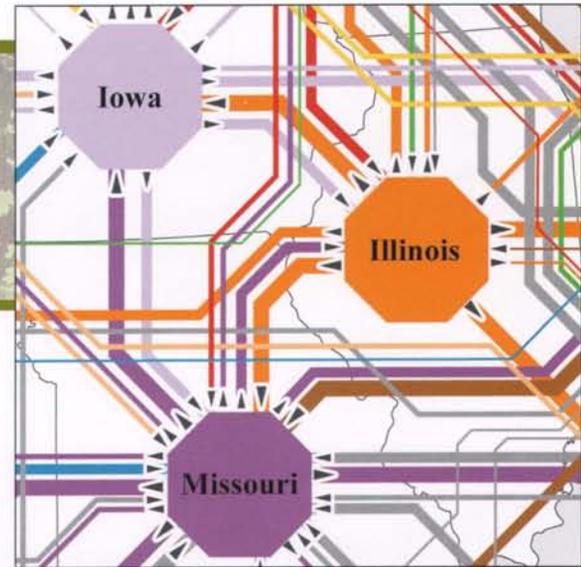


Imports and exports of roundwood in the upper midwestern United States

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Industrial roundwood is the raw material produced from harvested trees that is used to manufacture a wide range of wood products. Roundwood is harvested from the forest and is transported to primary manufacturing facilities to be processed into primary and secondary wood products. Roundwood includes sawlogs that are processed into dimensional lumber, veneer logs peeled into plywood and panels, pulpwood chipped for pulp and paper products, composite logs chipped for oriented strand board panels, and fuelwood that is converted into a variety of energy products.

This map of roundwood imports and exports in the upper midwestern United States illustrates the movement of roundwood out of state from harvest locations to primary wood processing facilities. Roundwood processed in the same state where it is harvested is not depicted. The U.S. Department of Agriculture (USDA), Forest Service produced the primary map by drawing stylized vectors from harvesting operations to processing locations. We also produced two secondary maps (not shown here) that highlight those states with the largest volume of roundwood movement and identify net importers and exporters of raw logs.

We produced this map using mill survey data collected from primary wood processing facilities in the upper midwestern United States. We added each state's industrial roundwood receipts to a regional timber removal database and supplemented with data on out-of-state uses to provide a complete assessment.

A visual solution

The forest service's Forest Inventory and Analysis (FIA) program conducts forest inventories to enhance our understanding of the nation's forest resources. FIA data, information, and knowledge are collected, produced, and distributed to describe the biophysical, social, and economic benefits of forest resources for all types of timberland ownerships.

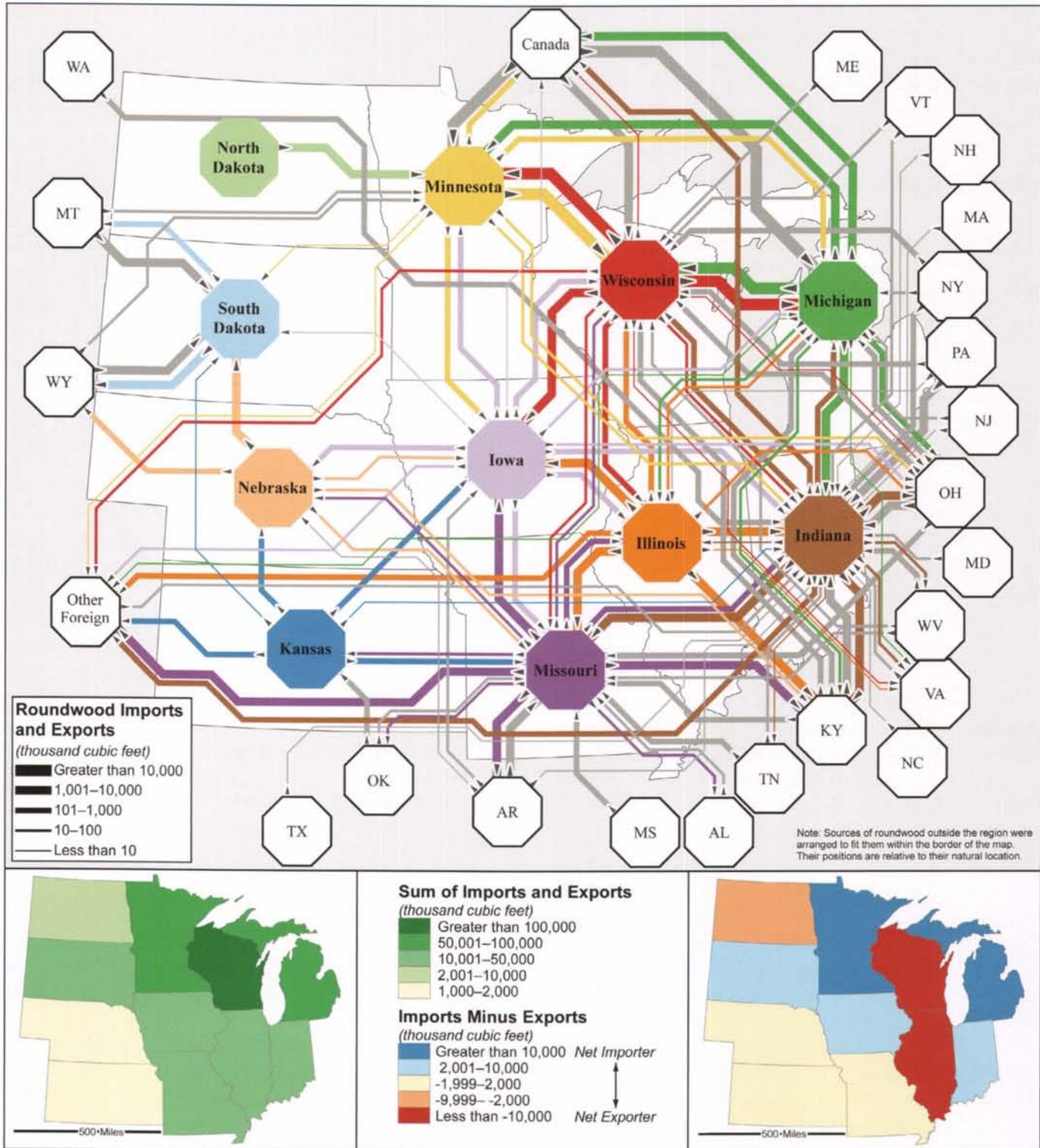
FIA's tabular data and summary reports are publicly available (see fiatools.fs.fed.us) and geospatial data and accompanying cartographic map products are becoming increasingly important to achieving FIA's mission. In this map we highlight FIA's economic product line by portraying the amount, distribution, and shipment of roundwood in the upper Midwest.

The general public often does not understand the complexity of timber flow. In particular, there is often confusion about the final destination of roundwood harvested in-state versus the overall source of wood processed at various mills throughout the region. This map helps the public understand the connectivity between forest resources, distant populations, and employment centers.

To help regulatory agencies and the forest products industry better understand the flow of roundwood, FIA designed a questionnaire to determine the source and destination of roundwood at the county level for all fifty states. FIA achieves close to a 100-percent response rate from primary mills through canvassing using mail questionnaires, phone surveys, and/or mill visits. As part of data editing and processing, all industrial roundwood volumes reported are converted to standard units of measure using regional conversion factors.

This map portrays interstate movement of roundwood based on survey data collected during the past decade from nearly 1,900 mills. The volume and direction of roundwood movements are portrayed using stylized vector features. Lines connect sources and destinations of roundwood, arrow symbols represent the direction of movement, line colors tie export routes to the state of origin, and line thickness represents the volume of roundwood.

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Data courtesy of ESRI Data & Maps, 2006, from ArcUSA, U.S. Census, ESRI (Pop2005 field); USDA Forest Service.

The number, volume, and complexity of import and export networks may be surprising. The map reveals that Indiana is by far the most diverse importer of roundwood, receiving roundwood from twenty-two different states and even some foreign countries. Wisconsin and Missouri are also diverse importers with fourteen different external sources of roundwood. The lake states of Michigan, Minnesota, and Wisconsin have the most timber flow, realizing more than 50 million cubic feet of annual imports and exports combined.

States can also be identified as net importers or net exporters of roundwood. Wisconsin and Illinois each export at least 10 million cubic feet of roundwood more than they import; Michigan and Minnesota, by contrast, are the largest net importers of roundwood.

Resource tables

Data dictionary

General data description	Data sources
Roundwood movements vector data layer	USDA Forest Service, Forest Inventory and Analysis Program.
Roundwood production point data layer	USDA Forest Service, Forest Inventory and Analysis Program.
Basemap layers of states	ESRI Data & Maps (See ESRI Web site).

Software dictionary

Software	Description
ESRI ArcGIS Desktop	Build vector data layer. Build point file for sources and destinations of roundwood. Layout and export map products.
Text editor	The original roundwood data files are available as simple text files. These files were reformatted to easily identify the origin and destination of each roundwood transfer. This data is joined to the vector layer created below. The text editor is also used to create the attribute files for the point data layers.

Additional resources

Resource	Description and source
FIA database documentation	Understand the format of FIA data and produce custom queries. fiatools.fs.fed.us
FIA's TPO analysts for consultation	North: Ron Piva, USDA Forest Service, rpiva@fs.fed.us South: Tony Johnson, USDA Forest Service, tjohnson09@fs.fed.us West: Todd Morgan, University of Montana, todd.morgan@business.umt.edu

Recipe for map-building success

Step 1: Develop and refine your question

An effective map addresses a specific question. Our original question was, what is the pattern of log movement from harvest sites to mills across the United States? A review of the available data made clear that this question is too complex to address in a small-format map. We refined our question to generalize our unit of interest to the state level, thereby simplifying the data by summarizing it at a coarser scale. We then restricted our field of interest to the Midwest, balancing a desire for detail with the constraints of the demonstrated map format.

Step 2: Identify the audience

Data collected on timber products output (TPO) commonly includes attributes that are economically sensitive, so published results must be presented in a way that protects confidentiality. Selecting states as the basic unit of interest achieves this end. Our intended audience includes timber buyers, mill owners, forest landowners, and the general public.

Step 3: Decide if a map is the best communication tool

Many different customers are interested in our field data collections and survey results. Our traditional users are accustomed to tabular summaries of TPO data. One of our goals for this map was to introduce a new, spatial perspective on timber products output.

Step 4: Acquire, understand, and prepare tabular data

The information collected by FIA is provided online at fiatools.fs.fed.us. Our databases are complex, so it is helpful to review the documentation and become familiar with available tables, attributes, states, and years of inventory. For this map, we acquired a text file that summarized the volume of harvested roundwood by state of origin and state of destination. The database was simplified to include only those transfers that included states in the upper Midwest. We added a unique field combining the states of origin and destination to join the table with the vectors created below.

Step 6: Create new spatial files

Three primary data layers were created for this map: (1) a series of points highlighting the “center” of each state, (2) a related series of points identifying necessary states outside the region, and (3) a series of vectors from roundwood sources to destinations. Each of these layers was joined with tabular attribute data such as state name and volume of roundwood in transit.

Step 7: Summarize the data

This data is extremely complex, and summaries improve the reader’s understanding. We wanted to highlight two significant issues: (1) the total volume of roundwood in transit between states, and (2) the net balance of imports and exports.

Step 8: Prepare the map

An effective map includes several elements: scale bars, legends, neatlines, and consistent typography, to name just a few. Our program has defined cartographic standards to give each map a consistent look and feel.

Conclusion

Estimates of roundwood production and consumption are readily available at the county and state level, but few maps highlight the movement of roundwood between states. Our choice to represent roundwood movement as vector features offers a unique perspective on the movement of raw forest products. It also makes it possible to attribute and stylize the routes more efficiently than is possible with graphics software. ArcGIS facilitates the development of a spatial database of roundwood movement that can be adapted to the needs of individual states.

The style of cartographic illustration used in this map is unique in the industry. Traditional maps of timber procurement display actual routes from harvest sites to mill sites, but complete data for such maps is not available over larger geographic extents or for multiple owners of timberland resources. Readers of this set of maps readily observe the substantial and complex pattern of interstate roundwood movement. Movements of other resources and populations and have been portrayed in map formats that provide partial solutions for our needs; maps of waterfowl migrations show generalized flyways and relative population sizes.

We created the main map in a style that purposefully mimics public transportation system maps from major metropolitan areas. Transportation maps, like subway maps, show stylized routes, but don’t capture directional dependencies or volumes of passengers. Used in a forestry context, this design is unique, yet familiar because of its cartographic lineage. The inset maps serve as a complement to the main map by simplifying and summarizing the seemingly chaotic pattern of movement. By integrating components from these and other maps, we were able to accomplish our objective of cartographically portraying several characteristics simultaneously, including sources, routes, directions, and volumes of roundwood movements between states and other countries.