SYNOPSIS OF METHODS USED TO MAP HISTORICAL VEGETATION IN OREGON AND WASHINGTON

John A. Christy, Oregon Biodiversity Information Center, Institute for Natural Resources, Portland State University
Edward R. Alverson, The Nature Conservancy of Oregon

December 2011

Mapping historical vegetation in Oregon and Washington has been ongoing since about 1993. It is based primarily on General Land Office (GLO) surveyors' descriptions of vegetation, recorded between 1851 and about 1940. For areas along the coast and the lower Columbia River, topographic maps ("T-sheets") of the U.S. Coast Survey (later called U.S. Coast and Geodetic Survey, and more recently the National Geodetic Survey)—based on field work conducted between 1852 and 1889—have been integrated whenever possible with GLO data because of their superior cartography and land cover symbology. For more detailed descriptions of mapping methods, see Christy and Alverson (2011) and Hickman and Christy (2011). A more detailed data entry guide is available on request from john.christy@pdx.edu.

Maps of historical vegetation are created in four steps: (1) transcription of GLO survey notes, (2) mapping and classifying historical vegetation based on GLO data, (3) integrating data and cartography from U.S. Coast Survey maps where available, and (4) digitizing the product to create a GIS layer.

Transcription of GLO survey notes. GLO survey notes are transcribed from digital archives of the USDI Bureau of Land Management, microfiche, or typescript transcriptions of survey notes. They are entered into MS Access database tables to facilitate mapping of vegetation and analysis of the notes. Data for each township are entered in two tables. The first table records the names of surveyors, the dates of surveys, the surveyors' descriptions of the 6-mile exterior boundary lines of the townships (often lacking in the notes), and the surveyors' descriptive summary ("General Description") for all townships transcribed. The second table records data for the northern boundary, eastern boundary, and interior subdivision of each township into 36 sections, following in part methods used by previous GLO projects in Minnesota and Michigan (e.g., Comer et al. 1995; Albert and Comer 2008). Survey notes for meander lines are occasionally transcribed if they contain references to vegetation. "Random lines" and calibration of survey equipment are not transcribed because they contain no references to vegetation. Survey notes for boundaries of Donation Land Claims and Indian Allotments contain varying amounts of vegetation data and are a potential source of badly-needed detail for the interiors of sections, but have not been used to any great extent because of limited time and funding. Notes about triangulations, offset lines, sighting flags, etc., are usually omitted unless they include useful information for mapping purposes. In cases where lines were resurveyed at a later date, we use the earliest surveys whenever possible.

Some omissions or abbreviations of survey notes have been required to streamline the process of transcription. Repetitive phrases are often reduced to standardized abbreviations. In mountainous terrain, streams less than 10 links wide are usually omitted, and this width coincides with the

minimum width for streams depicted on USGS 7.5" quad maps. At meander points where rivers or lakes were intersected by survey lines, only (1) details about meander posts and their witness trees, (2) condition or height of streambanks, and (3) distance across the body of water along the survey line are included. In mountainous terrain, references to minor or repetitive topographic ups and downs along the survey line are omitted unless there are references to vegetation and witness trees. In these instances, only major topographic features such as main ridges, divides between named drainages, and bottomlands are recorded. When recording compass bearings to witness trees, degrees are omitted but their cardinal directions are transcribed. Compass bearings to cultural features are transcribed verbatim.

Original spelling is retained whenever possible, but punctuation and capitalization is added to improve readability. Modern geographical names, if known, are inserted in brackets to aid in mapping. Illegible words are left as blank lines, and editorial or explanatory comments are sometimes inserted in brackets to aid interpretation. All survey data are recorded in chains and links.

Each data record is flagged with a single-letter code to facilitate sorting. Codes are used to identify (1) data recorded at quarter corners, section corners, and meander posts, (2) plant names mentioned in line descriptions but not previously recorded along the line, (3) ponded water, (4) rivers, (5) streams, (6) both Native American and Euroamerican cultural features, (7) objects (usually trees) directly in the path of the survey line, (8) topographic features along section lines, and (9) changes in vegetation types along survey lines.

Names of plants recorded along the survey line, including witness trees for quarter and section corners and meander posts, or those listed in the line description, are entered in a separate field. Witness tree diameters (in inches), bearings from corners and meander posts, and distances (in links) from corners and meander posts are recorded in separate fields.

Mapping and classification of vegetation. Vegetation units are mapped manually on mylar overlays, using USGS 1:24,000 topographic maps as a base. Vegetation types are defined whenever possible using the surveyors' original descriptions, independent of existing vegetation classifications. A progressively expanding vegetation classification develops as different vegetation types are encountered in the survey notes, defined by species used as witness trees or listed in line descriptions. Stands are further segregated using distances to witness trees as recorded in the survey notes, in an attempt to preserve distinctions recorded by the surveyors (Table 1).

Boundaries between vegetation units are first delineated along survey lines using distances in chains as recorded by the surveyors. Boundaries in the interiors of sections, for which no accurate survey data are available in typical subdivision survey notes (Donation Land Claim and Indian Allotment surveys sometimes do include such data), are delineated when shown on surveyors' township plat maps, and secondary sources such as historical air photos, soil maps of the Natural Resources Conservation Service (NRCS), and best professional judgement based on topographic features. Boundaries must sometimes be inserted subjectively between vegetation types when specific entry or exit data are scanty, inconsistent, or altogether lacking in the survey notes but present on the plat maps. Given these limitations, a map showing discrete polygons is

therefore a simplification of what really occurred on the landscape. We estimate our mapping accuracy to be within 10 meters along section lines, as long as modern section corners are the same as at the time of survey, and 100-300 meters in the interiors of sections. Mapping accuracy within sections in some cases could no doubt be improved by using related GLO surveys (Donation Land Claim boundaries, meanders, Indian reservation lot lines) when available, but we lacked the time and funding to do this.

NRCS soil maps are useful in when mapping the extent of hydric soils in the interiors of sections. Because surveyors did not always distinguish between wet and dry prairie, particularly if surveys were done during the dry season, we map all prairie without regard to hydrology. Once mapping is completed, digital NRCS SSURGO data are used to distinguish wet prairie from dry upland prairie, based on the presence of hydric soils. Surveyors' township plat maps are used to delineate stream and river channels as recorded at the time of survey, unless they were sketched in topographically impossible positions such as on ridges or hillsides, in which case standard USGS quads are used as a base.

Cultural features (e.g., buildings, gardens, fences, roads, agricultural fields) recorded at the time of survey are not included in the vegetation maps. Because most agricultural fields in the early 1850's were established on what originally had been prairie, we map them as prairie.

Integration of U.S. Coast Survey maps. Where available, land cover data and cartography from topographic maps ("T-Sheets") of the U.S. Coast Survey (later called the U.S. Coast and Geodetic Survey) are integrated with GLO data to produce a final product. Cartography of the Coast Survey maps was superior to that of the GLO township plat maps, and when georeferenced, is substituted for linework shown in the plat maps. Georeferenced maps for the lower Columbia River are available from the University of Washington. Land cover symbology used in the Coast Survey maps was interpreted by Shalowitz (1964) and Graves et al. (1995), and provides important detail in vegetation structure and hydrology. The Coast Suvey maps provide highly accurate delineations of small-patch vegetation and stream alignments at a level of detail not possible from GLO data, while the GLO data provide information on vegetation, streams, and cultural features that are not available from Coast Survey data. When combined, the two sources of information provide high-quality cartography on the composition and extent of various vegetation types at the time of survey.

Digitizing. The manuscript mylar overlays with polygons of historical vegetation are scanned or digitized by hand to create ArcMap shapefiles. Details of the digitizing process are contained in the GIS metadata.

REFERENCES

Albert, D. A. and P. J. Comer. 2008. Atlas of early Michigan's forests, grasslands, and wetlands: an interpretation of the 1816-1856 General Land Office Surveys. Michigan State University Press, East Lansing. 136 pp.

Christy, J.A. & E.R. Alverson. 2011. Historical vegetation of the Willamette Valley, Oregon, circa 1850. Northwest Science 85: 93-107. http://www.bioone.org/doi/pdf/10.3955/046.085.0202

Comer, P. J., D. A. Albert, H. A. Wells, B. L. Hart, J. B. Raab, D. L. Price, D. M. Kashian, R. A. Corner and D. W. Schuen. 1995. Michigan's Native Landscape as interpreted from the General Land Office Surveys 1816-1856. Report to the U.S. Environmental Protection Agency Water Division, Michigan Department of Natural Resources Wildlife Division, Michigan Department of Natural Resources Saginaw Bay Watershed Initiative, Michigan Department of Natural Resources Land and Water Management Division, Coastal Management Program, Hiawatha National Forest, and Michigan Department of Military Affairs. Michigan Natural Features Inventory report 1995-07. 78pp.

Graves, J.K, J.A. Christy, P.J. Clinton & P.L. Britz. 1995. Historic habitats of the lower Columbia River. Report to Lower Columbia River Bi-State Water Quality Program, Portland, Oregon. Columbia River Estuary Task Force, Astoria, Oregon. 14 pp + GIS cover depicting historic vegetation along 145 river miles, based on U.S. Coast Survey cartography, 1860-1890. http://www.lcrep.org/sites/default/files/pdfs/47.%2001785.pdf

Hickman, O.E. & J.A. Christy. 2011. Historical vegetation of central southwest Oregon, based on GLO survey notes. Final report to USDI Bureau of Land Management. Medford District, Oregon. 124 pp.

Shalowitz, A.L. 1964. Shore and sea boundaries, with special reference to the interpretation and use of Coast and Geodetic Survey data. Volume 2. Publication 10-1. U.S. Government Printing Office, Washington D.C. 749 pp. http://www.nauticalcharts.noaa.gov/hsd/shalowitz.html

Table 1. Classification of stand structure for historical vegetation, based on General Land Office survey data.

Vegetation class	Distance to witness tree	GLO descriptors
Forest	< 100 links [66 ft] all witness trees present	"timber," "heavy," "dense," "thick;" understory brushy or ferny
Woodland	100-200 (400) links [66-132 (265) ft] most witness trees present	"timber," "scattering timber," "thinly timbered," "sparsely timbered," "open;" understory dense, brushy
Savanna	(100) 200-400 links [(66) 132-265 ft] most witness trees present	"openings," "scattering timber," "thinly timbered," "sparsely timbered," "open;" understory "open" or with shrubs, with "good grazing," "good for stock," "grass in abundance," or not described
Prairie	> 200-800 (1750) links [132-528 (1155) ft] witness trees often absent	"prairie," "plains," "fern prairie;" understory lacking shrubs, or not described