Department of Defense
Legacy Resource Management Program

PROJECT NUMBER 04-215

Ecoregional Conservation Data for the Columbia Plateau Ecoregion

Interim Final report

The Nature Conservancy in Oregon

December 19, 2006

Background

The Oregon chapter of The Nature Conservancy has been involved with ecoregional assessments (EA) since the mid 1990s. Over that span of time, the chapter has developed data on biological and anthropogenic values across the ecoregions that intersect the state (Figure 1). Examples of datasets include ownership/management status, roads, land use and conversions, and data describing the extent and condition of species and habitats.

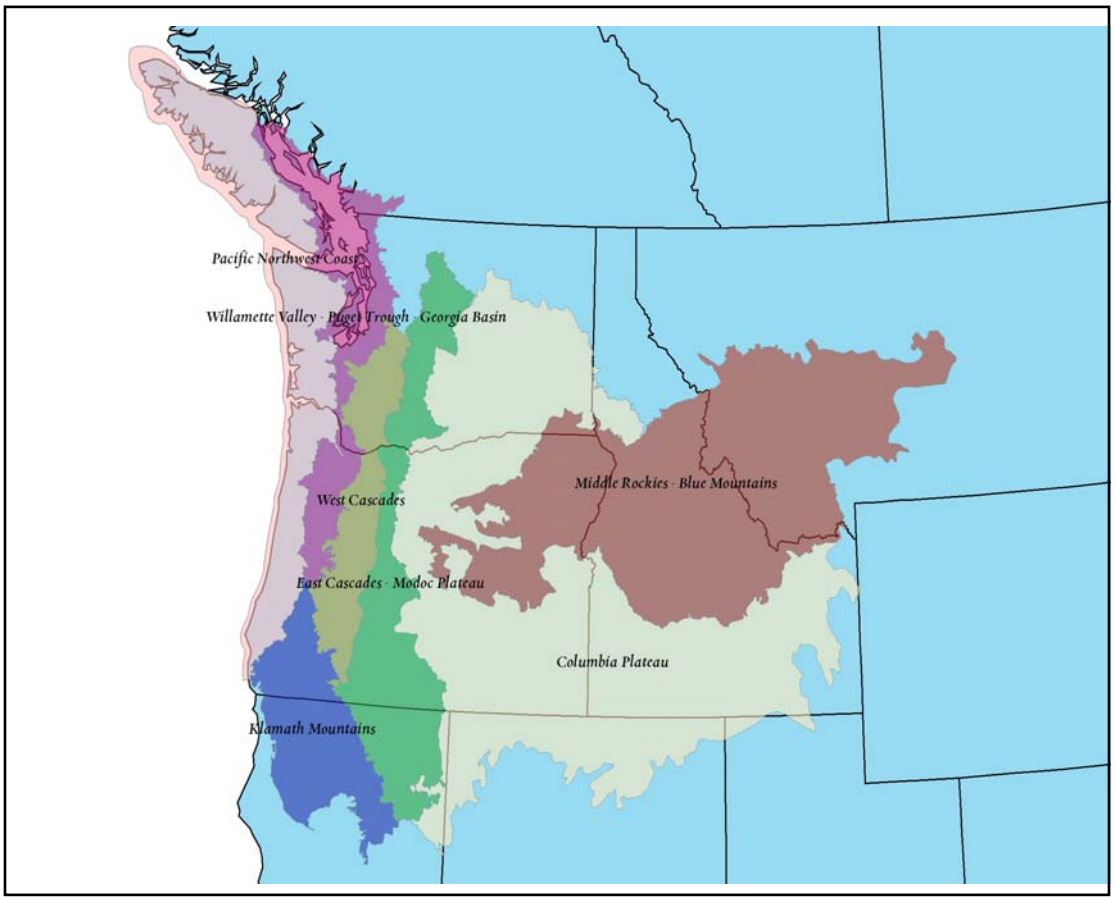

Figure 1 – All ecoregions which intersect Oregon

In 2004, the Department of Defense (DOD) contracted with The Nature Conservancy to update information on the biological diversity within the Columbia Plateau ecoregion. Five datasets were requested: 1) an updated vegetation cover and sagebrush map; 2) an invasive annual grass GIS coverage map; 3) a high-resolution fire risk map; 4) threatened, endangered and at-risk species data; and 5) freshwater aquatic systems and species data.

The Columbia Plateau ecoregion covers 74 million acres and portions of six states. These broad expanses of sagebrush-covered volcanic plains and valleys are punctuated by isolated mountain ranges and the fertile river valleys of the Columbia, Snake, John Day, Owyhee and Boise rivers.

It is also home to six large military training facilities managed by the Army, Navy, Air Force and the Oregon and Idaho National Guards.

Despite its untamed appearance, habitat loss and degradation in the Columbia Plateau have had major, deleterious affects on the region's biological diversity. Emblematic of the region's natural resource problems, the greater sage grouse (*Centrocerus urophasianus*), has declined more than 90 percent from historic population numbers, disappeared from nearly half of its historic range, and been extirpated from five states in the last century. At least six petitions have been filed to list the sage grouse under the federal Endangered Species Act.

Beyond the sage grouse, at least another 238 vulnerable plant and animal species are considered to be threatened with extinction according to state Natural Heritage programs, including 72 plant species endemic to the Columbia Plateau.

The primary causes for the decline of these species are conversion of land, diversion of water for agricultural and urban use, energy production and mining, degradation of habitat associated with livestock grazing, introduced species, and altered fire regimes. In addition, military training is harming sage grouse populations (Stinson et al. 2003, U.S. Federal Register 2001).

As the number of listed species has grown, decisions regarding land allocations and natural resource use are becoming increasingly complex for land managers and regulatory agencies. Recovery planning efforts that focus species by species, or approach endangered species recovery from the perspective of individual ownership, are becoming increasingly impractical and inefficient.

Comprehensive, consistent and locally relevant biodiversity data is critical to designing effective and efficient conservation strategies. The data included with this delivery are intended to fill that need, and include all the GIS layers described in the original proposal, plus a synthesis tool which will allow planners to see the known distributions of all tracked species and vegetation across the ecoregion with relatively high resolution. These can be most easily accessed via the 'DOD.mxd' included on the DVD.

This report provides an overview of the data products, sources and methods used to develop those products. Specifically we have placed all GIS data and associated tables and documents on DVD in a single directory, "DOD_Legacy". Additional information may be found within embedded meta-data and/or in technical reports that give much more detailed information about individual data layers.

Data Products and Methods

Complete GIS coverage of the Columbia Plateau Terrestrial Ecological Systems, with meta-data and attribute tables

The ability to make vegetation maps relevant to planning at multiple scales has improved considerably in the last few years. Advances include better interpretive methods for remotely sensed data, and improvements in vegetation classifications. The Nature Conservancy has adopted the Ecological System vegetation classification throughout the Western region, as

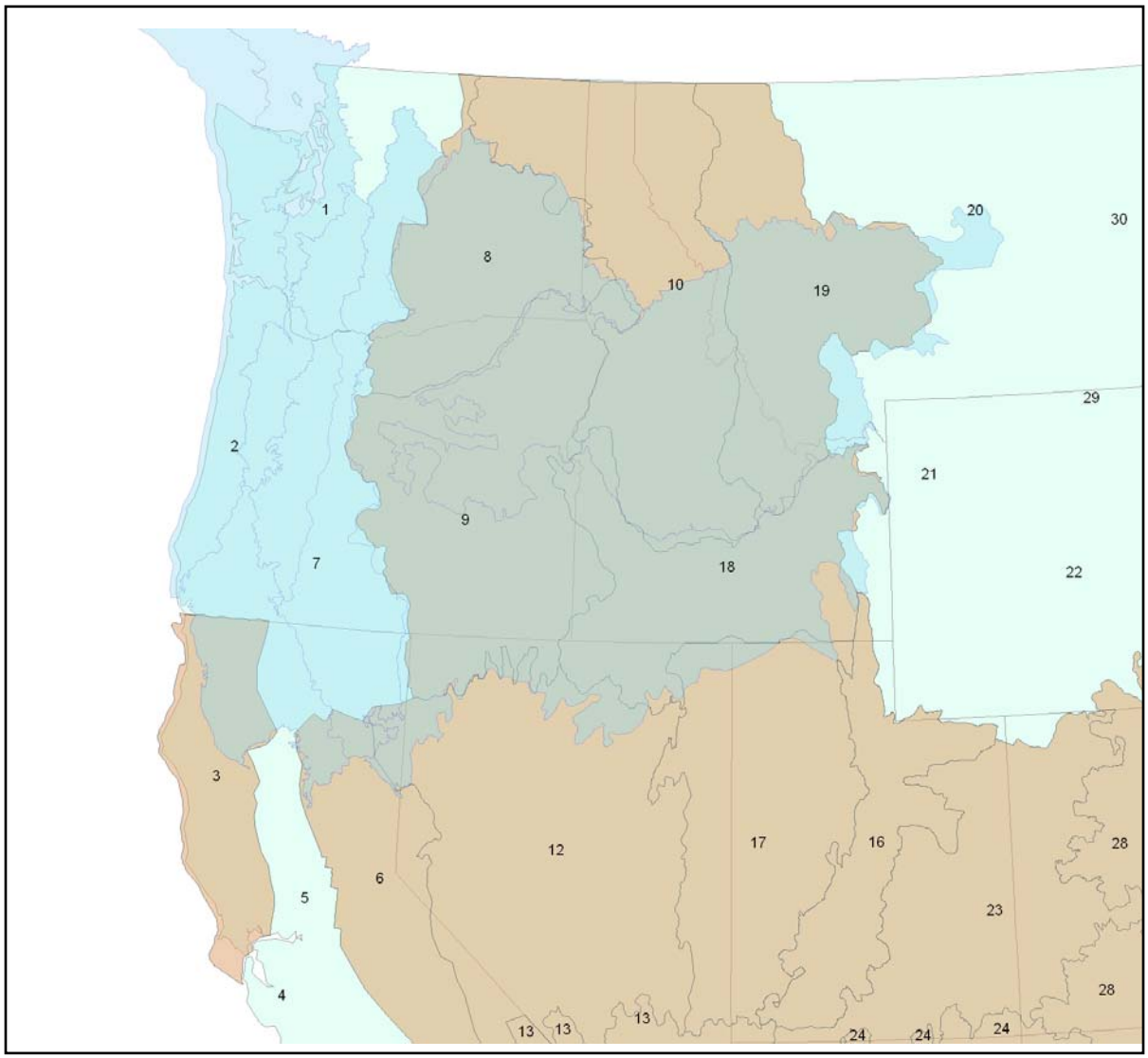

Figure 2 – LandFire data availability by Zone as of 10/2006. Brown areas are completed.

promulgated by NatureServe. Several agencies have also adopted this classification as their standard. As a result, several new vegetation mapping projects have been applied to the Ecological System classification, including LandFire and ReGAP (Gap Analysis Project, second

iteration). New vegetation data for the Columbia Plateau was compiled in October 2006. By that time, LandFire had published Ecological Systems for the entire Columbia Plateau (Figure 2). The U.S. Geological Survey GAP analysis program had also recently completed an Ecological Systems map for zones 8 and 9 that was regarded as more accurate in the shrub-steppe environment than the LandFire data product. This map, based largely upon the "SageMap" product produced under contract by Oregon State University's Natural Heritage Information Center, incorporated recent updates and more stringent quality control methodologies. We used both of these products to compile the final map included in this data delivery.

LandFire data was downloaded from the National Map using the LandFire Data Access Tool. Five tiles of LandFire data had been completed within the planning area. Meta-data and lookup tables were also acquired. These were merged in ArcGis, and clipped to the borders of the Columbia Plateau. ReGAP maps, meta-data and lookup tables for zones 8 and 9 were obtained from the USGS GAP program. These two products allowed us to tile together a seamless, 30-meter grid of existing vegetation/land cover for the entire Columbia Plateau.

Both of these component maps were projected to a common coordinate system (Oregon Lambert, NAD 83), attributed with the original name of the concept per their respective classifications, and from NatureServe's Ecological System classification (v1.03), the name, Global Element ID, ESLF code (where available) and Elcode for that system. For converted landscapes, a distinct suite of classes based upon the National Land Cover Dataset (NLCD) from USGS were used. Portions of the LandFire data that overlapped the ReGAP data were removed. These final component grids were then merged together using the Global Element ID as the primary value.

> *Complete GIS coverage of the Columbia Plateau salmon distributions, with meta-data and attribute tables.*

(Note: this first iteration product is attributed with the full species names, but not sub-species or population information. We are currently intersecting each species layer with polygons depicting ESUs, Rus, or other specific population information.)

This snapshot of StreamNet data has been modified from its original format to make the information more compatible with a GIS environment. Instead of separate line coverages for each species, we have created a single event table that links to the routed StreamNet hydrography. This allows the stream network to be intersected once with any given feature(s) of interest, and then data for all salmonids in the StreamNet database can be related to the output in a single step. All attributes from the original StreamNet database have been retained in our version of the data. Attributes regarding sub-runs, Evolutionarily Significant Units, Recovery Units, etc., are currently being developed to add a level of detail to this information that is lacking. The next iteration of this dataset will include those attributes.

Complete aquatic classifications for the following EDUs: Yakima-Palouse, John Day-Umatilla, Deschutes, Great Basin, Owyhee-Malheur, North Humboldt Headwaters, and Snake River Plains, with meta-data and attribute tables.

(Note: data for the Grand Ronde and Powder Burnt EDUs are under development for delivery early next year. A shape file of EDU boundaries is also included for reference.)

Figure 3 – Ecological Drainage Units (EDUs) in the Pacific Northwest. Gray areas have been classified. Remaining northeastern Oregon EDUs will be complete in spring 2007.

Aquatic habitat classification has been a focus of The Nature Conservancy's aquatic planners for several years. The methods used are based upon the paper, "A Freshwater Classification Approach for Biodiversity Conservation Planning," published by the Conservancy's Freshwater Initiative in 2005. The basic process is to define freshwater ecoregions, or Ecological Drainage Units (EDU). EDUs are defined by similarities in the abiotic features and physical processes that drive biodiversity. GIS representations of these abiotic features are created and broken into classes based upon the judgment of aquatic experts for each
EDU. The National Hydrography Dataset (NHD) routed hydrography is then intersected with those classed parameters. This dataset represents classified stream macrohabitats – river reaches that are relatively homogenous with respect to their physical features. These macrohabitats are then attributed to drainage basins of varying size classes, from small
headwaters and tributaries to large river mainstems. Each of these attributed basins is then

analyzed using ordination techniques to define Aquatic Ecological Systems. Aquatic Ecological Systems can be defined as catchments composed of similar patterns of macrohabitats.

These individual EDU classifications have been archived in geodatabase format by the Oregon GIS staff. Each has meta-data which lists the specific parameters and classes used in the classification. This information is used much like the terrestrial coarse-filter data; goals are set for each system type by EDU, and areas are selected to meet those goals in conjunction with other targets in the assessment. Early ecoregional plans, such as the Columbia Plateau, did not incorporate this information.

Information on the distribution of rare and endangered species

Data compilation for rare species across vast ecoregions presents certain unique challenges. For example, many data points used in the Conservancy's ecoregional assessments are for species not tracked by the Heritage network, and for which only a subset of the standard data attributes are available. Also, the species tracked by the Heritage network vary from state to state, while ecoregional assessments cross state boundaries. This has forced us, in many cases, to collect data for species that vary in specifications from standard heritage information. Using bald eagles as an example, agency and Conservation Data Center (CDC) staff rarely track the same life history phase from state to state. Nests, winter roosts or congregation areas may be mapped in various portions of the eagle's range across the Columbia Plateau. We have tried to capture sufficient detail for each data point to be able to reconcile these differences where necessary, or to select various subsets of the data for any particular analysis.

Data collection began with the acquisition of NatureServe's Multi-Jurisdictional Dataset (MJD) in October 2006. That dataset provided precise element occurrence data on plants, animals and invertebrates for the Montana, Oregon and Washington portions of the analysis extent. In addition, recent snapshots of Heritage data from the California, Idaho and Nevada CDCs were acquired. Element occurrences are known locations (current and historic) of species. For natural resource planners, data on rare species is most desirable. This information has been collected over the last three decades by a wide variety of institutions, including state and federal land management agencies, CDCs, and natural resource professionals. The Nature Conservancy has collected data from all of these sources in support of ecoregional assessments. Additionally, information created in the Conservancy's first iteration ecoregional assessments was assembled. Meta-data for all datasets were also captured.

The Nature Conservancy staff cross-walked the tabular attributes from each of these datasets to a common data schema. All species points from the Conservancy's ecoregional assessments were compared against the aggregated CDC dataset. If an EA data point fell within the uncertainty buffer from the aggregated CDC layer for the same species, it was dropped from inclusion. Only those EA data points which represented data not captured in the aggregated Heritage data were retained. This generally included all Washington Department of Fish and Wildlife vertebrate data for targets from first iteration EAs, data for species not tracked by the heritage network, data from private researchers not yet forwarded to the Heritage Network, and data from state and federal agencies which did not meet the strict data standards promulgated by the Heritage network for inclusion into their data (.i.e. ISMS, WILDOBS). As these data had been used in the

original ecoregional assessments, we felt it was important to retain the information and document each point to the fullest practicable extent.

Many natural resource analyses require data be attributed to precise polygons like parcels or small assessment units. To make this spatial data as useful as possible, a series of processes are performed to make each record locationally specific. In the simplest case, a single point location for a species is buffered by a locational uncertainty distance. The centroid represents the most likely location of that species, though it could conceivably occur anywhere within the radius of spatial uncertainty. For our purposes, we would represent that entity as a point at the centroid of the original source polygon. A slightly more complex case involves several points that all belong to a single occurrence, all buffered with spatial uncertainties. In cases where those buffers overlap, we use the centroid of that single feature. In cases where they are disjunct, we explode the polygon into its constituent pieces and create centroids for every resulting shape. This has the result of creating multiple shapes and records in the attribute table for a single occurrence. Therefore, when the species data is intersected with any other spatial features, "partial occurrences" may result. We report those as percentages of the total. An occurrence created from three points, for example, could represent 0.33 percent, 0.66 percent or one occurrence, depending on the boundaries of the intersecting features.

Another class of feature is represented by polygons drawn around a population or specific habitat type. These tend to have very small locational uncertainties, but may be very large polygons in some instances. These occurrences may be multi-polygons, in cases where two or more disjunct pieces are part of a single occurrence. These specific polygons are intersected with features of interest in their raw form, and again may be reported as fractional occurrences.

The last category of feature is a buffered line reach, usually associated with an aquatic species, or species that rely upon aquatic habitats for major portions of their life history. Those are treated as lines, and reported in terms of stream meters or stream kilometers. All of these data are then merged into a single GIS layer that forms the final species data coverage for the analysis extent.

Finally, a series of tests are run against the attributes to screen out those points least likely to remain today as viable occurrences, or which may not be mapped with sufficient accuracy to be useful for local scale analysis. Data failed if any of the following three conditions are met:

Locational uncertainty >= 5000 meters
The occurrence was last seen before 1980
EO Rank = 'D' (poor condition), 'F' (failed to find at last site visit), 'H' (historic), or 'X' (extirpated)

These data points are retained in our databases to show that an area may have once supported the species, but they are reported with attributes clearly indicating they are not of sufficient quality for analysis.

Species locations for aquatic taxa have been derived from three sources: many aquatic plants and resident fishes are tracked and mapped by the Heritage Network, salmon distributions are tracked regionally by StreamNet, and additional points for some taxa were created for use in ecoregional

assessments. All three data types are captured in our data. Salmon data is often also captured by individual Heritage programs as well as by StreamNet. However, since StreamNet works closely with state game agencies in the region to keep their information updated, we rely upon StreamNet for the most current salmonid data. That is the information reported in this suite of data products.

Finally, a 500-hectare hexagon grid was generated for the entire 73-million-acre Columbia Plateau ecoregion. Data on salmonid distributions, terrestrial Ecological Systems and Element Occurrences were intersected with this grid. The tabular output is contained within the Access database, 'cp_hex_species.mdb' included in the 'DOD_Legacy' data directory. This table is related to hexagon shape file (cp_hex.shp), and that relationship is saved within the 'cp_hex.lyr' file, also in this directory. Attributes include global element IDs, Elcode, scientific and common names, abundance and a confidence rating on the presence of the element. This is to allow planners to see the known distributions of any tracked species across the ecoregion with relatively high resolution. Licensing agreements prevent us from sharing the complete Heritage dataset for all lands across the Columbia Plateau, but we will forward the specific locational data for the individual DOD installations once we have their boundaries in-house. Macrohabitats are not reported due to the vast number of records that would result, nor are aquatic systems as those polygons do not nest well within these small assessment units.

Complete GIS coverage of invasive annual grasses for zones 8 and 9, with meta-data and attribute table

The percent cover of annual grasses in zones 8 and 9 (anngrssz8_9) were based upon plots listing the composition and percent cover of invasive species. These were obtained as points or as polygons from a variety of sources:

Source	**N**	**Type**
Burns BLM	5098	Points
Lakeview BLM, north	2351	Points
Lakeview BLM, south	2444	Polygons
Nevada NHP	130	Points
SageMap (OR, WA, ID, NV)	1786	Polygons

Pseudo-replication within SageMap polygons was conducted in order to increase the number of samples used by the classification algorithm. This type of non-independent data has been found to improve classification accuracies, and allowed to take advantage of the known quality of the SageMap samples. Sub-sampling was not done with South Lakeview data (only the polygon centroids were used). Five to ten random points were placed within each SageMap polygon using the ArcMap Hawth's Tools extension.

Three categories of weeds were modeled: annual grasses, perennial grasses, and perennial forbs. Percent cover of annual grasses, perennial grasses and perennial forbs were obtained at each point by adding percent cover of each species within each weed category.

A CART model was generated for each weed category, for each map zone. Tree methods are non-parametric and non-linear, fast to train, and as or even more accurate than other classifiers (Homer et al. 2004). All the base spectral and biophysical layers were entered in Erdas Imagine's NLCD Sampling Tool to generate the input files required by See5, a data-mining tool where decision trees were created using a 10-classifier boosting (Rulequest 2004). Predictive maps were generated by applying these rule sets to the input images in Imagine's NLCD Classifier Tool.

Categorization: Percent weed cover in each category (annual grasses, perennial grasses, perennial forbs) was converted from continuous to categorical data using Idaho State University's cheatgrass cover classes (PNWRC 2004): 0% (1); 0.5 - 5% (2); 6 - 15% (3); 16 - 25% (4); > 25% (5). Only three classes were used to recode perennial forb cover though, because of small sample sizes: 0% (1); 0.5 – 15% (2); > 15% (3).

Partial GIS coverage of invasive annual grasses for zones 12, 17 and 18, with meta-data and attribute table

The Annual Grass Index (anngrssnvid) was derived from multitemporal Landsat 5 TM and MODIS Imagery with statistical models utilizing 806 training sites. Source imagery for the northern approximately two-thirds of the area is from 2004, the southern approximately one-third from 2005. Statistical modeling attempted to estimate percent ground cover for each pixel; however, accuracy analysis shows that higher-coverage areas were frequently underestimated. Thus the map is now considered an index rather than estimates of actual ground cover. Besides, ground cover varies from year to year, so a specific ground cover estimate has less meaning than the relative density patterns from one site to another. The focal area was the state of Nevada; however, the statistical models were allowed to run beyond the border within the Landsat data footprint. A no-data value of minus one is used outside of that footprint and within that footprint west of the Sierra crest.

30-meter pixel Resolution Fire Risk Map for the Columbia Plateau ecoregion, with meta-data and attribute table

LandFire Rapid Assessment (RA) fire regime condition classes (FRCC) delineate a standardized, interagency index to measure the departure of current conditions from reference conditions. FRCC is defined as a relative measure describing the degree of departure from the reference fire regime (Hann and Bunnell 2001). This departure results in changes to one (or more) of the following ecological components: vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances (such as insect and disease mortality, grazing, and drought) (Schmidt and others 2001). FRCC is composed of three classes:

FRCC 1 - Within the natural (historical) range of variability ("reference fire regime") of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.
FRCC 2 - Moderate departure from the reference fire regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.

FRCC 3 - High departure from the reference fire regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.

Additional data layer values were included to represent non-vegetated types (such as water, snow/ice, and barren), wetlands/alpine, development (such as residential, commercial, roads, and mines), agriculture, and unclassified vegetation (in other words, vegetation that was not classified during the RA process).

LandFire Rapid Assessment FRCC was calculated for each RA potential natural vegetation group (PNVG) within an ECOMAP subsection using standard Interagency Fire Regime Condition Class Guidebook methods (Hann and others 2004). Reference conditions were estimated through the RA PNVG modeling effort (for more information, please visit the "Rapid Assessment Reference Condition Model" section of www.LandFire.gov). Current conditions were estimated as part of the RA Succession Classes spatial data layer (for more information, please visit the "Rapid Assessment Products" section of www.LandFire.gov). For additional information on the methods used to calculate FRCC, please visit www.frcc.gov.

Follow-on Work

The proposed next phase of this project would use these updated biodiversity data with identified conservation opportunity areas and protected areas to determine how well these sites capture the ecoregion's biodiversity and meet conservation goals for the ecoregion's habitats and species. As part of this project, conservation goals would be updated for each habitat and most species included in the assessment – namely, number and distribution of occurrences of species, and area and distribution of terrestrial and aquatic habitats. For conservation opportunity areas, we will use the areas of biodiversity significance identified in the Conservancy's 1999 ecoregional assessment (The Nature Conservancy 1999) and the recently developed "conservation opportunity areas" identified by the Oregon Department of Fish and Wildlife (Oregon Department of Fish and Wildlife 2006). Both of these lists of sites include existing "protected" areas such as wilderness areas, ACECs, Wildlife Refuges, other agency special designation, and local and private preserves. Products would include site summaries for each of these areas that list the species and habitats of significance, their abundance, and the contribution the site makes to the conservation of rare species across the ecoregion.

We will do the same assessment for each of the military establishments and complete site summaries for these. Each military base/facility will know the significance of its biodiversity relative to other sites across the ecoregion and its contribution to the conservation of rare species across the ecoregion.

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