
Accepted: 6 October 2000

**Abstract** In late May 1998, a large area of the land-fast ice in Prince Albert Sound, Northwest Territories bordering the Amundsen Gulf, broke up almost 1 month earlier than usual. In June and July, 92 neonate ringed seals were sampled. Of 50 examined in June 1998, 25 still had remains of their white lanugal pelage. In July, 2 of 42 pups collected still retained some of their white lanugal fur. The pups, with lanugo still showing, were in significantly poorer body condition than their fully moulted cohort members. Mean condition of moulted pups, in June 1998, was higher than that of moulted pups collected in June of 1971, 1972, 1976–1978, and 1993–1997. All indications were that marine productivity was high in June 1998. Fully moulted pups fed more on Arctic cod (*Boreogadus saida*) than did the smaller pups retaining some lanugal fur. Adult and juvenile seals fed primarily on Arctic cod. Mean lengths of lanugal pups and fully moulted pups in June were lower than predicted using growth equations. This may have resulted from later birth dates or shortened lactation and consequent slower growth, but the causes are not defined.

**Introduction**

Land-anchored ice, such as that which is found along island-fringed, fiord-indented Arctic coastlines, provides an ideal breeding habitat for the ringed seal, *Phoca hispida* (McLaren 1958). Ringed seal pups are the smallest neonates of any polar seal species. They depend on subnivean lairs in the stable land-fast ice (Smith and Stirling 1975) for thermal protection and shelter against predators (Smith et al. 1991). Little is yet known of their use of the vast areas of Arctic pack ice although some evidence points to some ringed seal breeding in these areas (Finley et al. 1983; Lunn et al. 1997; Wiig et al. 1999).

Because they have the longest lactation, in the order of 36–41 days (Hammill et al. 1991), and the slowest growth of pagophilic pinnipeds (Lydersen 1998), ringed seal pups would appear to be vulnerable if circumstances obliged them to abandon their stable ice platform prior to the end of the normal nursing period. Since pups attain 93% of their 1st year growth during the suckling period (Smith 1987), reduction of maternal care might compromise growth and, in extreme cases, result in wasting, stunting and even increased mortality. Indeed, it is widely held among Inuit hunters that there are two ecotypes of ringed seals: small animals born in the off-shore (i.e., Wiig et al. 1999) and nurtured in unstable ice, and larger seals born in stable land-fast ice (McLaren 1958). Inuit hunters also note the occurrence of starveling or wasted seals, which they term *sirkolik*, referring to the prominence of the hip bones (*sirkok*) in emaciated animals (McLaren 1958).

Here we document the early break-up of the land-fast ice breeding habitat of ringed seals in a portion of western Prince Albert Sound, Victoria Island, Northwest Territories (NT), Canada in 1998. The subsequent scientific examination of the Inuit-harvested pups born in the area sheds some light on the possible impact of such an event on the birthing season, growth, and condition of pups.

**Materials and methods**

The Inuvialuit of Holman hunt ringed seals in the Prince Albert Sound area to the east of their community (Fig. 1). The sound is 225 km long and 50 km wide at its seaward (western) end, which borders on Amundsen Gulf. Land-fast ice normally forms over the

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sound between mid-October and early November. The average date of ice clearing in western Prince Albert Sound was 29 July for 1970–1978, and 23 July for 1990–1998 (Harwood et al. 2000). This large area of stable land-fast ice is prime ringed seal breeding habitat, containing higher densities of birth lairs than any other area in the Amundsen Gulf or southeastern Beaufort Sea (Stirling et al. 1977; Kingsley 1984; Smith 1987).

A total of 511 ringed seal pups were in our database, 347 from a reanalysis of a previous data set (1971–1978, Smith 1987), and 164 from recent sampling (1992–1998) by Inuvialuit monitors (Harwood et al. 2000). All seal pups were harvested from northwestern Prince Albert Sound, NT (Fig. 1), mostly during the months of June (31.9%) and July (53.6%).

Field and laboratory procedures are described in Smith (1987). The standard length of each pup was measured using a steel tape measure to the nearest ±1.25 cm (American Society of Mammalogists 1967), and body weight measured to the nearest 0.5 kg using a spring dial scale suspended from a tripod. No corrections were made for blood loss. Lower jaws were collected and canine teeth extracted for age determination, by reading dentinal annuli of cross sections of a lower canine under transmitted light (Smith 1973).

Records were kept of any wounds and notes made on the presence or absence of lanugal hair and general body condition. Pups sampled in 1998 were noted in the field to be, firstly, either fully moulted, or lanugal if any remaining white natal hair was observed and, secondly, subjectively categorized as starving when protruding hip bones were observed and blubber thickness was < 1 cm. In 1998, the stomach contents of 31 seal pups and 14 older seals were examined in the field.

All statistical analyses were conducted according to Sokal and Rohlf (1981), using SAS 6.11. Body condition based on the body-mass index (BMI) was calculated using the same procedures as outlined in Hammill et al. (1995). A body-mass index formula was developed for our pooled sample of pups and subadults (ages 1–6 years) for the years 1992–1998 (n = 306; Harwood et al. 2000), where BMI = weight (kg) × 10,000/standard length (cm)².

Using an F-test to examine homogeneity of variances, followed by the appropriate t-test to compare the mean BMI values, the condition of lanugal pups in June 1998 was compared to that of moulted pups in June 1998.

The mean BMI of moulted pups during June 1998 was compared to the mean BMI of moulted pups from June 1971, 1972, 1976–1978, and 1993–1997 (pooled), using a t-test. The same comparison was repeated for moulted pups sampled during the month of July.

We also examined the prevalence of stunting in pups. This phenomenon was noticed previously in seals from this area by