Priority Habitats and Species Technical Report

PHS Shrubsteppe
Type
- Shrubsteppe
- Presumptive Shrubsteppe

PHS Eastside Steppe
Type
- Eastside Steppe
- Presumptive Eastside Steppe

Counties_UGAs_Cities

PHS Shrubsteppe and Eastside Steppe Map

Mapping Washington's Shrubsteppe and Eastside Steppe Priority Habitats

PHS Mission: To effectively communicate WDFW's conservation priorities via data driven maps, guidance, and technical assistance to influence terrestrial and aquatic land use decisions such that Priority Habitats and Species are protected and perpetuated.

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March 30, 2023

Acknowledgements

Citations:

The recommended citation for this publication:

> Folkerts, K. E., T. P. Johnson, and J. L. Michalak. 2023. Priority Habitats and Species Technical Report: PHS Shrubsteppe and Eastside Steppe Map. Habitat Program, Washington Department of Fish and Wildlife, Olympia, Washington.

The recommended citation for the Shrubsteppe and Eastside Steppe map:

> Washington Department of Fish and Wildlife. PHS Shrubsteppe and Eastside Steppe Map. 2022. Available from the Washington Geospatial Open Data Portal geo.wa.gov (Accessed <date>).

Contents

Acronyms

BAS	Best Available Science	SWAP	State Wildlife Action Plan
CAO	Critical Areas Ordinance	TAG	Technical Advisory Group
DNR	Department of Natural Resources (Washington State)	USGS	United States Geological Survey
ESOC	Ecological Systems of Concern	WAC	Washington Administrative Code
EVT	Existing Vegetation Type	WDFW	Washington Department of Fish and Wildlife
FAQ	Frequently Asked Question	WSDA	Washington State Department of Agriculture
GIS	Geographic Information System		
HGCN	Habitats of Greatest Conservation Need	WSDOT	Washington State Department of Transportation
NHD	National Hydrography Dataset		
PHS	Priority Habitats and Species		
RCW	Revised Code of Washington		

Background

Shrubsteppe is an arid ecosystem found in Eastern Washington and other western states. As one of Washington's most diverse ecosystems, shrubsteppe provides habitat for species found nowhere else in the state, such as the greater sage-grouse, sagebrush sparrow, and burrowing owl. With an estimated 80% of historic shrubsteppe lost or degraded to development and agriculture since the arrival of non-native settlers, protecting remaining shrubsteppe habitats is more important than ever.

Washington is at the northern extent of the great "Sagebrush Sea" that once sprawled across much of the American West. A growing collaboration between agencies, Native American tribes, conservation organizations, local landowners, and other partners seeks to preserve and restore shrubsteppe ecosystems while supporting cultural and economic values.

Despite impacts from severe wildfires and habitat fragmentation, recovery programs are underway for species such as the greater sage-grouse, pygmy rabbit, sharp-tailed grouse, and pronghorn antelope, while efforts including the Arid Lands Initiative and Conservation Reserve Program foster constructive partnership for the future of Washington's shrubsteppe.

Shrubsteppe and the related but distinct vegetation type, Eastside Steppe, meet the criteria for being Priority Habitats under the Washington Department of Fish and Wildlife's (WDFW) Priority Habitats and Species (PHS) program. The PHS List provides the criteria for qualification as a Priority Habitat and provides the technical definition (performance standards) for what qualifies as a Shrubsteppe or Eastside Steppe Priority Habitat. PHS also provides several management recommendations for Shrubsteppe, including an 85-page report with protocols for delineating Shrubsteppe, and summaries of this document for long-range planners and current planners. PHS also provides a 113-page manual on Shrubsteppe restoration with accompanying identification guides, data forms, and new addition for 2020: a page of resources regarding pollinators.

In November 2021, WDFW updated its mapping of two Priority Habitats under PHS program: Shrubsteppe and Eastside Steppe. This was a major revision. Prior to November 2021, PHS mapping of shrubsteppe was limited to places where WDFW biologists had verified that shrubsteppe existed (either through on-the-ground surveys or careful analysis of aerial imagery). Starting in November 2021, PHS began mapping Shrubsteppe areas based on the US Geological Survey's (USGS) Landfire Existing Vegetation Types (EVT) dataset. This comprehensive, wall-to-wall, LandSat-based dataset allows for consistent and comprehensive mapping of Shrubsteppe habitat in Washington state.

In May 2022, PHS staff—in consultation with a Technical Advisory Group (TAG)—conducted a significant update of the map by making the following changes:

1. Changed the method for classifying Eastside Steppe to reduced errors of over-identification. Previous methods misclassified some places where recently burned areas appear in aerial images as Eastside Steppe but are Shrubsteppe in an early stage of regeneration.
2. Identified the Shrubsteppe as "Presumptive" in places where the vegetation type was classified as "urban," "developed," "ruderal" (non-cultivated, invasive species), or "introduced".
3. Retained places designated by Washington State Department of Agriculture (WSDA) as "Pastures" that otherwise qualify as a Priority Habitat.

Methods

Mapping PHS Shrubsteppe and Eastside Steppe

The PHS Shrubsteppe and Eastside Steppe map is based on the US Geological Survey's (USGS) Landfire Existing Vegetation Types (EVT) dataset (Landfire 2016). The Landfire vegetation data was chosen because it is scientifically sound, easily updatable, and leverages existing datasets that are maintained and available for all Eastern Washington.

To produce the Shrubsteppe and Eastside Steppe map, we reclassified EVTs in the Landfire data as shown in Table 1 based on recommendations from the TAG. For a description of EVTs, see Appendix B.

The TAG concluded that PHS's Eastside Steppe Priority Habitat occurs commonly within the Palouse Prairie region of the state and only rarely elsewhere as mapped by WSU Professor Rex Daubenmire[1] in 1988 (see Figure 1). The TAG decided to constrain mapping of East Steppe to the Palouse Prairie ecoregion as identified by the US Forest Service[2] (see Figure 1)[3].

Consequently, when select EVTs occur outside of the Palouse Prairie area, they are considered PHS Shrubsteppe whereas when that same EVT occurs within the Palouse Prairie area, they are considered PHS Eastside Steppe. See Table 1.

1. Vegetation zones that comprise the steppe region of Washington, and the adjacent mountain systems. See figure 2 also.

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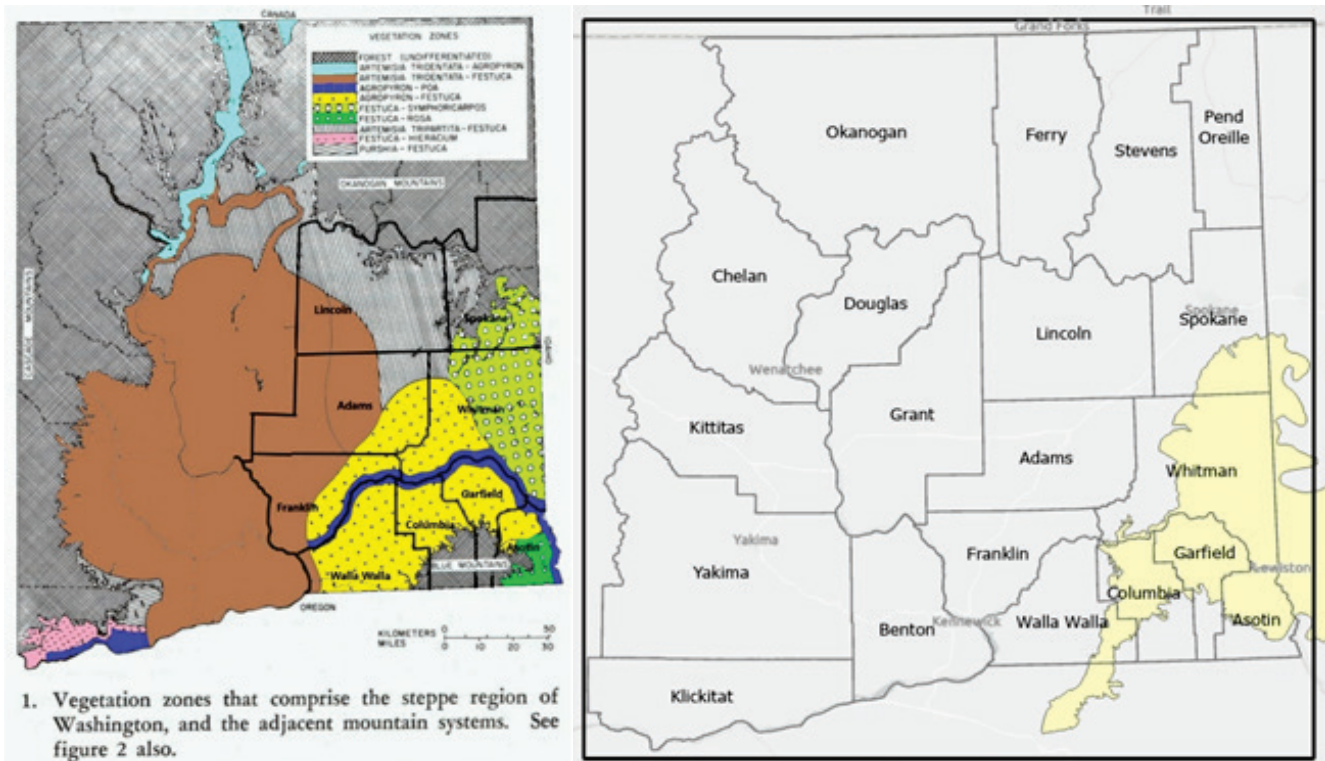
[1] Daubenmire, Rexford F, 1988. Shrubsteppe Vegetation of Washington. Technical Report. 131 pp. Washington State Cooperative Extension. Pullman, Washington.

[2] Cleland, D.T.; Freeouf, J.A.; Keys, J.E.; Nowacki, G.J.; Carpenter, C.A.; and McNab, W.H. 2007. Ecological Subregions: Sections and Subsections for the conterminous United States. Gen. Tech. Report WO-76D (A.M. Sloan, cartographer). Washington, DC: U.S. Department of Agriculture, Forest Service.

[3] This data is available at data-usfs.hub.arcgis.com/ (search term: *ecological sections*).

Table 1: EVT Classification, November 2021 and May 2022. Orange denotes Shrubsteppe, green Eastside Steppe; "presumptive" is shown in a lighter shade.

Landfire Existing Vegetation Type	Landfire Grid Code	Classification in Nov 2021	May 2022 Classification outside of Palouse Prairie	May 2022 Classification within Palouse Prairie
Columbia Plateau Scabland Shrubland	7065	Shrubsteppe	Shrubsteppe	Shrubsteppe
Columbia Plateau Steppe and Grassland	7123	Eastside Steppe	Shrubsteppe	Eastside Steppe
Columbia Plateau Low Sagebrush Steppe	7124	Shrubsteppe	Shrubsteppe	Shrubsteppe
Inter-Mountain Basins Big Sagebrush Steppe	7125	Shrubsteppe	Shrubsteppe	Shrubsteppe
Inter-Mountain Basins Montane Sagebrush Steppe	7126	Shrubsteppe	Shrubsteppe	Shrubsteppe
Inter-Mountain Basins Semi-Desert Shrub-Steppe	7127	Shrubsteppe	Shrubsteppe	Shrubsteppe
Columbia Basin Foothill and Canyon Dry Grassland	7134	Eastside Steppe	Shrubsteppe	Eastside Steppe
Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	7139	Eastside Steppe	Shrubsteppe	Eastside Steppe
Northern Rocky Mountain Subalpine-Upper Montane Grassland	7140	Eastside Steppe	Shrubsteppe	Eastside Steppe
Columbia Basin Palouse Prairie	7142	Eastside Steppe	Shrubsteppe	Eastside Steppe
Inter-Mountain Basins Greasewood Flat	7153	Shrubsteppe	Shrubsteppe	Shrubsteppe
Western Cool Temperate **Urban** Shrubland	7904	NA (not used)	Presumptive Shrubsteppe	Presumptive Shrubsteppe
Western Cool Temperate **Developed Ruderal** Shrubland	7923	NA (not used)	Presumptive Shrubsteppe	Presumptive Shrubsteppe
Western Cool Temperate **Developed Ruderal** Grassland	7924	NA (not used)	Presumptive Shrubsteppe	Presumptive Eastside Steppe
Great Basin & Intermountain **Introduced** Annual and Biennial Forbland	9307	Eastside Steppe	Presumptive Shrubsteppe	Presumptive Eastside Steppe
Great Basin & Intermountain **Introduced** Annual Grassland	9308	Eastside Steppe	Presumptive Shrubsteppe	Presumptive Eastside Steppe
Great Basin & Intermountain **Introduced** Perennial Grassland and Forbland	9309	Eastside Steppe	Presumptive Shrubsteppe	Presumptive Eastside Steppe
Interior W. North American Temperate **Ruderal** Shrubland	9328	Shrubsteppe	Presumptive Shrubsteppe	Presumptive Shrubsteppe
Western North American **Ruderal** Wet Shrubland	9329	Shrubsteppe	Presumptive Shrubsteppe	Presumptive Shrubsteppe
Great Basin & Intermountain **Ruderal** Shrubland	9336	Shrubsteppe	Presumptive Shrubsteppe	Presumptive Shrubsteppe
Interior Western North American Temperate **Ruderal** Grassland	9828	Eastside Steppe	Presumptive Shrubsteppe	Presumptive Eastside Steppe

"Presumptive" Shrubsteppe and Eastside Steppe

The TAG identified a set of "non-natural" (e.g., cultivated and/or non-native vegetation) Landfire EVTs Landfire that potentially contain PHS Shrubsteppe or Eastside Steppe Priority Habitat. These are:

1. Any EVT with a "Ruderal" or "Introduced" vegetation type.
2. One EVT described as "Urban" and two as "Developed"

The TAG had less certainty that these vegetation types truly contain Shrubsteppe or Eastside Steppe vegetation and cautioned that if they do, the vegetation is likely to be degraded by non-native or introduced vegetation. Consequently, the TAG sub-classified these as "Presumptive Shrubsteppe" and "Presumptive Eastside Steppe" (e.g., in the map, the "Occurrence_Name is "Shrubsteppe"; the modifier is in the "Site_Name" field.) See Table 1 for a list of EVTs that are sub-classified as "Presumptive Shrubsteppe" and "Presumptive Eastside Steppe."

Despite this greater uncertainty, the TAG recommended including these "Presumptive" vegetation types to err on the side of over-identifying potential critical areas (an error which can be corrected with a rapid site assessment) as opposed to under-identifying critical areas (an error likely to result in the loss of critical areas).

Subtractive Layers

We used several polygon layers to "subtract out" (clip) roads, crops, and waterbodies from the raster-based Landfire EVTs. Subtracting out non-Shrubsteppe and Eastside Steppe areas improves the accuracy by decreasing our errors of commission (i.e., falsely showing an area as Shrubsteppe or Eastside Steppe when it is not).

WSDA Agricultural Land Use Layer: WSDA publishes and annually maintains an accurate map of crop types and locations (available at geo.wa.gov). All CropGroups were subtracted out (clipped) from the Shrubsteppe/Eastside Steppe layers, except two: Other and Pasture (Table 2). We retained places WSDA classified as Other and Pasture because an analysis of these area shows a high proportion of these areas likely qualify as PHS Shrubsteppe/Eastside Steppe.

Table 2: WSDA CropGroups Used in the Subtractive Process

CropGroups NOT Clipped from Landfire EVTs	**CropGroups Clipped from Landfire EVTs (i.e., these were removed from consideration as Shrubsteppe/Eastside Steppe)**
Other, Pasture	Berry, Cereal Grain, Commercial Tree, Developed, Flower Bulb, Green Manure, Hay/Silage, Herb, Melon, Nursery, Oilseed, Orchard, Seed, Turfgrass, Vegetable, and Vineyard

NHD Hydrography Dataset: NHD maps the hydrography of the United States and is the statewide standard for hydrography in Washington. NHD is regularly updated and is the best available statewide information regarding the location of waterbodies; it is available at geo.wa.gov/. The following NHD polygons were subtracted out (clipped) from Landfire EVTs:

- NHDWaterbody: LakePond, Reservoir, Swamp/Marsh (only "perennial" features)
- NHDArea: StreamRiver, CanalDitch (only "perennial" features)

Roads: Road layers depict centerlines; we buffered centerlines by standard distances based upon road type and traffic volume[4]. The table below shows widths associated with different road types and the data sources we utilized for creating road polygons to subtract out (clip) from Landfire EVTs.

Table 3: Road Types, Sources, and Width used in the Subtractive Process.

Data Layer	Types of Roads	Width Calculation (from centerline)
DOTWidth	Interstates, US Highways, State Routes	($\frac{1}{2}$ * RdwyWidth) + 8
LAPR (WSDOT Local Agency Public Road Lines)	Arterials, Collectors, County roads, City streets	28' both sides of centerline
DNR Active Roads	Unimproved. dirt roads	6' both sides of centerline

Railroads: We used WSDOT's Rail24K data layer (also available on geo.wa.gov) and, like roads, we buffered railroad line features. We used 28' width for single-track rail lines and 48' for double-track.

Airports: We manually digitized each airport's built environment (runways, taxiways, tarmac, hangars, etc.) and disturbed areas using the National Airborne Imaging Program (NAIP) 2017 and 2019 digital orthophotos. This data is available from WDFW PHS upon request.

Building Footprints: Microsoft publishes a nationwide dataset of building footprints github.com/. In Washington, this dataset contains over 3.1 million computer-generated building footprints based on satellite imagery. Portions of the study area (mostly areas in the vicinity of large cities) are based on 2019-2020 images; the remainder is based upon older images (~2012 on average). We buffered structures by 20' to account for disturbed areas (lawns, driveways, etc.).

Spatial Data Processing

We carried out the spatial data processing using WDFW's enterprise GIS products, including ArcGIS Pro Version 2.9.3. The process was largely scripted to facilitate revising and re-running. The general steps in producing the Shrubsteppe map are:

1. Extract the EVTs listed in Table 1 from the most recent Landfire dataset and convert to a polygon feature.
2. Create buffers around roads, railroads, and structures as described above.
3. Merge the WSDA Ag Land Use dataset (excluding "Other" and "Pasture CropGroups), NHD polygons (described above), airports, and polygons created in Step 2.
4. From the Landfire EVTs extracted in Step 1, clip and delete the areas identified in Step 3.
5. Remove the EVTs that are considered Eastside Steppe within the Palouse Prairie ecoregion.
6. Add the modifier "Presumptive" to the "Site_Name" for the appropriate EVTs as described in Table 1.

Because of the size and complex geometry of Landfire EVT polygons, the above process was carried out on a county-by-county basis.

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[4] See Table 42.5 in Chapter 42 of WSDOT's *Manual 36-63 Local Agency Guidelines.*

Mapping Results

This effort identified 7,331,045.91 acres of PHS Shrubsteppe in Eastern Washington and 325,582.10 acres of Eastside Steppe (Figure 2). Table 4 shows "Shrubsteppe" and "Presumptive Shrubsteppe" acreage divided among counties. Table 5 provides the same information for Eastside Steppe.

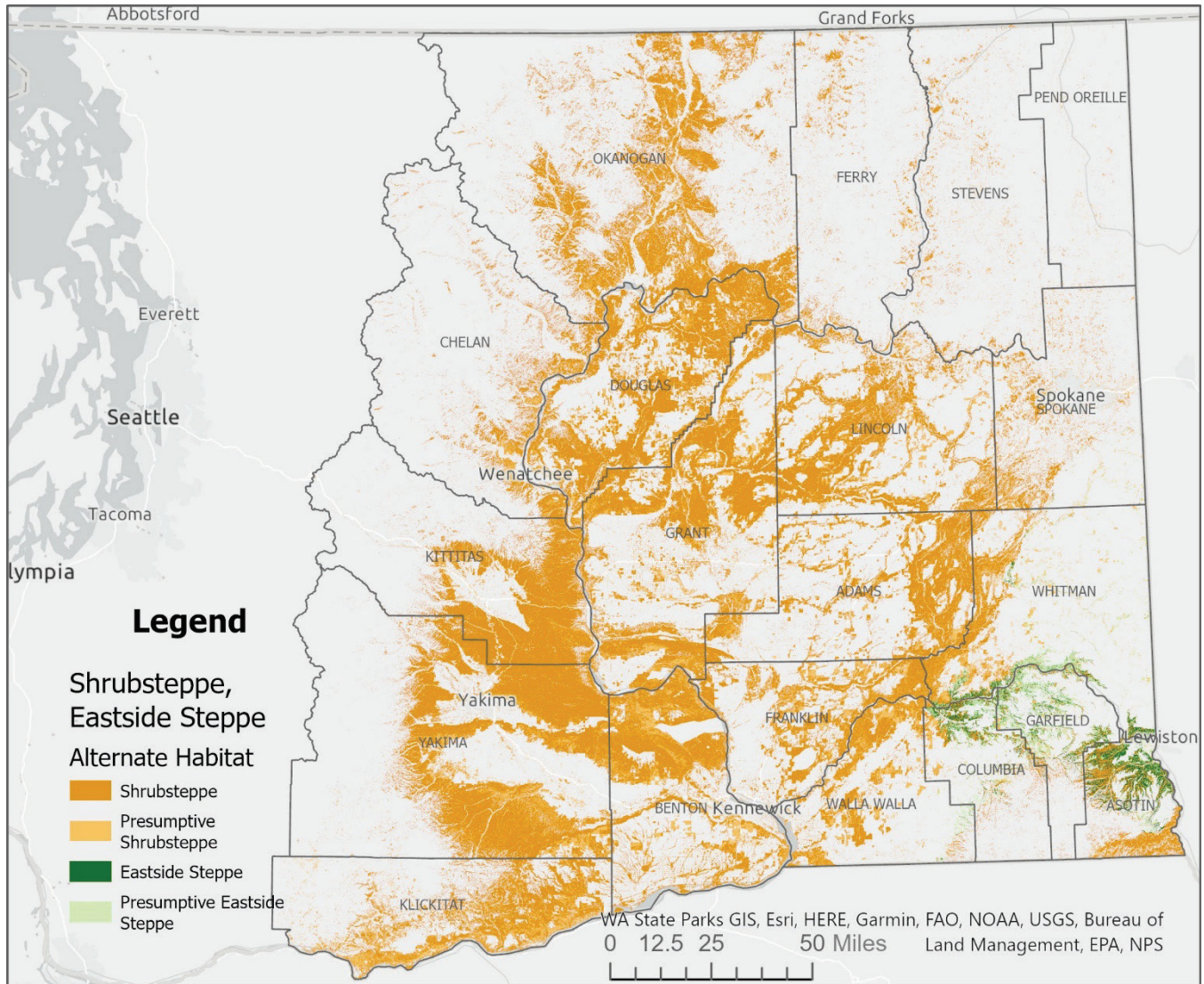*Figure 1: PHS Shrubsteppe and Eastside Steppe*

The resulting data layer is available via PHS on the Web and via geo.wa.gov by county and as a full statewide dataset. For WDFW staff, this information is available through the enterprise database, GeoLib (called PHS_Shrubsteppe_SV and PHS_EastsideSteppe_SV).

Table 4: Results of Mapping PHS Shrubsteppe Habitat by County

County	Acres Classified as "Shrubsteppe"	Acres Classified as "Presumptive Shrubsteppe"	Total Acres PHS Shrubsteppe Priority Habitat
Adams	336,058.19	86,740.24	422,798.44
Asotin	92,953.92	21,265.53	114,219.45
Benton	368,723.39	151,784.48	520,507.87
Chelan	202,417.77	28,418.75	230,836.52
Columbia	40,531.72	22,746.32	63,278.04
Douglas	569,411.86	93,553.09	662,964.95
Ferry	75,229.24	17,142.01	92,371.24
Franklin	216,718.98	91,411.90	308,130.88
Garfield	25,437.55	14,826.33	40,263.88
Grant	590,036.30	188,126.68	778,162.97
Kittitas	451,880.32	39,239.90	491,120.22
Klickitat	313,456.48	142,479.28	455,935.77
Lincoln	441,678.04	116,661.35	558,339.39
Okanogan	791,070.12	96,426.31	887,496.43
Pend Oreille	4,380.96	5,190.79	9,571.75
Spokane	89,150.67	76,179.54	165,330.21
Stevens	50,762.72	28,494.00	79,256.72
Walla Walla	155,489.29	81,224.42	236,713.71
Whitman	128,124.84	101,212.65	229,337.49
Yakima	824,148.93	160,260.99	984,409.92
TOTAL	**5,767,661.28**	**1,563,384.57**	**7,331,045.85**
	78.7%	**21.3%**	**100%**

Table 5: Results of Mapping PHS Eastside Steppe Habitat by County

County	Acres Classified as "Eastside Steppe"	Acres Classified as "Presumptive Eastside Steppe"	Total Acres PHS Shrubsteppe Priority Habitat
Asotin	68,484.56	21,812.96	90,297.52
Columbia	32,122.46	29,087.34	61,209.80
Garfield	36,874.03	54,846.48	91,720.51
Spokane	450.92	3,356.26	3,807.18
Walla Walla	1,050.74	5,350.00	6,400.75
Whitman	28,122.37	44,023.98	72,146.34
TOTAL	**167,105.08**	**158,477.02**	**325,582.10**
	51.3%	**48.7%**	**100%**

Data Limitations and Sources of Error

The PHS Shrubsteppe and Eastside Steppe map uses satellite data to identify locations that likely contain Shrubsteppe or Eastside Steppe vegetation. We provide a summary of significant sources of error here, but more details can be found in this white paper.

Resolution. The resolution of the input satellite data is a source of error because the entire 0.22-acre pixel is classified by the predominant vegetation/land cover type within that 0.22 acres, meaning that in some cases individual pixels classified as Shrubsteppe or Eastside Steppe may not be entirely composed of Shrubsteppe or Eastside Steppe. Conversely, Shrubsteppe or Eastside Steppe can be present in small amounts in locations that are not classified as Shrubsteppe or Eastside Steppe in the PHS map.

Misclassification. Landfire classifies vegetation and land cover types using a mix of computer algorithms and human oversight; inevitably, some pixels will be mis-classified.

The overall agreement rate between Landfire EVTs and a sample of 9,724 plots in 130 National Vegetation Classification Groups was 47%. However, our process of grouping many similar EVTs into the more generalized categories of Shrubsteppe and Eastside Steppe reduces misclassification errors and results in a more accurate map. For example, Landfire's Producer Accuracy (row agreement) for Inter-Mountain Basins Big Sagebrush Shrubland was 33%; the most common error was mistaking Inter-Mountain Basins Big Sagebrush Shrubland for Inter-Mountain Basins Big Sagebrush Steppe. For our purposes, both Inter-Mountain Basins Big Sagebrush Shrubland and Inter-Mountain Basins Big Sagebrush Steppe are simply "Shrubsteppe." Because of this lumping, we are confident that our accuracy rate is higher than Landfire's classification. However, we have not conducted a formal accuracy assessment of the reclassified Shrubsteppe and Eastside Steppe data layers.

Another source of error is that the EVT categories do not perfectly fit with PHS' definition of the Shrubsteppe Priority Habitat. For example, the "ruderal" and "introduced" EVTs overlap with but are not the same as the PHS definition of Shrubsteppe.

Finally, in urban landscapes, misclassification is more likely because of the complexity of land cover and vegetation types. For this reason, the PHS map classifies urban Shrubsteppe and Eastside Steppe vegetation types as "Presumptive Shrubsteppe/Eastside Steppe," meaning that there is greater uncertainty as to whether the vegetation is Shrubsteppe or Eastside Steppe or not.

There are two types of misclassification errors:

False negatives (aka errors of omission) are a misclassification in which the map shows there is *no* Shrubsteppe or Eastside Steppe, but in reality Shrubsteppe or Eastside Steppe exists. We have tried to minimize false negatives by including all EVTs that are likely to include Shrubsteppe or Eastside Steppe. Minimizing false negatives is important because if these locations not identified as Shrubsteppe or Eastside Steppe in the PHS map, that habitat is much more likely to be overlooked in the development process and Shrubsteppe or Eastside Steppe vegetation could be lost.

False positives (aka errors of commission) are a misclassification in which the map shows there *is* Shrubsteppe or Eastside Steppe, but, in reality, there is no Shrubsteppe or Eastside Steppe. WDFW sought to reduce these errors by eliminating areas known to be non-Shrubsteppe and non-Eastside Steppe (roads, buildings, crops, etc.). A site-scale assessment can demonstrate that Shrubsteppe or Eastside Steppe does not exist as mapped.

In addition to Landfire classification errors, there will also be errors associated with the roads, agricultural lands, buildings, waterbodies, railroads, and airport data. Sources of error include:

a. New infrastructure and developments that occur after the data were created will not be reflected in the dataset
b. Estimates of road and railroad width and buffers around building footprints do not reflect the actual boundaries of these features.
c. Errors in digitization and projection standard to any GIS mapped data.

As a result, on-the-ground conditions may vary from what is shown in the map and a site visit and field assessment is necessary to accurately delineate Shrubsteppe and/or Eastside Steppe.

Expert Review

This map was created by PHS staff who have extensive experience in land use planning, map design, and shrubsteppe conservation. It was iteratively reviewed by a multi-disciplinary team of biologists and ecologists with extensive expertise in Shrubsteppe and Eastside Steppe ecosystems –13 staff with a combined 321 years of professional experience. The review team included 11 scientists; eight of whom have a master's degree and two of whom have a PhD. It included 10 people from WDFW and two from Washington Department of Natural Resources. The review team evaluated the map's intended use, sources of information used, methodology, and the resulting map. These subject matter experts confirmed that the map adequately identifies Shrubsteppe and Eastside Steppe in locations where they are familiar with on-the-ground conditions.

Status of the Map as Best Available Science

Criteria for qualification as "Best Available Science" with respect to the Growth Management Act (GMA, RCW 36.70A) are provided in WAC 365-195. This guidance ([WAC 365-195-905](#)) says that scientific information can only be produced through a valid scientific process. It identifies characteristics generally expected in a valid scientific process to include (1) peer review, (2) clear, reproduceable methods, (3) logical conclusions and reasonable inferences, (4) quantitative analysis, (5) proper context, and (6) references. The USGS-led modeling effort that produced the Landfire EVTs meets these criteria. The combining of EVTs with other datasets was based on expert opinion of qualified individuals; that effort also meets the BAS criteria. A valid scientific process produces "reliable information useful in understanding the consequences of a local government's regulatory decisions and in developing critical areas policies and development regulations that will be effective in protecting the functions and values of critical areas." By this measure, it is our professional opinion of the authors and TAG that this map qualified as BAS.

Future Updates

WDFW intends to correct consequential errors to this dataset as improved information becomes available. The datasets used to prepare this map are periodically updated. We anticipate updating this map to reflect these changes. When significant updates occur, this Technical Report will be updated as will the metadata provided with the map.

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Appendix A: Frequently Asked Questions

How common are the different categories of Shrubsteppe, Presumptive Shrubsteppe, Eastside Steppe, and Presumptive Eastside Steppe?

The pie graph shows that of all the area mapped as a Priority Habitat, 96% is shrubsteppe and 4% is Eastside Steppe. Of the area identified as some type of shrubsteppe, 79% is "Shrubsteppe" (meaning the Existing Vegetation Type is of a "natural" type") and 21% is "Presumptive Shrubsteppe" (meaning the Existing Vegetation Type is a modified type "ruderal", "introduced" or "developed"). Of the area identified as some sort of Eastside steppe, 51% is "Eastside Steppe" (a "natural" EVT type) and 48% is "Presumed Eastside Steppe" (a modified EVT type).
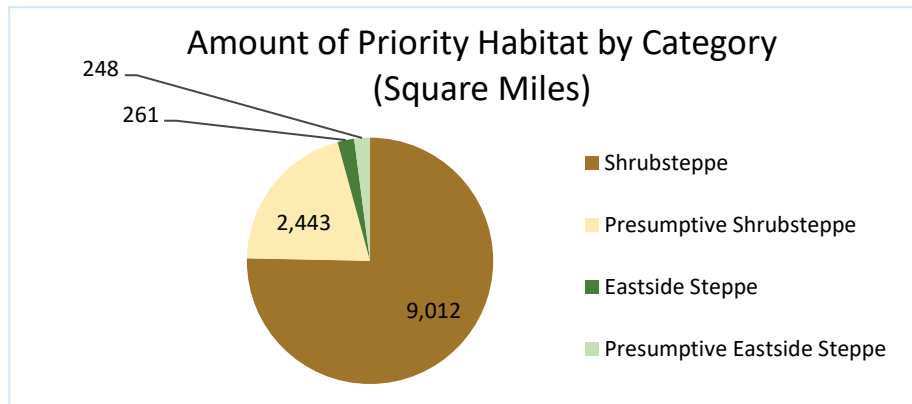
Where is the "Palouse Prairie" ecoregion?

The Palouse Prairie ecoregion, as used by this effort, is shown in the figure below left. It covers parts of Spokane, Whitman, Garfield, Asotin, Columbia, and Walla Walla counties. This area is mapped by the US Forest Service in its 2007 map of ecological subregions and sections.

Other reliable scientific sources (e.g., Daubenmire 1988), above right, show Eastside Steppe communities (yellow, purple, lime green, and pink areas) extending into the eastern portions of Adams and Franklin counties as well as in southern Klickitat County.
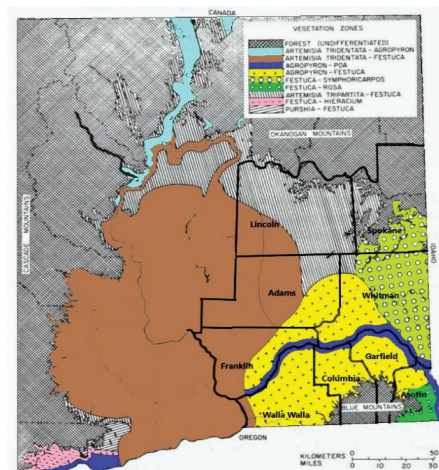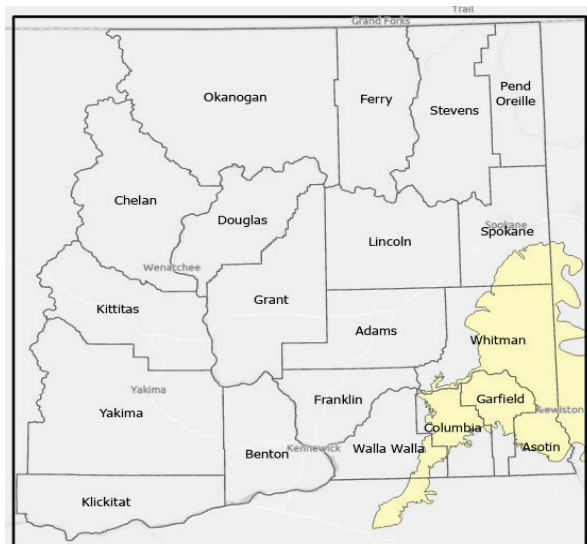
1. Vegetation zones that comprise the steppe region of Washington, and the adjacent mountain systems. See figure 2 also.

What can you tell me about the conservation status, importance to species, and climate vulnerability of the various Existing Vegetation Types?

See the table below. The Washington Natural Heritage Program assigns a conservation status state rank for EVT ecological systems:

S1 (Critically imperiled), S2 (Imperiled), S3 (Vulnerable), S4 (Apparently secure), S5 (Secure). A ranking with two codes (e.g., S1S2) denotes borderline cases. EVTs that are classified as *ruderal*, *introduced,* and *urban* are not ranked (NR) and are excluded from the table below.

WDFW's State Wildlife Action Plan (SWAP, 2015) identifies "Ecological Systems of Concern" (ESOCs) – ecological systems with S1, S2, or S1S2 state rank. The SWAP classifies ecological systems that provide habitat for six or more species as "Habitats of Greatest Conservation Need" (HGCNs). Finally, the SWAP classifies ecological systems into five categories based on their vulnerability to the effects of climate change.

While EVT information was used to create the PHS Shrubsteppe **map**, users are not able to use the PHS Shrubsteppe **map** to determine which EVT is at a specific location. This is because the PHS Shrubsteppe **map** provided via PHS on the Web merges (dissolves) EVTs by their classification into one of four categories (Shrubsteppe, Presumptive Shrubsteppe, Eastside Steppe, or Presumptive Eastside Steppe).

	Landfire Existing Vegetation Type	Classification	State Rank	Square Miles	ESOC?	HGCN?	Climate Vulnerability
1.	Inter-Mountain Basins Semi-Desert Shrubsteppe	Shrubsteppe	S1	80.48	Yes	No	Mod-High
2.	Columbia Basin Palouse Prairie	Eastside steppe (in Palouse Prairie)	S1	30.04	Yes	No	Mod
3.	Inter-Mountain Basins Greasewood Flat	Shrubsteppe	S1	0.16	Yes	No	Low-Mod
4.	Columbia Basin Foothill and Canyon Dry Grassland	Eastside steppe (in Palouse Prairie)	S1S2	911.00	Yes	No	Mod-High
5.	Columbia Plateau Low Sagebrush Steppe	Shrubsteppe	S1S2	1.09	Yes	Yes	
6.	Inter-Mountain Basins Big Sagebrush Steppe	Shrubsteppe	S2	**4,625.11**	Yes	Yes	Mod-High
7.	Columbia Plateau Steppe and Grassland	Eastside steppe (in Palouse Prairie)	S2	**1,836.66**	Yes	Yes	Low-Mod
8.	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Eastside steppe (in Palouse Prairie)	S3S4	593.22	No	No	Low-Mod
9.	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubsteppe	S3S4	197.40	No	No	Mod-High
10.	Northern Rocky Mountain Subalpine-Upper Montane Grassland	Eastside steppe (in Palouse Prairie)	S3S4	9.57	No	No	Mod
11.	Columbia Plateau Scabland Shrubland	Shrubsteppe	S5	**925.08**	No	Yes	Low-Mod

This mapping removes WSDA crops, but not crops classified as "Other" or "Pasture". Why is this?

We found that 72% of the acres classified by WSDA as "Other" fall within one of the Landfire Existing Vegetation Type (EVT) classifications that we consider shrubsteppe or Eastside steppe. Treating "Other" as we treat the remaining types of crops (i.e., removing them from the map) would make this a less accurate,

less effective flagging tool. We took the same approach for WSDA-classified "Pastures" because they also have considerable overlap with Shrubsteppe/Eastside Steppe EVTs.

How much of the Shrubsteppe and Eastside Steppe is within public land? How much is private?
Overall, 33% of the area mapped is on public lands (including tribal lands); 67% is on private land. Looking only at the public land, the federal government is the largest owner at 52%, followed by tribal governments with 31%, and the state government at 16%. Counties and cities own 0.6%.

When viewed by category, the highest public ownership is in Shrubsteppe. Eastside steppe has a

Ownership of Lands mapped as Shrubsteppe and Eastside Steppe
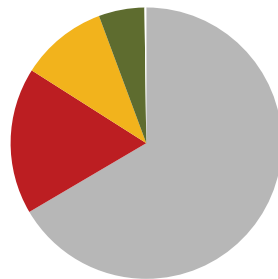
■ Private ■ Federal Government ■ Tribal Government ■ State Government ▪ Other

much lower proportion in public ownership:

	Private Ownership	**Public Ownership**
Shrubsteppe	62%	38%
Presumptive Shrubsteppe	78%	22%
Eastside Steppe	90%	10%
Presumptive Eastside Steppe	98%	2%

Appendix B: Natural EVT Concept Summaries

This appendix provides for each EVT (1) the "Concept" statements (i.e., a brief description) from Rocchio 2015[5], and (2) NatureServe's Conservation Status. They are sorted from most prevalent to least prevalent.

Inter-Mountain Basins Big Sagebrush Steppe

Conservation Status	Amount of PHS Shrubsteppe (mi²)	EVT Code	NatureServe link
Imperiled (S2)	4,625.11	7125	natureserve.org

Concept: Shrub-steppe (grassland with shrubs) dominated by *Artemisia* spp., and/or *Purshia tridentata* in an open to moderately dense (5- 40% cover) shrub layer and with at least 25% total perennial herbaceous cover. The natural fire regime of this ecological system maintains a patchy distribution of shrubs, so the general aspect is that of grassland.

Columbia Plateau Steppe and Grassland

Conservation Status	Amount of PHS Shrubsteppe (mi²)	EVT Code	NatureServe link
Imperiled (S2)	1,836.66	7123	natureserve.org

Concept: Grasslands dominated by perennial bunch grasses and forbs (>25% cover) and sometimes with a sparse (<10% cover) shrub layer. *Artemisia tridentata*, *Artemisia tripartita* and *Purshia tridentata* are absent and are unlikely to reestablish due to lack of seed source. This grassland system occurs over large areas, occasionally entire landforms, and is an alternative state of the Inter-Mountain Basins Big Sagebrush Steppe ecological system type where frequent fire (< 20 years) or fire severity results in an absence or very low cover of deep-rooted, fire intolerant shrub.

Columbia Plateau Scabland Shrubland

Conservation Status	Amount of PHS Shrubsteppe (mi²)	EVT Code	NatureServe link
Secure (S5)	925.08	7065	natureserve.org

Concept: Xeric, low (e.g. < 0.5 m tall) open shrublands dominated by *Artemisia rigida* along with or only by other dwarf-shrub species, particularly shrubby Eriogonum species (*compositum*, *douglasii*, *sphaerocephalum*, *strictum* or *thymoides*) located on sites with little soil development and extensive areas of exposed rock, gravel, or compacted soil. Some sites can be dominated by grasses and semi-woody forbs. 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.

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[5] Rocchio, J. and R. Crawford. 2015. Ecological Systems of Washington State: A Guide to Identification. Washington Department of Natural Resources. Olympia.

Columbia Basin Foothill and Canyon Dry Grassland

Conservation Status	Amount of PHS Shrubsteppe (mi²)	EVT Code	NatureServe link
Critically Imperiled (S1S2)	729.76	7134	natureserve.org

Concept: Perennial bunchgrasses and forbs (usually over 25% cover) dominated grasslands that occur on steep open slopes in the canyons and valleys of the Columbia Basin, particularly along the Snake River canyon and large tributaries. They can be floristically similar to the Columbia Basin Palouse Prairie but are distinguished by landform, soil, and process characteristics.

Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland

Conservation Status	Amount of PHS Shrubsteppe (mi²)	EVT Code	NatureServe link
Imperiled (S2)	590.23	7139	natureserve.org

Concept: Grasslands dominated by mid-tall bunchgrasses, such as *Pseudoroegneria spicata*, *Festuca campestris*, *Festuca idahoensis* or *Koeleria macrantha*, on level to moderate slopes and on steep slopes not associated with canyons. These grasslands range from small meadows to open parks surrounded by conifers within lower montane forests in the mountains surrounding the Columbia Basin and as foothill and valley grasslands below the lower tree line.

Inter-Mountain Basins Montane Sagebrush Steppe

Conservation Status	Amount of PHS Shrubsteppe (mi²)	EVT Code	NatureServe link
Vulnerable (S3S4)	197.40	7126	natureserve.org

Concept: Subalpine to montane shrub-steppe dominated by Artemisia tridentata ssp. vaseyana, and related taxa such as *Artemisia tridentata* ssp. *spiciformis* (= *Artemisia spiciformis*). *Purshia tridentata* may co-dominate some stands. In Washington, this ecological system occurs within forest landscapes in the East Cascades and western Okanogan Highlands.

Inter-Mountain Basins Semi-Desert Shrub-Steppe

Conservation Status	Amount of PHS Shrubsteppe (mi²)	EVT Code	NatureServe link
Critically Imperiled (S1)	80.48	7127	natureserve.org

Concept: This widespread matrix-forming ecological system occurs throughout much of the Intermountain West, most commonly in the southern portions. In Washington, it occurs as large to small patches in the hottest, driest (less than 8 inches (20 cm)/year) portions of the Columbia Basin (Pasco, Quincy, Umatilla, and lower Yakima basins). The woody layer is often a mixture of shrubs and dwarf-shrubs, although it may

be dominated by a single shrub species. Characteristic species include *Grayia spinosa* or *Krascheninnikovia lanata* with *Ericameria nauseosa*.

Columbia Basin Palouse Prairie

Conservation Status	Amount of PHS Shrubsteppe (mi²)	EVT Code	NatureServe link
Critically Imperiled (S1)	16.44	7142	natureserve.org

Concept: The Columbia Basin Palouse Prairie was once an extensive grassland system in southeast Washington and adjacent Idaho and Oregon but is now reduced to small remnants. It is characterized by dense bunchgrass cover and a high density of forbs on a dune-like topography composed of loess hills and plains over basalt. The Palouse prairie can be spilt into "moist" and "dry" variants based on increasing precipitation from eastern Franklin County to the Idaho state line.

Northern Rocky Mountain Subalpine-Upper Montane Grassland

Conservation Status	Amount of PHS Shrubsteppe (mi²)	EVT Code	NatureServe link
Imperiled (S2)	9.57	7140	natureserve.org

Concept: Upper montane to subalpine grasslands in the mountains of eastern Washington. These grasslands are lush and dominated by perennial grasses and forbs on dry sites, particularly southfacing slopes.

Columbia Plateau Low Sagebrush Steppe

Conservation Status	Amount of PHS Shrubsteppe (mi²)	EVT Code	NatureServe link
Critically Imperiled (S1S2)	1.09	7124	natureserve.org

Concept: Dwarf sagebrush shrub-steppe dominated by *Artemisia arbuscula*. And typically found on mountain ridges and flanks and broad terraces.

Inter-Mountain Basins Greasewood Flat

Conservation Status	Amount of PHS Shrubsteppe (mi²)	EVT Code	NatureServe link
Critically Imperiled (S1)	0.16	7153	natureserve.org

Concept: Open to moderately dense shrublands dominated or co-dominated by *Sarcobatus vermiculatus* and with saline soils. This system typically occurs near drainages on stream terraces and flats or may form rings around more sparsely vegetated playas. Seasonally high water tables and intermittent flooding is expected, however most sites remain dry at the soil surface through most growing seasons.

Appendix C: Key Resources

General Resources

Priority Habitats and Species

- WDFW shrubsteppe ecosystem page: wdfw.wa.gov/species-habitats/ecosystems/shrubsteppe

Existing Vegetation Types (EVT) and Ecological Systems

- Landfire Homepage: landfire.gov/
- NatureServe Explorer: explorer.natureserve.org/
- WA DNR Field Manual for Upland Rapid Ecological Integrity Assessments: dnr.wa.gov/publications/amp_nh_eia_protocol_upland_2020.pdf
- Ecological system state rank: dnr.wa.gov/publications/amp_nh_eco_sys_list.pdf
- EVT error assessment: landfire.gov/documents/LANDFIRE_Remap_Agreement_Assessment_Summary.pdf

GIS Data

Washington State Geospatial Portal:

- Homepage: geo.wa.gov
- National Hydrography Dataset (NHD): geo.wa.gov/maps/waecy::washington-state-nhd-wbd/explore?location=47.955679%2C-120.426800%2C5.32
- WSDOT Road data: geo.wa.gov/datasets/WSDOT::wsdot-local-agency-public-road-lines

Other

- Landfire Data viewer: landfire.gov/viewer/
- Microsoft building footprints: github.com/Microsoft/USBuildingFootprints
- US Forest Service geospatial portal: Palouse Prairie Ecological Section: data-usfs.hub.arcgis.com/
- Washington State Department of Agriculture: Agricultural land use map: nras.maps.arcgis.com/apps/webappviewer/index.html?id=3d61db30686d467ea6f5e0197be32b25