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POLAR BEAR REPORT

by
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PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperator: Jack W. Lentfer

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5.2R Polar Bear - Sea Ice Relationships

Period Covered: January 1, 1970 - December 31, 1970

SUMMARY

The Alaska Department of Fish and Game tagged 54 polar bears in the Point Barrow area, and the U. S. Fish and Wildlife Service tagged 27 bears in the Cape Lisburne area. Of 202 tags applied prior to 1970, 25 have been recovered nine months to three years after being applied. Tag returns indicate that bears marked in the Point Barrow area tend to return to the Point Barrow area more commonly than to move to other areas. Nylon ear tags are the best long-term marking device which has been used; there is some breakage of nylon tags, however, and other markers should be used concurrently.

Radio-tracking in the Point Barrow area provided short-term movement information for six polar bears in March and April. Signal strength for radio collars obtained on contract decreased from more than 100 miles when collars were not attached to bears to 30 miles or less when animals were carrying collars.

Long-term warming and cooling trends occur in the Arctic and probably affect polar bear distribution and numbers. Climatic trends should be considered when assessing bear distribution and population data on a long-term basis.

The Alaska polar bear harvest for July 1, 1969 through June 30, 1970 was 316. Natives, most with the aid of snowmachines, took five percent, and trophy hunters, most with the aid of aircraft, took 95 percent of the harvest. Nonresidents took 69 percent of the bears killed. The harvest was 72 percent males. Age determinations based on tooth cementum layering showed the mean age of males taken by nonresidents in the Chukchi Sea to be 6.5 years and in the Beaufort Sea to be 6.8 years. The mean number of days hunted by each hunter utilizing aircraft was 1.5.

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BACKGROUND

There are world-wide interest and a wide range of views about polar bear management. These range from the concept that bears are highly desired trophy animals that should be managed so as to furnish a maximum amount of hunting, to the concept that they are a unique and possibly endangered species that should be given complete protection. Polar bears are under the jurisdiction of five nations, each with different management philosophies. The Alaska Department of Fish and Game is responsible for management of polar bears in United States territory. Much of the past work of the Department to develop a management program has been an assessment of bear harvest by hunters and the gathering of abundance and composition data covering polar bears. Present efforts are directed toward determining distribution and movement patterns of bears off the coast of Alaska, with emphasis on identification of sub-populations. These studies are coordinated with those of other nations. The relationship of bears to different types of sea ice and the effects of ice formation, ice movements, and long-term climatic fluctuations on bear abundance, distribution, and movements are also being studied. Other studies are designed to describe breeding biology, determine parasite and pesticide levels, and develop a technique for age determination.

OBJECTIVES

To determine distribution and movement patterns of bears off the coast of Alaska, with emphasis on identification of sub-populations.

To determine the relative abundance of bears in different types of sea ice and how changes in ice movement and formation from year to year might affect abundance of bears along the Alaska coast. To describe the

movement patterns of ice throughout the polar basin with emphasis on those movements which would have the most effect on bears off the Alaska coast. To describe long-term climatic changes which might affect sea ice and, in turn, polar bears.

PROCEDURES

Polar bears were immobilized for the fourth year in the Point Barrow area in an attempt to recapture animals that had been marked in previous years and to mark additional animals. Work was conducted from the Naval Arctic Research Laboratory from March 2 through May 9. Aircraft used were a Hiller 12-E-4 helicopter, a Cessna 185 and a Cessna 180. Details on immobilizing and marking animals were as described by Lentfer (1968; 1969). After a few bears, marked in previous years, had been killed by hunters and recaptured in 1970, it became evident that metal ear tags were not being retained as well as nylon tags. Nylon Salascolor tags manufactured by Salt Lake Stamp Company, Salt Lake City, Utah, were then used instead of the metal tags. The U. S. Fish and Wildlife Service tagged bears in the Cape Lisburne area.

Equipment to radio-track polar bears was obtained on contract from Sensory Systems Laboratory, Tucson, Arizona, directed by Howard A. Baldwin. This contract called for six radio collars to be carried around the neck, weighing less than five pounds each, operational for 90 days and at -30°F., and constructed to withstand immersion in salt water and wear and shock to be expected when carried by a bear. The contract also called for two receivers, suitable for use in aircraft, for tracking. Performance objectives were 100 miles transmitting range, with bearing accuracies of approximately 15 degrees at ranges of 50 to 100 miles and approximately one degree at ranges of 0 to 50 miles.

The basic collars as supplied were of 2-1/2 inch-wide machine belting. Electronic components and batteries were attached to the belting in two packages; one positioned dorsally and one ventrally around the neck. The dorsal portion contained a low profile omnidirectional antenna, approximately 2.5 centimeters in height, which was embedded in dielectric foam to eliminate possible loading effects of ice and sea water. The lower portion contained a small transmitter and batteries embedded in foam. Foam was used to insulate and absorb shock. Both portions had an outer covering of fiberglass. Batteries in five collars were nickel-cadmium, operational for 90 days and at temperatures down to -60°F. Batteries in one collar were mercury with a calculated life of more than two years and capable of providing power only at freezing temperatures and above. Mercury batteries were covered with insulating foam and positioned in the collar so that they would be next to the neck of the bear. It was assumed that heat from the bear would keep them above freezing when ambient temperatures were much lower. All collars transmitted a pulsed omnidirectional signal, approximately once each second, on a VHF frequency of 148.5 megahertz. Pulse rates for each transmitter varied slightly to provide identification. Collars were attached around the necks of bears by lapping the ends of the belting and fastening with hog rings.

The receiver was a narrow band (four kilohertz) high gain circuit optimized to receive and detect transmitter pulses of about 13 milliseconds in length. Two receiving antennas were used. A commercial three-phase element Yagi (HyGain Model 23) was used for long-range unidirectional detection, and a dual, one-half wave antenna, was used for shorter range detection of a null bearing by interferometry. When a Cessna 180 or 185 was used for tracking, a long-range antenna was mounted on one wing strut and a short-range antenna on the other wing strut. When a Naval Arctic Research Laboratory R4D (DC-3) was used for tracking, only a long-range antenna was used, mounted so that it projected from the nose of the plane. Receivers were portable and battery powered.

Flights were made to test the range of transmitters before they were applied to bears and to gain proficiency in radio-tracking. Other tests were made in the laboratory to measure signal strength after subjecting a collar to various conditions that might be expected in the wild.

The five transmitters with nickel-cadmium batteries were attached to bears on the sea ice in March and April. One of these bears was subsequently killed by a hunter, and the transmitter, which was still functioning, was then attached to another bear. The transmitter with the mercury cells was attached to a large female bear thought to be pregnant. This bear had been held captive since May 9. She was released with the transmitter collar on the sea ice at Lonely, 75 nautical miles east of Barrow, on July 21.

The frequency of collar transmitters was VHF line-of-sight. Range increased as the elevation of the receiver increased, and the procedure for attempting to pick up signals from instrumented bears was to fly a predetermined course at the highest elevation allowed by weather conditions, aircraft capability, and comfort of passengers. This was usually between 8,000 and 12,000 feet. A 360 degree turn was made approximately every 25 miles to attempt to pick up signals to the side of the line of flight. The long-range tracking antenna was used until a signal was heard. The short range antenna, which gave a more precise bearing, was then used to home in on the signal. The receiver was constructed so that both the pilot and an observer could listen to signals at the same time, and it was possible for a pilot to fly the plane toward the signal with very little direction from the observer.

Sensory System Laboratory personnel provided assistance. Howard Baldwin was at Barrow March 4-14 and April 15-28, and Don Brumbaugh, a design engineer, was at Barrow April 15-22.

A program was started which may eventually permit bears to be tracked from an earth-orbiting polar satellite. The Smithsonian Institution, the coordinating agency for animal tracking by satellite, sent an engineer, James C. Maxwell, to Barrow for two weeks in March to become familiar with polar bear habitat and conditions under which bears are captured and would have to be fitted with radios for transmitting to a satellite.

The State obtained permission from the National Aeronautics and Space Administration for testing of a polar bear transmitter collar designed and constructed by Maxwell and Sensory Systems Laboratory, Tucson, Arizona. Transmission to a satellite (Nimbus 4) was attempted but was unsuccessful, apparently because of too little power in the transmitter. The Department then entered into a cooperative research proposal coordinated by the Smithsonian Institution to test the feasibility of satellite animal tracking. Funds were requested from NASA and the Atomic Energy Commission for tracking polar bear and caribou in Alaska, elk and grizzly bear in Wyoming, and green turtles in Costa Rica. Less funds were received than were requested, and the study was limited to the tracking of elk.

A study was continued on the relationships between polar bears and sea ice. Observations were made while searching for bears for tagging, during snow machine trips made along the coast, and during aerial surveys made shortly after freeze-up in the fall. Eskimo hunters provided information on relationships between bears and ice formation and movements along the coast. Literature was reviewed on sea ice and climatic changes which might affect sea ice.

FINDINGS

Mark and Recovery

Fifty-three bears were tagged in the Point Barrow area from March 2 to May 9. One bear was brought in from the ice, held at the Naval Arctic Research Laboratory, and released at Lonely, 75 miles east of Barrow, on July 21. The U. S. Fish and Wildlife Service tagged 27 bears in the Cape Lisburne area (Table 1). The total number of animals now tagged off the Alaska coast is 283 (Table 2).

In discussing movement data, the terminology used is defined as follows:

Recovery - movement data obtained by recapture, hunter kill, or resighting as defined below.

Recapture - data obtained when a marked animal is immobilized again by a tagging crew.

Hunter kill - data obtained when a marked animal is killed by a hunter.

Resighting - data obtained, usually from a number on the fur, when a marked animal is seen by a tagging crew, hunter, boat crew, or another person who reports it.

Recoveries nine months or longer after tagging are considered significant from a long-term movements standpoint. Twenty-five such recoveries

Table 1. Polar bear tagging data, Alaska, 1970.

	Ear Tag No.	Tattoo No.	Collar	Location		Date	Sex	Age Class
Lisburne	1209	None	None	69°30'N	166°48'W	2-25	F	Sub-Ad.
	1210*	1210	Green	69°30'N	166°48'W	2-25	F	Ad.
	1211	None	None	69°30'N	166°48'W	2-25	M	2
	1212	1212	Green	69°41'N	168°26'W	3- 1	F	Ad.
	1213	None	None	69°41'N	168°26'W	3- 1	M	2
	1214	1214	None	69°41'N	168°26'W	3- 1	M	2
	1215	1215	None	69°19'N	169°10'W	3- 2	F	Sub-Ad.
	1216	1216	None	69°19'N	169°10'W	3- 2	F	1
	1217	1217	Green	69°19'N	169°10'W	3- 2	F	Ad.
	1218	1218	None	70°11'N	166°05'W	3- 3	F	Sub-Ad.
	1220	1220	None	69°48'N	167°10'W	3-17	F	Ad.
	1221	1221	None	69°48'N	167°10'W	3-17	F	1
	1222	1222	None	69°48'N	167°10'W	3-17	F	1
	1223	1223	Green	69°08'N	167°51'W	3-19	F	Ad.
	1224	1224	None	69°08'N	167°51'W	3-19	F	2
	1225	1225	None	69°49'N	167°27'W	3-24	M	1
	1227	1227	Green	69°49'N	167°27'W	3-24	F	Ad.
	1228	1228	Red	69°49'N	167°27'W	3-26	M	Sub-Ad.
	1229	1229	None	69°49'N	167°27'W	3-26	F	Sub-Ad.
	1230	1230	None	69°28'N	167°47'W	3-27	F	Sub-Ad.
	1231	1231	Green	69°12'N	168°18'W	3-27	F	Ad.
	1232	1232	None	69°12'N	168°18'W	3-27	F	2
	1233	1233	None	69°12'N	168°18'W	3-27	M	2
	1234	1234	Red	69°00'N	166°05'W	3-27	M	Ad.
	1235	1235	Green	68°52'N	171°13'W	3-28	F	Ad.
	1236	1236	None	68°52'N	171°13'W	3-28	F	1
	1237	1237	None	68°52'N	171°13'W	3-28	F	1
Barrow	1127	1127	Olive Drab	71°45'N	156°38'W	3- 2	M	Ad.
	1029**	1029	None	71°16'N	157°17'W	3- 9	M	1
	1030	1030	None	71°16'N	157°17'W	3- 9	F	1
	1031	1031	White	71°27'N	157°42'W	3-10	F	Ad.
	1032	1032	Radio Collar #4	71°27'N	157°42'W	3-10	M	2
	1033	1033	White	71°44'N	156°43'W	3-16	F	Ad.
	1034	1034	None	71°44'N	156°43'W	3-16	F	1
	1036	1036	None	71°44'N	156°43'W	3-16	M	1
	1037	1037	Gold	71°39'N	157°42'W	3-23	M	Ad.
	1038	1038	White	71°39'N	157°42'W	3-23	F	Ad.
	1039	1039	Gold	71°54'N	157°43'W	3-23	M	Ad.
	1040	1040	Radio Collar #5	71°29'N	155°48'W	4- 2	F	Ad.
	1041	1041	None	71°29'N	155°48'W	4- 2	F	1
	1042	1042	None	71°29'N	155°48'W	4- 2	M	1

Table 1 (Continued).

	Ear Tag No.	Tattoo No.	Collar	Location		Date	Sex	Age Class
Barrow	[1043	1043	Radio Collar #6	71°52'N	157°15'W	4- 3	F	Ad.
	1044	1044	None	71°52'N	157°15'W	4- 3	M	2
	1045]	1045	None	71°52'N	157°15'W	4- 4	F	2
	[1046	1046	Radio-Collar #3	71°47'N	155°56'W	4- 3	F	Ad.
	1047]	None	None	71°47'N	155°56'W	4- 3	F	Cub of yr.
	1048	1048	White	71°44'N	158°22'W	4- 8	F	Ad.
	1049	None	None	71°44'N	158°22'W	4- 8	M	Cub of yr.
	[1050	1050	White	71°31'N	155°46'W	4- 9	F	Ad.
	1056	None	None	71°31'N	155°46'W	4- 9	M	Cub of yr.
	1057]	None	None	71°31'N	155°46'W	4- 9	F	Cub of yr.
	[1058	None	None	71°30'N	155°36'W	4- 9	?	Cub of yr.
	1059]	1059	White	71°30'N	155°36'W	4- 9	F	Ad.
	1060	1060	None	71°45'N	154°51'W	4- 9	F	Sub-Ad.
	[1061	1061	White	71°53'N	154°42'W	4-10	F	Ad.
	1062]	1062	None	71°53'N	154°42'W	4-10	M	2
	1063	1063	White	71°32'N	155°42'W	4-12	F	2
	[1064	1064	White	71°32'N	157°37'W	4-12	F	Ad.
	1065]	1065	None	71°32'N	157°37'W	4-12	F	1
	1066	1066	None	71°32'N	157°37'W	4-12	M	1
	1067	1067	None	71°47'N	156°19'W	4-13	F	Sub-Ad.
	1068	1068	White	71°48'N	156°01'W	4-13	F	Ad.
	1069	1069	Yellow	71°33'N	152°52'W	4-26	M	Ad.
	1070	None	White	71°38'N	151°37'W	4-26	F	Ad.
	1071	1071	None	71°30'N	153°56'W	4-27	M	Sub-Ad.
	1072	1072	None	71°51'N	157°59'W	4-30	M	Sub-Ad.
	[1073	1073	White	71°43'N	158°21'W	4-30	F	Ad.
	1074	1074	None	71°43'N	158°21'W	4-30	F	1
	1075]	1075	None	71°43'N	158°21'W	4-30	F	1
	[1077	1077	White	71°44'N	159°24'W	5- 2	F	Ad.
	1078	1078	None	71°44'N	159°25'W	5- 2	F	1
	1079]	1079	None	71°44'N	159°24'W	5- 2	F	1
	1080-81	1080	White	72°12'N	159°28'W	5- 2	F	Sub-Ad.
	1082	1082	White	71°44'N	158°26'W	5- 2	F	Ad.
	1084	1084	Yellow	71°06'N	158°36'W	5- 2	F	Sub-Ad.
	1085	1085	Yellow	71°17'N	157°04'W	5- 2	F	Ad.
	1088	1088	Yellow	71°21'N	158°11'W	5- 4	M	Ad.
	1089	1089	None	71°24'N	158°25'W	5- 4	M	2
	1090	1090	Yellow	71°15'N	159°10'W	5- 4	M	Sub-Ad.
	1091	1091	None	71°27'N	154°35'W	5- 9	F	2
	1092-93***	1092	Radio-Collar #7	70°55'N	153°18'W	7-21	F	Ad.

* Brackets indicate family groups.
** With mother which was tagged 4-29-68.
*** Bear No. 1092 originally captured 5-9-70 at 71°27'N 154°35'W, held at Barrow, and released 7-21-70 at 70°55'N 153°18'W.

Table 2. Location, sex and age composition of polar bears tagged in Alaska, 1967-1970.

	Cub-of-year			Yearling		2-yr-old		Sub-adult		Adult		
	M	F	Unk.	M	F	M	F	M	F	M	F	Total
Bering Strait												
1968				1			2			4	3	10
Lisburne												
1968				2	4	3	4	8	7	7	15	50
1969								1	2	4		7
1970				1	5	4	2	1	5	1	8	27
Barrow												
1967				3	3	4	2	2	4	4	9	31
1968				8	1	3	7	6	11	7	37	80
1969			2		1		4	2	2	2	9	22
1970	2	2	1	4	8	4	3	3	4	5	18	54
Barter Island												
1969				1	1							2
	2	2	3	20	23	18	24	23	35	34	99	283
	7(2%)			43(15%)		42(15%)		58(20%)		133(47%)		283

have been made through 1970 (Table 3). This table suggests that the most common movement is from the Barrow area back to Barrow. Quantitative comparisons cannot be made, however, when recapture and hunter harvest data are combined, because recovery effort by class of bears is not uniform from area to area. Females with young and young are sought by tagging and recapture teams, but not by hunters and are, therefore, recovered at higher rates in areas where recapture effort is high, as compared to areas where recapture effort is low.

A comparison can be made for hunter-killed bears only, which shows the percentage of tagged bears from each tagging area as they appear in the harvest of each major hunting area (Table 4). Sexes are separated because hunter selectivity varies from area to area. Seventeen tagged bears were killed by hunters nine months or longer after tagging, through 1970.

No tagged bears have been reported in the approximately 60-bear-per-year harvest from western Arctic settlements in Canada. Dr. Ian Sterling, western Arctic polar bear biologist for the Canadian Wildlife Service, feels reasonably certain that any polar bears with ear tags that might have been harvested in Northwestern Canada would have been reported (pers. comm.).

The number of recoveries is so low that data must be interpreted with caution. However, it appears that bears of both sexes, tagged at Barrow, are harvested nine months to three years after tagging at a significantly higher rate in the Barrow area than in the Chukchi Sea (0.6 percent of males and 0 percent of females harvested in Chukchi Sea were tagged at Barrow, and 2.6 percent of males and 4.6 percent of females in the Barrow harvest were tagged at Barrow).

For 30 marked bears which have been recaptured or shot by hunters, 28 could be identified either by one or both ear tags and/or a lip tattoo (Table 5). Some nylon tags were broken so that numbers were lost, and others were broken so that the number portion was still present. Some metal tags were lost, and the ear was split and healed. It appeared that the metal tag had not come unclinched, but had been lost by working to the edge of the ear. In some cases, ears with metal tags were infected and draining from the tagging site. Metal perhaps causes cold damage to tissue of the ear; nylon does not. Although the nylon tags break in some cases, it appears that they are superior to metal tags, which are subject to loss by sloughing. This became evident when the first recoveries were made in 1970, and another type of nylon tag was then substituted for the metal tag. In 14 bears which were examined for a lip tattoo, nine to 36 months after a tattoo had been applied, 11 had a tattoo which was legible. The lip tattoo was the only marker which identified one bear recaptured 36 months after tagging. Five of seven bears recovered nine to 25 months after having had nylon neck collars attached still had the collars.

Table 3. Polar bear movement data through 1970 from recovery of tagged animals nine months or longer after tagging.

Location Tagged	Location Recovered	Direction of Movement	Distance Between (Nautical Miles)	Time Interval	Sex	No. of Recoveries
Bering Strait	W. of Kotzebue	N	125	2 yrs.	F	1
Lisburne	S. of Pt. Hope	W	100	1 yr.	M	1
Lisburne	W. of Pt. Hope	W	160	2 yrs.	F	1
Lisburne	Lisburne	-	-	2 yrs.	F	1
Lisburne	Wainwright	NE	160	9 mos.	M	1
Lisburne	Franklin Pt.	NE	180	1 yr. 9 mos.	M	1
Lisburne	Barrow	NE	300	1 yr.	M	1
Barrow	N. of Van Karem, Russian Coast	SW	450	2 yrs.	M	1
Barrow	W. of Pt. Hope	SW	350	1 yr.	M	2
Barrow	Franklin Pt.	SW	50	9 mos.	M	1
Barrow	Barrow	-	-	1 yr.	M	4
Barrow	Barrow	-	-	1 yr.	F	6
Barrow	Barrow	-	-	2 yrs.	M	1
Barrow	Barrow	-	-	2 yrs.	F	1
Barrow	Barrow	-	-	3 yrs.	F	1
Barrow	Barter Is.	E	310	1 yr.	F	1

Table 4. Tagged polar bears in hunter harvest through 1970 by hunting area.

Of 10 bears (5 males, 5 females) tagged in Bering Strait in 1968, 1 was harvested as follows - 1969-70:

Females
1 in Chukchi Sea (1 of 84 equals 1.2% of harvest)

Of 57 bears (25 males, 32 females,) tagged at Lisburne, 1968-69, 5 were harvested as follows - 1969-70:

Males
1 in Chukchi Sea (1 of 344 equals 0.3% of harvest)
2 on coast between Pt. Lay and Franklin Pt. (2 of 8 equals 25% of harvest)
1 at Barrow (1 of 71 equals 1.4% of harvest)

Females
1 in Chukchi Sea (1 of 84 equals 1.2% of harvest)

Of 133 bears (41 males, 90 females, 2 unknown sex) tagged at Barrow, 1967-69, 11 were harvested as follows - 1968-70:

Males
3 in Chukchi Sea (3 of 526 equals 0.6% of harvest)
1 on coast between Pt. Lay and Franklin Pt. (1 of 27 equals 3.8% of harvest)
3 at Barrow (3 of 117 equals 2.6% of harvest)

Females
4 at Barrow (4 of 86 equals 4.6% of harvest)

Of 2 bears (1 male, 1 female) tagged at Barter Island, 1969, none were harvested.

Table 5. Condition of markers on tagged polar bears recaptured or killed by hunters.*

Tagging to Recovery Time	2 Months or Less	9-13 Months	21-25 Months	36 Months	Total 9-36 Months
No. of Recoveries	3	18	6	1	25
Nylon Tag					
Intact	3	10	4		14
Broken-No. present		7	1		8
Broken-No. gone		1	1	1	3
Metal Tag					
Present w/o infection	3	3	1		4
Present with infection		5	2		7
Present-ear condition not recorded		5	2		7
Missing		5	1	1	7
Collar					
Retained	2	5			5
Missing		1	1		2
Not collared	1	12	5	1	18
Lip Tattoo					
Legible	2	10		1	11
Illegible	1	4			4
Not tattooed		3	5		8
Not checked		1	1		2

* Does not include two bears killed by hunters which each had only a broken nylon ear tag and could not be identified.

Radio-Tracking

Table 6 and Fig. 1 summarize information on where and when polar bears were instrumented for radio-tracking and later relocated. In most cases, the radio signal from the transmitter collar brought the search plane to within one or two miles of the bear. Tracks on the ice were then followed to the bear, and it was identified visually.

The ranges at which signals were first received from bears did not exceed 30 miles. This was much less than the 85 nautical miles at which signals were received from a collar before it was put on a bear. The manufacturer's explanation was that the surface of the polar bear is a better conductor of radio frequency energy than was assumed when collars were constructed. He thought that the desired 100-mile range could be obtained in future transmitters by adjusting the transmitter and antenna.

Pulse rates of radio signals, which were different for each transmitter and were to identify individual animals, shifted after transmitters were applied to animals. The manufacturer had expected pulse rates to shift when transmitters were exposed to cold temperatures but thought all shifting would be in the same direction and at the same rate, and identity of individual transmitters would be maintained. Pulse rates clustered around a central value, however, and it was not possible to maintain identity of individuals. The manufacturer thought identity could be maintained in future transmitters by a greater spread between pulse rates.

Single engine Cessna 180's and Cessna 185's were used for tracking in March, April, and May. Signals were received in March and April, but not in May, although long tracking flights were made. It is not known if bears had moved beyond the search area, if transmitters were shielded by ice pressure ridges, if animals had removed collars which had then gone into the ocean, or if transmitters had stopped for some other reason.

A Naval Arctic Research Laboratory R4D (DC-3) was used for tracking in the summer when it was not possible to fly over open water and ice with single engine aircraft. A female bear, thought to be pregnant, which had been brought in from the ice and held at N.A.R.L. since May 9, was released with a radio collar on the beach at Lonely, 75 nautical miles east of Point Barrow on July 21. The objective was to monitor the bear's movements until she denned in the fall. The bear traveled to the northeast on the sea ice, which was against the beach at the time. The bear was radio-tracked for four days. Extensive flying after this failed to pick up signals. Since coverage was thorough and was continued immediately after the last signal was received, it is assumed that the bear did not make a long movement out of the search area, but that the transmitter stopped, either while on the bear, or because she was able to remove it and it went into the ocean.

One observation was made of the reaction of a bear, a mature female, to a radio collar as she recovered from Sernylan immediately after the

Table 6. Polar bear radio tracking data, 1970.

Bear No.	Description	Transm. No.*	Date & Location Tagged**	Dates & Locations Contacted
201	Female w/2 yearling cubs	2	3/9 259°T-24 mi.	3/10 259°T-24 mi. 3/21 322°T-23 mi. 3/22 342°T-28 mi.
1032	2 yr. old male w/ mother	4	3/10 289°T-22 mi.	3/11 280°T-25 mi. 3/21 328°T-23 mi. 3/22 344°T-22 mi.
1014	Female w/2 yr. old cub	6	3/16 002°T-22 mi.	3/21 360°T-14 mi. 3/25 032°T-43 mi. Killed by hunter.
1040	Female w/2 yearling cubs	5	4/2 061°T-18 mi.	4/3 057°T-16 mi. 4/9 052°T-15 mi.
1046	Female w/cub of year	3	4/3 026°T-30 mi.	4/7 335°T-18 mi.
1043	Female w/2 2-yr-old cubs	6	4/3 340°T-34 mi.	4/10 060°T-40 mi. 075°T-44 mi. 079°T-63 mi.
1092	Adult female	7	7/21 Lonely	7/22 068°T-20 mi. 7/23 068°T-20 mi. 7/24 049°T-35 mi.

* All transmitters except No. 7 contained nickel-cadmium batteries and had estimated lives of 90 days. Transmitter No. 7 contained mercury batteries and had an estimated life of more than two years.

** All locations are from Pt. Barrow, other than those for 1092, which are from Lonely.

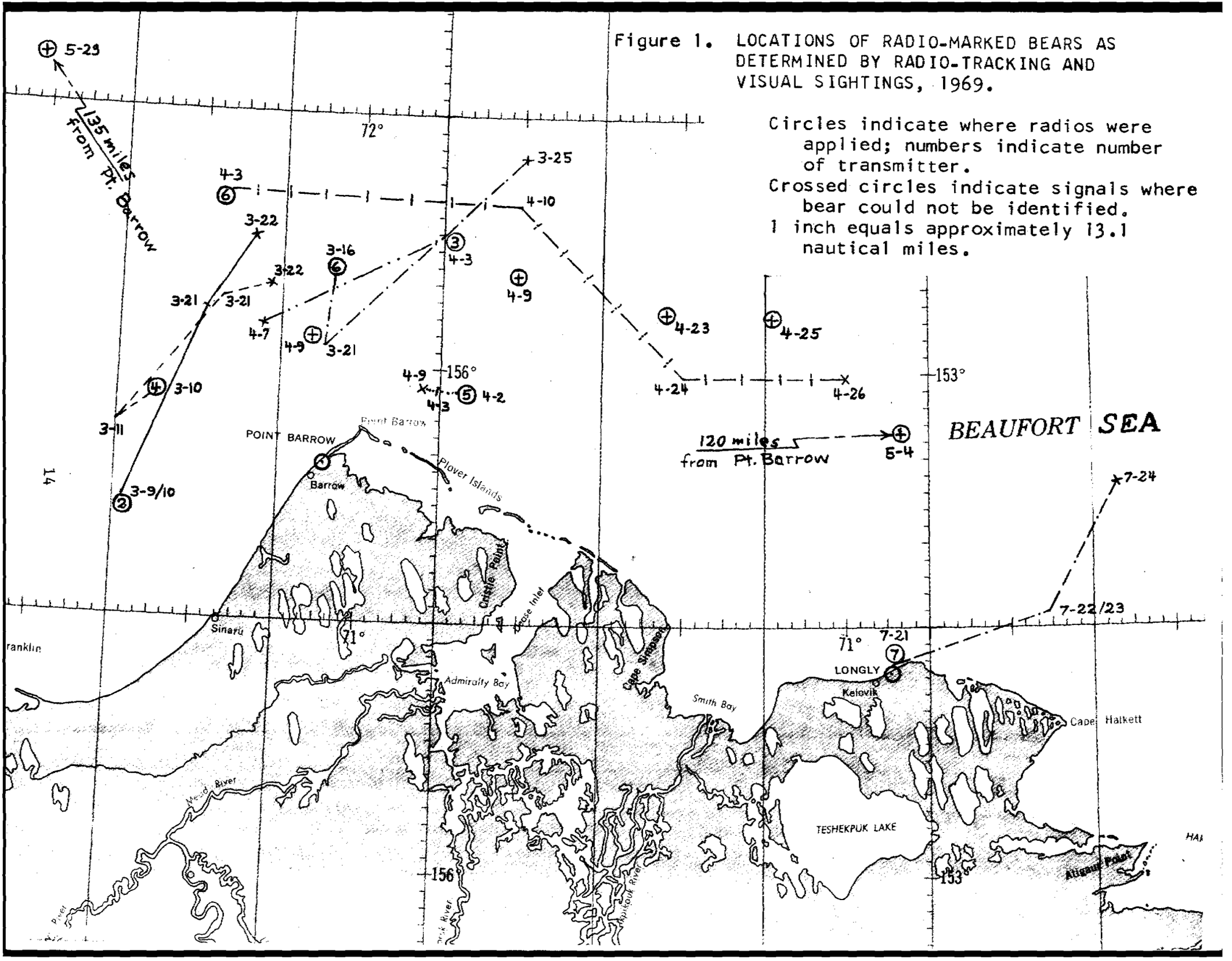

Figure 1. LOCATIONS OF RADIO-MARKED BEARS AS DETERMINED BY RADIO-TRACKING AND VISUAL SIGHTINGS, 1969.

Circles indicate where radios were applied; numbers indicate number of transmitter.

Crossed circles indicate signals where bear could not be identified.

1 inch equals approximately 13.1 nautical miles.

collar had been applied. She placed her front legs flat on the ice, and she then pushed forward with her hind legs so that the collar was scraped along the ice with the pressure of the collar directed toward the shoulders. This continued for 10 minutes. She then seemed to accept the collar and made only occasional, similar, but not as vigorous, attempts to remove it. She was not observed to attempt to move the collar forward over her ears. Observations were made for about two hours after she recovered from the drug.

The signal strength of transmitter collars was tested under various conditions before they were attached to bears. An oscilliscope provided a more sensitive measure of signal strength than the audio signals of the receivers used for tracking. Signal strength was decreased when a transmitter was placed around a person's neck. Cold to -20°C. did not affect signal strength of a transmitter with nickel-cadmium batteries. Signal strength was reduced considerably when a collar was submerged just below the surface of sea water. Immersion in sea water for 24 hours did not affect the collar. A layer of paper toweling soaked in sea water and laid over a collar to simulate a thin coating of sea ice decreased signal strength. The signal stayed the same as the toweling froze. Transmitters appeared to be slightly directional; the signal was slightly weaker from the sides of a collar than from the front and back.

Polar Bear-Sea Ice Relationships

Information obtained by direct observation and contact with Eskimo hunters on bear abundance in different types of sea ice, and on formation and movements of ice as it affects movements of bears, was similar to information reported previously (Lentfer, 1970). Likewise, published information obtained on ice movements throughout the polar basin was in agreement with that reported previously (Lentfer, 1970).

A review of literature indicated that long-term changes in ocean currents and climate occur. These changes can affect sea ice and, in turn, polar bears.

Vibe (1967) stated that the relative strengths of the Canadian, the East Greenland, and the Irminger Currents in Davis Strait off the southwest coast of Greenland determine sea ice distribution, which in turn influences climatic conditions and the composition, distribution, and stability of plant and animal communities on and adjacent to Greenland. He distinguished three different climatic periods, each about 50 years long, between 1810 and 1960, reflecting three stages of penetration of East Greenland ice into Davis Strait. He believed that conditions of 1810-1860 are now repeating themselves. He designated this as a drift ice stagnation stage where the Canadian current has a dominating influence, and east Greenland ice does not penetrate far north into Davis Strait. The climate is cold, dry, and stable.

Several authors have presented data indicating that sections of the Arctic have experienced warming trends prior to about 1950 and have experienced cooling trends since that time. Zubov's (1943) data show a warming of the Arctic for approximately 100 years prior to publication in 1943. He shows that Arctic glaciers have receded and the southern boundary of Siberian permafrost has moved northward. Zubov also presents comparative data obtained during the drift of the "FRAM" and the drift of the "SEDOV", 43 years later, over similar tracks in the Eurasian sector of the Arctic Ocean. The mean ice thickness was one-third less and mean air temperature 4°C. higher in 1937-40 than in 1893-96. Dorf (1960) quotes Willett (1950) who states that in Spitsbergen, mean winter temperatures have risen about 8°C. between 1910 and 1950. Dorf (1960) also quotes Ahlmann (1953) who reports ports in Spitsbergen to be ice-free and open to navigation about seven months of the year as compared with only three months 50 years earlier. Mitchell (1965) states that world climate during the past century has been characterized by a warming trend from the 1880's to the 1940's. Thereafter, the warming trend appears to have given way to a cooling trend that continued to at least 1960 with some evidence that it was continuing in 1965. Budyko (1966) says that polar ice cover is so sensitive to temperature that a summer anomoly of plus 4°C. would cause the entire ice pack to melt in four years; an anomoly of plus 2°C. would produce the same effect in a few decades. Once the ice pack had disappeared, negative temperature anomolies could reestablish it.

If changes in currents or a warming climate reduced the ice cover, bears might not be able to reach preferred maternal denning areas on large offshore islands. Productivity would be lowered if females were forced to den on ice which provided a less stable platform for denning than land. Periods of thawing and snow melt during winter caused by a warming climate would also adversely affect dens and production of young, both for polar bears and ringed seals, their principal food. Disappearance of the ice cover because of air temperature anomolies would have a severe impact on denning and the food chain supporting the polar bear. Periods of cooling trends, during which the ice cover increased, should make more land areas, especially those further south, accessible for denning.

RECOMMENDATIONS

The present polar bear mark and recovery program provides information on individual animals only at widely spaced intervals and most often only at certain times of the year when recoveries can be made by hunters or tagging crews. Continuous location information is needed from a number of animals to supplement this tag recovery information. It is recommended that emphasis now change from mark and recovery to radio-tracking. Tracking by aircraft is a possibility, but it is limited by much unflyable weather, darkness in the winter, and problems associated with flying over water and broken ice in the summer. It is recommended that the Department cooperate with other agencies in order to start

tracking by satellite as soon as possible. Tracking by aircraft should be a relatively minor interim activity to obtain specific pieces of information and to test techniques and equipment.

It is recommended that polar bear management objectives include high quality recreation in the form of esthetically acceptable hunting as the primary consumptive use of bears. This could be accomplished by changing present trophy hunting methods, where light aircraft are used to track and then drive bears to hunters, to hunting from the ground with dog teams or snowmachines and Eskimo guides. The average annual reported harvest of bears taken from the ground for a 25-year period prior to when planes were used for hunting was 117, indicating that the potential exists for a substantial amount of recreational hunting from the ground if use of aircraft were to stop. Elimination of use of planes for hunting would also do away with the difficult-to-stop hunting for commercial sale of skins, as is now done in conjunction with legitimate hunting with aircraft. Also, there is now public pressure, because of airplane hunting, to take polar bear management responsibility from the State of Alaska. Cause for such action, which would be to the disadvantage of Alaska coastal residents, would not exist if use of aircraft for hunting were stopped.

Hunting to obtain skins for sale, as can now be done by residents without the use of aircraft, is not compatible with a primary consumptive use objective of high-quality recreation. Such hunting for salable skins could increase as ground hunting develops. Money obtained from sale of skins by Arctic coast residents is becoming less significant as wage-earning opportunities and welfare measures increase. Therefore, it is recommended that sale of skins taken by hunting from the ground, as well as with the aid of aircraft, no longer be allowed. It should be recognized, however, that true subsistence hunting is a minor legitimate use of polar bears.

ADDITIONAL STUDIES

Harvest Characteristics

Harvest figures presented here are for the period July 1, 1969 through June 30, 1970. There were no significant changes from preceding regulatory years in hunting regulations for this period. The open season for trophy hunting extended from February 1 through April 30. The bag limit was one bear provided a bear had not been taken during the preceding three regulatory years. A permit was required prior to hunting. There was no limit on the number of permits issued except that imposed by a cut-off date of March 1 for permit application. Hunters who were not residents of Alaska were required to hire guides. Guides were limited to guiding six hunters and participating in six additional hunts. Residents were allowed to take bears at any time without a permit and without limit for food, provided aircraft were not used. Cubs (bears not yet two years old) and females with cubs were protected. Hides and skulls had to be presented to a Department representative within 30 days from the date

of kill for examination, sealing, and removal of a tooth for age determination. The only skins which could be sold were those from bears taken without the aid of aircraft.

Department personnel were stationed at Nome, Kotzebue, Point Hope, and Barrow during part or all of the period from late February through April when most of the sport hunting occurs. Information and specimen material was obtained from guides and hunters as in the past years (Lentfer, 1970). Testes were obtained early and late in the season to supplement information on male breeding biology reported by Lentfer and Miller (1969). Female reproductive tracts were obtained for the entire hunting period to add to the collection of material which will be used to describe female breeding biology. Blood sera were collected for Thor Larsen of the Norwegian Polar Institute who is using an electrophoretic technique to check for indications of racial differences among bears throughout the polar basin. Masseter muscle samples were collected for a cooperative study on Trichinella with Richard Barrett, U. S. Department of Agriculture. Fat and brain tissues were collected for pesticide analysis.

Harvest statistics for 1970 and comparative data for preceding years are presented in Tables 7-14 and Fig. 2. Some data are separated for north and west of Alaska because there is some indication that animals from these two areas belong to different sub-populations.

There has been a decline in the average age of bears harvested since 1965, the first year for which we have age determination data. This is because the number of old animals (10 years plus) in the harvest is decreasing and could indicate that hunting has changed the structure of the population. Age composition of the harvest could also be influenced by other factors, such as conditions for hunting. For instance, hunters are less selective and probably take younger animals in years when ice conditions are such that there are but few places to land.

Harvest data do not include an estimate of the number of bears not presented for sealing, which is thought to be substantial. Since 1967, one of the major controls on the number of bears taken has been a restriction on the number of hunts in which two guides working together could participate. Early in the 1970 season some guides started changing partners in a manner that would have made it nearly impossible to obtain a conviction, should this regulation be violated. Violations could have resulted in an excessive harvest, and an early season closure was considered. This caused some skins to be shipped out of the State without being sealed, so that harvest figures would not indicate an excessive kill. The early closure was not put into effect. In addition, the demand for polar bear skins was great enough that bears were taken with aid of aircraft so that skins could be sold. It was reported that large unsealed Alaska hides could be disposed of for as much as $2,000 in cash. The demand for skins was probably a result of increased publicity about polar bears and a wide-spread demand for increased restrictions on their harvest. Also, there have been fewer skins available since 1967 when a

Table 7. 1970 known polar bear harvest by Alaska based hunters. Data are catagorized on the basis of area, type of hunter, and sex of bear.*

Hunting Base	NONRESIDENT			RESIDENT - WHITE			RESIDENT - NATIVE			TOTAL						
	M	F	Sex Unk.	M	F	Sex Unk.	M	F	Sex Unk.	M	F	Sex Unk.	All Bears	% of Total Kill	% Male	% Non-Res.
Teller	12	1	-	8	4	-	-	-	-	20	5	-	25	7.9	80	52
Diomede	-	-	-	-	-	-	2	1	-	2	1	-	3	0.9	67	0
Shismaref	11	8	-	4	2	-	-	-	-	15	10	-	25	7.9	60	76
Kotzebue	91	9	6	23	10	3	-	-	-	115	18	9	142	44.9	86	75
Pt. Hope	29	7	-	3	1	-	1	2	-	33	10	-	43	13.6	77	84
Wainwright	1	-	-	-	-	-	1	1	1	2	1	1	4	1.2	67	25
Arlis V & VI**	-	-	-	-	-	-	1	2	-	1	2	-	3	0.9	33	0
Barrow	21	16	-	11	11	-	2	1	-	34	28	-	62	19.9	54	59
Colville R.	1	3	-	-	-	-	-	-	-	1	3	-	4	1.2	25	100
Barter Is.	1	-	-	3	-	-	1	-	-	5	-	-	5	1.5	100	20
Sub Total	167	44	6	52	28	3	8	7	1	228	78	10	316	100	72	69
Percent	79	21		65	35		53	47		72	25	3				
Total	217 (69%)			83 (26%)			16 (5%)									

* Does not include one bear killed at Barrow in defense of life while tagging.
** Drifting ice stations 150-300 miles north of Barrow when bears killed.

Table 8. Polar bear harvest and sex ratios, 1961-1970.

Year	Non-Resident		Resident White		All Sport Hunters		Resident Native		All Hunters	
	No.	% Male	No.	% Male	No.	% Male	No.	% Male	No.	% Male
1961	70	93	59	57	129	77	23	52	152	73
1962	78	85	103	60	181	70	16	50	201	69
1963	106	88	57	68	163	81	22	68	189	79
1964	142	89	86	60	228	78	23	69	253	77
1965	159	89	116	64	275	79	21	50	296	76
1966	195	89	152	66	347	79	52	46	399	74
1967	124	97	42	69	166	90	25	50	191	80
1968	184	84	56	66	240	80	111	61	351	74
1969	227	76	44	63	290	69	27	56	298	72
1970	217	79	83	65	300	76	15	53	316	72

Table 9. Age composition of polar bears harvested in 1970 based on tooth cementum layering (254 bears aged of 316 harvested).

	NUMBER OF BEARS				
	MALE			FEMALE	
	Airplane				
AGE	Nonres.	Res.	Ground	Airplane	Ground
Chukchi Sea					
1	-	-	-	-	-
2	3	-	-	1	-
3	21	7	-	10	-
4	21	9	-	6	-
5	19	4	-	-	-
6	19	1	-	2	-
7	14	2	-	2	-
8	10	1	-	2	-
9-10	13	1	-	3	-
11+	13	5	-	4	-
Mean Age	6.5	6.3		5.9	
Range	2-23	3-21		2-19	
Beaufort Sea					
1	-	-	-	-	-
2	-	1	-	-	-
3	1	3	1	6	1
4	3	3	2	4	1
5	5	-	1	3	-
6	2	-	-	4	-
7	1	-	-	-	-
8	2	-	-	2	1
9-10	2	1	-	1	-
11+	3	1	-	6	-
Mean Age	6.8	4.9	4.0	7.1	5
Range	3-13	2-11	3-5	3-22	3.8

Table 10. Average age based on tooth cementum layering of polar bears in hunter harvest, 1966-70.

	MALE			FEMALE	
	Airplane				
	Nonresident	Resident	Ground	Airplane	Ground
Chukchi Sea					
1966	9.1(64)*	7.0(13)	--	7.2(14)	3.0(1)
1967	7.0(39)	7.0(7)	--	6.0(12)	--
1968	8.2(76)	5.8(21)	--	8.3(8)	4.0(3)
1969	6.3(106)	4.6(10)	--	5.4(27)	4.5(2)
1970	6.5(133)	6.3(30)	--	5.9(30)	--
Beaufort Sea					
1966	10.1(16)	7.2(13)	10.6(4)	6.6(8)	5.0(6)
1967	7.7(17)	6.0(10)	4.5(2)	7.0(8)	5.0(2)
1968	8.1(21)	6.4(7)	5.6(28)	5.8(22)	6.2(23)
1969	7.4(25)	5.8(8)	6.0(15)	5.6(28)	4.6(8)
1970	6.8(19)	4.9(9)	4.0(4)	7.1(26)	5.0(3)

* Numbers in parentheses are numbers in sample.

Table 11. Average skull size* in inches of polar bears taken by airplane hunters based in Alaska, 1966-70.

	Nonresident		Resident-White		Total	
	Male	Female	Male	Female	Male	Female
Chukchi Sea						
1966	25.1(139)**	21.0(9)	24.1(48)	21.4(20)	24.8(187)	21.5(29)
1967	24.9(79)	21.2(6)	23.1(14)	22.1(4)	24.6(93)	21.6(10)
1968	25.2(121)	21.3(12)	24.5(24)	19.1(4)	25.0(145)	20.8(16)
1969	24.5(119)	21.3(24)	24.0(10)	21.3(3)	24.4(129)	21.3(27)
1970	24.4(142)	21.5(23)	23.6(36)	21.2(16)	24.2(178)	21.4(39)
Beaufort Sea						
1966	24.1(25)	20.5(6)	22.4(44)	19.9(26)	23.0(69)	20.0(32)
1967	23.6(22)	20.0(5)	22.6(14)	19.9(7)	23.2(36)	19.9(12)
1968	23.7(23)	21.1(12)	23.0(5)	19.7(10)	23.6(28)	20.4(22)
1969	23.4(20)	21.2(20)	22.5(10)	20.0(7)	23.1(30)	20.9(27)
1970	23.4(24)	20.5(19)	22.3(14)	20.0(11)	23.0(38)	20.3(30)

* Skull size is greatest length without lower jaw plus greatest width.
** Numbers in parentheses are numbers in sample.

Figure 2. Chronology of Polar Bear Harvest by Hunters Using Aircraft, 1970.

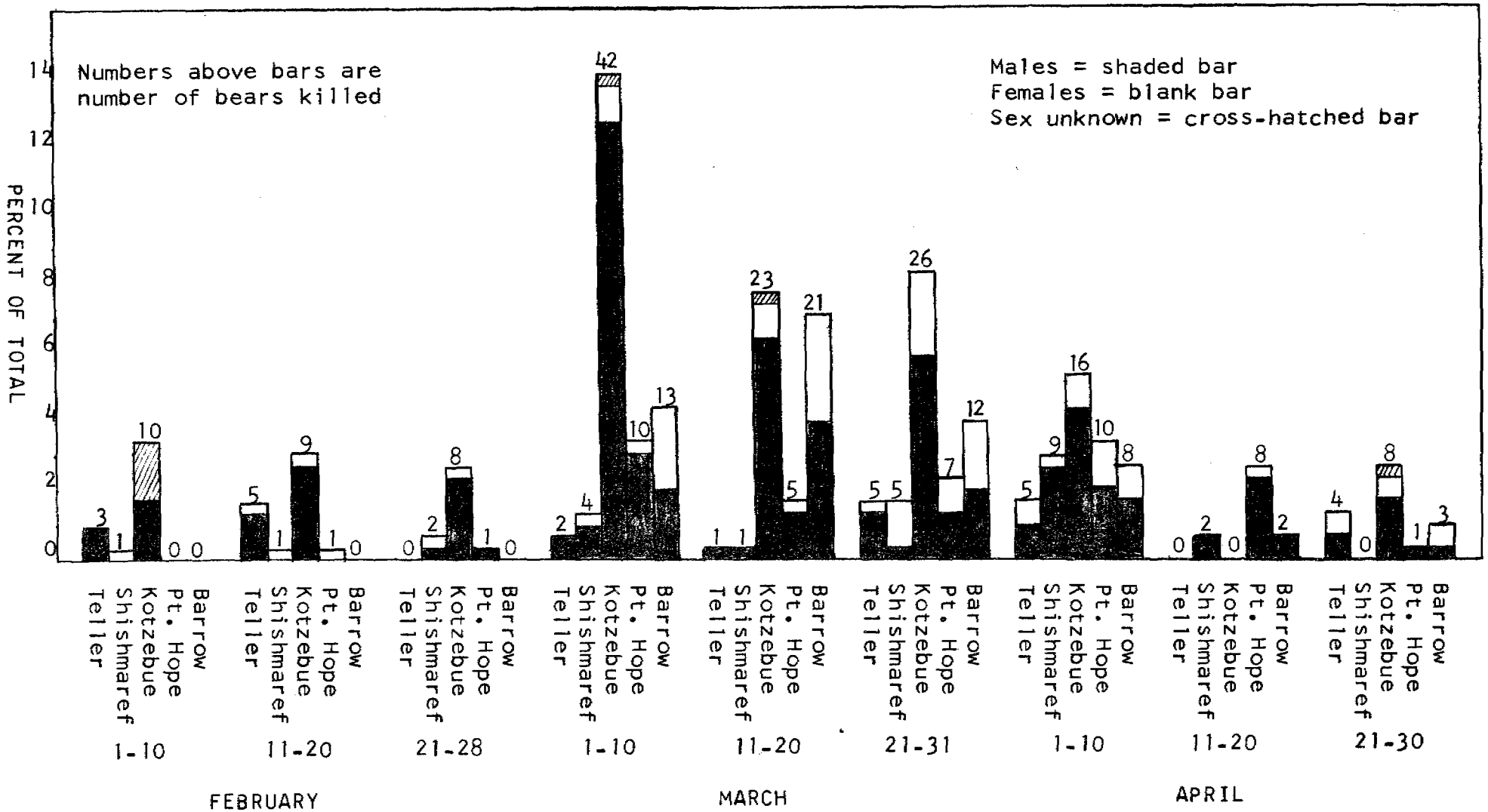

Table 12. Chronology of 1970 native polar bear harvest.*

Hunting Site	Nov.		Dec.		Jan.		Feb.		Mar.		Apr.		May	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Diomede	2	1												
Pt. Hope									1	2				
Wainwright	1											1		
Barrow	1													1
Barter Is.									1					
Total	4	1							2	2		1		1

* Does not include one bear of unknown sex killed in September at Wainwright.

Table 13. 1970 Polar bear airplane hunting data.

Hunting Base	No. of Guide Teams	No. of Bears Killed on Guided Hunts	No. of Bears Killed on Unguided Resident Hunts	Percent of Total Airplane Kill
Teller	3	20	5	8%
Shishmaref	2	25	0	8%
Kotzebue and Point Hope	18	158	24	61%
Barrow	6	47	12	20%
Colville River	1	4	0	1.5%
Barter Island	1	2	2	1.5%
Total	31	256	43	100%

Table 14. Hunting effort in days expended by polar bear hunters using aircraft, 1970.

Hunting Base	MALE				FEMALE				TOTAL		
	Resident		Nonres.		Resident		Nonres.				
	$\bar{x}$	Range	$\bar{x}$	Range	$\bar{x}$	Range	$\bar{x}$	Range	$\bar{x}$	Range	No. in Sample
Teller	2.0	1-3	2.1	1-4	1.0	1	1.3	1-2	1.8	1-4	19
Shishmaref	1.2	1-2	1.9	1-3	1.0	1	1.7	1-2	1.6	1-3	24
Kotzebue	1.4	1-6	1.3	1-5	1.6	1-4	1.0	1	1.3	1-6	130
Point Hope	1.0	1	1.6	1-5	1.3	1-2	1.6	1-4	1.5	1-5	43
Barrow	1.1	1-2	2.3	1-7	1.4	1-3	2.3	1-6	1.9	1-7	60
All Bases	1.3	1-6	1.6	1-7	1.4	1-4	1.7	1-6	1.5	1-7	277

regulation prohibiting sale of hides taken with the aid of aircraft went into effect. Traffic in unsealed and illegal hides was difficult to prevent for several reasons: 1) airborne activities on the high seas are difficult to monitor because of logistical and jurisdictional problems; 2) skins can be frozen and stored and kept hidden for long periods of time along the Arctic coast; 3) hunters who do not have permits (or for other reasons) can get coastal residents to have bears sealed for them as subsistence kills; and 4) pilot-guides can use legitimate guiding activities as a cover for illegal taking of bears.

Physiological Implant Study

A pilot study was conducted with Howard Baldwin, Sensory Systems Laboratory, Tucson, Arizona, and Larry Underwood, Ph.D. candidate, University of Pennsylvania, to gain experience and test equipment for future physiological studies requiring implanted instruments. A captive 15-month-old male polar bear was immobilized with Sernylan and Sparine and anesthetized with ether. A heat flow transducer coupled to a small transmitter was inserted surgically under the skin behind the point of the shoulder over the spine. A temperature transmitter was inserted in the body cavity near the liver. Temperature and heat flow were transmitted by pulse rate modulation and received by conventional receivers. Data were extracted by measuring the pulse interval with a digital counter. The bear was monitored on closed circuit television so that activities could be correlated with heat flow and temperature changes. Data that appeared reasonable were obtained for five days from the abdominal cavity and for 11 days from under the skin. Additional data will be needed from future studies to draw conclusions.

International Meeting

Jack Lentfer attended the second meeting of Polar Bear Specialists, February 2-4, 1970, at headquarters of the International Union for the Conservation of Nature at Morges, Switzerland. Delegates from each of the five polar bear nations attended. Notes of the meeting and copies of working papers prepared by delegates have been published by the I.U.C.N. (1970).

Population identity of polar bears was reported on and discussed in some detail. Tag returns, morphometric studies, and serum protein comparisons are starting to indicate that there are probably several fairly discreet populations of bears. Marking studies and observations are giving insight into movement patterns. Major denning areas were described in more detail than they have been previously. There was much discussion of immobilizing and marking techniques; over 450 bears had been marked by all countries at the time of the meeting. Harvest figures were presented, and new and proposed management practices discussed. A proposal by the Russians that a five-year moratorium on hunting be put into effect was modified and submitted to the I.U.C.N. with a request that the I.U.C.N.

request governments to examine their polar bear management programs closely and drastically curtail harvests. The possibility of an International Convention for research and management of polar bears was discussed. Delegates agreed to query their respective governments regarding a treaty or convention and report the results to the next meeting of the specialist group in January 1972.

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Lee Miller assisted with much of the polar bear tagging. Other Departmental personnel who assisted for shorter periods were Jerry Sexton, Mel Buchholtz, Ed Huizer, and Bob Hinman. James Brooks of the U. S. Fish and Wildlife Service tagged bears at Cape Lisburne. Harvest monitoring was by Bob Pegau at Nome, Jerry McGowan and Al Johnson at Kotzebue, John Trent and Don Cornelius at Point Hope, and Jerry Sexton and Mel Buchholtz at Barrow. Dan Wetzel and Walt Brunner assisted with data compilation. Nick Steen prepared excellent tooth sections. The director and staff of the Naval Arctic Research Laboratory at Barrow provided much support which is gratefully acknowledged.

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