Eastside Timber Habitat Evaluation Project: Phase 1 Check-in

- September 24, 2024

ETHEP Objectives

Objective:

1. **Develop an alternative framework(s)** for applying riparian harvest rules in eastern Washington based on the **FPHCP functional objectives and performance targets. (Phase 1)**
2. Test the framework(s) for characterizing eastside riparian forests using data collected in the field. (**Phase 2)**

Methods

Phase 1

Step 1:Publicly available and relevant datasets will be evaluated using criteria outlined [in the Study Plan] that discriminate **their ability to characterize and differentiate riparian stands in eastern Washington.**

Step 2:The development of the classification system will begin with an approach that differentiates the landscape by one or more factors important for **stand characteristics, stand development, riparian function, stand health, and disturbance regimes.**

Step 3: Each classification system will be evaluated based on its ability to produce riparian classification units that **meaningfully and reliably differentiate outcomes relevant to each FPHCP objective.**

Methods

Phase 2

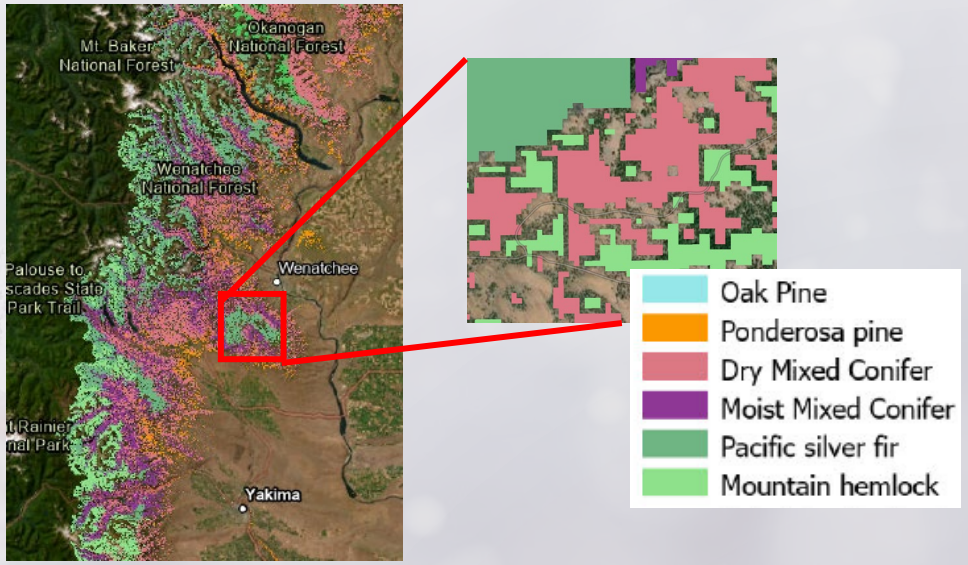
Step 1: **Field data will be collected** to assess the accuracy of the classification system within a **diversity of riparian environments and geographic regions** across eastern Washington and remedy any data gaps identified in Phase 1.

Step 2: Classification systems developed from the geospatial datasets during Phase 1 will be **assessed for accuracy with the newly acquired field data** and refined as needed. **Simulation modeling will be used to estimate how the classification units relate to FPHCP objectives over time.**

Step 1: Evaluation of Datasets

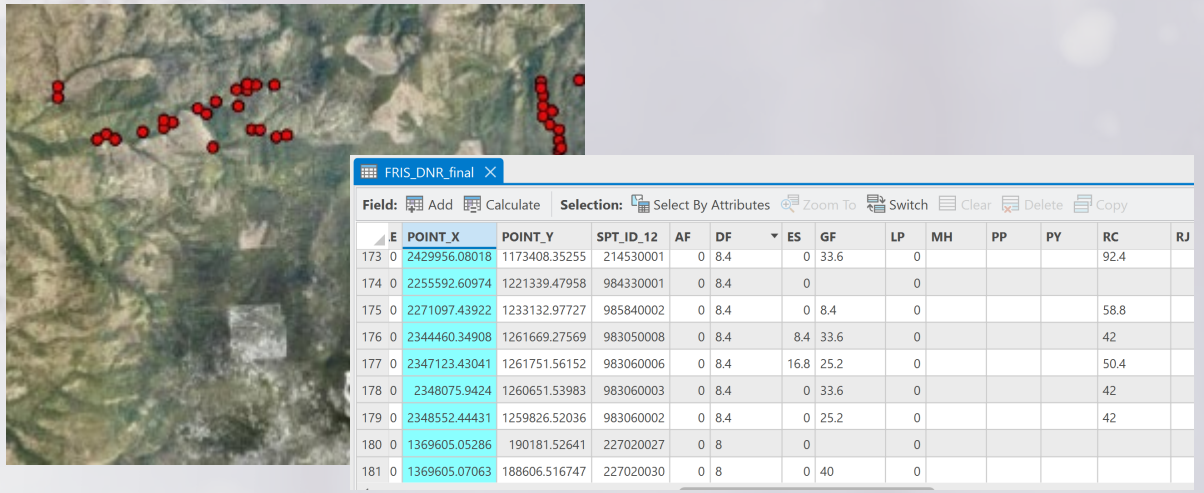
Geospatial data:

- High coverage
- Coarse description of vegetation, physiography, soil
  - Physiography and soil based on local and regional averages
  - Modeled <u>potential</u> vegetation



Existing field data (stand level):

- Lower Coverage
  - Point data
  - attributes
- Higher accuracy
  - <u>Existing</u> vegetation, physiography, and soil data



E	POINT_X	POINT_Y	SPT_ID_12	AF	DF	ES	GF	LP	MH	PP	PY	RC	RJ
173 0	2429956.08018	1173408.35255	214530001	0	8.4	0	33.6	0				92.4	
174 0	2255592.60974	1221339.47958	984330001	0	8.4	0		0					
175 0	2271097.43922	1233132.97727	985840002	0	8.4	0	8.4	0				58.8	
176 0	2344460.34908	1261669.27569	983050008	0	8.4	8.4	33.6	0				42	
177 0	2347123.43041	1261751.56152	983060006	0	8.4	16.8	25.2	0				50.4	
178 0	2348075.9424	1260651.53983	983060003	0	8.4	0	33.6	0				42	
179 0	2348552.44431	1259826.52036	983060002	0	8.4	0	25.2	0				42	
180 0	1369605.05286	190181.52641	227020027	0	8	0		0					
181 0	1369605.07063	188606.516747	227020030	0	8	0	40	0					

Step 1: Evaluation of Datasets

Geospatial data

- **Landscape Ecology, Modeling, Mapping, and Analysis (LEMMA) dataset (OSU)**
- **Modeled Potential Vegetation Zones of Washington and Oregon (USDA)**
- **Ecological Systems of Washington (NatureServe)**
- **Maximum Stand Density Models (UofI)**
- **Public data for the 20-year Forest Health Strategic Plan: Eastern Washington (WaDNR)**
- **Climate data and Predictions (USFS)**
- **Maps of Specific Forest Plant Species and Climate Profile Predictions (USFS).**
- **Individual Tree Species Parameter Maps (USFS)**
- **Forest Biomass geospatial dataset (USFS)**
- **SPTH/SitePotentialTreeHeightPublic (MapServer)**
- **TreeMap (USFS)**
- **BIGMAP (USFS)***

Does the data set cover lands managed under FPA?
Does the dataset differentiate between riparian and upland forest types?
Does the dataset contain suitable classification attributes?
Which have the best resolution (e.g., cell size)?

Step 1: Evaluation of Datasets

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Step 1: Evaluation of Datasets

Existing Field and Stand Level Datasets

- **PacFish/InFish Biological Opinion Monitoring Program (PIBO MP;USFS)**
- **Forest Inventory and Analysis (FIA)**
- **LANDFIRE (USFS)**
- **Eastern Washington Riparian Assessment Project (EWRAP) Phase 1 (Bonoff et al. 2008)**
- **Forest Resource Information System (FRIS; WaDNR)***

Does the data set cover lands managed under FPA?
Does the data set provide adequate spatial resolution?

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Step 1: Evaluation of Datasets

Geospatial data

- Landscape Ecology, Modeling, Mapping, and Analysis (LEMMA) dataset (OSU)
  - Vegetation data
- Maximum Stand Density Models (UofI)
  - Climate and soil data
- Public data for the 20-year Forest Health Strategic Plan: Eastern Washington (WaDNR)
  - Vegetation and climate data

Existing Field and Stand Level Datasets

- Eastern Washington Riparian Assessment Project (EWRAP) Phase 1 (Bonoff et al. 2008)
- Forest Resource Information System (FRIS; WaDNR)

Step 2: Preliminary Framework Development

Classification Approaches

Multi-factor Classification

- Similar to the habitat typing system this approach puts more weight on physiography and soil characteristics than on vegetation "Bottom up" (Schlenker, 1964; Barnes et al., 1982)

Habitat Typing

- Each ecosystem unit in this classification system is based on series, plant association, and community type. Focuses on late-successional communities "Top-down" (Layser, 1974; Pfister, 1976)

Forest Productivity Modeling

- Models forest growth rates and carrying capacity as a function of species mixing, climate, topography, and soils (Weiskittel et al., 2009; Kimsey et al., 2019)

Machine Learning*

- Gradient Boosting Machine (GBM) for Regression and Classification. GBM sequentially builds regression trees on all the features of the dataset in a fully distributed way - each tree is built in parallel (Elith et al., 2008).

Step 2: Preliminary Framework Development

Study Area

- 120 m buffer of the DNR Hydrography Watercourses
  - 80 m (260 ft) + 12.2 m (national mapping standard inaccuracy) + 26 m (DNR an USGS hydrography discrepancy) =112.2
  - equal to 12-10 m pixels

- 10 m x 10 m point grid (**47,089,718 points**)
  - Vegetation data
  - Climate, Topography, Soil data

Subsample

- Random list sample (1/1000th)
  - 50 m (160 ft) buffer
  - **14,888 points**

Step 2: Preliminary Framework Development (Results)

Multi-factor Classification Approach (Bottom-up): Ordination by physiography and soil

- Most important factors by variation across point distributions **= All Temperature Factors, Elevation, and Mean Annual Precipitation**

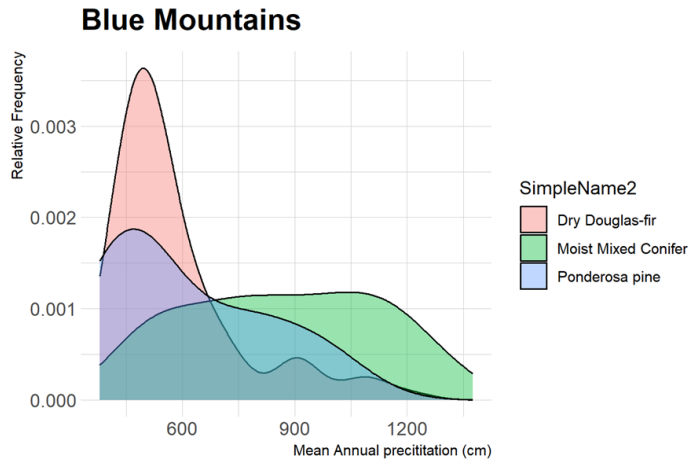
Habitat Typing Approach (Top-down) : Ordination by species coverage

- Most important factors by variation across species distributions = **All Temperature factors, Elevation, and Mean Annual Precipitation**

Machine Learning Approach /Forest Productivity Modeling : Covertype prediction by species distribution relative to physiography and soil

- Most important factors for predicting species groups = **Ecoregion**, **Mean annual precipitation, Elevation, Minimum annual temperature, maximum summer temperature, and Heatload**

Phase 1 Preliminary Framework



A. Northeast (Okanogan and Canadian Rocky mountains)
   a. Mean annual precipitation
      i. < 700 mm.....Spruce-Fir; Ponderosa Pine; Dry Mixed Conifer (80.7%)
      ii. >700 mm.....Western Red Cedar; Moist Mixed Conifer (75.8%)
   b. Elevation
      i. < 700 m.....Ponderosa Pine (73.0%)
      ii. 600 -1100 m .....Dry/Moist Mixed Conifer; Western redcedar (72.0 %)
      iii. > 1050 m.....Spruce/Fir (84.8%)

B. Blue Mountains
   a. Mean annual precipitation
      i. < 745 mm.....Dry Douglas-fir, Ponderosa Pine (79.3%)
      ii. >745 mm .....Moist Mixed Conifer (65.3%)
   b. Elevation
      i. < 1000 m.....Dry Douglas-fir; Ponderosa Pine (75.3%)
      ii. >800 m.....Moist Mixed Conifer (68.5%)

C. East Cascades
   a. Mean annual precipitation
      i. < 600 mm .....Ponderosa Pine (85.0%)
      ii. 500 – 1000 mm .....Dry Mixed Conifer (67.5%)
      iii. >800 mm .....Moist Mixed Conifer (72.9%)
   b. Elevation
      i. < 800 m .....Ponderosa Pine, Dry Mixed Conifer (75.7%)
      ii. > 700 m.....Moist Mixed (68.9%)

D. Columbia Basin
   a. Mean annual precipitation
      i. <550 mm.....Dry Mixed Conifer; Ponderosa Pine (84.8%)
      ii. >550 mm.....Moist Mixed Conifer (67.5%)
   b. Elevation
      i. <725 m .....Ponderosa Pine (83.6%)
      ii. >600 m .....Dry/Moist Mixed Conifer (84.4%)

Step 3: Evaluation

Each classification system will be evaluated based on its ability to produce riparian classification units that meaningfully and reliably differentiate outcomes relevant to each FPHCP objective.

FRIS

- Only covers DNR trust lands (limited coverage)

EWRAP

- Better coverage than FRIS, but does not cover all conditions and has coarse resolution (e.g., extremes for moisture, elevation, and precipitation)

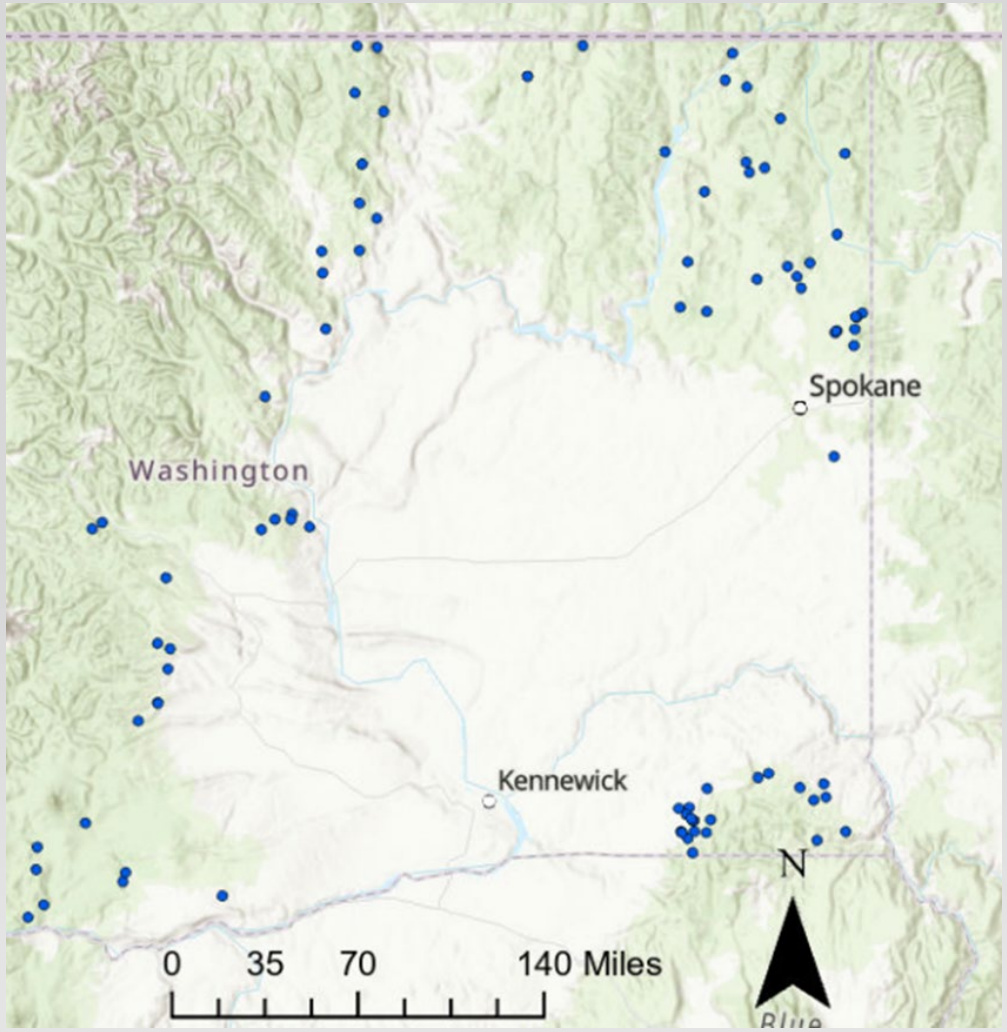
Phase 2, Step 1: Field Data

Stratified random sampling design drawn from the 14,888 subsample points used in Phase 1, Step 2.

Site selection:

- Divide study area into strata identified during Phase 1, Step 2
  - 5 ecoregions
  - 2 elevation categories
  - 3 precipitation categories
  - 3 Heatload categories

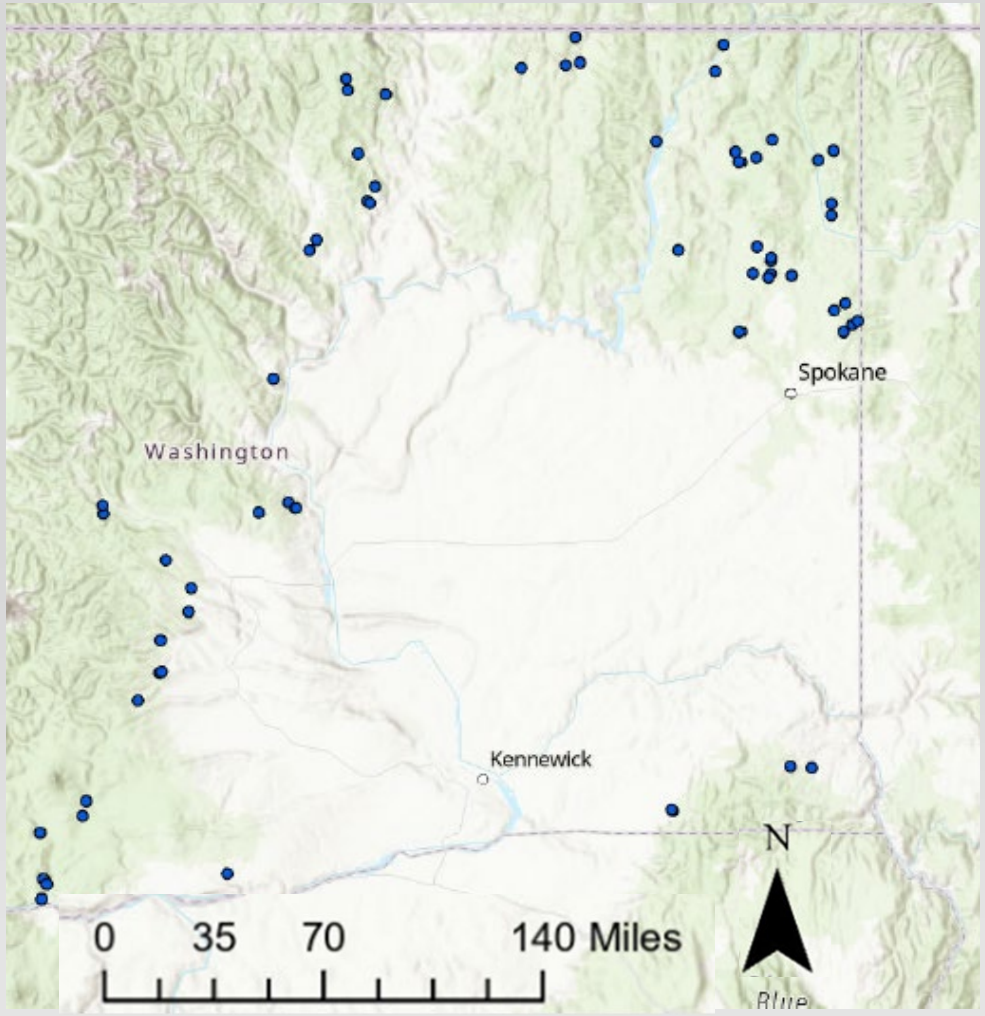
5 x 2 x 3 x 3 = 90 sites



Phase 2, Step 1: Field Data

Current Data Collected

- 68 of 90 sites
  - Canadian Rocky mountains 18/18
  - East Cascades 18/18
  - Okanogan 17/18
  - Columbia Plateau 9/18
  - Blue Mountains 6/18



Phase 2, Step 2: Validation

Future analysis

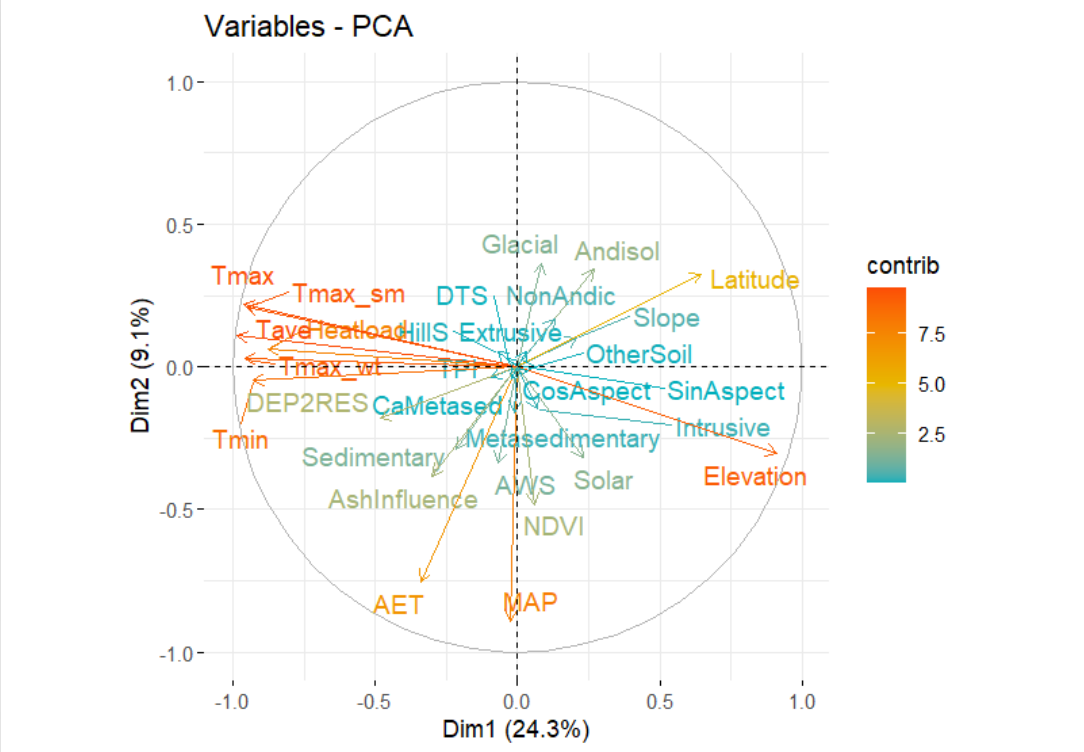
1. Classification systems developed from the geospatial datasets during Phase 1 will be assessed for accuracy with the newly acquired field data and refined as needed.

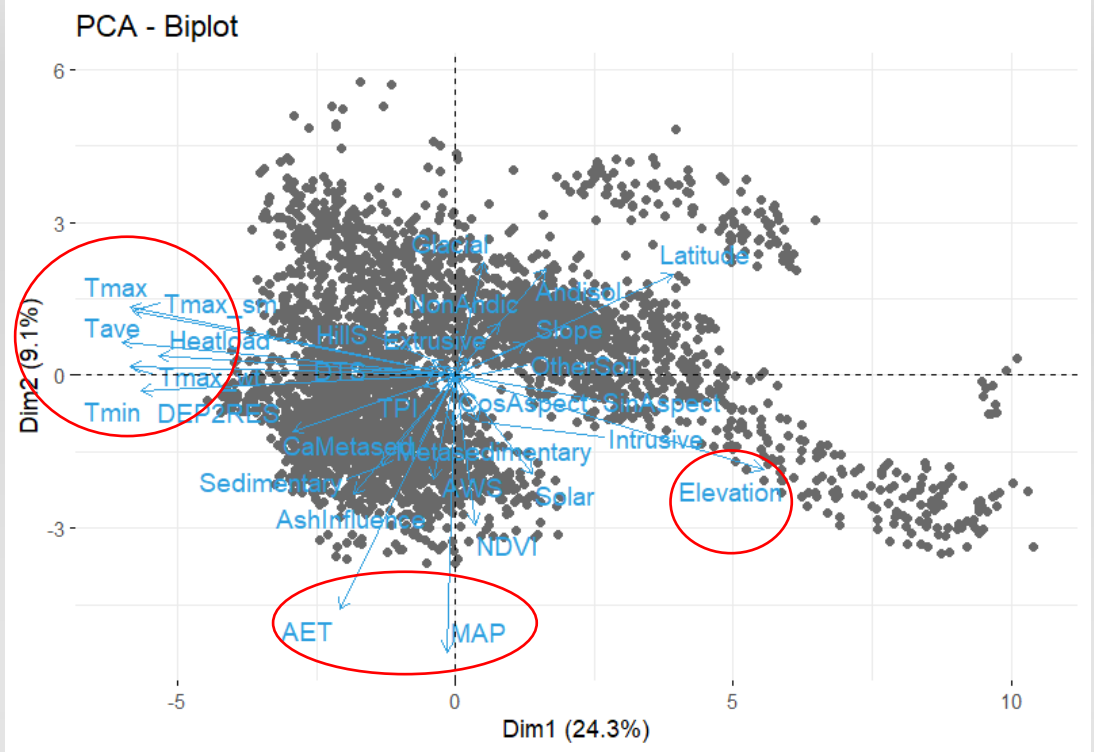
2. Simulation modeling will be used to estimate how the classification units relate to FPHCP objectives over time.

Step 2: Framework Development

Multi-factor Classification Approach: Principal Component Analysis (PCA)

- **Most important factors by variation across point distributions = Temperature, Elevation, and Precipitation**

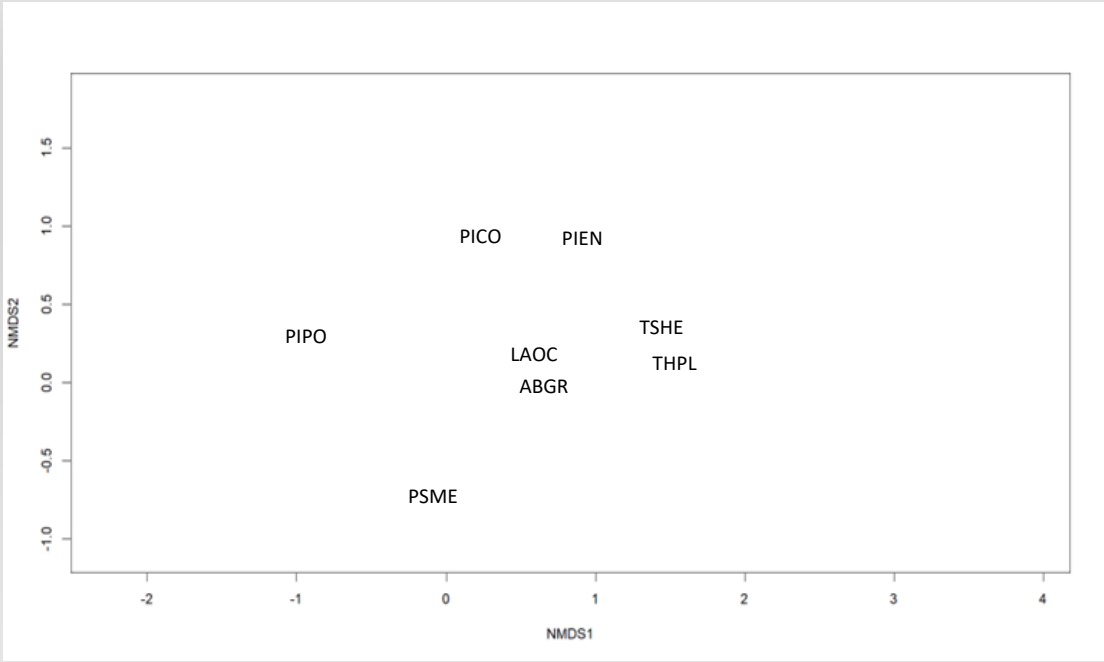


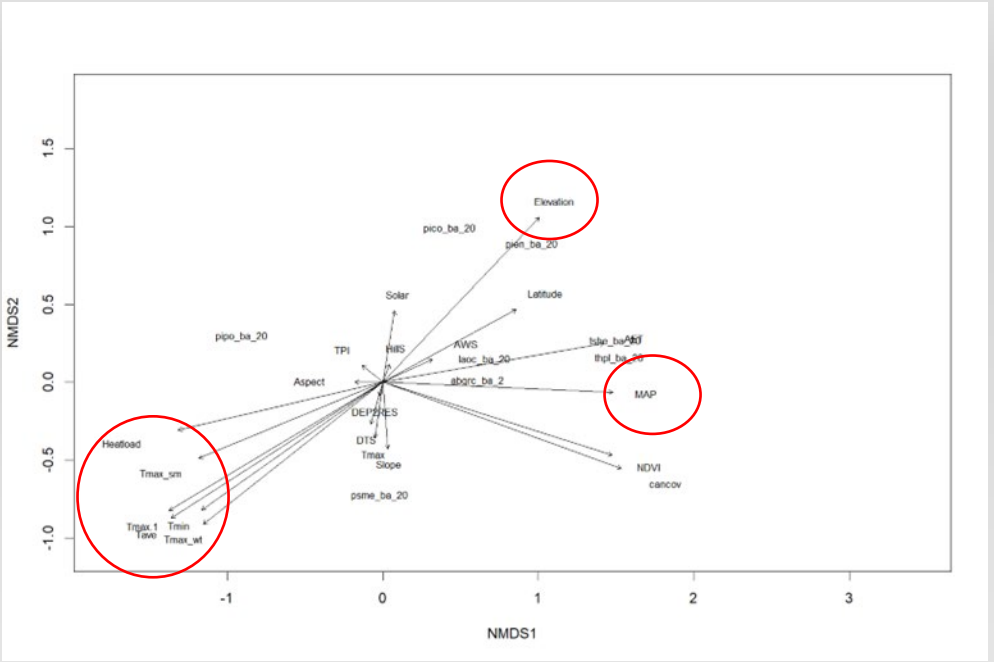


Step 2: Framework Development

Multi-factor Classification Approach: NMDS (LEMMA: Full Study Area)

- **Most important factors by variation across species distributions = Temperature, Elevation, and Precipitation**

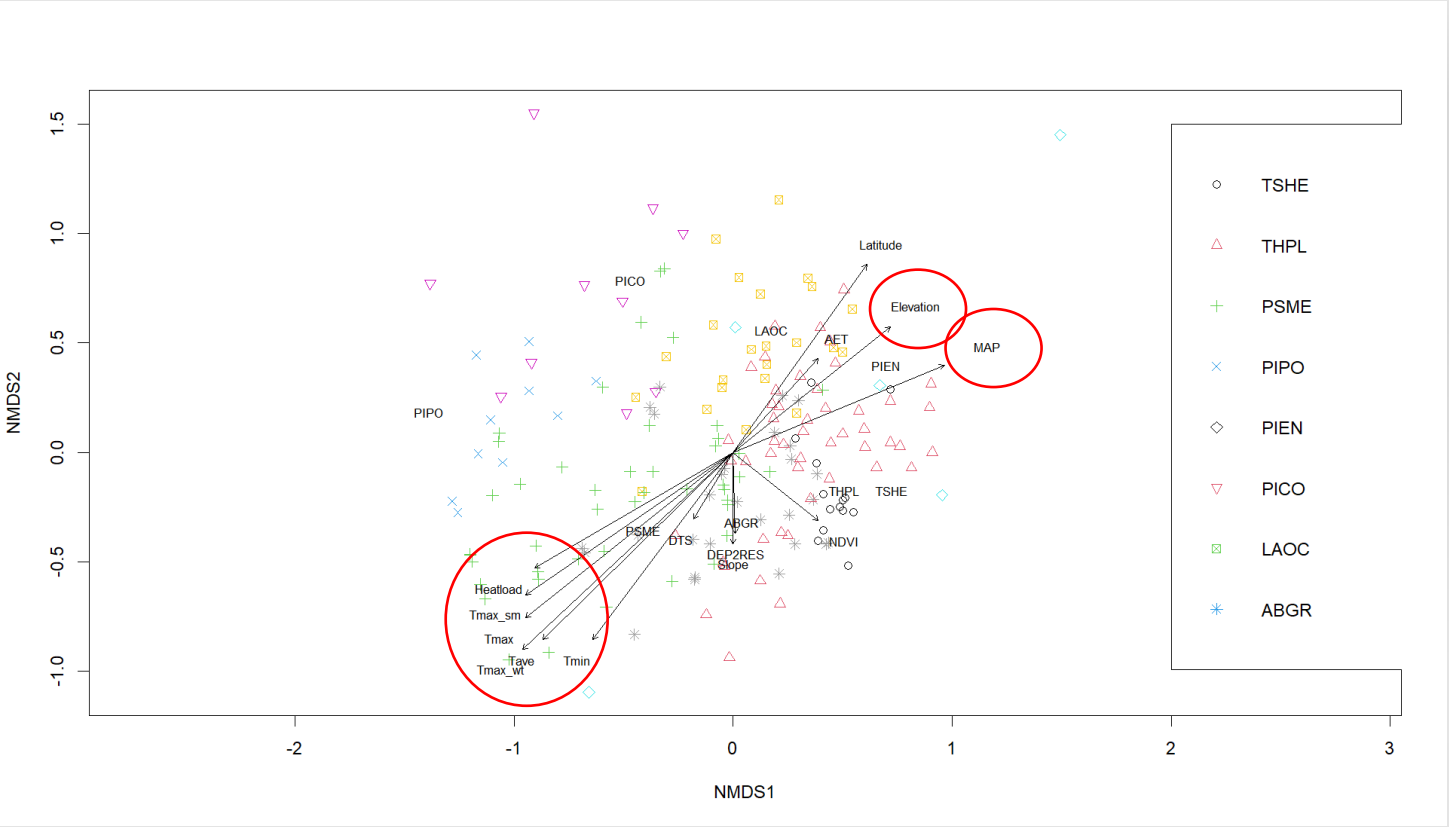




Step 2: Framework Development

Multi-factor Classification Approach: NMDS (LEMMA; Northern Rocky Mountains)

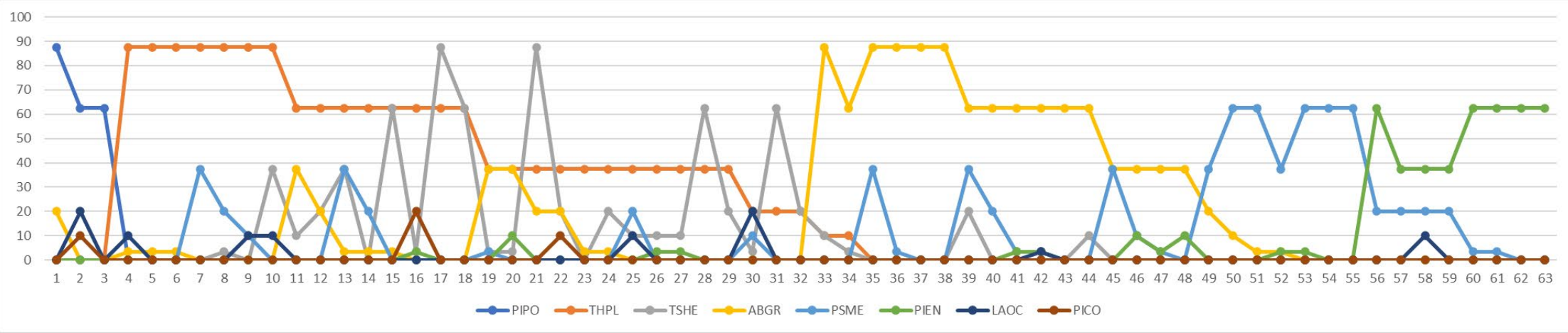
- **Most important factors by variation across species distributions = Temperature, Elevation, and Precipitation**



Step 2: Framework Development

Habitat Typing Approach: Ordination by species coverage

- **Results of the ordination showed alignment with riparian forest series developed by Kovalchik and Clausnitzer (2004)**
  - **One exception, PIPO shows evidence of being a definite type (not defined by Kovalchik and Clausnitzer (2004))**
  - **Each series is defined within a range of elevation, soil moisture, and soil temperature**



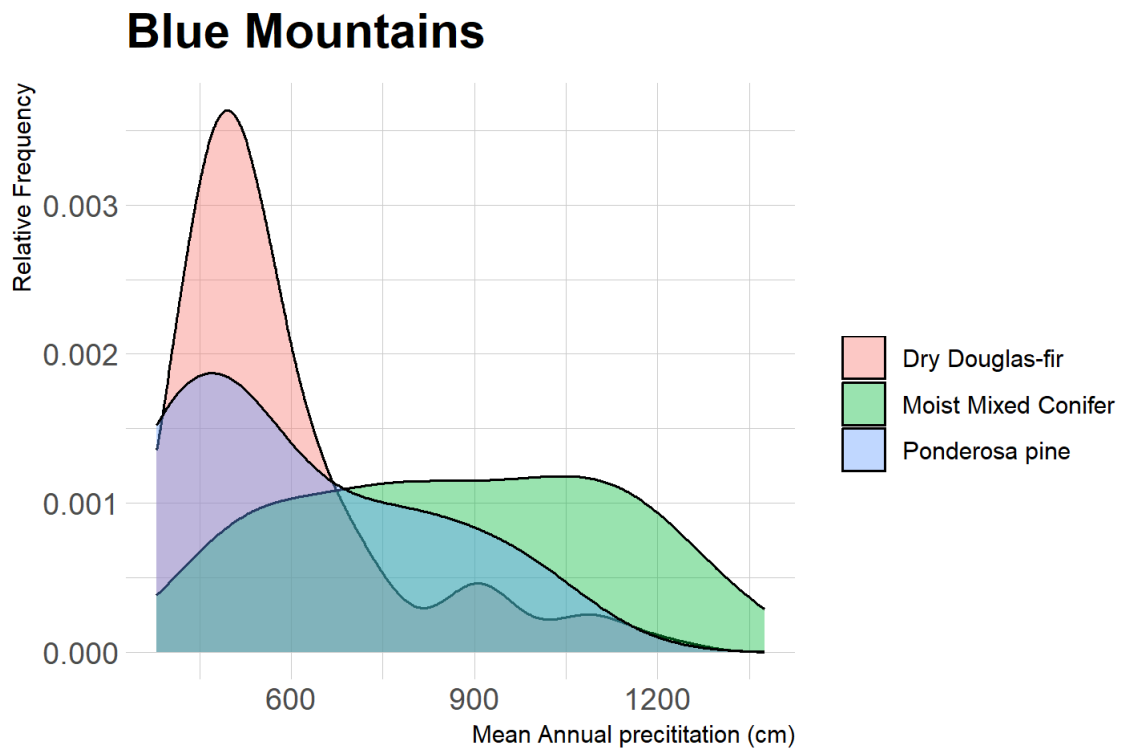
Step 2: Framework Development

Machine Learning Approach: Vegetation Groups Defined in the 20-yr FHP

Most important factors by variation across species groups = Mean annual precipitation, Elevation, Minimum annual temperature, maximum summer temperature, and Heatload.

	Dry Douglas-fir	Dry Mixed Conifer	Moist Mixed Conifer	Non-forest Vegetation	Ponderosa pine	Spruce/Fir	Western red cedar	Error	Rate
Dry Douglas-fir	202313	73	26651	0	5947	0	0	13.9%	32,671 / 234,984
Dry Mixed Conifer	136	13438372	277432	0	148199	15581	203841	4.6%	645,189 / 14,083,561
Moist Mixed Conifer	15144	319477	3558472	0	23214	9	0	9.1%	357,844 / 3,916,316
Non-forest Vegetation	0	0	0	11628608	0	0	0	0.0%	0 / 11,628,608
Ponderosa pine	11184	382936	33509	0	1863238	53	193	18.7%	427,875 / 2,291,113
Spruce/Fir	0	29415	179	0	255	576079	3522	5.5%	33,371 / 609,450
Western red cedar	0	354136	0	0	658	780	1453837	19.7%	355,574 / 1,809,411
	228777	14524409	3896243	11628608	2041511	592502	1661393	5.4%	1,852,524 / 34,573,443

Step 2: Framework Development



1a. Mean annual precipitation < 745 mm

-Dry Douglas-fir, Ponderosa Pine (79.3%)

1b. Mean annual precipitation >745 mm

-Moist Mixed Conifer (65.3%)

Kruskal-Wallis with pairwise comparison:

Moist Mixed Conifer-Dry Douglas-fir $p < 0.0000001$
Ponderosa pine-Dry Douglas-fir $p = 0.6446881$
Ponderosa pine-Moist Mixed Conifer $p < 0.0000001$

Phase 2, Step 1: Field Data

Riparian area data collection (adapted from EWRAP data)

Variable horizontal line sampling (160') for snags and live trees >= 3.0" DBH

- Species, Condition (live/dead), DBH, Height, Crown Ratio, Distance to BFW

Continuous 5' x10' fixed plots along line for tree seedlings and saplings < 3.0" DBH

- Tally by species
- stems > 5' tall will be grouped into 1-inch diameter classes.

In-stream data collection

- Bankfull width and depth, Stream gradient and azimuth, Canopy closure , Woody debris cover (percent aerial cover)

Site Characteristics

- Aspect, Percent Slope, Elevation, Geomorphic Features, Disturbance, Sketch and notes of interest

Phase 2, Step 1: Field Data

Current Data Collected

- 64 of 90 sites
  - Canadian Rocky mountains 18/18
  - East Cascades 18/18
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  - Blue Mountains 2/18

Potential to Supplement

- EWRAP data
- 98 sites in various conditions