

## VALLEY PEATLAND FLORA OF IDAHO

ROBERT J. BURSIK<sup>1</sup> and DOUGLASS M. HENDERSON  
Department of Biological Science, University of Idaho,  
Moscow, ID 83843

### ABSTRACT

Twenty-eight low elevation peatlands in Idaho and northeastern Washington were surveyed for their flora. The flora contains 20 bryophyte and 291 vascular species, 62% of the species are boreal, 22% are western cordilleran, and 16% are widespread. Although most species are of boreal affinity, the Idaho peatland flora has relatively low similarity to other peatland floras in North America. The low similarity may be explained in part by the lack of trees and ericaceous shrubs in Idaho peatlands, and the relatively unknown status of Idaho's bryophyte flora. Five species, previously unknown for Idaho, were documented as peatland inhabitants: *Carex chordorrhiza*, *Eleocharis tenuis*, *Eriophorum viridicarinatum*, *Iris versicolor*, and *Rubus pubescens*.

Floristic and phytogeographic studies of peatlands have been conducted in many parts of boreal and northern temperate North America (Glaser and Foster 1984 in Labrador; Jeglum 1971 in Saskatchewan; Moss 1953 in Alberta; Janssens 1967 and Wheeler et al. 1983 in Minnesota; Lesica 1986 in Montana). Floristic and phytogeographic trends and interrelationships among northern temperate and boreal peatlands have also been documented from numerous studies of peatland vegetations (Slack et al. 1980 and Vitt et al. 1975 in Alberta; Damman and Dowhan 1981 in Nova Scotia; Pollett and Bridgewater 1973 and Wells 1981 in Newfoundland; Jeglum 1975 and Vitt and Bayley 1984 in Ontario; Ovenden and Brassard 1989 in the Yukon; Schwintzer and Williams 1974, Vitt and Slack 1975, and Schwintzer 1978a, b in Michigan; Glaser 1983, in Minnesota; Damman and French 1987, Dunlop 1987, Karlin and Lynn 1988, Motzkin and Patterson 1991, and Mitchell and Niering 1993 in the northeastern U.S.; Stewart and Nilsen 1993 in Appalachia). Peatlands of Idaho, however, escaped intensive floristic and phytogeographic study until the study of Bursik (1990). Only one vegetational study (Rumley 1956) from this region (Hager Lake in Bonner Co., Idaho) had been accomplished prior to 1990. The vegetation and flora of Hager Lake were reanalyzed in 1992 to document changes during the last four decades.

Bursik (1990) recognized two broad types of peatlands in the northwestern Rocky Mountains based on vascular floristics: subalpine peatlands that generally form along low gradient streams and

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<sup>1</sup> Present address: Idaho Conservation Data Center, Idaho Fish & Game, P.O. Box 25, Boise, ID 83707.

around lakes at mid- to high elevations, and low elevation lacustrine peatlands which typically form around lakes in large river valleys in parts of this region. This study focuses on the latter. We refer to these low elevation peatlands as valley peatlands, in recognition of their position on the landscape, regardless of the presence of a lacustrine open body of water, which is present in most, but not all of the study sites. Valley peatlands are dominated by boreal species which range through all or part of the northern boreal regions. Sub-alpine peatlands are characterized by numerous cordilleran species which are generally restricted to the ranges of mountains in western North America. Valley peatlands support relatively few cordilleran species.

The current study includes bryophytes as well as vascular plants, whereas the previous study by Bursik (1990) included only vascular species. Ordination studies undertaken throughout Canada indicate that bryophyte species respond to water chemistry changes and are, therefore, most valuable in elucidating local conditions which may shape species composition and abundance (Horton et al. 1993).

#### STUDY AREA DESCRIPTION

The study sites include 26 in Idaho and two in Pend Oreille County, Washington (Table 1). Both Washington sites are in the Priest River Valley, which drains half of the extreme northern Panhandle of Idaho, and supports the majority of valley peatlands in Idaho. The 28 sites represent a general north-south transect (48°46' in Boundary County, to 44°02' in Fremont County) through the peatland-supporting portion of Idaho (Fig. 1). The sites range in elevation from 641 meters at Gamble Lake to 2000 meters at Robinson Lake (Table 1). Elevation increases along the transect from north to south. Legal locations of the study sites are also shown in Table 1.

Because of the latitudinal, elevational, and physiographic diversity of the region, it is difficult to characterize the climate of the valley peatland regions of Idaho. The climate of the Priest River Valley of northern Idaho, which supports the greatest concentration of valley peatlands in the state, has been described as "inland maritime" due to the prevailing westerlies, which carry air masses from the northern Pacific Ocean across the northern Rocky Mountains. Mean annual precipitation for the Priest River Experimental Forest in the southern part of the Priest River Valley is 81.3 cm, most of which occurs during the winter in the form of snow. The mean annual temperature is 6.8°C with a mean temperature of 18.2°C in July and -4.6°C in January (Cooper et al. 1987). The rest of the peatland regions of Idaho are similar, but somewhat drier and cooler in the higher elevations of the southern part of the study area.

TABLE 1. LOCATION, ELEVATION, AND LATITUDE OF 28 VALLEY PEATLAND STUDY SITES IN IDAHO AND WASHINGTON, U.S.A. Sites are listed in numerical sequence from north to south. S = Section, T = Township, R = Range. Legal locations without sections are unsurveyed.

| Site & Number                    | County       | Legal location | Elevation (m) | Latitude |
|----------------------------------|--------------|----------------|---------------|----------|
| Upper Priest Lake (1)            | Bonner       | S33 T63N R4W   | 790           | 48°46'   |
| Mosquito Bay (2)                 | Bonner       | S10 T62N R3W   | 752           | 48°45'   |
| Armstrong Meadows (3)            | Bonner       | S5 T62N R4W    | 794           | 48°45'   |
| Bottle Lake (4)                  | Bonner       | S20 T62N R4W   | 872           | 48°45'   |
| Perkins Lake (5)                 | Boundary     | S5 T62N R3E    | 810           | 48°45'   |
| Huff Lake (6)                    | Pend Orielle | S15 T36N R45W  | 820           | 48°44'   |
| Packer Meadows (7)               | Bonner       | S21 T62N R5W   | 1120          | 48°42'   |
| Rose Fen (8)                     | Boundary     | S3 T61N R3E    | 751           | 48°40'   |
| Three Ponds (9)                  | Boundary     | S14 T61N R1W   | 1124          | 48°37'   |
| Potholes (10)                    | Bonner       | S20 T61N R5W   | 900           | 48°36'   |
| Deerhorn Cr. Meadows (11)        | Pend Orielle | S15 T36N R45W  | 920           | 48°36'   |
| Hager Lake (12)                  | Bonner       | S34 T61N R5W   | 800           | 48°36'   |
| MacArthur Lake (13)              | Boundary     | S27 T60N R1W   | 642           | 48°30'   |
| Lee Lake (14)                    | Bonner       | S11 T59N R4W   | 762           | 48°20'   |
| Chase Lake (15)                  | Bonner       | S14 T59N R4W   | 768           | 48°27'   |
| Kaniksu Marsh (16)               | Bonner       | S25 T59N R4W   | 738           | 48°26'   |
| Chipmunk Potholes (17)           | Bonner       | S31 T59N R4W   | 740           | 48°25'   |
| Gamble Lake (18)                 | Bonner       | S7 T56N R1E    | 641           | 48°13'   |
| Shepherd Lake (19)               | Bonner       | S23 T56N R2W   | 702           | 48°11'   |
| Rose Lake (20)                   | Kootenai     | S33 T49N R1W   | 653           | 47°33'   |
| Lily Lake (21)                   | Valley       | S27 T19N R3E   | 1527          | 44°57'   |
| Tule Lake (22)                   | Valley       | S13 T15N R6E   | 1630          | 44°37'   |
| Big Springs (23)                 | Fremont      | S33 T13N R44E  | 1963          | 44°30'   |
| Gentian Meadows (24)             | Fremont      | T10N R46E      | 1994          | 44°10'   |
| Robinson Lake (25)               | Fremont      | T10N R46E      | 2000          | 44°10'   |
| West Boundary Trail Meadows (26) | Fremont      | T10N R46E      | 1994          | 44°10'   |
| Rock Creek Potholes (27)         | Fremont      | S10 T9N R45E   | 1965          | 44°08'   |
| Indian Lake (28)                 | Fremont      | S32 T9N R46E   | 1963          | 44°04'   |

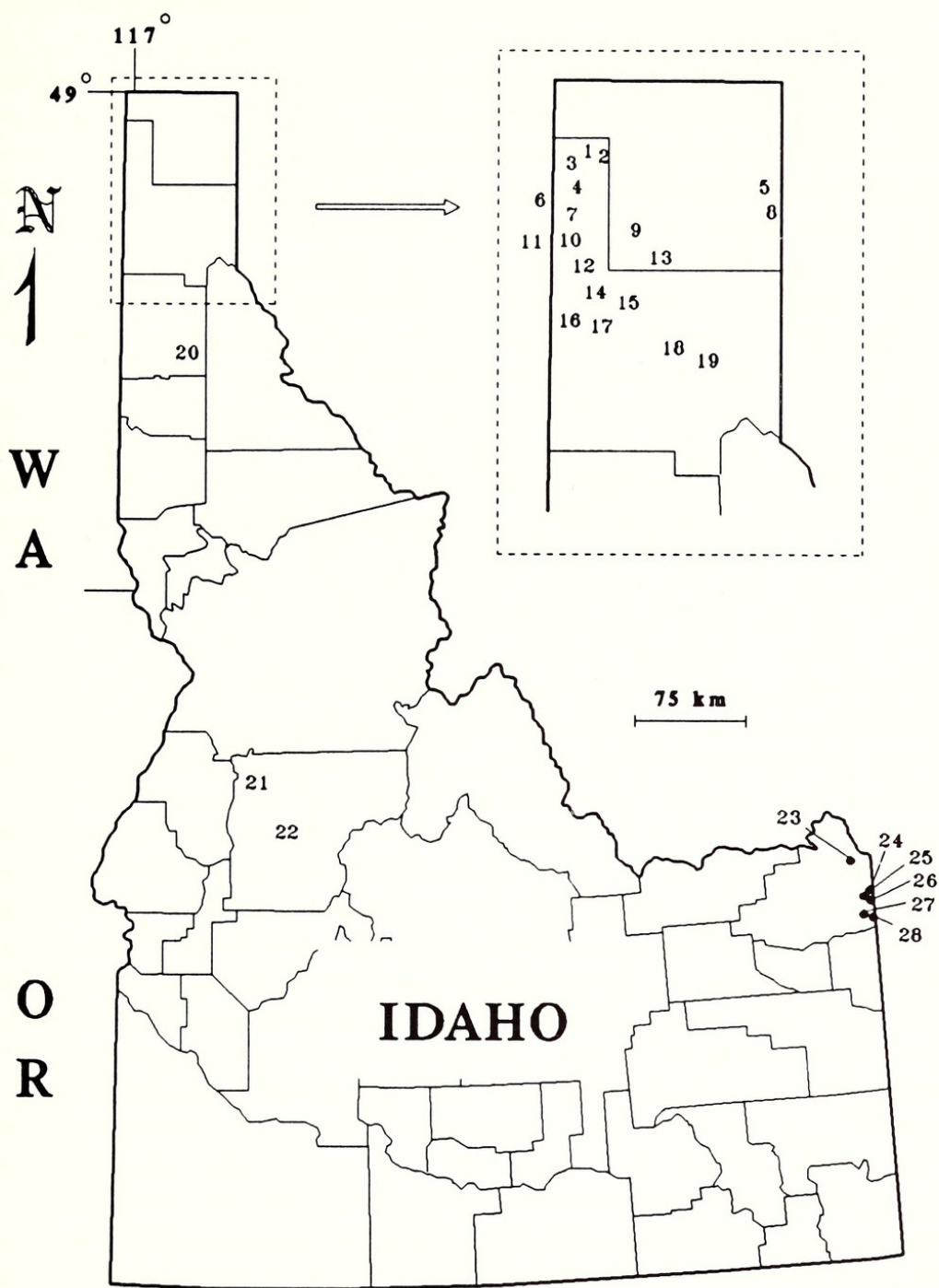


FIG. 1. Location of 28 peatland study sites in Idaho and adjacent northeastern Washington. Study sites and numbers are listed in Table 1.

The uplands adjacent to valley peatlands in northern Idaho and northeastern Washington are dominated by western temperate coniferous forests characterized by *Larix occidentalis*, *Pseudotsuga menziesii*, *Pinus contorta*, *P. ponderosa*, *P. monticola*, *Abies grandis*, *Tsuga heterophylla*, and *Thuja plicata*. *Pinus contorta*, *P. ponderosa*, and *Pseudotsuga menziesii* are dominant in the southern part of the study region. Valley peatlands occur in cirques, glacial kettles, glacial

scours, and glacial outwash channels, and are the product of continental Pinedale Wisconsin glacial activity (Rabe et al. 1986).

The 28 study sites represent predominantly *Sphagnum*-rich peatlands with oligotrophic ground waters (Horton et al. 1993). Several sites, e.g., Rose Fen, are *Sphagnum*-poor peatlands, dominated by brown mosses, sedges, and other graminoids. In the traditional sense, the *Sphagnum*-rich peatlands are fens, ranging from poor fens to moderately rich (mesotrophic) fens. Several of the poor fen sites (e.g., Chase Lake and Huff Lake) include localized raised bog (ombrotrophic) habitats dominated by *Sphagnum fuscum*, although the rich floras of each of these areas, considered as a whole, indicate the presence of predominantly poor fen conditions.

### METHODS

Twenty-eight sites, selected to represent a diversity of valley peatlands in Idaho, and adjacent Washington were studied from 1987 to 1993. Most of the peatlands are located on federal lands and several are included within Research Natural Areas (Table 1).

Most study sites were visited at different times during the growing season to document phenological changes in the vascular flora. Terrestrial (mat) habitats were surveyed extensively on foot. Open water was covered by canoe, inflatable raft, or by wading. To account for as much floristic diversity as possible, particular attention was given to habitats characterized by different types of vegetation, various degrees of microtopographic relief, and varied patterns of drainage.

The establishment of peatland boundaries for sampling was based on the presence of moist to wet peat soils dominated by peat mosses, brown mosses (e.g., *Aulacomnium palustre* and *Calliergon stramineum*), sedges and other characteristic wetland taxa. The narrow transition from peat to predominantly mineral soils supporting upland trees was considered the peatland boundary. Extensive paludified forest exists in several of the sites (e.g., Mosquito Bay, Armstrong Meadows, Lee Lake). Upland tree species such as *Tsuga heterophylla* and *Pinus contorta* were included in the species lists if they occurred on peat or on thick mats of *Sphagnum centrale*. Although no tree species are specifically adapted to peatland habitats in the region, most of the locally dominant conifers occur in the paludified habitats and scattered on raised hummocks in other, non-paludified portions of the peatlands.

Over 2000 voucher specimens were collected to document this study and are deposited in the University of Idaho Herbarium (ID). Data from these collections and specimens already on deposit in ID were used in compiling floristic lists for each study area. Nomenclature follows Hitchcock and Cronquist (1973) and Moss (1959) for Angiosperms, Flora of North America Editorial Committee (1993)

for Pteridophytes and Gymnosperms, Lawton (1971) for non-*Sphagnum* bryophyte species, and Andrus and Layser (1976) for *Sphagnum* spp.

Sorenson's Index of Similarity, with the formula:  $S = (2w/a + b) \times 100$ , where  $w$  is the number of species in common between two areas, and  $a$  and  $b$  are the number of species in areas A and B, respectively, was used to compare the valley peatland flora of Idaho with other regional peatland floras in North America. Sorenson's Index has been used in other phytogeographic studies (e. g., Wheeler et al. 1983; Lesica 1986). All comparisons were done at the species level. Species lists from other geographic regions in North America were compiled from the following studies: Lesica (1986) for north-central Montana; Jeglum (1975) and Vitt and Bayley (1984) for Northern Ontario; Vitt and Slack (1975), and Schwintzer (1978b) for northern Michigan; Damman and French (1987) for the North-eastern U.S.; Glaser (1983) for northern Minnesota; Wheeler et al. (1983) for the Red Lake Peatland in Minnesota; Jeglum (1971) for Saskatchewan; and Moss (1953), Slack et al. (1980), and Vitt et al. (1975) for Alberta.

## RESULTS

The valley peatland flora of the northwestern Rocky Mountains consists of 311 species, 20 bryophytes and 291 vascular (Table 2). The Cyperaceae is the most prominent vascular family with six genera and 46 species, accounting for 15% of the flora. *Carex* with 32 species and *Sphagnum* with 11 species are the most important genera in the flora.

One hundred ninety-three of the 311 species (62%) are boreal in distribution, most of which are at or near their southern limit in Idaho. Sixty-nine species (22%) have ranges centered in the western cordillera of North America, and 49 species (16%) are widespread in North America or cosmopolitan in distribution (Table 2). The last group also includes introduced weeds of wide or local distribution in North America.

Thirty species (10%) in the valley peatland flora are considered rare in Idaho (Moseley and Groves 1992). Five of these species were undocumented in Idaho prior to this study: *Carex chordorrhiza*, *Eleocharis tenuis*, *Eriophorum viridicarinatum*, *Iris versicolor*, and *Rubus pubescens*.

Forty-four of the 69 cordilleran species (64%) occur in three or fewer sites. Most of these species occur on moist, minerotrophic margins in areas otherwise characterized by poor fen conditions. Other cordilleran species are characteristic of dried or disturbed habitats within the peatlands. Very few of the cordilleran species occur on fixed or floating mat locations on deep peat. Exceptions



TABLE 2. CONTINUED

|                                | P | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|--------------------------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| <i>Sphagnum centrale</i>       |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| C. Jens.                       | b | x | x | o | o | o | x | o | o | o | o  | o  | x  | o  | x  | x  | x  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Sphagnum fuscum</i>         |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| (Schimp.) Klinggr.             | b | o | o | o | o | o | x | o | o | o | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Sphagnum magellanicum</i>   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Brid.                          | b | o | x | o | o | o | x | o | o | o | o  | o  | o  | o  | x  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Sphagnum russowii</i>       |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Warnst.                        | b | o | o | o | o | o | x | o | o | o | o  | o  | o  | o  | o  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Sphagnum squarrosum</i>     |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Crome                          | b | o | x | o | o | o | x | o | o | o | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Sphagnum subobesum</i>      |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Warnst.                        | b | o | o | o | o | o | o | o | o | o | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Sphagnum subsecundum</i>    |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Nees in Strum                  | b | o | x | o | o | o | x | o | o | o | o  | x  | o  | o  | x  | o  | x  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Sphagnum teres</i>          |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| (Schimp.) Aongstr.             | b | o | x | o | o | o | x | o | o | o | o  | x  | o  | o  | x  | x  | x  | o  | x  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Sphagnum warnstorffii</i>   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Russ.                          | b | o | o | o | o | o | o | o | o | o | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Warnstorffia exannulata</i> |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| (Schimp. in B.S.G.) Loeske     | b | o | o | o | o | o | x | o | x | o | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| PTERIDOPHYTES                  |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Isoëtaceae                     |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Isoëtes lacustris</i> L.    | b | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| Lycopodiaceae                  |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Lycopodium annotinum</i> L. | b | o | x | o | o | o | x | o | o | o | x  | o  | x  | o  | x  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Lycopodium clavatum</i> L.  | b | o | x | o | o | o | o | o | o | o | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Lycopodium obscurum</i> L.  | b | x | o | o | o | o | o | o | o | o | o  | x  | o  | o  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Lycopodiella inundata</i>   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| (L.) Holub                     | b | o | x | o | o | o | o | o | o | o | o  | x  | o  | o  | o  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | x  | o  |











TABLE 2. CONTINUED

|                                             | P | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---------------------------------------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| <i>Carex interior</i> Bailey                | b | o | x | o | x | o | x | o | x | o | o  | o  | x  | o  | x  | x  | x  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Carex lanuginosa</i> Michx.              | b | o | o | o | o | o | x | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Carex lasiocarpa</i> Ehrh.               | b | x | x | x | x | x | x | o | x | o | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  |
| <i>Carex lenticularis</i> Michx.            | b | o | x | o | x | o | x | o | o | x | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | x  | o  | o  | o  |
| <i>Carex leptolea</i> Wahl.                 | b | x | x | x | o | x | o | x | o | x | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Carex limosa</i> L.                      | b | x | x | x | x | x | x | x | o | x | o  | x  | o  | o  | x  | x  | x  | o  | o  | o  | x  | o  | x  | o  | o  | x  | x  | o  | o  |
| <i>Carex livida</i> (Wahl.) Willd.          | b | o | x | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | x  | x  | o  | o  |
| <i>Carex luzulina</i> Olney                 | w | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  |
| <i>Carex muricata</i> L.                    | b | o | x | x | o | o | x | o | o | o | o  | x  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | x  | x  | x  | x  | o  | o  | o  |
| <i>Carex nebraskensis</i> Dewey             | c | o | o | o | o | o | o | o | x | o | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  |
| <i>Carex oederi</i> Retz.                   | b | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  |
| <i>Carex paupercula</i> Michx.              | b | o | x | o | o | o | o | o | o | x | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Carex rostrata</i> Stokes                | b | o | x | o | o | o | x | o | o | o | o  | x  | o  | o  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Carex scopulorum</i> Holm                | w | o | o | o | o | o | x | o | o | o | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | x  | o  | x  | o  | o  | o  |
| <i>Carex simulata</i> Mack.                 | w | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | x  | x  | o  | o  | o  |
| <i>Carex stipata</i> Muhl.                  | b | o | o | o | o | o | o | o | o | x | o  | o  | o  | x  | o  | o  | x  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Carex utriculata</i> Boott               | b | x | x | x | x | x | x | x | o | x | o  | x  | o  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  |
| <i>Carex vesicaria</i> L.                   | b | o | x | x | o | x | o | o | o | x | x  | o  | x  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | x  | x  | x  | x  | x  |
| <i>Dulichium arundinaceum</i> (L.) Britt.   | b | o | x | o | x | o | o | o | x | o | o  | x  | o  | x  | x  | x  | x  | o  | o  | x  | x  | o  | x  | o  | o  | o  | o  | x  | o  |
| <i>Eleocharis acicularis</i> (L.) R. & S.   | b | o | o | o | o | o | o | o | o | o | o  | o  | x  | o  | o  | x  | o  | o  | o  | x  | x  | o  | o  | x  | o  | o  | o  | x  | o  |
| <i>Eleocharis ovata</i> (Roth.) R. & S.     | b | o | o | o | o | x | o | o | o | o | o  | o  | o  | o  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  |
| <i>Eleocharis palustris</i> (L.) R. & S.    | b | o | x | o | x | o | o | x | x | o | o  | x  | x  | x  | x  | x  | x  | o  | o  | o  | x  | x  | o  | o  | o  | o  | x  | x  | x  |
| <i>Eleocharis pauciflora</i> (Lightf.) Link | b | o | x | o | o | o | o | o | o | o | x  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | x  | x  | o  | o  | o  |
| <i>Eleocharis tenuis</i> (Willd.) Schultes  | b | o | o | o | o | o | o | o | o | o | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  |





TABLE 2. CONTINUED

|                                          | P | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|------------------------------------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Juncaceae                                |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Juncus acuminatus</i> Michx.          | b | o | o | o | o | o | o | o | o | o | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Juncus alpinus</i> Vall.              | b | o | x | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Juncus balticus</i> Willd.            | b | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  |
| <i>Juncus brachyphyllus</i> Wieg.        | w | o | o | o | o | x | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Juncus effusus</i> L.                 | c | o | x | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Juncus ensifolius</i> Wikst.          | w | o | x | o | x | o | x | o | x | o | x  | x  | x  | x  | x  | x  | x  | o  | o  | x  | x  | x  | o  | o  | x  | o  | o  | o  | x  |
| <i>Juncus filiformis</i> L.              | b | o | x | o | o | o | o | o | o | x | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Juncus nevadensis</i> Wats.           | w | o | x | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Juncus nodosus</i> L.                 | b | o | o | o | o | o | o | o | x | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Juncus tenuis</i> Willd.              | c | o | o | o | o | o | x | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Juncus tweedyi</i> Rydb.              | w | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  |
| <i>Juncus vaseyi</i> Engelm.             | b | o | o | o | o | o | o | o | o | o | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| Juncaginaceae                            |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Triglochin maritima</i> L.            | c | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  |
| <i>Triglochin palustre</i> L.            | b | o | o | o | o | o | o | o | o | x | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| Lamiaceae                                |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Lycopus americanus</i> Muhl.          | c | o | o | o | o | o | o | o | o | o | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Lycopus uniflorus</i> Michx.          | b | o | x | x | x | x | o | x | x | x | o  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | o  | x  | x  | x  | x  | x  |
| <i>Mentha arvensis</i> L.                | b | o | o | o | o | o | o | o | x | o | x  | o  | x  | x  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | x  |
| <i>Prunella vulgaris</i> L.              | c | o | x | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | x  | o  | o  | o  |
| <i>Scutellaria galericulata</i> L.       | b | o | x | o | o | x | o | o | x | o | o  | o  | o  | x  | o  | o  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | x  |
| <i>Scutellaria laterifolia</i> L.        | b | o | x | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| Leguminosae (s.l.)                       |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Trifolium repens</i> L.               | c | o | o | o | o | o | o | o | o | o | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| Lemnaceae                                |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Lemna minor</i> L.                    | b | o | o | o | o | x | o | o | x | o | o  | o  | o  | x  | x  | o  | o  | o  | o  | o  | x  | x  | o  | o  | o  | o  | o  | o  | o  |
| <i>Spirodela polyrhiza</i> (L.) Schleid. | b | o | o | o | x | o | o | o | o | o | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  |







TABLE 2. CONTINUED

|                                                    | P | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |  |
|----------------------------------------------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|
| <i>Puccinellia pauciflora</i><br>(Presl) Munz      | w | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  |  |
| <i>Sphenopholis obtusata</i><br>(Michx.) Scribn.   | c | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| <i>Trisetum cernuum</i> Trin.                      | w | o | o | o | o | o | x | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| <i>Zizania aquatica</i> L.                         | b | o | o | o | o | o | o | o | x | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| Polygonaceae                                       |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| <i>Polygonum amphibium</i> L.                      | b | o | o | o | o | x | o | o | x | x | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| <i>Polygonum coccineum</i><br>Muhl.                | c | o | o | o | o | o | o | o | o | o | o  | o  | x  | o  | o  | o  | x  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | x  | o  |  |
| <i>Polygonum hydropiperoides</i><br>Michx.         | c | o | o | o | o | o | o | o | x | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| <i>Rumex maritimus</i> L.                          | c | o | o | o | o | o | o | o | x | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| <i>Rumex occidentalis</i> S. Wats.                 | b | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| Potamogetonaceae                                   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| <i>Potamogeton amplifolius</i><br>Tuckerman        | b | o | o | o | x | x | o | o | o | o | o  | o  | o  | o  | x  | x  | o  | o  | x  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| <i>Potamogeton berchtoldii</i><br>Fieb.            | b | o | x | o | x | x | x | o | x | o | o  | o  | o  | o  | o  | o  | o  | x  | x  | x  | o  | x  | o  | o  | o  | o  | o  | o  | o  |  |
| <i>Potamogeton crispus</i> L.                      | c | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | x  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| <i>Potamogeton epihydrus</i> Raf.                  | b | o | o | o | o | o | x | o | o | o | o  | o  | o  | o  | x  | x  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | x  |  |
| <i>Potamogeton foliosus</i> Raf.                   | c | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| <i>Potamogeton gramineus</i> L.                    | b | o | o | o | o | o | o | o | x | o | o  | o  | o  | o  | o  | o  | o  | x  | x  | o  | o  | o  | o  | x  | o  | x  | o  | x  | o  |  |
| <i>Potamogeton natans</i> L.                       | b | o | o | o | x | x | x | o | x | o | x  | o  | o  | x  | o  | x  | x  | o  | x  | o  | x  | x  | x  | x  | o  | x  | o  | x  | x  |  |
| <i>Potamogeton robbinsii</i><br>Oakes              | c | o | o | o | o | x | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | x  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| <i>Potamogeton richardsonii</i><br>(Bennett) Rydb. | c | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | x  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  |  |
| <i>Potamogeton zosteriformis</i><br>Schum.         | b | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |  |

TABLE 2. CONTINUED

|                                        | P | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|----------------------------------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| <b>Primulaceae</b>                     |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Lysimachia ciliata</i> L.           | b | o | o | o | o | o | o | o | o | o | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Lysimachia thyrsiflora</i> L.       | b | o | x | x | o | x | o | o | x | o | o  | o  | x  | x  | o  | o  | x  | o  | x  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Trientalis arctica</i> Fisch.       | w | x | x | x | o | o | x | x | o | o | x  | x  | x  | o  | x  | x  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <b>Ranunculaceae</b>                   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Ranunculus flamula</i> L.           | b | o | x | o | x | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Ranunculus gmelinii</i> DC.         | c | o | o | o | o | o | o | o | x | o | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Ranunculus pensylvanicus</i> L.f.   | b | o | o | o | o | x | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <b>Rhamnaceae</b>                      |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Rhamnus alnifolia</i> L. 'Her.      | b | o | x | o | o | x | o | o | o | x | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Rhamnus purshiana</i> DC.           | w | o | x | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <b>Rosaceae</b>                        |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Amelanchier alnifolia</i> Nutt.     | w | o | o | o | o | o | x | o | o | o | o  | o  | o  | o  | o  | x  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Crataegus douglasii</i> Lindl.      | b | o | o | o | o | o | o | o | o | o | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Fragaria virginiana</i> Duchesne    | c | o | o | o | o | o | o | o | o | x | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Geum macrophyllum</i> Willd.        | b | o | o | o | o | o | o | o | x | o | x  | o  | x  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Potentilla norvegica</i> L.         | b | o | x | o | o | o | o | o | x | o | o  | o  | x  | o  | x  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Potentilla palustris</i> (L.) Scop. | b | x | x | x | x | x | o | x | x | x | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  |
| <i>Rubus pedatus</i> J. E. Smith       | w | o | o | o | o | o | x | o | o | o | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Rubus pubescens</i> Raf.            | b | o | o | o | o | o | o | o | o | o | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Spiraea densiflora</i> Nutt.        | w | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  |
| <i>Spiraea douglasii</i> Hook.         | w | x | x | x | x | x | o | x | o | x | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | x  | o  | o  | o  | o  | o  | o  |

TABLE 2. CONTINUED

|                                   | P | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Rubiaceae                         |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Galium trifidum</i> L.         | b | o | x | o | x | o | o | o | x | o | x  | o  | x  | x  | x  | o  | x  | x  | o  | x  | x  | x  | o  | o  | o  | x  | x  | x  | x  |
| Salicaceae                        |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Salix bebbiana</i> Sarg.       | b | o | x | o | o | o | o | o | x | o | o  | x  | o  | x  | o  | x  | x  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Salix candida</i> Fluegge      | b | o | o | o | o | x | o | o | o | o | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Salix commutata</i> Bebb       | w | o | o | o | o | o | o | o | o | o | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  |
| <i>Salix drummondiana</i> Barratt | c | o | x | x | o | o | o | o | o | o | x  | o  | o  | o  | x  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Salix geyeriana</i> Anderss.   | c | o | x | o | o | o | o | o | o | o | x  | o  | o  | o  | o  | o  | x  | o  | o  | x  | x  | o  | o  | x  | o  | o  | o  | o  | x  |
| <i>Salix pedicularis</i> Pursh    | b | x | x | x | o | x | o | x | o | o | x  | o  | o  | o  | x  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Salix planifolia</i> Pursh     | b | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | x  | x  | o  | o  | o  |
| <i>Salix scouleriana</i> Barratt  | w | o | o | o | o | o | x | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  |
| <i>Salix sitchensis</i> Sanson    | w | x | x | o | o | o | x | o | o | o | x  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| Santalaceae                       |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Comandra livida</i> Richards.  | b | x | x | o | o | o | x | o | o | o | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| Saxifragaceae                     |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Tiarella trifoliata</i> L.     | w | o | o | o | x | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| Scheuchzeriaceae                  |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Scheuchzeria palustris</i> L.  | b | o | x | o | o | x | x | o | x | o | o  | o  | x  | o  | x  | x  | x  | o  | o  | o  | o  | o  | x  | o  | o  | x  | x  | o  | o  |
| Scrophulariaceae                  |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Melampyrum lineare</i> Desr.   | c | o | o | o | o | o | o | o | x | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Mimulus guttatus</i> DC.       | w | o | o | o | o | o | o | o | o | o | x  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  |

TABLE 2. CONTINUED

|                                          | P | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|------------------------------------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| <i>Mimulus moschatus</i> Dougl.          | b | o | o | o | o | o | o | o | o | o | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  |
| <i>Mimulus primuloides</i> Benth.        | w | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  |
| <i>Pedicularis groenlandica</i><br>Retz. | b | o | o | o | o | o | o | x | o | o | x  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | x  | x  | o  | o  | o  |
| <i>Verbascum thapsus</i> L.              | c | o | o | o | o | o | o | o | o | o | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Veronica americana</i><br>Schwein.    | b | o | o | o | o | o | o | o | o | o | x  | o  | o  | x  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Veronica scutellata</i> L.            | b | o | x | o | o | o | o | o | o | o | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | x  | x  |
| Sparganiaceae                            |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Sparganium emersum</i><br>Rehmann     | b | o | o | o | x | o | o | o | o | x | x  | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | x  | o  | o  | o  | x  | x  |
| <i>Sparganium eurycarpum</i><br>Engelm.  | c | o | o | o | o | o | o | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Sparganium minimum</i><br>Fries.      | b | o | x | o | x | o | x | o | x | o | o  | o  | o  | o  | x  | x  | x  | x  | o  | o  | o  | x  | o  | x  | x  | o  | x  | x  | o  |
| Typhaceae                                |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Typha latifolia</i> L.                | c | o | x | o | o | x | o | o | x | o | x  | o  | o  | x  | x  | x  | x  | o  | x  | x  | x  | x  | o  | o  | o  | o  | o  | x  | x  |
| Violaceae                                |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <i>Viola glabella</i> Nutt.              | w | o | o | o | x | o | x | o | o | o | o  | o  | o  | o  | o  | o  | o  | o  | o  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |
| <i>Viola macloskeyi</i> Lloyd            | c | o | x | o | x | x | o | o | x | o | x  | o  | x  | o  | x  | x  | x  | x  | x  | x  | o  | x  | x  | o  | o  | o  | o  | x  | x  |
| <i>Viola palustris</i> L.                | b | o | o | o | x | o | o | o | o | o | x  | o  | x  | o  | o  | o  | o  | o  | x  | o  | x  | o  | o  | o  | o  | o  | o  | o  | o  |

TABLE 3. SORENSSEN'S INDEX OF SIMILARITY VALUES (S) FOR THE VALLEY PEATLAND FLORA OF IDAHO (WITH 311 SPECIES TOTAL) COMPARED WITH PEATLAND FLORAS FROM ELSEWHERE IN NORTH AMERICA. b = number of species on comparison flora; w = number of species in common.

| Comparison flora and author(s)                                      | b   | w  | S    |
|---------------------------------------------------------------------|-----|----|------|
| Pine Butte Fen, Montana, U.S.A.<br>(Lesica 1986)                    | 102 | 54 | 26.2 |
| Northwestern Alberta, Canada<br>(Moss 1953; Slack et al. 1980)      | 247 | 98 | 35.1 |
| Candle Lake, Saskatchewan, Canada<br>(Jeglum 1971)                  | 165 | 92 | 38.7 |
| Red Lake Peatland, Minnesota, U.S.A.<br>(Wheeler et al. 1983)       | 251 | 94 | 33.5 |
| Northern Minnesota, U.S.A.<br>(Glaser 1987)                         | 297 | 94 | 30.9 |
| Upper Great Lakes Region, U.S.A.<br>(Crum 1988)                     | 204 | 71 | 27.6 |
| Northern Michigan, U.S.A.<br>(Vitt and Slack 1975; Schwintzer 1978) | 164 | 52 | 21.9 |
| Northern Ontario, Canada<br>(Jeglum 1975; Vitt and Bayley 1984)     | 84  | 36 | 18.2 |
| Northeastern U.S.A.<br>(Damman 1987)                                | 155 | 28 | 12.0 |

include *Carex cusickii*, *Kalmia microphylla*, *Trientalis arctica*, and *Spiraea douglasii* (Table 2). The majority of the dominant species in the valley peatlands in Idaho are boreal, including *Sphagnum angustifolium*, *S. centrale*, *S. subsecundum*, *S. magellanicum*, *Carex lasiocarpa*, *C. utriculata*, *Dulichium arundinaceum*, *Drosera anglica*, *D. rotundifolia*, *Lycopus uniflorus*, *Menyanthes trifoliata*, *Potentilla palustris*, and *Scheuchzeria palustris*.

The valley peatland flora of Idaho was compared with peatland floras from elsewhere in North America using Sorenson's Index of Similarity (Table 3). Similarity values ranged from 12.0 for the Northeastern USA. to 38.7 for Candle Lake, Saskatchewan. Generally, the most distant comparison areas from Idaho were least similar (Northeastern USA; Northern Ontario; and Northern Michigan). Floristic similarity, however, did not necessarily increase with geographic proximity.

#### DISCUSSION

As is true with other northern temperate peatland floras, the valley peatland flora of Idaho contains few regional species adapted specifically to peatland habitats. Rather, the flora is comprised predominantly of boreal species at or near their southern range limits. This fact, however, makes the relatively low Similarity Index values between Idaho's valley peatland flora and other regional North American peatland floras somewhat surprising.

Water chemistries of valley peatlands in Idaho (Bursik 1990) fall within the range of water chemistry values given for *Sphagnum*-rich and *Sphagnum*-poor peatlands studied throughout North America (e.g., Vitt and Slack 1975; Schwintzer 1978a, b; Vitt and Bayley 1984). Although ombrotrophic habitats are localized and rare in valley peatlands of Idaho, poor, mesotrophic and rich fen conditions, as indicated by surface and subsurface water cation concentrations, alkalinity, pH, and conductivity values gathered at more than half of the study sites, are well-represented in the region (Bursik 1990). Additionally, fen habitats support far more species than do the ombrotrophic bog habitats (Wheeler et al. 1983), hence the lack of abundant bog habitat would exclude relatively few species from the region and could not alone account for the unique flora.

Lesica (1986) reported that floristic similarity with the flora of Pine Butte Fen decreased with increasing distance from Pine Butte Fen, and also decreased with decreasing pH of the peatland groundwater. The regional peatland floras nearest to Idaho are from Pine Butte Fen, Montana, and northwestern Alberta (Fig. 2). The two regions with peatland floras most similar to the peatland flora of Idaho, however, are the Candle Lake region of Saskatchewan, and Red Lake Peatland in northern Minnesota (Table 3). All of the studies except for Lesica (1986) represent a wide range of trophic diversity. The most distant comparison areas (northern Ontario, northern Michigan, and the Northeastern USA) were least similar to Idaho's valley peatland flora, otherwise no geographic trend is apparent. The surprisingly low floristic similarity with Pine Butte Fen, which is in the western cordillera, can perhaps be explained by the narrow range of chemical diversity of that area (minerotrophic fen), compared to the wide diversity of peatlands included in this study.

Several other factors may account for the overall lack of floristic similarity between the valley peatlands of Idaho and other regional peatlands examined. The most obvious source of uniqueness is the presence of 69 western cordilleran species which may be shared with only two of the comparison areas. Bryophyte diversity in Idaho is still poorly documented, which may account for the low similarity with other peatland floras. With the exception of the Pine Butte Fen flora, all other regional floras include thorough documentation of the bryophyte components. Most of those areas support more than 60 bryophyte species, whereas we documented only 20, all of which are boreal. Wheeler et al. (1983) noted an equal to greater similarity among bryophytes versus vascular species between Red Lake Peatland, Minnesota and other peatlands floras in North America and Europe. Further documentation of the bryophyte flora of valley peatlands in Idaho will likely produce more species in common with peatlands of other North American regions.

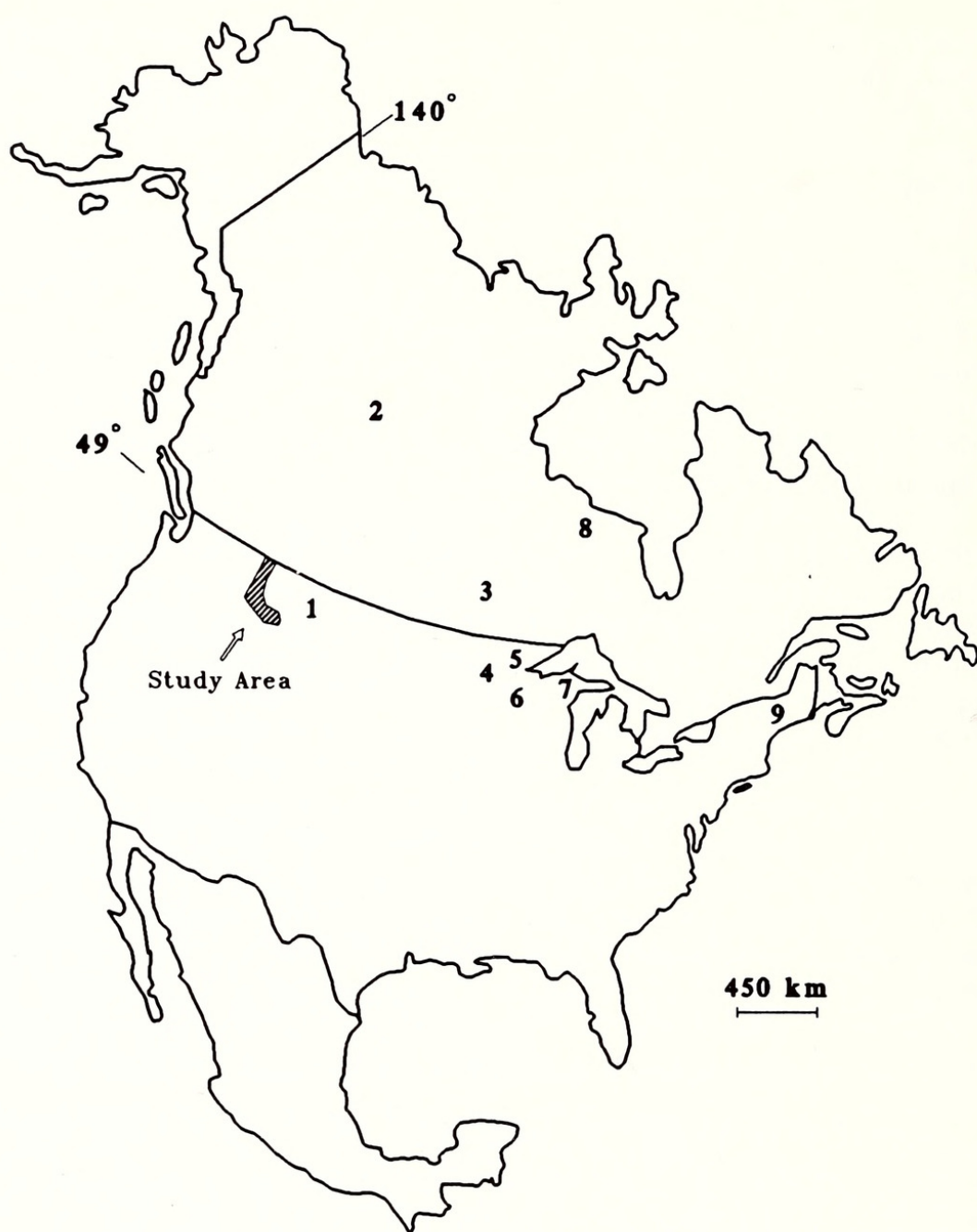


FIG. 2. North America with locations of study area in Idaho and regional peatland floras used for comparison. 1 = Pine Butte Fen, Montana; 2 = Northwestern Alberta; 3 = Candle Lake, Saskatchewan; 4 = Red Lake Peatland, Minnesota; 5 = Northern Minnesota; 6 = Upper Great Lakes Region; 7 = Northern Michigan; 8 = Northern Ontario; 9 = Northeastern USA. Publications from each of these sites are listed in Table 3.

We collected extensively in marginal minerotrophic to marshy areas and in aquatic habitats present within many of the study areas. These areas often support the greatest diversity of any habitat within a particular peatland due to mineral influences of adjacent uplands or inflowing streams. Most of the other regional studies from which

species lists were compiled were concerned only with true peatland habitats and did not include marginal habitats. Because many species in this flora are generally restricted to aquatic or marginal habitats, this also served to amplify differences between the Idaho valley peatland flora and other areas.

In boreal peatlands the three most important environmental factors influencing the development of peatland vegetation are trophic status of surface and groundwater, height of substrate surface above the water table, and degree of shading (Vitt and Bayley 1984; Vitt and Slack 1984; Kenel 1987). The first two factors also influence the abundance and distribution of species in Idaho's valley peatlands. Clearly, however, the absence of tree species adapted to peatlands must account for some of the uniqueness. Tree species adapted to peatland habitats account for the considerable physiognomic diversity of boreal peatland vegetation (Kenel 1987). Tree species such as *Picea glauca*, *P. mariana*, *Larix laricina*, *Thuja occidentalis*, and *Abies balsamea*, prominent components in boreal and other northern temperate peatlands, have no counterparts in valley peatlands in Idaho. Recently paludified forest habitats in Idaho are limited to the Priest River Valley, but the young age of these habitats, as evidenced by the shallow depth of the sphagnum mat and the persistence of tree species seemingly unsuited to such habitats, may not have allowed the development of a shade-tolerant portion of the flora that would accompany peatland tree species.

Unlike the peatlands of other North American regions, the valley peatlands of Idaho also lack a prominent ericaceous shrub component. *Ledum groenlandicum*, *Chamaedaphne calyculata*, *Gaylussacia baccata*, and *Vaccinium vitis-idaea*, which can form dense shrub covers in boreal peatlands, have no counterpart in Idaho. The suite of conditions created by such shrub stands are largely absent from Idaho peatlands as are the species suited to those conditions.

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