Ursus maritimus. By Douglas P. DeMaster and Ian Stirling

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Ursus maritimus. Phipps, 1774

Polar bear

Ursus maritimus Phipps, 1774:185. Type locality Spitzbergen.

Ursus maritimus Pallas, 1776:691. Type locality Arctic Ocean, Siberia.

Ursus polaris Shaw, 1792:7. Renaming of maritimus Pallas.

Thallastarctos eurecanlandicus Knotterus-Meyer, 1908:182. Type locality pack ice off coast of eastern Greenland.

Thallastarctos labradorensis Knotterus-Meyer, 1908:183. Type locality Okak, Labrador.

Thallastarctos maritimus Knotterus-Meyer, 1908:184. Type locality Jena Island, Spitzbergen.

Thallastarctos spitzbergensis Knotterus-Meyer, 1908:184. Type locality Seven Islands, Spitzbergen.

CONTEXT AND CONTENT. Order Carnivora, Family Ursidae. The genus Ursus includes three species. The living populations of Ursus maritimus are not divided into subspecies (Wilson, 1976), although one fossil subspecies is recognized (Kurtten, 1964).

DIAGNOSIS. Typically the body of a polar bear is stocky but lacks a shoulder hump. Polar bears have a longer neck and smaller head than other ursids (Fig. 1). The combined length of the first and second molars is less than the palatal width.

GENERAL CHARACTERS. Far color varies among white, yellow, grey, or almost brown, depending on season and light conditions. The nose and lips are black, as is the skin. Adult males weigh 300 to 800 kg and measure 200 to 250 cm in length from tip of nose to tip of tail. Adult females weigh 150 to 300 kg, and their total body length is about 180 to 200 cm. It is not meaningful to give mean weights because there is a cline in size from Spitsbergen, where the bears are smallest, to the Bering Strait where they are largest (Manning, 1971). Presumably the cline is similar across the Soviet Arctic to the Bering Strait, but this has not been investigated. Cubs weigh roughly 0.6 kg at birth and 10 to 15 kg when they emerge from dens in March or April. In March, yearlings weigh between 45 and 80 kg, while 2-year-olds weigh between 70 and 140 kg. Females reach adult weight by age 5 and males between years 8 and 10.

The length of skull (Fig. 2) ranges from 353 to 412 mm in males and from 303 to 380 mm in females. For adults, the height at the shoulder varies from about 130 to 160 cm. The length of tail ranges between 76 and 127 mm (Uspenski, 1977).

Polar bears have a plantigrade gait and five toes on each foot. The claws are not retractable and in adults are 5 to 7 cm in length. The forepaws are large and oarlike, as an adaptation for swimming. The dentition of polar bears reflects a rapid evolutionary shift from the heterodont dentition of other ursids toward more homodont cheek teeth, as in other aquatic carnivores (Hecht, 1963).

FOSSIL RECORD. Polar bears are thought to have originated from a segment of the Siberian population of brown bears (Ursus arctos) which was isolated during the glacial advances of the mid-Pleistocene (Kurtten, 1964). With the exception of the Western Canadian Arctic where brown bears have been seen on the sea ice and polar bears have been seen chasing caribou, the geographic ranges of polar bears and brown bears do not overlap. The distribution of polar bears reflects a rapid evolutionary shift from the heterodont dentition of other ursids toward more homodont cheek teeth, as in other aquatic carnivores (Hecht, 1963).

FORM. The pelage of the polar bear is made up of a thick layer of underfur (5 cm in length) and an abundance of tufted intermediate guard hairs (15 cm in length). The color of the fur varies mostly with the season of the year. After the molt the fur is often pure white. The yellowish shade often seen during the summer probably results from oxidation by the

Figure 1. Adult male polar bear (Ursus maritimus). Photograph courtesy of H. P. L. Kiliaan.
Polar bears can accumulate considerable amounts of subcutaneous fat. In adults, the thickness of this fat varies from 1 to 10 cm on either side of the midline of the belly slightly posterior of the axillae, and two of which are approximately 15 cm posterior to the anterior pair.

The dental formula is $\frac{1}{3}, \frac{1}{3}, \frac{2}{3}, \frac{2}{3}$, and m 2, 1, 1, total 38-42 (Banfield, 1974). Incisors are unspecialized and the canines are elongated, conical, and slightly hooked. The carnassial teeth are weakly developed. The first premolars are usually rudimentary. The fourth upper premolar does not have a third root (Stains, 1967). Sexual differences in the mandibular length were given by Larsen (1971) and molar measurements were reported by Gordon et al. (1977). The sex ratio at birth appears to be equal. Newborn cubs have hair at birth (Blix and Lentfer, 1979), but are blind and weigh only about 0.6 kg. By the time they leave the den in late March or early April, the cubs weigh approximately 10 to 15 kg. Geographic differences in the age of weaning may exist, especially between the Hudson Bay population and other populations (Stirling et al., 1977). The average age of first breeding appears to be 4-8 years of age, but this was not confirmed for animals of known age. Usually, cubs are born in December and January in dens (Van de Vorder, 1957, 1967; Lentfer, 1976a). Two young are commonly produced (conduction), and by panting (evaporative cooling) (Oritsland, 1970; Oritsland et al., 1974). Lentfer et al. (1971) described the physiology of two males that were held in captivity under conditions that induce denning in brown bears.

Ontogeny and Reproduction.

Spermatogenesis takes place from February to May, and possibly into June (Erickson, 1962; Lentfer and Miller, 1969; Lennep, 1970). In Alaska, paired bears have been observed in the field between 21 March and 10 May (Lentfer, 1976a). Lennep (1970) noted breeding pairs in Spitsbergen between 8 March and 20 June. Uspenskii (1977) reported that implantation is apparently delayed and gestation (conception to parturition) is therefore relatively long (195 to 265 days). Cubs are born in December and January in dens (Van de Vorder, 1957, 1971; Lentfer, 1976a). Two young are commonly produced (conduction), and by panting (evaporative cooling) (Oritsland, 1970; Oritsland et al., 1974). Lentfer et al. (1971) described the physiology of two males that were held in captivity under conditions that induce denning in brown bears.

The composition of polar bear milk has been described (Baker et al., 1965a, 1965b; Cook et al., 1970; Jenness et al., 1972); it contains more fat than whale milk, but less than seal milk (Jenness et al., 1972). The milk content was similar to that of other mammals and the sodium content was high compared to that of other mammals (Jenness et al., 1972). An analysis of baseline blood parameters suggests that cubs have higher alkaline phosphatase and calcium levels than adults, and that an overall increase in blood glucose occurs in October and November (Lee et al., 1972). Cardiac physiology at rest and during exercise has been studied (Hock, 1968; Folk et al., 1970, 1973; Oritsland et al., 1976, 1977).

Oritsland (1970) presented data on hypothermia in polar bears and indicated that polar bears use both blubber and pelt for insulation. The oxygen consumption rate during walking increases at the rate of most mammals (Oritsland, 1970; Oritsland et al., 1974). Lentfer et al. (1971) described the physiology of two males that were held in captivity under conditions that induce denning in brown bears.

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FICURE 3. Distribution of polar bears. Their range is closely coupled to the distribution of polar sea ice. The inner dark line represents an average summer range of polar bears. The outer dark line represents an average winter range. The stipple pattern outside the winter range represents land areas which may be visited by female polar bears searching for den sites. Land areas enclosed by the winter range are also potential den sites. The ice cap is shown in an average summer position.

epididymis, the minimum and maximum age of breeding in males was estimated to be 3 and 19 years respectively (Lentfer and Miller, 1979). However, the presence of sperm does not necessarily indicate that copulation has occurred. Based on growth data alone (Kingsley, 1979), we suggest that it is unlikely that male polar bears mate before they are 6 years of age.

In Alaska, Lentfer (1976) suggests that the maximum longevity for polar bears is between 20 and 25 years. Stirling et al. (1975) reported captures of animals 25 years of age, estimated maximum longevity to be between 25 and 30 years. Age specific rates of survival are not precisely known. Mortality of adult males and females has been estimated to be between 8 and 16% (Lentfer et al., 1976; Lentfer et al., in press). Typically, an annual mortality rate of 8 to 12% has been assumed (Stirling et al., 1976; DeMaster et al., 1980). Subadult mortality has been estimated between 3 and 16% (Lentfer et al., in press). The annual mortality of cubs prior.set weaning is considered to be between 10 and 30% (Stirling et al., 1975; DeMaster and Stirling, in press).

ECOLOGY. Polar bears feed primarily on ringed seals, Phoca hispida (Stirling and Smith, 1975; Stirling and Archibald, 1975). The energetics of predation and caloric value of these seals were discussed by Stirling and McEwan (1975) and Best (1976). During spring at least half of the ringed seals killed by polar bears in the western Canadian Arctic were newborn pups (Stirling and Archibald, 1977). Bearded seals (Erignathus barbatus) are taken less often than ringed seals, but are important prey items. Polar bears also eat harp seals (Phoca groenlandica) and hooded seals (Cystophora cristata); and scavenge on whale, walrus (Odobenus rosmarus) and seal carcasses (Russell, 1973; Heyland and Hay, 1976). Polar bears have been reported to prey on walruses, but polar bear mortalities have been attributed to walruses as well (Kiliaan and Stirling, 1978). Occasional references (Freeman, 1973; Heyland and Hay, 1976) have been made to polar bears attacking beluga whales (Delphinapterus leucas). Polar bears occasionally eat small mammals, birds, eggs, and vegetation when other food is not available (Russell, 1975). Scavenging on the remains of seals killed by polar bears is probably of great importance to the survival of arctic fox (Alopex lagopus) through the winter (Stirling and Archibald, 1977).

The diseases of polar bears have not been well documented. Roughly 60% of Alaskan bears harbor Trichinella spiralis, apparently contracted through eating infected seals (Lentfer, 1976; Rogers and Rogers, 1976). The pattern of environmental contaminants in bears from western and northern Alaska was reported to be different, suggesting that these populations are relatively isolated from each other (Lentfer, 1974a, 1976).

The population dynamics of polar bears vary geographically (Larsen, 1971; Stirling et al., 1975, 1977, 1978, 1980). Adult males (5 and above) comprise 12% of the Alaskan Arctic population (Lentfer et al., in press), 19% of the western Canadian Arctic (Stirling et al., 1975), and 17% of the Hudson Bay population (Stirling et al., 1977). Adult females comprise 20%, 19%, and 7% of these three populations, respectively. Cubs of the year, yearlings, and 2-year-olds constitute 32% and 26% of the Alaskan Arctic and western Canadian Arctic populations, respectively. Age composition reported from Alaska may include bias (Lentfer et al., in press) because a major portion of the sampling of natural populations was carried out in March and April when adult females with cubs
of the year would be near their dens. Therefore, the number of cubs of the year and older females has probably been undersampled relative to other age classes. However, in southeast Baffin Island, where ecological conditions are quite different, females with cubs of the year were not undersampled, but females with yearlings were (Stirling et al., in press).

Although estimates as low as 10,000 have been proposed by the Soviets (Uspenskii, 1977), the total number of polar bears is roughly estimated at 20,000 by Larsen (1972). The higher estimate was derived by assuming the current harvest of polar bears (roughly 1000 animals) is roughly 5 percent of the total population. Larsen (1972) also obtained a similar total by summing the regional estimates of polar bear populations.

In Alaska, polar bear densities have been estimated between 1 bear per 38 km² (Lentfer et al., in press) and 1 bear per 139 km² (Paul E. Toovey, unpublished report in file of author). The total population of Alaskan bears is estimated to be between 6000 and 9000 (D. G. Chapman, pers. comm.), and available evidence indicates that the population is stable or only slowly increasing (Lentfer et al., in press). In the western Canadian Arctic, where numbers have recently undergone large fluctuations owing to natural causes, the number of polar bears was estimated to be between 1000 and 1700 or 1 bear per 37 to 52 km² (Stirling et al., 1975, 1976). Estimates for the Soviet Union, Greenland, and Norway are not available, but populations are assumed to be stable or slightly increasing in Greenland and Norway, and stable or increasing, after recovery from previously reduced numbers, in the Soviet Union (Uspenskii, 1977).

In preferred bays, polar bears are ice that is periodically active, where wind and sea currents cause movements and fracturing of the ice followed by refreezing. This process creates permanent lans or patches of seasonally refrozen ice (Stirling et al., 1975). This may occur at the interface between landfast ice and drifting pack ice, across the mouths of bays, or in tidal inlets along coastlines. It is in this habitat that hunting success is highest (Stirling and Archibald, 1977).

Pregnant females leave the drifting pack ice in October or November to find suitable areas for denning. The relative dis-tribution of the areas is therefore greatly influenced by the distribution and movements of the sea ice (Lentfer, 1971, 1972; Stirling et al., 1975, 1976). Pederson (1945) suggested that polar bears were denned on landfast ice, but populations are now stable. However, the results of recent tagging studies indicate that polar bears are divisible into relatively discrete populations (Jonkel, 1967; Lentfer, 1969, 1976; Larsen, 1972; Stirling et al., 1975, 1977, 1978, in press; Uspenskii, 1977). The sizes of the areas in which these populations exist vary from relatively small areas in the Chukchi Sea to relatively large areas in the Canadian Arctic.
Lentfer and Hensel, in press). Maternity dens are often dug on slopes of 20 to 40° where snow has accumulated to depths of 1 to 2 m (Uspenski, 1977). These dens are usually located within 8 km of the coast (Harington, 1968; Lentfer, 1976b; Lentfer and Hensel, in press; Uspenski, 1977), and rarely beyond 48 km. Polar bears have been reported to bear young in maternity dens along the pack ice (Lentfer, 1975). Den range from single chamber with short tunnels to complex structures with several chambers and tunnels (for detailed descriptions of maternity den consult Uspenski and Chernyavskii, 1965; Harington, 1968; Jonkel et al., 1972; Uspenski and Kitischinski, 1972; Lentfer, 1976a). Another type of den is a temporary shelter formed in the snow, particularly by females with young, during inclement weather (Jonkel et al., 1972; Lentfer, 1976a). A third type of den is dug into the earth, as a temporary shelter in summer and fall (Kolenosky and Stanfield, 1966; Doutt, 1967; Jonkel et al., 1972, 1976).

**GENETICS.** Crosses between brown bears and polar bears produced fertile hybrids (Gray, 1972). The 2n chromosome number is 74 (Low et al., 1964).

**REMARKS.** The first description and name of the polar bear, *Ursus maritimus*, means maritime bear. The reduction of stocks in the Soviet Union (Uspenski, 1977) with subsequent moratoria on the taking of polar bears in the Soviet Union, Norway, and the U.S. is the result of the news media to mean that polar bear numbers over their entire range were reduced. There is no evidence from studies in Alaska, Canada, or Greenland to support this opinion. No information is currently available on hereditary or genetic differences between the various subpopulations of polar bears.

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**LITERATURE CITED**


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