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RECOVERY POTENTIAL ASSESSMENT FOR FRESHWATER HARBOUR SEAL, *PHOCA VITULINA MELLONAE*, (LAC DES LOUPS MARINS DESIGNATED UNIT (DU))

Adult harbour seal and two pups, hauled out on rocks.

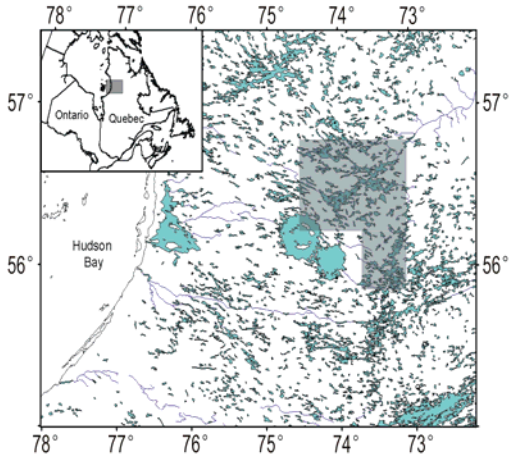

Figure 1: Occurrence area of freshwater harbour seals in northern Québec. The dark zone showed the Lacs des Loups Marins, Lac Bourdel and Petit Lac des Loups Marins.

Context :

Harbour seals are a coastal species that are often found close to freshwater rivers and estuaries. It is well known that this species often moves into freshwater areas for food, however, the sub-species, Phoca vitulina mellonae is the only population known to occur all year-round in freshwater. This population lives in the Lacs des Loups Marins in the Ungava peninsula of northern Québec and has been isolated from its marine neighbouring since the most recent glaciations approximately 5000 to 8000 years ago. The Lacs des Loups marins is located about 160 km east of Hudson Bay at 260 m of elevation above sea level. The watershed area of at least 16 600 km^2 is composed of a complex layout of lakes interconnected by numerous rivers where fall and rapids were abundant. The freshwater harbour seal was designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as "Special Concern" in 1996. In 2007, this status was changed to "Endangered" under some criteria where the most important is the very low population size. Other criteria include the suspected decline in population, the limited area occupancy and the endemic status of the subspecies. The recovery potential assessment (RPA) was undertaken to provide information and guidance towards a recovery target and a timeframe for recovery with which to develop a management strategy that will increase recovery likelihood of this subspecies.

SUMMARY

- There is limited information available related to the ecology and biology of this subspecies. More information is needed to understand all threats that may play a role in recovery.

- The available information on abundance is highly uncertain. Numbers may vary from a few dozen to a few hundred animals.

- Assuming a small population on the order of about 50 animals, an optimistic assessment suggests that recovery to 200 animals could occur within 10-20 years and a recovery to 350 animals could occur within 15-30 years depending on the type of model used. Recovery to the higher level assumes that there are no barriers to dispersal to re-occupy former areas. This assumption is likely to be optimistic.

- Although the population size is unknown, if it numbers around 50 animals, then the population could allow approximately one removal every three years.

- Freshwater harbour seals may be threatened by two main causes; increased extirpation risk as a result of low population size, and disappearance of ice-free areas during winter by hydroelectric development.

- Further information on abundance, population parameters, pupping habitat, and dietary requirements are needed to develop an effective strategy.

BACKGROUND

Rationale for Assessment

The freshwater harbour seal is an endemic subspecies that only occurs in a series of freshwater lakes found in northern Québec, Canada. It has been listed as Endangered since 2007 mainly because of its very small population size (COSEWIC 2007). Information on population size is limited and uncertain, with an estimate of 80-100 animals. However, this level is around the threshold where demographic stochasticity becomes a major threat to continued population viability. It has been reported that First Nations hunters occasionally take a few individuals, but there is no traditional hunting that has focused on this species. However, with the very low population numbers, even a very few removals pose a threat to the population. A second threat that has been identified is potential hydro-electric development by the provincial utility Hydro-Québec.

Species Biology and Ecology

The freshwater harbour seal population was first described by Doutt (1942) and morphological differences were used as a proof of subspecies designation. However, owing to the small sample size (n=2), this subspecific designation was questioned. Additional morphological and microsatellite genetic analyses have strengthened support for the subspecific designation. Genetic differences were highlighted by comparisons with marine harbour seals in eastern Canada, *Phoca vitulina concolor*, but no samples from marine Hudson Bay harbour seals were used in the analysis. If there is still some exchange with marine forms of this species it seems to be clear that it is at a very low level.

The freshwater harbour seal, *Phoca vitulina mellonae*, inhabits a vast area that is composed of a series of interconnected lakes where the principal lake is the Lacs des Loups Marins and rivers in Ungava peninsula of northern Québec, approximately 160 km east of Hudson Bay. Habitat use appears to be reduced since first mentioned by Low (1898) where seals were reported as far north as Lac Minto. First Nation knowledge also mentioned freshwater seals in Golfe du Richmond and Lac à l'Eau Claire (Fig. 2). The current distribution appears to be limited to the Lac Bourdel, Lacs des Loups Marins and the Petit Lac des Loups Marins (Fig. 1).

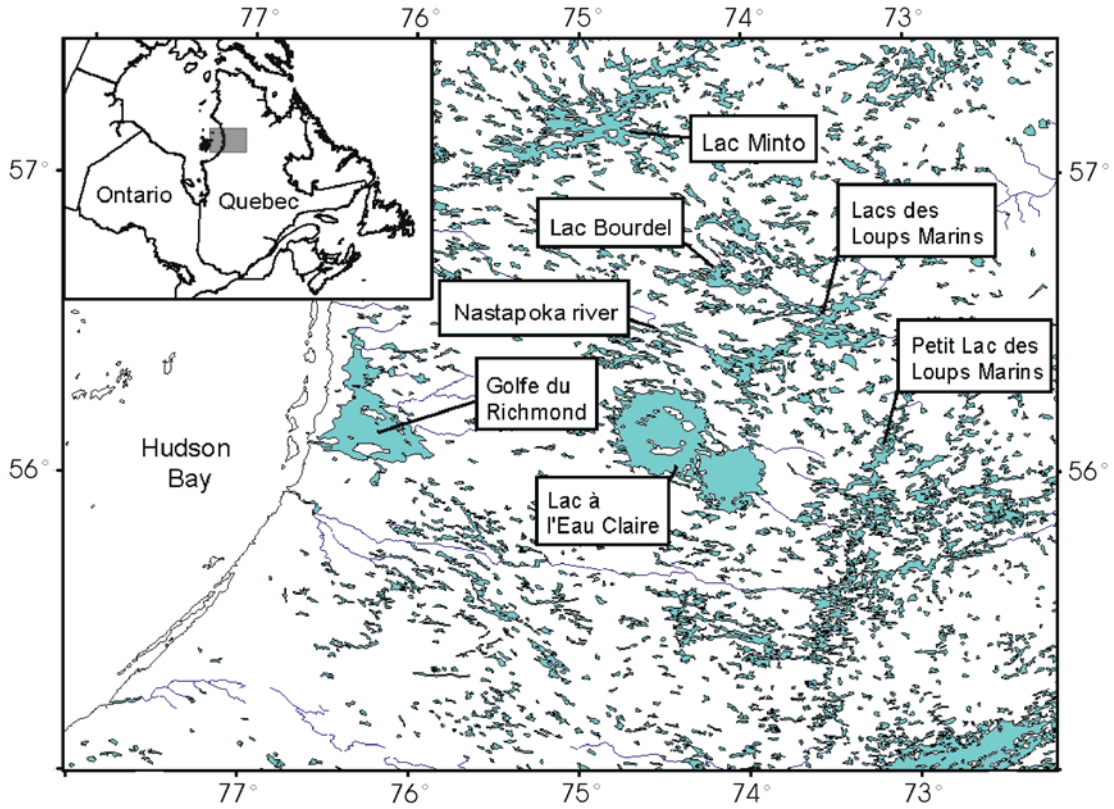

Figure 2: Historical distribution deduced from early reports and First Nation knowledge.

Information on freshwater harbour seal biology and ecology is limited. Stable isotope analysis suggests that these seals feed exclusively on freshwater fish all year-round. Community ecology research during the 1970s identified significant differences in age/size structure composition of the fish species between lakes occupied by seals and those lakes where seals were apparently absent. The most significant changes were observed in the Lacs des Loups Marins. Lake trout, *Salvelinus namaycush*, appeared to be the most affected species where its occurrence was reduced by at least 20%, whereas Brook trout, *Salvelinus fontinalis*, and Lake whitefish, *Coregonus clupeaformis*, appeared to be more abundant. The most significant effects on Lake trout were an increased growth rate, a reduction in longevity where fish rarely exceeded 55 cm fork length, age at sexual maturity was halved and increased fecundity per unit weight. In the fishing nets, seals seemed to prefer Brook trout, Lake whitefish and Cisco, *Coregonus artedii*. The Lacs des Loups Marins area has traditionally been used by Cree hunters during fishing and hunting trips to the area. It is not known if these trips affected fish availability for seals. However, the Lacs des Loups Marins was known by First Nation's to have

poor fishing. Power and Gregoire (1978) suggested that this was due to the lack of large fish because of seal predation on the larger size classes, or that high seal predation rates overall, resulted in reduced fish longevity and hence fish size.

Reproduction is thought to occur in the freshwater lakes area. No direct observation of birth or reproduction behaviour has been noted in the few studies on this subspecies. However, two female seals with swollen abdomens suggesting pregnancy have been photographed and a foetus from a pregnant female was collected by Doutt (1942). Births appear to start in early May and continue until the end of the month when the lake is still ice-covered. This seems to be significantly earlier than what is predicted by Temte's gradient at this latitude (Temte *et al.* 1991), but this gradient may not be applicable. However, the general view is that births occur on ice or in lairs close to the shore formed by a decreasing water level during winter. A description of the foetus by Doutt (1942) suggested that freshwater seal pups are usually born with an adult pelt, like marine harbour seals pups. Haulout activity increases during spring when pupping occurs and a second peak occurs in August likely during the moult. Seals haulout on ice at the marginal zone of ice free areas during spring and they use rocks, isolated islands and beaches along the shore during summer.

Unfortunately, there are no data available on life history parameters for these animals. However, if this harbour seal population is similar to their marine counterparts, then the average age at first reproduction would be expected to be about 5 years old (range=3-6 years old) among females and 5 to 6 years old in males. At sexual maturity, about 90% of females (range from 85 to 95%) would breed each year. Survival rates are expected to be low among young animals. First year survival for marine harbour seal pups is usually around 70 to 80% (range from 50 to 96%). The maximum adult survival rate is about 90% (range from 87 to 95%) and is reached close to sexual maturity.

Contaminant levels have not been investigated either in lake sediments nor in these seals, but the low level of human activity in this area would suggest low contamination levels, with most of the contamination likely coming from atmospheric transport. Information on causes of death, apart from occasional hunting, are not available. No data are available on annual mortality rates. Black bears, *Ursus americanus*, red, *Vulpes vulpes*, and arctic foxes, *Alopex lagopus*, wolves, *Canis lupus*, and lynx, *Lynx* sp., are potential predators of freshwater seals but no data have been collected. However, if there is predation it is likely directed toward pups and inexperienced juveniles.

During winter seals appear to be confined to ice-free areas in the Lacs des Loups Marins and Lac Bourdel. During this period, movement of seals is not restricted to water. The seals use trails on the ice and snow to travel between two ice free areas. Trails can be as long as 150 meters with up to 25 degrees of inclination. Conditions that prevail during winter may help seals to get over physical barriers that are impassable during summer. During spring, seals extended their territories to the neighbouring lakes around the Lacs des Loups Marins by river and terrestrial travel.

RECOVERY POTENTIAL ASSESSMENT

Population Status and trajectory

There are no reliable estimates of abundance. Early information on population size is from a guess (N= 500) by Doutt (1942) that he made based on a number of annual kills reported by Low (1898) (30 animals / year). Power and Gregoire (1978) using the same harvest data and assuming a stable age structure suggested that the population numbered around 600 animals. Another abundance population estimate using an indirect method based on fish productivity and theoretical food consumption by seals, resulted in a theoretical carrying capacity of 200 animals in the Lacs des Loups marins if some fish were also taken from tributaries. A mark-recapture study resulted in an estimate of 80-100 animals. But only two out of 14 animals marked were recaptured making this estimate highly uncertain. At best it can probably be said that the population probably numbers between a few dozen and the low hundreds. Obviously, no population trend data are available. Interviews with first Nations have resulted in contradictory views on the population limiting the usefulness of this information to evaluate abundance.

Critical habitat

The Species at Risk Act (SARA) defines “critical habitat” as a habitat that is necessary for the survival or recovery of the listed wildlife species. To qualify as critical habitat, detailed information on biology and ecology of the species are essential. Unfortunately, the information on freshwater harbour seals is sparse, but some critical aspects can be proposed. The watershed of the Nastapoka river and the Lacs des Loups marins encompasses a huge territory of 16 600 km^2. In this territory, seals seem to be grouped within an area of about 532 km^2, represented by the Lacs des Loups Marins. It is not known if seals are only observed in this area because of the small population size or because it is the exclusive portion of this area that is viable for seals. The first explanation was most likely to occur based on traditional knowledge that reported seals in many others areas. Harbour seals, unlike the true arctic seals such as ringed, *Phoca hispida*, and bearded seals, *Erignathus barbatus*, are not able to maintain breathing holes during the ice-covered season. The freshwater harbour seals are thus dependent on ice-free areas created by rapids or water movement and air cavities created along shore under ice cover by the decreasing water level during winter. Consortisum Gilles Shooner & Associés *et al.* (1991) show that the crown-shaped cracks on shore-fast ice may be less useful for seals than previously suggested, but ice cover that stays suspended on boulders creating a cavity big enough to shelter a seal might be used.

Population recovery target

It is difficult to fix targets for population recovery given the inaccuracy of the historical population size and the uncertainty about the carrying capacity of this area. The 535 km^2 of the Lacs des Loups Marins is suspected to be able to support a population of about 200 animals. Therefore a first target may be a population of about 200 to decrease likelihood of extinction through stochastic events. A population of 200 animals is still low with respect to environmental modification that can occur. If neighbouring lakes of the Lacs des Loups Marins complex could be considered as viable for seals, then the suitable habitat could be increased to 1 431 km^2. If these lakes have similar fish productivity to the Lacs des Loups Marins, the carrying capacity of the whole area may be estimated at about 500 animals. Using recovery targets that have been set at 70% of pristine levels or carrying capacity, such as beluga (DFO 2005). The population

might be expected to recover to about 70% of the carrying capacity (N=350 animals). This can be viewed as a longer-term target.

Recovery time

Information on the dynamics of the population are needed to estimate time needed to recover. Unfortunately, information on age-specific pregnancy rates, age of maturity, and survival rates are not available. If it is assumed that the population dynamics of the freshwater seal are similar to their marine counterparts some indication of how long recovery might take can be provided. There are no current nor reliable estimates of population size. If the current population were to number around 50 animals, then assuming no removals, exponential growth and a maximum population growth rate (0.12), then the first recovery target (N=200) could be reached in 12 years and the second (N=350) in 16 years (Fig 3). However, the population growth rate used was a maximum growth rate observed for a marine population. Freshwater seals in Finland, *Phoca hispida saimensis*, although a different species to those in northern Quebec appear to be less productive than marine ringed seals, with mature pregnancy rates of around 70%. Therefore, if we apply a more conservative rate of increase of 0.0565, that has been observed among some harbour seal populations then the time for recovery would increase to 25 and 35 years for a target of 200 and 350 animals respectively (Fig. 3). If growth is density-dependent, then assuming a starting population of 50 animals a carrying capacity fixed at 500, theta of 2.4, and a maximum rate of increase of 0.12, then the population may reach the lower recovery target (200) after 12 years and the higher target after 18 years. However, overall, this modelling process is very hypothetical without more information on dynamics of the population. Also, the density dependent model assumes that animals will disperse rapidly to occupy the entire potential habitat. Unfortunately too little is known about mechanisms affecting dispersal, other than to say that the time presented to recovery to the upper target of >350 animals is very likely to be considerably longer than suggested by the model.

Allowable Harm

Without detailed information on abundance, trends and dynamics a very conservative approach to determine allowable harm levels would be to use the Potential Biological Removal or PBR. PBR can be calculated as follows:

$$PBR = N_{MIN} \text{ X } ½ R_{MAX} * F_R$$

where:

- $N_{MÌN}$ = the minimum population estimate,
- ½ R_{MAX} = one-half the maximum theoretical or estimated net productivity rate at a small population size,
- F_R = a recovery factor between 0.1 and 1.

The values used for PBR calculation were:

N_{MIN}= 50; R_{MAX}= 0.12; annual growth rate of harbour seal from Europe, F_R= 0.1 as recommended for a very low abundance population. If the population numbered around 50 animals, then the PBR for freshwater seals would be 0.3 per year and thus about 1 seal removed every three years. If the population could withstand one removal per year, then the minimum population size would be in the order of 167 animals.

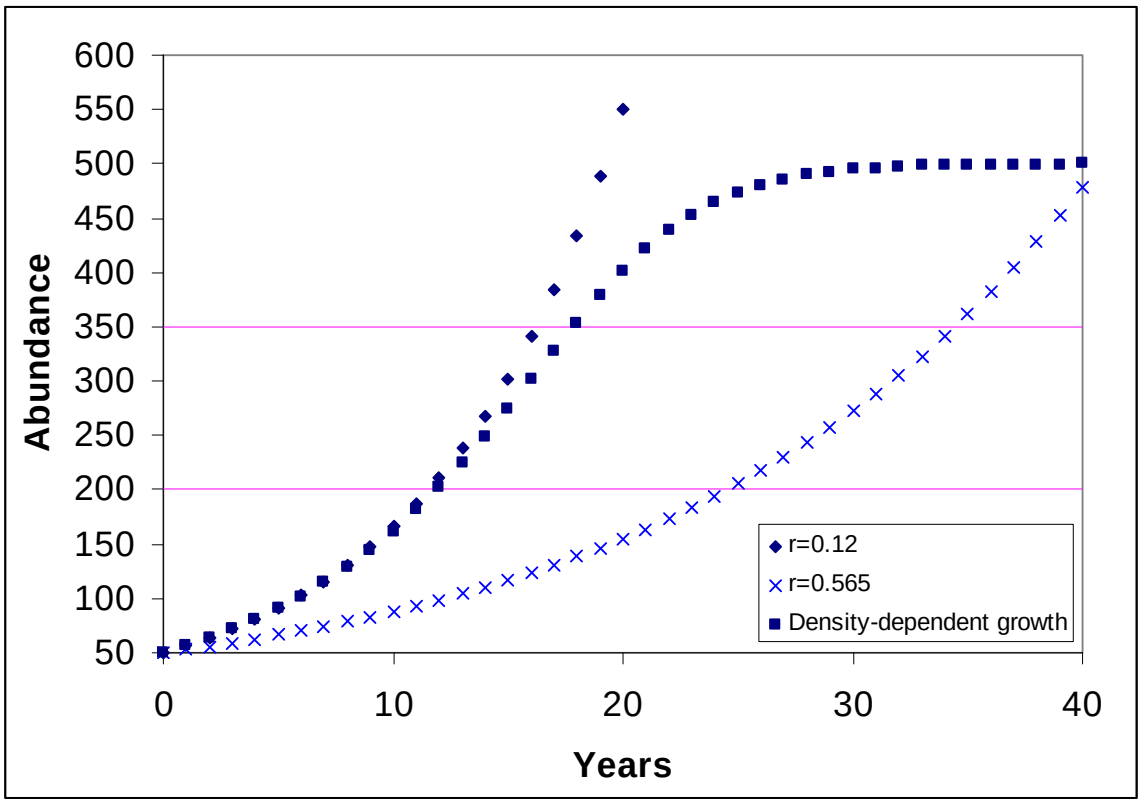

Figure 3: Possible recovery projections for a seal population with an initial population size of 50 animals. Population growth is modelled assuming the model : $N_{t+1}=N_o * exp^{(r)}$, where N represents population size at time 0 and t+1, exp is the exponent and r is the maximum rate of increase of r=0.12 or r=0.0565. Density-dependent growth was described by $N_{t+1}=N_o * exp^{(r*(1-(N/K)^{\theta})}$, where K is carrying capacity of 500 and θ is 2.4. The horizontal lines represent recovery target of 200 and 350 animals.

Threats

The primary threat for this subspecies is the small size of the population, which makes it vulnerable to stochastic events that could lead to extinction.

This subspecies has been listed on Schedule 3 (Special concern) of SARA and has legal protection. Since the COSEWIC status has been upgrade to Endangered the process is now engaged to add this subspecies to Schedule 1. In the past, the Québec government has proposed the creation an ecological reserve around the Lacs des Loups Marins to protect this freshwater harbour seal population. This may no longer be the case owing to potential hydro-electric development by the provincial utility. There is a new project underway by the Québec government to create a provincial park “Parc national des Lacs-Guillaume-Delisle-et-à-l'Eau-Claire” in this area. However, the most important area for freshwater seals, the Lacs des Loups Marins, was excluded from the park. For hydro-electric development, some holding water basins were created along a river to provide sustainable electrical production. If filled, these basins would remove all rapids and thus ice free areas during winter would no longer be available to the seals, which would pose a significant threat. Unlike ringed seals, the harbour seal does not dig out lairs under the snow. However, they may use naturally created shelters. Experience from the Lake Saimaa system, occupied by ringed seals has shown that hydro

related fluctuating water levels may result in some overhangs collapsing leading to high mortality among young animals. The seasonality of pupping is different for harbour seals, but such fluctuations in water levels may result in changes in the quantity of open water. This may result in increased mortality directly or indirectly through increased exposure to predation. Changes in fish biomass and species composition as a result of hydro-electric activity might also have a negative impact on the population. The flooding of the area for holding water basins will also increase mercury (Hg) levels in this environment and thus in seals by biomagnification. The toxic impacts of methylmercury (MeHg), the organic form of the Hg, on seals are not well known. MeHg is known to be immunotoxic and to damage the central nervous system. A very large dosage of 25 mg/kg of body weight in harp seals, *Phoca groenlandica*, resulted in renal failure and death before nervous system damage was observed. It was suggested that a lower dosage may produce more classical nervous system damage.

There does not appear to be extensive fishing activity in the Lacs des Loups Marins. However, drowing in fish nets has occurred in the area and is a leading cause of mortality in other freshwater areas with seals such as in Lake Saimaa in Finland.

Sources of uncertainty

General information about ecological and biological features of the freshwater harbour seals that inhabit northern Québec is sparse and limits our ability to assess the recovery potential of this sub-species. Accurate information on population parameters, size and trends are crucial to evaluating the recovery potential. As well, improving data on distribution and movement between summer and winter is needed to evaluate habitat utilisation in this area. More information is also needed on diet composition and fish productivity in the area to be able to understand carrying capacity within the freshwater environment.

CONCLUSIONS AND ADVICE

Ice-free areas during winter have been suggested to be essential for survival of the freshwater harbour seals. Thus disappearance of these areas as a result of hydro-electric development represents the main threat for this population in the short-term.

Information is needed on abundance, trends, diet composition, and seasonal distribution to properly assess the recovery potential of this population. First Nations involvement and collaboration will be essential for assistance in obtaining such information.

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