This document is part of a collection of Ecological Integrity Assessments addressing 67 of Washington's 99 Ecological Systems. These documents were prepared by the Washington Natural Heritage Program with funding provided by the Washington Department of Fish and Wildlife.

Ecological Integrity Assessment: East Cascades Oak-Ponderosa Pine Forest and Woodland

Ecological Summary

The East Cascades Oak-Ponderosa Pine Forest and Woodland ecological system is narrowly restricted appearing at or near lower treeline in foothills of the eastern Cascades in Washington and Oregon within 65 km (40 miles) of the Columbia River Gorge. Disjunct occurrences in Klamath and Siskiyou counties, Oregon, have more sagebrush and bitterbrush in the understory, along with other shrubs. This system dominates in areas between shrub steppe at lower elevations and conifer-dominated woodlands or forest above. Elevations range from 460 to 1920 m. They occur in slopes ranging from steep, lower slopes to more moderate slopes on dry benches. Substrates are usually very gravelly, stony coarse loams derived from basalt colluvium.

Most occurrences of this system are dominated by a mix of *Quercus garryana* and *Pinus ponderosa* or *Pseudotsuga menziesii*. Scattered *Pinus ponderosa* or *Pseudotsuga menziesii* can comprise the upper canopy over *Quercus garryana* trees but only occur in favorable microsites and do not regenerate well. Clonal *Quercus garryana* can create dense patches across a grassy landscape or can dominate open woodlands or savannas. The understory may include dense stands of shrubs or, more often, be dominated by grasses, sedges or forbs. Shrub-steppe shrubs may be prominent in some stands and create a distinct tree / shrub / sparse grassland habitat, including *Purshia tridentata, Artemisia tridentata, Artemisia nova* (not in Washington), and *Chrysothamnus viscidiflorus*. Understories are generally dominated by herbaceous species, especially graminoids. Mesic sites have an open to closed sodgrass understory dominated by *Calamagrostis rubescens, Carex geyeri, Carex rossii, Carex inops*, or *Elymus glaucus*. Drier savanna and woodland understories typically contain bunchgrass steppe species such as *Festuca idahoensis* or *Pseudoroegneria spicata*. Common exotic grasses that often appear in high abundance are *Bromus tectorum, Cynosurus echinata* and *Poa bulbosa*. These woodlands occur at the lower treeline/ecotone between *Artemisia* spp. or *Purshia tridentata* steppe or shrubland and *Pinus ponderosa* and/or *Pseudotsuga menziesii* forests or woodlands. In the Columbia River Gorge, this system appears as small to large patches in transitional areas in the Little White Salmon and White Salmon river drainages in Washington and Hood River, Rock Creek, Mosier Creek, Mill Creek, Three-mile Creek, Fifteen Mile Creek, and White River drainages in Oregon. *Quercus garryana* can create dense patches often associated with grassland or shrubland balds within a closed *Pseudotsuga menziesii* forest landscape. Commonly the understory is

shrubby and composed of *Ceanothus integerrimus*, *Holodiscus discolor*, *Symphoricarpos albus*, and *Toxicodendron diversilobum* and similar to the North Pacific Oak Woodland ecological system.

East Cascades Oak-Pine Forest and Woodland is characterized by frequent (5-30 year fire return interval) low intensity ground fires that maintain the open savanna structure that characteristic of most of this system (Landfire 2007 fire regime I). Fire severity increases with density of understory shrubs and canopy trees. Soil drought plays a role, maintaining an open tree canopy in part of this dry woodland habitat. Increasing timber harvest or altered fire regime can result in lower densities of large live trees and increasing dominance of smaller size classes and sprouting clumps which creates conditions that support cloning of oak and invasion by conifers resulting in denser stands. In Klickitat County, dense stands of stunted oak indicate effects of fire exclusion in this community type (M. Vander Haegen, WDFW; pers. comm. 9/2/2010 as cited in Evans 2010). Decades of fire suppression have led to invasion by *Pinus ponderosa* in favorable sites along lower treeline and by *Pseudotsuga menziesii* in the gorge and other oak patches on xeric sites in the east Cascade foothills. Where this system occurs on river terraces and other more mesic sites, fuel loads are increased and a mixed severity fire regime prevails, with return intervals of 50-60 years (Clausnitzer and Crawford 2008). Thus, canopy cover can both increase or decrease outside the historic range of variability due to altered fire regime, timber harvest, and grazing.

The Little White Salmon drainage near Augspurger Mountain is the transition area between North Pacific Oak Woodland and this system (Dog Mountain is the westernmost in Washington). East Cascade oak-pine differ from westside oak in that easterly sites respond more positively (in terms of growth) to minimum temperatures in the spring and in the fall than other Oregon white oaks west of the Cascade Mountains. (Maertens 2008). Eastside oak have a positive growth response to previous year spring and summer precipitation whereas many westside stands have the opposite relationship (Maertens 2008).

As mentioned previously, oak types associated with wetlands or riparian areas are not included here. They are associated with the Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland or Columbia Basin Foothill Riparian Woodland and Shrubland ecological systems.

Stressors

The stressors described below are those primarily associated with the loss of extent and degradation of the ecological integrity of existing occurrences. The stressors are the cause of the system shifting away from its natural range of variability. In other words, type, intensity, and duration of these stressors is what moves a system's ecological integrity rank away from the expected, natural condition (e.g. A rank) toward degraded integrity ranks (i.e. B, C, or D).

Conversion to agricultural and range lands, urban development, past homesteading, and fuelwood cutting are the most significant sources of oak-pine decline. With fire

suppression, many oak-pine woodlands have been invaded by a greater density and cover of oak and conifer trees. Fire suppression has also increased shrub cover in many oak woodlands leading to the development of fuel ladders. Fire sensitive species have also become more common due to fire suppression. Some areas have been lost to urban or agriculture development. Ongoing threats include residential development, increase and spread of exotic species, and fire suppression effects. Conifer encroachment can occur in wetter sites, such as the White Salmon River drainage, but for the most part is not a significant stressor in this system. Improper grazing can result in the replacement of native bunchgrasses with nonnative species such as *Bromus tectorum, Poa bulbosa,* or *Cynosurus echinatus*. Some stands have been harvested for firewood and fenceposts. Logging and grazing have created scrub-like stands of oak, which are more susceptible to stand-replacement fires. In summary, composition, abundance, and structure of native species in this system have been significantly affected by fire suppression, grazing, homesteading and development, and logging.

Conceptual Ecological Model

The general relationships among the key ecological attributes associated with natural range of variability of the East Cascades Oak-Ponderosa Pine Forest and Woodland system are presented in Figure 1. A model of oak dynamics in the Puget Sound is presented in Figure 2. Hanna and Dunn (1996) provide a conceptual model of the oak dynamics associated with human-induced stress (Figure 3).

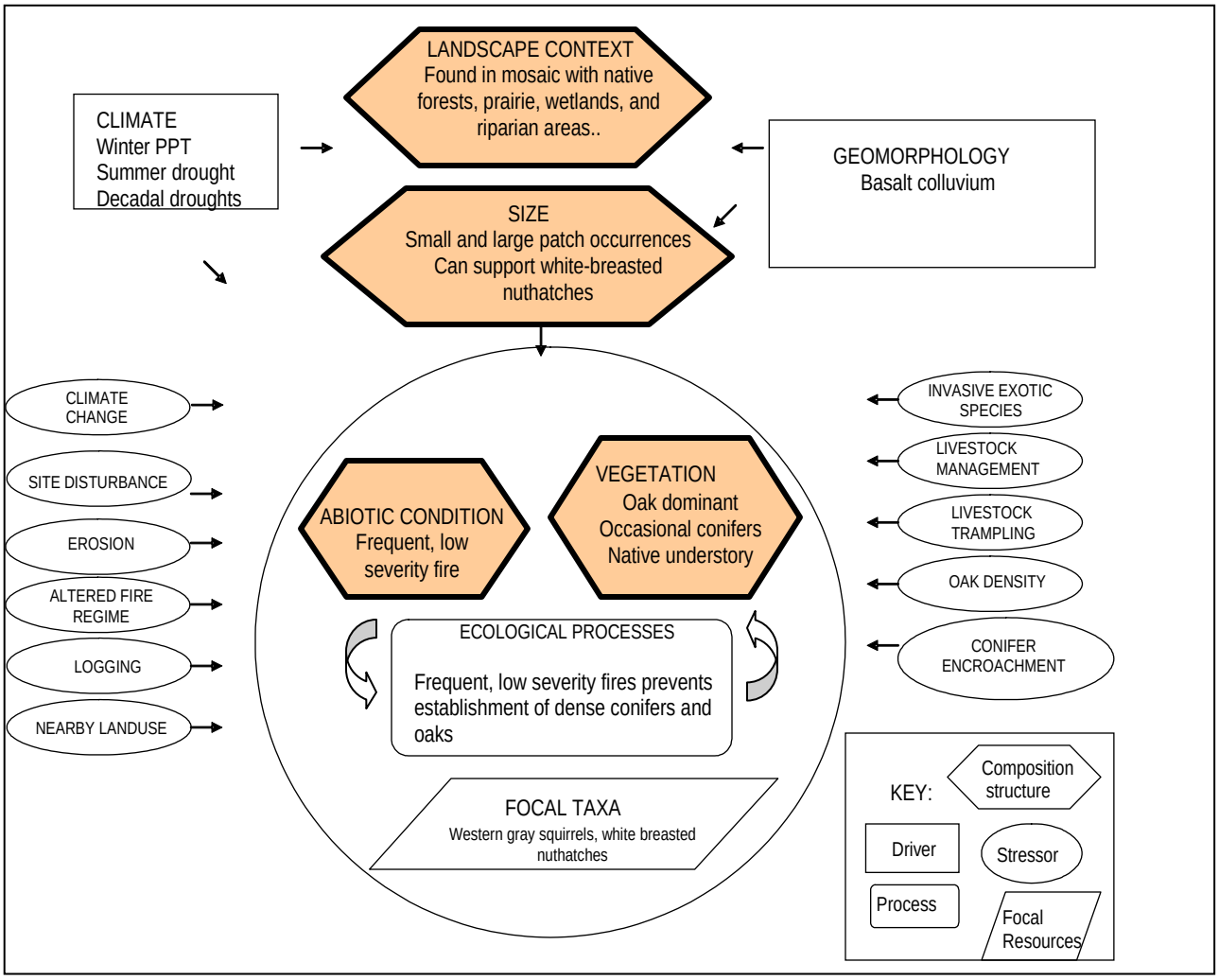

Figure 1. Generalized Conceptual Ecological Model for East Cascades Oak-Ponderosa Pine Forest and Woodland Ecological System.

Ecological Integrity Assessments

The assessment of ecological integrity can be done at three levels of intensity depending on the purpose and design of the data collection effort. The three-level approach is intended to provide increasing accuracy of ecological integrity assessment, recognizing that not all conservation and management decisions need equal levels of accuracy. The three-level approach also allows users to choose their assessment based in part on the level of classification that is available or targeted. If classification is limited to the level of forests vs. wetlands vs. grasslands, the use of remote sensing metrics may be sufficient. If very specific, fine-scale forest, wetland, and grassland types are the classification target then one has the flexibility to decide to use any of the three levels, depending on the need of the assessment. In other words, there is no presumption that a fine-level of classification requires a fine-level of ecological integrity assessment.

Because the purpose is the same for all three levels of assessment (to measure the status of ecological integrity of a site) it is important that the Level 1 assessment use the same kinds of metrics and major attributes as used at Levels 2 and 3. Level 1 assessments rely almost entirely on Geographic Information Systems (GIS) and remote sensing data to obtain information about landscape integrity and the distribution and abundance of ecological types in the landscape or watershed. Level 2 assessments use relatively rapid field-based metrics that are a combination of qualitative and narrative-based rating with quantitative or semi-quantitative ratings. Field observations are required for many metrics, and observations will typically require professional expertise and judgment. Level 3 assessments require more rigorous, intensive field-based methods and metrics that provide higher-resolution information on the integrity of occurrences. They often use quantitative, plot-based protocols coupled with a sampling design to provide data for detailed metrics.

Although the three levels can be integrated into a monitoring framework, each level is developed as a stand-alone method for assessing ecological integrity. **When conducting an ecological integrity assessment, one need only complete a single level that is appropriate to the study at hand.** Typically only one level may be needed, desirable, or cost effective. But for this reason it is very important that each level provide a comparable approach to assessing integrity, else the ratings and ranks will not achieve comparable information if multiple levels are used.

Level 1 EIA

A generalized Level 1 EIA is provided in Rocchio and Crawford (2009). Please refer to that document for the list of metrics applicable to this ecological system. For the Level 1 Fire Condition Class metric, please use the metric ratings for that same metric found below in the Level 2 EIA.

Level 2 EIA

The following table displays the metrics chosen to measure most of the key ecological attributes in the conceptual ecological model above. The EIA is used to assess the ecological condition of an assessment area, which may be the same as the element occurrence or a subset of that occurrence based on abrupt changes in condition or on artificial boundaries such as management areas. **Unless otherwise noted, metric ratings apply to both Level 2 and Level 3 EIAs. The difference between the two is that a Level 3 EIA will use more intensive and precise methods to determine metric ratings.** To calculate ranks, each metric is ranked in the field according the ranking categories listed below. Then, the rank and point total for each metric is entered into the EIA Scorecard (Rocchio and Crawford (2009) for details) and multiplied by the weight factor associated with each metric resulting in a metric 'score'. Metric scores within a key ecological attribute are then summed to arrive at a score (or rank). These are then tallied in the same way to arrive at an overall ecological integrity score.

Table 1. East Cascades Oak-Ponderosa Pine Forest and Woodland Ecological Integrity Assessment Scorecard

Metric	Justification	Rank			
		A (5 pts.)	B (4 pts.)	C (3 pts.)	D (1 pts.)
Rank Factor: LANDSCAPE CONTEXT					
Key Ecological Attribute: *Edge Effects*					
Edge Length	The intactness of the edge can be important to biotic and abiotic aspects of the site.	75 – 100% of edge is bordered by natural communities	50 – 74% of edge is bordered by natural communities	25 – 49% of edge is bordered by natural communities	< 25% of edge is bordered by natural communities
Edge Width		Average width of edge is at least 100 m.	Average width of edge is at least 75-100 m.	Average width of edge is at least 25-75 m.	Average width of edge is at least <25 m.
Edge Condition		>95% cover native vegetation, <5% cover of non-native plants, intact soils	75–95% cover of native vegetation, 5–25% cover of non-native plants, intact or moderately disrupted soils	25–50% cover of non-native plants, moderate or extensive soil disruption	>50% cover of non-native plants, barren ground, highly compacted or otherwise disrupted soils
Key Ecological Attribute: *Landscape Structure*					

Connectivity	Intact areas have a continuous corridor of natural or semi-natural vegetation	Intact: Embedded in 90-100% natural habitat; connectivity is expected to be high.	Variegated: Embedded in 60-90% natural or semi-habitat; habitat connectivity is generally high, but lower for species sensitive to habitat modification;	Fragmented: Embedded in 20-60% natural or semi-natural habitat; connectivity is generally low, but varies with mobility of species and arrangement on landscape.	Relictual: Embedded in < 20% natural or semi-natural habitat; connectivity is essentially absent
Landscape Condition Model Index	The intensity and types of land uses in the surrounding landscape can affect ecological integrity.	Landscape Condition Model Index > 0.8		Landscape Condition Model Index 0.75 – 0.65	Landscape Condition Model Index < 0.65
Landscape Fire Regime Condition	Low to mixed severity fire is vital to maintaining ecological integrity. (Fire Regime Condition Class) 2008)	FRCC 1 No departure from historic fire regime.	FRCC 2 Slight-moderate departure from historic fire regime.		FRCC 3 Severe departure from historic fire regime. Fire suppression is evident; Fuel laddering is severe and throughout much of stand.
Rank Factor: CONDITION					
Key Ecological Attribute: *Vegetation Composition*					
Relative Cover Native Plant Species	Native species in shrub and herbaceous layers; non-natives increase with human impacts.	Total cover of native species in shrub and herbaceous layers >95% and dominate all physiognomic layers;	Total cover of native species in shrub and herbaceous layers > 90%	Total cover of native species in shrub and herbaceous layers 50 to <90%. Nonnative may be codominant with native species	Total cover of native species in shrub and herbaceous layers <50%. Nonnative species dominate understory with minor native component.
Absolute Cover of Invasive Herbaceous Species	Invasive species can inflict a wide range of ecological impacts. Early detection is critical. Most common invasives are *Bromus tectorum, Poa bulbosa, Cynosurus echinata*	None or minimal (<1%) present.	Invasive species present, but sporadic (<5% cover).	Invasive species prevalent (5–30% absolute cover).	Invasive species abundant (>30% absolute cover).
Relative Cover of Understory Native Increasers	Some stressors can shift or homogenize native composition toward species tolerant of high anthropogenic stress.	Absent or incidental	<10% cover	10-20% cover	>20% cover
Key Ecological Attribute: *Vegetation Structure*					

Tree Age and Size Class	Presence of large open-grown trees and scattered recruitment of younger age classes. Stumps may indicate departure where few if any large trees remain. (Sites with low potential productivity may have never supported more than stunted pines or scrubby oak) (Evans 2010)	Large open-grown trees common. Multiple age & size classes present throughout system. Little if any harvest of large, old trees.	Dense even-aged regeneration (incl. sprouting oaks) occurring across a limited portion of system. No more than 30% of large old trees have been harvested.	Dense even-aged regeneration (incl. sprouting oaks) occurring across much of system, most trees < 100 years old; or 30-75% of old trees have been harvested.	Single age class of trees present, all < 100 yrs old; or, > 75% of old trees have been harvested.
Percent live tree canopy cover (*Quercus garryana* and native conifers)	Canopy structure (Evans 2010; WDFW 2004; Lilybridge et al. 1995; John & Tart 1986)	25-50%		15-25%or 50-60%	< 15% or > 60%
Relative live canopy cover of *Quercus garryana*	Canopy structure (Evans 2010)	≥50%	40-50%	20-40%;	< 20%
Density of large (> 38 cm DBH) oak or conifer trees & snags	Habitat structure (Evans 2010; Blume, L. 2009; Rodrick, E.A. 1986. WDFW 2004.)	> 7 large trees & snags /ha	≥ 7 large trees & snags/ha	< 7 large trees & snags /ha	Large trees & snags absent
Key Ecological Attribute: *Physicochemical*					

Soil Surface Condition	Soil disturbance can result in compaction, erosion thereby negatively affecting many ecological processes (Napper et al 2009)	**Soil-disturbance Class 0** Undisturbed • No evidence of past equipment. • No depressions or wheel tracks. • Forest-floor layers are present and intact. • No soil displacement evident. • No management-generated soil erosion. • No management-created soil compaction. • No management-created platy soils.	**Soil-Disturbance Class 1** • Wheel tracks or depressions evident, but faint and shallow. • Forest-floor layers are present and intact. • Surface soil has not been displaced. • Soil burn severity from prescribed fires is low (slight charring of vegetation discontinuous). • Soil compaction is shallow (0 to 4 inches). • Soil structure is changed from undisturbed conditions to platy or massive albeit discontinuous.	**Soil Disturbance Class 2** • Wheel tracks or depressions are evident and moderately deep. • Forest-floor layers are partially missing. • Surface soil partially intact and maybe mixed with subsoil. • Soil burn severity from prescribed fires is moderate (black ash evident and water repellency may be increased compared to preburn condition). • Soil compaction is moderately deep (up to 12 inches). • Soil structure is changed from undisturbed conditions and may be platy or massive.	**Soil Disturbance Class 3** • Wheel tracks or depressions are evident and deep. • Forest-floor layers are missing. • Surface soil is removed through gouging or piling. • Surface soil is displaced. • Soil burn severity from prescribed fires is high (white orreddish ash, all litter completely consumed, and soil structureless). • Soil compaction is persistent and deep (greater than 12 inches). • Soil structure is changed from undisturbed and is platy or massive throughout.
Rank Factor: SIZE					
Key Ecological Attribute: *Size*					
Relative Size	Indicates the proportion lost due to stressors such as complete fire suppression (conversion to a new system), development, roads, etc.	Site is at or minimally reduced from natural extent (>95% remains)	Occurrence is only modestly reduced from its original natural extent (80-95% remains)	Occurrence is substantially reduced from its original natural extent (50-80% remains)	Occurrence is severely reduced from its original natural extent (<50% remains)
Absolute Size	Absolute size may be important for buffering impacts originating in the surrounding landscape	>7,500 ha	500-7,500 ha	50-500 ha	<50 ha

Level 3 EIA
Level 3 metrics would include more quantitative measures of the metrics listed above. In addition, further consideration might be given to:

- presence/absence of wildlife species such as woodpeckers, Flammulated Owl, Western Gray Squirrel
- presence/absence of woodpeckers, and neotropical migrant birds. (Hanna and Dunn 1996).
- Species composition of lichens and bryophytes on oak trees.
- Fire Regime Condition Class standard landscape worksheet method (FRCC 2010)

Triggers or Management Assessment Points
Ecological triggers or conditions under which management activities need to be reassessed are shown in the table below. Since the Ecological Integrity rankings are based on hypothesized thresholds, they are used to indicate where triggers might occur. Specific details about how these triggers translate for each metric can be found by referencing the values or descriptions for the appropriate rank provided in the Table above.

Table 2. Triggers for Level 2 & 3 EIA

Key Ecological Attribute or Metric	Trigger	Action
Any metric (except Connectivity or LCM)	▪ C rank ▪ Shift from A to B rank ▪ negative trend within the B rating (Level 3)	Level 2 triggers: conduct Level 3 assessment; make appropriate short-term management changes to ensure no further degradation Level 3 triggers: make appropriate management adjustments to ensure no additional degradation occurs. Continue monitoring using Level 3.
Any Key Ecological Attribute	▪ any metric has a C rank ▪ > ½ of all metrics are ranked B ▪ negative trend within the B rating (Level 3)	Level 2 triggers: conduct Level 3 assessment; make appropriate short-term management changes to ensure no further degradation Level 3 triggers: make appropriate management adjustments to ensure no additional degradation occurs. Continue monitoring using Level 3.

Protocol for Integrating Metric Ranks
If desired, the user may wish to integrate the ratings of the individual metrics and produce an overall score for the three rank factor categories: (1) Landscape Context; (2) Condition; and (3) Size. These rank factor rankings can then be combined into an Overall Ecological Integrity Rank. This enables one to report scores or ranks from the various hierarchical scales of the assessment depending on which best meets the user's objectives. Please see Table 5 in Rocchio and Crawford (2009) for specifics about the protocol for integrating or 'rolling-up' metric ratings.

Supporting documents for the EIAs can be found at:
http://www1.dnr.wa.gov/nhp/refdesk/communities/eia.html

Documentation about Ecological Systems can be found at:
http://www1.dnr.wa.gov/nhp/refdesk/communities/ecol_systems.html

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