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: North Pacific Montane Shrubland

Ecological Summary

The North Pacific Montane Shrubland ecological system occurs on upland sites within the zone of continuous forest (not associated with avalanche chutes and sheets) at montane into subalpine elevations below subalpine parklands. They occur in the Cascades and Olympic Mountains Washington and into adjacent western Oregon and north into British Columbia. These shrublands or shrubfields are a typically seral to coniferous forest and their persistence depends on periodic fires or other periodic disturbance that limits tree growth. It is less common to absent on the windward sides of the coastal mountains where fires are rare due to very wet climates. The shrub species in this system provide important browse and cover species for wildlife as well as berries for people.

This system consists of long-lived, typically deciduous, broadleaf, seral shrublands that persist for several decades or more after major wildfires, or smaller patches of shrubs that periodically burn on dry sites that are marginal for tree growth. The system can occur in small to large patches on ridgetops and upper to lower mountain slopes, especially on sunny southern aspects. Elevation ranges from about 152 m (500 feet) elevation up to the lower limits of subalpine parkland.

Composed mostly of deciduous broadleaf shrubs, the North Pacific Montane Shrubland sometimes contains a mix of shrub-statured trees or sparse cover of conifer trees. Species composition is highly variable; however, some of the most common species include *Acer circinatum, Acer glabrum, Holodiscus discolor, Sorbus* spp., *Rubus parviflorus* and *Vaccinium membranaceum.* This system can also be dominated by evergreen shrubs *Arctostaphylos nevadensis,* and *Ceanothus velutinus.* Herbaceous cover is often low as well as litter accumulation (Smith and Fisher 1997). The evergreen, woody-based "forb" *Xerophyllum tenax* can be dominant in some areas often with *Vaccinium membranaceum*. Important forbs include *Chamerion angustifolium, Heracleum maximum* and *Pteridium aquilinum*.

They appear as large and small patches surrounded by conifer trees but lack significant tall tree cover within them. Shrublands vary in height from less than 3 feet (1m) in higher, drier environments to over 10 ft (3m) in mild moist areas and often are vigorous sprouting species. The shrubfields occur on all aspects and soils although they are more prevalent on south and west-facing slopes that have periodically burned (Smith and Fisher 1997). They are generally associated with well-drained sites. Soils tend to be moist to wet and can be too rocky to support forest cover. North Pacific Shrubland is maintained by recurring disturbances, including fire and downslope movement of soil, water, snow and rock. *Vaccinium membranaceum* is an important member of this mixed shrubland vegetation being the focus of native people burning. Fire was used by native people to expand or rejuvenate shrubfields for berries and/or beargrass (Richards and Alexander 2006, Boyd 1999, Fisher 1996) so shrubfields are sometimes anthopogenic in extent.

This system is floristically similar to North Pacific Avalanche Chute Shrubland, but the avalanche chutes originate from very different processes. Avalanche sheets that cover wide swaths of slopes are difficult to distinguish often overlap. Avalanche shrublands tend to be more diverse within stands, and are often wetter, being driven ecologically by snow-loading and concomitant snowmelt. Seral shrubfields of comparable composition that will develop into a forest stand development stage with trees (over 10% cover within 50 years) are excluded from this shrub system and are included in their appropriate forest system. This system overlaps with the Northern Rocky Mountain Subalpine Deciduous Shrubland System at higher elevation in the Cascades and is distinguished at lower elevation by species more associated with North Pacific flora such as *Acer circinatum*, *Gaultheria shallon* and *Vaccinium ovatum.* This system occurs below subalpine parklands and lacks heathers (*Cassiope* and *Phyllodoce*) and associated species. Small shrub patches below approximately 500 feet elevation maybe included within North Pacific Herbaceous Bald and Bluff or North Pacific Hypermaritime Shrub and Herbaceous Headland systems.

Stressors

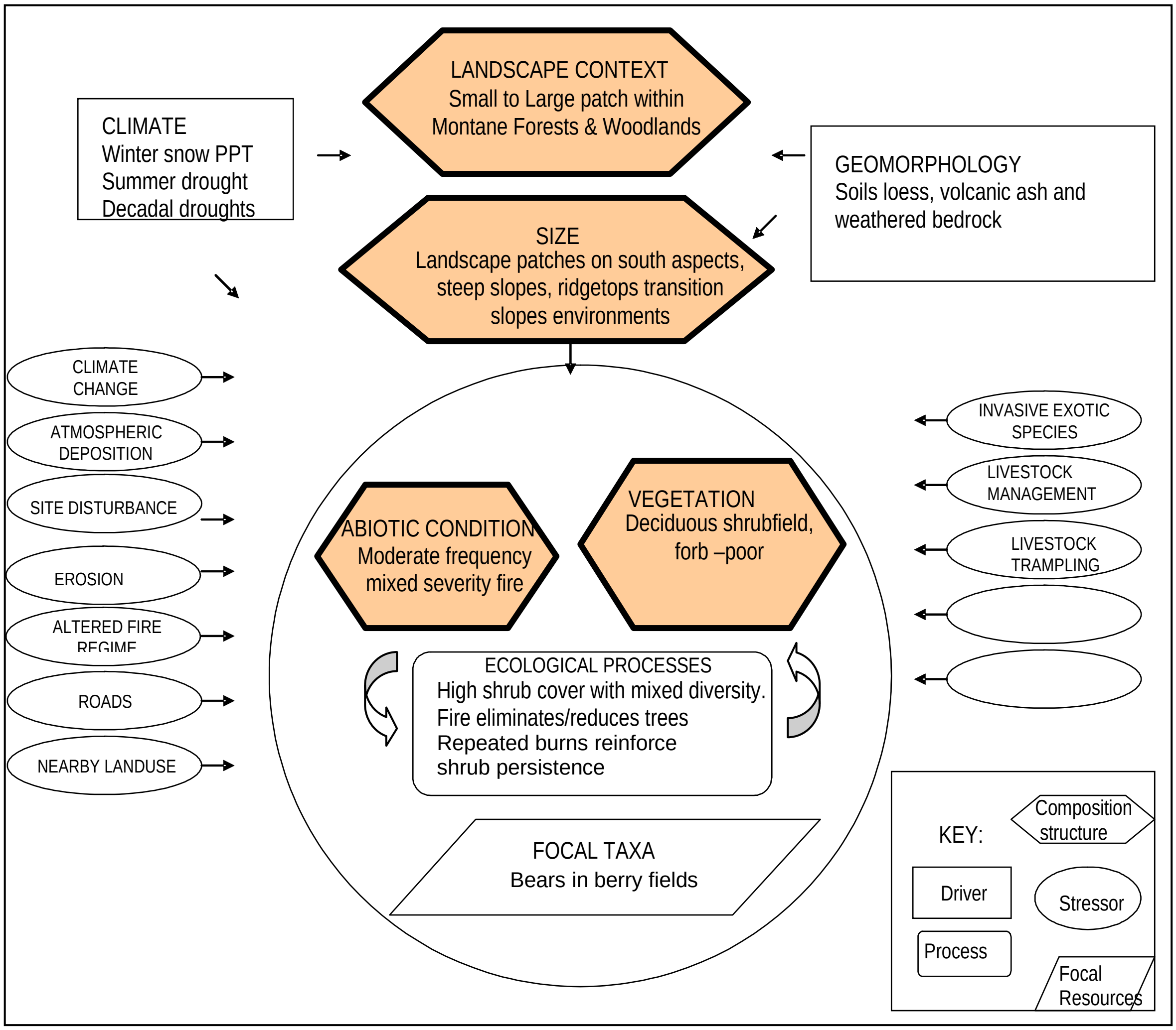
The stressors described below are those primarily associated with the loss of extent and degradation of the ecological integrity of existing occurrences. The stressors are the cause of the system shifting away from its natural range of variability. In other words, type, intensity, and duration of these 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).

Maintenance and expansion of seral shrubfields have been reduced due to fire exclusion and fuel management may have reduced their reburning (Wellner 1970). In response to fire suppression, trees may invade these shrublands. With heavy livestock grazing, shrubs are browsed, broken, and trampled, which eventually creates a more open shrubland with a more abundant herbaceous layer. Fisher (1996) states that some berry gathering areas were historically cleared and farmed by Euro- Americans, or grazed, especially by sheep. Minore (1979) concluded that sheep grazing did not damage huckleberry production in a controlled experiment. Invasive species are generally not as problematic at higher elevations and in closed forests as lower elevation disturbed forests and riparian areas. There is some concern about invasive species threatening subalpine and alpine environments (Parks *et al.* 2005).

Conceptual Ecological Model

The general relationships among the key ecological attributes associated with natural range of variability of the North Pacific Shrubland System are presented in Figure 1.

Figure 1. Conceptual Ecological Model for the North Pacific Shrubland 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.

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. North Pacific Shrubland 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 0.79 – 0.65	Landscape Condition Model Index < 0.65
Landscape Fire Regime Condition	Mixed to high 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*					
Relative Cover Native Plant Species	Native species dominate this system; non-natives increase with human impacts.	Relative Cover of native plants 95-100%.	Relative Cover of native plants 80-95%.	Relative Cover of native plants 50 to 80%.	Relative Cover of native plants <50%.
Species Composition Note: Once developed, the Floristic Quality Assessment index could 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.
Relative Shrub Cover	Mechanical disturbance of shrublands create patches of grass-dominated patches	Relative Cover of shrubs 95-100%.	Relative Cover of shrubs 80-95%.	Relative Cover of shrubs 50 to 80%.	Relative Cover of shrubs <50%.
Tree Abundance	The amount and spatial distribution of trees is an indication of the integrity of disturbance regimes	Trees are absent.	Trees shorter than shrubs and 1-10% cover	Trees pole-sized or smaller susceptible to fire mortality, and 1-10% cover	Trees larger than pole-sized not susceptible to fire mortality, and 1-10% cover.
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/livestock causes but the extent and impact is minimal.		Bare soil areas due to human/livestock causes are common. ORVs or other machinery may have left some shallow ruts.
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	Large occurrences support a mosaic of plant associations likely to contain variability of biophysical gradients and natural disturbances.	Over 405 ha (1,000 ac)	40-405 ha (100-1000 ac)	4-40 ha (10 -100 ac)	Less than 4 ha (10 ac)

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)
- Microphytic species composition and abundance (Eldridge and Rosentreter 1999).
- Fire Regime Condition Class standard landscape worksheet method (FRCC 2010)

4.?.5 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 ▪ 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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