Topic & Title of Project

Use of LANDFIRE Vegetation Dynamics Models and FRCC Maps to Support Ecological Assessments and Forest Plan Revisions in the Southwest Region

Date of Project

June 2007 -- Present

Background

In U.S. Forest Service (USFS) Southwest Region (Region 3 – see map below) and elsewhere across the western U.S., the plans that guide the management of National Forests and Grasslands are being revised (for more information, visit http://www.fs.fed.us/r3/plan-revision/index.shtml). The goal of these revisions is to update plans developed under 1982 planning guidelines to support current rules and land management objectives. Revision of the Region's forest plans involves ecological, social, and economic assessments that determine which elements of the current plan need to be changed. These assessments are currently underway in the Region and will likely continue through 2010. The Region 3 analysis team is using the LANDFIRE Project's Vegetation Dynamics Models (VDMs) and Fire Regime Condition Class (FRCC) maps to characterize historical and current vegetation conditions, as required for the development of ecological assessments and the Forest Plan Revision process.

Ecological assessments are designed to evaluate the ecological sustainability of the resources in a Forest or Grassland by examining key indicators, including biological diversity, the natural range of variability, and the current conditions of the forest or grassland ecosystems. Plan revisions are designed to be strategic in nature; existing plans are revised only when management direction or land management objectives have changed such that a change in the plan becomes necessary. Therefore, the ecological assessment helps to identify where changes are needed in the current plan to achieve the desired conditions. In the final plan, ecological, social, and economic concerns are all considered in determining management direction for an area.

LANDFIRE Vegetation Dynamics Models are quantitative state-and-transition models that describe historical or reference vegetation conditions. The models are created by regional experts using the Vegetation Dynamics Development Tool (VDDT; Beukema et al. 2003) and include information on the rates and pathways of succession and probabilities and pathways of disturbances – see figure at end of document. For LANDFIRE, one model was created for each biophysical setting (BpS)* mapped by the project, and the simulated reference conditions were used to establish a baseline from which to measure current vegetation departure or FRCC. Because LANDFIRE VDMs contain fundamental ecological information about the cumulative effects of vegetation succession and disturbance dynamics, they also provide a foundation for retooling models to understand current conditions and predicting future trends. These characteristics made LANDFIRE VDMs a valuable tool for Region 3 analysts when creating their ecological assessments.

**A biophysical setting is the vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based on both the current biophysical environment and an approximation of the historical disturbance regime.*

Fire Regime Condition Class (FRCC), as mapped by LANDFIRE, is a measure of the departure of current vegetation composition and structure from the historical reference condition. FRCC is divided into three categories:

- FRCC 1: 0-33% departed or within the historical range of variation (HRV),
- FRCC 2: 34-66% departed or moderately departed from the HRV,
- FRCC 3: 67-100% departed or highly departed from the HRV (Hann and others 2004).

HRV is defined in the VDM and then spatially simulated using the LANDSUM landscape simulation model. LANDFIRE maps the current conditions from satellite imagery and compares them to the HRV to measure FRCC.

Key Points

Why use LANDFIRE data? LANDFIRE data have been and will continue to be used in conjunction with local data to support the ongoing ecological assessments for each Forest and Grassland in Region 3. Local data sets used in the analysis – including R3 mid-scale existing vegetation map data and Terrestrial Ecosystem Survey data on National Forest lands and the Southwest Re-GAP map on Non-Forest and Grasslands – provided sufficient information on the distribution and composition of vegetation types. However, the analysis team also needed information on historical vegetation conditions from which to establish a baseline for measuring the current condition of ecosystems. The choice to use LANDFIRE data as an integral part of the ecological assessments was

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Key Points, continued...

driven by several of the assessment requirements:

1. The foundation of an ecological assessment is documentation on the HRV in plant communities and an evaluation of the current status of these communities relative to the HRV and the desired future condition. LANDFIRE VDMs provide written documentation on historical conditions and, with updates, can provide information on the trend of these communities into the future. For the Region 3 assessments, some models were retooled with current probabilities for fire, insects and disease, and management activities. These changes allowed analysis teams to analyze how the landscape would shift over time if current trends continued.
2. Ecological assessments are conducted for the entire ecological section (Cleland et al. 2007) in which each of the Region's Forests and Grasslands are located. An ecological section is defined as an ecological unit, ranging in size from 1000s to 10,000s of acres, based on similarity in climate and environmental factors used for land management planning. Therefore, data that extends beyond the boundaries of an individual Forest or Grassland is required for these assessments. LANDFIRE data were chosen for the assessments because they do not end at jurisdictional boundaries and could be used to fill gaps where no local data existed.
3. Ecological assessments require an evaluation of the departure of current vegetation conditions from the HRV. Regional analysts selected the fire regime condition class (FRCC) assessment system as the measure of ecological departure. Because FRCC had not previously been mapped on most Forest Service or private lands in Region 3, LANDFIRE FRCC maps were used.

Data analysis for Ecological Assessment

***Documenting Historical Conditions*:** LANDFIRE VDM description documents provided the information on historical vegetation conditions for each vegetation type, which is a required part of the documentation in an ecological assessment. The description of the vegetation community, the disturbance regime, and the reference information contained in each model description provided the Region 3 analysts with an ecological framework for understanding each vegetation type, its reference condition, and current trends.

***Analyzing Future Trends*:** Although LANDFIRE vegetation state-and-transition models are designed to represent reference or historical vegetation conditions, regional analysts modified them to analyze current trends and predict future conditions. For example, local information was used to determine current fire frequency, the probability of insects and disease, and the prevalence of management activities. This information was translated into annual probabilities that were added to the state-and-transition model in place of the reference condition probabilities. Multiple simulations were then run for simulation periods of 10 to 1,000 years, depending on the vegetation type, to predict future conditions. Future conditions were then compared to the LANDFIRE reference conditions and FRCC was recalculated for each projection to determine future departure. These results helped the analysis team to estimate the future departure of various vegetation types if current trends in fire frequency, insect and disease probability, and management activities continue.

Assessing Spatial Trends in Sustainability: The LANDFIRE FRCC map was used to understand the spatial distribution of departure within and between Region 3 Forest and Grasslands as well as for the surrounding landscape. For example, shinnery oak vegetation, an important native ecosystem in Region 3, has been converted to agricultural land across much of its range. LANDFIRE FRCC data indicate that shinnery oak communities within Black Kettle National Grasslands represent some of the best remaining (least departed from the reference condition) examples of this community in the region today. This analysis highlights the conservation contribution of the Black Kettle to shinnery oak communities and helps planners understand where management actions might be taken to improve the ecological sustainability of native, regionally important ecosystems.

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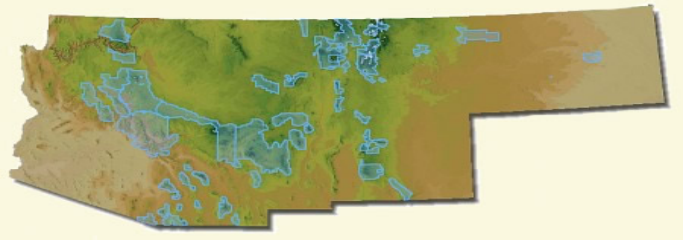
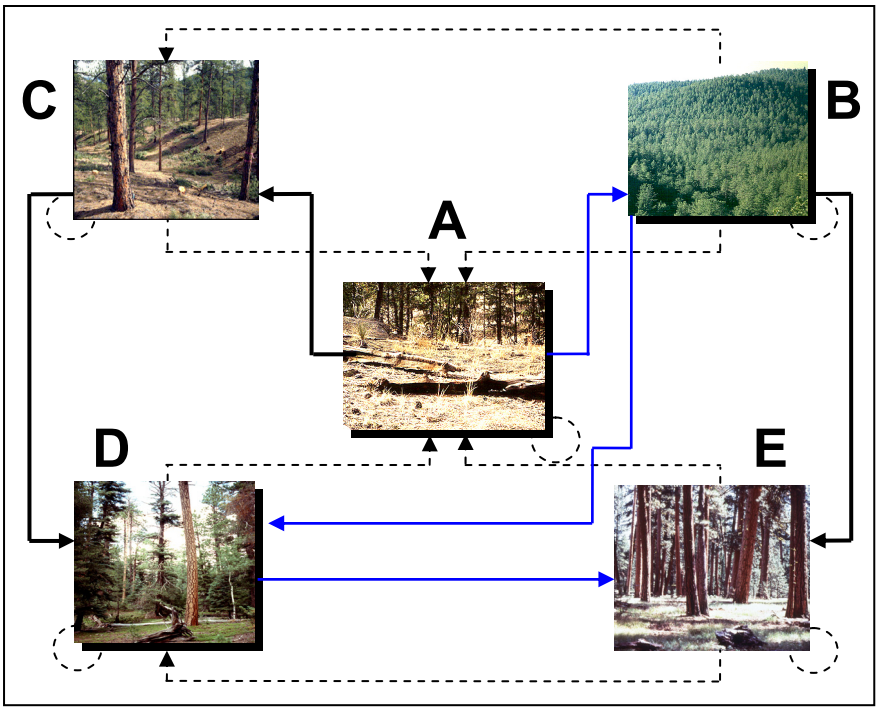


USFS Region 3 stretches across 22.3 million acres in the southwestern U.S. and includes 11 National Forests and 3 National Grasslands.

Region 3 staff sample vegetation in a "Madrean Encinal" woodland on the Coronado National Forest.



Graphic and tabular representation of the Southern Rocky Mountain Ponderosa Pine Woodland vegetation dynamics model (LANDFIRE National VDM 2007; BpS #2510540). Solid black lines represent the main successional pathways, solid blue lines represent alternate successional pathways and dashed lines represent fire disturbance pathways (non-fire disturbances were modeled but are not included in the graphic).

State Name	Landscape Percent*	Description
A: Early1 All Structures	10	Openings with grass, shrub and forbs created after replacement fire. Post replacement vegetation is patchy and episodic. Ponderosa pine seedlings can be very limited and variable. Gambel Oak and ceanothus fendleri are vigorous, rapid resprouters. Succession to class C after 50yrs.
B: Mid1 Closed	2	Forest canopy closure is >=30%. Closed pole- sapling/grass and shrubs. Replacement fire occurs every 80yrs on average. Mixed severity fire (MFRI of 25yrs) will open stand structure, thus causing a transition to class C. Surface fire is considered unlikely in dense stands. Without fire, the stand will grow into a late successional closed state (class E) after 70yrs.
C: Mid1 Open	10	Forest canopy closure is <30%. Open pole-sapling/grass and shrubs. Replacement fire every 300yrs causes a transition back to class A, whereas surface fire and mixed severity fire maintain the open structure of the class. Without fire, the stand will transition to the open condition (class D) after 25yrs. With fire, the stand grows into class D after 60yrs.
D: Late1 Open	75	Forest canopy closure is <30%. Open large trees/grass and shrubs. Rare transition to class A is caused by replacement fire every 400yrs. Surface fire (MFRI of 10yrs) and mixed severity fire (MFRI of 50-100yrs; Moir & Dieterich 1988) maintain vegetation in class D indefinitely. Without fire vegetation will close and transition to class E.
E: Late1 Closed	3	Forest canopy closure is >=30%. Closed large, trees, poles, saplings and shrubs. Replacement and surface fires occur every 250yrs on average. Mixed severity fire (MFRI of 50- 100yrs; Moir & Dieterich 1988) and mountain pine beetle outbreaks (every 50yrs on average) will return vegetation to class D.

**The landscape percent represents the central tendency calculated by the model for the reference condition.*

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Key Points, continued...

Results / summary The ecological assessments for each Forest and Grassland in the Region will be used in conjunction with social and economic analyses to revise forest plans. LANDFIRE data played an important role in the ecological assessments by allowing consistent analyses to be completed across the Region using comparable, gapless data on all Forests and Grasslands. VDMs provided the information on the HRV that was required to conduct an ecological assessment for every vegetation type in the region. In addition, the information is housed in one organized package, which saved the analysts many hours of literature review. Ecological assessments also require analysis teams to determine the departure between current vegetation conditions and the HRV, but this information can be costly and time consuming to produce locally and requires input data that are often not available outside of federal lands. VDMs, in conjunction with FRCC maps, provided the tools needed by the analysis team to determine the departure in a timely and cost-effective way for the entire region. These tools helped planners to determine where changes to existing forest plans might be needed to achieve desired future conditions.

Recommendations

LANDFIRE spatial data and VDMs need to be carefully inspected to ensure that they are of appropriate scale or resolution for a specific application.

VDMs can be used without modifications to understand the HRV for vegetation types. However, with modifications, such as adding current fire probabilities or management activities, the models can be used as a predictive tool to assess future conditions.

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