Using LANDFIRE Products for FSC compliance

The Nature Conservancy's LANDFIRE team

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Chapter 1

LANDFIRE and the Forest Stewardship Council US Standards

1.1 LANDFIRE and FSC Principle 6: General Potential

Principle 6 of the US Forest Stewardship Council standards (both current and draft) centers on Environmental Values and Impacts. There are several assessment criteria, with some focusing on documenting historical ecosystem attributes then comparing them to current. These criteria are where LANDFIRE products best fit.

Below we'll explore use of LANDFIRE products for specific indicators, with the DRAFT standards as the focus.

1.2 General

- list LANDFIRE datasets to obtain
- scale issue warning

1.3 Criteria 6.1, Assessing Environmental Values and Impacts

From the standards document (currently page 35 in draft):

The Organization shall assess environmental values in the Management Unit and FSC® NATIONAL FOREST STEWARDSHIP STANDARD OF THE UNITED STATES (V2-0 D1-0) 36 those values outside the Management Unit potentially affected by management activities. This assessment shall be undertaken with a level of detail, scale, and frequency that is proportionate to the scale, intensity, and risk of management activities, and is sufficient for the purpose of deciding the necessary conservation measures, and for detecting and monitoring possible negative impacts of those activities.

1.3.1 Indicator 6.1.1-assessment of conditions

This indicator seems to speak directly to LANDFIRE, as the suite of products can be used pretty directly to get at:

- forest community types
- succession classes
- natural disturbance regimes
- historical conditions (community types and succession classes)
- comparing historical to current conditions

Chapter 2

Software and Datasets

2.1 To get started you will need the LANDFIRE products. The hyperlined text will lead you to descriptions:

- Spatial datasets, clipped to your area(s) of interest
  - Biophysical Settings (BpS). This dataset will be used to get at "community habitat", or where ecosystems could occur based on abiotic factors (e.g., soils, climate).
  - Succession classes characterizes structural classes on the landscape at the time the dataset represents (e.g., 2016 for LF Version 200).
  - Existing Vegetation Type maps NatureServe's Ecological Systems (see descriptions here).
- Non-spatial products
  - Biophysical Settings Descriptions which has information on natural disturbance regimes and succession class descriptions (also available here).
  - Reference Condition Table supplements the BpS descriptions with the "reference" percentages for each succession class, for each Biophysical Settings.

2.2 Guidance on obtaining LANDFIRE products

There are multiple ways to get LANDFIRE depending on whether you are looking to obtain BpS models and descriptions or the spatial data:

- For BpS models and descriptions go to: http://landfirereview.org/search.php. Start by clicking on the "View map of LANDFIRE Map Zones". This will help you narrow down your search. Alternatively, you can wait to download BpS descriptions until you do some GIS work and get specific names of BpSs of interest.
- For the spatial datasets you can explore options here which include:

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* Downloading [Full Extent Mosaics](https://www.landfire.gov/version_comparison.
* Using the [LANDFIRE Data Distribution Site](https://www.landfire.gov/viewer/).
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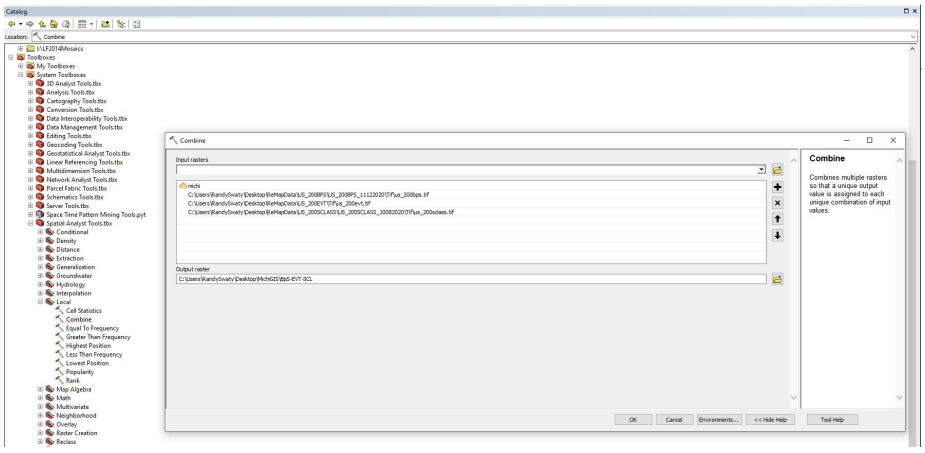
Chapter 3

GIS prep

3.1 Combine data

Once spatial data is properly projected and clipped to area of interest, perform a "combine" in ArcMap (Toolbox > Spatial Analyst > Local > Combine) of the BpS, SCL and EVT datasets. Alternatively, you can combine a raster of the area of interest with those 3 datasets which are stored as larger extents (like shown below).



3.2 Join in attributes

There are multiple ways-we recommend using the Join Field tool (Toolbox > data management tools > joins > add join). One reason to do this is to be able

to select which fields to join in. A potential resulting table looks like this for a landscape in Michigan (with minimal cleaning/formatting):

Show 3 entries Search:

	VALUE	COUNT	BPS_NAME	BPS_MODEL	GROUPVEG	EVT_NAME	EVT_PHYS	LABEL
1	1	155604	Open Water	na	Open Water	Open Water	Open Water	Water
2	2	4217	Laurentian-Acadian Northern Hardwoods Forest - Hemlock	13022_41_50_51	Hardwood	Northern & Central Ruderal Meadow	Exotic Herbaceous	UE
3	3	6051	Laurentian-Acadian Northern Hardwoods Forest - Hemlock	13022_41_50_51	Hardwood	Laurentian Jack Pine-Red Pine Forest	Conifer	UN

Showing 1 to 3 of 6 entries Previous 1 2 Next

As is this table does not mean too much-we will need to do some cleaning, formatting and calculating.

3.3 Clean data table

You will first need to save the combined ".csv" file file as an ".xlsx" file so that you can have multiple worksheets. We recommend keeping the original output as a "raw" spreadsheet in Excel, pasting that data into a new sheet and working with that new sheet moving forward. * It is OK to remove the "US_200BPS", "US_200EVT", and "US_200SCLASS" columns * Rename some columns: "GROUPVEG" to "BPSGROUPVEG"; "EVT_PHYS" to "EVTGROUPVEG"; "LABEL" to "SUCCESSIONCLASS", or similar as needed for clarity * COUNT = number of 30m x 30m pixels for that combination of BpS-EVT-SCLS. Insert a column named "ACRES", then calculate acres by multiplying COUNT by "0.222". Copy-Paste Values for that new column. Below is an example of what our new data table looks like.

Show 3 entries Search:

	VALUE	COUNT	BPS_NAME	BPS_MODEL	GROUPVEG	EVT_NAME	EVT_PHYS	LABEL
1	1	155604	Open Water	na	Open Water	Open Water	Open Water	Water
2	2	4217	Laurentian-Acadian Northern Hardwoods Forest - Hemlock	13022_41_50_51	Hardwood	Northern & Central Ruderal Meadow	Exotic Herbaceous	UE
3	3	6051	Laurentian-Acadian Northern Hardwoods Forest - Hemlock	13022_41_50_51	Hardwood	Laurentian Jack Pine-Red Pine Forest	Conifer	UN

Showing 1 to 3 of 6 entries Previous 1 2 Next

Now we are ready for some Pivot Table excitement!

Chapter 4

Historical Ecosystems

4.1 First Question: how many acres (what percent) of each ecosystem were in the area of interest historically?

For the next few questions we will work in a Pivot Table. To get started copy the entire "clean" sheet, click "Insert" at in the Excel ribbon then click "Pivot Table". Once your pivot table is created you can start to explore.

1. In the Pivot Table Fields pane, select BpS Name then acres.

2. Right click in the top "Sum of ACRES" field (not the table header), then sort in descending order.
3. In our example we have some BpSs that have low ACRES values. We also have categories that are not meaningful, such as "Barren-Rock/Sand/Clay". We can do a little formatting/cleaning before making a chart:

    - To remove BpSs from the table you will click the drop-down menu to the right of "BPS_NAME" in the Pivot Table Fields pane. You can uncheck BpSs as appropriate.
    - It is also possible to filter by right clicking on the top value in the list of BpSs, then selecting Filter > Top 10…. Once in that menu you can refine the filtering.

4. To get percentages, drag "ACRES" from the top Pivot Table Field pane to the "Values" pane. This will add a second "ACRES" column to the table. Click the drop down in the second instance of "ACRES" (reads "SUM of ACRES2" in our example), then Value Field Settings.

In this menu select the "Show Values As" tab, click the "Show Values As" drop down then select "% of Grand Total% to get percentages of each BpS (make sure that"BPS_NAME" is selected as the "Base field").

5. To get a "running total" of percentages you will add a third instance of "ACRES" to the "Values" pane, then Value Field Settings. In this menu select the "Show Values As" tab, click the "Show Values As" drop down then select "% Running Total In" to get running totals of percentages of each BpS (make sure that "BPS_NAME" is selected as the "Base field").
6. Save and keep this pivot table as is for now. We will make a couple modifications in the next section to get at a different question.

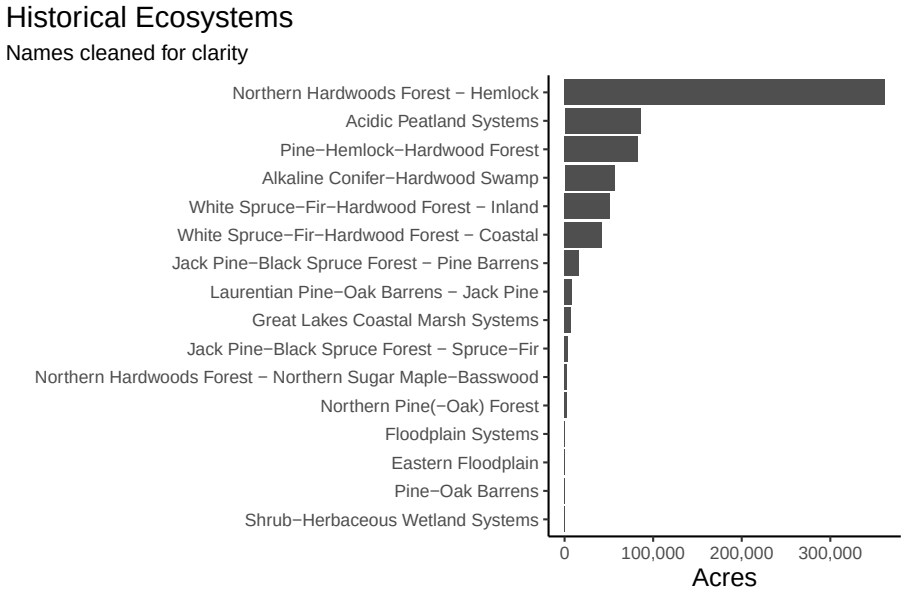
Formatted table of BpSs:

Show 3 entries Search:

	BpS	ACRES	PERCENT	RUNNING_PERCENT
1	Northern Hardwoods Forest - Hemlock	361509.018	50.09601316	50.09601316
2	Acidic Peatland Systems	85712.424	11.87757568	61.97358884
3	Pine-Hemlock-Hardwood Forest	82992.702	11.50069095	73.47427979

Showing 1 to 3 of 6 entries Previous 1 2 Next

We see that the top 4 BpSs comprised ~80% of our example landscape historically. We can visually confirm this and other patterns with a quick chart made in R (though similar charts available in Excel):



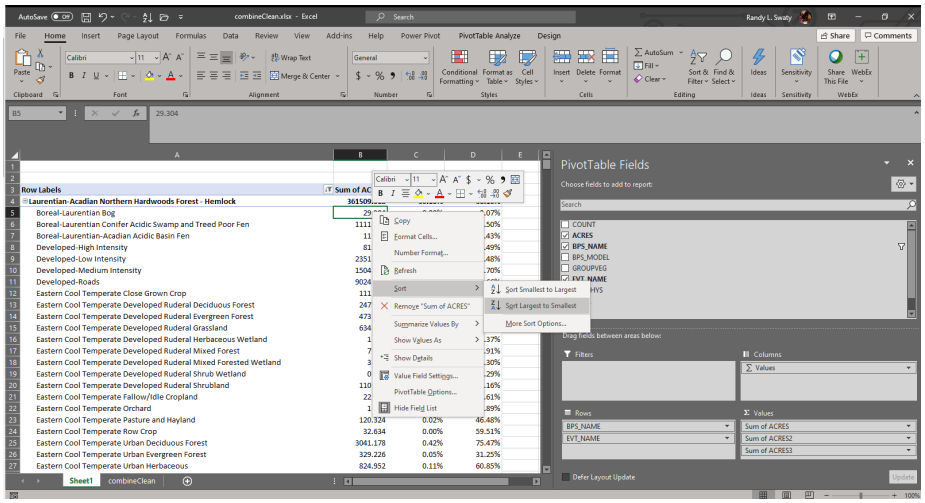
From LANDFIRE Biophysical Settings data

4.2 Second question: how much of the historic ecosystems have been converted to a different land use (e.g., agriculture), or have succeeded to a different ecosystem?

If you are new to Pivot Tables this next section will 1) demonstrate their power and 2) showcase ways they can mislead!

Working in the Pivot Table from before (or you can create a new one if you prefer):

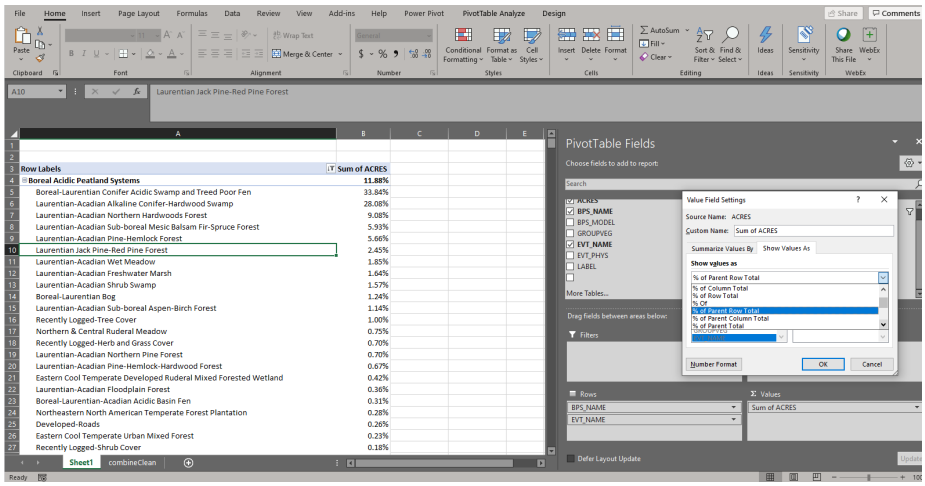
1. Check the box next to "EVT_NAME" in the Pivot Table Fields pane. Make sure that everything is arranged as in the screenshot below (e.g., "BPS_NAME" is on top of "EVT_NAME" in the "Rows" pane). Note-I am about to sort in descending order.



2. Review the results. In the example above we can see that what LANDFIRE mapped as Laurentian-Acadian Forest-Hemlock in the BpS data set has been split into many Existing Vegetation Types. If ordered we get a little more information, but the numbers are misleading. We'd like to see how much of what was Ecosystem X is still Ecosystem X, and how much is now Ecosystem Y, and so on, but the numbers are looking across the whole landscape. They need to be recalculated so we get the percentage of EVT per BpS.
3. To reconfigure the Pivot Table:

    - Drag the "Sum of ACRES2" and "Sum of ACRES3" field from the "Values" pane up to the Pivot Table Fields to remove it.
    - Click the "Sum of ACRES" item in the "Values" pane to access the Value field settings.
    - Click on the "Show Values As" tab, then select "% of Parent Row Total" in the "Show Values As" drop down.

Here's a screenshot of making that selection:



You'll see that ~34% of what was classified as "Boreal Acidic Peatland Systems" in the BpS dataset for our landscape is now classified as "Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen" in the Existing Vegetation Type dataset. Scroll through the table below to explore the resulting data. The table has been exported from the Pivot Table and cleaned up a bit for viewing.

Note: I filtered for the Top 10 EVTs per BpS.

Show 5 entries Search:

	BPS_NAME	EVT_NAME	Percent
1	Laurentian-Acadian Northern Hardwoods Forest - Hemlock	Laurentian-Acadian Northern Hardwoods Forest	77.83%
2	Laurentian-Acadian Northern Hardwoods Forest - Hemlock	Laurentian-Acadian Pine-Hemlock-Hardwood Forest	6.59%
3	Laurentian-Acadian Northern Hardwoods Forest - Hemlock	Laurentian-Acadian Sub-boreal Mesic Balsam Fir-Spruce Forest	2.75%
4	Laurentian-Acadian Northern Hardwoods Forest - Hemlock	Developed-Roads	2.73%
5	Laurentian-Acadian Northern Hardwoods Forest - Hemlock	Laurentian-Acadian Sub-boreal Aspen-Birch Forest	2.63%

Showing 1 to 5 of 179 entries Previous 1 2 3 4 5 … 36 Next

Looking at the Laurentian-Acadian Northern Hardwoods Forest - Hemlock for our landscape we note a few things:

- Most of what was mapped as this type historically in the BpS dataset is still mapped as that type

- Cumulatively about 6% of this type is now roads and recently logged types.
- The other EVTs mapped are not terribly "off-site" (e.g., something like "Plantation").

The fine print While this assessment is illustrative, it is important to note that the methods used to create the BpS and EVT datasets are substantially different, and LANDFIRE datasets are not made for assessing small areas. Please review.

Chapter 5

Applications

Some *significant* applications are demonstrated in this chapter.

5.1 Example one

5.2 Example two

Chapter 6

Final Words

We have finished a nice book.