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Researchers Develop an Effective Approach to Forest Cover Analysis

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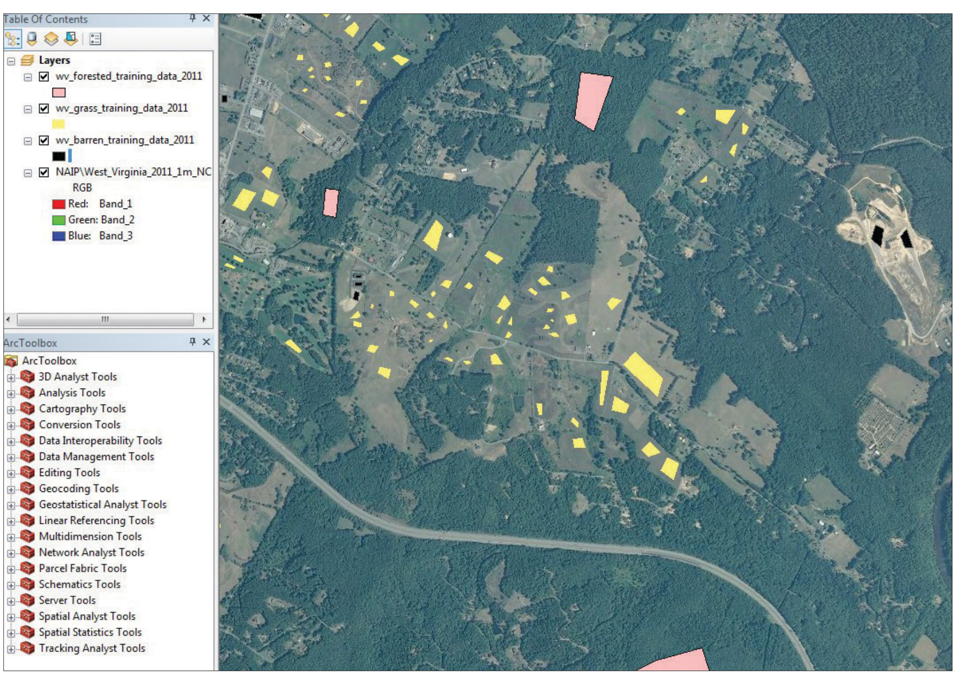
State resource agencies model wildlife habitat to support the planning and management of natural resources. The most widely available land cover for states to use is the Landsat-derived National Land Cover Dataset (NLCD). Because of its coarse resolution (30 meters) and temporal lag to the current conditions, using the NLCD is a challenge for wildlife modeling at a local scale. Researchers from West Virginia University (WVU) created a more effective approach for modeling habitat. They implemented a GIS and remote-sensing methodology for creating statewide forest cover and forest fragmentation data layers.

The approach was to use publicly available orthophotography from the National Agriculture Imagery Program (NAIP). This provided better resolution for raster data layers, increased accuracy of forest cover analysis, and delineation of fragmented wildlife habitat. NAIP orthophotography has a one-meter cell size and four-band spectral information (true color bands and an infrared band). The photography is captured on a two-year cycle, so datasets can be regularly updated.



↑ Figure 1. This training data was derived from interpreting photo imagery as polygons in ArcGIS. This base imagery is 2011 NAIP orthophotography displayed in true color.

The analyst used Esri's ArcGIS for Desktop image analysis tools and tools from the Feature Analyst 5 extension for ArcGIS by Overwatch. The outcome was a statewide forest cover and forest fragmentation map created from raster data at a nine-meter cell size for the state of West Virginia.

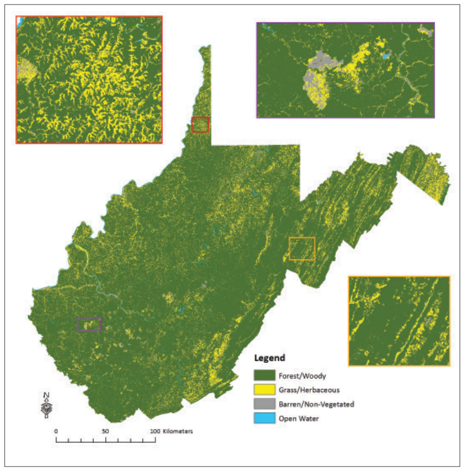
The project goal was to capture the spectral, textural, and land-use variability with defined classes. WVU researchers relied on object-based image analysis, which uses spectral and textural information within an image to extract thematic data. The project's imagery was from the United States Department of Agriculture (USDA) Farm Service Agency. This was four-band, leaf-on, one-meter pixel size, uncompressed imagery representing forest conditions during the growing season.

The bulk of the researchers' time was spent extracting cover from each image and classifying it as either forested/woody, grasslands/herbaceous, or barren/nonvegetated cover. It was necessary to collect a large number of samples to accurately extract the cover of interest. Researchers spent from one to three hours creating training data, which contains examples of the cover types of interest. They manually interpreted photographs within ArcGIS, using its functionality to create training data as vector and polygon features. This training data process allowed user input of vector data and generated examples of the cover of interest. Figure 1 shows an example of the training data digitized throughout the state.

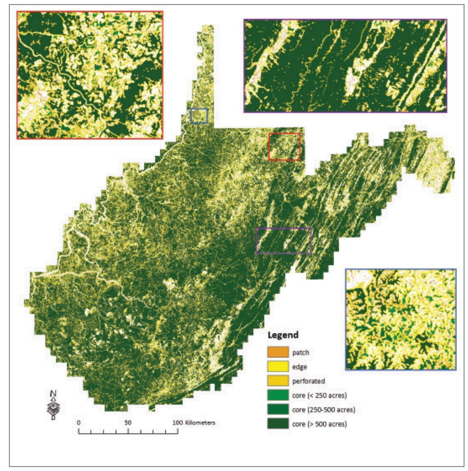
To extract cover, researchers used Feature Analyst 5 to process each image. The integration of its extraction tools with ModelBuilder enabled users to complete mapping tasks in a timely manner. They visually inspected all outputs for accuracy and, when necessary, reprocessed outputs.

Having completed this mapping task, researchers merged the resultant raster data to produce a statewide grid at a nine-meter cell size. They did this by using the Mosaic To New Raster tool in the ArcGIS Data Management toolbox. The outcome was a statewide forest cover map representing the 2011 growing-season conditions at a higher resolution than is currently available from existing datasets, such as the NLCD. Figure 2 shows the resultant cover.

To assess the accuracy of the forest cover data, researchers compared the cover extraction to manual photograph interpretation at randomly selected point locations across the state. They streamed the 2011 NAIP orthophotography through ArcGIS for Server, which was hosted by the Aerial Photography Field Office (APFO) of the USDA. This allowed them to quickly and easily access photography and assess the accuracy of the resultant cover. This approach yielded a forest cover map with accuracy that was greater than 90 percent.



↑ Figure 2. Researchers created thematic tree cover for West Virginia. They derived this coverage from 2011 NAIP orthophotography by using object-based image analysis tools in the Feature Analyst 5 extension for ArcGIS.



↑ Figure 3: Forest researchers were able to derive this forest fragmentation data for West Virginia by using a script within ArcToolbox to extract forest cover thematic data layers.

Forest fragmentation was created as a derivative of the raster forest cover. First, researchers smoothed the resultant cover to provide a more general representation of fragmentation and to remove small canopy interruptions that were deemed too small to fragment the forest. To create the forest fragmentation data, they employed morphological image analysis, applying mathematical morphology to analyze the shape and form of objects.

Running the downloadable Landscape Fragmentation Tool (LFT) version 2.0 in ArcGIS, researchers mapped the types of fragmentation present in specified land cover types, including patch, edge, perforated, and core, which is based on a specified edge width.

To complete the processing, researchers segmented the state into manageable units and then merged the final results, ultimately producing a raster grid of statewide forest fragmentation with a nine-meter cell size. Figure 3 shows the fragmentation data.

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