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POLAR BEAR REPORT

By Jack W. Lentfer

Volume XIII Project Progress Report Federal Aid in Wildlife Restoration Project W-17-3, Job 5.1R (2nd half) and Project W-17-4, Jobs 5.1R, 5.3R, 5.4R and 5.5R (1st half)

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JOB PROGRESS REPORT (RESEARCH)

State:	<u>Alaska</u>		
Cooperator:	Jack W. Lentfer		
Project Nos:	$\frac{W-17-3}{W-17-4}$	Project Title:	Big Game Investigations
Job Nos:	<u>5.1R</u>	Job Titles:	Polar Bear Distribution and Movements
	<u>5.3R</u>		Polar Bear Age Determination Technique
	<u>5.4R</u>		Polar Bear Reproduction and Denning
	5.5R		Environmental Contaminants and Parasites in Polar Bears

Period Covered: January 1, 1971 - December 31, 1971

SUMMARY

The Alaska Department of Fish and Game tagged 52 polar bears in the Point Barrow area, and the U.S. Fish and Wildlife Service tagged 22 bears in the Cape Lisburne area. Of 283 tags applied prior to 1971, 35 have been recovered 9 months to 4 years after being applied. Tag returns indicate that bears marked in the Point Barrow area tend to return to that area more commonly than 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.

Transmitter collars fastened to polar bears have provided a limited amount of movement data. Transmitters and the method of attachment should be improved.

The accuracy of the tooth cementum age determination technique for polar bears will be checked by examining teeth from bears of known age. Skull size, tooth wear, and reproductive status will aid in assigning ages.

Age composition of polar bears tagged indicates good productivity in the area north of Point Barrow. An undetermined, although greater than previously believed, amount of polar bear denning occurs along the north Alaska coast and on drifting sea ice north of Alaska.

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<u>Trichinella</u> larvae occurred in approximately 55 percent of masseter muscle samples from 308 bears. Environmental contaminants in polar bear tissues include DDT and DDT metabolites, polychlorinated biphenyls, and mercury.

The Alaska polar bear harvest for July 1, 1970 through June 30, 1971 was 203. Natives, most with the aid of snowmachines, took 13 percent, and trophy hunters, most with the aid of aircraft, took 87 percent of the harvest. Non-residents took 38 percent of the harvest. The harvest was 70 percent males. The mean number of days hunted by each hunter utilizing aircraft was 1.6. Age composition of the harvest suggests that hunting has not significantly altered the average age of males in the area west of Alaska. There has been a decline in average age of males and an increase in the percentage of females in the harvest north of Alaska.

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BACKGROUND

There is 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 hunter harvest and the gathering of abundance and composition data. 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 have also been studied. 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. Other studies are designed to test the accuracy of the cementum age determination technique, describe breeding biology and denning in the Alaska sector of the polar basin, and determine levels of parasites and environmental contaminants in polar bears.

OBJECTIVES

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

To determine if tooth cementum layering provides accurate age

determinations for polar bears.

To determine the extent of past and present denning by polar bears along the coast of Alaska and possible reasons for changes in denning patterns. To obtain an indication of the amount of denning on sea ice.

To determine parasite levels and types and levels of environmental contaminants in polar bears.

PROCEDURES

Polar bears were immobilized for the fifth year in the Point Barrow area to recapture animals that had been marked in previous years, to mark additional animals, and to obtain data on sex and age composition and reproductive status. Work was conducted from the Naval Arctic Research Laboratory from March 20 through May 17. Aircraft used were a Bell Jet Ranger helicopter and a Cessna 185 fixed-wing plane. Lentfer (1968; 1969; 1971) gives details on immobilizing and marking procedures. The U.S. Fish and Wildlife Service tagged bears in the Cape Lisburne area.

The recovery effort for tags was similar to that of past years. Residents of coastal villages were informed of the marking program and \$25 tag reward. Department personnel stationed in hunting villages to monitor hunting with use of aircraft in February, March, and April checked for marked animals in the harvest. U.S. and Canadian icebreaker personnel were asked to examine bears which they saw for marks. Canadian and Russian officials publicized the tagging program and need for tag return in appropriate areas in their countries.

Radio transmitter collars supplied by Sensory Systems Laboratory, Tucson, Arizona, originally for tracking grizzly bears on the Arctic Slope, were made available for polar bear tracking. Receivers, antennas, and basic design of transmitter collars were the same as used for tracking polar bears in 1970 (Lentfer, 1971). Antennas on 1971 transmitters had been adjusted to attempt to increase range of transmission. Mercury batteries in transmitters had a calculated life of more than 2 years. Transmitters were tested on a captive bear and on two bears on the ice. A radio collar applied to a bear in 1970 was recovered when the bear was shot by a hunter in 1971 and provided information on durability of the collar.

Bears tagged as yearlings and 2-year-olds provided teeth from known-age animals at the time of tagging and later when some of these animals were killed by hunters or recaptured. Other tagged animals which were killed or recaptured provided tooth sections for comparison from individual animals when they were at different ages. Rudimentary premolars removed periodically from captive bears at the Naval Arctic Research Laboratory at Barrow provided other teeth from known-age animals. Attempts to secure teeth from known-age animals which died in zoos were unsuccessful. Lentfer (1968; 1970) describes the preparation of tooth sections for microscopic examination.

Female reproductive tracts were collected from bears killed by Alaskan hunters. Thor Larsen, Norwegian polar bear research biologist, provided female reproductive tracts from Spitsbergen bears. These reproductive tracts and tracts collected from Alaska bears in past years were examined. Data recorded included reproductive status and age of female; weight of each ovary; weight of uterus; length and split width of each uterine horn; type, size, and abundance of ovarian bodies; and number, location, and brightness of placental scars.

Tagging provided information on reproductive status and age of females, age of young, and size of litters in the live population.

Residents of Point Hope, Wainwright, Barrow, and Barter Island were interviewed to obtain information on polar bear denning. Aerial surveys, one objective of which was to locate polar bears going into dens in the fall, were flown from Cape Lisburne to the Canadian border in October. The locations of new cubs and their tracks on sea ice, observed while tagging bears in late March and April, were recorded to aid in an assessment of sea ice denning. Attempts to backtrack females with new cubs to sea ice dens were not successful.

Richard Barrett, U. S. Department of Agriculture Animal Health Service biologist, continued determining incidence and intensity of <u>Trichinella</u> infestations in polar bear masseter muscles obtained from bears killed by hunters in past years.

The Wisconsin Alumni Research Foundation, Madison, Wisconsin, under contract to the Department, determined chlorinated hydrocarbon levels in 50 polar bear tissue samples collected in 1970.

FINDINGS

Mark and Recovery

In 1971, the Alaska Department tagged 52 bears in the Barrow area, and the U. S. Fish and Wildlife Service tagged 22 bears in the Cape Lisburne area (Table 1). Each tagging group recovered one bear that had been tagged in a preceding year. Hunters in 1971 killed eight bears that had been tagged in previous years. The total number of animals tagged off the Alaska coast through 1971 is 357 (Table 2, Fig. 1).

Recoveries 9 months or longer after tagging are considered significant from a long-term movement standpoint. Thirty-five such recoveries of 283 animals tagged through 1970 have been made through 1971. Animals that have been tagged and then recovered in the Point Barrow area appear most frequently in the recovery data. Quantative comparisons of the rate of recovery in different areas cannot be made, however, when recapture and hunter harvest data are combined, because recovery effort by class of bear is not uniform from area to area. Females with young and lone young are sought by tagging-recapture teams, but not by hunters, and are therefore recovered at higher rates in areas where tagging and recapture effort is high as compared to areas where tagging and recapture effort is low.

A comparison can be made of only bears killed by hunters which shows the percentages of tagged bears from each tagging area as they appear in the harvest of each major hunting area. In making this comparison, sexes are separated because hunter selectivity for sex of bear varies from area to area. Through 1971, 26 tagged bears had been killed by hunters 9 months or longer after they had been tagged. (Figs. 2 and 3). No tagged bears have been reported in the approximately 60-bear-per-year harvest from settlements in western Canada. 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 tagged at Cape Lisburne may be harvested on the coast between Point Lay and Franklin Point at a significantly higher rate than elsewhere. It also appears that bears of both sexes tagged at Barrow are harvested 9 months to 4 years after tagging at a significantly higher rate in the Barrow area than in the Chukchi Sea, which is the other major hunting area (0.6 percent of the males and none of the females harvested in the Chukchi Sea were tagged at Barrow; 3 percent of the males and 6 percent of the females in the Barrow harvest were tagged at Barrow). More females than males are recovered in the same location where tagged, or conversely, males tend to range over greater distances than females.

The data then suggest that bears to the west of Alaska and bears to the north of Alaska form partially discrete populations with only a limited amount of movement between them. A line extending northwest from Point Lay has been chosen as a rather arbitrary dividing line.

Effectiveness of the various marking devices has been evaluated (Table 3). For 43 marked bears which have been shot by hunters or recaptured, 39 could be identified either by one or both ear tags and/or a lip tattoo; 4 could not be identified.

Of 35 nylon ear tags which were retained, 15 (43 percent) were intact, 19 (54 percent) were broken but present, and one was missing. For the broken tags, more than half still had a number present which permitted identification. Metal tags were retained in about 75 percent of the cases and were lost in about 25 percent of the cases. Where metal tags were not present, the ear was split and healed. It appears that metal tags do not come unclinched but rather are lost by working to the edge of the ear. More than half of the ears which retained metal tags were infected and draining from the tagging site. Metal perhaps







	Ear Tag No.	Tattoo No.	Collar	Location	Date	Sex	Age Class
Lisburne	1/ 1238-39	1239	None	69°47'N 168°37'W	3-9	F	1
	1241-40	1240	None	69°47'N 168°37'W	3-9	F	Ad.
	1242-43	None	None	69°36'N 170°05'W	3-9	M	Ad .
	1245-46	None	None	69°08'N 167°50'W	3-12	M	Ad.
	1248-47	None	None	69°13'N 166°05'W	3-13	M	Ad.
	1249-51	None	None	69°02'N 166°05'W	3-13	М	Ad .
	1253-52	None	None	69°02'N 166°05'W	3-13	F	Ad .
	1254-55	None	None	69°04'N 165°55'W	3-14	M	Ad .
	1257-56	None	None	69°13'N 166°05'W	3-14	M	Ad .
	1259-58	None	None	69°02'N 166°05'W	3-20	М	Ad.
	1260-61	None	None	69°12'N 169°45'W	3-20	М	Ad.
	1263-62	None	None	69°21'N 165°35'W	3-20	М	Sub-Ad.
	1264-65	None	None	68°52'N 169°40'W	3-25	М	Ad .
	1267-66	None	None	68°52'N 169°40'W	3-25	F	Ad.
	1268-69	None	None	71°14'N 166°05'W	3-25	М	1
	1270-71	None	None	71°14'N 166°05'W	3-25	F	Ad.
	1272-73	None	None	71°14'N 166°05'W	3-25	M	1
	1274-75	None	None	68°52'N 170°50'W	3-29	F	Ad.
	1276-77	None	None	68°52'N 170°50'W	3-29	\mathbf{F}	1
	1279-78	None	None	68°52'N 170°50'W	3-29	\mathbf{F}	1
	1280-81	None	None	69°45'N 172°00'W	4-2	\mathbf{F}	Ad.
	1282-83	None	None	69°45'N 172°00'W	4-2	М	1
Barrow	1094	1094	None	72°17'N 157°24'W	3-25	М	2
	1096	1096	White	72°17'N 157°24'W	3-25	F	Ad.
	1097	1097	None	72°17'N 157°24'W	3-25	F	2
	1099	1099	Yellow	71°56'N 156°25'W	3-27	М	Ad.
	1100	1100	None	71°56'N 156°25'W	3-27	F	1
	1102	1102	White	71°56'N 156°25'W	3-27	F	Ad.
	1103	1103	None	71°56'N 156°25'W	3-27	F	1
	T1 04	1104	White	71°56'N 157°26'W	3-30	\mathbf{F}	Ad.
	1105	1105	None	71°56'N 157°26'W	3-30	М	2
	11 06	1106	None	71°56'N 157°26'W	3-30	\mathbf{F}	2
	1107	1107	White	72°14'N 159°22'W	3-31	F	Ad.
	1108	1108	None	72°00'N 157°45'W	3-31	\mathbf{F}	Sub-Ad.
	1109	1109	White	71°56'N 157°30'W	4-1	F	Ad.
	1110	110	None	71°56'N 157°30'W	4-1	М	1
	1128	1128	Blue	71°32'N 156°27'W	4-2	М	Sub-Ad.
	1129	1129	None	71°47'N 156°55'W	4-3	М	2
	1130	1130	None	71°15'N 159°12'W	4-7	М	1
	1131	131	None	71°15'N 159°12'W	4-7	М	1
	1132	1132	None	71°15'N 159°12'W	4-7	\mathbf{F}	1
	1133	1133	White	71°15'N 159°12'W	4-7	F	Ad.
	1134	1134	White	71°20'N 157°00'W	4-7	\mathbf{F}	Sub-Ad.

Table 1. Polar bear tagging data, Alaska, 1971.

1/ Brackets indicate family groups.

Tab la	1	(continued)
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		Ear Tag No.	Tattoo No.	Collar	Location	Date	Sex	Age Class
Barrow		1135	1135	White	72°10'N 154°55'W	4-19	F	Ad.
		1136	None	None	72°10'N 154°55'W	4-19	F	Cub
		1137	None	None	72°10'N 154°55'W	4-19	F	Cub
		1146	None	None	72°10'N 154°55'W	4-19	М	Cub
		1147	1147	White	72°10'N 154°55'W	4-19	F	Ad.
		1148	1148	White	72°10'N 154°55'W	4-19	F	Ad .
		1149	None	None	72°10'N 154°55'W	4-19	м	Cub
		1150	None	None	72°10'N 154°55'W	4-19	F	Cub
		1138	1138	None	71°53'N 155°45'W	4-22	F	Sub-Ad.
		1139	1139	White	71°52'N 157°10'W	4-22	F	Sub S Ad.
		1140	1140	None	71°48'N 157°16'W	4-22	F	Ad.
		1167-66	1167	None	71°42'N 157°5 8' W	4-22	\mathbf{F}	Sub-Ad.
		1142-43	1142	White	71°45'N 157°30'W	4-24	М	Ad.
		1144-45	1144	White	71°45'N 157°30'W	4-24	F	Ad.
		1152-53	1152	None	71°56'N 157°27'W	4-24	F	Sub-Ad.
		1154	None	None	71°30'N 156°40'W	5-7	М	Cub
		1156-57	1156	White	71°30'N 156°40'W	5-7	F	Ad.
		1158-59	1158	None	71°40'N 156°31'W	57	F	Ad.
		1160-61	1160	None	71°51'N 156°10'W	5-7	F	Sub-Ad.
		1162-63	1162	None	72°06'N 155°33'W	5-7	F	Ad.
		1168-69	1168	None	71°17'N 157°15'W	5-10	М	Ad.
		1170-71	1170	None	71°16'N 157°40'W	5-10	\mathbf{F}	Ad.
		1172-73	1172	None	71°16'N 157°40'W	5-10	М	1
		1174-75	1174	None	71°16'N 157°40'W	5-10	М	1
		1186-87	1186	None	71°05'N 157°50'W	5-10	Μ	Ad.
		1188-89	1188	White	71°36'N 156°35'W	5-11	М	Ad.
		1190-91	1190	White	71°20'N 157°30'W	5-17	F	Ad.
		1192-93	1192	None	71°20'N 157°30'W	5-17	М	1
		1194-95	1194	None	72°43'N 158°15'W	5-17	М	Ad.
		1196-97	1196	None	72°36'N 158°27'W	5-17	F	Sub-Ad.
	<u>1</u> /	1198-99	None	None	71°50'N 156°30'W	5-23	F	Ad.

1/ Captured 4-3-71 with # 1129 at 71°47'N 156°55'W and taken to Barrow for physiological studies. Released 5/23/71 at 71°50'N 156°30'W.

	Cub-of- M F	year Unk.	Year M	<u>ling</u> F	<u>2-уеа:</u> М	r-old F	<u>Sub-</u> M	adult F	<u>Adu</u> M	<u>lt</u> F	Total
Bering Strait											
1968			. 1			2			4	3	10
1/Lisburne											
1968 1969 1970 1971			2 1 <u>3</u> 6 18 (4 5 3 12 $17%$	3 4 7 13 (12	4 2 <u></u>	$ \begin{array}{r} 8\\1\\1\\\underline{1}\\\underline{1}\\\underline{11}\\25\end{array}$	7 2 5 <u>14</u> (24%)	7 4 1 <u>9</u> 21 50 (15 8 <u>6</u> 29 47%)	50 7 27 22 106
Barrow								()			
1967 1968 1969 1970 1971	2 2 3 3 5 5	2 1 3	3 8 4 <u>5</u> 20	3 1 1 8 4 17 (15%)	4 3 3 <u>3</u> <u>13</u> 21	$2 \\ 7 \\ 4 \\ 3 \\ 2 \\ 18 \\ (12\%)$	2 6 2 4 1 15		4 7 2 5 7 25	9 37 9 18 <u>16</u> 89	31 80 22 54 <u>52</u> 239
Barter Island	13 (3%	1	16	(13%)	31	(13%)	44	(18%)	114	(48%)	
1969			, 1 .	1						·	2
Totals	<u> </u>	3	<u>28</u> 58	<u>30</u> (16%)	<u>20</u> 46 (3	<u>26</u> 13%)	26 69	<u>43</u> (19%)	<u>50</u> 171	121 (48%)	<u>357</u> 357

Table 2. Location and sex and age composition of polar bears tagged in Alaska, 1967-1971.

1/ Bears at Lisburne tagged by U. S. Fish and Wildlife Service.

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Tagging to Recovery Time in Months	Less than 2	9-13	21-25	36	48	Total 9-48
No. of Recoveries	4	20	6	8	1	35
Nylon Tag Intact Broken-No. present Broken-No. gone Missing	4	11 8 1	4 1 1	1 6 1	1	15 11 8 1
Metal Tag Present w/out infection Present with infection Present - Ear condition not recorded Missing	4	3 5 6	1 2 2 1	4 3 1	1	4 12 11 8
Collar Retained Missing Not collared	2 1 1	5 3 12	1 5	1 2 4	1	6 6 22
Lip Tattoo Legible Illegible Not tattooed Not checked	3 1	10 5 3 2	5 1	2 2 2 2	1	12 8 10 5

Table 3. Condition of markers on tagged polar bears recaptured or killed by hunters through 1971. 1/

1/ Does not include four hunter-killed bears which each had only a broken nylon tag and could not be identified.

causes cold damage to tissue of the ear; nylon does not. After several recoveries where metal tags had been lost or ears were infected, another type of nylon tag was used in place of the metal tag.

For 20 bears which were examined for a lip tattoo 9 to 48 months after a tattoo had been applied, 12 had a tattoo which was legible. A lip tattoo was the only marker which identified one bear recaptured 36 months after tagging.

Six of 12 bears recovered 9 to 36 months after having had nylon neck collars attached still had the collars.

Nylon ear tags are the best long term marking device used to date. They are subject to breakage, however, and lips will still be tattooed so animals will have another identifying marker.

Radio-Tracking

A Sensory Systems Laboratory radio-collar attached to a 2-year-old male polar bear confined in an unheated wooden hut located on the tundra away from buildings and equipment allowed the transmitter to be tested in cold temperatures away from metal, generators, vehicles, and other objects which might interfere with radio signals. Most testing was done with a transmitter attached to an animal rather than unattached because transmitters used in 1970 lost signal strength after they were attached to animals. Maximum transmission range, when the collar was attached to a bear and the aircraft receiver was at or above 9,000 feet, was 50 nautical miles. Transmission range decreased when the receiver was below 9,000 feet, and could not be increased by flying at altitudes above 9,000 feet. A range of 50 nautical miles is considerably less than considered necessary for polar bear tracking and requested in specifications.

Results of testing on a captive bear and tracking two bears in the wild in 1971 indicated a need for improvement in collar design or a change to another type of transmitter attachment. In one case, a collar rotated so the antenna was ventral to the neck. Maximum range of transmission was then 8 nautical miles. In two cases, bears were able to slip collars over their heads even though collars had been fastened quite tightly. In a third case, the radio on a collar which had been fitted to a bear on the ice stopped transmitting. The bear was located by visually tracking it from the area where it had last been seen. The collar was removed and a broken wire found as the cause of malfunction. A transmitter collar attached in 1970 was recovered a year later when the bear carrying it was shot by a hunter. An external copper plate was corroded away or so weakened by corrosion that the bear had been able to remove it. An external wire connecting the antenna and transmitter was also gone.

The above results indicate that improvements in neck collar transmitters or a new approach is needed to provide enough reliability to warrant an intensive long-term tracking program. A nylon harness has been fitted to a captive bear and observed for 6 months. It appears that this might be a satisfactory attachment for a transmitter pack.

Age Determination

Examination of tooth sections from known-age polar bears indicates that some bears have annual layers in cementum which can be recognized and which provide an exact age. Cementum layering in other animals is difficult to interpret. The technique which will probably be the best for assigning age will combine several indicators including cementum layering, skull size, tooth wear, and reproductive status. A detailed age determination report will be prepared after tooth sections from known-age animals killed and recaptured in 1972 can be combined with known-age material now on hand.

Reproduction and Denning

Results of examination of reproductive organs will be combined with results of examination of material obtained in 1972, and a final report then prepared.

Composition of bears tagged gives an indication of productivity. Table 2 lists percentages of cubs, yearlings, and 2-year-olds tagged. The true percentage of cubs-of-the-year in the population is probably higher than shown in Table 2 because much of the tagging has been done when cubs were still in dens. The difference in the percentages of yearlings (16 percent) and 2-year-olds (13 percent) suggests the extent of mortality during the second year. Tagging data might suggest that 2-year-olds annually increase the adult and sub-adult population by 17 percent. This figure is probably greater than actually occurs, however. When bears are tagged, if there is a choice, family groups are tracked for tagging rather than single bears. Also, in the Barrow area, fairly intensive hunting may have removed enough adults from the population that percentage composition figures show more young animals than would occur in an unhunted population.

All cubs-of-the-year that have been tagged have been on drifting pack ice. Tracks of other small cubs that have not been tagged have also been seen on drifting ice. It is believed that most of these cubs were born on the drifting pack ice because they were not yet capable of traveling the distances across the rough ice and open water between them and the shore. Those that were not born on the drifting ice were probably born along or inland from the Alaska coast.

Interviews in 1971 with residents of Point Hope, Wainwright, Barrow, and Barter Island indicate that a limited amount of denning occurs along the coast from the Point Hope area to the Canadian border. Bears were reported to den on small offshore islands, on shorefast ice, and inland along river banks. No areas of intensive denning were reported, but more scattered denning was indicated than was previously thought to occur. Flights were planned along the north Alaska coast shortly after ice had drifted to the coast or frozen in the fall to search for bears that might be moving inland to den. Storms during the period of freeze-up in October limited the amount of flying that could be done, and the coast was surveyed only once during the last half of October. High winds from the south prior to survey flights had obliterated most tracks and opened a wide lead along most of the coast. No bears and relatively few tracks were seen. Most of the tracks that were seen were east of Barter Island, and were of bears hunting for seals. One set of tracks went up Turner River on the Canadian border to the foothills about 12 miles inland. This was possibly a female going inland to den, but tracking and flying conditions prevented finding a den.

Parasites and Environmental Contaminants

Richard Barrett, U. S. Department of Agriculture, has examined masseter muscle samples from 308 polar bears killed by hunters from 1967 through 1971 for presence of <u>Trichinella</u>. Larvae were present in 60.4 percent of 187 males and in 50.6 percent of 89 females. The number of larvae per gram in positive samples ranged from 0.4 to 69.4.

Fifty tissue samples (subcutaneous fat and brain) from 42 polar bears were analyzed by the Wisconsin Alumni Research Foundation for chlorinated hydrocarbons. In all samples, levels were higher in fat than in brain tissue. Polychlorinated biphenyls (PCBs) were present in all samples. The average amount of PCBs in fat samples of 23 bears was 15.0 ppm; range was 1.1 to 29.4 ppm. DDT and DDT metabolites (DDE and DDD) were also detected in all samples tested. With the method of analysis used, PCBs interfered with determination of DDT and DDT metabolite levels and values which were obtained must be considered estimates. The estimated mean level of DDT and DDT metabolites in fat samples from 23 bears was 0.7 ppm; range was 0.1 to 1.1 ppm.

Polar bear tissue samples were sent to two investigators working independently of each other for mercury analysis. After one set of samples had been analyzed using a neutron activation technique, it was concluded that some of the mercury had been lost during irradiation. Results of analyses of the other set of tissues are not yet available.

RECOMMENDATIONS

The marking phase of the polar bear mark and recovery program is complete. Efforts will continue to recover tags from bears killed by hunters, and a final report will be prepared. Mark and recovery provides information on individual animals only at widely spaced intervals and most often only at certain times of the year when hunters and investigators can make recoveries. More detailed movement information is needed from a number of animals to supplement tag recovery information. Emphasis should be on following pregnant females as they move to denning sites. It is recommended that a limited number of pregnant females be radio-tracked from aircraft. Radio-tracking from aircraft should be done with the possibility in mind of eventually tracking from satellites, and contact should be maintained with agencies that are involved with animal tracking from satellites. The Alaska Board of Fish and Game passed regulations, effective July 1, 1972, which prohibit the use of aircraft for hunting polar bears, and lengthen the sport hunting season to encourage recreational hunting from the ground. Several aspects of this new management approach require consideration. The change from hunting with aircraft to ground hunting will reduce the harvest considerably, and a permit system to limit the harvest is not believed to be necessary. It is recommended, however, that some type of permit system be maintained to provide information on hunting pressure by time period and location, and hunting success. The only limitation on the number of permits issued could perhaps be a cut-off date for application. Stipulations of the permit should include that prior to hunting the permittee notify a Fish and Game office where and when he plans to hunt and the name of his guide. The permittee should also turn in a hunt report when the hide is sealed or, in the case of unsuccessful hunters, after the season has closed.

Surveillance is recommended in late February, March, and April when illegal hunting with aircraft might occur. It is presumed that most bears taken with the use of aircraft would be presented for sealing under the guise of having been taken from the ground. If the use of aircraft is fairly widespread and cannot be controlled, an immediate emergency closure and an earlier closure in succeeding years is recommended. All unsealed skins would then be subject to seizure during the closed period. Coastal residents should be informed that their cooperation with hunters using aircraft could result in earlier season closures and therefore a shorter period when they could hunt and guide hunters.

It is believed that Arctic coast residents could provide the best guiding services for polar bear ground hunts. Present regulations make it extremely difficult for such persons who are qualified to guide to actually become licensed, and the commissioner of Fish and Game may therefore issue permits to guide in lieu of guide licenses. It is recommended that criteria be established for persons to qualify for permits to guide, and coastal residents informed about such permits so interested persons could apply. Permits in lieu of licenses are probably not as desirable as licenses, and it is also recommended that guiding regulations be modified or a new guide class established so qualified Arctic coast residents could actually receive guide licenses.

It is recommended that new polar bear hunting regulations be widely publicized so persons who might be contacted by pilot-guides soliciting clients for hunting with aircraft will be aware that this type of hunting is no longer permitted.

It is believed that the present opening date of October 15 for the sport hunting of polar bears is late enough that most pregnant females that were coming ashore to den would already have done so, and would not be available to hunters along the coast. If, however, there is a significant harvest of mature females during the period immediately after October 15, it is recommended that the season open later in succeeding years.

It is recommended that the Department of Fish and Game and the Board of Fish and Game consider if it is still desirable to allow the sale of polar bear skins. The price of skins is high enough now that the primary reason for hunting by coastal residents is to obtain skins for sale rather than to obtain meat. Money obtained from sale of skins can be used to purchase food, gasoline and other necessities, however, so, in this sense, polar bears might still be considered a subsistence resource. If ground hunting with coastal residents as guides develops, however, money obtained from guiding could be more significant than that obtained from sale of skins. Present regulations might also encourage hunting of bears with aircraft in order to sell the skins, since a bear taken with the use of aircraft could be sealed under the pretense of having been taken from the ground and the skin then sold on the open market.

Federal legislation is being considered which would substitute a protectionist philosophy for a management philosophy for marine mammals, including polar bears, and would transfer authority for protection and/or management from the state to the federal government. Polar bears are a renewable resource, a certain number of which can be harvested annually without adversely affecting populations. Under Alaska's new management approach, where bears will be hunted only from the ground, nearly all hunting will be in state waters or on state lands. It is recommended that Alaska reiterate its position that legislation should be management rather than protection oriented, and that Alaska should retain management authority for polar bears on and adjacent to its coasts.

The International Union for the Conservation of Nature is the focal point for coordination of international polar bear research and management including proposals for treaties or other international agreements. It is recommended that contact be maintained with the I.U.C.N. and with the international polar bear specialist group which is organized under the auspices of the I.U.C.N.

ADDITIONAL STUDIES

Harvest Characteristics

Harvest figures presented here are for the regulatory period July 1, 1970 through June 30, 1971. This year, for the first time, a limited number of permits were issued for trophy hunting of polar bears. Two management areas were established with a quota of 210 for the west area (west and south of a line extending northwest from Point Lay) and a quota of 90 for the north area (east and north of a line extending northwest from Point Lay). The cutoff date for application for permits was August 31, 1970. A drawing where resident and non-resident applications were placed together was held September 4 to choose the 300 permittees. There were no other significant regulatory changes from preceding years. 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 3 regulatory years. Non-residents 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 2 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.

A total of 621 applications were received for the 300 permits; 131 (21 percent) were rejected because they were received after the deadline for application or were incomplete. More state residents applied for permits than have taken bears in past years. Some applied because they wanted to hunt before regulations became more restrictive; others applied who were not seriously interested in hunting but might consider it if they had a permit; others applied in order to obtain permits which could be used illegally in some manner to enable hunters without permits to take bears; and others applied to obtain permits which would not be used and which would thus "save" bears. The drawing allocated permits to 120 residents and 90 non-residents in the west area and 81 residents and 9 non-residents in the north area.

Department personnel monitored the harvest from Nome, Kotzebue, Point Hope, and Barrow during part or all of the period from late February to April when most of the sport hunting occurred. Information was obtained on marked bears that were seen and/or killed and on bears presented for sealing. Information obtained at time of sealing included date and location of kill, method of hunting, time spent hunting, sex, hide length and width, and skull length, width, and condylobasal length. A tooth (P, or M_2) was obtained from all bears for age determination, and reproductive tracts were obtained from females. Data on bears sighted by guides were not obtained as in past years because such information is no longer reliable. In 1970, cross-checking between guides and their clients and between guides hunting in the same area indicated that some guides reported more bears than they actually saw. This apparently was to inflate population or relative abundance figures in order to weaken any justification for hunting restrictions based on a reduced number of animals in the population.

Harvest statistics for 1971 and comparative data for preceding years are presented in Tables 4-10 and Fig. 4.

Changes from year to year in age composition of the harvest may be indicative of changes in the population. A regulation enacted in 1966 whereby a tooth is obtained from each bear harvested has provided age composition data for the harvest each year since then. Generally, non-resident hunters are more selective than resident hunters for large





NON-RESIDENT Hunting Sex Base M F Unk,	RE	RESIDENT-		RE	RESIDENT-			TOTAL								
	F	Şex Unk,	M	F	Sex Unk.	M	F	Sex Unk.	M	F	Sex Unk.	A11 Bears	% 01 Total K i 11	% Male	% Non- Res.	
Teller	6	1	-	4	1	-		-	-	10	2	-	12	5.9	83	58
Wales	-	-	-	-	-	-	1	-	-	1	-	-	1	0.5	100	0
Shishmaref	5	, •	-	5	1	-	-	-	-	10	1	~	11	5.4	91	45
Kotzebue	39	6	1	25	11		-	-	-	64	17	1	82	40.4	79	56
Pt. Hope	11	3	-	16	8	-	1	.	-	28	11	-	39	19.2	72	36
Wainwright	-	-	6 3	-	-	-	8	10	1	8	10	1	19	9.4	42	0
Barrow	4	-	-	9	13	-	4	2	-	17	15	-	32	15.8	53	16
Colville R.	1	 -	-	-		-	-	-	-	1	-	-	1	0.5	100	100
Barter Is.	-	-	1	4	1	**	-	-	-	4	1	1	6	2.9	80	17
Sub Total	66	10	2	63	35	~	14	12	1	143	57	3	203	100	70	38
Percent	87	13		64	26		54	46		71	28	1		یچ پی ک ^و بنای می در می می می ا		
Total	78 (38%)		98	(48%)		27	(13%)								

Table 4. 1971 known polar bear harvest by Alaska based hunters. Data are categorized on the basis of hunting base, type of hunter, and sex of bear. 1/

1/ Does not include one bear killed on drifting ice station T3 850 miles north of Alaska.

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	NO	NONRES I DENT		RF V	RESIDENT- WHITE		RE N	RESIDENT- NATIVE			TOTAL % of					<u>%</u>		
MGMT. <u>1</u> / AREA	M	F	Sex Unk.	M	F	Sex Unk.	М	F	Sex Unk.	М	F	Sex Unk.	All Bears	Total Kill	% Male	Non- Res.		
West	61	10	1	50	21		2	-	· · · · ·	113	31	1	145	71	78	50		
North	5	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	1	13	14	-	12	12	1	30	26	2	58	29	54	10		
Sub Total	66	10	2	63	35	(1) in 10,00 (1) i	14	12	1	143	57	3	203	100	70	38		
Percent	87	13		64	26		54	46		71	28	1						
Total	78	(38%)	<u></u>	98	(48%))	27	(13%)					<u> </u>				

Table 5. 1971 known polar bear harvest by Alaska based hunters. Data are categorized on the basis of area, type of hunter, and sex of bear.

1/ West management area is south and west of a line extending northwest from Point Lay; North management area is north and east of this line.

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Non Resident		Resid White	ent	All S Hunte	port rs	Resid Nativ	ent e	All Hunter	ŝ	
Year	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
1 96 5	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	11 1	61	351	74
1 9 69	227	76	44	63	290	69	27	56	298	72
1970	217	79	83	65	300	76	15	53	316	72
1971	78	85	98	64	176	73	27	52	203	70

Table 6. Polar bear harvest and sex ratios, 1961-1971.

		MALE		FEMALE					
	Airpla Nonresident	ne Resident	Ground	Airplane	Ground				
West Area <u>1</u> /	₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩		- <u>A - an an an an an Alba</u> da - an an Angarana - an						
1966	9.1(64)2/	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)					
1971	7.0(53)	6.0(38)		5.5(24)					
North Area 1/									
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)				
1971	5,3(3)	4.2(11)	6,0(5)	3,3(7)	2.9(9)				

Table 7.	Average age based on tooth cementum layering of polar bears in	
	hunter harvest, Alaska, 1966-71.	

 $\frac{1}{2}$ West area is west and south of a line extending northwest from Point Lay; north area is north and east of this line.

2/ Numbers in parentheses are numbers in sample.

·····														
Hunting Site	Ju	ne	<u>0c</u>	t.	No	<u>v.</u>	Dec	<u>.</u>	Ma	r.	Apt	<u>r.</u>	May	<u>y</u>
	М	F	М	F	М	F	М	F	М	F	М	F	M	F
Wales	1							-						
Pt. Hope									1					
Wainwrigh	t			3	6	1		2	3			2	1	
Barrow	1		2	1								1	1	
Total	2		5	7	1		2	3	1		2	2	1	

Table 8. Chronology of 1971 native polar bear harvest.1/

 $\underline{1}/$ Does not include one bear of unknown sex killed in October at Wainwright.

Table 9.	1971	polar	bear	airplane	hunting	data.
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Hunting Base	No. of Guide Te <i>a</i> ms	No. of Bears killed on Guided Hunts	No. of Bears Killed on Unguided Resident Hunts	Percent of Airplane Kill	
Teller	3	8	4	7	
Shishmaref	2	8	3	6	
Kotzebue and Point Hope	17	83	37	68	
Barrow	5	21	5	15	
Colville River	1	1	0	1	
Barter Island	1	4	2	3	
Total	29	125	51	100	

		MALE			FEMALE					TOTAL		
Resident		Non-Res.		Resident		Non-R	esident					
Hunting Base	x	Range	x	Range	x	Range	x	Range	x	Range	No. in Sample	
Teller	1.8	1-2	1.7	1-3	1.0	1	2.0	2	1.7	1-3	12	
Shishmaref	1.5	1-3	2.4	1-5	1.0	1			1.9	1-5	10	
Kotzebue	1.3	1-3	1.2	1-3	1.9	1-5	1.5	1-3	1.3	1-5	64	
Point Hope	1.6	1-3	1.8	1-4	1.4	1-3	3.0	2-4	1.8	1-4	34	
Barrow	1.3	1-3	4.8	2-8	1.8	1-4			2.1	1-8	26	
All Bases	1.5	1-3	1.7	1-8	1.7	1-5	2.1	1-4	1.6	1-8	146	

Table 10. Hunting effort expended in days by polar bear hunters using aircraft, 1971.

animals, which means they are seeking older males. Changes in age composition of males taken by non-residents might indicate changes in abundance of older males in the population, and changes in age composition of males taken by residents might indicate changes in the entire huntable male population, i.e., all males older than 2 years.

West of Alaska, the average of age of males taken both by non-residents and residents using aircraft has fluctuated since 1966, but does not show any definite trend. Also, the ratio of males to females harvested west of Alaska does not show a trend.

North of Alaska, there has been a decline in the average age of males harvested by both classes of hunters and an increase in the percentage of females harvested, suggesting that hunting has significantly lowered the average age and reduced the proportion of males in the population.

Changes in the amount of hunting effort required to harvest a bear over a period of years could reflect changes in relative abundance. Successful hunters reported an average hunting period of 1.6 days to harvest a bear in 1971 (Table 10). This is similar to 1.5 days reported in 1970, the first year this information was obtained on sealing forms.

Harvest data do not include an estimate of the number of bears killed and not presented for sealing. Motives and methods for taking bears illegally were the same in 1971 as in 1970 (Lentfer, 1971). There has been much speculation about the number of bears taken illegally. Not all pilot-guides have taken bears illegally, and those that have, have been limited in the number they could take by weather and ice conditions and legitimate obligations to clients. It is estimated that the greatest number of unreported bears that could have been taken in 1970 did not exceed one-third of the reported harvest. It is believed that increased surveillance and enforcement activities in 1971 cuased the 1971 unreported kill to be lower than in 1970.

Physiological Studies

Nils Øritsland of the Universities of Oslo and Guelph continued his thermoregulatory studies on polar bears by implanting temperature transmitters in a mature female bear which was brought in from the ice and held at Barrow in April 1971. Data were obtained at different activity levels and a range of ambient temperatures. Monitoring on closed circuit television allowed activities and animal temperatures to be related. An AGA thermovision scanner provided temperature readings and pictures showing temperatures on the surface of the bear. Detailed findings are reported by Øritsland and Lentfer (1971).

A. K. Fisher of the University of Iowa expanded his long term studies of the respiration rates of tissues of Arctic animals to include polar bear. He accompanied hunting parties from Barrow to obtain tissue specimens and measured respiration rates with a Gilson respirometer. Results are still to be reported.

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