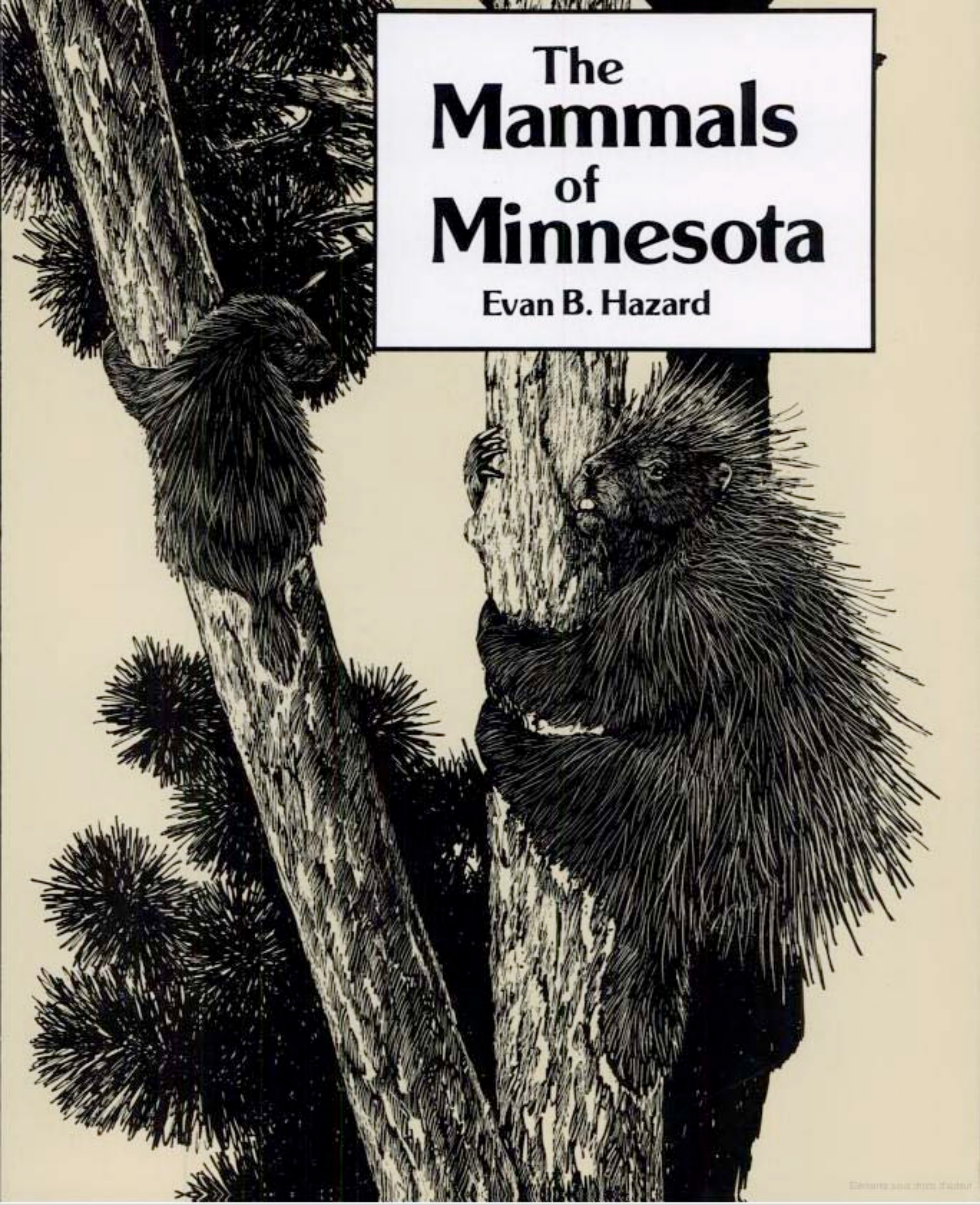


A detailed black and white illustration of two porcupines on a tree trunk. One porcupine is on the left, facing right, with its body angled upwards. The other is on the right, facing left, with its body angled downwards. Both animals have long, dense quills. The tree trunk is textured with bark, and there are some pine-like branches with needles visible on the left side.

The Mammals of Minnesota

Evan B. Hazard

Table of Contents

Acknowledgments vii

Introduction 3

Accounts of Species 13

Order Polyprotodonta (Opossums and
Allies) 17

Family Didelphidae (New World
Opossums) 17

Order Insectivora (Insectivores) 20

Family Soricidae (Shrews) 20

Family Talpidae (Moles) 28

Order Chiroptera (Bats) 32

Family Vespertilionidae (Vespertilionid
Bats) 32

Order Lagomorpha (Rabbits, Hares, and
Pikas) 43

Family Leporidae (Rabbits and Hares) 43

Order Rodentia (Rodents) 51

Family Sciuridae (Squirrels) 51

Family Geomyidae (Pocket Gophers) 74

Family Heteromyidae (Pocket Mice and
Kangaroo Rats) 78

Family Castoridae (Beaver) 79

Family Cricetidae (New World Rats and
Mice, and Voles and Lemmings) 82

Subfamily Cricetinae (New World Rats
and Mice) 83

Subfamily Microtinae (Voles and
Lemmings) 89

Family Muridae (Old World Rats and
Mice) 102

Family Zapodidae (Jumping Mice) 105

Family Erethizontidae (Arboreal, or New
World, Porcupines) 109

Order Carnivora (Carnivores) 113

Family Canidae (Dogs) 113

Family Ursidae (Bears) 124

Family Procyonidae (Raccoons and
Allies) 127

Family Mustelidae (Weasels and
Allies) 129

Family Felidae (Cats) 149

Order Artiodactyla (Even-toed
Ungulates) 155

Family Cervidae (Deer) 155

Family Antilocapridae (Pronghorns) 166

Family Bovidae (Cattle and Allies) 168

Domestic and Feral Mammals 170

Keys to Minnesota Mammals 175

Key to Adult Skins and Whole
Specimens 177

Key to Skulls 184

Appendixes

Subspecies List 199

Glossary 201

Bibliography 215

Index 275

List of Figures

1. Skull of *Didelphis virginiana*, Virginia opossum. 18
2. *Didelphis virginiana*, Virginia opossum. 19
3. Skull of *Sorex palustris*, water shrew. 22
4. *Sorex palustris*, water shrew. 23
5. *Sorex arcticus*, arctic shrew. 24
6. Skull of *Blarina brevicauda*, short-tailed shrew. 25
7. *Blarina brevicauda*, short-tailed shrew. 27
8. Skull of *Condylura cristata*, star-nosed mole. 30
9. *Condylura cristata*, star-nosed mole. 31
10. *Myotis lucifugus*, little brown myotis. 34
11. Skull of *Eptesicus fuscus*, big brown bat. 38.
12. Skull of *Lasiurus borealis*, red bat. 39
13. *Lasiurus cinereus*, hoary bat. 42
14. *Sylvilagus floridanus*, eastern cottontail. 45
15. Skull of *Lepus townsendii*, white-tailed jackrabbit. 48
16. *Lepus townsendii*, white-tailed jackrabbit. 49
17. Skull of *Tamias striatus*, eastern chipmunk. 52
18. *Tamias striatus*, eastern chipmunk. 53
19. Skull of *Marmota monax*, woodchuck. 56
20. *Marmota monax*, woodchuck. 57
21. Skull of *Spermophilus richardsonii*, Richardson's ground squirrel. 58
22. *Spermophilus richardsonii*, Richardson's ground squirrel. 59
23. Skull of *Spermophilus tridecemlineatus*, thirteen-lined ground squirrel. 60
24. *Spermophilus tridecemlineatus*, thirteen-lined ground squirrel. 62
25. *Sciurus carolinensis*, gray squirrel. 65
26. Skull of *Sciurus niger*, fox squirrel. 67
27. Skull of *Tamiasciurus hudsonicus*, red squirrel. 69
28. *Tamiasciurus hudsonicus*, red squirrel. 70
29. *Glaucomys volans*, southern flying squirrel. 72
30. Skull of *Glaucomys sabrinus*, northern flying squirrel. 73
31. Skull of *Geomys bursarius*, plains pocket gopher. 76
32. *Geomys bursarius*, plains pocket gopher. 77
33. *Perognathus flavescens*, plains pocket mouse. 79
34. Skull of *Castor canadensis*, beaver (young adult). 80
35. *Castor canadensis*, beaver. 81
36. Skull of *Reithrodontomys megalotis*, western harvest mouse. 83
37. *Peromyscus maniculatus gracilis*, woodland deer mouse. 86
38. Skull of *Peromyscus leucopus*, white-footed mouse. 87
39. *Onychomys leucogaster*, northern grasshopper mouse. 89
40. Skull of *Microtus pennsylvanicus*, meadow vole. 92
41. *Microtus chrotorrhinus*, rock vole. 94
42. Skull of *Ondatra zibethicus*, muskrat. 97
43. Skull of *Synaptomys cooperi*, southern bog lemming. 100
44. *Synaptomys cooperi*, southern bog lemming. 101
45. *Rattus norvegicus*, Norway rat. 103
46. Skull of *Mus musculus*, house mouse. 104
47. Skull of *Zapus hudsonius*, meadow jumping mouse. 106
48. *Zapus hudsonius*, meadow jumping mouse. 107
49. Skull of *Napaeozapus insignis*, woodland jumping mouse. 108
50. Skull of *Erethizon dorsatum*, porcupine. 109
51. *Erethizon dorsatum*, porcupine. 111
52. *Canis latrans*, coyote. 115
53. Skull of *Canis lupus*, wolf. 116

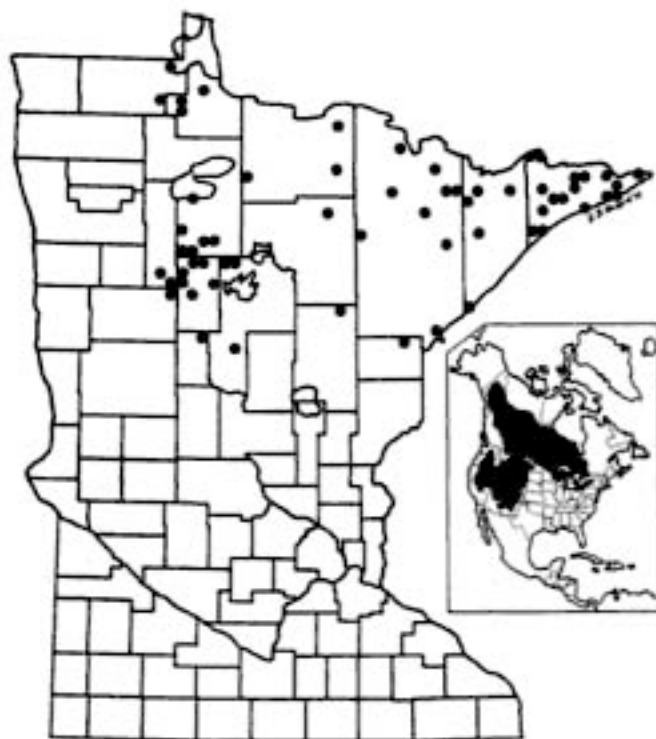
54. *Canis lupus*, wolf. 118
55. Skull of *Vulpes vulpes*, red fox. 120
56. *Vulpes vulpes*, red fox, and *Philohela minor*, American woodcock. 121
57. Skull of *Urocyon cinereoargenteus*, gray fox. 122
58. Skull of *Ursus americanus*, black bear. 124
59. *Ursus americanus*, black bear. 125
60. Skull of *Procyon lotor*, raccoon. 127
61. *Procyon lotor*, raccoon. 128
62. *Martes americana*, marten, and *Clethrionomys gapperi*, red-backed vole. 131
63. Skull of *Martes pennanti*, fisher. 132
64. Skull of *Mustela erminea*, ermine. 133
65. *Mustela frenata*, long-tailed weasel, and *Zapus hudsonius*, meadow jumping mouse. 136
66. Skull of *Mustela vison*, mink. 137
67. *Mustela vison*, mink. 139
68. Skull of *Gulo gulo*, wolverine. 140
69. Skull of *Taxidea taxus*, badger. 141
70. *Taxidea taxus*, badger. 142
71. *Spilogale putorius*, eastern spotted skunk, and *Picoides villosus*, hairy woodpecker. 144
72. Skull of *Mephitis mephitis*, striped skunk. 145
73. *Lutra canadensis*, river otter. 148
74. Skull of *Lynx canadensis*, Canada lynx. 151
75. *Lynx canadensis*, Canada lynx, and *Lepus americanus*, snowshoe hare. 152
76. Skull of *Odocoileus virginianus*, white-tailed deer. 160
77. Skull of *Alces alces*, moose. 162
78. *Alces alces*, moose. 164
79. *Bison bison*, bison. 169
80. Skull of *Equus caballus*, domestic horse. 170
81. Rear of right mandible of *Didelphis virginiana*. 184
82. Diagrammatic outlines of the front upper dentitions of five shrews. 186
83. Ventral views of mandibles of *Marmota monax* and *Erethizon dorsatum*. 188
84. Left M1 of *Peromyscus maniculatus gracilis* and *Mus musculus*. 189
85. Front of palate of *Peromyscus maniculatus gracilis* and *P. leucopus*. 190
86. Diagrams of selected cheek teeth of microtines, excluding *Ondatra*. 191
87. Underside of skulls of *Lynx canadensis* and *L. rufus*. 192
88. Oblique ventral view of *Canis lupus* skull. 192
89. Palate of *Canis lupus*. 193

List of Maps

1. Presettlement vegetation types in Minnesota. 7
2. Minnesota counties. 14
3. Minnesota townships. 15
4. Distribution of *Didelphis virginiana*. 18
5. Distribution of *Sorex cinereus*. 21
6. Distribution of *Sorex palustris*. 22
7. Distribution of *Sorex arcticus*. 23
8. Distribution of *Microsorex hoyi*. 25
9. Distribution of *Blarina brevicauda*. 26
10. Distribution of *Scalopus aquaticus*. 29
11. Distribution of *Condylura cristata* and *Cryptotis parva*. 30
12. Distribution of *Myotis lucifugus*. 34
13. Distribution of *Myotis keenii*. 35
14. Distribution of *Lasionycteris noctivagans*. 36
15. Distribution of *Pipistrellus subflavus*. 37
16. Distribution of *Eptesicus fuscus*. 38
17. Distribution of *Lasiurus borealis*. 40
18. Distribution of *Lasiurus cinereus*. 41
19. Distribution of *Sylvilagus floridanus*. 44

xii Contents

20. Distribution of *Lepus americanus*. 46
21. Distribution of *Lepus townsendii*. 48
22. Distribution of *Tamias striatus*. 52
23. Distribution of *Eutamias minimus*. 55
24. Distribution of *Marmota monax*. 56
25. Distribution of *Spermophilus richardsonii*. 59
26. Distribution of *Spermophilus tridecemlineatus*. 61
27. Distribution of *Spermophilus franklinii*. 63
28. Distribution of *Sciurus carolinensis*. 64
29. Distribution of *Sciurus niger*. 67
30. Distribution of *Tamiasciurus hudsonicus*. 69
31. Distribution of *Glaucomys sabrinus*. 74
32. Distribution of *Thomomys talpoides* and *Glaucomys volans*. 75
33. Distribution of *Geomys bursarius*. 76
34. Distribution of *Castor canadensis*. 80
35. Distribution of *Peromyscus maniculatus bairdii*. 84
36. Distribution of *Peromyscus maniculatus gracilis* and *Reithrodontomys megalotis*. 85
37. Distribution of *Peromyscus leucopus*. 87
38. Distribution of *Onychomys leucogaster*. 88
39. Distribution of *Clethrionomys gapperi*. 90
40. Distribution of *Microtus pennsylvanicus*. 93
41. Distribution of *Phenacomys intermedius* and *Microtus ochrogaster*. 95
42. Distribution of *Microtus chrotorrhinus* and *Microtus pinetorum*. 96
43. Distribution of *Ondatra zibethicus*. 98
44. Distribution of *Synaptomys cooperi*. 100
45. Distribution of *Synaptomys borealis* and *Perognathus flavescens*. 102
46. Distribution of *Rattus norvegicus*. 103
47. Distribution of *Mus musculus*. 105
48. Distribution of *Zapus hudsonius*. 106
49. Distribution of *Napaeozapus insignis*. 108
50. Distribution of *Erethizon dorsatum*. 109
51. Distribution of *Canis latrans*. 114
52. Distribution of *Canis lupus*. 117
53. Distribution of *Vulpes vulpes*. 120
54. Distribution of *Urocyon cinereoargenteus*. 123
55. Distribution of *Ursus americanus*. 125
56. Distribution of *Procyon lotor*. 127
57. Distribution of *Martes americana*. 130
58. Distribution of *Martes pennanti*. 132
59. Distribution of *Mustela erminea*. 134
60. Distribution of *Mustela nivalis*. 135
61. Distribution of *Mustela frenata*. 136
62. Distribution of *Mustela vison*. 138
63. One twentieth-century township specimen of *Gulo gulo*. 140
64. Distribution of *Taxidea taxus*. 142
65. Distribution of *Spilogale putorius*. 144
66. Distribution of *Mephitis mephitis*. 146
67. Distribution of *Lutra canadensis*. 147
68. Distribution of *Lynx canadensis*. 151
69. Distribution of *Lynx rufus*. 153
70. Distribution of *Cervus elaphus*. 156
71. Distribution of *Odocoileus hemionus*. 158
72. Distribution of *Odocoileus virginianus*. 159
73. Distribution of *Alces alces*. 163
74. Distribution of *Rangifer tarandus*. 165
75. Sightings of *Antilocapra americana* by the Minnesota Department of Natural Resources. 167
76. Selected sites of old *Bison* bones, both *B. bison* and the extinct *B. occidentalis*. 168



Map 23. Distribution of *Eutamias minimus*. ● = township specimens, selected locations. (Map produced by the Department of Biology, Bemidji State University.)

United States. There are many other species of the genus *Eutamias* in western North America, and others in Eurasia. (Some mammalogists consider *Eutamias* a subgenus of *Tamias*.)

Eutamias minimus is common in the boreal forest region of north central and northeastern Minnesota, often occurring in the same general areas as *Tamias*. The least chipmunk, however, is more partial to conifers, and particularly to open, dry, or disturbed areas within the coniferous forest biome (Forbes 1966c). It is less likely to be found under dense shrub cover or in mature closed forest than is the eastern chipmunk.

Natural History: The habits of least chipmunks, so far as we know, differ little from those of eastern chipmunks. Although least chipmunks are solitary, they are reported to be less aggressively territorial than eastern chipmunks (Jackson 1961). Least chipmunks are diurnal, omnivorous, and primarily terrestrial. Both species will climb trees on occasion, and both have been

known to nest above ground (Broadbooks 1974; Genoways and Jones 1972). Broadbooks (1977) suggests that *Eutamias* females typically move their litters from a ground nest to a tree nest before the young disperse. *Eutamias minimus* feeds on a variety of plant and animal matter but is particularly fond of various seeds and nuts, and of insects and their eggs and larvae (Criddle 1943; Vaughan 1974). It doubtless feeds on some birds and their eggs. Like *Tamias*, it hibernates next to a substantial underground store of seeds which it has transported in its cheek pouches (Forbes 1966c).

The least chipmunk has a gestation period of 28-30 days. In Minnesota, the litter of four to seven young probably arrives most often from mid-May to early June (Forbes 1966a). Second litters may be less common than they are in eastern chipmunks; the chances of producing a second litter are greatest when the first litter is lost shortly after birth (Skryja 1974).

Relationship to People: In Minnesota, least chipmunks occur less commonly in association with people than do eastern chipmunks. They may occasionally damage garden crops or stored food but are likely to compensate for this by feeding on pests such as cutworms.

Additional References: Aldous 1941; Beuch, Siderits, et al. 1977; Ellis and Maxson 1979; Guilday and Hamilton 1978; Iverson et al. 1967; C. E. Johnson 1922; Manville 1949; Martinsen 1968; Meredith 1977; Nadler et al. 1977; Peterson 1966; Sheppard 1968, 1972a; Sutton and Nadler 1969; Wydeven and Wydeven 1976.

Genus *Marmota* Marmots

Marmots are widespread in Eurasia and North America. Most species inhabit open country at high altitudes in mountainous regions. The woodchuck, as a denizen of wooded and brushy habitats at relatively low altitudes, is unique within the genus.

*Marmota monax***Woodchuck, Ground Hog**

Measurements: Total length 536 (501–594); tail 117 (95–140); hind foot 78 (70–85); ear from notch 27 (19–30); weight 1,985–4,167.

Description: The woodchuck is Minnesota's largest squirrel. It is stocky, with short ears, short legs, and a medium-length, somewhat bushy tail. There is much individual variation in pelage, but most woodchucks have a salt-and-pepper appearance on the top and sides, resulting from guard hairs with alternate light and dark bands overlying yellowish-tipped underfur. The top of the head is dark, and the underside and upper parts of the legs are reddish brown. The feet are black. Occasional individuals are totally black. The skull is distinguished by a flattened or depressed area between the orbits. In contrast to other squirrels, the enamel on the front of the upper incisors has little or no pigment. The tooth formula is $1/1, 0/0, 2/1, 3/3 \times 2 = 22$.

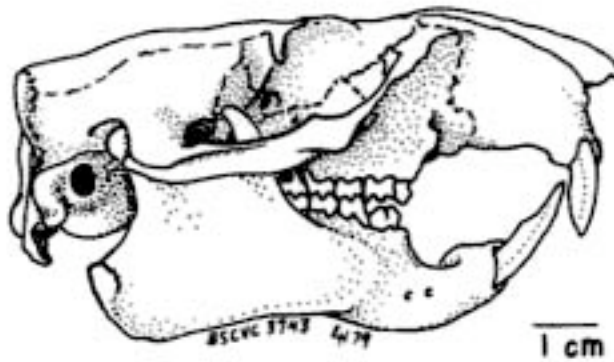


Figure 19. Skull of *Marmota monax*, woodchuck, BSCVC 3743.

Range and Habitat: *Marmota monax* ranges from the eastern seaboard of Canada and the United States (except for the Deep South) west and northwest within forested regions into the Yukon. It is primarily a mammal of woodlands, both coniferous and deciduous, though more characteristic of open woodlands, clearings, and edges than of deep unbroken forest. The wood-



Map 24. Distribution of *Marmota monax*. ● = township specimens. ○ = other township records, selected locations. (Map produced by the Department of Biology, Bemidji State University.)

chuck became more abundant in the deciduous and coniferous forest biomes after clearing and settling. Woodchucks do so well in some farming areas that they are often thought of as open country mammals, but they are seldom found far from woods or brush and are not characteristic of unbroken prairie.

Natural History: *Marmota monax* is relatively solitary; all other members of the genus are colonial (Barash 1974b; Bronson 1963, 1964; Merriam 1971). Each adult has an extensive burrow with one main entrance and one or more plunge holes; the latter are usually well hidden in brush (Grizzell 1955). Summer dens may be in the woods or in adjacent fields, and are most often on well-drained slopes (Doucet et al. 1974; Merriam 1966, 1971). In Minnesota most woodchucks probably enter hibernation in October, the older, fatter animals hibernating first. The hibernaculum is usually a woodland den with a single opening (Grizzell 1955). Woodchucks