PROSPECTUS

VALLEY PEATLANDS ECOSYSTEM PROJECT, IDAHO

Prepared by:
Rob Bursik and Bob Moseley

Conservation Data Center
Idaho Department of Fish and Game
600 S. Walnut, P.O. Box 25
Boise, ID 83707
(208) 334-3402

September 1992

BACKGROUND

Peatlands are generally defined as wetlands with waterlogged substrates and at least 30 cm of peat accumulation. Bursik (1990) recognized two types of peatlands in Idaho based on vascular floristic composition: (1) *Valley Peatlands*, which generally occur around lakes and ponds at relatively low elevations in major river valleys, from near Bonners Ferry, in the panhandle, to near Driggs, in eastern Idaho; and (2) *Subalpine Peatlands*, which are more common throughout the same portion of Idaho, but generally form along low-gradient, subalpine streams. Subalpine peatlands are generally characterized by plant species common throughout the western cordillera, while valley peatlands are characterized by numerous boreal species whose Idaho populations are disjunct by hundreds of miles from the main portion of their range in boreal regions of Canada.

The biodiversity value of Idaho's valley peatlands is high. Although wide-ranging across the state, the occurrence of valley peatlands is very rare on the landscape as a whole and they contain some of the highest concentrations of rare species found in Idaho. Approximately 12% of Idaho's rare vascular flora is more or less restricted to peatland habitats, as is one rare mammal. The narrow suite of environmental conditions that lead to the formation of peatlands create conditions suitable only for species specifically adapted to these sites.

Peatlands are an important terrestrial habitat worldwide where they cover an estimated one percent of ice-free continental land masses. As much as 15 percent of Canada is covered by peatlands where they are not only important from a biodiversity perspective, but also economically important from an industrial and energy perspective (in the form of peat mining). Peatlands contain a record of the postglacial landscape in the form of pollen and plant macrofossils that make up the peat substrates.
Paleoecologists have analyzed pollen and plant macrofossil spectra to infer climatic and vegetational history of the postglacial landscape.

Aside from containing a unique biota and being an archive of Pleistocene and Holocene vegetational and climatic history, peatlands also apparently exert a tremendous influence on the earth's climate. Methanogenic anaerobic bacteria inhabiting peat soils produce as much as 40 percent of the methane (an important "greenhouse gas") released into the atmosphere annually (Breining 1992). On the other hand, peatlands act as immense sinks of carbon dioxide, the most important greenhouse gas. In fact, it is estimated that peatlands store 15 to 20 percent of terrestrial carbon reserves, more than twice the amount in all living northern latitude forests (Breining 1992).

Globally peatlands have long been looked at as worthless, forbidding land. Every effort was made to drain them for forestry or to mine them for peat fuels. Northern European countries with once immense peat reserves are now scrambling to preserve their last remaining tracts of pristine peatland habitat. Finland has drained more than half of its 25 million acres of peatlands for forestry. Only five percent of Ireland's 3 million acres of peatland remain untouched (Breining 1992). Although North American peatlands have fared far better, the continued threat of development exists, particularly if conventional sources of fuel and electricity generation become limiting or expensive.

Peatlands are relatively stable ecosystems, taking many centuries to recover from disturbances. It is estimated that in boreal and temperate climates, peat accumulates at the rate of approximately 2 cm/century. Mechanical disturbances are highly disruptive to native biota due to the soft nature of peat substrates. This is the case at Beaver Lake in the Cabinet Mountains, Bonner County, where fishermen traffic has had a significant impact on a floating mat community and the population of the rare bog clubmoss (*Lycopodium inundatum*) that occurs there.

Many peatland taxa are sensitive to subtle changes in water table level and nutrient concentrations of the ground water (Vitt and Slack 1975; Glaser 1987). Consequently, activities such as filling, draining, and peat mining, which directly impact hydrological regimes are a constant threat to the stability of peatland communities. Drainage ditches have significantly altered the vegetation of Hager Lake fen and portions of Lee Lake fen, both in Bonner County, by changing water levels. Additionally, logging or ground disturbances within the watershed of a given peatland could also effect the peatland plant communities by increasing nutrient runoff. Vegetative changes in Hager Lake fen that have occurred during the last 40 years may be attributed to the amelioration of increased nutrient runoff resultant of logging immediately around the lake during the 1940's (Bursik and Moseley in prep.).

Conservation Data Center (CDC) ecologists have made some interesting discoveries in valley peatlands in Idaho during the last two field seasons. During 1991, *Scirpus hudsonianus* (Hudson's Bay bulrush) was discovered in Cow Creek Meadows in the Selkirk Mountains, Boundary County; a new species for Idaho and the only known Pacific Northwestern location outside of Glacier National Park. Also during 1991, *Eleocharis tenuis* (slender spike rush) was discovered in Yellowstone National Park in Idaho, a species previously not known from the state. In 1992, *Drosera intermedia* (intermediate sundew), a new record for Idaho and the Pacific Northwest, widely disjunct from any known locations, was discovered in the Smith Creek Research Natural Area (RNA) on the Idaho Panhandle National Forests.

Each year, discoveries such as these have raised intriguing questions about biogeography, migration, the autecology of individual species, and the synecological interactions of various components within these systems that maintain their stability and account for their biodiversity. These discoveries also underscore the biodiversity value of these sites and the need for an integrated inventory, research, and monitoring program directed toward conservation and restoration of these habitats.

This prospectus reviews past and ongoing work on peatland habitats in Idaho, as well as identifies gaps in our knowledge of Idaho peatland ecology and management.

INVENTORY OF FLORA AND FAUNA

The vascular flora is the most well-known component of the Idaho valley peatland biota (Bursik 1990; Rabe *et al.* 1990; Moseley *et al.* 1991). It has been best inventoried in the northern Panhandle region, which contains the greatest concentration of valley peatlands in the state. It is poorly documented in some areas, however, particularly in the Warm Lake, Bear Valley, and Sawtooth Valley areas of central Idaho. Additionally, areas that have received attention in the past have recently been found to harbor previously unknown species for Idaho (e.g., Cow Creek Meadows and Smith Creek RNA, mentioned above), indicating that each area must be thoroughly surveyed to document its flora.

Vascular plant species found in peatlands that are considered rare in Idaho are listed in Table 1. The CDC has accumulated a preliminary list of high priority peatlands in Idaho that will be the focus of future research and conservation efforts (Table 2). Other sites will certainly be added to the list as inventory efforts are expanded into under-explored areas.

The panhandle holds the greatest concentration of valley peatlands in Idaho, and to date has received the greatest amount of attention from CDC and other researchers (Rumely 1956; Caicco 1987; 1988; Moseley 1989; 1990; Bursik 1990; 1992; Bursik and Moseley in prep.; Bursik in prep.; Rabe *et al.* 1990). Recently, the CDC has inventoried the peatland flora of the Island Park and Yellowstone National Park areas in Idaho (Moseley *et al.* 1991). Much of this floristic work was funded by the U.S. Forest Service, with major contributions from the Stillinger Foundation.

The fungal, lichen, and bryophyte components of the biota are largely unknown. New projects must be initiated to document the bryophyte, lichen, and fungal diversity within Idaho valley peatlands. These biotic components of valley peatlands likely harbor numerous boreal disjuncts, much like the vascular component, but this is yet to be ascertained.

Dr. Fred Rabe, University of Idaho, for the last two decades has worked extensively on aquatic invertebrate communities in valley peatlands throughout Idaho (Rabe and Savage 1977; Rabe *et al.* 1986; Rabe *et al.* 1990). Dr. Rabe's inventory work in the above-listed publications and additional unpublished works needs to be organized into one document or checklist, against which future comparisons can be made. From this checklist, sensitive elements within the aquatic invertebrate communities can be identified for conservation purposes. Danks and Rosenberg (1987) report that some species of aquatic insects in Canada, including 14 odonates, are restricted to bog habitats. Further inventory of aquatic invertebrates may reveal the presence of endemic and disjunct populations of these bog specialists in valley peatlands in Idaho. The recent discovery of an undescribed species of *Pyrgulopsis*, an aquatic snail, at Birch Creek fen underscores this statement.

Additionally, Dr. Rabe has gathered water chemistry data for several of the high-priority valley peatlands during the same time period. Many invertebrate species, like plant species, are sensitive indicators of water chemistry factors, and may disappear from, or colonize a system as the nutrient composition of a peatland's surface water changes. All this information should be organized and condensed for future baseline comparisons to monitor the effects of activities such as timber harvesting and fire on these systems as well as for the effects of acid precipitation.

Table 1. Rare vascular plant species known from valley peatlands in Idaho.

Species	CDC Rank [1]	INPS Category [2]
1. *Andromeda polifolia* (bog rosemary)	S1	1
2. *Aster junciformis* (rush aster)	S1	R
3. *Betula pumila* (dwarf birch)	S2	S
4. *Carex buxbaumii* (Buxbaum's sedge)	S3	S
5. *Carex chordorrhiza* (string-root sedge)	S1	1
6. *Carex comosa* (bristly sedge)	S1	1
7. *Carex flava* (yellow sedge)	S3	S
8. *Carex leptalea* (bristle-stalked sedge)	S1	S
9. *Carex livida* (pale sedge)	S2	S
10. *Carex paupercula* (poor sedge)	S2	2
11. *Cicuta bulbifera* (bulb-bearing waterhemlock)	S1	2
12. *Comandra livida* (northern comandra)	S1	R
13. *Cypripedium calceolus* (yellow lady's-slipper)	S1	1
14. *Drosera intermedia* (intermediate sundew)	S1	R
15. *Dryopteris cristata* (crested shield-fern)	S2	S
16. *Eleocharis tenuis* (slender spike-rush)	S1	R
17. *Epilobium palustre* (swamp willow-weed)	S2	2
18. *Eriophorum viridicarinatum* (green-keeled cotton grass)	S1	1
19. *Gaultheria hispidula* (creeping snowberry)	S1	2
20. *Hypericum majus* (large Canadian St. John's-wort)	S1	2
21. *Lomatogonium rotatum* (marsh felwort)	S1	1
22. *Ludwigia polycarpa* (many-fruited-false-loosestrife)	S1	1
23. *Lycopodium inundatum* (northern bog clubmoss)	S1	1
24. *Lycopodium sitchense* (sitka clubmoss)	S1	S
25. *Muhlenbergia racemosa* (green muhly)	S1	1
26. *Petasites sagittatus* (arrowleaf coltsfoot)	S3	M
27. *Picea glauca* (white spruce)	S1	2
28. *Primula alcalina* (alkali primrose)	S1	N
29. *Primula incana* (Jones' primrose)	S1	1
30. *Rhynchospora alba* (white beakrush)	S1	1
31. *Salix candida* (hoary willow)	S2	2
32. *Salix pedicellaris* (bog willow)	S1	2
33. *Scheuchzeria palustris* (pod grass)	S2	2
34. *Scirpus cyperinus* (wool-grass)	S3	M
35. *Scirpus hudsonianus* (Hudson's bay bulrush)	S1	R
36. *Scirpus subterminalis* (water clubrush)	S1	S
37. *Trientalis arctica* (northern starflower)	S3	S
38. *Vaccinium oxycoccos* (bog cranberry)	S1	2

[1]CDC Ranks: S1 = critically imperiled in Idaho, extremely rare; S2 = imperiled in Idaho, rare; S3 = uncommon in Idaho, not necessarily imperiled (Moseley and Groves 1992).

[2]Idaho Native Plant Society Categories: 1 = Priority 1, state endangered; 2 = Priority 2, state threatened; S = Sensitive; M = Monitor; R = Review; N = No INPS rank for federal candidates (Moseley and Groves 1992).

Table 2. Preliminary list of high priority peatlands of Idaho. Refer to Table 1 for rare plant species corresponding to numbers in the third column.

Location/Peatland	Ownership	Rare Plant Species
Priest River Valley		
Armstrong Meadows	Kaniksu NF	4,8,15,19,26,38
Bottle Lake RNA	Kaniksu NF	19,23,33,36,37,38
Chase Lake	ID Dept. Lands, pvt.	5,11,15,17,19,23,26,30,32,36,37,38
Hager Lake	Kaniksu NF, private	20,23,33,36,37
Huff Lake (WA)	Kaniksu NF	12,19,33,37,38
Kaniksu Marsh RNA	Kaniksu NF	10,11,15,17,19,20,23,26,32,33,36,37,38
Lee Lake	private	11,20,36,37,38
Mosquito Bay	private	1,9,23,30,32,33,37,38
Packer Meadows	Kaniksu NF	8,32,37
Potholes RNA	Kaniksu NF	8,10,15,17,19,22,32,37,38
Kootenai River Valley		
Beaver Lake	Kaniksu NF	7,23
Bog Creek	Kaniksu NF	4,7,10
Bonner Lake	private	2,3,7,31
Cow Creek Meadows	Kaniksu NF	4,7,8,10,23,35,37,38
Herman Lake	private	2,3,7
Herman Lake Road	private	3,7,26,31
Perkins Lake	Kaniksu NF, private	3,6,7,8,11,15,17,30,32,33,36
McArthur Lake	ID Fish & Game, pvt.	3,13
Smith Creek RNA	Kaniksu NF	10,14,24,37
Vicinity of Lake Pend Oreille		
Gamble Lake	BLM, pvt., TNC	11,20,34,36
Shepherd Lake	ID Fish & Game, pvt.	11,20,36
Coeur d'Alene River Valley		
Rose Lake	ID Fish & Game, pvt.	22,34
Central Idaho		
Crooked Creek	Nature Conservancy	none
Lily Marsh RNA	ID Parks & Rec.	none
Iron Bog RNA	Challis NF	none
Mays Creek pRNA	Sawtooth NF	9
Vat Creek pRNA	Sawtooth NF	9
Tule Lake	Boise NF	4,30,33
Rich Fens of Eastern Idaho		
Birch Creek	IFG, pvt., NF, BLM	21,28,31
Summit Creek	BLM, private	21, 28, 31
Texas Creek	BLM, private	9,21,28, 31
Woods Creek	private	4,25,29,31

Table 2. Continued.

Location/Peatland	Ownership	Rare Plant Species
Island Park Area		
Big Springs-Henrys Fk. Confl.	Targhee	4,11,17
Gentian Meadows	Yellowstone NP	4,9,16
Henry's Lake White Spruce	BLM, private	27
Howard Creek Fen	ID Parks & Rec.	17,31
Ingals Creek	private	25,31
Robinson Lake	Yellowstone NP	9,23,33,36
Targhee Creek Mouth	private	2,17,18,31
West Boundary Trail Mdw.	Yellowstone NP	4,9,23,33

The terrestrial invertebrate fauna for valley peatlands in Idaho is almost entirely unknown. Little, if any literature exists on this subject. Inventory of valley peatlands to ascertain biodiversity in these sites as well as to identify sensitive elements and geographical ranges of species in the terrestrial invertebrate communities are needed.

The vertebrate fauna of valley peatlands in Idaho has received relatively little attention. Craig Groves, Idaho CDC, Don Johnson, University of Idaho, and Earl Larrison, University of Idaho-deceased, surveyed the small mammal populations of peatlands in Idaho, although this survey work was regional and centered in the panhandle. At least one state Species of Special Concern, northern bog lemming (*Synaptomys borealis*), is restricted to peatland habitats. The only recently documented populations of the northern bog lemming in Idaho are from Cow Creek Meadows (Groves and Yensen 1989) and near Distillery Bay on Priest Lake in 1991-92 (Groves unpublished data). More survey work is needed on small mammal populations in valley peatlands to ascertain distribution of species and to identify additional sensitive elements, if any, for conservation purposes. Work also needs to be done on the population dynamics of the northern bog lemming and the effects of cattle grazing on this population. Peatlands are also important habitats for amphibians, many of which are declining in western North America (Groves and Peterson 1992).

Large mammals, including the federally threatened grizzly bear (*Ursus arctos*) and the federally endangered woodland caribou (*Rangifer tarandus* ssp. *caribou*), are known to frequent peatlands in the panhandle region. Indeed, many mammals use wetlands, including peatlands, at some point during their life cycles (Stevens 1990). The degree to which peatlands are used by large mammal species and the attributes that peatlands provide for large mammal populations needs further study, as well.

Riparian and wetland habitats, including peatlands, are the single most important habitat for neotropical migratory land birds in western North America. Some migratory bird species, such as the common snipe (*Capella gallinago*) are specific to peatlands throughout much of their range (Tuck 1972). No literature is known on bird communities within valley peatlands in Idaho. Saab and Groves (1992) noted that a dearth of information exists overall for neotropical migrant species in the western United States. They cited a need for data on population trends of neotropical species in different habitats. Specifically, survey work to ascertain avian species composition and distribution in valley peatlands in Idaho is warranted for conservation purposes and to identify as yet overlooked sensitive elements in this portion of the biota.

****
*

PEATLAND INVENTORY GAPS

-- Vascular flora - Sawtooth Valley, Bear Valley, Warm Lake.
-- Synthesize/compile aquatic invertebrate data.
-- Synthesize/compile water chemistry data.
-- Begin inventory of fungi, lichens, bryophytes, terrestrial invertebrates, vertebrates.

****
*

COMMUNITY CLASSIFICATION

Community classification of peatland habitats will be the basis for a comprehensive conservation and management strategy for these habitats and their unique biota. Habitat classifications can provide land managers with a means to effectively identify, manage, and conserve important habitats such as peatlands. Community classifications can also elucidate successional trends within the system as well as environmental parameters that effect the abundance and distribution of species within the system. The link between habitat and the occurrence of sensitive plant and animal species is clear. Only by classifying these habitats can we determine what conditions are required by sensitive elements (both plant and animal) within valley peatland communities.

Regional wetland community classifications that include some peatland habitats exist for particular regions of Idaho, Montana, Utah, and Wyoming. Some of the plant associations occurring in valley peatlands in Idaho are treated in these classifications (Table 3). These studies, however, were not focused on peatland habitats, and consequently cover only few of the plant associations known to occur in valley peatlands of Idaho.

By doing a statewide, comprehensive classification of peatland habitats in Idaho, a far more useful and complete classification can be constructed for these habitats. Certain associations may range throughout the region while other community types may be far more localized. Region by region wetland plant classifications will not likely give adequate attention to peatland habitats because of their relative rarity on the landscape as a whole, compared to, for example, marsh habitats. Regional wetland classifications, therefore have been of little value for classifying all but the most common peatland community types. Additionally, classifications to date have failed to include coverage data on bryophyte species, which are important indicators of water level and nutrient status. Certain bryophyte species, particularly some *Sphagnum* species, can also direct succession in peatland habitats, and are therefore perhaps the most important component of a peatland vegetational classification (Vitt and Slack 1975; Glaser 1987). Any peatland classification scheme must therefore include the bryophyte component to be of any value.

Plant associations inadequately covered by regional wetland classifications to date include all *Sphagnum*-dominated habitats, including floating mats, which harbor most of the sensitive species found in peatlands in Idaho. During 1992, the Idaho CDC initiated classification work on these habitats with the reanalysis of the Hager Lake and Huff Lake vegetations in the Priest River Valley, Bonner County (Bursik and Moseley in prep.), and with the establishment of permanent plots in Cow Creek Meadows and Smith Creek RNA in the Selkirk Mountains, Boundary County (Bursik in prep.). Methodologies used in these studies can be adapted to a systematic statewide approach to peatland classification.

Table 3. Plant associations and community types occurring in valley peatlands of Idaho, described in regional wetland or riparian habitat classifications from the Rocky Mountains.

Plant Association/Community Type	Regions Where Described[1]
Herbaceous	
Caltha leptosepala	3
Carex aperta	1
Carex aquatilis	1,2,3,7,8
Carex atherodes	2
Carex buxbaumii	6,7
Carex lasiocarpa	1,3,8
Carex limosa	1,3,7
Carex nebraskensis	2,3,8
Carex rostrata	1,2,3,4,5,7,8
Carex saxatilis	3,6
Carex scopulorum	8
Carex simulata	2,3,8
Carex vesicaria	2
Eleocharis pauciflora	3,4,5,7,8
Glyceria borealis	8
Juncus balticus	2
Scirpus acutus	2,8
Scirpus caespitosus-Carex livida	6
Typha latifolia	3,8
Shrub-dominated	
Betula glandulosa/Carex rostrata	1
Kalmia microphylla/Carex scopulorum	1,8
Salix bebbiana	1,8
Salix boothii/Carex aquatilis	2,3
Salix boothii/Carex rostrata	2
Salix boothii/Equisetum arvense	2
Salix boothii/Mixed graminoid	3
Salix candida/Carex rostrata	8
Salix drummondiana	1
Salix geyeriana/Carex aquatilis	3
Salix geyeriana/Carex rostrata	1,2,3
Salix planifolia/Carex aquatilis	2,3,5,8
Salix wolfii/Carex aquatilis	2,3,7,8
Salix wolfii/Carex rostrata	2
Salix wolfii/Carex nebrascensis	2
Salix wolfii/Swertia perennis	4,5,6
Spiraea douglasii	1
Vaccinium occidentale/Carex aquatilis	7
Vaccinium occidentale/Calamagrostis canadensis	7

Table 3. Continued.

Plant Association/Community Type	Regions Where Described
Tree-dominated	
Abies lasiocarpa/Calamagrostis canadensis	3,9,10
Abies lasiocarpa/Caltha biflora	9
Abies lasiocarpa/Ledum glandulosum	8
Picea engelmannii/Carex disperma	9,10
Pinus contorta/Vaccinium occidentale	4,6

[1]1=northwestern Montana (Boggs *et al.* 1990)
2=eastern Idaho - western Wyoming (Youngblood *et al.* 1985)
3=Utah and southeastern Idaho (Padgett *et al.* 1989)
4=central Idaho (Tuhy and Jensen 1982)
5=central and eastern Idaho (Mutz and Queiroz 1983)
6=Sawtooth Valley (Tuhy 1981)
7=central Yellowstone National Park (Mattson 1984)
8=southwestern Montana (Hansen *et al.* 1988)
9=central Idaho (Steele *et al.* 1981)
10=eastern Idaho-western Wyoming (Steele *et al.* 1983)
===

****
*

PEATLAND COMMUNITY CLASSIFICATION GAPS

-- Compile existing peatland community data into Community Characterization Abstract; identify gaps in classification.
-- Complete classification with *de novo* sampling.

****
*

PEATLAND STRUCTURE AND FUNCTION

The inventory and classification of Idaho's peatlands are largely descriptive in nature and are important first steps in understanding peatland ecology. Using inventory and classification studies as the basis, questions relating to the structural (physical arrangement) and functional (process) attributes of peatlands can then be addressed.

This is one of the least studied aspects of peatlands in Idaho, and very few studies have taken place. The CDC has sampled four peatland complexes in northern Idaho as part of a larger monitoring project. These ongoing studies have elucidated some of the structural characteristics of peatland plant populations and communities, including the demography of rare plant populations and vegetation physiognomy. Sampling conducted by ecologists as part of various community classification projects mentioned in the previous section has also elucidated structural characteristics of some peatland communities, including vegetation physiognomy and physical variables. Several ongoing studies relating to the ecology of the threatened

plant, alkali primrose (*Primula alcalina*), are being coordinated by the Salmon District BLM. Biologist from Oregon State University and the CDC are
studying the population ecology of alkali primrose, including population structure and demographic processes and vegetation structure. Pollination and reproductive ecology is being studied by a graduate student from Utah State University, while a student from the College of Idaho is studying the hydrological processes of its peatland habitat.

There is a great paucity of knowledge concerning the structure and function of Idaho's peatlands that need to filled. An important topic that needs further research involves determining hydrological and chemical factors that affect the distribution and abundance of species and communities within peatlands. Subtle hydrological and chemical gradients are known to effect species and community distribution in peatlands of other regions and countries (Sjors 1950; Heinselman 1963; 1970; Jeglum 1971; Vitt and Slack 1975; Schwintzer 1978), but have not been addressed to any degree in the Rocky Mountains.

****
*

PEATLAND STRUCTURE AND FUNCTION GAPS

-- Population ecology (*i.e.*, structure, demographic processes, metapopulation dynamics).
-- Hydrologic processes and patterns.
-- Patch dynamics (fine-scale disturbance processes); patch persistence and turnover rate.
-- Genetic structure among and between populations.
-- Nutrient/chemical flows.
-- Physical processes and attributes of different communities.
-- Soil/substrate variables
-- etc.

****
*

PALEOECOLOGY

Aside from having a unique biota, Idaho's peatlands also provide an important historical perspective through the plant fossils and volcanic ash preserved in their peat deposits. Peat contains a postglacial record of regional and on-site vegetation (in the form of pollen and plant macrofossils), which allows ecologists to reconstruct the regional vegetation patterns and climatic history, as well as the historical development of the peatland itself. Peat deposits enable ecologists to address questions about landscape and community development and evolution in the context of centuries or millennia rather than over one or a few field seasons (Schoonmaker and Foster 1991). Whether a given ecosystem is stable and relatively unchanging, or whether it is dynamic and undergoing frequent and rapid changes can be investigated by analyzing peat deposits. Models for community development and landscape evolution supported from studies of the peatland archives can provide more enlightened and long-term management strategies, not only for valley peatlands in Idaho, but for Rocky Mountain ecosystems as a whole.

At least three peat deposits in Idaho have been sampled for their paleoenvironmental information. Hager Lake in the Idaho panhandle has been the subject of four paleoecological studies in the past (Hansen 1939; 1947; Rumely 1956; Mack *et al.* 1978). These studies were focused on the reconstruction of postglacial vegetational and climatic history of the Priest River Valley. Mehringer *et al.* (1977a; 1977b) cored a peatland in Lost Trail Pass on the Idaho/Montana border, north of Salmon, and looked at Holocene vegetational change and volcanic ash chronology for this part of the Bitterroot Mountains. During 1992, Robinson Lake in Yellowstone National Park was cored by Cathy Whitlock, University of Oregon; the core has yet to be analyzed.

No paleoecological studies of valley peatlands of Idaho have been undertaken to reconstruct *in situ* bog vegetational history as has been done elsewhere (Watts and Winter 1966; Miller and Futyma 1987). During 1992, Peter Mehringer, Washington State University, in cooperation with the CDC and the USFS Intermountain Research Station, cored Hager and Huff lakes as part of the vegetational reanalysis of both sites. The CDC is primarily interested in the vegetative and developmental history of these sites, particularly during the last 2,000 years. In particular, the question of whether the vegetative changes at Hager Lake that have occurred during the last 40 years (Bursik and Moseley in prep.) are "typical" or "unusual" can only be answered by analysis of the peat. These compositional fluctuations include the apparent extirpation of three FS Sensitive plant species and the appearance of another FS Sensitive species.

Peatland development is affected by climatic conditions and the physical nature of the peat deposits. Peatland development has certainly varied in valley peatlands in Idaho due to the latitudinal and elevational ranges at which they occur, and the variety of prevailing climatic regimes under which they are found throughout the state. Whether peatland vegetation and biodiversity is in part a function of age of the system (as suggested by Bursik 1990) or whether it is a product of the suite of other factors discussed earlier (including chemistry and hydrology), or whether it is simply the result of chance arrivals of plant propagules during the Holocene, may be inferred from peat core analyses.

From a biodiversity perspective, the Idaho CDC is interested in dating the arrival (and exit) of certain floristic elements (particularly sensitive elements) into peatland systems and in ascertaining their persistence and relative abundance since colonization. This will give us an idea of system stability, degree of persistence of certain parts of the peatland biota, and whether certain species might "come and go" from a system through time and whether these "comings and goings" are correlated with certain climatic events (e.g., drought). If species do come and go, and if what has happened at Hager Lake during the last 40 years is typical, then subsequent sections of peat may be used to determine rate of recolonization of these species back into the system. We must also use the paleoenvironmental data to place peatland development in the context of changes in regional climate and vegetation.

****
*

PALEOECOLOGY GAPS

-- Analysis of cores from valley peatlands throughout Idaho.

-- Develop models of peatland development and species colonization rates of these disjunct peatland "islands" under varying climates.

-- Develop peatland management/conservation strategies based on these paleoecological models.

****
*

RESTORATION

Several of the high-priority valley peatlands in Idaho have been disturbed to some degree (recreational impacts, draining, filling, heavy livestock grazing, etc.). Any program directed toward conservation should also be concerned with restoring those areas that have not been totally destroyed. Prerequisite to developing a sound and informed restoration model for valley peatlands will be to first build our knowledge base of the composition, structure, and function of these systems. From this information base, peatland restoration technology can then be developed.

****
*

PEATLAND RESTORATION GAPS

-- Document restoration opportunities at high priority valley peatlands.

****
*

MONITORING

Monitoring of peatland plant communities has two facets. One is basic inventory of the biota, which was discussed in an earlier section. Documenting the presence or absence of the elements of biodiversity at these sites should be the immediate priority. The importance of thorough inventory work should not be underestimated. Persistence of existing populations of plants, animals, and fungi will be the first indication of a relatively stable and secure system that is being properly managed. For instance, Rumely's (1956) checklist of the vascular flora of the Hager Lake fen has provided an important 40 year-old baseline from which to measure change. Recent floristic inventories of Hager Lake revealed the disappearance and colonization of several vascular plants, including four rare species (Bursik and Moseley in prep.).

While the inventory work is being completed, we should proceed with the second facet of monitoring, that is the long-term, quantitative monitoring of certain populations and communities within peatlands. The CDC has initiated three long-term monitoring studies in valley peatlands of the Idaho panhandle in 1992. We reread transects established through the Hager Lake peatland by Rumely in the early 1950's (Bursik and Moseley in prep.). At Huff Lake, we are remapping the peatland communities to see if we can detect any changes, using a 20 year-old vegetation map as the baseline. To supplement this spatial data, we have also placed permanently-located vegetation transects at Huff Lake to collect quantitative data on community composition and structure (Bursik and Moseley, in prep.). In a third area, we are establishing monitoring plots in peatlands to study the effects of livestock grazing and logging of adjacent forests on rare plant populations and community structure and composition. Plots were placed in Cow Creek Meadows, which will be affected by the above-mentioned activities, and in the nearby Smith Creek RNA, which will be used as a control (Bursik in prep.). These studies are funded by the Idaho Panhandle National Forest and the USFS Intermountain Research Station.

All our vegetational monitoring plots will be linked with on-site water chemistry monitoring to ascertain natural fluctuations in cation concentrations and pH levels, which may result from prolonged drought or other climatic phenomena. Also, because the occurrence and distribution of peatland species are closely tied to certain water chemistry conditions, peatlands are perhaps the ideal ecosystem to monitor the effects of anthropogenic acid precipitation on the landscape. By tying permanent vegetative plots with water chemistry analysis, this will be accomplished.

Many other monitoring opportunities exist in Idaho's valley peatlands. While we need to establish more monitoring plots in relatively undisturbed peatlands to provide baselines, they also provide an opportunity to help isolate the independent variables where we are monitoring the recovery of disturbed sites. Monitoring the recovery of peatlands at Iron Bog RNA from grazing impacts and Vat Creek from ditching and draining are two such opportunities. A well-planned monitoring program in high priority peatlands to detect status and trends of plants and animals may also aid in the early recognition of changes that would put these sensitive and high-priority habitats at risk.

Although still evolving, monitoring methodologies developed by Bursik (Bursik in prep.; Bursik and Moseley in prep.) for peatlands in northern Idaho in 1992, appear to be thorough yet efficient. A peatland monitoring program should be expanded state-wide as soon as possible. Skalski (1990) suggests that new protocols need to be developed to detect spacial and temporal changes so that a given situation, such as forest die-offs attributed to acid rain in the northeastern U.S., need not reach catastrophic proportions before the need for effects monitoring and action is needed (see Alston 1985). The monitoring technique which includes sampling with partial replacement (Skalski 1990) to ascertain population status and trends will be carefully evaluated for its application in the Valley Peatlands Project in Idaho.

****
*

PEATLAND MONITORING GAPS

-- Presence/Absence - inventory projects should be continued and expanded.

-- Quantitative - expand population, vegetation, and water chemistry monitoring to high priority peatlands state-wide.

****
*

LITERATURE CITED

Alston, R.M. 1987. Inventory and monitoring endangered forests: a critical report on the 1985 IUFRO Conference. Journal of Environmental Management 25:181-189.

Boggs, K., P. Hansen, R. Pfister, and J. Joy. 1990. Classification and management of riparian and wetland sites in northwestern Montana. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula, MT. 217 pp.

Breining, G. 1992. Rising from the bogs. Nature Conservancy (July/August) 24-29.

Bursik, R. 1990. Floristic and phytogeographic analysis of northwestern Rocky Mountain peatlands, U.S.A. Unpublished M.S. Thesis, University of Idaho, Moscow, ID. 37 pp.

Bursik, R. 1992. Field investigation of sensitive plant taxa occurring on the Priest Lake Ranger District, Kaniksu National Forest, Idaho Panhandle National Forests. Unpublished report prepared for the

Idaho Panhandle National Forests; on file at Idaho Department of Fish and Game, Conservation Data Center, Boise, ID. 141 pp., plus appendices.

Bursik, R. In preparation. Baseline monitoring of peatland communities in the Cow Creek proposed Botanical Area, Bonners Ferry Ranger District, Idaho Panhandle National Forest.

Bursik, R. and R.K. Moseley. In preparation. Reanalysis of vegetation at Hager and Huff Lakes in the Priest River Valley, northern Idaho and eastern Washington.

Caicco, S.L. 1987. Field investigations of selected sensitive plant species on the Idaho Panhandle National Forest. Unpublished report prepared for the Idaho Panhandle National Forests; on file at Idaho Department of Fish and Game, Conservation Data Center, Boise, ID. 44 pp., plus appendices.

Caicco, S.L. 1988. Studies in the genus *Carex* on the Idaho Panhandle National Forest. Unpublished report prepared for the Idaho Panhandle National Forests; on file at Idaho Department of Fish and Game, Conservation Data Center, Boise, ID. 44 pp., plus appendices.

Danks, H.V. and D.M. Rosenberg. 1987. Aquatic insects of peatlands and marshes in Canada: synthesis of information and identification of needs for research. Memoirs of the Entomological Society of Canada 140:163-174.

Glaser, P. 1987. The ecology of patterned boreal peatlands of northern Minnesota: a community profile. U.S. Fish and Wildlife Service Report 85(7.14). 98 pp.

Groves, C.R. and E. Yensen. 1989. Rediscovery of the northern bog lemming (*Synaptomys borealis*) in Idaho. Northwest Naturalist 70:14-15.

Groves, C.R., and C. Peterson. 1992. Distribution and population trends of Idaho amphibians as determined by mail questionnaire. Unpublished report on file at the Idaho Department of Fish and Game, Nongame and Endangered Wildlife Program, Boise. 16 pp.

Hansen, H.P. 1939. Pollen analysis of a bog in northern Idaho. American Journal of Botany 26:225-228.

Hansen, H.P. 1947. Postglacial forest succession, climate, and chronology in the Pacific Northwest. Transactions of the American Philosophical Society 37:1-130.

Hansen, P., S. Chadde, R. Pfister, J. Joy, D. Svoboda, J. Pierce, and L. Meyers. 1988. Riparian site types, habitat types, and community types of southwestern Montana. Montana Riparian Association, School of Forestry, University of Montana, Missoula, MT. 140 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 and peatland types, and the environment in the Lake Agassiz Peatlands Natural Area, Minnesota. Ecological Monographs 40:235-261.

Jeglum, J.K. 1971. Plant indicators of pH and water levels in peatlands at Candle Lake, Saskatchewan. Canadian Journal of Botany 49:1661-1676.

Mack, R.N., N.W. Rutter, V.M. Bryant Jr., and S. Valastro. 1978. Reexamination of postglacial vegetation history in northern Idaho: Hager Pond, Bonner Co. Quaternary Research 10:241-255.

Mattson, D.J. 1984. Classification and environmental relationships of wetland vegetation in central Yellowstone National Park, Wyoming. Unpublished M.S. Thesis, University of Idaho, Moscow, ID. 326 pp.

Mehringer, P.J., S.F. Arno, and K.L. Petersen. 1977a. Postglacial history of Lost Trail Pass bog, Bitterroot Mountains, Montana. Arctic and Alpine Research 9:345-368.

Mehringer, P.J., E. Blinman, and K. Peterson. 1977b. Pollen influx and volcanic ash. Science 198:257-261.

Miller, N.G. and R.P. Futyma. 1987. Paleohydrological implications of Holocene peatland development in northern Michigan. Quaternary Research 27:297-311.

Moseley, R.K. 1989. Field investigations of 16 rare plant taxa occurring in wetlands on the Bonners Ferry Ranger District, Idaho Panhandle National Forests. Unpublished report prepared for the Idaho Panhandle National Forest; on file at Idaho Department of Fish and Game, Conservation Data Center, Boise. 75 pp., plus appendices.

Moseley, R.K. 1990. Field investigations of eight rare plant taxa occurring in wetlands on the Sandpoint Ranger District, Idaho Panhandle National Forests. Unpublished report prepared for the Idaho Panhandle national Forest; on file at Idaho Department of Fish and Game, Conservation Data Center, Boise. 42 pp., plus appendices.

Moseley, R.K., R. Bursik, and M. Mancuso. 1991. Floristic inventory of wetlands in Fremont and Teton counties, Idaho. Unpublished report prepared for the Targhee National Forest; on file at Idaho Department of Fish and Game, Conservation Data Center, Boise, ID. 60 pp., plus appendices.

Moseley, R.K. and C.R. Groves. 1992. Rare, threatened and endangered plants and animals of Idaho. Conservation Data Center, Nongame and Endangered Wildlife Program, Idaho Department of Fish and Game, Boise, ID. 38 pp.

Mutz, K.M., and J. Queiroz. 1983. Riparian community classification for the Centennial Mountains and South Fork Salmon River, Idaho. Meiiji Resource Consultants, Layton, UT. 106 pp.

Padgett, W.G., A.P. Youngblood, and A.W. Winward. 1989. Riparian community classification of Utah and southeastern Idaho. R4-Ecol-89-01. USDA, Forest Service, Intermountain Region, Ogden, UT. 191 pp.

Rabe, F.W. and N.L. Savage. 1977. Aquatic natural areas in Idaho. Project A-046-IDA, Idaho Water Resources Research Institute, University of Idaho, Moscow, ID. 111 pp.

Rabe, F.W., R.C. Biggam, R.M. Breckenridge, and R.J. Naskali. 1986. A limnological description of selected peatland lakes in Idaho. Journal of the Idaho Academy of Science 22(2):63-90.

Rabe, F.W., R.J. Bursik, and E.B. Cantor. 1990. Classification and monitoring of wetlands in established and proposed Natural Areas. Unpublished report prepared by the University of Idaho for the U.S. Forest Service; on file at Idaho Department of Fish and Game, Conservation Data Center, Boise. 209 pp.

Rumely, J.H. 1956. Plant ecology of a bog in northern Idaho. Unpublished Ph.D. Dissertation, Washington State University, Pullman, WA. 85 pp.

Saab, V., and C.R. Groves. 1992. Idaho's migratory land birds. Idaho Wildlife (Summer 1992). 16 pp.

Schoonmaker, P.K. and D.R. Foster. 1991. Some implications of paleoecology for contemporary ecology. Botanical Review 57(3):204-245.

Schwintzer, C.R. 1978. Vegetation and nutrient status of northern Michigan fens. Canadian Journal of Botany 56:3044-3051.

Sjors, H. 1950. On the relation between vegetation and electrolytes in north Swedish mire waters. Oikos 2:241-258.

Skalski, J.R. 1990. A design for long-term status and trends monitoring. Journal of Environmental Management 30:139-144.

Steele, R., R.D. Pfister, R.A. Ryker, and J.A. Kittams. 1981. Forest habitat types of central Idaho. General Technical Report INT-114. USDA Forest Service, Intermountain Research Station, Odgen, UT. 138 pp.

Steele, R., S.V. Cooper, D.M. Ondov, D.W. Roberts, and R.D. Pfister. 1983. Forest habitat types of eastern Idaho - western Wyoming. General Technical Report INT-144. USDA Forest Service, Intermountain Research Station, Odgen, UT. 122 pp.

Stevens, M. 1990. Between land and water. Idaho Wildlife 10(4):13-24.

Tuck, L.M. 1972. The snipes, a study of the genus *Capella*. Canadian Wildlife Service Monograph Series No.5, Ottawa, Ontario.

Tuhy, J.S. 1981. Stream bottom community classification for the Sawtooth Valley, Idaho. Unpublished M.S. Thesis, University of Idaho, Moscow. 230 pp.

Tuhy, J.S., S. Jensen. 1982. Riparian classification for the Upper Salmon/Middle Fork Salmon River drainages, Idaho. Smithfield, UT, White Horse Associates. 183 pp.

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.

Watts, W.A. and Winter, T.C. 1966. Plant macrofossils from Kirchner Marsh, Minnesota, a paleoecological study. Bulletin of the Geological Society of America 77:1339-1359.

Youngblood, A.P., W.G. Padgett, and A.W. Winward. 1985. Riparian community type classification of eastern Idaho - western Wyoming. R4-Ecol-85-01. USDA Forest Service, Intermountain Region, Ogden, UT. 78 pp.

Prepared by: Rob Bursik and Bob Moseley, Idaho Conservation Data Center.