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SHEEP REPORT

by
Lyman Nichols

Volume XVI
Project Progress Report
Federal Aid in Wildlife Restoration
Project W-17-7, Jobs 6.5R and 6.7R

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(Printed July, 1975)

JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperator: Lyman Nichols

Project Nos.: W-17-7 Project Title: Big Game Investigations

Job No.: 6.5R Job Title: Dall Sheep Population Trends and Composition on the Kenai Peninsula

Job No.: 6.7R Job Title: Dall Sheep Winter Range and Climate

Period Covered: July 1, 1974 to June 30, 1975

SUMMARY

Thirty-eight Dall sheep of both sexes were removed from the Crescent Mt. herd in the fall of 1974 by public hunting. Continued adult-ram-only hunting accounted for the removal of seven rams from the Surprise Mt. herd, while the Cooper Landing Closed Area remained closed to all sheep hunting. However, an estimated five rams were removed from this herd by hunters outside the boundaries of the closed area. Effects of this hunting season have not yet been assessed.

Replicate aerial surveys were conducted on each of the three herds under study, and population models constructed from the results. Total herd sizes were estimated for each area during the summer of 1974 as follows: Crescent Mt., 250; Surprise Mt., 189; Closed Area, 266. Lamb production in the spring of 1974 for each herd in the same order was: 43:100♀, 27:100♀, and 27:100♀. Overwinter mortality from 1973 to 1974 was again lower on Crescent Mt. than on either of the others, although higher in all three herds than over the winter of 1972-73.

Wind and temperature data were again obtained from a recording weather station in each area. Average and maximum seasonal and annual winds during the period of October 1973 to September 1974 were highest on Crescent Mt. and lowest on Slaughter Mt. in the Closed Area. Average annual and winter temperatures were lowest on Crescent Mt. and highest on Surprise Mt.

Snow measurements, obtained in February 1975 in each area, indicated that snow depth was similar on Surprise and Slaughter Mts. and less than either on Crescent Mt. The snow was significantly harder on Crescent Mt. than on Surprise Mt. and significantly harder on Surprise Mt. than on Slaughter Mt. It was found to be harder on all three areas than during any previous winter examined.

Although still too early for definite conclusions to be drawn, it is suggested that decreased winter mortality and increased lambing success during the preceding two years on Crescent Mt. are in response to herd control by either-sex hunting. Further confirmation is needed through continued control of this herd combined with monitoring and comparing populations and climate.

CONTENTS

Summary	1
Background.	1
Objectives.	1
Procedures.	2
Population Trends.	2
Winter Range and Climate	2
Findings.	2
Population Trends.	2
Winter Range and Climate	5
Discussion.	12
Recommendations	17
Literature Cited.	17

BACKGROUND

The detailed background of this study has been presented in previous progress reports (Nichols 1974). In brief, it was designed to compare results of three management techniques (herd control through either-sex harvest; traditional 3/4 curl ram-only harvest and complete protection) on three adjacent but relatively isolated herds of Dall sheep (*Ovis dalli*) in the Kenai Mountains. The respective herds are located in the Crescent Mountains complex, on Surprise Mountain and in the Cooper Landing Closed Area, of which Slaughter Mountain is the most significant subunit. An additional objective of the study was to obtain basic life history information concerning the species.

During the current segment, an either-sex, controlled hunt in fall 1974 resulted in the removal of a known 17 rams, 20 ewes and 1 lamb from Crescent Mountain. Seven rams were reported taken from Surprise Mountain, while an estimated 5-10 rams were taken from the Closed Area herd outside the boundaries of the Closed Area itself. The effects of these hunts cannot be assessed until summer 1975 when snow and weather conditions make accurate herd estimates possible.

Portions of the study (Jobs No. 6.3R and 6.4R) have been completed; data have been analyzed and final reports are being submitted for publication. Results of those jobs are not included in this report.

Jobs No. 6.5R and 6.7R will be continued for at least one more year to enable monitoring of the populations and habitats involved and the writing of final reports for publication.

OBJECTIVES

To determine the population compositions and trends on Crescent Mountain, Surprise Mountain and Cooper Landing Closed Area, Kenai Peninsula.

To compare Dall sheep winter range composition, trend and availability and gross winter climate on Crescent Mountain, Surprise Mountain and Cooper Landing Closed Area, Kenai Peninsula.

PROCEDURES

Population Trends

Aerial classification counts of sheep herds on each of the three study areas were conducted as previously described (Nichols 1970), although bad weather made it impossible to complete all winter counts as planned. A Piper PA-18-150 airplane was used for all surveys; I flew alone and recorded each animal or group seen on a portable tape recorder, later transcribing the data. Population models were constructed mathematically from the count data, taking into consideration hunting harvest and probable classification errors. Mortality estimates were based upon these population models.

Winter Range and Climate

Analyses of forage plant specimens from both summer and winter ranges were completed. Results were combined with those of the food habits study in a final report on Job No. 6.3R which is being submitted for publication.

The three self-contained weather stations installed under a previous segment were maintained. Considerable problems were encountered due to instrument malfunction and several blocks of data were lost. Recorded data on wind direction and velocity and temperature were reduced from the instrument charts to a usable form on a piecework basis by nonemployee technicians, then further reduced to monthly and seasonal averages for comparative purposes.

Snow surveys were conducted as previously described on each study area during the winter of 1974-75. Data were examined and compared statistically between areas and years.

FINDINGS

Population Trends

Listed in Table 1 are the results and dates of the main aerial surveys conducted during 1973 and early 1974. Results of incomplete surveys and lambing progression counts are not included. Population models for each herd were constructed from results of the several surveys with consideration given to probable classification errors and hunting harvest. These models are shown in Table 2, and are the best available estimates for the status of each herd during the summer of 1974.

Table 1. Results of aerial sheep classification surveys, 1974-75.

Area	Date	Young Rams	Legal Rams	All Rams	Ewes plus Yearlings ^{1/}	Ewes	Yrlgs. ^{2/}	Lambs ^{3/}	Total
Crescent Mt.	5/74	32	23	55	140	110	30	-	195
	6/10/74	-	-	-	-	-	-	41	244
	6/29/74	-	-	-	-	-	-	40	214
	9/8/74	31	29	60	-	-	-	-	170
	2/75	25	23	48	81	65	16	-	129
Surprise Mt.	5/10/74	13	9	22	133	110	23	-	155
	6/5/74	-	-	-	-	-	-	29	189
	2/28/75	12	1	13	80	73	7	-	93
Cooper Landing Closed Area	5/10/74	29	24	53	172	144	28	-	225
	5/31/74	-	-	-	-	-	-	38	227

1/ This category may include a few young rams mis-identified as "ewes".

2/ "Yearlings" is used to distinguish lambs of the previous summer from new lambs.

3/ "Lambs" includes those born in the summer of the survey year.

Table 2. Estimated population models and ratios, 1974.

Area	Date	Rams	Ewes	Yearlings	Lambs	Non-Lambs	Total
Crescent Mt.	6/74	63 (57:100 ff)	110	30 (27:100 ff)	47 (43:100 ff)	203	250
Surprise Mt.	6/74	27 (25:100 ff0)	109	24 (22:100 ff)	29 (27:100 ff)	160	189
Cooper Landing Closed Area	6/74	54 (37:100 ff)	145	28 (19:100 ff)	39 (27:100 ff)	227	266

Comparison with similar models constructed during the previous segment (Nichols 1974) shows that the overall herd on Crescent Mountain decreased by 7 percent between 1973 and 1974, including a hunting harvest of 21 animals removed during fall 1973. The Surprise Mountain herd decreased by 11 percent during the same period, including a harvest of only three rams, while the Closed Area herd decreased by 15 percent with only five rams removed.

Lamb production decreased in all three herds between 1973 and 1974, but dropped by only 2 percent on Crescent Mountain while falling by 31 percent on Surprise Mountain and by 46 percent in the Closed Area. Production in 1974 was 59 percent higher on Crescent Mountain than on either of the other areas.

Mortality estimates from 1971 through 1974 are listed in Table 3. Lamb mortality was calculated from the change in estimated number of lambs in the herd during one summer to the number of yearlings in the herd the following summer. Overwinter lamb mortality in the Crescent Mountain herd was 19 percent and 33 percent lower, respectively, than in the Surprise Mountain and Closed Area herds. Herd mortalities, based on the change from estimated total herd size to total number of non-lambs in each herd from 1973 to 1974, were in similar order, with that in the Crescent Mountain herd being 25 percent lower than in the Surprise Mountain herd, and 31 percent lower than in the Closed Area herd. However, both lamb and overall herd mortalities increased in all three herds over those determined for the previous winter.

Winter Range and Climate

Average monthly temperature and wind data from each area are presented in Figs. 1 and 2. Temperature and wind data averaged by summer and winter seasons and by area are illustrated in Figs. 3 and 4. Average annual temperature and wind data are shown in Fig. 5.

Crescent Mountain ranked lower in average summer temperature than Surprise Mountain, which in turn was cooler than Slaughter Mountain in the Closed Area. In winter, however, Crescent and Slaughter Mountains were similar in average temperature, and both were cooler than Surprise Mountain. The average annual temperature was lowest on Crescent Mountain, intermediate on Slaughter Mountain, and highest on Surprise Mountain. Examination of the average monthly temperature graphs reveals that during the winter of 1973-74, average monthly temperatures were below freezing for approximately 6.5, 7.0 and 7.5 months, respectively, on Slaughter, Surprise and Crescent Mountains.

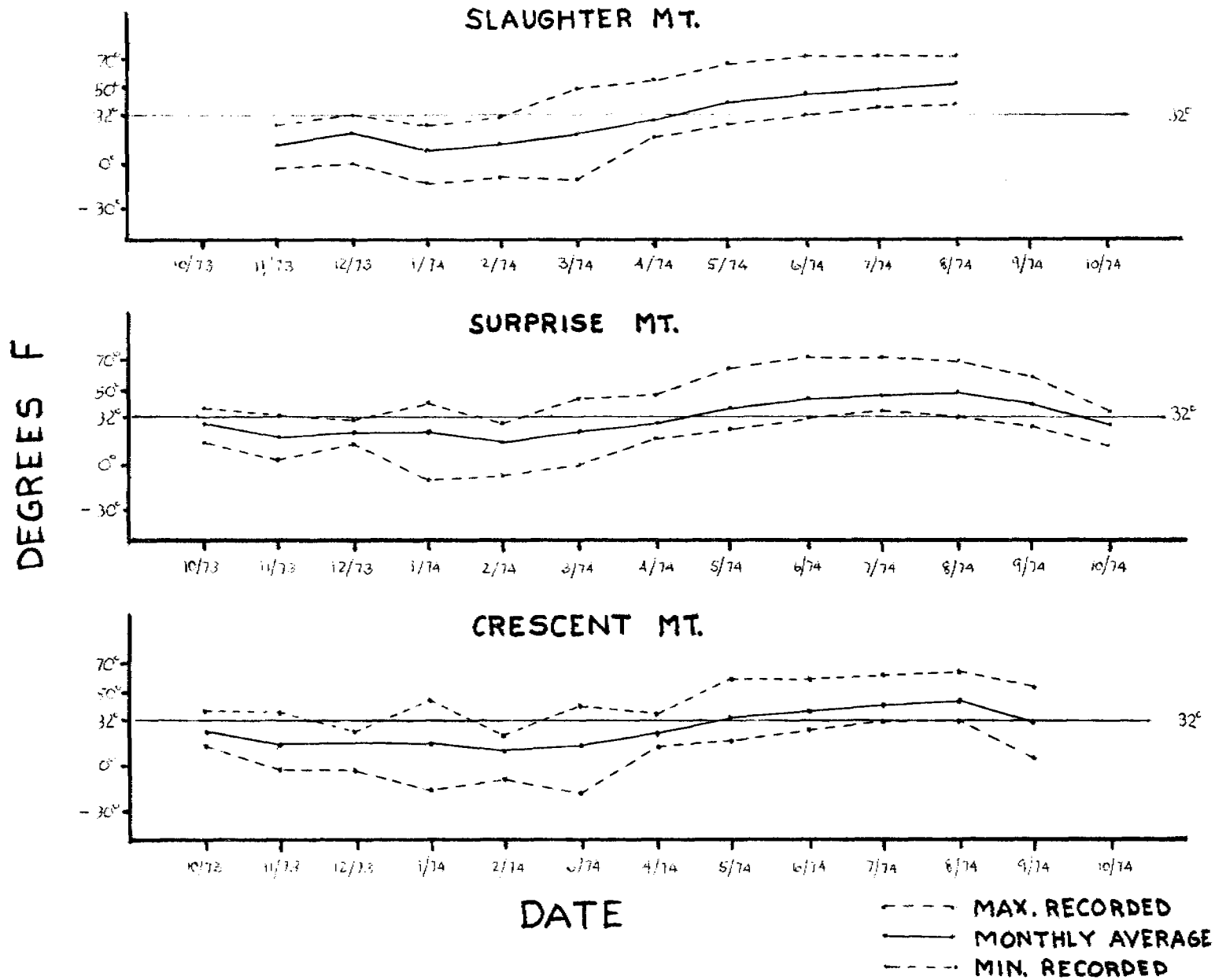
Average and maximum recorded winds were found to be consistently higher on Crescent Mountain than on Surprise Mountain, and higher on Surprise than on Slaughter Mountain. The seasonal and annual wind direction patterns on Crescent and Surprise Mountains were very similar to those plotted during the previous winter (Nichols 1974). Winds blew

Table 3. Mortality^{1/} estimates from 1971 to 1974 based on computed population models.

Area	Date	Yearlings	Lamb Mortality	Lambs	Total Non-Lambs	Herd Mortality	Total Herd
Crescent Mt.	6/71	----		20	208		228
			-35%			-15%	
	6/72	13	-11%	35	194	-5%	229
	6/73	31	-39%	50	218	-18%	268
	6/74	30		47	203		250
Surprise Mt.	8/71	9		21	156		177
			-33%			-12%	
	6/72	14	-44%	45	156	-17%	201
	6/73	25	-48%	46	167	-24%	213
	6/74	24		29	160		189
Cooper Landing Closed Area	6/71	17		50	238		288
			-56%			-19%	
	6/72	22	-50%	50	232	-13%	282
	6/73	25	-58%	67	245	-26%	312
	6/74	28		39	227		266

^{1/} Mortality estimates are exclusive of known removal by hunting

Fig. 1 . Average, Maximum and Minimum Monthly Temperatures by Area.



7

Fig. 2 . Average and Maximum Monthly Winds by Area.

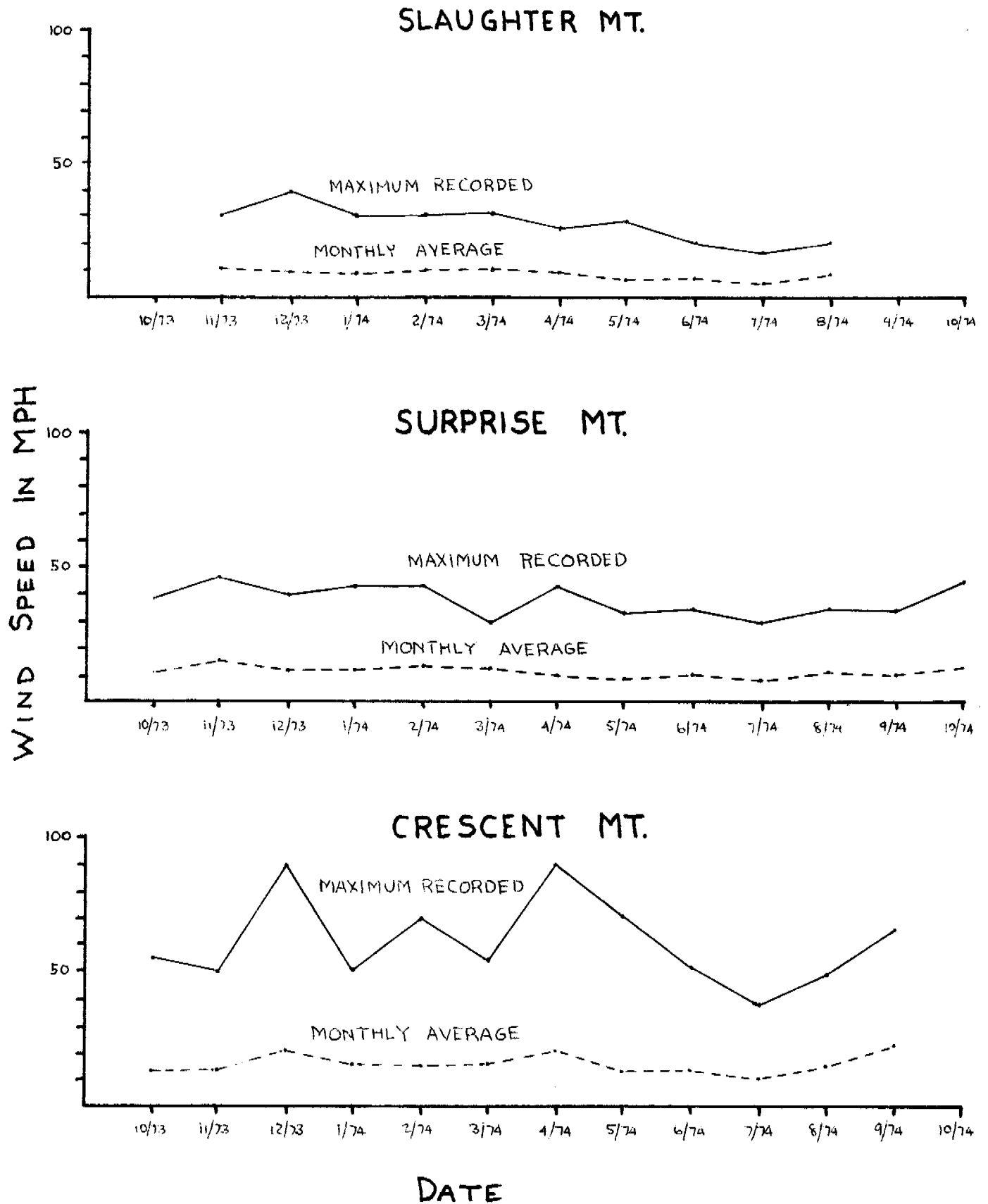


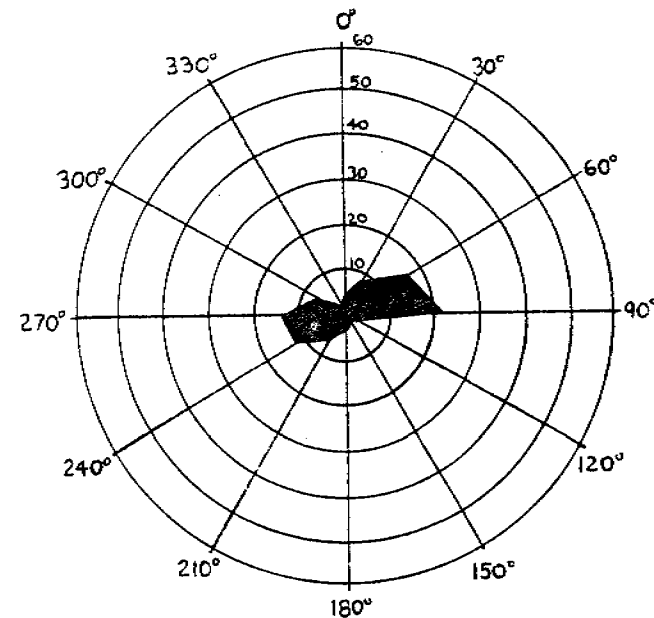
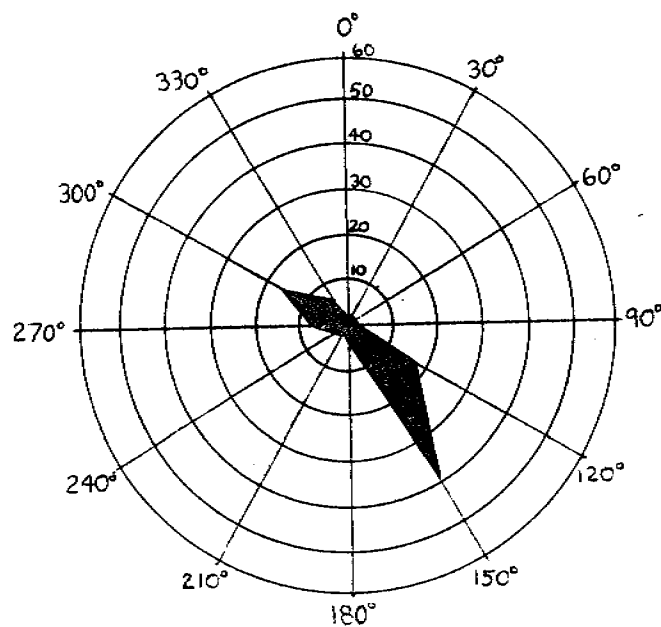
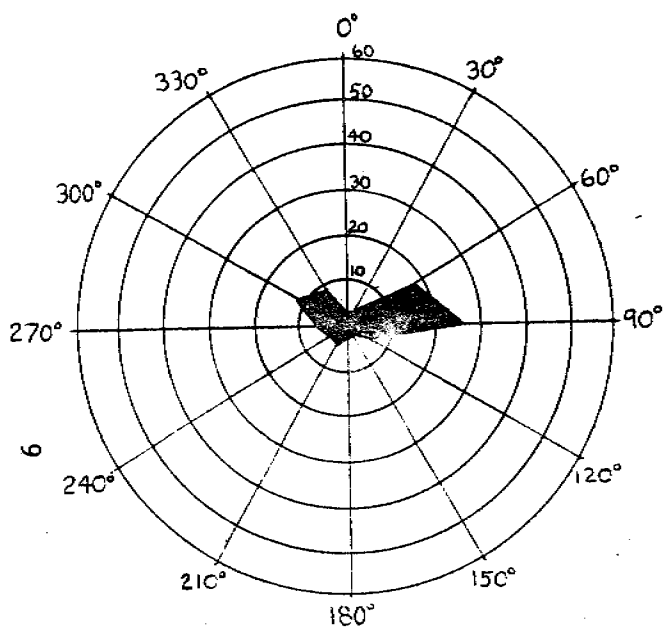
Fig. 3 Summary of wind and temperature data during the summer (May through September) period, 1974.

Average wind direction by degrees magnetic from which it blows and by percent of time.

CRESCENT MT.

SURPRISE MT.

SLAUGHTER MT.



WIND (MPH)
Max. recorded
72
Aver. seasonal
15.7

TEMP.(DEG.F)
Max. recorded
64°
Min. recorded
6°
Aver. seasonal
37.0°

WIND(MPH)
Max. recorded
35
Aver. seasonal
10.6

TEMP.(DEG.F)
Max. recorded
71°
Min. recorded
24°
Aver. seasonal
43.9°

WIND (MPH)
Max. recorded
28
Aver. seasonal
7.3

TEMP.(DEG.F)
Max. recorded
72°
Min. recorded
27°
Aver. seasonal
47.0°

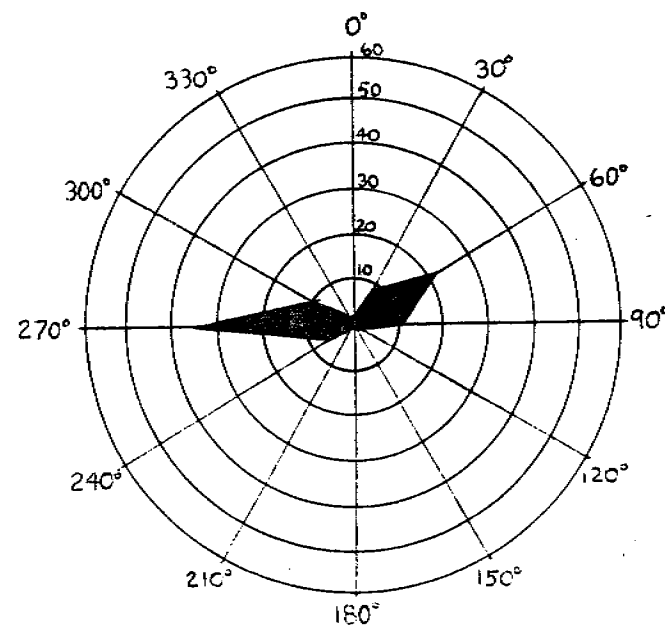
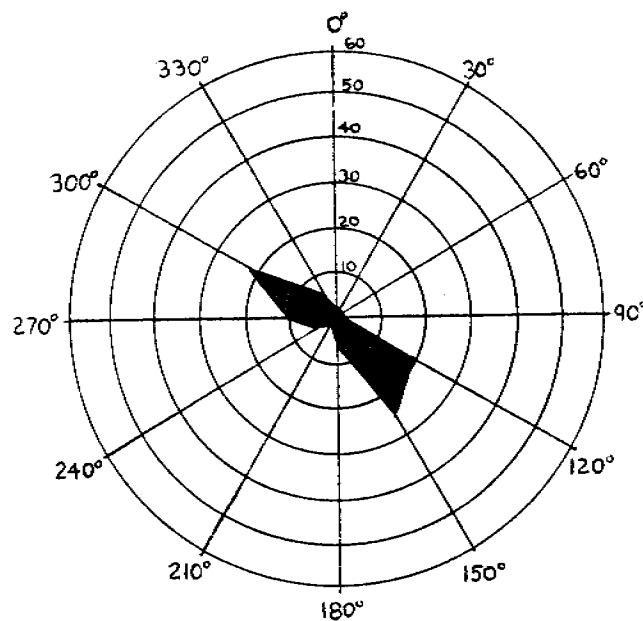
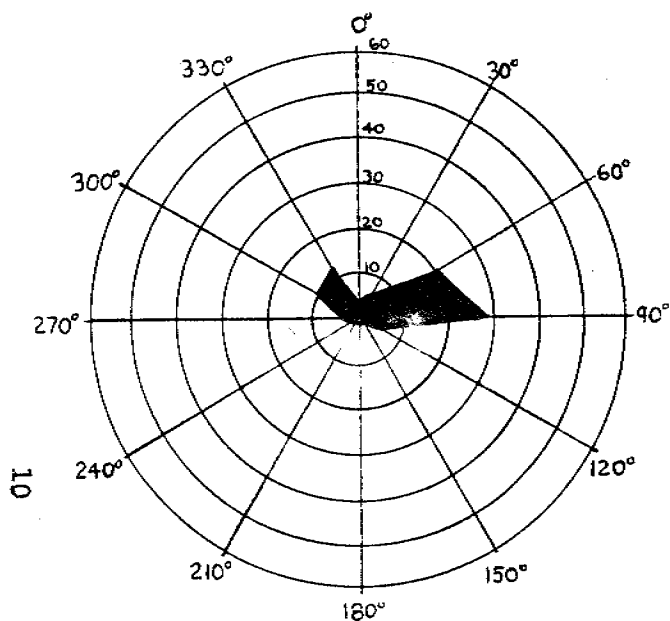
Fig. 4. Summary of wind and temperature data during the winter (October through April) period, 1973-74.

Average wind direction by degrees magnetic from which it blows and by percent of time.

CRESCENT MT.

SURRISE MT.

SLAUGHTER MT.



WIND (MPH)
Max. recorded
90
Aver. seasonal
17.1

TEMP.(DEG.F)
Max. recorded
45°
Min. recorded
-18°
Aver. seasonal
17.4°

WIND (MPH)
Max. recorded
47
Aver. seasonal
12.8

TEMP.(DEG.F)
Max. recorded
47°
Min. recorded
-10°
Aver. seasonal
22.5°

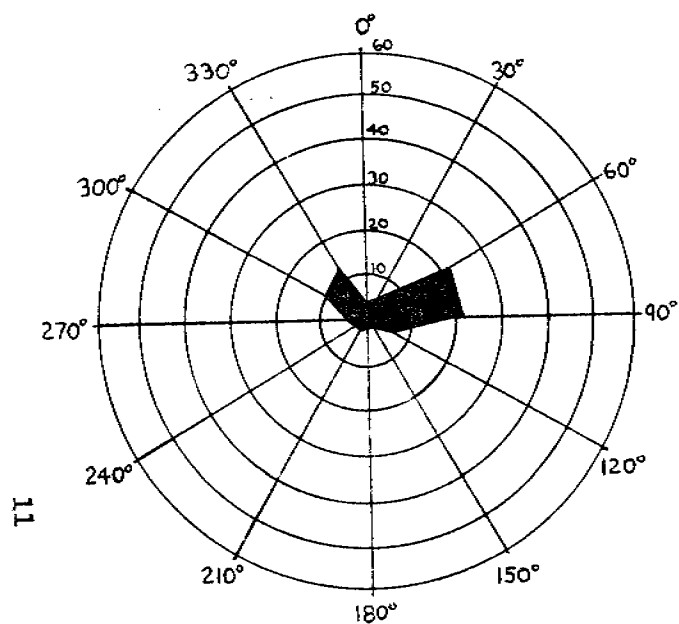
WIND (MPH)
Max. recorded
40
Aver. seasonal
9.8

TEMP.(DEG.F)
Max. recorded
54°
Min. recorded
-13°
Aver. seasonal
17.6°

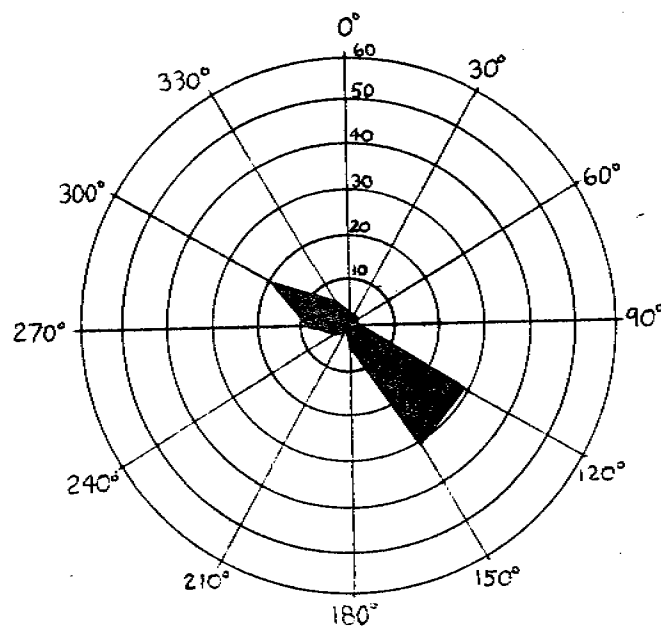
Fig. 5. Summary of Annual Weather, Snow, Lamb Production and Mortality Data by Area, 1973 - 1974.

Average wind direction by degrees magnetic from which it blows and by percent of time.

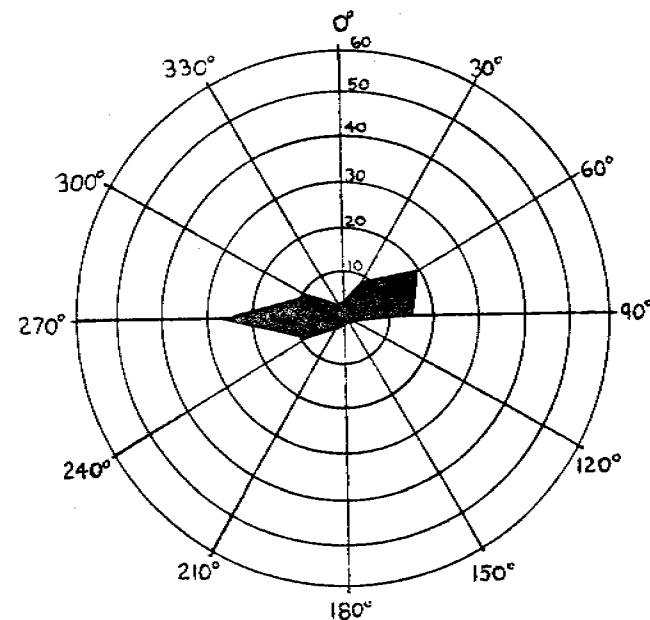
CRESCENT MT.



SURPRISE MT.



SLAUGHTER MT.



WIND (MPH) TEMP.(DEG.F)
 Max. recorded Max. recorded
 90 64°
 Aver. annual Min. recorded
 16.6 -18°
 Aver. annual
 25.6°

WIND (MPH) TEMP.(DEG.F)
 Max. recorded Max. recorded
 47 71°
 Aver. annual Min. recorded
 11.9 -10°
 Aver. annual
 31.5°

WIND (MPH) TEMP (DEG.F)
 Max. recorded Max. recorded
 40 72°
 Aver. annual Min. recorded
 8.8 -13°
 Aver. annual
 29.4°

Aver. snow depth: 6.3 in.
 Aver. snow hardness: 16.7 lb/cm²

Aver. snow depth: 17.2 in.
 Aver. snow hardness: 23.0 lb/cm²

Aver. snow depth: 16.0
 Aver. snow hardness: 6.9 lb/cm²

Lamb production: 43:100♀

Lamb production: 27:100♀

Lamb production: 27:100♀

Mortality (1973-1974):

Lambs: 39%
 Overall: 18%

Mortality (1973-1974):

Lambs: 48%
 Overall: 24%

Mortality (1973-1974):

Lambs: 58%
 Overall: 26%

predominantly from the east and northeast on Crescent Mountain, and to a lesser extent from the northwest. They blew primarily from the southeast on Surprise Mountain and secondarily from the northwest. However, in winter, they blew less from the southeast than in summer, probably because of a lesser influence of the Harding Ice Field (lying to the southeast of Surprise Mountain) during the winter. On Slaughter Mountain, the wind pattern shifted slightly counterclockwise from that of the previous year, exhibiting a more east-northeast and west trend than the former east-southeast and northwest trend.

Snow transects were read on Crescent Mountain (Feb. 1), Surprise Mountain (Feb. 3) and Slaughter Mountain (Feb. 4) in 1975, over the same courses used in previous years. Depth and hardness data were analyzed and compared statistically between areas; results are listed in Table 4. Snow hardness ranked from highest to lowest from Crescent Mountain through Surprise Mountain to Slaughter Mountain in that order, with significant differences found between each area. Although no difference could be detected in snow depth between Surprise and Slaughter Mountains, snow on both was significantly deeper than on Crescent Mountain.

In comparing current data with those from previous winters (Nichols 1973), it was found that there has been little change in average snow depth on any of the three mountains since the winter of 1972 when snow transects were first read. The only significant difference detected in depth was between the winters of 1973 and 1975 on Crescent Mountain, with the snow averaging 106 percent deeper in 1975 than in 1973. Snow hardness, on the other hand, was found to be higher in 1975 than in any of the previous years of study on all three areas. Average hardness was 146 percent higher on Crescent Mountain in 1975 than in 1974; 36 percent higher on Surprise Mountain; and 91 percent higher on Slaughter Mountain. A summary of results of the statistical comparisons of average snow depths and hardnesses between 1974 and 1975 is presented in Table 5.

As an aid in comparing the significant findings between the three herds under study during this segment, a summary of annual climatological, mortality and lamb production data is presented in Fig. 5.

DISCUSSION

Although this study has been broken down into several jobs for reporting purposes, its major original objective was to assess the effects of three management techniques, and in particular, the effects of first reducing and then holding a sheep herd at a level below the estimated carrying capacity of its range. A brief summary of the pertinent results from 1970, when the study began, through 1974 is in order.

To be reasonably sure that habitats of the three herds being studied were similar, and especially that the herd to be controlled did not enjoy a habitat advantage which might offset the effects of reduction, comparative range and climate studies were undertaken. These studies indicate that in general, range conditions were most favorable on Slaughter Mountain and

Table 4. Comparison of snow depth (in inches) and hardness (in pounds per cm²) between areas in the winter of 1975.

<u>Snow condition</u>	<u>Comparison</u>	<u>t</u>	<u>DF</u>	<u>Difference</u>
	<u>Crescent vs. Surprise</u>			
Depth	($\bar{x}_D=9.7$) ($\bar{x}_D=17.8$)	2.6122	98	Significant difference at p=.05
Hardness	($\bar{x}_H=41.0$) ($\bar{x}_H=31.2$)	3.9708	346	Highly significant at p=.01
	<u>Surprise vs. Slaughter</u>			
Depth	($\bar{x}_D=17.8$) ($\bar{x}_D=17.3$)	0.1753	98	No significant difference
Hardness	($\bar{x}_H=31.2$) ($\bar{x}_H=13.0$)	-8.7883	338	Highly significant at p=.01
	<u>Crescent vs. Slaughter</u>			
Depth	($\bar{x}_D=9.7$) ($\bar{x}_D=17.3$)	2.6025	98	Significant difference at p=.05
Hardness	($\bar{x}_H=41.0$) ($\bar{x}_H=13.0$)	13.3781	342	Highly significant at p=.01

Table 5. Comparison of snow depth (in inches) and hardness (in pounds per cm²) between winters of 1974 and 1975 by areas.

<u>Area</u>	<u>Snow Condition</u>	<u>Comparison</u>	<u>t</u>	<u>DF</u>	<u>Difference</u>
Crescent					
		<u>1974 vs. 1975</u>			
	Depth	($\bar{x}_D=6.3$) ($\bar{x}_D=9.7$)	-1.4101	98	No significant difference
	Hardness	($\bar{x}_H=16.7$) ($\bar{x}_H=41.0$)	-10.3678	318	Highly significant at p=.01
Surprise					
		<u>1974 vs. 1975</u>			
	Depth	($\bar{x}_D=17.2$) ($\bar{x}_D=17.8$)	-0.1742	98	No significant difference
	Hardness	($\bar{x}_H=23.0$) ($\bar{x}_H=31.2$)	-3.8024	362	Highly significant at p=.01
Slaughter					
		<u>1974 vs. 1975</u>			
	Depth	($\bar{x}_D=16.0$) ($\bar{x}_D=17.3$)	0.4707	98	No significant difference
	Hardness	($\bar{x}_H=6.8$) ($\bar{x}_H=13.0$)	-5.6743	354	Highly significant at p=.01

least favorable on Crescent Mountain (Nichols and Heimer 1972, Nichols 1973). The climates, considering only wind, temperature and snow conditions, appear to be in the same order: least favorable on Crescent Mountain and most favorable on Slaughter Mountain. Therefore, the sheep herd on Crescent Mountain does not seem to have any obvious habitat advantage over either of the other herds, but, on the contrary, is existing under the least favorable conditions.

The initial reduction of the Crescent Mountain herd, which included both public hunting and scientific collection, resulted in removal of 63 sheep during fall and winter 1970-71. The intent was to maintain the herd at a pre-lambing population of about 200 animals. Natural mortality during that winter (in addition to those deliberately removed) appeared to have been about 7 percent (Table 6) which was undoubtedly an abnormal figure resulting from the influence of the herd reduction. Lack of previous classification data precluded the computation of lamb production (as indicated by the ratio of lambs born per 100 ewes) in 1971 and overwinter lamb mortality from 1970 to 1971.

No response by the herd could be detected between 1971 and 1972, nor were any additional sheep removed either year. However, comparative surveys of winter range between 1971 and 1972 indicated that production of preferred forage species, namely grasses and sedges, increased only on Crescent Mountain despite a general reduction in forage production on all three areas examined which in turn was probably related to a drier summer in 1972.

Between 1972 and 1973, both herd and lamb mortality dropped sharply in relation to that in the other two herds, and lamb production increased in the spring of 1973. A similar comparative reduction in overwinter mortality occurred between 1973 and 1974, while lamb production again increased despite a lowered number of lambs per 100 ewes in the other herds in 1974.

In the fall of 1973, 21 more sheep were taken from the Crescent Mountain herd by public hunting. If the initial reduction is ignored, that herd has supplied a hunting harvest of 21 animals between the summers of 1971 and 1973. During the same period, only six rams were reported harvested from Surprise Mountain (open each year for 3/4 curl ram, only, hunting), and some 14 rams from the Closed Area herd. The latter were taken outside the boundaries of the Closed Area, but probably were rams from the resident herd. During this time period, the three herds remained relatively static in numbers when considering the basic, pre-lambing herd sizes.

The Crescent Mountain herd has thus provided more sheep to hunters than either of the other areas during the three years from 1971 through 1973, while at the same time exhibiting lower mortality and higher lambing success despite the fact that this herd exists under harsher environmental conditions. Although it is too early to draw definite conclusions, the inference is that the herd is responding favorably to reduction in size and presumed lowered competition for winter forage.

Table 6. Significant population statistics of three Dall sheep herds under study from mid-1970 to mid-1974.

Area	Period ^{1/}	No. removed ^{2/} by hunting	Lamb production	Overwinter lamb mortality	Overwinter herd mortality	Herd size ^{3/} non-lambs
Crescent Mt.	1970	63	-	-	-	245
	1970-71	-	-	-	7%	208
	1971-72	-	34:100♀	35%	15%	194
	1972-73	21	44:100♀	11%	5%	218
	1973-74	38	47:100♀	39%	18%	203
Surprise Mt.	1970	1	-	-	-	165
	1970-71	1	18:100♀	55%	16%	156
	1971-72	2	38:100♀	33%	12%	156
	1972-73	3	39:100♀	44%	17%	167
	1973-74	7	27:100♀	48%	24%	160
Cooper Landing Closed Area	1970	3 ^{4/}	-	-	-	220
	1970-71	4	38:100♀	39% ^{5/}	4% ^{5/}	238
	1971-72	5	45:100♀	56%	19%	232
	1972-73	5	50:100♀	50%	13%	245
	1973-74	5	27:100♀	58%	26%	227

^{1/} from mid-summer to mid-summer

^{2/} includes removal by scientific collecting; removal in fall of latter year of period.

^{3/} estimated pre-lambing herd size during latter year of period.

^{4/} estimated from reported harvest in adjoining areas.

^{5/} data probably erroneous (too low) due to inadequate previous data.

In 1974 it was decided to further reduce this herd to maintain a pre-winter population of about 200 sheep (as against a pre-lambing population of that level). It was felt that such a reduction would reduce winter competition even more, and so possibly invoke an even greater response in the form of increased overwinter survival and successful lambing.

A two-phase hunt was held in the fall of 1974, consisting of a preliminary, limited-permit hunt for full curl rams, and later an unlimited hunt for animals with horns of 1/2 curl or less, regardless of sex. The latter hunt was to be terminated when the desired number of sheep had been taken. Altogether, 38 sheep were known to have been killed--a somewhat lower number than anticipated. A post-hunt aerial count revealed a total pre-winter population of only 170 animals remaining on Crescent Mountain rather than the expected 210-215. At present, it is not known whether the census was in error, whether wounding loss was excessive or whether some 40 sheep moved off the mountain to other areas. Further effects of this hunt have not yet been assessed.

RECOMMENDATIONS

Due to the variability of climatic and biological factors influencing the sheep populations under study, I recommend that the Crescent Mountain herd be maintained at a level of approximately 200 sheep by public hunting for a period of at least two more years, with concurrent monitoring of populations, reproduction, mortality and climate so trends may be assessed over a sufficiently long period for accurate judgements on the effects of either-sex hunting to be made.

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