

AN INEXPENSIVE METHOD OF MARKING LARGE NUMBERS OF
DALL SHEEP FOR MOVEMENT STUDIES

by

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ABSTRACT

A device for spraying Dall sheep with colored dyes from an aircraft has been developed to assist researchers in obtaining information about the movements of the sheep. Inadequate movement data have always been a major obstacle to population dynamics studies of mountain sheep in rugged wilderness areas. Now large numbers of Dall sheep can be safely and economically marked with brilliant dyes anywhere in their range. During tests in 1970 in the Mackenzie Mountains, Northwest Territories, 111 Dall sheep were marked with dyes dropped from a Super Cub aircraft during 13 sorties. Each sheep was marked at a cost of about \$5.00. The device employed to deliver the dyes was a standard Sorenson crop spraying tank with a modified quick-release valve. When the aircraft was used on a short, rough airstrip, the tank carried up to 45 Imperial gallons of a clothing dye-water-isopropyl alcohol mixture. The dye was released about 10 feet above bunched sheep at 75 mph indicated air speed. The sheep were marked in September, and some were found again still well colored in November, February and March.

THE PROBLEM

A problem common to most of us who have studied mountain sheep in wilderness areas is that of marking the sheep to document their seasonal movements. That information is a basic ingredient of successful studies of sheep demography.

The well known techniques of drugging and trapping sheep so that they can be marked have proven to be too slow, inflexible, and expensive in the vast, rugged Mackenzie Mountains wilderness where I work. We tried immobilizing Dall sheep with a syringe-firing weapon from blinds at mineral licks. That operation tied down two men at each mineral lick for lengthy periods of frustrating inactivity. With the low sheep density in that area and failures inherent to that technique, costs averaged about \$70 per sheep.

We designed a portable trap to capture Dall sheep at mineral licks, but it was also expensive because the traps had to be checked daily by boat. That method also involved two men. During the past two summers, we caught an average of one sheep each day at the cost of about \$60 per sheep. I preferred trapping to drugging because there were no known sheep fatalities and the men could engage in other projects since the traps were triggered by the sheep themselves.

Both methods of capturing sheep were inflexible since they were most effective at mineral licks. I needed marked sheep in other areas of the mountains, but unfortunately I knew of no mineral licks suitable for trapping operations in the other areas.

A PARTIAL SOLUTION

THE METHOD

We have successfully experimented with aerial spraying of dyes on Dall sheep to determine their seasonal movements. During our tests in September, 1970, we used two aircraft: a Cessna 180 and a Piper Super Cub. The faster Cessna was used to spot groups of sheep in gently rolling alpine tundra, and then it returned to our base camp. While the dye was being pumped into the Sorenson tank on his aircraft, the Super Cub pilot was given 1:250,000 scale maps showing the locations of the sheep. Both planes then headed for the sheep, the Cub pilot to apply the dye and the Cessna crew to watch and photograph the action.

Once a group of sheep was located, the Super Cub pilot made a low pass (about 100 feet above the ground) over the sheep to cause them to run in a tight group. He would then circle for his second pass. This time he would approach the sheep at about 75 mph (indicated air speed) with the engine relatively quiet at low rpm. When he was just behind the last sheep and about 10 or 15 feet above them, he would release the dye. The sheep usually kept running in a straight line and would not scatter until the plane passed beyond them. The pilot would "follow through" on his pass and not turn until he was well beyond the sheep.

The pilot of the Cub and the crew of the Cessna would then inspect, photograph, and count the marked sheep. Their location was plotted on a 1:250,000 scale topographic map.

THE MATERIALS

The Tank

In 1969 the late Stan Burrell, a skilled mountain pilot, Vern Rehbein, an aircraft engineer, and I designed and tested a valve and quick release mechanism that was installed in a 75 (Imperial) gallon Sorenson crop spraying tank normally used on a Piper Super Cub aircraft (Fig. 1). The valve was a 12-inch diameter hole cut into the bottom of the tank around which a 20-inch section of 12-inch diameter tire inner tube was glued and bolted. To close the valve, the tube was folded forward under a steel strap just in front of the hole (Fig. 2). The strap was connected to a tension buckle, clamped tight manually (Fig. 3), and released by the pilot with a Bowden cable. The cap to the standard filler tube was left off to supplement the air vent tube during the sudden release of marking fluid (Fig. 4).

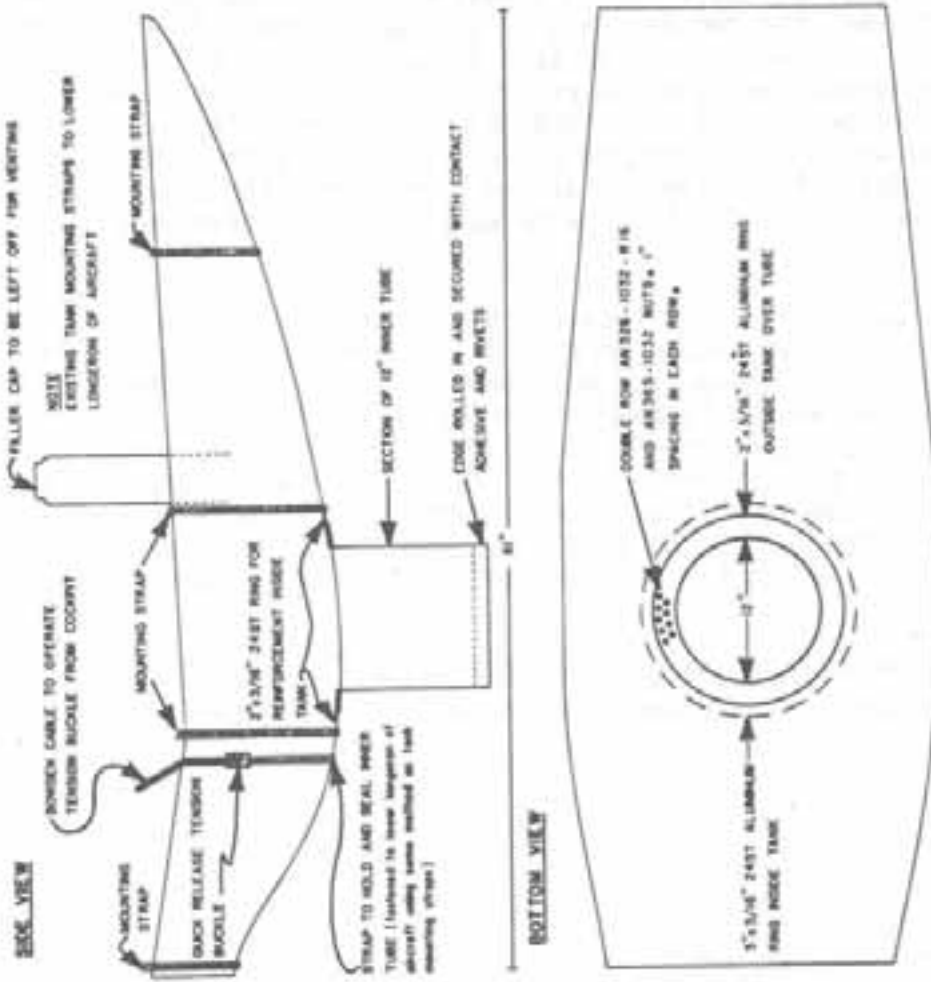


Figure 1 — Ninety gallon (U.S.) Sorenson tank for Piper PA-18 aircraft, modified for spraying dye on Dall sheep in the Mckenzie Mountains, Northwest Territories.

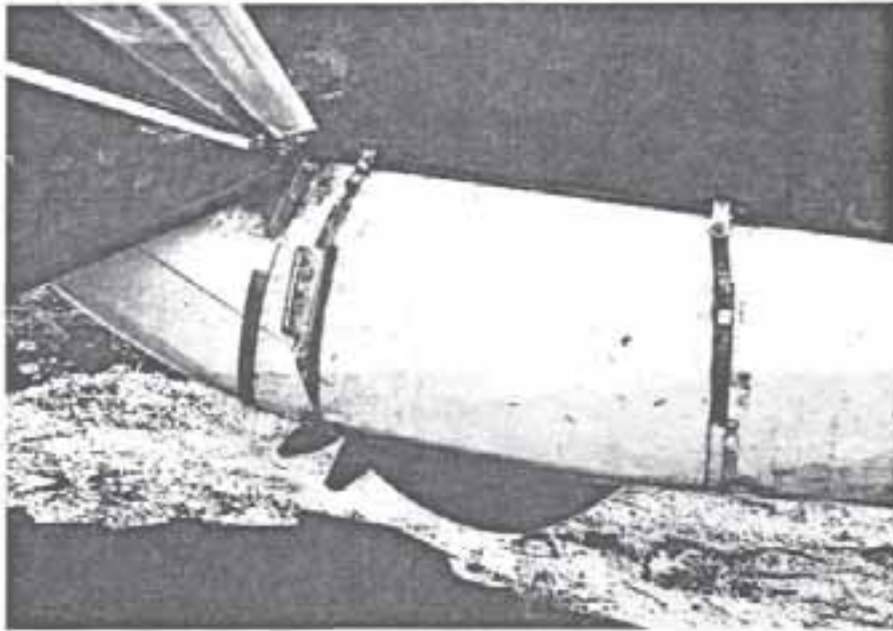


Fig. 2. View of left side of modified Sorenson tank mounted on a Piper Super Cub. The inner tube valve can be seen bulging with the weight of the dye solution. The Bowden cable leads forward, from the quick-release buckle on the strap clamping the valve shut.



Fig. 3. View of Sorenson tank mounted on Super Cub showing the Bowden cable leading forward into engine cowling. The air vent tube from the tank can be seen leading up to window.



Figure 4. View of the left side of the Sorenson tank showing the filler tube. The cap to the filler tube has been left off to supplement the air vent tube.

The Plane

The Sorenson tank was held to a Piper Super Cub crop-spraying aircraft by steel straps clamped to the plane's lower longerons. Other aircraft could be used for marking sheep, but the Super Cub was best because it was the only plane rated for agricultural work that could be used on the short, rough airstrips we constructed in the mountains. The Cub lifted up to 40 (Imperial) gallons of fluid in the tank from a 1100 foot-long airfield at 3500 feet elevation.

The Super Cub could also slow down safely to 60 mph (indicated air speed) or less during a straight approach to a group of sheep to be marked. Generally, the Super Cub is an excellent aircraft for low altitude mountain flying (Simmons and Robertson 1970).

The Marker

For aerial marking by the technique described above, a non-toxic solution was needed that would not injure the sheep but would penetrate the dense pelage to the skin and remain easily visible for long periods. Non-toxic clothing dye solutions had been used successfully on desert bighorn sheep (Hansen 1964, Simmons and Phillips 1966), so I decided to try the same markers on Dall sheep.

The two dyes I have used are made by Cyanamid of Canada Ltd. (635 Dorchester Blvd. West, Montreal 101, Quebec): Calcocid Blue AX Double and Calcocid Scarlet 2 R.I.L. (The same dyes can be purchased in the U.S.A. from the Dyes Department, American Cyanamid Company, Bound Brook, New Jersey). Of the two dyes, the red seemed best for marking Dall sheep since it withstood fading better than the blue. Initially, however, the blue was more brilliant a color than the red. The powdered dyes were mixed according to the following ratios:

Scarlet 2 R.I.L.: 8 oz. powder/gal. liquid
Blue AX Double: 13 oz. powder/gal. liquid

The powders were stirred into a warm solution of 50% water and 50% isopropyl alcohol. The solution was heated so that the dye powders would dissolve more readily (Fig. 5). The alcohol was used primarily to permit the solution to penetrate the oily pelts of the sheep, but it also kept the liquid in the valve tube and in the tank from freezing.

The Results

Dall sheep can be marked from an aircraft in the Mackenzie Mountains in a safe, flexible, economical manner. They can be marked from the air in large numbers in a short period of time. The marks will last until the following molt, enabling investigators to plot the movements of the sheep for periods up to ten months, depending on how long the marks resist weathering. The white coats of the sheep, the gently rolling alpine tundra the sheep inhabit, and their habit of bunching defensively when approached by a fixed wing aircraft are factors that spell success for such a technique.

In 13 sorties, 111 Dall sheep were well marked with dye over 25% to 90% of their bodies. Usually over 50% and sometimes 100% of the sheep in each group sprayed were well marked. The group sizes ranged from 5 to 20 sheep. During that operation, each sheep was marked at an average cost of \$5.00.

Red-dyed sheep were seen from aircraft in October, November, February, and March of 1970 and 1971. Blue-dyed sheep were seen from an aircraft in November, 1970, but by March, 1971, the blue dye was not visible from the air. Several sheep that had been dyed blue were collected in March. Their horns and hair bases were still blue, but the colors could only be seen within a few feet of the sheep.

DISCUSSION

ADVANTAGES

The short amount of time needed to mark Dall sheep is a major advantage of this technique. Under ideal conditions, over 100 sheep could be marked in three days.

The cost of \$5.00 per sheep is inexpensive when compared with the cost of marking sheep in wilderness areas by other methods. This cost may be reduced in areas of greater accessibility where aircraft charter fees and the costs of transporting fuel, dyes, and alcohol are less.

Initially, both dyes showed up very well on the white coats of the Dall. By using a different color in each of several small, widely spaced areas, an observer can follow group composition changes and long-distance movements of the sheep. By using photographs of the marked animals, the observer can follow individual sheep marked with distinctive patterns of dye.

The three pilots I employed during tests of the dye spraying technique last year considered the required maneuvering of the dye-loaded Cub to be safe and well within pilot and aircraft capabilities. The experienced crop dusting pilot who flew the Super Cub enjoyed the work and found it far less hazardous than his normal duties. Approaches to the sheep and exit patterns involved no sharp turns or steep angles of pitch, and there was no violent reaction by the plane to the release of the dye.

Compared with the stresses placed on drugged and trapped sheep, the stress on the sheep caused by aerial dye spraying may be minimal. The entire operation from the first pass to the release of the dye was usually over in less than five minutes. The terrain was not precipitous, so the sheep did not injure themselves while running. Once the aircraft climbed to an altitude of about 500 feet above ground level, the sheep stopped running and often stood still or milled around. An indication that the aircraft did not abnormally frighten the sheep was that they did not change their normal reaction patterns to subsequent overflights.

DISADVANTAGES

Through a haze of personal prejudice, there appears to be one major weakness in this system, and that is the ephemeral nature of the dye itself. Tests on the dyes made in southwestern Arizona in the summer showed that the colors faded badly in the brilliant sunlight and were not readily discernible three months after the dyes were applied. Due to the short day length in the Mackenzie Mountains after the September application of dyes, the colors remained visible much longer. That may not be the case with dyes applied in June because of the long daylight hours.

In any case, the marks are entirely lost by the time of the next molt. For this reason, our dye-spraying efforts will continue to be supplemented by a program of trapping and permanently marking Dall sheep.

The method described above is restricted in flexibility only by terrain type. Sheep should not be marked in rugged terrain because of the increased potential for injury to the animals and to the pilot. However, gently rolling alpine tundra habitat abounds in the Mackenzie Mountains and is preferred by sheep in nearly all areas.

OTHER USES OF THE AERIAL DYEING TECHNIQUE

In June or July, 1971, we will mark Dall sheep in a small sample area and then wait a week or more for the groups of sheep to intermingle and change composition. Then we will return and count marked and unmarked animals from the air in the same area. By applying a modified Lincoln Index formula (Bailey 1951), we hope to estimate the population in that area as well as the confidence limits of our estimate.

There may be other animals that can be usefully marked with dyes from the air. We have discussed with the Game Management Division of the Northwest Territories Government the possibility of marking the light-colored Peary caribou in the arctic islands so that their movement patterns may be studied. Quick drying dyes sprayed from an aircraft may also be used to mark polar bear. The technique is applicable to any light-colored large mammal on which non-toxic dyes will show up, especially animals like caribou and Dall sheep that can be sprayed as a group, in situations where economy and flexibility are desired.

LITERATURE CITED

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DISCUSSION

QUESTION BY BILL CRUMP, G & F WYOMING: I have a comment relative to this technique. We have used it to mark antelope for migration and distribution studies in Wyoming and have found it very useful. It has become a common technique in areas where we have to determine definite movements. We have been using the nyanzol dye and I was wondering if you might have been using the same.

REPLY BY SIMMONS: No. I was under the impression that the nyanzol dye would irritate the membranes around the eyes and nose. Since we are drenching the animals, this was something we wanted to avoid.

REPLY BY CRUMP: We had used it with some experimental animals at the Sybille Research Unit before we went into application from air. We did not discover any irritation. We have used this method with antelope and found it a very interesting and useful method.

REPLY BY SIMMONS: You spray this with boom sprayers, don't you?

REPLY BY CRUMP: We have modified these since the original report came out. We now use a massive dose drench.

REPLY BY SIMMONS: What kind of tank do you use?

REPLY BY CRUMP: A tank very similar to yours with a very large apparatus. We release the whole load at one time.

REPLY BY SIMMONS: This is a black dye?

REPLY BY CRUMP: We have used black mostly.

REPLY BY SIMMONS: How long does it last?

REPLY BY CRUMP: We have marked them in the fall. It lasts until the shedding begins in the spring. There is difficulty in telling black marks from hair that is about to be shed and is dark in appearance.

REPLY BY SIMMONS: I have heard that they have used this technique in Saskatchewan but I know that they were using the crop spraying booms to spread a fine mist.

REPLY BY CRUMP: We did this first but we went to large hole in the bottom of the tank to release the dye in large quantities.

QUESTION BY GENE DECKER, CSU: What other colors did you use, Bill?

REPLY BY CRUMP: We have tried reds and blues. Black seems to work best because of the light color of the antelope itself. There is a need for improvement in the materials for a more residual effect.

QUESTION BY JOE TRLICA, CSU: When you dump the entire load over the 50 yard area, what is the effect of the dye and the alcohol mix on the vegetation? Are you actually getting a killing of this strip?

REPLY BY SIMMONS: I don't know. I haven't considered whether the isopropyl in the dye mixture might harm plants. We're usually dumping it on the lichen, moss association and on a lot of bare soil. Does anyone here have any ideas on this?

REPLY BY TRLICA: I have an idea that the alcohol mix might be killing vegetation even though the dye itself might not be harmful. You might want to check some of these strips.

QUESTION BY AL WHITAKER, G & F COLORADO: Has any interaction been noted between marked and unmarked animals or lack of such interaction?

REPLY BY SIMMONS: We have watched marked animals mixing in with unmarked animals but I haven't been able to detect any reaction. This is the same type of deal that we get with permanently marked animals like the critter you saw with ear streamers and collars and so on. After the initial shock of seeing this monster coming at them with flopping ear tags, etc., there is very little reaction. They are well accepted it seems.

REPLY BY WHITAKER: Any reaction noticed at the breeding time?

REPLY BY SIMMONS: I just started this last year so I didn't really comment on that with any assurance. Intuitively, I feel it will not have any effect. Chuck, did you notice any effect on dyed sheep on the desert game range when we dyed sheep? (Answer not recorded). I didn't notice any effect and we watched the sheep during the breeding season. Unfortunately, during the breeding season in the northwest territories it is dark as the ace of spades, so we do not get too many good observations.

REPLY BY WHITAKER: Have you considered marking the horns of big rams with a dye such as this?

REPLY BY SIMMONS: Yes, but we have gotten a lot of static from the outfitters. I would like very much to mark adult rams, to paint their horns and everything else, but we have to avoid this. I think that in some areas I am going to mark adult rams with dye and of course this would drench their horns too. The color seems to be absorbed by the horn, at least with the dyes I am using. It really doesn't stand out too well, but of course the paint would.

I had another comment on reaction. You may have noticed in the pictures that we had sheep bedded down in the background while we were marking sheep in the foreground. This young ewe was turned loose while the others were bedded down. She ran right towards them. The others looked at her and got up, then turned and ran up the hill and left this one in the dust. Later we saw this same individual feeding peacefully with unmarked animals.

QUESTION BY WAYNE SANDFORT, G & F COLORADO: From a Rocky Mountain bighorn and desert bighorn point of view, what dyes or marking materials would you recommend?

REPLY BY SIMMONS: As I said, Chuck used different dyes than I used. I am using clothing dyes from American Cyanamid. I have listed the dyes and the addresses in the paper. It depends on the application method. We were using a spray at a waterhole. I am not sure that you would even want to use this method on desert bighorns since there is such a little area to mark and your country is so rugged. Also, your Rocky Mountain bighorn habitat is so rugged that I think you would end up losing the pilot, the plane and the sheep.