*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: Columbia Plateau Scabland Shrubland

## Ecological Summary

The large to small patch Columbia Plateau Scabland Shrubland ecological system occurs on the Columbia Plateau in eastern Washington, eastern Oregon, southern Idaho, and extreme northern Nevada. It is a xeric, low (e.g. < 0.5 m tall) open shrubland with short grasses that occurs on sites with little soil development and extensive areas of exposed rock, gravel, or compacted soil. Found across a wide range of elevations from 500 to 5,000 ft, this system is characteristically associated with flats, plateaus, and gentle to steep slopes with rock. Bare ground and rock usually account for greater than 60% of the ground cover. Shallow (4-9 inches) lithic soil occurs over fractured basalt or rarely deep gravel that has limited water-holding capacity and is a major environmental driver. Due to poor drainage through basalt, winter precipitation can saturate soils from fall to spring but typically dry out completely to bedrock by spring to midsummer. Precipitation ranges from 8 to 16 inches.

Total vegetation cover is typically low, generally less than 50% and often much less. The open dwarf-shrub canopy is usually dominated by *Artemisia rigida* along with or only by other dwarf-shrub species, particularly shrubby *Eriogonum* species (*compositum, douglasii, sphaerocephalum, strictum* or *thymoides*). Some sites can be dominated by grasses and semi-woody forbs, such as *Stenotus stenophyllus*. More than a presence of other *Artemisia* species besides *Artemisia rigida* indicates a different ecological system. Low cover of perennial short bunchgrasses, primarily *Poa secunda* with scattered forbs, including species of *Allium, Antennaria, Balsamorhiza, Lomatium, Phlox*, and *Sedum*, characterize scabland sites. Other short bunchgrasses, *Danthonia unispicata, Elymus elymoides* can characterize sites. Annuals may be seasonally abundant, and cover of moss and lichen is often high in natural areas (e.g. 1-60% cover). Biological soil crust cover in Columbia Plateau Scabland Shrublands is considered to be high (Belnap et al 2001). Tyler (2006) found that tall moss (*Tortula)* is positively correlated with dwarf shrub-steppe in Yakima County, Washington. Hardman (2007) concluded from a study in the Blue Mountains that *Artemisia rigida* steppe and thin soil grasslands are sensitive habitats greatly impacted by soil disturbance and that they host rare lichen and bryophyte species, such as, vagrant lichens *Grimmia ovalis* and *Dermatocarpon bachmannii* and the lichen *Cladonia imbricarica*. Johnson and Swanson (2005) indicated little difference in biological soil crust cover in grazed areas although they stated overgrazing will destroy crusts. Freezing of saturated soils results in "frost-heaving" that churns the soil and is a

major disturbance factor in determining vegetation patterns. Native ungulates utilize this ecological system in early spring and also contribute to churning of the soil surface. Severely grazed *Artemisia rigida* bushes are browsed to "compact mats" (Johnson and Swanson 2005). Vegetation cover is too low to carry fires and scablands "rarely" burn (Agee 1994). Sites with co-dominance of *Artemisia rigida* and *Artemisia tridentata* or *Purshia tirdentata* are included as part of the matrix Inter-Mountain Basins Big Sagebrush Steppe system. These are rocky sites with fine texture soils and have intermediate characteristics of scablands and shrubsteppe.

### *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).

Land uses in this system are few and stressors to natural processes are confined to livestock use, exotic species invasion and direct use of sites. This system provides little forage and consequently is used only as a final resort by livestock. However, heavy use by livestock or vehicles, particularly after the sites have dried, disrupts the moss/lichen layer and increases exposed rock and bare ground increasing the potential for invasion by non-native plants. Grazing also reduces the cover of bunchgrasses and increases the abundance of many forbs such as *Achillea millefolium*, *Phlox* sp., *Trifolium macrocephalum*, *Balsamorhiza serrata*, *Sitanion hystrix*, and annual bromes. All dwarf-shrub species are intolerant of fire and do not sprout. Consequently, redevelopment of dwarf shrub-steppe habitat is slow following fire or any disturbance that removes shrubs. Wind farms and industrial solar panel "farms" have been developed on scabland sites and represent conversion and fragmentation of scabland occurrences.

### *Conceptual Ecological Model*

The general relationships among the key ecological attributes associated with this system are presented in Figure 1.

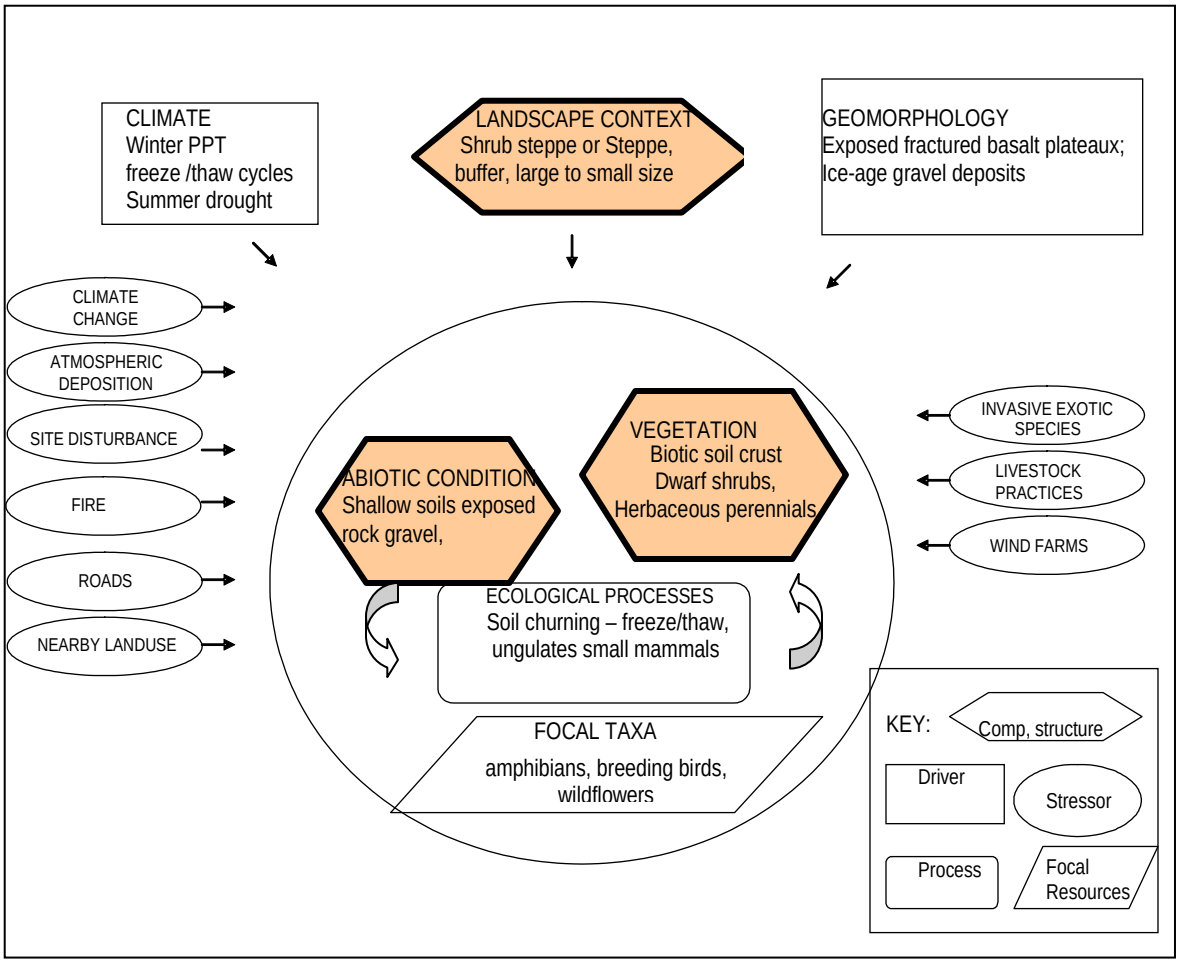

Figure 1. Conceptual Ecological Model for Columbia Basin Scabland Shrubland.

## 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.

**Level 2 EIA**

The following tables display 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 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. Columbia Basin Scabland Shrubland Level 2 EIA

| Metric | Justification | Rank | | | |
|---|---|---|---|---|---|
| | | A (5 pts.) | B (4 pts.) | C (3 pts.) | D (1 pts.) |
| **Rank Factor: LANDSCAPE CONTEXT** | | | | | |
| **Key Ecological Attribute: *Edge Effects*** | | | | | |
| **Buffer Length** | The buffer can be important to biotic and abiotic aspects as it provides connectivity and a 'filter' from exogeneous threats. | Buffer is > 75 – 100% of occurrence perimeter. | Buffer is > 50 – 74% of occurrence perimeter. | Buffer is 25 – 49% of occurrence perimeter | Buffer is < 25% of occurrence perimeter. |
| **Buffer Width** | | Average buffer width of occurrence is > 200 m, adjusted for slope. | Average buffer width is 100 – 199 m, after adjusting for slope. | Average buffer width is 50 – 99 m, after adjusting for slope. | Average buffer width is < 49 m, after adjusting for slope. |
| **Buffer Condition** | | Abundant (>95%) cover native vegetation, little or no (<5%) cover of non-native plants, intact soils, AND little or no trash or refuse. | Substantial (75–95%) cover of native vegetation, low (5–25%) cover of non-native plants, intact or moderately disrupted soils; minor intensity of human visitation or recreation. | Moderate (25–50%) cover of non-native plants, moderate or extensive soil disruption; moderate intensity of human visitation or recreation. | Dominant (>50%) cover of non-native plants, barren ground, highly compacted or otherwise disrupted soils, moderate or greater intensity of human visitation or recreation, no buffer at all. |
| **Key Ecological Attribute: *Landscape Structure*** | | | | | |
| **Connectivity** | Intact areas have a continuous corridor of natural or semi-natural vegetation between shrub steppe areas | 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 0.65 – 0.79 | Landscape Condition Model Index < 0.65 |
| **Rank Factor: CONDITION** | | | | | |
| **Key Ecological Attribute: *Vegetation*** | | | | | |
| **Relative Cover Native Plant Species** | Native species dominate this system; non-natives increase with human impacts. | Relative cover of native plants relative 95-100%. | Relative cover of native plants relative 80-95%. | Relative cover of native plants relative 50 to <85%. | Relative cover of native plants < relative 50%. |
| **Relative Native Bunchgrass Cover** | Native bunchgrass dominate vascular layers | Perennial short bunchgrass dominant cover near site potential. | Perennial short bunchgrass dominant cover but cover reduced from site potential by human stressors | Perennial short bunchgrass dominant cover but cover reduced from site potential by human stressors. | Perennial short bunchgrass dominant cover but cover much reduced from site potential by human stressors. |
| **Absolute Cover of Invasive Species** | Invasive species can inflict a wide range of ecological impacts. Early detection is critical. *Bromus tectorum* abundance is critical. | None present. | Invasive species present, but sporadic (<3% cover). | Invasive species prevalent (3–10% absolute cover). | Invasive species abundant (>10% absolute cover). |
| **Species Composition** Note: Once developed, the Floristic Quality Assessment index could be used here instead. | The overall composition of native species can shift when exposed to stressors. | Species diversity/abundance at or near reference standard conditions. Native species sensitive to anthropogenic degradation are present, functional groups indicative of anthropogenic disturbance (ruderal or "weedy" species) are absent to minor, and full range of diagnostic / indicator species are present. | Species diversity/abundance close to reference standard condition. Some native species reflective of past anthropogenic degradation present. Some indicator/ diagnostic species may be absent. | Species diversity/abundance is different from reference standard condition in, but still largely composed of native species characteristic of the type. This may include ruderal ("weedy") species. Many indicator/diagnostic species may be absent. | Vegetation severely altered from reference standard. Expected strata are absent or dominated by ruderal ("weedy") species, or comprised of planted stands of non-characteristic species, or unnaturally dominated by a single species. Most or all indicator/diagnostic species are absent. |
| **Biological Soil Crust** | Crust cover and diversity is greatest where not impacted by trampling, other soil surface disturbance and fragmentation (Hardman 2007; Belnap et al. 2001) | Largely intact biological soil crust that nearly matches the site capability where natural site characteristics are **not** limiting. | Biological soil crust is evident throughout the site but its continuity is broken | Biological soil crust is present in protected areas and with a minor component elsewhere | Biological soil crust, if present , is found only in protected areas |
| **Key Ecological Attribute: *Vegetation Structure*** | | | | | |
| **Fire-sensitive Shrubs** | Fire, naturally rare, eliminates or reduces *Artemisia rigida* or woody *Eriogonum* cover | Fire-sensitive shrubs mature and recovered from past fires | Fire-sensitive shrubs common not fully recovered from past fires; | Fire-sensitive shrubs present recovering from past fires; | Fire-sensitive shrubs rare due to past fires; |

| Key Ecological Attribute: *Physicochemical* | | | | | |
|---|---|---|---|---|---|
| **Soil Surface Condition** | Soil disturbance can result in erosion thereby negatively affecting many ecological processes; the amount of bare ground varies naturally with site type. | Bare soil areas are limited to naturally caused disturbances such as burrowing or game trails | Some bare soil due to human causes but the extent and impact is minimal. The depth of disturbance is limited to only a few inches | Bare soil areas due to human causes are common. There may be disturbance to several inches. ORVs or other machinery may have left some shallow ruts. | Bare soil areas substantially & contribute to long-lasting impacts. Deep ruts from ORVs or machinery may be present, or livestock and/or trails are widespread. |
| **Rank Factor: SIZE** | | | | | |
| **Key Ecological Attribute: *Size*** | | | | | |
| **Relative Size** | Indicates the proportion lost due to stressors. | 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** | Scabland patches are determined by soil depth naturally small. | Very Large (>1000 ac; 250 ha) | Large (100-1000 ac; 25-250 ha) | (1-10 ac; 2.5-25 ha). | Small (< 1 ac; 2.5 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:

- Quantitative measurements of range health indicators (Pellant and others 2005)
- Biological Soil Crust Stability Index (Rosentreter and Eldridge 2002).
- Biological soil crust species composition and abundance (Hardman 2007; Eldridge and Rosentreter 1999).

**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) | ▪ C rank<br>▪ Shift from A to B rank<br>▪ 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<br><br>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<br>▪ > ½ of all metrics are ranked B<br>▪ 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<br><br>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*

## References


Agee, James K. 1994. Fire and weather disturbances in terrestrial ecosystems of the eastern Cascades. Gen. Tech. Rep. PNW-GTR-320. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 52 p.

Belnap, J., J. Kaltenecker, R. Rosentreter, J. Williams, S. Leonard, and D. Eldridge. 2001. Biological Soil Crusts: Ecology and Management. Technical Report 1730-2, United States Department of the Interior. 110 pp.

Eldridge, D. J. and R. Rosentreter 1999 Morphological groups: a framework for monitoring microphytic crusts in arid landscapes. Journal of Arid Environments, Volume 41(1):11-25.

Hardman, A. 2007. Terrestrial Lichen and Bryophyte Communities of the Blue Mountains in Northeast Oregon. M.S. Oregon State Univ.

Johnson, C.G. and D.K. Swanson. 2005 Bunchgrass Communities of the Blue and Ochoco Mountains: A Guide for Managers. U.S.D.A. For. Ser. PNW-GTR-641.

Pellant, M. 1996. Cheatgrass: The Invader that Won the West- Bureau of Land Management, Idaho State Office, Interior Columbia Basin Ecosystem Management Project. 22 p.

Rocchio, F.J. and R.C. Crawford. 2009. Monitoring Desired Ecological Conditions on Washington State Wildlife Areas Using an Ecological Integrity Assessment Framework. Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia, WA.

Rostentreter, R. A. and D.J. Eldridge, 2002. Monitoring Biodiversity and Ecosystem Function: Grasslands, Deserts, And Steppe. *in*: Monitoring with Lichens—Monitoring Lichens. Eds.Nimis, Scheidegger and Wolseley. Dordrect: Kluwer Academic Publishers.199-233 pp.

Tyler, K.J. 2006. Biological Crusts: Analysis of Monitoring Techniques at the Yakima Training Center, Washington. M.S. Thesis Central Washington University, Ellensberg, Wa. 117p.



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