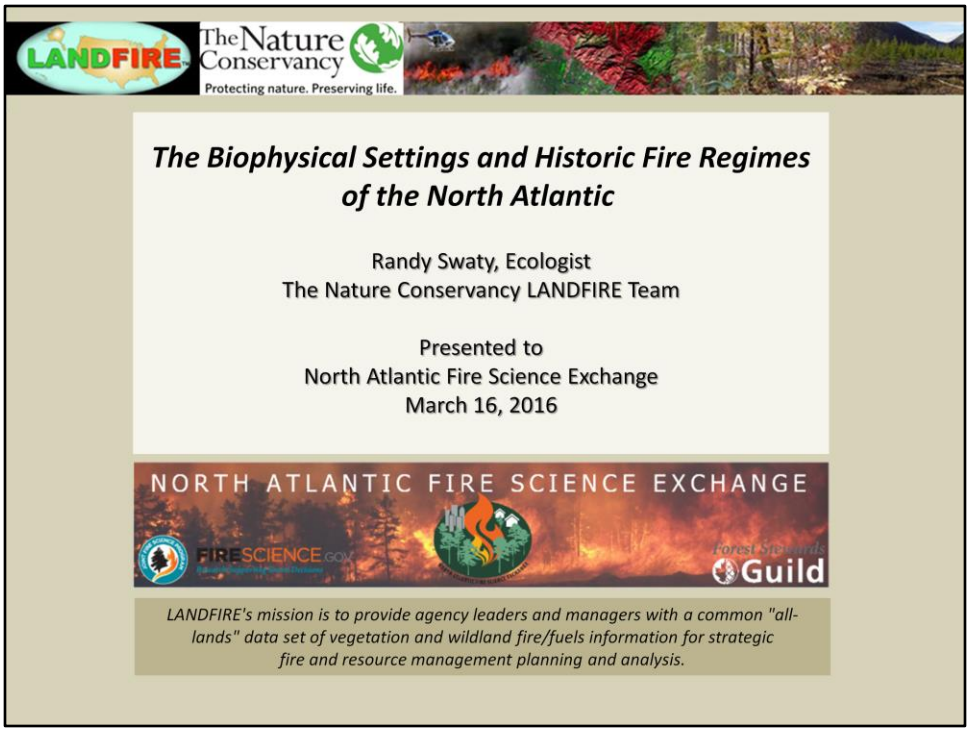


Welcome, and Randy's biographical information

- Received BS/MS at Northern Arizona University in Flagstaff.
- Scientific specialties span spatial scales, ranging from community genetics to mycorrhizal ecology and landscape-scale planning.
- As Michigan's Forest Ecologist, Randy worked with a variety of large landowners to promote sustainable landscapes
- He has worked to improve forest certification standards, participated in Conservation Area Planning, served on TNC's Conservancy's Forest Management SOP team, participated in the Global Fire Assessment and directs workshops and seminars on the use of LANDFIRE data and products.
- Started at TNC in 2002 and joined LANDFIRE program in 2007, as the Great Lakes region modeling lead.
- He develops vegetation models and helps people apply LANDFIRE products within and outside of the Conservancy.

Today's Agenda

Randy Swaty
rswaty@tnc.org

- LANDFIRE Primer
- North Atlantic Historic Fire
- Great, but wait…
- How you can obtain and improve LANDFIRE data
- Learning opportunities

My LANDFIRE Story…

My story…worked with industrial land owners in the Upper Peninsula to develop landscape-scale assessments and found that a big obstacle for this work was cross-boundary data. Most of the industrial land owners had timber stand data, as did the agencies, but there was no data for the non-industrial private land owners, much of the data was not comparable. Also, we had gaps in documentation of historic ecosystem structure and function. Then I heard about LANDFIRE, a program aimed at mapping vegetation conditions across the country and along the way modeling how all the ecosystems of the US worked historically. I was in. 10 years later, while acknowledging it's not perfect, I'm still amazed and excited about LANDFIRE. There's nothing like it in the world!

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.

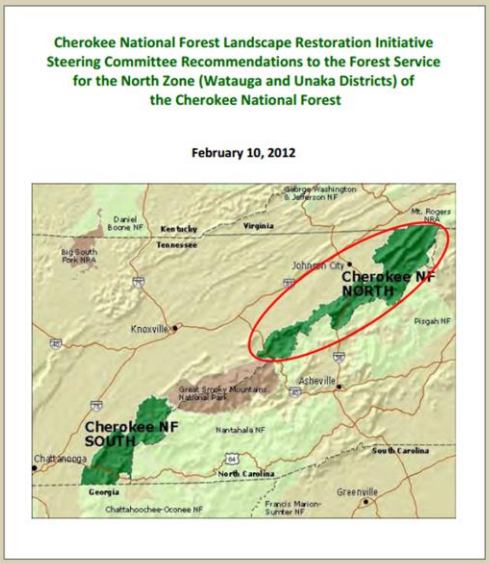
So LANDFIRE is a name, perhaps conjured up over a beer. It's OK but it pigeonholes us. I keep plenty busy using the data in areas that are not fire driven. I wish it were Land-veg. As much as I respect and admire fire managers, I come from a background in soil fungi so watch for a LAND-FUNGI paper coming out this year!

Some Uses for LANDFIRE

Landscape assessments
- Rx fire
- Forest Certification (FSC)

Research
- Wildlife habitat
- Modeling

Management planning
- Scenario modeling
- Collaborative learning



- Landscape assessments
  - Rx fire-IW, MI, CO and others have used LANDFIRE combined with local data have aimed to ID high priority areas for RX fire
  - Forest Certification (FSC). You'd think I wrote Principle 6 of the Forest Stewardship Council as it requires a broad view of current and historic vegetation types and succession classes.
- Research
  - Wildlife habitat-By combining different LANDFIRE datasets then filtering the combinations you can map Bigfoot Habitat.
  - Modeling-LANDFIRE data and models have jumpstarted carbon, fire, wildlife and climate modeling
- Management planning
  - Scenario modeling-The Cherokee NF had a problem-vocal stakeholders who did not agree on what to do. More fire/less fire, more thinning/less thinning. They brought in a talented facilitator modeler named Greg Low who basically modeled out their positions and thoughts. Now they have a partnership who developed recommendations for the forest together.
  - Collaborative learning

Application Stories

WHAM!

- To explore some of the ways people are using LANDFIRE, visit the WHAM! It's not all the uses, and focuses on non-fire uses.
- One of our goals with this map is to transfer lessons learned from the user community. Users are always innovating, working around data issues and combining datasets in novel ways to answer questions that we never considered.
- You can check it out at the address shown here. Every orange dot on the map takes you to a short description of the project which includes links to more detailed information.

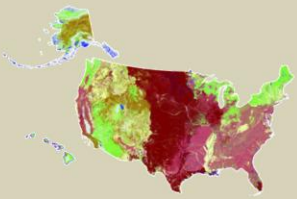
Introduction to LANDFIRE

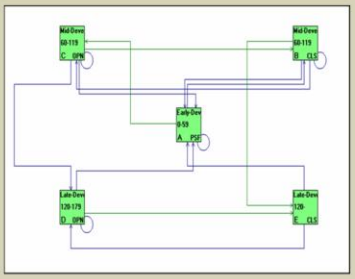
- Aspatial models and descriptions
- Tons of spatial datasets
- Software and GIS extensions
- A way of thinking
- A vibrant community of users/hackers/contributors

More than fire, more than GIS, more than a "toolbox"

To set the stage for some of the maps and graphs to come, we'll need to tour the state and transition models developed in LANDFIRE.

Model Development





TNC had a cooperative agreement to describe and model "Reference Conditions" for the ecosystems of the US.

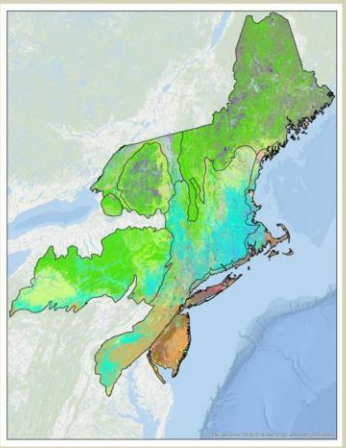
http://landfire.gov/NationalProductDescriptions24.php

I want to separate out some of the aspatial and spatial products. Here I want to drill into what we call models.

Essentially, LANDFIRE produced the country's first encyclopedia of ecosystems! LANDFIRE described how the ecosystems of the US looked and worked prior to major European settlement. To do this, TNC ran dozens of workshops with hundreds of experts who first described the ecosystems, then modeled the disturbances to get an estimate of how much of each developmental stage or succession class would be on the landscape. These descriptions and models were then reviewed, QA/QCd and are available to you here. We'll provide these links to you later.

Reference Conditions/BpS

- Described how 1300+ ecosystems looked and worked prior to pre-European settlement
- Broke each ecosystem into 5 or fewer succession classes defined by species, % cover and height
- Used Vegetation Dynamics Models to model % of each



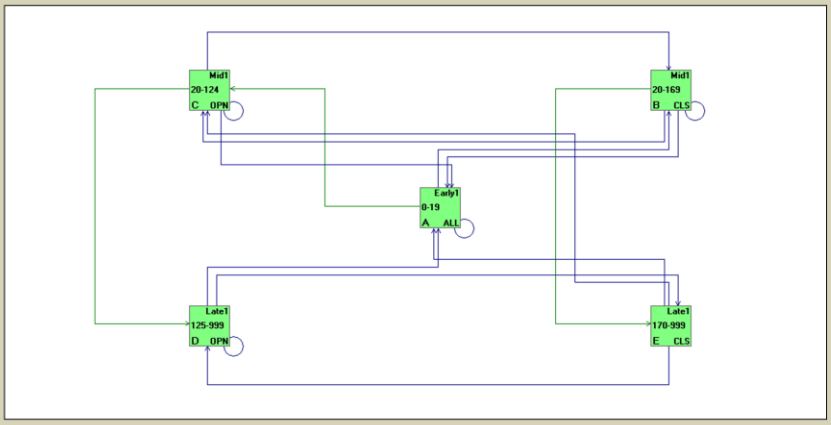
LANDFIRE calls these types "Biophysical Settings" or BpS

A note about Biophysical Settings as Reference Conditions: 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 view 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.

Vegetation Modeling is used in LANDFIRE to

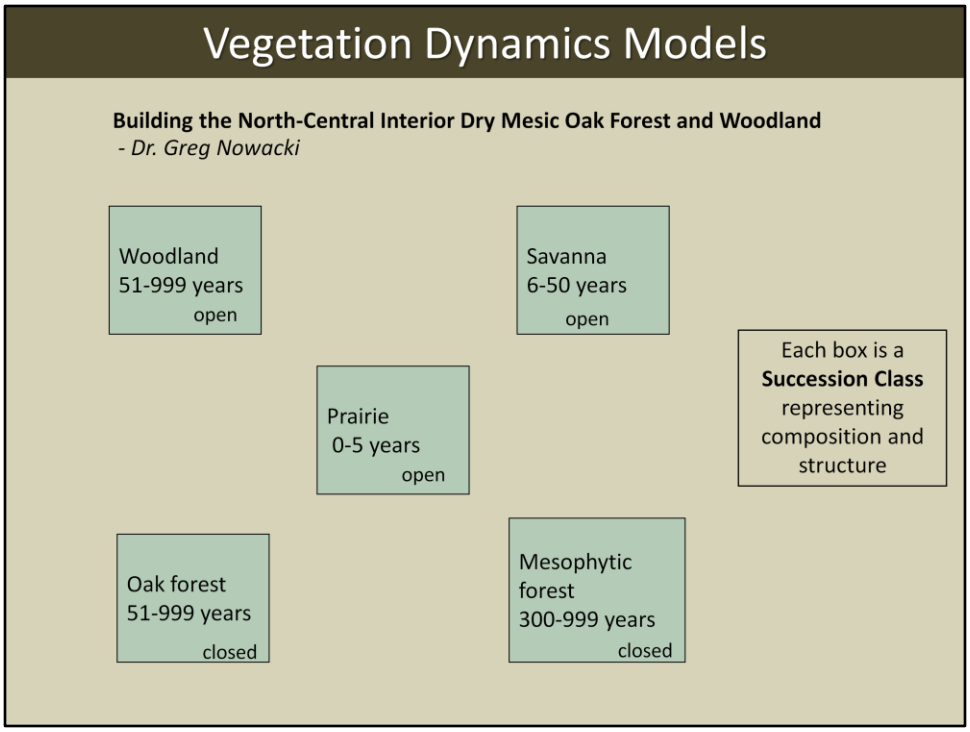
- Understand historic disturbance patterns
- Estimate proportions of succession classes
- Get overall return interval of surface, mixed and replacement fires
- Map spatial layers
- Engage experts

Vegetation Dynamics Models

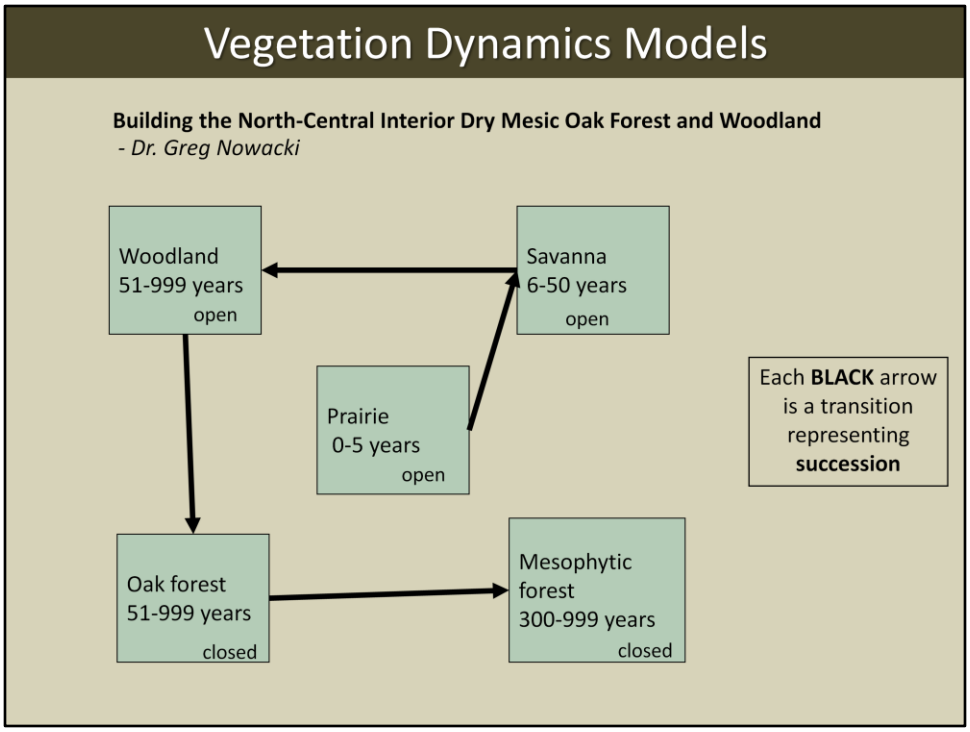


The models look like this. Using the Vegetation Dynamics Development Tool, which has been since replaced by software called ST-sim, we entered in the parameters of the succession classes, up to 5, then the natural disturbance regimes and their impacts. These natural disturbances include 3 types of fire, wind, flooding, insects and can also have user defined disturbances such as beaver herbivory.

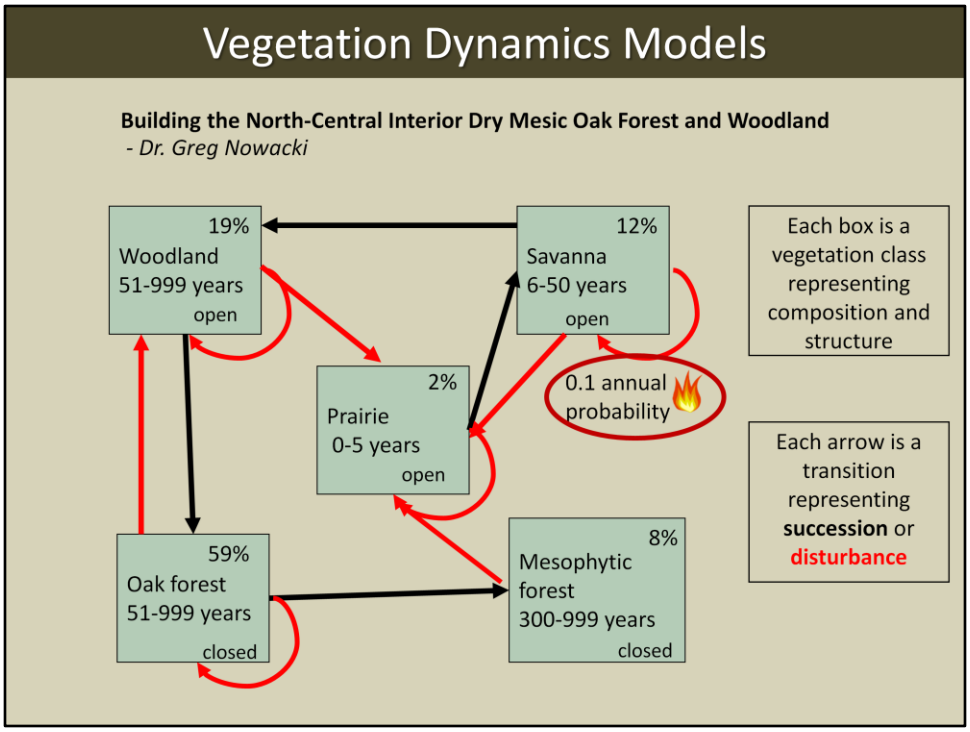
- These are state-and-transition models that quantify rates and pathways for succession and probability of disturbance under pre-settlement reference conditions.
- Accompanied by a description document that describes the site characteristics, species, geographic ranges, etc. for each Biophysical Setting, or BpS.
- Models used to estimate reference conditions for each BpS , specifically how much of each succession class that would be on the landscape.



Here's another representation of how we build the model, one by Greg Nowacki for an ecosystem in Wisconsin. First we define the succession classes in terms of their dominant species, canopy cover, height and duration.

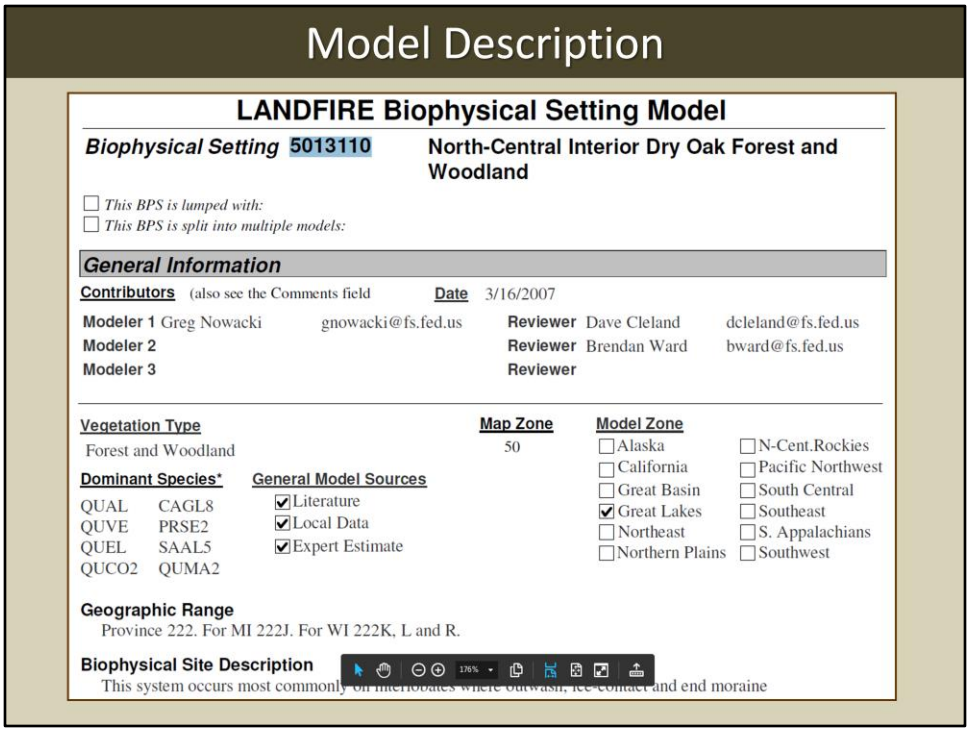


Next we add in succession, or what happens to a succession class if it does not experience disturbance. As you might imagine the canopy typically fills in, and the trees get taller in general.



Ok then the fun really kicks in. Here is an incomplete model that includes the succession classes, succession and some of the disturbances. In the software we input each disturbance type (could be one of 3 types of fire, wind/weather stress, beaver herbivory, flooding, any type of natural disturbance), the result of that disturbance and the annual probability. Thinking in annual probability is a bit strange as we typically think in return intervals. To get the return interval you simply divide 1 by the probability. In this case Greg modeled surface fire occurring in the savanna succession class every 10 years, with no change in the succession class status. It would simply open up the savanna, keeping it from succeeding to the woodland succession class.

Model Description



LANDFIRE Biophysical Setting Model

Biophysical Setting **5013110** **North-Central Interior Dry Oak Forest and Woodland**

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

General Information

Contributors (also see the Comments field) **Date** 3/16/2007

Modeler 1 Greg Nowacki gnowacki@fs.fed.us **Reviewer** Dave Cleland dcleland@fs.fed.us
Modeler 2 **Reviewer** Brendan Ward bward@fs.fed.us
Modeler 3 **Reviewer**

Vegetation Type
Forest and Woodland

Map Zone
50

Model Zone
☐ Alaska ☐ N-Cent.Rockies
☐ California ☐ Pacific Northwest
☐ Great Basin ☐ South Central
☑ Great Lakes ☐ Southeast
☐ Northeast ☐ S. Appalachians
☐ Northern Plains ☐ Southwest

Dominant Species*
QUAL CAGL8
QUVE PRSE2
QUEL SAAL5
QUCO2 QUMA2

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
Province 222. For MI 222J. For WI 222K, L and R.

Biophysical Site Description
This system occurs most commonly on interfluves where outwash, ice-contact and end moraine

- The models are accompanied by a text description. You can get a PDF file with all of the descriptions for a LANDFIRE map zone or a large database with the information for all BpSs across the country at www.landfire.gov...more information on the next slide.
- The descriptions contain information on the disturbance regimes, vegetation, abiotic factors that influence distribution (mapping), references and descriptions of the succession classes.

Getting the Bundles

http://www.landfire.gov/national_veg_models_op2.php

- To get the background files to run the actual models, and to get the descriptions navigate to this page from www.landfire.gov.
- LANDFIRE developed the descriptions and models by Map Zone…that you click to get the models you want

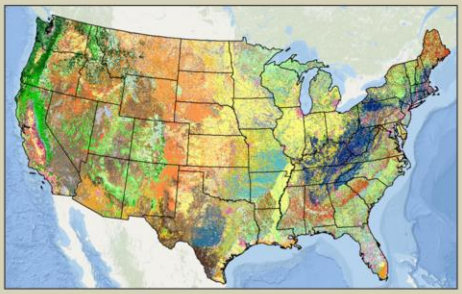
Models Summary

- Represent how the ecosystems of the US worked prior to major European settlement
- Two parts: the model and the description
- Linked to several spatial datasets
- Not a prescription for how things should be today or tomorrow
- Models can be hacked or modified

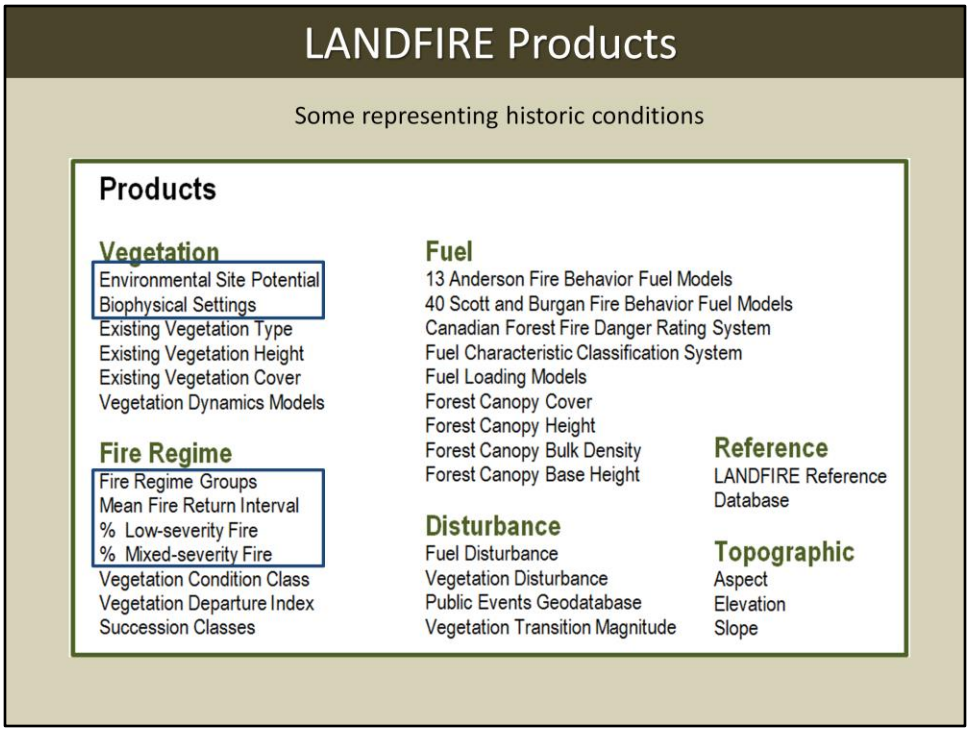
LANDFIRE and Spatial Context

LANDFIRE spatial data

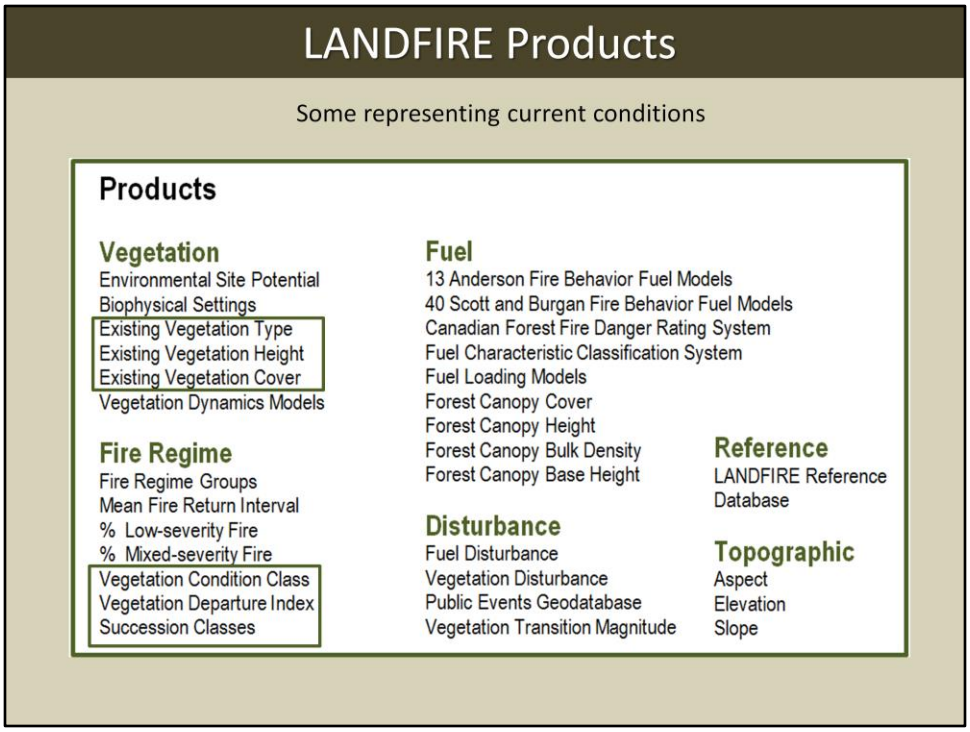
- Free
- Covers all lands in the U.S.
- Updated
- "Plays well with others"
- 30m pixel size; designed for large-scale use



LANDFIRE's Existing Vegetation Types, 2012



- This is a list of the LF products.
- They can be divided into 4 major groups: vegetation, fuel, fire regime and disturbance products. (Not shown here are the three topographic datasets: aspect, slope and elevation.)
- In the Vegetation group you can see that we map not only current vegetation but also several potential vegetation concepts.
- The Fire Regime suite maps reference fire regime information.
- Under Fuels you see that we map all the layers required to run common fire behavior modeling systems like Farsite and FlamMap.
- And, as a result of our updating process, we now have a new Disturbance product suite that maps the location of natural and human-caused disturbances.



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Today's Questions

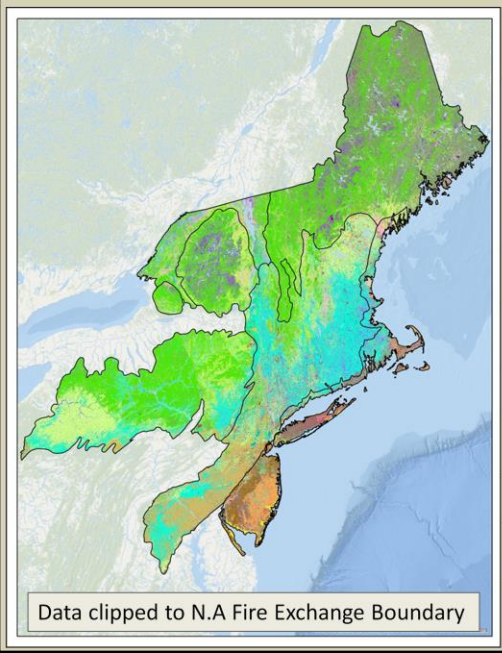
- What were the dominant Biophysical Settings of the North Atlantic Region?
- How many of those BpS's were fire-dependent, and how many acres did they cover?
- For some illustrative BpS's, how many acres would have burned annually?

- Questions I will *attempt* to address

Questions for You

- What do you agree with?
- What do you disagree with?
- How can/will you use the information?
- How will you help make LANDFIRE better?

Biophysical Settings

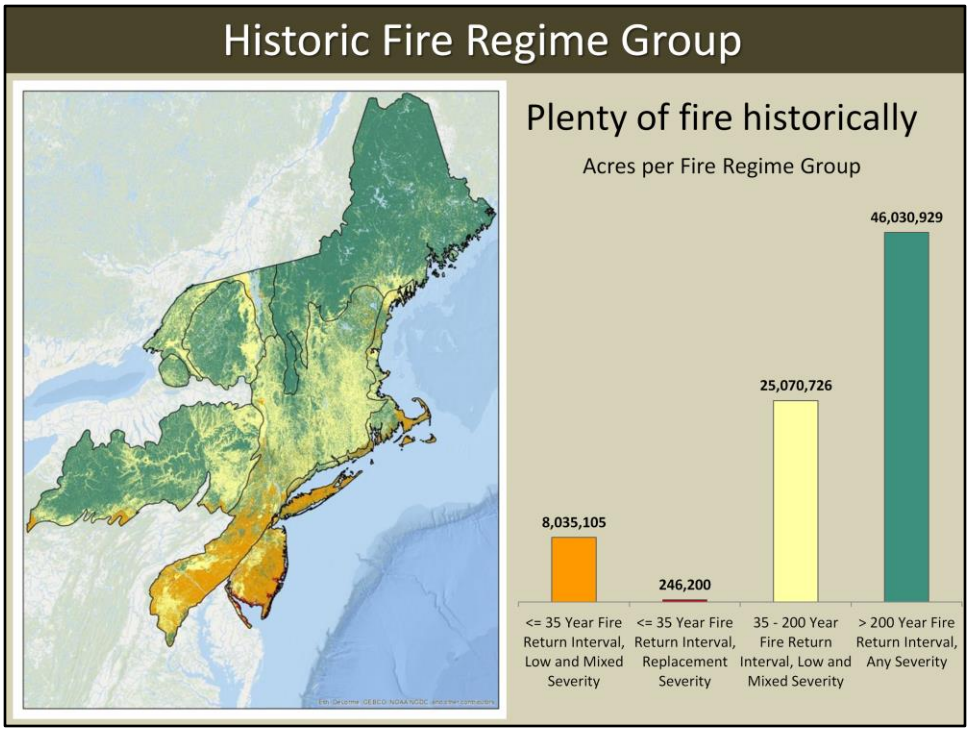


- 49 BpS's mapped
- 10 BpS's cover ~80% of the area

Laurentian-Acadian Northern Hardwoods Forest	23.62%
Central Appalachian Dry Oak-Pine Forest	13.37%
Acadian Low-Elevation Spruce-Fir-Hardwood Forest	12.20%
Appalachian (Hemlock-)Northern Hardwood Forest	8.96%
Laurentian-Acadian Pine-Hemlock-Hardwood Forest	8.17%
Northeastern Interior Dry-Mesic Oak Forest	5.41%
Acadian-Appalachian Montane Spruce-Fir Forest	3.26%
Laurentian-Acadian Swamp Systems	2.49%
Northern Atlantic Coastal Plain Hardwood Forest	2.34%
Central Interior and Appalachian Riparian Systems	2.09%

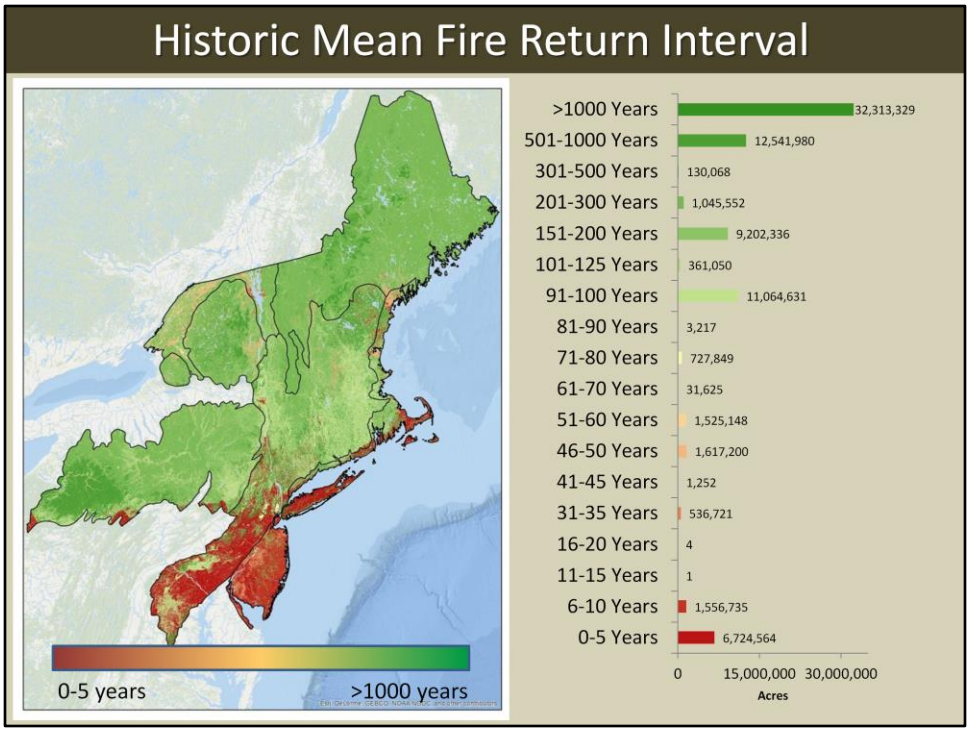
Here is one view of the pre-Settlement North Atlantic.

- LANDFIRE mapped 49 BpSs over this area, many having very minor representation
- 10 BpSs cover ~80% of the area.
- As you'll note some of these are very fire-dependent such as the Central Apps Dry Oak Pine Forest
- You'll also note no legend…I'll be digging into some of these BpSs in detail shortly, and would be happy to explore in more detail with you any time.



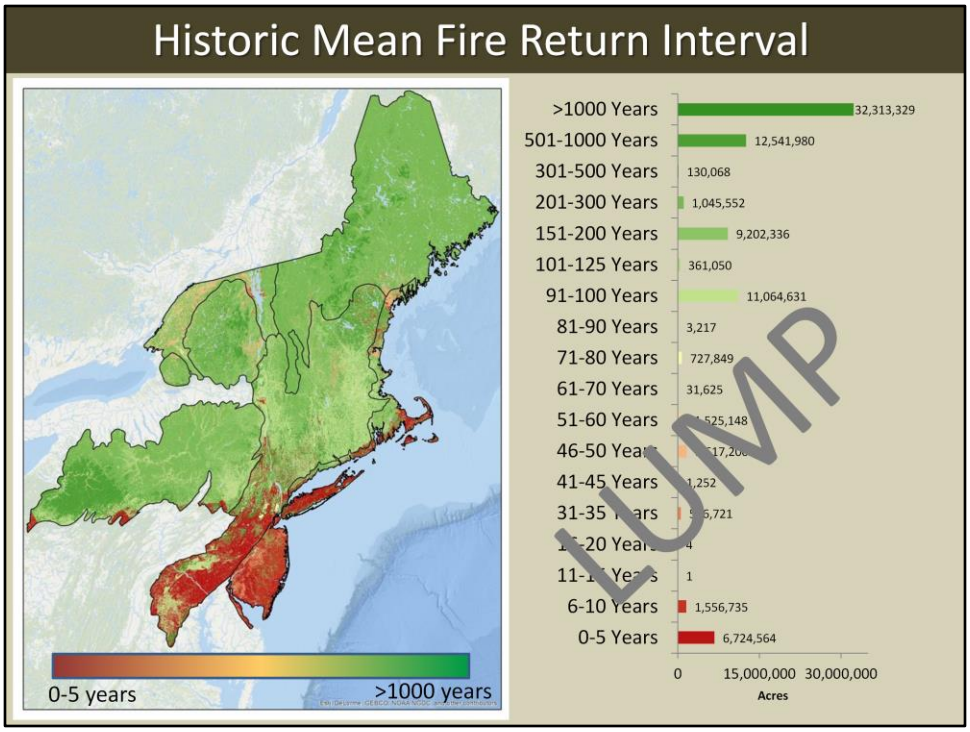
One way LANDFIRE characterizes historic fire patterns is by mapping Fire Regime Group. There are 5…only 4 mapped in the North Atlantic. This metric is coarse in terms of time, but includes severity information. As I, an uninitiated ecologist in the Midwest expected most, almost all fires modeled in the North Atlantic were low severity. The replacement fires were in the Gulf and Atlantic Coastal Plain Tidal Marsh Systems.

Honestly I prefer the more detailed look from the Mean Fire Return Interval data which I'll snow next.

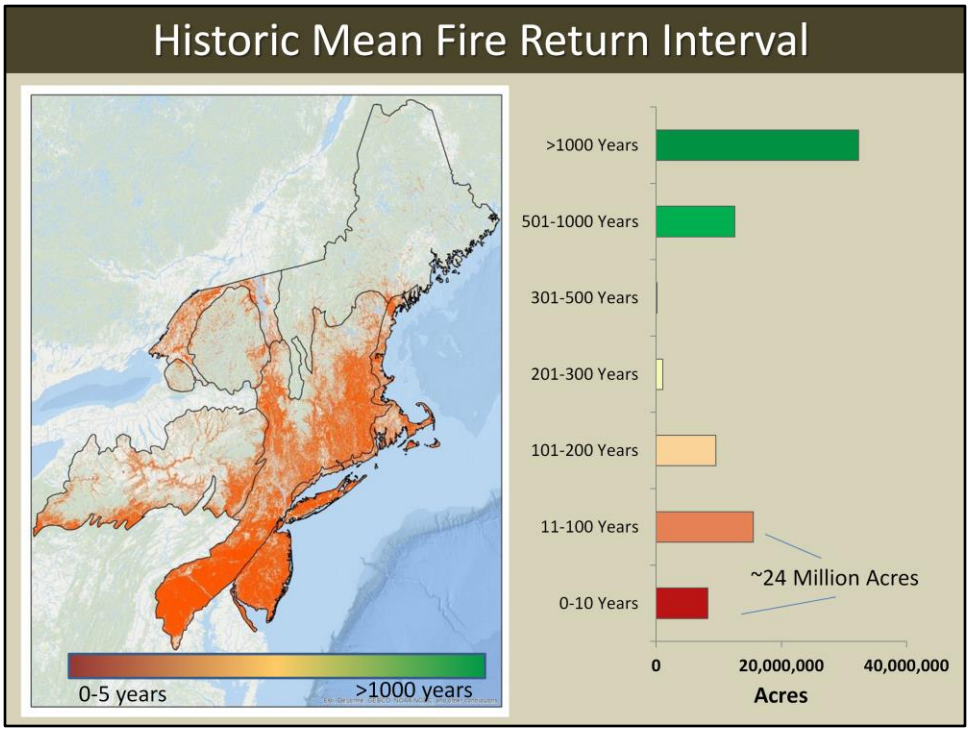


- ~30% of the North Atlantic has a historic mean fire return interval of less than 100 years
- This area has largely missed at least one fire…much of the area multiple
- Much of the fire comes from the oak ecosystems, but also as you know Pitch Pine and mixed Pine-Oak ecosystems and some coastal systems
- You can't miss multiple potential fires without consequence. What are those consequences in your mind?

- Ecologically it's important to have this level of detail. That said…depending on your view point it may be useful to lump.

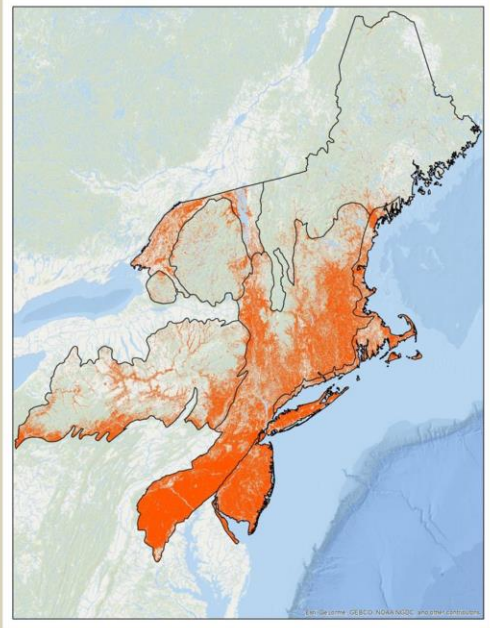


One way to think about this is in terms of missed fire. If we assume that most areas have missed fire since initiation of fire suppression we can do some lumping. Also, you may dig into the models and not agree with them. You may think that LANDFIRE has to short or long of fire return intervals for some areas.



- Here I have done some severe lumping. I like to separate out the very frequent fire from the rest. The amount of fire-dependent area is staggering to me. Not surprising, but amazing. Again this is pre-settlement, no ag or urban.
- As I mentioned earlier no one has ever criticized me for having too much fire. You might be the first today…we welcome the feedback. That said I expected more fire in the boreal systems up north.

Fire-Dependent Biophysical Settings



27 BpS's have modeled Mean Fire Return Interval of <100years

0-5 Years

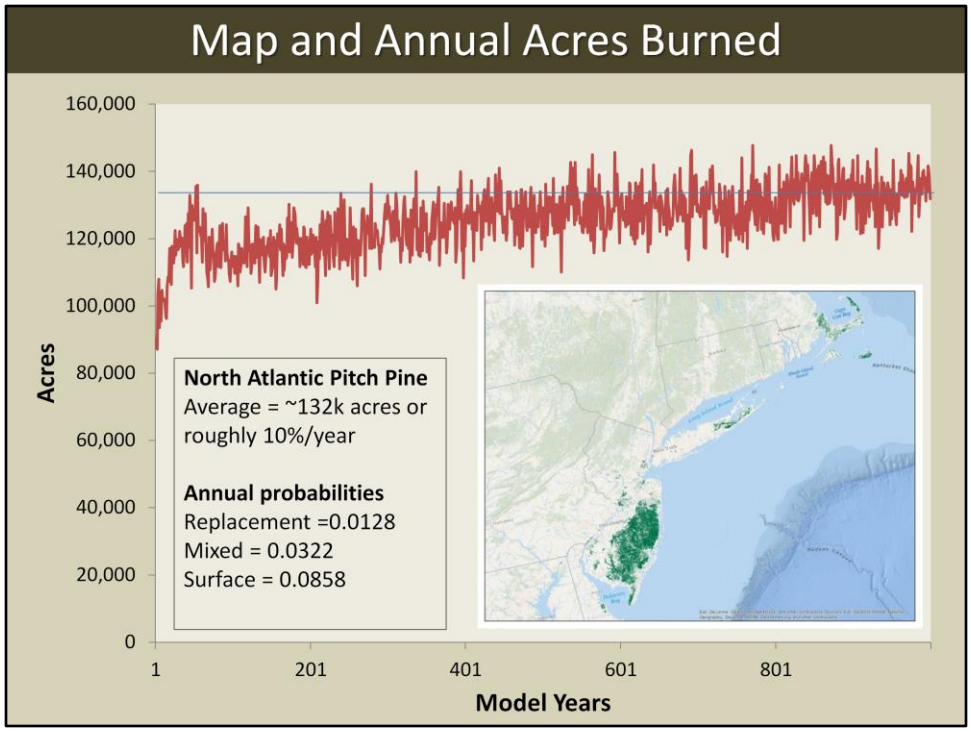
Central Appalachian Alkaline Glade and Woodland
Eastern Serpentine Woodland
Gulf and Atlantic Coastal Plain Tidal Marsh Systems
Northeastern Interior Dry-Mesic Oak Forest
Northern Atlantic Coastal Plain Dune and Swale
Northern Atlantic Coastal Plain Hardwood Forest
Southern Appalachian Montane Pine Forest and Woodland
Southern Piedmont Dry Oak(-Pine) Forest

6-10 Years

Allegheny-Cumberland Dry Oak Forest and Woodland
Atlantic Coastal Plain Peatland Pocosin and Canebrake
Northeastern Interior Pine Barrens
Northern Atlantic Coastal Plain Dune and Swale
Northern Atlantic Coastal Plain Maritime Forest
Northern Atlantic Coastal Plain Pitch Pine Barrens

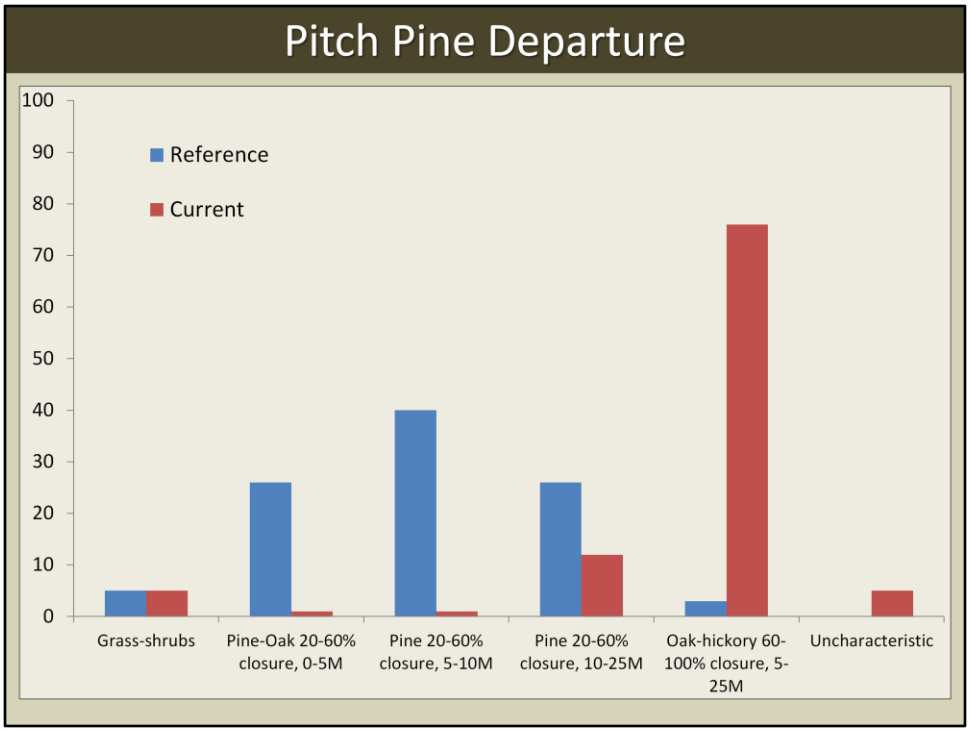
Here's another way to look at the previous data.

OK, we've explored some broad patterns of historic fire in the North Atlantic. There's potential for more in-depth explorations though. Let's dig into some fire-dependent ecosystems. As we do, look at the information and let me know what you think. Also, imagine the potential for further work. I spent a fair amount of time putting this together, but nothing like it would have been prior to LANDFIRE.

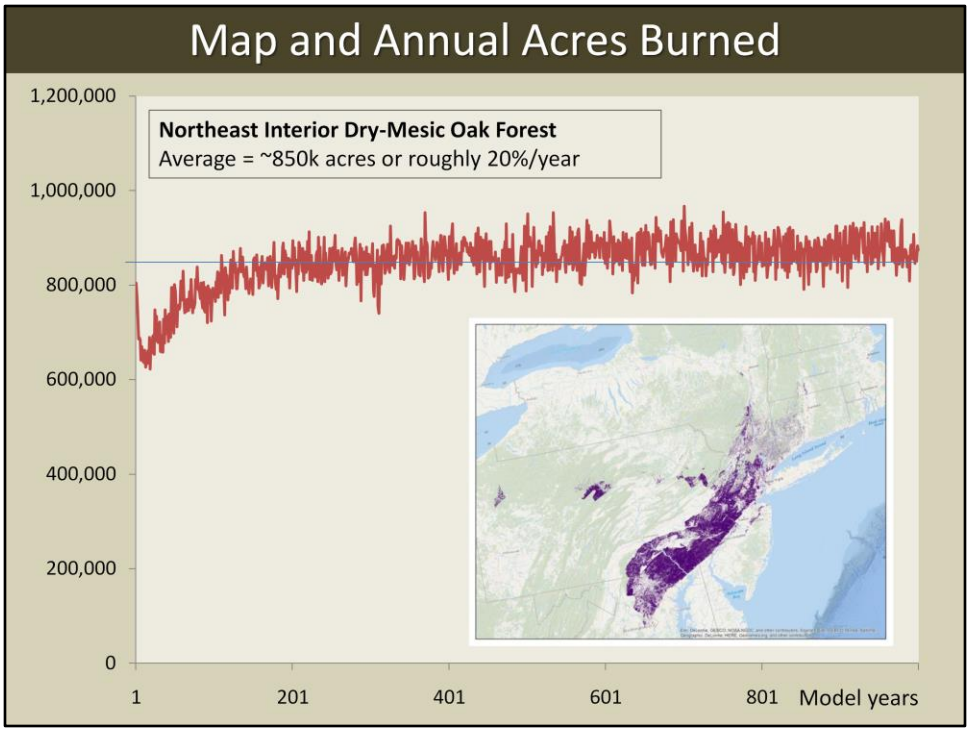


A lot of information here. The next few slides will be similar. Here is a map of the historic North Atlantic Pitch Pine in darkish green. I also went into the modeling software we use, St-Sim and ran the model. For LANDFIREE we ran the models for 1000 years with natural disturbance regimes. Not as an effort to literally go back 1000 years, but as a way to get to a more stable state.

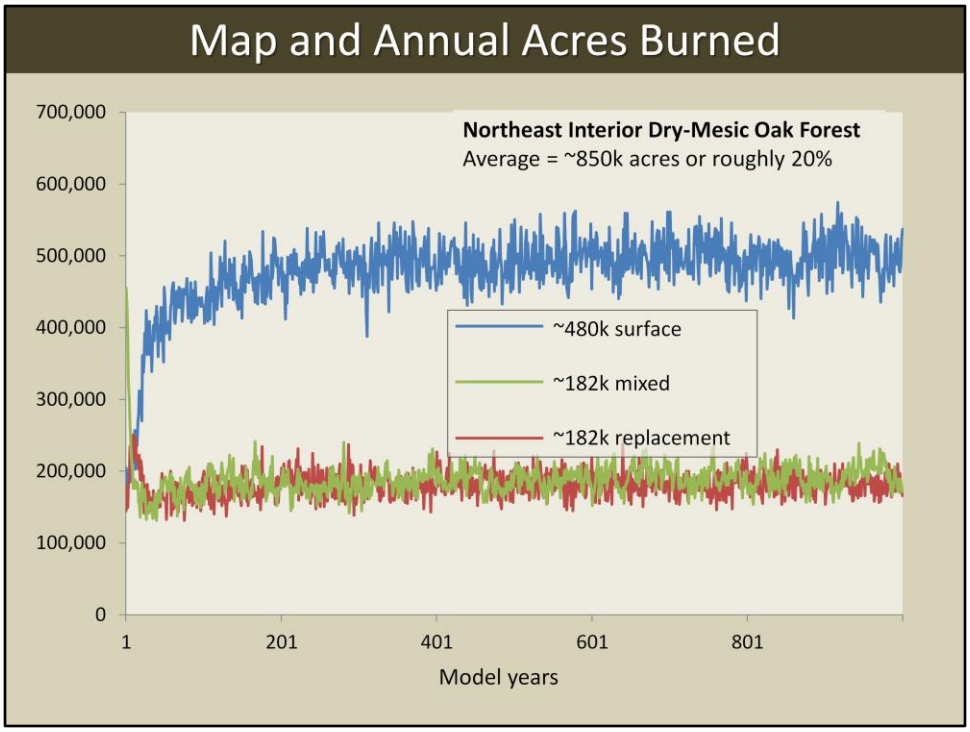
Based on our models, there would have been roughly 132,000 acres of fire in the Pitch Pine ecosystem annually. I have not split out surface, mixed or replacement fire here.



- Picking on the Pitch Pine again. See what fun you can have with Pivot Tables? On the bottom you'll see oh so short descriptions of the succession classes. On the y axis percent of the non AG, non Urban landscape currently in each succession class in red. The blue bars represent reference conditions from the models.
- Even though I am no expert in pitch pine, the trend makes sense and fits what we see around the country. More of the closed canopy succession classes in fire dependent ecosystems than under natural fire regimes.
- The devil's in the details. For example, should we have put more acres in Uncharacteristic? These are pixels that fall outside of reference in terms of height, cover or type. We may have mapped some red maple in the Oak-hickory class.
- Also, this is not a prescription…

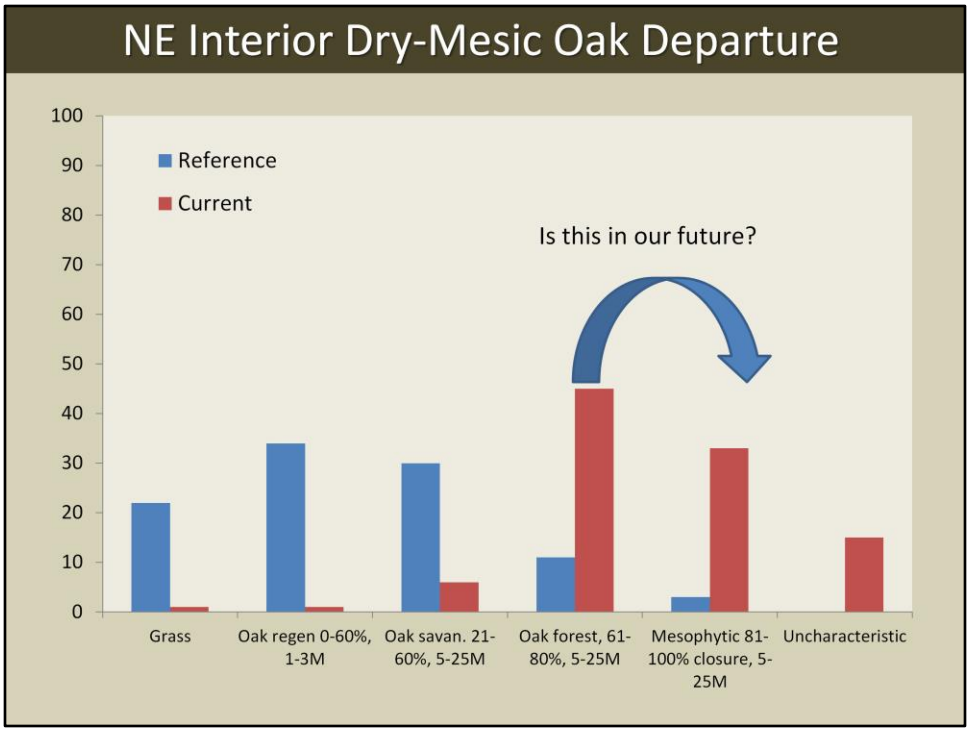


- Same set up, but for the NE Interior Dry-Mesic Oak Forest…roughly ~850, 000 acres of fire per year. We are almost up to one million acres already.
- This model was written by Daniel Yaussey and Greg Nowacki. I feel that it's a robust and credible model.
- Covers white and red oaks mostly, and on drier sites chestnut, clack and scarlet oaks. Chestnut and some hickories are also present in the description. Rarely did you find red maple or beech in this type.

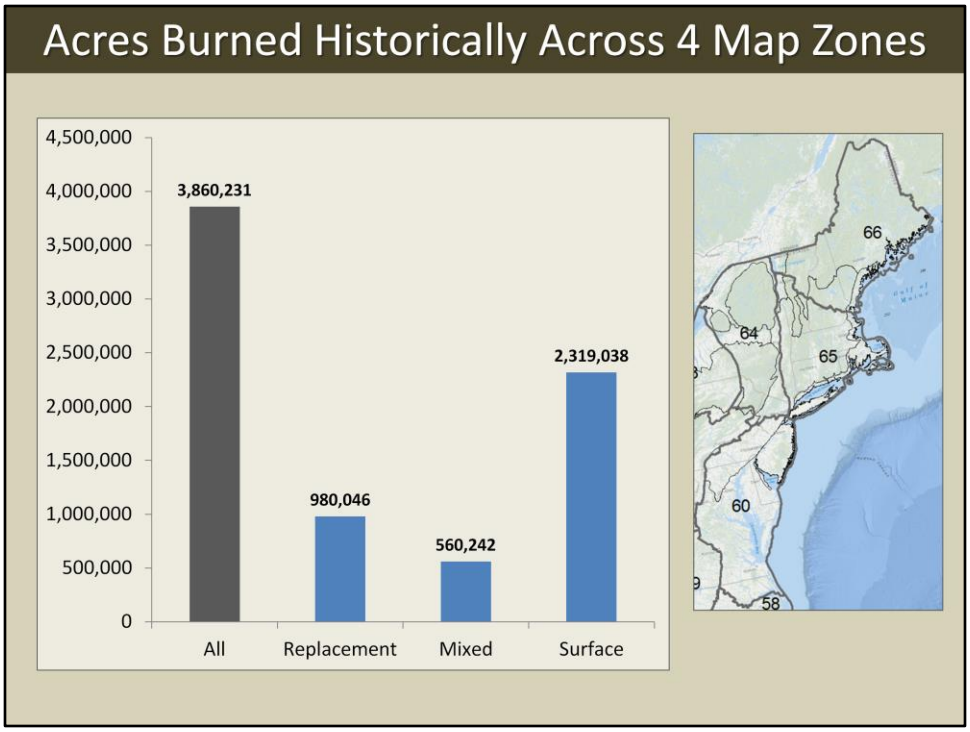


- Here I drilled in a bit more for the NE interior dry-mesic oak forest to find, as expected that annually more than half of the fire in this type would have been surface. I'd be curious to get your thoughts on this model. It spans a large area, and this is an average of the fires.

- Now that the models are parameterized it is easy to run them and generate graphs such as this to review and for background. We can also present other disturbances such as wind/weather/stress, insects and disease, herbivory (beaver), flooding and competition.



Same story, different species and different amounts. My guess is that without fire we're going to see more acres move to the more mesophytic succession class and/or the uncharacteristic class. Maybe this is good in some places, maybe a real headache for others.



I may have mentioned LANDFIRE map zones before. All of the datasets and models were delivered by Map Zone. These do not represent anything but data delivery polygons. They are obviously not political and in most cases not ecological.

Here I have departed from previous slides and present the fire types for these Map Zones. This is important to note. For a particular BpS that spans multiple Map Zones we could have had different experts with different views. Sometimes you'll get unfortunate lines in the data that follow these Map Zones. Sometimes the models are outstanding, but since they represent a large area you can get differences, reasonable ones, but differences just the same. I would expect the same Oak BpS to have different fire regimes from the southern part of MZ 60 to northern part of MZ 65. This may be represented as an unsightly line in the datasets.

Or-it may mean we need to improve the models…please help us. More on that in a moment.

LANDFIRE's Hope

1. **The basic patterns fit your understanding**
   - Historically, there was a lot of fire in some ecosystems.
   - Due to fire suppression, some BpS's are very different today from what they were.
2. **You saw something that needs improvement**
3. **You want to help LANDFIRE make it right**

You see potential for use

LANDFIRE + Users = Better Products

We are reviewing BpS bundles

- www.landfirereview.org
- Review Word documents or work with me to play with the models
- 30 minutes or ?????
- Mini-workshops
- Single models or regional patterns

Submit plot data

Online Connections

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

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

Twitter: @nature_LANDFIRE

YouTube: 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/