SUMMARY REPORT

Of

URAL-TWEED SHEEP PROJECT

October 15, 1940 to June 15, 1941

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Cooperating Agencies

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I. OBJECTIVE

To gain a fund of accurate information fundamental to the management of the Ural-Tweed band of bighorn sheep, Ovis canadensis.

II. LOCATION AND DESCRIPTION OF AREA

The area inhabited by the Ural-Tweed band of bighorn sheep lies in the extreme northwestern corner of Montana in Lincoln County. It occupies roughly three townships along the east side of the Kootenai River in the vicinity of Ural, Montana, and is traversed by four small drainages which empty into the Kootenai River.

With regard to slope and elevation, this area consists of two distinct subdivisions: (1) the escarpment which slopes from about 2500 feet elevation at the river's edge up to approximately 5000 feet and having an average slope of 30-50 percent, and (2) the table land, which slopes gradually from 5,000 feet up to the summits of peaks of about 6,500 feet.

The topography of the escarpment consists of a series of discontinuous benches and ledges varying in vertical height from a few feet to about 200 feet. The horizontal planes of these benches are usually level or nearly so, and vary in width from a few feet to about 150 feet.

The west and south exposures of the bighorn range are covered sparsely with Ponderosa pine and Douglas fir timber with an understory of ninebark, service berry, mountain maple, osage orange, and chokecherry. The chief grasses found on the range are western wheatgrass, Sandberg's blue grass, rough fescue, Idaho fescue, purple reedgrass, and pinegrass. The principal perennial herbs are wild buckwheat, penstemon, and alumroot. Very few annual grasses and herbs are found.

III. CLIMATIC CONDITIONS

Weather conditions throughout the winter were decidedly unfavorable for good results. Due to the abnormally mild temperatures, sufficient snow for tracking remained on the south slopes of the winter range only during short periods immediately following storms. These animals are extremely wary and difficult to approach without their becoming aware of the observer's presence. Hence, favorable tracking conditions are essential for definite information on predation, numbers, movements and feeding habits.

(pgs. 2, 3, 4, 5 omitted (weather chart))

IV. HISTORY

During the course of the study, several local residents were interviewed in an attempt to determine whether or not this was ancestral range of the bighorn. Mr. Oscar Bigler, who states that he came to the area in 1886, says that the mountain sheep were more numerous at that time than at present. Several others who came during the first decade of the present century state that sheep were here, but vary in their concepts of the numbers then in comparison with the numbers now.

V. METHODS OF STUDY

Several methods of study were used in an attempt to determine the most satisfactory one. Throughout the project, the objective borne in mind was that the maximum number of hours of actually observing the animals would yield the maximum results. During October and November most of the time spent in the field was utilized in wide coverage of the area to detect the extent of poaching and keep it at a minimum.

It seemed desirous to select an area known to be frequented by the sheep and make intensive observations on it. For this purpose the area between Sheep Creek and Ten Mile Creek was chosen. This area consists of roughly, two square miles, hence it could be covered rather thoroughly on a day's trip. The greater part of the field work during December and January was one on this study area.

The general procedure on a field trip varied with existing conditions. When there was insufficient tracking snow, the routing was to climb to an elevation of 2000-3000 feet above the river, then gradually work downward. It was found that when the animals were approached from higher ground they were less likely to become aware of the observer's presence and take flight. When a band of sheep was sighted, an effort was made to stalk up within a distance of approximately 200 yards, providing the topography of the ground permitted such an approach. An eight-power binocular was used to observe the animals when they were located.

When there was sufficient snow to track the animals, band trailing yielded good results, particularly in studying food habits.

During February and March, when most of the range used by the bighorn was free from snow, a different method was tried. It was noticed that the sheep were found at lower levels as spring approached. When this was true, quite satisfactory results were obtained by traveling along the foot of the escarpment during morning and evening hours and examining the exposed faces of the bench rock ledges. When the animals are first located in this manner, it is less difficult to stalk upon them by circling above. However, it is believed that this method is practical only during late winter and spring when the sheep are at the lower elevations and the atmosphere is free from fog.

VI. NUMBERS

Conditions did not permit an actual count of the bighorns in the Ural-Tweed band. However, from the results of this study, the observer estimates that there is in the neighborhood of 100 head.

On each field trip an effort was made to determine the age and sex of each animal seen. A study of these frequency tabulations indicates that there are approximately 50 mature ewes, 25 mature rams, and 25 yearlings. These figures do not include the 1941 lambs.

VII. DISTRIBUTION

According to previous information, the Ural-Tweed band ranged over the area bounded on the west by the Kootenai River, on the south by Five Mile Creek, and on the east by the Kootenai River-Pinkham Creek Divide, and on the north by the Sutton Creek-Pinkham Creek Divide. (See Map A). An open mind was maintained regarding this, however, and several field trips made to determine whether or not these were the definite limits of distribution. On November 14 and on December 9, 1940, sheep signs were encountered on the south facing slopes of Cripple Horse Creek. On March 20, 1941 seven head of ewes and yearlings were actually seen in this area. Residents of Lincoln County report seeing mountain sheep at various points in the country, but it may be generally stated that the activities of the Ural-Tweed band are largely confined within the above described area.

VIII. MOVEMENTS

At the outset it may be stated that the observations made during this study indicates that the seasonal movement of the Ural-Tweed band is gradual and may be incomplete. That is, we cannot point out specific winter range areas and say that the sheep are never found in them during the summer.

The fall movement appeared to be a gradual drift. A moderate storm on November 9 evidently had no accelerating effect on it. It was not until December 24 that the mature ram bands, as well as the bands of ewes and young stock, appeared in any abundance on the winter range. In view of the abnormally mild weather, however, it cannot be concluded that movement occurs at this time each year. Other workers point out that weather conditions regulate this movement onto winter range.

Studies this spring showed that the bands of mature rams gradually drifted back to the higher summer range during April. The last band of rams seen was using the natural lick at Valcour on April 21. The ewes and young stock remained on the winter range where the lambs were dropped later. Unfortunately, the study was terminated before the ewes

and lambs migrated, consequently little is known of their spring migration and to what extent it takes place. Casual observations made in the summer of 1940 and 1941 indicate that ewes and lambs may use the winter range to some extent during the summer.

1. WINTER RANGE

The winter range is the more precipitous area of west and south exposures along the face of the river and the mouths of the major drainages. As previously mentioned, it is characterized by slopes up to 50 percent. The topography is extremely rough with numerous rock cliffs and ledges. The timber type is sparse Ponderosa pine and Douglas fir, while the soil type is rocky and of light glacial silt.

It was noticed throughout the winter that snow remained on these steep areas only during and shortly after storms. The observer's opinion is that the chief reasons for the bighorn's preference of this for winter range are: (1) the steep slopes exposed to the sun remain free from snow the greater part of the winter, (2) the reflection of the sun's heat from the rock walls tends to keep the forage plants green throughout the winter, and (3) the cliffs offer adequate protection from natural enemies and inclement weather.

2. SUMMER RANGE

As the study was terminated on June 15, only casual observations could be made during the time the sheep were on summer range. The meager information here set forth was gleaned from contacts with local residents and forest employees whose work takes them into the summer range.

Reference to Map A will show the general boundaries of the summer range. It is not to be implied that all the area shown as summer range is actually used by the bighorns, because the greater part of this area is covered with dense lodgepole pine at the higher elevations and with Douglas fir and tamarack on the north facing slopes at lower elevations.

Open rocky areas of Ponderosa pine type are scattered throughout the summer range. Indications are that the mountain sheep use only those local spots because they afford adequate protection and food.

There was little opportunity to study the daily movements because of the difficulty of keeping a band of bighorns under observation continuously from one day to the next. However, it may be stated that the daily movements, as tied up with feeding habits, are largely horizontal. The bighorn flocks generally feed along on the contour and many trails are in evidence on the range.

IX. LIFE HISTORY AND HABITS

1. DAILY ROUTINE

The bighorns of this band have rather fixed habits with reference to feeding and bedding, but weather conditions and seasons have a marked influence on these habits. During the summer on clear warm days the flocks leave their beds before sunup and feed during the early morning hours. Usually by 10 a.m. all are bedded down on some rocky bedground. During this siesta it is rare that all individuals of a flock are inactive for more than a few minutes at a time. One or more animals are usually up stretching or nibbling at some forage. As the cools hours of evening come on, the bighorns begin the second feeding period. By dark they have sought a bedground where they spend the night. As the days draw shorter these mid-day bedding periods grow shorter and nightly bedding periods longer. On cloudy days in winter they may be seen feeding at any time during the day.

2. BEDGROUNDS

The bedgrounds of these mountain sheep are generally situated atop some prominent wall or cliff where the animals may have commanding view of the country below. During inclement weather, however, the beds are found at the base of a cliff on some narrow ledge where the terrain below can be viewed. At times these beds are located under the overhanging boughs of a pine or fir tree, but more often are in the open. Likewise, they are sometimes found on solid bare rock, but equally as often in loose soil or slide rock. These sheep were noted to bed down with the long axis of their bodies parallel to the contour but in such a manner as to permit a constant watch down hill.

3. FECES AND TRACKS

The droppings of the bighorn are similar in shape, size and color to those of deer. They vary somewhat with the season and diet. In the spring when the animals are using the natural licks the feces contain varying amounts of soil. Some have been examined and found to be made up almost entirely of soil with very little organic material. Those which are made up chiefly of organic matter are so firm and indurate that it is difficult to crush them between the thumb and forefinger. In this condition they probably remain on the range for several years. It is known by experiment that droppings which have been exposed to the weather for over a year show no signs of disintegration.

The tracks of the bighorn are characterized by several features which distinguish them from the tracks of deer: (1) in the sheep the toes

are separated to a greater extent, (2) the toes are more blunt at the end, and (3) the face of the track presents a convex surface. It was interesting to find that the front feet of the mountain sheep are considerably larger than the hind.

In the following tracks in the snow another point of interest noted was that where it was necessary for sheep to negotiate a large log across the trail, they did so by jumping up onto the log and landing on all four feet, then with a second jump, landing on the opposite side. In contrast, the deer was found to clear the log in one jump.

4. BREEDING SEASON

By the time the observer had become familiar with the terrain and the habits of the animals, the bighorn breeding season was nearly completed. The only light we have on this phase of the study is the testimony of local residents at Ural, Montana. Mr. Jerry Ritchie, who has lived at Ural for more than 20 years states that he witnessed breeding on the ledges above the Ural school house in the latter half of November but is unable to recall the specific date and year. Mr. Primo Paolini, who has been a section foreman along the food of the sheep range for more than ten years, states that he saw a ram fight on the ledge above the Ural school house "after the hunting season" (which implies late November) but he too, does not recall the exact date.

On December 24, 1940, the adult rams were found with the ewes. Since these mature rams do not run with the ewes except during the rutting season, it is probable that this observation was made during the later subsiding stages of the period.

Taking approximately 180 days as the gestation period (as established by the Idaho and Wyoming workers of the Rocky Mountain Sheep Study), and taking May 25 as the peak date of lambing (as established from observations here during the spring), we may calculate that the peak date of the previous breeding season fell on November 25. This is not intended as a dogmatic statement but is only correct insofar as our meager observations on lambing dates are correct for this past year.

There is reason to believe that successful breeding spreads over a period of at least 15 days, judging from the spread over which the lambs were dropped.

5. YOUNG

(a) Time of Lambing and Rate of Reproduction

The first 1941 lamb found was known to have been dropped during the early morning hours of May 21. The following table gives the number of lambs found between May 21 and June 6. None were found after the

later date. There is, undoubtedly, considerable duplication in these records because most of the observations were made in the same general area.

Table 4 - Number of lambs found between May 21 and June 6

1 Date Seen	2 Ewes	3 Lambs	4 Estimated date lambs born
May 21	1	1	May 21*
27	4	2	1 May 17#; one May 24#
29	6	4	All between May 20-26
30	4	2	All between May 20-26
30	1	1	Between May 24-28
30	5	2	Between May 24-28
30	3	3	Between May 22-28
30	1	1	Between May 22-28
June 4	1	1	Between May 28-June 2
4	2	2	Between May 28-June 2
5	1	1	Between May 28-June 2
6	6	1	Between May 30-June 4

NOTE: *Known. Column 2 includes young stock. Observations generally made at a distance to great to classify. Column 4 estimated dates lambs born by comparison of size with that of known lamb; #-observations made at fairly close range.

As may be seen from Table 4 these observations indicate a spread of the lambing season from May 17-June 4. With the exception of one, all these lambing dates are based on estimation, hence we cannot state definitely that this is true but the indication is that the peak lambing date falls within the period of May 20-June 1.

Again referring to Table 4 we find that during the lambing season 35 ewes, barring duplication, were seen with 21 lambs. Taking this figure as it is we arrive at a 60 percent increase, and we have reason to know that of this number of ewes, a considerable percent has not yet reached breeding age, and that some may be senile. In addition, it is probable that some of these "lambless" ewes may have lambed later. Thus we would probably find the true percent of increass for ewes of breeding age even greater than 60 percent.

As a check against this figure, let us consider the observations

made on May 30. On that date 14 ewes with 9 lambs were seen. It is known that there is no duplication here because, (1) they were all observed from one point, (2) they were seen in five widely separated bands, and (3) they were seen almost simultaneously. Here it is seen that we have a 64 percent increase and again may logically assume that the group of five remaining ewes contains immature, senile, and pregnant animals.

Based on the observations of a single season it is apparent that the lack of increase of this band of bighorns is not due to unsuccessful breeding.

From time to time considerable variance of opinion has been expressed regarding the twinning of lambs in bighorn sheep. In this connection, the testimony of Mr. Frank Bolles, forest employee since 1929 in the bighorn range, is of interest. Mr. Bolles states that in early September, 1937, he observed four adult ewes, each with twins. He states that he watched them for a period of about two hours and during this time observed each pair nursing its mother.

The only possible indication of twinning seen during this study was on May 29 when two lambs were seen following one ewe. Only one of the lambs was seen nursing the ewe, however, and other ewes were in the band.

(b) Development of Young

In order that the reader may have a truer picture of the conditions surrounding lambing of the bighorns on this area, the following excerpts from field notes are given:

> May 21, 1941 - 9:50 a.m. Sighted one ewe directly above at about 100 feet. This animal had evidently dropped a lamb only a few hours previously, as shown by the fetal membrane hanging from the vulva. She appeared in good flesh and extremely alert. The ewe was "jumped" at an elevation of about 3,700 feet on a rocky ridge directly above Ural. This animal was in view only a few seconds as she bounded up over a series of ledges.
>
> 10:02 am. The ewe was sighted again and appeared to be circling back to the point where originally seen. From the behavior of this ewe it was believed that the lamb was in close proximity so the observer remained on a bluff overlooking the surrounding area.
>
> 11:00 a.m. The wind was blowing moderately when the observer believed he heard the faint bleat of a lamb so moved a few yards in the direction from which the sound came.

11:20 a.m. The sound was heard again, this time unmistakably a lamb. Upon moving to the edge of a wall and peering over, the lamb was sighted on a grassy ledge below. It was lying down with all four legs folded beneath its body, with neck stretched far out and head resting upon the ground similar to the manner in which a young fawn crouches. In a few moments it was observed to raise its head, glance furtively about and bleat again. The observer then descended and as the lamb was approached it came bounding wabbly-legged up to within a foot or so of the observer. This lamb showed no fear until it scented the observer.

The hair of the head and neck of this young bighorn was not thoroughly dry. The amnionic fluid was still in a gelatinous state when found at about 11:30 am. on the hot, dry, windy day, all of which indicated that the lamb was probably not six hours old.

This lamb, examined at a distance close enough to touch it, had a strong, healthy appearance and stood about 20 inches high. Its color did not differ greatly from that of the ewe, except for being slightly darker. It appeared light on its front feet, having a tendency to rear up on its hind legs, a habit noticed many times in adult sheep when ascenting low perpendicular cliffs. Another interesting proclivity displayed was that of seeking ahiding place in the cliff. When such was found it crept in and remained motionless. (when measured later, the crevice into which it crawled proved only 5½ inches wide.)

Observations made on this lamb of known age and subsequent observations made on others, point out that the growth and development is rapid during the first few days. Specifically, at 8:10 a.m. on May 23 the lamb found on May 21 (then scarcely 24 hours old) was seen following its mother over rough terrain at a pace difficult for a man to maintain. On May 27 a band of sheep was observed at close range. The lead ewe had a young lamb (estimated three days old) following her. When the band scented and later saw the observer, it took flight up a nearly perpendicular wall. The small lamb had difficulty following and was seen to stumble several times and fall from small ledges twice. This lamb's mother led the band up the smooth face of a rather steep cliff but the tiny lamb missed its footing and fell four or five feet - it was uninjured, however. Having seen that her lamb could not follow she took another route of escape. In one hour the band had descended into a precipitous canyon three or four hundred feet deep, and climbed to a higher point on the opposite side. The young lamb still followed. This jaunt would have taken a man at least an hour and a half.

When the ewes are ready they isolate on some grassy ledge and give birth to the lamb. Here they remain in the immediate vicinity caring for the lamb until it is able to follow. It was apparent that

this period is probably not more than a week or so in duration. It was not determined whether or not the ewe leaves her lamb to go for water. During this time the ewes are extremely wary and so alert it is almost impossible to approach them.

On several different occasions lambs were seen nursing. Several of these "nursing periods" were clocked and found to range from 1/2 minute to 1½ minutes in duration. On may 27 a lamb was seen nibbling at plants for five minutes, but its age could not be determined nor could it be told whether or not any of the plants were actually eaten.

(c) Lambing Range

For lambing grounds the bighorn ewes of the Ural-Tweed band seem to choose the roughest, most inaccessible areas of the winter range. Reference to Map B will show where lambs were found and observations made. These areas are characterized by many precipitous cliffs, ranging in height from 10-150 feet and broken by narrow shelves. The most ideal lambing grounds were found in Sheep Creek where water was available up into the middle of the summer.

A brief description of the bench upon which a lamb was actually known to be born may help to complete the picture of bighorn lambing range. This lamb was born at the very base of one of the few Ponderosa pine trees supported by the sloping, shallow, rocky soil. A few sparse bunches of beardless wheatgrass dotted the floor of this shelf which was hidden from above and below by vertical walls of 10-20 feet.

6. FLOCK COMPOSITION

One of the most striking characteristics of bighorn sheep is their habit of maintaining distinct bands with reference to their sex and age. Throughout the year, except during breeding season, the mature rams run in bands by themselves. While the ewes and all young stock maintain bands of their own kind. The bands of mature rams usually occupy a unit of range higher than the ewe-lamb flocks and seldom come near until late autumn.

The size of these bachelor groups generally range from 3-12 animals, but there may be as many as 22 in a group, according to local residents.

All the young stock remain with the mature ewes in bands similar in size to those of the rams. As the young rams reach breeding age (3-4 years according to other workers) they break away from the ewe bands and join the mature rams.

As the breeding season comes on the ram flocks begin to mingle with the ewes and young stock. When the rutting season is completed the breeding rams again assume their bachelor life.

Another rather rigid trait of the bighorn is that each band has a leader. In ewe-lamb bands the leader is nearly always an old ewe, while in the ram flocks this job must fall to one of the older rams. During that part of the year when both sexes run together, the rams are content to be led about by one of the old ewes.

7. COMMUNICATIONS

Means of communication is more or less well developed in most social animals and the bighorn does not differ in this respect. We have previously mentioned that the young lambs bleat. This call is not unlike that of a domestic lamb. Throughout the project the observer never heard any bighorn but the young lambs emit a vocal sound.

Observations made on March 24 threw some light on this phase of bighorn life. At 12:10 p.m. the noise of a rolling rock disclosed the location of a young ram. Knowing that this animal was a member of a band previously sighted, the observer carefully stalked down to the spot in the hope of locating the rest of the band. Stalking conditions were ideal as approach could be made from the leeward side; the animals were on lower ground, and the ground cover was damp. The observer approached to a point a few yards from where he believed the band to be bedded down, then after a few minutes, located two of the sheep by the reflection of the sun in their eyes as seen through screening brush. They lay not more than 60 feet distant. At 1 p.m. the old ewe leading the flock arose from her bed and led four animals out to feed. From this position the observer was in full view of the band but by remaining motionless he was able to avoid detection. The band foraged about within a radius of 150 feet and in full view of the observer. At 2:30 p.m. they again bedded down.

The alertness of this old ewe leader was apparent when, each time the chatter of a squirrel or chipmunk was heard in the distance, for some moments she fixed her attention in the direction from which the sound came.

At 3 p.m. the observer attempted to relieve a cramped position, and even though the movement was slight, the wise old ewe detected it. In rapid succession she jumped to her feet, stamped one hind foot, and emitted a series of short guttural "grunts." At this signal the entire band arose and converged to her side and she promptly led them around the mountainside. Perusal of available literature on mountain sheep has failed to reveal any mention of these "grunting" signals.

8. AGILITY

Much has been written about the mountaineering feats of bighorn sheep. During the study many hours spent in trailing these animals have shown that unalarmed mountain sheep rarely travel where man cannot follow. A species which depends almost wholly on rough terrain for protection from enemies must often be required to accomplish breath-taking and sure-footed mountaineering feats. But as most observations were made on animals on an unalarmed state of behaviour, few of these daring feats were witnessed. On two separate occasions, however, bighorns were known to have negotiated a sheer vertical descent of 9-12 feet in one jump. Several instances were seen where they ran, at what appeared to be top speed over areas of hugh sharp-angled sliderock boulders.

X. FOOD HABITS

1. GENERAL FEEDING HABITS

It has been previously mentioned in this report that the bighorns have definite daily feeding periods and that during these feeding hours they wander along mostly in a horizontal direction.

As may be expected, the bighorn must vary his foraging methods to concur with existing seasons and weather conditions. In this connection it was noted that during times of loose snow up to six inches in depth, the sheep reached grasses by "nozzling", not unlike the manner in which a horse feeds under similar conditions. It was not until the snow was icy and crusted that he pawed to uncover the grass crowns. Because of the mild weather there was no opportunity to determine just how deep they would go to uncover forage. When the range is free from snow they graze or browse similar to any other ruminant.

When snow covered the more gentle slopes, the sheep seemed to spend more of their time feeding among the cliffs. Several times animals were seen on their front knees with their necks far outstretched reaching overhanging vegetation that could not be obtained from below. On several different occasions it was noticed that sheep did not venture too dangerously close to the edges of high perpendicular cliffs. This was noticed on the winter range, when Sandberg's bluegrass, (a plant eagerly sought by the sheep) was left untouched on the edges of precipitous cliffs while the same plant growing back a safe distance was closely cropped. Here it may be stated that the smaller grasses such as the Sandberg bluegrass and bluebunch fescue are cropped very closely by the bighorns.

2. FOOD PREFERENCES

The mountain sheep of the Ural-Tweed band are principally grazers. It is estimated that the grasses form at least 60 percent of the year-round diet and 90 percent of the winter food.

The data on food habits was accumulated by (1) direct observation of the feeding animal, (2) band trailing, and (3) stomach contents analysis.

The author considers that sufficient data was accumulated during the winter months to be truly representative of the bighorn's diet at this time. However, due to wariness of the animals and unfavorable tracking conditions, the data on autumn and spring foods is inadequate. It can be used only to indicate tendencies. Not much is known of the summer diet; it very probably consists of a greater percentage of weeds and browse.

Undoubtedly, the plants contributing most to the bighorn's winter food are five species of the Gramineae: (1) beardless wheatgrass, Agropyron inerme, (2) bluebunch fescue, Festuca idahoensis, (3) rough fescue, Festuca scabrella, (4) Sandberg bluegrass, Poa secunda, and (5) purple reedgrass, Calamagrostis purpurascens. Probably the most important single item is beardless wheatgrass because it is most abundant, but where all are available, the two festucas and the bluegrass were preferred.

Table 5 on the following page gives a list of all the plants found to be taken during the period from November 23, 1940 to June 6, 1941. This table was made up almost entirely from field observations; the results of one stomach contents analysis are included, however.

Table 5. List of plants found to be taken during period November 23, 1940 to June 6, 1941

Scientific Name	Common Name	Parts Used	Season of Use	Rating
GRASSES				
Agropyron inerme	Beardless wheatgrass	C,L	A,W,Sp.	S
Festuca Idahoensis	Bluebunch wheatgrass	C,L	A,W,Sp.	S
Festuca scabrella	rough fescue	C,L	A,W,Sp.	S
Poa secunda	Sandberg bluegrass	C,L	A,W,Sp.	S
Calamagrostis purpurascens	purple reedgrass	C,L	A,W,Sp.	S
Carex sp.	sedge	C,L	W	
WEEDS				
Heuchera glabella	alumroot	S, L (F)	A,W,Sp*	C
Pentstemon sp.	beardtongue	S,L. (F)	S,W,Sp*	C
Eriogonum sp.	buckwheat	S,L (F)	W,Sp*	C
Ranunculus glaberrimus	buttercup	F	Sp	O
Arnica cordifolia	arnica	L,F	Sp	O
Achillea lanulosa	yarrow	F	Sp	O
Sedum sp.	stonecrop	L	W	I
BROWSE				
Prunus melanocarpa	black chokecherry	B,T	A,W	O
Odostemon squifolium	Oregon grape	L,B,S	A,W	C
Amelanchier alnifolia	common serviceberry	(L)B,T	W,Sp*	C
Ceanothus velutinus	evergreen ceanothus	L,B,T	A,W,Sp	C
Ribes spp.	currant	L,S	Sp	O
Philadelphus lewisii	Lewis mockorange	(L), B,T	A,W,Sp*	C
Symphoricarpos albus	common snowberry	L,T	Sp	O
Rubus parviflorus	thimbleberry	L	Sp	
Arctostaphylos uri-ursi	bearberry	L	W	I
Populus tsmuloides	aspen	L,T	Sp	I
Purshia tridentata	bitterbrush	L,B,T	Sp	I
Pseudotsuga taxifolia	Douglas fir	L,B,T	Sp	I
Pinus ponderosa	ponderosa pine	L	W	I
BRYAIES				
Moss like plants		Sp		

NOTE: Under column "parts used", C-culms, L-leaves, S-stems, letter in parenthesis corresponding with symbol under astarisk in next column means that part was available and used at that season, i.e., (F) with Sp*-flowers used when available in spring, B-buds, T-twigs. Under "Season of Use", Column A-autumn; W-winter, Sp.-Spring. Under "Rating" column, S-staple, C-common, O-Occasional, I-infrequent.

It seemed desirous to tie down food habits observations as nearly as possible to objective measurements but it soon became apparent that little could be obtained on the relative importance of each species of food plant by observing the length of grazing time spent on each. This was due to (1) difficulty in locating the animals, and (2) difficulty in approaching closely enough to identify the forage being taken without frightening the animals away.

Table 6 on the following page gives a sample of the method used in recording the observations.

Table 6. Sample of method used in recording observations of forage being taken

1 Date	2 Hour	3 Locality	4 Snow Depth	5 Cover Type	6 Age & Sex of Animals Observed	7 How Observations made	8 How forage taken	9 Name of Plant	10 Parts taken	11 Amt. Taken	12 Remarks
1940											
11/26	1 p	Ural	0-3"	YP-DF	?	A	G	Ag.in.	L,C	1	took exposed tops only
					?	A	N	"	L,C	2	
12/2	2 p	Sutton Cr.	0-5	YP-DF	?	B	P	Fsc.	L,C	2	
					?	B	P	Fid.	L,C	1	
					?	B	B	P.tr.	B,L,T	3	
1941											
1/7	10:30 a	Ural	6-10	" "	?	C	P	ca.pu	L,S	2	
					?	C	G	Ag.in.	L,C	4	
1/30	1:40 p	"	0-10	" "	A*	D	G	" "	L,C	1	protected by cliff
2/5	1:20 p	"	0-2	" "	A#	B,D	G	Fsc	L,C	2	
2/21	3:50 p	Rat Gul.	0-8	" "	Y#	B	G	He.gl	L,S	3	overhanging on cliff
3/27	9 a	Cripple Horse Cr.	0	" "	?	C	B	A.Al	L,B,T	5	browsed 1A twigs

Explanation: 2 column: p-p.m.; a-a.m;, 4, 0-3" indicates ground bare in spots and up to 3 inches in others, 5-YP-DF yellow pine-Douglas fir, 6-A-adult, Y-young, #male, *female. 7-A, by tracks only;B-jumping animal then backtracking; C-tracing the animal then "jumping" it; D-actually observing the feeding animal. 8-G-grazing, N-"nozzling" like a horse feeds in loose snow, P-pawing, B-browsing. 9. Abbreviation of scientific name of plant, ie, Ag in-Agropyron inerme. 10. L-leaves, C-culms, B-buds, T-twigs. 11 is subjective, 1 to 5 i.e., 1-if any part of plant was bitten off; up to 5 as maximum amount taken.

It may be seen by studying Table 6 that by multiplying the figure in column 11 by one (for each time the plant appears in column 9, and totaling these values, the relative importance of each plant will result. For example; agropyron inerme (Ag.in.)appears in column 9 four times; by adding the corresponding figures in column 11 we get a relative value of "eight" for this plant. It was in this manner that the value ratings for each plant were reached.

The one stomach sample available was from a crippled yearling male bighorn collected on March 5, 1941 on Sutton Creek. It was submitted to the Food Habits Laboratory of the Fish and Wildlife Service at Bowie, Maryland. The examination was done by C. H. Jensen, whose findings were as follows:

Vegetable matter - 100%

Gramineae blades and some fragments of Carex sp.	98%
Heuchera sp. leaf fragments	2%
Pinus ponderosa (leaves)	trace
Pseudotsuga taxifolia (leaves)	"
Amelanchier sp. (leaves)	"
Bryales	"

It is seen from Table 5 that browse plays a more important role in the spring than in autumn and winter. Field observations showed that usually only the young, tender, succulent growing tips were eaten.

The following tabular form fairly well sums up the foods used by these bighorns during the period of study.

	Autumn*	Winter	Spring*
Grasses	80%	90%	50%
Weeds	10	5	20
Browse	10	5	20

*Estimated

3. CARRYING CAPACITY

Before a definite sustained carrying capacity can be worked out for this sheep range, it will be necessary to know more about the year-round foods, the number of "bighorn months" spent on the winter range during summer, and a more successful method of measuring range values for big game animals.

It is felt, however, that there is sufficient winter range to accommodate 200-300 head of bighorn sheep.

4. RANGE COMPETITION

An estimated number of 500 mule deer and a negligible number of whitetail deer use the winter range with the sheep. Competition between these animals exists only to the extent that the deer are chiefly browsers, taking some grasses and the amountain sheep are chiefly grazers, taking some browse. In the opinion of the observer, it would be desirous to reduce the number of mule deer on this area, if for no other reason than to benefit the deer population itself. To "pressure areas" are developing at the present time.

In the event that this band of mountain sheep can be built up to the desired number, this deer reduction may be necessary.

There has been very little use of this bighorn range by domestic stock. A few head of horses use Cripple Horse Creek during fall and winter and a few head of cattle use Sutton Creek in summer and fall, but no signs of domestic stock were seen on the winter range of bighorn sheep.

5. MINERAL REQUIREMENTS

(a) Natural licks:

Reference to Map C will show the location of three natural licks known to be used by the bighorns. Lick #1 was baited with artificial salt in the spring of 1940 and renewed with sulphurized stock salt in February and May, 1941. Licks #2 and #3 are now known to have ever been baited.

The bighorns began using the licks about February 15 and continued until June. The greatest use was during April (just previous to lambing seasons.) There appeared to be no definite time of day during which the licks were frequented; the sheep were as likely to be seen using them during the heat of the day as during morning and evening hours.

Some observers have found that mountain sheep appear to prefer the salt-concentrated soil around the block rather than the block itself. Regarding this an observation of interest was made on April 21. At 2:30 p.m. eight adult rams were seen on Lick #1. A portion of a block of sulphurized salt had previously been placed on the lick. In the scramble to get at the salt the rams had pawed at it until they had moved it downhill about 80 feet from where it was originally placed. These large rams fought over the salt similar to the manner in which domestic stock do.

Samples were taken from Lick #1 in June, 1940, and March, 1941 with the intention of submitting them for analysis; if these analyses were ever made the results never reached the observer. Hence, nothing is known of mineral deficiencies that may exist.

(b) Water

Again referring to Map C one may see where water was known to be

available to the sheep up to June. But little is known about how frequently water is taken, or where it is obtained by these animals during the summer months.

On one occasion the observer believed he witnessed an adult ewe drinking at the spring near Lick #2 but was not certain of his observation. On February 18 an adult ewe was seen eating snow, and on several other occasions tracks and "nose holes" in loose snow indicated that the sheep had eaten snow. So it is probable that during the time snow is available the bighorn satisfies his water requirement in this manner.

XI. POSSIBLE DECIMATING FACTORS

The accomplishments in this phase of the work have been disappointing. The information has been too fragmentary and scattered to be of much real significance.

1. PREDATORS

Attack was made on this part of the problem by (1) direct observation. (2) tracking, and (3) coyote dropping analysis. Concerning the first method, an observation was made under date of January 15, 1941. At 3 p.m. a band of four ewes and lambs was seen running. Fresh snow covered the ground, hence tracks found were necessarily made within an hour previous to the observation. On proceeding toward the point to investigate the cause of this alarm, a fresh coyote track was found. At no time was the coyote in view of the sheep, but they were directly down wind from the predator and only about 125 yards distant. It was apparent that the coyote had never located the sheep but they were frightened from scenting it.

An attempt was made to collect and examine coyote droppings at field headquarters but the lack of necessary time and equipment, as well as the lack of adequate knowledge of technique caused abandonment of the idea. No bighorn remains were found in the few droppings examined, however. Likewise, tracking yielded no incriminating evidence against the coyote.

Nevertheless, the coyote is abundant on the sheep range. There appears to be several factors responsible for this high coyote population: (1) four Great Northern passenger trains daily pass along the area at or near meal time and considerable food scraps are cast off to be available to coyotes; (2) throughout the year the trains kill domestic stock and deer, which are eagerly devoured by the coyotes, and (3) no intensive trapping has been carried on in the past few years because of the high percentage of mangy coyotes present.

At the present time the mountain lion is definitely out of the picture as a factor in keeping the bighorn population in this area at

a low ebb. Only one track was seen on the study area.

One bobcat was seen and tracks of another encountered but no evidence against this animal resulted from the study.

Trappers catch a few Canadian lynx in the lodgepole pine timber type adjacent to and above the winter range, but again, this animal is not considered a factor.

An interesting observation was made on June 4, which gives us some insight into the behavior of a bighorn ewe in the presence of a black bear. The observer had been watching the ewe with her very young lamb when a falling rock directed his attention across the precipitous canyon. The source of this commotion was soon discovered to be a large bear with two small cubs. She was unconcernedly turning rocks over in her search for food and some of these were tumbling from the narrow shelf with a thundering noise. An eager glance at the ewe showed her assuming an alert stance with her attention fixed on the bears not 400 yards distant. This "spell" was soon broken as the wise ewe promptly took her wabbly lamb around the mountainside. At no time were the bears aware of what went on.

Over most of the West the golden eagle has been blamed for serious predation on lambs of the bighorn. It is felt that we have no eagle problem here. Only two or possibly three of these birds were seen near the area and none of these on the lambing range.

2. MAN

The effort to determine the "poacher load" the Ural-Tweed bighorns are forced to carry yielded no results. This may have been due to the wholesome effect of the presence of someone on the area. The very wary nature of these sheep leads one to believe that they are poached. One ram skull was found with a lead bullet still imbedded in the forehead and the cervical vertebra sawed squarely off with some sort of saw. This had taken place at least two years previous to the study. Several rumors of illegal killing reached the observer but no evidence of it was seen.

3. PARASITES AND DISEASES

The complete or remnant skeletons of five animals that were lost previous to the beginning of the study are reported on as follows:

#1 - Adult ram
date found - Oct. 15, 1940
Probable cause of death - poacher (lead bullet in skull and "sawed" vertebra.
Teeth-good condition
Length of time probably dead - 2-5 years.

#2 - Adult ram
Date found, Oct. 29, 1940
Probable cause of death - unknown, probably natural causes
Teeth - molars with cavities
Length of time probably dead - 6 months

#3 - Adult ram
Date found, March 20, 1941
Probable cause of death - undeterminable from remains
Teeth - cavities in molars
Length of time probably dead - 2 years

#4 - Adult ewe
Date found - March 20, 1941
Probable cause of death - undeterminable from fragmentary skull
Length of time probably dead - over 4 years

#5 - Adult ram
Date fournd - May 29, 1941
Probable cause of death - undeterminable from remains
Teeth - cavities in molars
Length of time probably dead - 5 years.

#6 - Yearling ram

On march 5, 1941, a crippled yearling ram was found. One and one-half hours of constant observation of this animal revealed no abnormal behavior except a severe lameness. At 1 p.m. the young ram was shot for autopsy. It weighed only 54 pounds. The carcass was taken to the Rocky Mountain Laboratory in Hamilton, Montana and examined at 8 p.m. March 6, 1941, by Dr. Wm. L. Jellison, Assistant Parasitologist, U. S. Public Health Service. Following is Dr. Jellison's report verbatim:

Autopsy of Rocky Mountain Sheep, Ovis canadensis

On March 6, 1941, Mr. Brink, of the U. S. Forest Service, brought to the Rocky Mountain Laboratory for autopsy a young male Rocky Mountain Sheep, Ovis canadensis, from Lincoln County, Montana. This ram had been injured and was sacrificed the previous day.

The animal was examined for ectoparasites and endoparasites. The skin, skull, and skeleton were preserved by Mr. Brink.

Large number of engorged and engorging adults of Dermacentor Andersoni (wood tick) were collected from the skin of the animal, 63 specimens of which were preserved. It was also infested with Dermacentor albipictus, the winter tick, in nymphal and adult stages. Two numphs and 57 adults of this species were preserved.

Deep in the ears were found numerous specimens of the spinose ear tick, Otobius megnini. Apparently this constitutes the first record of the ear tick from mountain sheep, but few wild sheep have been examined carefully for parasites so it is probably not a new parasite to the sheep. Thirteen nymphs of the spinose ear tick were collected and preserved.

No intestinal parasites were found of autopsy but the stage of post mortem change made careful examination of intestinal contents difficult.

No nasal bots, Oestris ovis were found in the head.

The posterior tips of the lobes of both lungs were consolidated and numerous lung worms were found in the bronchial tubes. These were determined by G. Dikmans, of the Bureau of Animal Industry as Protostrongylus rushi. Portions of the diseased lungs were preserved in formalin and were also examined by Dikmans and reported there might also be an infestation of another species of Prolostrongylus in this tissue.

A small, subcutaneous cyst from the neck region contained only coiled hairs and not parasites as suspected.

The ticks were determined by Dr. R. A. Cooley, of the Rocky Mountain Laboratory, the lung worms by Dr. G. Dikmans, of the Bureau of Animal Industry at Washington, D. C. The autopsy was made and parasites collected by Dr. Wm. L. Jellison.

Dr. R. A. Cooley in a letter to the project manager dated March 8, 1941 states of the spinose ear tick:.

> From your point of view, it is probable the presence of Otobius megnini was the most interesting point because this tick becomes quite injurious when abundant. It might be even more injurious to mountain sheep than to cattle which it usually attacks, or it might be less injurious.

#7. Adult Ram.

After the study had terminated the observer was notified of a dead ram. This ram had died on one of the old flood planes of the Kootenai River, at the very foot of winter range.

Date found - July 6, 1941.
Probable cause of death - old age
Teeth - The molars of this ram had great cavities in them and there were wide spaces between the molars. Decayed foods were tightly wedged and packed into these cavities and spaces

External parasites - A few ticks (probably winter ticks though identification has not been checked) were collected and preserved. These ticks were numerous even as late as this date.

External lesions - There was a skin wound across the nose as though the animal had struck some sharp object, perhaps a ledge of rock. There was also a wound on the left hip as though the ram had run under an overhanging snag.

Post mortem change was too far advanced for internal examination.

Length of time probably dead - 2 days.

Recapitulation

Poachers	1 adult ram
Accident	1 yearling ram*
Unknown	4 (adult rams, 3, and adult ewe)
Old age	1 adult ram

*it is problematical whether to class this #6 loss as pure accident from fall or parasites causing a spell of dizziness resulting in the fall which broke its shoulder.

It will be recalled that the only two carcasses examined were infested with ticks. It is known that the winter tick, Dermacentor albipictus, was annoying the sheep as early as January 22. This was determined from collecting ticks with wads of hair from bedgrounds during freezing weather. The low temperatures rendered the ticks inactive when they were freed. The tick infestation appeared to be most severe during February and March. During these months it was noticed that the sheep were scratching almost continuously.

The ewes were seen scratching the back of the neck in a peculiar fashion. The neck was outstretched and the head thrown back in such a manner as to allow the point of one horn to touch the back of the neck. By rotating the head from side to side the back of the neck was scratched.

By the last of March, nearly all the sheep had bare spots on the hind part of the neck and shoulders, the result of attempts to free themselves from ticks.

There appears to be much divergence of opinion as to whether ticks are capable of attacking and killing healthy animals. It has been noted that tick infestations are most severe on diseased or otherwise weakened animals. Perhaps they may be the end result of some nutritive deficiency

or disease. At any rate, some losses in domestic stock here have been attributed to ticks alone. Likewise, there is disagreement as to how effective sulphurized salt is as a repellent to these parasites. On this we may report one observation. A rancher living at the very foot of the winter range had pastured an old mare with a yearling colt in an enclosure all spring. Within this pasture sulphurized salt was kept available at all times; in spite of this, an examination of these animals during the severe part of the season revealed numerous ticks on them. Of course, we do not know how severe the infestation might have been, had there been no access to the sulphurized salt.

4. INBREEDING

We know that inbreeding produces weak and diminutive animals. One method of attacking this phase of the problem would be to secure measurements of these bighorns to compare with those of normal animals of other areas. Obviously, this could not be done without capturing and studying the animals at close hand.

There seems little danger of inbreeding in wild animals where conditions permit free movement and mixing. However, where a small number of one species is isolated, with little or no apparent exchange of breeding stock with separate herds, there would appear to be danger of this condition. As far as could be determined, the nearest bighorn herds are those of Glacier National Park in the neighborhood of 60-75 miles distant. There is little likelihood that exchange of breeding males is taking place between these herds. Highway No. 93 divides the two areas, the valleys adjacent to this highway are relatively thickly populated, and a bighorn has never been reported crossing as far as the writer could determine. Just how far north into British Columbia it would be necessary to go to find bighorns was not learned.

In past years bighorns were seen crossing the Tobacco Valley near Eureka, Montana, but one have been reported in recent years. However, during the summer of 1940 a large ram was seen on Highway No. 2 near the Lincoln-Flathead County Line. This point is perhaps 50 miles from any known bighorn range. It is possible that the animal was enroute to or from a small band in the Cabinet Mountains near Thompson Falls.

VII. DISCUSSION AND CONCLUSIONS

The decline of the bighorn has given rise to a series of guesses, hunches, theories and speculations as to the cause of such decline.

Let us consider some of these in the light of our problem as seen from our inconclusive studies.

1. SHEEP FORCED TO USE HIGH UNNATURAL RANGE

To begin with, the evidence is not at all clear to some that even the

elk was "forced" up into the rugged country. It now appears that the wapiti once occupied both rugged and plains country but was simply exterminated in the plains. Thus, perhaps we should not be too hasty in our wholesale acceptance of this factor for our wild sheep. Be that as it may, our bighorns spend their lives mostly below 6500 feet and their winters mostly below 4500 feet. Furthermore, if the bighorns were here in 1886 there is little reason to doubt that this is primitive range.

2. DISEASES TRANSMITTED BY DOMESTIC SHEEP

Two parasitic diseases appear to have played an important role in the mountain sheep reduction. These diseases, (scabies, caused from the scab mite, Psoroptes communis, and pneumonia, caused by infestation with lung worms and/or bacteria, are found in both domestic and wild sheep, (2) the same species of lung worms occurring in bighorn has not been found in domestic sheep.

As far as could be determined, domestic sheep have not used any of the bighorn's range on the Kootenai National Forest.

3. INSUFFICIENT FOOD

Over some of the West this appears to be a definite limiting factor but it is not considered such here.

4. PREDATORS

The mountain lion may have exercised serious predation when it was abundant, but now it is scarce.

The coyote is probably accounting for some sheep but not an appreciable number, certainly not enough to hold the band in check.

5. POACHING

It is felt that this is contributing to our losses to an unknown extent, but as a single factor, it does not seem responsible for the lack of increase.

6. REVERSAL OF SEX RATION

Reversal of sex ratio has been given as a factor in Yellowstone Park. With an estimated ratio of two ewes to each ram, this hardly seems feasible here.

7. WIDE SPREAD OF BREEDING SEASON

The wide spread of breeding season with consequent early and late lambs has been given some attention in Yellowstone Park. Our observation of a known increase of at least 64 percent for 14 ewes (seen near peak lambing date) does not support this idea.

That lung worm infection was found in one of the sheep is significant. Review of the literature has pointed out that pneumonia is still causing losses of our bighorns.

Studies carried on in the three states that have the largest herds of our remnant bighorn population incidate a serious lamb loss. The lambs die during their first summer and winter. These losses seem to be due to pneumonia and coccidiosis. The casual agents of the latter are protozoan parasites which attack the cells of the intestinal tract. District Ranger Harold M. Ratcliff in the March, 1941 Progress Report on the Bighorn Sheep Study in Rocky Mountain National Part states:

> Eimeria arloingi (one of the causative organisms of coccidiosis) is the most dangerous, for its effects can be very virulent and fatal to young lambs---- The danger period is early in life, a natural immunity being developed with age... Lambs may be chronically affected, showing symptoms at about two months, but eventially die of cachexia (debility). Younger lambs may die of acute infection, and show marked symptoms/.. Such cases are probably due to infestation while grazing at first with the mother who has harbored the parasite over the winter.
>
> The importance of coccidia as a lethal factor in the park bighorns has not been determined....
>
> There is no known remedy for coccidiosis that could be applied to park bighorns.

From a Progress Report of Studies being carried on in Wyoming under the Tri-State Bighorn Study, it appears that bacterial pneumonia is dealing the death blow to lambs. There a lamb was found dead on July 25 and autopsied. The general findings were that one lung was diseased with massive lobar pneumonia. Further comments on this autopsy are quoted:

> The culture from the lung and trachea showed four types of bacteria, three of which were isolated by the routine laboratory methods. The fourth organism did not grow well on the media, and therefore could not be isolated. For this reason, ground diseased lung tissue was injected into rabbits. Five rabbits were used and all of them died within 12-48 hours. From the body cavity of three (of the rabbits), a pure culture of streptococcus was

isolated. This organism is believed to be the one causing the loss in lambs, although a bacillus similar to the one causing hemorrhagic septicemia was seen in cultures.

Another lamb showing symptoms was shot and autopsied and similar conditions found. Quoting further:

> The general findings are the same in both cases, which show the lamb loss is due to a contagious pneumonia of bacertial origin.
>
> There yet remains two important things to be determined. First, the identification of the causative organism and, secondly, the solution of the manner by which this contagion is carried from year to year, and if there be predisposing causes.

This loss of lambs seems to come nearer fitting our own case than any that have been discussed. If these lambs are dying on the Ural-Tweed range, it would seem that more skeletons would be found. But when it is remembered that with one man searching over an area as large and rough as the winter range, the chances are rather remote of his finding dead animals before predayors devour them and scatter the bones.

The factor limiting the increase of the Ural-Tweed band may not have been touched upon in this report. Allow us to report an opinion expressed by T. B. Murray, Assistant Regional Director, Fish and Wildlife Service. At a conference of the Cooperative Bighorn Sheep Study held at Fort Collins, Colorado on January 13, 1941, Mr. Murray expressed the opinion that: "while progress has been made, relatively little is known about influences affecting bighorn sheep."

It may be encouraging to learn that at least one band of bighorn sheep in the West is on the upgrade.

> The tarryall herd in Colorado has increased from an estimated 7 head in 1923 to some 400 now (January, 1941). Their present available range is believed to be about the same as in pre-white man times. There is little predation, no evidence of disease, and poaching is almost negligible. A 90% lamb crop was still at 75% in mid-December, with a 70% yearling and a 63% two-year old survival based on counts. The problem is one of management.

If it seems practical to continue bighorn studies in Montana. In the face of partial repetition of the work of the Tri-State Study, there appears to be other bands in the state occupying range that permits better observation of the animals.

More could be learned of the true status of bighorn sheep in Montana by a more thorough attack. This can be briefly outlined as follows:

1. Secure the cooperation and guidance of the Fish and Wildlife Service.

2. Attack predator problem by a correlation of field observations and analysis of stomach contents and droppings.

3. Determine presence of parasites and disease by autopsy and final analysis correlated with field observations.

4. Determine possible nutriment deficiencies by analysis of forage plants, lick samples and water.

5. Correlate this work with that of the Tri-State Study so that all agencies might profit by the findings of each.

XIII. RECOMMENDATIONS:

1. It is felt that, in the light of developing pressure areas and some confliction of food habits with bighorn sheep, the mule deer population using the Ural-Tweed winter range should be reduced by 25%.

2. It is recommended that 50% of the coyote population be trapped from the north half of Lincoln County.

3. It is further recommended that forest officers and local game wardens cooperate in launching an aggressive campaign against poaching these bighorns.

4. It is recommended that four blocks of mineralized salt be made available to the bighorns in early spring of each year. This all-purpose salt can be purchased from the Cudahy Packing Company. It is composed of the following ingredients: Steamed bone meal, potassium iodide, limestone, salt, molasses, anise, iron oxide and copper sulphate.

5. Four to six young rams of breeding age be exchanged with some other bighorn herd of the state.

6. It is recommended that studies be made of hereditary bighorn range of the state to learn what problems are to be overcome first, then put mountain sheep back on these ranges, keeping in mind that they are wilderness game animals and are harmful to and harmed by economic land uses.

7. Lastly, it seems desirous to keep in touch with the Tri-State

study so that any management practices that may result from their efforts may be put into effect here.

XIV. ACKNOWLEDGEMENTS

Part of the success of this study is due Drs. L. C. Browman and P. L. Wright of Montana State University for helpful suggestions and encouragement, credit is due officers of the Kootenai National Forest for use of equipment; and various workers in this field for reports of their studies elsewhere. We also wish to acknowledge the aid given by Dr. Wm. L. Jellison of the Rocky Mountain Laboratory in Hamilton, Montana, and members of the Food Habits Laboratories of the Fish and Wildlife Service

NOTE TO COOPERATORS: Check lists of the birds and mammals of the study area and their relationships are being prepared and will follow later.