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A comparison of ringed seal (*Phoca hispida*) biology on the east and west sides of the North Water Polynya, Baffin Bay

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Abstract

In conjunction with the International North Water Polynya Study (NOW) in northern Baffin Bay, we compared aspects of the biology of ringed seals (*Phoca hispida*) on the west (Grise Fiord, Nunavut) and east (Qaanaaq, Greenland) sides of the polynya. From May to July 1998, Inuit hunters collected 99 ringed seals near Grise Fiord, and 100 ringed seals were collected near Qaanaaq. Adult ringed seals from Qaanaaq were significantly shorter ($P=0.007$) and weighed less ($P=0.0005$) than those from Grise Fiord, but did not differ in axillary girth. Female ringed seals from Grise Fiord had significantly greater blubber thickness than seals from Qaanaaq ($P=0.04$). The ovulation rates for adult female ringed seals were 100% at Grise Fiord and 93% at Qaanaaq. Evidence of pregnancy in the previous year was found in 80% of females from Grise Fiord and in 77% of females from Qaanaaq. The average age of sexual maturity of females at Qaanaaq was earlier than in areas of the Canadian Arctic. Differences in the biology of ringed seals on the west and east sides of the North Water Polynya could reflect variations in biological productivity within the polynya.

Key words: Polynya, ringed seal, *Phoca hispida*, ovulation rate, sexual maturity, biological productivity.

Introduction

The North Water Polynya in northern Baffin Bay is one of the most biologically productive polynyas in the Arctic and an important spring feeding and breeding area for the ringed seal (*Phoca hispida*) (Stirling, 1980, 1997; Stirling *et al*., 1981). Ringed seals are opportunistic feeders (McLaren, 1958*a*; Johnson *et al*., 1966; Lowry *et al*., 1978; Weslawski *et al*., 1994), and their reproductive success and growth can be significantly influenced by changes in biological productivity and food abundance (Lowry *et al*., 1980). For example, studies in the Beaufort Sea and Amundsen Gulf have shown that reproductive rates sometimes vary markedly in response to differences in ecological circumstances that apparently affect productivity (e.g., Stirling *et al*., 1977; Smith, 1987; Stirling & Øritsland, 1995; Stirling & Lunn, 1997; Kingsley & Byers, 1998).

In 1998, the International North Water Polynya Study (NOW) was undertaken to examine the physical and biological mechanisms occurring within the polynya. Several studies have speculated that the North Water Polynya could be maintained by sensible heat on the east side and latent heat on the west side (e.g., Steffen, 1985; Steffen & Ohmura, 1985; Mysak & Huang, 1992; Darby *et al*., 1994; Lewis *et al*., 1996), which in turn could stimulate differences in the timing and development of phytoplankton blooms and food webs within the polynya. One of the central hypotheses of the NOW posited that the east side of the polynya was more biologically productive than the west side. If differences in the level of biological productivity exist within the polynya, they could affect the biology of the ringed seal.

The purpose of this study was to compare aspects of the biology of ringed seals from the east and west sides of the polynya, including age distribution, growth rate, sexual maturity, condition, ovulation rate, and pregnancy rate, to examine whether any significant differences exist that might relate to the hypothesized differences in productivity.

Materials and Methods

Comparisons of ringed seal populations were based on samples collected on the west side of the North Water Polynya near Grise Fiord, Nunavut (76°12′N, 83°06′W) and on the east side near Qaanaaq, Greenland (77°40′N, 69°00′W) (Fig.1). From 27 May to 28 June 1998, 99 ringed seals were

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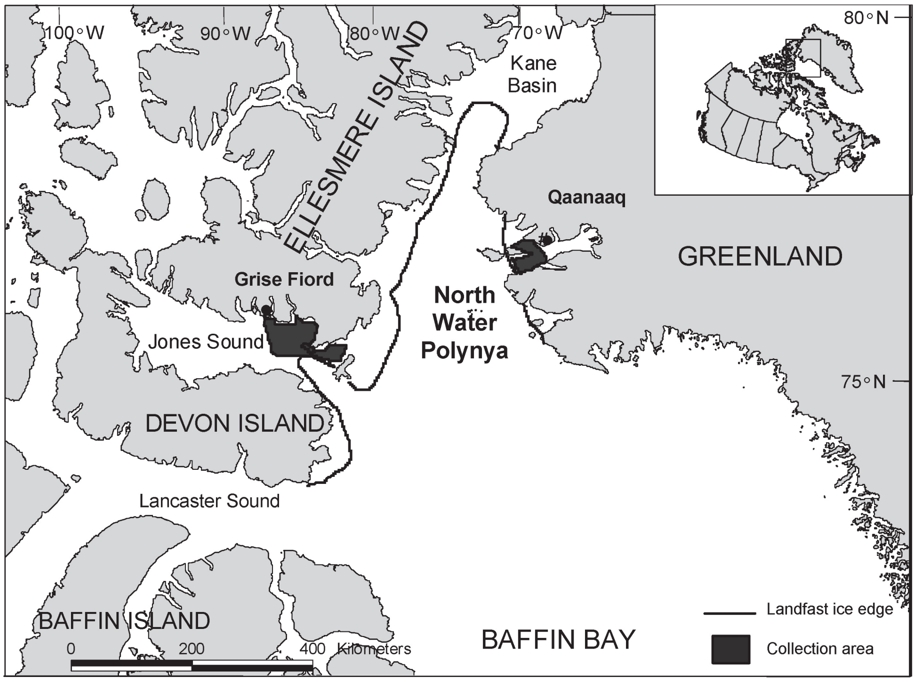

Figure 1. Map of the study area and ringed seal collection sites in 1998, adjacent to the North Water Polynya.

taken by Inuit hunters near Grise Fiord, of which 95% were collected on landfast ice. Between 8 May and 11 July 1998, another 100 ringed seals were collected near Qaanaaq, of which 89% were collected on landfast ice and 11% were collected in the water at the ice edge. Hunters were asked to collect seals non-selectively with respect to sex or age class, so that the samples would be representative of the seals available at the time. Samples collected from each seal included the lower jaw and reproductive tract. All samples were frozen in the field.

Measurements for seals collected in Grise Fiord followed Scheffer (1967) and Bonner and Laws (1993) and included: standard length, axillary girth, and fat thickness (on the ventral mid-line between the front flippers). Seals were not weighed in the field, instead weights for specimens from Grise Fiord were calculated following methods by McLaren (1958*b*):

$$\log(\text{weight}) = 3.005 \log(\text{length}) - 2.9882,$$

where weight is in pounds and length is in inches.

For seals collected in Qaanaaq, axillary girth, fat thickness, and scale weight were recorded. Due to different measurement techniques employed by collectors in Qaanaaq, seal length was measured from the nose to the base of the tail (instead of to the tip of the tail—as measured for standard length), and had to be corrected by adding tail lengths. Tail lengths for each specimen were determined by fitting a linear regression to tail length *vs.* nose to base of tail length data from 24 ringed seals taken near southwest Baffin Island as well as the Belcher Islands (McLaren, unpublished data). The equation used was:

$$\text{tail length (cm)} = 0.0276\text{x} + 5.0378;\ R^2 = 0.33,$$

where x is the length from nose to base of tail in cm.

Mean lengths, girths, and weights were calculated for adults ($\geq$6 years) only. Mean blubber thickness was used as an index of condition and was calculated only for animals collected in June, when animals were collected from both sides of the polynya. The condition of pups was assessed separately, since their mean condition at that time was probably still reflective of the condition of their mothers. Morphometric measurements were compared using Student's *t*-tests.

To compare growth rates of seals on either side of the polynya, von Bertalanffy growth curves, as parameterized by Hammill *et al.* (1995), were fitted to length *vs.* age data using the non-linear regression program of SigmaPlot (Ver. 4.0). Likelihood ratio tests were used to test for statistical differences between growth curves and curve parameters (Kimura, 1980). Homogeneity of

Table 1. Comparison between ringed seal populations on the east and west sides of the North Water Polynya (means ± standard deviation; numbers in brackets are sample sizes; M=males, F=females; adults are ≥6 years old).

Comparison	Grise Fiord	Qaanaaq	Significance*
Sex ratio	43M:56F	55M:45F	No
Age of adults (yrs)			
Males	19.4 ± 9.4 (27)	15.5 ± 10.3 (22)	No
Females	27.1 ± 8.3 (31)	21.4 ± 11.8 (14)	No
Length of adults (cm)			Yes
Males	136.3 ± 14.3 (25)	129.3 ± 15.6 (22)	
Females	136.0 ± 13.5 (29)	125.6 ± 11.4 (14)	
Girth of adults (cm)			No
Males	107.0 ± 13.9 (25)	102.5 ± 12.7 (21)	
Females	101.9 ± 17.2 (29)	99.2 ± 13.7 (13)	
Weight of adults (kg)			Yes
Males	75.8 ± 24.5 (25)	62.7 ± 11.3 (22)	
Females	75.2 ± 22.3 (29)	56.3 ± 12.7 (14)	
Blubber thickness (cm fat)			
YOY	4.4 ± 1.1 (30)	2.4 ± 1.5 (7)	Yes
Males ≥1 year old	4.3 ± 1.2 (24)	4.2 ± 0.7 (17)	No
Females ≥1 year old	3.7 ± 1.2 (34)	4.4 ± 1.2 (16)	Yes
Age of sexual maturity (yrs)	N/A	4.70	
Ovulation rate	100% (25)	93% (14)	No
Pregnancy rate	80% (25)	77% (13)	No

*Significance of test for Grise Fiord *vs.* Qaanaaq; $P<0.05$ was considered significant.

variances, an assumption under the Likelihood ratio method (Kimura, 1980), was evaluated using an *F*-test (Sokal & Rohlf, 1981).

Seal ages were determined using cementum growth layer groups in canine teeth from the lower jaw (Stewart *et al.*, 1996). Seals less than one year of age are referred to as 0+ or young-of-the-year (YOY), seals 1 through 5 years of age as subadults, and those 6 years and older as adults because, on average, that is the age at which females in most populations reach sexual maturity (e.g., McLaren, 1958*a*; Smith, 1973, 1987). Since sample sizes were not large enough to compare sex-specific age structure for each individual age class, they were pooled as described by Holst *et al.* (1999), to facilitate statistical comparisons by age structure: 0+, 1–2, 3–5, 6–10, 11–15, 16–20, 21–25, 26–30, 31–35, 36–40, and 41+ years of age. Age distributions were tested using a Likelihood chi-square test. Ages of males and females at the two locations were compared with Mann-Whitney *U*-tests, and sex ratios were tested using Pearson's chi-square test.

Ovaries were sectioned at 2-mm intervals and were examined macroscopically for the presence of corpora lutea (indicative of ovulation in the current year) and corpora albicantia (indicative of pregnancy in the previous year) (McLaren, 1958*a*). The proportion of females that had a corpus luteum or a corpus albicans was used to calculate age-specific ovulation rates and the average age of sexual maturity for females (DeMaster, 1978).

Results

Sex ratio

Although there were slightly more males than females in the sample of ringed seals from Qaanaaq and slightly more females than males in the sample from Grise Fiord, the difference was not statistically significant in either case (Table 1). Ringed seals from Grise Fiord and Qaanaaq conformed to a 1:1 sex ratio (Grise Fiord: $\chi^2=1.71$, df=1, $P=0.19$; Qaanaaq: $\chi^2=1.00$, df=1, $P=0.32$).

Age distribution

The age distributions for males and females (Fig. 2) differed significantly between the two locations (males: $\chi^2=22.55$, df=10, $P=0.01$; females: $\chi^2=46.63$, df=10, $P < 0.0001$). In the Grise Fiord sample, 32% were YOY and 9% were subadults, whereas the proportion of YOY in the Qaanaaq sample was 7% and 56% were subadults. There was a greater proportion (18%) of older seals

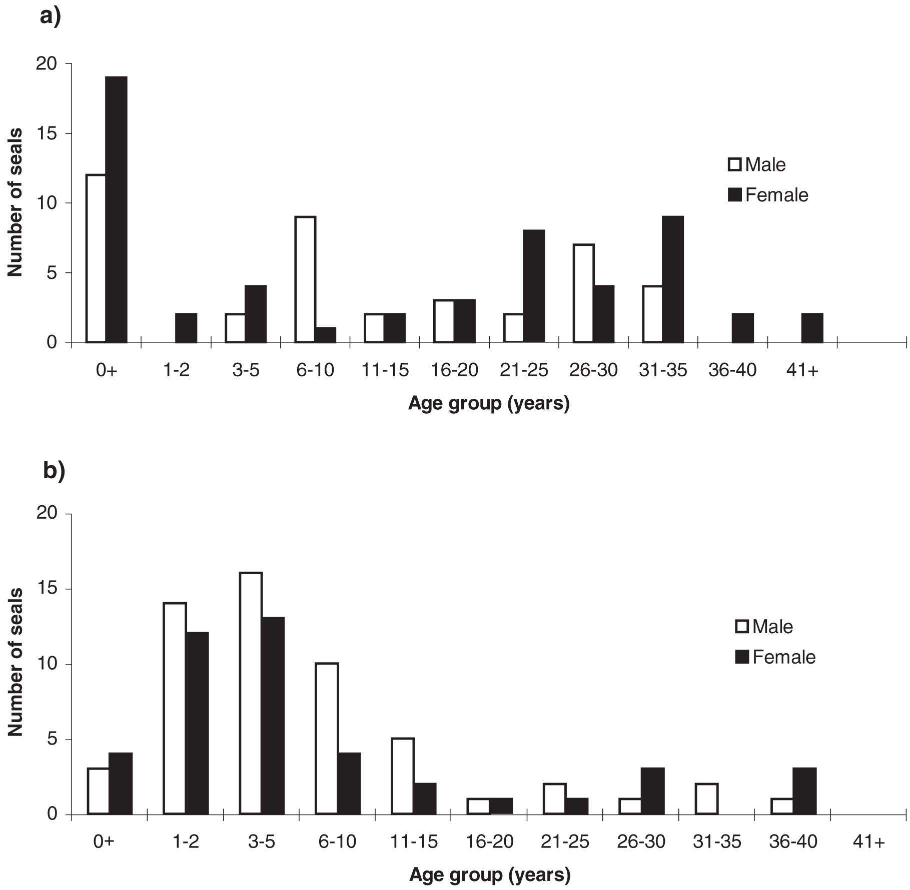

Figure 2. Age distributions of (a) male (n=41) and female (n=56) ringed seals collected in Grise Fiord and (b) male (n=55) and female (n=43) ringed seals collected in Qaanaaq during May–July, 1998.

($\geq$31 years) in the Grise Fiord sample than in the Qaanaaq sample (6%).

On average, adult females collected near Grise Fiord were significantly older than adult males (P=0.005; Table 1). Adult females collected near Qaanaaq also were on average older than adult males, but the difference was not statistically significant (P=0.14). The mean ages of adults of the same sex were not significantly different between the two locations (P=0.14). The maximum ages for males and females collected near Grise Fiord were 34 and 43, respectively, and for Qaanaaq, the maximum ages were 40 and 38 years, respectively.

Morphometrics

Adult male and female ringed seals did not differ significantly in mean length or axillary girth at either Grise Fiord or Qaanaaq (Table 1), so the data were pooled for each location. Seals from Grise Fiord were significantly longer compared with those from Qaanaaq (t=2.77, df=88, P=0.007). Although the axillary girths of seals collected in Grise Fiord were slightly greater, there were no significant differences between the mean girths of seals collected in Qaanaaq and those collected in Grise Fiord (t=0.93, df=86, P=0.36).

The von Bertalanffy growth curves differed significantly between ringed seals from the two sides of the polynya (Fig. 3). Ringed seals from Qaanaaq had a significantly higher growth rate (P=0.006) than seals from Grise Fiord (Table 2). However, seals from Grise Fiord were significantly longer at birth (P=0.007) and reached a significantly greater asymptotic length (P=0.002) than seals from Qaanaaq (Table 2).

Body condition

The mean weights of adult males and females did not differ significantly at either location (Table 1),

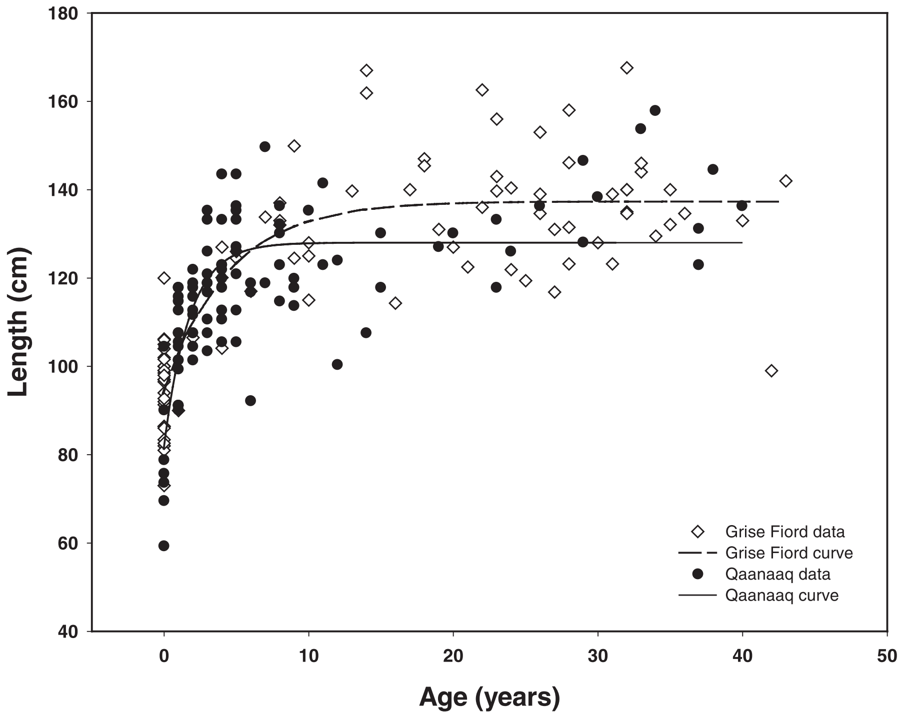

Figure 3. Von Bertalanffy growth curves for ringed seals collected near Grise Fiord and Qaanaaq.

Table 2. Parameter estimates (± SE) and R^2 values for the von Bertalanffy growth curves for ringed seals collected around Qaanaaq and Grise Fiord; L_∞=asymptotic length (cm), k_o=absolute growth rate at birth (cm/year), and l_o=length at birth (cm).

Sample	Sample size	L_∞	k_o	l_o	R^2
Grise Fiord	89	137.50 ± 1.99	9.60 ± 2.43	94.53 ± 2.28	0.72
Qaanaaq	98	128.22 ± 1.95	26.73 ± 6.09	81.50 ± 4.13	0.58

thus the data were pooled. The mean calculated weight of adult seals from Grise Fiord was significantly higher than the mean scaled weight of adults from Qaanaaq (t-test=3.64, df=88, P=0.0005).

There were no significant differences in the mean blubber thickness between males and females ≥1 year old from the same location (Table 1). The mean blubber thickness of males ≥1 year did not differ between the two locations (t=0.33, df=39, P=0.74). The mean blubber thickness of females ≥1 year old from Grise Fiord was significantly lower than from Qaanaaq (t=2.14, df=48, P=0.04). YOY from Grise Fiord had a greater mean blubber thickness than those from Qaanaaq (t=4.03, df=35, P=0.0003; Table 1).

Reproduction

The average age of sexual maturity for female ringed seals from Grise Fiord could not be determined, since no females 5–8 years old were sampled. Ovulation had not taken place in the only 4-year-old female but had occurred in the single 9-year-old. All females ≥9 years old had ovulated, and a corpus albicans was found in the ovaries of 80% of them (Table 1). The average age of sexual maturity for female ringed seals from Qaanaaq was 4.7 years. Ovulation (Table 1) had occurred in 29% of 4-year-old females, all of the 5-year-olds, and 93% of females ≥6 years old. A corpus albicans was found in the ovaries of 77% females ≥6 years old.

Discussion

The sex ratios of ringed seals from Grise Fiord and Qaanaaq did not differ from unity, as is characteristic of ringed seal populations throughout the Canadian Arctic (Smith, 1973, 1987; Holst *et al.*, 1999), as well as other locations (Helle, 1974; Fedoseev, 1965; Lydersen & Gjertz, 1987).

The mean age of adult female ringed seals collected near Grise Fiord was significantly older than for adult males, as has also been found in studies of ringed seals from other areas (Helle, 1974, 1979; Lydersen & Gjertz, 1987). Ringed seals are slightly polygynous (Stirling, 1983), and male seals maintain and defend underwater territories around breathing holes (Stirling, 1973, 1977). Thus, males might be expected to have shorter longevity than females.

A low proportion of YOY in the samples of ringed seals from Qaanaaq and Grise Fiord was expected, since YOY are generally less available for sampling during late spring. Some pups use subnivean lairs until about mid May, where they are less visible and thus less vulnerable to hunters. After that time, most pups are weaned and molted, and spend more time in the water feeding (Smith, 1973). Thus, the low proportion of YOY in the spring sample from Qaanaaq is consistent with results obtained in other studies (e.g., Smith, 1973; Lydersen & Gjertz, 1987).

However, the proportion of YOY in the Grise Fiord sample was higher than expected. This discrepancy could be at least partially explained by differences in the landfast ice habitat, where most of the sampling took place in each area. At Qaanaaq, seals were taken mainly in the breeding habitat in the landfast ice, although some were taken further out toward the unstable floe edge, where pupping is expected to occur less frequently. In comparison, at Grise Fiord, seals were taken further from the floe edge in Jones Sound and more in fiords on southern Ellesmere Island, where pupping was likely more prevalent, thus making pups more vulnerable to sampling.

The Grise Fiord sample had a significantly lower proportion (9%) of subadults than did the sample from Qaanaaq, which is typical for spring samples taken on landfast ice (e.g., McLaren, 1958*a*; Smith, 1973, 1987; Smith & Stirling, 1975). Undersampling of subadults in Grise Fiord could have occurred because during spring, subadults tend to be excluded from the breeding areas in landfast ice to unstable moving ice areas further offshore where they are encountered less frequently by hunters (McLaren, 1958*a*; Smith, 1973, 1987; Smith & Stirling, 1975). As with the difference in proportions of pups in the samples from the two areas, the difference in the proportions of subadults is also likely related to relatively small, but important differences in the habitat in which the two samples were taken. There are likely to be fewer subadults present in habitat sampled farther from the floe edge, such as near Grise Fiord, than in habitats that are sampled closer to the floe edge, as near Qaanaaq.

Adult male and female ringed seals collected at Grise Fiord and Qaanaaq were similar in length and weight. Smith (1973) reported that in Davis Strait, males were significantly larger than females, and Goodyear (1999) showed that males from Baffin Bay reached a greater asymptotic length than females. At Point Hope, Alaska, Johnson *et al.* (1966) found that males were heavier than females from November to May, but females were heavier than males in June. In Svalbard, females collected between March and July were significantly heavier than males (Lydersen & Gjertz, 1987). Females could be heavier than males during the spring because of different behaviour associated with mating and pupping (Lydersen & Gjertz, 1987).

Ringed seals show considerable variation in adult length among populations throughout their circumpolar range (e.g., McLaren, 1958*a*, 1993; Fedoseev, 1965; Fedoseev & Nazerenko, 1970; Smith, 1973, 1987; Helle, 1979; Finley *et al.*, 1983; Frost & Lowry, 1981; Lydersen & Gjertz, 1987; Goodyear, 1999). Ringed seals from Grise Fiord were similar in size to other seal populations from the Canadian northeastern Arctic (McLaren, 1958*a*, 1993; Finley *et al.*, 1983; Goodyear, 1999). However, adult ringed seals from Qaanaaq were shorter than those from Grise Fiord, but were comparable in size to those from Svalbard (Lydersen & Gjertz, 1987), the Beaufort Sea and Amundsen Gulf (Smith, 1987), southeastern Baffin Bay (McLaren, 1958*a*, 1993; Smith, 1973; Goodyear, 1999), and the pack ice of Baffin Bay (Finley *et al.*, 1983). Correspondingly, the growth curves suggested that pups sampled at Qaanaaq were smaller than those at Grise Fiord.

The growth curve parameters may have been influenced by the age composition of the samples. For example, the lack of newborn pups and preponderance of weaned pups in the sample are responsible for the parameter l_o (length at birth) being more representative of length of weaned rather than newborn pups. However, asymptotic length tends to be estimated more robustly (McLaren 1993).

Differences in size among populations of ringed seals may be due to several factors, including genetic variation, stability of breeding habitat, density-dependent effects resulting from differential levels of harvesting, and differences in food availability. Finley *et al.* (1983) speculated that differences in size between landfast ice and pack ice seals could be due to genetic differences, but demonstrated none. Preliminary analyses of samples collected during this study indicate that ringed seals from Qaanaaq and Grise Fiord are genetically similar (Davis *et al*., 1999), suggesting that at least some interbreeding occurs between ringed seals from either side of the polynya. Therefore, any existing differences in size are likely the result of environmental factors.

McLaren (1958*a*) and Pastukhov (1969) suggested that differences in adult ringed seal sizes occur because of variation in the stability of ice conditions in the pupping habitat, i.e., pups born in more stable ice areas were likely to be nursed longer than those in less stable habitat and thus would be larger at weaning. In general, coastal areas are more stable than drifting pack ice and thus are thought to be better habitat for pupping (McLaren, 1958*a*). Finley *et al*. (1983) and Fedoseev (1975) found seals from drift or pack ice to be smaller than seals from coastal landfast ice, and Smith (1973) concluded that differences in size between adult seals from southeastern Baffin Island were due to differences in ice stability. Ice conditions could partially explain size differences between ringed seals from the east and the west sides of the polynya. Although ringed seals collected in both Qaanaaq and Grise Fiord were harvested in generally similar landfast ice areas, the landfast ice break-up in the Qaanaaq collection area occurred on approximately 26 May 1998, whereas break-up in the Grise Fiord collection area occurred around 4 June 1998. Therefore, if early break-up in the Qaanaaq area led to a shorter suckling period, then pups would have been weaned earlier in that area. However, it remains uncertain whether ice conditions would cause the significant difference in seal size observed, or whether other factors also affected seal growth in the area.

Goodyear (1999) speculated that variation in stability of sea ice pupping habitat did not adequately explain differences in seal lengths for populations in the northeastern Canadian Arctic. He proposed that predation pressure from polar bears (*Ursus maritimus*) and Inuit hunters, and availability of food resources, have a greater effect on the growth of ringed seals than ice conditions. Although it is possible that human hunting pressure may be higher in the Qaanaaq area than in Grise Fiord (e.g., Teilmann & Kapel, 1998; Finley & Miller, 1980; Stewart *et. al.*, 1986), that of polar bears may be lower, possibly cancelling each other out (e.g., Stirling & Øritsland, 1995; Taylor *et al*., 2001). Regardless, it is unlikely that human or bear predation explain the observed differences. Consequently, other factors such as food availability and the quality of the prey are more likely to determine growth in these populations. For marine mammals in general, nutrition is thought to be the most important factor affecting the shape of growth curves, with better nutrition leading to more rapid growth rates (Laws, 1956*b*).

In accordance with the NOW hypothesis, if biological productivity is higher on the east side of the polynya, food biomass and availability could be greater on that side. Lewis *et al*. (1996) demonstrated an increase in phytoplankton biomass on the east side of the North Water Polynya in May. An early bloom on the east side could lead to greater food availability early in the spring and an increase in fish biomass. Consequently, ringed seals sampled near Qaanaaq could have access to a more abundant food supply and have faster early growth rates. Faster growth rates also could be due to increased consumption of prey with higher energy content, such as Arctic cod (*Boreogadus saida*) (e.g., Bradstreet & Finley, 1983). Differences in the diet of ringed seals on either side of the polynya have already been demonstrated. Ringed seals near Qaanaaq had a greater proportion of Arctic cod in their diet compared to seals near Grise Fiord (Holst *et al*., 2001).

Ringed seals from Svalbard, a highly productive area, also have high growth rates (Lydersen & Gjertz, 1987), as do seals from Arctic Bay, although data on primary productivity are not available for that area (Goodyear, 1999). However, even though ringed seal populations from Svalbard, Arctic Bay, and Qaanaaq had higher growth rates for young seals than those from other areas, they did not attain higher asymptotic lengths when compared to slower growing populations (see review by McLaren, 1993). It is not apparent why ringed seal populations with high growth rates do not reach greater asymptotic lengths.

Age of sexual maturity varies among and within species of pinnipeds. Factors proposed to affect the onset of sexual maturity are density-dependence and overall ecosystem productivity. Age of sexual maturity of seals has been linked to a density-dependent response, decreasing during periods of low population size (e.g., Laws, 1953, 1956*a*; Carrick *et al*., 1962; Capstick & Ronald, 1982; Sjare *et al*., 1996). In female ringed seals of different geographic regions, the average age of sexual maturity varies greatly (Table 3), ranging from 4.4 years in Svalbard (Lydersen & Gjertz,1987) to 7.0 years in Cumberland Sound, Baffin Bay (Smith, 1973). Growth rates and sizes of seals from Grise Fiord are similar to those from surrounding areas in the Canadian northeastern Arctic (McLaren, 1958*a*, 1993), suggesting that average age of sexual maturity is likely similar as well. The relatively higher early growth rates for ringed seals from Qaanaaq are consistent with achieving sexual maturity at an earlier age than those from Grise Fiord, as would be predicted by Laws (1956*b*). Ringed seals from Qaanaaq reached sexual maturity earlier than those from other areas in the Arctic, except for Svalbard (Lydersen & Gjertz,

Table 3. Age-specific ovulation rates of female ringed seals from selected areas of the Arctic and average age of sexual maturity.

Location	% Ovulation in age class								Average age of sexual maturity	Data source
	3	4	5	6	7	8	9	10		
Northwestern Hudson Bay	17	29	33	57	100	100	100	100	5.6	Holst *et al.*, 1999
Foxe Basin, Hudson Strait	0	12	22	78	100	100	100	100	5.9	McLaren, 1958
Cumberland Sound, Baffin Bay		13	20	12	58	92	100	100	7.1	Smith, 1973
Hoare Bay, Davis Strait		40	33	80	100	75	100	100	5.7	Smith, 1973
Ellesmere Island and Northwest Baffin Island		22	53	72	81	98			ca. 5.7	Miller & Finley, 1982
Grise Fiord, Southern Ellesmere Island	0	0					100			This study
Qaanaaq, Northwestern Greenland	0	29	100	100	100	100	100		4.7	This study
Point Hope, Alaska	0	8	60	55	93	100	100	100	5.8	Johnson *et al.*, 1966
Amundsen Gulf and Southeastern Beaufort Sea	0	25	53	61	100	100	100	100	5.6	Smith, 1987
Svalbard	20	60	80	100	100	100	100	100	4.4	Lydersen & Gjertz, 1987

1987). It is unlikely that density-dependent factors reduced the age of sexual maturity at Qaanaaq, since ringed seals are thought to be numerous in that area and hunting pressures are low.

Laws (1956*b*) suggested that nutrition was likely the most important factor that caused early sexual maturation, by increasing growth rates, whereas a decrease in food availability would lead to delayed sexual maturation (Eberhardt, 1977). Lydersen & Gjertz (1987) suggested that early sexual maturation of ringed seals in Svalbard could be explained by the abundance of food in that area. Thus, in Qaanaaq, the hypothesized increase in food availability on the east side of the polynya could explain early sexual maturation in ringed seals.

The mean weights for seals collected in Grise Fiord were similar to those of ringed seals collected at a similar time of year near Pond Inlet, northern Baffin Island (Finley *et al.*, 1983) and those of Qaanaaq are comparable to mean weights of seals sampled at Svalbard (Lydersen & Gjertz, 1987). The mean blubber thicknesses of ringed seals collected near both Grise Fiord and Qaanaaq were similar to the blubber thickness of seals collected in the same season in the Barents Sea (Wathne, 1997) and southeastern Baffin Island (Goodyear, 1999).

The reproductive status of female ringed seals has been shown to be affected by their condition, with a decrease in reproductive rates when body condition is low (e.g., Smith, 1987; Kingsley & Byers, 1998). Even though adult females from Grise Fiord had less blubber than those from Qaanaaq, females from both locations were likely in good condition, since both had high ovulation and pregnancy rates. The mean condition of YOY from Grise Fiord was higher than that for YOY collected in Qaanaaq, which is consistent with the larger size of the adult females from Grise Fiord. YOY sampled in Qaanaaq could have had less blubber (or been in poorer condition) than pups in Grise Fiord, if they were indeed weaned earlier, and had been foraging independently for some time.

Conclusions

The major differences between ringed seals inhabiting the east and west sides of the North Water Polynya were in growth rates, average age of sexual maturity, and total body lengths. Seals on the east side of the polynya had faster early growth rates and appeared to attain sexual maturity earlier, but had shorter adult lengths than seals on the west side of the polynya. Ice stability and food availability likely had the greatest effect on growth rates.

Ringed seals on both sides of the polynya appeared to be in similar body condition and had high ovulation and pregnancy rates. Since polynyas are considered to be more productive than surrounding non-polynya areas, an increase in biological productivity within the polynya would likely have a limited effect on the biology of ringed seals on either the east or west sides of the North Water Polynya, since an adequate food supply is most likely available throughout the entire area.

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