



ESTIMATES OF ABUNDANCE AND TOTAL ALLOWABLE REMOVALS FOR HUDSON BAY-DAVIS STRAIT AND SOUTH AND EAST HUDSON BAY ATLANTIC WALRUS (*ODOBENUS ROSMAREUS ROSMAREUS*) STOCKS



Atlantic walrus *Odobenus rosmarus rosmarus*
(Jason Hamilton, DFO)

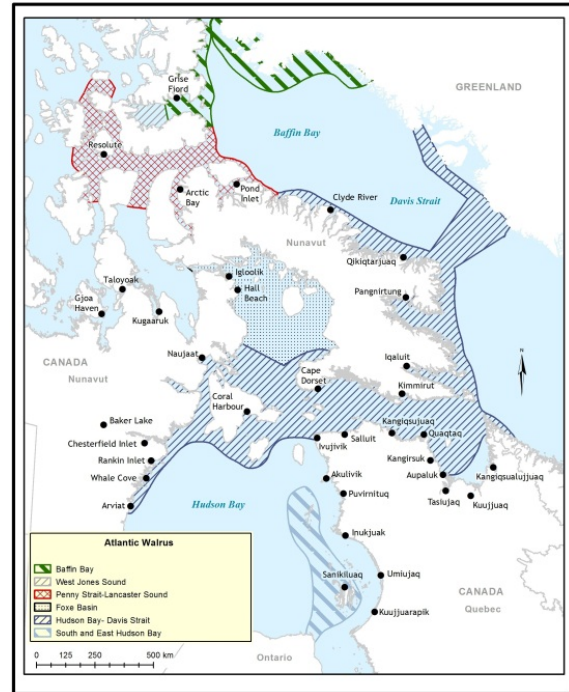


Figure 1. Location of Atlantic walrus stocks in the eastern Canadian Arctic. The stocks are Baffin Bay (AW-01), West Jones Sound (AW-02), Penny Strait-Lancaster Sound (AW-03), North and Central Foxe Basin stocks (AW-04), Hudson Bay-Davis Strait and South and East Hudson Bay stocks.

Context:

There are seven walrus stocks in the eastern Canadian Arctic. Increasing national and international attention regarding how Canada is managing these walrus stocks require the Department to be able to demonstrate a sustainable harvest or to take appropriate actions if current harvesting is deemed unsustainable.

The management of the Hudson Bay-Davis Strait (HBDS) and South and East Hudson Bay (SEHB) stocks is shared between Central & Arctic and Quebec Regions, as well as between two land claim areas (Nunavut and Nunavik). Greenland also harvests from the HBDS stock.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recommended that Atlantic Walrus be designated as a "Species of Special Concern" in 2006. COSEWIC is currently re-assessing the status of Atlantic walrus.

Currently, Resource Management is in the process of developing an Integrated Fisheries Management Plan (IFMP) for Atlantic walrus for Nunavut, and where there is sufficient information to do so, the objective of sustainable harvest levels will be included.

Abundance estimates and sustainable harvest level recommendations are still required for the SEHB stock and need to be updated for the northern Hudson Bay-Hudson Strait area of the HBDS stock. This information will be provided to the Nunavut Wildlife Management Board (NWMB) and the Nunavik Marine Region Wildlife Board (NMRWB) for their consideration in identifying Total Allowable Harvest (TAH) or Total Allowable Take (TAT) levels.

Objectives: *To provide population abundance estimates and advice on Sustainable harvest level recommendations for the Hudson Bay-Davis Strait (HBDS) and South and East Hudson Bay (SEHB) Atlantic walrus stocks.*

SUMMARY

- Walrus are a challenging species to enumerate owing to their aggregated distribution and correlated haulout behavior resulting in highly variable proportion of animals hauled out at one time.
- Several methods have been used to estimate walrus abundance. All methods that estimate the number of animals on land or ice, require a correction factor to adjust the counts for animals that are in the water (not visible) when the surveys are conducted.
- Based on simulation studies, the Simple Count (SC) method, using mean counts provides a reliable and unbiased estimate of the number of animals hauled out.
- Aerial surveys were flown during September 2014 to count walrus in the northern Hudson Bay-Hudson Strait portion of the Hudson Bay-Davis Strait stock, and the South and East Hudson Bay stock.
- The uncorrected counts for the surveyed portion of the Hudson Bay-Davis Strait stock and the South and East Hudson Bay stock were 2,144 and 58 animals, respectively.
- These counts were adjusted to an estimate of total numbers using an estimated proportion of animals hauled out of 0.3. This estimate was obtained by taking the average haulout proportion from seven published studies.
- The corrected survey estimates of walrus abundance were 7,100 (95%CI: 2,500-20,400) (rounded to the nearest 100) for the Hudson Bay-Davis Strait stock and 200 (95% CI:70-570) (rounded to the nearest 10) from the South and East Hudson Bay stock.
- A 2007 survey of the east Baffin component of the Hudson Bay-Davis Strait stock resulted in an estimate of 2,500 (95% CI 1,800-3,500)(rounded to the nearest 100) for that region.
- Over 85% of the animals counted were detected on haulout sites on a complex of islands bounded by Southampton and Coats islands in northern Hudson Bay and by an island complex formed by Nottingham/Salisbury islands in western Hudson Strait. These counts are similar to counts from similar surveys of these island areas completed during the 1950s, 1970s, 1980s.
- Counts of walrus from the South and East Hudson Bay stock from the Sleeper Islands area were low, but were also similar to previous reports from this area. The survey did not cover the Hudson Bay arc or James Bay, although walrus have been seen in these areas in the past.
- A surplus production population model, that included reported harvest information, was fitted to the time series of abundance estimates from the northern Hudson Bay-Hudson Strait area of the HBDS stock, using Bayesian methods. One of the strengths of the

Bayesian approach is that it provides a framework to account for uncertainty in model inputs.

- The model indicated that the population declined from approximately 10,400 (95% Credible Intervals=6,400-19,800) animals in 1954, reaching a minimum of 3,600 (95% Credible Intervals=2,600-6,100) in 1993, but has increased to 7,000 (95% Credible intervals=4,100-10,700) (rounded to the nearest 100) animals in 2014.
- Total Allowable Removals of walrus in the northern Hudson Bay-Hudson Strait component of the HBDS stock were estimated using the Potential Biological Removal method. In previous walrus assessments, a maximum rate of increase (R_{max}) =0.07 has been used. This review concluded that an R_{max} of 0.08 is more appropriate. Harvest options using a Recovery Factor of 0.5 and 1.0 are also presented.
- A PBR estimate based on the estimated 2014 population size from the model for the area of the HBDS stock that was surveyed was 114 and 228 for Recovery Factors of 0.5 and 1, respectively.
- A previous review, in 2013, for the east Baffin Island component of the HBDS stock presented a PBR estimate of 38 animals, but this was based on using a R_{max} of 0.07. The PBR increases to 44 and 88 for Recovery Factors of 0.5 and 1.0 respectively, when recalculated using an R_{max} of 0.08.
- The PBR calculation includes removals from all sources. The average reported harvest over the last 5 years from the HBDS stock has been 85 animals per year. This implies a total removal of 121, assuming a Struck and Loss (S&L) rate of 30%, but does not include removals due to non-reporting or other possible human sources of mortality, e.g., ship strikes.
- A population model was not fit to the South and East Hudson Bay stock because abundance information is more limited. PBR estimates for this stock ranged from 2 and 4 animals with Recovery Factors of 0.5 and 1, respectively. Reported average removals over the last 5 years have been 4 animals per year, implying a total removal of 6 animals, assuming a S&L of 30%, but does not include removals due to non-reporting or other human sources of mortality.
- Samples are needed to confirm if the walrus in southeast Hudson Bay are a separate stock as currently considered or are connected to the HBDS stock.
- In addition to research on stock structure, additional surveys are needed to evaluate abundance of walrus in the SEHB stock.
- A Precautionary Approach framework with clear management objectives is needed. This would allow for more risk-based advice to be provided. In the meantime, the model should be periodically updated with new survey data and model outputs used to provide PBR estimates.

INTRODUCTION

Walrus in the Canadian Arctic have been divided into two genetic populations and seven stocks (Figure 1) based on genetic, isotope, satellite tag, and elemental analysis. Two stocks, located in Foxe Basin, are managed as a single group. DFO Science has provided abundance estimates and sustainable harvest advice on four stocks and one partial stock: the Baffin Bay (BB), Western Jones Sound (WJS) and Penny Strait-Lancaster Sound (PS-LS) units belonging to the high Arctic population and for the Foxe Basin and the southeast Baffin Island portion of the Hudson Bay-Davis Strait (HBDS) stock, belonging to the central Arctic population.

Walrus are widely distributed in the eastern Canadian Arctic and are often found in aggregations of tens to thousands. During summer months, groups of walrus often haul out on ice floes or, if no ice is available, at terrestrial sites. The practice of using haulout counts to estimate stock size for walrus is thought to be an appropriate survey method but this method is not well developed. As a result, several approaches have been used. Data from satellite tags are used to adjust the haulout counts to account for those animals missed by the survey because they are at sea.

Owing to limited survey effort, walrus stocks are considered data poor with respect to the assessment of population status. DFO has used the Potential Biological Removal (PBR) method to develop advice about sustainable removals for marine mammals considered data poor. PBR refers to all human-caused mortality so estimating a Total Allowable Removal (TAR) provides the level of removals from all human-caused mortalities that should allow the population to maintain an optimal population size, or grow. The purpose of this document is to use recent aerial survey information to estimate TARs for these two walrus stocks.

Background

Walrus is a key fishery for DFO and is reported on via the national Sustainability Checklists. 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. Increasing national and international attention regarding how Canada is managing walrus stocks requires the Department to be able to demonstrate sustainable harvests, or take appropriate actions if current harvest levels are deemed unsustainable. Currently, an Integrated Fisheries Management Plan (IFMP) for Atlantic walrus in the Nunavut Settlement Area is being developed. Surveys, along with abundance estimates and Total Allowable Removal estimates, have been completed for the High Arctic and Foxe Basin (FB) walrus stocks. However, abundance estimates and sustainable harvest level recommendations are still required for the South and East Hudson Bay (SEHB) stock and portions of the Hudson Bay-Davis Strait (HBDS) stock. This advice will be considered by the Nunavut Wildlife Management Board (NWMB) and the Nunavik Marine Region Wildlife Board (NMRWB) in the possible establishment of total allowable harvest (TAH) or Total Allowable Take (TAT) levels. The management of the South and East Hudson Bay and the Hudson Bay-Davis Strait stocks is shared between Central & Arctic and Quebec Regions, as well as between two land claim areas (Nunavut Settlement Area and Nunavik Marine Region). The Canadian communities harvesting from these stocks are listed in Table 1. Greenland also harvests the Hudson Bay-Davis Strait stock.

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 Atlantic walrus is currently listed on Appendix III of the Convention on International Trade in Endangered Species (CITES). As such, anyone wishing to export walrus parts or derivatives from Canada must obtain an export permit from the Canadian CITES administration. However, a non-detriment finding is not required for species

listed on Appendix III of CITES. In 2009 and again in 2012, the United States consulted with range states on the possibility of putting forward a proposal to uplist walrus to Appendix II, citing potentially unsustainable exploitation rates, lack of scientific information on population abundance, lack of a formal management plan, high value international trade in walrus ivory, and the difficulty in distinguishing fresh ivory from fossilized as some reasons for seeking increased protection. If listed on Appendix II, a non-detrimental finding would be required for continued trade in this species.

Species Biology

The walrus (aivik, Inuktitut 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. All 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, walruses 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 depths less than 100m, 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 system of walruses involves males competing for and defending access to females for mating for periods of up to five days. The mating season extends from 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 about 35%.

Table 1. Nunavut and Nunavik communities harvesting from the Hudson Bay-Davis Strait stock and from the south and East Hudson Bay stock.

Population	Stock or management unit	Nunavut Harvesting Communities	Nunavik Harvesting Communities
Central Arctic	Davis Strait portion of the Hudson Bay Davis Strait stock	Clyde River Qikiqtarjuaq Iqaluit Pangnirtung	
	Northern Hudson Bay-Hudson Strait portion of the Hudson Bay-Davis Strait stock	Arviat Cape Dorset Chesterfield Inlet Coral Harbour Kimmirut Rankin Inlet Naujaat Whale Cove	Puvirnituq Akulivik Ivujivik Salluit Kangiqsualujjuaq Kuujjuaq Tasiujaq Aupaluk Kangirsuk Quaqtaq Kangiqsujuaq
Unknown	South and East Hudson Bay	Sanikiluaq	Inukjuak Kuujuarapik Umiujaq

ASSESSMENT

Walrus are a challenging species to enumerate owing to their aggregated distribution and correlated haulout behavior resulting in highly variable numbers of animals hauled out at one time. Several methods have been used in the past to obtain a best count of animals hauled out during the survey. These counts must then be corrected for the estimated proportion of animals that were in the water when the survey was completed. In this assessment, simulations were used to examine the effectiveness of the different methods of counting hauled out animals. It was concluded that the least biased method was to use the average counts from haulout sites that have been surveyed multiple times. These are referred to as Simple Counts. The Simple Counts are adjusted for animals in the water when the survey was completed using the average proportion of animals hauled out (from satellite tags) and taking into account that walrus tend to haulout together, i.e. there is some correlation among animals in their haulout behaviour.

Hudson Bay-Davis Strait stock

Communities located in the northern Hudson Bay and the Hudson Strait portions of the Hudson Bay-Davis Strait stock were consulted to obtain information on the location of walrus haulout sites and timing to conduct surveys of walrus in this area (Fig. 2). The aerial survey was flown using two deHavilland Twin Otter 300 aircraft. Two observers were stationed on the shoreward side of the aircraft, with a third team member acting as a navigator and camera operator and making observations on the offshore side of the aircraft. The survey used both visual and photographic survey methods.

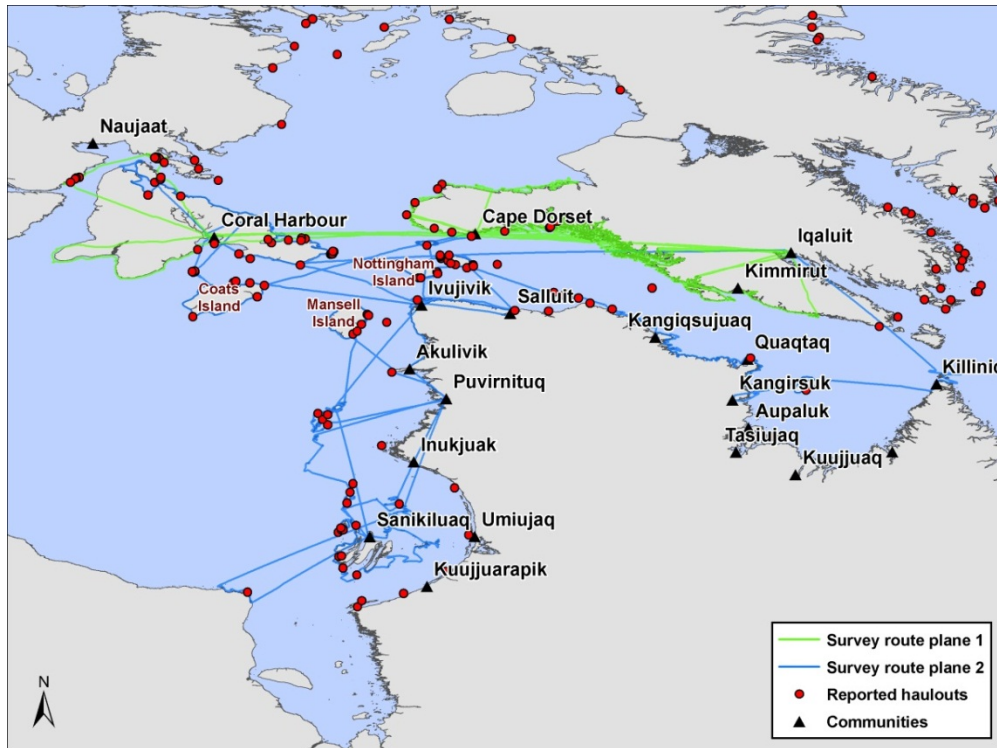


Figure 2. Locations of known walrus haulout sites from the literature and from discussions with hunters and survey tracks flown by the two survey aircraft during September 2014.

The visual observations and the photographed animals were compared and matched to eliminate duplicates. If haulout sites were visited two or more times, the average count was recorded for that site. The counts were then corrected by dividing the number of walrus recorded at the site when surveyed by the estimated proportion of the population that was hauled out. We used an average haul out proportion of 0.3 (SE=0.187), taken from 7 studies involving a total of 58 transmitters deployed on walrus. The uncertainty associated with the proportion of the population hauled out was incorporated into the corrected abundance estimate.

In addition to the current survey, aerial surveys using similar methods were flown over the Southampton Island and Nottingham Island areas during the 1950s, 1970s, and 1980s. These areas accounted for over 85% of observations in the 2014 survey. Additional estimates are available from two strip-transect surveys flown during the spring of 2012 in Hudson Strait (Table 2).

These data were incorporated into a stochastic stock-production model, assuming density dependence acting on the population growth rate. The model was fitted using Bayesian methods to the 1983-2011 aerial survey time-series and included information on reported harvests (1954-2014).

Table 2. Walrus counts from different studies of the Hudson Strait and northern Hudson Bay components of the HBDS stock.

Location	Type	Date	Number	Study
Hudson Strait/northern Hudson Bay	Aerial	Sept 2014	2144 ¹	Current study
Hudson Strait	Aerial	Mar-Apr/2012	5254 ²	Elliot et al. 2013
Walrus-Coats Island-Southampton Island	Aerial	Sept 2014	1859 ³	Current study
	Aerial	Aug 1990	1373	Richard 1993
	Aerial	July 1989	1231	Richard 1993
	Aerial	Aug 1988	757	Richard 1993
	Aerial	July –Aug 1977	6-2171	Mansfield & St Aubin 1991
	Aerial	July-Aug. 1976	254-1491	Mansfield & St Aubin 1991
	Aerial / boat	Aug 1961	2650	Fisher 1961
Nottingham/Salisbury Islands	Aerial	August 1954	2900	Loughrey 1959
	Aerial	Sept 2014	445 ³	Current study
	Aerial	Aug 2010	714	Gosselin pers. Comm.
	Aerial	Aug 1990	461	Richard 1993
	Aerial	July 1989	97	Richard 1993
	Aerial	Aug 1988	92	Richard 1993
	Aerial	Aug 1952	0	Loughrey 1959

¹ 86% of walrus observed from Nottingham/Salisbury and Southampton/Coats/Walrus Islands. Each area counted twice, average presented

² Strip transect surveys, numbers corrected for animals hauled out

³ Included as part of the counts in ¹

Reported harvests underestimate the number of walrus killed because of animals wounded or killed but not recovered, as well as an absence of harvest reports for some communities in different years. For missing harvest data, an estimate of harvests was obtained by averaging harvests from adjacent years. The proportion of animals that were killed but not recovered was estimated by the model, and is referred to as struck-and-loss.

The method used to calculate the total Allowable Removal (TAR) levels is as follows:

$$TAR = PBR = N_{min} \cdot R_{max} \cdot 0.5 \cdot F_R$$

where : N_{min} is the estimated minimum population size.

R_{max} is the maximum rate of increase for the population.

F_R is a recovery factor with values set to reflect known population status.

Estimates of N_{min} were calculated from the population size estimated by the population model (HBDS stock), or from the aerial survey estimate (SEHB), taking into account the uncertainty around this estimate.

In previous assessments, a maximum rate of increase (R_{max}) = 0.07 has been used. This review concluded that a R_{max} = 0.08 is more appropriate (United States Federal Register 2013).

There are no defined criteria for setting F_R . The Department has previously accepted that, $F_R = 0.5$ should be used for stocks where there is evidence that abundance is declining – otherwise $F_R = 1.0$ can be used, or it has suggested that $F_R = 0.5$ should be used for populations with a conservation status considered to be threatened or endangered – otherwise $F_R = 1.0$ can be used.

The survey covered the islands in northern Hudson Bay and the coastal areas of Hudson Strait (Table 2, Fig. 3) and the northern Hudson Bay islands of Southampton/Walrus/ and Coats Islands and the western Hudson strait islands of Salisbury and Nottingham Islands and accounted for 86% of the 2,144 animals that were counted. After correcting for animals not hauled out, the abundance estimate in 2014 was 7,147 (SE=4,122) (Table 2).

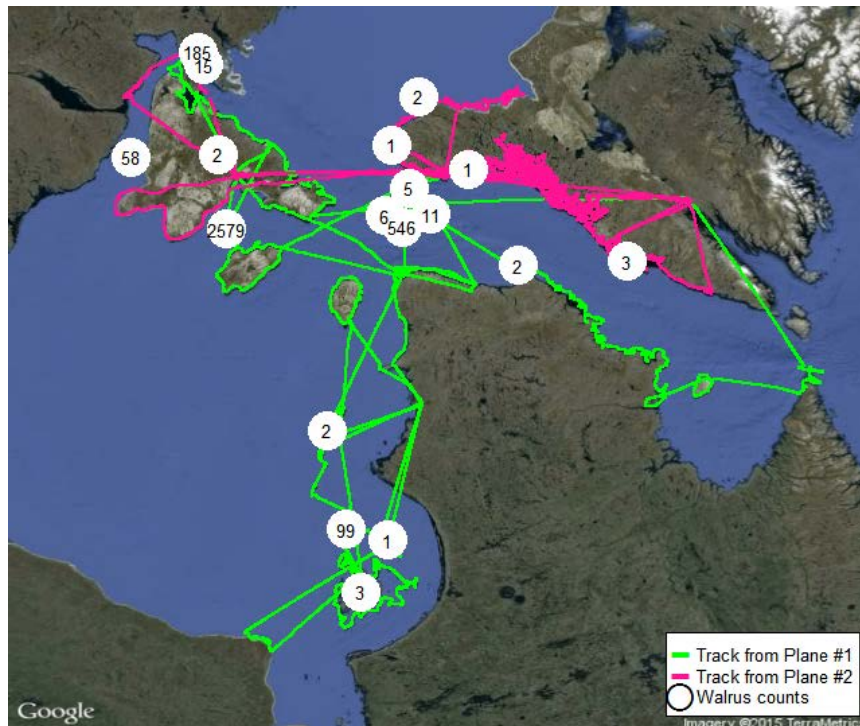


Figure 3. Maximum counts from photographs of hauled out walrus from the study area.

This survey did not cover the east Baffin Island component of the HBDS stock. The east Baffin Island region was surveyed in 2007 and resulted in an estimated population of 2,533 (SE=420) animals after correcting for the proportion of the population hauled out. There is some genetic differentiation between animals from Hudson Strait and animals from east Baffin, but there is also some evidence of movement from Hudson Strait to the east Baffin region, which is not well understood at the current time.

Population model

The model was fitted to the time series of survey data (1954-2014), incorporating harvest information (1954-2014) (Table 2, Fig. 4). The model indicated that the population declined from 10,400 (95% CI 6,400 to 19,800) animals in 1954, reaching a minimum of 3,600 (95% CI: 2,600 to 6,100) in 1993, but has increased to 7,100 (95% CI: 4,100 to 10,700) animals in 2014 (Fig. 4).

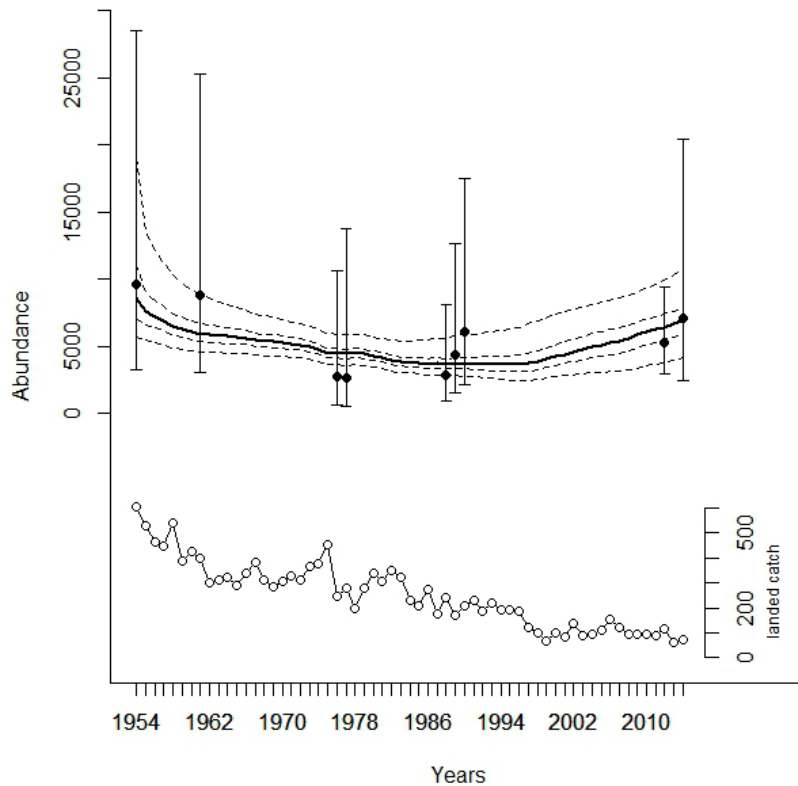


Figure 4. Model estimates of HBDS walrus abundance. Solid line: median estimates. Dashed lines : 95% Bayesian Credible Interval. The model was fitted to corrected aerial survey estimates (closed circles, $\pm 95\%$ confidence intervals), which were adjusted assuming that the proportion of the population hauled out was 0.30. Right y-axis: Reported catch of walrus from communities hunting this stock (Table 1).

South and East Hudson Bay stock

The survey flown in southeast Hudson Bay followed the same design as that used to survey the HBDS stock. The area covered by the survey is shown in Fig. 2. Walrus were seen on the Ottawa, Sleeper, Driftwood Islands and among the southern islands. Both the Ottawa and the Sleeper Islands were surveyed twice. The first flight flew over the area on 13 September. The survey flew around the Belcher Islands (Sanikiluaq) on the 14 September, then flew to Cape Henrietta Maria, at the northwest tip of James Bay, then flew a second time over the Sleeper Islands. The Ottawa Islands were surveyed a second time on 15 September. A total of 112 animals were seen during the survey of the South and East Hudson Bay stock. The largest group of 99 animals was photographed on the Sleeper Islands during the 14 September survey.

Taking the counts, and excluding possible duplicates, resulted in an average number hauled out of 58. Adjusting for the average proportion of animals hauled out results in an abundance estimate of 200 (SE=60) walrus (rounded to the nearest 100 animals). This survey was the first dedicated walrus survey of this stock, but some counts are available from other studies (Table 3).

Table 3. Walrus counts reported from the SEHB stock

Location	Type	Date	Count	Source
Belcher/Sleeper Islands	Aerial	Sept 2014	58 [†]	Current study
	Aerial (beluga)	Aug 2011	57	Gosselin pers. Comm.
	Aerial (beluga)	Aug 2008	14	Gosselin pers. Comm.
	Aerial	Summer 1993	30	Desrosier in Stewart and Higdon, unpubl.
	Boat	Summer 1971	100	Manning 1976
	Boat	1930	400	Twomey and Herrick (1942) in Stewart and Higdon unpubl
Cape Henrietta Maria		2007	147	Stewart and Higdon 2014
Cape Henrietta Maria		Spring 1955	1000	Loughrey 1959

[†] Average of two counts

Catch data for communities harvesting from the Hudson Bay-Davis Strait stock and from the South and East Hudson Bay stock suggests that the number of walrus harvested is declining, but assessing trend is problematic because data are missing from some communities throughout the time series. Missing reports were interpolated by taking the average reported harvests of the nearest 5 years for that community. Reported harvests from all Canadian communities harvesting from the Hudson Bay-Davis Strait stock averaged 130 (SE=52, N=25) animals annually from 1989 to 2014, but have declined to an average harvest of 85 (SE=10.5, N=5) animals per year over the last 5 years (Table 1, Fig. 4).

Reported harvests from the South and East Hudson Bay stock were relatively constant from the beginning of the time series (1973-1998) with an average of 12 (SE=1.62, N=26) animals reported harvested every year. Since 2009, fewer animals have been reported harvested with the annual mean dropping to 2 (SE=0.9, N=5) animals per year (Fig. 5).

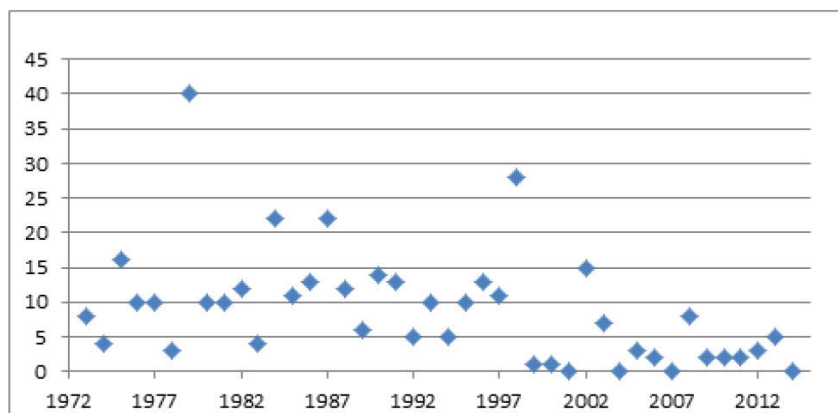


Figure 5. Reported harvests from communities hunting the South and East Hudson Bay stock.

Total allowable Removals

PBR estimated from the 2014 population estimate obtained from the population model would be 114 or 228 for $Fr = 0.5$ and $Fr = 1.0$, respectively, for the Hudson Strait/northern Hudson Bay portion of the HBDS stock.

The PBR calculation includes removals from all sources. The average reported harvest over the last 5 years from the northern Hudson Bay-Hudson Strait area of the HBDS stock has been 85 animals per year. We do not have data on non-reporting rates, nor recent data on struck and loss rates. Using a Struck and Loss rate of 30%, which has been used in the past for illustration, a reported harvest of 85 animals implies a total removal of 121 animals. This estimate of total removals does not include non-reporting, nor other possible human induced mortality, e.g., ship strikes.

For the east Baffin Island component of the HBDS stock a PBR estimate of 38 animals has been reported previously. This estimate was obtained using an R_{max} of 0.07. This PBR estimate increases to 44 and 88 for Fr of 0.5 and 1.0 respectively, when the PBR was recalculated using an R_{max} of 0.08.

For the South and East Hudson Bay stock the PBR would be 2 and 4, for recovery factor of 0.5 and 1.0, respectively.

Sources of Uncertainty

Walrus are widely distributed. The use of haulout sites can change seasonally and between years. Disturbance by boat activity at some haulout sites during the surveys can cause animals to disperse, which will lead to negatively biased estimates.

The abundance estimates reported here rely on correction factors developed from other studies from other areas. Although species correction factors from non-concurrent studies have been used in other assessments, e.g., Nunavik beluga, the correction factor is large for walrus, consequently the uncertainty is quite high. Furthermore, there is some evidence that walrus haulout behaviour is correlated among animals, but the strength of this correlation is not well known.

Walrus from the Hudson Bay-Davis strait are also harvested by Greenland. Walrus from Hudson Strait and the east coast of Baffin Island show some genetic differentiation, but there is also some evidence of movement between Hudson Strait and east Baffin and between east Baffin and west Greenland. The amount of exchange between Hudson Strait and east Baffin, and between east Baffin and Greenland is not well understood. In this analysis, it was assumed that Greenland hunters did not harvest animals from the northern Hudson Bay-Hudson Strait portion of the HBDS stock.

There have been few surveys to determine walrus abundance and those that have been completed did not always cover the same area, or the total stock, which adds to uncertainty in the overall estimates and modeling population trend.

Recent stock-specific information on struck and loss is very limited, and information on reported harvests is also uncertain. The completeness of the harvest records is not known. Uncertain harvest data have an important impact on the results of the model and our understanding of population trends.

The South and East Hudson Bay stock has not been sampled for genetics. There is considerable uncertainty as to whether it forms a unique stock, or represents the southern limits to the Hudson Strait-Davis Strait stock.

We have assumed that Inukjuak hunters harvest from the SEHB stock. If their harvests have been taken from the Nottingham Island area instead, then this will reduce the harvest from the South and East Hudson Bay stock, and will increase the harvest from the Hudson Bay-Davis Strait stock.

Other sources of human-caused mortality (e.g., ship strikes, net entanglements) have not been quantified.

Stakeholders Perspective

In Coral Harbour, hunters report that walrus are now seen in greater numbers much closer to the community and are seen more frequently throughout the year in the Southampton Island area. The walrus hunts for the last ten years have harvested walrus closer to Coral Harbour (within 40-50 kilometres). Hunters believe that the walrus harvest has declined because of a reduction in the demand for walrus meat due to fewer dog teams.

Hunters from Cape Dorset report increased sightings of walrus near the community. The majority of the walrus are harvested during the late fall and winter from the floe edge by boat in open water areas. In the fall walrus are seen migrating east along the pack ice. It is believed that these animals originate from the south Foxe Basin and North Hudson Bay area. There are walrus at the floe edge throughout the winter.

In Sanikiluaq hunters report that, in the past, there were many walrus near the community and neighboring islands. Now there are very few walrus seen near Sanikiluaq. Walrus hunts are now conducted near the Sleeper Islands during September.

Hunters from Nunavik report that walrus hunting has declined because there are fewer dog teams to feed. There is concern about trichinosis particularly in the southern portions of the walrus range. There is concern among Inuit, particularly the four Eastern Hudson Bay communities, about the impact of hydroelectric development on marine wildlife.

CONCLUSIONS

The HBDS stock encompasses a large area, extending from northern Hudson Bay, through Hudson Strait and along the east Baffin Island coast (Fig 1). The 2014 survey and the population modeling covered only the northern Hudson Bay/Hudson Strait region of the HBDS stock (Fig 2). There have been surveys that covered the east Baffin Island coast (2005-2008), which have resulted in an estimate of 2,500 walrus (rounded to the nearest 100). Some of these surveys have included the southeastern part of Baffin Island, within eastern Hudson Strait, but no walrus were detected in this area. This eastern Baffin Island portion of the stock is shared with Greenland. A better understanding of walrus movement patterns and total hunting mortality is required to ascertain the sustainability of the cumulative harvest in both countries.

Incorporating available information on harvests and abundance estimates from different surveys over the last 60+ years into a population model reduced uncertainty around estimates of the HBDS stock abundance and provided insights into current population trends. Using model estimates of abundance, rather than the most recent survey estimate as the basis for advice is preferred as all available information is used in the model. There are no immediate concerns about the sustainability of the northern Hudson Bay/Hudson Strait/ component of the HBDS walrus stock.

The South and East Hudson Bay stock is not abundant and there is anecdotal evidence that it no longer occurs in parts of its former range or in very limited numbers only. However, much of this decline appears to have occurred prior to the 1950s. Numbers are low, but compared to the HBDS stock, there has been minimal survey effort, so the abundance information is very uncertain.

MANAGEMENT CONSIDERATIONS

The northern Hudson Bay, Hudson Strait and east Baffin coast are very large areas. These areas have not been surveyed completely in any single year. Improving information on the stock relationships among animals in these areas might allow these areas to be modelled separately, administered as two different management stocks, or a model that accounts for some exchange between them would facilitate management in these areas.

A Precautionary Approach framework with clear management objectives is needed for walrus. This would allow for more risk-based advice to be provided. In the meantime, the model should be periodically updated with new survey data and model outputs used to provide PBR estimates.

Criteria need to be developed to establish Fr factors, as well as clear criteria when PBR would be applied and when other risk based evaluation processes would be used.

SOURCES OF INFORMATION

This Science Advisory Report is from the October 20-23, 2015 Annual Meeting of the National Marine Mammal Peer Review Committee (NMMPRC). Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

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ISSN 1919-5087

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Correct Citation for this Publication:

DFO. 2016. Estimates of abundance and total allowable removals for Hudson Bay-Davis Strait and South and East Hudson Bay Atlantic walrus (*Odobenus rosmarus rosmarus*) stocks. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/063.

Aussi disponible en français :

MPO. 2016. Estimations de l'abondance et prélèvements totaux autorisés pour les stocks de morses de l'Atlantique (*Odobenus rosmarus rosmarus*) de la baie d'Hudson et du détroit de Davis et de la partie sud et est de la Baie d'Hudson. Secr. can. de consult. sci. du MPO, Avis. sci. 2015/063.

Inuktitut Atuinnaummijuq:

ΔLΓDCCnλδ. 2016. ΓγΔίCΔLΓC ΔΓΓσρC V°QCDJ°QJ°C ΔΓΔΓCΓCΔΓCΔΓCΔΓC ΔPΓH°LσC Δ°LΔ ΓΓPσΔσC ΓΓPσΔσC ΔΔΔΔσC CΓΔΓCΓCΔΓC ΔC°°Γ° ΔLΓAΓC VΔΓdΓ°Γ°σC (*Odobenus rosmarus rosmarus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/063.