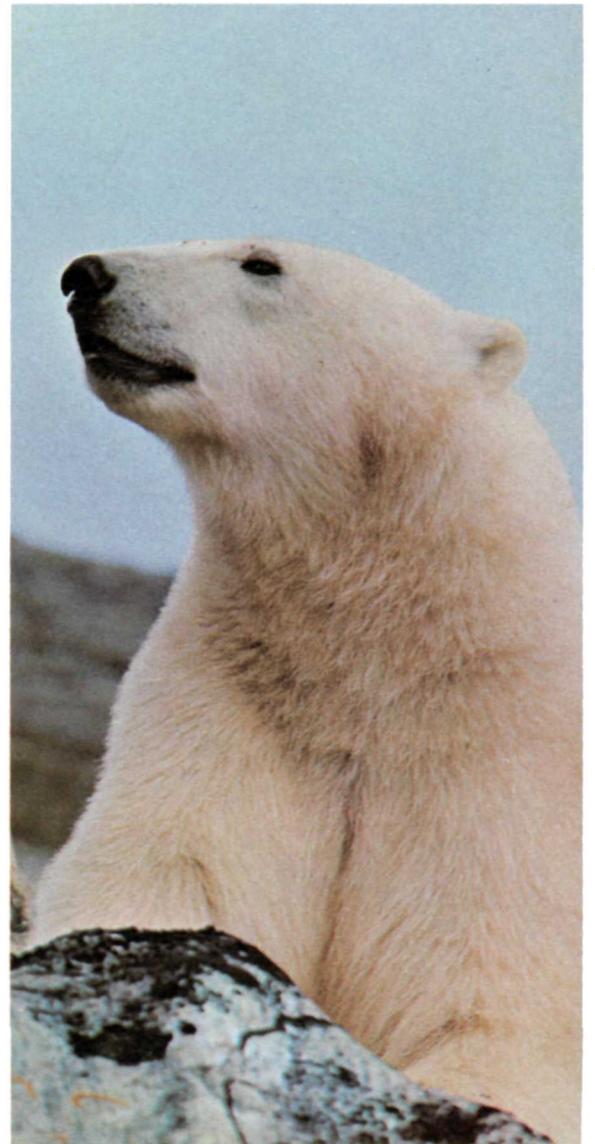


C. RICHARD HARRINGTON

Denning habits of the polar bear (*Ursus maritimus* Phipps)

 CANADIAN WILDLIFE SERVICE REPORT SERIES—NUMBER 5



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(Ursus maritimus Phipps)

by C. Richard Harington



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All cover photographs by
Fred Bruemmer

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Abstract

Common denning areas (core areas) for polar bears are northern Greenland, Svalbard, the archipelagos north of the Soviet mainland, and the islands of northern Canada. In autumn, bears are often rafted on broken pack ice to suitable denning places. Some experienced individuals probably find denning areas by their ability to navigate within a region.

Site factors exert an important influence on the location of polar bear dens. Dens are usually excavated in the thick snowbanks that develop on leeward slopes of coastal hills and valley sides, and are characterized by entranceways leading to one or more rooms.

Although polar bears of both sexes and various ages occupy dens, pregnant females seem to be most regular in this habit, commonly denning between October and April. The cubs, usually born in early December, are mature enough to leave the dens and travel with their mothers down to the sea ice by March or April.

Core areas and denning habits require further investigation, so that polar bears can be more effectively safeguarded should any threat arise to their survival.

Perspective

Depletion of polar bears by successive waves of explorers, whalers, sealers, and fur traders since the early seventeenth century has caused concern for their survival. Polar bears, once secure in their arctic wilderness, protected from man by the natural barrier of severe environment and the technical barrier of poor human transportation, now face the threat of increased hunting from aircraft and motor toboggans. Bears are hunted for sport, captured for zoos, and killed for their meat and luxurious pelt.

The world population is about 10,000, of which about 6,000 are thought to be in Canada. In 1964 the total world kill was about 1,300. The Canadian kill has approached 600. In the Northwest Territories, only Eskimos, Indians, and the few holders of a general hunting licence can legally hunt polar bears. Killing of cubs under a year of age or females accompanied by such cubs is forbidden. A quota system instituted in the summer of 1967 limits kill in the Northwest Territories to 383. Approximately 50 are killed each year in the Yukon Territory and Manitoba, Ontario, Quebec, and Labrador.

The two greatest problems in polar bear research and management are establishment of confident population estimates and major patterns of popula-

tion movement. These and other problems in polar bear conservation were discussed in September 1965 at the First International Scientific Meeting on the Polar Bear, held in Fairbanks, Alaska. It was unanimously agreed that polar bears, which roam widely throughout the arctic basin, must be considered an international circumpolar resource, but that until enough scientific research has been done to provide the basis for more precise management each nation should take all necessary conservation action for itself. It was agreed that cubs, and females with cubs, would be protected at all times. The participating nations also agreed to consider ways to promptly exchange information and to step up or redirect their polar bear research to make it more effective. Further international meetings on the polar bear will be held when urgent problems, or new scientific information, warrant them.

Although this valuable and impressive wildlife species is not in immediate danger of extinction, there is certainly no room for complacency. Should polar bear survival be threatened in the future, it would be essential to protect their breeding areas. Therefore, we must know more about polar bear denning areas and habits.

Frontispiece courtesy U.S. Coast Guard.



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Introduction

Few detailed observations have been made of polar bear denning habits. The inaccessibility of the denning range and the inconspicuousness of the dens, together with the rigorous weather conditions that prevail during the denning period, hinder study of this phase of polar bear life history. This paper presents some data on denning habits of polar bears in the Canadian Arctic, gathered between 1961 and 1964, and relates them to the findings of other observers.

Gerrit De Veer (1876), an officer of Barents', was probably the first to record a description of a polar bear den. On April 15, 1597, toward the end of the winter when the expedition was stranded on north-eastern Novaya Zemlya he wrote,

. . . there came a great beare towards us, against whom we began to make defence, but she perceaving that, made away from us, and we went to the place from whence she came to see her den, where we found a great hole made in the ice, about a man's length in depth, the entry thereof being very narrow, and within wide; there we thrust in our pikes to feele if there was anything within it, but perceaving it was emptie, one of our men crept into it, but not to farre, for it was fearfull to behold.

Van der Brugge, who with his men overwintered on the northwestern coast of West Spitsbergen in 1634, stated on February 27 (in Conway, 1904): "We then walked about the country, and saw in high, steep places on the mountains great caves, where the bears had made their camp, two of our comrades getting up to them after much trouble."

Payer (1877) gave one of the earliest descriptions of an occupied polar bear den. It was discovered on March 29, 1874, on Koldewey Island, Franz Josef Land, and consisted of a cavity in a mass of snow beneath a rocky wall.

Koettlitz (1898), Manniche (1910), Freuchen (1935), Pedersen (1957), Van de Velde (1957), and Lønø (1957) have made important contributions on this subject. Novikov (1956) summarized findings in the Soviet Union. Uspenskii and Chernyavski (1956) gave interesting details of bear dens on Wrangel Island.

Acknowledgements

I am grateful to the many Eskimos who have helped me with this study, particularly my field assistants: Tony Eecherk and Akat (Coral Harbour), Jacobie (Clyde), Ooingoot (Resolute Bay), Tim Lennie and Noah Elias (Sachs Harbour). Thanks are also due to Mr. Barrie Gunn and Mr. Harvey Gale (Department of Indian Affairs and Northern Development), Corporal R. Gordon and Constable D. Wheeler (R.C.M. Police), the Hudson's Bay Company, and the Department of Transport, for facilitating travel and accommodation in the field.

I wish to thank Dr. A. H. Macpherson (Canadian Wildlife Service) for reading the manuscript and for suggesting many improvements. Mr. K. C. Arnold (Department of Energy, Mines and Resources) kindly helped me to estimate the degree of error involved in using a watch-sun "compass" to obtain directions of slopes at polar bear den sites.

Methods

To study polar bear denning habits it is, of course, desirable to find as many dens as possible. This was accomplished by travelling through regions where dens were reported frequently by local inhabitants. Although I employed dog sleds, motor toboggans can be used to advantage in some denning areas. Finding dens is often difficult, and experienced Eskimo assistants aided me greatly. In my study areas (especially eastern Southampton Island), most dens were found on leeward, south-facing slopes of coastal hills and valleys, particularly where the earliest snowbanks formed in autumn.

Although a few dens at lower levels may be seen with the unaided eye, the best method is to methodically glass (7 x 35 Bushnell binoculars were used) upslope areas from suitable vantage points. Ventilation holes (or vents) of dens were most easily observed by this means. Usually they appear as small, black spots with adjacent platforms of pushed-out snow. If a search is made when denning begins in autumn, or when the bears are about to abandon their dens in spring, tracks may be found leading to or from the sites. Sled dogs, with their keen sense of smell, may also lead one to polar bear dens (see Iversen, 1941). When dens are likely to be drifted over or when visibility is poor, it is sometimes useful to take a few good "bear dogs" on leashes across snow slopes where denning is suspected or has been reported previously (Fig. 1). I have observed only two polar bear dens from low-flying light aircraft: an abandoned one in June 1961, on western Bathurst Island, and another in March 1965, on eastern Southampton Island. Helicopter surveys for polar bear dens might be profitable.

Occupied dens can be detected by fresh tracks in the vicinity of the den, wisps of vapour rising from vents or exits, reactions of dogs released near the holes, or (as a last resort) listening at the vents or exits for sounds of life inside. When an occupied den was to be examined, an assistant with a rifle was placed so as to guard the vent. Inhabited rooms were located by probing the area toward which the vent descended with a long iron rod (Eskimo lance). As soon as the ceiling of a room is pierced the rod slips easily through, allowing approximate calculation of snow thickness over the room and of the height of the room.

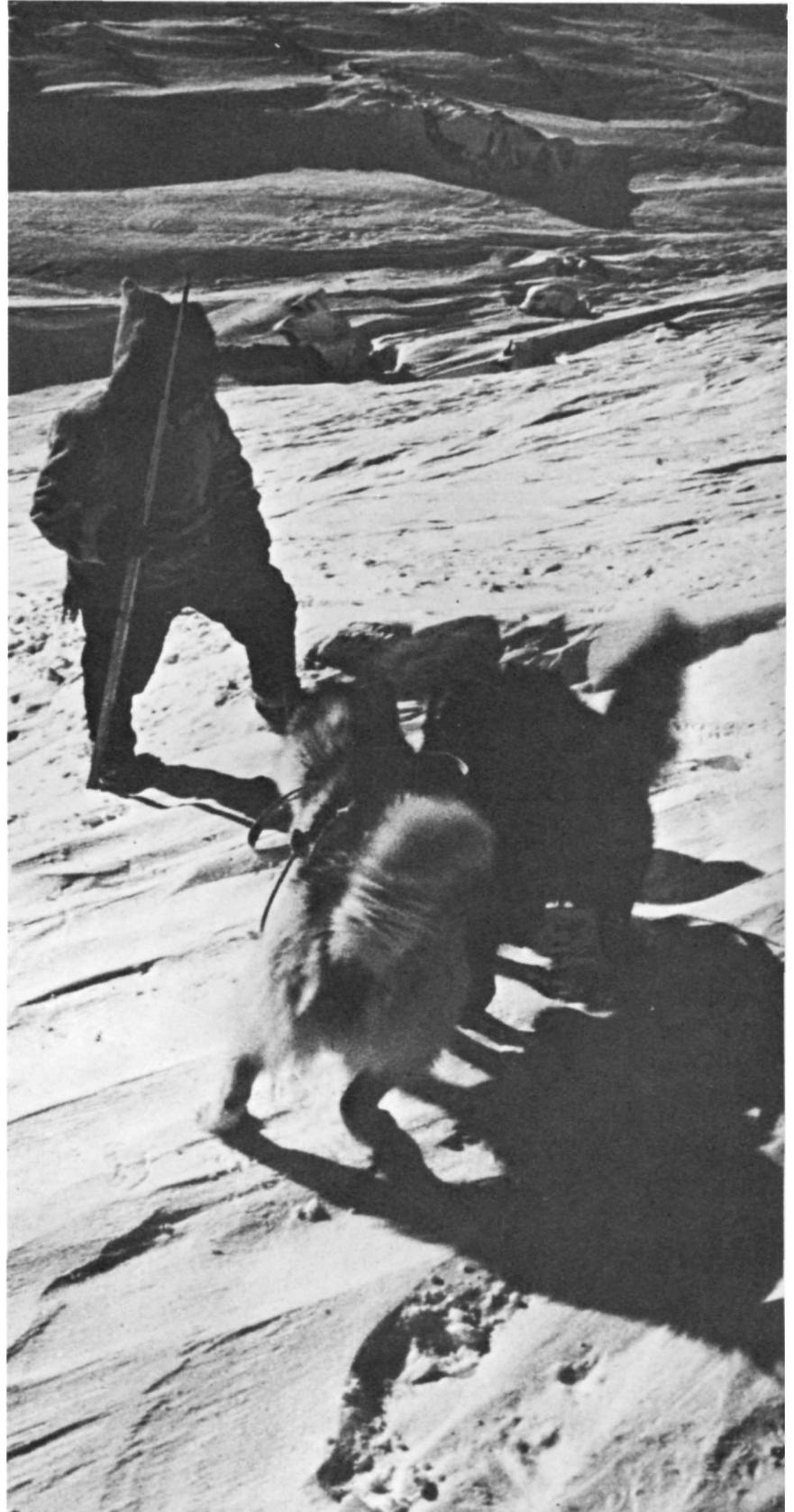
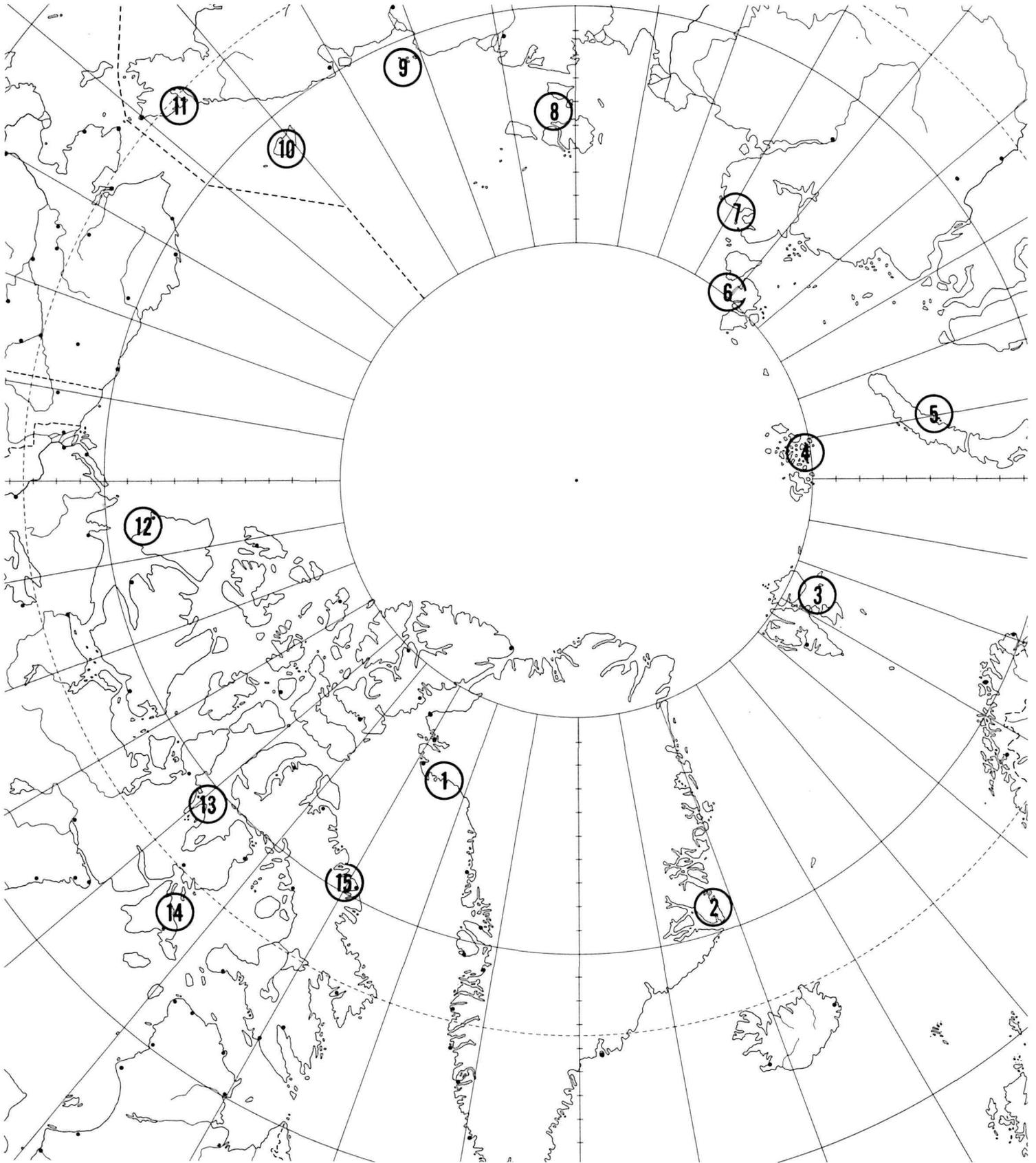


Figure 1 Searching for dens with "bear dogs", Southampton Island, N.W.T. A den entrance is in front of the dogs. Photo by C. R. Harington.

Figure 2 Distribution of polar bear core areas (important denning and cubbing places): 1) Northwestern Greenland, 2) Northeastern Greenland, 3) Eastern Svalbard, 4) Franz Josef Land, 5) Novaya Zemlya, 6) Severnaya Zemlya, 7) Taimyr Peninsula, 8) New Siberian Islands, 9) Bear Islands, 10) Wrangel Island, 11) Chukchi Peninsula, 12) Southern Banks Island, 13) Simpson Peninsula, 14) Eastern Southampton Island, 15) Eastern Baffin Island. (5, 6, 7, 8, 9, and 11 are of secondary importance.) Dots indicate weather stations.



Core areas

Den temperatures were obtained by lowering a Weksler thermometer on a cord through a narrow hole in the snow until it just projected through the den ceiling. Two readings were taken, and the results averaged. Such holes were enlarged to find out more about the dimensions and appearance of the dens, and to see their occupants. A folding military spade was found to be well suited for den excavation.

Dimensions of abandoned dens, or dens whose occupants were killed for study, were measured with a Lufkin 2-metre chrome-clad tape. Diagrams of dens and notes on their appearance were made on the spot in a field notebook. Data on den elevation (using a Hughes Owens No. 8000 aneroid barometer corrected for pressure), direction in which the slope faced at the den site (using a watch-sun "compass"* with local topographic maps), and degree of slope (by averaging spirit level readings above and below the den site) were recorded also.

In some cases, information on polar bear dens or denning habits was obtained from Eskimos (see particularly Harington, 1962). Most data used were provided by Eskimos I knew well, or had travelled with for extended periods. This gave me an opportunity to estimate the reliability of their statements. Other verbal reports were used if corroborated by more than one individual, or if they were consistent when checked over a period of time. More detail on methods and sources of information is provided in my reports to the Canadian Wildlife Service (see References).

*Correcting for longitudes of den sites in time zones and for the equation of time, azimuthal error is estimated to be no more than 8 degrees. Use of the watch-sun "compass" is outlined in *Manual for Map Reading, Photo Reading and Field Sketching* (War Office, London, 1929, p. 141).

It is convenient to consider circumpolar zones where polar bears commonly den as "core areas" of their range (Fig. 2).

Polar bears find the fiorded northeastern coast of Greenland, particularly the Scoresby Sound district, favourable for denning (Pedersen, 1957). Dr. Christian Vibe (verbal comm., 1965) mentions that Melville Bay and Kane Basin are important denning areas in northwestern Greenland. In addition, the bears often den on Svalbard, for example, on the east coast of West Spitsbergen, on Edgeøya, and Kong Karls Land† (Iversen, 1941; Ognev, 1931; Rodahl, 1953). The best denning areas in the Soviet Union occur chiefly on the islands north of the mainland, especially Franz Josef Land and Wrangel Island. Novaya Zemlya, Severnaya Zemlya, the New Siberian Islands, Bear Islands, and the coasts of the Taimyr and Chukchi Peninsulas are less important (Geptner, in Ognev, 1931; Sverdrup, 1904; Uspenskii, 1965). No major denning areas seem to exist in Alaska, but polar bears may den occasionally in the vicinity of the northern and northwestern coasts, for example, Colville River, Kuparuk River, and Ooliktok Point (Vogelsang, 1959).

In Canada, denning is most common on southern Banks Island, Simpson Peninsula, eastern Southampton Island (Fig. 3), and eastern Baffin Island (Harington, 1964b). Since 1961, I have had the opportunity to do field work in all of those areas but Simpson Peninsula. Much of that work, which provided data for this paper, was concerned with distribution and ecology of polar bear dens.

†A polar bear sanctuary since 1939.

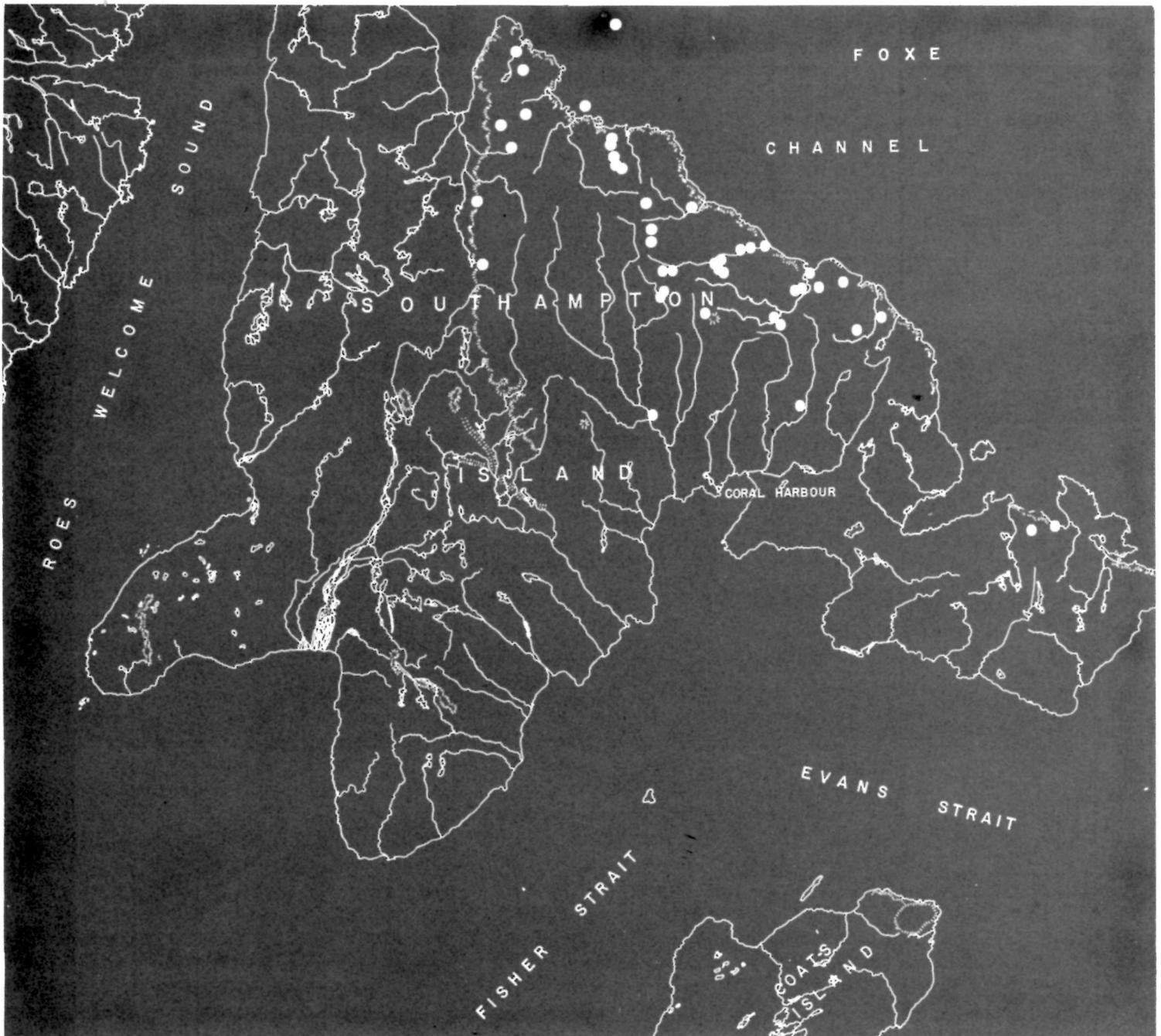
Types of dens and shelters

Dens and shelters may be categorized as maternity dens, temporary dens, and natural shelters.

Maternity dens are excavated by pregnant females, and are usually occupied by them (and, after parturition, their cubs) for a long time, about 6 months. These dens may have more than one room by the time they are abandoned (Fig. 4).

Temporary dens are generally excavated by single bears, such as adult males, non-pregnant females, and immatures. Except, perhaps, for some non-pregnant females, bears may occupy these dens for periods of a day or two up to 3 or 4 months. Non-pregnant females may occupy dens for up to 6 months. Temporary dens vary from large single-

Figure 3 Polar bear den locations (black dots) on Southampton Island, N.W.T. (Harington, 1961, 1964). Records of dens on pack ice are rare, but two have been reported in the vicinity of Cape Bylot. Den sites are virtually confined to the Precambrian upland of eastern Southampton Island. The remainder of the island is a Paleozoic lowland.



room structures with long entranceways, to small shallow pockets gouged in the snow (Fig. 5). They are often used temporarily by polar bears to escape bad weather, or as shelters to return to after feeding or hunting. Uspenskii and Chernyavski (1965) say such dens occur in northern Taimyr and northern Greenland.

Unlike dens, natural shelters offer bears immediate cover and require little or no modification by their occupants. Four cases are known from eastern Baffin Island in which adult males were found sleeping on dried-up stream beds beneath protecting river ice in late August and early September (Harington, 1962). Similarly, on Southampton Island, a female with a yearling cub was discovered under a "permanent" snow bridge in October (Fig. 6) (Harington, 1964). In bad weather, bears may take shelter in caves or icebergs, or among pack ice (Freuchen, 1935; Uspenskii and Chernyavski, 1965). Twice, while taking cover in caves during snowstorms, Freuchen (1935) was visited by single bears seeking shelter. Conversely, Murdoch (1917) tells of a man who stumbled into a bear's cave in a blizzard.

Polar bears, like brown bears (Holzworth, 1930), den alone, except for mothers with young and for cubs, which may den or shelter together after leaving their mother.

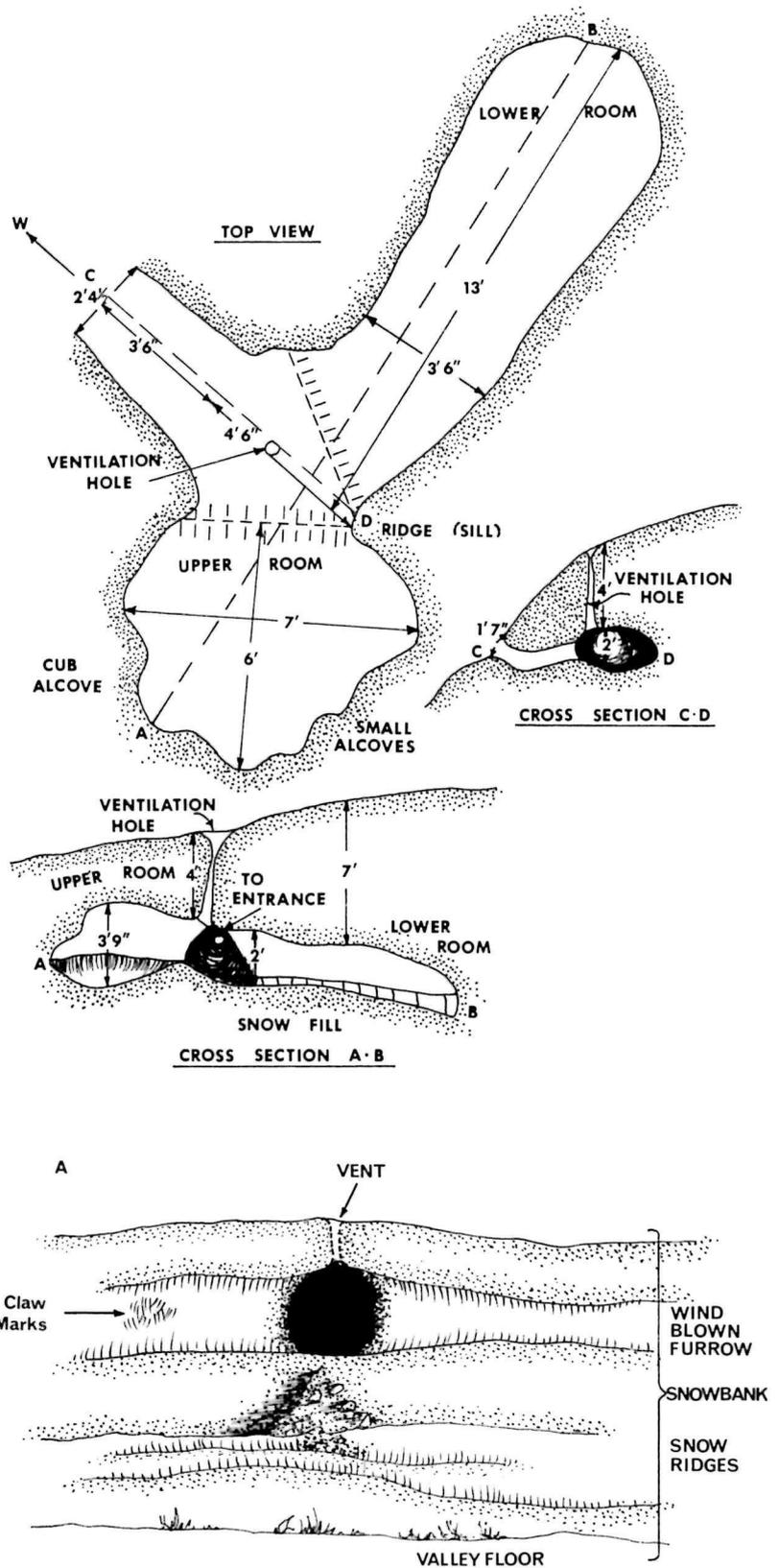
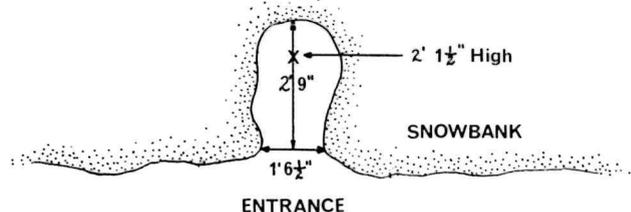


Figure 4 A polar bear maternity den, Southampton Island, N.W.T., March 23, 1963. Note the presence of upper and lower rooms. The den was occupied by a female with two young cubs.

Figure 5 A temporary den, southern Banks Island, N.W.T., May 9, 1963. It was briefly occupied by an immature polar bear. A. View of den entrance from the south. Claw marks indicate the bear's abandoned attempt at another excavation. B. Diagrammatic top view showing den dimensions.



Presence of bears in core areas

Pregnant females tend to concentrate in core areas in autumn, perhaps mainly because polar bears are generally abundant in those areas, and also because similar patterns of regional pack ice movement occur at that time of year. Winds, currents, and tides prevailing when the ice breaks up in autumn cause polar bears to be drifted to these core areas. Strong northeasterly winds in August and September drive masses of Foxe Basin ice, often inhabited by bears, to the east coast of Southampton Island. An Eskimo informed Loughrey (1956) that in August 1948 he and a companion counted over 180 bears along the east coast of the island. Eskimos have told me of similar concentrations since, claiming that it is only when much ice touches the coast in autumn that bears are common on Southampton Island in the denning period and the following spring. According to Manning (1942), the number of polar bears visiting Southampton Island varies considerably from year to year, probably due to ice conditions. Similarly, Gavin (1954) has remarked that in the Perry River district of the central Canadian Arctic, polar bears are fairly common when the "big ice" comes from the north (Victoria Strait). In years when it does not come in, bears are rare or entirely absent. Although Perry River is not a core area, the same circumstances seem to govern the abundance of bears elsewhere. Northerly winds usually bring heavy pack ice into Pelly Bay in early September (Canadian Hydrographic Service, 1959). This annual movement of ice probably brings many polar bears to den sites in the Simpson Peninsula core area from Lancaster Sound and Prince Regent Inlet.

Climatic and sea ice conditions also influence the number of denning bears in Svalbard. For instance, the later the drift ice (rafting bears) arrives at Negro Point, the fewer the denning bears and the fewer the cubs seen in spring (Lønø, 1957). At Cape Flora, on nearby Franz Josef Land, Jackson (1899) noted a definite increase in polar bears and said it was "due probably to the south-west and south-east winds having brought in the ice on which they were, toward the land".

It is also probable that good sealing on fiords at the beginning of winter (e.g. eastern Baffin Island, northeastern Greenland) and the presence of Eskimo meat caches and many washed-up carcasses of marine mammals along the coasts attract or hold bears near core areas about the time of denning (Harington, 1962). Abundant vegetation may also attract bears, for occasionally they demonstrate a definite desire for plant food (Koettlitz, 1898).

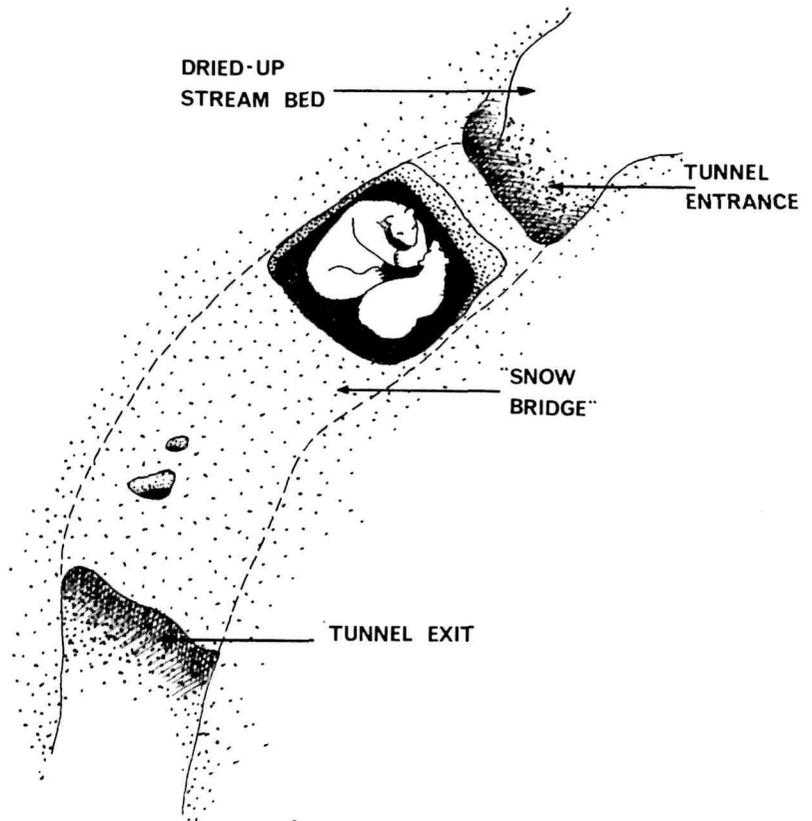


Figure 6 Cut-away view through the top of a natural shelter, showing its occupants, a female and her yearling cub. Southampton Island, N.W.T., October 1962.

Although many polar bears are "passively" drifted toward core areas, some may reach them by other means (see for example Lee, 1928). Bears may sense their own locations relative to the surrounding topography, as seems indicated by the way they select short-cuts across land or make their way directly across barren expanses to good sealing places (Harington, 1962a). Mills (1919) has described an instance of "homing" by a free-ranging brown bear kept as a pet, and much of his other evidence on the species suggests that brown bears have a good knowledge of their territories.

Of course, some pregnant polar bears do not den in core areas, but elsewhere—some evidently give birth out on the ice with little or no protection from the environment (Van de Velde, 1957).

Site factors

Within the core areas, various factors influence the bears in their choice of den location. Most bears den near coasts. Of 113 dens recorded in the Canadian Arctic, about 61 per cent were within 5 miles (8 km.) of the coast and 81 per cent lay within 10

For example, leeward sides of valley slopes, hills, cliffs, and large rock outcrops are often suitable for bear dens because thick snowbanks accumulate there. Bedrock sometimes affects the size, shape, and orientation of den interiors. Small patches of

TABLE 1 Distances of polar bear dens from coasts in the Canadian Arctic

Areas	Number of dens	Number of dens at 5-mile intervals from coasts					
		0-5	5-10	10-15	15-20	20-25	25-30
E. Baffin Is. (20)*	29	25	2	2	—	—	—
Southampton Is. (18, 24)	48	12	16	6	6	3	5
Resolute Bay area (21)	6	4	2	—	—	—	—
Banks Is. (25)	30	28	2	—	—	—	—

*Numbers in parentheses in this and following tables refer to numbered references. See p. 28.

miles (16 km.) of it (Table 1). None was found more than 30 miles (48.3 km.) inland. Polar bear dens are evidently at similar distances from the coast on Wrangel Island, in the Soviet Arctic (Uspenskii and Chernyavski, 1965).

Snow depth is very important to denning bears. Formozov (1964) has emphasized that many species are dependent upon snow's insulating properties for protection from low winter temperatures, and suffer severely in winters with little snow. Lønø (1957) says that polar bear denning on Svalbard was delayed when snow did not fall until mid-November. Snowdrifts must be sufficiently deep to cover the bears. Special Constable Paul Oolatectah, R.C.M. Police, found the freshly dug den of a pregnant female on southwestern Cornwallis Island one October (Harington, 1962a). The bear had started her den lower down the slope (chunks of snow having been excavated), but left it and made her final den higher, in deeper snow.

Snow density is another important site factor. On Southampton Island, Baffin Island, and Banks Island I have noticed places where polar bears have abandoned excavations, evidently because of very dense snow. On southern Banks Island, 30 yards (27.4 m.) west of an immature bear's temporary den, I found many claw marks recording an attempted excavation which had been abandoned because the snow was too hard (Fig. 5). If pressed, however, polar bears can dig shelters in very tough firn* (Harington, 1964c). Extremely hard or soft snow is unsuitable for denning.

Topographic factors also influence den locations.

bedrock were observed on the innermost walls of three dens examined on Southampton Island. This rock limited deeper excavation by the bear, and thus probably influenced den structure (Harington, 1964). The entranceway of a den I observed on Banks Island was unusually short, verging on a vertical cliff of sand and gravel. The main part of the den was very long and narrow, paralleling the cliff face. Its shape and orientation were obviously affected by local topography (Harington, 1964a). Similar situations arise in Svalbard, for Lønø (1957) mentioned that two young cubs he caught emerging from a den had sand in their fur. But polar bear dens are usually surrounded entirely by snow.

In Canadian core areas, dens frequently occur on south-facing slopes, where northerly prevailing winds create the best drifts, where windchill is least and insolation† greatest. South-facing slopes are excellent places for cubs to bask and exercise in the spring (Harington, 1962a; Van de Velde, 1957). Of 78 polar bear dens, 59 (76 per cent) faced in a southerly direction (Table 2). Local variations in wind direction and topography, in addition to the preferences of individual denning bears, cause exceptions. My observations from the Northwest Territories do not coincide with those of Uspenskii and Chernyavski (1965) from Wrangel Island. They say that the females "den up in pits or shallow caves, which were dug in last year's snowdrifts", and further, that the "she-bears very eagerly 'colonize' the northern and eastern slopes of mountains, for on the southern slopes, which receive more heat in summer, no last year's snowdrifts remain by fall".

*Compact, granular snow over a year old.

†Received solar radiation.

TABLE 2 Orientation of polar bear dens in the Canadian Arctic

Areas	Number of dens	Number of dens facing each direction*							
		N	NE	E	SE	S	SW	W	NW
E. Baffin Is. (20)	17	—	1	4	3	8	1	—	—
Southampton Is. (18, 24, 27)	47	2	1	6	6	20	8	3	1
Resolute Bay area (21)	5	—	—	—	1	4	—	—	—
Banks Is. (25)	9	—	—	—	1	4	3	1	—
Total	78	2	2	10	11	36	12	4	1

*Readings grouped to the nearest 45 degrees.

Yet it is interesting to note that all the brown bear dens Mills (1919) recalled were upon northerly or easterly—the cooler—slopes. Climatic differences (e.g. in temperature regimes and prevailing wind directions) between core areas in northern Canada and on Wrangel Island may help to explain the discrepancy.

Nineteen snow slopes on which polar bear dens were found averaged 38 degrees. They ranged between 20 and 70 degrees (Harington, 1961, 1964, 1964a, 1964c). One den entrance was situated on the break in slope at the edge of a drift: the slope beneath the entrance was 45 degrees, and that above was 25 degrees.

Polar bears excavated their dens from the level of sea ice to 1,800 feet (548.6 m.) above sea level (Harington, 1962). The range varied with that of regional topography. For example, the average elevation of 13 dens situated along the low coastal bluffs of southwestern Banks Island (Harington, 1964a), which reach about 60 feet (18.3 m.) above sea level, was 39 feet (11.9 m.) above sea level; whereas on the much higher coast of eastern Southampton Island, average den elevation was 907 feet (276.5 m.) above sea level (Table 3). Brown bears have been known to den at altitudes up to 12,000 feet (Mills, 1919). Only 2 of 104 polar bear dens

were found on sea ice, which suggests that polar bears prefer to den on their ancestral home, the land. Possibly polar bears den more commonly on sea ice in other parts of the Arctic. Bear dens or shelters on the sea ice have been mentioned by Koettlitz (1898), Sverdrup (1904), and Manniche (1910). My findings agree basically with those of Geptner (ca. 1951) that female bears usually give birth on land and not on ice.

So important are the preceding factors, that polar bears which arrive late in a favourable denning place are not deterred by the presence of other denned bears nearby. I first observed evidence of this in early April 1963 on Southampton Island (Harington, 1964). Two dens, both of which had been occupied by females with young, lay only 25 yards (22.9 m.) apart near the crest of a snowbank. In March 1964, nine polar bear dens were discovered near "Nanuqarvik" (about 25 miles (40 km.) north of Coral Harbour) within an area of 28 square miles (73 sq. km.) (Fig. 7). Two pairs of dens were only about 50 feet (15.2 m.) apart, and another pair was less than 100 feet (30.5 m.) apart (pers. comm., E. H. Mitchell, Hudson's Bay Company; Tony Eecherk). In favourable denning places on Wrangel Island (the central part of the eastern plateau, and the Drem-Khed mountains) two and even three dens have been encountered on about half a square mile (1 sq. km.) of slopes (Uspenski and Chernyavski, 1965).

TABLE 3 Elevations of polar bear dens in the Canadian Arctic

Areas	Number of dens	Average elevation*
E. Baffin Is. (20)	29	749
Southampton Is. (18, 24, 27)	56	907
Resolute Bay area (21)	6	642
Banks Is. (25)	13	39

*In feet above sea level.

Structure and temperature of dens

The main structural features of polar bear dens are the entranceways and the rooms inside (Figs. 4, 5). Special features include porches, lairs, sills, alcoves, and ventilation holes. Thirteen entranceways (passages to the interior) of dens which I measured averaged 6 feet, 5 inches long by 1 foot, 11 inches wide by 1 foot, 10 inches high (2.0 m. by 0.6 m. by 0.6 m.). Except on very steep slopes, excavated snow collects outside den entrances, forming porches (Harington, 1964). Giaever (1958) gives a succinct description of them: "Snow removed by her excavations was scooped out and trodden firmly into a kind of plateau with her broad paws." On Southampton Island in 1963, I noticed that most of the dens examined had entranceways which rose a few feet, so that the tops of the entrances were slightly lower than the lairs (bottoms of the occupied rooms). Such dens, like Eskimo igloos, are effective in conserving warm air (Anonymous, 1956). But polar bear dens do not always have rising entranceways. Sills also characterize many dens. These ridges of packed snow divide entranceways from

the depressed, basin-like lairs, and sometimes separate the lairs of different rooms in a den. Probably Koettlitz (1898) was referring to a sill when he mentioned that two rooms of a maternity den were divided by a "waist" 18 inches high and 3 feet wide. Rodahl (1953) also refers to the feature: "The main cave is separated from the entrance tunnel by an elevated doorstep. . . ."

Polar bear dens may have one or more rooms. I have never seen more than two in a den, but Paul Oolateetah told me he found a three-room den occupied by a mother and two yearling cubs on southern Bathurst Island (Harington, 1962a). Mary-Rousseliere (1957) has described a den on Simpson Peninsula which had four. Where two rooms exist, the second, larger one, appears to be made by the pregnant female, about the time of parturition, by clawing out a rising passage from her first room. Fourteen rooms I measured averaged 6 feet, 8 inches long by 4 feet, 11 inches wide by 3 feet, 2 inches high (2.0 m. by 1.5 m. by 1.0 m.). Pedersen (1957) states that dens occupied by a mother with

Figure 7 Single adult female polar bear in a den at Nanuqarvik, Southampton Island, N.W.T., March 29, 1964. Part of the den roof has been removed. Photo by E. H. Mitchell.



cubs over a year old (“half grown”) are larger than the average maternity dens, but not appreciably higher. Remarks on polar bear den dimensions have been made by a number of authors (Koettlitz, 1898; Manniche, 1910; Mary-Rousseliere, 1957; Pedersen, 1957; Rodahl, 1953; Uspenskii and Chernyavski, 1965).

A quotation from Mills (1919), a leading authority on brown bears, shows the general similarity between polar bear and brown bear dens:

The entrance was about three feet in diameter. Just inside, the den was a trifle larger. It extended, nearly level, about twelve feet into the mountainside. At the back it was six feet across and four feet high.

The size of the den varies and is apparently determined by the character of the soil in which it is made and also by the inclination of the bear making it. Most other dens measured were smaller than this one.

Alcoves are common in dens occupied by female polar bears and cubs. These recesses in the walls of rooms seem to have a number of causes. The larger ones may be excavated by the female to provide more room for her cubs (Harington, 1964). Lønø (1957) states that two trappers on Svalbard discovered a maternity den with an alcove on the side. They thought the small alcove was for the young cub accompanying its mother. Smaller alcoves may be excavated by cubs in play (Harington, 1964) or may result from adults gnawing into the snow walls to quench their thirst (Harington, 1964a; Van de Velde, 1957). No “side dens or additional chambers” were found in polar bear dens on Wrangel Island by Uspenskii and Chernyavski (1965).

Little is known about temperatures inside occupied polar bear dens. Both depth and density of snow surrounding the dens influence their warmth. The deeper and fluffier the snow, the greater its capacity for retaining heat in the dens (Formozov, 1964). Thus, it might be expected that dens would become colder as winter progressed, unless increasing thickness of drifts over the dens could offset the effect of wind compacting. Occurrence of thaws during the denning period would also make polar bear dens colder, due to resulting increases in snow density and heat conductivity. I have found the thickness of snow over dens to vary from about 1 to more than 7 feet (Harington, 1964).

From thin crusts of ice sometimes seen on their roofs or walls, it is evident that temperatures within the dens may occasionally rise above the freezing point (Harington, 1961; Pedersen, 1957). The body heat of a denned polar bear can cause ice 7 inches thick to form on the lair in which it rests (Harington, 1964). Tony Eecherk, a Southampton Island

Eskimo, recalled cutting through the heavy ice of a deeply buried den. He said it was “hot as an oven” inside (Harington, 1961). I managed to insert a thermometer through a small perforation in the roof of a maternity den on Southampton Island on February 28 (Harington, 1961). The temperature of the upper room, occupied by a mother and her two cubs, averaged 14.3°F (−9.9°C)—about 37°F (21°C) warmer than that of the outside air. The inside temperature of another similarly occupied den on Southampton Island was taken on March 23 (Harington, 1964). It averaged 0°F (−17.8°C)—about 18°F (7.8°C) higher than the temperature outside. This den was very large and well-ventilated, for the mother had opened the exit.

Polar bears often keep ventilation holes open in their dens, if holes are not formed naturally by heat rising from their bodies (Harington, 1964). The holes generally measure from a few inches to over a foot in diameter and vary in length, according to thickness of snow over the den. As early as 1782, Hutchins (cited in Seton, 1929) stated that there was always a small hole in the snow dome over the den to admit fresh air. Koettlitz (1898) and Ognev (1931) have also commented on ventilation holes. The observations of Bean (in Mitchell, 1921), a former director of the Washington Park Zoo in Milwaukee, provide a fascinating insight into the way a polar bear* can regulate den temperatures:

It was very interesting to note her ability to determine approaching storms. When a storm was on the way, she would pack the opening from the inside with straw, just leaving a small vent at the top. When mild weather was on, she would take her paws and pat the straw until the opening was practically full size.

Probably polar bears in nature can adjust den temperatures similarly by varying the size of ventilation holes, using snow instead of straw (see Jackson, 1899, Vol. 1, p. 77). Polar bears sometimes enlarge ventilation holes, converting them to entranceways (Jackson, 1899). Occasionally, brown bears partly close the entrances to their dens by clawing in earth or raking in trash and leaves. But usually nothing is done, closure of entrances being left to drifting snow (Mills, 1919).

*The mother had given birth to a cub on December 2 in an artificial sleeping den about 6 feet by 8 feet.

Duration of denning

A general perspective on duration of polar bear denning may be obtained by reference to collected data on their occurrence in and out of dens (Figs. 8, 9). Gaps in the histograms mean only that bears were not detected over certain periods, and not necessarily that they were entirely absent.

Despite limitations of the data, it is safe to say

that polar bears generally begin to den in October, and do not stay in dens later than April. This denning period is similar to that of Kodiak bears (*Ursus arctos*), which usually den from November 15 until early April (Troyer, 1961). Single adult females and pregnant females (or females with young cubs) evidently occupy dens during the

Figure 8 Occurrences of polar bears in dens or shelters in the Canadian Arctic (Harington, 1961, 1962, 1962a, 1964, 1964a, 1964c; Mary-Rousseliere, 1957; Van de Velde, 1957).

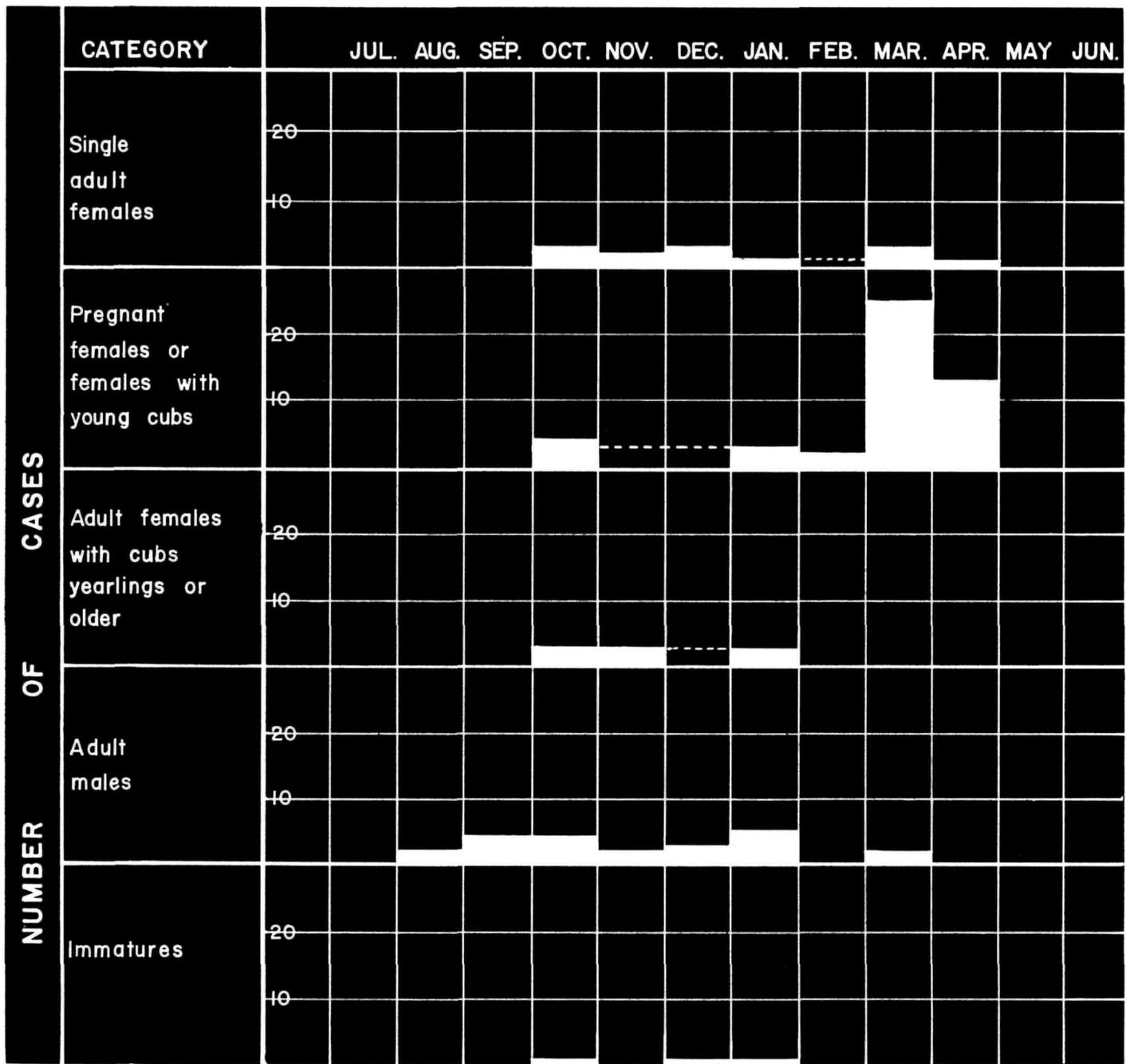


TABLE 4 Dates of commencement of polar bear denning in the Canadian Arctic

Date	Area	Occupants	Remarks
Oct. 1-7	Baffin Is. (20)	Pregnant female	About to den on fiord slope
Oct. 15	Cornwallis Is. (21)	Pregnant female	Killed near freshly dug den
Oct. 15-31	Southampton Is. (24)	Adult female	Abandoned excavation when disturbed
Nov. 16	Southampton Is. (69)	Male	Chased away after starting den
Dec. 26	Banks Is. (25)	Adult female	Killed near a freshly dug den
Jan. —	Banks Is. (25)	Immature (2-year-old female)	Abandoned excavation when disturbed

October–April period, although pregnant females have been seen on the sea ice as late as December. In the Canadian Arctic (Harington, 1962, 1962a, 1964, 1964a) and on Wrangel Island (Uspenskii and Chernyavski, 1965) most females with young cubs abandon their dens during the third week in March. Most grizzly bears also come forth in March (Mills, 1919). Female polar bears with cubs over a year old and immature bears sometimes den between October and January. Adult males are occasionally found in natural shelters from late August to the end of September, but some den from October to January (rarely in March).* On eastern Baffin Island, many males head eastward from the land toward the fast ice edge in November and December

(Harington, 1962, 1962b). Troyer (1961) and Holzworth (1930) have noted that male brown bears may also emerge from dens earlier than females. Many adult male polar bears are active throughout the year (Fig. 9), but they appear to be least active in autumn and winter.

Rutilevskii (in Novikov, 1956) has estimated that pregnant females remain in dens from 160 to 170 days, while non-pregnant females stay in them for only 115 to 125 days. He stated that females with cubs over a year old den for about 106 days, while immatures (“young animals”) and old males remain in dens for approximately 50 to 60 days. Denning patterns may be established very broadly, but it is doubtful that existing evidence can justify such a precise statement.

In a few cases, specific information is available on times when polar bears begin their dens (Table 4). It is difficult to generalize from such sparse data, but they suggest that most pregnant females excavate their dens in October (Fig. 8). Jackson (1899) discovered a young adult female which had begun to den on October 12 on Franz Josef Land. Lønø (1957) has given evidence for a female beginning her den in mid-November on Svalbard.

Almost certainly polar bears exhibit delayed implantation* (see Hamlett, 1935), as do their relatives, the black bears (*Ursus americanus*) and brown bears (*Ursus arctos*) (Dittrich and Kronberger, 1963; Prell, 1930). Likewise, it seems that the blastocyst is implanted from 8 to 10 weeks prior to birth (Dittrich and Kronberger, 1963) (i.e. during the latter half of September—see Table 5 and Fig. 10). Internal

*There has been some confusion about whether adult male polar bears den. It has been established definitely that some do. Koettlitz (1898) and Jackson (1899) discovered an adult male's den on October 7, 1894, in Franz Josef Land. Manniche (1910) found the den of an old male bear in northeastern Greenland in late December 1906. In 1939, Rutilevskii (in Novikov, 1956) reported that old males denned in the Soviet Arctic. Although Freuchen (1935) made reference to it earlier, Van de Velde (1957) provided the first solid evidence that male polar bears den in Canada. Of 14 adult males killed at Pelly Bay, N.W.T., between November 1952 and June 1954, six were killed in dens, four of these in the month of January. Data from Baffin Island indicate that adult males may den from September to November at least (Harington, 1962). Circumstantial evidence for males denning on Southampton Island has been mentioned by Sutton and Hamilton (1932). Two reliable Southampton Island Eskimos told me they had encountered mature males in dens and claimed that such denning took place between October and January (Harington, 1961, 1963). Three adult males occupied dens on Banks Island between mid-December and the first week of January (Harington, 1964a). Adult male brown bears and black bears are known to den (Erickson *et al.*, 1964; Mills, 1919).

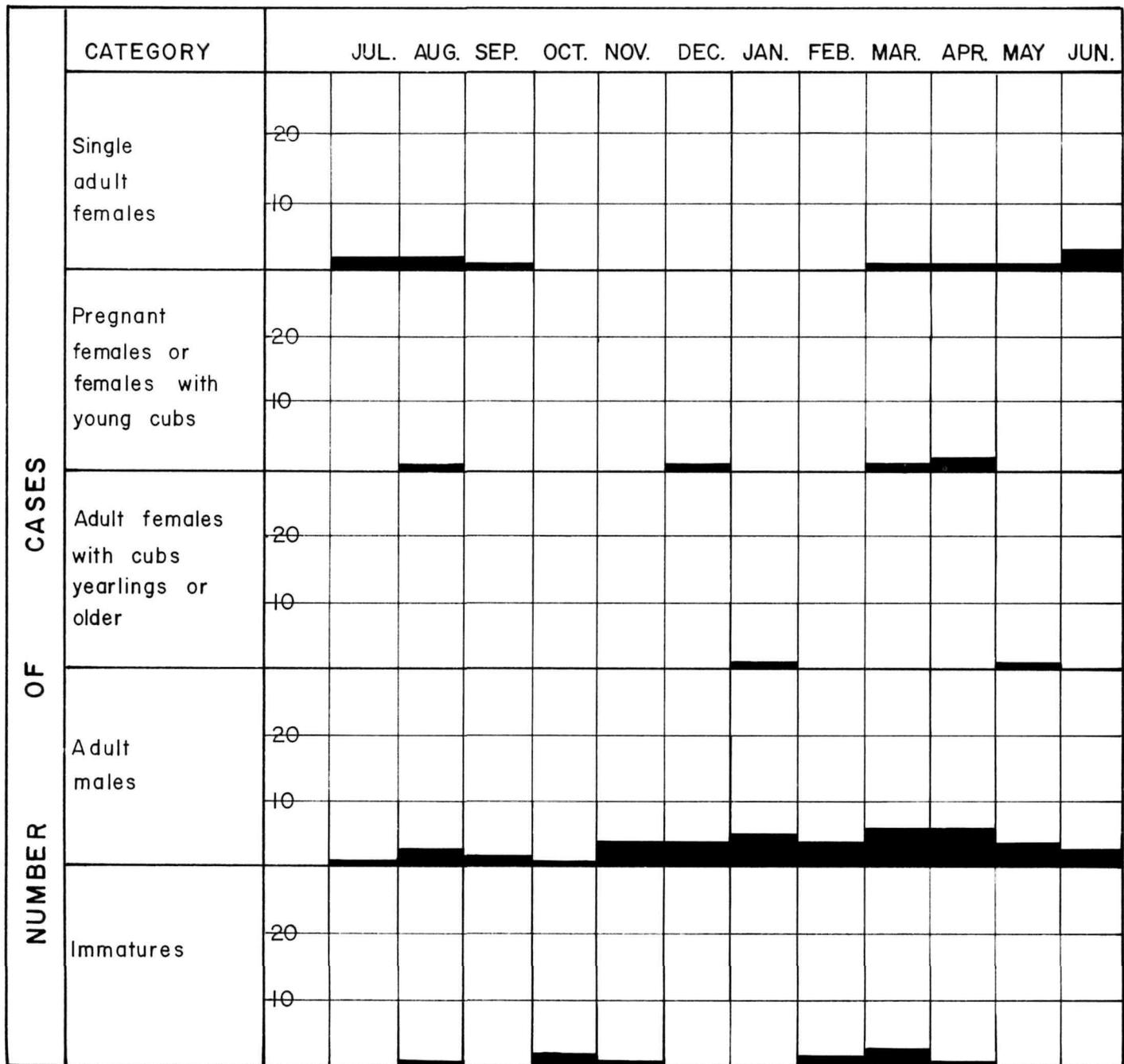
*The physical fact remains to be proven.

changes following implantation could prompt gravid females in satisfactory condition to begin denning shortly after. Kostyan's (1954) observation

that pregnant females become lethargic and irritable 6 weeks before parturition may support this opinion. Nevertheless, climatic rigours (Erickson *et al.*,

Figure 9 Polar bears active outside dens. A. Franz Josef Land, 1894-97 (Jackson, 1899). Based on a 3-year sample of polar bear activity near the Jackson-Harmsworth Expedition base at Cape Flora. Most bears seen were shot, and Jackson made a detailed record of them. B. Northeast Greenland and the Canadian Eastern Arctic (Freuchen, 1935; Manniche,

1910). Based on detailed reports of polar bear activity in northeastern Greenland by Manniche from August 10, 1906, to November 2, 1907, and in the Canadian Eastern Arctic by Freuchen from July 10, 1921, to April 24, 1924. Samples suggest a general decline of polar bear activity during the winter, although some adult male bears are active throughout the year.



1964), abundance of food, and fat reserves of polar bears (see below) are probably very important in determining the onset of denning. If a bear is fat and food is scarce, early severe weather will likely cause it to den early. But if weather is good and food is still available, the bear will probably delay its denning (Harrington, 1964c). Individual inclinations may complicate the timing (Mills, 1919).

Adequate fat reserves seem to be a prerequisite to denning in bears (see Rausch, 1961). Erickson *et al.* (1964) and Mills (1919) have referred to a late autumn fattening period prior to denning in black bears (*Ursus americanus*) and brown bears (*Ursus arctos*), as has Jennov (1956) for the polar bear. King (1836) states that Eskimos were aware of the significance of a thick fat layer to denning polar

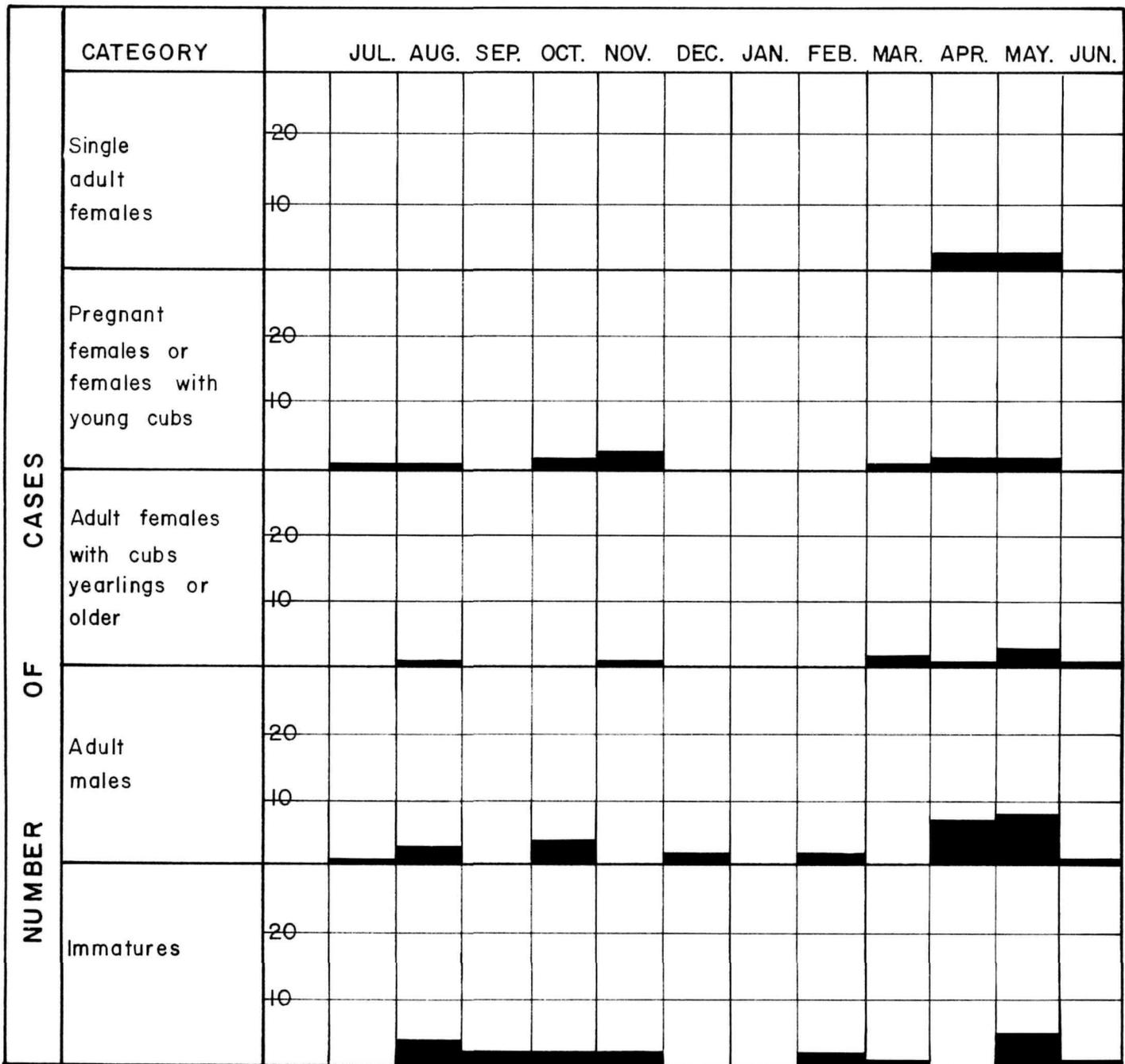


TABLE 5 Records of embryos from polar bears in nature

Date	Area	Number of embryos	Approx. length, inches
Oct. 1	Baffin Is., N.W.T. (20)	2	6, 8
Oct. 1-7	Baffin Is., N.W.T. (20)	2	8, 8
Oct. 1-7	Baffin Is., N.W.T. (20)	1	5-6
Oct. 1-7	Baffin Is., N.W.T. (20)	1	4-5
Oct. 15	Cornwallis Is., N.W.T. (21)	1	6
Dec. 6	Franz Josef Land (34)	2	4¼, 4¼
Dec. 15	Baffin Is., N.W.T. (20)	2	4, 4
Dec. 15	Baffin Is., N.W.T. (20)	1	6

bears as early as the 1830's. Lack of fat may explain why pregnant females have been found hunting on the ice as late as December* (Harington, 1962; Koettlitz, 1898). In October and November on Southampton Island, I have noticed that many bears go inland, but that some, which have made dens, leave them and return to the coast to hunt (Harington, 1964c). This may be because they have insufficient fat (see also Freuchen (1935)). Freuchen, who knew both the Hudson Bay and northwest Greenland regions very well, remarked on a seemingly lower inclination to den among bears of the latter region (only about 50 per cent denning, the rest active). If this is so, a possible explanation is that there is less time to build up fat reserves before the onset of the next dark period in the high Arctic.

*Van de Velde (1957) and Nansen (1925) even refer to cases in which females have given birth in the open.

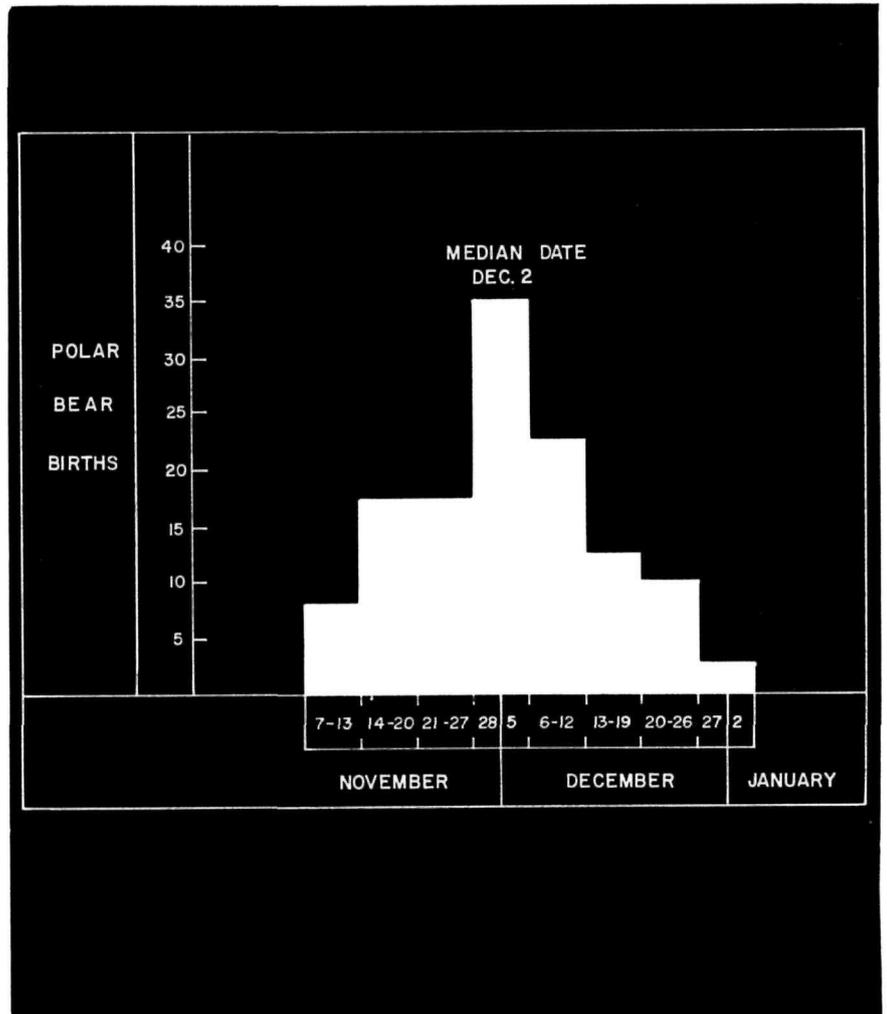


Figure 10 Dates of parturition of captive polar bears (grouped by weeks). Based on 118 dates gathered by Dittrich (1961). I have added six dates from the Calgary Zoo, the Jardin Zoologique de Québec, the Prague Zoo (Volf, 1963), and the Circus Amarant, Pirna (Prell, 1930). The parturition period is centred on December 2.

Activities associated with denning

Because few observations have been made of the activities of polar bears in and around their dens, indirect evidence such as sign, and inference from the behaviour of bears in captivity, must be relied on for some details of polar bear denning habits.

Polar bears first choose a den site, and then begin excavation. I have never seen den interiors unmarked by their claws (Fig. 11). Snow excavated from the interior is thrust out the entranceway. At times the bears are quite neat about their excavations. Manniche (1910), commenting on the temporary den of a young male bear, stated that snow blocks had been heaped up with great precision on one side of the recess. Porches outside and sills inside dens, as previously noted, are formed by digging. Pressure and body heat also help to enlarge the dens, particularly the often icy basins or lairs

in which the polar bears rest. Once I was able to determine that a bear had rested facing the den entrance by the icy print of its muzzle (Harington, 1964). Thickly frosted polar bear hairs hanging from den roofs show that their backs often press upwards against them.

When polar bears are in their dens, they may display "carnivorean lethargy", but do not hibernate in the strict sense of the word (see Hock, 1958). Although they may sleep through parts of the winter with markedly reduced respiration rates (Svihla and Bowman, 1954), their body temperatures do not decrease more than a few degrees from

Figure 11 Interior of a polar bear den, Southampton Island, N.W.T. Light is from entrance to left. Note icy floor and claw marks on ceiling. Photo by C. R. Harington.



normal. And, of course, the mothers must be awake when they give birth, in order to care for the young. One denned mother, which I found on February 28, breathed very slowly and heavily when undisturbed, as if sleeping. But as soon as a lance was pushed through the den ceiling, she began walking around and growling (Harrington, 1961). Brown bears are similarly alert when disturbed at any stage of their lethargic period (Mills, 1919). Carnivorean lethargy aids polar bears (which have relatively low metabolic rates in this condition) by enabling them to rest and husband their vital fat reserves (Schmidt-Nielsen, 1964) during periods of poor hunting, or when the bears need shelter for their cubs. Evidently, fat not only acts as an energy source during lethargy, but when deposited around the peripheral blood vessels reduces heat loss (Svihla and Bowman, 1954).

Shereshevskii and Petriaev (1949) remark that it is easy to scare females from their dens before parturition. Even after the cubs have been born, Freuchen (1935) says that they are so small the mother can easily carry two in her mouth at the same time if scared into flight. She carries them with their heads (Ouweland, 1939), or sometimes their heads and forelegs, in her mouth. Smith (1946)

has mentioned a black bear female that abandoned her den and her three young cubs when disturbed.

Birth of the young is perhaps the most important event that occurs in dens. Yet opinions are diverse on the time when cubs are born. A number of scientists and explorers (see Dittrich, 1961), and some northerners I have talked to, believe that parturition occurs between January and May, for that is when they first see the cubs. And they seem so small then, compared to mature polar bears. Still, it is known from animals in captivity that the cubs are born in almost a "larval" state (Friant, 1932; Starck, 1956). They are only 10 inches (25.4 cm.) long at birth, and are blind, deaf, and helpless for the first month (Bachofen von Echt, 1939; Kostyan, 1954).

Data on embryos from females shot between the first of October and mid-December (Table 5), and information on recently born cubs in dens (Table 6), suggest that in nature cubs are born in November or December. In Table 6, cubs with their eyes closed are less than a month old. According to age/weight tables given by Kostyan (1954), the cubs from Ontario may have been slightly over a month old. The cub from Franz Josef Land discovered on February 3 was probably about 2 months old, for

TABLE 6 Records of recently born polar bear cubs in nature

Date	Area	Number of cubs	Estimated date of birth	Remarks
Dec. 15	Southampton Is., N.W.T.	1 ?	Dec. 1-15	Cub. Nat. Mus. Can. Mammal Collection No. 1528*
Dec. 30	Winisk R., Ont. (41)	2	Nov. 30	Cubs small. Est. wt. 4 lbs. each
Jan. 1-7	Banks Is., N.W.T. (25)	1	Dec. 3- Jan. 3	Cub's eyes closed. A little fur. Total length about 12 in.
Jan. 3	Cape Bathurst, N.W.T. (25)	1	Dec. 3- Jan. 3	Cub's eyes closed. Weasel size. Signs of blood in den
Feb. 3	Franz Josef Land (34)	1	Dec. 3	Cub's eyes open. Mother's uterus showed signs of recent birth

*Mr. P. M. Youngman, National Museum of Canada, kindly allowed me to examine this prepared skin, which was collected about December 15, 1909, by Captain George Comer. Although the specimen (sex not given and indeterminable from the skin) is recorded as being "a foetus?", its size and appearance suggest that it was recently born. The skin, covered with off-white hair up to ¼ inch long, seems to have been stretched slightly during preparation. The specimen's approximate measurements are as follows: total length 12 inches, heart girth 7¾ inches, shoulder height 4 inches, tail length ½ inch, maximum breadth of forepaw pad 1 inch, maximum breadth of hind paw pad ¾ inch, claw length ¼-¾ inch.

TABLE 7 Litter sizes of polar bears in natural dens*

Areas	Number of litters	Litter size			
		1	2	3	4
Baffin Is., N.W.T. (20)	16	2	13	1	0
N. Ontario (41)	2	0	1	1	0
Southampton Is., N.W.T. (48)	1	0	1	0	0
Southampton Is., N.W.T. (18, 24)	16	4	10	1	1
Pelly Bay, N.W.T. (76)	51	19	28	4	0
Simpson Pen., N.W.T. (44)	1	1	0	0	0
Resolute Bay area, N.W.T. (21)	2	0	1	1	0
Banks Is., N.W.T. (25)	10	5	5	0	0
N. E. Greenland (42)	35	10	25	0	0
Svalbard (37)	1	0	1	0	0
Franz Josef Land (34)	1	1	0	0	0
Total	136	42	85	8	1

*Applies to cubs about 0-5 months old.

Mean litter size = 1.75

Litter-size frequency: single cubs 30.9 per cent
 twin cubs 62.5 per cent
 triplet cubs 5.9 per cent
 quadruplet cubs 0.7 per cent.

its eyes were open and it weighed 17 pounds (Kostyan, 1954). Koettlitz (1898) incorrectly estimated it to be a week old. This field evidence supports Dittrich's (1961) conclusion that both captive and wild polar bears are born in November and December (see Fig. 10). The central date for parturition is about December 2, and 50 per cent of polar bear births occur between November 24 and December 10. Known births have ranged from November 9 to December 29. The shape of the parturition histogram (Fig. 10) suggests that the effective mating season for polar bears lies between March 10 and April 29, their gestation period averaging 8 months (Kostyan, 1954). Brown bear and black bear cubs are commonly born in January or February (Dittrich and Kronberger, 1963; Erickson *et al.*, 1964; Mills, 1919; Zuckerman, 1953).

Many opinions have been expressed concerning size of litter in polar bears. Some authorities (Lydekker, 1910; Murdoch, 1917; Ognev, 1931; Shereshevskii and Petriaev, 1949) say there are usually two cubs, but sometimes three. Others (Lønø, 1957; Pedersen, 1957; Tzalkin, 1936) merely say that twins are most common. Geptner (in Ognev, 1931) says that one or sometimes two cubs are born, and Novikov (1956) that sometimes one, usually two, and rarely three or four are born. Freuchen (1935) has stated that about two thirds

of the pregnant polar bears he has examined had two fetuses. Data collected on size of litter in natural dens (Table 7) and in captivity (Table 8), and the fact that twins were born in about two thirds of the cases, support Freuchen. Although Tables 5 and 6 suggest that twins are born more rarely, the data are less reliable than those from Tables 7 and 8 because of much smaller samples. My data do not agree with those of Pedersen (1957) who states: "On the basis of my own observations and on the basis of reports received from elsewhere from the most varied parts of the Arctic about 80% of the females that produced cubs have two." Some litter-size comparisons for black, brown, and polar bears are given in Table 9. Compared to black and brown bears, polar bears have the smallest mean litter size, the highest percentage of twins, and the lowest percentage of triplets and quadruplets.

At birth, both in nature* (Harington, 1961a) and captivity (Kostyan, 1954), the sex ratio of polar bears seems to be about 50:50. This ratio at birth also holds for brown bears according to Dittrich and Kronberger (1963).

During their first week of life in the den the cubs suck at their mother's breast most of the time, while she lies on her side and supports them (Kostyan, 1954; Meyer-Holzappel, 1957). The cubs cry a great

*In the Northwest Territories.

TABLE 8 Litter sizes of polar bears in captivity

Location	Number of litters	Litter size	
		1	2
Nuremberg Zoo, Germany (63, 64)	17	3	14
Prague Zoo, Czechoslovakia (78)	14	8	6
Leningrad Zoo, U.S.S.R. (35)	13	2	11
Washington Park Zoo, U.S.A. (60)	8	5	3
Auckland Zoo, N.Z. (6)	2	1	1
Circus Amarant, Pirin (58)	2	1	1
Ouwehand's Zoo, Netherlands (54)	1	1	0
London Zoo, England (57)	1	0	1
	58	21	37

Mean litter size = 1.64

Litter-size frequency: single cubs 34 per cent
twin cubs 66 per cent.

deal then, especially if the air temperature falls. In response, the mother often curls up, forepaws embracing hind paws, so that the cubs are pressed to her nipples. Her warm breath over them may also help to alleviate the effect of chilling air (Kostyan, 1954). By the time the cubs are a month old and their eyes are open, the mother assumes a sitting position while feeding them. Placing the cubs between her hind legs, she holds them to her breast with her large forepaws. The females have four teats. Sucking cubs often alternate from one nipple to another; first sucking the lower teat, then suddenly breaking away to suck the upper one on the same side. During the first 3 or 4 months the cubs suck up to six times daily (Kostyan, 1954). The period of sucking gradually decreases from 15 minutes after 2½ months to 2½ minutes after 6 months. When the young are satisfied, they fall asleep quickly (Meyer-Holzapfel, 1957). Occasionally milk drips from the edges of the cubs' mouths, and I once noticed a few spots of frozen milk on the floor of a den on Southampton Island (Harington, 1964).

Van de Velde's (1957) remarks on young polar bears in dens, evidently derived from field observations in the Northwest Territories, corroborate the previous data on captive animals. However, he states that after birth, instead of lying down to feed the cubs, the mother leans against the den wall, supporting her almost naked cubs at her breast.

With frequent nourishment the cubs grow quickly and their bodies are soon covered by thick, whitish fur. At the age of 2 months, when their teeth erupt, the cubs can sleep apart from their mother on warm days. They also play together then, despite the fact that they can only walk clumsily (Kostyan, 1954; Van de Velde, 1957). I was able to measure a male and a female cub on March 23, when they were about to leave the den. The male had a total length of 30 inches (76.2 cm.) and weighed 27 pounds (12.3 kg.); the female was 29 inches (73.7 cm.) long and weighed 24 pounds (10.9 kg.) (Fig. 12).

Mortality can also occur in the maternity dens. Van de Velde (1957) mentions a case in which a cub was apparently suffocated and crushed by the mother. One cub was left alive. Cases of mothers

TABLE 9 Litter size in black bears (*Ursus americanus*), brown bears (*Ursus arctos*), and polar bears (*Ursus maritimus*)

Species	Number of litters	Litter-size frequency, per cent				Mean litter size
		1	2	3	4	
<i>U. americanus</i> (10)	176	23	52	21	4	2.05
<i>U. arctos</i> (9)	213	31.1	45.5	20.6	2.8	2.48
<i>U. maritimus</i> (Table 7)	136	30.9	62.5	5.9	0.7	1.75



in captivity eating their young are known (Prell, 1930), and this may occur in nature (Harington, 1964). I have never heard of adult polar bears dying in their dens, but two dead brown bears found in dens are described by Mills (1919): one was old, in poor condition; the other was fat, young, and apparently healthy (the winter had been cold and little snow had fallen). Evidently both had frozen to death. Wright (1910) has remarked on carcasses of black bears in dens.

There is some doubt whether or not polar bears excrete in their dens. Six of nine which I examined on Southampton Island in 1963 had mere traces of urine inside. Minute fecal fragments were observed in only two of the dens. In contrast, relatively large amounts of excreta were found within 40 yards (36.6 m.) of three den entrances (Harington, 1964). Evidently an "ideal cleanliness is maintained" in dens on Wrangel Island (Uspenskii and Chernyavski, 1965). Van de Velde (1957) states that prior to excreting, the mother raises herself and scratches a hole in the snow floor. When there is no space left to excrete, he says that the mother moves into a newly excavated room with her young. I have often tested lairs in dens, but found no evidence to support Van de Velde's remarks. Lyon's (1825)

Figure 12 Twin cubs taken from a den on Southampton Island, N.W.T., on March 23, 1963. They were about 4 months old. The female weighed 24 pounds, the male 27 pounds. The shovel handle indicates scale. Photo by C. R. Harington.

early account on this subject deserves quotation: "The Esquimaux affirm that during this long confinement the bear has no evacuations, and is herself the means of preventing them by stopping all the natural passages with moss, grass or earth." Freuchen (1935) has observed that polar bears "evacuate quite a lot of excrement, very small and hard lumps, just after leaving their winter quarters". I have noticed similar droppings, composed largely of dried sedges and moss, outside of dens. But it was impossible to say whether they were remains of an anal plug, or whether they had been derived from plants eaten after the bears had left their dens (Harington, 1964). In any case, polar bears usually keep their dens clean and defecate outside. Mills (1919) found a freshly abandoned brown bear den in March which was clean enough for him to occupy at night: polar bears and brown bears are evidently similar in this respect. Svihla and Bowman (1954) have remarked on cessation of digestive and kidney activity in a captive lethargic black bear, "for there was no evidence that either urinary excretion or

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defecation took place during the three month period of dormancy. . . .”

Sometimes mothers of newly born cubs leave their dens periodically before finally abandoning them; but probably rarely, if ever, during the first month after birth. On February 20 on Franz Josef Land, Neal (1882) saw a bear outside its den, which was only about 400 feet (121.9 m.) uphill behind an expedition hut. The bear retired to its den when pursued. It remained near the den and was seen outside at times during the last week of February. It was last seen on March 1, and a day or two later prints of an adult and cub were found about 300 yards (274.3 m.) east of the hut. In February, Cook (1951) found a den containing two cubs less than a mile west of his hut on northern Devon Island. The mother was absent. Cook said that she had visited his meat cache a number of times before mid-winter, and returned occasionally as spring approached. This female evidently foraged regularly at about 11:00 a.m. every fifth day.

Usually it is not until March, when increasing sunlight makes the dens brighter each day, that the mother clears an exit and nudges her cubs outside. According to Van de Velde (1957) the mother searches ahead for plants under the snow to curb her hunger. After a walk all return to the den to sleep. He mentions that they will emerge in the following days if the weather is suitable, before finally abandoning the den. Evidence at a den on Southampton Island (Harington, 1964) supports Van de Velde's observations and similar observations of others (Pedersen, 1957; Shereshevskii and Petriaev, 1949). It shows clearly that polar bears do not necessarily leave their dens immediately upon breaking out, as some authors have suggested (Jennov, 1956; Tzalkin, 1936). In this case the mother had left the den and returned a number of times after foraging and exercising in the vicinity. She had been accompanied by her cubs on at least two occasions. Like other females with cubs in March, she had made resting spots (Harington, 1964b; Pedersen, 1957) where she reclined to bask in the sun and suckle her cubs.* Mother and cubs were in the den when it was found on March 23. Such cases imply a period of adjustment before the bears undertake their sometimes long journey to the sea ice.

*Mills (1919) notes that toward spring brown bears sometimes make short excursions from their dens for fresh air and exercise, or to sun themselves. He adds that they eat lightly after denning, as do polar bears (Harington, 1964).

Winds, currents, and tides prevailing when the sea ice breaks up in autumn are often responsible for rafting bears to suitable denning areas. But polar bears are not always passive drifters, and some experienced individuals probably find the denning areas by their ability to navigate within a region.

There appear to be three main types of polar bear winter refuges: maternity dens, temporary dens, and natural shelters. Polar bears usually excavate dens in snowbanks of suitable depth and density, which develop on leeward slopes of coastal hills and valley sides. Den elevations range from the level of sea ice to 1,800 feet (548.6 m.) above sea level. Structurally, polar bear dens are characterized by entranceways leading to one or more rooms. Some special den features are porches, sills, lairs, alcoves, and ventilation holes. The air in occupied dens may be as much as 37°F warmer than that outside.

Polar bears of both sexes and various ages occupy dens or shelters. They generally begin to den in October and do not stay in dens later than April. Females, both pregnant and non-pregnant, seem to be most regular in this habit. Adult males sometimes den. Denning enables sufficiently nourished polar bears to avoid unfavourable environmental conditions. The habit probably originated as an adaptation to seasonal food scarcity. Pregnant females require protection from the chill of winter to bring forth their cubs (usually twins), which are helpless for a month or more after birth. By the time the cubs are mature enough to function in their rigorous arctic environment, outside conditions are suitable for travel down to the sea ice.

Polar bear denning habits are similar in many respects to those of other bears of the genus *Ursus*—particularly to those of the brown bear (*Ursus arctos*), as might be expected from their close phylogenetic relationship.

Core areas and denning habits require further investigation, so that polar bears can be more effectively safeguarded should any threat arise to their survival.

Résumé

Les vents, les courants marins et les marées qui prédominent lors de la rupture des glaces polaires, à l'automne, jouent un grand rôle dans l'acheminement des ours vers un repaire favorable. Mais les ours polaires ne se laissent pas toujours mener au gré des courants, car certains d'entre eux, grâce à leur expérience et à leur habileté à s'orienter à la nage dans une région donnée, peuvent probablement trouver les endroits appropriés pour y faire leur tanière.

Il semble exister trois sortes de repaires d'hiver pour l'ours polaire: le repaire de mise bas, le repaire temporaire et l'abri naturel. L'ours polaire creuse d'ordinaire son repaire dans un banc de neige de bonne consistance et de profondeur suffisante, comme il s'en forme sur les pentes sous le vent des collines et des vallées côtières. Ces repaires se retrouvent à des altitudes variées, à partir du niveau des glaces flottantes jusqu'à celui de 1,800 pieds (548.6 m). Ils se composent d'ordinaire d'un passage débouchant sur une ou plusieurs chambres. Ils ont même un portique, un seuil, des couches, des niches et des ouvertures d'aération. L'écart entre la température qui règne à l'intérieur d'une tanière habitée et celle de l'extérieur peut atteindre jusqu'à 37°F.

Les abris et les repaires sont habités par des ours polaires de tout âge, tant mâles que femelles. Leur période d'hibernation, qui commence au mois d'octobre, se termine au plus tard en avril. Ce sont les femelles, gravides ou non, qui semblent suivre le plus fidèlement cette habitude. Les mâles adultes hibernent aussi parfois. L'hibernation permet à l'ours polaire bien nourri d'éviter les rigueurs du milieu où il vit. Cette habitude date probablement de l'époque où l'animal dut s'adapter au manque saisonnier de nourriture. Les femelles gravides ont besoin de se protéger du froid de l'hiver pour mettre bas (la portée est généralement de deux), les oursons étant incapables de se suffire à eux-mêmes avant d'avoir atteint l'âge d'un mois ou plus. Lorsque les oursons sont enfin prêts à affronter les rigueurs de l'Arctique, les conditions à l'extérieur de leur repaire se prêtent à la descente vers les glaces de la mer.

Il y a lieu d'approfondir nos connaissances sur l'habitat et sur les habitudes d'hibernation de l'ours polaire, afin d'être en mesure d'assurer la survie de l'espèce, si jamais celle-ci était menacée d'extinction.

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