TAMARACK IN MINNESOTA: INVESTIGATING MORTALITY FROM EASTERN LARCH BEETLE USING FIA DATA

Susan J. Crocker, Jana Albers, Fraser R. McKee, Brian Aukema, and Greg C. Liknes[1]

Abstract.—Prior to European settlement, tamarack dominated the bogs, peatlands, and uplands of Minnesota's North Woods. Still a major component of Minnesota's forests, the extent and volume of tamarack has since waned. Mortality of tamarack has increased over the past decade. The majority of this mortality has been attributed to the activity of the eastern larch beetle (*Dendroctonus simplex* LeConte, Coleoptera, Scolytidae; ELB), a pest native to North America. Outbreaks of ELB have been documented in Minnesota since 1938. Largely separated by decades, the current outbreak of ELB has been ongoing since 2000. ELB frequently colonizes trees weakened by defoliators, however, within the current outbreak, it appears to be acting as the primary cause of mortality. While conditions that predispose stands to ELB attack are not well understood, physiological stress is often associated with infestation (Seybold et al. 2002). Factors related to the current outbreak are undetermined. However, drought, which has been a fixture in 9 of the past 10 years, could be playing an important role. Using data from the Forest Inventory Analysis program of the U.S. Forest Service, we analyzed trends in tamarack area and mortality over time. Additionally, tamarack mortality was aggregated by climate division to examine the relationship between mortality and drought. Future work will attempt to quantify the relative contribution of predisposing factors to tree mortality.

LITERATURE CITED

Seybold, S.J.; Albers, M.A.; Katovich, S.A. 2002. **Eastern larch beetle.** Forest Insect and Disease Leaflet 175. Washington, DC: U.S. Department of Agriculture, Forest Service.

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AGENT-SPECIFIC TREE MORTALITY RATES IN THE EASTERN UNITED STATES FROM FIA DATA

Alan V. Di Vittorio and Jeffrey Q. Chambers[1]

Abstract.—Forest tree mortality plays an important role in the global carbon budget through so-called "background" mortality rates and larger, less frequent mortality events. The actual mortality turnover rates of forest biomass are not well understood and can vary with forest type, stand characteristics, and environmental conditions. Different agents, such as fire, insects, disease, and weather, operate on different time scales with effects varying across different ecosystems. This variability makes it difficult, but important, to determine patterns of agent-specific mortality for model projections of forest carbon balance. However, many regional and global ecosystem models assume a single, nonfire mortality rate for all forests, which introduces bias to projections of forest carbon balance. Using the U.S. Forest Service Forest Inventory Analysis database (FIADB), we estimate annual average mortality rates, on a per-tree basis, for eastern U.S. forests between 2000 and 2010 (except for 1974-1984 Louisiana estimates). We present spatially explicit estimates of total mortality and of agent-specific mortality due to animals, disease, insects, fire, harvest, weather, vegetation, and unknown agent. These estimates include all trees greater than or equal to 1 inch in diameter in remeasured forest- or timberland plots, and exclude plots with annual average harvest rates greater than 3.5 percent. Estimated annual average mortality rates vary from 0.2 percent to 7.5 percent across the eastern United States. Removing fire and harvest effects limits this range to 0.2 percent to 4.9 percent. The unweighted regional average is 3.3 percent for total annual average mortality (30 states), and removing fire and harvest effects lowers this average to 2.4 percent. Unknown agents dominate the northern state estimates and vegetation encroachment dominates southern state estimates. Weather mortality estimates can be up to 98 percent, but are generally on the order of disease and fire estimates. These estimates indicate that uniform mortality rates in ecosystem models would be improved by spatially explicit values.

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REMOTE SENSING DATA AS A MONITORING TOOL: TRENDS IN WILDFIRE ACTIVITY FOR THE PAST QUARTER CENTURY AND THE RELATIONSHIP TO OTHER BIOPHYSICAL AND ENVIRONMENTAL VARIABLES.

Mark Finco, Brad Quayle, Kevin A. Megown, C. Kenneth Brewer, and Jennifer Lecker[1]

Abstract.—The Monitoring Trends in Burn Severity (MTBS, www.mtbs.gov) project is mapping extent, size, and severity of all large wildland fires greater than 1000 acres in the west and 500 acres in the east over the conterminous United States (CONUS), Alaska, and Hawaii. In 2012 the project reached a milestone, completing the mapping for all fires between 1984 and 2010. The MTBS project produces geospatial and tabular data using a consistent protocol for fire trend analysis at a range of spatial, temporal, and thematic scales.

Our poster presents some of the more important trends observed by intersecting the MTBS geospatial data with data layers related to other biophysical and environmental landscape characteristics. Many of these trends were stated in the initial chartering of the MTBS project by the Wildland Fire Leadership Council, including understanding the trends in burn severity by vegetation type, how burned area and severity differ by administrative ownership, and whether there is any trend in the proximity of fires to the wildland-urban interface.

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DETAILED MAPS OF TROPICAL FOREST TYPES ARE WITHIN REACH: FOREST TREE COMMUNITIES FOR TRINIDAD AND TOBAGO MAPPED WITH MULTISEASON LANDSAT AND GOOGLE EARTH

Eileen H. Helmer, Thomas S. Ruzycki, Jay Benner, Shannon M. Voggesser, Barbara P. Scobie, Courtenay Park, David W. Fanning, and Seepersad Ramnarine[1]

Abstract.—Tropical forest managers need detailed maps of forest types for REDD+, but spectral similarity among forest types, cloud and scan-line gaps, and scarce vegetation ground plots complicate producing such maps from satellite imagery. How can these challenges be overcome? We describe a case study of mapping tropical forests to floristic classes for Trinidad and Tobago with gap-filled Landsat imagery by judicious combination of field and remote sensing work (Helmer et al. 2012). Recent and forthcoming developments are making such mapping with Landsat imagery far more accessible to nonspecialists. We highlight some key steps to mapping tropical forest habitats with cloudy Landsat and related insights from this study.

In the study area, class characteristics like "deciduousness" allowed discrimination of floristic classes. We also discovered that the extensive training data needed for mapping tropical forest types with "noisy" gap-filled imagery can be collected by learning to identify tree communities in 1) imagery with fine spatial resolution of ≤1 m; 2) multi-season fine resolution imagery (usually only viewable on Google Earth™); or 3) Landsat imagery from different dates, particularly imagery from drought years, even if decades old. Further, we show that gap-filled, synthetic multi-season Landsat imagery significantly improves class-level accuracy for several seasonal forest associations (by 14 to 21 percent for deciduous, 7 to 36 percent for semi-evergreen, and 3 to11 percent for seasonal evergreen associations, and by 5 to 8 percent for secondary forest and woody agriculture). Moreover, in some cases the seasonal spectral patterns in multiseason Landsat imagery have much more spatial detail than available ancillary maps of environmental variables, making them more useful when mapping tropical forest tree communities with Landsat. These detailed mapping efforts can lead to new views of tropical forest landscapes. Here we learned that the xerophytic rain forest of Tobago is closely associated with ultramaphic geology, helping to explain its unique physiognomy.

LITERATURE CITED

Helmer, E.H.; Ruzycki, T.S.; Benner, J.; Voggesser, S.M.; Scobie, B.P.; Park, C.; Fanning, D.W.; Ramnarine, S. 2012. **Detailed maps of tropical forest types are within reach: forest tree communities for Trinidad and Tobago mapped with multiseason Landsat and multiseason fine-resolution imagery.** Forest Ecology and Management. 279: 147-166.

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DOTS AND PLOTS

Dennis M. Jacobs and Joseph M. McCollum[1]

Abstract.—Fixed-radius circles provide fixed-area plots for sampling. An array of dots within circles provides secondary sampling points within fixed-area plot circles. The hexagonal grid offers an elegant equidistant array of points that will deliver a balanced association between the circular area and number of points. A chosen target is 100 points within the circular plot and no less than 100, to approximate the mental process that one dot is about 1 percent. Equidistant integer spacing provides a minimal 109 hexagonal points with one dot on the plot center, but the visual weight is not well balanced along the circle perimeter. However, the centers of 102 hexagons can be strategically placed inside the circle by using the inscribed and circumscribed radii of hexagons, and will provide equal weighting between the dot spacing and each dot's representative area. Dividing the area of the circle by 102 gives the area of each small hexagon. We can then determine the non-integer spacing for the equidistant dot grid, which has no point at the center of the circular area, but with the first ring of three dots balanced around the plot center placed upon the vertex of the three central hexagons. By the use of Cartesian coordinates and the Pythagorean Theorem, we present the numerical balance of the points bounding the circle perimeter. Solutions of 104 and 100 dots may be obtained by balancing upon the bisector of two hexagon centers.

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PROGRESSION OF THE INVENTORY AND MONITORING OF NONFOREST LANDS WITH TREES

Dacia M. Meneguzzo, Greg C. Liknes, and Charles H. Perry[1]

Abstract.—Since its inception more than 80 years ago, the Forest Inventory and Analysis (FIA) Program has evolved from a timber-based inventory to an enhanced inventory that includes all forest land. However, FIA's definition of forest land requires areas of tree cover to be 120 feet wide and 1 acre in size. As a result, small scattered patches and linear plantings of trees are excluded from the inventory yet they are of ecological and economic importance. In the Great Plains region, it is these types of nonforest lands with trees that make up much of the total tree cover. In Nebraska, for example, past inventory reports have contained information only about the extent of nonforest tree cover but it has not been included consistently and explicit spatial information is lacking. Moving to an all-tree inventory would be ideal but ground-based data collection is cost prohibitive. Advances in remote sensing offer a promising solution to this problem. Our poster presents a timeline of past methodologies and area estimates of nonforest lands with trees as well as a new methodology for an image-based inventory of all tree cover using freely available, digital aerial photography from the National Agriculture Imagery Program (NAIP). Furthermore, the repeat availablity of NAIP imagery will make it possible to continuously monitor tree cover in the Great Plains.

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FOREST ATLAS OF THE UNITED STATES

Charles H. Perry, Linda R. Smith, Mary A. Carr, Randy Vreeke, and others[1]

Abstract.—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 is used to share information about the value of these forests and the challenges that confront them. More recent technological and methodological advancements make it possible to create spatial products (maps) from the inventory data and other spatial data, such as digital elevation models and satellite imagery. The Forest Atlas of the United States uses these maps to highlight the value of our nation's forest in a graphic and novel manner. In the Forest Atlas of the United States, we explore these questions and many more: Where do forests grow? What else lives in forests? What shapes forests? What benefits do forests provide? What is in the future for our forests? This project represents a strategic partnership between several parts of the Forest Service, integrating FIA inventory data with remote sensing and GIS applications. Our poster provides a sample of the content that will be included in the forthcoming atlas and highlight the use of maps, graphics, accessible text, and images to communicate forest monitoring information with the public.

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ASSESSING CHANGES IN VEGETATION COMPOSITION AND STRUCTURE: WHAT CAN WE LEARN FROM 500 PLOTS?

Bethany K. Schulz and W. Keith Moser[1]

Abstract.—Using remeasurement data from more than 500 plots measured by the Northern Research Station's Forest Inventory and Analysis Program, we assess changes in vegetation indicator estimates, including species richness, vegetation composition, and structure. We highlight changes in the frequency of introduced species at the plot, subplot, and quadrat levels. Most introduced species are increasing in constancy, with a few exceptions.

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LOGGING RESIDUE UTILIZATION IN THE STATE OF IDAHO 2008 AND 2011

Eric A. Simmons, Erik C. Berg, Todd A. Morgan, Charles B. Gale, Stanley J. Zarnoch, and Steven W. Hayes[1]

Abstract.—The purpose of this study was to respond to land managers' need for better information on growing-stock removals, utilization of trees, and logging residues as a result of harvesting timber.

A two-stage sampling design was used to select felled trees for measurement within active Idaho logging sites in 2008 and 2011. Fifty percent of the harvested trees were ≤12 inches diameter at breast height (d.b.h.) and accounted for 18 percent of the total growing-stock volume removed and 19 percent of the mill-delivered (utilized) volume. Trees in this range produced 20 percent of the logging residue. About 49 percent of the harvested trees were between 12.1 and 27 inches d.b.h. and accounted for 80 percent of the total growing-stock volume removed and 80 percent of the mill-delivered volume. Trees in this range produced 78 percent of the logging residue. Removal factors quantifying impacts on growing stock revealed that harvesting efforts removed 1,011 cubic feet of timber volume from growing stock for every thousand cubic feet delivered to the mill, with just 24 cubic feet left in the forest as logging residue.

Weight estimates in green tons for the tops and limbs were added to the bole residues to obtain a total tree residue factor to be used as a biomass estimation tool. This tool can provide forest planners and managers the ability to predict potential feasibility of utilizing residues, and to gauge the impact on air quality or fire behavior if the residues burned.

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MINING HISTORICAL FIA REPORTS TO DEVELOP ESTIMATES OF FOREST LAND THROUGH TIME IN THE NORTH CENTRAL REGION OF THE UNITED STATES

Paul A. Sowers[1]

Abstract.—The Forest Inventory and Analysis (FIA) Program began collecting inventory data in the early 1930s. While contemporary data (from approximately the last decade) is actively managed in a relational database system and readily accessible with a variety of software tools, older data was previously available only in printed reports for many parts of the United States. For 11 states in the North Central United States, printed reports spanning the 1940s to the 1980s were scanned and made available on demand as a series of CD-ROMs. These scanned reports have now been manually converted to data files and assembled as county-level, GIS compatible datasets.

Data from the first annual FIA inventory were acquired using FIA's online EVALIDator tool and combined with the historical data. A series of county-level choropleth maps are presented showing forest land area change across the 11 state region. The maps are portrayed in a matrix depicting the pairwise changes across the different inventory combinations.

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MAPPING ASPEN IN THE INTERIOR WEST

Charles E. Werstak, Jr.[1]

Abstract.—Quaking aspen (*Populus tremuloides* Michx.) is a critical species that supports wildlife and livestock, watershed function, the forest products industry, landscape diversity, and recreation opportunities in the Interior West (Bartos and Campbell 1998). Studies have indicated that changes in fire regimes, an increase in herbivore presence in young aspen stands, and recent drought episodes have been the main factors for increased mortality rates in aspen stands (Deblander et al. 2010). Forest Inventory and Analysis (FIA) plot data are a consistent source of ground-based information that if used appropriately, can be extremely valuable for mapping and modeling forest attributes such as forest type and canopy cover. GEO-object based image analysis, or GEOBIA, is a relatively new subdiscipline of geographic information systems (GIS) focused on developing automated techniques for partitioning remotely sensed imagery into image objects and accessing them for use in a variety of mapping applications (Hay and Castilla 2008). Spatial data mining is an automatic or semi-automatic exploration to identify patterns in data that have a geographic component (Shekhar et. al. 2005). Random Forests™ is an ensemble classifier that uses multiple decision trees to predict target variables from input variables (Breiman and Cutler 2003). To help understand the current status and extent of quaking aspen across the Interior West, efficient and repeatable mapping and modeling techniques need to be further established. This investigation aims at exploring viable methods for creating canopy cover maps of quaking aspen for several different locations across Utah. FIA plot data for inventory years 2000-2009 that correspond to image objects derived from Landsat TM imagery will be analyzed along with other ancillary geospatial data using spatial data mining and Random Forests™. Information gained from this investigation may provide further insight into object based segmentation and classification techniques using FIA plot data, satellite imagery, and ancillary geospatial data.

LITERATURE CITED

Bartos, D.L.; Campbell, R.B., Jr. 1998. **Decline of quaking aspen in the Interior West—examples from Utah.** Rangelands. 20: 17-24.

Breiman, L.; Cutler, A. 2003. **Random forests. Version 4.0.** Berkeley, CA: University of California at Berkeley. Available at www.stat.berkeley.edu/users/breiman/RandomForests/. (Accessed September 13, 2012).

DeBlander, L.T.; Shaw, J.D.; Witt, C.; Menlove, J.; Thompson, M.T.; Morgan, T.A.; DeRose, R.J.; Amacher, M.C. 2010. **Utah's forest resources, 2000-2005.** Resour. Bull. RMRS-RB-10. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 144 p.

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(Continued on next page)

Hay, G.J.; Castilla, G. 2008. **Geographic object-based image analysis (GEOBIA): A new name for a new discipline? Section 1.4.** In: Blaschke, T.; Lang, S.; Hay, G.J., eds. Object-based image analysis – spatial concepts for knowledge-driven remote sensing applications. New York, NY: Springer-Verlag: 81-92.

Shekhar, S.; Zhang, P.; Huang, Y. **Spatial data mining.** In: Maimon, O.; Rokach, L. The data mining and knowledge discovery handbook. New York, NY: Springer-Verlag: 833-851.

SUSTAINABILITY OF OAKS IN WEST VIRGINIA

Richard H. Widmann[1]

Abstract.—There is growing concern for the sustainability of the oak resource in West Virginia. A look at the U.S. Forest Service's Forest Inventory and Analysis data over the 12 million acres of timberland in West Virginia shows that oak volume has continued to increase, but all of this increase has been due to growth on large-diameter trees. High mortality in the lower diameter classes and low recruitment has resulted in oaks being underrepresented in the lower diameter class. Oak species now represent 46 percent of trees more than 20 inches in diameter, but only 7 percent of the trees less than 9.0 inches in diameter. In 2- and 4-inch diameter classes, oaks represent 5 and 6 percent of trees in these classes, respectively. Because of this disparity, volumes of oak will likely decrease across the State as large trees are harvested or die and recruitment into large-diameter classes decreases. Loss of this keystone species will affect wildlife populations and wood-using industries that now depend on oak.

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DOES STANDING WATER OR SNOW PACK BIAS ASSESSMENTS OF TREE REGENERATION WITHIN LARGE-SCALE FOREST INVENTORIES?

Christopher W. Woodall, James A. Westfall, Brian F. Walters, Daniel J. Johnson, and Kai Zhu[1]

Abstract.—A critical component of large-scale assessments of forest ecosystem sustainability and function is that of tree regeneration. As forest inventory measurements may occur year round at high latitudes, winter snow banks and subsequent spring floods may impede measurement of tree seedlings (<1 inch diameter at breast height [d.b.h.]), especially at high latitudes/elevations. Using FIA's measurements of seedlings across eastern states, potential biases of tree seedling measurements as affected by snow depth and water obstruction was assessed. It was found that there is a general trend of a decrease in average annual seedling density across time as stand density increases across the eastern United States—a trend that is potentially exacerbated within plots where there is substantial snow/water obstruction (>10 cm) to seedling measurement. Assessments of seedling surveys should not be biased if sufficient temporal and spatial scales are used relying on the unbiased spatial and temporal allocation of field plot measurement to eliminate potential bias. However, seedling assessments may be biased if they occur at the plot-level with snow/water present on the plot with the greatest potential bias found on plots with no obstruction at time one but with substantial snow/water obstructions at time two.

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RATES OF COARSE WOODY DEBRIS BIOMASS LOSS AND CARBON DEBT IMPLICATIONS IN EASTERN U.S. FORESTS

Christopher W. Woodall, Matthew B. Russell, Anthony W. D'Amato, Shawn Fraver, and Brian F. Walters[1]

Abstract.—Emerging questions from bioenergy policy debates have highlighted knowledge gaps regarding the carbon and biomass dynamics of individual pieces of coarse woody debris (CWD) across the diverse forest ecosystems of the United States. Using a subset of CWD pieces remeasured across eastern U.S. forests, the rate of biomass loss was estimated over time using decay class transition models coupled with volume and wood density loss trajectories. Results indicate that biomass loss is related to the genera of the species considered, its size, and location within the broad climatic regions of the eastern United States. This biomass loss may be broadly summarized as CWD "half-life's" across the eastern U.S. FIA's inventory of CWD may provide carbon debt policy discussions with objective assessments of CWD biomass/carbon loss.

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FRAMEWORK FOR ASSESSING CLIMATE CHANGE RISKS TO FOREST CARBON STOCKS

Christopher W. Woodall, Grant M. Domke, Karin L. Riley, Christopher M. Oswalt, Susan J. Crocker, and Gary W. Yohe[1]

Abstract.—Efforts to negotiate the role of forest carbon stocks in global efforts to mitigate potential climate change effects has highlighted the need to quantify risks to forest carbon stocks such as massive disturbance events. As risk may be conceptualized around the magnitude of an event and its associated probability, this study examined potential changes to forest carbon stocks following major disturbance (e.g., hurricane) and proposed a framework for assessing the probability of climate change risks to these stocks. Results suggest that a valid framework for conceptualizing risk may be centered on the various forest carbon pools (e.g., forest floor and belowground), the variability of the associated stocks across large scales, and the magnitude of the stocks themselves. Furthermore, given the diversity of the forest pools involved, the nature of massive disturbances themselves (e.g., insects versus wildfires) can have divergent effects of forest carbon stocks resulting in major research unknowns.

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BIOMASS AND CARBON ATTRIBUTES OF DOWN WOODY MATERIALS ACROSS FORESTS OF THE UNITED STATES

Christopher W. Woodall, Brian F. Walters, Grant M. Domke, Chris Toney, Andrew N. Gray, Sonja N. Oswalt, and James E. Smith[1]

Abstract.—In past decades, down woody material (DWM) has emerged as central to wildlife habitat, a controlling factor of forest nutrient cycles, facilitator of tree regeneration, a carbon store, and fire hazard. Using the first ever national empirical inventory of DWM across forests of the United States, the biomass and carbon attributes of DWM were assessed. Results indicated that DWM are ubiquitous in forests; however, they are only found in large amounts in certain specific ecosystems subject to unique climatic or disturbance attributes (e.g., slow decay or recent tree mortality). It is suggested that the national empirical inventory of DWM carbon stocks replace the simulated stocks used in past national greenhouse gas inventories.

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