Historical Vegetation of the Tiller Area, Douglas County, Oregon,

Based on GLO Survey Notes

Report to

DOUGLAS COUNTY COMMISSIONERS

Roseburg, Oregon

By

O. Eugene Hickman and John A. Christy

January 31, 2014

Historical Vegetation of the Tiller Area, Douglas County, Oregon, Based on GLO Survey Notes

Report to

DOUGLAS COUNTY COMMISSIONERS

Roseburg, Oregon

January 31, 2014

By

O. Eugene Hickman and **John A. Christy**

Consulting Rangeland Ecologist
Retired, USDA - NRCS
61851 Dobbin Road
Bend, Oregon 97702
(541, 312-2512)
ghickman@bendcable.com

Oregon Biodiversity Information Center
Portland State University
PSU – INR, P.O. Box 751
Portland, Oregon 97207-0751
(503, 725-9953)
john.christy@pdx.edu

Suggested citation: Hickman, O. Eugene and John A. Christy. 2014. Historical Vegetation of the Tiller Area, Douglas County, Oregon, Based on GLO Survey Notes. Report to Douglas County Commissioners. Roseburg, Oregon. 80 pp.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This project was conducted in the Tiller area east of Canyonville, to develop a landscape perspective of historical vegetation for the early settlement era. The project area covered about 128,214 acres, of which 42% was private land, 17% BLM, and 41% USFS. This area of complex topography, transitional between interior valleys of the Umpqua River and the Cascade Range, has a small rural population base sometimes impacted by local natural resource problems and management. The study area includes portions of the South Douglas County Wildland-Urban Interface zone.

Historical land survey notes from General Land Office (GLO) were used to create a historical vegetation cover for the study area. Surveys began in the 1850's and were completed in the more remote areas by 1923. Retrieval of the early GLO data to both describe and map historical vegetation, was done using standard protocols developed since 1994 by the Oregon Natural Heritage Information Center, and have been used for historical vegetation research in numerous parts of Oregon.

The historical vegetation matrix can be simplified using groups with similar structural characteristics called classes. Prairies (all types) covered 2.2% of the project; shrublands (brush fields and thickets) covered 0.7%, savannas with sparse tree cover (17%), woodland or open tree stands (2%), riparian forests (1%), and upland forest with thick tree cover (77%).

Each vegetation class is composed of subclasses, unique types of historical cover described from witness tree notes, descriptions of section lines, and general descriptions of townships. Prairies occurred on both bottomlands and dry uplands typically on warm southern slopes. Shrublands were small and scattered in a variety of environments, most of which we attribute to wildfire. Woodland stands have wide tree spacing and are a botanically diverse class. Natural woodlands of oak- pine types are believed to have been treated by burning as an Indian cultural practice, but partly stocked mixed conifer woodlands with shrubby undergrowth may be the product of wildfire impacts.

Five types of savanna were described, found primarily on warm southerly topography, the majority of which was believed to have been converted from either woodland or forest to thin tree cover types through periodic understory burning by the Indians. This was the largest landscape feature in the project area that was an artifact of historical burning treatments. With fire exclusion, most of it has reverted to denser canopies and woody undergrowth.

The large acreage of upland forest was classified into twelve subclasses or map units, eight very moist habitats and four types in a warm, higher moisture stress group. Brush fields and burned tree stands were mostly small and scattered, which we attribute to wildfire, not cultural burning practices. There was no GLO evidence of widespread type conversion here from burning practices. Significant treatment areas must have been confined around important cultural sites, and possibly at numerous incidental ignition sites by lighting or Indians throughout the forest. Either did not appear to have uniformly impacted large areas of adjacent moist forest, unless these areas were low impact areas missed in the survey, or areas not crossed by GLO survey lines.

PREFACE

This study is a continuation of our earlier investigations of historical vegetation in Oregon, but at a different location. The scope has always been narrow, that of recovering vegetation data from the General Land Office (GLO) township surveys made early in the settlement era, for developing a landscape level perspective of plant cover for a baseline perspective, even though the data is coarse and lacks the refinement of a high quality ecological inventory.

We appreciate the invitation made by the Douglas County Commissioners to conduct and fund a study of several townships east of Canyonville, surrounding the Tiller community. OSU foresters Steve Fitzgerald and Paul Adams, who contacted us on behalf of the County, have been supportive in facilitating this new project, and Steve has been an important contact for information and made helpful inputs for proceeding with this work.

It has been invaluable to have the assistance of the County Surveyor's staff to produce the major GIS products, saving our very limited budget and enabling us to map a larger area than would have been possible otherwise. It has been very rewarding to work with Terrie Franssen and see our work maps and data turned into high quality GIS materials.

A considerable amount of background text regarding standard GLO procedures and our research protocols has been taken from a previous report written for the Rogue River basin (Hickman and Christy 2011). This material is applicable to our work at Tiller to help readers interpret our results, and is included here without further citation.

Gene Hickman and John Christy

INTRODUCTION

Historical vegetation of our nation at the time European settlement is of great interest to natural resource managers and the general public, but is poorly documented. Many assumptions about potential vegetation or historical land cover have been made as a basis for management decisions, particularly for restoration goals, without good baseline data or even general information regarding site potential or site specific historical cover. Some question the validity of baseline data for restoration because of the instability of natural landscapes over time, and the difficulty in finding a “point in time” across a large variable landscape that represents the most natural "presettlement" vegetation (Noss 1985). What is perceived as the least disturbed or most natural examples of historical cover were influenced by millennia of management by Native Americans. Noss asks “is there any point in knowing what the vegetation was like at a one point in time if, as many paleoecological studies suggest, each point represents a transient association of species, each responding individualistically to long-term change?” He does suggest that “the presettlement model may yet be salvageable” and “despite all complications, presettlement vegetation is a concept that conservationists must reckon with, as it figures prominently in our laws and statements of management policy.” We recognize the dynamic nature of natural landscapes and concur with the difficulties and implications of describing a presettlement “state.” Knowing that there is valuable information and understanding to be gained from the investigation of historical landscapes, we promote its use for both restoration and natural resource management.

One source of data is the earliest land survey record by the federal government’s **General Land Office** (GLO). This was the first systematic, detailed, spatially-explicit inventory of natural resources of the United States, during the early period of Euroamerican settlement and development. These records have been used extensively to develop historical baseline data, such as plant community composition and/or tree stand structure, in the midwestern and western United States (Bourdo 1956; Habeck 1994; Whitney and DeCant 2001; Cowell and Jackson 2002), and in the Pacific Northwest (Habeck 1961; Buckley 1992; Sullivan 2000; Christy and Alverson 2010, Peter and Harrington 2010; Duren et al. 2012; Labbe et al. 2013). The GLO record provides an accurate insight into presettlement vegetation, at least for the period of the survey, and for the ecological state of the landscape at that date. It also improves our understanding of where and how vegetation has changed over the last 150 years. GLO cadastral survey data provided a valuable contribution to the study of historical vegetation in southwestern Oregon, since surveys began here very early in the period of European settlement and land development.

The General Land Office, Its Function and History

The Land Ordinance Act of 1787 passed by the U.S. Congress established a rectangular survey system, the foundation for public land surveys. All unsettled land west of the original 13 colonies was considered public domain, where exploration, settlement and development were encouraged. In 1812, the US Congress established the General Land Office (GLO) to implement the Act and supervise land surveys (Bureau of Land Management 2002a). An excellent overview of the beginnings and progression of this national survey program, along with an evaluation and the application of this data for judging presettlement landscapes, was provided by Galatowitsch (1990).

For the first century, the work was done by private surveyors who contracted with the GLO. Work progressed across the West as Congress authorized surveys where settlement was being initiated. For example, contractors began surveying the Willamette Valley in 1851, because a constant influx of settlers was arriving from the Oregon Trail. Not until 1854 were surveys authorized for the upper Rogue Valley, well after gold was discovered and miners rushed into SW Oregon (Atwood 2008).

The rectangular survey system first required the creation of a grid of townships, each measuring 6x6 miles, followed by the subdivision of each township into 36 sections of one square mile each. Later surveys established the boundaries of settler's land under the Donation Land Claim Act. The rectangular grid formalized a system for locating property boundaries, within which homestead claims could be surveyed and legal ownership established. A manual standardizing GLO procedures for the Oregon Territory was published in 1851 and revised in 1855 (White 1983).

Planning to begin a survey program in Oregon began in Congress in 1850 (Atwood, 2008). The program was to be supervised by a **Surveyor General** headquartered in the Territorial Capitol at Oregon City. During the winter and spring of 1851, Congress authorized funds, the Surveyor's office was established, and recruitment of qualified surveyors was initiated. In May, 1851, contracts with two Deputy Surveyors were signed to begin the first GLO land surveys in Oregon near Oregon City. From there, work extended in all directions, especially southward into the Willamette Valley, where much settlement was occurring. Atwood (2008) provided an excellent account of the background and politics of this early survey work, the hardships of the survey teams, their personal efforts to perform the work during periods of Indian unrest, and the settler history unfolding as they laid out the townships and sections.

Transition to Southern Oregon

"Although the General Land Office planned eventually to extend the Willamette Meridian [from the initial point near Portland] to the Oregon-California boundary, for now [early 1851, Commissioner] Butterfield instructed Preston [Oregon Surveyor General] to survey only the Willamette and Umpqua valleys' rich farmlands, discounting southwestern Oregon as too unattractive to make the surveying of it available at present." (Atwood 2008, p. 27)

After three years of surveying in the Willamette Valley, adjacent foothills and western Washington, pressure was building for the Oregon Surveyor General to issue contracts to survey the newly settled interior valleys of extreme SW Oregon. As a result, a GLO contract signed on January 4, 1854, instructed two seasoned surveyors, George Hyde and Butler Ives, to extend the northern survey southward through the Umpqua Valley and into the central Rogue River Basin. On May 1, 1854, in southern Douglas County, they began surveying an extension of the Willamette Meridian and its offset around rough terrain, southward into the Rogue Valley, preliminary to chaining the townships of southwest Oregon (Atwood 2008).

Tiller Area GLO Survey Program

Township surveys near Tiller, Oregon, began in 1855 with just a few miles of township boundary surveyed. In 1857, for just one year, the work accelerated in the productive valleys and forage rich uplands of the central and SE portion of our study area as it was already being populated by settlers involved in mining and ranching. The remainder of the area, mostly remote, rough mountainous topography, was left unsurveyed until many years later.

Objectives of Project

This project was conceived for the purpose of developing a landscape perspective of historical vegetation cover for the Tiller study area, based primarily on the GLO township surveys. In accordance with intent to limit our research to this specific dataset, our literature review and historical information base will be quite limited, making our interpretation of base line conditions largely a product of the GLO data.

Objective 1: Transcribe digital or microfiche copies of original hand written GLO rectangular survey field notes into a Microsoft Access database. Newer "resurveys" of previously surveyed areas were not used except where resurveys were needed to merge or join with original survey work.

Objective 2: Use the transcribed data to classify and describe the historical vegetation types. Although considerable work of this type has been done elsewhere in western Oregon, some of the study area differed from other areas previously mapped, resulting in new descriptive material.

Objective 3: Map the landscape vegetation mosaic for the time period of the dataset, based on our interpretation of local GLO data in relation to topographic features, soil mapping, or other ecological information. Digitize line work for GIS products.

Objective 4: Analyze and summarize the dataset, with additional emphasis on the lower, more populated west side of the project area in the Wildland-Urban Interface (WUI) zone. Write a final project report.

STUDY AREA

The Tiller GLO study area is located in SE Douglas County, east of Canyonville. It follows the South Umpqua River from about 4 miles below Milo, eastward to near South Umpqua Falls, and extends from 8 miles north of Tiller south 15 miles to near Cowbell Mountain (Figure 1). It encompasses the equivalent of 5.5 townships, nearly 200 sections, or about 128,214 acres (based on GIS). GLO surveyor acreages derived from early plats total only 127,430 acres. Because of this discrepancy which is not easily accounted for, plat acreage has been used for only one analysis, the GLO land survey progress (Table 2), and acreage used for all other reporting is summarized from GIS.

Land managed by BLM are prominent in the western half of the area up to about Tiller, covering about 21,418 acres or 17% of the project area (Figure 2). USFS lands, located primarily east of Tiller, cover about 52,846 acres or 41% of the area. Private, state or county lands cover about 52,925 acres, or 42% of the study area. Ownerships are mostly mixed, with private land parcels being scattered throughout BLM and FS holdings, except in the extreme NE portion of the project. Some miscellaneous land is not accounted for in this summary.

Besides the South Umpqua River, there are at least seven or eight other major tributaries within the project area (Figure 3). Days Creek, a large drainage system NW of this project, runs for less than three miles through the area. Elk Creek and a branch Beaver Creek, is the longest internal drainage system, running NW several miles to Tiller, and is followed by the highway from Shady Cove. Jackson Creek comes from the east but runs less than 5 miles within the project. Stouts Creek, St.John Creek, Coffee Creek, Deadman Creek and Ash Creek form other significant subwatersheds within the area.

Three small communities are located in the project area, found a few miles apart along the main highway. Milo, Tiller and Drew were important social and shopping centers early in the settlement history and are still the population centers for the area’s residents. Milo is the largest community, and Drew is the smallest. The estimated population for the project area is about 550 people (Population Research Center, Portland State University) and knowledgeable local residents (Kehoe 2014). The Milo area is estimated to have a population of about 350, the Tiller area about 125, and the Drew area about 75. Tiller is home to the USFS Tiller Ranger District. A considerable portion of the GLO project area contains Wildland-Urban Interface (WUI) zones, indicating how much of the area is composed of these sensitive rural population centers (Figure 4).

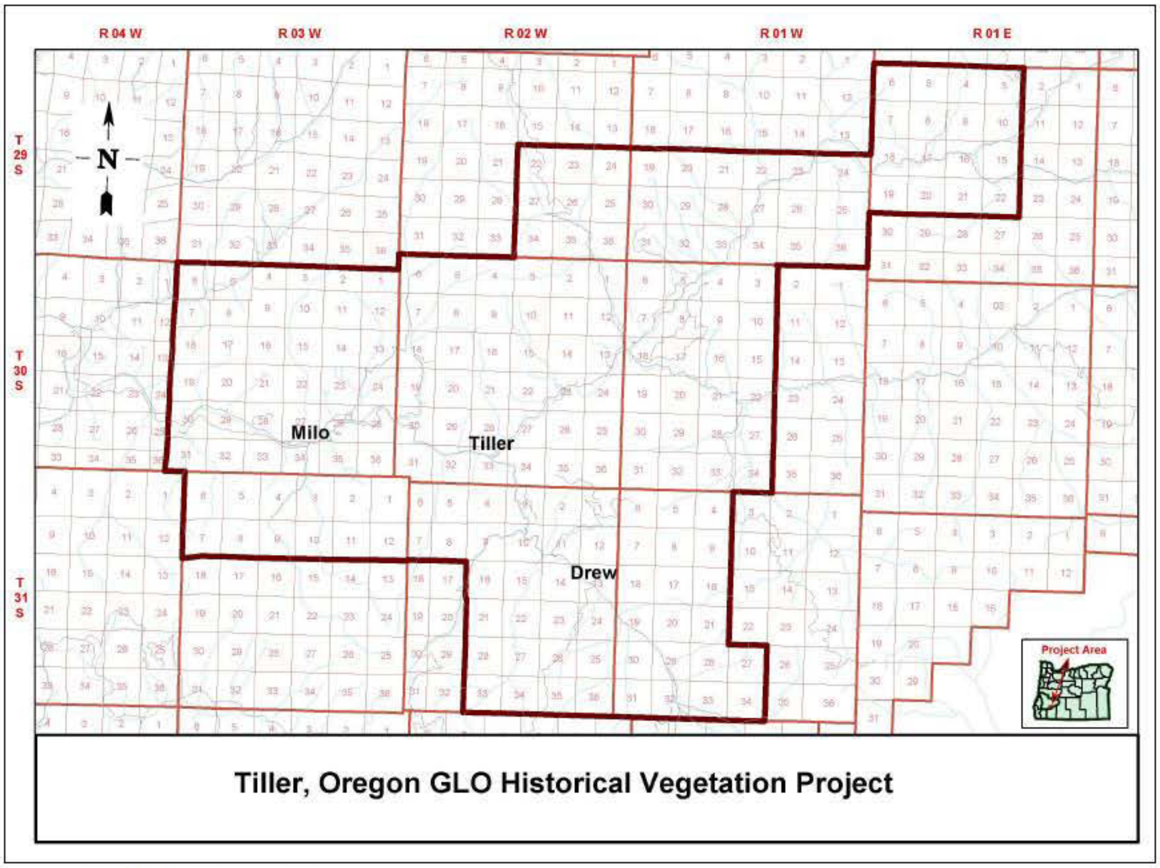


Figure 1. Tiller GLO study area.

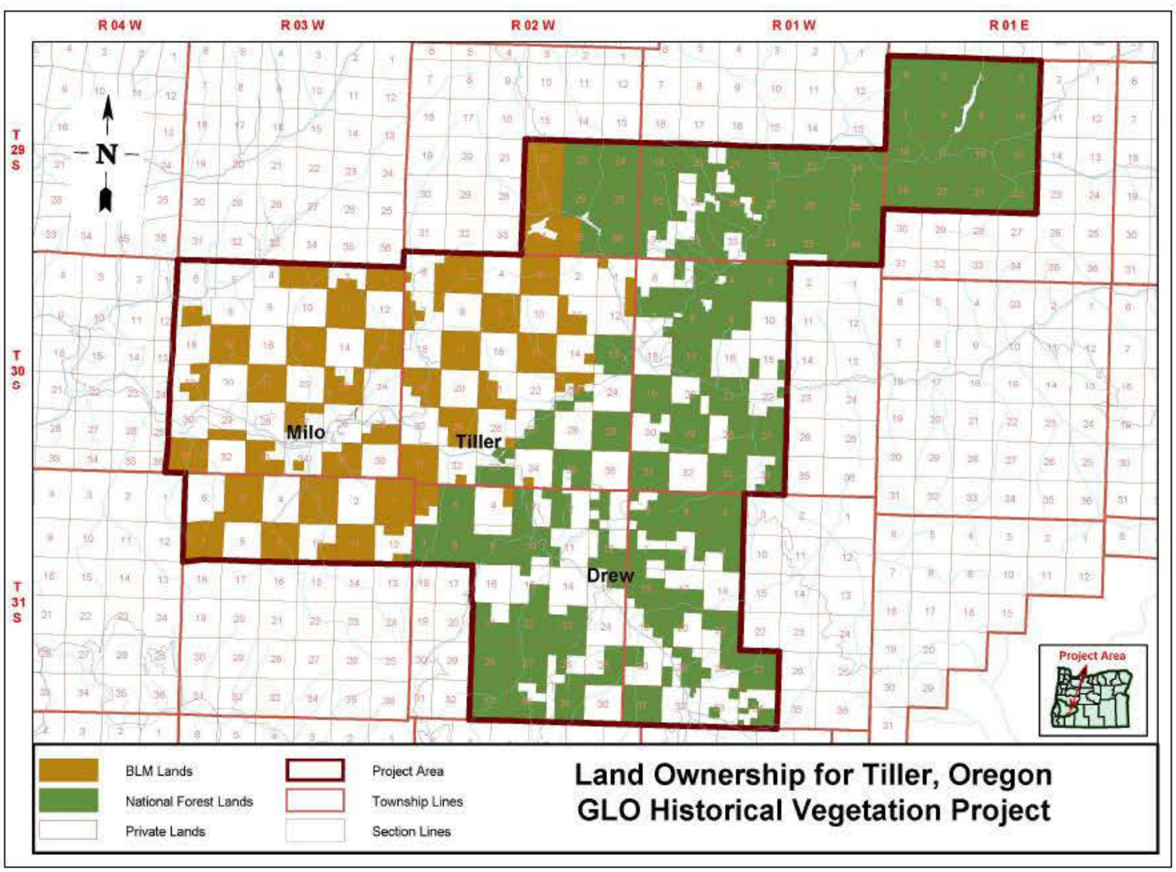


Figure 2. Land ownership status, Tiller GLO study area.

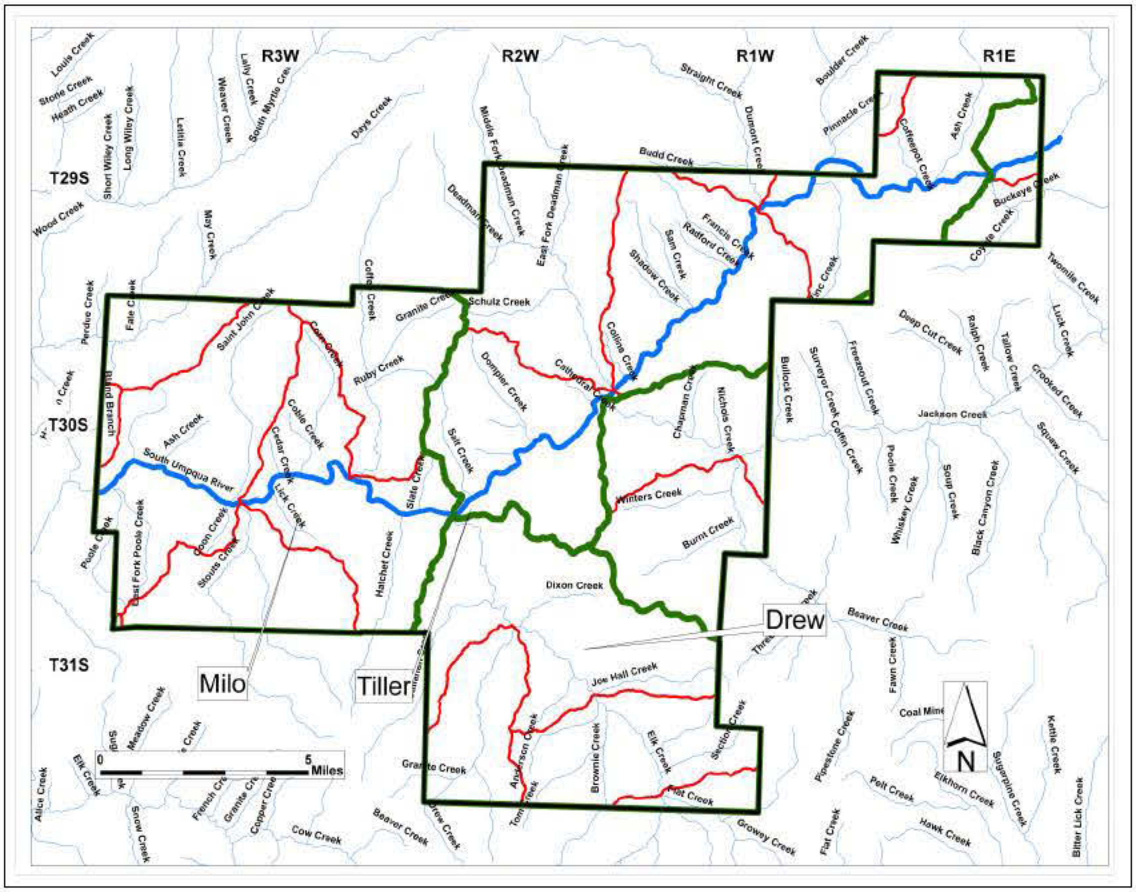


Figure 3. HUC5 (green) and HUC6 (red) watersheds in Tiller GLO study area. Heavy blue line is South Umpqua River.

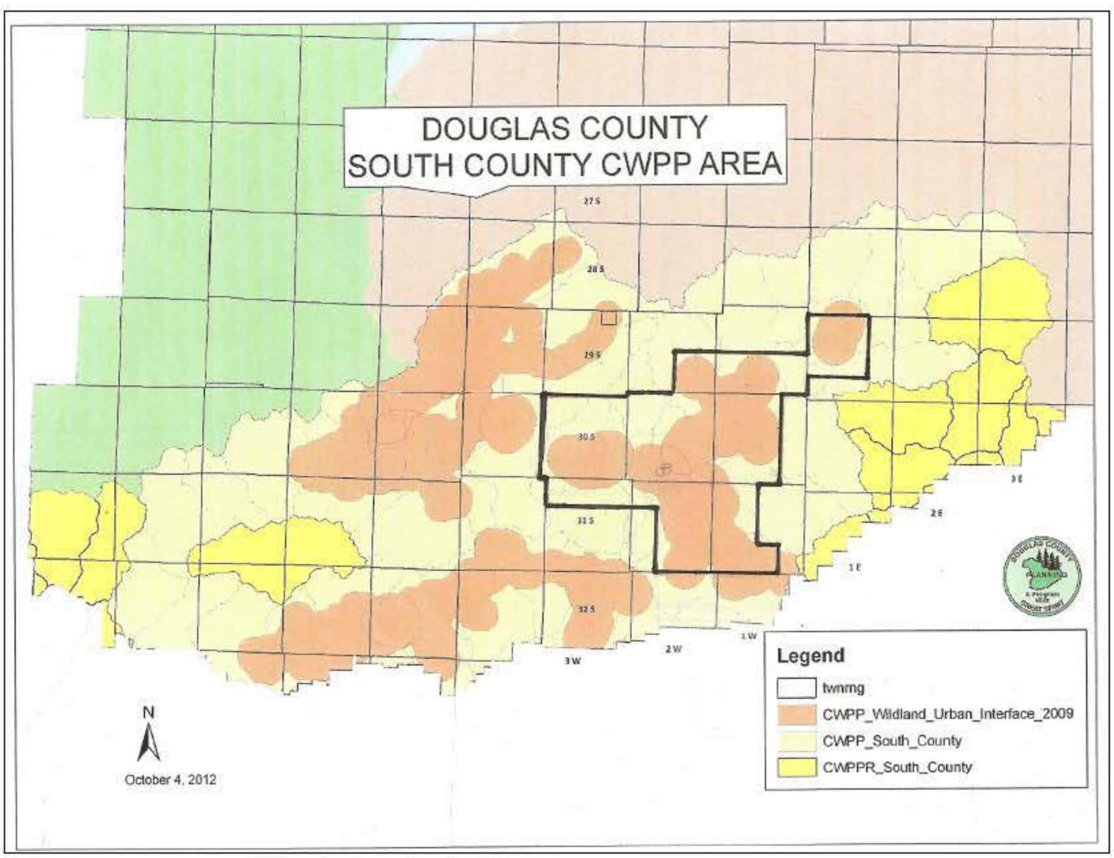


Figure 4. Wildland-Urban Interface (WUI) and Tiller GLO study area.

Environmental Setting

Most of southwest Oregon has a diverse set of climate, topography, geology, and soil features, creating a complex mosaic of vegetation. This diversity is made even more complex by variation in stand condition or ecological status resulting from the local disturbance history prior to Euro-American settlement. An awareness of these factors is helpful in trying to explain landscape level vegetation patterns in the dataset. It is also important in helping to identify differences that relate to disturbance and those that relate to the broad biotic and abiotic features characterizing the project area.

Fortunately, many ecological studies, and decades of field investigations of natural vegetation, geology, and soils have been conducted in southern Oregon to help us begin to understand more of the complexity of this region. However, the level of intensity of classifying and inventorying landscape features today far exceeds the quality and intensity of historical data available in GLO records. Direct correlation of historical data with modern land classification inventories, or its use as a baseline to measure change since the historic period, is difficult because of limitations in the GLO data. Nevertheless, current knowledge of local environments and ecological relationships here is very helpful in interpreting the historical vegetative records and for discovering landscape relationships within the GLO dataset.

Ecological Divisions

Southwest Oregon is a unique ecological region in Oregon. Because of its similarity to northwestern California in climate, geology and physiography (Sawyer, 2007), it is included within the Klamath Mountains Ecoregion (Thorson, T. D. et al. 2003). A similar area was delineated by Anderson et al. (1998), as the Siskiyou Ecological Province. They provide considerable detail about the unique edaphic, geologic and vegetative characteristics of this province that differentiate it from the rest of the Oregon.

Franklin and Dyrness (1973) used vegetation zones to identify broad distinctions within the Pacific Northwest. For southwest Oregon in the vicinity of this study, they classified the dryer major valleys as the “Interior Valley Zone of Western Oregon,” the temperate uplands and moist valleys as a set of “Mixed Conifer and Mixed Evergreen Zones,” and a cooler mid elevation belt along the western Cascades as the “Tusga heterophylla” Zone.”

Large portions of the region have been also been characterized as Ecological/Climatic Zones (Hickman 1973, 1999). These add some refinement to the broader vegetation zones of Franklin and Dyrness (1973). For the Tiller project area (western half) covered by the NRCS soil survey, the report’s general vegetation map shows the majority of the area falls within the “Grand Fir Zone, and higher elevations are part of the cooler “Western Hemlock Zone” (Hickman, 2004).

Geology

An overview of the complex geology of the very old and unique Klamath Mountains was provided by Whittaker (1960). The geology of the younger Cascade Range at the eastern edge of our study was described by Orr, Orr and Baldwin (1992), who also discussed the Klamath Mountains that cover most of this project area. Baldwin (1964) and Franklin and Dyrness (1973) described two physiographic regions or provinces for the area, the Western Cascades and Klamath Mountains. The provinces have a very different geologic history and have formed distinctly different parent materials, topographic features and soil development. Through its ultimate effect on topography, microclimate and soils, geology indirectly helps produce the complex vegetation patterns seen today in southwest Oregon.

Topography

Southwest Oregon is characterized by complex topographic patterns, a product of its unique geologic history. The study area consists of primarily of low to mid elevation mountains with some significant interior river valleys, especially along the South Umpqua River. The lowest elevations drop to about 850 feet west of Milo, and about 900 feet at Days Creek. Each of the larger valleys have active, narrow flood plains bordering the rivers, higher, less active alluvial terraces and some broader plains of older alluvium joining low foothills. Mountains surrounding these valleys range from low gentle ridge slopes to steep rough terrain, mostly below 3500 feet but infrequently to 4000 feet.

Topographic position is a critical element in landscape analysis and is key to understanding ecological site potential. Topography determines aspect, a major environmental factor in the mountains of SW Oregon. Both north and south facing aspects strongly influence plant cover types and productivity throughout the region. And elevation, another product of topography that changes climate, has great impact on ecosystems. At about 2800-3000 feet elevation in the vicinity of the Rogue-Umpqua Divide, and northward up the western Cascades, vegetation grades into mid-elevation plant cover types adapted a cool, moist environment.

During the historic period of Euroamerican settlement, the large accessible valleys, open savannas and prairies were very attractive for development and the focal point for GLO surveys. The adjacent mountains were mostly dissected, complex relief, sometimes with steep slopes, and often with thick forest. Rough inaccessible topography was often encountered by GLO land surveyors who cited this situation as low in value and too difficult to survey, delaying their completion, sometimes for decades.

Climate

Significant climatic variations must occur across the range of this study area that influence vegetation and the results of our GLO work, but precipitation zones are not well known here (Kehoe 2014). Average annual precipitation for the interior valley floor west of Milo is estimated at 30-33 inches, about 38-40 at Tiller, and much less in the Drew area. Precipitation in the adjacent high uplands north and south of Tiller is estimated to average 40-45 inches. The eastern extent of the project area up the South Umpqua River reach may reach 40-50 inches, especially going north, and appears to be a cooler area. There is little evidence of more than a brief intermittent winter snow zone on the higher elevations.

In the higher mountains, elevation changes near about 3000 feet (discussed in the Douglas Soil Survey (Johnson 2004) introduce soil temperature changes, and may be a subtle climatic threshold where shifts in vegetative composition occur. The small belt of upper elevation ridge tops in this project may be cooler, have higher precipitation, a shorter growing season and more snow. However, landscapes here can have a rich flora with high tree productivity on the better soils.

Soils

Throughout the study area, soil characteristics are expected to influence plant cover. Soils have been mapped by NRCS only across the west side of the project area (Johnson 2004), and we reviewed them here along with topography maps when delineating delineate GLO map units. A published soil survey was also completed by the USFS for the NE portion of the project (USFS 1973). Portions of the remaining south central part of our study were recently mapped by the NRCS but never compiled or prepared for publication. Previously we have found areas where soil maps were helpful for interpreting GLO vegetation data and for aiding in the creation of boundaries for vegetation polygons. However, the coarse resolution of GLO data is not often directly comparable with the more intense and detailed soil surveys. Careful judgment is needed to apply soil surveys to GLO vegetation data without misrepresenting or overstating the information documented by the GLO land surveyors.

The western Cascade Range has less geologic diversity than the Klamath Mountains, but have an abundance of soils developed from basalt, andesite and tuffs or breccia. The Klamath Mountains contain very diverse parent materials that can form distinctly different soil types and have unique relationships with the vegetation matrix, i.e. plant composition, tree site quality, productivity, plant succession, and regeneration. Some of the more common examples of unique soil-parent material influence on vegetation are found on wet poorly drained soils, and on both granitic and peridotite or serpentine geology. Soils from these rock types strongly influence plant composition and/or site productivity.

Local Survey Procedure

GLO field work began by surveying a township grid for a large area. Later, separate contracts were issued for subdividing each township. Field work to subdivide a township typically began near the SE corner (on the previously surveyed township perimeter) between sections 35 and 36 (line 35-36), running north and including all E-W lines on the right (east tier of sections). Upon reaching the north boundary of the township, the surveyors moved south and west to begin the next tier of sections as before, advancing north again, and so on, until they eventually ended near the northwest corner of the township. Figure 5 illustrates important features of GLO surveys.

Having concluded the survey, the GLO surveyor was required to create a plat (map) and write a "General Description" of the entire township, describing vegetation, topography, settlement taking place, agricultural and mining development, and its value or lack of value for further settlement. Later, field notes were finalized and the plats drafted by office staff to visually display survey data. The completed GLO records were submitted to the Oregon Surveyor General for contract approval and payment.

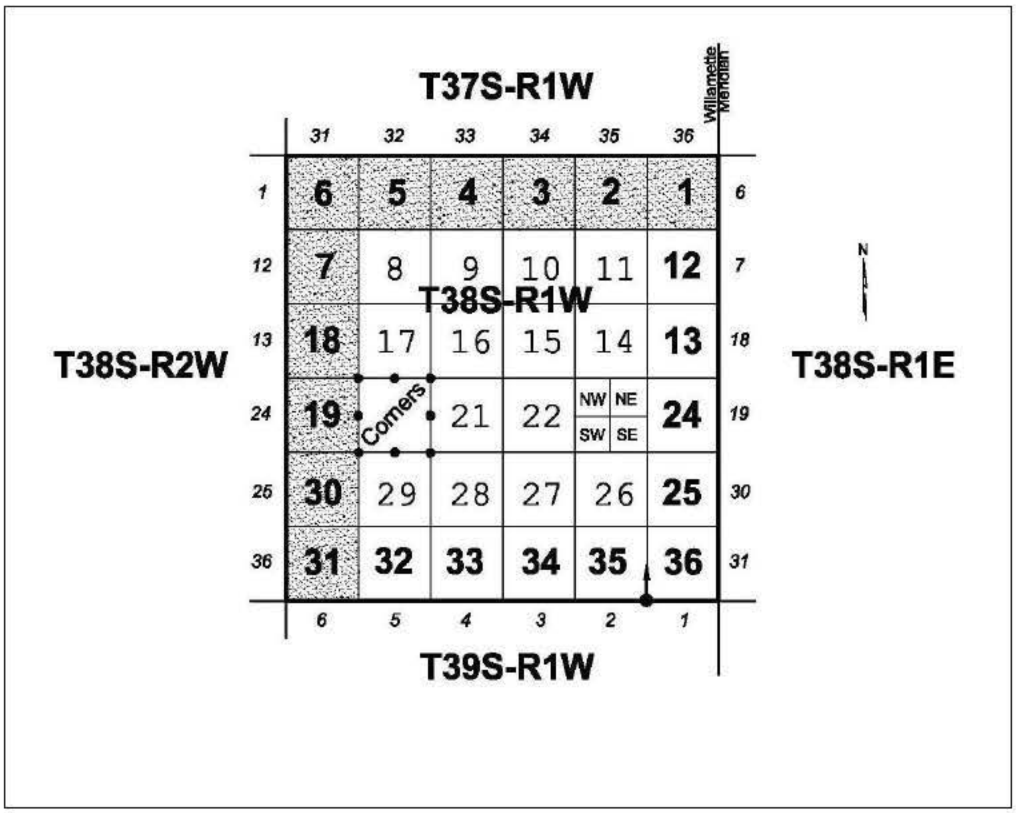


Figure 5. Township and section schematic. In general, each section encompasses 640 acres, and a township contains 23,040 acres. The shaded sections are where adjustments are usually made in order to close survey corners with adjoining surveys, and the length of section lines may vary from the usual 80 chains. A township subdivision survey usually begins at the arrow between Sections 35 and 36. Four section corners and four quarter section corners are established for each section, as shown in Section 20.

GLO RECORDS

Surveyor data was available in two forms, field diary notebooks and township plats (survey maps). Five kinds of landscape data are found in the field dataset. (1.) **Bearing or witness tree data** at section corners and at quarter corners midway between the section corners. (2.) **Section line measurements, intercepts and references** made along the survey lines, to features noted by the surveyor. (3.) **Descriptions of section lines** which briefly described each survey line and often included more detail such as additional species. (4.) **General descriptions of townships**, with landscape, settlement, and development information for the interior of the township, after surveying the township's exterior boundary or subdividing the township. (5.) **Township plats** or maps drawn to scale for each township, that were based on the GLO survey notes. These components are further described and discussed below. See the Appendix, Section II, for examples of Line Tables from this study, displaying the GLO data discussed below.

Bearing or Witness Tree Data

The most precise GLO records other than those with distance measurements from the corners or defined boundaries (entry or exit points), are witness tree data at corners. Section corners usually had four trees documented, if trees were present and suitable for blazing, to serve as references or witnesses to the corner location. Bearing trees were supposed to be sizable, durable and healthy trees if available, and one was selected in each quadrant adjacent to the corner monument. Each tree was identified by species, and its diameter, bearing and distance from the corner was recorded. Midway between section corners, a quarter corner was established with two witness trees, if available. With four section corners and four quarter corners per section, up to 24 trees per section were documented when enough trees were present. If no suitable trees were available, a mound and pit or large rock was used instead to witness the corner.

In this study, species of witness trees helped us to classify vegetation into plant communities or vegetation types. Tree diameters provided some general information about stand age. Distances to corners from witness trees were used to estimate stand density and were helpful to classify stands into coarse cover classes of forest, woodland, savanna or prairie (Christy et al. 2011).

Section Line Measurements, Intercepts and References

Each section line survey ran between two section corners. The line at the point of beginning (section corner) began at zero chains and a direction or azimuth was stated for the line. Measurements in chains and links were recorded when objects were intercepted such as topographic features like ledges, bottoms, ridgetops or steep slopes. These included stream crossings with their widths, and changes in major vegetation types such as transitions from prairie to timber. Large trees (species and diameter) were documented when directly intercepted by the section line.

Also, surveyors recorded cultural features encountered such Indian trails, settler roads, homesteads, fields, fences, saw mill sites, flouring/grist mills, early town sites and mining locations with ditches (traces) for water conveyance. At times they recorded bearings and distances from a point on the line to features noted along the route such as a nearby settler cabin, sawmill, field corners, or distant mountain peaks.

<u>Descriptions of Section Lines</u>

Line descriptions recorded information about the landscape, plant cover, forage productivity, special features such as cultural activities and development, including mining, written at the end of each section line survey. They described soils, topography, sometimes geology, and a summary of vegetation, ending with a short plant species list, primarily trees and shrubs. Recent burns were sometimes noted, and tree regeneration or shrub cover sometimes included density notes like "thick or brushy." Forage value for grazing was often indicated by terms like "good grazing" or "good grass." Soil class ratings reflecting productivity and site limitations were always given but were quite crude, such as the following descriptions: "first-rate loam, second-rate clay loam & gravelly, rough and stony," or "black garden loam."

<u>General Description of Townships</u>

General descriptions were written after township boundaries (six miles on a side) were surveyed, but before contracts were issued to subdivide the interior of townships into sections. The general description was not very detailed, and was less helpful than other GLO data reviewed for this project. It usually recorded the surveyor's impressions including a topographic and vegetative overview of the township, and its value for development and settlement, but sometimes contained considerable cultural information.

<u>Township Plats</u>

Plats were maps drawn to a scale of ca. 1:31,000 after the subdivision survey, based on the section line and township boundary field notes. Examples of GLO plats from this survey, are displayed in Appendix, Section III. They are very helpful at times, to display such features as the section line grid, topography, road systems, stream systems and other water features, vegetation boundaries which have an entry and exit point on the line survey, and other cultural features. Usually, any feature noted on the section line survey with a distance measurement was also drawn on the plat. Surveyors sometimes extended these features as sketches across the interiors of sections. These renderings were frequently inaccurate, especially when showing topography and drainage systems.

Lastly, the plats indicated which portions of the townships had been surveyed, and if they had been surveyed in stages at different time periods. Portions of some townships were not surveyed in the first decade because of surveying challenges or due to the lack of economic value for mining, agriculture, timber or settlement. Areas that were rough or too difficult to survey were often labeled on the plats as "rough mountains and unfit for settlement." These isolated blocks of land were left unsurveyed, sometimes until many decades later, and were often delineated on a new plat.

METHODS

Introduction

The first step in the study was to retrieve all the landscape information from the handwritten GLO field notes which were sometimes hard to read and often included unfamiliar words from archaic American dialect. Field notes were transcribed into a Microsoft Access database using protocols developed by Christy et al. (2002). Data is organized by township and usually includes all sections in each township, regardless of survey date. The data was transferred to the Oregon Biodiversity Information Center (PSU) in Portland, Oregon, where it was added to the GLO database for Oregon.

Next, it was necessary to review and classify the GLO vegetation data along each section line into vegetation types or plant communities. Key GLO notes were transferred or copied to their corresponding locations on mylar overlays of 1:24,000 USGS quad base maps to identify their distribution and detect patterns of similar data that could be grouped into vegetation types and delineated as map unit polygons. The composition of these groups needed to allow for considerable variability but be distinct enough to be mapable. Because grass and forb species were generally not documented by name in plant lists, only trees, shrubs and references to plant types like bunchgrass, prairie, creek prairie, etc. were useful for classifying historic vegetation groups and for writing descriptions.

Mapping vegetation and creating map unit polygons required the use of several sources of information. The author's personal experience in local field inventories, and any landscape or topographic feature that appeared related to GLO vegetation type distribution was utilized for mapping, such as contours, aspect, elevation and USDA soil surveys. Vegetation boundaries were then drawn on the mylar overlays (over quad base maps) where contour lines could easily be used as an aid in map development. Some vegetation breaks were precisely recorded at points on the section line by GLO surveyors. Most vegetation boundaries were not delineated on plats for the interiors of sections, so we had to extended polygon boundaries beyond known points on section lines by using landscape information and professional judgment. Topography and modern soil surveys were the most important supplemental information used for this purpose.

At times the data were too variable or coarse to delineate pure (single) vegetation types. When plant communities were un-mapable, we combined vegetation types into groups or "complexes" of vegetation types to create map units or polygons. In all cases, we recognize that small inclusions of other units, named or un-named, are were probably present historically.

The mylar overlays with the vegetation polygons were then digitized and merged to create a single GIS map data file. Review and editing of the mylars was needed prior to digitizing, to check edge matching between maps and to assure accuracy of the map unit labels. The GIS dataset included abbreviated descriptions of map units attributes, and a separate Word document contained detailed descriptions of the vegetation map units.

Transcription of GLO Survey Notes

Overview

Our GLO information was transcribed into two types of Microsoft Access tables, one called a **Township Table** and the other called a **Line Table**, using a standardized format and procedure developed in 1994 by the Oregon Biodiversity Information Center (Christy et al. 2002). This study procedure involved transcribing the original handwritten diaries from a set of micro fische film using a viewer with magnification, at the desk beside the computer station. Surveyor notes were usually transcribed verbatim, sometimes with added editorial comments in square brackets [ ]. These bracketed notes were used to add clarity, an explanation, or supplemental notes as needed, or to speculate on wording where the handwritten text was illegible. Some original survey data was omitted from the transcriptions, such as equipment calibration notes, meanders, random line surveys, and voluminous unimportant repetitive topographic notes. However, all vegetation data, stream data, soil/geology notes, cultural resource information, and most topographic data were included.

Township Table

A single or master Township Table was produced for the project, listing general township information for all townships in which data was collected. It is primarily background data recording the surveyors' names, the portion of each township that they surveyed (perimeter or subdivisions), the date of each survey, the General Description for each township, and occasionally brief exterior boundary descriptions. Townships were identified by their number, according to Township and Range (e.g., 36S-05W). See Appendix (Section I) for examples of the contents of this table.

Line Table

A set of Line Tables was produced for the project, since the transcribed data is displayed on separate Line Tables for each township. Line Tables contain GLO survey data transcribed from the field diaries, with editorial notes, for each township, and most were about 15-45 pages in length. Formatting for the database was different from that found in the original GLO notes, so that the information can be sorted, viewed in columns, or queried if desired. Transcription of the survey data into the database proceeded in the order in which it was surveyed, from one section corner to the next along the section line, covering one mile segments or 80 chains.

Each section line was identified by a number derived from the adjoining sections (e.g. 11-12, 35-36, 01-06). Direction of the survey along the line is critical to relating data to the correct landscape features, and this is identified in a data field as N, S, E or W. All features described along the line or intercepted by the line were coded and identified with their distance, in chains, from the starting point of that line. Each record in the table was coded to characterize the data, i.e. topography, vegetation, cultural, corner, etc. for easy review, sorting and queries. Any trees intercepted on the line were entered in the species field, along with its diameter.

Section corners and quarter corners are entered in the intercept field, and their witness trees were entered in the species column along with diameter (inches), azimuth or direction to the tree, and distance from the corner in links (7.92 inches/link). The lines were usually one mile or 80 chains long. However, any adjustments needed in distance measurements for the township were only made in the western and northern rows of sections (see Fig. 5). These sections were often longer or shorter than one mile in order to close the survey at the established township perimeter boundary. At the end of the mile a general (verbatim) vegetative and landscape description for the line was transcribed with the original spelling. There was a great deal of variation in the amount of detail provided in the line tables, depending on the surveyors. Some surveyor notes were quite detailed, while others were very brief, almost inadequate for analysis.

A complete Line Table contains data for section lines along the north and east exterior boundaries of the township, and all the interior section lines for the township, even if surveyed under different contracts at different dates. South and west boundary data are always found with the adjacent Line Tables as either their north or east boundary. The year showing when each mile was surveyed is derived from the Township Table, which also indicates the deputy surveyor responsible for the survey. Due to the volume of material, the transcribed data is not included in this report, but examples of Line Tables are included in the Appendix (Section II).

Classification and Mapping of Historical Vegetation

Overview

Mapping of historical vegetation required the use of several sources of information. Most important was our completion of the vegetation classification from raw GLO survey data followed by the development of vegetation type (map unit) descriptions. Mapping also involved the use of all landscape or topographic features that were consistently related to the vegetation, and these were all used for delineating vegetation polygons. The product was developed on clear Mylar overlays, using 1:24,000 USGS topographic maps as a base. The overlays were then digitized and merged to create a GIS layer of the study area.

Fine-Scale Map Units (Vegetation Subclasses)

Delineation of vegetation polygons began with identification of fine-scale map units ("subclasses") based on discrete vegetation types described from the surveyors data. Creating and delineating polygons of similar plant cover was sometimes difficult because the GLO data was coarse, incomplete and sometimes inaccurate. Mapping is much like trying to put a puzzle together with missing pieces, and trying to extend the lines between the pieces to create an approximate image of what may have existed at the time of survey. Therefore, the GLO historical vegetation map is our attempt to interpret the main picture from the limited dataset, but lacking some of the finer details.

Classifying GLO data as described above is simply a process of identifying all significantly different vegetation groups that have enough acreage to justify their delineation as vegetation map units. Completed Line Tables were essential for the review, analysis and classification of GLO data into vegetation types or plant communities. It can be difficult at times to compose unique substantive descriptions from the broad characterizations surveyors provided for each section line. The survey notes were usually inadequate to identify the subtle detail and variety of vegetation, often present within local landscapes. After similar fine-scale vegetation data was grouped together to represent a subclass, a Type description was created, based on both dominance and the presence or absence of species. Witness trees can be helpful for developing the species list but do not necessarily indicate dominance in the stand. Our descriptions sometimes included geographic, topographic and climatic parameters which were not part of the original dataset, but were inferred from modern environmental data. This was done when enough area had been mapped to make inferences about the landscape setting including soils, geographical distribution, and associations with other subclasses. Although this procedure was subjective, our professional judgment was based on lengthy field experience in SW Oregon.

Coarse-scale Map Units (Vegetation Classes)

Once fine-scale map units were identified and described as subclasses, these were aggregated into coarse scale-scale map units called "Classes," based on general stand structure. Vegetation classes provide a way to summarize stand characteristics, and to display broad distributions of these vegetation groups. As an overview of a large landscape, classes may have future use for comparing changes in tree cover, over time, between early settlement and the present.

One component of plant community structure is "stand density," an important attribute of historic vegetation which can be identified in GLO data (Christy et al. 2014). Stand density is determined from both the line description and from witness tree distances at the corners. As the fine scale subclasses were identified and described, each was assigned to a Vegetation Class, based primarily on criteria described as follows:

Prairie. Line descriptions describing prairie included terms such as "prairie," "rich grass," "grass plenty," "covered with grass," "good grazing," "good bunchgrass," "meadow," "creek meadow," or "open plains." Grass species were rarely identified in GLO records, but woody species were sometimes noted. Corners were usually treeless, sometimes with descriptors added such as "no trees in a convenient distance" or "no tree near" or "dug trench and raised mounds as per instructions." However, in a region like western Oregon where environmental conditions so strongly favor trees, it was unusual to find large prairies without occasional clumps or groves of trees and shrubs. Historically, landscape burning by Indians probably reduced the occurrence of trees in these settings from what they may have supported without fire. If witness trees were present, distances of 2 to 8 chains (200-800 links, or 132 -528 feet), or even further were typical.

Shrubland. A stand that was primarily described as shrubs with few or no trees, and with few or very widely spaced witness trees, represents the "shrubland" vegetation class. These stands are sometimes described as "brush," "brush fields," "thickets," "thick growth," or "chaparral." Very young tree regeneration reported within thickets or dense brush was classified as shrubland. When any larger trees were present, such as witness trees, spacing was similar to that of savanna.

Savanna. The most open tree stands were classed as savanna. Distances of witness trees from section and quarter corners typically ranged from about 2 to 4 chains (200-400 links, or 132-265 feet). However, occasional trees were recorded at only half that distance. Line descriptions that described stands as "Openings" have long been thought to represent savanna. Understory was not always described but may have been given as "open," "good grazing," "good for stock," or "grass in abundance." Open stands that met tree density standards for savanna, but were brushy or had dense chaparral-like understories were difficult to classify if savanna was not justified, and generally were called shrubland.

Woodland. The woodland class was referred to in a variety of ways in line descriptions, namely "open," "scattering," "scattering timber," "thinly timbered," "sparsely timbered," or just "timber" as in the forest class. Witness trees were generally located 1-2 chains (100- 200 links, or 66-132 feet) from section or quarter corners, with an occasional tree up to twice that distance. Understory varied from dense brushy to sparse or was undescribed. It was often difficult to classify some stands as either forest or woodland because of excessive variation in the dataset. This was especially true in the mixed conifer-mixed hardwood stands of dryer locations. When in doubt, the Woodland Class was generally selected.

Forest. The greatest stand density was classified as forest, where the composition was dominated by either conifers or hardwoods. Witness trees generally averaged less than 1 chain (100 links, or 66 feet) from corners and quarter corners. Also, the wording used in a line description, such as "timber," timber thick," "heavy" or "dense," suggested a forest class. Understory was irrelevant to class definition here, but ranged from dense or brushy to sparse, or it may not have been described in the dataset. Both upland and riparian/wetland forest classes were recognized.

RESULTS

GLO Surveys in the Tiller project area

Transcription of the GLO survey notes and the GIS dataset have been provided to Douglas County. Samples of GLO transcriptions, GLO plat maps, historical plant names, and detailed descriptions of historical vegetation types are given in the Appendix. Additional GLO-related datasets and other information area available at http://www.pdx.edu/pnwlamp/glo-historical-mapping-oregon.

GLO Surveyors

The original GLO surveys in the Tiller study area were completed by eight Deputy Surveyors (Table 1). The earliest surveys were conducted during the mid 1850's under the direction of Deputy Surveyor Dennis Hathorn, except for the brief appearance on a township boundary by Nathaniel Ford (1855). In 1881, Surveyor W. H. Byars made a short Township boundary survey, but GLO surveys of the rest of this project area did not begin until the following decade. Over the next four decades, five Deputies continued the work on un-surveyed areas, namely William M. Bushey, Homer D. Angell, Charles L. Campbell, Fred Mensch, and Elmer F. Stickler. Of these, Mensch was given by far the most locations and acreage to survey. Figure 6 shows what may have been a typical land survey camp in southwest Oregon in 1887.

Table 1. Deputy Surveyors for Tiller GLO Study Area

Deputy Surveyors	**Survey Years**
Nathaniel Ford	1855
Dennis Hathorn	1857
W. H. Byars	1881
William M. Bushey	1893 – 1894
Homer D Angell	1902
Charles L Campbell	1902
Elmer F. Stickler	1917
Fred Mensch	1905 -1923

GLO Survey Progress

The time period for GLO surveys of the Tiller Project area, was much longer than for the more accessible and developed regions such as the Rogue Valley, Willamette Valley and central Douglas County. Here work extended almost seventy years before completion. The highest priority for early surveys was area around settlements, mining districts, and ranching/agricultural development. These were surveyed in the 1850's, enabling settlers to initiate legal claims for property. Remote areas, difficult topography and low value landscapes, all avoided during the first decade of surveys, were eventually completed under new contracts as these lands were given higher priority.

Figure 6. Survey team: an engineer's camp in the Siskiyou Mountains, 1887. (Source: Southern Oregon Historical Society, #1171)

Table 2. GLO SURVEY PROGRESS BASED ON ACREAGE COMPLETED (127,430 acres)

1850's	1860-1889	1890's	1900-1909	1910'sS	1920's
39%	0	18%	21%	12%	10%
50,013 ac	0	23,218 ac	27,170 ac	14,795 ac	12,234 ac

Unfortunately, the time period for some of the dataset extended well beyond the initial settlement period during which we had hoped to document historical vegetation. It is not known if any of these scattered, remote or less accessible pieces had recent disturbance (i.e. fire, logging) related to early settlement activities, or a change in fire regime, by the time they were actually surveyed. Regardless of GLO contract date, all surveys were transcribed, merged into the dataset, and included for historic vegetation map preparation. Because later surveys were always in remote, or difficult areas to develop or utilize, there is less likelihood of large, major land treatment impacts and changes that could greatly alter the character of the landscape.

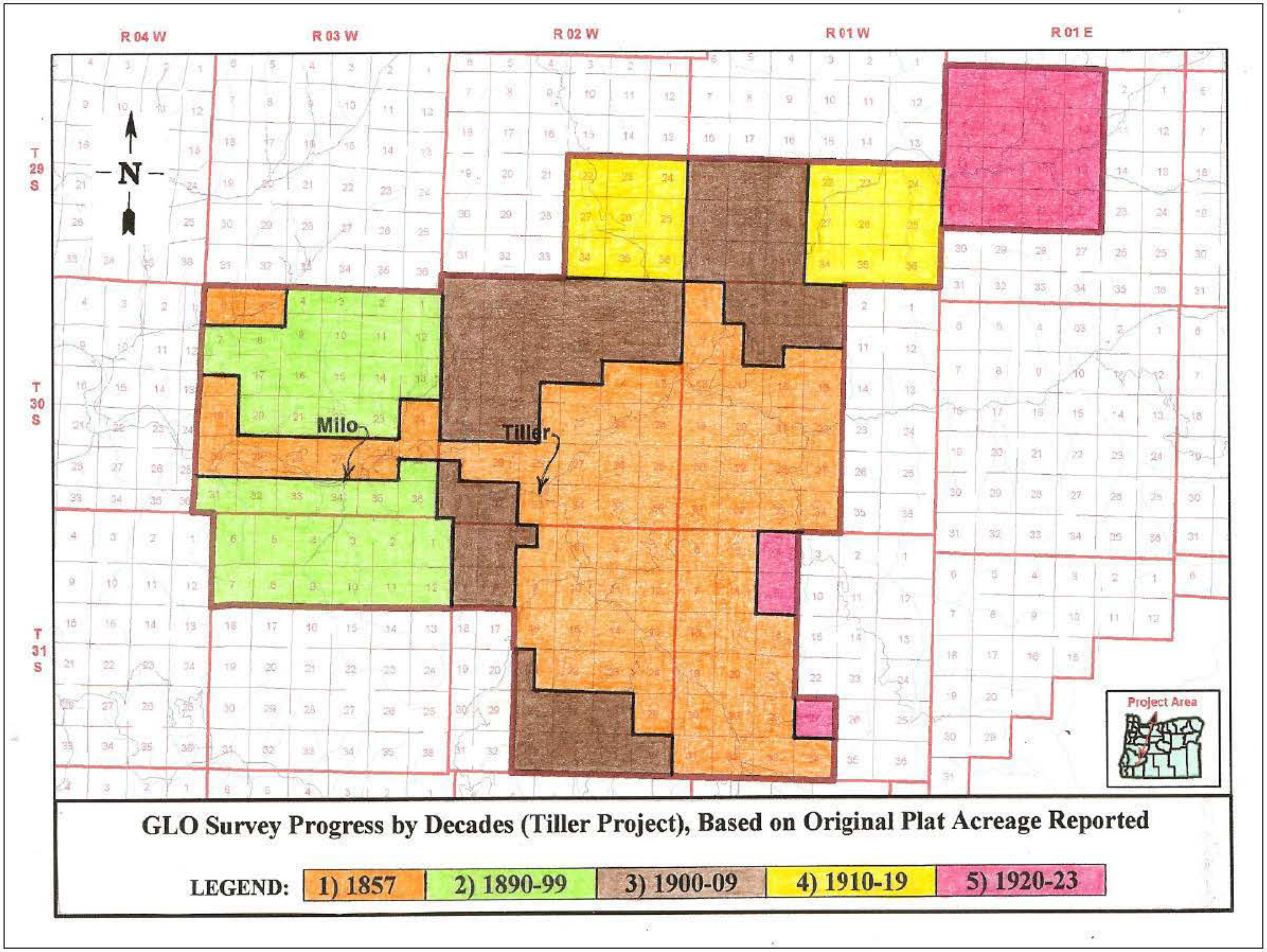


Figure 7. GLO survey progress in Tiller study area.

Soil Classes and Soil Features Reported by GLO Surveyors

GLO records were no doubt the first soil assessment and survey of the nation. All townships in the project area, regardless of surveyor, contained comments about the geology, topography, surface rocks and/or soil types encountered. This information cannot be queried in the data base but can be read in the line descriptions provided throughout the transcribed datasets.

Both township and section line descriptions refer to soil classes designated as 1st rate, 2nd rate, 3rd rate or 4th rate. These were used to describe soil suitability for agriculture. No published guidelines or GLO instructions have been found that define these classes (Frederick 2007). In this study it was obvious that a 1st rate soil was always applied to outstanding valley prairies and level bottoms with the best soils for crops and gardens. For example, GLO soils data for T29S, R1E, line 8-9 was described as "soil in flat: vegetable loam, 1st rate." The 2nd rate soils were merely the next best of everything else in the valleys. Both 3rd and 4th rate classes were used in the hills and mountains, presumably to describe rocky colluvium on steeper slopes. Some surveyors seemed to use one class almost exclusively over the other. Generally it was hard to see any consistent correlation with the landscape information or logic for the use of these two classes.

Related physiographic data usually provided useful information. Topographic notes included common terms such as steep, rough, surface broken, mountainous, hilly, rolling, bottom, or land level. Geology and common rock types were sometimes given such as scoriaceous rocks, serpentine stone, trap rocks (basalt), "trapean hills" and granite. Soil and rock type were sometimes combined in their descriptions such as "decomposed slate and redshot clay, 3rd rate" and "shaly clay loam."

Cultural Resources Reported by GLO Surveyors

Cultural features, development and other settlement information were often reported by the surveyors, which was transcribed and documented. The Line Table can be queried for cultural information recorded on the line survey, such as man-made features with an entry and exit point (i.e. a field crossed by the survey), and man-made features representing point data (i.e. trail, fence or point of reference to a nearby cabin or barn). Also, these features were usually drawn on the plats that were prepared from survey notes after the field work. General comments about the extent of settlement, mining activities, surveyor opinions as to the worth of the land, and the economic value of settler improvements are examples of information available in the Township Table.

A variety of features were recorded: Indian trails which frequently became early travel routes for settlers; also "wood" roads, local "wagon" roads, stage routes, as well as settler houses (often with the owner's name), barns, fields, fences and settlements. Except for trapping, mining was the earliest industry in SW Oregon, and this was faithfully documented on all the surveys, especially along creeks that were heavily impacted by placer and hydraulic mining. Ditches or traces were noted for transporting water for mining operations, irrigation and operating grist or flouring mills.

As the central valleys were being developed, prairie and savanna were frequently sought after by settlers. Homesteads were usually located to include prairie for livestock pasture and/or for developing farmland. These locations usually had good soil, and were the easiest and quickest to prepare for cultivation when farming was in its infancy and food was in demand by the growing population (Bowen 1978; Boag 1992; Christy and Alverson 2011).

Plant species recorded by GLO surveyors

Vegetation notes were a mandatory component of GLO surveys. A standard format for recording plant information helped keep the field records uniform, especially when many different surveyors were doing field work. However, the plant records of some surveyors were extremely brief. For example, a section line reads "dense fir with all kinds of undergrowth," giving only the overstory but no names for the understory species present. Frequently, only general terms were used for vegetation such as "brush," "grass" or "chaparral," and it was common for some surveyors to greatly shorten the amount of plant data by ending their list with: "and etc." or "and etc, etc, etc." Occasionally, they would finish a line with the comment "same as last mile," to avoid preparing a new list. Surveyors were not required to list herbaceous species, so these were poorly documented in the GLO record.

Deputy surveyors had three obvious problems in describing landscapes and recording plant data. At the beginning of GLO work in Oregon, the surveyors were new arrivals from the East and unfamiliar with the western flora. Second, early surveyors were usually engineers or land surveyors who probably had little training in botany, soils or geology. Third, the shrubs or trees they were familiar with in the East, sometimes resembled western species which resulted in naming errors. The inevitable use of incorrect names from other regions, plus the use of archaic vegetation jargon from 150 years ago has made it challenging to interpret all of the plant data and identify the correct modern plant names for some GLO species.

The native plants list generated from the GLO data for this project area, 54 plant names or plant groups, is extremely short compared to what would be identified in a modern landscape inventory (Table 3). Line Tables can be queried for the field locations where plant names were intercepted on the section line survey, and for those recorded in the section line descriptions (Christy et al. 2002).

Table 3. Native Plant List and Name Variations Used in SW Oregon GLO Surveys (Tiller GLO Project, SE Douglas County)

TREES

- alder
- ash
- balm, balm gilead, balm of gilead
- black oak
- cedar, ceder
- chinquapin, chincapin, chinkapin, chinkopin, chincopin
- dogwood
- fir
- hemlock
- laurel, laurrel, laurell
- live oak, live-oak, liveoak
- madrone, madrona, matherone
- maple
- oak
- pine
- red fir
- spruce (misidentified?)
- sugar pine
- tamarack (misidentified?)
- white fir
- white oak
- yellow pine
- yew, Pacific yew

SHRUBS

- arrowwood, arrow-wood, Indian arrowwood, arrowood
- balm (shrub form)
- blackberry
- briars
- cherry, wild cherry
- chincapin, chinquapin, chinkapin, chicapin, chincopin, chinkopin
- currant, wild currant
- elkbrush, elk-brush
- grape, wild grape, grape vine
- greasewood, greecewood
- hazle, hazel
- huckleberry
- laurel, laurrel, laurle, lauarel
- lilac, wild lilac, lilack, lilach
- manzanita, mancenita, mancinita, manzinita, mansanita
- mountain balm
- Oregongrape, grape, Oregon grape
- poisonoak, poison oak
- rhododendron
- salal, sallal, sallalberry
- serviceberry, service, sarvice
- snowbrush, snow brush
- spruce
- thimbleberry
- thorn brush
- vine maple, vine-maple, vinemaple
- willow (shrub form)
- witch hazel

OTHER

- grass
- fern
- high fern

Because of the questionable identities of archaic plant names, a crosswalk of modern names and scientific names was developed for use with our legends and map products (Table 3 and Appendix, Section IV).

Extensive experience in describing and mapping GLO vegetation in Oregon has enabled us to correlate most of the historic plant names to local species or the most likely species. Many local or regional references were used to search for some unfamiliar archaic plant names, often with only limited success (e.g, Sweetser and Kent 1908; Yocum and Brown 1971; Atwood 1995; Hickman and Johnson 1992). Some name choices could not be finalized until the location of occurrence for the questionable species was determined, to assure compatibility with the environmental setting. At times, the actual surveyor reporting the data had to be determined, or even the decade of the survey. Different surveyors often reported data using different terminology. And in more recent surveys, common names in use were sometimes different than names used for the same species in the earliest surveys transcribed.

A number of unknown common names, or names most likely borrowed from other regions, are difficult to associate with local species. A plant name correlation list for GLO work in Christy and Alverson (2011) was reviewed, but it did not include many of the unusual names encountered in SW Oregon. In the past, our species list has been distributed to botanists and others, to help identify candidate species for those without an identity. This was invaluable for resolving some name questions and greatly improved the plant name correlation table.

Vegetation Classes

Vegetation classes were mapped (Figure 8) and acreage is given in Table 4.

Table 4. Vegetation Class Acreage and Number of Subclasses

Upland Forest	-	12 subclasses	(98,779 acres)	77.0%
Woodland	-	6 subclasses	(2,559 acres)	2.0%
Prairie	-	2 subclasses	(2,860 acres)	2.2%
Riparian Forest	-	3 subclasses	(1,312 acres)	1.0%
Savanna	-	5 subclasses	(21,238 acres)	16.6%
Shrubland	-	4 subclasses	(893 acres)	0.7%
		(vegetation subclasses = 33)		
Other (water, gravel, unk.)	-	6 subclasses	(573 acres)	0.5%
Total	=	38 subclasses	128,214 acres	100%

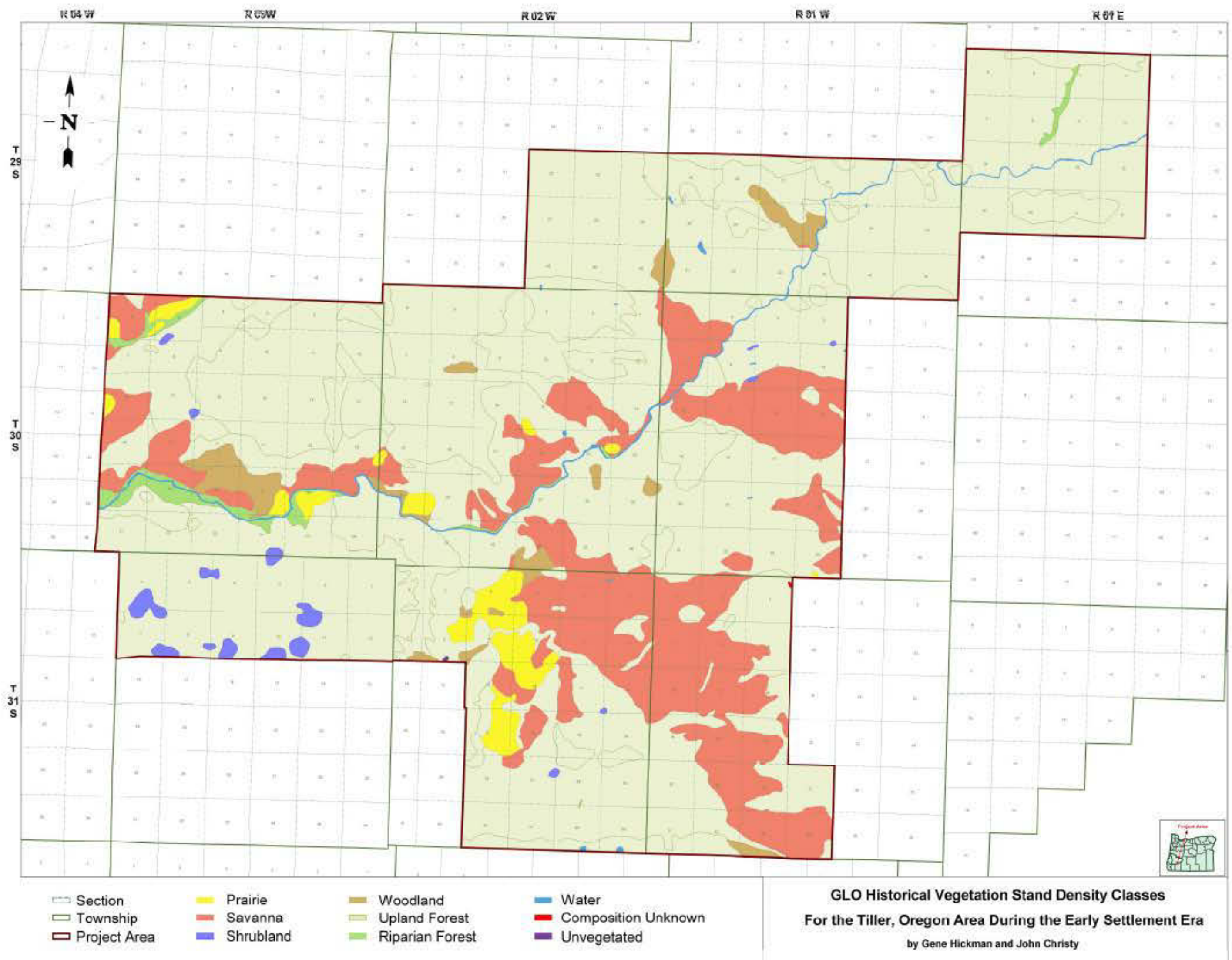


Figure 8. Stand density classes, Tiller GLO study area.

Prairie

Prairie comprised 2,860 acres or about 2.2% of the study area and contained two subclasses (Figures 8, 9, and 12; Tables 4 and 5). Because prairies were noted by surveyors without naming herbaceous species, we can only describe them without plant composition data, being defined by the absence of most woody species, and by a few GLO descriptors. Without detailed information on vegetation, our prairie classification relied on landscape position and soils, relatively stable physiographic features that would have existed historically.

Because of contrasting microsite differences, there is a high probability of large differences in the historic plant species and herbage production between upland and bottomland prairies. The Douglas soil survey (Johnson 2004) was compared with GLO prairie mapping to look for areas of correlation between these features.

Upland prairie. Upland prairie (PU) comprised about 91% of prairie vegetation mapped in the Tiller GLO project area. It occurred almost exclusively on droughty soils on southerly to eastern slopes, at low or middle elevations in the warmest western half of the study area. A few occurrences were on serpentine soils. Three examples remaining today are found near the top of Bland Mountain NW of Milo, the upper south slope of O'Neil Butte, NE of Milo, and Callahan Meadows just south of Tiller.

Historical upland prairies here were found on a variety of soil map units, seemingly best suited for natural prairie, but some capable of woodland or forest development. This means that periodic burning probably maintained prairie on soils marginal for timber, especially for the set of upland prairies found north of the South Umpqua River.

The large GLO prairies mapped just south of Tiller at Callahan Meadows and on the ridge called "The Drew" are generally southerly or east facing, and are situated on serpentine geology according to soil maps. Soils in southern Oregon derived from serpentine soils, particularly further south in the region, have distinct impacts on local flora and productivity because of their unique chemistry. Although we have no GLO plant data to indicate vegetation composition, we can assume these were mostly natural meadows because of soil restrictions on other vegetation, and generally not artifacts of fire. It follows that the upland prairies north of the river (PU) are probably not comparable to those located on serpentine geology.

Bottomland prairie. Bottomland prairie (PF) comprised about 9% of the prairie vegetation in the Tiller GLO project area. It occurred in a few locations in the major valleys, but probably on a variety of soils. In the Rogue Valley it was identified as "creek prairie, marshy swale, glades, springy swale," etc., but in the Tiller area it was only referred to as "prairie." It is associated with bottoms and low terraces, often on floodplains, and sometimes with seasonally high water tables. Soil survey map units did not correlate directly with GLO prairies except in general. Several valley floor soils are apparently present from well drained to poorly drained, and from sandy or ashy to loams, silt loams or clay loams, or sometimes gravelly, depending on location. Soil features certainly would have favored prairie, at some locations. However, we suspect that natural prairies here were expanded and maintained by burning on adjacent soils that were potentially savanna and woodland (mixed hardwood or hardwood/conifers).

Across western Oregon, where ecological pressure is so great for open landscapes to shift toward woody vegetation, some explanation is needed as to why some areas still exist as open grassland. Generally this relates to either microsite restrictions favoring prairie or site disturbance. Several environmental factors may be responsible for the maintenance of prairie at some locations, such as a dry climate in combination with south slopes, shallow soils, low water-holding capacity, and dense clayey soils. Also, wet or seasonally wet soils, and/or serpentine geology can influence vegetation. In some cases, wildfire or periodic burning by Native Americans may have been responsible, particularly in food gathering areas and at the margin of natural prairies where the transition would fluctuate with burning cycles. In the Pacific Northwest, it has been established from early settler and explorer accounts that there was frequent low intensity burning on most prairie and oak woodlands (Agee 1993; Boyd 1999).

Because certain combinations of soil features and other site factors favor prairie vegetation at some local areas, there is an ecological threshold or barrier that restricts the development of oak savanna or woodland/forest over time. Historical prairie acreage has no doubt been shrinking in this study area since settlement began, but this limitation defines the ultimate base line for natural prairie occurrence in today's landscape. On the other hand, the use of management treatments including prescribed burning on prairie margins and on suitable tree habitats would result in the expansion of transitional natural prairie acreage. In central Douglas County, many areas of hardwood/conifer ecosystems have been converted to non-native grassland seedings by ranchers for improved pastures.

Because of the lack of GLO data for the interiors of sections, prairie was probably under-reported in the study area. Prairies are often small and some along section lines may have been disregarded at times by surveyors.

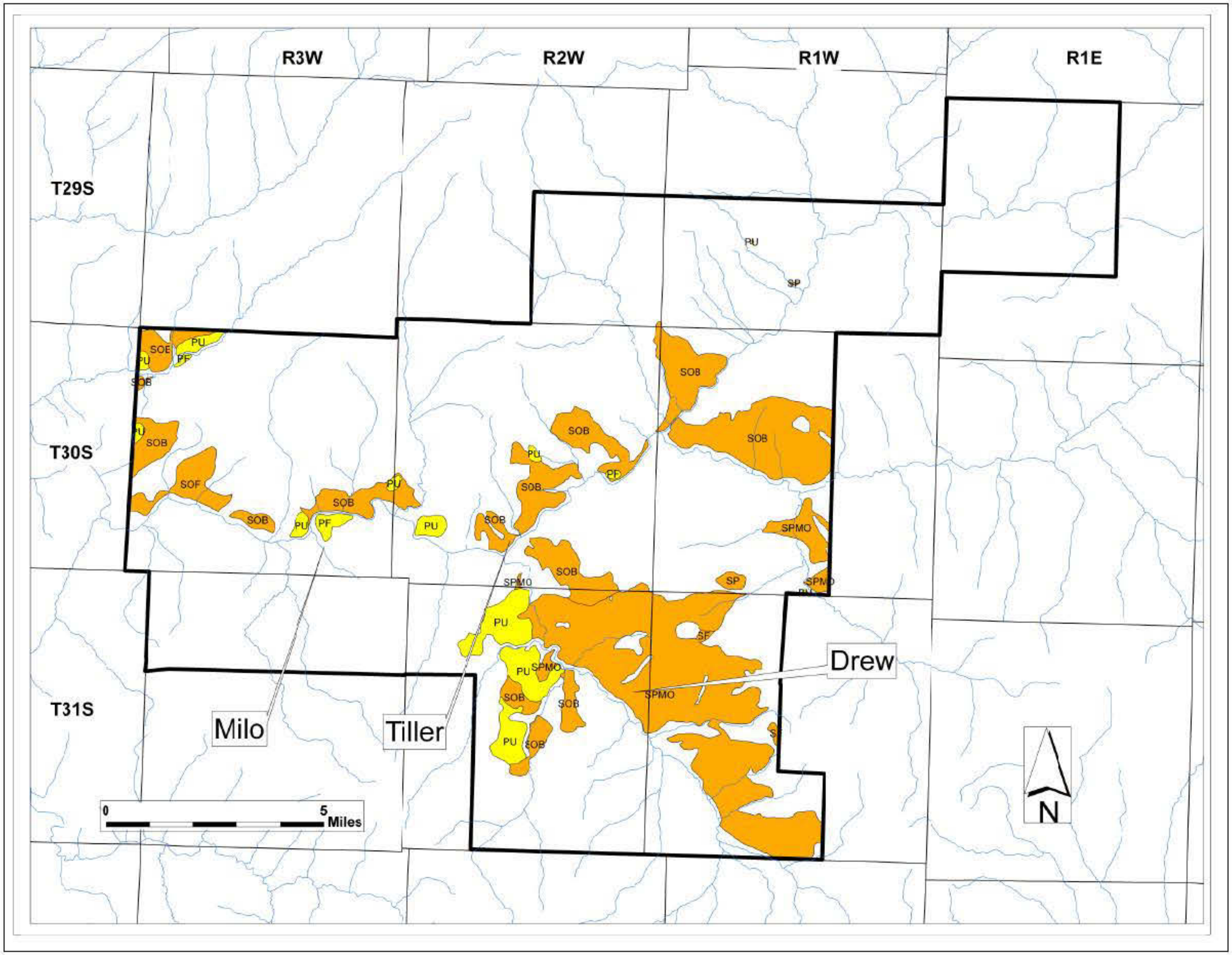


Figure 9. Prairie and savanna map units, Tiller GLO study area.

Shrubland

Shrubland was a minor vegetation class that comprised only 893 acres or about 0.7% of the study area, containing four subclasses (Figures 8 and 12; Tables 4 and 5). All examples were small polygons clustered in a few areas primarily in the west side of the study, and none were well described by GLO surveyors. The largest shrubland map unit was identified only as "brush" or "thicket" (HU), lacking any information on species composition. This type comprised 95.3 % of the shrubland mapped in the area. These are likely to represent disturbance types in recovery, and should be related ecologically to the adjacent forest communities by which they are surrounded. A small area was identified as "hazel brush" or "hazel thicket" (HZ), comprising 2.3 % of mapped shrubland. Small delineations of willow swamp or thicket (HW) were delineated NE of the mouth of Jackson Creek, comprising 1.4% of mapped shrubland.

A single occurrence of greasewood brush (HN), very uncommon locally, was found south of Drew. This type, comprising 1% of mapped shrubland, occurred on a south facing ridgetop referencing "greasewood bushes." We assume this was a droughty and possibly shallow stony location. In western Oregon, greasewood is generally considered to be a chaparral species or common buckbrush, which is very common in the warm dry portions of Jackson and Josephine Counties.

Most upland shrub communities recorded in the study area were temporary cover types created after stand replacement fires events, probably not after under burning. Many of these sites, especially those in more moist environments, are seral stages of woodland or forest, expected to recover over time and convert to a characteristic tree cover type. The role of fire in the development and maintenance of these shrublands is discussed in more detail later in this report in the section titled "Fire Disturbance and Historic Burn Mapping."

The small acreage of shrubland reported for the project is surprising, given the disturbance history for Southwest Oregon landscapes. No large brushfields in the early stages of recovery were recorded by GLO. However, a number of factors probably were responsible for the small acreage of shrubland. Brushfields and thickets were usually small inclusions or openings within large areas of forest and woodland, and may have been ignored by surveyors, or just averaged into the prevailing vegetation composition data. Because only section lines were documented, many small areas of shrubland were probably missed in the survey because they were located in the interiors of sections.

In the southwestern Oregon, GLO surveyors recorded a variety of shrublands as thickets, brush fields, creek brush, brushy bottoms, chaparral, stands of thick scrub tree cover, and dense woody undergrowth. This assortment of ecologically diverse shrub communities was usually distributed at mostly small scattered locations that are correlated with specific climatic zones. "Dense undergrowth" was also a common GLO term for woody or shrubby ground cover and thickets, even without a canopy. However, it is mostly reported with significant forest and woodland overstories, and if so, was not reported in the shrubland class dataset.

The GLO data set also includes a very large number of tree stands characterized by heavy to dense woody undergrowth of various species. These were not identified here as shrubland because they also had tree canopies, unless it was clear that these trees were incidental or minor components. Consequently, brushy, woody thickets and dense undergrowth reported by surveyors that were associated with significant tree overstories, would have been classified as forest or woodland vegetation classes.

Savanna

Savanna comprised 21,238 acres, or about 16.6% of the study area, and contained five subclasses (Figures 8, 9, and 12; Tables 4 and 5).

Savanna may have prominent oak, white and/or black oak, often mixed with madrone, and may have pine and/or Douglasfir. It occurrs in the lower to mid elevation center and west side of the study area. Two possibly dryer subclassses with a strong prominence of oak (SOB, SOF) covered 49.2% of mapped savanna. Douglasfir savanna (SF) occurred at one site near the southeast edge of the study, and represented 0.5% of mapped savanna. Ponderosa pine savanna (SP, SPMO), usually with hardwoods, was prominent in the south center of the study area, and comprised about 50.3% of mapped savanna. Although SPMO is similar to SOB, the former has more pine in many locations.

It is interesting that nearly all of the savanna types, except small examples south of Tiller on "The Drew" ridge near the serpentine area, occurred on warm southern slopes above drainages. These are all adjacent to or representative of the mixed oak and dry conifer types in the project area. None were mapped within the moist, cooler Douglasfir-hemlock areas, especially the NE corner of the project so dominated by the mixed conifer Douglasfir-hemlock-cedar-pine vegetation type (FFHE) .

Most savanna reported here was a probably a transitional cover type, maintained over long periods by ground fires, as a seral state of woodland or forest. They are very open tree stands by definition, but for some reason in the Tiller GLO project, have closely spaced witness trees at many of the corners which has yet to be explained. Savanna can be temporarily created in these environments as the result of major site disturbance. Our small SF map unit probably represents this situation where the adjacent forest (FFC) was converted temporarily to a savanna type by a stand replacement wildfire.

The mixed oak-conifer savanna type (SOB) is mostly found on warm lower southern slopes near the river and up Jackson Creek. It may have some soil related feature correlated with its location as well, or a climatic difference with that of where the more pine dominant SPMO is located.

Savanna types SPMO, SOF and possibly SP are believed to have site potential for forest or woodland. Historically, they were maintained by periodic underburning, and have largely disappeared from today's landscape. Each of the GLO line descriptions from the area shown in Figure 10 described pine and oak openings, oak and pine openings, pine openings, or openings, some grassy or with good grass. GLO use of the word openings is believed to refer to "savanna" in all Oregon surveys, as well as in other parts of the country (Christy and Alverson 2011). The line descriptions also noted when surveyors entered fir timber (FFC). Even without returning to the field to examine these locations, aerial photography indicates that the SPMO savanna type has restocked in unmanaged areas and converted to mixed conifer-hardwood forest over the last 150 years.

An interesting connection can be seen in Figure 11, between the progress of GLO surveys in the study area and the distribution of vegetation classes at the time of the surveys. Note the correlation between the earliest survey period and the location of savanna (orange) and prairie (yellow). Obviously, the 1857 survey period focused only on the area most important to the early ranchers and farmers, and helps support the historical evidence of the abundance of large open grazing areas.

It is assumed that the historical acreage of savanna would have been considerably less than reported here, if it were not for periodic burning by the Native Americans. The biggest site potential for development of savanna in this study area, was on the warm southerly low elevations, supporting fir, pine and mixed oak woodland/forest. This would have required frequent ground fires and possibly more severe burning to suppress hardwood/conifer tree density, in a region where the ecological pressure is great for landscapes to develop and maintain dense woody vegetation.

Even though savanna was a large acreage class, savanna may have been under reported. On the other hand, within the large delineations of savanna, it is certain that the survey did not report inclusions of woodland or forest inside the interiors of the sections. Some small savanna types were likely to have been ignored by surveyors as they tended to generalize their line data descriptions and record the more common features. Savanna would have been unreported when located within the interiors of sections.

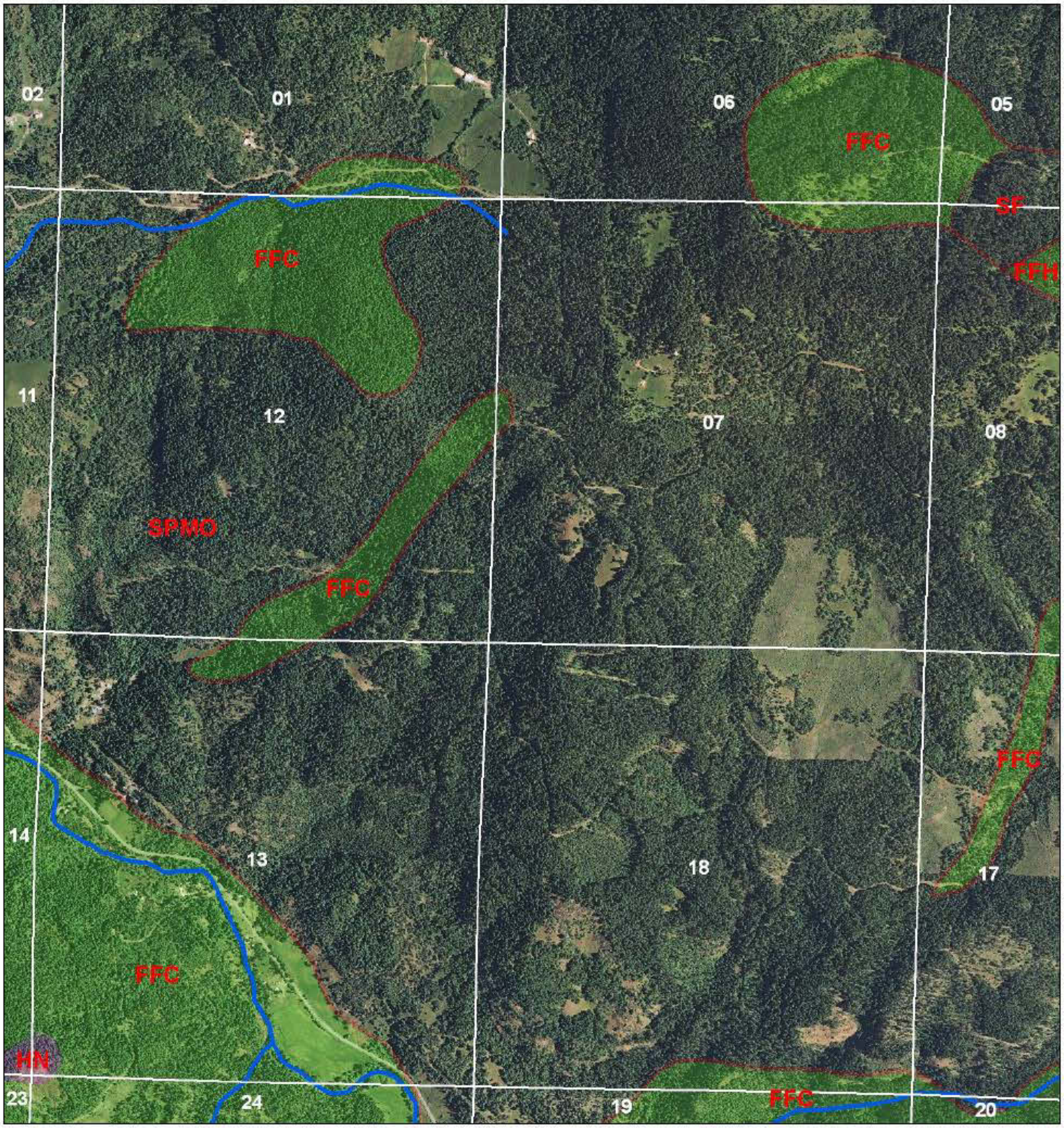


Figure 10. Conversion of extensive historical savanna (SPMO) to forest, vicinity of Drew, Elk Creek drainage. Historical forest shown in light green (FFC). Source imagery: NAIP 2011.

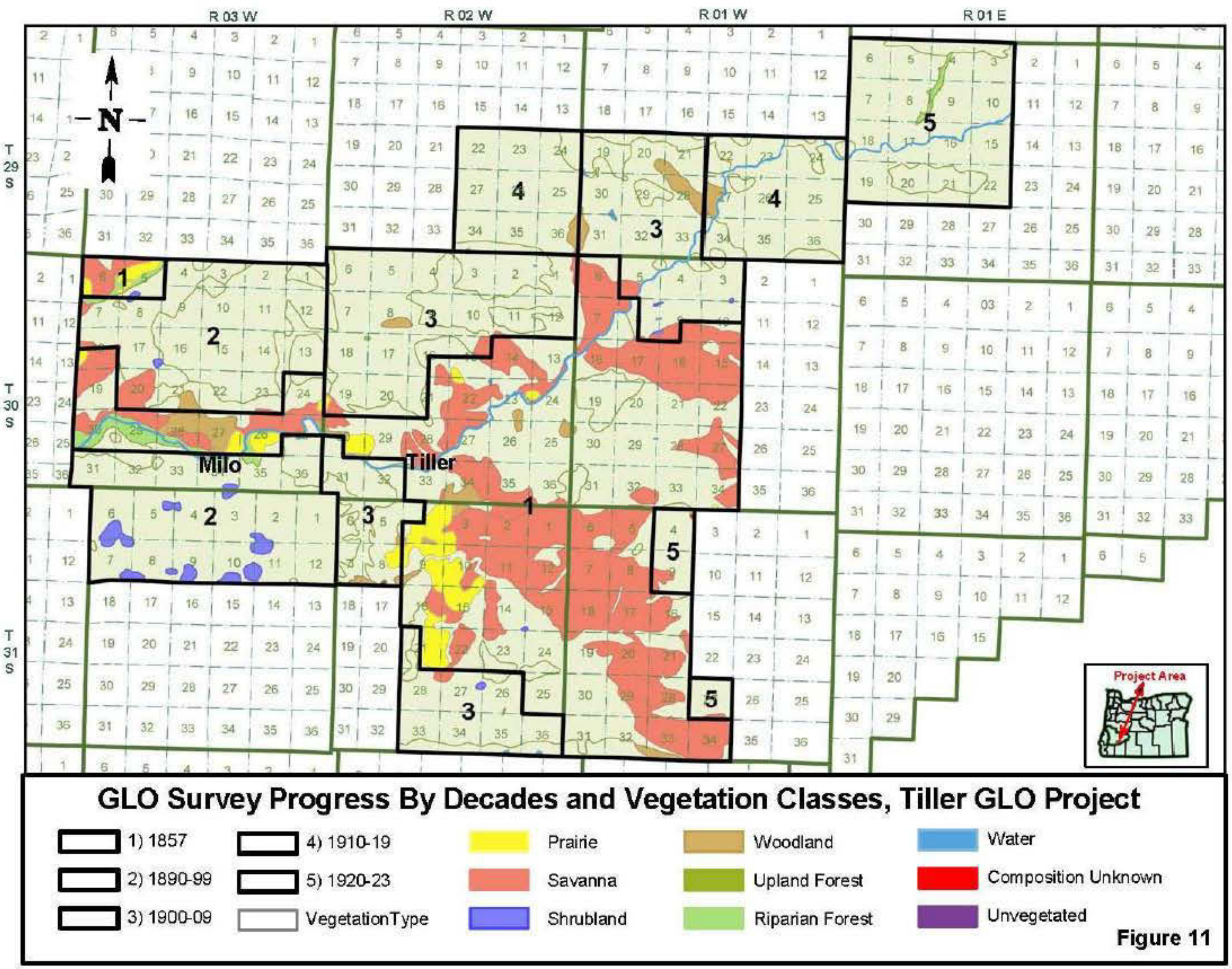


Figure 11. Correlation of historical prairie and savanna with earliest GLO surveys, Tiller study area.

Woodland

Woodland comprised 2,559 acres or about 2% of the study area, and contained 6 subclasses (Figures 8 and 12; Tables 4 and 5). Woodland types were scattered across the foothills and lower elevation mountains of the center and west side of the project area.

Ecologically, woodland composition varied greatly across the project area because it was a structural class based on tree spacing. With only 2% of the area described as woodland, it is unclear why woodland was not more prominent historically. Probably some was already converted to savanna by periodic burning.

Three of the types represent more moist and cooler environments and include about 36% of the woodland class acreage. In this setting we believe the woodland GLO types are seral disturbance states of adjacent forest communities. Except on unusual soil inclusions, we would expect some similarity in floristics between adjacent woodland and forest classes of these more favorable climatic areas. Here oak, if encountered historically, was most likely to be black oak. Over time, these woodland types without management or fire, would have increased in stand density and converted into the forest density class. Map unit codes: OFC, OFH, OPFOC.

Three other woodland types represent much warmer and dryer ecosystems and include about 64% of the woodland class acreage. The set of dryer, warmer types described as oak and/or pine communities, sometimes with fir, probably include both white and black oak. Without more specific soil information and historic data than was available, it is not clear as to their ecological status. This is key to whether these are transitional to denser forest or whether they will remain more widely spaced as woodland because of site limitations. Map unit codes: OFOM, OOB, OPMO.

Throughout the moist climatic region of SW Oregon, on productive soils without site restrictions, woodlands are usually a seral stage with forest density as the potential. Although woodland may have developed after a dense brush or thicket stage is overtopped by sizable tree regeneration following a single fire, it was more likely the result of very uneven, mixed severity burning; or the result of repeated burning at short intervals. Also, stands recovering from other spotty disturbances like disease, insect and storm damage are sometimes reduced to a woodland structural class. On more restrictive soils influenced by unique geology, some stands were naturally more open and may remain over time with lower tree densities.

Forest

Both upland and riparian forest categories were recognized in the GLO dataset, based on their landscape position, vegetation, and soils.

Upland Forest. Upland forest occupied 98,779 acres or about 77% of the study area, and contained 12 subclasses (Figures 8 and 12; Tables 4 and 5). Four of these subclasses were actually documented as burned stands by GLO, significantly altered by fire but representing the adjacent forest types before burning (Figures 12 and 13).

Eight subclasses (FFH, FFHBu, FFHE, FFHEBu, FFHU, FFHUBu, FFY, FM) were high precipitation, or at least low moisture stress, Douglasfir - hemlock forests found at all elevations in the study area. These very productive and floristically rich environments included cedar and sometimes grand fir or white fir, sugar pine and madrone, with both warm and cold tolerant understory vegetation, depending on location. Oak is not normally mentioned. The moist subclasses comprised 48% of the upland forest class acreage.

Four subclasses (FFC, FFCBu, FFOM, FFON) were low elevation and dryer or higher moisture stress sites than the hemlock communities. Vegetation was mixed conifer-mixed hardwood types dominated by Douglasfir or ponderosa pine, along with cedar, madrone and sometimes maple, chinquapin, or sugar pine. Oak was not normally mentioned, but it is likely that black oak was present in some stands. The warmer, higher moisture stress sites comprised 52% of the upland forest class acreage.

Conifer-mixed hardwood forest, without the impacts of disturbance, could potentially occupy nearly all of the GLO study area, where favorable, non-restrictive soil conditions are present. However, when actual soil properties in place are encountered, site potential is limited to hardwood-conifer woodland/savanna, and prairie/wetland communities in some areas. By adding historical disturbance regimes, landscape cover over most area has been impacted, and sometimes greatly altered from the true climatic potential. For this study, the most obvious examples discernable from the dataset are the brush fields probably generated from wildfire, some woodland stands present on sites where forest cover could occur, and the very large area of savanna, some of which may also have had forest cover without periodic burning.

The distribution of the upland forest density class indicates a favorable climate as it spans the project from the lowest to highest elevations, and from dryer to mesic locations. However, there is evidence that the distribution of actual forest community types is related to climate differences and sometimes aspect, position, or soil restrictions. For example, the moist group of fir-hemlock forest types (above) was distributed geographically in relation to these factors. It is interesting to note that GLO type FFHU which has western hemlock only reported in the understory, occurs in the generally dry warm west end of the project, but primarily on moist northerly aspects and apparently on more mesic topography. The status of hemlock in this map unit is unclear. It is either climatically restricted here, or just represented by an earlier seral stage and will eventually emerge into the canopy as a viable subordinate species.

Types FFH and FFHE are found further east; both contain hemlock in the overstory, but it is nearly always secondary to Douglasfir. FFH is found only in the middle of the project area where there appears to be more deciduous shrubs in the composition. FFHE is found only in the more remote eastern extent of the study where evergreen shrubs are generally more common in the understory. This appears to be the more the moist and colder portion of the project area.

Moist upland forests are characterized by a large list of mesic species in this study area. A number of mesic woody species were recorded in GLO notes that normally were absent or uncommon in dry locations. In the overstory these species included big leaf maple, ash, alder, willow, hemlock, grand fir, white fir, chinquapin, yew, dogwood and cedar (only if western red cedar). Some of the shrubs thought of as moist site indicators included cherry, balm (snowbrush), huckleberry, vine maple, willow, Oregongrape, thimbleberry, salal, elkbrush, manzanita, and rhododendron.

In dryer parts of the study area with an estimated 32 to under 40 inches average annual precipitation, several combinations of mixed conifer and mixed hardwood cover were encountered. Refer to the above list of four dry forest subclasses and the woodland section of this report for these GLO map units. Included tree species, depending on location, are primarily fir (Douglasfir), yellow pine, sugar pine, cedar (probably incense cedar), maple, laurel (madrone), white and black oak, with fir being the most sensitive of these species in xeric forests. From modern investigations in dry climatic zones of SW Oregon, we know that the status of Douglasfir is related to a number of environmental variables such as precipitation, elevation, aspect, moisture stress, and local soil features (texture, depth, stoniness, drainage, water holding capacity, restricting layers, chemistry). Performance and survival of the species is influenced primarily by these site characteristics.

In addition to site characteristics, dominance between Douglasfir and pine or hardwoods may relate to past disturbance history, competition in the stand, and the time elapsed since the last disturbance. We have not analyzed the GLO tree diameter record to develop age classes of the stands, which would add considerable value to understanding these historical records. However, it is our judgment that Douglasfir dominant forests in the dry environment, are either mid or late seral stands. Pine and/or hardwood stands with less Douglasfir presumably are either in mid seral status (fire, etc) or older stands (mid or late seral) adapted to droughty positions and/or soil limiting environments.

Riparian Forest. Riparian forest comprised 1,312 acres or about 1% of the study area, and contained three subclasses (Figures 8 and 12; Tables 4 and 5). These vegetation types were broadly mapped on the wider valley bottoms in this study. Creek or river crossing measurements were generally documented throughout the project, but riparian zone or creek side vegetation was rarely recorded except as a species in the line description.

The largest riparian map unit (FOAM) was a poorly described oak timber bottom with only a few trees listed, i.e. oak maple, alder, madrone, laurel (madrone) and fir (possibly either grand fir or Douglasfir). Certainly willow and possibly cottonwood and ash would have been present but listed by surveyors. As expected on riparian zones and floodplains, a complex of microsites and vegetation types are expected. Oak savanna was also cited but without other plant data. Inclusions of creek meadow would have been natural components since prairie was documented on nearby bottoms. This type comprised nearly 90% of the riparian forest subclass acreage.

Two other GLO types noted include a bottomland “dense thicket” (FAS) that was presumed to be ash with willow and other undocumented species, and a maple swamp (FMA), assumed to be big leaf maple, but possibly vine maple. Together these occupied about 10% of the riparian subclass acreage.

Riparian vegetation was poorly documented in the larger valleys and was certainly under reported as an important feature in the study area. Small stream riparian zone vegetation was not described in the GLO survey notes, although the drainages (crossings) were faithfully located on their section line measurements.

Vegetation Subclasses

Thirty two (32) vegetation types or map units (subclasses) and six other subclasses (non-vegetative such as water, gravel bars, swamp without species information, etc.) were identified for the Tiller GLO project (Figure 12, Table 5). Most map units represent single vegetation types, with un-named inclusions. Others are complexes that contain unmappable single components. Vegetative classes are separated by tree density and witness tree spacing. But, floristics and site characteristics are used for identifying subclasses (types). See Appendix: Section V for definitions of all map unit codes in the table.

Table 5. GLO Map Unit (Subclass) Codes for Vegetation Types with acres and percent of study area (total acreage: 128,214 acres)

M. U. Code	Acres	%	M. U. Code	Acres	%
F (a). Forest (Uplands and High Terrace Positions)					
FFC	47,283	36.88	FFHU	16,613	12.96
FFCBu	1,633	1.27	FFHUBu	187	0.15
FFH	16,565	12.92	FFOM	1,834	1.43
FFHBu	5	trace	FFON	173	0.14
FFHE	14,015	10.93	FFY	30	0.02
FFHEBu	427	0.33	FM	15	0.01
F (b). Forest (Riparian / Low Terrace Positions)					
FAS	134	0.10	FOAM	1,175	0.92
FMA	3	trace			
H. Shrublands and Thickets					
HN	8	0.01	HW	13	0.01
HU	851	0.66	HZ	20	0.02
N. Composition Unknown					
NG	8	0.01			
O. Woodland					
OFC	411	0.32	OOB	203	0.16
OFH	154	0.12	OPFOC	486	0.38
OFOM	1,037	0.81	OPMO	268	0.21
P. Prairie					
PF	247	0.19	PU	2,612	2.04
S. Savanna					
SF	100	0.08	SP	137	0.11
SOB	9,774	7.62	SPMO	10,428	8.13
SOF	799	0.62			
U. Unvegetated					
UR	10	0.01			
W. Water and Wetlands					
W	500	0.39	WMU	2	trace
WG	4	trace	WSU	50	0.04

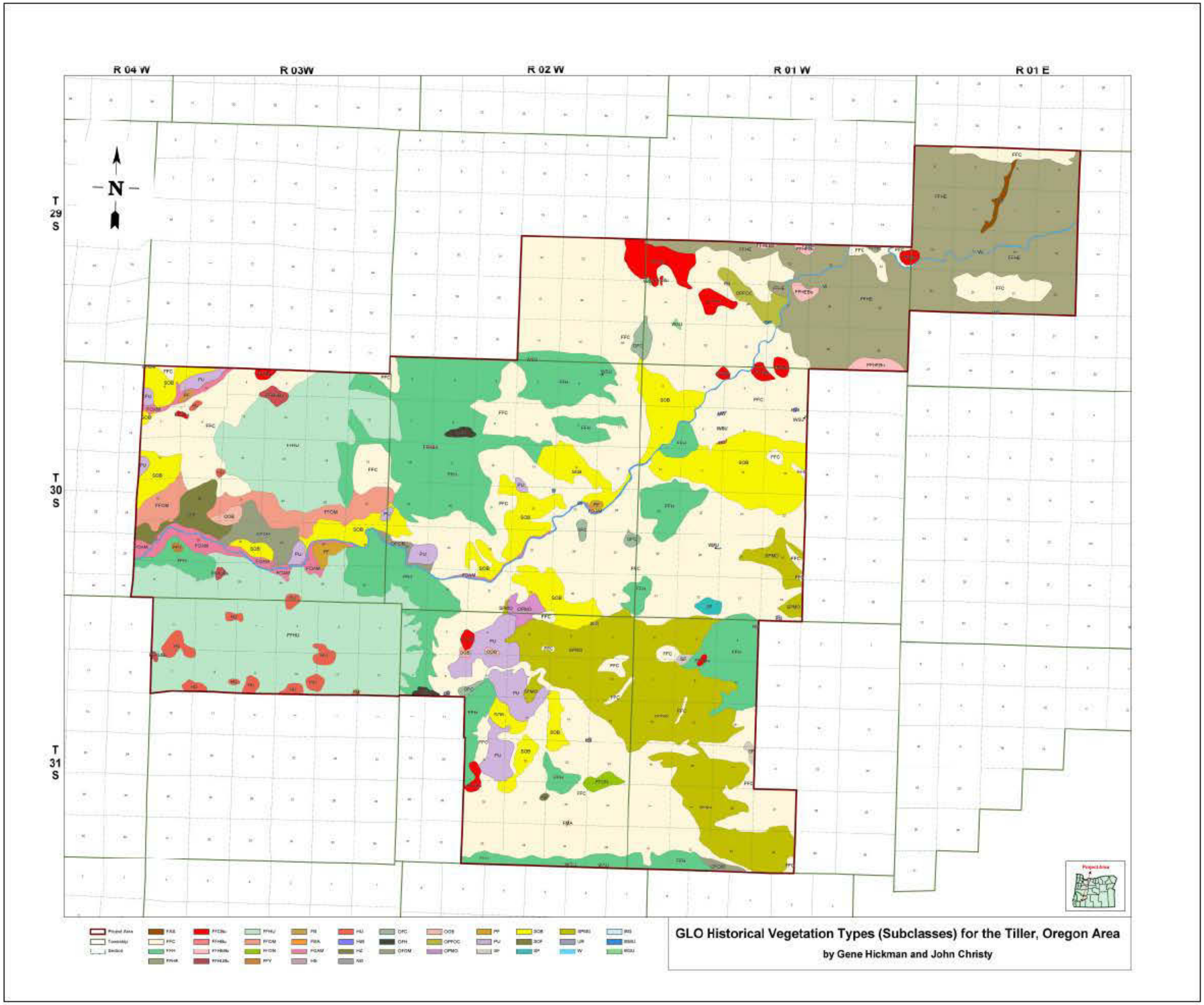


Figure 12. Historical vegetation types (subclasses), illustrating complecity of Tiller study area.

Fire Disturbance and Historic Burn Mapping

Fire history had a major impact on the composition and structure of pre-settlement landscapes as determined by modern ecological surveys and research (Whittaker 1960; Atzet and Wheeler 1982; LaLande and Pullen 1999; Lewis and Ferguson 1999; Carloni 2005). Early accounts of explorers and travelers sometimes noted fires, smoke or the results of burning by the Indians in the late summer and fall (Lalande and Pullen 1999). The September, 1841 diary from the Wilkes Expedition, moving south from the Umpqua towards California, noted their "course over burned woods and small patches of prairie." (Bornholdt 2005).

It is commonly believed that explorers, early settlers and travelers encountered much open forest in some areas, making access easier. However, it is evident that this was very much related to locality and was dependent on both stand potential and disturbance history. Our study classified about 77% of the uplands as forest (with "dense" canopies) as opposed to more open woodland. Close reading of the GLO data indicates that most of this forest had "very dense" witness tree spacing, often with considerable brush undergrowth. Overland travel was less difficult along old Indian trails in the valleys and on open ridgetops (Carloni 2005), but locating suitable routes for wagon roads was challenging in many areas.

Burned acreage probably was under-reported in the study area for a variety of reasons. GLO surveyors did not provide consistent records of fire evidence, and may not have documented burns older than 20 years because physical evidence such as ash and charcoal was relatively short-lived (Christy and Alverson 2011). Savannas and prairie, historically maintained by fire, were not likely to exhibit long-lasting evidence (fresh ash) of low intensity burning. Because only section lines were documented, any fires in the interiors of sections would not have been recorded in the notes. According to knowledgeable local land managers (Rusch 2014), there no local records of large, very old fires in the project area.

In spite of the wildfire history and very widespread burning by Native Americans in southwest Oregon, GLO surveyors identified only a few sites as having been burned. Common terminology used by surveyors to identify burned landscapes included "burned," "deadenings," "burnt timber," "snags," "undergrowth partly dead from burning," "enter green timber," etc. In the Tiller study area GLO documented 20 locations (about 2,250 acres) with a specific reference to fire (Figure 13). Nearly all brush fields or thickets mapped as "shrubland" had cover that was probably the result of a single stand replacement wildfire, although these lacked direct evidence in the dataset. At some locations, fire might be inferred from typical GLO stand descriptions such as "open timber and thickets of small firs," "undergrowth of fir thickets and bull pine," "dense thicket of manzanita and small pines," "part of timber dead," "undergrowth mostly dead manzanita and greasewood." The sizable area of savanna (17% of the study area) is largely found on soils capable of supporting woodland or forest stands (Johnson 2004). These locations are typically on topography with warm southerly slopes and were historically more open stands, primarily as the result of periodic burning by native Americans in combination with wildfire ignitions.

Fire regimes changed significantly during the early settlement era. Traditional burning by Indians ceased, but fires set by prospectors, farmers and stockmen began to greatly impact portions of southern Oregon and California (Morris 1934; Atzet and Wheeler 1982; Robbins 1997; Fried et al. 2004). Many early photographs adjacent to some southern Oregon frontier towns and mining sites, show very brushy, sparsely stocked stands. Some may be the result of earlier wildfires and/or the cessation of traditional burning practices. But most are probably stands recovering from settlers or miners doing burning for prospecting, or early logging for firewood, building materials and fence rails. Besides high grading virgin stands, leaving thin or scattered overstories, the abundance of slash was likely to have been burned. This would have initiated brush fields or shrub ground cover under residual partial cuts. Periodic burning by Indians could not compare with the widespread impact of more recent fires occurring since the beginning of white settlement (Leiberg 1900; Morris 1934). This study found no large brush fields or burns comparable to those observed by Leiberg about the turn of the century, or to the large extensive brush cover identified later by Gratkowski in SW Oregon (1961). These shrub stands evidently developed after severe burning episodes that occurred much later in the settlement period.

Our landscape perspective for the project area is partly the result of vegetation cover type modification by wildfire (estimated to have affected 3% of the study area) and periodic burning by Indians in conjunction with wildfire (estimated 18%) at the time of the GLO surveys. Major wildfire impact areas were generally small, scattered acreages on the very moist mixed conifer communities. In addition, there were no doubt numerous unrecorded, incidental ignition sites by lighting or the Indians through out the forest which impacted only small local patches or a few trees. Major GLO inferred burning areas attributed to the Indians were typically on warm or droughty southerly slopes and bottomland prairie or meadow sites in the dryer climatic zone. Light burning was a cultural practice used by the Indians in site-specific application for hunting, food production, and maintaining access by reducing woody vegetation in some vegetation types. It was timed seasonally to accomplish their management objectives (LaLande and Pullen 1999).

Prairies or meadows were present historically in numerous locations centered on soil-site features favoring grasslands. These were sought out in this area by the earliest settlers in the 1850s and 1860s for farming, hay production, and pastures. A number of upper elevation meadows on the main ridge systems were grazed, some very productive but some rocky, drying early and with low yields (Waddel 2014). The GLO prairies reported were located adjacent to savanna and or woodland vegetation, and upland prairies were often called meadows by early ranchers. They were typically on the warm southern side of ridges and peaks and on wet swales, benches or bottoms, but are more widespread on serpentine geology in the Callahan Meadows and Drew ridge area. We assume that there were other prairies unreported in our dataset because they were not encountered along section lines.

Because of the common burning practices by Indians, the size of individual prairies would have expanded into adjacent woodlands or savannas by periodic firing of prairie and prairie margins, the usually brushy transitions. Expanded prairie transitions into wooded types could be maintained by burning, with low woody encroachment, indefinitely, as desired by the local Indians, shrinking back to the core of the prairie over time if periodic burning ceased.

Some **mixed oak conifer woodlands** in the region are naturally open even without underburning, because of soil-site limitations including warm droughty locations. These generally have light to heavy, mixed shrub cover and tree regeneration, with light grass understories. Other examples have much better soil-site potential for tree production and were maintained as more open stands because of regular burning. Pine and/or oak woodlands were likely priority sites for periodic burning along with the adjacent prairies, since oak stands may have been burned to facilitate harvesting of the future acorn crop, especially black oak (Pullen 1995). Ecological changes expected would be a reduction in tree stems, canopy cover, thinning of the shrub layer, increased grass cover, and development of oak sprouts that thrive until the next fire.

A few examples of fire impacted types classified as woodland were found in the very cool moist mixed conifer zone of the project which we attribute to wildfire, not periodic burning. These have a patchy or open conifer overstory with dense woody undergrowth and regeneration in places. These are apparently recovering from mixed severity burning, and in time these canopies are expected to fill in and return to a forest stand density class.

Most **savannas** in this study were associated with warm or seasonally hot positions on large southerly aspects. These typically run up long gentle or steep slopes, sometimes to the ridgetops, from the creeks or valley bottoms. Although the modern soil survey show these sites are generally capable of supporting commercial stands of mixed conifer-hardwood woodland or forest, the GLO records describe savanna ranging from good to light grass cover. These could not have been maintained as very open tree stands in a lower successional status without periodic burning (fire climaxes). The typical geographical pattern is for these to be connected to prairie and/or woodland stands with almost continuous coverage along the toe slopes in the valleys. We suggest that these were fired as desired in conjunction with the meadows and/or woodlands at the base of these slopes, since these burns would easily run up slope to natural fire breaks or the ridge tops. Native Americans are believed to have concentrated their burning efforts on warm southerly aspects, not the cooler densely covered north slopes, so that their efforts would be more effective (Pullen p. 4, 1995). And although annual burning could have been achieved on some very productive sites if needed, most savanna areas would not easily reburn unless enough grass production and litter had built up to provide the herbaceous fuel needed to carry a fire.

Except for inclusions of conifer forest on protected or mesic topographic locations within these landscapes, a regular burning program for stand management by the Indians would maintain savanna structure, low woody undergrowth, and improved grass production over large areas. An 1869 (April-May) expedition with an Indian guide at the request of the Douglas County Commissioners [County Court Journal # 717, June 1869], conducted a mission up the South Umpqua River through our project area, to search for a possible overland route for a new wagon road to the Klamath area. On their ascent up Jackson Creek on Collins Ridge and for miles eastward they encountered what they described as" thousands of acres of prairie with rich bunchgrass." Their Indian guide assured them that "on the main South Umpqua River (below) there is as much or more grass than on the fork up which we are exploring" (Bacon 1991). This southerly slope up Jackson Creek viewed by the explorers, at least to our project boundary, is classified as savanna in this study, along with many areas along the Umpqua River and in the Elk Creek Drainage (Drew).

Both the nature and results of burning in **moist mixed conifer ecosystems** was much different than in the savanna types. For the entire study area, most burned sites identified by GLO were in moist forest vegetation types, and we believe these were probably initiated by wildfire. A number of brush fields (Shrubland Class) were reported here which we also interpret as wildfire areas. The composition of these units, where data is available, resemble stands in recovery (early seral) from a single event. Indian use of fire in this moist forest ecosystem zone, must have been concentrated around unique ecosystems or smaller local areas of high cultural value without impacting large areas of adjacent forest. No important cultural sites with routine burning impacts were identified by GLO surveyors in this study, and possibly none with impressive evidence were crossed by the land survey routes. In addition, we assume there were many intentional, incidental ignition sites by Indians, and certainly by lighting occurred through out the forest which impacted only small local patches or a few trees and are not recorded in the GLO record.

For the broad expanse of moist forest cover surveyed, most stands had "very dense" tree spacing at corners with frequent GLO notations of dense undergrowth. Apparently these moist Douglasfir-hemlock forests and related types in this study were not at high risk for wildfire spreading long distances, as most burns were small and scattered. Neither do we have evidence that the Indians were managing very large areas of moist mixed conifer sites here by fire as in the savanna types, and converting extensive areas to altered ecological states.

The east end of our project, T29S, R1E, was the most uniform area in GLO plant composition descriptions, and is apparently the highest precipitation zone. About 86% of the corners supported "very dense" stands, 14% were classified "dense," and nearly all lines were described as "heavy timber with dense undergrowth" in the early1920's when surveyed by GLO. It is possible that in the many decades that preceded this survey after Indian cultural use here ceased, evidence of impacts were no longer obvious. Very mixed size classes were reported for many witness tree groups. Many trees were large enough to assume that most but not all tree stands, at the corners, originated prior to nearby European settlement. Tree canopy descriptions for the section lines were dominated by Douglasfir, with subordinate cedar, hemlock, sugar pine and chinquapin, which we consider to be generally mid seral. No recent canopy burns were reported or evident from the data set. Apparently there is a long stand replacement fire interval for the region, but in this project area there is evidence that stand replacement may also be in scattered patches at much younger intervals.

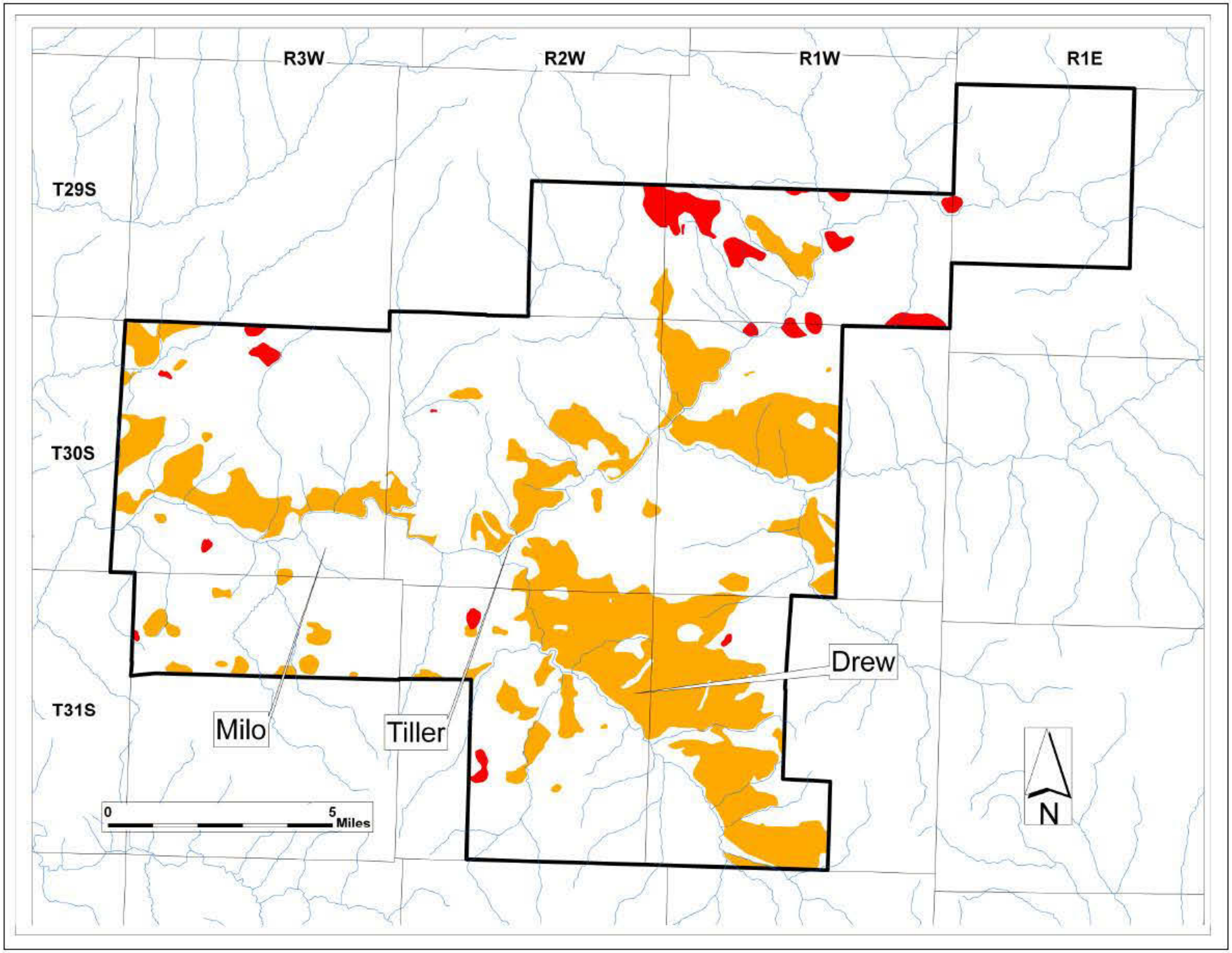


Figure 13. Units recorded as burns at time of GLO survey (red), and units inferred as fire legacy sites older than 20-25 years (oreange).

Analysis of Stand Density

Vegetation classes used for grouping vegetation types by tree density (average spacing of witness trees at corners) have routinely been divided at <1 chain (forest class), 1-2 chains (woodland class), and 2-4 chains (savanna), as discussed previously. In previous GLO projects in southwest Oregon, it has become clear that the forest spacing class may be too broad for the best correlation of stand characteristics. It is likely that subdividing the 1 chain (66 ft) distance that currently defines the forest class would refine forest characteristics by providing better correlation with tree diameter groups, stand age classes, and possibly crown canopy cover at the corners.

For the Tiller project area, we segregated the forest class into "very dense" and "dense" forest, based on surveyors' descriptions and distances to witness trees. "Very dense" forest was identified as stands where witness tree distances averaged less than about 55 links (35 feet), **and** with either no single tree in the group more than 70 links distant, or with any two trees over 60 links from the corners. “Dense forest” was limited to stands where the average distance to witness trees was greater than 55 links (35 feet) from the corners.

Using BLM's CADNSDI point layer representing section and quarter corners, we assigned values to each corner based on their tree density, and overlaid these on the vegetation class layer (Figure 14). The forest density class is colored green, as are the “very dense” corners which occur at 76% of all forest class corners. Red dots indicate “dense” corners, which are very scattered but are grouped in several areas. These make up only 20% of all forest class corners. Occasional black dots indicate woodland density, occurring at only 5% of all corners in the forest class. These are considered isolated inclusions in the forest polygons, important locally but too small to map as woodland. Figure 14 indicates that a high percentage of stands were “very dense,” and that wider spaced stands were less common.

It is apparent that “very dense” corners best characterize the traditional forest density map unit as a landscape perspective for the project. “Dense” plots are either scattered or slightly grouped, and the latter could be delineated in places to represent islands or patches of wider spacing. These may have added significance if connected to a black woodland dot.

Even without this more intense delineation of GLO stand characteristics, we suspect that there should be some correlation with stand age (diameter groups), seral status, crown canopy cover, tree species composition and possibly disturbance period for a given area. A more intense analysis of this witness tree data as we have described, is beyond the scope and funding for this study but would be a logical extension of this project. This could be valuable as a means to better understand historical baseline characteristics of forests, and to improve correlations with modern stand inventories that are essential for management.

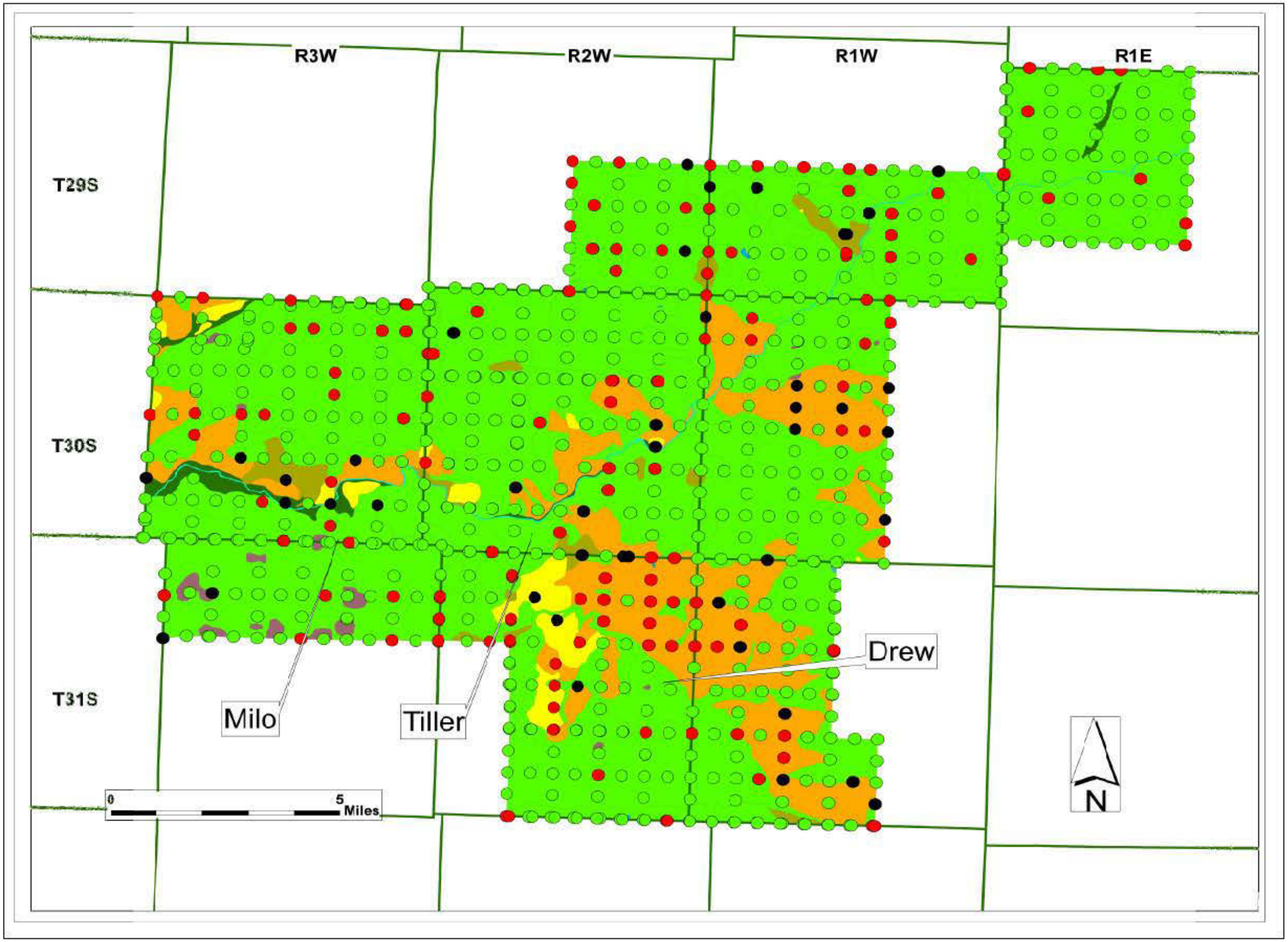


Figure 14. Stand densities at section corners and quarter section corners, by vegetation class. Green circles = "very dense." red = "dense," black = woodland, as recorded by GLO surveyors.

PROJECT EVALUATION AND CONCLUSIONS

Limitations of GLO Data

GLO survey notes contain a limited amount of information about historical landscapes, and the style and detail of records varied somewhat by surveyor. Surveyors were not required to document herbaceous species, so almost all plant lists are restricted to a few common trees and shrubs. At times some surveyors even ignored recording shrubs in their line descriptions.

Line descriptions only provide a composite or average of vegetation dominance for each mile, unless a break was made in the line and a distinction made between different segments of the line. Changes in vegetation types along the lines are important for the historical record but were not always identified by surveyors. It is unlikely that subtle ecosystem changes would have been noticed by the untrained surveyor. Possibly other vegetation boundaries were simply not identified in order to save time during surveys, because it would have required extra time to record new entry and exit points.

Survey data essentially created line transects around each section, so that the interiors of sections were not documented by the surveyors. Topographic errors in township plat maps were common, particularly in the interiors of sections, particularly when mapping drainage systems and ridgelines. Also, the documentation of burning evidence, although important, was weak.

The amount of field notation was not always consistent between surveyors, so that less information was provided for some locations than others. Because surveyors were not trained botanists, the quality of vegetation records was sometimes lower than expected. Some errors in species identification were obvious, and needed correction (greasewood, redwood, etc.).

Interpretive maps and research based on GLO data are subjective because of limitations in the data, and the need for professional judgment in creating and delineating map units. Consequently, local field experience in the project area was valuable for interpretation of the data and judging how to relate the data to local landscapes.

Data derived from more recent surveys may impart less historical baseline data, when compared to the earliest decade of surveys. Our historical vegetation map was intended to represent conditions in the early settlement period, as close to "presettlement" as possible. Although 39% of the project area was surveyed in the first decade of settlement, completion of the entire study area extended over about 65 years. Fortunately, the remote and rough nature of the areas surveyed in later decades decreased the possibility that human disturbance or altered burning patterns had greatly impacted their condition.

Regrettably, our data set was not old enough to precede possible site impacts on local areas close to the earliest settlements and ranching or mining locations. However, these areas represent a relatively small portion of our dataset. These locations were being altered by prospecting, development including burning by settlers, tree harvesting and farming before the GLO surveyors completed their first decade of surveys.

Landscape Changes since Settlement

This GLO study did not investigate the degree and extent of vegetation changes since settlement began. However, knowing that changes have occurred widely in the West, it is appropriate to conclude this study by noting some significant impacts that have been imposed on southern Oregon presettlement landscapes over the last 150 years.

Initially, historical landscapes were altered or influenced primarily in the major valleys and low mountains near mining districts, settlements and homesteads. The influx of miners, farmers, ranchers, and business people quickly enlarged the area of land use and development. Within only a few years, the Indian culture had vanished and their impacts on ecosystems in southwest Oregon rapidly disappeared. The absence of periodic low intensity burning was by itself a major change on large areas, in combination with agricultural development in the valleys as the population of settlers increased. There was new livestock grazing on valley savannas, prairies, woodlands and throughout portions of the mountains, along with a wave of widespread, severe, indiscriminate burning of the uplands.

Five generalized but very significant types of post-settlement ecosystem impacts across Southwest Oregon are highlighted below.

1. **Development:** Conversion of natural ecosystems to mining districts, settlements, industrial areas, road and canal systems, farmland, orchards and pastures.

2. **Tree Harvesting:** Logging for construction materials, fencing, poles, railroad ties, cordwood for home, business or locomotive fuel.

3. **Grazing**: Valley prairies and wooded grasslands were heavily used for seasonal grazing and wintering of livestock. Late spring and summer grazing by large herds in the mountains was often followed by years of fall burning, as livestock left the woods (Galbraith and Anderson 1971).

4. **Weeds:** Weeds were introduced from many sources, and invasion accelerated as settlement expanded. The most vulnerable sites were heavy disturbance areas and degraded natural ecosystems. Because of proximity to settlement, agriculture, and wide-ranging grazing, most lower-elevation sites were heavily impacted by weeds, particularly in grasslands, savanna, and oak woodland. Forests and wetlands at higher elevations sustained the least damage and today contain the best remnants of native vegetation.

5. **Changes in Burning Patterns:** The "presettlement" fire history, a product of lightning and Native American cultural practices, changed dramatically after the settlement period (Morris 1934; Boyd 1999), followed by a century of aggressive fire control efforts. High density forests resulting from overstocking have become a concern in recent decades, the result of forest management decisions and altered burning cycles. There has been a shift from savanna to woodland or forest density at many locations, due to fire control, no burning by native Americans, and less logging or thinning treatments in altered historical savanna types (Figure 10). These are natural landscape changes over time where site features (soil, etc.) are not restricting the development of greater tree density.

Summary of Results and Questions Remaining

GLO survey notes were used to map historical vegetation for 128,214 acres in the Tiller area. Surveys began in 1855, but the entire study area was not completed until 1923. Only 39% of the area was surveyed in the first decade, but this includes most of the land that was of high value to the original European settlers. The remaining 61% of our project was based on surveys between 1881 and 1923. The survey dataset listed 54 common plants or plant groups, which we cross-referenced to modern scientific names.

Historical vegetation data was classified into six vegetation classes based on witness tree spacing. **Prairie** vegetation covered 2.2% of the project area, located on wet valley bottoms, broad uplands with serpentine geology, and on steep droughty southern slopes of ridges or peaks. **Shrublands** (brush or thickets) covered 0.7% of the project area. These were small areas scattered across the area but mostly within conifer forest uplands and developed after wildfire. **Savanna** covered 17% of the project area and included five subclasses (vegetation types or map units). Savanna was located primarily on broad warm southerly slopes with better soils in the center and dryer west end of the study. It is believed to have originated as the result of periodic underburning by the Indians. Most of the historical savanna cover would have reverted, over time, to woodland or forest density classes when burning ceased, except where land managers have maintained other conditions. **Woodland** covered about 2% of the project area. Six subclasses are described ranging from mixed oak- pine slopes in the warm dry climatic zone, to wide spaced canopies within the moist conifer forest zone. The latter are probably wildfire disturbance sites in seral states of adjacent forest communities.

Riparian forest was mapped mainly on wide bottoms in the Milo and Days Creek area and in Ash Valley, and covered about 1% of the project area. Riparian zones were not often identified in this area, and very poorly documented by GLO surveyors. Consequently, these are certainly under reported and poorly described in this report. **Upland forest** was the largest vegetation class, covering about 77% of the project area. Twelve subclasses (types) were described. Eight were cool, moist, low moisture stress sites covering about 48 % of the total forest class acreage. Four were warmer higher moisture stress sites covering about 52% of the forest acreage. Moist forest types in this class were characterized as Douglasfir-western hemlock forest: type FFHE occupied the apparently cooler east end of the study with considerable evergreen shrubs in the composition; type FFH occupied the apparently warmer center of the study with similar vegetation but more abundance of deciduous shrubs; Type FFHU, apparently dryer/warmer climatic zone, had similar composition to FFH but hemlock was only sporadically listed by surveyors in the understory, not in the canopy as the other types above. In this warmer west end of the project, FFHU was primarily found on north aspects or on the most favorable environmental positions. Four forest types were found on warm, higher moisture stress positions, but mapped across the whole extent of the project from east to west. Here ponderosa pine and black oak are more likely to be present in these mixed conifer-mixed hardwood canopies. Burned map units were recognized in both the dry and the moist forest zones.

Fire history can be summarized as follows: Prairies and woodland were probably impacted by Indian's cultural practices or periodic burning. The savanna types were likely created here from dry forest and natural woodland communities, with maintenance by ground fires. These historical savannas occurred on warm dry southern slopes along major drainages. When regular burning ceased, savannas converted to woodland and forest classes.

From a landscape perspective, the entire forest class zone as mapped for the historical period (about 77% of the project), was subject to wildfire, but with only small scattered acreages of wildfire burn sites were recorded by GLO. Sizable dry forest areas had also been impacted with periodic burning treatments by the Indians on managed, warm south slope topography. These locations had already been converted to savanna and were no longer part of the historical forest class acreage record.

The moist forest types we have mapped, although certainly much used by the local Indians, had no GLO evidence of broad burning treatments resulting in large-scale landscape conversion to open stands, as has occurred in the savanna areas. With many important cultural sites probably scattered within the moist forest types, treatment must have been confined to smaller acreages surrounding these cultural sites. However, we assume the broad forest zone would also have many locations of intentional ignitions (single events) by the Indians affecting small patches, or a few trees and undergrowth, throughout the forest, even without supporting GLO evidence. There was no evidence in the dataset of widespread treatment zones impacting broader expanses of adjacent forest, unless these were unreported by GLO surveyors, or the survey routes did not cross any highly impacted stands in cultural use areas.

Questions Remaining

This project was not designed or funded to do a more extensive analysis of GLO corner data. Could much more be learned from corner information review and analysis related to stand density groups, tree species composition, stand age, seral status, correlation with crown canopy cover, and possibly the disturbance period? For the Tiller study, we think the answer is yes.

Change is inevitable, over time, in landscape cover, especially where there major new impacts have occurred since the historical period. What kind and extent of changes in composition and ecological status has occurred in the study area since settlement? How can ecological processes be restored or maintained without fire, or what landscape areas need management treatment to lower wildfire risk? What more can be learned about historical baseline for these landscapes, for locations where restoration is an important goal?

There is a need to relate GLO records and historical vegetation maps to modern inventory systems that use aerial photography and a variety of methods for ecosystem classification. How can we accurately compare GLO plant composition and corner data analysis with modern crown or basal cover, stand exam records, dominance ratings, or other field plot information? And can we make historical GLO data more useful by combining it to a greater degree with modern ecological inventories, modern soil surveys, or other historic data (old pictures, etc.), to develop better baseline assessments?

REFERENCES

Abrams, Leroy and Roxana Stinchfield Ferris. 1923-1960. Illustrated flora of the Pacific states, Washington, Oregon, and California. 4 volumes. Stanford University Press. Stanford, California.

Anderson, E. William, Michael M. Borman and William C. Krueger. 1998. The ecological provinces of Oregon. SR 990, Oregon Agricultural Experiment Station.

Atwood, Kay. 2008. Chaining Oregon; surveying the public lands of the Pacific Northwest, 1851-1855. The McDonald & Woodward Publishing Company. Blacksburg, Virginia.

Bacon, Doris. 1991. Phantom Road. The Umpqua Trapper (quarterly). Douglas County (Oregon) Historical Society. Roseburg, Oregon.

Baker, David. 2014. Personal Communication to Gene Hickman. Botanist. Tiller Ranger District. Umpqua National Forest. USFS. Tiller, Oregon.

Baldwin, Ewart M. 1964. Geology of Oregon. 2nd edition, University of Oregon Cooperative Bookstore. Corvallis, Oregon. 165 pp.

Boag, P. G. 1992. Environment and Experience: Settlement Culture in Nineteenth-century Oregon. University of California Press, Berkeley.

Bourdo Jr., Eric A. 1956. A review of the General Land Office survey and of its use in quantitative studies of former forests. Ecology, 37:754-768.

Bowen, W. A. 1978. The Willamette Valley: Migration and Settlement on the Oregon Frontier. University of Washington Press, Seattle.

Boyd, Robert (ed.). 1999. Indians, fire and the land in the Pacific Northwest. Oregon State University Press. Corvallis, Oregon.

Bureau of Land Management. 2002. Surveying Our Public Lands, BLM Cadastral Survey. U.S. Department of Interior. BLM/WO-G1-02-003-1420. 17 pp.

Carloni, Kenneth R. 2005. The ecological legacy of Indian burning practices in southwestern Oregon. PhD Dissertation. Oregon State University. Corvallis, Oregon. http://ir.library.oregonstate.edu/jspui/handle/1957/13086

Christy, John A. and Edward R. Alverson. 2010. Synopsis of methods used to map historical vegetation in Oregon, based on General Land Office survey notes. Oregon Biodiversity Information Center and The Nature Conservancy. Portland, Or. 3 pp. http://www.pdx.edu/sites/www.pdx.edu.pnwlamp/files/GLO%20methods%20overview.pdf

Christy, John A. and Edward.R. Alverson. 2011. Historical vegetation of the Willamette Valley, Oregon, circa 1850. Northwest Science 85:93-107.

Christy, John A., Edward R. Alverson, Molly P. Dougherty, Susan C. Kolar, Clifford W. Alton, Susan M. Hawes, Gene Hickman, Jennifer A. Hiebler, and Eric M. Nielsen. 2014. Classification of historical vegetation in Oregon and Washington, as recorded by General Land Office surveyors. Oregon Biodiversity Information Center, Portland State University. Portland, Or. 36 pp. http://www.pdx.edu/pnwlamp/sites/www.pdx.edu.pnwlamp/files/glo_classification_0.pdf

Christy, John A, Molly P. Dougherty, Susan C. Kolar, Cliff Alton and Susan Hawes. 2002. GLO data base structure and data entry. Oregon Natural Heritage Information Center. Oregon State University. Portland, Or. 15 pp.

Cowell, C. Mark and Marion T. Jackson. 2002. Vegetation change in a forest remnant of the eastern presettlement prairie margin, USA. Natural Areas Journal, 22: 53-60.

Duren, Olivia C., Patricia S. Muir, and Paul E. Hosten. 2012. Vegetation change from the Euro-American settlement era to the present in relation to environment and disturbance in Southwest Oregon. Northwest Science 86: 310-328.

Franklin, Jerry F. and C. T. Dyrness. 1973. Natural vegetation of Oregon and Washington. General Technical Report PNW-8. Pacific Northwest Forest and Range Experiment Station. Forest Service. USDA. Portland, Or.

Frederick, Orrin. 2007- 2010. Personal communication to Gene Hickman. USDI Bureau of Land Management, State Office. Section Chief for Spatial Products, Portland, Oregon.

Froehlich, Henry, David H. McNabb and Frank Gaweda. Average annual precipitation, 1960-1980, southwest Oregon. EM 82:20 (brochure). Extension Service, Oregon State University. Corvallis, Oregon.

Galatowitsch, S. M. 1990. Using the original land survey notes to reconstruct presettlement landscapes in the American West. Great Basin Naturalist, 50:181-191.

Galbraith, William A. and E. William Anderson. 1971. Grazing history of the Northwest. Journal of Range Management 24: 6-12.

Gardner, Wayne M. 1995. Personal communication to John Christy. USDI Bureau of Land Management, State Office. Section Chief for Spatial Products, Portland, Oregon.

General Land Office. 1851. Instructions to the Surveyor General of Oregon; being a manual for field operations. Washington: Gideon and Co., Printers.

Gilkey, Helen M. and La Rea J. Dennis. 2001. Handbook of northwestern plants. Revised edition. Oregon State University Press. Corvallis, Oregon. 494 pp.

Gratkowski, H. 1961. Brush problems in southwestern Oregon. Pacific Northwest Forest and Range Experiment Station. Forest Service. USDA. Portland, Oregon.

Habeck, James R. 1994. Using General Land Office records to assess forest succession in Ponderosa Pine/Douglas-fir forests in western Montana. Northwest Science, 68: 69-78.

Habeck, James R. 1961. The original vegetation of the mid-Willamette Valley, Oregon. Northwest Science, 35: 65-77.

Hickman, Gene (O. Eugene). 1999. Watershed vegetation / ecosystems inventory and analysis. In: Illinois River Watershed Assessment. USDA Natural Resources Conservation Service. Oregon.

Hickman, Gene (O. Eugene). 2004. Vegetation (Douglas County Area) pp.28-31, and General Vegetation Zone Map (separate insert). In Johnson, David R, John T. Haagen and Alan C. Terrell. Soil Survey of Douglas County Area, Oregon. USDA Natural Resources Conservation Service.

Hickman, James C. (ed.). 1993. The Jepson manual, higher plants of California. University of California Press. Berkeley.

Hickman, O. Eugene. 1977. Geographical distribution of natural vegetation in southwestern Oregon. Oral Paper presented at the 31st Annual Meeting, Society for Range Management, Portland, Oregon.

Hickman, O. Eugene and Douglas E. Johnson. 1992. Plant checklist for range and forest inventories in southwest Oregon (eastern Siskiyous and southern Cascade Mountains). Second Edition. Rangeland Science Series No. 1. Dept. of Rangeland Resources, Oregon State University. Corvallis, Oregon.

Hickman, O. Eugene and John A. Christy. 2011. Historical Vegetation of Central Southwest Oregon Based on GLO Survey Notes. Final report to the USDI Bureau of Land Management. Medford District, Oregon. 124 pp.

Hitchcock, C. Leo and Arthur Cronquist. 1973. Flora of the Pacific Northwest, an illustrated manual. Twelfth printing 2001. University of Washington Press. Seattle.

Hopkins, Lois, Mildred Thiele, Joan Fosback and Mary Carlson. 1986. Floral Survey of Douglas County, 1978-1986. Douglas County Museum of History and Natural History. Roseburg, Or.

Jackson, Charles Chuck. 2014. Personal communication to Gene Hickman. Former chairman: Cow Creek Band of Umpqua Tribe of Indians. Drew, Oregon.

Johnson, David R, 2014. Soil Survey of Douglas County Area, Oregon. USDA Natural Resources Conservation Service, in cooperation with Forest Service, Bureau of Land Management, Oregon Agricultural Experiment Station, and Douglas County. US Gov. Printing Office.

Kehoe, Kevin. 2014. Personal Communication Gene Hickman. Fire Chief, Tiller Rural Fire District. Tiller, Or.

Kelly, Christopher J. 2014. Personal Communication to Gene Hickman. Forest Archaeologist and Tribal Liaison. Umpqua National Forest, Roseburg, Oregon.

Labbe, Ted, Ashley Adams and Robert Conrad. 2013. Historical condition and change in riparian vegetation, Hood Canal and eastern Strait of Juan de Fuca, Washington. Northwest Science 87: 24-39.

LaLande, Jeff and Reg Pullen. 1999. Burning for a "fine and beautiful open country," native uses of fire in southwestern Oregon. pp. 255-276. In: Robert Boyd (ed), Indians, Fire, and the Land in the Pacific Northwest. Oregon State University. Corvallis, Oregon.

Leiberg, John B. 1900. Cascade Range Forest Reserve, Oregon …. together with the Ashland Forest Reserve and adjacent forest regions. pp. 276-280. In: H. Gannet. Twenty-first Annual Report, 1899-1900. Part V, Forest Reserves. US Geological Survey. US Gov. Printing Office. Washington D. C.

Lewis, Henry T, and Theresa A. Ferguson. 1999. Yards, Corridors, and Mosaics; How to Burn a Boreal Forest. pp. 164-184. In: Robert Boyd (ed), Indians, Fire, and the Land in the Pacific Northwest. Oregon State University. Corvallis, Oregon.

Morris, W. G. 1934. Forest fires in western Oregon and Washington. Oregon Historical Quarterly, 35:313-339.

Noss, Reed F. 1985. On characterizing presettlement vegetation: how and why. Natural Areas Journal. 5:5-19.

Orr, Elizabeth L, William N. Orr and Ewart M. Baldwin. 1992. Geology of Oregon. Fouth edition. Kendall / Hunt Publishing Company. Dubuque, Iowa. 254 pp.

Peck, Morton E. 1962. A manual of the higher plants of Oregon. 2nd edition. Binfords & Mort Publishers, Portland, in cooperation with the Oregon State University Press. Corvallis, Oregon. 936 pp.

Preston, Richard J. 1966. North American trees. Revised, 2nd edition/paperback edition. Massachusetts Institute of Technology. M.I. T. Press. Cambridge.

Pullen, Reg. 1995. Overview of the environment of native inhabitants of southwestern Oregon, late prehistoric era. Report for the USDA Forest Service, Grants Pass, Oregon. Pullen Consulting. Bandon, Oregon.

Randall, Warren R. 1965. Manual of Oregon trees and shrubs, O.S. U. Book Stores, Inc. Corvallis, Oregon.

Richlen, Ellsworth M. 1973. Soil Survey, South Umpqua Area Oregon. USDA Forest Service and Soil Conservation Service in Cooperation with Oregon Agricultural Experiment Station. US Government Printing Office.

Robbins, William G. 1997. Landscapes of promise: the Oregon story 1800-1940. University of Washington Press. Seattle, Washington. 392 pp.

Rusch, Chris. 2014. Personal communication to Gene Hickman. Silviculturalist (retired, Tiller Ranger District, USFS). Tiller, Oregon.

Rynerson, Charles. 2014. Personal communication and report: Population Census for Milo, Tiller, Drew Study Area. Population Research Center. Portland State University. Portland, Or.

Sawyer, John O. 2007. Forests of northwestern California. chapter 10 in: Michael G. Barbour, Todd Keeler-Wolf and Allan A Schoenherr (eds.). Terrestrial Vegetation of California. 3rd edition. University of California Press. Berkeley, California.

Sudworth, George B. 1908. Forest Trees of the Pacific Slope. U.S. Dept. of Agriculture.Forest Service. U. S. Gov. Printing Office. Wash. D. C.

Sullivan, Allen E. 2000. The expected potential native vegetation of the Kittitas Valley, central Washington: a soil based approach to the reconstruction of vegetation landscapes. Ph.D. dissertation, Geography, Oregon State University, Corvallis, Oregon.

Sweetser, Albert R. and Mary E. Kent. 1908. Key and flora, some of the common flowers of Oregon. The Atheneum Press. Ginn & Company, Boston. 157 pp.

Thorson, T. D., S. A. Bryce, D. A. Lammers, A. J. Woods, J. M. Omernik, J. Kagan, D. E. Pater, and J. A. Comstock. 2003. Ecoregions of Oregon [color poster with map, descriptive text, summary tables, and photographs]. U. S. Geological Survey, Reston, Virginia, (map scale 1:1,5000,000).

Waddle, Susan. 2014. Personal communication to Gene Hickman. Pioneer Indian Museum. South Umpqua Historical Society. Canyonville, Oregon.

White, C. Albert. 1983. A History of the Rectangular Survey System. USDI Bureau of Land Management. US Gov. Printing Office. Washington D. C. pp. 433-456.

Whitney, Gordon G. and Joseph P. DeCant. 2001. Government land office surveys and other early land surveys. Pp. 147-172 in: Dave Eagen and Evelyn A. Howell (eds.). The Historical Ecology Handbook, a Restorationist's Guide to Reference Ecosystems. Island Press. Washington D.C., 457 pp.

Whittaker, R. H. 1960. Vegetation of the Siskiyou Mountains, Oregon and California. Ecological Monographs, 30:279-338.

Williams, Mark A. and William L Baker. 2010. Bias and error in using survey records for ponderosa pine landscape restoration. Journal of Biogeography, 37: 707-721.

Williams, Mark A. and William L Baker. 2011. Testing the accuracy of new methods for reconstructing historical structure of forest landscapes using GLO survey data. Ecological Monographs, 81:63-88.

Yocom, Charles and Vinson Brown. 1971. Wildlife and Plants of the Cascades. Naturegraph Publishers. Healdsburg, California.

ADDITIONAL READING

Agee, J. K. 1991. Fire history along an elevational gradient in the Siskiyou Mountains. Northwest Science, 65, pp. 188-199.

Agee, James K. 1993. Fire Ecology of Pacific Northwest Forests. Island Press. Wash. D.C.

Betts, Matthew and Judy Loo. 2002. A comparison of pre-European settlement forest characterization methodologies. The Forestry Chronicle. 78: 422-432.

Bornholdt, Mariana D. 2005. Botanizing Western Oregon in 1841 – The Wilkes Inland Expedition. Kalmiopsis, volume 12. pp. 16-24.

Dubrasich, Mike. 2010. Stand Reconstruction and 200 years of Forest Development on Selected Sites in the Upper South Umpqua Watershed. White Paper No. 2010-5. Western Institute for the study of the Environment. Lebanon, Oregon.

Hickman, Gene (O. Eugene). 2010. Where are they, the oaks of southwest Oregon? Unpublished White Paper. Manuscript date 2003: revised Feb. 2010. 5 pp.

Hosten, Paul E, O. Eugene Hickman, Frank K. Lake, Frank A. Lang and David Vesely. 2006. Oak Woodlands and Savannas. (chapter 4) In: Dean Apostol and Marcia Sinclair (eds.), Restoring the Pacific Northwest, The Art and Science of Ecological Restoration in Cascadia. Society for Ecological Restoration International. Island Press. Washington.

Hutchison, Max. 1988. A guide to understanding, interpreting, and using the public land survey field notes in Illinois. Natural Areas Journal, 8:245-255.

Kolar, Susan, Molly Dougherty, John Christy and Edward Alverson. 1999. Bibliography of presettlement vegetation for Oregon and Washington. Oregon Natural Heritage Program. Portland, Oregon. 67 pp.

Moore, Margaret M, W. Wallace Covington, and Peter Z. Fule. 1999. Reference conditions and ecological restoration: a southern ponderosa pine perspective. Ecological Applications, 9:1266-1277.

White, C. Albert. 2001. A casebook of Oregon donation land claims (chapter 1). Produced for Professional Land Surveyors of Oregon, by LLM Publications. Oregon City, Oregon.

Zybach, Bob. 2010. (Tiller) South Umpqua Headwaters Pre-contact Reference Conditions Study. Report to the Douglas County Board of Commissioners. 159 pp.

APPENDIX

TOWNSHIP TABLE - ALL RECORDS

Twp	N bdy/E b	Surveyor	Start	End	Bdy descr	Gen descr
29S-01E	N	MENSCH, FRED	OCT 1922	NOV 1922	[NONE]	
29S-01E	SUB	MENSCH, FRED	OCT 1910	OCT 1910		[none used here; only a few lines surveyed]
29S-01E	SUB	MENSCH, FRED	SEP 1921	NOV 1921	[none, but NW portion of twp interior was surveyed and described]	This tp lies in drainage basin of S Umpqua. It is mtns but not rough except in a few localities, & abounds in long mod. slopes & benches. The soil is a clay loam of fair quality, capable of producing fair ordinary crops nearly anywhere that the land is not too sreep or rocky for cult. The S. U. River runs diag across the tract from NE to SW. It is mainly in a canyon but there are a number of bottoms & flat benches along its course. The basin of Rock Cr, also called Ash Cr is exceptionally rich land. The tp except in a few burned areas is covered with timber, principally fir, with scattering growth of y. & s. pine, cedar & hemlock. Only a minor portion of this can be classed as commercial timber. [continued below]
29S-01E	SUB	MENSCH, FRED	SEP 1921	NOV 1921		[CONTINUED FROM ABOVE] No mineral indications were found in the township. The nearest trading point is Tiller, about 17 miles distant from the west boundary. A wagon road is built to a point about 10 miles from Tiller and the district is well provided with good trails, built by the Forest Service. The land is situated within the Umpqua National Forest. The elevation ranges from about 1500 to 2500 feet. The land is valuable chiefly for timber, agriculture and grazing.
29S-01W	E	ANGELL, HOMER D.	JUN 1902	JUL 1902	[SOUTH HALF OF EAST BDY]	[NONE]

Twp	N bdy/E b	Surveyor	Start	End	Bdy descr	Gen descr
30S-03W	SUB	BUSHEY, WILLIAM M.	0CT 1893	N0V 1893		This township is mountainous. It is mostly covered with fir, laurel, cedar and hemlock timber. The soil is mostly 3rd rate. There is some good land along the South Fork of the Umpqua River which will produce good crops without irrigation. The township is well watered by the S. Fork of the Umpqua River River and numerous mountain streams of pure clean water.
30S-03W	SUB	HATHORN, DENNIS	AUG 1857	SEP 1857		There is a narrow strip of country along the South Umpqua [River] which runs through this township, and a very little in the NW part adapted to settlement. The balance of the township is very mountainous and unfit for settlement.
31S-01W	SUB	HATHORN, DENNIS	AUG 1857	SEP	1857	[SURVEY PRIMARILY WEST HALF OF TP] This fractional township is very hilly. A large part is grassy oak and pine openings adapted to grazing. Soil 2nd and 3rd rate. The unsurveyd part of the township is very broken and mountainous and unfit for settlement or cultivation.
31S-01W	SUB	MENSCH, FRED	OCT 1922	MAY 1923		[only portions of the description are included here as most of his survey is the east half of the township, not included in this project] Southwest of this divide [Beaver-Elk creek], on the Elk Creek slope, there is considerable good grazing land and some postions are suitable for agricultural purposes. No evidence of mineral was found. The greatest value of this land is in the timber, with the grazing industry second.
31S-02W	N	HATHORN, DENNIS	1857	1857	[EAST 4 MILES]	This township is about one fourth adapted to grazing. The balance is mountainous and unfit for settlement.
31S-02W	N	CAMPBELL, CHARLES L.	AUG 1902	SEP 1902		This township is rough and mountainous, the northern and western part; rolling in eastern and somewhat level in the southern part, in addition to the broken land.

Section II: Examples from Line Table

(single page excerpts from two different Line Tables)

Codes below are used for transcribed GLO data when presented in Access "Line Tables." Expanded code definitions are available in Christy et al. (2002).

C	=	Section corner
D	=	Plant names added from the line description
E	=	Meander post
F	=	Flooded, including ponds or lakes with entry and exit points
H	=	Man-made features, point data on the survey line
I	=	Intercepted objects (usually tree), directly in the path of the line
Q	=	Quarter section corner
R	=	River, having separate entry and exit points on the line
S	=	Stream, point data without separate entry or exit points on line
T	=	Topographic features intercepted
V	=	Vegetation intercepted, or having separate entry and exit points
W	=	Water, non-flowing, small size without entry or exit points

TOWNSHIP 31S-02W

Line	Dir	Dist	Code	Intercept	Species	Tree Diam	Tree Bear	Tree Dist	Year	Line Description
	E	51.00	S	BRANCH 8 LKS WIDE, COURSE NE					1857	
01-02	S	20.00	V	A SMALL GRASSY SWAMP BEARS EAST ABOUT 5 CHS	GRASS	.	.	.	1857	
01-02	S	20.00	W	A SMALL GRASSY SWAMP BEARS EAST ABOUT 5 CHS					1857	
01-02	S	40.80	Q	SET QUARTER SECTION POST [TREE AZ. = 75]	OAK	12	SW	68	1857	
01-02	S	40.80	Q	[TREE AZ. = 68]	OAK	18	SE	87	1857	
01-02	S	62.40	S	DRY BED OF CREEK 10 LKS WIDE, COURSE WSW					1857	
01-02	S	80.80	C	TO SECTION CORNER [1, 2, 11, 12]	.	.	.	.	1857	Land hilly, pine and oak openings. 2nd rate soil.
01-02	S	80.80	D		PINE	.	.	.	1857	
01-06	S	00.00	C	[BEGIN SURVEY AT NE COR OF TWP, RUN SOUTH]					1857	
01-06	S	40.00	Q	SET QUARTER SECTION POST [TREE AZ. = 60]	OAK	18	NW	23	1857	
01-06	S	40.00	Q	[TREE AZ. = 80]	OAK	20	SE	15	1857	
01-06	S	59.00	S	BRANCH 2 LKS WIDE, COURSE WEST					1857	
01-06	S	60.00	S	BRANCH 2 LKS WIDE, COURSE WEST					1857	
01-06	S	80.00	C	[TREE AZ. = 14]	OAK	10	NW	100	1857	
01-06	S	80.00	C	[TREE AZ. = 28]	OAK	12	NE	36	1857	
01-06	S	80.00	C	[TREE AZ. = 18]	OAK	9	SW	79	1857	
01-06	S	80.00	C	[TREE AZ. = 68]	PINE	24	SE	49	1857	Land high and hilly oak and pine openings. Soil 2nd rate.
01-12	W	06.00	V	ENTER TIMBER, COURSE NE AND SW					1857	
01-12	W	13.50	S	BRANCH 8 LKS WIDE, COURSE WEST [DIXON CREEK]					1857	
01-12	W	25.50	S	SAME BRANCH, COURSE WSW [DIXON CREEK]					1857	
01-12	W	35.00	V	ENTER OPENINGS, COURSE NE AND WSW					1857	
01-12	W	39.73	Q	SET QUARTER SECTION POST [TREE AZ. = 70]	OAK	12	SE	68	1857	
01-12	W	39.73	Q	[TREE AZ. = 25]	OAK	10	NW	79	1857	
01-12	W	79.46	C	TO SECTION CORNER [1, 2, 11, 12]	.	.	.	.	1857	Land about one third hilly and timbered with fir, cedar, maple and laurel. Balance about the same as last mile [line 11-12: Land hilly pine and oak openings; first half 2nd rate soil producing good grass].

TOWNSHIP 29S-01W

Line	Dir	Dist	Code	Intercept	Species	Tree Diam	Tree Bear	Tree Dist	Year	Line Description
01-06	N	00.00	V	DESCEND THROUGH HEAVY TIMBER AND DENSE UNDERGROWTH					1902	
01-06	N	15.00	S	A SPRING BRANCH 2 LKS WIDE, CO. NW					1902	
01-06	N	40.00	Q	SET A STONE IN THE GROUND FOR 1/4 SEC COR	PINE	24	NE	42	1902	
01-06	N	40.00	Q		PINE	24	NW	40	1902	
01-06	N	45.00	T	TOP OF RIDGE POINTBEARS SE AND NW					1902	
01-06	N	75.00	T	FOOT OF DESCENT					1902	
01-06	N	75.00	S	OVER CREEK BOTTOM [ENTER CREEK BOTTOMLAND, NOT CREEK]					1902	
01-06	N	80.00	C	SET A STONE IN THE GROUND FOR COR OF TPS 28 AND 29S, RS 1W	FIR	30	SW	69	1902	
01-06	N	80.00	C		FIR	36	NW	27	1902	Land mountainous. Soil stoney and 3rd rate. Timber fir, pine, laurel and cedar; undergrowth laurel, willow and huckleberry. Mountainous or heavily timbered land or land covered with dense undergrowth; 80 chs.
01-06	N	80.00	D		LAUREL	.	.	.	1902	
01-06	N	80.00	D		CEDAR	.	.	.	1902	
01-06	N	80.00	D		WILLOW	.	.	.	1902	
01-06	N	80.00	D		HUCKLEBERRY	.	.	.	1902	
07-12	N	00.00	V	OVER W SLOPE THROUGH HEAVY TIMBER AND DENSE UNDERGROWTH					1902	
07-12	N	16.75	T	TOP OF RIDGE, BEARS E AND W					1902	
07-12	N	40.00	Q	SET A STONE IN THE GROUND FOR 1/4 SEC COR	FIR	10	SE	25	1902	
07-12	N	40.00	Q		FIR	12	SW	19	1902	
07-12	N	42.00	T	FOOT OF DESCENT					1902	
07-12	N	42.15	S	A SPRING BRANCH 5 LKS WIDE, CO. W					1902	
07-12	N	75.00	T	TOP OF RIDGE, BEARS E AND W					1902	
07-12	N	80.00	C	SET A STONE IN THE GROUND FOR COR OF SECS 1 AND 2	FIR	14	SW	18	1902	
07-12	N	80.00	C		FIR	12	NW	14	1902	Land mountainous. Soil stoney and 3rd rate. Timber fir, pine, hemlock and laurel; undergrowth laurel, willow and huckleberry. Mountainous or heavily timbered land or land covered with dense undergrowth; 80 chs.
07-12	N	80.00	D		PINE	.	.	.	1902	

Section III: Examples of GLO Plat Maps

- **T30S, R2W (plat date: February 20, 1858) - SE Douglas County:**

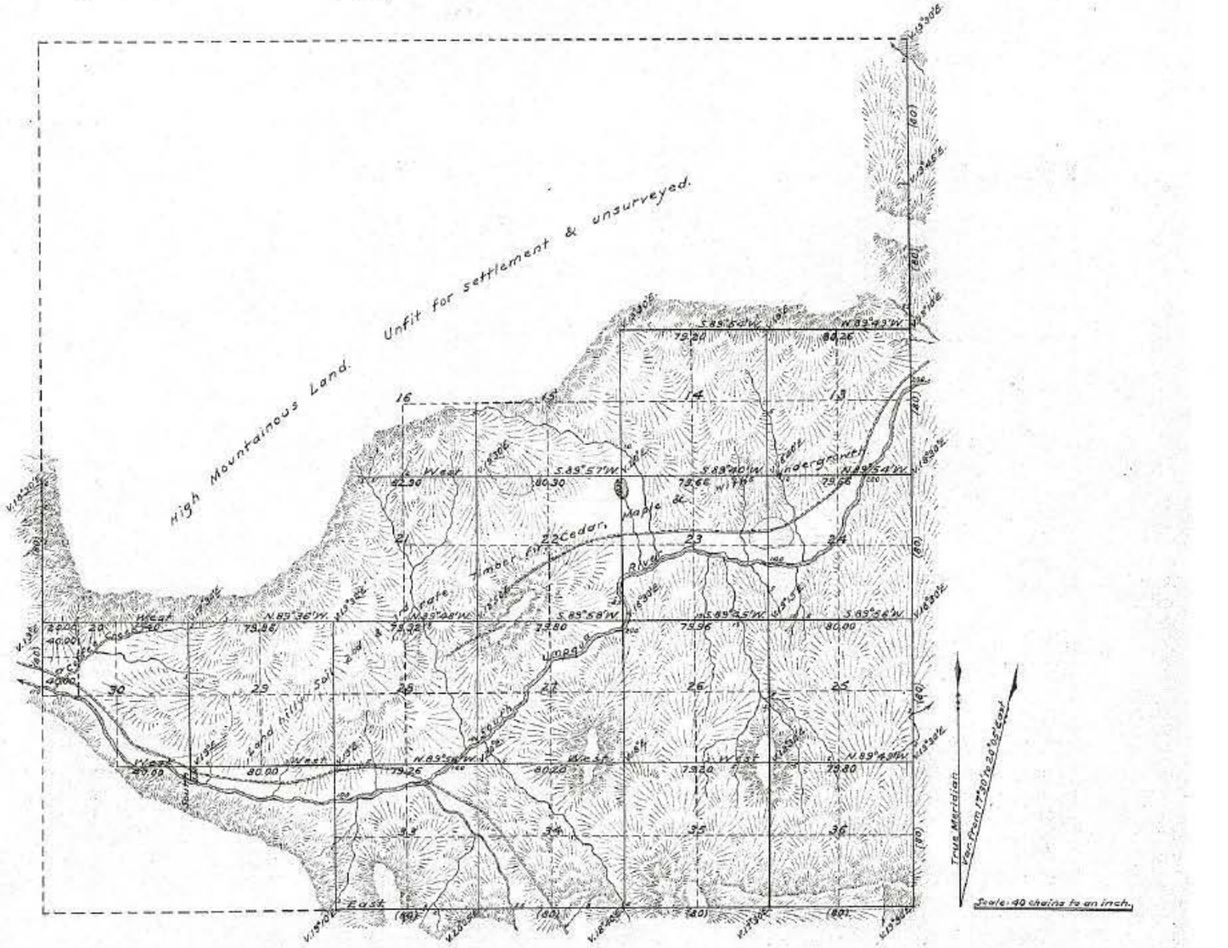
Surveyor drawing (plat) of the Tiller area, a partial GLO survey of the township, approved by the Surveyor General of Oregon in 1858.

- **T30S, R3W (plat date: February 20, 1858) - SE Douglas County:**

Surveyor drawing (plat) of the Milo area, a partial GLO survey of the township, approved by the Surveyor General of Oregon in 1858

353

Township No. 30 South, Range No. 2 West, Willamette Meridian, Oregon.



Surveys designated	By whom surveyed	Contract No.	Contract Date	Am't of Surveys Miles	Am't of Surveys chains	Am't of Surveys links	When surveyed
Township Lines	Dennis Hathorn	73	June 6, 1857	05	40	00	February 20th, 1858
Subdivisions	Dennis Hathorn	73	June 8th 1857	31	64	68	February 20th, 1858
Total number of Acres 10240.00							

The above Map of Fractional Township No. 30 South, of Range No. 2 West, of the Willamette Meridian, Territory of Oregon, is strictly conformable to the field notes of the survey thereof on file in this office which have been examined and approved.
Surveyor General's Office,
Salem, February 20th, 1858.

(Signed) John S. Zieber.
Sur. Gen. of Oregon.

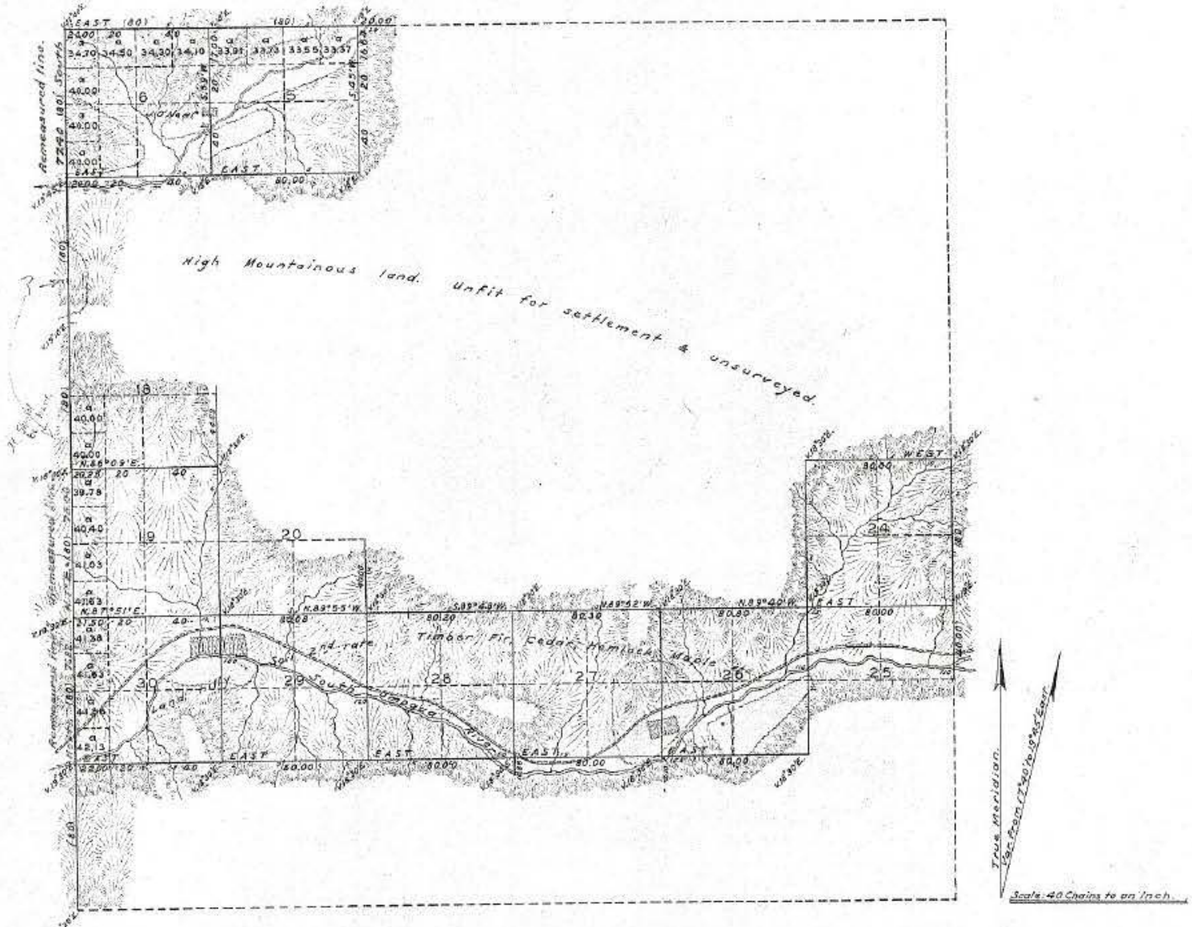
Public Survey Office,
Portland, Oregon, Sept. 9, 193

I certify this to be a correct copy of the original plat on file in this office.

Joseph A. Gaung
Office Cadastral Engineer.

398

TOWNSHIP Nº 30 SOUTH, RANGE Nº 3 WEST, OF THE WILLAMETTE MERIDIAN, OREGON.



Surveys designated	By whom surveyed	Contract		Amt. of Surveys			When surveyed.
		No.	Date	Miles	chains	links	
Township Lines	Nathaniel Ford	44	May 30th, 1854	06	00	00	March 9th, 1855
Subdivisions	Dennis Hathorn	73	June 8th, 1857	25	16	26	February 20th, 1858
Total number of Acres 6682.02							

The above Map of Fractional Township No. 30 South, of Range No. 3 West, of the Willamette Meridian, Territory of Oregon, is strictly conformable to the field notes of the survey thereof on file in this office, which have been examined and approved.
Surveyor General's Office,
Salem, February 20th, 1858.

(signed) John S. Zieber.
Sur. Gen. of Oregon.

Public Survey Office,
Portland, Oregon,
October 9, 1946.

I certify this to be a correct copy of the original plat on file in this office.

Joseph A. Gamoug
Regional Cadastral Engineer

Section IV: Historical Plant Names and Cross Reference to Scientific Names

Scientific names follow the current checklist of the Oregon Flora Project at Oregon State University. Other works consulted are shown at the end of the table.

GLO Plant Name & Variations	Modern Common Name or Probable Name(s) / Notes	Scientific Name*
TREES		
alder	white alder (most likely in bottoms, low drainages)	*Alnus rhombifolia*
alder	red alder (may occur in bottoms and moist uplands; probably much more likely here than white alder)	*Alnus rubra*
ash	Oregon ash	*Fraxinus latifolia*
balm, balm gilead, balm of gilead, balsam	black cottonwood	*Populus trichocarpa* (= *P. balsamifera* ssp. *trichocarpa*)
black oak	California black oak	*Quercus kelloggii*
cedar, ceder	incense cedar (more common in dryer forest/woodland) areas)	*Calocedrus decurrens* (= *Libocedrus decurrens*)
cedar, ceder	western red cedar (more common in moist areas)	*Thuja plicata*
chinquapin, chincapin, chinkapin, chinkopin, chincopin	golden chinquapin, giant golden chinkapin	*Chrysolepis chrysophylla* (= *Castanopsis chrysophylla)*
cottonwood	black cottonwood	*Populus trichocarpa* (= *P. balsamifera* ssp. *trichocarpa*)
dogwood	Pacific dogwood	*Cornus nuttallii*
fir	Douglas-fir: the primary conifer throughout this project; possibly with minor grand fir, in moist low elev. sites and mixed Dfir-white fir in higher cool sites	*Pseudotsuga menziesii*, *Abies grandis*, *Abies concolor*
hemlock	western hemlock	*Taxus brevifolia*
laurel, laurrel, laurell	Pacific madrone; (also see shrub list for laurel)	*Arbutus menziesii*;
live oak, liveoak, live-oak	canyon liveoak	*Quercus chrysolepis*
madrone, madrona, matherone	Pacific madrone	*Arbutus menziesii*
maple	assume bigleaf maple (= Oregon maple)	*Acer macrophyllum*
oak	usually white &/or black oak; possibly live oak to the west in project	*Quercus garryana*; *Q. kelloggii*;
		Q. chrysolepis
pine	usually ponderosa pine; sugar pine in local areas, Jeffrey pine on serpentine	*Pinus ponderosa*; *P. lambertiana*; *P. jeffreyi*
red cedar	incense cedar or western red cedar depending on location	*Calocedrus decurrens* (= *Libocedrus decurrens*); *Thuja plicata*
red fir	Douglas-fir	*Pseudotsuga menziesii*
redwood	used mostly for incense cedar; also possibly western redcedar &/or Port Orford cedar (SW coast)	*Calocedrus decurrens* (= *Libocedrus decurrens*), *Thuja plicata*, *Chamaecyparis lawsoniana*
spruce	possibly Douglasfir for this area, or ? (spruce is assumed absent here)	possibly *Pseudotsuga menziesii*, or ?
sugar pine	sugar pine	*Pinus lambertiana*

tamarack	assume white fir since lodgepole (= tamarack elsewhere) is absent; possibly Douglasfir (similar bark)	*Abies concolor* or possibly *Pseudotsuga menziesii*
timber	any older tree stand, conifer or hardwood	---
white fir	white fir (cool mid elevation snow zone)	*Abies concolor* or its hybrid with *A. grandis*
white oak	Oregon white oak, also known as Garry oak	*Quercus garryana*
willow	some likely tree willows here are: Pacific willow, Arroyo willow, Red willow, Scouler willow, or ?	likely *Salix lasiandra*, *S. lasiolepsis*, *S. laevigata*, *S. scouleriana*, &/or etc.
yellow pine	ponderosa pine &/or assume Jeffrey pine on serpentine	*Pinus ponderosa*; assume *P. jeffreyi* on serpentine soil or both species
yew, Pacific yew	Pacific yew	*Taxus brevifolia*
SHRUBS		
aroma balm (see balm)	sticky laurel, mountain balm, snowbrush, or varnishleaf ceanothus (west side)	*Ceanothus velutinus* or *C. velutinus* var. *laevigatus*
arrowwood, arrow-wood, Indian arrowwood, arrowood	creambush oceanspray	*Holodiscus discolor*
balm (shrub form)	sticky laurel, mountain balm, snowbrush, varnishleaf ceanothus	*Ceanothus velutinus* var. *velutinus* or *C. velutinus* var. *laevigata* (= var. *hookeri*)
blackberry	evergreen bb; Himilayan bb; or trailing bb (native sp.)	*Rubus laciniatus; R. bifrons* (= *R. procerus, R. discolor*)*; R. ursinus* (*most likely choice*)
briars	assume prickly or spiny shrubs	Various
brush	any dense shrub stand, or mix of shrubs & young tree regeneration	---
buckbrush, buck brush, buck, buck bush	probably redstem ceanothus or less likely snowbrush in moist areas; wedgeleaf ceanothus is likely only on very droughty warm sites or possibly on dry serpentine	*Ceanothus sanguineus* or less likely *C. velutinus* (cool moist climates); *C. cuneatus* (only dry warm sites)
ceanothus	various species in project area	*Ceanothus* velutinus*, C. cuneatus, C. integerrimus, C. sanquineus, C. cordulatus*
cherry, wild cherry	bittercherry at high cold elevations; chokecherry in low elev. riparian; less likely serviceberry or Kl. plum	*Prunus emarginata* (high cold) ; riparian: *P. virginiana* var. *demissa* (= *P. demissa*), in low uplands consider *Amelanchier* or *Prunus subcordata*
chincapin, chinquapin, chinkapin, chicapin, chincopin, chinkopin	golden chinquapin or giant chinquapin (also spelled chinkapin)	*Castanopsis chrysophylla* (= *Chrysolepis chrysophylla*)
elkbrush, elk-brush	may be generic locally for dense impenetrable brush: lilac, buckbrush, balm, etc	possibly *Ceanothus integerrimus*, *C. cuneatus*, *C. velutinus*, *C. sauguineus*, etc.
grape, wild grape, grape vine	western wildgrape	*Vitis californica*
greasewood, greecewood	wedgeleaf ceanothus or common buckbrush (our area); greasewood (Gilkey & Dennis 2001)	*Ceanothus cuneatus*
hazle, hazel, hazl	California hazel or western hazel	*Corylus cornuta* var. *californica*

huckleberry (see whortle)	huckleberry: various species depending on location , i..e. big, grouse, red or evergreen huckleberry.	*Vaccinium membranaceum* or *V. scoparium*, high cold east side; also *V. parvifolium* or *V. ovatum*, warm moist west side)
laurel, laurrel, laurle, lauarel (also, see trees)	snowbrush or varnishleaf ceanothus (also balm – shrub form, or mountain balm)	*Ceanothus velutinus* or *C. velutinus* var. *laevigatus*
lilac, wild lilac, lilack, lilach	deerbrush, wild lilac (lower elevations); but probably snowbrush in high east side snow zone	*Ceanothus integerrimus*, but probably *C. velutinus* in high cold eastside snow zone
manzanita, mancenita, mancinita, manzinita, mansanita	hoary manzanita; less likely bristly manzanita, or whiteleaf manzanita in dry warm sites; greenleaf manzanita only in colder climates and high elevations	*Arctostaphylos canescens, A. columbiana*; *A. viscida* (*dry warm areas*), *A. patula* (only in colder high elevations)
mountain balm	Snowbrush	*Ceanothus velutinus* (= *C. velutinus* var. *velutinus*)
Oregongrape	mainly tall Oregongrape & Cascade Oregongrape; also Piper's Oregongrape	*Berberis aquifolium*, *B. nervosa*, *B. piperiana*
poisonoak, poison oak	poison oak or Pacific poison oak	*Toxicodendron diversilobum* (= *Rhus diversiloba*)
red whortleberry, red whortl. bush	probably red huckleberry	*Vaccinium parvifolium*
rhododendron	Western or Pacific rhododendron (= mountain laurel). But sometimes misapplied to an unknown shrub	*Rhododendron macrophyllum* (except where misidentified by GLO)
rose	probably baldhip rose in mtns; less likely Nootka rose, dwarf rose, California rose, clustered wildrose, or ?	*Rosa gymnocarpa*; less likely *R. nutkana*, *R. spithamea*, *R. californica*, *R. pisocarpa, or ?*
salal, sallal	salal	*Gaultheria shallon*
serviceberry, service, sarvice	primarily Pacific / Western serviceberry; less common is pale serviceberry	*Amelanchier alnifolia* var. *semiintegrifolia* (= *A. florida*); *A. pallida* (minor)
snowbrush, snow brush	snowbrush (also see balm)	*Ceanothus velutinus*
tasslewood, tasselwood	creambush oceanspray	*Holodiscus discolor*
thimbleberry	thimbleberry	*Rubus parviflorus*
thorn brush	unknown; may be mountain whitethorn, particularly in brush fields or disturbed mixed conifer stands	*unknown; may be Ceanothus cordulatus*
vine maple, vine-maple	generally vine maple; rarely Douglas maple in high cold true fir forest but probably not in the Tiller GLO study	*Acer circinatum* (probably throughout this study area); unlikely to be *Acer glabrum* var *douglasii* (very high cold snow zone)
whortle, whorttle, whortleberry	huckleberry: mainly red huckleberry (warm moist), evergreen huckleberry (?), big huckleberry (cool); less likely is grouse huckleberry (cold)	*Vaccinium parvifolium; V. ovatum; V. membranaceum*, *V. scoparium*;
willow (shrub form)	various in riparian i.e. Coyote willow, sandbar willow, etc; others in uplands	various in riparian i.e. *Salix exigua*, *S. sessilifolia*, etc; other willow species in uplands

witch hazel	unknown shrub or small tree mistaken for witch-hazel ; most likely a misidentified California hazel (see hazle)	unknown: see Hamamelis virginiana (witch-hazel) native to eastern USA but not here; ours is probably *Corylus cornuta* var. *californica*
OTHER		
fern	fern, various sp.	---
grass	grass, various sp.	---
high fern	unknown fern sp.	---
* Scientific name references (primary sources): Abrams and Ferris (1923-1960); Gilkey and Dennis 2001; Hickman (ed. Jepson Manual) 1993; Hitchcock & Cronquist 1973; Peck 1962; Preston 1966; Sudworth 1908; see Pullen (1995), for local Indian cultural plant names. (also see botanist contributors list in "Acknowledgements Section" for those who assisted correlating difficult historical plant names with modern names).		

Section V: Descriptions of Vegetation Type (Subclass) Map Units

* Indicates new subclass described for this project.

F (a) <u>Upland Forest</u>

FFC - Low to mid-elevation dry Douglasfir dry forest with combinations of incense cedar, madrone ("laurel"), ponderosa pine , sugar pine and bigleaf maple. Dense understory may include fir, hazel, canyon live oak, vine maple, yew, salal, madrone, arrowwood, ceanothus ("mountain balm"), briars, fern, huckleberry, dogwood, manzanita, chinquapin, grass. Madrone frequently used for witness trees. No hemlock, white oak, or black oak. Umpqua Valley and southward.

FFCBu - Burned FFC, often with scattered trees surviving fire. May include red alder or willow.

FFH * Moist lower elevation fir-hemlock-cedar forest (assume both incense and w. red cedar), often with "laurel" (madrone), chinquapin and big leaf maple. Occasionally there is sugar pine, yew or red alder. The generally dense, mixed evergreen undergrowth is primarily "laurel" (sticky laurel or snowbrush), vine maple, hazel, Oregongrape and tree regeneration, namely fir (Douglasfir) and western hemlock. Less commonly cited is salal, huckleberry, thimbleberry, arrowwood and lilac (also probably snowbrush). Rare references to spruce and tamarack are probably miss-identifications of white fir in the upper elevations in this map unit FFH differs from the (similar) Lane and Douglas County Type, FFHC, by the absence of coastal/northern species of devils club, myrtle or salmonberry, and the occasional inclusion of southern species of ponderosa pine and sugar pine. In the Tiller project, stand density class was almost always "very dense forest" and the understories were usually "dense undergrowth."

FFHBu * Burned FFH; except for the reference to fire - an "old burn," there is no GLO plant composition data. However, we can assume a partial canopy with brushy undergrowth, or brushfield/thicket dominated by species indicated in the adjacent stands.

FFHE - Mid-elevation (1500-4000 ft) mixed conifer forest with mostly broadleaved evergreen understory; various combinations of Douglasfir, white fir, western hemlock, western red cedar, sugar pine, "bull pine," incense cedar, madrone ("laurel"), bigleaf maple, dogwood, red alder and grand fir. Sparse to dense understory may include rhododendron, Oregon grape, yew, vine maple, chinquapin, live oak, madrone, ceanothus ("mountain balm," "balm," "greasewood," "chaparral," "buckbrush," "chamise," "slickleaf,"), manzanita, salal, ocanspray ("arrowwood"), "tasselwood," huckleberry. Occasionally cherry and thimbleberry; sometimes "bunchgrass" or "good grazing." Consistent presence of rhododendron, ceanothus, chinquapin, manzanita and madrone in understory is diagnostic with only occasionally use as witness trees.

FFHEBu - Burned FFHE, often with scattered trees surviving fire.

FFHU ***** Moist low elevation mountains, fir forest with laurel and cedar (assume either incense or w. red cedar), often including chinquapin and bigleaf maple. Fir is primarily Douglasfir, but we can assume that grand fir may be a minor component in very moist positions. **<u>Western hemlock was regularly present in the understory here, but never listed in the canopy.</u>** Other undergrowth is usually vine maple, hazel and arrowwood, plus tree regeneration of chinquapin, cedar, fir, madrone, and bigleaf maple. Occasionally thimbleberry, huckleberry, willow, alder, snowbrush, elkbrush, high fern, and rhododendron are present. In the Tiller project, FFHU is mapped exclusively in two large areas west of the Tiller community, both north and south of the river near Milo. It is classified as "very dense" forest canopy at most locations, and the understory is usually described as "dense undergrowth."

FFHUBu * Burned FFHU, described as "dense brush" or "dense undergrowth," sometimes with "laurel" (snowbrush), hazel, vine maple, arrowwood, thimbleberry, elkbrush, huckleberry, rhododendron; may also include fir, cedar, and chinquapin regeneration.

FFOM - Low to mid-elevations, dry Douglasfir-black oak-white oak-madrone ("laurel") forest, often with ponderosa pine or sugar pine. Oak and madrone consistently used for witness trees but also fir in the Tiller area. May also include bigleaf maple, myrtle, incense cedar ("redwood"), and red cedar. Dense or open understory may include hazel, poison oak, chinquapin, madrone, willow, oak brush, briars, ferns, ninebark, Oregongrape, salal, but sometimes only madrone. Vine maple is occasional. No hemlock, live oak and tanoak indicated in GLO data. In the Tiller project, FFOM is mapped on warm southerly topography near Milo where pine was surprisingly unreported; oak and cedar are included but the species for each occurrence is not given. The moist site species (myrtle, chinquapin, ninebark, salal and vine maple) are absent or seldom mentioned, possibly due to the dry environment but possibly due to the very scanty dataset provided here by the GLO surveyor. Witness tree spacing data (all fir) is classified as "very dense" forest canopy, and understory density descriptions are either "dense undergrowth" or not given a rating.

FFON - Low to mid-elevation xeric mixed hardwood-mixed conifer forest. Either yellow pine (ponderosa) or hardwoods are dominant. Douglasfir is less abundant and can be minor along with incense cedar. Both black oak and madrone (laurel) are usually present, with white oak included at dryer, lower or more open locations. This community is typically mapped on warm droughty sites such as southern aspects, or as developing stands that are early to midseral stages of a fir Type. Understory species are not specified on some surveys, but in others are described as "thick/some" manzanita, greasewood, lilac ("lilach"), occasionally "plumb", or willow, and at high elevations cherry (bittercherry). Other plants less often mentioned include arrowwood, chimesal, hazel and bigleaf maple. Unmappable areas of OFON and dryer pine, oak woodland or savanna may be included. Areas with granitic soils may also have sugar pine although not listed in GLO survey notes.

FFY - Young forest, "fir brush," or "fir thicket," species unspecified, burned within last ca. 20 years. Diameters < 12-14 inches. May include cedar, hemlock, alder, maple, rhododendron, salal, ceanothus, hazel, madrone, "birch," and brush." At the Tiller project, a single example occurred about 3 miles west of Milo and was describe as "brushy fir openings," probably an old burn representing the FFHU type.

FM - "Laurel" (madrone) forest or "thicket." Douglasfir occasional in some locations. At Tiller, a single example was mapped south of Milo within the FFHU type and was described as "dense madrone brush."

F (b) Riparian and Wetland Forest

FAS - Ash swale, sometimes "brushy" or "thick." Ash, willow and briars are the only plants mentioned in GLO notes. It is found in low valley floor depressions/swales associated with creeks or dry channels of the Rogue Valley. FAS (the most similar Type for the tiller project) was mapped in the Ash Creek valley near South Umpqua Falls, about 15 miles NE of Tiller. Here GLO data mention only a "dense thicket" with ash and willow in places, on flat bottomland with "vegetable loam" soil. A modern soil survey here refers to alluvial land with wide ranging characteristics, some on high terraces suitable for the local conifers and some on lower level flood plains and poorly drained where ash is present. A second GLO vegetation Type, FA (not used here), is also similar to ours but with more data described as: Brushy ash "swamp," "swale," "bottom, or "ash land," sometimes with red alder, bigleaf maple, crabapple. It has no conifers, but our example is probably a complex of soil environments where conifers would have also occurred in places.

FMA * Maple swamp (assume bigleaf maple, not vine maple although not specified by surveyors), but no other GLO data is available. It is likely that ash, alder, willow and/or other riparian trees/shrubs were present.

FOAM - Southern Oregon (south coast and Umpqua Valley) mixed riparian forest with various combinations of oak, ash, bigleaf maple, myrtle, willow, alder, Douglasfir, grand fir ("ponderosa fir"), and white fir. "Dense" or "brushy" understory may include hazel, fern, ninebark, wild grape, poisonoak and briars, with salal or salmonberry near the coast. It may include ponderosa pine on gravelly soils. In the Tiller project, FOAM was mapped in the Days Creek floodplain and along the South Umpqua River (bottomland) near Milo and Tiller. Here this riparian zone is very poorly documented making its classification uncertain. It is referred to as "oak timber" in places, with witness trees of black oak (and probably white oak), maple (bigleaf), alder, "laurel" (madrone) and fir ("red fir" or Douglasfir, and possibly grand fir). In some areas this zone is also referred to as "oak openings" (savanna). Witness tree density can be classed as forest, woodland or savanna, depending on location, so that the Tiller map unit of FOAM must be viewed as a group of historic Types representing a complex set bottomland environments (soils and ecosystems) and varied ecological status within the zone. We would expect these to be mixed canopies with brushy understories and a rich flora of riparian species. However, in our dataset, we did not have records of ponderosa pine, cottonwood or willow (expected to have occurred here in places). We would not have expected the coastal salmonberry to have been present. Some wet meadow/prairies (PF) are probably inclusions within the Type.

H. Shrubland and "thickets"

HN - "Greasewood" (wedgeleaf ceanothus) brush or "thickets," primarily in a dry climate on plains or uplands and droughty sites. In the Rogue Valley, treeless based on GLO notes but assumed to have incidental white oak or yellow pine in places. In the Tiller project, HN is mapped just south of Drew in a higher precipitation zone, but no additional GLO data is given.

HU - Brush; includes thickets where no species or other descriptors are given; composition unknown.

HW - Willow "swamp," "thicket," or "swale" at lower elevations, sometimes scattering willow or willow openings. May include unmappable inclusions of crab apple, cascara, ninebark, hard hack, briars, gooseberry, "swamp grass." May contain standing water or beaver dams. May contain small amounts of alder, ash or bigleaf maple but trees are mostly peripheral. No conifers. Minor extent in the Tiller project where species composition may not be typical for the Type; no other (local) GLO descriptive information provided.

HZ - Hazel brush or thicket, sometimes with vine maple.

N. <u>**Composition Unknown**</u>

NG - "Glade," "opening," "open ground," or "open space" within forest or shrubland where composition is unknown; if grassy it should be reclassified as prairie, nor should it be confused with savanna "openings." In the Tiller project it is minor in extent and refers to a "rocky glade" or opening in forest with no vegetation data provided.

O. <u>**Woodland**</u> (Stands are variable & sometimes include areas of "Forest" density)

OFC - Low to mid-elevation dry Douglasfir-incense cedar woodland with combinations of ponderosa pine, sugar pine, bigleaf maple, and madrone ("laurel). Umpqua Valley and southward. No hemlock or oak indicated from GLO records. At Tiller project, it is found just NE of Tiller and is probably a more open example of Type FFC.

OFH - Mesic mixed conifer woodland, with various combinations of Douglasfir, red cedar, and western hemlock, with lesser amounts of bigleaf maple, white oak, ash, madrone and red alder. Understory may include vine maple, dogwood, hazel, viburnum, fern, briars, yew; rarely open with grass and fern or "good grazing." Probably a more open example of type FFH. In the Tiller project, OFH is mapped at middle elevations north and south of Tiller, is minor in extent and probably without the potential for white oak, ash, viburnum or briars mentioned above.

OFOM - Dry mixed Douglasfir-black oak-white oak-madrone woodland. May include ponderosa pine, bigleaf maple, incense cedar ("redwood"), and red cedar. Dense brushy understory may include hazel, poison oak, oak sprouts, madrone, willow, oak brush, bracken, sometimes only madrone. Vine maple occasional. No hemlock. Southern Lane County and southward. In the Tiller project, OFOM is mapped mainly on low warm southerly slopes along the South Umpqua River; stands are referred to as "fir timber" where oak and "laurel" (madrone) are common but secondary. Some lines describe undergrowth as "very thick oak," or "thick oak undergrowth."

OOB - White oak-black oak woodland, often with madrone ("laurel") and ponderosa pine. "Dense understory may include hazel, poison oak, madrone, bigleaf maple, willow, oak, fern, briars. No fir. Southern Lane County and southward. In the Tiller project, mapping is just south of Tiller and minor in extent with little GLO data provided.

OPFOC - Moist woodland with ponderosa pine, black oak, madrone ("laurel"), red fir, white fir, "ceder" (incense cedar), and sugar pine. Understory is poorly documented in GLO survey notes, but presumed to have had low to moderate shrub cover and some grass. Southern Cascades plateau and foothills near Butte Falls. In the Tiller project, OPFOC was mapped in uplands about 9 miles NE of Tiller and described as either scattering pine timber or scattering timber (red and white fir, sugar and yellow pine, cedar); varied undergrowth includes white oak grubs, vine maple, arrowwood, chinkapin, fir. This map unit is probably the result of an old mixed severity burn (or repeat understory burning) representing forest cover class FFC.

OPMO - Ponderosa ("yellow") pine-mixed oak (black and white) woodland, usually with madrone ("laurel"). Douglasfir and incense cedar are sometimes present in minor amounts. Topography is typically low mountains, foothill slopes and valley floor positions. Understory is often unspecified but may include "greasewood <u>or</u> buckbrush" (wedgeleaf ceanothus), oak, scrub oak, poisonoak, Oregongrape, serviceberry and whiteleaf manzanita. Occasionally "plum," "bugwood" (mtn. mahogany), or grass are cited in GLO notes and inclusions of riparian brush or creek timber are often present in the Applegate and Rogue River valleys and foothills. In the Tiller project, OPMO is found just SE of Tiller, and is described as "Land hilly and sparsely timbered with pine, oak and fir."

P. **<u>Prairie</u>**

PF - Wet meadow or "creek prairie" found on low terraces, clayey swales, wetlands and riparian zones, subjected to incidental or seasonal flooding and/or seasonal watertables. GLO descriptions refer to "prairie bottom, fine grassy glade, marshy swale, springy swale, grass and clover moist glade," and "swaley."

PU - Xeric upland prairie mapped on gentle to moderate hill slopes and steep uplands, also on steep mountain ridges, mostly south facing. Clayey soils are common in the lower elevations of the Rogue-Bear Creek Valley slopes; shallow loamy (or stony) soils are common in upper elevations and in the Siskiyou Mountains. Although treeless, PU may have inclusions of scattered or incidental trees/shrubs, especially on margins, sometimes with patches, "scattering" or "a few scattering" white oak (savanna), and sometimes with islands of oak woodland on included slopes. References are made to "good grazing land, hills covered with grass, good grass, grassy, bald hills."

S. **<u>Savanna</u>**

SF - Douglasfir savanna, "fir openings, "fir and fern openings." Understory may contain fern. No oak.

SOB - White oak-black oak savanna, usually with madrone ("laurel") and sometimes ponderosa pine. May contain unmappable inclusions of "brush" or "thick undergrowth," and woodland or forest on northerly slopes, ravines and along streams. No Douglasfir is typical in

Southern Lane County and southward.   However, in the Tiller project, fir is sometimes present as a minor component or part of inclusions on more favorable positions.

SOF - White oak-Douglasfir savanna. Understory mostly herbacious. Madrone may be present in southern lane County and southward. In the Tiller project, SOF was mapped NW of Milo on low warm southerly foothills. It is assumed to be mixture of oak savanna slopes, and clumps or groves of fir (with associated trees) on more favorable positions in the map unit.

SP - Pine savanna; usually ponderosa pine or species is unspecified. On ultramafic soils (serpentine), pine may indicate Jeffrey pine.

SPMO - Ponderosa pine-mixed oak (black and white) savanna, usually with madrone ("laurel"). Either pine or oak may dominate. On some locations, including some serpentine soils, fir is present but is minor or secondary to the other canopy species. This Type is the same as woodland Type OPMO but has lower tree canopy density, referred to as "openings." Understory may be unspecified by GLO surveyors, or described as "little, very little, some, or very sparse." In some areas, there is "good grass" or "good grazing." Understory shrub references have included "greasewood" (wedgeleaf ceanothus), lilac and whiteleaf manzanita (sometimes in bunches). This xeric type is mostly found on valley floors, foothills and southerly slopes in central eastern Josephine County. In the Tiller project, SPMO was mapped E and SE of Tiller, mostly described by GLO surveyors as "pine and oak openings." They often mentioned "grass" or "good grass."

U. Unvegetated

UR - Rock outcrops, talus, exposed bedrock, "barren slopes."

W. Water and Wetlands

W - Water bodies and rivers (> 1 chain across).   Includes rivers, sloughs, ponds, lakes, and "marshy lakes."

WG **-** "Grass marsh" or "grassy marsh." Composition unknown.

WMU - Marsh, "wet meadow," "marshy bottomland," Marshy swale," "marshy ground," "springy ground." Composition unknown.

WSU - "Swamp" or "open swamp," and "beaver swamp."   Composition unknown.   Very wet and miry.