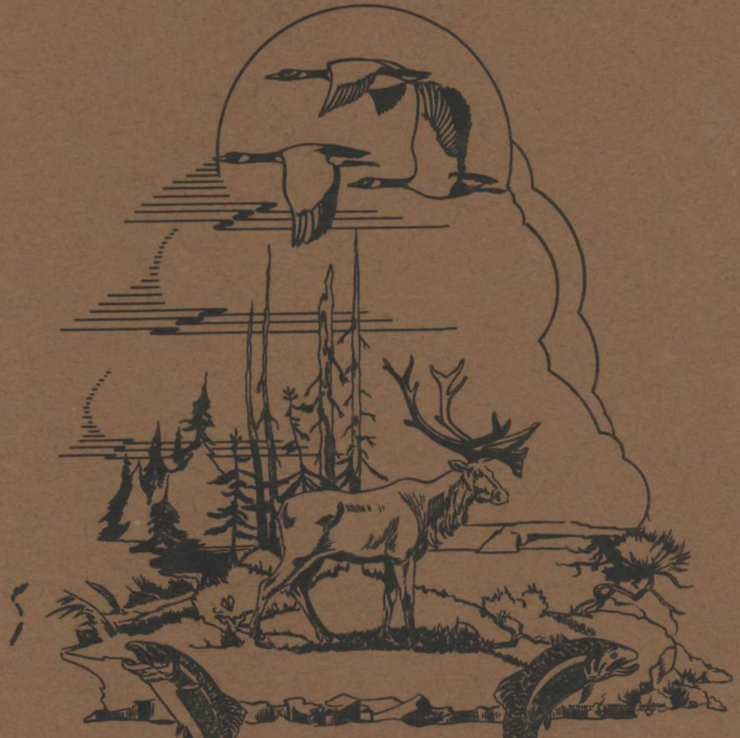
WILDLIFE MANAGEMENT BULLETIN



DEPARTMENT OF NORTHERN AFFAIRS
AND NATIONAL RESOURCES
NATIONAL PARKS BRANCH
CANADIAN WILDLIFE SERVICE

SERIES 1 — OTTAWA — NUMBER 13

1957

CANADA

DEPARTMENT OF NORTHERN AFFAIRS

AND

NATIONAL RESOURCES

NATIONAL PARKS BRANCH

CANADIAN WILDLIFE SERVICE

RANGE STUDIES IN BANFF NATIONAL PARK, ALBERTA, 1953

by

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SERIES 1 NUMBER 13

Issued under the authority of
The Minister of Northern Affairs and National Resources

Ottawa

1957

91709—1

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Wildlife Management Bulletins are produced to make available to wildlife administrators the information contained in reports which are submitted by officers of the Canadian Wildlife Service.

The reports do not, in most cases, cover extensive studies and are not written primarily for publication. Recommendations arising from the studies are not included.

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INTRODUCTION

In 1944 Dr. Ian McT. Cowan conducted an investigation of game conditions in Banff National Park and noted an over-population of browse-eating ungulates. Elk were obviously damaging certain vegetative types (Fig. 11). Surveys were undertaken in an attempt to determine range conditions (Cowan, 1946).

Four game exclosure plots were fenced in conjunction with the surveys, one each on deer and sheep winter ranges and two on areas heavily utilized by elk. All were in the lower Bow Valley. In 1952 Dr. A.W.F. Banfield added a fifth plot on willow flats regularly frequented by moose. Details regarding the location, size, purpose, and examination of the plots may be summarized as follows:

Plot Number	Date Erected	Dimensions (feet)	Miles West of Banff Townsite	Reason Erected	Date Examined in 1953
1	Spring 1944	20x24	½	To ascertain the effect of ungulates on erosion	June 17
2	Spring 1944	20x24	3	Heavily used sheep range	June 18
3	Spring 1944	60x85	10½	Typical aspen winter range of elk and deer.	June 11-18
4	Spring 1944	30x50	12	Winter grass range of elk and deer	June 11
5	Autumn 1952	40x60	17	Swamp willow and birch winter moose range	Aug. 29-30

The exclosure plots were built to provide permanent locations for long-term research on the cumulative effect on plant succession of grazing and browsing by elk and other ungulates. A secondary purpose was to provide control areas for detecting yearly trends in range conditions. It was hoped in this way to obtain a basis for the manipulation of animal populations.

The plots have served the main purpose successfully; this report attempts to describe the degree to which they have done so. Their value for the secondary purpose remains uncertain. Hillsdale Meadows (Range 4) has been the only range checked periodically since its inception. Management practices for the Bow Valley have been based on this key area, on visual signs of range conditions, and on animal census.

The present study, undertaken during the summer of 1953[1], under the direction of Dr. Banfield, was an attempt to evaluate numerically and pictorially the successional changes brought about by animal exclusion i.e., the fulfilment of the first purpose of the plots. It was accomplished by quantitative measurement of the important fodder species inside and immediately outside the plots. These two data groups are contrasted and positive ecological differences are described. The biological importance of changes due to grazing and browsing is discussed and some predictions for the future are ventured.

Methods

Three recognized vegetative sampling techniques were employed. The first was the point-sample method (Clarke et al, 1942); the second was the Aldous browse survey method (Aldous, 1944); and the third was the clip-quadrat system of measuring total vegetative production in grassy zones, with results expressed in average weights per unit of area (Cowan, 1946; Banfield, 1947).

The statistical significance of data obtained by using a fixed 1,000 points of the point sample method is in doubt. The comparative significance of forage data gathered at various stages of seasonal growth is likewise uncertain. However, these methods had been used by the previous workers, and new techniques would have provided no greater degree of comparative

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1. The writer was then employed by the Canadian Wildlife Service.

accuracy. Special caution was exercised when interpreting data secured by these methods.

The comparison of point sample data can also lead to error in some instances, when the data are collected by different workers. In the 1953 study only live plants were tallied; none of the previous investigators are clear on the method they used. In 1953 a "hit" was recorded only when the base of the plant was touched. Clarke and Cowan advocated this method; Green didn't specify; and Banfield counted hits when a plant was touched anywhere by a point. As a result Banfield's figures may be significantly higher than the others.

Each range was inspected in a manner best suited to its peculiar nature. Future surveys should be similar for best comparative results.

Range 1

On June 17, 1,000 points were tallied on the range immediately surrounding Plot 1. A clockwise spiral line originating at one of the four corner posts was followed. Samples of ten points were taken every five paces. Approximately three circuits of the plot constituted 1,000 points.

On the same day 500 points were taken inside the plot by similar means.

Production figures were obtained on July 25. Two square yards inside the plot were selected at random and clipped. Five quadrats of the same size were selected at random outside the plot and within five yards of it.

Range 2

On June 18, samples of 1,000 and 500 points were selected as on Range 1.

Ten square-yard quadrats were clipped from range adjacent to the plot on July 25. Two similar quadrats from inside the exclosure were selected at random and clipped.

Range 3

Exclosure Plot 3 had been located purposely on typical aspen terrain subject to heavy winter use by elk. Detailed measurements had been taken in 1944. Thus an excellent opportunity for a nine-year contrast was afforded in 1953.

Exhaustive total counts were undertaken on June 15 with this in view. All shrubs (two species) and trees (one species) inside the exclosure were tallied according to height. Milacre figures were calculated for each height class, using the measured plot size of 113.4 milacres. This allowed comparison with data derived from a 50-milacre Aldous survey sample taken "mechanically" around the exclosure (Fig. 1). Transects paralleling each plot wall at a distance of two yards were extended 25 yards from each plot corner. A single milacre was tallied every ten paces. Dominancy figures such as suggested by Aldous were obtained but discarded in favour of more comparable per cent occurrence data.

Diameters at breast height (4.5 feet) were determined for 37 tagged aspens inside the plot. Two tagged willows and two dwarf birches were located and measured for height and diameter.

Shrubs tagged in 1944 on the open range could not be found. Excessive browsing had apparently destroyed the tags.

No aspens had been tagged or sampled outside the plot in 1944. To obtain comparative data, the nearest 26 aspens of location and age apparently similar to those of the aspens in the plot were measured for d.b.h.

Range 4

During the period June 11 to 15, 1,000 and 500 points were tallied on the open range and the plot respectively, as on Ranges 1 and 2.

On July 25, ten clip-quadrats from the open range and three from the plot were weighed and averaged. The quadrats on the open range were all within five yards of the plot.

Range 5

The Aldous browse survey method was used from August 28 to 31 to tally Plot 5 for the first time since its erection. A total count of shrubs was included.

An arbitrary four-foot height-class division was used. Inspection indicated that it would illustrate numerically the amount of willow growth during one season of moose exclusion.

Fifty-two milacres completely covered the plot. Fifty milacres outside the exclosure were correspondingly examined. One milacre square was tallied every ten paces along transects placed two yards from each side of the plot. The four transects were projected outwards from the four corners (Fig. 1). The plot and open range data thus garnered have two comparative aspects: (1) Aldous dominancy values, and (2) relative abundance in numbers per milacre.

Results

Range 1

Some effects of the nine-year period of animal exclusion on Range 1 were revealed. The relative percentages of plant cover and bare ground inside and outside the exclosure plot were as follows:

	Plot %	Open Range %
Grasses	14.0	20.1
Forbs	17.6	10.7
Shrubs	.2	.7
Bare ground	68.2	68.5

It is remarkable that total percentages of plant cover on the range and in the exclosure remained equal; both were approximately 32 per cent. However, changes in plant cover composition did occur.

It is assumed that densities were the same for range and plot in 1944. In 1953 there were fewer grass plants per unit area inside the plot than outside of it, but the reverse was true for the forbs. Twenty per cent of the open range plants were grass-like and 11.4 per cent herbaceous. The plot had 17.6 per cent forbs and 14.0 per cent grasses. It would appear that the forbs became so abundant inside the plot that they retarded the reproduction of grass, through competition for some unknown factor.

Forage production was nearly two and one-half times greater inside than outside the plot (Table 1). Plants of the genera Rosa, Fragaria, and Anemone contributed directly to this. Such heavy growth (although light in comparison to other ranges) may have prevented sufficient light from reaching the short grass plants to enable them to reach maximum reproduction.

It is also possible that grazing stimulated vegetative reproduction in grasses on the open range, although it prevented them from fruiting. As forbs generally do not have such powers of compensatory asexual reproduction, grazing would naturally reduce their rate of increase.

The observed differences were caused by "light to moderate" grazing. Heavy grazing and trampling would have had different results. The kind of forbs present must also influence the ultimate effect of grazing.

The shrub count was below the level of significance of the point sample method. Young aspens existed inside the plot but not outside it (Fig. 6).

It is interesting to speculate that on this area, where forb and tree seed sources were abundant, moderate grazing served to prolong the grassy phase of succession. If there had been no animals grazing on the forb, shrub, and tree growth, it would have at least partially replaced certain grass species.

Recent grazing had been light and plant growth heavy in this area (Green, personal communication). As a result the plant cover of the open range had been sufficient to prevent extreme erosion. Thus spectacular results which might have been expected had not materialized: erosion was not particularly evident either inside or outside the exclosure plot. Theoretically, however, the heavy carry-over allowed by the exclusion of ungulates breaks the force of heavy rain, shielding the topsoil from its battering effect.

However interesting the present figures, more significant figures would have been available after another nine years. Therefore it is to be regretted that Plots 1 and 2 have been destroyed by the Trans-Canada Highway project.

Range 2

In 1953, grass plants were significantly more abundant in the surrounding sward than in the plot on this range, just as on Range 1. Forbs were many times more plentiful outside than inside, a condition opposite to that on Range 1.

The data obtained by point sampling on Range 2 were as follows:

	Plot		Open Range	
	1944 %	1953 %	1944 %	1953 %
Grasses	43.0	21.4	29.0	29.5
Forbs	4.0	.8	8.0	6.5
Shrubs	-	.6	-	.5
Bare ground	53.0	77.2	63.0	63.5

As on Range 1, forage production was about two and one-half times the greater in the plot (Table 1).

The data given in the summary above show that Range 2 was supporting a healthier, denser grass and sedge component than Range 1 (Fig. 7). More than 21 per cent of plants inside Plot 2 were grasses and sedges, whereas only 14.0 per cent were grasses in Plot 1. This is reflected by the production data (Table 1). Plot 2 averaged 114.2 grams per square yard, Plot 1 slightly less than 33 grams.

Apparently the amount of matted dry grass (greatest in Plot 2 of all the areas measured) was sufficient to restrict the forb growth, whereas the grass in Plot 1 was sparse enough to permit forbs to grow abundantly. Also, the lack of seed sources on Range 2 apparently helped restrict the growth of forbs. The open range figure for forbs (6.5 per cent) was only a little more than one-half that for Range 1 (10.7 per cent).

The dense canopy of unutilized material in the plot probably also retarded seasonal grass reproduction. Again it can be deduced that moderate grazing had stimulated vegetative reproduction among grasses.

If all grazing animals were removed from Range 2, natural selection would ultimately lead to fewer grass plants. Forbs would also be almost completely suppressed by unutilized grass. Since the yearly cropping by ungulates stimulates grass reproduction, it follows that an optimum amount of grazing (i.e. by a herd of optimum size with regular seasonal movements) would raise the annual forage production rate and so be the most efficient use of the range. To reach this high degree of efficiency, grazing pressure would have to be regulated.

The author believes that no legitimate comparisons between the 1944 and the 1953 data can be made. At the date of plot erection, grasses were shown to be twice as abundant inside as outside the plot. Perhaps these data are incorrect.

Range 3

Plot 3 originally contained 37 aspens (Populus tremuloides), 4 dwarf birches (Betula glandulosa), and 4 willows (Salix sp.). These were all tagged and measured. In addition 4 birches and 4 willows outside the plot were tagged.

The phenomenal growth and reproduction of all three species inside the plot (Fig. 8) is the most striking feature of the data for this range. All 37 aspens were alive in 1953, even though some were badly scarred and listed as dying in 1944. The measurement data for these trees is given in Table 2. Their average d.b.h. was 19.31 inches as compared with 4.49 inches in 1944. Individual increases varied from $2\frac{3}{4}$ to $28\frac{3}{4}$ inches.

Twenty-seven trees outside the plot, presumably of the same age, had an average d.b.h. of 20.9 inches. This is not significantly different from that of the protected aspens. However, there were numerous small dead trees in this group, an indication that some saplings were killed by persistent elk and deer damage.

Elk in over-abundance must exert a powerful influence on plant succession. By thinning out small trees they tend to produce more open stands, with subsequently greater amounts of shrubby under-growth. Heavy aspen mortality at stand edges tends to prevent forest encroachment on land favourable for grazing.

A complete tally of aspen regeneration in the plot since 1944 was made. Six hundred and eight new trees were tabulated by height class (Fig. 2). Excluding the shortest height class, a regular decrease in numbers with height (and thus age) can be observed. This decrease is a result of climatic, competitive, and edaphic factors, i.e. all factors except animal pressure. The shortest height class (0-1 feet) was expected to be the largest, and was probably larger than indicated. Undoubtedly a few tiny plants were overlooked in the dense ground cover.

Similar figures obtained by means of a 50-milacre Aldous survey of the open range are contrasted with the data for the plot in Fig. 3. Table 3 contains the data from which Fig. 3 is derived.

Two main points are illustrated.

First, more trees up to two feet high were found per milacre on the open range then in the plot. This difference can be attributed to the hedging effect of browsing by elk and deer. Outside, more than one age class had been browsed to less than two feet. Inside, only plants two years old or less were found in that height class.

Second, aspen from two to eight feet high were completely lacking in the open range, but abundant everywhere in the plot (Fig. 3). Browsing by elk was not only causing visible damage but was totally suppressing aspen regeneration. Seed seemed to be plentiful but apparently seedlings regularly reached a height of two feet each summer only to be browsed to snow level in the following winter.

A similar situation existed for the two important browse shrubs, willow and glandular or dwarf birch. Each milacre of the open range averaged 5.16 willows less than four feet high, and there was none more than four feet high (Table 3). Inside the plot, noticeably fewer (3.43) short willows were found per unit area. Assuming that seed distribution and germination were equal inside and outside the plot, the difference is explained by the 0.3 plants per milacre more than four feet high that were recorded in the plot. Elk were keeping all willows in the open range stunted and hedged.

Dwarf birches less than four feet high numbered 0.52 per milacre on the open Range. 3. Inside the plot 0.02 were recorded per milacre. Again the taller height class was evident inside but not outside. The prevention of browsing made possible a general increase in height.

Shrubby cinquefoil (<u>Potentilla sp.</u>) was apparently not a preferred species and was only lightly browsed. Significantly, it was the only shrub more abundant on the open range than in the plot. One of this species was found for every five milacres (0.22 per milacre) in the open, where grazing repressed competing shrubs. There were fewer (0.07 per milacre) among the heavy willow and birch growth in the plot.

All the tags placed in 1944 on birches and willows on the open range were missing. Four tags were eventually located in the plot. The data regarding the growth of the tagged willows and birches is given in Table 4.

Each birch had more than doubled in height. Willow growth was slightly less; all four willows were between 55 and 87 inches high. No birch or willow outside the plot was more than 30 inches high.

The observations of shrub and tree growth and reproduction indicated that browsing had not only damaged shrubby vegetation, but also, in this case, retarded normal plant succession. Grassy swales and treeless areas had been protected from forest encroachment by elk activity. Elk were currently reaping a greater total grass harvest from the Bow Valley because of their former range destruction. At the same time they were inadvertantly lengthening their period of tenure by prolonging the grass stage of succession.

Elk had reached their peak of abundance a few years before. The carrying capacity of Range 3 was then probably greater than at the time of the investigation. The smaller current elk population was quite capable of restricting aspen regeneration to seedling size. Thus, while prolonging their tenure they were limiting drastically the number that could be maintained in a healthy condition.

Range 4

Hillsdale meadows (Fig. 9), considered to illustrate Bow Valley range trends, has been frequently inspected since 1944.

The forage production data for this range are given with those for Ranges 1 and 2 in Table 1. Carry-over calculations for 1953 are lacking because clip-quadrats could not be obtained until August.

An average of 136 grams from open range quadrats indicates that seasonal growth in 1953 was as great as, or greater than, in any previous year. The 1952 figure is larger but was obtained in October.

Of particular significance is the low plot average of 112.5 grams, approximately one-third that of 1952. The heavy 1952 carry-over evidently suppressed or at least retarded the next season's production. At the time of clipping, individual plant development was greatest in the open range. Brown grass spikes predominated there, but only green shoots with no flowers or seeds grew inside the plot.

Forbs were denser outside the plot than inside it. This group contributed considerable weight to the forage data.

Summer grazing at Hillsdale was negligible in 1953, This, combined with the above conditions, explains why there was more forage per square yard outside than inside the plot. The inference is that moderate grazing increases the total forage production by removing excess carry-over material, as well as by retarding plant succession.

The plant density data for this range were as follows:

	Plot		Open Range			
	1944	1953	1944	1946	1947	1953
	%	%	%	%	%	%
Grasses	40.0	36.0	39.4	49.1	54.4	43.5
Forbs	12.0	.6	6.0	4.5)	6.6	3.0
Shrubs	-	-	-	)	5.0	1.0
Bare ground	48.0	65.4	54.6	46.4	34.0	52.5

On this open range there were more plants per unit area than on either Ranges 1 or 2. The plot also had a greater total plant coverage than on other ranges. The extreme abundance of grasses, with proportionately high forage production, shows that Hillsdale meadows is an exceptional area. Its good condition may have been due to animal movements or to local climatic influences. A study of both factors is needed before range data can be used in the control of animal abundance.

As on Range 2, grass and sedge density was greatest on the open range and this was also true for forbs. Grazing seems favourable to the growth of some forbs, probably through the constant removal of the canopy of dried grass.

Range 5

Willow and dwarf birch were the only browse species inside Plot 5. They showed no change in growth form since 1952, but on the average they were taller inside the plot than in 1952 (Fig. 10).

Average density figures (Aldous dominancy system) show that willows four feet or more high predominated inside the plot. Willows less than four feet high predominated outside it (Fig. 5).

Based on a numerical count the shorter willow class was the more abundant per unit area in the open range with 6.86 plants per milacre (Fig. 4). The open range had only 0.52 plants per milacre more than four feet high (Table 5 and Fig. 4).

Inside the plot, 2.08 willow plants per milacre of the taller class were recorded. Willows less than four feet high were more abundant (3.96) but to a lesser degree than in the open range. The difference is the result of one winter's growth free from utilization by moose.

The average density method was more sensitive than its counterpart in this instance. It illustrated the plot growth increment dramatically.

There were no birches more than three feet high on Range 5. The birch plants found were evenly distributed inside and outside the exclosure (Figs. 4 and 5). Willows dominated, and were more abundant than, birches in both areas.

Shrubby cinquefoil was sampled near the roadside and may not be recorded in future.

Summary and Conclusions

Four game exclosure plots were erected on key game ranges in the Bow Valley of Banff National Park in conjunction with 1944 general range surveys. Another was added in 1952.

The present study, undertaken during June, July, and August, 1953, attempts to estimate the successional changes brought about by animal exclusion. From this data general animal effects on plant succession are deduced and described.

On Ranges 1, 2, and 4, committed entirely to grasses and forbs, forage production in relation to animal pressure showed two features. In the first two cases production figures were increased by complete animal exclusion. Range 4 had more forage per unit area outside the plot. In that case, it appeared that heavy unutilized growth from the previous year had effectively retarded the 1953 growth in the plot, whereas light to moderate grazing had probably stimulated asexual reproduction among grasses on the open range. Forbs were also more abundant on the open range and undoubtedly contributed to the large forage production figure.

On Range 1 forbs were more numerous inside the plot. This unique situation is attributed to abnormally numerous nearby seed sources, and the general sparseness of the grass. In this instance grazing tended to suppress forbs and prolong the dominance of grasses and sedges.

On Range 2 forbs were more plentiful outside the plot, probably because of suppression inside the plot by the heavy grass carry-over.

The grass cover in this plot gave the impression that the total grass production was heavy. Actually more grass per unit area was probably being produced outside the plot. In other words the land may produce more with moderate grazing than without grazing. This phenomenon may be explained as an effect of grazing on grass reproduction. In all three ranges grass plants were most numerous in the open range where there was regular utilization. Cropping by ungulates seems to stimulate grass reproduction.

To harvest grass ranges effectively and to prolong the life of desirable grass species, moderate grazing is necessary. Heavy grazing and trampling, on the other hand, probably produce disastrous results. Thus a fine population balance must be reached to maintain optimum grazing pressure.

It is doubtful whether population numbers can be manipulated successfully for this purpose before the climatic effects on the movements of the animals have been studied. However, it is wise in principle to reduce populations when the possibility of damage by over-population exists. The potential rate of increase of elk is so great that permanent harm is seldom done by occasional reduction.

Unusually great aspen reproduction and growth characterized Plot 3. Young aspen were numerous in the expected height classes inside the plot. On the open range, however, browsing by elk and deer had completely prevented aspen seedlings from reaching more than two feet in height. The many small trees on the range were being browsed each winter to upper snow depth. No regeneration was allowed, and thus the spread of existing aspen stands into grassy areas was being prevented. Willow and birch were similarly affected. Mature plants were hedged and stunted in appearance.

Some aspen killing by elk through bark and twig mutilation seemed to have taken place during the previous nine years. However, some badly scarred trees had made remarkable recovery after the elk population was reduced.

Shrubby cinquefoil apparently thrives best in areas subject to heavy browsing. It is not a preferred species and probably suffers in competition with willow and birch.

The cumulative effect of grazing by elk on Range 3 indicated that they were preventing the encroachment of aspen, willows, and birch on favourable grazing areas and were thinning existing aspen stands, which potentially allowed a greater undergrowth of shrubs. Thus, through a process of retardation, elk were prolonging successional phases desirable from the point of view of production. At the same time, however, they had limited the maximum number of their own species that the range could support.

Willows predominated on Range 5. Inside the plot willows more than four feet tall were fewer in number but dominated those less than four feet in height. Outside the plot the shorter height-class was more numerous. A similar situation existed for glandular birch. The exclusion of moose for one season had allowed the observed growth and consequent dominance of taller height classes in the plot.

The five exclosure plots provided an excellent means of discerning animal effects on ranges in the lower Bow Valley. These plots are invaluable and should be kept permanently. The two plots destroyed by the Trans-Canada Highway project should be replaced elsewhere in suitable locations.

Literature Cited

Aldous, Shaler E.	1944	A deer browse survey method. J. Mamm. 25: 130-137.
Banfield, A.W.F.	1947	Wildlife investigations in Banff National Park, 1947. Unpublished report in files of Can. Wildlife Serv.
	1952	Range studies - Banff National Park, 1950-1952. Unpublished rept. in files of Can. Wildlife Service.
Clarke, S.E., J.A. Campbell J.B. Campbell	1942	An ecological and grazing capacity study of the native grass pastures in Southern Alberta, Saskatchewan. and Manitoba. Can., Dept. Agr., Div. of Forage Crops, Pub. No. 738, Tech. Bull. 44.
Cowan, Ian McT.	1946	General report upon wildlife studies in the Rocky Mountain National Parks in 1946. Unpublished rept. to Dept. Mines and Res. Mimeographed.

Table 1. Forage Production of Three Exclosure Plots and Adjacent Open Ranges, in Grams of Air-dried Material per Square Yard.

Year	1946	1950 Oct.	1951 May	1951 Sept.	1952 April	1952 Oct.	1953 Aug.
Range 1							
A. Plot	-	-	-	-	-	-	32.9
B. Open Range	-	-	-	-	-	-	14.6
Range 2							
A. Plot	-	-	-	-	-	-	114.2
B. Open Range	-	-	-	-	-	-	46.0
Range 4							
A. Plot	-	-	244	233	-	337	112.5
B. Open Range	130	127	38.4	128	64	164.5	136.0

Table 2. Growth in Inches of Tagged Aspen Trees in Exclosure Plot 3.

Tag. No.	D.B.H. 1944	D.B.H. 1953	Increase	Tag No.	D.B.H. 1944	D.B.H. 1953	Increase
1	4½	20	15½	21	3	13	10
2	2½	11	8½	22	7½	32	24½
3	4¾	23	18¼	23	5	21	16
4	3	16	13	24	5	22	17
5	5	24	19	25	5	20	15
6	4¾	21	16¼	26	3¼	14½	11¼
7	5¾	27	21¼	27	4	17	13
8	2½	14	11½	28	5¼	21	15¾
9	4½	22½	18	29	3½	15	11½
10	5	23	18	30	5½	22	16½
11	4¼	18	13¾	31	2¾	11½	8¾
12	3¼	16	12¾	32	4½	18½	14
13	4¼	7	2¾	33	10¼	39	28¾
14	2 1/8	10	7 7/8	34	8¾	36½	27¾
15	4½	18½	14	35	5	23	18
16	6¼	27	20¾	36	3	13	10
17	3	14	11	37	2¾	12¾	10
18	4 1/8	16	11 7/8				
19	5¾	24	18¼	Av.	4.49	19.31	14.82
20	2½	11	8½				

Note - Average d.b.h. of 27 untagged aspens of the same age in the open range adjacent to the plot - 20.9 inches.

Table 3. Shrubs and Trees Tallied Inside Exclosure Plot 3 (113.4 Milacres) Contrasted with Those Tallied in a 50-Milacre Sample of the Open Range.

Plant	Height Class in feet	Plot		Open Range	
		Total No.	% Occurrence (No./milacre)	Total No.	% Occurrence (No./milacre)
Populus tremuloides	0-2	223	1.97	151	3.02
	2-4	184	1.62	nil	-
	4-6	119	1.05	"	-
	6-8	50	0.44	"	-
	8+	32	0.28	10	0.2
Shepherdia sp.	0-4	8	0.07	nil	-
	4+	nil	-	"	-
Salix sp.	0-4	389	3.43	258	5.16
	4+	34	0.30	nil	-
Potentilla	0+	8	0.07	11	0.22
Betula glandulosa	0-4	2	0.02	26	0.52
	4+	9	0.08	nil	-
Rosa sp.	0+	58	0.51	55	1.1

Table 4. Growth in Inches of Tagged Shrubs in Exclosure Plot 3.

Plant	Tag.No.	Diameter		Height	
		1944	1953	1944	1953
Betula glandulosa	1A	29-25	-	33	-
	2A	56-53	86-75	35	87
	3A	70-62	-	40	-
	4A	70-68	93-85	32	87
Salix sp.	1B	33-25	33-30	26	55
	2B	29-18	-	23	-
	3B	48-22	-	30	-
	4B	23-18	43-34	40	58

Table 5. Shrub Composition in Plot 5 (52 Milacres) Contrasted with that of a 50-Milacre Sample of the Open Range.

Plant	Height Class (feet)	Totals		Dominancy Value		Average Density		Occurrence (No./Milacre)	
		Plot	Open Range	Plot	Open Range	Plot	Open Range	Plot	Open Range
Salix sp.	-4	206	343	995	1,660	19.1	33.2	3.96	6.86
	+4	108	26	1,620	445	31.2	8.9	2.08	0.52
Betula glandulosa	-3	7	11	50	25	0.96	0.5	0.14	0.22
	+3	nil	-	-	-	-	-	-	-
Potentilla sp.	-3	nil	2	-	5	-	0.1	-	0.04
	+3	"	-	-	-	-	-	-	-

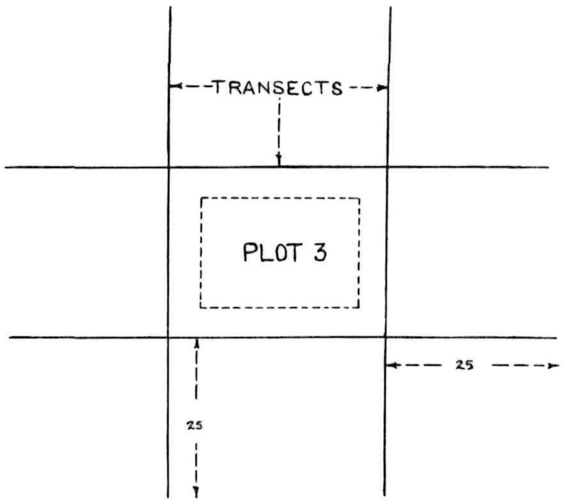

Fig. 1. Transects followed in obtaining Aldous browse survey samples on Ranges 3 and 5. Measurements in linear yards.

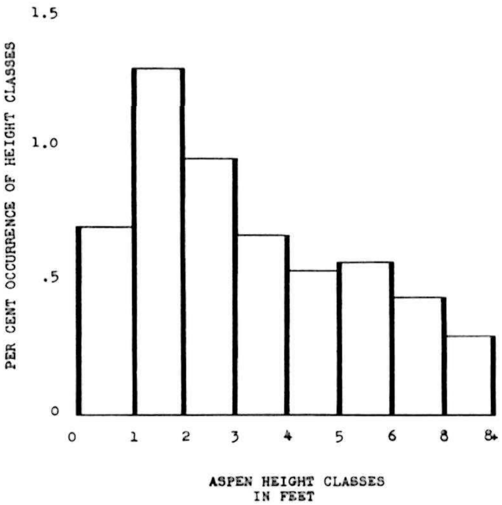

Fig. 2. Aspen height classes inside Exclosure Plot 3, 1953.

One hundred plants per milacre represents 100 per cent occurrence.

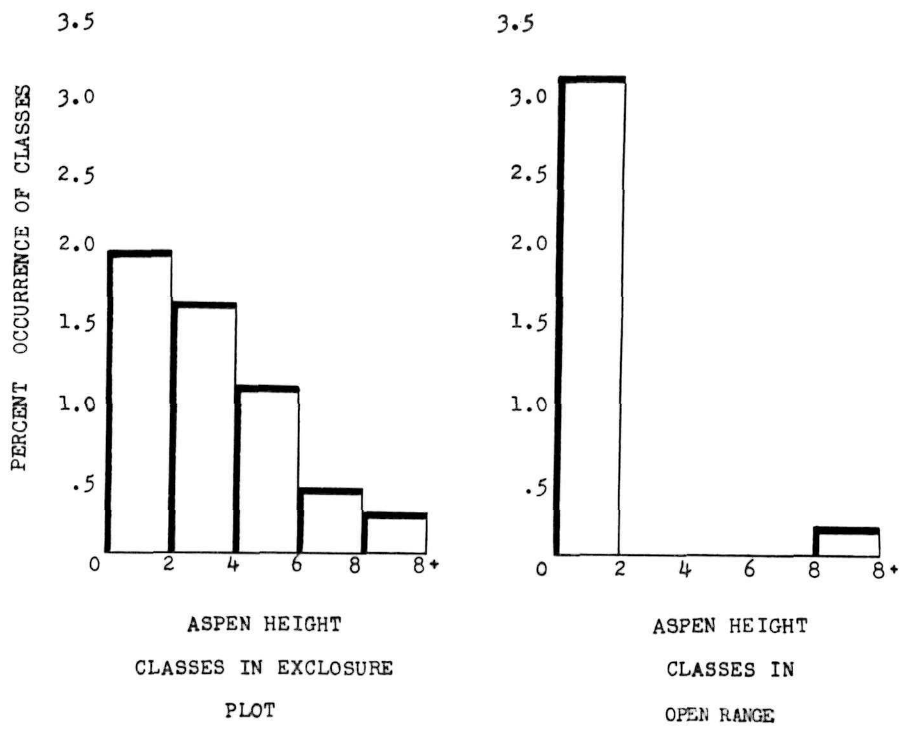

Fig. 3. Numbers per milacre of five aspen height classes in Exclosure Plot 3 and in the adjacent range.

Classes in feet. One hundred plants per milacre represents 100 per cent occurrence.

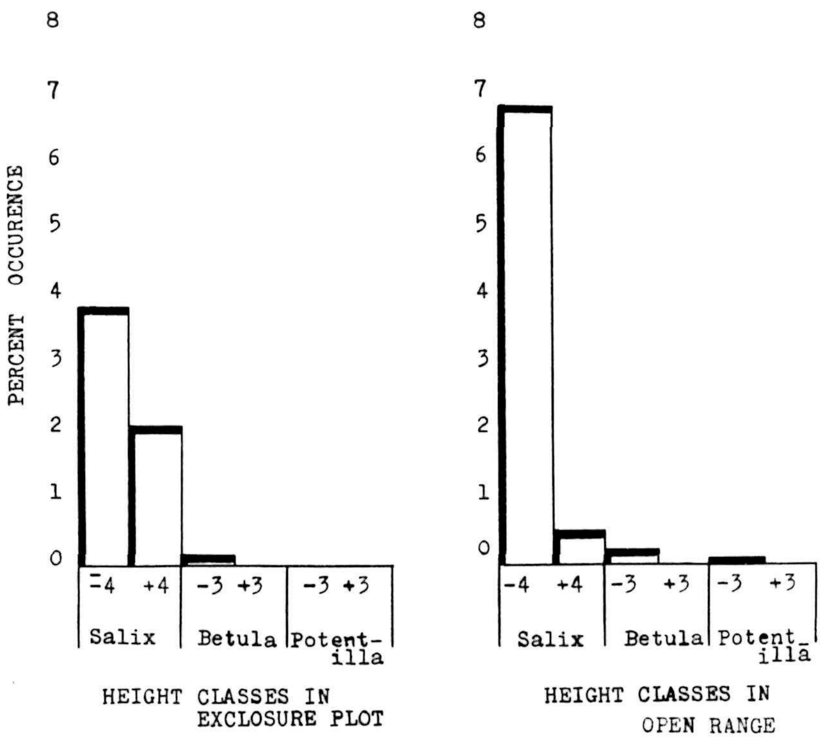

Fig. 4. Numbers per milacre of six height classes representing three plant genera inside Exclosure Plot 5 and on the open range.

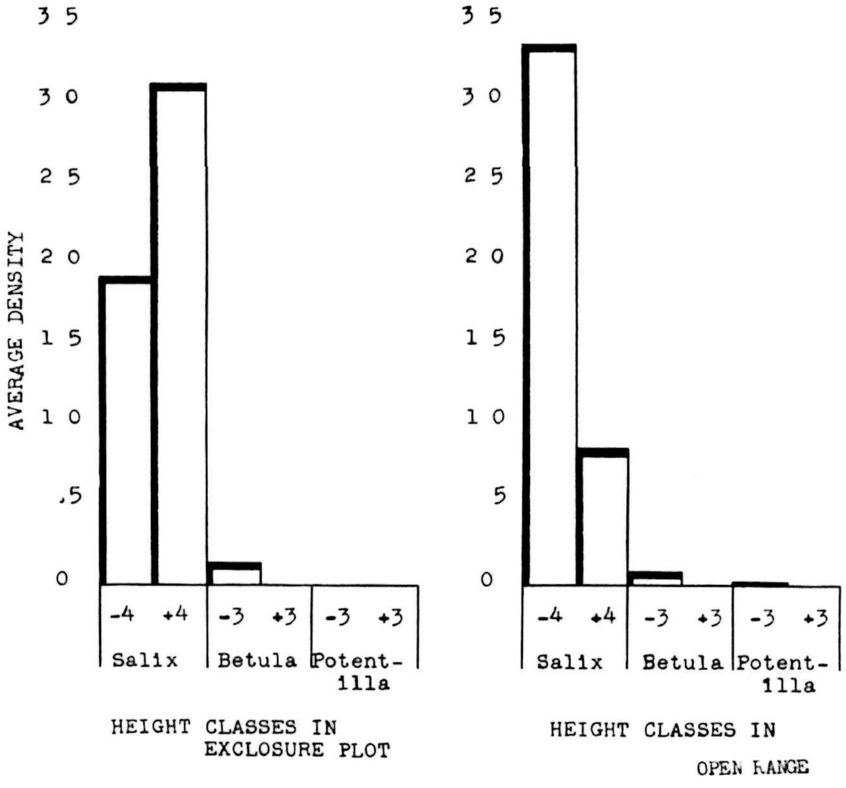

Fig. 5. Average densities of six height classes inside Exclosure Plot 5 and same six classes on the open range.

Height classes are in feet. Density figures calculated from dominancy values.

Fig. 6. Exclosure Plot 1.

Fig. 7. Exclosure Plot 2.

Fig. 8. Exclosure Plot 3.

Fig. 9. Exclosure Plot 4.

Fig. 10. Exclosure Plot 5.

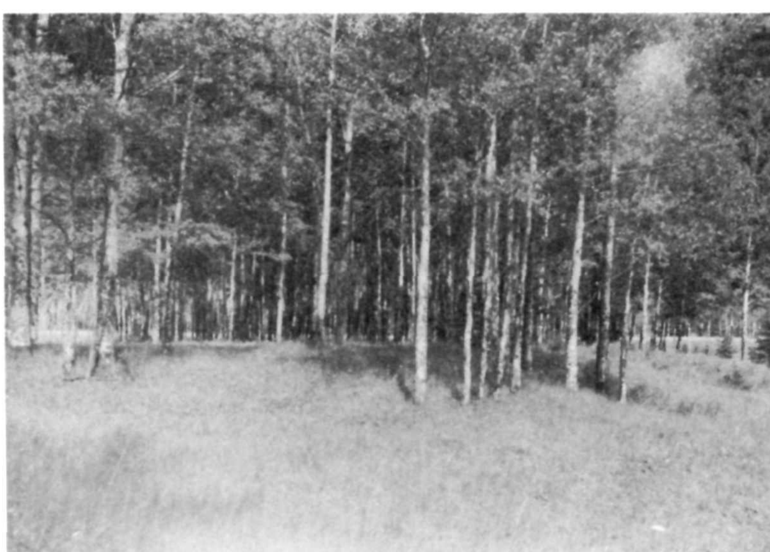

Fig. 11. Aspen on Range 3, showing dark mutilation scars caused by extensive gnawing by elk.

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OTTAWA, 1957