NAMMCO SCIENTIFIC COMMITTEE
WORKING GROUP ON WALRUS

STOCK STATUS OF WALRUS IN GREENLAND

Greenland Representation
Copenhagen 8-10 November 2013

DRAFT Report

1. OPENING REMARKS

Chair Wiig (Norway) welcomed the participants (Appendix 1) to the Walrus Working Group meeting of 2013.

There was a request from Council (**R-2.6.6**) to investigate the possibility for catch quota carryover, which will be discussed at this meeting, however the main topic for the meeting will be the standing request for an assessment.

2. ADOPTION OF AGENDA

The adopted agenda is in Appendix 2.

3. APPOINTMENT OF RAPPORTEURS

Prewitt was appointed as rapporteur, with the help of participants where needed.

4. REVIEW OF AVAILABLE DOCUMENTS

The list of available documents (Appendix 3) was reviewed.

5. STOCK STRUCTURE

Heide-Jørgensen presented working document SC/20/WWG/04. In this study, a total of 35 walruses during 2010 – 2013 were instrumented with satellite-linked transmitters in Smith Sound, Northwest Greenland. The tags transmitted from 3 – 125 days and one average daily position of good quality was used to identify the movement of the walruses. Thirty-two walruses moved to Canadian waters after instrumentation and 6 walruses furthermore entered Jones Sound in July or August.

The purpose of the study was to obtain correction factors for aerial surveys. Some tagged animals had dive recordings, and those have been published in Heide-Jørgensen *et al.* (2013a and 2013b). This working paper presented only the movement information.

The last tags were put out in June 2013, and the analyses are still pending. Tagging occurred in spring to coincide with aerial surveys, when the walruses are in Greenland. The walruses moved to Canada in July, and returned to Greenland in November, where they stay until spring. When they are in Canada, they are primarily using the fjords on east Ellesmere Island including Jones Sound, but it is not thought that they are hauling out on land on Ellesmere Island. Some animals (both males and females) move to Jones Sound, where hunting is occurring during the summer and fall. It was reported that the walruses were tagged via harpooning, and it was not always known what the sex is of the animal.

The group was informed that tag failures are usually due to physical damage to the tags, e.g., from animals rolling around on the ice or against each other rather than battery exhaustion. It appears that animals that do not haul out as much get better tag durations, likely because there is not as much physical stress on the tag.

The present information does not change the perception of the stock structure: there is a separate stock in northern Baffin Bay with interchange between Greenland and Canada, e.g., the animals spend the winter/spring in Greenland and summer/fall in Canada.

6. CATCH STATISTICS

6.1 Reported catch

Witting reported that catch histories were used in the assessment (see Fig. 1 from SC/20/WWG/05). These included catches from Greenland, and a few settlements in Canada. SC/20/WWG/05 describes how the catch histories were produced from reported catches (Table 1).

Table 1. Reported catches. NR= not reported, NA= not available

Year	Qaanaaq Area	Grise Fjord	West Greenland	Qikiqtarjuaq	Clyde River	Iqaluit	Pangnirtung	East Greenland
1993	265	12	241	0	0	29	0	15
1994	156	24	270	5	0	26	40	10
1995	128	5	265	16	0	25	8	11
1996	122	8	176	0	1	9	2	7
1997	74	12	155	3	0	0	16	1
1998	72	11	139	0	1	27	4	7
1999	101	5	184	0	0	15	3	10
2000	126	4	196	0	0	19	15	7
2001	171	2	162	1	1	7	19	10
2002	147	3	150	33	0	1	9	34
2003	160	7	113	1	0	1	15	11
2004	90	5	100	0	2	NR	NR	4
2005	78	2	158	NR	NR	10	NR	16
2006	67	5	73	9	1	9	15	5
2007	80	4	43	6	0	11	NR	10
2008	66	NR	28	NR	NR	NR	10	9
2009	90	7	33	NR	NR	14	NR	4
2010	60	2	40	6	NR	14	NR	7
2011	42	4	50	5	0	14	NR	5
2012	76	NA	34	NA	NA	NA	NA	4
2013	62	NA	NA	NA	NA	NA	NA	NA

In Greenland, hunters are required to fill out a "special form" (*Særmeldingsskema*) which, among other things, requests information on the sex of each of the catches of walruses.

Examination of the hunter's "special form" for East Greenland indicated that all walruses caught were males (between 2011-13). This is in agreement with Born *et al.* (1997), which estimated 10% females in the hunt in East Greenland. This value was used for the assessment.

Greenlandic regulations forbid hunting of mature females and calves (except the Qaanaaq area). It is considered likely that the gender reported in the "special forms" in West Greenland is affected by this regulation and the sex ratio is biased towards males. Instead samples from the walrus hunt during 1988-2007, where the gender was determined genetically, were used to estimate a female fraction of 0.59 (Andersen *et al.* 2013) and in the assessment this estimate was applied to catches after 1988 (Table 2).

For the hunt in Qaanaaq (Baffin Bay stock), where it is legal to hunt females, no bias was expected in the "special forms" and reports from 2007-2013 were used to derive a weighted average (weight = number of samples) female fraction of 0.39 (SD=0.085). The assessment used an even sex ratio except for the years since 2007 where the reported sex ratios were applied (Table 2).

Table 2. Sex ratio of the Greenland walrus hunt. Genetics data are representative samples from the catch; other data given are from hunters' special forms.

Year	Females	Males	Sum	Prop FF	Reference
West Greenland					
1988-2007	75	52	127	0.59	Genetics: Andersen et al. 2013
Baffin Bay/Qaanaaq					
1987-1991	179	197	376	0.47	
1990-91	26	37	63	0.41	Genetics: Andersen et al. 2013
2007	23	40	63	0.37	Hunters' special forms
2008	10	8	18	0.56	Hunters' special forms
2009	38	46	84	0.45	Hunters' special forms
2010	24	37	61	0.39	Hunters' special forms
2011	8	34	42	0.19	Hunters' special forms
2012	31	45	76	0.41	Hunters' special forms
2013	25	39	64	0.39	Hunters' special forms
East Greenland					
2011	0	5	5	0.0	Hunters' special forms
2012	0	4	4	0.0	Hunters' special forms
2013	0	5	5	0.0	Hunters' special forms

It was noted that a comprehensive review of Canadian catch history is now available (SC/20/WWG/O06).

6.2 Struck and lost

Witting reported that the information about struck and lost is summarized in the assessment paper SC/20/WWG/05 and was obtained from Born *et al.* (1995, 1997 and references therein). These loss rates were used in earlier assessments.

The models include low and high catch histories. The low catch history does not include the struck and lost animals, where the high catch history includes struck and lost. The average loss rate is about 15% for the North Water area and West Greenland, and about 11% for East Greenland.

There is some effect of method of hunting on struck and lost rates. In Qaanaaq, hunters report that they usually harpoon first, and do not shoot from long distances. The working group recognizes that the loss rates used in the assessment may be lower in some areas and in some types of hunts, but more information is required before the numbers used in the assessment can be adjusted.

The working group identified that complete statistics on total removal levels is critical for the assessment, and therefore the group **strongly recommended** that Greenland obtains reliable reports of all animals struck and lost.

7. ABUNDANCE AND TRENDS

West Greenland-Southeast Baffin Island
In the current assessment, the abundance from Stewart *et al.* (2013a) of 2500 animals was used as an estimate of absolute abundance for West Greenland-Southeast Baffin Island.

Stewart et al. (2013a) also provided a series of four estimates from 2005 to 2008 of hauled out walruses from Baffin Island. It was decided not to use these estimates as a series of relative abundance because the number of walruses on a few haulout grounds fluctuates widely and because no site and year specific correction factors were available.

It was noted that the LGL report (SC/20/WWG/O08) provided estimated numbers of walruses in Hudson Strait of 4675 (95% CI= 1845 – 11842) – 6020 (2485 – 14585). Taking into account that it is uncertain to what extent these animals contribute to the West Greenland-Southeast Baffin Island stock, the group did not use this estimate for the assessment.

Heide-Jørgensen presented Heide-Jørgensen *et al.* (2013a) which uses aerial surveys of walruses on the wintering grounds on the banks of West Greenland. In contrast to previous surveys, this survey assumed that animals on ice were constantly available, whereas animals in the water have a correction factor for availability. The detection depth for animals in the water was assumed down to 2 m. There are no area-specific correction factors for animals that were submerged, so correction factors from the North Water were used.

It was noted that effort did not change depending on sea ice cover, since the survey strata were determined beforehand, and were not changed based on where the ice was located at the time of the survey.

There was not a big difference in effort across years. The discussion continued on whether to weight the model by effort since survey areas changed slightly from year to year. Possibilities included correcting for effort by stratum, and/or including total effort (km) versus only the strata where walrus were sighted. The group concluded that since the same core areas with walrus were surveyed in all years, it was not necessary to correct for effort.

The numbers presented in this paper were used as an index of the abundance in West Greenland-Southeast Baffin Island in the current assessment.

The assessment included also an earlier time series (1981 – 1999) of densities of walruses wintering in West Greenland between 66°15 and 68°15 N (SC/17/WWG/04) to provide trend information on a longer time scale.

Baffin Bay

The estimates in Stewart *et al.* (2013b) are similar to, although slightly lower, than those from the North Water reported in Heide-Jørgensen *et al.* (2013b). Stewart *et al.* (2013b) covered the coastal areas in Canadian waters, however they did not survey some locations in Ellesmere Island, and 2009 was the year with the best coverage. This survey did not include all localities visited by animals tagged in Northwest Greenland (SC/20/WWG/04) and it was therefore decided not to include the 2009 estimate in the assessment.

The abundance estimates presented in Heide-Jørgensen *et al.* (2013b) are not statistically different from each other and can be used as a trend. The group discussed the fact that this was a multi-species survey which may affect the perception bias for walrus. However the group agreed that the approach was acceptable given the data available. The correction factors used in this survey were derived from animals tagged in the North Water (SC/20/WWG/04).

The group concluded that these two estimates (1238 CV=0.19 for 2009 and 1759 CV= 0.29 for 2010) should be treated separately for the assessment.

East Greenland

There was no new information from East Greenland (the previous info from SC/WWG/07 was used in this assessment).

8. ASSESSMENT BY STOCK

8.1 Present status

The historical and current dynamics of the three walrus stocks that occur in Greenland was estimated in SC/20/WWG/05 using age- and sex-structured population models with exponential growth, density-regulated growth and selection-delayed dynamics. These models were integrated with the agreed catch data in a Bayesian framework, where the likelihood of the simulated population trajectories were evaluated from the agreed abundance estimates and the age-structure of a selective hunt in Qaanaaq.

The fit of the model to the age-structured data from Qaanaaq showed an under-representation of animals younger than ten years in agreement with a hunt that takes mainly adult animals. The estimated selectivity is steep and concave, characteristic of selection for full-grown animals, with selection against animals that are almost but not yet fully grown.

The overall decline in the Baffin Bay stock caused by historical catches is unclear due to incomplete catch reporting prior to 1950s. An exponential model (Fig. 1, top) was considered the best to reflect the production in the stock. It estimated that the stock declined by 63% from the 1960s to 2007, and decreased catches (~140 to ~70) have subsequently allowed this stock to increase. The 2014 abundance estimated by the model was 1,430 (95% CI: 999-2,170) with an annual natural growth rate of 7.7% (95% CI: 6.4-9.5%) and a replacement yield in 2014 of 120 (95% CI: 73-180) walruses.

The historical trajectory for West Greenland-Southeast Baffin Island walruses is unclear owing to problems in resolving long term models with current abundance data. The exponential model is unreliable here because it was unable to provide sufficient updated estimates of population growth. A density regulated model (Fig.1, middle) initiated in 1960, however, solved the problem. It estimated a stock that decreased from 4,000 (95% CI:1,210-18,600) walruses in 1960 to 2,360 (95% CI:1,720-3,280) in 2007. Annual catches were then reduced from more than hundred to around 60, and the stock was again increasing with a 2014 model estimate of 2,630 (95% CI: 1,640-3,790) walruses and a replacement yield of 120 (95% CI: 42-180).

A 2014 estimate of 1,400 (95% CI: 720-3,200) walruses in East Greenland has apparently recovered relative to 1888, the year prior to our first historical catches by European sealers. The historical trajectory is uncertain. Density regulation estimates a relatively flat trajectory (Fig. 1, bottom), with a maximum depletion in 1890 to 80% of the initial abundance, and a slow continuous increase to almost no current growth. A recovered stock was also estimated by selection-delayed dynamics providing a continued increase and a historical depletion to 3% in 1957.

Updated abundance estimates for West Greenland, and modelling with age-structured data from Baffin Bay, have generally improved the status estimates for Baffin Bay and West Greenland/Baffin Island.

8.2 Management recommendations

8.2.1 Sustainable harvest levels

The estimated trade-offs between total removals and the probability of population size increase is shown in Table 3 for the Baffin Bay and the West Greenland-Southeast Baffin Island stocks. A target of a 70% probability for increasing stock sizes from 2014 to 2018 results in recommended total removals of no more than 93 animals from the Baffin Bay stock and no more than 100 animals from the West Greenland-Southeast Baffin Island stock.

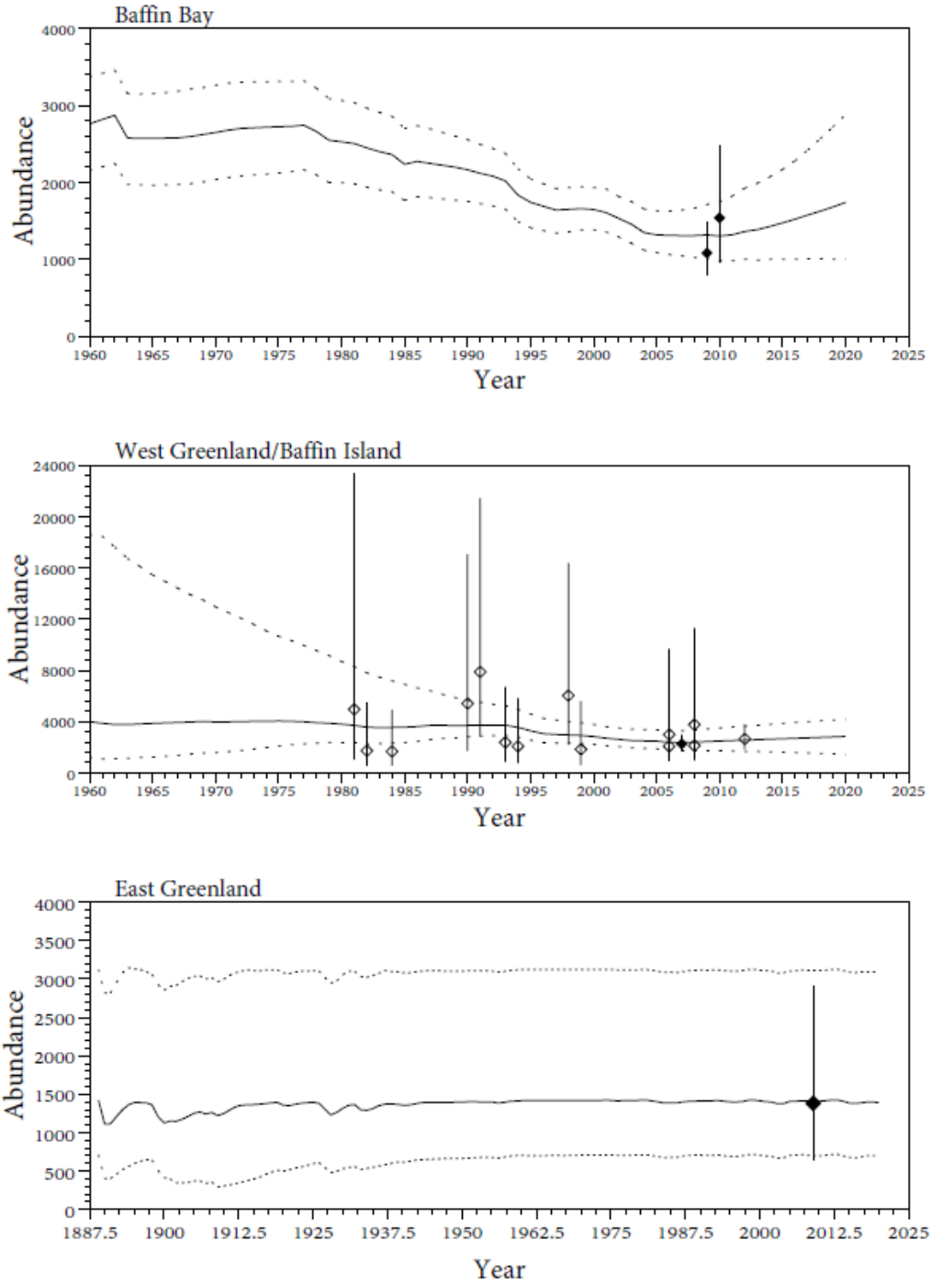

Figure 1. Projections of population models for the three walrus stocks in Greenland, together with absolute (solid diamond) and relative (open diamond) abundance estimates, with 95% confidence intervals. The solid curves are median projections, and the dashed curves span the 95% credibility interval.

Table 3. The estimated probabilities of increasing stock sizes from 2014 to 2018 for 6 levels of annual removal from the Baffin Bay and West Greenland-Southeast Baffin Island stocks. Canadian and Greenlandic catches and struck and lost walruses are assumed to be included in removals. These removals do not assume a specific sex ratio.

Removals	**75**	**80**	**85**	**90**	**95**	**100**
Baffin Bay	0.94	0.86	0.81	0.75	0.67	0.58
West Greenland – Southeast Baffin Island	0.87	0.85	0.81	0.78	0.74	0.70

In the East Greenland hunt, there is a high ratio of males, and the overall catch is small. A run of the assessment model with the extra years of catch data shows that this is still sustainable, and the recommendation of an annual total removal of no more than 20 individuals from the last assessment is reiterated.

8.2.2 Carryover of quotas

R-2.6.6 The Management Committee requested the Scientific Committee to investigate the possibility to include a carryover for quotas in order to include this possibility in the next hearing for the new quota block period.

The working group discussed the request and **concluded** that there is no biological argument against carryover of quotas. A problem arises if carryovers accumulate over time and/or across assessments.

9. RECOMMENDATIONS FOR RESEARCH

The working group **recommended** that:

- new estimates of sex and age structure of the catch for West Greenland are obtained. The sex determination that is reported by the hunters should be validated using genetics.

- the fraction of the catches and abundances in Canada that belong to the West Greenland-Southeast Baffin Island stock are clarified.

- complete catch statistics from Canada are collated.

- reliable reports of struck and lost are obtained for the entire range of the stocks in Greenland and Canada.

- regular abundance estimates (5-10 years) from Baffin Bay, West Greenland, and the southeast coast of Baffin Island are obtained.

10. OTHER BUSINESS

The completed papers in *NAMMCO Scientific Publications Volume 9: Walrus of the North Atlantic* have been published online and are available at http://septentrio.uit.no/index.php/NAMMCOSP/index.

Greenland plans to conduct a survey in the North Water in spring 2014 of marine mammals and birds, and will target walruses along the ice edge.

11. ADOPTION OF REPORT

The report was adopted in a preliminary form at the end of the meeting on 10 November 2013. The final version was adopted by correspondence on 12 November 2013.

References

Andersen, L.W., Born, E.W., Stewart, R.E.A, Dietz, R., Doidge, D.W. and Lanthier, C. 2013. A genetic comparison of West Greenland and Baffin Island (Canada) walruses: Management implications. *NAMMCO Scientific Publications.* Volume 9. doi: http://dx.doi.org/10.7557/3.2610

Born, E. W., Gjertz, I., and Reeves, R. 1995. Population Assessment of Atlantic Walrus, *Norsk Pol. Medd.* 138:1–100.

Born, E. W., Dietz, R., Heide-Jørgensen, M., and Knutsen, L. 1997. Historical and present status of the Atlantic walrus (*Odobenus rosmarus rosmarus*) in eastern Greenland. *Meddr. Grønland, Biosci.* 46:1–73.

Heide-Jørgensen, M.P., Laidre, K.L., Fossette, S., Rasmussen, M., Nielsen, N.H. and Hansen, R.G. 2013a. Abundance of walruses in Eastern Baffin Bay and Davis Strait. *NAMMCO Scientific Publications.* doi: http://dx.doi.org/10.7557.3.2606

Heide-Jørgensen, M.P., Hansen, R.G., Nielsen, N.H. and Rasmussen, M. 2013b. The significance of the North Water polynyas to Arctic top predators. *Ambio.* 42(5):596-610. doi: http://dx.doi.org/10.1007/s13280-012-0357-3

Stewart REA, Born EW, Dietz R and Ryan AK 2013a. Estimates of Minimum Population Size for Walrus around Southeast Baffin Island, Nunavut. *NAMMCO Sci. Publ*. doi: http://dx.doi.org/10.7557/3.2615

Stewart REA, Born EW, Dietz R, Heide-Jørgensen MP, Rigét FF, Laidre K, Villum Jensen M, Knutsen LØ, Fossette S and Dunn JB 2013b. Abundance of Atlantic

walrus in western Nares Strait, Baffin Bay stock, during summer. *NAMMCO Sci. Publ.* doi: http://dx.doi.org/10.7557/3.2611

NAMMCO SCIENTIFIC COMMITTEE WORKING GROUP
ON
STOCK STATUS OF WALRUS IN GREENLAND

Greenland Representation
Copenhagen 8-10 November 2013

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11. ADOPTION OF REPORT

In a new request (**R-2.6.6**), 6.2 page 16 of annual report 2012: The Management Committee requested the Scientific Committee to investigate the possibility to include a carryover for quotas in order to include this possibility in the next hearing for the new quota block period.

NAMMCO SCIENTIFIC COMMITTEE

WORKING GROUP ON WALRUS
POPULATION STATUS OF WALRUS IN GREENLAND

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List of Documents

Document Number	Agenda Item	Title
SC/20/WWG/00		Practical arrangements
SC/20/WWG/01	1	List of participants
SC/20/WWG/02	2	Draft Agenda
SC/20/WWG/03	4	List of Documents
SC/20/WWG/04	5	Heide-Jørgensen *et al.* Satellite tracking of Atlantic walruses from Northwest Greenland
SC/20/WWG/05	6,8	Witting. Revised assessment runs of walrus in Greenland
Background Documents		
SC/20/WWG/O01	8	Witting and Born (2013) Population dynamics of walruses in Greenland. *NAMMCO Scientific Publications.* Vol 9. http://dx.doi.org/10.7557/3.2612
SC/20/WWG/O02	8	Stewart and Hamilton (2013) Estimating total allowable removals for walrus (*Odobenus rosmarus rosmarus*) in Nunavut using the potential biological removal approach. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/031. iv + 13 p.
SC/20/WWG/O03	7.1	Stewart, R.E.A., Hamilton, J.W., and Dunn, J.B. 2013. Results of Foxe Basin walrus (*Odobenus rosmarus rosmarus*) surveys: 2010-2011. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/017. iv + 13* p.
SC/20/WWG/O04	8	Proceedings of the Pre-COSEWIC Peer Review Meeting for Atlantic walrus (*Odobenus rosmarus rosmarus*)
SC/20/WWG/O05	6.1	Canadian catch data
SC/20/WWG/O06	6	Stewart DB *et al.* A catch history for Atlantic walruses (*Odobenus rosmarus rosmarus*) in the eastern Canadian Arctic. (*DRAFT- not for further circulation)*
SC/20/WWG/O07	7.1	LGL Report- Hudson Straight aerial surveys
SC/20/WWG/O08	7.1	Stewart *et al.* (2013) Estimates of Minimum Population Size for Walrus near Southeast Baffin Island, Nunavut. *NAMMCO Scientific Publications.* Vol. 9. http://dx.doi.org/10.7557/3.2615
SC/20/WWG/O09	7.1	Stewart *et al.* (2013) Abundance of Atlantic walrus in Western Nares Strait, Baffin Bay Stock, during summer. *NAMMCO Scientific Publications.* Vol. 9. http://dx.doi.org

		/10.7557/3.2611
SC/20/WWG/O10	7.1	Heide-Jørgensen *et al.* (2013) The significance of the North Water polynyas to Arctic top predators. *Ambio.* 42(5):596-610.
SC/20/WWG/O11	7.1	Heide Jørgensen *et al.* (2013) Abundance of walruses in Eastern Baffin Bay and Davis Strait. *NAMMCO Sci Publ.* doi*:* http://dx.doi.org/10.7557.3.2606
SC/20/WWG/O12		Report from last WWG meeting
SC/17/WWG/07		Born *et al.* Abundance of Atlantic walrus (Odobenus rosmarus rosmarus) in East Greenland