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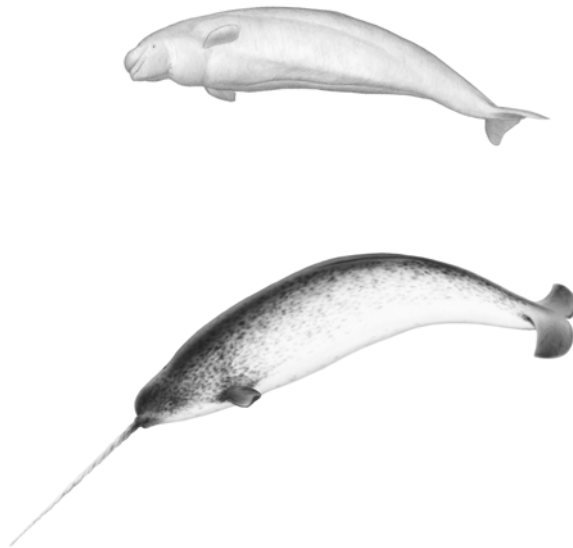Science Advisory Report 2008/035

TOTAL ALLOWABLE HARVEST RECOMMENDATIONS FOR NUNAVUT NARWHAL AND BELUGA POPULATIONS

Beluga by G. Kuehl and Narwhal by R. Phillips.

Figure 1: Map with the Nunavut Settlement area highlighted. Advice on harvest levels applies to whale populations hunted by Nunavummiut.

Context :

In response to a request from the Nunavut Wildlife Management Board, DFO Fisheries and Aquaculture Management (FAM) asked that DFO Science recommend Total Allowable Harvest (TAH) levels for all Nunavut stocks of narwhals and belugas. The NWMB would like to establish TAH for these stocks and FAM will use the recommendations in development of their Fisheries Management Plans.

SUMMARY

- Harvest level recommendations are made for Nunavut narwhal and beluga populations where an estimate of their population size is available.

- Cumberland Sound beluga are not included in this analysis as harvest level advice was previously provided and there is no new information with which to update the analysis.

- For the current analysis the Nunavut narwhal and beluga populations are considered data-poor.

- For data-poor populations, where there is insufficient recent data, Potential Biological Removal (PBR) estimates are used as the bases for providing advice on harvest levels.

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- Total allowable harvest level recommendations are presented as Total Allowable Landed Catch after removal of hunt losses.

- Hunt loss corrections are derived from annual reports of landed and lost whales from communities under Community Based Management.

- Allocation of harvest should consider that some populations are shared by communities within and outside of Nunavut during annual migrations and while in summer and winter ranges.

INTRODUCTION

In keeping with the Precautionary Approach Framework of DFO Fisheries and Aquaculture Management (DFO 2007), determining a total allowable removal must be done in spite of uncertainty in our knowledge of population size, growth dynamics and hunting losses. Because management control is done more effectively on the landed catch rather than the total removal (landed and lost), total allowable landed catch after removal of losses are proposed as Total Allowable Harvest levels.

ANALYSIS

Methods

The narwhal (Fig. 1) and beluga (Fig. 2) populations considered here are those that are known to be hunted by Nunavummiut. This includes those that were identified by the Canada/Greenland Joint Commission on Narwhal and Belugas and for which an estimate of population size is available. In addition, populations known to be harvested by Nunavummiut were identified from knowledge of range and genetic information (P. Richard unpublished data.). No attempt was made to estimate allowable landed catch for the narwhal populations which inhabit Smith Sound, Jones Sound and the Parry Islands because there are no estimates of their numbers. [*] The Eastern Beaufort Sea population is included because it is sometimes hunted by hunters from Kugluktuk. For the Cumberland Sound beluga population, a full assessment was done in the past to estimate population parameters. The results of this assessment supported the present annual landed quota of 41 and have been incorporated into the draft management and recovery plans for the population. The methods used for this population are not covered here but can be found in Alvarez-Flores (2005) and DFO (2005).

The Potential Biological Removal (PBR) method was used to evaluate the Total Allowable Harvest (Richard 2008). This method was developed in the United States for the regulation of human-induced mortality on marine mammals (Wade 1998). It is a conservative approach that produces a single threshold value for removals from a population. If removals are below the threshold, then the population is likely to increase or maintain itself above what is known as the optimum sustainable population level (OSPL) (Wade 1998). An optimum population size is defined as one above the Maximum Net Productivity Level (MNPL), i.e.: the population size at which the combined size and growth rate of the population produces the largest number of animals per year (largest productivity).

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PBR is estimated as:

$$PBR = N_{Min} \bullet R_{Max} \bullet 0.5 \bullet F_R$$

N_{Min} is the 20th percentile of the log-normal distribution of the estimated population size. R_{Max} is the maximum rate of increase for the population. It is equal to 1 - finite growth rate (λ) in a discrete time growth model. When unknown, as is the case for most narwhals and beluga populations, R_{Max} is set at a default of 0.04 for cetaceans. F_R is a recovery factor with values set to reduce the base PBR value depending on the known population status to promote recovery of those populations back to an OSPL (Wade and Angliss, 1997). For populations not known to have been depleted, the recovery factor is set to 1 as was done here except for Admiralty Inlet where it was set to 0.5.

The PBR method and the resulting Allowable Landed Catch (ALC) is the preferred method for stocks that are considered "data-poor", i.e.: where there is insufficient data to make a full assessment. Often, these stocks only have a single recent survey to assess population size or insufficient data to estimate population dynamic parameters.

The PBR is converted to an Allowable Landed Catch (ALC) as follows:

$$ALC = PBR\ (1 - LR)$$

Where LR is the loss rate. Loss rates were derived from the narwhal and beluga community-based management (CBM) community reports. For each species, a single LR was derived from the annual reports of the landed and lost numbers of hunted whales from the CBM communities and applied to all the ALC calculations.
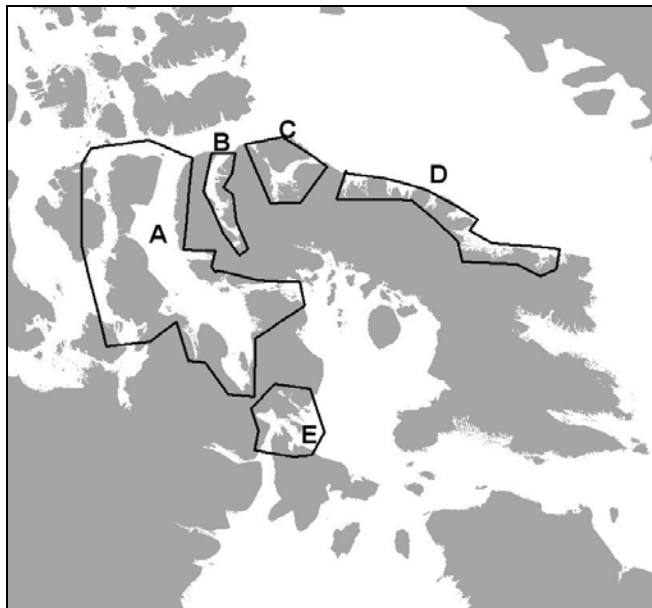

Fig 1: Summer range of Nunavut narwhal stocks discussed in document: A- Somerset, B- Admiralty, C- Eclipse, D- East Baffin, E- Northern Hudson Bay.
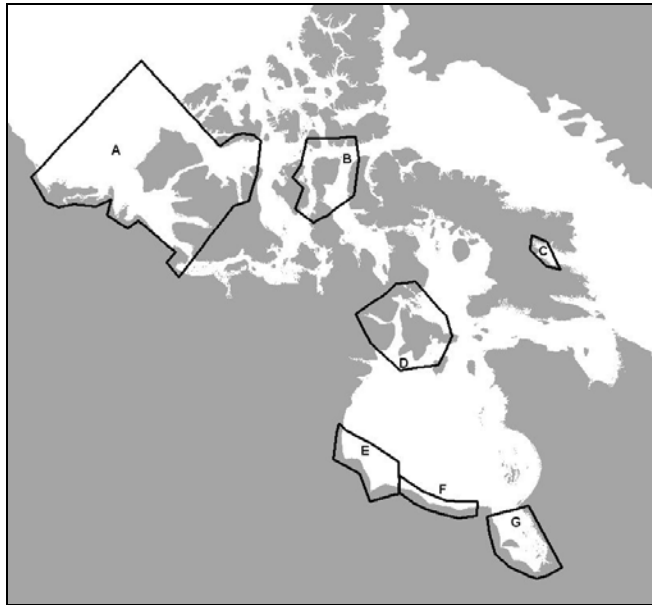
Fig 2: Summer range of Nunavut beluga stocks discussed in document: A- East Beaufort Sea, B- Somerset, C- Cumberland Sound, D- Northern Hudson Bay, E- Western Hudson Bay, F- Southern Hudson Bay. It is possible the James Bay beluga population (G) is occasionally hunted by Sanikiluaq hunters in winter, but this has not been confirmed.[*]

Results

The population estimates used in PBR calculations and risk analyses are presented in Table 1. The 20% percentile of the population estimate (N_{min}) used to calculate PBR and the corresponding Allowable Landed Catch (or PBR - mean losses) are presented in Table 2.

Table 1: Population estimates used for beluga and narwhal Allowable Landed catch estimates.

Population	Estimate	SE	CV	References
Nunavut narwhal stocks				
Somerset Narwhal	45358	15875	35%	Innes *et al.* 2002
Admiralty Narwhal	5362*	2681*	50%	Richard *et al.*, in prep.
Eclipse Narwhal	20225*	7285*	36%	"
East Baffin Narwhal	10073*	3123*	31%	"
N Hudson Bay Narwhal	5053	2009	40%	Bourassa, 2003; Richard *et al.*, unpubl. data*
Nunavut beluga stocks				
W+N+S Hudson Bay Beluga	63122	12429	20%	Richard 2005; Richard and Barber 1990
Eastern High Arctic*- Baffin Bay Beluga	21213*	5303*	25%	Innes *et al.* 2002
E Beaufort Sea Beluga	41803	7577	18%	Harwood *et al.* 1996, Kingsley and Gauthier 2002

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*Table 2: Recommended Allowable Landed Catch estimates obtained by the PBR – loss method. Shown for comparison are results from the risk analysis (greyed-out). A recovery factor of 1 was used, except in the case of Admiralty Inlet where it was set to 0.5. * Note: A TALC of 41 for Cumberland Sound Belugas was assessed in a previous science advice document (DFO 2005).*

Population	N_{min}	Loss rate correction (SD)	PBR	Total Allowable Landed Catch (TALC) — PBR minus losses	Risk Analysis — TALC for Prob(change ≥ - 10%) = 0.05
Nunavut narwhal stocks					
Somerset Narwhal	34068	1.28 (0.15)	681	532	598
Admiralty Narwhal	3602[*]	1.28 (0.15)	36	28	51
Eclipse Narwhal	15074*	1.28 (0.15)	301	236*	235*
East Baffin Narwhal	7805*	1.28 (0.15)	156	122	126*
N Hudson Bay Narwhal	3660	1.28 (0.15)	73	57	56
Nunavut beluga stocks					
W+N+S Hudson Bay Beluga	53563	1.18 (0.07)	1071	908	991
Eastern High Arctic*-Baffin Bay Beluga	17241*	1.18 (0.07)	345*	292*	315*
East Beaufort Sea Beluga	35930	1.18 (0.07)	719	609	668

CONCLUSIONS AND ADVICE

It is recommended that total allowable harvests be based on the recommended Allowable Landed Catch (Table 2). These are conservative numbers but, as a consequence of this conservatism, these levels are likely to allow sustained catches into the future until enough data, in terms of multiple index surveys and catch records, can be obtained to do more detailed population dynamic assessments. These TAH estimates can later be adjusted when there is good evidence of a change in loss rates or if there are new surveys to support a full assessment of these populations. For Cumberland Sound Belugas, it is recommended that the present landed quota of 41 be maintained.

In allocating the TAH, the NWMB should consider the fact that narwhal and beluga populations are shared by communities in different regions of Nunavut and in some cases with other regions outside of Nunavut. Narwhals are hunted locally in their summer range but may also be caught elsewhere in Nunavut during spring and fall migrations. Part of the Eastern High Arctic-Baffin Bay* beluga population is shared with Greenland, while the Western-Northern-Southern Hudson Bay population and possibly the James Bay population are shared with Nunavik.

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