A forest vegetation database for western Oregon

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Richard T. Busing

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Abstract

Data on forest vegetation in western Oregon were assembled for 2323 ecological survey plots. All data were from fixed-radius plots with the standardized design of the Current Vegetation Survey (CVS) initiated in the early 1990s. For each site, the database includes: 1) live tree density and basal area of common tree species, 2) total live tree density, basal area, estimated biomass, and estimated leaf area; 3) age of the oldest overstory tree examined, 4) geographic coordinates, 5) elevation, 6) interpolated climate variables, and 7) other site variables. The data are ideal for ecoregional analyses of existing vegetation.

Introduction

Forest vegetation data suited for ecological monitoring and assessment were assembled for western Oregon. The database of recent (>1993) forest vegetation plot data was created from standardized field surveys. The surveys consist of field plot data collected under ecological programs of the UDSA and the USDI including forests that are not heavily managed.

Methods

A set of data on 2323 forest stands in western Oregon was assembled from USDA and USDI databases (Fig. 1). All stands were inventoried after 1993 following USDA Forest Service conventions adopted for an ecological survey of forested federal lands (Max et al. 1996). In that system, known as the Current Vegetation Survey (CVS), plots were established on a square grid at 5.5 km intervals. A five-subplot design covered a 1-ha area for tree stratum data collection at each plot site. Measurements on live trees included diameter at breast height, canopy height and, for selected individuals at most sites, tree age. See documentation at http://www.fs.fed.us/r6/survey/ for further details on the survey data.

Sites in which all five subplots were inventoried and tree age data were collected were selected for analysis. Because the surveys involve site re-measurements on a rotating panel with an assigned measurement year, one measurement visit for each site was selected. Because of plot design modifications early in the CVS program, data from later sampling dates (Panel 2) were used for most sites. Panel 2C, a second, subsetted measurement in the CVS cycle, was used for Forest Service data except in Siuslaw National Forest where Panel 1 was used. The reason for using Panel 1 data in Siuslaw National Forest was that the full set of plots was sampled on Panel 1, yielding a higher number of plots per unit area. This provided adequate information on old forest stands (>150 yr), which are relatively scarce in coastal regions encompassed by Siuslaw N.F. The first Panel was also used for BLM data because it was all that was available in early 2003. The BLM data received had not been screened and edited. Although it is highly unlikely that this would result in major errors in estimates of forest vegetation composition in the database, users should be aware of the potential for minor errors.

Summaries from the Current Vegetation Survey data included all live trees $\geq$7.6 cm dbh. Basal area for selected dominant species and for all species combined was calculated (Barbour et al. 1980). Stand age was estimated as the maximum age of a cored tree at each plot site. Biomass and leaf area were estimated with regional allometric

equations for major species (Dale and Hemstrom 1984, Ter-Mikaelian and Korzukhin 1997). Climate data from a 4-km grid were assigned to each plot site using the geographic coordinates of the plot and the interpolated climate data sets documented by Lugo et al. (2000). Ecoregion data for each site follow the Omernik classification (Thorson et al. 2002).

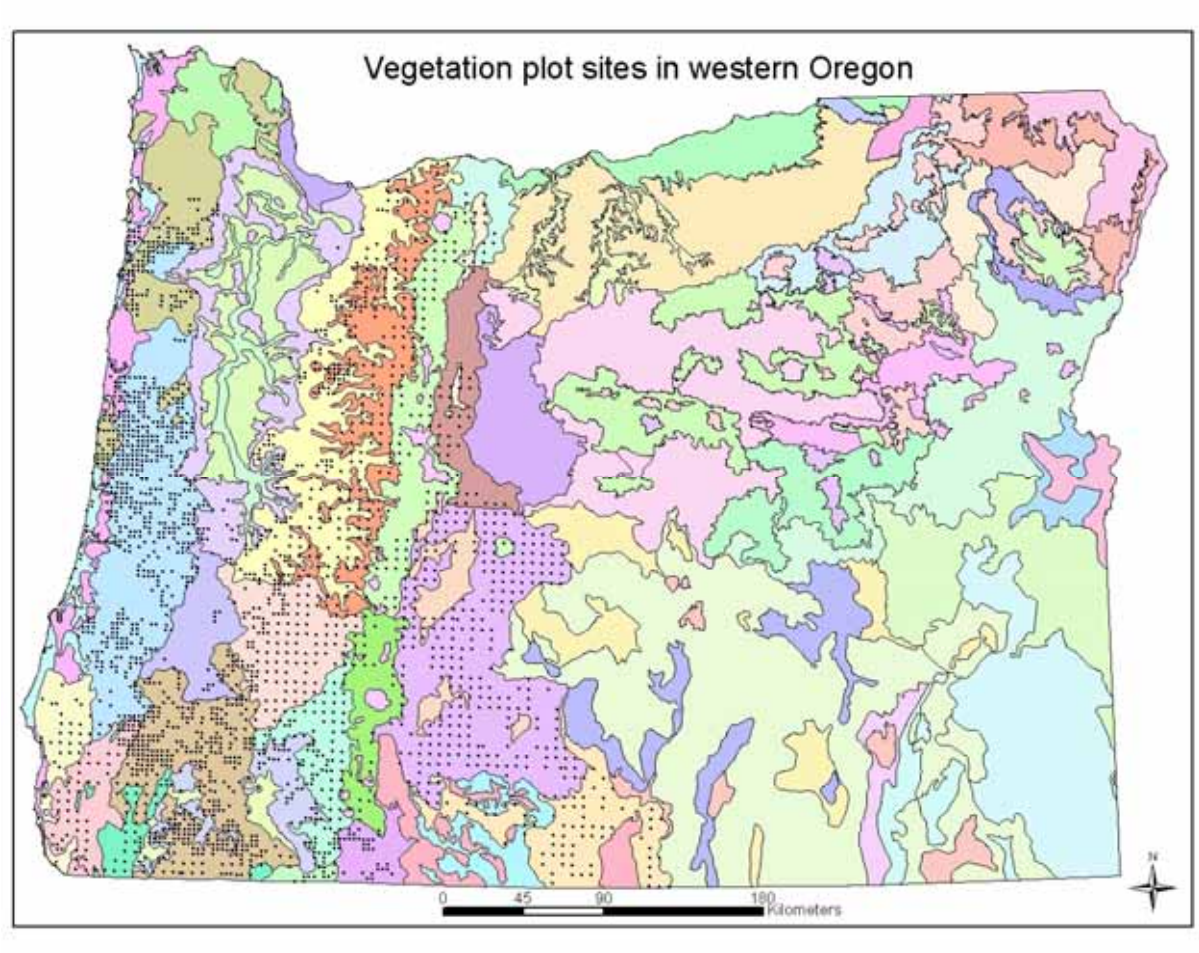

Fig. 1. Locations of the forest survey plots in the database in relation to Omernik ecoregions (level IV).

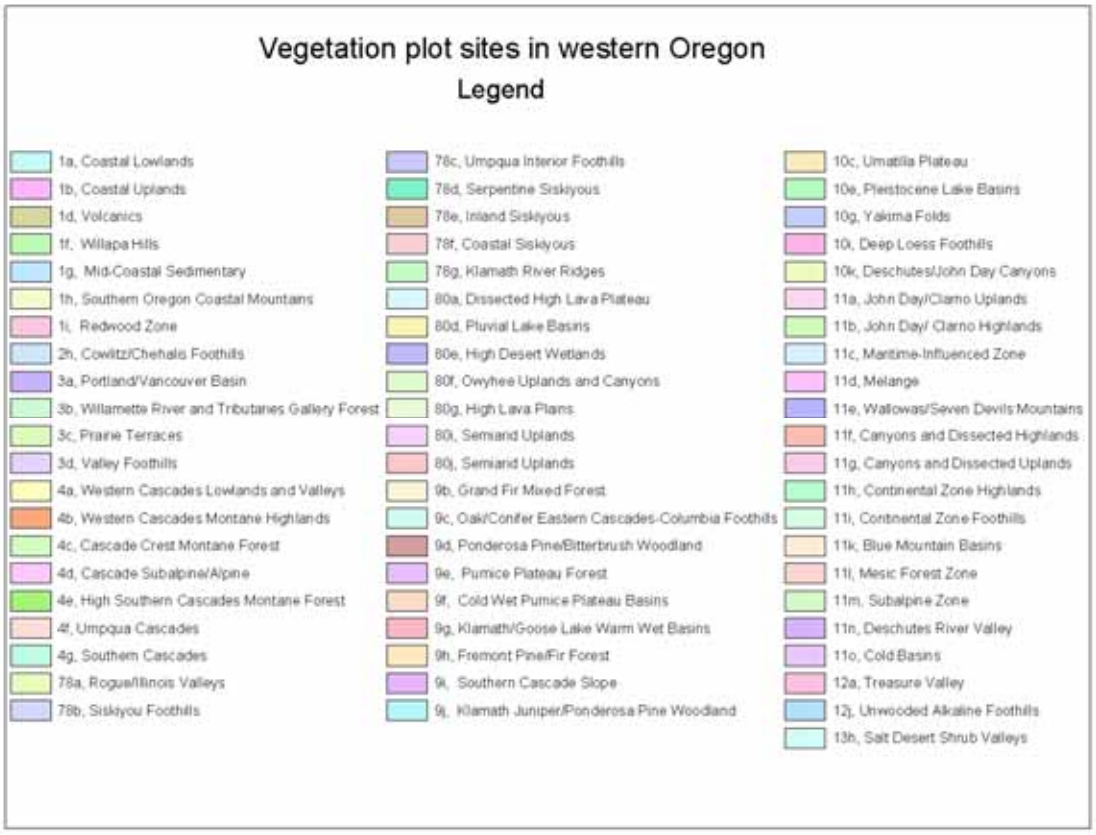

Figure 1 Legend

Sources of the vegetation data

The source data files were obtained in 2003. The USDA data were obtained from the USDA Pacific Northwest Research Station's website (see above) on Current Vegetation Survey data. USDA data included nine National Forest areas (Deschutes, Fremont, Mt. Hood, Rogue River, Umpqua, Willamette, Winema, Siskiyou & Siuslaw). The USDI data were obtained from Jim Alegria, USDI BLM, Oregon State Office, Portland, Oregon. USDI data were from five areas (Coos Bay, Medford, Eugene, Roseburg & Salem). The database described herein contains a small subset of the information available from the original, unsummarized data files. A vegetation survey manual describing the raw data can be obtained at the CVS website listed above.

Results and discussion

Example applications

The data are applied to examine the composition of old stands (>150 yr) within selected level IV ecoregions (Fig. 2). Mean basal area values for each ecoregion show forest vegetation patterns typical of western Oregon (Fig. 3). Total basal area declines as one moves inland from wet maritime ecoregions to dry-continental ecoregions. Dominance shifts from *Pseudotsuga* forests to *Pinus* forests along this gradient.

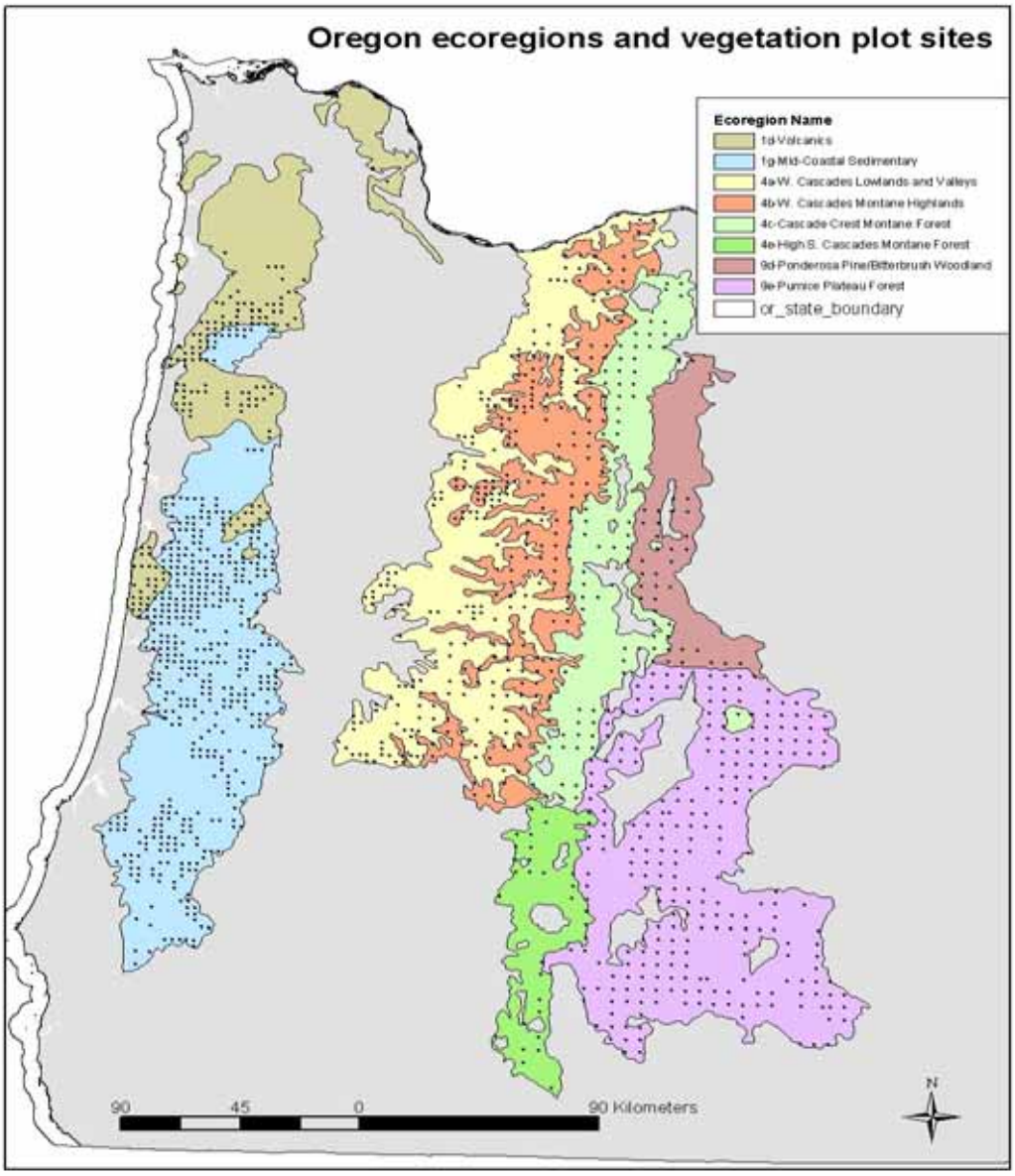

Fig. 2. Forest survey plots in 8 ecoregions selected for analysis.

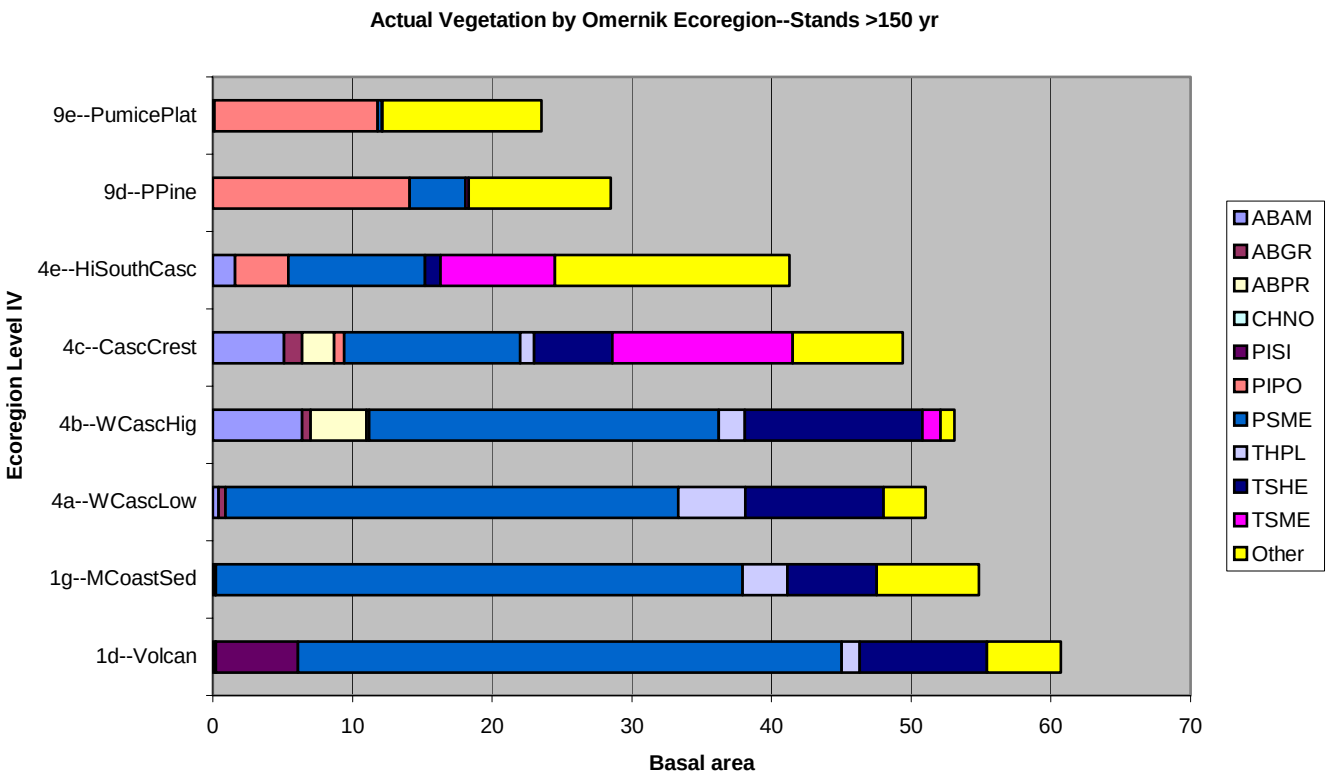

Fig. 3. Forest composition in old stands by ecoregion. Basal area is measured in square meters per hectare.

Stand age patterns can also be examined. When mean stand age estimates are plotted for the selected ecoregions, it becomes clear that, on average, the western Cascades have older stands (Fig. 4).

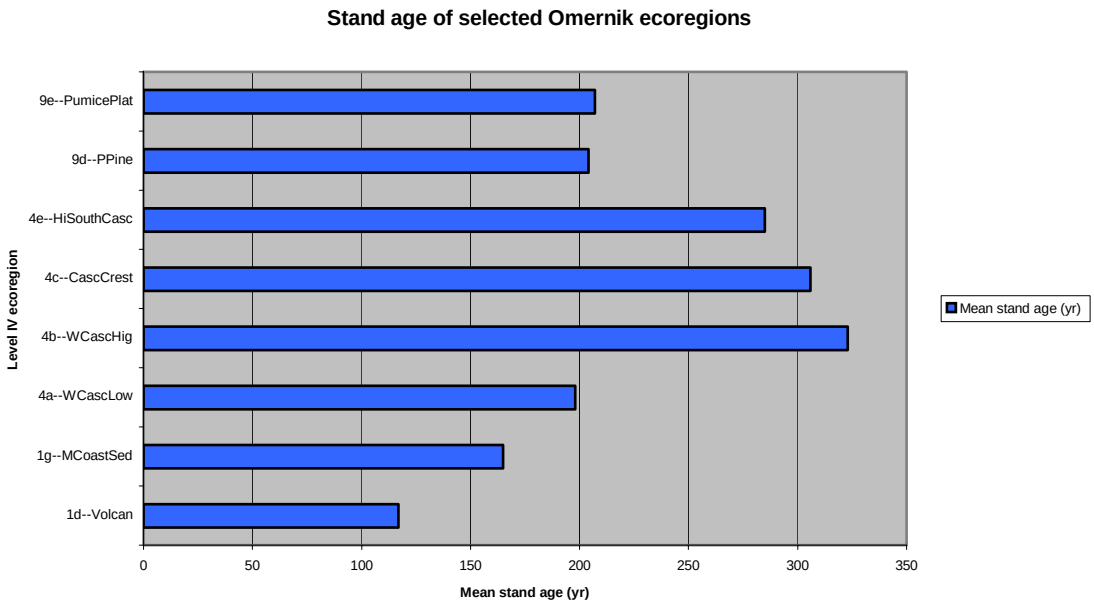

Fig. 4. Mean forest stand age of selected ecoregions.

Climate patterns can be derived from the mean monthly data for precipitation and temperature. When two descriptors of climate, created from monthly means in the database, are plotted for the selected ecoregions, the tendency for drier growing seasons and cooler winter temperatures east of the Cascade Crest is evident (Fig. 5).

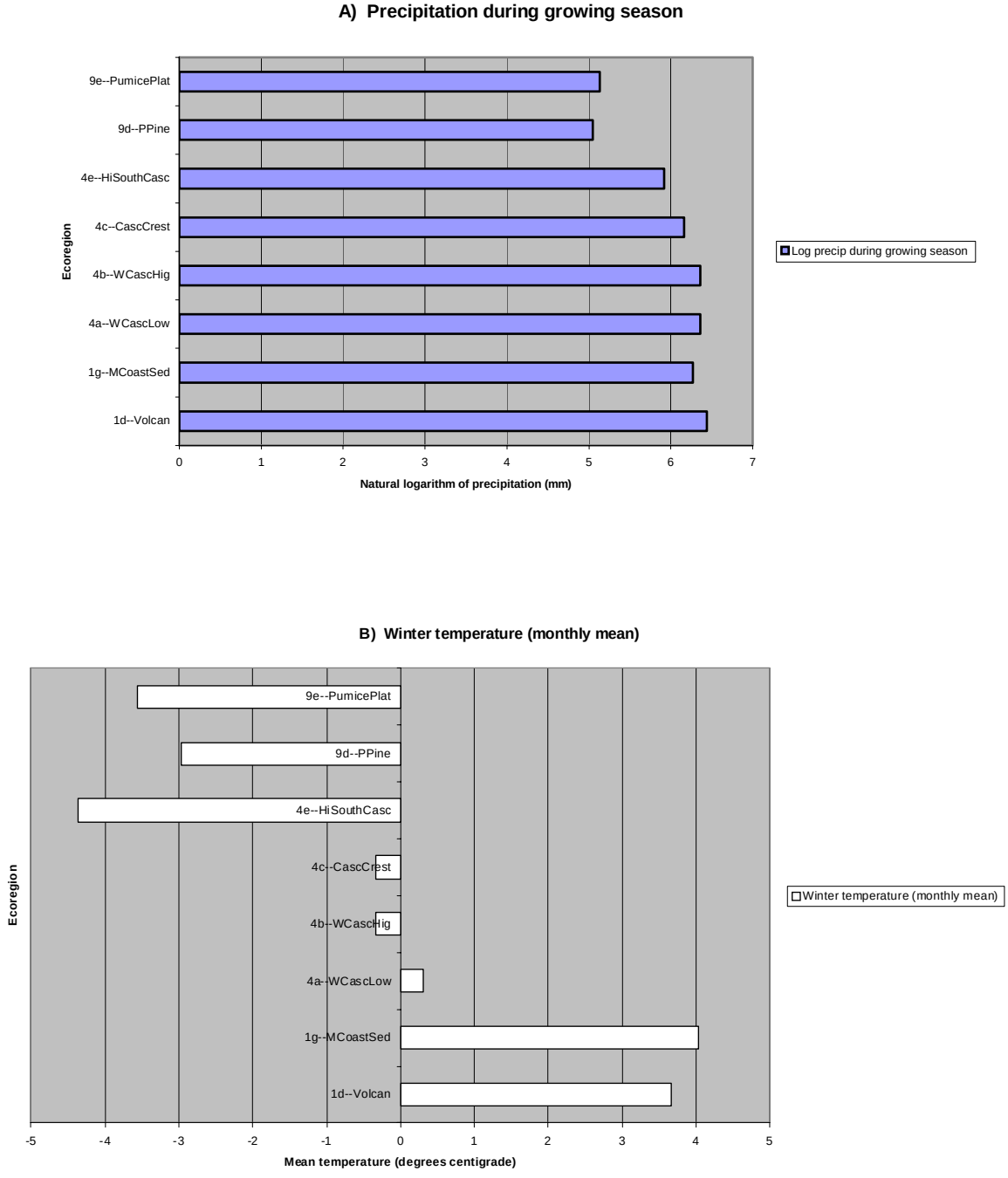

Fig. 5. Mean values of two climate descriptors on forested sites by selected ecoregion: a) precipitation during growing season, and b) winter temperature.

Fundamental ecosystem measures including total biomass and leaf area can be examined using the allometric estimates in the dataset. Strong regional gradients in such parameters are evident. For example, the decline in biomass from wet maritime ecoregions to dry-continental ecoregions is marked (Fig. 6). Forests of dry-continental regions dominated by *Pinus* have less than one-fourth the mean biomass of coniferous forests near the coast.

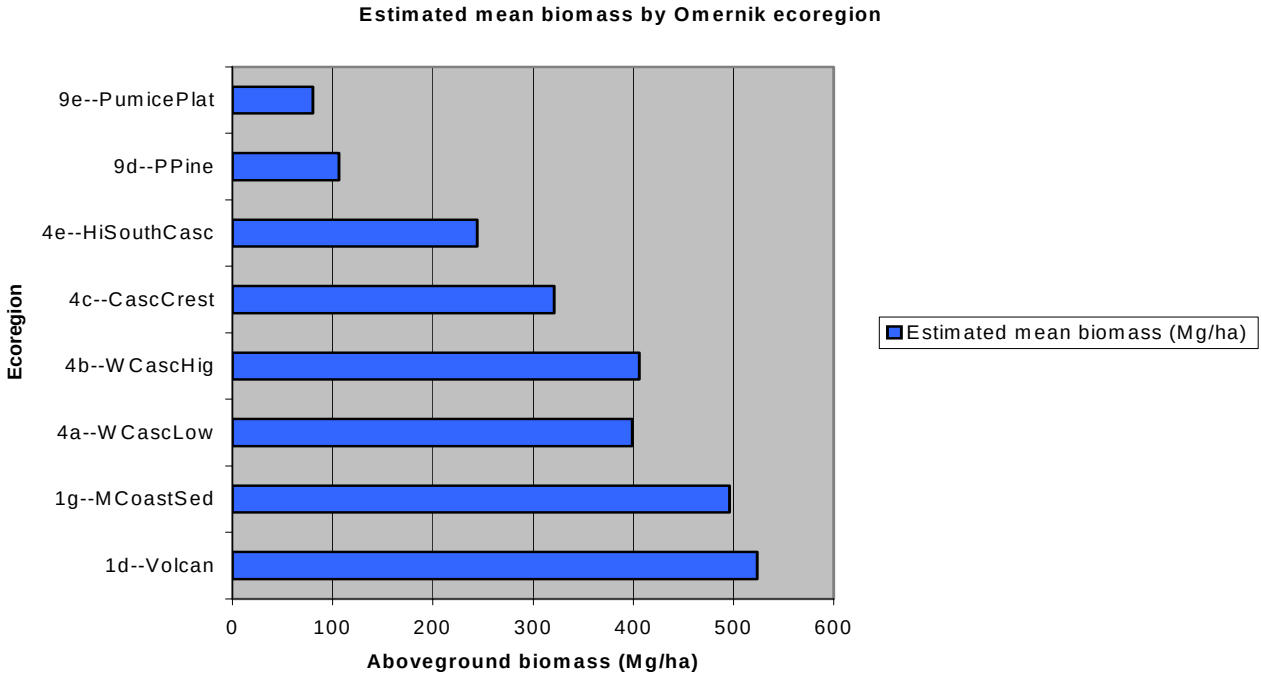

Fig. 6. Estimated mean biomass of old stands (>150 yr) by ecoregion.

Other potential applications and limitations

The database has many potential uses in addition to the fundamental analyses demonstrated above. Climate data enhance the versatility of the database. Relations between vegetation and climate can be explored using the monthly mean precipitation and temperature data. The distributions of major tree species can be modeled in relation to environment. These data can also be used to evaluate climate-driven models of vegetation (e.g., Busing and Solomon 2004). Data on stand age make it possible to explore forest dynamics using a chronosequence approach.

Caution must be used for analyses of a single site, or of a few sites restricted to a small geographic area. First, the geographic locations of individual sites are approximate. Second, the climate data are from a 4-km grid. For these reasons, the database is best used for analyses of at least several sites spread across an area or region. Also, accuracy of the allometric estimates of biomass and leaf area has not been rigorously tested; nonetheless, the estimates are suitable for comparative analyses (e.g. trends along climatic gradients).

Use of the database

The data are stored in a single SAS dataset (SAS Institute 1985) file named VEGWORA.sas7bdat. A file is also available in a general spreadsheet format (VEGWORA.dbf). Each line in the database represents a unique site with a unique identification number (the PSUNR variable). There are 94 variables per site. Most values are present; however, a few missing values exist. Many forest measures are in English units unless noted otherwise. The major variables are described in Table 1. Data values are available for the species (termed regional dominants) in Table 2.

Values for tree species not listed in Table 2 are lumped into the "other" variables. See Table 3 for further information on variables and formats in the dataset.

Table 1. Major variables in the database.

Variable name	Description
COUNTY	county of the site
CURRDATE	date site data were collected
ECO	Omernik ecoregion level IV (finest ecoregion division) code of the site
ECONAME	ecoregion level IV name
ECOREGION	Omernik major ecoregion classification number (coarse division)
ECOREGION1	Omernik subclass number
OCCNR	sampling occasion number of site (e.g. first or second sampling)
STATE	state in which the site is located
Aprtemp	April mean monthly temperature C; same name format for all 12 months (see Table 3); -9999=no data (caution must be used to omit such values from analyses)
Elevft	site elevation in feet
Longitude	N longitude of site in degrees (approximate location)
Latitude	W latitude of site in degrees (approximate location)
Maxage	age of the oldest tree examined at the site in yr
Pan	sampling panel in which the site data were collected
Pptapr	April mean monthly precipitation cm; same name format for all 12 months (see Table 3); -999.9=no data (caution must be used to omit such values from analyses)
Psunr	unique ID number of site
RbaABAM	relative basal area of *Abies amabilis*; same name format for all species (see Table 2)
RbaOther	relative basal area of the remaining species
RdABAM	relative density of *Abies amabilis*; same name format for all species
RdOther	relative density of the remaining species
TbaABAM	total basal area of *Abies amabilis* sq ft per 5 acres; multiply by 0.0459 for sq m per ha; same name format for all species
TbaDom	total basal area of regional dominants (listed in Table 2) in sq ft per 5 acres
TbaOther	total basal area of other species in sq ft per 5 acres
TbarHa	total basal area in sq m per ha
TbiomHa	allometric estimate of total aboveground biomass of live trees in kg per ha
TLAI	allometric estimate of total all-sided leaf area in sq m per sq m
TlarHa	allometric estimate of total all-sided leaf area in sq m per ha
TdABAM	stem density of *Abies amabilis* stems (3in dbh minimum) per 5 acres; multiply by 0.494 for stems per ha; same name format for all species
TdDom	total density of regional dominants (listed in Table 2) in stems per 5 acres
TdOther	total density of other species in stems per 5 acres
TotBA	total live stand basal area sq ft per 5 acres (see TbarHa for metric values)
TotDen	total live stem density stems (3in dbh minimum) per 5 acres

Table 2. Dominant tree species in the database.

Code	Scientific name	Common name
ABAM	*Abies amabilis*	Pacific silver fir
ABGR	*Abies grandis*	grand fir
ABPR	*Abies procera*	noble fir
CHNO	*Chamaecyparis nootkatensis*	Alaska cedar
PISI	*Picea sitchensis*	Sitka spruce
PIPO	*Pinus ponderosa*	ponderosa pine
PSME	*Pseudotsuga menziesii*	Douglas-fir
THPL	*Thuja plicata*	western redcedar
TSHE	*Tsuga heterophylla*	western hemlock
TSME	*Tsuga mertensiana*	mountain hemlock

Table 3. The SAS database contents with names, types and formats of all variables.
The database is available from the author upon request.

#	Variable	Type	Len	Pos	Format
27	COUNTY	Char	2	706	$2.
25	CURRDATE	Num	8	184	DATE9.
82	ECO	Char	4	764	$4.
79	ECONAME	Char	44	720	$44.
80	ECOREGION	Num	8	584	9.
81	ECOREGION1	Num	8	592	10.
24	OCCNR	Num	8	176	19.5
1	PSUNR	Num	8	0	19.5
78	SAMPLETY	Char	8	712	$8.
23	SAMPLETYPE	Char	8	696	$8.
26	STATE	Char	2	704	$2.
3	_FREQ_	Num	8	16	
2	_TYPE_	Num	8	8	
11	aprtemp	Num	8	80	
15	augtemp	Num	8	112	
19	dectemp	Num	8	144	
74	elevft	Num	8	560	
9	febtemp	Num	8	64	
8	jantemp	Num	8	56	
14	jultemp	Num	8	104	
13	juntemp	Num	8	96	
76	latitude	Num	8	576	20.10
75	longitude	Num	8	568	20.10
10	martemp	Num	8	72	
22	maxage	Num	8	168	10.
12	maytemp	Num	8	88	
18	novtemp	Num	8	136	
17	octtemp	Num	8	128	
77	pan	Char	4	708	
86	pptapr	Num	8	624	
90	pptaug	Num	8	656	
94	pptdec	Num	8	688	
84	pptfeb	Num	8	608	
83	pptjan	Num	8	600	
89	pptjul	Num	8	648	
88	pptjun	Num	8	640	

Table 3. The SAS database contents with names, types and formats of all variables. *continued*

#	Variable	Type	Len	Pos	Format
85	pptmar	Num	8	616	
87	pptmay	Num	8	632	
93	pptnov	Num	8	680	
92	pptoct	Num	8	672	
91	pptsep	Num	8	664	
54	rbaABAM	Num	8	400	
56	rbaABGR	Num	8	416	
58	rbaABPR	Num	8	432	
60	rbaCHNO	Num	8	448	
64	rbaPIPO	Num	8	480	
62	rbaPISI	Num	8	464	
66	rbaPSME	Num	8	496	
68	rbaTHPL	Num	8	512	
70	rbaTSHE	Num	8	528	
72	rbaTSME	Num	8	544	
52	rbaother	Num	8	384	
55	rdABAM	Num	8	408	
57	rdABGR	Num	8	424	
59	rdABPR	Num	8	440	
61	rdCHNO	Num	8	456	
65	rdPIPO	Num	8	488	
63	rdPISI	Num	8	472	
67	rdPSME	Num	8	504	
69	rdTHPL	Num	8	520	
71	rdTSHE	Num	8	536	
73	rdTSME	Num	8	552	
53	rdother	Num	8	392	
16	septemp	Num	8	120	
28	tbaABAM	Num	8	192	
29	tbaABGR	Num	8	200	
30	tbaABPR	Num	8	208	
31	tbaCHNO	Num	8	216	
33	tbaPIPO	Num	8	232	
32	tbaPISI	Num	8	224	
34	tbaPSME	Num	8	240	
35	tbaTHPL	Num	8	248	
36	tbaTSHE	Num	8	256	
37	tbaTSME	Num	8	264	
38	tbadom	Num	8	272	
50	tbaother	Num	8	368	
4	tbarha	Num	8	24	
7	tbiomha	Num	8	48	
39	tdABAM	Num	8	280	
40	tdABGR	Num	8	288	
41	tdABPR	Num	8	296	
42	tdCHNO	Num	8	304	
44	tdPIPO	Num	8	320	
43	tdPISI	Num	8	312	
45	tdPSME	Num	8	328	
46	tdTHPL	Num	8	336	
47	tdTSHE	Num	8	344	

Table 3. The SAS database contents with names, types and formats of all variables. *continued*

#	Variable	Type	Len	Pos	Format
48	tdTSME	Num	8	352	
49	tddom	Num	8	360	
51	tdother	Num	8	376	
6	tlai	Num	8	40	
5	tlarha	Num	8	32	
21	totba	Num	8	160	
20	totden	Num	8	152	8.2

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