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Classification and Inventory of Upland Non-Forest Vegetation on Boise and Sawtooth National Forests

INTERIM REPORT

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Introduction

Non-forest vegetation on Boise and Sawtooth National Forests has received relatively little systematic inventory and classification attention. A number of vegetation and community classification studies are potentially applicable to woodland, shrubland, and grassland vegetation on the Forests (e.g., Mueggler and Harris 1969; Hironaka et al. 1983; Tisdale 1986; Johnson and Simon 1987; Rust 1999; Rust et al. 2000; Rust et al. 2001) or have been conducted on the Forests but are limited in geographical or biological scope (e.g., Lewis and Riegelhuth 1964; Roberts 1971; Schlatterer 1972). Nearly 23 and 50 percent, respectively, of the area of the Boise and Sawtooth is upland non-forested potential natural vegetation (Boise, Payette, and Sawtooth National Forests 2000). These woodland, shrubland, and grassland plant communities represent important plant and animal species habitats, provide basic natural resource commodities, and constitute important components of biological diversity. A systematic, Forest-wide classification of upland non-forest vegetation will assist management by providing consistent information on the composition and structure of these communities; provide basic information on the distribution and abundance of plant species (common and rare); increase understanding of the influence of fire, grazing, and exotic species introductions; and increase knowledge of the potential of this vegetation to provide key species habitats.

This project focuses particularly on native shrub-dominated plant communities of the Boise and Sawtooth National Forests. The objective of the project is to produce a field guide to upland non-forest vegetation on Boise and Sawtooth National Forests. The field guide will summarize the composition, structure, environmental setting, and management considerations of upland non-forest vegetation on the Forests. The goal is to produce a guide that will be applicable to vegetation management planning and evaluation needs and assist in the characterization and inventory of key plant and animal species habitats.

The purpose of this report is to summarize the current status of the upland non-forest vegetation inventory and classification project. The multi-year project has grown to incorporate an earlier study of the low-elevation shrub-steppe and grassland vegetation on Boise National Forest (Rust 2003). Specific objectives of the report are to: (1) develop an initial description of the physical characteristics of the study area, (2) provide detailed documentation of sample site selection, and (3) provide a summary of initial analysis of vegetation data.

Study Area

The study area encompasses areas of non-forest potential natural vegetation on Boise and Sawtooth National Forests. This area extends from the West Mountains in the northwest portion of the study area to the Sublett Mountains in the southeast (Figure 1). The are encompasses a high level of biological diversity. Rare plant and animal species known or expected to occur within the study area are listed in Table 1.

Geology: The Cretaceous pluton of the Idaho Batholith is the dominant geological formation within the study area. The batholith extends from the Soldier Mountains, through the Smokey, Boise, and northern Salmon River mountains (Figure 2). The massive plutonic batholith formed about 63-135 million years ago. Characteristic rocks are: granite, quartz monzonite, monzonite, grandodiorite, quartz diorite, and diorite. Key bedrock and surficial inclusions within the extensive batholith include Miocene Columbia Plateau flow basalt of the Weiser embayment located on the west slope of the West Mountains; recent flow basalt of the Smith Prairie/South Fork Boise River region; and Quaternary glacial drift of the Sawtooth Valley, upper Bear Valley Creek, Elk Creek, Johnston Creek, and South Fork Salmon River.

Eocene mixed siliceous and basaltic ejecta, flows, and reworked volcanic debris of the Challis Volcanics formation is second most prevalent. The formation occurs on the eastern edge of the study area, in the southern Pioneer, Smokey, and White Knob mountains. The western edge of the Challis Volcanics region (in the Pioneer Mountains, eastern Smokey Mountains, and Boulder Mountains) is intricately intermixed

with older Paleozoic thrusted marine sedimentary rocks (Figure 2).

In the south, Snake River Plain rhyolite is the prominent rock on the slopes of the South Hills Mountains. These silicic welded tuff, ash, and flow rocks of Pliocene origin are interrupted by older Paleozoic marine sedimentary and metamorphic rocks. The Albion, Black Pine, and Sublett mountains encompass a diverse mosaic of Precambrian igneous metamorphic rock, Paleozoic marine sedimentary deposits, Cretaceous batholithic rock, and late Tertiary and Quaternary fluvial and colluvial deposits.

Climate: The study encompasses a broad climatic gradient, from the prevalence of a Pacific maritime climatic regime in the northwestern portion of the study area to a hot, dry continental regime in the southeastern portion. Figure 3 provides an overview of mean annual precipitation, minimum temperature, and maximum temperature. Coarse patterns in the distribution of climatic regimes within the study area are summarized using a modified Koppen system climatic classification (Godfrey 1999).

The Pacific maritime-influenced climate of the northwestern portion of the study area is primarily affected by the seasonal movement of two opposing weather systems (Ross and Savage 1967). From the late fall to early spring months, the climate is influenced by cool, moist Pacific maritime air. Periodically this westerly flow is interrupted by outbreaks of cold, dry, continental air from Canada normally blocked by mountain ranges to the east. During the summer months, the westerly winds weaken and a Pacific high pressure system becomes dominant, resulting in decreased precipitation, and more continental climatic conditions.

The west-central portion of the study area (including the West, Boise, western Salmon River, Smokey, and Soldier mountains) is generally characterized by (relatively) long, warm summers (at least four months with mean temperature greater than 50 F) and mild or cool winters (Appendix 1, climate charts for Anderson Dam, Arrowrock Dam, Boise, Cascade, Fairfield, Garden Valley, Hailey, and Lowman). In the northern and eastern portion of the study area (encompassing the eastern Smokey, eastern Salmon River, and Boulder mountains and Sawtooth Range) summers are (relatively) short (less than three, to only one, months with mean temperature greater than 50 F) and winters are cold (Appendix 1, climate charts for Deadwood Dam, Galena, and Yellow Pine). Precipitation throughout this central mountainous region of the study area typically occurs as snow during the winter months. Summer months are comparatively dry.

The eastern and southeastern portions of the study (including the South Hills, Albion, Blackpine, and Sublett mountains; Raft River Range; and Sawtooth Valley) are characterized by warm summers and cold winters. Mean annual precipitation is comparatively evenly distributed throughout the year (Appendix 1, climate charts for Grouse Creek, Malad City, and Strevell). Precipitation typically occurs in the early summer months when convective showers are common. Winters are relatively dry. High mountainous areas of this portion of the study area (Sawtooth Valley) are distinguished by comparatively short summers (Appendix 1, climate charts for Middle Fork Lodge and Stanley).

Disturbance History: The primary disturbance factors within shrubland habitats on the study area are fire and domestic and wild ungulate foraging. The perimeters of major wildfire events (1908 - 2003) within the study area are shown in Figure 4 (Strom et al. 1998). Major recent fires that burned in non-forest vegetation on Boise National Forest include: 8th Street (1996), Whiskey (1995), Thunderbolt (1994), Rabbit Creek (1994), Bannock (1994), Star Gulch (1994), and Foothills (1992) fires. Large areas of the Danskin Mountain foothills and Middle Fork Boise River breaklands have burned in multiple wildfire events.

Westward-bound cross country immigrants traveled the study area on several different routes during the period (circa) 1840 -1860 (Hutchison and Jones 1993). Yensen (1980) estimates 250,000 head of livestock crossed the Snake River Plain annually during the peak years of westward migration. A large percentage of these animals trailed, bedded, and grazed on lower slopes and valley bottoms within the study area.

A principal attraction to settlement within the study area during the mid- to late-1800's was the great

abundance of grass and plentiful supply of water (Campbell 1969). Rust and Coulter (2000) summarize the history of livestock grazing in Cassia County, which encompasses southern portions of the study area, including eastern South Hills, Albion, Blackpine, and western Sublett mountains. Though this is only a portion of the study area, the grazing history of this area provides a general portrait of the historic patterns of livestock grazing throughout the lower elevation portions of the study area.

The number of cattle in the Cassia County area grew rapidly between the period 1871 - 1885 (Roberts-Wright 1987; Estes 1977). It is difficult to derive precise values for the number of cattle within the study area during this period, due to (for example) the distances herds were driven (often between state and county jurisdictions), the use of steers (and later wethers), and (prior to the development of rail) the occurrence of overland cattle drives (Yensen 1980). Estes (1977) estimates 230,000 head of cattle and several thousand horses were present on rangelands within the study area and surrounding vicinity. For reference, numerous single operations managed more head of cattle than are currently reported for the entire county (Estes 1977; USDA National Agricultural Statistical Service 2000; Rust and Coulter 2000).

By the early 1890's, as cattle herds were severely diminished due to depletion of forage resources, drought, and a series of severe winters, sheep began to increase (Estes 1977; Clark 1995; Ogle and DuMond 1997). In 1895, for example, 85,000 sheep are reported to have occurred in the Goose Creek drainage of the study area (Clark 1995). Roberts-Wright (1987) estimates that approximately 72 families ran sheep in the area with bands of 2,500 - 3,500 head (approximately 216,000 head total; an order of magnitude more than are present in recent decades). Overgrazing by sheep and cattle was prevalent in the early 1900's, a period of compounded loss of rangeland resources due to the conversion of valley bottom sites to agricultural cultivation.

During the period 1920 -1934, below normal precipitation followed by severe drought and overstocking (resulting from response to post World War I market opportunities and financial pressures of the Great Depression) caused severe overgrazing in southern Idaho (Yensen 1980; Pechanec et al. 1937). With the passage of the Taylor Grazing Act in 1934 the era of the open range came to close. The number of cattle on rangelands within Cassia County peaked most recently in 1959 (USDA National Agricultural Statistical Service 2000).

In recent years concern has increased over the accelerated lose of sagebrush-steppe vegetation (in particular) due to the compounding effects of livestock grazing, exotic annual grass abundance, and wildfire.

Sample Site Selection

Methods: The study area consists of shrubland non-forest habitats on Boise and Sawtooth National Forests. Plant community classification and inventory study sites are identified through stratified random and expert opinion processes. A brief step-wise description of the geographical information system (GIS) based process of selecting sample sites follows. Decisions made through the process are discussed in more detail below.

The stratified random selection of sample sites involved the following steps: (1) Areas of non-forest vegetation were identified using the Idaho GAP Program vegetation coverage, Idaho Land Cover (Landscape Dynamics Lab 1999) for Idaho portions of the study area and Intermountain Region Land Cover and Characterization (Homer et al. 1995) for the portion of the study area located in Utah. (2) GIS layers for major lithology (Bond and Wood 1978, Jensen et al. 1997), elevation class, and watershed boundaries (defined as fourth code hydrological unit boundaries) were combined within the areas of non-forest vegetation (Figure 5). (3) The coverage of combined environmental strata was converted to polygonal regions. (4) Regions equal to, or larger than, 720 30 x 30 meter pixels (approximately 160 acres) were selected randomly. The number of random selections made for each unique strata was proportional to the relative abundance of the respective strata. Each strata with a polygonal region of this

size was represented by at least one randomly selected polygon. (5) The largest polygonal region was selected as the study site to represent unique strata (i.e., unique lithology-elevation-watershed combinations) that have no regions equal to, or greater than, 720 pixels. The minimum area for selection was set as 90 30 x 30 meter pixels (approximately 20 acres). Thus, the portion of potential environmental strata that are only represented by polygonal regions less then 90 pixels in size were not selected for sampling.

Discussion: Areas of non-forest vegetation were identified by using Landscape Dynamics Lab (1999) and Homer et al. (1995). The focus of this study is shrubland natural vegetation and habitats. In principal it is awkward to use spatial information on existing vegetation cover (such as Landscape Dynamics Lab (1999) and Homer et al. (1995)) to determine the distribution of potential natural vegetation. For example, high quality, late-seral *Artemisia* shrub-steppe is often classified in remote sensing projects as grassland vegetation. This is not unexpected as the shrub cover in these stands is often low while the grass and forb cover is high. The use of spatial information on existing vegetation cover is necessary, however, as there appears to be no adequately detailed spatial information on the distribution of potential natural vegetation.

A list of the covertypes selected to represent potential natural non-forest vegetation within the study area is in Appendix 2. A liberally wide interpretation of "non-forest" was employed to avoid errors of omission inherent in the vegetation coverages, to achieve independence of underlying classification concepts represented in the vegetation mapping projects, and to avoid bias toward particular seral stages of shrubland vegetation. Particular difficulty was encountered with the Landscape Dynamics Lab (1999) class, "herbaceous burn" (# 3106). This class was included in the first selection of areas of "non-forest". Areas classified as "herbaceous burn", however, were later removed from consideration for selection as study sites when it was determined that the class is applied to both areas of potential natural shrubland and forest. This step in the selection process eliminated early-seral shrubland stands located in the lower Middle Fork Boise River drainage and Danskin Mountains foothills.

Three major environmental factors were selected to stratify the study area: lithology, elevation, and watershed. Lithology (taken from Jensen et al. 1997; Bond and Wood 1978) provides a summarized representation of plant parent materials and is often correlated to general characteristics of the landform and topography. The watershed boundaries provide a basic geographic control on the distribution of the sample sites. Watershed, coupled with elevation, is representative of major climatic patterns. Elevation is highly correlated with basic environmental factors such as soil and air moisture availability and temperature. These three factors were selected for the stratification as they appear (in combination) to provide sufficient detail regarding the distribution of shrubland habitats within the study area while maintaining a level of generality that is required to identify logistically manageable study areas.

The spatial combination of lithology, elevation, and watershed within the study area gives rise to 627 unique strata. Of these, 259 strata (41 percent of the total) are represented by polygonal regions that are greater than or equal to 720 pixels (approximately 160 acres). Fourteen of these strata occur over more than one percent of the study area and are represented by multiple random selections. The remaining 245 strata are represented by a single random selection. Two hundred, thirty-eight of the strata (38 percent of the total) are only represented by polygonal regions that are less than 720 pixels (160 acres) but greater than or equal to 90 pixels (20 acres). Each of these strata are represented by the one largest region of the respective strata. Approximately 21 percent (130) of the strata are only represented by polygonal regions that are less than 90 pixels in size. None of these strata were selected for sampling. While some of these strata may represent interesting, unique settings on the ground, the majority appear to represent spatial noise created through the process of combining information on lithology, elevation, and watershed boundary. The underlying objective of this mixed selection strategy is to provide random selection of the major, most abundant strata while also preserving representation of the diversity of different shrubland habitats. In all, 516 polygonal regions (or sites) were selected for sampling (Figure 6).

Field Data

Shrubland plant community composition data from 2002 and 2003 field seasons were combined with data collected within (or adjacent) the study area in previous years through a range of different projects (Mancuso 2001; Mancuso and Moseley 1997; Miller and Rust 2002; Murphy 2002; Rust 1995a, 1995b, and 1999; Rust and Coulter 2000; Rust and Miller 2003; Rust et al. 2003, 2001, and 2000). These data were reviewed and analyzed with the following objectives: (1) review and test the flow of data management and analysis, (2) if possible contribute to an initial classification, (3) generate lists of plant species and communities within the study area, (4) compile field keys, and (5) identify initial questions regarding the classification.

Field Methods: Plant community composition data were collected on 0.1 acre fixed-area plots using standard plant community ecology methods (Bourgeron et al. 1992; USDA Forest Service 1992). Plots were located to represent the range in composition and structure observed within each survey site. The location of plots was recorded in the field using navigation grade geographical positioning system (GPS) units (e.g., Garmin 12XL) and by hand on 1:24,000 USGS quadrangles. The data card and data dictionary used in 2003 field season is provided in Appendix 5.

Analysis: Data for 248 plots from sites with potential bearing on the project were compiled. Five hundred and six species are reported for the plots selected for analysis. A plant species list generated from these data is provided in Appendix 3. The shrubland plant associations observed within these data are summarized in Table 2.

Statistical analyses were conducted using PC-ORD (McCune and Mefford 1999). Absolute percent cover data were converted to relative abundance values. Only species that occur on five percent of the plots were considered for the initial analyses. Key indicator species (*Acer glabrum, Artemisia arbuscula* ssp. *thermopola, Artemisia frigida, Artemisia longiloba, Artemisia nova, Artemisia rigida, Artemisia tripartita, Artemisia tridentata* var. *wyomingensis, Artemisia tridentata* ssp. *xericensis, Carex hoodii,* and *Glossopetalon nevadense*) that are relatively rare in the data set as a whole were added back into the data set for final analyses. One hundred and thirty species occurring on 248 plots were included in the final data matrix. Hierarchical cluster analysis was completed on the relative abundance data using the Sorensen distance measure (or Bray-Curtis coefficient), with the flexible beta linkage method ($\beta = -0.25$). Twenty-four groups were (arbitrarily) requested on the basis that this is the number of associations represented by two or more plots (Table 2).

Multi-response permutation procedures (MRPP) were used to test the significance of the cluster analysis grouping. MRPP was executed using Sorensen (Bray-Curtis) distance measure. One group from the cluster analysis (label 188) was eliminated from the analysis as it includes only one sample. The MRPP test statistic ($T = -68.26$) suggests that separation between groups is significant ($p < 0.001$). Though considerable heterogeneity within groups appears to be present, the chance-corrected within-group agreement was relatively high ($A = 0.37$) for community ecology data (McCune and Grace 2002).

Indicator species analysis was conducting using the method of Dufrene and Legendre. (1997, as cited by McCune and Grace 2002). As with MRPP, group 188 was eliminated from this analysis as it contains only one species. A Monte Carlo test of the significance of observed maximum indicator values was executed on the 247 x 130 plots by species data matrix with 1000 permutations. Fifty-one species are identified through the analysis as having particularly significant indicator value ($p \leq 0.05$) in this set of community composition data (Table 4, Appendix 4). Species indicator values are listed by cluster analysis group in Table 5, Appendix 4.

Ordination of the data was conducted using non-metric multidimensional scaling (NMS) on the relative abundance 248 x 130 plots by species data matrix. The analysis was conducted using Sorensen (Bray-Curtis) distance measure for the determination of three axes through 200 iterations with a stability criterion of 0.0001. Initial coordinates for three axes were selected from the best solution of 15 runs on the basis of

a Monte Carlo randomization test of 30 runs (p = 0.0323). In the final solution of 200 iterations stress is 17.265; instability is 0.00137. Though the solution appears stable, the reliability of the solution is questionable (using Clark's rule of thumb as cited by McCune and Grace 2002). The cluster analysis grouping corresponds fairly well to the NMS ordination of plots. Additional investigation of the correlation of ordinations axes to environmental variables was not attempted.

Discussion: The initial analysis of composition data appears to produce meaningful results. In-depth analyses were not warranted at this time, however, as the current data is a small portion of what the project is expected to generate (most of the sampling for the project will occur in the coming field season) and provides spotty geographic and environmental representation of the study area as a whole. This said, the initial results readily provide lists of common plant species and key indicator species within the study area.

In Table 3 the percent of plots within each cluster analysis group is listed by plant association. It is interesting to note the differential affinity of cluster analysis group to plant association (or series). For example, plots in group 1 have a strong affinity to *Artemisia arbuscula* associations. This shrub and an array of perennial forbs are the strongest indicator species of the group (Table 5, Appendix 4). The strongest perennial grass indicator species is *Poa secunda*. Conversely, group 5 traverses numerous shrubland series, but has a consistent affinity to associations in which *Festuca idahoensis* is the dominant perennial grass species. The strongest indicator species in this group are *Festuca idahoensis* and an array of perennial forbs. These results suggest potential differences between the assignment of plots to a classification of potential natural vegetation versus assignment to a covertype classification (based on the frequency and dominance of species) and may address questions such as the significance of differences between *shrubland vegetation* versus *shrub herbaceous vegetation* (Grossman et al. 1998; Anderson et al. 1998; Reid et al. 2002). Surely, more questions arise than are answered in these results regarding the defining break-points of key indicator species. For example, what are the breaks in the abundance of *Purshia tridentata* versus *Symphoricarpos oreophyllus* that define ARTRV-PUTR/AGSP versus ARTRV-SYOR/AGSP? What are the distinguishing environmental parameters of these associations?

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Figures

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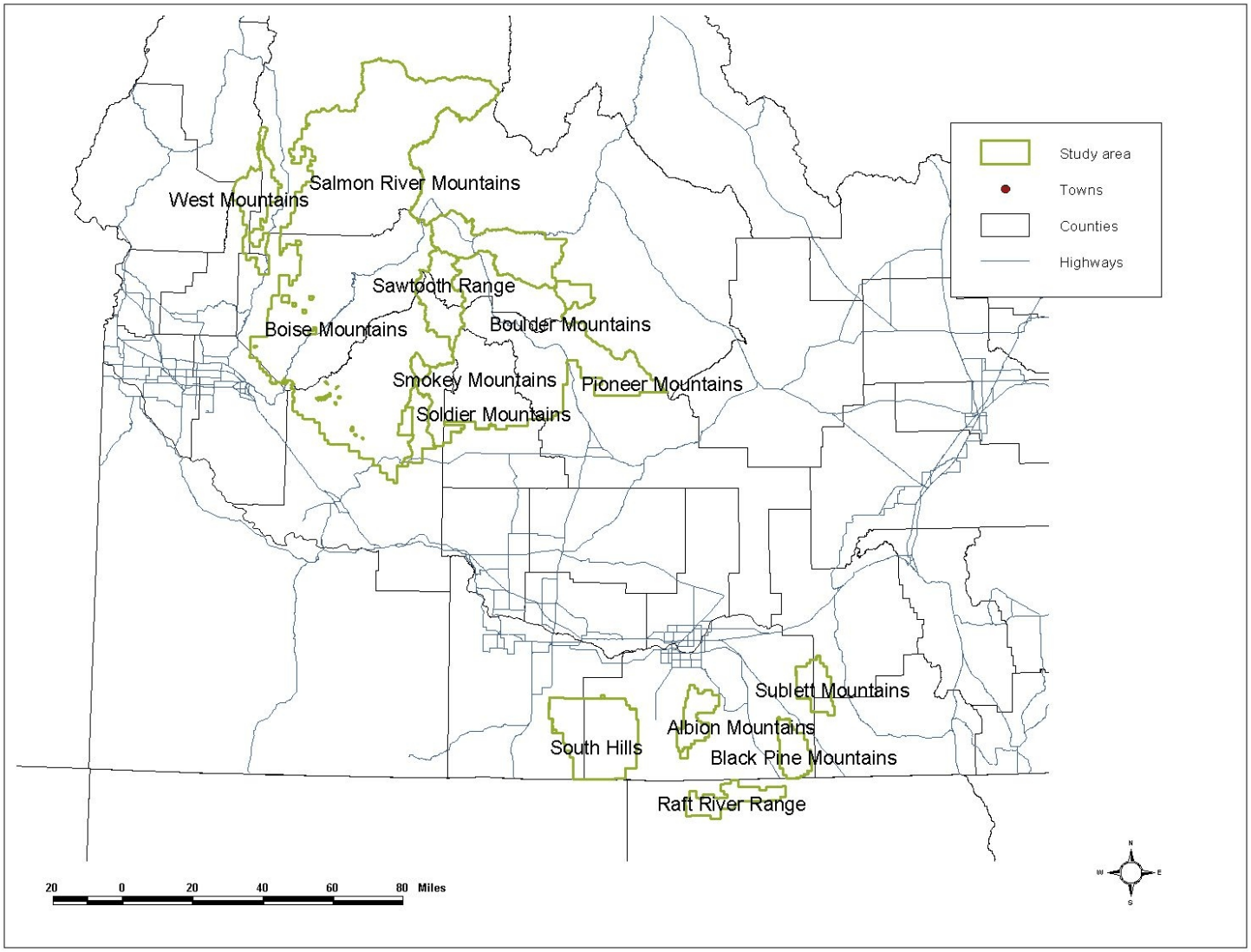


Figure 1. Boise and Sawtooth National Forests study area. The non-forest vegetation inventory and classification study area is shown in relation to major landmarks, cities and towns, highways, and county lines.

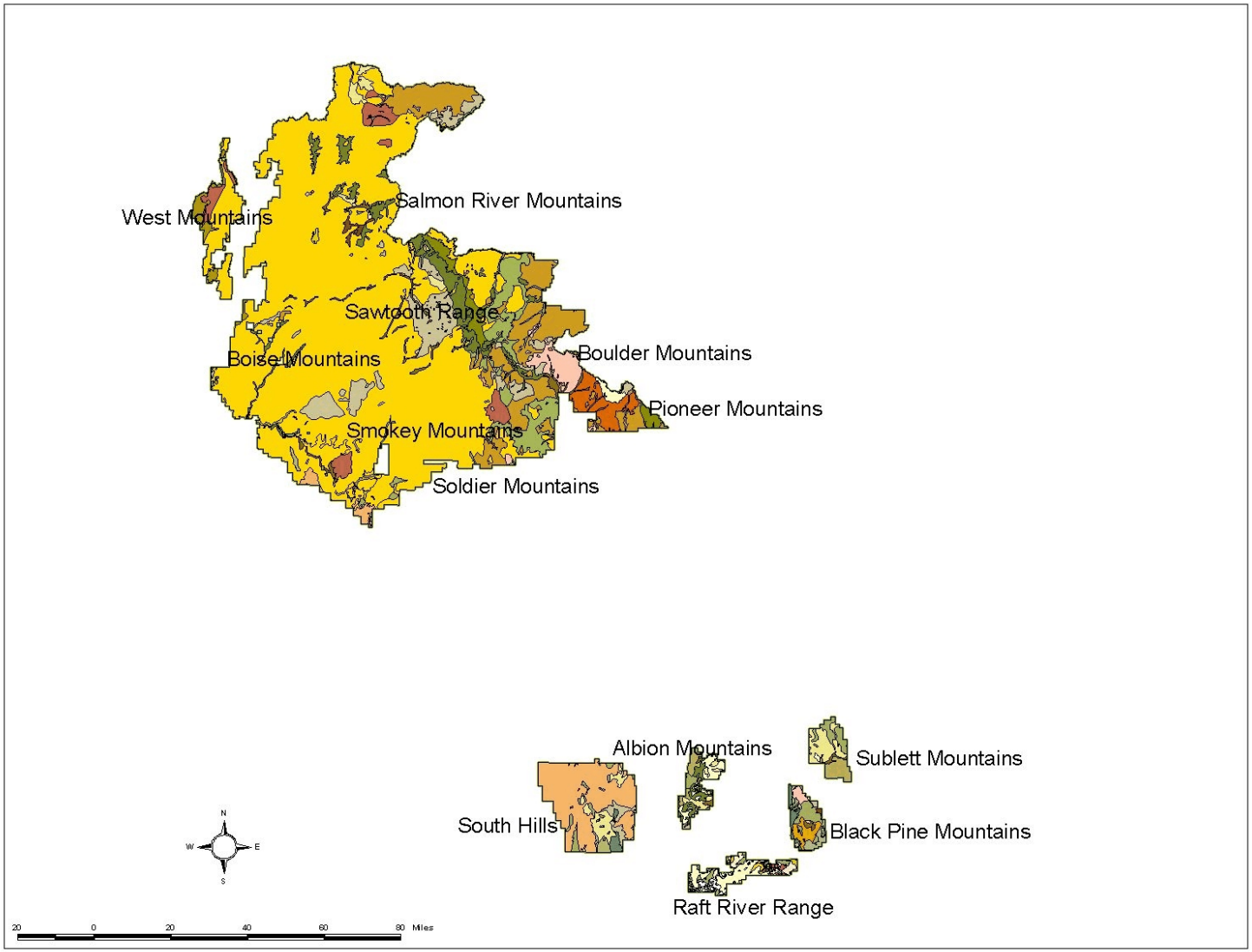


Figure 2. Geology of the Boise and Sawtooth National Forests. Geological mapping units are adapted from Bond and Wood (1978) and Jensen et al. (1997). The key to the figure follows on the next page.

Figure 2 (continued). Key to Geology of the Boise and Sawtooth National Forests.

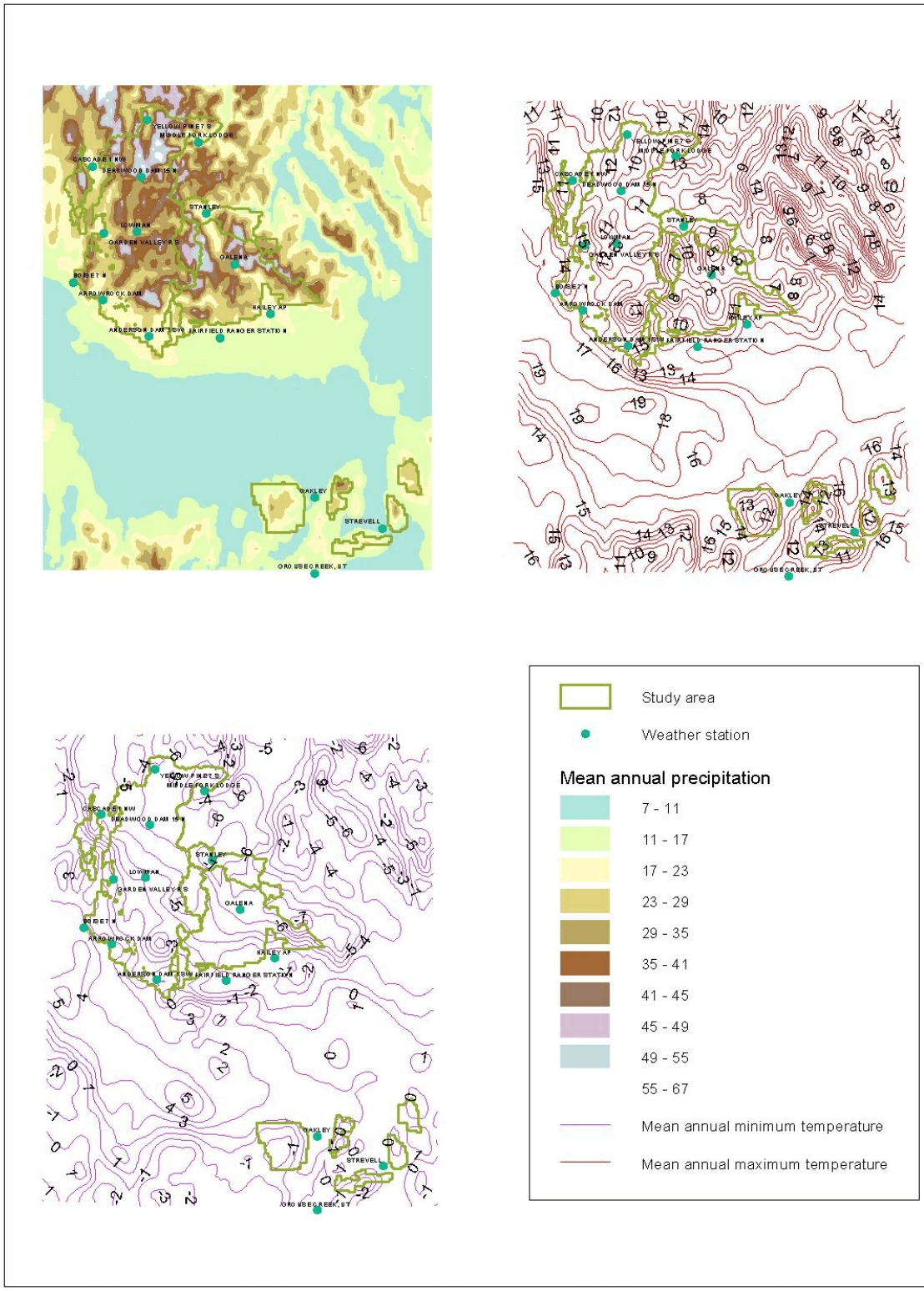


Figure 3. Climate overview. Patterns of mean annual precipitation, minimum temperature, and maximum temperature on the Boise and Sawtooth National Forests study area are shown in relation to locations of selected weather stations.

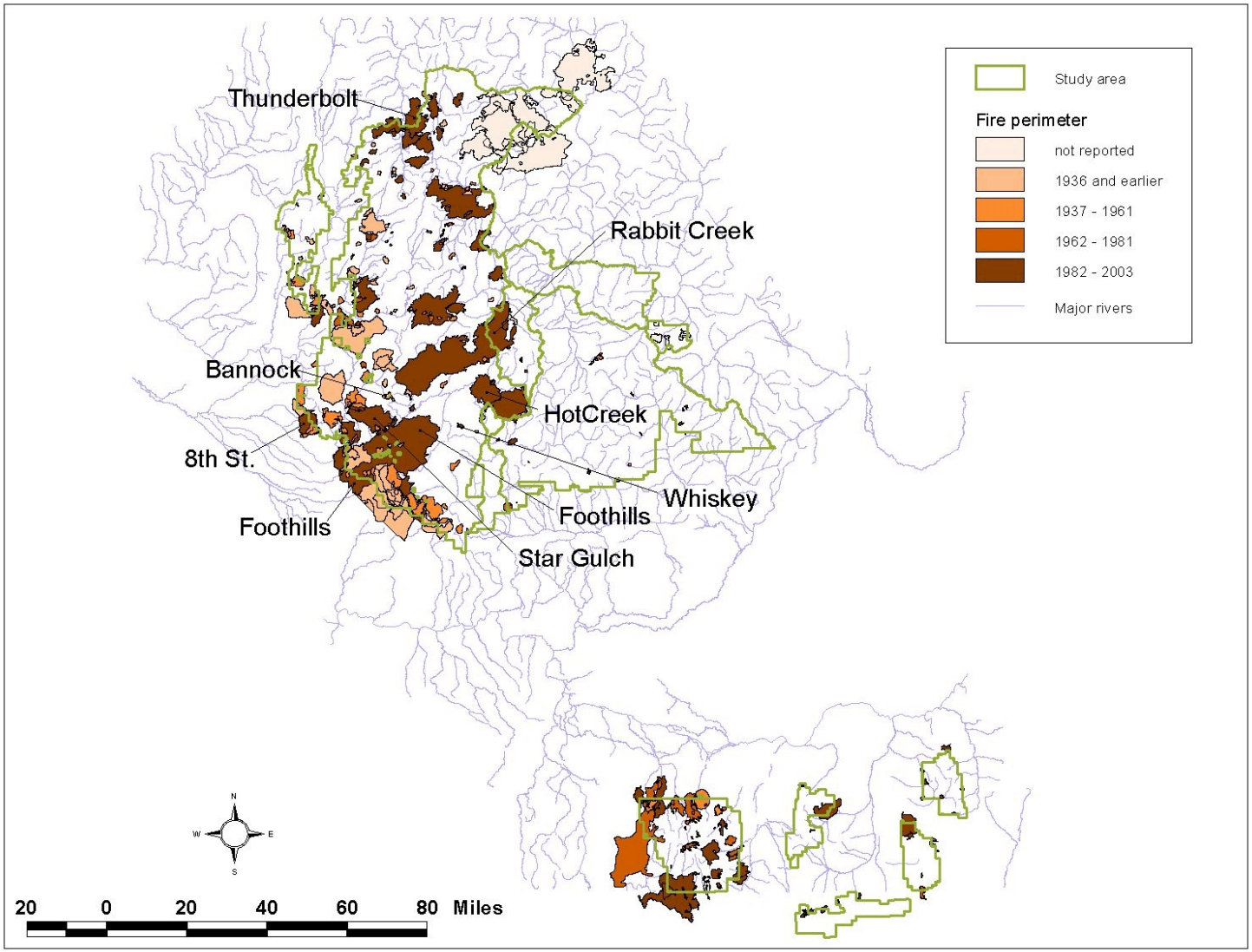


Figure 4. Fire on Boise and Sawtooth National Forests. The perimeters of recent and historic fires within the study area are shown by age class. The area of recent fires that burned in non-forest vegetation are labeled (where the name is known).

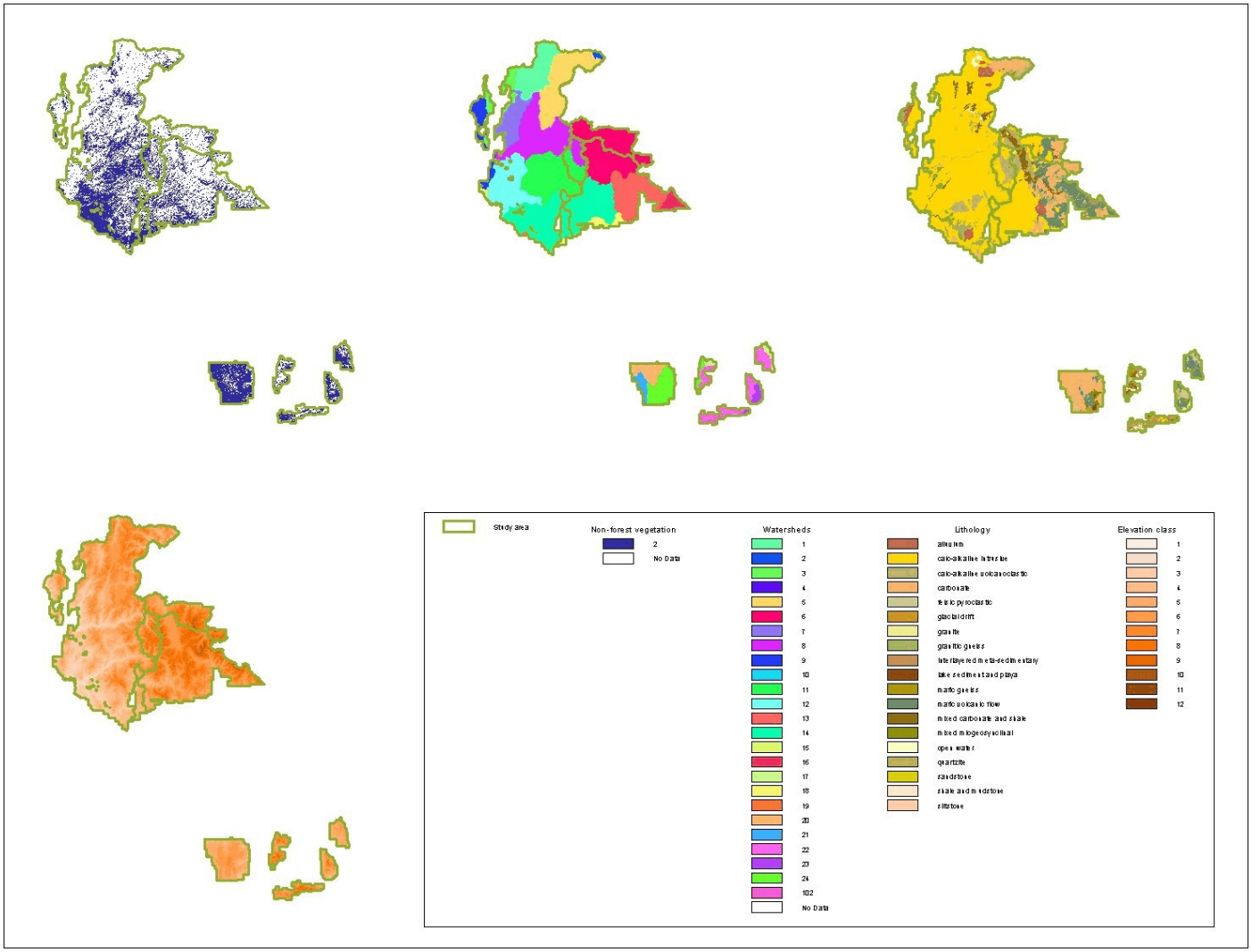


Figure 5. Summary of study site selection. Spatial data layers employed in the selection and stratification of areas of non-forest vegetation are shown (clockwise: non-forest vegetation, watershed (sixth hydrological unit code), major lithology, and elevation class). Class values for watershed and elevation class are listed in the accompanying table. Major lithology adapted from Jensen et al. (1997).

Figure 5 (continued). Summary of codes. Data values for watershed and elevation coverages are listed.

Data Layer	Code	Description
Watershed (watershed name)	1	South Fork Salmon
	2	Lower Middle Fork Salmon
	3	North Fork Payette
	4	Weiser
	5	Upper Middle Fork Salmon
	6	Upper Salmon
	7	Middle Fork Payette
	8	South Fork Payette
	9	Payette
	10	Big Lost
	11	North and Middle Fork Boise
	12	Boise-mores
	13	Big Wood
	14	South Fork Boise
	15	Lower Boise
	16	Little Wood
	17	Lake Walcott
	18	Camas
	19	C. J. Strike Reservoir
	20	Upper Snake-rock
	21	Salmon Falls
	22	Raft
	23	Curlew Valley
	24	Goose
	102	Northern Great Salt Lake Desert
Elevation (range)	1	688.00 - 950.75
	2	950.75 - 1213.50
	3	1213.50 - 1476.25
	4	1476.25 - 1739.00
	5	1739.00 - 2001.75
	6	2001.75 - 2264.50
	7	2264.50 - 2527.25
	8	2527.25 - 2790.00
	9	2790.00 - 3052.75
	10	3052.75 - 3315.50
	11	3315.50 - 3578.25
	12	3578.25 - 3841.00

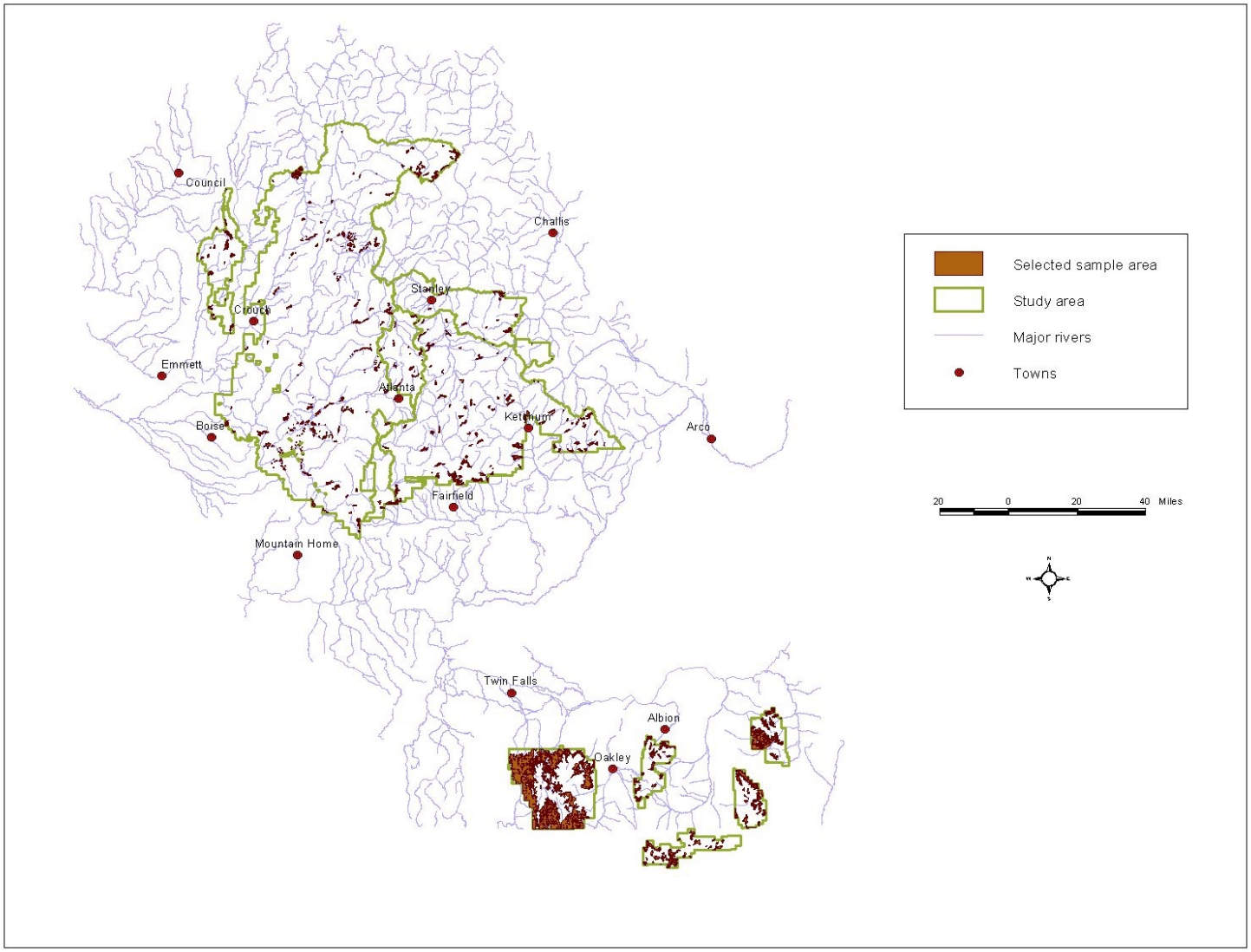


Figure 7. Location of selected study sites. The location of study sites is shown in relation to the study area boundary, major cities and towns, and major rivers.

Tables

List of Tables

Table 1. Sensitive plant and animal species with potential for occurrence within the study area. Sensitive plant and animal species that may occur in within the Boise and Sawtooth National Forests study area are listed with global and state ranking. The element code (a unique key identifier) used by Idaho Conservation Data Center (2004) is also shown. A. Plants. B. Animals

A. Plants

Species	Common Name	Global Rank	State Rank	Element Code
Allium madidum	swamp onion	G3	S3	PMLIL021E0
Allium tolmiei var persimile	Tolmie's onion	G4T3	S3	PMLIL022C1
Allium aaseae	Aase's onion	G3	S3	PMLIL02010
Artemisia campestris ssp. borealis var. purshii	Northern sagewort	G5T5	S1	PDAST0S0D3
Astragalus mulfordiae	Mulford's milkvetch	G2	S2	PDFAB0F5Q0
Astragalus purshii var ophiogenes	Snake River milkvetch	G5T3	S3	PDFAB0F7A5
Astragalus cusickii var packardiae	Packard's milkvetch	G5T1	S1	PDFAB0F2N3
Astragalus atratus var inseptus	mourning milkvetch	G4G5T3	S3	PDFAB0F0Z2
Astragalus newberryi var. castoreus	Newberry's milkvetch	G5T5	S2	PDFAB0F5Y4
Astragalus vexilliflexus var. nubilus	White Clouds milkvetch	G4T2	S2	PDFAB0F9E1
Bryum calobryoides	Beautiful bryum	G3	SH	NBMUS1A1W0
Calamagrostis tweedyi	Cascade reedgrass	G3	S2	PMPOA17150
Camassia cusickii	Cusick's camas	G4	S2	PMLIL0E010
Carex straminiformis	Mt. Shasta sedge	G4	S2	PMCYP03D10
Carex breweri var. paddoensis	Brewer's sedge	G4T4	S2	PMCYP03242
Castilleja pulchella	beautiful Indian paintbrush	G3G4	S2	PDSCR0D2N0
Castilleja christii	Christ's Indian paintbrush	G1	S1	PDSCR0D0D0
Catapyrenium congestum		G4	S2	NLTEST91A0
Ceanothus prostratus	mahala-mat ceanothus	G5?	S1	PDRHA04140
Cladonia luteoalba	reindeer lichen	G2	S1	NLTEST6460
Cymopterus davisii	Davis' wavewing	G3	S3	PDAPI0U110
Douglasia idahoensis	Idaho douglasia	G2	S2	PDPRI04070
Draba globosa	Pointed draba	G3	S2	PDBRA11350
Draba incerta	Yellowstone draba	G5	S2	PDBRA11180
Draba trichocarpa	Stanley whitlow-grass	G2	S2	PDBRA112R0
Draba fladnizensis	Austrian draba	G4	S1	PDBRA110Z0

Species	Common Name	Global Rank	State Rank	Element Code
Eatonella nivea	white eatonella	G4	S3	PDAST37020
Erigeron salmonensis	Salmon River fleabane	G3	S3	PDAST3M4Q0
Erigeron humilis	Low fleabane	G4	S2	PDAST3M1W0
Eriogonum ochrocephalum var calcareum	calcareous buckwheat	G5T3	S2	PDPGN084C2
Eriogonum meledonum	guardian buckwheat	G2	S2	PDPGN086H0
Eriogonum desertorum	desert buckwheat	G3?	S1	PDPGN081R0
Glyptopleura marginata	white-margined wax plant	G4	S3	PDAST43010
Hackelia davisii	Davis' stickseed	G3	S3	PDBOR0G0A0
Haplopappus insecticruris	bugleg goldenweed	G3	S3	PDASTDT080
Helodium blandowii	Blandow's helodium	G5	S2	NBMUS3C010
Lepidium papilliferum	slick spot peppergrass	G2	S2	PDBRA1M140
Lewisia kelloggii	Idaho bitterroot	G4	S2	PDPOR04070
Mimulus clivicola	bank monkeyflower	G4	S3	PDSCR1B0S0
Pediocactus simpsonii	Simpson's hedgehog cactus	G4	S3	PDCAC0E070
Penstemon idahoensis	Idaho penstemon	G2	S2	PDSCR1L7J0
Phacelia minutissima	least phacelia	G3	S2	PDHYD0C300
Poa abbreviata ssp. marshii	Marsh's bluegrass	G5T2	S1	PMPOA4Z013
Primula incana	Jones' primrose	G4G5	S1	PDPRI080A0
Ranunculus pygmaeus	pygmy buttercup	G5	S1	PDRAN0L280
Ranunculus gelidus	Arctic buttercup	G4	S1	PDRAN0L0Y0
Sanicula graveolens	Sierra sanicle	G4	S1	PDAPI1Z070
Saxifraga adscendens var. oregonensis	wedge-leaf saxifrage	G5T4T5	S2	PDSAX0U011
Saxifraga cernua	nodding saxifrage	G4	S2	PDSAX0U0B0
Sedum borschii	Borsch's stonecrop	G4?	S2	PDCRA0A070
Silene uralensis ssp. montana	petalless campion	G4TNR	S1	PDCAR0U202
Sphaeromeria potentilloides	cinquefoil tansy	G5	S1	PDAST8S060
Stylocline filaginea	stylocline	G4	S2	PDASTD5010
Sullivantia hapemanii var hapemanii	Hapeman's sullivantia	G3T3	S2	PDSAX0X012
Texosporium sancti-jacobi	wovenspore lichen	G2	S2	NLTEST7980
Thamnolia subuliformis		G3G5	S1	NLT0000290

Species	Common Name	Global Rank	State Rank	Element Code
Thelypodium repandum	wavy-leaf Thelypody	G3	S3	PDBRA2N0C0
Thlaspi idahoense var. aileeniae	Stanley thlaspi	G3G4T3	S3	PDBRA2P082
Trifolium douglasii	Douglas' clover	G3	S2	PDFAB400T0

B. Animals

Species	Common Name	Global Rank	State Rank	Element Code
Accipiter gentilis	Northern Goshawk	G5	S4	ABNKC12060
Aechmophorus occidentalis	Western Grebe	G5	S4B	ABNCA04010
Aegolius funereus	Boreal Owl	G5	S2	ABNSB15010
Antrozous pallidus	Pallid Bat	G5	S1?	AMACC10010
Athene cunicularia hypugaea	Western Burrowing Owl	G4TU	S3S4	ABNSB10012
Bartramia longicauda	Upland Sandpiper	G5	S1B	ABNNF06010
Brachylagus idahoensis	Pygmy Rabbit	G4	S3	AMAEB04010
Bucephala albeola	Bufflehead	G5	S3B,S3N	ABNJB18030
Bucephala islandica	Barrow's Goldeneye	G5	S3B,S3N	ABNJB18020
Bufo boreas	Western Toad	G4	S4	AAABB01030
Buteo regalis	Ferruginous Hawk	G4	S3B	ABNKC19120
Corynorhinus townsendii	Townsend's Big-eared Bat	G4	S2	AMACC08010
Crotaphytus bicinctores	Mojave Black-collared Lizard	G5	S2	ARACF04010
Euderma maculatum	Spotted Bat	G4	S2	AMACC07010
Falco columbarius	Merlin	G5	S1B,S2N	ABNKD06030
Falco peregrinus anatum	Peregrine Falcon	G4T3	S1B	ABNKD06071
Gavia immer	Common Loon	G5	S1B,S2N	ABNBA01030
Glaucidium gnoma	Northern Pygmy-owl	G5	S4	ABNSB08010
Gulo gulo luscus	North American Wolverine	G4T4	S2	AMAJF03011
Gymnorhinus cyanocephalus	Pinyon Jay	G5	S2?	ABPAV07010
Haliaeetus leucocephalus	Bald Eagle	G4	S3B,S4N	ABNKC10010
Lynx canadensis	Lynx	G5	S1	AMAJH03010
Martes pennanti	Fisher	G5	S1	AMAJF01020

Species	Common Name	Global Rank	State Rank	Element Code
Myotis ciliolabrum	Western Small-footed Myotis	G5	S4?	AMACC01140
Myotis evotis	Long-eared Myotis	G5	S3?	AMACC01070
Myotis thysanodes	Fringed Myotis	G4G5	S2	AMACC01090
Myotis volans	Long-legged Myotis	G5	S3?	AMACC01110
Myotis yumanensis	Yuma Myotis	G5	S3?	AMACC01020
Numenius americanus	Long-billed Curlew	G5	S3B	ABNNF07070
Oreortyx pictus	Mountain Quail	G5	S2	ABNLC24010
Otus flammeolus	Flammulated Owl	G4	S3B	ABNSB01020
Ovis canadensis californiana	California Bighorn Sheep	G4T1	S3	AMALE04015
Picoides albolarvatus	White-headed Woodpecker	G4	S2B	ABNYF07070
Picoides arcticus	Black-backed Woodpecker	G5	S3	ABNYF07090
Picoides tridactylus	Three-toed Woodpecker	G5	S3?	ABNYF07080
Podiceps grisegena	Red-necked Grebe	G5	S3B	ABNCA03020
Rana pipiens	Northern Leopard Frog	G5	S3	AAABH01170
Sitta pygmaea	Pygmy Nuthatch	G5	S2S3	ABPAZ01030
Sorex merriami	Merriam's Shrew	G5	S2?	AMABA01230
Sorex nanus	Dwarf Shrew	G4	S2S3	AMABA01130
Spermophilus brunneus endemicus	Southern Idaho Ground Squirrel	G2T2	S2	AMAFB05032
Strix nebulosa	Great Gray Owl	G5	S3	ABNSB12040
Tamias dorsalis	Cliff Chipmunk	G5	S1?	AMAFB02110
Tympanuchus phasianellus columbianus	Columbian Sharp-tailed Grouse	G4T3	S3	ABNLC13033
Vulpes macrotis	Kit Fox	G4	S1	AMAJA03040

Global Rank (GRANK) and State Rank (SRANK) - Components of Ranks:
G = Global rank indicator; denotes rank based on rangewide status.
T = Trinomial rank indicator; denotes rangewide status of infraspecific taxa.
S = State rank indicator; denotes rank based on status within Idaho.
1 = Critically imperiled because of extreme rarity or because some factor of its biology makes it especially vulnerable to extinction (typically 5 or fewer occurrences).
2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (typically 6 to 20 occurrences).
3 = Rare or uncommon but not imperiled (typically 21 to100 occurrences).
4 = Not rare and apparently secure, but with cause for long-term concern (usually more than 100 occurrences).
5 = Demonstrably widespread, abundant, and secure.
E = Exotic or introduced.
U = Unknown.
H = Historical occurrence (i.e., formerly part of the native biota with the implied expectation that it might be rediscovered).
X = Presumed extinct or extirpated.
Q = Indicates uncertainty about taxonomic status.
? = Not yet ranked.

State Rare Species

1 = State Priority Taxa in danger of becoming extinct or extirpated from Idaho in the foreseeable future if identifiable factors contributing to their decline continue to operate; these are taxa whose populations are present only at critically low levels or whose habitats have been degraded or depleted to a significant degree.

2 = State Priority Taxa likely to be classified as Priority 1 within the foreseeable future in Idaho, if factors contributing to their population decline or habitat degradation or loss continue.

S = Sensitive Taxa with small populations or localized distributions within Idaho that presently do not meet the criteria for classification as Priority 1 or 2 but whose populations and habitats might be jeopardized without active management or removal of threats.

M = Monitor Taxa that are common within a limited range as well as those taxa which are uncommon but have no identifiable threats.

Review Species
R = Review. Defined above.

Table 2. Summary of plant associations sampled. The number of plots (count) sampled (2002 and 2003) or compiled for previous projects is summarized by series and plant association. Plots that are not classified to an association are labeled (in the association code column) as the series. Series and association codes are compiled from USDA, NRCS (2004). The G/S Rank is the concanated global and state rarity rank. The codes follow the conventions listed for Table 1 (?/? indicates that the association has not been ranked).

Series	Association Code	Association	G/S Rank	Count
AMAL2	AMAL2	*Amelanchier anlifolia*	n. a.	1
ARAR8	ARAR8	*Artemisia arbuscula arbuscula*	n. a.	3
ARAR8	ARAR8/AGSP	*Artemisia arbuscula arbuscula/Agropyron spicatum*	G5/S3	5
ARAR8	ARAR8/FEID	*Artemisia arbuscula arbuscula/Festuca idahoensis*	G5/S3?	14
ARAR8	ARAR8/POSE	*Artemisia arbuscula arbuscula/Poa secunda*	G5/S4	8
ARAR8	ARAR8/STTH2	*Artemisia arbuscula arbuscula/Stipa thurberiana*	?/?	2
ARART	ARART/FEID	*Artemisia arbuscula thermopola/Festuca idahoensis*	G2/S2	1
ARART	ARART/POSE	*Artemisia arbuscula thermopola/Poa secunda*	?/?	1
ARFR4	ARFR4/AGSP	*Artemisia frigida/Agropyron spicatum*	?/?	3
ARLO9	ARLO9/FEID	*Artemisia longiloba/Festuca idahoensis*	G3?/S1	3
ARNO4	ARNO4/AGSP	*Artemisia nova/Agropyron spicatum*	G4G5/S3	1
ARNO4	ARNO4/FEID	*Artemisia nova/Festuca idahoensis*	G2?/S2	1
ARNO4	ARNO4/POSE	*Artemisia nova/Poa secunda*	G3Q/S3	1
ARRI2	ARRI2/FEID	*Artemisia rigida/Festuca idahoensis*	?/?	3
ARRI2	ARRI2/POSE	*Artemisia rigida/Poa secunda*	G4/S2	3
ARTR4	ARTR4/POSE	*Artemisia tripartita/Poa secunda*	?/?	1
ARTRT	ARTRT/AGSP	*Artemisia tridentata tridentata/Agropyron spicatum*	G2G4/S1	1
ARTRV	ARTRV	*Artemisia tridentata vaseyana*	n. a.	6
ARTRV	ARTRV-CEVE/AGSP	*Artemisia tridentata vaseyana-Ceanothus velutinus/Agropyron spicatum*	?/?	1
ARTRV	ARTRV-CEVE/FEID	*Artemisia tridentata vaseyana-Ceanothus velutinus/Festuca idahoensis*	?/?	1
ARTRV	ARTRV-PUTR2/AGSP	*Artemisia tridentata vaseyana-Purshia tridentata*	?/?	12
ARTRV	ARTRV-PUTR2/FEID	*Artemisia tridentata vaseyana-Purshia tridentata*	?/?	2
ARTRV	ARTRV-SYOR2/AGSP	*Artemisia tridentata vaseyana-Symphoricarpos oreophilus/Agropyron spicatum*	G5?/S3	12
ARTRV	ARTRV-SYOR2/BRCA5	*Artemisia tridentata vaseyana-Symphoricarpos oreophilus/Bromus carinatus*	G4Q/S3?	1
ARTRV	ARTRV-SYOR2/CAGE2	*Artemisia tridentata vaseyana-Symphoricarpos oreophilus/Carex geyeri*	G4/S4	2
ARTRV	ARTRV-SYOR2/ELCI2	*Artemisia tridentata vaseyana-Symphoricarpos oreophilus/Elymus cinereus*	?/?	1
ARTRV	ARTRV-SYOR2/FEID	*Artemisia tridentata vaseyana-Symphoricarpos oreophilus/Festuca idahoensis*	G4/S4	13

Series	Association Code	Association	G/S Rank	Count
ARTRV	ARTRV-SYOR2/POSE	*Artemisia tridentata vaseyana-Symphoricarpos oreophilus/Poa secunda*	?/?	1
ARTRV	ARTRV/AGSP	*Artemisia tridentata vaseyana/Agropyron spicatum*	G5/S4	32
ARTRV	ARTRV/CAGE2	*Artemisia tridentata vaseyana/Carex geyeri*	G3/S3	6
ARTRV	ARTRV/ELCI2	*Artemisia tridentata vaseyana/Elymus cinereus*	G4?/S2	3
ARTRV	ARTRV/FEID	*Artemisia tridentata vaseyana/Festuca idahoensis*	G5/S4	47
ARTRV	ARTRV/LEKI2	*Artemisia tridentata vaseyana/Leucopoa kingii*	G3/S3	1
ARTRV	ARTRV/STTH2	*Artemisia tridentata vaseyana/Stipa thurberiana*	?/?	1
ARTRW8	ARTRW8/AGSP	*Artemisia tridentata wyomingensis/Agropyron spicatum*	G4/S3	5
ARTRW8	ARTRW8/FEID	*Artemisia tridentata wyomingensis/Festuca idahoensis*	G3G4/S1	2
ARTRW8	ARTRW8/STCO4	*Artemisia tridentata wyomingensis/Stipa comata*	G2/S2	1
ARTRX	ARTRX/AGSP	*Artemisia tridentata xericensis/Agropyron spicatum*	G2?/S1	3
ARTRX	ARTRX/FEID	*Artemisia tridentata xericensis/Festuca idahoensis*	G2?/S2	1
CELE3	CELE3-SYOR2/FEID	*Cercocarpus ledifolius-Symphoricarpos oreophilus/Festuca idahoensis*	?/?	1
CEVE	CEVE	*Ceanothus velutinus*	n. a.	1
CRDO2	CRDO2	*Crataegus douglasii*	n. a.	1
GLNE	GLNE/AGSP	*Glossopetalon nevadense/Agropyron spicatum*	G4/S3	1
HASU	HASU	*Haplopappus suffruticosus*	n. a.	2
HASU	HASU/FEID	*Haplopappus suffruticosus/Festuca idahoensis*	G2?/S2	2
PHMA5	PHMA5	*Physocarpus malvaceus*	n. a.	1
PHMA5	PHMA5	*Physocarpus malvaceus-Symphoricarpos albus*	G3/S2	2
PREM	PREM	*Prunus emarginata*	n. a.	3
PRVI	PRVI	*Prunus virginiana*	n. a.	6
PRVI	PRVI/ELCI2	*Prunus virginiana/Elymus cinereus*	?/?	1
PUTR2	PUTR2	*Purshia tridentata*	n. a.	1
PUTR2	PUTR2/AGSP	*Purshia tridentata/Agropyron spicatum*	G3/S1S2	12
PUTR2	PUTR2/FEID	*Purshia tridentata/Festuca idahoensis*	G3G5/S2	4
ROSA5	ROSA5	*Rosa woodsii*	n. a.	2
SYOR2	SYOR2	*Symphoricarpos oreophilus*	n. a.	2

Table 3. Summary of cluster analysis group by plant association. The percent distribution of plots within plant association is summarized for each hierarchical cluster analysis group (columns sum to 100 percent).

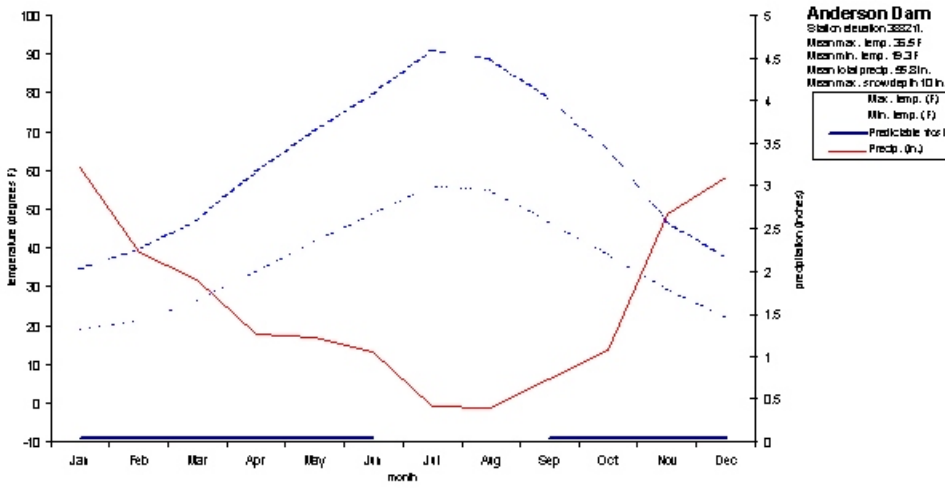
Series	Association (number of plots)	1 (19)	2 (43)	5 (38)	8 (25)	9 (12)	11 (3)	12 (17)	19 (2)	22 (3)	30 (16)	35 (11)	36 (4)	41 (4)	42 (4)	67 (8)	69 (4)	74 (5)	86 (3)	88 (9)	160 (2)	188 (1)	199 (5)	210 (4)	241 (6)
AMAL2	AMAL2										6														
ARAR8	ARAR8	11																							17
	ARAR8/AGSP	5									19														17
	ARAR8/FEID	37		11																					50
	ARAR8/POSE	37												25											
	ARAR8/STTH2	11																							
ARART	ARART/FEID			3																					
	ARART/POSE																			11					
ARFR4	ARFR4/AGSP											27													
ARLO9	ARLO9/FEID						100																		
ARNO4	ARNO4/AGSP																			11					
	ARNO4/FEID																			11					
	ARNO4/POSE																			11					
ARRI2	ARRI2/FEID																			11			40		
	ARRI2/POSE																						60		
ARTR4	ARTR4/POSE													25											
ARTRT	ARTRT/AGSP											9													
ARTRV	ARTRV		5					18								13									
	ARTRV-CEVE/AGSP																		33						
	ARTRV-CEVE/FEID				4																				
	ARTRV-PUTR2/AGSP		14			17		12			6					13									
	ARTRV-PUTR2/FEID		2													13									
	ARTRV-SYOR2/AGSP		19					12		67															
	ARTRV-SYOR2/BRCA5		2																						
	ARTRV-SYOR2/CAGE2				4					33															
	ARTRV-SYOR2/ELCI2		2																						
	ARTRV-SYOR2/FEID		5	11	20			12																	
	ARTRV-SYOR2/POSE														25										

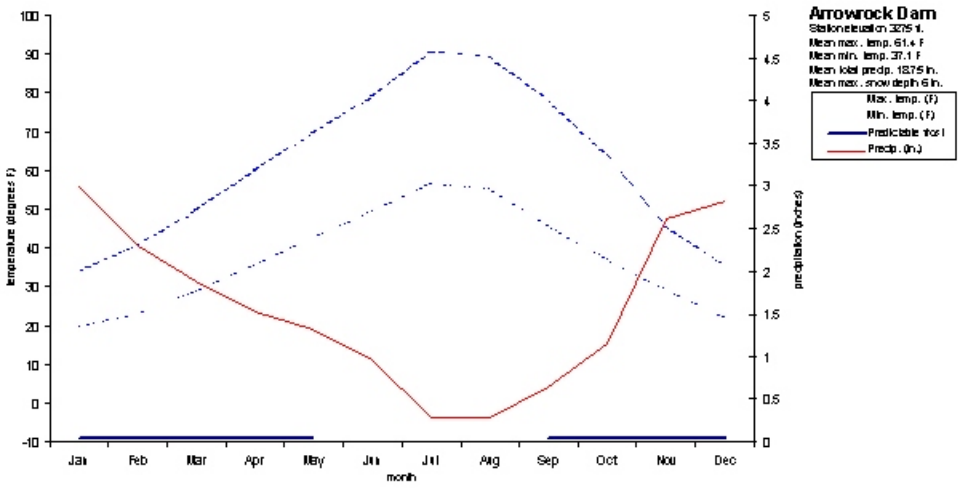
Series	Association (number of plots)	1 (19)	2 (43)	5 (38)	8 (25)	9 (12)	11 (3)	12 (17)	19 (2)	22 (3)	30 (16)	35 (11)	36 (4)	41 (4)	42 (4)	67 (8)	69 (4)	74 (5)	86 (3)	88 (9)	160 (2)	188 (1)	199 (5)	210 (4)	241 (6)
	ARTRV/AGSP		35					29			25	9			25	63						100			
	ARTRV/CAGE2				24																				
	ARTRV/ELCI2		7																						
	ARTRV/FEID		7	66	48			12	50		6	9					25								17
	ARTRV/LEKI2		2																						
	ARTRV/STTH2							6																	
ARTRW8	ARTRW8/AGSP													25						44					
	ARTRW8/FEID			3										25											
	ARTRW8/STCO4											9													
ARTRX	ARTRX/AGSP					8					13														
	ARTRX/FEID			3																					
CELE3	CELE3-SYOR2/FEID			3																					
CEVE	CEVE																		33						
CRDO2	CRDO2																25								
GLNE	GLNE/AGSP																							25	
HASU	HASU												100												
PHMA5	PHMA5								50			9					25								
PREM	PREM														25				33		50				
PRVI	PRVI										13							60							
	PRVI/ELCI2																	20							
	PRVI/STCO3																	20							
PUTR2	PUTR2/AGSP					42					6	18									50			75	
	PUTR2/BASA3											9													
	PUTR2/FEID					33																			
ROSA5	ROSA5										6						25								
SYOR2	SYOR2			3											25										

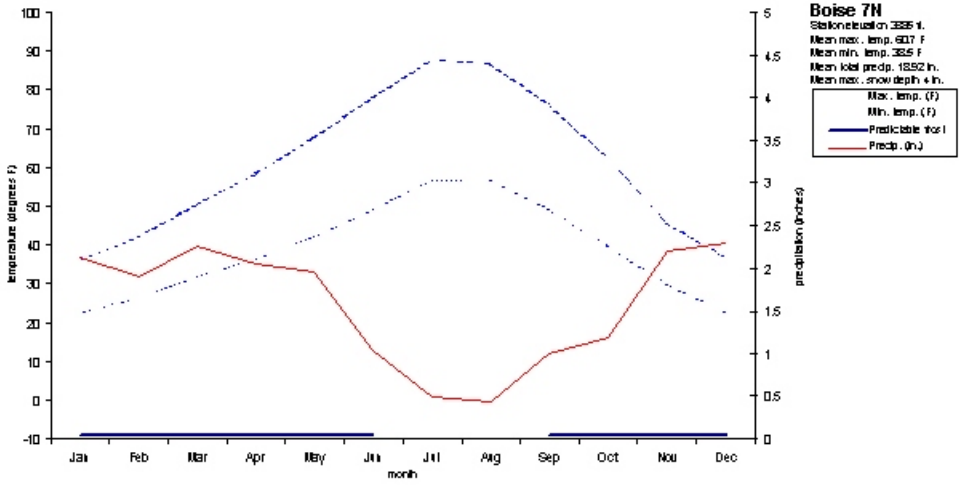
Appendix 1. Climate Charts.

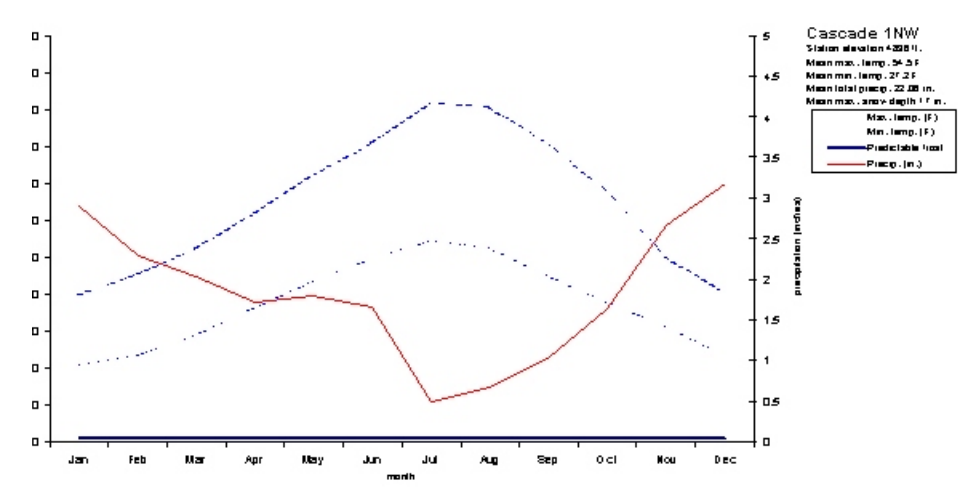
Climate charts for the following weather stations are shown in alphabetical order:

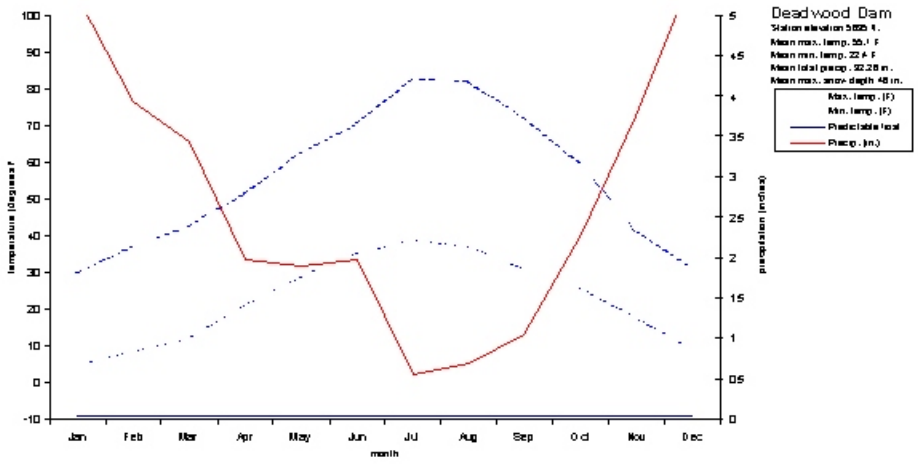
ANDERSON DAM 1 SW
ARROW ROCK DAM
BOISE 7 N
CASCADE 1 NW
DEADWOOD DAM 15 N
FAIRFIELD RANGER STATION
GALENA
GARDEN VALLEY R S
GROUSE CREEK, UT
HAILEY AP
LOWMAN
MIDDLE FORK LODGE
STANLEY
STREVELL
YELLOW PINE 7 S


Anderson Dam
Station elevation 3882 ft.
Mean max. temp. 35.5 F
Mean min. temp. 19.3 F
Mean total precip. 9.53 in.
Mean max. snow depth 10 in.
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
month


Arrowrock Dam
Station elevation 3275 ft.
Mean max. temp. 61.4 F
Mean min. temp. 37.1 F
Mean total precip. 13.75 in.
Mean max. snow depth 6 in.
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
month


Boise 7N
Station elevation 3838 ft.
Mean max. temp. 60.7 F
Mean min. temp. 38.5 F
Mean total precip. 13.52 in.
Mean max. snow depth 4 in.
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
month


Cascade 1NW
Station elevation 4838 ft.
Mean max. temp. 54.5 F
Mean min. temp. 27.2 F
Mean total precip. 22.08 in.
Mean max. snow depth 17 in.
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
precipitation (inches)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
month


Deadwood Dam
Station elevation 5605 ft.
Mean max. temp. 55.1 F
Mean min. temp. 22.4 F
Mean total precip. 32.28 in.
Mean max. snow depth 48 in.
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
month
Jan
Feb
Mar
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Jun
Jul
Aug
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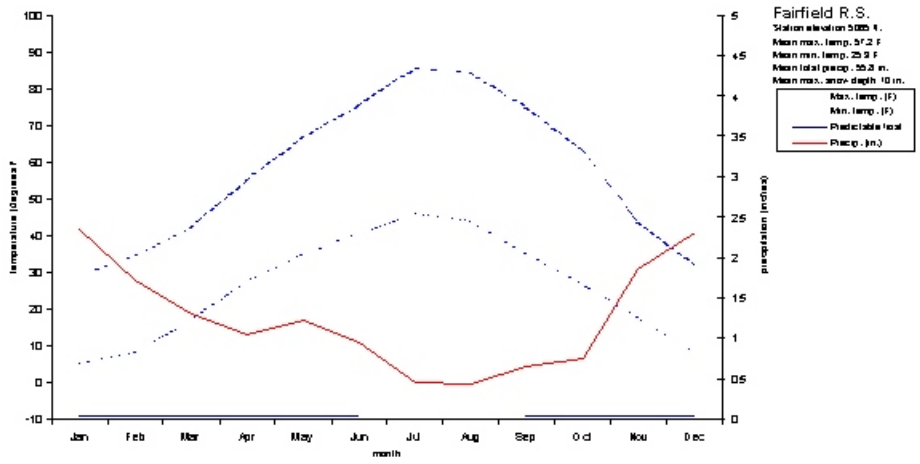
Oct
Nov
Dec


Fairfield R.S.
Station elevation 5085 ft.
Mean max. temp. 57.2 F
Mean min. temp. 25.2 F
Mean total precip. 35.2 in.
Mean max. snow depth 10 in.
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
month
Jan
Feb
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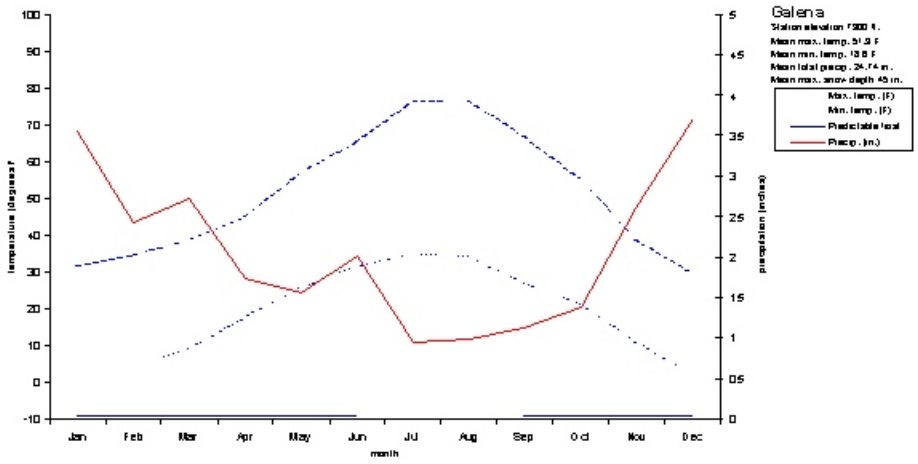
Aug
Sep
Oct
Nov
Dec


Galena
Station elevation 5200 ft.
Mean max. temp. 54.9 F
Mean min. temp. 13.6 F
Mean total precip. 24.74 in.
Mean max. snow depth 45 in.
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
month
Jan
Feb
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May
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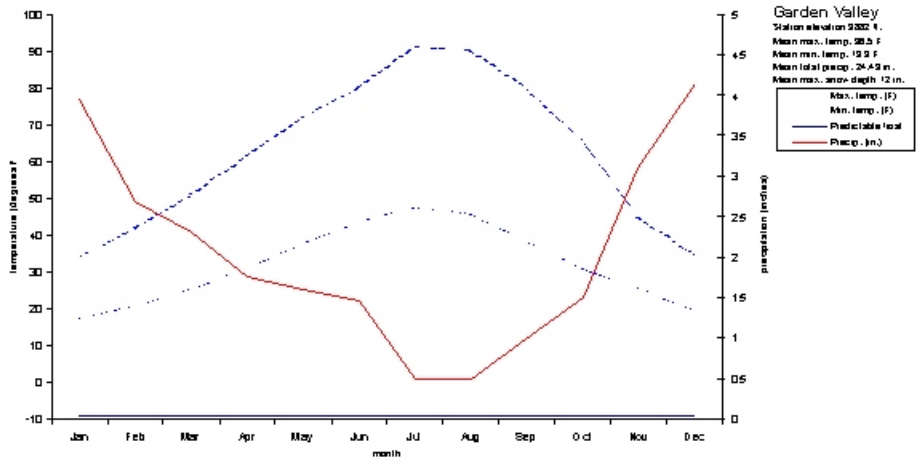
Jul
Aug
Sep
Oct
Nov
Dec


Garden Valley
Station elevation 5382 ft.
Mean max. temp. 58.5 F
Mean min. temp. 19.9 F
Mean total precip. 24.49 in.
Mean max. snow depth 12 in.
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
month
Jan
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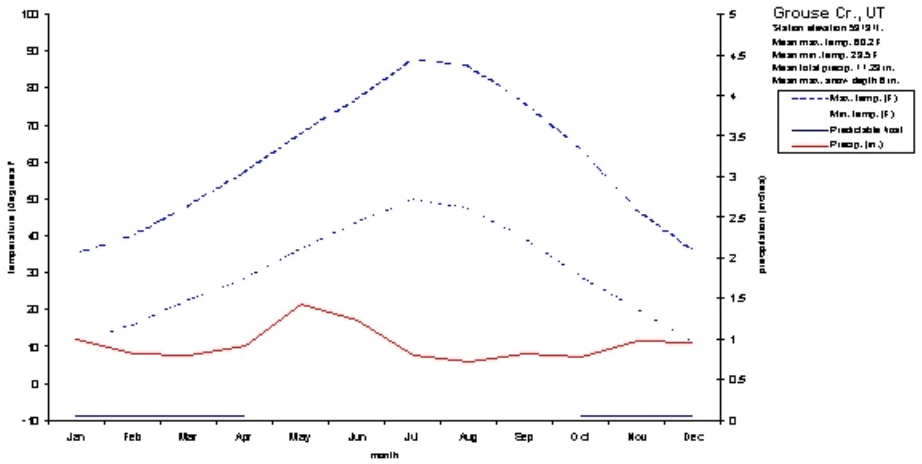
Nov
Dec


Grouse Cr., UT
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
month
Jan
Feb
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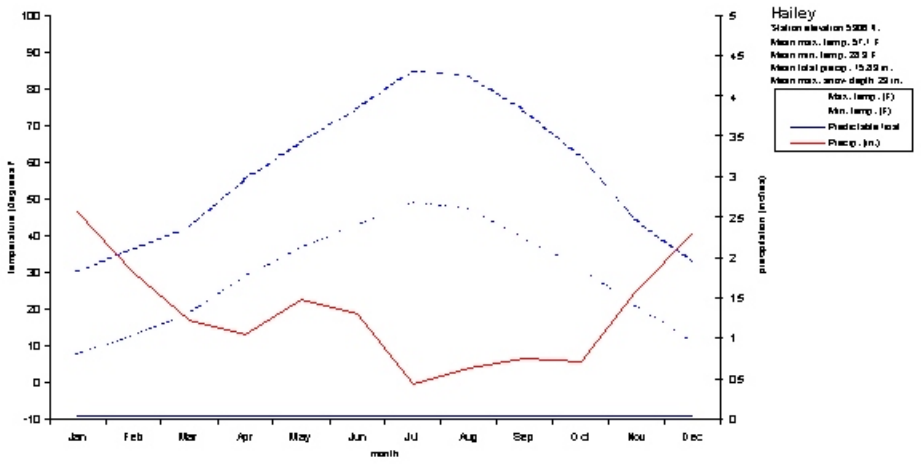
Sep
Oct
Nov
Dec


Hailey
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
month
Jan
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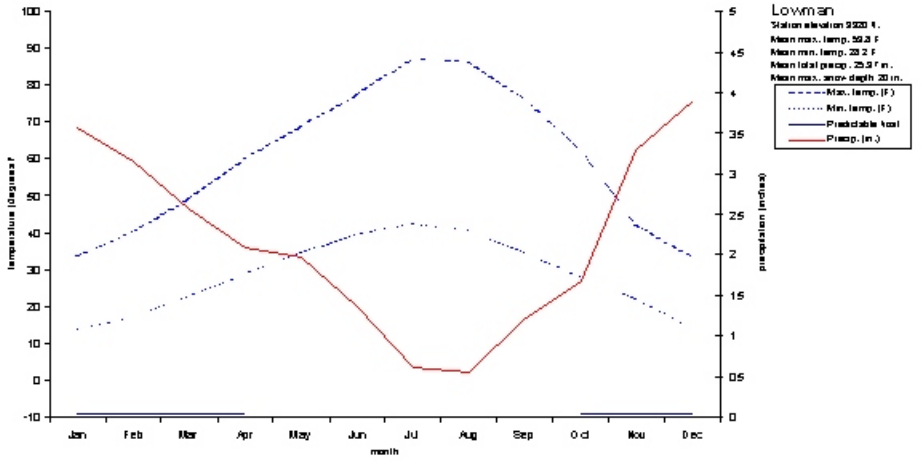
Oct
Nov
Dec


Lowman
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
month
Jan
Feb
Mar
Apr
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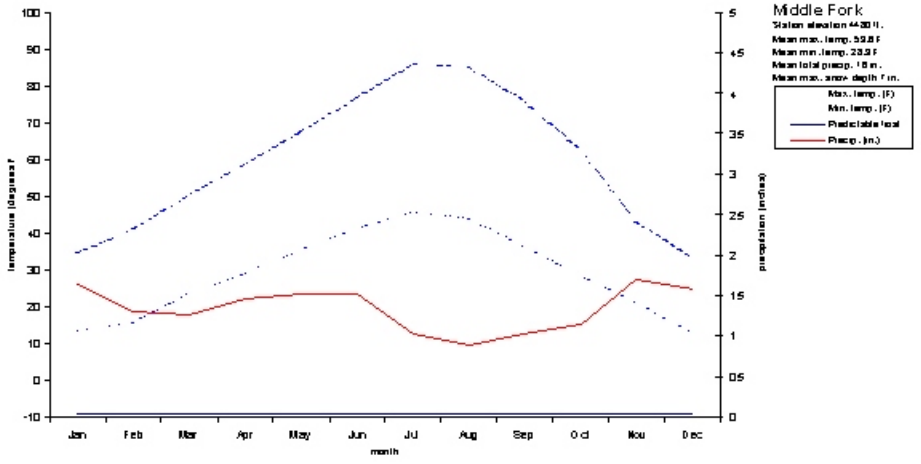
Sep
Oct
Nov
Dec


Middle Fork
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
month
Jan
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May
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Jul
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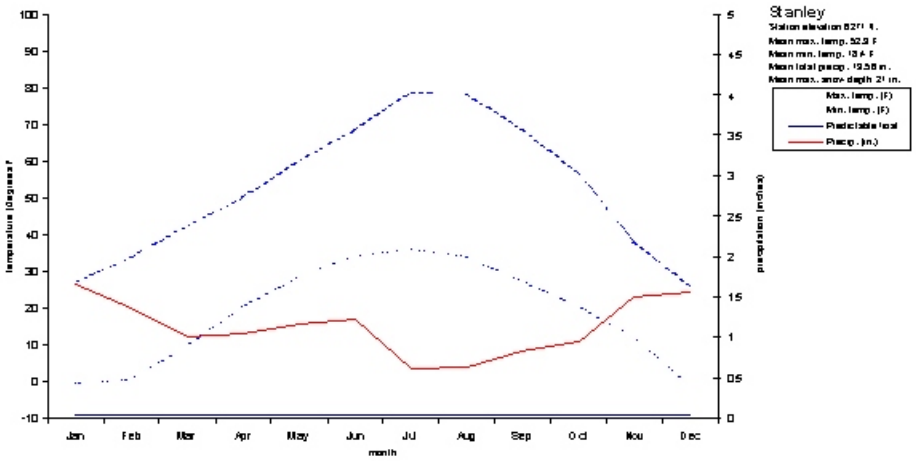
Sep
Oct
Nov
Dec


Stanley
Station elevation 8211 ft.
Mean max. temp. 52.9 F
Mean min. temp. 19.4 F
Mean total precip. 19.58 in.
Mean max. snow depth 21 in.
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
month
Jan
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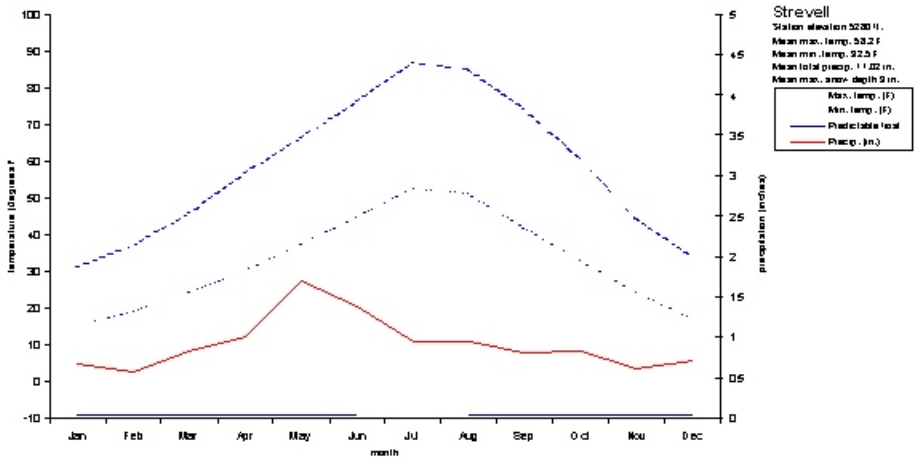
Dec


Strevell
Station elevation 5230 ft.
Mean max. temp. 58.2 F
Mean min. temp. 32.5 F
Mean total precip. 11.02 in.
Mean max. snow depth 9 in.
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
month
Jan
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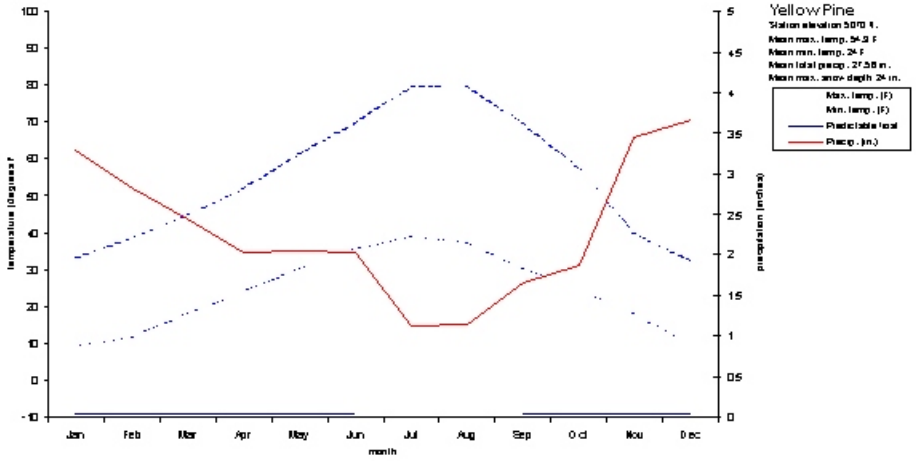
Oct
Nov
Dec


Yellow Pine
Station elevation 5070 ft.
Mean max. temp. 54.9 F
Mean min. temp. 24 F
Mean total precip. 27.58 in.
Mean max. snow depth 24 in.
Max. temp. (F)
Min. temp. (F)
Predictable frost
Precip. (in.)
temperature (degrees F)
precipitation (inches)
month
Jan
Feb
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Dec

Appendix 2. List of covertypes.

Covertypes selected from Landscape Dynamics Lab (1999)

3101	Foothills Grassland
3102	Disturbed Grassland
3104	Montane Parklands and Subalpine Meadow
3107	Shrub/Steppe Annual Grass-Forb
3109	Perennial Grassland
3110	Perennial Grass Slope
3201	Mesic Upland Shrubs
3301	Curlleaf Mountain Mahogany
3304	Bitterbrush
3305	Mountain Big Sagebrush
3306	Wyoming Big Sagebrush
3307	Basin & Wyoming Big Sagebrush
3308	Black Sagebrush Steppe
3309	Silver Sage
3310	Salt-desert Shrub
3312	Rabbitbrush
3315	Low Sagebrush
3316	Mountain Low Sagebrush

Covertypes selected from Homer et al. (1995)

34	BITTERBRUSH
35	BLACKBRUSH
36	BURN_SHRUB
38	CREOSOTE-BURSAGE
39	GREASEWOOD
40	HOPSAGE
41	MESQUITE
42	MOJAVE MIXED SCRUB
43	MONTANE SHRUB
44	MOUNTAIN SAGE
45	PICKLEWEED
46	SAGEBRUSH
47	SAGEBRUSH STEPPE
48	SALT DESERT SCRUB
53	DESERT GRASSLAND
54	DRY MEADOW
55	GRASSLAND
56	PERENNIAL GRASS MONTANE
57	TALL FORB MONTANE

Appendix 3. Plant species list. Plant species observed on Boise and Sawtooth National Forest shrubland ecology plots are listed by physiognomic group with common name. Nomenclature follows (for the most part) Hitchcock and Cronquist (1973).

Trees	
Acer glabrum	Rocky Mountain maple
Pinus ponderosa	ponderosa pine
Populus tremuloides	quaking aspen
Pseudotsuga menziesii	Douglas-fir
Shrubs	
Amelanchier utahensis	Utah serviceberry
Artemisia arbuscula	low sagebrush
Artemisia arbuscula ssp. thermopola	little sagebrush
Artemisia frigida	prairie sagewort
Artemisia longiloba	early low sagebrush
Artemisia nova	black sagebrush
Artemisia rigida	scabland sagebrush
Artemisia tridentata	big sagebrush
Artemisia tridentata ssp. vaseyana	mountain big sagebrush
Artemisia tridentata ssp. xericensis	big sagebrush
Artemisia tridentata var. wyomingensis	Wyoming big sagebrush
Artemisia tripartita	threetip sagebrush
Atriplex	saltbush
Berberis repens	creeping barberry
Brickellia	brickellbush
Ceanothus velutinus	snowbrush ceanothus
Cercocarpus ledifolius	curl-leaf mountain mahogany
Chrysothamnus humilis	Truckee rabbitbrush
Chrysothamnus nauseosus	rubber rabbitbrush
Chrysothamnus viscidiflorus	yellow rabbitbrush
Crataegus douglasii	black hawthorn
Eriogonum ovalifolium	cushion buckwheat
Eurotia lanata	winterfat
Glossopetalon nevadense	spiny greasebush
Holodiscus dumosus	rockspirea
Philadelphus lewisii	Lewis' mock orange
Physocarpus malvaceus	mallow ninebark
Potentilla fruticosa	shrubby cinquefoil
Prunus emarginata	bitter cherry
Prunus virginiana	chokecherry
Purshia tridentata	antelope bitterbrush
Ribes aureum	golden currant
Ribes cereum	wax currant
Ribes montigenum	gooseberry currant
Rosa nutkana	Nootka rose
Rosa woodsii	Woods' rose
Sambucus cerulea	blue elderberry
Spiraea betulifolia	white spirea
Symphoricarpos albus	common snowberry
Symphoricarpos oreophilus	mountain snowberry
Tetradymia	horsebrush
Herbs	
Achillea millefolium	common yarrow
Agastache urticifolia	nettleleaf giant hyssop
Agoseris	agoseris
Agoseris aurantiaca	orange agoseris
Agoseris glauca	pale agoseris
Agoseris grandiflora	bigflower agoseris
Agoseris heterophylla	annual agoseris
Agoseris retrorsa	spearleaf agoseris
Alisma	water plantain
Allium	onion
Allium acuminatum	tapertip onion
Allium brandegeei	Brandegee's onion

Alyssum desertorum	desert madwort
Amelanchier alnifolia	Saskatoon serviceberry
Amsinckia	fiddleneck
Amsinckia retrorsa	Menzies' fiddleneck
Anaphalis margaritacea	western pearly everlasting
Antennaria dimorpha	low pussytoes
Antennaria flagellaris	whip pussytoes
Antennaria luzuloides	rush pussytoes
Antennaria microphylla	littleleaf pussytoes
Antennaria stenophylla	narrowleaf pussytoes
Antennaria umbrinella	umber pussytoes
Apocynum	dogbane
Apocynum androsaemifolium	spreading dogbane
Arabis	rockcress
Arabis glabra	tower rockcress
Arabis holboellii	Holboell's rockcress
Arabis microphylla	littleleaf rockcress
Arabis puberula	silver rockcress
Arabis sparsiflora	sicklepod rockcress
Arabis suffrutescens	woody rockcress
Arenaria	sandwort
Arenaria aculeata	prickly sandwort
Arenaria capillaris	slender mountain sandwort
Arenaria congesta	ballhead sandwort
Arenaria kingii	King's sandwort
Arenaria serpyllifolia	thymeleaf sandwort
Arnica sororia	twin arnica
Artemisia dracunculus	tarragon
Artemisia ludoviciana	white sagebrush
Artemisia ludoviciana var. incompta	white sagebrush
Artemisia ludoviciana var. latiloba	white sagebrush
Aster	aster
Aster engelmannii	Engelmann's aster
Aster foliaceus	alpine leafybract aster
Aster perelegans	elegant aster
Aster scopulorum	Lava aster
Astragalus	milkvetch
Astragalus anserinus	Goose Creek milkvetch
Astragalus convallarius	lesser rushy milkvetch
Astragalus eremiticus	hermit milkvetch
Astragalus filipes	basalt milkvetch
Astragalus inflexus	bent milkvetch
Astragalus lentiginosus	freckled milkvetch
Astragalus obscurus	arcane milkvetch
Astragalus purshii	woollypod milkvetch
Astragalus whitneyi	balloonpod milkvetch
Balsamorhiza hookeri	Hooker's balsamroot
Balsamorhiza incana	hoary balsamroot
Balsamorhiza sagittata	arrowleaf balsamroot
Besseya rubra	red besseya
Blepharipappus scaber	rough eyelashweed
Brodiaea douglasii	largeflower triteleia
Calochortus	mariposa lily
Calochortus eurycarpus	white mariposa lily
Calochortus macrocarpus	sagebrush mariposa lily
Calochortus nuttallii	sego lily
Camassia quamash	small camas
Camelina microcarpa	littlepod false flax
Castilleja	Indian paintbrush
Castilleja angustifolia	northwestern Indian paintbrush
Castilleja applegatei	wavyleaf Indian paintbrush
Castilleja chromosa	wavyleaf Indian paintbrush
Castilleja flava	yellow Indian paintbrush
Castilleja hispida	harsh Indian paintbrush
Castilleja linariifolia	Wyoming Indian paintbrush
Castilleja longispica	longspike Indian paintbrush
Castilleja lutescens	stiff yellow Indian paintbrush
Castilleja miniata	giant red Indian paintbrush

Castilleja oresbia	pale Wallowa Indian paintbrush
Castilleja pallescens	pale Indian paintbrush
Castilleja rustica	country Indian paintbrush
Cerastium	mouse-ear chickweed
Chaenactis	pincushion
Chaenactis douglasii	Douglas' dustymaiden
Chenopodium album	lambsquarters
Chenopodium fremontii	Fremont's goosefoot
Chenopodium leptophyllum	narrowleaf goosefoot
Chondrilla juncea	hogbite
Cirsium canovirens	graygreen thistle
Cirsium utahense	Utah thistle
Clarkia pulchella	pinkfairies
Clarkia rhomboidea	diamond clarkia
Clematis hirsutissima	hairy clematis
Collinsia grandiflora	giant blue eyed Mary
Collinsia parviflora	maiden blue eyed Mary
Collomia grandiflora	grand collomia
Collomia linearis	tiny trumpet
Collomia tenella	diffuse collomia
Comandra umbellata	bastard toadflax
Cordylanthus ramosus	bushy bird's beak
Crepis	hawksbeard
Crepis acuminata	tapertip hawksbeard
Crepis modocensis	Modoc hawksbeard
Crepis occidentalis	largeflower hawksbeard
Cryptantha	cryptantha
Cryptantha ambigua	basin cryptantha
Cryptantha annual	cryptantha
Cryptantha perennial	cryptantha
Cryptantha sobolifera	Waterton Lakes cryptantha
Cryptantha spiculifera	Snake River cryptantha
Cryptantha torreyana	Torrey's cryptantha
Cryptantha watsonii	Watson's cryptantha
Cymopterus	springparsley
Cymopterus terebinthinus var. foeniculaceus	turpentine wavewing
Delphinium	larkspur
Delphinium andersonii	Anderson's larkspur
Delphinium glaucescens	smooth larkspur
Delphinium nuttallianum	twolobe larkspur
Delphinium occidentale	duncecap larkspur
Descurainia pinnata	western tansymustard
Descurainia richardsonii	mountain tansymustard
Descurainia sophia	herb sophia
Dodecatheon	shootingstar
Draba	draba
Draba douglasii	alkali cusickiella
Draba trichocarpa	Stanley Creek draba
Draba verna	spring draba
Epilobium	willowherb
Epilobium angustifolium	fireweed
Epilobium glaberrimum	glaucus willowherb
Epilobium minutum	chaparral willowherb
Epilobium paniculatum	tall annual willowherb
Eriastrum sparsiflorum	Great Basin woollystar
Erigeron	fleabane
Erigeron asperugineus	Idaho fleabane
Erigeron bloomeri	scabland fleabane
Erigeron chrysopsidis var. austiniae	sagebrush fleabane
Erigeron compositus	cutleaf daisy
Erigeron corymbosus	longleaf fleabane
Erigeron filifolius	threadleaf fleabane
Erigeron linearis	desert yellow fleabane
Erigeron peregrinus	subalpine fleabane
Erigeron pumilus	shaggy fleabane
Eriogonum	buckwheat
Eriogonum caespitosum	matted buckwheat
Eriogonum capistratum	hidden buckwheat

Eriogonum capistratum var. welshii	Welsh's buckwheat
Eriogonum compositum	arrowleaf buckwheat
Eriogonum elatum	tall woolly buckwheat
Eriogonum flavum	alpine golden buckwheat
Eriogonum heracleoides	parsnipflower buckwheat
Eriogonum meledonum	bridle buckwheat
Eriogonum microthecum	slender buckwheat
Eriogonum sphaerocephalum	rock buckwheat
Eriogonum strictum	Blue Mountain buckwheat
Eriogonum strictum ssp. proliferum	Blue Mountain buckwheat
Eriogonum strictum ssp. strictum	Blue Mountain buckwheat
Eriogonum thymoides	thymeleaf buckwheat
Eriogonum umbellatum	sulphur-flower buckwheat
Eriogonum umbellatum var. subalpinum	sulphur-flower buckwheat
Eriogonum vimineum var. shoshonense	wickerstem buckwheat
Eriophyllum lanatum	common woolly sunflower
Erodium cicutarium	redstem stork's bill
Erysimum asperum	sanddune wallflower
Erythronium grandiflorum	yellow avalanche-lily
Fragaria vesca	woodland strawberry
Frasera speciosa	elkweed
Fritillaria atropurpurea	spotted fritillary
Fritillaria pudica	yellow fritillary
Galium	bedstraw
Galium aparine	stickywilly
Galium bifolium	twinleaf bedstraw
Galium multiflorum	shrubby bedstraw
Galium trifidum	threepetal bedstraw
Galium triflorum	fragrant bedstraw
Gayophytum	groundsmoke
Gayophytum diffusum	spreading groundsmoke
Gayophytum ramosissimum	pinyon groundsmoke
Geranium viscosissimum	sticky purple geranium
Geum triflorum	old man's whiskers
Gilia gilia	
Gilia aggregata	scarlet gilia
Gilia congesta	ballhead ipomopsis
Grindelia squarrosa	curlycup gumweed
Hackelia	stickseed
Hackelia annual	annual stickseed
Hackelia floribunda	manyflower stickseed
Hackelia micrantha	Jessica sticktight
Haplopappus acaulis	stemless mock goldenweed
Haplopappus carthamoides	largeflower goldenweed
Haplopappus insecticruris	wholeleaf goldenweed
Haplopappus lanuginosus	woolly mock goldenweed
Haplopappus radiatus	ray goldenweed
Haplopappus stenophyllus	narrowleaf mock goldenweed
Haplopappus suffruticosus	singlehead goldenbush
Helianthella uniflora	oneflower helianthella
Helianthus annuus	common sunflower
Helianthus cusickii	Cusick's sunflower
Heuchera	alumroot
Heuchera cylindrica	roundleaf alumroot
Heuchera parvifolia	littleleaf alumroot
Hieracium albertinum	houndstongue hawkweed
Hieracium cynoglossoides	houndstongue hawkweed
Holosteum umbellatum	jagged chickweed
Hydrophyllum capitatum	ballhead waterleaf
Hydrophyllum fendleri	Fendler's waterleaf
Kelloggia galioides	milk kelloggia
Lactuca serriola	prickly lettuce
Lathyrus	pea
Lemna minor	common duckweed
Lepidium perfoliatum	clasping pepperweed
Leptodactylon pungens	granite prickly phlox
Lesquerella	bladderpod
Lesquerella occidentalis	western bladderpod

Leucopoa kingii	spike fescue
Lewisia pygmaea	alpine lewisia
Lewisia rediviva	bitter root
Linanthus nuttallii	Nuttall's linanthus
Linanthus pharnaceoides	lighthouse flaxflower
Linum perenne var. lewisii	prairie flax
Lithophragma	woodland-star
Lithophragma bulbiferum	bulbous woodland-star
Lithophragma parviflorum	smallflower woodland-star
Lithospermum arvense	corn gromwell
Lithospermum ruderale	western stoneseed
Lomatium	desertparsley
Lomatium cous	cous biscuitroot
Lomatium dissectum	fernleaf biscuitroot
Lomatium grayi	Gray's biscuitroot
Lomatium leptocarpum	Wasatch desertparsley
Lomatium macrocarpum	bigseed biscuitroot
Lomatium nudicaule	barestem biscuitroot
Lomatium rollinsii	Rollins' biscuitroot
Lomatium serpentinum	sweetscented biscuitroot
Lomatium triternatum	nineleaf biscuitroot
Lotus purshianus	American bird's-foot trefoil
Lupinus	lupine
Lupinus arbustus	longspur lupine
Lupinus argenteus	silvery lupine
Lupinus laxiflorus	silvery lupine
Lupinus lepidus	Pacific lupine
Lupinus sericeus	silky lupine
Lygodesmia spinosa	thorn skeletonweed
Machaeranthera canescens	hoary tansyaster
Madia	tarweed
Madia exigua	small tarweed
Madia gracilis	grassy tarweed
Medicago sativa	alfalfa
Mentha arvensis	wild mint
Mentzelia albicaulis	whitestem blazingstar
Mertensia	bluebells
Mertensia oblongifolia	oblongleaf bluebells
Microseris	silverpuffs
Microseris nutans	nodding microceris
Microseris troximoides	weevil prairie-dandelion
Microsteris gracilis	slender phlox
Mimulus cusickii	Cusick's monkeyflower
Mimulus guttatus	seep monkeyflower
Mimulus nanus	dwarf purple monkeyflower
Montia parvifolia	littleleaf minerslettuce
Montia perfoliata	miner's lettuce
Myosotis discolor	changing forget-me-not
Myosotis micrantha	strict forget-me-not
Navarretia	pincushionplant
Navarretia breweri	Brewer's navarretia
Navarretia intertexta	needleleaf navarretia
Nemophila	baby blue eyes
Oenothera caespitosa	tufted evening-primrose
Oenothera pallida	pale evening-primrose
Onopordum acanthium	Scotch cottonthistle
Opuntia polyacantha	plains pricklypear
Orobanche	broomrape
Orobanche corymbosa	flat-top broomrape
Orobanche fasciculata	clustered broomrape
Osmorhiza chilensis	sweetcicely
Osmorhiza occidentalis	western sweetroot
Oxytropis	locoweed
Paeonia brownii	Brown's peony
Pedicularis contorta	coiled lousewort
Pediocactus simpsonii	Simpson hedgehog cactus
Penstemon	beardtongue
Penstemon attenuatus	sulphur penstemon

Penstemon deustus	scabland penstemon
Penstemon fruticosus	bush penstemon
Penstemon fruticosus var. serratus	sawleaf bush penstemon
Penstemon gairdneri	Gairdner's beardtongue
Penstemon glandulosus	stickystem penstemon
Penstemon globosus	globe penstemon
Penstemon humilis	low beardtongue
Penstemon procerus	littleflower penstemon
Penstemon speciosus	royal penstemon
Penstemon venustus	Venus penstemon
Penstemon wilcoxii	Wilcox's penstemon
Perideridia gairdneri	Gardner's yampah
Phacelia hastata	silverleaf phacelia
Phacelia heterophylla	varileaf phacelia
Phacelia humilis	low phacelia
Phacelia inconspicua	hidden phacelia
Phacelia linearis	threadleaf phacelia
Phacelia sericea	silky phacelia
Phlox	phlox
Phlox aculeata	sagebrush phlox
Phlox austromontana	mountain phlox
Phlox colubrina	Snake River phlox
Phlox diffusa	spreading phlox
Phlox hoodii	spiny phlox
Phlox longifolia	longleaf phlox
Phlox muscoides	musk phlox
Phlox pulvinata	cushion phlox
Phlox viscida	sticky phlox
Phoenicaulis cheiranthoides	wallflower phoenicaulis
Physaria oregona	Oregon twinpod
Plagiobothrys	popcornflower
Plagiobothrys scouleri	Scouler's popcornflower
Plectritis macrocera	longhorn plectritis
Polemonium	Jacob's-ladder
Polemonium pulcherrimum	Jacob's-ladder
Polemonium viscosum	sticky polemonium
Polygonum	knotweed
Polygonum douglasii	Douglas' knotweed
Polygonum kelloggii	Kellogg's knotweed
Polygonum polygaloides	milkwort knotweed
Potentilla diversifolia	varileaf cinquefoil
Potentilla glandulosa	sticky cinquefoil
Potentilla gracilis	slender cinquefoil
Pteridium	brackenfern
Ranunculus testiculatus	curveseed butterwort
Sanguisorba occidentalis	western burnet
Scutellaria angustifolia	narrowleaf skullcap
Sedum lanceolatum	spearleaf stonecrop
Sedum stenopetalum	wormleaf stonecrop
Selaginella wallacei	Wallace's spikemoss
Senecio canus	woolly groundsel
Senecio integerrimus	lambstongue ragwort
Senecio multilobatus	lobeleaf groundsel
Senecio serra	tall ragwort
Sidalcea oregana	Oregon checkerbloom
Silene	catchfly
Silene antirrhina	sleepy silene
Silene douglasii	seabluff catchfly
Silene menziesii	Menzies' campion
Silene oregana	Oregon silene
Sisymbrium altissimum	tall tumblemustard
Sisyrinchium inflatum	inflated grasswidow
Smilacina racemosa	feathery false lily of the vally
Smilacina stellata	starry false lily of the vally
Solidago canadensis	Canada goldenrod
Solidago missouriensis	Missouri goldenrod
Solidago multiradiata	Rocky Mountain goldenrod
Stellaria	starwort

Stellaria jamesiana	tuber starwort
Stephanomeria tenuifolia	narrowleaf wirelettuce
Taraxacum officinale	common dandelion
Tetradymia canescens	spineless horsebrush
Thalictrum occidentale	western meadow-rue
Thelypodium	thelypody
Thlaspi arvense	field pennycress
Thlaspi idahoense var. aileeniae	Idaho pennycress
Tonella floribunda	manyflower tonella
Townsendia	Townsend daisy
Tragopogon dubius	yellow salsify
Trifolium macrocephalum	largehead clover
Vaccaria segetalis	cow soapwort
Valeriana acutiloba	sharpleaf valerian
Valeriana sitchensis	Sitka valerian
Verbascum blattaria	moth mullein
Verbascum thapsus	common mullein
Vicia vetch	
Viola violet	
Viola beckwithii	Beckwith's violet
Viola purpurea	goosefoot violet
Wyethia amplexicaulis	mule-ears
Zigadenus elegans	mountain deathcamas
Zigadenus venenosus	meadow deathcamas

Grasses, sedges, and rushes

Agropyron	wheatgrass
Agropyron cristatum	crested wheatgrass
Agropyron dasystachyum	thickspike wheatgrass
Agropyron intermedium	intermediate wheatgrass
Agropyron smithii	western wheatgrass
Agropyron spicatum	bluebunch wheatgrass
Agropyron trachycaulum	slender wheatgrass
Alopecurus aequalis	shortawn foxtail
Bromus brizaeformis	rattlesnake brome
Bromus carinatus	California brome
Bromus inermis	smooth brome
Bromus japonicus	Japanese brome
Bromus mollis	soft brome
Bromus tectorum	cheatgrass
Bromus vulgaris	Columbia brome
Calamagrostis rubescens	pinegrass
Carex	sedge
Carex douglasii	Douglas' sedge
Carex geyeri	Geyer's sedge
Carex hoodii	Hood's sedge
Carex microptera	smallwing sedge
Carex raynoldsii	Raynolds' sedge
Carex rossii	Ross' sedge
Carex siccata	dryspike sedge
Danthonia californica	California oatgrass
Danthonia intermedia	timber oatgrass
Danthonia unispicata	onespike danthonia
Elymus	wildrye
Elymus canadensis	Canada wildrye
Elymus caput-medusae	medusahead
Elymus cinereus	basin wildrye
Elymus glaucus	blue wildrye
Festuca bromoides	brome fescue
Festuca idahoensis	Idaho fescue
Festuca ovina	sheep fescue
Juncus tenuis	poverty rush
Koeleria cristata	prairie Junegrass
Melica bulbosa	oniongrass
Melica fugax	little oniongrass
Oryzopsis exigua	little ricegrass
Oryzopsis hymenoides	Indian ricegrass
Poa bluegrass	

Poa ampla	Sandberg bluegrass
Poa bulbosa	bulbous bluegrass
Poa cusickii	Cusick's bluegrass
Poa leibergii	Leiberg's bluegrass
Poa nevadensis	Sandberg bluegrass
Poa pratensis	Kentucky bluegrass
Poa secunda	Sandberg bluegrass
Poa wheeleri	Wheeler's bluegrass
Scirpus microcarpus	panicled bulrush
Sitanion hystrix	squirreltail
Stipa	needlegrass
Stipa columbiana	Dore's needlegrass
Stipa comata	needle and thread
Stipa lettermanii	Letterman's needlegrass
Stipa occidentalis	western needlegrass
Stipa thurberiana	Thurber's needlegrass
Trisetum spicatum	spike trisetum
Vulpia octoflora var. octoflora	sixweeks fescue

Ferns and fern allies

Cystopteris fragilis	brittle bladderfern
Woodsia oregana	Oregon cliff fern

Mosses

Bryum	bryum
Bryum caespiticium	dry calcareous bryum moss
Encalypta	encalypta
Encalypta vulgaris	encalypta moss
Eurhynchium pulchellum	eurhynchium moss
Homalothecium nevadense	Nevada homalothecium moss
Tortula	tortula
Tortula ruralis	tortula moss

Lichens

Cladonia	cladonia
Cladonia fimbriata	trumpet lichen
Collema	collema
Dermatocarpon miniatum	common stippleback
Peltigera	peltigera
Peltigera canina	dog-lichen
Peltigera rufescens	field log-lichen
Psora	psora
Psora tuckermanii	brown-eyed scale

Appendix 4. Indicator species analysis.

Table 4. Key indicator species. Plant species selected for hierarchical cluster analysis are list alphabetically with observed indicator values (based on combining values for relative abundance and relative frequency), the group in which the maximum indicator value occurs, and statistics generated through the Monte Carlo test of significance.

Species code		Species	Max group	Observed indicator	Mean random	Standard deviation	p-value
1	**ACGL**	***Acer glabrum***	**69**	**39.8**	**12.1**	**9.6**	**0.026**
2	**ACMI2**	***Achillea millefolium***	**69**	**28.2**	**11.6**	**4.7**	**0.005**
3	AGGL	*Agoseris glauca*	30	5.2	11.8	8.5	0.792
4	AGGR	*Agoseris grandiflora*	86	7.5	10.7	6.6	0.607
5	**AGSP**	***Agropyron spicatum***	**30**	**29.2**	**11.1**	**2.9**	**0.001**
6	AGTR	*Agropyron trachycaulum*	8	12.4	12.9	10.2	0.399
7	AGUR	*Agastache urticifolia*	42	17.3	14.2	10.3	0.268
8	**ALAC4**	***Allium acuminatum***	**199**	**54.9**	**12.8**	**8.5**	**0.004**
9	**AMAL2**	***Amelanchier alnifolia***	**86**	**36.2**	**12.7**	**8.6**	**0.022**
10	ANDI2	*Antennaria dimorpha*	88	15.4	12.7	8.9	0.281
11	**ANMI3**	***Antennaria microphylla***	**241**	**25.0**	**12.0**	**6.7**	**0.051**
12	ARABI2	*Arabis*	8	5.5	11.8	6.3	0.915
13	ARAC2	*Arenaria aculeata*	8	14.7	12.0	8.7	0.261
14	**ARAR8**	***Artemisia arbuscula***	**1**	**62.5**	**10.3**	**5.9**	**0.001**
15	ARART	*Artemisia arbuscula ssp. thermopola*	88	9.0	11.7	10.1	0.450
16	**ARFR4**	***Artemisia frigida***	**35**	**27.3**	**11.7**	**10.0**	**0.074**
17	ARHO2	*Arabis holboellii*	241	14.7	12.1	8.6	0.257
18	ARKI	*Arenaria kingii*	11	17.1	12.5	8.7	0.220
19	**ARLO9**	***Artemisia longiloba***	**11**	**100.0**	**12.4**	**9.9**	**0.001**
20	**ARNO4**	***Artemisia nova***	**88**	**30.0**	**12.6**	**9.6**	**0.067**
21	**ARRI2**	***Artemisia rigida***	**199**	**96.1**	**11.7**	**8.1**	**0.001**
22	**ARTR4**	***Artemisia tripartita***	**41**	**49.5**	**11.6**	**10.2**	**0.003**
23	**ARTRV**	***Artemisia tridentata ssp. vaseyana***	**12**	**36.4**	**9.2**	**2.1**	**0.001**
24	**ARTRW8**	***Artemisia tridentata var. wyomingensis***	**41**	**30.7**	**12.2**	**8.1**	**0.044**
25	ARTRX	*Artemisia tridentata ssp. xericensis*	9	8.6	13.0	10.5	0.560
26	ASPE3	*Aster perelegans*	86	12.8	11.9	8.1	0.332
27	ASPU9	*Astragalus purshii*	1	20.3	10.8	7.6	0.101
28	**BASA3**	***Balsamorhiza sagittata***	**42**	**42.4**	**13.4**	**6.2**	**0.004**
29	**BERE**	***Berberis repens***	**86**	**53.7**	**12.8**	**9.4**	**0.007**
30	**BRBR7**	***Bromus brizaeformis***	**210**	**54.7**	**13.5**	**9.8**	**0.006**
31	**BRCA5**	***Bromus carinatus***	**22**	**62.5**	**13.0**	**8.9**	**0.005**
32	BRJA	*Bromus japonicus*	69	20.0	13.2	9.0	0.152
33	**BRTE**	***Bromus tectorum***	**41**	**36.6**	**15.6**	**8.1**	**0.031**

Species code		Species	Max group	Observed indicator	Mean random	Standard deviation	p-value
34	CAEU	*Calochortus eurycarpus*	30	8.0	12.4	6.9	0.705
35	CAFL7	*Castilleja flava*	5	22.9	13.6	8.8	0.139
36	**CAGE2**	***Carex geyeri***	**8**	**34.4**	**14.1**	**9.3**	**0.034**
37	CAHO5	*Carex hoodii*	69	10.0	11.6	9.2	0.448
38	CAMA5	*Calochortus macrocarpus*	11	5.2	9.8	6.1	0.789
39	CAMI12	*Castilleja miniata*	5	10.0	11.2	7.0	0.438
40	CAPA25	*Castilleja pallescens*	1	29.5	12.7	10.4	0.069
41	CARO5	*Carex rossii*	86	26.8	12.9	10.0	0.079
42	CASTI2	*Castilleja*	5	6.7	12.8	8.5	0.740
43	**CEVE**	***Ceanothus velutinus***	**86**	**93.5**	**14.0**	**9.5**	**0.001**
44	**CHDO**	***Chaenactis douglasii***	**41**	**24.1**	**12.1**	**7.8**	**0.054**
45	CHNA2	*Chrysothamnus nauseosus*	67	20.2	16.2	9.6	0.243
46	**CHVI8**	***Chrysothamnus viscidiflorus***	**41**	**54.9**	**17.3**	**9.3**	**0.008**
47	CICA6	*Cirsium canovirens*	12	12.1	10.9	8.0	0.271
48	CLPU	*Clarkia pulchella*	69	20.5	12.6	9.1	0.152
49	**COGR4**	***Collomia grandiflora***	**160**	**58.9**	**12.2**	**7.4**	**0.002**
50	**COLI2**	***Collomia linearis***	**42**	**31.2**	**12.2**	**7.4**	**0.040**
51	**COPA3**	***Collinsia parviflora***	**42**	**51.0**	**15.0**	**8.8**	**0.007**
52	CORA5	*Cordylanthus ramosus*	5	14.3	13.3	10.5	0.351
53	COUM	*Comandra umbellata*	74	6.3	12.5	9.0	0.721
54	CRAC2	*Crepis acuminata*	5	9.1	12.6	6.6	0.639
55	CROC	*Crepis occidentalis*	30	9.1	11.5	7.3	0.524
56	CRWA2	*Cryptantha watsonii*	42	14.8	11.4	9.2	0.227
57	CRYPTa	*Cryptantha, unknown annual*	42	8.9	9.3	5.0	0.497
58	DELPH	*Delphinium*	210	9.4	11.5	8.7	0.516
59	DENU2	*Delphinium nuttallianum*	11	13.4	10.8	7.1	0.264
60	DRABA	*Draba*	11	28.0	12.6	9.8	0.060
61	DRVE2	*Draba verna*	67	12.6	11.7	9.2	0.340
62	ELCI2	*Elymus cinereus*	74	18.6	13.2	9.2	0.194
63	**EPPA2**	***Epilobium paniculatum***	**160**	**47.7**	**12.9**	**7.2**	**0.002**
64	**ERBL**	***Erigeron bloomeri***	**199**	**32.3**	**13.2**	**10.7**	**0.060**
65	**ERCA8**	***Eriogonum caespitosum***	**11**	**56.5**	**13.7**	**10.1**	**0.008**
66	**ERCO4**	***Erigeron compositus***	**241**	**76.4**	**12.7**	**9.5**	**0.003**
67	ERHE2	*Eriogonum heracleoides*	22	14.9	12.1	5.2	0.226
68	**ERLA6**	***Eriophyllum lanatum***	**210**	**38.9**	**14.4**	**10.7**	**0.040**
69	ERMI4	*Eriogonum microthecum*	41	19.8	12.5	8.9	0.157
70	ERPU2	*Erigeron pumilus*	41	12.6	12.5	10.1	0.348
71	**ERUM**	***Eriogonum umbellatum***	**36**	**47.5**	**15.1**	**9.8**	**0.014**
72	**FEID**	***Festuca idahoensis***	**5**	**42.1**	**10.6**	**3.6**	**0.001**

Species code		Species	Max group	Observed indicator	Mean random	Standard deviation	p-value
73	FRAT	*Fritillaria atropurpurea*	11	11.7	11.5	8.7	0.377
74	FRPU2	*Fritillaria pudica*	41	4.9	10.4	6.8	0.868
75	GADI2	*Gayophytum diffusum*	67	13.5	14.6	9.6	0.414
76	GETR	*Geum triflorum*	241	8.1	12.7	9.3	0.630
77	GEVI2	*Geranium viscosissimum*	74	17.2	12.1	8.1	0.197
78	GIAG	*Gilia aggregata*	74	13.1	12.0	8.2	0.307
79	**GLNE**	***Glossopetalon nevadense***	**210**	**100.0**	**11.7**	**8.6**	**0.001**
80	**HAAC**	***Haplopappus acaulis***	**11**	**53.8**	**12.2**	**9.2**	**0.006**
81	HAMI	*Hackelia micrantha*	22	15.2	12.4	7.6	0.247
82	**HASU**	***Haplopappus suffruticosus***	**36**	**99.5**	**14.1**	**10.6**	**0.001**
83	HEUN	*Helianthella uniflora*	42	20.2	14.3	9.5	0.198
84	HIAL	*Hieracium albertinum*	69	14.4	13.4	9.1	0.313
85	HYCA4	*Hydrophyllum capitatum*	2	4.6	11.4	8.3	0.853
86	KOCR	*Koeleria cristata*	8	9.7	13.5	7.9	0.626
87	LASE	*Lactuca serriola*	42	19.6	10.9	8.1	0.114
88	LERE7	*Lewisia rediviva*	1	15.7	10.5	7.1	0.165
89	LIPA5	*Lithophragma parviflorum*	69	18.4	11.2	7.8	0.128
90	LIRU4	*Lithospermum ruderale*	74	11.8	12.1	6.9	0.406
91	LODI	*Lomatium dissectum*	35	9.2	15.6	10.8	0.690
92	LOTR2	*Lomatium triternatum*	199	29.6	13.4	9.9	0.078
93	**LUAR3**	***Lupinus argenteus***	**36**	**44.3**	**12.2**	**5.9**	**0.006**
94	LUPIN	*Lupinus*	160	19.9	11.6	7.2	0.117
95	**LUSE4**	***Lupinus sericeus***	**22**	**38.2**	**12.4**	**7.3**	**0.010**
96	MACA2	*Machaeranthera canescens*	241	20.0	12.4	8.6	0.166
97	MEAL6	*Mentzelia albicaulis*	35	10.9	11.6	8.2	0.416
98	MEBU	*Melica bulbosa*	22	11.0	13.4	8.4	0.501
99	MEOB	*Mertensia oblongifolia*	5	7.4	13.6	10.2	0.689
100	MIGR	*Microsteris gracilis*	67	15.4	13.3	8.1	0.270
101	**MINU**	***Microseris nutans***	**11**	**45.9**	**10.5**	**7.9**	**0.006**
102	MITR5	*Microseris troximoides*	88	7.4	10.9	8.0	0.562
103	**PEAT3**	***Penstemon attenuatus***	**36**	**62.6**	**13.8**	**10.7**	**0.007**
104	**PEDE4**	***Penstemon deustus***	**210**	**74.0**	**12.7**	**9.5**	**0.002**
105	PEHU	*Penstemon humilis*	11	9.8	12.0	6.6	0.545
106	**PHHA**	***Phacelia hastata***	**160**	**91.5**	**15.8**	**11.5**	**0.002**
107	**PHHE2**	***Phacelia heterophylla***	**160**	**57.4**	**12.7**	**8.3**	**0.003**
108	PHHO	*Phlox hoodii*	1	16.7	12.8	7.0	0.220
109	**PHLI**	***Phacelia linearis***	**160**	**34.0**	**12.6**	**9.1**	**0.040**
110	PHLO2	*Phlox longifolia*	30	8.5	13.4	7.8	0.714
111	POBU	*Poa bulbosa*	9	12.3	12.0	8.0	0.339

Species code		Species	Max group	Observed indicator	Mean random	Standard deviation	p-value
112	PODO4	*Polygonum douglasii*	199	23.9	13.7	8.4	0.112
113	**POGL9**	***Potentilla glandulosa***	**241**	**33.4**	**11.9**	**7.3**	**0.021**
114	**POSE**	***Poa secunda***	**88**	**29.3**	**11.1**	**3.8**	**0.004**
115	**PRVI**	***Prunus virginiana***	**74**	**67.5**	**14.5**	**8.9**	**0.002**
116	**PUTR2**	***Purshia tridentata***	**9**	**64.0**	**12.6**	**6.7**	**0.001**
117	**RICE**	***Ribes cereum***	**22**	**37.8**	**11.6**	**7.6**	**0.008**
118	**ROWO**	***Rosa woodsii***	**69**	**95.6**	**13.3**	**10.4**	**0.002**
119	SEIN2	*Senecio integerrimus*	5	7.0	13.8	8.3	0.844
120	**SELA**	***Sedum lanceolatum***	**241**	**51.0**	**11.4**	**6.9**	**0.002**
121	SIDO	*Silene douglasii*	5	13.8	13.2	9.3	0.340
122	**SIHY**	***Sitanion hystrix***	**41**	**38.3**	**15.2**	**8.3**	**0.020**
123	STCO3	*Stipa columbiana*	36	10.4	12.7	7.7	0.492
124	STOC2	*Stipa occidentalis*	36	14.3	12.0	8.0	0.264
125	**STTH2**	***Stipa thurberiana***	**41**	**46.2**	**13.6**	**9.9**	**0.011**
126	**SYOR2**	***Symphoricarpos oreophilus***	**22**	**72.2**	**14.4**	**8.6**	**0.001**
127	TECA2	*Tetradymia canescens*	88	5.3	11.7	8.3	0.811
128	TRDU	*Tragopogon dubius*	42	19.8	14.0	7.8	0.182
129	VIPU4	*Viola purpurea*	160	10.6	9.8	5.8	0.372
130	ZIVE	*Zigadenus venenosus*	19	8.0	13.4	9.4	0.654

Table 5. Species indicator value - cluster analysis group matrix. Plant species selected for hierarchical cluster analysis are list alphabetically with observed indicator values (based on combining values for relative abundance and relative frequency), average indicator value, maximum indicator value, the group in which the maximum indicator value occurs, and the indicator value for the species in each of 24 hierarchical cluster analysis groups. The number of plots classified within in each group is also indicated.

Column/species code		Avg	Max	Max group	1	2	5	8	9	11	12	19	22	30	35	36	41	42	67	69	74	86	88	160	199	210	241
				Number of plots:	19	43	38	25	12	3	17	2	3	16	11	4	4	4	8	4	5	3	9	2	5	4	6
1	ACGL	2	40	69	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0
2	ACMI2	3	28	69	0	0	8	3	8	0	2	1	3	6	1	0	0	3	2	28	1	1	0	3	0	4	0
3	AGGL	1	5	30	0	1	0	0	0	4	0	0	4	5	0	2	0	0	1	0	1	0	0	0	0	0	0
4	AGGR	1	7	86	0	0	0	0	2	0	0	0	0	0	5	0	0	4	0	0	0	7	0	0	0	4	0
5	AGSP	4	29	30	0	7	4	1	14	0	2	0	4	29	8	0	0	4	2	0	1	1	7	1	1	4	0
6	AGTR	1	12	8	0	0	0	12	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0
7	AGUR	1	17	42	0	0	0	0	0	0	1	0	0	2	0	0	0	17	0	0	4	0	0	0	0	0	0
8	ALAC4	3	55	199	0	1	1	0	0	3	1	0	0	1	0	0	2	0	0	0	0	1	0	0	55	0	0
9	AMAL2	2	36	86	0	0	0	0	1	0	0	6	0	1	0	0	0	2	0	2	1	36	0	0	0	0	0
10	ANDI2	1	15	88	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	15	0	1	0	4
11	ANMI3	2	25	241	0	0	14	5	0	1	0	0	0	0	0	6	0	0	4	0	0	0	0	0	0	0	25
12	ARABI2	1	5	8	2	2	2	5	0	4	1	0	0	1	0	1	1	3	3	0	3	0	0	0	0	1	3
13	ARAC2	1	15	8	0	1	1	15	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0
14	ARAR8	3	62	1	62	0	1	0	0	0	0	0	0	1	0	0	8	0	0	0	0	0	0	0	0	0	7
15	ARART	0	9	88	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0
16	ARFR4	1	27	35	0	0	0	0	0	0	0	0	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0
17	ARHO2	1	15	241	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	1	0	1	1	0	0	0	15
18	ARKI	2	17	11	13	0	0	0	0	17	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Column/species code		Avg	Max	Max group	1	2	5	8	9	11	12	19	22	30	35	36	41	42	67	69	74	86	88	160	199	210	241
19	ARLO9	4	100	11	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	ARNO4	1	30	88	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0
21	ARRI2	4	96	199	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	0	0
22	ARTR4	2	50	41	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	0
23	ARTRV	4	36	12	0	18	10	18	0	0	36	0	5	0	0	0	0	2	2	0	1	1	0	0	0	0	0
24	ARTRW8	2	31	41	0	0	0	0	0	0	0	0	0	0	0	0	31	0	0	0	0	0	24	0	0	0	0
25	ARTRX	1	9	9	0	0	1	0	9	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
26	ASPE3	1	13	86	0	0	0	2	0	0	1	0	1	0	3	0	0	0	0	0	0	13	0	0	0	0	0
27	ASPU9	2	20	1	20	1	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	14	0	0	0	0
28	BASA3	4	42	42	1	1	1	1	10	0	0	1	0	19	1	0	0	42	1	0	0	1	0	3	0	1	0
29	BERE	3	54	86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	54	0	0	0	0	0
30	BRBR7	3	55	210	0	0	0	0	6	0	0	5	0	0	0	0	0	0	0	1	0	0	0	0	3	55	0
31	BRCA5	3	63	22	0	0	0	0	0	0	1	0	63	0	0	0	0	0	0	3	6	0	0	0	0	0	0
32	BRJA	2	20	69	1	1	0	0	2	0	4	0	0	1	1	0	11	0	0	20	0	0	0	0	0	0	0
33	BRTE	3	37	41	0	3	0	0	1	0	3	0	0	6	0	0	37	8	2	0	1	0	2	0	0	11	2
34	CAEU	2	8	30	0	0	4	5	0	8	0	4	3	8	1	0	0	0	0	0	1	0	4	0	0	0	0
35	CAFL7	1	23	5	2	1	23	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	CAGE2	2	34	8	0	0	0	34	0	0	0	3	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	CAHO5	1	10	69	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0
38	CAMA5	1	5	11	0	1	1	0	2	5	0	0	0	2	0	0	3	0	1	0	0	0	1	0	0	3	0
39	CAMI12	1	10	5	0	0	10	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	CAPA25	2	30	1	30	0	0	0	0	16	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Column/species code		Avg	Max	Max group	1	2	5	8	9	11	12	19	22	30	35	36	41	42	67	69	74	86	88	160	199	210	241
41	CARO5	1	27	86	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	27	0	0	0	0	6
42	CASTI2	1	7	5	1	0	7	3	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
43	CEVE	4	94	86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	94	0	0	0	0	0
44	CHDO	2	24	41	0	1	0	0	1	0	0	0	0	0	3	0	24	0	0	0	0	1	2	1	0	3	15
45	CHNA2	3	20	67	0	1	0	0	1	0	1	0	1	3	4	0	0	3	20	0	5	0	9	8	0	0	3
46	CHVI8	3	55	41	0	3	3	1	0	0	1	0	0	1	0	0	55	0	0	0	0	0	1	0	0	0	2
47	CICA6	1	12	12	0	5	1	1	1	0	12	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0
48	CLPU	2	21	69	0	0	0	0	2	0	0	2	0	4	0	0	0	0	0	21	0	0	0	0	1	6	0
49	COGR4	4	59	160	0	0	0	0	0	0	1	1	0	0	0	0	0	12	0	2	6	0	0	59	0	0	0
50	COLI2	2	31	42	0	2	1	0	5	0	0	0	0	3	1	0	0	31	0	1	8	0	0	0	0	0	0
51	COPA3	3	51	42	0	5	1	0	3	0	4	0	0	3	1	0	1	51	0	0	3	1	0	0	0	0	0
52	CORA5	1	14	5	0	0	14	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
53	COUM	1	6	74	0	0	1	0	4	0	1	0	0	0	0	0	0	0	5	1	6	0	0	0	0	0	0
54	CRAC2	2	9	5	0	4	9	6	0	0	2	0	1	5	3	0	0	1	0	1	5	0	1	0	0	0	0
55	CROC	1	9	30	3	0	0	0	3	5	0	0	0	9	1	0	1	0	0	0	0	0	0	0	0	0	0
56	CRWA2	1	15	42	0	1	0	0	0	0	0	0	0	2	2	0	0	15	1	0	0	0	0	0	0	0	0
57	CRYPTa	1	9	42	0	1	0	0	4	0	0	0	4	1	1	0	2	9	0	0	1	4	0	0	0	2	0
58	DELPH	1	9	210	0	2	0	0	1	0	0	0	0	0	3	0	2	2	0	0	0	0	0	0	2	9	0
59	DENU2	1	13	11	0	3	0	0	1	13	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
60	DRABA	1	28	11	1	0	0	2	0	28	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
61	DRVE2	1	13	67	0	0	0	0	0	0	0	0	0	0	0	0	0	2	13	0	1	0	2	0	1	2	0
62	ELCI2	1	19	74	0	6	0	0	1	0	0	0	0	1	0	0	0	0	0	0	19	0	0	0	0	0	0

Column/species code		Avg	Max	Max group	1	2	5	8	9	11	12	19	22	30	35	36	41	42	67	69	74	86	88	160	199	210	241
63	EPPA2	3	48	160	0	0	0	0	0	0	0	0	0	4	1	0	0	10	5	2	5	0	0	48	0	4	0
64	ERBL	2	32	199	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	1	0
65	ERCA8	4	57	11	28	0	0	0	0	57	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	ERCO4	3	76	241	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76
67	ERHE2	2	15	22	0	2	7	8	4	0	2	4	15	1	4	0	0	0	1	4	2	0	0	0	0	0	0
68	ERLA6	2	39	210	0	0	0	2	2	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	39	0
69	ERMI4	2	20	41	8	0	0	0	0	8	0	0	0	0	0	0	20	0	0	0	0	1	0	0	0	0	0
70	ERPU2	1	13	41	0	0	0	0	0	2	0	0	0	0	6	0	13	0	0	0	0	0	1	0	0	0	0
71	ERUM	3	48	36	0	4	0	2	0	0	0	0	0	0	2	48	0	0	1	0	3	0	0	2	0	0	3
72	FEID	3	42	5	2	0	42	9	2	9	0	1	0	0	0	6	2	0	0	1	0	1	1	0	2	0	1
73	FRAT	1	12	11	0	1	5	0	1	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	FRPU2	1	5	41	0	2	0	0	0	0	2	0	0	3	3	0	5	5	0	0	0	0	0	0	0	0	0
75	GADI2	1	14	67	0	1	0	0	2	0	0	0	0	2	0	0	0	0	14	0	13	0	0	0	0	0	0
76	GETR	1	8	241	0	0	1	1	0	0	0	2	0	1	1	0	0	0	0	1	0	0	0	0	0	0	8
77	GEVI2	1	17	74	0	0	0	1	0	0	0	0	2	1	0	0	0	0	0	11	17	0	0	0	0	0	0
78	GIAG	1	13	74	0	3	0	1	0	0	0	0	0	0	0	0	0	0	1	0	13	0	0	0	0	0	0
79	GLNE	4	100	210	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0
80	HAAC	3	54	11	6	0	0	0	0	54	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
81	HAMI	2	15	22	0	1	0	0	0	0	2	0	15	2	0	0	0	8	0	0	3	8	0	0	0	0	0
82	HASU	4	99	36	0	0	0	0	0	0	0	0	0	0	0	99	0	0	0	0	0	0	0	0	0	0	0
83	HEUN	2	20	42	0	0	2	0	0	0	0	0	0	3	10	0	0	20	0	0	1	1	0	0	0	0	0
84	HIAL	2	14	69	0	0	6	14	0	0	0	0	0	0	0	0	0	0	1	14	6	0	0	0	0	0	0

Column/species code		Avg	Max	Max group	1	2	5	8	9	11	12	19	22	30	35	36	41	42	67	69	74	86	88	160	199	210	241
85	HYCA4	1	5	2	0	5	0	0	3	0	1	0	0	4	2	0	0	3	0	0	0	0	0	0	0	0	0
86	KOCR	2	10	8	0	1	8	10	1	2	0	9	8	0	0	0	0	0	7	2	1	0	0	0	0	0	4
87	LASE	2	20	42	0	0	0	0	0	0	0	0	0	1	2	0	0	20	10	8	1	2	0	0	1	8	0
88	LERE7	1	16	1	16	0	1	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
89	LIPA5	2	18	69	1	0	0	0	0	0	0	0	0	1	9	0	0	2	1	18	5	0	0	0	0	0	0
90	LIRU4	2	12	74	0	2	0	1	2	0	1	0	0	0	2	0	1	11	11	1	12	0	0	0	0	0	0
91	LODI	1	9	35	0	2	0	0	4	0	0	0	0	3	9	0	0	1	0	0	0	0	0	9	1	1	0
92	LOTR2	2	30	199	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	30	0	0
93	LUAR3	3	44	36	0	3	4	2	0	0	11	0	3	1	1	44	0	6	3	1	0	1	0	0	0	0	0
94	LUPIN	2	20	160	0	0	2	1	7	0	0	1	0	1	1	0	0	0	0	0	0	0	0	20	0	2	0
95	LUSE4	2	38	22	0	2	1	1	0	0	0	0	38	0	0	0	1	0	1	0	0	0	0	0	0	0	11
96	MACA2	2	20	241	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	8	2	0	0	0	20
97	MEAL6	1	11	35	0	0	0	0	6	0	0	0	0	1	11	0	0	0	0	0	1	4	0	0	0	0	0
98	MEBU	2	11	22	0	5	0	1	0	0	4	0	11	4	2	6	0	5	0	0	5	0	0	0	0	0	0
99	MEOB	1	7	5	0	3	7	6	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
100	MIGR	2	15	67	0	1	0	0	1	0	2	0	0	2	1	0	1	15	15	0	4	1	0	11	1	0	0
101	MINU	2	46	11	0	0	1	0	0	46	1	5	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
102	MITR5	1	7	88	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	7	0	3	0	0
103	PEAT3	3	63	36	0	0	1	2	0	0	0	0	1	0	0	63	0	0	0	0	0	0	0	0	0	0	0
104	PEDE4	4	74	210	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	74	0
105	PEHU	2	10	11	6	4	1	1	0	10	0	0	0	0	3	0	0	2	0	0	0	0	3	0	0	0	4
106	PHHA	4	91	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	91	0	0	0

Column/species code		Avg	Max	Max group	1	2	5	8	9	11	12	19	22	30	35	36	41	42	67	69	74	86	88	160	199	210	241
107	PHHE2	3	57	160	0	0	0	0	2	0	0	0	0	2	0	0	0	3	3	0	5	0	0	57	0	0	0
108	PHHO	2	17	1	17	2	1	6	0	7	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	4
109	PHLI	2	34	160	0	0	0	0	4	0	0	0	1	1	0	0	0	0	15	0	0	0	0	34	0	2	0
110	PHLO2	1	8	30	1	1	3	0	1	0	8	0	0	8	0	0	1	2	0	0	0	0	6	0	0	0	0
111	POBU	1	12	9	0	0	0	0	12	0	0	0	0	2	5	0	0	8	0	0	0	0	0	0	0	0	0
112	PODO4	2	24	199	0	0	0	0	0	0	1	0	0	0	1	1	0	12	1	0	3	0	0	0	24	0	0
113	POGL9	2	33	241	0	0	0	2	1	0	0	0	1	0	1	0	0	0	0	3	3	1	0	0	0	0	33
114	POSE	4	29	88	9	1	2	0	1	4	2	0	0	2	1	0	7	0	9	0	0	0	29	0	16	1	1
115	PRVI	4	68	74	0	0	0	0	1	0	0	0	0	2	0	0	0	1	0	1	68	12	0	0	0	0	0
116	PUTR2	4	64	9	0	5	0	0	64	0	1	0	0	1	1	0	0	0	3	0	0	0	0	1	0	9	0
117	RICE	2	38	22	0	0	0	2	0	0	0	0	38	1	0	0	0	0	0	3	1	3	0	0	0	0	0
118	ROWO	4	96	69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	1	0	0	0	0	0	0
119	SEIN2	2	7	5	3	6	7	3	0	4	0	2	0	5	1	1	2	1	0	0	0	1	0	0	0	0	0
120	SELA	3	51	241	14	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	51
121	SIDO	1	14	5	0	0	14	6	0	1	0	0	0	0	0	0	0	0	3	0	0	5	0	0	0	0	0
122	SIHY	4	38	41	7	1	1	1	0	5	1	0	0	0	0	4	38	0	2	0	0	0	8	0	6	0	11
123	STCO3	2	10	36	0	1	2	3	0	0	4	0	8	0	0	10	0	0	0	0	6	4	0	0	0	0	0
124	STOC2	1	14	36	0	0	0	1	2	2	3	0	3	0	0	14	0	0	0	0	1	5	0	0	0	0	0
125	STTH2	3	46	41	4	0	0	0	0	0	0	0	0	0	0	0	46	0	0	0	0	0	8	0	0	2	0
126	SYOR2	4	72	22	0	2	0	1	0	0	0	0	72	0	0	0	0	3	0	0	6	1	0	0	0	0	0
127	TECA2	0	5	88	2	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
128	TRDU	3	20	42	1	1	0	0	5	0	1	1	0	11	1	0	0	20	1	8	1	0	1	1	0	2	9

Column/species code		Avg	Max	Max group	1	2	5	8	9	11	12	19	22	30	35	36	41	42	67	69	74	86	88	160	199	210	241
129	VIPU4	1	11	160	0	1	0	0	0	0	1	0	5	0	0	3	0	0	6	0	0	5	0	11	0	0	0
130	ZIVE	1	8	19	1	0	0	1	0	0	3	8	0	0	0	0	0	0	7	1	0	0	6	0	0	0	0

Appendix 5. Field form. The fix area ecology plot field form and data dictionary are shown.

Site: _____ Plot ID: _____

Observer(s): _____

Species	Cover

Slope	
Aspect	
Topographic position	
Micro vertical	
Micro horizontal	
Topographic moisture	
North horizon	
East horizon	
South horizon	
West horizon	
Basal vegetative	
Bedrock	
Boulders	
Stones	
Cobbles	
Gravel	
Soil	
Litter	
Wood	
Moss	
Lichen	
Water	

Quadrangle Name	Photo ID

Way point ID	FOM	UTM X	UTM Y

Elevation	

Bedrock origin		Landscape	
Bedrock comp		Landscape mod	
PM origin		Landform	
PM origin modifier		Landform mod	
Erosion potential		Erosion type	

Soil moisture _____ Drainage _____
Texture _____ Rooting depth _____
Color _____

NVC Subgroup _____ Series _____
Plant Association _____
NVC Community Association _____
Stuctural Condition _____ Seral Status _____

Ecological condition: _____ Comments: _____

Distribution pattern: _____

Wildlife use: _____

Other comments: _____

2003 - UPLAND FIXED AREA PLOT FORM - ID CDC

FIXED AREA ECOLOGY PLOT
DATA DICTIONARY - ID CDC (07/2003)

FIELD	VALUE	DESCRIPTION
Aspect	RANGE	0 - 360 degrees; Declination-corrected azimuth of slope aspect to nearest degree
Bedrock Composition		
	ANDE	Andesite
	ARGI	Argillite
	BASA	Basalt
	BREC	Breccia
	CHAL	Chalk
	COAL	Coal
	CONG	Conglomerate
	DACI	Dacite
	DAIR	Dairite
	DOLO	Dolomite
	DIOR	Diorite
	EJEC	Ejecta
	GABB	Gabbro
	GLAS	Glass
	GLAU	Glauconite
	GNEI	Gneiss
	GRAN	Granite
	GYPS	Gypsum
	HALI	Halite
	HORN	Hornfels
	LATI	Latite
	LIME	Limestone
	MARB	Marble
	MARL	Marl
	MONZ	Monzonite
	OBSI	Obsidian
	PAHO	Pahoehoe
	PHYL	Phyllite
	PUMI	Pumice
	QUAR	Quartzite
	RHYO	Rhyolite
	SAND	Sandstone
	SCHI	Schist
	SCOR	Scoria
	SERP	Serpentinite, Serpentine
	SHAL	Shale
	SILT	Siltstone
	SLAT	Slate
	SYEN	Syenite
	TUFF	Tuff
Bedrock Origin		
	CO	Conglomerate
	IG	Igneous
	ME	Metamorphic
	MI	Mixed
	MS	Metasedimentary
	PY	Pyroclastic
	SE	Sedimentary
	UN	Unconsolidated
Bedrock	RANGE	Bedrock cover; 0 to >100; percent ground cover
Boulder	RANGE	Boulder (> 61 cm [> 24 inches]) cover; 0 to >100; percent ground cover
Basal vegetation	RANGE	Basal vegetation cover; 0 to >100; percent ground cover
Cobble	RANGE	Cobble (10 - < 25 cm [3 - < 10 inches]) cover; 0 to >100; percent ground cover

Distribution Pattern	NARRATIVE	Description of the size and placement of the stand in relation to adjacent stands and key environmental factors. Examples: a) extensive on this and adjacent slope aspects; b) occurs on small inclusions of deeper soil within a mosaic dominated by ARAR/AGSP on shallow soils, this pattern is repeated throughout extensive tablelands; or c) restricted to lower slope positions with northerly aspects.
East horizon	RANGE	0 to >100; Vertical angle (degrees) between plot center and eastern horizon
Ecological Condition	A	Pristine condition. Evidence of post-industrial human-caused disturbance is absent. Exotic species are absent.
	B	Little evidence of post-industrial human-caused disturbance is present. Stand composition and structure is predominantly natural. Exotic species are only common (≤ one percent cover).
	C	Post-industrial human-caused disturbance is apparent. Stand composition and structure is altered. Exotic species are well represented to abundant (5 - 25 percent cover).
	D	Evidence of post-industrial human-caused disturbance is prevalent. Stand composition and structure is altered. Native species are present, but are in peril of loss. Increasers dominate the stand. Invader species are a significant compositional component.
	F	Native stand composition, structure, and function are significantly altered. Re-establishment of native stand composition, structure, and function will require large energy inputs.
Ecological Condition; Comments	NARRATIVE	Description of the factors that contribute to the assignment of the ecological condition class
Elevation	RANGE	0 >25000; Elevation of plot in feet
Erosion potential	sa	soil surface is stable with no evidence of accelerated erosion
	uc	soil surface is unstable because of compaction
	ud	soil surface is unstable because of displacement and/or churning of the soil
	up	soil surface is unstable because of lack of protective vegetation cover
	ua	unable to assess
Erosion type	no	none
	se	sheet erosion
	re	rill erosion
	ge	gully erosion
	de	deposition
	we	wind erosion
	sc	soil creep
	sl	slump (earth flow)
	td	terrace development
	sd	slide
Gravel	RANGE	Gravel (0.2 - < 10 cm [1/16 - < 3 inches]) cover; 0 > 100; percent ground cover
Landform	see Appendix A	
Landform modifier	IT	Intermediate (100-300 ft)
	N	Not applicable
	NW	Narrow (<100 ft)
	WI	Wide (>300 ft)
	X	Unable to assess
Landscape	BA	Badlands
	BK	Breaks
	DE	Delta
	FH	Foothills
	HI	Hills
	IB	Intermontane basin
	LP	Lacustrine plain
	MG	Glaciated mountains
	MO	Mountains

	PL	Plain
	PT	Plateau
	TP	Till plain
	VA	Valley
Landscape Modifier	CS	Coastal
	DE	Delta
	DI	Dissected
	GF	Glaciofluvial
	GL	Glaciated
	HI	High
	IN	Inter-montane
	LA	Lake
	LC	Lacustrine
	LE	Level
	LV	Lava
	MA	Marine
	MO	Mountain
	RI	River
	TI	Till
	UN	Undulating
	VO	Volcanic
Lichen	RANGE	Lichen cover; 0 to >100; percent ground cover
Litter	RANGE	Litter (<1/4 inch diameter) cover; 0 to >100; percent ground cover
Moss	RANGE	Moss cover; 0 to >100; percent ground cover
Micro horizontal Micro vertical		Horizontal and vertical micro-topographical configuration
	1	Convex
	2	Straight
	3	Concave
	4	Undulating
North horizon	RANGE	0 to >100; Vertical angle (degrees) between plot center and northern horizon
NVC Subgroup	ag	annual grassland (these are not entirely consistant with NVC)
	df	deciduous forest
	ds	deciduous shrubland
	dw	deciduous woodland
	eds	evergreen dwarf-shrubland
	ef	evergreen forest
	es	evergreen shrubland
	ew	evergreen woodland
	pf	perennial forb ???
	pg	perennial grassland
	sv	sparse vegetation
NVC community association		the existing plant community; covertype
PM Origin	AL	Alluvium
	BS	Beach sand
	CI	Cinders
	CM	Coprogenic material
	CO	Colluvium
	CR	Cryoturbate
	DE	Diatomaceous earth
	DI	Diamictin
	DP	Deposits
	EO	Eolim
	GD	Glacial drift
	LO	Loess

	MA	Marl
	OR	Organic
	OU	Outwash
	PE	Pedisediment
	RE	Residuum
	TE	Tephra
	TI	Till
	VA	Volcanic ash
	VB	Volcanic bombs
PM Origin Modifier	ABLA	Ablation
	ACID	Acidic
	ANDE	Andesitic
	BASA	Basal
	BASI	Basic
	BASL	Basaltic
	BY	Bouldery
	BYV	Very bouldery
	BYX	Extremely bouldery
	CALC	Calcareous
	CB	Cobbly
	CBA	Angular cobbly
	CBV	Very cobbly
	CBX	Extremely cobbly
	CN	Channery
	CNV	Very channery
	CNX	Extremely channery
	COLL	Colluvial
	ESTU	Estuarine
	FL	Flaggy
	FLOW	Flow
	FLV	Very flaggy
	FLX	Extremely flaggy
	GLFL	Glacio fluid
	GLLA	Glacio lacustrine
	GLMA	Glacio marine
	GR	Gravelly
	GRAS	Grassy
	GRC	Coarse gravelly
	GRF	Fine gravelly
	GRM	Medium gravelly
	GRV	Very gravelly
	GRX	Extremely gravelly
	HERB	Herbaceous
	LACU	Lacustrine
	LODG	Lodgement
	MARI	Marine
	MELT	Melt
	MK	Mucky
	MOSS	Mossy
	PF	Non-consolidated permafrost
	PT	Peaty
	RB	Rubbly
	SLOP	Slope
	SLUM	Slump
	ST	Stony
	STV	Very stony
	STX	Extremely stony
	SUPR	Supraglacial
	UNSP	Unspecified
	VASI	Valley side
	WOOD	Woody
Photo ID	CODE	The identification of imagery related to the plot - onsite photograph, aerial photograph, etc.
Plant association	CODE	potential natural vegetation plant community

Quadrangle name	NARRATIVE	The name of the 1:24k scale USGS topographical quadrangle the plot is mapped on.
Seral status	pnc	The potential natural community; seral species are scarce to absent. Species composition and density are relatively stable. The dominant species are reproducing.
	late	Late-seral species are well represented to abundant and increasing in abundance. Seral species may still persist.
	mid	Late-seral species are well represented to abundant in the understory and are beginning to occupy the overstory or are present with low density and abundance.
	early	Seral species are dominant in the overstory or late seral species are present with low density and abundance or absent.
	retro	Native species are either absent or so low in abundance as to make recolonization very difficult. Increasers and invaders dominate. The vegetation is disclimax. Only mechanical manipulation will result in the reintroduction of native late seral species.
Series	CODE	potential natural vegetation series
South Horizon	RANGE	0 to >100; Vertical angle (degrees) between plot center and southern horizon
Slope	RANGE	Slope; 0 - 150 percent; Inclination of the surface of the soil from the horizontal
Soil	RANGE	Soil (<1/16 inch particles) cover; percent ground cover
Soil color	see Appendix B	
Soil drainage	see Appendix B	
Soil moisture	see Appendix B	
Soil rooting depth	RANGE	
Soil texture	see Appendix B	
Stone	RANGE	Stone (25 - < 61 cm [10 - < 24 inches]) cover; 0 to >100; percent ground cover
Structural condition		see Appendix C
Topographical Moisture	(needs additional work - is this redundant?) commonly used values:	
	3	dry, well drained ridgetop or prow
	4	dry mid-slope
	5	mesic toe slope
	7	moist basin
Topographic Position	ridge	linear top of ridge, hill, or mountain; the elevated area between two fluves (drainageways) that sheds water to the drainageways (crest, summit, interfluve).
	high slope	geomorphic component that forms the uppermost inclined surface at the top of a slope. Comprises the transition zone from backslope to summit. Surface is dominantly convex in profile and erosional in origin (shoulder slope, upper slope, convex creep slope).
	high level	level top of plateau (mesa).
	midslope	intermediate slope position (transportational midslope, middle slope).
	backslope	subset of midslopes which are steep, linear, and may include cliff segments (fall faces) (dipslope).
	step in slope	nearly level shelf interrupting a steep slope, rock wall, or cliff face (ledge, terracette).
	lowslope	inner gently inclined surface at the base of a slope. Surface profile is generally concave and a transition between midslope or backslope, and toe slope (lower slope, foot slope, colluvial footslope).
	toeslope	outermost gently inclined surface at base of a slope. In profile, commonly gentle and linear and characterized by alluvial deposition (alluvial toeslope).
	low level	valley floor or shoreline representing the former position of an alluvial plain, lake, or shore (terrace).
	channel wall	sloping side of a channel (bank).
	channel bed	bed of single or braided watercourse commonly barren of vegetation and formed of modern alluvium (narrow valley bottom, gully arroyo).
	basin	

	floor	nearly level to gently sloping, bottom surface of a basin (depression).
UTM X UTM Y	VALUE	The Universal Transverse Mercator (UTM) easting (UTM X) and northing (UTM Y) recorded using the central 1927 North American Datum (NAD27 Central)
West Horizon	RANGE	0 to >100; Vertical angle (degrees) between plot center and western horizon
Water	RANGE	Water cover; 0 to >100; percent ground cover
Way point ID	VALUE	GPS way point identification - convention: six character alpha-numeric consisting of the last three digits of GPS unit serial number followed by the three digit identity automatically assigned by the GPS unit
Way point FOM	VALUE	Way point figure of merit (FOM - a value reflecting the estimated accuracy of the averaged position) recorded off GPS unit
Wildlife use	NARRATIVE	Record the species and the type of sign observed on, or adjacent, the plot.
Wood	RANGE	Wood (≥ 1/4 inch diameter) cover; 0 to >100; percent ground cover

Appendix A - Landform (from NYNHP)

Select the best landform name from the list below. More than one landform name may be listed for each community, listing the most specific name first (e.g., a cliff community could be: CLIFF, ESCARPMENT) (Definitions from Driscoll et al. 1984).

Landform	Description
Active slope	(metastable slope) A mountain or hill slope that is responding to valley incision, and has detritus accumulated behind obstructions, indicating contemporary transport of slope alluvium. Slope gradients commonly exceed 45 percent.
Alluvial cone	The material washed down mountain and hill slopes by ephemeral streams and deposited at the mouth of gorges in the form of a moderately steep, conical mass descending equally in all directions from the point of issue.
Alluvial fan	A body of alluvium, with or without debris flow deposits, whose surface forms a segment of a cone that radiates downslope from the point where the stream emerges from a narrow valley onto a less sloping surface. common longitudinal profiles are gently sloping and nearly linear. Source uplands range in relief and aerial extent from mountains and plateaus to gullied terrains on hill and Piedmont slopes.
Alluvial flat	A nearly level, graded, alluvial surface.
Alluvial plain	A flood plain or a low-gradient delta. It may be modern or relict.
Arroyo	(wash) The flat-floored channel or an ephemeral stream, commonly with very steep to vertical banks cut in alluvium.
Backswamp	(valley flat) Extensive marshy, depressed areas of flood plains between the natural levee borders of channel belts and valley sides or terraces.
Bar	An elongated landform generated by waves and currents and usually running parallel to the shore, composed predominantly of unconsolidated sand, gravel, cobbles, or stones with water on two sides.
Basin	A depressed area with no or limited surface outlet. Examples are closed depressions in a glacial till plain, lake basin, river basin, or fault-bordered intermontane structure such as the Bighorn Basin of Wyoming.
Bay	a) An inlet of the sea or other body of water usually smaller than a gulf. b) a small body of water set off from the main body.

Landform	Description
Bedrock	The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.
Beach	The unconsolidated material that covers a gently sloping zone, typically with a concave profile, extending landward from the low-water line to the place where there is a definite change in material or physiographic form (such as a cliff) or to the line of permanent vegetation; the relatively thick and temporary accumulation of loose water-borne material (usually well-sorted sand and pebbles, accompanied by mud, cobbles, boulders, and smoothed rock and shell fragment) that is in active transit along, or deposited on the shore zone between the limits of low water and high water.
Bluff	(a) A high bank or bold headland, with a broad, precipitous, sometimes rounded cliff face overlooking a plain or body of water, especially on the outside of a stream meander; (b) any cliff with a steep, broad face.
Bog	Waterlogged, spongy ground, consisting primarily of mosses, containing acidic decaying vegetation such as sphagnum, sedges and heaths, that develops into peat (includes poor fens).
Braided channel or stream	(flood-plain landforms) A channel or stream with multiple channels that interweave as a result of repeated bifurcation and convergence of flow around interchannel bars, resembling in plan the strands of a complex braid. Braiding is generally confined to broad, shallow streams of low sinuosity, high bedload, non-cohesive bank material, and step gradient. At a given bank-full discharge, braided streams have steeper slopes and shallower, broader, and less stable channel cross sections than meandering streams.
Canyon	A long, deep, narrow, very steep-sided valley with high and precipitous walls in an area of high local relief.
Cave	Aquatic and non-aquatic habitats beneath the earth's surface, including air-filled cavities with openings to the surface, water filled cavities and aquifers, and interstitial habitats in small crevices.
Cirque	Semicircular, concave, bowl-like area with steep face primarily resulting from erosive activity of a mountain glacier.
Cliff	Any high, very steep to perpendicular or overhanging face of rock or earth; a precipice.
Cove	A deep recess or small valley in the side of a mountain.
Crest	(summit) The commonly linear top of a ridge, hill or mountain.
Delta	A body of alluvium, nearly flat and fan-shaped, deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, usually a sea or lake.
Dome	A roughly symmetrical upfold, with bed dipping in all directions, more or less equally, from a point. A smoothly rounded landform or rock mass such as a rock-capped mountain summit, roughly resembling the dome of a building.
Drumlin	A low, smooth, elongated oval hill, mound, or ridge of compact glacial till that may or may not have a core of bedrock or stratified glacial drift. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition.
Dune	A mound, ridge, or hill of loose, windblown granular material (generally sand), either bare or covered with vegetation.
Escarpment	(scarp) A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and produced by erosion or faulting. The term is more often applied to cliffs produced by differential erosion.

Landform	Description
Esker	A long, narrow sinuous, steep-sided ridge composed of irregularly stratified sand and gravel that was deposited by a subsurface stream flowing between ice walls, or in an ice tunnel of a retreating glacier, and was left behind when the ice melted.
Estuary	a) The seaward end or the widened funnel-shaped tidal mouth of a river valley where freshwater comes into contact with seawater and where tidal effects are evident. b) A portion of an ocean, as a firth or an arm of the sea, affected by freshwater. c) A drowned river mouth form by the subsidence of land near the coast or the drowning of the lower portion of a nonglacial valley due to the rise of sea level.
Fen	Waterlogged, spongy ground, containing alkaline decaying vegetation, characterized by reeds, that develops into peat (excludes poor fens). It occurs in sinkholes of karst regions.
Flat	A general term for a level or nearly level surface or small area of land marked by little or no relief, e.g., mud flat or valley flat.
Floodplain	(bottomland) The nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is usually a constructional landform built of sediment deposited during overflow and lateral migration of the stream.
Gorge	(a) A narrow, deep valley with nearly vertical rocky walls, enclosed by mountains, smaller than a canyon, and more steep-sided than a ravine; especially a restricted, steep-walled part of a canyon. (b) A narrow defile or passage between hills or mountains.
Hill	(foothills) A natural elevation of the land surface, rising as much as 300 m above the surrounding lowlands, usually of restricted summit area (relative to a tableland) and having a well-defined outline; hill slopes generally exceed 15%. The distinction between a hill and a mountain is often dependent on local usage.
Hummock	A rounded or conical mound of knoll, hillock, or other small elevation. Also, a slight rise of ground above a level surface.
Island	A tract of land surrounded by water.
Isthmus	A narrow strip of land connecting two larger land areas.
Kame	A moundlike hill of ice-contact glacial drift, composed chiefly of stratified sand and gravel.
Kettle	A steep-sided bowl-shaped depression without surface drainage. It is in glacial drift deposits and believed to have formed by the melting of a large, detached block of stagnant ice buried in the glacial drift.
Knob	(a) A rounded eminence, as a knoll, hillock, or small hill or mountain; especially a prominent or isolated hill with steep sides, commonly found in the southern United States. (b) A peak or other projection from the top of a hill or mountain. Also a boulder or group of boulders or an area of resistant rocks protruding from the side of a hill or mountain.
Lake	A body of water in a topographic depression or dammed river channel that lacks persistent emergent vegetation, but may include areas with submerged or floating-leaved aquatic vegetation.
Ledge	A narrow shelf or projection of rock, much longer than wide, formed on a rock wall or cliff face, as along a coast by differential wave action on softer rocks. A rocky outcrop; solid rock. An underwater ridge of rocks, especially near the shore; also a near shore reef. A quarry exposure or natural outcrop of a mineral deposit.
Levee	(floodwall, earth dike) An artificial or natural embankment built along the margin of a watercourse or an arm of the sea, to protect land from inundation or to confine streamflow to its channel.
Marsh	An area intermittently or permanently covered with water, having herbaceous vegetation but essentially without the accumulation of peat.

Landform	Description
Moraine	A drift topography characterized by chaotic mounds and pits, generally randomly oriented, developed in superglacial drift by collapse and flow as the underlying stagnant ice melted. Slopes may be steep and unstable and there will be used and unused stream coursed and lake depressions interspersed with the morainic ridges. Consequently, there will be rapid or abrupt changes between materials of differing lithology.
Mountain	(hill) A natural elevation of the land surface, rising more than 300 m above surrounding lowlands, usually of restricted summit area (relative to a plateau), and generally having steep sides (greater than 25 percent slope) with or without considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are primarily formed by deep-seated earth movements and/or volcanic action and secondarily by differential erosion.
Outwash plain	(glacial outwash, kettles) An extensive lowland area of coarse textured, glaciofluvial material. An outwash plain is commonly smooth; where pitted, due to melt-out of incorporated ice masses, generally low in relief.
Oxbow	(meander belt, oxbow lake) A closely looping stream meander having an extreme curvature such that only a neck of land is left between the two parts of the stream. A term used in New England for the land enclosed, or partly enclosed, within an oxbow.
Peninsula	A portion of land nearly surrounded by water and connected with a larger body by an isthmus; also a piece of land jutting out into water whether with or without a well-defined isthmus.
Pingo	A large frost mound; especially a relatively large conical mound of soil-covered ice (commonly 30 to 50 m high and up to 400 m in diameter) raised in part by hydrostatic pressure within and below the permafrost of Arctic regions, and of more than 1 year's duration.
Plain	(lowland, plateau) An extensive lowland area that ranges from level to gently sloping or undulating. A plain has few or no prominent hills or valleys, and usually occurs at low elevation with reference to surrounding areas (local relief generally less than 100m, although some, such as the Great Plains of the United States, are as much as 1000 to 1800 m above sea level.) Where dissected, remnants of a plain can form the local uplands.
Plateau	(mesa, plain) An extensive upland mass with a relatively flat summit area that is considerably elevated (more than 100m) above adjacent lowlands, and is separated from them on one or more sides by escarpments. A comparatively large part of a plateau surface is near summit level.
Pond	see LAKE.
Ravine	(gulch, draw) A small stream channel; narrow, steep-sided, and commonly V-shaped in cross section; and larger than a gully.
Ridge	A long, narrow elevation of the land surface, usually sharp rested with steep sides and forming an extended upland between valleys. The term is used in areas of both hill and mountain relief.
River	Aquatic communities of flowing water that lack persistent emergent vegetation, but may include areas with submerged or floating-leaved aquatic vegetation.
Saddle	A low point on a ridge or crestline, generally a divide (pass, col) between the heads of streams flowing in opposite directions.
Salt marsh	Flat, poorly drained land subject to periodic or occasional overflow by salt water, containing water that is brackish to strongly saline, and usually covered with a thick mat of grassy halophytic plants; for e.g., a coastal marsh periodically flooded by the sea, or an inland marsh (or salina) in an arid region and subject to intermittent overflow by water containing a high concentration of salt.

Landform	Description
Shoal	a) a relatively shallow place in stream, lake, sea, or other body of water; a shallows. b) a submerged ridge, bank, or bar consisting of or covered by sand or other unconsolidated material, rising from the bed of a body of water to near the surface. c) a rocky area on the sea floor within soundings. d) a growth of vegetation on the bottom of a deep lake, occurring at any depth.
Shoulder	(hill slope) The geomorphic component that form the uppermost inclined surface at the top of a hillslope. It comprises the transition zone from backslope to summit of an upland. The surface is dominantly convex in profile and erosional in origin.
Sinkhole	(doline) A closed depression formed either by solution of the surficial bedrock (e.g., limestone, gypsum, salt) or by collapse of underlying caves. Complexes of sinkholes in carbonate-rock terraces are the main components of karst topography.
Sound	a) A long broad inlet of the ocean generally parallel to the coast. b) A long passage of water connecting two larger bodies (as a sea with an ocean) or separating a mainland and an island.
Spit	a) A small point or low tongue or narrow embankment of land, commonly consisting of sand or gravel deposited by longshore drifting and having one end attached to the mainland and the other terminating in open water, usually the sea; a fingerlike extension of the beach. b) A relatively long, narrow shoal or reef extending from the shore into a body of water.
Splay	A small alluvial fan or other outspread deposit formed where an overloaded stream breaks through a levee and deposits its material (often coarse-grained) on the flood plain.
Stream	see RIVER
Swale	a) A slight depression, sometimes swampy, in the midst of generally level land. b) A shallow depression in an undulating ground moraine due to uneven glacial deposition. c) A long, narrow, generally shallow, trough-like depression between two beach ridges, and aligned roughly parallel to the coastline.
Swamp	An area intermittently or permanently covered with water, having shrubs and trees but essentially without the accumulation of peat.
Talus	Rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep, rock slope. The accumulated mass of such loose broken rock formed chiefly by falling, rolling, or sliding.
Terrace	A step-like surface, bordering a valley floor or shoreline, that represent the former position of an alluvial plain, or lake or sea shore, The term is usually applied to both the relatively flat summit surface (platform, tread), cut or built by stream or wave action, and the steeper descending slope (scarp, riser), graded to a lower base level of erosion.
Tidal flat	An extensive, nearly horizontal, marshy or barren tract of land that is alternately covered and uncovered by the tide, and consisting of unconsolidated sediment (mostly mud and sand). It may form the top surface of a deltaic deposit.
Valley	(basin) An elongate, relatively large, externally drained depression of the Earth's surface that is primarily developed by stream erosion.
Valley side	The sloping to very steep surfaces between the valley floor and summits of adjacent uplands. Well-defined, steep alley sides may be termed "valley walls." Note: Scale, relief, and perspective may require use of closely related terms such as hillslope, mountain slope, and ridge side.

Landform	Description
Wave-built terrace	A gently sloping coastal feature at the seaward or lakeward edge of a wave cut platform, constructed by sediment brought by rivers or drifted along the or across the platform and deposited in the deeper water beyond.

Appendix B - Soil (as adapted from NYNHP)

Soil color

"Color is the most obvious of soil properties, and is easily determined. It has little known direct influence on the functioning of soil, but it is useful because other more important characteristics that are not so easily quantified may be inferred from it. The importance of soil color is greatest within a local set of microenvironments. Some common relationships of color to other soil properties can serve as a basis for interpreting color.

"Commonly, dark colors suggest more organic matter than light colors. Light gray or grayish colors commonly indicate reducing conditions, either current or past. In some environments, yellowish or reddish mottles indicate alternating oxidizing and reducing conditions. Yellowish and reddish mottles are concentrations of material of which iron is one of the most important components.

"Munsell soil color charts are used to determine the moist soil color for each horizon described. This system uses three elements of color: hue, value, and chroma. Hue is the dominant spectral color and is related to wavelength of the light. The most common hues in the northeast are 10R, 2.5R, 5YR, 7.5YR, 10YR, 2.5Y, and 5Y. Value refers to the relative lightness of color and is a function of the total quantity of reflected light. Chroma is the relative purity of the dominant spectral color. The notation is recorded in the form: hue, value/chroma. For example, 5Y 6/3. The three attributes of color are arranged in the system in orderly scales of equal visual steps, which are used to measure and describe color and accurately under standard light conditions.

Soil Drainage

"The soil drainage classes are defined in terms of (1) actual moisture content (in excess of field moisture capacity), and (2) the extent of the period during which excess water is present in the plant-root zone.

"It is recognized that permeability, level of groundwater, and seepage are factors affecting moisture status. However, because these are not easily observed or measured in the field, they cannot be used generally as criteria of moisture status. It is further recognized that soil profile morphology, for example, mottling, normally, but not always, reflects soil moisture status. Although soil morphology may be a valuable field indication of moisture status, it should not be the overriding criterion. Soil drainage classes cannot be based solely on the presence or absence of mottling. Topographic position and vegetation as well as soil morphology are useful field criteria for assessing soil moisture status. For rocky substrates with little or no soil: guess at value based on levels of steady water and degree of runoff.

Class	Description
Rapidly drained	The soil moisture content seldom exceeds field capacity in any horizon except immediately after water addition. Soils are free from any evidence of gleying throughout the profile. Rapidly drained soils are commonly coarse textured or soils on steep slopes.
Well drained	The soil moisture content does not normally exceed field capacity in any horizon (except possibly the C) for a significant part of the year. Soils are usually free from mottling in the upper 3 feet, but may be mottled below this depth. B horizons, if present, are reddish, brownish, or yellowish.
Moderately Well drained	The soil moisture in excess of field capacity remains for a small but significant period of the year. Soils are commonly mottled (chroma < 2) in the lower B and C horizons or below a depth of 2 feet. The Ae horizon, if present, may be faintly mottled in fine-textured soils and in medium-textured soils that have a slowly permeable layer below the solum. In grassland soils the B and C horizons may be only faintly mottled and the A horizon may be relatively thick and dark.
Somewhat poorly Drained	The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year. Soils are commonly mottled in the B and C horizons; the Ae horizon, if present, may be mottled. The matrix generally has a lower chroma than in the well-drained soil on similar parent material.

Class	Description
Poorly drained	The soil moisture in excess of field capacity remains in all horizons for a large part of the year. The soils are usually very strongly gleyed. Except in high-chroma parent materials the B, if present, and upper C horizons usually have matrix colors of low chroma. Faint mottling may occur throughout.
Very poorly Drained	Free water remains at or within 12 inches of the surface most of the year. The soils are usually very strongly gleyed. Subsurface horizons usually are of low chroma and yellowish to bluish hues. Mottling may be present but at depth in the profile. Very poorly drained soils usually have a mucky or peaty surface horizon.

Soil moisture

"While soil drainage is based on soil morphology only, soil moisture is based on the amount of water available to plants. It is evaluated on the basis of soil drainage, soil structure and texture, and climate. Thus, a well-drained till is much more moist than a well-drained coarse textured glacio-fluvial deposit within the same area, or a well-drained sandy loam in a humid climate is moister than the same soil in a climatically dry region. Local soils may be moister due to proximity of water spray or fog zone.

Class	Description
Extremely dry	steep eroding sands, rock piles, gravel.
Very dry	medium and coarse sands; shallow soils, not influenced by ground water.
Dry	deep silty sands and loamy sands, not influenced by ground water.
Well-drained	deep sandy loams and loams, not influenced by ground water.
Somewhat moist	loams and sandy loams with some rust mottling in lower part of B or C horizon. Moist variants or zonal soil types.
Moist	soil surface above the maximum water level; normal soil profile development hampered because of imperfect drainage. Upper 1-2 feet of soil well-aerated during vegetative season. On mineral soils a severely mottled to homogeneous brown horizon (color B) is present. Occurs also on heavy textured soils with perched water table and on dry deep peat.
Somewhat wet	maximum water level at or close to the soil surface. Anaerobic soils; on mineral soils reduced, grey soil matrix with rust mottling. Gleysols, some peat soils.
Wet	water level at soil surface* for most of vegetative season. Reduced gley layer up to mineral soil surface on mineral soils; mottling usually absent or insignificant. Organic soil, gleysol.
Very wet	water level above soil surface for most part of vegetative season. Minimum water level approximately at soil surface. Organic soil.
Permanently Inundated (hydric)	minimum water level above soil surface, soils permanently inundated.
Periodically Inundated (hydric)	known to be periodically inundated due to flood/drought cycles or other variable moisture regimes.

*soil surface implies top of A horizon for peatlands, or at least top of muck layer, but not in peat layer.

Soil texture - Simplified Key to Soil Texture (for use with non-peat soils; after Brewer and McCann, 1982 - as stolen from NYNHP).

First, moisten soil to saturation, and add excess water if noted in key.

A1 Soil does not remain in a ball when squeezed - **sand**
A2 Soil remains in a ball when squeezed - go to B

B1 Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger. Soil makes no ribbon - **loamy sand**
B2 Soil makes a ribbon; may be very short - go to C

C1 Ribbon extends less than 1" before breaking - go to D
C2 Ribbon extends 1" or more before breaking - go to E

D1 Add excess water to small amount of soil; soil feels at least slightly gritty - **loam or sandy loam**
D2 Soil feels smooth - **silt loam**

E1 Soil makes a ribbon that breaks when 1-2" long; cracks if bent into a ring - go to F
E2 Soil makes a ribbon more than 2" long; doesn't crack when bent into a ring - go to G

F1 Add excess water to small amount of soil; soil feels at least slightly gritty - **sandy clay loam or clay loam**
F2 Soil feels smooth - **silty clay loam or silt**

G1 Add excess water to a small amount of soil; soil feels at least slightly gritty - **sandy clay or clay**
G2 Soil feels smooth - **silty clay**

Appendix C - Structural Condition Conventions

The code is a five character string incorporating code for diameter (for forest and woodland stands) or height (for shrubland and grassland stands), canopy cover, and canopy layering (strata) (from Hall et al. 1995). Examples:

ltmae - an moderately open (> 25 and ≤ 40 percent total tree canopy cover) woodland dominated by large-diameter trees

maobe - an open (≥ 15 and ≤ 25 percent total shrub canopy cover) shrubland dominated by medium height shrubs with a relatively homogeneous, single-layered canopy

Tree stem size class	sa	sapling	20 trees per acre 1 - 4.9 inches dbh*
	po	pole	15 trees per acre 5 - 8.9 inches dbh
	mt	medium tree	10 trees per acre 9 - 20.9 inches dbh
	lt	large tree	10 trees per acre 21 - 31.9 inches dbh
	gt	giant tree	5 trees per acre > 31.9 inches dbh

* This applies to the largest trees present. A class is determined by the average dbh of the number of trees per acre indicated.

Shrub/Grass height class:	he	herbland. Grasses and herbs are the only lifeform present.
	ls	low shrub. Shrubs are 0 - 1.5 feet tall.
	ma	medium shrub. Shrubs are 1.6 - 2.5 feet tall.
	mb	medium tall shrub. Shrubs are 2.6 - 4.0 feet tall.
	ta	tall shrub. Shrubs are 4 - 6.5 feet tall.
	tb	very tall shrub. Shrubs are ≥ 6.5 (and < 16.5) feet tall.
Cover class:	na	< 10 percent canopy cover.
	oa	≥ 10 and < 15 percent canopy cover.
	ob	≥ 15 and ≤ 25 percent canopy cover.
	ma	> 25 and ≤ 40 percent canopy cover.
	mb	> 40 and ≤ 66 percent canopy cover.
	da	> 66 percent cover.
Strata	n	no strata.
	e	one stratum with < 30 percent difference in height.
	u	Two or more strata (of the same life form) with > 30 percent difference in height. If shrubland, a second shrub strata must have ≥ 25 percent cover. If herbland or grassland, a second herb or grass strata must have ≥ 10 percent cover (including cryptograms).