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BEAR STUDIES

by

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Volume V
Annual Project Segment Report
Federal Aid in Wildlife Restoration
Project W-6-R-5 Work Plan F

The subject matter contained within these reports is often fragmentary in nature and the findings may not be conclusive; consequently, permission to publish the contents is withheld pending permission of the Department of Fish and Game.

(Printed June 1965)

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-6-R-5 TITLE: Alaska Wildlife Investigations

WORK PLAN: F TITLE: Bear Studies

JOB NO.: 2, 3 TITLE: Polar Bear Segment

PERIOD COVERED: July 1, 1963 to December 31, 1963
(This report incorporates material to be uses in a forthcoming comprehensive report on polar bears in Alaska.)

Of the 50 states in the Union, Alaska alone can count the polar bear (Thalarctos maritimus Phipps) as a member of its native fauna. It is not surprising, therefore, that the species is highly prized as a trophy and that the sport of polar bear hunting has developed into a major Alaskan industry. It may be conservatively estimated that the annual value of this industry to the state is not less than a third of a million dollars.

Slightly over 100 non-resident hunters annually pursue polar bears in Alaska and each brings approximately $2,500 into the economy in the form of guide fees, transportation, lodging and incidentals (Tovey and Scott, 1957). An additional 100 or more resident hunters also hunt for polar bears each year but costs for them are perhaps only about a third of those for non-residents.

A particularly salient feature of the polar bear industry in Alaska is its direct contribution to the economy of arctic Eskimos. They derive a small income from the sale of polar bear skins worth approximately $200.00 each. Of far greater importance, however, is the money spent in the villages by hunters and guides for services and the purchase of native arts and crafts.

HUNTING THE POLAR BEAR

Light ski-equipped aircraft are used to take most polar bears in Alaska. Hunting begins in February and is largely concluded by the first of May when the ice pack has usually begun to break up. Peak hunting activity occurs between mid-March and mid-April with hunting success governed largely by favorable flying weather.

Flying over the arctic ice pack is not without elements of danger and, for safety, hunting is uaually done in pairs. Abreast, the planes fly across the pack ice searching for bears or their tracks. If tracking conditions are ideal a relatively fresh track can usually be followed to its owner. However, broken ice and drifting or hard-packed snow, generally result in conditions less than ideal and often hunting is limited to actual searches for bears. Under these circumstances best success is usually realized by searches for bears along open water leads where they assemble to feed on seals.

Even when a hunting party locates a suitable bear, it is not always possible to take it as a trophy. Broken or new ice may preclude a landing and bears often escape from hunters once they have landed. Customarily one aircraft remains aloft until the other hunting party has landed and killed the bear. This is partly in the interest of safety but also to keep track of the bear in case it escapes.

There has been considerable criticism voiced against the hunting of polar bears with the use of aircraft. For the most part it has been contended that this mode of hunting poses a threat to the welfare of the species. Harvest data do not support this contention, however, and limiting this mode of hunting would essentially preclude polar bear hunting as practiced in Alaska today, and would also adversely affect the State's economy.

Sport hunting for polar bears by dog sled was attempted by one or two guides during the late 1950's, but hunting success was meager and the quality of trophy produced was far inferior to the average trophy taken by hunters using aircraft. There are two deterrents to this mode of hunting. First, hunts require considerable periods of time and secondly, the hardships of living on the ice are usually more severe than the average hunter wants or is capable of enduring.

DESCRIPTION

The polar bear is among the largest of the living bears and like all bears is bulky in build and quite variable in size depending upon sex, age, and time of year. Limited records show that large adult males attain at least 1200 pounds in weight. Most are considerably smaller than this and, except for young age classes, females normally weigh only about half as much as equivalent-aged males. Table 1 presents the weights and hide and skull sizes of a series of bears recently killed in Alaskan waters.

Merriam (1896) describes the adult dental formula of the polar bear as I-3/3, C-1/1, P-4/4 and M-2/3, the first three premolars being non-functional. The last molar on the lower jaw appears underdeveloped and much smaller than the same tooth in the brown-grizzly or black bear. According to Novikov, (1962), replacement of the milk teeth begins at the age of 5 1/2 months and adult dentition is attained between 10 and 11 months.

In appearance, the polar bear is slightly longer limbed and more elongate in build than the familiar black bear or brown-grizzly bear. The long legs are perhaps an adaptation to his nomadic way of life in contrast to the more sedentary habits of the other species mentioned. These features, together with the long neck and attenuated flattened head and close-cropped ears, remind one of the weasel.

The pelt of the polar bear is a valuable commodity. In addition to being in demand for rugs, it is in high demand for use in the tying of artificial fishing flies. The coat color of the polar bear is uniformly creamy-white, except for the nose, lips, eyes and claws which are black. With advanced age, even the claws lose much of their pigment. Surprisingly, the pelt of the polar bear is generally shorter haired and less dense than is the coat of other North American bears. The length of the fur seldom exceeds 2 1/2 inches except for the long feathering along the backs of the legs.

CLASSIFICATION

As with most living bear species, considerable disagreement exists concerning the classification of the polar bear. Burt and Grossenheider (1959) and Pedersen (1957) recognize three distinct species -- Thalarctos eogroenlandicus on the east coast of Greenland, T. labradorensis along the coast of Labrador, and T. maritimus elsewhere in the arctic. On the other hand, Hall and Kelson (1959) consider the polar bear as a single species, but recognize five subspecies. These classifications appear in need of critical review. The validity of a separate generic classification (Thalarctos) for the polar bear appears especially questionable. Not only are cross breedings of polar bears with European brown bears (Ursus arctos) and the brown-grizzlies possible but the offspring of such matings are fertile as well (Davis, 1950; Stendel and van Martens, 1877). This is strong argument against generic separation for the polar bear since by definition a species is reproductively isolated from other species; yet, here, separation fails even at the generic level.

DISTRIBUTION

The distribution of the polar bear coincides with the holarctic ice pack. As a consequence the polar bear is not a permanent member of Alaska's fauna but only a seasonal visitor. Occasional bears are stranded ashore when the ice pack retreats to the north each summer, however, and there are records of large numbers of polar bears summering on St. Matthew Island during the 1800's (for a summary see Klein, 1959). The reappearance of polar bears in Alaskan waters each year coincides with the advance of the ice pack in the fall. The degree of southern penetration from year to year is quite variable, being influenced by the southern limits of the ice pack and the movements of bears. There are recent records of polar bears as far south as Nunivak Island and earlier records for the Pribilof Islands. In the 17th century polar bears were seen as far south as Japan (Pedersen, 1957).

Table 1. Weights and Skull and Hide Sizes of a Series of Polar Bears Taken by Hunters in Alaskan Waters, 1961-64.

Specimen No.	Date	Sex	Hide Measurements (Feet & Inches) Length	Width	Total	Skull Measurements Length	Width	Total	Weight in Pounds (less blood)
0059	3/27/61	♂	8'- 9"	10'- 5"	19'- 2"	16 15/16"	9 11/16	26 5/8	1059
1814	3/ 3/63	♂	9'- 1"	10'- 1"	19'- 2"	17 1/4	9 1/2	26 3/4	1082
1844	4/10/63	♂	8'- 2"	9'-10"	18'- 0"	16 1/8	9 1/4	25 3/8	852
1848	4/12/63	♂	9'- 0"	11'- 0"	20'- 0"	17 3/8	9 5/8	27	1141
1852	4/13/63	♂	8'-10"	10'- 0"	18'-10"	16 3/8	10 1/8	26 1/2	1044
2691	2/29/64	♂	9'- 0"	10'- 4"	19'- 4"	15 7/8	9 5/8	25 1/2	999
2732	3/24/64	♂	9'- 1"	9'-10"	18'-11"	15 3/4	9 3/4	25 1/2	940
2759*	4/11/64	♀	7'- 5"	7'-10"	15'- 3"	14 5/16	7 4/16	21 9/16	485

* Lactating

Some authorities (Scott et. al., 1959; Brooks, 1963; and others) hypothesize that the polar bears adjacent to the Alaskan coast are a segment of one large holarctic population. To date, no data confirm or disprove this hypothesis. We are inclined to disagree with this supposition and consider it likely that major segments of the population are more or less fixed in their movements to certain land areas, particularly island groups, such as in Spitzbergen and Wrangel Island, where large numbers of bears, particularly females, consistently gather to seek den sites and to raise young (Lønø, 1963; Uspenskii, 1961; and see beyond).

Within the world distribution limits of the polar bear, it seems probable that the bulk of the population is contained within a belt of variable magnitude surrounding the polar cap. In the area near the pole it is probable that the ice is heavier, less broken, and therefore that fewer seals are available for food (Tovey and Scott, 1957). Bears have been noted in the mid-arctic sea, however, (Ellsworth, 1927) and at the ice island research station located 600 miles north of Pt. Barrow. This indicates at least a general distribution of polar bears throughout the polar cap.

ABUNDANCE

Although estimates of the total world polar bear population have been made, they must be regarded as subjective until far more data are available. The spread between minimum (4,000) and maximum (19,000) estimates indicates just how subjective all such estimates are at present. Some figures on density off Alaska's coastline, as reported by guides, are provided in Table 2 for those who would like to make their own guesses. These figures may well be biased, for experienced guides will quite naturally spend more time scanning areas where bears are found to be concentrated.

Tovey and Scott (1957) and Scott et. al. (1959) calculated a world population based on hunter observations of bears off the coast of Alaska. For the years 1956-57, they calculated an average annual population of 2,000 bears within a 75 mile strip along the arctic coastal areas of Alaska. The estimates were calculated on the basis of the number of bears seen per unit area searched; area searched being calculated from an assumed 1/4 mile strip effectively searched by aerial hunting parties at an average 90 mph. flight speed. Projecting these data to the total polar rim and adding 2,000 possible bears for the central ice cap they suggested a world polar bear population of 17,000- 19,000 bears.

Since the estimates by Tovey and Scott (1957) and Scott et. al. (1959), we have compiled an additional seven years of hunter observation data (Table 2). These data are reasonably consistent. The year-to-year fluctuations are not considered changes in population status, but are attributed to slight yearly differences in distribution and to varying hunting conditions. The data should reveal population trends over a span of years, but are probably not reliable indicators of year-to-year population trends.

TABLE 2. Comparison of bear density indices based on numbers of bears seen per hour by aerial hunters and number of square miles per bear (1956-1964).*

Year	No. Flying Hours	No. Bears Sighted	Bears Seen Per Hour	No. Square Miles Scanned	Square Miles per Bear Seen
1956**	84	33	0.4	1,888	57
1957**	383	222	0.6	8,618	37
1958	185	201	1.1	4,151	21
1959	265	498	1.9	5,963	12
1960	164	179	1.0	3,690	22
1961	356	340	1.0	8,010	24
1962	313	304	1.0	7,042	23
1963	343	588	1.7	7,718	13
1964	608	947	1.6	13,680	14

* Based on flight and observation data provided by hunting parties as recorded on forms provided by the U. S. Fish and Wildlife Service for the years 1956 & 1957 and by the Alaska Department of Fish and Game thereafter.

** From Tovey and Scott (1957) and Scott et. al. (1959).

The data of Table 2, pooled and treated in the manner of Scott et al. (1959), indicate a world polar bear population on the order of 13,000 - 14,000 bears.

Brooks (1963) has critized these estimates as being too high, contending that because bears were tracked they were sighted with more than normal frequency. It snould be pointed out, however, that polar bears in their natural environment are quite difficult to see and that many bears along flight paths were undoubtedly overlooked, particularly when the attention of hunters was concentrated on individual tracks. We are of the opinion that polar bears are at least as difficult to observe as brown bears, and as has been demonstrated by Erickson and Siniff (1963) attempts to census brown bears from the air are decidedly inefficient. Their studies indicated that survey crews observed less than half the bears along survey transects and we suspect a similiar observation success for polar bears. Composition data calculated from hunter observations (See Table 5,) suggest, also, that single bears were not seen disproportionate to their occurrence which suggests that bears were seen with approximately normal frequency without bias to particular population elements.

Another way of estimating the polar bear population is on the basis of harvest statistics and recruitment potentials. Data compiled for the late 1950's (Scott, et al., 1959) indicated annual world harvests at that time on the order of 900 to 1,350 polar bears. This rate of harvest has shown no sign of diminishing in recent years (Table 3) which suggests that the population has not been excessively exploited as has been contended by Spark (1956), Sdobnikov (1956) and Harrington (1961).

POPULATION DYNAMICS

Information on the population dynamics of the polar bear is at best fragmentary. It is probably that polar bears, like brown-grizzly bears, achieve sexual maturity when approximately four years old. Among captives, Novikov (1962) and Volf (1963) reported first breedings at five years. Breeding takes place from mid-February to mid-May with female receptivity lasting 3 to 8 days (Volf, 1963). The time of ovulation is unknown, but it is probably induced at mating as with the black bear (Erickson and Nellor, 1964). Gestation lasts approximately seven months but this is highly variable. Among captives, Volf (1963) has recorded gestations varying between 228 and 303 days. This irregularity is presumably due to a delay in the implanting of the embryo as has been established for the black bear (Winsatt, 1963: and Erickson and Nellor, 1964). Thus, although breeding, ovulation and conception are spread over a rather wide period of time, blastocyst implantation and major growth of the embryo occurs at approximately the same time in most bread females. Presumably implantation occurs in October or November, since there is apparently no record of a macroscopic embryo being found in a female bear prior to winter-denning (Pedersen, 1957).

TABLE 3. World Harvests of Polar Bears[1]

Year	Alaska[2]	Canada[3]	Greenland[4]	Norway Commercial	Norway Sport[5]	U.S.S.R.[6]
1949-50	69	277	205	536	0	
1950-51	60	357	186	374	0	
1951-52	39	406	105	127	19	
1952-53	50	433	95	341	6	
1953-54	100	437	131	182	27	120
1954-55	128	507	158	444	26	a year
1955-56	135	420		416	25	
1956-57	206	416		279	29	
1957-58	128	525	?	125	35	
1958-59	250	382		311	23	
1959-60	162	509		150	23	
1960-61	152	-		105	21	Scientific collections only
1961-62	201	-		172	5	Approx. 10 per year
1962-63	189	-		-	-	
1963-64	251	-		-	-	

1. Adapted in part from Scott et. al. 1959.

2. From the Annual Reports of the Alaska Game Commission for the years 1949 to 1958; from Alaska Department of Fish and Game records for the years 1959 to 1964.

3. **Harrington** (1961) based on pelts exported; believed 20% below actual kills.

4. Spark (1956).

5. Lønø, Ødd (1963).

6. Khuzen, R. Sh. (1964).

Whelping regularly occurs in late November or December (Pedersen, 1957; and Volf, 1963) while the female is in a winter lair. At birth the cubs weigh only 8-10 ounces, the eyes are closed and they have little hair. Litters normally number one or two cubs, but occasionally three (Table 4) are born. Yearling litters observed in Alaskan waters indicate that the average litter is about 1.8 cubs indicating high cub survival akin to that in the black bear (Erickson & Nellor, 1964).

How frequently females give birth to young is unknown. Among captives, Volf (1963) reports that females do not breed the year after whelping regardless of whether the young were suckled or lost. It appears likely that female polar bears breed in alternate years, although a three year breeding cycle is possible.

Volf (1963) reports that weaning occurs at approximately 20 months, but the age of self-sufficiency or of family breakup is unknown.

According to Pedersen (1957) female polar bears move toward shore-fast ice to den and give bitth to cubs. Recent data (Uspenskii, 1961; and Lønø, 1963) indicate, however, that concentrations of bears are regularly found on island areas which Uspenskii has labeled "maternity centers". The seeming dependency of polar bears on such island areas is a likely reason that few polar bear young-of-the-year litters are observed off the coast of Alaska. North of Bering Strait there are no significant island areas in Alaskan waters, and among 545 litter observations in these waters, only 5 litters were cubs-of-the-year (Table 4). It should be pointed out, however, that many cub-of-the-year litters may still have been in winter dens during a large portion of the time that these observations were made. Litter records are especially rare south of Pt. Ley (Tovey and Scott, 1957) but there are reports from Pt. Hope, Teller and St. Lawrence Island.

Although literature on the size and development of the polar bear is scant, cubs apparently weigh 6-8 pounds upon emergence from the den in March or April. The cubs of a litter of three killed April 7, 1960, by John Kulowiyi on St. Lawrence Island were about the size of housecats. This litter was unusual both as to number and its occurrence so far to the south. Even before the time of family breakup the cubs are approximately the same size as the mother. Maximum size has been estimated by Pedersen(1957) to be attained at about 7 or 8 years.

The maximum length of life (longevity) of polar bears is unknown although captives have lived as long as 30 years. It is unlikely that many wild specimens attain this advanced age, however, since they are subjected to the normal rigors of the wilds and are forced to secure their own food.

POPULATION COMPOSITION

Population composition data are unavailable except as can be derived from harvests and sight observations. Harvest data for Alaska are relatively meaningless for this purpose since by

TABLE 4. Litter Sizes of Polar Bears Observed in Alaskan Waters[1]

	Sows w/1 cub	Sows w/2 cubs	Sows w/3 cubs	Average Litter Size
1958	12	22	-	1.65
1960	22	14	-	1.39
1961	39	34	-	1.47
1962	33	41	-	1.55
1963	70	76	4	1.56
1964	66	109	3	1.64
	242	296	7	1.57

1. All yearling litters except one litter each of 1, 2, and 3 cubs of the year for 1964 and two litters of 2 cubs of the year for 1963.

TABLE 5. Population composition of polar bears observed on the Chukchi Sea by Alaska-based hunters.

	Sows with			Sows with*			Other Bears			
Year	1 cub	2 cubs	3 cubs	1 yrl	2 yrls	3 yrls	Sm.	Med.	Large	Undet.
1958	-	-	-	12	22	-	26	71	22	-
1960	-	-	-	39	34	-	27	95	37	9
1961	-	-	-	22	14	-	32	73	25	-
1962	-	-	-	33	41	-	33	113	42	19
1963	-	2	-	70	76	2	69	99	51	54
1964	1	1	1	66	109	-	105	207	59	85
Totals	1	3	1	242	296	2	292	658	236	167

Composite Population Composition Summary, 1958-1964

Population Element	Number	Per Cent of Observations
Cubs of year	10	Trace
Yearlings	840	30.6
Sows with cubs	5	Trace
Sows with yrls.	540	19.6
Other bears	1353	49.2
	2748	100.0

* May include some 2 year old bears still accompanying sows.

regulation cubs and sows with cubs (cubs-of-the-year and yearlings) are protected, and because huntes are highly selective of large male bears. (Tables 8 and 10)

A measure of the composition of polar bears in Alaska waters is possible, however, from sight observations made by hunters. The observations are recorded daily on forms provided by the Department of Fish and Game. A summary of these data (Table 5) indicates that the population composition of polar bears in Alaska waters during the spring is approximately 20% sows with accompanying yearlings, 31% accompanying young and 49% other bears. Obviously these data do not reveal a true picture of the composition of the total population. The greatest discrepancy is the almost complete absence of sows with new cubs in these observations.

MORTALITY

Hunting is the only polar bear mortality factor about which concrete information presently exists, and is doubtless the most significant one. Direct death at the hands of other enemies appears to be rare and inconsequential. A few bears are victims of conflicts with walruses and an occasional bear is reported as killed by the killer whale (Anthony, 1928; and Dufresne, 1946). It is likely, too, that larger and older bears occasionally kill cubs and other small bears as has been reported for the brown-grizzly and black bears (Troyer and Hensel, 1962; and Erickson, 1957). Another possible mortality cause is drifting far to sea on ice cakes. There is no evidence that diseases or parasites are significant mortality factors. A high incidence of trichina has been found in the polar bear (Thorshaug and Rosted, 1956; Abs and Schmidt, 1954; and others) but afflicted bears appear as thrifty as uninfected animals. Presumably the polar bear, as the black bear (Erickson, 1957 and 1964; and Erickson and Rausch, 1964) is highly resistant to disease in general and when afflicted shows little evidence of debilitating effects.

FOODS AND PREDATORY HABITS

The principle food of the polar bear is seals, notably the ringed seal (Phoca hispida). However, a wide variety of other animal and plant foods are included in the diet. Other seal species, walruses and whales are frequent food items, the latter two being obtained primarily as carrion. Sea birds and their eggs, and other lesser prey are taken as opportunity affords. A wide variety of vegetable foods is also eaten. Bears stranded ashore during the summer eat large quantities of grass, Vaccinium and crowberries (Empetrum sp.) (Petersen, 1957; and Lønø, 1963). Lønø has also observed polar bears diving for sea weed and has found their stomachs filled with this food. Novikov (1962) also reports algae and moss as food items.

Without doubt, the polar bear is the most predatory of the various bear species. Seals are hunted in several ways. During March and April young seals are obtained by digging them from their snow lairs on the ice (Lønø). Seals on open ice are approached by moving cautiously across the ice or swimming. Sometimes bears lurk near the exit holes of seals. Of the seal, the skin and blubber is first eaten and often the remains of the carcass are buried and sometimes revisited (Novikov).

PARASITES, DISEASE AND PATHOLOGICAL CONDITIONS

The bulk of the literature concerning the parasites, diseases and pathological conditions of polar bears concerns the occurrence of trichinosis and the toxicity of the liver.

Williams (1946), MacGinitie (1955) and Brandley and Rausch (1950) all mention that Trichinosis spiralis larvae are regularly harbored by polar bears in Alaska. These studies indicated, generally, that over half of the population is infected with this disease. The degree of infestations reported varied from .4 - 4.0 larvae/gm. of diaphragm tissue. A similar degree and rate of infestation is reported for Spitzbergen (Thorshaug and Rosted, 1956) as summarized below:

Trichinosis spiralis occurrences in polar bear and walrus

	Number Examined	Number Positive	Per cent Positive
Polar bear	278	163	59
Walrus	74	7	9

Trichinosis spiralis occurrences in polar bear by age difference

	Number Examined	Number Positive	Per cent Positive
Young bears (1 - 2 years)	12	2	17
Older bears	29	23	79

As is apparent from these data, younger bears show a lesser degree of infestation than older animals. This suggests general increases of trichinosis infestation with advancing age.

Oddly, studies to date have failed to identify the source of trichinosis infection in the arctic. The primary animals food items--seals, walruses and whales---all show very low occurrences of Trichinosis spiralis (Abs and Schmidt, 1954; and Thorshaug and Rosted, 1956). In view of the extensive studies of the subject, it appears that the transmission of trichinosis in the arctic must be a complex and intricate system of continual transmission. It is interesting, however, that none of the authors cited considered the polar bear itself as a logical source of transmission. This appears an oversight to us considering the quite extensive harvest of polar bears by hunters and trappers the carcasses of which for the most part are left on the ice and possible scavenged by bears and foxes.

The toxicity of polar bear liver when eaten as food is of considerable interest. Very little has been written on this subject in Alaska, but it is generally well known by Eskimos and local hunters. Rodahl and Moore (1943) cite several incidents of lethal effects resulting from persons eating polar bear liver. The symptoms were typically those of vitamin A hypervitamintosis. These workers found that polar bear liver contained 13,000 - 18,000 i.u. (International Units) of vitamin A per wet gram of tissue and Rodahl (1947) reported concentrations as high as 26,700 i.u./gram of wet tissue in Spitzbergen bears. These concentrations are over 40 times grater than those found in beef liver and 20 times greater than in pork liver (Williams & Wilkins, 1961). In tests with rats it has been found, however, that hypervitamintosis symptoms occur only after large quantities of liver are ingested. Thus it may be considered a suitable and desirable food item when eater in small quantities.

MOVEMENTS AND DENNING

As previously mentioned, the movements of polar bears are in part passive and in part active. As the major ice movement is clockwise around the pole, it may be assumed that bears are carried passively westward (Tovey and Scott, 1957). Active movements are more probably responsible for their distribution, however, and such movement is doubtless concerned primarily with food procurement and with the bringing forth of young. That active movements are on occasion estensive is demonstrated by the fact that airborne hunters frequently follow fresh bear tracks 75 or more miles before overtaking bears.

Recent observations in Spitzergen by Lønø (1963) indicate that female polar bears actively seek island areas for making winter lairs and for bearing young. He reports that dens are made in snowdrifts and usually high up in mountains. Winter lairs have not been found on the ice pack in Spitzebergen. Pregnant females usually den in late October and emerge with their young between mid-March and mid-May, but usually in May. Short trips are usually made from the den before it is deserted permanently.

Non-pregnant females and males are also reported to den but for shorter periods and in less elaborate dens (Pedersen, 1957). Denning is perhaps resorted to on occasion during periods of food scarcity as might occur during unbroken ice conditions.

PHYSIOLOGICAL CONSIDERATIONS

The deep body temperature of the polar bear as determined from six animals that were killed, ranges from 37.1 - 37.8°C and averages 37.6 (Irving and Krog, 1954). This compares closely with the 37°C (98.6 F) temperature mean determined for the black bear (Youatt and Erickson, 1959). How much the body temperature is depressed during the period of winter-denning has not been established though a 3 - 6 degree drop has been determined for the black bear (Hock, 1951; and Erickson and Youatt, 1961).

It is surprising that the fur of the polar bear has been found to provide very poor insulation against heat loss (Scholander et. al., 1950). These authors state that heat loss is especially pronounced when the bear is immersed in icy water, since apparently the water quickly penetrates to the skin surface dislodging all air and there is no subcutaneous blubber to afford insulation. In our experience the latter statement appears incorrect, however, since typically winter-killed bears possess a 1-1/2 to 2 inch subcutaneous fat layer. Heat loss is probably reduced also by peripheral vasoconstriction and cooling can be further compensated for by heat production while swimming. The polar bear is also a large animal with a large heat capacity and has a proportionately small surface area. Compensation is also afforded by a high metabolic rate and a fat-rich diet. Even small cubs with shorter fur than adults evidently need little insulation because of their high metabolic rate (Scholander et. al., 1950).

At room temperature polar bear milk has the consistency of sweetened condensed milk, is white in color and possesses a strong, fish like odor. As determined from analysis of a sample obtained from a female accompanied by a 1 1/2 year old cub (Baker et. al. 1963a and 1963b), polar bear milk is very high in total solids (44.1%), particularly fats. At least 14 fatty acids were to be recognized. Carbohydrates, while lower than normally found in bovines, were higher in caseins and separable into at least three fractions. Milk proteins and lactose contents were similar to those determined for whales, porpoises and seals.

HARVEST DATA

The estimated and known harvests of polar bears in Alaska from 1925 through 1963 are presented in Table 6. The data prior to 1961 were variously calculated and estimated by the authorities indicated. They are believed to be under-estimates.

It will be noted that kills prior to 1956 averaged about 125 bears annually. Kills for this period were made almost exclusively by native hunters. Kills since 1956 have increased slightly, averaging about 185 annually. During the latter period there has been a marked shift in the manner of harvesting. Native hunter activity has decreased markedly while sport hunting has increased. At first glance sport hunting would appear to have displaced native hunting but this is merely happenstance. Polar bears taken by sport hunters are almost without exception far beyond the range of native hunters (Table 7). Furthermore, sport hunters are highly selective to large male bears whereas natives take all bears, cubs and females included, as opportunity affords (Table 8). The bulk of the native kill also occurs prior to march whereas the bulk of the sport kill occurs in March and April. It is also significant that most sport hunting is from Kotzebue, a village at least 50 miles removed from the nearest available polar bears. Actually native hunting effort has been greatly reduced voluntarily in recent years due to greater opportunities for wage-earning employment and welfare benefits.

The chronology of the polar bear kill in recent years is shown in Figure 1. Kills prior to February were strictly by native hunters. Sport hunting usually begins about mid-February and continues through the first part of May. As is apparent from the data of Figure 1, the period of greatest activity occurs between mid-March and mid-April with hunting effort largely dependent on flying weather. Ice and snow conditions play a part in hunter success, influencing both tracking and landing opportunities.

The degree of hunter success is by normal standards exceptional. No measure is available for resident sport hunters, but non-resident success may be judged by comparing the number of polar bears sealed for nonresidents and sales of non-resident polar bear tags (Table 9). These data for the years 1961-63 show an overall hunter success in excess of 94 per cent. Resident hunter success is perhaps slightly below this figure. Success for native hunters is without meaning since they take bears as opportunity affords incidental to trapping, seal hunting and other activities.

MANAGEMENT

During recent years concern has been expressed in many quarters over the welfare of the polar bear (Spark, 1956; Sdobnikov, 1956; Harrington, 1961; and others). Over exploitation has been charged and in Alaska the use of aircraft in hunting bears has been condemned as damaging (Foote, 1960; and others). The sealing program employed in Alaska since 1961 has provided excellent data on recent harvests and does not support this contention. These data show Alaskan harvests approximately akin to those of earlier times when the animals were hunted commercially.

TABLE 6. The estimated and known harvest of polar bears in Alaska from 1925 through 1964 according to hunter type.

Year	Resident Hunter White	Resident Hunter Eskimo	Non-Res. Hunter	Unk.	Total Harvest
1925-1953[1]	Very few	Majority	Few		117 (Average)
1954	?	?	?		100
1955	?	?	?		128
1956	?	?	?		135
1957[2]	53	78	75		206
1958[3]	19	40	69		128
1959[4]	?	53	?		250
1960	?	62	?		162
1961	59	23	70		152
1962	103	16	78	4	201
1963	57	22	106	4	189
1964	89	23	139		251

1. From annual reports of the Alaska Game Commission for the years 1925 through 1956.
2. From Tovey and Scott (1957).
3. From Scott et. al. (1959).
4. From unpublished data in Alaska Department of Fish and Game files for the years 1959 through 1964.

TABLE 7. Distances Alaska-based hunters killed polar bears from Alaskan shores in miles.

	Res. Hunters		Non-Res Hunters		Native Hunters	
Year	No.	Av. dist. from shore	No.	Av. dist. from shore	No.	Av. dist. from shore
1961	58	66	64	72	19	19
1962*	96	68	85	88	12	21
1963	57	49	106	64	11	9
1964**	73	68	137	82	12	11

* Average distance for native hunters on foot seven miles.
** Data incomplete.

TABLE 8. Sex composition of polar bears taken by Alaska hunters, 1961-1964.

Year	Native Hunters		Res. Hunters		Non-Res. Hunters		All Hunters	
	No.	% Male	No.	% Male	No.	% Male	No.	% Male
1961	23	52	59	57	70	93	152	73
1962	16	50	103	60	78	85	197	69
1963	22[1]	68	57	68	106	88	185	79
1964	23	70	89	61	139[2]	88	251	76

1. Includes 4 bears of unknown sex.
2. Includes 2 bears of unknown sex.

TABLE 9. Non-resident hunter success for polar bears.

	1961	1962	1963
Tag sales	78	96	110
Bears sealed	69	89	109
Per cent success	88.5	92.7	99.1

TABLE 10. 1961-63 comparative polar bear average skull[1] and hide[2] measurements by hunter type.

Year	Skull and Hides sizes of Bears Taken by Non-Res.		Resident		Native	
	Skull Size (inches)	Hide Size (feet)	Skull Size (inches)	Hide Size (feet)	Skull Size (inches	Hide Size (feet)
1961	24.9	17.5	22.7	15.8	21.7	14.6
1962	24.8	17.5	22.7	15.6	20.0	15.0
1963	25.2	18.1	24.1	16.8	21.5	15.2

1. Length plus width in inches.
2. Length plus width and flap in feet. (see fig. 2)

The present sport harvest is also potentially less damaging since males constitute over 75% of the kills. This is in sharp contrast to harvests in Canada and Norway where aircraft hunting is not practiced. In these countries, females and cubs predominate in the total take. (Harrington, 1961; Lønø, 1963).

The size composition of bears taken by hunters suggests also that the population has not diminished. Hides and skulls have not declined in average size which indicates that the kills have been drawn from populations similar in composition (Erickson, 1962) (Table 10). The number of bears seen per hour by airplane hunters since 1956 further emphasizes that no marked change in the polar bear population in Alaskan waters has occurred (Table 11).

Despite the seeming security of the polar bear at present, management agencies should give early attention to learning greater details about this noble animal and valuable resource. Precise knowledge of the numbers, size and sex composition of bears taken by all nations should be ascertained and closely scrutinized for evidence of over-exploitation. Practical field studies should be initiated to determine the movements of bears and to determine whether the species is represented by more-or-less discrete sub-populations or is truly one large holarctic population. Above all, greater understanding of the species' ecology and life history in Alaska is essential, particularly as regards recruitment potentials.

Continued and growing interest in the animal as a trophy underscores the need for greater knowledge of the species if it is to be managed in an enlightened manner. Above all the present sealing program should be continued and the data obtained from it should be closely analyzed for changes in the harvest picture.

The sealing program as presently administered is extremely workable and seemingly holds most promise for the management of the polar bear in Alaska at this time. In brief, the program is an adjunct to the Alaska game regulation which stipulates that the hides of all polar bears taken by Alaska based hunters must be presented to the Alaska Department of Fish and Game for compulsory sealing, together with such information as stipulated by the Department. At the time of sealing the hunter attests to the legality of the bear presented for sealing and provides details concerning the animal and the circumstances of its being taken (Figure 2). In addition to sealing the hides of bears, sealing officers obtain the skull and hide measurements of bears and their sex.

As is apparent, this program affords an excellent means of ascertaining biological factors concerning the harvest which are very useful in managing the species. Furthermore, the program has not proven too cumbersome to administer since the number of bears presented for sealing is not great and most hides can be intercepted for sealing at just a few locations.

TABLE 11. Polar bear observations in relation to hours of flying as reported by aircraft hunters, 1956-64.

Year	Number Flying Hours	Number Bears Sighted	Bears Seen Per Hour
1956	84	33	0.4
1957	383	222	0.6
1958	185	201	1.1
1959	265	498	1.9
1960	164	179	1.0
1961	356	340	1.0
1962	313	304	1.0
1963	343	588	1.7
1964	608	947	1.6

As regards the future welfare of the polar bear, it appears that of all the bear species in the world it stands the best chance of being maintained at reasonably high population levels. Several reasons may be advanced in support of this statement. First the species occurs in an environment which is for the most part devoid of humans. Consequently opportunities for man to exploit or to come in conflict with him are less frequent than with other bear forms. Futhermore man's influence on the environment of the polar bear appears slight as compared to the changes which have occurred or are being wrought to the environment of other bear species.

Our toast to a long life for the polar monarch.

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In view of the general lack of technical contribution on the polar bear in Alaska, the following bibliography is presented for those wishing to seek additional information on the species. The bibliography is not complete but does include most of the important contributions to our understanding of the species and presents as well all papers known to the authors on the polar bear in Alaska and the works cited in this paper.

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