CONSERVATION BENEFITS TO ASSISTING LIVE-STRANDED NEONATES OR ENTRAPPED JUVENILE BELUGA (*DELPHINAPTERUS LEUCAS*) FROM THE ST. LAWRENCE RIVER ESTUARY

Photo: Véronique Lesage

Context:

The St. Lawrence Estuary (SLE) beluga is listed as endangered under the Species at Risk Act (SARA); a Recovery Strategy has been developed, and their summer Critical Habitat has been identified and protected. After a period of stability or slight increase over the period 1988 to early 2000, the population appears to be declining at a rate of approximately 1% per year.

Sporadically, DFO receives reports of live-stranded neonates, or of juveniles that are entrapped in semi-enclosed areas and cannot return to their normal habitat on their own.

Under SARA there are no provisions for the euthanasia or rehabilitation of animals unless there is scientific value. The SARA directorate has requested advice from Science on the potential benefits to recovery of the SLE beluga population of assisting neonates and juveniles, and the animal welfare concerns related to rehabilitation, euthanasia, or no human intervention. Specifically, advice is requested concerning the following items:

1. *Is attempting to rehabilitate or relocate a live-stranded neonate beluga or a juvenile likely to contribute to the recovery of the SLE beluga population?*
2. *What are the chances of survival of a live-stranded neonate, and how should we assess health status?*
3. *In the case of a live-stranded neonate, what factors should be considered in the decision to rehabilitate, re-locate, or leave the animal where it is? What practical steps should be undertaken to minimize animal welfare concerns?*
4. *In the event that a live-stranded animal is relocated, what scientific information should be collected during the relocation?*

SUMMARY

- There are periodic reports (i.e., one or two reports every two to three years) of a live-stranded neonate (days to weeks old) SLE beluga, or of an independent (weaned) juvenile entrapped in semi-enclosed areas that cannot return to their normal habitat unassisted.
- Beluga neonates that are found stranded alive have been separated from their mother. Calves feed exclusively on milk during the first year, so if left alone, neonates will die.
- The health of neonates deteriorates rapidly when stranded relative to healthy conspecifics of the same age. Therefore, the chances of survival if relocated are likely to be low.
- For a live-stranded neonate to survive, nursing must resume quickly (i.e., within several hours) after relocation. Therefore, there needs to be a female willing to care for the calf. The likelihood of such an event occurring within this time frame is unknown but, based upon existing literature, is most probably close to nil.
- The chances of survival of entrapped juvenile beluga are better than for neonates given their ability to feed independently.
- The benefits of assisting live-stranded or entrapped juvenile beluga were examined from the perspective of their contribution to population recovery to determine if they meet the objective of Conservation Translocation, which requires that such actions result in a measurable conservation benefit at the population level.
- The age-frequency distribution of dead animals found in the St. Lawrence Estuary, from the years 1983-2017 was used to construct a population model. Different model scenarios were examined in attempts to replicate a period of stability in the population (1983-2000) and a period of population decline (2001-2012).
- Model results showed that improvements in survival made a greater contribution to population trend than did changes in reproduction. They also indicated that calves are much more likely to die than juveniles and adults, and that the greatest increase in population growth rate is achieved by improving survival among juveniles and young adults. There are uncertainties in some of the model parameters or assumptions but they are unlikely to affect these general model conclusions.
- The model indicated that, assuming survival of an entrapped and released juvenile is similar to that of conspecifics, 10 juveniles would need to be relocated each year to halt the decline. For neonates, up to 19 individuals per year would need to be reintroduced and adopted successfully to halt the decline.
- Reports of live-stranded neonates or entrapped juveniles are infrequent and the probability of survival of relocated neonates is close to nil. Therefore, the benefit of relocating these few individuals to population recovery is nil and does not meet the objectives of Conservation Translocation.
- Although the occurrences of entrapped juveniles are rare, there is a higher likelihood that these individuals can survive following relocation. While from a conservation perspective the benefit of relocating entrapped juveniles to the population as a whole is likely nil given the rarity of these events, relocating these individuals may be considered on other grounds. Some of the factors that need to be considered have been identified previously (e.g. DFO Release and Rehabilitation Criteria).

- From an animal welfare perspective, relocating neonates or letting nature take its course might result in increased distress and suffering, and ultimately mortality. Under these situations, euthanasia should be considered. In this case, a necropsy would improve our understanding of potential causes for stranding. An alternative consideration would be to take live-stranded neonates into captivity. However, neonates are not considered suitable for future release under the proposed DFO guidelines for the release of rehabilitated marine mammals.

INTRODUCTION

Responses to animals in difficulty can vary from pushing the individual back into the water, to euthanasia, to a full rehabilitation in specialized facilities, where the objective is to improve health status to levels that favour its survival in the wild. Assisting compromised individuals can thus require considerable resources, may pose risk to the individuals themselves and human handlers, or the population through potential disease transfer. From a conservation perspective, the value of returning compromised individuals to the population depends in part on the current status of the population, the probability that the animal survives, the number of offspring that it is likely to produce (reproductive value), and the number of animals that are assisted and released.

The International Union for the Conservation of Nature (IUCN) has proposed a framework for assessing benefits and risks from reintroductions and other conservation translocations. In this framework, the intent is to not only benefit to translocated individuals, but to yield a measurable benefit at the level of the population. Steps therefore include an assessment of overarching goal, feasibility, risk, alternatives, and outcome, as well as the implementation of an action plan and monitoring program.

SLE belugas are the most southerly of the beluga populations. After a period of relative stability or slight increase, this population is currently declining at an estimated rate of approximately 1% per year. In this context, translocation might be an option favourable to conservation.

Beluga can live for up to at least 75 years. Sexual maturity in female beluga occurs at around age 8, with the first successful births observed at age 9 or 10. The duration of lactation is 1.5 to 2 years. Milk is the exclusive food of neonates during their first year of life. Therefore, left alone, newborn calves will die.

ASSESSMENT

Relocation attempts and calf adoption success

Since 1983, 13 abandoned neonates have been reported stranded alive in the SLE, including five individuals over the past four years. There have also been occasional reports of independent (weaned) juveniles trapped in semi-enclosed environments, and in need of assistance for returning to their natural environment.

Of the neonates, responses have been to push back the animal in the water (but the animal came back and died shortly after, n = 2), let nature follow its course (n = 2), euthanasia (n = 2), transport to a facility without additional care (n = 2), transport to aquaria for rescue and rehabilitation (n = 2), and relocation near herds of females with young (n = 3). The two neonates brought to aquaria died within 3 to 10 days of capture. The fate of the three relocated neonates is unknown; post-release tracking was limited and restricted to visual observations.

Two juveniles, both trapped several km up rivers located outside the SLE, were captured and relocated. One juvenile later identified as originating from the Arctic, survived the operation; the animal was relocated at the entrance of the river, and was sighted again in a port in Newfoundland where it became human-friendly and eventually died as a result of being hit by a propeller. The second juvenile was flown back to the SLE and released there. Rehydration procedures and blood tests were conducted during transport, and a satellite transmitter was deployed on the animal for monitoring movements. The signal was lost after 19 days. This animal's fate remains unknown. It is unclear how long the two juveniles had been in the river, but their poor condition upon capture suggested that they had spent some time in the area. This raised concerns that perhaps the animals could have benefitted from additional rehabilitation efforts before release.

Beluga neonates that are found stranded alive are a few days or weeks old. They have been separated from their mother. Based on experience with beluga and other cetaceans, pushing the animal back in the water only rarely leads to survival. Once stranded, the health of calves deteriorates rapidly. Chances of survival if relocated are therefore greatly diminished relative to healthy conspecifics of the same age. For a live-stranded beluga to have any chance to survive if relocated, lactation must resume within hours from relocation. Females with calves are unlikely to adopt a second calf while females without calves are not nursing. Induced lactation can take anywhere between 5 days and two weeks in dolphins. Therefore, the only possibility for a calf to resume lactation within hours from release would be a rapid encounter with a female that has just lost her calf. Willingness of the female to care for the calf, and calf vigour for establishing such a relationship are also requirements to successful adoption. Adoption also affects the energetics of the foster mother, which may change her likelihood of survival and fitness.

Adoption is an uncommon phenomenon in nature, but that has been reported in over 150 avian species and 120 mammalian species, including odontocetes. Adoption and allonursing of a newborn calf has been documented in belugas and dolphins in captivity but never in the wild for such young individuals (cases documented in the wild were for older animals).

The health of trapped juvenile (weaned) beluga depends largely on access to food and duration of entrapment, and whether they are in salt or freshwater. Chances of survival once released are better for juveniles than for neonates given their ability to feed independently.

Demographic Analysis

The potential conservation benefits of assisting individual beluga of different age classes to SLE population recovery were examined using a demographic model. The data consisted of age frequency distribution and fecundity data from a healthy population of beluga in Alaska, and records of dead SLE beluga reported from 1983-2017 as part of the carcass monitoring program. It was assumed that the sex ratio is 1:1 in the population, females give birth to a single calf, calves are born at the same time (birth-pulse), animals are mature at age 8, first births occur at age 9, and onset of senescence is at age 70. Only female reproductive and survival rates were considered in the demographic model.

Different models were developed to address uncertainties about the biology of the SLE beluga. There are concerns that reproductive rates may not be normal in this population, therefore the effects of lower reproductive rates on the dynamics of the population were simulated. Also, the demographic model is based on the age frequency distribution of beluga carcasses that have been detected on the beach or at sea. Beluga calves are much smaller and may not be detected as easily as older animals. Therefore, the impact of varying detection probability of newborn carcasses was also examined (Figure 1).

The projections of population growth and dynamics for SLE made while assuming reduced reproductive rates or lower detection of calves provided population growth estimates similar to those obtained recently using an integrated population model which estimated changes of 0.13% · y^{-1} between 1983 and 2002, followed by a decline of -1.13% · y^{-1} between 2003 and 2012 (Mosnier et al. 2015) (Figure 1). These scenarios were considered more reflective of the current situation of SLE beluga than those based on fertility and survival rates from a healthy (i.e., Alaska) population.

Generally, survival rates improved rapidly from birth to age 1, then increased slowly until maturity. Survival rates among adults remained high until age 40, but dropped off quickly for animals aged 40+ years (Figure 2).

Reproductive values, i.e., the expected number of future offspring produced by an animal of a specific age, increased rapidly in the first year in the SLE model where only 17% of the calves were detected. Reproductive value remained at a plateau until maturity but then declined. Among the remaining models the increase in reproductive value was more gradual, peaking at around 9-10 years old, then declining gradually with no definitive plateau.

The greatest impact on the population rate of increase would be achieved by improving the relative survival of immature individuals and young adults; changes in fertility had a lesser effect.

A second part of the analysis examined how many animals need to survive to contribute to halting the decline and recovery of the population. Currently if the population is declining at a rate of 1.13%·y^{-1} (i.e., $\lambda = 0.987$), then 10 to 19 animals will have to be saved and returned each year to the population, depending on their age class and probability of survival (Table 1). This number increases if chances of survival of the stranded or trapped animal are less than healthy conspecifics at release. The numbers of animals that would need to be released to be beneficial to population recovery far exceeds the numbers of compromised animals that are found each year.

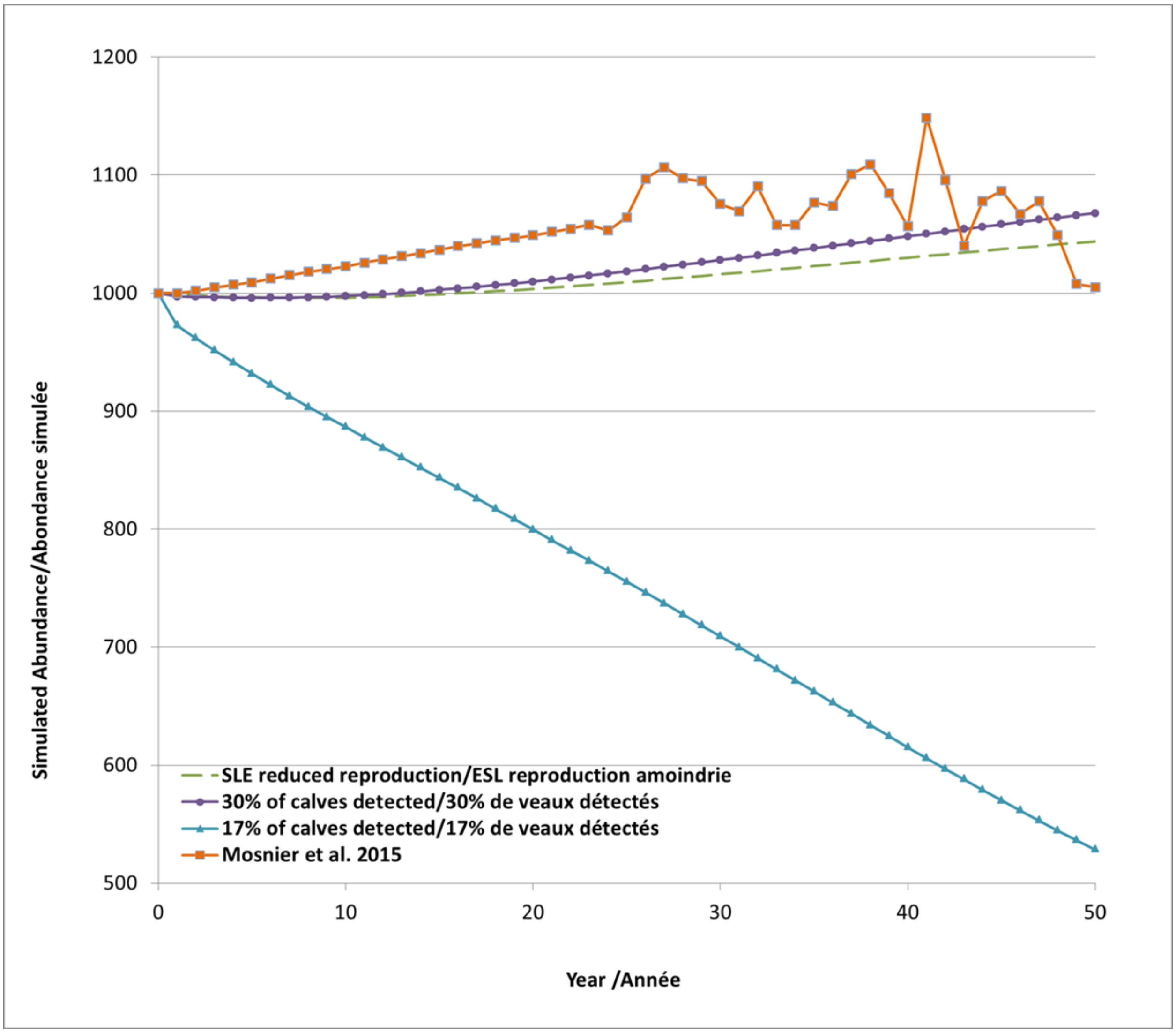

Figure 1. Model trajectories based on survival and fertility schedules for St. Lawrence Estuary (SLE) beluga. In all simulations the populations were scaled to a starting population of 1,000 animals. Only the first 50 years of the 100 year projection are shown to show how the trends deviate. The 'Mosnier et al.' run uses trend data from Mosnier et al. (2015) where the 1960-2010 SLE beluga trend has been re-scaled to a starting population of 1,000 animals and setting 1960 as year zero. The 'SLE reduced reproduction' and '30% of calves detected' runs simulate the slowly increasing population observed during the first 40 years by Mosnier et al (2015), while the '17% of calves detected' run represents the declining trajectory observed over the last decade (Mosnier et al. 2015).

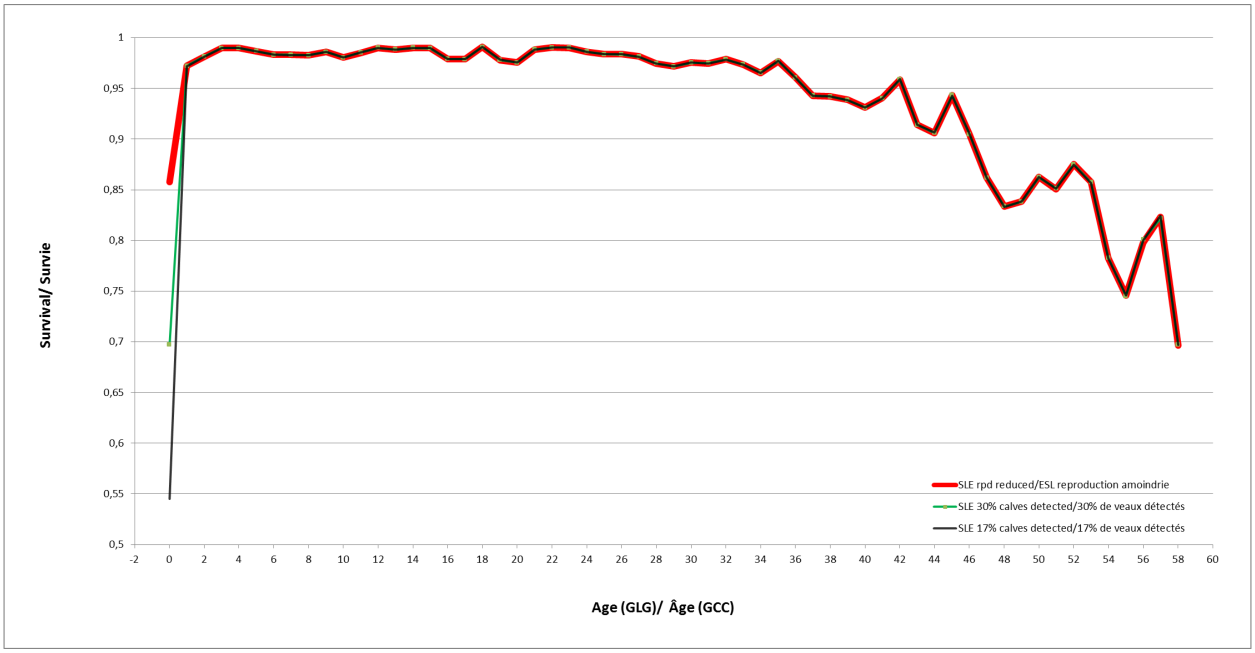

Figure 2. Estimated changes in age-specific survival rates from different models of St. Lawrence Estuary beluga. The y axis has been offset to clearly show survival at age 0 years. Survival values overlap for the scenarios starting at age 1 year. Age is defined assuming deposition of one growth layer group (GLG) per year.

Table 1. Minimum number of individuals that would need to be rescued successfully each year (n) to reverse the current decline (population growth rate λ = 0.9887; Mosnier et al. 2015) and achieve a stable population (λ = 1.0). Calculations were made assuming probability of survival P is unaffected by the animal having stranded alive (% reduction in P = 0), as well as for various percent reductions of this probability of survival. Note that if n > 100, then it exceeds the estimated annual calf production for this population.

% reduction in P	P for Calf		Minimum n of calves to rescue λ =0.9887	P for Juvenile	Minimum n of juveniles to rescue
	Initial model	17% calves detected		Any model	λ =0.9887
0	0.86	0.54	12-19	0.98	10
10	0.774	0.486	13-21	0.882	11
20	0.6192	0.3888	16-26	0.7056	14
30	0.43344	0.27216	23-37	0.49392	20
40	0.260064	0.163296	38-61	0.296352	34
50	0.130032	0.081648	77-122	0.148176	67
60	0.0520128	0.0326592	192-306	0.0592704	169
70	0.01560384	0.0097978	641-1021	0.01778112	562
80	0.00312077	0.0019596	3204-5103	0.00355622	2812
90	0.00031208	0.000196	32043-51032	0.00035562	28120

Sources of uncertainty

There is uncertainty in some of the assumptions and input parameters to the population model, including stability of age structure for SLE beluga after year 2000, and current reproductive rates. However, they are unlikely to affect model conclusions.

Live-stranding or entrapment are likely to affect probability of survival, but size of this effect is uncertain. Adoption success is considered to be close to zero based on the existing literature. However, the difficulty of documenting these cases in the wild makes this estimate uncertain.

There is also uncertainty about the potential consequences of adoption for the foster female in terms of probability of survival and fitness.

CONCLUSIONS AND ADVICE

Considering the current rate of decline of the SLE population, a large number of additional individuals (around 10 juveniles or 12-19 neonates) are needed each year to stabilize the population; even more to reverse the current trend and achieve population growth. Currently, reports of live-stranded neonates or entrapped juveniles are limited to one or two cases every 2-3 years, and the probability of survival of relocated neonates is close to nil. In this perspective, the benefit of relocating these few individuals to population recovery is nil and does not meet the objectives of Conservation Translocation., i.e., to have a measurable conservation benefit at the level of the SLE beluga population.

From an animal welfare perspective, relocating neonates or letting nature take its course might result in increased distress and suffering for animals that will not survive. Under these circumstances, euthanasia should be considered followed by a necropsy to improve our understanding of potential causes for stranding. An alternative consideration would be to take live-stranded neonates into captivity. However, abandoned calves are considered unsuitable for releasable once in captivity under the proposed DFO guidelines for the release of rehabilitated marine mammals.

Recognizing that multiple actions are needed to mitigate threats to the SLE population and stabilize it, relocating entrapped juveniles may be considered on other grounds given the higher likelihood that these individuals can survive following relocation. Effective translocation programs for juveniles require thorough pre-release planning, and post-release monitoring such as conducting health screening, assessing habitat quality at the release location and tracking of individuals to monitor health and survival. An evaluation by a veterinarian will provide insights into the general health status of the animals and probability of survival. If rehabilitation is considered as an option, then consideration must also be given towards the expected timeline for rehabilitation, since the chances for release decrease with increasing time in captivity. Guidelines developed for use in translocation operations associated with the capture, care, release and subsequent monitoring of released animals to evaluate survival and success could provide guidance to situations dealing with animals in difficulty.

OTHER CONSIDERATIONS

The model assumed a 1:1 sex ratio and only included females in the model. The conservation value was assumed to be greater for females than males given their potential contribution to recruitment. However, females are induced ovulators and thus, there needs to be a critical mass of male beluga in the population for mating to occur.

If future research suggests that the survival of relocated neonates has been substantially underestimated, then the recovery benefit of reintroducing these animals to the population would need to be revisited.

SOURCES OF INFORMATION

This Science Advisory Report is from the 26 February – 2 March 2018 St. Lawrence Estuary live beluga calf strandings. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Daoust, P.-Y., Ortenburger, A. 2015. Advice on euthanasia techniques for small and large cetaceans. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/111. v + 36 p.

DFO 2014. Status of beluga (*Delphinapterus leucas*) in the St Lawrence River estuary. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/076

DFO 2018. Advice on criteria for the release of rehabilitated marine mammals. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/026.

Hammill, M.O., and Lesage, V. 2018. Conservation value to assisting live-stranded neonates and entrapped juvenile beluga (*Delphinapterus leucas*) from the St. Lawrence Estuary population. DFO Can. Sci. Advis. Sec. Res. Doc. 2018/065. iii + 20 p.

IUCN/SSC. 2013. Guidelines for reintroductions and other conservation translocations. Version 1.0. Gland, Switzerland: IUCN Species Survival Commission, viiii + 57 pp.

Mosnier, A., Doniol-Valcroze, T., Gosselin, J.-F., Lesage, V., Measures, L.N., and Hammill, M.O. 2015. Insights into processes of population decline using an integrated population model: the case of the St. Lawrence Estuary beluga (*Delphinapterus leucas*). Ecol. Model. 314: 15-31.

Norris, T.A., Littman, C.L., Gulland, F.M.D., Baker, J.D., and Harvey, J.T. 2017. An integrated approach for assessing translocation as an effective conservation tool for Hawaiian monk seals. Endang. Species Res. 32:103-115.

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