PROGRESS AND PROBLEMS - MARKING AND COUNTING DALL SHEEP IN THE MACKENZIE MOUNTAINS, NORTHWEST TERRITORIES

by

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Abstract

In early 1968, work was started on the design of a management plan for big game in the Mackenzie Mountains, Northwest Territories. A phase of this project involves the development of a method of surveying Dall sheep populations. Experiments are being conducted in a small block of mountains to determine the usefulness of aerial surveys and to develop techniques for conducting them. Trial surveys to date have pointed out that major errors may occur in aerial counts of Dall sheep. Those errors, plus the high cost of the surveys have led the authors to question the practicality of the counts. Essential to the aerial survey program is a knowledge of the seasonal movements of Dall sheep. Dall have been successfully trapped with simple, inexpensive, portable traps, and marked with ear tags and streamers, horn notches and screws, and paint, but no traps have been located in areas suitable for aerial surveys. Furthermore, trapping is slow and expensive. Experiments are now being conducted on a flexible and relatively inexpensive method of applying dye to groups of Dall sheep from the air to supplement the trapping and tagging program.

Introduction

The hunting of big game animals by non-residents in the vast Mackenzie Mountains wilderness was first permitted by the Government of the Northwest Territories in 1965. The greatest non-resident hunting pressure has been applied to Dall sheep (*Ovis dalli*). Hunter success continues to be high (75-95%), however, and 60% or more of the rams killed have been over eight years of age and have had full curl horns.

In March 1968, Project Leader Norman Simmons began working toward the design of a management plan for big game in the Mackenzie Mountains. The plan is to be presented to the

Territorial Game Management Service for implementation. Since then, he has received the assistance of Territorial Game Management Officers with several phases of the study. During the summer and fall of 1969, Park Warden Jim Robertson conducted a program of trapping and marking sheep in the Mackenzie Mountains as a part of the project.

Aerial Dall sheep surveys

Because of the importance of Dall sheep to non-resident hunters, a major portion of the project has been devoted to that species. A basic step toward Dall sheep management is the development of a population survey technique. Aerial surveys with fixed-wing aircraft seemed to be the logical solution to the problem so we began developing and testing techniques in a small block of mountains near the Keele River.

Goals and assumptions. The specific purpose of our experiments with aerial Dall sheep surveys in the Mackenzie Mountains is to determine our ability to identify legal rams and count all adult rams from an aircraft, count total numbers and plot the distribution of sheep on their summer and winter ranges, and find the boundaries of summer and winter sheep ranges.

Several assumptions were made regarding sheep behavior and movements:

1. Except with rare and insignificant exceptions, summer and winter sheep ranges are above timberline,
2. During the late winter (February through April) and early summer (July) the population in the survey area is relatively static with no significant recruitment or loss of sheep to the area,
3. The sheep will not hide from the aircraft as do mountain goats, but instead will flush and facilitate aerial observations,
4. We can depend on tracks in snow to lead us to groups of sheep; where there is snow cover and no tracks, we will assume there are no sheep and act accordingly,
5. And, of course, all the sheep have an equal probability of being counted.

At least for the study, area, we tried for a census, a total count of the Dall sheep occupying the terrain above timberline. Dall sheep seemed to lend themselves to a census, at least in the winter, because of their limited range and habit of congregating in flocks. The extrapolation of population numbers from random sample counts is not practical because of the highly "clumped" distribution of sheep bands.

Study area 6h. For ease of planning and identification, the mountainous area hunted by non-residents was divided into 20 major areas that appeared easily defined by wide river or stream valleys and/or dense timber stands. These were in turn divided into 173 subdivisions also bounded by timber and drainage valleys. Each subdivision appeared small enough to be thoroughly searched by aircraft in 10 hours or less. The major divisions were identified by numbers and the subdivisions by letters (Fig. 1).

For experiments with aerial survey techniques, area 6h was chosen because of its small size, clearly defined boundaries, and relatively large population of regularly hunted sheep. The numbers of sheep killed there each year are known. Unfortunately, no mineral licks suitable for trapping were found in 6h.

Area 6h is located at about 64° 35' N latitude and 127° 55' W longitude, between the Keele River and the headwaters of the North Redstone River. Relatively gentle slopes of alluvium form the base of the mountain block from about 3000 feet elevation to about 5000 feet. The upper limit of the white spruce cover is at about 4500 feet. Alpine tundra vegetation, which the sheep prefer to occupy most of the year, covers the rest of the area. The southern half of area 6h is made up of rugged, unstable slopes which are largely unoccupied by sheep in the winter. The highest point there is 7812 feet above sea level. The northern half of 6h is characterized by gentler terrain and long, flat-topped ridges. This northern area is preferred by sheep for winter range (Fig. 2).

There are roughly 80 to 100 sheep in area 6h. During the winter there may be 20 or more moose and several hundred woodland caribou on the timbered slopes fringing 6h. Grizzly bears and wolves have occasionally been seen in the area.

Marking sheep. A plan to mark sheep was included in the survey design program so that the seasonal movements of sheep could be related to counts in each sample area. At first the use of syringe-firing weapons at mineral licks to capture Dall was tried, but that method proved slow and costly. Then traps were set up at easily accessible mineral licks in areas 4f and 4g. Dall sheep in these traps have been

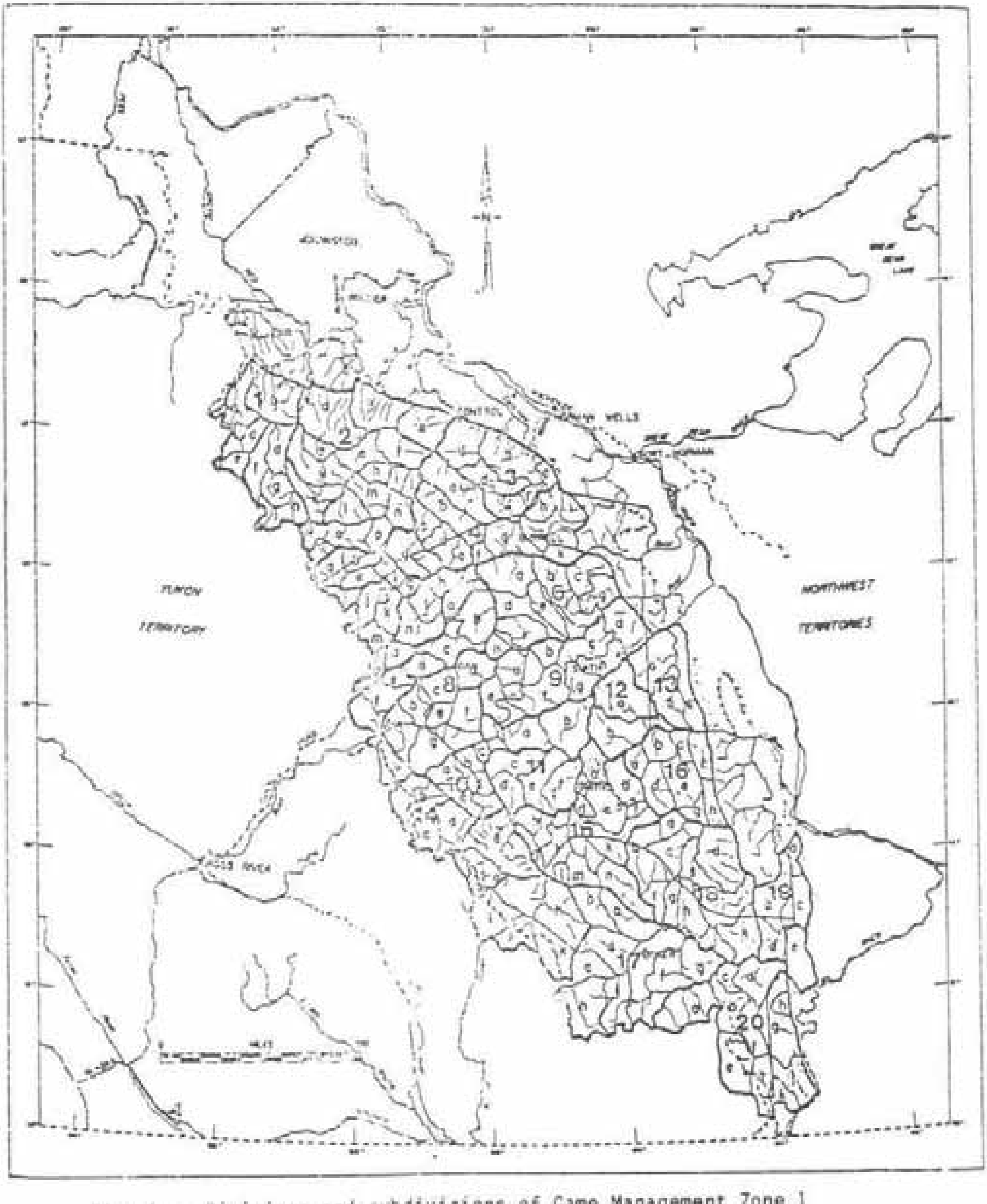

Fig. 1 -- Divisions and subdivisions of Game Management Zone 1 into sample areas for aerial surveys.

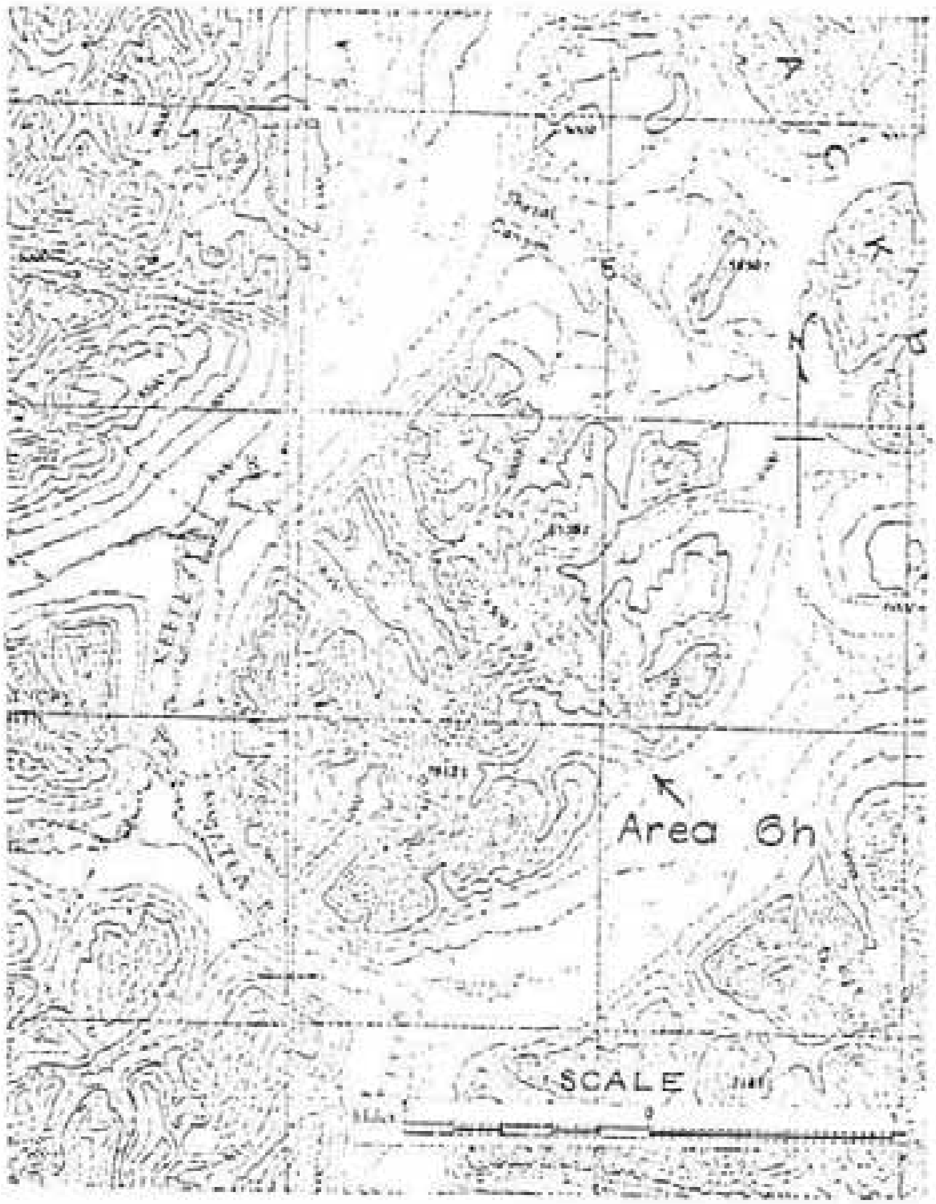

Fig. 2 -- Topographic map of area 6h. (Geological Survey of Canada. Scale 1:250,000.)

marked and released and their movements occasionally plotted since September, 1969.

Progress

Development of an aerial survey technique.

Considerable time was spent testing various types of aircraft and flying techniques before work could begin on identifying sources of error and evaluating survey results. Thought he first flights in search of Dall sheep in the Mackenzie Mountains were made by N. Simmons in 1966, the choice of the equipment and general technique currently used was not made until early 1968.

Choice of equipment. The Piper Super Cub and the Helio Courier were chosen as the best available fixed-wing aircraft for Dall sheep surveys in the Mackenzie Mountains. Helicopters were considered, but the expense of ferrying them to the survey areas and holding them through periods of poor weather was prohibitive.

Of the two aircraft chosen, the Helio Courier was preferred. It offered the most ideal combination of comfort, load-carrying capacity, safety, and manoeuverability in the Mackenzies. Though it won't climb quite as rapidly, it will turn about as sharply as a Super Cub. It won't stall and spin like most other aircraft. Lateral control is maintained at any speed, through its rate of descent at 30 mph may cause the observer to blanch. The 260 to 300 hp engine is relatively quiet, especially in the recent models. The Courier will carry more of a load than aircraft with similar STOL capabilities, which means kegs of fuel can be hauled to survey areas and then deposited on river ice or sand bars before surveys are started. The plane is also comfortable and can be adequately heated in the winter. Observer comfort and peace of mind are highly significant ingredients of a successful aerial survey.

To further observer comfort and reduce fatigue, noise abating ear muffs were worn during surveys. Records were kept on a battery-operated tape recorder, backed up by standard observation forms and 1:250,000 scale topographic maps.

Observation techniques. The most effective method found to survey 6h consisted of flying over the entire area in overlapping contour strips at approximately 20 foot intervals of elevation. Each pass overlapped the previous one so that "blind spots" obscured by the fuselage or wing were covered. The length of the strips flown and their elevational sequence varied according to the topography and to principles of fuel economy. The pilot acted as navigator and plotted our course and locations of wildlife sightings on maps. The area viewed was nearly always on the passenger side of the aircraft.

The ground-to-aircraft distance varied according to season and topography. In the winter, sheep tracks in snow could be seen from 500 yards or more in bright sunlight, but sheep were harder to see. After sheep tracks were seen the pilot would approach the slope to within 500 feet or less and remain at that distance until the sheep were found. Slopes blown nearly free of snow were searched from elevations closer to the ground than were snow covered slopes because of their speckled appearance. During summer months, white sheep above timberline could usually be spotted with ease from a considerable distance, except in steep-walled, rugged canyons. The latter were searched carefully closer to the ground.

Attempts were made to determine the accuracy of counts from a fixed-wing aircraft by searching 6h with a Bell Jet Ranger helicopter. Those efforts were repeatedly foiled by bad weather. This winter we planned to check on our precision by searching 6h several times in a 30-day period with the Helio Courier. Again, because of bad weather, we failed to complete more than one survey.

Weather had to be nearly ideal before it was worthwhile to conduct aerial surveys. Ideal weather would be calm air, clear skies, and five hours of good sunlight bathing the survey area. Deep shadows of early morning and late afternoon precluded surveys during December and January, even though large parts of the survey area would be brightly illuminated.

Positive results. Three late-winter surveys have been flown in area 6h. During those intensive surveys, we were able to identify adult rams and legal rams with confidence. Their dark horns showed clearly against their white coats and the background of snow. We were also able to delineate at least the late winter range of the Dall in 6h, and we suspect that this same range is used from December through April.

Sheep tracks in snow were a boon to the surveys. Rarely did we search along sheep tracks and not find the animals that made them. This gave us some confidence in the validity of our counts, especially when fresh snow blanketed the entire sample area.

Dall sheep show up beautifully against alpine tundra in 6h in the summer. This fact also led us to believe that a total count of Dall sheep is feasible.

Development of trapping and marking techniques

Requirements. In the Mackenzie Mountains we are faced with problems of economics and transportation peculiar to a large roadless wilderness. We need a method whereby two to four men could mark a significant number of sheep in a short field season. Trapping seemed to be the answer. However, we needed a trap that was fairly inexpensive, was transportable in available STOL aircraft and small boats, was simple to erect and easy to operate either automatically or by an observer in a blind. The trap had to be readily and economically accessible daily, even in inclement weather. It had to be capable of holding sheep without serious injury for at least 24 hours.

The material used to mark sheep had to be long-lasting and readily visible from a fixed-wing aircraft. The material had to lend itself to coding so that individual sheep could be identified, at least as members of a group, from the air.

The trap. The Canadian Wildlife Service purchased 10-foot wide cargo net made of 3/16 inch polypropelene rope in a 4-inch mesh from False Creek Industries in Vancouver, B.C., for the traps we planned to use to capture Dall sheep. The netting costs about $0.30 per square foot, assembled. It is light weight and portable, strong enough to hold a panicky moose (as we later proved), and withstands the harsh northern environment well. It is slightly elastic and will not seriously injure captive animals.

After some experimenting, J. Robertson designed a box-like sheep trap made of the cargo netting stretched around a frame of spruce logs. He made two of the traps, both approximately 14 feet wide, 16 feet long, and 6 feet high. Single gates measuring about 2 feet by 2 1/2 feet were hung on rope hinges on each trap so that they opened from the bottom. The gates were held open by simple nail and screw-eye triggers which were attached to trip cords (Fig. 3). Other gates, hinged like normal doors, were placed opposite each trap-gate to permit sheep to pass easily through the trap when it is tied open and to permit the trappers easy access to captured sheep.

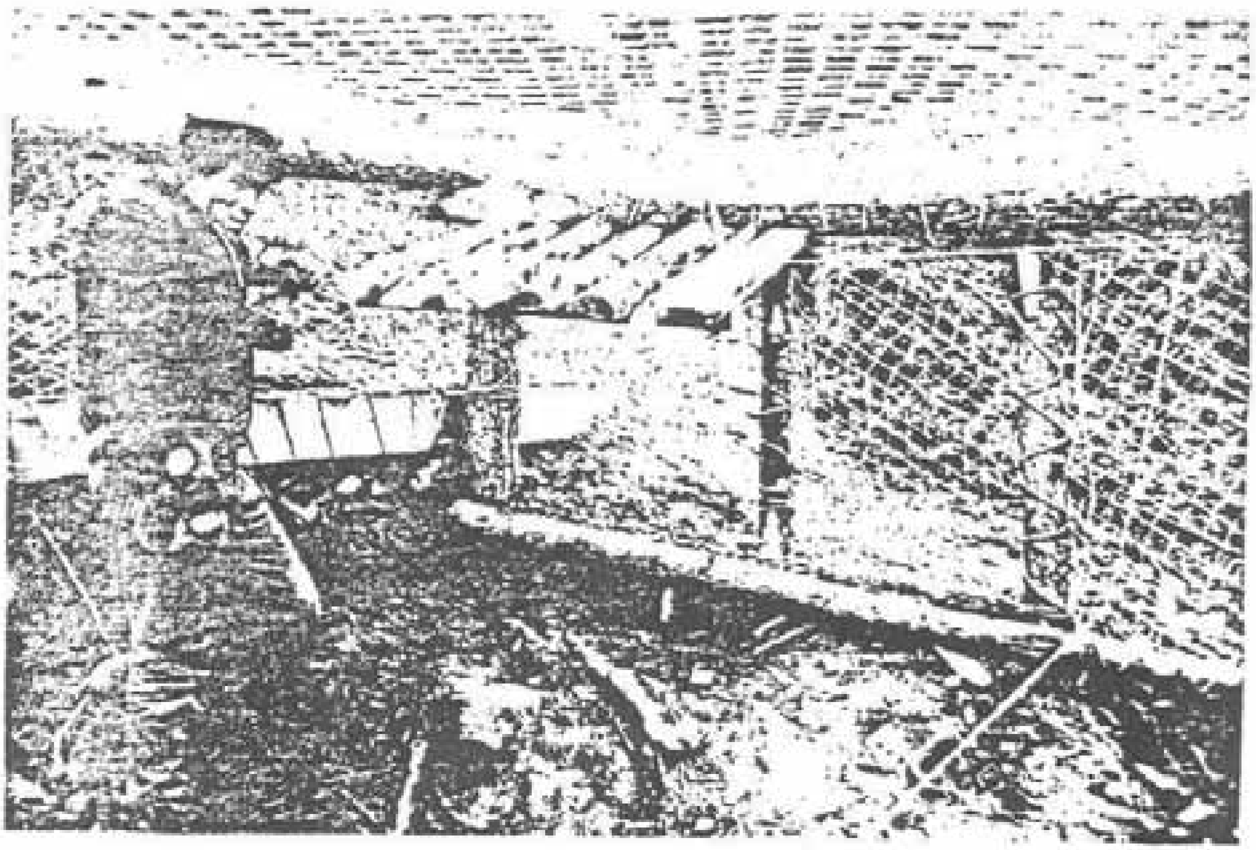

FIG. 3 -- TRAP FOR DALL SHEEP USED ON THE KEELE RIVER, MACKENZIE MOUNTAINS, NWT. DETAILS OF THE SIMPLE AUTOMATIC TREGGIER ARE SHOWN. (PHOTO: W. SIMMONS, CANADIAN WILDLIFE SERVICE)

Each trap can be constructed by two men in less than a normal work day. It can be stripped of its netting in an hour or less, and the net may then be transported by pack frame, canoe, or small plane to another trap frame. The traps are simple and nearly maintenance-free, Unless you catch a grizzly bear. In that unfortunate case, you merely sew the netting together again.

Fifty-pound salt blocks were placed in each trap to bait the sheep into the trap. Such salt blocks had been at the natural mineral licks for two years preceding trap construction, and the sheep sought them out in preference to the mineral-laden soil.

The traps were located at natural mineral licks on the shore of the Keele River. One trap is about 13 miles up-stream from our base camp, and the other is only about 4 1/2 miles upstream (Fig. 4). The traps can be checked daily by boat or aircraft.

Marking sheep. We used both NASCO (Fort Atkinson, Wisconsin) Jumbo Rototags and Perfect ear tags, and Day-Glo Saflag 3/4 by 18 inch strips (The Safety Flag Co. of America, Pawtucket, Rhode Island) in various color and number combinations to mark the ears of captured sheep. Such markers are in common use and will not be discussed in detail here.

Robertson developed a simple identification code using notches filed in the trailing edge of horns and small brass screws imbedded in horns. This system should enable a sheep to be identified when "in-hand", either alive or as a skeleton.

The captured sheep were also spray-painted in such a manner that they could be recognized as individuals from the air until the painted hair wore off or was shed.

Positive results. Eighteen sheep were caught between 30 August and 21 September, 1969. One died of unknown causes while it was being tagged.

The traps themselves worked very well. The trip cord was placed near the rear half of the trap so that several sheep could enter before springing the trap as they jostled one another around the centrally-located salt block. The trapped sheep were caught one at a time by hand, sometimes with the aid of a lariat, and carried outside through the access door for weighing, measuring, and marking.

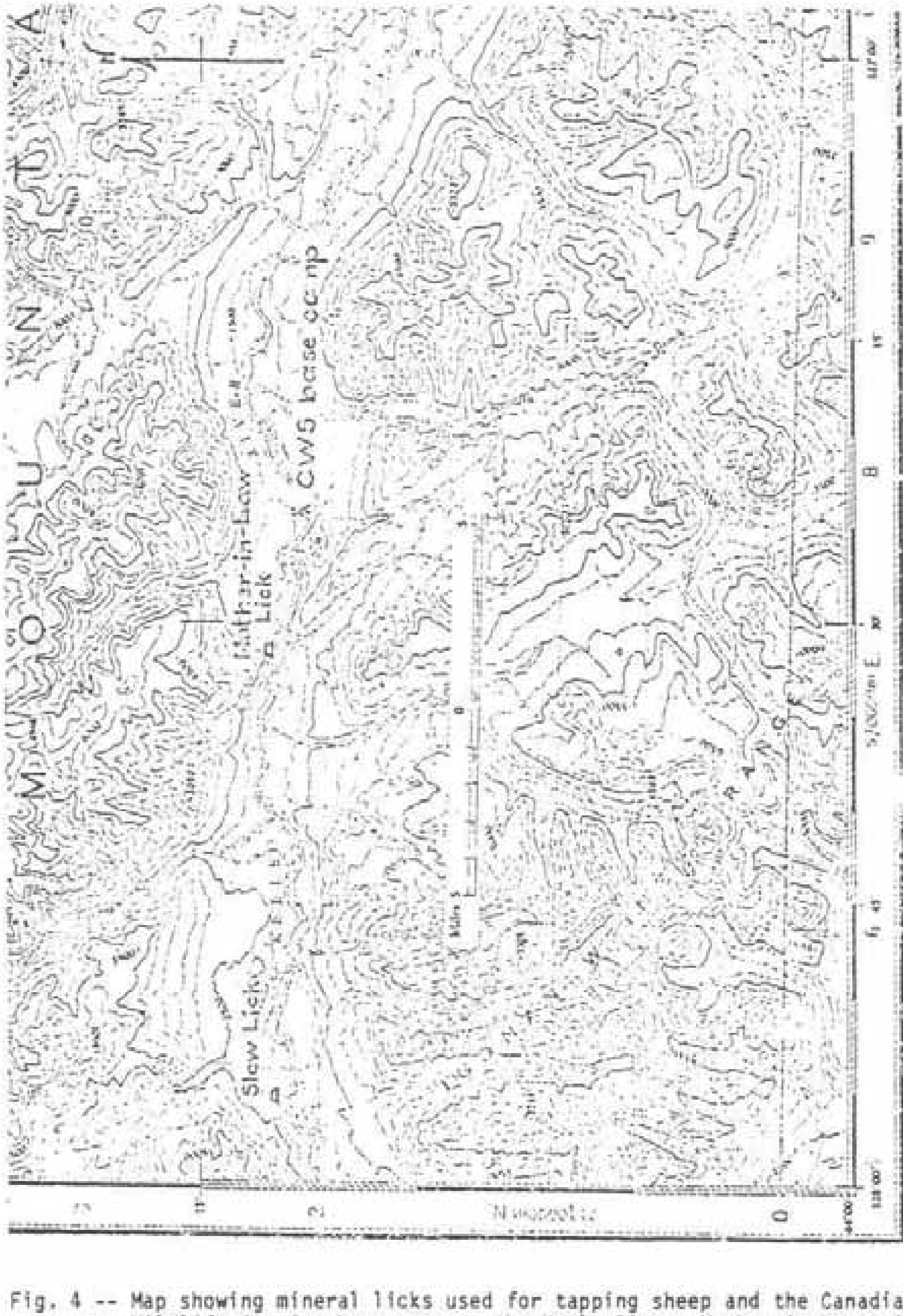

Fig. 4 -- Map showing mineral licks used for tapping sheep and the Canadian Wildlife Service base camp on the Keele River, Mackenzie Mountains (Carcajou Cany on Sheet 96D; scale 1:250,000).

Six marked sheep were seen in September, 1969, by pilots flying within a 10-mile radius of the traps. The pilots were only casual observers and were not looking for the marked sheep. The readily saw the paint on the white coats of the sheep, and they saw the ear streamers on closer inspection.

Four marked sheep were seen from the air by Simmons and pilot Perry Linton in March, 1970, during about 8 hours of searching. Some paint remained on three of the sheep. This made spotting much easier. However, the ear streamers were visible from the aircraft at first sighting. All of the marked sheep seen in September, 1969, and march, 1970, were identifiable as individuals were recognized by their paint pattern. The color code of the ear tags and streamers could not be discerned from the air.

Problems and Proposed Solutions

Aerial survey technique

Aerial surveys conducted to gather information about Dall sheep are useful and perhaps even necessary in wilderness areas like the Mackenzie Mountains. However, when the information gathered includes total counts of Dall, the survey may be weakened in value by inherent observer-caused errors and the high cost of conducting the survey for a questionable return. Sources of error are numerous and some are well hidden, but only a few major ones will be discussed here.

Sources of error. When we saw how well Dall sheep stand out on alpine tundra in the summer and how clearly their tracks show up in bright sunlight in the winter, we became confident of our ability to make a total count of the sheep in a small, well-defined area. However, after comparing aerial surveys conducted under similar conditions for two or more years, we became confused by the variability in our figures. Where might we have gone astray?

In February and March, 1970, all or most of are 6h was searched three times by fixed-wing aircraft and several sources of error came to light. In the first place the basic assumptions made prior to the surveys did not all hold true:

1. We found quite a few sheep below timberline. A group of six were found in the forest on the

bank of the Keele River, nearly two miles from timberline. Sheep in timber are hard to see and no doubt are a major cause of variability.

2. There is a possibility that sheep may cower and hug rock outcrops when they hear an airplane, and thus become hard to see, especially in rugged areas swept nearly bare of snow in the winter. We noticed that after our third search of 6h this past winter, the sheep were frightened more easily by our plane than they were during the first search.

Several other potential sources of variability in counts of Dall sheep are fairly well known and require little discussion. Observer fatigue and subsequent inattention to the demanding task of searching for sheep can be caused by turbulence, engine noise, infrequent rest periods, and uncomfortable aircraft. Variability in the skills and techniques of both pilot and observer directly affects the accuracy of the count. Variability in the amount of sunlight and shadows covering the survey area is a very important factor. Like shadows, uneven snow cover in the winter can mask the presence of sheep that may leave no tracks and that blend well with their mottled habitat.

Of the above factors, poor weather was the most vexing. For example, even after repeated tries we have been unable to complete a single aerial survey of 6h during summer months because of unsuitable weather.

Expense. The minimum cost for conducting an aerial survey of 6h with a Helio Courier is about $1000. This includes the cost of positioning fuel for the survey and aircraft ferry charges. Often you can add to that amount the cost of holding the aircraft until weather improves and the cost of aborted attempts to survey the area. The latter expense may be considerable, especially when you nearly complete your area and are forced by deteriorating weather to quit and start over again later. With our normal luck the cost of surveying 6h could easily be $2000.

Area 6h is a relatively small mountain block that takes about five hours to search thoroughly. Other sample areas in the Mackenzie Mountains take 10 hours or more to survey.

Until we know the validity of survey results, we cannot decide whether the results merit the high cost of aerial surveys. If the results do not justify the expense, we may have to rely on only indirect indicators of population status such as hunter kill statistics.

Further work needed. More work in 6h, with both fixed-wing and rotary-wing aircraft, is needed before we can determine the magnitude of errors indirectly caused by movements of sheep to and from timbered areas and by hidden sheep. Until then, we cannot suggest solutions to the dilemma. Observer fatigue, pilot and observer skill problems, and inadequate lighting problems have been solved for the current experiment. However, these problems may be practically insoluble when different pilots, observers, and aircraft are used by the Game Management Service. The magnitude of errors caused by these factors could be estimated once the validity of aerial surveys conducted under ideal conditions has been determined.

Marking sheep

Trapping and tagging - problems and solutions. The trapping and tagging program itself has a few recognized "bugs", but they may be easily remedied. The main problem with the present traps is in the handling of captured sheep. The sheep become quite excited when a trapper enters the trap to catch each sheep. We propose to build dark rooms into which the sheep can be coaxed before they are handled. The sheep may bed down in these rooms and may not become excited even when men enter the rooms. This technique has been used successfully with bighorn sheep (*O. canadensis*).

We noticed that the sheep become very thirsty if allowed to remain in the trap a day. We will build wooden watering troughs in each trap to solve this problem. This will also help in our effort to minimize physiological stress and increase chances that our marked sheep will survive.

Two major problems with our trapping and tagging program are: 1) It is slow and costly in man-hours and 2) we have been unable to locate traps in sample areas that can be surveyed from the air in 10 hours or less. We are now experimenting with a method of dyeing sheep from an aircraft. If this proves feasible, it will be less costly than the trapping and tagging program, and we will be able to study the movements of marked sheep in any area we choose. Even if it is successful, however, this technique will only supplement our trapping and tagging program. The latter will be expanded to include at least two more traps.

Conclusions

When we identify major sources of error in conducting aerial counts of Dall sheep in the Mackenzie Mountains, work out correction factors and requirements that will minimize the effects of these errors, and weigh the cost of the surveys against the results, we may conclude that aerial counts are impractical. In that case we will have to recommend less costly, indirect indicators of population health. In any case, we believe that periodic aerial surveys, less intense than the aerial counts, will be valuable in determining Dall sheep distribution, relative abundance, seasonal range boundaries, a minimum number of rams available for harvest in heavily hunted areas, and lamb:ewe ratios in the early summer (July).

The success of our aerial survey program will depend partly on our ability to learn the seasonal movements of marked Dall in each area surveyed. The trapping and tagging program will provide us with valuable information about sheep movements, especially after we increase the number of tagged sheep each year. However, we are also hoping for the success of our aerial dye-spraying program, for this technique may be a key to the success of the entire Dall sheep project.