# Svalbard's ringed seal harvest

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SVALBARDS MILJØVERNFOND

# End Report for Svalbardmiljøvernfond Project no 11/76 - Svalbard's ringed seal harvest

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## Project rationale

Ringed seals have evolved in close association with arctic sea ice and depend on it for virtually all aspects of their life history. This high arctic endemic seal begins its life on land-fast sea ice in fjords and along coastlines in arctic waters including those in Svalbard. Some birthing also takes place in areas of drifting sea ice in some parts of the Arctic including the Barents Sea, though land-fast ice appears to be a strongly favoured habitat. Ringed seal pups are born in snow caves (birth lairs) that are dug out of snow drifts on the sea ice above a breathing hole. The birth lair is essential for the survival of pups, which weight only ca. 4 kg when they are born; it provides thermal protection and also some protection against polar bears, arctic foxes and other predators. Each mother has a series of lairs and if the lair where her pup is resting is attacked, she will move it to another location. If there is not sufficient ice with enough snow cover by late winter to build such a series of shelters, pup mortality levels are very high in this species. Ice stability is also important because ringed seals have the longest nursing period of any of the northern true seals (members of the family Phocidae) and need stable ice throughout the period of maternal care, which lasts about six weeks. Warm spring temperatures or rain during the nursing period can result in lair collapse and hence reproductive failure. Loss of lairs impacts all age classes and both sexes because all ringed seals use lairs to avoid harsh weather conditions and predators, although pups are certainly the most vulnerable age class. Ringed seals also use sea ice as a platform for their annual moult in late spring, when they replace their hair coat (and upper skin layers). Moulting in the water is energetically costly and is much more stressful for the animals than when it occurs on sea ice where they can sun bathe and circulate the blood to the skin in the air (without the high heat loss that would occur in water). Ringed seals also depend on sea ice for resting at other times of year, close to food sources. They feed predominantly on ice-associated prey, including polar cod and large arctic zooplankton species such as *Parathemisto libellula* that are part of the sea ice ecosystem.

The ringed seal's extreme affiliation with sea ice raises serious concern for their future survival. Dramatic reductions in sea ice have already taken place in recent decades in the Arctic and these declines are predicted to continue, and in fact escalate, in the decades to come. Reductions in this unique habitat reflect a direct loss of habitat availability for ringed seals. Climate change will also pose other risks to this arctic resident via: impacts of reduced availability of their traditional lipid-rich prey species due to shifts occurring in arctic food webs; increased risk of disease; increased predation by killer whales in some regions; increased human impacts from shipping and development in the North and the potential for increased effects of pollution. Declines in pup production, body condition and ovulation rates associated with changing ice conditions have been documented for ringed seals in the Canadian Arctic, where extensive hunt monitoring is undertaken. In the United States, a status review of ringed seals has led to the listing of this species (and bearded seals) on the Endangered Species list of the US, because a significant portion of their range is expected to be lost due to the reduction in available ice habitat in the foreseeable future.

Svalbard is a "hot-spot" in the context of climate change. Sea ice has been declining markedly in the Archipelago since 2006 and temperature increases in this region in both the sea water and the air are well above the norm for the Arctic as a whole. These changes are undoubtedly impacting the ringed seal population, but we have little data regarding the effects

that these on-going changes are having on this species in this region. Ringed seals are difficult (and expensive) to survey, so it is common to resort to looking at biological parameters measured on hunted animals to determine changes in population parameters and to infer population trajectories from such data. Ringed seals are harvested by local hunters and trappers in Svalbard in addition to intermittent research collections (the last research collection was conducted a decade ago in 2002-2004).

The harvest in Svalbard is small but biological data collected from locally hunted animals, grouped into time intervals (several years together to provide sufficient sample sizes) can provide information that is valuable for management decisions and these data can also provide insight regarding whether the ringed seal population in the Archipelago is experiencing changes in vital parameters (age at maturity, pregnancy rates etc.), growth rates or body condition in relation to climate change.

The Svalbard Environmental Protection Fund provided financial support in 2012 for a pilot project to collect biological samples from sport hunters and trappers, which has supported harvest sampling (and aging) for two hunting seasons – 2012 and 2013.

## Results and discussion

Eighty sets of samples were turned in to the Norwegian Polar Institute by hunters (of 119 reported to the Governor), representing 67% of the overall ringed seal harvest in Svalbard. Hunting took place from Kongsfjorden in the north to Svea in the south (Figure 1), with most animals being taken in St Jonsfjorden and Isfjorden.

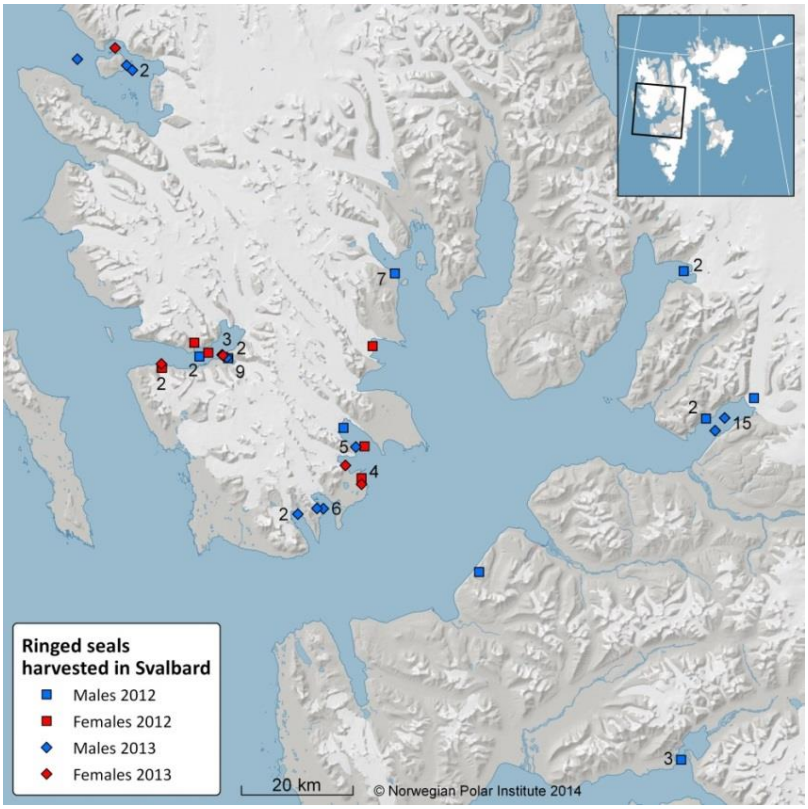


***Figure 1. Ringed seal harvest locations in 2012 and 2013.***

The number of animals reported in each of the two years was not markedly different, and each reflected the majority of the respective total harvests in the two years (2012 38/57 seals = 66.7 %; 2013 42/62 = 67.7 %). But the seasonal spread of the hunt was concentrated in the fall in 2012 and more spread in 2013, with spring and fall hunting being of similar magnitude in the latter year (Figure 2). Ice formation occurred very late in 2012 and was minimal, so there was almost no hunting conducted before the midsummer (open water) harvest season that year.

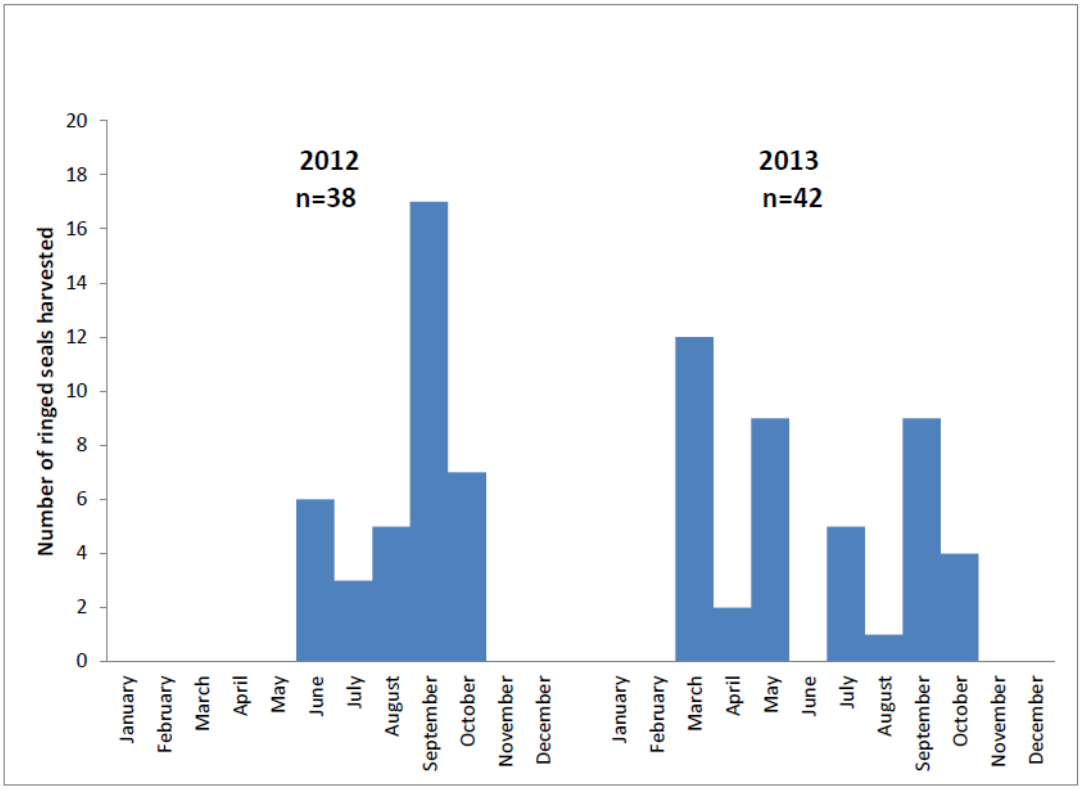


***Figure 2. Seasonal spread of ringed seal harvesting in Svalbard in 2012 and 2013.***

The youngest age class grouping was the most numerous in the harvest, which is typical for seal hunts generally (Figure 3). This is due to the fact that naïve animals are easier to shoot because they are less wary. Additionally, young animals are proportionally speaking more numerous. But despite the 0-2 age group being the most strongly represented age group in the hunt, the young age classes in the Svalbard harvest are actually markedly under-represented compared to the norm for large-scale harvests elsewhere in the Arctic (see Figure 4); both the under 2 year old animals and the 3-5 year age class. This could be a small sample size artefact with only 78 (teeth were not available for aging two of the 80 animals) aged animals spread across 12 age groupings (age range in the sample - 0-34 years). But it is also possible that the under-representation of juvenile age classes might be due to low production of pups, or low survivorship of pups in the springs from 2006 through to the present, because of the reduced spring ice cover in the west coast fjords in Svalbard resulting in smaller cohort groups (total young-of-the-year production). Although no scientific data has been collected on survivorship in this period on Svalbard, opportunistic observations during spring research activities in the polar bear and sea ice programmes suggest that very high mortalities of ringed seal pups have taken place in recent springs. The seals that have given birth have been highly concentrated in the small areas of available sea ice, and little snow cover on the ice because of its short period of existence left ringed seal pups very exposed to predators.

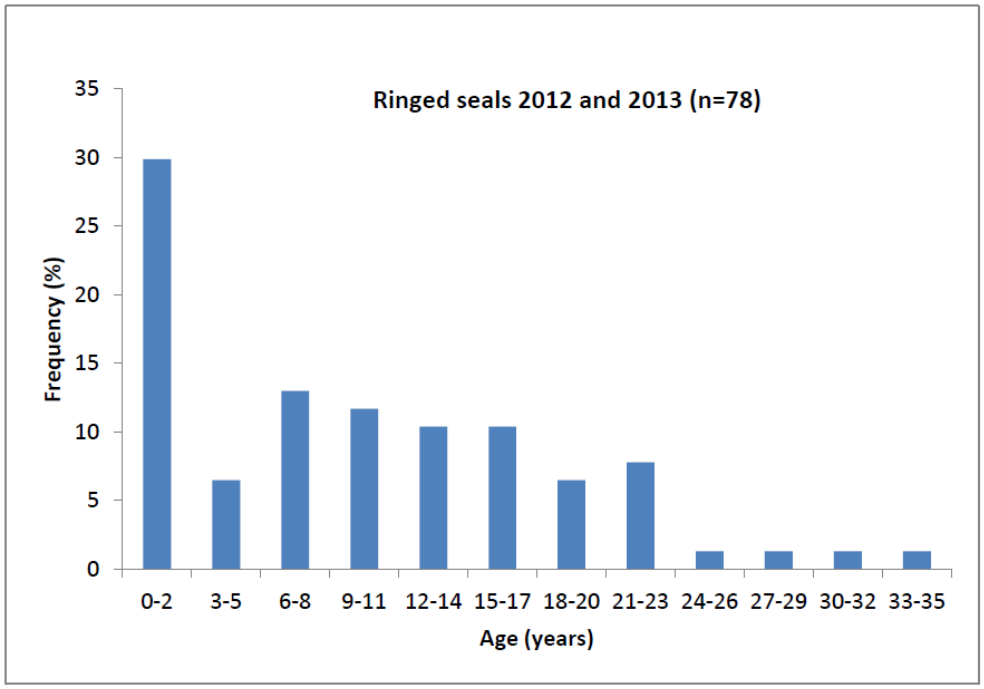


***Figure 3. Frequency of age classes (in three-year clusters) in the Svalbard ringed seal harvest in 2012 and 2013 combined (two animals were not aged of the 80 sample sets because the jaw was not returned to the harvest programme).***

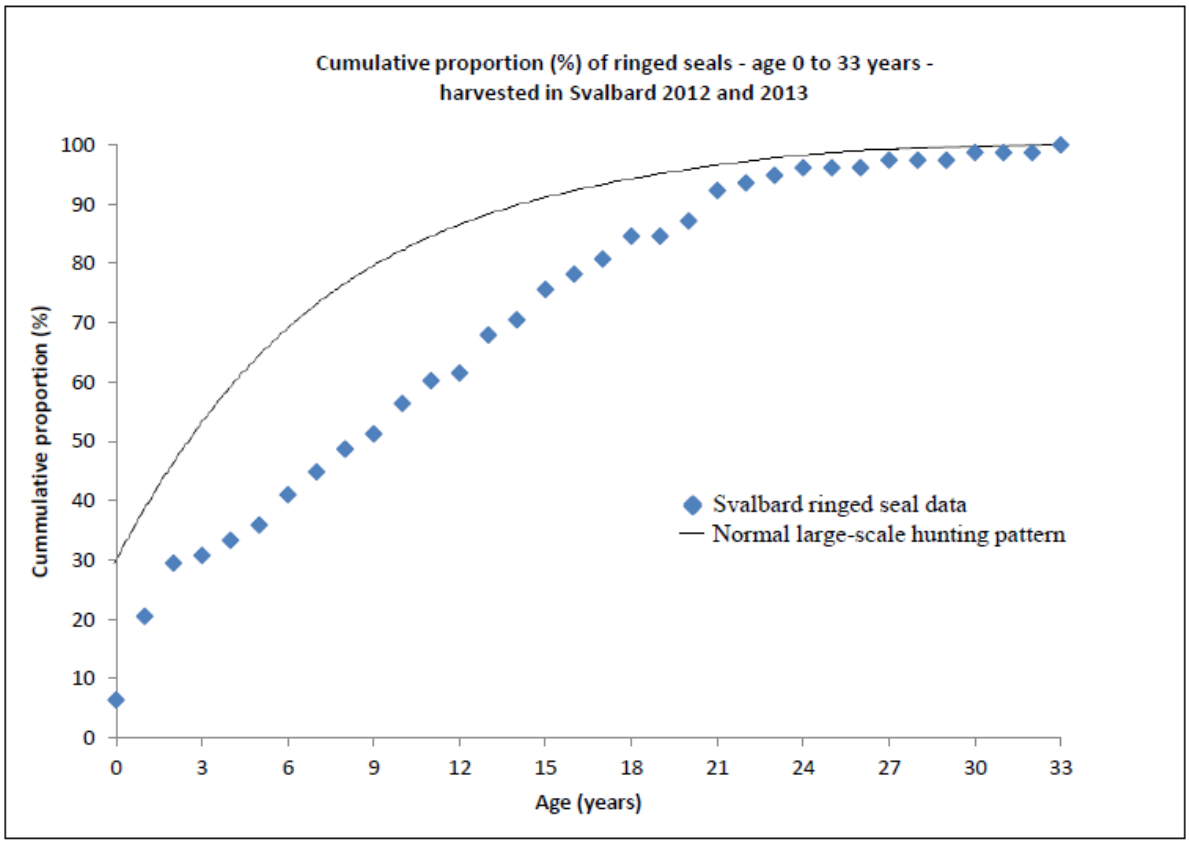


***Figure 4. Cumulative proportion of the ringed seal harvest according to age for Svalbard in comparison to the norm for large-scale harvests elsewhere in the Arctic.***

Phocid seals usually reach sexual maturity when they have grown to approximately 80% of their final body size. Thus, there is some flexibility in the age when they are first able to reproduce depending on how fast they grow, which in turn depends on food availability. Age of first maturity for ringed seals in Svalbard dropped between the 1980s and the early part of this century, reaching a minimum for this species at 3.8 years of age. This was either due to fewer seals competing for food or greater availability of prey resources for this population. Given the small hunt in Svalbard and the good ice conditions (i.e. good breeding habitat conditions) prior to the most recent scientific harvest (2002-2004), the drop in age at sexual maturity was likely due to abundant food resources. The sample size in this harvest project (2012-2013) is too small to say anything definative regarding the current age at sexual maturity based on the analysis of reproductive organs. But body size vs age in the current sample spans the earlier sampling periods in 1981-1982 and 2002-2004, suggesting that no dramatic changes are likely to have occurred in this biological parameter recently (Figure 5, Table 1).

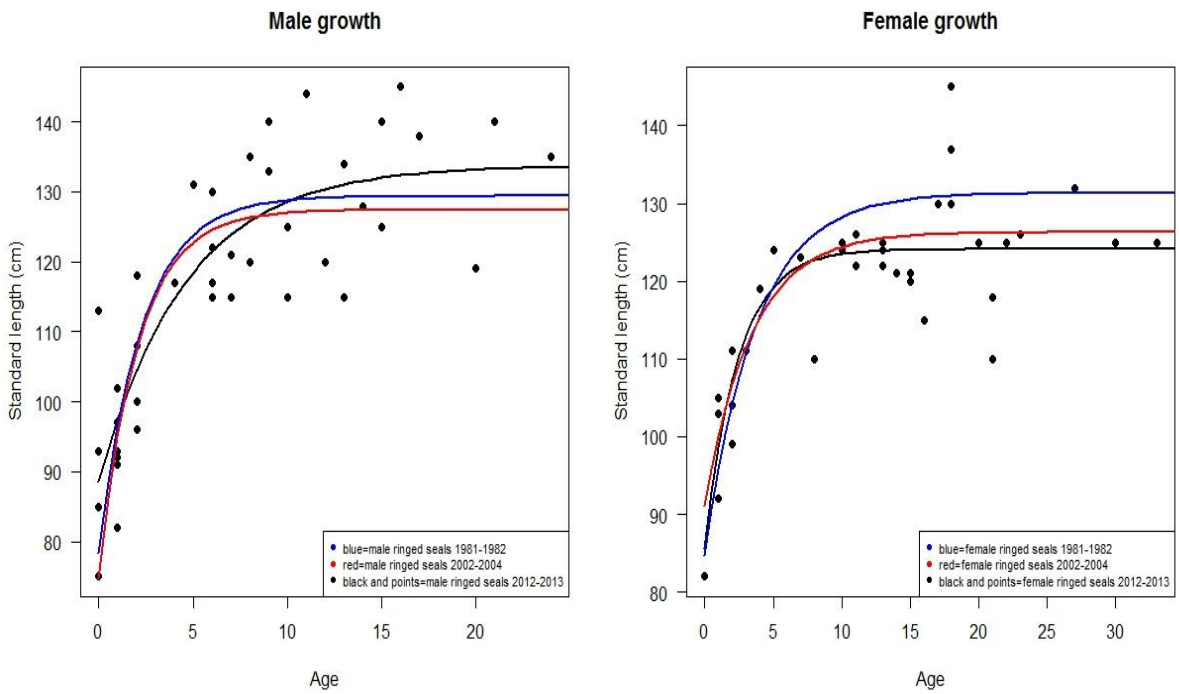


***Figure 5. Standard length vs age for male and female ringed seals harvested in 2012-2013 (black curves and sampling points) vs two earlier scientific sampling collections.***

Table 1. Von Bertalanffy growth function parameter estimates for ringed seal length–age data collected during th ree periods (1981-1982, 2002-2004 and 2012-2013) in the Svalbard area. Growth functions were fitted using the *vbFuns*-function in the FSA-package (http://www.rforge.net/FSA/InstallFSA.R) for R (R version 3.0.2 (2013-09-25)).

| | | Parameter estimates | | |
|---|---|---|---|---|
| Growth parameter | n | $L_\infty$ | a | b |
| Male length 1981-82 | 131 | 129,39 ± 1,1 | 0,44 ± 0,06 | -2,10 ± 0,46 |
| Female length 1981-82 | 144 | 131,35 ± 1,1 | 0,27 ± 0,04 | -3,80 ± 0,79 |
| Male length 2002-04 | 170 | 127,42 ± 0,8 | 0,49 ± 0,07 | -1,82 ± 0,51 |
| Female length 2002-04 | 102 | 126,30 ± 1,2 | 0,29 ± 0,07 | -4,38 ± 1,50 |
| Male length 2012-13 | 42 | 133,74 ± 3,9 | 0,22 ± 0,07 | -4,99 ± 1,56 |
| Female length 2012-13 | 37 | 124,10 ± 1,5 | 0,41 ± 0,12 | -2,83 ± 1,11 |

Body length of adult animals (8+ years of age) over the three periods did not differ for males (F=1.45, P = 0.237), but females in the recent two periods were slightly shorter than they were during the 1980s (F = 111.39, P = 0.002) (Figure 6). The large amount of variance in the small sample from the current study period is notable (2012-2013, see Figure 5). Small-scale regional variance in environmental conditions and food resources might play a role in this high variability. There are marked differences fjord to fjord in Svalbard with respect to the prevalence of different water masses (Atlantic Water versus Arctic Water), water temperature, wind exposure and hence the probability that ice will form. This has large impacts on community structure and the availability of different types of prey for ringed seals and other top predators.

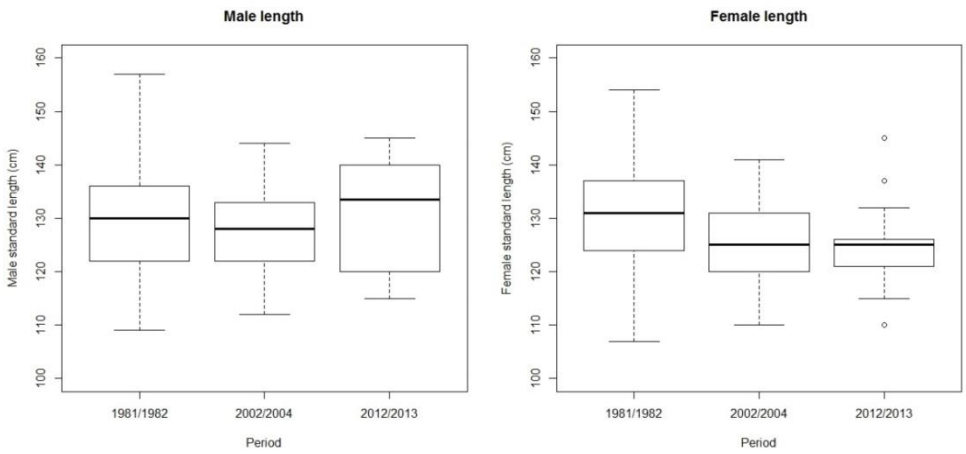


***Figure 6. Standard length comparisons between two earlier periods of scientific sampling and the current local harvest of ringed seals in 2012-2013 for adult male and female ringed seals (8+ years of age).***

Body mass data was not collected during 2012-2013 by the local hunters. But girth and length provide a means to crudely estimate total body mass. Estimated body mass values from the 2012-2013 harvest according to seal age are again quite variable, but suggest that males are heavier in the current sampling period compared to earlier, while females are very similar to the 2002-2004 values (Figure 7). A body condition index (also based on length and girth CI = Girth x 100/length) suggests that males in 2012/13 and 2002/04 were in better condition ($F = 15.26$, $P < 0.01$) than in 1981/82, but that no differences were seen in females between the periods ($F = 0.52$, $P = 0.59$) (i.e. they are not fatter or thinner now compared to earlier periods) (Figure 8).

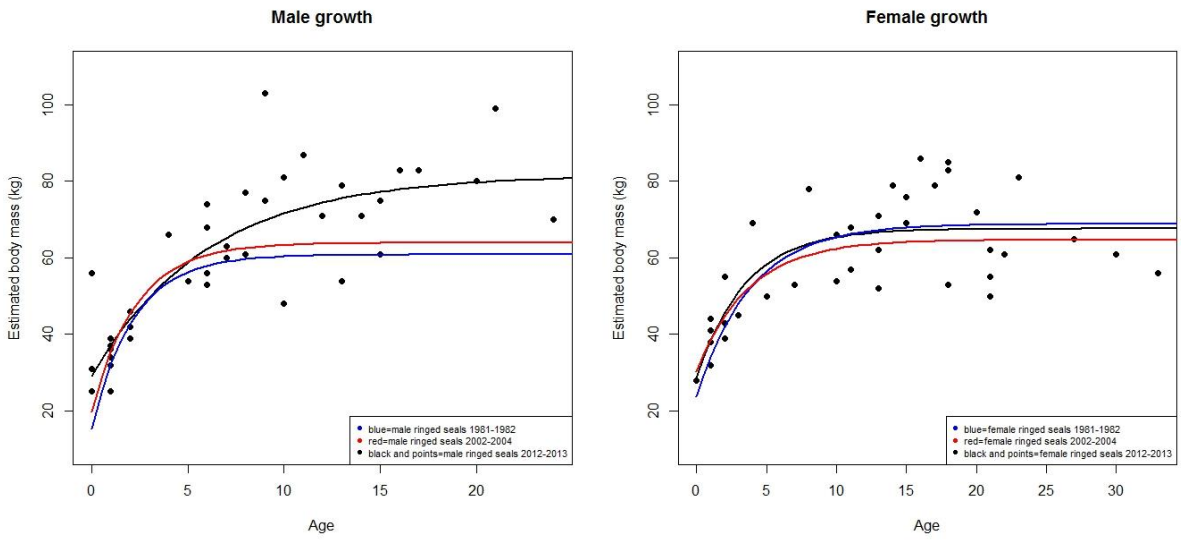


***Figure 7. Estimated total body mass of male and female ringed seals from the 2012-2013 harvest in Svalbard compared to earlier scientific sampling periods in 1981-1982 and 2002-2004.***

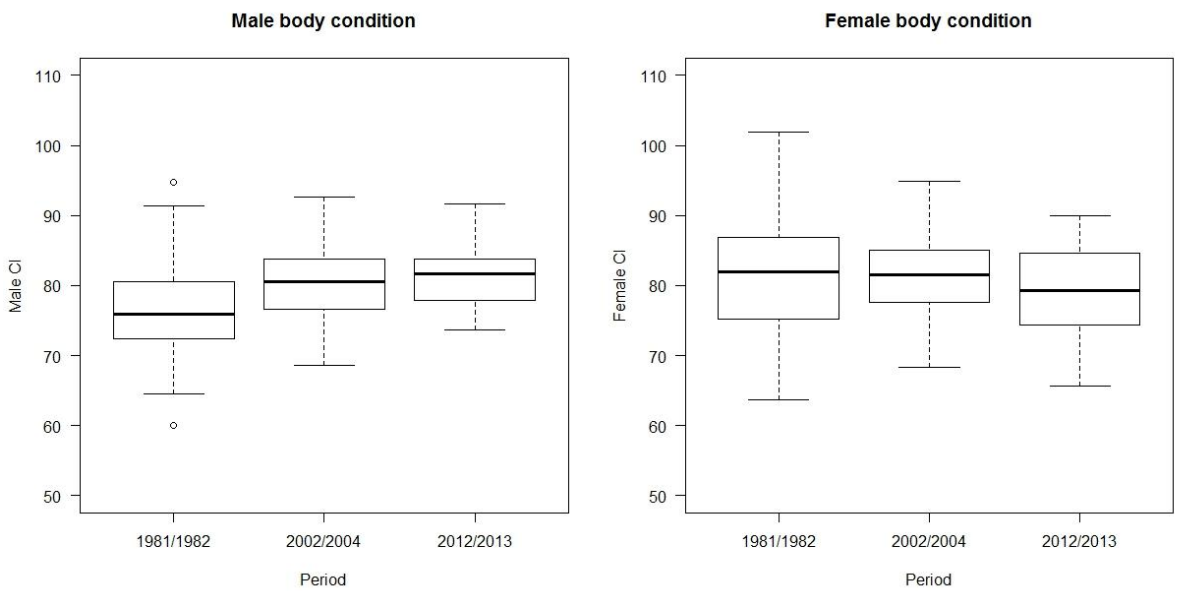


***Figure 8. Box plots comparing estimated body condition of male and female ringed seals from the 2012-2013 harvest in Svalbard to earlier scientific sampling periods in 1981-1982 and 2002-2004.***

Ringed seals mate in late spring, but the fertilized egg does not implant into the uterine wall until approximately 4 months later making pregnancy difficult to detect before the autumn. Only 12 female seals in our sample were old enough to be sexually mature; 75% of these were pregnant (Table 2). This is low compared to the norm for ringed seals (and other phocid seals), which is often 90%+, but it may simply be an artefact of small sample size.

Table 2. Number of mature and immature male (n=40) and female (n=33) ringed seals in the Svalbard harvest (for which data was available) in Svalbard in 2012 and 2013, and the number (and %) of mature females that were pregnant carrying fetuses in the period from September to March (when detection of pregnancy is feasible.

| **Year** | **$F_{immature}$** | **$F_{mature}$** | **Fetus/$F_{mature}$** (Sept-Mar) | **$M_{immature}$** | **$M_{mature}$** |
|---|---|---|---|---|---|
| **2012** | 4 | 15 | 6/8 | 11 | 5 |
| **2013** | 4 | 10 | 3/4 | 6 | 18 |
| | | | (9/12 = 75 %) | | |

## Conclusions

The ringed seal harvest in Svalbard is very small, with less than 100 animals taken annually, from a population that likely numbers in the 10s of thousands locally, and is hence unlikely to impact population abundance or trends. The data from the 2012-2013 hunts suggest that the ringed seals are growing normally and have good body condition (and hence are finding enough food). However, the data also suggest that the production or survival of young animals might be low, with juvenile age classes not being represented as fully as would be expected in the hunt. Additionally, pregnancy rates might also be lower than the norm for this species, though sample sizes are so small in this two year local harvest sampling period that definitive conclusions are not possible. However, low pup production or survival and pregnancy rates are not unexpected, given that there has been 9 years (since 2006) with markedly reduced ice cover in west coast fjords. Even when the sea ice has formed such that ice extent is quite large in some years of this period, the ice has started to form later than normal and hence has insufficient snow depth for optimal ringed seal breeding conditions.

Sampling of the local harvest in Svalbard should be continued for several more years to gain further insight into possible changes in age structure, condition and life-history parameters during this time of marked environmental change. The Governor might want to consider making the return of jaws for aging a mandatory part of the licensing system for hunting seals to maximize data collection on age structure of the hunt in Svalbard. The hunting data analyses should also be supplemented by additional monitoring activity on ringed seals to study potential dietary shifts and regional patterns of change within different fjords in Svalbard. There is a marked contrast in the rate of environmental change in west coast vs east coast fjords that could provide considerable insight into ringed seals' plasticity and their current responses to climate change, as well as providing insight into the overall status of this species in our region.

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