

Northern bog lemming survey

1993

A Report to:

USDA Forest Service

Kootenai National Forest
506 U.S. Highway 2 West
Libby, MT 59923

Flathead National Forest
1935 Third Avenue East
Kalispell, MT 59901

and

Rocky Mountain Ranger District
Lewis and Clark National Forest
1102 Main Ave. NW
Box 340
Choteau, MT 59422

Submitted by:

*James D. Reichel
and
Stan G. Beckstrom*

February 1994

*Montana Natural Heritage Program
1515 E. 6th Avenue
P.O. Box 201800
Helena, MT 59620-1800*

© 1994 Montana Natural Heritage Program

This document should be cited as follows:

Reichel, J.D. and S.G. Beckstrom. 1994. Northern bog lemming survey: 1993.
Montana Natural Heritage Program. Helena, MT. 87 pp.

ABSTRACT

During the 1993 field season we surveyed for small mammals at 30 sites, catching northern bog lemmings at 5 new sites. One site, Wood Creek on the Rocky Mountain Ranger District, Lewis and Clark National Forest, is the eastern-most site known in Montana and 90 km from the nearest previously known site. Three sites on the Kootenai National Forest were in the Sunday Creek drainage, 1-6 km from the site discovered there in 1992. The last new site, also in the Kootenai National Forest, was found at Cody Lake, 32 km from the nearest known site. Despite surveys at 5 sites with apparently good-excellent habitat on the Flathead National Forest, no new lemming sites were found there. The total number of known bog lemming sites in Montana is 17, the most sites in any of the lower 48 states. All sites found during 1993 had moss mats at or near the trap location. Known sites in Montana range in size from 1 to approximately 340 acres. The best habitat predictor for potential northern bog lemmings sites in Montana is the presence of large, thick moss mats, particularly sphagnum moss. More sites with apparently good quality habitat were trapped unsuccessfully in 1993 than 1992; whether lemmings are actually present at some or all of those sites is unknown.

TABLE OF CONTENTS

ABSTRACT i

LIST OF TABLES AND FIGURES iii

ACKNOWLEDGEMENTS iv

INTRODUCTION 1

METHODS AND MATERIALS 3

RESULTS 5

 Trapping 5

 Site Characteristics 5

DISCUSSION 29

 Distribution 29

 Habitat Patches 30

 Research Methods 32

MANAGEMENT RECOMMENDATIONS AND RESEARCH NEEDS 34

LITURATURE CITED 36

APPENDIX 1. ANNOTATED BIBLIOGRAPHY 38

APPENDIX 2. SITES WHICH SHOULD BE TRAPPED IN THE FUTURE 58

APPENDIX 3. PLANT COMMUNITY SURVEYS AT NORTHERN BOG LEMMING
 SITES 62

APPENDIX 4. OCCURRENCE RECORDS OF NOTHERN BOG LEMMINGS
 TRAPPED IN 1993 89

LIST OF TABLES AND FIGURES

Table 1. Sites trapped during 1993 northern bog lemming surveys. 10

Table 2. Sites examined for bog lemming habitat, but found only marginally or not suitable. 12

Table 3. Sites for which only air photos were examined for bog lemming surveys. 16

Table 4. Results of snap trapping during 1993 northern bog lemming surveys. 17

Table 5. Success of two baits used in snap traps at sites where northern bog lemmings were found in 1992 and 1993. 19

Table 6. Northern bog lemmings captured during 1993. 20

Table 7. Plant communities present at 6 northern bog lemming sites. 21

Table 8. Plant species present, percent coverage of each species, and number of habitats surveyed at 7 northern bog lemming sites. 22

Table 9. Characteristics of known bog lemming sites, plus several additional sites in the Sunday Creek complex, in Montana. 28

Figure 1. Map of northern bog lemming sites in Montana. 8

Figure 2. Map of Sunday Creek bog lemming complex showing potential and known habitat patches. 9

ACKNOWLEDGEMENTS

We would like to thank Bob Summerfield, Nancy Warren, and Seth Diamond for their help throughout the study. D.E. Pearson provided access to his invaluable unpublished information. S.W. Chadde, S.V. Cooper, J.C. Elliott, and B.L. Heidel identified plants and plant communities. Help with field work, location of possible trapping sites, and other logistical support was provided by G. Altman, J. Berglund, A. Bratkovich, C. Castren, P. Finnegan, C.E. Hidy, G. Heinz, P. I. Jelinek, L. Johnson, W. Johnson, R.L. Krepps, L.J. Kuennen, D. Roemer, and many other Forest Service personnel. D.L. Genter helped with all phases of the project. S.W. Chadde, P. Lesica, and J.S. Shelly gave advice on fen locations. M. Beer, C. Craig, and C. Jones helped with database applications and mapping in the preparation of the report. Financial support for the project came from the Kootenai National Forest, Flathead National Forest, Rocky Mountain Ranger District of the Lewis and Clark National Forest (U.S. Forest Service), Montana Department of Transportation, and the Montana Natural Heritage Program (Montana State Library).

INTRODUCTION

The northern bog lemming (Synaptomys borealis) is a small, grayish brown, vole-like microtine, related to the true arctic lemmings (Lemmus). Nine poorly differentiated subspecies are currently recognized. The northern bog lemming has a total length of 118-140 mm including its very short tail (19-27 mm) (Banfield 1974, Hall 1981). The combination of a tail less than 28 mm and a longitudinal groove in the upper incisors distinguish the northern bog lemming from all other mice found in Montana.

Little is known about northern bog lemming life history. Litter sizes vary from 3-8, with 2 (or more?) litters per year. It has been suggested some animals breed the same year they are born (60-90 days old?). This information is scattered throughout the literature. All literature on specific to northern bog lemmings is essentially distributional in nature; other publications mention bog lemmings as a sideline to the main publication (Appendix 1).

The northern bog lemming is boreal in distribution, occurring in North America from near treeline in the north, south to Washington, Idaho, Montana, Minnesota, and New England. It typically inhabits sphagnum bogs and fens, but is also occasionally found in other habitats including mossy forests, wet sub-alpine meadows, and alpine tundra. One subspecies (S.b. artemisiae) lives on sagebrush hillsides in eastern British Columbia (Anderson 1932). Southern bog lemmings (S. cooperi) also inhabit a wide variety of habitats, all of which are marginal for Microtus; bog lemmings may be competitively excluded from better quality habitats by Microtus (Doutt et al. 1973, Linzey 1981). The northern bog lemming is rarely trapped and is one of the least known mice in North America.

A few relict populations occur in the lower 48 states; the subspecies chapmani occurs in Montana, Idaho, and northeast Washington (Hall 1981). Bog lemmings are known from 4 locations in Idaho and 8 in Washington, all from within 80 km of the Canadian border (Johnson and Cheney 1953, Wilson et al. 1980, Reichel 1984, Groves and Yensen 1989, D. Johnson pers. comm.). The reasons for the disjunct nature of the populations may include: 1) the localized nature of its primary habitat; and 2) the currently patchy distribution of a boreal species that was more widely distributed during the Pleistocene (a glacial relict).

Prior to 1992, evidence of bog lemmings in Montana included: 1) 6 locations on the west side of Glacier National Park (Wright 1950, Weckwerth and Hawley 1962, Hoffmann et al. 1969, Pearson 1991); 2) Shoofly Meadows in the Rattlesnake drainage north of Missoula (Adelman 1979), and 3) a single skull recovered from a Boreal Owl (Aegolius funereus) pellet west of Wisdom (J. Jones pers. comm.); where the owl captured the lemming was unknown. In 1992 we trapped 21 riparian areas finding five new populations of northern bog lemmings (Reichel and Beckstrom 1993). These included: 1) Sunday

Creek drainage, Lincoln Co.; 2) a fen along Bowen Creek, Lincoln Co.; 3) around a pond in upper South Fork Hawkins Creek, Lincoln Co.; 4) meadows along Meadow Creek, Ravalli Co.; and 5) Maybee Meadows, Beaverhead Co. The Maybee Meadows site was the southern-most known population of the species outside of New England and the only Montana population from east of the Continental Divide. All five sites found in 1992 were associated with thick mats of sphagnum moss.

The U.S. Forest Service, Region 1, lists the northern bog lemming as Sensitive. It is listed as a Species of Special Concern by the Idaho and Montana Natural Heritage Programs (Moseley and Groves 1990, Genter 1992).

We began a multi-year study of northern bog lemmings in Montana in 1992. Objectives during 1993 included:

- 1) surveying at least 16 sites with potential habitat for bog lemmings in northwest Montana, concentrating on the Kootenai National Forest, Flathead National Forests, and Rocky Mountain District of the Lewis and Clark National Forest;
- 2) determining efficient and effective survey techniques;
- 3) describing habitat where bog lemmings were found; and
- 4) preparing an annotated bibliography of literature on northern bog lemmings.

METHODS AND MATERIALS

We visited 103 sites in western Montana, examining riparian habitats to determine if they appeared suitable for northern bog lemmings; 30 of these sites were trapped (Tables 1). Sites were examined but not trapped (Table 2) included: very small riparian areas; standing water with only very narrow fen border; homogeneous vegetation (such as all sedges) lacking moss mats; entire area with thick brush such as alder; cattail marshes; or small ponds surrounded by dry meadows. Lack of moss mats did not exclude a site from trapping, however sites trapped without a moss mat were generally large, diverse, wetland complexes with at least some sphagnum present. We examined air photos of 21 additional sites; 4 may be suitable habitat but were not visited due to their locations being far from roads, while 17 appeared unsuitable on the photo (Table 3). Most sites examined were suggested by botanists, plant ecologists, biologists and others from the U.S. Forest Service and Montana Natural Heritage Program (MTHP). Several were identified while in the field or by examining maps of the general areas we were to visit.

From 15 June - 5 September 1993 we used Museum Special snap-traps to sample 30 sites in western Montana (Table 1). Traps were baited with a combination of peanut butter and rolled oats, either alone or with E.J. Dailey's muskrat lure. Relative success of baits used was examined using the G test (Sokal and Rohlf 1969). Two traps with different baits were placed within 2 m of each other at each station. We placed each trap at a station to maximize success (runway, burrow, etc.). Stations were placed 5-20 m apart.

At sites where northern bog lemmings were not caught, trapping effort ranged from 109 to 280 trap-nights over 1-4 nights. A trap-night is equivalent to one trap set for one 24-hour period (traps sprung and empty, or completely missing, are not counted). All traps were removed immediately following the first bog lemming capture.

Lemming habitat patch sizes in the Sunday Creek complex were determined via GIS following digitization from the USGS 7.5' quad map. For other known lemmings sites, patches were measured using dot overlays on USGS 7.5' maps. Habitat patches for sites we have visited were drawn on the maps and represent suitable moss mat habitat. Habitat patches for sites we have not visited were drawn on the maps in the area shown as wetlands on the maps. We have found that these are likely to be overestimates. Some habitat in the forest may be suitable but is not shown on the maps, however the area shown as wetlands typically includes sedge meadows or other habitat types not suitable for lemmings. Distances to the nearest potential patch were measured either to 1) patches we have visited and know to be suitable, or 2) patches which D.E. Pearson or P. Lesica have indicated to us are suitable.

Bonnie Heidel, Steve Cooper, and Steve Chadde of the MTHP conducted botanical surveys at 2 bog lemming locations discovered

during 1993 and 3 sites discovered in 1992 (Appendix 3). Joe Elliott identified mosses collected at those sites. ECODATA methodology was used for botanical surveys (DeVelice 1991).

RESULTS

Trapping. Northern bog lemmings were captured at 5 of the 30 sites trapped (Figure 1; Tables 1, 4; Appendix 4). An additional 73 sites (most suggested by botanists, plant ecologists, biologists and others from the USFS and MTHP) were examined but were not trapped because they appeared either marginally suitable, or unsuitable, for northern bog lemmings (Table 2).

Snap trap effort required to document bog lemming presence at sites found to contain the species averaged 114 trap-nights, and ranged from 46 trap-nights (during 1 night) to 224 trap-nights (during 3 nights of trapping). The lemming caught at Paul Creek after 224 trap-nights is the only one we have captured in an area having only a thin covering of moss. Areas where no bog lemmings were found received 109-280 trap-nights of effort. At sites where northern bog lemmings were captured, we averaged 1.40 lemmings per 100 trap-nights. Eleven additional sites had apparently suitable habitat (Sunday Creek 2-4, Magnesia Creek, bog NW of Lost Lake, Bent Flat Fen, Trail Creek Fen, Swan River Fen, Lost Creek Fen, Plum Creek Fen, and Sawmill Flat). At all sites with apparently suitable habitat, we averaged 1 lemming per 350 trap-nights. Traps baited with peanut butter and oatmeal alone appeared less effective at capturing northern bog lemmings than when the bait was mixed with Dailey's muskrat lure (Table 5), but differences were not significant ($G = 1.56, 1 df$).

A total of 8 northern bog lemming specimens will be placed in one or more regional university museums (Table 6). All will be prepared as skins and skulls/skeletons. Only two females were collected. Stomach contents will be analyzed during the winter of 1993-4.

During bog lemming surveys, at least 12 other species of small mammals were captured (Table 4). Some vole specimens, particularly subadults, and shrews will need field identification verified when the skulls are cleaned.

At the five sites where bog lemmings were captured, 1-3 other species of voles were also captured (Table 4). These included meadow voles (Microtus pennsylvanicus), long-tailed voles (Microtus longicaudus) and red-backed voles (Clethrionomys gapperi). One red-backed vole was captured at the forest edge, a higher/dryer micro-site than where bog lemmings typically occur. The other red-backed vole was captured in a sphagnum mat about 10 m from the forest edge at Cody Lake. Unlike last year, meadow voles were frequently caught in sphagnum mats with lemmings; however, most meadow voles were caught in areas with little or no sphagnum, as was the single long-tailed vole captured.

Site characteristics. Elevation of the sites where bog lemmings were captured ranged from 4220-5590 ft (1360-1800m), while all sites surveyed ranged from 2750-6080 ft (890-1960m).

Sunday Creek site 5, where bog lemmings were captured during 1992, had a plant community survey completed last year (Reichel and Beckstrom 1993); other lemming sites in the Sunday Creek complex appeared similar to that site. Those sites have not been surveyed by a botanist. Three sites where bog lemmings were captured in 1992 (Bowen Creek, Maybee Meadows, Meadow Creek) and the Wood Creek and Cody Lake sites found during 1993 had plant community surveys completed this year (Tables 7, 8; Appendix 3).

At 8 of 10 sites where northern bog lemmings were caught during 1992-93, they were trapped either in, or very close to, thick mats of sphagnum moss (Sphagnum spp.). The ninth site, Wood Creek, also had a thick moss layer but it was composed primarily of Tomenthypnum nitens rather than sphagnum. At Paul Creek (in the Sunday Creek complex) a single individual was caught in thin sphagnum after 224 trap-nights. Thick moss mats appear to be the most reliable indicator of a potential site. Of sites trapped during 1992-3 where bog lemmings were not caught, only 12 of 41 had thick, extensive moss mats. All lemming sites gave the impression of openness; none were thick, tangled, difficult-to-walk-through, thickets often found in wetland/riparian areas. Other vegetative characteristics of these moss habitat patches are given below.

Specific plant community types were quite different between sites (Table 8), and included tree, shrub and graminoid dominated communities. Some lemming sites had an open overstory (to 40% canopy cover) of subalpine fir (Abies lasiocarpa) and/or spruce (Picea); others were without a tree component. Shrubs were present on all sites; however, in most areas the moss habitat patches were without shrubs on at least part of the patch. Shrub canopy cover ranged from 0-80% at any particular location on a site, and shrubs were typically <1.5 m tall. Bog birch (Betula glandulosa) and/or a small willow (Salix sp.) were present at all sites (Table 7).

Graminoid cover ranged from 40-90%, and was dominated by sedges at all sites except Cody Lake where Eleocharis pauciflora was dominant (Table 7). The dominant sedge species at other sites were quite variable, but all were in the genus Carex. Seven Carex species had at least a 20% coverage at one or more sites; they included aquatilis, arcta, buxbaumii, canescans, lasiocarpa, utriculata, and vesicaria. Carex utriculata was the only graminoid found at more than half the sites.

Forb coverage was typically sparse (3-40%) (Table 7). The densest forb coverage occurred at Cody Lake, where it was 40% on part of the area; the other five sites had a maximum forb coverage of 15%. The species of forbs present were extremely variable between sites, with only 2 forb species occurring on half the sites (Aster foliaceus, Pyrola asarifolia).

The Sunday Creek complex has 210 acres of apparently suitable habitat along 8 miles of the drainage, with at least 15 patches

ranging from <1 to 61 acres (habitat separated by <100 m was considered the same patch) (Figure 2). We have trapped at 7 of these patches ranging in size from 5-61 acres; bog lemmings have been caught at 4 of the seven sites. Known sites include the highest and lowest known habitat patches in Sunday Creek, and the highest known patch in the Paul Creek tributary. The longest breaks between suitable habitat patches are slightly more than 1 km. Comparisons between patches where lemming were trapped and were not trapped do not reveal consistent patterns relating to trapping effort, size of the patch, distances from other patches, or apparent habitat quality.

Known lemming habitat patches in Montana range in size from 1-61 acres, with 7 of 15 being smaller than 10 acres (Table 9). Distances between known lemming sites range from 0.3 - 90 km (Table 9). Distances between a known bog lemming site and the nearest known suitable habitat patch range from 0.2 - 18 km (Table 9).

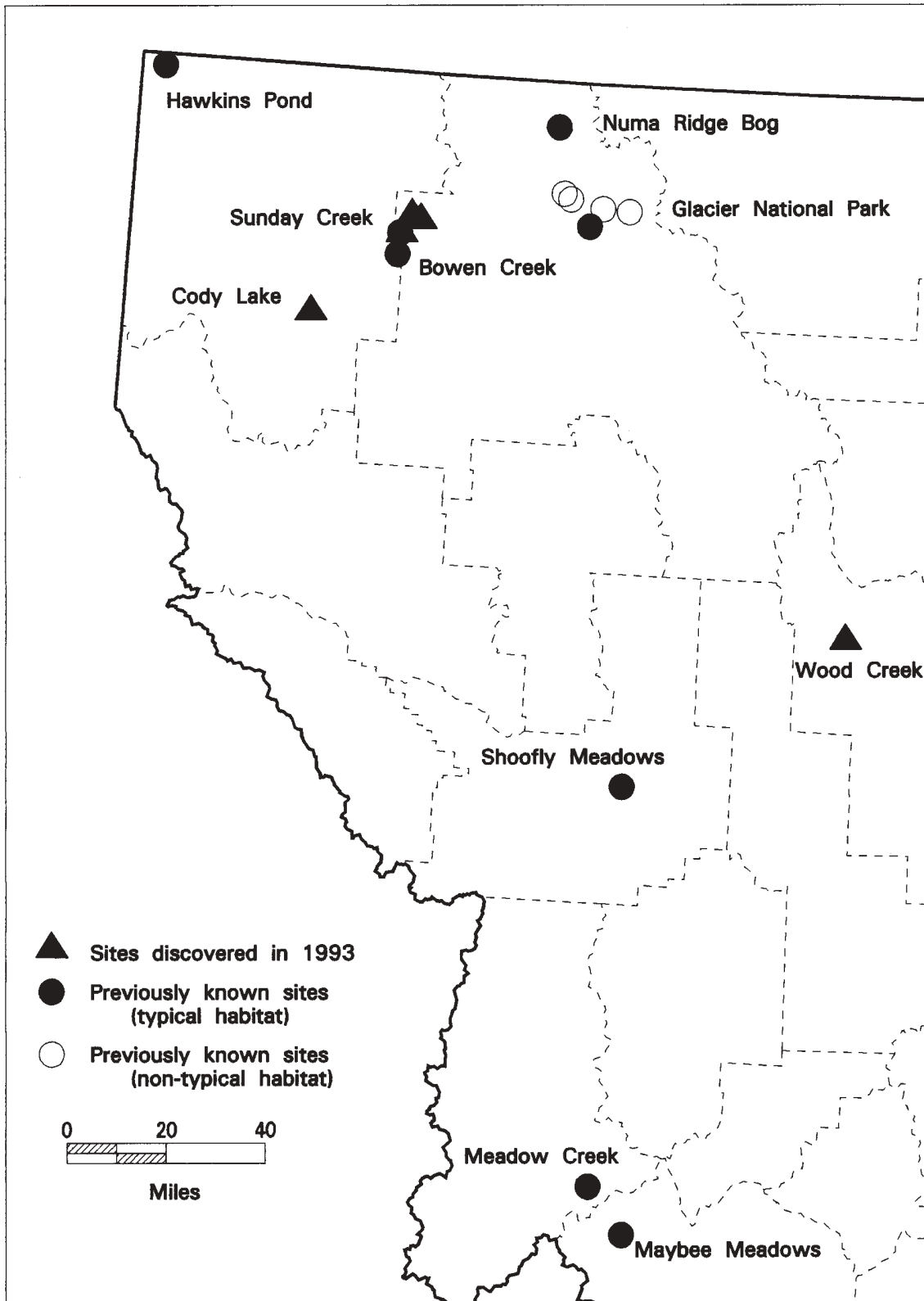


Figure 1. Northern Bog Lemming occurrences in Montana.

Locations are from Wright (1950), Weckwerth and Hawley (1962), Adelman (1979), Pearson (1991), Reichel and Beckstrom (1993), and this report.

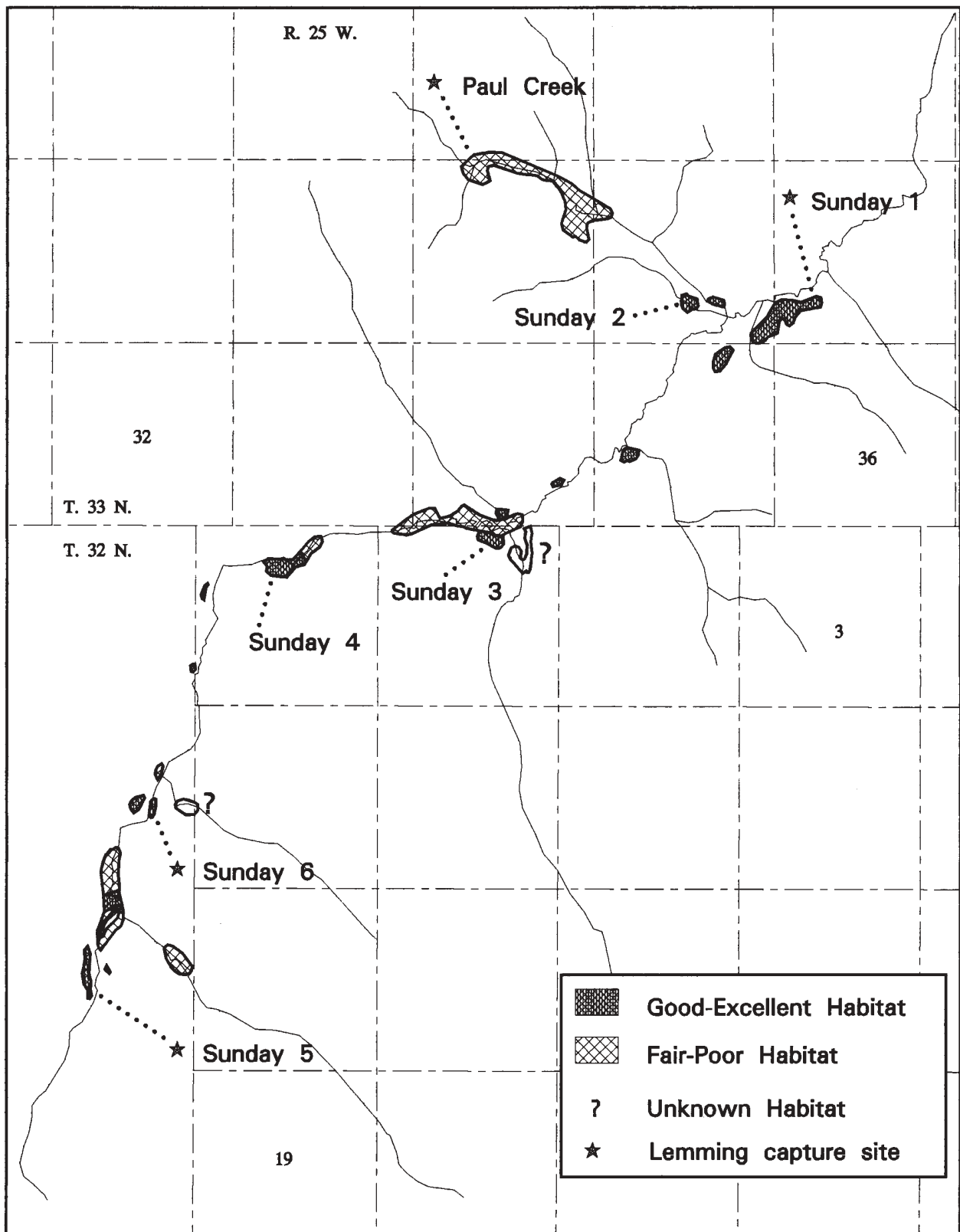


Figure 2. Sunday Creek bog lemming complex showing potential and known habitat patches.

Table 1. Sites trapped during 1993 northern bog lemming surveys.

Site	Location	Elev.	Date	Trap-nights
KOOTENAI NATIONAL FOREST				
Fortine District				
*Sunday Creek site 1, Lincoln Co.	T33N R25W S25	4220	26-27 Aug	46
Sunday Creek site 2, Lincoln Co.	T33N R25W S26	4230	26-29 Aug	182
Sunday Creek site 3, Lincoln Co.	T32N R25W S5	4300	27-29 Aug	87
"	"	"	3-5 Sep	128
Sunday Creek site 4, Lincoln Co.	T32N R25W S6	4460	3-5 Sep	115
*Paul Creek, Lincoln Co.	T33N R25W S27	4440	26-29 Aug	224
*Sunday Creek site 6, Lincoln Co.	T32N R26W S12	4680	27-29 Aug	90
Magnesia Creek, Lincoln Co.	T33N R25W S7	3790	18-21 Jun	252
Libby District				
Flower Lake, Lincoln Co.	T30N R32W S24	3830	14-16 Jul	183
Quartz Creek, Lincoln Co.	T32N R32W S23	3050	15-16 Jul	109
LaFoe Lake, Lincoln Co.	T33N R32W S13	3820	23-25 Jun	280
Cabinet District				
Rush Lake, Sanders Co.	T24N R29W S19	5360	12-14 Jul	198
Lyons Gulch, Sanders Co.	T25N R30W S22	4000	11-14 Jul	259
Smeads Bench bog, Sanders Co.	T26B R33W S7, 8	3100	10-11 Jul	115
Fisher River District				
#*lower Cody Lake, Lincoln Co.	T29N R28W S6	4700	15-16 Jun	96
bog NW of Lost lake, Lincoln Co.	T29N R30W S13	3800	7-10 Jul	272
Alexander Creek, Lincoln Co.	T31N R29W S31,32	2750	8-10 Jul	170

*= Synaptomys found at this site

#= Plant community survey done at this site

Table 1. (cont.) Sites trapped during 1993 northern bog lemming surveys.

Site	Location	Elev.	Date	Trap-nights
FLATHEAD NATIONAL FOREST				
Spotted Bear District				
Bent Flat Fen, Flathead Co.	T25N R15W S11	3990	14-16 Aug	171
Trail Creek Fen, Flathead Co.	T25N R14W S16	4220	14-16 Aug	173
Swan Lake District				
Mile 49 Pond, Missoula Co.	T22N R17W S34	3540	20-22 Jul	215
Swan River Fen PRNA, Lake Co.	T24N R18W S2	3120	28-30 Jun	202
Lost Creek Meadows, Lake Co.	T25N R18W S36	3180	20-23 Jul	220
Plum Creek Lands				
Pierce Bog, Missoula Co.	T19N R16W S21	4300	30 Jun-2 Jul	227
Plum Creek Fen, Lake Co.	T23N R18W S1	3330	20-23 Jul	226
Swan River State Forest				
S. of Simmons Meadows, Lake Co.	T23N R17W S32	3390	28-30 Jun	143
Point Pleasant Fen, Lake Co.	T24N R17W S19	3210	20-22 Jul	216
LEWIS AND CLARK NATIONAL FOREST				
Rocky Mountain District				
SE of Hidden Lake, Lewis & Clark Co.	T20N R9W S9	6080	30 Aug-1 Sep	227
#*Wood Creek, Lewis & Clark Co.	T20N R10W S26	5590	30-31 Aug	114
Hannan Gulch, Teton Co.	T22N R9W S26	4680	31 Aug-2 Sep	217
Sawmill Flat, Lewis & Clark Co.	T21N R9W S27	5120	1-3 Sep	199
LOLO NATIONAL FOREST				
Seeley Lake District				
Plum Creek Lands				
N. of Salmon Lake, Missoula Co.	T16N R15W S25	3920	30 Jun-2 Jul	221

*= Synaptomys found at this site

#= Plant community survey done at this site

Table 2. Sites examined for bog lemming habitat, but found only marginally or not suitable.

Site	Location	Comment
KOOTENAI NATIONAL FOREST		
Fortine District		
pothole	T32N R26W S1 SESWNE	dry, sedge-bordered pothole
pothole	T32N R26W S1 SESENW	dry, grassy pothole
Louis Lake	T33N R25W S15	sedge border, very marginal
marsh	T33N R27W S1 center	small pond; no moss mats
Deep Creek	T35N R25W S20 S-central	alder thickets, poor
Mud Lake	T36N R27W S25	mud hole, no moss mat
Three Rivers District		
Skinner Lake	T32N R33W S6	no moss mat, poor, dry at edge
upper Kilbrennan Creek	T33N R33W S20 N1/2	sedge/cattail pond, poor
Kilbrennan Lake, S end	T33N R33W S32	sedge/brush marsh, marginal
lower Kilbrennan Creek	T33N R33W S32 NW1/4	beaver pond, no moss mat, poor
marsh .5 mi S Horse Lake	T34N R31W S36 E border	sedge marsh, poor
Rexford District		
Horse Lakes	T34N R30W S31 NW1/4	sedge ponds, poor
Tepee Lake	T35N R27W S21 N border	small pond, no moss mat, dry grazed edge
marsh 3/4 mi E Tepee Lk	T35N R27W S21 E border	no moss mat, grazed grassy meadow
Phills Lake	T36N R27W S27	no moss mats, dry edge
Pinkham Creek trib.	T36N R27W S31 N border	small sedge meadow, poor
Poverty Creek ponds	T37N R28W S34	cattail bogs, marginal
Libby District		
Spring Creek Lake	T27N R30W S12 SE1/4	lily pond, poor

Table 2. (cont.) Sites examined for bog lemming habitat, but found only marginally or not suitable.

Site	Location	Comment
Libby District (cont.)		
Spring Creek bog	T27N R30W S12 NE1/4	large, complex bog, little sphagnum, poor access; has some potential
marsh	T28N R31W S14 center	sedge pond, poor
marsh	T28N R31W S24	sedge pond, poor
marsh	T28N R31W S25 SW1/4	brushy sedge pond, very marginal
Lost Lake	T29N R30W S13	marshy lake, very marginal
marsh 1/4 mi SW Lost Lk	T29N R30W S13	cattail pond, poor
Deep Creek road	T29N R31W S11 SW1/4	sedge pond, poor
Deep Creek road	T29N R31W S15 E-border	sedge & lily pond, poor
Deep Creek road	T29N R31W S21 N1/2	sedge bog/pond, very marginal
marsh	T30N R31W S21 NE1/4	cattail pond, poor
marsh	T30N R32W S13 S1/2	sedge pond, poor
Blue Lake & marsh	T32N R30W S16, 17	no moss mats, dry borders
marsh on divide	T32N R30W S15-16 border	sedge pond, poor
Bull Creek marsh	T32N R31W S21 SE1/4	sedge pond, poor
Rice Creek marsh	T32N R31W S36 NW1/4	sedge pond, poor
Deception Creek	T34N R31W S27 N-central	old beaver area, poor
Cabinet District		
Big Beaver Creek	T22N R31W S3, 4	marginal habitat
Image Lake area; 4 ponds	T23N R29W S10, 11, 14	sedge ponds, poor
White Pine Creek	T23N R31W S15, 16	farmed meadows, willows
Cataract Creek swamp	T24N R30W S16, 22	thick brush, no moss mats, poor
Grouse Lake	T24N R30W S24	little moss, poor

Table 2. (cont.) Sites examined for bog lemming habitat, but found only marginally or not suitable.

Site	Location	Comment
Cabinet District (cont.)		
Bear Lake	T24N R30W S24	little moss, poor
Trout Creek	T24N R32W S23, 27	no moss mats; thick willows
Willow Creek	T25N R29W S36	sedge marsh, poor
Elk Lake	T25N R30W S25	no moss mats
Frog Lake	T25N R30W S28	no moss mats
Tuscor Hill pond NE	T25N R32W S16 N1/2	sedge pond, poor
Copper Gulch	T27N R32W S20 E-border	couldn't find pond
Star Gulch pond	T27N R34W S13	pond w/ rocky edge, poor
Fisher River District		
Sylvan Lake	T25N R29W S24	marginal habitat
McKillop Lake	T27N R29W S1 E border	sedge and lily pond, poor
Little Wolf Creek	T29N R26W S4 E-central	grassy, alder area, poor
lower Doe Creek	T29N R29W S20 NE1/4	small beaver area, marginal
Buck Creek	T29N R29W S5	alder thicket, poor
Sinclair Creek	T30N R25W S20 S-central	2 sedge ponds, poor
Weigel Creek/wolf Creek	T31N R27W S1	sedge pond, thick willows, poor
marsh/fen	T31N R27W S11 SW1/4	sedge pond, poor
marsh	T31N R27W S21	wet, grassy clearcut
Summit Spring	T31N R27W S17	small, no moss mats
Cripple Horse Creek	T31N R28W S11, 12	thick willows, poor
South Fork Jackson Creek	T31N R29W S8 N-border	alder thicket, poor
South Fork Jackson Creek	T31N R30W S1 center	sedge pond, poor
South Fork Jackson Creek	T31N R30W S2 SE1/4	alder thicket, poor

Table 2. (cont.) Sites examined for bog lemming habitat, but found only marginally or not suitable.

Site	Location	Comment
Fisher River District (cont.)		
stream	T32N R27W S34 S-central	boggy stream area, marginal
stream	T32N R27W S34 SW1/4	boggy stream area, poor
Fivemile Creek	T32N R28W S15, 16	no moss mats; willows, poor marshes, sloughs along Fisher River from Kootenai River to McKillop Road- poor
FLATHEAD NATIONAL FOREST		
Swan District		
Crystal Fen	T18N R17W S10 N1/2	large sedge meadow with very little sphagnum around pond; poor
LOLO NATIONAL FOREST		
Seeley Lake District		
Elk Meadows	T16N R17W S35, 36	large bog complex; little sphagnum; appears marginal
LEWIS AND CLARK NATIONAL FOREST		
Rocky Mountain District		
Ford Creek	T19N R9W S16 N1/2	dry willow thicket, poor
road to Willow Creek	T20N R9W S26 E-border	small, marginal but possible
Little Willow Creek	T20N R9W S11, 14	beaver ponds, poor
Beaver Basin (by road)	T20N R9W S10 NE1/4	marginal but possible
Wagner Basin	T22N R9W S35-36 border	beaver area, brushy, poor
upper Hannan Gulch	T22N R9W S10-11 border	beaver area, brushy w/ bog birch, little moss, marginal

Table 3. Sites for which only air photos were examined for bog lemming habitat.

Site	Location	Comment
KOOTENAI NATIONAL FOREST		
Cabinet District		
93 Mile Lake	T23N R33W S16	may be suitable; long hike
pond	T26N R31W S7 NW	may be suitable; wilderness area
Cliff Lake	T27N R32W S25	may be suitable in ponds S of Lake;
pond	T28N R32W S28 NWNW	wilderness area may be suitable; wilderness area

pond nw of 87 Mile Peak	T24N R33W S20	doubtful if suitable; long hike
Moran Basin	T27N R32W S14	doubtful if suitable; wilderness area
Little Ibex Lake	T28N R32W S9	doubtful if suitable; wilderness area
pond	T28N R32W S22	doubtful if suitable; wilderness area

Beaver Lake	T22N R32W S34	does not appear suitable
Berry Lake	T23N R33W S13	does not appear suitable
East Lake	T23N R33W S24	does not appear suitable
Marmot Lakes	T24N R29W S30	does not appear suitable
small pond & seep	T25N R29W S30	could not see on air photo
pond ne of Ulm Peak	T25N R34W S22	does not appear suitable
Eagle Lake	T26N R32W S18	does not appear suitable
Isabel Lake	T27N R32W S18	does not appear suitable
Libby Lakes	T27N R32W S19	does not appear suitable
Copper Lake	T27N R32W S23	does not appear suitable
St. Paul Lake	T27N R32W S24	does not appear suitable
pond on South Fork	T27N R34W S2	does not appear suitable
Snowshoe Lake	T29N R32W S32	does not appear suitable

Table 4. Results of snap trapping during 1993 northern bog lemming surveys.

Site	Trap Nights	Total number of each species caught ¹												
		SOPA	SOVA	SOCI	SOMO	SOSP	MIPE	MILO	PHIN	SYBO	CLGA	ZAPR	PEMA	NECI
Sunday Creek #1	46					1	6			1	1			
Sunday Creek #2	182		7				1							
Sunday Creek #3	215	1	13			1	10				1			
Sunday Creek #4	115		2	1	1		1				6		1	
Paul Creek	224		17				22			1		1		
Sunday Creek #6	90		8				1		1					
Magnesia Creek	252					8	7							
Flower lake	178		2			1	3							1
Quartz Creek	109		8					1			2		2	
LaFoe Lake	280					13	13							
Rush Lake	198	1		1	1			1	1			2		
Lyons Gulch	259		3		1	7	6	8			1	3		
Smeads Bench bog	115		1										1	
lower Cody Lake	96					4	4	1		4	1			
bog NW Lost lake	272		1			2	3					1		
Alexander Creek	170		3			2					1		17	1
Trail Creek Fen	173	2	4	1		2	22		7					
Bent Flat Fen	171		2				33		2		2	1		
Mile 49 Pond	215	2	8				15					1		
Swan R. Fen PRNA	202		28				7				2			
Lost Crk Meadow	220		1	1			12						1	
Pierce Bog	227		5		1	2	12				1		4	
Plum Creek Fen	226		7	1			6					1		
S of Simmons M.	143		8		1	1	2				3			
Pt Pleasant Fen	216		7	3	1		16					2		
Wood Creek	114					4	2			1				

Table 4. (cont.) Results of snap trapping during 1993 northern bog lemming surveys.

Site	Trap Nights	Total number of each species caught ¹													
		SOPA	SOVA	SOCI	SOMO	SOSP	MIPE	MILO	PHIN	SYBO	CLGA	ZAPR	PEMA	NECI	MUMU
SE of Hidden Lk	221		4	2		2	2								
Hannan Gulch	217		6		1		8					1			
Sawmill Flat	199					9	2								
N of Salmon Lake	221	1	5			1	4	1				5	24		
Grand Total	5566	7	150	10	7	60	220	12	10	8	21	18	50	1	1

Table 4. (cont.) Results of snap trapping during 1993 northern bog lemming surveys.

¹SOPA=*Sorex palustris*; SOVA=*Sorex vagrans*; SOCI=*Sorex cinereus*; SOMO=*Sorex monticolus*;
SOSP=*Sorex* spp.; MIPE=*Microtus pennsylvanicus*; MILO=*Microtus longicaudus*; PHIN=*Phenacomys*
intermedius; SYBO=*Synaptomys borealis*; CLGA=*Clethrionomys gapperi*; ZAPR=*Zapus princeps*;
PEMA=*Peromyscus maniculatus*; NECI=*Neotoma cinerea*; MUMU=*Mus musculus*.

Table 5. Success of two baits used in snap traps at sites where northern bog lemmings were found in 1992 and 1993.

Site	*PB & O		Dailey's	
	T-N	SYBO	T-N	SYBO
Bowen Creek			56	1
Sunday Creek #5	180	2		
Hawkins Pond	2.5		2.5	1
Meadow Ck	49		48	1
Maybe Meadows	72	2	68	2
Sunday Creek #1	24		22	1
Sunday Creek #6	44	1	47	
Paul Creek	112		112	1
Cody Lake	49	2	47	2
Wood Creek	59		55	1
Grand Total	592	7	458	10
#Sybo/100 trap-night	1.18		2.19	

* PB&O = peanut butter and oatmeal; Dailey's = Dailey's muskrat lure, peanut butter and oatmeal; T-N = number of trap-nights; SYBO = number of *Synaptomys borealis* captured.

Table 6. Northern bog lemmings captured during 1993.

Site	Date	Sex	Misc.
Sunday Creek #1 T33N R25W S25	27-Aug	M	adult, testes inguinal
Sunday Creek #6 T32N R26W S12	29-Aug	M	adult, testes scrotal
Paul Creek T33N R25W S27	29-Aug	F	perforate, non-lactating
lower Cody Lake T29N R28W S6	16-Jun	M	adult, testes scrotal
	"	M	"
	"	M	adult, testes inguinal
	"	M	juv., testes inguinal
Wood Creek T20N R10W S26	31-Aug	F	perforate, non-lactating

Table 7. Plant communities present at 6 northern bog lemming sites.

Community\\phase	Sunday Creek	Cody Lakes	Bowen Creek	Wood Creek	Maybee Meadows	Meadow Creek
Abies lasiocarpa \\Calamagrotis canadensis	yes					
Picea \\Salix geyeriana- Carex utriculata				yes		
Salix drummondiana	yes					
Salix planifolia- Salix wolfii \\Carex aquatilis					yes	
Betula glandulosa \\Carex utriculata					yes	
Betula glandulosa- Eleocharis pauciflora \\Carex lasiocarpa		yes				
Betula glandulosa- Carex lasiocarpa			yes			
Carex utriculata (=C. rostrata)					yes	yes
Eleocharis pauciflora		yes				

Table 8. Plant species present, percent coverage of each species, and number of habitats surveyed at 7 northern bog lemming sites.

Plant	Sunday Creek (2)	Cody Lakes (2)	Bowen Creek (1)	Wood Creek (1)	Maybee Meadows (3)	Meadow Creek (1)	Shoofly Meadows ¹
TREES	0-40	0-1	0	10	0-3	0	
Picea spp.		0-1		10			
Pinus contorta					0-3		
Abies lasiocarpa	0-40			3			
SHRUBS	20-80	0-30	70	40	1-60	30	
Betula glandulosa	0-60	0-30	60	3	0-10		
Kalmia microphylla		0-3					x
Ledum glandulosum							x
Linnaea borealis				1			
Lonicera caerulea					1		
Lonicera involucrata				1			
Menziesia ferruginea				1			
Pentaphylloides floribunda	3						
Potentilla fruticosa				3			
Rosa acicularis				1			
Salix bebbiana				20			x
Salix boothii	0-1			10		3	
Salix candida		0-3	20				
Salix drummondiana	10-30						
Salix geyeriana				3	1		
Salix lemmonii						1	

¹ Data from partial species list for entire complex, not just sphagnum mat patches

Table 8. (cont.) Plant species present, percent coverage of each species, and number of habitats surveyed at 7 northern bog lemmings sites.

Plant	Sunday Creek (2)	Cody Lakes (2)	Bowen Creek (1)	Wood Creek (1)	Maybee Meadows (3)	Meadow Creek (1)	Shoofly Meadows ¹
SHRUBS (cont.)							
<i>Salix planifolia</i>					0-20	20	
<i>Salix wolfii</i>					0-30		
<i>Symphoricarpos</i> spp.	0-40						
<i>Symphoricarpos oreophilus</i>						1	
<i>Vaccinium myrtilloides</i>	0-1						
<i>Vaccinium occidentale</i>							x
<i>Vaccinium scoparium</i>				1	0-1		
GRAMINOIDS							
	80-90	70-90	60	70	85-95	40	
<i>Agrostis scabra</i>					1	1	
<i>Alopecurus geniculatus</i>						1	
<i>Alopecurus pratensis</i>					0-1		
<i>Calamagrotis canadensis</i>	0-1						x
<i>Calamagrotis inexpansa</i>					0-3	1	
<i>Carex</i> spp.			1				
<i>Carex aquatilis</i>					1-80	1	x
<i>Carex arcta</i>	0-60						
<i>Carex aurea</i>			1				
<i>Carex buxbaumii</i>	0-80						x
<i>Carex canescans</i>					1-20		
<i>Carex dioica</i>			3	1			

¹ Data from partial species list for entire complex, not just sphagnum mat patches

Table 8. (cont.) Plant species present, percent coverage of each species, and number of habitats surveyed at 7 northern bog lemmings sites.

Plant	Sunday Creek (2)	Cody Lakes (2)	Bowen Creek (1)	Wood Creek (1)	Maybee Meadows (3)	Meadow Creek (1)	Shoofly Meadows ¹
GRAMINOIDS (cont.)							
<i>Carex disperma</i>		0-1					
<i>Carex interior</i>						3	
<i>Carex lasiocarpa</i>	0-1	10	50				
<i>Carex limosa</i>		1					x
<i>Carex paupercula</i>							x
<i>Carex utriculata</i> ²		10-20	20	60	3-90	30	x
<i>Carex vesicaria</i>	80						x
<i>Dulichium arundinaceum</i>							x
<i>Eleocharis pauciflora</i>		50-80					x
<i>Eriophorum chamissonis</i>						1	x
<i>Eriophorum polystachion</i>					0-1		
* <i>Eriophorum viridicarinatum</i>		1	1				
<i>Juncus balticus</i>				10			
<i>Luzula campestris</i>					0-1		
<i>Luzula parviflora</i>						1	
<i>Muhlenbergia filiformis</i>		10-Mar				1	
<i>Muhlenbergia glomerata</i>			1				
<i>Poa palustris</i>					0-1		

¹ Data from partial species list for entire complex, not just sphagnum mat patches

² refers to *C. rostrata* in terms of community types

* TES plant species

Table 8. (cont.) Plant species present, percent coverage of each species, and number of habitats surveyed at 7 northern bog lemmings sites.

Plant	Sunday Creek (2)	Cody Lakes (2)	Bowen Creek (1)	Wood Creek (1)	Maybee Meadows (3)	Meadow Creek (1)	Shoofly Meadows ¹
FORBS	3-10	10-40	3	10	3-15	5	
<i>Adenocaulon bicolor</i>	0-3						
<i>Aster foliaceus</i>				1	0-1	1	
<i>Aster occidentalis</i>							x
<i>Castilleja miniata</i>		0-1					
<i>Cornus canadensis</i>	0-3						
<i>Epilobium glaberrimum</i>					1	1	
<i>Equisetum arvense</i>		0-10		1			
<i>Equisetum hyemale</i>	0-1			1			
<i>Equisetum palustre</i>	0-1						
<i>Equisetum pratense</i>	0-3						
<i>Equisetum variegatum</i>		1					
<i>Fragaria virginiana</i>	1-1					1	
<i>Galium triflorum</i>					0-1		
<i>Galium verum</i>	0-1						
<i>Geum macrophyllum</i>					0-1		
<i>Geum rivale</i>	1						
<i>Habenaria dilatata</i>	1-1	0-1					
<i>Habenaria hyperborea</i>		0-3				1	
<i>Ligusticum tenuifolium</i>					0-1	1	
<i>Lupinus polyphyllus</i>					0-1		
<i>Menyanthes trifoliata</i>		10-30					

¹ Data from partial species list for entire complex, not just sphagnum mat patches

Table 8. (cont.) Plant species present, percent coverage of each species, and number of habitats surveyed at 7 northern bog lemmings sites.

Plant	Sunday Creek (2)	Cody Lakes (2)	Bowen Creek (1)	Wood Creek (1)	Maybee Meadows (3)	Meadow Creek (1)	Shoofly Meadows ¹
FORBS (cont.)							
Mitella breweri			3				
Mitella (nuda?)		0-3					
Parnassia palustris		0-1					
Pedicularis bracteosa						1	
Pedicularis groenlandica				3			
Polemonium occidentale					0-1		
Potamogeton gramineus							x
Potentilla palustris			3				x
Pyrola asarifolia			1	3	0-1		
Rubus acaulis	0-3						
Saxifraga spp.					0-1		
Saxifraga lyallii	1-1						
Scheuchzeria palustris							x
Senecio spp.					0-1		
Senecio integerrimus					1-10		
Senecio pauperculus	0-1						
Smilacina stellata			1				
Spiranthes romanzoffiana		1					x
Stellaria nitens	0-1						
Swertia perennis				3			
Viola nephrophylla						1	
Zigadenus elegans		0-3					

¹ Data from partial species list for entire complex, not just sphagnum mat patches

Table 8. (cont.) Plant species present, percent coverage of each species, and number of habitats surveyed at 7 northern bog lemmings sites.

Plant	Sunday Creek (2)	Cody Lakes (2)	Bowen Creek (1)	Wood Creek (1)	Maybee Meadows (3)	Meadow Creek (1)	Shoofly Meadows ¹
MOSSES	50-60	70-90	90	90	50-90	90	
<i>Aulacomnium palustre</i>					x	x	
<i>Bryum</i> spp.				x	x		
<i>Bryum caespiticium</i>					x		
<i>Calliergon giganteum</i>					x	x	
<i>Campylium</i> spp.		x					
<i>Cratoneuron williamsii</i>				x			
<i>Drepanocladus</i> spp.		x					
<i>Drepanocladus capillifolius</i>						x	
<i>Drepanocladus fluitans</i>					x		
<i>Hypnum pratense</i>					x		
<i>Meesia triquetra</i>						x	
<i>Plagiomnium venustum</i>					x		
<i>Polytrichum strictum</i>					x		
<i>Scorpidium scorpioides</i>		x					
<i>Sphagnum</i> spp.	x	x	x				
<i>Sphagnum fuscum</i>					x	x	
<i>Sphagnum nemoreum?</i>					x		
<i>Sphagnum riparium</i>							x
<i>Sphagnum warnstorffii</i>					x		
<i>Tomenthypnum nitens</i>				x	x	x	

¹ Data from partial species list for entire complex, not just sphagnum mat patches

Table 9. Characteristics of known bog lemming sites, plus several additional sites in the Sunday Creek complex, in Montana.

Site	Location	Elevation (ft)	Size ¹ (ac)	Distance to nearest site	
				Known (km)	Potential (km)
Hawkins Pond	T37N R33W S18	6200	5	602	?
Numa Ridge Bog	T36N R20W S21	5040	2-4	23	5
Anaconda Creek West	T34N R20W S27	3600	? ³	2.8	≤6.9
Anaconda Creek East	T34N R20W S36	3600	? ³	2.8	≤6.9
Camas Creek	T33N R19W S12	3800	? ³	11	≤6.5
McGee Meadows	T33N R19W S27	3870	340	6.5	≤3.2
McDonald Creek	T33N R18W S12	3422	? ³	8.9	4
Sunday Creek complex	T32-33N R25-26W	4220-4800	210	6.6	6.4
Site 1	T33N R25W S25	4220	23	1	0.2
Site 5	T32N R26W S13	4800	30	0.3	0.3
Site 6	T32N R26W S12	4680	5	0.3	0.3
Paul Creek	T33N R25W S27	4440	61	1.7	1
*Site 2	T33N R25W S26	4230	6	0.5	0.5
*Site 3	T32N R25W S5	4300	45	2.6	0.6
*Site 4	T32N R25W S6	4460	16	2.3	0.5
Bowen Creek	T31N R26W S1	4760	23	6.6	0.2
lower Cody Lake	T29N R28W S6	4700	6	32	?
Wood Creek	T20N R10W S26	5590	2	90	≤13
Shoofly Meadows	T14N R17W S4	5880	24	90	≤14
Meadow Creek	T01N R18W S10	5920	1	19	≤18
Maybee Meadows	T01S R17W S26	6520	8	19	1.8

* Sites in Sunday Creek complex with suitable habitat, but no bog lemmings trapped in 115-215 trap-nights per site

¹ Size of habitat patch, or patches with less than 100 m separation between patches

² nearest site @ Cow Creek, Idaho ³ site lacks typical bog lemming habitat w/ deep moss; see text

DISCUSSION

Distribution. Bog lemmings are now known from across the northwest corner of the state east to the Rocky Mountain Front, and south through the mountains to Lost Trail Pass on the Continental Divide. The Maybee Meadows site is the southern-most site known for the species outside of New England; two sites in New Hampshire are about 160 km farther south (Clough and Albright 1987). The Maybee Meadows and the Wood Creek sites are the only known northern bog lemming sites east of the Continental Divide in Montana. We expect additional populations to be found across western Montana, perhaps as far south as Yellowstone National Park, and possibly east to mountain ranges such as the Belt or Snowy ranges. Elevations from which bog lemmings are known in Montana range from 3340 ft (McDonald Creek, Pearson 1991) up to 6520 ft (Maybee Meadows, Reichel and Beckstrom 1993).

During 1992, lemmings were found at 5 of 6 sites that appeared to have good lemming habitat (not at Tom Poole Lake). However, during 1993 sixteen sites we trapped had apparently good lemming habitat and yet we failed to capture them at 11. Either the lemmings are at those sites and we failed to detect them, or we sampled more sites with apparently good habitat, which actually lacked lemmings, in 1993. Probably a combination of the two is actually the case. The percentage of sites with good habitat which had lemming captures for 1993 is similar to that of Pearson (1991) who found lemmings at 3 of 11 bog/fen sites trapped with Sherman live traps in 1989-90.

If lemmings were present but we failed to detect them, several explanations are possible. First, lemming populations in Montana in general may have been lower in 1993 than 1992. At sites where lemmings were caught in 1993 we averaged 1.40 lemmings per 100 trap-nights, compared to 1.67 in 1992. While the rate was lower in 1993, the difference should not have altered our success at various sites to the degree found. Additionally, we trapped more voles in general per trap-night in 1993 than 1992; voles which cycle typically have synchronous highs and lows for all species within a habitat. Second, lemming populations at more individual sites (rather than region wide) may have had low populations simply by chance. Third, we averaged 1 lemming capture per 350 trap-nights at sites with apparently suitable habitat. Thus we may have under-sampled some sites, however the number of such sites is questionable since some of the apparently suitable sites may actually have lacked lemmings. Fourth, given the general difficulty in trapping lemmings we may just have been luckier in 1992 than 1993. This may be the likeliest explanation in the Sunday Creek habitat complex.

If the sites actually lacked lemmings several explanations again are possible. First, some relatively large areas do not have lemmings because they were extirpated since the Pleistocene or never recolonized following the melting of the glaciers. Of 11 areas trapped with good habitat but lacking lemmings, 5 were in the Swan

River or adjacent South Fork Flathead drainages. This was surprising since there were multiple habitat patches considered appropriate in relatively close proximity to each other. Second, patches within a metapopulation may frequently have extirpations and recolonizations; this may be the case in the Sunday Creek habitat complex. However, if this were common we would not expect to have as many apparently isolated lemming populations as we have found.

It has been assumed that populations of northern bog lemmings in the northwest U.S. have been isolated since shortly after the last ice age ended over 10,000 years ago. It seems likely lemming populations were more wide-spread at that time, then were reduced in size and number during the Hypsithermal 6000-3000 years ago, when the climate was warmer than at the present time. However, several populations now known in Montana are very small and isolated (Table 9). It seems extremely unlikely that an isolated population restricted to an area with a single patch less than 10 acres in size could survive for thousands of years.

Habitat Patches. Bog lemmings have been found in at least nine community types (Table 7). However, peatland communities are a very small proportion of the landscape in the region and have not been adequately classified (Bursik and Moseley 1992). Whether new information on these fens results in newly defined community types which closely approximate habitat used by northern bog lemmings remains to be seen. All but one site where we have found lemmings have extensive thick moss mats, as do Numa Ridge Bog, McGee Meadows (Pearson 1991, P. Lesica pers. comm.) and Shoofly Meadows (Pearson 1991, S. Chadde pers. comm.); the actual Sunday Creek 3 trapping site had a thin sphagnum moss mat, but is near other higher quality patches.

JDR spent several hours along Camas Creek in the vicinity of the first lemming population known from the state (Wright 1950) and found only scattered clumps of moss. Weckwerth and Hawley (1962) did not adequately describe the two specific sites where they captured bog lemmings, but they were visited by D.E. Pearson (pers. comm.) who found they were not located in fens or covered by thick moss mats. At these three sites trapping was conducted multiple years, often twice each year (Camas Creek: 18 yrs [Hoffmann et al. 1969]; Anaconda #1: 6 yrs spring and fall [Jonkel 1959]; Anaconda #6: 4 yrs spring and fall [Jonkel 1959]). Despite this intensive trapping, only a total of 3 individuals have been taken in Camas Creek in 2 of 18 years, and 1 individual at each of the two Anaconda Creek sites. A similar situation exists with the McDonald Creek site in an old-growth western hemlock (Tsuga heterophylla) forest (Pearson 1991); this site has been trapped multiple times while yielding only a single lemming (June 1991 - September 1993, total 3600 trapnights, D.E. Pearson, pers. comm.). Apparent high quality habitat patches exist within 7 km of all four sites (Table 9, 10; Pearson 1991; P.

Lesica, pers. comm.). It seems likely that these sites are very marginal, and/or that the individuals were found while dispersing from a nearby high quality site.

Other habitat descriptions of S. b. chapmani trapping sites in the northern Rocky Mountains have sometimes included mention of sphagnum moss (Layser and Burke 1973, Groves and Yensen 1989) while others have not (Wilson et al. 1980). JDR captured a single juvenile male lemming on a dry alpine/subalpine ridge in northeast Washington (Wilson et al. 1980).

We believe that areas with extensive moss mats, particularly sphagnum, are the most likely sites in which to find new bog lemming populations in Montana. Several of these potential sites are given in Appendix 2. Other habitats in Montana may support lower densities of bog lemmings; may be used primarily by dispersing individuals; may be used during specific seasonal, climatic, or competitive situations; or may be population sinks. Marginal habitats and areas may be important to maintain population viability. The only certainty is that there is much to be learned about habitat use by northern bog lemmings.

Patch size of known bog lemming sites in Montana varies from 1-340 acres, with 7 of 13 being less than 10 acres (Table 9). No patch sizes are given for 4 sites since they are not in typical habitat (see preceding paragraph). Most sites found thus far in Montana appear to be patches within potentially larger metapopulation patch complexes. These could include: Sunday Creek complex with a Bowen Creek complex; a Maybee Meadows complex possibly with the Meadow Creek patch; and a McGee Meadows complex which may be part of a larger complex in Glacier National Park. However several small patches appear to be isolated. Numa Ridge Bog (3 ac) is 5 km from the nearest fen/bog patch (Pearson 1991). Shoofly Meadows is larger (24 ac) but may be 14 km from another suitable patch. Wood Creek is certainly at the extreme, having only about 2 ac of moss mat habitat and being 13 km from the nearest known potential site. While there appears to be substantial amounts of marginal habitat along Wood Creek which might support bog lemmings, much of the riparian has been heavily impacted by domestic livestock grazing.

This leads to questions about what constitutes a viable population of northern bog lemmings. Three (somewhat) alternative hypotheses could apply: 1) lemmings live in habitat patches which have been isolated for thousands of years; 2) lemmings may move substantial distances between patches supplementing (or recolonizing) the sub-population within a patch and contributing genetic material; and 3) lemmings may use habitats other than moss bogs/fens.

Alternative 1. Patches such as Wood Lake and Numa Ridge Bog would not appear to have been able to survive given the small habitat patch size, if they are indeed totally isolated and lemmings do not use habitats other than moss mats. This leads us to think that this alternative is not completely true.

Alternative 2. In several areas such as Sunday Creek complex, the distribution and size of known patches suggest movement between patches. The overall view that most patches in Montana are relatively near other known, or potential, patches, gives support to this hypothesis. Arctic lemmings are known to make spectacular movements during highs in the population cycle and this could also be true of northern bog lemmings. Northern bog lemmings do undergo populations fluctuations at least in central Canada (Edwards 1963). However, population cycles in general appear to be less dramatic in: 1) more southerly areas, and 2) in areas with less contiguous habitat for the cycling species.

Alternative 3. Lemmings have certainly been found in habitats other than bogs/fens in Montana and other areas of their range. In the Montana sites where the habitat is atypical, captures seem a rare event. Multiple trapping periods prior to and/or following the capture have not resulted in regular additional captures of lemmings. In Glacier National Park, general trapping for small mammals over nearly 100 years in numerous habitats has resulted in captures of 5 lemmings at 4 sites (all atypical habitats) (Wright 1950, Hoffmann et al. 1969, Weckwerth and Hawley 1962, Pearson 1991). In the rest of Montana, only 1 site has been found during general small mammal trapping (Shoofly Meadows, a typical habitat site) (Adelman 1979). However, when trapping has focused on bog/fen habitat, 12 new sites were discovered in the past 4 years (Pearson 1991, Reichel and Beckstrom 1993, this report). Many of these sites have had multiple animals captured in a single night. This gives weight to the premise that the fen\bog habitat is the primary habitat for northern bog lemmings in Montana. The extent of lemming use of other habitats has yet to be determined, but would appear to be low.

Probably all three alternatives have some element of reality. It seems likely that 1) some patch complexes are isolated from others and have been for long periods of time; 2) some relatively long distance movements may increase gene flow, supplement small populations, and allow for recolonization of extirpated patches; and 3) while bog lemmings use a variety of habitats to a limited (and largely unknown) extent, bog and fen habitats hold the densest populations of lemmings.

Research Methods. How do we get the information on distribution, habitat use, and movement we need to manage this species? Distributional information, and to a lesser extent habitat use, has often been gathered using snap-traps. Detailed habitat use and movement data for small mammals are most commonly obtained using mark-recapture techniques with live traps. However, for northern bog lemmings, live traps are of very limited usefulness. This is because Sherman live-trap use: 1) is labor intensive throughout the trapping period; 2) has very low success with any bait tried; and 3) results in at least some mortality (4 of 6 known captures) (Pearson 1991,

Reichel and Beckstrom 1993). Pitfalls, used as live traps: 1) are labor intensive especially during placement; 2) cannot be used in the saturated soil situations commonly encountered in bog lemming habitat; and 3) result in at least some mortality during and between trapping periods. Given these drawbacks, it seems doubtful that live-trapping methods, by themselves, will yield much information on habitat use, population parameters, movements, or home range sizes. Incidental mortalities may be a significant factor over a study long-term enough to yield good information. Additionally, live-trapping to initially find populations will take at least 10 times the effort and cost when compared to snap-trapping and will still cause some mortality. Given the very low Sherman live-trapping success, negative results for even 1000 trap-nights per site would not give much confidence that lemmings are not present.

Dropping boards may provide one option, but we think differentiating northern bog lemming dropping from other voles will be difficult. Jones and Birney (1988) report that northern bog lemming droppings are bright green while other vole droppings are brown or black. However, we found that at least some bog lemmings had brown droppings. If color alone is used to differentiate the droppings, it may lead to serious biases. Pearson (1991) was not confident of identification of droppings (Microtus versus Synaptomys) in a test of the technique in Glacier National Park. He did speculate that it might be possible using more sophisticated identification techniques.

Snap-trapping for bog lemmings was much more successful than live-trapping and only 3 females were captured using this method (at all locations in Montana in 1992 and 1993). It appears to be the method of choice for initial survey work to find new populations, both from an economic and time-constraint view. Concerns have been expressed that snap-trapping is not a suitable technique to use on a "sensitive species." This argument may have some validity from a public perception point of view, but has little or no biological basis (Reichel and Beckstrom 1993).

Very small radio-telemetry packages have recently been used to study other voles and this technique seems to hold the most promise for studying Synaptomys. It would require relatively few individuals to be captured and recapture of those individuals would not be necessary. It would seem to be the method of choice for examining activity patterns, habitat selection and use, home range size, and typical movements by Synaptomys.

Long range movements, such as dispersal, are more difficult to determine using radio-telemetry. This is due to 1) the relative rarity of such movements; and 2) time and equipment limitations for finding animals moving far from their expected location. Indirect means of determining the amount of inter-patch movement are available using biochemical analyses of various types to measure gene flow.

This may be a viable approach to learning about inter-patch movements and gene flow.

MANAGEMENT RECOMMENDATIONS AND RESEARCH NEEDS

Based on limited observations at the sites where bog lemmings were found we would make several interim management recommendations. We feel these are the minimum necessary to maintain viable bog lemming populations. Additional research is needed which may lead to other management actions necessary for maintaining viable bog lemming populations.

- 1) Assume northern bog lemmings are present on all National Forests in north Idaho and Montana (except Custer N.F.) during land management planning processes.
- 2) Do not harvest timber within 100 m of sphagnum or other fen/bog moss mats or associated riparian areas which could provide corridors for inter-patch movements.
- 3) Minimize domestic livestock grazing in drainages with sphagnum mats present. Range conditions in riparian areas with sphagnum mats should be maintained in good to excellent categories. Stocking rates should be reduced to a point where rapid recovery occurs if either 1) current range condition is fair or poor; or 2) livestock are impacting moss mats.
- 4) No management activities which could destroy moss mats should be undertaken. Examples could include (but are not limited to): 1) road building in, or in some cases upslope from, bogs/fens; 2) pothole blasting in bogs/fens; 3) trail construction across or adjacent to bogs/fens; 4) dam construction upstream from bogs/fens, or downstream if flooding of bogs/fens would occur; and 5) snowmobile use in bogs/fens which could compact vegetation or collapse lemming runways or nests.

Very little information is available on the northern bog lemming. Even the distribution in the U.S. is poorly understood; most populations have been found within the past 15 years. Habitat use by northern bog lemmings has never been determined in any systematic way. Descriptions of habitat in the U.S. consist of anecdotal accounts of where each specimen has been captured; only about 35 individuals had been collected in the Pacific Northwest prior to this study. Food habits and reproductive information also are limited to a very few anecdotal accounts. No information is available on such subjects as movements, population densities, longevity, or home range. Much additional research is required to make intelligent land management decisions where northern bog lemmings are present. We recommend the following as the highest priority needs:

- 1) Conduct additional surveys to better understand macro- and micro-distribution in Montana; on a state-wide basis this should include surveys on Helena NF, Deerlodge NF, Gallatin NF, Custer NF, Lewis and Clark NF (Jefferson Division), and sites on the Beaverhead NF south and east of Maybee Meadows.
 - a) Flathead NF: resurvey sites listed in Appendix 2; survey additional areas particularly on the Tally Lake and Glacier View districts; conduct detailed follow-up surveys for actual and potential sites in the Bowen Creek drainage (as was done on Sunday Creek in 1993).
 - b) Kootenai NF: resurvey sites listed in Appendix 2; conduct detailed follow-up surveys for actual and potential sites in the areas of presently known lemming sites (as was done on Sunday Creek in 1993).
 - c) Lewis and Clark NF: resurvey sites listed in Appendix 2; survey additional areas particularly in the Jefferson Division; conduct detailed follow-up surveys for actual and potential sites in the vicinity of the Wood Creek site (as was done on Sunday Creek in 1993).
- 2) Analyze all stomachs of bog lemmings collected to provide food habits information; this should give some indication of potential habitat use.
- 3) Conduct plant community surveys at all known bog lemming locations. This should include identification of dominant mosses present.
- 4) Gather information on the autecological requirements of the mosses found at bog lemming sites.
- 5) Carry out research on northern bog lemming habitat use. Given the extreme difficulty in capturing northern bog lemming we feel radio-telemetry is the only viable means to obtain satisfactory answers as to how bog lemmings use habitat within their home ranges.
- 6) Carry out research on northern bog lemming movements to gather information on home ranges and possibly dispersal. This information needs to be integrated with simultaneously collected habitat use data. Again, we feel radio-telemetry is the only viable methodology available.
- 7) Carry out biochemical research on allelic diversity and gene flow between habitat patches. It is possible that hair/skin from specimens already collected could be used for analysis. This should be done utilizing information on patch size and isolation, across the range of the lemming in Montana. Ideally, Montana information should be compared to information from a population in Canada at a site with relatively continuous habitat over a large area.

LITERATURE CITED

- Adelman, E.V. 1979. A survey of the nongame mammals in the Upper Rattlesnake Creek drainage of Western Montana. M.S. Thesis, University of MT, Missoula. 129 pp.
- Anderson, R.M. 1932. Five new mammals from British Columbia. Natl. Mus. Can. Bull 70:99-107.
- Banfield, A.W.F. 1974. The mammals of Canada. University of Toronto Press, Toronto.
- Bursik, R. and R.K. Moseley. 1992. Prospectus: Valley peatland ecosystem project, Idaho. Idaho Dept. Fish Game, Conserv. Data Cntr. Boise, Idaho. Unpubl. 16 pp.
- Clough, G. C. and J. J. Albright. 1987. Occurrence of the northern bog lemming, Synaptomys borealis, in the northeastern United States. Canadian Field Naturalist 101:611 613.
- DeVelice, R.L. 1991. MTNHP site and community survey manual. version 91B. Mont. Nat. Heritage Pro., Helena, Mont.
- Doutt, J.K., C.A. Heppenstall and J.E. Guilday. 1973. Mammals of Pennsylvania, 3rd edition. Penn. Game Comm., Harrisburg. 283 pp.
- Edwards, R. L. 1963. Observations on the small mammals of the southeastern shore of Hudson Bay. Can. Field Nat. 77:1 12.
- Genter, D.L. 1992. Animal species of special concern. Unpubl. Rep., Mont. Nat. Heritage Prog., Helena. 9 pp.
- Groves, C. and E. Yensen. 1989. Rediscovery of the northern bog lemming (Synaptomys borealis) in Idaho. Northw. Nat. 70:14-15.
- Hall, E.R. 1981. The mammals of North America, 2nd edition, 2 vols., John Wiley and Sons, New York.
- Hoffmann, R.S., P.L. Wright and F.E. Newby. 1969. The distribution of some mammals in Montana I. Mammals other than bats. J. Mammal. 50:579-604.
- Johnson, M.L. and P.W. Cheney. 1953. Synaptomys in Idaho and northeastern Washington. Murrelet 34:10.
- Jones, J.K., Jr. and E.C. Birney. 1988. Handbook of mammals of the north-central states. U. Minn. Press, Minneapolis.

- Jonkel, C.J. 1959. An ecological and physiological study of pine marten. M.S. Thesis, Montana State Univ., Missoula. 81 pp.
- Layser, E.F. and T.E. Burke. 1973. The northern bog lemming and its unique habitat in northeastern Washington. *Murrelet* 54:7-8.
- Linzey, A.V. 1981. Patterns of coexistence in Microtus pennsylvanicus and Synaptomys cooperi. Unpubl. Ph.D. dissert., Virg. Polytechnic Inst. and State Univ., Blacksburg. 97 pp.
- Moseley, R. and C. Groves. 1990. Rare, threatened and endangered plants and animals of Idaho. Unpubl. Rep., Nat. Heritage Sect., Nongame and Endangered Wildl. Prog., Idaho Dept. Fish Game, Boise. 33 pp.
- Pearson, D.E. 1991. The northern bog lemming in Montana and the contiguous United States: Distribution, Ecology and relic species theory. Unpubl. Senior Thesis, Univ. Mont., Missoula. 33 pp.
- Reichel, J.D. 1984. Ecology of Pacific Northwest alpine mammals. Ph.D. thesis, Washington State Univ., Pullman. 91 pp.
- Reichel, J.D. and S.G. Beckstrom. 1993. Northern bog lemmings survey: 1992. Montana Natural Heritage Program. Helena, MT. 64 pp.
- Sokal, R.R. and F.J. Rohlf. 1969. Biometry. W.H. Freeman and Co., San Francisco, California. 776 pp.
- Weckwerth, R.P. and V.D. Hawley. 1962. Marten food habits and population fluctuations in Montana. *J. Wildl. Manage.* 26(1):55-74.
- Wilson, C., R.E. Johnson and J.D. Reichel. 1980. New records for the northern bog lemming in Washington. *Murrelet* 61:104-106.
- Wright, P.L. 1950. Synaptomys borealis from Glacier National Park, Montana. *J. Mammal.* 31:460.

APPENDIX 1. ANNOTATED BIBLIOGRAPHY

Adelman, E. B. 1979. A survey of the nongame mammals in the Upper Rattlesnake Creek drainage of western Montana. [M.S. Thesis] University of Montana, Missoula. 129 pp.

Small mammal diversity, niche width and niche overlap were studied in the Upper Rattlesnake Creek drainage, Montana. Snap trap results, habitat associations and observations are described. For *SYNAPTOMYS*: habitat was a wet sedge bluejoint meadow (subalpine fir/bluejoint bluejoint habitat type); one male caught 9/8/78 in 200 trap nights; measurements; associated species included: *SOREX VAGRANS*, *CLETHRIONOMYS GAPPERI*, and *MICROTUS PENNSYLVANICUS*.

Allen, J. A. 1903. Mammals collected in Alaska and northern British Columbia by the Andrew J. Stone expedition of 1902. Bull. Amer. Mus. Nat. Hist. 19:521 567.

For *SYNAPTOMYS BOREALIS*: Describes the Type specimen of *SYNAPTOMYS CHAPMANI*, sp. nov. (=S. *BOREALIS*) by an adult male specimen taken in July 1901 in Glacier, B.C. Gives external and skull measurements and pelage description.

Allen, J. A. 1904. Mammals collected in Alaska by the Andrew J. Stone expedition of 1903. Bull. Amer. Mus. Nat. Hist. 20:273 292.

Gives lists of all locations trapped and species at each (arranged in species accounts). 66 *SYNAPTOMYS BOREALIS* were taken at 5 locations trapped. 1/3 were adults, 4 females and 15 males. Measurements were taken and separated by sex. At Seldovia *SYNAPTOMYS* was found "most frequently in little marshy meadows, but was also sometimes taken in timber in places like those inhabited by red backed mice."

Anderson, R. M. 1932. Five new mammals from British Columbia. Natl. Mus. Can. Bull. 70:99 119.

Describes 5 new species of mammals from Canada including Type of *SYNAPTOMYS BOREALIS ARTEMISIAE* from Stevenson Creek, SW of Princeton at 2400 ft elevation. Known only from Similkameen valley from 2400 5600 ft. Description of color, size, skull. Five individuals (4 males, 1 female) were taken at 2400 ft site, 4 (2 males, 2 females) at a 5600 ft site. The habitat at the lower site is dry Transition zone, with sagebrush, pine grass, and occasional *PINUS PONDEROSA*. The upper site is Engelmann spruce, subalpine fir, and abundant ground cover including *VALERIANA SITCHENSIS*, *VERATRUM VIRIDE*, *ANEMONE OCCIDENTALIS*, *VACCINIUM*, *LUPINUS*, and waist high dense *SALIX*. Compares external and skull measurements of subspecies *ARTEMISIAE* (6Male, 3Female), *CHAPMANI* (10M, 3F), *WRANGELI* (2M, 2F), *BOREALIS* (2M), and *DALLI* (3?).

Anderson, R. M. 1947. Catalogue of Canadian Recent mammals. Natl. Mus. Can. Bull. 102. 238 pp.

For SYNAPTOMYS BOREALIS: Taxonomic review of specimens by location. Gives 9 subspecies all in single species.

Anderson, R. M., and A. L. Rand. 1943. A new lemming mouse (SYNAPTOMYS) from Manitoba with notes on some other forms. Can. Field Nat. 57:101 103.

Distribution, measurements, descriptions, and taxonomy.

Anderson, S. 1962. A new northern record of SYNAPTOMYS BOREALIS in Ungava. J. Mammal. 43:421 422.

Record of SYNAPTOMYS for the Ungava peninsula is a new northern record for the species. Bones of 2 lemmings were found in an owl pellet.

Baker, R. H. 1951. Mammals taken along the Alaska Highway. Univ. Kansas Publ., Mus. Nat. Hist. 5(9):87 117.

Gives lists of all locations trapped and species at each (arranged in species accounts). SYNAPTOMYS BOREALIS taken at 2 of 43 locations trapped. At one 30X60 ft grassy area near McIntyre Creek, Yukon, 2250 ft elevation 5 were taken in 66 trap nights. In thick sedge bordering a small pond at Deadman Lake, Alaska, 1800 ft., one was taken.

Banfield, A. W. F. 1974. The mammals of Canada. University of Toronto Press, Toronto. Reprinted, 1981.

Detailed accounts of 196 species. Includes information on description, habits, habitat, reproduction, ecological status, and distribution. 46 color plates, 100 black and white drawings. SYNAPTOMYS BOREALIS: distribution; description; short underground burrows and runways through vegetation; constructs globular nests of grass above ground in winter and below ground in summer; active all winter and throughout 24 hr day; food includes grasses and sedges which are cut into short sections and piled in runways; habitat primarily sphagnum labrador tea black spruce bogs but also found in deep mossy spruce woods, wet subalpine meadows, alpine, and sagebrush (one subspp) habitat; breeding season from May Aug; litters average 4, range 2 8; uncommon in NW Can and rare in E Canada; nine poorly differentiated subspp.

Banfield, F. A. 1941. Notes on Saskatchewan mammals. Can. Field Nat. 55:117 123?.

Short accounts of new records. SYNAPTOMYS BOREALIS was collected (adult male) from the edge of a grassy flat bordering a small marshy bay of Emma Lake.

Bangs, O. 1897. On a small collection of mammals from Hamilton Inlet, Labrador. Proc. Biol. Soc. Wash. 11:235 240.

SYNAPTOMYS BOREALIS collected at Fort Chimo, Labrador; description of single male collected.

Bangs, O. 1898. A list of the mammals of Labrador. Amer. Nat. 32:489 507.

An early list of Labrador mammals. Lists Type specimen of SYNAPTOMYS INNUITUS (=BOREALIS) from Fort Chimo, Labrador.

Bangs, O. 1900. Three new rodents from southern Labrador. Proc. New England Zool. Club 2:35 41.

Describes Type specimen of SYNAPTOMYS INNUITUS MEDIOXIMUS (=BOREALIS) from Lance au Loup, Labrador. Adult male with description and measurements.

Beasley, L. E. and L. L. Getz. 1986. Comparison of demography of sympatric populations of MICROTUS OCHROGASTER and SYNAPTOMYS COOPERI. Acta Theriologica 31:385 400.

Both species followed multi year cycles. Population changes and survival were similar, with lemmings showing less dramatic changes during the cycle.

Beckstrom, S. G. 1993. Food habits of boreal owl during brood rearing in southwest Montana. Unpubl. ms. 15 pp.

Pellets from 10 nest boxes found CLETHRIONOMYS GAPPERI the most important food item (53.6%). PHENACOMYS INTERMEDIUS was next most important with 20.7% biomass. Small mammals in general were 99% of prey biomass. 8 SYNAPTOMYS BOREALIS were found in 4 nests, comprising 0.7% of the diet.

Booth, E. S. 1947. Systematic review of the land mammals of Washington. Ph.D. Thesis, Wash. State Univ., Pullman.

Good review of knowledge up to that time; has some locations missed by Dalquest (1947). Has information (by subspecies) for all Washington land mammals and includes: dot maps, systematics, taxonomy, descriptions, and habitat. For SYNAPTOMYS BOREALIS: shows 2 locations in the North Cascade Mountains. Only subspecies then known was WRANGELLI but Booth speculated others would be found farther east (he was right). Description and measurements. Habitat is described as wet, boggy places in the mountains.

Clark, B. K. and D. W. Kaufman. 1990. Short term responses of small mammals to experimental fire in tallgrass prairie. *Can. J. Zool.* 68:2450-2454.

Short term response to burning was moving off area by most harvest mice, southern bog lemmings, and prairie voles; deer mice moved onto burned area.

Clough, G. C., and J. J. Albright. 1987. Occurrence of the northern bog lemming, *SYNAPTOMYS BOREALIS*, in the northeastern United States. *Can. Field Naturalist* 101:611-613.

Three specimens of *SYNAPTOMYS BOREALIS* for Maine and one for New Hampshire are reported. On 18-20 July 1 immature female and 1 adult female (4 embryos) were captured in pitfalls (117 sherman live trap nights, 108 pitfall trap nights). Both were captured at 1375 m in a wet sedge meadow dominated by *CAREX*, sphagnum moss, lichen (*CETRARIA NIVALIS*), *SALIX UVA URSI*, and *BETULA GLANDULOSA*. Associated species at the site were *MICROTUS PENNSYLVANICUS*, *CLETHRIONOMYS GAPPERI*, *PEROMYSCUS MANICULATUS*, *BLARINA BREVICAUDA*, and *SOREX CINEREUS*. A single immature male *SYNAPTOMYS BOREALIS* was captured on 11 Aug in a stand of dead fir and spruce at 400 m elevation. Understory was dominated by fir, spruce, mountain ash, and paper birch; shrub and ground layer was dense raspberry, ferns, some grass and sedge, and sphagnum in scattered damp areas. The area was trapped in 1982 (360 trap nights), July 1985 (135 longworth live trap nights) and Aug 1985 (300 snap trapnights). Other mammals at this site included *MICROTUS CHROTORRHINUS*, *M. PENNSYLVANICUS*, *CLETHRIONOMYS GAPPERI*, *PEROMYSCUS MANICULATUS*, and *SOREX CINEREUS*. There are now a total of 7 specimens from 4 locations in Maine and New Hampshire.

Coffin, B. and L. Pfanmuller (eds). 1988. Minnesota's endangered flora and fauna. U. Minn. Press, Minneapolis.

Good reference for Minnesota sensitive species with state maps with county of occurrence, status and basis for status, habitat, identification, recommendations, and selected references. *SYNAPTOMYS BOREALIS* summarizes the 5 locations in N MN where lemmings are known. Suggests the species may be difficult to trap. Habitat given as dominated by sphagnum and graminoids; may include forested bogs or open ericaceous shrublands over total range. Recommend additional sampling by qualified professionals and preservation of large tracts of peatlands.

Cowan, I. M., and C. J. Guiguet. 1965. The mammals of British Columbia. *Brit. Columb. Prov. Mus. Handbook* 11. 414 pp.

For *SYNAPTOMYS BOREALIS*: description and measurements; Habitat: usually wet alpine and subalpine meadows; runways and burrows well defined; moves to higher ground in winter; eats sedges, grasses, saxifrages, and other plants; makes small piles of cuttings in runways; deposits droppings in special places where 2 cupfuls may accumulate; 2-8 young per litter, usually 4-5; young born May-Aug; winter nest of dry grass 8" diameter; no citations for any of this information.

Cowan, I. McT. 1939. The vertebrate fauna of the Peace River District of British Columbia. Occas. Papers B.C. Prov. Mus. 1.

For SYNAPTOMYS BOREALIS: On 28 June found a colony in muskeg and 4 were taken. Habitat was 50 feet square and the "mossy carpet was honeycombed with tunnels." Fecal pellets were strewn about the tunnels, concentrated where feeding was occurring. 1 1.5 inch cuttings of grass were piled throughout the colony. Also caught here were MICROTUS PENNSYLVANICUS. Measurements.

Cross, E. C. 1938. SYNAPTOMYS BOREALIS from Godbout, Quebec. J. Mammal. 19:378.

Single immature taken, with description and measurements.

Dalquest, W. W. 1948. Mammals of Washington. University of Kansas Mus. Nat. Hist. Publ. 2:1 444.

Distributional accounts which include brief descriptions and accounts of habits; dot and associated shading on maps; key to spp. SYNAPTOMYS BOREALIS shows known 2 locations and a possible location (later verified by Wilson, Johnson and Reichel 1980).

Dearden, L. C. 1958. The baculum in LAGURUS and related Microtines. J. Mammal. 39:541 553.

Describes variation in the baculi of LAGURUS. Compares baculi across Microtine genera including LEMMUS, SYNAPTOMYS, DICROSTONYX, CLETHRIONOMYS, PHENACOMYS, and MICROTUS (drawings). SYNAPTOMYS is shown to be most closely related to DICROSTONYX.

Dice, L. R. 1921. Notes on the mammals of interior Alaska. J. Mammal. 2:20 28.

Records of unusual specimens taken in Alaska. Two SYNAPTOMYS BOREALIS taken, one in scrub willows and one in horsetails.

Downing, S. C. 1940. First Ontario record of the subgenus MICTOMYS. Can. Field Nat. 54:109 110.

One immature male 25 July 1939 at Moosonee, Ontario. Taken on an open bank of a small creek draining a bog. Surrounding area had spruce trees and deep mossy ground cover. Measurements and description.

Dutcher, B. H. 1903. Mammals of Mt. Katahdin, Maine. Proc. Biol. Soc. Wash. 16:63 72.

Describes 36 mammals known from Mt. Katahdin. For SYNAPTOMYS BOREALIS, 2 were trapped in balsam scrub by a spring at 4500 ft. during >270 trapnights.

Edwards, R. L. 1963. Observations on the small mammals of the southeastern shore of Hudson Bay. *Can. Field Nat.* 77:1 12.

Caught 25 individuals at 5 sites (185 trapnights); most were caught in open, very wet places. No scat piles or cuttings were associated with this species. Only 2 showed breeding activity, a male with scrotal testes on 23 Aug and a female with 3 embryos on 10 Sept. Most mice appeared to be yearlings. There appeared to be two litters per year, with some young breeding the same summer they were born. Description & measurements.

Foresman, K. R. and D. E. Pearson. 1990. Ecology of the northern bog lemming [abstract]. *Sci. Glacier Natl. Park 1990, Ann. Rep. Coop. Park Studies.* p. 41.

Relocated Shoofly Meadows site and found lemmings in Numa Ridge Bog in 1990.

Gaines, M. S., C. L. Baker and A. M. Vivas. 1979. Demographic attributes of dispersing southern bog lemmings (*SYNAPTOMYS COOPERI*) in eastern Kansas. *Oecologica (Berlin)* 40:91 101.

There was a positive correlation between lemming colonizing removal grids and density of control grids. 41% of losses of control grids were accounted for by dispersal. Residents differed from dispersers by: 1) higher % males; 2) lower % of adult females colonizing grids were in breeding condition; reversed for subadult females; and 3) higher % subadults.

Gaines, M. S., R. K. Rose and L. R. McClenaghan, Jr. 1977. The demography of *SYNAPTOMYS COOPERI* populations in eastern Kansas. *Can. J. Zool.* 55:1584 1594.

Annual and multi year population cycles were found. Adult and juvenile survival was higher in winter than summer. Breeding was higher in summer than winter, but occurred during both periods.

Garton, E. R. 1977. Late Pleistocene and Recent mammals remains from two caves at Bowden, West Virginia [abstract]. *Proc. W. Vir. Academy Sci.* 49:41.

Found *SYNAPTOMYS BOREALIS* in a limestone cave; no time correlation could be done since they were in a cave stream deposit.

Godin, A. J. 1977. *Wild mammals of New England.* Johns Hopkins University Press, Baltimore. 304 pp.

Popular account of the mammals of New England. Covers description, distribution, ecology, behavior, age and sex determination, list of specimens examined, records and reports for each species. Literature references and museum sources cited.

Godin, A. J. 1977. Wild mammals of New England. Johns Hopkins University Press, Baltimore. 304 pp.

Popular account of the mammals of New England. Covers description, distribution, ecology, behavior, age and sex determination, list of specimens examined, records and reports for each species. Literature references and museum sources cited. SYNAPTOMYS BOREALIS "occurs in cold sphagnum bogs, in bluebunch fields matted with weeds, and in dense hemlock and beech woods." Lemmings may build runways above ground or burrow in leaf litter. Nest is lined with leaves, grasses, and sometimes fur, and located either above or below ground. May be in small colonies or burrows of other small mammals. Known to eat raspberry seeds and the fungus ENDOGONE.

Green, M. M. 1930. Notes on some small Canadian mammals. Can. Field Nat. 44:69.

Two SYNAPTOMYS BOREALIS were taken near Pine Falls in Apr 1929. They were in an open tamarack bog with SOREX HOYI and SOREX CINEREUS. In May 1929 a male was taken 50 miles north of Pas and had side glands 11x7 mm. A female taken 8 May had 3 embryos 30 mm long.

Groves, C. and E. Yensen. 1989. Rediscovery of the northern bog lemming (SYNAPTOMYS BOREALIS) in Idaho. Northw. Nat. 70:14 15.

A single adult male was captured on 14 July 1988 at Cow Creek, Boundary Co., Idaho at 1304 m elevation. The site was at the edge of a sphagnum bog next to an Englemann spruce tree. Dominant vegetation in the bog included: DESCHAMPSIA CAESPITOSA, CAREX ROSTRATA, ERIOPHORUM CHAMISSONIS, BETULA GLANDULOSA, KALMIA MICROPHYLLA, and SPHAGNUM spp. Other small mammals captured at the site included: ZAPUS PRINCEPS, CLETHRIONOMYS GAPPERI, SOREX spp, TAMIAS RUFICAUDUS, and MICROTUS PENNSYLVANICUS. The lemming was taken during 2 nights of trapping with 32 museum special snap traps and 16 pitfalls. The other Idaho SYNAPTOMYS site on Gold Peak Road (Johnson and Cheney 1953) was re sampled in 1987 but no SYNAPTOMYS taken; it was logged sometime between the original capture and the re trapping attempt in 1987. States that records of SYNAPTOMYS BOREALIS captured by Larrison (Larrison 1967; Larrison and Johnson 1981) were actually misidentified PHENACOMYS INTERMEDIUS.

Guthrie, R. D. 1968. Paleoecology of a Late Pleistocene small mammal community from interior Alaska. Arctic 21:223 244.

SYNAPTOMYS BOREALIS is currently present at the site but was not found in Late Pleistocene deposits. Guthrie is unsure if it is a post glacial immigrant or was present but not found.

Hall, E. R. 1981. Mammals of North America. 2nd edition. 2 vol. John Wiley and Sons.

Identification and distribution information for mammals of North America. SYNAPTOMYS BOREALIS: description and measurements; distribution; 9 subspp.

Hall, E. R. and E. L. Cockrum. 1953. A synopsis of the North American Microtine rodents. Univ. Kansas Publ., Mus. Nat. Hist. 5:373 498.

Good for synonymys, distribution, subspecies, key, and citations of original descriptions. For SYNAPTOMYS BOREALIS: places in subgenus MICTOMYS and lists 9 subspecies and their distributions. Gives external measurements as total:118 135; tail:19 27; hind foot:16 22; ear:12 13; weight 32 34 g (n=2). Pelage description.

Hall, F. S. 1932. A historical resume of exploration and survey mammal types and their collectors in the state of Washington. Murrelet 13:63 91.

Gives original citation and information from it on the description of SYNAPTOMYS TRUEI (=S. BOREALIS) from the Skagit Valley of Washington in 1859.

Hamilton, W. J., Jr. and J. O. Whitaker, Jr. 1979. Mammals of the eastern United States. Cornell University Press. Ithaca, NY. 346 pp.

Listed by order. Useful information concerning distribution, habits. Provides range maps and illustrations. For SYNAPTOMYS BOREALIS: distribution and description only.

Harper, F. 1961. Land and fresh water mammals of the Ungava Peninsula. Univ. Kansas Publ., Mus. Nat. Hist. 27: includes pp.55 62.

For SYNAPTOMYS BOREALIS: measurements and description. On 16 June an adult female was trapped on a mossy log in swamp among tall and low willows, dwarf birch, CAREX?, sphagnum, and liverwort. She had 7 embryos (13mm), enlarged mammary glands (2 pair pectoral, 2 pair inguinal, with drawing), and lateral glands slightly developed (10x4.5mm). On 17 July a male was trapped on a rock in a brook flowing through mossy woods. Surrounding vegetation included white spruce, tamarack, alder, willow (tall and low), Labrador tea, VIBURNUM EDULE, CORNUS CANADENSIS, RUBUS, COPTIS GROENLANDICA, VIOLA, TRIENTALIS BOREALIS, USNEA, and SPHAGNUM. He had moss (HYLOCOMIUM PYRENACIACUM) in his mouth. Testes were 8X5mm; lateral glands greatly developed 14X8 and 2mm thick; a less developed glandular area was located between each ear and foreleg. Another male found dead on 13 June had testes 7.5X6mm and lateral glands greatly developed 15X7mm. On the lemmings were found a flea (MEGABOTHRIS ASIO ASIO) and 3 species of mites (HEMOGAMASUS ALASKENSIS, LAELAPS ALASKENSIS, HAEMOLAE LAPS GLASGOWI).

Heaney, L. R. and E. C. Birney. 1975. Comments on the distribution and natural history of some mammals in Minnesota. Can. Field Nat. 89:29 34.

Observations on the distribution and natural history of 18 species. SYNAPTOMYS BOREALIS found 10 mi S of Big Falls, an extension of the

range in the central U.S approximately 50 miles to the south of previous records (Gunderson 1949).

Heller, E. 1910. Mammals of the 1908 Alexander Alaska expedition. Univ. Calif. Publ. Zool. 5:321 360.

For SYNAPTOMYS BOREALIS: collected 8 specimens. 3 are from Cordova in "a tangle of rye grass, stumps, and salmonberry bushes." Five are from Port Nell Juan in open tundra in very swampy situations near the beach.

Hinton, M. A. C. 1926. Monograph of the voles & lemmings (Microtinae). Vol. 1. British Mus. Nat. Hist., London.

Taxonomic discussion of the subfamily. Places SYNAPTOMYS in the group Lemmi and says it is the most primitive of the true lemmings (SYNAPTOMYS, LEMMUS, MYOPUS). Divides the genus in two subgenera (SYNAPTOMYS, MICTOMYS) of which MICTOMYS is the most primitive. Long descriptions of skeletal and dental (rootless cheek teeth) differences with excellent drawings of cheek teeth. Says S. BOREALIS has 8 mammae and S. COOPERI 6. Gives 8 species and 9 forms but says many of doubtful validity.

Hoffmann, R. S., P. L. Wright and F. E. Newby. 1969. Distribution of some mammals in Montana. I. Mammals other than bats. J. Mammal. 50(3): 579 604.

Distribution and specimen records listed for select mammals in Montana. SOREX PREBLEI, SCIURUS NIGER, PEROGNATHUS PARVUS, and PROCYON LOTOR are reported for the first time in Montana. Not extensive data. Two SYNAPTOMYS BOREALIS taken at same site in Glacier NP as Wright (1950) on 20 21 July 1953 but not taken in other of 17 years trapped since 1949. Gives dates, 15 Sep 1953 and 12 Sept 1956 for 2 additional specimens taken at Anaconda Creek, Glacier N.P. (see Weckwerth and Hawley 1962).

Hooper, E. T. and B. S. Hart. 1962. A synopsis of Recent North American Microtine rodents. Misc. Publ. Mus. Zool., Univ. Michigan 120. 68 pp.

Systematic study primarily using glans characteristic and comparing cranial and external characteristics. Includes measurements and description of glans for a wide range of rodents including SYNAPTOMYS BOREALIS. The 2 SYNAPTOMYS species are shown to be closely related and the most closely related to them may be PHENACOMYS INTERMEDIUS.

Howell, A. B. 1927. Revision of the American lemming mice (genus SYNAPTOMYS). N. Amer. Fauna 50. 37 pp.

A taxonomic revision of the genus SYNAPTOMYS. Gives distribution maps, drawings of dental and cranial characteristics, descriptions of the different subspecies (7), Type localities and citations, and lists of specimens. Ecological information is primarily based on SYNAPTOMYS COOPERI.

Ingles, L. G. 1965. Mammals of the Pacific States. Stanford University Press, Stanford, California. 506 pp.

Very brief description, habitat, shaded map, and key to mammals in WA, OR, and CA.

Johnson, M. L. and P. W. Cheney. 1953. SYNAPTOMYS in Idaho and northeastern Washington. Murrelet 34:10.

SYNAPTOMYS BOREALIS was collected at one site each in WA and ID. Two immature specimens (1 male, 1 female) were collected at Sema Meadows, Washington, 3000 ft, "at the edge of open beaver meadows" on 4 5 Aug 1952. Two adults (1 male, 1 female) were collected on Gold Peak Road, Idaho, 4200 ft, in a small bog along a stream on 8 Aug 1952.

Jones, J. K., Jr. and E. C. Birney. 1988. Handbook of mammals of the north central states. U. Minn. Press, Minneapolis. 346 pp.

Semi popular account of mammals of the North Central U.S. with general distribution maps (shading only), description with measurements, some natural history, and selected references. SYNAPTOMYS BOREALIS habitat is primarily bogs and marshy areas, but occasionally occurs in more xeric areas including dry woods and sagebrush. It digs short burrows and uses conspicuous runways. Globular nests of dry vegetation are built above ground in winter and below in summer. They do not hibernate. Food is grasses and sedges. Fecal pellets are bright green. The middle claws are enlarged during winter, presumably an adaptation to living in snow. Breeding season from May Aug. Females produce several litters per year. Number of young range from 2 8, averaging 4. Females have 4 pair mammae (2 pectoral, 2 inguinal). Presumably northern bog lemmings have 3 maturational pelages and 2 seasonal molts in adults as do other microtines.

Jonkel, C. J. 1959. An ecological and physiological study of pine marten. M.S. Thesis, Montana State Univ., Missoula. 81 pp.

Concluding phase of a long term (1952 1958) study in Glacier NP. Investigated minimum breeding age, time of implantation, and ensuing time to parturition and continued studies on the relationship between small mammals and marten population densities. 2 individual SYNAPTOMYS BOREALIS trapped at two grids during 2 years.

Koenigswald, W. v., and L. D. Martin. 1984. Revision of the fossil Lemminae (Rodentia, Mammalia). Spec. Publ. Carnegie Mus. Nat. Hist. 9:122 137.

Fossil history of the Lemminae is revised and three genera recognized: LEMMUS, SYNAPTOMYS, and MICTOMYS. DICROSTONYX and LAGURUS are excluded. Speculates Lemminae originated in Eurasia and SYNAPTOMYS immigrated to North America in the late Pliocene. Uses enamel patterns for comparison. Places SYNAPTOMYS BOREALIS in the genus MICTOMYS.

Krebs, C. J. and I. Wingate. 1985. Population fluctuations in the small mammals of the Kluane Region, Yukon Territory. Can. Field Nat. 99:51 61.

Looks at population changes in small mammals in the Yukon. Caught 7 SYNAPTOMYS BOREALIS in 110,628 snaptrap nights.

Larrison, E. J. 1970. Washington mammals, their habits, identification, and distribution. Seattle Audubon Soc., Seattle, Wash.

Gives brief and anecdotal information about life history, identification, and distribution of Washington mammals. Lists locations for SYNAPTOMYS BOREALIS in Washington including E. Fork Gold Creek; specimens from that site have been reidentified as PHENACOMYS. Use of life history information for bog lemmings from this book is problematical since Larrison had misidentified material from both WA and ID (J.D. Reichel, pers. comm.).

Larrison, E. J. and D. R. Johnson. 1981. Mammals of Idaho. Univ. Press of Idaho, Moscow. 166 pp.

Gives brief and anecdotal information about life history, identification, and distribution of Idaho mammals. Lists locations for SYNAPTOMYS BOREALIS in Idaho; Larrison states that some specimens lack grooves in the upper incisors; these and perhaps others have been reidentified as PHENACOMYS. Use of life history information for bog lemmings from this book is problematical since Larrison had misidentified material from both WA and ID (J.D. Reichel, pers. comm.).

Layser, E. F. and T. E. Burke. 1973. The northern bog lemming and its unique habitat in northeastern Washington. Murrelet 54:7 8.

SYNAPTOMYS BOREALIS is described from Bunchgrass Meadows in NE Washington at 5000 ft. Area is a true bog/fen of over a square mile with a few small spruce and fir islands. Plants present included: BETULA GLANDULOSA, CAREX LIMOSA, C. SCOPULORUM, DROSERANGLICA, LYCOPIUM SITCHENSE, KALMIA POLIFOLIA, SCHEUCHZERLA PALUSTRIS, SIBBALDIA PROCUMBENS, and SPHAGNUM. Authors list bird and herp spp also present. Present on the site were piles of grass and sedge cuttings at the base of small shrubs and along runways; most common cuttings were CAREX SCOPULORUM. A single bog lemming was captured during 140 snaptrap nights on 10 11 July 1972. Suggest threats to population may include: overgrazing, compaction of snow (destroying runways and nests) by snowmobiles, and impoundments which could flood the area.

Linzey, A. V. 1983. SYNAPTOMYS COOPERI. Mammalian Species 210:1 5.

Good summary of available information.

Linzey, A. V. 1984. Patterns of coexistence in *SYNAPTOMYS COOPERI* and *MICROTUS PENNSYLVANICUS*. *Ecol.* 65:382-393.

SYNAPTOMYS are excluded from preferred habitats by *MICROTUS*. The following patterns were observed: 1) In undisturbed sympatric populations, microhabitat partitioning was observed when habitat was marginal for voles. 2) Lemming microhabitat had more trees and shrubs when voles were present. 3) If vole populations declined, lemmings shifted into habitat previously occupied by voles. 4) Removal of voles from a grid resulted in immediate colonization by lemmings. 5) A year following lemming removal, former lemming habitat remained empty despite an increasing vole population. 6) Food of lemmings was less digestible than voles on grids where both occurred. 7) When voles were removed from a grid, lemming diets became more similar to voles (72 vs 37%).

Lyon, M. W., Jr. and W. H. Osgood. 1909. Catalogue of the Type specimens of mammals in the United States National Museum, including the Biological Survey Collection. U. S. Natl. Mus. Bull. 62. 325 pp.

Lists the Type specimens with citations of original description, what is present in collection and the state of the material.

Manville, R. H. and S. P. Young. 1965. Distribution of Alaskan mammals. Bur. Sport Fish Wildl. Circular 211. 74 pp.

Provides dot range map for *SYNAPTOMYS BOREALIS*. Describes habitat as wet tundras and sphagnum bogs, occasionally dry or moist meadows.

Martell, A. M. 1974. A northern range extension for the northern bog lemming, *SYNAPTOMYS BOREALIS BOREALIS* (Richardson). *Can. Field Nat.* 88:348.

Near Inuvik, 4 specimens (3 M, 1 F) captured in 75,000 trapnights.

Merriam, C. H. 1896. Revision of the lemmings of the genus *SYNAPTOMYS*, with descriptions of new species. *Proc. Biol. Soc. Wash.* 10:55-64.

Descriptions and some locations. First to break *SYNAPTOMYS* into two subgenera.

Miller, G. S., Jr. 1896. Genera and subgenera of voles and lemmings. *N. Amer. Fauna* 12. 84 pp.

Gives description of both species of *SYNAPTOMYS*, including pelage, measurements, skull, and teeth.

Morlan, R. E. 1989. Paleoecological implications of Late Pleistocene and Holocene microtine rodents from the Bluefish Caves, northern Yukon Territory. *Can. J. Earth Sci.* 26:149 156.

A single SYNAPTOMYS BOREALIS found (in Holocene birch phase sediment) among 10s of thousands of small mammal remains. Currently inhabits the area.

Munro, J. A. 1947. Observations of birds and mammals in central British Columbia. *Occas. Papers B.C. Prov. Mus.* 6.

For SYNAPTOMYS BOREALIS: 2 locations in central BC; female w/ 4 embryos taken 15 May; all trapped in runways through VACCINIUM; associated species included MICROTUS PENNSYLVANICUS and CLETHRIONOMYS GAPPERI.

Osgood, W. H. 1900. A biological reconnaissance of the Yukon River Region: annotated account of mammals. *N. Amer. Fauna* 19:1 45.

Collected SYNAPTOMYS DALLI (=BOREALIS) at several locations. At one location near Lake Lebarge they were in long grass at the edge of a small pond, while other locations were in cold boggy places near small streams. Gives description and measurements.

Osgood, W. H. 1904. A biological reconnaissance of the base of the Alaska Peninsula. *N. Amer. Fauna* 24. 86 pp.

Collected 24 SYNAPTOMYS DALLI (=BOREALIS) of all age and sex categories. Found much age variation in skull measurements. Usually found in small colonies "in very wet swampy places, preferably in wet moss." One area was a small boggy place partially filled with dead logs and branches and overgrown with moss. Says they make runways slightly smaller than MICROTUS and usually in "moss rather than grass and weeds." Gives description and measurements.

Osgood, W. H. 1904. Natural history of the Cook Inlet region, Alaska. *N. Amer. Fauna* 21:51 81.

Collected 1 SYNAPTOMYS DALLI (=BOREALIS) a small peat bog near Hope. Gives description and measurements.

Osgood, W. H. 1907. Some unrecognized and misapplied names of American mammals. *Proc. Biol. Soc. Wash.* 20:43 52.

Redescribes Type specimen and gives some of original description of ARVICOLA (=SYNAPTOMYS) BOREALIS from Richardson (1828).

Osgood, W. H. 1909. Biological investigations in Alaska and Yukon Territory. *N. Amer. Fauna* 30. 86 pp.

For SYNAPTOMYS BOREALIS: "Rather rare, only 4 specimens taken" in E

Central AK. 1 taken in a "grassy swamp" other 3 near timberline at the head of Seward Creek. In the Ogilvie Range 2 were taken in "cold Swamps." In the MacMillan region 5 were taken in a sphagnum swamp near mouth of Russell Creek.

Pearson, D.E. 1991. The northern bog lemming in Montana and the contiguous United States: Distribution, Ecology and relic species theory. Unpubl. Senior Thesis, Univ. Mont., Missoula. 33 pp.

SYNAPTOMYS surveys were conducted with Sherman live traps at 16 sites. Describes 4 new lemming capture sites in Glacier National Park (McGee Meadows (1 animal), Little McGee Meadows (2), Numa Ridge Bog (1), and McDonald Creek (1)) and a new specimen from the known Shoofly Meadows site. The McDonald Creek site was part of a general small mammal project and has been surveyed on multiple occasions but only a single lemming has been captured. This site is in an old-growth western hemlock (*TSUGA HETEROPHYLLA*) without typical bog/fen habitat (includes plant list). The other sites are all typical bog/fen habitat with thick sphagnum moss mats and are structurally described in some detail with vegetation mentioned to the generic level. Other small mammals captured at lemming sites included: *CLETHRIONOMYS GAPPERI*, *PEROMYSCUS MANICULATUS*, *SOREX* spp., *MICROTUS* spp, *TAMIAS* spp. Trapping success was 1 lemming per 806 Sherman live trap-nights (16 sites with 4030 TN). Mortality rate for lemmings was 60%. Tracking board sampling was tried, but lemming dropping could not be differentiated from *MICROTUS* (*CLETHRIONOMYS* and *SOREX* could be). Includes a summary of most of the specimens taken in the lower 48 states. Good discussion of distribution and sampling methodologies.

Peterson, R. L. 1966. The mammals of eastern Canada. Oxford University Press. Toronto, Canada. 465 pp.

Good general reference; body measurements; references. For *SYNAPTOMYS BOREALIS*: rarest rodent in collections for eastern Canada. Description. Notes that 2 specimens taken in mid January and mid April at Indian House Lake, Quebec, showed extreme enlargement of 2 middle claws on the front feet; it is unknown if this is normal since only 2 specimens have ever been taken during this season. A series of 6 specimens taken in northern Quebec were from a dry, partly wooded habitat. Specimens of three pregnant females in the Royal Ontario Museum taken in June had 4, 4, and 7 embryos.

Preble, E. A. 1899. Description of a new lemming mouse from the White Mountains, New Hampshire. Proc. Biol. Soc. Wash. 13:43 45.

Description of the subspecies *SYNAPTOMYS BOREALIS SPHAGNICOLA* based on one specimen trapped at Fabyans (1600') near the base of Mt. Washington on 29 June 1898. Habitat "is swampy and quite densely carpeted with moss..." Associated species included *MICROTUS*, *PEROMYSCUS*, *BLARINA*, *CLETHRIONOMYS*, *ZAPUS HUDSONICUS*, and *NAPOZAPUS INSIGNUS*.

Preble, E. A. 1902. A biological investigation of the Hudson Bay Region. N. Amer. Fauna 22. 140 pp.

For SYNAPTOMYS BULLATUS (=BOREALIS): Only trapped 2 specimens, one near Norway House. The other was a female with 6 embryos in a swamp bordering the Echimamish River on June 25.

Preble, E. A. 1902. Descriptions of new species of SYNAPTOMYS and PHENACOMYS from MacKenzie, Canada. Proc. Biol. Soc. Wash. 15:181-182.

Description of new species SYNAPTOMYS BULLATUS (=S. BOREALIS) from Great Slave Lake, Canada from a skin and skull of adult male.

Preble, E. A. 1908. A biological investigation of the Athabaska Mackenzie Region. N. Amer. Fauna 27. 574 pp.

For SYNAPTOMYS BOREALIS: took 8 near site (Ft. Franklin) of those originally described by Richardson (1829) and quotes extensively from that paper. Caught one female with 4 embryos. Habitat at various sites where lemmings were captured include: 1) border of a small meadow; 2) wet swamp; 3) near small muskeg ponds; and 4) marsh. Says Loring found SYNAPTOMYS rather common in October in a sphagnum swamp and caught about a dozen. Gives measurements and descriptions and merges S. DALLI with S. BOREALIS as S.B. DALLI.

Prince, L. A. 1942. SYNAPTOMYS BOREALIS from Fort Severn, Hudson Bay, Ontario. J. Mammal. 23:216.

An immature male SYNAPTOMYS BOREALIS was trapped at Ft. Severn on 11 July 1940. Was taken in a "water trap" on alder and willow bordered bank of a stream draining a black spruce bog. Gives measurements of the single specimen.

Rand, A. L. 1945. Investigations on the Canal Road, Yukon and Northwest Territories, 1944.. Natl. Mus. Can. Bull. 99.

For SYNAPTOMYS BOREALIS: 7 taken in 400 trapnights in open, wet moss, sedge, willow and spruce swamp on Lapie River. Also taken were MICROTUS PENNSYLVANICUS. At Mount Sheldon 12 were taken in marshy sedge fringing ponds in a dwarf birch flat 11-15 Aug. On 22-25 Aug 7 were taken in a wet grassy glade on the Macmillan River. In all cases the species was very local, with none being caught during extensive trapping in the surrounding area.

Rand, A. L. 1945. Mammals of Yukon. Natl. Mus. Can. Bull. 100. 93 pp.

For SYNAPTOMYS BOREALIS: description and measurements. States "...scarce animal, found in grass and sedge areas in bogs and marshes where it makes runways" but no indication this is based on observations or literature or?

Reichel, J. D. 1984. Ecology of Pacific Northwest alpine mammals. Unpubl. Ph.D. Thesis, Wash. State U., Pullman. 91 pp.

Information on distribution, dispersal, population structure and habitat use of alpine areas in WA and OR by small mammals. For *SYNAPTOMYS BOREALIS* one new site, and additional information on another site (Wilson et al. 1980), is given. At sites where lemmings were trapped, Gypsy Peak (918 snap trapnights) and Slate Peak (1173 snap trapnights) each produced a single animal (one male, one female). The Gypsy Peak site was fellfield habitat, while the Slate Peak site was a sedge/graminoid wet meadow. Lemmings were not relocated at the Cascade Creek site of Shaw (1930).

Reichel, J. D. and S. G. Beckstrom. 1993. Northern bog lemming survey: 1992. [Unpublished report] Montana Natural Heritage Program. Helena, MT. 64 pp.

Survey of 21 sites in western Montana for *SYNAPTOMYS BOREALIS* using primarily snaptraps (some comparisons using live traps and pitfalls). Found 5 new sites including the southern most sites in western North America (map). Compares baits. Lemmings were captured at elevations from 4760 6520 feet. All sites had thick mats of sphagnum moss present. Bog birch and/or a dwarf willow were present at all sites. At sites where lemmings were found, it took 5 140 trapnights for the 1st lemming capture; in contrast, 240 556 trapnights were tabulated at sites where none were captured. Other species captured at sites with bog lemmings included: *MICROTUS PENNSYLVANICUS*, *CLETHRIONOMYS GAPPERI*, *SOREX*, and *PHENACOMYS INTERMEDIUS*. Includes research needs and methods, management recommendations, and references.

Rhoads, S. N. 1894. Descriptions of a new subgenus and new species of arvicoline rodents from British Columbia and Washington. Proc. Acad. Nat. Sci. Philadelphia 1894:282 288.

Description of Topotype of *ARVICOLA BOREALIS* (=SYNAPTOMYS BOREALIS) of an adult female taken near Ft. Anderson, north of Great Bear Lake. [NOTE: drawing of dentition looks like *MICROTUS* not *SYNAPTOMYS BOREALIS*].

Rose, R. K. and A. M. Spevak. 1978. Aggressive behavior in two sympatric microtine rodents. J. Mammal. 59:213 216.

SYNAPTOMYS were less aggressive and showed more avoidance than *MICROTUS* in lab encounter trials.

Saunders, W. E. 1927. *PHENACOMYS UNGAVA* in Ontario. J. Mammal. 8:305 307.

Notes on captures of *PHENACOMYS UNGAVA* (=INTERMEDIUS) and *SYNAPTOMYS*. Caught a *SYNAPTOMYS* almost daily.

Scott, P. A. and R. I. C. Hansell. 1989. The lemming community on the lichen heath tundra at Churchill, Manitoba. *Can. Field Nat.* 103:358 362.

Describes lemming community by species and habitat. For *SYNAPTOMYS BOREALIS* only 2 were captured (2360 trapnights), one each in a *CAREX* moss *SALIX* community and a *SALIX* community. Other species present on the sites of capture included: *DICROSTONYX RICHARDSONI* and *MICROTUS PENNSYLVANICUS*.

Seton, E. T. 1909. Life histories of northern animals. An account of the mammals of Manitoba. Vol. 1. Charles Scribner's Sons, New York.

Repeats other literature briefly (description, distribution, habitat of cold sphagnum bogs). No original information except "shy, secretive, nocturnal" but no citation or indication of where the information came from.

Severinghaus, W. D. 1981. Methods useful in distinguishing *Microtines* sympatric with the subgenus *PEDOMYS*. *J. Tenn. Acad. Sci.* 56:20 22.

Shaw, W. T. 1930. The lemming mouse in North America and its occurrence in the state of Washington. *Murrelet* 11:7 10.

SYNAPTOMYS BOREALIS (immature) was first captured in Washington in "the Skagit Valley, Skagit Co. on 6 Aug 1859. At the head of Cascade Creek a single individual was taken on 30 Jul 1923 and 11 more during summer 1926; none were trapped in 1928 and 1929 at the same location. The location was at 5000 ft at the head of the drainage in a bog like area. The bog had many logs from avalanches, *PERNASSIA FIMBRIATA*, *CAREX SPECTABILIS*, *HABENARIA SACCATA*, *TOFIELDIA OCCIDENTALIS*, *MIMULUS TILINGI*, *M. LEWISII*, and a thick carpet of moss (*HYPNUM*).

Smith, H. C. 1993. Alberta mammals, an atlas and guide. *Prov. Mus. Alberta*, Edmonton. 238 pp.

Good general information guide with keys, dot maps, habitat, status in Alberta, and measurements. For *SYNAPTOMYS BOREALIS*: identifying characteristics and description; mapped locations in N part of Alberta down W side in mountains to within 150 km of US border; status is uncommon though widely distributed; habitat is "moist meadows and bogs;" table with weight and external measurements for male (n=15) and female (n=4) lemmings.

Smith, R. W. 1940. The land mammals of Nova Scotia. *Amer. Midl. Nat.* 24:213 241.

Short accounts of new records during 1925 1940. *SYNAPTOMYS COOPERI* was collected but *S. BOREALIS* was not.

Smits, C. M. M., B. G. Slough and C. A. Yasui. 1989. Summer food habits of sympatric arctic foxes, *ALOPEX LAGOPUS*, and red foxes, *VULPES VULPES*, in the northern Yukon Territory. *Can. Field Nat.* 103:363 367.

Diets of both foxes were similar with small mammals predominating. *SYNAPTOMYS BOREALIS* was up to 3.7% frequency in the diet at some locals for Arctic Fox.

Soper, J. D. 1948. Mammal notes from the Grande Prairie Peace River region, Alberta. *J. Mammal.* 29:49 64.

For *SYNAPTOMYS BOREALIS*: "scarce and local." One male taken in moist spruce woods near shore of Lake Ray, Alberta on 6 July 1944. Measurements and pelage description.

Soper, J. D. 1973. The mammals of Waterton Lakes National Park Alberta. *Can. Wildl. Serv. Rep. Ser.* 23:1 57.

No *SYNAPTOMYS BOREALIS* have been found in Park. Short summary of nearby locations and general information.

Swath, H. S. 1922. Birds and mammals of the Stikine River region of northern British Columbia and southeastern Alaska. *Univ. Calif. Publ. Zool.* 24:125 314.

For *SYNAPTOMYS BOREALIS*: Great Glacier on Stikine River, B.C.; 3 males caught; description; habitat alder thicket.

True, F. W. 1894. Diagnoses of new North American mammals. *Proc. U.S. Natl. Mus.* 17:241 243.

Description of Type of *MICTOMYS INNUITUS* (= *SYNAPTOMYS BOREALIS*) collected Fort Chimo, Ungava, Labrador by L.M. Turner spring 1884. Nursing female.

Weckwerth, R. P. and V. D. Hawley. 1962. Marten food habits and population fluctuations in Montana. *J. Wildl. Manage.* 26(1):55 74.

A 5 year investigation of the relationships between marten population fluctuations, food habits, & prey densities in Glacier NP. Foods were mostly mammals Cricetidae. Varied with season & availability; population trends strongly influenced by prey densities. *SYNAPTOMYS BOREALIS* was trapped in 2 of 5 years trapping was done. Marten scats contained *SYNAPTOMYS BOREALIS* at a 1.6% frequency during the study, while lemmings comprised only 2 of 223 small mammals trapped.

Wetzel, R. M. and H. L. Gunderson. 1949. The lemming vole, *SYNAPTOMYS BOREALIS*, in northern Minnesota. *J. Mammal.* 30:437.

Gives locations for 1 immature female (5 Aug 1932) and 1 adult male (27 July 1948).

Wilson, C., R. E. Johnson, and J. D. Reichel. 1980. New records for the northern bog lemming in Washington. *Murrelet* 61:104 106.

Describes 3 new sites for *SYNAPTOMYS BOREALIS* in Washington. One individual (immature, sex unknown) was collected 22 Jun 1979 in a wet (standing water) hummocky sedge meadow with willow and bog birch at 6100 ft. On 25 June 1980 an adult male was collected at a similar site (less hummocky, no bog birch) at 5400 ft, about 6 mi from the first site. At both these sites *MICROTUS PENNSYLVANICUS* was also trapped. An immature female was captured at the third site (extreme NE WA) at 7250 ft on 23 Aug 1980. The habitat was a barren alpine ridge (15% vegetative cover) at least 900 vertical ft above the nearest boggy meadow.

Wright, P. L. 1950. *SYNAPTOMYS BOREALIS* from Glacier National Park, Montana. *J. Mammal.* 31(4):460.

First record of northern bog lemming in Montana. Adult male caught. HABITAT: a swampy area; plants included Englemann spruce, timothy, false hellebore, alder, nannyberry, cow parsnip, horsemint, yellow monkey flower, and snowberry. ASSOCIATED SPECIES included: *MICROTUS PENNSYLVANICUS* and *SOREX VAGRANS*. TRAPPING SUCCESS: 1 lemming in 62 trapnights; not found at same site for 200 trapnights 2 months later.

Wrigley, R. E. 1974. Ecological notes of animals of the Churchill region of Hudson Bay. *Arctic* 27:201 214.

One *SYNAPTOMYS BOREALIS* collected in sedge moss tundra 35 mi. NW of Churchill.

Youngman, P. M. 1964. Range extensions of some mammals from northwestern Canada. *Natl. Mus. Can., Nat. Hist. Paper* 23. 6 pp.

For *SYNAPTOMYS BOREALIS*: lists far north records including Old Crow and Rampart House, Yukon, the farthest know north records for the species at the time.

Youngman, P. M. 1968. Notes on mammals of southeastern Yukon Territory and adjacent Mackenzie District. *Natl. Mus. Can. Bull.* 223:70 86.

For *SYNAPTOMYS BOREALIS*: collected in the N. W. T.: 1) a male and nonparous female in a hot spring meadow with *MICROTUS PENNSYLVANICUS* and *M. LONGICAUDUS* at 4000 ft, Flat River; 2) one at a marsh at Glacier Lake, 2500 ft; in the Yukon: 3) a male in riparian brushlands 5 mi E of Little Hyland River, 6000 ft and a male at 4000 ft; 4) 11 males and 4 females in white spruce at North Toobally Lake, 2200 ft.

Youngman, P. M. 1975. Mammals of the Yukon Territory. Natl. Mus. Canada, Publ. Zool. 10. 192 pp.

Very good general reference with sections on environmental influences, vegetation and refugium effects on mammal distribution. Species accounts have detailed taxonomic synonymys, dot maps, external and skull measurements, and remarks on fossils, habitat, and ecology. For SYNAPTOMYS BOREALIS: distributed throughout the wooded portion of the Yukon. Has external and skull measurements of males (n=18) and females (n=5 6); pelage description. Suggests that S. BOREALIS speciated in a south western refugium and is a post glacial immigrant to the north. Collected in the Yukon "between 800 and 6000 ft mostly in bogs and marshes." Stated 10 pregnant females averaged 4.4 (3 6) embryos.

APPENDIX 2. SITES WHICH SHOULD BE TRAPPED IN THE FUTURE.

Appendix 2. Sites which should be trapped in the future.

Site	Location	Comment
FLATHEAD NATIONAL FOREST		
Spotted Bear District		
Trail Creek Fen	T25N R14W S16	Trapped 14-16 Aug 93 but no lemmings; habitat is good and should be retrapped
Swan Lake District		
Swan River Fen PRNA	T24N R18W S2	Trapped 28-30 Jun 93 but no lemmings; habitat is excellent and site should be retrapped
Porcupine Fen	T24N R18W S14 NW4NE4	Good habitat, checked on-site; (located above creek on slope; not shown on map; 4711377)
Plum Creek Lands		
Plum Creek Fen	T23N R18W S1	Trapped 20-23 Jul 93 but got no lemmings; habitat is excellent and site should be retrapped
KOOTENAI NATIONAL FOREST		
Fortine District		
Magnesia Creek	T33N R25W S7	trapped 18-21 Jun 93 but got no lemmings; good habitat, should be retrapped
Sunday Creek site 2	T33N R25W S26	trapped 26-29 Aug 93 but got no lemmings; good habitat, should be retrapped
Sunday Creek site 3	T32N R25W S5	trapped 27-29 Aug and 3-5 Sep 93 but got no lemmings; good habitat, should be retrapped

APPENDIX 2. (cont.)

Site	Location	Comment
Sunday Creek site 4	T32N R25W S6	trapped 3-5 Sep 93 but got no lemmings; good habitat, should be retrapped
Fortine Creek	T32N R26W S8 NENW	Good habitat, checked on-site; can see small part from the road
Fisher River District		
bog NW of Lost Lake	T29N R30W S13	trapped 7-10 Jul 93 but no lemmings; very good habitat about 8 ac.; marginal habitat for 1/2 mi downstream
LOLO NATIONAL FOREST		
Seeley Lake District		
Plum Creek Lands		
Finley Creek Fen	T16N R16W S33	Good habitat, checked on-site; located just off road
LEWIS AND CLARK NATIONAL FOREST		
Rocky Mountain District		
Sawmill Flat	T21N R9W S27	Trapped 1-3 Sep 93 but no bog lemmings; habitat is good and should be retrapped
GLACIER NATIONAL PARK		
Adair Ridge Bog	T34N R20W S12	Good habitat (P. Lesica, pers. comm.) near currently known site without thick moss mat

APPENDIX 2. (cont.)

Site	Location	Comment
Winona (Mud) Lake Bog	T34N R21W S1, 12	Trapped unsuccessfully 6/90 (Pearson 1991); habitat is good, is near currently known sites without thick moss mat, and should be retrapped
Johns Lake	T33N R18W S12	Trapped unsuccessfully 5/90 (Pearson 1991); habitat is good, is near currently known sites without thick moss mat, and should be retrapped
Fish Lake	T33N R18W S25	Trapped unsuccessfully 5/90 (Pearson 1991); habitat is good, is near currently known sites without thick moss mat, and should be retrapped
Howe Lake	T33N R19W S24	Trapped unsuccessfully 7/90 (Pearson 1991); habitat is good, is near currently known sites without thick moss mat, and should be retrapped
Threetops Bog	T31N R17W S22-23	Good habitat (P. Lesica, pers. comm.)
NATURE CONSERVANCY PRESERVES		
Pine Butte Swamp	T24N R08W S12	Good habitat, checked on-site; similar habitat to Wood Creek lemming site

APPENDIX 3. PLANT COMMUNITY SURVEYS AT NORTHERN BOG LEMMING SITES.

COMMUNITY SURVEY FORM

MTNHP

5/27/91

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

MANUAL 91 UNITS ft m
 PLOT NO. 93WL/SC001 MO 09 DAY 08 YEAR 93 EOCODE _____ *
 EXAMINER(S) S. COOPER & J. REICHEL
 PNC PICEA/ CT SALIX GEYERIANA/CAREX UTRICULATA
 SITE WOOD LAKE BOG LEMMING STATE MT COUNTY LEWIS & CLARK
 PURP _____ PREC _____ QUADNAME WOOD LAKE QUADCODE 471247
 ZON T/10WR/26 S/SE 4S/NW 4/4 COMMUNITY SIZE (acres) >1
 PLOT TYPES _____ PLTRL _____ PLOT W _____ SURVEY _____
 PHOTOS
 DIRECTIONS -->

CONSERVATION RANKING

COND _____ Com: _____
 VIAB _____ Com: _____
 DEFN _____ Com: _____
 RANK _____ Com: _____
 MGMT: _____
 PROT: _____

ENVIRONMENTAL FEATURES

DL _____ SOIL RPT _____
 SOIL UNIT _____ SOIL TAXON _____
 PM peat LANDFORM AC43 PLOT POS WVBS SLP SHAPE str ASP N.A.
 SLOPE % <01 ELEVATION 5600 EROS POTENT none EROS TYPE none
 HORIZON ANGLE (%): N 12 E 18 S 40 W 46 IFSLP see map IFVAL _____
 SPFE fen site - with drainage waters from limestone ridges to west / std water
 GROUND COVER: 0 S+ 0 G+ 0 R+ P L+ T W+ 9 M+ 1- BV+ T O = 100%
 DISTURBANCE HISTORY (type, intensity, frequency, season) -->
Upslope cutting - nothing on plot - Beaver cutting of willow & Picea(?)

RIPARIAN FEATURES: Channel Width _____ Channel Entrench _____
 Surface Water _____ Ht. Abv. H20 _____ Dist. from H20 _____

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

Edge of Carex utriculata fen - zone delimiting upland Picea/Linbaea
Picea/Vacces hit. (a dom. type) from C. utric. fen - Standing water
in depressions not more than 1'; Moss mat thickness 6"-9" (thick & spongy)
Elk pellets; Small rodent den beneath stump in moss-mat; Some quaking to
mat, very little; This zone form nearly concentric boundary (but not on NE side)

OCULAR PLANT SPECIES DATA

MOSSES COLLECTED

PlotID# _____

PLOT NO. 93ML/5C001 NO. SPECIES 19 PNC _____

TREES Tot Cv 1 Mht 10
 Tal Cv _____ Med Cv _____
 Low Cv _____ Grd Cv _____ CC

FRBS Tot Cv 1 Mht _____
 Med Cv _____ Low Cv _____
 Grd Cv _____ CC

T 1 PICEA / 1
 T 2 ARILAS (25 mat) / P-
 T 3 _____ / _____
 T 4 _____ / _____
 T 5 _____ / _____

F 1 PEDGRO / P-
 F 2 PYRASA / P+
 F 3 SWE PER / P- *confirm
 F 4 Aster FOLI / T +confirm
 F 5 _____ / _____
 F 6 _____ / _____

SHRBS Tot Cv 4 Mht 2.5
 Tal Cv _____ Med Cv _____
 Low Cv _____ Grd Cv _____ CC

F 7 _____ / _____
 F 8 _____ / _____
 F 9 _____ / _____
 F 10 _____ / _____

S 1 BETGLA / P+
 S 2 SALIX GEYE / P+
 S 3 SALIX BEBB / 2+
 S 4 SALIX BOOT / 1
 S 5 POTE/FRUT / P
 S 6 LONINV / T
 S 7 ROSACI / T
 S 8 MENFER / T
 S 9 VACSCO / T
 S 10 LINBOR / T
 S 11 _____ / _____
 S 12 _____ / _____

F 11 _____ / _____
 F 12 _____ / _____
 F 13 _____ / _____
 F 14 _____ / _____
 F 15 _____ / _____

GRAM Tot Cv 7 Mht _____
 Med Cv _____ Low Cv _____
 Grd Cv _____ CC

EQUHYE / T
EQUARV / T

G 1 CAREUTRI (ROST) / 6
 G 2 JUNCBALT / 1+
 G 3 CAREX DIOICA / 7+ confirm
 G 4 _____ / _____
 G 5 _____ / _____
 G 6 _____ / _____
 G 7 _____ / _____
 G 8 _____ / _____
 G 9 _____ / _____
 G 10 _____ / _____
 G 11 _____ / _____
 G 12 _____ / _____

Tomenthypnum nitens / 9 ?
Cratoneuron williamsii / P+ ?
Bryum sp / P+ ?
re: J. Elliott

FERN Tot Cv _____ Mht _____ Med Cv _____
 Low Cv _____ Grd Cv _____
 BRYO/LICH Tot Cv _____

COMMENTS (EODATA) --> _____

93WL15C002

COMMUNITY SURVEY FORM

MTNHP
5/27/91

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

MANUAL 1991 UNITS ft m
 PLOT NO. 93WL15C002 MO 09 DAY 08 YEAR 93 EOCODE *
 EXAMINER(S) S. Cooper & J. Reichel
 PNC PICEA / CT CAREX UTRICULARIA -
 SITE WOOD LAKE-BOG LEMMING STATE MT COUNTY LEWIS & CLARK
 PURP PREC QUADNAME WOOD LAKE QUADCODE 4711247
20NT/10WR/26 S/SE 4S/NW4/4 COMMUNITY SIZE (acres)
 PLOT TYPES PLTRL 36 ft. PLOT W 36 ft. SURVEY
 PHOTOS Two - looking west w/ marker & number
 DIRECTIONS --> Take Benchmark Rd from Augusta, to Wood Lake & beyond
to Mule Creek - park & walk west crossing Wood Creek - walk periphery of fen
to NW end - This plot represents Carex-dominated stage of fen succession

CONSERVATION RANKING

COND Com:
 VIAB Com:
 DEFN Com:
 RANK Com:
 MGMT:
 PROT:

ENVIRONMENTAL FEATURES

DL SOIL RPT
 SOIL UNIT SOIL TAXON
 PM peat LANDFORM ACA3 PLOT POS wvbs SLP SHAPE Str. ASP N.A.
 SLOPE % <1% ELEVATION 5600 EROS POTENT low EROS TYPE none
 HORIZON ANGLE (%): N 11 E 18 S 38 W 46 IFSLP see map IFVAL
 SPFE Oligotrophic fen devd. at base of steep limestone
 GROUND COVER: 0 S+ 0 G+ 0 R+P L+ 7 W+ 2-M+ 1-BV+ 0 = 100%
 DISTURBANCE HISTORY (type, intensity, frequency, season) -->
Small rodents working; Elk pellets -

RIPARIAN FEATURES: Channel Width N Channel Entrench NA
 Surface Water 0-4" Ht. Abv. H20 Dist. from H20

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

Next zone in toward center from Spruce-dominated zone;
standing water depth increases towards center of fen - in normal year !!

OCULAR PLANT SPECIES DATA

"Mosses" collected

PltIDL _____

PLOT NO. 93WL/SC002 NO. SPECIES _____ PNC _____

TREES				FRBS			
Tot Cv	Mht			Tot Cv	Mht		
Tal Cv	Med Cv		CC	Med Cv	Low Cv		CC
Low Cv	Grd Cv			Grd Cv			
T 1	PICEA	/	T	F 1	POTAMOGETON ALPINUS	/	T+
T 2		/		F 2	EQUHYE	/	T
T 3		/		F 3		/	
T 4		/		F 4		/	
T 5		/		F 5		/	
				F 6		/	
SHRBS							
Tot Cv	Mht						
Tal Cv	Med Cv		CC	F 7		/	
Low Cv	Grd Cv			F 8		/	
S 1	SALIBERR	/	T	F 9		/	
S 2	SALIBOOT	/	T	F10		/	
S 3	SALIGEYE	/	T	F11		/	
S 4	BETUGLAN	/	T	F12		/	
S 5		/		F13		/	
S 6		/		F14		/	
S 7		/		F15		/	
S 8		/				/	
S 9		/				/	
S10		/				/	
S11		/				/	
S12		/				/	
GRAM							
Tot Cv	Mht						
Med Cv	Low Cv		CC				
Grd Cv							
G 1	CARUTR	/	9			/	
G 2	CALCAN	/	T			/	
G 3	JUNBAL	/	T			/	
G 4		/				/	
G 5		/				/	
G 6		/				/	
G 7		/				/	
G 8		/				/	
G 9		/				/	
G10		/				/	
G11		/				/	
G12		/				/	
				Scorpidium scorpioides re J. Elliott			
				FERN Tot Cv _____ Mht _____ Med Cv _____ Low Cv _____ Grd Cv _____			
				BRYO/LICH Tot Cv _____			

COMMENTS (EODATA) --> _____

COMMUNITY SURVEY FORM

MTNHP

5/27/91

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

MANUAL 91 UNITS ft m
 PLOT NO. 93WL/SC003 MO 09 DAY 08 YEAR 93 EOCODE _____ * _____
 EXAMINER(S) S. COOPER & J. REICHEL
 PNC PICEA/CALAMAGROSTIS CANADENSIS ^{HT.} CT SALIX BOOTHII / CALAMAGROSTIS CANADENSIS
 SITE WOOD LAKE - BOG LEMMING STATE MT COUNTY LEWIS & CLARK
 PURP _____ PREC _____ QUADNAME WOOD LAKE QUADCODE 47112A7
20N T/10W R/26 S/SE 4S/NW 4/4 COMMUNITY SIZE (acres) 2-3 areas contiguous
 PLOT TYPES _____ PLTRL 36 PLOT W _____ SURVEY _____
 PHOTOS Two looking N toward center of fen -
 DIRECTIONS --> Take Benchmark Rd. from Augusta to Wood Lake & beyond to Mule Creek park & walk west around N. end of fen to west side of fen below steep slopes & narrow upland forest community -

CONSERVATION RANKING

COND _____ Com: _____
 VIAB _____ Com: _____
 DEFN _____ Com: _____
 RANK _____ Com: _____
 MGMT: _____
 PROT: _____

ENVIRONMENTAL FEATURES

DL _____ SOIL RPT _____
 SOIL UNIT _____ SOIL TAXON _____
 PM alluvium LANDFORM ACAF PLOT POS WYAF SLP SHAPE STR ASP N.A.
 SLOPE % <1% ELEVATION 5600 EROS POTENT none EROS TYPE none
 HORIZON ANGLE (%): N 10 E 11 S 26 W 50 IFSLP _____ IFVAL _____
 SPFE At edge of fen but largely on mineral soils; strongly surirrigated
 GROUND COVER: 0 S+ 0 G+ 0 R+ 4 L+T W+T M+5 BV+ 1-0 = 100%
 DISTURBANCE HISTORY (type, intensity, frequency, season) --> Elk use by pellet piles - also moose; old beaver use on Salix, none of late

RIPARIAN FEATURES: Channel Width _____ Channel Entrench _____
 Surface Water _____ Ht. Abv. H2O _____ Dist. from H2O _____

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

At edge of fen but w/o peat-dominated soils - old beaver use includes channels & browsing - This site is well on way to Picea domination but currently at Salix-domination stage; never Carutr dom (probably)

Liverwort - not collected
 "looked like" Marchantia

OCULAR PLANT SPECIES DATA

PltIDL _____

PLOT NO. 93WL/SC003 NO. SPECIES 42 PNC PICEA/CALACANA

TREES				FRBS			
Tot Cv	Mht	CC	Tot Cv	Mht	CC	Low Cv	CC
Tal Cv	Med Cv		Med Cv	Low Cv		Grd Cv	
Low Cv	Grd Cv		Grd Cv				
T 1	PICEA	/	T	F 1	GALITRIF	/	T
T 2	ABIELASI	/	1	F 2	PEDIBRAC	/	T
T 3		/		F 3	GEUM MACR	/	P+
T 4		/		F 4	VEROAMER	/	T
T 5		/		F 5	SIMILSTEL	/	P-
				F 6	SIMILRACE	/	T+
SHRBS Tot Cv <u>7</u> Mht <u>11</u>				F 7	SENEPSEU	/	1+
	Tal Cv	Med Cv	CC	F 8	PYROASAR	/	1
	Low Cv	Grd Cv		F 9	FRAGVIRG	/	P
S 1	SALIXIG ssp. exigua (rather atypical)	/	1	F10*	ASTER FOLI	/	T+ confirmed
S 2	SALIBEBB	/	2	F11	TARAOFFI	/	T
S 3	SALIBOOT	/	3	F12	EPILANGU	/	T+
S 4	BETUGLAN	/	2+	F13	THALOC CI	/	T
S 5	RIBES LACU	/	T	F14	ZIZIAPTE	/	T
S 6	POTEFRUT	/	P	F15	CIRSCANA	/	T
S 7	LONIINVO	/	T	F16	ASTRAMER	/	T
S 8	VACIGLOB	/	T	F17	PARNPALU	/	T
no flwr. or frt. * S 9	RIBES AMER (?)	/	T+	F18	EQUIARVE	/	T
S10	LINABORE	/	T	F19	ACHIMILL	/	T
S11		/		F20	HERALANA	/	P+
S12		/		F21	ASTEFOLI	/	T
GRAM Tot Cv <u>4</u> MHT <u>1.5</u>				F22	PEDIGROE	/	T
	Med Cv	Low Cv	CC	F23	ACTERUBR	/	T
	Grd Cv						
*G 1	GLYC STRI	/cnfrm.	P				
*G 2	CAREDISP	/	T+				
G 3	CALACANA	/	3+				
*G 4	BROMUS CILI	/cnfrm.	P				
G 5	AGROSTOL	/	T				
G 6	CAREUTRI	/	P				
G 7	CARE OEDERI	/					
G 8		/					
G 9		/					
G10		/					
G11		/					
G12		/					
				FERN Tot Cv _____ MHT _____ Med Cv _____			
				Low Cv _____ Grd Cv _____			
				BRYO/LICH Tot Cv _____			

COMMENTS (EODATA) --> _____

NOT OF 93WL/SC003 but Sawmill Flats site, visit 9/8/93
 the Carex dominant of upper site

COMMUNITY SURVEY FORM

MTNHP
5/27/91

When ...

①

ERIVIR

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

PLOT NO. C93#05 MO 6 DAY 8 MANUAL _____ UNITS ft m
 EXAMINER(S) SWC/JSS YEAR 93 EOCODE _____ * _____
 PNC BETGLA/CARLAS CT Same
 SITE BOWEN CREEK PEATLAND STATE MT COUNTY LINCOLN
 PURP _____ PREC _____ QUADNAME DUNSIRE POINT QUADCODE _____
 3IN T/26WR/01S/NW4S/SW4/4 COMMUNITY SIZE (acres) 5
 PLOT TYPES 50m² PLTRL _____ PLOT W _____ SURVEY _____
 PHOTOS _____
 DIRECTIONS --> _____

CONSERVATION RANKING

COND _____ Com: _____
 VIAB _____ Com: _____
 DEFN _____ Com: _____
 RANK _____ Com: _____
 MGMT: _____
 PROT: _____

ENVIRONMENTAL FEATURES

DL _____ SOIL RPT _____
 SOIL UNIT _____ SOIL TAXON _____
 PM DRG LANDFORM _____ PLOT POS _____ SLP SHAPE _____ ASP SW
 SLOPE % 2-3 ELEVATION _____ EROS POTENT _____ EROS TYPE _____
 HORIZON ANGLE (%): N _____ E _____ S _____ W _____ IFSLP _____ IFVAL _____
 SPFE _____
 GROUND COVER: - S+ - G+ - R+ + L+ + W+ 9 M+ | BV+ 0 = 100%
 DISTURBANCE HISTORY (type, intensity, frequency, season)--> None

RIPARIAN FEATURES: Channel Width _____ Channel Entrench _____
 Surface Water _____ Ht. Abv. H2O _____ Dist. from H2O _____

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

Peatland, marsh complex with active beaver on part (south portion) near main creek. North 1/2 has 5 acres Betula/Carlar c.t. Site slopes to SW w 2-3% slope.
Water to surface. 6" hummocks throughout plot
Plot located in central portion of peatland in representative stand of Betula glandulosa/Carax lasiocarpa comm. type.

OCULAR PLANT SPECIES DATA

PtIDL _____

PLOT NO. <u>C93005</u>		NO. SPECIES _____		PNC <u>Betula/Carlar</u>		
TREES Tot Cv <u>φ</u> Mht _____ Tal Cv <u>φ</u> Med Cv _____ Low Cv _____ Grd Cv _____			CC	FRBS Tot Cv <u>P</u> Mht <u>1"</u> Med Cv _____ Low Cv _____ Grd Cv _____		CC
T 1	/			F 1	<u>MITBRE</u>	<u>P</u>
T 2	/			F 2	<u>Pyrasa</u>	<u>T</u>
T 3	/			F 3	<u>Dotpal</u>	<u>P</u>
T 4	/			F 4	<u>Smista</u>	<u>T</u>
T 5	/			F 5		
				F 6		
SHRBS Tot Cv <u>1</u> Mht <u>1.5'</u> Tal Cv _____ Med Cv _____ Low Cv _____ Grd Cv _____			CC	F 7		
S 1	<u>Betula</u>	<u>2'</u>	<u>6</u>	F 8		
S 2	<u>Salix</u>	<u>1'</u>	<u>2</u>	F 9		
S 3	/			F 10		
S 4	/			F 11		
S 5	/			F 12		
S 6	/			F 13		
S 7	/			F 14		
S 8	/			F 15		
S 9	/				<u>Mosses: (collected)</u>	<u>9</u>
S 10	/				<u>C93005-1</u>	
S 11	/				<u>= Sphagnum</u>	
S 12	/				<u>C93005-2</u>	
GRAM Tot Cv <u>6</u> Mht <u>1'</u> Med Cv _____ Low Cv _____ Grd Cv _____			CC			
G 1	<u>Carlar</u>	/	<u>5</u>			
G 2	<u>Carrus</u>	/	<u>2</u>			
G 3	<u>Erivir</u>	/	<u>T</u>			
G 4	<u>Carcar</u>	/	<u>T</u>			
G 5	<u>unk Carex</u>	/	<u>T</u>			
G 6	<u>Cardio</u>	/	<u>P</u>			
G 7	<u>Muhlo</u>	/	<u>T</u>			
G 8	/					
G 9	/					
G 10	/					
G 11	/					
G 12	/					
				FERN Tot Cv _____ Mht _____ Med Cv _____ Low Cv _____ Grd Cv _____		
				BRYO/LICH Tot Cv <u>9</u>		

COMMENTS (EODATA) --> - 2 N. Bog lemming - like critter. seen running amongst Sphagnum hummocks on N-edge of Betula/Carlar type (about 4" long, grey-brown, short tail (I think). About center of most-open peatland, N-side.

Bowen Creek site = occurrence φφ5 for N. bog lemming.

COMMUNITY SURVEY FORM

MTNHP
5/27/91

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

PLOT NO. C93008 MO 8 DAY 17 MANUAL _____ UNITS ft m
 EXAMINER(S) Steve Chade YEAR 93 EOCODE _____ *
 PNC Eleocharis pauciflora CT _____
 SITE CODY LAKE STATE MT COUNTY Lincoln
 PURP _____ PREC _____ QUADNAME Richards Mountain QUADCODE _____
 29N T/28W R/ 6 S/NW4S/ 4/4 COMMUNITY SIZE (acres) _____
 PLOT TYPES 50m² PLTRL _____ PLOT W _____ SURVEY _____
 PHOTOS Aerial photo USDA-F 16-611140 192-33, dated 6-21-92.

DIRECTIONS --> Travel west from Libby, MT for 1.5 miles on Highway 37 to bridge over Kootenai River. Turn south on east side of bridge onto Forest Road 530. Travel south on 530 for 8 miles to Forest Road 4596 (Cody Lake Road). Travel east on 4596 for 7 miles to lowermost Cody Lake. Site is 50 m east of road.

CONSERVATION RANKING

COND _____ Com: _____
 VIAB _____ Com: _____
 DEFN _____ Com: _____
 RANK _____ Com: _____
 MGMT: _____
 PROT: _____

ENVIRONMENTAL FEATURES

DL _____ SOIL RPT _____
 SOIL UNIT _____ SOIL TAXON _____
 PM _____ LANDFORM _____ PLOT POS _____ SLP SHAPE _____ ASP _____
 SLOPE % _____ ELEVATION _____ EROS POTENT _____ EROS TYPE _____
 HORIZON ANGLE (%): N _____ E _____ S _____ W _____ IFSLP _____ IFVAL _____
 SPFE _____

GROUND COVER: - S+ - G+ - R+ / Lt+ - W+ 7 M+ 2 BV+ - 0 = 100%
 DISTURBANCE HISTORY (type, intensity, frequency, season) -->

None adjacent - pond & peatland are within Mamit Area 13 (old-growth) & not scheduled for harvest. Downslope areas have been heavily logged.

RIPARIAN FEATURES: Channel Width _____ Channel Entrench _____
 Surface Water _____ Ht. Abv. H2O _____ Dist. from H2O _____

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

Site is near headwaters of Cody Creek. The pond & surrounding peatland is the lowermost of 3 ponds, of which this one (lowermost) is the most diverse, supporting a well-developed peatland. The pond is deep (up to 4 m) and about 1 hectare in size. Adjacent forests are dominated by Plccq, Laroc and Douglas-fir.
 (w. larch)

OCULAR PLANT SPECIES DATA

PltIDL _____

PLOT NO. <u>C93008</u>		NO. SPECIES <u>9</u>		PNC <u>Eleocharis pauciflora</u>	
		(vascular)			
TREES	Tot Cv <u>0</u>	Mht _____	FRBS	Tot Cv <u>1</u>	Mht <u>12 cm</u>
	Tal Cv <u>0</u>	Med Cv _____		Med Cv _____	Low Cv _____
	Low Cv _____	Grd Cv _____		Grd Cv _____	CC
T 1	/	/	F 1	<u>Spiranthes vomanaefolia</u>	<u>12 cm</u> <u>T</u>
T 2	/	/	F 2	<u>Monarda trifoliata</u>	<u>10 cm</u> <u>I</u>
T 3	/	/	F 3	<u>Equisetum variegatum</u>	<u>15 cm</u> <u>T</u>
T 4	/	/	F 4	/	/
T 5	/	/	F 5	/	/
			F 6	/	/
			F 7	/	/
SHRBS	Tot Cv <u>0</u>	Mht _____	F 8	/	/
	Tal Cv <u>0</u>	Med Cv _____	F 9	/	/
	Low Cv _____	Grd Cv _____	F10	/	/
S 1	/	/	F11	/	/
S 2	/	/	F12	/	/
S 3	/	/	F13	/	/
S 4	/	/	F14	/	/
S 5	/	/	F15	/	/
S 6	/	/			
S 7	/	/			
S 8	/	/			
S 9	/	/			
S10	/	/			
S11	/	/			
S12	/	/			
GRAM	Tot Cv <u>9</u>	Mht <u>20 cm</u>	Mosses:		
	Med Cv _____	Low Cv _____	<u>Scorpidium scopoides</u>		
	Grd Cv _____	CC	<u>Campylopus</u>		
G 1	<u>Carex lasiocarpa</u>	<u>30 cm</u>	<u>Drepanocladus</u>		
G 2	<u>Carex rostrata</u>	<u>30</u>			
G 3	<u>Muhlenbergia filiformis</u>	<u>15</u>			
G 4	<u>Eriogonum viridicarpum</u>	<u>30</u>			
G 5	<u>Eleocharis pauciflora</u>	<u>15 cm</u>			
G 6	<u>Carex limosa</u>	<u>15</u>			
G 7	/	/			
G 8	/	/			
G 9	/	/			
G10	/	/	FERN Tot Cv <u>1</u>	Mht _____	Med Cv _____
G11	/	/	(Squar)	Low Cv _____	Grd Cv _____
G12	/	/	BRYO/LICH	Tot Cv <u>7</u>	

COMMENTS (EODATA) --> Water to surface. Small hummocks present and up to 6 cm high.

Plot is about 10 m east of east pond edge.

Cody Lake, Kootenai NF

COMMUNITY SURVEY FORM

MTNHP
5/27/91

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

PLOT NO. C930089 MO 8 DAY 17 MANUAL _____ UNITS ft m
 YEAR 93 EOCODE _____ * _____
 EXAMINER(S) Steve Chade
 PNC Betula glandulata / Eriochloa sp. aff. flava
 SITE Cody Lake STATE MT COUNTY Lincoln
 PURP _____ PREC _____ QUADNAME Richard Mountain QUADCODE _____
29N T/ 28W R/ 6 S/NW 4S/ 4/4 COMMUNITY SIZE (acres) _____
 PLOT TYPES 50m² PLTRL _____ PLOT W _____ SURVEY _____
 PHOTOS _____
 DIRECTIONS --> (see C93008)

CONSERVATION RANKING

COND _____ Com: _____
 VIAB _____ Com: _____
 DEFN _____ Com: _____
 RANK _____ Com: _____
 MGMT: _____
 PROT: _____

ENVIRONMENTAL FEATURES

DL _____ SOIL RPT _____
 SOIL UNIT _____ SOIL TAXON _____
 PM _____ LANDFORM _____ PLOT POS _____ SLP SHAPE _____ ASP _____
 SLOPE % _____ ELEVATION _____ EROS POTENT _____ EROS TYPE _____
 HORIZON ANGLE (°): N _____ E _____ S _____ W _____ IFSLP _____ IFVAL _____
 SPFE _____
 GROUND COVER: S+ G+ R+ L+ W+ M+ BV+ O = 100%
 DISTURBANCE HISTORY (type, intensity, frequency, season)--> _____
(see C93008)

RIPARIAN FEATURES: Channel Width _____ Channel Entrench _____
 Surface Water _____ Ht. Abv. H2O _____ Dist. from H2O _____

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

(see C93008)

OCULAR PLANT SPECIES DATA

PltidL _____

PLOT NO. <u>C93009</u> NO. SPECIES _____ PNC <u>BETGLA/ELEPAU-CARLAS</u>			
TREES		Tot Cv <u>7</u> Mht <u>1m</u>	CC
		Tal Cv _____ Med Cv _____	
		Low Cv _____ Grd Cv _____	
T 1	<u>PICENG</u>	<u>1m</u>	<u>T</u>
T 2			
T 3			
T 4			
T 5			
SHRBS		Tot Cv <u>3</u> Mht <u>1m</u>	CC
		Tal Cv _____ Med Cv _____	
		Low Cv _____ Grd Cv _____	
S 1	<u>Betula glandulosa</u>	<u>1-2m</u>	<u>3</u>
S 2	<u>Salix candida</u>	<u>0.5-1m</u>	<u>P</u>
S 3	<u>Kalmia microphylla</u>	<u>0.2m</u>	<u>P</u>
S 4			
S 5			
S 6			
S 7			
S 8			
S 9			
S 10			
S 11			
S 12			
GRAM		Tot Cv <u>7</u> Mht <u>30cm</u>	CC
		Med Cv _____ Low Cv _____	
		Grd Cv _____	
G 1	<u>Carex lasiocarpa</u>	<u>30cm</u>	<u>1</u>
G 2	<u>Carex rostrata</u>	<u>30</u>	<u>2</u>
G 3	<u>Eriochloa pauciflora</u>	<u>15</u>	<u>5</u>
G 4	<u>Eriophorum viridicaundum</u>	<u>30</u>	<u>7</u>
G 5	<u>Carex disperma</u>	<u>15</u>	<u>7</u>
G 6	<u>Muhlenbergia (Sili-formis?)</u>	<u>15</u>	<u>1</u>
G 7	<u>Carex limosa</u>	<u>15</u>	<u>T</u>
G 8			
G 9			
G 10			
G 11			
G 12			
		FERN Tot Cv <u>1</u> Mht _____ Med Cv _____	
		(Equisetum) Low Cv _____ Grd Cv _____	
		BRYO/LICH Tot Cv <u>9</u>	
F 1	<u>Equisetum arvense</u>	<u>20cm</u>	<u>1</u>
F 2	<u>Equisetum variegatum</u>	<u>15</u>	<u>T</u>
F 3	<u>Spiranthes romanzoffiana</u>	<u>15</u>	<u>T</u>
F 4	<u>Habenaria hyperborea</u>	<u>15</u>	<u>P</u>
F 5	<u>Fuzedenus elegans</u>	<u>15</u>	<u>P</u>
F 6	<u>Melastomaceae trifoliata</u>	<u>15</u>	<u>3</u>
F 7	<u>Mitella (nuda?)</u>	<u>10</u>	<u>P</u>
F 8	<u>Panicum palustre</u>	<u>10</u>	<u>T</u>
F 9	<u>Castilleja miniata</u>	<u>15</u>	<u>7</u>
F 10	<u>Habenaria dilatata</u>	<u>30</u>	<u>7</u>
F 11			
F 12			
F 13			
F 14			
F 15			

COMMENTS (EODATA) --> Water to surface of plot.

Plot is east of Plot C93008, about 15 m east of pond edge.
Sequence is open water → Eriochloa pauciflora community → Betula glandulosa/Eriochloa pauciflora - Carex lasiocarpa community → moist conifer forest (PICEA/Linnæa borealis).

December 1, 1993

PLANT SPECIES OF CODY LAKES
Kootenai National Forest, Fisher River Ranger District

(List based on site visit by Steve Chadde on August 17, 1993.)

Trees

Picea engelmannii Engelmann Spruce

Shrubs

<i>Alnus sinuata</i>	Sitka Alder
<i>Betula glandulosa</i>	Bog Birch
<i>Cornus canadensis</i>	Bunchberry
<i>Kalmia microphylla</i>	Small-leaved Laurel
<i>Linnaea borealis</i>	Twinflower
<i>Lonicera involucrata</i>	Twin-berry
<i>Rhamnus alnifolia</i>	Alder Buckthorn
<i>Salix candida</i>	Hoary Willow
<i>Vaccinium myrtillus</i>	Dwarf Bilberry

Graminoids

<i>Calamagrostis canadensis</i>	Bluejoint Reedgrass
<i>Carex buxbaumii</i>	Buxbaum's Sedge
<i>Carex dioica</i>	Yellow-bog Sedge
<i>Carex disperma</i>	Soft-leaved Sedge
<i>Carex interior</i>	Inland Sedge
<i>Carex lasiocarpa</i>	Slender Sedge
<i>Carex limosa</i>	Mud Sedge
<i>Carex rostrata</i>	Beaked Sedge
<i>Eleocharis pauciflora</i>	Few-flowered Spike-rush
<i>Eriophorum viridicarinatum</i>	Green-keeled Cotton-grass
<i>Muhlenbergia</i> spp.	Muhly
<i>Scirpus acutus</i>	Hardstem Bulrush

Forbs

<i>Angelica arguta</i>	Sharptooth Angelica
<i>Aster junciformis</i>	Rush Aster
<i>Castilleja miniata</i>	Scarlet Paintbrush
<i>Epilobium palustre</i>	Swamp Willow-herb
<i>Habenaria dilatata</i>	White Orchis
<i>Habenaria hyperborea</i>	Northern Green Bog-orchid
<i>Menyanthes trifoliata</i>	Buckbean
<i>Mitella</i> spp.	Mitrewort
<i>Nuphar polysepalum</i>	Spatter-dock
<i>Parnassia palustris</i>	Northern Grass-of-parnassus
<i>Pedicularis bracteosa</i>	Bracted Lousewort
<i>Petasites sagittatus</i>	Arrowleaf Coltsfoot
<i>Potamogeton gramineus</i>	Grass-leaved Pondweed
<i>Potentilla palustris</i>	Purple Cinquefoil
<i>Spiranthes romanzoffiana</i>	Hooded Ladies-tresses
<i>Zigadenus elegans</i>	Glaucous Zigadenus

PLANT SPECIES OF CODY LAKES - continued
Kootenai National Forest, Fisher River Ranger District

Ferns and Fern Allies

Equisetum arvense

Equisetum variegatum

Field Horsetail

Variegated Horsetail

Mosses

Campylium stellatum

Sphagnum (fuscum?)

Scorpidium scorpioides

Tomenthypnum nitens

40 vascular species

4 nonvascular species

COMMUNITY SURVEY FORM

MTNHP
5/27/91

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

MANUAL _____ UNITS ft m
PLOT NO. 93B14 04 MO 08 DAY 04 YEAR 93 EOCODE _____ *
EXAMINER(S) B. Heidel; w later visit by David Lockman (Bitterroot NF)
PNC _____ CT _____
SITE _____ STATE ND COUNTY RAVA
PURP _____ PREC _____ QUADNAME Schultz Saddle QUADCODE 4511377
IN T/IRWR/10 S/SW4S/NE4/4 COMMUNITY SIZE (acres) ca. 2
PLOT TYPES 5 m. radius PLTRL PLOT W _____ SURVEY _____
PHOTOS Across plot
DIRECTIONS --> Meadow Creek

CONSERVATION RANKING

COND _____ Com: _____
VIAB _____ Com: _____
DEFN _____ Com: _____
RANK _____ Com: _____
MGMT: _____
PROT: _____

ENVIRONMENTAL FEATURES

DL _____ SOIL RPT _____
SOIL UNIT _____ SOIL TAXON histosol
PM _____ LANDFORM _____ PLOT POS _____ SLP SHAPE _____ ASP _____
SLOPE % 2 ELEVATION 5810 EROS POTENT _____ EROS TYPE _____
HORIZON ANGLE (%): N _____ E _____ S _____ W _____ IFSLP _____ IFVAL _____
SPFE _____
GROUND COVER: S+ G+ R+ L+ W+ M+ BV+ 0 = 100%
DISTURBANCE HISTORY (type, intensity, frequency, season)--> _____

RIPARIAN FEATURES: Channel Width _____ Channel Entrench _____
Surface Water _____ Ht. Abv. H2O _____ Dist. from H2O _____

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

Gently sloping beatland of dense almost uninterrupted
sedde cover with hummocks, and one small open pool at base.
It is bordered by forest above, thickets to either side and meadow
with beaver ponds down below.

OCULAR PLANT SPECIES DATA

PltIDL _____

PLOT NO. _____		NO. SPECIES _____		PNC _____			
TREES Tot Cv _____ Mht _____ Tal Cv _____ Med Cv _____ Low Cv _____ Grd Cv _____		CC _____		FRBS Tot Cv _____ Mht _____ Med Cv _____ Low Cv _____ Grd Cv _____		CC _____	
T 1	/			F 1	PEDBKA	/	T
T 2	/			F 2	FRAVIR	/	T
T 3	/			F 3	EPIGLA	/	T
T 4	/			F 4	VIDNEP	/	T
T 5	/			F 5	HABHYP	/	J
SHRBS Tot Cv _____ Mht _____ Tal Cv _____ Med Cv _____ Low Cv _____ Grd Cv _____		CC _____		F 6	ASTFOL	/	T
S 1	SALLEM	/	1	F 7	LIGTEN	/	T
S 2	SALPLA	/	2	F 8		/	
S 3	SALBDO	/	P	F 9		/	
S 4	SYMORE	/	T	F10		/	
S 5		/		F11		/	
S 6		/		F12		/	
S 7		/		F13		/	
S 8		/		F14		/	
S 9		/		F15		/	
S10		/			Mosses	/	
S11		/			Caliergon giganteum	/	
S12		/			Aulacomnium palustre	/	
GRAM Tot Cv _____ Mht _____ Med Cv _____ Low Cv _____ Grd Cv _____		CC _____			Drepanocladus capillifolius	/	
G 1	CARUTR	/	3		Toxenthyrium nitens	/	
G 2	AGASCA	/	T		Sphagnum fuscum	/	
G 3	LUZPAR	/	T		Meesia triquetra	/	
G 4	CARINT	/	P			/	
G 5	CALINE	/	T			/	
G 6	MUH FIL	/	T			/	
G 7	ALOGEN	/	T			/	
G 8	CERXQU	/	T			/	
G 9	ERICHA	/	T			/	
G10		/				/	
G11		/				/	
G12		/				/	
				FERN Tot Cv _____ Mht _____ Med Cv _____ Low Cv _____ Grd Cv _____			
				BRYO/LICH Tot Cv _____			

COMMENTS (EODATA) --> _____

Figure 1. (continued)

COMMUNITY SURVEY FORM

MTNHP
5/27/91

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

PLOT NO. 93BH05 MO 08 DAY 05 MANUAL _____ UNITS ft m
YEAR 93 EOCODE _____ *
EXAMINER(S) B. Heidel, S. Cooper, D. Svoboda
PNC _____ CT _____
SITE _____ STATE MT COUNTY BEAU
PURP _____ PREC S QUADNAME Big Hole Battlefield QUADCODE 451136
15 T/17WR/26S/SW1S/NW1/4 COMMUNITY SIZE (acres) ca. 5 total
PLOT TYPES 5m. radius PLTRL PLOT W _____ SURVEY _____
PHOTOS Across plot
DIRECTIONS --> Maybe Meadows

CONSERVATION RANKING

COND _____ Com: _____
VIAB _____ Com: _____
DEFN _____ Com: _____
RANK _____ Com: _____
MGMT: _____
PROT: _____

ENVIRONMENTAL FEATURES

DL _____ SOIL RPT _____
SOIL UNIT _____ SOIL TAXON histsol
PM _____ LANDFORM _____ PLOT POS _____ SLP SHAPE _____ ASP _____
SLOPE % 0 ELEVATION 6550 EROS POTENT _____ EROS TYPE _____
HORIZON ANGLE (%): N _____ E _____ S _____ W _____ IFSLP _____ IFVAL _____
SPFE _____
GROUND COVER: S+ G+ R+ L+ P W+ T M+ 9 BV+ / 0 = 100%
DISTURBANCE HISTORY (type, intensity, frequency, season)--> _____

RIPARIAN FEATURES: Channel Width _____ Channel Entrench _____
Surface Water _____ Ht. Abv. H20 _____ Dist. from H20 _____

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

This plot represents the primary plant association within the prevailing short stature shrub association of the raised fen which lies at the upper end of Maybe Meadows at Addition Creek inter. Maybe Meadows is surrounded by second-growth lodgepole including areas of clearcut away from the fen.

100+ PINON cut

OCULAR PLANT SPECIES DATA

PlotID: _____

PLOT NO. 93BLH05 NO. SPECIES _____ PNC _____

TREES	Tot Cv	Mht	CC	FRBS	Tot Cv	Mht	CC	
	Tal Cv	Med Cv			Med Cv	Low Cv		
	Low Cv	Grd Cv			Grd Cv			
T 1	<u>PINCON IV</u>	<u>/</u>	<u>P</u>	F 1	<u>PYRASA</u>	<u>/</u>	<u>T</u>	
T 2	<u>PINCONI decd</u>	<u>/</u>	<u>T</u>	F 2	<u>LIGTEN</u>	<u>/</u>	<u>T</u>	
T 3	<u>/</u>	<u>/</u>		F 3	<u>SENSPP</u>	<u>/</u>	<u>T</u>	
T 4	<u>/</u>	<u>/</u>		F 4	<u>ASTFOL</u>	<u>/</u>	<u>T</u>	
T 5	<u>/</u>	<u>/</u>		F 5	<u>POLOCC</u>	<u>/</u>	<u>T</u>	
SHRBS	Tot Cv	Mht	CC	F 6	<u>LUPPOL</u>	<u>/</u>	<u>T</u>	
S 1	<u>BETGLA</u>	<u>/</u>		<u>3</u>	F 7	<u>EPIGLA</u>	<u>/</u>	<u>T</u>
S 2	<u>SALDOL</u>	<u>/</u>		<u>1</u>	F 8	<u>/</u>	<u>/</u>	
S 3	<u>SALPLA</u>	<u>/</u>	<u>P</u>	F 9	<u>/</u>	<u>/</u>		
S 4	<u>LONCAE</u>	<u>/</u>	<u>T</u>	F 10	<u>/</u>	<u>/</u>		
S 5	<u>VACSCO</u>	<u>/</u>	<u>T</u>	F 11	<u>/</u>	<u>/</u>		
S 6	<u>SALGEY</u>	<u>/</u>	<u>T</u>	F 12	<u>/</u>	<u>/</u>		
S 7	<u>/</u>	<u>/</u>		F 13	<u>/</u>	<u>/</u>		
S 8	<u>/</u>	<u>/</u>		F 14	<u>/</u>	<u>/</u>		
S 9	<u>/</u>	<u>/</u>		F 15	<u>/</u>	<u>/</u>		
S 10	<u>/</u>	<u>/</u>		<u>See Ellist letter</u>				
S 11	<u>/</u>	<u>/</u>		<u>for mosses of</u>				
S 12	<u>/</u>	<u>/</u>		<u>area ; specimens</u>				
GRAM	Tot Cv	Mht	CC	<u>got combined in</u>				
G 1	<u>CARUTR</u>	<u>/</u>		<u>8</u>	<u>ID phase</u>			
G 2	<u>CARCAN</u>	<u>/</u>		<u>T</u>				
G 3	<u>CARAOU</u>	<u>/</u>	<u>P</u>					
G 4	<u>POAPRA</u>	<u>/</u>	<u>T</u>					
G 5	<u>LYZCAMUL</u>	<u>/</u>	<u>T</u>					
G 6	<u>AGR SCA</u>	<u>/</u>	<u>T</u>					
G 7	<u>/</u>	<u>/</u>						
G 8	<u>/</u>	<u>/</u>						
G 9	<u>/</u>	<u>/</u>						
G 10	<u>/</u>	<u>/</u>						
G 11	<u>/</u>	<u>/</u>						
G 12	<u>/</u>	<u>/</u>						

COMMENTS (EODATA) --> _____

Figure 1. (continued)

28
5.2/51

COMMUNITY SURVEY FORM

MTNHP

5/27/91

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

MANUAL UNITS ft m
PLOT NO. 93BH06 MO 08 DAY 05 YEAR 93 EOCODE _____ *
EXAMINER(S) R. Heidel, S. Cooper, J. Svoboda
PNC _____ CT _____
SITE _____ STATE MT COUNTY BEAV
PURP _____ PREC _____ QUADNAME _____ QUADCODE 4511366
15 T/17WR/26S/SW4S/NW4/4 COMMUNITY SIZE (acres) ca. 5 total
PLOT TYPES 5 m. radius PLTRL PLOT W _____ SURVEY _____
PHOTOS Across plot
DIRECTIONS --> Maybe Meadows

CONSERVATION RANKING

COND _____ Com: _____
VIAB _____ Com: _____
DEFN _____ Com: _____
RANK _____ Com: _____

MGMT: _____
PROT: _____

ENVIRONMENTAL FEATURES

DL _____ SOIL RPT _____
SOIL UNIT _____ SOIL TAXON histosol
PM _____ LANDFORM _____ PLOT POS _____ SLP SHAPE _____ ASP _____
SLOPE % 0 ELEVATION 6550 EROS POTENT _____ EROS TYPE _____
HORIZON ANGLE (%): N _____ E _____ S _____ W _____ IFSLP _____ IFVAL _____
SPFE _____
GROUND COVER: S+ G+ R+ L+ P+W+ T+M+9 BV+ 0 = 100%
DISTURBANCE HISTORY (type, intensity, frequency, season) --> _____
It appears that livestock graze the meadows late in the season at light/moderate intensity, but not penetrating the peatland.

RIPARIAN FEATURES: Channel Width _____ Channel Entrench _____
Surface Water _____ Ht. Abv. H2O _____ Dist. from H2O _____

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

This plot represents a secondary plant association within the prevailing short-stature shrub vegetation, in the raised peatland below Addition Creek inlet at upper end of Maybe Meadows.

OCULAR PLANT SPECIES DATA

PlotIDL _____

PLOT NO. <u>93BL406</u> NO. SPECIES _____ PNC _____			
TREES		Tot Cv _____ Mht _____ Tal Cv _____ Med Cv _____ Low Cv _____ Grd Cv _____	CC
T 1	/		
T 2	/		
T 3	/		
T 4	/		
T 5	/		
SHRBS		Tot Cv <u>5</u> Mht _____ Tal Cv _____ Med Cv _____ Low Cv _____ Grd Cv _____	CC
S 1	<u>SALWOL</u> /		<u>3</u>
S 2	<u>SALPLA</u> /		<u>2</u>
S 3	<u>LONCFE</u> /		<u>T</u>
S 4	<u>FETGLA</u> /		<u>1</u>
S 5	<u>SALGEY</u> /		
S 6	/		
S 7	/		
S 8	/		
S 9	/		
S 10	/		
S 11	/		
S 12	/		
GRAM		Tot Cv _____ Mht _____ Med Cv _____ Low Cv _____ Grd Cv _____	CC
G 1	<u>CARAQU</u> /		<u>8</u>
G 2	<u>CARCAN</u> /		<u>P</u>
G 3	<u>CARUTR</u> /		<u>P?</u>
G 4	<u>AGRSCA</u> /		<u>T</u>
G 5	/		
G 6	/		
G 7	/		
G 8	/		
G 9	/		
G 10	/		
G 11	/		
G 12	/		
		FERN Tot Cv _____ Mht _____ Med Cv _____ Low Cv _____ Grd Cv _____	
		BRYO/LICH Tot Cv _____	

F 1 LUPPOL / T
 F 2 PYRASA / T
 F 3 POLVCC / T
 F 4 LIGTEN / T
 F 5 SENINT / T
 F 6 EPIGLA / T
 F 7 GALTRI / T
 F 8 / T
 F 9 / T
 F 10 / T
 F 11 / T
 F 12 / T
 F 13 / T
 F 14 / T
 F 15 / T
See Elliot letter for
Mosses of area;
specimens got
combined in 10 phase

COMMENTS (EODATA) --> _____

Figure 1. (continued)

Mosses - *Some red Spk* 8
Polysphaera

COMMUNITY SURVEY FORM

MTNHP
5/27/91

GENERAL PLOT DATA

IDENTIFICATION AND LOCATION

PLOT NO. 9384 07 MO 08 DAY 05 YEAR 93 EOCODE _____ *
EXAMINER(S) B. Heidel, S. Cooper, D. Svoboda
PNC _____ CT _____
SITE _____ STATE MT COUNTY BEAU
PURP _____ PREC _____ QUADNAME Torrey Mountain QUADCODE 4511366
1S T/ 17WR/ 26S/ SW4S/ NW4/4 COMMUNITY SIZE (acres) ca. 5 total
PLOT TYPES 5 m. radius PLTRL PLOT W _____ SURVEY _____
PHOTOS Across plot
DIRECTIONS --> Maugbee Meadows

CONSERVATION RANKING

COND _____ Com: _____
VIAB _____ Com: _____
DEFN _____ Com: _____
RANK _____ Com: _____
MGMT: _____
PROT: _____

ENVIRONMENTAL FEATURES

DL _____ SOIL RPT _____
SOIL UNIT _____ SOIL TAXON histosol
PM _____ LANDFORM _____ PLOT POS _____ SLP SHAPE _____ ASP _____
SLOPE % 0 ELEVATION 6550 EROS POTENT _____ EROS TYPE _____
HORIZON ANGLE (%): N _____ E _____ S _____ W _____ IFSLP _____ IFVAL _____
SPFE _____
GROUND COVER: S+1 G+ R+ L+ 6 W+ P M+ 1 BV+ 1 O = 100%
DISTURBANCE HISTORY (type, intensity, frequency, season) --> Livestock trample margins of this habitat

RIPARIAN FEATURES: more than any other peatland habitat locally, except pools
channel Width _____ Channel Entrenchment _____
Surface Water ✓ Ht. Abv. H2O _____ Dist. from H2O _____

GENERAL SITE DESCRIPTION (landscape features and adjacent ct's)

Graminoid fen habitat at the north end of the peatland

OCULAR PLANT SPECIES DATA

PltIDL _____

PLOT NO. <u>93HE107</u> NO. SPECIES _____ PNC _____			
TREES Tot Cv _____ Mht _____		FRBS Tot Cv _____ Mht _____	
Tal Cv _____ Med Cv _____		Med Cv _____ Low Cv _____	
Low Cv _____ Grd Cv _____ CC		Grd Cv _____ CC	
T 1	/	F 1	<u>GEUMAC</u> / <u>T</u>
T 2	/	F 2	<u>SENINT</u> / <u>T</u>
T 3	/	F 3	<u>ASTFOL</u> / <u>T</u>
T 4	/	F 4	<u>SAX.SPP</u> / <u>T</u>
T 5	/	F 5	<u>GALTRI</u> / <u>T</u>
SHRBS Tot Cv _____ Mht _____		F 6 <u>EPIGLA</u> / <u>T</u>	
Tal Cv _____ Med Cv _____		F 7 _____ / _____	
Low Cv _____ Grd Cv _____ CC		F 8 _____ / _____	
S 1	<u>SALGEY</u> / <u>T</u>	F 9 _____ / _____	
S 2	<u>LONGAE</u> / <u>T</u>	F 10 _____ / _____	
S 3	/	F 11 _____ / _____	
S 4	/	F 12 _____ / _____	
S 5	/	F 13 _____ / _____	
S 6	/	F 14 _____ / _____	
S 7	/	F 15 _____ / _____	
S 8	/	<u>See Felliot letter</u> / _____	
S 9	/	<u>for masses of ares;</u> / _____	
S 10	/	<u>specimens got</u> / _____	
S 11	/	<u>combined in ID phase</u> / _____	
S 12	/	_____ / _____	
GRAM Tot Cv _____ Mht _____		FERN Tot Cv _____ Mht _____ Med Cv _____	
Med Cv _____ Low Cv _____		Low Cv _____ Grd Cv _____	
Grd Cv _____ CC		BRYO/LICH Tot Cv _____	
G 1	<u>CARUTR</u> / <u>9</u>	_____ / _____	
G 2	<u>CARAN</u> / <u>2</u>	_____ / _____	
G 3	<u>AGRSCA</u> / <u>T</u>	_____ / _____	
G 4	<u>ALO PRA</u> / <u>T</u>	_____ / _____	
G 5	<u>CALINE</u> / <u>P</u>	_____ / _____	
G 6	<u>FRIPOL</u> / <u>T</u>	_____ / _____	
G 7	<u>POAPAL</u> / <u>T</u>	_____ / _____	
G 8	<u>CARABU</u> / <u>T</u>	_____ / _____	
G 9	/	_____ / _____	
G 10	/	_____ / _____	
G 11	/	_____ / _____	
G 12	/	_____ / _____	

COMMENTS (EODATA) --> _____

Figure 1. (continued)

Psu men / yer ten H.T.



Northwest Resource Consultants

Natural Resources & Socioeconomic Consultants
835 Eighth Avenue
Helena, Montana 59601
(406) 442-2889

Ms. Bonnie Heidel
Botanist
Montana Natural Heritage Program
P.O. Box 201800
1515 East Sixth Avenue
Helena, MT. 59620-1800

Dear Bonnie:

I looked at your moss specimens and was able to determine most to the species level. Two of your sites are very interesting bryologically - Maybee Meadows and Meadow Creek. I would like to collect these sites more thoroughly as there should be several other species present that often are found in the same habitat. I hope that I did not screw-up in not recording each collection to specific plot. I did not realize that many specimens were labeled on the bag with a separate plot number; rather, I lumped all specimens to a given site (e.g., Maybee Meadows). If you would like additional information on the ecology or distribution of your specimens, do not hesitate to contact me. I saved the more interesting collections for submission to MONTU or some other herbarium.

Lost Trail Bog

Calliergus stramineum (subplot #2)
Calliergus stramineum (subplot #6)
Drepanocladus fluitans (subplot #3)
Sphagnum fuscum (subplot #2)
Calliergus stramineum (subplot #4)

Maybee Meadows

Calliergus giganteum
Aulacomnium palustre
Hypnum pratense
Polytrichum strictum
Bryum caespiticum
Drepanocladus fluitans
Sphagnum nemoreum (? this seems anomalous)
Sphagnum warnstorffii
Bryum sp.
Sphagnum fuscum
Tomenthypnum nitens
Plagiomnium venustum

Moose Park

Polytrichum juniperinum

Neihardt

Tortula ruralis
Polytrichum juniperinum
Brachythecium albicans

French Creek

Cratoneuron commutatum
Aulacomnium palustre
Leptobryum pyriforme

Kings Hill

Bryum caespiticium

Russian Creek

Brachythecium albicans

Sp.

Meadow Creek

Callerigon giganteum
Drepanocladus capillifolius
Tomenthypnum nitens
Meesia triquetra
Aulacomnium palustre
Sphagnum fuscum

I would be happy to look at other collections, particularly those from fens and bogs.

Sincerely,



Joe C. Elliott

PLANT SPECIES OF SHOOFLY MEADOWS BOTANICAL AREA
Lolo National Forest
Missoula Ranger District
June 1, 1992

Shrubs

Kalmia microphylla	Small-leaved Laurel
Ledum glandulosum	Labrador-tea
Salix bebbiana	Bebb Willow
Vaccinium occidentale	Western Huckleberry

Graminoids

Calamagrostis canadensis	Bluejoint Reedgrass
Carex aquatilis	Water Sedge
Carex buxbaumii	Buxbaum's Sedge
Carex limosa	Mud Sedge
Carex paupercula	Poor Sedge
Carex rostrata	Beaked Sedge
Carex vesicaria	Inflated Sedge
Dulichium arundinaceum	Dulichium
Eleocharis pauciflora	Few-flowered Spike-rush
Eriophorum chamissonis	Chamisso's Cotton-grass

Forbs

Aster occidentalis	Western Aster
Potamogeton gramineus	Grass-leaved Pondweed
Potentilla palustris	Purple Cinquefoil
Scheuchzeria palustris	Pod Grass
Spiranthes romanzoffiana	Hooded Ladies-tresses

Mosses

Sphagnum fuscum
Sphagnum riparium

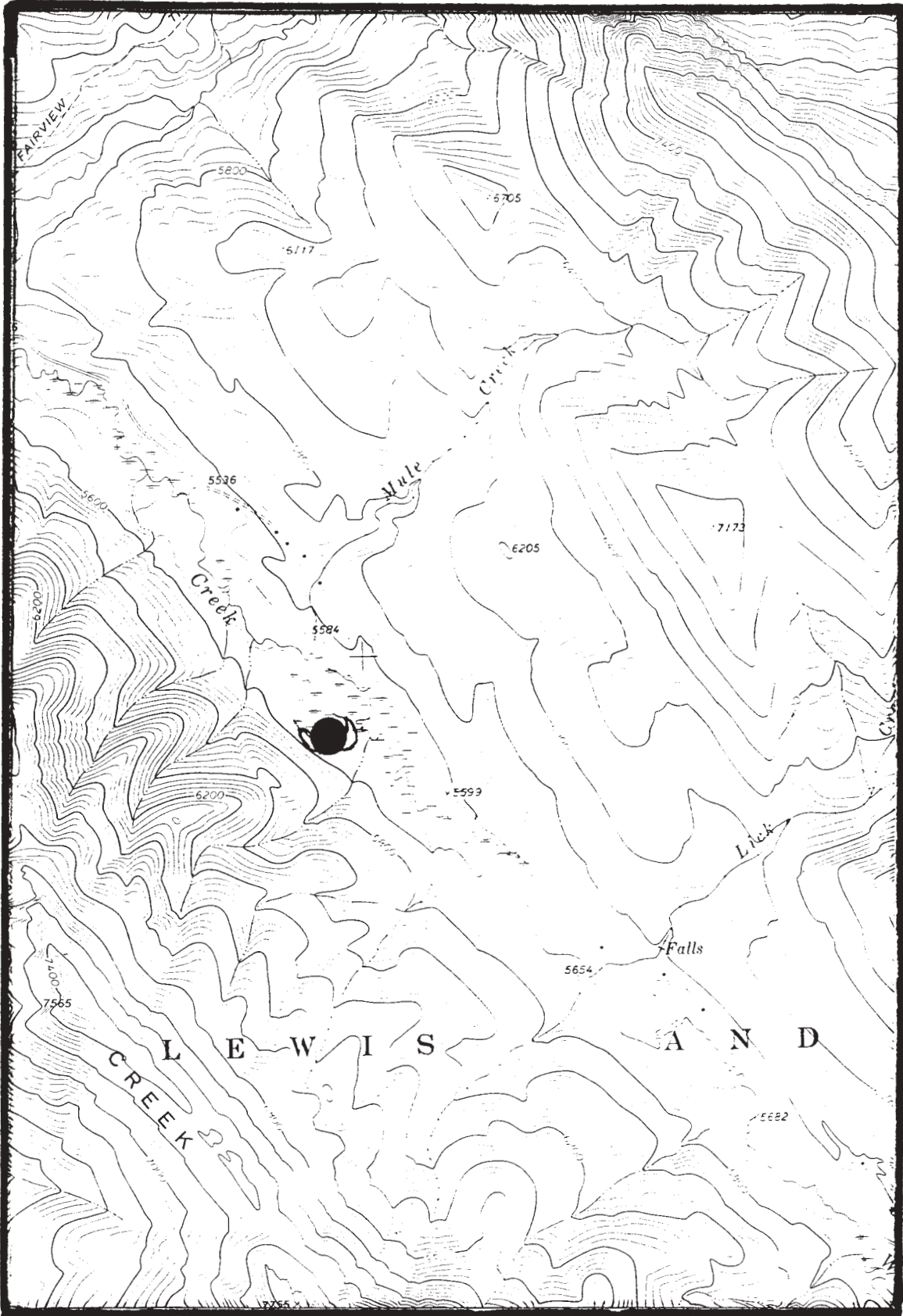
TABLE 2

SPHAGNUM COMPOSITION OF MONTANA BOGS AND FENS

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12
<i>Sphagnum angustifolium</i>	X	X				X				X		
<i>S. capillaceum</i>							X					
<i>S. centrale</i>								X				X
<i>S. compactum</i>				X								
<i>S. contortum</i>								X				
<i>S. fimbriatum</i>	X						X					
<i>S. fuscum</i>					X			X		X		
<i>S. girgensohnii</i>							X					
<i>S. macellanicum</i>												X
<i>S. mendocinum</i>		X										
<i>S. nemoreum</i>										X	X	
<i>S. platyphyllum</i>			X									
<i>S. riparium</i>					X							
<i>S. russowii</i>	X		X	X			X				X	
<i>S. squarrosum</i>								X		X		
<i>S. subsecundum</i>	X		X	X		X		X		X		X
<i>S. taras</i>				X		X		X	X	X		
<i>S. warnstorffii</i>				X		X			X			

Legend: Site 1 - Skull Creek Meadows
 Site 2 - Mary's Frog Pond (Missoula County)
 Site 3 - Needles-Mt. Edith (Meagher County)
 Site 4 - Mud Lake-Skalkaho Pass (Granite County)
 Site 5 - Shoofly Meadows (Missoula County)
 Site 6 - Sheep Mountain Bog (Missoula County)
 Site 7 - Sperry Glacier (GNP)
 Site 8 - Fish Lake (GNP)
 Site 9 - McGee's Meadow (GNP)
 Site 10 - John's Lake (GNP)
 Site 11 - Akaiyan Lake (GNP)
 Site 12 - Adair Ridge Bog (GNP)

APPENDIX 4. OCCURRENCE RECORDS OF NORTHERN BOG LEMMINGS TRAPPED IN
1993



010 *Synaptomys borealis*

7.5' USGS Wood Lake

Scientific Name: SYNAPTOMYS BOREALIS

Common Name: NORTHERN BOG LEMMING

Global rank: G5 Forest Service status: SENSITIVE

State rank: S2 Federal Status:

Element occurrence code: AMAFF17020.010

Element occurrence type:

Survey site name: WOOD CREEK

EO rank:

EO rank comments:

County: LEWIS AND CLARK

USGS quadrangle: WOOD LAKE

Township: Range: Section: TRS comments:

020N 010W 26

Precision: S

Survey date: 1993 08 31 Elevation: 5590

First observation: 1993 08 31 Slope/aspect:

Last observation: 1993 08 31 Size (acres): 2

Location:

ROCKY MOUNTAIN FRONT. FROM AUGUSTA GO WEST CA. 25 MILES
ON FS RD 235 TO THE BRIDGE OVER MULE CREEK. PARK AND WALK
SOUTH CA 200m, CROSSING WOOD CREEK, TO SITE.

Element occurrence data:

SINGLE FEMALE (PERFORATE, NON LACTATING) CAUGHT DURING
114 TRAP NIGHTS.

General site description:

A FEN MEADOW BEAVER POND COMPLEX. BEST HABITAT AREA IS
CA. 25 x 300m WITH SMALL, SCATTERED SPRUCE, BOG BIRCH,
WILLOWS AND GROUND COVER OF THICK MOSS ALONG SOUTH
EDGE OF AREA; REST OF AREA IS MARGINAL. SURROUNDING
TIMBER HAS HAD SELECTIVE CUTTING. BEAVER ARE NOT
CURRENTLY PRESENT. RIPARIAN AREA ALONG WOOD CREEK
JUST EAST OF SITE IS BADLY OVERGRAZED.

Land owner/manager:

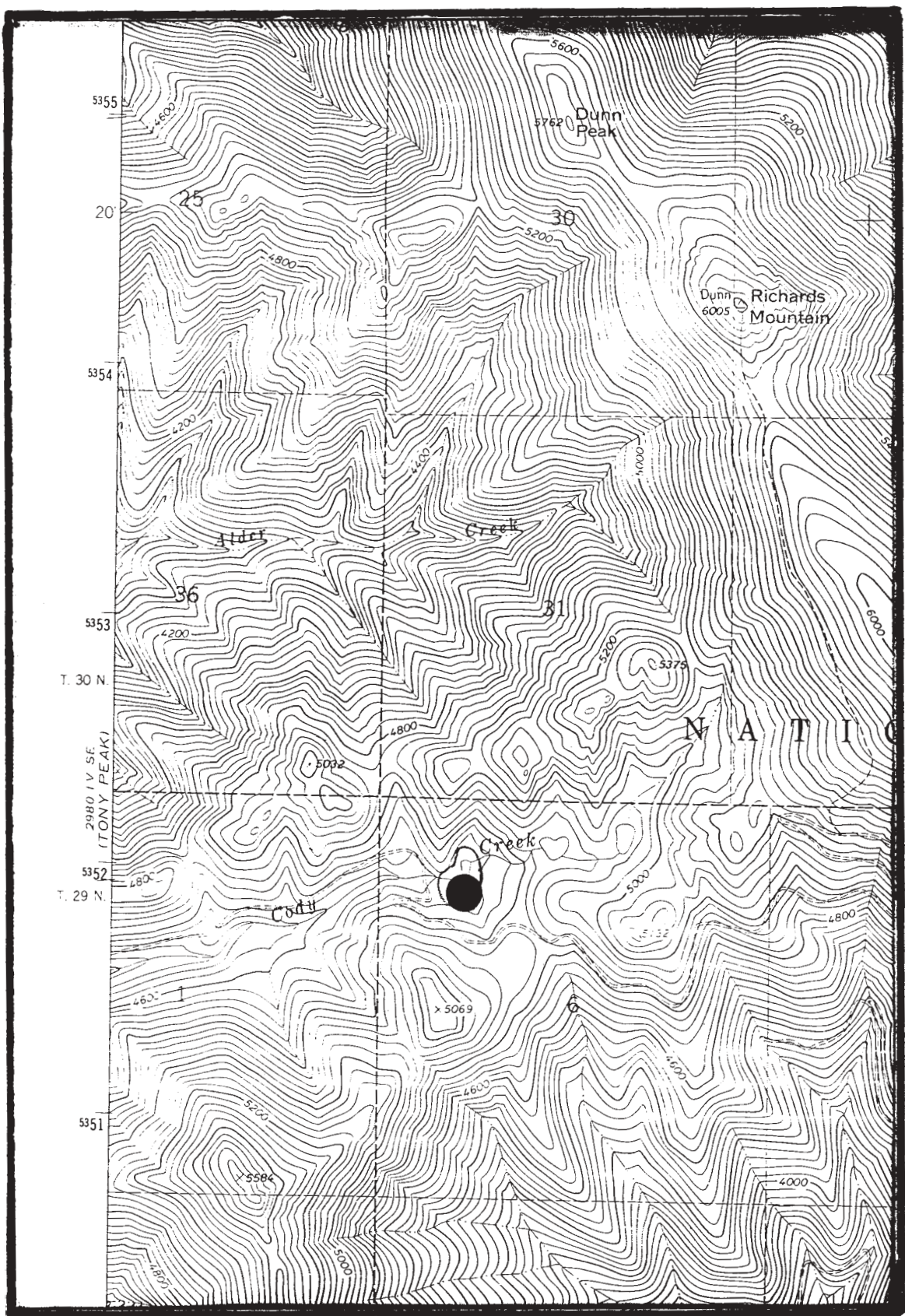
LEWIS & CLARK NATIONAL FOREST, ROCKY MOUNTAIN RANGER
DISTRICT

Comments:

PLANT SURVEY OF SITE WAS CONDUCTED BY S. V. COOPER ON 8
SEPTEMBER 1993.

Information source: REICHEL, J.D. AND S.G. BECKSTROM. 1994.
NORTHERN BOG LEMMING SURVEY: 1993. [UNPUBLISHED REPORT IN
PROGRESS] MONTANA NATURAL HERITAGE PROGRAM. HELENA, MT.

Specimens: to be prepared



011 *Synaptomys borealis*

7.5⁺ USGS Richards Mountain

Scientific Name: SYNAPTOMYS BOREALIS

Common Name: NORTHERN BOG LEMMING

Global rank: G5 Forest Service status: SENSITIVE

State rank: S2 Federal Status:

Element occurrence code: AMAFF17020.011

Element occurrence type:

Survey site name: LOWER CODY LAKE

EO rank:

EO rank comments:

County: LINCOLN

USGS quadrangle: RICHARDS MOUNTAIN

Township: Range: Section: TRS comments:

029N 028W 06 NW4NW4

Precision: S

Survey date: 1993 06 16 Elevation: 4700

First observation: 1993 06 16 Slope/aspect:

Last observation: 1993 06 16 Size (acres): 6

Location:

FROM LIBBY DRIVE EAST ON HWY 37 CA. 12 MILES; IMMEDIATELY AFTER CROSSING THE KOOTENAI TURN RIGHT OF FS RD 530; DRIVE SOUTH FOR CA. 9 MILES TO FS RD 4596. TURN LEFT AND GO UP CA. 7 MILES TO THIRD CROSSING OF CODY CREEK, SITE IS VISIBLE ON THE LEFT. PARK AND WALK 50m EAST OF ROAD TO SITE.

Element occurrence data:

4 MALES (2 SCROTAL, 1 SMALL JUVENILE) CAUGHT DURING 96 TRAP NIGHTS; CAUGHT ON SOUTH AND EAST SIDES OF LAKE.

General site description:

A POND FEN COMPLEX. POND IS BORDERED BY A 10m WIDE AREA OF GRASS/SEDGE WITH THIN SPHAGNUM COVER. THIS IS SURROUNDED BY A 10 20m AREA OF THICK SPHAGNUM, BOG BIRCH AND SUBALPINE FIR. POND IS DEEP (TO 4m). ADJACENT FOREST IS DOMINATED BY SPRUCE, WESTERN LARCH AND DOUGLAS FIR.

Land owner/manager:

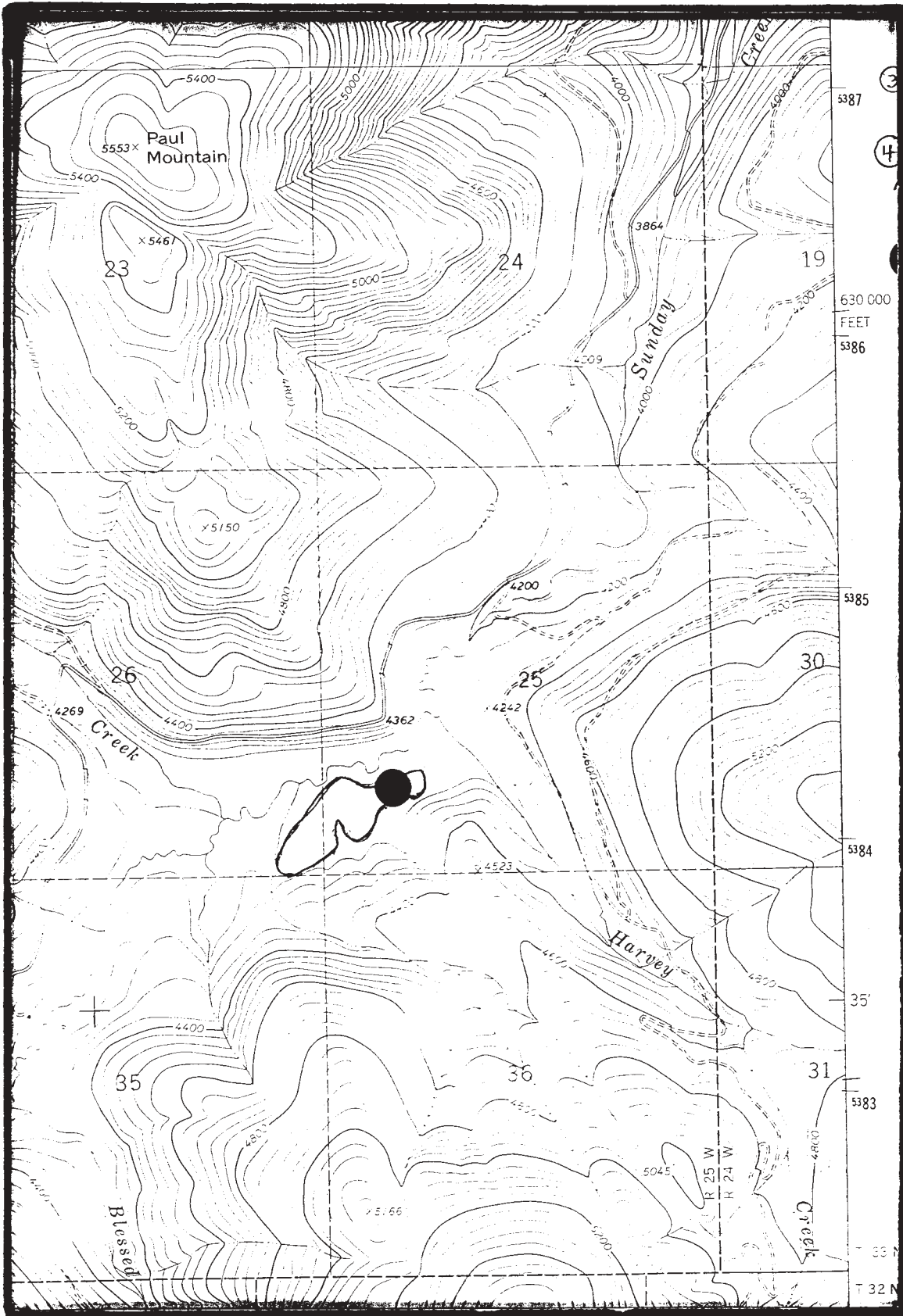
KOOTENAI NATIONAL FOREST, FISHER RIVER RANGER DISTRICT

Comments:

SITE IS WITHIN USFS MANAGEMENT AREA 13 (OLD GROWTH) AND NOT SCHEDULED FOR HARVEST. PLANT SURVEY OF SITE WAS CONDUCTED BY S. CHADDE ON 17 AUGUST 1993. NO SUITABLE HABITAT FOUND DOWNSTREAM; UPSTREAM WAS NOT SURVEYED BUT AIR PHOTOS SHOWED LITTLE, IF ANY, SUITABLE HABITAT.

Information source: REICHEL, J.D. AND S.G. BECKSTROM. 1994. NORTHERN BOG LEMMING SURVEY: 1993. [UNPUBLISHED REPORT IN PROGRESS] MONTANA NATURAL HERITAGE PROGRAM. HELENA, MT.

Specimens: 2 to MSU; 2 to UM



012 *Synaptomys borealis*

7.5[#] USGS Sunday Mountain

Scientific Name: SYNAPTOMYS BOREALIS

Common Name: NORTHERN BOG LEMMING

Global rank: G5 Forest Service status: SENSITIVE

State rank: S2 Federal Status:

Element occurrence code: AMAFF17020.012

Element occurrence type:

Survey site name: SUNDAY CREEK SITE 1

EO rank:

EO rank comments:

County: FLATHEAD

USGS quadrangle: SUNDAY MOUNTAIN

Township: Range: Section: TRS comments:

033N 025W 25 SW4SW4; 26 SE4SE4

Precision: S

Survey date: 1993 08 27 Elevation: 4220

First observation: 1993 08 27 Slope/aspect:

Last observation: 1993 08 27 Size (acres): 21

Location:

SALISH MOUNTAINS. FROM STRYKER TAKE FS RD 315 SOUTHWEST
CA. 6 MILES TO INTERSECTION WITH FS RD 3791. CONTINUE ON
FS RD 315 FOR 0.8 MILE; PARK AND WALK SOUTH 0.1 MILE
(CROSSING SUNDAY CREEK) TO SITE.

Element occurrence data:

ONE ADULT MALE CAUGHT DURING 46 TRAP NIGHTS. MAY BE PART
OF A SINGLE LARGE OCCURRENCE, ENCOMPASSING MTHP RECORDS
6 AND 12 14.

General site description:

A RELATIVELY OPEN FEN STREAM BEAVER POND COMPLEX. BEST
HABITAT IS IN AREA 100 x 300m WITH LARGE SPHAGNUM MOUND,
BOG BIRCH, SMALL MEDIUM SPRUCE AND DWARF WILLOW. AREA
IS VERY WET, WITH STANDING WATER BETWEEN MOUNDS.
CLEARCUT ON THE HILLSIDE ABOVE SITE, EXTENDING INTO THE
RIPARIAN AREA. CURRENT BEAVER USE; ADJACENT MEADOW IS
BADLY OVERGRAZED.

Land owner/manager:

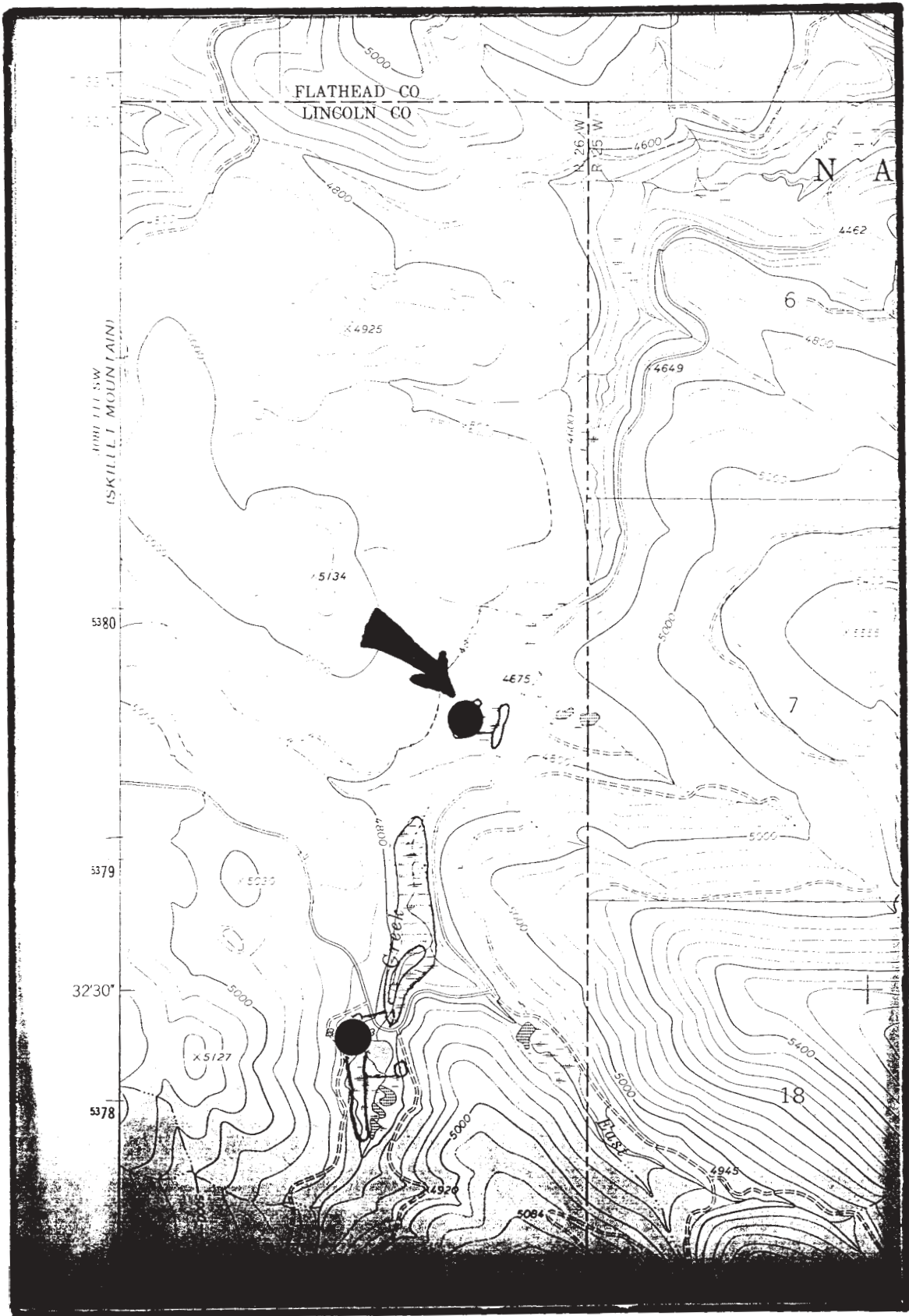
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE) KOOTENAI
NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:

BOUNDARY UNCERTAIN; SITE MAY BE ON BOTH PRIVATE AND
KOOTENAI NATIONAL FOREST LAND. MAPPED POINT IS
CAPTURE SITE.

Information source: REICHEL, J.D. AND S.G. BECKSTROM. 1994.
NORTHERN BOG LEMMING SURVEY: 1993. [UNPUBLISHED REPORT IN
PROGRESS] MONTANA NATURAL HERITAGE PROGRAM. HELENA, MT.

Specimens: to be prepared



013 *Synaptomys borealis*

USGS 7.5' Sunday Mountain

Scientific Name: SYNAPTOMYS BOREALIS

Common Name: NORTHERN BOG LEMMING

Global rank: G5 Forest Service status: SENSITIVE

State rank: S2 Federal Status:

Element occurrence code: AMAFF17020.013

Element occurrence type:

Survey site name: SUNDAY CREEK SITE 6

EO rank:

EO rank comments:

County: LINCOLN

USGS quadrangle: SUNDAY MOUNTAIN

Township: Range: Section: TRS comments:

032N 026W 12 N2SE4

Precision: S

Survey date: 1993 08 29 Elevation: 4680

First observation: 1993 08 29 Slope/aspect:

Last observation: 1993 08 29 Size (acres): 5

Location:

SALISH MOUNTAINS. FROM STRYKER TAKE FS RD 315 SOUTHWEST
CA. 14 MILES TO CA. 1 MILE BEFORE INTERSECTION WITH FS RD
3708. SITE IS VISIBLE JUST OFF ROAD ON THE RIGHT (WEST).

Element occurrence data:

ONE ADULT MALE CAUGHT DURING 46 TRAP NIGHTS. MAY BE PART
OF A SINGLE LARGE OCCURRENCE, ENCOMPASSING MTHP
RECORDS 6 AND 12 14.

General site description:

SITE ADJOINS AN OLD BEAVER AREA WITH THICK SEDGES, GRASSES AND
WILLOW BUT NO SPHAGNUM. SITE BORDERS THE BEAVER AREA TO THE EAST
AND WEST BY SEEPS AND SPRINGS, WITH SPHAGNUM MAT, BOG BIRCH,
SEDGES AND SPRUCE.

Land owner/manager:

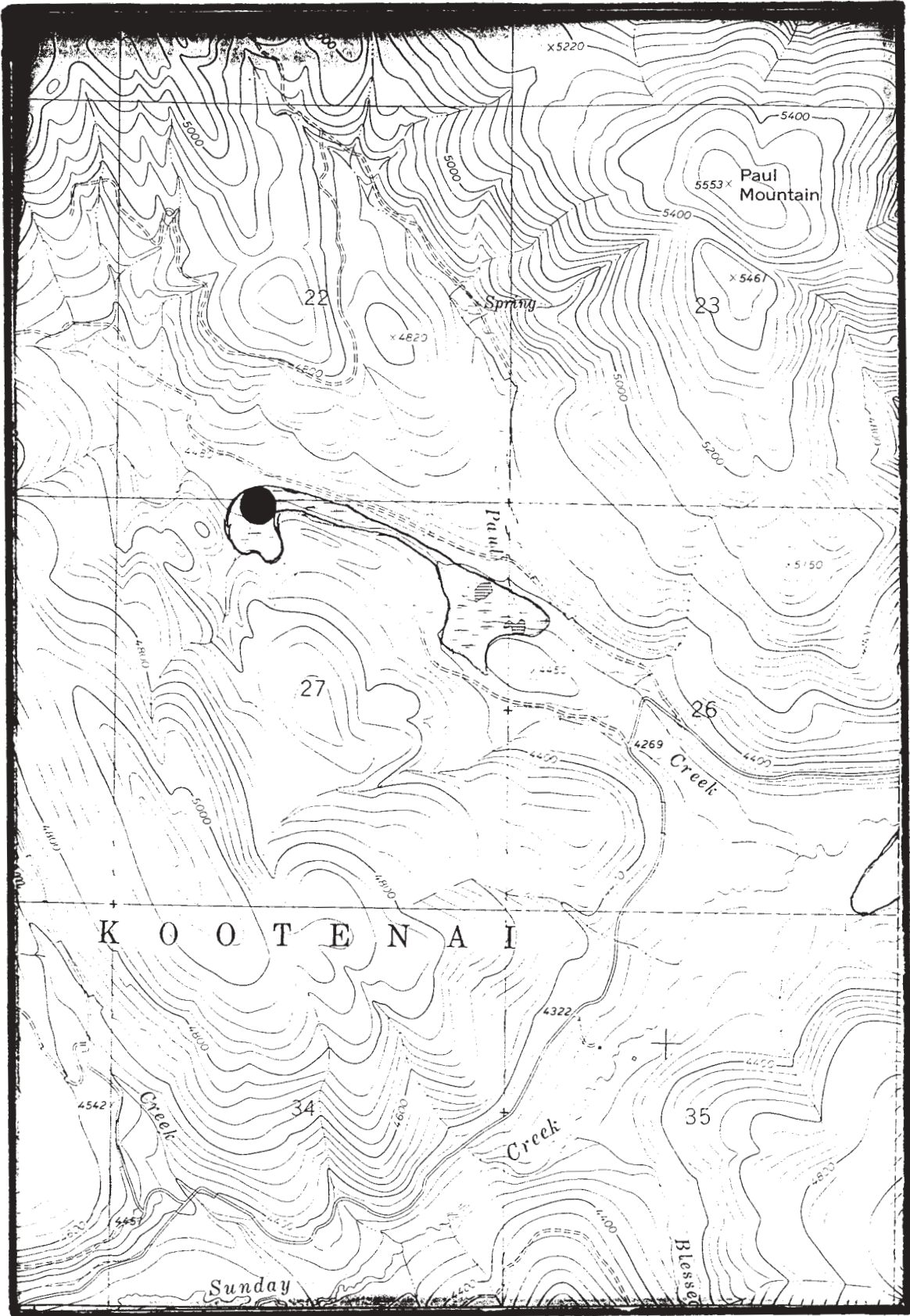
KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:

POINT MAPPED IS CAPTURE SITE; IMMEDIATE HABITAT (CA. 50 x
20m EAST SIDE, 150 x 50m WEST SIDE) CONSTITUTES
OCCURRENCE.

Information source: REICHEL, J.D. AND S.G. BECKSTROM. 1994.
NORTHERN BOG LEMMING SURVEY: 1993. [UNPUBLISHED REPORT IN
PROGRESS] MONTANA NATURAL HERITAGE PROGRAM. HELENA, MT.

Specimens: to be prepared



014 *Synaptomys borealis*

7.5' USGS Sunday Mountain

Scientific Name: SYNAPTOMYS BOREALIS

Common Name: NORTHERN BOG LEMMING

Global rank: G5 Forest Service status: SENSITIVE

State rank: S2 Federal Status:

Element occurrence code: AMAFF17020.014

Element occurrence type:

Survey site name: PAUL CREEK

EO rank:

EO rank comments:

County: FLATHEAD

USGS quadrangle: SUNDAY MOUNTAIN

Township: Range: Section: TRS comments:

033N 025W 27 N2; 26 NW4; 22 SE4SW4

Precision: S

Survey date: 1993 08 29 Elevation: 4400 - 4480

First observation: 1993 08 29 Slope/aspect:

Last observation: 1993 08 29 Size (acres): 58

Location:

SALISH MOUNTAINS. FROM STRYKER TAKE FS RD 315 SOUTHWEST CA. 7 MILES TO INTERSECTION WITH FS RD 3525; TURN RIGHT AND GO CA. 1.3 MILES. SITE IS VISIBLE ON THE LEFT (SOUTH).

Element occurrence data:

ONE ADULT FEMALE (PERFORATED) CAUGHT IN 215 TRAP NIGHTS. MAY BE PART OF A SINGLE LARGE OCCURRENCE, ENCOMPASSING MTHP RECORDS 6 AND 12 14.

General site description:

HABITAT FOR LEMMINGS APPEARS ONLY FAIR. BEAVER POND FEN MEADOW COMPLEX. AREA VERY WET, WITH THIN, SCATTERED SPHAGNUM MOUNDS, BOG BIRCH, SEDGES, AND SOME SPRUCE. HUGE AREAS UPSLOPE HAVE BEEN CLEARCUT, IN SOME PLACES DOWN INTO THE RIPARIAN AREA.

Land owner/manager:

KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:

POINT MAPPED IS CAPTURE SITE. AREA LACKED BEAVER DURING SURVEY IN 1992 AND WAS MUCH DRIER OVERALL WITH SPHAGNUM BROWN AND DYING/DEAD OVER MUCH OF THE AREA. AREA SEEMS TO BE RECOVERING WITH RETURN OF THE BEAVER.

Information source: REICHEL, J.D. AND S.G. BECKSTROM. 1994. NORTHERN BOG LEMMING SURVEY: 1993. [UNPUBLISHED REPORT IN PROGRESS] MONTANA NATURAL HERITAGE PROGRAM. HELENA, MT.

Specimens: to be prepared