THE SPECIES AND INCIDENCE OF HELMINTH PARASITES FOUND IN THE WILD AND DOMESTIC RUMINANTS OF IDAHO AND THEIR POSSIBLE TRANSMISSION FROM THE WILD TO THE DOMESTIC RUMINANTS

A Thesis

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THE SPECIES AND INCIDENCE OF HELMINTH PARASITES FOUND IN THE WILD AND DOMESTIC RUMINANTS OF IDAHO AND THEIR POSSIBLE TRANSMISSION FROM THE WILD TO THE DOMESTIC RUMINANTS

BY

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INTRODUCTION

In many instances, cattle and sheep utilize the same ranges occupied by deer, elk and other wild ruminants. There has been very little work done in the State of Idaho concerning the species and incidence of internal parasites found in either wild or domestic ruminants, although parasitic infections are common in both in many areas within the state.

In order that effective controls may be initiated to combat the internal parasites of domestic sheep and cattle, it is necessary to determine the source of infection. Research on this subject has been carried out in various states such as California, Wyoming and Oregon, but no work of great consequence has been done in Idaho. More information is needed regarding the complex relationships of parasitic infections. Since the geographical conditions of other states are quite different from Idaho and observations have shown that the acquisition and pathogenicity of parasites is significantly affected by these and other factors, it was apparent that a controlled study should be carried out in this state. Such a study was begun in 1956 and there are plans to continue it for an indefinite period. Part of the preliminary results are incorporated in this thesis.

This study is a product of a regional interest regarding parasites and parasitism. The 11 western states have come to realize that parasitic diseases of western livestock and wild ruminants are generally insidious

in character, with definite symptoms and long duration. The nature of these diseases are such that considerable loss occurs before the disease is recognized. These considerations, plus the fact that the livestock industry is one of the most important bases of the economy of the western region, prompted setting up a regional project in February, 1955 to gather information regarding species and incidence of internal parasites of wild and domestic ruminants and their transmissibility from one to the other. Many other phases of parasite research were also initiated by this project to supplement already known facts. Such things as the relationship of parasites to environmental conditions, evaluation of various management practices in parasite control, new anthelmintic and physiological studies of the host were included in the regional project. It is quite evident that no one state could carry out a project of so great a magnitude.

The Agricultural Experiment Station at the University of Idaho, under these conditions, was given the responsibility of carrying out a research program by the Western Regional Experiment Station Directors. This thesis is a contribution to this program.

Information concerning the species and incidence of helminth parasites to be found in the State of Idaho is of paramount importance before other research assigned to the state can be effectively initiated. Thus the first objective of the writer was to examine fecal specimens collected throughout the Southeastern part of the state in order to obtain this information. Samples from domestic sheep and cattle along with samples from deer, elk and moose were collected and examined and the species of helminth parasites were determined through ova identification. The second phase of this project was to determine the extent of transmissibility of

OBJECTIVES

The objectives of this study are as follows:

1. To determine the species and incidence of internal parasites in wild ruminants.
2. To determine the species and incidence of internal parasites in domestic ruminants.
3. To determine the transmissibility of internal parasites of wild ruminants to domestic ruminants.

Due to the magnitude of this project, since it involves the state as a whole, the basic study has been set-up in such a way that several years will be required to obtain sufficient data for complete coverage of the state. The material obtained up to this time is reported in this thesis and will give some sort of a base from which future work can be done.

METHODS

Proper examination of the feces can provide a reasonably accurate identification of most of the helminth parasites which inhabit the alimentary or respiratory tract. Since wild ruminants will acquire some of the same internal parasites as the domestic ruminants the writer relied upon information available at the Veterinary Science Department of the University of Idaho for identification. Texts by Cameron (1934), Craig and Faust (1940), Monnig (1950), and Morgan and Hawkins (1953) were invaluable throughout this study.

The fecal samples of the domestic ruminants utilized in this study were collected by Dr. James W. Bailey of the Veterinary Science Department at the University of Idaho. The specimens were collected mainly from adult sheep and cattle at private farms. These field samples were obtained from freshly defecated or rectal material. The writer collected many of the wild ruminant samples but also received assistance from the Idaho Cooperative Wildlife Research Unit. The domestic ruminant fecal samples were obtained primarily from Southeastern Idaho although the basic study will eventually cover the rest of the state. The wild ruminant samples came primarily from the Farragut Wildlife Refuge and the Hatter Creek Enclosure. Other wildlife samples came from Southeastern Idaho and from the Selway River drainage in Idaho County.

The samples were collected in small jars containing a 10 percent solution of formalin. The jars were then numbered and labeled to show the county and location within the county where the sample was obtained. In addition the host animal was recorded.

To fully evaluate the contents of fecal material it was necessary to

determine the most practical and effective method to use in isolating the ova. A list of methods for the preparation of fecal material for examination was obtained and 50 samples were run using each method.[1] The methods utilized included: Sugar Flotation Method, Zinc Sulfate Solution Method, Saturated Solution of Sodium Nitrate Method, Saturated Solution of Sodium Chloride Method and the Sedimentation Method.

After experimenting with these various methods it was decided that the sedimentation technique was by far superior both in time expended and in results obtained. This technique requires the minimum of equipment and has the advantage that it will recover all eggs and larvae. It is particularly suitable for the trematode eggs which are operculated, heavy and sink to the bottom when flotation techniques are used. Since the sedimentation technique is essentially a washing process, the concentration is not as marked as in some of the other techniques. This situation was remedied to a certain degree through the use of a 10 percent alcohol solution in the washing process. By this method the surface tension of the liquid is reduced resulting in a greater yield of eggs. The basic procedure was that of Morgan and Hawkins (1953), with certain modifications.

"The technique is described as follows:

a. Place a sample of feces about the size of a walnut into a 250 cc beaker; add 1/4 full of water and emulsify; then fill 3/4 full with water.
b. Strain this preparation through wet cheesecloth into a 500 ml. coneshaped graduate.
c. Allow to settle for 1 hour.
d. Carefully pour off the upper 2/3 of the supernatant, but do not allow the sediment to escape.

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[1] The list of methods and their make-up are as set up by Morgan and Hawkins (1953).

e. Add fresh water to the graduate, again agitating the sediment.
f. Allow to settle for 1 hour.
g. This washing procedure may be repeated until the supernatant is clear, although once will generally be sufficient.
h. Carefully pour off the last supernatant without losing any of the sediment.
i. Pour this material into a small 10 ml. coneshaped graduate and allow to settle for 20 minutes.
j. Remove some of the sediment by means of a pipette and place on a clean microscope slide.
k. Examine under the low power of the microscope."[1]

The measurements of the ova are useful in their identification. However, there are numerous species of internal parasites that have overlapping ova measurements. This necessitates reference to other differential characteristics for final identification.

The measurements of the ova were obtained with the use of an ocular micrometer scale in a calibrated microscope. The measurements were converted to microns. The results of the measurements are shown in Table 1. The stage of development of the ova and other differential characteristics are also noted on this table. In Table 2 this same information is given for the domestic sheep ova.

Differentiation between most ova is relatively simple providing proper methods are used to measure the differences. In order to best accomplish this, the characteristics outlined by Coffin (1945) were utilized. These included: (1) the over-all size of the ovum, (2) proportion of length to width, (3) shape and contour of the shell, thickness and structural details of the shell, (4) color of the ovum and opacity of the central protoplasmic mass, and (5) stage of development of the embryo.

Coffin indicated that the proportion of the length to the width is a helpful characteristic. He stated that this characteristic can be exemp-

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[1] Page number 347, Morgan and Hawkins (1953).

Table 1. Measurements of eggs of nematodes and trematodes reported for cattle in Idaho.

Species of Parasites	Maximum and Minimum Length and Width of Eggs (μ)	Mean Length and Width of Eggs (μ)	Stage of Development	Remarks
Oesophagostomum radiatum	97-69 x 52-41	80 x 46	4-16 cells	2nd and 3rd layers of shell 1.9 μ thick
Haemonchus contortus	83-79 x 45-41	81 x 43	Morula	
Trichostrongylus sp.	107-86 x 55-41	94 x 49	Morula	
Neoascaris vitulorum	86-73 x 79-69	81 x 74	?	Thick shells with prominent projections on albuminous layer
Nematodirus spathiger	211-208 x 104-100	209 x 101	1-8 cells	
Fasciola hepatica	159-128 x 90-69	141 x 76	Undeveloped	Shell light yellow
Chabertia ovina	114-93 x 83-52	101 x 62	Morula	2nd and 3rd layers of shell 2 μ thick
Trichuris ovis	76-69 x 38-31	72 x 35	?	Eggs with plug in each end
Dicrocoelium dendriticum	41-38 x 31-27	40 x 28	?	Operculated, dark-brown eggs
Dictyocaulus viviparus	101-76 x 49-42	84 x 47	Fully developed Embryo and hatched larvae	First stage larvae in feces, no cuticular knob at anterior end, numerous brown granules in intestine
Bunostomum phlebotomum	93-72 x 38	82 x 38	Morula	Ends bluntly rounded
Mecistocirrus digitatus	125 x 59	—	Morula	
Paramphistomum cervi	166-163 x 83-76	164 x 79	Undeveloped	Shell clear, operculated
Ostertagia circumcincta	86 x 45	—	Morula	Sides of egg curved, 1.5 μ thick
Eurytrema pancreaticum	41 x 31	—	?	Operculated egg
Fischoederius elongatus	152 x 83	—	?	Operculated egg
Cooperia pectinata	69 x 31	—	Morula	Cells almost lacking in yellow pigment

lified through the comparison of the nodule worm of sheep, Oesophagostomum columbianum, and the hookworm, Bunostomum phlebotomum. The latter, for example, is much broader in relation to its length than the former. Coffin goes on to say that differences in shape or contour of the shell may be very obvious, as between the whipworm and the hookworm of dogs, Trichuris vulpis, Fröhlich, and Ancylostoma caninum, Ercolani. A more subtle difference exists between the ova of the nodule worm of the hog, Oesophagostomum dentatum, Rudolphi, and that of the red stomach worm, Hyostrongylus rubidus, Hassall and Stiles. The majority of the latter have one narrow end that gives a slightly pointed appearance when compared with the more symmetrical outline of the Oesophagostomum. Variations in the thickness of shells can be seen by contrasting the extremely thin-shelled ovum of Strongyloides sp. and the thick-shelled egg of the hog metastrongyle.

Most ova appear to have no color other than gray when viewed with the microscope. The several species of Trichuris, however, are pale lemon-yellow to brown as are the various species of Fasciola.

The stage of development of the embryo is an important differential characteristic. Those of the ascarids and Trichuris are seen in the single-cell stage. Those of Ancylostoma caninum, Oesophagostomum columbianum and the strongyles are generally in the 8-cell to 16-cell stage. Those of Strongyloides sp. and the metastrongyles contain fully developed motile embryos.

It must be noted that the age and method of preservation of the fecal samples will have some influence on the extent of the development of the embryos. Thus refrigeration or preservation with formalin will prevent the maturation of the embryonal mass.

Careful attention to the differential features outlined by Coffin gave the writer an extremely effective method for recognizing the parasitic ova encountered in the fecal samples examined.

Methods Used in Checking Treated Animals After Exposure in the Field

The 10 experimental steers were checked and treated until June 1, 1956 at which time they were moved to Hatter Creek. On July 1, July 15, August 1, and August 15, an animal was brought in, sacrificed and examined for parasites.

During the months of July and August, 1956, two collections of fecal samples from the penned steers were made. On July 18, a total of 15 samples was collected and on July 25 a total of 10 samples was collected. On August 2 a total of 16 samples was collected and on August 9, 8 samples were collected.

On August 20, the 6 remaining steers were brought in because the creek that supplied the water for their up-keep had dried up. They were placed on clean ground and on the 15th of September were sacrificied and examined.

During the summer of 1957, animals were checked and treated as in 1956. However, only eight head of steers were placed in the low-fenced pen.

Cattle Pen Within the Hatter Creek Enclosure

With the cooperation of the Idaho Cooperative Wildlife Research Unit, the Veterinary Science Department was authorized to construct a low fence enclosing 25 acres within the Hatter Creek Enclosure. This low-fence pen was built in such a way as to permit easy access by the deer located in the area. A free association between the two animal species was encouraged. Figure 1 shows this fence with the experimental steers inside of it.

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Special features as noted in Figure 2 include low height and a large space between the ground and first wire strand. The writer, on one occasion observed a white-tail doe crawl under this fence with little difficulty.

Control Enclosure

During the summer of 1956 a control exclosure was not utilized. On June 6, 1957, the Board of Regents at the University of Idaho approved a request from the Veterinary Science Department for expenditures necessary for materials and labor in constructing a deer-proof exclosure to be built in the Hatter Creek area. This temporary control area will be used for several years in order to obtain more reliable results in the transmissibility experiments. This exclosure will be 8 feet high and will encompass 10 acres. When completed it will afford a means of determining whether domestic ruminants that have free association with wild ruminants are characterized by a greater degree of parasitic infection.

Figure 1. Hatter Creek Experimental Steer Pen.

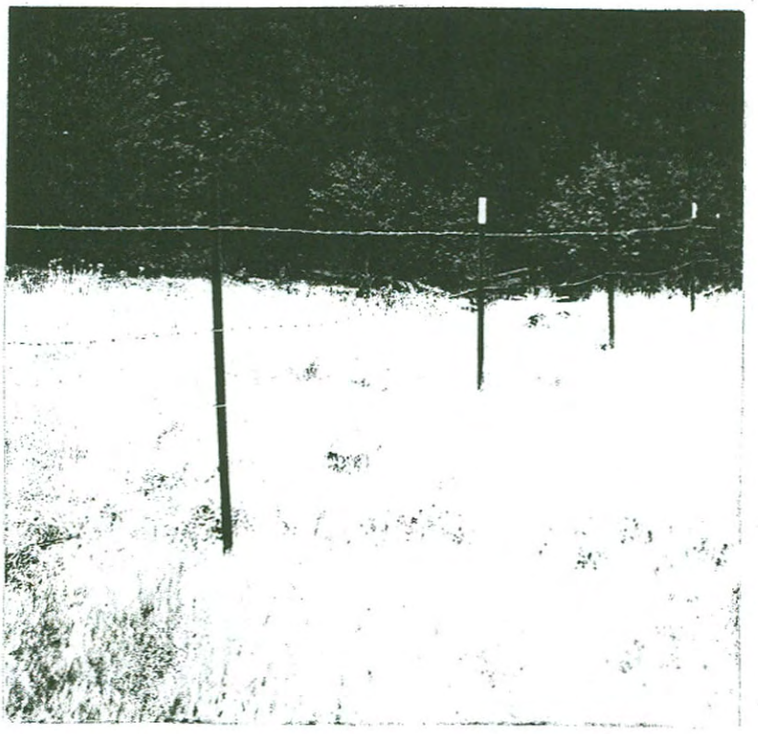


Figure 2. Hatter Creek Experimental Steer Pen. Note the low height and large space between the ground and first wire strand.

CONCLUSIONS AND RECOMMENDATIONS

Strongyles and trichostrongyles were found in 43 percent of the 367 cattle samples examined and in 53 percent of the 174 sheep samples examined. It has already been noted that our present-day anthelmintics are quite effective against these parasite species. The remainder of the parasite species found are not significant as far as the whole state is concerned but may be considered as a local problem in a few states. The remaining 24 counties in Idaho will have to be investigated to complete the work already started. Once this has been accomplished, the State of Idaho can work more effectively on the management of both wild and domestic ruminants to lessen the effects of the parasites found within its borders. Therefore, it is recommended that the state, in its entirety, be completely surveyed in order to supplement these data.

The wild ruminant samples to date have revealed the presence of six species of parasites, five of which are also found in cattle and sheep. These results are primarily based on white-tail deer samples. In order that a more complete analysis be made of parasitic infestations in wild ruminants, more fecal samples will have to be collected. It is recommended that some coordinated plan be set up, with this objective in mind, involving the Idaho Fish and Game Department, Idaho Cooperative Wildlife Research Unit and the Veterinary Science Department.

Transmissibility Experiments

After being exposed within the Hatter Creek Enclosure the experimental steers were noted to be highly infected with the strongyles Oesophagostomum and Haemonchus. Of the 49 samples examined in 1956, 45 percent were infected by these species. In the experiments carried out in the summer of 1957, it

was noted that these particular parasite species were found in 37 percent of the samples examined. As of the date of this report, the Hatter Creek deer herd has not been surveyed completely as to the species and incidence of parasites they possess. The final analysis of the transmissibility experiments will depend on this information. With this in mind, it is recommended that a thorough parasite survey be made of these animals.

From present results the writer suspects that the transmissibility of some species of parasites from wild to domestic ruminants does occur. It is recommended that these suspicions be further substantiated through the use of a control group by future investigators.

SUMMARY

1. In 1956 a series of parasitological studies were started in the State of Idaho. The primary aims of these studies included the determination of the species and incidence of internal parasites in the wild and domestic ruminants within the state and determination of whether there might be some transmissibility of these parasites from the wild to the domestic ruminants.

2. The domestic ruminant fecal samples examined in this study were collected primarily from Southeastern Idaho and the wild ruminant samples were obtained from the Farragut Wildlife Refuge, Hatter Creek Enclosure, Selway drainage in Idaho County and from Southeastern Idaho. All fecal samples were preserved in a 10 percent formalin solution.

3. The technique utilized in preparing the fecal material for examination was the sedimentation technique. This method was chosen after several flotation methods proved to be less efficient.

4. Identification of the ova encountered in this study was accomplished through the use of the following differential characteristics: (1) the over-all size of the ovum, (2) proportion of length to width, (3) shape and contour of the shell, thickness and structural details of the shell, (4) color of the ovum and opacity of the central protoplasmic mass, and (5) stage of development of the embryo.

5. The nodular worm, Oesophagostomum radiatum was present in 33 percent of the 367 cattle samples examined. Haemonchus contortus was next in occurence being present in 5 percent of the cases. This species was closely followed by Neoascaris vitulorus, Trichostrongylus sp., Hematodirus spathiger and Fasciola hepatica.

6. In the sheep samples the nodular worm, Oesophagostomum columbianum was

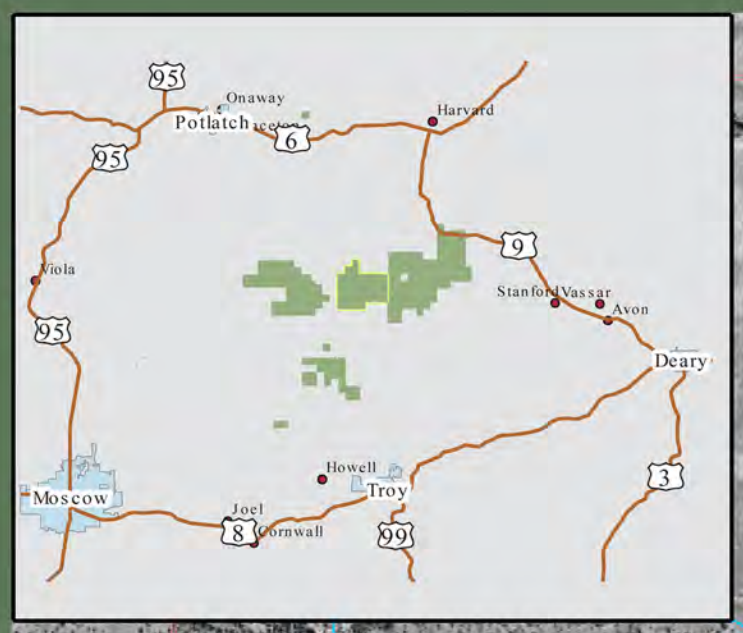
present in 23 percent of the 174 specimens examined. This species was closely followed by the thread-necked strongyle, Nematodirus spathiger, which was present in 21 percent of the cases. The other species ranked in order of their importance include: Trichostrongylus sp., Chabertia ovina, Haemonchus contortus and Fasciola hepatica.

7. The cattle used in the transmissibility experiments were treated with a therapeutic dosage of Phenothite (12.5 gms. phenothiazine per fluid ounce) until they were considered parasite free. They were then placed in a low-fence enclosure in the Hatter Creek area where they could freely associate with the white-tail deer that are located in that area.

8. Fecal samples were collected from these cattle during the summer of 1956 and 1957. They were examined for parasite infections and it was noted that Oesophagostomum radiatum and Haemonchus contortus were found in 45 percent of the samples collected in 1956. Other parasite species found in this year included Chabertia ovina, Nematodirus spathiger and Bunostomum phlebotomum. In the summer of 1957 it was noted that Oesophagostomum radiatum and Haemonchus contortus were again the most abundant parasite species encountered. They occurred in 37 percent of the samples obtained while Chabertia ovina and Trichuris ovis were found in 10 percent of the samples.

9. The majority of the wild ruminant fecal samples collected for this project came from the white-tail deer (Odocoileus virginianus ochrouris, Bailey). Collections also included moose and elk samples. In the deer samples it was noted that 27 percent were infected with Haemonchus contortus and Dictyocaulus viviparus. Oxyuris equi and Ascaris sp. were also found to a lesser extent.

10. The nematode parasites Nematodirus spathiger, Dictyocaulus viviparus and Capillaria sp. were found in the samples of elk and moose that were on hand. The number of specimens available were too few to be of any significance.



Bennett Lumber Products

UI Experimental Forest Administrative Map 2004

- Running Surface Water
- Railroad Grade
- Forest Gravel Road
- County Paved Road
- County Gravel Road
- County Dirt Road
- State Road
- Public Land Survey System
- Forest Gates
- CB Mile Markers
- Cattleguards
- Fire Ponds
- Bennett Lumber Products
- Potlatch Corporation
- City of Troy Forest

Hatter Creek Road

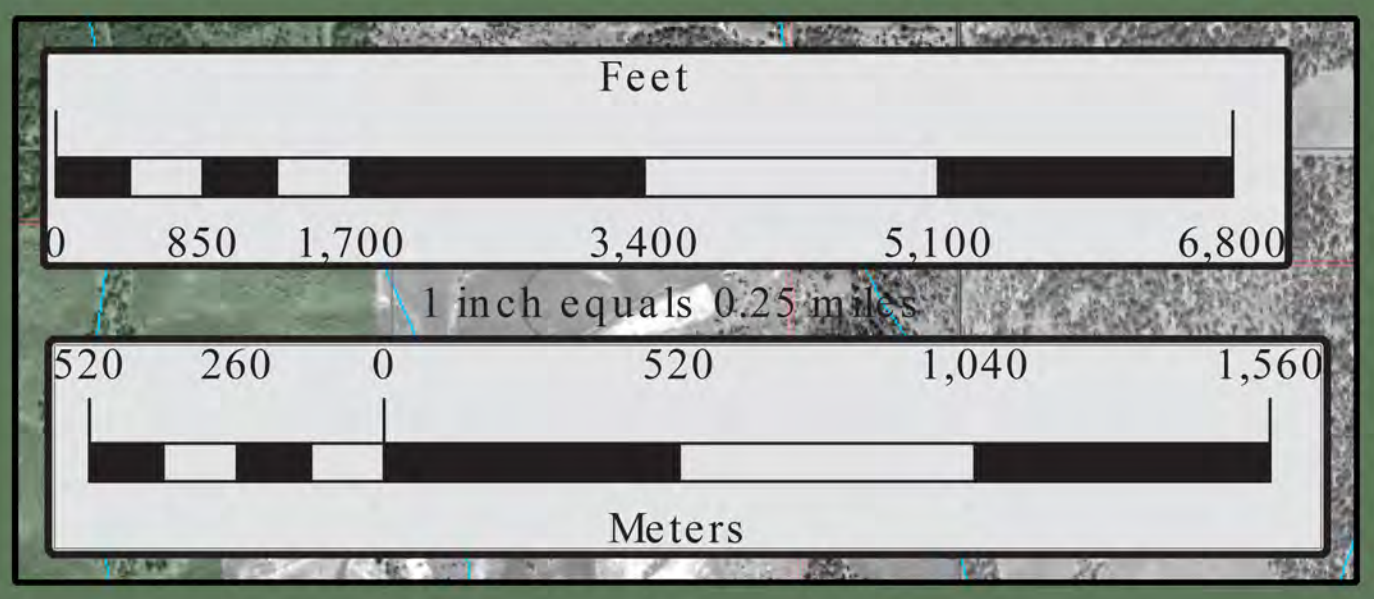
East Hatter Creek

40N04W02

40N04W01

40N04W11

40N04W12



East Hatter Creek

Location of Complete Research:

Author & Title: Greiehue, Algirdas

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University of Idaho Library:

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College of Natural Resources:

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Other Sources: