Mt Hood National Forest:
Fire behavior and forest conditions inferred from early surveys and inventories

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Introduction

Late-nineteenth- and early-twentieth-century land and timber surveys are often the earliest available spatially explicit records of landscape conditions (Arno, 2012). These maps and records have been used to complement tree-ring and fire-scar reconstructions to enhance our understanding of the conditions that existing on other landscapes in eastern Oregon prior to more than a century of modification through policies that favored fire exclusion and industrial agriculture (Hagmann et al., 2019; Merschel et al., 2021).

Tree-ring studies utilizing partial or full cross-sections provide fine-scale, high-resolution reconstruction of individual fire events to gain insights on fire frequency, severity, and extent spanning several centuries. Fire regime reconstructions describe one of the key processes influencing the spatial patterns documented in early land classifications. Early surveys and inventories provide coarse-scale, low-resolution depictions of the conditions that existed at the time over large areas. They depict the conditions that existed between and around tree-ring plots.

Cover type classifications oversimplify the heterogeneity of ecosystems and assign artificial boundaries to gradients. This facilitates communication and visualization of key differences between forest types and areas. Late-nineteenth- and early-twentieth-century land and cover type classifications were generated from a variety of survey and inventory methods. The accuracy of an individual record is unknowable; however, consistency across multiple records can reveal credible patterns and bolster confidence in inferences based on those patterns (Swetnam et al., 1999).

Comparisons of early survey and inventory records with each other and with other records demonstrate substantial similarity in the depiction of historical conditions (Hagmann et al., 2017, 2019, 2022). For example, the distribution of high-severity burns and dominant cover types documented in early surveys and timber inventories were consistent with fire frequency reconstructed from tree-ring records for a ponderosa pine-dominated landscape in southcentral Oregon (Hagmann et al., 2019). Similarly, early survey and inventory records demonstrate consistency with the conditions documented in the earliest available aerial photography for the Warm Springs Indian Reservation (Hagmann et al., 2022).

For this study area, we compare the distribution of high-severity burn areas and forest structure and composition in early inventory and survey records with each other and with the results of a tree-ring reconstruction of historical fire events.

Early surveys and inventories

We used records spanning from the late nineteenth- to the early twentieth-century (Table 1, Appendix A). Records include early land surveys (*1859-1939 GLO*) and land classifications and timber surveys ranging in scale from township-level estimates (*1903 USGS Langille*), which typically covered roughly 23,040 acres, to estimates covering quarter-quarter sections (*1922 USFS*), which typically encompass 40 acres. Early land cover classifications, such as the United States Geological Survey (USGS) of the Forest Reserves, were generated by natural scientists traversing uncharted territory on foot and horseback

(Arno, 2012). Later surveys, such as the Extensive Timber Reconnaissance Revision of 1922 Mount Hood National Forest (NF), were based on a systematic 10% sample of each quarter-quarter section (typically 40 acres) to estimate volume for merchantable timber species. Descriptions of burned area classifications in these records suggest high-severity to stand-replacing fire effects (Table 2).

Table 1: Records of high-severity burns and forest and landscape structure and composition. Note that Oregon National Forest (NF) was renamed Mt Hood NF in 1924. See Appendix A for more information about each record.

Record name (this study)	**Record name**	**High-severity burns**	**Forest structure and composition**
1859-1939 GLO	Bureau of Land Management General Land Office Survey	Surveyor's descriptions of land cover between surveyed points	Surveyor's descriptions. Bearing (witness) trees marking section corners and midpoints, up to 8 trees per 640 acres
1902 USGS	United States Geological Survey (USGS) of the Forest Reserves	Map of cover types	Map of cover types and volume estimates
1903 USGS	USGS Survey of Forest Reserves	Map of cover types and township-level estimates of burned area	Map of cover types and township-level estimate of timber volume by species and description of forest conditions
1914 ODF	State Board of Forestry	Map of cover types	NA
1914-1915 USFS	USDA Forest Service (USFS) Land Classification of Oregon National Forest (NF)	Map of cover types	Map of cover types and timber volume classes. Descriptions of forest conditions for each township
1922 USFS	Extensive Timber Reconnaissance Revision of 1922 Mount Hood NF	Map of cover types	Map of timber volume classes
1930s USFS	1930s Survey of Forest Resources	Map of cover types	Map of timber species by size/age classes
1933-1935 USFS	Osborne fire lookout panoramas	Panoramic images taken from fire lookouts between 1933 and 1935	

Table 2: Descriptions of burned area classification from early land and timber surveys.

Record name (this study)	**Description of burned area**	**Reference**
1859-1939 GLO	*"Burned forest, often with "scattering" trees (> 100 links distant) surviving fire. Used when (1) "burn" or "fire" is mentioned specifically, (2) exiting "green timber," or (3) in dead timber ("deadening"), standing or fallen timber, or presence of dead "stubs." Older burns may have openings, brush, and "groves" or "thickets" of young trees (alder, fir) up to 12-14 inches in diameter."*	Christy et al., 2016, p. 3
1902 USGS	*"… areas represented here as burned are only those in which the destruction of timber was nearly or quite complete."*	Gannett, 1902, p. 11
1903 USGS	*"The areas here classified as burns are those on which the fires are of comparatively recent occurrence and on which the stocking has not reached a size which can be called merchantable as timber."*	Langille et al., 1903, p. 88
1930s USFS	*"Uncut stands killed by fire and restocked, remaining green timber, if any, being unloggable…"*	Cowlin et al., 1942, p. 6

Contemporary fires and forest conditions

Contemporary fires (hereafter, *1984-2021 MTBS*) are represented by fire perimeters and burn severity estimates from Monitoring Trends in Burn Severity Program (mtbs.gov, Eidenshink et al., 2007). The MTBS data set extends from 1984-2021 and includes fires that cover at least 1,000 acres.

Current forest conditions are represented by Gradient Nearest Neighbor (GNN) models produced by LEMMA team (lemma.forestry.oregonstate.edu). GNN uses field inventory data and predicts vegetation composition and structure using multiple spectral indices from 30-meter, annualized Landsat TM time-series covering 1984–2010, as well as data on topography and climate (Ohmann and Gregory, 2002). Imputation (i.e., predicting the vegetation likely to exist in the space between field plots) was based on Euclidian distance in multivariate space derived from Canonical Correspondence Analysis (Ter Braak 1986), a direct ordination technique (Ohmann et al., 2012).

The output from this model is a high-resolution raster (30-meter pixel, <0.25 acre); however, the maps are "insufficiently accurate for local or stand-level applications" (lemma.forestry.oregonstate.edu/methods/accuracy-assessment). They are designed to represent conditions at landscape (e.g., the study area) or regional scales, not the pixel scale.

To represent current species distribution, we used the FORTYPBA model output generated in 2017 which indicates the species dominated to predict basal area for each pixel. Accuracy of the model output is indicated by the Kappa coefficient (Cohen, 1960) for each species. Kappa coefficient values range from <0 to 1 and indicate the level of agreement between measured plot values and values predicted by the model. Values ≤ 0 indicate no agreement, 0.01–0.20 none to slight, 0.21–0.40 fair, 0.41– 0.60 moderate, 0.61–0.80 substantial, and 0.81–1.00 almost perfect agreement. Kappa coefficient values for species in the study area are: larch=0.25, grand fir=0.44, oak=0.54, silver fir=0.55, ponderosa pine=0.58, mountain hemlock=0.62, and Douglas-fir=0.67 (GNN Accuracy Assessment Report Oregon and California Cascades (Modeling Region 224) Model Type: Basal-Area by Species-Size Combinations Release Version: 2020.1.)

Potential vegetation types (PVT) indicate the species expected to dominate a site if disturbance were excluded. PVTs aggregate areas with similar growth rate, disturbance regime, and response to management. For this assessment, we used the ???? map of PVTs. In the absence of disturbance, species like Douglas-fir and grand/white fir are expected to expand into areas historically dominated by drought- and fire-tolerant species like ponderosa pine.

High-severity burn patterns

Four independent early twentieth-century maps show a relative abundance of high-severity burn area in high-elevation forest types compared to area burned since 1984 (Figure 1). The early twentieth-century maps document considerable variation in patch shape and size. They also show a distinct difference in the distribution of high-severity burned area between ponderosa pine and other forest types in the *1930s USFS* survey.

The abundance of high-severity burned area recorded in early twentieth century maps, particularly *1903 USGS* (Figure A2), contrasts sharply with the relative dearth of area burned in the *1984-2021 MTBS* record (Figure 1). The *1903 USGS* survey mapped the most (n=98) and the largest (two >10,000 acres) patches. However, roughly half of the burned patches in that record covered fewer than 100 acres, 14 covered >1,000 acres, and 4 covered more than 4,000 acres (Figure A3a). Those largest patches were not the norm. It is highly likely that these patches contained live trees. Surviving trees can be seen in burned areas in *1933-1935 USFS* panoramas (Figure 3 and Figure 8) and was observed for similar records on the Warm Springs Indian Reservation (Hagmann et al., 2022).

Patches of second growth, small trees, seedings, and saplings may also reflect the influence of high-severity fire. Note, however, that in the absence of evidence of stand-replacing fire, these patches might also reflect the influence of other disturbance types, e.g., insect or pathogen activity, or the suppression of frequent fire. In ponderosa pine forests, bark beetle and pandora moth activity historically created high-severity patches followed by a flush of regeneration (Speer et al., 2001; Weaver, 1961, 1943). Abundant regeneration following the essential exclusion of fire around the turn of the nineteenth century has been documented repeatedly for similar forest types elsewhere in eastern Oregon (Hagmann et al., 2022; Johnston et al., 2021; Merschel et al., 2021, 2014).

In the *1930s USFS* survey, these smaller tree size classes are distributed across all forest types in a variety of patch sizes (Figure 1). The local *1922 USFS* classification shows a much finer classification and more variation in the structure of ponderosa pine forest than the regional *1930s USFS* survey (Figure 2). Patches classified as immature, poles + saplings, and seedlings in the *1922 USFS* classification may reflect the influence of high-severity fire or other agents of mortality, e.g., insects. They may also be forest-capable sites that had been kept in nonforest conditions due to frequent fire, perhaps cultural burning in oak or shrub steppe habitat east of these sites (Steen-Adams et al., 2019). As with other early twentieth century classifications (Figure 1), burned area and smaller trees patch sizes in this classification also appear to be generally larger in mixed conifer than in ponderosa pine forest types (Figure 2).

The *1933-1935 USFS* panoramas provide another look at spatial patterns of high-severity burns and regenerating forest early in the era of policies favoring fire suppression and industrial logging. As these images were taken from fire lookouts, they generally depict high-elevation areas. Incidentally, images showing east-facing slopes of Mt Hood (e.g., Figure 3) show patches of dead trees in a spatial pattern that more closely matches the *1903 USGS* than the *1902 USGS* map (Figure A2). The *1902 USGS* map of burned areas on the east slopes of Mt Hood has previously been found to be inconsistent with other early twentieth century records (Hagmann et al., 2022).

Early twentieth-century records of burned area do not explain the abundant patches of regeneration in ponderosa pine forest types. Logging, homesteading, and agricultural activity likely explain some of the regeneration patches in ponderosa pine forests along the lower timberline (Figure 4). However, note that reports accompanying the *1914-1915 USFS* classification of the Wamic Project (Figure A7, Table A2) noted that "*The timber is accessible and there is now, or has been, a sawmill on each of the streams within the area. Comparatively little of the National Forest timber has been cut.*" Mills mentioned in *1903 USGS* survey (Figure A3, Table A2) were not indicated on the *1914-1915 USFS* map of the same area.

Across all these early records, burned area and regeneration patterns suggest the dominance of a mixed-severity fire regime in cool moist to cool wet forests, rather than one dominated by extensive stand-replacing fire. The absence of large patches of burned area and regeneration in ponderosa pine forest types suggests a low-severity fire regime historically structured and maintained forest, nonforest, and landscape conditions in that forest type.

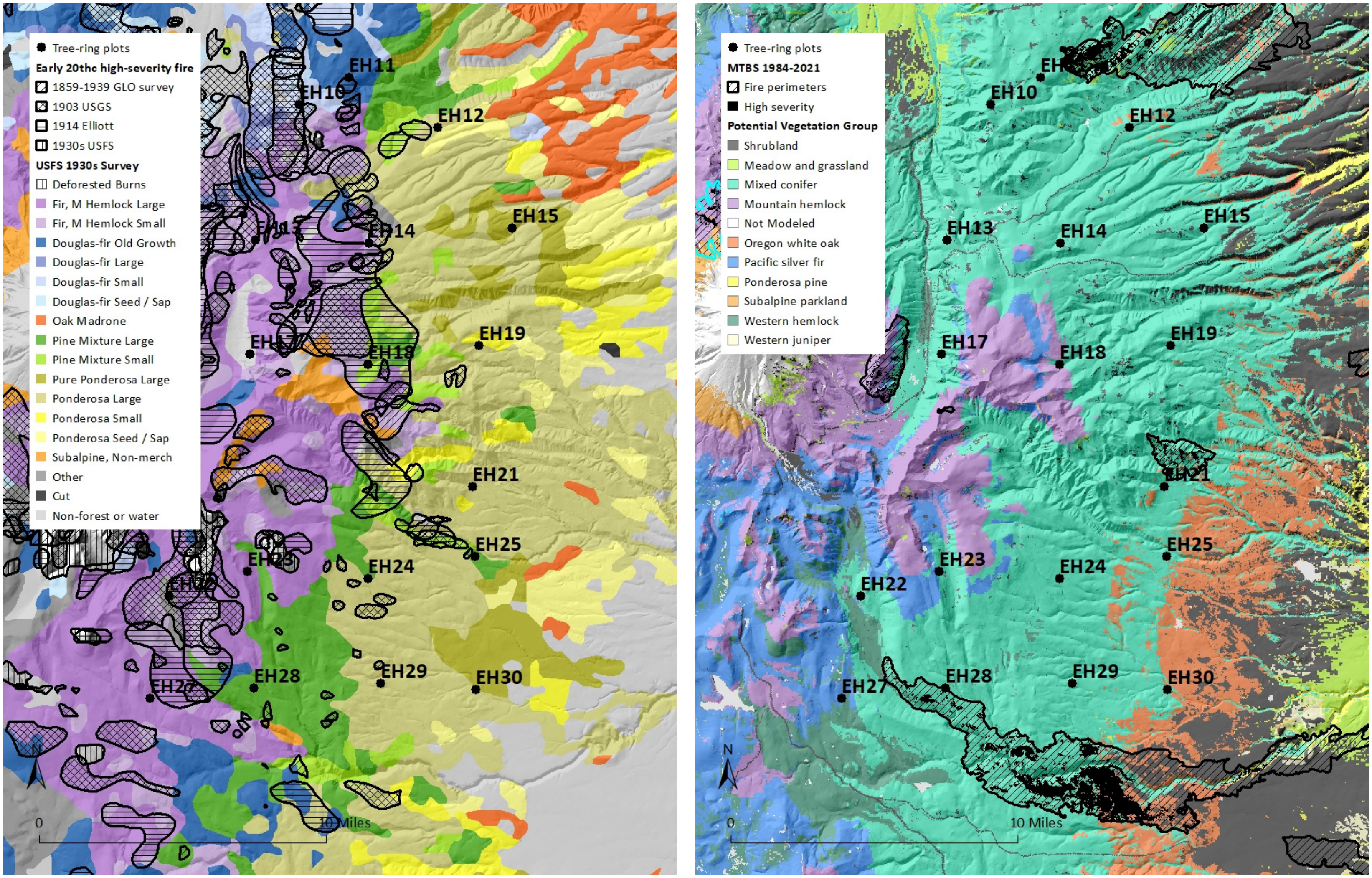


Figure 1: Maps of high-severity burn areas on early twentieth-century (left) and contemporary (right) maps. Early twentieth century maps suggest that high-severity burn area differed substantially between forests dominated by ponderosa pine and other forest types. PVTs (right) indicate the species that would most likely dominate a site if disturbance were excluded. Whereas, cover type classes in the USFS 1930s survey (left) were named for the dominant merchantable species and size class that existed at that time (Table A5). Tree-ring plots indicate the locations where fire scars were collected by Andrew Merschel and crew to reconstruction of fire frequency and extent.

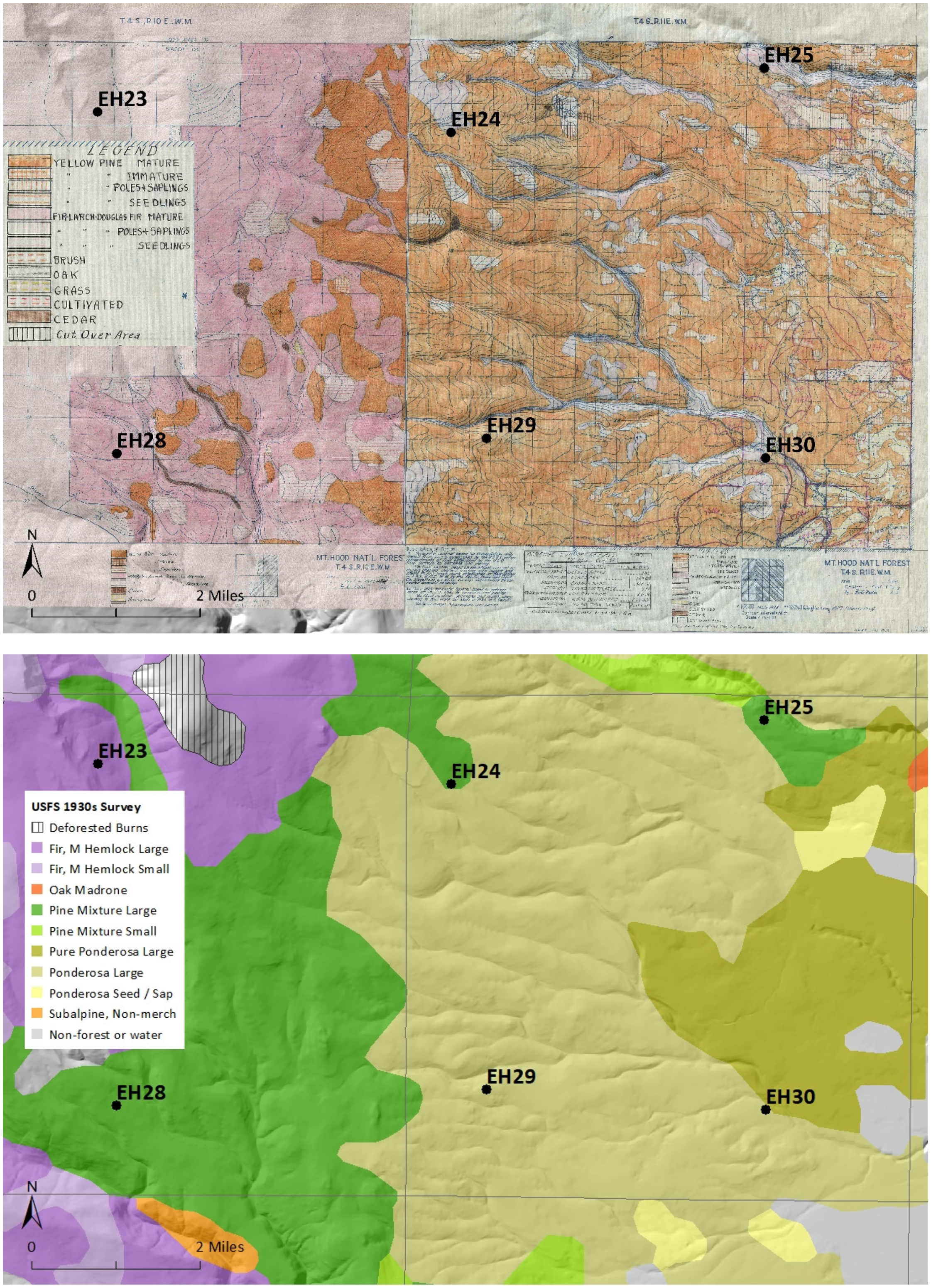


Figure 2: Early twentieth-century maps of tree species and size class. The 1922 USFS classification generated for the Mt Hood NF (top) documents more variation in landscape patterns in the distribution of patches of trees of distinct size classes than the 1930s USFS survey *that covered all of Oregon and Washington (bottom). Note "cedar" cover type in valley bottoms in the 1922 USFS classification.*

Figure 3: High-severity burn areas in 1933-1935 USFS panoramas. Patches of dead trees are evident on the northeast slopes of Mt Hood in the southwest view from Mill Creek Butte, which looks across tree-ring study plot EH13 (top). Note the abundant larch in the foreground. Regenerating forest cover with remnant larch and snags are apparent in the view from Flag Point looking east-southeast across EH26 (bottom). Refer to (Figure A10) for a map of fire lookouts relative to tree-ring plots.

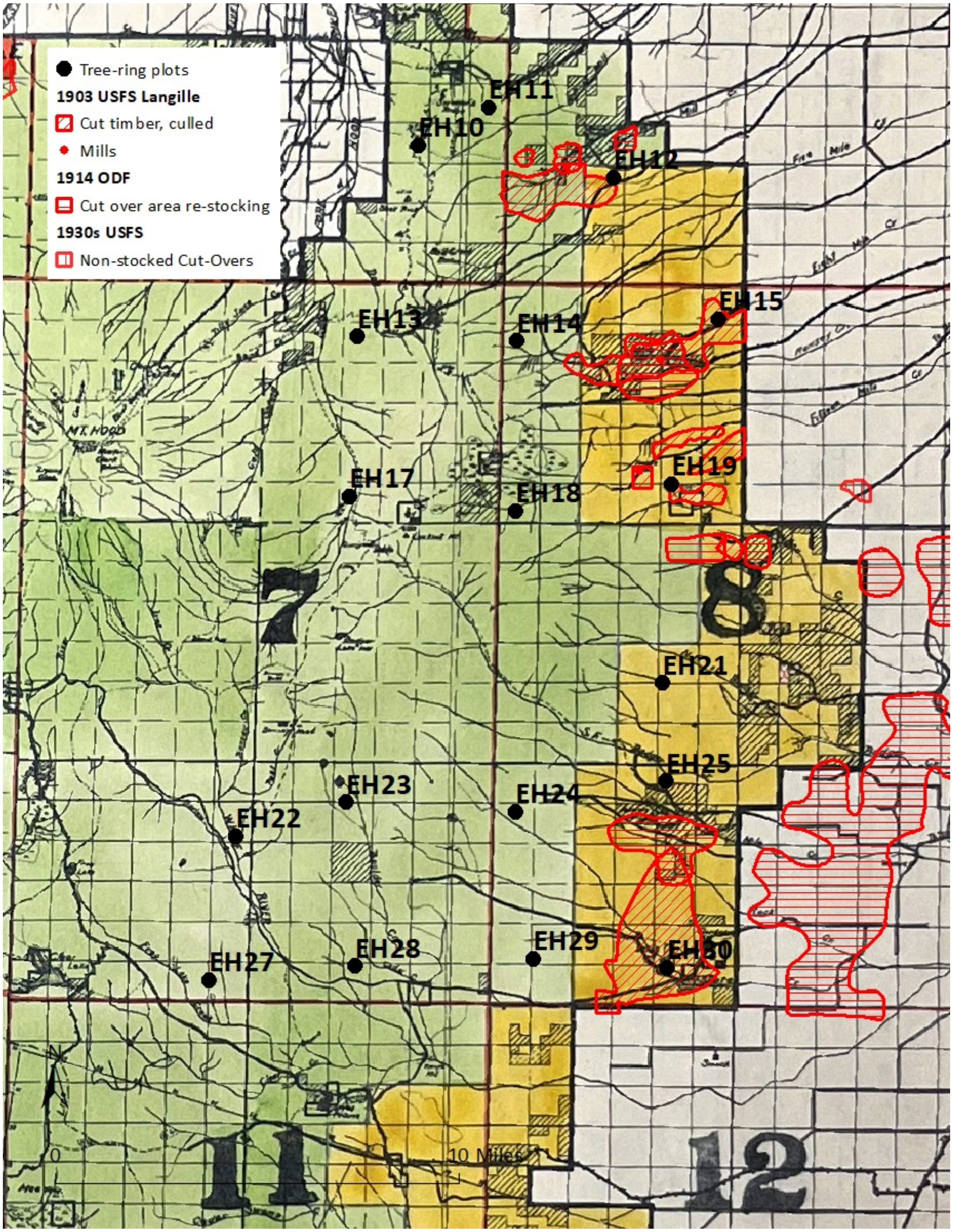


Figure 4: Areas mapped as cut or patented land on early twentieth-century maps. The map in the background is dated 1913; lands in private ownership (patented lands) at that time are indicated with black diagonal hatching. For a view of the full map, refer to Figure A6.

Species composition

The abundance of ponderosa pine cover, particularly of large trees, in areas which today support abundant cover of less drought- and fire-tolerant tree species suggests that frequent low-severity fire maintained landscape composition and structure in areas historically dominated by ponderosa pine (Figure 5). Note that all fire regimes, even low-severity fire regimes, include some high-severity fire (Agee, 1993). Across western North America and throughout the twentieth century, shade-tolerant and fire-intolerant conifer species have expanded into areas historically dominated by shade-intolerant, fire-tolerant species, such as ponderosa pine (Hessburg et al., 2019). Studies integrating multiple independent sources documented this trend on the Warm Springs Indian Reservation just south of the study area (Hagmann et al., 2022) and in other fire-dependent forest landscapes of eastern Oregon (Merschel et al., 2021).

At the start of the twentieth century, Langille (1903, p. 36) observed, "*In the yellow-pine forests most of the young growth is red or white fir, which, taking advantage of the shade and moisture afforded by the yellow-pine cover, is growing rapidly, and will, in time form a larger percentage of the forest than it has in the past*." Tree-ring studies in mixed conifer and ponderosa pine forest types in the Ochoco Mountains and on the Deschutes NF (Merschel et al., 2014) show that this trend started earlier on the moistest sites ("Persistent Shade Tolerant") and by 1900 on the driest sites ("Persistent Ponderosa Pine"). Comparison of the distribution of current tree species with that of the dominant timber species in the *1930s USFS* survey reflects the extent to which this expansion has occurred in the study area (Figure 5). Douglas-fir and grand/white fir appear to be far more common in the eastern half of the study area than both the *1922 USFS* and *1930s USFS* surveys indicate they were in the early twentieth century (Figure 2 and Figure 5).

Larch is mentioned in the *1922 USFS* classification (Figure 2); however, it is not represented as a timber type in the *1930s USFS* survey. Observations in *1903 USGS* (Table A2) suggest that larch was well represented in places. For example, surveyors noted that larch "*resisted the fires more than any other species, and is, therefore, the prevailing tree in the burned areas*" (Table A2). Larch show up prominently in *1933-1935 USFS* panoramas taken in the fall (Figure 3 and Figure 6). Larch is not widely distributed in the *2017 GNN* model of current conditions (Figure 5). In the southern Blue Mountains, substantial declines in larch populations have been observed after more than a century of fire suppression (Johnston, 2017).

"Cedar", likely incense cedar, mapped in valley bottoms in ponderosa pine and dry mixed-conifer landscapes (Figure 2) supports inferences about the prevalence of a low-severity fire regime in ponderosa pine dominated landscapes. Incense cedar may be more common in riparian than upland areas in landscapes maintained by frequent fire (Van de Water and North, 2011).

Oak cover is predicted as an extensive PVT in the southeast corner of the study area (Figure 1) relative to oak cover indicated in early twentieth-century classifications. Small patches of oak were mapped in the *1922 USFS* classification and *1930s USFS* survey (Figure 7). However, the majority of the area mapped as oak PVT was mapped as ponderosa pine in early twentieth century classifications. Acres by cover type class were tabulated in the Wamic Project area in the *1914-1915 USFS* classification (Figure A8). For township T04S R11E (Figure 2), 83 acres are listed as oak. Roughly one-third of this township, which encompasses 23,075 acres, is projected to be oak PVT. This discrepancy may be attributed to the focus on timber species in early surveys. Note also that in the *1930s USFS* survey, oak indicates a stand in which at least 60% of the trees are oak (Table A5). No description of cover types was found for the *1914-1915 USFS* or *1922 USFS* classifications.

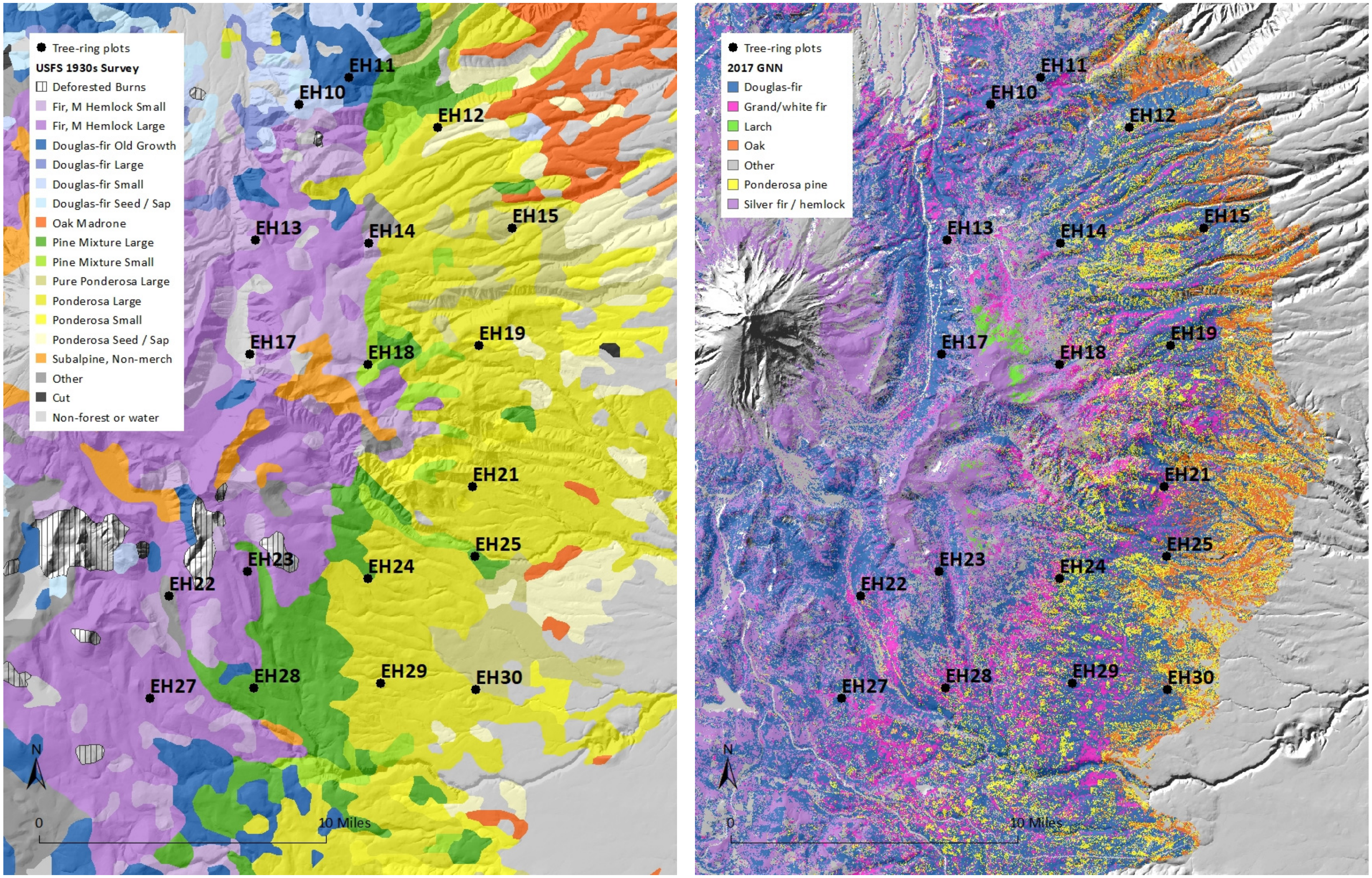


Figure 5: Historical and contemporary distribution of tree species. Cover type classes in the 1930s USFS survey *(right) indicate the dominant timber species at that time. The 2017 GNN map (left) shows the tree species expected to exist today based on integration of plot data, remote sensing data, and geophysical variation.*

Figure 6: Larch are especially visible in the fall as in this panorama taken on November 5, 1933 looking southeast from Elk Mountain.

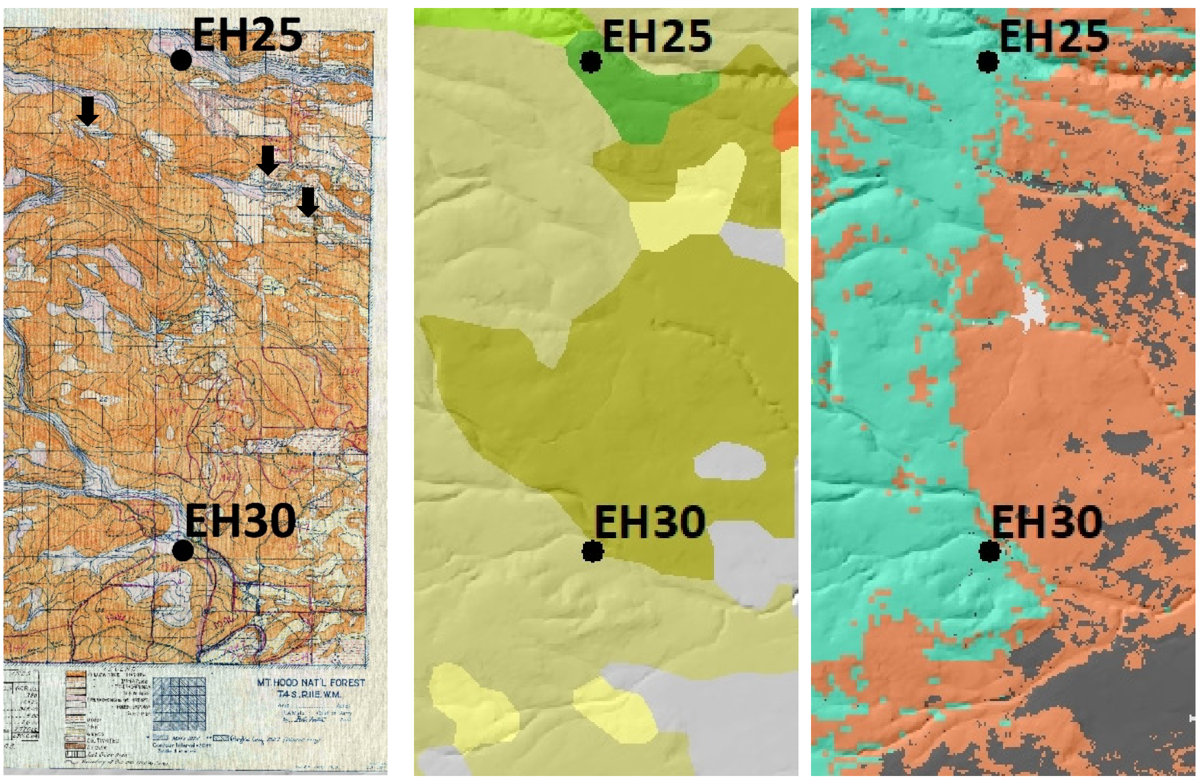


Figure 7: Oak cover mapped in 1922 USFS (left), 1930s USFS survey *(center), and as a potential vegetation type (PVT, right). Small patches of oak were mapped in the 1922 USFS classification (e.g., areas like those indicated by black arrows) and in the 1930s USFS* survey *(orange).*

Forest structure and landscape spatial patterns

At the very start of the twentieth century, Langille described an abundance of nonforest (grass and shrub) cover in previously burned areas (Table A2). Langille's observations are consistent with landscape conditions documented in the *1933-1935 USFS* panoramas (Figure 3 and Figure 8). Repeat photography of the south slopes of Mt Hood from Tom Dick and Harry Mountain (maps.tnc.org/osbornephotos/about.html) as well as Jackpot Point, Basin Point, and Clear Lake Butte (John Marshall personal communication), which lie just west of the southwest corner of the study area, show dense homogenous forest cover today across areas that had high structural diversity in the *1933-1935 USFS* panoramas.

Variation in stand age and forest density were also documented in these early records. The *1922 USFS* and *1930s USFS* survey maps show abundant patches of small trees to seedlings in a landscape dominated by large trees (Figure 2 and Figure 9). The fine-grained *1914-1915 USFS* classification for the Wamic Project area shows a high-degree of heterogeneity in timber volume (Figure 10). These patterns could reflect variation in the number or size of trees or amount of defect. The report of the *1914-1915 USFS* classification (Table A4) noted that, "*The stand of timber varies from 2 M.B.F. per acre on the light stands, to more than 50 M.B.F., in the heavily timbered areas*." Given the wide range in volume, number of trees was likely a strong influence. The tables from which this map was generated partition the volume per quarter-quarter section (typically 40 acres) by species and age class (Figure A8). Evaluating them and the *1922 USFS* maps could provide more insight into landscape-level variation in species and age class composition.

The abundance of area with large trees suggests that extensive stand-replacing fire was not a factor influencing the landscape conditions that existed in the early twentieth century. The abundance of patches of small trees to seedlings reflects a mixed-severity regime with relatively limited stand-replacing fire effects. A predominantly low-severity fire regime in ponderosa pine dominated areas is supported by the extent of large ponderosa pine in areas expected to support less drought- and fire-tolerant species in the absence of disturbance (Figure 1); the absence of burned area in early twentieth-century classifications (Figure 1); and the similarity in early twentieth-century records for this area with other areas in eastern Oregon where low-severity fire regimes have been documented in fire-scar reconstructions of historical fire regimes (Hagmann et al., 2019; Merschel et al., 2021).

Descriptions of the area surveyed in the *1914-1915 USFS* classification of the Wamic Project area (Table A4) include the observation that "*Reproduction is established over practically the entire area and ranges from 5 to 40 years old*." This observation is also consistent with other studies that document an abrupt change in stand densities in the late nineteenth century associated with substantial reduction in fire frequency (Merschel et al., 2014). Prior to widespread changes in land use in the late nineteenth century, frequent predominantly low-severity fires would have favored open canopy forests dominated by mature to old ponderosa pine trees. Images from the *1933-1935 USFS* panoramas offer some insight into what those forests might have looked like had historical fire regimes not been disrupted by policies that favor fire exclusion and suppression (Figure 11).

From the earliest available survey, meadow areas seem to coincide with the location of structures built by early European settlers and land managers, e.g., corrals, houses, and ranger stations (Figure 12 and Figure A6). Also, note that tree-ring plot EH18 is on a south-facing slope near extensive meadow area (Figure 10). Note also that burns (including relatively large burns) were mapped in the vicinity of "Pine

Mixture” types in this area but not in other “Pine Mixture” areas adjacent to cool moist forest types (Figure 1). Tree-ring reconstruction of fire history around areas known or likely to be highly valuable cultural use areas might add insight to the processes that maintained historical conditions and might be relevant to contemporary management of areas with high biodiversity and cultural significance.

Figure 8: Nonforest cover in 1933-1935 USFS panoramas. The view southwest from Rim Rock across EH10 shows conifers establishing in nonforest patches (top). The view from Barlow Butte looking southeast shows abundant nonforest cover in recently burned areas (bottom).

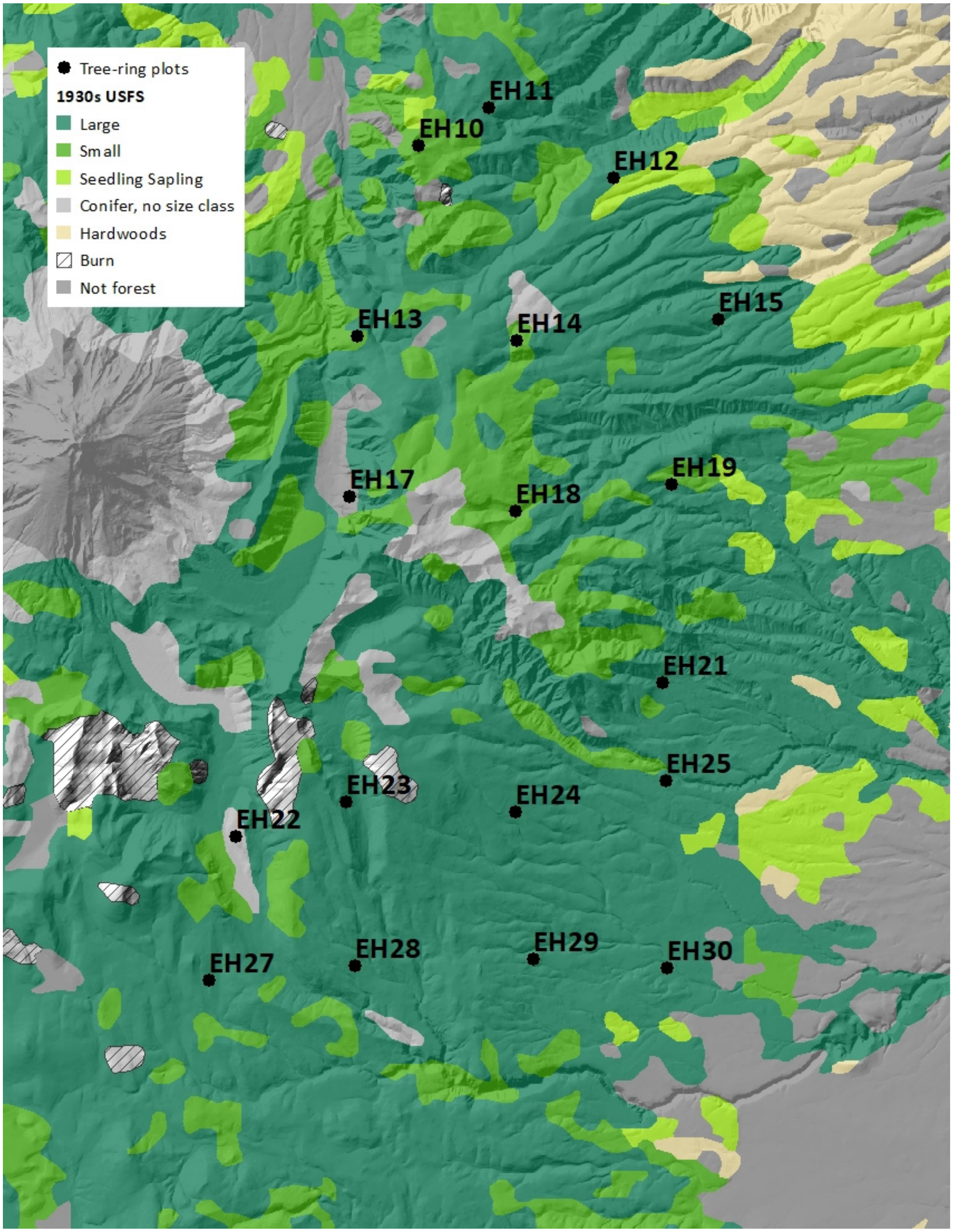


Figure 9: Distribution of dominant timber size classes in the 1930s USFS survey. Note that the fine-grained 1914-1915 USFS and 1922 USFS classifications show more variation in the spatial patterns of distinct tree size classes (Figure 2 and Figure 4).

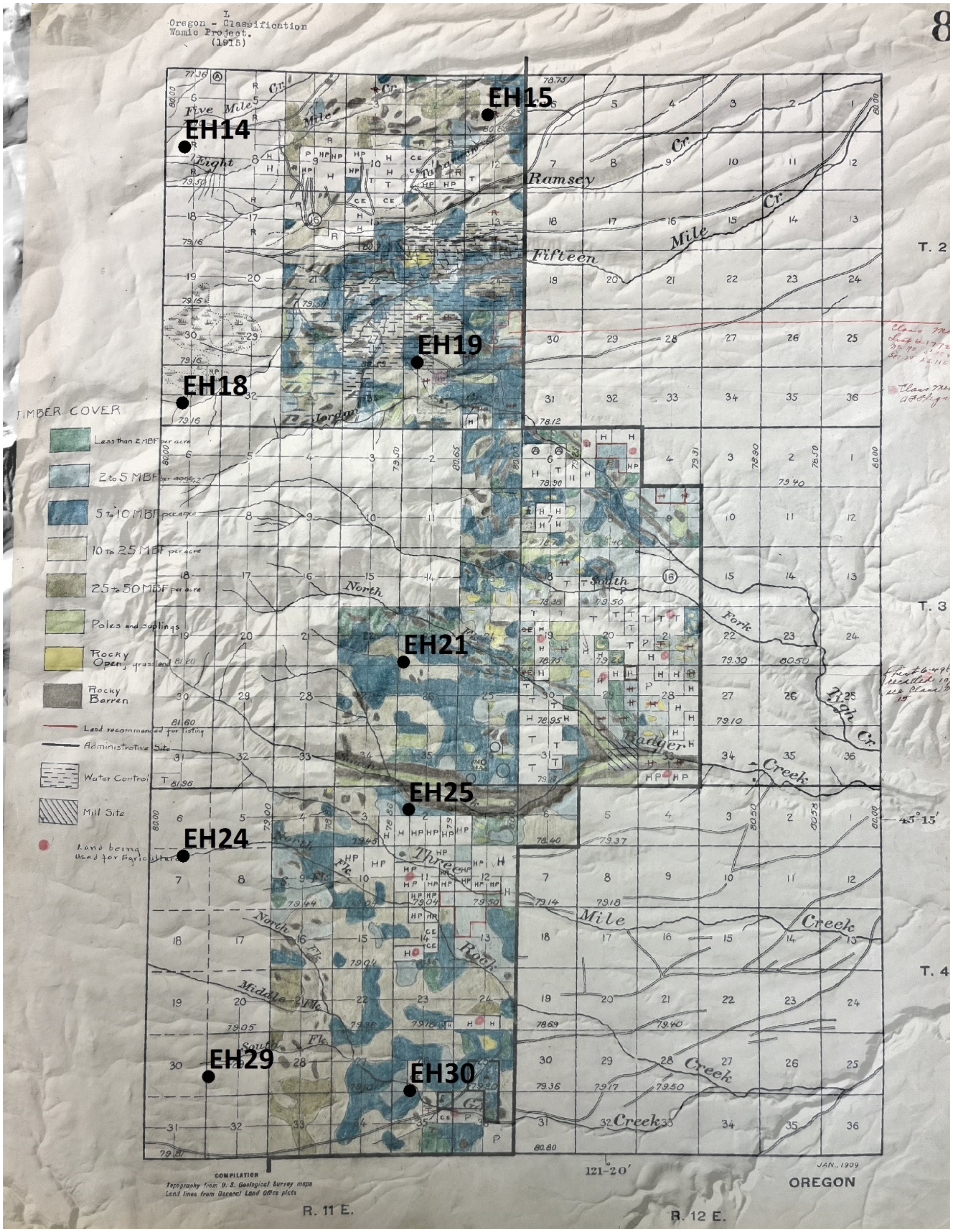


Figure 10: Distribution of cover types in the Wamic Project area of the 1914-1915 USFS classification. Volume estimates were generated for each quarter-quarter section (typically 40 acres), probably from a 10% sample of the area on transects one chain (66 feet) wide (Graves, 1912).

Figure 11: Panoramas taken in locations that are surrounded by areas classified as large ("the dominant stand averaging more than 22 inches d. b. h.") ponderosa pine ("approximately 50 percent or more by volume of ponderosa pine") in the 1930s USFS survey *(Table A5).*

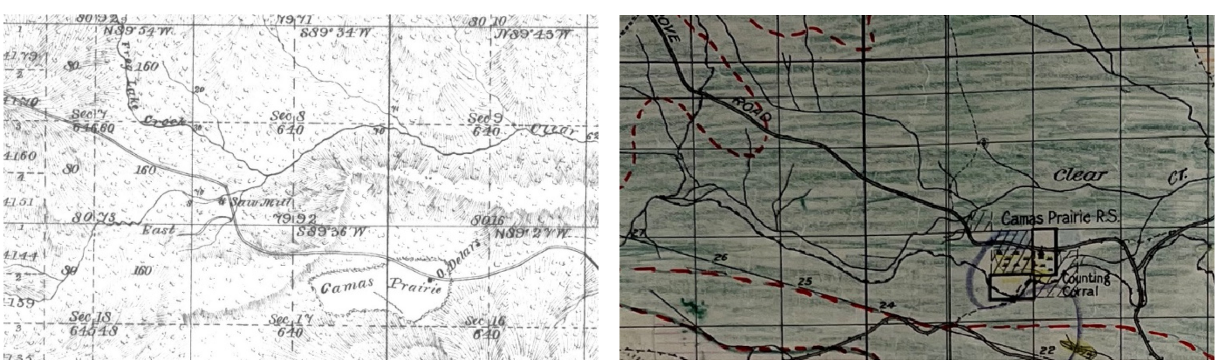


Figure 12: Example of building in areas mapped as meadows in the early twentieth century. A residence is mapped on Camas Prairie in the 1859–1939 GLO land survey (left), and a ranger station and counting corral are mapped on that prairie in the 1922 USFS classification (right).

APPENDIX A

General Land Office (GLO) Public Land Survey System (PLSS)
1859–1939 GLO

Under the PLSS, land is divided into townships (typically 6 x 6 miles) which were subdivided into sections (typically 36 section of 1 x 1 mile each). Section corners and midpoints were monumented using nearby witness (bearing) trees. Where trees were not available, surveyors relied on the materials at hand, e.g., rocks, soil pits, or posts.

Field notes described the type of monument and for bearing trees, the location (distance and angle relatively to the surveyed point). Field notes may include land cover descriptions between surveyed points. Section corners and midpoints typically form a grid with 0.5-mile spacing. Line descriptions cover the distance between section corners (typically 1 mile). PLSS records include maps for each township that show monumented corners and may include sketches of the terrain and features of interest, e.g., marsh, creeks, trails, and vegetation cover.

John Christy and colleagues developed a classification system for inferring cover type from land survey records (Christy et al., 2016). Christy (2010) published a cover type classification encompassing the study area (Figure A1). GLO survey records for the study area date from 1859-1939.

Christy and colleagues (2016) infer cover type from line descriptions, and secondarily, distance from the surveyed point to witness (bearing) trees are used to infer cover type. Distance was measured in links with each link covering 66 feet. Generally, Forest = 0-100 links, Woodland = 100-200 (max 400) links, Savanna = (min 100) 200-400 links, Prairie = 200-800 (max 1750) links. Forest area is classified as burned (often with a “scattering” of live trees) when “burn” or “fire” are explicitly mentioned or dead timber is described (Christy et al., 2016).

The classification for the study area refers to closed forest; however, Christy et al. (2016) subsequently modified this classification to avoid inferences about canopy density. The extremely low sampling density (maximum of 2 to 4 trees per 0.5 mile) of the 1860–1919 GLO land survey limits credible density estimates to an average value for large areas, e.g., one or more townships depending on the number of trees recorded at each survey point and the acceptable level of error (Hanberry et al., 2011; Knight et al., 2020; Levine et al., 2017). Average values over such large areas in forest types characterized by heterogeneity at multiple spatial scales (Franklin and Van Pelt, 2004; Hessburg et al., 2005) have limited value for contemporary management plans.

Records available from blm.gov/or/landrecords/survey/ySrvy1.php

GIS shapefile of vegetation cover types inferred from survey records for the eastern Columbia River Gorge and east slope of Mount Hood available from inr.oregonstate.edu/hvmp/available-maps

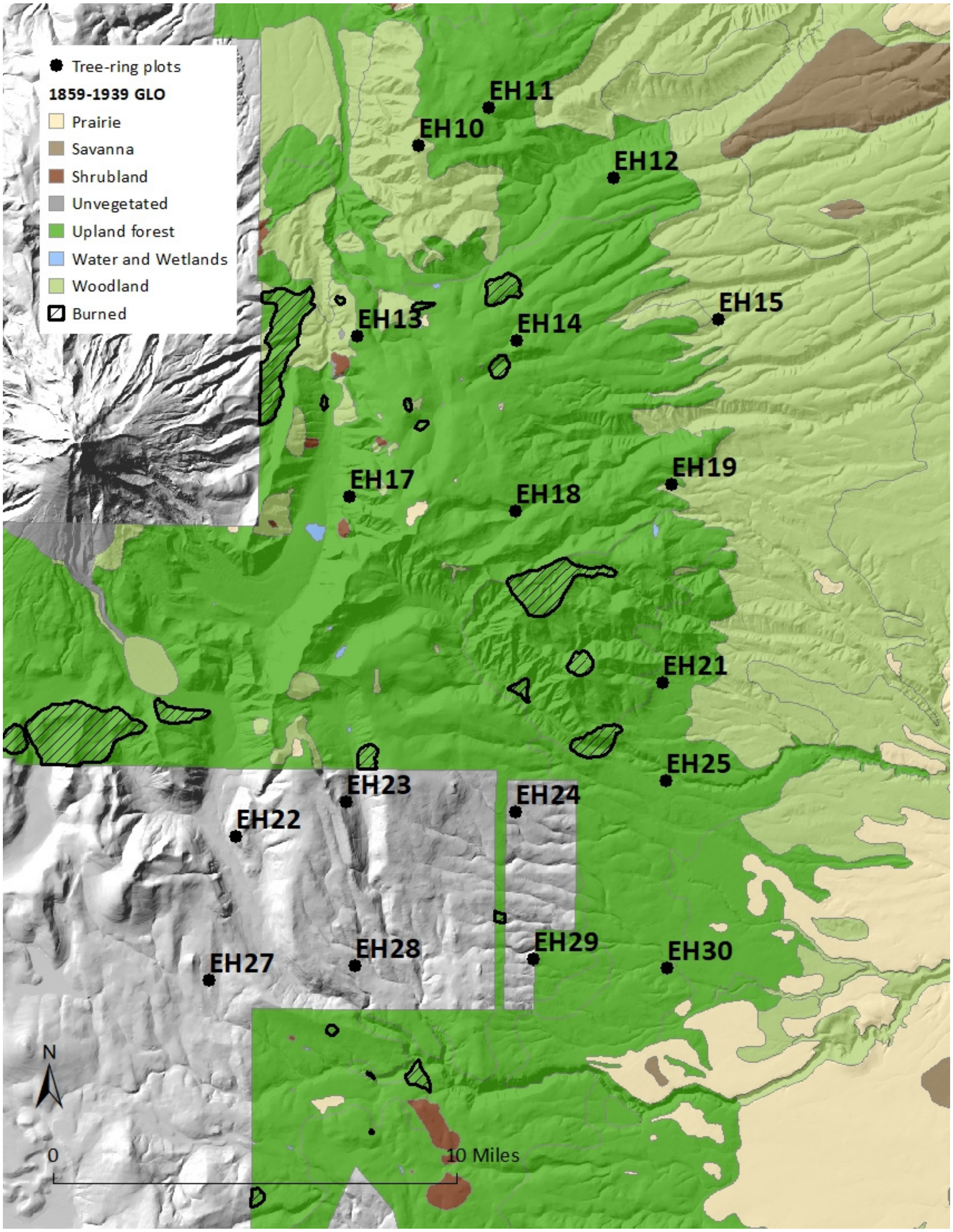


Figure A1: Cover types inferred from General Land Office (GLO) records of monuments (e.g., bearing trees, rocks, soils pits) at surveyed points and descriptions of conditions encountered between those points. Source: Christy, 2010.

United States Geological Survey (USGS) of the Forest Reserves

1902 USGS and *1903 USGS*

For areas designated as Forest Reserves at the end of the nineteenth century, the USGS generated cover type maps showing volume of merchantable timber and cut and burned areas (Figure A2). The map published in 1902 for the state of Oregon (Gannett, 1902, Plate I) shows substantially different extents for burned area than the maps published one year later for the Mt Hood area (Langille et al., 1903, Plate VI). Although generated at almost the same time, they record cover types at substantially different scales of resolution. The finer scale maps show more variation in cover types and less area burned (Figure A2). In both cases, burned area was described at the time as areas without merchantable timber following fire (Table 2).

The township-level (typically 23,040 acres) survey (Langille et al., 1903) includes estimates of the condition of timber and undergrowth as well as the extent of past fires and timber harvesting (Figure A3 and Table A1). Descriptive text accompanies the quantitative estimates and provides an impression of the conditions that existed at the turn of the century (Table A2).

Records available from pubs.er.usgs.gov/publication/pp4 for *1902 USGS* and pubs.er.usgs.gov/publication/pp9 for *1903 USGS*.

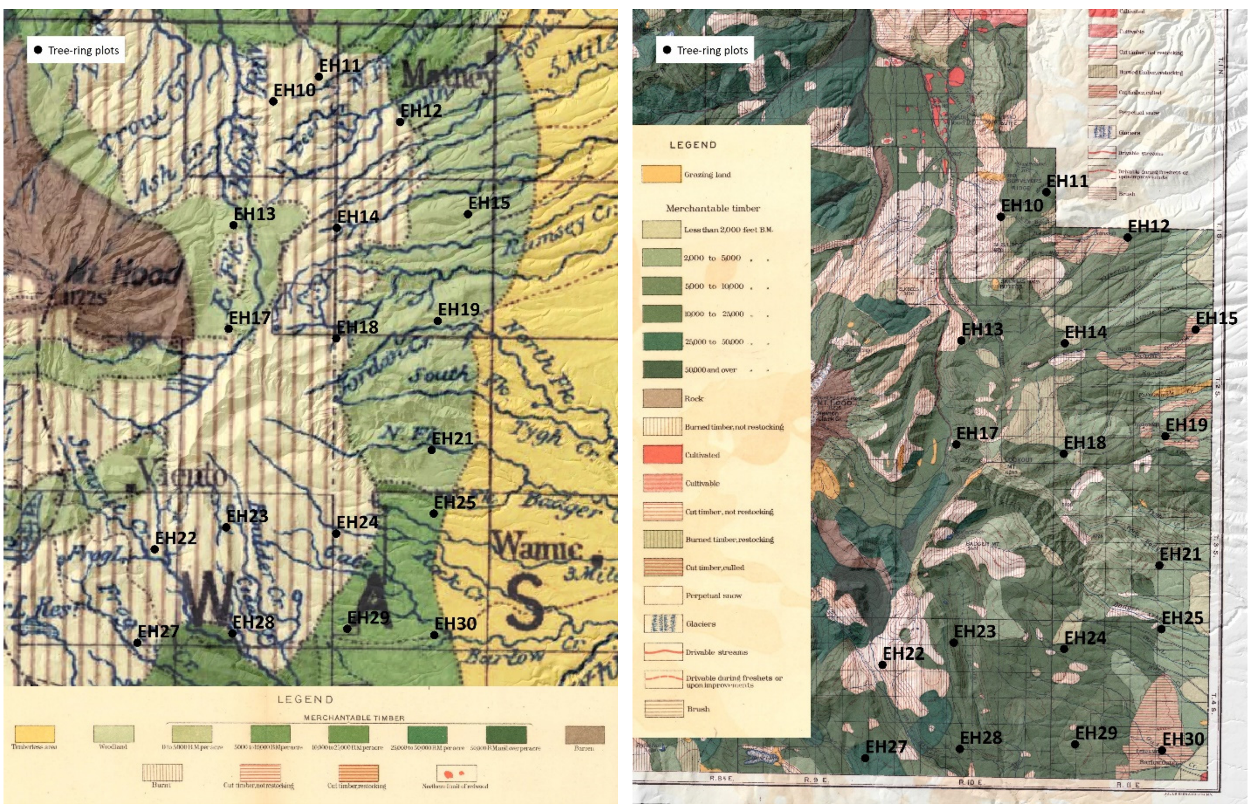


Figure A2: USGS land classification maps generated for the state of Oregon (left) and at much finer resolution for areas within the Forest Reserves (right). Sources: Gannett, 1902; Langille et al., 1903, respectively.

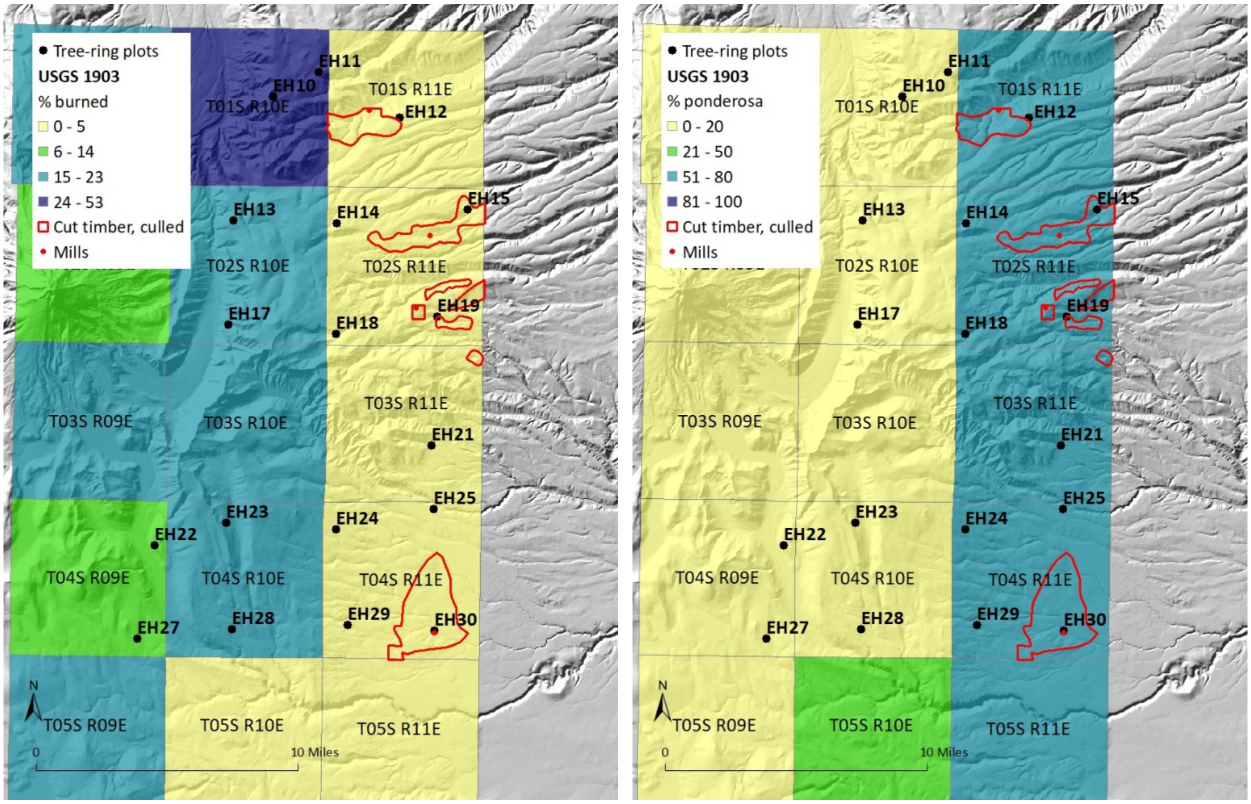


Figure A3: Township-level estimates of percent of timbered area burned (left) and percent of timber volume in ponderosa pine (right). Breaks in percent of timbered volume in ponderosa pine match those used in the 1930s USFS survey *of timber volume (Figure A10). Source: Langille et al., 1903.*

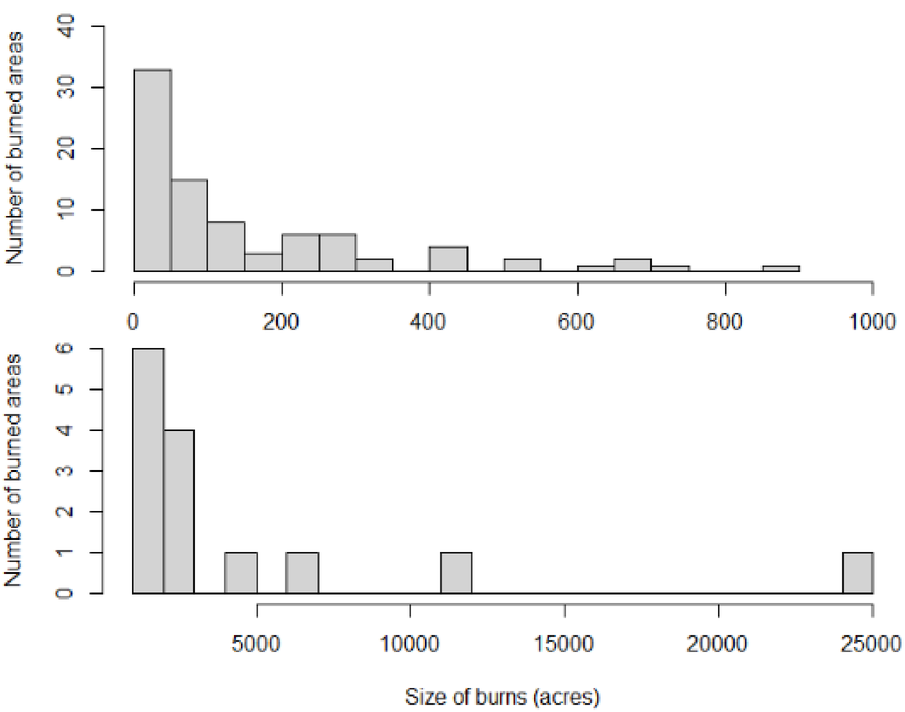


Figure A3a: Distribution of patch sizes of area classified as burned by Langille et al. (1903, Plate VI). Histograms show the number of patches (y-axis) in each size bin (x-axis). Burn patch sizes are separated into 0-1,000 acres (top) and 1,000-25,000 (bottom).

Table A1: Township-level estimates of area burned and volume by species. Township descriptions refer to species by the names then in common use (e.g., red fir rather than Douglas-fir). A table of common and botanical names provides clarification (Langille et al., 1903, p. 31). Note that "Restocked area" was not one of the classifications used by the surveyor (F.G. Plummer) responsible for the southern portion of this study area (i.e., T05S). Source: Langille et al., 1903.

	Acres			Timber volume (M feet B.M.)				
Township	**Timbered**	**Burned**	**Restocked**	**Total**	**Ponderosa**	**Grand fir**	**Douglas-fir**	**Larch**
NORTHERN PORTION OF CASCADE RANGE FOREST RESERVE By H. D. LANGILLE								
T01S R09E	16,867	5,035	388	478,157	900	17,591	286,807	81
T01S R10E	10,121	11,283	1,274	77,571	12,388	10,231	-	4,570
T01S R11E	9,658	240	100	47,117	32,630	1,582	12,130	609
T02S R09E	11,560	1,225		90,280	277	865	15,848	11,957
T02S R10E	16,745	3,310	2,745	189,766	6,455	31,527	50,062	28,250
T02S R11E	20,880	320	1,350	120,374	81,650	10,682	19,263	5,518
T03S R09E	14,900	4,255		357,524	-	2,401	108,771	3,435
T03S R10E	19,050	3,815		302,181	18,790	3,108	69,570	23,779
T03S R11E	21,580	1,225		107,244	78,289	7,569	14,823	3,051
T04S R09E	18,855	3,015		383,061	-	2,356	170,969	9,445
T04S R10E	19,205	3,770	65	291,177	48,569	26,894	137,495	10,253
T04S R11E	22,299	455		154,053	103,662	8,180	40,437	726
CENTRAL PORTION OF CASCADE RANGE FOREST RESERVE By FRED G. PLUMMER								
T05S R09E	17,979	3,980	NA	159,327	3,187	4,780	103,562	4,780
T05S R10E	22,470	350	NA	262,285	104,914	13,114	131,143	5,246
T05S R11E	18,145	670	NA	43,880	30,716	1,316	10,970	878

Table A2: References to burns and forest conditions excerpted from the USGS Survey of the Forest Reserves. Source: Langille et al., 1903.

Township	**Fire study plot**	**References to burns or fire in the description of this area**
Fires		Prior to the establishment of the Cascade and Bull Run reserves and their patrol by officers, fires raged in different parts of the mountains every summer, and no effort was made to prevent or check them. Doubtless many fires were set by sheepmen to increase the acreage of range land, and hunters, fishermen, travelers, campers, and others thoughtlessly left their fires to spread, or deliberately set them to destroy hornet nests obstructions in roads, trails, or the forest. p. 40
Area burned		The most destructive fires have taken place south of Mount Hood along the old Barlow road and southward on the western slope to Salmon River. Some of these are said to have occurred as early as 1852, when the sections in the vicinity of Government Camp were burned…. restocked lands may also be considered as burns, since the timber was destroyed by fire…. There are many wide tracts over which creeping fires have burned, killing a large percentage of the timber, but these have been considered as timber lands. p. 41
Cutting		There are at present four sawmills in operation within this area. The most important of these is situated in the SW. ¼ of sec. 26, T. 4 S., R. 11 E., Willamette meridian…. The timber in this vicinity is almost all yellow pine of two classes, viz. old trees, with an average diameter of 30 inches, and a younger growth about 18 inches in diameter. Only the best trees of the former class have been cut, leaving a fairly good stand of younger growth…. In the more remote sections only the choicest trees have been cut, but on sections near the mill sites everything of merchantable size and quality has been taken. In many places 50 per cent of the forest has been logged…. Besides the cutting- done in this territory by millmen, the amount removed by farmers has been considerable, and this demand will increase. pp. 33-34
Reforestation		In all bodies of timber there is uniformity of size, showing that the growth all began at about the same time…. In the yellow-pine forests most of the young growth is red or white fir, which, taking advantage of the shade and moisture afforded by the yellow-pine cover, is growing rapidly, and will, in time form a larger percentage of the forest than it has in the past…. Tamarack has done

Township	Fire study plot	References to burns or fire in the description of this area
		more than any other species to restock the immense burns that have taken place in this part of the reserve. p. 36
T01S R09		East of this stream nearly everything has burned and has grown up over the greater part to a dense growth of chaparral, or thickets of young trees.
T01S R10E	EH10-11	The greater part of this township has been burned over and has grown up to a dense tangle of willow, ceanothus, and other shrubs.
T01S R11E	EH12	Along the north slopes the red fir, white fir, and tamarack extend down almost to the reserve line, comprising from 10 to 20 percent of the forest, while on the south slopes the yellow pine is almost the only tree. Along the east side of the township the southern exposures are almost barren of timber, but in places are densely covered by oak grubs. This is good grazing land during the fall and spring. Sheep and cattle devour everything.… In the old burns the chaparral is very dense.
T02S R09		(No mention of fire or burns)
T02S R10E	EH13, EH17	Forest fires have devastated nearly the entire township, but abundant seed trees remain, from which an excellent young growth has sprung. The tamarack has resisted the fires more than any other species, and is, therefore, the prevailing tree in the burned areas.… Along the eastern side the soil is fertile, and wherever burns have taken place a fine growth of grass has followed.
T02S R11E	EH14-15, EH18-19	Extensive burns have taken place along the western side of the township, but the seed trees have done good work in restocking this area, and a dense young growth of tamarack, white fir, lodgepole pine, Engelmann spruce, red fir, and yellow pine (named in the order of their prevalence), from 3 to 20 feet in height, now cover almost the entire area.
T03S R09E	EH20	Evidences of an old forest remain, showing that at one time this canyon was heavily forested, but now nothing of any value remains…. South of White River, where the forest has not been devastated by fire, there is generally a good stand of timber.
T03S R10E		Along the crests of these ridges the timber is comprised mainly of true alpine species of small size and little value, but immediately below the summits, in the canyons and on the lower slopes, some excellent timber is found, consisting of noble fir, red fir, Engelmann spruce, tamarack, and yellow pine in the more eastern sections…. Forest fires have devastated large areas, but the best timber remains uninjured. Cattle range over all of this township except the basin and slopes of Hood River.
T03S R11E	EH21	Below the summits of these ridges the timber is mainly yellow pine, but on top and about the heads of the canyons this species gives way to tamarack, lodgepole pine, lovely fir, subalpine fir, and spruce of small size. Much of this has been scorched by fires, but reforestation is persistent, and in most areas dense…. Along the lower canyon of Tygh Creek, on the southern exposure, the timber is very light in places, consisting mainly of scrub oak.
T04S R09E	EH22, EH26-27	This township covers the low pass across the main divide of the Cascade Mountains where crossed by the Barlow and Oak Grove roads…. The original forest was red fir and some of the old trees are still standing, apparently sound and clear, but all are badly decayed. A number of burns have occurred, but these are not extensive.
T04S R10E	EH23, EH28	The timber is spotted, and peculiar intermingling of timber occurs. Yellow pine, tamarack, noble fir, and Patton hemlock grow side by side as though native to the same zone. In the basins of the small streams flowing into Bowlder Creek from the west the timber is poor and fires have burned through much of it.… Creeping fires have killed a large amount of timber throughout the township, and on the slope of White River extensive areas have been burned.
T04S R11E	EH24-25, EH29-30	In the northwestern sections the brush is very dense where old burns have taken place.

State Board of Forestry map of Oregon state (1914)
1914 ODF

This map depicts six vegetation classifications: merchantable timber, cut over areas re-stocking, cut over areas not re-stocking, burned areas re-stocking, burned areas not re-stocking, and brush. This map was compiled by Theodore Rowland under the direction of F.A. Elliott, State Forester and published by the State Board of Forestry in 1914. We are not aware of any documentation of methods or class descriptions.

Map archived with Oregon Department of Forestry Maps (MAPS ODF), Oregon State University Special Collections and Archives Research Center, Corvalis, Oregon. No description of methods was found.

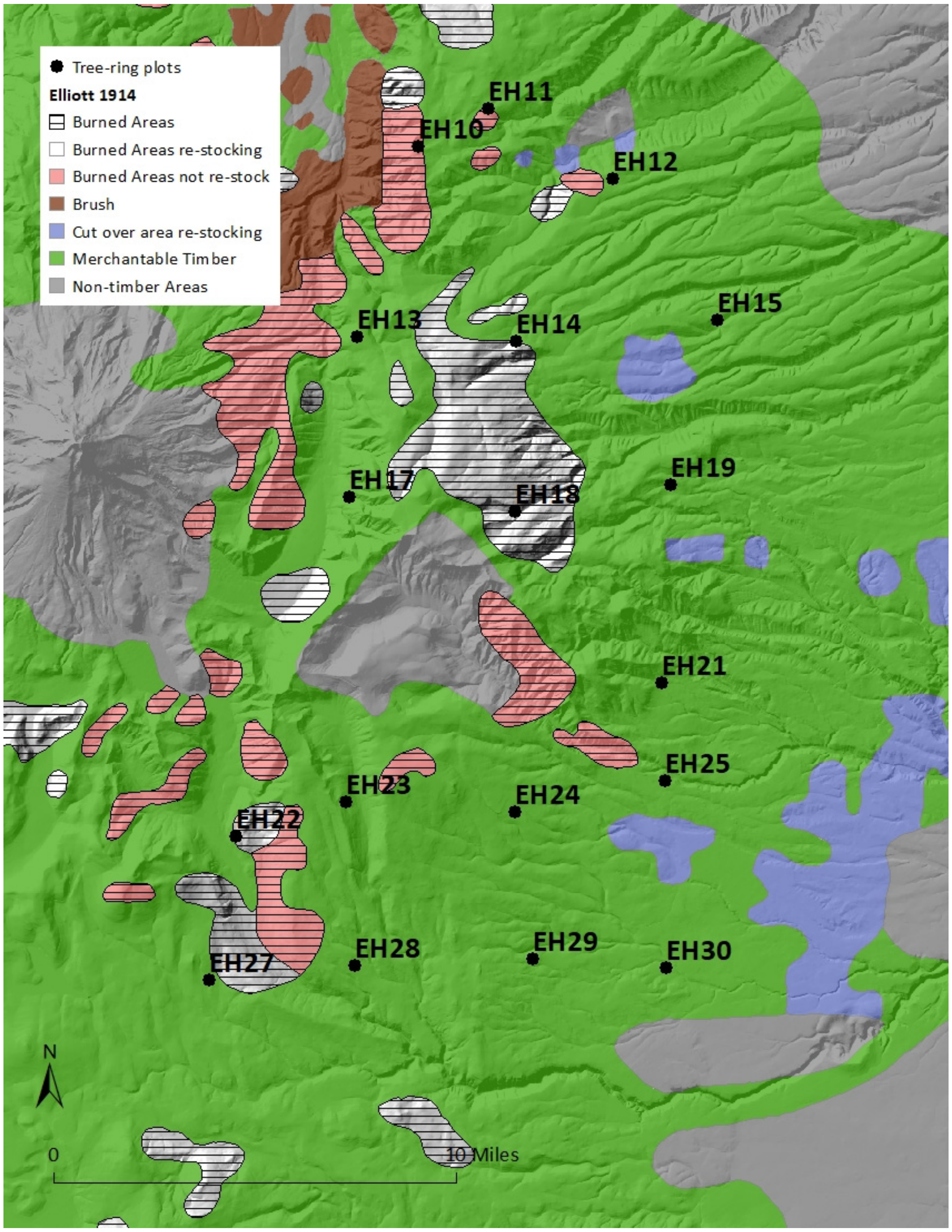


Figure A4: Land classification compiled by Oregon's State Board of Forestry in 1914. Source: Elliott, 1914.

USDA Forest Service (USFS) Land Classification Oregon National Forest

1914-1915 USFS

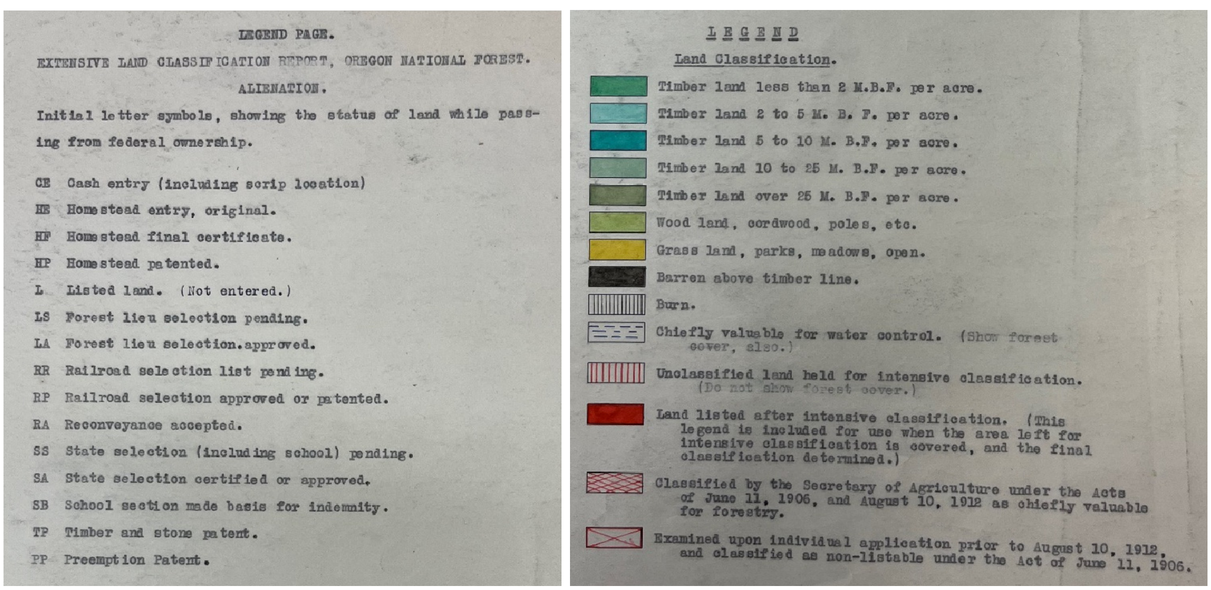
At the time of this survey and until 1924, Mt Hood National Forest (NF) was named Oregon NF. This classification was undertaken in response to an increasing number of applications for decreasing availability of designated agricultural lands. The classification was intended to identify remaining unlisted lands with agricultural potential, prevent applications for lands designated for other purposes, and establish the relative timber value of forested areas (Figure A5).

Most of the area is covered by a coarse-scale timber volume estimate (Figure A6Figure A7). The Wamic Project evaluated the eastern edge of the forest at a finer scale because the potential for agricultural value was higher. In this area, estimates of timber volume by species and age class (>150, 80-150, 20-80, and 1-20 years) were generated for each quarter-quarter section (typically 40 acres).

Survey reports for each township or series of townships include descriptions of site and timber conditions which often reference the influence of past fires (Table A4). Classification of the Wamic Project area included extent of cover by forest type and age class

Classifications indicate burned areas and timber volume. No description of these classes was found with the maps. Burn area on these maps is generally consistent with other early twentieth century maps which were documented as indications of high-severity burns (Table 2). Report on the Wamic Project references a 1911 timber cruise of that area. We have not yet located records for this cruise.

Included here are a sample of the records in this classification. The full set of records are archived at the National Archives and Records Administration, Seattle Facility in Historical Land Acquisition: Exchange [Classification Books], Mt Hood volume, Region 6 Timber Survey Maps, Records of the Forest Service, Record Group 95.



LEGEND PAGE.

EXTENSIVE LAND CLASSIFICATION REPORT, OREGON NATIONAL FOREST.

ALIENATION.

Initial letter symbols, showing the status of land while passing from federal ownership.

CE Cash entry (including scrip location)
HE Homestead entry, original.
HF Homestead final certificate.
HP Homestead patented.
L Listed land. (Not entered.)
LS Forest lieu selection pending.
LA Forest lieu selection.approved.
RR Railroad selection list pending.
RP Railroad selection approved or patented.
RA Reconveyance accepted.
SS State selection (including school) pending.
SA State selection certified or approved.
SB School section made basis for indemnity.
TP Timber and stone patent.
PP Preemption Patent.

LEGEND

Land Classification.

Timber land less than 2 M.B.F. per acre.
Timber land 2 to 5 M. B. F. per acre.
Timber land 5 to 10 M. B.F. per acre.
Timber land 10 to 25 M. B.F. per acre.
Timber land over 25 M. B.F. per acre.
Wood land, cordwood, poles, etc.
Grass land, parks, meadows, open.
Barren above timber line.
Burn.
Chiefly valuable for water control. (Show forest cover, also.)
Unclassified land held for intensive classification. (Do not show forest cover.)
Land listed after intensive classification. (This legend is included for use when the area left for intensive classification is covered, and the final classification determined.)
Classified by the Secretary of Agriculture under the Acts of June 11, 1906, and August 10, 1912 as chiefly valuable for forestry.
Examined upon individual application prior to August 10, 1912, and classified as non-listable under the Act of June 11, 1906.

Figure A5: Legend for the 1914-1915 Land Classification of Oregon National Forest.

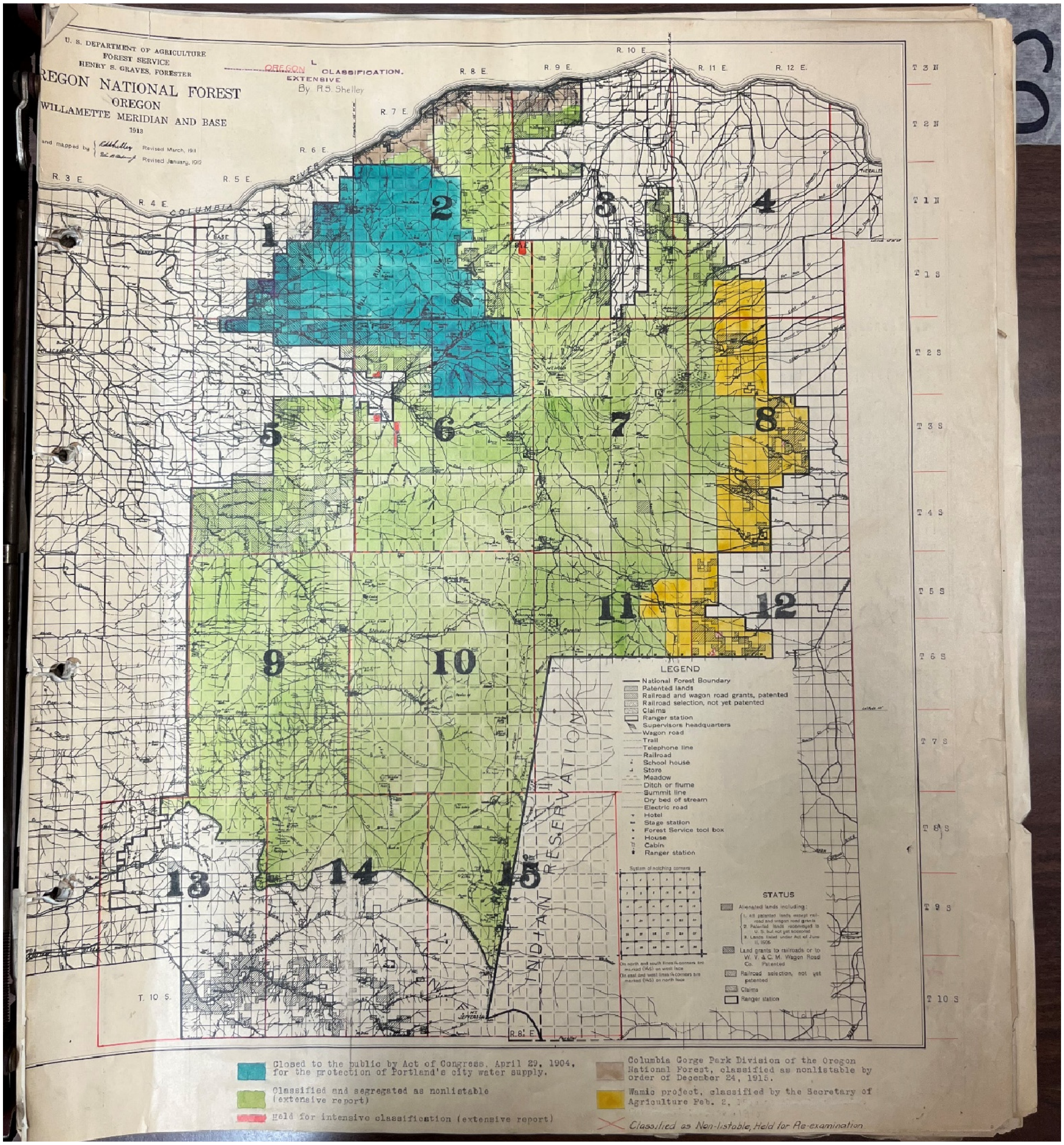


Figure A6: Map showing areas included in the 1914 USFS classification and Wamic Project Area.

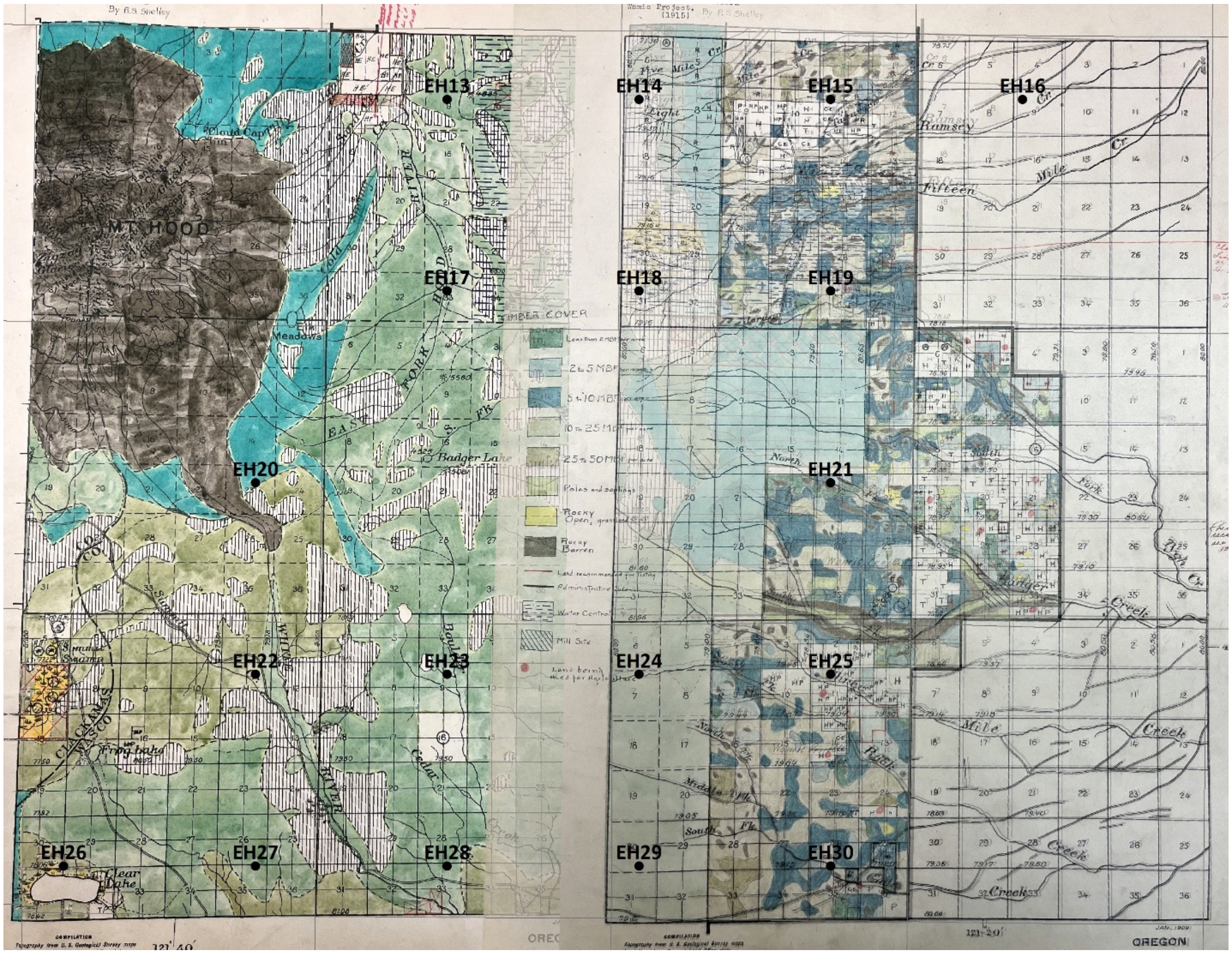


Figure A7: Timber volume estimates for the majority of the area (left) are at a coarser scale that those generated for the Wamic Project (right). Table A3: References to forest conditions and burns in the 1914-1915 USFS classification.

Table A4: References to burns and forest conditions excerpted from the extensive classification of the Oregon NF (former name of the Mt Hood NF) by the USFS in 1914.

Township	**Fire study plot**	**References to burns or fire in the description of this area**
T01 R10	EH10	Roads were built into these townships many years ago and were used by trappers and squatters for a time…. The remainder of the township supports a stand of merchantable timber or it restocking where this timber has been burned.
T01 R11	EH11-12	These townships were accessible to the public by means of roads and trails for years prior to the creation of the Forest. Their chief use has been for grazing and recreation purposes, although posts and fire wood have been acquired under free use and timber sale regulations. As the greater part of the area is covered with a mature stand of merchantable timber …
T02 R10	EH13, EH17	This township has been accessible by trail for 20 or 30 years and has been used for hunting and fishing purposes for the same period…. The west half of the township contains some merchantable timber and the burned portion, which is used as a sheep range, is restocking slowly.
T03 R09	EH20	This township has been accessible by means of the Barlow Road since the days of the pioneers. It is used by the public for hunting, fishing and recreation purposes.

Township	Fire study plot	References to burns or fire in the description of this area
T03 R10		This township has been accessibly by means of a number of old trails for twenty or thirty years. Badger Lake is visited by scores of people and is a noted fishing resort…. About 80% of this township is covered with a stand of mature timber a portion of it is merchantable although much of it, especially on the high ridges, is of the alpine type consisting mainly of wester white pine, Engelmann spruce, and alpine hemlock. The burns have restocked in part and the other portions in general are covered with a sufficient growth of grass and weeds to prevent erosion.
T02-04 R11	EH14-15, EH18-19, EH21, EH24-25, EH29-30	These townships have been accessible by means of trails for many years, but they have not been used by the general public except for fishing and hunting purposes…. Nearly all the remaining portion is covered with a good stand of merchantable yellow pine and fir.
T04 R09	EH22, EH26-27	This township has been accessible by means of the Barlow and Oak Grove Roads since the days of the early pioneers, but it is not used in any way by the general public except for hunting, fishing and recreation purposes…. The grass lands are valuable for grazing purposes and are used as a summer range for sheep. The burned areas present all stages of forest cover from absolutely barren, rocky hillsides, from which the soil has been removed by erosion, to dense stands of thrifty young growth which protect the soil …
T04 R10	EH23, EH28	This township has been accessible by means of the Barlow and Oak Grove Roads since the days of the early pioneers, but it is not used in any way by the general public except for hunting, fishing and recreation purposes. This township contains a part of the largest body of mature timber on the east slope of the Cascade Mts. This timber is principally Douglas Fir mixed with western white pine and hemlock. At the lower elevations there is a small amount of western yellow pine. The burns have sufficiently restocked to form a protective cover.
T05-06 R10	EH31	These townships have been accessible by means of roads and trails since the days of the pioneer, but their only use by the general public has been for fishing, hunting and other recreation purposes…. This tract contains a stand of mature timber estimated a 500,000 M. ft. B.M. It is, therefore, unquestionably of great forest value. Its lack of agricultural value is shown by the fact that logged-off lands of similar character have not been placed in cultivation and that the lone homestead which was the pick of the entire tract, from an agricultural standpoint, has been allowed to lie idle for years.
T01-05 R10-12	EH12, EH15, EH19, EH21, EH25, EH29-30	The stand of timber on the area north of Badger Creek, consists of a stand of yellow pine and Douglas fir timber, averaging about eight thousand B.F. per acre. South of Badger Creek to White Riber the stand is heavier, averaging over most of the area approximately 14 M.B.F. of pine, with a heavy stand of red fir in Secs. 13, 14, 21, 22 T. 5 S., R. 10 E. The pine will run 64% of the stand over the entire area. The timber is, however, short boled throughout the area and will average not more than 10% clear. Reproduction is established over practically the entire area and ranges from 5 to 40 years old…. The timber is accessible and there is now, or has been, a sawmill on each of the streams within the area. Comparatively little of the Nation Forest timber has been cut…. The stand of timber varies from 2 M.B.F. per acre on the light stands, to more than 50 M.B.F., in the heavily timbered areas.

S
Timber Surveys, Mt. Hood
Wamic Project
(T. 4 S., R. 11 E.)

Note: Reproduction on cut-over areas designated as A, B, C.

WAMIC PROJECT. T. 4 S., R. 11 E., W. M.

Description	Timber Stand M. ft. B. M.			Acres of Forest Type and Age Classes																			Acreage Alienated Land
				Yellow Pine				Cut-over							W. F. - Larch - D. F.								
Sec. 1	Yellow pine	D. F.	W. F.	Y-4	Y-3	Y-2	Y-1	Y-4	Y-3	Y-2	Y-1	FL-3	FL-2	FL-1	FL-3	FL-2	FL-1	Alder	Brush	Grass	Oak	Cultivated	Land
NW¼SW¼	125	75		20.0	18.0																2.0		40
SW¼SW¼	50	5		15.2					8.0	8.0(A)													40
				35.2	18.0				8.0	8.8(C)											2.0		80
Sec. 2										16.8													
NE¼SW¼	80	175		8.0											24.0						8.0		40
NW¼SW¼	175	20		36.0											4.0								40
SW¼SW¼	160	300		40.0																			40
SE¼SW¼	200	125		26.0											14.0								40
NE¼SE¼				20.0	5.6										14.4								40
NW¼ "	112	120		14.0						3.2					20.8						2.0		40
SW¼ "	10	120								16.0					24.0								40
SE¼ "										36.0					4.0								40
				144.0	5.6					55.2					105.2						10.0		320
Sec. 3																							
NE¼SE¼	160	50		40.0																			40
SE¼ "	175	60		36.0		4.0																	40
				76.0		4.0																	80
Sec. 10																							
NE¼NE¼	100	50		24.8	2.0	10.0														3.2			40
NW¼ "	200	100		38.0																	2.0		40
SW¼ "	300	150		40.0																			40
SE¼ "	240	210		36.0		4.0																	40
NE¼NW¼	160	80		34.8																	4.0	1.2	40
NW¼ "	280	100		40.0																			40
SW¼ "	180	120		36.0																			40
SE¼ "	200	60		34.4												4.0						5.6	40
				284.0	2.0	14.0										4.0				3.2	6.0	6.8	320
Sec. 11																							
NE¼NE¼	300			40.0																			40
NW¼ "	240	200		40.0																			40
SW¼ "	60	30		26.0																			40
SE¼ "	20			14.8											14.0								40
SW¼NW¼	30	15		34.0									18.0		7.2								40
SE¼ "	240	8		39.0	1.0										6.0								40
NE¼SW¼	80			40.0																			40
NW¼ "	200	200		40.0																			40
SE¼ "	100	50		40.0																			40
NE¼SE¼	20				2.0	25.0																	40
NW¼ "	40			24.0		12.0									12.0						1.0		40
SW¼	100			34.8		5.2									4.0								40
SE¼	20			2.0		38.0																	40
				374.6	3.0	80.2							18.0		43.2						1.0		520
Sec. 12																							
NE¼NE¼	100			34.0		2.0																4.0	40
NW¼	25			7.6	5.2					16.4(C)											4.8	6.0	40
SW¼	50			7.0	4.0					3.0													
										3.0(C)													
										16.0(A)										7.0			40
SE¼	10			1.6						28.4													
NE¼NW¼	75			11.8	7.0	1.2				20.0(C)	FL-1=									2.0		8.0	40
SW¼ "	65	10		1.6	22.0					4.0(C)	2.0(C)							2.4			8.0		40
SE¼ "	100			9.6	12.8	8.0				9.6(C)													40
NE¼SW¼	50			10.0	5.2	8.0				16.8(C)													40
NW¼ "	90	30	5	6.0	7.5	7.2				16.1											3.2		40
SW¼ "	75			26.4		12.0														1.6			40
SE¼ "	30			23.2		4.0														4.8	8.0		40
NE¼SE¼	50			24.8	4.0	6.0				3.2(C)											2.0		40
NW¼ "	60	15		14.0	2.0					24.0(C)													40
SW¼ "	30			6.8						8.0(C)										8.0	11.2	6.0	40
SE¼ "	100	25		9.2	10.0	8.8					FL-1 =									4.0	8.0		40
				193.6	727	57.2				168.5	2.0							2.4		27.4	45.2	24.0	600
Sec. 13																							
NE¼NW¼	320			40.0																			
NW¼ "	320			40.0																			40
SW¼ "	160			20.0																			40
																				20.0			40
				100.0																20.0			120
Sec. 14																							
NW¼NE¼	100			24.0	4.0	12.0																	
SW "	150			28.2	4.8	6.0					FL-1= 1.0												40
NE¼NW¼	100	10		26.8						4.(A)	Y-1=												40
										2.(C)	4.8(A)												
S½NE¼SW¼	50	13		6.0		6.0														5.0		1.2	40
S½NW¼ "	65	33		19.0		1.0														8.0			20
S½SW¼ "	13			11.4							FL-1=												20
N½SE¼ "	12	2		6.0		4.0					4.0	5.6											20
NW¼SE¼	30			13.4		25.6					FL-1=										10.0		20
											1.0												40
				134.8	8.8	54.6				6.0	Y-1=4.8 FL-1=6	5.6								13.0	10.0	1.2	240
Sec. 24																							
SW¼SW¼				20.0																			
SE¼ "	Cultivated			12.0																		20.0	40
SW¼SE¼	"			32.0																		28.0	40
																						40.0=88	40=120
Sec. 23																							
SE¼SE¼SE¼	Immature			2.0						8 (A)													10
Sec. 26																							
NE¼SW¼	50			18.0		6.0									14.0					2.0			40
SE¼ "	150	25		21.2	3.2										10.0					5.6			40
				39.2	3.2	6.0									24.0					7.6			80

Figure A8: Classification of the Wamic Project area on the eastern half of the study area includes estimates of timber volume and area by cover type (including hardwoods, brush, and grass) and age class for timber types.

Extensive Timber Reconnaissance of Mt Hood National Forest
1922 USFS

Cover type classifications include timber species by size/age class. Volume by timber species were recorded for each quarter-quarter section (40 acres). No description of methods was found with the maps. Maps are available for the areas indicated in Figure A9.

Records are archived at the National Archives and Records Administration, Seattle Facility in Timber Survey Maps, Mt Hood National Forest 1912-1933, Records of the Forest Service, Record Group 95.

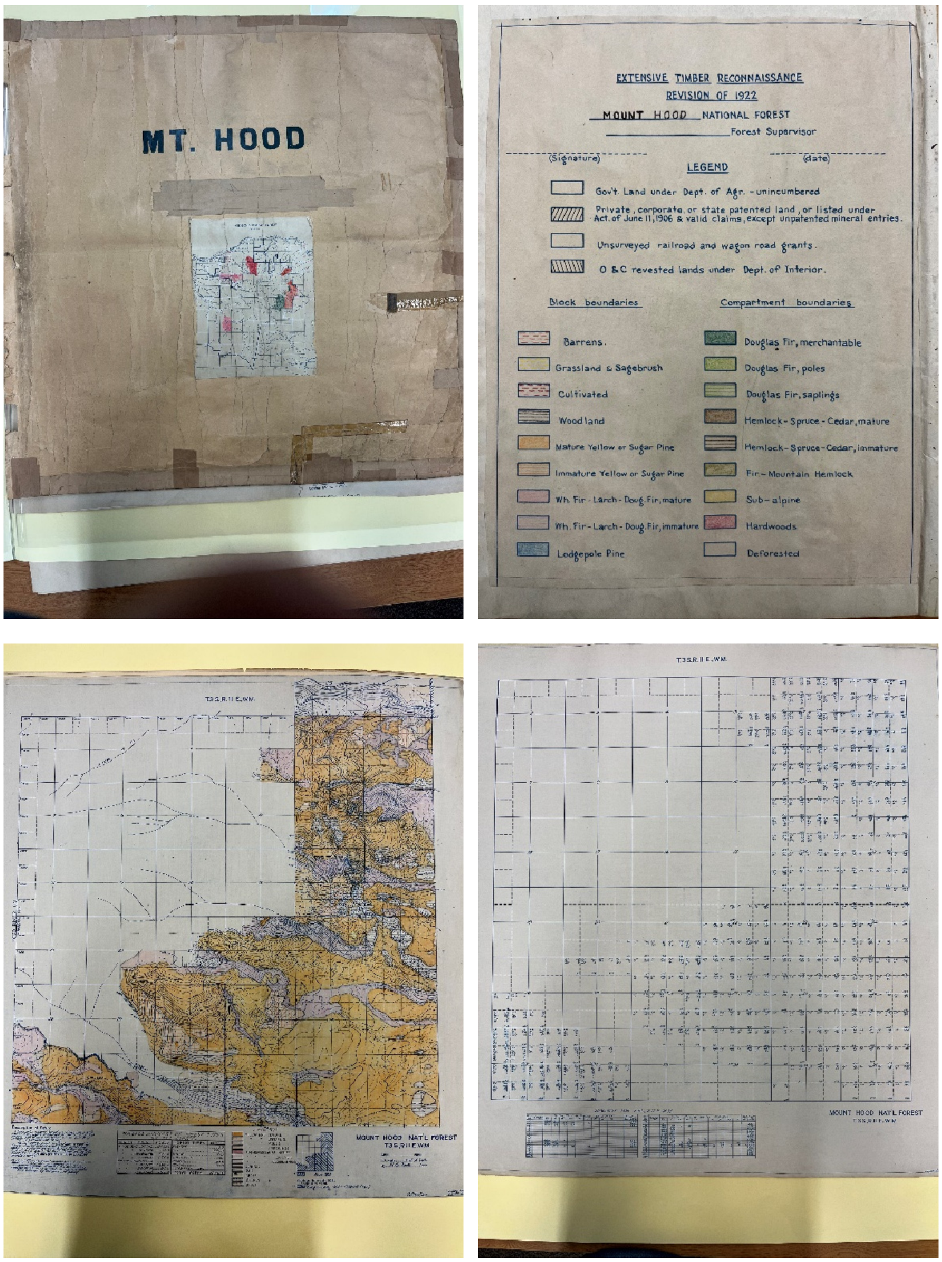


Figure A9: Sample pages from the 1922 Timber Reconnaissance. Clockwise from top left: surveyed areas indicated in color; legend; map for one of the townships in the survey; and listing of volume by species for each quarter-quarter section (40 acres) for the same township.

The 1930s Survey of Forest Resources in Washington and Oregon
1930s USFS

The 1930s Survey of Forest Resources in Washington and Oregon incorporated and evaluated earlier inventories. In compiling the *1930s USFS* survey, the Forest Service conducted check cruises to obtain reliable adjustment factors for existing inventories (Cowlin et al. 1942). In 2003, the USFS re-published original reports of the *1930s USFS* survey to accompany recently digitized maps (Harrington, 2003).

Documentation and GIS shapefile are available from fs.usda.gov/research/treesearch/6230 and databasin.org/datasets/0eac68a40c064d65bb29108d0857aa1c/, respectively.

Table A5: Descriptions from Cowlin et al., 1942 of forest-cover and land-use types in the 1930s USFS survey. Cover type classes documented by Cowlin and colleagues but not represented in the digital files for this study area include: juniper and ponderosa pine woodland, upper slope mixture, white fir, deforested by insects or wind throw, and grass or shrub. Original maps are available at the National Archives and Records Administration, Seattle Facility and could be checked against the digitized version used here.

Woodland Types
Oak A stand containing approximately 60 percent or more of one or more species of oak. No separation of age classes.
Timberland Types
Douglas-fir These are forests containing approximately 60 percent or more by volume of Douglass-fir. The six types, differentiated by the size class into which most of the volume falls or, in the case of the two smallest sizes, the diameter class of most of the dominant trees, are **large old growth** (6), 40 inches d. b. h. and more; **small old growth** (7), 22 to 40 inches; **large second growth** (8), 22 to 40 inches (coarse-grained timber yielding only a small percent of the upper grades of lumber); **large poles** (9A), 12 to 20 inches; **small poles** 5 (9B), 6 to 10 inches; **seedlings and saplings** (10), less than 6 inches d. b. h.
Ponderosa pine These are forests containing approximately 50 percent or more by volume of ponderosa pine, sugar pine, or Jeffrey pine, or any combination of these species (except those in which sugar pine attains 20 percent and becomes the key tree); stands are continuous in contrast to the more open ponderosa pine woodland type. The five types, differentiated by mixture and size class, are **large** (20), the dominant stand averaging more than 22 inches d. b. h. (so-called yellow pine more than 150 or 200 years old), no material part cut, and including occasional stands of mature or overmature ponderosa pine averaging smaller than 22 inches; **large, pure** (20½), approximately 80 percent or more, by volume, ponderosa or Jeffrey pine; … **small** (21), containing at least 1 M board feet of ponderosa pine 12 inches d. b. h., or more, and comprising either (a) selectively cut stands of any age, or (b) immature bull pine, usually 12 to 22 inches d. b. h. but including occasional immature stands of more than 22 inches; **seedlings, saplings, and poles** (22), on old burns or heavily cut-over land, less than 12 inches d. b. h., containing less than 1 M board feet per acre of saw timber, if any.
Fir-hemlock Noble fir, Pacific silver fir, alpine fir, Shasta red fir, white fir, mountain hemlock (or, occasionally, western hemlock), or any combination of these species composes at least 50 percent of the volume of the stand. The two size classes, characteristic of the upper slopes of the Cascade Range, are **large** (23), most of the volume in trees 12 inches d. b. h., or more, and sawlog material (other mature stands ordinarily classed as subalpine, No. 33); **small** (24), dominant trees mostly less than 12 inches d. b. h., usually young trees on old burns.
Pine mixture Characteristic of north slopes and cooler basins and consisting of about 20 to 50 percent by volume of ponderosa pine with a variable quantity of western larch, white fir, Douglas-fir, lodgepole pine, western white pine, or other species, or of any combination of these species. The two types recognized are **large** (27), including forests in which most of the volume is in trees 12 inches d. b. h., or more, and in which cutting has been immaterial; and **small** (28), in which dominant trees are mostly less than 12 inches d. b. h.
Subalpine Alpine fir, mountain hemlock, Shasta red fir, lodgepole pine, whitebark pine, western white pine, and alpine larch predominating and usually interspersed with meadows and glades. At upper limits of tree growth, usually unmerchantable because of poor form and small size. No volume recorded.

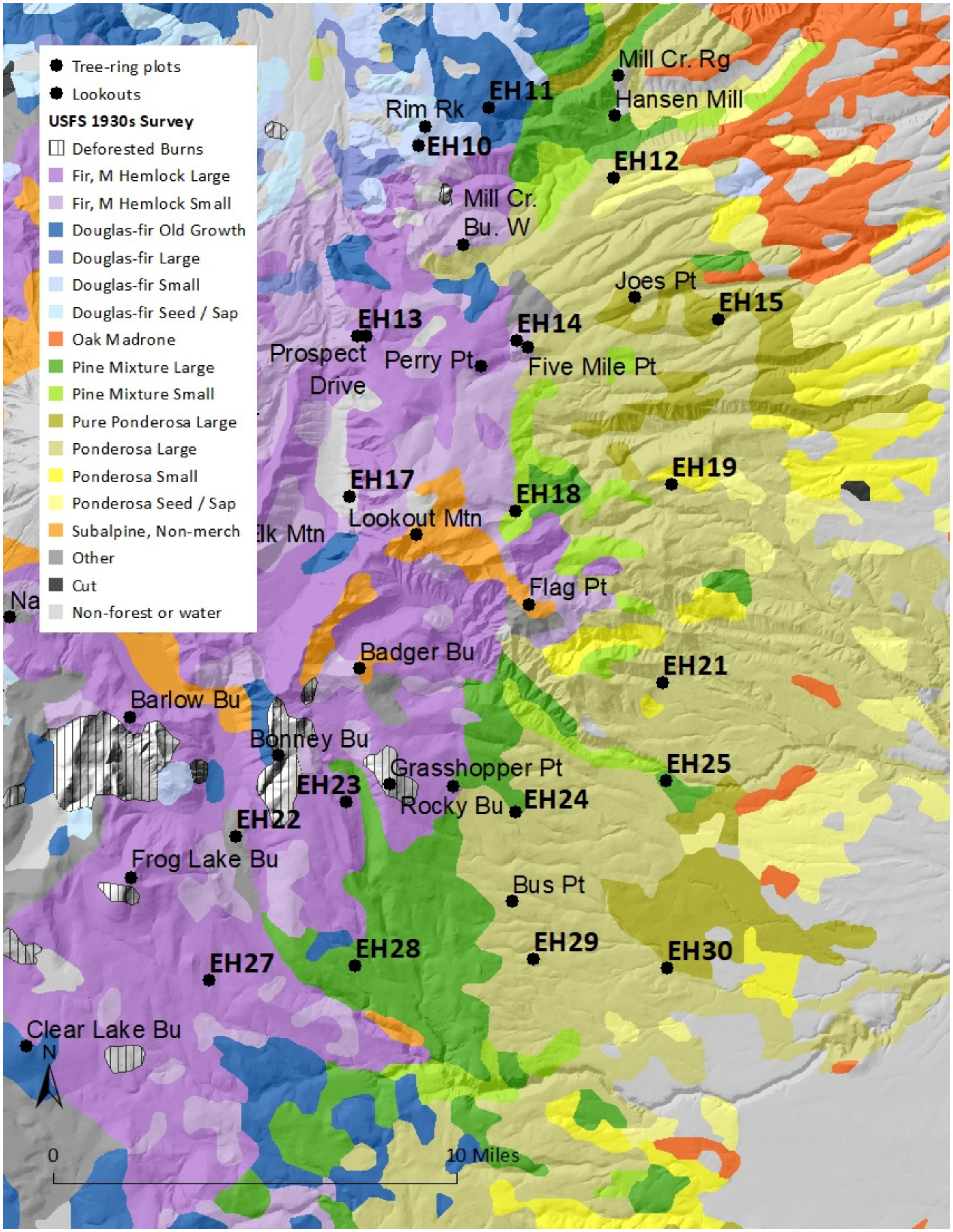


Figure A10: Cover types assigned by the USFS Survey of Forest Resources in the 1930s. Source: Harrington, 2003. Location of tree-ring plots in the study area relative to fire lookouts from which Osborne panoramas were taken between 1933 and 1935.

USFS Osborne fire lookout panoramas
1933-1935 USFS

Panoramic photos were taken from fire lookouts and other locations used as fire detection stations in Oregon and Washington between 1933-1935 (Arnst, 1985). Three images, each one covering 120 degrees, were collected from each location. Each image included location, date, and an azimuth scale.

Images like these have subsequently proven valuable for illustrating (wildlandnw.net/osborne-panoramas-historic-and-modern) and evaluating (Butler and DeChano, 2001; Fortin et al., 2019) landscape level change since the 1930s. The Nature Conservancy sponsored a project to scan the best of these images for Oregon and currently hosts them on their website (maps.tnc.org/osbornephotos/). Images can be previewed on the site. High-resolution images can be downloaded by clicking on a link at the bottom of the table accessed via the “Table” tab (maps.tnc.org/osbornephotos/table.html). Original images and images not included in the subset hosted by TNC are held at the National Archives and Records Administration, Seattle Facility.

Refer to Figure A10 for a map of fire lookouts relative to tree-ring plots and *1930s USFS* survey cover type classifications.

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