A DISTRIBUTION STUDY OF SOME SMALL MAMMALS THAT ARE IMPORTANT TO THE PUBLIC HEALTH OF ALBERTA

by

Wm. H. Lawrence

A DISTRIBUTION STUDY OF SOME SMALL MAMMALS THAT ARE IMPORTANT TO THE PUBLIC HEALTH OF ALBERTA

By William H. Lawrence

A Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree
of Master of Forestry in the
University of Michigan.
Ann Arbor, Michigan
January 1948

PREFACE

The writer wishes to express his deep appreciation to Mr. J. H. Brown, Director of the Alberta Plague Survey and of the Division of Entomology, Alberta Department of Public Health for securing the funds and equipment necessary to undertake this study.

Many thanks are due to Drs. W. W. Chase, E. C. O'Roke and S. A. Graham for helpful suggestions in the preparation of the manuscript and to Professor E. H. Moss of the Department of Botany, University of Alberta for information on the vegetation zones of the province.

In the conception of this paper it was necessary for the writer to keep in mind the two uses which the paper would serve. The first consideration was the preparation of a thesis acceptable to the School of Forestry and Conservation in partial fulfillment of the requirements for the Degree of Master of Forestry. The second consideration to be kept in mind was the use of the paper as a report to the Director of the Division of Entomology, Alberta Department of Public Health on the results of a research project financed by that division.

The portion of the paper dealing with the role of small mammals in the epidemiology of several important diseases occurring within the province is a brief review of the literature on this subject and has been included as background material to round out the thesis.

Table of Contents

List of Tables, Maps,, Figures, and Photographs

Page

TABLES

FIGURES

MAPS

DISTRIBUTION MAPS

Page

PHOTOGRAPHS

Page

INTRODUCTION

During the Spring semester of 1947, Mr. J. H. Brown, Director of the Division of Entomology, Alberta Department of Health contacted the Dean of the School of Forestry and Conservation of the University of Michigan regarding the possibilities of employing a graduate student assistant for the summer. This student would be expected to assist the division's field parties (Alberta Plague Survey) in collecting data for a small mammal survey of the province. Mr. Brown thought the type of work projected for the summer would provide sufficient data for the basis of a Master's Thesis.

The mammal survey was to deal mainly with the small rodents collected for epidemiological studies by the plague survey. Identification, distribution by habitat types, range extensions, censusing techniques and the establishment of a reference collection were among the problems to be considered by the student assistant.

The writer, being given the opportunity to assist in this study, left for Alberta in June and was able to spend two months in the field with the survey crews. During this two months period collections totalling 105 specimens were made from all major soil and vegetation

zones of the province. The area covered was north from the International Boundary as far as the roads permitted and east and west to the provincial boundaries of British Columbia and Saskatchewan.

THE ROLE OF SMALL MAMMALS IN THE EPIDEMIOLOGY OF IMPORTANT INSECT BORNE[1] DISEASES OF ALBERTA

As mentioned in the preface, this portion of the paper has been included as background material for a better understanding of the importance of small mammals to the public health of the province. The epidemiological importance of small mammals is discussed for only those diseases with which the Alberta Plague Survey is concerned; namely sylvatic plague, Rocky Mountain spotted fever, tularemia, and equine encephalomyelitis.

Sylvatic Plague

Genus Citellus: The history of sylvatic plague (Pasteurella pestis, causal organism) in the province dates from the first positive determination of this disease in the Richardson ground squirrels (Citellus richardsonii) of the Stanmore area in 1939. (Gibbons and Humphreys 1941, pp. 27) In 1937, two years prior to the discovery of plague in the province, a mink rancher near Stanmore, Alberta died of a disease which now in retrospect is highly suggestive of plague. The evidence collected concerning the rancher's death, though circumstantial, supports the hypothesis that the mink first became infected from the ground

---

1/ The term "insect borne" is used loosely and includes other arthropod borne diseases.

squirrels and the rancher in turn contracted the disease from the mink (Gibbons and Humphreys, 1941).

How this ground squirrel originally became infected is not yet understood. Work of the Alberta Plague Survey 1938-47 (Alberta 1938-47) indicates the presence of this disease in mammals is limited to this single species and that the plague infected area though increasing in size is isolated from any of the known plague foci in the States.[2]

Meyer (1942 a) hints that plague may be endemic to North America. However at the present time general agreement among public health workers is that plague was introduced on the West Coast in the early 1900's by infected rats from the Orient (Eskey and Haas 1940, pp. 1). Hampton (1940, pp. 1147, 1152-1156) prepared maps and a table indicating the eastward spread of this disease from 1900 to 1939; such data supports the introduction theory.

J. H. Brown (in conversation) speculated on the possibility of the burrowing owl (Speotyto cunicularia), a migratory form, as a possible means of transport for infective fleas. Brown in Alberta and Jellison (1939) in

---

2/ In 1939 positive plague determinations had been made in four townships, 144 sq. miles. Now the plague area of the province embraces some 30 townships, 1080 sq. miles.

Montana have recovered from this owl's burrows, fleas known to infect rodents (ground squirrels) and to transmit plague.

Plague is maintained in nature by the exchange of infective ectoparasites between the rodents. Eskey and Haas (1939, pp. 1477) list the fleas Opiscrostis labis J & R, O. tuberculatus B., and O. rupestris Jord (and possibly other ectoparasites) as definite insect vestors of infection.

Other members of the Genus Citellus occurring in Alberta (C. franklinii, C. lateralis, C. columbianus, C. tridecemlineatus) are of seemingly minor importance at the present time. All species with the possible exception of C. lateralis, the golden mantled ground squirrel, have overlapping ranges with the Richardson ground squirrel. This may be important in the light of findings reported on by Hampton (1940). In the Western States the Columbian and golden mantled ground squirrels are known carriers of plague. However, the presence of this disease in these species has not been demonstrated in Alberta. The remaining two species, Franklin and 13-lines ground squirrels occur in such limited and scattered numbers that if plague infected populations did exist they would be of minor importance. Work done in the States by the

U. S. Public Health Service and Charles William Hooper Foundation for Medical Research indicate that a great number of the rodents found in the province are potential carriers of plague.

However the role played by these other rodents is of secondary importance as the ground squirrels (Citellus) are considered the primary carriers of plague (Myer 1942 b). The plague infection usually spreads from ground squirrel populations when an epizootic is developing. During the "low periods" in plague incidences, the disease is found in the primary carriers, ground squirrels.

Order Lagomorpha: Eskey and Haas (1940) report that the sage brush cottontail (Sylvilagus nuttallii) has been found carrying the plague organism. How important this species is in the epidemiology of sylvatic plague is not yet known, but it is probably of secondary importance. A sub-specific form of this cottontail, grangeri (Black Hills cottontail) is found in the southern portions of Alberta. Results of the mammal survey indicate that this form probably occurs in very limited and scattered numbers and hence would be of minor importance as a carrier of plague in the province.

Eskey and Haas (1940 pp. 13) have prepared a list of genera and species from which the plague organism has

been recovered. Many of these genera have representatives in the fauna of Alberta; in many instances the Alberta forms are sub-specific to those listed for the States.

Table I (modified from Eskey and Haas 1940) summarizes the present information relating to the occurrence of sylvatic plague in natural populations of small mammals.

Rocky Mountain Spotted Fever

Compared to Rocky Mountain spotted fever elsewhere in North America, the history of spotted fever in Alberta is rather recent, dating back to 1935 when the first known human case was recorded. After the discovery of this disease within the province public health officials organized R. M. S. F. vaccination clinics in the vicinity of the disease foci. The establishment of these clinics has been very successful in reducing the number of human cases.

Brown and Roy (1943 pp. 182) concluded from their studies on the Richardson ground squirrel that this species acts not only as the main host in Alberta of Dermacentor andersoni Stiles, the Rocky Mountain spotted fever tick but as an important reservoir of this disease in the province.

Many workers believe that small rodent and rabbit populations can act as a natural reservoir of spotted fever,

but according to Jellison (1945 pp. 958) and Phillip (1947 AAAS Symposium of Rickettsial Diseases of Man, in press) conclusive evidence is lacking as no actual strains of the disease have ever been recovered from natural animal populations.[3]

Studies indicate that the continued presence of the rickettsiae of spotted fever in a tick population (D. andersonii) is not dependent on a reservoir of infective rodents. (Steinhaus 1946 pp. 333). The rickettsiae are passed from development stage to development stage, i.e., egg-numph-adult. Since the rickettsiae may be transmitted from one individual tick to another during copulation (Phillip & Parker 1933), the disease can be transmitted from one generation to the next.

Investigations conducted by the Alberta Plague Survey indicates that spotted fever is not wide spread throughout the range of D. andersonii but is localized about four centers, Lethbridge, Manyberries, Whitla and Redcliff. (Alberta 1945).[4]

3/ Possible exception is an unverified report by Hassler, Sizemore and Robinson (Parker et al 1943) of the recovery of a spotted-fever-like infection from a pocket gopher (Geomys breviceps). The strain was lost before cross immunity tests could be made with a known strain of spotted fever.

4/ This tick is distributed north from the International Boundary to the Red Deer River (Drumheller) then west to Lake Louise. The area of highest concentration is south of the Canadian Pacific R. R. right-of-way between MacLeod and Walsh south to the International Boundary. (Brown & Roy 1943)

TABLE I

North American Mammals Known to be Naturally Infected with Plague

(modified after Eskey and Haas '40)

Genera	Species	
	Known carriers in U. S.	Potential carriers in Alberta
Citellus	richardsonii	richardsonii (known carrier)
	columbianus	columbianus
	lateralis	lateralis
Marmota	flaviventris	monax
Cynomys	sp.	?
Eutamias	quadrivittatus	quadrivittatus miminus
Neotoma	cinerea	cinerea
Peromyscus	truii	maniculatus
Tamiasciurus	douglasii	hudsonicus
Glaucomys	sabrinus	sabrinus
Sylvilagus	nuttallii	n. grangeri

Tularemia

Rodents: Ozburn (1944) first reported the presence of Pasteurella tularensis, the causal organism of tularemia, in the Richardson ground squirrel in a paper presenting the results of a disease survey conducted by the Army. Prior to this, Gibbons (1938) reports the disease organism in the ticks (D. andersonii) found in southern Alberta. A great variety of animal hosts and many vectors have been demonstrated for this disease (Steinhaus 1946, recent summary of the literature pertaining to tularemia; Ozburn 1944, Richardson ground squirrel, Osgood white-footed mouse, Drummond meadow vole, Franklin gull; Bow and Brown 1943, white-tailed jack rabbit; Gwatkin 1942, sheep; Jellison et al 1942, beaver in Montana; Shaw and Jamieson 1932, Northern Alberta; Parker et al 1931, American varying hare) so that it is difficult to designate a single species as the most important reservoir.

The wide-spread range and great numbers of the Richardson ground squirrel plus the fact that this species is an important host of D. andersonii no doubt makes it one of the more important natural reservoirs for this disease in Alberta.

Lagomorpha: The presence of tularemia has been demonstrated in two of the three species of rabbits found in

the province.[5] Bow and Brown (1943) reported the occurrence of Pasteurella tularensis in the white tailed jack rabbit and Parker et al (1931) recovered this same organism from the varying hare.

In 1944 Jellison and Parker published an interesting study on some zoological and epidemiological considerations of tularemia. The results of their study indicated that 90 per cent of the human cases of tularemia are caused by some form of contact with rabbits (Sylvilagus sp.) and that members of the genus Lepus were of minor importance as sources of human infection. These results can probably be explained by the fact that members of the Genus Sylvilagus are prized more highly for game by the hunter than are the members of the Genus Lepus. The Black Hills cottontail probably plays a very minor role in the epidemiology of tularemia in the province as other known carriers of the disease are much more abundant and subject to a greater number of contacts with humans.

Tularemia possesses an "heredity" mechanicm similar to that of spotted fever permitting it to be passed from one generation to the next in D. andersonii (Steinhaus 1946 pp. 163). Again there is the possibility that a natural reservoir of infection (other than that existing

---

5/ The term rabbit is used loosely and refers to Lepus americanus, varying hare, Lepus townsendii, white tailed jack rabbit, and Sylvilagus nuttallii grangeni Black Hills cottontail.

in the insect vector) is not necessary for the continued existence of the disease. Field work of the Alberta Plague Survey indicates that tularemia is wide-spread in southern Alberta south of township line 24 (Brown 1943, pp. 56). This area roughly corresponds to the range of the D. andersonii.

Information pertaining to the occurrence of tularemia in wild animals in Alberta is summarized in Table II. (modified after Burroughs et al 1945) More work resulting in positive determinations of tularemia in Alberta makes the table more complete in this respect than was the table prepared for sylvatic plague.

TABLE II

North American Mammals Known to be Naturally Infected with Tularemia

(modified after Burroughs '45)

Genera	Species	
	Known carriers in U. S.	Known and Potential carriers in Alberta
Sorex	vagrans	vagrans
Citellus	richardsonii columbianus	richardsonii (known carrier) columbianus
Castor	canadensis	canadensis
Eutamias	sp.	sp.
Peromyscus	maniculatus	maniculatus (known carrier)
Neotoma	fuscipes	cinerea
Microtus	pennsylvanicus	pennsylvanicus
Ondatra	zibethica	zibethica
Lepus	americanus townsendii	americanus (known carrier) townsendii (known carrier)
Sylvilagus	nuttallii	nuttallii

Equine Encephalomyelitis

This disease in relation to the others discussed has the most recent history. The presence of the disease in horses in the province had been noted sometime before Gwatkin (1940) published the results of an experiment which indicated the presence of the virus of equine encephalomyelitis in the brain of the Richardson ground squirrel. This was the first indication that small rodents may play a part in the epidemiology of the disease. Brown and Roy (1943 pp. 188) in mentioning the work done by the plague survey on this disease believe that the Richardson ground squirrel plays an important role in the epidemiology of equine encephalomyelitis. It has been demonstrated by the same worker (Gwatkin) that mosquitoes (Culex) are capable of transmitting this disease.

Based on present epidemiological research the Richardson ground squirrel seems to play the role of a universal mammalian host for those insect borne diseases occurring within its distribution. The great abundance of this squirrel and the ease with which study material can be collected may account for this singular role.

METHODS OF STUDY

Statement of Objectives

Up to the present study little work had been done on the distribution of mammals within Alberta. With the increased knowledge about the epidemiology of insect borne diseases the importance of mammalian hosts becomes more evident. For this reason the Director of the Division of Entomology thought that a project organized to study the small mammals of the province should be established. The studies would be limited to those mammals with which the field survey parties would be concerned. The first task of the projected series of studies was the preparation of a reference collection of small mammals. Such a collection would be of value in the orientation of new personnel as most of the men employed for the summer's field work have medical backgrounds.

In conjunction with the preparation of the reference collection, distribution maps of the species collected were to be prepared. The maps included within this paper are copies of larger and more detailed office maps which were prepared first. The office maps will serve as a base on which to record further distribution data as it is collected.

The final objective of this study was the collection of ecological and natural history data which might be of some importance in the epidemiological studies of the division.

Study Methods

Prior to entering the field it was necessary for the writer to become acquainted with the various physiographic, vegetation, and soil zones of the province. In addition, it was essential to become familiar with the specialized field technique of the plague survey, regarding the handling of collected specimens. It was necessary to consider every specimen handled as potentially infected. The maintenance of aseptic conditions during the preparation of study skins was difficult.

As the mammal survey was to deal with those forms collected for epidemiological studies, a greater portion of the larger specimens of the reference collection were collected by crew members. Suitable specimens for skinning were selected from the day's kill. For the collection of the smaller mammals the live traps of a construction which permitted several specimens to be trapped during the set period were used.

The soils map prepared by the Alberta Soils Survey (1945) proved very useful as a guide in planning the field

work. Later, in the preparation of distribution maps, this map again proved useful. The distributions of the mammals treated in this paper were worked out using three sources of data; the unpublished reports and 10 year file of records of the Alberta Plague Survey, literature records, and information collected by the writer while accompanying the field crews.

Detailed field and catalogue notes were kept covering the day's activity, type of habitat, and methods of collecting.

A series of photographs were taken to illustrate the portion of the paper pertaining to the description of the various vegetation zones.

HABITAT ANALYSIS

Soil and Vegetation Zones of Alberta

Before the distribution map of a species is prepared, a study of the habitat requirements of the form in question should be made and the location and extent of its habitat type should be determined. Such a plan as this was followed in the preparation of the distribution maps for the species collected on the survey.

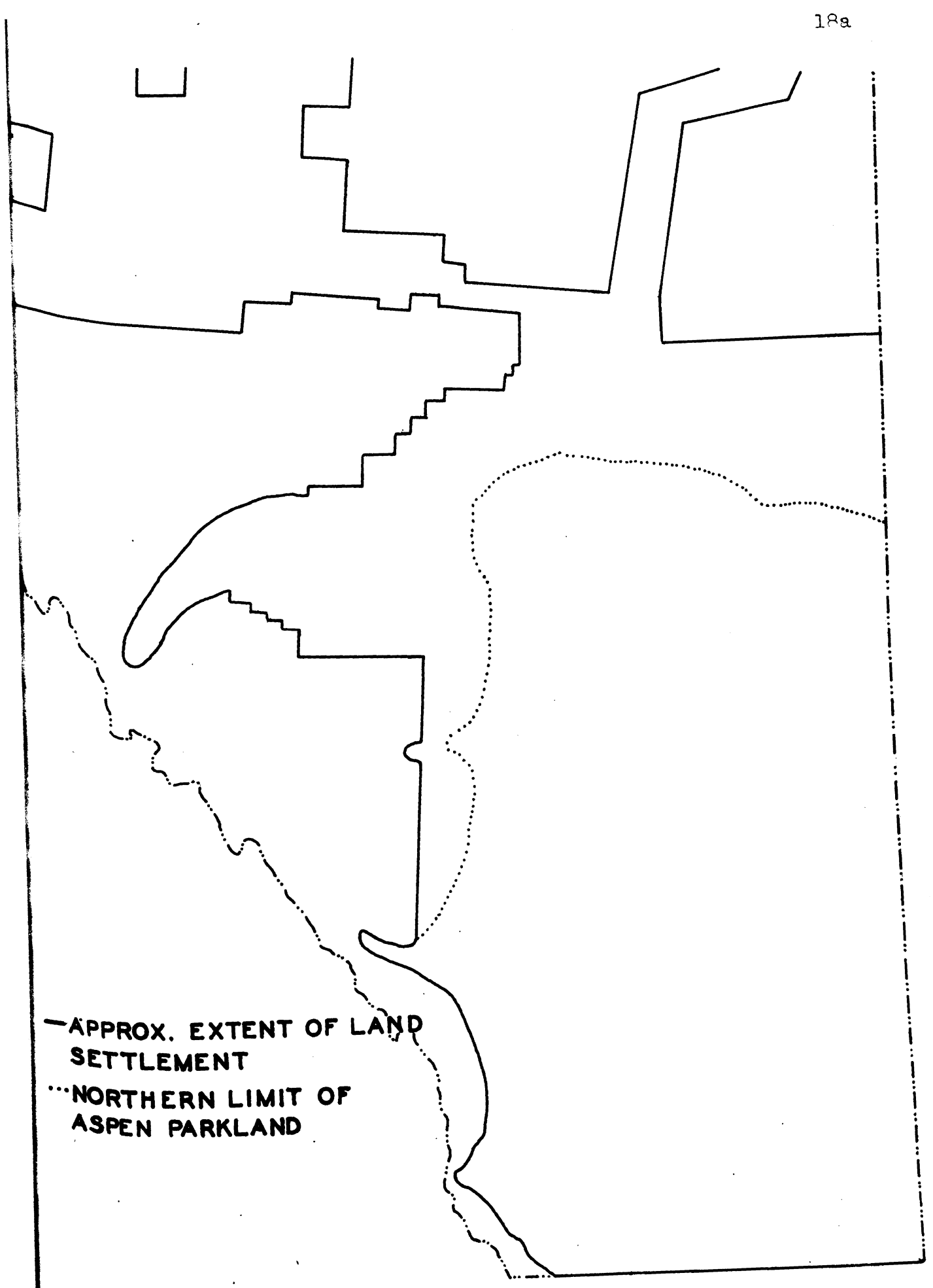
It was impossible for the writer to make any detailed studies of the vegetation of the province therefore the discussion of soil and vegetation zones are based on the studies of other workers. (Alberta Soils Survey 1945; Moss, correspondence, 1932, 1944, 1947; Lewis et al, 1928).

A simplified scheme of classification for the vegetation of Alberta was prepared using the data on soils collected by the Alberta Soils Survey and Moss's studies on the vegetation of the province.

The simplified vegetation classification recognized three main zones i.e. Prairie,[6] Parkland, and Forest which in turn are subdivided into five types --- prairie parkland, northern parkland, northern climax, forest, northern

---

6/ In terms of the plant ecologist this area is known as mixed prairie. (Clements & Shelford 1939)


—APPROX. EXTENT OF LAND SETTLEMENT
···NORTHERN LIMIT OF ASPEN PARKLAND

Map I

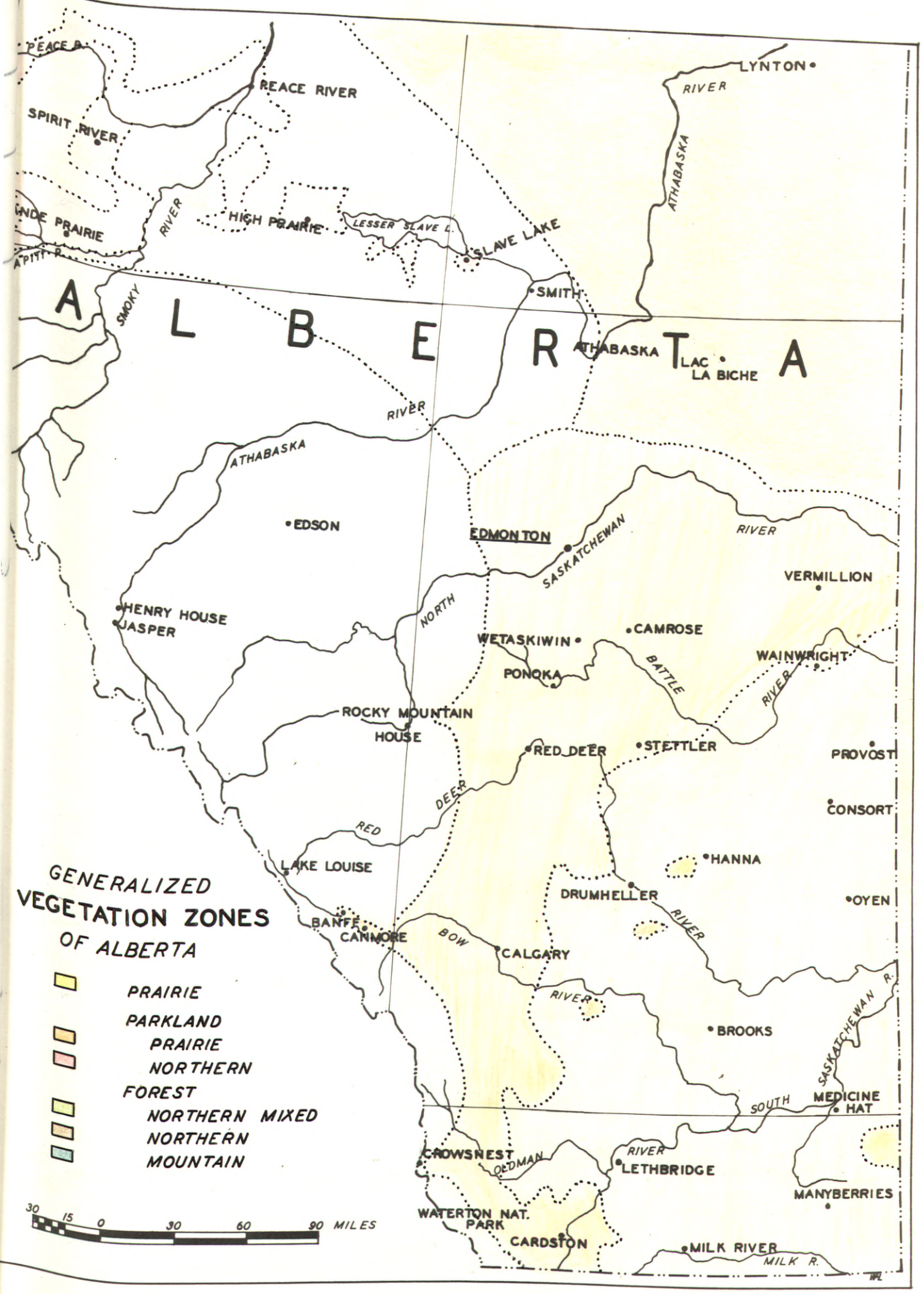
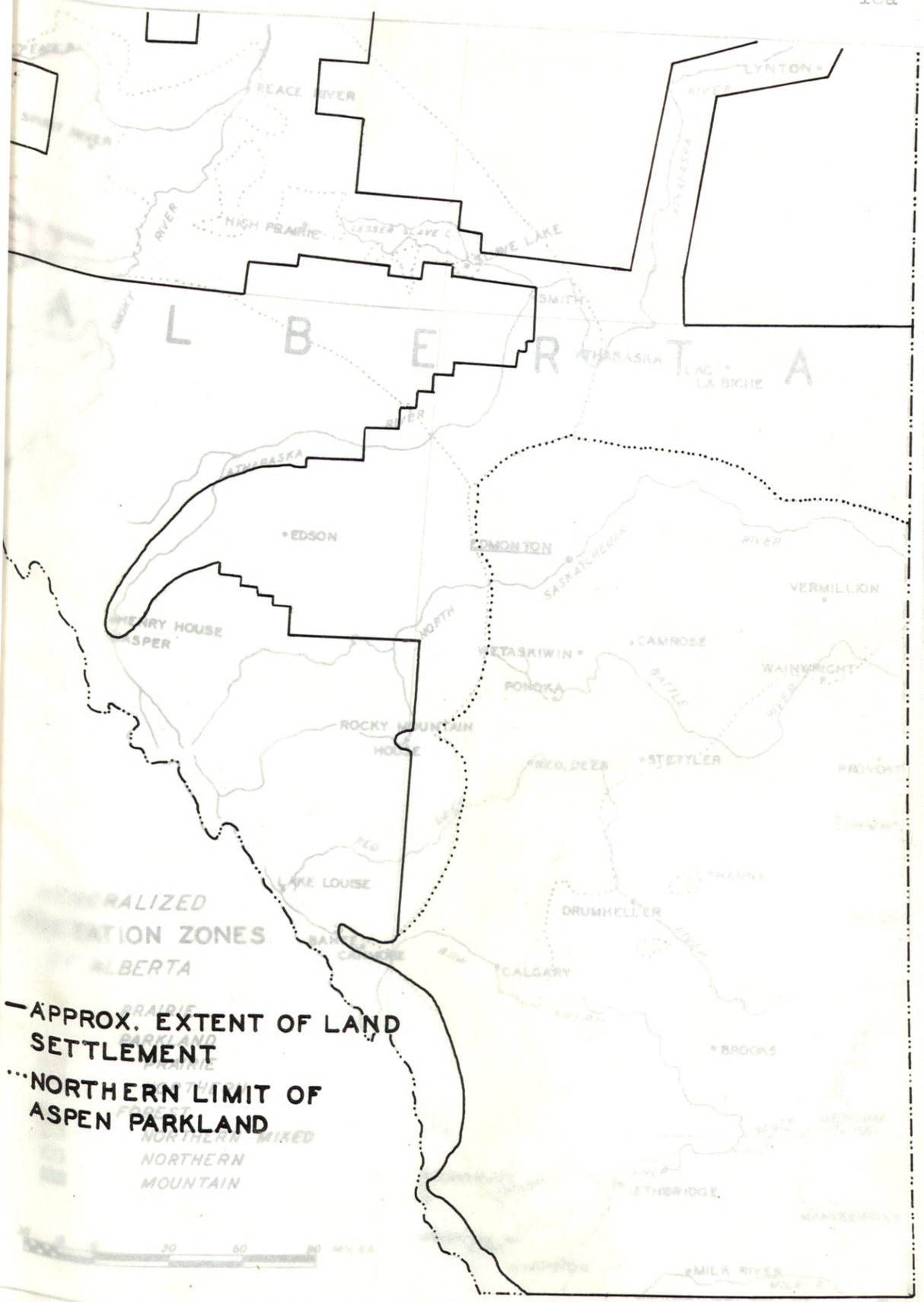


TABLE III GENERALIZED VEGETATION ZONES OF ALBERTA

GENERALIZED VEGETATION ZONES			SOIL ZONES	VEGETATION ZONES AFTER MOSS '32 '44
PRAIRIE			BROWN	SOUTHERN PRAIRIE (*BOUTELOUA-STIPA* ASSOC.)
			DARK BROWN (IN PART)	TRANSITIONAL TYPE (*AGROPYRON-STIPA* ASSOCIES)
PARKLAND	PRAIRIE		DARK BROWN (IN PART)	
			BLACK	NORTHERN PRAIRIE (*FESTUCA* ASSOCIATION)
			TRANSITION	POPLAR ASSOCIATION (LOCATED ABOUT EDMONTON)
	NORTHERN		TRANSITION	THE ECOLOGY OF NORTHERN PARKLANDS IS NOT YET WELL UNDERSTOOD.
FOREST	NORTHERN	CLIMAX	GRAY WOODED	NORTHERN FOREST (WHITE SPRUCE CLIMAX)
		MIXED		NORTHERN MIXED FOREST (LARGLY POPLAR)
	MOUNTAIN			CORDILLERAN FOREST



MAp I

TABLE III GENERALIZED VEGETATION ZONES OF ALBERTA

GENERALIZED VEGETATION ZONES			SOIL ZONES	VEGETATION ZONES AFTER MOSS '32 '44
PRAIRIE			BROWN	SOUTHERN PRAIRIE (*BOUTELOUA-STIPA* ASSOC.)
PRAIRIE			DARK BROWN (IN PART)	TRANSITIONAL TYPE (*AGROPYRON-STIPA* ASSOCIES)
PARKLAND	PRAIRIE		DARK BROWN (IN PART)	TRANSITIONAL TYPE (*AGROPYRON-STIPA* ASSOCIES)
PARKLAND	PRAIRIE		BLACK	NORTHERN PRAIRIE (*FESTUCA* ASSOCIATION)
PARKLAND	PRAIRIE		TRANSITION	POPLAR ASSOCIATION (LOCATED ABOUT EDMONTON)
PARKLAND	NORTHERN		TRANSITION	THE ECOLOGY OF NORTHERN PARKLANDS IS NOT YET WELL UNDERSTOOD.
FOREST	NORTHERN	CLIMAX	GRAY WOODED	NORTHERN FOREST (WHITE SPRUCE CLIMAX)
FOREST	NORTHERN	MIXED	GRAY WOODED	NORTHERN MIXED FOREST (LARGLY POPLAR)
FOREST	MOUNTAIN		GRAY WOODED	CORDILLERAN FOREST

mixed forest and the mountain forest of the Rockies. This classification is outlined in Table III with an accompanying map to show the location and extent of each type.[7]

A copy of the soils map prepared by the Alberta Soils Survey has been included in the appendix for reference.

7/ The map of the province extends northward to about township line 90, this is roughly 180 miles south of the northern boundary. The vegetation of the area not included in the map is largely the northern forest type.

DESCRIPTION OF THE VEGETATION ZONES

Prairie Zone: The climate is semi-arid to dry. The annual precipitation varies from 11 to 13 inches for brown soil zone to 13-15 inches for the dark brown soils to the west and north. Hot drying winds coupled with the low precipitation frequently cause droughts.

The vegetation is characterized by the Bouteloua-Stipa association of the drier region and the disclimax Agropyron-Stipa associes of the heavier soils. Some of the more characteristic species of the prairie zone are:

Bouteloua gracilis
Stipa comata

Important associated grasses

Koeleria gracilis
Agropyron Smithii) Characterized the
A. dasystachyum) Agropyron-Stipa
Stipa viridula associes.

Associated Shrubs

Rosa arkaniana
Elaeagnus argentea
Artemisia sp. (limited to more arid regions)

Cattle or sheep ranching is the predominant land use over most of the prairie zone. Much of the land suitable for ranching is leased from the government on a township basis. Moisture is the principal limiting factor to crop production and only those soils with the most favorable

moisture conditions can be considered arable. Where farming can be practiced small grains, predominantly wheat, are grown; however, the yield is uncertain. Dry farming procedures are necessary to protect the soil from drifting. Large areas in this zone were denuded in an early attempt (1920's) to farm the land. Most of the denuded land has been reseeded by the government and with the projected irrigation projects crop production is expected to be increased.

The topography of the prairie zone is typified by a flat to gently rolling landscape gradually sloping eastward. The low rolling prairie is broken only by the "bad land" formations of the deeply entrenched tributary rivers of the South Saskatchewan system. Scattered groups of hills i.e., Hand Hills, Wintering Hills and Cypress Hills, protrude above the flatness. These hills are of interest in that they are covered with the more mesophytic type of vegetation found in the parklands.

About 14% of the land area of the province is included within the prairie zone.

#1 This photograph was taken in the vicinity of Hanna looking south towards the Hand Hills. Much of this land abandoned during the drought period of the early '30's accounts for the absence of farm sites. The Dominion government's reseeding project has accomplished a great deal in the rehabilitation of this area. The absence of fences probably indicates that much of this land has reverted to government control. There is some indication that light grazing is permitted, however the maintenance of grass cover is of prime importance. It is this type of cover that provides an ideal habitat for the Richardson ground squirrel. Clouds seem to be the only scenery in such areas.

#2 Bad lands formation along the South Saskatchewan River near Medicine Hat. Note the presence of cottonwoods and aspens in the river flood plain. Such tongues of parkland vegetation occur across the plains along water courses. The vegetation of the Bouteloua-Stipa association characterizes the upland area. Small clumps of sagebrush (Artemisia sp.) are evident in the foreground. This species occurs on the drier sites of the plains.

#3 A farm site wind break near the interprovincial boundary with Saskatchewan in the brown soil zone. U-shaped wind break inclosing the home site and out-buildings is characteristic on the plains. A slough still containing water can be seen in the foreground. The 1947 summer was exceptionally wet, many sloughs remaining full during the whole summer providing the ducks and shore birds with suitable nesting areas. The soils of this area are more arable hence wheat farming is the predominant land use.

#4 A typical scene on the survey. The plague survey members preparing an autopsy site in the rear of an abandoned home site in the Hanna area. The truck carries the equipment necessary to set up a field laboratory for autopsying the specimens. Flea and tissue pools are expressed daily in iced containers to the laboratory at Kamloops, B.C. for further study. Two such field crews are maintained by the Alberta Plague Survey. The man in the center is digging the waste pit while the other crew member prepared the specimen for the collection of ectoparasites.

#5 Three farm sites are visible in this picture of the prairies near Hanna. This was taken north of the town on more arable soil. Wheat is the predominant crop on the better soils.

Parkland: The parkland vegetation of the province is of two types, the prairie parkland to the south and the northern parkland of the High Prairie--Grande Prairie-Peace River triangle. This subdivision of the zone is necessary as the two parkland types occur in widely separated areas and have different ecological histories.

The prairie parkland occurring in the southern half of the province are considered by some ecologists to be a transition zone between the northern coniferous forest and the grasslands of the Great Plains.

The northern parkland on the other hand is still an open question. The ecological relationships of this type to the prairie parkland and the intervening and surrounding vegetation (northern forest type) have not yet been determined. Local moisture and edaphic conditions probably resulted in the development of this type.

Prairie Parkland

The climate is considerably more moist than in the prairie zone. Droughts occur occasionally in the drier portions of the type adjacent to the prairies. The rainfall varies between 14-17 inches in the drier southern portions to 17-20 inches in the more moist northern portions adjacent to the forest zone.

Included within the prairie parkland type are three major soil series; the remainder of the dark brown soils (shallow black series according to Alberta Soils Survey 1944), the black soil series and a portion of the transition soil type. Each of the three soil types possesses a characteristic vegetation; enough similarity exists, however, so that they may be included in one broad zone.

The dark brown soils are characterized by the Agropyron-Stipa associes. Small groves of aspens (Populus tremuloides) begin to occur where there is sufficient soil moisture. The vegetation of the heavier black soils is the typical parkland type, grasslands with regularity occurring aspen groves.

Moss (1944) proposed the name of Festuca Association for the vegetation type found on the black soils. Some of the more important species of the type are:

Festuca scabrella
F. idahoensis
Danthonia intermedia
Populus tremuloides
P. balsamifera - moist river bottom sites

Important associated grasses

Koeleria gracilis
Agropyron Smithii
A. dasystachyum
Stipa spartia

Associated trees

Picea mariana)
Larex laricina) bogs and kettle holes

Associated shrubs

Rosa sp.
Elaeagmus argentea
Amelanchier alinfolia
Salix sp.

Spruce bordered bogs begin to be more abundant than the prairie type sloughs and shrubs.

A portion of the transition soil type has been included within the prairie parkland. As the name transition indicates, this soil type is intermediate to the gray podzol soils of the forest types and the black soils of the parkland. Although E. H. Moss (correspondence) does not believe this soil type is important enough to warrant separate consideration, it has been included to indicate the relationship of the simplified vegetation classification with the soils map in the appendix.

The vegetation of this soil type is similar to that of the rest of the parkland area except that tree growth is heavier and evergreens are more common (*Pinus banksiana* *Picea glauca*).

A local modification of the vegetation of the transition and black soil types occurs centered about Edmonton

and is known as the Poplar Association. In this wooded area aspen is the dominant species in the vegetation.

A high percentage of the Prarie parkland type is arable. The land is well suited to mixed farming and wheat and dairy products are the principal crops. Transition soils are subject to some bleaching so that they are usually not as fertile as the black soils. Non-arable land is generally well suited for use as pasture.

The general topography of the prairie parklands is similar to that of the prairies. The drainage for the most part is to the east as a greater area of the zone lies within the North Saskatchewan River Basin. The watersheds of Hudson's Bay and the Arctic Ocean meet in the northwestern corner of this zone, and along a portion of the northern boundary of the parkland the drainage flows northward into the Athabaska Basin. As in the prairies the rivers are deeply intrenched, but lacking the extensive development of the bad lands formation characteristic of the drier areas.

Vegetation of the more northern types extend out into the parkland along the water courses in the same manner as does the parkland vegetation extend out into the prairies along rivers.

About 15% of the land area of the province is included within prairie parkland type.

#6 Looking east, across a meander of the Red Deer River; east of the town of Red Deer. The river bank is steep, exceeding 150 feet in many places, but lacking the bad land formations so characteristic of the prairie river. The bank is subject to much less erosion due to the heavy cover of woody vegetation. Northern forest species can be found along the banks with a northern aspect. The flood plain visible on the north side of the river is a suitable site for the Balm of Gilead tree. (Populus balsamifera)

#7 A scene near the southern boundary of the prairie parkland looking West to the Rockies. Scattered clumps, of aspen occur where moisture conditions permit. The soil is much lighter than that of the parkland to the north. On arable land wheat is the principal small grain crop; oats are also grown. Non-arable land is suitable for ranching.

#8 Stock raising in the Red Deer area. Farm wood lots occur more frequently as one goes north in the prairie parkland zone. The land is better adapted to mixed farming practice.

Northern Parkland

The ecology of this type is not yet fully understood. Professor E. H. Moss of the University of Alberta is at present engaged in an ecological study of the type.

The average annual precipitation amounts to about 12 inches. This is considerably less than the average record for the southern parkland type. The reduced amount of rainfall in the High Prairie-Grande Prairie-Peace River triangle probably accounts for the presence of this grassland type within the northern coniferous forest.

With present knowledge (conversation with E. H. Moss) the vegetation of northern parkland or high prairie as it is some times called seems to be very similar to that of the prairie parkland. The only exception being that rough fescue (F. scabrella) is absent from the northern type. Tree growth is frequently more dense and conifers are more common. (Picea glauca, Pinus banksiana)

The fertility of the soil (transition and gray wooded types) in this region is reduced due to surface leaching. The land is best suited to a system of mixed farming that includes legumes in the rotation. Wheat as in the south is the principal crop. Flax was observed growing in several areas, however the importance of this crop was not determined.

The general topography is flat with low rolling hills. The landscape is similar to the prairie parkland. Rivers of the region are tributaries of the Peace which flows to the north of this type. As in the other zones the rivers are deeply intrenched making formidable barriers to land transportation.

#9 A typical scene in northern parkland area near Grande Prairie. Though mixed farming is carried on, wheat still remains the prime money crop. The High Prairie-Grande Prairie-Peace River region is somewhat removed from the rest of the province. There is but a single highway and railroad serving the area. Air transportation to this region is much more satisfactory. The "high prairies" are rapidly developing and considerable acreage of land is being cleared by the federal government for veterans homesteading.

#10 Crossing the Peace River on the Dunvegan Ferry. This is the only crossing on the Peace between Grande Prairie and Peace River. The government operates the ferry during the summer months between the spring break up and the fall freeze. The river current is utilized in making the crossing as no motor is installed on the barge. During the winter, traffic crosses the river directly on the ice. Note the steep river banks so characteristic of all the major rivers in the province. The flood plain along the left bank is a suitable site for the Balm of Gilead tree which you can see.

#11 Peace River, Alberta, southern terminal on the Peace for Hudson's Bay river packets operating to the north. This town is the second in size of the three in the region. The Northern Alberta R. R. connects Peace with Edmonton some 250 miles to the southeast. The highway to Grande Prairie can be traced climbing out of the river valley to the uplands.

Forest Zone: This is by far the largest of the three vegetation zones of the province, covering roughly 70 per cent of the land area of Alberta. About 10 per cent of the zone is permanently occupied with less than 5 per cent cleared and under cultivation. The extent of lumbering operations in the north was not determined but it seemed to be limited to areas adjacent to population centers. In the Rocky Mountain region much of the land is in federal ownership in a large forest reserve.

The forest zone has been divided into three sub types; the northern forest or white spruce climax, the mountain or cordilleran forest and the transition type between the two, the northern mixed forest. The latter type is predominantly poplar. This is probably traceable to man's activities.

The vegetation of the two main types is very similar in the lower altitudes. The only difference being the present or absence of jack pine and lodge pole pine (Pinus contorta). The lodge pole pine indicates the mountain forest while the jack pine is characteristic of the northern forest. The two intermingle in the northern mixed forest and are sometimes difficult to distinguish. Hybridization takes place and adds to the confusion.

Muskeg bogs of varying sizes are found scattered throughout northern and northern mixed forest types. Some of more important tree species of the two main types are:

Northern forest

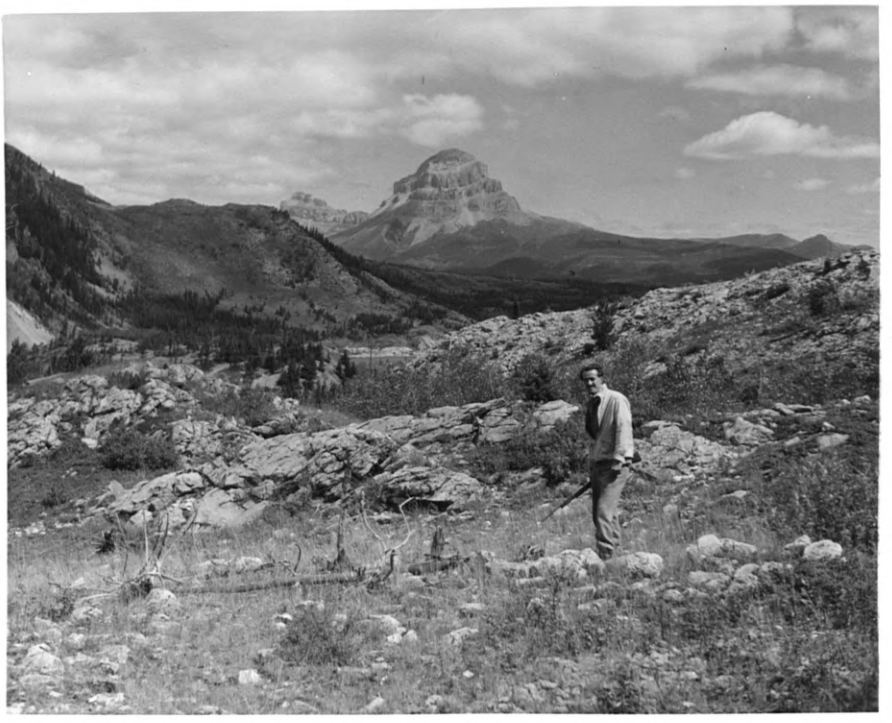
Picea glauca P. mariana Larix laricina	moist sites
Pinus banksiana	
Populus tremuloides	
P. balsamifera	
Betula papyrifera	

Mountain forest

Pinus contorta	
Picea glauca	
P. englemannii	
Pseudotsuga douglasii	higher altitudes
Pinus albicaulis	
Abies lasiocarpa	
Populus tremuloides	lower altitudes
Betula papyrifera	

The topography of this zone except for the mountainous region of the Rockies is unchanged from the prairie parkland; flat low rolling landscape with deeply intrenched rivers. There are scattered remnants of old mountain to break the flatness. These hills rarely exceed 1500 feet above the surrounding terrain.

Two large river systems drain the north country; these are the Peace and the Athabaska. They join north of Lake Athabaska to form the Slave River.



#12 Crowsnest Mountain near Crowsnest Pass, Alberta. An open grassy slope such as this make ideal habitat for the Columbian ground squirrel. C. E. Collins, one of the crew members was photographed while hunting for this ground squirrel. Limited areas within the mountains are used for grazing.

#13 Foot hills country on the Elbow River West of Calgary. Black spruce mark the far bank of the river. Scrub willows are present in the foreground. Some farming is attempted by the local inhabitants but the greatest value of this land lies in recreational use for hunting and fishing.

#14 An area cleared for farming in the mountain forest type. Land use was predominantly cattle-grazing. It was into such areas as this land that grassland forms such as the Richardson ground squirrel have been able to extend their distributions. This has happened in the above area. R.G.S. were found to occur in this field; one of the western most points in the distribution of this species in the province. (T22 R4 W of the 5th Meridian)

#15 Crossing the Athabaska River at Athabaska Landing. Even in this northern country the grain elevators still dominate the scene. One of the few saw mills noted on the survey in the north can be seen on the far bank of the river. During the spring break up and first winter freeze the river is closed to car traffic and the bucket cable car must be used. As bridges are few in the north, broad rivers like the Athabaska and Peace may prove to be impassable barriers to many animal forms. The Richardson ground squirrel was present on the south bank of the Athabaska yet was unable to cross the north bank.

#16 A scene typical of the northern mixed forest type which is now predominantly poplar. Early logging operations for R. R. ties, packet boat fuel, building materials, etc. has probably resulted in the present modification of this type to that of being largely aspen.

#17 Peace River flood plain. This picture was taken in British Columbia but is typical of the Peace River in Alberta. The steep banks show some signs of erosion but not nearly as much as along the larger prairie rivers. Poplar largely covers the flood plain. The uplands are cleared for farming. The picture was taken prior to crossing the Peace River before entering Ft. St. John, B.C.

Some Ecological Relationships of the Vegetation Zone

In a recent paper on the fescue grassland of Alberta, Moss (1944) stated that he believed the Festuca Association comprised the greater part of the virgin grassland of the black soils. He also stated that this same vegetation association originally dominated the transition soils (gray-black) which are now for the most part wooded.

On the lighter soils of the southeast, brown soil zone, Stipa Association was the dominant vegetation. However today these original grassland types exist only in scattered relect communities and in time these will also be gone. In place of the original vegetation a modified vegetation of the associated species has developed. (See Vegetation Zone description for lists of these plants).

The dark brown soil zone marks the tension or transition zone between the two major grassland types.

Where moisture conditions are suitable, woody vegetation invades the prairie, and the indications are that the forest vegetation is slowly displacing the grassland. Aspen and willows are usually the predominant invaders in ungrazed areas. Overgrazing grasslands also encourages the growth of shrubby species such as shrubby cinquefoil

(Potentilla) and sage (Artamisia).

Man's activities, in the Poplar Association and north of the parkland type has produced a great change in the natural vegetation. Clearing the land for farming in reality has extended the grassland zone northward beyond its normal limits. This has permitted several mammals that normally occur farther south in the prairies and parkland types also extend their ranges northward. The importance of this artificial extension of the grassland type to the distribution of mammals will be discussed later.

An overlay for the vegetation zone map has been prepared which indicates the approximate extent of land settlement in the province. The limits of settlement are based on the boundaries of surveyed township lines; unsurveyed land being considered unsettled land.

The approximate northern boundary of the prairie parkland is indicated by the dotted line. The area to the north of this line, within the land survey boundaries, was once thickly wooded but now contains much land that has been either cleared for agriculture or logged over.

The High Prairie-Smith strip south of Lesser Slave Lake separates the farming areas of the Northern Parkland

and Prairie Parkland. This strip is too poorly drained to be suitable for extensive farming and much of the area is in muskeg. The land was probably surveyed in connection with the construction of the railroad to the "high prairie" country.

DISTRIBUTION MAPS

Distribution maps have been prepared for 21 species which make up the reference collection. Maps for two other important species which the survey was unable to collect have also been included with the 21 making the total 23. The two added species are the golden-mantled ground squirrel and the varying hare. (The year 1947 was a low in the abundance cycle of the hare; only two individuals were seen during the collecting period.)

The distribution maps in this paper have been redrawn from detailed laboratory base maps for the species. The base maps are 20 miles to the inch which permits a rather accurate location of collection points. The plan is to have the distribution data collected by the field crews, plotted on these permanent base maps after each summer's field work is completed. In this way a store of valuable distribution data will be readily available for future studies.

This is the first attempt at preparing ecological distribution maps for the province so that mistakes in tentative distribution limits are inevitable, but as the field work is continued the ranges will become better defined.

Data other than that collected by the Plague Survey has been used in the preparation of the base maps. The sources of such records are indicated by Roman numerals corresponding with the source material listed below.

I. Field Investigations: Summer 1947

II. Field Investigations: Crew Reports, Alberta Plague Survey, 1938-46.

III. Municipality Gopher Population Questionnaire, CIBD Laboratory, Division of Entomology, Alberta Department of Public Health, 1945.

IV. "Catalogue of Canadian Recent Mammals." by R. M. Anderson. Bulletin #103, National Museum of Canada, 1945.

V. North American Faunal Series pertaining to the species under consideration.

VI. "Mammals of the Northern Great Plains Along the International Boundary in Canada." by J. Dewey Soper. Journal of Mammalogy 27:127-153, 1946.

VII. "Mammal Notes from the Grande Prairie-Peace River Region, Alberta." by J. Dewey Soper Journal of Mammalogy, 29:49-64, 1948.

ACCOUNTS OF THE SPECIES

Sorex cinereus Kerr. Masked Shrew.

Distribution by Habitat: Occurs throughout most of the province in all of the vegetation zones (grassland and both deciduous and coniferous forest types) with the possible exception of the drier portions of the prairie zone. A brief review of the literature failed to reveal any records from southeastern Alberta. Soper (1946) in his paper on the mammals of the International Boundary area reported he was unable to collect any specimens of S. cinereus in this area.

Distribution Records: Red Deer area, Sec. 17 T38 R28 W4[8]; I
Rocky Mountain House, Sec. 7 T40 R7 W5; -I
Grande Prairie area, Sec. 29 T71 R7 W6; -I
Athabaska-Grande Prairie area; VII
Cardinal Lake (near Berwyn); VII
Kimiwan Lake (near Roxana); VII
Athabaska; V
Athabaska River (Cascade Rapid); V
Banff; V
Calgary; V
Jasper Park (Cavell Creek); V
Crowsnest Pass; V
Dunvegan Ferry (Peace River); V
Edmonton; V
Waterton Lake National Park; V[9]
Islay; IV

8/ Abbreviated method of writing Township 38, Range 28 West of the 4th Meridian.

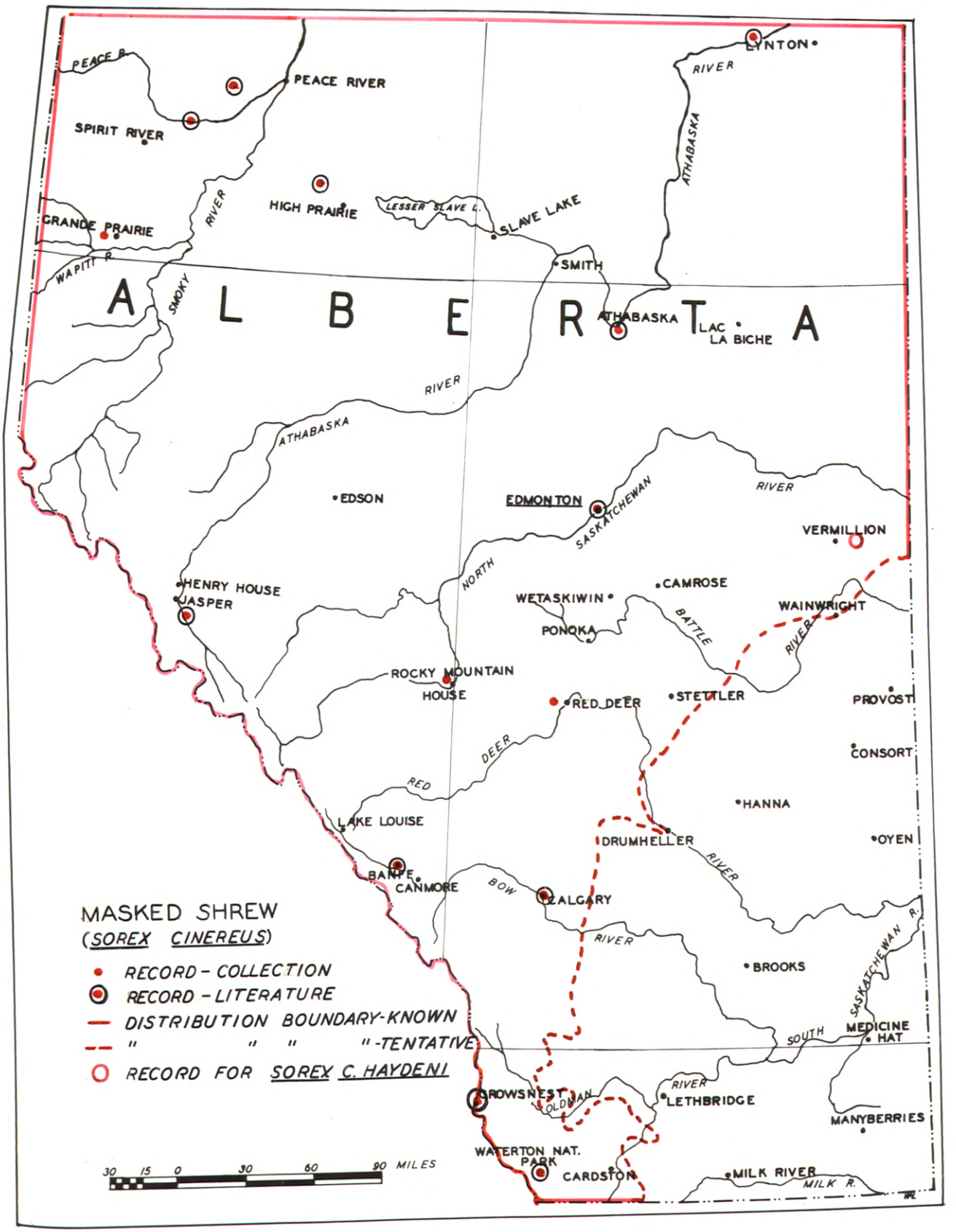
9/ Not all the more northern records from this source have been listed.

None of the above records indicate that this species occurs in the prairie zone hence the southern boundary is tentatively set as the southern boundary of the prairie parkland zone.

Two forms of the masked shrew are known to occur in the province, Sorex c. cinereus and haydeni. The latter is known from only a single specimen taken at Islay (Anderson 1946).

Reference Collection Numbers:

1, 2, 3.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
WAPITY R.
SMOKY RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
SMITH
LYNTON
ATHABASKA RIVER
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
BATTLE RIVER
PONOKA
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
RED DEER
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
MASKED SHREW
(SOREX CINEREUS)
RECORD - COLLECTION
RECORD - LITERATURE
DISTRIBUTION BOUNDARY-KNOWN
" " " "-TENTATIVE
RECORD FOR SOREX C. HAYDENI
30 15 0 30 60 90 MILES

MAP II

Mustela frenata longicauda Bonaparte. Prairie Long-tailed Weasel.

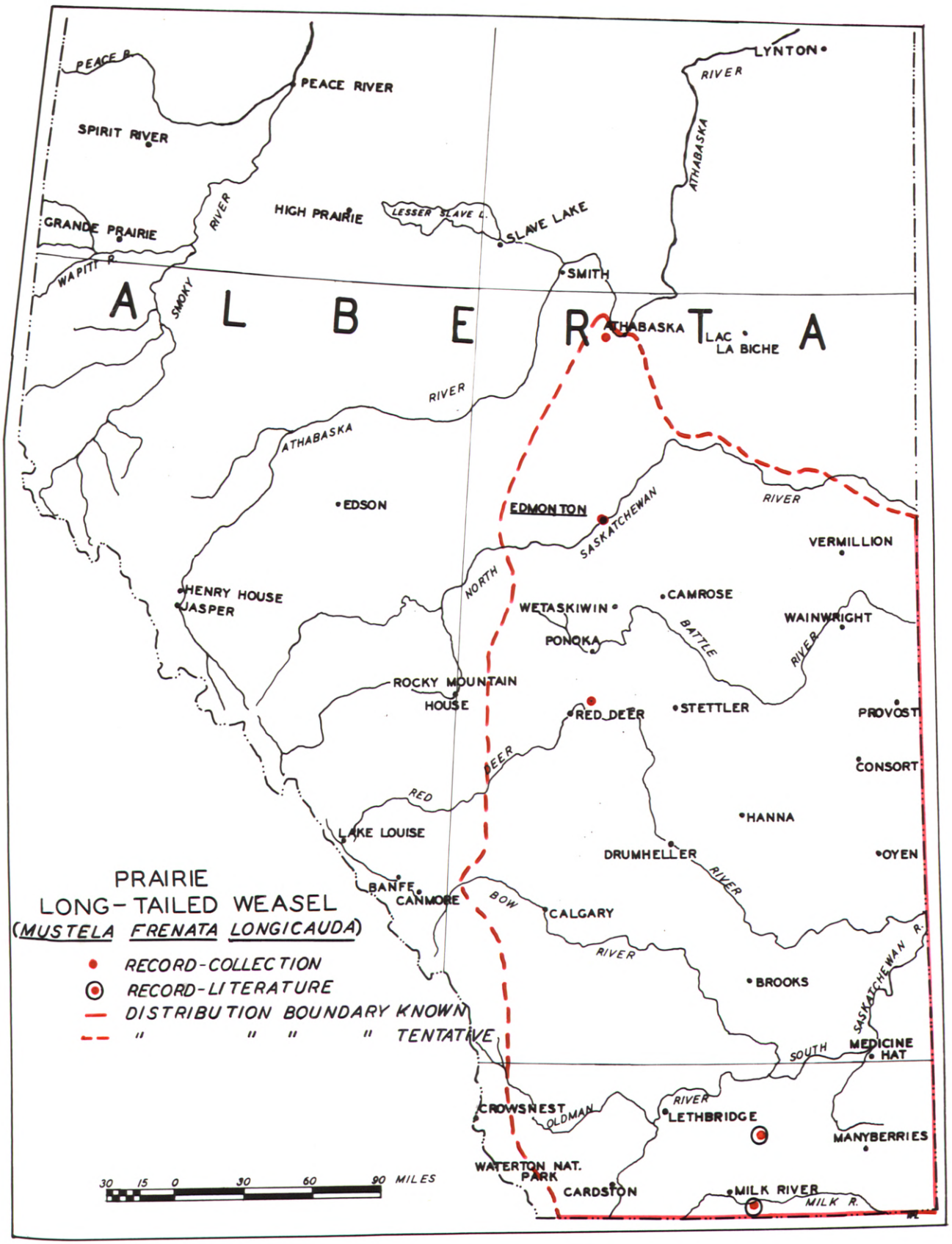
Distribution by Habitat: Prairie and prairie parkland zones, north to Athabaska and Baptiste Lake in the northern mixed forest type. This species, however, is usually associated with the prairie types.

Distribution Records: Red Deer area, Sec. 6 T39 R26 W4; I
Edmonton (city limits); I
Athabaska - Baptiste Lake Region; VII
Milk River (Writingonstone); VI
Nemiskon; VI

Soper (1948) reports the presence of this species as far north as Athabaska and Baptiste Lake. This represents a rather recent extension in range within the past 20 years. This northward extension in range is characteristic of other prairie forms and is probably explained by man's clearing land for agriculture. The Athabaska River will probably act as an effective barrier in preventing any further extension northward. More detailed studies in the northeast farming district of the province would probably reveal the presence of this weasel.

Reference Collection Number:

5.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
WAPITI R.
SMOKY RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
ATHABASKA RIVER
SMITH
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
BATTLE RIVER
PONOKA
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
RED DEER
CONSORT
LAKE LOUISE
HANNA
DRUMHELLER
OYEN
RIVER
BANFF
CANMORE
BOW
CALGARY
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
PRAIRIE
LONG-TAILED WEASEL
(MUSTELA FRENATA LONGICAUDA)
RECORD-COLLECTION
RECORD-LITERATURE
DISTRIBUTION BOUNDARY KNOWN
" " " TENTATIVE
30 15 0 30 60 90 MILES

MAP III

Taxidea t. taxus Schreber. American Badger.

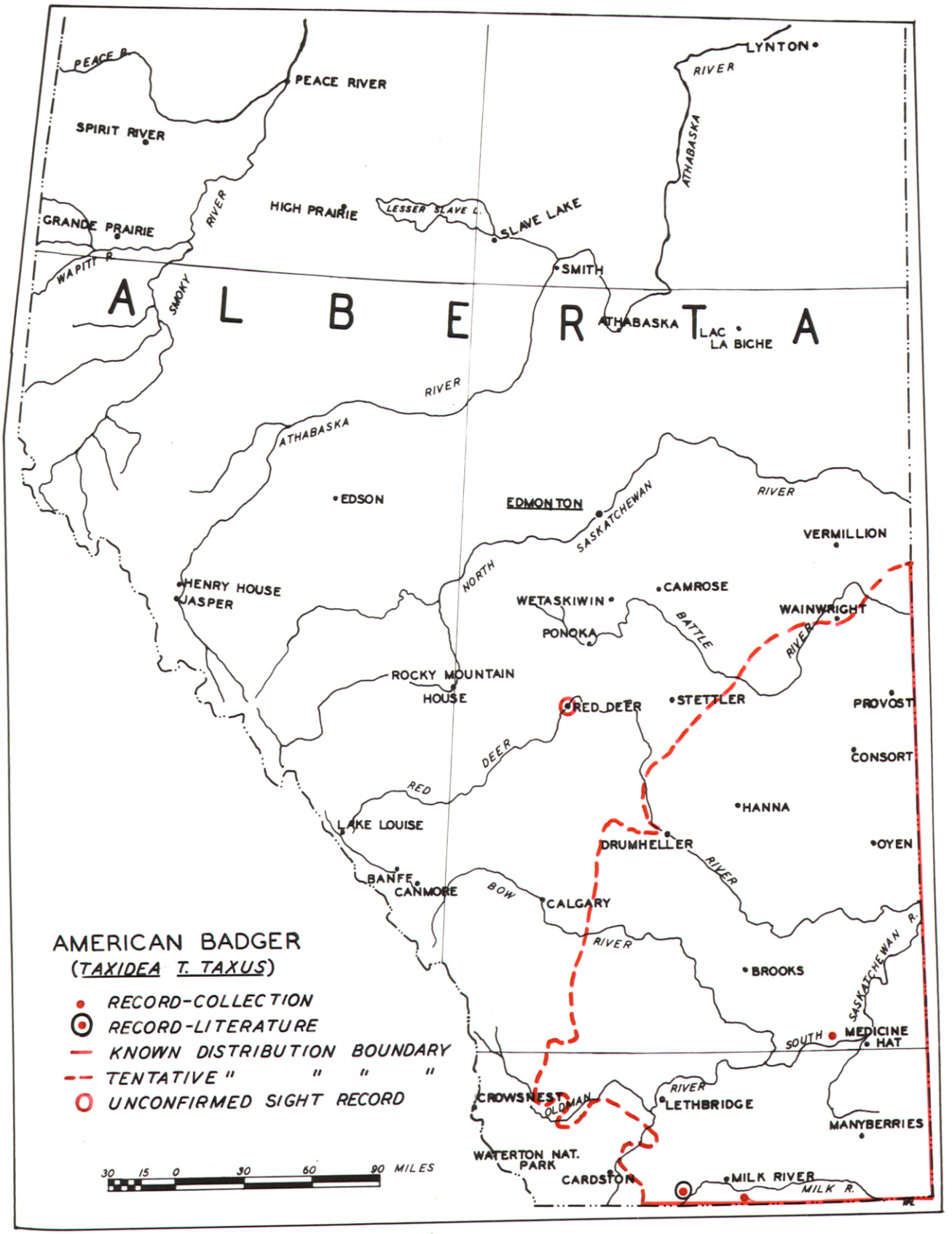
Distribution by Habitat: With present knowledge this species seems to be limited to the prairie zone. With ground squirrels being a major item in the diet of the badger, it would seem reasonable to presume that this species also would occur in drier portions of the prairie parkland. However, confirmed records do not indicate this.

Distribution Records: Milk River area, Sec. 33 T1 R19 W4; I
Medicine Hat area, Sec. 15 T14 R8 W4; I
Milk River (S. E. of Cardston); VI
Unverified sight record Red Deer; - I

The region of greatest abundance was the Milk River area along the International Boundary. This observation is in keeping with Soper's (1940) account on this species.

Reference Collection Number:

6.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
RIVER
ATHABASKA
WAPITI R.
SMOKY
SMITH
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN
RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE
RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
DEER
RED
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
RIVER
BANFF
CANMORE
BOW
CALGARY
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
RIVER
CROWSNEST
OLDMAN
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
AMERICAN BADGER
(TAXIDEA T. TAXUS)
RECORD-COLLECTION
RECORD-LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
UNCONFIRMED SIGHT RECORD
30 15 0 30 60 90 MILES

MAP IV

Marmota monax canadensis Erxleben. Woodchuck.

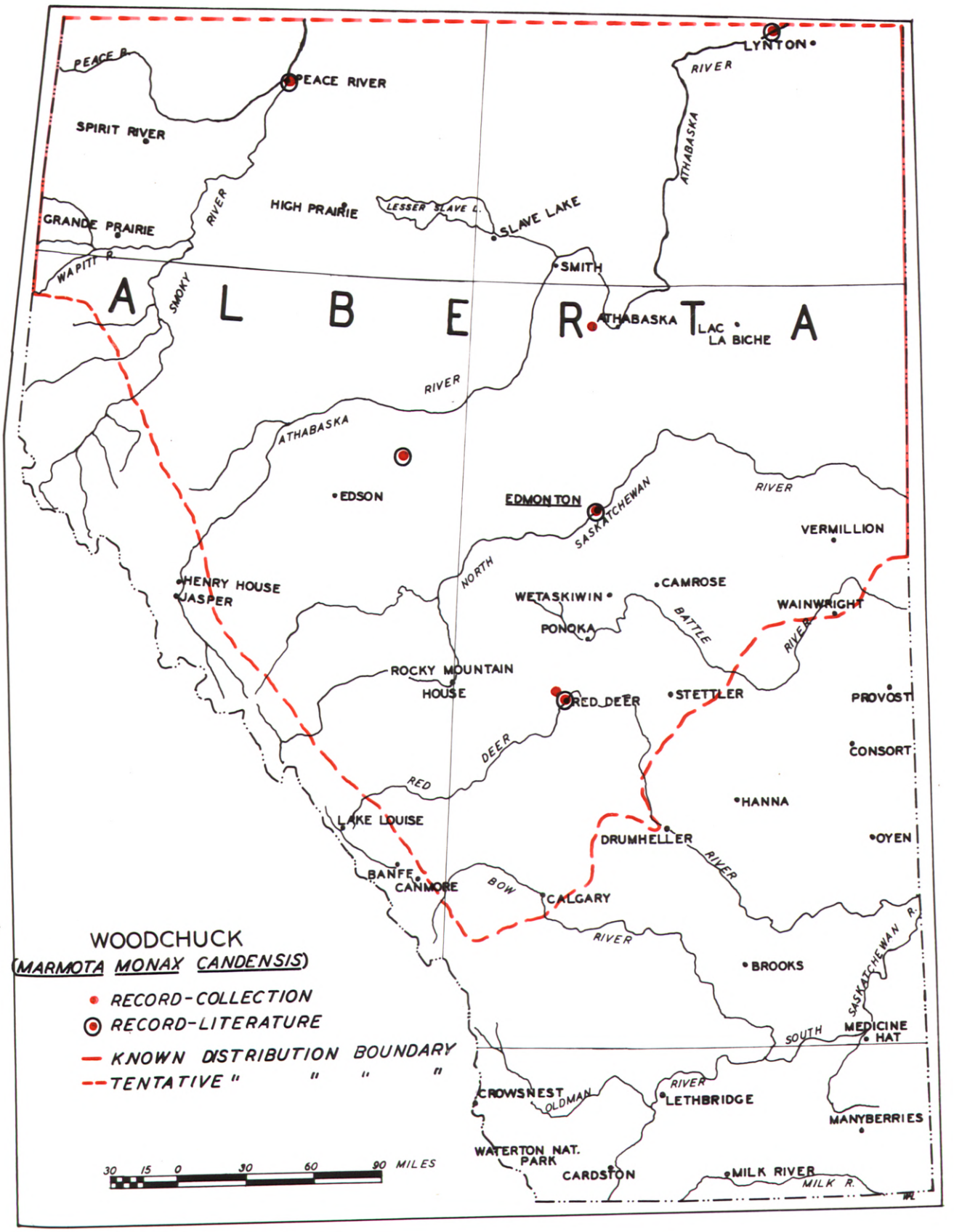
Distribution by Habitat: Occurs throughout most of the northern mixed and northern coniferous forest, south into the parkland zone. Probably occurs in the lower reaches of the cordilleran forest but is replaced by Marmota caligata (Hoary Marmot) in the higher altitudes.

Distribution Records: Black Falls area, Sec. 5 T39 R27 W4; I
Athabaska - Baptiste Lake area, Sec. 35 T66 R24 W4; I
Athabaska River (vicinity of Fort McMurray); V
McLeod River; V
Peace River Landing; V
Red Deer; V
Edmonton; V

Soper (1948) writes, "the woodchuck is distributed in varying degrees of abundance throughout practically the entire extent of territory brought under observation." (west central Alberta). He further stated there was no definite evidence of their presence south west of Pinto Creek (Grande Prairie Area). This species is less abundant north of the Peace River than in the High Prairie Grande Prairie - Peace River triangle.

Reference Collection Numbers:

7, 8.


LYNTON
RIVER
ATHABASKA
PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
WAPITI R.
SMOKY
SMITH
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN
RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
BATTLE
RIVER
PONOKA
ROCKY MOUNTAIN
HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
DEER
RED
HANNA
LAKE LOUISE
DRUMHELLER
RIVER
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
WOODCHUCK
(MARMOTA MONAX CANDENSIS)
RECORD-COLLECTION
RECORD-LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

MAP V

Citellus richardsonii Sabine. Richardson Ground Squirrel.

Distribution by Habitat: Prairie and prairie parkland zones, north into the northern mixed forest and coniferous forest wherever suitable habitat is maintained by agriculture. Originally this form was restricted to grass land areas; the prairie and drier portions by the prairie parkland zones.

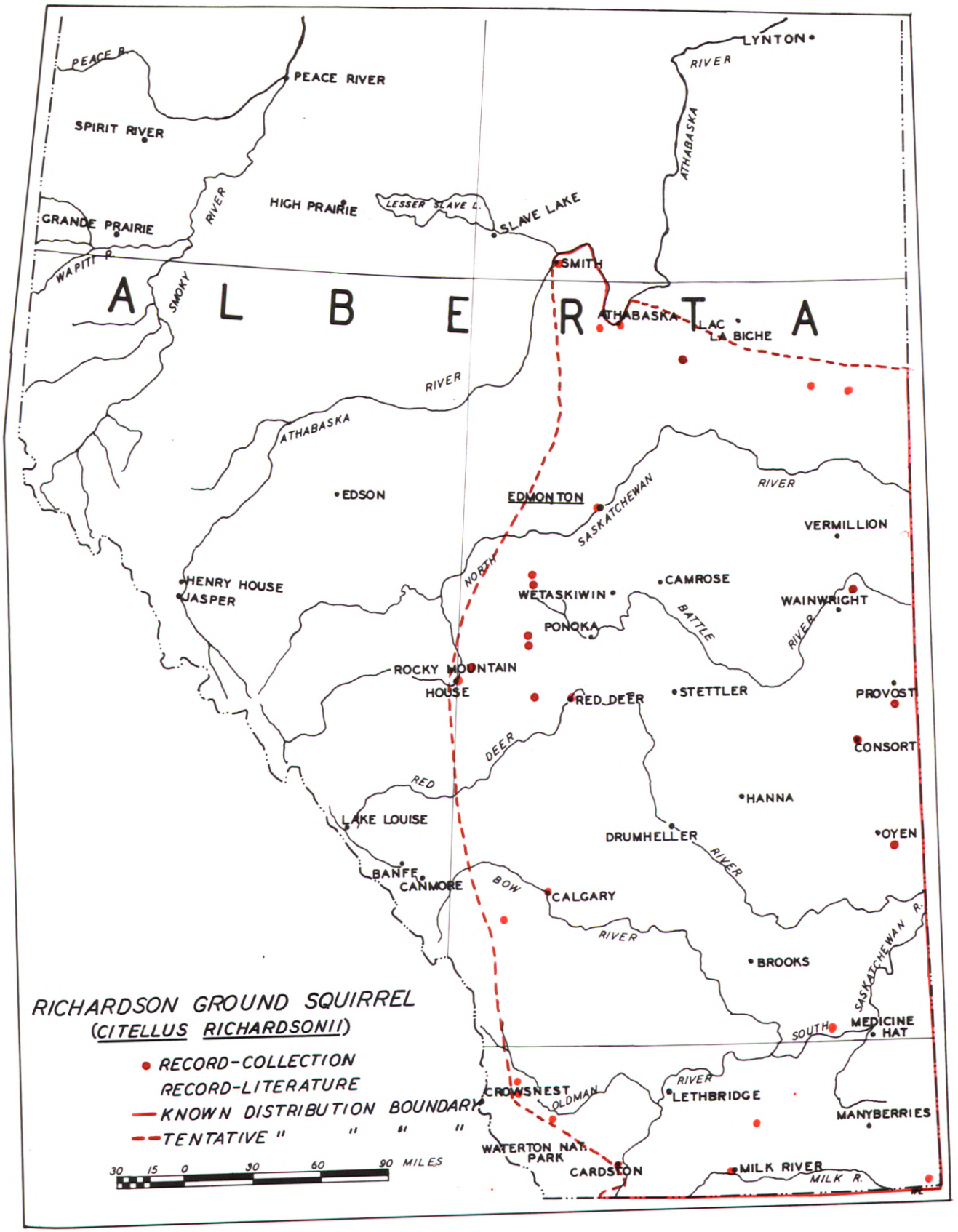
Distribution Records: Wild Horse area, Sec. 1 T1 R1 W4, sight record; I
Milk River area, T2 R16 W4, sight record; I
Milk River area, T5 R15 W4; I
Cardston, sight record; I
Pincher Creek area, T6 R30 W4; II (1946)
Lundbreck area, T8 R2 W5; II (1945)
Lundbreck area, T9 R2 W5; II (1945)
Bragg Creek area, T22 R4 W5; I (reliable report of local inhabitant)
Calgary area, T25 R1 W5; sight record; I, V
Rocky Mt. House area, T39 R7 W5; II (1946)
Rocky Mt. House area, T40 R6 W5; II (1946)
Hespero area, T38 R3 W5; II (1946)
Red Deer (city limits), sight record; I, V
Thorsby area, T48 R1 W5; II (1946)
Thorsby area, T49 R1 W5; II (1946)
Rembey area, T41 R3 W5; II (1946)
Rembey area, T42 R3 W5; II (1946)
Edmonton City, sight record; I
Smith Landing, T71 R1 W5, sight record; I
Baptiste Lake, (S. E. shore) T66 R24 W4; I
Municipality #103; III
Municipality #87; III
Municipality #88; III
Wainwright area, T46 R5 W4; II (1945)
Provost area, T38 R2 W4; II (1945)
Consort area, T35 R4 W4; II (1945)
Sibbald area, T27 R2 W4; I
Medicine Hat area, T13 R8 W4; I

Only those records which were used in establishing the limits of distribution of this species are listed or indicated on the distribution map. Records from the interior of the distribution area are far too numerous to list or plot on the map.

The above records for the distribution of this ground squirrel in the province are as complete as possible to date, and result in a reasonably accurate distribution map for this important ground squirrel. Several of the records are of interest and merit some comment.

The Rocky Mountain House records were collected in 1946 when the Survey operated in this area, but when the same areas were revisited in 1947 the ground squirrels were no longer evident. Habitat conditions had been changed. The fields from which the first specimens had been collected were no longer being pastured. The short grass condition, maintained by haying and grazing, had been replaced by a rank growth of grass and various weeds. The fields no longer were acceptable to the prairie gopher as sites for their burrows.

Much of the range extension in the past 20 years has taken place in similar marginal habitat whose acceptance


ALBERTA
PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
WAPITI R.
SMOKY RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
ATHABASKA RIVER
SMITH
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
BATTLE RIVER
PONOKA
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
DEER
RED
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
RICHARDSON GROUND SQUIRREL
(CITELLUS RICHARDSONII)
RECORD-COLLECTION
RECORD-LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

MAP VI

by the R.G.S. is directly related to various farming practices. No doubt in succeeding years if the fields about Rocky Mountain House are again pastured the prairie gopher would return.

The Pincher Creek Area is a point of overlap in the distribution of the Richardson and Columbian ground squirrels. It appears that the latter species has spread in to this agricultural area from the foothills.

In the Smith Landing[10] (on the Athabaska River) - Baptiste Lake area, the R.G.S. has reached the northern most point in its distribution. At present the Athabaska River is acting as a barrier to any farther extension northward even though suitable habitat exists across the river. A highway bridge was constructed at Smith crossing the Athabaska, and this in time may permit the ground squirrels to cross and become established in the farming area north of the river. It is not likely, however, that the Richardson Ground Squirrel will be able to spread into the farming region of the "high prairies." (High Prairie-Grande Prairie - Peace River triangle) The extensive muskeg area south of Lesser Slave Lake will prevent this. This area is much too wet for both burrowing animals and extensive farming.

10/ Prof. Millar of the Zoology Dept., University of Alberta also mentioned, in conversation, the presence of the R.G.S. at this point (1946).

The municipality (Municipality Gopher Report 1945) reports from nos. 103, 87, 88 are interesting in that they indicate the recent arrival of this species. The report from the Athabaska Region (#103) stated that the prairie gopher had moved into the municipality from the south within the past 2-3 years.

Past records are not complete enough to permit a detailed analysis of the rate of spread of the species. It is interesting to note, however, that the northern limit of the R.G.S. in 1922 was the Battle River (Lauton, 1922). This is about 130 miles south of Smith Landing, the northern most point of distribution (1947). Accepting Lauton's data means that the R.G.S. covered a straight line distance of about 150 miles in nearly 23 years, (based on municipality #103 Prairie Gopher Report 1945) or 6.5 miles per year during the 23 year period. This seems to be an excessive rate for a species producing a single litter a year and moving into marginal habitat. Brown (unpublished) has prepared land settlement maps which indicate that the greater portion of the prairie parkland was settled by 1916 and that by 1921 the land settlement of the province had nearly present (1947) limits. Unless the Battle River acted as a barrier preventing northwest extension into the

newly cleared farm land of the parkland zone, the northwest extension should have begun by 1917. The possibility also exists that Lauton may have been in error in designating the Battle River as the northern distribution limit for the Richardson ground squirrel in 1922. Actually the species may have been crossed the Battle River at an earlier date.

Natural History Data:

Notes on a Burrow Study

This burrow study was undertaken as a preliminary step in the planning of a life history study and was to aid in the selection of a study area. As the greater part of the range of the Richardson Ground Squirrel lies within two major soil types, the brown soils of the prairie zone and the black soils series of the prairie parkland zone, two burrows, one in each of the two soil types was selected for excavation. The excavation was done in late summer, August, in hopes of obtaining some data on the hibernation nest and winter food storage of this species.

Black drawings (Figs. 1 and 2) showing the general outline in three dimensional views, have been prepared from field note data.

The brown soil zone burrow, located well within the original range of the species, was some 10 miles northeast of Milk River (T2 R16 W4). Two days were required to excavate the burrow, the work being completed on August 20, 1947. Numerous burrows were scattered throughout the area, but this particular burrow (Fig. 1) was selected as the owner was actively engaged in collecting and storing food from an adjacent wheat field. The main entrances were without spoil piles and led abruptly down through the hard pan layer (Bca). Most of the burrow was constructed in the moist sandy soil found below the hard pan.

The total length of the burrow was about 52 feet with a single main tunnel amounting to nearly 48 feet. The greatest depth reached by the burrow was 42 inches while the average depth based on nine measurements, was 36 inches. Five cavities leading from the main tunnel were uncovered (Fig. 1).

Cavity no. 1 occurred at a depth of 40 inches and measured 8" x 6" x 6". This chamber appeared to be a storage room as it was filled with short lengths of grass and herbaceous material which was old.

Figure I--Block drawing of a Richardson ground squirrel's burrow in the brown soil zone near Milk River, Alberta. The numbered chambers are referred to in the text discussion. On the left edge of the drawing the profile of the soil type in which the burrow was dug is shown. The letters correspond to the lettered horizons; (A, B and Bca layers) the frost line depth is also indicated by the dotted line.

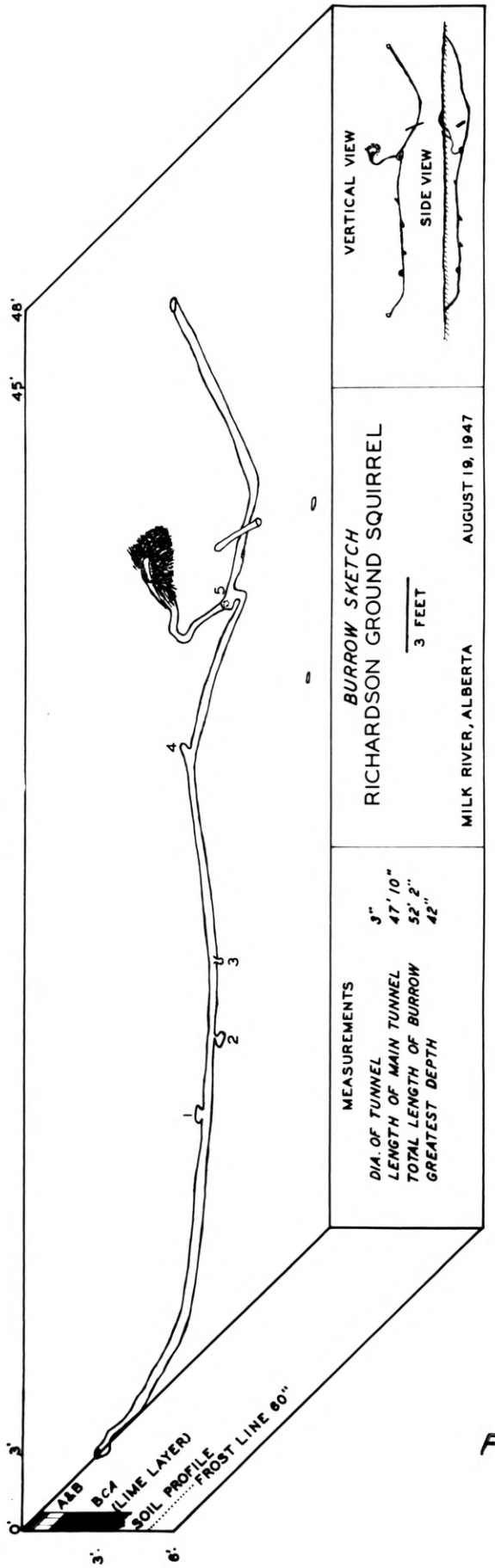

0'
3'
6'
45'
48'
A&B
BCA
(LIME LAYER)
SOIL PROFILE
FROST LINE 80"
1
2
3
4
5
BURROW SKETCH
RICHARDSON GROUND SQUIRREL
3 FEET
MILK RIVER, ALBERTA
AUGUST 19, 1947
MEASUREMENTS
DIA. OF TUNNEL 3"
LENGTH OF MAIN TUNNEL 47' 10"
TOTAL LENGTH OF BURROW 52' 2"
GREATEST DEPTH 42"
VERTICAL VIEW
SIDE VIEW

FIG. 1

Cavity no. 2 was similar to no. 1 and also contained old and decaying short lengths of grass and herbaceous material.

Cavities nos. 3 and 4 were short dead end tunnels.

Cavity no. 5 was the largest cavity approximately a foot in diameter, and contained what appeared to be a nest. Fresh cut grass material and thistle made up the cavity lining. From this chamber, a branch tunnel led to the surface. The chamber was 41 inches below the surface and within the frostline depth. The entrance to this branch tunnel had been enlarged by a badger, possibly attempting to dig out the ground squirrel. Fresh signs, tracks on the spoil, seemed to indicate this. There was an active badger den in the vicinity.

A cross tunnel was encountered just under the hard pan about three feet from the nest cavity. No definite tunnel connection was uncovered due to the technique used in excavation. However, actions of the ground squirrel indicated a connection. During the excavation the ground squirrel, on several occasions, dug out the plugs sealing the two adjacent holes and on one occasion, made a trip to the wheat field for grain. There was no indication of fresh grain being stored in the tunnel system excavated even

though the occupant was observed carrying grain into the burrow. While on one of these forage trips the squirrel was collected for diseased parasite determination.

The black soil zone burrow located at T52 R24 W4 (seven to eight miles S. E. of Edmonton) was selected in an area which has been invaded by the Richardson Ground Squirrel. Originally much of the black soil zone with its tall grass and woody vegetation was not a suitable habitat for the species. As the parklands were cleared for agriculture and dairying the R. G. S. was able to extend its range northward into this type of vegetation.

The immediate habitat of the burrow was pasture. The short grass requirement for a suitable habitat was being maintained by grazing. The burrow was excavated August 27, 1947.

Digging was easy in the black soil and the entire burrow was uncovered in twenty minutes. The total length of the burrow was about 20 feet with the main tunnel measuring nearly 14 feet. The greatest depth was 21 inches while the average depth was 18 inches. A single cavity containing a well constructed nest was uncovered. This nesting cavity measured 16" x 8" x 8" and was located 21" below the surface - well above the frost line depth of 7 feet.

No storage chambers were uncovered. The main tunnel had a short branch leading up to the surface giving the burrow three entrances.

This ground squirrel's behavior was not at all like that of the first. This animal was not curious but wary and disappeared into his burrow on the first approach of man. He remained in his burrow, during the excavation, until approximately a yard of tunnel was left uncovered. An attempt to live trap the animal failed. Making good his escape, he ran hesitatingly about until he encountered another burrow entrance. This behavior seems to indicate a lack of familiarity as to the location of other burrows.

It appears that the population never reaches the high densities found on the short grass plains of Southern Alberta. Only three animals were observed in the pasture area of approximately 20 acres. This ground squirrel's feeding activities were observed before excavating his burrow. At no time was it observed bringing food even though the squirrel returned to the burrow at frequent intervals.

Figure II--Block drawing of a Richardson ground squirrel burrow in the black soil zone near Edmonton. The soil profile of the burrow site is indicated on the left edge of the drawing. The frost line depth occurs at 7 ft. in this area.

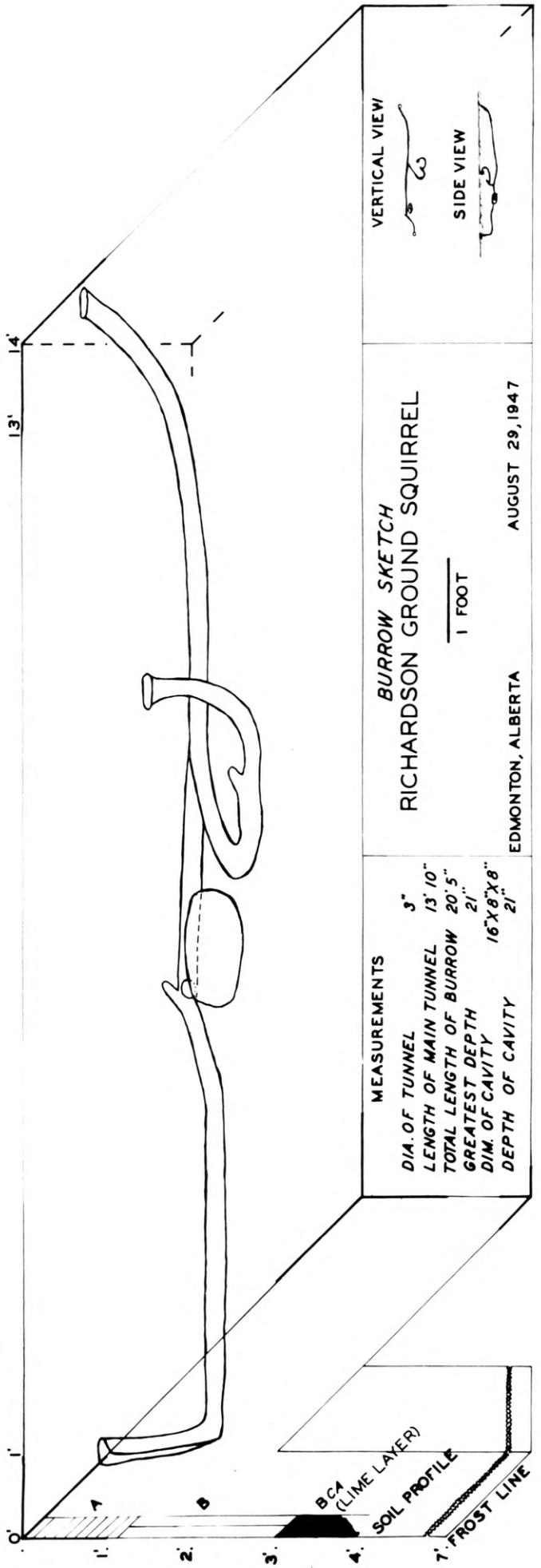

VERTICAL VIEW
SIDE VIEW
BURROW SKETCH
RICHARDSON GROUND SQUIRREL
1 FOOT
EDMONTON, ALBERTA
AUGUST 29, 1947
MEASUREMENTS
DIA. OF TUNNEL 3"
LENGTH OF MAIN TUNNEL 13' 10"
TOTAL LENGTH OF BURROW 20' 5"
GREATEST DEPTH 21"
DIM. OF CAVITY 16"X8"X8"
DEPTH OF CAVITY 21"
0'
1'
2'
3'
4'
7'
13'
14'
A
B
BC4 (LIME LAYER)
SOIL PROFILE
FROST LINE

FIG. 2

Census Technique:

A PROPOSED METHOD OF GROUND SQUIRREL (CITELLUS) CENSUSING FOR USE ON SYLVATIC PLAGUE SURVEYS

At the 2nd International Conference on Diseases of Wild Animals Transmittable to Man (Hamilton, Montana, August, 1947) several public health field workers pointed out the need for a report and reasonable accurate census technique for ground squirrels. At present the field studies of the plague survey crews are mainly concerned with the collection of specimens and not the effect of the disease on animal population in nature.

This phase of epidemiological studies has been somewhat neglected for want of a census technique suitable for use over large areas. Censusing techniques have been devised for population studies on limited areas or single colonies. (Dice 1938, Burt 1940, Evan and Holdenried 1943, Storer et al 1944). However such techniques required special equipment and are quite time consuming.

A census technique, to be suitable for use on a plague survey, must fit in with the daily activities of the survey party and not be too time consuming. Also, the use of extra equipment, such as live traps and the services of extra personnel, should not be required to make the census.

This paper proposes, for use, a strip count made from a moving vehicle. Fitch (1948) reports counts made at night by this method provide a satisfactory basis for gauging relative population densities of the Tulare kangaroo rat (Depoclomys heermanni). He further stated that this type of censusing must be carried out under optimum activity conditions. In a recent paper, Fisher et al (1947) criticized the use of the roadside census for determining ring-necked pheasant populations on the basis of the great variation in results. He believes the factors causing these variations are too complex to warrant their consideration on a game survey. This criticism will probably be true for any species which will use a variety of cover types. However, where a species is limited to a single vegetation type, and similar habitat conditions prevail on the census strip the writer believes strip censuses made under similar conditions (climatic, time of day, method) will result in reliable indices of abundance.

This census method was developed for use by the Alberta Plague Survey, which deal for the most part with the Richardson ground squirrel. As other plague surveys are organized and operated along similar lines this method with local modification may be of some value in census work of other survey groups.

PROCEDURE -- This strip count technique is best suited for use on lands that have been subdivided by a rectangular land survey. Here, the road allowance between sections can be used as the census strip.

Representative townships are selected in the municipal districts (counties) covered by the survey. In selecting these sample townships, road allowance conditions, land use patterns and general topography should be considered. The number of townships selected from a municipal district (county) would depend on the size of the district and whether plague was present. General cover type and land use maps indicating the census route are prepared for the sample townships. Major changes affecting the vegetation condition of the road allowance and adjacent fields should be noted as they occur between censuses. Where possible, thirty miles of road allowances per township, following the pattern indicated by fig. 3, should be selected. This will give adequate coverage of the sample township. Tallying should be done while travelling at a speed between 20-25 m. p. h.

Only those ground squirrels occurring within the road allowance, which is one chain wide, are tallied. The boundaries of the road allowances are usually marked either by fence lines or, where fences are lacking, the outer edges

of the road grade. The censusing of sample townships should be carried out under similar weather conditions. This is not a difficult prerequisite to meet in range country. The period of greatest activity among these ground squirrels seems to be shortly after sunrise. Later in the day, as the temperature rises, activity is limited and many squirrels remain in the shade of their burrows. The procedure of censusing the township first, will fit the daily schedule of the crew as on the return trip through the township animals can be collected for disease determinations.

The result of the strip count is expressed in terms of ground squirrels observed per mile of strip per 1/4 township, i.e. 7 R.G.S. / mile NE 1/4 T1, R6, W5. This procedure of tabulating results is in keeping with the Alberta Plague Survey's method of reporting the occurrence of sylvatic plague. All plague determinations are based on flea and tissue pools collected from the quarter township. Collecting specimens on the census route for disease determination after the census has been made will not remove an appreciable number of animals to affect next year's count. The Alberta Survey crews collect, on the average, 3 ground squirrels per mile of road allowance covered; the day's kill averages around fifty animals per township.

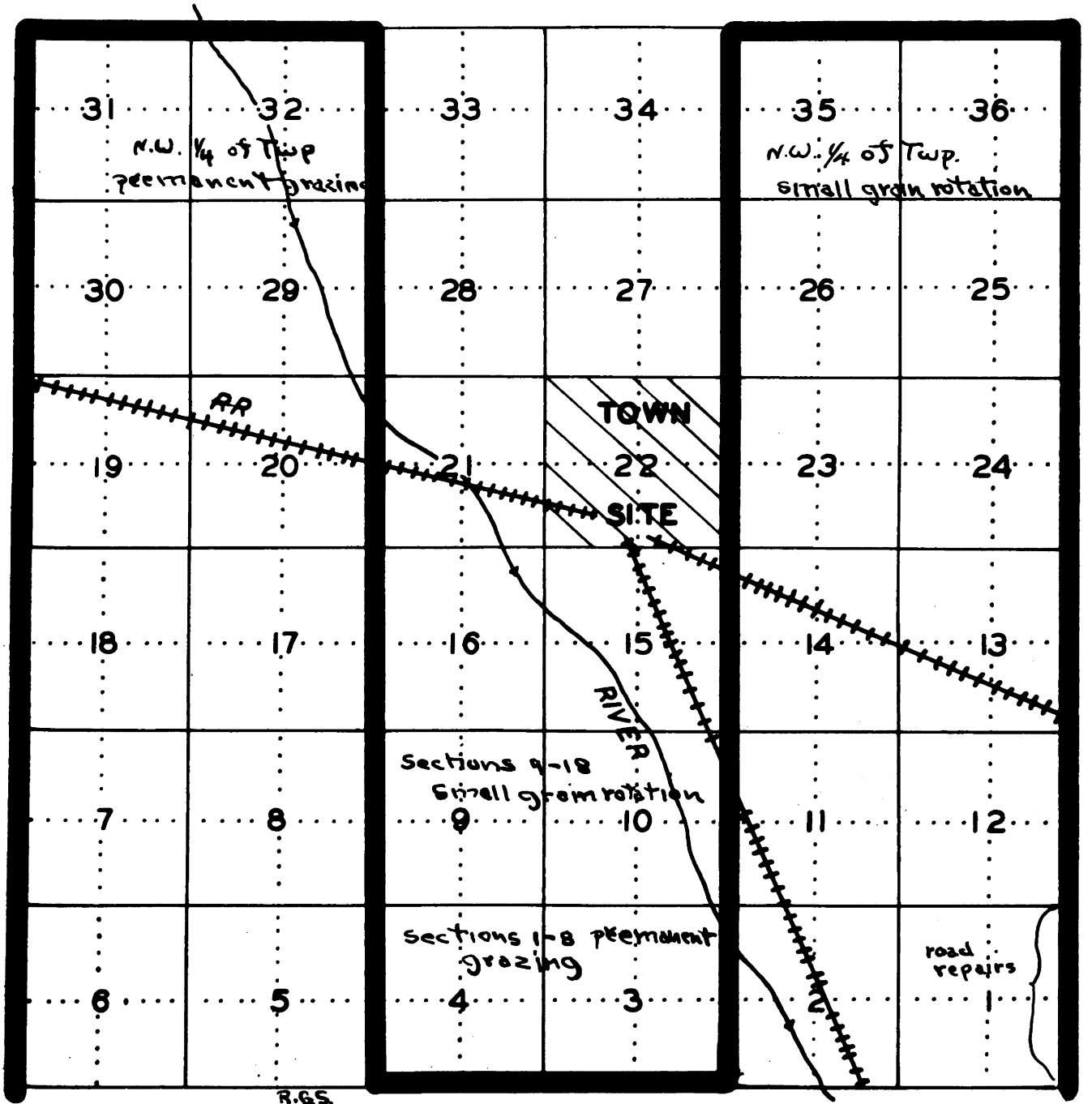
Figure III--Sketch map of the township selected for Richardson ground squirrel census.

The census route is indicated by the heavy black line, direction of travel is not important. Data pertaining to a theoretical census has been recorded on this sample map in the same manner that data of an actual census would be recorded. The drawing illustrates the text discussion on the use of the sketch map in recording census data. (See the back side of fig. III for method of recording numbers in the field.)

SKETCH OF

TOWNSHIP NO. RANGE WEST OF MERIDIAN

RICHARDSON GROUND SQUIRREL POPULATION STUDY



R.G.S.

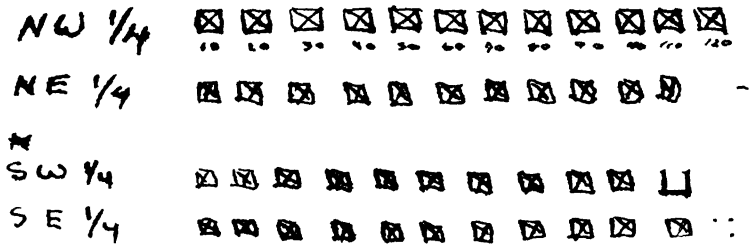
NW 1/4	8 miles - 120	15/mile	R.G.S./mile
NE 1/4	7 miles - 110	16/mile	" "
SW 1/4	7 miles - 107	15/mile	" "
SE 1/4	6 miles - 105	17/mile	" "

DATE May 9, 1944 TIME 5:30-7:00 AM

WEATHER Clear

CREW # 2

FIG. III


NW 1/4
-120
NE 1/4
-110
N
SW 1/4
SE 1/4

As was previously mentioned, tissue and flea pool from these animals are based on the 1/4 township. By recording ground squirrel densities per mile per 1/4 township, a closer correlation with population fluctuations and positive plague determinations is possible.

DISCUSSION AND LIMITATIONS.---This census technique is best suited for use with species which are found in open short grass habitats. Under such conditions the road allowance will not grow up to woody vegetation and the ground squirrels inhabiting the strip are readily observed. Their habit of standing upright at the burrow entrance facilitates the counting. In unsurveyed areas, or areas where the road allowances are not designated, the width of the census strip can be estimated by eye. The practice of estimating the width of a sample strip is common on timber surveys. With some practice and a minimum of checking crew members should be able to estimate the width of a chain strip with little difficulty.

A continuous distribution on the census strip of the species to be tallied is desirable. However, there will be instances where breaks caused by unsuitable vegetation conditions or topographic conditions may occur. These breaks or blank areas, in the census route are designated on the sketch map of the township. The mileage of such naturally

occurring areas is not subtracted from the total mileage of the 1/4 township; only when the blanks are artificially created is the mileage subtracted. (see figure III road repairs in section 1 and the town site section 22). In instances where discontinuous distribution results from the habits of the animal, this method would be of little value. Other methods of obtaining relative abundance indices could be used to better advantage.

Using this census technique, a three man crew will work best with the following division of labor; driver, recorder, and counter. However, a two man crew will work satisfactorily by combining the recording and counting duties. The counter should ride on the front fender of the vehicle as this provides a vantage point with no obstruction. The recorder may ride either next to the driver or on the opposite fender, the latter is desirable because he is closer to the counter. Tallies are kept on the back of the sketch map and final results are recorded on the front in the appropriate blank. (See figure III). The equipment needed for the census consists of a supply of the township sketch maps and one tatum board. A tatum board is more desirable than a clip board because the former provides more protection to the map sheets.

Reference collection numbers:

9, 10, 11, 12, 13, 14, 15, 16.

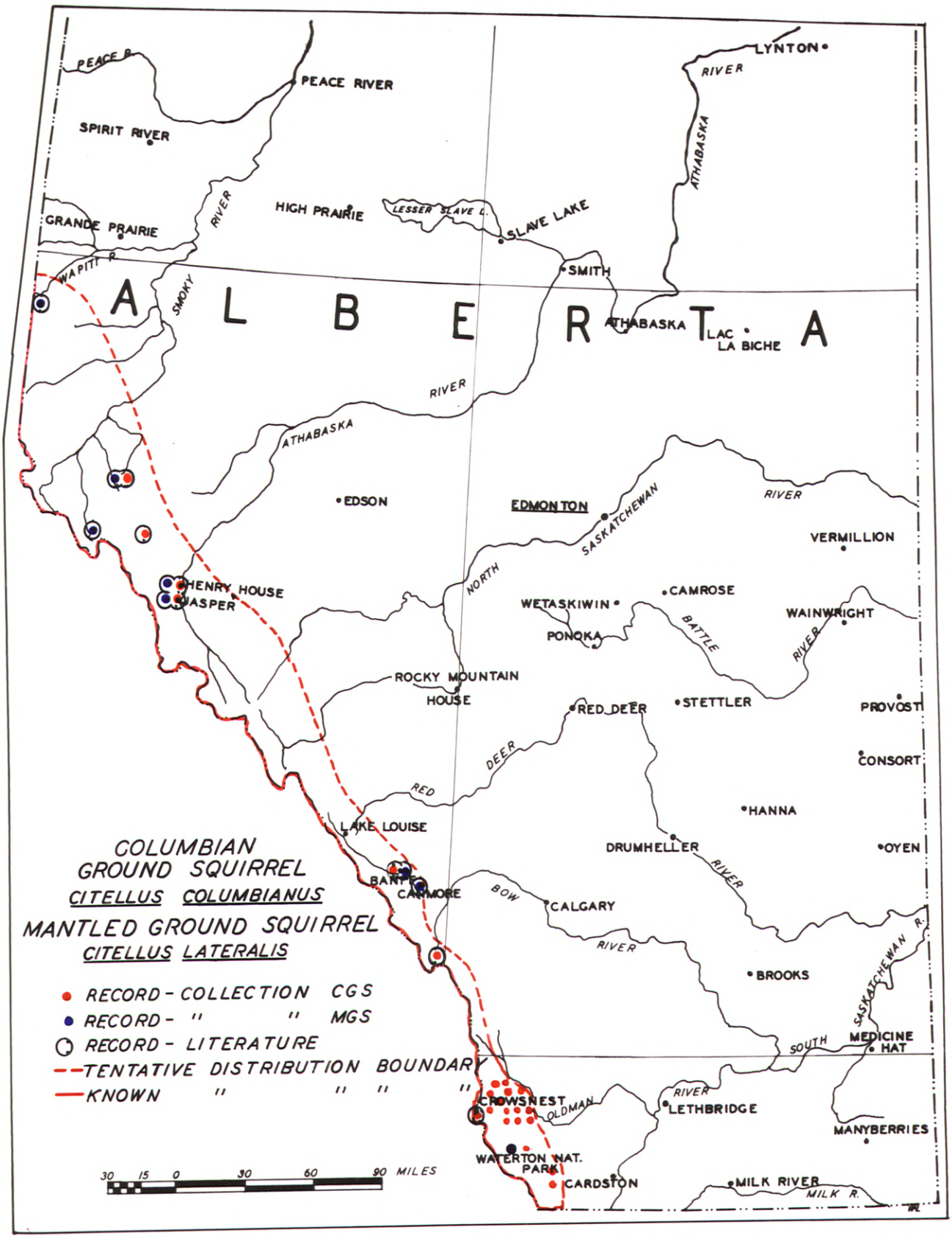
Citellus columbianus Ord. Columbian Ground Squirrel.

Distribution by Habitat: This species is restricted to the mountain forest zone of western Alberta where it is found on open rough, rocky, half forested slopes. In the Pincher Creek area the Columbia ground squirrel has moved out from the foot hill country into the flat agriculture land where it overlaps with the Richardson ground squirrel.

Distribution Records: Crowsnest Mountain; I
Waterton Lake National Parks; II (1938)
Pincher Creek area, T4 R29 W4; II (1938)
Pincher Creek area, T6 R2 W5; II (1941)
T6 R3 W5; II (1941)
T7 R1 W5; II (1941)
T7 R2 W5; II (1941)
Crawly area, T6 R1 W5; II (1941)
Coleman area, T8 R4 W5; II (1941)
Gentry area, T8 R5 W5; II (1941)
Twin Butts, T3 R29 W4; II (1941)
T9 R2 W5)
T8 R3 W5) II (1945)
T8 R2 W5)
Banff; V
Blairmore area, T7 R3 W3; II (1946)
T7 R4 W5; II (1941)
Crowsnest Pass; V
Rocky Mt. (75 miles S. W. of Calgary); V
Hay River (near headwaters); V
Henry House (25 miles west); V
Smoky Valley (150 miles N. Jasper); V
Jasper House; V

In regards to the Pincher Creek record, a local inhabitant stated that the mountain gopher had extended its distribution to Pincher Creek within the last five years (1938).

Reference Collection Number:
17.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
RIVER
ATHABASKA
WAPITI R.
SMOKY
ALBERTA
SMITH
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN
RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE
RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
DEER
RED
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
COLUMBIAN GROUND SQUIRREL
CITELLUS COLUMBIANUS
MANTLED GROUND SQUIRREL
CITELLUS LATERALIS
RECORD - COLLECTION CGS
RECORD - " " MGS
RECORD - LITERATURE
TENTATIVE DISTRIBUTION BOUNDARY
KNOWN " " " "
30 15 0 30 60 90 MILES

MAP VII

Citellus tridecemlineatus Mitchill. 13-Lined Ground Squirrel.

Distribution by Habitat: Present records in Alberta indicate that the species occurs in the prairie parkland type and extends northwest into the modified mixed forest type. This distribution is in disagreement with the published distribution (Howell, 1938; Anderson, 1946). These authorities state that this species or a subspecies occurs in the dry plains of southern Alberta. However, a close check on the collections data of the Alberta Plague Survey failed to reveal any records for this species south of the prairie parkland where there are records from Cypress Hills and Waterton Lake National Park but none from the drier prairie area between them. Soper (1946) states, "Despite prolonged investigation on the southern plains (Alberta), this form has not been personally encountered." The writer believes that the records from Cypress Hills and Waterton Lake National Park should not indicate a continuous distribution between these points, as the moisture conditions, soil and vegetation types are different in these areas than in the intervening country.

For this reason the record for the Cypress Hills is indicated separately on the distribution map.

Like the Richardson ground squirrel this form has been

able to extend its range northward into the northern mixed forest and coniferous forest types. The Athabaska River will probably act as a barrier to further range extension in this direction.

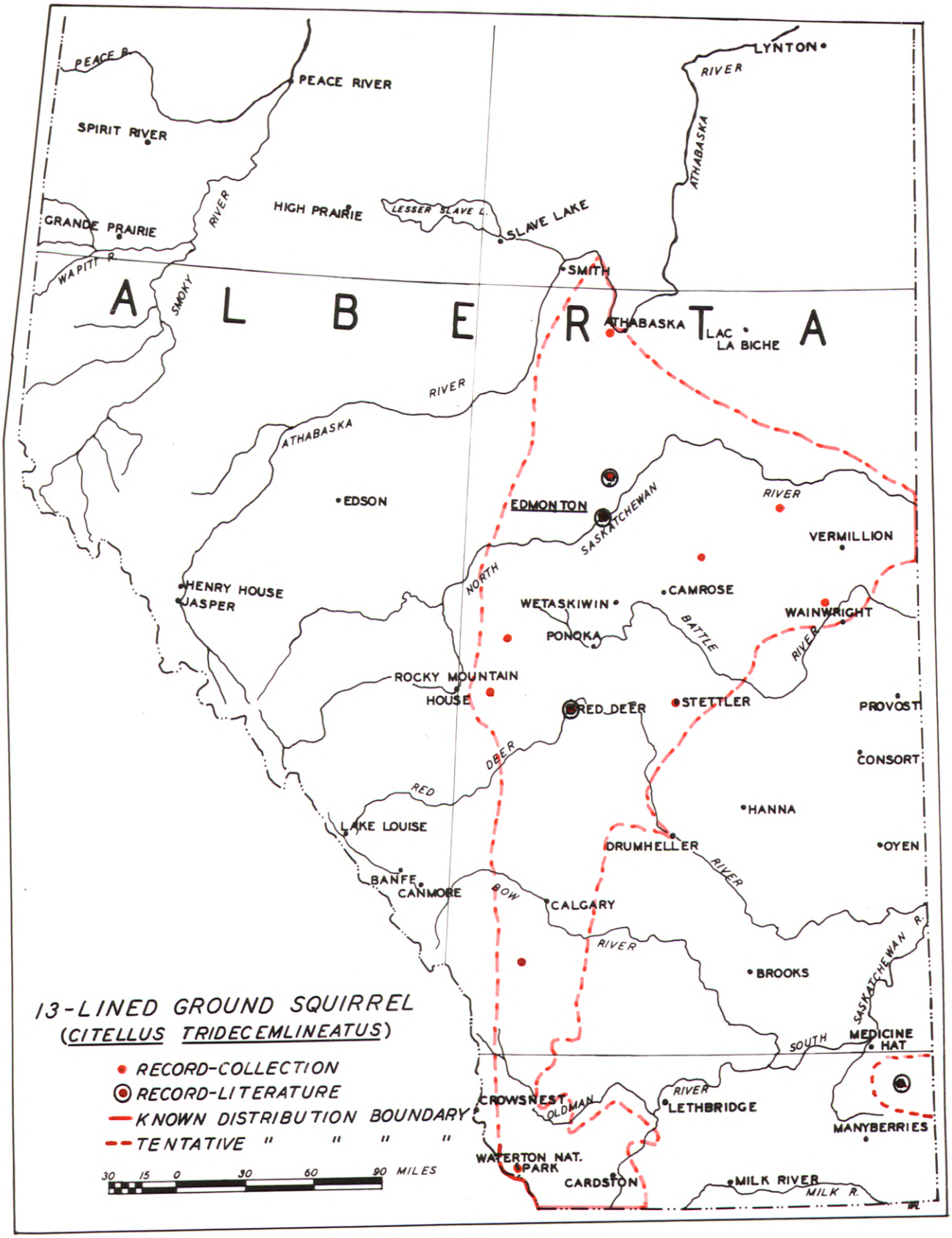
Distribution Records: Baptiste Lake, T66 R24 W4; I
Rocky Mountain House area, T37 R5 W5; II (1946)
Lost Lake Municipality #67; III
T19 R2 W5; II (1946)
Wainwright area, T45 R7 W4; II (1946)
High River area, T19 R1 W5; II
Beaver Municipality #73; III
Eagle Municipality #81; III
Stetter Municipality #54; III
Sturgeon River (25 miles N. of Edmonton); V
Red Deer V
Edmonton V
Waterton Lake National Park; IV
Cypress Hills; IV

The two southern most records are for the subspecies C. t. pallidus which occurs in the drier habitat type than C. t. tridecemlineatus.

The species never occurs in large number and the distribution is rather spotty. According to Lauton (1922) this species is not tolerant of intensive cultivation. This fact may account for the uneven distribution pattern.

Reference collection number:

18.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
RIVER
ATHABASKA
WAPITI R.
SMOKY
SMITH
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN
RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE
RIVER
ROCKY MOUNTAIN
HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
RED
DEER
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
13-LINED GROUND SQUIRREL
(CITELLUS TRIDECEMLINEATUS)
RECORD-COLLECTION
RECORD-LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

MAP VIII

Citellus franklinii Sabine. Franklin's Ground Squirrel.

Distribution by Habitat: Originally the Franklin's ground squirrel was restricted to the prairie parkland zone but now it is also found in agricultural areas in the northern mixed forest and coniferous forest (Baptiste Lake Area).

Distribution Records: Wainwright Sight record; I
Baptiste Lake T66 R24 W4; I
Hanna area, T32 R19 W4; II
Nelson Municipality #105; III
Smoky Lake Municipality #89; III
Beaver Mountain Municipality #73; III
Red Deer Municipality #55; III
Ponoka Municipality #66; III
Camrose Municipality #63; III
Edmonton City; V
Sturgeon River (25 miles N. of Edmonton); V

The distribution map for this species is very similar to that of the 13-striped ground squirrel, both being parkland land forms.

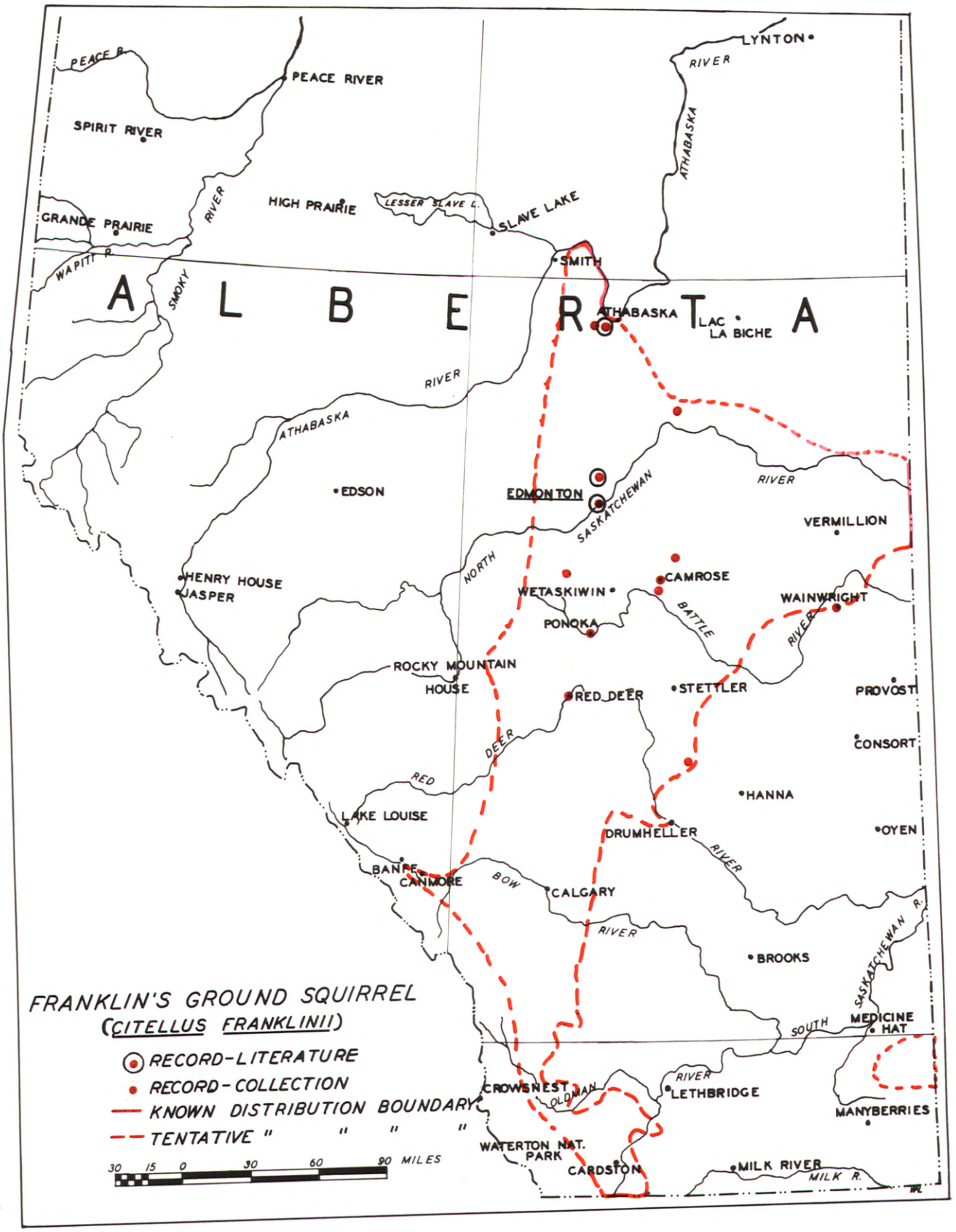
The northern most record for the species is the Baptiste Lake record established by the collection of a specimen (No. 19) from this area. It is interesting to note that the three "low land" members of the Genus Citellus found in the province occur in the Baptiste Lake area and that this locality is at present the northern most point in their distributions. The three species (C. richardsonii, C. tridecemlineatus, C. franklinii) did not originally occur

in this area but moved in as man cleared the land for settlement. The Athabaska River will probably remain a barrier to any further northwest extension in range.

The Franklin's Ground Squirrel like the 13-lined ground squirrel, is difficult to observe in the field. This is due to the brushy character of the habitat; hence the Franklin's ground squirrel never seem to be very abundant.

Reference Collection Number:

19.


ALBERTA
PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
WAPITI R.
SMOKY RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
ATHABASKA RIVER
SMITH
ATHABASKA LAC LA BICHE
ATHABASKA RIVER
EDSON
EDMONTON
SASKATCHEWAN RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH SASKATCHEWAN RIVER
WETASKIWIN
CAMROSE
WAINWRIGHT
BATTLE RIVER
PONOKA
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
RED DEER RIVER
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
BANFF
CANMORE
BOW RIVER
CALGARY
BROOKS
SASKATCHEWAN R.
SOUTH SASKATCHEWAN RIVER
MEDICINE HAT
CROWSNEST
OLDMAN RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
FRANKLIN'S GROUND SQUIRREL
(CITELLUS FRANKLINII)
RECORD-LITERATURE
RECORD-COLLECTION
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

MAP IX

Citellus lateralis tescorum Hollester. Golden Mantled Ground Squirrel.

Distribution by Habitat: Confined to the mountainous region of Western Alberta. This species is found in much the same habitat as the Columbian ground squirrel, open forested mountain and foothill slopes. Their burrows are usually dug under rocks or stumps.

Distribution Records: (See map no. 6)

Waterton Lake National Park; II (1938)

This is the only record collection by the Plague Survey.

Banff; V
Canmore; V
Jasper House (60-70 N. Grand Cache River); V
Henry House; V
Jasper House; V
Wapitii River (S. of Grande Prairie); IV
Smoky River (head) V

Reference Collection Number:

No specimens were collected during the 1947 survey. The species was included to complete distribution data on the members of the Genus Citellus in Alberta.

Eutamias minimus borealis Allen. Northern Chipmunk.

Distribution by Habitat: The species is semi-arboreal and is generally associated with woody vegetation. Occurs throughout most of the prairie parkland type, northern parkland type, northern mixed forest and northern coniferous forest. Probably also occurs in the lower reaches of mountain forest type but is replaced by other forms in higher altitudes.

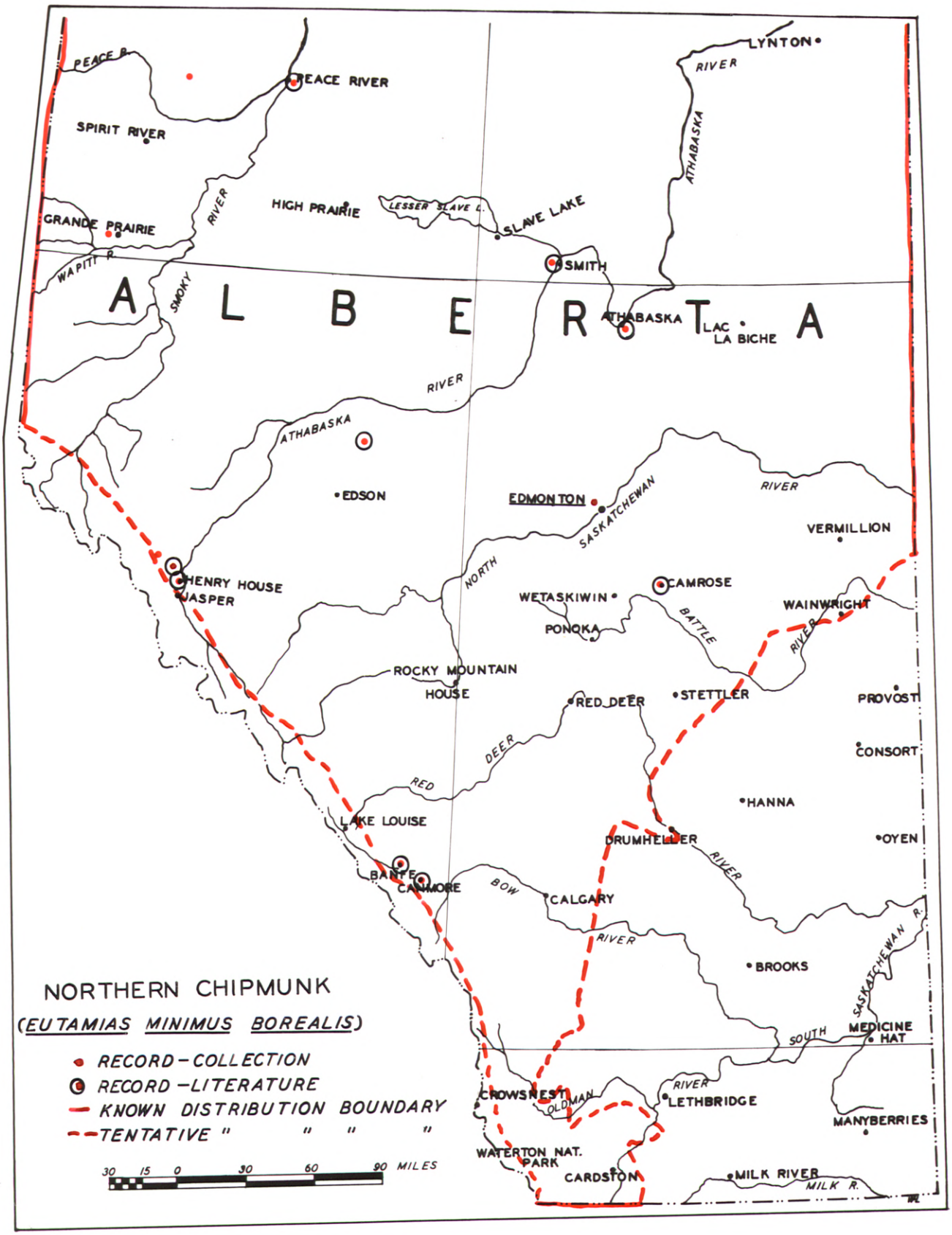
Distribution Records: Fairview area, T82 R3 W6; I
Grande Prairie area, T70 R5 W6; I
Edmonton (City limits); I
Athabaska V
Banff V
Camrose V
Canmore V
Fort McMurray V
Henry House V
McLeod River V
Peace River V
Smith V
Donalda V
Grand Cache River (70 N. Jasper House) V

Soper (1948) did not record the species within the farming-parkland area of Grande Prairie-High Prairie-Peace River Triangle. No doubt this species does occur in this area in limited numbers. Eutamias m. oreocetes (Timberline Chipmunk) occurs in alpine meadows of the Rocky Mountains on Waterton Lake National Park. Two subspecies of Eutamias

amoenus also occur in the province but are limited to higher altitudes of the Rockies from the west central Alberta to Waterton Lake National Park.

Reference Collection Numbers:

20, 21, 22, 23, 24.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
RIVER
ATHABASKA
WAPITI R.
SMOKY
SMITH
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN
RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE
RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
DEER
RED
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
NORTHERN CHIPMUNK
(EUTAMIAS MINIMUS BOREALIS)
RECORD - COLLECTION
RECORD - LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

Eutamias amoenus luteiventris Allen. Buff-bellied Chipmunk.

Distribution by Habitat: Occurs in the mountain forest type of the Rocky Mountain region between 3,000-10,000 ft.

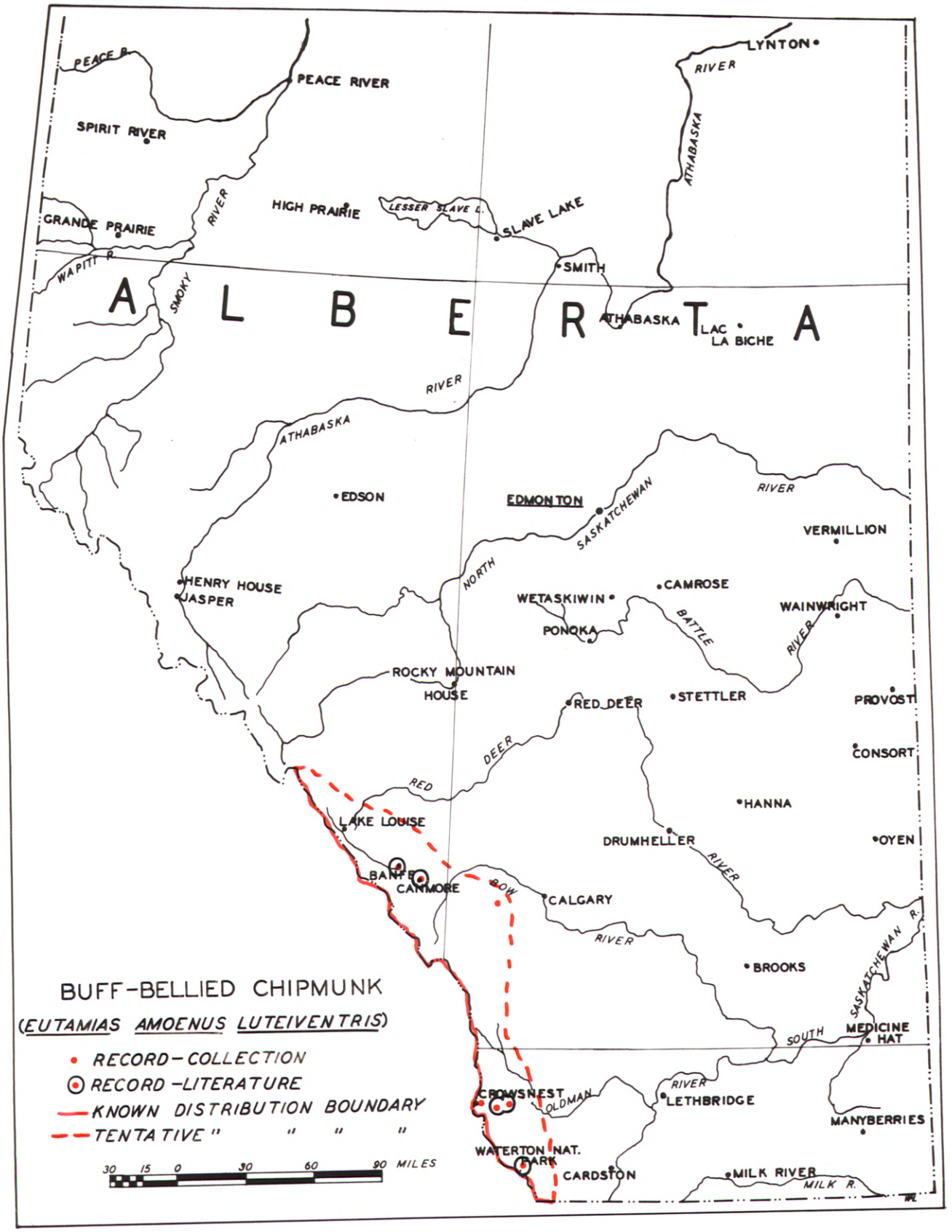
Distribution Records: Crowsnest Mountain; I
Bragg Creek area; I
Banff; V
Burmis; V
Canmore; V
Coleman; V
Laggan; V
Waterton Lake National Park; V

Identification: In separating this species from individuals of the more widely distributed northern chipmunk (Eutamias minimus borealis) two points are to be remembered:

1. the more or less restricted mountain distribution of this species;
2. the buff wash to the belly fur which is lacking in the northern chipmunk.

Reference Collection Numbers:

25, 26, 27.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
RIVER
ATHABASKA
WAPITI R.
SMOKY
SMITH
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN
RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE
RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
DEER
CONSORT
RED
HANNA
LAKE LOUISE
DRUMHELLER
RIVER
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
BUFF-BELLIED CHIPMUNK
(EUTAMIAS AMOENUS LUTEIVENTRIS)
RECORD-COLLECTION
RECORD-LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

Map XI

Tamiasciurus hudsonicus. Red Squirrel.

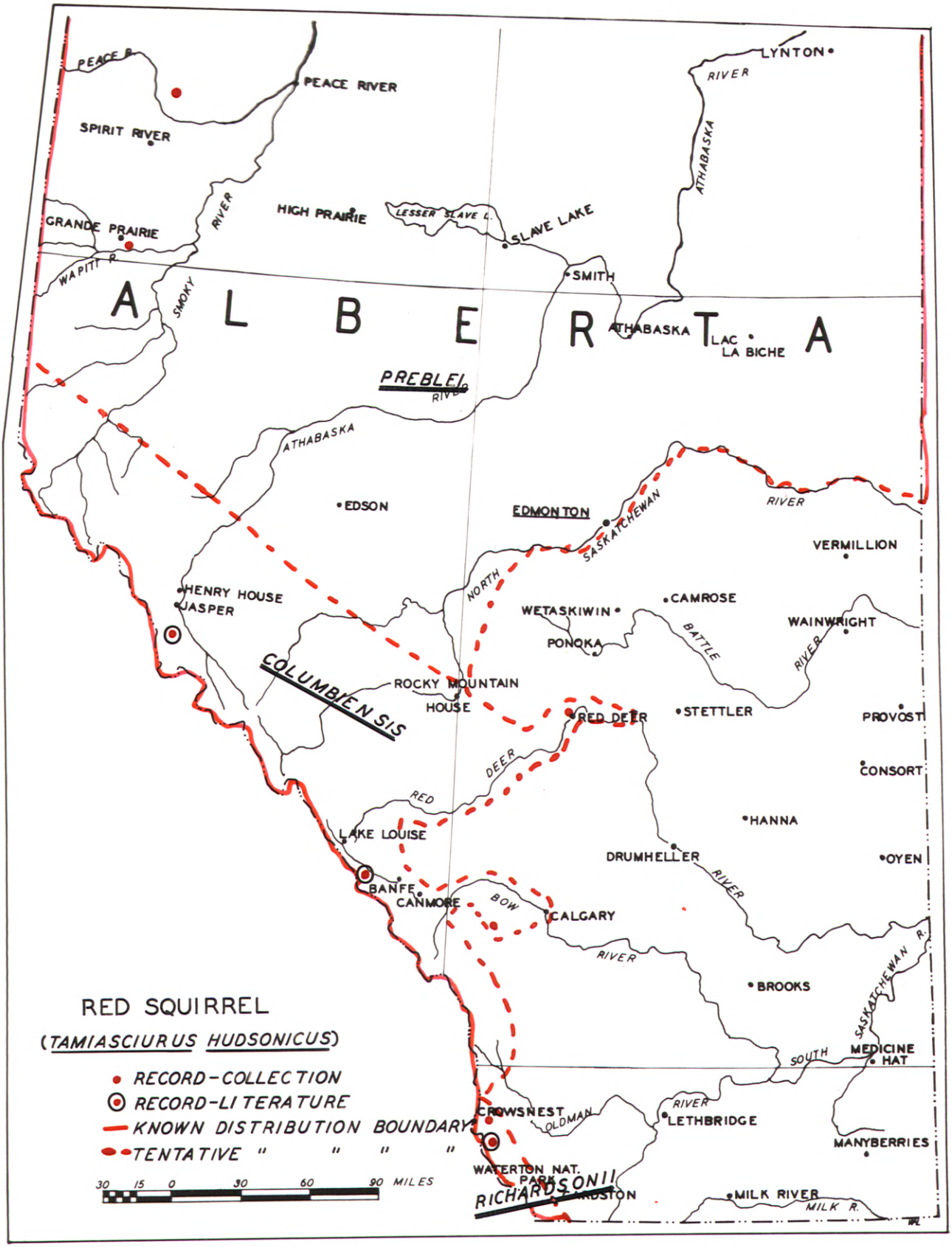
Distribution by Habitat: Occurs with varying degrees of abundance in all of the coniferous forest types in the province. In the prairie parkland the red squirrel occurs along the larger water courses associated with coniferous vegetation that is present. In general the distribution of this squirrel, in the province, corresponds with the occurrence of coniferous vegetation.

Distribution Records: Grande Prairie area, T70 R5 W6; I
Fairview area, T84 R3 W6; I
Calgary area, T23 R4 W5; I
Red Deer area, T39 R26 W4; I
Crowsnest Mountain; I
Banff and Jasper National Parks; V
Waterton Lake National Park; V

Three subspecific forms of this species have been described for Alberta; preblei the form found north of the North Saskatchewan River, richardsonii found in the Rockies north to Crowsnest Pass where it intergrades with columbiensis. columbiensis is the form found northward through the national parks (Banff and Jasper).

Reference Collection Numbers:

28, 29, 30, 31.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
WAPITI R.
SMOKY RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
ATHABASKA RIVER
SMITH
ATHABASKA
LAC LA BICHE
ALBERTA
PREBLEI RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
BATTLE RIVER
PONOKA
COLUMBIENSIS
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
DEER
RED
CONSORT
LAKE LOUISE
HANNA
DRUMHELLER
RIVER
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
SASKATCHEWAN R.
BROOKS
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
RICHARDSONII
MILK RIVER
MILK R.
RED SQUIRREL
(TAMIASCIURUS HUDSONICUS)
RECORD-COLLECTION
RECORD-LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

Thomomys talpoides Pocket Gopher.

Distribution by Habitat: Occurs throughout much of the prairie parkland zone and northward into the farming districts towards Athabaska. It is also found in the prairie zone in more moist situations i. e. river valleys.

Distribution Records: Blindman River; V
Calgary; V
Didsbury; V
Edmonton; I
Irwin Lake; V
Red Deer area, T32 R3 W5; I
Red Deer area, T38 R28 W4; I
Waghorn; V
Camrose; IV
Elk Island National Park; IV
Medicine Hat; IV
Moose Mountain; V
St. Abert; V

Three subspecies have been recognized as occurring in the province; talpoides, andersoni, and loringi. Of the three, talpoides is the most common and widespread.

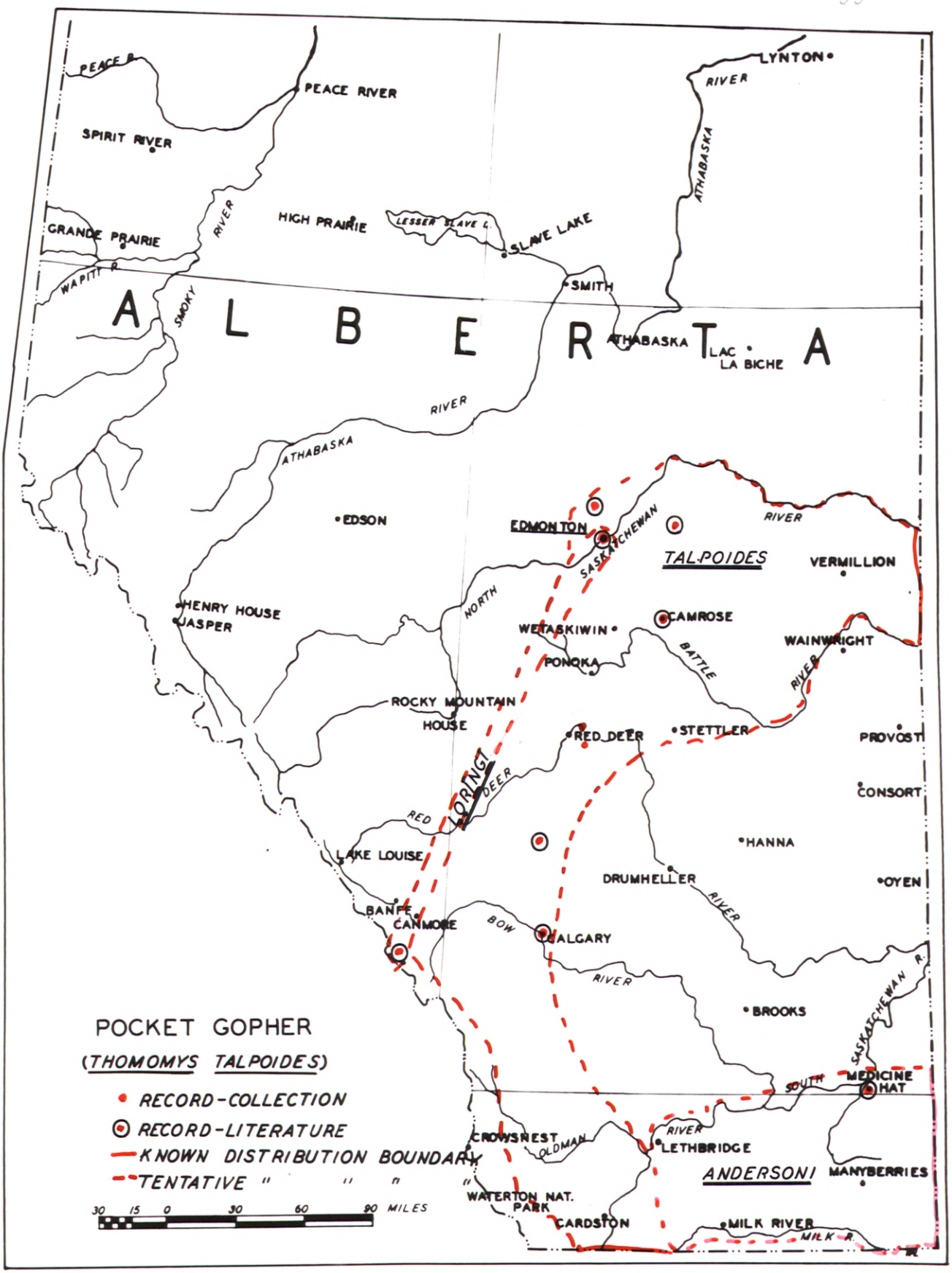
loringi is known from only two localities, Edmonton and Moose Mountain. andersoni occurs in the valleys of the South Saskatchewan River and Milk River.

Natural History Data: Small mounds of dirt, with no apparent hole, scattered about a pasture are characteristic signs of the presence of this mammal.

This mammal can be easily collected by setting a #1 steel trap in one of their underground runways. The runways can be located by digging down under the spoil pile. After locating a tunnel enlarge it slightly for the steel trap. After the set has been made cover the excavation with a board using dirt from the soil pile to make it tight. The trap should be fastened down to prevent its loss.

Reference Collection Numbers:

32, 33, 34.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
RIVER
ATHABASKA
WAPITI R.
SMOKY
SMITH
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN
RIVER
TALPOIDES
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE
RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
LORING
RED DEER
CONSORT
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
ANDERSONI
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
POCKET GOPHER
(THOMOMYS TALPOIDES)
RECORD-COLLECTION
RECORD-LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " "
30 15 0 30 60 90 MILES

Map XIII

Peromyscus maniculatus. White-footed Mouse.

Distribution by Habitat: Representatives of the species are found in all of the vegetation zones of the province. In all, three forms (subspecies) of this mouse occur in the province; P. m. borealis, P. m. osgoodi, and P. m. artemisiae. Insufficient material was collected to prepare distribution maps for individual subspecies. A single map has been prepared (modified from Osgood's distribution map of the Genus Peromyscus, 1909) outlining the three areas characterized by the subspecies.

Borealis occurs throughout most of the forested regions of the province and intergrades with osgoodi in the prairie parkland zone and artemisiae in the Rocky Mountain region of the province. osgoodi is the subspecies occurring in the drier habitat of the prairie zone. These two forms are more widespread than the third, artemesiae, which is limited to mountains in the extreme southwest corner of the province.

Identification: On the average, as the specimens in the reference collection illustrate, the peltage of borealis is darker than that of osgoodi which is usually a brighter ochraceous buff. White tufts of fur occur in the form of

the ears of both forms but seem to be more prominent in osgoodi. The differences between borealis and artemisiae are even more slight and depend on minor skull characteristics. It appears that only two forms borealis and osgoodi were collected.

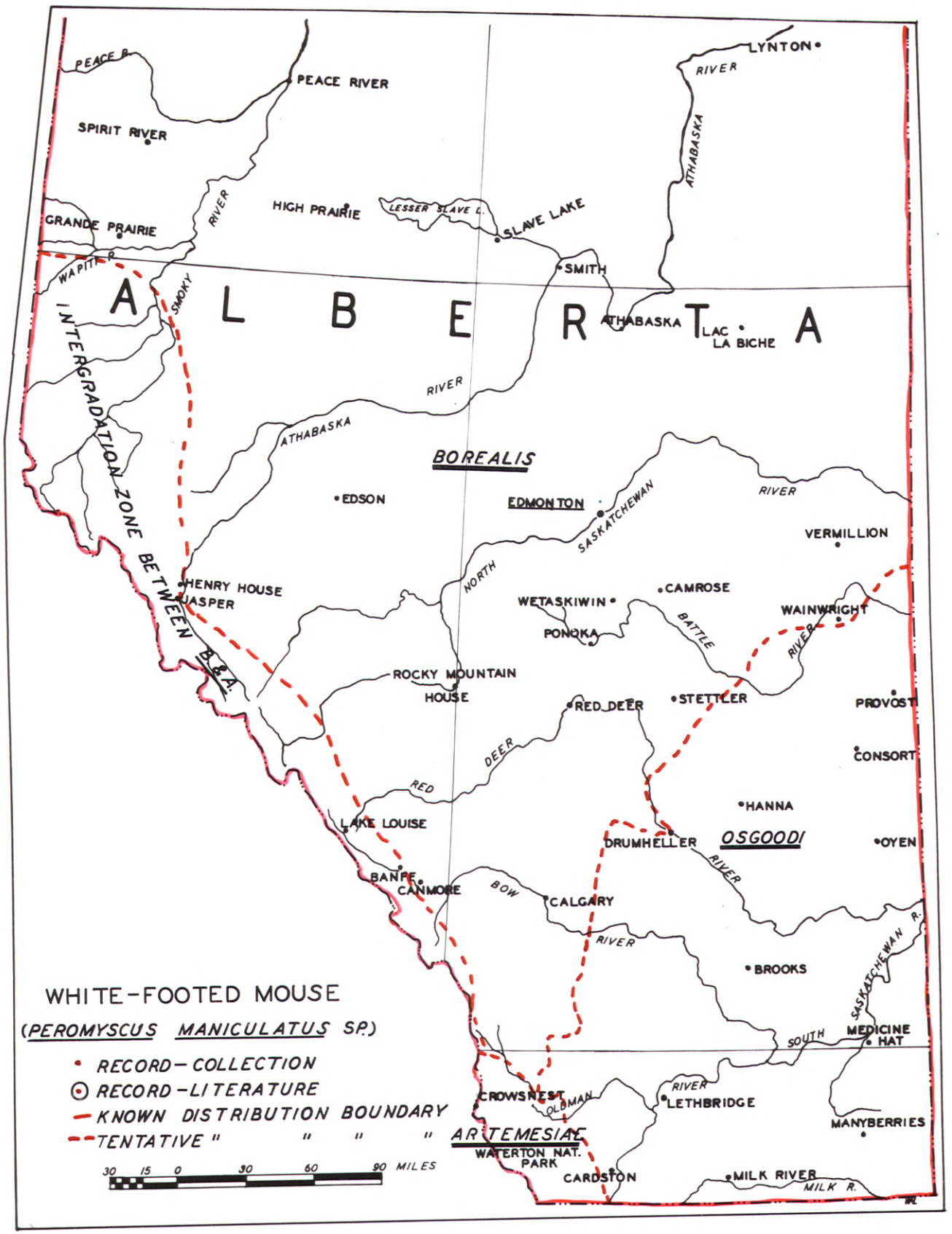
In the Milk River area another species of white-footed mouse occurs P. leucopus aridulus. According to Osgood the absence of the white spot in front of the ears of the grey light colored mouse will distinguish it from P. m. osgoodi which it closely resembles.

Immature mice of both forms are very similar and quite different from the adults. Juvenile peltage is dark grey readily distinguishable from the adult.

Reference Collection Numbers:

borealis 35, 36, 37, 38, 39 (imm.), 40 (imm.).

osgoodi 41, 42, 43, 44, 45, 46, 47 (imm.).


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
RIVER
ATHABASKA
SMITH
WAPITI R.
SMOKY
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
BOREALIS
EDSON
EDMONTON
SASKATCHEWAN
RIVER
VERMILLION
INTERGRADATION ZONE BETWEEN B. & A.
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE
RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
DEER
RED
HANNA
LAKE LOUISE
DRUMHELLER
OSGOODI
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
RIVER
SASKATCHEWAN R.
BROOKS
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
ARTEMESIAE
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
WHITE-FOOTED MOUSE
(PEROMYSCUS MANICULATUS SP.)
RECORD-COLLECTION
RECORD-LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

Neotoma cinerea. Gray Bushy-tailed Wood Rat.

Distribution by Habitat: Two forms of this species occur within the province drummondii essentially a Rocky Mountain form and cinerea occurring in rough rocky areas along the Milk River in the prairie zone.

Distribution Records: drummondii
Frank (Frank Slide); I
Jasper House; V
Wapitii River (S. of Wembley); VII
Pinto Creek; VII
Dunvegan; VII
Fairview; I

cinerea
Waterton Lake National Park; IV
Milk River (north of Sweet Grass Hills) IV

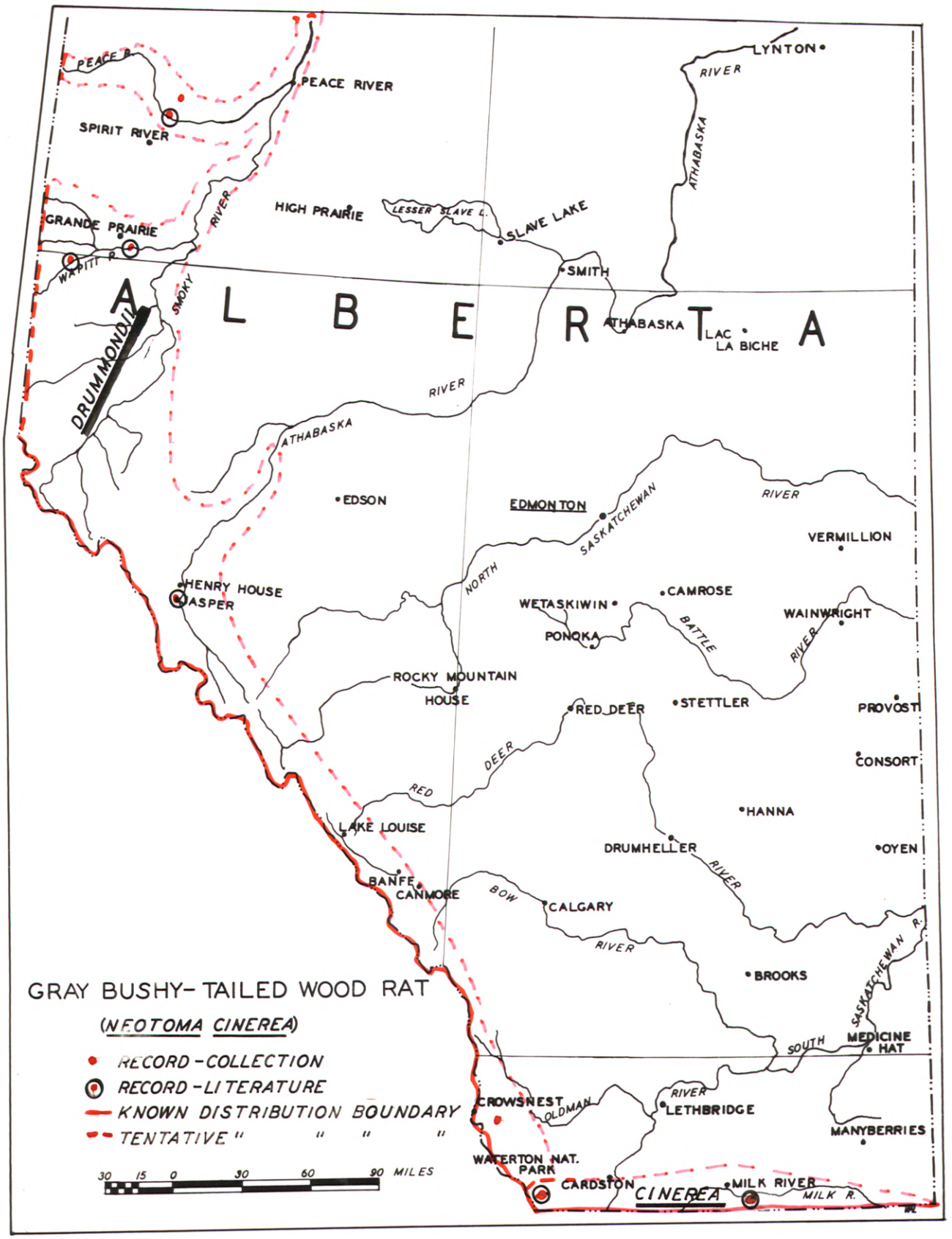
drummondii is essentially a Rocky Mountain form occurring in and about rock slides and rough rocky terrain. Soper (1948) reports that he believes this form has extended range in to high prairie country. A reliable source told him that wood rats could be found along the Peace River as far east as Dunvegan Ferry. Local inhabitant of the Fairview area mention seeing large gray rats about some abandoned buildings (1947).

cinerea occurs in a similar type of habitat along the Milk River but in the much drier vegetation zone (prairie zone) of southern Alberta. (Soper 1946).

Identification: Two methods of separating the subspecies; location and peltage. In drummondii the white of the hind foot makes an abrupt change to the gray fur of the leg while in cinerea the change is gradual.

Reference Collection Number:

48.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
WAPITI R.
SMOKY RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
ATHABASKA RIVER
SMITH
ALBERTA
DRUMMONDVILLE
ATHABASKA RIVER
ATHABASKA LAC LA BICHE
EDSON
EDMONTON
SASKATCHEWAN RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH SASKATCHEWAN RIVER
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
RED DEER RIVER
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
BANFF
CANMORE
BOW RIVER
CALGARY
BROOKS
SASKATCHEWAN R.
SOUTH SASKATCHEWAN RIVER
MEDICINE HAT
CROWSNEST
OLDMAN RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
NEOTOMA CINEREA
GRAY BUSHY-TAILED WOOD RAT
(NEOTOMA CINEREA)
RECORD - COLLECTION
RECORD - LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

Map XV

Clethriomomys gapperi. Red-backed Mouse.

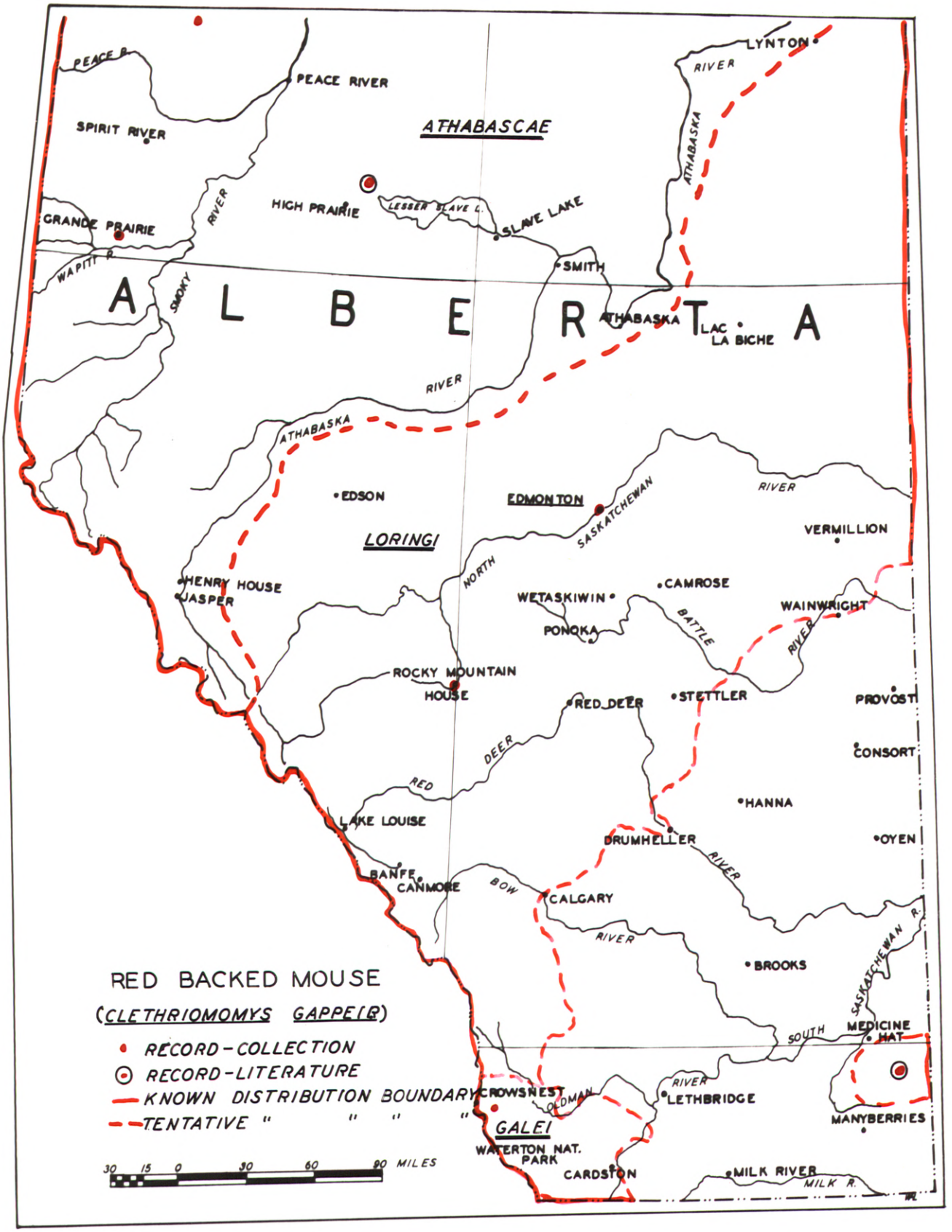
Distribution by Habitat: The red-backed mouse inhabits wooded areas and does not occur in the prairie zone except along bushy water courses. In view of the species habitat requirements the southern boundary of the prairie parkland can serve as the southern boundary of this form in Alberta.

Distribution Records: Red Deer area, Sec. 6, T39 R26 W4; I
Red Deer area, Sec. 17, T38 R28 W4; I
Blair Moor area, Sec. 9, T8 R5 W5; I
Rocky Mountain House, Sec. 7, T40 R7 W5; I
Edmonton (city); I
Grande Prairie area, Sec. 29, T70 R5 W6; I
Manning area, Sec. 26, T93 R23 W5; I
Cypress Hills; VI
Sinclair Lake; VII
Kimawan Lake; VII

Three subspecies of the red-backed mouse occur in Alberta; athabascae in the Athabaska Basin northwestward, loringi probably north from the prairie parklands to Athabaska Landing area, galei which is restricted to the Rocky Mountains in the extreme southwest corner of the province. The Manning specimen is typical of athabascae.

Reference Collection Numbers:

49, 50, 51, 52, 53.


PEACE R.
PEACE RIVER
SPIRIT RIVER
ATHABASCAE
LYNTON
RIVER
ATHABASKA
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
GRANDE PRAIRIE
SMOKY RIVER
WAPITI R.
SMITH
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN
RIVER
VERMILLION
LORING!
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE
RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
DEER
RED
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
RIVER
CROWSNEST
OLDMAN
LETHBRIDGE
MANYBERRIES
GALEI
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
RED BACKED MOUSE
(CLETHRIOMOMYS GAPPERI)
RECORD - COLLECTION
RECORD - LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

Microtus pennsylvanicus. Meadow Mouse.

Distribution by Habitat: There are two subspecies of this mouse occurring in the province, drummondii and insperatus. insperatus is restricted to the semi-arid regions of the province intergrading with drummondii in the prairie park-land zone. drummondii is widespread throughout the wooded region occurring in open brushy areas.

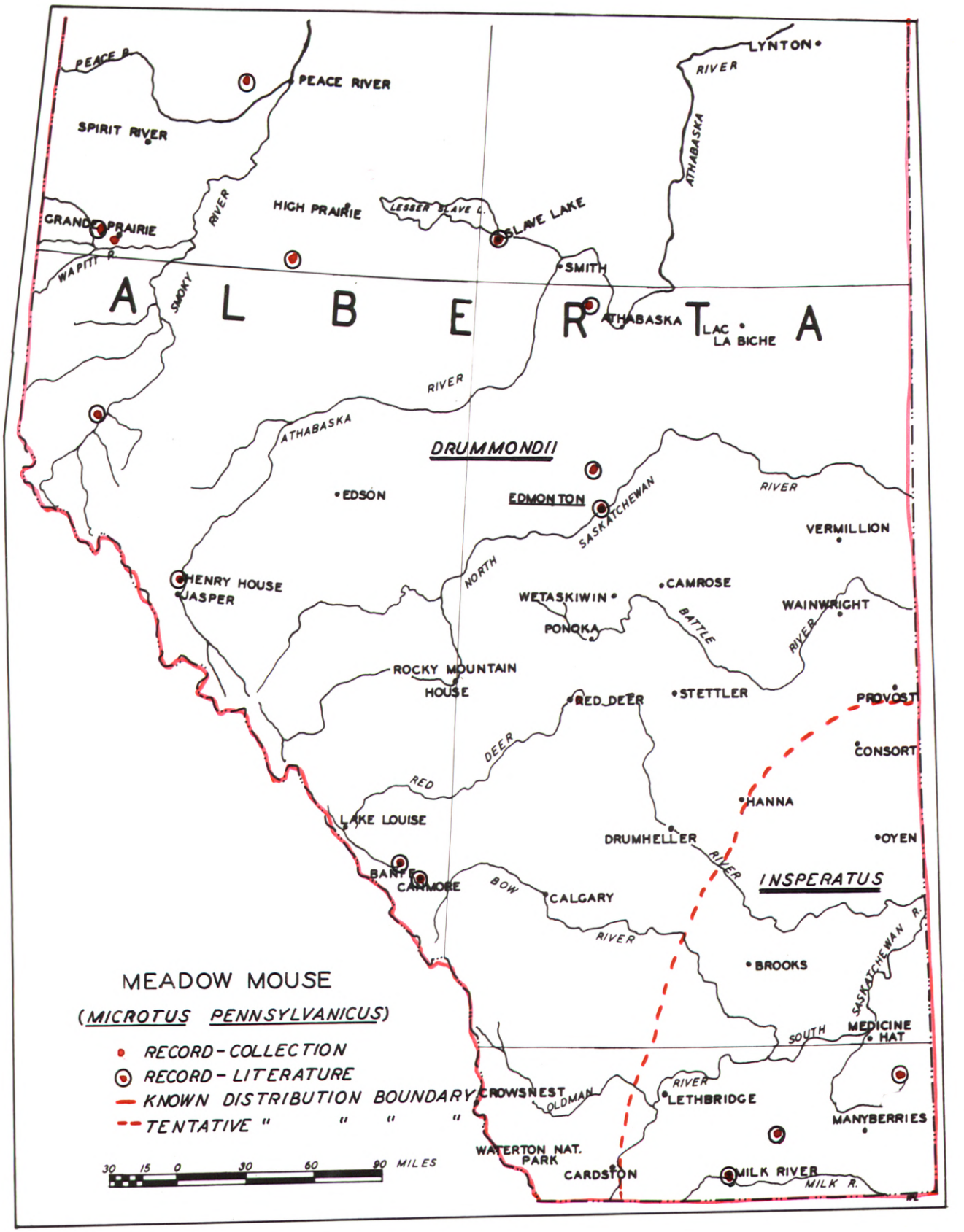
Distribution Records: drummondii
Red Deer area, Sec. 17, T38 R28 W4; I
Grande Prairie area, Sec. 30, T71 R7 W6; I
Smoky Valley; V
Henry House; V
Edmonton; V
St. Albert; V
Canmore; V
Banff; V
Lesser Slave Lake; V
Baptiste Lake;VII
Sturgeon Lake; VII
Saskatoon Lake; VII
Cardinal Lake; VII

insperatus
Milk River; VI
Nemiskam; VI
Cypress Hills area; VI

Soper (1946) reports that in the dry treeless International Boundary zone specimens have been taken that are very similar to drummondii. The integrading zone between these forms must be very broad.

Reference Collection Numbers:

54, 55, 56, 57.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
WAPITI R.
SMOKY RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
ATHABASKA RIVER
SMITH
ATHABASKA LAC LA BICHE
ALBERTA
ATHABASKA RIVER
DRUMMONDII
EDSON
EDMONTON
SASKATCHEWAN RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
RED DEER
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
BANFF
CANMORE
BOW
CALGARY
INSPERATUS
RIVER
SASKATCHEWAN R.
BROOKS
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
MEADOW MOUSE
(MICROTUS PENNSYLVANICUS)
RECORD - COLLECTION
RECORD - LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

Map XVII

Rattus r. rattus. Black Rat.

At present Alberta is considered the only rat-free area of its size in North America. However, to remain so will require considerable vigilance on the part of the citizenry and prompt reporting of the presence of rats to the Department of Public Health. The specimens in the collection were taken off of a circus train in Calgary. Prompt action on the part of the Public Health authorities prevented the escape of these animals from the circus car into the R. R. yards. No doubt, in time with the present lack of detailed shipping inspection the railroads will bring rats into the province. Some of these entries will go unnoticed until it is too late and a colony has become established. At present the Director of the Division of Entomology, Mr. J. H. Brown is actively engaged in organizing provincial wide rat exclusion campaign.

Reference Collection Numbers:

58, 59, 60, 61

Mus musculus domesticus. House Mouse.

The house mouse is probably distributed throughout the entire province in and about farm and settlement buildings.

Specimens were trapped from Fairview south to Milk River.

Reference Collection Numbers:

62, 63, 64.

Lepus townsendii campanius Hollester. White-tailed Jack Rabbit.

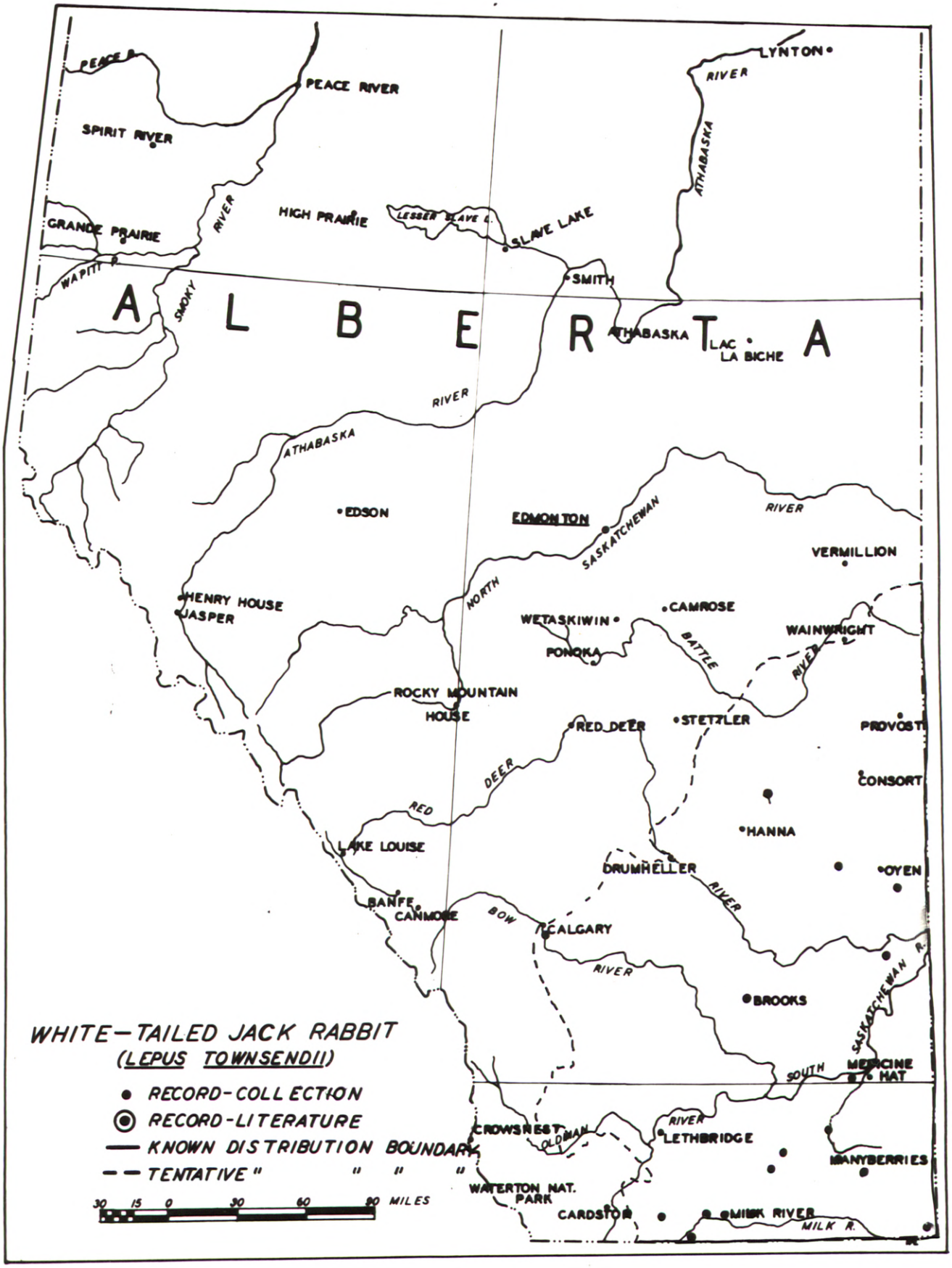
Distribution by Habitat: Originally this species was confined to the prairie zone and (probably) the drier portions of the prairie parklands. At present much of the parkland area is under cultivation creating suitable habitat for the white-tailed jack rabbit. Local reports indicate that the species has moved northward, how far still remains an unanswered question. A short time in the field would answer this question.

Distribution Record: Calgary area, T23 R1 W5; I
Sibbald area, T27 R2 W4; I
Hanna area, T34 R13 W4; II (1941)
Milk River area, T2 R17 W4; I
Cereal area, T28 R6 W4: II (1941) T2 R21 W4
Sibbald area, T26 R2 W4; II (1941)T2 R23 W4
Bindloss area, T21 R2 W4; II
Brooks; II (1938)
Scandia area, T15 R15 W4; II (1940)
Medicine Hat area, T13 R5 W4; II (1941)
Medicine Hat area, T12 R6 W4; II
T8 R8 W4; II
Manyberries area, T6 R6 W4; II (1940)
Foremost area, T6 R11 W4; II (1940)
Etzikom Coulee T5 R12 W4; II (1940)
Manyberries area, T5 R5 W4; II (1940)
Wild Horse, T1 R1 W4; II
Milk River, T2 R14 W4; (1939)
Milk River, T2 R16 W4; II
T1 R19 W4; II
T2 R21 W4; II
Woolford area, T2 R23 W4; II

No doubt this and the varying hare overlap in distribution in the prairie parkland zone. The southern boundary of this zone tentatively marks the northern limit of distribution.

Reference Collection Number:

65.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
RIVER
ATHABASKA
WAPITI R.
SMOKY
SMITH
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN
RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE
RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
DEER
RED
HANNA
LAKE LOUISE
DRUMHELLER
RIVER
OYEN
BANFF
CANMORE
BOW
CALGARY
RIVER
SASKATCHEWAN R.
BROOKS
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
WHITE-TAILED JACK RABBIT
(LEPUS TOWNSENDII)
RECORD-COLLECTION
RECORD-LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

Lepus americanus. Varying Hare.

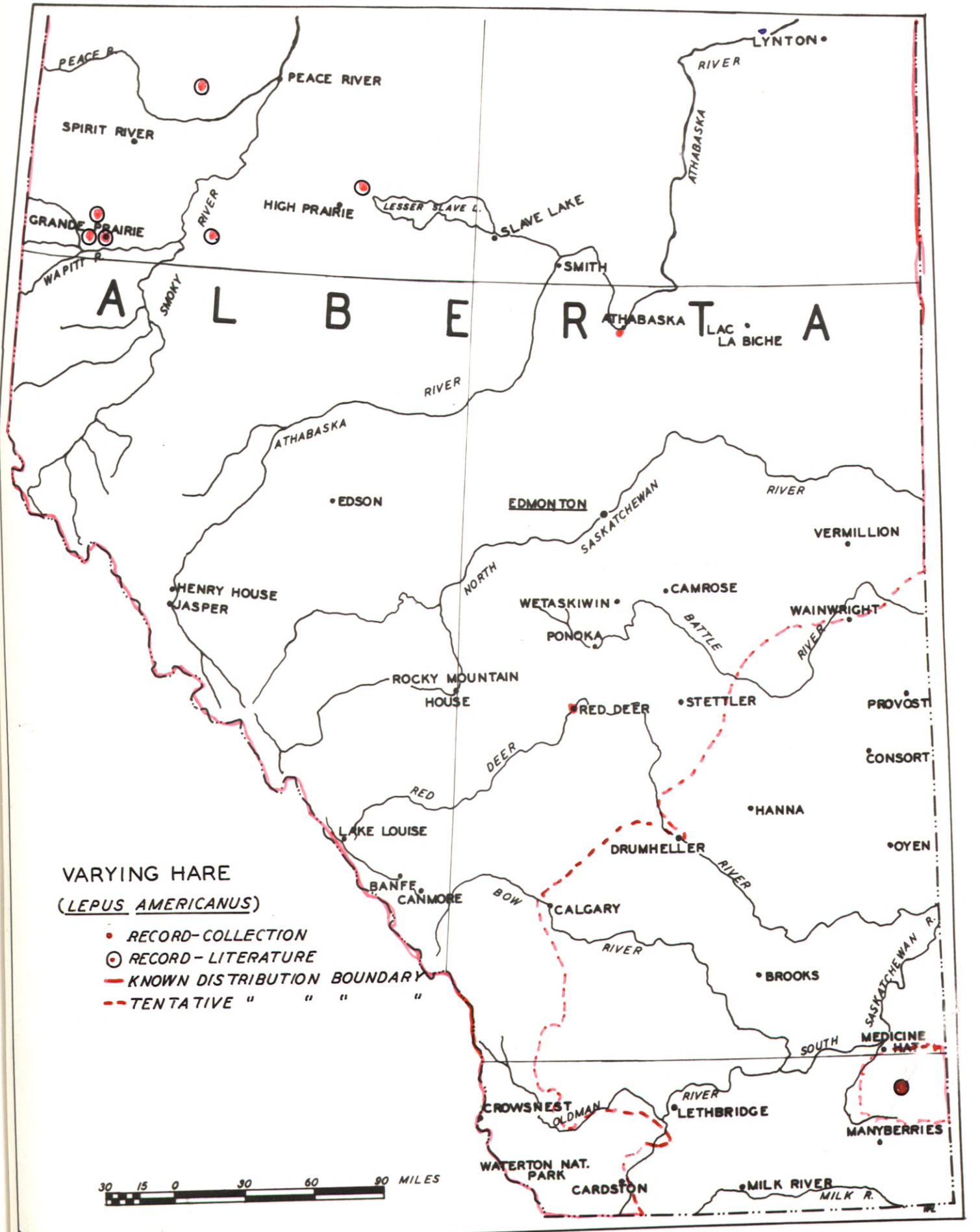
Distribution by Habitat: Various forms of the varying hare occur throughout most of the wooded region of the province.

Distribution Records: Cypress Hills; VI
Athabaska, sight record; I
Red Deer, sight record; I
Cardinal Lake; VII
Kimawan Lake; VII
Bear Lake; VII
Saskatoon Lake; VII
Grande Prairie; VII

L. a. americanus is the widely distributed subspecies occurring both in the Cypress Hills area and the northern forest area of the province. The species must overlap in distribution with the white-tailed jack rabbit in the prairie parkland zone.

Reference Collection Number:

Only two specimens were observed during the whole summer period. (sight records above) The year 1947 was a low in varying hare cycle as according to local inhabitants several years previous the "bush rabbits" were very abundant.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
WAPITI R.
SMOKY RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
ATHABASKA RIVER
SMITH
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
RED DEER
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
BANFF
CANMORE
BOW RIVER
CALGARY
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
VARYING HARE
(LEPUS AMERICANUS)
RECORD-COLLECTION
RECORD-LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

Map XIX

Sylvilagus nuttallii grangeri. Allen Black Hills Cottontail.

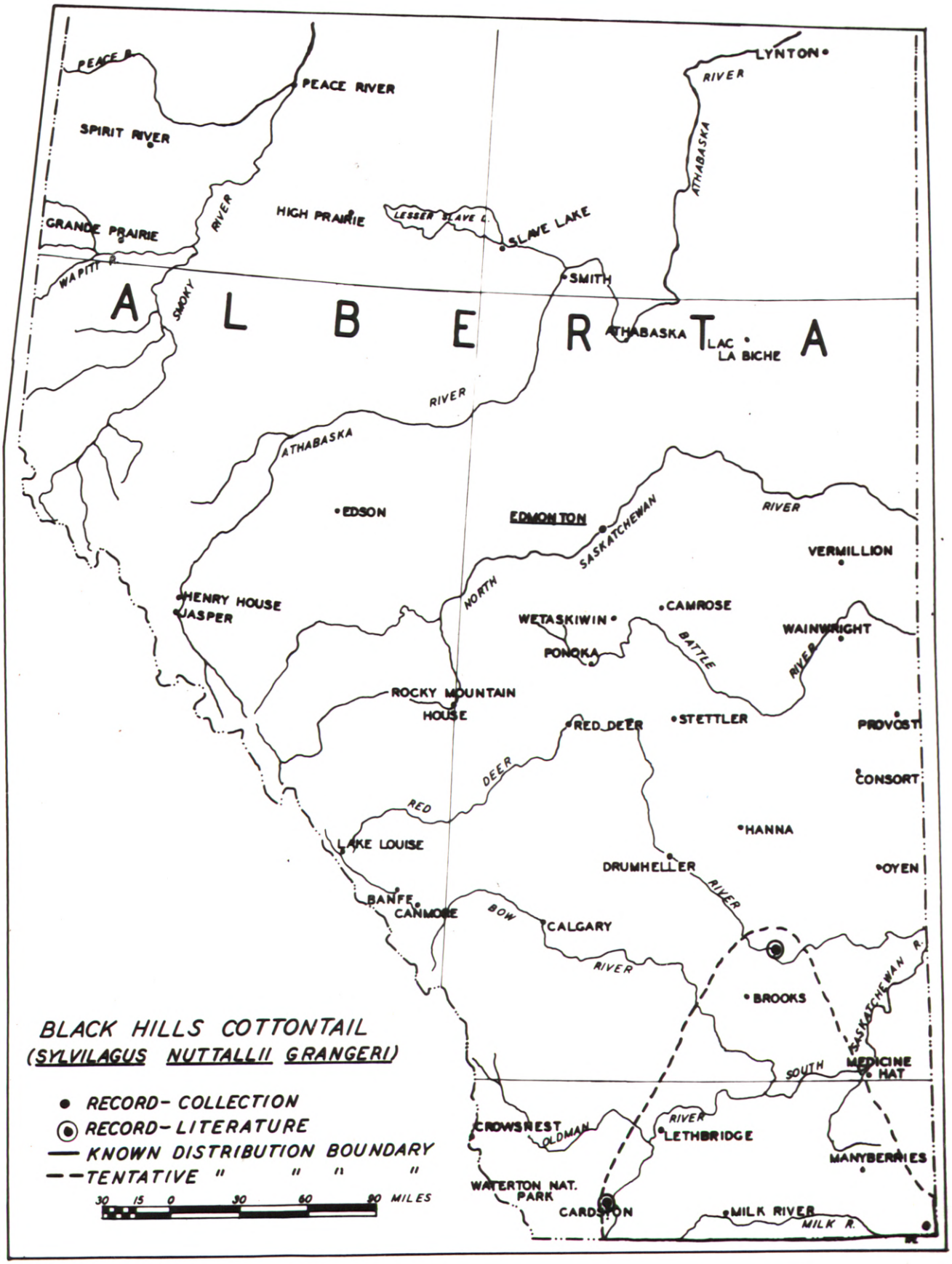
Distribution by Habitat: This rabbit occurs in the southern portion of the prairie zone. It appears to have a rather limited distribution in the province.

Distribution Records: Wild Horse Creek T1 R1 W4; I
Memiskan National Park; VI
Milk River North of Sweet Grass Hills; VI
Steveville; IV
Cardston; IV

According to Soper (1946) the Black Hills Cottontail prefers brushy coulees and tributary ravines associated with bad land formation. The single specimen taken on the 1947 survey was collected from a group of three using the foundation of an abandoned farm building. The distribution pattern for this arrival is spotty in many localities. Within its distribution the species is apparently absent or occurs in very limited numbers.

Reference Collection Number:

15.


PEACE R.
PEACE RIVER
SPIRIT RIVER
GRANDE PRAIRIE
RIVER
HIGH PRAIRIE
LESSER SLAVE L.
SLAVE LAKE
LYNTON
RIVER
ATHABASKA
WAPITI R.
SMOKY
SMITH
ALBERTA
ATHABASKA
LAC LA BICHE
RIVER
ATHABASKA
EDSON
EDMONTON
SASKATCHEWAN
RIVER
VERMILLION
HENRY HOUSE
JASPER
NORTH
WETASKIWIN
CAMROSE
WAINWRIGHT
PONOKA
BATTLE
RIVER
ROCKY MOUNTAIN HOUSE
RED DEER
STETTLER
PROVOST
CONSORT
DEER
RED
HANNA
LAKE LOUISE
DRUMHELLER
OYEN
RIVER
BANFF
CANMORE
BOW
CALGARY
RIVER
BROOKS
SASKATCHEWAN R.
SOUTH
MEDICINE HAT
CROWSNEST
OLDMAN
RIVER
LETHBRIDGE
MANYBERRIES
WATERTON NAT. PARK
CARDSTON
MILK RIVER
MILK R.
BLACK HILLS COTTONTAIL
(SYLVILAGUS NUTTALLII GRANGERI)
RECORD- COLLECTION
RECORD- LITERATURE
KNOWN DISTRIBUTION BOUNDARY
TENTATIVE " " " "
30 15 0 30 60 90 MILES

Map XI.

SUMMARY

1. The paper first briefly reviews the literature on the role of small mammals in the epidemiology of insect borne diseases (sylvatic plague, Rocky Mountain spotted fever, tularemia, equine encephalomyelitis) in the province of Alberta, Canada. The Richardson ground squirrel (Citellus r. richardsonii Sabine), at present, seems to play the role of a universal mammalian host for those insect borne diseases occurring within its distribution. The great abundance of this squirrel and ease with which study material can be collected may account for this singular role.

2. A simplified scheme for the classification of the vegetation of the province has been prepared. The simplified classification recognizes three major vegetation zones; prairie, parkland, and forest. These broad zones are in turn subdivided into five types, prairie parkland, northern parkland, northern climax forest, northern mixed forest and the mountain forest of the Rockies. This classification is outlined in Table III pp.18a with an accompanying map to show the location and extent of each zone and type.

3. Before the distribution map of a species is prepared, a study of the habitat requirements of the form in question

should be made. The location and extent of its habitat type should be determined. This was the procedure followed in the preparation of the distribution maps for the 22 species treated in the paper. The vegetation classification provided the basis for drawing the tentative distribution limits of the various species collected. Man's activities in vegetation zones other than the prairie zone have so modified the natural vegetation that prairie species have been able to extend their distribution limits both northward and westward. The Richardson ground squirrel serves as the best example of a prairie species that has been successful in extending its distribution into cleared agricultural land of the forested zones.

4. As a preliminary step in planning of a life history study of the Richardson ground squirrel a comparative burrow study was made in the two major soil types of the province. Excavation of the burrows was made in late August in hopes of collecting information on the hibernation nest and food storage of the species. Block drawings of the two excavated burrow systems have been prepared. (See Fig. I and II pps. 69-73)

A. Location of the hibernating nest bears no relationship to the frostline depth, but rather to the soil conditions. The presence or absence of a hard pan layer

will regulate to some extent the average depth of a burrow.

B. No definite information was obtained on winter food storage. The excavations of both burrows failed to uncover any fresh food caches even though an individual was observed carrying grain to its burrow. Several old food storage chambers were uncovered in one burrow.

C. In areas where there is a high density of ground squirrels per acre, it is possible that burrow systems may be interlocking.

D. Control measures such as fumigation would probably prove more successful in the black soil zone where the burrow systems seem to be less complex.

E. Depth and type of hard pan formations are important factors to consider in the location of a life history study area. Location of a study area within the black soil or transition soil zones would be more favorable, considering the above two factors.

5. A strip count census made from a moving vehicle has been proposed for use by plague surveys operating in short grass plains areas. The road allowance between sections of a sample township is used as the census strip. The use of this strip in the prairie zone will insure fairly uniform habitat conditions. All ground squirrels observed while travelling at a constant speed within the road allowance are tallied on the back of the sketch map of the

sample township. (See fig. III, pp. 78 sample form of a township sketch map showing the method of recording field data.) In unsurveyed areas, chain census strips can be estimated by crew members with reasonable accuracy. Results of the census are expressed in the number of R.G.S. observed per mile per 1/4 township, thus permitting closer coordination with plague determinations which are also recorded per 1/4 township. Limitations in the use of the technique are discussed. Suggestions as to the organization of the crew and the supplies needed to make the census are made.

Alberta.

1938-47. Annual Report of Alberta Rocky Mountain Spotted Fever and Sylvatic Plague Survey. Dept. of Public Health (unpublished).

Alberta. Map

1945. Map "Soil Zones of Alberta." Alberta Soil Surveys, (Dept. of Soils, Univ. Alberta; Dominion Experimental Farm Service; Alberta Research Council and Department of Agriculture).

Anderson, R. M.

1946. "Catalogue of Canadian Recent Mammals." National Mus. of Canada, Bul. No. 102: 1-238.

Bailey, Vernon.

1900. "Revision of the American Voles of the Genus Microtus." North Amer. Fauna, No. 17: 1-88.

1915. "Revision of the Pocket Gophers of the Genus Thomomys." North Amer. Fauna, No. 39: 1-136.

Bow, M. R. and J. H. Brown.

1943. "Tularemia in the Seven Person's Coulee Alberta." Can. Jour. Pub. Hlth. 34: 415-418.

Brown, J. H.

1943a. "Tularemia in Southern Alberta." Can. Jour. of Med. Tech., 5: 55-57.

Brown, J. H. and G. D. Roy.

1943b. "The Richardson Ground Squirrel Citellus Richardsonii Sabine, in South Alberta: Its Importance and Control." Scientific Agriculture, 24: 176-197.

Burroughs, A. L. et al.

1945. "A Field Study of Latent Tularemia in Rodents With a List of All Known Naturally Infected Vertebrates." Jour. Inf. Dis., 76: 115-119.

Burt, W. H.

1940. "Territorial Behavior and Populations of Some Small Mammals in Southern Michigan." Misc. Publ. Mus. Zool. Univ. Mich., No. 45: 1-58.

Clements, F. F. and V. F. Shelford.

1939. Bio-ecoloy. illus. 425.

J. Wiley & Son, N. Y.

Dice, Lee R.

1938. "Some Census Methods for Mammals." Jour. Wildlife Mgt., 2: 119-30.

Eskey, C. R. and J. H. Haas.

1939. "Plague in the Western Part of the United States; Infection of Rodents, Experimental Transmission by Fleas and Inoculation Tests for Infection." Public Health Reports, 54: 1467-1481.

Eskey, C. R. and J. H. Haas.

1940. "Plague in the Western Part of the United States." Public Health Bulletin, No. 254: 1-83.

Evans, F. C. and R. Holdenried.

1943. "A Population Study of the Beechey Ground Squirrel in Central California." Jour. Mammalogy, 24: 231-260.

Fisher, H. I. et al.

1947. "The Validity of the Roadside Census as Applied to Pheasants." Jour. Wildlife Mgt., 3: 205-231.

Fitch, H. S.

1948. "Habits and Economic Relationships of the Tulare Kangaroo Rat." Jour. Mammalogy, 29: 5-35.

Gibbons, R. J.

1938. "Survey of Rocky Mountain Spotted Fever and Sylvatic Plague in Western Canada During 1938." Can. Pub. Hlth. Jour., 30: 184-187.

---------- and F. A. Humphreys.

1941. "Plague Survey in Western Canada." Can. Pub. Hlth. Jour., 32: 24-28.

Goldman, E. A.

1910. "Revision of the Wood Rats of the Genus Neotoma." North Amer. Fauna, No. 31: 1-124.

Gwatkin, R.

1940. "Indication of the Presence of the Virus of Equine Encephalomyelitis in Brain of Ground Squirrel." Can. Jour. Compar. Med., 3: 131-133.

Gwatkin, R. et al.

1942. "Tularemia in Sheep." Can. Jour. Comp. Med., 6: 163-168.

Hampton, B. C.

1940. "Plague in the United States." Public Health Reports, 55: 1143-1158.

Howell, A. H.

1915. "Revision of the American Marmots." North Amer. Fauna, No. 37: 1-80.

Howell, A. W.

1929. "Revision of the American Chipmunks (Genera Tamias and Eutamias)." North Amer. Fauna, No. 52: 1-157.

Howell, A. H.

1938. "Revision of the North American Ground Squirrels, With a Classification of the North American Sciuridae." North Amer. Fauna, No. 56: 1-256.

Jackson, Hartley H. T.

1928. "A Taxonomic Review of the American Long-tailed Shrews (Genera Sorex and Microsorex). North Amer. Fauna, No. 51: 1-238.

Jellison, W. L.

1939. "Sylvatic Plague: Studies of Predatory and Scavenger Birds in Relation to Its Epidemiology." Public Health Reports, 54: 792-798.

Jellison, W. L.

1945. "The Geographical Distribution of Rocky Mountain Spotted Fever and Nuttall's Cottontail in the Western United States." Public Health Reports, 60: 958-661.

---------- and R. R. Parker.

1944. "Rodents, Rabbits and Tularemia in North America: Some Zoological and Epidemiological Considerations." Amer. Jour. Trop. Med., 25: 349-362.

---------- et al.

1942. "Epizootic Tularemia in the Beaver, Castor canadensis and the Contamination of Stream Water with Pasteurella tularensis." Amer. Jour. of Hyg., 36: 168-182.

Lewis, F. J. et al.

1928. "The Vegetation of Alberta. II. The Swamp, Moor and Bog Forest Vegetation of Central Alberta." Jour. Ecol., 16: 19-70.

Merriam, C. Hart.

1896. "Synopsis of the Weasels of North America." North Amer. Fauna, No. 11: 1-44.

Meyer, K. F.

1942a. "The Known and Unknown in Plague." Amer. Jour. Trop. Med., 22: 9-36.

1942b. "The Ecology of Plague." Medicine, 21: 143-174.

Moss, E. H.

1932. "The Vegetation of Alberta. IV. The Poplar Association and Related Vegetation of Central Alberta." Jour. Ecol., 20: 380-415.

1944. "The Prairie and Associated Vegetation of Southwestern Alberta." Can. Jour. Research, C, 22: 11-31.

--- and J. A. Campbell.

1947. "The Fescue Grassland of Alberta." Can. Jour. Research, C, 25: 209-227.

Nelson, E. W.

1909. "The Rabbits of North America." North Amer. Fauna, No. 29: 1-314.

Osgood, W. H.

1908. "Revision of the Mice of the American Genus Peromyscus." North Amer. Fauna, No. 28: 1-285.

Ozburn, R. H.

1944. "Problems of Medical Entomology of Military Importance in Canada." Jour. of Econ. Entom., 37: 455-459.

Parker, R. R., G. M. Kohls and E. A. Steinhaus.

1943. "Rocky Mountain Spotted Fever: Spontaneous Infection in the Tick Amblyomma americanum." Public Health Reports, 55: 721-729.

Phillip, C. B.

1947. A. A. A. S. Symposium on Rickettsial Diseases of Man (now in press).

Phillip, C. B. and R. R. Parker.

1933. "Rocky Mountain Spotted Fever: Investigation of Sexual Transmission in the Wood Tick Dermacentor andersoni." Public Health Reports, 48: 266-272.

Shaw, R. M. and H. C. Jamieson.

1932. "Tularemia." Med. Ass'n. Jour., 26: 305-307.

Soper, J. Dewey.

1946. "Mammals of the Northern Great Plains Along the International Boundary in Canada." Jour. Mammalogy, 27: 127-152.

1948. "Mammal Notes from the Grande-Prairie-Peace River Region, Alberta." Jour. Mammalogy, 29: 49-64.

Steinhaus, E. A.

1946. "Insect Microbiology." illus. x 763 pp. Comstock Pub. Company. Ithaca, N. Y.

APPENDIX

1. Contains reference collection catalogue
2. Soil map of Alberta
3. Political map of Alberta

Reference Collection Catalogue
(Nomenclature after Anderson, 46)

Nos.

1 *Sorex cinereus* (?) Masked Shrew

July 16, 1947 Black Soil Zone
Red Deer Area, Sec. 17 T38 R28 W4
Elev. 2750'

T. L. 86 T. 31 H.F. 10 E. 5 ♀

2 *Sorex c. cinereus* Masked Shrew

July 29, 1947 Transition Soil Zone
Grande Prairie Area, Sec. 29 T71
R7 W6
Elev.

T. L. 101 T. 40 H. F. 10 E ♀ skull only

3 *Sorex c. cinereus* Masked Shrew

August 7, 1947 Gray Wooded Soil Zone
Rocky Mt. House Area, Sec. 7 T40
R7 W5
Elev.

T. L. 92 T. 38 H. F. 12 E. 8 ♀ skull only

4 *Microsorex* (sp. ?) Pigmy Shrew

July 16, 1947 Black Soil Zone
Red Deer Area, Sec. 17 T38 R28 W4
Elev. 2750'

T. L. 98 T. 40 H. F. 12 E. 8 ♀

5 *Mustela frenata longicauda* Prairie long-tailed Weasel

July 14, 1947 Black Soil Zone
Red Deer Area, Sec. 6 T39 R26 W4
Elev. 2900

T. L. 460 T. 165 H. F. 54 E. 26 ♂

Nos.

6 Taxidea t. taxus — Am. Badger

August 25, 1945 — Brown Soil Zone
Medicine Hat Area,
Sec. 15 T14 R8 W4

T. L. 645 T. 150 H. F. 122 E. 52 ♂ skull

7 Marmota monax canadensis — Woodchuck

July 24, 1947 — (Transition Zone)
Gray Wooded Soil Zone
Athabaska Area,
Sec. 35 T66 R24 W4
Elev. 2200

T. L. 440 T. 104 H. F. 66 E. 25 ♀ skull

8 Marmota monax canadensis — Woodchuck

August 6, 1947 — Black Falls Area,
Sec. 5 T39 R27 W4
Elev.

T. L. 540 T. 120 H. F. 70 E. 27 ♂

9 Citellus r. richardsonii — Richardson Ground Squirrel

July 5, 1947 — Dark Brown Soil Zone
Hanna Area,
Sec. 32 T30 R14 W4
Elev. 2650'

T. L. 276 T. 72 H. F. 42 ♀ skull

10 Citellus r. richardsonii — Richardson Ground Squirrel

July 3, 1947 — Shallow Black Soil Zone
Calgary Area,
Sec. 4 T26 R2 W5
Elev. 4150'

T. L. 308 T. 66 H. F. 46 E ♂ skull

Nos.

11 Citellus r. richardsonii Richardson Ground Squirrel

July 3, 1947 Shallow Black Soil Zone
Calgary Area, Sec. 4 T26 R2 W5
Elev. 4150'

T. L. 228 T. 73 H. F. 41 E. 11 ♀ skull

12 Citellus r. richardsonii Richardson Ground Squirrel

July 3, 1947 Shallow Black Soil Zone
Calgary Area, Sec. 4 T26 R2 W5
Elev. 4150'

T. L. 227 T. 66 H. F. 38 E. 11 ♀ skull

13 Citellus r. richardsonii Richardson Ground Squirrel

August 19, 1947 Brown Soil Zone
Milk River Area, Sec. 1 T3
R15 W5

T. L. 308 T. 69 H. F. 46 E. 8 ♂ skull

14 Citellus r. richardsonii Richardson Ground Squirrel

July 7, 1947 Dark Brown Soil Zone
Hanna Area, Sec. 11 T31 R13 W4
Elev. 2700'

T. L. 263 T. 55 H. F. 39 ♀

15 Citellus r. richardsonii Richardson Ground Squirrel

July 5, 1947 Dark Brown Soil Zone
Hanna Area, Sec. 32 T30 R14 W4
Elev. 2650'

T. L. 264 T. 66 H. F. 42 ♀ skull

Nos.

16 Citellus r. richardsonii Richardson Ground Squirrel

July 7, 1947 Dark Brown Soil Zone
Hanna Area, Sec. 25 T31 R13 W4
Elev. 2700'

T. L. 300 T. 68 H. F. 42 ♀

17 Citellus columbianus Columbian Ground Squirrel

August 19, 1947 Gray Wooded Soil Zone
Blairmoor Area
Crowsnest Mt.
Elev.

T. L. 301 T. 81 H. F. 48 E. 18 ♀ skull

18 Citellus t. tridecemlineatus 13-lined Ground Squirrel

July 27, 1947 (Transition Zone)
Gray Wooded Soil Zone
Athabaska Area
Sec. 25 T66 R24 W4
Elev. 2000'

T. L. 292 T93 H. F. 36 E. 12 ♂ skull

19 Citellus franklinii Franklin's Ground Squirrel

July 17, 1947 Black Soil Zone
Camrose Area
Sec. 18 T46 R19 W4
Elev.

T. L. 364 T. 136 H. F. 49 E. 16 ♂

20 Eutamias minimus borealis Northern Chipmunk

July 22, 1947 Black Soil Zone
City of Edmonton
Elev. 2050'

T. L. 219 T. 100 H. F. 32 E. 16 ♀

Nos.

21 Eutamias minimus borealis Northern Chipmunk

July 27, 1947 — Grey Wooded Soil Zone
Grande Prairie Area
Sec. 21 T70 R5 W6
Elev. 2200'

T. L. 215 T. 100 H. F. 32 E. 18 ♀

22 Eutamias minimus borealis Northern Chipmunk

July 27, 1947 — Grande Prairie Area
Gray Wooded Soil Zone
Sec. 21 T70 R5 W6
Elev. 2200'

T. L. 211 T. 102 H. F. 31 E. 16 ♀ skull imm.

23 Eutamias minimus borealis Northern Chipmunk

July 21, 1947 — Black Soil Zone
City of Edmonton
Elev. 2050'

T. L. 220 T. 100 H. F. 33 E. 16 ♀

24 Eutamias minimus borealis Northern Chipmunk

July 31, 1947 — Transition Soil Zone
Fair View Area
Sec. 32 T82 R3 W6
Elev.

T. L. 206 T. 98 H. F. 31 E. 16 ♀ skull

25 Eutamias amoenus luteiventris Buff-bellied Chipmunk

August 10, 1947 — Gray Wooded Soil Zone
Blairmoor Area
Crowsnest Mt.
Elev.

T. L. 205 T. 98 H. F. 33 E. 19 ♂ skull only

Nos.

26 Eutamias amoenus luteiventris Buff-bellied Chipmunk

August 10, 1947 Gray Wooded Soil Zone
Blairmoor Area
Crowsnest Mt. Area
Elev.

T. L. 212 T. 100 H. F. 31 E. 18 ♂ skull only

27 Eutamias amoenus luteiventris Buff-bellied Chipmunk

July 12, 1947 Transition Soil Zone
Calgary Area
Sec. 12 T23 R4 W5
Elev.

T. L. 197 T. 87 H. F. 31 E. 18 ♀

28 Tamiasciurus hudsonicus (columbiensis?) British Columbian Red Squirrel

July 12, 1947 Transition Soil Zone
Calgary Area
Sec. 12 T23 R4 W5
Elev.

T. L. 334 T 133 H. F. 48 E. 25 ♂

29 Tamiasciurus hudsonicus (columbiensis?) British Columbian Red Squirrel

July 14, 1947 Black Soil Zone
Red Deer Area
Sec. 6 T39 R26 W4
Elev. 2900'

T. L. 324 T. 129 H. F. 50 E. 27 ♂

30 Tamiasciurus hudsonicus preblei Mackenzie Red Squirrel

July 27, 1947 Gray Wooded Soil Zone
Grande Prairie Area
Sec. 21 T70 R5 W6
Elev. 2200'

T. L. 319 T. 123 H. F. 48 E. 25 ♀ skull

Nos.

31 Tamiasciurus hudsonicus preblei Mackenzie Red Squirrel

July 31, 1947

Transition Soil Zone
Fair View Area
Sec. 4 T84 R3 W1
Elev.

T. L. 311 T. 132 H. F. 50 E. 26 ♀

32 Thomomys t. talpoides Richardson's Pocket Gopher

July 13, 1947

Transition Zone between
Black Soil Zone & Transition Zone
Sec. 32 T22 R3 W5
Elev.

T. L. 199 T. 55 H. F. 25 E. 6 ♀

33 Thomomys t. talpoides Richardson's Pocket Gopher

July 17, 1947

Black Soil Zone
Red Deer Area
Sec. 17 T38 R28 W4
Elev. 2750'

T. L. 188 T. 56 H. F. 26 E. 5 ♀

34 Thomomys t. talpoides Richardson's Pocket Gopher

July 22, 1947

Black Soil Zone
City of Edmonton
Elev. 2050'

T. L. 219 T. 50 H. F. 27 E. 7 ♂

35 Peromyscus m. borealis Mackenzie White-footed Mouse

July 25, 1947

(Transitional)
Gray Wooded Soil Zone
Lesser Slave Lake
Sec. 20 T73 R5 W5
Elev. 1900'

T. L. 151 T. 70 H. F. 20 E. 17 ♂ skull

Nos.

36 Peromyscus m. borealis Mackenzie White-footed Mouse

July 25, 1947 (Transitional)
Gray Wooded Zone
Lesser Slave Lake
Sec. 20 T73 R5 W5
Elev. 1900'

T. L. 160 T. 75 H. F. 20 E. 19 ♂ skull

37 Peromyscus m. borealis Mackenzie White-footed Mouse

August 1, 1947 Gray Wooded Soil Zone
Manning Area
4 Mis north Mickel R
Elev. 1700'

T. L. 167 T. 87 H. F. 19 E. 19 ♂ skull

38 Peromyscus m. borealis Mackenzie White-footed Mouse

August 9, 1947 Gray Wooded Soil Zone
Blairmoor Area
Sec. 9 T8 R5 W5
Elev.

T. L. 130 T. 62 H. F. 20 E. 18 ♂ skull

39 Peromyscus m. borealis Mackenzie White-footed Mouse

July 27, 1947 Gray Wooded Soil Zone
Grande Prairie Area
Sec. 25 T70 R6 W6
Elev. 2100'

T. L. 152 T. 74 H. F. 20 E. 18 ♀ skull

40 Peromyscus m. borealis Mackenzie White-footed Mouse

July 25, 1947 (Transitional)
Gray Wooded Soil Zone
Lesser Slave Lake
Sec. 20 T73 R5 W5
Elev. 1900'

T. L. 149 T. 68 H. F. 20 E. 18 ♀ skull

Nos.

41 Peromyscus m. osgoodi Osgood's White-footed Mouse

July 10, 1947 Brown Soil Zone
Cereal Area
Sec. 26 T28 R6 W4
Elev. 2550'

T. L. 146 T. 62 H. F. 19 E. 17 ♂ skull

42 Peromyscus m. osgoodi Osgood's White-footed Mouse

July 3, 1947 Shallow Black Soil Zone
Calgary Area
Sec. 5 T25 R2 W5
Elev. 3600'

T. L. 147 T. 65 H. F. 18 E. 17 ♀ skull

43 Peromyscus m. osgoodi Osgood's White-footed Mouse

July 3, 1947 Shallow Black Soil Zone
Calgary Area
Sec. 5 T25 R2 W5
Elev. 3600'

T. L. 147 T. 61 H. F. 19 E. 17 ♂ skull

44 Peromyscus m. osgoodi Osgood's White-footed Mouse

August 19, 1947 Brown Soil Zone
Sec. 18 T1 R15 W4
Milk River Area

T. L. 155 T. 68 R. H. 20 E. 17 ♀ skull

45 Peromyscus m. osgoodi Osgood's White-footed Mouse

July 19, 1947 Black Soil Zone
Red Deer Area
Sec. 6 T39 R26 W4
Elev. 2900'

T. L. 159 T. 73 H. F. 19 E. 17 ♂ skull

Nos.

46 Peromyscus m. osgoodi Osgood's White-footed Mouse

July 2, 1947
Shallow Black Soil Zone
Calgary Area
Sec. 35 T22 R1 W5
Elev. 3300'

T. L. 173 T. 76 H. F. 20 E. 18 ♀

47 Peromyscus m. osgoodi Osgood's White footed Mouse

July 19, 1947
Black Soil Zone
Red Deer Area
Sec. 6 T39 R26 W4
Elev. 2900'

T. L. 111 T. 53 H. F. 17 E. 14 ♂ skull

48 Neotoma c. drummondii Gray Bushy-tailed Wood Rat

August 11, 1947
Gray Wooded Soil Zone
Frank Area
Frank Slide
Elev.

T. L. 363 T. 158 H. F. 44 E. 32 ♀ skull

49 Clethrionomys g. athabascae Athabaska Red-backed Mouse

August 1, 1947
Transition Soil Zone
Manning Area
Sec. 26 T93 R23 W5
Elev. 1050'

T. L. 142 T. 40 H. F. 17 E. 17 ♀ skull

50 Clethrionomys gapperi spp. Red-backed Mouse

July 23, 1947
Black Soil Zone
City of Edmonton
Elev. 2050'

T. L. 120 T. 30 H. F. 18 E. 14 ♂

Nos.

51 Clethrionomys gapperi spp. Red-backed Mouse

July 15, 1947 — Black Soil Zone
Red Deer Area
Sec. 6 T39 R26 W4
Elev. 2900'

T. L. 134 T. 34 H. F. 17 E. 13 ♀

52 Clethrionomys gapperi spp. Red-backed Mouse

August 7, 1947 — Gray Wooded Soil Zone
Rocky Mt. House
Sec. 7 T40 R7 W5
Elev.

T. L. 133 T. 37 H. F. 18 E. 14 ♂ skull

53 Clethrionomys gapperi spp. Red-backed Mouse

July 31, 1947 — Grande Prairie Area

T. L. 153 T. 42 H. F. 17 E. 16 ♀ skull

54 Microtus pennsylvanicus drummondii Drummond's Meadow Mouse

July 29, 1947 — Transition Soil Zone
Grande Prairie Area
Sec. 27 T71 R7 W6
Elev.

T. L. 156 T. 37 H. F. 17 E. 12 ♂ skull

55 Microtus pennsylvanicus spp. Meadow Mouse

July 16, 1947 — Black Soil Zone
Red Deer Area
Sec. 17 T38 R28 W4
Elev. 2750'

T. L. 163 T. 47 H. F. E. ♂

Nos.

56 Microtus pennsylvanicus spp. Meadow Mouse

July 16, 1947 — Black Soil Zone
Red Deer Area
Sec. 17 T38 R28 W4
Elev. 2750'

T. L. 162 T. 45 H. F. 14 E. 14 ♀

57 Microtus pennsylvanicus drummondii Drummond's Meadow Mouse

July 29, 1947 — Transition Soil Zone
Grande Prairie
Sec. 30 T71 R7 W6
Elev.

T. L. 158 T. 37 H. F. 17 E. 11 ♂ skull

58 Rattus r. rattus Black Rat

July 12, 1947 — Shallow Black Soil Zone
R. R. Yards, Calgary
(Royal American Shows)

T. L. 236 T. 133 H. F. 28 E. 20 ♂ skull

59 Rattus r. rattus Black Rat

July 12, 1947 — Shallow Black Soil Zone
R. R. Yard, Calgary
(Royal American Shows)

T. L. 234 T. 132 H. F. 28 E. 19 ♂ skull

60 Rattus r. rattus Black Rat

July 12, 1947 — Shallow Black Soil Zone
R. R. Yards, Calgary
(Royal American Shows)

T. L. 242 T. 133 H. F. 28 E. 20 ♂ skull

Nos.

61 Rattus r. rattus — Black Rat

July 12, 1947 — Shallow Black Soil Zone
R. R. Yards, Calgary
(Royal American Shows)

T. L. 242 T. 132 H. F. 29 E. 20 ♂ skull

62 Mus m. domesticus — House Mouse

August 12, 1947 — Shallow Black Soil Zone
Cardston

T. L. 127 T. 67 H. F. 18 E. 12 ♀ skull

63 Mus m. domesticus — House Mouse

July 28, 1947 — Fair View R. R. Yards
Sec. 2 T83 R3 W6

T. L. 173 T. 90 H. F. 19 E. 14 ♀

64 Mus m. domesticus — House Mouse

August 24, 1947 — Brown Soil Zone
City of Manyberries

T. L. 162 T. 82 H. F. 18 E. 14 ♂ skull

65 Lepus townsendii campanius — White-tailed Jack Rabbit

August 19, 1947 — Brown Soil Zone
Sec. 22 T2 R17 W4

T. L. 575 T. 80 H. F. 146 E. 130 ♂ skull

66 Sylvilagus nuttallii grangeri — Black Hills Cottontail

August 22, 1947 — Brown Soil Zone
Wild Horses
Sec. 19 R1 T1 W4

T. L. 377 T. 40 (?) H. F. 98 E. 73 ♂ skull

SOIL ZONES OF ALBERTA

AS ESTABLISHED BY

ALBERTA SOIL SURVEYS

(Department of Soils, University of Alberta; Dominion Experimental Farms Service; Alberta Research Council and Department of Agriculture)

BROWN

CLIMATE—Semi-arid, characterized by an average annual precipitation of 11 to 13 inches, frequent drought, high evaporation and frequent hot dry winds.

VEGETATION—Short grass prairie.

SOIL PROFILE—In the normal profile the surface (A) horizon is about 5 inches deep and brown in color. The B horizon is commonly brownish in color and lime (Bca) is found at depths averaging 15 inches below the surface. The parent material (C) is found at depths of 20 to 24 inches. In the other zones this horizon occurs at greater depths.

FERTILITY—Moisture is the principal limiting factor in crop production. Soils in this zone are relatively low in nitrogen and under irrigation often respond to phosphorus fertilizers.

LAND USE—Only the most favorable soil types can be considered arable. Most of the area is desirable for ranching. Where farmed, wheat is the principal crop grown. Cropping practices must provide for moisture conservation and control of soil drifting. The long frost-free period makes this zone a desirable area for the development of irrigation.

DARK BROWN

CLIMATE—The average annual precipitation is 13 to 15 inches, and there are less frequent droughts than in the brown zone. Fairly high evaporation and hot dry winds are added characteristics.

VEGETATION—Chiefly short grass prairie. The grass makes a denser cover and taller growth than in the brown zone.

SOIL PROFILE—In the normal profile, the surface (A) horizon averages about 7 inches in depth and is dark brown in color. The B horizon is brownish, and the lime layer (Bca) is found usually at depths of 20 to 24 inches below the surface. In this zone as in other zones, the B horizon, having received some finer materials from the A, is usually somewhat heavier and more compact than the A horizon.

FERTILITY—Moisture continues to be the principal limiting factor in crop production. Soils in this zone are relatively low in nitrogen and organic matter, but are higher in these constituents than soils of the brown zone.

LAND USE—Only the better soil types can be considered arable. The remainder generally is good pasture land. Wheat is grown almost to the exclusion of all other crops. Cropping practices must provide for conservation of moisture and control of soil drifting. The best quality wheat in the province is grown in this and the other grassland zones.

SHALLOW BLACK

CLIMATE—Annual precipitation averages between 14 and 17 inches. The higher rainfall is in the southern part of the province where there is a correspondingly higher evaporation. Droughts occur only occasionally.

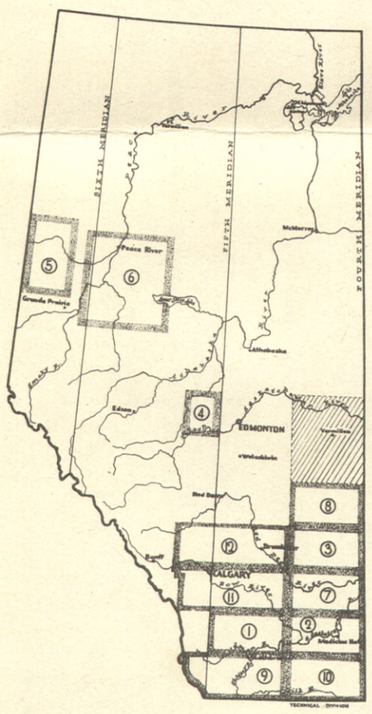
VEGETATION—Grassland in which bluffs of trees are found in places where moisture conditions are more favorable.

SOIL PROFILE—The normal profile has an A horizon that averages about 10 inches in depth and which in its upper 3 to 6 inches is black in color. The remainder is usually dark brown. The B horizon is usually brown to dark brown and the lime horizon (Bca) is found at depths of 24 to 30 inches below the surface. Generally the depth to the lime layer is considered as indicative of the efficiency of rain penetration.

FERTILITY—Soils in this zone are usually fairly well supplied with nitrogen and organic matter. In any zone exhaustive cropping depletes the soil's native food supply and fibre. A permanent system of cropping provides for the adequate replacement of depleted plant foods and the maintenance of organic matter.

LAND USE—A greater number of soil types can be considered arable than in the brown zones. Wheat is the principal crop grown, but considerably more diversification is possible and should be practised to maintain soil fertility. The non-arable land is generally very good pasture.

LOCATION OF SURVEYED AREAS FOR WHICH SOIL REPORTS AND MAPS HAVE BEEN PUBLISHED



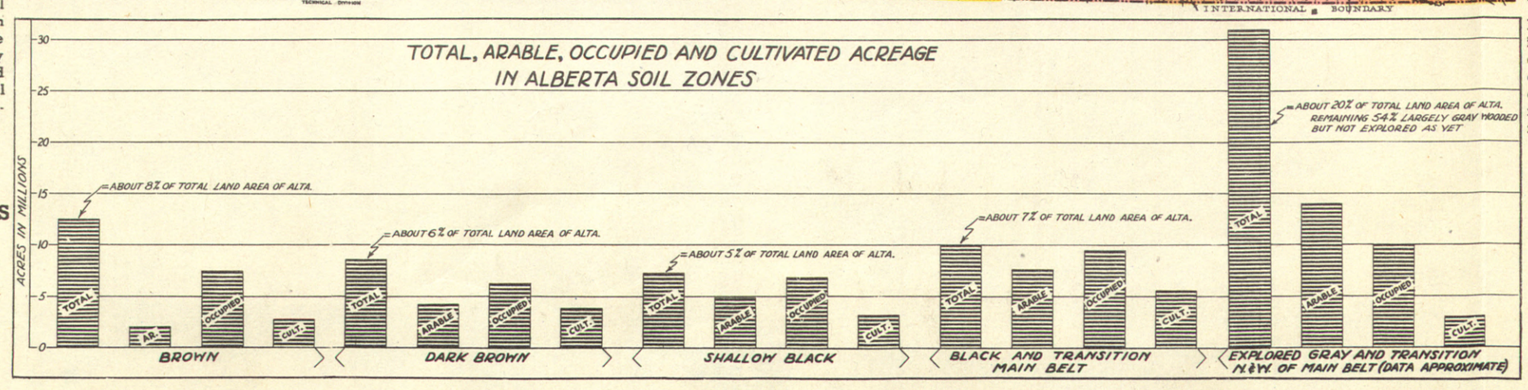
1. Macleod sheet
2. Medicine Hat sheet
3. Sounding Creek sheet
4. St. Ann sheet
5. Dunvegan sheet
6. Peace River - High Prairie Sturgeon Lake area
7. Rainy Hills sheet
8. Sullivan Lake sheet
9. Lethbridge and Pincher Creek sheets
10. Milk River sheet
11. Blackfoot and Calgary sheets
12. Rosebud and Banff sheets

Wainwright and Vermilion sheets hatched (last published report)

Arranged and Drawn by
WM. ODYNSKY
DECEMBER, 1945

▲ LOCATION OF EXPERIMENT STATIONS AND SCHOOLS OF AGRICULTURE.

BASE MAP BY THE DEPARTMENT OF LANDS AND MINES, EDMONTON, ALBERTA



BLACK

(Boundaries Tentative)

CLIMATE—Annual precipitation averages between 17 and 19 inches and droughts are rare. Evaporation is lower and hot winds less frequent than in the previous zones.

VEGETATION—Grassland which has been partially invaded by woodlands (mainly deciduous trees), often referred to as a parkland.

SOIL PROFILE—The normal profile has a black to very dark brown surface (A) horizon that averages about 12 to 14 inches in depth. The more compact B horizon is brown to dark brown, and the lime layer (Bca) is usually found at 30 to 40 inches below the surface.

FERTILITY—Soils in this zone are the most fertile in the province and they have in their surface foot about 3 to 4 times as much nitrogen and organic matter as there is in the average brown or gray wooded soil. Every precaution should be taken to see that they are not allowed to deteriorate.

LAND USE—A high percentage of the zone is arable. Wheat of fairly good quality can be grown, but mixed farming, including the use of fertilizer when needed, is desirable from the standpoint of both profit and permanence.

TRANSITION

(Boundaries Tentative)

CLIMATE—Annual precipitation averages from about 12 inches in the northern section to about 20 inches in the southern. Evaporation is lower than in the previous zones.

VEGETATION—Mainly woodland in which the tree growth is frequently denser and has more evergreens than in the black zone.

SOIL PROFILE—Generally quite mixed, ranging from nearly black to gray. The surface horizon consists of a thin layer of semi-decomposed litter (A0) which may be absent in burned over areas, underlain by a mineral horizon that can usually be divided into two parts. The upper (A1) part may be black, gray black or dark brown. The lower part (A2) is frequently somewhat leached of organic matter and considerably grayer than the A1. The total depth of these surface horizons averages about 10 to 12 inches. The B horizons are generally dark brown in color and lime is found at depths of about 30 to 40 inches.

FERTILITY—These soils are usually not as rich as those of the black zone. Leaching of the surface horizons has resulted in the loss of some plant foods.

LAND USE—A system of mixed farming that includes legumes in the crop rotation, supplemented with applications of fertilizer when required, should be practised for best results.

GRAY WOODED

(Boundaries Tentative)

CLIMATE—Annual precipitation averages from about 12 inches in the northern sections to about 20 inches in the southern. This is accompanied by cooler temperatures, lower evaporation and shorter growing seasons than those of the previous zones.

VEGETATION—A mixed deciduous and evergreen woodland in which peats and muskegs frequently occur.

SOIL PROFILE—These soils have developed under humid soil moisture conditions. The surface horizon consists of a semi-decomposed leaf mold layer, A0, that may be absent if the area has been burned over; a thin (sometimes absent) A1 horizon that may be gray black, brown or gray brown, and a severely leached and platy, grayish A2 horizon, whose depth will average about 6 to 8 inches. The B horizons are heavier textured, compact, and often darker in color than the A. The depth to lime is quite variable, often ranging from 30 to 50 inches.

FERTILITY—Soils in this zone are relatively less fertile because of leaching; the deeper the leached layer, the less fertile. However patches of transition soils are found within the zone.

LAND USE—This is a mixed farming area in which legumes, hays and coarse grains are the most desirable crops. Rotations including legumes and supplemented with fertilizers, where needed, have given the most satisfactory results.

AREA NOT EXPLORED BY SOIL SURVEYS—BELIEVED GRAY WOODED.

GOVERNMENT OF THE PROVINCE OF ALBERTA
DEPARTMENT OF LANDS AND MINES
Edmonton, Alberta

DEPARTMENT OF THE INTERIOR
HON. THOMAS G. MURPHY, Minister; R. A. GIBSON, Assistant Deputy Minister
TOPOGRAPHICAL SURVEY OF CANADA

ALBERTA

Scale 1:2,217,600 or 35 Miles=1 Inch

10 0 10 20 30 40 50 60 70 80 90 100 110

Highways Surfaced

Improved Earth

PRODUCED IN CO-OPERATION WITH THE DEPARTMENT OF LANDS AND MINES, PROVINCE OF ALBERTA, FROM WHOM COPIES MAY BE OBTAINED

BASE MAP FROM 1930 EDITION

Price 15 Cents

PREPARED AND PRINTED AT THE OFFICE OF THE SURVEYOR GENERAL, OTTAWA, 1935