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Quebec and Central and Arctic Regions

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Science Advisory Report 2017/040

IMPACTS OF FLEXIBLE QUOTA SYSTEM ON WALRUS (*ODOBENUS ROSMARUS ROSMARUS*) HARVESTING

Atlantic walrus Odobenus rosmarus rosmarus (Jason Hamilton, DFO)

Figure 1. Location of Atlantic walrus stocks as identified by management units in the eastern Canadian Arctic. The stocks are Baffin Bay (AW-01), West Jones Sound (AW-02), Penny Strait-Lancaster Sound (AW-03), North and Central Foxe Basin stocks (AW-04), Hudson Bay-Davis Strait and South and East Hudson Bay stocks.

Context:

DFO is continuing to build on the Sustainable Fisheries Framework for key fisheries that contains existing DFO policies for resource management decisions, and builds on new policies to address ecosystems factors and precautionary considerations. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recommended in 2006 that Atlantic Walrus be designated as a "Species of Special Concern." COSEWIC is currently re-assessing Atlantic walrus.

The Integrated Fisheries Management Plan (IFMP) for walrus in the Nunavut Settlement Area has been presented to the Nunavut Wildlife Management Board (NWMB) for approval. The Nunavut Wildlife Management Board (NWMB) has requested that the Department evaluate options for the carryover of the unused walrus Total Allowable Harvest (TAH) within a Management Unit.

Central and Arctic region resource managers have requested Science advice on the viability of a harvest credit accumulation and/or borrow-back system for unfilled annual Marine Mammal Tags within walrus management units in Nunavut.

SUMMARY

- The impact on the population of transferring harvest levels among years within a five year manage plan was examined.
- Several harvest scenarios were examined. These ranged from taking the same number of animals in each year of the plan to taking the entire Total allowable Harvest (TAH) in one year of the plan,
- Results indicate that varying the number of animals taken in any year of the management plan did not have a significant impact on the population, as long as the total number of animals taken over the entire five year period did not exceed the TAH identified for that five year period.

INTRODUCTION

Walrus is a key fishery for DFO and is reported on via the national Sustainability Checklist. DFO is continuing to build on the Sustainable Fisheries Framework for key fisheries that contain existing DFO policies for resource management decisions, and builds on new policies to address ecosystem factors and precautionary considerations. Increasing national and international attention regarding how Canada is managing these walrus stocks requires the Department to be able to demonstrate that harvests are sustainable, or take appropriate actions if current harvest levels are deemed unsustainable. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recommended in 2006 that Atlantic Walrus be designated as a “Species of Special Concern.” COSEWIC is currently re-assessing Atlantic walrus.

The Potential Biological Removal (PBR) method has been used to establish Total Allowable Harvests in Canada for stocks that are considered to be ‘Data Poor’, to generate an allowable harvest that has a very low probability of causing significant harm to the stock. It is calculated as $PBR= N_{min}*0.5*R_{max}*F_r$, where N_{min} is the minimum population size, R_{max} is the maximum rate of increase (R_{max} =0.08) and F_r is the recovery factor, which is a measure of uncertainty in the abundance estimate and understanding of the population (F_r =0.5 or 1.0 examined here). The implied management objective underlying the PBR formula is that the population will recover to a size that results in maximum productivity of the stock or population, referred to as the Optimal Sustainable Population (OSP). In Canada, OSP has no meaning. Instead, the term Maximum Sustainable Yield (MSY) is used. If the population is above the MSY size, the population remains there. Simulation trials have shown that the PBR method performs well with respect to the management objective under different types of bias and uncertainty (Wade 1998).

The present analysis address requests for advice from Ecosystem and Fisheries Management concerning what form of flex-quota, or Carry-Over provisions, could be established for use in the management of walrus once a Total Allowable Harvest (TAH) is established for a management unit.

The questions posed were:

1a. 100% carry-over for 1 year only.

1b. If 1a is not sustainable, is there any proportion of carry-over that is sustainable?

1c. If 1a and 1b are sustainable, could unused TAH from each season be accumulated for use in subsequent harvest seasons for consecutive years, potentially indefinitely until the existing TAH is modified?

2a. In any given harvest season can any portion of the next year's TAH be used in the current harvest season? In this scenario, the next year's TAH is reduced by the amount borrowed back for use in the current season.

2b. If a 100% borrow back from year 2, to use in year 1, is not sustainable, is there any proportion less than 100% that is sustainable?

3. May the 5 year sum of annual TAH for each walrus MU be applied as an overall walrus harvest limit that may be prosecuted at any time during this 5 year consecutive period?

Species Biology

The walrus (aivik, Inikutitut name) is Canada's largest pinniped. Both males and females are about 125 cm long at birth but adult males are significantly longer (315 cm) than adult females (277 cm). In both sexes, the upper canine teeth develop into long tusks that start to appear when the animal is about 2 years old. In adult males from Foxe Basin, tusks averaged about 28.5 cm in length with a circumference at the base of about 16.7 cm. Tusks of females may be as long (~28.1 cm) but are more slender, with a base circumference around 13.2 cm. Walrus routinely haul-out onto ice or land in all seasons and show a high degree of fidelity to haulout sites and feeding areas. It is thought that females and their young return to certain sites more faithfully than do adult males. Although some hauled out groups may contain animals of all ages and both sexes, walrus tend to segregate by age and sex most of the year. Walrus distribution is thought to be influenced not only by the availability of haul-out sites, but also shallow water for feeding on bivalve molluscs, their main prey, and other invertebrates. Most feeding is believed to take place in water less than 100m deep although walrus can dive deeper. Some walrus also eat seals, a behaviour that may be more common when they do not have access to shallow water areas. Hunters distinguish seal-eating walrus by their yellow tusks. The mating season is in January to April. Implantation in the uterus appears to occur in late June to early July and the calf is born the following May-June. Age of first ovulation varies among populations, but is generally between 5-10 years. The calving interval is generally 3 years. The overall pregnancy rate among mature females is 33-35%.

ASSESSMENT

Two general approaches were used to examine the impact of a flexible TAH system on a simulated population of Atlantic walruses. In the first approach, we adopted the framework used previously to examine a similiar question for narwhal (DFO 2015). In a second approach, we conducted the simulation using the stock assessment model. Both models included a small amount of natural variability in population growth rates, to reflect that natural populations are unlikely to increase at a constant rate.

Five harvest scenarios were tested by varying the number of animals removed in each year, assuming a 5 year management plan. The TAH taken in each year (t) was a multiplier (O_t) of the PBR estimate i.e. the TAH in year t was a multiple such that TAH= PBR_t*O_t. The scenarios examined were:

1. the Base scenario, which assumed a constant harvest, where O_t=(1,1,1,1,1),
2. the Front ended scenario, where harvest is composed of the current year harvest allocation plus the total harvest quota borrowed from the next year ie O_t=(2,0,2,0,1),
3. the Back ended scenario, where the total harvest allocation for the current year is carried over to the next year ie O_t=(1,0,2,0,2), and finally,

4. the 5X scenario, where all the quota planned for the 5 year management plan is taken in one year i.e. O_t=(5,0,0,0,0).

Impacts of these scenarios were evaluated using a starting population of 5,000 or 10,000 animals and were projected for 100 years into the future. The carrying capacity (K) was set at 20,000 walruses and it was assumed that the MSY population was 10,000 individuals. All projections for each scenario resulted in the median population estimate moving above MSY within 20 years (Fig. 2).

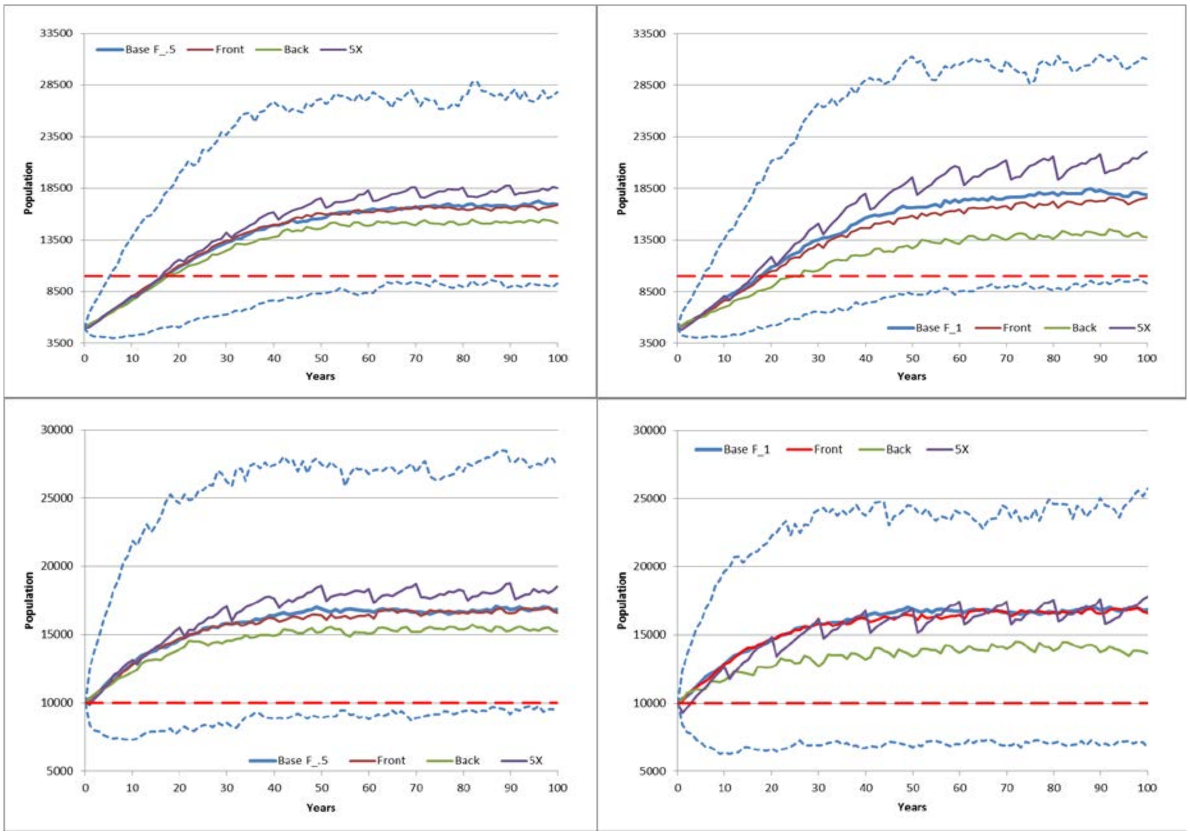

*Figure 2. Projected changes in abundance for a population subject to the different harvest scenarios projected forward 100 years. The red dashed line is the abundance at the Maximum Sustainable Yield (MSY) level. The dotted lines represent the 95% confidence intervals for a population projected forward with the same harvest taken in each 5 year block (Base scenario). Projections assumed a population that started below MSY levels (N=5000) and a recovery factor of 0.5 (top left), a starting population at the MSY level (N=10,000) and a recovery factor of 0.5 (bottom left), a starting population below MSY (N=5,000) and a recovery factor of 1 (top right) and a starting population at MSY (N=10,000) and a recovery factor of 1 (bottom right). Annual harvests varied according to the scenario, but the overall harvest in a 5 year block did not exceed 5*PBR.*

Only slight differences were observed in the median trajectories of the population between the different scenarios. The probability that the population would be above MSY after 100 years was high (more than 75% of the modelled populations). Some differences in population trajectories were observed, but these differences were not consistent between scenarios, indicating they were due more to variability/uncertainty in net productivity, than to the type of harvest scenario applied during the simulation.

In a second approach, we conducted the simulation using the stock assessment model. This model was fitted to survey data and the PBR was calculated. The model was projected forward five years, and a simulated abundance estimate was generated. The model was refitted, taking into account this new simulated abundance estimate and the PBR was recalculated. This simulation repeated six times resulting in an overall projection into the future of 35 years. Three different scenarios were examined: Base scenario where an equal PBR was taken every year [O_t ~ (1,1,1,1,1)], a Front ended harvest [O_t ~ (2,0,2,0,1)] and a Back ended harvest [O_t ~ (1,0,2,0,2)].

Under all scenarios the population increased, but the probability that the population was above MSY was only 0.5 after 35 years. Overall, the population did not appear to recover above MSY as quickly using the stock assessment model, but the results were generally the same as those obtained in the first series of simulations (Fig. 3).

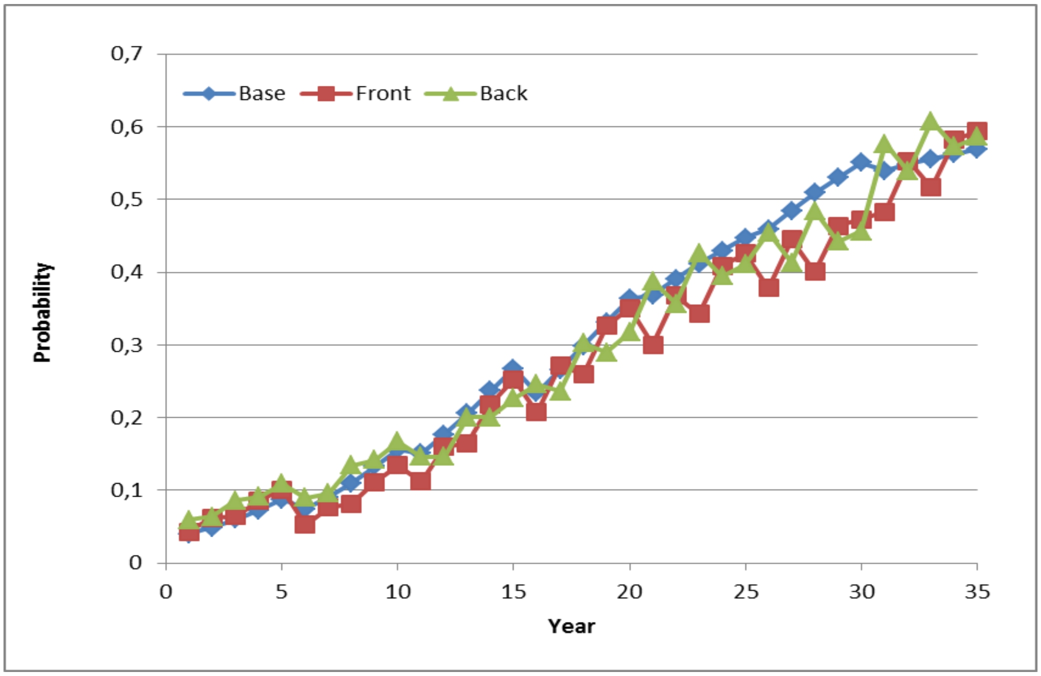

Figure 3. The probability that the population was above the Maximum Sustainable Yield (MSY) level of 10,000 after a simulation with MSY projections extending 35 years into the future. Three harvest scenarios (Harvest=PBRO_t) were examined: Base O_t=(1,1,1,1,1), Front ended O_t=(2,0,2,0,1), and Back ended O_t=(1,0,2,0,2).*

Sources of Uncertainty

In this study, it was assumed that the proportion of males and females as well as the age structure of the harvest are same as that found in the population. If the harvest is focussed towards one sex or certain age classes, then the harvest may have a different impact on the conclusions from the simulation exercise.

The simulations examined here made certain assumptions about the productivity of the herd. If environmental changes result in changes in productivity of the herd that exceed the level of uncertainty already included, it may lead to different conclusions from the simulations.

CONCLUSIONS

Both approaches tested suggest that the use of a flexible quota system is unlikely to have an impact on the population as long as the overall harvest does not exceed levels identified under a regime of constant harvest levels.

OTHER CONSIDERATIONS

If the TAH is distributed evenly over the period of the management plan, then adjustments in the catch can be made if unexpected environmental conditions are encountered. If the entire TAH identified for the management period is taken in a single year, then this may reduce manager's ability to adjust for unexpected events.

SOURCES OF INFORMATION

This Science Advisory Report is from the October 17-21, 2016 Atlantic Walrus flexible quota advice. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

DFO. 2015. Sustainability of a flexible system of total allowable annual catches of narwhals (*Monodon monoceros*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/006. v + 13 p.

Hammill, M.O., Young, R.A., and Mosnier, A. 2016. Evaluating impacts of a flexible quota system on walrus harvesting. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/112. iv + 17 p.

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