BIRTH-SITE CHARACTERISTICS AND PRENATAL MOLTING IN BEARDED SEALS (*ERIGNATHUS BARBATUS*)

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In Svalbard, Norway, bearded seals give birth on small, first-year, ice flows in the free-floating packice or on similarly sized white, glacial-ice areas frozen into gray, land-fast ice. Sites of the latter type usually were located near the edge of the ice. Access to the sea was always readily available; all birth sites were <1 m from water. Well-formed, dark, gray, lanugo hair disks, similar to those of hooded seals (*Cystophora cristata*), were found at all parturition sites of bearded seals. All young weighing <40 kg had a mixture of 30-mm long, wavy, gray hairs and 20-mm, straight, coarser hair of a somewhat darker gray. Older, larger young had increasingly less lanugo and more stiff hair.

Key words: *Erignathus barbatus*, bearded seal, parturition site, lanugo hair disks, prenatal molt, precocial

The bearded seal (*Erignathus barbatus*) is a northern phocid seal that has a circumpolar distribution. Because of its large size, high quality of meat and blubber, and durable skin, the bearded seal always has been important to coastal peoples in the Arctic (J. J. Burns, in litt.). Despite commercial and subsistence harvesting by humans, little is known about the population status or even basic life-history parameters of this species. This is largely because bearded seals are not particularly gregarious and usually are associated with free-floating packice, rarely coming ashore in most parts of their range (Kelly, 1988).

Bearded seals give birth in spring (April–May—J. J. Burns, in litt.). Young bear a dark coat at birth that is blue-gray, or gray-brown on the dorsal side, with a paler ventral surface (J. J. Burns, in litt. Chapskii, 1938). They have white facial markings that are pronounced on the eyebrows and muzzle. Some young also have cream-colored spots on the top of the head or on the dorsal surface (Mansfield, 1967). J. J. Burns (in litt.) suggested that bearded seals can swim within a few days of birth and reported that Eskimo hunters indicate they are sometimes

born in the water. Lydersen et al. (1994) documented the swimming and diving abilities of young bearded seals within the first weeks of life and Hammill et al. (1994) described distribution patterns during this time interval. There are no reports of births or birthing sites of bearded seals documented in the scientific literature.

This study is part of a research program designed to investigate the reproductive behavior and energetics of bearded seals. It describes the characteristics of birth sites and documents a prenatal molt in this species.

MATERIALS AND METHODS

During our ongoing research program on bearded seals in Svalbard, Norway, we had the opportunity to examine newborn seals and their birth sites. For a description of the study area see Hammill et al. (1994). The first site documented was reported to the research team by staff of the Norwegian Polar Institute when they observed a birth event. We found all subsequent sites through surveys by boat looking for birth blood, or through intensive searches of areas where young weighing <40 kg had been found.

RESULTS AND DISCUSSION

During spring 1994 and 1995, we located seven birth sites of bearded seals. The first site was documented 16 May 1994, when a bearded seal gave birth on the land-fast ice of Kongsfjorden, Svalbard. This neonate was born on a patch of snow on gray ice adjacent to a piece of glacial ice that was frozen into new first-year ice. There was a space of ca. 2 m² between the multiyear-ice and new ice, about one-half the circumference of the glacial ice, which created a sheltered pool where the female hauled out. She gave birth <1 m from the water. The young entered the water for the first time when it was ca. 2 h old. It swam regularly for short periods, hauling out to rest and to suckle. The mother spent most of her time in the water, adjacent to her young, monitoring it much of the time. About every 3 h around the clock the young performed bouts of vocalizations that seemed to stimulate the mother to haul out and nurse. The neonate was killed by a polar bear (*Ursus maritimus*) when it was ca. 48 h old. The pelage of the young seal was examined postmortem. It was a mixture of 30-mm, wavy, gray hairs and 20-mm, straight, coarser hair of a somewhat darker gray. The long hair was loose and came out in small tufts when tugged lightly. Examination of the birth site revealed the presence of many discrete, tightly packed, dark-gray disks of hair (Fig. 1) similar to, but larger than, those of hooded seals (*Cystophora cristata*)—(Kovacs and Lavigne, 1986a: Oftedal et al., 1991). The lanugo disks were spread over 1 m². The fleshy placenta was consumed by gulls shortly after the birth, but clear, dry bits of membrane lay adjacent to the largest pile of lanugo.

In spring 1995, a second birth site was encountered on 5 May in free-floating packice, several kilometers from land. The birth flow measured 3 by 3 m and the birthsite was within 1 m of the ice edge. The newborn seal was ca. 20 m away, on another ice flow. Five additional sites were found in 1995 (Table 1).

About one-half of the birth sites were located on first-year flows in the free-floating packice that were only a few square meters in area (Table 1) and ca.1 m thick. In these areas, open water surrounds each flow, providing complete, direct access for mother-young pairs. The others were found a short distance from the edge of the ice on white-ice areas frozen into gray ice. Access to open water was readily available from these sites because shallow dives involving swimming a few hundred meters do not seem to present any difficulty to young bearded seals (Hammill et al., 1994; Lydersen et al., 1994). Only one female in this study gave birth >0.5 km inside the land-fast ice (Table 1) and her neonate was killed by a polar bear <48 h after birth. The advantage of locating birth sites near ready access to water in areas where polar bears are common seems obvious (J. J. Burns and K. J. Frost, in litt.). Presumably white ice is used because the birth flow must be sufficiently buoyant to support the weight of the female, which can be >400 kg (Kovacs et al., in litt.).

Well-formed, dark-gray, hair disks were found at all parturition sites. The number of disks was variable, ranging from ca. 20 to >100 (Table 1). Variability in the amount of hair found at individual locations was in part due to differential disturbance of the sites by gulls. Their disruption of the birth area undoubtedly resulted in some hair disks being lost into the sea. Despite the large amounts of hair shed before birth, young bearded seals in this study were not born with a smooth pelt as are hooded seals. All seven young (<40 kg) handled during the 2 years of study had a mixture of soft, wavy, long, gray hair that was actively shedding and a shorter, stiff-hair coat that was not loose. Two of four medium-sized young (40–60 kg) had completely molted into a short pelage and two were still shedding. Ten of 11 young >60 kg had no la-
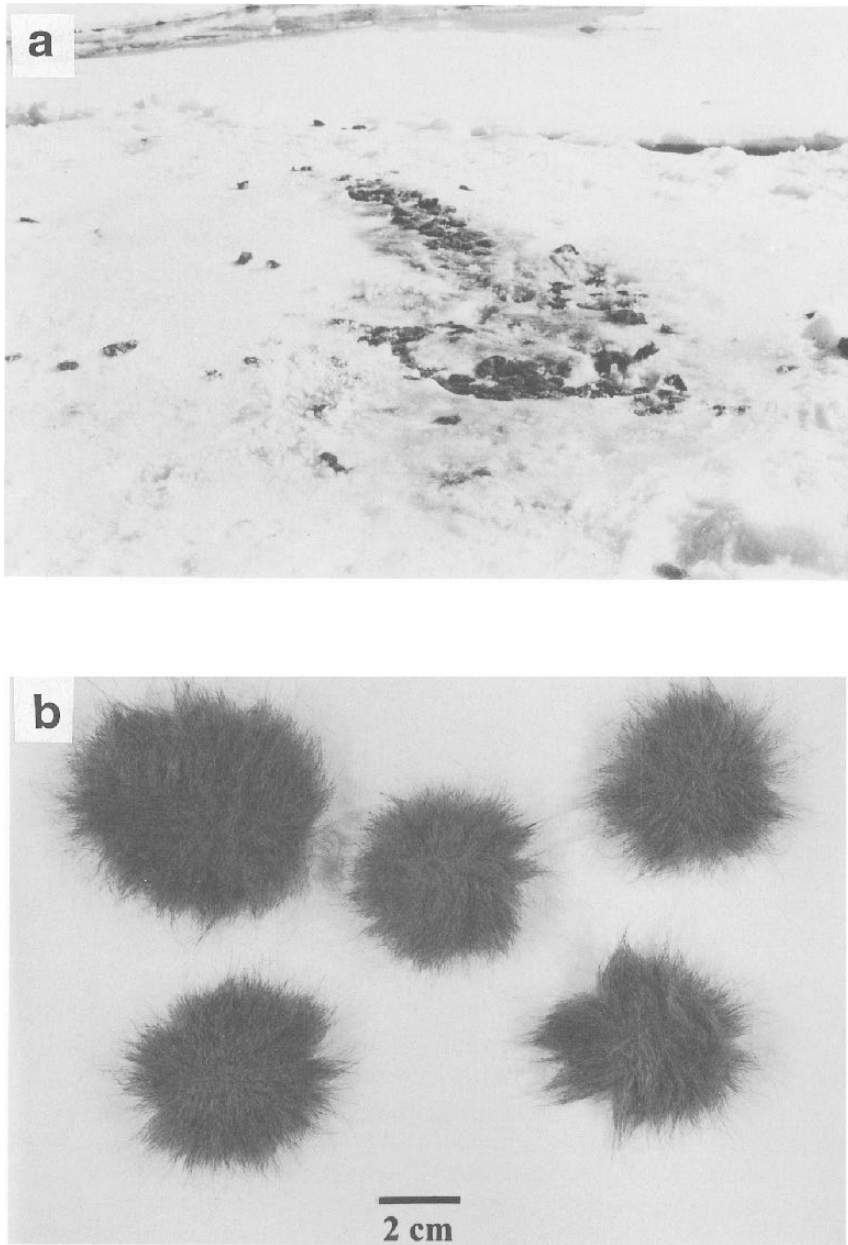
FIG. 1.—Birth site of bearded seals, showing birth blood, hair disks, and proximity to open water (a), and close-up view of prenatally molted hair disks (b).

nugo remaining, while the other still had wisps of loose hair.

The prenatal molt in bearded seals has been reported previously, somewhat obtusely, in the scientific literature. Burns (1970) refered to prenatal shedding of a white la-

nugo in bearded seals and suggested that young born in late May had nearly completely molted at birth. He did not provide data and mentioned the intrauterine molt only in passing in a paper on distribution and natural history of pagophilic pinnipeds.

TABLE 1.—*Birth-site characteristics of bearded seals in Svalbard, Norway.*

Date of birth	Distance from birth site to water (m)	Type of ice	Size of flow (m)	Distance to ice-free water	Distance to land	Approximate number of hair disks
16 May 1994	<1	white first-year ice in gray, land-fast ice adjacent to glacial-ice piece		>2 km	500 m	40
5 May 1995	<1	white first-year floe	3 by 3	0	3 km	30
7 May 1995	<1	white first-year floe	4 by 3	0	2 km	115
9 May 1995	<1	glacial-ice piece in gray first year land-fast ice	6 by 4	200 m	2 km	20
10 May 1995	<1	white first-year floe	2 by 3	0	25 m	60
11 May 1995	<1	glacial-ice piece in first-year gray ice	7 by 8	50 m	200 m	40
15 May 1995	<1	glacial-ice piece in first-year gray ice	7 by 7	150 m	300 m	50

Ling and Button (1975) refered to the findings of Burns (1970) in their review of fetal and neonatal molting in pinnipeds, but subsequent papers reviewing the development of neonatal pinnipeds do not refer to prenatal molting in bearded seals (e.g., Bowen, 1991; Oftedal et al., 1991). Oftedal et al. (1991) cite harbor (*Phoca vitulina*) and hooded seals as unique among phocid seals in molting their lanugo prenatally.

Prenatal molting in mammals is rare (Ling, 1970). Ling and Button (1975) suggested that loss of lanugo prior to birth in seals was related to the ability of seals to enter the water and swim early in life. McLaren (1966) proposed that prenatal shedding was related to selection of the breeding site and that the in utero molt of harbor seals reflects a secondary adaptation to breeding on land. Oftedal et al. (1991) supported the former suggestion, citing many land-breeding species of phocids that shed the fetal coat after birth. The lanugo of young phocids that remain dry, either on land or on ice, throughout their periods of maternal dependence is clearly important for thermoregulation. Many studies have demonstrated the insulating value of the lanugo in air (Davydov and Markarova, 1965; Elsner et al., 1977; Shepeleva, 1971). When wetted, however, the lanugo loses its insulating value and simply becomes a hydrodynamic burden (Davydov and Markarova, 1965).

Prenatal molt is a normal phenomenon in harbor seals (Boulva, 1975; Boulva and McLaren, 1979), hooded seals (Brown, 1868; Shepeleva, 1971), walruses (*Odobenus rosmarus*—Fay, 1982), and bearded seals (Burns, 1970; this study). Newborns of these species are uncommonly large relative to maternal size (Kovacs and Lavigne, 1986b) and enter the water at a young age. Harbor seals commonly enter water on the first day of life, sometimes within hours of birth (Renouf et al., 1983; Scheffer and Slipp, 1944; Venables and Venables, 1955). Hooded seals remain on the surface of the ice with their mothers throughout the nursing period, but the period of maternal dependence in this species is extremely short (Bowen et al., 1985, 1987; Kovacs and Lavigne, 1986a, 1992). Thus, young of this species spend time in the water at a early age. Walruses can enter the water immediately after birth if disturbed (Fay, 1982). Bearded seals enter the water with their mothers within hours of birth and in the first weeks of life spend one-half of their time in the water (Lydersen et al., 1994). This pattern supports the suggestion of Ling and Button (1975) that prenatal molting may be linked to early postnatal development of swimming and diving abilities.

However, a few species of phocids exhibit some degree of prenatal shedding although young do not typically swim prior to weaning. Three percent of southern elephant seals (*Mirounga leonina*) born on Signy Island molt prenatally (Laws, 1953) and some young gray seals (*Halichoerus grypus*) commence molting of the lanugo prior to birth (Hickling, 1962). In both of these species, it is possible that young spend time in the sea prior to weaning (*M. leonina*—Laws, 1953, 1956; *H. grypus*—Hickling, 1962), but for the majority of neonates of these species a shore- or ice-based nursing period and a postnatal molt is typical. Conversely, young of some species swim with some regularity while still bearing lanugo. Young Weddell seals (*Leptonychotes weddellii*—Tedman and Bryden, 1979) and Hawaiian monk seals (*Monachus schauinslandi*—Kenyon and Rice, 1959) are born with lanugo, but swim regularly with their mothers once they are a few weeks old. They are, however, not aquatic to the same degree as harbor seals or bearded seals.

Ringed seals (*Phoca hispida*) are the most pronounced exception to the prenatal molt-early swimming pattern among phocid seals. Young of this species are proficient divers at a young age and, like bearded seals, they spend one-half of their time in water when only a few weeks old (Lydersen and Hammill, 1993a; Lydersen et al., 1993). However, they do not shed their lanugo until they are 6–8 weeks old (Lydersen and Hammill, 1993a). The lanugo may be retained as cryptic coloration in this species, despite the increased cost involved in swimming, because of the extreme levels of predation on neonatal ringed seals by polar bears, arctic foxes (*Alopex lagopus*), and avian predators (Lydersen and Smith, 1989; Smith, 1976, 1980). An alternative hypothesis is that the small size of ringed seals makes retention of the lanugo essential for thermoregulation in air, despite the burden it may incur in the water. This seems unlikely, however, given that ringed seals spend much of their haulout time in lairs that offer thermal protection and young seals accumulate an insulating blubber layer quickly after birth (Lydersen and Hammill, 1993b).

The organization of the prenatally shed hair of bearded seals is similar to that of hooded seals. It is woven in disks, unlike the loose masses of shed hair found in the placental remains of harbor seals. Mansfield (1967) suggested that the disks of hair of hooded seals were excreted from the fetal digestive tract after hair-containing amniotic fluid was swallowed. Oftedal et al. (1991) investigated the mechanism of hair-disk formation in hooded seals, but could not determine definitively how they were formed. They suggested that the interweaving of the hair might take place in the amniotic fluid by fetal or uterine movements or by the mechanism suggested by Mansfield (1967). Further, they suggested that differential timing of molt might explain the difference in structuring of the molted hair in the womb of harbor versus hooded seals. This seems unlikely given that walruses molt several months prior to birth (Fay, 1982; Oftedal et al., 1991), but do not produce hair disks and bearded seals produce hair disks although young are still actively shedding hair at birth. Only comparative embryological studies that include histological investigations of formation and replacement of hair will provide a definite explanation of the differences observed in prenatally molting species of pinnipeds.

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