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ECOLOGY OF BROWN BEARS INHABITING THE COASTAL PLAIN AND ADJACENT FOOTHILLS AND MOUNTAINS OF THE NORTHEASTERN PORTION OF THE ARCTIC NATIONAL WILDLIFE REFUGE

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Ecology of brown bears inhabiting the coastal plain and adjacent foothills and mountains of the northeastern portion of the Arctic National Wildlife Refuge.

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Abstract: A total of 103 brown bears (Ursus arctos) were captured and marked in May, June, and July 1982-1984 on the coastal plain and adjacent foothills and mountains of the northeastern portion of the Arctic National Wildlife Refuge (ANWR). Radio-transmitters were attached to a total of 74 different bears during this time period and these bears were monitored through denning (October-November) each year. More males were captured in age classes 5.5 years of age or less, while females were more abundant in age classes 6.5 years old and older. No natural mortalities occurred among sample bears in 1982, however, 10 apparent mortalities occurred among 17 young bears (cubs and yearlings) in 1983. In 1984, 13 of 24 young bears were apparent mortalities. Reasons for these high mortality rates in 1983 (58.9%) and 1984 (54.2%) among young bears is unknown. Three mortalities were recorded among female bears in 1984. A young female (4.5-year old) was killed by an adult male; a mature female (14.5-year old) died of accidental strangulation on a survey marker, and another mature female (20.5-year old) died of unknown causes in October. Brown bears were observed feeding on cariobu (Rangifer tarandus) carcasses (adults and calves) on 6 occasions in 1982, on 15 occasions in 1983, and 17 occasions in 1984. Preliminary analysis of radio-relocation data indicate that brown bears appear to shift habitat use patterns to coastal areas in June and early July to coincide with occupancy of those habitats by calving and post-calving caribou. Emergence from winter dens occurred in late April and throughout May in 1983, but was confined to late April through mid-May in 1984, with early emergence of males and non-parturient females and later emergence of females with cubs and females with young. Elevations of den sites averaged 816 $\pm$ 61 m (SE) in 1983, and 966 $\pm$ 46 m (SE) in 1984. Aspects of den sites were predominantly southeast facing slopes (mean aspect, 1983 = 145° $\pm$ 20° SE; 1984 = 150° $\pm$ 18° SE). Slope at den sites averaged 54 $\pm$ 4% (SE) in 1983 and 56 $\pm$ 2% (SE) in 1984. In October and November, bears moved south into to foothills and mountainous habitats to den in both years. Only two bears in 1983 and two bears in 1984 denned on the coastal plain and foothill habitats in the 1002c study area.

Ecology of brown bears inhabiting the coastal plain and adjacent foothills and mountains of the northeastern portion of the Arctic National Wildlife Refuge.

Brown bear (Ursus arctos) are year-round residents of the Arctic National Wildlife Refuge (ANWR) and use the coastal plain of ANWR during portions of their life cycle. Knowledge specific to ecology of brown bears using the coastal plain of ANWR are limited (USFWS 1982). Impending petroleum exploration on the coastal plain and the potential impacts of this activity upon brown bears using the coastal plain requires expanded knowledge of brown bear ecology in the area. Of specific concern is the potential for disturbance during denning, which is postulated to have adverse effects of brown bear populations (Watson et al. 1973, Harding 1976). A study of brown bear ecology was initiated in 1982. The objectives of this study were as follows:

1. Determine location of denning and ecology of denning for brown bears using the coastal plain of ANWR.
2. Determine seasonal habitat use patterns of brown bear using the coastal plain of ANWR.
3. Determine seasonal interrelationships between brown bears and other wildlife species, especially caribou (Rangifer tarandus), occupying the coastal plain and adjacent foothills and mountains of the northeastern portion of ANWR.
4. Determine the structure, size, status, and reproductive biology of brown bear populations on the northern slope of the eastern Brooks Range.

This project is a cooperative effort between the USFWS and the Alaska Department of Fish and Game (ADF&G), with FWS having primary responsibility for the first three objectives and ADF&G being primarily responsible for objective 4.

Methods and Materials

The study area is located between the Canning River and the Canadian border, and extends southward to the Brooks range. A detailed description of the study area was presented in the Initial Report - Baseline Study of the ANWR Coastal Plain (USFWS 1982).

Field work was based at Barter Island and extended from 19 April through 7 November 1984. Bears were captured between 21 May and 15 June using a Bell 205B Jet Ranger helicopter. Fixed-wing aircraft were used to locate bears and direct the helicopter and capture crew to the site. Capture procedures followed standard helicopter immobilization techniques used on brown bears in northern Alaska (Reynolds 1974, 1976). M-99 (Etorphine, 1 mg/ml, D-M Pharmaceuticals) was injected into the rump using Cap-Chur equipment (Palmer Chemical and Equipment Co., Douglasville, Ga). Bears recovered after the antidote (M50-50, Dipremorphine, 0.2 mg/ml, D-M Pharmaceuticals, Rockville, MD) was administered intravenously (same dosage as M99) and intramuscallary in the rump at 1/2 the dosage of M99. Certain bears (large males, etc.) were immobilized with the sernylan (phencyclidine hydrochloride, Bio-Centic

Laboratories, St. Joseph, Mo) and acepromazine maleate (Ayerst Labs, New York) using the Cap-Chur equipment. Young bear (cubs) were captured by hand and were injected with sernylan and acepromazine for handling and processing. Captured animals were measured, weighed, tattooed for permanent identification, ear-tagged, and marked with color-coded visual ear flags (Reynolds 1974). In addition, certain bears were fitted with collars containing radio-transmitters (Telonics, Inc., Mesa Az). Young age animals were fitted with expandable breakaway collars. These animals will be recaptured annually and the collars replaced. Also, young bears (3-4 years) of radio-collared females were captured and collared in late May to document disruption and dispersal of the family unit during the breeding season.

The two vesitgial premolars of the lower jaw were extracted for age determination based on cementum layering (Mundy and Fuller 1964, Stoneburg and Jonkel 1966, Craighead et al. 1970). Teeth were sectioned, stained and mounted for reading as described by Glenn (1972). Whole blood was collected from femoral arteries using Vacutainers (Bection-Dickinson, Rutherford, NJ) for seriological study by ADF&G personnel.

Movements and range size were determined by aerial surveys using fixed-wing aircraft to relocate radio-collared bears. Radio-relocations were attempted on a weekly basis; however, inclement weather and extensive movements of radio-collared bears increased intervals between relocations to 7-10 days. Attempts were made to visually observe each bear during a relocation; however, terrain, cover, and weather conditions did not always permit visual observation. Therefore, when visual relocations were not possible, radio-fixes were determined by triangulation or by abrupt changes in radio-signal strength. Radio-relocations and fixes were recorded in 1:63,360 scale topographic maps and other relevant information was recorded on form sheets.

Range sizes will be calculated using Curatolo and Moore's (1975) modification of the exclusive boundary strip method (Stickel 1954). This method uses the approximate size of daily movements to define the range area. Grid size will be a 4.83 km square (Reynolds 1980). These determinations will be used for comparing this study's results with results of other studies of brown bear in northern Alaska. Additionally, range sizes will be calculated using the minimum area method described by Mohr (1947). Radio-relocations will be digitized and computer graphic techniques will be used to analyze home range and species interrelationships. Movement distances between consecutive radio-relocations will be measured on 1:63,360 scale topographic maps. Winter dens were located by relocating radio-collared bears throughout October and early November. During these den surveys, dens of non-radio-collared bears were often sighted and their locations were recorded on 1:63,360 scale topographic maps.

Movement and home range data will be used to determine seasonal shifts in range use and an attempt will be made to relate these shifts to food availability. Concurrent observations of other species (especially caribou) will be used to evaluate the interrelationship between brown bear and their potential prey species. Upon completion of an extensive vegetation mapping effort in the study area (Walker et al. 1982, USF&WS 1982) the locational information for brown bear will be integrated into the digital data base of vegetation/land cover types. These integrated data sets will be examined statistically to determine habitat correlates. These data will be used to

evaluate the suitability of using Landsat-derived land cover maps for identifying and assessing brown bear habitat in arctic Alaska. Movement, range size and habitat use data analyses are ongoing and will be presented in later progress reports.

Data on various parameters of den sites were recorded at the time of denning (October-November) and at the time of emergence in the spring (April-May). Each den site was visited in mid-summer (July) and the vegetation and soil characteristics of the site were documented. Variables measured during the three den sample periods were based on den site studies of arctic fox (Chesmore 1969), brown bear (Craighead and Craighead 1972), Harding 1976, Reynolds et al. 1976, Vroom et al. 1980) and black bear (Johnson and Pelton 1980, Tietje and Ruff 1980, Johnson and Pelton 1981).

At each den site, two 30.5-m bisecting lines were established, with one line along the axis of the slope (up-slope line) and the other line (cross-slope line) perpendicular to the first. The den site was located at the midpoint of each line (the bisection point) in the manner described by Reichelt (1973). A sharpened surveyor's pin was lowered vertically to ground line at 30.5 cm intervals along each line and the point contact and the plant nearest to the pin at ground level was recorded at each point (200 total points per den site). Species composition data will be analyzed using analysis of variance and linear correlations analysis. Analysis of vegetational data is ongoing and will be presented in later progress reports.

Spring snow depths at each den site were recorded. Soil samples were taken at all sample locations to determine soil texture (Brady 1974). Regression analyses will be used to determine interrelationships between snow depth, soil texture, permafrost depths, and aspects. These data will be useful in more clearly defining denning habitat in the study area.

Results and Discussion

A total of 50 brown bear were captured and marked between 23 June and 3 July 1982 (Table 1). An additional 30 bears were captured and marked between 28 May and 16 June 1983. In addition, 11 bears captured in 1982 were recaptured in 1983 and refitted with new radio-collars (Table 1). An additional 23 bears were captured and marked between 21 May and 15 June 1984. In addition 34 bears captured in 1982 and 1983 were recaptured in 1984 and refitted with new radio-collared (Table 1). A total 74 different bears were outfitted with radio-collared during 1982-1984. Distribution of capture locations for 57 bears captured in 1984 included 27 (13 males, 14 females) in coastal plain habitats, 16(4 males, 12 females) in foothills habitats, and 14 (7 males, 7 females) in mountainous habitats(Fig. 1).

Average weights of captured adult bears from 1982-1984 were comparable to weights of adult bears in the interior of the southern Yukon Territory, but were less than average weights recorded for adult brown bears in other localities of northern Alaska and the Yukon Territory (Table 2). It should be noted that weights recorded in other studies were for bears captured throughout the year, and included fall captured bears which are considerably heavier than bears captured in the spring (Pearson 1976). Bear captured in the current study were limited to spring and early summer capture periods.

Table 1. Physical characteristics of brown bears captured on the Arctic National Wildlife Refuge, Alaska, May June and July 1982-1984 (Measurements shown in cm, except as noted).

Bear number	Sex	Cementum age	Weight (lbs./kg)	Total length	Body length	Hind foot	Neck	Girth	Head width	Head length	Shoulder height	Upper left canine	Lower left canine	General capture location	Date
1056	M[a]	20.5	365/166	181	129	29	74	126	22.5	35.7	118	3.9	3.2	Old Man Cr.	28 June 1982
1056	M[a]	22.5	350/159	-	-	-	68	130	22.6	35.6	-	-	-	Niguanak R.	10 June 1984
1182	F[a]	15.5	170/ 77	170	92	27	57	92	18.3	34.0	104	3.0	2.7	Jago R.	23 June 1982
1182	F[a]	17.5	200/91	-	-	-	56	-	19.9	33.3	-	-	-	Jago R.	13 June 1984
1183	F	0.5	14/ 6	74	34	18	22	35	9.4	15.6	41	0.3	0.3	Jago R.	23 June 1982
1184	F	0.5	14/ 6	72	35	13	22	36	9.2	16.0	46	-	-	Jago R.	23 June 1982
1185	F[a]	18.5	215/98	163	99	27	57	99	19.5	31.0	103	2.8	2.8	Aichilik R.	23 June 1982
1185	F[a]	20.5	220e/100	-	-	-	57	95	19.6	31.5	-	-	-	Aichilik R.	21 May 1984
1186	M[a]	6.5	205/ 93	155	99	28	57	102	17.9	32.2	97	3.3	3.0	Siksikpalak R.	23 June 1982
1186	M[a]	7.5	250e/113	174	102	31	63	104	18.6	31.6	113	3.4	3.1	Kongakut R.	10 June 1983
1187	F[a]	6.5	168/ 76	147	93	24	52	99	17.0	29.8	98	3.1	2.9	Egaksrak R.	23 June 1982
1187	F[a]	7.5	180e/82	158	96	28	56	102	17.0	27.6	107	3.0	2.8	Siksikpalak R.	10 June 1983
1188	M[a]	4.5	285/129	201	95	22	67	110	19.5	36.0	102	1.5	1.5	Kongakut R.	23 June 1983
1188	M[a]	6.5	350e/159	-	-	-	68	121	20.5	36.4	-	-	-	Kongakut R.	13 June 1984
1189	F[a]	5.5	- -	168	94	26	55	99	17.1	32.1	100	3.4	2.8	Kongakut R.	23 June 1982
1189	F[a]	6.5	230/104	170	40	28	57	101	17.7	33.1	107	3.0	3.0	Turner R.	13 June 1983
1189	F[a]	7.5	185/84	-	-	-	-	-	-	-	-	-	-	Turner R.	21 May 1984
1189	F[a]	7.5	-	-	-	-	-	-	-	-	-	-	-	Turner R.	9 June 1984
1190	F[a]	7.5	220/100	171	109	24	58	102	18.1	31.9	97	3.1	2.8	Turner R.	24 June 1982
1190	F	9.5	-	-	-	-	-	-	-	-	-	-	-	Clarence R.	10 June 1984
1191	M	0.5	19/ 9	69	42	15	26	43	10.2	15.7	46	-	-	Turner R.	24 June 1982
1192	M	0.5	20/ 9	88	33	14	25	43	9.8	16.5	41	-	-	Turner R.	24 June 1982
1193	F[a]	8.5	190/ 86	177	90	19	63	114	21.0	32.5	68	2.8	2.8	Clarence R.	24 June 1982
1194	M[a]	11.5	305/138	191	99	23	74	116	21.0	37.0	41	3.8	3.3	Clarence R.	24 June 1982
1194	M[a]	13.5	380/172	-	-	-	83	122	21.7	37.7	-	-	-	Turner R.	9 June 1984
1195	M[a]	4.5	210/ 95	174	83	22	62	-	18.4	32.2	80	3.4	3.2	Kongakut R.	24 June 1982
1196	M[a]	6.5	- -	155	78	25	62	104	17.0	30.3	98	3.0	2.9	Ekaluakat R.	24 June 1982
1196	M[a]	7.5	220e/100	175	86	25	66	99	18.0	31.2	104	3.1	3.1	Siksikpalak R.	11 June 1983
1197	F[a]	8.5	190/ 86	163	92	27	57	100	19.2	30.9	96	2.9	3.0	Jago R.	24 June 1982
1197	F[a]	10.5	200/91	-	-	-	58	103	19.5	31.5	-	-	-	Aichilik R.	9 June 1984
1198	M[a]	5.5	205/ 93	167	89	29	60	107	16.9	33.0	94	3.5	3.1	Sadlerochit R.	25 June 1982
1198	M[a]	6.5	245/111	184	118	30	65	108	19.1	33.5	111	3.6	3.3	Akootoaktuk R.	10 June 1983
1199	M[a]	6.5	220/100	175	86	30	61	100	18.8	33.0	103	3.2	3.3	Katakturuk R.	25 June 1982
1200	M[a]	13.5	335/152	189	90	32	76	120	22.5	35.5	108	3.4	3.2	Katakturuk R.	25 June 1982
1200	M[a]	15,5	380/173	-	-	-	71	-	22.8	35.6	-	-	-	Marsh Cr.	12 June 1984
1201	F	5.5e[b]	190/ 86	159	80	28	62	97	18.3	31.1	92	2.8	2.7	Katakturuk R.	25 June 1982
1202	F[a]	16.5	215/ 98	160	97	24	60	109	18.2	31.6	98	3.1	2.8	Marsh Cr.	25 June 1982
1202	F[a]	18.5	- -	-	-	-	-	-	-	-	-	-	-	Nularvik R.	21 May 1984
1203	M	1.5	30/ 14	90	51	16	33	53	11.0	18.6	57	0.6	1.0	Marsh Cr.	25 June 1982
1203	M[a]	3.5	- -	-	-	-	-	-	-	-	-	-	-	Nularvik R.	21 May 1984
1204	M	1.5	55/ 25	97	64	19	39	75	12.2	21.5	68	1.0	1.2	Marsh Cr.	25 June 1982
1204	M[a]	3.5	- -	-	-	-	-	-		-	-	-	-	Nularvik R.	21 May 1984
1205	M	1.5	46/ 21	101	62	20	39	66	11.2	20.4	61	1.1	1.0	Marsh Cr.	25 June 1982
1205	M[a]	3.5	- -	-	-	-	-	-	-	-	-	-	-	Nularvik R.	21 May 1984
1206	F[a]	7.5	165/ 75	161	78	25	54	100	17.6	29.3	95	2.6	2.2	Hulahula R.	26 June 1982
1206	F[a]	8.5	190e/86	-	-	-	-	-	17.9	29.7	-	-	-	Itkilyariak Cr.	10 June 1983
1207	M	5.5	190/ 86	157	104	28	61	93	18.8	32.2	109	3.7	3.5	Hulahula R.	26 June 1982
1208	F[a]	7.5	180/ 82	160	105	28	58	102	17.7	31.7	93	2.9	2.8	Old Man Cr.	26 June 1982

Table 1 (Continued.)

Bear number	Sex	Cementum age	Weight (lbs./kg)	Total length	Body length	Hind foot	Neck	Girth	Head width	Head length	Upper Shoulder height	Lower left canine	General left canine	capture location	Date
1208	Fa	9.5	205/93	-	-	-	58	95	19.5	32.1	-	-	-	Hulahula R.	12 June 1984
1209	M	3.5	125/ 57	139	85	27	49	81	15.5	29.0	86	3.0	2.9	Hulahula R.	26 June 1982
1210	Fa	3.5	151/ 69	154	83	23	53	94	16.7	29.3	91	2.6	2.6	Okpilak.R.	27 June 1982
1210	Fa	4.5	175/79	156	90	26	55	92	18.0	30.0	99	2.7	2.6	Jago R.	10 June 1983
1210	Fa	5.5	- -	-	-	-	58	92	18.1	31.1	-	-	-	Okerokovik R.	9 June 1984
1211	Ma	4.5	152/ 69	143	81	27	53	91	15.8	28.0	84	3.0	2.9	Okpilak R.	27 June 1982
1212	Fa	13.5	235/107	166	98	25	58	103	21.0	31.7	99	3.0	2.4	Old Man Cr.	28 June 1982
1212	Fa	15.5	220/100	-	-	-	54	98	21.0	31.7	-	-	-	Okpirourak Cr.	13 June 1984
1213	Fa	12.5	210/ 95	170	103	27	61	105	19.7	31.9	92	3.2	2.8	Marsh Cr.	28 June 1982
1213	Fa	14.5	200/91	-	-	-	67	92	18.1	30.9	-	-	-	Katakturuk R.	7 June 1984
1214	F	2.5	80/ 36	109	66	22	44	74	14.0	24.6	74	1.2	1.7	Marsh Cr.	28 June 1982
1214	Fa	3.5	115/52	143	77	26	45	76	14.8	27.7	86	2.3	2.6	Marsh Cr.	28 May 1983
1214	Fa	4.5	175/79	-	-	-	51	84	17.2	30.6	-	-	-	Carter Cr.	12 June 1984
1215	M	18.5	400/181	194	121	33	83	133	22.7	37.3	112	4.3	3.5	Jago R.	28 June 1982
1216	Fa	5.5	195/ 88	163	102	26	65	107	17.5	28.9	100	2.6	2.7	Jago R.	28 June 1982
1216	Fa	7.5	190/86	-	-	-	53	105	18.1	31.5	-	-	-	Hulahula R.	12 June 1984
1217	Fa	12.5	250/113	150	107	30	58	98	18.8	29.9	103	2.7	2.5	Jago R.	29 June 1982
1217	Fa	14.5	225/102	-	-	-	63	101	-	-	-	-	-	Okerokovik R.	6 June 1984
1218	M	2.5	144/ 65	154	93	29	48	87	14.6	27.7	88	2.3	2.5	Egaksrak R.	29 June 1982
1219	M	4.5	170/ 77	159	89	27	53	87	16.2	29.6	101	3.2	2.9	Jago R.	30 June 1982
1220	F	10.5	230/104	168	100	25	58	110	19.4	29.5	101	2.9	2.6	Jago R.	30 June 1982
1220	Fa	11.5	235/107	163	88	26	66	102	20.3	30.9	109	3.0	2.6	Jago R.	8 June 1983
1221	Ma	3.5	150/ 68	145	80	26	50	96	15.8	27.3	88	2.8	2.9	Jago R.	30 June 1982
1222	M	3.5	120/ 54	148	82	25	47	87	15.2	26.2	91	3.0	2.7	Clarence R.	30 June 1982
1223	M	6.5	250/113	176	98	27	66	109	19.1	34.6	109	3.1	2.9	Kongakut R.	30 June 1982
1223	Ma	7.5	245/111	182	97	28	63	99	19.2	33.5	108	3.0	2.7	Jago R.	10 June 1983
1223	Ma	8.5	210/95	-	-	-	63	104	19.6	34.6	-	-	-	Okerokovik R.	6 June 1984
1224	M	3.5	190/ 86	155	99	27	62	96	16.7	31.2	94	3.1	3.1	Beaufort L.	1 July 1982
1225	Ma	17.5	310/141	185	114	28	72	117	22.3	34.2	114	3.7	3.5	Sadlerochit R.	1 July 1982
1225	Ma	19.5	390/177	-	-	-	67	119	22.4	34.1	-	-	-	Egaksrak R.	14 June 1984
1226	Ma	10.5	385/175	203	116	28	78	135	22.9	36.8	123	4.1	3.3	Kongakut R.	2 July 1982
1226	Ma	12.5	400/181	-	-	-	76	126	23.3	37.1	-	-	-	Kongakut R.	14 June 1984
1227	Fa	13.5	255/116	176	120	33	61	113	20.3	32.9	97	3.4	3.0	Kongakut R.	2 July 1982
1228	Ma	6.5	230/104	167	99	26	59	97	18.7	31.4	95	3.1	2.8	Okpilak R.	3 July 1982
1229	Ma	4.5	- -	143	92	29	53	102	16.2	30.2	109	4.0	3.5	Kongakut R.	3 July 1982
1229	Ma	5.5	190/86	165	94	31	57	90	16.9	32.0	105	3.8	3.5	Turner R.	13 June 1983
1230	Fa	7.5	170/ 77	163	93	25	54	96	17.9	30.3	99	2.9	2.6	Kongakut R.	3 July 1982
1230	Fa	9.5	150/68	-	-	-	49	94	17.5	30.5	-	-	-	Kongakut R.	14 June 1984
1231	Fa	2.5	75/34	129	65	23	45	67	14.1	25.6	75	2.6	2.8	Aichilik R.	28 May 1983
1231	Fa	3.5	145/66	-	-	-	49	84	16.1	29.1	-	-	-	Angun R.	8 June 1984
1232	Ma	2.5	85/39	136	75	24	47	69	14.4	26.8	90	2.1	2.4	Aichilik R.	28 May 1983
1232	Ma	3.5	150/68	-	-	-	53	87	16.2	29.6	-	-	-	Angun R.	8 June 1984
1233	Ma	12.5	375e/170	186	104	32	63	110	22.4	33.4	109	3.8	3.2	Sadlerochit R.	28 May 1983
1234	Fa	2.5	90/41	136	75	25	46	79	14.7	26.4	84	2.7	2.8	Turner R.	29 May 1983
1234	F	3.5	140/63	-	-	-	-	-	-	-	-	-	-	Turner R.	8 June 1984
1235	Fa	2.5	95/43	138	74	24	43	69	14.6	27.4	85	2.7	2.8	Turner R.	29 May 1983
1235	Fa	3.5	140/63	-	-	-	46	15.8	29.4	-	-	-	-	Kongakut R.	14 June 1984
1236	Fa	8.5	195/88	167	97	23	54	110	18.5	31.1	107	2.9	2.5	Okpilak R.	8 June 1983
1237	Fa	2.5	110/50	136	82	20	49	87	15.4	24.7	79	2.8	2.6	Okpilak R.	8 June 1983

Table 1 (Continued.)

Bear number	Sex	Cementum age	Weight (lbs./kg)	Total length	Body length	Hind foot	Neck	Girth	Head width	Head length	Upper Shoulder height	Lower left canine	General left canine	capture location	Date
1238	F	2.5	95/43	127	63	21	47	86	143.	23.8	76	2.6	2.6	Okpilak R.	8 June 1983
1239	F[a]	8.5	230e/104	167	83	27	60	116	19.1	32.5	105	3.2	2.6	Jago R.	8 June 1983
1240	M[a]	6.5	228/103	165	103	30	59	102	18.3	32.9	108	3.7	3.1	Okpilak R.	9 June 1983
1241	M[a]	18.5	355/161	185	106	25	70	123	23.0	35.7	120	3.8	3.2	Okpilak R.	9 June 1983
1242	F[a]	5.5	160/73	163	88	24	53	111	16.2	29.5	101	3.1	3.0	Okerokovik R.	9 June 1983
1243	F[a]	11.5	235/107	170	92	28	59	109	18.4	32.4	110	3.0	2.8	Okerokovik R.	9 June 1983
1244	M[a]	11.5	310/141	194	115	25	73	117	21.0	33.0	105	3.2	2.7	Okerokovik R.	9 June 1983
1245	F[a]	14.5	215/98	168	94	28	58	99	19.1	33.4	109	2.9	2.6	Itkilyariak R.	10 June 1983
1246	M[a]	10.5	340/154	190	107	31	70	113	21.1	35.8	126	3.6	3.1	Itkilyariak R.	10 June 1983
1247	F[a]	18.5	220/100	174	100	27	61	109	19.4	31.4	110	3.0	2.3	Katakturuk R.	10 June 1983
1248	F[a]	10.5	180/82	158	88	25	55	93	19.1	30.7	92	-	-	Kongakut R.	12 June 1983
1248	F[a]	11.5	-	-	-	-	59	89	18.6	30.6	-	-	-	Kongakut R.	11 June 1984
1249	F	3.5	110/50	122	74	22	53	86	15.2	28.1	83	-	-	Kongakut R.	12 June 1983
1249	F[a]	4.5	130/59	-	-	-	48	84	16.0	28.5	-	-	-	Kongakut R.	10 June 1984
1250	M[a]	20.5	405/184	197	114	28	80	131	23.0	36.0	124	3.5	2.8	Turner R.	12 June 1983
1251	M[a]	19.5	330/150	182	111	29	77	114	23.9	35.9	113	2.9	3.2	Turner R.	12 June 1983
1252	F[a]	7.5	195/88	160	98	28	61	99	18.9	31.5	97	2.8	2.7	Kongakut R.	13 June 1983
1252	F[a]	8.5	205/93	-	-	-	57	93	19.2	30.7	-	-	-	Kongakut R.	15 June 1984
1253	M	1.5e	62/28	109	58	-	42	61	12.7	23.1	67	-	-	Kongakut R.	13 June 1983
1254	M	12.5	255e/116	174	104	27	66	93	21.8	34.0	111	3.4	2.8	Old Man Cr.	14 June 1983
1255	M[a]	1.5	48/22	107	62	19	32	52	12.2	21.2	68	0.9	0.5	Old Man Cr.	14 June 1983
1256	M[a]	4.5	220/100	172	98	30	56	94	18.1	32.8	111	3.7	3.3	Jago R.	15 June 1983
1257	F[a]	8.5	160/73	163	101	27	54	86	18.5	31.3	98	3.0	2.8	Okpilak R.	15 June 1983
1257	F[a]	9.5	190/86	-	-	-	53	89	18.8	31.8	-	-	-	Okpilak R.	13 June 1984
1258	F[a]	9.5	195/88	195	163	26	57	98	17.6	30.8	93	3.1	2.9	Akootoaktuk R.	15 June 1983
1259	F[a]	23.5	215/98	153	103	25	58	102	19.3	31.4	106	3.4	3.1	Hulahula R.	15 June 1983
1259	F[a]	24.5	195/88	-	-	-	60	94	19.6	32.1	-	-	-	Itkilyariak R.	13 June 1984
1260	F[a]	10.5	220/100	166	107	28	59	108	19.8	32.1	107	3.2	2.9	Egaksrak R.	16 June 1983
1260	F[a]	11.5	255/16	-	-	-	58	110	19.5	32.4	-	-	-	Egaksrak R.	10 June 1984
1261	F[a]	7.5	190e/86	-	-	-	52	89	18.0	31.2	-	-	-	Aichilik R.	21 May 1984
1262	M[a]	10.5	395/179	-	-	-	82	-	24.0	35.9	-	-	-	Okerokovik R.	6 June 1984
1263	M[a]	11.5	300/136	-	-	-	71	108	21.5	36.6	-	-	-	Katakturuk R.	7 June 1984
1264	M[a]	11.5	445/202	-	-	-	79	129	24.1	38.2	-	-	-	Aichilik R.	8 June 1984
1265	M	0.5	22/10	-	-	-	26	43	10.7	16.5	-	-	-	Aichilik R.	9 June 1984
1266	M	0.5	17/8	-	-	-	25	40	10.1	15.0	-	-	-	Aichilik R.	9 June 1984
1267	F[a]	10.5	220e/100	-	-	-	63	103	19.3	30.4	-	-	-	Jago R.	9 June 1984
1268	M[a]	3.5	145/66	-	-	-	51	80	15.4	28.1	-	-	-	Egaksrak R.	10 June 1984
1269	F[a]	10.5	175/79	-	-	-	49	79	17.9	31.1	-	-	-	Itkilyariak R.	11 June 1984
1270	M	0.5	14/6	-	-	-	21	39	9.7	15.1	-	-	-	Clarence R.	11 June 1984
1271	M	0.5	15/7	-	-	-	23	37	9.7	15.6	-	-	-	Kongakut R.	11 June 1984
1272	F	0.5	17/8	-	-	-	25	41	9.9	15.0	-	-	-	Kongakut R.	11 June 1984
1273	M[a]	7.5	205/93	-	-	-	56	93	17.9	32.6	-	-	-	Jago R.	13 June 1984
1274	M[a]	4.5	165/75	-	-	-	51	93	15.9	27.3	-	-	-	Niguanak R.	13 June 1984
1275	M[a]	12.5	385/175	-	-	-	63	113	20.7	33.6	-	-	-	Aichilik R.	14 June 1984
1276	F	0.5	15/7	-	-	-	21	36	9.1	15.2	-	-	-	Kongakut R.	14 June 1984
1277	M	0.5	16/7	-	-	-	21	35	10.1	15.8	-	-	-	Kongakut R.	14 June 1984
1278	F[a]	8.5	185/84	-	-	-	50	99	18.5	31.0	-	-	-	Paulaluk R.	15 June 1984
1279	M	0.5	10/5	-	-	-	19	32	9.0	14.3	-	-	-	Paulaluk R.	15 June 1984
1280	M	0.5	14/6	-	-	-	22	37	10.3	15.0	-	-	-	Paulaluk R.	15 June 1984
1281	M[a]	6.5	260/118	-	-	-	61	106	19.9	33.9	-	-	-	Aichilik R.	June 1984
1282	F[a]	6.5	205/93	-	-	-	53	90	18.2	31.4	-	-	-	[illegible]	June 1984
1283	M[a]	4.5	195/88	-	-	-	56	90	14.0	30.0	-	-	-	[illegible]	June 1984

[a]Radio-collared

Fig.1 Capture locations of brown bears on the Arctic National Wildlife Refuge, 1984.

N

Table 2. Average weights (kg) of adult brown bears in northern Alaska and Yukon Territory.

Sex	Sample Size	Weight		Location	Reference
		Average	Range		
Male	40	139	106-240	interior-southern Yukon Territory	Pearson 1975
Female	21	95	74-124	interior-southern Yukon Territory	Pearson 1975
Male	25	169	-	northern Yukon Territory	Pearson 1976
Female	31	111	-	northern Yukon Territory	Pearson 1976
Male	-	180	136-268	Canning R. drainage, northeast Alaska	Reynolds 1976
Female	18	109	88-41	Canning R. drainage, northeast Alaska	Reynolds 1976
Male	19	167	107-218	northwestern Alaska, NPR-A	Reynolds 1980
Female	24	111	84-177	northwestern Alaska, NPR-A	Reynolds 1980
Male	26	145	93-202	north slope, ANWR	This study 1982-1984
Female	33	93	68-116	north slope, ANWR	This study 1982-1984

Productivity

Age structure of 75 captured bears and 21 associated unmarked young (Fig. 2) that were theoretically alive in late winter 1984 indicated a preponderance of males in age classes 5.5 years or less (15 males versus 8 females, plus 21 unidentified bears), while females predominated in age classes 6.5 years and older (31 females versus 21 males). Immature bears (4.5-years old or less) comprised 45.8% of the theoretical population in the late winter of 1984, with cubs, yearlings, 2.5-year old, 3.5-year old, and 4.5-year old comprising 24.0%, 1.0%, 6.3%, 10.4%, and 4.2% respectively. Adults comprised 54.2% of the theoretical population, while the sex ratio for the 75 captured bears was 36 males and 39 females.

This age structure differs from that presented for bears in northeast Alaska along the Canning River (Reynolds 1976). On the coastal plain and adjacent foothills and mountains of ANWR, 44 bears were captured that aged 3.5-11.5 years old, but only 22 bears captured aged 12.5 years and older. In contrast to the ANWR data, Reynolds (1976) captured more older age class bears (12.5+ years, n=43) than younger bears (3.5-11.5 years old, n=29) in the Canning River drainage. If the age structure of captured bears is representative of the population, these data indicate a shift from a declining population identified by Reynolds (1980) to a population status of

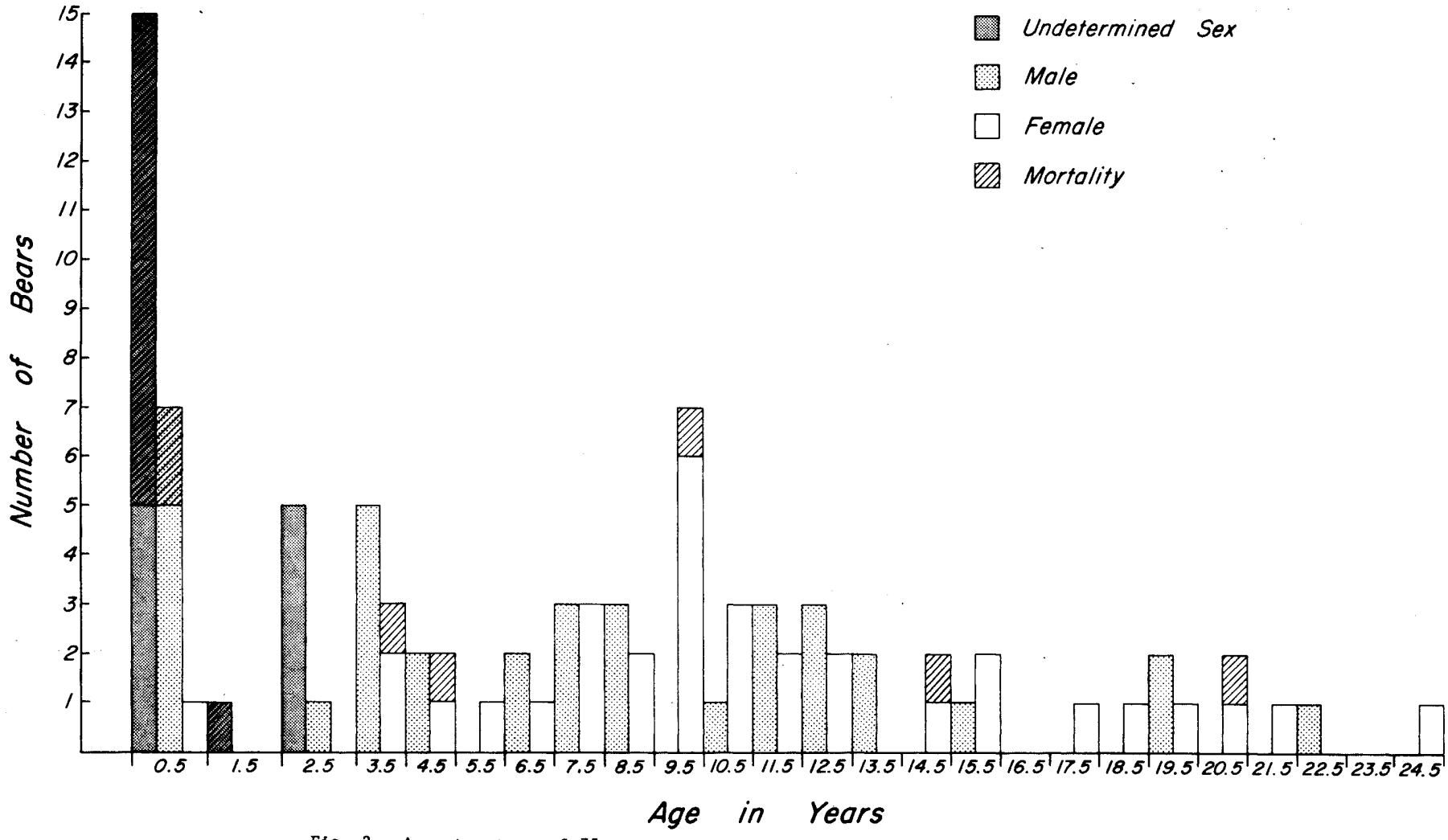

Fig. 2. Age structure of 75 captured bears and 21 associated unmarked young based upon known denning in fall 1983 an subsequent capture of new individuals in May and June 1984 in the northeastern portion of the Arctic National Wildlife Refuge, Alaska.

stable or increasing. It should be noted that search and capture efforts during the current study were focused on the coastal plain and adjacent foothills, and intensive search efforts were not conducted in mountainous terrain. Therefore, these data are biased towards bears using the coastal plain and foothill habitats.

Age structure for immature bears in 1982 indicated relatively good survival of young bears through the first four years of life (Table 3). During 1982, nine females were captured that had young. All young survived throughout the 1982 monitoring period and all young apparently denned with the maternal female, except bear 1221 (Garner et al. 1983). In 1982, mortalities were recorded for only two study related deaths and those data indicated a high survival rate for young bears from one year to the next (Garner et al. 1983). The 1983 survival data were not consistent with the 1982 data (Table 3). During 1983, 9 of 17 young brown bears (cubs and yearlings), either dying or disappearing from the maternal sow and are assumed dead. One radio-collared yearling (#1225) was killed by another bear in late June 1983. This apparent mortality represents a 58.9% mortality rate among the cubs and yearling cohorts in 1983. The 1984 survival data for young bears were similar to 1983, with 13 of 24 young bears (cubs and yearlings) either dying or disappearing from the maternal sow and are assumed dead (54.2% mortality rate). Reasons for the high mortality among young bears in 1983 and 1984 are undetermined at this time.

Two capture related mortalities occurred in 1984: bear 1190 (a 9.5-year old female with two cubs) and bear 1234 (a 3.5-year old female) died as a result of overheating while under the influence of M99. Capture procedures were modified following these two deaths. If body temperature was elevated at capture above 40°C, processing was suspended while the bear was placed in cold water or on snow fields until body temperature was lowered to approximately 38°C. The bear was then processed using normal procedures. Once this procedural change was implemented, overheating of immobilized bears was easily controlled. Three other mortalities occurred during 1984 (Fig. 2), bear 1249, a 4.5-year old female, was apparently killed on 30 August by bear 1226, a 12.5-year old male. On September 18, bear 1213 (a 14.5-year old female) was found dead at a survey monument on the coastal plain. The radio-collar was entangled in the metal survey stake and the bear had apparently suffocated due to strangulation. On 15 October, a wolverine (Gulo gulo) was feeding on the carcass of bear 1185 (a 20.5-year old female). The carcass was no inspected and the cause of death is unknown.

Breeding season normally extends from May through approximately 10 July, with peak of breeding occurring between 10-20 June. Observations of pairs in 1984 were common during this period (Fig. 3), and pairs observed after late July were probably short-term reassociations of siblings and/or family groups. Sexual maturity in females evidently occurs at 6.5 years of age, with 8 of 26 females with young breeding at 5.5 years of age (Table 4). Two females apparently successfully bred when 4.5 years of age. The loss of young bears (cubs and yearlings) noted earlier that occurs early in the summer often results in rapid recycling of the maternal females into the breeding cycle. Bears 1212 and 1217 each lost cubs in one year and produced another litter of cubs the following year (Table 4). Bears 1190 and 1197 lost yearlings and 2.5-year old respectively, and each produced cubs the following year(Table 4).

Table 3. Maternal females brown bears captured on the Arctic National Wildlife Refuge their associated offspring, and the fate of those offspring, 1982-1984.

	Offspring			Time period with female		
	1982	1983	1984			
Bear #	Number/age/sex	Number/age/sex	Number/age/sex	1982	1983	1984
1182	2/cubs/FF	2/yrlg/FF	no young	all season	both disappear-9 June	--
1185	2/yrlg	2/2.5yr/FM	3/3.5yr/FM	all season	all season	2 separated 5 June
1190	2/cubs/MM	2/yrlg/MM	3/cubs	all season	only 1 emerge den disappear 9 June	sow died at capture
1193	--	2/cubs	radio failed 83	--	through 7 Aug (radio failed)	--
1197	2/yrlg	2/2.5yr	2/cubs	all season	both disappear 27 June	2 disappear 23 June
1202	3/yrlg/MMM	3/2.5yr/MMM	3/3.5yr/MMM	all season	all season	1 separated 8 June 2 separated 13 June
1206	--	--	1/cub	--	--	disappear 1 June
1208	2/cubs	2/yrlg	no young	all season	1 disappear 9 June 1 disappear 15 June	--
1212	--	1 cub	no young emerge den	--	all season	--
1213	1/2.5yr/F	1/3.5/F	1/4.5/F	all season	all season	separate 27 May
1217	--	1/cub	2/cubs	--	disappear 8 May	2 disappear 16 May
1220	1/3.5yr/M	--	2/cubs	until 23 Aug	--	1 disappear 19 July 1 all season
1227	2/yrlg	2/2.5yr/FF	collar failed 83	all season	1 separated 30 May 1 separated 9 June	--
1230	--	--	2/cubs/FM	--	--	all season
1236	--	2/2.5yr/FF	no young	--	2 disappear 9 June	--
1239	--	2/yrlg	2/2.5yr	--	all season	2 disappear 27 Aug?
1245	--	2/yrlg	1/2.5yr	--	1 disappear 5 Sept 1 all season	disappear 15 May
1248	--	1/3.5yr/F	2/cubs +1	--	disappeared 17 June	1 disappear 25 June 2 with sow 28 July; collar failed
1252	--	1/yrlg/M	1/2.5yr/M	--	all season	disappear 5 June
1257	--	1/yrlg	no young	--	disappeared-date?	--
1260	--	--	1/cub	--	--	disappear 8 June
1261	--	--	2/cubs	--	--	2 disappear 13 June
1267	--	--	2/2.5yr	--	--	all season
1269	--	--	3/cubs	--	--	all season
1278	--	--	2/cubs	--	--	all season

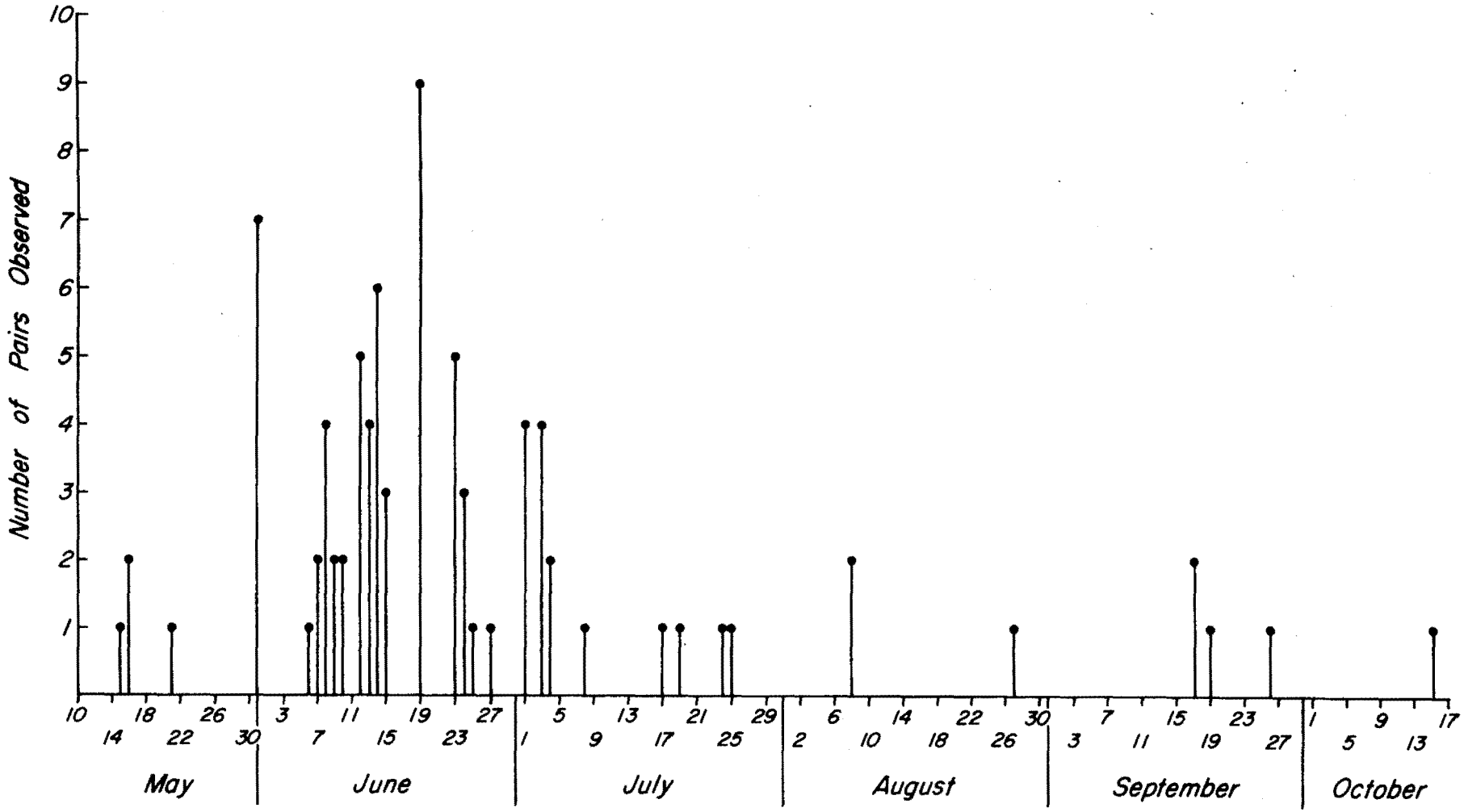

Fig. 3. Chronology of observations of brown bear pairs in the northeast portion of the Arctic National Wildlife Refuge, Alaska, 1984.

Table 4. Age of earliest observed breeding and known reproduction history for 26 female brown bears in the northeaster portion of the Arctic National Wildlife Refuge, 1982-1984.

Bear #	Cementum age-1984	Reproductive Status 1982	1983	1984	Age at earliest breeding
1182	17.5	2 cubs	2 yrlgs	none	14.5
1185	20.5	2 yrlg	2-2yr	2-3yr	16.5
1190	9.5	2 cubs	2 yrlg	3 cubs	6.5
1193	10.5	none	2 cubs	2 yrlg	8.5
1197	10.5	2 yrlg	2-2yr	2 cubs	6.5
1202	18.5	3 yrlg	3-2yr	3-3yr	14.5
1206	9.5	none	none	1 cub	8.5
1208	9.5	2 cubs	2 yrlg	none	6.5
1212	15.5	none	1 cub	2 cubs	13.5
1213	14.5	1-2yr	1-3yr	1-4yr	9.5
1217	14.5	milk,no cubs	1 cub	2 cubs	12.5
1220	12.5	1-3yr	1-4yr	2 cubs	6.5
1227	15.5	2-2yr	2-3yr	unknown	10.5
1230	9.5	none,no milk	none	2 cubs	8.5
1236	9.5	--	2-yr	none	5.5
1239	9.5	--	2-yrlg	2-2yr	6.5
1245	15.5	--	2 yrlg	1-2yr	12.5
1247	19.5	--	milk,no cubs	2 cubs	18.5
1248	11.5	--	1-3yr	2 cubs	6.5
1252	8.5	--	1 yrlg	1-2yr	5.5
1257	9.5	--	1 yrlg	none	6.5
1260	11.5	--	none,no milk	1 cub	10.5
1261	7.5	--	--	2 cubs	6.5
1267	10.5	--	--	2-2yr	7.5
1269	10.5	--	--	3 cubs	9.5
1278	8.5	--	--	2 cubs	7.5

Population Characteristics

Conclusions based on data presented here should be viewed as preliminary and contingent upon further observations. Because arctic brown bears are generally solitary, wide-ranging, and have low population densities, accurate population estimates and density calculations require intensive capture programs coupled with detailed movements and home range use data collected over a three or four year period. Similarly, parameters describing population dynamics and productivity, especially litter size, reproductive interval, and survival of young must be recorded for more than three years in order to be accurate (Reynolds 1980, Reynolds and Hechtel 1983).

Age and Sex Structure. The age and sex by 1984 of 100 captured and 24 associated unnmarked bears (Table 5) indicates a relatively young age structure. In the 3.5 to 11.5-year old age classes, 62 bears are represented by 32 males and 30 females. However, the 12.5 and older age classes contained only 24 bears (12 males and 12 females). This age structure would indicate an apparently stable or increasing population. These data are biased towards those bears that frequent the coastal plain and adjacent foothills of ANWR. Bears were only captured along the edges of more mountainous terrain and the central mountains were not searched to capture bears for this study.

Table 5. Age and sex structure of brown bears and associated young captured in the Arctic National Wildlife Refuge, 1982-84.

Age by cementum (yr)	Number of bears											
	Age at capture 1982			Age at capture 1983			Age at capture 1984			Age, by 1984, of all bears captured[a]		
	M	F	Unk	M	F	Unk	M	F	Unk	M	F	Unk
0.5	2	2	12	0	0	4	7	2	17	7	2	17
1.5	3	0	4	2	0	12	0	0	2	0	0	2
2.5	1	1		1	5	2	0	0	5	3	2	5
3.5	4	1		0	1		1	0		5	5	
4.5	5	0		1	0		2	0		3	2	
5.5	2	3		0	1		0	0		5	1	
6.5	5	1		1	0		1	1		6	2	
7.5	0	4		0	1		1	1		4	3	
8.5	0	2		0	3		0	1		5	3	
9.5	0	0		0	1		0	0		0	7	
10.5	1	1		1	2		1	2		1	5	
11.5	1	0		1	1		2	0		3	2	
12.5	0	2		2	0		1	0		3	2	
13.5	1	2		0	0		0	0		3	0	
14.5	0	0		0	1		0	0		0	2	
15.5	0	1		0	0		0	0		1	3	
16.5	0	1		0	0		0	0		0	0	
17.5	1	0		0	0		0	0		0	1	
18.5	1	1		1	1		0	0		0	1	
19.5	0	0		1	0		0	0		2	1	
20.5	1	0		1	0		0	0		1	1	
21.5	0	0		0	0		0	0		1	0	
22.5	0	0		0	0		0	0		1	0	
23.5	0	0		0	1		0	0		0	0	
24.5	0	0		0	0		0	0		0	1	
Total	28	22	16	12	18	18	16	7	24	54	46	24

[a] These figures do not include bear # 1201F or 1215M, 5.5 yrs and 18.5yrs old respectively, which died of capture-related causes in 1982, bear no. 1255M, a 1.5 yr-old bear killed by another bear in 1983, or any unmarked offspring of marked females which disappeared from family groups and were presumed dead prior to 1984.

Reproductive Biology. Reproductive rates for brown bears are dependent upon the following measures of reproductive biology: age at first production of young, length of the productive life for females, average litter size, and length of the reproductive cycle or reproductive interval, (Craighead et al. 1974, Bunnell and Tait 1980, 1981). Arctic brown bears have low reproductive rates (Reynolds, 1980, In press). Because the proportion of females with offspring in arctic populations is low and reproductive cycles may be six years or longer (Reynolds In press, Reynolds and Hechtel 1983), accurate measures of reproductive rates require long-term observations. As mentioned earlier, the reproductive history of female brown bears in ANWR (Table 6) indicates a rapid recycling of females into the breeding cycle, when young cubs are lost early in the breeding season.

Interaction Between Brown Bears and Caribou

Brown bears were observed in the vicinity of caribou (Rangifer tadarandus) throughout June on the coastal plain. In a majority of these instances, caribou did not react to bears, nor did bears react to caribou. Bears were observed chasing caribou on three occasions between 11-23 June, and were observed feeding on caribou calf carcasses on 10 occasions between 1-24 June. Bears were observed feeding on adult-sized caribou carcasses on six occasion between 1 June and 8 July, and large male bear was feeding on a caribou carcass on 16 October. These observations are in agreement with previous years data (Garner et al. 1984) and indicate that caribou are probably an important food source during June and early July. However, this use appears to be limited to the time when the Porcupine herd is present on the coastal plain and adjacent foothills. Detailed analyses of bear and caribou movement patterns and use of home ranges by bears will clarify this temporal relationship.

Denning

During fall 1983, dens of 46 radio-collared and 12 unmarked brown bears were located (Garner et al. 1984). Beginning on 19 April 1984, 43 radio-collared bears were monitored regularly to determine approximate dates of emergence from winter dens (Table 7). One bear was out of the den on 19 April, 0 on 23 April, 7 on 27 April, 0 on 28 April, 1 On 1 May, 18 on 6 May, 7 on 7 May, 6 on 15 May, and 3 on 16 May 1984. In contrast to 1983 when 18 of 28 radio-collared bears were out of the den by 1 May (Garner et al. 1984), only 9 of 43 radio-collared bears were out of the den by 2 May 1984. No females with cubs of the year were out of the den by 6 May 1984. On 6 and 7 May, an additional 25 bears were out of the dens. This group included six sows with cubs of the year. By 16 May all 43 radio-collared bears were out of the den, including an additional three sows with cubs of the year (Table 7). Den emergence among radio-collared bears followed the general patterns of early emergence by males and no-paturient females and later emergence of females with new cubs and females with young (Quimby 1974, Ruttan 1974, Harding 1976). Den emergence of radio-collared bears in 1984 was more compressed than 1983, when emergence extended from 24 April through 30 May. In 1984, radio-collared bears were out of dens between 19 April and 16 May. Reasons for differences in emergence dates is unknown, but assumed to be related to variations in temperatures and snow cover.

Den sites of 38 radio-collared bears and 11 unmarked bears were inspected in late May 1984 and physical characteristics of each den were measured. Each

Table 6. Reproductive history and litter size for female brown bears in the Arctic National Wildlife Refuge, 1982-84.

Bear #	Age in 1984[a] (yr)	Offspring No.	Offspring prior to capture	Reproductive history/litter size[b] 1982	1983	1984	Comments[c]
1182	17.5	1283F,1284F	Yes	2 cub	2 ylg/B	B	1983: Mort 2 ylg
1185	20.5	1231F,1232M	Yes	2 ylg	2 2yr/B	2 3yr/B	w/2yr after B
1187	8.5		No	B?	B	UN	
1189	7.5			B?	B	B	
1190	9.5	1191M, 1192M; 1270M, 2Um Cub	Yes	2 cub	1 ylg/B	3 cub	1983: Mort 1 ylg; 1984: Capture mort, Mort 2 cubs
1193	10.5	2UM cub	Yes	B	2 cubs	UN	
1197	10.5	2UM; 1265M 1266M	Yes	2 ylg	2 2yr/B	2 cub/B?	1984: mort 2 cubs
1201	6.5[d]		No	B			1982: Capture mort
1202	18.5	1203M,1204M, 1205M	Yes	3 ylg	3 2yr	3 3yr/B	
1206	9.5	1UM cub	Yes	B	B	1 cub/B	1984: Mort 1 cub
1208	9.5	2UM cub	Yes	2 cub	2 ylg/B	B	W/ylg after B; 1 ylg mort
1210	5.5		No	NB	B	B	
1212	15.5	1UM cub	Yes	B	1 cub	B	1983/84: mort cub in den?
1213	14.5	1214F	Yes	1 2yr	1 3yr/B	1 4yr/B	W/3yr after breed
1216	7.5		No	B?	B	B	
1217	13.5	1UM cub; 2UM cub	Yes	B	1 cub/B	2 cub/B	1983: 1 cub mort; 1984: mort 2 cubs
1220	12.5	1221M; 2UM cub	Yes	1 3yr	1 4yr/B	2 cub	1984: mort 1 cub
1227	15.5	1234F, 1235F	Yes	2 ylg	2 2yr/B	UN	
1230	9.5	1276F, 1277M	Yes	B	B	2 cub	
1236	9.5	1237F, 1238F	Yes	2 ylg	2 2yr/B	B	1983: Capture-related weaning?
1239	9.5	2UM ylg	Yes	2 cub	2ylg	2 2yr	
1242	5.5		No		B	UN	
1243	12.5		Yes		B	B	
1245	15.5	2UM ylg	Yes	2 cub	2 ylg	1 2yr/B	1983: mort 1 ylg
1247	19.5	2UM cub	Yes		B	2 cyb/B	1984: mort 2 cub
1248	11.5	1249F; 1271M, 1272F	Yes	1 2yr	1 3yr/B	2 cub	1984: mort 1 cub
1249	4.5		No		NB	NB	1984: killed by no. 1226
1252	8.5	1253M	Yes	1 cub	1 ylg	1 2yr/B	
1257	9.5	1UM ylg	Yes	1cub	1 ylg	B	Separation at capture, mort?
1258	10.5		Yes		B?	UN	
1259	24.5		Yes		B	B	
1260	11.5	1UM cub			B	1 cub/B	1984: mort 1 cub
1261	7.5	2UM cub	Yes		B	2 cub	1984: mort 2 cub
1267	10.5	2UM 2yr	Yes	2 cub	2 ylg	2 2yr	
1269	10.5	3UM cub	Yes		B	3 cub	
1278	8.5	1279M, 1280M	Yes		B	2 cub	May be 1983 Kongakut F
UM Hulahula, 1983 3 UMylg			Yes	3 cub	3 ylg	UN	
UM Kongakut, 1983 2UM 2yr			Yes	2 ylg	2 2yr/B?	UN	
UM Egaksrak, 1984 2UM ylg					2 cub	2 ylg	
UM Okerokovik, 1984 2 UM cub					B	2 cub	

[a] These ages were determined from dementum annuli during the year of capture, but the ages reported here include years subsequent to the bear's capture. However, in cases of bears known or presumed dead, the data listed represent their ages when last known to be alive.

[b] Designations are as follows: UM, unmarked; UN, unobserved; B, bred during that season; NB, did not breed; cub, ylg, 2yr,3yr-female accompanied by cub, yearling, 2-year-old, or 3-year-old young; cub/B-cubs lost prior to breeding season, subsequent breeding by female; and, mort-mortality occurred. Litter sizes should be biewed as minimum since mortality to other offspring may have occurred prior to observation.

[c] Cub 1270 was placed with and adopted by female 1248 on 11 June 1984 after the capture-related death of female 1190. By 25 June 1984, one of 1248's cubs, either 1271 or 1272 had disappeared and was presumed dead.

[d] Age estimated from tooth wear.

Table 7. Approximate dates of emergence from winter dens for 43 radio-collared brown bears in the Arctic National Wildlife Refuge, 1984.

Bear #	Age/sex	Date first observed out of den	Den type	Associated bears number/age/sex/bear#
1056	22.5/M	15 May	dug	none
1182	17.5/F	6 May	dug	none
1185	20.5/F	6 May	dug	2/3.5-year old/FM/ 1231,1232
1188	6.5/M	6 May	dug	none
1189	7.5/F	6 May	dug	none
1190	9.5/F	6 May	dug	3/cubs
1194	13.5/M	27 April	dug	none
1196	8.5/M	6 May	dug	none
1197	10.5/F	16 May	dug	2/cubs/MM/1265,1266
1198	7.5/M	27 April	dug	none
1200	15.5/M	7 May	cave	none
1202	18.5/F	2 May	cave	3/3.5-year old/MMM/1203,1204,1205
1206	9.5/F	7 May	dug	1/cub
1208	9.5/F	27 April	dug	none
1210	5.5/F	6 May	dug	none
1212	15.5/F	6 May	dug	none
1213	14.5/F	15 May	dug	1/4.5-year old/F/1214
1216	7.5/F	7 May	dug	none
1217	14.5/F	6 May	dug	2/cubs
1220	12.5/F	16 May	dug	2/cubs
1223	8.5/M	15 May	snow den	none
1225	19.5/M	16 May	dug	none
1226	12.5/M	6 May	dug	none
1230	9.5/F	6 May	dug	2/cubs/FM/1276,1277
1233	13.5/M	6 May	dug	none
1234	3.5/F	6 May	dug	none
1235	3.5/F	27 April	dug	none
1236	9.5/F	19 April	dug	none
1239	9.5/F	27 April	dug	2/2.5-year old
1240	7.5/M	7 May	dug	none
1241	19.5/M	15 May	dug	none
1243	12.5/F	27 April	dug	none
1244	12.5/M	7 May	cave	none
1245	15.5/M	27 April	dug	1/2.5-year old
1246	11.5/M	7 May	dug	none
1247	19.5/F	7 May	dug	2/cubs
1248	11.5/F	15 May	dug	2/cubs/MF/1271, 1272
1250	21.5/M	6 May	dug	none
1251	20.5/M	6 May	dug	none
1252	8.5/F	6 May	dug	1/2.5-year old/M/1253
1257	9.5/F	6 May	dug	none
1259	24.5/F	15 May	dug	none
1260	11.5/F	6 May	dug	1/cub

den was revisited in late July and early August 1984 and the vegetational and soil characteristics of the den site were sampled. All dens were located in foothills and mountainous terrain except one den which was located in coastal plain tundra habitat. Elevations of all den sites averaged 965.7 ± 45.8 m (SE) with a range of 347-1649 m. Dens located in mountainous terrain (n=33) averaged 1106.4 ± 42.8 m (SE), while dens located in foothills terrain (n=12) averaged 637.3 ± 34.5 m (SE). The den located in tundra habitat on the coastal plain was 347 m in elevation (Table 8). The average elevation of all dens was similar to that found along the Canning River (975 m) by Reynolds et al. (1976) and is slightly higher in average elevation than reported for 29 den sites measured in 1983 by Garner et al. (1984) in the same area. Den sites were equally divided between the three slope positions of lower 1/3 (15), middle 1/3 (16), and upper 1/3 (15) in contrast with results of similar den surveys in 1983, when no den sites were located in the upper 1/3 of the slope (Garner et al. 1984).

Of the 45 dens inspected in late May, 25 were intact, 14 were partially collapsed, and 2 were collapsed (Table 8). One den was a snow den in 2 m of snow. The bed in this den was scraped tundra vegetation. Three dens were rock caves. In contrast, 31 dens were collapsed and 11 dens were partially collapsed in late July and early August. These data are in agreement with results reported for the same area in 1983 (Garner et al. 1984), and by Reynolds et al. (1976) and Reynolds (1980) for the Canning River and the western arctic areas in northern Alaska. No reuse of dug dens has been documented in the current study, however, reuse of rock caves does occur, and certain bears traditionally den in rock caves on ANWR (Bears 1202, 1203, 1204, 1205, and 1242, Table 8). All den sites were well drained and were located on slopes ranging from 26% to 99% ($\bar{x}$= 55.7 ± 1.90% SE). The incidence of collapsed dens in July and August agrees with Pearson's (1978) and Reynolds' (1980) conclusions that soil depth and moisture content are important factors in den site selection by northern brown bears (Table 8).

Aspects of den sites (Table 8) were examined using circular statistics (Batschelet 1981, Zar 1984). Aspects were concentrated in a southeast direction (Fig. 4), with a mean aspect of 150° (95% C.I, 132°-168°) with an angular dispersion of 52°. Aspects were not uniformly distributed in all directions (Raleigh's test; Z=16.3, P<0.001) and were strongly oriented in a southeast direction (mean aspect= 150°; V-test, u=3.25, p<0.0005). Reynolds et al. (1976) reported that 47 of 52 dens (90%) were located on southerly slopes along the Canning River. These data are also in close agreement with aspects (mean aspect= 145°) of 29 bear dens examined in 1983 (Garner et al. 1984). These data indicate that bear dens in the northeastern Brooks Range are located on slopes with aspects strongly oriented in a southeasterly direction. These slopes are warmer and are normally snow free earlier than northern facing slopes. Bears may be selecting southeastern facing slopes for the earlier warming trend; however, other edaphic factors may also be influencing this selection (i.e. permafrost depths, etc.)

During October and early November 1984, den sites of 41 radio-collared and two unmarked bears were recorded during den surveys. Distribution of these dens were 35 in mountainous terrain, six in foothills terrain, and two in coastal plain terrain (Fig. 5). In general, all radio-collared bears captured on coastal plain or foothills habitats denned south of their capture sites (Figs. 1 and 5). Chronology of denning indicated that 3 bears were denned by 15 October, while an additional 31 bears were denned by the end of October

Table 8. Physical characteristics of 46 den sites used by brown bears during winter of 1983-1984 in the northeastern portion of the Arctic National Wildlife Refuge, Alaska.

Den#	Bear #	Date inspected 1984	(%)Slope	Aspect	Elevation(m) Den	Valley floor	Crest	Slope position (1/3)	Topography	Den status May 1984	Den status July 1984
84-1	1220	18 May & 20 July	63	211°	1311	1213	1829	lower	mountains	partially collapsed	collapsed
84-2	1212	18 May & 27 July	70	169°	1219	1000	1512	mid	mountains	intact	collapsed
84-3	1241	18 May & 25 July	38	125°	1338	835	1658	mid	mountains	intact	collapsed
84-5	1240	16 May & 21 July	63	202°	777	564	877	upper	mountains	intact	collapsed
84-6	1217	20 May & 28 July	54	253°	750	536	856	upper	foothills	collapsed	collapsed
84-6w	unmarked	20 May & 28 July	36	237°	750	536	856	upper	foothills	intact	collapsed
84-7	1243	31 May	75	88°	981	640	1170	mid	mountains	partially collapsed	collapsed
84-10	1239	19 May & 29 July	46	85°	1384	1176	1487	upper	mountains	intact	collapsed
84-11	1185	20 May & 30 July	62	132°	835	579	1039	mid	foothills	partially collapsed	collapsed
84-12	1260	20 May & 30 July	63	147°	591	482	774	mid	foothills	intact	partially collapsed
84-12s	unmarked	20 May & 30 July	52	147°	543	482	774	lower	foothills	intact	partially collapsed
84-13	1233	31 May	65	154°	1024	792	1250	mid	mountains	partially collapsed	collapsed
84-14	unmarked	19 May & 29 July	68	242°	1192	735	1414	upper	mountains	partially collapsed	collapsed
84-14L	unmarked	19 May & 29 July	59	242°	1109	735	1414	mid	mountains	intact	partially collapsed
84-15	1056	18 May & 27 July	55	106°	1134	988	1500	lower	mountains	partially collapsed	collapsed
84-16	1230	20 May & 11 Aug	65	145°	866	518	963	upper	mountains	partially collapsed	collapsed
84-17	unmarked	31 May & 22 July	57	192°	1079	658	1170	upper	mountains	partially collapsed	partially collapsed
84-18	1235	4 May & 17 July	52	194°	938	774	1225	mid	mountains	partially collapsed	partially collapsed
84-19	1252	31 May & 22 July	52	205°	933	817	981	upper	mountains	partially collapsed	collapsed
84-22	1259	16 May & 24 July	47	102°	933	811	1186	lower	mountains	intact	partially collapsed
84-23	1202	16 May & 24 July	99	220°	890	652	975	upper	mountains	cave	cave
84-24	1200	16 May & 21 July	72	112°	872	594	1030	mid	mountains	cave	cave
84-25	1247	16 May & 24 July	80	74°	945	677	994	upper	mountains	intact	collapsed
84-26	1246	16 May & 21 July	49	195°	1067	991	1490	lower	mountains	intact	collapsed
84-27	1245	18 May & 25 July	56	130°	1341	1222	1621	lower	mountains	partially collapsed	collapsed
84-28	1208	18 May & 27 July	56	108°	1048	933	1378	lower	mountains	intact	collapsed
84-29	1236	2 May & 25 July	46	46°	1189	988	1207	upper	mountains	intact	collapsed
84-30	1244	2 May & 26 July	60	135°	1372	1231	1500	mid	mountains	cave	cave
84-32	1213	16 May & 24 July	26	18°	347	346	351	lower	tundra	intact	collapsed
84-33	1257	18 May & 28 July	47	122°	1649	1557	1743	mid	mountains	intact	partially collapsed
84-34	unmarked	18 May & 28 July	50	100°	1478	1262	1603	mid	mountains	intact	collapsed
84-35	1182	18 May & 20 July	49	133°	1048	866	1250	mid	mountains	intact	collapsed
84-36	1225	20 May & 28 July	45	213°	674	640	969	lower	foothills	intact	collapsed
84-37	1210	18 May & 22 July	54	175°	1634	1469	2444	lower	mountains	intact	collapsed
84-38	1197	20 May & 30 July	67	46°	613	573	671	mid	foothills	intact	collapsed
84-39	1223	20 May & 30 July	35	121°	573	475	607	upper	foothills	snow den	--
84-40	1196	31 May --	68	114°	1161	833	1234	upper	mountains	partially collapsed	collapsed
84-42	1234	20 May & 23 July	58	161°	859	805	1298	lower	mountains	intact	collapsed
84-43	1248	20 May & 11 Aug	40	210°	579	457	744	mid	foothills	partially collapsed	partially collapsed
84-44	1226	20 May & 10 Aug	38	126°	384	207	482	mid	foothills	intact	collapsed
84-45	unmarked	20 May & 17 July	57	186°	689	664	1131	lower	mountains	intact	partially collapsed
84-47	unmarked	20 May --	54	167°	628	384	664	upper	foothills	collapsed	collapsed
84-48	1188	20 May & 19 July	45	106°	728	311	799	upper	foothills	intact	collapsed
84-49	1189	20 May & 23 July	45	97°	689	607	927	lower	mountains	intact	partially collapsed
84-57	1198	-- 29 July	58	176°	1219	1146	1469	lower	mountains	--	collapsed
84-58	1216	18 May & 26 July	65	244°	1061	902	2088	lower	mountains	partially collapsed	partially collapsed

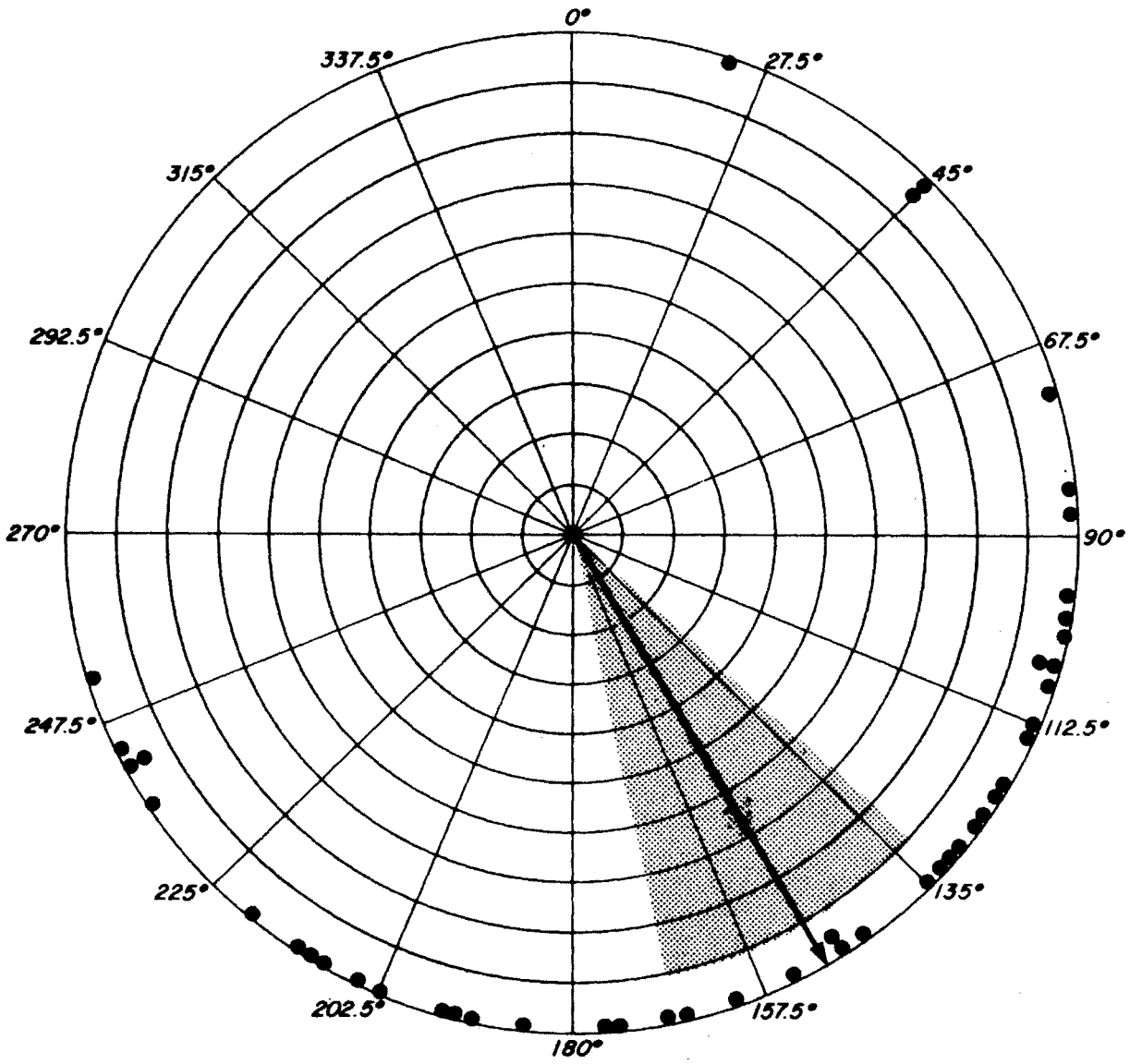

Fig. 4. Aspects, mean aspect (arrow), and 95% confidence interval (shaded arc) of 46 bear dens used during winter 1983-1984 on the Arctic National Wildlife Refuge, Alaska

Table 9. Fall denning characteristics of 43 brown bears in the northeastern portion of the Arctic National Wildlife Refuge, 1984.

Bear #	Reproductive status	Terrain	Date observed denned	Estimated aspect	Estimated elevation(m)
1056	male	mountainous	17 Oct	105°	1006
1182	potential breeder	mountainous	17 Oct	77°	1250
1188	male	foothills	6 Nov	205°	427
1189	probable breeder	mountainous	28 Oct	184°	686
1197	potential breeder	foothills	23 Oct	254°	762
1200	male	mountainous	16 Oct	122°	838
1202	probable breeder	mountainous	6 Oct	200°	671
1203	male	mountainous	16 Oct	149°	808
1204	male	mountainous	5 Nov	92°	747
1205	male	mountainous	16 Oct	182°	853
1208	probable breeder	mountainous	17 Oct	120°	1341
1210	probable breeder	mountainous	3 Nov	22°	1615
1212	probable breeder	mountainous	17 Oct	143°	1432
1214	immature female	coastal plain	5 Nov	19°	373
1217	probable breeder	foothills	29 Oct	310°	853
1220	1 cub	mountainous	17 Oct	181°	1813
1223	male	foothills	28 Oct	335°	366
1226	male	foothills	7 Nov	261°	549
1230	2 cubs	mountainous	28 Oct	180°	1036
1232	male	mountainous	23 Oct	181°	1493
1233	male	mountainous	23 Oct	111°	1006
1235	immature female	moutainous	28 Oct	102°	853
1236	probable breeder	foothills	5 Nov	95°	747
1239	2-2.5 year old?	mountainous	23 Oct	181°	1173
1241	male	mountainous	16 Oct	166°	1265
1245	probable breeder	mountainous	29 Oct	144°	1189
1246	male	mountainous	29 Oct	142°	914
1247	probable breeder	mountainous	16 Oct	99°	731
1252	probable breeder	mountainous	28 Oct	271°	686
1257	probable breeder	mountainous	6 Nov	242°	1585
1259	probable breeder	mountainous	16 Oct	113°	930
1260	probable breeder	mountainous	29 Oct	338°	671
1261	probable breeder	mountainous	15 Oct	236°	701
1263	male	mountainous	5 Nov	91°	792
1264	male	mountainous	16 Oct	174°	808
1267	2-2.5 year old	mountainous	16 Oct	209°	1021
1269	3 cubs	mountainous	16 Oct	160°	777
1278	2 cubs	mountainous	15 Oct	232°	640
1281	male	mountainous	23 Oct	111°	1067
1282	young female	mountainous	23 Oct	142°	808
1283	male	coastal plain	17 Oct	277°	114
Unmarked	unknown	mountainous	23 Oct	153°	1250
Unmarked	unknown	mountainous	5 Nov	96°	747

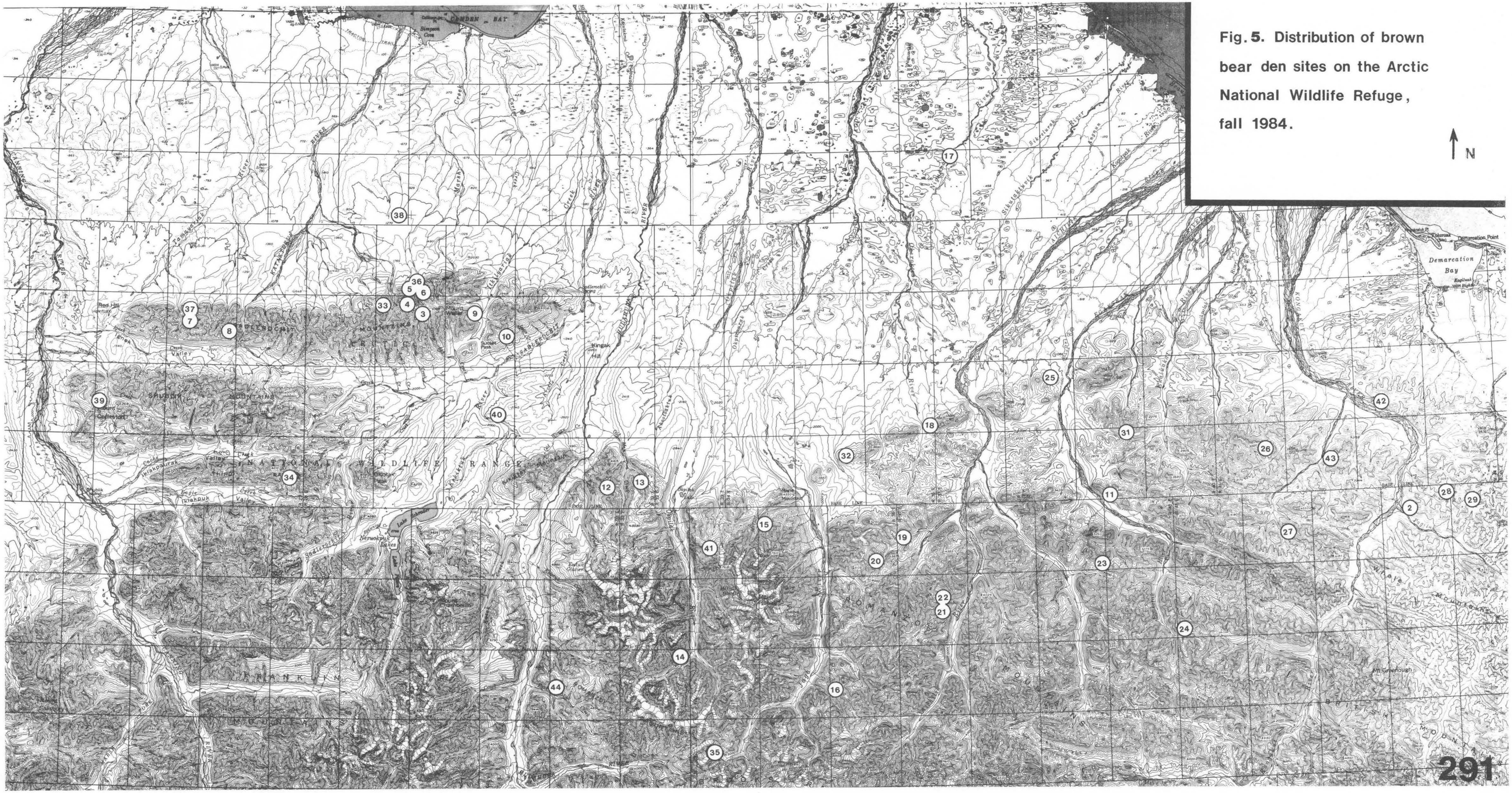

Fig. 5. Distribution of brown bear den sites on the Arctic National Wildlife Refuge, fall 1984.

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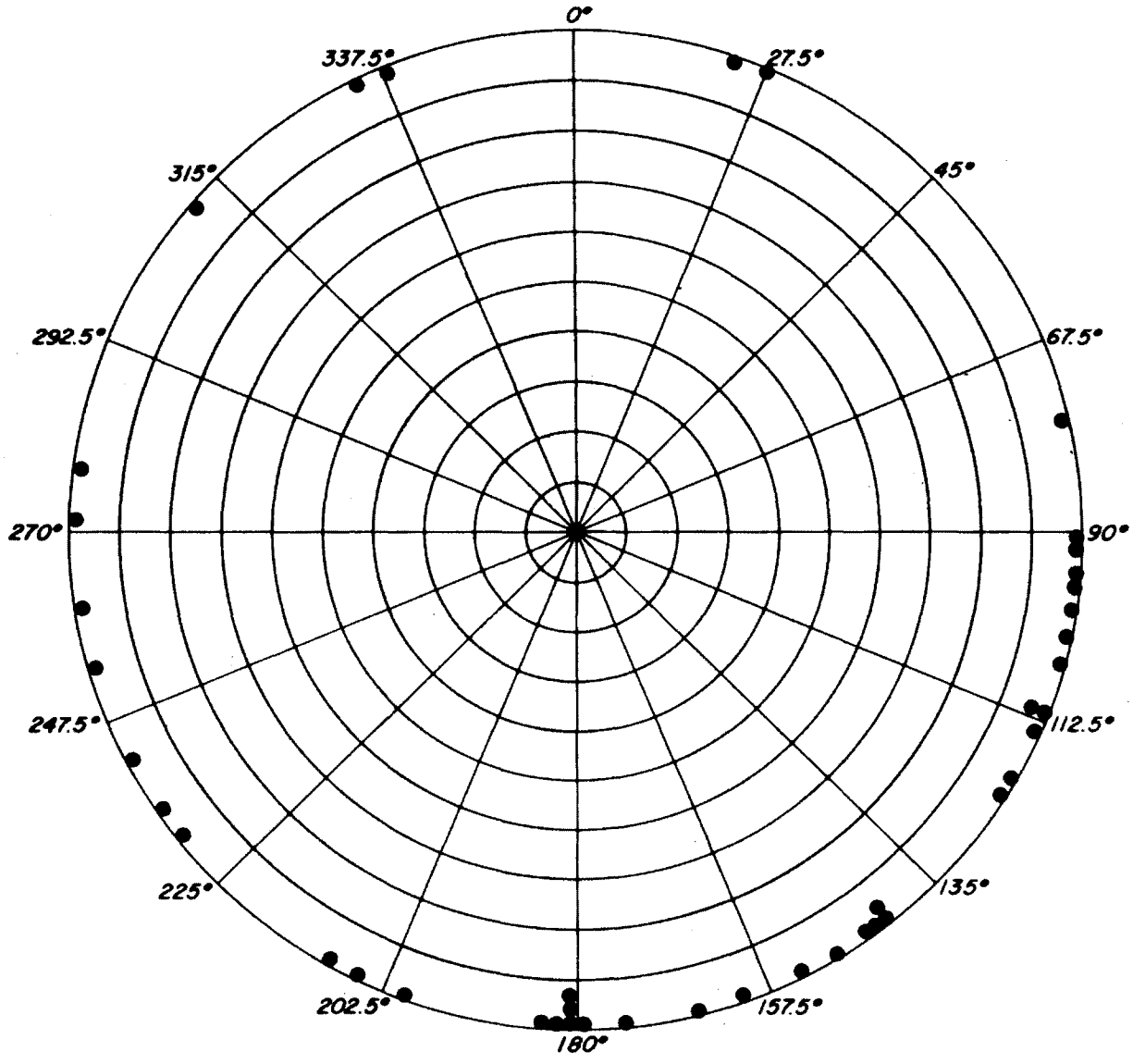

Fig. 6. Estimated aspects of 43 bear den sites located on the Arctic National Wildlife Refuge in October and November 1984.

(Table 9). In contrast to denning chronology in 1983, when only 3 of 46 radio-collared bears denned in early November (Garner et al. 1984), 9 bears were not denned in 1984 until 7 November (Table 7).

Elevations and aspects of the 43 fall den sites were estimated from 1:63,360 move to top of next pages scale topographic maps (Table 9). Average estimated elevation was 916 ± 54 m (SE) and is comparable to the average elevation of the 46 measured den sites in summer 1984. Estimated aspects for these 43 fall dens are depicted in Fig. 6. In general, estimated aspects of the 43 dens show a wider dispersion than the 46 den sites visited during summer 1984 (Figs. 4 and 6). However, the southeast and southwest quadrants contained a majority of the estimated aspects of den sites (27 and 13 respectively). These den sites will be inspected in early summer 1985 and actual aspects and elevation will be determined at that time.

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Literature Cited

Batschelet, E. 1981. Circular statistics in biology. 2and edition. Academic Press, Inc., London. 371pp.

Brady, N.C. 1974. The nature and property of soils. 8th edition. Macmillan Publ. Co., Inc., New York. 639pp.

Bunnell, F.L., and D.E. N. Tait. 1980. Bears in models and reality--implications to management. Pages 15-23 in C.J. Martinka and K.L. McArthur, eds. Bears--their biology and management. Bear Biology Assoc. Ser. No. 3. U.S. Gov. Print. Off. Washington, D.C.

Bunnel, F.L., and D.E.N. Tait. 1981. Population dynamics of bears--implications. Pages 75-98 in C.W. Fowler and T.D. Smith, eds. Dynamics of large mammal populations. J. Wiley and Sons, New York.

Chesmore, D.L. 1969. Den ecology of the arctic fox in northern Alaska. Can. J. Zool. 47:121-129.

Craighead, F.C., Jr., and J.J. Craighead. 1972. Grizzly prehibernation and denning activities as determined by radio tracking. Wildl. Mono. 32:1-35.

Craighead, J.J., F.C. Craighead, Jr., and H.E. McCutchen. 1970. Age determination of grizzly bears from fourth premolar tooth sections. J. Wildl. Manage. 34:353-363.

Craighead, J.J., J.R. Varney, and F.C. Craighead. 1974. A population analysis of the Yellowstone grizzly bears. Montana For. and Conserv. Sta. Bull. 40. School of Forestry, Univ. Montana, Missoula. 20pp.

Curatolo, J.A., and G.D. Moore. 1975. Home range and population dynamics of grizzly bear (Ursus arctos L.) in the eastern Brooks Range, Alaska. in R.D. Jakimchuk, ed. Studies of large mammals along the proposed Mackenzie Valley Gas Pipeline route from Alaska to British Columbia. CAGSL Biol. Rep. Ser. Vol. 32, Chapter 1, 79pp.

Garner, G.W., G.J. Weiler, and L.D. Martin. 1983. Ecology of brown bears inhabiting the coastal plain and adjacent foothills and mountains of the northern portion of the Arctic National Wildlife Refuge. Pages 275-290 in G.W. Garner and P.E. Reynolds, eds. 1982 update report baseline study of the fish, wildlife, and their habitats. U.S. Fish and Wildlife Service, Anchorage, Ak. 379pp.

Garner, G.W., H.V. Reynolds, L.D. Martin, T.J. Wilmers, and T.J. Doyle. 1984. Ecology of brown bears inhibiting the coastal plain and adjacent foothills and mountains of the northeastern portion of the Arctic National Wildlife Refuge. Pages 330-358 in G.W. Garner and P.E. Reynolds eds. 1983 update report baseline study of the fish, and wildlife, and their habitats. U.S Fish and Wildlife Service, Anchorage, Ak. 614pp.

Glenn, L.P. 1972. Report on 1971 brown bear studies. Alaska Dept. Fish and Game, Fed. Aid Wildl. Rest. Rep. Proj. W-17-3 and W-17-4, Juneau. 109pp.

Harding, L. 1976. Den site characteristics of arctic coastal grizzly bears (Ursus arctos L.) on Richards Island, Northwest Territories, Canada. Can. J. Zool. 54:1357-1363.

Johnson, K.G., and M.R. Pelton. 1981. Selection and availability of dens for black bears in Tennessee. J. Wildl. Manage. 45:111-119.

Mohr. C.O. 1947. Table of equivalent populations of North American small mammals. Am. Midl. Nat. 37:223-249.

Mundy, K.R.D., and W.A. Fuller. 1964. Age determination in the grizzly bear. J. Wildl. Manage. 28:863-866.

Pearson, A.M. 1975. The northern interior grizzly bear Ursus arctos L. Can. Wildl. Serv. Rep. Ser. 34:86 pp.

Pearson, A.M. 1976. Population characteristics of the Arctic mountain grizzly bear. Pages 247-260 in M. Pelton, J. Lentfer, and E. Folk, eds. Bears - their biology and management. IUCN New Series No. 40.

Phillips, M.K. 1984. Habitat use and behavior of grizzly bears in the Arctic National Wildlife Refuge. Pages 45-73 in G.W. Garner and P.E. Reynolds, eds. 1983 update report baseline study of fish, wildlife, and their habitats. U.S. Fish and Wildlife Service, Anchorage, Alaska. 614pp.

Quimby, R. 1974. Grizzly bear. in R.D. Jakimchuk, ed. Mammal studies in northeastern Alaska with emphasis within the Canning River drainage. CAGSL Biol. Rep. Ser. vol. 24, Chapter 2, 97pp.

Reichelt, L.R. 1973. Characteristics of elk calving sites along the west fork of the Madison River, Montana. M.S. Thesis. Montana State Univ., Bozeman. 39pp.

Reynolds, H.V. 1976. North slope grizzly bear studies. Alaska Dept. Fish and Game, Fed. Aid Wildl. Rest., Final Rep., Proj. W-17-6, Jobs 4.8R, 4.9R, 4.10R, and 4.11R. 20pp. (mimeo).

Reynolds, H.V. 1980. North slope grizzly bear studies. Alaska Dept. Fish and Game, Fed. Aid Wildl. Rest., Progress Rep., Proj. W-17-11, Jobs 4.1R and 4.15R.

Reynolds, H.V. In press. Grizzly bear population biology in the western Brooks Range, Alaska. in D. Graber, ed. Bears-their biology and management. Internatl. Assoc. for Bear Res. and Manage.

Reynolds, H.V., J.A. Curatolo, and R. Quimby. 1976. Denning ecology of grizzly bears in northeastern Alaska. Pages 403-409 in M. Pelton, J. Lentfer, and E. Folk, eds. Bears - their biology and management. IUCN New Series No. 40.

Reynolds, H.V., and J.L. Hechtel. 1983. Structure, status, reproductive biology, movement, distribution, and habitat utilization of a grizzly bear population. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Rep. Proj. W-22.1, Job 4.14R. Juneau. 22pp.

Ruttan, R.A. 1974. Observations of grizzly bear in the northern Yukon Territory and the MacKenzie River valley. in R.A. Ruttan and D.R. Wooley, eds. Studies of furbearers associated with proposed pipeline routes in the Yukon and Northwest Territories. CAGSL Biol Rep. Ser. Vol. 9, Chapter 7, 31pp.

Stickel, L.F. 1954. A comparison of certain methods of measuring ranges of small mammals. J. Mammal. 35:1-15.

Stoneburg, R.P., and C.J. Jonkel. 1966. Age determination of black bears by cementum layers. J. Wildl. Manage. 30:411-414.

Tietje, W.D., and R.L. Ruff. 1980. Denning behavior of black bears in boreal forest of Alberta. J.Wildl. Manage. 44:858-870.

U.S. Fish and Wildlife Service. 1982. Arctic National Wildlife Refuge coastal plain resource assessment -- initial report. Baseline study of the fish, wildlife, and their habitats. U.S. Fish and Wildlife Service, Anchorage, Ak. 507pp.

Vroom, G.W., s. Herrero, and R.T. Ogilvie. 1980. The ecology of winter den sites of grizzly bears in Banff National Park, Alberta. Pages 321-330 in C.J. Martinka and K.L. McArthur, eds. Bears-their biology and management. Bear Biology Assoc. Conf. Series.

Walker, D.A., W. Acevedo, K.R. Everett, L. Gaydos, J. Brown and P.J. Weber 1982. Landsat-assisted environmental mapping in the Arctic National Wildlife Refuge, Alaska. CRREL Report 82-27 U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory. Hanover, New Hampshire. 59pp.

Watson, G.H., W.H. Prescott, E.A. DeBock, J.W. Nolan, M.C. Dennington, H.J. Poston, and I.G. Sterling. 1973. An inventory of wildlife habitat on the Mackenzie Valley and the northern Yukon. Environmental Social Comm., Northern Pipeline. Task Force on Northern Oil Development. Rep. No. 73-27.

Whitten, K.R., G.W. Garner, and F.M. Mauer. 1984. Calving distribution, initial productivity and neonatal mortality of the Porcupine caribou herd, 1983. Pages 359-420 in G.W. Garner and P.E. Reynolds, eds. 1983 update report baseline study of fish, wildlife, and their habitats. U.S. Fish and Wildlife Service, Anchorage, Ak. 614pp.

Zar, J.H. 1984. Biostatistical analysis. Prentice-Hall, Inc., Englewood Cliffs, N.J. 718pp.

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