Fire Regime Condition Class (FRCC)

Documentation to accompany Northwest Oregon FRCC grid (Veg_fuel_cc)
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Introduction

For centuries, fire has played an important role in shaping the composition, structure and processes of most native ecosystems. Wildfire suppression for the last 60-100 years, along with livestock grazing, introduction of invasive plants, and logging, has altered the natural disturbance regimes of most ecosystems in Oregon, especially those of short-interval fire-adapted ecosystems. As a result, in some ecosystems the number, size, and severity of wildfires have departed significantly from historic conditions, sometimes with catastrophic consequences (Allen and others 1998; Leenhouts 1998; U.S. GAO 1999; U.S. GAO 2002b). In addition, these altered fire regimes affect habitat conditions for plants and animals and other aspects of biodiversity. To evaluate the current conditions of lands in relation to their historic or "natural" reference condition, an interagency standardized assessment method, Fire Regime Condition Class (FRCC), was developed to describe the degree to which vegetation condition and structure, fire frequency and severity depart from natural or historical ecological reference conditions (Hann et al. 2005). Assessing FRCC can help managers gain a landscape perspective of conditions, evaluate risk to ecosystem sustainability, and develop a long-term strategy to improve condition class and assess management implications.

In 2005 FRCC methods were used to evaluate the landscapes of northwest Oregon to assist in fuels treatment planning, biodiversity assessment, and other aspects of restoration ecology. The intent was to provide resource managers with information at the local level to assess deviation in vegetation pattern, fire frequency/severity, and recommend treatment alternatives using the authorities under the Healthy Forests Restoration Act and the National Fire Plan. To achieve this, our specific objective was to map FRCC status at local watershed scales (4^{th} and 5^{th} HUCs). The analysis project area covers the Mt Hood, Willamette, Siuslaw, and portions of the Umpqua National Forests and Salem, Eugene and portions of Coos Bay and Roseburg Bureau of Land Management (BLM) units located in the Coast Range, Willamette Valley, Cascade West and a portion of Cascade East physiographic provinces. Several GIS coverages were produced and are available through the ecoshare website (www.reo.gov/ecoshare) for use by field managers. This paper documents the process followed to produce these coverages.

Background

Fire has been a dominant disturbance process over much of northwest Oregon for centuries. Fires play an important role in shaping the composition, structure and processes of most native ecosystems. A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995). Heinselman (1981), Morgan et al. (1996), and Brown (1995) describe five historical natural fire regimes which were modified and adopted for use at the national level (Schmidt et al. 2002) (Hann et al. 2004). Table 1 illustrates these five groups, organized by fire frequency and severity, as refined for the USDA Forest Service Pacific Northwest Region (Oregon and Washington).

Table 1. Fire regimes of Oregon and Washington using national categories refined for the Pacific Northwest Region.

Fire regime group	Frequency (Fire return interval)	Severity
I	0-35 years	Low severity (underburn)
II	0-35 years	High severity (stand-replacing)
III A	< 50 years	Mixed severity
III B	50-100 years	Mixed severity
III C	100-200 years	Mixed severity
IV A	35-100 years	High severity (stand-replacement), juxtaposed
IV B	100+ years	High severity (stand-replacing), patchy arrangement
IV C	100-200 years	High severity (stand-replacement)
V. A	200-400 years	High severity (stand-replacing)
V B	400+ years	High severity (stand-replacing)
V C	No Fire	
V D	Non-forest	

FRCC describes the degree of current fire regime departure from the natural or historic regime (Hann and Bunnell 2001, Hann et al. 2005). Table 2 describes each condition class, along with potential management implications. Condition classes rank the changes in both the type (fire size, frequency and severity) and effects (vegetation composition, structure) of fire from historic levels. The higher the condition class, the more altered the fire type and effects are, implying significant alteration of stand and landscape function. Condition class can also be expressed along a continuum of 1 to 100, rather than the categorical 1, 2, and 3 designations (i.e., conditional class 1 = 1-33% departure; condition class 2 > 33% departure and < 66% departure; and condition class 3 > 66% departure).

Table 2. Condition Class descriptions

Condition Class	Attributes	Example management options
1.	• Fire regimes within or near historical range (e.g. fire frequencies have departed from historical range by no more than one return interval) • Low risk of losing key ecosystem components • Vegetation attributes (composition and structure) are intact and functioning within historical range	• These areas can be maintained within the historical fire regime by such treatments as fire use.
2.	• Fire regimes have been moderately altered from their historical range (e.g. fire frequencies have either increased or decreased from range by more than one interval). Moderate changes in fire size, frequency intensity, severity or landscape pattern has resulted. • Moderate risk of losing key ecosystem components • Vegetation attributes (composition and structure) have been moderately altered from the historical range.	• These areas may need moderate levels of restoration treatments, such as fire use, hand or mechanical treatments to be restored to historical regime.
3.	• Fire regimes have been significantly altered from their historical range (e.g. fire frequencies have departed from historical range by multiple return intervals). Dramatic changes in fire size, frequency, intensity, severity or landscape pattern has resulted. • Vegetation attributes (composition and structure) have been significantly altered from the historical range.	• These areas may need high levels of restoration treatments, such as hand or mechanical before fire is used to restore to historical fire regimes.

In response to increasing severity of wildland fire effects across the United States over the last decade, the US Forest Service and Department of Interior developed both independent as well as interagency management strategies, with the primary objectives focused on hazardous fuel reduction and restoration of ecosystem integrity in fire-adapted landscapes. In 2000, Hardy et al. (2001) and Schmidt et al. (2002) developed a coarse-scale (1 square kilometer resolution) nationwide map of historical fire regimes and current departure. Designed to assist landscape and wildland fire management at the national level, these data layers include mapped potential natural vegetation groups, existing vegetation, historical fire regimes, departures, FRCC, fire occurrence histories and wildland fire risk to structures. This coarse-scale FRCC data, however, lacked the necessary spatial resolution and detail for regional planning and prioritization and guidance for specific local projects. In 2003, Schmidt et al.'s assessment, *(*GTR-RMRS-87*, Development of Course-Scale Spatial Data* *for Wildland fire and Fuels Management),* was used as guidance for assigning fire condition class until a rapid assessment protocol and fine-scale spatial data became available for immediate project planning. While Schmidt et al.'s (2002) assessment of conditions was coarse; it identified the significant challenges and opportunities in restoring forest resilience, reducing risk of unnaturally severe fires, and managing lands to avoid this problem in the future.

To improve on the Schmidt et al. (2002) assessment, the US Forest Service, US Department of the Interior land management agencies, and the Nature Conservancy began working on a five-year mapping effort called LANDFIRE (http://www.landfire.gov/). LANDFIRE is charged with developing consistent nationwide spatial data required to implement the National Fire Plan at regional levels. LANDFIRE recently released Rapid Assessment geospatial data and models of potential natural vegetation groups, fire regimes, and fire regime condition classes at a 30 meter resolution. Rapid Assessment, a preliminary version of LANDFIRE, was designed meet information needs until LANDFIRE National is completed in 2009. LANDFIRE National data is replacing Rapid Assessment data as it becomes available. (See www.landfire.gov.)

Fire management plans at the project level require an analysis of the historic role of fire by describing the types and distribution of fire regimes across our landscapes. In 2004, a nationally standardized, interagency FRCC protocol was released (Hann et al. 2005) which used the original FRCC concepts and definitions published in Hardy and others (2001), Hann and Bunnell (2001), and GTR- RMRS-87 (Schmidt and others 2002). This methodology provides a landscape level assessment of mapped conditions and incorporates two measures for condition class determination: 1) Succession class (S-Class)) distribution and 2) fire frequency and severity. Since disturbances operate at landscape scale, this methodology gives us a better picture of condition class by placing stand conditions in context with landscape conditions. This landscape approach recognizes that a range of stand conditions contribute to a condition class determination and is intended to capture the characteristic patterns of a fire regime. Within each landscape, the biophysical settings or BpS (the potential vegetation communities likely to exist under natural disturbance regimes) are delineated and the range of historical (reference) conditions (vegetation structures & fire frequency/severity) are described and modeled. Comparison of the current and reference conditions displays which stands are 'similar' (within reference conditions) and which stands are 'underrepresented' or 'overabundant' (outside reference conditions). A condition class determination is made for each BpS and overall for the landscape. This landscape perspective provides a framework for prioritization of treatment areas and provides information on the proportion of a landscape needing treatment to lead to an improvement of the landscape condition class. FRCC is therefore highly scale dependent and it is critical to work at the scale appropriate for the ecological processes under review. In general, the longer-interval fire regimes require larger landscapes for proper assessment.

Current and historical vegetation conditions are essential for planning, implementing, and monitoring projects supported by the National Fire Plan (2000) and the Healthy Forest Restoration Act of 2003. Under the Healthy Forest Restoration Act, FRCC is required to be assessed every five years. An FRCC analysis helps fire managers in a variety of ways. It:

- Identifies the amount and locations of land or communities with extreme departure from historical conditions. More departed ecosystems are generally less resilient and less likely to provide desired ecological services (wildlife habitat, water quality, etc.) over time.

- Facilitates the prioritization of ecosystem restoration and may aid in hazardous fuel reduction treatments.
- Identifies areas at risk of losing key ecosystem components
- Identifies areas of potential effects of uncharacteristic fire that would be detrimental to resource objectives.

FRCC Analysis

FRCC is computed using methods consistent with the Interagency Fire Regime Condition Class Guidebook (www.frcc.gov) using locally developed fire and fuels information. Calculating FRCC involves two distinct steps:

1. determination of the succession class (S-Class) condition class
2. determination of the fire frequency/severity condition class

The larger of the two condition classes becomes the overall condition class. Condition class can be expressed at the landscape Bps (or stratum), or overall landscape (weighted average of entire landscape, adding in all of the BpSs within that landscape). A stand FRCC can also be determined (described below).

Succession Class (S-Class) Condition Class

This is the vegetation distribution component of the FRCC analysis. It measures the degree of departure of current vegetation attributes (composition and structure) from reference (historical) conditions found under a natural fire regime and within a given landscape. Three coverages are needed to complete this step:

1. **Biophysical settings (BpS**) describe the potential plant communities that would exist from a combination of soils, climate, and topography and natural disturbance regimes. Based on Kuchler's Potential Natural Vegetation Classification (1964), this definition of potential natural vegetation incorporates natural disturbances including anthropogenic influences. BpS is typically identified by vegetation series or zones and is an indicator of the mix of fire severity, frequency, and size across the landscape. It offers our best understanding of functioning landscapes with the full array of ecosystem structure, composition, and processes. In short, this is what we know was functioning and sustainable. LANDFIRE's Rapid Assessment models developed reference conditions for each BpS using the VDDT (Vegetation Dynamics Development Tool) software. VDDT (a state and transition model) was used to model the frequency and effects of disturbances and the rates and pathways of succession. These models synthesized the best available data on vegetation dynamics and disturbances for vegetation communities. They have received formal peer review and include associated literature references, interpretations, and sensitivity modeling. They can be accessed at http://www.landfire.gov/models_EW.php or at www.reo.gov/ecoshare. The Rapid Assessment used the term "Potential Natural Vegetation Groups (PNVGs)" instead of "Biophysical Settings (BpS)." Equivalent in concept, PNVGs differ from BpS in that they were defined and mapped using a series of expert workshops. In contrast, BpS in LANDFIRE National are based on ground data and are mapped using a modeling process (LANDFIRE 2006). LANDFIRE National will continue to provide refined BpS classification and associated reference values as they are completed. At this writing (October 2007), mapping for the western U.S. has been completed, but the reference values have not yet been made available.

2. **Current vegetation layer** assigns vegetation attributes into five possible FRCC succession classes or S-classes (early, mid-seral closed, mid-seral open, late seral open, late seral closed) by BpS. (Earlier FRCC documentation referred to succession classes as “vegetation-fuel classes.”) Current conditions can be determined using a combination of GIS vegetation queries, aerial photo assessment, fire history, local knowledge and field visits. A sixth designation, “uncharacteristic,” is used to designate areas affected by invasive plants, development, excessive grazing, clearcutting, and other phenomena that did not exist prior to Euro-American settlement.
3. **Landscapes.** A landscape is considered to be the contiguous area within a delineation that encompasses the variation of the natural fire regime. The selection of the appropriate landscape size to describe the BpS is important since it strongly influence FRCC determinations. The landscape size needs to be broad enough to display the characteristic patterns of a fire regime representing the mix of fire severity, frequency and size. Typically, sixth through fourth field watersheds or “HUCs” (Hydrologic Units of Capability) of 25,000-250,000+ acres can be used as assessment areas for FRCC evaluation.

This analysis has been automated with the *Fire Regime Condition Class Mapping Tool* (Hann et al. 2005, Barrett et al. 2006) software which can be found at www.reo.gov/ecoshare. This tool, developed for the ArcGIS environment, analyzes and reports FRCC at any specified scale. Using the three input layers identified above, the FRCC Mapping Tool produces eight output layers (see Output Grids section). **At this time, the Mapping Tool assesses only the departure of succession class classes; it does not assess Fire Frequency-Severity departure (although development on this has begun).**

Fire Frequency/Severity Condition Class

This component assesses the degree of departure of current fire frequency and severity from reference fire regimes. Estimates of reference fire frequency and severity are derived from research in local areas, existing literature and expert opinion.

1. Fire Frequency is the average number of years between fires. Current fire frequency is estimated from fire history records. Fire atlas and fire polygon coverages can be used to calculate acres burned over a time period. The current annual acre burned is compared to the reference fire frequency to calculate the fire frequency departure.
2. Fire Severity is the percent of the BpS area that would experience greater than 75% upper-canopy replacement during an unconstrained, naturally occurring fire event. Local fire expert opinion or results from fire effects and behavior modeling is used to estimate current conditions. As with fire frequency, fire severity current and reference conditions are compared to calculate the fire severity departure.
3. Fire Frequency/Severity condition class is the average of the departures assigned to a condition class. This is developed into a GIS layer.

Stratum Fire Regime Condition Class

The final FRCC calculation, the condition class, is the higher of the succession class and fire frequency/severity condition class value. A common, useful way to express condition class is the stratum FRCC. This represents the FRCC by BpS within a given landscape.

Stand FRCC

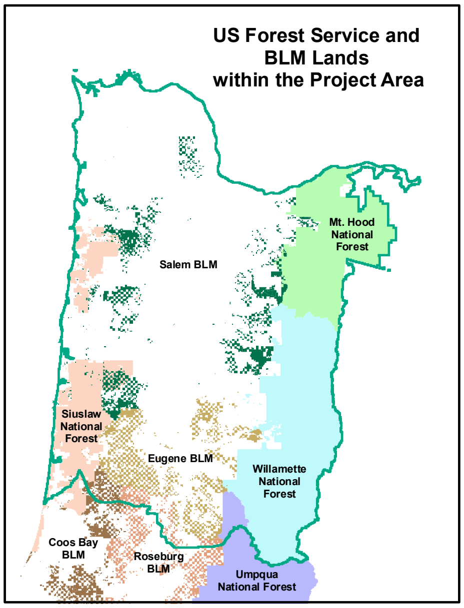
Stand frcc uses only the S-class component of FRCC . The stand-level succession class FRCC looks at departure of a stand or small-scale project within the context of the larger landscape FRCC. Stand FRCC assigns a condition class based on the membership of stands within a current seral stage. All stands within the same current seral stage will get the same condition class**. The primary purpose of the Stand-level S -Class FRCC is to facilitate FRCC reporting for projects that target individual stand under the National Fire Plan Operations & Reporting System (NFPORS).** Because natural fire regimes operate at landscape scales, the determination of FRCC is based on the condition of the succession class mosaics and fire regime characteristics as a whole across a landscape. This landscape determination provides an important perspective in the use of a stand FRCC and to understanding stand scale relationships. The effects and behavior of fire within a stand are equally dependent on the effects and behavior of fire in adjacent stands. For example, a managed harvest unit or recent burn may be considered in condition class 1 by itself, but is actually part of the larger strata (vegetation type) that is condition class 2 overall. Therefore, at the landscape scale, changing the STAND condition class may or may not change the landscape condition class. The Stand FRCC does provide insights as to which stands are contributing to a departure in the overall landscape's condition class when placed in a landscape context. Therefore, the landscape FRCC must be determined first to provide this context. Specific areas can then be targeted for treatment.

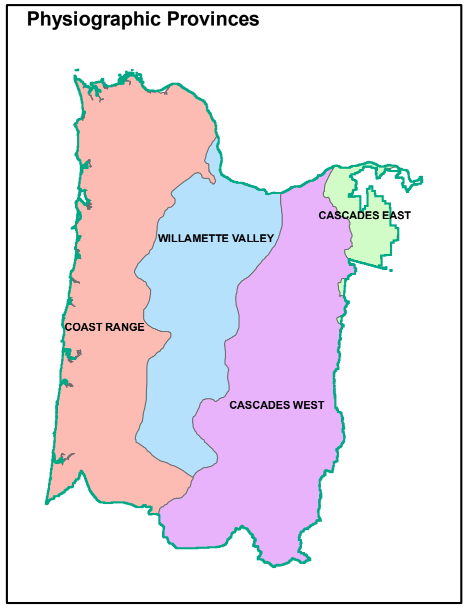
NW Oregon FRCC Methodology

In 2005, with the release of the Rapid Assessment models for the Pacific Northwest, the NW Oregon Ecology group began a new FRCC mapping effort following the Interagency Fire Regime Condition Class Guidebook version 1.1, updated in 2005 (www.frcc.gov) and using the FRCC Mapping Tool, a program developed to automate the succession class FRCC process. A previous FRCC mapping effort was completed for NW Oregon in 2000 before development of the new protocol. The goal of this project is to map conditions at the local watershed scale for use at the Forest and evaluated at the project scale. The intent is to provide managers with information at the local level to assess deviation in vegetation pattern and provide information on fire frequency/severity, which may aid in determining treatment alternatives using the authorities under the Healthy Forests Restoration Act and the National Fire Plan.

Project Area

The project area covers the Willamette, Siuslaw, Mt Hood and portions of the Umpqua National Forests plus Salem, Eugene and portions of the Coos Bay and Roseburg BLM units located in the Coast Range, Willamette Valley, Cascade west and a portion of Cascade east physiographic provinces.





FRCC Mapping Tool:

The FRCC Mapping Tool requires current seral stage, BpS, and landscape (watershed) grids as inputs to the model. All grids need to have the same projection and extent. There are eight output layers, two of which are strata FRCC (a condition class map by BpS by landscape) and stand FRCC (by stand seral stage level). The FRCC Mapping Tool can be downloaded from the ecoshare website: http://www.reo.gov/ecoshare/news-issues/maptool.asp.

Reference Vegetation Condition Mapping

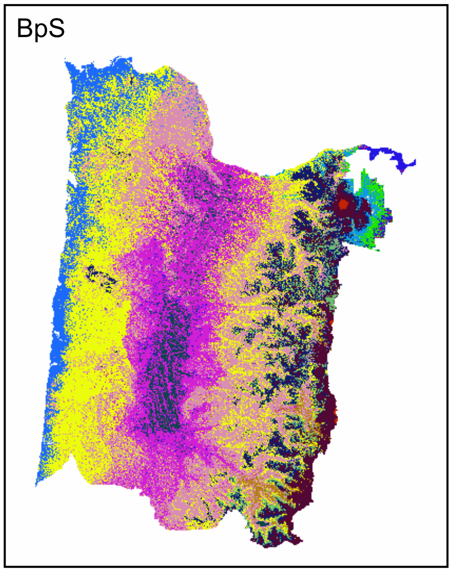
Steps:

- Download the plant association group (PAG)coverage from www.reo.gov/ecoshare.
- Develop crosswalk assigning a BpS for each combination of PAG, fire regime and geographic fire zone and/or aspect. Use the Rapid Assessment BpS model descriptions found on the LANDFIRE website to help in this determination.
- Develop BpS coverage and refine with field verification.
- Once the landscape layer is mapped, determine acres of each BpS represented within each watershed (landscape) and lump the rare BpS, setting a minimum acreage size, to avoid making conditional class determinations on small amount of acres.

To develop this coverage, we used the plant association group (PAG) coverage and the Rapid Assessment reference condition models descriptions to define and map biophysical settings (Bps) and provide the reference condition for the FRCC determination. A draft set of the BpS models for the Pacific Northwest was released in 2004 and an approved set was released September 2005. These peer reviewed models were a synthesis of the best available data on vegetation dynamics and disturbances for vegetation communities by regional vegetation and fire ecology experts. The crosswalk from PAG is available upon request (Jeanne Rice, jrice@fs.fed.us or Jane Kertis jkertis@fs.fed.us)

We used the nibble/shrink commands in GIS to remove null values. We also did some nearest neighbor filtering to reduce salt and pepper areas.

This coverage can be accessed in the veg_fuel_cc combined grid at www.reo.gov/ecoshare. It is the Bps attribute.



Current Vegetation Conditions
Steps:

- Download the most recent version of IVMP (Interagency Vegetation Mapping Project) ftp://ftp2.fs.fed.us/incoming/r6/ro/Monitoring/IVMP/qmd/ ftp://ftp2.fs.fed.us/incoming/r6/ro/Monitoring/IVMP/structure/ ftp://ftp2.fs.fed.us/incoming/r6/ro/Monitoring/IVMP/veg_cover/ for conifer and broadleaf. (Call Melina Moeur (503-808-2811) for more information.)
- Download the most recent IVMP change detection layers (*orwa_dist72to02_2ha_nov04.img*, *codes_orwa_dist72to02_2ha_nov04.xls)* from http://www.reo.gov/monitoring/10yr-report/old-growth/maps-maps.html.
- Overlay with the BpS layer.
- Develop a crosswalk assigning a FRCC seral stage to each combination of IVMP cover type, canopy closure, size class by BpS. Use the Rapid Assessment model description for the FRCC seral stages to make the determinations. Assign a seral stage to those cells on the change detection layer with no quadratic mean diameter (QMD coded 9999) and were in disturbance class 3 or above.
- Determine minimum patch size based on value to field users.
- Develop a current vegetation coverage and refine with field verification.

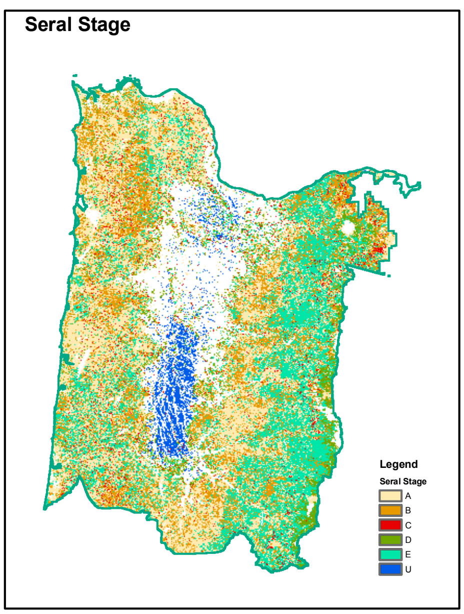
The Interagency Vegetation Mapping Project (IVMP) was used to provide the current conditions for our project. IVMP covers the entire range of the Northern Spotted Owl using 1996 satellite imagery from Landsat Thematic Mapper and was updated in 2004 with a change detection layer showing vegetation structure changes (stand-replacing harvests and fires greater than 5 acres in size) from 1995 to 2002. IVMP is stratified into 9 physiographic provinces. Each Province contains 4 grid files containing classification on diameter (qmd), conifer crown closure, broadleaf crown closure, and both conifer and broadleaf crown closure. For this project we used qmd (quadratic mean diameter), conifer and broadleaf crown closure for the 4 provinces in our project area:

- Coast Oregon Province Version 3.0, October 2003
- Eastern Cascade Oregon Province Version 1.1, June 2003
- Western Cascades Province Version 2.2 April 2001
- Willamette Valley, Oregon Province Version 1.0 January 2004.

For each province in the project area, a frequency table for classified data was developed for qmd, conifer cover, and broadleaf cover. The BpS grid was combined with the IVMP coverages into one grid.

Develop a table that crosswalks IVMP + change detection layer to the FRCC seral stages. See the Rapid Assessment BpS models for descriptions of the seral stages by BpS.

A series of 'IF Then' statements were applied to assign a seral stage value. The change detection layer had some QMD values of 9999, indicating that the diameter could not be determined. These polygons were reviewed to determine the appropriate call.



Seral Stages were assigned using aml macros. The aml's beginning with _1 were used in this step i.e. *_101_Slice_qmd_nwo.aml.* In general the aml's were run in order of their beginning number.

Once combined into one grid the resulting grid was run through a majority filter (Ingrid, eight, half) grid function three consecutive times. By visual inspection the best one was chosen as the *seral* grid. In this case, the third consecutive run of the majority filter was chosen.

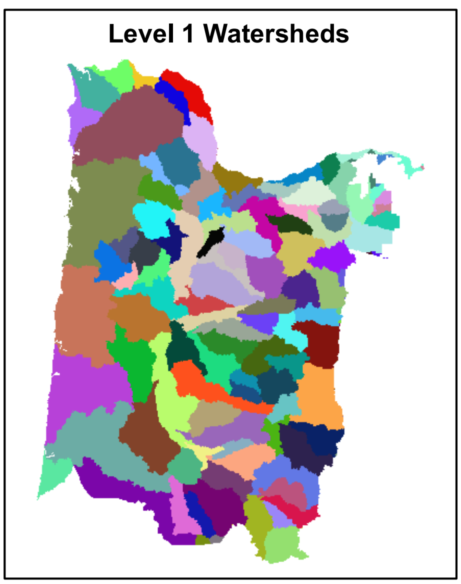
Landscapes:

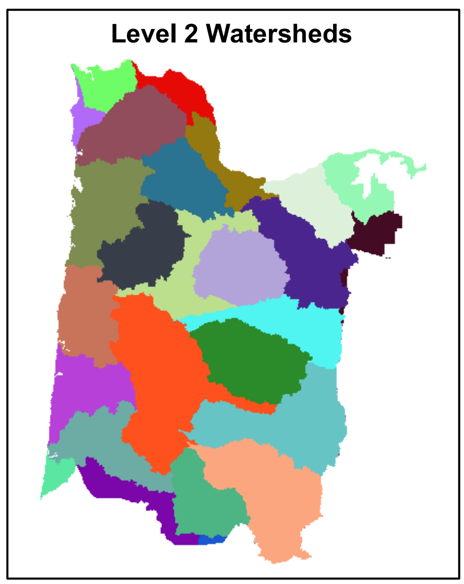
Steps:

- Assemble watershed boundaries for 4th through 6th field watersheds
- Select an appropriate watershed size. The landscape size needs to be broad enough to display the characteristic patterns of a fire regime representing the mix of fire severity, frequency and size. Rule of thumb: the landscape size should be at least twice as big as the historic fire size. Look at boundaries via a hillshade layer, topography and BpS acres represented in each watershed can also help make this determination.
- Develop two tables for Map Tools: a table with reference condition values by BpS and landscape size and fire regime (from the BpS model descriptions) by BpS and landscape size.

For NW Oregon, we found that a combination of 4th and 5th field watersheds provided an adequate landscape size for FRCC analysis. We choose fifth field watersheds for most of the project area and fourth field watershed for the BpS located in the Coast Range province that flowed into the Pacific Ocean and for mountain hemlock BpS. Fourth field watersheds were selected for these areas due to the size and frequency of historical fire regimes. The FRCC Mapping Tool can accept up to three levels of landscapes. Level 1 is the 5th field watersheds (most of the project area) with 4th field watershed representing the Coast Range watersheds. Level 2 is the 4th field watersheds that were used to evaluate mountain hemlock frcc.

List of watersheds can be found in *frcc/spatial/lookuptables.mdb table ws_landscape_Map Tools_lookup.*





Determination of the Succession Class (S-Class)

Once the seral stage (current conditions), BpS (reference conditions) and landscape (watershed) grids are completed, they are used as inputs into the FRCC Mapping Tool program. The FRCC Mapping Tool automates the succession class FRCC process and maps condition class by BpS (strata S-class FRCC) and stand seral stage level (stand level FRCC)

Steps:

- Run Mapping Tool. Mapping Tool produces eight output grids.
  1. S-Class percent difference
  2. S-class relative amount
  3. S-class departure
  4. Stand FRCC
  5. Strata departure
  6. Strata FRCC
  7. Landscape Departure
  8. Landscape FRCC

When initially running the Mapping Tool using the wall to wall BpS grid, errors were found in the resulting FRCC analysis where the current seral stage layer was missing size class data, canopy cover data or coded as non-forest. To correct this, a new grid was developed coding the BpS value '9999' where seral stage data was missing or did not exist.

Output Grids:

Stratum FRCC

The Stratum FRCC was determined and mapped for NW Oregon. This layer depicts the S-class for each BpS by its appropriate landscape. Results of this analysis are summarized below.

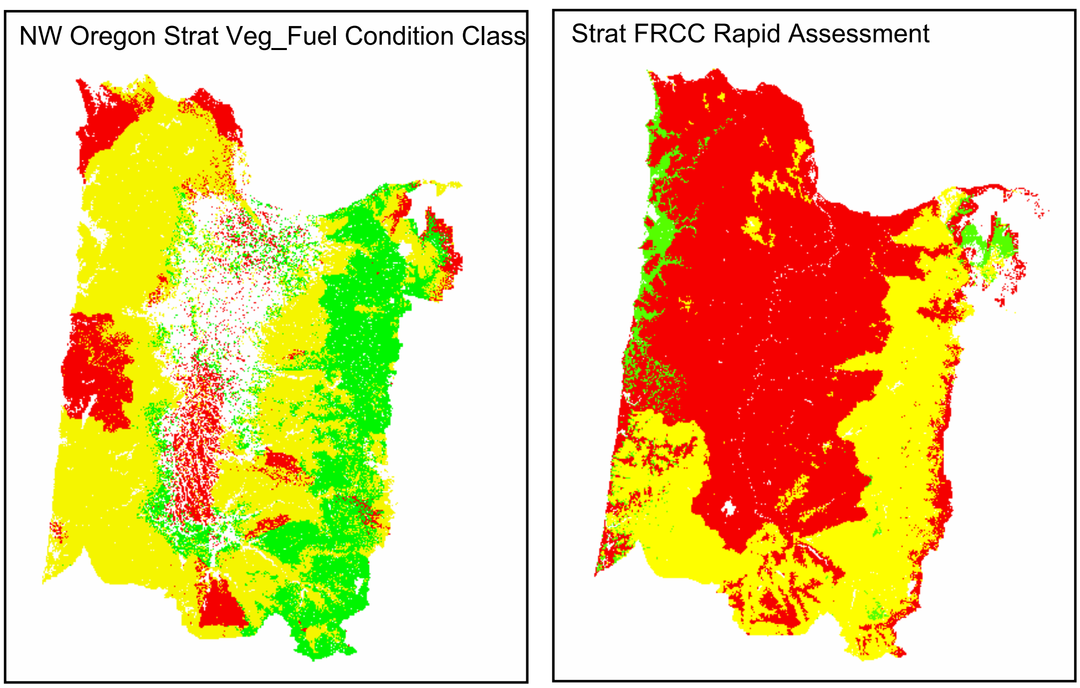
- Condition class 1 (representing low departure) occupies 34% of the project area primarily on Westside Cascade.
- Condition class 2 occupies 51% of the project area, primarily in the Willamette Valley and Coast Range provinces; and
- Condition class 3 occupies 14% of the project area, primarily in the Cascades East and Coast Range areas.

The Northwest Oregon stratum FRCC was compared to the Rapid Assessment stratum FRCC. The Mapping Tool was run for the same area using the Rapid Assessment's BpS and existing vegetation layers, but replacing the landscape grid with the one created for this project. In other words, both assessments were done at the same spatial extent (scale). The Rapid Assessment comparison had significantly more area in more departed condition classes both when assessed at the same scale as the Northwest Oregon stratum FRCC. These results are presented in the figure below, and illustrate:

- **Scale matters!** It's important to compare different map products at the same scale for a meaningful result. It is also useful to look at results at different scales to discern how processes may be changing with scale. In this assessment the Rapid Assessment stratum assessment showed much greater departure in FRCC than the Northwest Oregon stratum FRCC. This was true whether it was analyzed using HUCs or using subsections.

- **Know your input source grid quality**. We used local data to develop our BpS and current vegetation layers . A careful comparison is recommended when deciding which spatial layers are most accurate for your area.

Red = condition class 3, Yellow = condition class 2, Green = condition class 1.



Stand Level FRCC

This metric is another representation of the comparison between existing S-class condition and the reference condition but at the stand or small-scale project level. A stand is assigned a condition class based on its membership to a seral stage. The primary purpose of this output is to facilitate FRCC reporting for projects that target individual stands under the National Fire Plan Operations & Reporting Systems (NFPORS). While the Stratum FRCC looks at the compositional makeup of all the seral stages within a BpS by watershed for determination of the condition class, the stand level FRCC looks at how much each seral class departs from reference conditions within a Bps and classifies the seral classes into relative amount categories and stand FRCC values. A 'similar' relative amount classification indicates the seral stage is within reference conditions. A 'trace', 'under represented', 'over represented' or 'abundant' relative amount classification indicates the seral stage is outside of reference conditions. Placed into a landscape context, the Stand FRCC provides insights as to which seral classes are contributing to a departure in the overall landscape's condition class. Specific areas can then be targeted for treatment. For example, a BpS has an overall stratum succession class FRCC of 3 indicating departed conditions. The seral class D – late seral open (DLSO) makes up only "trace" amounts within this BpS, therefore a stand FRCC for any stand within DLSO is 1. In the same BpS, a seral class E – late seral closed (ELSC) is classified as "abundant" and receives a stand FRCC of 3. Treating stands in late seral closed can move stands into late seral open and thus contribute to a condition class change.

Stratum FRCC Departure (Stratfrccdep)

This layer depicts the percent departure from reference conditions within a BpS for the appropriate landscape. It is derived by subtracting the sum of the percent similarity of each seral stage within a BpS to its reference condition from 1.0. It is a continuous variable with values ranging from 0% (no departure) to 100 % (completely departed).

This coverage can be used to help inform and interpret the stratum succession class layer. Since the stratum FRCC layer has only 3 classes (the condition class), there are times when adjacent BpS areas are quite similar in their departure, but have fallen into different classes. For example BpS1 could have a departure of 65% and BpS2 could have a departure of 67%. These results would place BpS1 in condition class 2 and BpS2 in condition class 3.

Landscape FRCC departure (Landfrccdep)

This grid displays the overall departure of each landscape. It is derived by computing an area weighted average of the strata departure values across the lowest (smallest) level of landscape hierarchy used in the analysis. In our case that would be the fifth field HUC. Values range from 0 % (no departure) to 100% (totally departed).

This grid could be used to get a general idea of departure across landscapes.

Landscape FRCC (Landfrcc)

The landscape frcc grid classifies the landscape frcc departure (landfrccdep) coverage into low (condition class 1: < 34 % departed), moderate (condition class 2: 34-66% departed) and high (condition class 3: > 66% departed). It is a very coarse scale assessment of condition class at the broad, landscape scale.

***Succession class Percent Difference (Sclasspctdiff*)**
This grid looks at the percent difference between the existing proportion of the S-class (seral stage) within a BpS and the reference condition proportion. Values range from -100 % to +100%. A positive value indicates there is currently more of that class than in reference conditions. A negative value signifies the current seral class occupies less area than in reference times.

This grid is used to classify the seral classes into relative amount and stand FRCC values. It can be used to help understand and interpret the classed coverages by knowing the exact departure value.

***Succession Class Relative Amount (Sclassrelamt*)**

This grid is the result of grouping the succession class (vegetation class attribute in our grid) into 6 classes (unclassified, trace, under-represented, similar, over-represented and abundant) based on their departure from current to reference conditions. As such it is a relative departure.

This coverage can be used to get a specific understanding of which seral classes are departing from reference conditions within a Bps, and their distribution within a landscape. It can help interpret and clarify the stand FRCC coverage.

Master Grid
The Master Grid contains all the output data.

Recommendations:

Variations may be found in this mapping effort compared to other efforts or what is validated in the field. This may be due to differing spatial scales (of analysis, reporting), how much subjectivity was involved, presence and amount of uncharacteristic classes, whether the BpS model is sound for the local area, how accurate is each spatial layer and how close did departures approach FRCC thresholds. Understanding and knowing where the data came from and how it was used in this mapping effort will help to refine and validate the FRCC assessment. In addition, local units may have access to fire history data, studies and local vegetation layers that was not available for this mapping effort and that could be used to further refine and update the fire regime condition class assessment. As a minimum, the FRCC assessment needs to be updated every five years, as required under the Healthy Forest Restoration Act. Field updates of the FRCC layers (BpS, Seral Stage, and Stratum FRCC layers) should be documented and reported to the FRCC Implementation Team (Jeanne Rice: jrice@fs.fed.us or Jane Kertis: jkertis@fs.fed.us).

How to Use the Data & Update the Mapping:

- Review assumptions made in the methodology and interpret the results. For example: the canopy cover classification determining seral stages in the high elevation Pacific silver fir on the eastside of Mt Hood strongly influenced the resultant condition class 2 designation. Coastal watersheds received a condition class 2 or 3 primarily due to the amount of young seral stage represented on the landscape due to logging. In this case, the condition class assignment was due to management activities and was not fire related.

- Field verification of BpS and Succession Class layers. Validate and update the mapped layers at the fifth field watershed level. The mapping provided a FRCC call at the landscape (5^{th} or 4^{th} field watershed) level by BpS. So, for example, all the mixed conifer dry (MCONdy) BpS polygons contained within a 5^{th} field watershed are evaluated together as one and receive one FRCC stratum call for that watershed. Validate the polygons for the correct BpS, seral stage call realizing that there might be small inclusions of other polygons. Read the biophysical setting model descriptions to see if they are appropriate for that watershed. Remember, this represents the historic conditions and in some cases, conditions may have been significantly altered with encroachment. For example, where oak habitat may have been historically found, there may now exist a mixed conifer stand with very little oak or even an orchard. The current condition is represented by the FRCC seral stage. Using the appropriate BpS model description, review the seral stage descriptions to classify the area covered by that BpS in that landscape. Document major changes: treatments changing seral stages, misclassification of the BpS or seral stage maps, etc.
- Determination of Stand FRCC and use in treatment priorities. Use the procedures in the FRCC protocol to determine the stand level FRCC. This will provide treatment guidance and is what will be used to for accomplishment reporting in NFPORS. FACTS will record before and after stand level FRCC assessments (observations) by project. FACTS will have a spatial link as well. Unfortunately, at this point in time, it doesn't appear that FACTS will track the change in FRCC seral stages. To be able to document condition class changes due to treatments or disturbances, an annual map, like the annual harvest layer, will need to be developed. Then update the FRCC assessment every five years.

Following field validation of the data, the following next steps are recommended to apply the data in a planning strategy:

- Complete a current fire risk assessment to identify high risk areas for current catastrophic fire disturbance.
- Identify landscape issues and other resource issues (such as high value habitats, wildland urban interface (WUIs), hot spots for species diversity, etc).
- Integrate the FRCC results, fire risk assessment and resource issues to map priority areas. The FRCC process identifies the amount of area and vegetation types (specifically current seral stages) deviating from reference conditions (identifies the WHAT). The current fire risk assessment and landscape issues identifies key resource "hot spots" and fire behavior risk (identifies the WHERE) and HOW to treat the landscape.
- These next steps will help units:
    - To prioritize treatment areas
    - To demonstrate how FRCC fits into landscape planning incorporating in local issues such as WUI and rare habitats and
    - To provide a more holistic approach to treatments.

Structure- versus process-based forest management.

Look at the existing fire regimes in the context of ecological integrity: Are the rates and scale of ecological process (disturbances) compatible with maintenance of natural levels of biodiversity? If contemporary fires are not changing high severity patterns and increasing risk, when weather, climate, topography and neighboring vegetation are taken into account, and if there is evidence that fire can restore past influences, then management could probably shift towards process-based restoration. Structure-based management (prescribed fires and mechanical treatments to modify forest structure as a means of counteracting the effects of fire suppression) may never mimic the heterogeneous effects of fire or provide for diversity of species dependent on effects specific to fire. Often, however, structure-based management will be a necessary precursor to reintroducing fire, because fuel levels will be too hazardous for prescribed burning until reduced by mechanical treatments.

Role of fire frequency and severity

The Interagency Fire Regime Condition Class Guidebook also recommends determination of the fire frequency/severity condition class. This component assesses the degree of departure of the current frequency and severity of the current fire regime from reference conditions. We attempted to calculate the fire severity condition class, but were unable to obtain all the local fire history information, develop the queries or adequately express the current fire severity to complete the analysis.

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