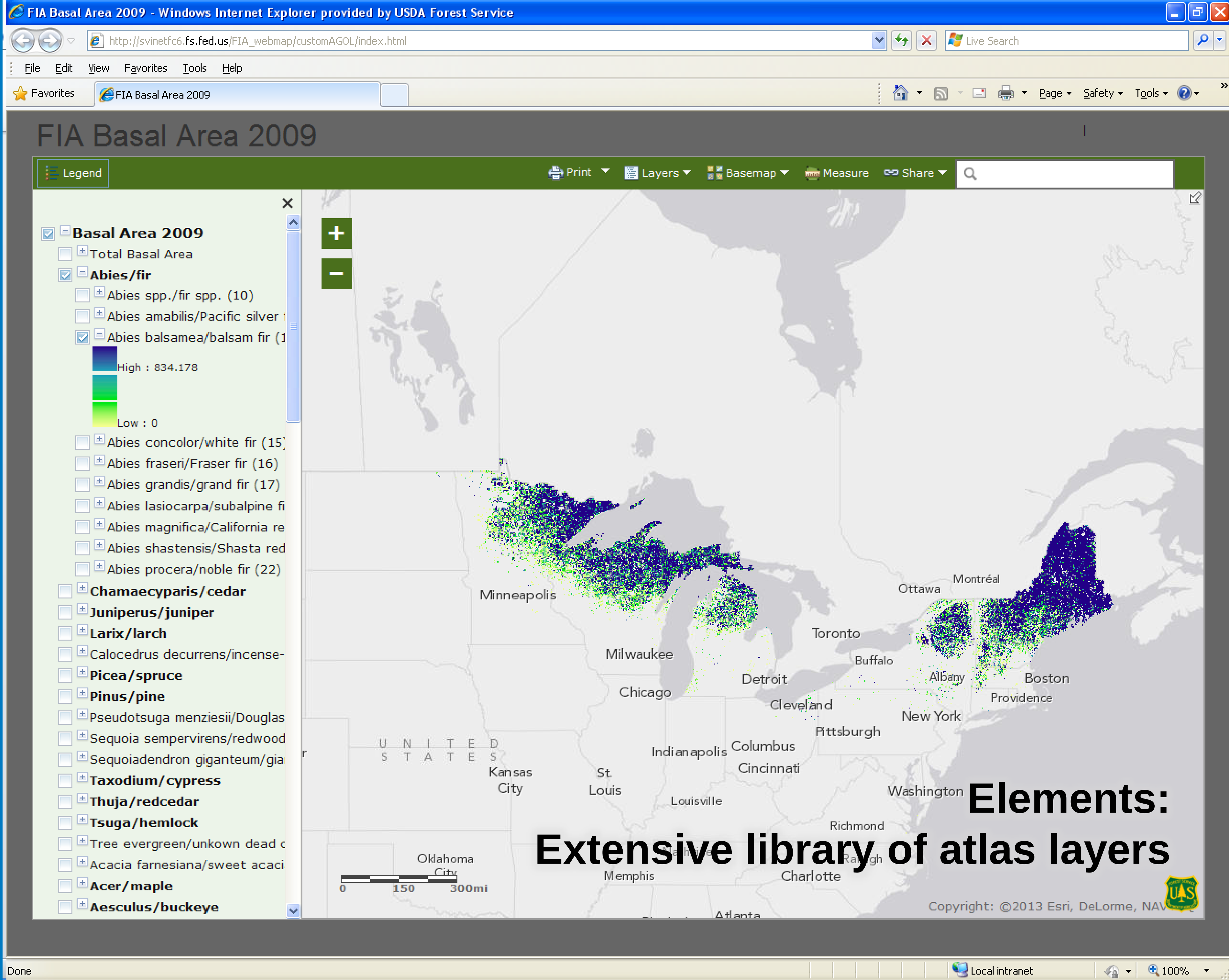
MOVEMENT PREDICITONS. As in past centuries, the future also shows the potential for large changes in suitable habitat for tree species: some will have their suitable habitat shrink, some expand, some move north, some remain stable, and some even move south. The concern is that the climate is changing – and suitable habitat is moving – quickly, but can tree species migrate as fast? Models indicate no, especially with the fragmented state of today's forest. Thus, human management will be needed. Examples might include facilitating movement via creating landscape corridors, or directly assisting migration by physically moving plant materials.

SUGAR MAPLE (*Acer saccharum*). This economically and culturally important species is distributed across the northern half of the eastern US (left map). It is likely to lose substantial habitat by 2100 under a harsh climate model and emission scenario (Hadley A1fi, right), but lose much less or even gain habitat in some states under the mild scenario (PCM B1, center).

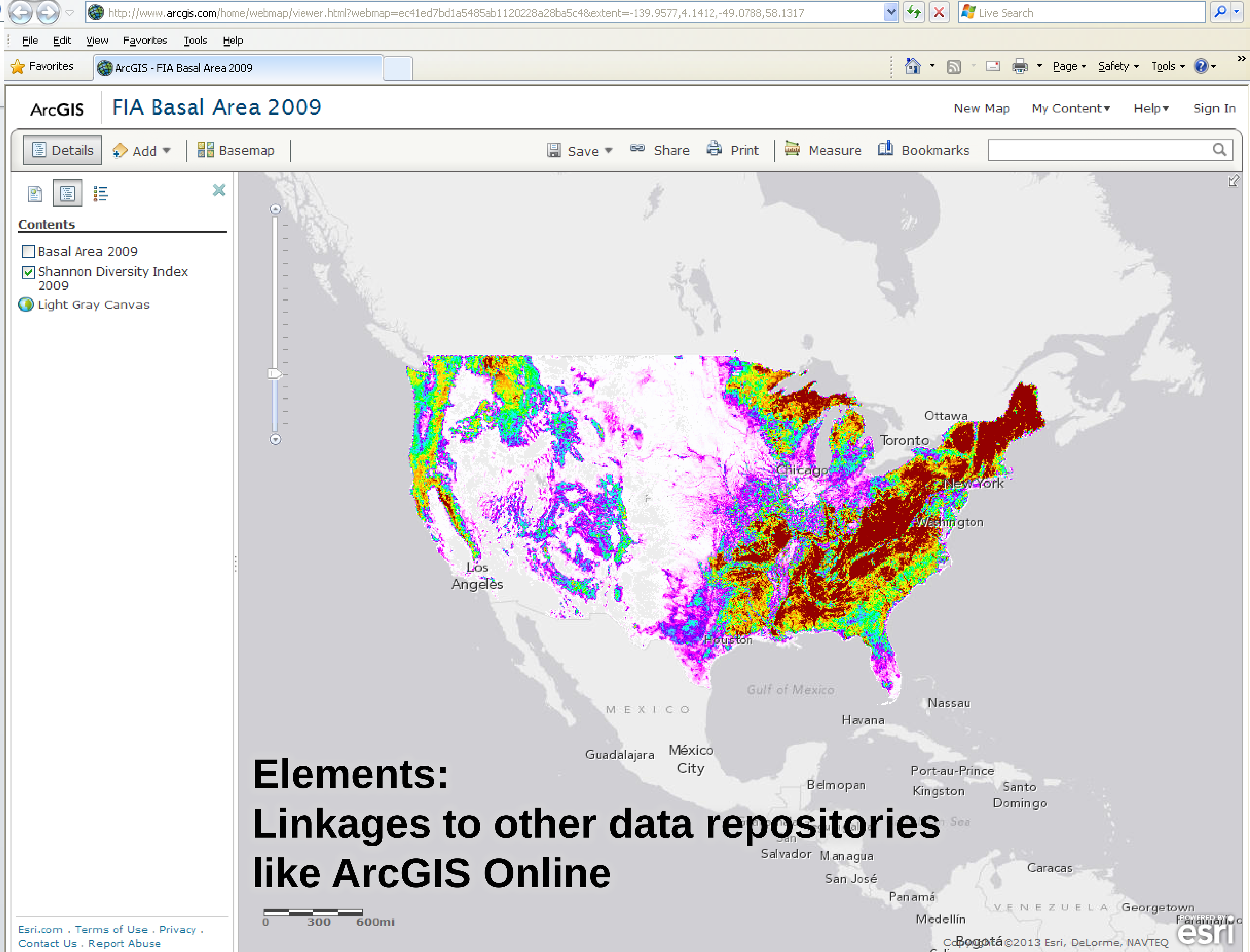
SHORTLEAF PINE (*Pinus echinata*). This southern pine occupying much of the southeastern US has high commercial value (left map). Shortleaf pine is likely to gain substantial habitat under any scenario of climate change with modest increases under the more mild PCM B1 model and emission scenario (center) to larger gains in habitat under the harsher Hadley A1fi (right).

FOREST TYPES. Foresters group associated tree species into forest types (left map). Because each tree species has the potential to respond differently to climate change, we need to assess how their habitats may change independently and then reassemble the species to discover changes in forest types. These results show the potential for northern types (like spruce-fir and aspen-birch) to become uncommon, while the oak-hickory types increase in abundance, particularly under more harsh climates (right).

Elements:
Content from a variety of data providers



Elements: Extensive library of atlas layers



Elements:
Linkages to other data repositories like ArcGIS Online

Transition to Third Segment

- The success of these ventures in contextual computing and forthcoming forest information products depends on harnessing the opportunities for:
  - **Cloud-based computing**
  - **Increased mobility**
  - **Integrating information products from multiple sources**

Why the Cloud?

- Fewer security issues & hassles for non-Forest Service information users à *lower risks*
- Improved accessibility of information à *work from anywhere; everyone working off the same data layers across organizations & time zones*
- Improved flexibility à *scalability, pay-as-you-go*
- Openness and transparency of data & information products to a broader user community à *increased collaboration*
- Lower “carbon footprint” à *environmentally “friendly”*
  - 30+% reduction in energy consumption and carbon usage compared to on-site servers

Why Increased Mobility

- Proliferation of hardware & software platforms in use
  - **Smartphones, tablets, ultrabooks & operating systems**
- When people want info, they want it NOW !! Wherever they are. This user demand for more mobility is changing expectations.
  - **“Four bars” of cellphone service everywhere**
  - **Faster cellular networks and more WiFi hotspots**
- Create an information product/layer/map once; use it many times à saves time (money & bandwidth) & energy (intellectual as well as electrical)
  - **Big issue for FIA is so many people downloading the same data to develop the same data layers BEFORE they can really begin analyses to answer their questions**
  - **That was the catalyst for FIAtlas!**

Why Integrated Information from Multiple Sources?

- Trouble storing partners' data layers and analytical applications on FS servers "inside the firewall"
- Types of information of value to resource managers and policy makers are increasing; geospatial analyses need to grow
  - **Structured Data --> databases (raw/cleaned, modeled/imputed/classified, metadata**
  - **Digital images/photographs**
  - **Unstructured text & data from social media**
  - **ALL of it with locations geo-referenced with varying precision**

Why Integrated Information from Multiple Sources?

- Critical to find ways to integrate all this information from multiple sources—including the FIA program and other FS research, development & applications activities
- Why?
  - **Because it contributes to contextual computing**
  - **Because people want to be more connected to each other and the places they visit in ways that are MEANINGFUL TO THEM**

Bottom Line --AGAIN

- Opportunities are emerging to broaden the information available for analyses—"contextual computing" is emerging as the new normal
- A suite of new information products are emerging from Forest Service Research & Development's FIA Program that offer promise for expanding the types of geospatial analyses that can be conducted
- The success of these ventures depends on harnessing the opportunities for
  - Cloud-based computing
  - Using multiple platforms/mobile devices
  - Integrating information products from multiple sources

Closing Thoughts

"There are just two things on this material earth—people and natural resources."

Gifford Pinchot (1947) ***Breaking New Ground***

(An insight from a February 1907 evening horseback ride in Rock Creek Park, Washington, DC)

- Forest geospatial activities need to move aggressively into the contextual computing era !
  - **Blending information from people; their attitudes & sentiments from bubbling social media & other unstructured data**
  - **With more traditional bio/physical information about natural resource conditions and trends.**
- Why? To create new value & insights for the people who use/depend/love forests as well as for the people who manage them!
  - **Better information à Better dialogue à Better decisions**
- The tools exist. Creative & innovative uses are needed.

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