REVIEW OF AERIAL SURVEY ESTIMATES FOR RINGED SEALS (*PHOCA HISPIDA*) IN WESTERN HUDSON BAY

J. Blair Dunn, DFO, Winnipeg, MB

Figure 1: Study area in western Hudson Bay and transect lines surveyed for ringed seal abundance in 2007 and 2008.

Context:

Ringed seals (Phoca hispida) are the main food resource for polar bears (Ursus maritimus) and contribute the bulk of the Inuit subsistence harvest of marine mammals. Periodically Fisheries and Oceans Canada (DFO) receives inquiries about the feasibility of establishing a commercial hunt in Nunavut, however little information is currently available to assess the potential impact of such an activity in Hudson Bay. Development of an Integrated Fishery Management Plan for Nunavut ringed seals is planned.

This Science Advisory Report is in support of a request for science information from DFO Fisheries Management.

SUMMARY

- Results of two aerial surveys in 2007 and 2008 indicate that the relative density of ringed seals in western Hudson Bay falls in the range of densities estimated in previous years and within estimated densities at different locations in the Canadian Arctic.
- Advice on stock status and temporal trend for ringed seals in western Hudson Bay cannot be provided at present due to lack of sufficient data to evaluate the health of this stock.

INTRODUCTION

Species biology and ecology

The ringed seal is a small phocid that has a northern circumpolar distribution and in Hudson Bay occurs at the southern limit of its range. The optimal habitat for sexually mature ringed seals has been described as stable land-fast ice with sufficient snow cover and pressure ridges, where they can build subnivean structures (lairs) for resting and pupping. Ringed seal pups are born in early spring and the ice platform is critical for their pre- and post-weaning survival. Breeding is thought to occur after weaning and precedes the annual moult in June, when ringed seals bask on the ice. Ringed seals feed primarily on Arctic cod (*Boreogadus saida*) and/or other pelagic fish, and amphipods. Ringed seals are the main prey of polar bears and are hunted for subsistence by native communities around the Arctic.

Rational for assessment

Considered to be an indicator species for arctic environmental monitoring, the evolutionary adaptations of ringed seals to exploit the land-fast ice habitat for reproduction and survival could expose this species to critical challenges with predicted global warming.

Evidence of changes has been recorded in Hudson Bay in the last 20 years and is thought to be related to climate warming. Indicator species representative of the arctic ecosystem, like thick-billed murres (*Uria lomvia*) and polar bears, showed a shift in diet toward less cod and more capelin (*Mallotus villosus*) for the former, and a decline in body condition, reproduction rate, and survival of cubs for the latter. In the same period, the time of break-up in western Hudson Bay advanced by 2.5 weeks.

Concerns have arisen over possible declines in ringed seal numbers in western Hudson Bay as indicated by reduced pregnancy rate, reduced pup survival, and older age structure. Management concerns are fuelled by a pattern of decreasing ringed seal abundance estimates for western Hudson Bay provided from aerial surveys of basking ringed seals during springs 1995-2000 that estimated population size declines from 100,000 to 45,000 seals. More research is required to assess whether ringed seal numbers have continued to decline in the 2000s and provide management options to shelter ringed seal populations through future changes in sea ice extent under forecasted climate change.

ANALYSIS

The study was located in western Hudson Bay, Canada. Hudson Bay is a shallow water mass (mean depth 150m) with a strong coastal counter-clockwise current. The bay is ice-covered from November to June when break-up occurs and is completely free of ice during the summer and early fall months. Coastal leads are present throughout the ice-covered season. The study area encompassed a zone from Churchill, Manitoba (58°45'N; 94°3.6'W) in the South and Arviat, Nunavut (61°6'N; 94°4.2W) in the North, and from the shoreline to the West, and to 89°W of longitude offshore to the East. The 79,512 km^2 study area represented about 10% of the total Hudson Bay basin. The area surveyed was dominated by moving ice with floes of different sizes, whereas landfast ice represented only about 2% of available sea ice.

Two aerial surveys in western Hudson Bay in May 2007 and 2008 consisted of ten lines flown in three days both years. The survey protocol was designed following Lunn *et al.* (1997) and analyses were conducted using strip-transect analysis.

Ringed seal relative density estimates reported in this study (Table 1) are in general agreement with results from previous studies in the Arctic for a comparable ice type environment, i.e. dominated by non stable fast ice, (range 0.19 to 1.16). Relative to density on the landfast ice, a prime habitat for ringed seals, density on moving ice is generally lower.

Table 1: Ringed seal relative density and abundance estimates and associated variability estimated using strip-transect analyses from data collected by two observers during two aerial surveys of ringed seals on ice in western Hudson Bay.

	Density (seal/km^2) [1]	95%CI [2]	Abundance	95%CI	%CV [3]
2007	*0.92 ±0.07*	*0.79-1.06*	*73170±5440*	*63260-84633*	*7.44*
2008	*0.44±0.05*	*0.35-0.54*	*33701±3704*	*27188-41776*	*11*

[1] Estimated parameter ± SE (standard error).
[2] Log-based confidence interval at 95% level of significance.
[3] Percent coefficient of variation.

Density estimates for ringed seals varied greatly from year to year in western Hudson Bay. Inter-annual variation in the density of ringed seals hauled-out on the ice has been widely reported in the literature. Apart from an actual change of seal abundance, several factors could explain such inter-annual variation. Ice type and conditions, water depth, temperature, wind speed and cloud cover, and time of the day and year could potentially affect ringed seal presence, haul-out activity and detectability. Other evidence, in combination with seal count data, can help interpret aerial survey density estimates. During our study, seals holes without associated seals were recorded as well as sign of recent polar bear kills. The number of kills detected remained relatively constant over the two-year period but the number of holes without seals more than doubled in 2008 compared to 2007, while the mean density of animals decreased by half. This finding suggests that many ringed seals may not have been available for detection in 2008 relative to 2007, and an actual population decline may not be an accurate interpretation of results.

The main assumption of strip-transect analysis is that all animals on transect are detected. This assumption was not met in our study due to decreasing detectability with increasing distance and some animals close to the trackline that were not detected. Consequently, density and abundance estimates presented in this study are likely to be an underestimate. Also, ringed seal density and abundance estimates were not corrected for the fraction of ringed seals in the area not available for detection during the survey (availability bias).

CONCLUSIONS AND ADVICE

The relative density estimates found in this study are in the range of ringed seal densities estimated previously for this area and are within the expected range of densities estimated using similar methods at other locations in the Canadian Arctic. However, previous studies

reported demographic difficulties for ringed seals in western Hudson Bay in the 1990s and recent data on demography is not available. Advice on stock status and temporal trend for ringed seals in western Hudson Bay should be assessed once sufficient data is available to evaluate the health of this stock. In the meantime, in the context of global warming and continued ice loss in the Arctic, caution is necessary in interpreting the abundance estimates of ringed seals in western Hudson Bay.

SOURCES OF INFORMATION

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FOR MORE INFORMATION

Contact: Steven Ferguson
501 University Crescent
Winnipeg, MB, R3T 2N6

Tel: 204-983-5057
Fax: 204-984-2403
E-Mail: steve.ferguson@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
Central and Arctic Region
Fisheries and Oceans Canada
501 University Crescent
Winnipeg, MB
R3T 2N6

Telephone: (204) 983-5131
Fax: (204) 984-2403
E-Mail: xcna-csa-cas@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1919-5079 (Print)
ISSN 1919-5087 (Online)

La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2009. Review of aerial survey estimates for ringed seals (*Phoca hispida*) in western Hudson Bay. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/004.