

PANEL 3: POLAR BEAR STUDIES

Further Notes on Polar Bear Denning Habits

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SUMMARY

Polar bears construct maternity dens in the snow throughout their range. The Owl River maternity denning area on the Manitoba coast of Hudson Bay, Canada, had a measured productivity of 100-150 cubs in 1970 and 1971. Maternity denning is now confirmed for the Twin Islands in James Bay, but estimates of productivity for James Bay and the Ontario coast of Hudson Bay should still be made. Female polar bears build a variety of dens in the vicinity of their winter dens and along their route as they move to the sea ice. This makes the censusing of maternity dens and estimating of productivity difficult. The winter dens in Hudson and James bays differ from high arctic dens in that earth chambers are used, with snow dens added as winter progresses. Summer denning occurs along the Manitoba and Ontario coasts of Hudson Bay, and on the islands in James Bay. Surface pits, shallow dens and deep burrows are the three basic types of earth dens built. All three types appear to be constructed for temperature regulation by the bears, but each type is sometimes used later for shelter, protection from insects, protection from other bears or for winter dens. These behavioural adaptations appear significant in delineating a discrete polar bear population for James Bay and southern Hudson Bay.

INTRODUCTION

Polar bears (*Ursus maritimus* Phipps) den throughout their circum-polar range. Winter maternity dens constructed in drifted snow by pregnant females are the most common type and have been described by many arctic writers, especially Uspenski & Chernyavski (1965) & Harington (1968). Such dens are typically prepared by the female digging into a new drift, but sometimes she lies on or digs into a drift remnant from the previous year, allowing the snow to cover her. The maternity den is later expanded, perhaps by body heat, consumption of snow, scratching or digging. Maternity dens dug into deeply drifted areas show considerable evidence of design and construction (Uspenski & Chernyavski *op.cit.*; Harington *op.cit.*).

Certain polar bears other than pregnant females construct winter dens in the snow, especially in maternity denning areas (Van de Velde 1957, 1971; Harington, *op.cit.*). Uspenski & Chernyavski (*op.cit.*) found no such evidence on Wrangel Island and the ecological and behavioural causes for this type of denning

remain unknown. Another form of winter den, referred to as 'temporary' or 'natural' by Harington (*op.cit.*), is used only for short periods as shelter during severe storms.

In the Hudson and James bay areas of Canada, polar bears construct earth dens during summer and autumn. Unique to the Southern portions of polar bear range, such dens were first mentioned by Kolenosky & Standfield (1966) from aerial observation along the Ontario coast, and by Doult (1967) from the Twin Islands of James Bay. The structure and function of earth dens are very different from those of typical winter dens.

The present study of winter denning, denning areas and the types and distribution of summer earth dens of polar bears was begun by the Canadian Wildlife Service in 1969, in response to a request by the IUCN Polar Bear Study Group based at Morges, Switzerland.

While there is increasing evidence from the recapture of tagged animals that female polar bears return to ancestral denning areas to produce their young, Uspenski & Chernyavski (*op.cit.*) thought it probable that females breed each time in a different area of the Arctic. If maternity areas are indeed ancestral, it is important to investigate why certain geographical areas are favoured; what ecological; genetical and behavioural forces are involved; what the total productivity is for specific denning areas; and where as yet undiscovered denning areas are located. New denning areas in Canada are suspected on Devon, Elsemere, Somerset, Prince of Wales and Akpatok islands, and along Prince of Wales Sound, but adequate field studies on the extent of these localities have not been made. The urgency of undertaking such studies is growing, as mineral exploration teams and, particularly, their seismic activities could be having profound effects on polar bear behaviour and reproductive success.

METHODS

Suspected winter denning areas were visited by us during March and early April of 1970 and 1971 using skidoo, fixed-wing plane and helicopter; during July through September of 1969, 1970 and 1971 using helicopter and on foot; and during November-December 1970 by helicopter.

March-April studies included recording the numbers of females with young moving to the sea, back-tracking families to locate specific winter den sites, taking measurements of and marking winter dens, and collecting data on litter sizes.

July through September field work involved making observations of bear distribution and bear behaviour in the summer denning areas and of bears in the summer dens, checking winter den locations, and capturing and marking individual bears found in dens. We measured and permanently marked specific dens with tape, for further study. Permafrost measurements were made inside the dens and in surrounding areas with the aid of a case-hardened serrated steel probe 1.5 cm in diameter (Brown 1968). We investigated the extent of summer denning areas and the purpose of summer denning by systematic searches and extensive behavioural observations.

November-December studies consisted of locating specific occupied dens for winter studies, marking pregnant females in dens, recording the behaviour of females during their selection and preparation of winter dens, and observing the behaviour of bears in dens.

RESULTS

A major polar bear winter denning area discovered in the Owl River drainage of Cape Churchill during 1969 (Jonkel 1970) has provided additional data on polar bear productivity rates and behavioural adaptations. This denning area is located between the Nelson and Churchill rivers in a partially treeless zone underlain with discontinuous permafrost (Fig. 1). It is centered about 10 to 20 km inland from Hudson Bay, but its outer boundaries include patches of tundra within a heavily forested zone 15 km north of the Nelson River. The area extends northward 100 km to the almost treeless coastal tundra between Cape Churchill and the mouth of the Churchill River.

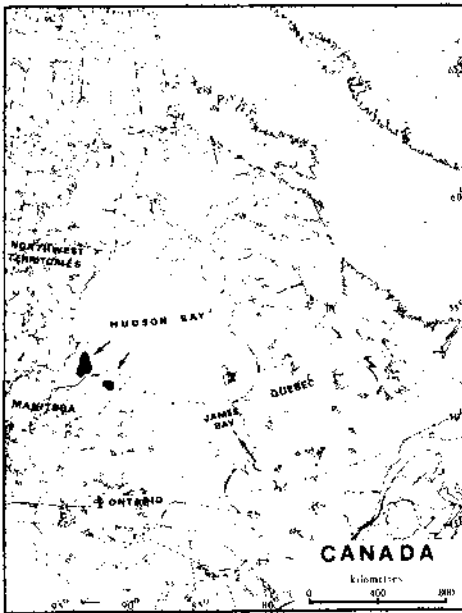


Fig. 1 Geographic location of the Cape Churchill (Owl River) and Cape Tatnum, Manitoba, winter denning areas.

Emergence and Productivity.

During 1970 and 1971 females with young started to leave the denning area and move to the sea in late February (Fig. 2). We saw additional females with young moving eastward all through March and as late as 12 April. Not all of the area was searched in 1970, because we had not yet found its northern projection but, on the basis of four winter trips, we concluded that approximately 60 females had produced young in the area. During late February and early March the temperature averaged 20 °F below zero, but by early April there was mid-day thawing.

In 1971 we observed a similar pattern of movement although the weather was milder. Many bears left their dens earlier, building alternate dens in the vicinity or, as during a warm period in early March, lounging on the snow near

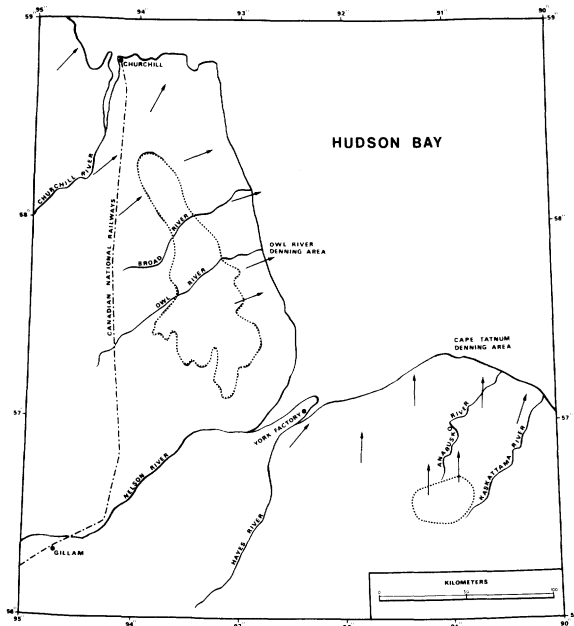


Fig. 2 Detailed map of the Owl River and Cape Tatnum maternity denning areas in Manitoba, showing the general direction of family movements to the sea during March and April.

den entrances. Again in 1971 at least 60 females produced young in the Owl River denning area. We noted additional females with young travelling to the sea from outside the main denning area, of which, three were observed north of the Churchill River and 16 came from distant inland areas and crossed the Churchill rail line (Fig. 2). Some of the 16 females from inland may have been inadvertently included with the 60 from the Owl River denning area because of poor tracking conditions on certain days.

Preliminary summer and winter studies show that a similar but smaller maternity denning area occurs inland from Cape Tatnum south of the Nelson River (Fig. 2). In 1971 a partial survey of this area indicated that at least 16 females produced young here. The average litter size for the Owl River denning area in 1970 was 1.9 for 52 families; in 1971 it was 1.8 for 93 families in both areas.

Maternity denning also occurs in scattered areas along the Ontario coast south to James Bay (Jonkel *ob. cit.*). Detailed studies of the productivity of bears in this area are planned for 1972 and 1973.

We also suspected that there were maternity dens on the Twin Islands in James Bay (lower arrow Fig. 1). During March and April 1968 and 1969, we tracked bears but failed to find any maternity dens, though females with young were in the area. Summer studies in those two years revealed only one den that had clearly been used as a winter den. In March 1970, however, we found three females with young denning on the Twin Islands. At least eight females with young, seen in the vicinity of the Twin Islands that year, apparently had maternity dens on James Bay islands.

A small number of denned adults with no cubs were noted in the denning areas: one was on North Twin Island in 1968, and two were seen leaving the Owl River denning area in 1971.

Winter Dens

Winter dens in the Owl River district occur most often in treeless or almost treeless areas (Fig. 3) wherever steep banks occur, such as along lakeshores, meandering tundra streams or the sides of palsas and hummocks created by permafrost. Bears avoid other likely sites such as the high mineral soil banks of rivers, eskers and stream banks in heavily forested areas, as well as shores of lakes with low banks. Banks which drift deeply with snow provide particular attraction, especially if sloping to the south or southeast. Willow (*Salix* spp.) and black spruce (*Picea mariana*) are usually present along such banks and result in additional drifting.

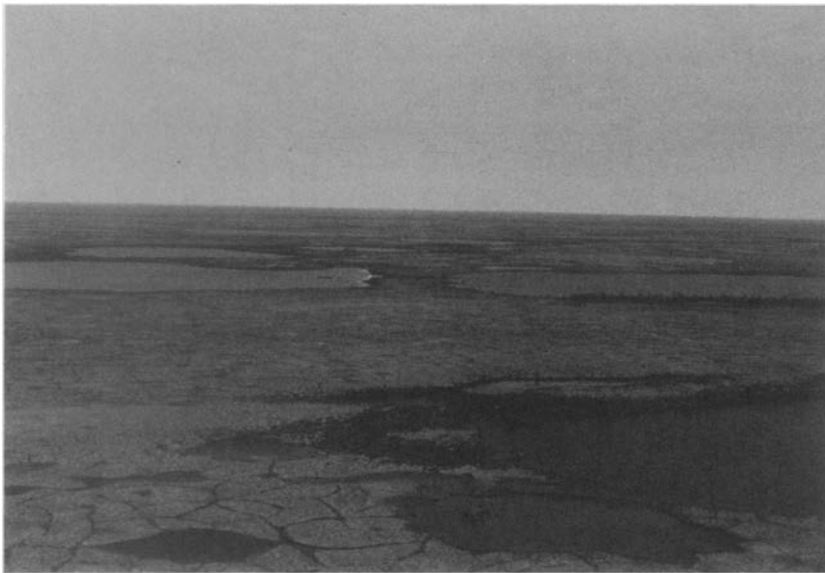


Fig. 3 An aerial view of the summer-winter polar bear denning area south of Cape Churchill, Manitoba.

These winter dens in the snow closely resemble high arctic dens as described by Harington (*op.cit.*), but whereas the latter include extensive snow chambers and alcoves, many maternity dens in our area consist of an earthen chamber in peat banks, with a large snow chamber either added to the entrance (Fig. 4) or constructed nearby (Fig. 5). Dens which did not have a snow chamber attached, opened by a long tunnel through 1-2 m of snow directly to the outside.

Females leaving winter dens followed a uniform pattern of behaviour. After breaking through the ceiling of the snow chamber (Fig. 6), they spent up to a month in the vicinity of the den (Fig. 7), apparently leaving and re-entering the den repeatedly, as reported in the High Arctic by Harington (*op.cit.*). The cubs played on banks of the snow and in nearby willow bushes, while the females

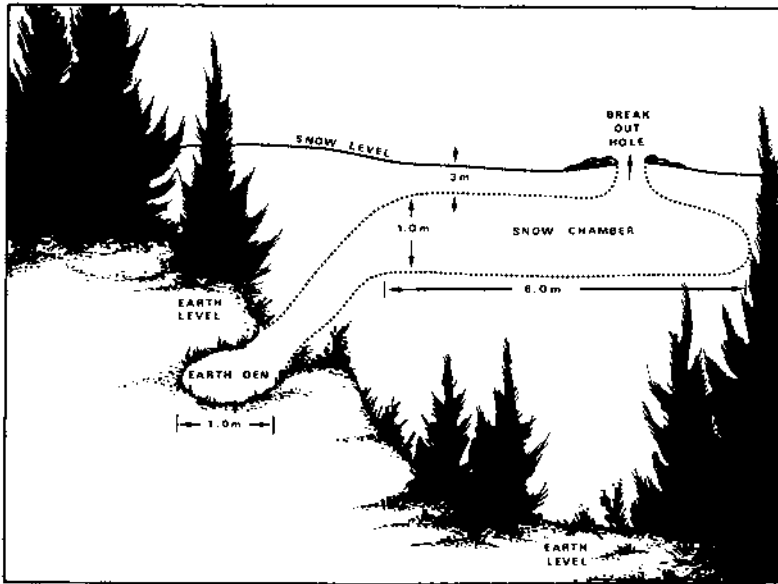


Fig. 4 Diagram of a typical Owl River or James Bay winter den showing an earth den with the snow chamber added during winter.

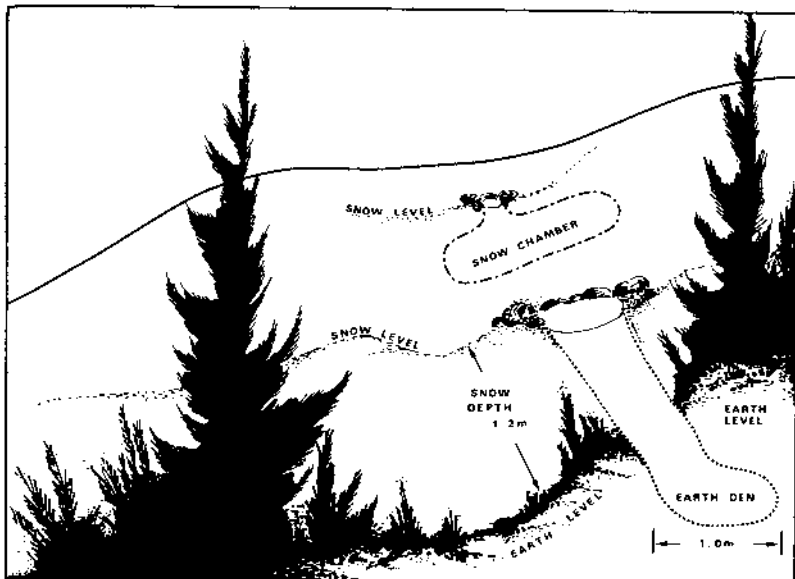


Fig. 5 Diagram of a maternity den located in an earth den, but with a snow chamber added nearby.



Fig. 6 A winter den of a female and cub, showing the break-out hole used on 3 March, and a hold dug for re-entry to the maternity den in a peat-moss bank, used during the animals' stay in the vicinity.



Fig. 7 The tracks of polar bear cubs indicate considerable 'playing' in the willow bush. Centre of photo shows where female polar bear dug down in stream bottom to obtain herbaceous foods.

dug additional dens or dug down to stream bottoms to consume grasses (*Calamagrostis* spp.) and mosses (*Sphagnum* spp.).

Upon leaving the vicinity of the winter den, the family usually moved to heavier cover, especially along a meandering stream, and constructed temporary dens. These comprised either a series of single dens a few kilometers apart, or groups of dens in a particular area, especially an area with summer dens, banks and variable snow conditions. The bears usually dug down to existing summer dens in the earth, made surface pits and shallow dens in the snow, or dug deep L-shaped dens with a rounded bed at the end. Debris from inside the summer dens was often thrown out onto the snow in the process, and at least one earth den was found which was dug entirely in the winter. Unless bears are carefully tracked, many of these temporary dens could be mistaken for winter dens.

By late March or early April the families move directly towards the sea. They travel perhaps 0.3 to 0.5 km at a time initially; at each stop the females construct a rounded bed 20 to 40 cm deep in the snow and feed and warm the cubs. When the temperature is low, the cubs spend these rest stops sitting or standing on top of the female and sometimes curling up in her fur. In this halting manner the family moves in a relatively straight line to the sea, across the floe edge and out onto the drifting pan ice (Fig. 8). In rare cases a cub will even ride on the female, especially if frightened as well as cold. In James Bay we saw a female giving the smallest of three cubs a ride for a considerable distance.



Fig. 8 The floe edge of Hudson Bay. Females and young move onto the drifting pan ice (left) to hunt seals and seal pups during early spring.

Summer Dens

Summer denning in the earth occurs most commonly within the winter denning areas already discussed, but also occurs on coastal beaches and offshore islands of southern Hudson Bay and James Bay. We also found a few small excavations on Southampton and Coats islands. Denning in the earth by polar

bears has never been reported outside of these areas, but could be expected in higher latitudes wherever the ground thaws sufficiently. Earth dens are constructed during late July through October by bears of various sexes and ages (Table 1), and sometimes the dens are modified by pregnant females during November or later for winter denning.

TABLE 1. SEX AND AGE OF BEARS OBSERVED IN SUMMER DENNING AREAS DURING 1969 AND 1970. CLASSIFICATIONS WERE BASED ON BODY SIZE AND FORM.

| Year | Date | Ad. ♀♀ with | | Ad. ♀♀ | Ad. ♂♂ | Sub-adults |
|--------|---------------------|-------------|-------|---------------|--------|------------|
| | | ♀♀ | young | without young | | |
| 1969 | Aug. 13 | 3 | 6 | — | 4 | 7 |
| 1970 | Aug. 31- Sept. 2 | 7 | 12 | 3 | 31 | 10 |
| | Nov. 9-13 | 1 | 2 | 7 | 3 | — |
| Totals | | 11 | 20 | 10 | 38 | 17 |

There are three basic types of summer-autumn earth dens built by polar bears. These include (1) a shallow surface pit or bed similar to a canid day bed or the snow beds discussed above; (2) a bed in the form of a shallow den dug into the side of various types of banks; and (3) a deep burrow also dug into the side of a bank.

Surface pits are common along the coastal areas and islands of southern Hudson Bay and James Bay. They are usually 1.0 m in diameter, 20.0 cm to 0.5 m deep, and are constructed on level ground (Fig. 9). Sites most often selected are the tops of (1) low coastal beaches (berms) and 'ice pushes' (ridges of sand) just above the high-tide line, (2) old inland beaches and eskers, (3) sand dunes, and (4) ice-pushes around inland lakes. In permafrost zones they are found (5) on the tops of peat-covered palsas and hummocks, or (6) on the crests of high banks of lakes. In rare cases they are constructed (7) on steep slopes by making a shallow excavation into a bank and locating the pit on the excavated soil, or (8) on the tailings of a deep den. The most popular sites are coastal beaches or the banks of inland lakes in open or thinly treed permafrost zones.

Shallow dens are similar to the temporary winter dens of polar bears described by Harington (*op. cit.*), to brown bear (*U. arctos* L.) winter dens described by Craighead & Craighead (1966), and to certain black bear (*U. americana* Pallas) winter dens found by Jonkel & Cowan (1971).

Shallow dens are occasionally located close to the sea on high sand or gravel beaches which are vegetated sufficiently to provide support, but most commonly they are dug into the steep banks of eskers on the James Bay islands, and the peat banks of palsas, hummocks, lake-shores and streams in permafrost zones inland from the Manitoba-Ontario coast. They are deep enough only for a bed, and average 1.0-2.0 m wide and 1.0-2.0 m deep, with entrances 1.0 m or less high (Table 2). In peat soils they often terminate at permafrost. In sand or

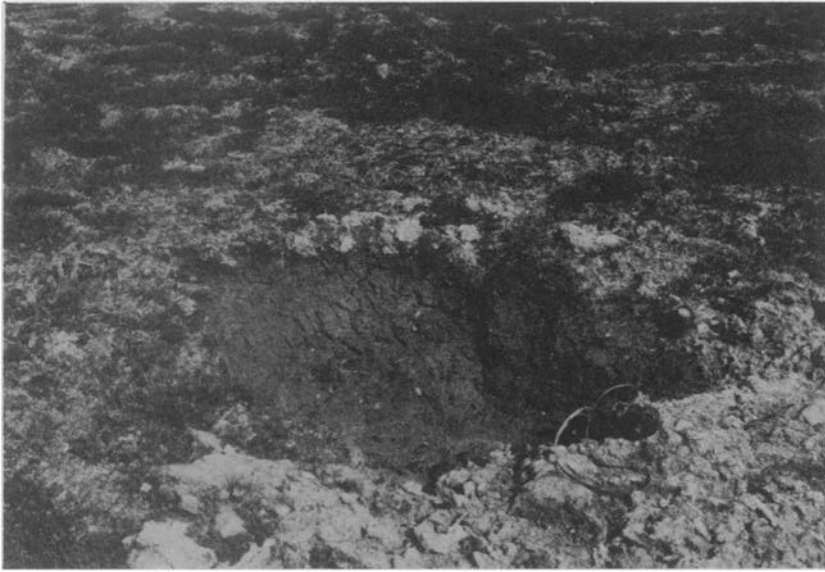


Fig. 9 Photo of a typical Polar Bear surface pit or bed.

TABLE 2. THE MEASUREMENTS OF SHALLOW DENS BUILT IN THE SUMMER AND AUTUMN BY POLAR BEARS, NORTH TWIN ISLAND, N.W.T.

| Den No. | Approx. Slope (Degrees) | Measurements (meters) | | | Remarks |
|---------|-------------------------|-----------------------|-------|--------|--|
| | | Length | Width | Height | |
| 1 | 40 | 2.4 | 2.4 | 1.2 | Sod and sand |
| 2 | 40 | 3.6 | 1.6 | 1.1 | Birch clump |
| 3a | 30 | 1.1 | 0.9 | 0.9 | Three beds in one den, nest materials added. |
| 3b | 30 | 1.1 | 1.1 | 0.6 | |
| 3c | 30 | 2.0 | 0.8 | 1.0 | |
| 4 | 40 | 2.4 | 2.4 | 1.0 | Sod and sand |
| 5 | 40 | 2.4 | 2.0 | 1.0 | Sod and sand |
| 6 | 35 | 2.4 | 2.4 | 1.2 | Sod and sand |
| 7 | 30 | 2.6 | 2.4 | 1.0 | Willow and birch, sand |
| 8 | 45 | 1.0 | 1.0 | 1.0 | Sod and sand |
| 9 | 45 | 2.3 | 2.8 | 1.1 | Willow and gravel |
| 10 | 20 | 1.6 | 1.6 | 1.0 | Willow and sand |
| 11 | 20 | 2.3 | 2.8 | 1.1 | Willow and sand |
| 12 | 10 | 1.6 | 2.9 | 1.1 | Birch and willow, sand |

gravel areas shallow dens are dug laterally into banks which slope approximately 45° from the horizontal, whereas in areas of peat substrate the banks used are often vertical (Fig. 10). The soil type and vegetation are important, with bears usually choosing sites where caving of the walls or ceiling is unlikely. Sand or peat substrates are sought most often. The dens face any direction, especially those in the perimeter of palsas and hummocks, but dens on lakeshores dens often face south or east because the land slopes towards the sea and the banks on inland shores are higher than on seaward shores, especially on large lakes. The extent of permafrost action in the tundra surrounding the lake also affects the height of banks and the location of the dens.



Fig. 10 Photo of a typical shallow den in peat bank.

Deep burrows, which are found only in high banks with peat substrates, are not frequent. They are similar in construction to shallow dens, but may extend for 4 to 6 m into the earth, terminating at permafrost.

The lair at the end of one such den occupied by a 562 kg adult male was 2.0 m long and wide and 1.2 m high. The den turned to the left and down, so that the floor of the lair was located about 2.0 m below the entrance of the den (Fig. 11) and was very dark and cold.

Permafrost measurements were made in and around recently occupied summer dens (Table 3). In one case an adult male had dug a shallow den so that the rear wall was permafrost and was lying against the ice. In most cases the permafrost was 0.1 to 0.2 m from the surface of the bed. The depth from the surface of the ground to permafrost behind the dens and on the surrounding stream and lake banks was usually uniform. Lake or stream shores in front of the dens or below the banks generally had no permafrost or had permafrost too deep for us to measure. Mineral soil was at the surface or very close to the surface at the lakeshores, whereas the banks or the level ground above the banks normally had 1 to 1.5 m of peat overlying the mineral soil.

TABLE 3. PERMAFROST MEASUREMENTS FROM RECENTLY OCCUPIED POLAR BEAR DENNING SITES, AUGUST AND SEPTEMBER, 1970.

| Area | Direction Facing | Den No. | Depth to Permafrost (Cm) | | | | Remarks |
|----------------|------------------|---------|--------------------------|--------------|------------------|--------------|------------------------------|
| | | | Interior of Den | | Surrounding Area | | |
| | | | Back Wall | Floor of Den | Top of Bank | Foot of Bank | |
| Broad River | NE | 1 | 12.5 | 22.5 | 35.0 75.0* | 45.0 | Shallow bank |
| Beale Creek | NW | 2 | 5.0-10.0 | 10.0 | 37.5 | 45.0 | Adult male # 704; lake bank |
| Rupert Creek | E | 3 | — | 50.0-52.5 | 50.0-52.5 | 200.0† | Winter den site: stream bank |
| Rupert Creek | SE | 4 | 11.0 | 12.5 | 50.0 | — | Adult male; lake bank |
| Anabusko River | NE | 5 | 20.0 | 20.0 | 45.0 | 250.0 | Hummock |

* Depth to permafrost from surface of a shallow lake

† Could not reach permafrost.

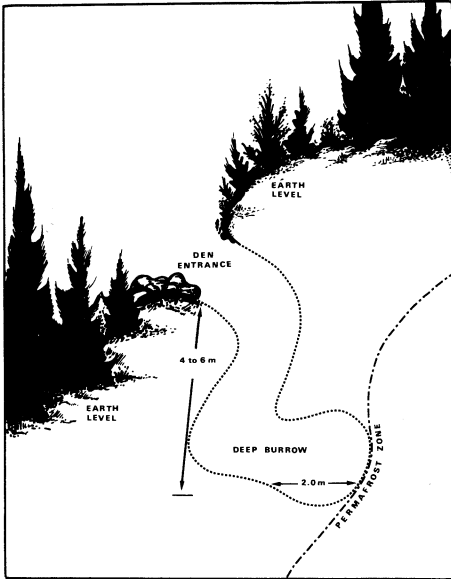


Fig. 11 Diagram of a typical deep burrow.

Several dens were found containing lichens and mosses from the surrounding surface. In one case, in a peat and permafrost area, a bear had raked the vegetation from an irregular area measuring approximately 10 m wide and 40 m long (Fig. 12). Some of this material was in a surface pit, apparently used as a winter den, but much of the material was missing. In another case, mosses and herbaceous plants had been raked into a shallow den which had been dug into a raised beach on North Twin Island. Beds within the den indicated that it had been used during winter by a female and two cubs.

During August and September 1969, we counted 286 bears along the Hudson and James Bay coasts between Churchill and Moosonee, at the southern end of James Bay. Bears were found along the coastal beaches and in the inland denning areas. A similar aerial survey during September 1970 gave a total of 260 bears. A majority of the bears were resting either in surface pits, shallow dens (Fig. 13), deep burrows or moist grassy areas, when first observed. A flight over the Twin Islands in September 1967 revealed that bear behaviour there was similar. During all three surveys certain bears showed a marked reluctance to leave their beds.

Similar observations conducted during October and early November 1970, revealed many bears (we assumed pregnant females) in dens in the maternity denning area, but few bears in dens or pits along the coast. In fact, large numbers of bears were walking along the shore, sitting or lying on frozen lakes near the coast, or lying very near the edge of the sea. Bears that were in dens, were in the deeper of the shallow dens rather than in surface pits, and they were even more reluctant to leave the dens than in summer. A few of these bears appeared by their body form to be young animals. Most were medium-sized adults, which one can usually assume to be females. One bear which we chased from a den and drugged was an adult female. Several others remained in their dens and were identified as females in March when their tracks and the tracks of their cubs were observed leading away from their dens.



Fig. 12 The area from which mosses and lichens had been raked into a shallow bed and apparently used as a winter den by a polar bear.



Fig. 13 A polar bear emerging from a shallow den dug into a sand ridge along the Ontario coast.

DISCUSSION

The winter polar bear denning area found in northern Manitoba has particular biological significance because data on the productivity of denning areas is basic to the management of the species. Although Kolenosky & Standfield (*op.cit.*) and Douth (*op.cit.*) had reported that polar bears den along the coast from Cape Churchill to the Twin Islands, the great concentration of dens north of the Nelson River was not previously known.

Judging from their large size, from caving and the degree to which they are re-vegetated, many summer dens appear to be ancient. Some bears use the summer dens for winter dens, and if summer dens are a valid indication of past use of the area as a winter denning area, we could assume that it has been an important centre of productivity for many decades. It seems likely, however, that considerably more bears have used the area in recent years. Coastal aerial surveys do not show a marked increase (Jonkel & Standfield 1969), but many persons long familiar with the area believe that the number of bears has increased rapidly since the York Factory settlement was closed and the military personnel left Fort Churchill. The number of bears present on Cape Churchill each autumn since 1968 does appear greater than in earlier years (Jonkel *op.cit.*).

On the other hand, the area is still seldom visited. If biologists had not made a special effort to visit Cape Churchill in late autumn and the denning area during late summer and March the past several years, the large autumn concentrations of bears on Cape Churchill, as well as the existence of the western Hudson Bay denning area, would be unknown today. Inadequate research in the past and the almost complete lack of travel into particular geographical areas during inhospitable times of the year lead one to question how many denning areas in the Arctic are still unknown. For example, the eight females which we believe denned on the Twin Islands in 1970 comprise only a small fraction of the total bear population in the south end of Hudson Bay and James Bay. Scattered records of dens from earlier publications (Kolenosky & Standfield *op.cit.*, Jonkel *op.cit.*), and accounts by Indian trappers suggest that the entire Ontario coast of Hudson Bay and northern James Bay should be investigated.

The purpose of summer dens seems to be unrelated to winter denning. They appear to be hastily constructed and their two basic functions are as a resting and cooling place. The beds on ridges are located where they receive the most cooling winds from the sea or large lakes. Once constructed, the pits apparently can be re-used indefinitely. Many times during July and August adult polar bears were observed using old pits which were completely overgrown with lichens and mosses. They are, by personal experience, delightfully comfortable. In very sandy areas, pits are difficult to distinguish from holes made by wind and seem easily converted into large useless holes or sand dunes. Surface pits are found in most of the same areas as the other types of dens, but not on coastal beaches.

The shallow dens and deep burrows are more detailed in construction than the pits described above and provide more sheltered beds. The sheltering results from the location of the dens below the crests of ridges and from a partial or complete overhang of earth and shrubbery.

Douth (*op.cit.*) surmised that the earth dens of the Twin Islands were used by bears during the winter. Our winter studies showed little evidence of this and use of only a small portion of the more suitable peat dens in Manitoba. A vast majority of the earth dens are unsuitable for use as winter dens because of

their size or location. We believe, therefore, that bears dig most summer and autumn earth and peat dens in order to reach the cool substrate, and to escape the direct rays of the sun, high ambient temperatures and, in some cases, insects. These earth dens are sometimes used later for shelter in the autumn and as maternity dens in winter merely because they exist.

In the autumn the dens offer shelter from severe winds, storms or snow. Two young bears on North Twin Island appeared to use shallow dens for protection from the weather as well as a sanctuary from large males in the area. We have observed polar bears using trees, shrubs and ice blocks as cover when pursued by a helicopter. In taking cover, four bears ran into shallow dens, and at least 12 bears found in dens stayed in the dens for cover. Again, we believe that the summer dens were used for cover as a secondary function.

The selection of the den sites seems directly influenced by the slope of the terrain. The height of the ridge or slope does not seem important; some are as little as 2 m high but the higher the ridge the more space there is for additional dens. Most were located in high peat banks of the mainland or in the 45 m high sand and gravel ridges on the Twin Islands. There were no dens at the crest of the ridge where the slope ceased, but bears often made dens in areas where the shrubs (birch *Betula nana* and willow *S. arctica*) were particularly dense and also dens about 1 m high, even if the slope was slight. No earth dens were found dug into level ground.

Certain areas along the high banks of the Twin Islands consist of gravel and sand which is attractive to bears. In one part of this area there was a concentration of dens near where a sand ridge meets the main ridge of mixed gravel and sand. This perhaps indicates that sand substrate may be the most stable for den construction, or that a sandy bottom may somehow serve the function of the den more properly.

On slopes rising to 45 m above the shore on the Twin Islands, a curious pattern of den formation was noted. The original dens apparently were built at mid-point or lower on the slope, but then were extended higher each year, or each several years, as the overhang collapsed and the den had to be rebuilt. The collapsed den evidently is a preferred location to dig new dens, and this has resulted in long shallow trenches which extend as far as 40 m up the slope. These trenches sometimes branch in ascending the slope and often terminate in a new den just below the crest of the ridge. Other trenches which continued to the top of the ridge terminated in unused and overgrown dens on almost level ground at the abrupt ecotone of the shrub-dominated vegetation and a tundra vegetation (dominated at the ecotone by white mountain saxifrage *Saxifraga groenlandica*). The amount of re-vegetation indicates that the progress of these dens up the slope must be very slow, but we found no way to determine their age. The reconstruction of most dens after one year would involve the removal of approximately 0.5 to 1.0 cubic meters of earth and debris.

Despite the unique denning behaviour discussed here, bears of southern Hudson Bay and James Bay hunt seals, make annual migrations and seek sanctuary in the sea as do polar bears everywhere. Apparently certain bears in the area, besides pregnant females, den in the winter as do bears observed by Van de Velde (*op.cit.*) in the High Arctic. But the types of dens constructed differ in many ways from the dens that the more northern bears dig into snow banks during the summer. These earth dens have existed for generations on the Twin Islands and along the southern Hudson Bay coast. Similar earth dens of polar bears have not been found elsewhere in the circumpolar range of the species, including the nearby southern summer sanctuary for polar bears on Akpatok Island in Ungava Bay.

Even the winter dens differ from the usual type of winter den in having both earth and snow chambers. Some of these differences in denning can be attributed to topographical conditions—especially the hummocks caused by discontinuous permafrost upheavals and the thawed earth, but, more probably, some of the differences may be related to learned behavioural traits. These adaptations in the behaviour of polar bears therefore may be significant in delineating a discrete population of the species in James Bay and southern Hudson Bay.

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