Alaska Department of Fish and Game
Division of Wildlife Conservation

Federal Aid in Wildlife Restoration
Research Progress Report

Investigation and Improvement of Techniques for Monitoring Recruitment, Population Trend, and Nutritional Status in the Western Arctic Caribou Herd

by

Patrick Valkenburg, James R. Dau,
Timothy O. Osborne, Geoffrey Carroll,
and Robert R. Nelson

Project W-24-1
Study 3.40
April 1993

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SUMMARY

The Western Arctic caribou (*Rangifer tarandus granti*) herd (WACH) is currently at an historic high level (415,692 in 1990) and high density (1.4/km^2 in 1992). The objective of this research project is to develop, validate, and implement techniques for monitoring the nutritional status and predicting the productivity and population trend of the WACH and to increase our knowledge of its movements and distribution. In 1992 we estimated the fall calf:cow ratio and monitored the distribution of radio-collared caribou in late September-early October. We determined the mean body weight (BW), mean ingesta-free body weight (IFBW), mean mandible and diastema lengths (ML and DL), and mean mandibular marrow fat content (MMFC) of calves collected in April-May and October-November 1992. We estimated the fatness of calves based on the presence or absence of fat at four sites--rump, brisket, omentum, and heart. Caribou calves were collected from two separate wintering areas in the range of the Nelchina caribou herd, and similar body condition parameters were measured and tabulated.

Despite the large size and relatively high density of the WACH, fall calf:cow and bull:cow ratios were high in 1992 (51 and 52:100). Calves appeared to be in good condition (despite their small size compared with calves from Interior herds) in April-May 1992 and in October 1992 based on body fat deposits and/or MMFC. There were no apparent area-, season-, or sex-related differences in the BW, IFBW, ML, or DL of WACH calves. In contrast, Nelchina herd calves that wintered in Unit 13 had a lower MMFC and IFBW than those that wintered in Unit 12.

Of 114 caribou (collared prior to 1992) thought to have functioning radiocollars in fall 1992, 72 (63%) were located south of the Kobuk River west of the Yukon and Koyukuk Rivers, 14 (13%) were located on the North Slope, 5 were located in the John River drainage, and 1 was located in the Pah Flats in late September-early October. No WACH radios were heard on the north slope of the Brooks Range between the Chandler and Sagavanirktok Rivers. Thirteen bull caribou were radio-collared at the Kobuk River in early September 1992 to aid in finding nonbreeding segments of the herd during the census planned in 1993.

Key Words: body condition, caribou, distribution, Nelchina caribou herd, population dynamics, *Rangifer*, Western Arctic caribou herd.

CONTENTS

BACKGROUND

Caribou (*Rangifer tarandus granti*) from the Western Arctic caribou herd (WACH) are a significant source of food for about 20,000 people from 36 villages and 4 regional centers in northwestern Alaska. Approximately 10,000-15,000 caribou representing 1-1.5 million pounds of meat are taken from the herd each year. The replacement value of the meat alone is approximately 2.5-3.5 million dollars annually. Many people within the herd's range cannot easily or economically obtain substitutes for the meat that caribou provide. Abrupt changes in regulations in response to unanticipated population declines, such as those that occurred in the mid-1970s, could cause economic hardship. To better predict caribou population changes, this research project was initiated to provide more information on body condition, natality rate, calf recruitment, and herd distribution than was being collected under the population monitoring program between 1982 and 1992.

Causes of declines in caribou herds are still not well understood and there are several competing and/or complementary hypotheses explaining documented declines in various caribou herds (Leopold and Darling 1953, Skoog 1968, Bergerud 1980, Haber and Walters 1980, Skogland 1985, Van Ballenberghe 1985, Bergerud and Elliot 1986, Messier et al. 1988, Bergerud and Ballard 1989, Davis and Valkenburg 1991, Seip 1992, Valkenburg et al. 1993). The WACH reached an historic high level (415,692) in 1990 and is continuing to grow at about 13% annually. Population density was estimated to be 1.4/km^2 in 1992. The George River herd in northern Quebec reached about 1.9/km^2 before density declined due to a decline in population size and range expansion (Couturier et al. 1990). With this research project in place as the WACH approaches a probable population peak, we expect to document and study the mechanics of population regulation during a decline.

STUDY OBJECTIVES

To develop, validate, and implement techniques for monitoring recruitment, distribution, and nutritional status and predicting the productivity and population trend of the WACH.

Job Objectives

Annually estimate calf:cow ratio in October.

Annually collar a sample of female calves at the Kobuk River or other river crossings to estimate the age at first reproduction of females and to aid in finding nonreproductive segments of the population during censuses.

Annually determine the mean fall body weight of a sample of female calves and adult cows and the spring body weight of a sample of female calves from 1992 to 1997 to determine if weight and/or fat indices can be used as predictors of pregnancy rate and/or calf survival to fall.

Annually determine the distribution of radio-collared caribou in September/October and in February/March.

Place 10-20 radiocollars on bull caribou in years prior to censuses to facilitate finding bull groups during the census.

METHODS

Estimating Calf:Cow Ratio in Fall

On 10-12 October 1992 we used a Robinson R-22 helicopter (two-place) to conduct standard fall composition counts in the upper North Fork Koyukuk, Tinayguk, John, Ungalik, Inglutalik, Koyuk, and Buckland drainages. G. Carroll served as observer during the counts in the North Fork and Tinayguk drainages. T. Osborne was the observer during the remainder of the counts.

Collaring a Sample of Female Calves in Fall

No progress was made on this objective.

Determining Body Weight and Condition of Caribou

Body weight of adult female caribou in fall has been shown to be a reasonably good predictor of calf production among individually marked Central Arctic caribou (Cameron et al. 1993). In addition, body weight of 10-month-old calves appeared to be a reasonable predictor of calf:cow ratio in the Delta herd in fall from 1979 to 1991 (Valkenburg 1992), and calf weights (especially ingesta-free body weight) may be more sensitive to changes in herd nutrition than adult weights (Klein 1968, Gates et al. 1986, Huot 1989). In this project we proposed to investigate whether adult female weight and condition in fall and calf weight and condition in fall and spring could be used as predictors of calf:cow ratio the following fall in the WACH. Because the WACH project was underfunded in FY93, we could not afford to collect weight and condition data on both calves and adults. We opted to collect calf data only because a smaller sample size is required for each collection (weights of adults are more variable and subject to influences from lactation and age), and because adult females are larger and, therefore, much more difficult and expensive to process and transport.

As a pilot project, on 10 April 1992, 10 female calves were collected with the aid of a helicopter for transportation in the range of the WACH on the Pah Flats. The animals

were weighed with a calibrated scale, gutted (G.I. tract, heart, lungs, and liver removed), and weighed again. Mandibles were saved for later measuring and determination of marrow fat content (Neiland 1970). Presence or absence of subcutaneous (rump), intramuscular (brisket), and internal (omentum and heart) fat deposits was noted. The carcasses were taken to Galena and distributed among elderly residents. Seventeen female calves were collected from the ground in the Nelchina herd's range to determine the feasibility and utility of collecting from the ground, and as part of a research project to determine factors limiting Interior caribou herds (Project W-23-5, Job 3.27). Carcasses from these collections were distributed for human consumption in Tok and Glennallen.

We planned to involve local residents in the WACH collections where feasible. G. Bamford from the Hogatza River, R. Ahgook from Anaktuvuk Pass, and S. Kantner from the Kobuk River were enlisted as cooperators and trained to help obtain samples and body weights of female caribou calves in April and October. All cooperators were given calibrated scales, plastic labels (premarked with a list of information needed from each animal), and a notecard with instructions. G. Bamford was issued a collecting permit (allowing him to take caribou for this study the same day airborne), but the other cooperators were able to take the necessary caribou under hunting regulations.

Determining Distribution of Radio-collared Caribou

We determined the distribution of radio-collared WACH caribou prior to the fall composition counts. On 28 September 1992, J. Dau and L. Ayres radio-tracked in a PA-18 from the Kobuk River south to the northern Seward Peninsula, Buckland valley, and Purcell Mountain. The area between Kotzebue and Point Hope had been searched previously. On 29 September, S. Machida and R. Nelson used a Cessna 185 and radio-tracked over the Koyuk, Ungalik, Kateel, Gisasa, and Shaktoolik drainages. On 10-11 October, P. Valkenburg radio-tracked in a Bellanca Scout over the Koyukuk, John, Alatna, Wild, Itkillik, Kuparuk, Nanushuk, Anaktuvuk, Chandler, and Killik River drainages in the central Brooks Range and southern arctic coastal plain north to the latitude of Umiat. All known active radio-collared caribou from the WACH, Teshekpuk, and Central Arctic herds were monitored in the central Brooks Range and adjacent coastal plain as were all missing Porcupine herd radio-collared caribou. On 11-12 October, P. Valkenburg also tracked over the lower Alatna, Hogatza, Pah, and Koyukuk drainages, and the area searched by S. Machida and R. Nelson. All missing WACH, Teshekpuk, Central Arctic, and Porcupine herd caribou frequencies were monitored. Due to poor weather, the Noatak drainage was not searched. On 6-8 and 13-14 November, G. Carroll tracked on the arctic coastal plain from Barrow southeast to Umiat and from Barrow southwest to the Lisburne Peninsula.

Radio-collaring Caribou

We radio-collared 13 adult bull caribou from a riverboat at the Kobuk River in early September. We radio-collared 20-25 cows to replace individuals that have died or whose collars were failing from battery exhaustion.

RESULTS AND DISCUSSION

Estimating Calf:Cow Ratio in Fall

Results of the fall composition counts indicate that recruitment to fall was high in the WACH in 1992 (Table 1). Calf:cow and bull:cow ratios were high in all areas (Table 1); however, we did not sample on the arctic coastal plain.

Fall 1992 was the first time the Robinson R-22 helicopter was used for caribou composition counts in Alaska. Its relatively inexpensive charter rate, low fuel consumption (ca. 9 gal/hr), long range (3.5 hrs), and relatively good speed (105 mph) resulted in over a 50% decrease in the cost of the composition counts. Compared with other piston helicopters, the R-22 also has an excellent mechanical safety record (Anonymous 1992).

Determining Body Weight and Condition of Caribou

There were no significant differences in body weight (BW) or ingesta-free body weight (IFBW) among collections of WACH calves, and male WACH calves that were inadvertently collected were not significantly heavier than female calves (Table 2, Appendix A). In the Nelchina herd, the mean BW of calves that wintered in the Tok area (Unit 12) was marginally heavier than the BW of those that wintered in traditional winter range in Unit 13 ($0.05 < P < 0.1$, $t = 2.06$, $df = 15$). IFBW was significantly different between areas ($P < 0.05$, $t = 2.18$, $df = 15$).

Mean mandible length (ML) and diastema length (DL) were not different among late winter samples of WACH caribou calves or among samples of Nelchina calves, and there were no differences in these variables between males and females collected in April-May in the WACH (Table 2). However, the ML of WACH calves collected in April-May 1992 was significantly longer than the ML of WACH calves collected in October 1992 ($P < 0.001$, $t = 8.76$, $df = 21$), indicating either that we can expect growth of bones over winter or that there was less growth in the 1992 cohort than in the 1991 cohort (Table 2). Future collections will clarify this issue.

Mean mandibular marrow fat content (MMFC) was significantly greater in Nelchina herd calves that wintered in Unit 12 than in calves that wintered in the traditional winter range in Unit 13 ($P < 0.001$, $t = 4.14$, $df = 15$) (Table 3). For the WACH, MMFC values were only available for calves collected in the Pah Flats in April. The remaining jaws arrived in Fairbanks too dessicated to be evaluated. MMFC values in the WACH and Nelchina calves were relatively low compared with marrow fat values from other studies (c.f. Davis et al. 1987), and in view of the presence of fat in other fat deposits, especially in the WACH Pah Flats collection (Mech and DelGiudice 1985) (Appendix A). However, mandibles were kept frozen from April to December and could have become freeze-dried. Also, Davis et al. (1987) recommended that additional work be done to evaluate the utility of MMFC as an indicator of condition, because MMFC values may require more adjustment for nonfat residue than femur marrow fat values (Neiland 1970). In future collections we plan to collect a femur from each animal.

Cooperators and biologists had variable success at selecting female calves. G. Bamford collected four female calves in late April with the aid of his aircraft for transportation. S. Kantner obtained 2 female calves, 11 male calves, and 2 2-year-olds in late May and early June. In late October, G. Bamford collected an additional 15 caribou, including 12 female calves, 1 male calf, and 2 female yearlings. S. Kantner was out of the state in October and did not participate, and R. Ahgook obtained only two female calves because there were few caribou in the vicinity of Anaktuvuk Pass in October-November. In collections by department biologists in April and October in the WACH, 12 female calves, 3 male calves, and 1 adult female were taken. Biologists took 17 female calves, 2 female yearlings, and 1 2-year-old female from the Nelchina herd in April. No mistakes were made classifying the sex and age of caribou during the helicopter-assisted collection on the Pah Flats. To minimize shooting caribou other than female calves, one biologist used a spotting scope to identify individuals and the other did the shooting. It may be more difficult to collect female calves in the WACH without the use of a helicopter for transportation. Caribou of

the WACH have been shown to be more reactive to aircraft than those of the Delta and probably other Interior herds, possibly because WACH caribou are routinely hunted from snowmachines (Valkenburg and Davis 1985). However, G. Bamford was quite successful using his Citabria, and he found that most caribou did not run after he landed.

Determining Distribution of Radio-collared Caribou

Of 114 caribou (collared prior to 1992) with functioning radiocollars in fall 1992, 72 (63%) were located south of the Kobuk River west of the Yukon and Koyukuk Rivers, 14 (13%) were located on the north slope of the Brooks Range and arctic coastal plain, 5 were located in the John River drainage, and 1 was located in the Pah Flats. No WACH radios were heard on the north slope of the Brooks Range between the Chandler and Sagavanirktok Rivers. Of the 22 radiocollars not located, 10 were 5 years old or older and could have had exhausted batteries. The location of the remaining radio-collared caribou was unknown, but some may have been in the Noatak drainage which was not searched due to poor weather.

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Table 1. Results of sex and age composition counts of the Western Arctic caribou herd in October 1992.

Area	Date	Bulls: 100 cows	Calves: 100 cows	% calves	% cows	% bulls	Total caribou
Tinayguk River Unit 24	10/10/92	64	51	24	47	30	739
John River Unit 24	10/11/92	84	50	21	43	36	1,270
North River Unit 22	10/12/92	74	67	28	41	31	1,187
Granite Mountain Unit 22	10/12/92	50	48	24	51	25	1,704
Wrench Lake Unit 23	10/12/92	49	44	23	52	25	497
All Areas		64	52	24	47	29	5,397

Table 2. Body weight (BW), ingesta-free body weight (IFBW), mandible length (ML), diastema length (DL), and mandibular marrow fat content (MMFC) of Western Arctic and Nelchina caribou herd calves collected in 1992 (raw data in Appendix A).

Collection	Month	BW			IFBW			ML			DL			%[a] MMFC			Fat deposit index[b]
		Mean	SE	n	Mean	SE	n	Mean	SE	n	Mean	SE	n	Mean	SE	n	
Nelchina (Unit 13)	April	109	6.7	8	76	4.6	8	216	4.5	7	83	2.0	8	15	2.4	8	3.1
Nelchina (Unit 12)	April	124	2.6	9	87	1.9	9	225	1.4	9	87	0.9	9	34	3.5	9	4.0
Western Arctic (Pah Flats)	April	88	2.0	14	64	1.6	14	209	1.8	14	79	0.7	14	41	4.2	10	3.7
Western Arctic (Ambler)[c]	May-June	87	2.9	11	59	2.5	11	208	2.8	11	80	1.4	11	not available			1.9
Western Arctic (Galena and Pah Flats)	October	89	3.9	13	60	2.7	13	193	1.8	13	74	1.4	13	34	8.7	3	3.7

[a] After Neiland (1970).

[b] Fat deposit index is calculated by assigning a value of one point for the presence of fat in each of four sites on the carcass (i.e., rump, brisket, mesentaries, heart), summing the values for all animals, and dividing by the number of animals in each collection. For example, if each calf in a collection of 10 all had fat in each of the four fat deposit sites, the Fat Deposit Index would be 40/10 = 4.0.

[c] All calves in this sample were males. All others were females.

Appendix A. Data from caribou collections in the Nelchina (NC) and Western Arctic (WA) herds in 1992.

Accession Number	Herd	Date	Location	Sex	Age	BW	IFBW	ML	DL	Marrow wet wt.	Marrow dry wt.	Container weight	% dry weight	%[a] fat	Presence of fat: Rump	Brisket	Omentum	Heart	Warbles[b]	Bots[b]
103930	NC	4/23/92	Denali Hwy	F	Calf	105	75		85	6.7	4.4	3.6	26	20	N	N	N	Y	L	M
103931	NC	4/23/92	Denali Hwy	F	Calf	135	94	229	92	7.5	4.7	3.6	28	22	Y	Y	Y	Y	L	M
103932	NC	4/23/92	Denali Hwy	F	Calf	123	85	229	89	8.1	4.4	3.6	18	11	Y	Y	Y	Y	L	M
103933	NC	4/23/92	Denali Hwy	F	Calf	110	76	220	78	7.3	4.7	3.6	30	23	Y	Y	Y	Y	L	M
103934	NC	4/23/92	Denali Hwy	F	Calf	133	91	226	87	8.0	4.7	3.6	25	19	Y	Y	Y	Y	L	M
103935	NC	4/23/92	Denali Hwy	F	Calf	98	70	213	82	7.0	4.2	3.6	18	11	N	Y	Y	Y	L	M
103946	NC	4/25/92	Crosswind L.	F	Calf	76	52	204	78	7.2	4.0	3.6	11	3						
103949	NC	4/25/92	Crosswind L.	F	Calf	95	65	196	74	6.5	4.0	3.6	14	8	N	Y	N	Y	L	N
103947	NC	4/25/92	Crosswind L.	F	Ylng	146	100	253	97	11.5	4.7	3.6	14	8						
103948	NC	4/25/92	Crosswind L.	F	Ylng	140	96	250	93	8.5	4.7	3.6	22	14						
103945	NC	4/18/92	Tok	F	2 yr	165	117	247	88	7.7	6.3	3.6	66	63	Y	Y	Y	Y		
103936	NC	4/18/92	Tok	F	Calf	138	94	224	87	8.9	5.1	3.6	28	22	Y	Y	Y	Y		
103937	NC	4/18/92	Tok	F	Calf	131	92	227	87	7.4	5.0	3.6	37	33	Y	Y	Y	Y		
103938	NC	4/18/92	Tok	F	Calf	131	94	217	86	7.8	5.6	3.6	48	43	Y	Y	Y	Y		
103939	NC	4/18/92	Tok	F	Calf	126	89	220	82	8.2	5.3	3.6	37	33	Y	Y	Y	Y		
103940	NC	4/18/92	Tok	F	Calf	123	88	232	88	8.5	4.9	3.6	27	21	Y	Y	Y	Y		
103941	NC	4/18/92	Tok	F	Calf	112	77	227	87	6.7	4.9	3.6	42	36	Y	Y	Y	Y		
103942	NC	4/18/92	Tok	F	Calf	121	82	224	87	7.2	5.6	3.6	56	52	Y	Y	Y	Y		
103943	NC	4/18/92	Tok	F	Calf	123	87	223	85	6.8	4.5	3.6	28	21						
103944	NC	4/18/92	Tok	F	Calf	115	81	229	93	9.9	6.7	3.6	49	45						
104082	WA	6/7/92	Ambler	F	Calf	75	49	200	78						N	N	N	N	L	H
104083	WA	5/27/92	Ambler	F	Calf	84	55	203	78						N	Y	N	Y	H	H
104084	WA	6/7/92	Ambler	M	2 yr	114	82		89						N	Y	N	Y	H	M
104070	WA	5/8/92	Ambler	M	2 yr	162	110								N	Y	N	Y	M	M
104071	WA	5/30/92	Ambler	M	Calf	101	70	221	83						N	Y	N	Y	H	M
104072	WA	5/30/92	Ambler	M	Calf	94	66	205	86						N	Y	Y	Y	L	M
104073	WA	5/30/92	Ambler	M	Calf	81	51	209	80						N	Y	Y	Y	H	M
104074	WA	5/30/92	Ambler	M	Calf	90	63	212	80						N	Y	Y	Y	H	M
104075	WA	5/30/92	Ambler	M	Calf	85	62	205	80						N	Y	N	Y	H	L

Appendix A. Continued.

Accession Number	Herd	Date	Location	Sex	Age	BW	IFBW	ML	DL	Marrow wet wt.	Marrow dry wt.	Container weight	% dry weight	%[a] fat	Presence of fat: Rump	Brisket	Omentum	Heart	Warbles[b]	Bots[b]
104076	WA	5/30/92	Ambler	M	Calf	87	61	205	78						N	Y	Y	Y		
104077	WA	5/8/92	Ambler	M	Calf	105	72	224	88						N	Y	N	Y	L	H
104078	WA	5/27/92	Ambler	M	Calf	82	59	213	81						N	Y	N	Y	M	H
104079	WA	6/1/92	Ambler	M	Calf	77	50	189	70						N	N	N	Y	H	L
104080	WA	6/7/92	Ambler	M	Calf	82	52	200	76						N	Y	N	Y	M	M
104081	WA	6/7/92	Ambler	M	Calf	72	45	206	82						N	N	N	Y	M	M
104095	WA	10/16/92	Bamford	F	Yling	118	78	214	84						N	Y	Y	Y	N	N
104097	WA	10/16/92	Bamford	F	Yling	154	94	229	88						Y	Y	Y	Y	N	N
104101	WA	10/24/92	Bamford	M	Calf	90	63	186	68						N	Y	Y	Y	L	N
104090	WA	10/17/92	Bamford	F	Yling	152	102	234	95						Y	Y	Y	Y	L	N
104091	WA	10/24/92	Bamford	F	Calf	85	60	191	74						Y	Y	Y	Y	L	N
104092	WA	10/20/92	Bamford	F	Calf	104	65	197	77						Y	Y	Y	Y	L	N
104093	WA	10/20/92	Bamford	F	Calf	90	61	190	71						N	Y	Y	Y	L	N
104094	WA	10/22/92	Bamford	F	Calf	94	65	199	77						N	Y	Y	Y	L	N
104096	WA	10/22/92	Bamford	F	Calf	105	77	194	64						Y	Y	Y	Y	N	N
104098	WA	10/22/92	Bamford	F	Calf	92	62	192	77						N	Y	Y	Y	L	N
104099	WA	10/22/92	Bamford	F	Calf	99	66	198	77						Y	Y	Y	Y	L	N
104100	WA	10/23/92	Bamford	F	Calf	79	54	193	78						N	Y	Y	Y	L	N
104102	WA	10/23/92	Bamford	F	Calf	74	52	189	72						N	Y	Y	Y	M	N
104103	WA	10/20/92	Bamford	F	Calf	118	78	206	82						Y	Y	Y	Y	N	N
104104	WA	10/22/92	Bamford	F	Calf	76	49	183	69						N	Y	Y	Y	L	N
104105	WA	11/11/92	Galena	F	Calf	72	52	195	74	6.4	4.9	3.6	46	41						
104106	WA	11/11/92	Galena	F	Calf	71	44	179	66	6.2	4.9	3.6	50	45						
104107	WA	11/11/92	Galena	M	Calf	88	52	191	72	6.7	4.3	3.6	23	17						
104108	WA	4/8/92	Pah Flats	M	Calf	75	53		78	6.5	4.9	3.6	45	40	Y	Y	Y	Y	L	L
104109	WA	4/8/92	Pah Flats	F	3-4 yr			263	102	15.4	11.5	3.6	67	62	Y	Y	Y	Y	L	L
104110	WA	4/8/92	Pah Flats	M	Calf	97	69	217	80	7.8	5.7	3.6	50	45	Y	Y	Y	Y	L	L
104111	WA	4/12/92	Pah Flats	F	Calf	91	65	210	80	6.0	4.7	3.6	46	41	Y	Y	Y	Y		
104112	WA	4/12/92	Pah Flats	F	Calf	101	75	216	83	7.4	5.7	3.6	55	50	Y	Y	Y	Y		

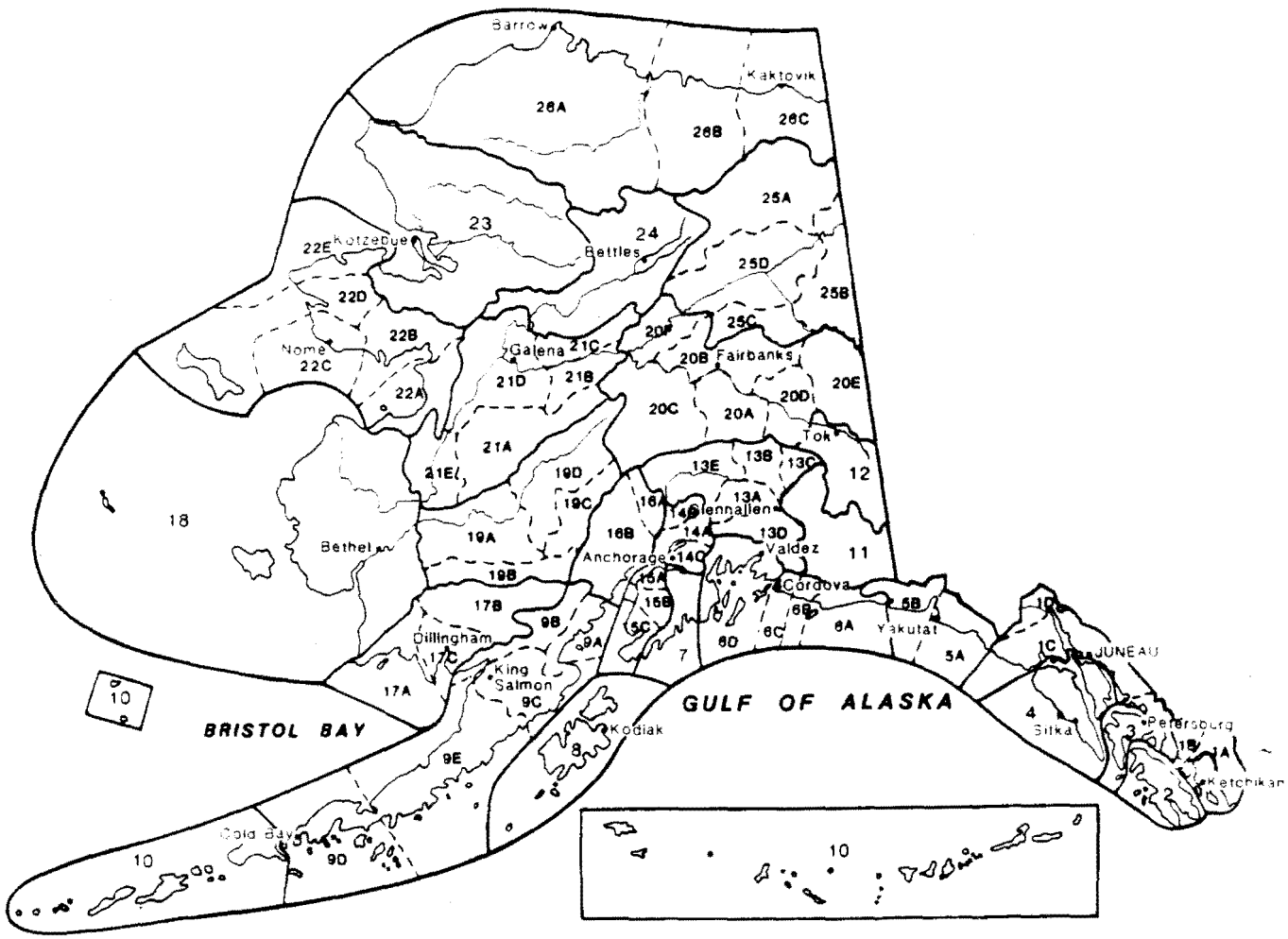
Appendix A. Continued.

Accession Number	Herd	Date	Location	Sex	Age	BW	IFBW	ML	DL	Marrow wet wt.	Marrow dry wt.	Container weight	% dry weight	%[a] fat	Presence of fat: Rump	Brisket	Omentum	Heart	Warbles[b]	Bots[b]
104113	WA	4/12/92	Pah Flats	F	Calf	77	55	200	76	7.5	4.7	3.6	28	21	N	Y	Y	Y		
104114	WA	4/12/92	Pah Flats	F	Calf	94	69	212	83	9.5	6.6	3.6	51	46	Y	Y	Y	Y		
104115	WA	4/12/92	Pah Flats	F	Calf	95	64	213	82	7.3	5.5	3.6	51	46	Y	Y	Y	Y		
104116	WA	4/12/92	Pah Flats	F	Calf	95	69	212	80	8.2	6.1	3.6	54	49	Y	Y	Y	Y		
104117	WA	4/12/92	Pah Flats	F	Calf	94	71	215	82	7.0	5.7	3.6	62	58	Y	Y	Y	Y		
104118	WA	4/12/92	Pah Flats	F	Calf	86	62	199	76	7.5	5.9	3.6	59	55	Y	Y	Y	Y		
104119	WA	4/12/92	Pah Flats	F	Calf	90	66	215	82	9.0	5.1	3.6	28	21	N	Y	Y	Y		
104120	WA	4/12/92	Pah Flats	F	Calf	83	57	197	73	6.4	4.5	3.6	32	25	N	Y	Y	Y		
104068	WA	4/27/92	Holly Lakes	F	Calf	75	54	204	77						N	Y	N	Y	M	M
104069	WA	4/28/92	Holly Lakes	F	Calf	82	59	202	78						N	Y	Y	Y	M	M
104085	WA	4/27/92	Holly Lakes	F	Calf	78	59	210	78						Y	Y	Y	Y	L	H
104086	WA	4/27/92	Holly Lakes	F	Calf	92	64	217	80	N	Y	Y	Y	L	M					

[a] Corrected for nonfat residue as in Neiland (1970).

[b] H = heavy, M = moderate, L = light.

Alaska's Game Management Units



Federal Aid in Wildlife Restoration

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program then allots the funds back to states through a formula based on each state's geographic area and the number of paid hunting license holders in the state. Alaska receives 5% of the revenues collected each year, the maximum allowed. The Alaska Department of Fish and Game uses the funds to help restore, conserve, manage, and enhance wild birds and mammals for the public benefit. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes necessary to be reponsible hunters. Seventy-five percent of the funds for this project are from Federal Aid.