



Ringed seal productivity in Alaska using harvest-based monitoring, 1975–2015

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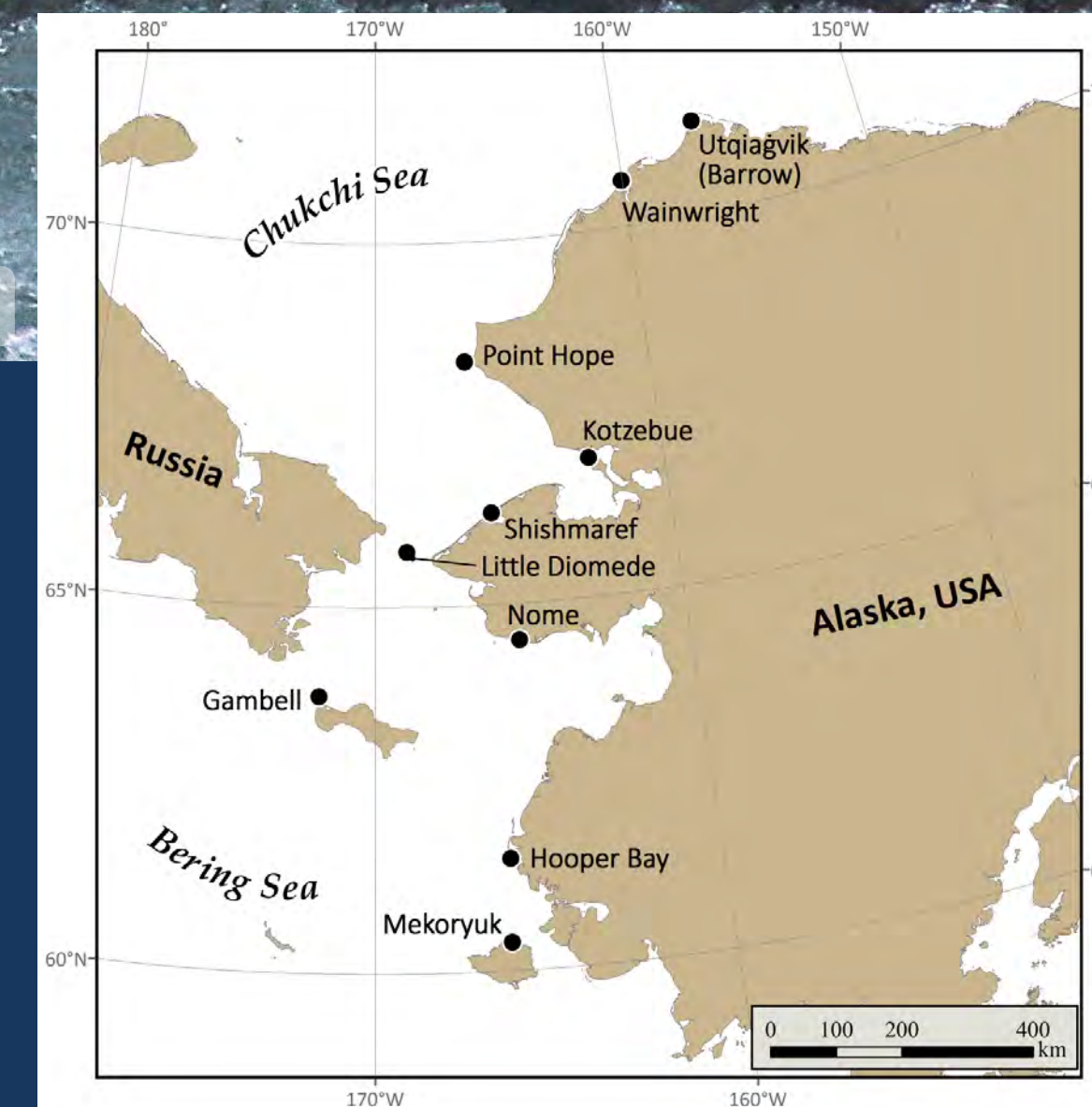
Introduction

Declines in sea ice are predicted to negatively affect ringed seals (*Pusa hispida*) by reducing their time to rest, pup, nurse, and molt on sea ice. Since satellite records began in 1979, the lowest Arctic sea ice coverage has occurred during the last 10 years; 2012 was the lowest followed by 2007. Declines are predicted to continue along with a reduction in snow cover. Ringed seals construct pupping lairs under the snow, but on top of the sea ice, for protection from weather and predators. Reduced snow cover is expected to be detrimental to ringed seal productivity and pup survival. There are no reliable estimates of ringed seal abundance or trend in Alaska; however, since 1960, the Alaska Department of Fish and Game has worked with Alaska Native hunters to collect data from subsistence harvested ringed seals that can be used as an index to population health and status.

We have previously published an examination of several population indices to determine if declines in sea ice have affected ringed seals between 1975 and 2012 (Crawford et al. 2015); these indices included age of maturity, pregnancy rate, and the proportion of pups in the harvest. Here we update our 1975–2012 results to include 2013–2015.



Villages in the Bering and Chukchi seas where harvested ringed seals were sampled (2000–2015).



Methods

We sampled ringed seals from subsistence harvests at 9 villages in Alaska along the Bering, Chukchi, and Beaufort sea coasts from 2000–2016. Female reproductive tracts and canine teeth were collected. These data were compared to data previously collected from seals in the same region during 1975–1984. We examined reproductive tracts for sexual maturity and reproductive condition. Age of seals was determined by counting annuli in the dentine and cementum layers of sectioned teeth.

Age of Maturity

- Seals that had ovulated at least once were classified as mature.
- We estimated average age of maturity as the age at which 50% of females were mature (DeMaster 1978) using a probit regression in SAS (PROC PROBIT).

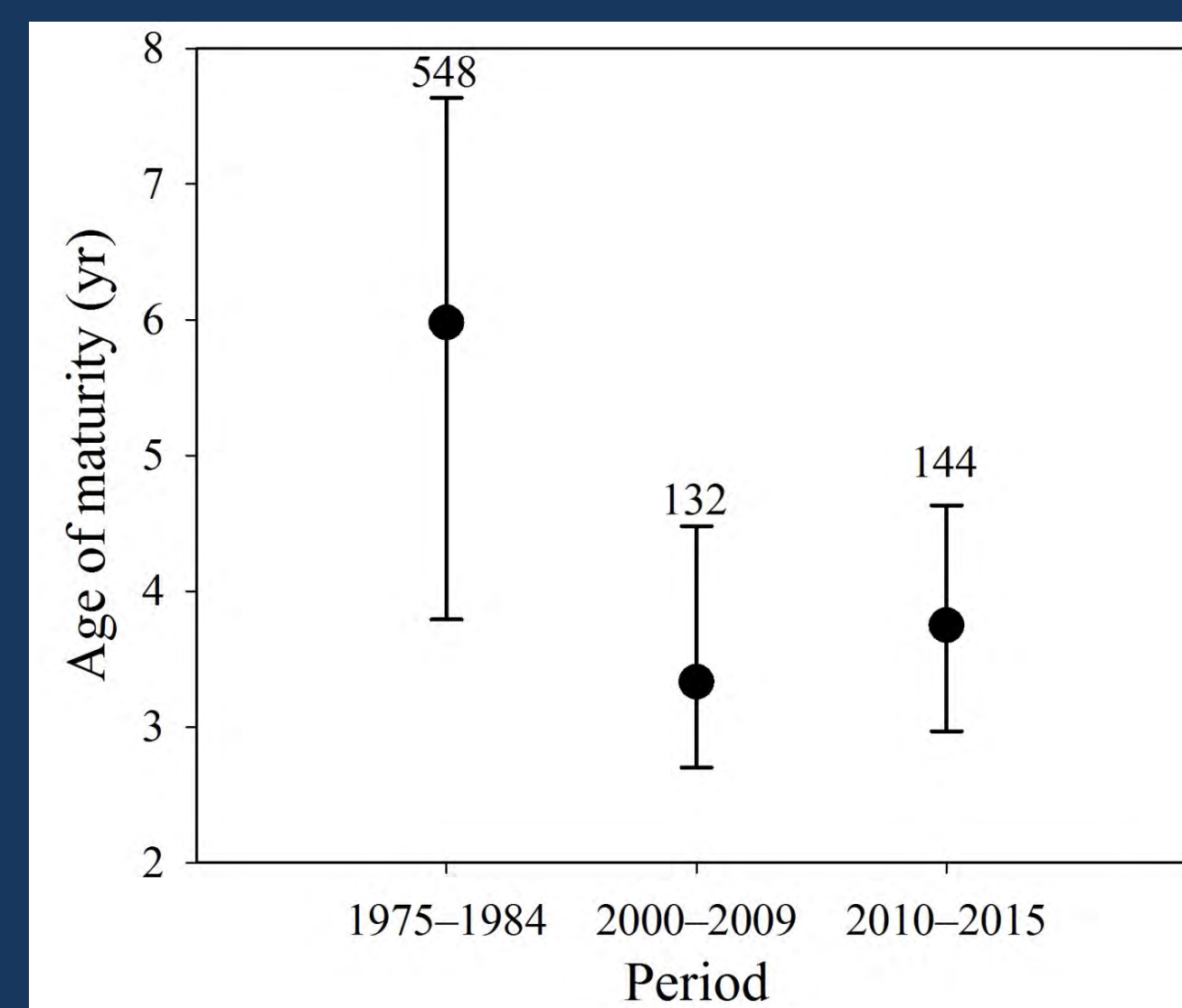
Pregnancy Rate

- We defined pregnancy rate as the proportion of mature females that were pregnant when harvested.
- We estimated average pregnancy rate and evaluated differences among periods using a logistic regression model in SAS (PROC LOGISTIC).

Proportion of Pups Harvested

- The proportion of pups (<1 year of age) harvested is representative of their presence in the population. If pups were not surviving past weaning, their presence in the harvest would decrease.
- We evaluated differences in the proportion of pups harvested during each period, including only villages where ≥ 50 seals were sampled, using SAS (PROC FREQ).

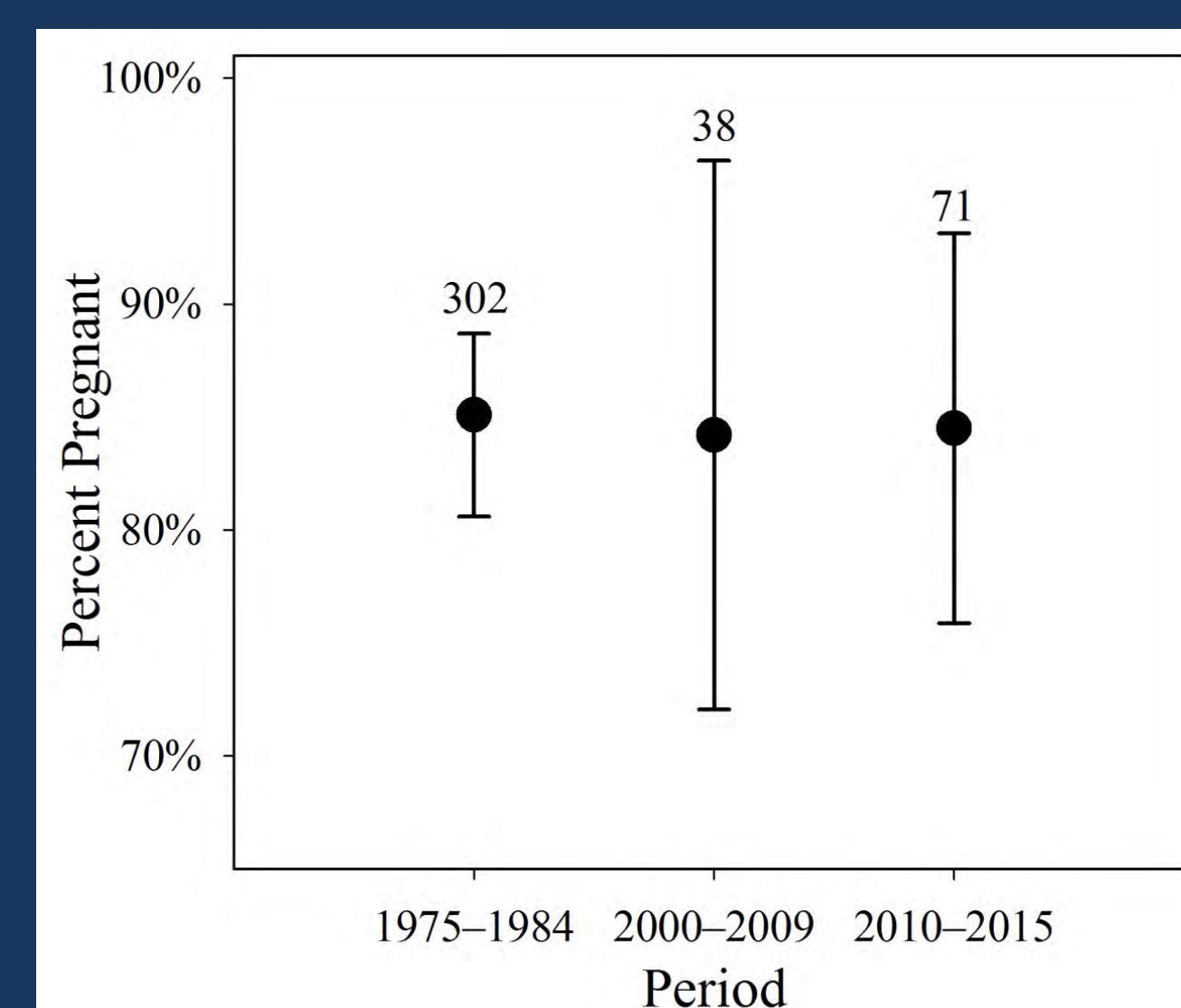
Age of Maturity



Average age of maturity by time period.

- Average age of maturity has been significantly younger since 2000 than during 1975–1984 ($P < 0.05$)

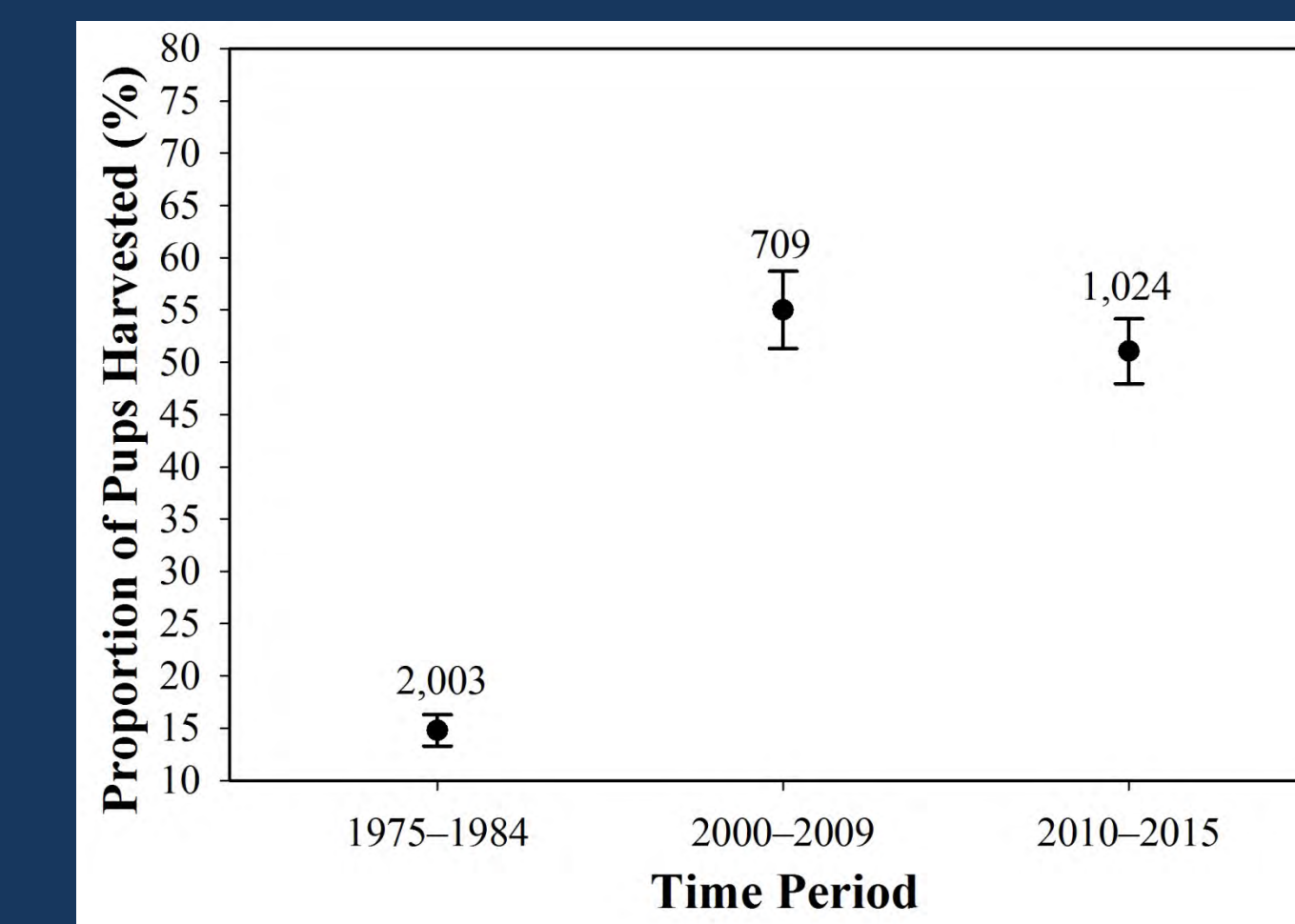
Pregnancy Rate



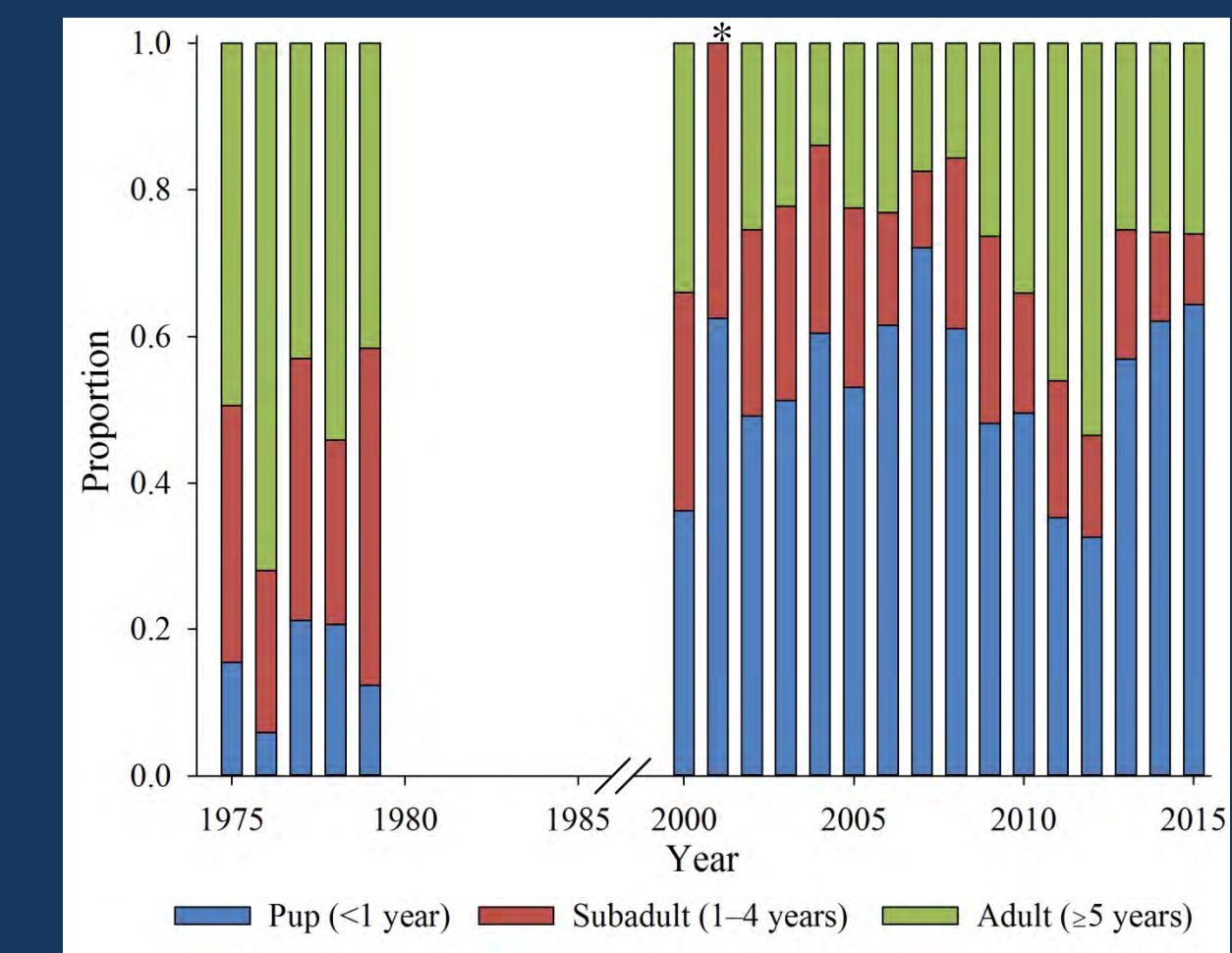
Average pregnancy rate by time period.

- Pregnancy rate has not changed among periods.
- In 2010 and 2011, reproductive tracts from six mature (13–30 yrs.) females appear to be senescent. The thickness of their uterine horns indicated previous reproductive activity, but no corpora lutea or albicans were present.

Proportion of Pups Harvested



Proportion of pups harvested by time period. N = all seals harvested during each time period.



Annual proportions of age classes harvested. *Sample size in 2001 was low with only 8 aged seals, none of which were adults. All other years had >40 seals harvested.

- The proportion of ringed seal pups harvested has been significantly higher since 2000 than during 1975–1984 ($P < 0.0001$)

Conclusions

- Indices of productivity and weaning success have not declined in recent years.**
 - Age of maturity remains younger since 2000 than during 1975–1984.
 - Pregnancy rates remain unchanged.
 - Proportion of pups harvested remains higher since 2000 than during 1975–1984.
- These results are inconsistent with predicted negative effects of climate change for ringed seals.**
- Continued monitoring is important to detect effects as conditions continue to change.**

Acknowledgements

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