

**PROJECT TITLE: DYNAMICS OF THE DENALI CARIBOU HERD, DENALI
NATIONAL PARK, ALASKA: PROGRESS REPORT
(OCTOBER 2002 - SEPTEMBER 2003)**

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This progress report summarizes field activities conducted during October 2002 - September 2003 (FY03) of the long-term research on the Denali Caribou Herd (DCH). The National Park Service has supported intensive monitoring of the DCH since 1983. In FY03, this research effort was in a state of transition, while Denali National Park managers evaluated options for continuing large mammal monitoring in the park and attempted to secure long-term funding. The goal for the year was to conduct the minimum effort necessary to maintain long-term data streams on the DCH and to maintain the age-structured sample of radiocollared females so that the program could be reinvigorated in FY04 if park managers were successful in accumulating sufficient funding. Specific objectives for the year were to:

- 1) monitor herd size and composition, adult female survival, and calf production and recruitment;
- 2) maintain the age-structured sample of radiocollared cows by adding calves from the 2002 cohort and additional adult females as required (collar replacements on adult cows were deferred to FY04);
- 3) relate caribou population characteristics to winter snowfall and wolf predation.

During the year, a paper on marrow fat deposition and skeletal growth in caribou calves was published in the Journal of Wildlife Management, and a manuscript entitled AEffects of maternal characteristics and environmental variation on birth masses of Alaskan caribou≡ was completed (Appendix 1).

BACKGROUND

The National Park Service has supported intensive caribou research at Denali National Park since 1983. Since 1986, this research program has applied the same methodology to census the population annually and estimate calf production, calf recruitment, adult female survival, and herd composition, representing the longest and most consistent effort of its kind on caribou anywhere in North America. One unique aspect of the research design is that since 1986, a sample of approximately 50 radiocollared females representative of the herd=s age structure has been maintained, thus providing annual assessment of population vital rates faithful to the herd=s age structure. Even with the

general acceptance of the important influences of age on productivity and survival, this age-structured sample is the only one of its kind ever attempted in a wildlife population and has been maintained for 18 years.

To date, we have learned much about the interactions between predation and weather that drive the dynamics of the DCH. When this study began, the DCH was increasing at about 7%/year through a period of relatively mild winters in the mid-1980s. Winter survival of caribou cows was high (96%/year) and about 50% of the calves produced were recruited into the herd. With the onset of a period of severe winters in 1988, caribou numbers plateaued at about 3,200 in Autumn 1989 and then declined by a third over 2 years reach about 2,300 caribou by fall 1992. During the period of decline, adult cow winter survival dropped substantially (85%/year) and calf recruitment dropped to a mere 5%. Since 1992, winter snowfall has been moderate and the caribou herd has declined slowly at about 2% annually. Adult cow survival has been comparable to the mid-1980s, but calf recruitment has continued to be relatively low (35 calves:100 cows during Autumn 1984-89 vs. 14:100 during Autumn 1994-2002).

With the overall decline in calf recruitment since 1990, the female age structure has become heavily weighted towards older females, a harbinger of impending population declines regardless of winter snowfall patterns. In May 2001, we estimated that 31% of the females in the herd were ≥ 12 years old. Between May 2001 and September 2002, half of those older cows died and such high losses of cows can be expected to continue for the next couple of years as the remaining old cows are removed from the population.

The current dynamics and trends of the DCH may largely be determined by weather events that occurred over a decade ago and are just now finally being played out. Following the severe winters of 1888-89 to 1992-93, the Denali herd has been at a threshold of predation on their calves where the population could maintain near stability for over a decade. However, as the preponderance of old cows in the population die, I predict that the herd will sink below that threshold and calf recruitment will deteriorate even further because fewer calves will be produced but the same number of predators will exist. The combined effect of higher mortality of adult cows and decreased calf recruitment will result in an acceleration of the decline of the herd. If the rate of decline approaches that of the Mentasta or Chisana herds, which appear to be a few years ahead of the Denali Herd on the same trajectory, then we can expect a 50% decline in herd size by about 2007.

FIELDWORK RESULTS

As of 1 October 2002, 51 female caribou were radiocollared in the DCH, including 42 from the age-structured sample. On 1 April 2003, I captured 8 caribou including 5 10-

month-old females and 3 older females. During the year 11 caribou died and on 30 September 2003, 48 female caribou constituted the radiocollared sample.

HERD SIZE

I tentatively estimated the DCH to number about 1,590 caribou in late September 2003 (Table 1, Fig. 1). During 1993-2002, the DCH declined at about 1.6% annually ($\ln(n) = 39.75 - 0.016 * \text{Year}$; $r^2 = 0.380$). Assuming that the rate of decline was the same in 2003, I would predict a population of size of about 1,780 caribou, but the current estimate is 11% lower than that prediction and indicative of a greater decline. Although some of the decline may be attributed to variability in the estimation procedures, such a decline in herd size is corroborated by the continued low calf recruitment in Autumn 2002 and poor survival of adult females over the 2002-03 winter.

ADULT SEX RATIO

In September 2003, I estimated the adult sex ratio at 36 bulls:100 cows (Table 1). The bull segment of the herd was weighted toward large, fully-mature males which comprised 54% of the bulls tallied. The bull:cow ratio continued to exhibit a slow increase from the low of 29-30 bulls:100 cows during 1995-98. This increase is likely a result of poorer survival of cows as a result of the age structure anomaly and better $A_{\text{relative}} \cong$ recruitment of males compared to females. The recruitment rate for males is higher than it is for females, even with a skewed sex ratio of recruited calves, because of the lower number of adult males. For example, in Autumn 2002 (Table 1), approximately 9 female calves were recruited into a population of 100 females for a rate of 9%, while 7 male calves were recruited into a population of only 32 males for a rate of 22%.

CALF PRODUCTION AND SURVIVAL

Based on observations of radiocollared females of the age-structured sample near the peak of calving in May 2003, approximately 74% of the cows produced calves (Table 2). By 8 June, when I conducted the annual census and post-calving composition survey, only 17% of the cows had calves at heel (Table 3), below the average of 22% over the last decade. Therefore, about 77% of the calves produced were dead by 8 June. In late September, only 7.8% of the cows still had calves (Table 1) resulting in an estimated 90% mortality of calves by that point. This was surprisingly low given that the 2002-03 winter had the lightest snowfall on record and calf:cow ratios had dropped into single digits in only 3 of the previous 19 years. Based on the calf:cow ratio and sex ratio for calves, the recruitment rate for females of the 2003 cohort was about 4.6%. This will translate into further population declines given that adult female mortality has recently been about 3 times this level of recruitment.

ADULT FEMALE SURVIVAL

During the year, 11 radiocollared caribou died including 5 lost to wolves, 3 to bears, 2 to unknown predators, and 1 in an avalanche. As usual, most died in April ($n = 6$) and May ($n = 3$), with the remainder dying during summer. Six of the cows that died were ≥ 10 years old.

Even though the 2002-03 winter was one of the lowest snowfall winters on record, the overwinter mortality of caribou cows was the highest I have recorded (19%) during the study. When added to the normal mortality we observed last summer, we ended up losing an estimated 23% of the cows in the last year. The high losses can be attributed to the age structure in the herd that was biased strongly to older females. On 1 May 2002, 24% of the cows in the herd were ≥ 13 years old and 55% of them died in the ensuing year. In comparison, $< 9\%$ of the younger cows in the herd died. This 23% adult mortality was substantially greater than the estimated recruitment of yearling females on 1 May 2003 of only 9%.

PLANNED ACTIVITIES DURING OCTOBER 2003 - SEPTEMBER 2004

In the upcoming year, we plan to continue efforts to assess population dynamics of the DCH and investigate influences of environmental variation and wolf abundance on those dynamics. Specifically, we plan to:

1. Capture and radiocollar caribou females as needed to maintain an age-structured sample of 60 individuals for estimation of calf production, age structure, survival patterns and seasonal distribution, and to aid in population monitoring. Instrumented caribou will be radiotracked in late November, late January, mid-March, late April, mid-May, early June, late July, and late September, or as needed to meet study objectives.
2. Conduct post-calving census and composition survey and the fall composition survey to determine herd size, calf recruitment, and adult sex ratio.

Table 1. Results of helicopter composition surveys in late September and fall population estimates for the Denali Caribou Herd, Denali National Park and Preserve, Alaska, 1984-2003.

Date	Fall Survey Results									Estimated Fall			
	Cows > 1 YO ^a	Calves	Bulls	Ratios (:100 Cows)		Calf Sex				Fall Herd Size	Herd Composition		
				Calves	Bulls	Ratio (m:100f)	Bulls% ^b				Cows	Calves	Bulls
							S	M	L				
9/27/1984	375	154	184	41	49	--	--	--	--	2,200	1,158	475	567
9/25-26/1985	654	183	368	28	56	72	--	--	--	-	-	-	-
9/27/1986	547	210	305	38	56	--	--	--	--	2,470	1,272	488	709
9/25/1987	631	234	356	37	56	73	28	39	33	2,430	1,256	466	709
9/27-28/1988	678	221	451	33	67	70	27	34	39	2,950	1,482	483	986
9/28/1989	830	246	428	30	52	84	34	34	32	3,210	1,771	525	913
9/26-27/1990	777	130	387	17	50	59	39	28	33	3,100	1,861	311	927
9/26/1991	1067	72	409	6.7	38	112	32	39	29	2,610	1,799	121	690
9/25/1992	643	103	282	16	44	66	31	40	29	2,340	1,464	234	642
9/27/1993	849	54	336	6.4	40	74	26	46	28	1,970	1,350	86	534
9/27-28/1994	648	128	253	20	39	88	21	38	41	2,140	1,348	266	526
9/25/1995	685	131	204	19	30	75	29	29	42	2,170	1,457	279	434
9/29/1996	820	103	243	13	30	69	32	26	42	2,060	1,449	182	429
9/26/1997	777	124	228	16	29	110	38	28	34	2,070	1,425	227	418
9/26/1998	718	87	205	12	29	98	41	27	32	1,790	1,272	154	363
9/29/1999	667	92	261	14	39	51	30	34	36	1,760	1,151	159	450
9/24-26/2000	730	52	257	7.1	35	86	32	31	37	1,930	1,356	97	477
9/27/2001	778	90	248	12	32	64	22	38	40	1,750	1,220	141	389
9/29/2002	453	72	145	16	32	76	22	17	61	1,960	1,325	211	424
9/30/2003	743	58	264	7.8	36	71	23	23	54	1,590 ^c	1,106	86	398

Footnotes for Table 1.

^a YO = year-old.

^b S = small: antlers indistinguishable from those of adult cows, body size comparable to cows.

M= medium: antlers larger than adult cows, but having smaller beam diameter, fewer points, and/or shorter antler length than the large bull class.

L = large: antlers fully developed with large diameter beams, many points, and long antler length.

^c 2003 herd size estimate and composition is tentative.

Table 2. Estimated natality rates for the Denali Caribou Herd, Denali National Park and Preserve, Alaska during 1987-2003. Rates are based on observations a sample of radiocollared females ≥ 1 year old, designed to approximate the age structure of the population, during the calving season.

Year	n	Pregnant	Not Pregnant.	Natality Rate % (95% CI)
1987	37	26	11	70.3 (53.0-84.1)
1988	46	33	13	71.7 (56.5-84.0)
1989	55	37	18	67.3 (53.3-79.3)
1990	49	29	20	59.2 (44.2-73.0)
1991	44	29	15	65.9 (50.1-79.5)
1992	46	41	5	89.1 (76.4-96.4)
1993	41	27	14	65.9 (49.4-79.9)
1994	47	43	4	91.5 (79.6-97.6)
1995	50	43	7	86.0 (73.3-94.2)
1996	53	46	7	86.8 (74.7-94.5)
1997	53	42	11	79.3 (65.9-89.2)
1998	46	39	7	84.8 (71.1-93.7)
1999	48	43	5	89.6 (77.3-96.5)
2000	55	46	9	84.6 (71.2-92.2)
2001	52	43	9	82.7 (69.7-91.8)
2002	45	38	7	84.4 (70.5-93.5)
2003	42	31	10	73.8 (58.0-86.1)

Table 3. Results of post-calving composition surveys of the Denali Caribou Herd, Alaska, 1984-2003.

Date	Cows > 1 YO	Calves	Calf:Cow Ratio
5/30,31,6/3/1984	519	201	39:100
1985 NO SURVEY			
5/28/1986	335	134	40:100
5/29-30/1987	1124	487	43:100
5/27-29/1988	1002	435	43:100
5/30/1989	1263	500	40:100
6/1/1990	1402	512	37:100
6/4-5/1991	1213	220	18:100
6/1/1992	909	278	31:100
6/2-3/1993	822	177	22:100
6/1-2/1994	985	376	38:100
5/30/1995	693	238	34:100
5/29/1996	682	139	20:100
5/31/1997	759	101	13:100
5/29-30/1998	624	141	23:100
5/29/1999	522	108	21:100
6/7/2000	665	68	10:100
6/6/2001	736	140	19:100
6/8/2002	431	120	28:100
6/8/2003	613	104	17:100

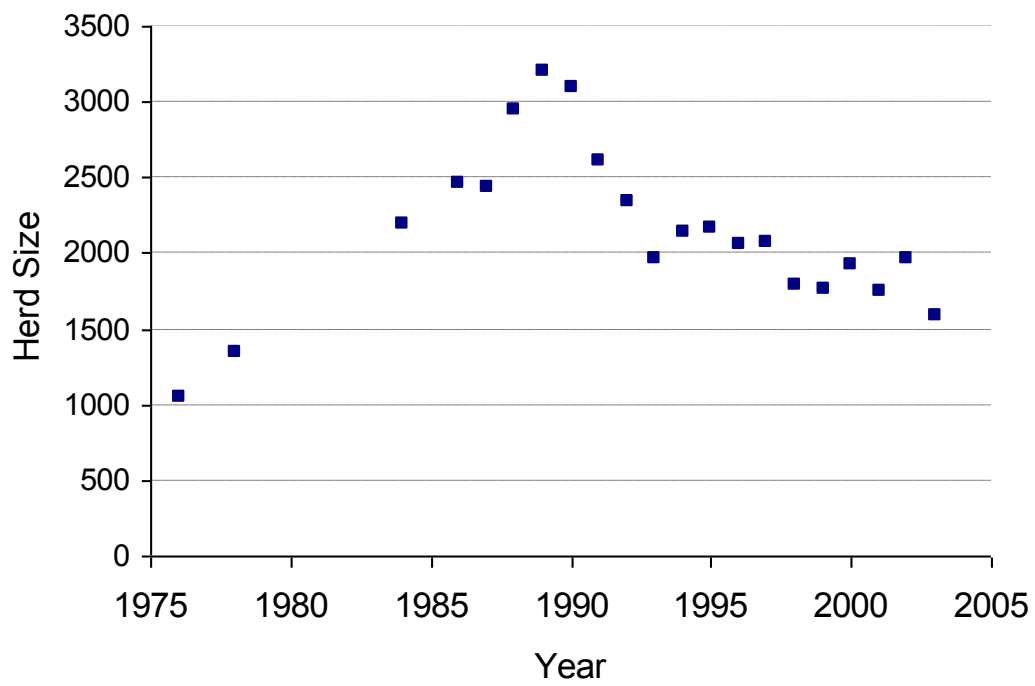


Fig. 1. Population estimates for the Denali Caribou Herd, Denali National Park, Alaska, late September, 1976-2003.

Appendix 1. Products of the Denali Caribou research program during 1986-2003.

Manuscript - Adams, L.G. Effects of maternal characteristics and environmental variation on birth masses of Alaskan caribou. Intended for Canadian Journal of Zoology.

Publication - Adams, L.G. 2003. Marrow fat deposition and skeletal growth in caribou calves. Journal of Wildlife Management 67:20-24.

Report - Adams, L.G. 2002. Population dynamics of wolves and their prey in Denali National Park, Alaska: progress report (May 2000 - April 2001). USGS Alaska Biological Science Center, Anchorage, AK. 26pp. + appendices.

Publication - Ben-David, M., E. Shochat, and L.G. Adams. 2001. The utility of stable isotope analysis in studying foraging ecology of herbivores: examples from moose and caribou. Alces 37:421-434.

Report - Adams, L.G. 2001. Population dynamics of wolves and their prey in Denali National Park, Alaska: progress report (May 1998 - April 2000). USGS Alaska Biological Science Center, Anchorage, AK. 26pp. + appendices.

Report - Adams, L.G. 1999. Population dynamics of wolves and their prey in Denali National Park, Alaska: progress report. USGS Alaska Biological Science Center, Anchorage, AK. 17pp. + appendices.

Publication - Adams, L.G., and B.W. Dale. 1998. Reproductive performance of female Alaskan caribou. Journal of Wildlife Management 62:1184-1195.

Book - Mech, L.D., L.G. Adams, T.J. Meier, J.W. Burch, and B.W. Dale. 1998. The wolves of Denali. University of Minnesota Press. 238pp.

Publication - Adams, L.G., and B.W. Dale. 1998. Timing and synchrony of parturition in Alaska caribou. Journal of Mammalogy 79:287-294.

Thesis - Adams, L.G. 1996. Calf production and survival in the Denali Caribou Herd, Alaska. Ph.D. Thesis. University of Minnesota, St. Paul. 152pp.

Publication - Adams, L.G., F.J. Singer, and B.W. Dale. 1995. Caribou calf mortality in Denali National Park, Alaska. Journal of Wildlife Management 59(3):584-594.

Publication - Adams, L.G., B.W. Dale, and L.D. Mech. 1995. Wolf predation on caribou calves in Denali National Park, Alaska. Pages 245-260 in L.N. Carbyn, S.H. Fritts, and D.R. Seip, eds. Ecology and conservation of wolves in a changing world - proceedings of the second North American symposium on wolves. Canadian Circumpolar Institute Occasional Paper 35. University of Alberta, Edmonton. 642pp.

Publication - Adams, L.G., and L.D. Mech. 1995. Population trends of wolves and caribou in Denali National Park, Alaska. Pages 347-348 in E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac, eds. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals and ecosystems. U.S. Department of Interior, National Biological Service, Washington, DC. 530pp.

Popular article - Adams, L.G. 1992. Snowfall tips the balance of wolf-caribou

relationships in Denali National Park. Pages 56-57 in Highlights of natural resource management. U.S. Department of Interior, National Park Service, Washington, DC. 67pp.

Publication - Davis, J.L., L.G. Adams, P. Valkenburg, and D.J. Reed. 1991. The relationship between caribou body weight and age and cohort specific reproduction. Pages 115-142 in Butler, C.E. and S.P. Mahoney (eds.). Proceedings of the fourth North American caribou workshop. Newfoundland and Labrador Wildlife Division, St. John's, Newfoundland. 529pp.

Report - Adams, L.G., B.W. Dale, and B. Shults. 1989. Population status and calf mortality of the Denali Caribou Herd, Denali National Park and Preserve, Alaska - 1984-1988. U.S. National Park Service Natural Resources Progress Report AR-89/13. Anchorage, AK. 131pp.

Publication - Adams, L.G., B.W. Dale, and F.J. Singer. 1988. Neonatal mortality in the Denali Caribou Herd. Proceedings of the third North American caribou workshop. Alaska Department of Fish and Game Wildlife Technical Bulletin 8:33-34.

Publication - Adams, L.G., P. Valkenburg, and J.L. Davis. 1988. Efficacy of carfentanil citrate and naloxone for field immobilization of Alaskan caribou. Proceedings of the third North American caribou workshop. Alaska Department of Fish and Game Wildlife Technical Bulletin 8:167-168.

Popular article - Adams, L.G. 1987. Fate of caribou calves studied in Denali. Page 16 in Highlights of natural resource management. U.S. Department of Interior, National Park Service, Washington, DC. 53pp.

Report - Adams, L.G. 1986. Population status and neonatal mortality of the Denali Caribou Herd-progress report. U.S. National Park Service Natural Resources Progress Report AR-86/05. Anchorage, AK. 13pp.