THE REPRODUCTIVE BIOLOGY OF THE ALASKA LYNX (*Lynx canadensis*)

A

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By

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THE REPRODUCTIVE BIOLOGY OF THE ALASKA LYNX (*Lynx canadensis*)

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ABSTRACT

A collection of 1,105 lynx (Lynx canadensis) taken from November 1, 1964 to October 31, 1965 in the central portion of Alaska has been analyzed to describe the physical characteristics and reproductive patterns of lynx. Skinned weights ranged from 15 to 31 pounds for adult males and from 10 to 23 pounds for adult females. Age determination is based on legbone development and is compared with the tooth section method. Yearling animals made up a much larger percent (over 60%) of the harvest than would be expected from a wild population.

Analysis of the reproductive tracts indicates that most of the lynx commence their breeding activity in late March and early April and are bearing their first litter on about their first birthday. They average approximately four kits per litter. There is no evidence to indicate that they do not breed every year, unless an extreme bi-annual synchrony of breeding can be shown by using data from other years.

No positive statements can be made regarding transmigration or twinning in these animals because of the macroscopic nature of the study, but there are many unexplained disparities between the numbers of corpora albicantia and the numbers of placental scars.

All original data is presented in the appendix in punchcard format so that anyone who wishes to do so may complete any further analysis on this sample or make comparisons with any other sample.

ACKNOWLEDGEMENTS

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INTRODUCTION

Elton and Nicholson (1942) very meticulously collected data on lynx furs purchased during a 206-year period by the Hudson's Bay Company in Canada. These data clearly showed persistent, large, and unchanged cycles during this entire period. The cycle frequency averaged 9.6 years, and, according to the two investigators, closely followed the snowshoe hare cycle because of the food dependency relationship.

Fur export records and the memories of local trappers substantiate the fact that lynx populations have been subject to wide fluctuations of size in the past in Alaska. Their rise and fall generally follows an 8- to 10-year cycle. Researchers have shown that the lynx cycle always follows almost directly behind the snowshoe hare cycle (Odum 1959).

The snowshoe hare population north of the Alaska Range was at the highest point in its cycle during the winter of 1962-1963. South of this mountain barrier the hare population was at the peak of its cycle during 1963-1964. In 1964-1965, when the sample of 1,105 lynx used for this thesis was taken, there were very few hares evident in any area from which this sample of lynx was obtained. In the following season (1965-1966) lynx were very scarce north of the range, and the majority of the 1,223 lynx collected by the Alaska Department of Fish and Game that year came from the Glennallen area (Personal Communication, Oliver Burris, Furbearer Project Leader, Alaska Department of Fish and Game, Fairbanks). The lynx population and harvest were very low in the winter of 1966-1967 and have remained low since.

In order to obtain information not evident from this collection of lynx, a questionnaire was sent to 98 trappers who were known to cooperate with biologists. The geographic distribution of these trappers was the same as the geographic distribution of this collection of lynx. Of these 98 trappers, seven had caught no lynx during the 1964-1965 trapping season. The other 91 trappers caught 1,481 lynx during the 1963-1964 trapping season. These same 91 trappers caught 1,960 lynx during the 1964-1965 trapping season. Of these 1,960 lynx, 874 (53%) were males, and 775 (47%) were females. There were 41 listed as sex unknown. The lynx take of these trappers was higher in the 1964-1965 season by 209 lynx or 14.1% over their take in the 1963-1964 season. The average number of lynx trapped per trapper in 1963-1964 was 16, but this average was up to almost 19 in the 1964-1965 trapping season.

METHODS

The Alaska Department of Fish and Game was collecting data for a wolf study in the early 1960's by purchasing the carcasses of wolves after the trappers had skinned them. During 1961 the Department started purchasing lynx carcasses also. A fee of $3.50 was paid; and the animals could be sent collect, in frozen condition, to the Fairbanks office. The take rose in the winter of 1962-1963 and again in 1963-1964. At this time, so many lynx were being taken that it would have been too expensive to purchase all carcasses. Since there was sufficient information on all aspects except the reproductive biology, the price was raised to $5, and only females were accepted. Knowledge of reproductive performance during the period of a population boom and decline is of great importance to management of the species as an economically important furbearer.

It is the collection of lynx carcasses taken from 1 November 1964 to 31 October 1965 that forms the basis for this thesis. Collections were made in the usual manner during the trapping season of November through March. In order to complete the picture of the reproductive cycle, a few trappers were given permits to trap for an additional 60 days, and I trapped during the remainder of the spring and summer. A total of 1,105 lynx carcasses was collected, and six females were taken alive during the period when they should have been carrying young.

The Alaska Department of Fish and Game's 1966 Furbearer Report states that during the trapping season of 1 November 1964 to 31 March 1965 an estimated 4,650 lynx were harvested (value $102,300), and 3,957 of these were exported from Alaska. There are 1,004 of the animals from this harvest represented in the sample that forms the basis for this paper. The other 101 lynx in this sample were taken outside of the trapping season. Thus, my sample represents 21.6% of the harvest. If I assume that the sex ratio reported by the trappers on the questionnaire is correct for the total harvest (47% females), then there were 2,186 females taken during the 1964-1965 trapping season. My sample includes almost 900 females that were taken during that period. Therefore, the females in my sample are approximately 40% of the harvested females for the 1964-1965 trapping season.

During the trapping season, carcasses were received frozen and stored until they could be thawed and autopsied. After the spring thaw, all were handled fresh. Harvest statistics on this complete sample of animals are probably not representative of the wild population because of trapping selectivity. We did not seek male carcasses, so the sex ratio is not indicative of the ratio in the entire harvest.

Weights and measurements were taken on all the carcasses. As many as possible were weighed with the hide on and then without it in order to establish a factor for weight loss due to skinning. All body measurements were taken either by the author or by a single technician under the direct supervision of the author. This assured consistency in methods of measurements. Some of the carcasses obviously were seriously desiccated, and their weights were not used in compilations. The skull and foreleg were taken for age determination. The eyeballs were stored in 10% formalin. An eye lens was taken, oven-dried, and weighed to see if its weight could be used as an indication of age. An upper canine was pulled and cross-sectioned at the gumline so that a measurement of lumen width and of total thickness could be made. Standard measurements were taken on the skulls after they were cleaned and dried. All the skull measurements were taken by the same person in order to reduce variance due to technique. The stomachs were checked for content but were not saved. The complete reproductive tracts of all females were saved and stored in a frozen condition.

Both horns of the uterus and both ovaries of each reproductive tract were measured. The uteri were split and placental scars were counted. The ovaries were sliced and corpora albicantia were counted macroscopically. Corpora albicantia were measured in selected ovaries. All ovaries were checked for corpora lutea which were counted whenever they were found.

The testes were saved from those few males that were sent to us, by accident or on purpose, purported to be females. The testes were stored in 10% formalin until laboratory work could be accomplished. The weight, volume, and length-width measurements were taken on the testes.

RESULTS

Age Determination

An animal was placed in the kit age class if the epiphyses on the radius and ulna were not yet attached. In one age class, it was evident that the epiphyseal plates of the legbones had not ossified; there was a definite line of demarcation between the epiphysis and the longbone. Animals with that condition were called yearlings. In the only other discernable age class the epiphyseal plate had disappeared, and the bone had narrowed at that spot. These animals were called adults. An effort was made to separate the lynx into more than the three major age classifications of kit, yearling and adult on the basis of longbone development. The yearlings were separated into young subadults and old subadults to see if the young subadults might belong in the kit class or if the old subadults might be 2-year-olds rather than yearlings (Table 1). Of 595 female yearlings, 517 were placed in the young subadult class. These were checked for corpora albicantia, and 430 (83%) of them had corpora albicantia which indicated clearly that they were not kits. Subsequent tooth sectioning and annual ring counting confirms that these young subadults are yearlings, and further breakdown of ages will have to be done in the adult class by the tooth section method (Figure 1).

Other criteria of age determination were investigated. The weights of the oven-dried eye lenses were plotted as a frequency distribution of size, and the kit age class was clearly different from all the rest with very little overlap. However, in the other age classes there was too much overlap to be able to separate them. Therefore, the eye lens

Table 1. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of age class 2 (young subadults)

Total number = 517

Number without corpora albicantia = 86

Number with corpora albicantia = 430

Percent with corpora albicantia = 83

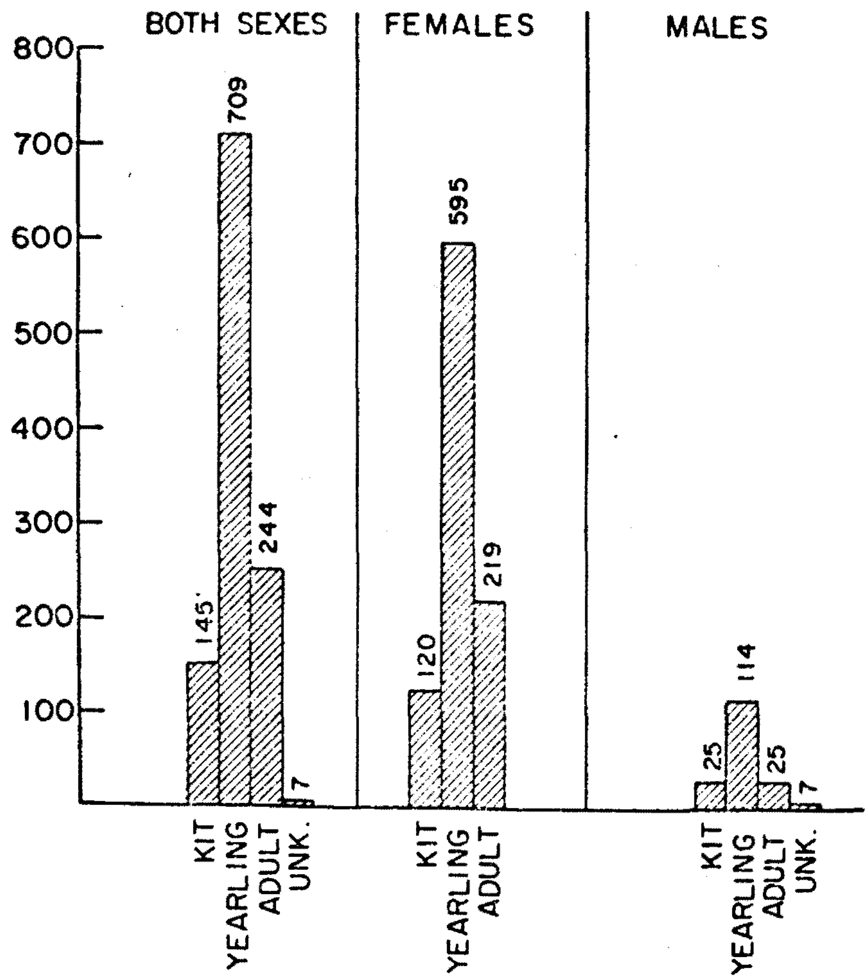


Figure 1. Alaska lynx sample, Nov. 1964 - Oct. 1965: Age distribution of 1,105 individuals (legbone method).

weight system was discarded as a method of age class separation in these animals.

The measurements of the lumens of the canine teeth which had been cross sectioned at the gum line were plotted to see if lumen size and/or the thickness of the tooth shell would indicate age. Here again, as in the eye lens weight, only the kit age class could be separated. Therefore, the canine tooth measurement method was abandoned.

Figure 2 shows the age distribution based on the age determination method I believe is best. That method involves sectioning a canine and then decalcifying and staining the section so that the cementum deposition layers are revealed. Figure 3 shows a comparison of this method with the longbone method indicating that there is good correlation between the two systems if the basic premise is made that no annual cementum deposition layer is laid down until the animal's second year of life. The teeth of the animals that obviously were kits because of size were not sectioned. The animals that were separated as yearlings by the longbone method showed no annual rings. The adult class, as determined by longbones, was separated into many age classes on the basis of tooth rings. Table 2 gives a complete tabulation of the comparison of the two systems.

Harvest Statistics

The major portion of the harvest was made up of yearlings. Examination of the reproductive tracts showed that the majority of these yearlings had given birth, probably near their first birthday.

On the basis of other furbearer harvest figures (muskrat, mink, etc.) the youngest age class (kits) could be expected to make up the

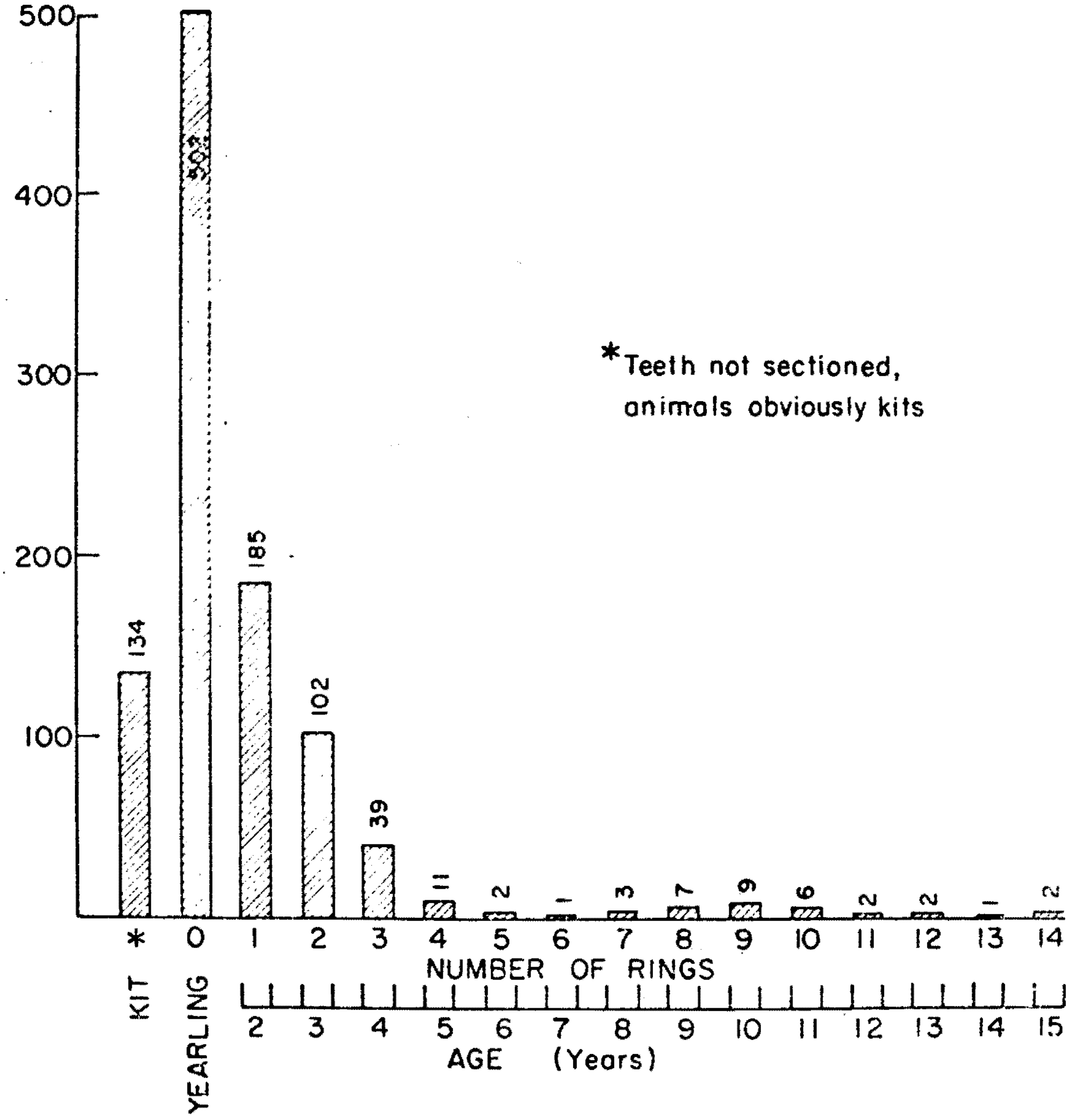


Figure 2. Alaska lynx sample, Nov. 1964 - Oct. 1965: Age distribution of 1,008 individuals (tooth cementum layer method).

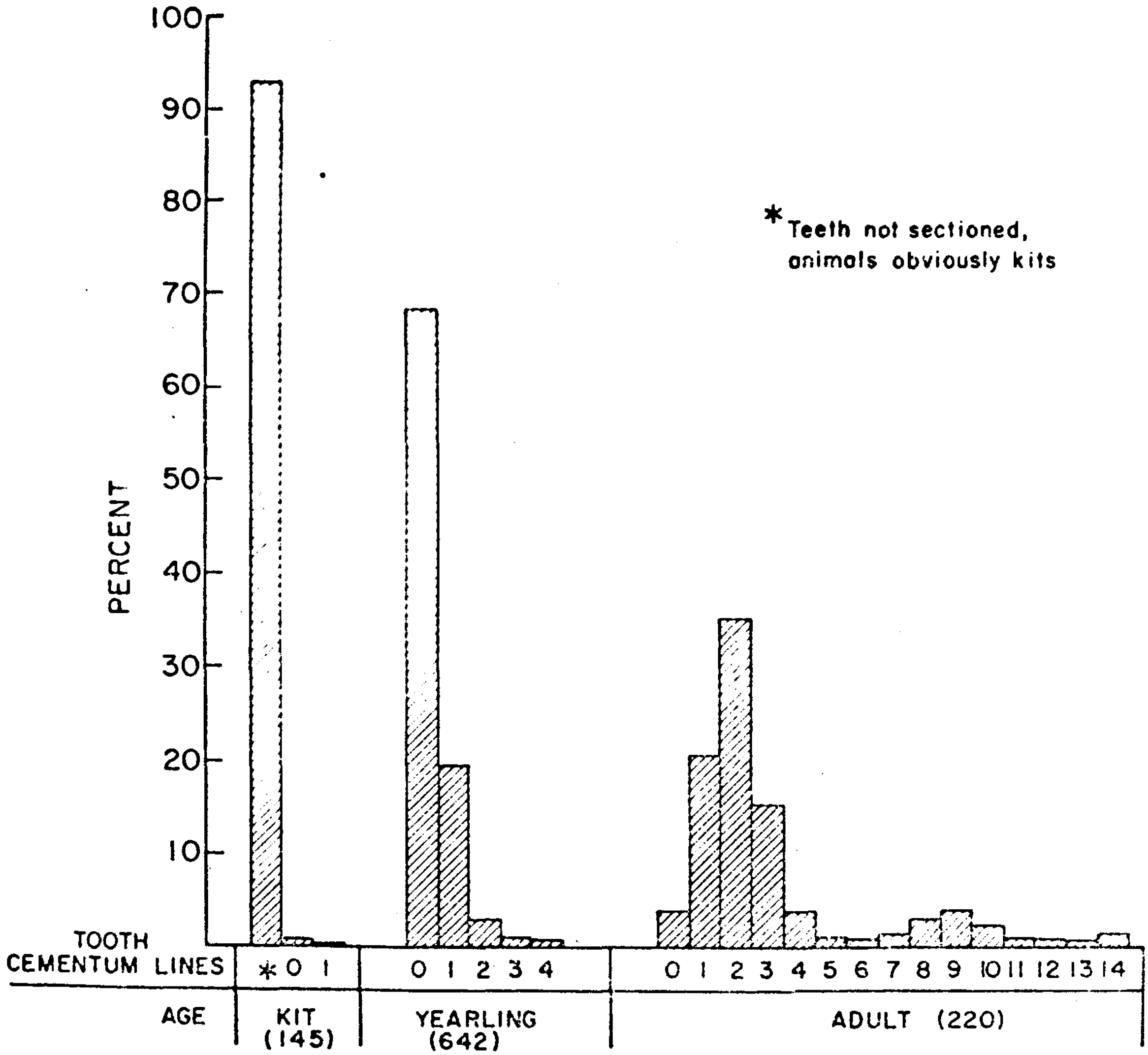


Figure 3. Alaska lynx sample, Nov. 1964 - Oct. 1965: Comparison of age distribution by the legbone and the tooth cementum layer methods.

Table 2. Alaska lynx sample, Nov. 1964 - Oct. 1965: Comparison of age distribution by the legbone and the tooth cementum layer methods

Legbone age	Number of tooth rings	n=	Percent of total animals in each tooth age class	
Kit	(not cut)	134	92.4	
	0	9	0.6	total 145
	1	2	0.1	
Yearling	(not cut)	66	9.3	
	0	485	68.4	
	1	134	18.9	
	2	17	2.4	total 709
	3	4	0.6	
	4	2	0.3	
	10	1	0.1	
Adult	(not cut)	24	9.8	
	0	8	3.3	
	1	49	20.1	
	2	85	34.8	
	3	35	14.3	
	4	9	3.7	
	5	2	0.8	
	6	1	0.4	total 244
	7	3	1.2	

Table 2. (Continued)

Legbone age	Number of tooth rings	n=	Percent of total animals in each tooth age class
Adult (continued)	8	7	2.9
	9	9	3.7
	10	5	2.0
	11	2	0.8
	12	2	0.8
	13	1	0.4
	14	2	0.8

largest segment of the annual harvest, but actually the kits fell far short of the number of yearlings. There were fewer adults than kits. The kits are evidently in the wild population but are not being trapped in direct proportion to their population numbers because they show up as the dominant age group of the harvest as yearlings the following year. Why the kits are not trapped is open to conjecture; but it would seem that the fact the mother hunts for the food for them, at least during the early part of the winter, must have some effect. There was a slight increase in the percentage of kits in the harvest as the 5-month long season progressed.

In an attempt to get a clearer picture of the make-up of the lynx harvest, a Chi Square analysis of lynx age on month was made. Tables 3, 4, and 5 give the results and the contribution to Chi Square of each age group each month for some of these animals. The total Chi Square values of 58.102 for Table 3 (females) and 58.186 for Table 5 (both sexes) are both significant at the .001 level. The sample size for males was too small to warrant Chi Square analysis. The data in Table 3 reveal that the take of kits and adults was more than should be expected in March, and the take of yearlings was less than we would expect. These three age classes in this month made up the majority of the contribution to the Chi Square value. The only other group noticeably different than expected was the November kits. The indication is that trappers were harvesting fewer kits and more yearlings in the early part of the season. Later in the season the trend changed, and they were harvesting proportionally more kits and adults and fewer yearlings.

Table 4 shows the same information for the harvest of males. The

Table 3. Alaska lynx sample, Nov. 1964 - Mar. 1965: Compilation and pattern analysis (females only)

Age	Month	Observed	Expected	Contribution to Chi Square
Kit				
	Nov.	7	15	4.27
	Dec.	8	14	2.57
	Jan.	16	20	.80
	Feb.	27	20	2.45
	Mar.	31	17	11.53
Yearling				
	Nov.	96	81	2.78
	Dec.	84	77	.64
	Jan.	126	110	2.33
	Feb.	106	107	.009
	Mar.	58	92	12.57
Adult				
	Nov.	25	30	.83
	Dec.	29	28	.04
	Jan.	31	41	2.44
	Feb.	35	40	.63
	Mar.	56	34	14.4

Chi Square = 58.102

Degrees of Freedom = 8

Tabular Chi^2, 99.9% = 26.12

Hypothesis: The harvest distribution (relative frequency vs. month within age classes) is the same for each age class.

Table 4. Alaska lynx sample, Nov. 1964 - Mar. 1965: Compilation and pattern analysis (males only)

Age	Month	Observed	Expected	Contribution to Chi Square
Kit				
	Nov.	1	3	1.33
	Dec.	0	3	3.0
	Jan.	5	1	16.0
	Feb.	3	2	.50
	Mar.	3	1	4.0
Yearling				
	Nov.	13	13	0
	Dec.	17	13	1.23
	Jan.	3	6	1.50
	Feb.	9	8	.13
	Mar.	6	6	0
Adult				
	Nov.	5	2	4.50
	Dec.	3	2	.50
	Jan.	1	1	0
	Feb.	0	1	1.0
	Mar.	0	1	1.0

Chi Square = 34.689

Degrees of Freedom = 8

Tabular Chi^2, 99.9% = 26.12

Table 5. Alaska lynx sample, Nov. 1964 - Mar. 1965: Compilation and pattern analysis (both sexes)

Age	Month	Observed	Expected	Contribution to Chi Square
Kit				
	Nov.	8	18	5.56
	Dec.	8	17	4.77
	Jan.	21	22	4.55
	Feb.	30	22	2.91
	Mar.	34	19	11.84
Yearling				
	Nov.	109	94	2.39
	Dec.	101	90	1.34
	Jan.	129	117	1.23
	Feb.	115	115	0
	Mar.	64	99	12.37
Adult				
	Nov.	30	33	.27
	Dec.	32	32	0
	Jan.	32	41	1.98
	Feb.	35	41	.88
	Mar.	56	35	12.60

Chi Square = 58.186

Degrees of Freedom = 8

Tabular Chi^2, 99.9% = 26.12

sample sizes are so small that Chi Square analysis is not warranted. However, it is interesting that, even with such a small sample, the kits showed the same trend of being harvested lightly during the early part of the season and more heavily during the later part.

Table 5 shows the same trends as Table 3 which is to be expected since most of the Table 3 sample is represented there. There was a pronounced change in harvest make-up in March that appears unlikely to be due to chance.

The analysis of the sex composition of the harvest is presented in Table 6 and Figure 1. I conclude from Table 6, and based on a 0.5 significance level, that the hypothesis that the sex ratios in the harvest do not change with age cannot be rejected. In essence, I conclude that the sex ratio is the same for all age classes.

Table 7 shows the age structure of the harvest in several areas (see also Figure 4). From the Chi Square value of 122.19 I conclude that there definitely were some differences by area. The most obvious difference was in Area 6 which is the largest of my sample areas which lie south of the Alaska Range. Area 6 is where the hare population stayed high a year longer than the hare population did in all areas north of the Range. In Area 6 the harvest was composed of more kits than expected, less yearlings and about the same number of adults as expected. Area 19 had fewer kits and adults than expected while it had more yearlings than expected. Area 18 had more adults and somewhat fewer kits than expected.

Tables 8 and 9 show the same information broken down by sex. The sample sizes of males were too small to be meaningful, but the kits

Table 6. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of sex of harvest by age distribution

Age	Sex	Observed	Expected	Contribution to Chi Square
Kit				
	M	24	21	.43
	F	123	125	.03
Yearling				
	M	110	104	.35
	F	593	598	.04
Adult				
	M	29	36	1.36
	F	218	210	.30

Chi Square = 2.5144

Degrees of Freedom = 2

Tabular Chi^2, 95% = 5.99

Hypothesis: The sex ratio is the same for each age class.

Table 7. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of age distribution of harvest by area (both sexes)

Age	Area	Observed	Expected	Contribution to Chi Square
Kit				
	Tok	11	15	1.07
	Delta	10	15	1.67
	Glennallen	85	41	47.22
	Rampart-Manley	9	13	1.23
	Upper Yukon R.	6	16	6.25
	Fairbanks Area	21	40	9.03
Yearling				
	Tok	75	75	0
	Delta	88	75	2.25
	Glennallen	152	199	11.10
	Rampart-Manley	67	64	.14
	Upper Yukon R.	69	80	1.51
	Fairbanks Area	238	194	9.98
Adult				
	Tok	31	26	.96
	Delta	19	26	1.88
	Glennallen	73	69	.23
	Rampart-Manley	24	22	.18
	Upper Yukon R.	51	28	18.89
	Fairbanks Area	43	67	8.60

Table 7. (Continued)

Chi Square = 122.19

Degrees of Freedom = 10

Tabular Chi^2, 99.9% = 29.59

Hypothesis: The age structure is the same in all areas.

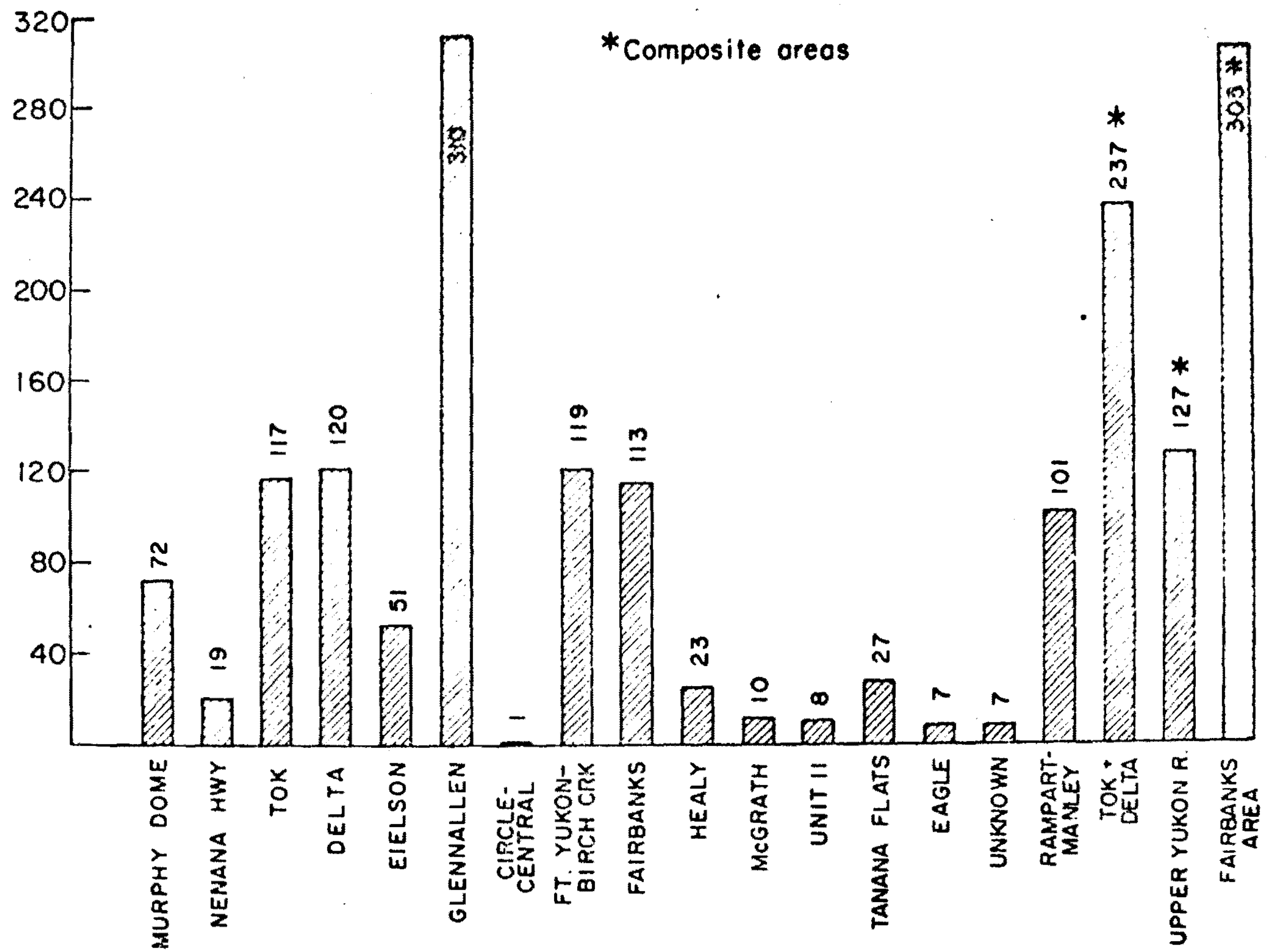


Figure 4. Alaska lynx sample, Nov. 1964 - Oct. 1965: Harvest distribution by area.

Table 8. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of age distribution of harvest by area (males only)

Age	Area	Observed	Expected	Contribution to Chi Square
Kit				
	Tok	1	2	.50
	Delta	1	0	1.0
	Glennallen	11	5	7.20
	Rampart-Manley	2	1	1.0
	Upper Yukon R.	1	1	0
	Fairbanks Area	7	11	1.45
Yearling				
	Tok	12	12	0
	Delta	4	3	.33
	Glennallen	21	24	.38
	Rampart-Manley	5	5	0
	Upper Yukon R.	10	8	.50
	Fairbanks Area	55	53	.08
Adult				
	Tok	6	4	1.0
	Delta	1	1	0
	Glennallen	6	8	.50
	Rampart-Manley	1	1	0
	Upper Yukon R.	2	2	0
	Fairbanks Area	22	19	.47

Table 8. (Continued)

Chi Square = 14.412

Degrees of Freedom = 10

Tabular Chi^2, 95% = 21.16

Table 9. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of age distribution of harvest by area (females only)

Age	Area	Observed	Expected	Contribution to Chi Square
Kit				
	Tok	10	12	.33
	Delta	9	14	1.79
	Glennallen	74	35	43.46
	Rampart-Manley	7	11	1.45
	Upper Yukon R.	5	14	5.79
	Fairbanks Area	14	29	7.76
Yearling				
	Tok	63	62	.02
	Delta	84	70	2.80
	Glennallen	131	173	10.20
	Rampart-Manley	62	58	.28
	Upper Yukon R.	59	71	2.03
	Fairbanks Area	183	145	9.96
Adult				
	Tok	25	22	.41
	Delta	18	25	1.96
	Glennallen	67	63	.25
	Rampart-Manley	23	21	.19
	Upper Yukon R.	49	26	20.35
	Fairbanks Area	31	53	9.13

Table 9. (Continued)

Chi Square = 118.14

Degrees of Freedom = 10

Tabular Chi^2, 99.9% = 29.59

difference in Area 6 was still evident. The females show the same trends as the group of both sexes together; this pattern would be expected because the females comprise most of the total. By far the greatest contribution to the Chi Square value was the Area 6 female kit population.

Table 10 shows the harvest, on a monthly basis, of males and females (Figure 5). The females seem to have been taken quite consistently throughout the trapping season, but the males seem to have been harvested more heavily early in the season and more lightly later. The male sample was of small size, however. Neither male nor female kits in Table 11 showed any change with time, but the harvest of yearlings in Table 12 seems to show a considerable shift in December and January. This shift may again be due to the small sample size of the males.

Physical Characteristics

Weight: Most of the animals were received in a skinned condition so no live body weights could be obtained. Weights prior to skinning, as well as after skinning, were obtained from 54 lynx.

For this sample of 54 animals the mean weight loss due to skinning was 2.3 pounds (range 1 to 5 pounds). If we break this down into sex and age classes we find that the mean weight loss was 1.7 pounds for three male kits (range 1 to 2 pounds), 1.0 pounds for one female kit, 2.3 pounds for 20 male yearlings (range 1 to 5 pounds), 2.2 pounds for 18 female yearlings (range 1 to 3 pounds), 2.3 pounds for nine adult males (range 1 to 4 pounds), and 3.3 pounds for three adult females (range 3 to 4 pounds).

Using these figures to find the unskinned weight of a 31-pound

Table 10. Alaska lynx samole, Nov. 1964 - Mar. 1965: Compilation and analysis of sex distribution of harvest by month (all ages)

Sex	Month	Observed	Expected	Contribution to Chi Square
Male				
	Nov.	19	12	4.08
	Dec.	20	12	5.33
	Jan.	9	15	2.40
	Feb.	12	15	.60
	Mar.	9	13	1.23
Female				
	Nov.	128	134	.27
	Dec.	121	128	.38
	Jan.	173	166	.30
	Feb.	168	164	.10
	Mar.	145	140	.18

Chi Square = 14.870

Degrees of Freedom = 4

Tabular Chi^2, 99% = 13.28

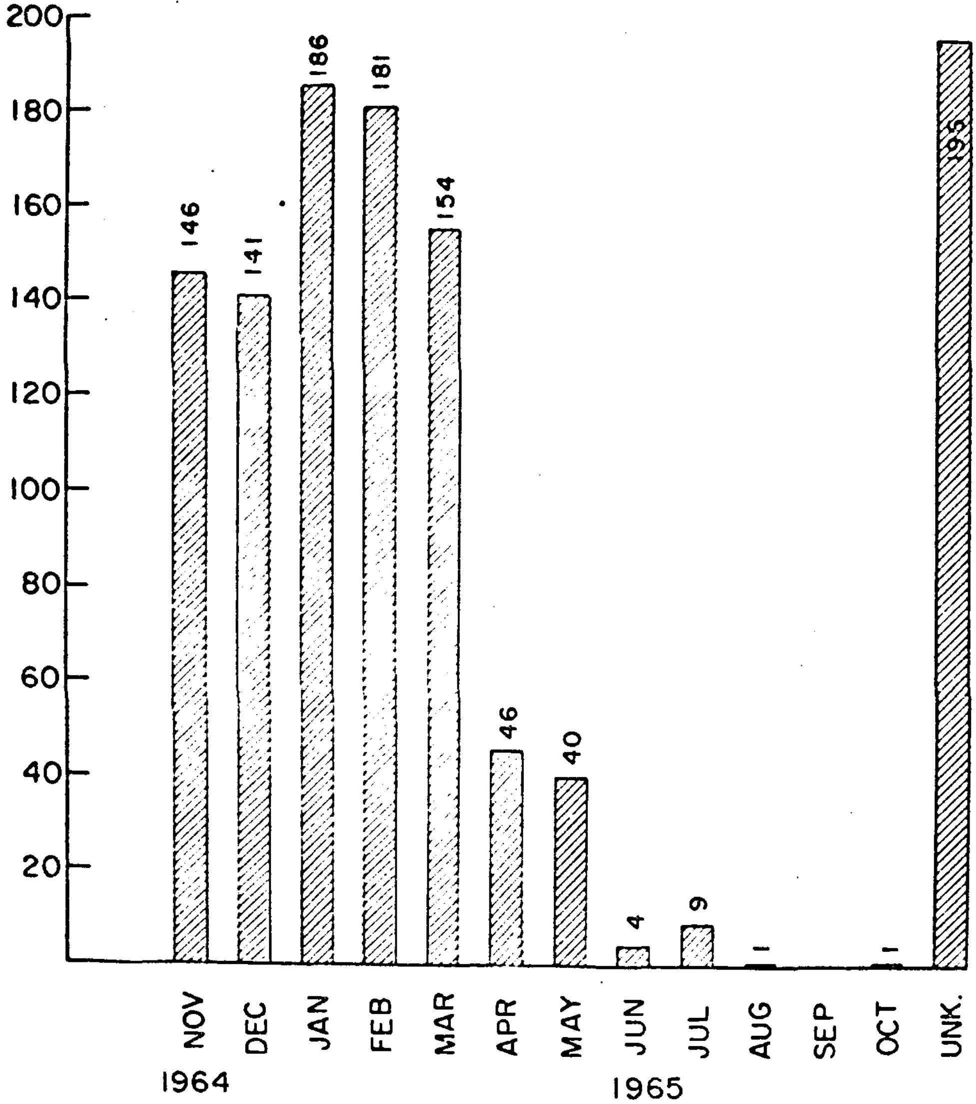


Figure 5. Alaska lynx sample, Nov. 1964 - Oct. 1965: Distribution of take over time of 1,105 individuals (trapping season was November through March).

Table 11. Alaska lynx sample, Nov. 1964 - Mar. 1965: Compilation and analysis of sex distribution of harvest by month (kits only)

Sex	Month	Observed	Expected	Contribution to Chi Square
Male				
	Nov.	1	0	1.0
	Dec.	0	0	0
	Jan.	5	2	4.50
	Feb.	3	3	0
	Mar.	3	4	.25
Female				
	Nov.	7	7	0
	Dec.	8	7	.14
	Jan.	16	18	.22
	Feb.	27	26	.04
	Mar.	31	29	.14

Chi Square = 6.2915

Degrees of Freedom = 4

Tabular Chi^2, 95% = 9.49

Table 12. Alaska lynx sample, Nov. 1964 - Mar. 1965: Compilation and analysis of sex distribution of harvest by month (yearlings only)

Sex	Month	Observed	Expected	Contribution to Chi Square
Male				
	Nov.	13	10	.90
	Dec.	17	9	7.11
	Jan.	3	11	5.82
	Feb.	9	10	.10
	Mar.	6	5	.20
Female				
	Nov.	96	98	.04
	Dec.	84	91	.54
	Jan.	126	117	.69
	Feb.	106	104	.04
	Mar.	58	58	0

Chi Square = 15.439

Degrees of Freedom = 4

Tabular Chi^2, 99% = 13.28

skinned adult male we would add 2.3 pounds and arrive at a figure of 33.3 pounds.

Another way of looking at this conversion problem is to use all those animals for which either a skinned or an unskinned weight was taken. By computing the means for all of each sex and age class for which there was an unskinned weight and then doing the same thing for those animals for which there was a skinned weight, weight conversion factors were obtained. Using the data in Table 13, equations to take account of the weight lost in skinning a lynx can be written as follows: for kit males unskinned weight = 1.43 x skinned weight; for kit females unskinned weight = 1.12 x skinned weight; for yearling males unskinned weight = 1.14 x skinned weight; for yearling females unskinned weight = 1.16 x skinned weight; and for adult males unskinned weight = 1.00 x skinned weight. The small size of the sample of males and/or the distribution over time of the specimens used could account for the fact that the calculations give exactly the same mean for skinned and unskinned adult male lynx. Therefore, we arrive at the conversion factor of 1.00 which is obviously incorrect because the skin of an animal cannot be weightless. This system can only be used if the sample is truly representative of the population. The variances of the adult males and the kit males are so large as to indicate unreliability of these factors. For adult females unskinned weight = 1.17 x skinned weight. Using the 1.17 adult female factor for adult males, the largest skinned carcass would have weighed 31 x 1.17 lbs. = 36 lbs. before skinning.

In each age class the males weighed more than the females, and the mean weight for each age class was larger than the next youngest age class.

Table 13. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of skinned and unskinned whole body weights with comparisons between sexes

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$	Variance	Standard deviation	Calculated "t"	Significance level
Unskinned weight in pounds									
Kit	M	6	18	14	15.2	2.57	1.60	3.976	.01
Kit	F	3	12	11	11.3	0.33	0.58		
Yearling	M	36	27	12	20.4	9.56	3.09	3.810	.001
Yearling	F	25	21	13	17.6	5.67	2.38		
Adult	M	9	26	18	21.9	9.61	3.10	1.622	.2
Adult	F	6	22	17	19.5	5.10	2.26		
Skinned weight in pounds									
Kit	M	11	14	4	10.6	11.25	3.35	0.617	.6
Kit	F	55	16	5	10.1	5.05	2.25		
Yearling	M	84	25	9	17.9	6.57	2.56	11.054	.001
Yearling	F	457	23	7	15.0	4.57	2.14		
Adult	M	20	31	15	21.9	11.67	3.42	8.305	.001
Adult	F	140	23	10	16.7	6.20	2.49		

Significance levels from Appendix Table II of Quantitative Zoology by Simpson, Roe and Lewontin. 1960. Harcourt, Brace and Company, Inc.

Foot Length: The hind foot length, from the hock to the base of the claws, showed the same size distribution among age classes as did the total weights with males being slightly larger than females in each age class. However, there was really very little difference, although the male yearlings measured slightly more than the female adults (Table 14).

Tail Length: The distribution on age of this measurement, which was based on tail bones, showed a trend similar to that of the hind foot length measurement. The tails of males were larger than those of females, but there was no significant difference between yearlings and adults indicating that the tail growth is completed early in life (Table 15).

Shoulder Height: The mean shoulder height measurement, taken from the tip of the scapula to the base of the claws on the foreleg, was again larger for males than for females in each age class. There was very little difference of means between yearlings and adults, although some small difference was evident (51.3 to 52.5 for males and 47.9 to 49.5 for females) (Table 16).

Girth at Heart: This measurement, taken around the largest portion of the chest, showed the same results as shoulder height although with a much higher average on the adult males (38.8 cm.). It is interesting to note that the largest measurement of girth at heart was on a yearling male (49 cm.) (Table 17).

Body Length: Two body length measurements were taken from the tip of the nose to the base of the tail, one following a straight line and the other along the body contour. The body length straight line (Table 18) is probably the poorer of the two measures of size due to the carcasses' variations in body position and conformation. The body length straight

Table 14. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of size (hind foot length)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(cm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	18	23	15	20.0	3.29	1.81	1.580	.2
Kit	F	102	23	14	19.3	2.94	1.72		
Yearling	M	100	26	19	21.6	2.39	1.54	5.364	.001
Yearling	F	491	25	19	20.8	1.74	1.32		
Adult	M	21	24	20	22.0	0.85	0.92	3.317	.001
Adult	F	164	25	18	21.0	1.79	1.34		

Table 15. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of size (tail length)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(cm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	23	12	4	9.3	2.87	1.70	1.756	.1
Kit	F	107	12	4	8.8	1.25	1.12		
Yearling	M	102	15	7	10.4	1.67	1.29	6.480	.001
Yearling	F	515	19	6	9.5	1.63	1.28		
Adult	M	21	13	8	10.5	1.86	1.36	4.307	.001
Adult	F	181	12	7	9.5	0.92	0.96		

Table 16. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of size (height at shoulder)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(cm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	21	50	20	42.7	50.13	7.08	0.358	.8
Kit	F	103	61	29	42.1	48.72	6.98		
Yearling	M	104	61	40	51.3	12.49	3.53	9.133	.001
Yearling	F	489	56	38	47.9	11.77	3.43		
Adult	M	22	59	42	52.5	11.97	3.46	3.667	.001
Adult	F	171	59	29	49.5	13.15	3.63		

Table 17. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of size (girth at heart)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(cm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	25	37	19	29.1	14.91	3.86	0.745	.5
Kit	F	117	37	20	28.6	8.11	2.85		
Yearling	M	110	48	27	35.6	10.56	3.25	7.482	.001
Yearling	F	549	49	25	33.4	7.42	2.72		
Adult	M	24	47	33	38.8	11.91	3.45	6.592	.001
Adult	F	189	43	28	34.8	7.34	2.71		

Table 18. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of size (body length straight)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(cm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	25	76	28	64.1	89.28	9.45	1.070	.3
Kit	F	116	73	47	62.7	23.95	4.89		
Yearling	M	109	83	49	75.5	20.99	4.58	8.151	.001
Yearling	F	537	83	58	72.2	13.62	3.69		
Adult	M	24	85	71	78.0	13.61	3.69	4.206	.001
Adult	F	186	82	67	74.9	11.26	3.36		

line measurement did show larger males in all age classes but with very large variances. The body length contour (Table 19) is probably more indicative of true body size than any other measurement. The variances are much less than those of the straight line measurement. The body length contour is probably a better measure of animal size than the weight is because the condition of the animal and the fat deposits enter into the weight measurements. Therefore, the body length contour measurement was used as the covariable in any analysis in which I desired to hold body size constant. The largest measurement taken was 99 cm. on an adult male.

Humerus Length: The length of the humerus was measured from the proximal surface of the head of the humerus to the distal surface of the groove between the trochlea and the capitellum whenever this bone was available for measurement. Only 64 measurements were taken, but they showed the same growth pattern as other body measurements. The males were larger than the females, and the kits were considerably smaller than the rest of the population, but there was very little difference between the yearling and adult age classes (Table 20).

Skull Measurements: Five standard measurements were taken on the skull as follows:

Greatest Length: from the most posterior extension of the occipital bone to the anterior plane of the premaxillary bones.

Basilar Length: from the anterior margin of the foramen magnum to the anterior plane of the premaxillary bones.

Zygomatic Breadth: Greatest width between lateral arches of the zygomatic arches.

Table 19. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of size (body length contour)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(cm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	25	87	38	71.2	82.08	9.06	0.966	.4
Kit	F	116	80	53	70.0	21.21	4.61		
Yearling	M	108	93	40	83.4	30.49	5.52	9.847	.001
Yearling	F	540	92	70	79.7	9.16	3.03		
Adult	M	23	99	81	87.0	14.18	3.77	7.709	.001
Adult	F	186	92	75	82.1	7.55	2.75		

Table 20. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of size (humerus length)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(cm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	2	148	144	146.0	8.00	2.83	2.019	.3
Kit	F	1	139	139	139.0	0	0		
Yearling	M	30	172	153	163.4	24.73	4.97	5.737	.001
Yearling	F	22	162	142	155.8	18.95	4.35		
Adult	M	6	174	159	166.8	26.17	5.12	3.277	.02
Adult	F	3	159	154	156.3	6.34	2.52		

Temporal Ridge Width: the greatest width between the temporal ridges.

Braincase Width: the greatest width of the braincase taken on the squamosal bones.

A histogram of these measurements showed no clear separation which would allow any individual to be placed definitely into an age class, but the means clearly show the difference between sexes and ages (Tables 21, 22, 23, 24 and 25). The sample sizes are large enough so that these measurements can be used for purposes of taxonomy.

Ovary Measurements

Table 26 shows a regression of ovary size (measured as length times width) on the sum of the squared corpora albicantia diameters. The corpora albicantia measurements were used as an indication of the size of the corpora albicantia. It is realized that these measurements give a planar comparison of the structures measured, but they are taken as a measure of size of the structures. In the yearlings and adults there was a good correlation between the ovary size and the sum of the squared corpora albicantia diameters. I conclude from the F test that the regression line is different from zero. This indicates that the sizes of the corpora albicantia and the size of the ovary are related.

Table 27 shows the same regression, but with the body length contour used as a covariable. The similarity of the results clearly shows that the size of the animal is not acting as an influence on these measurements.

Testes Measurements

Table 28 lists the means, variances and standard deviations of the

Table 21. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of skull measurements (greatest length)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(mm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	16	121	102	116.3	23.67	4.86	3.677	.001
Kit	F	74	123	101	112.1	15.86	3.98		
Yearling	M	99	136	121	127.9	10.02	3.17	18.069	.001
Yearling	F	502	131	105	121.8	9.31	3.05		
Adult	M	19	140	127	133.3	9.65	3.11	11.666	.001
Adult	F	195	132	118	125.6	7.35	2.71		

Table 22. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of skull measurements (basilar length)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(mm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	14	102	81	96.3	30.07	5.48	3.131	.01
Kit	F	70	102	82	92.7	12.67	3.56		
Yearling	M	91	117	101	107.4	7.89	2.81	15.939	.001
Yearling	F	468	124	91	102.1	8.51	2.92		
Adult	M	16	118	107	112.4	7.85	2.80	10.718	.001
Adult	F	184	112	98	105.4	6.15	2.48		

Table 23. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of skull measurements (zygomatic arch breadth)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(mm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	15	86	79	82.5	3.70	1.92	3.280	.01
Kit	F	79	87	71	79.7	10.18	3.19		
Yearling	M	94	94	82	89.3	4.29	2.07	12.818	.001
Yearling	F	460	93	79	86.2	4.61	2.15		
Adult	M	17	100	87	93.3	11.10	3.33	5.345	.001
Adult	F	178	97	85	90.1	5.06	2.25		

Table 24. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of skull measurements (temporal ridge width)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(mm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	23	48	27	37.6	19.98	4.47	2.325	.05
Kit	F	97	45	26	35.8	9.15	3.02		
Yearling	M	100	33	12	23.9	18.30	4.28	-7.052	.001
Yearling	F	520	36	11	26.8	13.43	3.66		
Adult	M	22	31	11	17.6	19.86	4.46	-4.074	.001
Adult	F	202	59	13	22.7	32.32	5.68		

Table 25. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of skull measurements (braincase width)

Age	Sex	n=	Maximum	Minimum	$\overline{Y}$(mm.)	Variance	Standard deviation	Calculated "t"	Significance level
Kit	M	15	60	54	57.3	2.24	1.50	1.891	.1
Kit	F	90	62	52	56.5	2.32	1.52		
Yearling	M	91	64	55	58.1	1.91	1.38	5.282	.001
Yearling	F	465	88	53	57.0	3.58	1.89		
Adult	M	18	60	56	58.3	0.92	0.96	1.432	.2
Adult	F	180	67	57	56.7	22.31	4.72		

Table 26. Alaska lynx sample, Nov. 1964 - Oct. 1965: Regression of ovary size (length x width) on the sum of the squared corpora albicantia diameters

Age Class	n=	$\overline{X}$(mm.)	$\overline{Y}$(mm.)	Regression coefficient	Correlation coefficient	Calculated F	Tabular F
Kits	225	.7352	88.431	.3504	.01	2.04	3.84
Yearlings	1100	26.21	140.6	.3486	.37	173.91	3.84
Adults	413	75.17	211.62	.3136	.53	160.93	3.84
All Ages	1738	34.548	150.746	.44677	.52	647.68	3.84

Table 27. Alaska lynx sample, Nov. 1964 - Oct. 1965: Regression of ovary size (length x width) on the sum of the squared corpora albicantia diameters with body length contour as covariable (yearlings and adults only)

Age Class	n=	$\overline{X}$(mm.)	$\overline{Y}$(mm.)	Regression coefficient	Correlation coefficient	Calculated F	Tabular F
Kits	225	.7352	88.431	.35040	.01	2.04	3.84
Yearlings	1100	26.211	140.63	.34716	.37	172.42	3.84
Adults	413	75.174	211.62	.29849	.52	151.04	3.84
All Ages	1738	34.548	150.74	.43731	.51	623.64	3.84

Table 28. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of body length contour measurement (males only)

Age	n=	$\overline{X}$(cm.)	Variance	Standard deviation
Kits	25	71.2	3.2833	1.81
Yearlings	108	83.4	.2823	.53
Adults	23	87.0	.6166	.79

body length contour of males and the sizes of the samples on which the statistics are based. The statistics of these body length contour measurements show, as one would expect, more variability in kit size than in the sizes of the other ages. The greater variability in kit size is most likely due to the fact that they are in a period of normally rapid growth relative to the other age classes.

Table 29 contains data for four measures of testes size: 1) Length in millimeters 2) Length times width in millimeters 3) Weight in grams and 4) Volume in cubic centimeters. Length alone is not a very good measure of the size of testes, but I do not know which of the others is the best measure. The volume may be the most dependable because it is inherently a total size measurement. The data reveal that mean testes size increases with age.

Table 30 shows the results of a regression of animal size on time and shows a poor correlation in all age classes. The kits show a slightly better correlation than the rest but still not significant. The regression indicates that the body length contour of the animals harvested did not change substantially during this seven-month period. Note that there was a very small sample of kits.

Table 31 shows the results of a regression of testes size on time. The analysis reveals essentially no growth of testes size during this time period. For some reason, the weights of the yearlings show a negative correlation coefficient value, but this is not present in any other measurement or age class. The F test values of regression are almost all too small to be significant at the .05 level. The weight and volume of the testes seem to bear more correlation to time than do

Table 29. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of testes measurements (two testes per animal averaged, all data used)

	n = Number of animals	$\overline{X}$	Variance	Standard deviation
Kits	6			
Length (mm.)		17.167	1.8944	1.38
Length x width(mm.)		146.50	337.18	18.36
Weight (g.)		772.00	15473.9	124.39
Volume (cc.)		11.333	1.4444	1.20
Yearlings	51			
Length		19.471	.0912	.30
Length x width		227.31	40.524	6.37
Weight		1689.0	4367.5	66.09
Volume		19.373	.3208	.57
Adults	10			
Length		21.400	.4267	.65
Length x width		246.70	104.07	10.20
Weight		1897.8	12141.3	110.19
Volume		21.900	.6767	.82

Table 30. Alaska lynx sample, Nov. 1964 - May 1965: Regression of body length contour on time (corresponding testes measurements known)

Age	n=	$\bar{Y}$	Regression coefficient	Correlation coefficient	Calculated F	Tabular F	Regression equations
Kit	5	77.2	.12982	.36	.44	10.1	Y = 100.98 + .1298X
Yearling	46	82.1	.000296	.003	.0003	4.08	Y = 82.13 + .0003X
Adult	10	86.3	.00525	.07	.038	5.32	Y = 85.48 + .0053X

Table 31. Alaska lynx sample, Nov. 1964 - May 1965: Regression of testes measurements on time (two testes summed, body length contour known)

	n=	$\bar{Y}$	Regression coefficient	Correlation coefficient	Calculated F	Tabular F	Regression equation
Kits	5						
Length (mm.)		34.8	.01635	.04	.005	10.1	Y = 37.80 + .02X
Length x width		301.4	.45042	.08	.02	10.1	Y = 383.92 + 45X
Weight (g.)		1619.8	3.6637	.10	.03	10.1	Y = 2290.98 + 3.66X
Volume (cc.)		24.0	.02725	.08	.02	10.1	Y = 19.01 + .03X
Yearlings	46						
Length		39.5	.00607	.09	.36	4.08	Y = 38.62 + .01X
Length x width		452.0	.01185	.008	.003	4.08	Y = 450.23 + .01X
Weight		3330.6	5.1337	.35	6.25	4.08	Y = 4077.18 - 5.13X
Volume		38.7	.01411	.11	.58	4.08	Y = 40.70 + .01X
Adult	10						
Length		43.4	.03182	.58	3.99	5.32	Y = 38.44 + .03X
Length x width		493.8	.59449	.64	5.45	5.32	Y = 401.06 + .59X
Weight		3796.1	5.1145	.51	2.76	5.32	Y = 2998.23 + 5.11X
Volume		43.9	.04298	.56	3.73	5.32	Y = 37.19 + .04X

the other measurements in Table 32 where the same analysis is made with the body length contour as a covariable. The results of the analysis in Table 32 are essentially the same as the results in Table 31. Sample sizes were very small in the male reproductive analyses, but these same analyses can yield more meaningful results in subsequent years with a larger sample.

Transmigration

The 595 yearling females were checked for discrepancies in the number of placental scars and the number of corpora albicantia (Table 33). If the number of corpora albicantia in any one ovary was smaller than the number of placental scars in the corresponding cornu, then transmigration possibly could have occurred. However, twinning from a single egg could have produced the same condition. If the total count of corpora albicantia in both ovaries was less than the total count of placental scars in both uterine horns, then this was taken as evidence of twinning. There is really no way to be sure which has occurred because the follicle of an unfertilized egg may be lutenized along with the follicles of fertilized and implanted eggs.

There were 150 cases in which the placental scar count in at least one cornu was greater than the corresponding ovary's corpora albicantia count. These are incidences of either transmigration or twinning. In 33 cases there was a total placental scar count greater than the total corpora albicantia count. This could mean twinning or transmigration or misinterpretation of placental scars or corpora albicantia.

It is possible that some placental scars were not counted due to fading, although the data show no hint of placental scar fading. However,

Table 32. Alaska lynx sample, Nov. 1964 - May 1965: Regression of testes measurements on time with body length contour as covariable (two testes summed)

	$\overline{Y}$	Regression coefficient	Correlation coefficient	Calculated F	Tabular F	Regression equation
Yearlings (46)						
Length (mm.)	39.5	.00566	.08	.31	4.08	Y = 38.68 + .01X
Length x width	452.0	.00408	.003	.0003	4.08	Y = 451.36 + .004X
Weight (g.)	3,330.5	5.1247	.35	6.23	4.08	Y = 4,075.83 - 5.13X
Volume (cc.)	38.7	.01406	.11	.57	4.08	Y = 40.70 + .01X
Adults (10)						
Length	43.4	.02921	.53	3.11	5.32	Y = 38.84 + .03X
Length x width	493.8	.54797	.59	4.20	5.32	Y = 408.32 + .55X
Weight	3,796.1	4.5685	.45	2.06	5.32	Y = 3,083.41 + 4.57X
Volume	43.9	.03828	.50	2.70	5.32	Y = 37.93 + .04X

Table 33. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of data showing possible incidences of transmigration and/or abortion

Number of possible occurrences of transmigrations = 150

Percentage of possible transmigrations = 25

Number of yearling animals in which total placental scars exceed total corpora albicantia = 33

Incidence of unsuccessful breeding and abortion, Nov. 1 to Mar. 15

Age	n=	Animals with corpora albicantia	Animals without placental scars visible	Percent without placental scars
Yearling	595	335	134	40
Adult	219	138	8	5.8
Total	814	473	142	30

with the meticulous care exercised in slicing ovaries and counting their corpora albicantia, it is very unlikely that any corpora albicantia could have been missed or mistaken for something else.

The incidence of unsuccessful breeding and/or abortion can be seen by analyzing the data from the animals which have corpora albicantia but have no placental scars. Ovulation is assumed to be induced in this species. This analysis was strikingly different for the yearling as compared to the adult age class. Of the 335 yearlings with corpora albicantia, 134 (40%) were without placental scars. Of the 138 adults with corpora albicantia, only 8 (5.8%) were without placental scars. It is impossible to say, from these data, what the cause of this unsuccessful breeding and/or abortion is, but whatever is operating is a function of age because of the great disparity between the percentage in yearlings and adults.

Placental Scar Analysis

Placental scars were tabulated for females of all ages, and the data were separated by area (Table 34) (Figure 6). Table 35 is a compilation of the yearling data, Table 36 is the data on adults, and Table 37 is a combination of both. Some of the area had very few animals and could be geographically combined with others. Areas 17, 18 and 19 are composites of other groups of areas (Figure 7). Areas 6, 11, 12 and 16 are the only ones not grouped into composite areas. The data indicate that the older animals have the largest number of placental scars, and the animals from Area 6 have a larger number (2.7) of placental scars per animal than do the animals from any of the composite areas. This may well be another reflection of the effects of the high hare population

Table 34. Alaska lynx sample, Nov. 1964 - Oct. 1965: Analysis of number of placental scars per animal by area (yearlings and adults only)

Area	n=	Yearlings	Adults	Total
Glennallen	147	3.7	5.5	4.4
McGrath	3	3.0	3.5	3.3
Unit 11	2	---	6.5	6.5
Unknown	4	4.5	---	4.5
Rampart-Manley	51	4.1	5.5	4.7
Tok-Delta	96	4.3	5.1	4.6
Upper Yukon R.	67	4.6	4.6	5.5
Fairbanks Area	123	4.5	4.8	4.6
All Areas	493	4.2	5.1	4.5

Table 35. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of placental scars per animal by area (yearlings only)

Area	n=	$\overline{Y}$	Variance	Standard deviation
Tok	40	2.2	.1486	.39
Delta	69	1.2	.0517	.23
Tok-Delta	109	1.6	.0424	.21
Circle-Central	0			
Ft. Yukon	55	1.9	.1050	.32
Eagle	0			
Upper Yukon R.	55	1.9	.1050	.32
Murphy Dome	37	2.3	.1586	.40
Nenana Hwy.	10	1.5	.4278	.65
Eielson AFB	21	1.5	.2458	.50
Fairbanks	40	2.6	.1345	.37
Healy	17	2.4	.3754	.61
Tanana Flats	8	3.0	.8571	.93
Fairbanks Area	133	2.2	.0421	.21
Glennallen	98	3.1	.0640	.25
McGrath	4	0.8	.5625	.75
Unit 11	0			
Rampart-Manley	32	1.6	.1610	.40

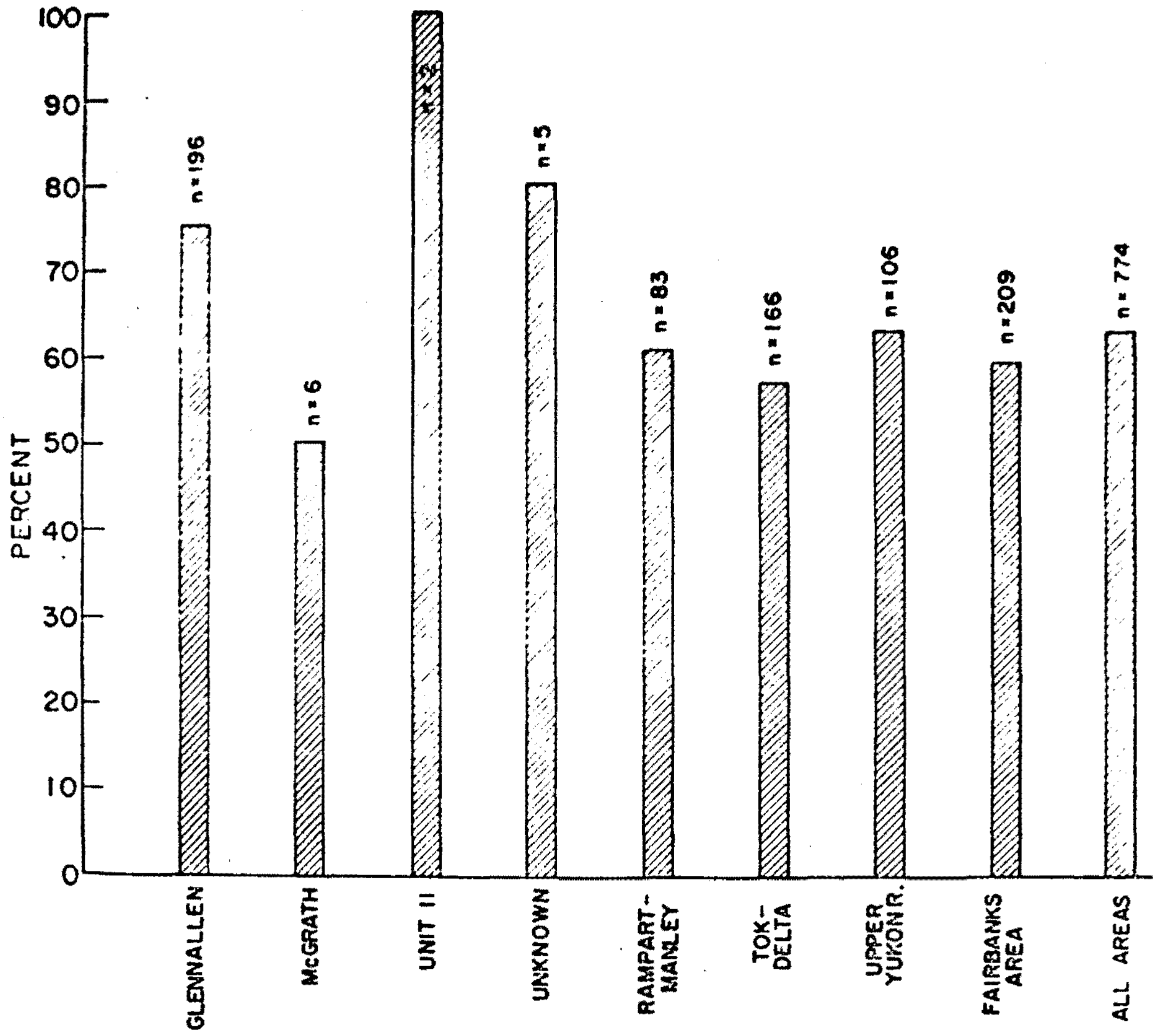


Figure 6. Alaska lynx sample, Nov. 1964 - Oct. 1965: Distribution by area of yearling and adult lynx having placental scars.

Table 36. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of placental scars per animal by area (adults only)

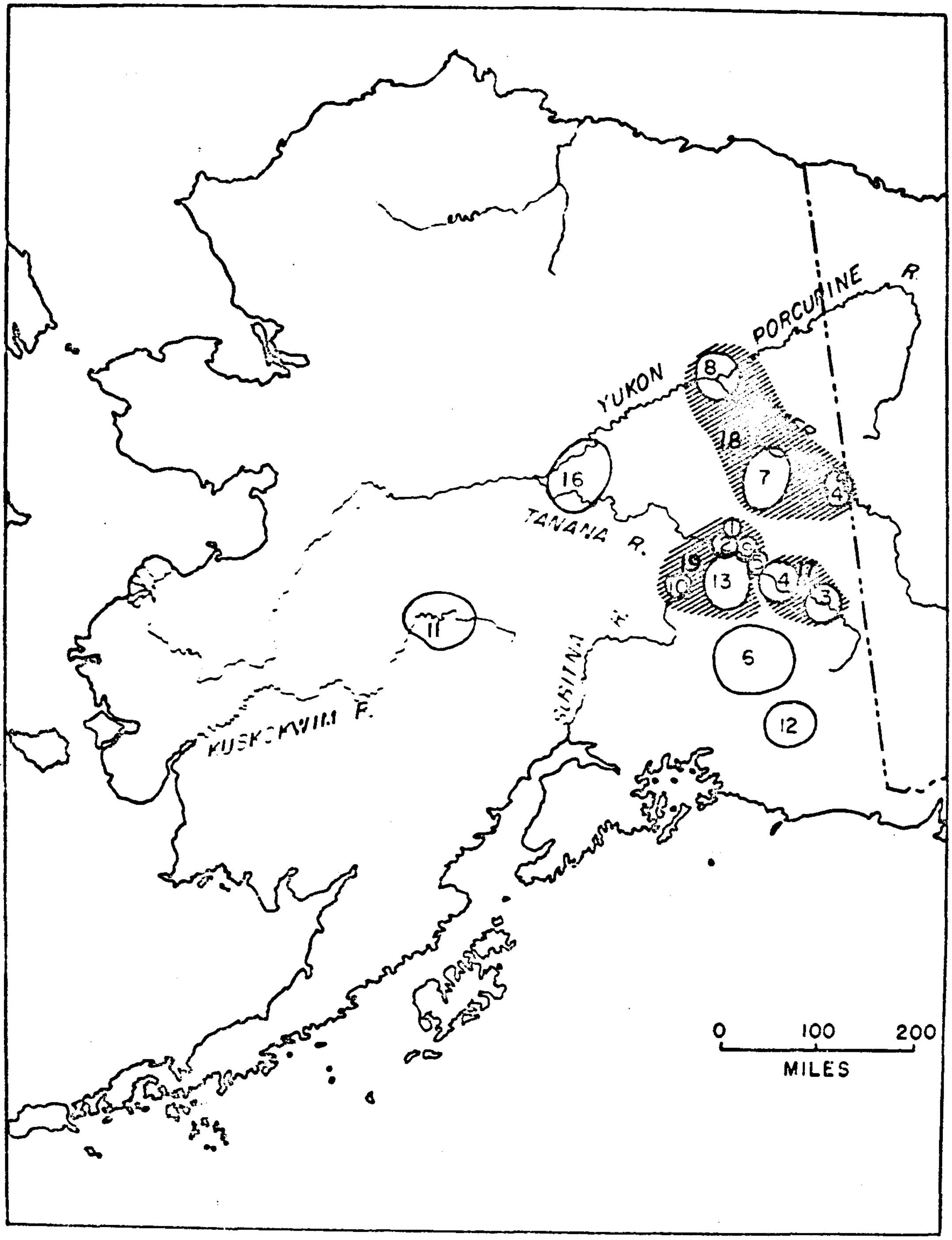
Area	n=	$\overline{Y}$	Variance	Standard deviation
Tok	18	4.8	.1736	.42
Delta	16	5.8	.1435	.38
Tok-Delta	34	5.3	.0861	.29
Circle-Central	0			
Ft. Yukon	37	3.9	.1468	.38
Eagle	6	2.0	.8667	.93
Upper Yukon R.	43	3.6	.1329	.36
Murphy Dome	4	6.5	.4167	.65
Nenana Hwy.	1	5.0		
Eielson AFB	4	5.5	.7500	.87
Fairbanks	10	4.7	.2456	.50
Healy	1	5.0		
Tanana Flats	5	4.6	.4600	.68
Fairbanks Area	25	5.1	.0944	.31
Glennallen	53	4.5	.1340	.37
McGrath	2	3.5	.2500	.50
Unit 11	0			
Rampart-Manley	15	5.9	.4140	.64

Table 37. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of placental scars per animal by area (all ages)

Area	n=	$\bar{Y}$	Variance	Standard deviation
Tok	64	2.7	.1035	.32
Delta	91	1.9	.0706	.27
Tok-Delta	155	2.2	.0427	.21
Circle-Central	0			
Ft. Yukon	97	2.6	.0674	.26
Eagle	6	2.0	.8667	.93
Upper Yukon R.	103	2.5	.0624	.25
Murphy Dome	47	2.3	.1473	.38
Nenana Hwy.	11	1.8	.4512	.67
Eielson AFB	25	2.2	.2756	.52
Fairbanks	54	2.8	.1055	.32
Healy	18	2.6	.3544	.60
Tanana Flats	13	3.6	.4172	.65
Fairbanks Area	168	2.5	.0370	.19
Glennallen	199	2.7	.0385	.20
McGrath	6	1.7	.5778	.76
Unit 11	0			
Rampart-Manley	53	2.6	.1764	.42

Figure 7. Alaska lynx sample, Nov. 1964 - Oct. 1965: Map of Alaska showing harvest areas.

Area Number	Area Name
1	Murphy Dome
2	Nenana Highway
3	Tok
4	Delta
5	Eielson Air Force Base
6	Glennallen
7	Circle - Central
8	Fort Yukon - Birch Creek
9	Fairbanks
10	Healy
11	McGrath
12	Unit 11 (Chitina R. Area)
13	Tanana Flats
14	Eagle
15	Unknown
16	Rampart - Manley
17	Tok - Delta (Composite of 3 + 4)
18	Upper Yukon River (Composite of 7+8+14)
19	Fairbanks Area (Composite of 1+2+5+9+10+13)


YUKON
PORCUPINE R.
TANANA R.
KUSKOKWIM R.
0 100 200
MILES

in Area 6 which is south of the Alaska Range.

I regressed the placental scars on time to determine if the number of placental scars decreased with time. A decrease could indicate that fading of scars occurred during the period November 1 to May 31 (Table 38). Tests of regression coefficients were not significant.

A linear regression of placental scars on corpora albicantia during this same time period showed significant tests of regression in females having placental scars and a large correlation between placental scars and corpora albicantia. This would indicate that the placental scars and the corpora albicantia are directly related (Table 39). To further define this relationship, Table 40 shows the results of a regression of the difference between the counts of corpora albicantia and placental scars on time. I believe this indicates that the placental scars are not fading to the point of being overlooked during this time period.

A regression of the body length contour on time for the females (Table 41) showed, as did a similar regression for the males, the largest change in the kits where growth is relatively more than it is in the other age classes, and an insignificant change in the other age groups. This same relationship is not seen quite so clearly in the ovary length measurement, but it is still indicated by the regression coefficient.

I examined a compilation of body length contour measurements by age for each area, and I could see that the kits were larger in Area 6 than they were north of the Range (Table 42). I could also see the same relationship for the yearlings as for the kits although not as distinctly

Table 38. Alaska lynx sample, Nov. 1964 - May 1965: Regression of placental scars on time

Age	n=	$\bar{Y}$	Regression coefficient	Correlation coefficient	Calculated F	Tabular F
Kit	81	0	0	0	0	4.00
Yearling	434	2.2	.00389	.07	1.97	3.84
Adult	172	4.6	.00026	.005	.004	3.92
All Ages	687	2.5	.00148	.02	.40	3.84

Table 39. Alaska lynx sample, Nov. 1964 - May 1965: Regression of placental scars on corpora albicantia

Age	n=	$\bar{X}$	$\bar{Y}$	Regression coefficient	Correlation coefficient	Calculated F	Tabular F	Regression equation
Yearling	434	4.3	2.2	.56080	.61	257.58	3.84	Y = -.24 + .56X
Adult	172	12.4	4.6	.17216	.46	46.46	3.92	Y = 2.51 + .17X
All Ages	687	5.8	2.5	.31784	.66	542.66	3.84	Y = .69 + .32X

Table 40. Alaska lynx sample, Nov. 1964 - Mar. 1965: Regression of sum of corpora albicantia minus sum of placental scars on time (sum of placental scars is greater than zero)

Age	n=	$\bar{X}$	$\bar{Y}$	Regression coefficient	Correlation coefficient	Calculated F	Tabular F	Regression equation
Yearling	424	70.9	2.1	.00381	.07	1.87	3.84	Y = 2.38 + .004X
Adult	171	85.7	7.7	.00103	.008	.01	3.92	Y = 7.83 + .001X
All Ages	674	78.0	3.3	.00090	.009	.05	3.84	Y = 3.22 + .001X

Table 41. Alaska lynx sample, Nov. 1964 - May 1965: Regression of female reproductive tract measurements on time

	n=	$\overline{X}$	$\overline{Y}$	Regression coefficient	Correlation coefficient	Calculated F	Tabular F	Regression equation
Y = body length contour (cm.)								
Kit	76	102.0	69.8	.06434	.53	28.95	4.00	Y = 63.19 + .06X
Yearling	395	72.1	79.7	.00338	.05	.93	3.84	Y = 79.50 + .003X
Adult	135	85.1	81.9	.00380	.07	.70	3.92	Y = 81.57 + .004X
Y = right ovary length + left ovary length (mm.)								
Kit	76	102.0	25.8	.01687	.18	2.35	4.00	Y = 24.12 + .02X
Yearling	395	72.1	29.9	.00293	.03	.35	3.84	Y = 30.07 + .003X
Adult	135	85.1	35.6	.00485	.04	.24	3.92	Y = 35.15 + .005X
Y = right ovary (length x width) + left ovary (length x width) (mm.)								
Kit	76	102.0	177.9	.32328	.24	4.67	4.00	Y = 144.94 + .32X
Yearling	395	72.1	287.5	.05693	.03	.29	3.84	Y = 291.62 + .06X
Adult	135	85.1	426.4	.16053	.06	.41	3.92	Y = 412.73 + .16X
Y = right cornu length + left cornu length (mm.)								
Kit	76	102.0	171.1	.22622	.36	10.85	4.00	Y = 148.07 + .23X
Yearling	395	72.1	233.8	.05278	.06	1.44	3.84	Y = 229.96 + .05X
Adult	135	85.1	282.6	.05305	.07	.59	3.92	Y = 287.08 + .05X

Table 42. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of body length contour by area (kits only)

Area	n=	Mean	Variance	Standard deviation
Tok	5	66.8	4.04	0.2
Delta	4	66.8	2.73	0.1
Tok-Delta	9	66.8	1.58	0.1
Circle-Central	0	---	---	---
Ft. Yukon	3	67.7	12.4	0.3
Eagle	0	---	---	---
Upper Yukon R.	3	67.7	12.4	0.3
Murphy Dome	5	64.4	1.06	0.1
Nenana Hwy.	1	70.0	---	---
Eielson AFB	0	---	---	---
Fairbanks	4	64.5	.417	0.6
Healy	0	---	---	---
Tanana Flats	0	---	---	---
Fairbanks Area	10	65.0	.600	0.7
Glennallen	49	71.4	.336	0.5
McGrath	0	---	---	---
Unit 11	0	---	---	---
Rampart-Manley	5	69.6	3.46	0.1

(Table 43). There did not seem to be any significant difference in size for adults from Area 6 as compared with adults from other areas (Table 44). Perhaps this faster growth of kits reflects the high hare population south of the Range during the spring of 1964.

The measurement of the sum of the left and right ovary lengths by area showed a definite difference in Area 6. They were larger in Area 6 for all age classes (Tables 45, 46 and 47). Tables 48, 49 and 50 show the same phenomenon for the measurement of the right ovary length times width plus the left ovary length times width. Again in cornu length, the Area 6 animals had definitely larger uteri measurement means in all age classes (Tables 51, 52 and 53). Perhaps this is another indication of better food conditions in Area 6.

Tables 54, 55 and 56 list the compilations of ovary sizes by area for each age class. Composite area results are shown in these tables.

A regression of size of female reproductive organs on time (November through May) with body length contour as a covariable (Table 57) yielded the same result as the regression in Table 41 without the covariable. The kits showed a higher regression coefficient than the other age classes, but only in cornu length measurement was it statistically significant.

A compilation of all ovaries having three corpora albicantia was made. One ovary was placed in the kit class which may have been a mistake in age determination or a mix-up of reproductive tracts, since no kit could really have corpora albicantia. There was very little difference in size between yearling and adult ovaries having three corpora albicantia (163.2 to 177.4), but there was a great difference in

Table 43. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of body length contour by area (yearlings only)

Area	n=	Mean	Variance	Standard deviation
Tok	35	79.4	.235	0.4
Delta	77	78.9	.095	0.3
Tok-Delta	112	79.0	.068	0.2
Circle-Central	0	---	---	---
Ft. Yukon	14	81.1	.280	0.5
Eagle	0	---	---	---
Upper Yukon R.	14	81.1	.280	0.5
Murphy Dome	41	79.5	.159	0.3
Nenana Hwy.	9	78.8	1.05	0.1
Eielson AFB	22	78.0	.643	0.8
Fairbanks	41	78.8	.186	0.4
Healy	12	80.1	.734	0.8
Tanana Flats	7	79.1	.544	0.7
Fairbanks Area	132	79.0	.064	0.2
Glennallen	99	81.0	.077	0.2
McGrath	4	79.8	.229	0.4
Unit 11	0	---	---	---
Rampart-Manley	34	80.8	.258	0.5

Table 44. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of body length contour by area (adults only)

Area	n=	Mean	Variance	Standard deviation
Tok	15	83.1	.633	0.7
Delta	16	81.7	.389	0.6
Tok-Delta	31	82.4	.259	0.5
Circle-Central	0	---	---	---
Ft. Yukon	10	81.6	.894	0.9
Eagle	6	82.2	.628	0.7
Upper Yukon R.	16	81.8	.418	0.6
Murphy Dome	4	81.8	1.90	0.1
Nenana Hwy.	1	80.0	---	---
Eielson AFB	3	80.7	5.78	0.2
Fairbanks	9	81.2	.327	0.5
Healy	1	81.0	---	---
Tanana Flats	3	79.3	.111	0.3
Fairbanks Area	21	80.9	.223	0.4
Glennallen	53	81.8	.091	0.3
McGrath	2	81.5	6.25	0.2
Unit 11	0	---	---	---
Rampart-Manley	12	83.1	.553	0.7

Table 45. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of ovary size by area (both ovary lengths summed, kits only)

Area	n=	Mean	Variance	Standard deviation
Tok	5	23.0	.700	0.8
Delta	4	20.5	.917	0.9
Tok-Delta	9	21.9	.540	0.7
Circle-Central	0	---	---	---
Ft. Yukon	3	23.7	4.11	0.2
Eagle	0	---	---	---
Upper Yukon R.	3	23.7	4.11	0.2
Murphy Dome	5	23.2	1.44	0.1
Nenana Hwy.	1	30.0	---	---
Eielson AFB	0	---	---	---
Fairbanks	4	23.8	.563	0.7
Healy	0	---	---	---
Tanana Flats	0	---	---	---
Fairbanks Area	10	24.1	.832	0.9
Glennallen	49	27.1	.238	0.4
McGrath	0	---	---	---
Unit 11	0	---	---	---
Rampart-Manley	5	25.0	.400	0.6

Table 46. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of ovary size by area (both ovary lengths summed, yearlings only)

Area	n=	Mean	Variance	Standard deviation
Tok	35	28.8	.363	0.6
Delta	77	28.4	.169	0.4
Tok-Delta	112	28.5	.114	0.3
Circle-Central	0	---	---	---
Ft. Yukon	14	28.8	.980	0.9
Eagle	0	---	---	---
Upper Yukon R.	14	28.8	.980	0.9
Murphy Dome	41	29.6	.363	0.6
Nenana Hwy.	9	27.4	1.00	0.1
Eielson AFB	22	29.0	.498	0.7
Fairbanks	41	28.8	.492	0.7
Healy	12	31.2	.982	0.9
Tanana Flats	7	26.7	1.13	0.1
Fairbanks Area	132	29.1	.116	0.3
Glennallen	99	33.0	.154	0.3
McGrath	4	29.3	2.23	0.1
Unit 11	0	---	---	---
Rampart-Manley	34	28.6	.340	0.5

Table 47. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of ovary size by area (both ovary lengths summed, adults only)

Area	n=	Mean	Variance	Standard deviation
Tok	15	34.3	1.49	0.1
Delta	16	36.4	1.11	0.1
Tok-Delta	31	35.4	.662	0.8
Circle-Central	0	---	---	---
Ft. Yukon	10	31.3	1.53	0.1
Eagle	6	28.3	2.24	0.1
Upper Yukon R.	16	30.2	.993	0.9
Murphy Dome	4	35.8	3.73	0.1
Nenana Hwy.	1	38.0	---	---
Eielson AFB	3	33.0	7.00	0.2
Fairbanks	9	38.0	2.58	0.1
Healy	1	43.0	---	---
Tanana Flats	3	31.3	3.44	0.1
Fairbanks Area	21	36.1	1.13	0.1
Glennallen	53	37.0	.637	0.7
McGrath	2	36.0	4.00	0.2
Unit 11	0	---	---	---
Rampart-Manley	12	35.7	1.13	0.1

Table 48. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of ovary size by area (summed length x width of both ovaries, kits only)

Area	n=	Mean	Variance	Standard deviation
Tok	5	140.8	88.141	0.9
Delta	4	100.3	66.896	0.8
Tok-Delta	9	122.8	86.383	0.9
Circle-Central	0	---	---	---
Ft. Yukon	3	140.3	611.44	0.2
Eagle	0	---	---	---
Upper Yukon R.	3	140.3	611.44	0.2
Murphy Dome	5	131.2	160.84	0.1
Nenana Hwy.	1	224.0	---	---
Eielson AFB	0	---	---	---
Fairbanks	4	137.3	205.23	0.1
Healy	0	---	---	---
Tanana Flats	0	---	---	---
Fairbanks Area	10	142.9	145.21	0.1
Glennallen	49	198.2	40.022	0.6
McGrath	0	---	---	---
Unit 11	0	---	---	---
Rampart-Manley	5	170.8	229.34	0.1

Table 49. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of ovary size by area (summed length x width of both ovaries, yearlings only)

Area	n=	Mean	Variance	Standard deviation
Tok	35	261.6	157.34	0.1
Delta	77	255.3	75.154	0.8
Tok-Delta	112	257.3	50.514	0.7
Circle-Central	0	---	---	---
Ft. Yukon	14	260.8	285.86	0.1
Eagle	0	---	---	---
Upper Yukon R.	14	260.8	285.86	0.1
Murphy Dome	41	281.8	138.03	0.1
Nenana Hwy.	9	228.9	268.29	0.1
Eielson AFB	22	266.8	213.87	0.1
Fairbanks	41	261.4	144.20	0.1
Healy	12	284.4	322.11	0.1
Tanana Flats	7	237.1	376.50	0.1
Fairbanks Area	132	267.2	38.891	0.6
Glennallen	99	361.1	89.561	0.9
McGrath	4	263.8	382.40	0.1
Unit 11	0	---	---	---
Rampart-Manley	34	265.4	151.61	0.1

Table 50. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of ovary size by area (summed length x width of both ovaries, adults only)

Area	n=	Mean	Variance	Standard deviation
Tok	15	401.1	923.84	0.3
Delta	16	443.7	583.92	0.2
Tok-Delta	31	423.1	374.42	0.1
Circle-Central	0	---	---	---
Ft. Yukon	10	297.3	731.60	0.2
Eagle	6	246.7	552.91	0.2
Upper Yukon R.	16	278.3	383.52	0.1
Murphy Dome	4	410.5	2,656.9	0.5
Nenana Hwy.	1	437.0	---	---
Eielson AFB	3	370.7	4,461.8	0.6
Fairbanks	9	460.9	1,873.7	0.4
Healy	1	626.0	---	---
Tanana Flats	3	298.7	668.78	0.2
Fairbanks Area	21	422.0	731.17	0.2
Glennallen	53	475.3	401.82	0.2
McGrath	2	436.0	1,690.0	0.1
Unit 11	0	---	---	---
Rampart-Manley	12	422.7	1,096.7	0.3

Table 51. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of uterus size by area (summed cornu lengths, kits only)

Area	n=	Mean	Variance	Standard deviation
Tok	5	152.6	44.662	0.6
Delta	4	152.8	43.229	0.6
Tok-Delta	9	152.7	19.611	0.4
Circle-Central	0	---	---	---
Ft. Yukon	3	141.7	32.445	0.5
Eagle	0	---	---	---
Upper Yukon R.	3	141.7	32.445	0.5
Murphy Dome	5	137.6	13.463	0.3
Nenana Hwy.	1	178.0	---	---
Eielson AFB	0	---	---	---
Fairbanks	4	163.5	62.750	0.7
Healy	0	---	---	---
Tanana Flats	0	---	---	---
Fairbanks Area	10	152.0	36.267	0.6
Glennallen	49	181.8	8.5557	0.2
McGrath	0	---	---	---
Unit 11	0	---	---	---
Rampart-Manley	5	155.6	55.662	0.7

Table 52. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of uterus size by area (summed cornu lengths, yearlings only)

Area	n=	Mean	Variance	Standard deviation
Tok	35	226.6	29.367	0.5
Delta	77	224.2	14.241	0.3
Tok-Delta	112	225.0	9.5260	0.3
Circle-Central	0	---	---	---
Ft. Yukon	14	208.4	51.920	0.7
Eagle	0	---	---	---
Upper Yukon R.	14	208.4	51.920	0.7
Murphy Dome	41	230.7	25.830	0.5
Nenana Hwy.	9	209.1	83.735	0.9
Eielson AFB	22	220.5	67.004	0.8
Fairbanks	41	230.3	26.930	0.5
Healy	12	227.3	62.335	0.7
Tanana Flats	7	221.6	122.18	0.1
Fairbanks Area	132	226.6	8.2030	0.2
Glennallen	99	260.0	14.748	0.3
McGrath	4	234.5	113.42	0.1
Unit 11	0	---	---	---
Rampart-Manley	34	224.5	20.972	0.4

Table 53. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of uterus size by area (summed cornu lengths, adults only)

Area	n=	Mean	Variance	Standard deviation
Tok	15	284.3	156.43	0.1
Delta	16	294.2	48.696	0.6
Tok-Delta	31	289.4	48.710	0.6
Circle-Central	0	---	---	---
Ft. Yukon	10	258.7	67.468	0.8
Eagle	6	232.3	224.91	0.1
Upper Yukon R.	16	248.8	64.277	0.8
Murphy Dome	4	297.0	305.50	0.1
Nenana Hwy.	1	252.0	---	---
Eielson AFB	3	278.3	87.115	0.9
Fairbanks	9	278.4	127.86	0.1
Healy	1	396.0	---	---
Tanana Flats	3	242.3	97.448	0.9
Fairbanks Area	21	281.1	80.083	0.8
Glennallen	53	289.5	19.618	0.4
McGrath	2	257.5	756.25	0.2
Unit 11	0	---	---	---
Rampart-Manley	12	286.0	125.15	0.1

Table 54. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of ovary size for selected areas (both ovary lengths summed)

Area	n=	Mean	Variance	Standard deviation
		Kits		
Glennallen	49	27.1	.23810	0.4
McGrath	0	---	---	---
Unit 11	0	---	---	---
Rampart-Manley	5	25.0	.40000	0.6
Tok-Delta	9	21.9	.54015	0.7
Yukon R. Area	3	23.7	4.1111	0.2
Fairbanks Area	10	24.1	.83225	0.9
		Yearlings		
Glennallen	99	32.9	.14862	0.3
McGrath	4	29.3	2.3984	0.1
Unit 11	0	---	---	---
Rampart-Manley	34	28.6	.33976	0.5
Tok-Delta	112	28.6	.11105	0.3
Yukon R. Area	14	28.6	.87794	0.9
Fairbanks Area	132	29.2	.11840	0.3
		Adults		
Glennallen	53	37.0	.64307	0.8
McGrath	2	36.1	2.0869	0.1
Unit 11	0	---	---	---
Rampart-Manley	12	35.4	1.0112	0.1
Tok-Delta	31	35.2	.68585	0.8
Yukon R. Area	16	30.5	.94465	0.9
Fairbanks Area	21	36.4	1.0332	0.1

Table 55. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of ovary size for selected areas (summed length x width of both ovaries)

Area	n=	Mean	Variance	Standard deviation
		Kits		
Glennallen	49	198.2	40.022	0.6
McGrath	0	---	---	---
Unit 11	0	---	---	---
Rampart-Manley	5	170.8	229.34	0.1
Tok-Delta	9	122.8	86.383	0.9
Upper Yukon R.	3	140.3	611.44	0.2
Fairbanks Area	10	142.9	145.21	0.1
		Yearlings		
Glennallen	99	359.0	87.613	0.9
McGrath	4	265.1	350.23	0.1
Unit 11	0	---	---	---
Rampart-Manley	34	264.1	155.74	0.1
Tok-Delta	112	258.0	48.701	0.6
Upper Yukon R.	14	256.6	259.91	0.1
Fairbanks Area	132	268.9	40.167	0.6
		Adults		
Glennallen	53	474.6	403.65	0.2
McGrath	2	440.3	11,546.	0.1
Unit 11	0	---	---	---
Rampart-Manley	12	412.7	919.85	0.3
Tok-Delta	31	417.9	373.35	0.1
Upper Yukon R.	16	284.1	414.64	0.2
Fairbanks Area	21	432.0	676.56	0.2

Table 56. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of uterus size for selected areas (summed cornu lengths)

Area	n=	Mean	Variance	Standard deviation
		Kits		
Glennallen	49	181.8	8.5557	0.2
McGrath	0	---	---	---
Unit 11	0	---	---	---
Rampart-Manley	5	155.6	55.662	0.7
Tok-Delta	9	152.7	19.611	0.4
Upper Yukon R.	3	141.7	32.445	0.5
Fairbanks Area	10	152.0	36.267	0.6
		Yearlings		
Glennallen	99	258.9	13.846	0.3
McGrath	4	235.2	121.13	0.1
Unit 11	0	---	---	---
Rampart-Manley	34	223.8	20.266	0.4
Tok-Delta	112	225.3	9.4744	0.3
Upper Yukon R.	14	206.2	44.573	0.6
Fairbanks Area	132	227.5	8.2726	0.2
		Adults		
Glennallen	53	289.5	18.596	0.4
McGrath	2	258.9	396.78	0.1
Unit 11	0	---	---	---
Rampart-Manley	12	282.6	123.29	0.1
Tok-Delta	31	287.9	46.143	0.6
Upper Yukon R.	16	249.8	73.812	0.8
Fairbanks Area	21	284.3	77.169	0.8

Table 57. Alaska lynx sample, Nov. 1964 - May 1965: Regression of female reproductive tract measurements on time

Age	n=	$\overline{Y}$	Correlation coefficient	Calculated F	Tabular F	Regression equation
Y = right ovary length + left ovary length (mm.)						
Kit	76	25.8	.18	2.3	4.00	Y = 24.12 + .02X
Yearling	395	29.9	.03	.27	3.84	Y = 30.04 + .003X
Adult	135	35.6	.04	.18	3.92	Y = 35.21 + .004X
Y = right ovary (length x width) + left ovary (length x width) (mm.)						
Kit	76	177.9	.24	4.67	4.00	Y = 144.94 + .32X
Yearling	395	287.5	.02	.22	3.84	Y = 291.08 + .05X
Adult	135	426.4	.04	.26	3.92	Y = 415.62 + .13X
Y = right cornu length + left cornu length (mm.)						
Kit	76	171.1	.36	10.85	4.00	Y = 148.07 + .23X
Yearling	395	233.8	.07	1.71	3.84	Y = 229.68 + .06X
Adult	135	282.6	.08	.94	3.92	Y = 288.17 + .07X

size of adult ovaries having 11 corpora albicantia (288.8) as compared with adult ovaries having three corpora albicantia (177.4) (Table 58).

The regression of cornu length on number of placental scars (Table 59) shows such large regression coefficients and tests so highly significant (.01 level) that it is clear that the length of the uterus of a lynx was a function of the number of fetuses that had been implanted in it. The uterus seemed to be stretched to accommodate the number of fetuses and not to return to original size. Some error may be introduced by adults who had larger numbers of placental scars in previous years. For example, a lynx that had four fetuses implanted in one uterine horn in 1963 might only have two implanted in the same horn in 1964 and so would show two placental scars, but the uterine horn length would still be long enough to accommodate four placental scars.

The compilation of ovary size with body length contour as a covariable (Table 60) was only slightly different from the compilation in Table 58. The ovary size seemed to be independent of the size of the animal.

I regressed the cornu length on number of placental scars using the body length contour as a covariable, and I found that this changed the regression or correlation values only slightly (Table 61) from the same regression without a covariable. This result is similar to the result for ovary size.

Table 62 shows a compilation of number of corpora albicantia per animal by area. Only the major areas are listed. Those kits listed as having corpora albicantia are obvious errors because no kit is old enough to really have corpora albicantia. In the yearling class, the animals

Table 58. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of all ovaries having three or eleven corpora albicantia

Ovaries having three corpora albicantia

Age	n=	Mean ovary length	Variance	Standard deviation	Mean ovary size (L x W)	Variance	Standard deviation
Kit	3	14.0	0	0	107.3	21.778	4.67
Yearling	199	15.9	.0199	.14	163.2	8.6035	2.93
Adults	26	16.7	.3285	.57	177.4	81.598	9.03
All Ages	228	15.9	.0198	.14	164.1	7.8560	2.80

Ovaries having 11 corpora albicantia

Age	n=	Mean ovary length	Variance	Standard deviation	Mean ovary size (L x W)	Variance	Standard deviation
Kit	0	---	---	---	---	---	---
Yearlings	0	---	---	---	---	---	---
Adults	14	20.3	.6091	.78	288.8	294.03	17.1
All Ages	14	20.3	.6091	.78	288.8	294.03	17.1

Table 59. Alaska lynx sample, Nov. 1964 - Oct. 1965: Regression of cornu length on number of placental scars

Age	n=	$\overline{X}$	$\overline{Y}$	Correlation coefficient	Calculated F	Tabular F	Regression equation
Yearling	1,005	1.21	116.4	.61	587.88	3.84	$Y = 105.72 + 8.77X$
Adult	343	2.41	141.9	.37	55.33	3.84	$Y = 128.06 + 5.74X$
All Ages	1,570	1.31	117.5	.68	1,359.9	3.84	$Y = 101.66 + 12.10X$

Table 60. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of ovaries having three or eleven corpora albicantia (body length contour is covariable for yearlings and adults)

Ovaries having three corpora albicantia

Age	n=	Mean ovary length	Variance	Standard deviation	Mean ovary size (L x W)	Variance	Standard deviation
Kits	3	14.0	0	0	107.3	21.778	4.67
Yearlings	199	15.9	.01956	.14	163.2	8.5046	2.92
Adults	26	16.7	.30193	.55	177.4	76.805	8.76
All Ages	228	15.9	.01921	.14	164.1	7.7205	2.78

Ovaries having 11 corpora albicantia

Age	n=	Mean ovary length	Variance	Standard deviation	Mean ovary size (L x W)	Variance	Standard deviation
Kits	0	---	---	---	---	---	---
Yearlings	0	---	---	---	---	---	---
Adults	14	20.3	.6034	.78	288.8	266.12	16.3
All Ages	14	20.3	.6034	.78	288.8	266.12	16.3

Table 61. Alaska lynx sample, Nov. 1964 - Oct. 1965: Regression of cornu length on number of placental scars (body length contour is covariable)

Age	n=	$\overline{X}$	$\overline{Y}$	Correlation coefficient	Calculated F	Tabular F	Regression equation
Yearlings	1,005	1.21	116.4	.60	572.74	3.84	Y = 105.98 + 8.56X
Adults	343	2.41	141.9	.36	50.70	3.84	Y = 128.76 + 5.44X
All Ages	1,570	1.31	117.5	.68	1,328.07	3.84	Y = 101.88 + 11.93X

Table 62. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation of corpora albicantia per animal by area

Area	n=	Average number of corpora albicantia	Variance	Standard deviation	Percent with corpora albicantia
Kits					
Glennallen	72	0	---	---	---
McGrath	0	---	---	---	---
Unit 11	2	0	---	---	---
Rampart-Manley	8	.750	.5625	.75	12.5
Tok-Delta	15	0	---	---	---
Upper Yukon R.	5	0	---	---	---
Fairbanks Area	14	.214	.0459	.21	7.1
All Areas	117	.077	.0033	.06	1.7
Yearlings					
Glennallen	130	5.21	.0477	.22	91.5
McGrath	4	5.75	.5625	.75	100
Unit 11	0	---	---	---	---

Table 62. (Continued)

Area	n=	Average number of corpora albicantia	Variance	Standard deviation	Percent with corpora albicantia
Rampart-Manley	62	3.81	.0671	.26	85.5
Tok-Delta	148	3.86	.0388	.20	81.8
Upper Yukon R.	58	4.36	.1638	.41	81.0
Fairbanks Area	183	4.04	.0285	.17	83.1
All Areas	590	4.27	.0103	.10	84.7
Adults					
Glennallen	66	13.5	.9558	.98	97.0
McGrath	2	16.5	30.250	5.50	100
Unit 11	2	14.0	81.000	9.00	100
Rampart-Manley	23	13.1	2.3040	1.52	95.7
Tok-Delta	42	13.5	.7343	.86	100
Upper Yukon R.	50	9.78	.5790	.76	96.0
Fairbanks Area	33	13.6	1.2198	1.10	100
All Areas	218	12.6	.2117	.46	97.7

Table 62. (Continued)

Area	n=	Average number of corpora albicantia	Variance	Standard deviation	Percent with corpora albicantia
All Ages					
Glennallen	268	5.85	.1579	.40	68.3
McGrath	6	9.33	7.3778	2.72	100
Unit 11	4	7.00	29.833	5.46	50.0
Rampart-Manley	93	5.84	.3650	.60	81.7
Tok-Delta	205	5.55	.1347	.37	79.5
Upper Yukon R.	113	6.57	.2350	.49	84.1
Fairbanks Area	230	5.17	.0979	.31	80.9
All Areas	925	5.71	.0340	.18	77.3

in Area 6 had considerably more corpora albicantia per animal than did the animals from any other area except Area 11. The samples from Areas 11 and 12 were not large enough to be treated statistically with confidence. All other areas have large enough samples to be statistically treated. The larger number of corpora albicantia per animal in Area 6 did not hold for the adult class which clearly shows that the pattern of reproduction was changing and might be related to the snowshoe hare population density since hare population is the most obvious factor that is different south and north of the Range.

Initiation of Breeding

Females were taken during the trapping season which ended March 31 and during the period April 1 to May 21, 1965. Females taken from March 22 to May 21 were checked for corpora lutea. No corpora lutea were recorded before May 1, and corpora lutea were recorded in only two out of the 11 lynx taken during the period from May 1 to May 21 (Table 63). Because these animals probably have induced ovulation as does the house cat (Zuckerman 1962), the presence of corpora lutea was taken as an indication of breeding. This indicates that the Alaska lynx breeds a few weeks later than the Newfoundland lynx (Saunders 1961).

Enlarged ovaries and follicle development were first apparent in very late March and early April. This development was interpreted as the earliest indication of the commencement of reproductive activity.

Food Habits

Even though the food habits of lynx were not a part of this study, the stomachs of most of the lynx autopsied were opened to ascertain the

Table 63. Alaska lynx sample, Nov. 1964 - Oct. 1965: Compilation and analysis of corpora lutea over time

Time period	Age	Total females	Unbred females	Bred females	Percent bred
Mar. 22-31					
	Kit	7	7	0	0
	Yearling	15	15	0	0
	Adult	22	22	0	0
	All Ages	44	44	0	0
Apr. 1-10					
	Kit	0	--	--	--
	Yearling	4	4	0	0
	Adult	1	1	0	0
	All Ages	5	5	0	0
Apr. 11-20					
	Kit	2	2	0	0
	Yearling	4	4	0	0
	Adult	1	1	0	0
	All Ages	7	7	0	0
Apr. 21-30					
	Kit	0	--	--	--
	Yearling	7	7	0	0
	Adult	2	2	0	0
	All Ages	9	9	0	0
May 1-10					
	Kit	0	--	--	--
	Yearling	5	4	1	20.0
	Adult	1	1	0	0
	All Ages	6	5	1	16.7
May 11-21					
	Kit	0	--	--	--
	Yearling	4	3	1	25.0
	Adult	1	1	0	0
	All Ages	5	4	1	20.0

contents, if any. There were snowshoe hare remains in 142 stomachs, and 732 were empty. Five had other remains such as moose meat, birds, and fish. Because this collection was made mainly during the winter months and almost entirely by trapping, this sample does not constitute a representative picture of lynx food habits. The data are presented here only to indicate the almost complete dependence of lynx on snowshoe hare in winter in Alaska.

DISCUSSION

Saunders (1961) reports lynx data taken in Newfoundland from four years of an ascending population. He drew two conclusions that do not appear to hold true for Alaska lynx. He believes that the lynx in Newfoundland first bear young on about their second birthday. Of 566 yearling female lynx from Alaska that I analyzed, 301 of them (53%) had placental scars, a condition I judged to be a positive indication of having born a litter. The development of the legbones and the skulls clearly separated these animals from the kits. The further development of the legbones was used as a means of separating them from the adults. Corroberation of this method was given by the tooth sections which did not show an annual ring for most of the animals placed in the yearling class on the basis of legbone development. The tooth sections did show at least one annual ring for the majority of the adult class (Figure 2).

Saunders states that the Newfoundland lynx may only breed in alternate years. This does not seem to be true for Alaska lynx. Of 209 adult females examined, 192 (95%) had placental scars which was taken as an indication of having born a litter in the spring of 1964. If they were breeding in alternate years only half would show these scars. It could be that the scars are remaining for two years. It could also be that these lynx are showing a bi-annual synchrony of breeding. This last can be ruled out if the preceeding or succeeding year's data show the same high percentage of females with placental scars. The fact that the pattern of reproduction changes with the population level is possible and warrants further study. Perhaps the lynx are only breeding in alternate years under some conditions of population pressure and food abundance and are breeding every year under other conditions. It is interesting to note that Carl H. Nellis, Department of Wildlife Ecology, University of Wisconsin (Personal Communication 1970) collected a sample of 50 lynx from central Alberta, and he states that apparently there were three years when no young lynx were added to the population.

Litter size is another variable influencing population that may vary with the population pressures inherent in the cyclic nature of these animals.

The fact that I collected six female lynx in Alaska during the time of the year when they should have been carrying young and none of them subsequently gave birth to young may indicate that these animals do not reproduce at a constant annual rate throughout the population cycle.

Smirnov (1967) states that the factor which maintains the population of the polar fox on an almost constant level is the mortality of young during the early life period. These data indicate that an entirely different mechanism of population control may be operating on the Alaska lynx. It appears as if it may be the reproduction rather than the mortality of young that is used to keep the population in balance with food conditions.

A clearly different rate of reproduction can be seen in the females taken south of the Alaska Range and those taken north of it. The percentage of lynx breeding was higher in those animals taken south of the Range where the snowshoe hare population had stayed high for one year longer than it had to the north of the Range.

The specimens are now available, and a continuing collection of carcasses is being made so that a study of much larger scope can be made to determine the pattern of change of reproduction during the complete cycle of the lynx population.

The age structure of the harvest should be studied to see how it varies from year to year. The number of animals bearing young and the number of young produced per litter should be examined for each year of a cycle. These are factors which might be fluctuating with population pressures and food abundance in order to keep the lynx population within the limits of its resources.

Further studies and analyses need only be based on two areas. One would be that area north of the Alaska Range which includes all but the Glennallen and Unit 11 Areas, and the other would include only those two areas. These are the only areas where in the past a difference could be seen in the timing of the rise and fall of the snowshoe hare population. There are always some small pockets of habitat that maintain a high hare density a little longer than the rest of an area, but, taking the complete area as a whole, these pockets can have very little effect on the reproductive patterns of the lynx population.

Age determination seems to be the key to accurate work with lynx specimens in the future. The small discrepency between the legbone development method and the tooth section method points out the need for resolution in this area. The tooth section method seems to be the most promising, even though the first annual ring is not evident until after the second year of life.

Nellis (op. cit.) does not have any known-age material, but he has tagged and recovered five lynx which were over a year old when tagged. His conclusion is that a detectable annulus is not formed in the lynx canine until the second winter of its life. This corroborates the tooth section readings taken on this sample of Alaska lynx. Perhaps future samples can be separated into age classes on the basis of legbone and skull development for the kits and on the basis of tooth sectioning for the rest of the age classes.

This needs to be substantiated in the very near future by some work done with known-age lynx. No one I know of at this time has any known-age material. It is the next very important building block with which to continue to construct the pattern of lynx reproduction and population fluctuation.

APPENDIX

Computer punch card format and code

Card #1

Column	Variable	Code	Missing Data
1 & 2	Year (This is part of the accession number and does not indicate the year taken.)	65 in all cases	
3-6	Number	Actual number from 6001 up	
7	Species	L for lynx in all cases	
8	Sex	1 = male 2 = female 3 = unknown	
9	Age	1 = kit 2 = yearling 3 = young subadult 4 = old subadult 5 = adult 6 = unknown	
10 & 11	Month	01 = January, etc.	
12 & 13	Day	01 = the first, etc. 31 = the thirty-first	
14 & 15	Year	64 = 1964, etc.	
16 & 17	Area	01 = Murphy Dome 02 = Nenana Hwy. 03 = Tok area 04 = Delta area 05 = Eielson AFB 06 = Glennallen 07 = Circle-Central 08 = Ft. Yukon-Birch Creek	

Column	Variable	Code	Missing Data
16 & 17	Area (Continued)	09 = Fairbanks area 10 = Healy area 11 = McGrath area 12 = Unit 11 13 = Tanana Flats-Dry Crk.-Wood R. 14 = Eagle area 15 = Unknown 16 = Rampart-Manley	
18 & 19	Unskinned weight in pounds		
20 & 21	Skinned weight in pounds		
22 & 23	Hind foot length in cm.		
24 & 25	Tail length in cm.		
26 & 27	Height at shoulder in cm.		
28 & 29	Heart girth in cm.		
30 & 31	Body length straight in cm.		
32 & 33	Body length contour in cm.		
34, 35 & 36	Skull greatest length in cm.		
37, 38 & 39	Skull basilar length in mm.		
40, 41 & 42	Skull zygomatic breadth in mm.		
43 & 44	Skull temporal ridge width in mm.		
45 & 46	Skull braincase width in mm.		
47,48 & 49	Humerus length in mm.		
53 & 54	Length of testes one in mm.		
55 & 56	Width of testes one in mgm.		
57-60	Weight of testes one in mgm.		
61 & 62	Volume of testes one in ml.		
63 & 64	Length of testes two in mm.		
65 & 66	Width of testes two in mm.		

Column	Variable	Code	Missing Data
67-70	Weight of testes two in mgm.		
71 & 72	Volume of testes two in ml.		
73	Stomach contents	1 = hare 2 = empty 3 = other	
74	Ulna proximal	1 = not fused 2 = fused	
75	Radius proximal	1 = not fused 2 = fused	
76	Ulna distal	1 = not fused 2 = fused	
77	Radius distal	1 = not fused 2 = fused	
78	Card number	1 = card one	
79	Blank		
80	Blank		

Card #2 - A few animals will not have a card two.

1-17	Identical to card one
18 & 19	Canine lumen length in tenths of mm. There is a decimal point implied but not punched between 18 & 19.
20 & 21	Canine lumen width in tenths of mm. There is a decimal point implied but not punched between 20 & 21.
22 & 23	Canine outside width in tenths of mm. There is a decimal point implied but not punched between 22 & 23.
24 & 25	Canine outside thickness in tenths of mm. There is a decimal point implied but not punched between 24 & 25.
26 & 27	Tooth rings - the number of visible rings in canine. Missing data not punched. No rings punched as 00. One ring punched 01, etc.

Column	Variable	Code	Missing Data
38	Fetuses - number in cornu one.		Missing data punched 9.
29	Fetuses - number in cornu two.		Missing data punched 9.
30 & 31	Placental scars - number in cornu one.		Missing data punched 99.
32 & 33	Placental scars - number in cornu two.		Missing data punched 99.
34,35& 36	Length of cornu one in mm.		
37,38 & 39	Length of cornu two in mm.		
40 & 41	Length of ovary one in mm.		
42 & 43	Width of ovary one in mm.		
44 & 45	Length of ovary two in mm.		
46 & 47	Width of ovary two in mm.		
48 & 49	Corpora albicantia number in ovary one.		Missing data punched 99.
50 & 51	Corpora albicantia number in ovary two.		Missing data punched 99.
52 & 53	Corpora lutea number in ovary one.		Missing data punched 99.
54 & 55	Corpora lutea number in ovary two.		Missing data punched 99.
56 & 57	Greatest width of first corpora albicantia in tenths of mm. <u>Decimal point implied but not punched between these two columns and all following measurements of corpora albicantia</u>.		
58 & 59	Greatest width of second corpora albicantia in tenths of mm.		
60 & 61	" " " third " " " " " "		
62 & 63	" " " fourth " " " " " "		
64 & 65	" " " fifth " " " " " "		

Column	Variable	Code	Missing Data
66 & 67	Greatest width of sixth corpora albicantia in tenths of mm.		
68 & 69	" " " seventh " " " " " "		
70 & 71	" " " eighth " " " " " "		
72 & 73	" " " ninth " " " " " "		
74 & 75	" " " tenth " " " " " "		
76 & 77	" " " eleventh " " " " " "		
78	Card number	2 = card two	
79	Blank		
80	Blank		

Card #3 - Most animals will not have a card three.

1-17	Identical to card one and card two. Now continuation of corpora albicantia measurements in ovary one.		
18 & 19	Greatest width of twelfth corpora albicantia in tenths of mm.		
20 & 21	" " " 13th " " " " " "		
22 & 23	" " " 14th " " " " " "		
24 & 25	" " " 15th " " " " " "		
26 & 27	" " " 16th " " " " " "		
28 & 29	" " " 17th " " " " " "		
30 & 31	" " " 18th " " " " " "		
32 & 33	" " " 19th " " " " " "		
34 & 35	" " " 20th " " " " " "		
36 & 37	" " " 21st " " " " " "		
38 & 39	" " " 22nd " " " " " "		

Column	Variable	Code	Missing Data
	Now we shift to corpora albicantia measurements in ovary two. These were taken in the same manner.		
40 & 41	Greatest width of first corpora albicantia in tenths of mm.		
42 & 43	" " " second " " " " " "		
44 & 45	" " " third " " " " " "		
46 & 47	" " " fourth " " " " " "		
48 & 49	" " " fifth " " " " " "		
50 & 51	" " " sixth " " " " " "		
52 & 53	" " " seventh " " " " " "		
54 & 55	" " " eighth " " " " " "		
56 & 57	" " " ninth " " " " " "		
58 & 59	" " " 10th " " " " " "		
60 & 61	" " " 11th " " " " " "		
62 & 63	" " " 12th " " " " " "		
64 & 65	" " " 13th " " " " " "		
66 & 67	" " " 14th " " " " " "		
68 & 69	" " " 15th " " " " " "		
70 & 71	" " " 16th " " " " " "		
72 & 73	" " " 17th " " " " " "		
74 & 75	" " " 18th " " " " " "		
76 & 77	" " " 19th " " " " " "		
	There was a decimal point implied but not punched between each two columns of corpora albicantia measurements because they are in tenths of mm.		
78	Card number	3 = card three	
79	Blank		
80	Blank		

Printout of all data in punchcard format

```
656001L250713640922  2112513876851201080912355                                   1
656002L1107100640918     0420192536                                              1
656003L2211040401  10221146357100123104    3157                              2   1
656004L2511000401  172110493672031201000572355                               2   1
656005L2211045404  10  1041347000          33                                2   1
656006L2210076403417  25104739727 7        24                                2   1
656007L2207190403910  23114235707 0        2557                              1   1
656008L2211100401     231043377185                                               1
656009L3509095404                  1321080911658                                 1
656010L1202100408                  1331110922257                                 1
656011L1211040604  17240951357284                                           11   1
656012L2211070401  162209483665701221020873156                              11   1
656013L2211160401  162209443471791221020862757                              11   1
656014L1211030404  152407453466791221040872757                              11   1
656015L2211170404  1720  513375791251060862358                              11   1
656016L2211130404  14191042327178                                           11   1
656017L2211136401  132108383372751170960833156                              11   1
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