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A PRELIMINARY INVESTIGATION OF CARIBOU IN
NORTHWESTERN UNITED STATES

by

H. Frank Evans

B. Ed. Southern Illinois University, 1934

Presented in partial fulfillment of the requirements
for the degree of

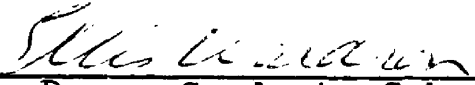
Master of Science in Teaching

MONTANA STATE UNIVERSITY

1960

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ACKNOWLEDGEMENTS

That science is a social activity is clearly emphasized in the preparation of this paper which is primarily the organization and interpretation of observations of others. But typically caribou papers draw heavily upon the contributions of those rather rare persons who have observed the animals. Gratitude is here expressed to the trappers, loggers, early settlers and others who were so prompt, so meticulous and so willing to assist the author. As a group, the men of the U. S. Forest Service, past and present, stand foremost among the informants. Of these, Karl Klehm, Supervisor of the Kanisku National Forest, was of paramount help. Special mention, too, is reserved for J. K. Dwinelle, retired Forest Service employee, who carried a notebook and so carefully recorded incidents of long ago that are now so precious. My sincere thanks also goes to my colleague, Mrs. Robert Scates, for assistance and criticism so graciously given in the preparation of the final product.

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-iii-

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TABLE OF CONTENTS

	PAGE
Introduction	1
The purposes of the study	3
Time of study	3
Designation of study area	4
Review of the Literature	5
Taxonomy	5
Distribution at southern limits of range	6
Ecology and natural history	7
Methods	11
Readings	11
Administrative sources	11
Field techniques	12
General Taxonomic Survey of Genus Rangifer	15
General morphological criteria for species determination	15
Designation of animal under study	17
Aspects of the Life History of Caribou	19
General behavior	19
Social behavior	20
Productivity	21
Migration	21

TABLE OF CONTENTS (CONT.)	PAGE
Nomadism	26
Food	28
General Nature of Caribou Habitat	33
Latitude	33
Topography	35
Climate	40
Vegetation	45
Geographical designation of study area	47
Temporal and Geographic Distribution of Caribou in Northwestern United States	54
Before 1900	55
1900 through 1910	66
1911 through 1920	70
1921 through 1930	74
1931 through 1940	79
1941 through 1950	83
1951 to 1960	87
Current populations	94
Factors Associated with Caribou Declines in Northwestern United States	99
Climate	101
Predation	102
Disease and parasitism	103
Faunal competition	103
Domestic grazing	104

TABLE OF CONTENTS (CONT.)	PAGE
Hunting	105
Habitat disturbance and destruction	109
Summary	132
The Future of Caribou in Northwestern United States	133
Bibliography	137

LIST OF TABLES

TABLE	PAGE
I. Average Precipitation by Month at Priest River Experiment Station, Kaniksu National Forest, Idaho, 1931-1955	42
II. April 1st and May 1st Snow Depths and Water Content on Smith Creek Snow Course, Elevation 4800 Feet, Kaniksu National Forest, Idaho, 1937-1960	43
III. April 1st and May 1st Snow Depths and Water Content on Blue Bird Basin Snow Course, Elevation 6800 Feet, Kootenai National Forest, Idaho, 1937-1952	44
IV. Geographical Place Names Associated with Caribou	60
V. Comparative Summaries of Caribou Estimates from Three Separate Sources	95
VI. Known Illegal Caribou Killings between 1929 and 1952	107

LIST OF FIGURES

FIGURE	PAGE
1. Adult Male Mountain Caribou	18
2. Adult Male and Female Mountain Caribou	18
3. Caribou Feeding Tree in Use	29
4. Caribou Feeding Tree After Use	29
5. Approximate Present Caribou Distribution in North America	38
6. The Approximate Location and Extent of Mountain Ranges in Caribou Study Area	49
7. National Forests of Northeastern Washington, Northern Idaho and Northwestern Montana	51
8. States of Northwestern United States in which Caribou have been Known to Occur and Extreme Territorial Sightings	57
9. Documented Occurrences of Caribou before 1900 (Not Including Wyoming Observation)	62
10. Documented Occurrences of Caribou 1900 Through 1910	67
11. Documented Occurrences of Caribou 1911 Through 1920	71

LIST OF FIGURES (CONT.)	PAGE
12. Documented Occurrences of Caribou 1921 Through 1930	75
13. Documented Occurrences of Caribou 1931 Through 1940	80
14. Documented Occurrences of Caribou 1941 Through 1950	84
15. Documented Occurrences of Caribou Between 1951 and 1960	89
16. Areas in which Caribou Presently Occur or are Considered Most Likely to Occur	97
17. Major Fires of the Kaniksu National Forest of Idaho, Washington and Montana, 1900 - 1950	112
18. Major Fires of the Kootenai National Forest of Idaho and Montana, 1900 - 1940. . .	114
19. Major Fires of the Upper Portion of Flathead National Forest and Glacier National Park, 1900 - 1930	116
20. The Approximate Logging Pattern of the Main Body of the Kaniksu National Forest and Adjacent Areas, Idaho, Washington and Montana, 1906 - 1954	119
21. Approximate Location of Unburned and Unlogged Forests in the Main Portion of the Kaniksu National Forest	121

LIST OF FIGURES (CONT.)	PAGE
22. Spruce Bark Beetle Infestation in Kaniksu National Forest, Idaho	125
23. Spruce Bark Beetle Infestation in Kootenai National Forest, Montana	127
24. Spruce Bark Beetle Infestation in Upper Portion of Flathead National Forest, Montana	129
25. The Probable Approximate Seasonal Components of Total Caribou Range	134

INTRODUCTION

Caribou originally occurred along the northern perimeter of the forty-eight states where there were mature coniferous forests. Remarkably little has been written of caribou in the United States, and the ecology and life history of the species as it relates to habitat in that country appears never to have been a subject of intensive study. A familiarity with caribou and the writings of those who have studied them reveal the reasons for this seeming rebuff. The complex seasonal migrations and the unpredictable wanderings in remote and secluded habitat render these animals so inconspicuous and so infrequently encountered that their very presence is difficult to establish. These facts are in severe contrast to the more northern forms of caribou which have been observed in great numbers on the treeless tundra.

Researchers in the animal sciences would certainly corroborate the opinion that first obligations rest in the understanding of those species which have been threatened with extirpation because of human activities. Caribou occur in such limited numbers in western United States that few wild life scientists are actually aware that they occur at all. The reasons for their decline are still more

obscure. It was with these things in mind and with the coincidence of a reasonably convenient geographic residence and a general familiarity with the area and a scattered acquaintanceship with many of its residents that this investigation was initiated.

At first the nature of the problem appeared difficult to define in precise terms. Information about when and where caribou occurred was so vague that it seemed proper to orient the overall subject. Then the results would bring into sharper focus the principal and specific enigmas which might later be subjects of further study in an attempt to understand the life history and habitat requirements of this vanishing big game species. So, with the feeling that first things should be first, the wise decision seemed to be to assemble and evaluate the existing knowledge of forest and mountain-frequenting caribou and to investigate all habitat disturbance with the objective of correlating disturbed and undisturbed habitat with caribou population behavior. To this would also be added pertinent facts that might be gathered concerning caribou behavior, caribou range or any other information germane to the total understanding of caribou. Such an approach would give more perspective to an animal study and should necessarily precede any field study.

The limitations involved in any investigation of caribou are impressive by their very enormity. These

hampering circumstances will be discussed principally in that section dealing with current population and range of caribou.

The purposes of the study. The objectives of the investigation were fivefold. It was desired (1) to gather information on caribou in northwestern United States in the recent past, (2) to establish the spacial and temporal distribution of caribou so as to detect trends in the population behavior, (3) to deduce possible factors associated with decline of caribou in northwestern United States if a decline was established, (4) to review significant published information about caribou and correlate it with habitat and all factors relating to caribou in northwestern United States and (5) to compare in general the southern latitudinal perimeters of caribou in northwestern United States with those in other regions inhabited by caribou.

Throughout the study, procedure has been to follow from general areas of understanding of caribou to specific application of that understanding to the animal under investigation and the definite geographically defined area. All temporal treatments have been presented sequentially from past to present.

Time of study. This presentation embraces work and investigation accomplished between September 1958 and June 1960. The breadth of time treated, however, spans

from days of Indian culture through the settlement of northwestern United States to the summer of 1960.

Designation of study area. The area designated in this study is a rather small section of northern Idaho, western Montana and a scant section of extreme northeastern Washington. Within this area all caribou occurrences can be circumscribed except for the single occurrence of caribou in Wyoming in the nineteenth century.

REVIEW OF THE LITERATURE

Taxonomy. The Old World reindeer were first named and described by Linnaeus in 1758 as Cervus tarandus (Flerov, 1933). The first New World form to be described, the woodland caribou, was designated Cervus tarandus caribou by Gmelin in 1788 (Seton, 1929). Hamilton Smith produced the modern generic term Rangifer in 1827, and "caribou" was derived from an Algonquin Indian designation (Wright, 1929). At the beginning of the present century the genus was categorized into two groups, the woodland and the barren-ground forms (Grant, 1902). The barren-ground group was further subdivided into Eurasian and American forms. This paper treated Rangifer montanus as one of the several woodland caribou forms. This species had been named by Seton (1927) in 1899. The relationship of R. montanus was shifted by Jacobi in 1931 to the barren-ground group. His interpretation was strengthened by the view that some specimens appeared intermediate between R. montanus and R. osborni (Anderson, 1938), but Grant's work had included both forms as woodland animals. Most current literature uses Jacobi's designation, Rangifer arcticus montanus. A clarification of the relationships

within the genus is anticipated in the forthcoming work of Banfield (1959), who is presently working on a taxonomic revision of the American caribou; this three-year study was begun in 1957. In the most recent and comprehensive treatment of North American mammals, Hall and Kelson (1959) chose to revert to the understanding of Lydekker in 1898 and the ungulates as catalogued by the British Museum in 1915. Thus, in this most current encyclopedia of American mammals, the animal studied became Rangifer tarandus montanus.

Distribution at southern limits of range. Eurasian distribution of Rangifer was treated by Flerov (1933) and Bobrinski and Kuzyakin (1944). The distribution of American forms as it was understood at the beginning of the century was reviewed by Grant (1902). Seton (1927) presented caribou distribution three decades later. Canadian distribution, including the United States extension in the Northwest, was given by Anderson in 1938. A modern summary of caribou distribution in the New World was accomplished at midcentury by Banfield (1949).

The extent of former occurrence of woodland caribou in northeastern United States was treated by Grant (1902) and Seton (1927). R. S. Palmer (1938; 1949) records isolated occurrences of the animals in Maine, and Cringan (1957) analyzed the decline of caribou in both northeastern

and midwestern United States.

The distribution of caribou in the lake states has been variously recorded by Johnson (1922), Swanson (1936), DeVos (1951) and Gunderson and Beer (1953).

The relationship of Indians to caribou in the Northwest is mentioned by Turney-High (1941), Ray (1942) and Teit (1928). In adjacent British Columbia caribou were noted by early explorers David Thompson (1916) and David Douglas (1959). Cooper (1868) makes the first reference to caribou in Montana while the first Idaho reference seems to be that of Merriam (1890; 1891). Seton (1929) also contributes information of early records in the Northwest and Nelson (1930) speaks of them in the third decade. Davis (1939) advises that they were no longer present in Idaho. Allen (1942), Rust (1946), Cahalane (1947; 1948), Dalquist (1948) and Buechner (1953) made contributions on caribou occurrences in northwestern United States.

Ecology and natural history. Whereas early accounts reported animal description and distribution, information about less apparent factors such as behavior, life history and ecology was much later in appearance. A book devoted to the natural history of American animals (Hornaday, 1904) has little information about caribou other than description. A quarter of a century later more

details on life history, predation, behavior and ecology were assembled (Seton, 1929). The Alaskan forms received comprehensive treatment by O. J. Murie (1935). A range utilization study by Murie was done for the Bureau of the Biological Survey, but was never published (Murie, 1959). Food requirements for Alaskan caribou were investigated (Palmer, L. J., 1944). More serious approaches to ecology and management were the result of importation of reindeer to Alaska, for the animal - range relationships were either not understood or not heeded. This fact resulted eventually in a catastrophic rise in reindeer population with range destruction and the inevitable rapid decline of both reindeer and wild caribou populations (Scheffer, 1951). Imported in 1892, the reindeer had reached populations of serious consequence by the 1920's (Leopold and Darling, 1953). The peak was reached in the 1930's with dire results. Disaster, as is frequently the case, became the stimulus for the pursuit of understanding. Troubles, but of a different nature, again occurred within the last two decades when caribou declines threatened the human populations of northern Canada. In 1947 a continuing study of barren-ground caribou was begun in Canada (Banfield, 1954; 1954b) and has resulted in much understanding of life history, ecology and desired management. Montana and Washington game bulletins have carried little more than rumors of caribou occurrence, and Idaho game bulletins

mentioned their occurrence in Boundary County after their rediscovery there in the 1950's (Flinn, 1959).

Pruitt (1960) made a contribution to the understanding of the winter ecology of animals including caribou.

The Selkirk or mountain caribou has received attention and study in several recent investigations. The decline of mountain caribou as it is related to fire in British Columbia was the subject of a paper by Edwards (1954). In 1958 Edwards contributed a theory of caribou distribution as it is related to land form. Migration of mountain caribou was treated by Edwards and Ritcey (1959).

The classic paper treating history, ecology and factors associated with the decline of woodland caribou is that of Cringan (1957).

The continuing studies in Canada carried management techniques and recommendations. Kelsall (1955; 1957) contributed papers to this investigation. Disease received treatment in these same continuing studies (Banfield, 1954a; 1954b), in the Alaskan study by Murie (1935) and by Cowan (1951). Tagging techniques as a study and management device were reported by Bossenmaier (1959). Banfield (1960) added another device for aging to be used with other criteria.

The subject of land use and its relations to caribou in Alaska was summarized in the study by Leopold and Darling (1953).

Reindeer herding which has been practiced for unknown centuries in the north of the Scandinavian countries is indeed related to caribou management. However, it appears to be more of an adaptation of humans to animal migration and behavior than a management of the animals (Manker, 1958). Reindeer herding has contributed to management through its overuse of ranges, a practice which has led eventually to better understanding of ranges and the needs of reindeer and caribou.

After several decades of concerted attack on the unknowns of wild animal populations in America, many contributions have resulted in a better understanding and development of management techniques. However, forest-frequenting caribou are still the least understood game animals in the United States and little has been published about them to date.

METHODS

Readings. For a broad comprehension of caribou and for insight into their behavior, their range and their disappearance from former areas of habitation, nearly one hundred scientific papers were studied. All pertinent information was categorized for treatment in the various aspects of the study.

To establish caribou as residents of northwestern United States during segments of time dating from before written records, ethnological papers were consulted. Then early journals were searched for mention of caribou. Origins of place names relating to caribou were sought.

From patterns established through reading, caribou declines were correlated with natural and cultural changes that occurred in caribou ranges other than in northwestern United States. Similarities of caribou disappearance from other areas were examined in light of related natural and cultural events having occurred in the Northwest. Inductions were then made.

Administrative sources. Through the offices of the U.S. Forest Service, much statistical information was obtained that related to caribou and caribou habitat. From

summary maps forest fire data were assembled by decade. The prevalence and location of domestic sheep grazing in the forests were assembled by area. Game animal inventories had been compiled for the various national forests and from these were obtained the data on caribou. Incidence of severe timber infestation by insects was examined. With the help of forest administrators, the pattern of timber harvest and climax forest destruction was mapped. Similar material was obtained from the National Park Service. Game inventories were also obtained from the U. S. Fish and Wildlife Service. The methods used in obtaining the data for the published game inventories were examined and evaluated for their worth in this study.

The Idaho State Forestry Department was consulted for information within the areas it administers. The state and provincial game departments were also contacted in the search for all facts and rumors about caribou. The large timber holding companies that operate in the caribou-connected country were also contacted in a similar manner. Records of caribou killed in British Columbia were obtained. From these many sources were compiled maps and data used in searches for correlations of habitat disturbances and caribou decline.

Field techniques. Acquaintances were made with early

settlers, trappers, loggers, miners, former U. S. Forest Service employees and all who had touch with early history. From these persons came first-hand accounts of caribou observations and popular reports about the animals. Correspondence was established with many persons who provided more information about the animals and human activities in the early days. Card files were established which recorded all reports by area and time and reporter. On extensive trips by automobile it was possible to meet a great many of the correspondents.

All informants were evaluated for reliability. Though no completely objective method could be used to appraise this trait, sincerity and familiarity with terrain and caribou behavior appeared adequate.

Forest Service officials and Washington and Montana game officials were most helpful in assisting to locate past records. All records that did not appear to be duplicates were plotted on maps of the entire caribou range of northwestern United States in ten year segments of time. These maps were then studied to show continuous use by caribou in some areas and discontinuous use or disappearance of caribou in other areas as related to habitat disturbance and human activities in each of the areas.

Familiarity with the various segments of caribou range was gained by actual observation from automobile on

forest roads, by surveillance from an airplane, by one trip in a Tucker Snowcat, by study of topography on maps and pictures, by hiking through areas frequented by caribou and by a midwinter trip on snowshoes. The composition of the vegetation was examined and recorded, and from loggers in contact with the animals, their seasonal movements were obtained.

Over 4,000 miles were traveled by automobile in both the examination of caribou range and in locating former caribou observers. Caribou were actually observed on two occasions.

GENERAL TAXONOMIC SURVEY OF GENUS RANGIFER

The genera of Cervidae are well defined but species definition has yet to be clarified. This is the only genus of cervids in which both sexes may be and usually are antlered. The main hooves are almost semicircular and the dew claws are so modified as to bear considerable weight in snow or soft ground. Tarsal glands are present but metatarsal glands are absent; ears are short; muzzle is wide; shaggy, long hair forms a whitish cape and ventral mane, antlers are palmated to various degrees, and dentition is $i.\frac{0}{3}$, $c.\frac{1}{1}$, $p.\frac{3}{3}$, $m.\frac{3}{3}$ (Banfield, 1954b).

General morphological criteria for species determination. No fully satisfactory criteria for species determination have been given in the many treatments of caribou. Size and color of animals and antler formation are both helpful and confusing as used in most studies. Weights are most frequently lacking and are often thought to be questionable estimates (Seton, 1929). Grant (1902) restates the warning of Linnaeus that little credence should be given to color but Seton uses it freely in his treatments.

Antler configuration is an extremely variable trait, and while it is helpful in group identification it is not very reliable for identifying individual specimens. Flerov (1933) states that antlers do not give satisfactorily constant characters. Murie (1935) advises that wide deviations of antler type appear in the same herd with many gradations between the types and that many of the differences are subtle; he further states that antler form appears fairly reliable but that it must be used with discretion. Nelson (1930), on the other hand, felt that all forms are so similar as to raise doubt as to the existence of more than a single species. Similar differences of opinion run through caribou literature. According to Banfield (1949) the most generally accepted classifications are those of Anderson (1946) and Murie (1935) who have accepted Jacobi's work of 1931.

This study did not attempt to resolve the species question, but it was felt that something similar to the subgeneric groups of Grant (1902) may be the ultimate solution. If Grant's two groups, the woodland and barren-ground forms can be established, and it appears that they have different habitats, different migratory behavior and different feeding habits, it then appears likely that ecological and behavioral barriers may have resulted in their divergence. Seton (1927) advised that intergradation occurred in all characteristics of caribou. It might

then appear that this is indeed a polytypic species with common pools of genetic material. This status would seem consistent for such nomadic migratory animals. Grant placed the mountain caribou in the woodland group; Flerov placed it in the barren-ground group. Grant's decision was favored in this study.

Designation of animal under study. The caribou of this study (Figures 1 and 2) is a native of the mountain and valley forests of the southern half of British Columbia and adjacent areas of northeastern Washington, northern Idaho and northwestern Montana. Such local names as mountain caribou, black caribou, black-faced caribou and Selkirk caribou have been used to designate the animal. Synonyms include the names Rangifer montanus, Rangifer tarandus montanus and Rangifer arcticus montanus. The mountain caribou was first named and described by Seton (1927) in 1899 and the type locality was given as the Illecillewat watershed near Revelstoke, British Columbia. The type specimen is in the National Museum of Canada.

An ecological and distributional opinion of the taxonomic relationships of the mountain caribou is treated in the section of this study that deals with caribou habitat for it appeared most germane to that aspect of the study.



Figure 1.

ADULT MALE MOUNTAIN CARIBOU. This bull has but a single antler after having shed one on November 1. (Photo by Kyle M. Walker)



Figure 2.

ADULT MALE AND FEMALE MOUNTAIN CARIBOU. (Photo by Kyle M. Walker)

ASPECTS OF THE LIFE HISTORY OF CARIBOU

Those behavioral traits of mountain caribou that are known are here discussed. However, since mountain caribou have been rather infrequently observed and thus many aspects of their life history not described, the generic characteristics of all caribou are treated in an effort to gain insight and suggest or predict probable traits that are unknown for this specific form.

General behavior. When observed by man, most caribou do not appear to exhibit the alertness and tension and readiness of flight that is generally evident in other cervids. The animals appear to be curious rather than startled, but Banfield (1954d) advises that the barren-ground caribou tend to show less fright when they are present in greater numbers. The gait is slow except when they are startled, and the general demeanor is one that exhorts the comment that they are "stupid." A Kootenai Indian said that to hunt them was "like shooting cows" (Turney-High, 1941). Eyesight appears to be poor according to Banfield (1954a) and the olfactory sense is keen and the animals do not appear to apprehend danger in sounds (Murie, 1935). They become extremely frenzied when captured.

The voice has been described as a guttural grunt or cough. During this investigation a band of caribou was observed to be quite noisy when feeding in a downed spruce. Because the observer was within thirty or forty feet, they were startled and took rapid flight. On this occasion the peculiar clicking sound of the feet described by Seton (1927) was clearly noted, for it produced considerable racket when the animals fled.

The caribou that frequent the Rock Creek area of the Upper Priest River drainage are said to be very much attracted by grease used for logging machinery (Lynch, 1958). They sometimes even climbed on the machinery and also sought the oil and grease spilled on the ground.

Loggers in the area related that the animals appeared to have definite periods of rest interspersed with periods of activity throughout the day; these intermittent periods had only been observed in the fall, however, for that is the only period of the year when they have been extensively observed by these woods workers.

Social behavior. Caribou are gregarious; seldom are they reported singly. Herd composition for mountain caribou has never been described and that of barren-ground caribou does not appear to show distinct pattern. All persons contacted who had observed mountain caribou confirmed that the animals were usually in small bands of a few to a dozen or more animals.

Productivity. The productivity of mountain caribou is not known, but the studies of barren-ground caribou by Banfield (1954b) revealed 64.3 per cent survival of calves to the end of the first year and 40.5 per cent survival to the end of the second year. The annual increment of calves at age two to four months was computed as 40.2 per cent of the adult cows or 21.6 per cent of the total herd.

Because of difficulties involved in such a study, productivity for mountain caribou is likely to be one of the last aspects of the life history of the animal to be investigated; it is here assumed to be approximately the same as for the northern races. Locally the issue has been made that caribou are the least prolific of all game animals but among all organisms there appears to be a direct correlation between productivity and survival. Thus a low fecundity rate might indicate a proportionately higher rate of survival of young. Interest should be focused on the environmental control of numbers rather than on fecundity.

Migration. Temporally patterned movements or migrations are described for all forms of Rangifer by their respective investigators. The most dramatic of such migrations are those of the barren-ground caribou, whose herds number in the thousands and whose annual treks are across vast distances of treeless tundra. Those far

northern animals migrate between tundra and taiga in two great movements per year. The European reindeer likewise have a complete annual cycle of movement (Manker, 1958).

The mountain caribou have altitudinal movements which are quite different from the simple migrations of other big game species. Such altitudinal migrations are, of course, ecologically related to latitudinal migrations since they both have seasonal implications that correspond.

In speaking of Alaskan forms, Murie (1935) notes that one of the most regular or certain factors about the migration is its lack of regularity and certainty of time. It is here suggested that seasonal movements of mountain caribou may, over a long study, prove to be quite an unpredictable calendar phenomenon. This suggestion is strengthened if migration is essentially an alimentary phenomenon as is held by Murie (1935) and Banfield (1954a), for it would then be drastically modified by such seasonally varying factors as fall frost dates, snow depths, snow density, snow frequency and crusting conditions. It may even be modified by logging activity which makes for availability of food.

With the help of a trapper, Edwards and Ritcey (1959) were able to portray seasonal movements of caribou in Wells Gray Park in British Columbia. The described area is one of high precipitation that is evenly distributed throughout the year. The migration pattern may be

assumed to be approximately the same in northwestern United States, but it may also be assumed to differ locally as weather factors differ. In Wells Gray Park the animals were said to descend from timberline forests as snow deepens in October and remain in the lower forests until snow settlement permits them to travel. Snow settlement is associated with the January thaw, a phenomenon that appears to be of a fairly regular annual occurrence. The animals then ascend to their favored higher haunts of greatest snow depths and most extreme cold until sometime in April. With the milder temperatures and snow settlement of approaching spring, the animals reappear in the lowland climax forests where they were said to remain until June. The caribou then follow the retreating snow until they have again reached their highland haunts.

The four migrations of these mountain animals appear to be quite unique, but an analysis of the complexities of this total environmental niche permits a logical understanding of the origins of such a behavioral pattern. Changing availability of food and changing snow conditions which can permit or impede travel would appear to largely explain the double migration of this animal which is structurally adapted to live in intense cold and travel on snow surfaces. Its broad feet which include functional dew claws are an advantage on dense or crusted

snow but do not prove to be an advantage in powdery snow. Fluctuating weather factors result in different snow densities (Pruitt, 1960) and consequently affect travel conditions for the animal. The January thaw is generally regarded as a remarkably reliable annual occurrence. This warming trend in midwinter would result in snow settlement that would so alter snow densities that extensive caribou travel would be possible. Snow settlement in the lower forests which contain larger trees probably works to the disadvantage of the animals in that it makes food less available. However, this disadvantage is beneficial in that it enables the caribou to travel; as a result, their trek to higher elevations and deeper and probably denser snow probably makes food getting an easier activity with more certain rewards. When winter storms with still deeper snows occur after the January thaw, each new snow depth lifts the animals to new heights where more arboreal lichens can be reached. Thus the caribou have a three-dimensional range (Edwards and Ritcey, 1960), and the third dimensional character of that range makes range analysis a most difficult problem.

When temperatures of approaching spring tend to settle the snow again, the animals are lowered in their three-dimensional range to previous grazing levels. Thus the caribou are stimulated by good travel conditions and decreasing food supply to wander toward the lower

elevations in their constant harvest of slow-growing lichen supplies. Spring also brings abundance of succulent forbs. This source of food would continue for an extended period and the use of plants as they appear with snow disappearance would lead the caribou back to the highlands. Caribou also seem to frequent boggy, poorly-drained areas. Here again their broad feet would be an advantage where a choice of succulent vegetation is available.

The preference of theories accounting for northern caribou migrations appears to be those which favor a gastronomic explanation as is previously suggested, but as Banfield (1954b) advises, the explanations are likely a complex of factors. The interactions of snow on availability of food and permissibility of travel seem quite adequate to explain mountain caribou movements as they are presently known.

Some animals may remain in the extremes of their range when food abundance modifies the normal migratory pattern, just as some barren-ground caribou have been described in all parts of their range in both winter and summer. This food abundance might easily be associated with snow patterns that differ extremely from what may be considered normal or average. Likewise, snow conditions might deter movement because of its failure to effect sufficient support. Pruitt (1960) observed in Alaska that caribou distribution was precisely regulated by the

character of the snow cover. However, in the north country aboreal lichens are not available and the harder snow prevents feeding; with the mountain caribou, where arboreal lichens provide the principal winter sustenance, harder snow permits feeding. So, in Alaska the snow fences of Pruitt consist of dense snow, but in the habitat of mountain caribou the snow barriers are probably powdery, light snow. Thus wind slab, sun slab and other dense snow conditions would favor mountain caribou whereas they would impede the northern forms.

It is, therefore, concluded that mountain caribou migration patterns may be radically affected by weather and may, as a result, be more complex and less predictable than described. Certainly the studies of their movements offer a challenge which is close to or even well beyond the limits of reasonable human observation.

Nomadism. The nomadic, restless behavior of caribou adds further to the complexities of migration, but it is a phenomenon that is worthy of treatment. It is also, like migration, one of the behavioral traits that add measurably to the limitations of a caribou study. Caribou do not appear to exhibit territoriality. In their seemingly restless behavior one can see survival value of a trait that keeps the animals in constant search for food which through much of the year exhibits a changing availability

because of changing snow depths and densities. Nomadism, or changing migration routes of barren-ground caribou, permits lichen pastures to be regenerated, whereas continued use would soon deplete food and exhaust the regeneration potential of the ground inhabiting lichens. In similar fashion, nomadism would tend to favor the regrowth of heavily-used, slow-growing arboreal lichens. The relationship between arboreal lichens and caribou is discussed further in the section on food.

Nomadism is likewise a trait favorable to the distribution of the animals when the environment approaches climax conditions after previous climax conditions have been destroyed. It also accounts for the occasional sightings of caribou in areas where they have been considered extinct. It may permit caribou to inhabit forests of northwestern United States if a sustained yield pattern of forest use allows for a sufficient maturity of forest stands that regain their ability to sustain the animals. The nature of the limiting factor of caribou is no doubt based on the slow growth of lichen forms. It does seem that there is a more tenuous relationship between caribou and their environment than is apparent in most animals.

Caribou in the logging area in the east spur of the Selkirk Mountains in Idaho have persistently appeared for several successive seasons in the same immediate area. It would appear that the topography is such that they are

likely to frequently encounter this area in their seasonal movements. The logging activity and the available food that is afforded have probably accentuated their use of this particular area.

Food. Caribou are essentially eaters of herbs and lichens. Winter survival of mountain caribou must be solely dependent on arboreal lichens. Those lichens occurring in mountain caribou habitat that are present in abundance appear to belong to the genera of Usnea, a gray-green form, and Alectoria, a black lichen. These fruiti-cose lichens abound in the coniferous forests throughout the Northwest. They are scarce in the drier forests of ponderosa pine, but occur in varying degrees in all of the forests. These lichens festoon the limbs of the conifers and are of relatively slow growth, a trait which seems typical of all lichens. Compensating for the slow growth of lichens, however, is the cumulative nature of the crop, for they do not deteriorate in their pendant, epiphytic habitat. Ultimately all of the lichen crop becomes harvestable unless it is burned or destroyed in slash disposal following logging or allowed to deteriorate on the ground. Under natural conditions a sustained yield of lichens is available for caribou in a climax forest (Figures 3 and 4), where mature trees fall and present lichens within reach of the foraging caribou (Cringan, 1957).



Figure 3.

CARIBOU FEEDING TREE IN USE. Eleven caribou were seen feeding in this downed spruce. Note limbs missing from top side of trunk. Undisturbed limbs are heavily festooned with lichens.



Figure 4.

CARIBOU FEEDING TREE AFTER USE. These downed spruce had fed caribou the previous day. Every limb had been broken from trunks and trampled by the feeding band of animals.

Terrestrial lichens are nowhere evident in sufficient abundance in the study area of northwestern United States to contribute an important measure of caribou diet. Even if terrestrial lichens were present, Cringan (1957) has deduced that they would not support a stable population of woodland caribou because the reproductive potential of caribou is greater than the regenerative rate of the lichens.

Cringan further observed that no species of woody browse was more than lightly utilized in an area where woodland caribou population was high. He showed conclusively that the lichen supply was of critical importance in sustaining caribou and that tree lichens probably constitute the most decisive single element of caribou habitat. Tree lichen abundance and availability, of course, are in turn dependent on forest maturity.

One is impressed with tree lichen growth in many areas of reasonably close proximity to caribou-occupied habitat. The question that immediately arises is: why are not these lichens being harvested by caribou if arboreal lichens appear to constitute one of the critical factors of caribou survival? When nomadic habit is taken into account, it appears that these areas may constitute reserves which will indeed be utilized in a future year when the caribou wander through them. In many instances

the noted lichen abundance was in medium-aged forest stands with which caribou are not usually associated. A further suggestion about the lack of use of the lichen pastures is that they may not be embraced within a reasonable traveling radius of highland ranges and thus the total environment lacks a seasonal component. A final possible explanation is that lichen growth is not in itself enough but must be coupled with such snow densities as is favorable for caribou travel and that the aforementioned lichen pastures may not often be coupled with the proper snow densities to attract caribou.

Summer food is probably not a critical factor in caribou habitat. Barren-ground caribou were shown to have rated a high palatability for lichens, mushrooms, grasses, sedges, willows, birches and horsetails. Most of the plants are associated with high moisture regimes. Cringan (1957) showed spring foods for woodland caribou as aster, bunchberry, mosses and lichens. Summer herbs most frequently selected were sarsaparilla, ferns and fireweed, and the summer choices of shrub leaves were highbush cranberry, mountain ash, mountain maple and bush honeysuckle.

One immediately recognizes that the plants mentioned for both barren-ground and woodland caribou are plants that are available in western mountain forests. The sedges and grasses are found in forest openings and along the ridges

and balds. Since this study did not include actual feeding observations, it is assumed that the aforementioned plants constitute important food sources of mountain caribou. They do not appear to be in critical supply in western forests but are ample for greater utilization.

The only plants noticed to have been utilized by caribou in the study area were arboreal lichens, leaves of mountain ash and wood rush.

So it would seem, in general, that there is a great deal of resemblance between the food habits of barren-ground, woodland and mountain caribou in respect to the component plants of their diets. The principal difference between the tundra-dwelling and forest-dwelling forms is that the former rely to a great extent on terrestrial lichens and the latter rely principally on arboreal lichens. Antipodal snow conditions are necessary for the harvest of the two lichen types. Terrestrial lichens can be reached through light snow of low density; arboreal lichens can be reached when snow density is high enough to support the animal's weight for traveling and reaching the hanging food supply.

GENERAL NATURE OF CARIBOU HABITAT

The genus Rangifer is of circumpolar distribution, but little information was sought on the nature of the Eurasian animals and their habitat except for a general picture of the latitudinal limits of their range. The latitudinal, topographic, climatic and vegetational aspects of caribou range in northwestern United States are treated in this section.

Latitude. Caribou, most northern of the cervids, are typical of the high latitudes and they range as far north as is found vegetation to support them. Since this study embraced the southernmost limits of caribou range, there was a constant search for subtle factors of the environment that might be significant in limiting the animal's range, for limiting factors might be more apparent along the periphery of range of any animal. On the other hand, it was kept in mind that the limits of a species might simply be an expression of the limits of the plants which support the animals. Flerov (1933) fixes the southern limits of European Rangifer at approximately 60 degrees north latitude with a southern extension to fifty

degrees in the Ural Mountains. Such a southern extension in mountain areas is in keeping with climatic modifications which are expressed in plant growth. Since most of the mountain systems of North America are in north-south positions, it would be anticipated that caribou would range farther south in the western hemisphere than in the eastern hemisphere. This is indeed true.

If the Wyoming observation (Murie, 1959), discussed in this paper under temporal and geographic distribution, is valid, then caribou occurred at or near 42 degrees north latitude in the latter third of the nineteenth century. As cited also in the section referred to, they had withdrawn to less than 47 degrees north latitude by the middle of the twentieth century. Most of the caribou are now near the Canadian line, which would put them little farther south than the 49th degree of latitude.

Accounting for their southern limits, one may suppose first that the southern extensions were vestigial remnants, so to speak, of earlier populations extant when a colder and snowier climate provided the climatic conditions generally associated with caribou. Or one can account for such a southern extension by assuming that this itinerant species wandered the almost continuous north-south mountain ridges. Spruce and fir forests do extend to the high mountains of western Wyoming and beyond, and forest-dwelling caribou are probably more closely associated with these forest species

than any other. The lichen richness of the Wyoming spruce-fir forests was not investigated in this study.

Topography. Caribou in northwestern United States are primarily associated with mountainous terrain and have been observed near the continental divide in Glacier National Park (Edgar, 1958), an area of extremely rugged topography. They have been known to inhabit only mountain and valley forests and areas closely adjacent to them.

The grasslands to the east of the Rockies appear to be barriers to caribou and the dry Snake River Plains and Columbia River basin to the south and west respectively are not caribou country. The mountain areas that fall within the range of caribou are from rolling to rugged. Bald-top mountains devoid of timber and supporting sedges, grasses and arctic alpine vegetation are interspersed along the mountain ridges of practically all areas that are or have been associated with caribou in the Northwest. However, it cannot be categorically stated that any terrain is necessary to the animal's habitat except as it alters regional weather factors to produce the physical requirements of forest habitat. By the same reasoning caribou are often associated with swamps or bogs, but it cannot be definitely stated that swamps and bogs are essential constituents of caribou range.

Edwards (1958) has associated land form with caribou in British Columbia. Though he suggests that the choice is not absolute and cites deviations at both extremes, he notes that in the summer caribou are found principally on "rolling mountains with extensive flats and gentle slopes near their tops and sufficiently high to support extensive alpine meadows above treeline." This "foothill" topography is well designated for the Canadian observer, for many Canadian ranges tower well beyond timberline in extremely rugged fashion. Thus an observer in the United States must be on guard, for "foothill topography" in this country may be interpreted as any subdued mountain terrain that is less rugged than the summits of the main range. However, Edward's description quoted above is quite adequate for a designation of the topography that he associates with caribou. He explains, however, that there is terrain that meets this designation which is not frequented by caribou, and that in some instances caribou are seen in more rugged mountains, and in the northeastern part of the province caribou are found in areas remote from such foothill topography.

It would appear, then, that range requirements may more frequently be found in such "foothill topography," and that the topography is quite incidental if the animals are not found in much terrain that fits the description but are found in areas that do not fit the description. It

was suggested by Edwards that the caribou found in the northeastern part of British Columbia, which is remote from his designated land form, may be of the woodland type. It is here suggested that the mountain caribou may indeed be of the woodland type and that it was named for its topographical habitat rather than recognized as being a woodland animal. Woodlands or forests in British Columbia are usually associated with mountains, because most of the province is mountainous. The same can be said of the mountainous range of caribou in northwestern United States. Caribou are never removed from the woodlands except when they visit openings within and at the upper limits of tree growth.

At this point a taxonomic digression seems most pertinent. Although it was not the purpose of this paper to define the species of caribou with a review of their morphological characteristics, an ecological designation of what might constitute the species was a temptation that was here undertaken. From an examination of the report of Banfield (1949) it became apparent that the sweep of habitat ascribed to Rangifer caribou sylvestris and Rangifer caribou caribou is contiguous or nearly so with the range of R. arcticus fortidens which is almost adjacent to the range of R. arcticus montanus (Figure 5). The conclusion, without contrary evidence of a morphological nature, is that the affinities of R. arcticus

Figure 5.

APPROXIMATE PRESENT CARIBOU DISTRIBUTION IN NORTH AMERICA

Data from Banfield (1949)

Legend:

Rangifer caribou terranovae

Rangifer caribou caribou

Rangifer caribou sylvestris

Rangifer arcticus arcticus

Rangifer arcticus pearyi

Rangifer arcticus fortidens

Rangifer arcticus montanus

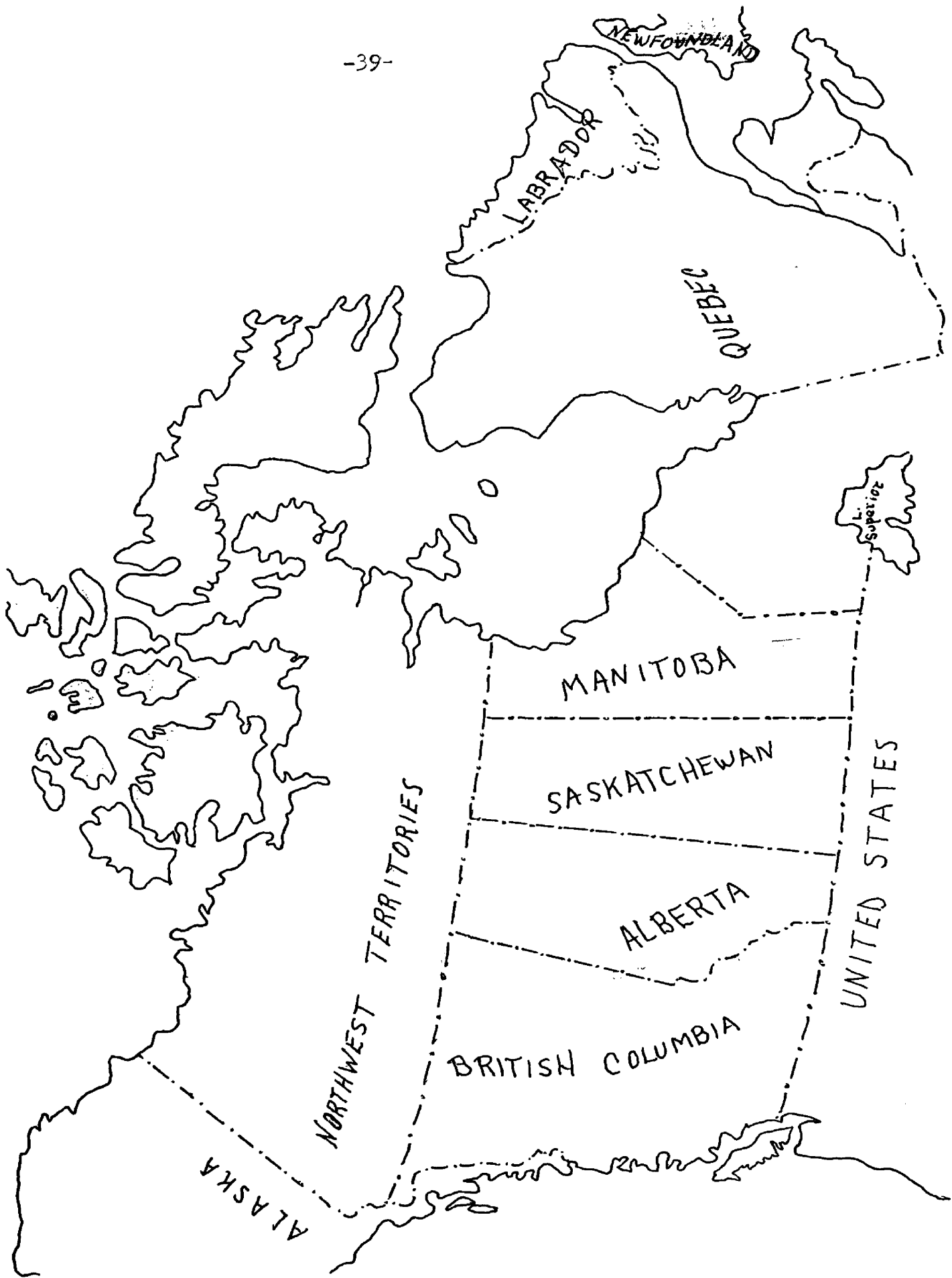
Rangifer arcticus osborni

Rangifer arcticus caboti

Rangifer arcticus stonei

Rangifer arcticus granti
(Alaska Peninsula - not shown)

Rangifer arcticus dawsoni
(Queen Charlotte Islands - not shown)



montanus are probably closer to those of R. caribou than to the affinities of R. arcticus. Rangifer caribou, R. fortidens and R. montanus may well be constituents of a polytypic species, for the nomadic and migratory habits of the animals may actually enable them to maintain common pools of genetic material. What the affinities of R. stonei and R. osborni are was not essentially the concern of this paper, but it is suspected that they also may be part of the woodland caribou complex rather than subspecies of the barren-ground caribou, R. arcticus. Throughout this study it appeared that a woodland or forest caribou was the subject of study, but it must be emphasized that specimens were not studied in an effort to arrive at this conclusion. The conclusions were reached solely through the insights that were stimulated by the ecological relationships and the geographical distribution of caribou and the distribution of North America's northern coniferous forests. Thus, as was suggested by Grant (1902), it is the inescapable conclusion that all caribou that do now occur or have previously occurred in the United States are woodland caribou, Rangifer caribou, even though subspecific designations may be in order.

Climate. Northeastern Washington, northern Idaho and northwestern Montana temperatures are influenced by both latitude and altitude. Since they are generally the same,

the summary here given is specifically that for northern Idaho. Of what may be considered as present and recently past caribou range, the mean minimum January temperature is from 12 to 16 degrees F., and the mean maximum January temperature is from 28 to 32 degrees F. In July the mean minimum is from 44 to 52 degrees F., and the mean maximum is from 76 to 88 degrees F. Because of a shortage of weather stations, no isotherms could be accurately established. The weather station closest to caribou-inhabited country is the Priest River Experiment Station, which showed the mean monthly temperatures ranging between 23.9 degrees F. for January to 64.4 degrees F. for July and a mean annual temperature of 44.1 degrees F. These temperature data from the U. S. Weather Bureau present only a general picture. Extreme temperatures within caribou-occupied habitat were not obtained. Periods of extreme summer heat and extreme winter cold of greater than one week duration are quite rare, according to the U. S. Weather Bureau (1959).

Rainfall averages 32.22 inches at the Priest River Experiment Station. Greatest precipitation is during the winter months, but it is fairly well distributed throughout the year (Table I). Snowfall is extremely variable in both depth and density or water content (Tables II and III). On the Smith Creek Snow Course in the Selkirk Mountains at an elevation of 4800 feet, the April 1st snow depths varied

TABLE I

AVERAGE PRECIPITATION BY MONTH AT PRIEST RIVER EXPERIMENT
STATION, KANIKSU NATIONAL FOREST, IDAHO, 1931-1955

Elevation 2368 ft.

January	4.26	July	.96
February	2.98	August	.80
March	2.85	September	1.60
April	2.04	October	3.36
May	2.03	November	3.71
June	2.65	December	4.98
Total average annual precipitation			32.22

Data from U. S. Weather Bureau, Climates of the States,
Idaho, 1959.

TABLE II

APRIL 1ST AND MAY 1ST SNOW DEPTHS AND WATER CONTENT ON
SMITH CREEK SNOW COURSE, ELEVATION 4800 FEET,
KANIKSU NATIONAL FOREST, IDAHO, 1937-1960

Year	<u>April 1*</u> Inches of Snow	Inches of Water	<u>May 1*</u> Inches of Snow	Inches of Water
1937			86	37.9
1938			88	44.6
1939	105	46.1	63	31.1
1940	74	29.6	49	22.6
1941	59	25.9	8	3.9
1942	77	25.7	40	17.8
1943	122	48.8	80	38.4
1944	66	23.0	33	15.1
1945	125	34.6	107	45.1
1946	148	57.7	130	61.1
1947	120	51.4		
1948	109	42.2		
1949	124	49.3	81	40.2
1950	155	51.8	119	51.8
1951	127	50.5	81	38.7
1952	116	44.0	65	32.6
1953			115	50.3
1954			131	61.8
1955			111	50.0
1956			108	55.4
1957			90	43.2
1958			102	48.7
1959			99	46.1
1960			96	41.1
Average	109.07	41.47	85.54	39.88

*Measurement dates varied from March 28 to April 4 and from April 30 to May 2.

Data from Soil Conservation Service, Snow Survey Data for the Columbia River Basin (1952) and Bonnors Ferry Herald.

TABLE III

APRIL 1ST AND MAY 1ST SNOW DEPTHS AND WATER CONTENT ON
BLUE BIRD BASIN SNOW COURSE, ELEVATION 6800 FEET,
KOOTENAI NATIONAL FOREST, IDAHO, 1937-1952

Year	April 1* Inches of Snow	Inches of Water	May 1* Inches of Snow	Inches of Water
1937			81	31.7
1938			93	40.8
1939	73	29.6	57	27.5
1940	101	33.1	93	39.0
1941	67	25.9	40	19.8
1942	87	29.8	72	30.1
1943	107	39.1	80	35.6
1944	66	21.4	62	23.4
1945	97	25.8	96	36.2
1946	129	50.6	118	51.2
1947	104	40.5		
1948	101	36.8		
1949	110	38.2	88	36.7
1950	137	46.3	131	53.7
1951	120	45.3	112	44.4
1952	108	40.4	73	34.9
Average	100.5	35.9	68.28	36.07

*Measurement dates varied from March 28 to April 3 and
from April 27 to May 3.

Data from Soil Conservation Service, Snow Survey Data
for the Columbia River Basin (1952).

from 59 inches to 155 inches in a nine-year period. May 1st measurements varied from 8 inches to 131 inches in a thirteen-year period. Likewise, snow density as computed from water content is extremely variable.

Windstorms, although generally associated with cold fronts, are not uncommon and may occur during any month of the year. The factor of humidity was not considered.

Vegetation. Caribou habitat, currently and previously occupied, is embraced by northern coniferous forests. Within this biome are many different forest associations which reflect various microclimates as they are modified by edaphic factors, slope, exposure, drainage and altitude. Caribou are associated with the moister forests, and Cringan (1957) states that woodland caribou are usually though not always associated with climax stands. Their highland habitat seems to be closely associated with spruce-fir forests and their lowland haunts are usually in mature cedar-hemlock associations. Many tree species are mixed within these stands. White pine, western larch, grand fir, alpine fir and Englemann spruce and other conifers are present in varying abundance. Yellow pine and Douglas fir, which are usually associated with drier regimes, do not appear to be frequented by caribou.

Under natural conditions there is discontinuity of climax forests with uneven-aged stands which reveal

destruction by fire followed by varying stages of succession.

The dense mature forests have little understory of vegetation. Shrubs are of rather scant occurrence except in the occasional openings. Grasses and forbs are scattered except where growth is favored by springs, streams and intermittent openings. Light is suppressed in the denser forests. Arboreal lichens festoon the limbs. Some trees such as white pine and larch are self-pruning and are usually devoid of lower limbs; others such as spruce and cedar may maintain foliage on lower limbs almost to ground level.

The higher drainages are usually forested with alpine fir and Englemann spruce which may grow in dense stands but often do not reach great height. Scattered trees on open slopes, however, frequently grow very tall. As local factors dictate, these forests give way to ericaceous shrubs and forbs and grasses. The upper tree line is often scattered and irregular and is interspersed with alpine vegetation, sedges, grasses and perennial forms of great variety. In protected spots snow may persist through all or much of the summer. At the upper limits of these mountains and ridges, rock is frequently exposed.

There are three diverse components of caribou range and no study has shown how dependent caribou are on any one

of them if food is seasonally available in the other two. Of course, in the deep snow country mountain caribou have only lichens available for food. In the discussion on migration the vegetational components of highland and lowland caribou range was implicit. But in addition to these two caribou environments may be added the bog or swamp environment with which they are frequently associated. How essential it is in their total range was not revealed.

From the foregoing account of caribou habitat it can be understood clearly that caribou are usually, though not always, associated with climax and near climax vegetations. In any management program it is imperative to learn at just what stage of development a climax condition caribou become successfully associated with the environment. It is apparent that this is well before the forest is old-aged.

Natural and cultural modifications of the environment are not here treated, but receive full consideration under the section of this paper dealing with factors associated with caribou decline.

Geographical designation of study area. Those areas of Idaho, Montana and Washington that are presently or were in the recent past occupied by caribou are all associated with mountains. The mountains vary from mild to rugged topography, but caribou have not been established

as frequenting the very rugged topography to any appreciable degree. Most of the mountains would fit fairly well into the "foothill topography" designation of Edwards (1958). The various ranges are separated by broad intermountain basins or trenches which have also been frequented by caribou if they contained the vegetation types associated with that animal. Designated as the northern Rocky Mountains, the area is one of the twenty-five physical provinces of the United States (Loomis, 1938). From main valley floors 2,000 to 3,000 feet above sea level, the mountains rise to 5,000 and 6,000 feet above sea level. In some instances peaks approach or exceed 7,000 feet. Barren elevations up to 9,000 and 10,000 feet occur in Glacier National Park.

The principal ranges are the Selkirk, Bitterroot, St. Joe (a spur of the Bitterroots), Cabinet, Whitefish, and the easternmost caribou associated ranges are the Livingston and Lewis Ranges of Glacier National Park (Figure 6). Of these the Bitterroot Range is the most extensive in both north-south and east-west dimensions. It alone comprises several thousand square miles of wooded, mountainous wilderness.

The area is administered as five national forests: Kaniksu, Kootenai, Flathead, St. Joe and a small portion of the Colville (Figure 7). In addition, some of the area is embraced by Glacier National Park. Many scattered

Figure 6.

THE APPROXIMATE LOCATION AND EXTENT OF MOUNTAIN RANGES IN CARIBOU STUDY AREA

ALBERTA

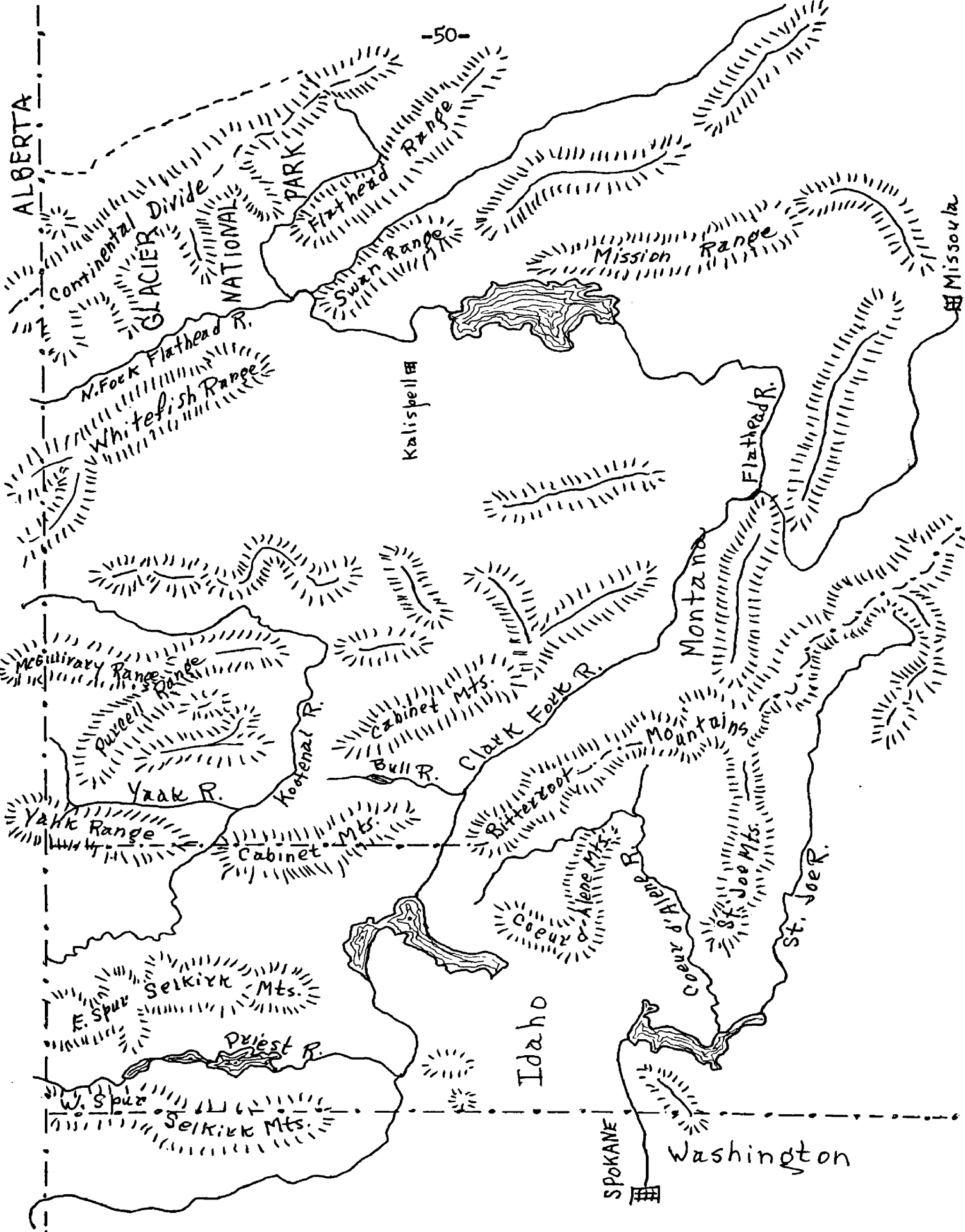
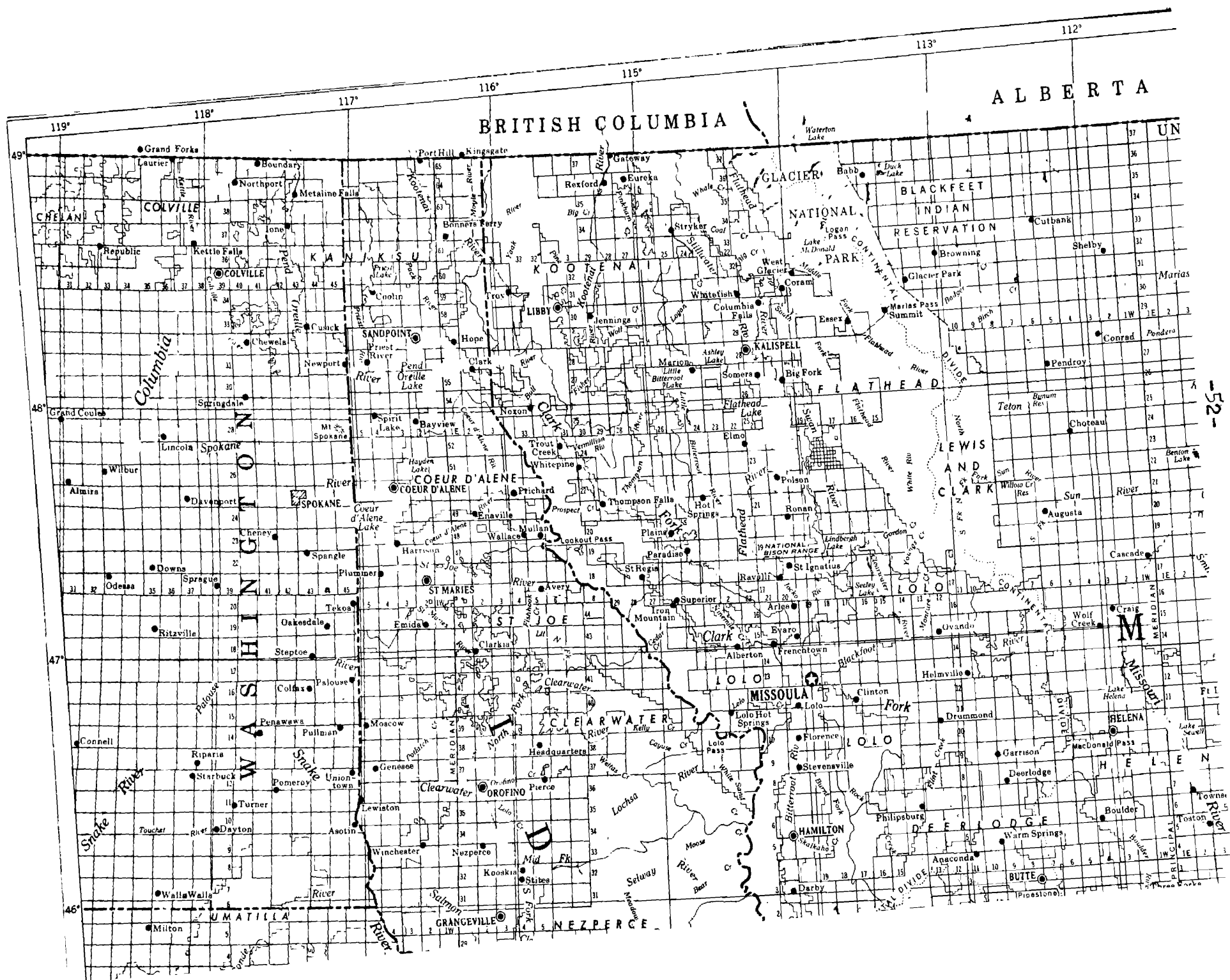


Figure 7.

NATIONAL FORESTS OF NORTHEASTERN WASHINGTON, NORTHERN IDAHO AND NORTHWESTERN MONTANA

Portion of U. S. Forest Service map of Northern Region.



BRITISH COLUMBIA

ALBERTA

-52-

properties are owned by individuals or by lumber companies, and still others are owned and administered by state forestry departments. For convenience in this study the entire area was subdivided into the national forests and national park referred to. Since their boundaries are irregular and embrace private lands, closely associated properties are not differentiated.

The area embraced by the Kaniksu National Forest received the most attention and the greatest amount of analytical treatment in this paper for several reasons. Since it was that area that showed greatest caribou activity in current times, it was deemed the most important. It was also possible to more completely appraise the environmental modifications that had occurred in the area.

The total area embraced in the study was over 10,000 square miles, but much of that area did not receive attention since no known caribou activity occurred within major segments.

TEMPORAL AND GEOGRAPHIC DISTRIBUTION OF CARIBOU IN
NORTHWESTERN UNITED STATES

Since caribou have occurred in and disappeared from two other general areas within the United States, it is first fitting to briefly review those declines. While woodland caribou formerly existed in Vermont and New Hampshire (Grant, 1902) and disappeared more recently from New York and Maine (Seton, 1927) by 1900 they remained only in Maine within northeastern United States and their status had deteriorated considerably (Cringan, 1957). By 1916 they had disappeared from Maine (Seton, 1927), but as might be expected of such an itinerant animal, a well-authenticated report of caribou came from Maine as late as 1946 (Palmer, 1949).

In the lake states caribou occurred in the northern half of Minnesota, northern Wisconsin and in the upper peninsula of Michigan (Cringan, 1957). While fairly abundant in Minnesota in the middle of the nineteenth century (De Vos, 1951), the decline followed a pattern similar to that in Maine. In 1917 a number of animals were reported in Lake County (Johnson, 1922); by 1927 there were

reported but twenty-seven individuals. By 1938 the remaining animals were in the bog region of Upper Red Lake, whereupon they were augmented by caribou transplanted from Saskatchewan (Gunderson and Beer, 1953). The last native animals died in 1940 and the imported ones disappeared after 1943. However, a caribou was seen near Manitou Rapids, Minnesota, during the winter of 1954-55 (Cringan, 1957).

The recession of caribou populations in the Northeast and Midwest followed similar patterns, and this has again been duplicated in their northwestern range. The reasons for these declines are treated in the section following. Now it remains to trace the occurrence of caribou in northwestern United States and pinpoint the times and places of sightings as revealed in this study.

It is at least unique that the animals are under study in their northwestern range before they have completely disappeared. Is it possible that an understanding of their life history and habitat requirements can preclude their extinction and possibly save them in at least remnant numbers?

Before 1900. In prehistoric times, according to ethnological studies, caribou occurred in northern Idaho (Turney-High, 1941) where they influenced the culture of the Kootenai Indians, who were principally a Canadian

people (Ray, 1942). They were usually considered to be beyond the tribal boundaries of the Coeur d'Alene Indians (Teit, 1928), but Indians reported them in the Bull Lake country and near Fish Creek (near the present town of Alberton) in northwestern Montana in the nineteenth century (Malouf, 1951).

David Thompson reported encountering caribou on the Columbia River above the present location of Revelstoke, British Columbia, in 1811 (Thompson, 1916) and thus leaves the first written record of caribou in the northwest. The botanist David Douglas (1959) recorded in his journal in 1827 that caribou were said to abound in the high altitudes of the mountains above Arrow Lakes. The first reference to caribou in northwestern United States is that of a pair of antlers by a roadway near Missoula, Montana (Cooper, 1868).

So it is certain that caribou ranged through the climax forests in the mountains of northwestern Montana, northern Idaho and northeastern Washington before the advent of European man. Although just how far south and to what extent they ranged are facts obscured by the passage of time. The southernmost record cannot be checked for validity. From an old man, Albert Richards, Murie (1959) obtained the information that seven caribou were known to be near Salt River, Wyoming in 1877 (Figure 8). The proximity of this supposed sighting to the several caribou place names in nearby Idaho might permit a



Figure 8.

STATES OF NORTHWESTERN UNITED STATES IN WHICH CARIBOU HAVE BEEN KNOWN TO OCCUR AND EXTREME TERRITORIAL SIGHTINGS

- Legend:
- | | |
|---|---|
| 1. Easternmost sighting in Montana | 2. Southernmost recent sighting in Idaho |
| 3. Reputed southernmost occurrence in Idaho (in 1870's) | 4. Reputed southernmost occurrence in United States (in 1870's) |

deception and leave the reader with the secure feeling that caribou were certainly there. However, the name "caribou" was here affixed to a mountain range, then a county and later a national forest--all apparently without connection with the animals. Caribou County and Caribou National Forest were named for the Caribou Mountains which, according to Hauley (1920), were named for a man named Fairchild who had been nicknamed "Caribou" for a mining camp by that name in British Columbia where he had formerly worked. Nevertheless, it is certainly possible that caribou might have occurred in the spruce and fir forests of that region of Wyoming. They might have been a remnant band from a waning population of former snowier and colder times, or they might have wandered there. Murie (1959) states that caribou have this urge to wander developed to an extreme degree. The mountain ranges extend from north to south in such fashion that they might indeed have been able to stay in fairly continuous habitat all the way from known ranges to the north. But the certainty of the Wyoming occurrence seems likely never to be solved.

The period before 1900 represents the period of greatest caribou abundance, yet is the period of which least information can be obtained by virtue of the lack of contact with persons who were in the area six or more decades ago. Because of relatively undisturbed environmental conditions, caribou may be assumed to have been at

or near the carrying capacity of their range unless inroads on their populations had been made by Indians. Inasmuch as caribou presented easy targets, the Indians may indeed have effectively reduced their numbers before the coming of white men. Nevertheless, caribou may be correctly assumed to have occurred in all areas in which they were later shown to occur.

The number of immigrant whites grew rapidly in the latter half of the eighteenth century. The most thriving activity from 1860 to 1900 was mining (Anon. 1955), (Grush, 1958), and hundreds of prospectors were combing the hills in search of mineral wealth. These men probably had more contact with caribou than anyone since that time, but they were men not likely to have left written records. It is safe to say that caribou furnished meat for these men when the animals made themselves available.

Many place names originated before 1900, but the time origins of place names is most frequently unknown. Of the place names that are associated with caribou (Table IV), only one can be positively dated.

Figure 9 shows fourteen documented occurrences of caribou before 1900. They were reputed to have occurred "as far south as the neighborhood of Elk City" in Idaho according to Merriam (1890), who quoted Captain Bendire, who had been on the Clearwater River in 1872. A place name of Caribou Creek which designates a tributary of the

TABLE IV

GEOGRAPHICAL PLACE NAMES ASSOCIATED WITH CARIBOU

Name	Location	Origin of Name	Source of Information
1. Caribou Cr.	Tributary of Pack R., Kaniksu Nat. Forest, Idaho	Unknown*	U. S. Forest Service maps
2. Caribou Cr.	Tributary of Deep Cr., Kaniksu Nat. Forest, Idaho	Unknown*	U. S. Forest Service maps
3. Caribou Hill	E. of Priest Lake, Kaniksu Nat. Forest, Idaho	Associated with No. 4	U. S. Forest Service maps
4. Caribou Cr.	Flows into Thorofare, Kaniksu Nat. Forest, Idaho	Was frequented by caribou	U. S. Forest Service maps
5. CaribouRidge	Between Caribou & Ruby Cr. drainages, Kaniksu Nat. Forest, Idaho	Associated with No. 2	U. S. Forest Service maps
6. Caribou L.O.	At head of Caribou Cr., Kaniksu Nat. Forest, Idaho	Associated with No. 1	U. S. Forest Service maps
7. Caribou Cr.	Tributary of Callahan Cr., Kootenai Nat. Forest, Idaho-Montana	Was frequented by caribou	U. S. Forest Service maps Klehm, 1958
8. Caribou Cr.	Tributary of Yaak R., Kootenai Nat. Forest, Montana	Was in country known to contain caribou	U. S. Forest Service maps Dwinelle, 1959

(continued on page 60)

TABLE IV (continued)

Name	Location	Origin of Name	Source of Information
9. Caribou T.P.	Above Caribou Cr., Kootenai Nat. Forest Montana	Associated with No. 8	U. S. Forest Service maps
10. Winkum Cr.	Tributary of Yaak R., Kootenai Nat. Forest Montana	Caribou killed in the drainage	U. S. Forest Service maps Dwinelle, 1959
11. Caribou Cr.	Tributary of Canyon Cr., N. Fork of Clear- water R., St. Joe Nat. Forest, Idaho	Unknown*	U. S. Forest Service maps
12. Caribou Mts.	Range of Mts. in S.E. Idaho	Named for a man who was nicknamed "Caribou" from having worked in a mining camp by that name in B. C.	Hauley, 1920
13. Caribou County	S.E. Idaho	Named for Caribou Mts.	Hauley, 1920
14. Caribou Nat. Forest	S.E. Idaho	Named for Caribou Mts.	

*Assumed to have been associated with caribou sightings

Figure 9.

DOCUMENTED OCCURRENCES OF CARIBOU BEFORE 1900 (NOT INCLUDING WYOMING OBSERVATION)

Each numbered dot indicates caribou occurrence or substantial evidence of the animals in the area designated. No attempt to indicate number of animals has been made. Below are listed, by number, the sources of information.

1. Klockmann (1959a)
2. Sutton (1959); Merriam (1890)
3. Arvish (1958); Oliver (1959); Pengelly (1958); Seton (1927)
4. Dwinelle (1959)
5. Klehm (1958)
6. Dwinelle (1959)
7. McBride (1959); Stannard (1936)
8. Pengelly (1960)
9. Ernst (1959)
10. Ernst (1959)
11. Merriam (1890)
12. This occurrence is presumed on basis of the place name, "Caribou Creek," in St. Joe National Forest. Time of naming is unknown.
13. Malouf (unpublished field notes)
14. Cooper (1868)

ALBERTA

GLACIER NATIONAL PARK

N. Fork Flathead R.

Kalispell

MONTANA

IDAHO

WASHINGTON

Spokane

Coeur d'Alene R.

Flathead R.

Clark Fork R.

Priest Lake and River

Kootenai R.

Yak R.

Pend Oreille R.

St. Joe R.

Missoula

1

4

5

3

7

Bull R.

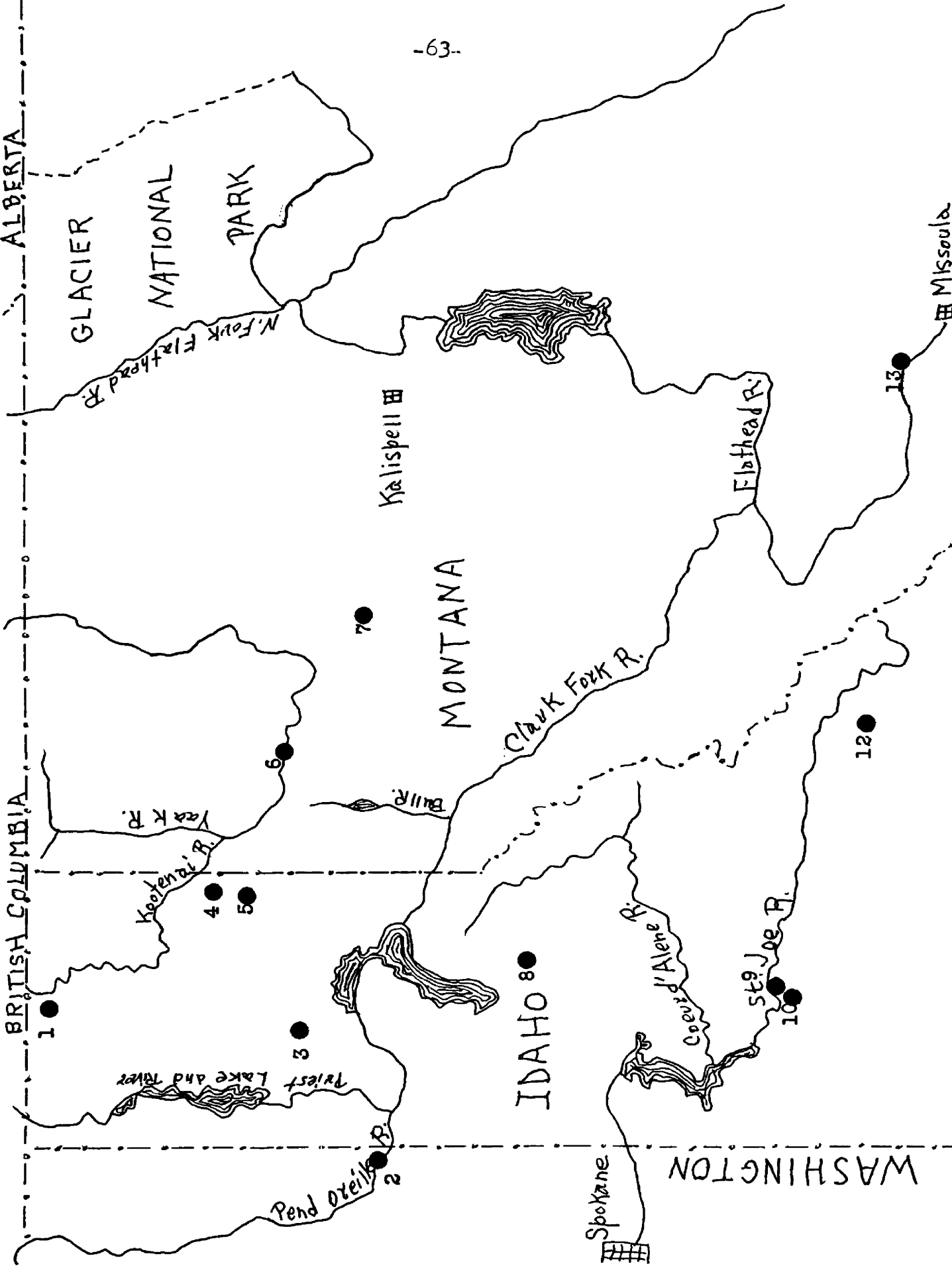
6

12

10

13

14



North Fork of Clearwater River (Table IV) would indicate the animals inhabited that area. Otto Ernst (1959) spoke of having killed one on his property on the St. Joe River in 1887, and said that there were "supposed to be quite a few of them about ten miles south of my homestead."

Ben Jensen, an early resident, related (Pengelly, 1960) that caribou were around the present site of McGee Ranger Station in about 1900. This is the only known record of caribou in what is now the Coeur d'Alene National Forest. Mining activity in Shoshone County, Idaho, may well have influenced their decline before that time.

A long-time resident, for fifty-one years, of Newport, Washington, at the Idaho-Washington line, said that he had been told of caribou crossing the Pend Oreille River at Indian Island (Sutton, 1959). And Merriam (1890) quoted from Field and Stream that a hunter named Linsley and his partner killed twenty-five caribou on the Pend Oreille River during the winter of 1888-89. Seton (1927) also tells of caribou skins taken by the Indians a few miles north of the Pend Oreille River in Idaho before 1900. Caribou were hunted on Bald Mountain eight miles northwest of Sandpoint in the late 1800's (Arvish, 1958) and caribou antlers have been unearthed near the mouth of Sand Creek (Pengelly, 1958) and Colburn Creek (Oliver, 1959).

Klockmann (1959a) told of one of the prospectors living all winter on caribou meat in the area near the Canadian line on the eastern spur of the Selkirks sometime near the turn of the century.

Just west of Leonia, Idaho, several caribou were killed by meat hunters in the late 1890's and the carcasses were not utilized (Dwinelle, 1959). Quite near this area a trapper named Roberts told of killing several caribou in the upper Callahan Creek drainage (Klehm, 1958), and a tributary of this stream is named Caribou Creek (Table IV).

Early caribou occurrences in Montana include caribou sign seen on Flower Creek at the present site of Libby on the Kootenai River; these were reported by a George Blackwell, Sr. who came to Libby in 1887 (Dwinelle, 1959). It is said that Indians killed the caribou in the Fisher River country after the buffalo were exterminated (McBride, 1959), and in a letter dated 1936 a Kalispell resident wrote of having a mounted caribou head that had come from about twenty-five miles west of Kalispell some forty-five years previously (Stannard, 1936).

An aged Indian reported (Malouf, 1959) having thought he saw a caribou near Fish Creek, which is near the town of Alberton, Montana.

It will be noted here that no caribou have been reported prior to 1900 from the North Fork of the Flathead

River area, which includes both Glacier National Park and the Whitefish Range in the upper section of the Flathead National Forest. The reason seems apparent, since a long acquaintance with that area has not revealed any person who knew the area until the second decade of the present century.

It is fitting to summarize that caribou once occurred over a wide area of northern Idaho and western Montana. If they ever had a wide range in northeastern Washington, and one could rather safely assume that they did have, time has obscured the records. However, this investigation did not reveal early residents in that area to the extent that they were found in Montana and Idaho.

As a prelude to decreased caribou activity in the first decade of the twentieth century, it should be noted here that the Northern Pacific Railroad was built through the mountains in the 1880's and the Great Northern Railway came through in the 1890's. In the Yaak River area of the present Kootenai National Forest in 1895, there were said to be a thousand people living at Sylvanite where the Goldflint and Keystone Mines were operating. These facts are also considered under factors associated with caribou declines (Grush, 1959).

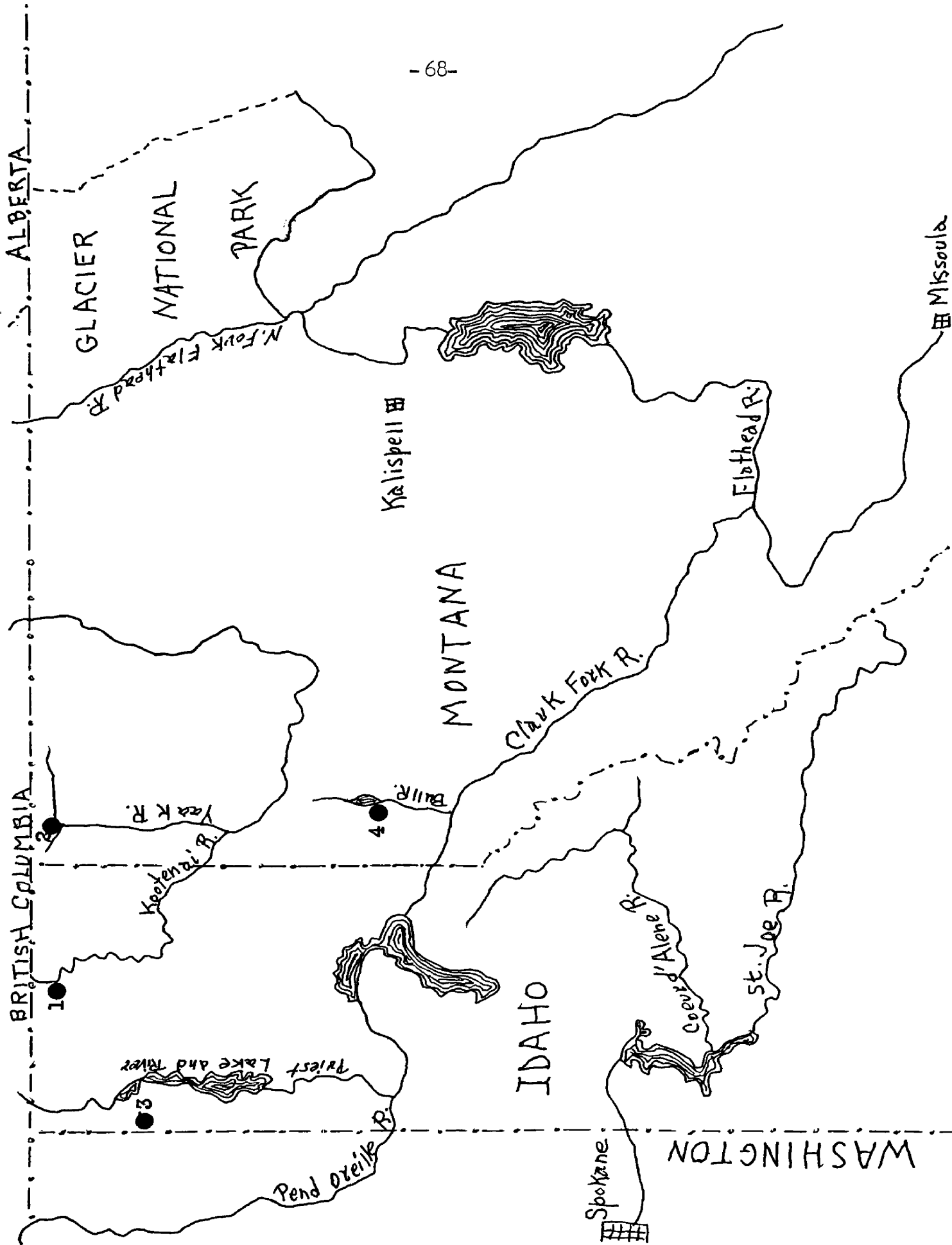
1900 through 1910. This period received the fewest documented accounts of caribou (Figure 10). Mining activity

Figure 10.

DOCUMENTED OCCURRENCES OF CARIBOU 1900 THROUGH 1910

Each numbered dot indicates caribou occurrences or substantial evidence of the animals in the area designated.

1. Klockmann (1959b)
2. Dwinelle (1959)
3. Arvish (1958)
4. Dwinelle (1959)



had begun to subside and lumbering began to play an important part in the economy of the area. The Milwaukee Railroad constructed its mountain crossing during this decade.

Caribou had now disappeared, as far as is known, from their more southern haunts. Klockmann (1959b) mentioned caribou taken for meat in the neighborhood of the Continental Mine in the mountains above Upper Priest Lake in 1903. A store was established at the foot of Priest Lake in 1906 and its proprietor still operates the establishment. He tells of Edward Moulton guiding a Mr. Meers and another man to hunt caribou in the high mountains. A mounted head taken by Meers is still in the area (Paul, 1959). Mr. Lou Whetsler reported that his father used to hunt for trophy heads in the mountains above Nordman, Idaho (Arvish, 1958). Frank Stanley, whose family homesteaded on Lower Bull Lake, between the Cabinet and Bitterroot Mountains, told of killing a caribou in their meadow (Dwinelle, 1959). A prospector, A. L. Dooley, also told Dwinelle (1959) that the caribou used to cross the Yaak River above Sylvanite. The place name of Winkum Creek (Table IV) owes its origin to an occasion when a member of a survey party killed a caribou in the upper Yaak drainage. When reporting that he had shot a caribou but that it had got away, his companions chided him and the

hunter said the animal was so close that he could see him wink. The next day the animal was found and the creek was thereafter known as Winkum Creek (Dwinelle, 1959).

The last year of this decade was characterized by serious fires which destroyed millions of acres of timber. Much caribou range was destroyed in a few days time and the future economy of many areas was seriously impaired for decades to come.

1911 through 1920. The second decade of the century was one of very great logging activity, and before its close another disastrous fire year, 1919, subtracted vast stands of virgin timber from caribou range. Sheep were grazed in the areas where the 1910 fires had destroyed the forests. Trapping was still a popular winter activity, and much homesteading occurred during the decade. It was during this decade that the North Fork of the Flathead was settled by many more people than presently live or work in the area. This was also the decade in which World War I occurred, a fact which may have taken many from the area who might otherwise be able to report on caribou occurrences.

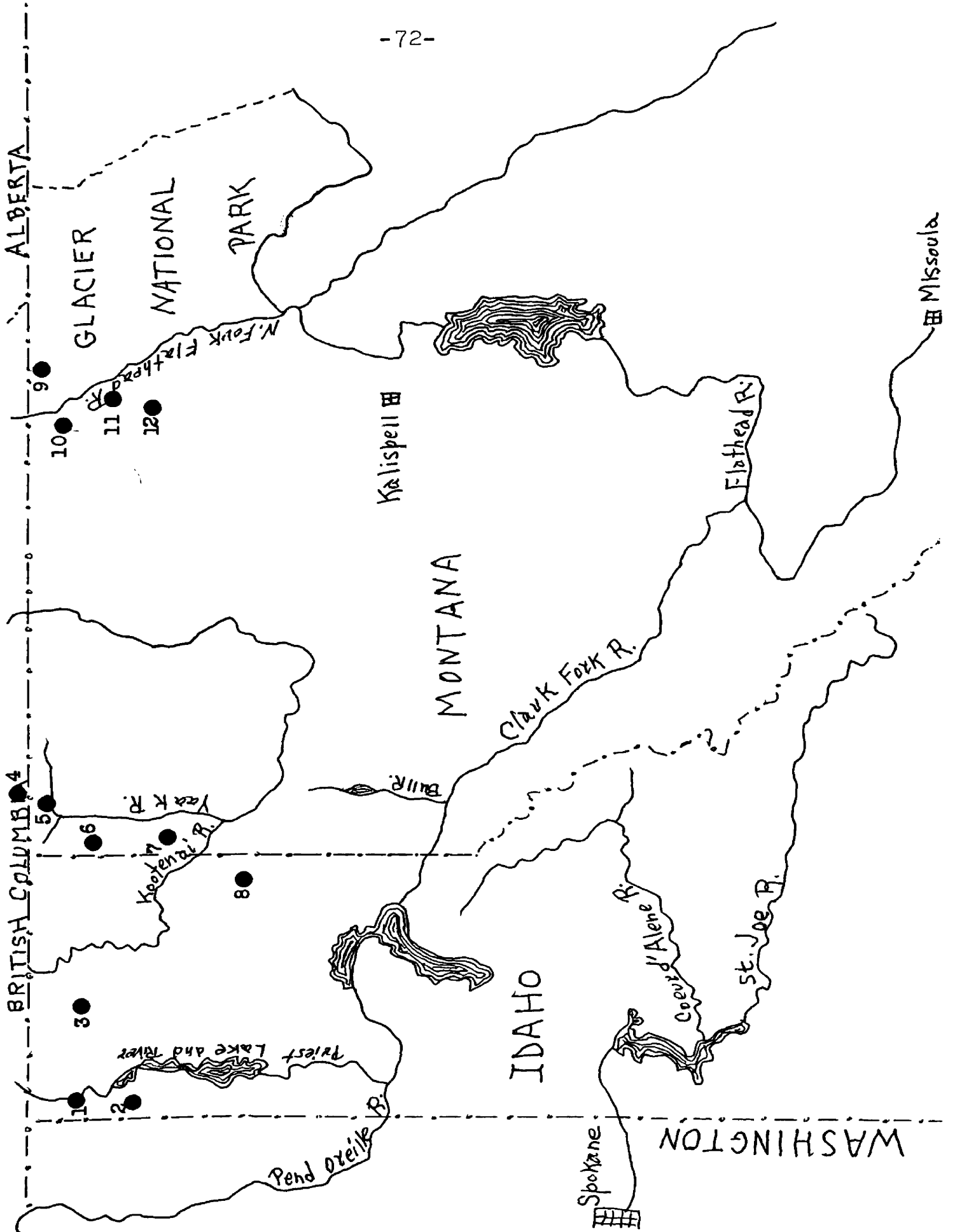
Mr. Lou Whetsler saw a band of caribou on Jackson Ridge (Figure 11) near Hughes Meadows in the western spur of the Selkirks (Arvish, 1958) and Pete Chace, reputed to

Figure 11.

DOCUMENTED OCCURRENCES OF CARIBOU 1911 THROUGH 1920

Each dot indicates caribou occurrences or substantial evidence of the animals in the area designated.

1. Arvish (1958)
2. Ahrens (1959)
3. Ahrens (1959); Grinell (1920)
4. Sanderson (1958)
5. Dwinelle (1959)
6. Sanderson (1958)
7. Dwinelle (1959); Sanderson (1958)
8. Dwinelle (1959)
9. Seton (1929)
10. Wurtz (1959)
11. Grinell (1920)
12. Wise (1959)



be one of the best and most reliable woodsmen in the Priest Lake country, who spent virtually all his life trapping the area, estimated 400 head of caribou wintered in the Granite Creek and Upper Priest River basins (Ahrens, 1959).

George Bird Grinnell wrote Vernon Bailey in 1920 that there were caribou east of the Priest Lake country. These observations are enough to verify that plenty of caribou were yet in the Selkirk Mountains, which are now embraced by the Kaniksu National Forest. It was still a roadless wilderness, and as yet had been but little damaged by fire.

Caribou still were present in the Callahan Creek drainage, for Dwinelle (1959) reported seeing five animals in 1919. This area, too, had escaped major fire damage.

The 1910 fire had destroyed a vast portion of the Kootenai National Forest, but the mountains that form a divide along the Idaho-Montana border still remained unburned. The last crossing of the Yaak River by caribou was said to be in 1915, according to the oldtimer, Gene Grush (Sanderson, 1958). Jack Baldwin, ranger at Sylvanite and homesteader in the area, said that the last crossing was in 1919 (Dwinelle, 1959), but in either case the well-established caribou crossing seems to have been last used during the decade. Caribou tracks were seen in Montana's extreme northwest corner by Dwinelle (1959) in 1920.

Adam Boyd, another homesteader and prospector, reported seeing several small herds of caribou just a mile or two

north of the international boundary between 1910 and 1913 (Sanderson, 1958).

The 1910 fire had done damage to caribou ranges in the North Fork of the Flathead valley, but here, too, caribou had survived even though they were never reported in appreciable numbers. Seton (1927) tells that guides in the area assured him that they were still seen. In 1918 or 1919 they were reported on Trail Creek (Wurtz, 1959), and Fletcher Stines, a homesteader and trapper, saw a band at the head of Coal Creek (Wise, 1959). In about 1915 one was killed on Red Meadow Creek by an old homesteader who is still living (Beebee, 1959).

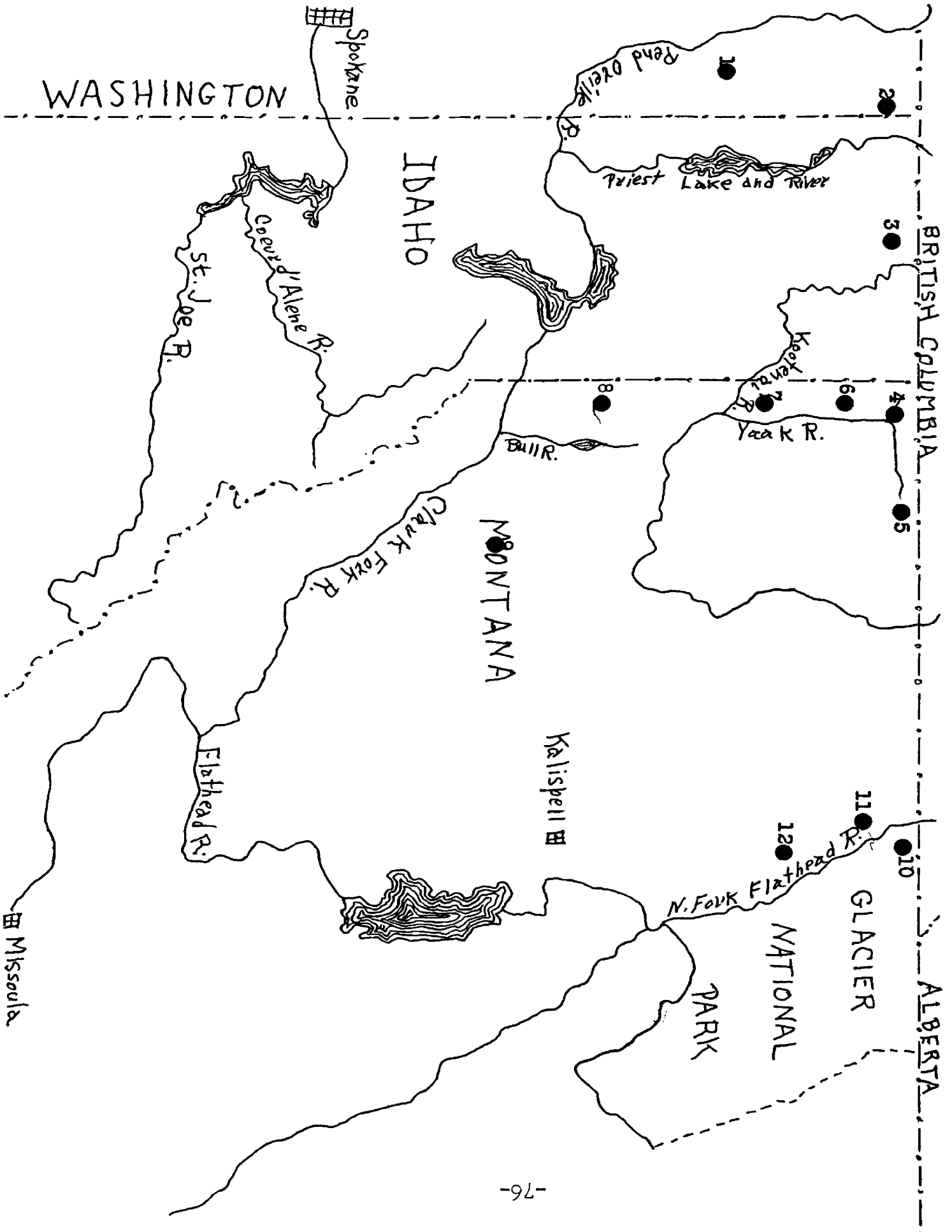
1921 through 1930. Though extensive fires resulted in further attrition of caribou range, most of the destruction was in the latter part of the third decade. Logging continued at an excessive rate, but probably tapered off some after 1922 (Klehm, 1959). Following the extensive fires of 1926 in the Kaniksu National Forest, Klehm further advises that mountain pine beetles destroyed vast stands of white pine, and then white pine blister rust was first discovered during this decade, making further depredations on all white pine timber throughout the forests of the area. These factors are treated in the section that analyzes the reasons for caribou declines. Figure 12 portrays the caribou sightings of the decade.

Figure 12.

DOCUMENTED OCCURRENCES OF CARIBOU 1921 THROUGH 1930

Each dot represents caribou occurrences or substantial evidence of the animals in the area designated.

1. Middleton (1959)
2. Nelson (1958)
3. Cornell (1959); Anderson (1938); Terrell (1959)
4. Klehm (1958)
5. Dwinelle (1959); Sanderson (1958)
6. Dwinelle (1959)
7. Dwinelle (1959)
8. Dwinelle (1959)
9. Atcheson (1960)
10. Ruhle (1930)
11. Edgar (1958)
12. Ruhle (1930)



Earl Middleton (1959) worked as a logger in north-eastern Washington in the 1920's, and recounted having seen caribou antlers and even caribou on occasion. William Nelson (1958), who trapped extensively in the northeastern section of Washington and who contributed many caribou observations in the following decades, advised that James Monroe and Bob Gray had reported them in the 1920's and 1930's.

Two Forest Service employees, G. T. Cornell (1959) and G. M. DeJarnette (Terrell, 1959), were formerly on the Kaniksu National Forest, and reported caribou antlers on Smith Creek. Anderson (1938) was assured by local residents in 1929 that there was still a band of caribou near the U. S. boundary.

In the Kootenai National Forest caribou were still to be seen. Karl Klehm (1958) reported having seen one running with several mule deer in a 1919 burn on the West Fork of the Yaak River. Dwinelle (1959) reported that a Forest Service packer had observed seven caribou on the East Fork of the Yaak in 1927 and Sanderson (1958) advised that Gene Grush picked up an antler on nearby Basin Creek. Dwinelle (1959) faithfully recorded other observations which gave reports of caribou on Little Spar Lake west of Bull Lake in about 1922, a caribou killed on Goat Mountain just north and west of Troy, Montana, in 1925, tracks on Red Top Cr. in 1926, tracks on the west side of Yaak River

from Meadow Cr. to the Canadian line on several occasions between 1920 and 1931, and he tells of picking up perhaps a dozen parts and whole antlers in a swampy place on the South Fork of Meadow Creek, and then a recently cast antler a mile below that point. Thus it is most evident that caribou continued through the third decade in the Yaak River drainage in the Kootenai National Forest.

Jack Atcheson (1960), Butte taxidermist, provided significant information whereby he knew of a person who killed two caribou, a cow and a bull, in the West Fork of the Fisher River in the Geiger Lakes area. One animal was killed in 1929 and the other in 1930. This information confirms that the animals were in an area where they had not been reported since before 1900.

In the North Fork of the Flathead River drainage a caribou was seen by Nelson in April, 1930 on Starvation Ridge, just south of the international boundary in Glacier National Park (Ruhle, 1930), and Ranger Puyear reported an eleven-inch "moose" track in the same district. It was also reported that a trapper saw fourteen caribou near Cyclone Lake; this was reported in 1929, but the date of the observation was not specified (Ruhle, 1930). Thus caribou can be affirmed to still have occupied the upper section of the Flathead National Forest and adjacent Glacier National Park through the third decade.

1931 through 1940. In the fourth decade major fire damage occurred on the Kootenai National Forest and much caribou range was destroyed. A severe economic depression probably caused many persons to engage in trapping to augment meager incomes. Logging activities were greatly reduced and poaching was probably more commonplace than usual.

Caribou were still reported in Washington. Two were killed in 1937 in the South Fork of the Salmo River (Rust, 1946), and the skins became specimens No. 264164 and No. 264165 in the National Museum (Manville, 1959). Two other animals were killed in 1940 (Dalquest, 1948). William Nelson started trapping in this decade and reported seeing two animals in 1935 at the head of Thunder Creek (Figure 13).

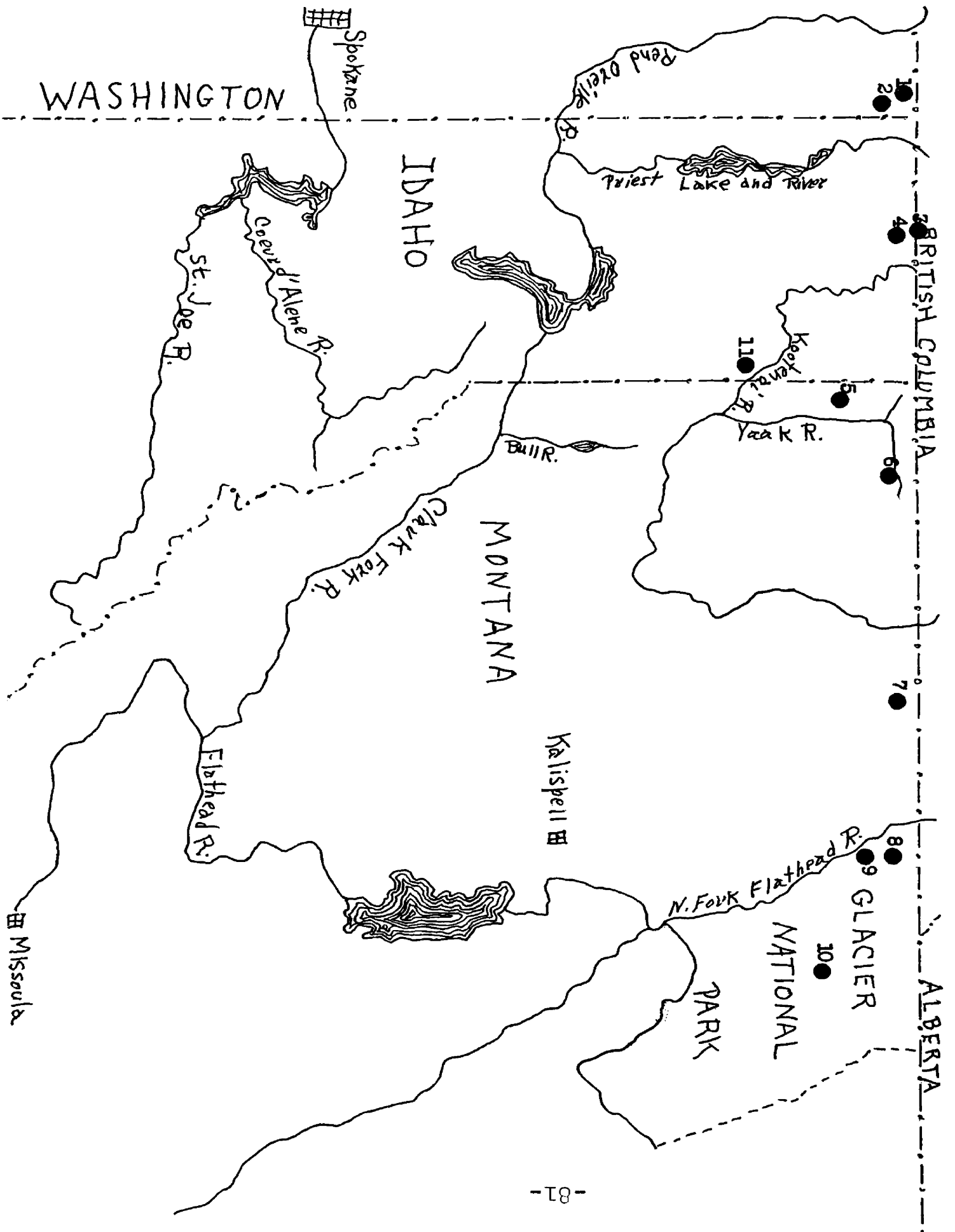
Caribou were still in the mountains around Priest Lake as evidenced by Harry Yerbury (1958), who has trapped the Boundary Creek district in Canada since 1924. They were usually in the heavy woods, but he had seen them on the ice of Boundary Lake. T. T. Terrell, a Forest Service employee, reported finding an antler in 1935 near the junction of Cow Creek and Smith Creek in the north part of the east spur of the Selkirks. The animals were obviously elsewhere in the Kaniksu National Forest, but lack of contacts has failed to show them. In 1939

Figure 13.

DOCUMENTED OCCURRENCES OF CARIBOU 1931 THROUGH 1940

Each dot represents caribou occurrences or substantial evidences of the animals in the area designated.

1. Rust (1946); Dalquest (1948); Guenther (1959); Manville (1959)
2. Nelson (1958)
3. Yerbury (1958)
4. Terrell (1959)
5. Sanderson (1958)
6. Sanderson (1958)
7. West (1958)
8. Brill (1958)
9. Anonymous (1932)
10. Anonymous (1932)
11. Ring (1959)



Ed Ring saw caribou tracks at a spring on Katka Mountain just west of the Montana line and south of the Kootenai River.

Two caribou were observed by Albert Breitenstein at the head of Hellroaring Creek, a tributary of the Yaak River in the Kootenai National Forest in 1936 (Sanderson, 1958), and Lee Jensen, a Forest Service packer, reported seeing caribou when packing on the 1931 fire.

Lloyd West (1958) of Eureka, Montana, observed a band of four caribou through the summer of 1935 when a lookout on Poorman Mountain. The animals were at the head of Phillips Creek in the Wolverine Lake area not many miles northeast of Eureka. This is the first observation obtained from this particular area. West has looked for evidence of the animals for years since.

The fourth decade continued to turn up caribou records from the North Fork of the Flathead. In Glacier National Park, Paul Schoenberger, then a park ranger, reported a caribou on his ranch on Big Prairie in 1932 (Anon., 1932). Matt Brill (1958), a homesteader, saw caribou in the bunch grass meadows on Kishenehn Creek just south of the international boundary in 1937. During the summer of 1932 three different saddle horse guides reported seeing caribou on the Highline Trail between Granite Park and Fifty Mountain Camp (Anon., 1932), just on the west side of the continental divide at or above

timberline. This is the only record of caribou ever having been in the park interior. Other sightings were restricted to the northwest section of the park.

1941 through 1950. William Nelson (1958), trapper, cited five specific instances of having seen bands of caribou in the northeast corner of Washington on upper Sullivan Cr., at Gypsy Meadows and on divides between Thunder Cr. and north of Shadroof Mt. (Figure 14).

Jack Costello (1958) recounted having seen caribou tracks in August, 1942 on Trapper Cr., above upper Priest River. Harry Yerbury (1958), Canadian trapper, advised that they were in the boundary district on the east spur of the Selkirks through the decade. Clyde Hanson (1959) saw a caribou on the divide between Smith and Boundary Creeks in 1948 while hunting mule deer. Fuller Joyce (1960), long-time employee of the Kaniksu National Forest, saw about twenty head of caribou in the last week of March, 1948, on Caribou Cr., which flows into the stream between Upper Priest and Priest Lakes. John Oliver (1959), many years a resident of the area, last saw caribou between the heads of Myrtle Creek and Pack River in 1948. Dick Lloyd (1959), while hunting, plainly saw a caribou on the east side of the summit of White Mountain north of Sandpoint, Idaho.

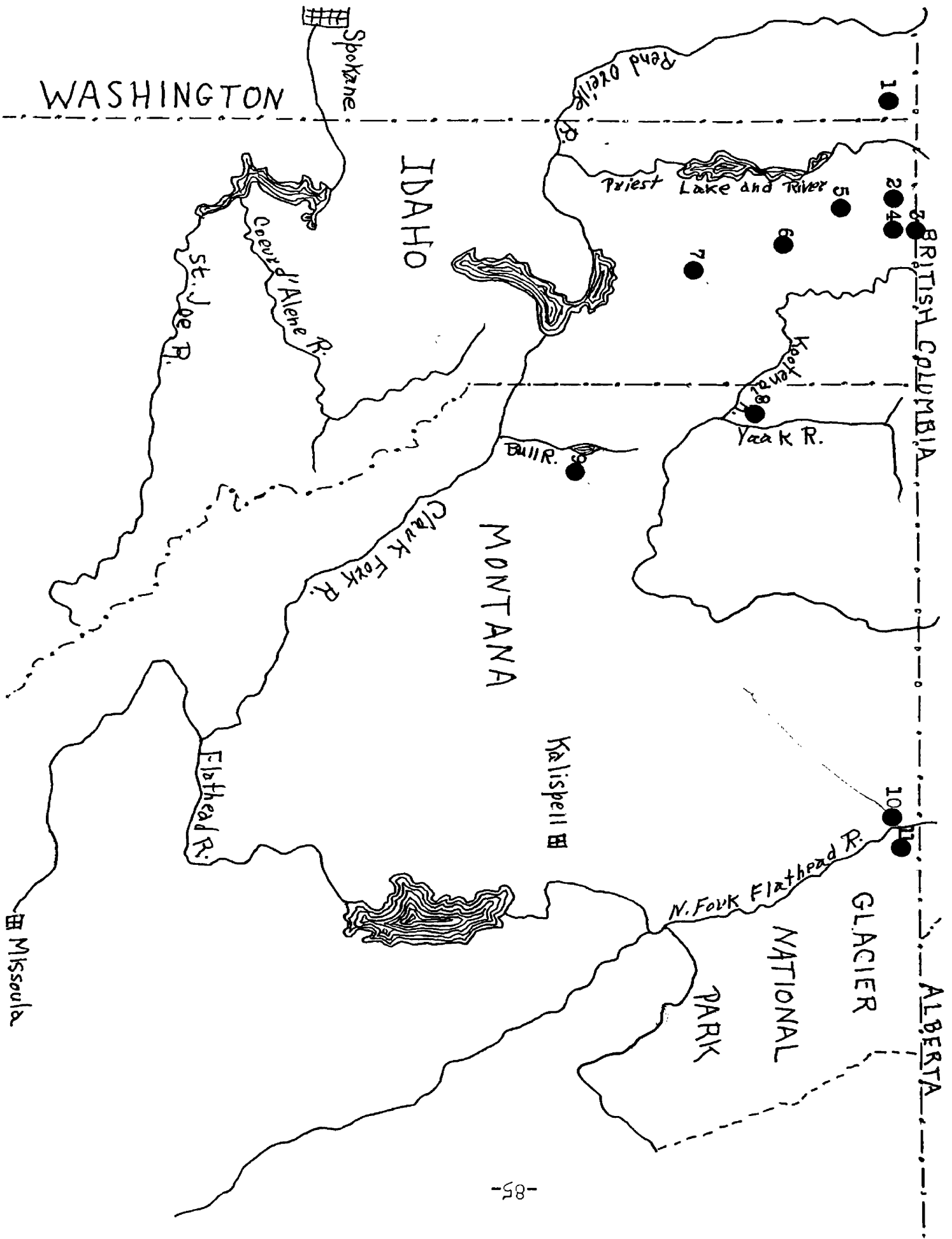
The foregoing observations again definitely establish caribou from the northwest corner of Washington in

Figure 14.

DOCUMENTED OCCURRENCES OF CARIBOU 1941 THROUGH 1950

Each dot represents caribou occurrences or substantial evidence of the animals in the area designated.

1. Nelson (1958)
2. Costello (1958)
3. Yerbury (1958)
4. Hanson (1959)
5. Joyce (1960)
6. Oliver (1959)
7. Lloyd (1959)
8. Sanderson (1958); Atcheson (1960)
9. Scribner (1958)
10. Peterson (1958)
11. Edgar (1958)



the Colville National Forest through the entire east spur of the Selkirks in the Kaniksu National Forest of Idaho.

William Lindsey, a forestry aid, in company with a former Montana game warden, counted thirty-five caribou in the vicinity of the Black Diamond Mine in the Pine Creek Flat country of the lower Yaak River in the Kootenai National Forest (Sanderson, 1958). Jack Atcheson, recalling a party who had killed two bull caribou in the Yaak country, believes the incident occurred in the 1940's. Caribou, then, had survived another decade in the Kootenai National Forest.

Charles Scribner (1958), retired Forest Service official, in company with another person, in 1944 or 1945, counted eleven caribou on the north side of Dad Peak, which is about six miles southeast of Bull Lake in the southern end of the Cabinet Mountains Wild Area. This mountain is now in the southern part of the Kaniksu National Forest, but was formerly a portion of the Cabinet National Forest. This is not far from the area where the animals were reported killed (Atcheson, 1960) in 1929 and 1930 in the West Fork of the Fisher River. Apparently caribou had continued to occupy this remote, seldom-frequented area.

Only one report came from the North Fork of the Flathead River area during the decade (Peterson, 1958). Information was that five caribou were in the yard of

Ed Peterson one winter. Since Peterson lived in the cabin above the river during the 1940's, the observation seems securely within the fifth decade.

Observations appear to be fewer during the fifth decade, but the better economic times caused by World War II brought better employment, with probably much less trapping and frequenting of the more remote areas. Logging accelerated, but the back country was not yet heavily exploited. No fires of great extent occurred in any of the areas under consideration.

1951 to 1960. During the sixth decade fires did not exert any great damage. Either climatic factors were a force in this shift of emphasis from major fire damage, or the suppression and detection methods of the U. S. Forest Service were really effective, for no appreciable fire damage had occurred in caribou country since the 1931 fire on the Kootenai National Forest. However, wind precipitated a succession of events that would have a major effect on caribou. In 1949 severe blowdowns in the high spruce-fir forests resulted in insect infestations which were controlled by logging of many of the areas. This is discussed in more detail under factors affecting caribou declines. The logging did result in bringing more persons in contact with caribou. The bull dozer had seen such effective work during the recent war that it became a new

influence in rapid road building into the high country where caribou had enjoyed reasonable security.

During this decade caribou were reported from neither the northern Bitterroot area south of the Kootenai River in Idaho, where they had not been reported since 1939 (Ring, 1959), nor the Fisher River-Cabinet Mountains area. Logging activity in these areas may yet reveal their presence, however.

Northeastern Washington still had caribou, as testified by observations of Nelson (1958) and several others (Figure 15). A Forest Service employee, E. L. Young (1958) and companions saw twelve to sixteen animals on the divide between Shedroof Mountain and Snowy Top on October 5, 1958. A Boy Scout picked up an antler in the Salmo drainage (Sholes, 1954), and two caribou were illegally killed in 1951 (Guenther 1959). Caribou were seen and photographed around a logging operation just west of the Idaho line in December, 1959.

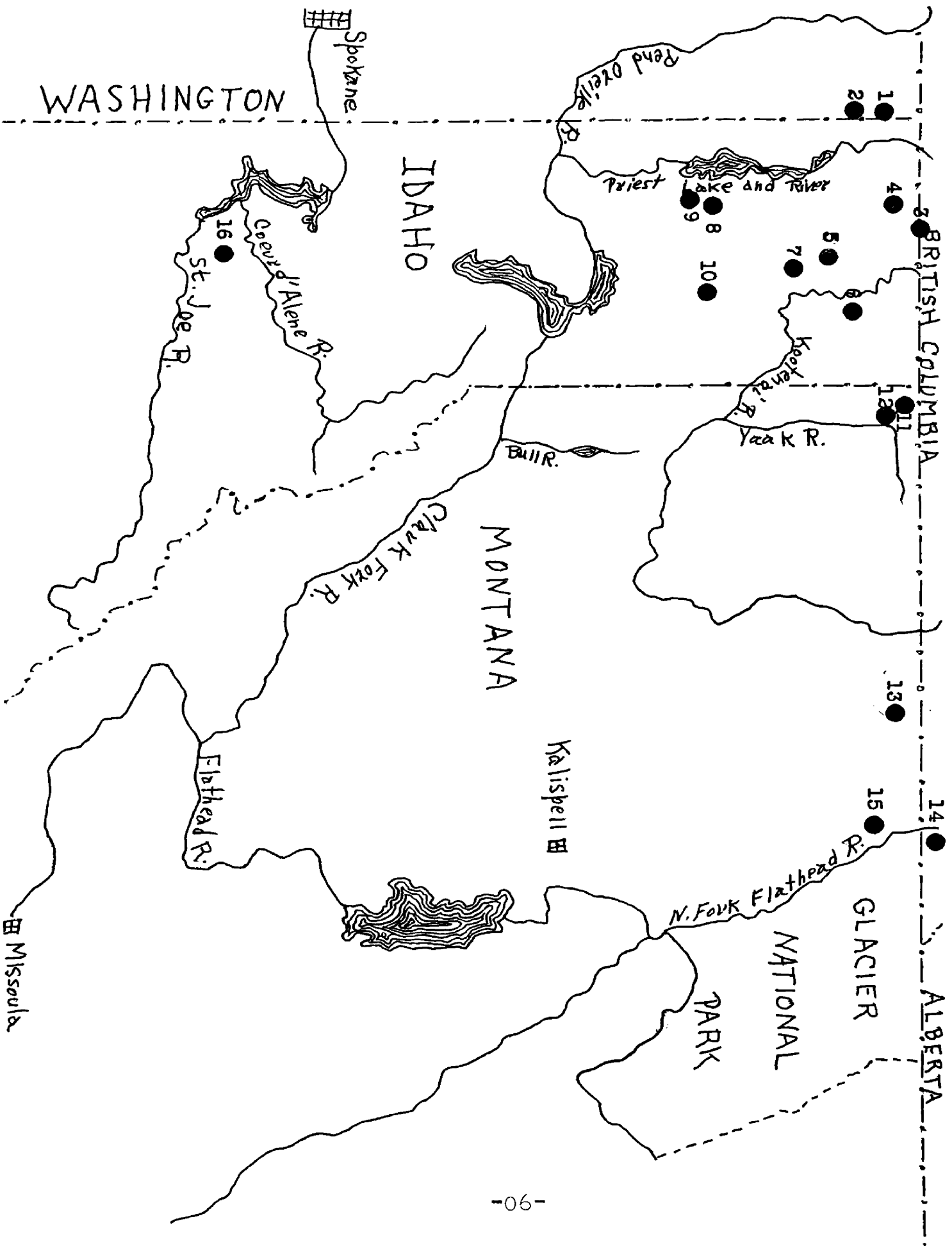
In the contiguous area of Idaho caribou still occurred. Pat Lynch is engaged in logging in the northern end of the eastern spur of the Selkirks and he has seen the animals for six years. He advises that no one believed him when he reported seeing them. These animals were observed in this study on November 1, 1958, when eleven head were seen and on October 31, 1959 when eight animals were observed. Many persons have observed the

Figure 15.

DOCUMENTED OCCURRENCES OF CARIBOU BETWEEN 1951 AND 1960

Each dot represents caribou occurrences or substantial evidence of the animals in the area designated.

1. Nelson (1958); Young (1958); Sholes (1954); Guenther (1959)
2. Guenther (1959)
3. Yerbury (1958)
4. Lynch (1958); Koppang (1959)
5. Flory (1958)
6. Hawks (1958)
7. Gill (1959)
8. Richards (1958)
9. McBride (1959)
10. Eichwald (1959); Pengelly (1958)
11. Sanderson (1958)
12. Norman (1959); Reedy (1960)
13. Dow (1957); Navratil (1959)
14. McDougall (1959)
15. Wurtz (1958)
16. Belle (1959); Pourett (1959)



caribou in the area where spruce was logged on Rock Creek on the west side of Continental Mountain. They have been observed many times by the local game warden and his friends. Milt Koppang (1959) also reported caribou in an adjacent area when he was engaged in a winter trap-tree program for the control of spruce bark beetles.

Lyle Plett (1959) observed tracks at the head of Smith Cr. Alvin Flory (1958), a Forest Service employee, reported a caribou seen on October 2, 1958 by his brush-burning crew on Myrtle Creek. That they are found farther south in the Kaniksu is proven by other observations. Richards (1958) saw one on a ridge between Cougar and Hunt Creek, a Mr. Cochran saw one in the Ruby Creek drainage in November, 1957 (Gill, 1959) and Art Trenkle saw one of a band of unknown number east of Chase Lake, which is south of Priest Lake (McBride, 1959).

The caribou likely cross the broad valley of the Kootenai River occasionally, for Roy Hawks (1958) and his wife saw one on the Rock Cr., which is south of Porthill, Idaho, near Christmas in 1956.

In the northeast corner of the Kaniksu National Forest a caribou carcass was found on American Creek, according to Sanderson (1958). A logger, Charles Norman (1959), saw a caribou on the Spread Cr., which flows into the Yaak River, in the fall of 1956. Stanley Reedy (1960), in a letter to Jack Atcheson, advises that some of the

logging crews "have seen three or four at different times," and this is taken to mean in the current decade. But the status of caribou in the Kootenai National Forest has seriously deteriorated with the advent of logging in the spruce timber following the bark beetle epidemic and the great fire of 1931.

In the spring of 1956 Chet Anderson, game warden, was said to have seen tracks on upper Wigwam Creek about twelve miles northeast of Eureka (Dow, 1957). Ted Navratil (1959), Kootenai Forest employee, told of a snow measurement trip that spring and of seeing tracks in nine feet of snow on a ridge between Blue Bird Basin and leading into the Wigwam drainage. Apparently his companion had been Anderson. No caribou had been reported in this area since West (1958) had reported the animals in 1935. Mountainous area here is continuous with the Whitefish Range which leads into the North Fork of the Flathead River. Wandering animals of one area might well reach the other area.

A reliable report of caribou came from the North Fork of the Flathead in December, 1956 (Wurtz, 1958), where an animal was observed by a logger. Joe McDougall (1959), hunting guide who lives on Sage Cr. just a few miles above the Canadian border, recounts having seen caribou tracks in the valley above his place in the North Fork valley. He said that he saw a single set of tracks in 1956, tracks of two animals in 1957 and tracks of three

animals in 1958, but none in 1959. McDougall lived in the Canadian bush and says he knows caribou tracks very well. So it seems that a few itinerant caribou still frequent the Flathead's North Fork in the sixth decade.

The most surprising item of the decade came from reliable reports that caribou were seen in the St. Joe River drainage where no specific occurrence of caribou had been reported since before 1900! On Streit Cr., just five miles from St. Maries, Idaho, caribou were reported by two people. Ernie Belle (1959), an oldtimer, saw a caribou in May, 1955; the following winter he saw two caribou on one occasion and three on another occasion. Dan Pourett (1959), who, like Belle, had been in the area for half a century, also saw a caribou just across the road when it was standing by his mail box. It was one of the same winters when Belle had observed caribou.

The St. Joe occurrence is encouraging, for it most likely means that wandering caribou will possibly continue to wander and make contact with environment of sufficiently mature forests to sustain them in areas where they have been excluded for decades. It does not seem likely that caribou have remained in the St. Joe area for over half a century without being observed. Wandering the ridges, the animals might have traveled from the Kootenai River country to the north or might have come from the Cabinet

Mountains. Extensive elk hunting in many parts of the St. Joe National Forest may imperil the animals if they remain in the area.

Caribou have been intermittently carried on game inventories for Washington, Idaho and Montana by both the U. S. Fish and Wildlife Service and the U. S. Forest Service. Some Forest Service figures were said to have been biased by one regional official who tended to discount reports of caribou. The discrepancies of the numbers given by these two agencies is apparent in Table V. The only conclusion that can be reached is that all the figures given were random guesses and that no census techniques were ever employed to arrive at the numbers given.

In Recent Mammals of Idaho, Davis (1939) states that caribou probably still occurred in small numbers in the Nez Perce National Forest. He cited Adams (1926) as saying that "as late as 1925 a small band of ten was found in the Nez Perce National Forest." In reality, Adams listed the animals under the Pend Oreille National Forest (since consolidated with the Kaniksu National Forest), and Davis erred in reading the table of estimates. Unfortunately Davis has been quoted by several other authors, so the error has persisted.

Current populations. It is doubted that there are today over a hundred animals in all of northwestern United

TABLE V

COMPARATIVE SUMMARIES OF CARIBOU ESTIMATES FROM THREE SEPARATE SOURCES

State									
Washing- ton			Montana			Idaho			Year
Source			Source			Source			Year
A	B	C	A	B	C	A	B	C	
0				30			0		1919
0				30			0		1920
10	0		25	25		0	0		1921
10	0		30	30		0	0		1922
0	0		20	20		0	0		1923
0	20		20	20		0	0		1924
0	52		20	20		68	0		1925
101				6			0		1926
2				-			0		1927
2				5			0		1928
21				-			0		1929
0				-			0		1930
0				3			8		1931
0				3			0		1932
0				10			0		1933
0				6			0		1934
0				8			0		1935
0				-			0		1936
0				-			0		1937
0				-			0		1938
10				-			0		1939
10				-			0		1940
10				-			0		1941
10				-			10		1942
10				-			10		1943
15				4			12		1944
15				4			10		1945
15	15	-		0		10	10		1946
-	15	15		0		10	10		1947
10	15	15		0		20	10		1948
15	15	-		0		20	10		1949
12	12	-		0		25	0		1950
-	12	-		0		25	0		1951
-	12	-		0		35	0		1952
10	20	-		0		35	0		1953
10	20	-		0		25	0		1954
10	10	-		0		25	0		1955
10	10	-		0		100	0		1956
10	10	-		0		125	75		1957
10	10	-		0			125		1958

Sources

A - Figures from U. S. Fish & Wildlife Service Leaflets (Young, 1958).

B - Cumulative Summary of Big Game Animals on the National Forests (Adams, 1926).

C - Summary of Estimates of Big Game Animals as recorded by Northern Regional Office of U. S. Forest Service.

States and certainly most of these, whatever their number, occur in the Selkirk Mountains of the Kaniksu National Forest of northern Idaho.

Individuals engaged in any caribou study are primarily restricted to trails and roads which are few considering the area's size. The terrain is rugged and the winter climate is cold and frequently erratic, making mechanized snow equipment difficult to use. In addition to these discouraging factors, the caribou are among the most elusive of creatures; they range more widely than other animals and they occupy remote and comparatively inaccessible habitat. Thus, sampling techniques for determining population over a large area are of little value.

Cringan (1958) assigned a carrying capacity of one woodland caribou per ten square miles to forests 91 to 150 years of age, and one caribou per five square miles to older forests. The remaining unburned and unlogged portions of the Kaniksu National Forest that are continuously connected comprise about 590 square miles. Deleting twenty per cent of this total as being unsuited for caribou would leave 472 square miles. If Cringan's higher assigned carrying capacity is then used, a carrying capacity of 94 animals is computed. This figure may be somewhere near the present population level.

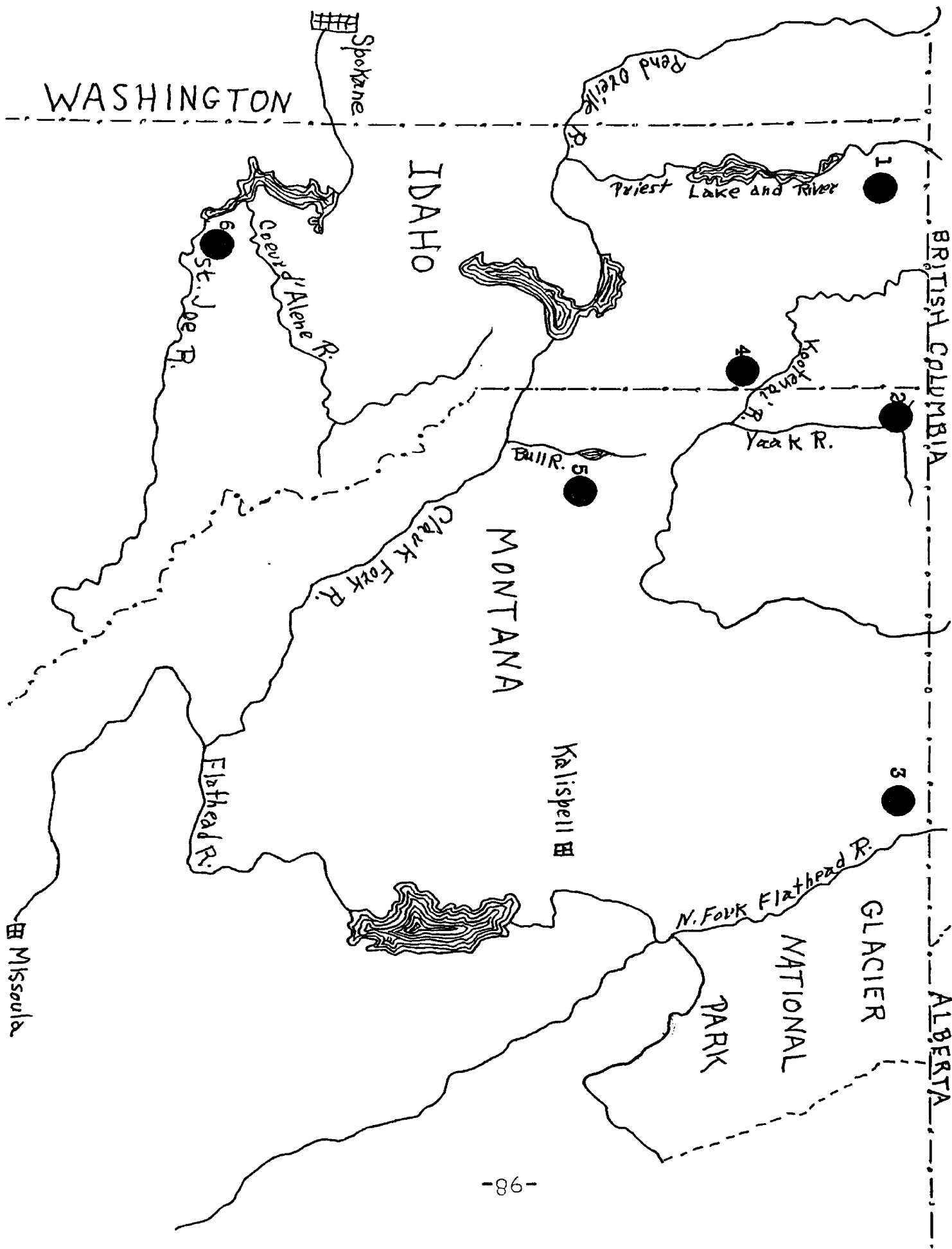
The areas in which caribou are either known to occur or are most likely to occur are shown in Figure 16. These areas have been deduced from studying Figures 9 through 15.

Figure 16

AREAS IN WHICH CARIBOU PRESENTLY OCCUR OR ARE CONSIDERED MOST LIKELY TO OCCUR

The dots indicate general areas described below.

1. The Selkirk Mountains of northern Idaho, adjacent Washington and British Columbia. Animals are currently present here.
2. The Purcell and Yaak Ranges of the Kootenai National Forest. A few remnant animals are thought to occur here.
3. The Whitefish Mountains of Flathead National Forest, adjacent Glacier National Park and adjacent British Columbia. A few remnant animals are thought to occur here.
4. The northern Cabinet Mountains of Idaho, lying south of the Kootenai River and close to the Montana boundary. In this portion of the Kaniksu and adjacent Kootenai National Forest caribou may possibly be occasionally encountered.
5. The Cabinet Mountains Wild Area of the Kootenai and Kaniksu National Forests may yet contain a few caribou among the wild, seldom-frequented peaks.
6. The St. Joe Mountains of the St. Joe National Forest may occasion reports of caribou, but little continuous range is thought to exist.



FACTORS ASSOCIATED WITH CARIBOU DECLINES IN NORTHWESTERN
UNITED STATES

For reasons of perspective, comparisons and aids to insight, the factors associated with caribou declines in eastern and midwestern United States are here reviewed. The studies of those declines and that of northwestern United States differ in a vantage point of time. The historical events of the Northwest are perhaps better documented than those of other sections and certainly, since they are of more recent occurrence, many of them are more within the grasp of memory of persons still living.

The history of caribou in all formerly occupied ranges in the United States is poorly recorded, but it is definitely a history of decline and disappearance. They were observed principally by trappers, prospectors, settlers and woodsmen--men whose pursuits seldom contributed to the written records of history. Seton (1927) has documented references to their former abundance and many instances of their decline as evidenced by reports of last sightings of the animals in various areas. Cringan (1957) has assembled other historical material concerning their decline.

In the eastern states general disappearance had occurred before 1900 as has been noted. In the midwestern lake states their disappearance was somewhat later. The same chronology should be noted in the settling of the two areas with forest exploitation and fires following in the wake of settlement.

In establishing the factors associated with woodland caribou decline in the East and Midwest, Cringan (1957) eliminated climate as a factor, and he further discarded disease, parasitism and predation as factors influencing decimation. He was unable to establish emigration of the animals as a force in their disappearance, but noted that disappearance of caribou coincided with rises in the deer and moose populations. The rise of moose and deer populations clearly indicated an increase in their habitat which was the result of changes in ecological conditions.

Woodland caribou declined markedly after human settlement of the general areas in which they occurred. Hunting and predation are most commonly attributed by the public as the cause for diminution of game animal populations, but actually habitat destruction is usually the principal cause for animal declines. It is true that caribou are more vulnerable to hunting than are other big game animals, and just what part it played in caribou declines may never be fully ascertained. Cringan (1957) favors habitat destruction as the principal eliminating

force, and certainly habitat destruction would have been a decisive factor in eliminating caribou whether hunting had previously affected the populations or not. Final declines in Nova Scotia were coincident with severe reduction of virgin forest habitat, and in Ontario there was a relationship between caribou populations and the amount of remaining mature forest. Thus it may be clearly stated that habitat destruction prevents the continuance of caribou populations even though it does not preclude that hunting may have been a major force in their elimination from native ranges before habitat was destroyed.

Factors associated with caribou declines in northwestern United States are treated under the categories of climate, predation, disease and parasitism, faunal competition, domestic grazing, hunting and habitat destruction. Cringan's treatment of factors associated with caribou decline in the East and Midwest are similarly categorized. The subject of hunting in this study is the basis for conclusions that vary with those of Cringan.

Climate. Even though warming trends have been established (Russell, 1941), the continued natural maintenance of vegetational climaxes in areas undisturbed by man and fire was considered as convincing enough evidence that climate has not been a factor in eliminating caribou. Climate, of course, may effect the frequency and extent

and intensity of fires, but fire has been a force since long before the advent of European man. The existence of seral species associated with natural reforestation following fires led to the conclusion that fire originally occurred in regions occupied by caribou. While fires would have temporarily excluded caribou, the animals would have again extended their range to include the area when it reached climax conditions. Climate, then, is herewith discarded as a factor influencing the general withdrawal of caribou.

Predation. The relatively low fecundity rate of caribou would appear to indicate relatively low predation under natural conditions. Wolves still occur in limited numbers along the international boundary, but it would be generally agreed that their numbers are more limited. Grizzlies are virtually extinct in Idaho, eastern Washington and much of the Montana area occupied by caribou, but they are present in fair numbers in the Whitefish range and in adjacent Glacier National Park. It is doubted that either wolves or grizzlies make serious inroads on caribou numbers. Cougars might also prey on caribou, but no evidences have been found in literature nor have coyotes been accused of this function. Predation, therefore, does not appear to have been an important factor in caribou declines in northwestern United States.

Disease and parasitism. Very few data are available on diseases and parasites of mountain caribou. Cowan (1951) reported the occurrence of nose bots which may cause coughing and debilitation. Also a pin worm is known to inhabit the caeca of mountain caribou; warble flies parasitize them, and two species of Cysticercus cause "measles." Caribou feces were collected in October, 1958, in the Rock Creek area of the eastern spur of the Selkirk Mountains, but yielded only soil nematodes, for the specimens were probably a week or more old. Fresh caribou feces were collected in the same area on October 31, 1959, and were analyzed for parasitic nematodes by Don Forester, graduate student at Montana State University. Two of the samples were found to be negative but a third was found to be positive and indicated a mild infection of lung worm. The larvae were then examined by Professor James R. Adams, University of British Columbia, and were thought to closely resemble those of Muellerius minutissimus, the sheep lung worm.

In the absence of more complete data, and with no facts to indicate unhealthy animals, disease and parasitism were likewise not considered to be likely factors in having caused caribou declines in northwestern United States.

Faunal competition. White-tailed deer, mule deer, and elk are considered to be generally more abundant than

in former times, and this fact is conceded as indicating changed ecological conditions which have resulted from extensive deforestation through logging and fire. In its normal environmental niche of mature forests there is no competition between these animals and caribou; Cringan (1957) reaches the same conclusion regarding caribou declines elsewhere. He also discards emigration as a factor in caribou disappearance. In the Northwest there is nothing to indicate either faunal competition or emigration of caribou as factors in their general decline through time.

Domestic grazing. Following severe fires in the several national forests, domestic sheep were herded to utilize the increased growth of annuals. The extent of the sheep grazing was rather enormous, reaching 45,000 animal months on the Flathead National Forest in 1935, 37,000 animal months on the Kootenai National Forest in 1930, 64,000 animal months on the Kaniksu National Forest in 1935, 39,000 animal months on the Pend Oreille National Forest (later consolidated with the Kaniksu) in 1933, 63,000 animal months on the Cabinet National Forest (later divided between Kaniksu, Kootenai and Lolo) in 1934 and 1935, and 139,000 animal months on the St. Joe National Forest in 1938. These figures would indicate extremely heavy animal use of forage; however, for the most part the

domestic sheep utilized forbs and grasses that had replaced trees. It must be considered, too, that sheep outfits often went to the high country where there was abundant grass and water. Presently sheep grazing has declined so as to become almost nonexistent.

Hunting. While hunting is not generally regarded by wildlife scientists as an exterminating force for big game animals, there are some exceptions, among which is the over-harvest of barren-ground caribou, which have led to serious declines. It must be borne in mind that caribou would have been exceedingly vulnerable to hunting, since they are gregarious, since they are so intensely nomadic, and since they are so very docile and curious that a whole band might be easily killed. These traits are most uncharacteristic of other big game animals. Several human forces must be considered to have exerted considerable hunting pressure on caribou.

Hunting by trappers must have been quite frequent in the winter and hunting by prospectors must have kept up the pressure in the summer. Increased hunting by Indians when the buffalo were exterminated would have had a telling effect. The sheep herders have been known to kill caribou (Grush, 1959) and they often occupied caribou summer habitat.

While literature on the subject is wanting, market hunting, for the several railroads that were built through

caribou habitat, must have been unusually severe on all available big game. Market hunting probably also supplied the early logging camps. Hunting, too, by the loggers themselves must have accounted for the decline in numbers.

The sites of several large mining operations were in the heart of caribou country on the Yaak River before 1900 and in the Selkirk Mountains in the 1920's. The only fresh meat available in early times would have been game, and caribou would have been sought since they could be found in groups.

There is much reason to believe that caribou are still not infrequently killed even though Idaho, Montana and Washington have laws protecting them. Cringan (1957) advises that law enforcement failed to prevent the ultimate extinction of caribou where range modifications were severely altered by man.

This study uncovered thirteen instances of caribou killings between 1929 and 1952 (Table VI), and this seems to be an impressive number of illegal kills when it is borne in mind that caribou frequent remote country where every factor is in favor of the violator.

Common observation has revealed a large number of instances of illegally taken elk, moose and deer, and there is reason to believe that caribou must be taken by loggers since these men spend much time in caribou habitat and since the animals frequent logging activities. It is not

TABLE VI

KNOWN ILLEGAL CARIBOU KILLINGS BETWEEN 1929 AND 1952

State	No.	Year	Details	Source
Washington	2	1937	Violator fined	Rust, 1946
Washington	2	1940	Violator fined	Dalquest, 1948
Washington	2	1951	Violator fined	Buechner, 1953
Washington	1	1940's	Trapper, admission	Confidential
Idaho	1	1951	Logger; not prosecuted	Eichwald, 1959
Idaho	1	1956	Unknown	Wolters, 1957
Montana	1	1929	Details not revealed	Atcheson, 1960
Montana	1	1930	Details not revealed	Atcheson, 1960
Montana	2	1940's	Details not revealed	Atcheson, 1960
Total	13	20 yrs.		

intended that loggers be indicted, but the circumstances of their employment permit poaching. Elk are not abundant in the general area where caribou occur even though much of the area is open to elk hunting. The caribou would afford an opportunity that many hunters would not decline from taking. Logging roads annually extend further into caribou range, and these roads aid in hunter distribution, for the sport of hunting has greatly deteriorated in recent years with the increase of roads (Pengelly, 1953). In one nearby area of northern Idaho the illegal takes of white-tailed deer has frequently exceeded the legal kill. So it seems safe to conclude that in a still more isolated area where opportunity to police hunting is more difficult, and since there is a general public indifference to the matter of game violations, the continued drain of caribou populations likely continues.

Hunting pressure may have been enormous and may well have eliminated caribou from some formerly occupied ranges because of the animals' particular vulnerability to hunting. This idea is further strengthened by the absence of caribou from some large areas of virgin forest where they have not been known to occur for many years. Hunting of caribou has continued from prehistoric times until the present with varying degrees of intensity and may be considered as one of the important causes of caribou decline in the Northwest.

Habitat disturbance and destruction. Major habitat disturbances alter environmental niches at the expense of the constituent animal populations. Caribou populations would have been reduced because of any extensive degradation of the climax coniferous forests that sustained them. The relatively stagnant conditions of old forests supply a continuous food source as old trees die and fall, and the meandering animals find the arboreal lichens that have been brought within their reach. Young forests do not supply this food source, and the caribou are not browsers of woody shrubs and are thus not attracted to the deciduous shrubs and trees that often become established for periods following forest destruction. Therefore, any violence that is exerted on the northern coniferous forest climax would have resulted in a similar reduction of caribou populations if those populations were at an optimum or maximum density.

Caribou habitat destruction has occurred principally through forest destruction by logging and fire. Some extensive habitat impairment has resulted from insect epidemics following fire and severe blowdowns. The following treatment attempts to appraise the extent of habitat destruction and impairment and evaluate its probable effect on caribou populations.

The influx of settlers began principally after the

Civil War. The homestead laws were made more liberal in 1911 and 1916, and this stimulated the populating of the Great Plains. This development created a gargantuan lumber market for the building of homes and barns and towns throughout the Dakotas and Montana. Railroads had made efficient delivery a reality and the luxuriant forests of western Montana and northern Idaho offered a seemingly endless supply of trees. The two northernmost counties of Idaho are Boundary and Bonner; the logging activities began here in 1904 (Klehm, 1959). The peak period of logging lasted from 1907 through 1922, a period of about fifteen years, with 1922 yielding probably the heaviest cut of the period. "Mills appeared beyond the capacity of the forests to support them, and during those early years the foothills and lowlands were heavily logged up to the present national forest boundaries," said Klehm, who came to the area in 1913 and who has been closely linked with forest administration for many years.

In 1907 Bonners Ferry had a population of about 1,200; about 300 men were employed by one sawmill and about 500 men worked in the woods in the vicinity to keep the mill in logs (Anon. 1957). Land clearing for settlement followed the logging of the major valleys, and diking of the fertile bottomlands of the Kootenai River began in 1922. Thus thousands of acres of old and mature forests were removed from caribou habitation.

A more graphic comprehension of the magnitude of the habitat disturbance can be gained by examining the figures which show the approximate locations and extent of the major fires on the Kaniksu (Figure 17), Kootenai (Figure 18) and Flathead National Forests (Figure 19) and Glacier National Park. Forest fires of 1926, 1929, 1931 and 1945 had a deleterious effect on the maintenance of a healthy lumber industry.

The pattern of forest exploitation reviewed here was that of but one general area of northern Idaho. To recite what occurred in other and contiguous areas would be a monotonous repetition and only the dates would vary slightly. Thus the moister valleys, which once exhibited forests closely resembling the rain forests of the Pacific coast, became the farmlands of today. Forest fires occurred on numerous occasions throughout the Northwest. In some of the national forests the most disastrous fire years were 1910 and 1919, but the end result was the same. The forest communities were dealt a violence which today is reflected in the economy of the region. The biota has been changed on millions of forest acres. Deer and elk abound where formerly they were relatively scarce, and this fact is a definite indication that the ecological conditions have been drastically altered.

The fires have been plotted by decade for the first forty years of the century; there were no significant forest

Figure 17.

MAJOR FIRES OF THE KANIKSU NATIONAL FOREST OF IDAHO, WASHINGTON
AND MONTANA, 1900 - 1950

Data compiled from Fire Overlay Maps, U. S. Forest Service,
Northern Region, Missoula, Montana. Base map courtesy U. S.
F. S.

Legend:



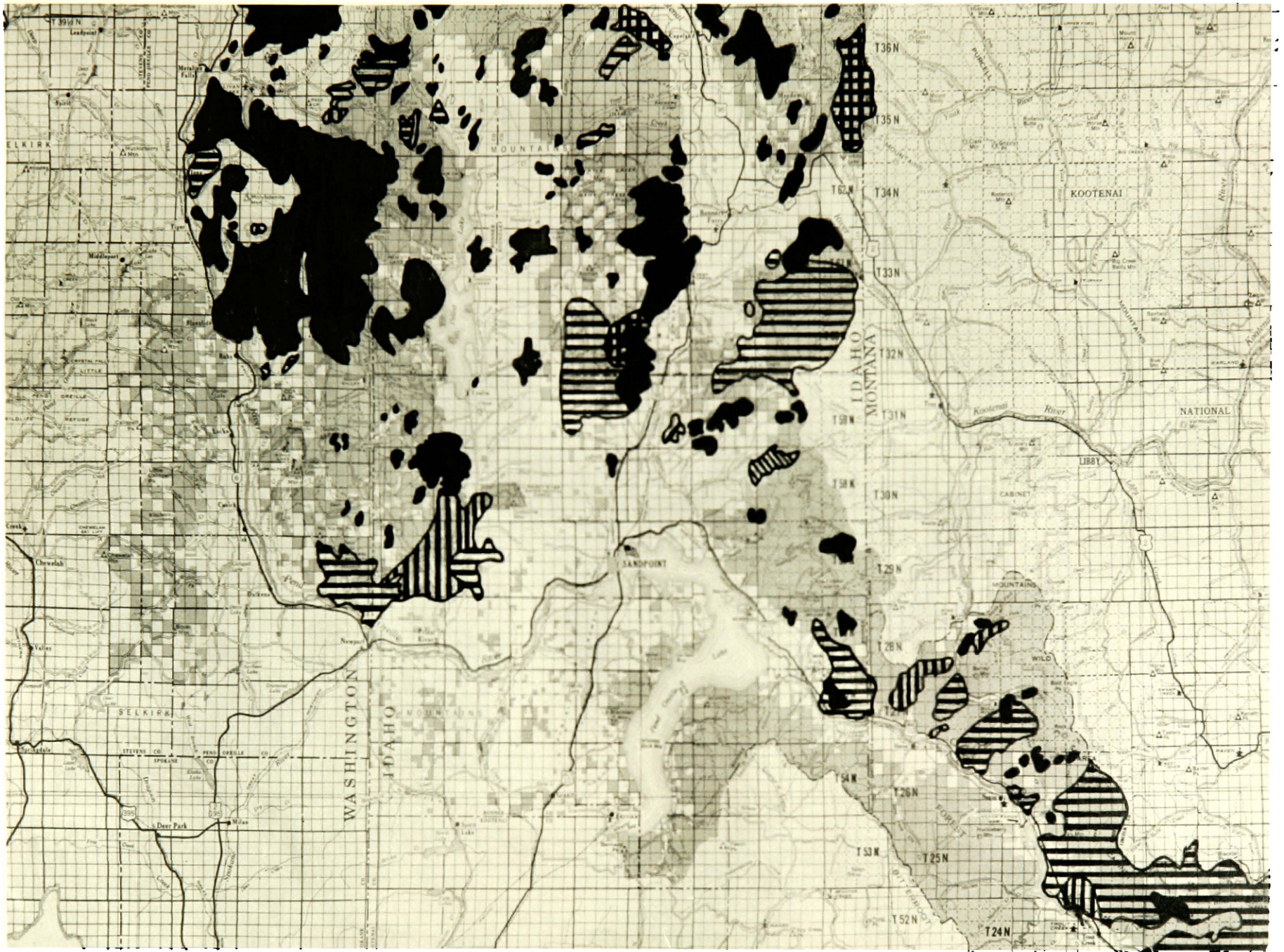
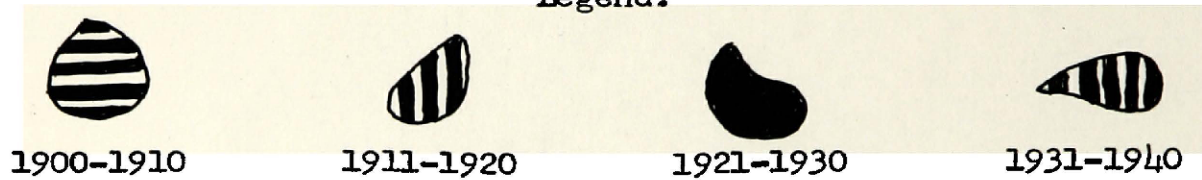


Figure 18.

MAJOR FIRES OF THE KOOTENAI NATIONAL FOREST OF IDAHO
AND MONTANA, 1900-1940

Data compiled from Fire Overlay Maps, U. S. Forest Service,
Northern Region, Missoula, Montana. Base map courtesy U. S.
F. S.

Legend:



No major fires have occurred since 1920.

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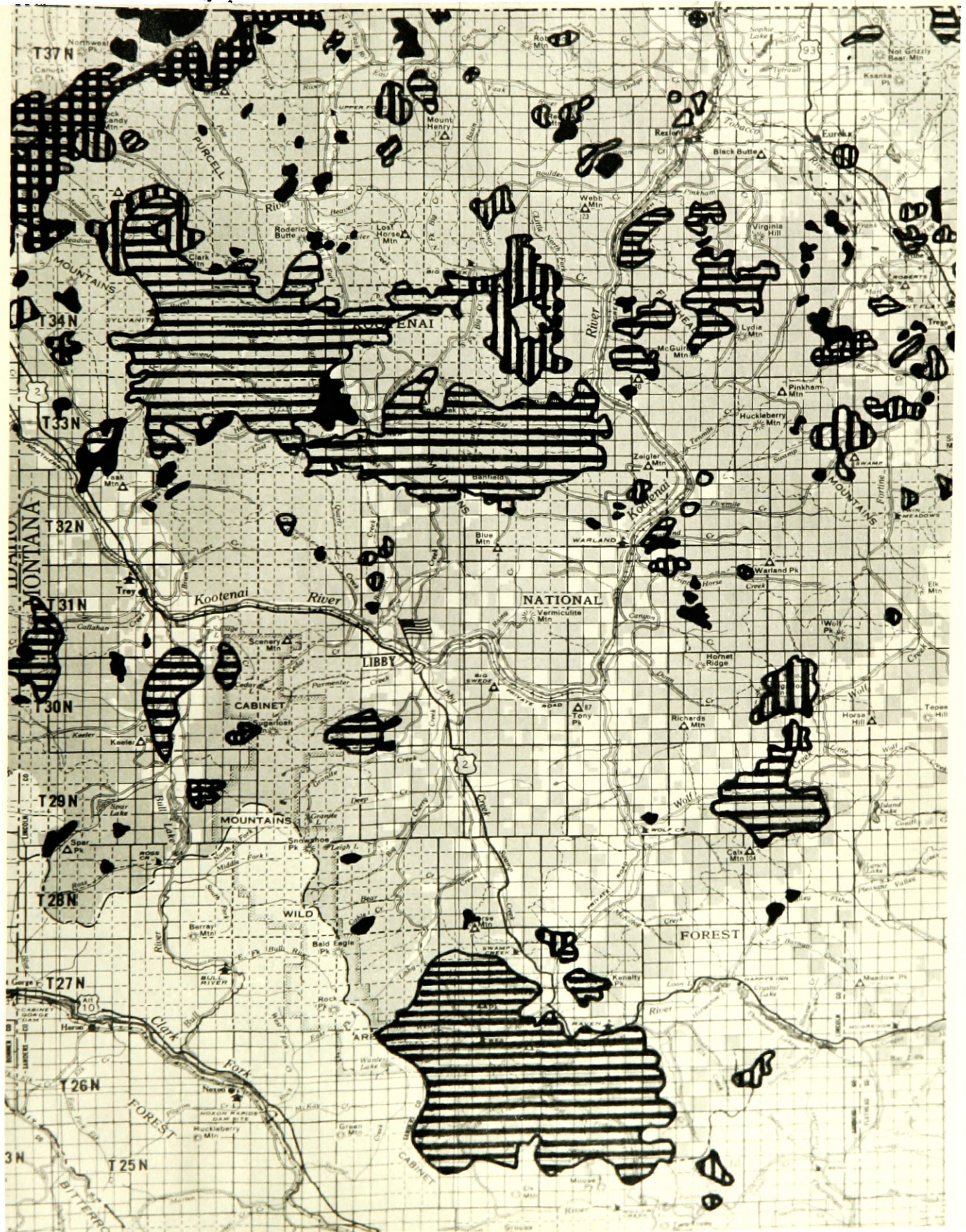


Figure 19.

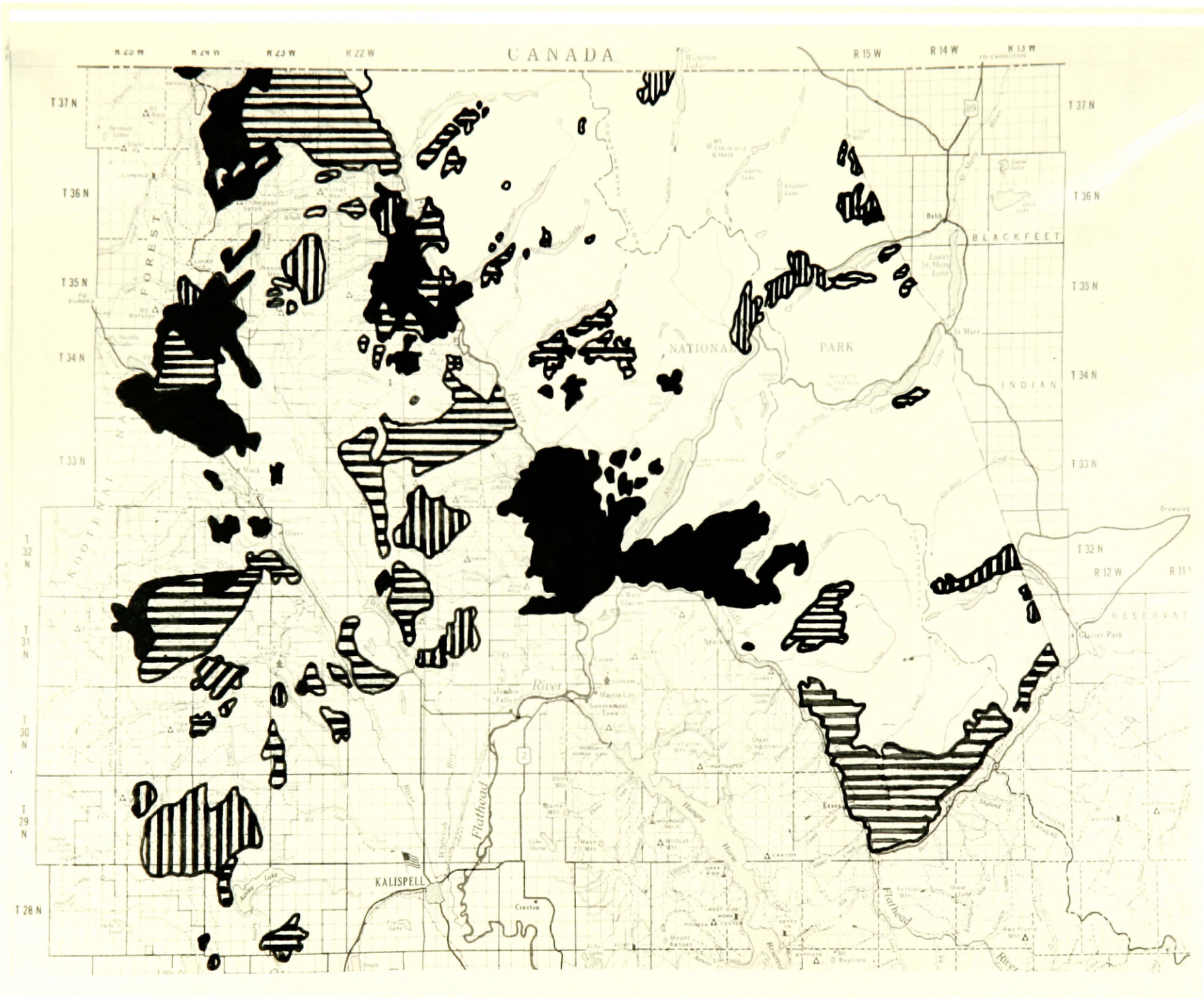
MAJOR FIRES OF THE UPPER PORTION OF FLATHEAD NATIONAL FOREST
AND GLACIER NATIONAL PARK, MONTANA, 1900-1930

Data compiled from Fire Overlay Maps, U. S. Forest Service, Northern Region, Missoula, Montana and Fire Overlay Maps, Glacier National Park, West Glacier, Montana. Base map courtesy U. S. F. S.

Legend:



No major fires have occurred since 1930.



losses from fire in the fifth and sixth decades probably because of both favorable weather factors and improved techniques in fire discovery and suppression.

The logging pattern throughout the Northwest is now quite difficult to decipher, but fortunately, the harvest pattern in the Kaniksu National Forest and adjacent areas has been mapped to show the approximate areas logged by decade from 1906 to 1959 (Figure 20). Supervisor Karl Klehm of the Kaniksu has drawn upon his memory and long familiarity with logging in Boundary and Bonner Counties in northern Idaho to provide the details. The map reveals both the magnitude and speed with which forests were destroyed during the fifty-four years. No complete records have been obtained for other areas of western Montana, eastern Washington and elsewhere in Idaho.

When the areas of the Kaniksu National Forest subtracted by fire were added to the areas subtracted by logging, the remaining climax forest was determined (Figure 21). This area appeared to be essentially the same as where caribou were reported during the 1951 to 1960 period (Figure 15). However, the large unburned and unlogged area in the southwest part of Figure 13 did not show any caribou sightings.

Natural reforestation has been generally good except where clearing was the intent and where repeated fires occurred (Klehm, 1959). However, the tree species

Figure 20.

THE APPROXIMATE LOGGING PATTERN OF THE MAIN BODY OF
THE KANIKSU NATIONAL FOREST AND ADJACENT AREAS, IDAHO,
WASHINGTON AND MONTANA, 1906 - 1959

Data from Karl A. Klehm, Forest Supervisor. Base map
courtesy U. S. F. S.

Legend:

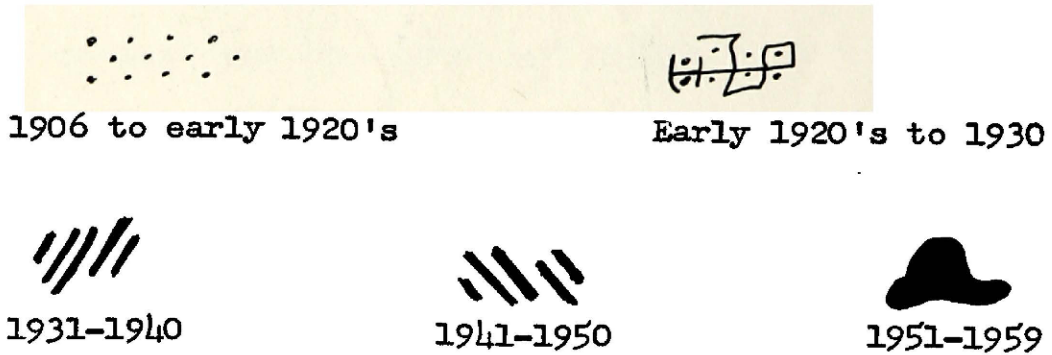




Figure 21.

APPROXIMATE LOCATION OF UNBURNED AND UNLOGGED FORESTS
IN THE MAIN PORTION OF THE KANIKSU NATIONAL FOREST

The blacked-out area indicates the principal unmolested forests of the area. However, much of this area is rocky mountain goat range and other parts are forested with drier forest communities unsuited for caribou. This figure is deduced from Figures 17 and 20. Base map courtesy U. S. F. S.

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pioneering the new forests are most often ones that grow under more xeric conditions, and the forest types associated with caribou habitation would not result simply from the maturation of these species.

Roads associated with logging and forest administration have developed continuously since 1900. During the fourth decade many roads were improved and many others constructed by the Civilian Conservation Corps. New and improved roads led to the feasibility of logging in new areas.

In many instances the forests not logged or burned were impaired by insects and disease. Following the severe forest fires of 1926 an infestation of mountain pine beetles attacked and killed one third of the mature white pine in the area. In 1927 white pine blister rust reduced the remaining white pine stands by approximately two thirds, according to Klehm. The subsequent spread of the rust throughout all white pine forests of the Northwest is difficult to evaluate in terms of its effect on caribou. However, the death of trees would imply their eventual loss of limbs with their lichen burden which may have sent food earthward for caribou. If this fact may have had a somewhat beneficial effect on caribou, the forest openings resulting from death of large stands probably affected the animals adversely.

The most important forest epidemic affecting caribou

was the result of high velocity winds on November 26 and 27, 1949. Winds of from sixty to one hundred miles per hour felled large blocks of spruce timber in the high mountains of the Kaniksu, Kootenai and Flathead National Forests (Anon., 1953). In April and May of 1950 another storm added to the damage in the forests mentioned and also effected large blowdowns of spruce timber in the Clearwater and St. Joe National Forests. The Englemann spruce beetles attacked the downed timber and soon reached epidemic proportions and attacked spruce stands throughout the mountains and affected probably every stand in caribou country (Klehm, 1959). A control program was soon launched through the cooperative efforts of the timber industry, the U. S. Forest Service and the Bureau of Entomology and Plant Quarantine. Blowdown timber, killed and infected timber in adjacent stands were heavily logged (Figures 22, 23, 24).

Most of the spruce timber was high in the drainages, and caribou are believed to be more closely associated with spruce than any other forest tree. What was the general effect on caribou habitat and on caribou from the salvage and control program, and what would have been in prospect for caribou had not the program been launched? Roads were improved and new roads pushed into the upper drainages, and logging of spruce and its associated species began in earnest. Spruce, previously regarded as an inferior lumber species, became the center of importance in the lumber

Figure 22.

SPRUCE BARK BEETLE INFESTATION IN KANIKSU
NATIONAL FOREST, IDAHO

Areas outlined in black indicate endemic areas and solid black indicates epidemic areas.

Data from Spruce Bark Beetle and Plans for its Control, 1953, U. S. Forest Service.
Base map courtesy U. S. F. S.

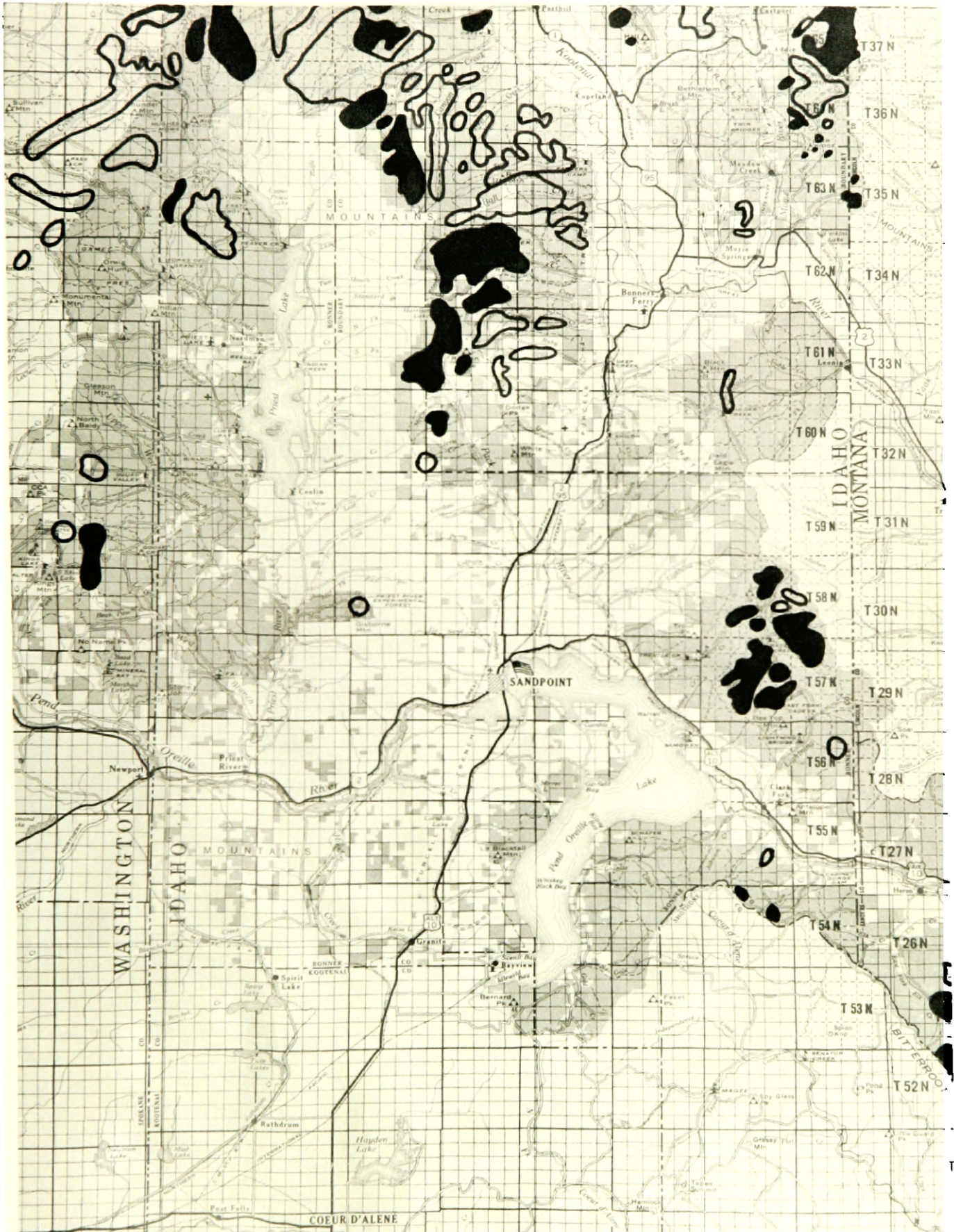


Figure 23.

SPRUCE BARK BEETLE INFESTATION IN KOOTENAI
NATIONAL FOREST, MONTANA

Areas outlined in black indicate endemic areas
and solid black indicates epidemic areas.

Data from Spruce Bark Beetle and Plans for its
Control, 1953, U. S. Forest Service. Base map
courtesy U. S. F. S.

CANADA

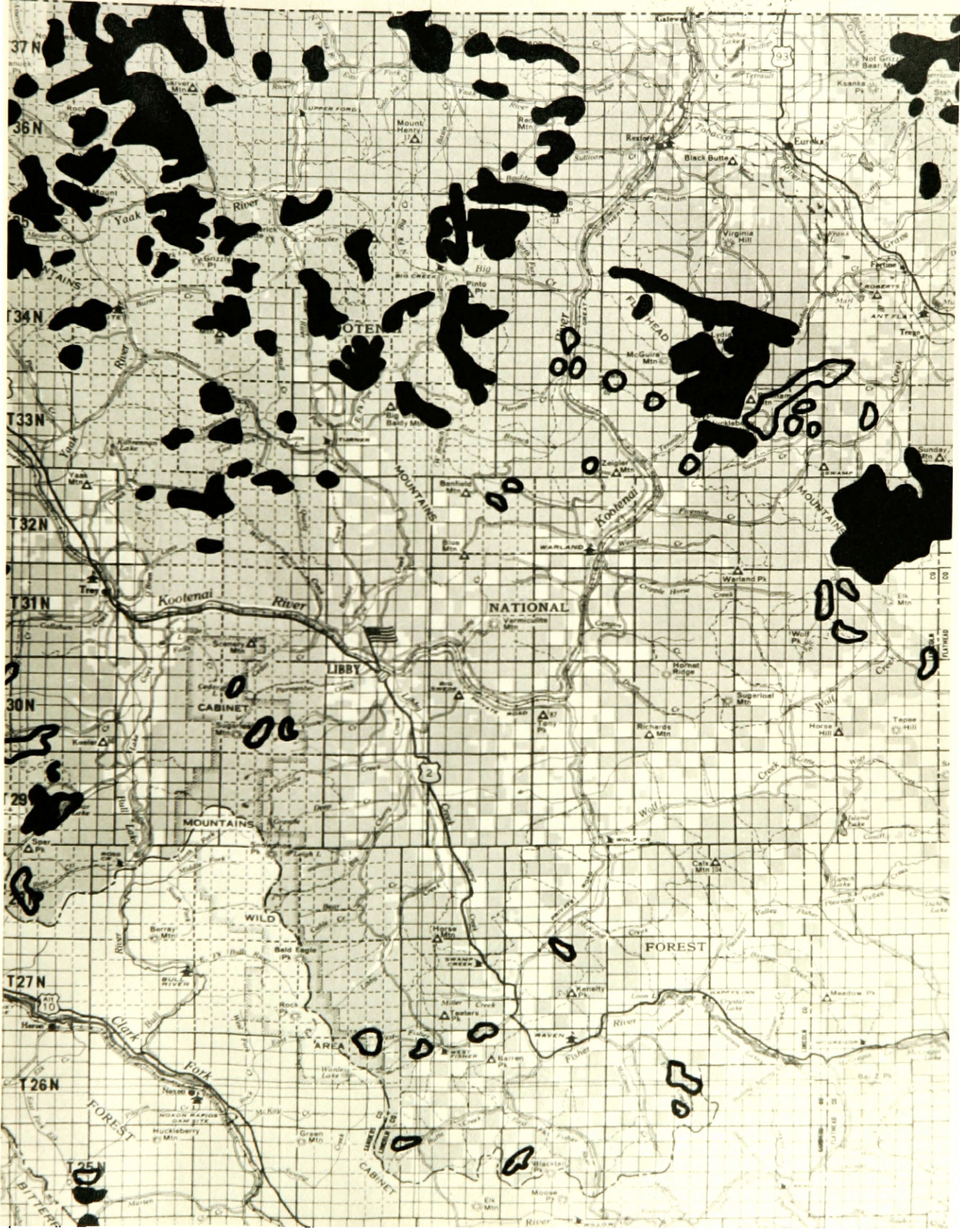


Figure 24.

SPRUCE BARK BEETLE INFESTATION IN UPPER PORTION OF
FLATHEAD NATIONAL FOREST, MONTANA

Areas outlined in black indicate endemic areas and solid black indicates epidemic areas.

Data from Spruce Bark Beetle and Plans for its Control, 1953, U. S. Forest Service. Base map courtesy U. S. F. S.

industry of the region. Seven billion board feet were lost, salvaged and harvested in the next several years. The demand for spruce timber which had been attractively presented to the public remained in demand after control and salvage programs had been completed. This fact has surely tended to continue logging in the adjacent high drainages unaffected by the epidemic.

During the logging operations connected with the spruce beetle infestation, caribou were reported frequenting several logging operations where the felled trees offered food, and they were observed feeding on lichens of the downed trees. Caribou were also reported in the trap tree program, where spruce were felled in an effort to attract the beetles and the trees then subsequently burned. Indeed, the spruce stands in the higher elevations proved to be caribou habitat. The felling of the timber has no doubt resulted in more ample food without the usual pattern of extensive wandering. The possible poaching of animals may have offset any advantage gained in the lichen harvest. The lichen harvest which would have resulted from the natural fall of the spruce timber would have been enormous, but it might have occurred at a rate which would have far exceeded the ability of caribou to respond appreciably in population growth. Had such a buildup ensued, it might have precipitated more disaster when the newly increased population had caught up with the lichen harvest and been

faced with large areas of its range subtracted from use. In such an event, the nomadicity would surely have led to repopulating many of the adjacent areas which do not presently appear to have caribou. So the total effect of the Englemann spruce beetle infestation can only be hypothesized. Obviously, it led to considerable forest destruction which cannot be interpreted as resulting in any advantage for caribou, but instead it led to further degradation of range.

Summary: In summarizing the factors associated with caribou decline in northwestern United States, it should be emphasized that the declines appear to have but continued coincident with habitat destruction. Hunting may have been one of the major forces in reducing caribou numbers. Habitat destruction has exerted a tremendous force in excluding caribou from much of the former habitat they occupied and the slow recovery of this range will prevent caribou from making a comeback in the near future. The remaining caribou habitat grows annually more limited as timber harvest continues in the limited stands of virgin forest. Fires, logging, and human contact which results in illegal hunting have been and will remain the principal enemies of caribou.

THE FUTURE OF CARIBOU IN NORTHWESTERN UNITED STATES

The present pattern of forest management will likely be deleterious to caribou and may result in their complete extermination in the United States or reduce their numbers to a dangerous low--if that point has not already been reached. Attempts to maintain present caribou numbers may expedite their disappearance in the face of decreasing mature forest through logging, for too many animals on too little range is always disastrous.

Timber harvest will continue and the forests most likely to be soon harvested are those which are mature; this procedure will further reduce caribou lowland winter range and modify their lowland spring range (Figure 25). A lowland winter range must be extensive enough to compensate for lichen growth and recovery which is unduly slow. If there are segments of lowland forest range that are not connected by corridors of mature forest, the caribou may be effectively isolated from such scattered segments by barriers of dense reproduction. Further study must determine whether or not caribou use these isolated segments and it must also determine how mature a forest must be, in terms of successional stages after logging or burning, to maintain caribou.

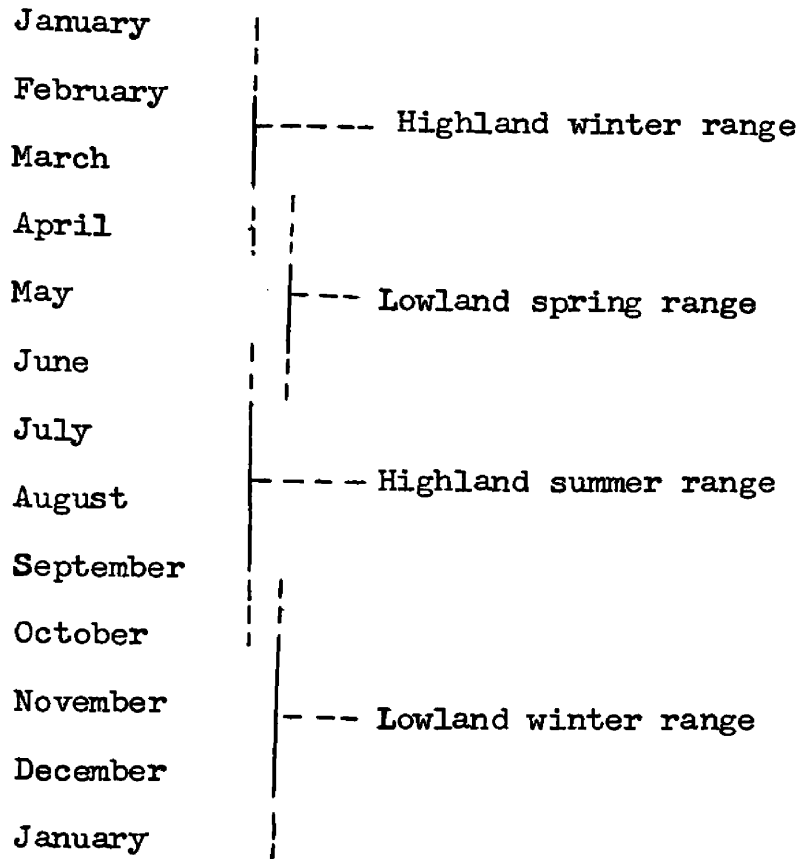


Figure 25.

THE PROBABLE APPROXIMATE SEASONAL COMPONENTS OF TOTAL
CARIBOU RANGE

Dotted lines indicate modifications dependent of food supply and weather factors.

Modified from Edwards and Ritcey (1959).

Some rather large areas of unburned and unlogged forests must be appraised in terms of the four component units of caribou range. If caribou require four seasonal components of their total range, that seasonal unit which is most limited will probably reveal the destiny of the animals.

Just as mature timber must be saved from logging to maintain caribou, so must this same range be protected from fire. While no serious fire losses have occurred during the 1940's and 1950's, how well forest administration can continue to suppress disastrous fires is not known.

It appears likely that the Forest Service will accelerate and intensify its timber stand improvement program. However, what practices will be employed and in what particular areas and to what extent will be determined locally by the forest administrators and their judgments will be modified by economic, political and perhaps other factors.

In employing timber stand improvement measures, the Forest Service recognizes a need for improving timber quality and increasing timber yields to meet anticipated demands which, it is assumed, will continue to rise to meet demands of an ever-increasing human population. There are presently areas of over-age forests, large areas which are understocked or nonstocked with valued timber species, stands of young and pole-size trees of excessive limbiness,

stagnated stands with suppressed growth and diseased and defective trees which impede growth of more desirable timber trees. The Forest Service proposes to correct and improve these conditions by employing the previously mentioned timber stand improvement techniques which must here be evaluated as to how they affect caribou.

The Forest Service outlines procedures to increase disease and insect-resistant trees, to reduce cull trees, to increase the proportion of desirable lumber species and to expedite growth of high quality lumber trees. These procedures include forest thinning, pruning, prescribed burning, elimination of plant competition and, where necessary, protection from wildlife (Anon., 1958). Limb pruning to increase the value of butt logs would be particularly bad for caribou.

Whereas the Forest Service does recognize forest uses other than timber yield, it advises that when conflicts of interest exist, decisions will be made on the basis of highest priority use. It is scarcely conceivable, therefore, that major forest policy would be modified to protect an animal species of no economic value. Public opinion would favor logging where it is of economic consideration rather than support an esthetic principle for the saving of a seemingly doomed species.

In summary, it is thought that caribou will continue to wander the mountain forests for some years to come, but it is doubtful that they will remain as a stable population.

BIBLIOGRAPHY

- Anonymous
1932. Glacier Nature Notes ("Glacial Drift") V(6)60.
- Anonymous
1952. Snow survey data for the Columbia River basin. Soil Conservation Service (mimeographed).
- Anonymous
1953. Spruce bark beetle infestation and plans for its control. U. S. Forest Service (unpublished, mimeographed).
- Anonymous
1955. Kootenai National Forest. U.S.F.S. (map).
- Anonymous
1956. Western News, Libby, Montana, December 27.
- Anonymous
1958. Planting and stand improvement handbook northern region. U.S.F.S., Missoula, Montana (unpublished, mimeographed), 94 pp.
- Anonymous
1958. Summary of estimates of big game animals. U.S.F.S., Nor. Reg. (unpublished, mimeographed).
- Anonymous
1959. Climates of the states. Idaho. U.S. Weather Bur., 16 pp.
- Anonymous
1959. Bonners Ferry Herald. Bonners Ferry, Idaho, May 7.
- Ahrens, R.
1959. Personal communication
- Allen, G. M.
1942. Extinct and vanishing mammals of the western hemisphere. Amer. Comm. Internat'l. Wildlife Project, Spec. Publ. no. 11, 620 pp.

- Anderson, C.
1957. Personal communication to P. Flinn.
- Anderson, R. M.
1938. Catalogue of Canadian recent mammals. Nat'l. Mus. of Can., Bull. 102, 238 pp.
- Arvish, A. J.
1958. Personal communication.
- Atcheson, J.
1960. Personal communications.
- Banfield, A. W. F.
1949. The present status of North American caribou. Trans. 14th N. A. Wildlife Conf. 477-491.
- 1954a. Preliminary investigation of the barren-ground caribou. Part I. Can. Dept. Nor. Affairs and Nat'l. Res., Can. Wildlife Ser. I, No. 10A., 79 pp.
- 1954b. Preliminary investigation of the barren-ground caribou. Part II. Can. Dept. Nor. Affairs and Nat'l. Res., Can. Wildlife Ser. I, No. 10B., 112 pp.
1959. Personal communication.
1960. The use of caribou antler pedicels for age determination. Jour. Wildlife Mgnt. 24:99-102.
- Beebee, C.
1959. Personal interview.
- Belle, E.
1959. Personal interview.
- Bobrinskii, N. A., and Kuzyakin, A. P.
1944. Key to the Mammals of U.S.S.R. (State Publ. House "Sovetskaya Nauka," Moscow).
- Bossenmaier, E. F.
1959. Tagging barren-ground caribou in northern Manitoba. 21st Midwest Wildlife Conf. (unpublished manuscript).

- Brill, M.
1958. Personal communications.
- Buechner, H. K.
1953. Some biotic changes in the state of Washington. Research Studies of St. Col. of Wash., XXI(2) 179.
- Cahalane, V.
1947. Mammals of North America. The Macmillan Co., New York, 682 pp.
- 1948. Status of mammals in the U.S. National Park system. Jour. of Mamm. 29:256.
- Cooper, J. G.
1868. The fauna of Montana Territory. Amer. Naturalist 2:528-538.
- Cornell, G. T.
1959. Personal communication.
- Costello, J. S.
1958. Personal interview.
- Cowan, I. McT.
1951. Diseases and parasites of big game mammals of western Canada. Rpt. Proc. 5th Ann. Game Conv., Prov. of B. C. Game Dept.
- Cringan, A. T.
1957. History, food habits and range requirements of the woodland caribou of continental North America. Trans. of 22nd N. A. Wildlife Conf. 485-501.
- 1958. Influence of forest fires and fire protection on wildlife. For. Chron. 34:25-30.
- Dalquest, W. W.
1948. Mammals of Washington. Univ. of Kans., Publs., Mus. of Nat. Hist., vol. 2, 444 pp.
- Davis, W. B.
1939. The recent mammals of Idaho. Caxton Printers, Ltd., Caldwell, Idaho, 400 pp.

- De Vos, A. 1951. A review of the status of woodland caribou in Ontario. Jour. of Mamm. 39:408-412.
- Douglas, D. 1959. Journal kept by David Douglas during his travels in North America 1823-1827. Antiquarian Press, Ltd., N. Y., 364 pp.
- Dwinelle, J. K. 1959. Personal communications.
- Edgar, M. E. 1958. Personal communication.
- Edwards, R. Y. 1954. Fire and the decline of a mountain caribou herd. Jour. of Wildlife Mgnt. 18:521-526.
- _____. 1958. Land form and caribou distribution in British Columbia. Jour. of Mamm. 39:408-412.
- Edwards, R. Y., and Ritcey, R. W. 1959. Migrations of caribou in a mountainous area in Wells Gray Park, British Columbia. Can. Field Nat. 73:21-25.
- Eichwald, E. 1959. Personal interview.
- Ernst, O. 1959. Personal interview.
- Flerov, C. C. 1933. Review of the palearctic reindeer or caribou. Jour. of Mamm. 14:328-338.
- Flinn, P. 1959. The caribou of northern Idaho. Idaho Wildlife Rev. XI:10-11.
- Flory, A. 1958. Personal interview.
- Gill, E. 1959. Personal communication.
- Grant, M. 1902. The caribou. N. Y. Zoo. Soc., 24 pp.

- Grinnell, G. B.
1920. Personal communication to Vernon Bailey.
- Grush, G.
1959. Personal interview.
- Guenther, S. E.
1959. Personal communication.
- Gunderson, H. L., and Beer, J. R.
1953. The mammals of Minnesota. Univ. of Minn. Press, Mpls., 190 pp.
- Hall, E. R. and Kelson, K. R.
1959. Mammals of North America. 2 vols., Ronald Press, N. Y., 1083 pp.
- Hanson, C.
1959. Personal interview.
- Hauley, J. H.
1920. History of Idaho; The Gem of the Mountains, Chicago: The S. J. Clarke Publishing Co., in 3 vols.: Vol. I, 895 pp.; Vol. II, 1008 pp.; Vol. III, 908 pp.
- Hawks, R.
1958. Personal interview.
- Hornaday, W. T.
1914. The American natural history. (Fireside Edition) Chas. Scribner's Sons, N. Y., vol. II, 332 pp.
- Johnson, C. E.
1922. Notes of the mammals of northern Lake County, Minnesota. Jour. of Mamm. 3:35.
- Joyce, F.
1960. Personal interview.
- Kelsall, J. P.
1955. Barren-ground caribou movements in the Canadian arctic. Trans. 20th N. A. Wildlife Conf., 519-532.
- 1957. Continued barren-ground studies. Can. Dept. Nor. Affairs and Nat. Res., Can. Wildlife Serv., Ser. I, No. 12, 148 pp.

- Klehm, K. A.
1958. Personal communication and interview.
- _____,
1959. Personal interviews.
- Klockmann, A. K.
1959a. The Klockmann diary. Bonners Ferry Herald,
Mar. 26.
- _____,
1959b. The Klockmann diary. Bonners Ferry Herald,
Apr. 30.
- Koppang, M.
1959. Personal communication.
- Leopold, A. S., and Darling, F. F.
1953. Wildlife in Alaska. Ronald Press, N. Y.,
129 pp.
- Lloyd, R.
1959. Personal correspondence and interview.
- Lynch, P.
1958. Personal interview.
- Malouf, C. I.
1958. Personal interview and unpublished field notes.
- Manker, E.
1958. The last of the reindeer Lapps. Nat. Hist.
LXVII:70-81.
- McBride, J. K.
1959. Personal communication.
- McDougall, J.
1959. Personal communication and interview.
- Merriam, C. H.
1890. Descriptions of twenty-six new species of
North American mammals. N. Amer. Fauna 4:1-55.
- Middleton, E.
1959. Personal interview.
- Murie, O. J.
1935. Alaska-Yukon caribou. N. Amer. Fauna,
No. 54, 93 pp.

- Murie, O. J.
1959. Personal communication and interview.
- Navratil, T.
1959. Personal interview.
- Nelson, E. W.
1930. Wild animals of North America. Revised Ed., Nat. Geog. Soc.
- Nelson, W.
1958. Personal communication and interview.
- Norman, C.
1959. Personal interview.
- Oliver, J.
1959. Personal interview.
- Palmer, R. S.
1938. Late records of caribou in Maine. Jour. of Mamm. 19:37-43
- Palmer, R. S.
1949. Rangifer caribou in Maine in 1946. Jour. of Mamm. 30:437-438.
- Palmer, L. J.
1944. Food requirements of some Alaskan game animals. Jour. of Mamm. 25:49-54.
- Paul, L.
1959. Personal interview.
- Pengelly, W. L.
1953. Completion report for Coeur d'Alene deer management study. Pitman-Robertson Proj. W90-R, 213 pp.
- _____
1958. Personal communication.
- _____
1960. Personal interview.
- Peterson, M.
1958. Personal communication.
- Plett, L. F.
1959. Personal communication.

- Pourett, D.
1959. Personal interview.
- Pruitt, W. O., Jr.
1960. Animals in the snow. Sci. Amer. 202:61-68.
- Ray, V. F.
1942. Culture element distributions XII plateau. Anthropol. Rec. 8:2.
- Richards, W.
1958. Personal interview.
- Ring, E.
1959. Personal interview.
- Ruhle, G. C.
1930. Mountain caribou. Glacier Nature Notes ("Glacial Drift") III(5).
- Rust, H. J.
1946. Mammals of northern Idaho. Jour. of Mamm. 27:326.
- Sanderson, J. E.
1958. Personal communication.
- Scheffer, V. B.
1951. The rise and fall of a reindeer herd. Sci. Mon. 73:356-362.
- Scribner, C. H.
1958. Personal communication and interview .
- Seton, E. T.
1927. Lives of game animals. Vol. 3. (Hooved animals) Doubleday, Doran and Co., Inc., N. Y., 780 pp.
- Sholes, W.
1954. Personal communication to W. L. Pengelly.
- Stannard, G. F.
1936. Personal communication to L. O. Vought.
- Sutton, W. D.
1959. Personal interview.
- Swanson, G.
1936. The Minnesota caribou herd. Proc. of N. A. Wildlife Conf. (Biological Survey Ed.), 416-419.

- Teit, J. A.
1928. The tribes of western plateaus. 45th
Ann. Rpt. Bur. of Ethnol.
- Terrell, T. T.
1959. Personal communication.
- Thompson, D.
1916. David Thompson's narrative of his explora-
tions in western North America, 1784-1812.
The Champlain Soc., Toronto, 582 pp.
- Turney-High, H. H.
1941. Ethnography of the Kutenai. Memoirs Amer.
Anthropological Assoc. 43(2) part 2,
no. 56.
- West, L.
1959. Personal communication and interview.
- Wise, C. C.
1959. Personal communication.
- Wright, A. H.
1929. The word "caribou." Jour. of Mamm.
10:353-356
- Wurtz, F.
1958. Personal communication.
- Yerbury, H.
1958. Personal communication and interviews.
- Young, S. P.
1958. Personal communication.