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Comments on document SC/68A/ASI/07 regarding the assessment of North Atlantic fin whales

D. Pike, G.A. Víkingsson, Th. Gunnlaugsson and B.Þ Elvarsson

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Introduction

The author of paper SC/68A/ASI/07 claims that fin whale abundance estimates based on the North Atlantic Sightings Survey (NASS) series are likely positively biased which, together with some other factors (regional distribution shifts, genetic analysis of pre-whaling era fin whale population levels and negative effects of the removal of pregnant females) cast serious doubts on the sustainability of the Icelandic fin whale quotas.

In this document, we intend to provide evidence that the criticism presented in ASI/07 is not supported by our sampling procedures, our data and our analysis and by the reveiws our work provided by the Scientific Committee.

Abundance estimates

The NASS series was initiated in 1987 and is among the most extensive cetacean survey series worldwide to date. From the beginning the surveys have been designed and conducted in close cooperation between the many participating countries and within relevant international scientific organizations, including the Scientific Committees of the IWC and NAMMCO. During the three decades of the survey period there have certainly been some methodological and technical developments that the surveys have taken advantage of, while following the main principles of line-transect theory throughout. At the same time, an effort has been made to retain some degree of compatibility between surveys so that they produce comparable estimates. The surveys have always adhered to the SC's requirements and guidelines for surveys to be used in assessments and the RMP.

ASI/07 focuses on the last two surveys in the series (2007 and 2015) and claims that three factors (see below) contribute to a significant overestimate of abundance and that the resulting apparent positive trend in fin whale abundance, primarily in the East Greenland-Iceland (EGI) stock area, is therefore spurious. It is important to make clear that the IWC Scientific Committee has considered all these issues before. All the factors discussed in SC/68A/ASI/07 were identified by the authors of the papers submitted to the SC (SC/60/PFI13-revised ;SC/66b/IA18, SC/66B/RMP1-rev1 and SC/66b/RMP2) and thus taken into consideration during the discussion within the SC(IWC 2013 (Annex D), 2014 (Annex D) 2017). Based on that discussion best estimates were subsequently formally adopted by the relevant subcommittees and the full SC for use in the RMP CLA in 2008 and 2016 for the NASS-2007 and NASS-2015 surveys respectively (JCRM 11 (SUPPL) 2009; JCRM 18 (SUPPL) 2017). During the first RMP Implementation (and pre-implementation) of North Atlantic fin whales all available estimates up to and including 2007 were reviewed and assigned to the RMP small and medium areas (Wade 2009). Estimates that have been agreed by the SC for use in the RMP CLA up to and including TNASS-2007 were summarized as a part of the RMP Implementation Review (IWC 2013 (Annex D/Appendix 5), IWC 2014 (ANNEX D)). At the 2016 annual meeting of the SC (66b) the Committee formally endorsed the 2015 NASS fin whale estimate for use in the RMP CLA (IWC 2017). At this same meeting the SC formally completed the RMP Implementation review of North Atlantic fin whales (JCRM 18 p. 11). The next Implementation Review for NA fin whales is scheduled to start in 2023 (JCRM 19 2018, item 6.4.).

Bias in estimation of distance and angles

SC/68a/ASI/07 states (p.4), *"In the 2007 NASS, separate abundance estimates were made on the basis of sightings from the primary platform and the combined primary and tracker platforms. Significantly, the survey report expressly acknowledged the possibility of positively biased abundance estimates due to measurement error from naked eye observations – stating that "an abundance estimate would be expected to be 34% too large if based only on primary [naked eye estimates] rather than only tracker data [reticle binocular estimates]" (Pike 2007)."*

2007 survey

The 2007 T-NASS survey used a Buckland-Turnock (BT) mode with a tracker platform using binoculars to search far ahead of the ship, and a primary platform which did not use visual aids, but did use "distance sticks" (essentially rulers to measure the distance from the horizon to the sighting) to aid in distance estimation. The possibility of measurement bias was first detected by comparison of platform (tracker and primary) distance measurements to duplicate sightings, with a time separation of 2 min or more. Primary platform measurements were, on average, about 66% of those from the tracker platform (Pike et al. 2007, 2019 in press). Normally this would be interpreted as evidence for responsive movement, i.e. movement towards the ship after first detection by the tracker platform. However, we were skeptical of that explanation because it seemed to hold for all species, and attractive movement by species other than some dolphins has heretofore not been observed. We also looked at tracker platform measurements to the same sighting, separated by 2 min or more. No difference was detected, suggesting that the tracker-primary difference must have another explanation.

While negative measurement bias by the primary platform was one explanation for the observed between-platform difference in distance measurements, it is important to point out that it is not the only possibility, and that other factors could play a role:

1. Distance measurements by the tracker platform could be positively biased;
2. Because observers on the primary platform did not use binoculars and therefore had a shorter visual range, they might preferentially detect groups that are moving towards the vessel, because they will be closer by the time the primary platform sights them. Note that this is not the same as attractive movement. Groups that happen to be moving towards the vessel would simply have a greater probability of detection by the primary platform.
3. A combination of 2 or more of the above factors (bias by primary, bias by tracker, animal movement) could explain the difference.

We chose to provide estimates of the bias in abundance estimates that would be induced by measurement bias by the primary platform, partially because we considered it the most likely explanation, but also because it was of most concern as it would cause a positive bias in abundance estimates.

Many sightings are duplicates between the tracker and primary platforms, and in those cases the distance measurement by the tracker platform, which were made using binocular reticles and for which no evidence of possible bias was found, were used in preference to measurements from the primary platform. In a recent paper (Pike et al. 2019 in press), we conducted sensitivity analyses to determine what effect the apparent measurement bias would have on estimates of abundance. Abundance estimates using the adjusted distance measurements were from 12% to 28% lower than those using the unadjusted values, depending on the species considered. For fin whales, the uncorrected (for perception bias) estimate of abundance would be 16% lower if the distance measurements were corrected for this apparent bias.

We note again that the possibility of measurement bias by the primary platform in the 2007 survey has been previously presented to both the IWC (JCRM 11 (SUPPL) 2009) and NAMMCO (NAMMCO 2010) Scientific Committees, and in both cases the Committees chose to accept the uncorrected estimates for use in assessments, primarily because they are consistent with previous estimates.

2015 survey

After the 2007 T-NASS, the NAMMCO Scientific Committee recommended that the next survey should take measures to to improve distance estimates from the primary platform (NAMMCO 2010). For various reasons the 2015 survey was conducted using an Independent Observer mode with symetrical platforms. The potential bias issue was addressed by equipping observers on the platforms with reticle binoculars and instructing them to use the reticles to measure distances when possible. During the survey, 79% of the radial distance estimates to fin whale groups were made using binocular reticles, 10% using distance sticks, and 11% were naked eye estimates. Since the potential bias in distance estimation was associated with the latter two measurement modalities, the only ones used on the 2007 primary platforms, we would therefore expect any bias to be much less in 2015 than in 2007.

The author of ASI/07 states that *"Accordingly, it is noteworthy that the strip widths derived for the 2015 NASS were particularly narrow as compared with those calculated in the 2001 NASS, which employed the same vessels and observation platforms (Víkingsson 2009). Specifically, strip widths for the Icelandic vessels in 2001 were 2.1-2.3 km, whereas they were only 1.1-1.8 km in 2015 (Víkingsson 2009; Pike 2016).*" We note that this is a faulty comparison, as the uncorrected fin whale estimate from 2001 detailed by Vikingsson (2009) incorporated sightings from the *combined* (i.e. tracker plus primary) platforms. We would expect observers on the tracker platform to sight more distant whale groups as they used binoculars, while observers on the symmetrical platforms in the 2015 survey did not use binoculars to search for whales. The wider strip width realized for the 2001 survey is therefore unsurprising and cannot be construed as evidence of measurement bias.

The question of bias in estimation of distance and angles has thus been recognized and thoroughly discussed both by the proponents of NASS and the SC's of IWC and NAMMCO. Future NASS (next one scheduled around 2022) will take this potential into further considerations with the aim of minimizing any such potential bias with the aid of available technology at that time (e.g. integrated binoculars-cameras, use of drones etc). The RMP/CLA is robust to fluctuations in abundance estimations and a feedback mechanism (regular surveys) will minimize the effect of potential errors in single estimates in the abundance series.

The methodology of the 2007 and 2015 NASS surveys was also discussed in detail by the ASI Standing Working Group in relation to estimation of humpback whale abundance (IWC 2019, Annex Q). The ASI (and subsequently the SC) reached the same conclusion as it had done previously for fin whales based on the same methodology. The SC **endorsed** the perception bias corrected 2007 abundance estimate and the perception bias corrected 2015 abundance estimate both applicable to the Icelandic/Faroese study area and that they would be classified as Category 1 estimates according to the newly adopted system.

Trends in fin whale abundance

The trend analyses that have been done (Vikingsson et al. 2009, 2015) rely on uncorrected, combined platform estimates to maintain comparability with the early surveys which used single platforms. They also use post-stratification to ensure that equivalent areas are compared. It is important to note that on all surveys prior to 2015, observers on the primary platforms primarily used naked eye and distance sticks to estimate radial distances. Therefore any bias associated with this methodology should be constant across surveys and therefore not compromise the detection of trends. In other words, if a bias exists, the early surveys would be similarly biased.

We disagree with the statement that the size of the surveyed areas in the NASS series is too small to warrant analysis of trends (see Pike et al 2019).

Distributional shift

The author of ASI/07 states that *"A principal assumption underlying all NASS fin whale surveys is that the assumed increases in abundance are explained by population growth."* We reject this characterization entirely. In fact there is no need for any such assumption, as the primary purpose of any survey is to estimate abundance. In fact, the author of ASI/07 goes on to note several occasions when the possibility of distributional shifts has been explicitly noted (Vikingsson et al. 2009, 2015; Pike et al. 2016)

Distributional shifts were discussed and taken into account, in the Implementation Simulation Trials for North Atlantic fin whales. Several stock structure hypotheses were included with various scenarios for mixing and dispersion. New hypothesis could be brought up during the next Implementation Review but would need to be more specific than as outlined in SC/68A/ASI/07

Duplicate identification

ASI/07: "*To the extent the survey <u>fails to sufficiently detect duplicates due to angle estimation error</u>, the resulting positive bias in encounter rates will affect the abundance estimates. Further, given that g(0) is estimated from the proportion of whales known to be present that are seen by the different observers, the failure to identify one or more animals as duplicates will reduce g(0) – thereby also positively biasing the abundance estimate. This result follows from the incorrect conclusion that one or both observation platforms missed sighting a whale (or whales), thus artificially inflating the number of whales believed to be present versus the number observed (reducing the probability of observation to less than 1)"*

We point out that the author presents no evidence that there was significant error in angle estimation in the NASS surveys.

In the 2007 T-NASS, duplicates were identified *in the field* by a dedicated observer on the tracker platform, the Duplicate Identifier (DI). This observer was in constant communication with both the tracker and primary platforms, and could simply look out to sea to determine if these observers were seeing the same or different groups of whales. We therefore regard duplicate identification by the DI as essentially unbiased.

In the 2015 survey, duplicates were identified post-survey by coincidence in time, angle and radial distance measurements. We note in passing that any possible bias in distance estimates should not affect this identification, as the platforms were symmetrical and both platforms would be similarly biased. While error in angle estimation (or distance estimation or time recording) could in theory lead to the non-detection of true duplicates (false negatives), it could also lead to the erroneous identification of sightings as duplicates when they were not (false positives). Because analysts are well aware that the former error (false negative identification) can lead to a positive bias in abundance estimates, duplicate identification procedures are "conservative" in the sense that they err on the side of over-classifying sightings as duplicates, rather than in the other direction.

We also note that the $p(0)$ estimated for fin whales in 2015 of 0.86 is higher than that realized for 2007 (0.73), likely primarily because the latter estimate applies to the primary platform only while the former applies to the two combined platforms. We do not find the estimate of $p(0)$ to be abnormally low, as it is characterized by the author of ASI/07, and in fact there is no basis whatsoever for this contention.

Genetic analysis of pre-whaling abundance

In SC/68A/ASI/07 the following statement is made: ``Using the genetic record, historical fin whale populations in the North Atlantic have been estimated at 360,000 (Roman 2003) – orders of magnitude greater than previous estimates and substantially greater than the 2015 NASS estimates (if those numbers are accurate). Accordingly, these considerably higher estimates of historical North Atlantic fin whale populations indicate they are a long way from even partial recovery from the impacts of the commercial whaling era."

This theory on pre-whaling abundance of large whales was discussed extensively by the SC, as it would radically undermine most of the assessment work done on large whales for decades if it were true (IWC 2005, 2006). The SC has found it impossible to reconcile these results with other known data sources and both within the IWC and other scientific bodies dealing with assessment of whale stocks and their impact (e.g. NAMMCO, IUCN, ICES) incorporated these results into their work.

Skewed sex ratios in the Icelandic whaling.

SC/68A/ASI/07 claims that 21 pregnant females were caught in 2018 off Iceland and that taking of pregnant females undescores the potential impact on the population. It is well known from most if not all whaling operations that pregnant females are included in variable proportions the catches. Therefore this is nothing peculiar for the Icelandic situation and any potential effects of this would be taken account of in the population modelling (e.g. by feedback from sightings surveys). By special consideration of the mature female component of the populations the RMP takes account of any bias in sex ratios. In the Icelandic fin whaling operation, the sex ratio has been close to parity. During 1979-1985 the proportion of females was 52.4% and after resumption of commercial whaling (2006-2018) the proportion of females was 48.1%. Pregnancy rates for these two periods were 38.5% and 34.7% respectively. These statistics are not biased towards (pregnant) females with respect to other known whaling operations or the population models on which the management is based.

Conclusion

The issues raised in SC/68A/ASI/07 have been recognized and discussed by the authors of papers reporting the results of the NASS series. They have been discussed thoroughly by the Scientific Committee's of the IWC and NAMMCO and these bodies have subsequently adopted the best estimates. The RMP is well known for it's precautionary nature and robustness regarding uncertainties in data inputs and is generally regarded as the most conservative management procedure developed for a natural resource as the large baleen whales. Therefore we disagree strongly with the opinion of the author of SC/68A/ASI/07 that the Icelandic fin whaling is based on weak scientific basis and likely unsustainable.

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