

A Plant Community Classification for Kootenai National Forest Peatlands

Prepared for:

The Kootenai National Forest

By:

S.V. Cooper and W. Marc Jones

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ABSTRACT

A vegetation classification and key was developed for the Kootenai National Forest (KNF) based on a dataset of 141 plots from this study and earlier work. The dataset included species cover and composition for vascular plants and bryophytes and ground water chemistry values for pH and electrical conductivity. Several plots were eliminated because they weren't peatlands or had invasive species. No forested peatland types were sampled. The dataset was analyzed with indirect ordination, agglomerative cluster analysis, and multi-response permutation procedure. Vegetation types were based on the National Vegetation Classification System (NVCS). Seventeen plant associations were recognized and described in a format currently compatible with the NVCS.

Peatlands were sampled across a continuum from poor to extreme-rich fens. The bryophyte component (mosses and liverworts) showed a strong response to this water chemistry gradient and was used to differentiate between plant associations indicative of poor and rich fens. Many KNF peatland types are similar to those recognized in a

regional peatland study Chadde et al. (1998), although some distinctions and refinements were noted. Except for forested peatlands, nearly the complete range of Northern Rocky Mountain peatlands is represented on the KNF. Additionally, KNF peatlands include some vegetation associations that are very similar to those recognized in Continental Canada and are also analogous to peatland types described elsewhere in North America and Northern Europe.

KNF peatlands support a considerable number of sensitive plant species and express a high degree of beta diversity. Species sampled from KNF peatlands included 17 "species of concern" (having a Montana Natural Heritage S-rank of 1 or 2) or "species of potential concern" (having S-rank of 3 or SU for unknown rank). We identified 40 vascular plant species undocumented in previously published work on peatland species in Montana. Of the 56 bryophyte species identified in the course of this study, five are considered rare in the state (S-rank of 1 or 2).

ACKNOWLEDGEMENTS

We are grateful to Toby Spribille for providing us with his dataset regarding samples of Kootenai National Forest (KNF) peatlands; he also shared a draft paper describing plant associations for the KNF using the Braun-Blanquet methodology. We acknowledge that our classification retains several of Toby's insights regarding KNF peatland ecology and classification of individual relevés.

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INTRODUCTION

The landmark publication “Peatlands of the Northern Rocky Mountains: Ecology and Conservation” (Chadde et al. 1996) is a valuable source of information regarding Montana, Idaho and to a limited degree, Wyoming mires on U.S. Forest Service lands. As these and other authors (Gorham 1994) acknowledge, standardized classifications of peatlands based on landscape features, hydrology, water chemistry and vegetation are useful descriptors of these systems and would facilitate modeling a site’s potential as rare plant habitat and as a baseline to maintain peatland functional integrity, especially with regard to the management of adjacent lands. Among other research needs they also called for additional floristic inventory as a

means to refine peatland community classification and understand rare plant distributions.

The continued refinement of the National Vegetation Classification System (NVCS) and its adoption by the Ecological Society of America as part of a methodology to achieve a standardized and data-based vegetation classification served as an impetus for analyzing two quantitative vegetation datasets specifically collected on Kootenai National Forest peatlands. We analyzed these datasets in a way that would provide insights to the dataset and a classification outcome that could be integrated with the NVCS, i.e., a focus on existing vegetation and the use of dominant or indicator species by vegetation strata.

PHYSICAL SETTING

The Kootenai National Forest is set within the Northern Rocky Mountain Steppe- Coniferous Forest – Alpine Meadow Province and includes two Ecological Subsections, Flathead Valley (M333B) and Northern Rockies Section (M333C) both of which are influenced by Inland Maritime and Continental weather patterns (Nesser et al. 1997). The maritime influence, generating mild, wet winters, is quite pronounced in northern Idaho and extreme northwestern Montana but is reduced moving to the east and south; Arctic air masses are strongly attenuated, if they are present at all on a yearly basis. A bulge in late spring-early summer precipitation is a reliable feature for most reporting stations in this area. Warm, dry days and cool nights have been described as typical of the Continental influence but in reality can be characterized as more Mediterranean (Continental air masses having appreciable water vapor and consequently high humidity). Topography, aspect and elevation serve to modify local climate in a very complex fashion.

Peatlands, waterlogged areas containing peat (organic plant remains) of at least 30 cm thickness, are present in all of Montana's lifezones from prairies, foothills, intermontane valley floors, montane and subalpine conifer forests to alpine tundra. Extensive peatland development is inhibited by the Northern Rocky Mountain region's low humidity and prolonged summer dry periods (Chadde et al. 1998). Peatlands in this area develop in topographic settings where water tables intercept the surface, typically in kettleholes or similar depressions, or in alluvial basins that collect surface waters. Figure 1 shows the locations of known fens that occur on the Kootenai National Forest.

Meta-sedimentary bedrock of the Pre-Cambrian Belt supergroup predominates in the study area, with rock-types such as quartzite, siltite, argillite

having major exposures; locally prominent are calcareous types (limestone, dolomite, calcareous sandstone). All peatlands in this setting are geogenous fens (i.e., their water derives from mineral sources). Bedrock mineralogy has a strong influence on the vegetation: calcareous substrates tend to support a ground layer dominated by "brown moss" (and vascular plants associated with calcium-rich substrates), while waters originating from non-calcareous substrates tend to support a ground layer dominated by *Sphagnum* mosses. Bogs, which are ombrotrophic ("food from the sky", all nutrients from rainwater), have not been described from Montana; continued peat accumulation that is required to elevate the peatland surface above the influence of local groundwaters does not occur under prevailing climatic conditions, with the exception of microsite hummocks (within fens) that can approximate a bog in environment and composition.

Three types of fens occur on the Kootenai National Forest: 1) **Poor fens**, which have bog-like conditions with the "poor" relating to a depauperate species count (Slack et al. 1980), have *Sphagnum* mosses and a relatively limited number of vascular species (typically *Cyperaceae* and *Ericaceae*) as codominants; based on Minnesota work (Glaser 1987) their pH ranges from about 4.2 to 5.8 and Ca of 2 to 10 mg/l, 2) **Rich fens** have a greater diversity of plant species, including sedges and other graminoids, shrubs and non-sphagnum mosses, especially "brown mosses" many of which are in the family *Amblystegiaceae*; pH values are higher (less acidic) and Ca is higher (10 to 30 mg/l) than that of poor fens, 3) **Extremely rich fens** are typified by a characteristic assemblage of calciphiles (plant species adapted to highly calcareous conditions) both vasculars and bryoids, especially "brown mosses"; pH is very high (> 7.0) and Ca is high as well (>30 mg/l) marl (biotically induced deposits of calcium carbonate).

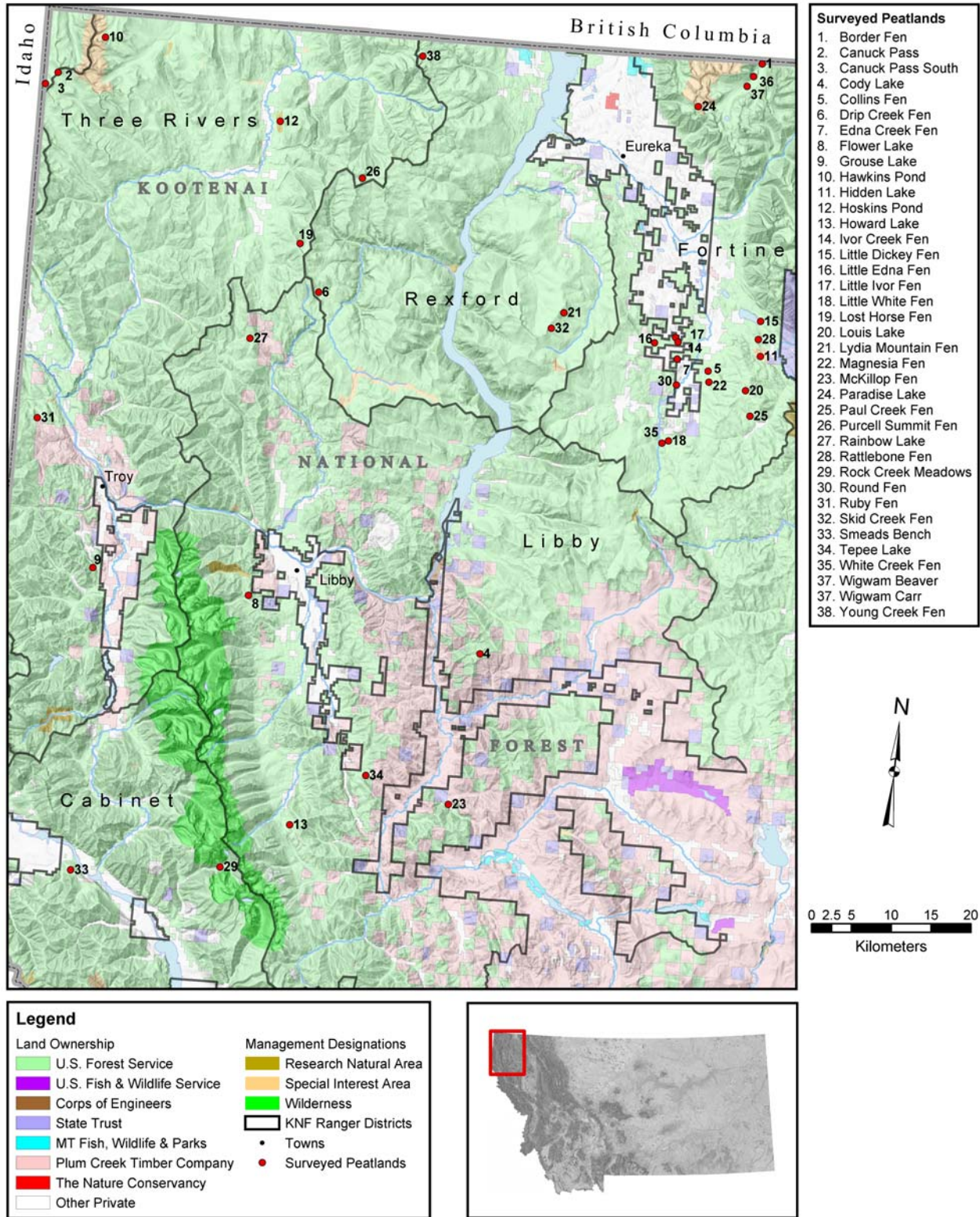


Figure 1. Map of known locations of peatlands on the Kootenai National Forest.

METHODS

Field Methods: Two investigators, T. Spribille and W. Marc Jones, contributed plots (relevés) to the database used in the vegetation analysis portion.

Spribille's sampling followed standard phytosociological tenets (Braun-Blanquet 1964, Westhoff and van der Maarel 1978) with relevés of 15 or 16 m² placed in vegetation stands judged to be visually homogeneous; transitions between communities and extreme microtopography were carefully avoided. A complete species list of both vascular plants and bryophyte species were recorded along with their cover estimates according to a twelve class "Londo" scale, where **r** = 0 – 1%, **+** = 1 – 5%, **1** = 5 – 15%, **2** = 15 – 25%, **3** = 25 – 35%...**9** = 85 – 100 % (Dierschke 1994). Observations were taken regarding general environment, including elevation, slope, aspect, and degree of shading, as well as peat decomposition classes and whether the position was anchored or floating peatland. Water samples were extracted from less than a quarter of the relevés for later analysis (within 24 hours of collecting) of pH, conductivity and total dissolved solids.

Jones' plots were 50 m², placed subjectively but without preconceived bias (Mueller-Dombois and Ellenberg 1974). The cover (sensu Daubenmire 1959) of all vascular plant and bryophyte species were recorded using the following thirteen cover classes that are very similar to those used in U.S. Forest Service ECODATA methodology (Bourgeron et al. 1992): **T** = 0 - < 1 %, **P** = 1 % - < 5 %, **1** = 5 % - < 15 %, **2** = 15 % - < 25 %, ...**9** = 85 - 95 %, **F** = 95 - 100 %. Cover class midpoints were used to compute abundance measures used in subsequent analysis. Environmental variables noted include elevation, slope and aspect, water source and probable substrate. For each plot, pH and conductivity readings (using Horiba U-10 water quality checker) were taken from soil pore water (depth to water table varied from 0 to 40 cm).

TAXONOMIC CONSIDERATIONS: For vascular plant nomenclature Kartesz (1999) is followed with the exception of *Betula*; the bog birches presented a continuing difficulty in field identification. This

fact is recognized by Furlow's (1997) reporting sympatry between *B. pumila* and *B. glandulosa* in northwestern Montana and intermediate characters in bog birch populations as evidence of putative hybridization of the two taxa. *Sphagnum* mosses follow Anderson (1990) and other mosses and liverworts conform to Anderson et al. (1990) and Stotler and Crandall-Stotler (1977), respectively. Exceptions are *Palustriella*, formerly *Cratoneuron* in part (Hedenäs 2000a), and *Scorpidium*, formerly *Limprichtia* in part (Hedenäs 2000b). "Brown mosses" (family Amblystegiaceae, *sensu lato*) have undergone noteworthy taxonomic revisions with many mosses referred to as *Drepanocladus* in classic phytosociological work now found in several genera of this family including among others *Scorpidium*, *Hamatocaulis*, and *Warnstorfia*. Two of the most common and abundant mosses of the older literature are *D. revolvens*, the most common occurrence of which in Montana is now *Scorpidium cossonii*, and *D. exannulatus*, now *Warnstorfia exannulata*. The dataset was scrutinized to remove all extraneous, non-peatland plots (e.g., mudflats) or sites dominated by invasives (e.g., *Phalaris arundinacea*).

DATA ANALYSIS: To identify groups and elucidate relationships between species composition and environmental factors, we analyzed plot data using agglomerative cluster analysis, multi-response permutation procedure, and indirect ordination. The program PC-ORD (McCune and Mefford 1999) was used for all multivariate analyses. To examine relationships among species and between species and environmental factors, sample sites were ordinated in species space and species were ordinated in environmental space using non-metric multidimensional scaling (NMS, Kruskal 1964, Mather 1976). Ordination is a data reduction method that attempts to describe underlying patterns of species composition by graphically summarizing complex relationships (McCune and Grace 2002). NMS is an indirect ordination technique that works without assuming that a species responds in a linear or unimodal fashion to environmental gradients and is robust to large numbers of zero values. It therefore avoids many of the distortions

of eigenvector-based ordination methods, such as detrended correspondence analysis (Kenkel and Orłóci 1986, Minchin 1987). NMS is an iterative method that attempts to reduce differences between the ranked distances in the original multidimensional species space and ranked distances in the reduced dimensions of the ordination. These differences, termed stress, are measured as the degree of departure from monotonicity in the original space and the reduced space (McCune and Grace 2002). Dimensionality was determined by running NMS on autopilot mode for 40 runs with real data and 50 runs with randomized data in each of six dimensions (McCune and Mefford 1999). Dimensionality was chosen by selecting the highest number of dimensions that appreciably reduced stress and where the final stress for real data was significantly lower than that for randomized data. Additional parameters included the use of the quantitative version of the Sørensen distance measure, the global form of NMS, and an instability criterion of 0.00001 to be achieved after 500 iterations or 50 continuous iterations within the criterion. To reduce beta diversity (β_w , compositional heterogeneity among sample units (Whittaker 1972)) and improve the interpretability of results, species occurring in fewer than 5% of sites were omitted from the analysis; this approach along with elimination of taxonomic entities identified to only genus resulted in reducing the species count to 113 from a complete accounting of 260. We also

eliminated several relevés based on the dominance of invasive species or non-peatland environment to yield 137 plots for analysis.

To define vegetation groups based on floristic similarity, we used a hierarchical, agglomerative cluster analysis. To improve the correspondence of the cluster analysis with the NMS ordination, we used quantitative version of the Sørensen distance measure and the flexible beta linkage method. A value of $\beta = -0.25$ was used, which gives results similar to Ward's linkage method (Lance and Williams 1967).

Multi-response permutation procedure (MRPP, Biondini et al. 1988) was used to test whether NVCS-based plant associations were significantly different in species composition and abundance. In addition to a P-value, MRPP describes group tightness with A, a statistic that compares the within-group heterogeneity to that expected by chance ($A = 1$ when items are identical within groups, $A = 0$ when heterogeneity within groups equals that expected by chance, and $A < 0$ when heterogeneity within groups is greater than that expected by chance) (McCune and Mefford 1999). To improve the correspondence between MRPP and NMS, MRPP was based on a rank-transformed Sørensen distance matrix (McCune and Grace 2002).

RESULTS

MULTIVARIATE ANALYSIS: The objective pruning of the dataset was intended to reduce beta diversity¹ and remove ecological outliers. Beta diversity, which is a measure of the amount of compositional change represented in a set of sample units, was thereby reduced from 14.3 to 6.8 (6.3 in the subset of the data with pH measurements). A “rule of thumb” holds that β_w should lie in the range of 1 to 5 if one is to avoid challenging the capacity of ordination to provide a useful result (McCune and Grace 2002); experience has shown that β_w has an exponential relationship to difficulty of obtaining a constructive ordination. Thus even eliminating “rare” species to reduce compositional heterogeneity and make the analysis more tractable left us with an ordination that evidenced some anomalies and difficulties in interpretation.

Figure 2 shows the distribution of plots in regard to the axes explaining the greatest percent of variation in the dataset. It may appear with the plant communities already coded (by color and symbol) that ordination was a mere formality; however, examination of several iterations of both ordinations and cluster analyses led us to first propose these classes (as tentative plant communities). One of the insights obtained from the ordination process was that the dominant graminoids (with several exceptions) are rather broadly distributed and overlapping in ordination space. Another was that there existed a gradient in bryophyte composition tied to a water chemistry gradient (most generally represented by pH) and arrayed along Axis 1; the plots to the right of the dashed line mostly represent poor fen conditions associated with lower pH and low species richness and diversity while those to the left correspond to rich and extreme-rich fens with higher pH and greater species richness and diversity (Figure 2). The *Carex lasiocarpa* community types are representative of this dichotomy. The distribution of plots representing *Carex lasiocarpa* / “Brown Moss” (CALA/BROWN) and *C. lasiocarpa* / *Sphagnum* (CALA/SPHAG) shows two clouds of points that overlap to a minor degree

with one another and to a greater degree with other community types. These two clusters in fact represent all those plots that have in common *Carex lasiocarpa* as a dominant but which are distinguished by differences in moss composition in the ground layer. The component plots of their respective clusters would be much more tightly grouped had they possessed more mosses, “brown” or *Sphagnum*, in common. Not uncommonly a particular species, or two, of moss would dominate a stand causing separation in ordination space that was not reflected by a comparable environmental distinction. Literature searches concerning niche breadth of mosses convinced us there was appreciable niche overlap among the moss species, both *Sphagnum* spp. and “brown mosses,” in our dataset (Jeglum 1971, Slack 1990, Gignac et al. 1991a, Gignac et al. 1991b, Slack 1994, Gignac 1992, Anderson et al. 1995). Without a much more robust dataset and accompanying environmental information, we had no means to further discriminate among the component mosses, a process that possibly would have resulted in recognition of yet more plant communities.

Some of the seemingly anomalous distributions of plots representing the two types discussed above deserve explanation. PC-ORD is limited in the number of classes that it can display; thus only 15 of the 17 plant associations recognized could be symbolized. Thus the plot symbolized as *C. lasiocarpa* / “Brown Moss” that occurs in the extreme southeast quadrant of the ordination diagram is in fact dominated by *C. buxbaumii*. Similarly, the three plots symbolized as *C. utriculata* / “Brown Moss” that occur to the right of the dotted line are representative of the *C. utriculata* / *Sphagnum* community type.

There are other seeming anomalies in the ordination diagram, such as the overlap of the carr, *Betula glandulosa* / *Carex* spp. / “Brown Moss”, with the herb-dominated *C. utriculata* / “Brown Moss” type, that have an explanation both in the mechan-

¹ We used Whittaker’s (1972) equation to calculate beta diversity: $\beta_w = (S_c / S) - 1$ where β_w = beta diversity, S_c = gamma diversity (number of all species sampled), and S = mean alpha diversity (mean species richness of sample units).

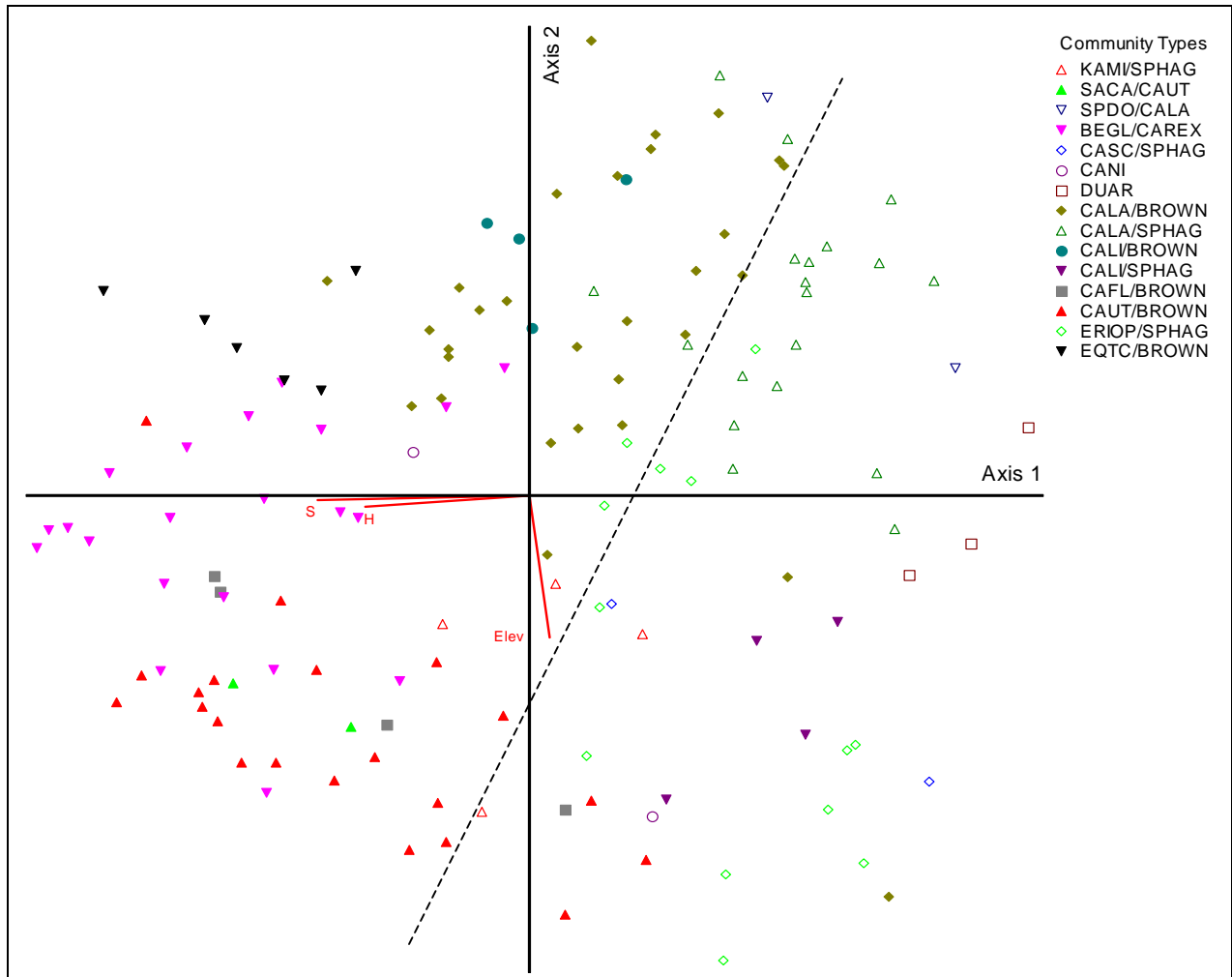


Figure 2. Graphical representation of the NMS ordination of peatland plots ($n = 137$). Points represent species cover and composition data, and distance between points is proportional to similarity between samples (i.e., samples with similar species composition are plotted closer together). Axis 1 represents 20.6% of the variation in the data and Axis 2 accounts for 15.2% (total variation explained = 35.8%). Vectors are joint plots of variables correlated with ordination scores. Vector lengths represent the strength of the correlation; all variables have an $R^2 > 0.20$. Vector labels are: Elev = elevation, H = Shannon diversity index, and S = species richness. Plots were symbolized such that filled symbols represent community types associated with rich fens and open symbols represent community types associated with poor fens. The dashed line shows the approximate boundary between rich and poor fens. Labels for community types are: KAMI/SPHAG = *Kalmia microphylla* / *Sphagnum* spp., SACA/CAUT = *Salix candida*/*Carex utriculata*, SPDO/CALA = *Spiraea douglasii*/*Carex lasiocarpa*, BEGL/CAREX = *Betula glandulosa*/*Carex* spp./brown mosses, CASC/SPHAG = *Carex scopulorum*/*Sphagnum* spp., CANI = *Carex nigricans*, DUAR = *Dulichium arundinaceum*, CALA/BROWN = *Carex lasiocarpa*/brown mosses (includes *Carex buxbaumii*/brown mosses), CALA/SPHAG = *Carex lasiocarpa*/*Sphagnum* spp., CALI/BROWN = *Carex limosa*/brown mosses, CALI/SPHAG = *Carex limosa*/*Sphagnum* spp., CAFL/BROWN = *Carex flava*/brown mosses, CAUT/BROWN = *Carex utriculata*/brown mosses (includes *Carex utriculata*/*Sphagnum* spp.), ERIOP/SPHAG = *Eriophorum* spp./*Sphagnum* spp., and EQTC/BROWN = *Eleocharis quinqueflora* – *Trichophorum caespitosum*/brown mosses.

ics of ordination and in the arbitrary procedures imposed by adhering to the NVCS. The NVCS recognizes the lower end of the continuum of shrub cover to be 10 % and our data set indicated *B. glandulosa* cover to be a broken continuum spanning the range from trace to 45 %. Thus a number of plots technically designated as *B. glandulosa* shrublands (having 10 % or more shrub cover) had barely more than this amount of shrub cover and otherwise are very similar floristically to *C. utriculata* / “Brown Moss” and occupy virtually the same ordination space.

The ordination diagram displays a measure of overlap among vegetation types and also indicates to various degrees groups (plant associations) that uniquely occupy ordination space. However, in a purely statistical sense are these groups of entities different? MRPP results indicate that the NVCS-based plant associations are significantly different from one another in terms of species cover and composition (A = 0.6430, P < 0.0001). This is a robust finding; in community ecology, A-values are

commonly less than 0.1, even when P is highly significant (McCune and Grace 2002). These statistics do not validate our classification but do support the objective reality of the associations; that groups overlap reflects the fact that a continuum in environments and vegetation is being artificially decomposed into “types.”

CLASSIFICATION OF PLANT ASSOCIATIONS:

All plant associations identified from the dataset were fens and spanned the range from poor to extremely rich and included those characterized by shrubs (carrs) or herbs in the tallest layer; no paludified forests were sampled in this dataset. We describe 17 associations (Table 1). Four are termed shrubland, but they exist at the very lower end of shrub cover (10 %) for what the NVCS terms shrub-herbaceous (a category that may be revised in future iterations of the NVCS). The other 13 associations are termed herbaceous due to that component being the tallest layer present; however, bryoids may occasionally express greater canopy cover. Five associations were designated

Table 1. Plant Associations found within Kootenai National Forest Peatlands.

Plant Association	Number of KNF plots
Shrub-characterized Peatlands	
<i>Betula glandulosa</i> / <i>Carex</i> spp. / “Brown Mosses” Shrubby Peatland	20
<i>Kalmia microphylla</i> / <i>Sphagnum</i> spp. Dwarf-shrub Peatland	5
<i>Salix candida</i> / <i>Carex utriculata</i> Shrubby Peatland	2
<i>Spiraea douglasii</i> / <i>Carex lasiocarpa</i> Shrubby Peatland	2
Herb-characterized Peatlands	
<i>Carex buxbaumii</i> / “Brown Mosses” Herbaceous Vegetation Peatland	1
<i>Carex flava</i> / “Brown Mosses” Herbaceous Vegetation Peatland	4
<i>Carex lasiocarpa</i> / “Brown Mosses” Herbaceous Peatland	31
<i>Carex lasiocarpa</i> / <i>Sphagnum</i> spp. Herbaceous Peatland	14
<i>Carex limosa</i> / “Brown Mosses” Herbaceous Vegetation Peatland	4
<i>Carex limosa</i> / <i>Sphagnum</i> species Herbaceous Vegetation Peatland	5
<i>Carex nigricans</i> Herbaceous Vegetation Peatland	2
<i>Carex scopulorum</i> / <i>Sphagnum</i> Mosses Herbaceous Vegetation Peatland	2
<i>Carex utriculata</i> / “Brown Mosses” Herbaceous Vegetation Peatland	16
<i>Carex utriculata</i> / <i>Sphagnum</i> spp. Herbaceous Vegetation Peatland	3
<i>Dulichium arudinaceum</i> Herbaceous Peatland	3
<i>Eleocharis quinqueflora</i> (= <i>E. pauciflora</i> , <i>Scirpus pauciflorus</i>) – <i>Trichophorum caespitosum</i> (= <i>Scirpus caespitosus</i>) / “Brown Mosses” Herbaceous Vegetation Peatland	6
<i>Eriophorum</i> Spp. / <i>Sphagnum</i> spp. Herbaceous Vegetation Peatland	12

provisional because they lacked a sufficient number of plots to confidently ascertain their composition and ecotope.

None of the associations named in this study have exact matches with the types named in EcoART, the most current repository of what might be termed nationally recognized plant associations (NatureServe 2002). Many of the vegetation types named as a result of our study in part overlap, both in composition and environment, with EcoART vegetation types, but it can be argued that a type occurring, for example, on mineral soil as well as peatlands is too broadly defined. This is the case with *Dulichium arundinaceum* Herbaceous Vegetation (CEGL001821) the global description of which notes it is found on mineral soils as well as well developed peatlands. We have recognized *D. arundinacea*-dominated communities on mineral soils as being readily distinguishable from peatland sites where this species dominates; other than the obvious substrate difference, the associated species, particularly the bryophyte component, are dissimilar between the two cases. It has been widely recognized that some wetland graminoids, such as *C. utriculata* and *C. lasiocarpa*, have broad ecological amplitudes. Both species occur in marsh conditions on mineral soil and also in peatlands, both poor and rich fens; for communities dominated (or characterized) by either of these sedges we employed bryophytes to further distinguish particular suites of environmental conditions.

A community's placement on the environmental gradient spanning the extreme-rich, rich, poor fen to bog conditions can be discriminated by the use of bryophyte species that are accurate indicators of water chemistry (pH, conductivity, Ca, organic N, etc.) and species richness; bryoids can also indicate the degree of shading and height above ground water (Gignac 1992, Gignac et al. 1991, Slack 1994). (We note that "rich" refers in particular to the presence of species indicative of high cation content as contrasted with that of poor fens and ombrotrophic bogs (Sjors 1950).) Though bryophyte niche breadth and response can exhibit geographic variation (Slack 1994, Anderson et al. 1995), it appears from our limited amount of water chemistry data that bryophytes of northwestern Montana are

responding similarly to their distributions (as conditioned by environment) in western Canada, especially Alberta (Slack et al. 1980, Vitt and Chee 1990, Gignac 1992), northern Minnesota (Vitt and Slack 1984), Maine (Anderson et al. 1995) and New York (Slack 1994). In our analysis, we employed bryophytes in a somewhat conservative fashion using the *Sphagnum* species as general indicators of poor fens. An exception to this is *Sphagnum warnstorffii*, which has broad ecological amplitude and occurs at sites with high pH and Ca (Gignac 1992, Anderson et al. 1995). It has been described from rich fens in Alberta, Minnesota, and New York (Horton et al. 1979, Slack et al. 1980, Vitt and Slack 1984, Slack 1994). In our dataset *Sphagnum warnstorffii* generally exhibits the response detailed above, but is not completely consistent in its occurrence by community type. It exhibits high cover in about half the stands comprising the *Kalmia microphylla* / *Sphagnum* spp. peatland; this is at variance with the interpretation of ericaceous *Kalmia*'s presence, which is conventionally thought to be indicative of acidic substrates.

The contrasting situation in terms of bryophytes is the occurrence (ranging from present to abundant and forming a continuous lawn) of "brown mosses" (mostly members of the family Amblystegiaceae, *sensu lato*) and the lack of *Sphagnum* spp. (excepting *S. warnstorffii*). Though brown mosses are predominantly indicative of rich to extremely rich fens, there is a spectrum of responses, from extreme generalists like *Pleurozium schreberi*, which ranges from bogs to rich and even extremely rich fens (Gignac 1992, Slack 1994), to *Aulacomnium palustre* (ranging from poor fens to extremely rich fens), to *Tomentypnum nitens* of rich to extremely rich fens, to *Scorpidium scorpioides* and *Campylium stellatum*, which attain their highest cover in extremely rich fens (average pH in Maine fens was 7.76 for *C. stellatum* (Anderson et al. 1995)). We lacked sufficient data, both in terms of water chemistry and numbers of plots, to make discriminations any finer than poor fen types versus rich and extremely rich fens.

Previous inventory and research regarding Inland Northwest peatlands was summarized and present-

Table 2. A comparison of peatland communities documented from the Inland Northwest, USA (Chadde et al. 1998) versus the findings for Kootenai National Forest (this study).

Peatland Community Types Described in Chadde et al. (1998) for Inland Northwest	Peatland Community Types Identified for Kootenai National Forest (2004)
Tree-dominated (or characterized) Types	
<i>Picea engelmannii</i> / <i>Carex disperma</i>	
<i>Picea engelmannii</i> / <i>Equisetum arvense</i>	
<i>Picea engelmannii</i> / <i>Lysichitum americanum</i>	
<i>Picea glauca</i>	
<i>Pinus contorta</i> / <i>Vaccinium occidentale</i>	
Shrub-dominated (or characterized) Types	
<i>Betula glandulosa</i> / <i>Carex lasiocarpa</i>	<i>Betula glandulosa</i> / <i>Carex</i> spp. / “Brown Mosses” Shrubby Peatland
<i>Kalmia microphylla</i> / <i>Carex aquatilis</i>	
<i>Kalmia microphylla</i> / <i>Carex scopulorum</i>	
	<i>Kalmia microphylla</i> / <i>Sphagnum</i> spp. Peatland
<i>Salix candida</i> / <i>Carex lasiocarpa</i>	
	<i>Salix candida</i> / <i>Carex utriculata</i> Peatland
<i>Spiraea douglasii</i>	<i>Spiraea douglasii</i> / <i>Carex lasiocarpa</i> (match ?)
Herb-dominated (or characterized) Types	
<i>Calamagrostis canadensis</i> c.t.	
<i>Carex aquatilis</i> c.t.	
<i>Carex buxbaumii</i> c.t.	<i>Carex buxbaumii</i> Herbaceous Peatland
	<i>Carex flava</i> / ‘Brown Mosses’ Herbaceous Peatland
<i>Carex lasiocarpa</i> c.t.	<i>Carex lasiocarpa</i> / ‘Brown Mosses’ Herbaceous Peatland; <i>C. lasiocarpa</i> / <i>Sphagnum</i> Mosses
<i>Carex limosa</i> c.t.	<i>Carex limosa</i> / ‘Brown Mosses’
<i>Carex scopulorum</i> c.t.	
	<i>Carex scopulorum</i> / <i>Sphagnum</i> Mosses Herbaceous Peatland
<i>Carex simulata</i> c.t.	
<i>Carex utriculata</i> c.t.	<i>Carex utriculata</i> / ‘Brown Mosses’ Herbaceous Peatland ; <i>C. utriculata</i> / <i>Sphagnum</i> Mosses Herbaceous Peatland
<i>Eleocharis pauciflora</i> c.t. (= <i>E. quinqueflora</i>) c.t.	
<i>Eleocharis rostellata</i> c.t.	
<i>Eleocharis tenuis</i> c.t.	
	<i>Dulichium arundinaceum</i> Herbaceous Peatland
<i>Scirpus cespitosus</i> (= <i>Trichophorum caespitosum</i>) c.t.	<i>Eleocharis quinqueflora</i> – <i>Trichophorum caespitosum</i> / ‘Brown Mosses’ Herbaceous Peatland
	<i>Eriophorum</i> Spp. / <i>Sphagnum</i> Moss’ Herbaceous Peatland

ed by Chadde et al. (1998). Table 2 is a compilation of their “community type” findings tabulated along with those of this study; if we consider two types to be equivalent (despite a disparity in their names) they occupy the same row. While our study did not document any tree-characterized

peatland types on the Kootenai N.F., it should be noted that of the five tree-dominated vegetation types of Chadde et al. (1998) only one, *Picea engelmannii* / *Lysichitum americanum*, occurs in northwestern Montana, where it is considered to be a rare community (only documented for the Flat-

head National Forest) and in fact occupies only mineral soils. Trees, principally *Picea engelmannii* and *P. engelmannii* x *P. glauca* hybrids, but including *Abies lasiocarpa* and *Pinus contorta*, do occur within Kootenai N.F. peatlands, but they are mere incidentals or they may occur in small clusters, often on raised microsites of such restricted size as to not warrant their sampling. Although there has not been comparable work immediately to the north in Canada, there have been intensive studies of rich peatlands at the latitude of Edmonton (Slack et al. 1980) where the dominant fen trees are *Picea mariana* and *Larix laricina*, both of which are at their southern limits in this westernmost extent of their distribution; they identified a single tree-characterized peatland, *Tomenthypnum nitens* / *Betula glandulifera* (= *B. pumila* var. *glandulifera*) / *Larix laricina* community type, which occurs only on strings and has a moderate floristic resemblance to our *B. glandulosa* / *Carex* spp. / Brown Moss type, especially in the sedge (*Carex limosa*, *C. chordorrhiza*, *C. interior*, *C. aquatilis*, and *C. lasiocarpa* common to both) and bryophyte components.

The four shrub-characterized peatlands of the Kootenai N.F. all have close analogues among the types identified by Chadde et al. (1998). *Betula glandulosa* / *Carex lasiocarpa* (and a portion of *B. glandulosa* / *Carex utriculata* of Hansen et al. (1995)) is subsumed by the *B. glandulosa* / *Carex* spp. / “Brown Mosses” type of the Kootenai N.F. Chadde et al. (1998) remark that *C. lasiocarpa*, rather than *C. utriculata*, tends to predominate on peat. Such was not the case on the Kootenai N.F. where these species demonstrated a variable co-occurrence; thus, the less specific epithet, *Carex* spp., was used in the name. The abundance of “brown mosses” confirmed this type as occurring on rich to extremely rich fens. *Salix candida* / *Carex utriculata* is very close floristically and environmentally to the *Betula* type. Chadde et al. (1998) remark again about the respective preferences of *C. lasiocarpa* and *C. utriculata*; we had too few samples to comment on their respective preferences and in our dataset *C. utriculata* clearly was dominant (thus the type name). We distinguish our Kootenai N.F. *S. candida* / *C. utriculata*

vegetation type from a Hansen et al. (1995) type of the same name (and environmentally overlapping), by adding the descriptor “Peatland.” Given its significant “brown moss” complement it occurs in rich to extreme-rich fens. *Spiraea douglasii* / *Carex lasiocarpa* Peatland is a poorly documented and provisional type; the brief description by Chadde et al. (1998) of *S. douglasii* (no modifier) casts little light on whether their type matches what we infer to be a poor fen type based on its very low species richness and *Sphagnum* sward in at least one plot. The *Kalmia microphylla* / *Sphagnum* spp. Peatland (provisional) is a very diffuse type with no two of the plots having appreciable similarity with regard to the herbaceous layer. Two of the plots bear considerable similarity to the *Kalmia* / *C. scopulorum* type of Hansen et al. (1995) due to the dominance of *C. scopulorum* or *C. nigricans*. The *Kalmia* / *C. aquatilis* type of Chadde et al. (1995) has a distinctly different forb composition from *Kalmia* / *Sphagnum* spp., and although they describe it as a poor fen type there is no mention of bryophytes present.

Overall, the Kootenai N.F. supports a less diverse assemblage of shrub-characterized peatlands than the surrounding region, as would be expected. There are also some floristic distinctions/variations among types having the same canopy dominant. These distinctions are probably worth preserving in the classification to document regional diversity. By emphasizing the bryophyte component we have made a closer tie between vegetation community, substrate type and soil chemistry. There are no named shrub-characterized peatlands described for west-central Alberta rich fens (Slack et al. 1980) but their photographs of string vegetation clearly shows areas of very low densities of *Larix laricina* over moderate to dense coverages of *Betula pumila* (with a brown moss and *Carex* spp. undergrowth); this string vegetation of Alberta would seem to be a mosaic of types with the shrub-dominated portion a close analogue to the *Betula* type recognized in this study.

The herb-characterized peatlands encompass much more floristic variability than either tree- or shrub-characterized communities; however, whether the larger number of herbaceous peatland types can be

attributed to greater environmental diversity is open to question. Not uncommonly in the field, one will note two different sedge-dominated communities immediately adjacent to one another, both occupying what, at least to casual observation, would be the same ecotope. We speculate this is a manifestation of resource appropriation, in these cases the resource being space. Virtually all of the peatland *Carex*, *Eriophorum* and *Scirpus* (including *Tricophorum*) species propagate by rhizomes, which have the capacity to rapidly proliferate and aggrandize space, often to the exclusion of competing species. Thus we have numerous herbaceous communities that have differing dominant rhizomatous graminoids but are rather similar in total floristic composition and ecotope, though we do not go so far as to say their niche overlap is total. Hansen et al. (1995) ostensibly recognizes the foregoing explanation of community structure and took the approach of recognizing “ecological equivalents” so as to simplify their classification, making it management oriented. In keeping with the NVCS orientation of describing existing vegetation (Jennings et al. 2003), we recognized as separate vegetation types those situations where a particular herb dominated the upper canopy. (We did not employ this approach in the shrub-characterized types where we used *Carex* spp. as a diagnostic (with a list of key carices) in stands dominated by *Betula glandulosa* because at least four distinct types would have been recognized based on sedge dominance; the bryophyte component, as an indicator of water chemistry, was similar between sites (rich to extremely rich carrs)).

Of the twelve herbaceous peatland plant associations listed for the Inland Northwest (Table 2), three, *Carex simulata* c.t., *Eleocharis rostellata* c.t., and *E. tenuis* c.t., were not encountered on the Kootenai N.F. because the forest is outside the distributional range of these potentially dominant species. The *Calamagrostis canadensis* c.t. is not entirely restricted to peatlands, although it does occur at fen and carr margins. There is no convenient explanation as to why a *Carex aquatilis* c.t., an extremely common wetlands type, including peatlands, was not found in our inventory. *Carex aquatilis* occurs in several of the types defined for the study area, but only as an incidental species that

seldom exceeded 5% cover. The *Carex buxbaumii* c.t. is cited by Chadde et al. (1998) as a minor peatland type confirmed only from the Sawtooth Valley (Tuhy 1981); it is apparently also uncommon to rare on the Kootenai N.F. as well with only one plot to substantiate its existence. *Carex buxbaumii* is one of a triumvirate of *Carex* species (including *C. lasiocarpa* and *C. lanuginosa*) considered by Hansen et al. (1995) to be ecological “equivalents;” it occurred in 33 % of their *C. lasiocarpa* habitat type plots with an average cover of 15 % and *C. lasiocarpa* was found in only about 45 % of plots in the *C. lasiocarpa* Habitat Type. Therefore, a *C. buxbaumii* c.t. can be distinguished based on the dominance of this *Carex* species and is potentially documented by as many as 10 stands; it is unknown how many of these stands might have occurred on mire conditions and matched our *Carex buxbaumii* Herbaceous Peatland Association.

Another minor peatland type of the Inland Northwest is the *Carex limosa* c.t.; as described by Chadde et al. (1998) it is not possible to ascertain whether this type is a match for our *C. limosa* / “Brown moss” Herbaceous Peatland or our *C. limosa* / *Sphagnum* Herbaceous Peatland type or whether it spans the range of these types. In the literature, *Carex limosa* either displays a broad ecotopic range/niche and/or has a geographically differentiated response because it is found as dominant in bogs and poor fen conditions. Anderson et al. (1996) report *C. limosa* as dominant in Maine peatlands with an average pH of 4.3. In this study, it occurred primarily in rich fens (albeit fens at the less rich end of the rich spectrum with 9-17 plant species per plot; pH values from 5.4 to 6.6). For the fens of west-central Alberta, Slack et al. (1980) emphasize *Carex limosa* is the dominant vascular plant of flarks and recognize only one herbaceous mire community type, *Scorpidium scorpioides* – *Drepanocladus revolvens* (= *S. cossonii*) – *Carex limosa*, and several phases further distinguished by both bryoids and vascular plants. *Carex limosa* also strongly dominates alkaline lake-edge communities of Michigan kettle-hole bogs (Vitt and Slack 1975, Schwintzer 1978). However, *C. limosa* is also prominent in the ombrotrophic or weakly minerotrophic flarks of the

Caribou Mountains of northern Alberta (Horton et al. 1979). In structure, composition and abiotic parameters the “open fen” of Pine Butte Fen on Montana’s Rocky Mountain Front (Lesica 1986) is quite similar to *C. limosa* / “Brown moss” (this study) and *C. limosa*-characterized fens of Alberta with the exception that *Carex simulata* is much more prominent than *C. limosa* and the fact that Pine Butte Fen has a continental climatic and a flora somewhat distinct from that of the Canadian Rockies.

The common *Carex*-dominated peatland communities identified by Chadde et al. (1998) included *Carex utriculata* c.t., *Carex lasiocarpa* c.t., *Carex aquatilis* c.t. (noted above) and *Carex scopulorum* c.t. These types were also among the most common types on the Kootenai N.F. With the benefit of more intensive sampling and quantitative bryophyte and water chemistry data we were able to make classification-worthy distinctions in the two most common *Carex*-dominated peatland types; both *C. lasiocarpa* and *C. utriculata* have a broad geographic distribution and, although both are obligate wetland species, span a wide range in elevation, substrate and water chemistry (Anderson et al. 1996). Chadde et al. (1998) noted both brown and *Sphagnum* mosses to be prominent in peatland stands with *Carex lasiocarpa* dominant; these conditions we formally recognized as *C. lasiocarpa* / *Sphagnum* Moss and *C. lasiocarpa* / “Brown Moss”; the same distinction was made for the range of *C. utriculata*-dominated stands (i.e., *Carex utriculata* / *Sphagnum* Moss and *C. utriculata* / “Brown Moss”). Within the *C. utriculata*-dominated stands the state rare *Carex prairea* occurred sporadically and in some stands was a co-dominant with *C. utriculata*, in rare cases even having greater cover than *C. utriculata*. Being unsure of the ecological requirements and responses of *C. prairea* we treated it as an analogue of *C. utriculata* for classification purposes. The *Carex scopulorum* c.t. as described by Chadde et al. (1998) and Cooper et al. (1997) is almost certainly a rich fen type based on composition (though no bryophyte composition was cited) and chemistry; this contrasts with the *C. scopulorum* / *Sphagnum* Moss peatland described herein, which represents a poor fen condition.

Two peatland community types of Chadde et al. (1998), *Eleocharis pauciflora* (= *E. quinqueflora*) and *Scirpus caespitosum* (= *Trichophorum caespitosum*), on the basis of a very limited description of vascular composition, bear at least a superficial resemblance to our newly described *E. quinqueflora* – *Trichophorum caespitosum* / “Brown Moss” Association; however, the fact that their *E. quinqueflora* type is described as having acidic soils and *Sphagnum* mosses is considerably at variance with our type. On the basis of having the greatest species richness (28 plant species per plot), dominance of “brown mosses” and evidence of high pH values and high conductivity we characterized the sites comprising this type as predominantly extremely rich fens. *Eleocharis quinqueflora* is apparently one of those wetland species that is a generalist with respect to water chemistry, ranging from acidic, *Sphagnum*-dominated sites (Chadde et al. 1998) to “brown moss”-dominated extreme-rich fens. *Trichophorum caespitosum*, on the other hand, is associated with alkaline waters and high species richness in northwestern Montana, Alberta (Slack et al. 1980) and Maine (occurring in Maine peatlands at an average pH of 7.93, Anderson et al. (1996)). Our type is a close approximation of the *Campylium stellatum* – *Scirpus* spp. phase of the *Scorpidium scorpioides* – *Scorpidium cossonii* (= *Drepanocladus revolvens*) – *Carex limosa* community type that Slack et al. (1980) describe for extreme-rich flarks of central Alberta. Their type differed from ours by having *C. limosa* as a prominent component; in fact, *C. limosa* is a dominant in virtually all of the rich to extreme-rich stands sampled by Slack et al. (1980) and Vitt and Chee (1990) in Alberta.

Only three peatland types have no closely corresponding type in Chadde et al. (1998) for the Inland Northwest: *Carex flava* / “Brown Moss”, *Dulichium arundinaceum*, and *Eriophorum* spp. / *Sphagnum* spp. There are no other *C. flava*-dominated types cited west of New York State; apparently *C. flava* dominance with brown mosses in the ground layer is quite an uncommon condition. A *Dulichium arundinaceum* Herbaceous Vegetation type is described in EcoART (NatureServe 2002), but its environmental amplitude is quite broad

and the type described herein, *D. arundinaceum* Herbaceous Peatland, relates to mires specifically. Based on very limited information, this type appears to be restricted to poor fens, which is contradictory of its occurrence in rich to extreme-rich fens of Maine (Anderson et al. 1996). Lacking water chemistry data for the third type, *Eriophorum* spp. / *Sphagnum* Moss, we relied on *Sphagnum* spp. and *Eriophorum* spp. composition as an indirect measure. A relatively broad spectrum of *Sphagnum* species occurred in this community, from *S. angustifolium*, *S. lindbergii* and *S. magellanicum* of bogs and poor fens (Gignac 1992, Slack 1994, Anderson et al. 1995) to *Sphagnum teres* and *S. warnstorffii*, which range from poor fens to rich fens and are more characteristic of the latter. The latter two *Sphagnum* spp. co-occurred with the afore cited *Sphagnum* spp. of bogs and poor fens and all plots lacked “brown mosses,” which would place these stands closer to poor, than to rich fens. Their average species richness (15 plant species) is within the transition from poor to rich fens, based on the data of this study. The most abundant and constant *Eriophorum* spp. of this type, *E. angustifolium*, is reported from Maine bogs and poor fens having an average pH of 4.04 (Anderson et al. 1996) and *E. chamissonis* is confirmed from central Alberta poor fens (Vitt and Chee (1990) further confirming this type’s association with poor fens.

Though no tree-characterized mire types were identified for the Kootenai N.F., the sixteen plant associations identified across shrub- and herb-characterized types compares favorably with the diversity of these mire types reported across national forests of the Northern Rocky Mountains (Chadde et al. 1998). Fewer types could have been described if ecological analogues were used for several vascular species (Hansen et al. 1995) but since basic information about the comparative niches/ecotopes of these species is lacking we generally opted for stratifying by dominance (in the shrub and herbaceous layers). However, we relied on niche differentiation reported elsewhere regarding the species comprising the bryophyte layer for differentiating within a given herbaceous type; this bryophyte-based differentiation is responsible for increasing the apparent diversity of Kootenai N.F.

peatland types. The types of Chadde et al. (1998) may well have been further divided had they had sufficient data regarding bryophyte composition and water chemistry. Although there is much overlap in bryophyte species niche space regarding soil chemistry, particularly pH and conductivity, it is with respect to these factors (and floristic patterns) that we based our classification. Within a given plant association there may be a diagnostic moss layer having as many as four or five different mosses dominant in component stands of the type; we are confident that some environmental conditions relating to soil chemistry have been discriminated in our classification, but there undoubtedly are other gradients, such as nutrients (N and P) or light, that are not being recognized (Bedford et al. 1999; Bedford et al. 2003).

It is instructive to realize that the herbaceous and bryophyte components, particularly the “brown mosses”, sampled from Kootenai N.F. peatlands, are quite like those of rich fens of central Alberta (Slack et al. 180, Vitt and Chee 1990), the Hudson Bay region of Canada (Sjörs 1963), northern Minnesota (Heinselman 1963, 1970) and Michigan (Schwintzer 1978). When one goes further afield, such as southeastern Alaska, boreal Canada exclusive of Hudson Bay, or Scandinavia, the vascular component is much less similar but the bryophyte component remains relatively constant. Based on work in Scandinavia and the Hudson Bay Lowlands (northern Ontario, Canada) Sjörs (1950, 1959, 1963) listed as nonexclusive indicators of rich fens the following species that are also present in Kootenai N.F. stands: *Sphagnum warnstorffii*, *Scorpidium cossonii* (= *Drepanocladus revolvens*), *Riccardia pinguis*, and *Equisetum palustre*. For rich fens proper (i.e., species not also occurring in intermediate fens), Sjörs’ indicator group for Scandinavia (including a Finnish study) had the following species in common with the Kootenai N.F. rich fens: *Scorpidium scorpioides*, *Calliergon trifarium*, *Campylium stellatum*, *Tomenthypnum nitens*, *Meesia triquetra* and *Carex capillaris*. The list of species in common is longer when comparing Kootenai N.F. fens with those of northern Ontario characterized as extremely rich (Sjörs 1963), including the vascular plant species *Carex capillaris*, *C. chordorrhiza*,

C. gynocrates, *C. limosa*, *Drosera anglica*, *D. rotundifolia*, *Equisetum fluviatile*, *E. variegatum*, *Epilobium palustre*, *Habenaria hyperborea* (= *Plantanthera hyperborea*), *Menyanthes trifoliata*, *Parnassia palustris*, *Comarum palustre* (= *Potentilla palustris*), *Rubus arcticus* ssp. *acaulis* (= *R. acaulis*), *Triglochin maritime*, and *Utricularia intermedia*. The following bryophytes occur in the fens of both areas: *Aneura pinguis* (= *Riccardia pinguis*), *Aulacomnium palustre*, *Bryum pseudotriquetrum*, *Calliergon giganteum*, *Campylium stellatum*, *Hylocomium splendens*, *Meesia triquetra*, *Paludella squarrosa*, *Sphagnum angustifolium*, *S. warnstorffii*, and *Tomenthypnum nitens*. Similarly, community types analogous to those of the Kootenai N.F. are found in much of Scandinavia. For example, Mörnsjö (1969) describes for the calcareous glacial moraines of southern Sweden a *Carex lasiocarpa* – *Scorpidium scorpioides* type which is quite similar to our *C. lasiocarpa* / “Brown Moss” type and Dahl (1956) for Norway’s Rondane region depicts a Scorpideto – Caricetum limosae association which is analogous to our *C. limosa* / “Brown Moss” type. Both the foregoing analogues are similar to our types in vascular and bryophyte composition as well as abiotic parameters.

The Kootenai National Forest peatlands thus can be appreciated as distinctly boreal in their floristic affinities but, due to having a number of different Cyperaceae dominating the herbaceous layer, present a more diverse tableau of communities than would be found in a extreme north temperate or boreal landscape of comparable geographic extent. Comparing Kootenai N.F. peatland communities to types within the western U.S. (and Northern Rocky Mountains specifically) is difficult because of the lack of appropriate bryophyte characterization of these peatlands. However it would appear that, except for forested peatlands, nearly the complete range of Northern Rocky Mountain peatlands is represented on the Kootenai N.F.

FLORISTICS AND SENSITIVE PLANT SPECIES:

Chadde et al. (1998) listed 356 vascular species with 48 (13 %) of these being designated as species of special conservation concern in Idaho, Montana

or Wyoming by state Natural Heritage or Conservation Data Center programs. Considering the vascular flora of just Montana peatlands, 174 species in 105 genera and 44 families have been documented to date (Chadde and Shelly 1995, Mantas 1993). However, as result of intensive peatland sampling on the Kootenai N.F., 214 vascular species have been documented, of which 17 (8 %) are currently designated “species of concern” (having an S-rank of 1 or 2) or “species of potential concern” (having S-rank of 3 or SU for unknown rank; See appendix A). Thus, at a minimum 40 vascular species have been identified as unique to Kootenai N.F. peatlands. This result should be considered tentative until a more complete inventory is accomplished statewide; however, it relate to the unique geographic local of the study area, perhaps representing the southern distribution limits of a number of species, such as *Carex chordorrhiza* and *C. rostrata*. Although uncommon in Montana and the Kootenai N.F., all 17 “listed” vascular species are common when their global range is considered, most having circumboreal distributions.

Of the 56 bryophytes species (mosses, including *Sphagnum* spp., and liverworts) identified in the course of Kootenai N.F. sampling, only five, *Meesia triquetra*, *Scorpidium scorpioides*, *Sphagnum centrale*, *Sphagnum magellanicum*, and *Warnstorffia exannulata* (= *Drepanocladus exannulatus*) are considered rare in the state (S1 or S2). All of these five bryophytes are exceedingly common, especially in boreal peatlands, where their distribution is circumboreal.

USE OF THE APPENDICES: Appendix B contains a dichotomous key to the peatland associations derived from the relevé database accumulated by W. M. Jones and T. Spribille. This key is based only on the database and peatland plant associations described from the KNF. The key can be used to identify to plant association a stand from recorded quantitative data or in the field proper. The key is constructed to avoid defaulting to a given plant association and to provide a general catch-all category for those stands that apparently do not have a good match with the types defined in this classification. For example, for one member of a

key couplet we have identified an association wherein *Carex flava* is dominant and the undergrowth is “brown moss”-dominated; the opposing member of the couplet has no specific type identified, just the note that a *C. flava*-characterized community exists given the stand data at hand.

Appendix C presents descriptions of the plant associations identified for the KNF in this study; it can be used to verify the choices of plant association made via Appendix B, the key to types. The format of Appendix C derives from the EcoART database (NatureServe 2002), the closest source we have to a national vegetation classification. We have used this format so that information from this study can be used to update the National Vegetation Classification System. The “OTHER NOTEWORTHY SPECIES” section of each description enumerates those plant species (including bryophytes) tracked by either the Montana or Idaho Heritage Program/Conservation Database, i.e. those federally listed or considered sensitive by

either program. This section also lists noxious weeds found in a given association.

Appendix D is a “constancy/cover” table (con/cov) for all but one of the plant associations described in Appendix C. This missing type, *Carex buxbaumii* Herbaceous Peatland, is provisional having only one representative plot. However, based on ancillary data it has a high probability of ultimately being formally described as an NVCS association. The species cover values of Appendix D have been obtained by summing the species cover and dividing by the total number of plots in the association; most previously published con/cov tables have presented average cover by type based on division by only the number of plots in which the species occurs (thus yielding a higher value than our approach when constancy is < 100%).

Appendix E contains photographs of for several of the types documented in Appendix C (appropriate photograph cited in lead portion of description).

LITERATURE CITED

- Anderson D. S., R. B. Davis and J. A. Janssens. 1995. Relationships of bryophytes and lichens to environmental gradients in Maine peatlands. *Vegetatio* **120**: 147-159.
- Anderson, D. S., R. B. Davis, S. C. Rooney and C. S. Campbell. 1996. The ecology of sedges (Cyperaceae) in Maine Peatlands. *Bulletin of the Torrey Botanical Club* **123**(2): 100-110.
- Anderson, L. E. 1990. A checklist of *Sphagnum* in North America north of Mexico. *Bryologist* **93**: 500-501.
- Anderson, L. E., H. A. Crum and W. R. Buck. 1990. List of mosses of North America north of Mexico. *Bryologist* **93**: 448-499.
- Bedford, B. L., M. R. Walbridge and A. Aldous. 1999. Patterns in nutrient availability and plant diversity of temperate North American wetlands. *Ecology* **80**(7): 2151-2169.
- Bedford, B. L. and K. S. Godwin. 2003. Fens of the United States: Distribution, characteristics, and scientific connection versus legal isolation. *Wetlands* **23**(3): 608-629.
- Biondini, M. E., P. W. Mielke, Jr., and K. J. Berry. 1988. Data-dependent permutation techniques for the analysis of ecological data. *Vegetatio* **75**:161-168.
- Bourgeron, P. S., R. L. DeVelice, L. D. Engelking, G. Jones and E. Muldavin. 1992. Western Heritage Task Force site and community survey manual, version 92B. Western Heritage Task Force, Boulder, Colorado. 32 pp.
- Braun-Blanquet, J. 1964. *Pflanzensoziologie: Gröndzuge der Vegetationskunde*. 3. Aufl. Vienna, New York. 865 pp.
- Chadde, S. W. and J. S. Shelly. 1995. Significant peatlands of western Montana: site descriptions and major features. Missoula, MT: U. S. Department of Agriculture, Northern Region, Natural Areas Program. [Unpaginated].
- Chadde, S. W., S. J. Shelly, R. J. Bursik, R. K. Moseley, A. G. Evenden, M. Mantas, F. Rabe, B. L. Heidel. 1998. Peatlands on National Forests of the Northern Rocky Mountains: Ecology and conservation. General Technical Report RMRS-GTR-11. Ogden, UT: U. S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 pp.
- Dahl, E. 1956. Rondane Mountain vegetation in south Norway and its relation to the environment. *Skr. Nor. Vidensk. Akad. Oslo* **1**.
- Dierschke, H. 1994. *Pflanzensoziologie: Grunlagen and Methoden*. Ulmer, Stuttgart, GDR. 683 pp.
- Daubenmire, R. F. 1959. Canopy cover method of vegetation analysis. *Northwest Science* **33**: 43-644.
- Gignac, L. D. 1992. Niche structure, resource partitioning, and species interactions of mire bryophytes relative to climatic and ecological gradients in western Canada. *The Bryologist* **95** (4): 406-419.
- Gignac, L. D., D. H. Vitt, S. Zoltai and S. Bayley. 1991. Bryophyte response surfaces along climatic, chemical, and physical gradients in peatlands of western Canada. *Nova Hedwigia* **53**: 27-71.
- Gignac, L. D., D. H. Vitt and S. E. Bayley. 1991. Bryophyte response surfaces along ecological and climatic gradients. *Vegetatio* **93**: 29-45.
- Hedenäs, I. 2000a. *Palustriella*, Bryophyte flora of North America, provisional publication. Buffalo Museum of Science. Retrieved October 10, 2002, from <http://ridgwaydb.mobot.org/BFNA/V2/AmbiPalustriella.htm>.
- Hedenäs, I. 2000b. *Scorpidium*, Bryophyte flora of North America, provisional publication. Buffalo Museum of Science. Retrieved October 10, 2002, from <http://ridgwaydb.mobot.org/BFNA/V2/AmbiPalustriella.htm>.

- Furlow, J. J. 1997. Betulaceae. Pages 507-538 in Flora of North America Editorial Committee, editor. Flora of North America north of Mexico, Volume 3, Magnoliophyta: Magnoliidae and Hamamelidae. Oxford University Press, New York.
- Glaser, P. H. 1987. The ecology of patterned boreal peatlands of northern Minnesota: a community profile. Report 85 (7.14). Washington, DC: U. S. Fish and Wildlife Service. 98 pp.
- Heinselman, M. L. 1963. Forest sites, bog processes and peatland types in the Glacial Lake Agassiz Region, Minnesota. Ecological Monographs **33**: 327-374.
- Heinselman, M. L. 1970. Landscape evolution, peatland types and the environment in the Lake Agassiz peatlands natural area, Minnesota. Ecological Monographs **40**: 235-261.
- Horton, D. G., D. H. Vitt and N. G. Slack. 1979. Habitats of circumboreal subarctic sphagna: I. A quantitative vegetation analysis and literature review of species in the Caribou Mountains, northern Alberta. Canadian Journal of Botany **57**: 2283-2317.
- Jeglum, J. K. 1971. Plant indicators of pH and water level in peatlands at Candle Lake, Saskatchewan. Canadian Journal of Botany **49**: 1661- 1676.
- Jennings, M., O. Loucks, D. Glenn-Lewin, R. Peet, D. Faber-Langendoen, D. Grossman, A. Damman, M. Barbour, R. Pfister, M. Walker, S. Talbot, J. Walker, G. Hartshorn, G. Waggoner, M. Abrams, A. Hill, D. Roberts, and D. Tart. 2003. Guidelines for describing associations and alliances of the U.S. national vegetation classification, version 2.0. The Ecological Society of America Vegetation Classification Panel, Washington, D.C.
- Jones, W. M. 2003. Kootenai National Forest peatlands: description and effects of forest management. Report to the Kootenai National Forest, Montana. Montana Natural Heritage Program, Helena. 14 pp. + appendices.
- Kartesz, J. T. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland. In J. T. Kartesz and C. A. Meacham, editors. Synthesis of the North American Flora, version 1.0. North Carolina Botanical Garden, Chapel Hill, North Carolina.
- Kenkel, N. C., and L. Orlóci. 1986. Applying metric and nonmetric multidimensional scaling to ecological studies: some new results. Ecology **67**:919-928.
- Kruskal, J. B. 1964. Nonmetric multidimensional scaling: a numerical method. Psychometrika **29**:115-129.
- Lance, G. N., and W. T. Williams. 1967. A general theory of classification sorting strategies. I. Hierarchical systems. Computer Journal **9**:373-380.
- Lesica, P. 1986. Vegetation and flora of Pine Butte Fen, Teton County, Montana. Great Basin Naturalist **46**(1): 22-32.
- Mantas, M. 1993. Ecology and reproductive biology of *Epipactis gigantea* Dougl. (Orchidaceae) in northwestern Montana. Thesis. University of Idaho, Moscow. 73 pp.
- Mather, P. M. 1976. Computational methods of multivariate analysis in physical geography. J. Wiley & Sons, London.
- McCune, B., and J. B. Grace. 2002. Analysis of ecological communities. MjM Software Design, Gleneden Beach, Oregon.
- McCune, B., and M. J. Mefford. 1999. Multivariate analysis of ecological data, version 4.26. MjM Software Design, Gleneden Beach, Oregon.
- Minchin, P. R. 1987. An evaluation of the relative robustness of techniques for ecological ordination. Vegetatio **69**: 97-110.
- Mörnsjö, T. 1969. Studies on vegetation and development of a peatland in Scania, South Sweden. Opera Botanica **24**: 1-187.

- Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and methods of vegetation ecology. John Wiley & Sons, New York, New York. 547 pp.
- NatureServe. 2002. International Classification of Ecological Communities: Terrestrial Vegetation. Natural Heritage Central Databases. NatureServe, Arlington, VA.
- Nesser, J. A., G. L. Ford, M. C. Lee, and D. S. Page-Dumroese. 1997. Ecological units of the Northern Region: subsections. General Technical Report INT-GTR-369, U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah.
- Pierce, J. 1986. Wetland community types of west-central Montana. Unpublished draft report to U. S. Forest Service, Region 1, Missoula, Montana. 57 pp.
- Schwintzer, C. R. 1978. Vegetation and nutrient status of northern Michigan fens. Canadian Journal of Botany **56**: 3044-3051.
- Sjörs, H. 1950. Regional studies in North Swedish mire vegetation. Bot. Not. **1950**: 173-222.
- Sjörs, H. 1959. Bogs and fens in the Hudson Bay Lowlands. Arctic **12**: 2-19.
- Sjörs, H. 1963. Bogs and fens on Attawapiskat River, northern Ontario. National Museum Canada Bulletin **186**: 45-133.
- Slack, N. G. 1990. Bryophytes and ecological niche theory. Botanical Journal of the Linnean Society **104**: 187-213.
- Slack, N. G. 1994. Can one tell the mire type from the bryophytes alone. The Journal of the Hattori Botanical Laboratory No. **75**: 149-159.
- Slack, N. G., D. H. Vitt and D. G. Horton. 1980. Vegetation gradients of minerotrophically rich fens in western Alberta. Canadian Journal of Botany **58**: 330-350.
- Spribille, T. No Date. Peatland vegetation (Scheuchzerio – Caricetea nigrae) of northwestern Montana (U.S.A.) [mimeographed draft to the Kootenai National Forest, Fortine Ranger District, P. O. Box 116, Fortine, MT 59918, U.S.A.]
- Stotler, R. and B. Crandall-Stotler. 1977. A checklist of the liverworts and hornworts of North America. Bryologist **80**(3): 405-425.
- Tuhy, J. S. 1981. Steam bottom community classification for the Sawtooth Valley, Idaho. Thesis, University of Idaho, Moscow, ID. 230 pp.
- Vitt, D. H., P. Achuff and R. E. Andrus. 1975. The vegetation and chemical properties of patterned fens in the Swan Hills, north central Alberta. Canadian Journal of Botany **53**: 2776-2795.
- Vitt, D. H. and W. Chee. 1990. The relationships of vegetation to surface water chemistry and peat chemistry in fens of Alberta, Canada. Vegetatio **89**: 87-106.
- Vitt, D. H. and N. G. Slack. 1975. An analysis of the vegetation of *Sphagnum*-dominated kettle-hole bogs in relation to environmental gradients. Canadian Journal of Botany **53**: 332-359.
- Vitt, D. H. and N. G. Slack. 1984. Niche diversification of *Sphagnum* relative to environmental factors in northern Minnesota peatlands. Canadian Journal of Botany **62**: 1409-1430.
- Westhoff, V. and E. van der Maarel. 1978. The Braun-Blanquet approach. pp. 287-399 in: Whitaker, R. H. (ed.) Classification of plant communities. Junk, The Hague, Boston.
- Whittaker, R. H. 1972. Evolution and measurement of species diversity. Taxon **21**: 213-251.

APPENDIX A. GLOBAL/STATE RANK DEFINITIONS

HERITAGE PROGRAM RANKS

The international network of Natural Heritage Programs employs a standardized ranking system to denote global (range-wide) and state status. Species are assigned numeric ranks ranging from 1 to 5, reflecting the relative degree to which they are “at-risk”. Rank definitions are given below. A number of factors are considered in assigning ranks — the number, size and distribution of known “occurrences” or populations, population trends (if known), habitat sensitivity, and threat. Factors in a species’ life history that make it especially vulnerable are also considered (e.g., dependence on a specific pollinator).

GLOBAL RANK DEFINITIONS (NatureServe 2003)

- G1 Critically imperiled because of extreme rarity and/or other factors making it highly vulnerable to extinction
- G2 Imperiled because of rarity and/or other factors making it vulnerable to extinction
- G3 Vulnerable because of rarity or restricted range and/or other factors, even though it may be abundant at some of its locations
- G4 Apparently secure, though it may be quite rare in parts of its range, especially at the periphery
- G5 Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery
- T1-5 **Infraspecific Taxon** (trinomial) —The status of infraspecific taxa (subspecies or varieties) are indicated by a “T-rank” following the species’ global rank

STATE RANK DEFINITIONS

- S1 At high risk because of extremely limited and potentially declining numbers, extent and/or habitat, making it highly vulnerable to extirpation in the state
- S2 At risk because of very limited and potentially declining numbers, extent and/or habitat, making it vulnerable to extirpation in the state
- S3 Potentially at risk because of limited and potentially declining numbers, extent and/or habitat, even though it may be abundant in some areas
- S4 Uncommon but not rare (although it may be rare in parts of its range), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern
- S5 Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range

COMBINATION RANKS

G#G# or S#S# **Range Rank**—A numeric range rank (e.g., G2G3) used to indicate uncertainty about the exact status of a taxon

QUALIFIERS

- NR Not ranked
- Q **Questionable taxonomy that may reduce conservation priority**—Distinctiveness of this entity as a taxon at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority (numerically higher) conservation status rank

- X **Presumed Extinct**—Species believed to be extinct throughout its range. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered
- H **Possibly Extinct**—Species known from only historical occurrences, but may never-the-less still be extant; further searching needed
- U **Unrankable**—Species currently unrankable due to lack of information or due to substantially conflicting information about status or trends
- HYB **Hybrid**—Entity not ranked because it represents an interspecific hybrid and not a species
- ? **Inexact Numeric Rank**—Denotes inexact numeric rank
- C **Captive or Cultivated Only**—Species at present is extant only in captivity or cultivation, or as a reintroduced population not yet established
- A **Accidental**—Species is accidental or casual in Montana, in other words, infrequent and outside usual range. Includes species (usually birds or butterflies) recorded once or only a few times at a location. A few of these species may have bred on the one or two occasions they were recorded
- Z **Zero Occurrences**—Species is present but lacking practical conservation concern in Montana because there are no definable occurrences, although the taxon is native and appears regularly in Montana
- P **Potential**—Potential that species occurs in Montana but no extant or historic occurrences are accepted
- R **Reported**—Species reported in Montana but without a basis for either accepting or rejecting the report, or the report not yet reviewed locally. Some of these are very recent discoveries for which the program has not yet received first-hand information; others are old, obscure reports
- SYN **Synonym**—Species reported as occurring in Montana, but the Montana Natural Heritage Program does not recognize the taxon; therefore the species is not assigned a rank
- * A rank has been assigned and is under review. Contact the Montana Natural Heritage Program for assigned rank
- B **Breeding**—Rank refers to the breeding population of the species in Montana
- N **Nonbreeding**—Rank refers to the non-breeding population of the species in Montana

**APPENDIX B. KEY TO PEATLAND VEGETATION TYPES
OF THE KOOTENAI NATIONAL FOREST, MONTANA**

NOTE: First verify the site is a peatland. Peatlands are wetland areas of continuous water saturation where peat (accumulated organic matter of various states of decomposition) has been deposited to a defined depth, generally 40 cm unless the organic soil accumulation overlies bedrock, gravel or cobbles. In the United State soil classification system a peatland corresponds to the soil order Histosol, refer to the definition for that order for more precise information if necessary.

1. Canopy cover of the following shrubs or dwarf-shrubs, considered singly or combined, at least 10%: *Betula glandulosa* (and putative hybrids with *B. pumila*), *Dasiphora floribunda* (= *Pentaphylloides floribunda*), *Spiraea douglasii*, *Salix candida*, *Kalmia microphylla* 2
1. Not as above; the individual or combined cover of any combination of the above shrub species < 10% 10
 2. *Kalmia microphylla* having at least 10% canopy cover 3
 2. *K. microphylla* having < 10% cover 4
3. Forb layer characterized by the presence (and often dominance) of *Carex nigricans*, *Carex scopulorum* or *Eriophorum* spp., their individual or combined cover at least 5% and *Sphagnum* species and/or *Warnstorffii exannulata* (= *Drepanocladus exannulatus*) also => 5% cover ***Kalmia microphylla* / *Sphagnum* Moss Peatland**
3. Not as above, *C. nigricans*, *C. scopulorum*, *Eriophorum* spp. (their combined or individual cover) < 5% and *Sphagnum* species < 5% as well **Undefined (for study area) *Kalmia microphylla*-characterized peatland type(s)**
 4. *Salix candida* the dominant shrub (having greater cover than any other shrub) 5
 4. *S. candida* not the dominant shrub, other shrub(s) with greater cover 6
5. *Carex utriculata*, *C. aquatilis*, *C. prairea* individually or their combined cover at least 10% ***Salix candida* / *Carex utriculata* Peatland**
5. *C. utriculata*, *C. prairea* and *C. aquatilis* or in any combination their cover < 10% **Undefined (for study area) *Salix candida* – characterized peatland type(s)**
 6. *Betula glandulosa* (or hybrids w/ *B. pumila*) singly or in combination with *Rhamnus alnifolia* and/or *Dasiphora floribunda* having cover => 10% 7
 6. *B. glandulosa* cover singly or combined with *D. floribunda* or *R. alnifolia* < 10% 8
7. Singly or in any combination the following *Carex* spp. having at least 10% cover: *Carex lasiocarpa*, *C. prairea*, *C. utriculata*, *C. aquatilis*, *C. interior*, *C. aurea*, *C. leptalea*, *C. buxbaumii*, *C. exsiccata* ***Betula glandulosa* / *Carex* spp. / “Brown” Mosses Peatland**
7. Not as above; canopy cover of the above listed *Carex* spp., either singly or their combined cover, < 10% **Undefined (for study area) *Betula/Rhamnus/Potentilla*-characterized peatland type(s)**
 8. *Spiraea douglasii* cover => 10% 9
 8. *S. douglasii* cover < 10% **Not a shrubland or shrub-herbaceous structure by NVCS; reevaluate shrub cover. If shrub species other than enumerated in opening lead are characteristic, see key to/descriptions of carr (shrub- or tree-dominated peatland) vegetation types in Hansen et al. (1995)**

9. <i>Carex lasiocarpa</i> canopy cover \geq 5	<i>Spiraea douglasii</i> / <i>Carex lasiocarpa</i> Peatland
9. <i>C. lasiocarpa</i> cover < 5% Undefined (for study area) <i>Spiraea douglasii</i>-characterized peatland type(s)
10. <i>Carex</i> spp., either singly or in combination with the cover of <i>Eriophorum</i> spp, having at least 10% and their cover greater than that of non-shrub vascular components	11
10. Not as above; <i>Carex</i> spp. having < 10% cover or their cover < than that of other non-shrub vascular species	24
11. <i>Carex scopulorum</i> or <i>Carex nigricans</i> or their combined cover \geq 5%	12
11. <i>C. scopulorum</i> and <i>C. nigricans</i> and their combined cover < 5%	14
12. <i>Sphagnum</i> species (including particularly <i>S. subsecundum</i> , <i>S. angustifolia</i>) dominating the ground layer	<i>Carex scopulorum</i> / <i>Sphagnum</i> Moss Peatland
12. Not as above; <i>Sphagnum</i> spp. a minor component (trace amounts) of the ground layer	13
13. <i>Carex nigricans</i> cover \geq 5%	<i>Carex nigricans</i> Peatland
13. <i>C. nigricans</i> cover < 5%	Undefined <i>C. scopulorum</i> or <i>C. nigricans</i> vegetation type(s)
14. <i>Carex lasiocarpa</i> alone or in combination with <i>Eriophorum gracile</i> , or <i>Dulichium</i> <i>arundinacea</i> having cover \geq 10%	15
14. Not as above; the singly or combined cover of above cited species < 10%	17
15. A suite of moss species indicating “rich fen” conditions present; may occur with low cover (\geq 1%); if several indicators are present, or, if only one or a couple are present, then their cover should be appreciable; this suite of species includes: <i>Scorpidium scorpioides</i> , <i>Scorpidium cossonii</i> (= <i>Drepanocladus revolvens</i>), <i>Campylium stellatum</i> , <i>Calliergon giganteum</i> , <i>Tomenthypnum nitens</i> , <i>Philonotis fontana</i> , <i>Hamatocaulis vernicosus</i> , <i>Meesia triquetra</i> , <i>Aulacomnium palustre</i> , <i>Drepanocladus aduncus</i> , <i>Hypnum lindbergii</i> : Note: none of the suite of contrasting indicators (see lead 16) should be well-represented (> 5% cover) <i>Carex lasiocarpa</i> / “Brown” Mosses Peatland
15. Not as above; the suite of rich to transitional fen indicators not present or only a couple of indicators present in trace amounts and contra-indicative indicators (see lead 12) present with significant cover	16
16. Suite of <i>Sphagnum</i> moss species capable of indicating “poor fen” conditions present: frequently this component may constitute a continuous undulating (hummocks and hollows) sward but may occur with low cover (< 5%) if several indicators are present; if only one or a couple of this suite of species are present, then their cover should be appreciable; this suite includes (but not limited to) <i>Sphagnum teres</i> , <i>S. angustifolium</i> , <i>S. russowii</i> , <i>S. subsecundum</i> <i>Carex lasiocarpa</i> / <i>Sphagnum</i> Moss Peatland
16. Not as above; <i>Sphagnum</i> mosses not present or only one species present poorly represented (< 5% cover) Undefined (for study area) <i>Carex lasiocarpa</i>-characterized peatland type(s)
17. <i>Carex limosa</i> cover \geq 10%	18
17. <i>C. limosa</i> cover < 10 %	20

18. A suite of moss species indicating “rich fen” conditions present; may occur with low cover ($\geq 1\%$), if several indicators are present, or, if only one or a couple are present, then their cover should be appreciable; this suite of species includes *Scorpidium scorpioides*, *Scorpidium cossonii* (= *Drepanocladus revolvens*), *Campylium stellatum*, *Calliergon giganteum*, *Tomenthypnum nitens*, *Philonotis fontana*, *Hamatocaulis vernicosus*, *Meesia triquetra*, *Aulacomnium palustre*, *Drepanocladus aduncus*, *Hypnum lindbergii*: Note: none of the suite of contrasting indicators (see lead 16) should be well-represented ($> 5\%$ cover) **Carex limosa / “Brown” Mosses Peatland**
18. Not as above **19**
19. *Sphagnum* spp. (particularly *S. angustifolium*, *S. subsecundum*) and/or *Warnstorfia exannulata* (= *Drepanocladus exannulatus*) well represented ($\geq 5\%$) **Carex limosa/ Sphagnum Moss Peatland**
19. Not as above **Undefined (for study area)**
C. lasiocarpa-characterized peatland type(s)
20. *Carex flava* canopy cover $\geq 10\%$ **21**
20. *C. flava* cover $< 10\%$ **22**
21. A suite of moss species indicates “rich fen” conditions; may occur with low cover ($< 1\%$) if several indicators are present or if only one or a couple are present then their cover should be appreciable; this suite of species includes (arranged approximately as to their declining indicator strength); *Scorpidium scorpioides*, *Scorpidium cossonii* (= *Drepanocladus revolvens*), *Campylium stellatum*, *Calliergon giganteum*, *Tomenthypnum nitens*, *Philonotis fontanus*, *Hamatocaulis vernicosus*, *Aulacomnium palustre*, *Drepanocladus aduncus*, *Hypnum lindbergii*: Note: none of the suite of contrasting indicators (see lead 12) should be well-represented ($> 5\%$ cover) **Carex flava / “Brown” Mosses Peatland**
21. Not as above **Undefined (for study area) Carex flava-characterized peatland type(s)**
22. *Carex utriculata*, *C. aquatilis*, *C. rostrata*, *C. exsiccata* (= *C. vesicaria* v. *major*) or *C. prairea*, individually or in any combination having cover $\geq 10\%$ **23**
22. Not as above; the above cited *Carex* spp. having $< 10\%$ **23**
23. A variable suite of moss species indicating “rich fen” conditions may occur with low cover ($< 1\%$); this suite of species includes, *Scorpidium cossonii* (= *Drepanocladus revolvens*), *Calliergon giganteum*, *Tomenthypnum nitens*, *Hamatocaulis vernicosus*, *Bryum pseudotriquetrum*, *Meesia triquetra*, *Cratoneuron filicinum*: Note: none of the suite of contrasting *Sphagnum* spp. indicators (see lead 12) should be well-represented ($> 5\%$ cover) **Carex utriculata / “Brown” Mosses Peatland**
23. Not as above; none of suite of “Brown mosses” is represented or only trace amounts or one or two of these species occur; *Sphagnum* spp. present indicative of a more acidic environment **Carex utriculata / Sphagnum Moss Peatland**
24. *Carex buxbaumii* the dominant *Carex* spp. **Carex buxbaumii Herbaceous Vegetation (CEGL001806)**
24. *Carex buxbaumii* not the dominant *Carex* spp. **Undefined (for study area) Carex-characterized peatland vegetation type**

25. *Dulichium arundinaceum* the dominant graminoid, canopy cover may be highly variable but \geq 5% .
..... ***Dulichium arundinaceum* Herbaceous Peatland**
25. *D. arundinaceum* not the dominant graminoid **26**
26. *Eriophorum angustifolium*, *Eriophorum chamissonis* or *E. viridicarinatum* or their
combined cover \geq 5% and *Carex* spp. < 5% **27**
26. *Eriophorum* spp. having < 5% cover, singly or combined **28**
27. *Sphagnum* species individually or collectively (including particularly *S. teres*, *S. angustifolium*,
S. magellanicum) and/or *Warnstorffii exannulata* well-represented (\geq 5%) in the ground layer
..... ***Eriophorum* spp. / *Sphagnum* Moss Peatland**
27. *Sphagnum* species poorly represented (< 5%)
..... **Undefined (for study area) *Eriophorum* spp.-“dominated” type(s)**
28. *Trichophorum caespitosum* (= *Scirpus caespitosus*) or *Eleocharis quinqueflora*
(= *E. pauciflora*) or their combined cover \geq 10% **29**
28. Not as above; cover of *T. caespitosum* and *E. quinqueflora* or their combined values < 10%
..... **As yet undescribed/unsampled vegetation type of Kootenai peatlands**
29. Suite of moss species indicating “rich fen” conditions present; may occur with low cover
(< 1%) if several indicators are present, or, if only one or a couple are present, then their cover
should be appreciable; this suite of species includes *Scorpidium scorpioides*, *Scorpidium cossonii*
(= *Drepanocladus revolvens*), *Campylium stellatum*, *Meesia triquetra*, *Tomenthypnum nitens*,
Hamatocaulis vernicosus, *Aulacomnium palustre*, and *Aneura pinguis*: Note: none of the suite
of contrasting indicators (see lead 16) should be well-represented (> 5% cover)
..... ***Eleocharis quinqueflora* – *Trichophorum caespitosum* / “Brown” Mosses Peatland**
29. Not as above
..... ***Eleocharis quinqueflora*- or *Trichophorum caespitosum*-characterized
communities not occurring on peatlands or lacking “Brown Mosses”**

APPENDIX C. DESCRIPTION OF PLANT ASSOCIATIONS

[Note: The content of the fields describing each plant association should largely be self-evident, with the following exception. Each association description has a field titled “**SYNONYMY:**”, the intent of which is to list other community type names used by agencies or other published or unpublished classification systems to describe vegetation types that are related in some measure to the Element (plant association) being described. Following the name and citation (author(s), year) for a community is a symbol designating the relationship of this community to the Element under consideration.

B – Broader – The concept embodied in the synonym community is broader than the concept of the Element (i.e. the community listed includes the entire concept of the Element under consideration, and more).

F – Finer – The concept designated in the synonym community is finer, narrower, than the concept of the Element in this description.

I – Intersecting – Concepts embodied in the synonym community and the Element under consideration overlap and neither fully includes its counterpart. The synonym community and Element are related in a more complex fashion than is captured by Broader/Finer relationship.

? – Undetermined – The relationship between synonym community and Element has not been determined (for any number of reasons).

= – Equivalent – Though the names of synonym community and Element may or may not be the same, they are conceptual equivalents.]

BETULA GLANDULOSA / CAREX SPP. / “BROWN MOSSES” SHRUBBY PEATLAND

Dwarf birch / Sedge species / “Brown Mosses” Shrubby Peatland

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This association encompasses both rich and extremely rich fens occurring on peatlands (accumulation of peat 30 cm or more thick) with predominantly anchored mats; pH values range from 5.7 to 7.6, averaging about 6.95. Apart from the crests of higher hummocks that dry somewhat by late summer, the peat is perennially saturated by a watertable within a few centimeters of the surface; often there is standing water on the surface, covering up to 60 %. The sampled elevations range from 1,025 to 1,495 (3,360 to 4,905 feet), though it is expected to exhibit a considerably wider range.

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: [Photographs Appendix E – A, B] The general aspect of this type is that of a species-rich (18 to 40 + species) carr (peatland dominated by broadleaved shrubs) but cover of the dominant shrub, *Betula glandulosa*, varies widely, from 10% (just barely defining a shrubby condition) to 60 %. Throughout the Kootenai N. F. putative hybrids of *Betula glandulosa* and *B. pumila*, rather than the expected *B. glandulosa*, are the predominant form. Shrub height is apparently determined in large part by the degree of substrate aeration, with the more aerated peatland margins and higher ground subject to drawdowns having shrubs up to 2.5 m. tall whereas shrubs only approach 0.5 m on sites saturated to the surface. The only other shrubs consistently present (with less than 5 % cover) are *Salix candida* and *Dasiphora floribunda* (= *Potentilla fruticosa* and *Pentaphylloides floribunda*, confined to hummocks). The herbaceous undergrowth is usually dominated by Carex species with the following species dominant or co-dominant in at least one stand *C. prairea*, *C. utriculata*, *C. lasiocarpa*, *C. disperma*, *C. buxbaumii*, *C. echinata*, *C. leptalea* and *C. aquatilis*. *C. prairea*, is both a state sensitive plant and has the highest constancy and is more dominant than any other sedge in these sites. *Carex capillaris* and *C. aurea* are moderately to highly constant but seldom occur in more than trace amounts. *Eriophorum* spp., including *E. chamissonis*, *E. angustifolia*, and *E. viridicarinatum* are present in about half the stands as is *Hordeum brachyantherum*. The forb complement is occasionally highly diverse (20 or more species); those with moderate to high constancy include *Menyanthes trifoliata*, *Epilobium* spp., *Galium trifidum*, *Petasites sagittata*, *Triglochin palustre*, *Viola nephrophylla*, *Zigadenus elegans* and *Dodecatheon pulchellum*. Only *Menyanthes trifoliata* is consistently present with more than 5 % cover. The ground layer is dominated by bryophytes of the “brown moss” variety (generally indicative of other than bog or poor fen condition) and *Sphagnum* mosses are lacking or present in trace amounts. As with the graminoid component no one moss is consistently dominant, this expression being variously shared among *Scorpidium cossonii*, *S. scorpioides*, *Meesia triquetra*, *Calliergon giganteum*, *C. stramineum*, *Campylium stellatum*, *Tomenthypnum nitens*, *Hamatocaulis vernicosus*, *Hypnum lindbergii*, *Aulacomnium palustre*, *Drepanocladus aduncus* and *Bryum pseudotriquetrum*. The first four or five of the afore-listed bryophytes are considered highly indicative of extremely rich fens.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Shrub	<i>Betula glandulosa</i> (or <i>B. glandulosa</i> x <i>B. pumila</i> hybrid swarm), <i>Dasiphora floribunda</i> (= <i>Potentilla fruticosa</i> and <i>Pentaphylloides floribunda</i>)
Graminoid	<i>Carex prairea</i> , <i>Carex utriculata</i> , <i>Carex buxbaumii</i> , <i>Carex disperma</i> , <i>Carex aquatilis</i> , <i>Juncus balticus</i> , <i>Hordeum brachyantherum</i>
Forb	<i>Menyanthes trifoliata</i> , <i>Petasites sagittata</i>
Bryoids	<i>Scorpidium cossonii</i> (= <i>Drepanocladus revolvens</i>), <i>Tomenthypnum nitens</i> , <i>Campylium stellatum</i> , <i>Bryum pseudotriquetrum</i> , <i>Drepanocladus aduncus</i> , <i>Aulacomnium palustre</i>

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Betula glandulosa, *C. prairea*, *C. utriculata*, *C. lasiocarpa*, *C. disperma*, *C. buxbaumii*, *C. echinata*, *C. leptalea*, *C. aquatilis*; “brown mosses”.

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Carex prairea (S2), *Carex leptalea* (S1:ID, NT:MT), *Carex magellanicum* (S3), *Eriophorum viridicarinaratum* (S1:ID, NT:MT), *Epipactis gigantea* (S2), *Meesia triquetra* (S2)

GLOBAL SIMILAR ASSOCIATIONS

- *Betula nana* (= *B. glandulosa*) / *Carex rostrata* (= *C. utriculata*) (CEGL001079)

SYNONYMY

- *Betula glandulosa* / *Carex rostrata* (= *C. utriculata*) (Hansen et al. 1995) I
- *Betula glandulosa* / *Carex lasiocarpa* (Chadde et al. 1998) I
- Dodecatheo puchelli – Zygadenetum elegantis Association (Spribille no date) I
- *Betula* spp. – *Potentilla fruticosa* (= *Dasiphora floribunda*) – *Salix glauca* / *Tomenthypnum nitens* (Holland & Coen 1982) I

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: This community, as defined for the Kootenai N. F., is virtually the same as *B. glandulosa* / *C. lasiocarpa* described by Chadde et al. (1998). Although their samples included west-central Montana and northern Idaho peatlands as well as northwestern Montana they reflect less diversity, especially in the graminoid component, than do the Kootenai N. F. samples. In general the *Carex* spp. (including *C. utriculata* and *C. lasiocarpa* used exclusively as indicators of comparable types to that described herein) have a relatively broad distribution across the nutrient/pH gradient and the uniqueness of these sites is better reflected in the “brown moss” appellation. We use *Carex* spp. for the type name and refer to a suite of *Carex* spp. as appropriate indicators (not just *C. lasiocarpa*, *C. utriculata* and *C. aquatilis*). The type identified by Hansen et al. as *B. glandulosa* / *C. utriculata*, a default type, was cited to occur on histosols as well as mineral soils, therefore a portion of their type overlaps with the conditions and composition described here. Hansen et al. (1995) make no reference to bryophytes, but almost certainly this component had to be present in their stands. Holland and Coen (1982) described a community very similar in composition to that under consideration but there was little indication that it occurred on other than wet mineral soils. Spribille (no date), following precepts of the floristically-based Zurich-Montpellier School, ignored the structural distinction imparted by the shrub component and classed all the plots supporting this type as belonging to the Dodecatheo pulchelli – Zygadenetum elegantis Association.

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: ID, MT

USFS Ecoregions: M333A

Federal Lands: Kootenai N. F., Lolo N. F., Flathead N. F., Idaho Panhandle N. F.

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS008, TS009, TS010, TS011, TS012, TS013, TS014, TS017, TS021, TS023, TS024, TS116, MJ0001, MJ0017, MJ0018, MJ0023, MJ0029, MJ0030, MJ0038, MJ0041

KOOTENAI NATIONAL FOREST Inventory Notes: This type is based on the sampling conducted by W. M. Jones and T. Spribille.

References: Chadde et al. 1998, Hansen et al. 1995, Holland and Coen 1982, Spribille no date

***KALMIA MICROPHYLLA* / *SPHAGNUM* MOSS DWARF-SHRUB PEATLAND (PROVISIONAL)**
Alpine Laurel / Sphagnum Moss Dwarf-shrub Peatland (Provisional)

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This community was sampled over a narrow elevation range, from 1,780 to 1,830 m (5,840 to 6,000 feet) and is confined to flats or gentle slopes where the driving environmental factor is subirrigation with relatively nutrient-poor waters. The high elevations, cold and low pH water favor the accumulation of peat, including moderately and highly decomposed forms. Most stands are anchored mats with a complex of fen vegetation though others occur as slope wetlands.

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: This type is basically a species-rich (average 18/macroplot) dwarf-shrubland generally dominated by *Kalmia microphylla*, but with this indicator ranging from a low of 10 % to upwards of 60 % and the forb component highly variable as well there is no consistent aspect to this community. Other woody species include *Vaccinium scoparium* and very scattered depauperate specimens of subalpine tree species, *Abies lasiocarpa* and *Picea engelmannii*. Perhaps owing to the small sample size there is no expressed consistency in species dominance for the herbaceous layer with *Eriophorum chamissonis*, *Menyanthes trifoliata*, *Ligusticum canbyi*, *Carex magellanica* and *Carex nigricans* all being dominant/co-dominant in at least one stand and not repeating in any other stand within the four plot sample. The only herb of high constancy is *Viola palustris*. The bryoid component is highly variable in overall cover but, at least two *Sphagnum* spp. occur with low to high cover in all sites; the following three *Sphagnum* spp. are dominant in at least one plot, *S. angustifolium*, *S. warnstorffii*, and *S. russowii*. *Scapania* spp. (a liverwort) and *Aulacomnium palustre* are also 100 % constant; the former had as much as 40% cover and the latter (a broadly distributed generalist with regard to nutrient regime) never less than 10%.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Shrub	<i>Kalmia microphylla</i>
Herbaceous	<i>Carex nigricans</i> , <i>Carex magellanica</i> , <i>Ligusticum canbyi</i>
Bryophyte	<i>Sphagnum angustifolium</i> , <i>Sphagnum warnstorffii</i> , <i>Sphagnum russowii</i> , <i>Aulacomnium palustre</i> , <i>Scapania</i> spp.

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Kalmia microphylla, *Sphagnum* spp.

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Carex magellanica (S3), *Viola palustris* (SU), *Warnstorfia exannulata* (S1)

GLOBAL SIMILAR ASSOCIATIONS

- *Kalmia microphylla* / *Aster alpigenus* Dwarf-shrubland (CEGL001402)
- *Kalmia microphylla* / *Carex scopulorum* (CEGL001403)

SYNONYMY

- Sphagnum – Kalmietum microphyllae Association (Spribille, no date) I

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: This association is very similar to the *K. microphylla* / *Carex scopulorum* H. T. described by Hansen et al. (1995) for Montana however, theirs was a default type (the only *Kalmia*-defined community that could be keyed via their manual). Their type clearly overlaps with that described here as they note soils are typically saturated to the surface Histosols and that soil reaction is strongly acidic (pH average of 5.0) but they also note their type to occur on mineral soils as a streambank stringer and never do they mention a bryophyte component. Thus the Hansen et al. type exhibits much broader ecological amplitude. Damm (2001) describes a *Aulacomnium paustre* – *Kalmia microphylla* moist heath community for Glacier National Park that occurs primarily on histic soils and exhibits a dominant bryophyte component but, the nutrient status for this high subalpine to alpine heath is much more favorable than that of the type defined here (and dominated by *Sphagnum* spp.). Spribille (no date) describes a Sphagno – Kalmietum Association that encompasses the type described herein but which, because of adherence to Braun-Blanquet (Zurich-Montpellier school of phytosociology) precepts, also includes plots having no, or only trace amounts, of *Kalmia microphylla* (quite at variance with NVCS).

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: ID, MT

USFS Ecoregions: M333B

Federal Lands: Kootenai National Forest

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: FS01140396TS100, FS01140396TS101, TS207, TS209, TS922

KOOTENAI NATIONAL FOREST Inventory Notes: All plots inventoried on Kootenai N. F. by T. Spribille.

References: Damm 2001, Hansen et al. 1995, Spribille (no date)

***SALIX CANDIDA* / *CAREX UTRICULATA* SHRUBBY PEATLAND**

Hoary Willow / Beaked Sedge Shrubby Peatland

ELEMENT CONCEPT

GLOBAL SUMMARY: This is a rare association that occurs between 1476 to 2348 m (4,840-7,700 feet) elevation in mountains and basins of western Montana, as well as at scattered localities in eastern Idaho, the Black Hills of South Dakota, and northwestern Wyoming. This association is restricted to the continuously wet, anaerobic Histosol soils of peatlands. Stands often form on anchored floating mats along montane lake margins and sometimes occur in spring-fed rich-fens in intermountain basins. The association is characterized by widely scattered clumps of 1- to 1.5-m tall *Salix candida*, with lesser amounts of other low *Salix* species (e.g., *Salix planifolia*, *Salix exigua*, *Salix bebbiana*, *Salix serissima*, or *Salix wolfii*), *Betula nana*, and/or *Dasiphora fruticosa* ssp. *floribunda*. The open shrub layer (up to 30% cover) occurs within a sward of *Carex utriculata*, often mixed with *Carex aquatilis*, and sometimes includes other graminoid species such as *Carex simulata*, *Carex nebrascensis*, *Deschampsia caespitosa*, *Calamagrostis canadensis*, *Glyceria striata*, and *Juncus balticus*. Total forb cover is generally low to moderate, mostly composed of *Gentianopsis thermalis*, *Menyanthes trifoliata*, *Packera streptanthifolia*, *Symphyotrichum foliaceum*, *Triglochin maritima*, and various rare and/or endemic fen species.

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: As remarked in the GLOBAL SUMMARY this is rare type on the Kootenai N. F. as well but the occurrences on this forest extend to considerably lower elevations (to 1035 m or 3,395 feet) than its known elevation range. It occurs on rich to extremely rich fens receiving water from a mineral source; the lone pH and conductivity values were 7.2 and 543 μ S respectively, well into the range of rich fens (Glaser 1987). Both stands occurred on anchored floating mats with more than a meter of accumulated peat. The water table remains at or near the substrate surface throughout the growing season.

GLOBAL Environment: This association is restricted to continuously wet, anaerobic Histosol soils of peatlands. Sites with these soils, such as anchored floating mats along montane lake margins and in rich-fens, are naturally rare across the landscape and difficult to restore when disturbed (Jankovsky-Jones 1999). In the Black Hills, the single stand at McIntosh Fen is on the eastern edge of the Limestone Plateau at 6000 feet elevation. It occurs in a broad drainage bottom underlain by metamorphic rocks and traversed by Castle Creek. Water issuing from springs in the limestone strata on the sides of the drainage contributes to the alkalinity of the wetland (Marriott and Faber-Langendoen 2000).

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: A low cover (10 - 20 %) of 0.5 to 1.5 m tall *Salix candida* characterizes these sites, with *Betula glandulosa* and *Dasiphora floribunda* consistently present in trace amounts; thus, these sites barely convey the impression of a shrubland. The herbaceous component is definitively dominated by *Carex utriculata*; other graminoids associated with these sites include *Carex prairea*, *C. aquatilis* and *C. leptalea*. Forbs thought to have high constancy include *Viola nephrophylla*, *Zigadenus elegans*, *Petasites sagittata* and *Parnassia fimbriata*. Most significant in terms of composition and indicator status (diagnostic of rich to extreme-rich fen) is the dominance of brown mosses in the ground layer; *Calliergon giganteum* and *Tomenthypnum nitens* each dominated a plot but a host of other brown mosses were present in varying amounts, including *Scorpidium cossonii* (= *Drepanocladus revolvens*), *Aneura pinguis* (= *Riccardia pinguis*), *Campylium stellatum*, *Drepanocladus aduncus*, *Bryum pseudotriquetrum*, *Philonotis fontana* and *Cratoneuron filicinum*.

GLOBAL Vegetation: Overall shrub cover is in the 25-60% range. Herbaceous cover is 60-100%. Stands consist of small patches of *Salix candida*, *Salix serissima*, *Salix exigua*, *Salix bebbiana*, and *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*). Any of these shrubs may be locally dominant. Common herbaceous species include *Carex rostrata*, *Carex nebrascensis*, *Juncus balticus*, *Calamagrostis canadensis*, and wetland forbs (Marriott and Faber-Langendoen 2000).

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Shrub	<i>Salix candida</i>
Graminoids	<i>Carex utriculata</i> , <i>Carex aquatilis</i>
Forbs	<i>Angelica arguta</i> , <i>Parnassia fimbriata</i>
Bryophytes	<i>Campylium stellatum</i> , <i>Tomenthypnum nitens</i> , <i>Calliergon giganteum</i>

CHARACTERISTIC SPECIES

Kootenai National Forest

Salix candida, *Carex utriculata*, *C. aquatilis*, *C. lasiocarpa*, ‘Brown mosses’

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Salix candida (S1:ID, NT:MT), *Carex leptalea* (S1:ID, NT:MT), *Carex prairea* (S2)

GLOBAL SIMILAR ASSOCIATIONS

- *Betula glandulosa* / *Carex* spp. / “Brown Mosses” (this report)

SYNONYMY

- *Salix candida* / *Triglochin maritimum* Extreme Rich Fen (Carsey et al. 2003) I
- *Salix candida* / *Carex lasiocarpa* Shrubland (Chadde et al. 1995) I

GLOBAL Conservation Status Rank: G2

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: The global description does not mention the presence and indicator values of the bryophyte component, which is quite rich in the Kootenai N. F. examples. It is not necessary to append the “Brown mosses” appellation because *Salix candida* is apparently found only within rich fens. A more meaningful name for this type would be *S. candida* / *Carex* spp. / “Brown mosses” because there are communities (*S. candida* / *C. lasiocarpa* of Chadde et al. 1998) that have the same environmental parameters and composition, with the exception that *C. lasiocarpa*, rather than *C. utriculata*, is the dominant herb. In the larger sample and regionally diverse data of Hansen et al. (1995) *Carex aquatilis*, *C. simulata*, *C. limosa* and *C. livida* may dominate about a third of the stands inventoried, thus suggesting the more appropriate name “*Carex* spp.” (there is no indication that environmental parameters differ among these sites). Other than the obvious difference in dominant shrubs, no one has addressed how this association might differ from *Betula glandulosa* / *Carex* spp. / “Brown Mosses”; their environments apparently strongly overlap, if not being virtually identical.

KOOTENAI NATIONAL FOREST Other Comments: Spribille (no date) following Zurich – Montpellier flora-centric concepts of classification did not mention *Salix candida*, placing stands in vegetation associations named for various herbs.

GLOBAL Classification Comments: This association has been quantitatively described from 24 stands in Montana (Hansen et al. 1995) and 1 stand in Wyoming (Walford et al. 2001). The association is loosely defined, and some stands classified by Hansen et al. (1995) as this type were dominated by *Betula nana* or *Salix glauca*, or had understories dominated by *Carex aquatilis*, *Carex simulata*, or *Juncus balticus* (MTNHP 2002). *Salix candida* / *Carex lasiocarpa* and *Salix candida* / *Juncus balticus* stands have also been sampled in Montana (MTNHP 2002). *Salix candida* is known from only 16 sites in Idaho, but at only two sites is it a common shrub species within the *Carex utriculata* meadow. Nevertheless, stands clearly characterized by *Salix candida* and *Carex utriculata* dominance have been sampled from throughout the range of the association in Montana and Wyoming.

ELEMENT DISTRIBUTION

GLOBAL Range: US

USFS Ecoregions: M333A, M333B

Federal Lands: Kootenai N. F., Lolo N. F., Flathead N. F.

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS015, TS930

KOOTENAI NATIONAL FOREST Inventory Notes: Intensive sampling by W. M. Jones (MTNHP) and T. Spribille (Kootenai N. F.) resulted in identifying only two stands on the Kootenai N. F.

Identifier: CEGL001188

References: Carsey et al. 2003, Chadde et al. 1998, Hansen et al. 1995, Walford et al. 2001

***SPIRAEA DOUGLASII* / *CAREX LASIOCARPA* SHRUBBY PEATLAND (PROVISIONAL)**
Rose spiraea / Woollyfruit Sedge Shrubland Peatland (Provisional)

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This putative peatland type is uncommon, represented by only two plots at 1035 m (3,400 feet) elevation. It is found on the margins of poor fens (pH values of 4.6 and 4.8) with deep accumulations of peat. The substrate is perennially saturated to the surface, except for hummock crests that may dry by late summer.

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: [Photograph Appendix E – c] *Spiraea douglasii*, the only shrub present in these depauperate environments, forms moderately dense to dense thickets that can obscure the undergrowth vegetation. The herbaceous component is dominated by graminoids, foremost of which is *Carex lasiocarpa*; *Dulichium arundinacea* is constant as an indicator of nutrient-poor fen conditions. *Comarum palustre* is consistently present in a very depauperate forb layer. *Sphagnum subsecundum* had high cover in one plot further emphasizing the acidic nature of this community.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Shrubs	<i>Spiraea douglasii</i>
Graminoids	<i>Carex lasiocarpa</i> , <i>Dulichium arundinacea</i>
Forbs	<i>Comarum palustre</i>
Bryophytes	<i>Sphagnum subsecundum</i>

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Spiraea douglasii, *Carex lasiocarpa*, *Sphagnum subsecundum* (and other *Sphagnum* spp. that may occur)

GLOBAL SIMILAR ASSOCIATIONS

- *Spiraea douglasii* Shrubland (CEGL001129)

SYNONYMY

- *Spiraea douglasii* Community Type (Chadde et al. 1998; Hansen et al. 1995)

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: The type described here differs from the *Spiraea douglasii* C. T. by occurring on Histosols or peatlands, not mineral soil as cited by Hansen et al. (1995); this is a significant distinction with regard to water chemistry, soil aeration and composition of the bryophyte layer, which is *Sphagnum* spp. dominated in this type.

ELEMENT DISTRIBUTION

KOOTENAI NATIONAL FOREST Range: This a relatively uncommon type on the forest, represented by only two sample plots.

Nations: US

States/Provinces: ID, MT

USFS Ecoregions: M333A, M333B

Federal Lands: Kootenai National Forest, Panhandle National Forest(s)

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: MJ0005, MJ0006

References: Chadde et al. 1998, Hansen et al. 1995

CAREX LASIOCARPA / “BROWN MOSSES” HERBACEOUS PEATLAND
Slender Sedge / “Brown Mosses” Herbaceous Peatland

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This small to large patch type is exclusively an herb-dominated peatland characterized by either an anchored or floating mat of vegetation and partially decomposed organic matter, usually more than a meter thick. It exhibits a broad elevation range from 925 to 1500 m (3,030 to 4,900 feet; quite possibly to 2195 m [7,900 feet] in other portions of the state). Based on a limited amount of water analysis pH values were found to range from 5.0 to 7.9 with more than 85 % of the values above pH 5.8, a value considered to define the uppermost range for poor fens. Thus the great majority of stands represent rich to extremely rich (pH > 7.0) fens. These sites are perennially saturated to within 10 cm of the surface, only the hummock crests (where present) dry to any extent.

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: [Photographs, Appendix E – D, E] Though all sites share a deep peat accumulation there is considerable variability in composition, from depauperate wetlands (as few as three plant species with a total cover < 30 %) with standing water for much of the growing season to species rich sites with upwards of 35 species and a virtual carpet of vegetation; other commonly occurring physiognomy has high density *Carex lasiocarpa* with traces of brown mosses contrasting with situations where *C. lasiocarpa* exhibits low cover (< 10 %) and brown mosses comprise a virtual blanket. Shrubs, including *Betula glandulosa*, *Salix candida*, and *Dasiphora floribunda*, are infrequently present in trace amounts. Usually a number of *Carex* spp. are present but in virtually all stands *Carex lasiocarpa* is the dominant graminoid occasionally sharing this status with *Carex diandra*, *C. flava*, *C. interior*, *C. buxbaumii* or *C. utriculata* or rarely with one of several forbs including *Comarum palustre*, *Menyanthes trifoliata* and *Typha latifolia*. The first three above named *Carex* spp. also exhibit moderate to high constancy. Forbs consistently present include *Dodecatheon pulchellum*, *Viola nephrophylla*, *V. palustris*, *Zigadenus elegans*, *Lycopus uniflorus*, *Polygonum amphibium* and *Equisetum fluviatile*. The “brown moss” component varies from several indicators having trace amounts to a sward composed of a few to many species. All of the following mosses are considered indicators (varying appreciably in the degree to which they are correlated with high pH) but only the first four were noted to occur with high cover and/or constancy; *Tomenthypnum nitens*, *Scorpidium cossonii*, *Campylium stellatum*, *Calliergon giganteum*, *Hamatocaulis vernicosus*, *Aulacomnium palustre*, *Bryum pseudotriquetrum*, *Cratoneuron commutatum*, *Drepanocladus aduncus*, *Hypnum lindbergii*, *Meesia triquetra*, *Philonotis fontana*, *Plagiomnium ellipticum* and *Scorpidium scorpioides*.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Graminoid	<i>Carex lasiocarpa</i> , <i>C. buxbaumii</i> , <i>C. chordorrhiza</i> , <i>C. diandra</i> , <i>C. flava</i> , <i>C. interior</i> , <i>C. utriculata</i>
Forbs	<i>Menyanthes trifoliata</i> , <i>Comarum palustre</i> (= <i>Potentilla palustris</i>), <i>Polygonum amphibium</i>
Bryophytes	<i>Tomenthypnum nitens</i> , <i>Scorpidium cossonii</i> , <i>Campylium stellatum</i> , <i>Calliergon giganteum</i> , <i>Hamatocaulis vernicosus</i> , <i>Aulacomnium palustre</i>

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST: *Carex lasiocarpa*, *Carex* spp., *Tomenthypnum nitens*, *Scorpidium cossonii*, *Campylium stellatum*, *Calliergon giganteum*, *Hamatocaulis vernicosus*, *Aulacomnium palustre*, *Bryum pseudotriquetrum*, *Cratoneuron commutatum*, *Drepanocladus aduncus*, *Hypnum lindbergii*, *Meesia triquetra*, *Philonotis fontana*, *Plagiomnium ellipticum*, *Scorpidium scorpioides*

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Carex livida (S2), *Carex leptalea* (S1: ID, NT:MT), *Carex prairea* (S2), *Eriophorum viridicarinarum* (S1:ID, NT:MT), *Trichophorum cespitosum* (S1), *Cirsium arvense* (noxious weed, MT), *Epipactis gigantea* (S2), *Lobelia kalmii* (SU), *Meesia triquetra* (S2), *Scorpidium scorpioides* (S2)

GLOBAL SIMILAR ASSOCIATIONS

- *Carex lasiocarpa* – *Calamagrostis* spp. – (*Eleocharis rostellata*) Herbaceous Vegetation (CEGL002383)
- *Carex lasiocarpa* – *Carex buxbaumii* – *Trichophorum caespitosum* (= *Scirpus cespitosus*) Boreal Herbaceous Vegetation (CEGL002500)
- *Carex lasiocarpa* Herbaceous Vegetation (CEGL001810)

SYNONYMY

- *Carex lasiocarpa* Habitat Type (Hansen et al. 1995) I
- *Carex lasiocarpa* Community Type (Chadde et al. 1998) I

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: This type has been explicitly defined to distinguish *Carex lasiocarpa*-characterized sites of rich to extremely rich fens from other environmental conditions supporting *C. lasiocarpa* as an indicator. In particular it is distinguished from *C. lasiocarpa* / *Sphagnum* spp., which occurs on poor fens characterized as relatively nutrient poor and having low pH values (< 5.7, according to the ranking of Glaser 1987).

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: ID, MT

Federal Lands: Idaho Panhandle National Forest, Kootenai National Forest, Flathead National Forest,

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS001, TS002, TS003, TS004, TS020, TS205, TS905, TS906, TS908, TS909, TS912, TS913, TS914, TS915, TS918, TS919, TS925, TS926, TS928, TS934, TS935, TS940, MJ010, MJ019, MJ020, MJ28, MJ037, MJ039, MJ039, MJ040, MJ043

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based.

References: Chadde et al. 1998, Glaser 1987, Hansen et al. 1995

CAREX LASIOCARPA / SPHAGNUM SPP. HERBACEOUS PEATLAND
Slender Sedge / *Sphagnum* spp. Herbaceous Peatland

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This type is exclusively a herb-dominated peatland (fen) characterized by either an anchored or floating mat of vegetation and partially decomposed organic matter, usually more than a meter thick. It exhibits a broad elevation range from 800 to 1805 m (2,625 to 5,920 feet; quite possibly to 2195 m [7,900 feet] in other portions of the state). Based on a limited amount of water analysis pH values were found to range from 4.6 to 5.4 with more than 75 % of the pH values less than 5.0; these values are considered well within the range characterizing poor fens (pH 4.2 to 5.8 in Minnesota poor fens [Glazer 1987]). These sites are perennially saturated to within 10 cm of the surface, only the hummock crests (where present) dry to any extent.

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: [Photographs Appendix E – c, F] Though all sites exhibit a deep (> 1 m) accumulation of peat, there is considerable variability in composition, from relatively depauperate wetlands (as few as five plant species with a total cover < 20 %) having standing water for much of the growing season to sites drying somewhat by late summer having as many as 21 species (average 13.5 species) and a virtual carpet of vegetation. The cover of *Carex lasiocarpa*, both the dominant graminoid and type indicator, averages in the high 20's percentage and varies broadly but it does not attain the high cover values registered in the richer *C. lasiocarpa* / "Brown Mosses" type. Shrubs are very uncommon, occurring at most as scattered individuals. Compared with the *C. lasiocarpa* / "Brown Mosses" type both the cover and diversity of *Carex* spp. are less; *Carex chordorrhiza*, *C. limosa*, *C. canescens* and *Dulichium arundinacea* evidence a distinctly higher cover and constancy in the type compared to the "Brown mosses" types with the importance of *D. arundinacea* thought to be associated with the low pH values. The forb component is definitely depauperate relative to the areas rich fens; only three forbs have greater than 50 % constancy, *Comarum palustre*, *Menyanthes trifoliata* and *Lycopus uniflorus*, and of the remaining forbs only another four expressed greater than 20 % constancy including *Viola palustris*, *Scheuchzeria palustris*, *Drosera rotundifolia* and *D. anglica*. "Brown mosses" may occur as incidentals, some stands having two or three species in trace amounts. *Calliergon stramineum* and *Aulacomnium palustre*, species broadly distributed with regard to pH, have high constancy and occasional high cover, respectively. However, *Sphagnum* spp are always dominant, including *S. angustifolium*, *S. russowii*, *S. subsecundum*, and *S. teres*, although their cover varies enormously from about 1 % to nearly complete cover. Conspicuously absent was *S. warnstorffii*, thought to be more characteristic of calcareous (higher pH) waters (Vitt et al. 1988).

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Shrubs	<i>Spiraea douglasii</i>
Graminoids	<i>Carex lasiocarpa</i> , <i>Carex limosa</i> , <i>Dulichium arundinacea</i>
Forbs	<i>Comarum palustre</i> (= <i>Potentilla palustris</i>), <i>Menyanthes trifoliata</i>
Bryoids	<i>Sphagnum angustifolium</i> , <i>S. russowii</i> , <i>S. subsecundum</i> , <i>S. teres</i> , <i>Aulacomnium palustre</i>

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Carex lasiocarpa, *Dulichium arundinacea*, *Sphagnum angustifolium*, *S. russowii*, *S. subsecundum*, *S. teres*

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Carex chordorrhiza (S1), *Carex rostrata* (S1), *Drosera anglica* (S2), *Epipactis gigantea* (S2), *Scheuchzeria palustris* (S1)

GLOBAL SIMILAR ASSOCIATIONS

- *Carex lasiocarpa* Herbaceous Vegetation (CEGL001018)

SYNONYMY

- *Carex lasiocarpa* Community Type (Padgett et al. 1989, Kovalchik 1987, Crowe & Clausnitzer 1997) I
- *Carex lasiocarpa* Habitat Type (Hansen et al. 1995) I
- *Carex lasiocarpa* Plant Association (Kovalchik 1993) I
- Sphagno – Caricetum lasiocarpae (Spribille No Date)

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: With the exception of Spribille’s (no date) Sphago – Caricetum lasiocarpae Association, a “limnogeneous floating mat community of intermediate peatlands”, none of the other authors (cited above in SYNONYMY) of *Carex lasiocarpa* types have made the distinction between fens with lower pH values (poor fens, as described here) and rich and extremely rich fens (*C. lasiocarpa* / “Brown Mosses”); this apparent oversight is a result of neglecting the indicator significance of the bryophyte-dominated ground layer (ultimately a result of lack of expertise in bryophyte identification). The *C. lasiocarpa* c.t. of Padgett et al. (1989) is cited to occur in an area “where glaciation left a series of ponds that have been replaced by sphagnum bogs”. Though the “sphagnum bogs” of Padgett et al. (1989) are most probably poor fens it would lead one to conclude that their *C. lasiocarpa*-dominated type would be a poor fen as well.

KOOTENAI NATIONAL FOREST Other Comments: See Jones 2003 for descriptions of sites from whence the plots documenting this type were derived.

ELEMENT DISTRIBUTION

States/Provinces: US

Federal Lands: Kootenai N. F., Lolo N. F., Flathead N. F.

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS201, TS202, TS203, TS901, TS902, TS904, TS907, MJ0002, MJ0003, MJ0004, MJ0007, MJ0008, MJ0009, MJ0011

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based; all of W. M. Jones’s plots were GPS georeferenced. Both datasets have incomplete water chemistry sampling.

References: Chadde et al. 1995, Crowe & Clausnitzer 1997, Hansen et al. 1995, Jones 2003, Kovalchik 1987, Padgett et al. 1989, Spribille No Date, Vitt et al. 1988

***ELEOCHARIS QUINQUEFLORA* (= *E. PAUCIFLORA*, *SCIRPUS PAUCIFLORUS*) – *TRICHOPHORUM CAESPITOSUM* (= *SCIRPUS CAESPITOSUS*) / “BROWN MOSSES” HERBACEOUS VEGETATION PEATLAND**

Fewflower Spikerush – Tufted Bulrush / “Brown Mosses” Herbaceous Vegetation Peatland

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This is a small patch community occurring in rich to extremely rich fens. Documented stands occur between 1035 and 1100 m (3,395 to 3,610 feet), always on deep peat of various states of decomposition that is perennially saturated to near the surface; only the hummocks dry in late summer. Only one water chemistry sample was taken but having a pH of 7.1 it confirms, what would be inferred from species composition, that this is a rich fen type.

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: This is a relatively species-rich herbaceous community averaging 27 plant species per plot (range from 14 to 40). Shrubs, both *Betula glandulosa* and *Dasiphora floribunda*, are consistently present in trace amounts. The composition is consistently diverse and generally so is the aspect, ranging from less dense with a total cover of around 30 % to dense culms and accompanying moss ground layer giving an impression of complete coverage. The graminoid component is conspicuous usually having indicators *Eleocharis quinqueflora* (= *E. pauciflora*) and *Trichophorum caespitosum* (= *Scirpus caespitosus*) dominant or co-dominant (averaging 38 % and 22 % cover, respectively). Several *Carex* spp. (*C. aquatilis*, *C. flava*, *C. lasiocarpa* and *C. utriculata*) are consistently present, although their cover seldom exceeds 5 %. The only other common graminoid is *Hordeum brachyantherum*, however it seldom exceeds trace amounts. Only four forb taxa exceed 50% constancy, *Dodecatheon pulchellum*, *Viola nephrophylla*, *Symphyotricum* spp. and *Zigadenus elegans* and they seldom approach even 5 % cover; *Comarum palustre* and *Menyanthes trifoliata* are notably absent and inconspicuous, respectively. Much of the diversity is contributed by a highly variable suite of “brown mosses” including *Bryum pseudotriquetrum*, *Campylium stellatum*, *Hypnum lindbergii*, *Pellia* spp., *Plagiomnium ellipticum*, *Scorpidium cossonii*, *Scorpidium scorpioides* and *Tomenthypnum nitens*; *Sphagnum* species were not found in this community.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Graminoids	<i>Eleocharis quinquefolia</i> , <i>Trichophorum caespitosum</i> ,
Bryophytes	<i>Scorpidium cossonii</i> , <i>Hypnum lindbergii</i> , <i>Campylium stellatum</i>

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Eleocharis quinquefolia, *Trichophorum caespitosum*, *Bryum pseudotriquetrum*, *Campylium stellatum*, *Hypnum lindbergii*, *Pellia* spp., *Plagiomnium ellipticum*, *Scorpidium cossonii*, *Scorpidium scorpioides*, *Tomenthypnum nitens*

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Carex leptalea (S1:ID, NT:MT), *Carex livida* (S2), *Trichophorum caespitosum* (S1), *Epipactis gigantea* (S2), *Scorpidium scorpioides* (S2)

GLOBAL SIMILAR ASSOCIATIONS

- *Eleocharis quinqueflora* – *Carex scopulorum* Herbaceous Vegetation (CEGL001837)
- *Eleocharis quinqueflora* Herbaceous Vegetation (CEGL001836)
- *Scirpus cespitosus* Herbaceous Vegetation (CEGL006260) doubtful, eastern only
- *Scirpus cespitosus* – *Carex livida* Herbaceous Vegetation (CEGL001842); G1, ID
- *Carex lasiocarpa* - *Carex buxbaumii* – *Scirpus cespitosus* Herbaceous Vegetation (CEGL002500)

SYNONYMY

- *Eleocharis pauciflora* Community Type (Chadde et al. 1995, Padgett et al. 1989) I
- *Eleocharis pauciflora* Habitat Type (Hansen et al. 1995) I
- Dodecatheo pulchelli – Zygadenetum elegantis Association, Trichophoretosum Subassoc. (Spribille No Date) I

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: There are a number of communities in the NVCS (and elsewhere) distinguished by *Eleocharis quinqueflora* or *Trichophorum caespitosum* but all apparently encompass a broader environmental spectrum than defined for this type. Both Hanson et al. (1995) and Padgett et al. (1989) define *E. quinqueflora* communities; Padgett et al. note that *S. cespitosus* (= *T. caespitosum*) is associated with this community and Hansen et al. note that pH varies from 6.0 to 7.0 and that soils are Borofibrists, Borohemists, and Borosaprists, which indicate organic accumulations. Thus the types of these two studies quite probably overlap with the type described herein, but the *Eleocharis pauciflora* c.t. described by Chadde et al. (1998) is noted to have *Sphagnum* common and “brown mosses” are not alluded to, so most probably they are describing a different water chemistry setting.

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: ID, MT

Federal Lands: Kootenai N. F.

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS016, TS018, TS019, TS022, TS917, TS929

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based; all of W. M. Jones’s plots were GPS georeferenced.

References: Chadde et al. 1995, Crowe & Clausnitzer 1997, Hansen et al. 1995, Jones 2003, Kovalchik 1987, Padgett et al. 1989, Spribille No Date, Vitt et al. 1988

CAREX UTRICULATA / “BROWN MOSSES” HERBACEOUS VEGETATION PEATLAND

Beaked Sedge / “Brown Mosses” Herbaceous Vegetation Peatland

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

KOOTENAI NATIONAL FOREST Environment: This small to large patch type is exclusively an herb-dominated peatland (fen) characterized by either an anchored or floating mat of vegetation and partially decomposed organic matter, usually more than a meter thick. The documented elevation range is from 1,035 to 1,490 m (3,395 to 4,890 feet); it quite probably extends to much higher elevations (2,195 m, 7,900 feet) to the south and southeast of the Kootenai N. F. Based on a limited amount of water analysis pH values were found to range from 6.3 to 7.7, considerably above pH 5.8, a value considered to define the uppermost range for poor fens; the majority of values exceeded pH 7.0, the lower limits of extremely rich fens. These sites have standing water from early in the growing season to midsummer and are perennially saturated to within 10 cm of the surface; only the hummock crests (where present) dry to any extent.

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: [Photographs Appendix E – G] Compared to the vegetation of fens with more acidic substrates, these sites are relatively diverse averaging 21 plant species per plot and ranging from 13 to 28 (by way of contrast *Carex lasiocarpa* / Sphagnum Mosses type averages 13.5 species per plot). Shrubs are present as incidentals with *Betula glandulosa*, *Salix candida* and *Rhamnus alnifolia* being present in more than 30 % of the plots. Though the herbaceous component is dominated by *Carex utriculata* with an average cover of about 45 %, in about 20 % of the plots it is co-dominant to subordinate to *Carex prairea*, an S2 within the state, and the only other *Carex* spp. consistently exhibiting more than 5 % cover. Graminoid spp. having at least 20% constancy include *Bromus ciliatus*, *Calamagrostis canadensis*, *Carex aquatilis*, *C. canescens*, *C. interior* and *C. leptalea*. A number of forbs have constancy greater than 20 %, including *Angelica arguta*, *Dodecatheon pulchellum*, *Epilobium palustre*, *Equisetum arvense*, *Galium trifidum*, *Geum macrophyllum*, *Maianthemum stellatum*, *Parnassia fimbriata*, *Petasites sagittatus*, *Symphotrichum* spp., *Triglochin palustre*, *Viola nephrophylla* and *Zigadenus elegans*; notably absent are *Comarum palustre* (= *Potentilla palustris*) and *Menyanthes trifoliata*. None of the listed herbs exceed 50% constancy and singly or combined their cover is seldom greater than 10 %. The ground layer is dominated by “brown mosses” (though the cover is highly variable) and *Sphagnum* spp., if present, occur in trace amounts. The following “brown mosses” occur with greater than 20 % constancy and at least half of them are the dominant of at least one plot: *Aneura pinguis* (= *Riccardia pinguis*), *Aulacomnium palustre*, *Bryum pseudotriquetrum*, *Calliergon giganteum*, *Campylium stellatum*, *Cratoneuron filicinum*, *Drepanocladus aduncus*, *Meesia triquetra*, *Palustriella falcata* (= *Cratoneuron falcatum*), *Philonotis fontana*, *Plagiomnium ellipticum*, *Scorpidium cossonii* and *Tomenthypnum nitens*.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Graminoids	<i>Carex utriculata</i> , <i>Carex prairea</i> , <i>Carex aquatilis</i>
Forbs	<i>Maianthemum stellatum</i> , <i>Petasites sagittatus</i>
Bryophytes	<i>Aulacomnium palustre</i> , <i>Calliergon giganteum</i> , <i>Campylium stellatum</i> , <i>Palustriella falcate</i> ,

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Carex utriculata, *C. prairea*, *C. aquatilis*, *Aneura pinguis* (= *Riccardia pinguis*), *Aulacomnium palustre*, *Bryum pseudotriquetrum*, *Calliergon giganteum*, *Campylium stellatum*, *Cratoneuron filicinum*, *Drepanocladus aduncus*, *Meesia triquetra*, *Palustriella falcata* (= *Cratoneuron falcatum*), *Philonotis fontana*, *Plagiomnium ellipticum*, *Scorpidium cossonii*, *Tomenthypnum nitens*.

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Salix candida (S2:ID, NT:MT), *Carex leptalea* (S2:ID, NT:MT), *Carex magellanica* (S3), *Carex prairea* (S2), *Eriophorum viridicarinatum* (S1:ID, NT:MT), *Cirsium arvense* (noxious weed), *Hamatocaulis vernicosus* (S1), *Meesia triquetra* (S2)

GLOBAL SIMILAR ASSOCIATIONS

- *Carex (rostrata, utriculata) – Carex lacustris – (Carex vesicaria)* Herbaceous Vegetation (CEGL002257)
- *Carex aquatilis – Carex rostrata (= C. utriculata)* Herbaceous Vegetation (CEGL001803)
- *Carex rostrata (= C. utriculata)* Herbaceous Vegetation (CEGL001562)

SYNONYMY

- *Carex rostrata (= C. utriculata)* Habitat Type (Hansen et al. 1995, Mattson 1984) I
- *Carex utriculata* Community Type (Chadde et al. 1998, Padgett et al. 1989, Tuhy and Jensen 1982) I
- *Carex utriculata* Plant Association (Carsey et al. 2003) I
- *Petasites sagittatus – Carex utriculata* Community (Spribille, no date) =
- *Carex aquatilis – Carex rostrata (= C. utriculata)* Vegetation Type (Holland & Coen 1982) =

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: The communities of GLOBAL SIMILAR ASSOCIATIONS and SYNONYMY sections above may overlap is part with the type described here but, the authors of these studies, with the exceptions of Spribille (no date) and Holland & Coen (1982), did not explicitly separate stands occurring on peatlands from those occurring on mineral soil and generally didn't consider the bryophyte flora, especially as it could be indicative of distinctly different environments. Hansen et al. (1995) clearly describe peatland conditions as part of their *C. utriculata (= C. rostrata)* type and note that it occupies a broad elevational gradient and is among the wettest of herb-dominated wetland types. Chadde et al. (1995) also recognized peatlands dominated by *C. utriculata* but did not separate poor from rich fens. Spribille (no date) for northwestern Montana described this type as the *Petasites sagittatus – Carex utriculata* Community and as characteristic of rich fens, often centered around springs; he recognized it as a provisional community type lacking sufficient samples to explicitly state how it differs from *C. utriculata*-dominated marshlands. Holland and Coen (1982) described a *C. aquatilis – C. rostrata* fen type in Banff and Jasper National Parks found from the Montane to Alpine Zone: the ground layer of this type is dominated by a variable suite of "brown mosses"

KOOTENAI NATIONAL FOREST Other Comments: The sources cited for this vegetation type were chosen to be geographically representative but not exhaustive; this is one of the more broadly defined, locally common and geographically extensive herbaceous vegetation types when referred to as merely *Carex utriculata* Herbaceous Vegetation.

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: ID, MT

Federal Lands: Flathead National Forest, Idaho Panhandle N. F., Kootenai N. F.

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS916, TS927, TS931, TS932, TS933, TS936, MJ0014, MJ0015, MJ0021, MJ0024, MJ0025, MJ0032, MJ0033, MJ0034, MJ0035, MJ0036:

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based; all of W. M. Jones's plots were GPS georeferenced. Both datasets have incomplete water chemistry sampling.

References: Carsey et al. 2003, Chadde et al. 1995, Hansen et al. 1995, Jones 2003, Kovalchik 1987, Padgett et al. 1989, Spribille No Date, Vitt et al. 1988, Tuhy and Jensen 1982:

ERIOPHORUM SPP. / SPHAGNUM SPP. HERBACEOUS VEGETATION PEATLAND

Cottongrass Species / Sphagnum Species Herbaceous Vegetation Peatland

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This small to large patch type is exclusively an herb-dominated peatland (fen) characterized by either an anchored or floating mat of vegetation and partially decomposed organic matter, usually more than a meter thick. It documented elevation range is from 925 to 1,890 m (3,030 to 6,200 feet). Based on single pH value, 4.7, this type is hypothesized to be characteristic of poor fens (pH values less than 5.7, Glaser 1987); *Sphagnum* spp. dominance of the ground layer would tend to confirm this interpretation. These sites have standing water from early in the growing season to midsummer and are nearly continuously saturated to the substrate surface, only the hummock crests (where present) dry to any extent.

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: Early and late in the growing season these communities look like common *Carex*-dominated fens but in late July they are distinctive with a riffling of white inflorescence topped stalks (hence cottongrass). For poor fens the plant species diversity of these sites (average 15, range 7 to 22) is appreciably higher than that of other poor fens in the vicinity. The near total lack of shrubs, the exception being a low cover of *Kalmia microphylla*, may be due to low pH values and lack of aeration. The dominance of *Eriophorum* species, including *E. angustifolia*, *E. chamissonis*, *E. viridicarinarum* (rather than wetland *Carex* spp.) is more inexplicable, although pH is probably not an important factor because *Eriophorum* spp. with brown mosses dominant is a common community in Banff and Jasper National Parks in Canada. Note that *Eriophorum gracile* is not part of the *Eriophorum* spp. suite defining this type; *E. gracile* is more associated with rich fens. *Calamagrostis canadensis* occurs with higher cover (average 7 %) and constancy (80%) than in any other peatland type on the forest. The same may be said of the following *Carex* spp. (all with constancy greater than 20 %) including *C. canescens*, *C. chordorrhiza*, *C. interior*, *C. lenticularis* and *C. magellanica*. *Carex* spp. thought of as peatland generalists and conspicuously absent or present in trace amounts in this type are *C. aquatilis*, *C. lasiocarpa*, *C. prairea* and *C. utriculata*. The following forbs exhibit between 20 and 50 % constancy and generally their single or combined cover does not exceed 10%: *Comarum palustre*, *Drosera anglica*, *Epilobium hornemannii*, *Equisetum arvense*, *Menyanthes trifoliata*, *Pedicularis groenlandica*, *Spiranthes romanzoffiana*, *Viola macloskeyi*, *V. palustris*. *Sphagnum* mosses including *S. angustifolia*, *S. subsecundum*, *S. teres* and *S. warnstorffii* dominate the ground layer. Brown mosses may also be present but their cover is minimal; only two of these mosses, *Aulacomnium palustre* and *Calliergon stramineum*, have more than 50 % constancy and unlike some other brown mosses both span the range from poor to rich fen types.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Graminoids	<i>Eriophorum angustifolium</i> , <i>E. chamissonis</i> , <i>E. viridicarinarum</i> , <i>Calamagrostis canadensis</i> , <i>Carex magellanica</i>
Herbs	<i>Comarum palustre</i> , <i>Drosera anglica</i> , <i>Menyanthes trifoliata</i>
Bryophytes	<i>Sphagnum angustifolium</i> , <i>S. subsecundum</i> , <i>Aulacomnium palustre</i> ,

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Eriophorum angustifolium, *E. chamissonis*, *E. viridicarinarum*, *Sphagnum angustifolium*, *S. subsecundum*

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Drosera anglica (S2), *Eriophorum viridicarinarum* (NT), *Carex chordorrhiza* (S1), *Carex magellanica* (S3), *Meesia triquetra* (S2), *Sphagnum magellanicum* (S1), *Sphagnum centrale* (S1)

GLOBAL SIMILAR ASSOCIATIONS

- *Eriophorum angustifolium* / *Drepanocladus* spp. Vegetation Type (Holland & Coen 1982) I

SYNONYMY

- Sphagno – Kalmietum microphyllae Association (Spribille, no date) I

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: Stands representing this association were included by Spribille (no date) as part of the Sphagno – Kalmietum microphyllae Association, even though they lacked *Kalmia microphylla* or supported only trace amounts of this species. Chadde et al. (1998) identified a *Kalmia microphylla* / *Carex aquatilis* Community Type described as “uncommon peatland community of poor fens at mid-elevations in western Montana; soils are wet, acidic Histosols”; somewhat surprisingly they listed neither *Eriophorum* spp. nor *Sphagnum* spp. as components of their poor fen type with the inference that there may be considerably more diversity of peatland types than had hitherto been appreciated. Within the dataset represented by the extensive Montana inventory of Hansen et al. (1995) *Eriophorum* spp. are very rare. Holland and Coen (1982) cite a *Eriophorum angustifolium* (= *E. polystachion*) / *Drepanocladus* spp. Vegetation Type for Banff and Jasper National Parks, however that is clearly a rich fen given the high cover of brown mosses and lack of *Sphagnum* spp. We infer from the above that this is a relatively uncommon type, and probably represented at a very limited number of sites.

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: ID, MT

USFS Ecoregions: M333A, M333B, M333D

Federal Lands: Kootenai National Forest

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS088, TS089, TS090, TS091, TS092, TS103, TS212, TS213, TS214, TS920, TS921, MJ0044:

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based; all of W. M. Jones’s plots were GPS georeferenced. Both datasets have incomplete sampling of water chemistry.

References: Chadde et al. 1998, Glaser 1987, Hansen et al. 1995, Holland & Coen 1982, Spribille (no date)

CAREX LIMOSA / SPHAGNUM MOSS HERBACEOUS VEGETATION PEATLAND

Mud Sedge / Sphagnum Moss Herbaceous Vegetation Peatland

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This small to large patch community type occurs as a floating mat peatland type, probably a poor fen based on a single pH reading (5.1, well within the poor fen range of 3.8 to 5.7, Glaser 1987) and the dominance of *Sphagnum* spp. mosses. Elevations of the four samples ranged between 1780 and 1805 m (5,840 to 5,920 feet), making this the highest elevation floating mat fen to occur on the Kootenai N. F. Soils are very poorly drained Histosols. Cold temperatures and perennially saturated conditions favor organic matter accumulation (peat formation) by retarding litter decay. Sites usually are bounded by open water and have any one of a number of sedge-dominated communities toward the drier end of the moisture gradient.

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: These sites, as is the case with most poor fens, exhibit low species diversity, the number of plant species (vascular and bryophytes) ranging from 7 to 13. The acidophilic *Kalmia microphylla* is the only shrub present, occurring in trace amounts. *Carex limosa* (averaging 48 % cover) can appear to be a monospecific dominant of the herbaceous layer but *Calamagrostis canadensis*, *Carex magellanica*, *C. utriculata*, *Eriophorum angustifolium* and *E. chamissonis* are consistently present, although their individual or combined cover usually does not exceed 10 %. Forbs are very weakly represented, only *Drosera rotundifolia* and *Menyanthes trifoliata* are present in at least half the plots, neither having more than 5 % cover. As expected for a poor fen “brown mosses” are uncommon, only the generalist *Calliergon stramineum* is present in half or more of the stands. *Sphagnum* mosses, especially *S. subsecundum*, dominate the ground layer; others include *S. angustifolium*, *S. russowii*, *S. tenerum*, *S. warnstorffii* and *S. centrale*. Leafy liverworts *Scapania undulata* and *Gymnocolea inflata* are intermixed with the Sphagnum and range in cover from mere traces to 20 % or more.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Graminoid	<i>Carex limosa</i> , <i>Eriophorum chamissonis</i>
Forbs	<i>Drosera rotundifolia</i> , <i>Menyanthes trifoliata</i>
Bryophytes	<i>Sphagnum subsecundum</i> , <i>S. angustifolium</i> , <i>Scapania undulata</i>

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Carex limosa, *Sphagnum subsecundum*, *S. angustifolium*, *S. russowii*, *S. centrale*, *S. tenerum*

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Carex magellanica (S3), *Sphagnum centrale* (S1)

GLOBAL SIMILAR ASSOCIATIONS

- *Carex limosa* Herbaceous Vegetation (CEGL001811)

SYNONYMY

- *Gymnocolea* – Caricetum limosae Dahl 1956 (provisional, Spribille no date) I
- *Carex limosa* Habitat Type (Hansen et al. 1995) I
- *Carex limosa* Community Type (Padgett et al. 1989, Chadde et al. 1998) I

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: This type (or a very close analogue) was first named as a plant association by Dahl in Norway (as *Gymnocoleo – Caricetum limosae*) and this name was subsequently applied by Spribille (no date) to relevés from extreme northwestern Montana following the conventions of the Zurich – Montpellier School of plant sociology. *Carex limosa* was absent from one of the plots assigned by Spribille to this type and this plot was subsequently categorized with *C. utriculata* / *Sphagnum* spp. based on the dominance of *C. utriculata*; Spribille’s placement of the plot in a type dominated by *C. limosa* is questionable on the notion of floristic affinity because the plot lacked both *G. inflata* and *Scapania* spp. as well. The *Carex limosa* Habitat Type (Hansen et al. 1995, equivalent to *C. limosa* Herbaceous Vegetation of NVCS) described for Montana leaves out all mention of a bryophyte layer but the component species listed lead one to conclude that their type overlaps in part (occurs in fens) with the more narrowly defined type described herein. The *C. limosa* c.t. of Padgett et al. (1989) of Utah and southeastern Idaho is characteristic of fens but based on the listed species the environment is hypothesized to be that of rich fens. Vitt et al. (1975) in a detailed analysis of patterned poor fens of the Swan Hills of north-central Alberta describe a *Carex limosa* Association which has two phases, a shallow water situation characterized by *Sphagnum jensenii* dominance and a deeper water condition where *Warnstorffii exannulata* (= *Drepanocladus exannulatus*) is dominant; both of these phases, and the abiotic conditions they indicate, would fit reasonably well with the concept of this type. The name we have applied accords with the NVCS emphasis on existing vegetation and recognizes the indicator significance of *Sphagnum* spp., while discounting the emphasis placed on floristic uniqueness conferred by the “Gymnocoleo” appellation of Spribille (no date).

KOOTENAI NATIONAL FOREST Other Comments: This vegetation type occurs as a small patch type in a complex mosaic of vegetation; mapping of this type at 1:24,000 scale is impracticable and the individual peatlands are best treated as a system type (for mapping or management).

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: ID, MT

USFS Ecoregions: M333A, M333B, M333D

Federal Lands: Flathead National Forest, Idaho Panhandle N. Fs., Kootenai N. F.

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS099, TS102, TS110, TS112, TS113

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based; all of W. M. Jones’s plots were GPS georeferenced. Both datasets are incomplete in terms of water chemistry sampling, though Jones has more data.

References: Chadde et al. 1995, Glaser 1987, Hansen et al. 1995, Jones 2003, Padgett et al. 1989, Spribille No Date, Vitt et al. 1988, Tuhy and Jensen 1982

CAREX UTRICULATA / SPHAGNUM SPP. HERBACEOUS VEGETATION PEATLAND
Beaked Sedge / Sphagnum Mosses Herbaceous Vegetation Peatland

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This small to large patch community type occurs as a floating mat peatland type, probably a type of poor fen based on a single pH reading (5.1, well within the poor fen range of 3.8 to 5.7, Glaser 1987) and the dominance of *Sphagnum* spp. mosses and a lack of a well developed “brown moss” component. Elevations of the three samples ranged between 1785 and 1805 m (5,855 to 5,920 feet), making this, along with the *C. limosa* / *Sphagnum* spp. community, the highest elevation floating mat fens to occur on the Kootenai N. F. Soils are very poorly drained Histosols. Cold temperatures and perennially saturated conditions favor organic matter accumulation (peat formation) by retarding litter decay. Sites usually are bounded by open water and any one of a number of sedge-dominated communities toward the drier end of the moisture gradient.

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: These sites, as is the case with most poor fens, exhibit low species diversity (richness), the number of plants (vascular and bryophytes) ranging from 4 to 13. No shrubs species were recorded for this type. *Carex utriculata* (averaging 20 % cover) can appear to be a monospecific dominant of the herbaceous layer but *Calamagrostis canadensis*, *Carex limosa*, *C. canescens* and *Eriophorum angustifolium* are consistently present, although their individual or combined cover usually does not much exceed 10 %. Forbs are very weakly represented, two plots having none and one plot having only one. As expected for a poor fen “brown mosses” are uncommon. *Sphagnum* mosses, especially *S. subsecundum* and *S. russowii* may dominate the ground layer; others include *S. tenerum* and *S. centrale*. One plot had a poor representation of both *Sphagnum* spp. and brown mosses and was considered to have greater affinity with the species depauperate poor fen represented by this type.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Graminoid	<i>Carex utriculata</i> , <i>Carex limosa</i> , <i>Carex canescens</i>
Bryoids	<i>Sphagnum russowii</i> , <i>Sphagnum subsecundum</i> ,

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Carex utriculata, *Sphagnum* spp. [not including *S. warnstorffii*]

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Carex magellanica (S3), *Drosera anglica* (S2), *Warnstorfia exannulata* (S1)

GLOBAL SIMILAR ASSOCIATIONS

- *Carex rostrata* (= *C. utriculata*) Herbaceous Vegetation (CEGL001562)

SYNONYMY

- *Carex utriculata* Community Type (Chadde et al. 1998, Padgett et al. 1989, Tuhy and Jensen 1982) I
- *Carex rostrata* (= *C. utriculata*) Habitat Type (Hansen et al. 1995) I

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: *Carex utriculata* dominated communities are among the most common of graminoid-dominated wetland types; they also span a considerable environmental range from

nutrient-rich marshes to low pH poor fens, such as exemplified by the type recognized in this description. However, until the two peatland types (*C. utriculata* / “Brown Mosses, *C. utriculata* / *Sphagnum* spp.) were recognized for the Kootenai N.F. the variability inherent in *C. utriculata*-dominated communities had only been recognized by Hansen et al. (1995) as “phases” representing either floristic differences or water regimes of varying duration, but did not relate to water chemistry in any way. Often this fen occurs in association with *Carex limosa* / *Sphagnum* spp., *C. lasiocarpa* / *Sphagnum* spp. and other *Carex*-dominated types; it is difficult to imagine that there are appreciable environmental differences between these communities, rather preemption of space by these aggressive, rhizomatous colonizers most likely accounts for their dominance and the identification of multiple communities in a given fen or complex of fens.

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: MT

USFS Ecoregions: M333A; M333B

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS111, TS210, TS211

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based; all of W. M. Jones’s plots were GPS georeferenced. Both datasets are complete with regard to species identification including nonvasculars and incomplete in terms of water chemistry sampling, though Jones had more data.

References: Chadde et al. 1995, Glaser 1987, Hansen et al. 1995, Jones 2003, Padgett et al. 1989, Spribille No Date, Vitt et al. 1988, Tuhy and Jensen 1982

CAREX NIGRICANS HERBACEOUS VEGETATION PEATLAND (PROVISIONAL)
Black Alpine Sedge Herbaceous Vegetation Peatland (Provisional)

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This small patch fen type is represented by only two plots, both occurring on anchored peat mats. *Carex nigricans* as a dominant is usually associated with high subalpine to alpine snowbed sites but in this case it is characteristic of far different environmental parameters, high-elevation fens between 1785 and 2040 m (5,855 and 6,690 feet). No information is available on water chemistry; no conclusion can be reached based on bryophyte composition either because in one case *Aulacomnium palustre*, a species ranging from marl fens to poor fens (Slack 1994), is strongly dominant and in the other plot a *Scapania* species is quite abundant (and this genus tends to be associated with lower pH environments, Slack 1994).

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: Plant species richness ranged between 8 and 12. These are comparatively open sites based on the appearance of the herbaceous layer having less than 40 % cover. *Carex nigricans*, *C. scopulorum* and *Eriophorum angustifolium* are the most abundant graminoids. *Viola palustris* is the only forb present in either plot. The ground layer is not particularly species rich but it forms nearly a complete cover with *Aulacomnium palustre* and *Scapania* spp. providing most of the cover.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Graminoids	<i>Carex nigricans</i> , <i>Carex scopulorum</i>
Bryophytes	<i>Aulacomnium palustre</i> , <i>Scapania</i> spp.

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Carex nigricans

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Carex magellanica (S3), *Viola palustris* (SU)

GLOBAL SIMILAR ASSOCIATIONS

- *Carex nigricans* Herbaceous Vegetation (CEGL001816)

SYNONYMY

- *Carex scopulorum* Habitat Type (Hansen et al. 1995) I

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: Prior to the description of this type the only *Carex nigricans*-characterized communities were typified as snowbed sites, with abundant and long-persisting snow cover (some representative types include Phleo communtati – Caricetum nigricantis (Komarkova) (Damm 2001), *Carex nigricans* community type (Cooper et al. 1997), and *Carex nigricans* – *Juncus drummondii* Herbaceous Vegetation [CEGL001818]). The type described here is distinctly different; occurring on perennially saturated peaty substrates. A few stands allocated to the *Carex scopulorum* H. T. of Hansen et al. (1995) might be *Carex nigricans*-dominated peaty wetlands but this is impossible to know without examining the original data. The *Carex nigricans* Peatland Association is poorly documented at present and given its probable environment parameters, high elevation wetlands with poor aeration, and no mention in the wetlands literature, it is almost certain to be an

uncommon type. More information is needed concerning water chemistry to place it on the poor fen to extremely rich fen gradient.

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: MT

USFS Ecoregions: M333A, M333B, M333D

Federal Lands: Kootenai National Forest

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS208, TS941:

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based; all of W. M. Jones's plots were GPS georeferenced. Both datasets are complete with regard to species identification including nonvasculars and incomplete in terms of water chemistry sampling, although that of Jones has more data.

References: Cooper et al. 1997, Damm 2001, Hansen et al. 1995, Slack 1994

CAREX FLAVA / “BROWN MOSSES” HERBACEOUS VEGETATION PEATLAND

Yellow Sedge / “Brown Mosses” Herbaceous Vegetation Peatland

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST ENVIRONMENT: This small to large patch type is exclusively an herb-dominated peatland characterized by either an anchored or floating mat of vegetation and partially decomposed organic matter, usually more than a meter thick. These sites are perennially saturated to the surface; only in late summer do the hummock crests (where present) dry to any extent. This type exhibits a narrow elevation range, from 1340 to 1430 m (4,395 to 4,690 feet). Based on a limited amount of water analysis pH values were found to range from 6.4 to 7.3, at the high end of the rich fen range and well into the extremely rich fen range (pH > 7.0, as defined by parameters for Minnesota peatlands by Glaser (1987).

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: Compared to the vegetation of fens with more acidic substrates these sites are relatively diverse averaging 21 plant species per plot and ranging from 13 to 27 (by way of contrast *Carex lasiocarpa* / *Sphagnum* Mosses type averages 13.5 species per plot). *Dasiphora floribunda* is present as an incidental shrub. The herbaceous component is dominated by *Carex flava* with an average cover of about 35 %; other *Carex* spp. are consistently present but only *C. utriculata* (100 % constant, 11 % cover), *C. leptalea* and *C. gynocrates* exhibit more than 5 % cover. *Eriophorum chamissonis*, *E. viridicarinarum* and *Juncus ensifolius* have high constancy, but only the *Eriophorum* spp. were noted to occasionally co-dominate the herbaceous layer with *C. flava*. A number of forbs have constancy greater than 50 %, including *Dodecatheon pulchellum*, *Equisetum arvense*, *Fragaria virginiana*, *Parnassia fimbriata*, *Petasites sagittatus*, *Symphyotrichum* spp., *Viola macloskeyi*, *Viola nephrophylla* and *Zigadenus elegans*; their single or combined cover is seldom greater than 10 %. Notably absent are *Comarum palustre* (= *Potentilla palustris*) and *Menyanthes trifoliata*. The ground layer is dominated by “brown mosses” (though the cover is highly variable). *Sphagnum* spp., if present, occur in mere trace amounts. The following “brown mosses” occur with greater than 20 % constancy and at least half of those listed are the expressed dominant of at least one plot: *Bryum pseudotriquetrum*, *Calliargon giganteum*, *Campylium stellatum*, *Meesia triquetra*, *Philonotis fontana*, *Scorpidium cossonii* and *Tomenthypnum nitens*.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Graminoids	<i>Carex flava</i> , <i>Carex utriculata</i> , <i>Carex leptalea</i> , <i>Eriophorum chamissonis</i> , <i>E. viridicarinarum</i>
Forbs	<i>Dodecatheon pulchellum</i> , <i>Petasites sagittatus</i> , <i>Zigadenus elegans</i>
Bryophytes	<i>Calliargon giganteum</i> , <i>Campylium stellatum</i> , <i>Scorpidium cossonii</i> , <i>Tomenthypnum nitens</i>

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Carex flava, *Carex leptalea*, “Brown mosses”

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Eriophorum viridicarinarum (S1:ID, NT:MT), *Cirsium arvense* (noxious weed), *Hamatocaulis vernicosus* (S1), *Meesia triquetra* (S1)

GLOBAL SIMILAR ASSOCIATIONS

- (none)

SYNONYMY

- (none)

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: This association appears to be newly described for Montana; none of the Hansen et al. (1995) wetland vegetation types even have *Carex flava* listed, except as a very minor component of some other *Carex*-dominated types. *Carex flava* is a circumboreal species and occurs in the northeastern US as a component of a number of saturated, shrub-herbaceous associations with common graminoid associates being *C. interior*, *C. hystricina*, *C. sterilis* and *Eriophorum alpinum* and the shrubs *Cornus racemosa*, *Myrica pensylvanica*, and *Dasiphora floribunda* (= *Pentaphylloides floribunda*); only the condition where *D. floribunda* and *C. flava* would be paired on a site is at all resonant with the composition of Kootenai NF stands. Chadde et al. (1998) make no mention of *C. flava* occurring within Northern Rocky Mountain peatlands. Slack et al. (1980) report not even trace amounts of *C. flava* for the minerotrophic rich fens of western Alberta (dominated by *C. limosa* and rather narrowly defined, based on differing bryophyte composition) that otherwise have much in common, both compositionally and environmentally, with the type described herein. Stands of this type were not grouped, despite their appreciable cover of *Eriophorum* spp., with the *Eriophorum*-characterized association recognized in this study because a “brown moss” component is conspicuously present and highly indicative of at least a rich fen environment. The conspicuous presence of *Carex leptalea*, recognized as an obligate rich fen indicator throughout North America (Anderson et al. 1996), also argues for classifying this grouping of stands as a rich fen assemblage.

KOOTENAI NATIONAL FOREST Other Comments: The rarity of this type is uncertain but it may be quite uncommon (with only 4 known occurrences and minimal inventory it could be considered a G1?).

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: MT

USFS Ecoregions: M333A, M333B

Federal Lands: Kootenai National Forest

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS006, TS007, MJ0013, MJ0016

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based; all of W. M. Jones’s plots were GPS georeferenced. Both datasets are complete with regard to species identification including nonvasculars and incomplete in terms of water chemistry sampling, although that of Jones has more data.

References: Anderson et al. 1996, Chadde et al. 1998, Hansen et al. 1995, Slack et al. 1980

CAREX LIMOSA / “BROWN MOSSES” HERBACEOUS VEGETATION PEATLAND Mud Sedge / “Brown Mosses” Herbaceous Vegetation Peatland

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This small to large patch type is exclusively an herb-dominated peatland characterized by either an anchored or floating mat of vegetation and partially decomposed organic matter (peat), usually more than a meter thick. These sites are perennially saturated to the surface, having standing water through the spring and early summer, only in late summer do the hummock crests (where present) dry to any extent. This type exhibits a narrow elevation range, from 925 to 1060 m (3,035 to 3,475 feet). Based on a limited amount of water analysis pH values were found to range from 5.3 to 6.6; based on Minnesota criteria (Glaser 1987) this is the upper end of the poor fen range and well into the rich fen range (pH > 5.8 and < 7.0).

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: Species richness of this assemblage is relatively low, ranging from 9 to 17, and reinforces the notion gained from water chemistry that this is a transitional type, from poor to rich fen. *Salix candida* is present as an incidental shrub. The herbaceous component is dominated by *Carex limosa* with an average cover of about 25 %; other *Carex* spp. are consistently present but only *C. lasiocarpa* (100 % constant, 5 % cover), *C. interior* and *C. diandra* exhibit more than 5 % cover and/or greater than 50 % constancy. *Eriophorum gracile* is the only other high constancy graminoid present. A number of forbs have constancy greater than 50 %, including *Comarum palustre*, *Epilobium palustre*, *Equisetum fluviatile*, *Menyanthes trifoliata*, *Spiranthes romanzoffiana* and *Utricularia minor*. Notably abundant (15 % average cover) is *Menyanthes trifoliata*, which in other “Brown Moss”-characterized types is absent or depauperate; this abundance reinforces the impression of this as a transitional type. The aquatic *Utricularia minor* characterizes standing water pools emphasizing these sites as among the wettest of Kootenai NF fen types. The ground layer is dominated by “brown mosses” (although the cover is highly variable) and *Sphagnum* spp., if present, occur in mere trace amounts. The following “brown mosses” occur with greater than 25 % constancy and at least half of them are the expressed dominant/co-dominant of more than one plot: *Aneura pinguis* (= *Riccardia pinguis*), *Aulacomnium palustre*, *Campylium stellatum*, *Hamatocaulis vernicosus*, *Meesia triquetra*, *Palustriella falcata*, *Scorpidium cossonii* (= *Drepanocladus revolvens*) and *Scorpidium scorpioides*. *Tomenthypnum nitens* is conspicuously absent, ostensibly due to these being extremely wet sites; *T. nitens* is characteristically associated with strings (drier ridges, Slack et al. 1980).

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Graminoids	<i>Carex limosa</i> , <i>Carex interior</i> , <i>Eriophorum gracile</i>
Forbs	<i>Comarum palustre</i> , <i>Menyanthes trifoliata</i> , <i>Lycopus uniflorus</i>
Bryoids	<i>Aneura pinguis</i> (= <i>Riccardia pinguis</i>), <i>Aulacomnium palustre</i> , <i>Campylium stellatum</i> , <i>Hamatocaulis vernicosus</i> , <i>Meesia triquetra</i> , <i>Palustriella falcata</i> , <i>Scorpidium cossonii</i> (= <i>Drepanocladus revolvens</i>) <i>Scorpidium scorpioides</i>

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Carex limosa, *Aneura pinguis* (= *Riccardia pinguis*), *Aulacomnium palustre*, *Campylium stellatum*, *Hamatocaulis vernicosus*, *Meesia triquetra*, *Palustriella falcata*, *Scorpidium cossonii* (= *Drepanocladus revolvens*), *Scorpidium scorpioides* and other “Brown Mosses”

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Hamatocaulis vernicosus (S1), *Meesia triquetra* (S2)

GLOBAL SIMILAR ASSOCIATIONS

- *Carex limosa* Herbaceous Vegetation (CEGL001811)

SYNONYMY

- *Carex limosa* Habitat Type (Hansen et al. 1995) I
- *Carex limosa* Community Type (Padgett et al. 1989, Chadde et al. 1998, Mattson 1984) I
- *Scorpidium scorpioides* – *Scorpidium cossonii* (= *Drepanocladus revolvens*) – *Carex limosa* Community Type (Slack et al. 1980)

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: There is but one *Carex limosa* association recognized at the US national level (NVCS) and it is probably largely derived from the Hansen et al. (1995) description of a *Carex limosa* Habitat Type for Montana; a similarly named community has been described for northwestern Wyoming (Mattson 1984), Idaho (Chadde et al. 1998) and the Uinta Mountains of Utah (Padgett et al. 1989). Despite having a much higher and broader elevation range (1787 to 2425 m or 5,860 to 7,950 feet), this Hansen et al. (1995) type still possesses environmental parameters of this type, floating or quaking mats and peaty soils; based on this elevation range the type was described for areas other than this northwestern corner of the state. The abiotic conditions described by the other authors clearly span a broad range from *Carex*-meadows with organic soils to floating peat mats. Much more intensive investigations have been conducted in western Canada focusing on composition, chemistry and hydrology, particularly by D. Vitt and associates; they have shown *C. limosa* and *Menyanthes trifoliata* to be peatland generalists, having a broad amplitude with regard to pH and conductivity; *C. limosa* is consistently dominant from extremely rich fens to poor fens. Slack et al. (1980) state that bryophytes “are extremely sensitive indicators of minerotrophic conditions and separate fens types to a fine degree.” The bryophytes *Scorpidium scorpioides* and *S. cossonii* characterize an extremely rich flark community type (*Scorpidium scorpioides* – *Drepanocladus revolvens* (= *S. cossonii*) – *Carex limosa*); bryophytes (and to lesser degree vasculars) are also used to distinguish at least three phases of this community. At least two of their phases match well with the composition recognized herein. The water chemistry and nutrient content of this and related types is thoroughly detailed and related to composition by Vitt and Chee (1990).

ELEMENT DISTRIBUTION

Nations: CA, US

States/Provinces: AB, ID, MT, UT (?), WY (?)

USFS Ecoregions: M333A, M333B, M333C, M333D, M331A (?), M341B (?)

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS910, TS911, MJ0026, MJ0042

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based; all of W. M. Jones’s plots were GPS georeferenced. Both datasets are complete with regard to species identification including nonvasculars and incomplete in terms of water chemistry sampling, although that of Jones has more data.

References: Chadde et al. 1998, Hansen et al. 1995, Mattson 1984, Padgett et al. 1989, Slack et al. 1980, Vitt and Chee 1990

CAREX SCOPULORUM / SPHAGNUM MOSSES HERBACEOUS VEGETATION PEATLAND
Mountain Sedge / Sphagnum Mosses Herbaceous Vegetation Peatland

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This provisional type has been sampled from one subalpine (1830 m, 6,000 ft.) wetland complex at Canuck Pass where it constitutes a perennially saturated, anchored peat mat. Water chemistry values are not available but the vegetation composition (*Sphagnum* spp. dominated) is consistent with the low pH and conductivity values of poor fens.

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: On the basis of minimal data, sites are characterized as species poor with only 11 to 14 plant species. The consistent presence of *Kalmia microphylla* is perhaps indicative of the presumed acidic substrate conditions. The graminoid component is dominated by *Carex scopulorum*, which averages 35 % cover; other consistently present graminoids include *C. nigricans*, *Agrostis humilis*, and *Eriophorum angustifolium*. Overall forb diversity is low; *Ligusticum canbyi* is the only forb with a conspicuous presence, higher here than any other KNF peatland type for unknown reasons. *Sphagnum angustifolium* and *S. subsecundum*, both characterized as poor fen hummock species in one detailed study (Vitt and Chee 1990) are the dominant bryophytes; in one case forming a virtual lawn and in the other being present with sufficiently high cover as to give the appearance of a bryoid layer. Of the other bryoids present none exceed 1 % cover. In one intensive study in western Alberta (Vitt and Chee 1990) *Calliergon stramineum* is typified as a widespread fen species; *Aneura pinguis* (= *Riccardia pinguis*) and *Aulacomnium palustre* are associated with extreme-rich fens and moderate-rich fens, respectively. However a study of mires in Alberta's Swan Hills (Vitt et al. 1975) showed *Aulacomnium palustre* to be associated with poor fens; so the current perspective on this species is that it exhibits a broad amplitude of adaptability with regard to pH and conductivity; the same conclusion of generalist holds in New York where it exhibited high cover (to 70 %) along the whole extremely-rich to poor-fen gradient (Slack 1994).

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Graminoids	<i>Carex scopulorum</i> , <i>Carex nigricans</i>
Forbs	<i>Ligusticum canbyi</i>
Bryoids	<i>Sphagnum angustifolium</i> , <i>Sphagnum subsecundum</i>

CHARACTERISTIC SPECIES

Kootenai National Forest

Carex scopulorum, *Sphagnum* spp. (except *S. warnstorffii*)

OTHER NOTEWORTHY SPECIES

KOOTENAI NATIONAL FOREST

Carex magellanica (S3), *Viola palustris* (SU), *Hamatocaulis vernicosus* (S1)

GLOBAL SIMILAR ASSOCIATIONS

- *Carex scopulorum* Herbaceous Vegetation (CEGL001822)
- *Carex scopulorum* / *Caltha leptosepala* Herbaceous Vegetation (CEGL001823)

SYNONYMY

- *Carex scopulorum* Habitat Type (Hansen et al. 1995) I
- *Carex scopulorum* Community Type (Chadde et al. 1998) I

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: The *Carex scopulorum* Community Types/Habitat Types described for Montana, the Northwest and Colorado (Hansen et al. 1995, Chadde et al. 1998, Carsey 2003) appear to characterize a spectrum of *Carex scopulorum*-dominated types from seasonally wet meadows to rich- to extremely-rich fens but, not poor fens as we believe to be the case with the community being described. These other communities lack the depth of peat demonstrated for KNF sites, if peat is present at all, and these communities have a rich and abundant complement of forbs, a feature conspicuously lacking in our plots. Thus this type is highly unusual and should be tracked and better documented.

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: MT

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS923, TS924

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based; all of W. M. Jones's plots were GPS georeferenced. Both datasets are complete with regard to species identification including nonvasculars and incomplete in terms of water chemistry sampling, although that of Jones has more data.

References: Carsey et al. 2003, Chadde et al. 1998, Hansen et al. 1995

***DULICHIMUM ARUNDINACEUM* HERBACEOUS PEATLAND (PROVISIONAL)**
Threeway Sedge Herbaceous Peatland (Provisional)

ELEMENT CONCEPT

ENVIRONMENTAL DESCRIPTION

USFWS Wetland System: Palustrine

KOOTENAI NATIONAL FOREST Environment: This peatland community of northwestern Montana and northern Idaho occurs as small to large patches on both anchored and floating mats, and is a relatively uncommon poor fen type. It has been documented to occur from 1170 to 1790 m (3,840 to 5,860 feet). It is found on sites flooded in spring and early summer that are saturated to the surface with the water table within a decimeter or two of the surface, even in late summer. Based on minimal water chemistry data, pH values (4.9) are well within the range expressed by poor fens at least in Minnesota (Glaser 1987) and New York (Slack 1994).

VEGETATION DESCRIPTION

KOOTENAI NATIONAL FOREST Vegetation: This poor fen type is characteristically species poor, the number of plant species ranging between 2 and 14, with cover of the indicator *Dulichium arundinaceum* ranging from about 5 to 30 %. Shrubs are not represented and the cover of herbaceous species, other than *Dulichium*, was not found to exceed 10 % with *Carex lasiocarpa* and *C. utriculata* being the commonly represented graminoids and *Comarum palustre* (= *Potentilla palustris*), *Menyanthes trifoliata* and *Lycopus uniflorus* the highly constant forbs. The bryoid component is comparably depauperate, only *Sphagnum subsecundum*, which is diagnostic and can form a virtual lawn, and *Aulacomnium palustre* are consistently present. A number of sensitive plants occur in coverages not exceeding 5 %, including *Drosera anglica*, *Carex chordorrhiza*, and *Scheuchzeria palustris*.

MOST ABUNDANT SPECIES

KOOTENAI NATIONAL FOREST

Stratum	Species
Graminoids	<i>Dulichium arundinaceum</i>
Bryophytes	<i>Sphagnum subsecundum</i>

CHARACTERISTIC SPECIES

KOOTENAI NATIONAL FOREST

Dulichium arundinaceum, *Sphagnum* spp. (except *S. warnstorffii*)

OTHER NOTEWORTHY SPECIES

Kootenai National Forest

Carex chordorrhiza (S2), *Drosera anglica* (S2), *Scheuchzeria palustris* (S1)

GLOBAL SIMILAR ASSOCIATIONS

- *Dulichium arundinaceum* Herbaceous Vegetation (CEGL001831)

SYNONYMY

- *Dulichium arundinaceum* Community Type (Pierce 1986) =
- Sphagno – Caricetum lasiocarpae Association (Spribille [no date]) I

CLASSIFICATION COMMENTS

KOOTENAI NATIONAL FOREST Classification Comments: This community described is a poor fen type developed on peatlands with histic soils and vegetationally characterized by *Sphagnum* spp. dominating the ground layer and *Dulichium arundinaceum* dominating the herbaceous component. This is a strong contrast to at least part of the description of *Dulichium arundinaceum* Herbaceous Vegetation (CEGL001931) where *Dulichium* is often a virtual monospecific dominant on mineral soils. *D. arundinaceum* seems to be one of the wetland graminoids, like *Carex*

lasiocarpa or *C. utriculata*, which have broad amplitudes with respect to rooting medium and substrate chemistry. A possible type would be *D. arundinaceum* dominance with *Sphagnum* spp. (at least those indicative of poor fens, i.e. not including *S. warnstorffii* and perhaps others) well represented and “brown mosses” not represented and occurring in peatland environments. Spribille (no date) included at least two stands dominated by *D. arundinaceum* and *Sphagnum* species in his Sphagno – Caricetum lasiocarpae Association that have considerable similarity in vegetation and environment (peatlands) to this type.

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: ID, MT

USFS Ecoregions: M333A, M333B

Federal Lands: Idaho Panhandle National Forest, Kootenai National Forest

ELEMENT SOURCES

KOOTENAI NATIONAL FOREST Plots Defining This Type: TS937, TS938, TS939:

KOOTENAI NATIONAL FOREST Inventory Notes: W. M. Jones (MTNHP) and T. Spribille (KNF) conducted inventories on the Kootenai N. F. and contributed the dataset upon which this description is based; all of W. M. Jones’s plots were GPS georeferenced. Both datasets are complete with regard to species identification including nonvasculars and incomplete in terms of water chemistry sampling, although that of Jones has more data.

References: Glaser 1987, Pierce 1986, Slack 1994

**APPENDIX D. COVER / CONSTANCY FOR KOOTENAI NATIONAL FOREST
PEATLAND ASSOCIATIONS**

	Shrub- or Dwarf-shrub-characterized Communities								Graminoid-characterized Communities							
	BETGLA / <i>Carex</i> spp. / Brown Moss		KALMIC / <i>Sphagnum</i>		SALCAN / CARUTR		SPIDOU / CARLAS		CARFLA / Brown Moss		CARLAS / Brown Moss		CARLAS / <i>Sphagnum</i>		CARLIM / Brown Moss	
TREE SPECIES	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons
<i>Abies lasiocarpa</i> (Hook.) Nutt.	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.13	25.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Picea engelmannii</i> Parry ex Engelm.	1.19	52.38	0.13	25.00	0.25	50.00	0.00	0.00	0.00	0.00	0.02	3.33	0.00	0.00	0.00	0.00
SHRUBS & DWARF-SHRUBS																
<i>Alnus viridis</i> (Vill.) Lam. & DC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	10.53	0.00	0.00
<i>Betula glandulosa</i> Michx.	26.29	100.00	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.28	23.33	0.16	5.26	0.00	0.00
<i>Cornus canadensis</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Cornus sericea</i> L.	0.02	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Dasiphora floribunda</i> (Pursh) Kartesz	8.05	85.71	0.00	0.00	0.25	50.00	0.00	0.00	0.13	25.00	0.20	6.67	0.00	0.00	0.00	0.00
<i>Kalmia microphylla</i> (Hook.) Heller	0.00	0.00	27.50	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Ledum glandulosum</i> Nutt.	0.02	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Rhamnus alnifolia</i> L'Hér.	0.26	28.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Ribes hudsonianum</i> Richards.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Rubus arcticus</i> L. ssp. <i>acaulis</i> (Michx.) Focke	0.02	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Rubus pubescens</i> Raf.	0.17	9.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	6.67	0.00	0.00	0.00	0.00
<i>Salix bebbiana</i> Sarg.	0.02	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Salix boothii</i> Dorn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Salix candida</i> Flueggé ex Willd.	0.81	66.67	0.00	0.00	11.50	100.00	0.00	0.00	0.00	0.00	0.35	20.00	0.00	0.00	0.13	25.00
<i>Salix drummondiana</i> Barratt ex Hook.	0.05	9.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Salix glauca</i> L.	0.02	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Salix</i> L.	0.26	28.57	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Salix planifolia</i> Pursh	0.05	9.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Salix tweedyi</i> (Bebb ex Rose) Ball	0.48	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Spiraea douglasii</i> Hook.	0.00	0.00	0.00	0.00	0.00	0.00	65.00	100.00	0.00	0.00	0.00	0.00	0.24	21.05	0.00	0.00

	BETGLA / Carex spp. / Brown Moss		KALMIC / Sphagnum		SALCAN / CARUTR		SPIDOU / CARLAS		CARFLA / Brown Moss		CARLAS / Brown Moss		CARLAS / Sphagnum		CARLIM / Brown Moss	
	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons
GRAMINOIDS																
<i>Agrostis gigantea</i> Roth	0.00	0.00	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.15	13.33	0.00	0.00	0.00	0.00
<i>Agrostis humilis</i> Vasey	0.02	4.76	0.88	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Agrostis scabra</i> Willd.	1.45	9.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	0.03	5.26	0.13	25.00
<i>Bromus ciliatus</i> L.	0.12	23.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Calamagrostis canadensis</i> Michx.	4.71	19.05	0.00	0.00	0.00	0.00	5.00	50.00	0.00	0.00	0.03	6.67	0.34	15.79	0.00	0.00
<i>Calamagrostis stricta</i> (Timm) Koel.	0.17	9.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	0.55	15.80	0.00	0.00
<i>Carex aquatilis</i> Wahlenb.	1.31	33.33	0.00	0.00	5.00	50.00	0.00	0.00	0.00	0.00	0.33	16.67	0.00	0.00	0.00	0.00
<i>Carex aurea</i> Nutt.	0.74	33.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	6.67	0.00	0.00	0.00	0.00
<i>Carex buxbaumii</i> Wahlenb.	4.05	14.29	0.00	0.00	0.00	0.00	0.00	0.00	2.50	25.00	4.23	20.00	0.03	5.26	0.00	0.00
<i>Carex canescens</i> L.	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	0.24	21.05	0.00	0.00
<i>Carex chordorrhiza</i> Ehrh. ex L.f.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.66	15.79	0.00	0.00
<i>Carex diandra</i> Schrank	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.48	30.00	0.18	10.53	0.88	50.00
<i>Carex echinata</i> Murr.	1.00	38.10	0.00	0.00	0.00	0.00	0.00	0.00	0.13	25.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Carex exsiccata</i> Bailey	0.00	0.00	0.00	0.00	0.00	0.00	1.50	50.00	0.00	0.00	0.33	3.33	0.05	10.53	0.00	0.00
<i>Carex flava</i> L.	1.00	14.29	0.00	0.00	0.00	0.00	0.00	0.00	35.75	100.00	1.07	20.00	0.00	0.00	0.00	0.00
<i>Carex gynocrates</i> Wormsk. ex Drej.	0.17	33.33	0.00	0.00	0.00	0.00	0.00	0.00	3.75	25.00	0.15	13.33	0.00	0.00	0.00	0.00
<i>Carex interior</i> Bailey	0.21	19.05	0.00	0.00	0.25	50.00	0.00	0.00	2.50	25.00	0.58	33.33	0.55	31.58	13.25	50.00
<i>Carex lasiocarpa</i> Ehrh.	4.12	28.57	0.00	0.00	0.00	0.00	35.00	100.00	0.00	0.00	7.93	100.00	28.05	94.74	5.88	100.00
<i>Carex lenticularis</i> Michx.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	6.67	0.53	5.26	0.00	0.00
<i>Carex leptalea</i> Wahlenb.	3.17	80.95	0.00	0.00	0.25	50.00	0.00	0.00	2.60	75.00	0.03	6.67	0.00	0.00	0.00	0.00
<i>Carex limosa</i> L.	0.00	0.00	0.75	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	16.67	7.92	63.16	25.00	100.00
<i>Carex livida</i> (Wahlenb.) Willd.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Carex magellanica</i> Lam.	0.14	4.76	8.25	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Carex nigricans</i> C.A. Mey.	0.00	0.00	12.50	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Carex prairea</i> Dewey ex Wood	14.64	66.67	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.03	6.67	0.00	0.00	0.00	0.00
<i>Carex scopulorum</i> Holm	0.00	0.00	2.50	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Carex utriculata</i> Boott	12.55	95.24	0.88	50.00	61.50	100.00	0.00	0.00	11.13	100.00	4.02	60.00	0.61	42.11	0.00	0.00
<i>Dulichium arundinaceum</i> (L.) Britt.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	11.29	52.63	0.00	0.00
<i>Eleocharis palustris</i> (L.) Roemer & J.A. Schultes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Eleocharis quinqueflora</i> (F.X. Hartman) Schwarz	0.10	23.90	0.00	0.00	0.00	0.00	0.00	0.00	0.75	25.00	0.03	6.67	0.00	0.00	0.00	0.00
<i>Eriophorum angustifolium</i> Honckeney	0.52	14.29	2.63	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	5.26	0.00	0.00
<i>Eriophorum chamissonis</i> C.A. Mey	0.48	4.76	2.50	25.00	0.00	0.00	0.00	0.00	8.25	75.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Eriophorum gracile</i> W.D.J. Koch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.02	26.67	7.00	15.80	2.75	75.00
<i>Eriophorum viridicarinatum</i> (Engelm.) Fern.	0.12	23.81	0.00	0.00	0.00	0.00	0.00	0.00	15.25	75.00	0.15	13.33	0.03	5.26	0.00	0.00
<i>Glyceria striata</i> (Lam.) A.S. Hitchc.	0.12	23.81	0.00	0.00	0.00	0.00	0.00	0.00	0.13	25.00	0.10	3.33	0.00	0.00	0.00	0.00
<i>Hordeum brachyantherum</i> Nevski	0.14	38.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	23.33	0.00	0.00	0.00	0.00
<i>Juncus balticus</i> Willd.	2.45	42.86	0.00	0.00	0.00	0.00	0.00	0.00	5.10	50.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Juncus ensifolius</i> Wikstr.	0.00	0.00	0.13	25.00	0.00	0.00	0.00	0.00	0.13	25.00	0.03	6.67	0.00	0.00	0.00	0.00
<i>Juncus nodosus</i> L.	0.19	14.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Muhlenbergia glomerata</i> Willd.	0.40	19.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Poa pratensis</i> L.	0.52	14.29	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Trichophorum caespitosum</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	6.67	0.00	0.00	0.00	0.00
<i>Triglochin palustre</i> L.	0.21	42.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	20.00	0.00	0.00	0.00	0.00

FORBS	BETGLA / <i>Carex</i> spp. / Brown Moss		KALMIC / <i>Sphagnum</i>		SALCAN / CARUTR		SPIDOU / CARLAS		CARFLA / Brown Moss		CARLAS / Brown Moss		CARLAS / <i>Sphagnum</i>		CARLIM / Brown Moss	
	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons
<i>Angelica arguta</i> Nutt.	0.00	0.00	0.00	0.00	1.50	50.00	0.00	0.00	0.00	0.00	0.03	6.67	0.00	0.00	0.00	0.00
<i>Argentina anserina</i> (L.) Rydb.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Comarum palustre</i> L.	0.05	9.52	0.00	0.00	0.00	0.00	1.75	100.00	0.00	0.00	3.00	60.00	3.13	89.47	3.50	100.00
<i>Dodecatheon pulchellum</i> (Raf.) Merr.	1.83	42.86	0.00	0.00	0.25	50.00	0.00	0.00	9.50	75.00	0.48	16.67	0.00	0.00	0.00	0.00
<i>Drosera anglica</i> Huds.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.61	31.58	0.00	0.00
<i>Drosera linearis</i> Goldie	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	10.53	0.00	0.00
<i>Drosera rotundifolia</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	6.67	1.58	31.58	0.00	0.00
<i>Epilobium ciliatum</i> Raf.	0.00	0.00	0.13	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Epilobium hornemannii</i> Reichenb.	0.00	0.00	0.13	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Epilobium palustre</i> L.	0.02	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.13	25.00	0.10	20.00	0.03	5.26	0.38	75.00
<i>Equisetum arvense</i> L.	0.24	23.81	0.25	50.00	0.00	0.00	0.00	0.00	0.38	75.00	0.07	13.33	0.08	15.79	0.13	25.00
<i>Equisetum fluviatile</i> L.	0.02	4.76	0.13	25.00	0.25	50.00	0.00	0.00	0.00	0.00	0.28	40.00	0.05	10.53	0.25	50.00
<i>Equisetum variegatum</i> Schleich.	0.12	23.81	0.00	0.00	0.00	0.00	0.00	0.00	0.13	25.00	0.05	10.00	0.00	0.00	0.00	0.00
<i>Fragaria virginiana</i> Duchesne	0.19	14.29	0.00	0.00	0.00	0.00	0.00	0.00	0.38	75.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Galium bifolium</i> S. Wats.	0.02	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Galium trifidum</i> L.	0.71	4.76	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.05	10.00	0.03	5.26	0.00	0.00
<i>Galium triflorum</i> Michx.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Geum rivale</i> L.	0.05	9.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Leptarrhena pyrolifolia</i> (D. Don) R. Br. ex Ser.	0.00	0.00	0.75	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Ligusticum canbyi</i> Coult. & Rose	0.00	0.00	7.63	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Lycopus americanus</i> Muhl. ex W. Bart.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Lycopus uniflorus</i> Michx.	0.02	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	23.33	1.05	52.63	2.50	25.00
<i>Maianthemum stellatum</i> (L.) Link	0.05	9.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Mentha arvensis</i> L.	0.02	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.13	25.00	0.17	16.67	0.00	0.00	0.00	0.00
<i>Menyanthes trifoliata</i> L.	3.91	33.33	2.50	25.00	0.00	0.00	0.00	0.00	0.00	0.00	4.55	46.67	7.47	63.16	15.00	75.00
<i>Packera pseudaurea</i> (Rydb.) W.A. Weber & A. Love	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	25.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Parnassia fimbriata</i> Koenig	0.86	33.33	0.00	0.00	5.00	50.00	0.00	0.00	2.75	75.00	0.35	10.00	0.00	0.00	0.00	0.00
<i>Pedicularis groenlandica</i> Retz.	0.00	0.00	0.88	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Petasites sagittatus</i> (Banks ex Pursh) Grey	1.74	19.05	0.00	0.00	0.25	50.00	0.00	0.00	0.13	25.00	0.12	6.67	0.00	0.00	0.00	0.00
<i>Platanthera dilatata</i> (Pursh) Lindl. ex Beck	0.14	28.57	0.00	0.00	0.00	0.00	0.00	0.00	0.13	25.00	0.15	13.33	0.00	0.00	0.00	0.00
<i>Platanthera hyperborea</i> (L.) Lindl.	0.07	14.29	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00	0.00	0.00
<i>Platanthera stricta</i> Lindl.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pyrola asarifolia</i> Michx.	0.20	47.70	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.02	3.33	0.00	0.00	0.00	0.00
<i>Scheuchzeria palustris</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.21	36.84	0.00	0.00
<i>Senecio triangularis</i> Hook.	0.02	4.76	0.75	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	6.67	0.00	0.00	0.00	0.00
<i>Solidago canadensis</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	6.67	0.00	0.00	0.00	0.00
<i>Spiranthes romanzoffiana</i> Cham.	0.07	14.29	0.00	0.00	0.00	0.00	0.00	0.00	0.25	50.00	0.07	13.33	0.08	15.79	0.25	50.00
<i>Symphotrichum</i> Nees	0.21	42.86	0.00	0.00	0.25	50.00	0.00	0.00	4.00	75.00	0.32	30.00	0.00	0.00	0.00	0.00
<i>Typha latifolia</i> L.	0.02	4.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	10.00	0.03	5.26	0.00	0.00
<i>Utricularia minor</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.05	16.67	4.21	5.26	0.13	25.00
<i>Valeriana dioica</i> L.	0.24	23.81	0.00	0.00	0.00	0.00	0.00	0.00	0.25	50.00	0.03	6.67	0.00	0.00	0.00	0.00
<i>Viola macloskeyi</i> Lloyd ssp. <i>pallens</i> (Banks ex Ging) M.S. Baker	0.10	19.05	0.00	0.00	0.00	0.00	0.00	0.00	3.88	50.00	0.00	0.00	0.21	15.79	0.13	25.00
<i>Viola nephrophylla</i> Greene	0.29	57.14	0.00	0.00	0.50	100.00	0.00	0.00	0.38	75.00	0.28	23.33	0.00	0.00	0.00	0.00
<i>Viola palustris</i> L.	0.00	0.00	0.38	75.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.33	0.55	31.58	0.00	0.00
<i>Zigadenus elegans</i> Pursh	0.14	28.57	0.00	0.00	0.25	50.00	0.00	0.00	0.88	50.00	0.43	20.00	0.00	0.00	0.00	0.00

	CARLIM / Sphagnum		CARNIG / Peatlands		CARSCO / Sphagnum		CARUTR / Brown Moss		CARUTR / Sphagnum		DULARU / Peatlands		ELEQUI-TRICES / Brown Moss		Eriophorum / Sphagnum	
	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons
GRAMINOIDS																
<i>Agrostis gigantea</i> Roth	0.00	0.00	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Agrostis humilis</i> Vasey	0.00	0.00	0.25	50.00	0.50	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.15	46.15
<i>Agrostis scabra</i> Willd.	0.00	0.00	0.00	0.00	0.00	0.00	0.22	16.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Bromus ciliatus</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.36	44.44	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Calamagrostis canadensis</i> Michx.	0.25	50.00	0.25	50.00	0.00	0.00	0.92	22.22	0.00	0.00	0.00	0.00	0.08	16.67	6.35	69.23
<i>Calamagrostis stricta</i> (Timm) Koel.	0.00	0.00	1.50	50.00	0.00	0.00	0.06	16.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Carex aquatilis</i> Wahlenb.	0.00	0.00	0.00	0.00	0.00	0.00	2.97	27.78	0.00	0.00	0.00	0.00	0.83	83.33	0.00	0.00
<i>Carex aurea</i> Nutt.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Carex buxbaumii</i> Wahlenb.	0.00	0.00	0.00	0.00	0.00	0.00	0.17	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Carex canescens</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.22	16.67	3.50	66.67	0.17	33.33	0.00	0.00	3.77	38.46
<i>Carex chordorrhiza</i> Ehrh. ex L.f.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	66.67	0.00	0.00	3.85	23.08
<i>Carex diandra</i> Schrank	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Carex echinata</i> Murr.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	33.33	0.00	0.00
<i>Carex exsiccata</i> Bailey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Carex flava</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.17	5.56	0.00	0.00	0.00	0.00	0.42	83.33	0.00	0.00
<i>Carex gynocrates</i> Wormsk. ex Drej.	0.00	0.00	0.00	0.00	0.00	0.00	0.17	5.56	0.00	0.00	0.00	0.00	0.17	33.33	0.00	0.00
<i>Carex interior</i> Bailey	0.00	0.00	0.00	0.00	0.00	0.00	1.42	44.44	0.00	0.00	0.17	33.33	0.17	33.33	1.69	38.46
<i>Carex lasiocarpa</i> Ehrh.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.50	100.00	0.83	83.33	0.00	0.00
<i>Carex lenticularis</i> Michx.	0.75	25.00	0.25	50.00	0.00	0.00	0.00	0.00	1.00	33.33	0.00	0.00	0.00	0.00	2.35	30.77
<i>Carex leptalea</i> Wahlenb.	0.00	0.00	0.00	0.00	0.00	0.00	1.00	38.89	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Carex limosa</i> L.	47.50	100.00	0.00	0.00	0.00	0.00	0.00	0.00	3.33	33.33	0.00	0.00	0.08	16.67	0.81	15.38
<i>Carex livida</i> (Wahlenb.) Willd.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75	66.67	0.00	0.00
<i>Carex magellanica</i> Lam.	1.50	50.00	0.25	50.00	0.25	50.00	0.03	5.56	1.00	33.33	0.00	0.00	0.00	0.00	5.31	69.23
<i>Carex nigricans</i> C.A. Mey.	0.00	0.00	10.00	100.00	5.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Carex prairea</i> Dewey ex Wood	0.00	0.00	0.00	0.00	0.00	0.00	12.22	38.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Carex scopulorum</i> Holm	0.00	0.00	5.00	50.00	40.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	15.38
<i>Carex utriculata</i> Boott	4.13	100.00	0.00	0.00	0.00	0.00	49.47	100.00	20.00	100.00	0.33	66.67	0.83	83.33	0.23	7.69
<i>Dulichium arundinaceum</i> (L.) Britt.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.33	100.00	0.00	0.00	0.00	0.00
<i>Eleocharis palustris</i> (L.) Roemer & J.A. Schultes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Eleocharis quinqueflora</i> (F.X. Hartman) Schwarz	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.70	66.70	0.00	0.00
<i>Eriophorum angustifolium</i> Honckeny	3.25	50.00	15.00	50.00	5.25	100.00	0.03	5.56	3.50	66.67	0.00	0.00	0.25	50.00	17.96	53.85
<i>Eriophorum chamissonis</i> C.A. Mey	5.75	75.00	0.00	0.00	0.00	0.00	0.56	5.56	0.00	0.00	0.00	0.00	0.00	0.00	13.35	84.62
<i>Eriophorum gracile</i> W.D.J. Koch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Eriophorum viridicarinatum</i> (Engelm.) Fern.	0.00	0.00	0.00	0.00	0.00	0.00	0.19	11.11	0.00	0.00	0.00	0.00	0.00	0.00	2.31	23.08
<i>Glyceria striata</i> (Lam.) A.S. Hitchc.	0.00	0.00	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Hordeum brachyantherum</i> Nevski	0.00	0.00	0.00	0.00	0.00	0.00	0.19	11.11	0.00	0.00	0.00	0.00	0.42	83.33	0.00	0.00
<i>Juncus balticus</i> Willd.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.17	33.33	0.00	0.00
<i>Juncus ensifolius</i> Wikstr.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Juncus nodosus</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Muhlenbergia glomerata</i> Willd.	0.00	0.00	0.00	0.00	0.00	0.00	0.33	11.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Poa pratensis</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Trichophorum caespitosum</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.67	66.67	0.00	0.00
<i>Triglochin palustre</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.31	33.33	0.00	0.00	0.00	0.00	0.17	33.33	0.00	0.00

	CARLIM / Sphagnum		CARNIG / Peatlands		CARSCO / Sphagnum		CARUTR / Brown Moss		CARUTR / Sphagnum		DULARU / Peatlands		ELEQUI-TRICES / Brown Moss		Eriophorum / Sphagnum	
	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons
FORBS																
<i>Angelica arguta</i> Nutt.	0.00	0.00	0.00	0.00	0.00	0.00	0.78	22.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Argentina anserina</i> (L.) Rydb.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Comarum palustre</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.17	5.56	0.00	0.00	0.33	66.67	0.00	0.00	1.54	46.15
<i>Dodecatheon pulchellum</i> (Raf.) Merr.	0.00	0.00	0.00	0.00	0.00	0.00	1.75	33.33	0.00	0.00	0.00	0.00	2.42	83.33	0.00	0.00
<i>Drosera anglica</i> Huds.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.17	66.67	0.00	0.00	2.00	30.77
<i>Drosera linearis</i> Goldie	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Drosera rotundifolia</i> L.	5.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Epilobium ciliatum</i> Raf.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Epilobium hornemannii</i> Reichenb.	0.00	0.00	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	30.77
<i>Epilobium palustre</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.69	55.56	0.00	0.00	0.00	0.00	0.00	0.00	0.27	15.38
<i>Equisetum arvense</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.92	72.22	0.00	0.00	0.00	0.00	0.08	16.67	3.23	46.15
<i>Equisetum fluviatile</i> L.	0.75	25.00	0.00	0.00	0.00	0.00	0.06	11.11	0.17	33.33	0.17	33.33	0.00	0.00	0.23	7.69
<i>Equisetum variegatum</i> Schleich.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Fragaria virginiana</i> Duchesne	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Galium bifolium</i> S. Wats.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Galium trifidum</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.14	27.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Galium triflorum</i> Michx.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Geum rivale</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Leptarrhena pyrolifolia</i> (D. Don) R. Br. ex Ser.	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	7.69
<i>Ligusticum canbyi</i> Coult. & Rose	0.00	0.00	0.00	0.00	10.25	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	15.38
<i>Lycopus americanus</i> Muhl. ex W. Bart.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Lycopus uniflorus</i> Michx.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	33.33	0.00	0.00	0.04	7.69
<i>Maianthemum stellatum</i> (L.) Link	0.00	0.00	0.00	0.00	0.00	0.00	0.31	33.33	0.00	0.00	0.00	0.00	3.33	16.67	0.00	0.00
<i>Mentha arvensis</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Menyanthes trifoliata</i> L.	5.13	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	66.67	0.58	33.33	7.15	38.46
<i>Packera pseudaurea</i> (Rydb.) W.A. Weber & A. Love	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Parnassia fimbriata</i> Koenig	0.00	0.00	0.00	0.00	0.00	0.00	1.61	22.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pedicularis groenlandica</i> Retz.	0.00	0.00	0.00	0.00	0.25	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	23.08
<i>Petasites sagittatus</i> (Banks ex Pursh) Grey	0.00	0.00	0.00	0.00	0.00	0.00	2.58	33.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Platanthera dilatata</i> (Pursh) Lindl. ex Beck	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Platanthera hyperborea</i> (L.) Lindl.	0.00	0.00	0.00	0.00	0.00	0.00	0.11	22.22	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Platanthera stricta</i> Lindl.	0.13	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	15.38
<i>Pyrola asarifolia</i> Michx.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Scheuchzeria palustris</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	66.67	0.00	0.00	0.00	0.00
<i>Senecio triangularis</i> Hook.	0.00	0.00	0.00	0.00	0.00	0.00	0.33	11.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Solidago canadensis</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	1.67	16.67	0.00	0.00
<i>Spiranthes romanzoffiana</i> Cham.	0.00	0.00	0.00	0.00	0.00	0.00	0.06	11.11	0.00	0.00	0.17	33.33	0.08	16.67	0.12	23.08
<i>Symphyotrichum</i> Nees	0.00	0.00	0.00	0.00	0.00	0.00	0.61	38.89	0.00	0.00	0.00	0.00	0.33	66.67	0.00	0.00
<i>Typha latifolia</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Utricularia minor</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	33.33	0.00	0.00
<i>Valeriana dioica</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Viola macloskeyi</i> Lloyd ssp. <i>pallens</i> (Banks ex Ging) M.S. Baker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	16.67	1.81	30.77
<i>Viola nephrophylla</i> Greene	0.00	0.00	0.00	0.00	0.00	0.00	0.97	38.90	0.00	0.00	0.00	0.00	0.42	83.33	0.00	0.00
<i>Viola palustris</i> L.	0.13	25.00	0.50	100.00	0.50	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.69	53.85
<i>Zigadenus elegans</i> Pursh	0.00	0.00	0.00	0.00	0.00	0.00	0.11	22.22	0.00	0.00	0.00	0.00	0.58	33.33	0.00	0.00

	CARLIM / Sphagnum		CARNIG / Peatlands		CARSCO / Sphagnum		CARUTR / Brown Moss		CARUTR / Sphagnum		DULARU / Peatlands		ELEQUI-TRICES / Brown Moss		Eriophorum / Sphagnum	
	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons	Cov.	Cons
BRYOPHYTES																
<i>Aneura pinguis</i> (L.) Dumort.	0.00	0.00	0.00	0.00	0.25	50.00	0.33	38.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Aulacomnium palustre</i> (Hedw.) Schwaegr.	0.00	0.00	45.00	50.00	0.25	50.00	2.89	33.33	0.17	33.33	0.17	33.33	0.00	0.00	3.77	46.15
<i>Bryum pseudotriquetrum</i> (Hedw.) Gaerth et. al.	0.00	0.00	0.00	0.00	0.00	0.00	3.69	66.67	0.00	0.00	0.00	0.00	0.50	83.30	0.00	0.00
<i>Calliergon giganteum</i> (Schimp.) Kindb.	0.00	0.00	0.00	0.00	0.00	0.00	2.40	66.80	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Calliergon stramineum</i> (Brid.) Kindb.	0.88	50.00	0.00	0.00	0.25	50.00	0.03	5.56	0.00	0.00	0.33	66.67	0.00	0.00	0.81	84.62
<i>Campylium stellatum</i> (Hedw.) C. Jens.	0.00	0.00	0.00	0.00	0.00	0.00	5.11	44.44	0.00	0.00	0.00	0.00	5.75	83.33	0.00	0.00
<i>Cratoneuron filicinum</i> (Hedw.) Spruce	0.00	0.00	0.00	0.00	0.00	0.00	6.14	33.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Drepanocladus</i> (C. Müll.) G. Roth	0.75	25.00	1.50	50.00	0.00	0.00	0.22	16.67	0.00	0.00	0.00	0.00	0.00	0.00	0.23	7.69
<i>Drepanocladus aduncus</i> (Hedw.) Warnst.	0.00	0.00	0.00	0.00	0.00	0.00	0.58	11.11	1.00	33.33	0.00	0.00	0.00	0.00	0.00	0.00
<i>Fontinalis hypnoides</i> Hartm.	3.25	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Hamatocaulis vernicosus</i> Mitt.	0.00	0.00	0.00	0.00	0.00	0.00	0.17	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.04	7.69
<i>Hypnum lindbergii</i> Mitt.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	13.33	16.67	0.00	0.00
<i>Marchantia polymorpha</i> L.	0.00	0.00	0.00	0.00	0.00	0.00	0.61	16.67	0.00	0.00	0.00	0.00	0.08	16.67	0.04	7.69
<i>Meesia triquetra</i> (Richt.) Ångstr.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.04	7.69
<i>Palustriella falcata</i> (Brid.) Hedenäs	0.00	0.00	0.00	0.00	0.00	0.00	2.72	33.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pellia raddi</i> nom. cons.	0.00	0.00	0.00	0.00	0.00	0.00	0.06	11.11	0.00	0.00	0.00	0.00	0.33	66.67	0.04	7.69
<i>Philonotis fontana</i> (Hedw.) Brid.	0.00	0.00	0.00	0.00	0.25	50.00	0.22	16.67	0.00	0.00	0.00	0.00	0.00	0.00	0.19	38.46
<i>Plagiomnium ellipticum</i> (Brid.) T. Kop.	0.00	0.00	0.00	0.00	0.00	0.00	2.42	33.33	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Plagiomnium</i> T. Kop.	0.00	0.00	0.00	0.00	0.00	0.00	0.06	11.11	0.00	0.00	0.00	0.00	0.08	16.67	0.00	0.00
<i>Polytrichum longisetum</i> Brid.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	7.69
<i>Scapania uliginosa</i> (Sw. ex Lindenb.) Dumort.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Scapania undulata</i> (L.) Dumort.	5.13	50.00	46.50	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Scorpidium cossonii</i> (Schimp.) Anderson et. al.	0.00	0.00	0.00	0.00	0.00	0.00	9.81	33.33	0.00	0.00	0.00	0.00	21.17	83.33	0.00	0.00
<i>Scorpidium revolvens</i> (Sw.) Heden	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Scorpidium scorpioides</i> (Hedw.) Limpr.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	33.33	0.00	0.00
<i>Sphagnum angustifolium</i> (C. Jens ex Russ.) C. Jens in Tolf	0.75	25.00	0.00	0.00	45.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.46	46.15
<i>Sphagnum capillifolium</i> (Ehrh.) Hedw.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Sphagnum centrale</i> C. Jens. In Arnell & C. Jens.	0.13	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62	23.08
<i>Sphagnum lindbergii</i> Schimp. In Lindb.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	15.38
<i>Sphagnum magellanicum</i> Brid.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.77	23.08
<i>Sphagnum russowii</i> Warnst.	0.75	25.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	33.33	0.00	0.00	0.00	0.00	0.00	0.00
<i>Sphagnum squarrosum</i> Crome	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	15.38
<i>Sphagnum subsecundum</i> Nees in S	42.50	50.00	0.00	0.00	10.25	100.00	0.00	0.00	13.50	66.67	60.00	66.67	0.00	0.00	1.54	15.38
<i>Sphagnum teres</i> (Schimp.) Ångstr. In Hartm.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	33.33	0.00	0.00	0.00	0.00	13.08	23.08
<i>Sphagnum warnstorffii</i> Russ.	0.75	25.00	0.00	0.00	0.00	0.00	0.00	0.00	16.67	33.33	0.00	0.00	0.00	0.00	5.39	15.38
<i>Tomentypnum nitens</i> (Hedw.) Loeske	0.00	0.00	0.00	0.00	0.00	0.00	34.61	55.56	0.00	0.00	0.00	0.00	0.67	50.00	0.00	0.00
<i>Warnstorfia exannulata</i> (Schimp. in B.S.G.) Loeske	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	66.67	0.00	0.00	0.00	0.00	0.08	15.38

APPENDIX E. PHOTOGRAPHS OF SELECTED PLANT ASSOCIATIONS



A: Wigwam Site: from foreground to forest occupied by *Betula glandulosa* / *Carex* spp. / Brown Moss Peatland.



B: *Betula glandulosa* / *Carex* spp. / “Brown Moss” Association showing a site that compared to A above has considerably less shrub cover and that dominance in this layer shared by *B. glandulosa* and *Dasiphora floribunda*.



c: *Spiraea douglasii* / *Carex lasiocarpa* Association to the right with a sharp ecotone to the adjacent *C. lasiocarpa* / *Sphagnum* spp. Association.



d: Open water is fringed by the *Carex lasiocarpa* / “Brown moss” Association, typical of a lake-fill or basin, rich fen condition (*Scorpidium cossonii* dominates the moss ground layer).



E: This extensive rich fen peatland has completely filled its basin and is typified by the *Carex lasiocarpa* / “Brown Moss” Association, the ground cover of which, at least in this stand, is dominated by *Aulacomnium palustre* and *Tomenthypnum nitens*.



F: Ground layer vegetation dominated by *Sphagnum teres* and *Menyanthes trifoliata* within a *Carex lasiocarpa* / *Sphagnum* Moss Association.



g: Extensive *Carex utriculata* / “Brown Moss” Association with scattered stems of *Salix candida*; in background is an abrupt transition to a *Salix drummondii*-dominated community that encompasses the fen’s periphery.