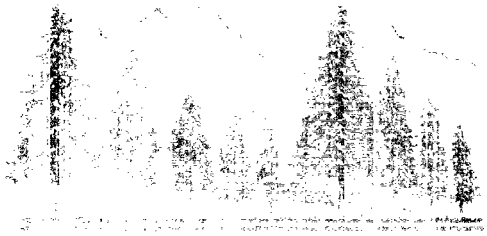

research notes

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AN AERIAL MOOSE CENSUS

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INTRODUCTION

The relatively new profession of Wildlife Management is continually searching for new techniques. A growing awareness of the value of the wildlife resource has resulted in an increased endeavour to learn through research, then to apply the new-found knowledge. This paper reports upon a technique for a moose census.

While the broad principles of good forestry and good wildlife management are similar, the two differ widely when carried into the field. An example is the timber cruise of forestry and the wildlife census. Both are inventory methods, and both are necessary for management. While in each case the information required is population or stand density, the same techniques will not work for both the stationary tree and the mobile, elusive animal. The science of wildlife management is young, so its procedures are not nearly so perfected as are those of forestry. Because the wildlife census is all-important to management, the difficulties it presents necessitate both research and management in this field to concentrate upon the perfection of census methods.

In March, 1952, the Parks and Recreation Division of the British Columbia Forest Service undertook an aerial census of moose in Wells Gray Park as the first step in management, designed to reduce this herd to the carrying capacity of its range. While there has been considerable interest in the large moose populations of Interior British Columbia for many years, there have been no serious attempts to assess these populations in absolute terms except in this park. Wells Gray Park has been the centre of this Division's wildlife activities. For three years there have been a number of attempts to determine the park's moose population, several techniques being used with variable success. The aerial technique discussed here is not wholly perfected, but it appears to be the best yet tried. It is described and discussed here in the hope that this pioneer operation will stimulate more use of aircraft in managing valuable moose populations in other areas.

THE TECHNIQUE

The aerial census is an established wildlife management technique. There is a growing amount of wildlife literature dealing with aerial counts of waterfowl, seals, elk, deer, antelope, bison, caribou, and others. While the writer can not recall published accounts of aerial moose counts, it is known that the method has been tried in Ontario and in the Northwest Territories.

As there is considerable literature dealing with the rudiments of the aerial census, discussion of this phase will not be duplicated here. This account will be confined to the specific successes and failures of this one moose-counting operation.

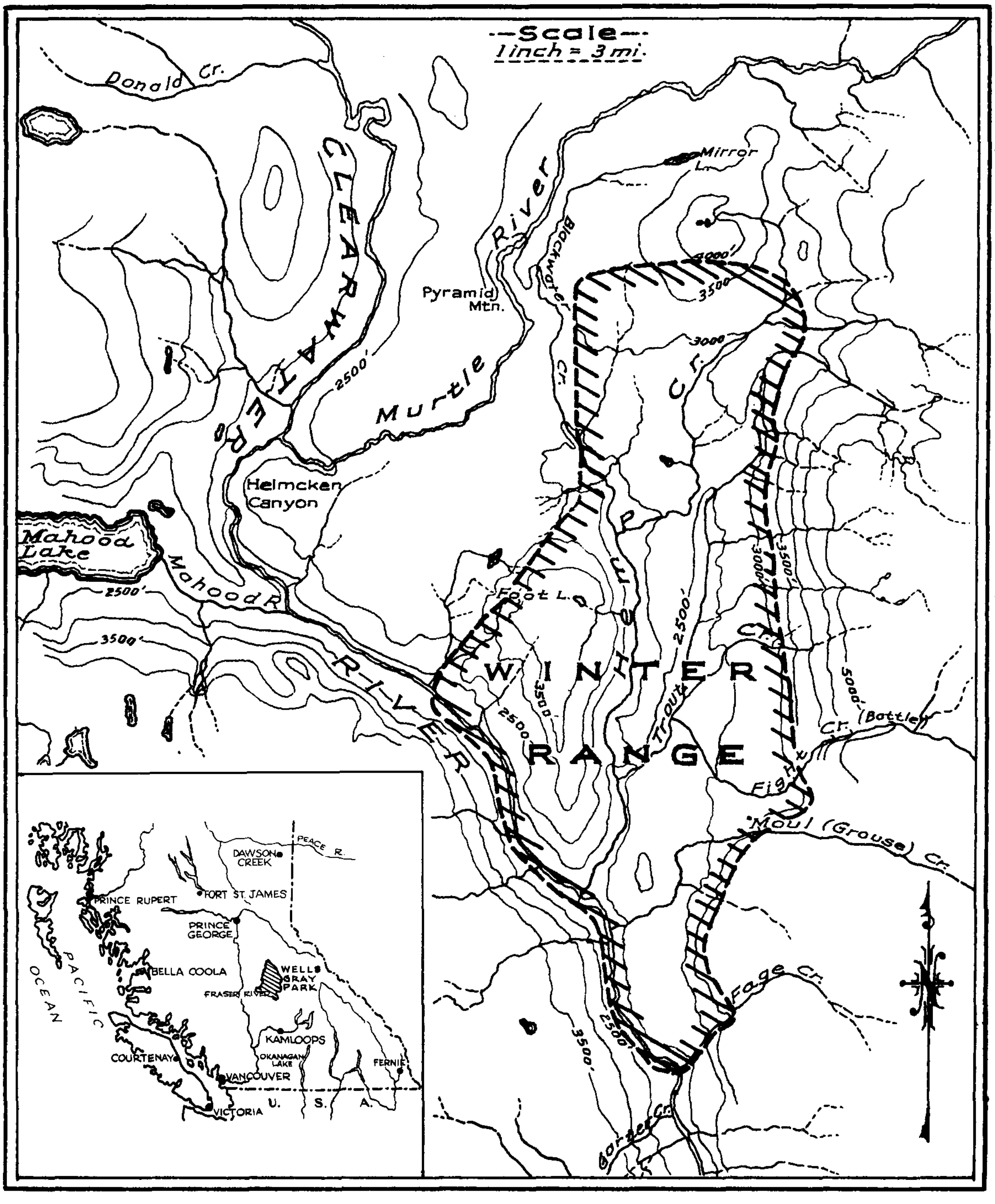
There are a number of conditions necessary for a successful aerial count. The animals must be reasonably visible in an open habitat, and the census is best undertaken when the animals are concentrated. Perhaps the reason for there being little previous aerial work on moose is that throughout most moose ranges the animals are found under heavy coniferous cover which hides them from above.

In Wells Gray Park census conditions are almost ideal. In winter the animals concentrate in relatively small areas of lowland where fire has completely removed coniferous cover, and the dominant vegetation consists of open stands of willow. Snow covers the ground and silhouettes the dark animals. The main winter range embraces an area of about 60 square miles and is contained in a basin surrounded by uplands and mountains (Fig. 1). The area of this winter range undoubtedly varies with moose distribution as affected by weather, but approximately 60 square miles were in use at the time of the census, as determined by aerial reconnaissance. Thus the area censused is nearly ideal in being a topographical unit and in having open vegetative cover. However, test flights over the lodgepole-pine-covered Cariboo Plateau to the west showed that the same methods are probably usable in these forests of intolerant conifers. Moose were quite easy to see in this forest when counted as described below.

Three census flights were undertaken through the period March 11 to 13, 1952, inclusive. On all flights a De Havilland Beaver aircraft was used, which enabled a ground speed of about 80 miles per hour when the flaps were lowered. Preliminary trials showed that 200 feet was the most satisfactory height from which to count, as at greater heights it was more difficult to see the animals. Most aerial counts reported in the literature were made from greater heights, and preparations for further moose counts should check the conclusion that 200 feet is best.

For figures on height and ground speed the observers were dependent mainly upon the experienced and excellent pilot. Occasionally, it was possible to check these figures when ground observers noted the height of the aircraft and flight lines between known points were timed with a watch.

While flying by landmarks, the pilot was able to maintain the 200-foot height. However, part of the census was run by compass, and here the pilot tended, quite unconsciously, to gain altitude. For the calculation of this part of the census a height of 300 feet was used, and this is believed to be a reliable average.



--Scale--
1 inch = 3 mi.
Donald Cr.
CLEARWATER R.
Murtle River
Pyramid Mtn.
Helmcken Canyon
Mahood Lake
Mahood R.
RIVER
Blackwater Cr.
Mirror L.
Foot L.
Trout Cr.
WINTER RANGE
Fight Cr. (Bottle)
Moul (Grouse) Cr.
Fage Cr.
Gorge Cr.
2500'
3000'
3500'
4000'
5000'
PRINCE RUPERT
FORT ST. JAMES
DAWSON CREEK
PEACE R.
PRINCE GEORGE
BELLA COOLA
WELLS GRAY PARK
FRASER RIVER
KAMLOOPS
OKANAGAN LAKE
FERNIE
COURTENAY
VANCOUVER
VICTORIA
U. S. A.
PACIFIC OCEAN

Fig. 1.

The pilot did not, and could not, participate fully in the count. Flying occupied most of his time. Two observers counted, one on each side of the plane. Each one counted only those moose seen within an angle of 30 degrees from the vertical, and thus the total strip width was a little larger than the total height from the ground. To assure counts within 30 degrees, a piece of cellulose tape fixed to the window, when lined up with heavy cord tied to the wing strut, gave the upper limit of an angle 30 degrees from the vertical. A loose end of the cord trailing back from the strut aided further in fixing the angle, but this loose end tended to sag and its position was, therefore, only approximate. The lengths of the counting strips were obtained by flying between known points or by timing compass-flown strips. From the distances flown and the width of strips the area sampled was calculated. (See Fig. 2 on page 9.)

Each observer was required to sit with face pressed to the window, and to concentrate fully upon the count. At the height and speed used the ground directly below passed rapidly, and exceptional alertness was required to make the counts. After an hour of this work, eye fatigue was marked and counting efficiency began to drop. However, periodic rests restored efficiency for further brief counts.

The winter range was divided topographically into three parts, and each of these was censused separately by parallel strips which were roughly equally spaced at three-quarter-mile intervals. For best sampling results strips should have been flown at right angles to the main trend of topography, but the necessity of maintaining a constant height required strips parallel with the topography.

RESULTS

In each of the three flights the whole of the winter range was sampled. Thus the coverage on each day was the same except for minor variations. Table I contains the results of these flights. From the calculated numbers of moose per square mile it may be seen that there is some inconsistency in the results. However, all figures indicate a high density. If the count had been made a few weeks earlier the density would have been even greater for, at the time of the census, the population was scattering on to spring range from the much smaller area used at the height of the winter. Because the moose were using an area of about 60 square miles, further calculation gives the total population as 2,148, 2,316, and 1,764. In some respects these figures are sadly variable, but they do suggest a moose herd of about 2,000 animals. They show also that the herd was probably far larger than was formerly suspected, even after considerable effort on the ground to estimate herd size.

TABLE I --
CENSUS DATA FROM THREE FLIGHTS OVER THE SAME MOOSE-RANGE

	Date of Flight		
	March 11	March 12	March 13
Area sampled in square miles	3.6	3.5	3.8
Percentage of occupied range sampled	6.0	5.9	6.3
Number of moose seen	129	137	111
Number of moose per square mile	35.8	38.8	29.4

The area just discussed is not the only area in which moose winter in Wells Gray Park. Some 25 miles to the north lies the Archer Creek winter range. On March 11, 1.2 square miles of this 20-square-mile area were censused, and 17 moose were seen. The total population here appears to be about 280 animals.

Reconnaissance along adjacent valleys and lakes revealed other small bands of moose in the southern part of the park. From all of these data, the moose population in, and immediately adjacent to, the park appears to consist of at least 2,000 animals, and probably the figure is close to 2,500. These figures are considered conservative, as noted below.

DIFFICULTIES ENCOUNTERED

The writer believes that papers of this sort can present an entirely misleading account, in that difficulties may be minimized or entirely ignored. Here the difficulties encountered are briefly discussed. These are the variables to be counteracted in future to improve the technique.

There can be no doubt that the very basis of the method depends upon the accurate determination of counting height. In the present instance, although the height estimations of the pilot were probably satisfactory, the direct measurements would have lent more confidence to the census figures.

In making a census of sloping ground, the use of angles does not give an accurate ground area. While one observer is looking far down a slope, the other has very little ground within his vision angle. In these calculations it has been necessary to ignore this variable because it could not be evaluated. Fortunately less than 20 per cent of the terrain sampled was subject to this variable.

Although very narrow strips were covered from a low level, it is probable the count missed a number of animals. At 80 miles per hour looking down only 200 feet, the terrain passed rapidly and the observers had no time to study the ground. The area was dotted with charred logs and stumps, and these were occasionally confused with moose until nearly passed. Standing moose were easily recognized but the counts were, of necessity, made near midday when many moose were lying down and at a glance might be confused with the other dark objects. Running animals were the easiest to see, but only occasionally were they stampeded by the low-flying aircraft.

Another condition suggests that animals were missed. On each flight one observer sat next to the pilot, the other behind the pilot. On all flights the observer next to the pilot saw more moose. This difference ranged from 33 per cent to 100 per cent and was present irrespective of which observer occupied the forward seat. This suggests a serious error, for the difference can not be explained, as far as can be determined, by anything other than differences in counting efficiency. It is suspected that the wider angle of vision at the front window reduced eye fatigue, and so increased counting efficiency. The window behind the pilot did not allow the observer there to look ahead. Because this counting error makes counts lower than actual, the final figures are considered to be conservative.

Finally, there was a very narrow strip beneath the aircraft which neither observer could see.

There has been some criticism of counting when flying as low as 200 feet, a height which increases eyestrain and enables counting on only a narrow strip. It was evident, however, that the ability to see moose was impaired at 300 feet and at 400 feet and over animals were seen rarely unless they were standing in unbroken expanses of snow, or were running.

DISCUSSION

The aim of all census work in the park has been to obtain absolute population figures and not relative figures. There is a growing misconception among some wildlife workers that relative counts are sufficient and that, therefore, absolute counts are unnecessary. While it is agreed that relative counts are better than nothing, it must be remembered that percentages standing alone are frequently quite misleading. Two populations increasing by 50 per cent suggest similarity, but there is a pronounced ecological difference between an increase of 10 to 15, and another from 100 to 150. There is no real substitite for absolute figures, and these only have been considered in this paper.

The technique here reported is far from perfect and it is intended to experiment further with all of its aspects. It did give results which

appear superior to any other method yet tried in the park. In the same area censused from the air, there have been tried pellet group counts, track counts, and counts of animals seen by ground parties. All of these methods have promise, and all can give valuable data, unobtainable from the air, to supplement the census figures. However, by contrast with the aerial census method, ground census work is slow, frequently tedious, and usually inadequate.

On two winters (1950 to 1951, 1951 to 1952) there were attempts to count moose on the main winter range. In both cases, the best woodsmen available snow-shoed for long hours through deep snow, and each winter the work was in progress for about a month. The first winter, one man saw 470 moose (L. E. Cook and J. Norman, 1951, unpub. report), and the next winter two men saw 514 moose during the same month of the aerial census (L. E. Cook, J. Norman, and C. Gaglardi, 1952, unpub. report).

During the summer of 1950 a wildlife survey party working in the southern part of the park from May to September saw 58 moose (P. W. Martin, 1951, unpub. report), and the following summer a similar party working for a similar period saw 94 moose (R. W. Ritcey, 1952, unpub. report).

From his work in 1950, basing his figures mainly upon counts of pellet groups, Martin (op.cit.) estimated the population in the southern part of the park as between 650 and 1,000 animals.

All the evidence suggests that ground work has yielded population figures that are too low. This condition is the opposite to that reported by Fuller (Aerial Census of Northern Bison in Wood Buffalo Park and Vicinity, 1950, Jour. Wild. Manag., 14: 445 to 451.) who reports that for bison, ground counts have been too high, and aerial counts too low. The best ground count in Wells Gray Park has been proven too low by further ground work. In the winter 1951 to 1952 two men moved among the moose herd on the winter range for a month and saw 514 moose, as noted above. As soon as migration from this range was pronounced and the animals were moving west, north, and east into higher country these same men counted the tracks of moose moving northward only. They could count for only a portion of the migration while snow conditions were suitable, yet they counted the tracks of 590 moose, more than they had seen after a month of enthusiastic and conscientious effort on the main wintering grounds.

None of these figures approach the figure obtained from the aerial sample, and there is every reason to believe that this sample yielded conservative data, and that the mechanics of this sampling procedure are reasonably correct.

CONCLUSIONS

The aerial census technique described can be improved considerably for several factors are involved which introduce inaccuracies. While some of these factors tend to give conservative figures, others operate towards figures that are too high. Of these two inaccuracy classes, the former seems to be the most important, with the result that our figures are probably conservative.

As a technique for establishing populations, the aerial census appears to be superior to several types of ground census that were tried. This superiority is due not only to apparent greater accuracy, but to the speed with which the figures can be obtained. Ground work is necessary, however, for the gathering of most other data to supplement the census figures. It is doubted if even age classes and sex ratios can be obtained with the aerial method used.

Moreover, before this method is unquestionably accepted as giving reliable results, the counts it yields must be shown to be consistently similar to figures obtained by another accurate census method. Future work should attempt so to assess this aerial method. Until real confirmation of accuracy is at hand, the figures it yields must be regarded with reservation.

There are other areas where moose can be counted from the air. In open burns, and it seems also in some coniferous forests, our figures show that aerial counts probably yield the best population figures. However, in those areas where vegetation, topography, or moose distribution render aerial counts impracticable, other methods must be used.

It is hoped that this brief account of the limited success attained will result in a wider use of aircraft to inventory large moose populations.

ACKNOWLEDGEMENTS

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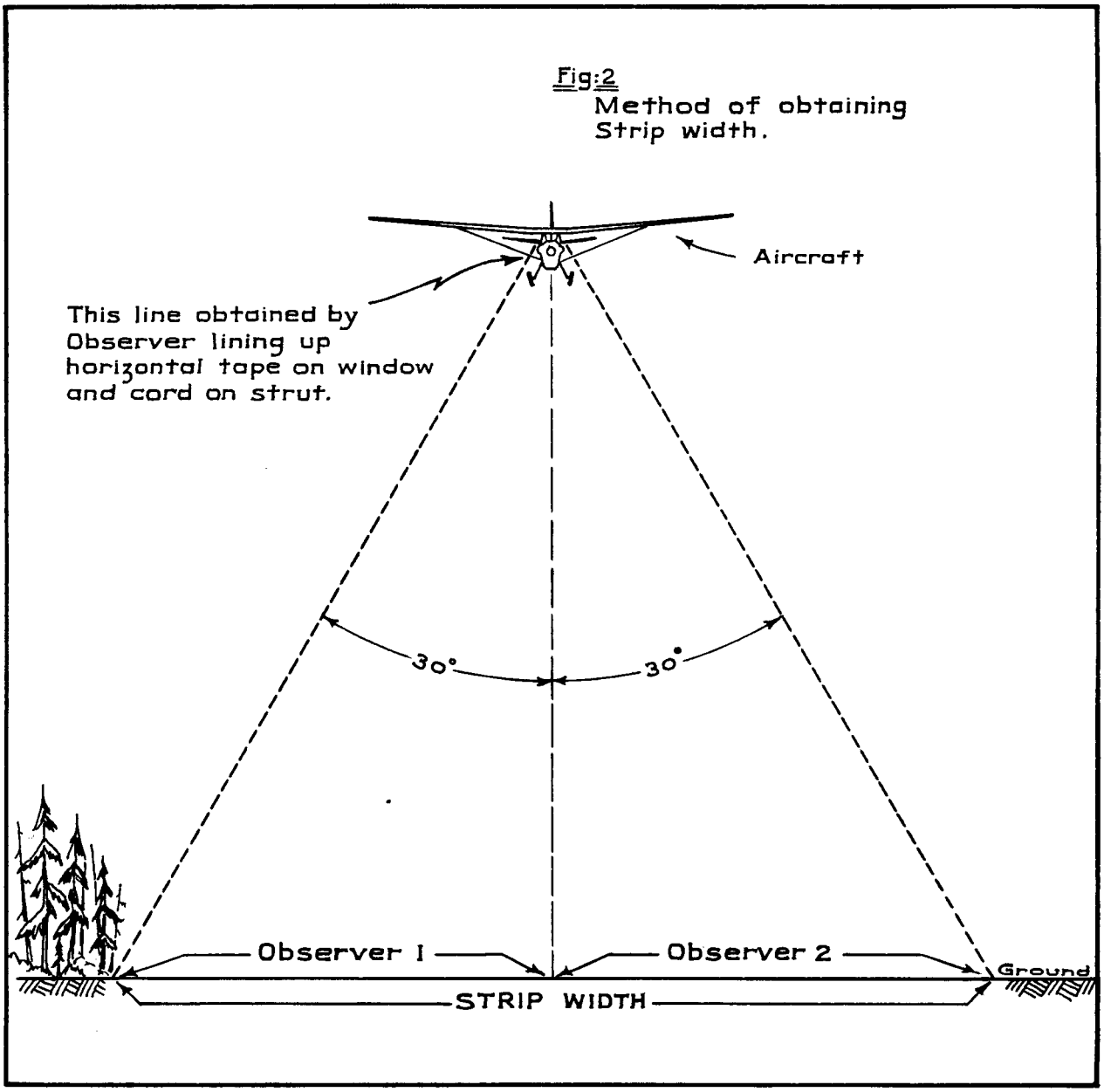
Fig:2
Method of obtaining
Strip width.
Aircraft
This line obtained by
Observer lining up
horizontal tape on window
and cord on strut.
30°
30°
Observer 1
Observer 2
Ground
STRIP WIDTH

Fig. 2.