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FLORISTIC REGIONS OF IDAHO

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Introduction

At the outset, it is important to establish what this presentation is, and what it isn't. What it is, is the current stage of an attempt to synthesize available knowledge of the Idaho flora in the form of delineated floristic units, similar to (and to a large extent inspired by) Hickman's (1989) floristic subdivisions of California. What it isn't, is an exhaustively researched and experimentally tested finished product. Rather, what is presented here should be considered a starting point, a preliminary hypothesis made available for testing, refining, challenging, and generally reworking as necessary.

Another factor that must be addressed is "why". Why bother trying to recognize floristic units? Why draw lines where nature has, at best, gradual transitions? The answer is the same reason that we draw lines around other units of nature, be they species, kingdoms, mountain ranges, or vegetation types. We draw lines to create categories, which we then use for our own purposes. We see three primary uses of the floristic categories presented here.

First is **organization** of knowledge. Suggested codes are provided for use in databases. a very important means of organizing knowledge. At the most mundane level, a system now exists for filing our slides of Idaho, especially the ones used in this symposium! At a more challenging level, each floristic region is a reasonable focus for separate floras, perhaps as Master's thesis projects, which could eventually form the basis for an updated Flora of Idaho.

Second, formalized units facilitate **communication**, especially in describing the range of a species both effectively and efficiently. Saying that a certain plant occurs in "the mountains of eastern Idaho" could as readily include the Wasatch Range as the Bitterroots, while political categories such as Elmore County can include very different deserts and forests.

A third use is in **planning**, becoming ever more important as environmental issues are coming to the fore. Of course, this can be accomplished with strictly artificial lines, particularly pre-existing county lines and national forest boundaries. Such artificial categories have their own advantages and will certainly not go out of use. However, units that emphasize natural boundaries have a greater predictive value in determining how translatable expertise and effective policies are from one area to another.

Methods

Attempts to divide Idaho into floristic subdivisions are certainly nothing new, but little has been formalized at a level comparable to those of Hickman's (1989) for California. Standard plant geography references (e.g., Takhtajan, 1986) paint too broad a picture, while Arnold's (1975) physiographic analysis of the Idaho Batholith is too detailed. Likewise, although we had access to the U.S. Forest Service's prototype vegetation map, the details were generally finer than needed.

There was also a lack of consensus; for example, Holmgren (1972) includes the mountains of southeastern Idaho in the Intermountain Region, while other treatments (e.g., Hunt, 1974) include these with the Yellowstone Plateau in the Middle Rocky Mountains. Omernik and Gallant (1986) combine the Snake River Basin with the High Desert as a single unit extending all the way to the Cascade Mountains, and McLaughlin (1989) further lumps this unit with the Columbia Plateau (based, however, upon a sample of only four included local floras).

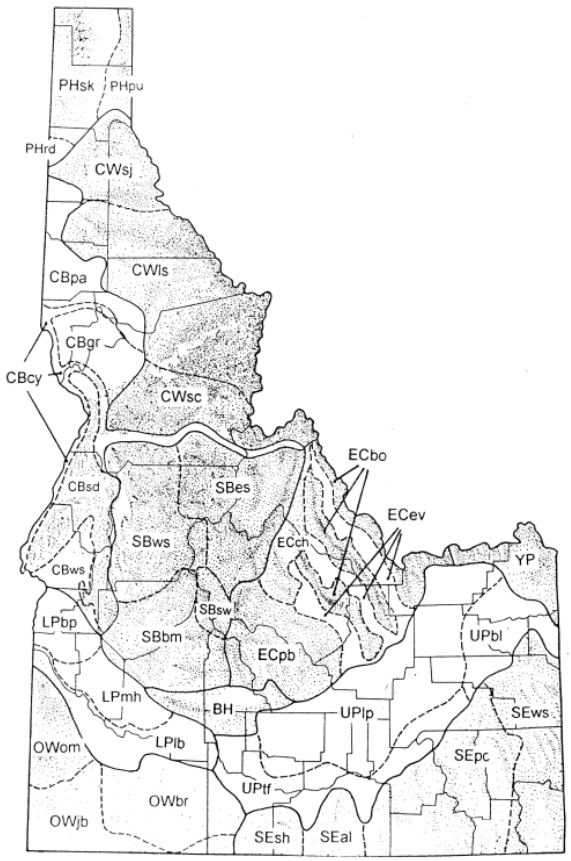

Figure 1. Map of Idaho Outlining the Statge's Proposed Floristic Regions.

As a result, although information in published sources has been incorporated whenever relevant, the floristic units presented here represent much more a synthesis of unpublished personal knowledge, the realization that field botanists develop that they're "someplace different". This includes not only the first-hand field experience of the authors, but perhaps more importantly the floristic knowledge and traditions accumulated in southern and northern Idaho at Albertson's College of Idaho and the University of Idaho, respectively. In particular, we acknowledge the contribution of our mentors at these institutions, Patricia L. Packard and Douglass Henderson. We are also indebted to Frederic Johnson, also of University of Idaho, for sharing some of his insights on a similar project done in conjunction with Bob Steele (U.S. Forest Service) but never published.

The most important supplementary information used in analysis and delineation of floristic regions was geology, the primary determinant of plant distribution. Substrate, physiography, and geological history all have direct effects on vegetation and are major determiners of soil type and climate. Because of the comprehensive nature of this floristic synthesis, the most useful and accessible sources of relevant geological information were similarly broad scale. In addition to

Figure 1. Map of Idaho Outlining the State's Proposed Floristic Regions.

1. Panhandle Division	PH
1a. Selkirk Unit	PHsk
1b. Purcell Unit	PHpu
1c. Rathdrum Unit	PHrd
2. Columbia Division	CB
2a. Palouse Unit	CBpa
2b. Grangeville Unit	CBgr
2c. Canyons Unit	CBcy
2d. Seven Devils Unit	CBsd
2e. Weiser Unit	CBws
3. Clearwater Division	CW
3a. St. Joe Unit	CWsj
3b. Lochsa/Selway Unit	CWls
3c. South Clearwater Unit	CWsc
4. South Batholith Division	SB
4a. Western Salmon River Mountains Unit	SBws
4b. Eastern Salmon River Mountains Unit	SBes
4c. Boise Mountains Unit	SBbm
4d. Sawtooth Unit	SBsw
5. East-Central Mountains Division	EC
5a. Pioneer/Boulder Unit	ECpb
5b. Borah Unit	ECbo
5c. East-Cental Valleys Unit	ECev
5d. Challis Unit	ECch
6. Yellowstone Plateau Division	YP
7. Upper Snake River Plain Division	UP
7a. Lava Plains Unit	UPlp
7b. Bottomlands Unit	UPbl
7c. Twin Falls Unit	UPtf
8. Lower Snake River Plain Division	LP
8a. Boise/Payette Valleys Unit	LPbp
8b. Mountain Home Unit	LPmh
8c. Lakebed Unit	LPlb
9. Bennett Hills Division	BH
10. Owyhee Division	OW
10a. Owyhee Mountains Unit	OWom
10b. Bruneau Plateau Unit	OWbr
10c. Jarbidge Uplands Unit	OWjb
11. Southeastern Mountains Division	SE
11a. South Hills Unit	SEsh
11b. Albion Unit	SEal
11c. Pocatello Unit	SEpc
11d. Wasatch Unit	SEws

the 1:500,000 scale Geologic Map of Idaho (Idaho Department of Lands, Bureau of Mines and

Geology, 1978), these sources included the popularized summaries of Idaho geology by Maley (1987) and, to a lesser extent, Alt and Hyndman (1989). Pre-Pleistocene events are incorporated into the discussions of each floristic subdivision, not because of their direct effect on current plant distribution but because they explain the geology that does effect the plants (as well as being fascinating in their own right!). In addition to the Geological Map of Idaho, other maps were used as available. The 1:500,000 scale Idaho map by Raven Maps and Images (1988) was particularly useful for incorporating physiography/elevation. Some useful soil information was obtained from the Soil Conservation Service's (1973) General Soil Map of Idaho.

Results and Discussion

The currently proposed floristic subdivisions are shown in Figure 1. There are a total of 34 minor subdivisions grouped into 11 major subdivisions, as summarized in Table 1. Plastic sheet overlays, suitable for 1:500,000 scale maps, are being deposited at the herbaria of the University of California, University of Idaho, Albertson College of Idaho, Idaho State University, Brigham Young University, University of Wyoming, and New York Botanical Garden.

1. Panhandle Division (PH)

The northernmost major subdivision coincides with the maximum extent of the Purcell lobe of the continental ice sheet during the Pleistocene. As a result, not only were the mountains heavily glaciated, but the valleys were as well. On the southern border, ice periodically dammed the Clark Fork to form Lake Missoula in the valleys of Montana. The massive floods resulting whenever the ice dam was breached scoured the scablands of eastern Washington, carving out Grand Coulee.

The impact of Pleistocene ice is responsible for many of the dominant landscape features of this division. Continental ice extending south from Canada scoured three large valleys. The Purcell Trench is the largest, bisecting the division, with the Priest River Valley to the west and the Moyie River valley on the east. Possibly due to its proximity to a continental ice sheet, alpine glaciation in this division was particularly intense for Idaho. Although the mountain ranges here are not high, with maximum elevation of approximately 2380 m, mountain glaciation created rugged terrain with relatively high relief.

Precipitation and humidity are relatively high in this division fostering numerous species characteristic of the Pacific Northwest, many of them disjunct *Tsuga mertensiana* (Bong.) Carr, however, is conspicuously absent.

1a. Selkirk Unit (PHsk): the Selkirk Mountains, as well as the Priest River Valley and, tentatively, the Purcell Trench. This unit is underlain largely by granite in the mountains, formed from the Cretaceous Kaniksu Batholith, and alluvial deposits in the valleys. Unifying floristic characteristics include the dominance of *Rhododendron albiflorum* Hook. in the understory of subalpine forests and the presence of *Leptarrhena pyrolifolia* (D. Don) R. Br., *Romanzoffia sitchensis* Bong., and *Ribes howellii* Greene in these same forests. Sphagnum substrates occurring in glacial kettles in the valleys contain several boreal species, such as *Carex chordorrhiza* Ehrh. ex L. f. and *Gaultheria hispidula* (L.) Muhl., that do not occur in similar habitats elsewhere in the state.

1b. Purcell Unit (PHpu): Purcell and Cabinet mountains. This unit is underlain almost entirely by metamorphosed sediments of the Precambrian Belt Series. Two deep valleys traverse the unit:

the Moyie River Valley bisects the Purcell Mountains and the Kootenai River Valley separates the Purcell Mountains on the north from the Cabinet Mountains on the south. The rugged mountains of this unit are covered by relatively rich coniferous forests. *Betula pumila* L., a boreal tree, occurs in bog and fen habitats exclusively in this unit in Idaho.

1c. Rathdrum Unit (PHrd): Rathdrum Prairie, through which the floodwaters from Lake Missoula poured. Because the Rathdrum Prairie was the Pleistocene drainage for outwash from the continental ice sheets to the north, well-drained sandy substrates underlie much of the area. Virtually no free water occurs on the prairie surface, although a large aquifer flows beneath it.

Nearly all of the Rathdrum Prairie is presently under cultivation, but the one small prairie remnant known has *Festuca scabrella* Torr. and *F. idahoensis* Elmer codominating a community that is rich in forbs. The prominence of *F. scabrella* is one of the main differences between this unit and the Palouse Prairie, where it occurs only at the northern edge.

2. Columbia Division (CB)

This division is a heterogeneous grouping of intertwined geology and physiographic features, loosely connected by the Columbia River Basalt flows, which define most of the boundaries. The geologic history is both complicated and fascinating. This was the western continental margin during the Mesozoic, with an active subduction zone. As a result, oceanic terranes were accreted, notably the Seven Devils and Cuddy mountains in Idaho and the Wallowa Mountains opposite Hells Canyon in Oregon. All lower elevations were then covered by massive outpourings of Columbia River Basalt in the Miocene, through which the Snake, Salmon, and Clearwater rivers cut deep, steeply walled canyons.

Prior to cultivation and grazing, the prairies, hills, and canyons were dominated by perennial bunchgrasses, especially *Agropyron spicatum* (Pursh), Scribn. & Smith, *Festuca idahoensis*, and *Poa secunda* Presl. This vegetation type is still relatively intact in the canyons but has been largely converted to agriculture on the prairies.

2a. Palouse Unit (CBpa): the eastern portion of the Palouse Prairie that extends into Idaho, partly coinciding with the St. Males Embayment of the Columbia Plateau. It formerly consisted of rolling grasslands and forested hills, interfingering with the Clearwater Mountains to the east. Because of the exceptionally rich soil, a deep layer of loess, most of the grasslands have been converted to agriculture. Most of the Palouse Prairie vegetation has therefore disappeared, and endemic species such as *Aster jessicae* Piper and *Haplopappus liatriformis* (Greene) St. John are threatened with extinction.

2b. Grangeville Unit (CBgr): Camas Prairie south of the Clearwater River and Joseph Plains south of the Salmon River, partly coinciding with the Clearwater Embayment of the Columbia Plateau. These prairies average 300 m higher elevation than the Palouse Prairie, and are correspondingly moister and cooler. Like the Palouse Prairie, however, they are underlain by deep loess and are therefore likewise largely converted to agriculture.

2c. Canyons Unit (CBcy): the steep-sided canyons of the Snake, Salmon, and Clearwater rivers, often several thousand feet deep. The lowest elevation in Idaho, ca 312 m, is where the Clearwater and Snake rivers meet and exit the state near Lewiston. The Salmon River Canyon extends far eastward, bisecting the Idaho Batholith and creating a low elevation corridor for the canyon flora into the mountainous regions of central Idaho.

The flora at the bottom and sides of the canyons differs dramatically from that of the adjacent forests and prairies, and the diverse layers of exposed geology have further encouraged the development of endemic taxa. In Hells Canyon these include *Ribes cereum* Dougl. var. *colubrinum* Hitchc., *Lomatium rollinsii* Math. & Const., *L. serpentinum* (M. E. Jones) Math., *Penstemon elegantulus* Pennell, and *Mirabilis macfarlanei* Constance & Rollins, Idaho's only Federally listed species.

2d. Seven Devils Unit (CBsd): the forested mountains between Hells Canyon and the Idaho Batholith, including the Seven Devils, Cuddy, Council, and West mountains. Basalt is the dominant substrate, but the Seven Devils Mountains, in particular, are geologically complex. As former oceanic islands comprised largely of metamorphosed volcanics, they include about the only serpentine in Idaho, though not in sufficient quantities to develop a distinct serpentine flora. Many of the species found in the Pacific maritime influenced forests of northern Idaho reach their southern limits here: for example, *Larix occidentalis* Nutt. and *Abies grandis* (Dougl.) Forbes.

2e. Weiser Unit (CBws): the unforested valleys and mountains at the south end of the Columbia River Basalts, largely coinciding with the Weiser Embayment. This includes not only the Weiser River valley but also, tentatively, Squaw Butte and Horseshoe Bend Hill. Indian Valley, where the presumed extinct *Carex aboriginum* M. E. Jones was once found, is part of this unit.

Floristically this unit is transitional to the Lower Snake River Plain Division, but the heavy clay soils and scablands support certain plants more characteristic of the Columbia Plateau. This includes thick-rooted *Lomatium* species, falcate-leaved *Allium* species, and subshrubby *Eriogonum*, such as *E. thymoides* Benth. and *E. sphaerocephalum* Dougl. Unlike the other non-forested units in this division, shrubby *Artemisia* species such as *A. tridentata* Nutt. and *A. rigida* (Nutt.) Gray are dominant.

3. Clearwater Division (CW)

The mountains of northern Idaho between the Panhandle and the Salmon River are relatively uniform compared to some other floristic divisions. The Clearwater Mountains on the west gradually rise to join with the Bitterroot Mountains on the Montana border. The geology consists primarily of Precambrian Belt metamorphics and Cretaceous batholith granites. This division contains much of Idaho's best forest lands, with a good diversity of conifers, and as a result is being extensively clearcut.

Of particular floristic interest is the number of taxa disjunct from west of the Cascade Sierran axis, such as *Cornus nuttallii* Aud., *Dodecatheon dentatum* Hook., *Carex hendersonii* Bailey, *Mertensia bella* Piper, and *Polypodium glycyrrhiza* D. C. Eat. This disjunction was the subject of a master's thesis by Christine Lorain (1988, University of Idaho, College of Forestry, Wildlife, and Range Sciences), who concluded that the various river drainages where they occur constitute Pleistocene refugia.

3a. St. Joe Unit (CWsj): the St. Joe and Coeur d'Alene mountains, north of the St. Joe River. The geology is almost exclusively Belt Series metasediments, not as heavily glaciated as units to the north, that were covered by continental ice, or the units to the south that contain high elevation massifs.

The relatively low, rounded mountains are dominated by a mesic coniferous forest of *Thuja plicata* Donn., *Tsuga heterophylla* (Raf.) Sarg., *T. mertensiana*, *Pinus monticola* Dougl., and *Abies grandis*, among others. The northern limit of the unit coincides with the northern limit of *Tsuga mertensiana* in Idaho (which coincides with the southern extent of continental ice), while the southern boundary coincides with the southern limit of *Tsuga heterophylla*. The low elevation canyons of the Coeur d'Alene and St. Joe rivers harbor some coastal disjunct taxa, but not as many as the Lochsa/Selway Unit to the south.

3b. Lochsa/Selway Unit (CWIs): between the St. Joe River and the Selway River/South Fork Clearwater River divide. *Thuja plicata*, *Pinus monticola*, and *Tsuga mertensiana* generally do not occur south of this hydrologic boundary. The moist, low-elevation canyons of the North Fork Clearwater, Lochsa, and Selway rivers create an environment similar to that west of the Cascades and, as a result, harbor many taxa disjunct from that region. Notable endemics include *Dasynotus daubenmirei* Johnst., *Corydalis caseana* Gray var. *hastata* (Rydb.) Hitchc., and *Synthyris platycarpa* Gail & Pennell.

3c. South Clearwater Unit (CWsc): between the Selway-South Fork Clearwater River divide and the Salmon River canyon. This unit is floristically transitional to the units south of the Salmon River and could as justifiably be associated with them as with the other Clearwater units.

An interesting floristic feature is the abundance of *Taxus brevifolia* Nutt., which, near the southern limit of its distribution in this unit, occurs in the highest density stands of anywhere in its range. These extraordinary stands coincide with the southern limit of *Thuja plicata*. *Larix lyallii*, a timberline tree, also reaches a southern limit in this unit.

4. South Batholith Division (SB)

The dominant and unifying feature of this division is the southern (Atlanta) lobe of the Idaho Batholith, formed during the Cretaceous in the lee of the continental margin subduction zone and subsequently uplifted. The primary exception is the northeastern section, characterized by the Eocene Challis volcanic rocks. There are also several intrusions of Tertiary granites, including the Sawtooth Range and the Big Horn Crags, which are among the few places in Idaho where granite is sculpted into spectacular peaks and abundant lakes.

Erosional history, including significant Pleistocene glaciation, has resulted in a confusing intertwining of the headwaters of the Salmon, Boise, and Payette rivers. There are no clearly defined ranges, though large montane valleys are a common feature. Substrates are often easily eroded; logging roads cut into steep slopes are subject to collapse, with catastrophic effects on formerly rich salmon streams. Soil formation on the batholith is generally poor; conifer diversity is accordingly much less than in the Clearwater division.

A significant floristic feature is the number of disjunctions from the other great western North American batholith, the Sierra Nevada of California. At least one species, *Eriogonum inerme* (Wats.) Jepson, was probably introduced as miners moved from the Californian gold fields to the newly discovered ones of Idaho, but other examples (e.g.. *Lewisia kelloggii* Brandg.) are clearly native. Some of these also occur at intermediate stations, such as Steens Mountain, Oregon, or extend on into the Bitterroot Mountains of Montana.

4a. Western Salmon River Mountains Unit (SBws): the granitic western half of the Salmon River Mountains, including Long Valley. This unit generally receives more precipitation

than do others in this division. One noteworthy floristic feature is the high diversity of *Saxifraga*, including the Sierran disjuncts *S. bryophora* Gray and *S. tolmiei* T. & G. var. *ledifolia* (Greene) Engl. & lrmsch. On the other hand, *Draba*, common elsewhere in the division, is almost completely absent. *Erythronium grandiflorum* Pursh var. *nudipetalum* (Applegate) Hitchc. is an endemic taxon.

The discontinuous high elevations, especially in the Payette Lakes area, deserve analysis as an example of island biogeography applied to continental situations. Preliminary studies indicate that each peak harbors a different assemblage of subalpine species, with distributions presumably affected by Pleistocene glaciation.

4b. Eastern Salmon River Mountains Unit (SBes): the eastern half of the Salmon River Mountains dominated by Challis volcanics. Although the geology has more in common with the East-Central Mountains division to the southeast, the physiographic uniformity with the Idaho Batholith apparently has a greater effect on the floristics. The geologically defined western boundary very roughly approximates that of the Middle Fork of the Salmon River drainage.

Botanical exploration of this unit is challenging due to the often difficult access, even outside the extensive wilderness areas, but definitely rewarding. The Big Horn Crags, for example, are a floristically interesting granitic intrusion into the Challis volcanics. Several eastern range disjunctions have been discovered here, notably *Lewisia columbiana* (Howell) Robins. var. *wallowensis* Hitchc. Portulaceae is particularly well-represented, while the *Saxifraga* diversity that characterizes the granites of the western batholith is essentially absent.

4c. Boise Mountains Unit (SBbm): Boise, Danskin, and Soldier mountains, encompassing most of the Boise River drainage. The northern boundary is the South Fork of the Payette River, though an elevational boundary north of the river might be more meaningful.

The Boise Mountains Unit is drier than the West Salmon River Mountains Unit and, as a result, has more open forests, less diversity of tree species, and fewer montane meadows. Fire frequency has probably been a major factor affecting current floristic composition. Noteworthy species that characterize the unit include *Chaenactis evermannii* Greene on decomposed granite slopes, *Corydalis caseana* var. *cusickii* (Wats.) Hitchc. along mountain streams, and *Astragalus adanus* Nels.

4d. Sawtooth Unit (SBsw): Sawtooth Range and Sawtooth Valley. The most meaningful boundaries of this unit are difficult to determine, although the core of the Sawtooth Range is dramatically distinct from other units. The boundaries presented here, including granitic portions of adjacent mountains ranges, are decidedly tentative.

The Sawtooths, probably Idaho's best-known mountain range, are glacially sculpted peaks of pink Tertiary granite intruded into the gray Cretaceous Idaho Batholith. The high crest of the Sawtooths capture more rainfall than do the adjacent Boise Mountains Unit to the west, creating environments more mesic than expected in this part of Idaho. The presence of *Menziesia ferruginea* Smith along subalpine creek bottoms is one indication of this.

The Sawtooth Valley is also floristically interesting. As one example, during the Pleistocene large glaciers exited the mountains and flowed into the valley. As these piedmont glaciers retreated, they created habitats in which peatlands formed, which now contain many boreal disjunct species such as *Carex livida* (Wahlenb.) Willd. and *C. buxbaumii* Wahlenb.

5. East-Central Mountains Division (EC)

In contrast to the granitic uniformity of the Idaho Batholith, the geology of east-central Idaho is a complex mixture of Precambrian and Paleozoic marine sediments and metamorphics, Tertiary volcanics, and, in the valleys, Quaternary continental sediments. The mountains are generally higher than elsewhere in Idaho and include the highest elevation, Borah Peak. In the west the named mountain ranges are not particularly distinct, while in the eastern half the parallel ranges and valleys are prominently defined. The seismic activity generally associated with such topography was spectacularly evident in 1983, in the form of the Borah Peak earthquake, 7.3 on the Richter scale.

As a result of both the geologic and topographic diversity, this division is perhaps the most floristically rich section of Idaho. It has therefore been the focus of ongoing botanical exploration by Douglass Henderson and his students at the University of Idaho. Floristic characteristics include the occurrence of several arctic-alpine disjuncts, such as *Papaver kluaense* D. Love. Several Great Plains species also enter Idaho in this division, e.g., *Astragalus bisulcatus* (Hook.) Gray.

5a. Pioneer/Boulder Unit (ECpb): Boulder, Pioneer, White Cloud, Smoky, and White Knob mountains. This geological jumble of mountains represents, to a certain extent, the strata that were displaced to the east by the uplift of the Idaho Batholith. Endemic taxa include *Astragalus vexillifiexus* Sheld. var. *nubilus* Barneby in the White Clouds. The Kane Lake area in the Pioneer Mountains has recently gained interest for the number of arctic-alpine disjuncts it harbors (e.g., *Draba fladnizensis* Wulfen) that require more mesic conditions than are generally found in the east-central mountains.

5b. Borah Unit (ECbo): Lost River, Lemhi, and Beaverhead (southern Bitterroot) ranges, east to Monida Pass. These mountains represent a northern extension of the Basin and Range Province, isolated by the Snake River Plain. Most of the essential structure of the Basin and Range Province was established during the Miocene, perhaps by back-arc spreading inland from the subduction zone. This unit is largely underlain by carbonate rocks, with small amounts of granite and quartzite.

The mountain ranges are much drier than are those of the adjacent Pioneer/Boulder Unit to the west. Sagebrush-steppe covers the lower slopes, while a relatively thin band of coniferous forest occurs on middle slopes. This unit contains the largest expanse of alpine zone anywhere in Idaho, rich in arctic-alpine disjuncts. The several endemic taxa include *Astragalus amnis-amissi* Barneby and *Cymopterus douglassii* Hartmann & Const.

5c. East-Central Valleys Unit (ECev): Big Lost River, Little Lost River, Birch Creek, Pahsimeroi, and Lemhi valleys. The large intermontane valleys that comprise this unit are underlain by deep alluvial deposits in the form of massive fans originating at the base of adjacent mountains. Mountain streams normally sink into the alluvium as they exit the mountains and surface as springs in the center of the valley. Therefore, most of the rivers and creeks flowing down the center of these valleys are spring-fed and are bordered by unique and sometimes extensive wetland communities. Due to the alkaline nature of the parent materials, the aquatic and wetland communities have a basic pH and are quite productive. *Primula alcalina* Cholewa & Henderson is endemic to this unit, occurring in rich fens along with several boreal disjuncts such as *Salix candida* Fluegge and *Lomatogonium rotatum* (L.) Fries.

Upland vegetation is largely dominated by woody *Artemisia* species, including *A. tridentata*, *A. arbuscula* Nutt., *A. nova* A. Nels., and *A. tripartita* Rydb.

5d. Challis Unit (ECch): generally unforested hills along the Salmon River from about Clayton to Salmon. This is one of the most arid portions of Idaho, being in the rain shadow of the White Cloud and Sawtooth ranges; the annual precipitation is generally only 18-23 cm (7-9 in).

The sparsely vegetated volcanic outcrops support several endemic taxa, including *Eriogonum verrucosum* Reveal, *Astragalus amblytropis* Barneby, *Oxytropis besseyi* (Rydb.) Blank. var. *salmonensis* Barneby, and *Cryptantha salmonensis* (Nels. & Macbr.) Pays. Several disjunct desert species, such as *Enceliopsis nudicaule* (Gray) A. Nels. and *Langloisia setosissima* (T. & G.) Greene, are also present; these may have used the valleys of the preceding unit as a migration route.

6. Yellowstone Plateau Division (YP)

Included here are the Centennial and Henrys Lake mountains as well as the Idaho portion of the Yellowstone Plateau around Island Park Caldera. The Yellowstone Plateau volcanic field is the current site of the hot spot above a mantle convection plume that may have caused the formation of the Snake River Plain. Rhyolite is therefore a common substrate, in contrast to adjacent areas. Portions of the Centennial and Henrys Lake mountains are comprised of carbonate Paleozoic sediments.

This division is less arid than the adjacent East-Central Mountains Division, having a heavier snowpack and correspondingly more streams and wetlands among coniferous forests. Many of the creeks and rivers are spring-fed, producing rich aquatic macrophyte and peatland communities.

The Yellowstone Plateau Division has floristic affinities with both the Central Rocky Mountains and the Wasatch Unit to the south, but the predominantly volcanic geology contrasts with the Wasatch's carbonate substrates. Several boreal wetland and aquatic species reach their southern limit in this division (e.g., *Lycopodium inundatum* L. and *Scirpus subterminalis* Torr.), while several species typical of the Central Rocky Mountains reach their northern limit (e.g., *Telesonix jamesii* (Torr.) Raf.)

7. Upper Snake River Plain (UP)

One leading hypothesis for the formation of the Snake River Plain is that the volcanic hot spot currently under the Yellowstone Plateau was in southwestern Idaho during the Miocene, and the Snake River Plain represents its track as the continental plate moved westward. Periodic explosive rhyolitic eruptions, dwarfing anything witnessed in historic times, ejected immense quantities of ash into the air. Ashfall Fossil Beds State Historical Park in Nebraska contains skeletons of hundreds of rhinos, horses, and camels, perfectly preserved in a sudden fall of volcanic ash that probably originated in one such eruption from the Snake River Plain.

Volcanic flows subsequent to the explosive eruptions have filled in the downwarp several thousand feet thick. Geological and resultant vegetational diversity is accordingly lower than for other divisions. There are nevertheless some endemic taxa, such as *Astragalus ceramicum* Sheld. var. *apus* Barneby.

7a. Lava Plains Unit (UPIp): the vast core with shallow or no soil and, with few exceptions, no surface water. The rivers flowing onto the Snake River Plain from the East-Central Valleys Unit (Big Lost River, Little Lost River, and Birch Creek) soon disappear underground. The primary outlet for the resultant aquifer is the Thousand Springs area over a hundred miles to the southwest along the Snake River. With typical foresight, a major radioactive waste storage area is situated atop this massive aquifer.

The vegetation is a generally monotonous sagebrush flat, punctuated by scattered volcanic buttes and basaltic lava fields, the most recent only a few thousand years old. Such relatively unweathered lava flows are often responsible for most of what floristic diversity does exist, including the extensive and somewhat anomalous stands of *Pinus flexilis* James on the Craters of the Moon and Hells Half Acre lava flows. Kipukas, geological islands in the lava fields, often preserve examples of the vegetation prior to grazing.

Additional diversity is provided by sand dunes, particularly the St. Anthony dunes at the extreme eastern edge where *Oenothera psammophila* (Nets. & Macbr.) W. Wagner et al. grows. In addition, several species commonly found on the Great Plains transcend the Continental Divide and the northern end of this unit, including *Bouteloua gracilis* (H.B.K.) Lag., *Stipa viridula* Trin.. and *Astragalus drummondii* Hook.

7b. Bottomlands Unit (UPbI): bottomlands of the Snake River and tributaries above Blackfoot, including Teton Basin. The fertile soil developed from the relatively thick alluvial and loess deposits that cover much of this unit has been largely converted to agriculture.

The loess-covered uplands were dominated by woody *Artemisia* species prior to settlement, especially *A. tripartita*. The riparian zones, dominated by *Populus angustifolia* James forests, are still extensive along the Snake River and tributaries.

7c. Twin Falls Unit (UPtf): agricultural valleys along the Snake River from about Pocatello to Gooding, including much of the Raft River Valley. This section of the Snake River bore the initial brunt of the Bonneville flood, when Pleistocene Lake Bonneville overflowed at Red Rock Pass about 15,000 years ago. The resultant catastrophic flood cut into the rock lining the Snake River, tumbling columnar basalt segments into boulders called "Melon Gravel." As a result, and in contrast to the Bottomlands Unit, the Snake River is generally confined to a canyon, so that reservoirs and canals are needed to provide water for agriculture.

Previously, the vegetation consisted of *Artemisia tridentata* ssp. *tridentata*/*Agropyron spicatum* steppe, a habitat type now very rare in Idaho. The most significant floristic elements currently are *Solanum tuberosum* L. and sweet forms of *Beta vulgaris* L.

8. Lower Snake River Plain Division (LP)

Although physiographically the Lower Snake River Plain is an extension of the Upper Snake River Plain (interminably so, to the average driver on Interstate 84), there is a transition near Glenns Ferry into a region that differs in several characteristics from the Upper Snake River Plain. There is less exposed lava, none recent, and more sediments, resulting in substrates with a relatively greater diversity of both texture and pH.

Fish fossils indicate a former drainage to California rather than to the Columbia River. The exact route and any effect this may have had on plant distributions remain undetermined.

8a. Boise/Payette Valleys Unit (LPbp): Boise and Payette river valleys and intervening hills from Boise and Emmett to Payette and Vale, Oregon. The original shrub-bunchgrass associations have been largely replaced by agriculture and urbanization, as predicted by William Judson Boone nearly a century ago. As a result, rare taxa associated with this unit are among Idaho's most imminently threatened. Prime examples are *Allium aaseae* Ownbey and *Lepidium montanum* Nutt. var. *papilliferum* Hend. Neither are restricted to the unit but also occur in the transition zones of adjacent units, particularly the Boise Mountains.

The riparian zones have accumulated a number of species more characteristic of the eastern United States. Some species have been deliberately introduced and subsequently become naturalized, such as *Acer saccharinum* L. and *Amorpha fruticosa* L. (and fox squirrels, for a non-botanical example). Others are more problematical, including *Mimulus ringens* L., *Bacopa rotundifolia* (Michx.) Wettst, and *Lindernia dubia* (L.) Pennell. In that several of these occur in the general area where the Oregon Trail crossed the first major riparian corridor below 1000 m elevation west of the Great Plains, it is interesting to speculate that wagon trains may have acted as a dispersal mechanism for some taxa.

8b. Mountain Home Unit (LPmh): relatively monotonous sagebrush plateau between the Boise and Snake river terraces. Where not converted to agriculture, the original shrub-steppe habitat has largely been overgrazed and replaced by "improved" rangelands of *Agropyron cristatum* (L.) Gaertn. or *Bromus tectorum* L. and other exotic annual weeds. Although the rare *Lepidium davisii* Rollins can be found on small playas in this unit, it is more common elsewhere.

8c. Lakebed Unit (LPIb): exposed lakebed and fluvial sediments of the Idaho Group with interbedded basalts along the Snake River. The sediments were largely deposited during the Miocene (Chalk Hills Formation) and Pliocene (Glenns Ferry Formation) when lakes filled much of the Lower Snake River Plain. The exposed lakebeds are generally ± alkaline and often seleniferous, as indicated by the presence of *Stanleya*. Noteworthy taxa include *Mentzelia torreyi* Gray var. *acerosa* (M. E. Jones) Barneby and *Astragalus nudisillquus* A. Nels.

Additional diversity is provided by the Bruneau Sand Dunes, which harbor several species seldom found in southwestern Idaho. This includes *Euphorbia ocellata* (Dur. & Hilg.) Millsp. var. *arenicola* (Parish) Jepson, *Psoralea lanceolata* Pursh, and *Enceliopsis nudicaule*.

9. Bennett Hills Division (BH)

The (Mount) Bennett Hills consist of a block fault gently rising from the Snake River Plain in the south and dropping abruptly on the north face into the Camas Prairie graben. Both the Bennett Hills and the Camas Prairie would be discordant in adjacent divisions, and are therefore placed together in their own division. The Picabo Hills, Black Butte, and lower Wood River Valley are other relatively discordant elements that are tentatively included at the eastern end of this division.

Most of the Bennett Hills is composed of Miocene Idavada volcanics, particularly silicic tuffs or rhyolite, isolated from the main concentration south of the Snake River Plain (the division is therefore delineated to include a lobe of Idavada volcanics in the Danskin Mountains). The geology is nevertheless relatively diverse, including scablands, basaltic outcrops, and diatomaceous deposits. The most interesting geological phenomena, however, are the bizarrely sculpted outcrops and boulders of the Gooding City of Rocks and other places. It is possible that

much of the erosion occurred before the downwarp of the Camas Prairie, when streams draining the Idaho Batholith flowed uninterrupted across the present-day Bennett Hills.

Only the highest elevations at the western end are forested; the vegetation of the rest of the Bennett Hills is a rich mix of bunchgrass, shrubs, subshrubs, and perennial herbs. The floristic distinctiveness of the Bennett Hills was generally not appreciated prior to studies of deer winter range by the Idaho Fish & Game Department in the late 1970's, at which time numerous disjunctions were discovered. Some species, such as *Downingia bacigalupii* Weiler, *Polygonum heterosepalum* Peck & Ownbey, and *Trifolium macrocephalum* (Pursh) Poiret, represent easternmost range extensions of species otherwise west of the Snake River Plains, often with ranges continuing through Oregon to northeastern California. *Artemisia papposa* Blake & Cronq. grows only in the Bennett Hills and Owyhee Uplift. Other species are disjunct from the Weiser Unit and Columbia Plateau, notably *Eriogonum thymoides* and *Erigeron disparipilus* Cronq.

The other regions included in this division have their own floristic novelties. *Haplopappus insecticruris* Henderson is endemic to the Camas Prairie, while *Astragalus oniciformis* Barneby likewise characterizes the Picabo Hills.

10. Owyhee Division (OW)

The Owyhee Division is in large part a plateau dominated by Miocene and Pliocene basalts and rhyolites, including Idavada volcanics, probably associated with the same hot spot that is now under the Yellowstone Plateau. The Owyhee and Bruneau rivers have cut dramatic canyons. whose vertical walls harbor such characteristic species as *Artemisia packardiae* Grimes & Ertter, *Leptodactylon glabrum* Patterson & Yoder-Williams and *lvesia baileyi* Wats. var. *beneolens* (Ness. & Macbr.) Ertter; river rafting is to a large extent the only way to botanize long stretches of these canyons.

The boundary with the Snake River Plain is tentatively set at where the alkaline scrub of the Lakebed Unit gives way to sagebrush, about 1660 m (4000 ft) elevation.

10a. Owyhee Mountains Unit (OWom): the northwest corner containing the Owyhee Mountains and South Mountain, essentially north of Mud Flat Road. Packard (pers. comm.) describes the geology as "taking an egg-beater to a geology textbook," with a wonderfully diverse flora as a result. Cretaceous granites protrude through the basalts and rhyolites of the division: these granites may be a southward extension of the Idaho Batholith. Curiously, although the granitic mountains are forested, the Ericaceae that are so common on the Idaho Batholith are essentially absent in the Owyhees. *Pinus ponderosa* Dougl., once present, was largely removed during the mining era.

In the extreme northwest edge, a sliver of Oregon's fascinating Succor Creek formation and associated flora enters Idaho. Outcrops of Miocene ash harbor *Trifolium owyheense* Gilkey, *Mentzelia mollis* Peck, *Chaenactis cusickii* Gray, and *Astragalus sterilis* Barneby. This small section could potentially be recognized as a distinct unit, intermediate with the Lakebed Unit of the Lower Snake River Plain.

10b. Bruneau Plateau Unit (OWbr): relatively uniform plateau, cut by canyons. *Lepidium davisii* is a noteworthy species of barren flats. Much of what was sagebrush-steppe has been converted to crested wheatgrass rangeland.

10c. Jarbidge Uplands Unit (OWjb): south part of Owyhee Plateau, above ca 2300 m (5500 ft) elevation. Though largely sagebrush steppe, this unit is relatively well watered compared to the Bruneau Plateau Unit, with wet meadows such as those at Duck Valley. Northern extensions of the Jarbidge Mountains enter Idaho here, adding an increased floristic diversity. The distribution of *Erigeron latus* (Nets. & Macbr.) Cronq. falls within this unit.

11. Southeastern Mountains Division (SE)

The Basin and Range Province is well developed in southeastern Idaho, with geologically diverse north-south trending ranges separated by generally narrow valleys. Most drainages empty into either the Snake River or the Great Salt Lake, so playa-bottomed valleys such as are common in the Great Basin further south are generally lacking. Higher elevations have sparse conifer forests, with pinyon generally absent from the juniper zone.

All but the western mountains in this division are largely composed of Paleozoic and Mesozoic marine sediments, laid down when this was the western edge of the continent. The eastern half is within the Idaho-Wyoming Thrust Belt, part of the much larger Overthrust Belt favored for oil exploration. Late Mesozoic deformation, perhaps related to the rise of the Idaho Batholith, folded and overturned strata so that older rocks can be found above younger ones.

The climate of southeastern Idaho has a continental influence, in contrast to the semi-maritime climate of southwestern Idaho. As a result, summer thunderstorms are a common phenomenon and precipitation is more evenly distributed throughout the year.

11a. South Hills Unit (SEsh): southeast of Twin Falls between Highway 93 and Goose Creek. Although the South Hills are geologically related to the Owyhee Division, floristic affinities are apparently stronger to the east. *Astragalus anserinus* Atwood, Goodrich & Welsh and *Penstemon idahoensis* Atwood & Welsh are endemic species.

11b. Albion Unit (SEal): Albion Range and Middle Mountain between Goose Creek and Raft River valleys. Cache Peak is the highest elevation south of the Snake River in Idaho, and Mount Harrison is also quite high. The Albion Range has extremely diverse geology, including probably the oldest rocks in Idaho. *Castilleja christii* N. Holmgren and *Cymopterus davisii* Hartmann are endemic to this unit.

11c. Pocatello Unit (SEpc): all the ranges and valleys between the Raft River Valley and the Wasatch Range, including Sublette, Black Pine, Deep Creek, Bannock, Portneuf, and Blackfoot ranges. Holmgren (1972) placed the last three ranges in his Wasatch Mountains Division, with the first three in the Bonneville Basin Section of the Great Basin Division. The relevance of this separation to Idaho floristics deserves closer examination.

11d. Wasatch Unit (SEws): more densely forested mountains to the east, including Bear River (= northern extension of Wasatch Range), Aspen, Webster, Caribou, Preuss, and Snake River ranges. This unit receives proportionally more rainfall during the growing season than any other part of Idaho, a situation similar to the central and southern Rocky Mountains. Consequently, deciduous forest communities, dominated by *Populus tremuloides* Michx., are well developed here.

Omernick and Gallant (1986) placed the Bear River Range and the Bear Lake Plateau in the Wasatch/Uintah and Wyoming Basin ecoregions respectively. These need to be examined as potential floristic units worth recognizing in Idaho; *Astragalus jejunus* Wats.and *Cryptantha*

breviflora (Osterh.) Pays., for example, enter Idaho only in the Bear Lake Plateau, while several Wasatch Range endemics such as *Penstemon compactus* (Keck) Crosswhite ascend into the Bear River Range from Utah.

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