ALASKA DEPARTMENT OF FISH AND GAME

JUNEAU, ALASKA

STATE OF ALASKA
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DEPARTMENT OF FISH AND GAME
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WOLF STUDIES

by

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Volume IX
Eighteen Months Project Report
Federal Aid in Wildlife Restoration
Project W-15-R-2 and 3, Work Plan O

(Printed July, 1968)

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WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE:	Alaska		
PROJECT NO.:	W-15-R-2 & 3	TITLE:	Big Game Investigations
WORK PLAN:	O	TITLE:	Wolf and Wolverine
JOBS:	1 (W-15-R-2) 1 & 3 (W-15-R-3)	TITLE:	Wolf Studies
PERIOD COVERED:	July 1, 1966 to June 30, 1967		(W-15-R-2)
	July 1, 1967 to December 31, 1967		(W-15-R-3)

ABSTRACT

Approximately 1,850 wolves were killed and presented for bounty during fiscal year 1967. This represents the largest kill of wolves in recent years. The large kill resulted from near ideal conditions for aerial hunting and a reasonably large increase in the number of wolves in the arctic regions (Units 23, 24 and 26). Wolf populations throughout Alaska are abundant, though intensively utilized in Interior Alaska.

The large kill resulted in a considerable collection of specimens: 520 carcasses and 1,248 leg bones (radii and ulnae). The information on reproduction follows the patterns previously described in last years segment report (W-15-R-1 and 2) with the exception of the material from the arctic. For the first time it appears litter sizes from this area are larger than those from the rest of the state, thereby reversing a trend. The samples, however, are small.

Food habits based on the analysis of stomach and colon contents from approximately 1,300 wolves collected statewide from 1959 through 1967 show that big game is clearly the most important food for wolves. The species used depends upon regional availability.

The chronology of the kill shows most (70%) of the wolves are killed during a four month period--December, January, February and March--when the pelts are of maximum value.

The Game Management Unit 13 (Nelchina basin) study of wolves inaugurated in 1957 is evaluated. Wolves increased slowly and reached a peak of abundance in 1965. Illegal hunting, egress and possibly poor survival of pups in 1967 resulted in a much reduced wolf population in 1967. During the ten year period when wolves were protected there were no detectable reductions in numbers of big game, moose, caribou, sheep and goats, that could be attributed solely to predation by wolves.

The greatest long term value of the study may have been to create an awareness amongst the public of the need to properly manage wolves.

RECOMMENDATIONS

1. The carcass collections should be discontinued for the time being.

2. Analysis of age composition based on the ossification of the epiphyses of long bones should be continued.

3. Wolves in Units 13 and 14 should not be hunted with the aid of aircraft until after annual censuses reveal surpluses exist.

4. Aircraft hunting of wolves should be on a quota basis throughout the state. No operator should be allowed more than 10 wolves per calendar year.

5. Wolf research should concentrate on summer food habits, ecology of den sites, and wolf population identities.

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-15-R-2 and 3 TITLE: Big Game Investigations

WORK PLAN: 0 TITLE: Wolf and Wolverine

JOBS: 1 (W-15-R-2) TITLE: Wolf Studies
1 & 3 (W-15-R-3)

PERIOD COVERED: July 1, 1966 to June 30, 1967 (W-15-R-2)
July 1, 1967 to December 31, 1967 (W-15-R-3)

OBJECTIVES

To determine wolf population levels and factors influencing these levels including initial productivity, population composition, survival, and population identity. To obtain information on the physical characteristics of animals killed by wolves. To assess food habits of wolves during spring and summer on selected ranges. To assess den site selection in relationship to the availability of prey species.

TECHNIQUES

Wolf carcasses were obtained from bounty hunters, trappers, and sport hunters. Standard measurements, weights, stomach and colon contents, skeletal parts useful in developing age determination techniques and reproductive organs are collected from each carcass. The radius and ulna of all wolves presented for bounty are collected as the degree of ossification of the epiphysis to the diaphysis provides a separation of young-of-the-year from adults.

Information on the size of wolf packs was obtained from aerial observations made by Department employees and from information obtained from bounty information sheets completed by individuals bountying wolves. A summary of wolf specimen and bounty data is presented in Tables 1, 2, 3, 4, and 5.

Characteristics of prey selection were obtained by landing at kill sites and collecting samples from the dead animals.

Several known age wolves were obtained from Arctic Aero Medical Laboratories, Fort Wainright, Alaska, and the Arctic Research Laboratories, Office of Naval Research, Barrow.

Table 1. Age composition of 5,405 wolves, based on the fusion of the epiphysis to the diaphysis of radius and ulna, 1959-1967.

Year	Adults		Pups		Totals
	Number	Percent	Number	Percent	
1959-60	195	(63)	116	(37)	321
1960-61	209	(53)	183	(47)	392
1961-62	311	(61)	200	(39)	511
1962-63	351	(57)	263	(43)	614
1963-64	289	(55)	241	(45)	530
1964-65	305	(52)	284	(48)	589
1965-66	671	(55)	542	(45)	1,213
1966-67	724	(58)	521	(42)	1,245
TOTALS	3,055	(56.5)	2,350	(43.5)	5,405

Table 2. Sex and age ratios of 1,245 wolves killed in 1967; based on the epiphysis ossification technique.

	Pup					Adult				
Unit	♂	♀	Unknown	Total	% Pup	♂	♀	Unknown	Total	% Adult
1-5	5	2	5	12	30	9	8	11	28	70
9	1	0	0	1	20	3	1	0	4	80
11	15	14	10	39	61	6	12	7	25	39
12	8	4	1	13	37	11	9	2	22	63
13	8	5	6	19	63	7	1	3	11	37
14	6	6	1	13	52	4	4	4	12	48
16	7	5	0	12	43	10	6	0	16	57
17	2	1	0	3	50	1	2	0	3	50
19	17	14	2	33	33	37	29	2	68	67
19-21							1		1	
20	96	49	15	160	44	107	72	23	202	56
21	16	10	11	37	32	26	15	36	77	68
22	6	3	0	9	50	5	2	2	9	50
23	11	3	19	33	38	5	7	41	53	62
24	26	38	7	71	39	61	40	10	111	61
25	12	4	6	22	37	20	10	7	37	63
26	18	6	14	38	51	17	11	8	36	49
Unk.	1	2	3	6	40	1	1	7	9	60
All Units				521	42				724	58

Table 3. Sex and age ratios of 520 wolves killed in 1967; based on carcass examination.

	PUP					ADULT				
Unit	♂	♀	Unknown	Total	% Pup	♂	♀	Unknown	Total	% Adult
1-5	14	13	4	31	48	17	14	2	33	52
11	9	2	0	11	65	1	5	0	6	35
12	4	0	0	4	80	1	0	0	1	20
13	0	3	0	3	100	0	0	0	0	0
14	0	0	0	0	0	0	1	0	1	100
19	14	11	0	25	40	22	14	1	37	60
19-21	5	4	0	9	31	6	14	0	20	69
20	45	32	3	70	41	47	47	5	99	59
21	14	17	0	31	32	38	28	0	66	68
22	1	0	0	1	33.3	2	0	0	2	66.6
23	5	0	0	5	29	7	5	0	12	71
24	4	9	3	16	52	7	7	1	15	48
25	0	0	0	0	0	5	1	0	6	100
26	0	0	0	0	0	3	2	0	5	100
Unkn.	0	0	0	0	0	1	1	0	2	100
Brewer @ Barrow	2	2	0	4	44	3	2	0	5	56
All Units				210	40				310	60

Table 4. Age ratios of 234 female wolf carcasses collected during 1967.

Unit	♀ Pup	% Pup	♀ Adult*	% Adult
1-5	7	44	9	56
11	2	33.3	4	66.6
13	3	100	0	0
14	1	100	0	0
19	10	38	16	62
19-21	4	22	14	78
20	32	39	50	61
21	16	36	29	64
23	1	25	3	75
24	8	47	9	53
25	2	66.6	1	33.3
26	3	23	10	77
TOTAL	89	38%	145	62%

*Adult here refers to all female wolves older than 1 year.

Table 5. - Statewide Wolf Bounty Analysis, 1959-1960.

Game Mgt. Unit	Class of Hunter: 1. Professional 2. Incidental 3. Recreational 4. Unknown				Sex*			Color					Method of Take: 1. Ground Shooting 2. Trapping 3. Snaring 4. Digging Out 5. Aerial Shoot 6. Unknown							Total Wolves Taken
	(1)	(2)	(3)	(4)	♂	♀	Unk	BL	BR	GR	W	Unk	(1)	(2)	(3)	(4)	(5)	(6)	(1-2)	
Unk			3				3			3			3							3
19				1			1					1						1		1
20	9	3	12		2	9	13	5	2	9		8	9		5	2		8		24
21	4	5		2	5	4	2	5		2		4	2	4	1			4		11
23	18						18	5		12		1	18							18
24	4			1			5		1	2		2	1	1				3		5
25	26	4		2	8	5	19	5		10		17	4	4	1			23		32
26	63	14	35	5	12	17	88	21		80	2	14	20	7		7	67	16		117
TOTAL	124	26	50	11	27	35	149	41	3	118	2	47	57	16	7	9	67	55		211

*Sex identifications based on skins presented for bounty are not considered accurate.

Table 5. (Cont.) - Statewide Wolf Bounty Analysis, 1960-1961.

Game Mgt. Unit	Class of Hunter: 1. Professional 2. Incidental 3. Recreational 4. Unknown				Sex			Color					Method of Take: 1. Ground Shooting 2. Trapping 3. Snaring 4. Digging Out 5. Aerial Shoot 6. Unknown							Total Wolves Taken
	(1)	(2)	(3)	(4)	♂	♀	Unk	BL	BR	GR	W	Unk	(1)	(2)	(3)	(4)	(5)	(6)	(1-2)	
12		1				1		1					1							1
19		1				1				1			1							1
20	35	11	2	1	21	13	15	9	3	36		1	11	22	13		1	2		49
21	9	4		1	4	3	7	2	2	7		3	7	2				5		14
23	17	2		1	7	12	1	2		18			4				15	1		20
24	44	3			9	5	33	15	7	23		2	25	7	1		7	7		47
25	49	7	2	4	15	14	33	17	5	31	3	6	21	25			6	10		62
26	60	1		2	15	14	34	9	7	44		3	26	11			25	1		63
TOTAL	214	30	4	9	71	63	123	55	24	160	3	15	96	67	14		54	26		257

Table 5 (Cont.) - Statewide Wolf Bounty Analysis, 1961-1962.

Game Mgt. Unit	Class of Hunter: 1. Professional 2. Incidental 3. Recreational 4. Unknown				Sex			Color					Method of Take: 1. Ground Shooting 2. Trapping 3. Snaring 4. Digging Out 5. Aerial Shoot 6. Unknown							Total Wolves Taken
	(1)	(2)	(3)	(4)	♂	♀	Unk	BL	BR	GR	W	Unk	(1)	(2)	(3)	(4)	(5)	(6)	(1-2)	
Unk	15				7	4	4	10		5							15			15
1	46	15	6		31	27	9	20	23	9		15	6	57			1	2	1	67
2	10	1	1		1	9	2	1	9			2	1	9				2		12
3	15	3			8	9	1	10	4	4			3	15						18
9		4			4			4					3	1						4
11	8				7	1		1		6	1			2			6			8
12	5	3			4	3	1	2		6					2	5			1	8
18	2				1	1				2			2							2
19	9	2	1		6	5	1	6	1	5			6		2		3	1		12
20	75	14		1	46	32	12	19	6	64		1	30	27	9	5	18	1		90
21	70	2		3	44	27	4	30	2	40	3		16	3	6		47	3		75
23	66	2	1	2	42	20	9	9	2	58		2	13	2	1		52	3		71
23& 24	84						84					84					84			84
24	11	1			8	2	2	2		10			9				3			12
25	69	8	3	2	27	27	28	14	2	59		7	40	18	8	6		10		82
26	45				19	8	18	7	1	36	1		22	8	1	2	2	10		45
TOTAL	530	55	12	8	255	175	175	135	50	304	5	111	151	142	29	18	231	32	2	605

Table 5. (Cont.) - Statewide Wolf Bounty Analysis, 1962-1963.

Game Mgt. Unit	Class of Hunter: 1. Professional 2. Incidental 3. Recreational 4. Unknown				Sex			Color					Method of Take: 1. Ground Shooting 2. Trapping 3. Snaring 4. Digging Out 5. Aerial Shoot 6. Unknown							Total Wolves Taken
	(1)	(2)	(3)	(4)	♂	♀	Unk	BL	BR	GR	W	Unk	(1)	(2)	(3)	(4)	(5)	(6)	(1-2)	
Unk	3	1			1	3		2		2			1	3						4
1	9	10		4	13	10		11	4	8			7	11				5		23
2	21	22			21	18	4	1	26	10		6	23	20						43
3	24	2			12	14		6	4	16			5	21						26
9	2	6	1		5	4		4	2	3			3	1			4	1		9
11	18		3		10	9	2	5		15		1	3	12			6			21
12	21	5			13	13		5		21			7	4	1		12	1	1	
14		1	2		3				2	1				2				1		3
16	2	1	2		3	2		1		4			1				4			5
17	10	5			8	7		5			10						15			15
18	1	1			1	1		1		1			1				1			2
19	26		8		23	11		14	1	19			6	7	3		17	1		34
20	64	12	19		41	41	13	17	3	75			28	22	40		3	2		95
21	110	5	15	2	58	46	28	50	2	63		17	18	9	4		101			132
22	4	2			5	1		3		3			6							6
23	15	4	4		11	3	9	8	1	9		5	3	2	3	5	10			23
24	79	5	1		47	34	4	20	2	54	1	8	16	5			64			85
25	50	20	14	2	46	20	20	33	2	50		1	35	24	8	3	1	15		86
26	20	11	6		22	6	9	4		33			28				3	4	2	37
TOTAL	479	113	75	8	343	243	89	190	49	387	11	38	191	143	59	8	241	30	3	675

Table 5. (Cont.) - Statewide Wolf Bounty Analysis, 1963-1964.

Game Mgt. Unit	Class of Hunter: 1. Professional 2. Incidental 3. Recreational 4. Unknown				Sex			Color					Method of Take: 1. Ground Shooting 2. Trapping 3. Snaring 4. Digging Out 5. Aerial Shoot 6. Unknown							Total Wolves Taken
	(1)	(2)	(3)	(4)	♂	♀	Unk	BL	BR	GR	W	Unk	(1)	(2)	(3)	(4)	(5)	(6)	(1-2)	
1	20	16			12	24		9	8	17		2	11	24				1		36
2	31	22			29	21	3	4	28	15		6	16	24				6	7	53
3	25	12			15	21	1	5	2	30			15	20	1			1		37
5		1				1		1					1							1
6		1			1			1						1						1
9	9	6	1		11	5		3	2	11			10		1		4	1		16
11	15	9			13	11		8	1	13	1	1	1	11			9	3		24
12	15	1	1		14	3		4		13			6	9	1		1			17
14	5	2		1	4	4				7		1	3		5					8
16	16	2	2	1	15	6		6		11		4	3	3			14	1		21
17	14				9	5		6		8							14			14
19	47	6			27	24	2	9		44			9	4	1		37	1	1	55
20	168	33	28	8	124	101	12	70	3	160	1	3	49	82	94		9	3		237
21	23	11	1	8	23	15	5	16	2	23		2	11	9	2		20	1		43
23	26	13	1	1	27	13	1	13	1	27			14	12			13	2		41
24	8	4			7	3	2	3		8		1	3	3	2		2	2		12
25	43	1	2	4	23	14	13	13	1	35	1		11	17	7		7	8		50
26	43		5	1	36	9	4	15		34			21	11			17			49
TOTAL	508	140	41	24	390	280	43	186	48	456	3	20	184	230	114		147	30	8	713

Table 5 (Cont.) - Statewide Wolf Bounty Analysis, 1964-1965.

Game Mgt. Unit	Class of Hunter: 1. Professional 2. Incidental 3. Recreational 4. Unknown				Sex			Color					Method of Take: 1. Ground Shooting 2. Trapping 3. Snaring 4. Digging Out 5. Aerial Shoot 6. Unknown							Total Wolves Taken
	(1)	(2)	(3)	(4)	♂	♀	Unk	BL	BR	GR	W	Unk	(1)	(2)	(3)	(4)	(5)	(6)	(1-2)	
Unk	1		2				3			1		2	1					2		3
1	25	8	3		25	10	1	9	4	23			17	19						36
2	37	20			31	18	8	6	18	16		17	26	31						57
3	15	9	2	1	15	12		4	4	18		1	14	12				1		27
5		4			3	1				4			4							4
6	1				1			1						1						1
9	16	17	11		19	19	6	1	3	37	3		25	5	6		8			44
11	19	4	6	1	13	17		11		19			7	14	1		8			30
12	13	6	5		19	4	1	10		14			8	4	5		6		1	24
14	5	2	4		6	5		2	1	8			9	2						11
16	14	9	14		22	15		14	5	17		1	13				24			37
17		1			1					1			1							1
19	19		37	1	12	8	37	22	1	33	1		39	4			14			57
20	167	24	74	2	158	98	11	81	4	180		2	66	58	76		60	7		267
21	20	2	10	1	12	9	12	12	1	16	1	3	22	7	1		1	2		33
22		1	2	1	1	2	1	2		2			1				2	1		4
23	16	8	6	5	26	8	1	8		27			10	15			7	3		35
24	34	10	1		28	12	5	17	1	25		2	39	4	1			1		45
25	24	1			5	6	14	15		10			6	2		8		9		25
26	47		10	2	29	18	12	10		46	3		12	9			19	19		59
TOTAL	473	126	187	14	426	262	112	225	42	497	8	28	320	187	90	8	149	45	1	800

Table 5. (Cont.) - Statewide Wolf Bounty Analysis, 1965-1966 (through June 1, 1966).

Game Mgt. Unit	Class of Hunter: 1. Professional 2. Incidental 3. Recreational 4. Unknown				Sex			Color					Method of Take: 1. Ground Shooting 2. Trapping 3. Snaring 4. Digging Out 5. Aerial Shoot 6. Unknown							Total Wolves Taken
	(1)	(2)	(3)	(4)	♂	♀	Unk	BL	BR	GR	W	Unk	(1)	(2)	(3)	(4)	(5)	(6)	(1-2)	
Unk		1				1			1				1							1
1	9	5		3	10	7		4	6	6		1	13	3			1			17
2	23	26	1		30	19	1	8	28	14			28	21				1		50
3	33	17	1	1	27	25		15	5	32			21	29				2		52
5	5	1	1		4	3		2		5			2				5			7
6		4	1		4	1				5			1				4			5
9	25	2		2	20	7		3	6	18			6	12			7	2		27
11	70	4	42	1	64	53		50		67			9	10	5		92	1		117
12	17	23	5	2	25	22		17	4	25		1	21	13	4		6	3		47
13	56	6	2		43	20	1	32	2	26		4	62	2						64
14	7	6	6		9	6	4	7		12			5	2	2		10			19
16	61	3	20		47	37		28		46	1	9	6	4			74			84
17	15	3			10	8		6		12							18			18
19	105		5		58	50	2	21		26		63	10	2	1		93	4		110
20	98	33	125	6	143	109	10	65	4	169	1	23	44	121	18		71	8		262
21	184	2		1	106	73	8	34	1	77	1	74	8	12	2		155	10		187
22	7	2	2		9	2		5		6			11							11
23	24	13	10		31	11	5	8		38	1		9	2			35	1		47
24	64	1	2		33	22	12	12		47	1	7	23	2	1		38	3		67
25	54		5		29	18	12	18	4	34	1	2	14	10	5	10	9	11		59
26	39		2		17	9	15	6	1	31	1	2	9				6	26		41
TOTAL	894	152	230	16	719	530	70	341	62	696	8	185	303	245	38	10	624	72		1,292

Table 5. (Cont) Statewide Wolf Bounty Analysis, 1966-67.

Game Mgt. Unit	Class of Hunter: 1. Professional 2. Incidental 3. Recreational 4. Unknown				Sex			Color					Method of Take: 1. Ground Shooting 2. Trapping 3. Snaring 4. Digging Out 5. Aerial Shoot 6. Unknown							Total Wolves Taken
	(1)	(2)	(3)	(4)			Unk	BL	BR	GR	W	Unk	(1)	(2)	(3)	(4)	(5)	(6)	(1-2)	
1	7	11	6		12	10	2	5	7	12			9	14	1					24
2	28	28	8	2	25	34	7	3	30	22			20	40	1			1		66
3	31	8	1		25	15		8	2	28			15	19	6					40
5		2	1		1	2				2			2	1						3
9	32	8	11		29	22		5		43			18				33			51
11	58	2	10		36	34		20	3	47			5	9			56			70
12	10	1	27		22	13	3	14	3	21			3	8	3		24			38
13	15	5	10	1	20	11		16		15			4	26				1		31
14	15	6	9		15	15		9		10			8	3	4		14	1		30
16	36				20	16		13	1	22			1				35			36
17	25	1			9	16	1	13		12	1		12	1			13			26
18	1					1				1			1							1
19	141	4	1	1	81	65	1	46	1	92	1		52	3	3		77	12		147
20	254	16	89	7	185	150	31	92	3	262			37	84	63		173	9		366
21	180	2	7		104	80	5	73		113	1		93	1	3		88	4		189
22	15				6	7	2	9		5			7	3			3	2		15
23	141	3	16	4	96	62	6	52	1	106	2		91	4			63	6		164
24	214	2		3	126	89	4	36		78			18	6	1		157	37		219
25	38	1	15	5	27	23	9	26		31			6	7	2		30	14		59
26	80	17	4	1	54	21	27	27	10	65			45	4		4	23	26		102
Unit Unknown	2					2				2							2			2
TOTALS	1323	117	215	24	893	688	98	467	61	989	5		306	233	87	4	967	82		1679

The wolf population of the Nelchina Basin Study area, Game Management Unit 13, and the northern portion of 14, and the adjoining portions of Game Management Unit 11, was censused twice. Once concurrent to the moose sex and age composition counts and the second time in December when wolves were the sole object of the work. All past records were consulted in an effort to summarize the status of the Nelchina wolf study.

Work on Job 3 (W-15-R-3) was not activated during this report period, but it will be inaugurated in May of 1968.

FINDINGS

Harvest

The annual kill of wolves increased during the 1966-67 recording year. Approximately 1,850 wolves were presented for bounty during this period as compared to approximately 1,300 during the preceding fiscal year. Professional bounty hunters took 79 percent of the harvest in 1966-67 and only 69 percent in 1965-66. Twenty-seven professional aerial hunters took in excess of 50 percent of the reported harvest. Both years were exceptional in that the second and third greatest recorded snowfall occurred in Interior Alaska (Unit 20, Fairbanks area). Conditions for individuals hunting from aircraft were nearly ideal. Units 19, 20, and 21 contributed nearly 40 percent of the total kill; this is similar to recent past years. The kill in the Arctic (Units 23, 24 and 26) rose sharply reflecting an increasing population of wolves. Other indices corroborate this increase (see Productivity).

The kill in Unit 20 rose nearly 40 percent. This reflects the ideal hunting conditions, an abundant population of wolves, and increased hunting from aircraft. This Unit has annually produced in excess of 200 wolves since 1963-64. It seems unlikely that this high rate of exploitation can be sustained for many years.

Productivity

A comprehensive review of wolf population status as measured by various indices to productivity was published in 1967 (Rausch 1967). Since there is only one year's additional information to present at this time, only the highlights are discussed.

The age ratios of the harvest presented in Tables 2 and 3 show some interesting and perhaps significant data. For example, in the Southcentral Region (Units 11, 12, 13, 14) 57 percent of a sample of 180 legbones and carcasses were pups. In the Interior Region, there was an interesting contrast between contiguous Units 19 and 21 and 20. Survival of pups in the former appeared poor, 35 percent, whereas in the latter, pups comprised 44 percent of the sample of 362 legbones. Unit 26 of the Arctic Region also exhibited high survival of pups.

If adequate samples can be obtained, smaller geographic areas probably should be analyzed separately. Lumping of the Game Management Units into larger wolf study regions may mask local fluctuations of considerable magnitude and importance.

The populations of wolves in Game Management Units 13, 11, and 14 seem to be functioning quite separate from Unit 20, at least as far as survival of pups is concerned. The question of egress from Unit 13 into Unit 20 has been a most controversial item. Preliminary information here suggests such movement, if it occurs, was not of consequence in 1966-67. Of course, tagging and labeling of live animals followed by subsequent recapture is the only satisfactory means of proving population identity, but age composition of the various populations may provide important clues for planning more detailed studies.

The carcass collection program provided 520 new specimens for autopsy. Collections were excellent from Interior and Southeast Alaska but disappointing from the Southcentral and Arctic regions where some of the most interesting population changes are taking place.

The data are presented in Tables 5, 6, 7, and 8, and Figure 1. The trend in the Arctic is most interesting. Prior to this sample, there was some indication, though slight, that female wolves in the Arctic produced fewer ova. The small sample for 1966-67 does not fit this pattern.

Chronology of Recent Harvests of Wolves

The chronology of the harvest of wolves during fiscal years 1966 and 1967 is presented in Tables 9, 10, and 11. The total kill figures in the chronologies are somewhat lower than the total obtained from the bounty affidavits because some individuals failed to complete bounty information forms. Chronology data is available on 1,208 wolves killed in FY 1966 and 1,688 wolves killed in FY 1967. I believe the information accurately portrays the recent harvests.

At present most (70%) of the harvest is during December, January, February, and March, a period when pelts are of maximum value.

Climatological factors, principally snow depth and quality affect the timing of the harvest. In FY 1966 and 1967 snowfall was unusually heavy in Interior Alaska and conditions were very good for aerial hunting, which accounted for 50 percent $\pm$ of the kill. The timing of the kill can be expected to change if weather patterns vary significantly.

Wolf Foods

A summary of the stomach and colon contents of wolves autopsied since 1959 is presented in Tables 13 and 14. The information is grouped to represent three major geographical regions of Alaska that support a somewhat different fauna: Southeast, Interior, and Arctic Alaska. Foods

Table 6. Indicators of Productivity in Adult Wolves, Alaska, 1957-1967.

	Corpora albicantia			Placental scars			Corpora lutea			Fetuses		
	No.	No. Animals	Ave.	No.	No. Animals	Ave.	No.	No. Animals	Ave.	No.	No. Animals	Ave.
Southeast	104	14	7.4	81	15	5.4	6	1				
Southcentral	112	18	6.2	78	12	6.5	32	5	6.4	8	1	
Interior	1400	190	7.4	464	71	6.5	517	77	6.7	141	21	6.7
Arctic	229	32	7.1	93	14	6.6	159	22	7.2	86	13	6.6
Totals	1845	254	7.3	716	112	6.4	714	105	6.8	235	35	6.7

Table 7. Indicators of Productivity in Adult Wolves, Alaska, 1967.

	Corpora albicantia			Placental scars			Corpora lutea			Fetuses		
	No.	No. Animals	Ave.	No.	No. Animals	Ave.	No.	No. Animals	Ave.	No.	No. Animals	Ave.
Southeast	7	7	3.5	11	2	5.5	6	1	6.0			
Southcentral	14	2	7.0	4	1	4.0	7	1	7.0			
Interior	433	62	7.0	143	26	5.5	136	21	6.4	22	3	7.3
Arctic	96	11	8.7	24	4	6.0	59	7	8.6	38	5	7.6
Totals	550	77	7.1	182	33	5.5	208	30	6.9	60	8	7.5

Table 8. Indicators of productivity in two-year-old wolves, Alaska, 1957-1967.

Area	Non-breeders	Corpora lutea			Fetuses		
	Number	No.	Animals	Ave.	No.	Animals	Ave.
Southeast	20	22	4	5.5	6	1	--
Southcentral	16	12	3	4.0	10	2	5.0
Interior	107	300	51	5.9	50	9	5.5
Arctic	17	75	13	5.8	26	5	5.2
Totals	160	409	71	5.8	92	17	5.4

Table 9. Indicators of productivity in two-year-old wolves, Alaska, 1967.

Area	Non-preg*	Corpora lutea			Fetuses		
	Number	No.	Animals	Ave.	No.	Animals	Ave.
Southeast	5	11	2	5.5	6	1	--
Southcentral	2	--	-	---	-	-	--
Interior	36	62	9	6.8	5	1	--
Arctic	5	13	2	6.5	12	2	6.0
Totals	48	86	13	6.6	23	4	5.7

* This includes 2 year old wolves taken prior to March; hence prior to when they normally breed.

FIGURE 1. PROGRESSION OF PREGNANCY OF ALASKAN WOLVES

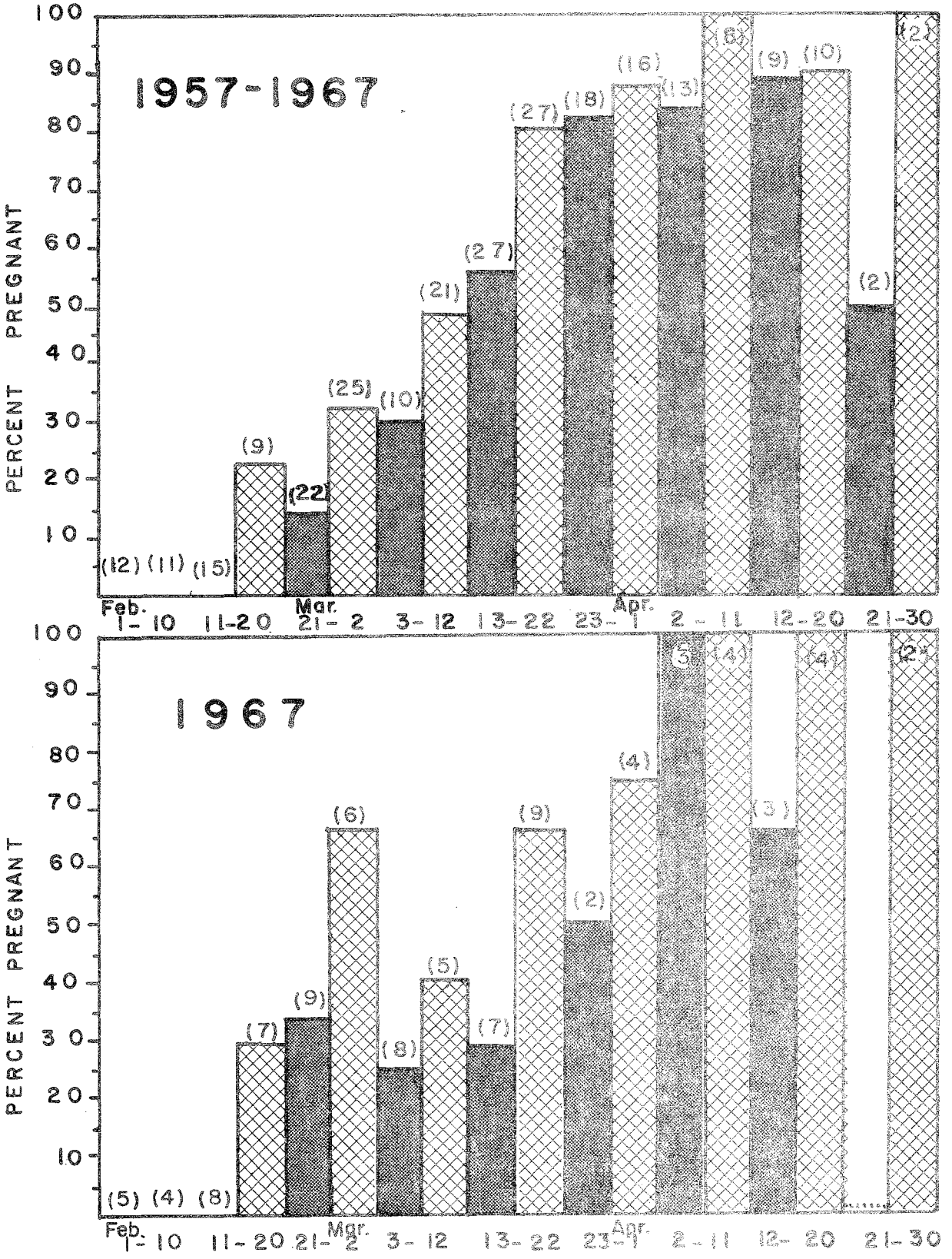


Table 10. The chronology and method of kill of wolves by Game Management Unit, Alaska, 1967.

Game Management Unit	Month	Method of Take: 1. Ground Shooting 2. Trapping 3. Snaring 4. Digging Out 5. Aerial Shooting 6. Unknown						Total
		1	2	3	4	5	6	
1	Sept.	2						2
	Dec.	1						1
	Jan.		4					4
	Feb.	1	3	1				5
	March		7					7
	May	2						2
	Unknown						3	3
		6	14	1			3	24 Total
2	Aug.	2						2
	Oct.	1						1
	Nov.	4						4
	Dec.	5	9				1	15
	Jan.	3	9					12
	Feb.	3	7	1				11
	March	1	3					4
	April		11					11
	May	1						1
	Unknown						5	5
		20	39	1			6	66 Total
3	Nov.	3	5					8
	Dec.	5	1					6
	Jan.		3	1				4
	Feb.	3	5	1				9
	March		2					2
	April	3	2	4				9
	Unknown						6	6
		14	18	6			6	44 Total
5	Nov.		1					1
	Jan.	1						1
	March	1						1
		2	1					3 Total

Table 10. The chronology and method of kill of wolves by Game Management Unit, Alaska, 1967 (Continued).

Unit	Month	Method of Take 1	2	3	4	5	6	Total
9	Sept.	3						3
	Nov.	2				4		6
	Dec.	4				9		13
	Jan.	9						9
	Feb.					16		16
	March					4		4
		18				33		51 Total
11	Sept.	1				1		2
	Oct.					1		1
	Nov.	1	4					5
	Dec.		1			5		6
	Jan.		4			11		15
	Feb.	1				19		20
	March	1				17		18
	April	1				2		3
		5	9			56		70 Total
12	Sept.	1						1
	Nov.	1	2					3
	Dec.		2	1		9		12
	Jan.	1	2	1				4
	Feb.			1				1
	March		2			15		17
		3	8	3		24		38 Total
13	Sept.	1						1
	Nov.	3	9					12
	Dec.		7					7
	Jan.		10					10
	May		1					1
		4	27					31 Total
14	Aug.		1					1
	Nov.	1					1	2
	Dec.			3				3
	Jan.	2				1		3
	Feb.		2			11		13
	March	4				1		5
	April			1				1
	May					1		1
	Unknown						1	1
		7	3	4		14	2	30 Total

Table 10. The chronology and method of kill of wolves by Game Management Unit, Alaska, 1967 (Continued)

Unit	Month	Method of Take 1	2	3	4	5	6	Total
16	Nov.	1				1		2
	Dec.					6		6
	Jan.					12		12
	Feb.					7		7
	March					7		7
	Unknown						2	2
		1				33	2	36 Total
17	Dec.		1					1
	Jan.	3						3
	March	9				13		22
		12	1			13		26 Total
18	March	1						1
		1						1 Total
19	Nov	7		3		6	1	17
	Dec.	10	3			8	11	32
	Jan.	9				3		12
	Feb.	1				48		49
	March	*24				2		26
	April	1				10		11
		52	3	3		77	12	147 Total
20	July	1						1
	August	1						1
	Sept.	2		1				3
	Oct.		3					3
	Nov.	4	30	2		26	4	66
	Dec.	2	22	9		61	1	95
	Jan.	1	14	11		22	3	51
	Feb.	1	5	2		18		26
	March	11	5	3	4	17		40
	April	2				12		14
	May	2						2
	June	5						5
	Unknown			25			34	59
		32	79	53	4	156	42	366 Total

Table 10. The chronology and method of kill of wolves by Game Management Unit, Alaska, 1967 (Continued)

Unit	Month	Method of Take 1	2	3	4	5	6	Total
21	Aug.						1	1
	Sept.	1						1
	Oct.						1	1
	Nov.	1					1	2
	Dec.	1	1	1				3
	Jan.	6				26	1	33
	Feb.	*40				34		74
	March	*40		1		28		69
	April	4		1				5
		93	1	3		88	4	189 Total
22	Sept.						1	1
	Nov.	2					1	3
	Dec.	3	2					5
	Jan.		1					1
	Feb.					1		1
	March	2				2		4
		7	3			3	2	15 Total
23	Sept.	13					1	14
	Nov.	3						3
	Dec.	*16	2					18
	Jan.	*24				5		29
	Feb.	*20		2		5		27
	March	*12				28	2	42
	April	2				19		21
	May					2		2
	Unknown						9	9
		90	2	2		59	12	165 Total
24	Sept.	2						2
	Nov.		2	1			4	7
	Dec.	5	1			2	1	9
	Jan.	1				36		37
	Feb.		2			89		91
	March		1			25		26
	April	1				5		6
	Unknown						44	44
		9	6	1		157	49	222 Total

Table 10. The chronology and method of kill of wolves by Game Management Unit, Alaska, 1967 (Continued)

Unit	Month	Method of Take 1	2	3	4	5	6	Total
25	Oct.	3						3
	Nov.	2	1				4	7
	Dec.		3	1			2	6
	Jan.			1				1
	Feb.					6		6
	March		3			19		22
	April	1				5	4	10
	Unknown						4	4
		6	7	2		30	14	59 Total
26	Oct.	2					1	3
	Nov.	1					11	12
	Dec.						2	2
	Jan.		1				1	2
	Feb.	1	1					2
	March	*16	1			7		24
	April	*21				16		37
	May		1					1
	June	2					3	5
	Unknown						15	15
		43	4			23	35	103 Total
Unknown							2	2
							2	2 Total
	Total	425	225	79	4	766	189	1688

* Shot from the ground with the aid of aircraft.

Table 11. The statewide chronology and method of kill, wolves, Alaska, 1967.

Month	Ground Shooting	Trapping	Snaring	Dig Out	Aerial Shooting	Unknown	Total	Percent
July	1						1	.05
August	3	1				1	5	.07
September	26		1		1	2	30	1.80
Oct.	6	3			1	2	12	.90
November	36	54	6		37	27	160	9.50
December	52	55	15		100	18	240	14.40
January	60	48	14		116	5	243	14.80
February	71	25	8		254		358	21.20
March	122	24	4	4	185	2	341	20.20
April	36	13	6		69	4	128	7.60
May	5	2			3		10	.06
June	7					3	10	.06
Unknown			25			125	150	8.90
Total	*425	225	79	4	766	189	1688	98.54%

* Several hundred ground shot/aid of aircraft.

Table 12. The statewide chronology and method of kill, wolves, Alaska, 1966.

Month	# Wolves	%	Ground Shooting	Trapping	Snaring	Digging Out	Aerial Shooting	Unknown
July	24	2.0	14	2		5		3
August	25	2.1	22		1		2	
Sept.	48	4.0	45					3
Oct.	38	3.1	29	1			7	1
Nov.	172	14.2	45	62	19		30	16
Dec.	116	9.6	20	43	6		40	7
Jan.	170	14.1	13	42	10		91	14
Feb.	231	19.1	15	37			172	7
Mar.	197	16.3	26	43	5		111	12
Apr.	133	11.0	22	12			95	4
May	22	1.8	16				5	1
June	30	2.5	21			5		4
Unknown Month	2	0.2	2					
Totals	1208		290*	242	41	10	553	72
% of Total harvest			24.0	20.0	3.4	0.8	45.8**	6.0

* Includes those taken with the aid of aircraft.

** Over 50% if all wolves taken with aid of aircraft are included.

Table 13. Wolf foods based on examination of stomach contents, November - April, 1959-1967, Alaska. (Units 11, 12, 13, 16, 19, 20, 21, 25).

Method of Take	Total No. Stom.	Empty #	Empty %	Total No. Food Occ.	Moose #	Moose %	Caribou #	Caribou %	Sheep #	Sheep %	Hare #	Hare %	Wolf #	Wolf %	Trace #	Trace %	Items
Aerial Shooting	696	289	(41.5)	409	284	(69.4)	75	(18.3)	1	(.2)	14	(3.4)	5	(1.2)	3	(.7)	Beaver
															3	(.7)	Vegetation
															1	(.2)	Spruce
															3	(.7)	Cervid
															3	(.7)	Paper
															3	(.7)	Bird
															13	(3.2)	Unkn.
															2	(.5)	Debris
Ground Shooting	95	33	(34.7)	65	34	(52.3)	5	(7.7)	2	(3.1)	10	(15.4)	3	(4.6)	1	(1.5)	Sm. Mammal
															2	(3.1)	Vegetation
															1	(1.5)	Lynx
															3	(4.7)	Bird
															1	(1.5)	Fish
															2	(3.1)	Unkn.
															1	(1.5)	Debris
Trapping	238	113	(47.4)	132	45	(34.1)	34	(25.7)	--		17	(12.9)	1	(.8)	1	(.8)	Bird
															2	(1.6)	Vegetation
															1	(.8)	Hair
															1	(.8)	Porcupine
															1	(.8)	Cervid
															1	(.8)	Lynx
															1	(.8)	Beaver
															5	(3.8)	Unkn.
															21	(15.9)	Debris
															1	(.8)	Grouse

Table 13. Wolf foods based on examination of stomach contents, November - April, 1959-1967, Alaska (Units 11, 12, 13, 16, 19, 20, 21, 25), (continued).

Method of Take	Total No. Stom.	Empty #	Empty %	Total No. Food Occ.	Moose #	Moose %	Caribou #	Caribou %	Sheep #.	Sheep %	Hare #	Hare %	Wolf #	Wolf %	Trace #	Trace %	Items
Snaring	72	36	(50.0)	38	10	(26.3)	8	(21.1)	--		7	(18.4)	--		1	(2.6)	Salmon
															4	(10.5)	Salmon
															2	(5.3)	Vegetation
															2	(5.3)	Unkn.
															4	(10.5)	Debris
Unknown	27	12	(44.4)	15	2	(13.3)	5	(33.3)	1	(6.7)	6	(40.0)	--		1	(6.7)	Vegetation
All Methods	1128	483	(42.8)	659	375	(56.9)	127	(19.3)	4	(.6)	54	(8.2)	9	(1.4)	4	(.6)	Beaver
															10	(1.5)	Vegetation
															1	(.2)	Spruce
															4	(.6)	Cervid
															3	(.4)	Paper
															7	(1.0)	Unid. Bird
															5	(.7)	Unid. Fish
															1	(.2)	Sm. Mammal
															1	(.2)	Lynx
															1	(.2)	Porcupine
															1	(.2)	Salmon
															1	(.2)	Unid. Hair

Table 13. Wolf foods based on examination of stomach contents, November - April, 1959-196 , Alaska. (Arctic Coastal Units 18, 22, 23, 24, 26). (Continued)

Method of Take	Total No. Stom.	Empty #	Empty %	Total No. Food Occ.	Moose #	Moose %	Caribou #	Caribou %	Sheep #	Sheep %	Hare #	Hare %	Wolf #	Wolf %	Trace #	Trace %	Items
Aerial Shooting	48	12	25.0	36	13	36.1	20	55.6							1	2.7	Grouse
															2	5.6	Debris
Ground Shooting	17	7	41.2	12	2	16.7	8	66.7			1	8.3			1	8.3	Debris
Trapping	4	1	25.0	3			3	100.0									
Snaring	2	2	100.0														
Poison	10	0	0.0	10			10	100.0									
Unknown	5	3	60.0	4			2	50.0			1	25.0	1	25.0			
All Methods	86	25	29.0	65	15	23.1	43	66.1			2	3.1	1	1.5			
SOUTHEASTERN UNITS 1-5																	
Aerial Shooting	2	1	50.0	1											1	100.0	Cervid
Ground Shooting	1	1	100.0														
Trapping	28	11	39.3	17											3	17.6	Debris
															1	5.9	Seal foot
															12	70.6	Cervid
															1	5.9	Grass
All Methods	31	13	41.9	18											3	16.8	Debris
															13	72.2	Cervid
															1	5.5	Grass
															1	5.5	Seal

Table 14. Wolf food data 1959-62, Alaska.

Area	Method of Take	Total No. Stom.	Empty	Total No. Food Occ.	Moose	Caribou	Sheep	Hare	Grouse	Unkn.	Debris	Wolf	Other	Items
Interior Units 11, 12, 13, 14, 16, 19, 20, 21, 25	Aerial Shooting	73	29	44	30	11				1			1	Cloth-paper
													1	Grass
	Ground Shooting													
	Trapping	14	7	8	1	3		3	1					
	Snaring	6	2	5	1								3	Fish-uniden.
													1	Salmon
	Unknown	7	3	4	1	3								
All Methods		100	41	61	33	17		3	1	1			6	
Arctic Coastal Units 23, 26	Aerial Shooting	9	3	6	1	3			1	1				
	Snaring	1	1											
	Unknown	1		3		2						1		
All Methods		11	4	9	1	5			1	1		1		

Table 14. Wolf food data 1963-64, Alaska

Area	Method of Take	Total No. Stom.	Empty	Total No. Food Occ.	Moose	Caribou	Sheep	Hare	Grouse	Unkn.	Debris	Wolf	Other	Items
Interior Units 11, 12, 19, 20, 21	Aerial Shooting	6	3	3	1	1						1		
	Ground Shooting	12	4	8	4	1		1					1	Sm. Mammals
	Trapping	46	28	20	6	6		3		2		1	1	Hair
													1	Unid. bird
	Snaring	21	12	11	3	2		3	2				1	Fish
	Unknown	6	2	4		1		2					1	Vegetation
All Methods		91	49	46	14	11		9	2	2		2	6	
Arctic Coastal Units 23 & 26	Poison	10		10		10								
	Aerial Shooting	2		3	2	1								
All Methods		12		13	2	11								

Table 14. Wolf food data 1964-65, Alaska.

Area	Method of Take	Total No. Stom.	Empty	Total No. Food Occ.	Moose	Caribou	Sheep	Hare	Grouse	Unkn.	Debris	Wolf	Other	Items
Interior Units 11, 12, 13, 16, 19, 20, 21, 25	Aerial Shooting	91	35	56	47	6		1		1		1		
	Ground Shooting	13	10	4	1		1	1				1		
	Trapping	37	22	15	10	1				1	1		1	Lynx
													1	Beaver
	Snaring	21	14	7	4	1					2			
All Methods		163	82	82	62	8	1	2		2	3	2	2	
Arctic Coastal Units 23, 24	Snaring	1	1											
	Unknown	2	2											
All Methods		3	3											

Table 14. Wolf food data 1965-66, Alaska.

Area	Method of Take	Total No. Stom.	Empty	Total No. Food Occ.	Moose	Caribou	Sheep	Hare	Grouse	Unkn.	Debris	Wolf	Other Items
Interior Units 11, 12, 13, 19, 20, 21, 25	Aerial Shooting	221	89	133	101	14	6	4	2	2	2 2		Cervid bone Paper
	Ground Shooting	23	8	15	11		2				2		Bird
	Trapping	53	25	29	6	9	5		9				
	Snaring	11	3	8	1	3	2		2				
	Unknown	6	3	3			3						
All Methods		314	128	188	119	26	18	4	13	2	6		
Arctic Coastal Units 22, 23, 26	Aerial Shooting	2	2										
	Ground Shooting	6	4	2		1			1				
All Methods		8	6	2		1			1				

Table 14. Wolf food data 1966-67, Alaska.

Area	Method of Take	Total No. Stom.	Empty	Total No. Food Occ.	Moose	Caribou	Sheep	Hare	Grouse	Unkn.	Debris	Wolf	Other	Items
Interior Units 11, 12, 13, 14, 16, 17, 20, 21, 25	Aerial Shooting	276	120	157	94	41		6		7		1	1	deer
													3	beaver
													2	bird
													2	grass
	Ground Shooting	29	10	20	12	4	1	1					1	lynx
													1	bird
	Trapping	64	26	39	19	9		2			8		1	cervid
	Snaring	8	3	5	1	2	1	1						
	Unknown	5	3	2		1		1						
All Methods		382	162	223	126	57	2	11		7	8	1	11	
Arctic Coastal Units 22, 23, 26	Aerial Shooting	28	6	23	10	11			1	1				
	Ground Shooting	11	1	10	2	7		1						
	Trapping	4	1	3		3								
All Methods		43	8	36	12	21		1	1	1				

Table 14. Wolf food data 1966-67, Alaska, continued.

Area	Method of Take	Total No. Stom.	Empty	Total No. Food Occ.	Moose	Caribou	Sheep	Hare	Grouse	Unkn.	Debris	Wolf	Other Items
South-eastern 1, 5	Aerial Shooting	2	1	1								1	Cervid
	Ground Shooting	1	1										
	Trapping	28	11	17						3		1	Seal foot
												1	Grass
												12	Cervid
All Methods		31	13	18						3		15	

are further grouped to classes representative of the methods used to kill the wolves. Again, this was an attempt to measure the influence that various techniques of harvest might have on the validity of the food analysis.

Further subdivision by geographical area and by method of take is probably desirable. For example, wolves ground-shot in the Interior Alaska region contained a higher incidence of snowshoe hare than did those aerial-shot from the same region (Table 13). Since many of the wolves shot from the ground are taken incidentally to hunting and trapping operations in areas supporting dense brush, (ideal habitat for snowshoe hares) and aerial-shot wolves are often taken at or above timberline or on lakes or open muskegs (areas that do not support abundant hare populations), the influence of technique of kill becomes important to understanding the degree that a particular prey species is used.

Big game undoubtedly is the mainstay of the wolf diet during the fall, winter, and early spring. The utilization of small mammals, fish, and birds varies with their availability. In some locations salmon and snowshoe hare could be vital foods during the summer. Hares may be important during the winter, particularly when hares are at periodic highs.

Present investigations are designed to determine summer foods, especially during the denning period. A detailed consideration of wolf foods is being prepared for publication.

An Evaluation of Wolf Studies Conducted in Game Management Unit 13, 1957 through 1968

This evaluation of the Nelchina (Unit 13) wolf study is based upon the stated objectives of a study inaugurated by the U.S. Fish and Wildlife Service in 1957 (R.F. Scott, Memo to Regional Wildlife Administrator, 1956) and the objectives of the wolf studies conducted by the State of Alaska from 1960 to the present time. Objectives of the two programs overlap considerably but because of program changes after Statehood, notably a decreased emphasis upon formal predator control, there are some significant differences in stated objectives.

The Federal program was a statewide all encompassing program with the major emphasis on obtaining accurate statistics on predators and other forms of game from all personnel, evaluating the predator control program and gathering biological information on wolves. The Nelchina study area (Unit 13) was intended as a demonstration area.

The procedures listed under the three general objectives were very comprehensive and if carried out would have resulted in a comprehensive study of the interrelationships of wolves and their prey and the effects of various poisons on wolf population levels.

The States program of wolf study has been equally widespread but the objectives were designed to provide an understanding of the life history and dynamics of wolf populations under varying degrees of stress and to continue using the Nelchina study area as a demonstration area. Here, as elsewhere, the primary prey species, moose, caribou, and sheep, were the subject of concurrent studies designed to reveal their abundance, productivity, the magnitude of the harvest by hunters and their overall wellbeing.

The basic difference between the two studies is that the Federal portion of the work revolved around evaluating a predator control program whereas the continuing studies of the State were designed to establish parameters useful in managing both the wolf and the prey species.

Long term management objectives were not available to the individuals who designed either study, but I assume the State's management program is guided by the constitutional provision of maximum sustained yield.

This summary evaluation is comprised of six sections and it is based on data that were collected by biologists and cooperators from all walks of life over the past 15 years. The six sections follow: 1) the wolf population and its foods, 2) the moose population, 3) the caribou population, 4) the sheep population, 5) public opinion, 6) discussion and recommendations.

The Wolf Population

There are no estimates of wolf numbers in the Nelchina Basin prior to 1953, when Burkholder as quoted by (Atwell 1962) estimated that there were not more than twelve wolves remaining in the area (Figure 2). Subsequent estimates, at least until 1960 were also based upon his general observations and knowledge of the area. In 1961 and 1962 population estimates based upon census efforts suggest that the 1958 estimate was too high. Even in wolf populations that are increasing, short term fluctuations caused by unusual mortality to pups in a given year, may significantly reduce their numbers in any one year. This is particularly true of an animal such as the wolf that has a tremendous capacity to increase. Thus the observed variation between the 1958 estimate and the 1961 and 1962 censuses may represent real change rather than any inaccuracy in estimates or census techniques. Whatever caused the apparent fluctuations, it is not particularly important to the long term study. The important fact is that the population did increase rather slowly and reached a peak of abundance in 1965 (Figure 2).

In 1967, duplicate surveys suggested a considerable reduction in wolf numbers (Figure 2). The cause of reduction can be related to two or three happenings, 1) changes in migration patterns of Nelchina caribou, 2) illegal aerial hunting in Game Management Unit 13, 3) apparent poor survival of pups during the summer of 1967.

1. In 1965, most of the Nelchina caribou moved into Game Management Units 11 and 12. Apparently large numbers of wolves accompanied them and many were killed by aerial hunters. The harvest of wolves in these units increased considerably concurrent to this egress of caribou (Table 15). Portions of the Nelchina caribou population continued these aberrant migration patterns in 1966 and 1967. The harvest of wolves in Unit 11 and 12 remained high though they have not equaled the 1965 harvest. This too suggests that wolves are not as readily available as demand for wolf pelts is good and bounty hunters are interested in hunting close to supply stations.

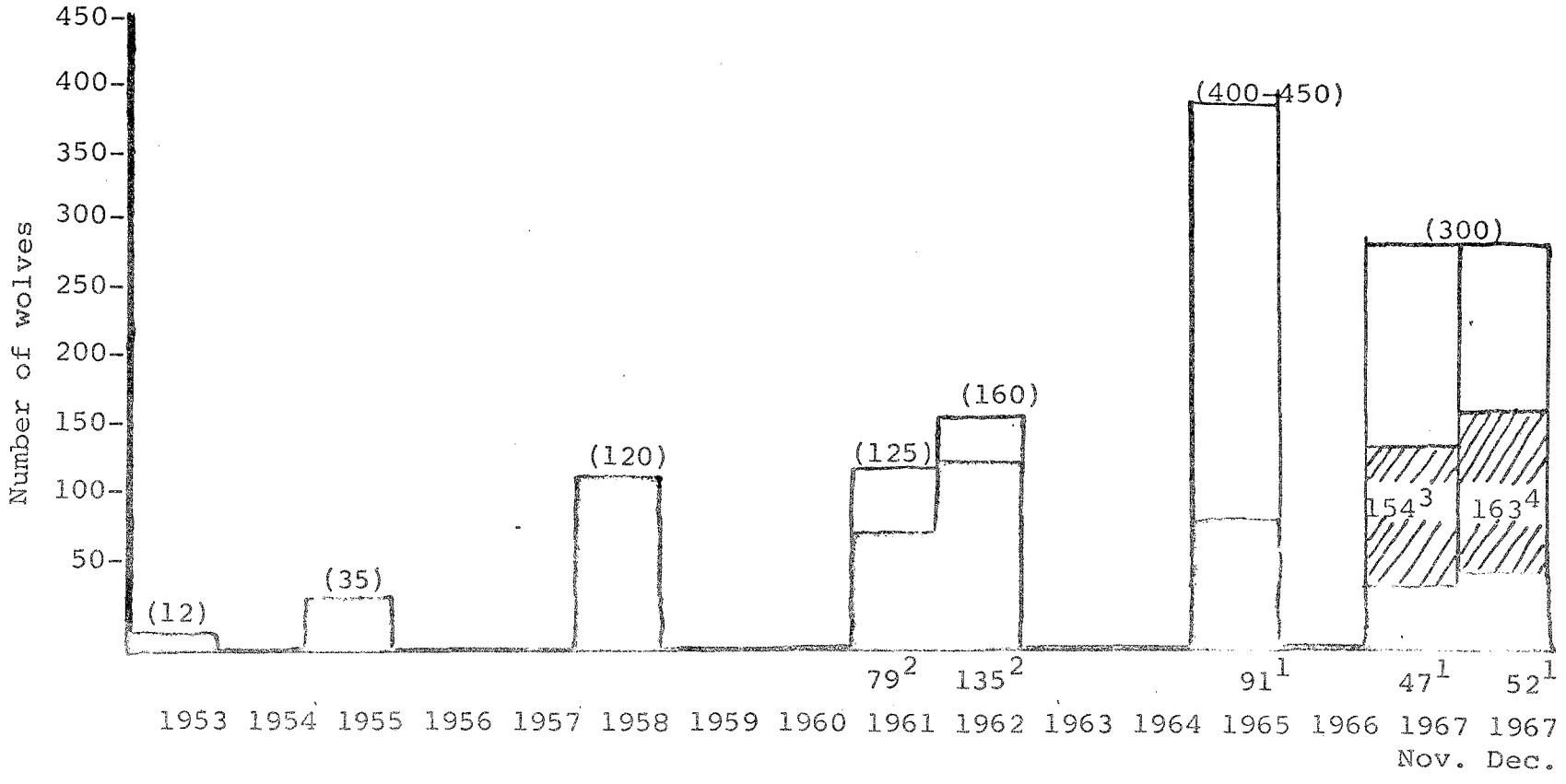
2. Illegal hunting, particularly in the northwest portion of the Unit 13 commenced on a large scale in 1965 and continued through 1966. The effort in 1965 was considerable and an estimated 64 wolves were taken.

3. If the 1965 population estimate was accurate then the combination of illegal hunting and egress with caribou should not have been sufficient to depress the population severely, as wolves have the capability of increasing by 50 to 60% each year if conditions are optimal for pup survival. In fact, pups comprised 60% of the wolves harvested in Unit 13 and adjoining areas in 1966. As mentioned earlier, high natural mortality to young-of-the-year in heavily exploited populations can precipitate a population failure similar to what occurred to the Nelchina wolf population.

Some information is already available from the 1967-68 hunting and trapping season and from the censuses. These data strongly suggest that few pups produced during the summer of 1967, survived to the fall. Within a few weeks confirmation or repudiation of this hypothesis will be available. Earlier work (Rausch, 1967) suggests that pack size is directly related to population density. The average pack size in the Nelchina is reduced from previous years.

At this time all indices and population parameters suggest a much reduced wolf population in the Nelchina Basin. The recent aerial hunt tends to corroborate indices used to project the population level as approximately 122 aerial hunters have reported harvesting only 69 wolves through April 3, 1968. Ground hunters and trappers killed another 26. Whatever the reasons for the population decline and in all probability no single factor was paramount the most discouraging aspect was the Department's total inability to enforce the regulation against aircraft hunting during 1965 and 1966. Somehow, this deficiency must be corrected if any of our big game populations are going to be managed appropriately.

Fig. 2. Wolf population estimates, 1953-1967, Unit 13, Alaska.



1. Individual wolves seen during census.
2. Wolves accounted for throughout the year.
3. 105 separate tracks, 9 instances where tracks could not be counted computed at 5 animals per pack, the average pack size in 1967.
4. Individual tracks seen.

( ) Maximum estimate.

Table 15. Harvest of wolves Units 11, 12, 13, 14.

Unit	Year 1962-63	1963-64	1964-65	1965-66	1966-67	1967-68
11	21	24	30	117	70	
12	26	17	24	47	38	
13				64*	31*	95**
14	3	8	11	19	30	

* Minimum estimates of illegal take based on interviews and bounty records of suspected violators.

** Known legal harvest reported through April 3, 1968; at least 20-25 wolves were taken illegally prior to the legal aerial hunt.

Wolf Foods

The basis for all problems between wolves and humans is the formers dietary habits. Wolves eat big game that men covet. Because the effects of this utilization of big game has never been adequately quantified, man has assumed the effects are largely undesirable. Slowly, ever so slowly, this broad proposition is being split into manageable questions that should eventually measure each situation in proper perspective.

At present we are still attempting to measure what wolves eat during the various seasons when they have a choice of foods as they do in Unit 13. A summary of foods found in the stomachs of 1,128 wolves killed in interior and south central Alaska from 1959 through 1967 is presented in Table 16.

These data show that moose is the most important food during the winter months. The information presented may not be representative of Unit 13 because the samples are heavily weighted with specimen material from Units 19, 20 and 21. Moose are more abundant than caribou in most portions of these units. The reverse is true in Unit 13. A partial listing of dead animals observed in Unit 13 from 1957 to 1968 reveals 71 moose, 61 caribou and 1 sheep. Most, but not all, of these animals were killed by wolves. Some undoubtedly had died of malnutrition. In 1962 examination of 45 dead animals suggested only 18 had been utilized by wolves. Of course, snow depths were tremendous in 1962 and a large number of moose perished. Carcasses of caribou and sheep disappear more rapidly than moose and therefore may be under represented in aerial observations of kills.

Moose are much larger than either caribou or sheep and therefore constitute more meals per animal. This fact may have influenced the stomach analysis data but it does not diminish the importance of moose in sustaining wolf populations.

Wolves do use a variety of foods even during the winter, including other wolves, but the overall importance of small mammals is not known. I assume that hares may be important food items during the summer months, especially during periods of abundance.

Studies conducted in Canada and on Isle Royale National Park show that beaver are used extensively in some situations. Marmot and ground squirrels, available only during summer months, may also be used.

Moose Populations

Records of the abundance of moose in the Nelchina Basin are not available prior to 1952 when the first aerial surveys were flown by the U.S. Fish and Wildlife Service, Bureau of River Basins. Interviews with long time residents suggest moose have been abundant in portions of the area for at least thirty to fifty years. Sex and age composition counts from a number of separate areas within the study unit have been

Table 16. Wolf foods based on examination of stomach contents, November - April, 1959-1967, Alaska.*

(Units 11, 12, 13, 16, 19, 20, 21, 25)

Method of Take	Total No. Stom.	Empty #	Empty %	Total No. Food Occ.	Moose #	Moose %	Caribou #	Caribou %	Sheep #	Sheep %	Hare #	Hare %	Grouse #	Grouse %	Unkn. #	Unkn. %	Debris #	Debris %	Wolf #	Wolf %
Aerial Shooting	696	289	(41.5)	409	284	(69.4)	75	(18.3)	1	(.2)	14	(3.4)			13	(3.2)	2	(.5)	5	(1.2)
Ground Shooting	95	33	(34.7)	65	34	(52.3)	5	(7.7)	2	(3.1)	10	(15.4)			2	(3.1)	1	(1.5)	3	(4.6)
Trapping	238	113	(47.4)	132	45	(34.1)	34	(25.7)			17	(12.9)	9	(1.8)	5	(3.8)	21	(15.9)	9	(1.8)
Snaring	72	36	(50.0)	38	10	(26.3)	8	(21.1)			7	(18.4)			2	(5.3)	4	(10.5)		
Unknown	27	12	(44.4)	15	2	(13.3)	5	(33.3)	1	(6.7)	6	(40.0)								
All Methods	1128	483	(42.8)	659	375	(56.9)	127	(19.3)	4	(.6)	54	(8.2)	1	(.2)	22	(3.3)	28	(4.2)	9	(1.4)

* Trace Items

#	%	
4	(.6)	Beaver
10	(1.5)	Vegetation
1	(.2)	Spruce
4	(.6)	Cervid
3	(.4)	Paper
7	(1.0)	Unident. Bird
5	(.7)	Unident. Fish (Salmon)
1	(.2)	Sm. Mammal
1	(.2)	Lynx
1	(.2)	Porcupine
1	(.2)	Salmon
1	(.2)	Unident. Hair

gathered every year since 1952. Sample sizes with the exception of 1959 have been adequate to reveal general trends in each year. More recent studies suggest that pooling of the information from all moose populations within the study unit may mask local variations that are significant to annual management decisions. But for the purposes of a general examination of the status of moose within this 20,000 to 30,000 square mile area I have assumed there is sufficient similarity in at least several of the basic parameters of population condition, calf survival and annual harvest of males, to use them to characterize herd status. Supplementary data such as pregnancy rates and age composition of the herd which are too detailed to present here, support this view for specific areas. Calf production is portrayed in Figure 3 and the annual harvest is shown in Table 17. There appears to be three peaks and troughs of calf survival to about 6 months that are not of equal amplitude. The extreme high production of 1953-54 cannot be adequately explained. Most of the counts were made on the central portion of Unit 13 where production of calves has been good for years. This may have biased the production figure for 1953-54. Similar population explosions of moose have been observed from time to time on a number of ranges in Alaska. Subsequent crashes in calf survival have invariably followed these highs, though the total population almost always remained high at least initially. Examples of such population explosions are the Alaska Peninsula, Koyukuk River, Middle Yukon-Tanana Valley and at present the Copper River Herd east of the Copper River, although there has been no crash as of yet in the latter example. The lowest estimates of calf survival, 1956, 1962 and 1965, all correspond with extremely severe winters, with 1962 being the most dramatic; at least we have the greatest amount of information concerning this die-off of moose. In 1966 and 1967, the calf crop was relatively good, particularly in those areas where hunters are killing a significant number of moose.

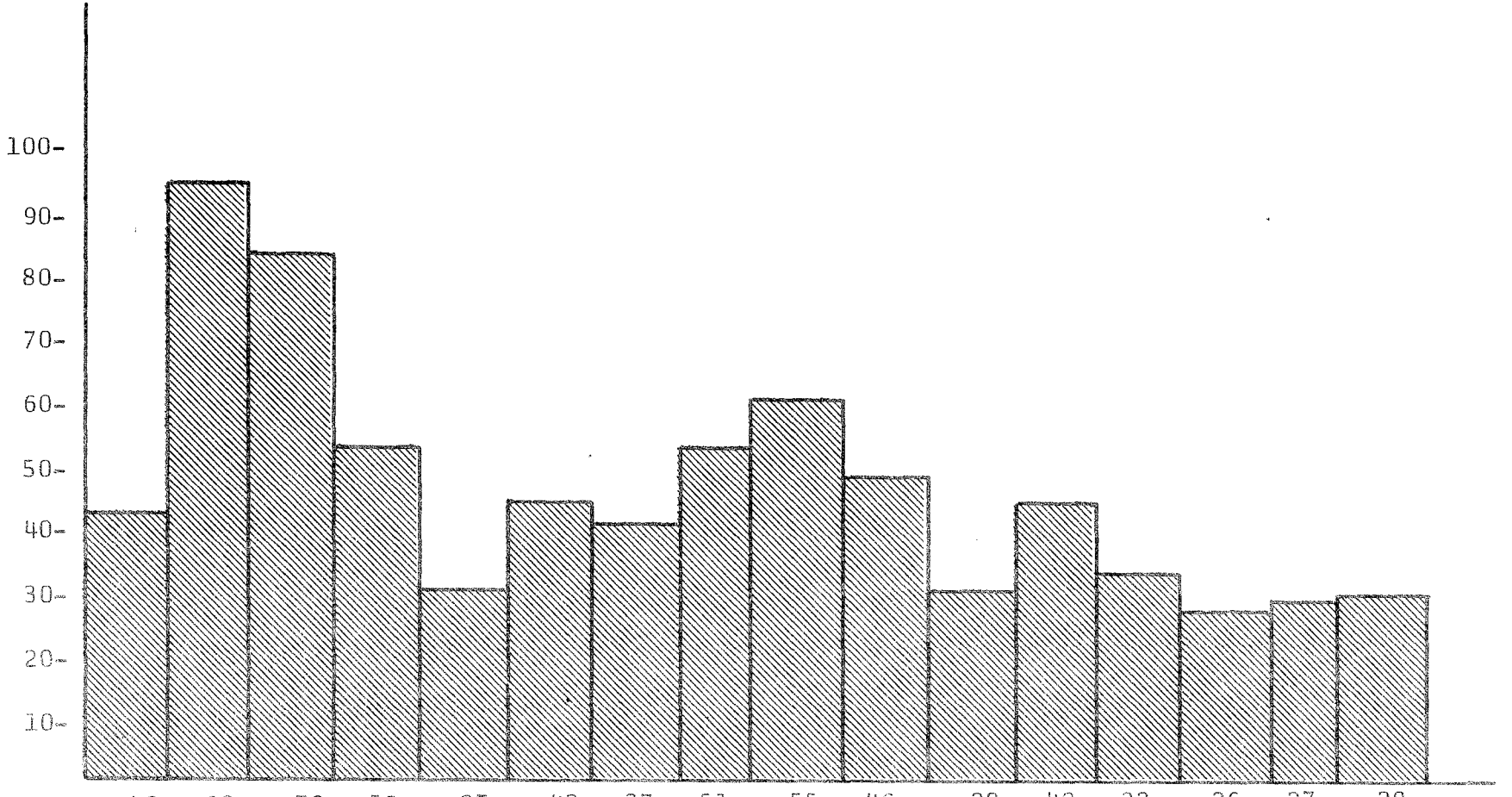
Table 17. Harvest of moose in Unit 13, 1963-1967

Year	Male	Female
1963	1,385	343
1964	1,213	394
1965	1,213	No season
1966	1,336	181
1967*	1,217	314

* Late season shortened by 10 days

Over the entire period of study wolves may have depressed local moose populations or held them at static levels, but it is extremely doubtful that they had a significant effect on the numbers of moose available to hunters, particularly in view of the fact that two of the lowest periods of calf survival, 1956 and 1962, occurred before wolves were truly abundant. The annual kill by hunters, another measure of the

Figure 3. Moose Calf Survival to Mid-Winter, Nelchina Basin, Unit 13, 1952-1967.



availability of moose, shows little fluctuation in annual harvests since harvest tickets were introduced in 1963 (Table 17). Hunting pressure is not increasing rapidly (see license sales and tag issuance projections, Table 18). About 4,000 hunters are using the Nelchina Basin for purposes of hunting moose and with the existing roads, lakes, rivers, and airfields, 1,200-1,400 male moose is about all these people will harvest.

In 1965, I estimated the total moose population within the area to be between 25,000 and 30,000. At present I see no reason to readjust this admittedly rough estimate. Approximately 6,000 moose were counted on annual sex and age composition surveys in 1965 and 1967 on selected portions of the area. In all probability the moose population will continue to fluctuate in abundance and the best correlation with population adjustments will be with the extremes of climate rather than influences of man or wolves. This prediction could change with the advent of more liberal seasons, or with construction of additional access.

The Caribou Population

Caribou in the Nelchina Basin and associated areas have been subjected to comprehensive studies since the late 1940's. Ron Skoog who did much of the work starting in the 50's believes the Nelchina Basin is a core area, one possessing all the attributes of good caribou range. The caribou story has been one of constant increase at least until 1965 when most of the animals left what traditionally was thought of as "The Nelchina Wintering Areas." By 1962 the population was estimated at about 70,000 plus or minus 18,000 based upon a random stratified census (Siniff & Skoog, 1964).

Harvests have been erratic (Table 19). Estimates of harvest have never exceeded 8,000 animals even with an August 10 to March 31 season and with a bag limit which has varied from two to four to three animals per hunter. The accessibility of animals to the roadside hunters apparently determines the magnitude of the kill. It should be noted that Skoog and others predicted that seasonal movements of the herd would become erratic as herd size increased. These predictions have been born out. In the spring of 1967, a census of the calving segment, primarily cows, using the traditional calving grounds suggested a post-calving population of 61,000 animals (Hemming, 1968). This estimate, however, did not include the animals around Mankomen Lake, Mentasta Pass, Mount Sanford, nor the unknown egress that took place into the Tetlin area and Nutzotin Mountains in 1965. Clearly a substantial population remains on the traditional areas at least part of the year and the populations in the surrounding areas have increased greatly either by egress from the Nelchina Herd or from natural increase of residual populations whose existence has been known for a number of years. The rapid increase probably resulted from both reasons.

The annual kill by humans mentioned earlier is greatly influenced by the proximity of the herd to the highway system. Increased harvests

Table 18. Hunting license sales by calendar year, 1959-1967**

Year	Resident Hunting	Nonresident Hunting	Subsistence (25¢)
1959	27,517		
1960	30,376		
1961	34,519		3,005
1962	34,609		2,925
1963	36,453	4,842	4,728
1964*	37,183	4,946	5,882
1965	37,667	6,288	5,048
1966	36,086	6,795	4,664
1967	35,182	7,717	4,354

*Fiscal year. Calendar year not available.
**Prepared by Oliver Burris, 1968.

Moose harvest ticket issuance & hunter participation, 1963-1967, Alaska

Year	Harvest ticket Issuance	Percent who Hunted
1963	32,412	82
1964	29,904	77
1965	32,824	
1966	31,549	77
1967	31,941	73

are dependent upon an increased number of hunters or better access. Competition between man and wolves for caribou has not occurred at this time. Calf crops are good and caribou abundant.

The Sheep Population

Studies of dall sheep in this area have been limited to an accurate assessment of harvest since 1962 and periodic aerial surveys since 1949. While hunting only three-quarter curl rams may have altered the sex composition of the population, wolves seem to have had little impact on total abundance of sheep. In the Southern Talkeetna Mountains, part of Unit 13 and adjoining 14, Scott, 1951, estimated a population of 626 sheep. In 1967, Nichols and Erickson counted 1,295 sheep on this range, (Nichols, 1968). The Watana Mountain sheep population which is near the center of the best wolf range in Unit 13 and which is isolated from other sheep range persisted throughout this study and 222 were counted in 1967. The harvest of 3/4 curl rams in unit 13, 11, and 20 has been remarkably stable over the past several years. The trends in harvest and hunter participation are shown in Figures 4 and 5 and Table 20.

While wolves undoubtedly use sheep, food habit studies based on observation of 1,128 stomachs (Table 16) suggest winter use of this food is proportionately low. Unusual winter conditions may change patterns of food usage (Murie 1944). The extent that wolves eat sheep during the summer has not been determined. This is one of the objectives of current studies on wolves. There is some evidence to suggest that wolves denning in alpine areas utilize lambs during the summer months, but the significance of their use to the welfare of a trophy species is conjectural, at best.

Public Opinion

Public opinion which has had, and continues to have, a considerable influence upon the management of wolf populations has changed considerably during the past 15 years. I believe the Unit 13 demonstration area has been a most effective instrument in helping bring about this change.

Exact measurements of intangibles like public opinion are impossible. Perhaps the spoken and written ideas of those individuals who are willing to be heard is our best gauge. If so, the change in attitude from the middle fifties to the late sixties is dramatic indeed.

I assess the present intense public interest in the management of wolves to mean a large number of people are interested in retaining wolf populations at levels of abundance that will not jeopardize their continued existence and will allow for sport hunting and trapping. Public opinion seems to be turning against wolf control involving non-selective means, i.e. poisons of all types, summer trapping, bounties, and unrestricted aerial hunting. The Department, however, must have some management tools at their disposal to affect management (control) of carnivore populations when their use of ungulates compete significantly with other human utilization or when such use jeopardizes the survival of a species.

Table 19. Caribou harvests, Nelchina herd*

1955	3,800
1956	
1957	3,500
1958	2,500
1959	4,000
1960	5,500
1961	8,000
1962	3,500
1963	6,300
1964	8,000
1965	7,100
1966	4,800
1967	4,000

*Harvest estimates based on check stations, guide interviews, and a general knowledge of hunting effort.

Table 20. Harvest of Dall sheep, Units 11, 13, 20, 1963-1967

Year	Unit 11	Unit 13	Unit 20
1963	131	132	157
1964	151	156	182
1965	131	143	165
1966	125	154	148
1967	149	152	132

Fig. 4. Number of hunters, kill of sheep, and percent of hunters successful, 1962 through 1967, Alaska, (from Nichols, 1968).

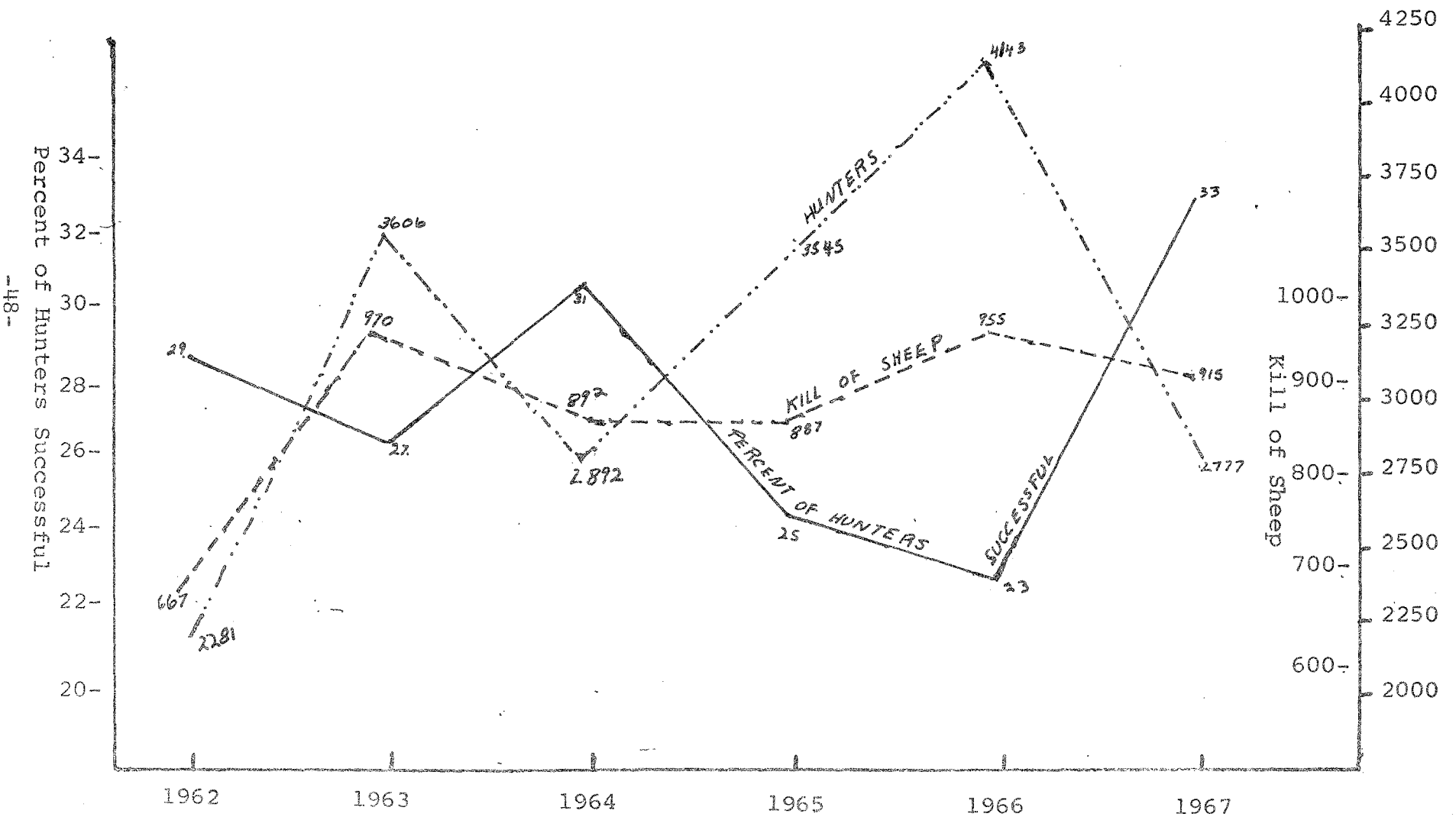


Fig. 5. Issue of sheep harvest tickets, 1962-1967, Alaska, (from Nichols, 1968).

In Interior and Arctic Alaska, public hunting from aircraft is the most efficient management tool. Some people enjoy it and the harvest results in direct economic benefits without jeopardizing wolf populations.

Summary and Recommendations

In Unit 13, during the period of 1953 to 1967, utilization of the wildlife resource undoubtedly increased. In fact, the area is probably the most important recreation area in Alaska. The only possible challenge would come from the Kenai Peninsula. Access to the area through road construction and improvement plus technical advances in design and construction of airplanes, tracked vehicles, and other off-the-road vehicles have contributed to this increased exploitation. More recently, the sales of hunting licenses and the distribution of moose harvest and sheep harvest tickets strongly suggest that interest in hunting by residents is decreasing. At least proportionately fewer people are participating in hunting.

Management of this complex of carnivores and ungulates must recognize changes in human attitudes as well as changes in the numbers of animals and their habitat. The Nelchina wolf population probably will be most beneficial to all interests if it is managed at a level where some sport hunting can be allowed each year. I suggest that to attain this goal there should be from 200 to 300 wolves in the fall population. Downward population adjustments of wolves might be advisable following exceptionally severe winters or other major catastrophies to ungulates such as disease. For example, brucellosis is prevalent in the Nelchina herd but at a low level. Under optimal conditions of stress or other unknown factors it could become a major decimating factor resulting in a much reduced survival of calves. Then serious thought might be given to reducing utilization by wolves and humans; however, there would be no assurance that intense exploitation might not be the "best cure".

Methods for utilizing the surplus wolves should include sport hunting and trapping. If surpluses exist by midwinter, I recommend recreational aerial hunting even though it is controversial. General aerial hunting without check in and check out procedures can only lead to severe management problems resulting from over utilization of the wolf resource. This may have occurred this year. The Nelchina Basin has so many lakes, ridges, rivers and other features where aircraft can land to retrieve wolf carcasses that such a reduction is inevitable and as mentioned before, it may have already occurred.

Exact relationships between wolves and their prey were not obtained from the study, that is, the physical condition of prey utilized has not been adequately characterized. A great deal of worthwhile information concerning the rate wolf populations may increase and their effect upon lightly hunted moose, caribou and sheep was obtained. I conclude that at the level of exploitation experienced, there was no significant conflict during the study between humans and wolves for utilization of the ungulate resource. Public attitudes toward wolves have changed during

the past 15 years and the Nelchina study may have been extremely important in this education effort. The public clearly wants a rational management of all game including carnivores. Furthermore, direct control of carnivores by the Department will probably be limited to aerial shooting or chemo-sterilants. The use of poisons, strychnine, 1080, or cyanide in Interior and Arctic Alaska, none of which are truly selective, cannot be justified, nor will the public accept such antiquated management tools.

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