

LANDFIRE BpS Review
What is it? How does it work?
Why does it matter?

Randy Swaty, Ecologist
The Nature Conservancy LANDFIRE Team

Presented to
Southwest Fire Science Consortium
January 20, 2016

LANDFIRE's mission is to provide agency leaders and managers with a common "all-lands" data set of vegetation and wildland fire/fuels information for strategic fire and resource management planning and analysis.

Welcome to LANDFIRE and Southwest Fire Science Network's webinar about Biophysical Settings review & update. I'm Jeannie Patton, Communications Lead for The Nature Conservancy's LANDFIRE Program. This is one in a series of collaborations with JFSP members, and we're inviting you to participate in a significant ecosystem review and update project that affects the Southwest.

Leading the conversation is Randy Swaty of The Nature Conservancy's LANDFIRE team. He is one of the ecologists leading this complex, important contribution to ecological knowledge.

Randy joined the TNC Michigan Chapter in 2002 and the LANDFIRE program in 2007. His scientific specialties span spatial scales from community genetics to mycorrhizal ecology and landscape-scale planning. Randy has worked with federal partners and a large landowners to promote sustainable management and was the Great Lakes LANDFIRE modeling lead. He lives in Evanston, IL.

Today's Agenda



Randy Swaty
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- The what and how about LANDFIRE BpS models
- A bit about BpS review: why it's necessary, and how it will work
- How you can be involved
- Where to go for more information and help

BpS = Biophysical Settings

BpS Review website: <http://www.landfirereview.org/>

I'm Randy Swaty, ecologist on The Nature Conservancy's LANDFIRE team. In the next half hour, I'll introduce LANDFIRE to you, talk about how we developed Biophysical Settings vegetation – BpS – descriptions and models, and try to set the stage for the upcoming BpS review.

Introduction to LANDFIRE

LANDFIRE

Landscape Fire and Resource Management Planning Tools Project

An innovative program designed to **create** and periodically **update** comprehensive vegetation, fire and fuel characteristics **data** using a **consistent process** for the entire United States.



KEYWORDS: nationwide, consistent, ecological models, GIS data, tools, fire/non-fire, spatial data



LANDFIRE is an innovative program designed to create and update vegetation, fire and fuel data for the entire United States. Leading partners are Department of the Interior, US Forest Service and The Nature Conservancy, along with collaborators in the natural resources world who contribute knowledge, data and technical expertise. LANDFIRE supports resource management activities across the country, with spatial data, vegetation models, and powerful user tools.

Spatial Datasets

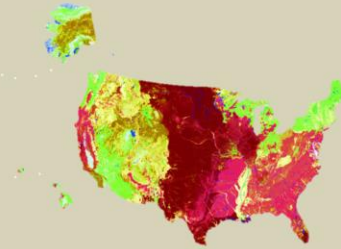
LANDFIRE

- Uses peer-reviewed, consistent, repeatable scientific methods
- Delivers an “all-lands” spatial dataset of vegetation



LANDFIRE Products

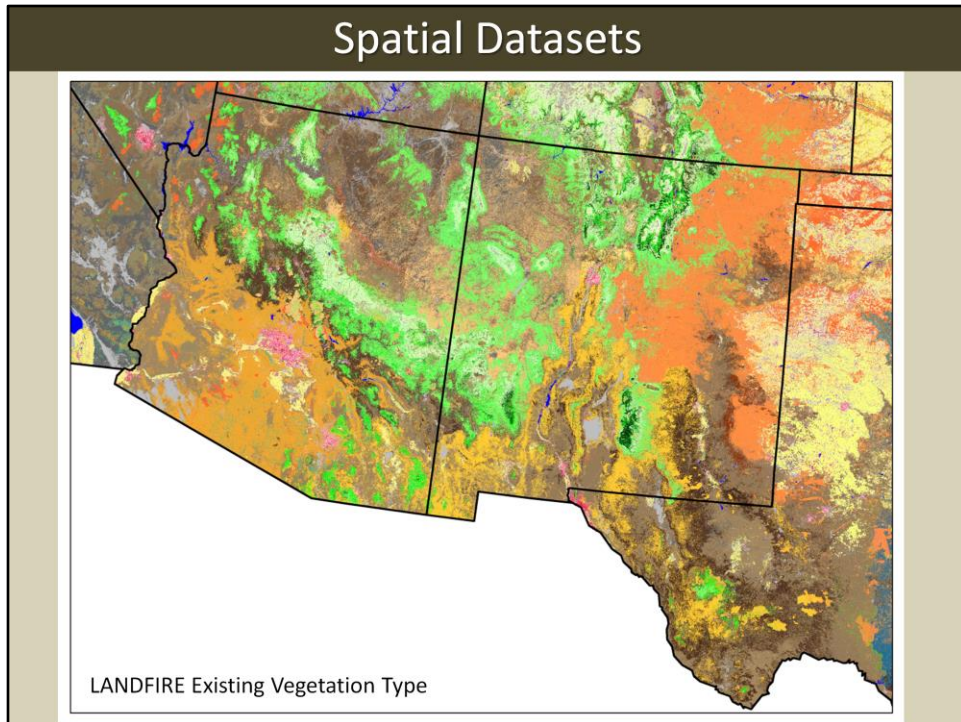
- Vegetation-not just fire
- Fire Regimes
- References and Baselines
- Fuels (Models and Measurements)
- Disturbance Characteristics
- Topographic and GIS Spatial Analysis



BpS Review website: <http://www.landfirereview.org/>

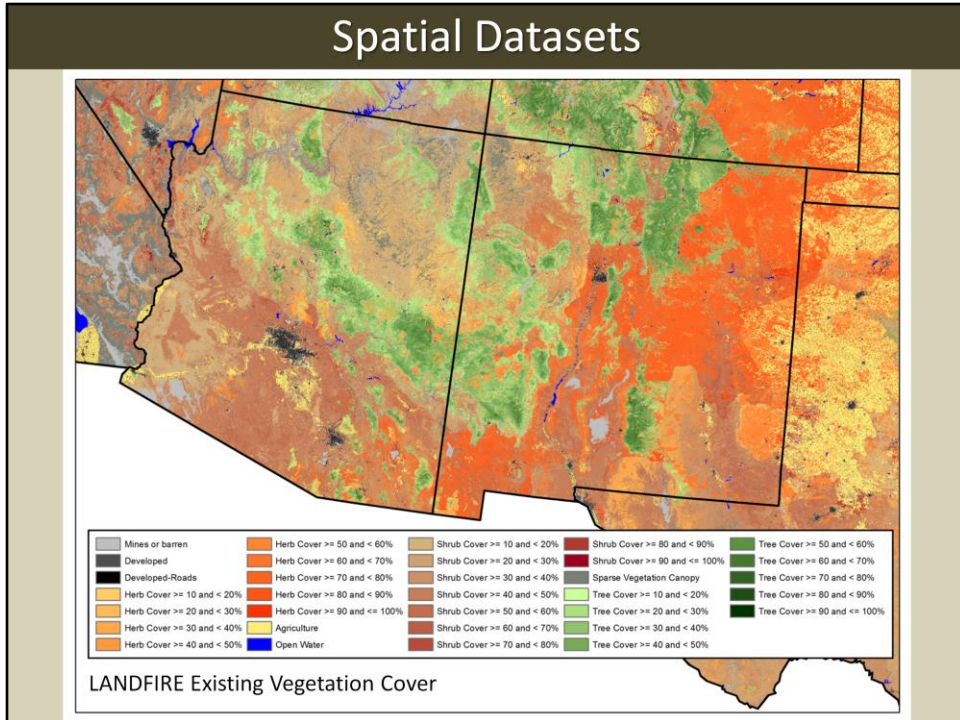
LANDFIRE uses peer-reviewed scientific methods, and delivers datasets of vegetation, fire, and fuels information for all land ownership types. Products include more than 20 geo-spatial layers and relational databases that support a wide range of analysis and modeling applications – whether fire-focused or not. And you can combine datasets to assess conditions on your own landscape.

Spatial Datasets



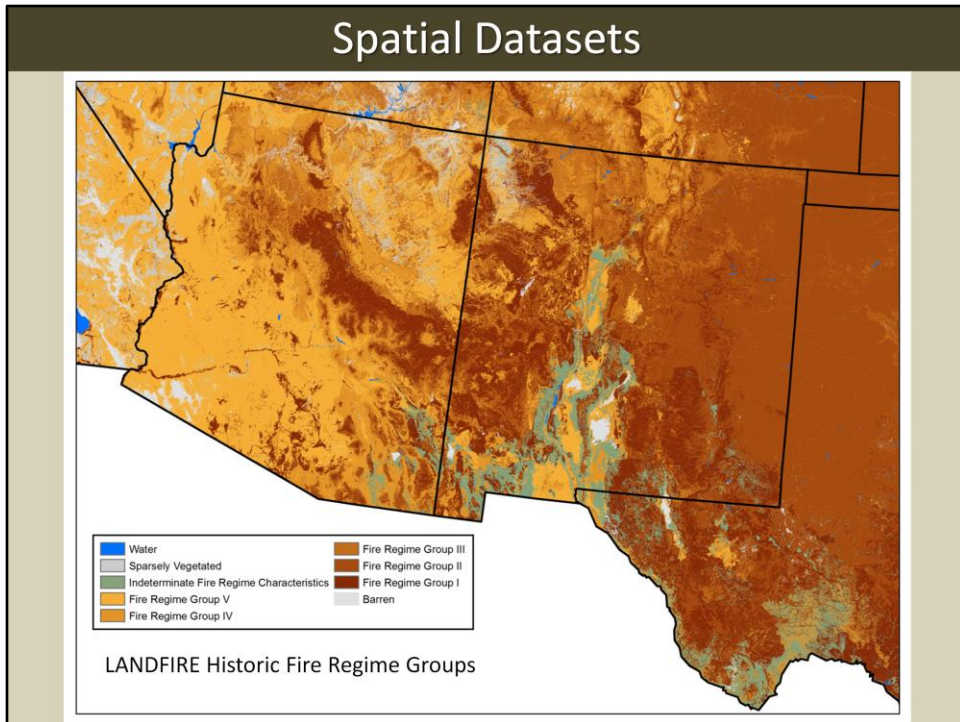
I want to give you a quick tour of a few of the LANDFIRE spatial datasets, current first. The Existing Vegetation Type map represents where Nature Serve's Ecosystems are currently. Again, legend left off due to number of items. That said the attribute table has a hierarchy based on the National Vegetation Classification Standards, and is also crosswalked to other classification systems such as one developed by the Society of American Foresters.

Spatial Datasets



This map represents LANDFIRE Existing Vegetation Cover with a legend.

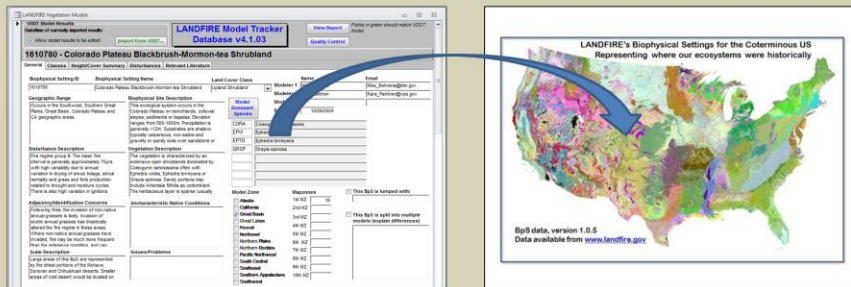
Spatial Datasets



Here is one of the LANDFIRE datasets that represents historic conditions. Here we have the historic fire regime groups dataset that represents pre-settlement fire frequency and severity. It is built from the Biophysical Settings models that we'll explore next.

The link...

- The Biophysical Settings Model and Description bundles are linked to many spatial data sets
- Spatial datasets are not perfect-we are always working to improve
- Some areas for improvement are linked to the BpS descriptions



BpS Review website: <http://www.landfirereview.org/>

The Biophysical Settings models are stand alone products that link to LANDFIRE mapping. For example the values for the first map I showed you come from the BpS models. The Succession Classes that I will talk about in a moment are represented on today's landscape by taking the rulesets from the BPS models. In other words, some of the spatial datasets rely on the models...the better the models the better the maps in some cases.

Vegetation Model & Description Bundle

- **WHAT:** describe how ecosystems (Biophysical Settings) looked and functioned prior to major European Settlement
- **WHY:** to use as a reference to compare current conditions to (READ-not a prescription)
- **HOW:** worked with hundreds of experts to describe and model, followed by expert review, incorporation of feedback then QA/QC
- **WHEN:** ~ 2,000 models and descriptions completed in 2008. TNC's LANDFIRE team submitted 200-400 pages of documentation and associated models every two weeks.



BpS Review website: <http://www.landfirereview.org/>

LANDFIRE model and description bundles represent how Biophysical Settings looked and worked prior to major European settlement. These the models and descriptions that accompany them play a part in national vegetation mapping and assessment, and on-the-ground management across the country.

We are not looking at climate change, and we are not necessarily saying that reference conditions are the same as “Desired Future Conditions.” However, we think this the reference information is helpful. In some ecosystems, departure from reference conditions means higher vulnerability to climate change, and we can look to the reference vs. current conditions to asses what we might need to do to adapt.

The bundles are used in LANDFIRE to

- Understand historic disturbance patterns
- Estimate proportions of succession classes
- Get overall return interval of surface, mixed and replacement fires
- Map spatial layers
- Engage experts

WHAT

Two-part bundle

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2810110 Rocky Mountain Aspen Forest and Woodland

This BPS is lumped with:
 This BPS is split into multiple models:

General Information

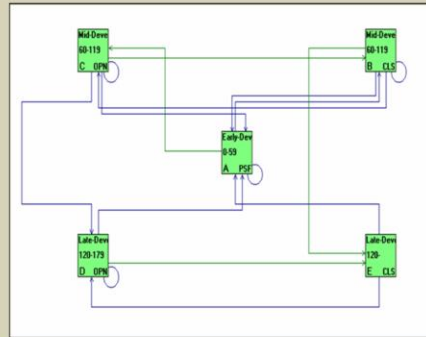
Contributors	(also see the Comments field)	Date	4/23/2005
Modeler 1	Kelly Pohl k.pohl@trc.org	Reviewer	Leslie Hackaby lhackaby@fl.fed.us
Modeler 2		Reviewer	Chuck Konczka konczka@webaccess.net
Modeler 3		Reviewer	Vic Ecklund vecklund@esa.org

Vegetation Type

Max Zones	0	Model Zones
Forested	<input type="checkbox"/>	<input type="checkbox"/> Alaska <input type="checkbox"/> N-Cent Rockies
Dominant Species*	<input type="checkbox"/>	<input type="checkbox"/> California <input type="checkbox"/> Pacific Northwest
POTRS	<input type="checkbox"/>	<input type="checkbox"/> Great Basin <input type="checkbox"/> South Central
SVOR	<input type="checkbox"/>	<input type="checkbox"/> Great Lakes <input type="checkbox"/> Southeast
ARLV	<input type="checkbox"/>	<input type="checkbox"/> Northern <input type="checkbox"/> S. Appalachians
	<input checked="" type="checkbox"/> Expert Estimate	<input type="checkbox"/> Northern Plains <input checked="" type="checkbox"/> Southwest

Geographic Range
Western Colorado, Utah, northern New Mexico, northern Arizona, central Nevada.

Biophysical Site Description
This type occurs on flat to moderately steep terrain (<50%) on all aspects. Elevation typically ranges from 2775m-3555m (9000' to 11500') in magnitude. Stable aspen typically occurs above grass, sagebrush, or PFL. Soils are generally deep, moist, cool, and moist. As a species, aspen is adapted to a much broader range of environments than most plants found associated with it.



*Textual description informed
by ecological model*

*State-and-transition
ecological model*

BpS Review website: <http://www.landfirereview.org/>

As we progress through the presentation today I will talk about BPS models and BPS descriptions. These are separate but linked items.

Description: the Basics

General		Classes	Height/Cover Summary	Disturbances	Relevant Literature																
Biophysical Setting ID	Biophysical Setting Name	Land Cover Class	Name	Email																	
5013110	North-Central Interior Dry Oak Forest and Woodland	Forested	Modeler 1 Greg Nowacki	gnowacki@fs.fed.us																	
Geographic Range		Biophysical Site Description		Model Dominant Species																	
Province 222. For Michigan 222J. For Wisconsin 222K, L and R.		This system occurs most commonly on interlobates where outwash, ice-contact, and end moraine landforms are situated between former glacial lobes. Other landforms suitable for development of the dry oak forest are sandy lake plain and dunes. Common to all these landforms is		<table border="1"> <tr><td>QUAL</td><td>Quercus alba</td></tr> <tr><td>QUVE</td><td>Quercus velutina</td></tr> <tr><td>QUEL</td><td>Quercus ellipsoidalis</td></tr> <tr><td>QUCC2</td><td>Quercus coccinea</td></tr> <tr><td>CAGL8</td><td>Carya glabra</td></tr> <tr><td>PRSE2</td><td>Prunus serotina</td></tr> <tr><td>SAAL5</td><td>Sassafras albidum</td></tr> <tr><td>QUMA2</td><td>Quercus macrocarpa</td></tr> </table>		QUAL	Quercus alba	QUVE	Quercus velutina	QUEL	Quercus ellipsoidalis	QUCC2	Quercus coccinea	CAGL8	Carya glabra	PRSE2	Prunus serotina	SAAL5	Sassafras albidum	QUMA2	Quercus macrocarpa
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QUCC2	Quercus coccinea																				
CAGL8	Carya glabra																				
PRSE2	Prunus serotina																				
SAAL5	Sassafras albidum																				
QUMA2	Quercus macrocarpa																				
Disturbance Description		Vegetation Description		Model Zone																	
The North-Central Interior Dry Oak Forest and Woodland is predominantly Fire Regime 1, characterized by low-to-moderate severity surface fires. Historically, indigenous fires accounted for over 95% of the ignitions over these landscapes. Vegetation types varied		Oaks dominated the presettlement vegetation, especially white oak (Quercus alba), black oak (Quercus velutina), northern pin oak (Quercus ellipsoidalis), and bur oak (Quercus macrocarpa). This system is distinguished from North-Central Interior		<table border="1"> <tr><th>Mapzones</th><th></th></tr> <tr><td>1st MZ</td><td>50</td></tr> <tr><td>2nd MZ</td><td></td></tr> <tr><td>3rd MZ</td><td></td></tr> <tr><td>4th MZ</td><td></td></tr> <tr><td>5th MZ</td><td></td></tr> <tr><td>6th MZ</td><td></td></tr> <tr><td>7th MZ</td><td></td></tr> </table>		Mapzones		1st MZ	50	2nd MZ		3rd MZ		4th MZ		5th MZ		6th MZ		7th MZ	
Mapzones																					
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5th MZ																					
6th MZ																					
7th MZ																					
Adjacency/Identification Concerns		Uncharacteristic Native Conditions		This BpS is lumped with:																	
This type intergrades and can be easily confused with North-Central Interior Dry-Mesic Oak Forest and Woodland (1310). Fire suppression within the last century has allowed this system to be converted to that system on the loamer soils within the historic range		Though present historically, red maple has been typified as the "native invasive" in oak forests. Its abundance in these systems measured in both stem density and basal area has grown considerably due to fire suppression and the marked increase in fire return		This BpS is split into multiple models (explain differences)																	

Originally captured in the "Model Tracker Database"

BpS Review website: <http://www.landfirereview.org/>

The description has multiple sections - I'll give you a quick tour of some of them today. In the "General" section or tab we find the basic information about a BPS- where it occurs, what the natural disturbance regimes were, a vegetation description and information on where the BPS would have occurred based on soils, surficial geology, climate, etc. This information was typed in by experts, Dr. Greg Nowacki in this case, often backed up by literature. These descriptions were originally developed in an Access database. That database and PDF documents of the descriptions are available on the Vegetation Tab of LANDFIRE.gov.

Description: Succession Classes

Class A

Landscape %: 2

Cover Type: Early Development 1

Struct. Stage: All Structures

Description: PRAIRIE. This class ranges from 0-4 years and succeeds to class B. Class A is grassland prairie maintained by frequently recurring fire. Replacement fire was modeled with the probability of occurring every 10 years. Native Americans used these lands for hunting, and agriculture/recreative plant gathering. If fire is absent for a few years, tree seedlings and sprouts would recruit into trees and form savannas. Heavy grazing, though unlikely to have large-scale impact, would have kept certain patches from progressing to a woody shrub vegetation stage and would have maintained Class A. Native grazing was modeled with the probability of occurring every 100 years.

Class Indicator Species	Indicator Spp.	Canopy Position
ANGE Andropogon gerardi	Upper	Upper
SCHZ4 Schizachyrium	Upper	Upper
SDNU2 Sorghastrum nutans	Upper	Upper

Fire Fuel Behavior Model: []

Structural Data (for upper layer lifeform):

Min Canopy Closure: 0 %

Max Canopy Closure: 100 %

Min Height: Herb 0m

Max Height: Herb >1.1m

Max tree size class: None

Upper Layer Lifeform (select one):

Tree Shrub Herb

Upper Layer Lifeform is not Dominant

If checked, please specify the dominant lifeform, and its minimum and maximum canopy cover and height:

Class B

Landscape %: 12

Cover Type: Mid Development 1

Struct. Stage: Open

Description: SAVANNA. This class ranges from 5-14 years and succeeds to class C. Savannas conditions occurred where fire was fairly frequent allowing some trees to develop (5-15 yrs). Any area that does not burn frequently would convert to woodland conditions (class C). Replacement fire, modeled at the probability of occurring every 40 years, would send class B to class A. Surface fire, modeled at the probability of occurring every 33 years, would maintain the system in this class. Native grazing, modeled at the probability of occurring every 100 years, would also maintain the system in this class.

Class Indicator Species	Indicator Spp.	Canopy Position
QUAL Quercus alba	Upper	Upper
QUVE Quercus velutina	Upper	Upper
ANGE Andropogon gerardi	Lower	Lower
SCHZ4 Schizachyrium	Lower	Lower

Fire Fuel Behavior Model: []

Structural Data (for upper layer lifeform):

Min Canopy Closure: 11 %

Max Canopy Closure: 20 %

Min Height: Tree 0m

Max Height: Tree 25m

Max tree size class: Large 21-33" DBH

Upper Layer Lifeform (select one):

Tree Shrub Herb

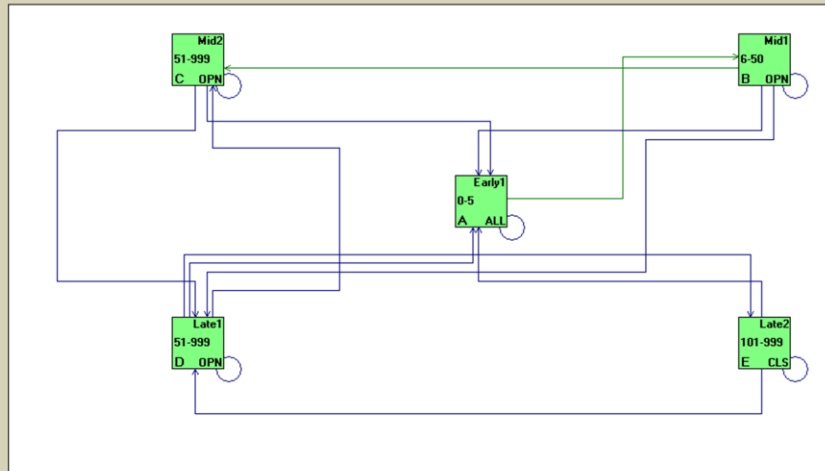
Upper Layer Lifeform is not Dominant

If checked, please specify the dominant lifeform, and its minimum and maximum canopy cover and height:

BpS Review website: <http://www.landfirereview.org/>

While the general information is interesting to me, the real value added in my mind is on the succession classes tab. For each LANDFIRE model and description we developed 5 or fewer succession classes or seral stages. We described them in terms of species, disturbance, canopy characteristics and percent of the landscape that would have been occupied by the succession classes under natural disturbance regimes. I've circled a couple of items here. While these succession classes shifted around the landscape historically due to disturbance so we did not develop a historic s-class map, but we do map these today. The canopy characteristic are important for that. Also, I wanted to point out that the percentages come from the modeling we'll discuss next.

Modeling: Succession Class Percent



Boxes = Succession classes. Lines = disturbances or succession

BpS Review website: <http://www.landfirereview.org/>

To get an estimate of how much of each succession class would have been on the landscape we used state and transition models developed in Vegetation Dynamics Development Tool by ESSA technologies. While the modeling platform has evolved- we now use ST-Sim, the concepts are the same. Each box represents a succession class, the green lines that come out of the sides of the boxes succession and the blue lines coming out of the tops and bottoms disturbance. You'll also see the age ranges (such as 0-5), a box label (such as "A") and a broad structure label (such as "Open").

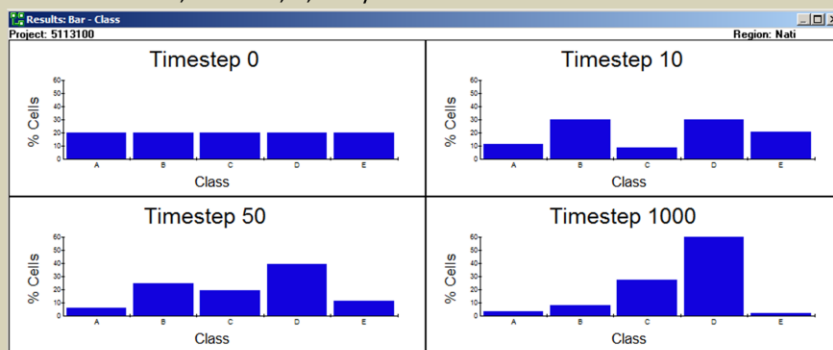
Modeling: Succession Class Percent

Inputs for VDDT modeling included:

- basic parameters for each Succession Class (structure, start and end age)
- types and annual probability of disturbances
- what happens when there is not a disturbance

Models were run:

- 10 times for 1,000 cells, 1,000 years



BpS Review website: <http://www.landfirereview.org/>

The experts looked to literature, personal experience and other data to come up with information to parameterize the models. The succession classes typically represent some sort of break in development of the BpS such as when shrubs start to fill in if there is no fire, when a dominant tree starts to bear cones or when the broad structural characteristics stabilize. The model is probabilistic so we entered an annual probability of a disturbance affecting a cell in a particular succession class and what happens to that cell. When a cell is not affected by a disturbance it succeeds to the next succession class. The models were run 10 times for a thousand years, which is long enough for them to stabilize.

Modeling: Review

“High-touch” hands-on process

1. Experts reviewed models and descriptions
2. Reviews were incorporated into the descriptions & models
3. Automated and manual quality assurance and quality control.

Not perfect!

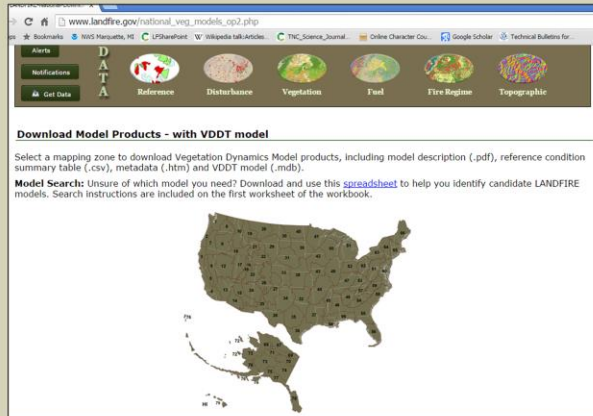


BpS Review website: <http://www.landfirereview.org/>

Once we had descriptions and models we began the review process, which was intense and fast. As mentioned earlier we were submitting BpS bundles every 2 weeks so we were not able to always incorporate feedback. This review will be different as we will have a long “open season” for review and incorporation. While the BPS bundles were our main focus for 2 years, we know there is room for improvement.

Delivered

- Description and Model bundles delivered every two weeks
- First cog in the machine of BpS, S-Class, Vegetation Departure and other mapping processes



BpS Review website: <http://www.landfirereview.org/>

After review and QA/QC we delivered the bundles to the LANDFIRE mappers who ingested them into their mapping processes. In many ways it was an insane time of life for people in the LANDFIRE project.

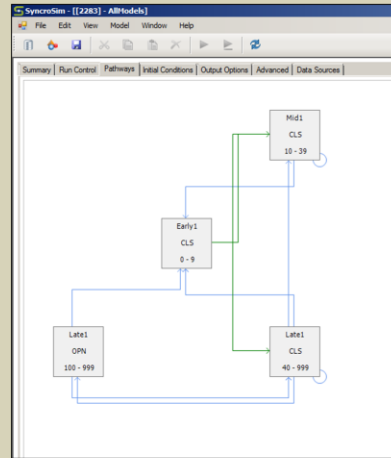
Uses

The screenshot displays three journal article entries from Elsevier. The first entry is from the *Journal of Arid Environments*, Volume 124, January 2016, Pages 388–397. The article title is "Precipitation regime classification for the Mojave Desert: Implications for fire occurrence" by Jerry Taguestad^a, Matthew Brooks^a, Valerie Cullinan^a, Janelle Downs^a, and Randy McKinley^b. The second entry is from *Forest Ecology and Management*, with the article title "Post-fire forest dynamics and climate variability affect spatial and temporal properties of spruce beetle outbreaks on a Sky Island mountain range" by Christopher D. O'Connor^{a,c,d}, Ann M. Lynch^{b,c}, Donald A. Falk^{d,e}, and Thomas W. Swetnam^c. The third entry is from *Ecosystems*, with the article title "Previous Fires Moderate Burn Severity of Subsequent Wildland Fires in Two Large Western US Wilderness Areas" by Sean A. Parks^{1,2,*}, Carol Miller¹, Cara R. Nelson², and Zachary A. Holden³. To the right of these articles is a list of uses: Research, Conservation planning, Input for other models, Fire management planning, and Ecological assessment.

In addition to the mapping I mentioned earlier, planners in multiple agencies are using them as “starter models.” They will take the basic LANDFIRE models, add in current management such as logging or fire suppression then develop optimization models to figure out land management strategies to get them to their desired future conditions. Also, I’ll note that programs such as FSC certification refer to LANDFIRE as a place to get historic ecological information.

Why Review?

- “Blunders” e.g. typos, inconsistencies, and so on
- New science
- Missed opportunities
- Potential for upgraded delivery system
- Updated modeling software

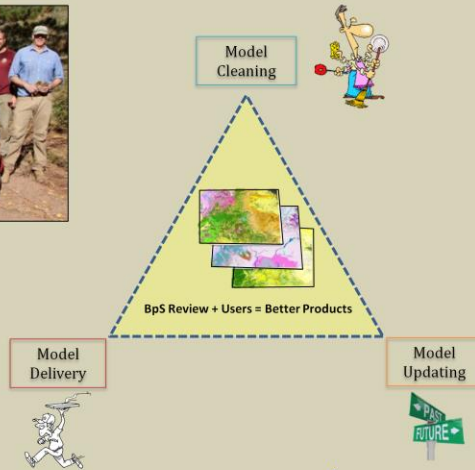


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There has been no comprehensive review of the LANDFIRE National model set since their original delivery from 2005 through 2009, only sporadic, ad hoc, inconsistent review based upon immediate opportunity. Since then, errors and inconsistencies have been discovered, and missing information identified. There is reason to believe that supporting science may have improved. Thus, the time is right to review and potentially revise LANDFIRE National BpS models. Leading the review process is The Nature Conservancy's (TNC) LANDFIRE team.

Our Philosophy

BpS Review + Users = Better Products



BpS Review website: <http://www.landfirereview.org/>

We are certain we can improve the BpS descriptions and bundles with your help, though not everyone agrees. Some feel that we will only make them different...We also know that there will be conflicting views. We will do our best to reconcile differences. We will try to make this process as painless and interesting as possible.

BpS Review Process

- We have “cleaned” the BpS list by removing duplicates and near duplicates.
- The documents are posted on the dedicated BpS Review website.
- Contributors may review the Word document/description, or do both the document and the model.
- Most review is conducted in contributors’ locations, e.g. office desk, laptop, etc., though the LANDFIRE team will hold WebEx training sessions and are available to help as needed.

BpS review website: <http://www.landfirereview.org/>



The BpS review involves three steps: model cleaning, model updating, and model delivery. If you know how vegetation systems function, or have ideas how we can better deliver the information, we want your expertise and input. Start at the BpS review website where you'll find information on how to join the effort

Online Connections



LANDFIRE Program Home <http://www.landfire.gov>



Conservation Gateway: <http://nature.ly.landfire>



Twitter: [@nature LANDFIRE](https://twitter.com/nature_LANDFIRE)



YouTube: [LANDFIREvideo](https://www.youtube.com/LANDFIREvideo)



Bulletins/Post cards via e-mail

– Opt in: <http://eepurl.com/baJ BH>



Email: LANDFIRE@tnc.org

BpS review website: <http://www.landfirereview.org/>