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Vol. 10, No. 3 September 1978

TABLE OF CONTENTS

THE COVER AND ITS ARTIST

The creator of this issue's cover illustration is Nan Marie Kane from Stacy, Minnesota. At the age of twenty-four Nan has nearly completed her degree in wildlife management from the University of Minnesota. Nan's experiences with wildlife extend far beyond her formal education to many hours as a preparator of the university's mammal collection, participation in wildlife-oriented projects involving wolves and raptors, and numerous observations of the abundant wildlife of northwestern Wyoming. She maintains a great interest in falconry. During the summer of 1978, Nan will be employed by the U.S. Fish and Wildlife Service monitoring the breeding and other behavior of migratory birds and mammals in Prince William Sound, Alaska.

The pronghorn antelope (*Antilocapra americana*) gregariously ranges across the middle and western plains from the Dakotas and Oklahoma to northern Mexico and southern Canada.

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Notes on Distribution of Three Species of Mammals in South Dakota

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No definitive account of the mammals of South Dakota has been published and, therefore, the distribution of species occurring in that state is relatively poorly documented save for several geographically restricted faunal studies (Andersen and Jones 1971, on Harding County, Findley 1956, on Clay County, and Turner 1974, on the Black Hills, for example). Our own work in South Dakota began almost two decades ago, but in recent years has focued primarily on the unique environmental area in southern Bennett County. Three species of mammals for which we have important unpublished distributional records from the state are the eastern mole, the woodchuck, and the plains pocket gopher, and these data are herein reported.

Measurements are given in millimeters and weights in grams. Specimens listed by catalogue number have been examined by the authors and are housed in the following institutions: Museum of Natural History, The University of Kansas (KU); Museum of the High Plains, Fort Hays State University (MHP); Museum of Zoology, University of Michigan (UMMZ); University of South Dakota, Vermillion (USD); National Museum of Natural History, including the collections of the U.S. Biological Survey (USNM). We are grateful to those in charge of these several collections for making specimens available to us for study.

Scalopus aquaticus, Eastern Mole

Two subspecies of *Scalopus aquaticus* occur in South Dakota, only one of which has been reported by name from the state. Jackson (1915) listed specimens of *S. a. machrinoides* from the mouth of the Big Sioux River and from Vermillion, and Findley (1956) also reported material from Vermillion. Additionally, Thurston (1942) noted the occurrence of the species in Minnehaha County and Reagan (1908) recorded it as "Not abundant" on the Rosebud Indian Reservation. Actually, this mole probably occurs in suitable habitat throughout much of the southern part of South Dakota (see Fig. 1), north at least to Minnehaha and McCook counties in the east and possibly to the eastern part of the White River drainage in the west.

Scalopus aquaticus machrinoides Jackson, 1914.—This subspecies is restricted in South Dakota to the southeastern part of the state. Records of occurrence are as follows: Vermillion, Clay County (Jackson 1915:46; Findley 1956:21); Sioux Falls, Minnehaha County (Thurston 1942:113); Canistota, McCook County (USD, specimen examined for us by R. W. Turner); mouth of Big Sioux River, Union County (USNM 1760), and Union County State Park, 9½ mi. N and 7½ mi. E Vermillion, 1200 ft. (KU 101644).

Jackson (*loc. cit.*) noted that specimens from Vermillion available to him were "distinctly paler" than typical *S. a. machrinoides* and in this regard approached *S. a. caryi*, the subspecies to the west. This situation also prevails in specimens we have examined, but they are referable to *machrinoides* on the basis of large size. For example, an adult male (KU 101644) from Union County has the following measurements: total length, 184; length of tail, 35; length of hind foot, 24; greatest length of skull, 37.5; mastoid breadth, 20.0; weight, 118.2. Corresponding measurements of five adult *S. a. caryi* (see following acount), a male and female from Bon Homme County and a male and female from Bennett County, are, respectively: 174, 168, 170, 160, 163; 29, 27, 27, 24, 28; 24.5, 23, 22, 21, 21; 36.0, 35.8, 34.8, 34.5, 34.7; 18.3, 18.5, 17.4, 17.7, 17.7; 82.5, 75.8, 74.4, 69.5, 76.6. As is to be expected, the specimens from Bon Homme County are somewhat larger than are those from Bennett County, indicative of the eastward trend toward larger size across southern South Dakota and indicative also of intergradation between the subspecies *machrinoides* and *caryi*. A specimen taken on 4 June 1965 in Union County was in the process of molting from winter to summer pelage.

Scalopus aquaticus caryi Jackson, 1914.—This small, pale subspecies of the eastern mole has not been reported previously by name from South Dakota. It occurs westward along the southern border of the state (Fig. 1) at least as far as the vincinity of Lacreek National Wildlife Refuge in Bennett County. To the north, it is tempting to speculate that *S. aquaticus* reaches the White River along the valleys of the several streams of that drainage with headwaters in Bennett and Todd counties, but our field work thus far has not revealed it there. In western South Dakota, the distribution is limited to suitable habitats along streams and rivers, and other mesic situations.

Records of occurrence are from Sand Creek Park, 4 mi. NE Springfield, Bon Homme County (KU 101641-43), Rosebud Indian Reservation, Todd County (Reagan 1908:163), and from the following locations in Bennett County: 4 mi. S and 8 mi. E Martin, 3050 ft. (KU 109890); 6½ mi. S and 3½ mi. E Martin (MHP 13126); 7 mi. S Martin, 3100 ft. (KU 109891); 7 mi. S Tuthill (MHP 13127).

Marmota monax, Woodchuck

The woodchuck possibly occurs in many of the easternmost counties of South Dakota and its presence there well may be known to local biologists. Nevertheless, we are unaware of any report of this species from the state in the primary literature of mammalogy, although it long has been known from adjacent parts of Iowa, Minnesota, Nebraska, and North Dakota, and Findley (1956:30) mentioned the possible occurrence of woodchucks in Clay County. In the summer of 1965, Percy L. Clifton, then a field representative of the Museum of Natural

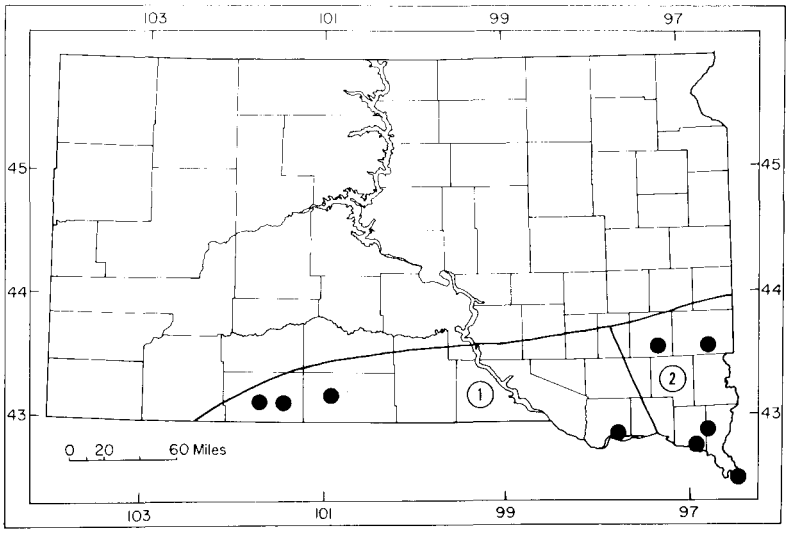

Fig. 1. Distribution in South Dakota of the eastern mole, *Scalopus aquaticus*: 1, *S. a. caryi*; 2, *S. a. machrinoides*. See text for list of records of occurrence, some of which are not plotted because crowding of symbols on the map would have resulted.

History at The University of Kansas, collected one adult female in each of the extreme southeastern and northeastern counties of South Dakota, thus establishing certainly the occurrence of *Marmota monax* in the state. On the basis of their characteristics, and also based on the reported geographic distribution of races in adjacent states, we herein assign the two specimens obtained by Clifton to different subspecies as detailed below.

Marmota monax monax (Linnaeus, 1758).—Even though Jones (1964:121-124) tentatively assigned woodchucks from south of the Missour River in eastern Nebraska to the subspecies *bunkeri*, a specimen from Union County State Park, 9½ mi. N and 7½ mi. E Vermillion (KU 101696), seems best referable to *M. m. monax*. It is noteworthy also that Bowles (1975:63-65) employed the subspecific name *monax* for woodchucks from throughout Iowa and implied that systematic analysis was needed for populations in at least the western part of the range of the species. Because the Missouri River evidently provides no distributional barrier for either of the fossorial species discussed in this paper, and is not a demarcation between subspecies in at least one of those species, it seems unlikely that the river is of import in terms of inhibiting gene flow between populations of *M. monax*.

Selected measurements of the female from Union County, followed by those of a female representing the subspecies *rufescens* from Roberts County (See below), both adults of which the latter is the older on the basis of tooth wear, are as follows: total length, 567, 570; length of tail, 135, 130; length of hind foot, 86,80; condylobasal length, 91.0, 85.5; zygomatic breadth, 62.9, 58.5; mastoid breadth, 44.1, 40.2; length of maxillary toothrow, 20.0, 19.3. The smaller size of the specimen of *rufescens* accords with the description and measurements of that subspecies given by Howell (1915).

Marmonta monax rufescens Howell, 1914.—A specimen from Hartford Beach State Park, on the southern border of Big Stone Lake in southeastern Roberts County (KU 101697), provides the first record from South Dakota of this subspecies (see previous account). P. L. Clifton recorded in his field notes that this female had half-grown young on 22 June 1965 and that woodchucks were commonly observed in the area.

Geomys bursarius, Plains Pocket Gopher

Although the plains pocket gopher long has been known from eastern and southern South Dakota (see Merriam 1895, for example) its distribution in the state has not been well documented. *Geomys bursarius* evidently is restricted in South Dakota (Fig. 2) to the loess, till, and sandy prairie soils of the eastern part of the state and to West River counties in, and to the south of, the White River drainage, as well as in the drainage of the Cheyenne River in the extreme southwestern part of the state. Most other areas in South Dakota are occupied by a competing species of pocket gopher, *Thomomys talpoides*, the distribution of which generally does not overlap that of *G. bursarius*. Three nominal subspecies of the plains pocket gopher occur in South Dakota.

Geomys bursarius bursarius (Shaw, 1800).—Populations of the plains pocket gopher in northeastern and east-central South Dakota are assignable to *G. b. bursarius* on the basis of the currently understood limits of distribution and characters of the several subspecies thought to occur in the state. Differentiation between the subspecies *bursarius* and *majusculus* has not been well documented, however, and the systematic relationship of these two races thus is poorly understood. Bowles (1975:79-81) assigned all *G. bursarius* from Iowa to *majusculus* and Jones (1964:160-163) employed that name for specimens from eastern Nebraska. Adults of *G. b. majusculus*, especially males, are alleged to be larger than those of *G. b. bursarius*; specimens from northeastern South Dakota are somewhat smaller than those from the southeastern part of the state and it is on this basis that they are assigned to the subspecies *bursarius*.

Records of occurrence of this race are as follows: Brookings County: Brookings (USNM 244473), 3½ mi. S and 1½ mi. W Volga (Coffman and McDaniel, 1975:189); Clark County: Clark (USNM 275003); Grant County: 6 mi. N Milbank (KU 101727-31); Kingsbury County: no specific locality (USNM 13735); Marshall County: Ft. Sisseton (USNM 192155, 192159), Roy Lake State Park (KU 101722-26); Minnehaha County: Sioux Falls (Coffman and McDaniel 1975:189), Valley Springs (UMMZ 104661-63); Moody County: Flandreau (USNM 192151), no specific locality (Coffman and McDaniel 1975:189); Roberts County: Lake Traverse (USNM 192161).

Geomy bursarius lutescens Merriam, 1890.—This subspecies, individuals of which are decidedly smaller than those of either *G. b. bursarius* or *G. b. majusculus* and also markedly paler, occurs to the west of the Missouri River in southern South Dakota (Fig. 2). It is known definitely from suitable habitats throughout the White River and Niobrara River drainages and is found also in Fall River County in the Cheyenne River drainage, but is not known to occur elsewhere in areas drained by the Cheyenne. It is of note that a specimen reported as *G. b. lutescens* by Long (1965:163) from along the Redwater River (a northern

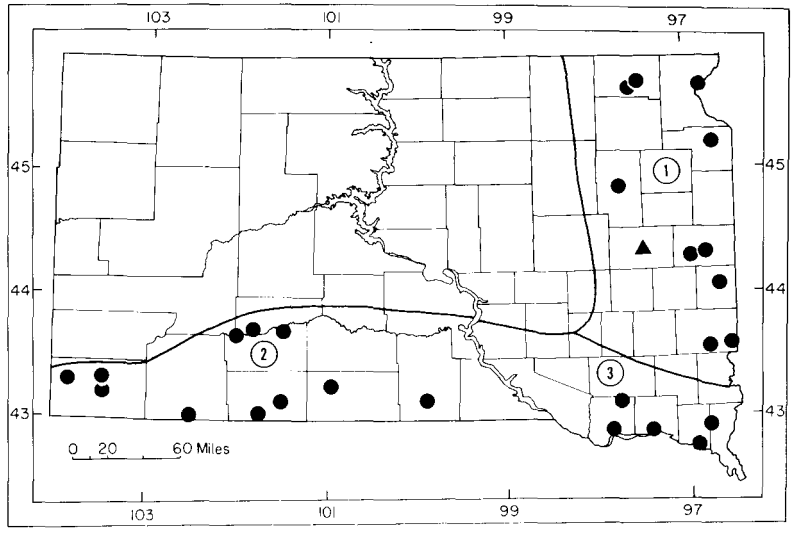

Fig. 2. Distribution in South Dakota of the plains pocket gopher, *Geomys bursarius*: 1, *G. b. bursarius*; 2, *G. b. lutescens*; 3, *G. b. majusculus*. See text for list of records of occurrence, some of which are not plotted because crowding of symbols on the map would have resulted. The one triangle represets a specimen known only to county.

tributary of the Cheyenne) near Beulah, Wyoming, was misidentified and actually represents another genus of pocket gopher (see Turner 1974:149).

Records of occurrence of *G. b. lutescens* are as follows: Bennett County: 4 mi. S and 8 mi. E Martin, 3050 ft. (KU 113056-57), 7 mi. S and 4 mi. E Martin (MHP 13154-59), 8 mi. S Martin, 3200 ft. (KU 113058-61), 9 mi. S Martin, 3300 ft. (KU 113062-63), 10 mi. S Martin, 3300 ft. (KU 113064), 1¼ mi. N and 2½ mi. W Tuthill (MHP 13152-53), 1½ mi. W Tuthill (MHP 13160); Fall River County: 1 mi. E Edgemont (KU 101963-65), 6 mi. S Hot Springs (UM MZ 97083-84), Hat Creek, 12 mi. S Hot Springs (Turner, 1974:149); Jackson County: 2 mi. S and 2 mi. E Interior (KU 124979-81), 2½ mi. S and 2½ mi. E Interior (KU 124982-86); Shannon County: Pine Ridge (USNM 65002-03); Tripp County: Dog Ear Lake (UMMZ 74879-80); Todd County: 2 mi. N and 3 mi. W Rosebud (KU 101042-44), Rosebud Agency (USNM 64999-65001); Washabaugh County: flood plain of Bear Creek, near White River (USNM 205908), 20 mi. N Long Valley (KU 101041), 10 mi. N and 4 mi. E Potato Creek (KU 101037-40).

Geomys bursarius majusculus Swenk, 1939.—Specimens from extreme southeastern South Dakota are tentatively assigned to this subspecies because they average somewhat larger than those from farther north that we have referred to *G. b. bursarius*. As noted in the account of the latter, a study of variation among populations of this species in the plains states is needed.

Records of occurrence of this subspecies in South Dakota are: Bon Homme County: Sand Creek Park, 4 mi. NE Springfield (KU 101732-34), Scotland (USNM 54165); Clay County: mouth Vermillion River (USNM 1775/2497), Vermillion (Findley, 1956:32); Union County: Union County State Park, 9½ mi. N and 7½ mi. E Vermillion, 1200 ft. (KU 101735-40); Yankton County: Yankton (USNM 144763).

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A Mid-Continent Irruption of Canada Lynx, 1962-63

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Lincoln, Nebraska 68588

Abstract: There was a mid-continent irruption of the Canada lynx (*Felis lynx*) population and subsequent extensive movement into non-lynx habitats during the years 1962-1963. Lynx were found in the prairie provinces of Canada and the prairie areas of Minnesota, and North and South Dakota. They were also found in urban areas such as Minneapolis and St. Paul, Minnesota; Winnipeg, Manitoba; and Calgary, Saskatchewan, Canada. Causes for the irruption remain unknown but speculations include primarily a change in snowshoe hare population, disease, extensive forest fires and extensive spraying. Unusual behavior seemed to be most often reflected by a lack of fear.

An irruptive population curve has been described as one which exhibits severe but irregular fluctuations of no fixed duration or amplitude and occurs infrequently (Leopold 1933). They occur most often in populations in unstable environments, and can be characteristic of disease epidemics. A mid-continent irruption of Canada lynx (*Felis lynx*) which occurred in 1962-1963 presented a dramatic example of an irruptive population curve, whose focus was centered on northeastern Minnesota. Until 1962 there were only three Canada lynx specimen records for Minnesota in the James Ford Bell Museum mammal collection at the University of Minnesota. That fall, October, 1962, Mr. Alan B. Sargeant, now of the Northern Prairie Wildlife Research Center, Jamestown, North Dakota, alerted me to the possibility of a lynx "invasion." He collected, in northwestern Minnesota, a lynx which was at the edge of a road watching a ruffed grouse perched in a tree. That fall and winter several more unusual reports and observations of Canada lynx were received at the museum, including those of individuals killed at population centers such as one in Golden Valley, a suburb of Minneapolis, Minnesota, and another in St. Paul, Minnesota. Both localities were far south of the lynx's normal range. These unusual reports prompted me to gather as much information as possible on Canada lynx movements for the years 1962-1963. a summary of this accumulated information forms the basis of this paper.

Mr. F.W. Johnson, then Chief Warden, Section of Warden Service of the Minnesota Department of Game and Fish (now the Department of Natural Resources) sent a letter for me, on January 28, 1963, requesting information on all bobcats (*Felis rufus*) and Canada lynx bountied during the winter of 1962-63. In the letter I also asked for data on weight, age and sex, when these were available. In most returns no distinction was made between the two species. Until very recently, the two species have not been distinguished in the annual fur harvest reports. Several trips were taken by myself to gather more data, to verify data and to obtain specimens. One trip was across northern Minnesota on February 4 to 8, 1963. Several shorter trips were made during the same season. Additional information was received from Robert Hines (deceased) a well-known trapper in northern Minnesota and William Jensen, a fur-buyer at Roseau, Minnesota. The following Minnesota wardens responded to our request for information: Ted

Abrahamson, Wenzel Anderson, Wallace R. Beyer, Lyoyd C. Billiar, Carl Burrell, Lawrence J. Downey, Burton Ellig, Don Fultz, Bert Getty, Philip Ham, W.E. Heineman, Milton M. Hockel, Alvin L. Hoger, Robert Jacobsen, Millard A. Jensen, Ray Jensen, Arthur Johnson, Carl J. Johnson, F.W. Johnson, Bernard Manthei, James T. Marcum, Orville Meyer, Mathey Minenich, James Myers, Ray C. Neumann, Warren O'Brien, Louis J. Peloquin, Harland C. Pickett, Don Polovina, J.C. Richards, William C. Richards, Marvin Smith, Francis Teske, and Fred Venning.

Dr. A.E. Allin (deceased), then Director and Pathologist, Regional Laboratory, Ontario Department of Health, Ft. William, Ontario and well-known naturalist of the "Lakehead" area, coordinated the gathering of the Canadian material, which came from officials, naturalists, hunters and trappers. Allin enlisted the help of R.A. Bilkwill, District Forester, Ontario Department of Lands and Forests, A.S. Bray, Regional Director, Ontario Department of Lands and Forests, W.J. Cleaveley, G.E. MacKinnon, W.L. Sleeman, and G.F. Coyne, District Foresters, Ontario Department of Lands and Forests, W.L. Newman, Predator Control Officer, Game Branch, Manitoba Department of Mines and Natural Resources, and J.D. Robertson, Game Administrator, Game Branch, Manitoba Department of Mines and Natural Resources. Canadian information was furnished by Dr. Charles H. Buckner, then Mammalogist, Winnipeg Forest Entomology Laboratory Canadian Department of Forestry.

Lyle Schoonover, then refuge Manager, Sand Lake National Wildlife Refuge, Columbia, South Dakota, was helpful with information from South Dakota.

MAGNITUDE OF POPULATION CHANGES AND EXTENT OF MOVEMENT

The "population explosion" of Canada lynx described in this study was reflected most dramatically in the bounty payments made on this species at Grand Marais, Cook County, in the northeastern corner of Minnesota. From March 1962 until February 1963, 147 individuals were bountied. State Warden Arthur Johnson, one of three wardens stationed there, believed they had not bountied more than half a dozen in the previous 35 years. From February 1, 1963 to January 1, 1964, 137 were bountied. Johnson (pers. comm.) wrote, "From my observation, I would say they are about the same as 1962." From 1963 until another influx began in 1971-1972, no lynx were reported. In 1971-1972 another influx started but apparently did not reach anywhere near the same magnitude as that of 1962-1963 (Mech 1973). In North Dakota the 1962-1963 irruption was also dramatic, as reported by Adams (1963). A trapper there caught 39 lynx in northeastern North Dakota in the winter of 1962, but had taken none in the previous 45 years of continuous trapping. For the state there was a total of 164 reported for 1962-63.

Population changes in the coniferous forest areas of the Canadian provinces bordering Minnesota and North Dakota were not as dramatic. In Canada trappers had to report their pelts to government officials. In the Sioux Lookout District of northern Ontario, figures forwarded by W.J. Barnes, District Forester for the Ontario Department of Lands and Forests, are shown in Table I.

Table I. Lynx Reported Taken by Years in Ontario*

Years	Sioux Lookout District (122,825 acres)	Geraldton District
1953-54	1079	125
1954-55	576	100
1955-56	280	40
1956-57	284	25
1957-58	537	39
1958-59	1360	47
1959-60**	2751	57
1961-62	3376	70
1962-63	3125	72
1963-64		70

*Ontario's figures for Sioux Lookout District were furnished by W.D. Barnes, District Forester for the Ontario Department of Lands and Forests; for the Geraldton District by G.E. MacKinnon, also District Forester for the Ontario Department of Lands and Forests.

**For 1957-60, the areas of Sioux Lookout, Hudson and Lac Seul were grouped together.

For the Geraldton District, Ontario, which is about 50 miles north and slightly to the east of a north-south line through the middle of Lake Superior, Mr. G.E. MacKinnon (per. comm.), District Forester for the Ontario Department of Lands and Forests, furnished the figures shown on Table I.

Mr. W.L. Newman, Predator Control Office, Game Branch, Manitoba Department of Mines and Resources, furnished figures for all of Manitoba (pers. comm.) shown in Table II.

J.D. Robertson, Game Administrator, Game Branch Manitoba Department of Mines and Natural Resources wrote (pers. comm. February 28, 1963), "There were very few lynx taken in Manitoba in recent years until the winter of 1959-60, when the values of lynx reached a point where it was profitable for the trappers to take pelts. The take during this season (1963) was three times greater than the previous year. This was not necessarily due to a greater lynx population during 1959-60, but as I have pointed out earlier, statistics in this regard, in that the values influenced the take in recent years."

It would seem that the increase in population was greatest in the Manitoba area, although the area covered is not known. For the Kenora, Fort Francis, and Port Arthur, Ontario districts, all close to Minnesota, the information was furnished by A.F. Coyne, District Forester at Kenora, R.A. Balkwill, District Forester at Port Arthur, Ontario and is summarized in Table III.

Both Dr. A.E. Allin (pers. comm.) and Sleeman mentioned that very few lynx were taken by trappers directly along the Ontario-Minnesota border. This prompted Allin to wonder ". . .whether the lynx taken in the general vicinity of

Table II. Lynx Reported Taken by Years in Manitoba*

Years	Manitoba
1952-53	1204
1953-54	911
1954-55	748
1955-56	645
1956-57	539
1957-58	1547
1958-59	2867
1959-60	7798
1960-61	6613
1961-62	5219
1962-63	----

*Figures for Manitoba were furnished by Mr. W.L. Newman, Predator Control officer, Game Branch, Manitoba Department of Mines and Resources.

Table III. Lynx Reported Taken by Years near Kenora, Ft. Francis and Port Arthur, Ontario*

Year	Kenora	Ft. Francis	Port Arthur
1953-54	12	0	3
1954-55	15	7	9
1955-56	16	12	32
1956-57	24	8	10
1957-58	29	9	18
1958-59	22	13	27
1959-60	56	16	44
1960-61	89	8	99
1961-62	76	32	121
1962-63	117	62	239

*Figures from areas bordering on Minnesota were provided by A.F. Cayne, District Forester at Kenora, R.A. Balkwell, District Forester at Ft. Francis; W.L. Sleeman, District Forester at Port Arthur.

the border and east of Quetico Park were being smuggled across into Minnesota to be sold and the bounty collected there. There is no bounty on lynx in Ontario. . . .''. There was and had been a bounty on lynx in Minnesota but they could just as easily have been smuggled across in years of low as well as high populations. I feel that the results were not greatly skewed by bounty payments, and the increase is good evidence of a population irruption.

In Canada it was reported that ''...a large number were taken alive in the city of Calgary, Alberta'' (Editors, Blue Jay, 1964). For Manitoba, Buckner (pers. comm.) reported, ''Starting in 1959, records and specimens of lynx (and a few bobcats as well) were taken in Winnipeg. . .'' and, ''Last summer, 1962, a record number of wildcats (most lynx from what I can gather) were taken in the city and suburbs of Winnipeg. . .''. He also noticed that lynx were reported as quite common in the Duck Mountain area along the Manitoba-Saskatchewan border in 1960-62. Several lynx were reported north of Beechey, Saskatchewan for 1963 (Santy 1964).

In Minnesota, lynx numbers were high for all northern border counties which were in the coniferous forest, although not as high as at Grand Marais, Cook County. South and west from here the numbers gradually dwindled, until the edge of the coniferous forest was reached. Beyond the deciduous forest and into the prairie areas, reports were scattered. These scattered records from non-lynx habitats emphasize the extent of the movement which took place during this irruption. Nellis and Wetmore (1969) reported one as having moved 102 miles in 163 days. Mech has reported one taken in northern Minnesota in 1974 was taken three years later nearly 300 miles away in Western Ontario. Lynx have the capability of moving great distances. Lynx were reported from Clay, Norman and Polk Counties in the western prairie areas and as far south as Goodhue County in the deciduous forest area. Specimens have been received at the James Ford Bell Museum at the University of Minnesota from both St. Paul and Minneapolis, Minnesota.

In North Dakota, the highest populations occurred in the Pembina Hills and Turtle Mountains in the northeastern part of the state. They were recorded for all the counties in the northern tier, as far south as Ransom County and in the three northern-most counties bordering Montana (Adams 1963).

For Montana, Hoffman et al. (1969) wrote, ''It is evident that lynx reached peak populations in all parts of the state except the southeast in 1963-64.''

In South Dakota, one was taken in Yankton County in 1961, one near Britton, Chamberlain County, in a clump of cottonwoods in 1962, and one near Chamberlain, Brule County in 1963 (Lyle Schoonover, pers. comm.).

In Iowa a lynx was taken in July 1963 in Shelby County and is in the possession of Jerry Rasmussen (1969). This is the first documented record for Iowa. There are undocumented records of three in 1869, one in 1875 and one in 1906.

The least dramatic increases were those of Wisconsin and Michigan where the Great Lakes may have impeded the southward movement of the moderate population increase directly north of Lake Superior, if the Geraldton figures in Table I are an indication.

Table IV. Lynx Trapped in Montana, 1959-1967*

Season	Montana
1959-60	43
1960-61	44
1961-62	36
1962-63	76
1963-64	376
1964-65	149
1965-66	167
1966-67	99

*Figures from Hoffman et al. (1969).

BEHAVIOR

Unusual and erratic behavior has been recorded for several species of mammals during movements presumably caused by irruptive or cyclic population fluctuations. Curry-Lindahl (1962) discussing a Norway or brown lemming (*Lemmus lemmus*) irruption in Sweden in 1960 wrote "The vicious temper was common to both sexes. . ." and when we examined screaming females we found no signs of pregnancy." The lemmings were on the move throughout that entire summer, but evidently not for lack of food for Curry-Lindahl (1962) wrote, "There is much evidence to suggest that the eliciting factors of mass migration are mental in character, a kind of psychosis, possibly due to the competition with other rodents for sheltering holes and territory, but primarily not for food, which, even when lemmings are most numerous, is available in the vicinity, both on the mountain hearths and lower down."

The behavior of gray squirrels (*Sciurus carolinensis*) during a 1968 "migration" was reported as unusual by many observers and summarized by Flyger (1969). They appeared in areas where they were not usually seen. But more unusual were the reports of the "dancing" of squirrels on a highway. Flyger (1969) wrote, "As cars approached, squirrels on the road would sometimes jump into the air, zigzag back and forth, and behave erratically. I also observed this." Flyger (1962) thought that squirrels caught in an unfamiliar area behaved erratically because they were confused and terrified.

Reports of erratic behavior observations in Canada lynx during the 1962-63 irruption were abundant. From near Beechy, in the prairie province of Saskatchewan, two reports were recorded (Santy 1964). In one instance a Canada lynx preyed on a flock of chickens in a farmyard during daylight hours and was finally caught in a snare. In another instance a young man plowing with a tractor was confronted by a lynx sitting directly in his path. When the operator stopped the tractor's movement the lynx came around and leaped at the operator, but could not reach him. The operator hit the lynx on the side of the neck with a hammer from the tool box. The lynx dropped to the ground and braced itself for another spring. The young man grabbed a coat which he had been using for a seat cushion and shook it vigorously in front of the lynx. This deterred the lynx and it walked

away! In North Dakota lynx "... were seen in plowed fields and pastures miles from trees," and "a few lynx were run down by cars on roads far from likely lynx habitat" (Adams 1963). In Ontario, too, there were reports of lynx entering agricultural areas during daylight hours and taking chickens from farmyards.

Three reports of unusual behavior in northwestern Minnesota were recorded: one of a lynx being shot at the edge of a road as it was watching a ruffed grouse perched in a tree, another of a lynx sitting at the edge of an aspen "island" several yards from a farmhouse. The farm wife drove into the yard, saw the cat, started the car, and went to get her husband. When they came back, the husband went into the house, got his gun and shot what turned out to be a lynx. It had remained there through all the noise and commotion. The third was a lynx which came in daylight and snatched a duck from out of a flock that the farmer was feeding.

Still another unusual observation was reported by Marvin Smith (pers. comm.). He reported that a resident on one of the many islands on Rainy Lake, which forms a part of the boundary between Minnesota and Ontario, shot a lynx which had killed and was eating a red fox near his cabin. When disturbed the lynx left the area, but returned about four hours later, at which time it was shot.

The Conservation Warden for Kanabec County, Central Minnesota, Bernard Manthei, (pers. comm.) reported on four lynx hunted in 1962 and wrote, "An odd thing about all four kills was that they were killed during the middle of the day and each one was walking along a road and seemingly paid little or no attention to the person who killed them." In Clay County, western Minnesota, one was shot in an open field, and in Polk County, also in western Minnesota, one was run over by a car (Jensen, pers. comm.).

Unusual behavior was also reported for the lynx taken in Iowa (Rasmussen 1969). The lynx was first seen when some cattle flushed it from among trees near a creek. It stood motionless within 50 feet (45 m) of a tractor and stared at Rasmussen for several moments and walked back into the trees. Rasmussen returned 20 minutes later and shot the lynx.

All of these observations seem to indicate a lack of fear and also confusion. These may stem in part from a lack of familiarity with the area, but there may also be other "psychotic" factors, which in turn influence the physiology of the individuals.

SPECULATION ON CAUSES OF POPULATION IRRUPTION AND MOVEMENT

Many reasons for the population irruption and extensive dispersals have been postulated, but strong evidence for any single reason is lacking.

Food. The snowshoe hare (*Lepus americanus*) is generally conceded to be a major food of the Canada lynx, and it is widely believed that peaks of abundance, and decline of the lynx are directly related to hare populations (Elton and Nicholson 1942). However, conflicting reports on snowshoe hare abundance were received. In Minnesota harvest statistics issued by the Division of Game and Fish for the snowshoe hare populations as indicated in Table V show prior to 1963 the first marked decrease in 1962-63.

Table V. Snowshoe Hares Taken in Minnesota 1956-1964*

Years	Number
1956-57	61,152
1957-58	48,150
1958-59	60,135
1959-60	60,000
1960-61	69,580
1961-62	63,300
1962-63	43,500
1963-64	28,000

*Figures furnished by William H. Longley, Minnesota Department of Natural Resources.

R.A. Balkwill, District Forester for the Ontario Department of Lands and Forest (pers. comm.) wrote, "Snowshoe hare (sic) not as abundant as usual." Buckner (pers. comm.), a mammalogist with the Canadian Department of Forestry, judged populations of snowshoe hare near Rennie, southeastern Manitoba to be high in 1952, 1953, moderate in 1954, 1955, 1956, low in 1957, 1958, moderate in 1959, and high in 1960, 1961, 1962. He further commented on the high number of lynx taken in Winnipeg, Manitoba especially along the rivers, and throughout the entire Red River Valley, and wrote, "Now there are virtually no *L. americanus* (snowshoe rabbits) in the valley, but don't forget the rather high numbers of cottontails here, that in my opinion could provide quite a good food source for lynx." J.D. Robertson, Game Administrator, Game Branch, Manitoba Department of Mines and Natural Resources wrote (pers. comm.), "I have no answers or suggestions for this last movement and expansion of the lynx population. It is certainly not tied in with any great population increase or die-off of the snowshoe rabbit." Manthei (pers. comm.) reporting from central Minnesota in February, 1963 wrote, ". . . but I think the great shortage of rabbits this year . . . has something to do with it." Adams (1962) wrote, "The large number of lynx in North Dakota during the past year or so were victims of a snowshoe hare die-off in Canada. In talking with some of the game biologists from Manitoba and Saskatchewan I found they experienced a decline in snowshoes starting in 1961." In North Dakota snowshoe hare were especially abundant in the Turtle Mountains and Pembina Hills areas in 1961 and 1962. These were the areas where most lynx were taken in 1962-1963.

Disease. Charles Buckner (pers. comm.), mammalogist with the Canadian Department of Forestry, wrote, "The provincial pathologist, Dr. R. Kirk, could give me no information on disease in either rabbits or lynx."

Fire. Bray (pers. comm.), Regional Director, Ontario Department of Lands and Forest, wrote in response to a suggestion that extensive forest fires in northwestern Ontario in 1961 were the cause: "For your information, I am enclosing, herewith, a map which shows the major areas burnt over in that year. We

had a total of about 700 fires, some of which, . . ., escaped control and did serious damage. Approximately 1,180,000 acres were burned and the fire areas, . . ., are a considerable distance from the Ontario-Minnesota boundary. I personally have doubts as to whether or not they were a factor.'' Doubt was also cast on this hypothesis because there were no recognizable movements of larger mammals such as deer or moose. Robertson (pers. comm.), Game Administrator of the Game Branch of the Manitoba Department of Mines and Natural Resources, wrote, ''I cannot agree that the serious fire situation in 1961 would have any major effect on the movement of lynx, no more so than any of our other mammals.''

Herbicides and Insecticides. Another hypothesis was that the animals had been driven out of their natural range by the lack of food caused by spray programs. This idea was soon discarded because of the obvious necessity of spraying vast areas to cause such a massive movement. No such spray program was in effect.

Habitat. J.D. Robertson (pers. comm.), Game Administrator of Game Branch of the Manitoba Department of Mines and Natural Resources, believed habitat changes might be one reason for the increase and dispersal of lynx. It was his ''strong belief'' that the lynx were practically exterminated from their normal range in Manitoba during the 1930s and 1940s because of high prices of pelts. Following these years of depressed populations habitat conditions became very favorable, and the harvest was minimal because fur prices were very low. It was not until 1959-60 that the value of lynx fur again made it profitable to take their pelts. Robertson (pers. comm.) added, ''However, (during) this past two years, 1961-62 and 1962-63, they have extended their range beyond what we considered normal range 40 to 50 years ago and seem to have adapted themselves to come out of the woods and live in populated areas.''

DISCUSSION

The center or beginning of this mid-continent lynx population irruption appeared to be in the coniferous forest region of Manitoba and Sioux Lookout District of Ontario. The bounty payments of pelt reports reflected enormous population changes in some areas, such as portions of Ontario, northern Minnesota and North Dakota, especially for the years 1962-1963. The Canada lynx is usually identified with coniferous forests, deep snow and snowshoe hares. During this irruption lynx were frequently observed on the open prairies, away from the parklands and gallery forests of the rivers. What was more dramatic was their appearance in population centers, such as Minneapolis and St. Paul, Minnesota, Winnipeg, Manitoba and Calgary, Alberta.

The evidence presented here is intended to show that the population peak of 1962-1963 was greater than a cyclic oscillation. Neither can this irruption be explained by the lynx-snowshoe hare interaction alone. The complexity of this problem has been well reviewed by Weinstein (1977) and others.

Reasons for their behavior were the source of much comment and speculation. Most of their behavior could probably be attributed to their unfamiliarity with the area, i.e. confusion. Those taken outside of their normal geographic range were mobile individuals, also outside of any home range.

Speculations as to the cause of this irruption were many, but no strong evidence appeared for any one of them. Even the Canada lynx snowshoe hare population fluctuation does not seem to offer much help in explaining this irruption.

Although such an irruption and movement as described here would seem to result in mass destruction, the destruction is probably not great in terms of the total population. The irruption and resulting movement does have survival value. One result is that suitable but unoccupied habitats may again become occupied. Another, and more indirect result, might be the maintenance of a greater gene plasticity by producing a flow of genes between lynx populations which had become isolated.

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Checklist of North Dakota Mammals (Revised)

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INTRODUCTION

A recently published checklist of North Dakota mammals (Wiehe and Crooke 1976) contained common names, scientific names, status, and approximate range of each species and was intended primarily for the general public. This revised checklist is directed more toward the professional scientist and students in mammalogy. It reflects recent name changes and additional information collected since the 1976 checklist was published.

This checklist is a companion to R. E. Stewart's bird checklist (1971) which also appeared in the *Prairie Naturalist*. Whereas Stewart used a letter code to indicate species status, we have divided the mammals into three categories: Current, Extirpated, and Hypothetical. Species of Extirpated status are those formerly occurring but no longer found in the state (some forms are extinct). Species of questionable record or of close occurrence to North Dakota are considered Hypothetical. Species presently occurring in the state are those of current status. Current species which are introduced (non-native) are prefixed by the letter I. Those that were extirpated and subsequently reintroduced are prefixed by the letters X and I. Those species that are considered Rare and/or Endangered are prefixed by an R and/or an E. Recently, there has been considerable debate within the scientific community concerning the designations of Rare and Endangered. Therefore, we are using the following criteria for those species designated as Rare: KcKenna and Seabloom (1976), Stan Kohn (N. D. Game and Fish Dept., personal communication), and our own personal knowledge. Berger and Phillips (1977) was the source for species designated as Endangered.

The sequence of Orders and Families in this checklist follows Simpson (1945). The listing of species within each of the families follows Hall and Kelson (1959). For each species the scientific name is given and is followed immediately by the authority for the name. The common name is then given and the approximate range is as follows: NW, NE, SE, SW, N, E, or W indicating quadrant or half of most likely occurrence. "All" designates statewide (or nearly so) distribution. Each species may occur in all or only part of the quadrant or half

range designations. Major mammalogical works should be consulted for more exact range information and for names and distribution of subspecies in the state.

Miller and Kellog (1955) was the primary source for authority (i.e., the person who first described the species) of scientific names. Scientific and common names are those used by Jones, Carter, and Genoways (1975).

		Current
Order Marsupialia		
Family Didelphidae		
R *Didelphis virginiana* Linnaeus	Virginia Opossum	SE
Order Insectivora		
Family Soricidae		
Sorex cinereus Kerr	Masked Shrew	All
Sorex arcticus Kerr	Arctic Shrew	N, E
R *Microsorex hoyi* (Baird)	Pigmy Shrew	E
Blarina brevicauda (Say)	Short-tailed Shrew	E
Order Chiroptera		
Family Vespertilionidae		
Myotis lucifugus (Le Conte)	Little Brown Myotis	All
Myotis keenii (Merriam)	Keen's Myotis	E
R *Myotis evotis* (H. Allen)	Long-eared Myotis	W
R *Myotis volans* (H. Allen)	Long-legged Myotis	SW
Myotis leibii (Say)	Small-footed Myotis	SW
Lasionycteris noctivagans (Le Conte)	Silver-haired Bat	All
Eptesicus fuscus (Palisot de Beauvois)	Big Brown Bat	All
Lasiurus borealis (Muller)	Red Bat	All
Lasiurus cinereus (Palisot de Beauvois)	Hoary Bat	All
Order Lagomorpha		
Family Leporidae		
Sylvilagus floridanus (J. A. Allen)	Eastern Cottontail	E, SW
R *Sylvilagus nuttallii* (Bachman)	Nuttall's Cottontail	W
R *Sylvilagus audubonii* (Baird)	Desert Cottontail	SW
Lepus americanus Erxleben	Snowshoe Hare	N, E
Lepus townsendii Bachman	White-tailed Jackrabbit	All
Order Rodentia		
Family Sciuridae		
Tamias striatus (Linnaeus)	Eastern Chipmunk	E
Eutamius minimus (Bachman)	Least Chipmunk	NE, W
Marmota monax (Linnaeus)	Woodchuck	E
Spermophilus richardsonii (Sabine)	Richardson's Ground Squirrel	N, E
Spermophilus tridecemlineatus (Mitchill)	Thirteen-lined Ground Squirrel	All

Family Sciuridae		
Spermophilus franklinii (Sabine)	Franklin's Ground Squirrel	E, NW
Cyomys ludovicianus (Ord)	Black-tailed Prairie Dog	SW
Sciurus carolinensis Gmelin	Gray Squirrel	E
Sciurus niger Linnaeus	Fox Squirrel	E, S
Tamiasciurus hudsonicus (Erxleben)	Red Squirrel	E
Glaucomys sabrinus (Shaw)	Northern Flying Squirrel	E
Family Geomyidae		
Thomomys talpoides (Richardson)	Northern Pocket Gopher	W, NE
Geomy bursarius (Shaw)	Plains Pocket Gopher	SE
Family Heteromyidae		
Perognathus fasciatus Wied-Neuwied	Olive-backed Pocket Mouse	All
Perognathus flavescens Merriam	Plains Pocket Mouse	SE
R *Perognathus hispidus* Baird	Hispid Pocket Mouse	SW
Dipodomys ordii Woodhouse	Ord's Kangaroo Rat	SW
Family Heteromyidae		
Castor canadensis Kuhl	Beaver	All
Family Cricetidae		
R *Reithrodontomys montanus* (Baird)	Plains Harvest Mouse	SW
Reithrodontomys megalotis (Baird)	Western Harvest Mouse	S
Peromyscus maniculatus (Wagner)	Deer Mouse	All
Peromyscus leucopus (Rafinesque)	White-footed Mouse	All
Onychomys leucogaster (Wied-Neuwied)	Northern Grasshopper Mouse	All
Neotoma cinerea (Ord)	Bushy-tailed Woodrat	SW
Clethrionomys gapperi (Vigors)	Southern Red-backed Vole	All
Microtus pennsylvanicus (Ord)	Meadow Vole	All
Microtus ochrogaster (Wagner)	Prairie Vole	All
R *Lagurus curtatus* (Cope)	Sagebrush Vole	SW
Ondatra zibethicus (Linnaeus)	Muskrat	All
Family Muridae		
I *Rattus norvegicus* (Berkenhout)	Norway Rat	All
I *Mus Musculus* Linnaeus	House Mouse	All
Family Zapodidae		
Zapus hudsonius (Zimmerman)	Meadow Jumping Mouse	All
Zapus princeps J. A. Allen	Western Jumping Mouse	E, NW
Family Erethizontidae		
Erethizon dorsatum (Linnaeus)	Porcupine	All
Order Carnivora		
Family Canidae		
Canis latrans Say	Coyote	All
R&T *Canis lupus* Linnaeus	Gray Wolf	NE
Vulpes vulpes (Desmarest)	Red Fox	E, NW
R&E *Vulpes velox* (Say)	Swift Fox	SW
Urocyon cinereoargenteus (Schreber)	Gray Fox	E

Family Ursidae		
R *Ursus americanus* Pallas	Black Bear	NE
Family Procyonidae		
Procyon lotor (Linnaeus)	Raccoon	All
Family Mustelidae		
R *Martes pennanti* (Erxleben)	Fisher	NE
Mustela erminea Linnaeus	Ermine	E
Mustela nivalis (Bangs)	Least Weasel	All
Mustela frenata Lichtenstein	Long-tailed Weasel	All
R&E *Mustella nigripes* (Audubon & Bachman)	Black-footed Ferret	SW
Mustela vison Schreber	Mink	All
Taxidea taxus (Schreber)	Badger	All
R *Spilogale putorius* (Linnaeus)	Eastern Spotted Skunk	SE
Mephitis mephitis (Schreber)	Striped Skunk	All
R *Lutra canadensis* (Schreber)	River Otter	All
Family Felidae		
R *Felis concolor* Kerr	Mountain Lion	N, W
R *Felis lynx* (Kerr)	Lynx	N
Felis rufus Schreber	Bobcat	All
Order Artiodactyla		
Family Cervidae		
R *Cervus elaphus* Linnaeus	Wapiti or Elk	?
Odocoileus hemionus (Rafinesque)	Mule Deer	All
Odocoileus virginianus (Zimmerman)	White-tailed Deer	All
R *Alces alces* (Linnaeus)	Moose	NE
Family Antilocapridae		
Antilocapra americana (Ord)	Pronghorn	W
Family Bovidae		
X&I *Bison bison* (Linnaeus)	Bison	?
X&I *Ovis canadensis* Shaw	Mountain Sheep	SW

Extirpated

Canis lupus Linnaeus, Gray Wolf —

The common name Gray Wolf applies to all 24 subspecies of *Canis lupus*. The subspecies *C. l. lycagon* is a casual wanderer usually occurring in the Pembina Hills. The subspecies *C. l. nubilis*, the so-called Buffalo Wolf (Bailey 1926: 150) that was once abundant on the native prairie of North Dakota, is now extinct (U.S.D.I. 1973).

Ursus arctos Ord, Grizzly Bear —

Several subspecies of this bear whose former scientific name was *U. horribilis* are recognized. The subspecies *U. a. horribilis* was formerly common over most of North Dakota (Bailey 1926:194). Between the efforts of early hunters

and trappers and the settling of the state by white men, this species apparently disappeared from the state near the turn of the twentieth century.

Martes americana (Turton), Marten —

Originally this species of boreal association was fairly common in the wooded sections of northeastern North Dakota. The value of the fur of this species was probably the main cause of its early disappearance from the state (Bailey 1926: 177).

Gulo gulo (Linnaeus), Wolverine —

This species of boreal association was formerly found mostly in the northern part of the state. There have been no records for quite some time (Bailey 1926: 179).

Rangifer tarandus (Richardson), Caribou—

There is some question as to whether or not this species ever did occur in the state (Bailey 1926:33), but it is certainly absent now.

Bison bison (Linnaeus), Bison —

An excellent account of the demise of this once very abundant North Dakota species is given by Bailey (1926:19-25). The last animal killed in the state was one shot near Dickinson in 1884 (Bailey 1926:24). It is not clear if the species was totally eliminated and reintroduced or if there were a few survivors. Nevertheless, those found at Sullys Hill refuge near Devils Lake, Theoldore Roosevelt National Memorial Park, and in private ownership are the only ones remaining in the state.

Ovis canadensis Shaw, Mountain Sheep —

The subspecies originally found in the Badlands of the state, *O. c. auduboni* is now extinct. The last record for North Dakota was one shot in 1905. In 1956, 18 individuals of the subspecies *O. c. californiana* were introduced into the Badlands (McKenna and Seabloom 1976:73). The population has since expanded and a limited hunting season was recently initiated.

Hypothetical

Sorex preblei Jackson, Preble's Shrew —

Records of this species formerly thought to be of *S. cinereus*, from Bloomfield and Glendive, Dawson County, Montana (Hoffman et al. 1969a:581) brings it to within 30 miles of the western border of the state. Taxonomic status appears to be uncertain at present.

Sorex palustris Richardson, Northern Water Shrew —

Records from Ft. Sisseton, South Dakota, Winnipeg, Manitoba (Bailey 1926:204), and Clearwater County, Minnesota (Gunderson and Beer 1953: 41) suggest that this species may occur in exteme eastern North Dakota. There are no known records for the state, however.

Sorex merriami Dobson, Merriam's Shrew —

On 30 June 1913, what was thought to be a specimen of this species was picked up from the top of a butte near Medora. Unfortunately, its head had

been eaten off and only the hindquarters were left (Bailey 1926:202). Diersing and Hoffmeister (1977:328) also question this record. Recent efforts in the southwestern part of the state (Genoways and Jones 1972, Seabloom, personal communication) have failed to turn up any specimens. This species does occur in southeastern Montana (Diersing and Hoffmeister 1977:324), however.

Scalopus aquaticus (Linnaeus), Eastern Mole —

A specimen dated April 1960 in the collection of the University of North Dakota (field number 657) is reportedly from a farm in Grand Forks County (Seabloom, personal communication). The next closest record is over 200 miles away in Sherburne County, Minnesota (Gunderson and Beer 1953:34).

Condylura cristata (linnaeus), Star-nosed Mole —

Bailey (1926:200) states that this species was reported several times from a meadow near Towner, McHenry County, in 1915. Supposedly a specimen was kept in a glass jar but none was saved. The closest record is from Becker County, Minnesota (Gunderson and Beer 1953:36). It is also reported from southeastern Manitoba (Soper 1942:134).

Plecotus townsendii Cooper, Townsend's Big-eared Bat —

Hoffman et al. (1969b:740) indicate that this species ranges to within 60 miles of the western border of the state. Hoffman and Jones (1970:375-376) report it to be "variously distributed in rocky areas or montane forest" in and adjacent to the Badlands in western North Dakota. There are no known records, however.

Glaucomys volans (Linnaeus), Southern Flying Squirrel —

A specimen in the collection at the University of North Dakota (UND #707) is supposedly from Grafton. The specimen is dated 19 July 1957 and was put up by H. V. Williams, a trapper for Vernon Bailey in 1912. There is no indication of where it was collected (Seabloom, personal communication). The closest record from Minnesota is Clearwater County (Gunderson and Beer 1953:88).

Microtus longicaudus (Merriam), Long-tailed Vole —

Recent records of this species in Montana indicate that it may range into northwestern Carter County, about 45 miles from the western border of North Dakota (Hoffman et al. 1969a:592).

Synaptomys cooperi Baird, Southern Bog Lemming —

Hall and Kelson (1959:761) show the range of this species to cover the southeastern part of North Dakota. There are no known records for the state, however. In Minnesota it is reported from Clearwater and Mahnomen Counties in the northwestern part of the state (Iverson et al. 1967:193).

Synaptomys borealis (Richardson), Northern Bog Lemming —

Recorded from southeastern Manitoba (Hall and Cockrum 1953:479) and central Roseau County, Minnesota (Gunderson and Beer 1953:109). The latter record brings it to within 60 miles of North Dakota.

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Note:

PILEATED WOODPECKER EATING RUSSIAN OLIVE FRUITS. — Vegetable materials are known to be regular dietary components for the Pileated Woodpecker (*Dryocopus pileatus*). Beal (U.S. Dept. Agr. Bull. 37, pp. 1-64, 1911) found 27.12% vegetable and miscellaneous (non-insect) materials in 80 stomach analyses over an annual cycle. Hoyt (Ecology 38.2, pp. 246-256, 1957) recorded utilization of about 25% vegetable matter in the diet as an annual average. She also noted seasonal variations, with fruit and mast materials being used mainly in the fall. Fruits used included grapes, Virginia creeper, sumac, wild cherries, poison ivy, and dogwood.

Analyses of 26 Pileated Woodpecker droppings from two excavation sites in Grand Forks, North Dakota during early February to mid-April 1976 revealed the presence of Russian olive seeds (*Eleagnus argentea*). Data were insufficient to speculate on quantitive or qualitative dietary importance of Russian olive fruits beyond merely their use by this one woodpecker. This, as far as is known, is the first recorded instance of Pileated Woodpeckers utilizing Russian olive fruits for food.

I thank Dr. R. D. Crawford for assistance with this project.—*Richard S. McVoy Department of Biology, University of North Dakota, Grand Forks, North Dakota 58202.*

Decline of Year-Class Strength of Buffalo Fishes in Lake Sakakawea, North Dakota

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INTRODUCTION

Buffalo fishes are currently among the most important commercial fish in Lake Sakakawea (Berard 1976). Little information exists for North Dakota populations and their year-class composition needs documentation while the older, pre-full pool fish are still alive. Lake Sakakawea reached full pool for the first time in 1967, and reproduction of buffalo fishes under reservoir conditions is controlled by fluctuating water levels and quality of spawning beds that are flooded at the time of spawning each year.

Water levels required for successful spawning, hatching, and survival of fishes in large multi-purpose reservoirs on the Missouri River are not uniformly available each year. Quality of spawning beds also is related to water levels, because buffalo fishes require submerged vegetation for best spawning success. After the reservoir reached full pool in 1967, submerged vegetation would be expected to be less available and reproduction less successful.

METHODS

The buffalo fish used in this study were obtained from Grasteit Dakota Fisheries, a commercial fishing operation headquartered in Newtown, North Dakota. Fish were captured by either large mesh (four inch bar measure) gill nets or smaller mesh (two inch bar measure) seines. Fish were sampled as they were unloaded from the commercial fishermen's truck in order that the data might be as random as possible.

Scales were removed from near the lateral line on the fish. Because large scales from older fish tend to be nearly opaque, they were impressed on acetate slides. Scales were read (aged) by counting growth rings with the use of a Bausch and Lomb microprojector.

RESULTS

All fish taken during the course of this study proved to be either bigmouth buffalo (*Ictiobus cyprinellus*) or smallmouth buffalo (*Ictiobus bubalus*). Two hundred two bigmouth buffalo were aged and their year-class composition is listed in Table 1. One hundred thirty-eight smallmouth buffalo were aged and their year-class composition can be found in Table 2.

TABLE 1. Year-class composition of bigmouth buffalo captured in Lake Sakakawea during 1977.

Year-class	Age group	No.	%
1976	I	0	0.00
1975	II	0	0.00
1974	III	1	0.49
1973	IV	6	2.97
1972	V	0	0.00
1971	VI	10	4.95
1970	VII	0	0.00
1969	VIII	26	12.87
1968	IX	0	0.00
1967	X	19	9.41
1966	XI	43	21.29
1965	XII	33	16.34
1964	XIII	39	19.31
1963	XIV	25	12.37
		202	100.00

TABLE 2. Year-class composition of smallmouth buffalo captured in Lake Sakakawea during 1977.

Year-class	Age group	No.	%
1976	I	0	0.00
1975	II	0	0.00
1974	III	11	7.97
1973	IV	6	4.35
1972	V	0	0.00
1971	VI	3	2.17
1970	VII	1	0.73
1969	VIII	11	7.97
1968	IX	0	0.00
1967	X	5	3.62
1966	XI	58	42.03
1965	XII	11	7.97
1964	XIII	22	15.94
1963	XIV	6	4.35
1962	XV	4	2.90
		138	100.00

DISCUSSION

As stated before, Lake Sakakawea reached full pool for the first time in 1967. Year-classes before this year (age groups XI to XV) are strong in both bigmouth and smallmouth populations, making up over 73% of the smallmouths that were aged and over 69% of the bigmouths that were aged. After the full pool elevation was reached, there was a dramatic decrease in year-class strength, with many year-classes being so weak that they were not collected during this study. In 1969, however, the pool elevation rose to 0.8 feet above the full pool level. Fish produced that year (age group VIII) constitute a moderate strength year-class, making up nearly 8% of the smallmouths and nearly 13% of the bigmouths that were aged.

Data collected in this study show that both bigmouth and smallmouth buffalo reproduction is closely related to water levels. The year-classes produced before the full pool elevation was reached are very strong in Lake Sakakawea, with a marked decline occurring after that time. This same phenomenon has also occurred in other Missouri River mainstem reservoirs, including Lake Sharpe (Elrod and Hassler 1971), Lake Francis Case (Gasaway 1970), and Lewis and Clark Lake (Walburg and Nelson 1966).

For more detailed information, the reader is referred to Willis (1978).

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Walburg, C. H. and W. R. Nelson. 1966. Carp, river carpsucker, smallmouth buffalo, and bigmouth buffalo in Lewis and Clark Lake, Missouri River. U.S. Fish and Wild. Ser. Res. Report 69. 30 pp.

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Book Reviews:

BIRDS OF THE PRAIRIE PROVINCES

The Birds of Alberta. W. Ray Salt and Jim R. Salt. 1976. Hurtig Publishers. Edmonton, Alberta. 498 pages. $10.00.

W. Ray Salt first published *The Birds of Alberta* in 1948 and revised it with co-author A. L. Wilk in 1958. Now, twenty years after the revision, Ray Salt and his son Jim R. Salt have produced this excellent and long-needed third edition. The new volume treats all 329 species known to have occurred in Alberta by July 1975. Only species documented by specimens or "other material evidence" are included. Twenty-six species for which there are only sight records are on a hypothetical list. The authors promise to keep this edition up to date, and an example of their dedication is on page xiv which includes four species added to the provincial list in the fall of 1975.

The complete title "The Birds of Alberta with their ranges in Saskatchewan and Manitoba" calls attention to a welcome feature. While covering only species whose presence has been confirmed in Alberta, the range of those species in all three of the prairie provinces is included in both text and range maps.

Each species is allotted approximately one page of text, and most species are illustrated by a half-page color photograph or painting, and a few black-and-white line drawings. The species accounts follow the order of the 1958 edition of the AOU check-list, and incorporate the changes published in the 1972 Auk. Separate English names for each subspecies are, thankfully, discontinued except where subspecific differences are very obvious in the field, (e.g. Red-shafted and Yellow-shafted Flicker). A checklist includes all subspecies in the province.

Each of the 52 families is introduced by a few lines giving the main characteristics of its members. The species accounts include: a description; a paragraph on identification comparing the species with forms with which it is likely to be confused; information on the nest, nest site, clutch and color of the eggs; and the species' entire range and details of the range on the prairies. Finally there is a section of remarks where the authors indulge themselves with information on the ecology, breeding biology, migration, song, conservation problems, folk lore, physiology, etc., in short, anything that strikes their fancy.

Thirty-three photographers are acknowledged for contributing their work. It is too bad that the photographic quality could not have been more uniform. The photographs vary widely in their appeal and usefulness. Many are too flat (Cooper's Hawk and Golden-crowned Sparrow) or too blue or green (Vesper Sparrow and Sprague's Pipit). Some are not in focus (House Finch and Thayer's Gull) and some are not useful for identification because of the angle at which they were taken. For example, I cannot distinguish the Lapland Longspur photograph from that of a Vesper Sparrow. Juvenile Whooping Crane and Lesser Yellowlegs are not captioned as such. Finally, the names of the plates of the Chestnut-collared Longspur and the Snow Bunting are reversed.

Having said all that, I don't want to leave the reader with the wrong impression. The majority of the photographs are good and many are beautiful.

The authors are commendably concerned about conservation and environmental relations and have taken every opportunity to comment on various problems. Well and good; but their approach is to uncritically blame human activities for every problem real or imagined. Some claims of society's guilt are exaggerated and some incorrect. For example, we are told that the Wood Duck has extended its range westward in search of suitable nesting sites as eastern forests have been destroyed, and also that the recent appearances of the Great Crested Flycatcher in Alberta are probably the result of destruction of habitat farther east, and again, that the Ringnecked Duck is extending its range into more southerly parts of the mountains and foothills of Alberta because of destruction of many ponds and small lakes in the muskeg regions it usually inhabits.

The ability to disperse is a fundamental characteristic of all plants and animals and dispersing individuals are repeatedly found outside the normal range of most species. When conditions are suitable range changes can be rapid and spectacular. Many northward range extensions in Scandinavia have been documented and the cause attributed to slight amelioration of the climate of that region. The range extensions mentioned above could equally be related to climatic factors, or the result of genetic factors if the population has by natural selection broadened its habitat tolerances or enhanced its competitive abilities. To suggest that a species extends its range "in search of suitable nesting sites elsewhere" ascribes a purposiveness to animal range changes that is simply not supportable. Furthermore, to claim as endangered the Sprague's Pipit, whose aerial song floats down over many thousands of square miles of prairie habitat each spring, strains credulity.

Ecologists and conservationists should above all try to be effective in their public statements, scrupulously factual in discussing problems, and both judicious and restrained in their claims, predictions and in assigning guilt. Nagging won't do. Conservation is only hurt by accusations that are seen by the public to be exaggerated or wrong.

There are other attitudes displayed in the book which I thought curious. For feminist bird watchers there is even sexism. Mating pursuit flights of ducks (salaciously called "rape flights" by waterfowl biologists) are not mentioned at all, whereas in the species account of Wilson's Phalarope, a member of a family in which the usual sex roles are reversed, we read of females competing for males and indulging in "unladylike brawls" and of the males succumbing to the "wiles of the winner" and becoming the "most henpecked husband of the bird world." Fie on you chauvinist authors!

The authors understand and indeed they continually justify the predatory role of the raptorial birds, but nest parasitism, certainly a rarer and more fascinating adaptation, is just too much. Thus we read that from the cowbird egg "a monster is hatched" and the young cowbird gets the "lion's share" of the food, and that it can "soon push the other young out of the nest." All of which makes the authors wonder if cowbirds are on balance really "beneficial" species. This sort of moral outrage was unexpected. I had hoped that in our slow striving for a conservation ethic we were past making this kind of moral judgment. It is curious that the authors, both of them professional biologists, adopt these attitudes; I hope they have misjudged their audience.

On the whole this book is well written, up to date and informative. Despite my comments I think it is a very big improvement over the previous edition and I recommend it unreservedly to anyone interested in the bird life on the Canadian prairies.

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WILDLIFE OF THE PRAIRIES

Wildlife of the Prairies and Plains. Keith E. Evans and George E. Probasco. 1977. USDA Forest Service, North Central Forest Experiment Station, 1992 Folwell Avenue, St. Paul, Minnesota 55108. General Technical Report NC-29. 18 pages (paper). No charge.

The pamphlet *Wildlife of the Prairies and Plains* provides a very broad view of the North American grasslands, the wildlife species found within the eight major grassland types, and some of the relationships of animals and plants within these areas.

The introductory historical background of grassland use is followed by sections addressing: (1) The Resource (terrain, soil, climate, vegetation and wildlife species) and (2) Habitat Management (general requirements of wildlife species as well as problems in management). The Discussion section outlines two alternatives for future management and zeros in on the problem of who is going to pay the bill for wildlife production.

Although many game as well as non-game species are considered individually and as groups, no mention is made of how the alteration of grasslands through cultivation or other use made possible the establishment of exotic species (primarily game birds) through introduction by man.

It was rather surprising that there was so little specific reference to public lands found within the various grassland types. Information on how these are being managed to benefit wildlife species or specific recommendations (in view of public ownership) on how they could be more efficiently managed to benefit all species would have added to the publication.

The contents of the report can be summed up for the most part as basic and general. The information presented should provide enough facts to keep the student and layman interested while stimulating him into thinking about some of the grassroots problems facing the land manager, and in so doing will make a contribution to better habitat management.

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DISTRIBUTION PATTERNS OF GREAT PLAINS PLANTS

Atlas of the Flora of the Great Plains. T. M. Barkley, Editor. 1977. Iowa State University Press, Ames. 600 pages. $25.00.

Not since 1932, when P. A. Rydberg's *Flora of the Prairies and Plains of Central North America* was published, has the Great Plains region had a book about its unusual and diversified flora. Rydberg's book has long been outdated by taxonomic changes and better distribution records, but the only other sources were a few state floras that have appeared in recent years. Now there is a monograph that documents the records of distribution of all vascular plants in the region extending from the Canadian border to the Texas panhandle and from the Rocky Mountains east to the beginnings of the continuous woodland in Minnesota, Iowa and Missouri. Compiled by a team of 11 taxonomic botanists at colleges and universities in the Great Plains states under the coordination of Dr. R. L. McGregor of the University of Kansas, this book contains dot-distribution maps for each of the nearly 3,000 species of vascular plants that naturally occur in the area, except for those that are either rare or of restricted occurrence. Records of the latter are listed in a table at the end of the volume. There is no text, only a three-page introduction. The maps and the list are both arranged in the conventional taxonomic sequence beginning with clubmosses and selaginella and ending with the flowering plants. There is an index to the families and genera and the common names.

The plant most frequently recorded (i.e., recorded from the largest number of counties) in the region appears to be the prairie coneflower (*Ratibida columnifera*) which has been found in all counties in Kansas, all but 17 in Nebraska, all but 9 in South Dakota and all but 3 in North Dakota. It seems clear from the maps that the distribution of plants in Kansas is better known than that of any other states.

Most of the maps show north-south trends; to a large extent this probably represents the distributional pattern. In other cases, the lack of dots in counties outside the region (even though those counties appear on the maps) gives this impression. A better understanding of the overall distribution and of the patterns would have come with the addition of a small inset map showing the North American distribution for each species.

It is hard to tell from some of the maps if the patterns are due to disjunct distributions or to inadequate collecting. This is especially true in the western part of the region, areas far removed from the colleges and universities where the researchers are located. Little bluestem (*Andropogon scoparius*) is a case in point. It is recorded from every county in Kansas but only 50 of 93 counties in Nebraska, 30 of 67 counties in South Dakota and 40 of 53 counties in North Dakota. The dandelion (*Taraxacum officinale*) is also recorded from every Kansas county but from many fewer counties in the other states. Alfalfa (*Medicago sativa*) is found in every county in Kansas and in most North Dakota counties but in less than 20% of South Dakota counties and in less than 30% of Nebraska counties. All three of these species probably occur in every county in all four states. Box elder (*Acer negundo*) distribution also illustrates the variation in extent of knowledge of plant distribution in each state. The map of this species shows western Missouri and eastern and northern Kansas covered with dots while the other states have many fewer.

Poison ivy (*Toxicodendron rydbergii*) is recorded from only 4 counties in North Dakota and sparsely from all the other states except western Kansas. Stevens in his *Handbook of North Dakota Plants* recorded poison ivy as "a common and troublesome plant, growing in all sorts of places all over the State." Thus, if the dots on the map of this species represent the only records known to taxonomic botanists in this region, then they must have been avoiding the species in the field.

This book is large and attractively bound; the printing is of good quality. While the price may put it out of the reach of all but the most dedicated botanists, it seems appropriate for the size and content. The *Atlas* is not only a document of plant distributions, but also a checklist of the vascular plants of the region. As such, it will be of value to both amateur and professional botanists.

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LEOPOLD IN COLOR

A Sand County Almanac Illustrated. Aldo Leopold. Photographs by Tom Algire. 1977. Tamarack Press, Madison, Wisconsin and Oxford University Press, London. 152 pages. $25.00.

Tamarack Press has come up with a new version of *the* classic work in conservation. The text is untouched: how could one improve on Leopold's prose? The "newness" is in the collection of color photographs interspersed throughout the text. The photographs are excellent, but do not seem to correspond closely with the text. On page 49, for example, Leopold discusses the woodcock and its courtship "sky dance." The facing page features, not a typical display area used by woodcocks, but a sunrise scene over the Wisconsin River.

Whatever the photography adds or detracts, the words of Leopold still work their magic. Each re-reading of *A Sand County Almanac* evokes welcome memories of earlier readings, and brings fresh insight into Leopold's thinking. Ideas newly noted on this occasion included the comment on "wheating land to death" in the western prairies (page 21). Leopold's definition of a conservationist (page 118) neatly separates the "preservationist" and the exploiter: "A conservationist is one who is humbly aware that with each stroke [of his axe] he is writing his signature on the face of his land." And his recognition (page 127) that tree diseases made his woodlot "a mighty fortress, unequaled in the whole county," should be noted by the modern-day foresters who crave "clean" woodlands.

The major concern with this version is the photographs. They give it the appearance of a coffee-table book, but Leopold is meant to be *read*, not displayed. If the photographs attract readers, then they are well worth the extra costs they entail. If the photographs distract the reader from Leopold's words, that reader would be far better served by an inexpensive paperback version.

Staff

Annual dues are $3.00 for Members, $4.00 for Family Membership, $10.00 for Supporting Membership, $25.00 for Patron, and $50.00 for Sustaining Associate. Library subscriptions are $6.00 per year. All memberships include subscriptions to *The Prairie Naturalist.* Correspondence concerning membership should be directed to the North Dakota Natural Science Society, P.O. Box 1672, Jamestown, North Dakota 58401.

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Manuscripts will be accepted from members of the North Dakota Natural Science Society and should be sent directly to the Editor. Allow about one month for manuscript review. Authors should follow a clear and concise style: the *A.I.B.S. Style Manual* is a good reference.

Articles should be typewritten on one side of 8½x11 inch paper of good quality, double-spaced throughout, and have a one inch margin all around. All pages should be numbered serially beginning with the title page. Longer papers may have sections with appropriate headings.

Footnotes should be used only when the material cannot be incorporated effectively in the text and should be numbered consecutively throughout the paper with superscript in Arabic numerals. Footnotes in the text should be written out on a separate page of the manuscript.

References: Authors cited in the text should be indicated by family name followed by year of publication, e.g., (Wade 1967). When a citation has more than two authors, the name of the first author followed by *et al.* should be used: thus: (Reilly, *et al.* 1967). Where more than one paper by the same author(s) have appeared in one year, the convention will be: (Stewart 1967a,b). Journal title abbreviations listed in the 4th edition of the *World List of Scientific Periodicals* should be used.

References cited in the text should be written out on a separate page of the manuscript under the heading: Literature Cited. The correct style is as follows:

> Frings, H., M. Frings, B. Cox & L. Peisner. 1955. Auditory and visual mechanisms in food finding behavior of the herring gull. *Wilson Bull. 67:155-170*

Illustrations should be done in black ink on firm paper. They should be identified on the back lightly in pencil with number and author's name, indicating "top." Prints of figures should be sharp, clear, and glossy. Captions should be typed on a separate sheet at the end of the manuscript. Indicate approximate point of insertion in the text. Illustrations that do not relate significantly to the text will be deleted.

Tables should be typed on separate sheets, indicating approximate point of insertion in the text. Authors are encouraged to record data in tabular form but must avoid incorporation of data of little relevance to the readers.