NAMMCO ANNUAL MEETING 29

13-15 September 2022
Grand Hotel, Oslo & Hybrid

MEETING OF THE COUNCIL

DOCUMENT 08	**REPORT OF THE SCIENTIFIC COMMITTEE**
Submitted by	Scientific Committee
Action requested	**Management Committees:** - Consider the management advice proposed by the SC and decide whether to forward this to the Member Countries. - Determine whether to endorse new proposals for conservation and management, and recommendations for research. **Council:** - Consider the proposed work plan.
Background	The NAMMCO Scientific Committee (SC) held its 28th meeting virtually on 24-28 January 2022. The report does not include the Working Groups reports, since they are made availble on the the NAMMCO website after completion of the meetings at https://nammco.no/scientific-working-group-reports/.

NAMMCO

30 Years: 1992 - 2022

28TH MEETING OF THE NAMMCO SCIENTIFIC COMMITTEE

January 24 – 28, 2022
Online

REPORT

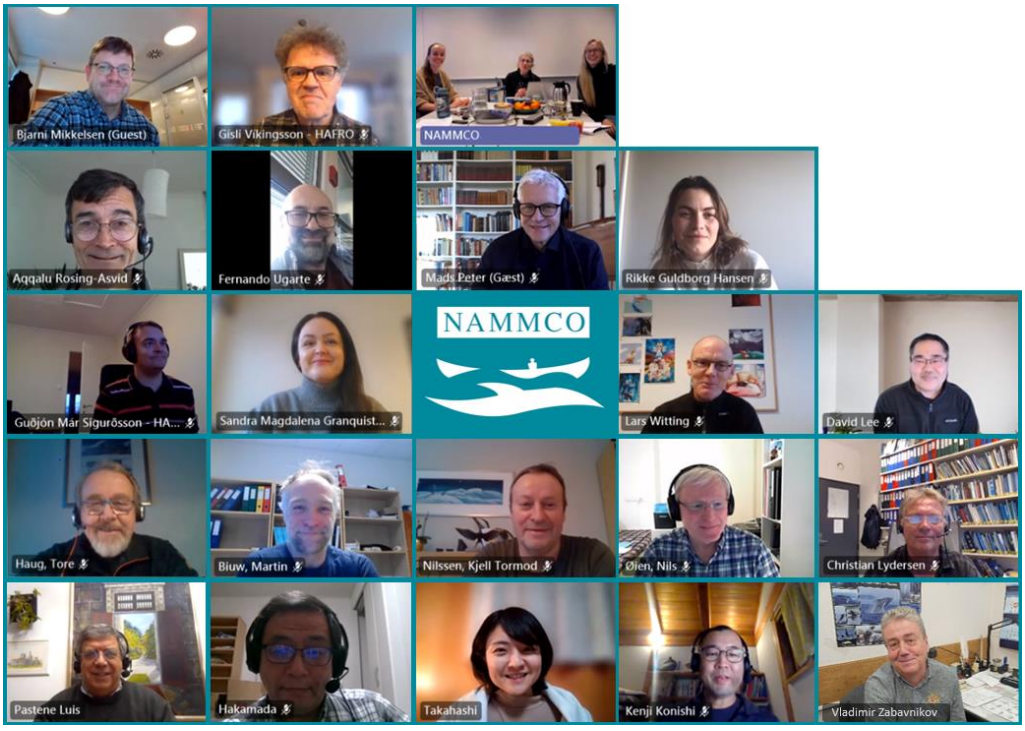

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The 28th meeting of the NAMMCO Scientific Committee (SC) was held online January 24 – 28, 2022. The meeting was chaired by Bjarni Mikkelsen (FO) and included observers from Japan, the Russian Federation, Makivik Corporation and Nunavut Tunngavik Inc.

Welcome and Opening Remarks (Item 1-3)

The Chair welcomed participants and observers to the meeting, extending a special welcome to the new Icelandic SC member Guðjón Már Sigurðsson. New members of the Secretariat were introduced, including Interim Scientific Secretary Heleen Middel, and current intern Josephine Schulze.

National progress reports (NPRs) were received from all NAMMCO countries, as well as written reports from Canada, Japan, the Russian Federation, and the Makivik Corporation. Observers from Japan gave a presentation on their satellite tagging experiments. A list of all documents available to the meeting is provided in Appendix 3 to the report, including the reports from three Working Groups (WGs): The By-Catch Working Group (BYCWG), the Ad hoc Working Group on Narwhal in East Greenland (NEGWG), and the NAMMCO-JCNB Joint Group on Narwhal and Beluga (JWG).

Updates from Council (Item 5)

An overview of comments and decisions taken by the NAMMCO Council 28 and relevant to the SC was presented. The SC was informed that the Council 29 was postponed to September 2022 in the hope of being able to convene a physical meeting. Decisions important for the continuation of the SC work will be taken by the Council inter-sessionally.

Collaboration between SC Members (Item 6)

The MINTAG project, originally called 'super-tag' project, was launched on the August 4, 2021, with the first meeting of the Steering Group, and has participation from all NAMMCO member countries as well as Japan. Two tag manufacturers have provided a proposal and the SC *recommended* to choose the latest technology in satellite and transmitting system.

Interaction with Other Organisations (Item 7)

Updates were provided on NAMMCO interactions with ASCOBANS, Arctic Council, ICES, IUCN, IWC, and JCNB. The SC *agreed* that it would be valuable to have an exchange of data with ASCOBANS for species with a broad and shared distribution.

Website Review (Item 8)

The SC reviewed the information provided on the NAMMCO website for the fin whale, humpback whale, beluga, and narwhal. Updates were provided throughout the meeting and the review was completed inter-sessionally before the adoption of the final SC report.

Environmental and Ecosystem Issues (Item 9)

Marine Mammal / Fisheries Interactions

The SC *recommended* that Request (R)-1.1.8 be re-written as a two-fold request as follows: 1) "In addressing the standing requests on ecosystem modelling and marine mammal fisheries interaction, to extend the focus to include all areas under NAMMCO jurisdiction." and 2) "In the light of the distributional shifts seen under T-NASS 2007, the SC should investigate dynamic changes in spatial distribution due to ecosystem changes and functional response".

By-Catch Working Group: The sixth meeting of the BYCWG reviewed the by-catch estimates for coastal seals in Iceland, and coastal seals and harbour porpoise in the Norwegian coastal gillnet fisheries. The SC *endorsed* all by-catch estimates for harbour porpoise, harbour and grey seals forwarded by the BYCWG. The SC also *endorsed* all its recommendations, but *recommended* that the largest of the upper CI from the Punt et al. (2020) by-catch estimates and the by-catch reported in the logbook be used by the Coastal Seal Working Group as a preliminary by-catch estimate for seals in the Icelandic cod and Greenland halibut fisheries. An overview of the endorsed and missing by-catch estimates can be found in the report. The SC *recommended* the BYCWG continue in its assessments of by-catch risk in the different fisheries. The next BYCWG meeting was scheduled for 2022.

Multi-species Approaches to Management and Modelling: An extensive review of ecosystem models that include the marine mammal compartment was presented. A large range of uncertainty related to marine mammals remains within these models, and input parameters need to be assessed. Other organisations (e.g., ICES, IWC) were working on these issues and the SC *agreed* the NAMMCO Secretariat would monitor their progress. Furthermore, the SC *agreed* that a workshop to assess the model portfolio available for the North Atlantic was desirable but further planning was postponed to the next SC meeting.

Environmental Issues: An update on the Mary River Project (Baffinland mine) was provided by the JWG. The SC *recommended* a workshop be held by the JWG to assess the anthropogenic impacts of mining projects (e.g.,

Baffinland mine in Canada, Wolstenholme Fjord mine in Greenland) on Arctic marine mammals, focussing on narwhal, beluga and walrus. The ToRs are detailed in the report.

Seal and Walrus Stocks (Item 10)

Bearded Seal: As a first step in assessing the status of the bearded seal in the North Atlantic, the knowledge and data that had become available since 2010 had been reviewed by former NAMMCO intern. Although data on stock structure and abundances were still limited, there was more information than before and the SC found a status meeting to be warranted. The SC *agreed* that the review would be reviewed by SC experts, *recommended* that data on local abundance in Greenland be analysed and made available, and *recommended* that catch data be attributed to smaller areas. The SC agreed to hold a Joint NAMMCO-CAFF Bearded Seal Workshop in May/June 2022 to assess the status of the bearded seal over its range, detailed objectives can be found in the report.

Ringed Seal: The SC *recommended* that R-2.3.1 be rephrased to include climate change, as this likely represents the biggest threat to ringed seals. The SC found it important to progress with a status review of ringed seals, as it was an exploited species in Greenland and Svalbard and will be impacted by climate change. The SC agreed that a small group should look at the outcomes of the review by NOAA, expected in June 2022, and the review by Canada from 2019, and propose how to proceed.

Harbour & Grey Seal: In Norway, analysis of survey data was not yet completed and further tagging of harbour seals and the modelling of the grey seal population was planned for 2022. Iceland presented a new population estimate for the harbour seal and informed that has a new grey seal survey was scheduled for which the analysis will be finalised before the end of 2022. Summer counts of grey seals in the Faroe Islands are ongoing. The SC *agreed* to postpone the Coastal Seal Working Group (CSWG) to 2023, when all analyses will be completed and more data should be available. The difficulty of getting reliable by-catch estimates because of misidentification was noted, and the SC *recommended* that in the Norwegian Coastal Reference Fleet, the collection of the lower jaw of seals becomes mandatory.

Harp and Hooded Seal: The next meeting of WGHARP was planned for autumn 2023, where new management tools and data will be discussed and implemented, and new advice for management be developed. Prior to this, improvements and advances in assessment models will be done at the joint ICES/NAMMCO/NAFO benchmark meeting planned for December 5 – 9, 2022.

Walrus: GINR deployed an autonomous camera to monitor a newly documented terrestrial walrus haul-out site in Qaanaaq. Norway has an ongoing tracking project in Svalbard, where 40 walrus were tagged in 2014 and 2015, of which 2 individuals are still reporting. The SC *reiterated* the recommendation that a workshop to assess the disturbance from the Baffinland mine and the Wolstenholme Fjord mine on Arctic species be held and include the walrus as focus species.

Cetacean Stocks (Item 11)

Narwhal:

Ad hoc Working Group on Narwhals in East Greenland: The NEGWG 2021 met for a second time to review its previous management advice in light of new data on stock structure, distribution, abundance and catch statistics. A weight of evidence, including hunter's records and genetic analysis, indicated there likely were a spring and summer sub-stock in Scoresby Sound.

All available knowledge and data, including hunter knowledge, had now been exhausted to update the assessment. The results of the assessment conclude a 34% and 30% risk that the hunt in Tasiilaq and Ittoqqortoormiit will cause these two narwhal populations to go extinct by 2025. Additionally, a list of evidence that indicates the narwhal stocks in Southeast Greenland are severely depleted was provided and can be found in the report. The SC *strongly reiterated* its management advice to reduce the hunt of narwhals to 0 in all three management areas in Southeast Greenland. The SC *firmly stressed* the urgency for immediate management action to secure the presence of narwhal in Southeast Greenland in the future.

The SC *endorsed* all recommendations made by the NEGWG.

KNAPK representatives stated at the MCC 2021 meeting that they had not been reimbursed for damaged nets during the live-capture of narwhals for scientific purposes in East Greenland. The SC was informed that these costs were considered to be included within the bounty paid to hunters for the live captures.

NAMMCO-JCNB Joint Working Group: The JWG 2021 updated availability estimates for narwhal stock surveys using results from the Quantitative Subworking Group (QSG) and updated the allocation model. It reviewed available research on climate change effects on narwhal in West Greenland and Canada and agreed that at this moment these effects cannot be incorporated into the model, as exact impact mechanisms are fully not known, but that a precautionary approach can be used. The JWG provided narwhal catch advice to the JCNB in the form of optimal catch allotments for each hunting region in West Greenland and East Canada. The SC agreed with this management advice and endorsed all additional recommendations provided by the JWG.

Beluga:
Narwhals in East Greenland Working Group: The NEGWG 2021 was asked to evaluate the available knowledge on belugas in East Greenland to develop management advice, as increasing sightings of belugas have been reported in this area. Although genetic studies are advancing, it remains unknown to which stock the belugas in East Greenland should be related, and no population of belugas has been identified in East Greenland. The SC *endorsed* the recommendation that belugas in East Greenland should remain fully protected as there was insufficient information to perform an assessment, as. It also endorsed the other recommendations given by the NEGWG for beluga.
NAMMCO-JCNB Joint Working Group: The JWG 2021 elaborated on its previous recommendation for seasonal closures and no hunt south of 65˚ in West Greenland, which had not been endorsed by the MCC. The JWG also assessed impacts of climate change on beluga management and agreed more data was needed to clarify connections between beluga distributions and other variables. Furthermore, the JWG was requested to hold a workshop on effective tagging practises for belugas, but suggested to include a broad range of experts as well as including tagging of narwhals in addition. The SC *endorsed* all the recommendations on beluga in West Greenland forwarded by the JWG.

Dolphins: A Dolphins Working Group (DWG) meeting was tentatively scheduled for 2023 and all member countries are *recommended* to compile a detailed review of the available information. The SC agreed this was important, in light of the unusually large hunt of *Lagenorhynchus* sp. in the Faroe Islands in 2021, and additionally recommended the ToR of this DWG to include also the potential effect of removing complete groups/family groups regarding genetic diversity and social knowledge. The SC was informed that the differentiation of white-sided dolphins in Greenland and white-beaked dolphins had been implemented in reporting forms in 2021.

Harbour Porpoise: Sufficient data was now available to conduct an assessment of harbour porpoises in Norway, and the SC *recommended* the Harbour Porpoise Working Group to meet in 2022. This WG was also tasked to review the information available on *Lagenorhynchus* sp. and pilot whales and advise on how to progress towards an assessment of these species in 2023. The harbour porpoise assessment for Iceland was scheduled for 2024, to wait for the result of the porpoise survey planned in 2023. An assessment for West Greenland was completed in 2019, SC28 was informed that the recommended catch of no more than 2,629 harbour porpoises in West Greenland had not yet been implemented.

Pilot Whale: The SC *agreed* to delay a pilot whale assessment to 2023 to allow for the Faroese analyses to be finalised. The SC *recommended* that the analyses of both the biological and tagging data be completed to inform possible recruitment of the drive hunt. The Faroe Islands are *urged* to provide the support necessary for this.

Northern Bottlenose Whale: Norway was progressing with the work of providing a single abundance estimate of northern bottlenose whales for the whole NAMMCO management area through re-stratification and recalculation. Norwegian sighting data from 2021, with high number of sightings, will be included.

Killer Whale: Greenland was the only NAMMCO member country with direct takes of killer whales, motivated by the consumption and sales of mattak, and to protect seal prey species and thus preserving the seal hunting culture. Communities in East Greenland suggested the regulation of killer whales to protect narwhal. The SC emphasized that due to the lack of overlap in habitat, killer whales do not represent a risk to narwhals. The SC did not find itself in a position to generate advice on sustainable catch levels of killer whales in Greenland, and in the absence of data *advised* that continued harvest may risk the local presence of killer whales in some areas.

Research updates on the **Blue Whale**, **Bowhead Whale**, **Fin Whale** and **Humpback Whale** were provided in the form of submitted For Information documents, for which a short summary can be found in the report.

Management Procedures (Item 12)

The SC had tasked the JWG to initiate the development of a principle-based approach for the sustainable management of small and/or depleted stocks. The JWG 2021 drafted 7 such principles incorporating a precautionary approach that were presented to the SC. The SC welcomed the effort by the JWG and agreed that these principles provide good reference points for further discussions.

NASS Survey 2024 (Item 14)

Council 28 supported the SC27 plan to have this coordinated survey in 2024, but asked the SC to also look into the possibilities of using combined survey platforms with fish surveys. The planning group had made no final decision on survey procedures yet but informed the SC that double platform procedures would be used in all survey segments. The SC noted the importance of progressing swiftly with the planning, and underlined the necessity for the Faroese pilot whale tracking data to be analysed to form a basis for the survey design of the Faroese strata.

NAMMCO Scientific Publications Update (Item 17)

The open-call for papers for Volume 12 "*Marine Mammals in the North Atlantic*" was closed on December 31, 2021. It received 8 submissions; 1 workshop report, 5 research articles, and 2 notes. The first article was published in January 2022, the remaining submissions are in review and will be published later in 2022. The planning of Volume 13 was not discussed due to time constraints.

Future Work Plans, Budget & Other Business (Item 15, 16, 18, 19)

The following workplan was agreed on, and the budget for 2022 and 2023 was revised accordingly.

2022	2023	2024
Working Groups: - Bearded seal (Jointly with CAFF/CBMP in June) Harbour porpoise (Norway) (+ review of *Lagenorhynchus* sp. and pilot whale available data) - By-catch (Spring) - JWG/WS on disturbance (November) **Other:** - MINTAG: development and testing - NASS planning - Harp & hooded seals Benchmark Meeting (5-9 December)) - Ringed seal (Ltd, fall)	**Working Groups:** - Harp & hooded seals - Dolphins - Coastal seals - Pilot whale - Narwhal in East Greenland - Ringed seal (tentatively) **Other:** - MINTAG: testing and field work - NASS planning - Beluga tagging workshop	**Working Groups:** - Walrus - Large Whale Assessment - Harbour porpoise (Iceland) **Other:** - MINTAG: field work and analysis - NASS planning and survey

The 28th SC meeting will be held January 23 – 27, 2023. As SC26 and SC27 took place online, Greenland would remain the host in 2023. The precise location will be determined at a later time.
Aqqalu Rosing-Asvid (GL) was elected as the new SC Chair and Sandra Granquist (IS) was elected as Vice Chair.

Recommendations (Item 20)

An overview of all recommendations by SC28 can be found under item 20 in the report. This includes catch recommendations, recommendations for conservation and management, recommendations for research, and procedural recommendations

Meeting Close (Item 21)

The meeting ended at 16:50 CET on January 27, 2022. A draft report was approved during the meeting and following minor revisions by correspondence, the final report was accepted on February 18, 2022.

MAIN REPORT

1. CHAIRMAN WELCOME AND OPENING REMARKS

The Chair of the NAMMCO Scientific Committee (SC), Bjarni Mikkelsen welcomed participants and observers to the 28th meeting of the Committee. A particularly warm welcome was extended to the newly appointed member to the SC from Iceland, Guðjón Már Sigurðsson. Unfortunately, it was decided last-minute to hold this meeting online, as it would not be responsible given the current COVID-19 situation to meet in person. The Chair acknowledged the challenges the SC has had in the past year because of the pandemic, but all scheduled working groups had held successful meetings.

New participants were given the opportunity to introduce themselves, including the Interim Scientific Secretary Heleen Middel and the current intern Josephine Schulze. A full list of participants and observers at the meeting can be found in Appendix 2.

2. ADOPTION OF AGENDA

A draft agenda was delivered to the committee 30 days prior to the meeting, as required under the NAMMCO rules of procedure. It was revised to accommodate the change from an in-person meeting to an online format, which included a shorter time schedule.

Because of the limited time, the cetacean species for which there are no active requests were not discussed during the meeting, except for killer whales, but written updates were provided to be included in the report, as well as For Information documents.

Because of the overlap in updates on harp and hooded seals it was decided to move these two agenda items under one item.

The revised draft agenda for the meeting was adopted without further amendment. This agenda is available as Appendix 1.

3. APPOINTMENT OF RAPPORTEURS

The NAMMCO Interim Scientific Secretary, Heleen Middel, was appointed as rapporteur for the meeting. Other members of the NAMMCO Secretariat (Geneviève Desportes, Charlotte Winsnes and Josephine Schulze) assisted in the rapporteuring. It was emphasised that to support this work, convenors and committee members were asked to submit written summaries on agenda items as relevant.

4. REVIEW OF AVAILABLE DOCUMENTS

4.1 NATIONAL AND ANNUAL PROGRESS REPORTS

The SC welcomed the 2020 national progress reports provided by the Faroe Islands, Greenland, Iceland, and Norway, as well as the written reports on activities submitted by Canada, Japan, the Russian Federation, and the Makivik Corporation. The 2021 national progress reports by Norway and Faroe Islands were also available.

4.1.1 Updates from observers

4.1.1.1 Update from Japan

The Progress Report 2021 by Japan consisted of four parts: SC/28/NPR-JP a) on large cetacean, SC/28/NPR-JP b) on small cetaceans, SC/28/NPR-JP c) on satellite tagging experiments (2021), and SC/28/NPR-JP d) on management procedures for North Pacific common minke whales (*Balaenoptera*

acutorostrata). Due to limitations in time, only the satellite tagging experiments were presented. A summary of the full Progress Report can be found in Appendix 4.

Japan presented the progress in technical development and results of satellite tagging experiments conducted by the Institute of Cetacean Research (ICR) during 2020/21. The tagging experiments are conducted to respond to questions on the habitat and stock structure of large whales. In the Antarctic, satellite-monitored tags were deployed on the Antarctic minke whales (*Balaenoptera bonaerensis*) and fin whales (*Balaenoptera physalus*) in the Atlantic and Indian sectors in the austral summer season 2020/21. Ten Antarctic minke and seven fin whales were tagged. Antarctic minke whales showed wide longitudinal movements, and one individual showed a northward migration in the Indian sector starting in April. Tagged fin whales in Antarctic waters did not show remarkable longitudinal nor latitudinal movements. Eight fin and 18 sei whales (*Balaenoptera borealis*) were tagged in the Okhotsk Sea and the North Pacific. Three fin whales moved between the Okhotsk Sea and the western North Pacific. In the central-eastern North Pacific one individual moved southward from August. Sei whales showed a movement pattern suggesting feeding activities. Preliminary experiments on diving patterns using Argos satellite transmitting tags were conducted on fin whales in the Okhotsk Sea and fin whales and humpback whales (*Megaptera novaeangliae*) in the Antarctic. The development of satellite tagging technology as well the application of tagging to respond to ecological and stock structure questions in large whales are current areas of collaboration between NAMMCO and Japanese scientists.

Discussion

The SC thanked Japan for the information provided. Louis Pastene stressed the importance of conducting satellite-tracking in parallel with biopsy sampling and genetic analyses, to gain knowledge on stock structure.

4.2 WORKING GROUP REPORTS

The reports of the three working group meetings that were held in 2021 were presented to the SC:

- By-catch Working Group (SC/28/05)
- Ad hoc Working Group on Narwhal in East Greenland (SC/28/06)
- NAMMCO-JCNB Joint Working Group on Narwhal and Beluga (SC/28/07). At the time of this SC meeting, the Joint Working Group (JWG) report was not yet released by either NAMMCO or JCNB and was considered strictly confidential until the release of the SC28 report.

4.3 OTHER REPORTS AND DOCUMENTS

Other working documents that were made available to the meeting included:

- List of active Council's requests to the SC (SC/28/04)
- Review of bearded seals in the North Atlantic (SC/28/08)
- Update from the Secretariat on a joint NAMMCO-CAFF bearded seal workshop (SC/28/09)
- A principle-based approach to setting management objectives for removals of small cetaceans and pinnipeds (SC/28/10)
- Participation report of the IUCN World Conservation Congress 2021 (SC/28/11a) and the posters presented at this congress (SC/28/11b)
- Report from the 2021 activities in ICES (SC/28/12)
- NAMMCO website species pages for review; narwhal (SC/28/13), beluga (SC/28/14), fin whale (SC/28/15), humpback whale (SC/28/16).
- Abundance estimate overview tables (SC/28/17)
- SC accounts and budget (SC/28/20)
- Annual report from the MINTAG project (SC/28/21)
- Minutes from the NASS planning meeting 2022 (SC/28/22)

The For Information documents available to the meeting are listed in the document list, which can be found as Appendix 3.

5. UPDATES FROM COUNCIL

5.1 GENERAL COMMENTS

The General Secretary of NAMMCO, Geneviève Desportes, provided an overview of comments and decisions from Council 28 that directly concern the SC:

The Chair of the Council thanked the Scientific Committee for its work, and on behalf of the Council, he thanked Þorvaldur Gunnlaugsson and Tore Haug for their long-term contributions to the work of the Scientific Committee over the years, indeed since its establishment in 1993.

Council 28 recommended that the necessity for physical meetings contra virtual meetings always be carefully weighed by committees and subsidiary bodies, both from a financial and an environmental perspective. The necessity for holding physical meeting should be considered in all aspects of the administration of the Commission.

Following the report of the Performance Review Working Group, Council 28 endorsed five priority issues for NAMMCO, with the aim of further strengthening and improving the work of the organisation, both in the shorter and longer terms. These were:

1) Data quality and reliability to ensure high-quality science, which is at the core of NAMMCO management,
2) Follow up on the scientific, conservation and management advice provided by the Committees,
3) Transparency in work processes,
4) Precautionary approach in management,
5) Communication efforts.

Council 28 adopted a set of follow-up actions for each of the five priority issues, which should benefit from greater attention and focus. These are presented in the Table 1 below.

Council 28 acknowledged the support for the revised Super-Tag project among all Member Countries and the willingness to open the project to non-NAMMCO members. Since March 2021, things have progressed with the Super Tag project, which was launched under a new name on August 4, 2021 (see document SC/28/21 and discussion in section 6.1). Two important steps were the inclusion of Japan as a full partner and therefore as a member of the Steering Group, and the agreement on a financial plan by the five partner countries.

About NASS 2024, the Council concluded that there was general support among Member Countries. It noted that the estimated costs for the planning of NASS 2024 should be included in the NAMMCO budget for the coming years. It requested the SC to further look into the feasibility of including fish surveys as observation platforms (see document SC/28/22 and discussion in section 14).

Desportes added that the Finance and Administration Committee had decided the week prior to the SC28 meeting to postpone the 29th meeting of the Council, initially planned for the last week of March, to September, in the hope that a physical meeting would then be possible; if not, the meeting would be virtual. However, if decisions concerning the continuation of the SC work needed to be taken before, the Council would do so inter-sessionally.

Table 1. Five priority issues for NAMMCO and follow-up actions as endorsed by Council 28. Actions concerning the SC (most of the actions) are shown in light grey.

Priorities identified by the Council	Recommended actions proposed by the Council	Responsible
Data quality and reliability	Strong attention be given to data quality, reliability, safe storage and accessibility	Committees / Members / Secretariat
	Complete overview documents on endorsed abundance estimates, removal levels, assessment status	Secretariat, Committees
Follow up on the scientific, conservation and management recommendations provided by the committees	Continue developing overview documents following up the responses to proposals from committees for advice on stock status and hunting activities	Secretariat / Committees / Members
	A new sequence of annual meetings, following SC recommendation, with the SC annual meeting held two months prior to the Commission Annual Meeting.	FAC / SC
Transparency in work processes	Basis for specific advice better articulated by the SC and the MCs, in particular where MC decisions differ from the advice provided by the SC.	MCs / SC
	Revisions of MCs and SC RoPs to clarify responsibilities	
	Better define the workflow of the NAMMCO advisory process	MCs & Secretariat
	Members to provide information to the relevant MCs on their management objectives, framework and plans, so the SC has a clear overview	Members / Secretariat
	Continue and increase the use of the website as a public information portal	Secretariat / organisation
	Develop a document consolidating NAMMCO financial rules and practises	Secretariat / FAC
Precautionary approach in management	MCs to more clearly define how the precautionary approach is applied in NAMMCO conservation and management, with focus on rebuilding depleted stocks	MCs / SC
	To not postpone the 2021 ringed seal WG	SC
	MCs to consider prioritising assessment effort, based on the SC overview of stock status	MCs / SC
Communication efforts	Website to be the focus of communication and outreach efforts; completion and update priority for Secretariat Regular review of content by Committees following the process recommended by the FAC.	Secretariat, Committees

5.2 ENDORSED SC WORK PLAN

The Council had endorsed the following work plan for the SC for 2021, 2022 and 2023 (Table 2). The SC further discussed and amended the work plan under section 15.

Table 2. Work plan for the SC as endorsed by Council 28.

2021	2022	2023
Working Groups: - Narwhal in East Greenland - NAMMCO-JCNB JWG on Narwhal and Beluga - By-catch **Other:** - Harp & Hooded Seals Benchmark kick off (online) - NASS Planning (online) - *(Super-tag: Development)*	**Working Groups:** - Bearded Seal - Ringed Seal - Harbour Porpoise - Coastal Seals - Pilot Whale **Other:** - Harp & Hooded Seals Benchmark Meeting - NASS Planning - *(Super-tag: Testing)*	**Working Groups:** - Harp & Hooded Seals - Dolphins **Other:** - NASS Planning - *(Super-tag: Research)*

6. COLLABORATION BETWEEN SC MEMBERS

6.1 MINTAG PROJECT

The final description of the MINTAG project was provided in the appendix of document SC/28/21.

The project has five countries participating, FO, GL, IS, NO and JP. It is led by a Steering Group, under the leadership of Mads Peter Heide-Jørgensen (GL) and composed of scientists with expertise in whale tracking nominated by the five participating countries. The Japanese Fisheries Agency and the Secretariat of NAMMCO are also member of the Steering Group and the project is administered by NAMMCO, through the NAMMCO Secretariat. The project refers to the NAMMCO Finance and Administration Committee (FAC) and shall provide annual reports on the progress of the project to the NAMMCO Scientific Committee, the NAMMCO Council and the Japanese Fisheries Agency.

The objective of the MINTAG project, originally called Super-Tag project, is to develop smaller and lighter tags than the ones existing on the market today, i.e., miniature tags – or MINTAG.

Heide-Jørgensen presented an update on the advances in satellite tagging technology and reported on the progress of the project (document SC/28/21).

The MINTAG project was launched on August 4, 2021, with the first meeting of the Steering Group. The first task was to develop tender material with specifications of the equipment needed to meet the project goals. These include details on tag dimensions, launching tubes, duration and battery life of transmissions as well as preliminary schedules for the project deliveries.

Seven manufacturers were invited to provide an expression of interest by October 1, 2021. Only two manufacturers (Lotek and Wildlife Computers) wanted to move forward with a full proposal, and both requested non-disclosure agreements to be signed by all SG members. By mid-January 2022 enough details on product development, schedules, deadlines, and budget considerations, were received by the SG to make a decision about the manufacturer.

A decision can presumably be made in late February 2022 with the possibility of contract development before next Council meeting. The schedule of the tag development, testing and deployments may be adjusted due to delivery issues with electronic components, changes in satellite constellation and COVID-19-related issues, but the project should get off the ground in 2022.

Discussion

The SC was very pleased that this cooperative project had been launched and thanked the Secretariat for its dedicated support.

The SC discussed the advances in technology and the relative advantage of staying with old, tested technology or moving to untested but promising new technology. The big advantage of the latter will be the lower power consumption, contributing to a longer transmission life of the tag, which is important in the case of fast-swimming rorquals for which the wintering areas remain unknown.

The SC **agreed** that regarding the trade-off, its preference was to go for something that works for a long time and uses the most updated technology, as the project will imply a lot of effort involved over a long time in putting the transmitters on the whales.

The decision of course remains in the hands of the Steering Group, which will likely be in a position of making its choice at its next meeting in February 2022.

The SC also discussed the important role of the design of the hardware in the lifetime of the tag. A smaller tag will have better ballistic performance, therefore a better positioning on the animals, and a longer retention time (less drag). The SC **recommended** to the Steering Group that it chooses to go for the new technology in the transmitter system, which will delay the project, and the Steering Group should use the waiting time by advancing on the design of hardware.

The SC was looking forward to receiving further update on the project.

6.2 OTHER COLLABORATION

Ugarte reported on a 3-year PhD fellowship in marine biology offered by the Faroe Marine Research Institute (FMRI) and the Greenland Institute of Natural Resources (GINR). The fellowship is part of the project Marine Top Predators as Ecosystem Indicators in the Central North Atlantic (TOPLINK) funded by the Research Council Faroe Islands. The fellowship, which will be carried out in close cooperation between the GINR and FMRI, is part of a project that will use top-predators as indicators for the status and long-term trend of the North-Atlantic ecosystem, with focus on the Greenland-Iceland-Faroe-Scotland Ridge, and explore impact and feedback mechanisms manifested in the indicators. The project will study the ecological role of three common but overlooked top-predators, pilot whale (*Globicephala melas*), dolphins, and killer whale (*Orcinus orca*), of major importance for the central North Atlantic ecosystem.

7. INTERACTIONS WITH OTHER ORGANISATIONS

7.1 ASCOBANS

Desportes provided an update of activities in relation with ASCOBANS.

Former NAMMCO Scientific Secretary Fern Wickson participated in the ASCOBANS Working Group on Beaked Whales and made the WG aware of the abundance estimates generated by the NASS surveys series over the 38-year period (the WG report is available as SC/28/FI16). The topic of beaked whales was raised in ASCOBANS in September 2020, because of the apparent increase in strandings that had occurred in the UK, Ireland, Iceland, the Faroes, and elsewhere in the region with several Unusual Mortality Events (UMEs) recorded over the last 30 years. The WG concluded that powerful sonars deployed in or close to important beaked whale habitat were likely in part responsible for these UMEs, and provided recommendations for monitoring and mitigation of noise

Desportes and Middel observed the 26th meeting of ASCOBANS Advisory Committee (AC) in November 2021. The main point of interest to the NAMMCO Scientific Committee was the decision of AC26, following the killing of Atlantic white-sided dolphins in the Faroe Islands, to establish an Intersessional Working Group on *Lagenorhynchus sp*. to: 1) Review the available information about the population structures and trends, distributions, abundances, mortalities, reproductive outputs, health, diet, behaviour, and data gaps related to both species in the NE Atlantic; and 2) Review issues that pose a conservation threat to the species and their populations. Desportes had informed the AC that the NAMMCO SC had planned to hold a WG on dolphins in 2023 to review the status of the species in the North Atlantic and possibly conduct assessments. She had suggested that a joint review might be a

possibility, as a fair amount of information will come from the NASS survey series and the study conducted in the Faroe Islands.

The report of this meeting was not available yet, but Action Points and Recommendations from the meeting could be found as document SC/28/FI17.

Discussion

It was noted that several beaked whales strandings also happened in the Faroe Islands, Iceland, and Norway in the period 2000–2020 but were not included in the WG dataset. Deportes asked whether it would be meaningful to facilitate the exchange of data between the two organisations when dealing with poorly-known species of concern. The SC **agreed** that, although there are no NAMMCO countries represented in ASCOBANS, it would be valuable to have an exchange of data for species with a broad distribution. It was suggested this could be done between the Secretariats of NAMMCO and ASCOBANS, who could then circulate the data to members of the SC.

The prospect of a joint WG meeting on dolphins with ASCOBANS would be further discussed under section 11.3.

7.2 ARCTIC COUNCIL

Desportes provided an update of activities in relation with the Arctic Council WGs.

The Secretariats of AMAP and NAMMCO held a meeting in January 2021 at the initiative of NAMMCO to establish further contact and discuss options for collaboration. One focus of the discussion was how the expertise of AMAP could best be made use of in answering Request R-1.5.4 of advising the Council on the best process to investigate the effects of non-hunting related anthropogenic stressors on marine mammal populations, including the cumulative impacts of global warming, by-catch, pollution and disturbance. No precise *modus operandi* was, however, defined.

Two members of the NAMMCO Scientific Committee (Rikke Guldborg Hansen and Fernando Ugarte) and the NAMMCO Secretariat (Desportes) are active member of the Conservation of Arctic Flora and Fauna (CAFF) Circumpolar Biodiversity Monitoring Program (CBMP) ï Marine and of its Marine Mammal Expert Network (MENN). They participated in the spring and fall meetings of the CAFF/CBMP marine. They contributed to the update of the information related to marine mammal endemic Arctic species (bowhead whale (*Balaena mysticetus*), narwhal (*Monodon monoceros*), beluga (*Delphinapterus leucas*), walrus (*Odobenus rosmarus*), ringed seal (*Pusa hispida hispida*), bearded seal (*Erignathus barbatus*), harp seal (*Pagophilus groenlandicus*), hooded seal (*Cystophora cristata*), ribbon seal (*Histriophoca fasciata*), spotted seal (*Phoca largha*)) for the regular update of the State of the Arctic Marine Biodiversity Report (document SC/28/FI32).

The MENN had in its work plan for 2021–2025 a project activity focussing on improving knowledge on the status and trends of bearded seal populations. Considering the SC previous records that the planned WG on bearded seals could be held in cooperation with the CAFF (document SC/28/09), Desportes suggested to the MENN that a joint NAMMCO-CAFF event could be organised. The project was later developed by a joint group including Christian Lydersen, Aqqalu Rosing-Asvid and Desportes for NAMMCO (document SC/28/09). The idea and current plans have now been endorsed by the CAFF Board and the CBMP Marine Steering Group, but still needs the green light from the NAMMCO SC, as well as its input and suggestions regarding the organisation (see further discussion on the issue in section 10.1.2).

7.3 ICES

Haug reviewed the 2021 activities in ICES which have some relevance to the work in NAMMCO SC. This included work in the ICES Working Group on Marine Mammal Ecology (WGMME), the Working Group on Bycatch of Protected Species (WGBYC), the ICES Workshop on estimation of Mortality of Marine Mammals due to Bycatch (WKMOMA), and the expert Workshop on Seal Modelling (WKSEALS). The ICES Annual Science Conference (ASC) generally include sessions with marine mammals included as an

integral part, occasionally (including the digital 2021 meeting) also sessions entirely devoted to marine mammals.

7.4 IUCN

NAMMCO's Secretariat participated as an exhibitor to the IUCN World Conservation Congress 2021, held in Marseille, France, in September. The main objective was to showcase NAMMCO's vision of conservation to experts as well as to the general public, and to open a dialogue on the sustainable use of marine mammals. Eight posters summarising different topics related to NAMMCO's work were displayed at this stand, these can be found in document SC/28/11b.

A majority of the visitors to the stand agree with or understood NAMMCO's vision that whaling and sealing can contribute to the blue economy. There was a general feeling that the dominant paradigm in conservation was starting to shift, and that an increasing share of conservationists were voicing their support for the right of local communities to use their resources (as long as it is done sustainably and properly documented) and that also among members of IUCN.

The full participation report is available as document SC/28/11a.

7.5 IWC

Gísli Víkingsson informed the SC on the following points discussed by the IWC SC that are of interest to NAMMCO.

The general reporting of NAMMCO activities (under the item Cooperation with other Organisations) was very short and general, noting that no NAMMCO SC meeting was held in 2020 and that the report from the 2021 meeting would be considered at the 2022 IWC SC meeting. It was noted that NAMMCO and the IWC share overlapping scientific and programmatic areas of work including cetacean surveys, stock assessments, by-catch and entanglement response.

Under other items on the IWC SC agenda, cooperation or overlap of interest with NAMMCO was specially mentioned in relation to ongoing work on status of stocks and ecosystem modelling. The IWC SC noted that both organisations are working on a list of status of stocks and emphasised "the need to take care not to introduce ambiguity in terminology and/or categorisation (e.g., with the IUCN Red List)".

The IWC SC has been tasked with investigating the contribution of cetaceans to ecosystem functioning. While recognising that this is a complex long-term task, the SC has initiated the process and held a first workshop during 19–21 April 2021. Subsequently, the IWC SC re-established a Steering group to guide the process towards a 2nd workshop. In addition, the SC agreed to establish a technical working group to provide input on historical and current cetacean abundance estimates for the Southern Ocean, North Atlantic and potentially some other regions. With regards to the North Atlantic, the IWC SC noted the importance of including NAMMCO scientists in this WG, but several members of the NAMMCO SC are already included as members of this working group.

The IWC SC has endorsed recommendations from the report of the International Workshop on the Status of Harbour Porpoises in the North Atlantic (NAMMCO & IMR, 2019) and made several suggestions for improved knowledge in this field.

Regular assessments of whale stocks conducted by the Scientific Committee of the IWC have been of high importance to NAMMCO in recent decades. In 2021, the IWC SC confirmed the following work plan for RMP/AWMP Implementation Reviews of whale stocks that are of special relevance to NAMMCO (Table 3).

Table 3. IWC SC work plan for Implementation Reviews (IR) of whale stocks of relevance to NAMMCO.

Stock	IR	Year IR completed	Next IR
West Greenland bowhead whale	AWMP	2015	Estimated completion 2022
North Atlantic minke whale	RMP	1993, 2003, 2008, 2017	Estimated start 2022
North Atlantic fin whale	RMP	2009, 2016	Estimated start 2023
West Greenland fin whale	AWMP	2018	Estimated start 2023
West Greenland minke whale	AWMP	2018, 2019	Estimated start 2026
West Greenland humpback whale	AWMP	2014	Estimated start 2024 or 2025

7.6 JCNB

A joint scientific working group meeting by NAMMCO and the JCNB took place December 13 – 17, 2021 in Winnipeg, Canada. The report of this meeting is available as document SC/28/07.

7.7 OTHER

No other interactions between NAMMCO and other organisations were presented.

8. WEBSITE UPDATES & QUALITY REVIEW

Following the procedure proposed by SC26 in 2019 (SC26 Report, page 14), and later on endorsed by the Council at its 28th meeting, the SC was asked this year to review the information on the NAMMCO website for four species: fin whale, humpback whale, beluga, and narwhal. The SC should ensure that the information was accurate and updated with the latest scientific information. The SC members provided the Secretariat with updates throughout the meeting, but due to time constraints the review could not be completed and was finalised inter-sessionally afterwards. The review documents stayed available and open for comments from the SC members until the adoption of the SC report, and the information provided was **endorsed** for use on the NAMMCO website.

9. ENVIRONMENTAL AND ECOSYSTEM ISSUES

9.1 MARINE MAMMAL / FISHERIES INTERACTIONS

9.1.1 Review and status of active requests (R-1.1.5, R-1.1.8)

Request (R-1.1.5 (standing)asks the SC "To periodically review and update available knowledge related to the understanding of interactions between marine mammals and commercially exploited marine resources."

R-1.1.8 (ongoing)asks the SC "In addressing the standing requests on ecosystem modelling and marine mammal fisheries interaction, to extend the focus to include all areas under NAMMCO jurisdiction. In the light of the distributional shifts seen under T-NASS 2007, the SC should investigate dynamic changes in spatial distribution due to ecosystem changes and functional response".

There were no specific updates regarding distributional shifts. Víkingsson informed that Iceland had made effort in investigating a possible distributional shift of capelin (*Mallotus villosus*) in association with humpback whales and fin whales. This included positioning whale observers on fishing boats targeting capelin, biopsy sampling, and satellite tagging. There are no results available from this study yet.

Additional studies were brought to the attention and discussed in more detail under section 9.2.

The SC **recommended** that R-1.1.8 be re-written as a two-fold request as follows: 1) "*In addressing the standing requests on ecosystem modelling and marine mammal fisheries interaction, to extend the focus to include all areas under NAMMCO jurisdiction*." and 2) "*In the light of the distributional shifts seen under T-NASS 2007, the SC should investigate dynamic changes in spatial distribution due to ecosystem changes and functional response*".

9.1.2 By-Catch Working Group

Convenor of the By-Catch Working Group (BYCWG), Desportes, provided an overview of the report from the meeting held on October 15, 2021 (document SC/28/05), which was the 6th meeting of the Working Group. All four NAMMCO member countries participated in this meeting.

The overall Terms of Reference (ToR) of the working group (WG) as defined by SC21 are: 1. Identify all fisheries with potential by-catch of marine mammals; 2. Review and evaluate current by-catch estimates for marine mammals in NAMMCO countries; 3. If necessary, provide advice on improved data collection and estimation methods to obtain best estimates of total by-catch over time.

The specific reference of the 6th meeting was to review by-catch estimates for coastal seals (harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*)) in Iceland and Norway and of harbour porpoise (*Phocoena phocoena*) in the Norwegian coastal gillnet fisheries. Presentations were given on: the by-catch of marine mammal in the Icelandic lumpsucker gillnet fisheries in the period 2014–2018 with a focus on coastal seals; the by-catch of harbour porpoise and coastal seals in Norwegian gillnet fisheries; the pinger experiments which had been conducted in Norway and Iceland. The WG did not have time to discuss how to progress in conducting a risk assessment for all fisheries.

Iceland

Onboard monitoring by inspectors from the Directorate of Fisheries have been severely limited over 2020 and 2021 due to COVID-19 restrictions. The estimates of by-catch in high-risk fisheries have therefore not been updated. For the lumpsucker gillnet fisheries, the available by-catch estimates remained those presented to the WG in 2020.

For gear other than lumpsucker (*Cyclopterus lumpus*) gillnets, summary information both from onboard inspectors and fishing logbooks were presented. Due to few observations, it was difficult to estimate the overall by-catch for most of the species observed. However, the cod and Greenland halibut (GHL) gillnets remain the gear of concerns for marine mammals, compared to demersal trawls and long-lines, with few or no by-catch of marine mammals reported in the latter by inspectors or in the logbooks for the period 2016-2019.

Lumpsucker gillnet fisheries

The WG focused its discussion on the challenges associated with the lumpsucker estimates and the follow-up on recommendations for improving them given by the 2020 BYCWG meeting (combined stratification scheme and interpolation of missing depths). However, the WG was informed that the statistical power was not sufficient to allow for a combined stratification analysis and that only few depth data were missing and only in 2014, and that an extrapolation was deemed unlikely to have a significant effect on the final estimates.

The WG acknowledged that species identification in the fishermen's logbooks may be an issue. Preliminary analysis indicated that some DNA samples coming from by-caught seals labelled as harbour seals or grey seals were actually ringed seals. Although accurate identifications could be validated and improved by requesting photos of bycaught seals, the problem would remain that many of the by-caught animals are not brought on deck but drop out of the net or are removed from the net in the water, which makes species identification challenging even for experts or trained inspectors.

The WG recommended that efforts towards improving species identification by both inspectors and fishermen continue, and that collecting DNA samples and taking photos of by-caught seals be

encouraged in 2022 to validate inspector reports and calculate the rate of misidentification by fishermen, so this could be corrected for.

As the lumpfish catch was considerably higher than before, some fishing areas had been closed ahead of the 2020 season as a protective measure against bycatch. However, the areas had been defined primarily based on what the fishermen considered to be important seal areas, while the MFRI haul-out data suggests that the most important sites for seals are outside the closed areas and are areas that overlap with a high level of fishing.

The Icelandic Directorate of Fisheries had planned to have a high level of observation coverage in 2022. This larger than usual observation effort was initially planned for 2020 and 2021 but could not be achieved due to COVID-19 limitations. The collection of additional data during 2022 will hopefully enable both further stratification analyses and assessing the effect of the closures.

Since the CSWG assessment will take place in early 2022, the data resulting from the 2022 observation will not be available for that assessment. At its 2020 meeting though, the WG endorsed the estimates of marine mammal by-catch in the lumpsucker fishery in Iceland and these can therefore be used in the upcoming assessments of coastal seals. The BYCWG agreed that all the stratification approaches could be presented as relevant but recommended that assessments use the estimates from the stratification by management area as this approach captured some of the spatial and temporal variations and characteristics of the fishery.

Cod and Greenland halibut gillnet fisheries

There are currently no endorsed by-catch estimates for the cod gillnet and/or other fisheries in Iceland. The WG recommended that the estimates of seal by-catch in the cod (*Gadus morhua*) and Greenland halibut (*Reinhardtius hippoglossoides*) gillnets published in Punt et al. (2020) be forwarded to the CSWG to be used as a preliminary information in the assessments, with associated caveats and uncertainties. However, the WG considers this an underestimate (18 seals by-caught annually, 95% CI 2-44), as it is roughly half the number that the fishermen themselves have reported in logbooks (38 harbour seals and 7 grey seals).

The Greenland halibut fishery is an emerging and growing fishery with considerable effort in recent years. Logbook records report by-catch of several species, including “usual species” (harbour porpoise, harp seal, grey seal, harbour seal, ringed seal, but also unusual species such as humpback whales (*Megaptera novaeangliae*), northern bottlenose whales (*Hyperoodon ampullatus*) and Risso’s dolphin (*Grampus griseus*) (which is suspected to be misidentified). The WG therefore recommended that by-catch in this fishery be closely monitored and followed.

It is challenging to differentiate between the cod and Greenland halibut fisheries in the Icelandic effort database, as both use the same mesh-size nets, and there is no field for target species in the fishermen’s logbooks. The WG recommended that a field for target species be included in the logbook as well as other ways to distinguish these coastal and offshore fisheries for monitoring bycatch.

Norway

Coastal seals cod/monkfish gillnet

The by-catch rates and total by-catch for harbour and grey seals caught in Norwegian commercial gillnet fisheries were estimated using a stratified ratio estimator, with number of hauls as a proxy for fishing effort. Estimates were derived from data collected with a contracted reference fleet of small coastal vessels (less than 15 meters length overall) and scaled up to the whole fleet using data from national landing statistics. To address unreliable species identifications, by-catch data on both species were pooled before by-catch estimates were calculated. The relative abundances of each seal species in different coastal regions were then used to apportion total estimates into species-specific estimates. Average yearly by-catch over a 15-year period, from 2006 to 2020, was estimated to be 757 seals (CV 0.12), of which harbour seals comprised 394 (95% confidence interval CI 303 - 479) and grey seals comprised 363 (95% CI 298 – 474) (Table 4).

Table 4. Estimated average yearly by-catch of harbour seals and grey seals in Norway (SC/28/BYCWG/04).

Species	Fishery	Region	Estimated by-catch	CV	95% CI
Harbour seal	Large mesh	1	90.0	0.16	65.6 – 123.6
		2	85.2	0.05	77.1 – 94.1
		3	55.3	0.16	40.4 – 75.8
	Medium mesh	1	114.8	0.13	89.1 – 148.0
		2	15.8	0.15	11.8 – 21.3
		3	7.3	0.16	5.3 – 9.9
	Small mesh	1	8.0	0.25	5.0 – 12.9
		2	2.6	0.20	1.8 – 3.8
		3	14.9	0.16	10.9 – 20.3
	Total	Total	394	0.12	303 – 479
Grey seal	Large mesh	1	90.3	0.16	65.8 – 124.0
		2	116.2	0.05	105.2 – 128.3
		2	7.3	0.16	5.3 – 10.0
	Medium mesh	1	110.5	0.13	85.8 – 142.4
		2	23.9	0.15	17.8 – 32.3
		3	0.9	0.16	0.7 – 1.3
	Small mesh	1	8.1	0.25	5.0 – 13.2
		2	3.7	0.20	2.5 – 5.5
		3	1.9	0.16	1.4 – 2.6
	Total	Total	363	0.12	298 – 474

The WG concluded that this updated analysis addressed the concerns and recommendations of the 2020 BYCWG, i.e., that the by-catch data of grey and harbour seals be pooled and apportioned according to: 1) the relative population estimate and 2) the relative harbour seal and grey seal pup/yearling abundance in the management areas. It commended the authors for their work.

Apportioning the total seal by-catch in proportion to the relative population estimates of grey and harbour seals by areas provided better by-catch estimates than previous analyses but remained a relatively crude approach to addressing the challenges posed by species misidentification. Although there is no trend in overall by-catch over the years, there seems to be a decreasing trend within some regions, likely linked to a dramatic reduction in effort in the monkfish (*Lophius piscatorius*) fishery.

The WG agreed that the use of fishery classifications presented in this paper, based on mesh size, was an interesting and useful approach. The inclusion of fisheries other than the cod fisheries was also viewed as valuable.

The WG endorsed the updated seal by-catch estimates presented and provided here in Table 4. The WG strongly recommended the continuous improvement of species identification through REM, habitat preference models, and photographs.

The WG was informed that Norway was currently exploring the use of Remote Electronic Monitoring (REM) in a pilot form, and if successful, this would be applied on up to 30 vessels (<15m). The intention is to deploy REM on vessels not already operating in the coastal reference fleet (CRF), and thereby effectively double the number of vessels 'reporting' by-catch. It is also anticipated that REM could significantly improve species identification. To address the problem of assessing drop-out rate, the vessels will be equipped with two cameras; one that monitors the deck and a second that monitors the net as it comes out of the water.

In some regions, the total removal (by-catch and direct takes) is higher than the calculated Potential Biological Removal limit (PBR). Despite this, the harbour seal population in Norway has been stable over the past 10–15 years. In contrast, grey seal pup production has been declining. In considering the stability of the harbour seal population despite total removal levels exceeding PBR, the WG strongly underlined that PBR is a conservative approach to calculating what constitutes an appropriate level of take and is not on its own directly a measure of sustainability.

Harbour porpoiseçgillnet fisheries

Moan et al. (2020) had estimated the harbour porpoise by-catch for Norwegian commercial gillnet fisheries from 2006 to 2018, using a traditional ratio estimator and generalised additive linear mixed models, with weight of fish landed and number of gillnet hauls as proxies for fishing effort. Estimates were derived from data collected with a contracted reference fleet of small coastal vessels and scaled up to the whole fleet using data from landing statistics. By-catch estimates exhibited large yearly variations, ranging from 1,151 to 6,144 porpoises per year. By-catch estimates in 4 of the last 5 years were significantly less than in the preceding 2 years. The best ratio-based and model-based yearly by-catch estimates were 1,580 porpoises (CV: 0.10, 95% CI = 1,302–1,902) and 1,642 porpoises (CV: 0.15, 95% CI = 1,165–2,142), respectively. About 75% of by-caught porpoises were taken in the cod and monkfish fisheries, while the rest were taken in a variety of different gillnet fisheries. The results suggested that by-catch of harbour porpoise in Norwegian gillnet fisheries had been unsustainable for several of the last 13 years but were currently within international by-catch limits due to a recent reduction in monkfish fishing effort.

The WG noted that in the past, the monkfish fishery had a high level of by-catch but this had decreased with a decrease in effort in the fishery. A possible recovery of this fishery in the future could therefore increase the by-catch again. Pingers were currently only used in the cod fisheries and the possibility of equipping monkfish gillnets with pingers was discussed. Monkfish nets have strings that can include up to 500 nets, with 14km per string. Covering all the nets could be overcome by using louder, rather than more, pingers and placing them 2km apart – although it was noted that this will increase the ensonification of the environment.

The WG endorsed the estimates provided, and due to the uncertainty in the trend in effort of the monkfish fishery agreed that these estimates should be presented for both time periods.

Harbour porpoiseçPinger experiments

In Norway, a field trial was conducted to determine the effect of acoustic deterrent devices (ADDs, or pingers (both) on harbour porpoise and harbour seal by-catch in three commercial gillnet fisheries targeting cod, saithe (*Pollachius virens*) and monkfish over two years. Both the Banana (Fishtek Marine Industries) and the Dolphin (Future Oceans) pingers were used for this trial, but no differentiation was made between these in the analysis. The only differentiation used in the analysis was the use of pingers vs. no pingers, with the same nets used for both the trial and the control. Modelling results indicated that using pingers on gillnets reduced the risk of by-catching a harbour porpoise by an estimated 96.9% (95% CI = 95% – 98%) compared to ordinary pinger-free nets. The effect of pingers was not significantly different between different fisheries, and pingers had no significant effect on catch rates of fish or harbour seals. The extra time costs associated with operating nets with pingers were low (averaging about 2.8 minutes per operation).

The WG remarked that the IWC, and other bodies, consider that the decrease of harbour porpoise by-catch using pingers was already a proven concept. Bjørge indicated that the purpose of the Norwegian trial was to test the practicalities and demonstrate the efficiency of using pingers in Norwegian fisheries and under the unique environmental conditions of Norway, and to thereby help convince the authorities – and the fishermen – that pingers were efficient.

In Iceland a trial was conducted using banana pingers. This study observed no effect of the pingers on harbour porpoise by-catch, but a negative effect on the catch of target species (cod). The trial and the control group took place at the same time, but they were at least 1nm, and usually 2nm, apart.

The WG noted that the Icelandic trial was the first they are aware of where the pingers did not reduce by-catch. The difference in results between Norway and Iceland could possibly be due to a difference in the acoustic environment, or due to differences in the sounds being emitted by the Banana pinger devices, as Fishtek regularly updates their models and changes their source levels. The WG recommended comparing the pingers used in the Norway and Iceland trials to investigate any possible differences in the noise they produced.

Discussion

The SC thanked the WG for its work. It asked clarification about the recommendation that the estimates of seal by-catch in the Icelandic cod and Greenland halibut gillnets published in Punt et al. (2020) be forwarded to the CSWG to be used as a preliminary information in the assessments, with associated caveats and uncertainties, as it was clearly an underestimation. The SC decided not to endorse this recommendation. It **recommended** instead that, since both the by-catch reported in the logbook and the Punt et al. (2020) estimates were both recognised as being underestimates, the largest of the upper Confidence Interval from Punt et al. (2020) and the by-catch reported in the logbook be used by the CSWG as a preliminary minimum by-catch estimate for seals in the Icelandic cod and Greenland halibut fisheries.

It was asked why the WG did not advise on implementing pingers in relevant risk fisheries. Desportes answered that the WG is a technical one, in charge of examining the reliability of by-catch estimates to be used by other WGs in assessments but not in advising on the sustainability of such by-catch and therefore on the necessity of mitigation measures. The BYCELS WG was the body dealing with the welfare aspect of by-catch.

Martin Biuw noted that, although the pinger experiment was very promising, the large-scale implementation of pingers in the Vestfjord of Norway, was not giving the expected results. The SC **agreed** that the results of the implementation should be communicated to and discussed by the WG at its next meeting, and that the SC would then follow up on the question.

The SC **endorsed** the by-catch estimates for harbour porpoise, harbour and grey seals forwarded by the BYCWG for the Norwegian commercial coastal gillnet fisheries. The SC also **endorsed** the recommendations of the BYCWG but the one cited above (see text block below) and also the SC recommendations regarding species identification under section 10.3.3. It commended the progress accomplished by Icelandic and Norwegian scientists and the WG in producing reliable by-catch estimates that could be used in assessments. The SC **recommended** that the By-Catch WG continue and progress in its assessments of the by-catch risk in the different fisheries and was looking forward to reviewing the advances at its next meeting.

RECOMMENDATIONS FROM THE BYCWG 2021 endorsed by SC 28

Recommendations for Research

Iceland

- ~~To use the estimates of seal by-catch in the cod fishery published in Punt et al. 2020 as a preliminary information in the CSWG assessments, with associated caveats and uncertainties.~~
- To forward to the CSWG the largest of the upper Confidence Interval from Punt et al. (2020) and the by-catch reported in the logbook as minimum by-catch estimate for seals in the Icelandic cod and Greenland halibut fisheries

Norway

- To investigate the value of using habitat preference models for apportioning seal species in the generation of by-catch estimates.

Norway/Iceland

- To compare the pingers used in the trials conducted in Norway and Iceland to investigate similarities and differences in their deterrent signals

Recommendations for Conservation & Management

Iceland

- To continue efforts towards improving species identification by both inspectors and fishermen and encourage collecting DNA samples and taking photos of by-caught seals in 2022 to validate inspector reports and calculate the rate of misidentification by fishermen, so this could be corrected for.
- To support the analysis of DNA samples to assess rates of species misidentification through the provision of necessary funding.
- To include a field for target species in the logbook as well as other ways to distinguish these coastal and offshore [cod and Greenland halibut] fisheries for monitoring by-catch.
- To closely monitor and follow the by-catch in the Greenland halibut gillnet fishery.

Norway

- To continue improving the monitoring of by-catch rates and accurate species identification through the implementation of REM systems, habitat preference models, and photographs.

Overview of By-catch estimates endorsed by the BYCWG and subsequently the SC

Iceland

- The estimates of marine mammal by-catch in the lumpsucker fishery 2014-2018 - the stratification by management area approach is recommended for use in assessments as this approach captured some of the spatial and temporal variations and characteristics of the fishery (BYCWG 2020).

Norway

- The estimates of harbour seal and grey seal by-catch in commercial coastal gillnet fisheries 2006-2020 (BYCWG 2021).
- The estimates of harbour porpoise by-catch in commercial coastal gillnet fisheries 2006-2018 (BYCWG 2021).

Overview of MISSING By-catch estimates

Faroe Islands: All fisheries
Greenland: All fisheries
Iceland: The cod and GLH gillnet fisheries (take many different species) and all other fisheries, foreign fisheries in Icelandic waters.
Norway: All fisheries other than the commercial coastal gillnet fisheries, recreational fisheries, foreign fisheries in Norwegian waters.

Sigurðsson gave a short update on the ICES Workshop on Estimation of Mortality of Marine Mammals due to bycatch (WKMOMA) held at a request from OSPAR in 2021, which focussed on the by-catch mortality of the harbour porpoise, common dolphin (*Delphinus delphis*), and grey seal within the OSPAR maritime area (provided as document SC/28/FI14). Additionally, ICES Working Group on By-catch of Protected Species (WGBYC) met in 2021 to, among other, address fisheries impacts on harbour seals in the North Sea (document SC/28/FI15).

Sigurðsson also informed the group of a newly published study (Basran & Sigurðsson, 2021) on testing by-catch reporting from logbooks compared to observers. The main findings, using data from New Zealand, United States, and Iceland, were that cetacean by-catch recorded by observers was higher than logbooks by an average of 774% in trawls, 7348% in nets, and 1725% in hook and line gears. If logbook monitoring is to continue, the study emphasised the need for clearer legislation, simplified reporting using new technology and combination with electronic monitoring cameras to verify compliance to improve bycatch reporting in fisheries. Importantly, the paper stressed that the significant underreporting was happening in the fisheries of all three states despite differences in geographic locations, cetacean species and density and EEZ size, suggesting that the results would likely be similar in many countries with comparable, well-developed fishing industries. The paper is provided as document SC/28/FI38.

These results strongly support the general opinion of the BYCWG and the SC, that by-catch information provided by the logbook cannot inform reliably on the level of by-catch in the different fisheries and

should always be supplemented by monitoring data from independent observers or REM for fisheries of concern.

The SC **stressed** the need for the BYCWG to progress with assessing the overall risk of by-catch in the fisheries in the waters of NAMMCO member countries.

9.1.3 Consumption of resources by marine mammals

At the SC27, Japan suggested the topic of consumption of resources by marine mammals could be an area for further collaborative research between Japan and the NAMMCO member countries, and Desportes asked whether there was a more concrete proposal.

Japan informed the SC that some work has been conducted on calculating prey consumption in the North Pacific in context of the work by the North Pacific Marine Science Organisation (PICES). As this is similar to the work done in the North Atlantic, Japan suggested a collaboration in terms of comparison of methodology and results in the near future. Japan informed that a more specific proposal for research collaboration on prey consumption by marine mammals will be developed inter-sessionally in consultation with relevant scientists, and will be available for consideration of the SC next year.

Mikkelsen added that, although within NAMMCO there is no specific working group dealing with this topic, the individual member countries may have ongoing project that could be open for collaboration.

Haug informed that new information is available on patterns of lipid-store body condition of humpback whales (SC/28/FI33), the trophic ecology of harp seals using stable isotope analyses of teeth (SC/28/FI34), the distribution of rorquals in relation to prey in the Norwegian high Arctic (SC/28/FI35), and how killer whale movements on the Norwegian shelf are associated with herring density (SC/28/FI36).

9.2 MULTI-SPECIES APPROACHES TO MANAGEMENT AND MODELLING

9.2.1 Review and status of active requests (R-1.2.1)

R-1.2.2 (Standing) asks the SC "In relation to the importance of the further development of multispecies approaches to the management of marine resources, to monitor stock levels and trends in stocks of all marine mammals in the North Atlantic."

The SC responds to this request by regularly coordinating, or reviewing plans for, abundance surveys of walrus, seals and cetaceans and reviewing analyses of abundance estimates and trends.

R-1.2.1 (Ongoing) asks the SC "To consider whether multispecies models for management purposes can be established for the North Atlantic ecosystems and whether such models could include the marine mammals compartment. If such models and the required data are not available, then identify the knowledge lacking for such an enterprise to be beneficial to proper scientific management and suggest scientific projects which would be required for obtaining this knowledge.

In response to this request, Mette Skern-Mauritzen presented a review of ecosystem models that include the marine mammal compartment.

Summary

The portfolio of multispecies and ecosystem models including marine mammals is increasing. Ecopath with Ecospace (EwE) is currently being developed for Iceland, and a more detailed EwE is also developed for the Barents Sea, that includes arctic food web associated with sea ice (Pedersen et al. 2021). Also, Gadget, a multi-species assessment framework, has been completely rewritten and now uses state of the art optimization and statistical techniques, via R and TMB (Lentin & Elvarsson, 2022). Both Iceland and Norway progress towards implementing management strategy evaluation routines in Atlantis. This will support modelling ecosystem responses to harvesting strategies (e.g., harvest

control rules) and provision of advice to support ecosystem-based management, also including forward projections taking climate change into account.

Recent results from the Non-Deterministic Network Dynamic (NDND) model for the Barents Sea food web, with 8 compartments, suggest different ecosystem states: one with high pelagic fish and seabird biomass and low zooplankton biomass, or vice versa, and one with high demersal fish and benthos biomass but low biomass of marine mammals, or vice versa (Sivel et al. 2021, Nansen Legacy project). These results support the hypothesised competition between demersal fish and mammals in this system. A master student will continue to explore this competition using an NDND model approach. Pedersen et al. 2021, using EwE to model the Barents Sea system, explored the development of the Barents Sea system through the period 1970–1990, covering periods of overexploitation, ecosystem recovery and warming. The paper does not have much focus on marine mammals but identifies a link between the decreasing trend in sea-ice coverage and reduced ice-algae production after ca. 1980, with associated reduced biomasses of ringed and bearded seals.

The model portfolio for North Atlantic thus include simple models, such as NDND model for the Barents Sea, to complex end-to-end models such as EwE and Atlantis. The model portfolio is suitable for management advice on harvesting strategies for some regions, such as the Icelandic areas and the Barents Sea, but not available for other areas, such as the Faroese areas, Greenland Sea and Arctic (although now included in the Barents Sea EwE). Also, the available models are perhaps less useful for developing tactical management advice, e.g., on fisheries quotas.

However, also for the existing models, more marine mammal focused studies are needed to appropriately address uncertainties related to parameterization of marine mammals (e.g., diet, distribution, abundance) as well as ensuring relevant taxonomic resolution of marine mammals to be suitable for management advice. As the more complex models are associated with often unknown uncertainties, multi-model comparison is a preferred approach to strengthen the scientific support for model-based management advice. Finally, model sensitivity analyses to marine mammal parameters can guide collection of new information important in an ecosystem or multispecies context (e.g., Skogen et al. 2021).

ICES productivity audit is a review of all stocks ICES provide quotas for (including marine mammals), that identifies important processes for stock productivity, and to which degree these processes have been addressed in the stock assessment process, and priorities for further work. This review, which will become available in 2022, may give some guidance on where there is a need for developing models for more tactical advice (e.g., stock assessments and quota setting) that includes marine mammals. ICES also has two working groups on multispecies and ecosystem modelling; Working Group on Multispecies Assessment Methods (WGSAM) that is more oriented towards the use of models for management advice, and the Working Group on Integrative, Physical-biological and Ecosystem Modelling (WGIPEM). Both groups are focusing on, among other things, assessing model skills and uncertainties. There is also an ongoing process in the IWC on the use of multi-species and ecosystem models for addressing the functional role of marine mammals in marine ecosystems.

Discussion

Skern-Mauritzen was thanked for her extensive review of the ecosystem models.

The SC acknowledged the geographical imbalance in the coverage of the existing ecosystem models, with the Barents Sea in the Icelandic area being largely covered, and the need for models that cover the Norwegian Sea and the Greenland Sea.

Although ecosystem models are available, these have not been reviewed within NAMMCO to the extent where it can be agreed that these models are good reflections of reality and can be used for management purposes. It was noted that within these models there is a large range of uncertainty related to the marine mammal component, and the input parameters should be assessed. Some of the required data input, such as marine mammal consumption and sometimes abundance were still very rough or missing.

The SC acknowledged the work on this currently being performed by other organisations (e.g., ICES, IWC) and the need to monitor their progress. It was **agreed** that the NAMMCO Secretariat, together with Skern-Mauritzen, would request advice from the ICES WG's (i.e., WGSAM and WGIPEM) on the coverage of marine mammals within these models.

The SC further discussed the need for a workshop to assess the model portfolio available for the North Atlantic from a marine mammal perspective, addressing model uncertainties and suitability for management advice, as well as identifying needs for additional models to support management advice in the North Atlantic. It was **agreed** that such a workshop is indeed desirable, but that determining the Terms of Reference and further planning of the workshop is best done at a face-to-face meeting, and therefore postponed to the next meeting of the SC.

9.3 ENVIRONMENTAL ISSUES

9.3.1 Review and status of active requests (R-1.5.3, R-1.5.4)

R-1.5.4 (ongoing) "Committed to furthering its ecosystem approach to the management of marine mammals, and recognising the range of anthropogenic pressures facing North Atlantic marine mammals associated with the climate and environmental changes taking place, the Council requests the SC to advise on the best process to investigate the effects of non-hunting related anthropogenic stressors on marine mammal populations, including the cumulative impacts of global warming, by-catch, pollution and disturbance."

The SC answers this request by requiring that all WGs systematically include *Other [than removals] anthropogenic impacts* as an agenda item in their consideration. A further answer is also provided by the response to R-1.5.3, see below.

R-1.5.3 (ongoing)asks the SC "To monitor the development of the Mary River Project and assess qualitatively or if possible, quantitatively the likely impact and consequences on marine mammals in the area."

SC27 responded to this request by suggesting the JWG could provide more specific terms of reference for a workshop on disturbance from the mine. The Mary River Project was discussed at the JWG 2021 and convenor of the JWG, Hansen, presented section 4.1.1. of the JWG report.

Summary

The JWG met in December 2021 and was updated on Baffinland activities. The Mary River project is an operating open pit iron mine based on North Baffin Island and the ore is transported to Europe via Milne Inlet, Eclipse Sound. Since 2018, the Phase 2 Expansion Project would involve constructing a railway from the Mary River Mine Site to the Port Site, adding a second ore dock at the Port and increasing production to 12 Mt per year (currently 6 Mt) along the northern transportation corridor and icebreaking during spring and autumn both through the Eclipse Sound and at the anchoring sites (outside Eclipse Sound, Canada and at Store Hellefiske Bank, Greenland). Shipping days will increase to 135 days between July 1 and November 15 and there will be an estimated 176 ore carrier round trips + supply ships annually. This is an unprecedented large-scale project for the Canadian Arctic. DFO, Nunavut state departments as well as several NGOs are hearing partners in the review process of the environmental impact assessment, EIA. Greenland has been involved in the hearing process where transboundary effects of the ongoing activities connected to the mine is suspected. The Espoo report (Baffinland, 2021) found no transboundary effects that could be negative for Greenland.

The GINR has provided a response to this report highlighting several serious defects of the report and has raised concern of the use of 1) an anchoring area at Store Hellefiske Bank (biodiversity hot spot high priority area, including presence of bowhead whales, narwhals, belugas, walrus during winter). The anchoring site will be in the shoulder season June and November/December introducing ship noise and possible oil spill and 2) the Eclipse Sound narwhal stock (one of the world's largest) is hunted in

West Greenland and any negative impacts on this stock will potentially impact the hunt negatively in Greenland.

DFO disagrees with the EIA that the proposed project operations will inflict no significant impacts on the marine ecosystem within Eclipse Sound. Particular concern regards icebreaking in the shoulder season where narwhal migration occurs, and the cumulative noise impact will have a negative impact on marine mammals. The EIA did not assess the cumulative noise impact of all vessels nor the disturbance at the anchoring place outside Eclipse Sound which is the entry point for migrating narwhals to and from the summering ground. No early warning signs and accompanied threshold for mitigation purposes has been developed. Since 2018, which was the first year of icebreaking, the local community in Pond Inlet has observed lower numbers of narwhals and decreased catches. The JWG noted that no quantitative tests were included in the EIA and that these as well as early-warning indicators (i.e., calf proportion and declining abundance in Eclipse Sound) should be developed. Transboundary effects (i.e., noise pollution) might also affect the already critically reduced stock of narwhals in Melville Bay.

Discussion

The SC discussed the opportunity to organise a WS to assess the impacts of such mining projects on Arctic marine mammals, and the effectiveness of such a WS.

David Lee, observer from Nunavut Tunngavik Inc., informed that the Nunavut Impact Review Board (NRB) recently concluded their public hearing process and thereby their review of Phase 2. Their advice will now be taken to the Government of Canada. Although a workshop on this topic would not directly influence any decision, it would benefit similar future processes.

The SC **recommended** a workshop be held by the JWG in the fall to assess the anthropogenic impacts on marine mammals of activities associated to both the Mary River project in Canada as well as the mining activities in Wolstenholme Fjord. The SC suggested the following terms of reference for this proposed workshop:

1) *To assess the impact of anthropogenic activities of the Mary River project on marine mammals, with emphasis on:*
   - *the behavioural response to noise pollution from shipping and ice breaking*
   - *the energetic consequences of behavioural adaptations to noise pollution*
   - *population responses including changes in abundance and demography of narwhals in Eclipse Sound and adjacent areas*
   - *the possible changes in recommended catch levels for narwhals from Eclipse Sound*
   - *disturbance of walrus, belugas and bowhead whales from shipping, anchoring and ice breaking activities*
2) *To assess the impact of shipping and mining activities in Wolstenholme Fjord on especially the wintering stock of walrus in the area and the fall migration of beluga.*

9.3.2 Updates

Skern-Mauritzen informed the SC of several ongoing projects that are working on assessing ecosystem vulnerability to anthropogenic pressures (e.g., noise, pollution, bycatch), and risk from cumulative impacts;

- Mission Atlantic, an EU Horizon 2020 funded project, with specific focus on the Azores and the Norwegian Sea
- BarentsRISK, funded by the Norwegian Research Council, focusing on the Barents Sea
- CoastRISK, funded by the Norwegian Research Council, focusing on Norwegian coastal zones
- Vulnerabilities and risk from cumulative impacts in proposed Ecological and Biological Significant Areas (EBSAs) in the Barents, Norwegian and North Seas.

While none of these projects focuses specifically on marine mammals, they all include marine mammals. The SC looked forward to the results of these projects, which could be valuable input to the disturbance workshop described above.

Additionally, through available For Information documents, the SC was informed about a recent study that investigated perfluoroalkyl and polyfluoroalkyl substances in Northern Hemisphere marine mammals (document SC/28/FI08). New information on the concentrations and endocrine disruptive potential of phthalates in marine mammals from the Norwegian Arctic is described in document SC/28/FI18. In Svalbard, Norway, the impact of remotely piloted aircraft systems (RPAS) on marine mammals has been investigated in particular for harbour seals, polar bears (*Ursus maritimus*) and beluga whales (document SC/28/FI19).

10. SEAL AND WALRUS STOCKS

10.1 BEARDED SEAL

10.1.1 Review and status of active requests (R-2.7.1)

R-2.7.1 (ongoing)asks the SC "To convene a working group in 2022 with the aim of conducting a thorough review of the existing data and to go ahead with the assessment of stocks for which it was possible. If the data required for a full assessment of (some of) the stocks were not available, the WGs and the SC should identify, and prioritise, which specific data essential to their assessments are still needed."

SC27 agreed that as a first step, an overview of the information required and available to perform an assessment should be generated, together with a review of the literature currently available and particularly that published since the last review was performed in 2010 (Cameron et al. 2010). This information would then be considered in the planning for a working group meeting no later than 2022. The Secretariat proposed that the intern starting at NAMMCO in February 2021, which had done his Bachelor thesis on bearded seals under the supervision of Hansen and Morten Tange Olsen, be tasked with producing the literature review under the supervision of the Secretariat.

Nicolai Scherdin, former NAMMCO intern, presented a review of the knowledge and data that had become available since 2010, with a focus on the North Atlantic (NAMMCO/SC/28/08). The review covered information on life history parameters and behaviour, distribution and movement, stock structures, abundance and anthropogenic stressors. Although research on bearded seals has remained a secondary focus in the Atlantic Arctic since 2010, new information and data have emerged either as the result of focussed research or as the by-result of research targeting other species (typically abundance surveys). Key data on stock structure and regional-wide abundance is still missing for bearded seals. Some data on stock structure and local abundance in Greenland should become available shortly. The results of a circumpolar genetic analysis of bearded seals due in spring 2022 should inform stock delineation. Other lines of evidence that have recently emerged from behavioural (tracking, vocalisation and dietary) studies will also inform the delineation of management areas if not of stocks. Partial abundance data are now available since 2010 in multiple years for the North Water Polynya (NOW), Baffin Bay and the North-East Water Polynya (NEW). Progress in these two types of information might allow for a first assessment of bearded seals for these areas. Catch data are available for Greenland and have recently become available for Svalbard, some information on by-catch risk is also available for different areas.

The SC thanked Scherdin for the presentation and the valuable review produced. It was **agreed** that the document would be reviewed by Lydersen, Rosing-Asvid and Hansen, as well as Tange Olsen. The finalised review would then be presented to the planned Working Group. Although data on bearded seals were still limited, the SC noted that there was more information than ever before, and that the organisation of a status meeting was warranted. New data were not available in many areas, but a lot of data and information had been acquired before 2010 and should also form the basis of the WG

status review. The SC **recommended** that the data on local abundance in Greenland be analysed and made available to the WG. It also **recommended** that the catch data be made available in such a way that the origin of the catch can be attributed to smaller areas than those reported now (West and East Greenland and Svalbard).

10.1.2 Bearded Seal Working Group

Desportes informed on the planned Bearded Seal Joint NAMMCO-CAFF Workshop, NAMMCO/SC/28/09b. The SC had planned to conduct a status review/assessment of bearded seals in the North Atlantic for several years, when enough data would have come available, and had mentioned the possibility of a joint effort with CAFF. In parallel, the CAFF CBMP Marine Mammal Expert Network (CBMP-MENN) had in its work plan for 2021-2025 a project activity that aimed to improve knowledge on the status and trends of bearded seal populations. Thus, a joint workshop between CAFF and NAMMCO had been proposed to conduct a pan-Arctic review of the status of the species that would help address knowledge gaps and identify priority actions needed to ensure effective monitoring and conservation.

A joint CBMP-MENN/NAMMCO group developed a proposal for such a WS (NAMMCO/SC/28/09b). The WS is scheduled for May/June 2022 and will focus on assessing bearded seals status and trends through its range and identify knowledge gaps. It will be Co-Chaired by NAMMCO and CAFF. The proposal had recently been endorsed by the CAFF and CBMP boards.

Workshop objectives:

- ¶ Consider new knowledge from 2010-present (post the review of bearded seals by Cameron et al. 2010)
- ¶ Examine progress in defining stock structure by exploring:
- ¶ Outcomes of new genetic analysis; and
- ¶ Other data informing stock structure (e.g., indigenous knowledge, distribution and movements, hunting patterns, vocalisations, etc.).
- ¶ Review the NOAA Bearded Seal Review (https://www.fisheries.noaa.gov/species/bearded-seal) and assess population/stock abundance, trends, status, health, and condition.

Organising Committee:

- ¶ Christian Lydersen, Norway, NAMMCO (NAMMCO Chair)
- ¶ Aqqalu Rosing-Asvid, Greenland, NAMMCO
- ¶ Kit Kovacs, Norway, CBMP Marine Mammal Group
- ¶ Steinunn Hilma Ólafsdóttir, Iceland, co-Lead CBMP Marine
- ¶ Thomas Juul-Pedersen, CBMP Marine
- ¶ Eirik Drabløs Pettersen, Norway, CBMP Marine
- ¶ Peter Boveng, US, CBMP Marine Mammal Group
- ¶ Geneviève Desportes, NAMMCO Secretariat - CBMP Marine Mammal Group
- ¶ Tom Barry, CAFF Secretariat

The SC **agreed** to the proposed Joint WS and charged its members and experts in providing input. It noted that a stronger Russian input than the one suggested in the document was needed in terms of invited experts.

10.1.3 Updates

Lydersen informed on a new project mainly sponsored by the Norwegian Research Council entitled: Arctic marine mammals in a time of climate change: a Kongsfjorden Case Study ("ARK" – ARktiske Klimaforandringer Konsekvenser). For more information see section 10.3.3.

Further updates were available in the form of submitted For Information documents. A recent study estimated marine mammal hotspots in the Greenland and Barents Seas based on biotelemetric

tracking devices deployed on 13 species including bearded seals (document SC/28/FI20). The distribution and habitat characteristics of pinnipeds (walrus, ringed seal, bearded seal, harbour, harp and hooded seal) in the Svalbard Archipelago between 2005 and 2018 was also available as document SC/28/FI21. New information about bearded seal male vocalisations across seasons and types of habitats in Svalbard and new health assessments of wild and captive seals from Svalbard could be found in document SC/28/FI22 and SC/28/FI23 respectively.

10.2 RINGED SEAL

10.2.1 Review and status of active requests (R-2.3.1, R-2.3.3)

R-2.3.1 (ongoing) asks the SC "To advise on stock identity of ringed seals for management purposes and to assess abundance in each stock area, long-term effects on stocks by present removals in each stock area, effects of recent environmental changes (i.e., disturbance, pollution) and changes in the food supply, and interactions with other marine living resources."

R-2.3.3 (ongoing) asks the SC "To convene a working group in 2022 with the aim of conducting a thorough review of the existing data and to go ahead with the assessment of stocks for which it was possible. If the data required for a full assessment of (some of) the stocks were not available, the WGs and the SC should identify, and prioritise, which specific data essential to their assessments are still needed."

The SC **recommended** that R-2.3.1 be rephrased to not only refer to disturbance and pollution but also climate change as this likely represents the biggest threat to ringed seals. This rephrasing would be proposed to the Council at its next meeting.

10.2.2 Ringed Seal Working Group

The Ringed Seal Working Group was scheduled for 2022 in the work plan. As for the bearded seal, SC27 had agreed that as a first step, an overview of the information required and available to perform an assessment should be generated, together with a review of the currently available literature, in particularly that published since the last review was performed in 2010 (Kelly et al. 2010). This information would then be considered in the planning for a working group meeting. The Secretariat had proposed to supervise such a review, but this so far had remained limited to a collation of references.

However, the Secretariat had corresponded with Boveng from the Alaska Fisheries Science Centre (NOAA Fisheries), which is preparing a review of the species within its framework of regular status reviews under the US Endangered Species ACT and shared the NAMMCO catch database and literature database with them.

The NOAA review should be finalised in June 2022. While focussing on US related requirements, the review aims at being very comprehensive by looking at the best available new scientific and indigenous knowledge (IK) information about: biology; habitat, including sea ice, snow, prey communities, ocean acidification; climate change projections; threats from shipping, oil & gas development; diseases and predation; adequacy of regulatory mechanisms.

On the basis of the information provided under section 10.2.3, the SC concluded that existing knowledge gaps were still important, while two important projects were still running in Greenland and Svalbard. However, knowledge advances had been made in both Greenland and Svalbard, and a review has been conducted in Canada in 2019 (see document SC/28/FI41). Additionally, the species is exploited in Greenland and Svalbard and will be impacted by climate change. For these reasons, the SC found it important to progress with a status review.

The SC **agreed** that it should wait for the NOAA review to be completed. A smaller group (Lydersen & Rosing-Asvid, supported by the Secretariat) would then look at the outcome of this and the Canadian review, supplement with new information from the Atlantic, and prepare a knowledge status review

to inform the decision of the SC on how to proceed. Rosing-Asvid proposed that the group also define management areas.

10.2.3 Updates

Rosing-Asvid informed that 2022 would be the last year of the 10-year tagging studies that has been conducted in Greenland.

Lydersen informed on a new project mainly sponsored by the Norwegian Research Council entitled: Arctic marine mammals in a time of climate change: a Kongsfjorden Case Study ("ARK" – ARktiske Klimaforandringer Konsekvenser). For more information see 10.3.3.

Further updates were available in the form of submitted For Information documents. A recent study estimated marine mammal hotspots in the Greenland and Barents Seas based on biotelemetric tracking devices deployed on 13 species including ringed seals (document SC/28/FI20). The distribution and habitat characteristics of pinnipeds (walrus, ringed seal, bearded seal, harbour, harp and hooded seal) in the Svalbard Archipelago between 2005 and 2018 is also available as document SC/28/FI21. Several studies have been conducted recently on ringed seals in various locations investigating diet, habitat use and body condition. Information on the diet of ringed seals in the European Arctic is available in document SC/28/FI26. A study that took place in Svalbard found that lagoons may serve as refuges for the animals, becoming increasingly important to the species as climate change alters their current habitat (document SC/28/FI27). Another study suggests that ringed seals in this region show plasticity to significant habitat change through stable body size throughout the seasons (document SC/28/FI24). Across the circumpolar Arctic, body size varies with location, although it is not yet clear what the driver of the variation is (document SC/28/FI25).

10.3 HARBOUR SEAL

10.3.1 Review and status of active requests (R-2.5.2)

R-2.5.2 (ongoing) asks the SC "To conduct a formal assessment of the status of harbour seals in all NAMMCO areas as soon as feasible".

This will be done through the next meeting of the CSWG, see section 10.3.2.

10.3.2 Coastal Seals Working Group (CSWG)

A meeting of the CSWG was initially planned for April 2020 but had been rescheduled to 2022 due to COVID-19. The WG held a short update meeting in January 2021 and reported to SC27 (SC/27/07). A full meeting of the CSWG is now planned for 2023. See further discussion under section 10.4.2.

10.3.3 Updates

Norway

Kjell Tormod Nilssen informed that harbour seal assessments were carried out along the entire mainland Norwegian coast during moult in 1996–1999, 2003–2006 and 2008–2015. In 2016, new harbour seal counts along the coast started in Norwegian Skagerrak and were continued along the coast north to Finnmark in August 2021. Results showed that the numbers of harbour seals in Norwegian Skagerrak had increased to approximately the levels before the PDV-outbreak in 2002. The largest increase was in Vestfold and Telemark. On the west coast south of Stad (62°N) the numbers were slightly lower than in the first counting period 1996–1999. North of Stad, harbour seals had decreased in numbers in the counties Møre and Romsdal, Trøndelag and Nordland compared with results in 1996–1999. In Troms, the numbers increased from ca 560 in 1996–1999 to ca 990 in 2008–2015 but were reduced to 760 in 2020. In Finnmark, the total harbour seal numbers increased by 14% since 2008–2015 to ca 1,120 in 2021. The total minimum numbers of harbour seals were ca 6,960 along the Norwegian coast in 2016-2021, which is close to the Target Level of 7,000 harbour seals.

Biuw informed that harbour seals have been equipped with GPS/GSM tags along the SE coast of Norway in 4 years since 2017. This was partly financed through a project aimed at describing the fish community in the Outer Oslofjord, and to suggest strategies for the restoration of coastal cod in this region. Tags were deployed at four sites, covering the management units of Aust-Agder, Telemark, Vestfold and Østfold, at the end of the annual moult, in September or October. Preliminary results showed great variability in habitat use and foraging range. Some individuals displayed an exclusively fjord-based strategy in the vicinity of the place of tagging, while others appeared to show similar fjord-based foraging in more distant regions. Several individuals also undertook regular migrations between haul-out sites along the Norwegian and Swedish coasts. One of three tagged seal, a large male harbour seals from the Aust-Agder management unit, undertook a long migration along the Swedish coast, prior to transiting over to Danish regions in the Kattegat in late October, where it has remained since. Tagging efforts will continue in 2022.

Svalbard

Lydersen informed on a new project mainly sponsored by the Norwegian Research Council entitled: Arctic marine mammals in a time of climate change: a Kongsfjorden Case Study ("ARK" – ARktiske Klimaforandringer Konsekvenser). The primary objective of this project is to: test hypotheses regarding impacts of global warming on Arctic endemic marine mammals (with a primary focus on High Arctic resident seals) in a region that is strongly affected by climate change. It will: 1) generate population abundance and trend data 2) quantify trends in breeding habitats; 3) explore distributional changes 4) document fine-scale space use and identify key habitats 5) determine overlap with "invading" species; 6) capture existing biomass and community composition data for fishes and extend these into time series; 7) explore disease and contaminant risks (with PRE and POST exposure scenarios) 8) model ecosystems interactions and function. In addition to the scientific intrigue of these studies in an Arctic fjord that has become an ideal "natural experiment" for studying impacts of climate change, ARK is designed to produce data that is relevant for decision makers - replacing hypothetical responses with facts.

In 2021, 10 harbour seals, 6 ringed seals and one bearded seal were equipped with SMRU data loggers that transmit data via UHF to a receiver station on a high mountain (Zeppelin Mountain) in Kongsfjorden. These tags report every surfacing with a GPS position and also every dive is transmitted to get the fine scale data needed for the analyses. Blood and other tissue samples were collected from all tagged animals.

The presence of harbour seals has increased all around Spitsbergen, due to the overall atlantification of the area and decrease of sea ice, which represents an increasing competition to bearded and ringed seals.

Further updates were available in the form of submitted For Information documents. A recent study estimated marine mammal hotspots in the Greenland and Barents Seas based on biotelemetric tracking devices deployed on 13 species including harbour seals (document SC/28/FI20). The distribution and habitat characteristics of pinnipeds (walrus, ringed seal, bearded seal, harbour, harp and hooded seal) in the Svalbard Archipelago between 2005 and 2018 is also available as document SC/28/FI21.

Iceland

Sandra Granquist presented a new population estimate for the Icelandic harbour seal population (document SC/28/FI11). The estimate is based on an aerial survey carried out during the moulting period of 2020. The total number of observed seals was 4,559 individuals, which yielded an estimated population size of 10,319 (95% CI: 6,733 – 13,906) animals. This estimate is 14% below the governmentally issued management objective for the minimum population size of harbour seals in Iceland of 12,000 animals. The estimated population size was roughly 9% larger than in 2018 (document SC/28/FI12), when the last complete population census was conducted, but 69% smaller than when first estimated in 1980. Trend analyses indicate that the population is currently fluctuating

around a stable minimum level. The current status of harbour seals on the Icelandic red-list for threatened populations is "endangered". Considering the sensitive conservation status of the population, it is necessary to assess and sustainably manage factors affecting the status of the population, such as direct and indirect removals, environmental changes, changes in prey availability and anthropogenic impacts. In addition, increased monitoring of population demographic factors is urgent.

Land-based monitoring of pup production and timing of the pupping period has been carried out annually at important haul-out sites in Northwest Iceland, since 2008. In 2018, monitoring during the pupping period was initiated at important pupping sites in South and Northeast Iceland for comparison.

In 2017, monitoring of haul-out behaviour by using wildlife trail cameras was initiated in Iceland. Cameras were deployed at several haul-out sites at Vatnsnes and Heggstaðanes, Northwest Iceland. The method has been tested in different conditions and data collection has been successful. The data will lead to improved knowledge on haul-out behaviour, which for example is a foundation for optimising population trajectory models.

Further updates were provided in the form of For Information documents. A recent study by Chauvat, Aquino and Granquist (2021) investigated visitor's values of seal watching management in Northwestern Iceland and found that harbour seal watching tourists are welcoming management action to conserve the species and support their population recovery (document SC/28/FI05). Aquino, Burns and Granquist (2021) developed an 'Ethical Management Framework' (EMF) which incorporates the needs of multiple stakeholders (i.e., the tourism industry, government, locals and academia) while implementing a more ethical ecocentrism approach to seal watching, and applied the EMF to Icelandic harbour seal watching as a case study (document SC/28/FI06). Passive acoustic monitoring of Icelandic harbour seals revealed lower calling intensity compared to Danish and Swedish seal populations, which may be linked to higher numbers of predators in Iceland and thus seals avoiding detection by predators by using more quiet calls (document SC/28/FI07).

Greenland

The latest update on harbour seals in Greenland was provided by the CSWG held in 2021, presented at the SC27. An evaluation of the status of harbour seals based on known human-induced mortality since the hunting ban in 2010 and an assessment of ongoing threat levels was presented. The CSWG concluded that harbour seals are severely depleted in most of West Greenland and agreed that the potential presence of harbour seals in unidentified breeding and moulting sites should be investigated. SC27 discussed inaccuracies in catch statistics and reiterated the recommendation that data should be validated before submission to formal databases.

Discussion

Nilssen reported on the difficulty getting reliable by-catch estimates for coastal seals because of the difficulty for the fishermen to differentiate between seals (harbour, grey, ringed and harp seals), especially for young specimens, an issue that had also been underlined by the BYCWG. The BYCWG had endorsed by-catch estimates for harbour seals and grey seals in the commercial coastal gillnet fisheries for 2006–2020 and the Icelandic lumpsucker fishery for 2014–2018 but had emphasised that there was a severe issue of species misidentification in the logbook data, including the Norwegian Coastal Reference Fleet data.

The SC **supported** the BYCWG recommendation that both in Iceland and Norway all efforts be made to alleviate the issue using all possible means, REM, DNA sample and collection of lower jaw, use of photograph, etc. It further **recommended** that in the Norwegian CRF, the collection of the lower jaw of seals becomes a mandatory term in the boat contract.

10.4 GREY SEAL

10.4.1 Review and status of active requests (R-2.4.2)

R-2.4.2 (ongoing) asks the SC "To provide a new assessment of grey seal stocks throughout the North Atlantic."

This will be done through the next meeting of the CSWG, see section 10.4.2.

10.4.2 Coastal Seals Working Group

A meeting of the CSWG was initially planned for April 2020 but had been rescheduled to 2022 due to COVID-19. The WG held a short update meeting in January 2021 and reported to SC27 (SC/27/07). The SC discussed the re-scheduling of the CSWG meeting from 2022 to 2023. Iceland was planning a grey seal survey in 2022. In Norway, the analysis of survey data was not completed, the tagging effort on harbour seal would continue through 2022 and the modelling of the grey seal population, including the newest data, would be done in 2022.

The SC noted the possibility of holding several shorter meetings focussing on species and/or areas. As there were no pressing needs for assessments by any member countries, the SC **agreed** to postpone the meeting of the CSWG to 2023, when more data should be available, and all analyses completed.

10.4.3 Updates

Mikkelsen informed the SC that summer counts of grey seals in the Faroe Islands are ongoing. The islands are divided into four areas, and the aim is to visit the entire shoreline in each area during good weather conditions once or twice a year. In 2021, all islands, except the southern area, were covered once. Increased numbers were seen in the central area, while numbers were lower in the western and eastern areas compared to 2018 and 2019. No survey was conducted in 2020. Adding up the highest counts for the four survey areas gives a total count of close to 600 grey seals, which is considered a minimum number. Future plans include tagging and placing camera traps at haul-out sites for movements and behavioural studies. This may also provide a correction factor for animals not available during surveys, in order to generate a total estimate.

Nilssen informed that the grey seal pup production was estimated in Troms and Finnmark in November – December 2021, thus completing the pup counts along the Norwegian coast for the period 2017 – 2021. Preliminary results showed a reduction of pups born in Troms by ca 25 % from 65 pups in 2016 to 49 pups in 2021. The pup production in Finnmark increased by ca 9.7 %, from 206 pups in 2015 to 226 pups in 2021. Total grey seal abundance modelling will be carried out in 2022.

Granquist informed that there are no new population estimates of grey seals in Iceland and that the most recent estimate is from 2017 (document SC/28/FI13). A new survey is scheduled in October 2022 and the analysis will be finalised by December 2022.

For Information document SC/28/FI10 provides an update on the at-sea spatial usage of recently weaned grey seal pups in Iceland revealing the importance of near-shore waters for foraging.

10.5 HARP SEAL AND HOODED SEAL

10.5.1 Review and status of active requests (R-2.1.9)

R-2.1.9 (ongoing) asks the SC "To investigate possible reasons for the apparent decline of Greenland Sea stock of hooded seals; and assess the status of the stock on basis of the results from the planned survey in 2007."

As the SC considered this request as ongoing, it **recommended** to remove the reference to the planned survey in 2007, as there several surveys had been conducted since 2007. The revised version will be proposed to the Management Committees and Council for approval.

10.5.2 Harp and Hooded Seals Working Group

The next meeting of WGHARP is planned for autumn 2023. Prior to this, improvements and advances of assessment models will be made through the planned joint ICES/NAMMCO/NAFO benchmark meeting in 2022.

Biuw gave an update on the ongoing efforts to address the fact that the assessment model used for harp and hooded seals was inflexible and unable to adequately account for rapid changes in e.g., pup production in the East Ice. SC26 had agreed to look at model development and the first modelling workshop (ICES-NAMMCO) was held in the autumn 2020. The work with model development continued by correspondence in 2021, progress and results will be discussed in digital meetings throughout 2022. In addition, ICES has facilitated the establishment of a benchmark process for harp seals. This process was formally started during a kick-off meeting in December 2021. This meeting agreed on a plan for preparatory work that will lead up to a face-to-face benchmark meeting to be held December 5 – 9, 2022. The benchmark is the first by ICES carried out for a seal species.

The envisaged outcome of this benchmark meeting will be an improved assessment approach centred around a modified version of the existing population model. Based on this improved assessment model, the research team will then meet to discuss the validity of existing reference points and harvest control rules, and the potential need to update these. Finally, the Joint ICES/NAFO/NAMMCO Working Group of Harp and Hooded Seals (WGHARP) will meet during autumn in 2023 to implement the new management tools, to discuss and include new data, and to develop new advice for the management of harp and hooded seals.

10.5.3 Updates

Updated pup production estimates for the Greenland Sea stock from the most recent survey (in 2018) are now published in NAMMCO Scientific Publications (SC/27/FI37). A new aerial pup production survey will be conducted in the Greenland Sea in March – April 2022 with the same methodology as for recent previous surveys. Challenging logistics are involved but the Norwegian Institute of Marine Research (IMR) is optimistic that it will be carried through. The survey will involve an icebreaker with an onboard helicopter, and a fixed-wing plane operating out of Akureyri, Iceland and Constable Point, East Greenland.

Haug reported that a high priority component of the Joint Norwegian-Russian Research Program on Harp Seal Ecology has been to deploy satellite transmitters on harp seals in the White Sea. The plan was to carry out fieldwork at the end of the year, or, alternatively, in late March – early April if ice conditions turned out to be unfavourable in early May. However, ever since the project was first discussed in 2007, either formal problems with permissions, lack of funding or difficult ice conditions have prevented tagging of seals. New attempts were, therefore, made in 2020 and 2021, but the COVID-19 pandemic resulted in new cancellations. If possible, the experiment will be conducted in 2022 with Russian colleagues doing the deployments of the Norwegian tags. All data obtained from the tags would be available for scientists involved (i.e., from IMR, VNIRO[1]/PINRO[2] and MMBI[3]). Due to expected difficult ice conditions and to simplify the logistics, only beaters (young of the year) will be tagged.

Vladimir Zabavnikov, observer from the Russian Federation, informed the SC that the last traditional multispectral aerial survey of harp seal pup production in the White Sea and the adjacent Barents Sea waters was carried out in 2013. The last WGHARP meeting was in 2019, where this stock was defined as “data-poor” and recommended this survey to be carried out as soon as possible (ICES, 2019).

[1] Russian Federal Research Institute of Fisheries and Oceanography
[2] Polar Branch of the Russian Federal Research Institute of Fisheries and Oceanography
[3] Murmansk Marine Biological Institute of the Russian Academy of Sciences

In 2018 Russian scientists from VNIRO carried out a survey with drones, but only less than 10% of the area where pup production could be distributed was covered. For this reason, WGHARP-2019 concluded that the drone data cannot be used to estimate the total pup production and the total of the White Sea/Barents Sea harp seal population. During 2019-2022, Russian scientists from PINRO tried to carry out a traditional multispectral aerial survey in the White Sea and adjacent Barents Sea waters. Unfortunately, they did not get the needed financial support. The SC **reiterated** the recommendation, that a survey of harp seal pup production be carried out as soon as possible in the White Sea and adjacent Barents Sea waters.

There was no update from Greenland on harp and hooded seals.

Further updates were available in the form of submitted For Information documents. A recent study estimated marine mammal hotspots in the Greenland and Barents Seas based on biotelemetric tracking devices deployed on 13 species including harp and hooded seals (document SC/28/FI20). The distribution and habitat characteristics of pinnipeds (walrus, ringed seal, bearded seal, harbour, harp and hooded seal) in the Svalbard Archipelago between 2005 and 2018 is also available as document SC/28/FI21.

10.6 WALRUS

10.6.1 Review and status of active requests (R-2.6.3)

R-2.6.3 (ongoing) asks the SC to "Provide advice of the effects of human disturbance, including fishing and shipping activities, tourism, hydrocarbon exploration and mineral extractions on the distribution, behaviour and conservation status of walrus in Greenland.

As a response to this request, the SC **reiterated** the SC27 recommendation that a workshop to assess disturbance from the Baffinland/Mary River mine project be held and consider impacts on narwhals, beluga and walrus. This should not be limited to the Mary River mine project but include impacts from all mining activities. See section 9.3 for further discussion.

10.6.2 Updates

Ugarte informed that terrestrial haul-out sites in West Greenland were abandoned during the first half of last century, due to disturbance and hunting. Since then, walruses come to Greenland only during winter, when they haul-out on sea ice. Recently, a new terrestrial haul-out site was documented in Qaanaaq, in the northern Baffin Bay, and in 2021 GINR deployed an autonomous camera for monitoring this site.

In relation to disturbance, it was noted that the UK registered company Bluejay Mining plc owns Dundas Titanium A/S, a company registered in Greenland, which mine ilmenite from beaches near the abandoned settlement of Moriusaq in Wolstenholme Fjord, a key wintering area for walruses of the Baffin Bay population. Exploitation, closure and activity plans are being prepared by the Government and the Company.

Lydersen reported from a tracking project in Svalbard where walruses were equipped with GPS loggers in 2014 (N=20) and 2015 (N=20). The loggers should collect 1 GPS position per hour and download data every time a walrus haul-out on a site with a logging station (7 of these in Svalbard), the batteries should last for a minimum of 5 years. In 2021, data were downloaded from 2 walruses that were tagged in 2015 and still reporting, providing tracks with duration length of 5.8 and 6.2 years for these two individuals. The SC noted the unexpected long duration of the tags and commended this work.

Further updates were available in the form of submitted For Information documents. A recent study estimated marine mammal hotspots in the Greenland and Barents Seas based on biotelemetric tracking devices deployed on 13 species including walrus (document SC/28/FI20). The distribution and habitat characteristics of walrus and other pinnipeds in the Svalbard Archipelago between 2005 and 2018 is also available as document SC/28/FI21.

11. CETACEAN STOCKS

11.1 NARWHAL

11.1.1 Review and status of active requests (R-3.4.11)

R-3.4.11 (standing) asks the SC *"To update the assessment of both narwhal and beluga, noting that new data warrant such an exercise."*

This work is done within the context of the Joint Working Group (JWG) with the JCNB, which met in December 2021, and the Ad hoc Working Group on Narwhals in East Greenland (NEGWG), which met in October 2021.

11.1.2 Narwhals in East Greenland Working Group

Hansen and Lars Witting co-presented the sections relevant for narwhal of the Report of the NEGWG2021, available as document SC/28/06.

Summary

The NAMMCO Ad hoc Working Group on Narwhal in East Greenland (NEGWG) met for the second time October 25 – 29, 2021, with participants from Canada and NTI Inc., Denmark, Faroe Islands, Greenland, Iceland, and the United States.

At its 2021 meeting, the Management Committee for Cetaceans (MCC) was presented both with the management recommendations of the SC for narwhal in East Greenland (based on the conclusions of the 2019 NEGWG meeting) and the observations of East-Greenland hunters (KNAPK). The MCC did not reach consensus for endorsing the SC recommendation that there be an immediate reduction to zero catches of narwhals in all three management areas of East Greenland (i.e., 1: Ittoqqortoormiit, 2: Kangerlussuaq, and 3: Tasiilaq). The MCC requested the SC to investigate ways to improve reporting of user observations to inform assessments, to recognise and include the impact of climate change on narwhals in management decision-making on all stocks, and to clarify the issue regarding payment to hunters for assisting in research.

The tasks for the NEGWG, besides responding to the MCC, involved reviewing its previous advice in the light of new data on stock structure, distribution, abundance, and catch statistics.

Development of advice on East Greenland narwhals

Hunters and User knowledge: The hunters' observation of three different types of narwhals is valuable and useful for generating hypotheses. Preliminary genetic analysis points to genetic differences between the narwhals summering in Scoresby Sound and those from Northeast Greenland/Svalbard. However, there is currently insufficient information to assess whether narwhals from another stock potentially summering in Northeast Greenland, and which fraction of this northeastern stock, are supplying the spring hunt close to Ittoqqortoormiit.

Economic considerations: The costs incurred by the damaging of nets during the capture of live narwhals for scientific purposes are included within the bounty paid to hunters for live captures, which amounted for the period 2010-2020 to over 3 million DKK.

The commercial trade in mattak in Greenland has created an incentive for narwhal hunting and the increasing catches can partly be explained by the ongoing price rise of this high-priced product (from 50 DKK/kg in 1982 to 500 DKK/kg in 2020). Any socio-economic assessment should to be carried out by an expert WG, considering both the effect of the present trade and of its termination, should a population crash materialise. It was underlined that an immediate reduction to zero catches is required and cannot wait for further economic/social assessment.

Request for hunter and user data and knowledge: The WG made recommendations regarding information that the hunters could provide for informing further assessments. *Recommendations 1.1, 1.2, 1.6, 1.7, 1.9*

Accounting for climate change in recommendations: It is not possible today to quantify the impacts of climate change on the narwhal populations in East Greenland. The increase in ocean temperature will reduce the suitable habitat for narwhals or might force animals to move north, which would impact their distribution and availability to hunting in the three management areas. Adapting to new environments may result in changes in reproductive and survival parameters. The impacts of climate change cannot presently be included in model-based assessments. Understanding the effect on life history parameters requires large sample sizes and long time series. Further research is needed to understand the mechanisms of the impact from climate change to include this in the WG recommendations. *Recommendation 1.4, 2.1*

Distribution & Abundance of East Greenland Narwhals

The historical distribution of narwhals indicates that the distribution patterns have not changed. Therefore, the decreasing occurrence at the Hjørnedal field station (manned since 2010) is supporting the larger signal provided by the assessment and indicating a decreasing population.

The analyses leading to the current abundance estimates were reviewed by the Joint NAMMCO-JCNB Scientific WG and deemed appropriate. The reliability of the 2016 abundance estimate, a few hundred narwhals in the Scoresby Sound area, is supported by a matching abundance estimate generated by mark-recapture, a method using a totally different dataset.

The planning of the aerial surveys planned for the spring and the summer 2022 were discussed. The aim of the exploratory spring survey around Scoresby Sound, over an area informed by satellite tracking data and user knowledge, is not intending to provide a count of the putative spring stock but to investigate whether there is a disjunct distribution of two wintering grounds, one in the southern part for narwhals summering in Scoresby Sound and one in the northern part (off Liverpool Land) for narwhals from unknown summer origin. The WG agreed with the adaptive design of the survey and advised that the planning of the survey should consider adding effort on the coastline north of Scoresby Sound to include areas with historical narwhal sightings reported by hunters.

The latest survey was conducted in 2017 and the decision by the Greenlandic authorities to conduct a new summer survey in 2022 was welcomed. The planning of this survey should be done in collaboration with the hunters, and follow international scientific standards to ensure that the abundance estimates are reliable, internationally accepted and useful for assessment. *Recommendations 2.2, 2.3*

Biology

Life history: In Scoresby Sound (management area 1), a decreasing trend in pregnancy rate was supported both by the increasing proportion of older animals and the declining proportion of pregnant females in the catch, the analysis of the biological samples, the observation of calves during surveys as well as the information provided in the hunters' Special Reports. The pregnancy rate observed in Scoresby Sound, obtained both from the hunters' Reports and the biological sampling, is significantly lower than in West Greenland and Canada.

It is likely that the hunt has shifted to older animals due to a lack of younger animals, and there is strong indication of a decline in reproduction (few pregnant females and few calves born each year) and loss of females, leading to a loss of recruitment (number of young reaching reproductive age).

Genetics: In agreement with other indicators (satellite tagging data, catch and hunters' records), a preliminary genomic analysis suggested a sub-structuring of the Scoresby Sound narwhal stock, with likely a spring and a summer sub-stock in the area. Significant additional information is needed to conduct a separate assessment of the putative spring stock. Because of the likely sub-structuring in

East Greenland, the NE Greenland stock cannot be assumed as one continuous large population supplying the spring hunt.

Anthropogenic impacts

Hunt and other removals: Updated catch records were discussed, with only two narwhals reported caught in Scoresby Sound in 2021. The recent drop in catches in management area 1 (Ittoqqortoormiit) is most likely caused by a decline in narwhal density. By-catch, entanglement and vessel strike of narwhals are uncommon, if any, and not of any concern.

Non-lethal impacts: As evidence suggests, narwhals are very sensitive to noise and disturbance. The noise level from anthropogenic activities is increasing in Scoresby Sound and could become an issue and should be monitored. Shipping activities from large vessels in East Greenland should be regulated to avoid further negative impacts on the narwhal populations. *Recommendation 1.3*

Habitat of East Greenland narwhals

Increased local observations of killer whales have been reported in East Greenland, with associated concerns among hunters that these may have a negative impact on narwhals. There was, however, no evidence to suggest that this increased presence was influencing narwhal distribution.

Stock Assessments

Stock structure: An emerging weight of evidence points to two separate aggregations in Scoresby Sound (management area 1), one coming in the spring and one in the summer. No evidence supports the presence of a separate offshore stock. Stock structure in management areas 2 and 3 remains unchanged.

As there is insufficient data to perform any assessment work of the putative spring stock in management area 1, the SC agreed that the recommendation of zero takes relates both to the summer and spring hunt.

Stock assessment model: The assessments are based on the same age-structured modelling framework that has been used by the NAMMCO SC for two decades in its assessments of beluga, narwhal, walrus, and harbour porpoise. The method is thoroughly peer-reviewed and agreed by NAMMCO as suitable to provide management advice.

Ittoqqortoormiit (management area 1): The model for the area is developed in more detail than any previous assessments. It reconciles not only abundance, age structure and removal data, but also data on life history parameters, including the negative trend in the birth rate reported in the hunters' Special Reports. The model estimates a small and depleted aggregation, with no more than 207 (90% CI: 42-441) individuals left. The narwhal population in management area 1 cannot sustain any further hunt. With continued catches at the current level, there is a 30% risk that the hunt causes the population to go extinct by 2025, a risk that increases to 74% by 2028, and reduced to 0% if there are no removals after 2021.

The WG concluded that there is a significant threat of extinction from a continued hunt, even on a timescale as short as a couple of years, as supported by the apparent collapse of the hunt in 2021. *Recommendation 1.0, 2.4*

Kangerlussuaq (management area 2): The model estimates a small and depleted aggregation with no more than 260 (90% CI: 142-442) individuals left. The current depletion ratio is 0.24 (90% CI:0.11–0.52), with an annual production (birth) of no more than 6 (90% CI:0–18) individuals.

With loss rates and potential underreporting added on top of an uncertain growth rate, the WG concluded that the narwhal population in management area 2 cannot sustain any further hunt. *Recommendation 1.0, 2.4*

Tasiilaq (management area 3): The model estimates a small and depleted aggregation with no more than 123 (90% CI: 12-394) individuals left. With an estimated production of no more than 5 (90% CI:

1–21) individuals per year, the narwhal population in management area 3 cannot sustain any further hunt. With continued catches at the current level, there is a 34% risk that the hunt causes the population to go extinct by 2025, a risk that increases to 62% by 2028, and is reduced to 0% if there are no removals after 2021.

The assessment for Tasiilaq includes only a single abundance estimate (2008), as no sightings were made during the 2016 survey. The density of narwhals in this area may be too low to be detected by traditional survey methods, thus the assessment was statistically adjusted to nonetheless acknowledge the presence of narwhals in the area.

The WG concluded that there is a significant threat of extinction from a continued hunt, even on a timescale as short as a couple of years. *Recommendation 1.0, 2.4*

Catch Recommendation for Narwhal from the NEGWG 2021, also endorsed by SC28

Rec.1.0 The WG strongly reiterated its previous recommendation of zero catches of narwhals in all three management are Southeast Greenland. The risk of hunting-imposed extinction is very high and the WG therefore stressed the importance of immediate management actions to secure the presence of narwhals in Southeast Greenland.

Additional recommendations for Narwhal from the NEGWG 2021, also endorsed by SC28

Recommendations for Conservation and Management:

Rec. 1.1 That a community-based biopsy programme of live narwhals be established, given that hunters report seeing narwhals regularly. This would generate information on the rate of encounters and provide samples for stock structure analysis.

Rec. 1.2 That, if a narwhal hunt goes ahead despite the WG's strong recommendations for 0 catches in all management areas of East Greenland, additional information be collected from any hunted narwhals besides the already mandatory information (length, sex, date and location of the catch, presence/absence of a foetus). This additional information includes: a skin biopsy sample, the type of the animal according to the three categories described by hunters, photograph of the back, girth measurements, information for females whether there is milk in the mammary glands.

Rec. 1.3 That shipping activities from large vessels (including cruise ships) in the summering grounds along the East Greenland coastline be regulated to avoid negative impacts on the narwhal populations, as narwhals are sensitive to noise and these small populations are particularly sensitive to impacts from disturbance.

Rec. 1.4 That the effects of climate change be reduced and mitigated to protect the narwhal's habitat, as climate change is probably causing increased habitat fragmentation of narwhal stocks and a drastic reduction of their winter ranges.

Recommendations for Research:

Rec. 2.1 That, for examining the impact of climate change on life history parameters, life history data be collected from non-depleted stocks of narwhals in West Greenland and Canada, where climate change is also expected to have an impact.

Rec. 2.2 That different approaches to counting narwhals in the fjords be further examined, but only to the extent that new approaches will be compatible with the existing time-series.

Rec. 2.3 That, although the planning of surveys should be done in collaboration with the hunters, the survey methodology (including the design of the track lines) continues to be done according to internationally accepted survey standards, to ensure that abundance estimates derived from the survey can be accepted by NAMMCO and used in the assessment.

Rec. 2.4 That definitions be developed for what constitutes small stocks, depleted stocks and stocks at risk of extirpation, and that frameworks for advice and management then be articulated for what actions should be taken for these different categories.

The WG concluded that, In addition to the results of the assessment model above, and in particular:

- The **34% risk** that the hunt in **Tasiilaq** causes this population to go **extinct by 2025**,
- The **30% risk** that the hunt in **Ittoqqortoormiit** causes this population to go **extinct by 2025**,

there is ample evidence that indicates the narwhal stocks in Southeast Greenland are severely depleted and require immediate protection:

1. several indicators suggesting multiple small, isolated populations of narwhals
2. low and declining abundance estimates of narwhals in all three management areas
3. mark-recapture estimate of narwhals from the summer population in Scoresby Sound supporting the low abundance estimate
4. severe depletion of narwhals in all three management areas
5. apparent collapse of total catches of narwhals in management areas 1 in 2021
6. drop of summer narwhal catches inside the Scoresby Sound fjord
7. collapse of live captures of narwhals in Scoresby Sound for research purposes
8. decline of females in the population in all three management areas as indicated by the proportion in the catch of narwhals
9. decline in younger animals in the population in management area 1
10. a reduction of more than 50% in observations of calves over a 40-year period of aerial surveys in management area 1
11. declining pregnancy rate in management area 1
12. low pregnancy rates in management area 1 compared to Canada and West Greenland
13. loss of habitat in the southern part of the range
14. contraction in distributional range of narwhals

Discussion

The SC commended the extensive work done by the NEGWG as well as the effort made by the Greenland Institute of Natural Resources (GINR) to update the data on narwhals in East Greenland. It underlined that all available knowledge and data, including hunter knowledge, had now been exhausted to update the assessment. The decision of the Greenlandic authorities to conduct a new summer survey in 2022 was welcomed, but the outcome of that survey was not expected to influence the assessment to such an extent that it would change the current advice. The SC **endorsed** all the recommendations made by the NEGWG for conservation and management, as well as for research. The SC also **agreed** that a new meeting of the NEGWG be scheduled when the new abundance estimates from the planned 2022 survey become available, possibly as early as fall 2023.

Previous advice from the SC resulted in the announcement of a gradual reduction of East Greenland quota for narwhals, down to a total of 20 whales in all 3 management areas (Tasiilaq, Kangerlussuaq, Ittoqqortoormiit) in 2023. The SC was informed that a total quota of 50 narwhals was set for 2022 (15, 15, 20 for Tasiilaq, Kangerlussuaq, and Ittoqqortoormiit, respectively). The SC **expressed** deep concern over these quotas.

Given that the narwhal stocks in Southeast Greenland are severely depleted, and at a very high risk of extinction if hunting continues, the SC **strongly reiterated** its management advice to reduce the hunt to 0 in all three management areas. The SC **firmly stressed the urgency of the situation** and the need for immediate management action to secure the presence of narwhal in Southeast Greenland in the future.

The SC **underlined** that an immediate reduction to zero catches is required and cannot wait for further economic/social assessment.

11.1.3 NAMMCO-JCNB Joint Working Group

Hansen and Witting co-presented the sections relevant for narwhal from the Report of the JWG, available as document SC/28/07.

Summary

The NAMMCO-JCNB Joint Working Group (JWG) on narwhal and beluga met during December 13 – 17, 2021, at the Canadian Museum for Human Rights located in Winnipeg, Manitoba, with mixed in-person and virtual attendants, under the leadership of Co-Chairs Cortney Watt (JCNB) and Roderick Hobbs (NAMMCO).

The Terms of Reference regarding narwhals for this meeting were to: b) review information on availability bias correction factors, updated abundance estimates, and movement of narwhal; c) assess the impacts of climate change on narwhal and beluga movements, distribution, population dynamics, habitat and hunt methods, timing and location; d) revise advice models to incorporate climate change impacts where information is available and identify additional information requirements; e) update and review the narwhal allocation model to assign harvested animals to individual summer stocks and; f) generate advice on management of narwhal stocks in West Greenland and eastern Canada, including: Smith Sound, Jones Sound, Inglefield Bredning, Melville Bay, Somerset Island, Admiralty Inlet, Eclipse Sound, East Baffin Island.

Using results from the Quantitative Subworking Group (QSG), availability bias estimates for narwhal stock surveys were updated and final abundance estimates were included in the narwhal allocation model. The allocation model was updated using expert knowledge and recent tag data which showed limited movement of narwhal between stocks in the summer.

New **abundance estimates** from Golder Associates Ltd. for Eclipse Sound and Admiralty Inlet were reviewed and adjusted to include all replicate surveys and update the CV to reflect variation among survey replicates. **Availability bias** estimates from satellite tracking data and overlapping aerial images were reviewed in the QSG and presented to the WG. Preliminary results from overlapping aerial images showed potential for investigating availability bias in the future but would not be used within this assessment. The JWG agreed that a CV of 20% be used for availability bias corrections, to account for uncertainty in the depth to which narwhal can be seen. To correct existing survey results, where the availability bias correction was embedded in the calculation, a CV of 18% could be added to the CV of the availability component. All survey estimates were adjusted to reflect this. Although water clarity is likely to have an impact on narwhal detection, and was shown to impact time-in-view, satellite tags do not have high enough accuracy in detecting depth to incorporate 0–1 m depths into availability bias calculations at this time; thus only 0–2 m availability bias adjustments were used for abundance estimation. Abundance estimates used in the allocation model are shown in Table 5.

Table 5. Narwhal abundance estimates used in the allocation model by the JWG in 2021.

Year	Smith Sound	Jones Sound	Inglefield Bredning	Melville Bay	Somerset Island	Admiralty Inlet	Eclipse Sound	East Baffin Island
1975	-	-	-	-	-	29,740 (0.47)	-	-
1981	-	-	-	-	32,520 (0.22)	-	-	-
1985	-	-	3,690 (0.32)	-	-	16,400 (0.43)	-	-
1986	-	-	9,560 (0.40)	-	-	-	-	-
1996	-	-	-	-	45,360 (0.35)	-	-	-
2001	-	-	3,010 (0.41)	-	-	-	-	-
2002	-	-	1,940 (0.33)	-	29,770 (0.58)	-	-	-
2003	-	-	-	-	-	5,700 (0.56)	-	10,710 (0.34)
2004	-	-	-	-	-	-	21,110 (0.41)	-
2007	-	-	4,110 (0.29)	1,830 (0.94)	-	-	-	-
2010	-	-	-	-	-	19,160 (0.31)	-	-
2012	-	-	-	920 (0.48)	-	-	-	-
2013	17,010 (0.68)	13,200 (0.38)	-	-	51,730 (0.28)	36,430 (0.47)	10,900 (0.31)	11,990 (0.40)
2014	-	-	-	1,770 (0.50)	-	-	-	-
2016	-	-	-	-	-	-	12,040 (0.30)	-
2019	-	-	2,870 (0.28)	4,760 (0.77)	-	25,260 (0.25)	8,460 (0.32)	-

Catch statistics for Canada for the period of 2017–2020, and an update on catch statistics in Greenland for the period of 2005–2020, were presented and accepted for use in the population models.

The **availability matrix** for the narwhal allocation model was updated to include known and unknown movement between narwhal stocks. In particular, the WG reviewed potential weights for stocks where no narwhal movement has been observed between stocks, but movement is possible. The potential for movement between these stocks, or soft zeros in the availability matrix, are represented by a value of 0/n. After discussion on the variance for different values of n, the WG agreed that n= 50 should be used, as it would reflect the maximum number of satellite tags deployed for any one stock within the availability matrix.

The **allocation model** that was used to determine recommendations for optimal catch was reviewed and revised. In previous assessments optimal catch levels were developed by trial and error. For this assessment an optimization routine was developed to determine the optimal distribution of landed catches. The WG agreed to an additional criterion for the optimization which set the lower 5% confidence limit in the probability of meeting the management objective of at least 0.5 as a precautionary method. This lower confidence limit was applied to all stocks with the exception of Melville Bay, where this was not possible. Considering this, the working group applied a 0.8 probability of meeting management objectives for Melville Bay at the point estimate. The global optimum in narwhal takes was determined by maximising the relative take (proportional to recent take levels) across all hunting areas. The global optimum in narwhal takes would close the hunt in Upernavik. To allow a small sustainable hunt allocated to Upernavik at the cost of a much larger reduction in the allowable takes in Uummannaq and Disko Bay, the WG agreed to present options for maximum yearly removals per hunting region based on average removals from Upernavik. An overview of the stock status and hunting regions that take from each stock is provided in Table 6:

Table 6: Stock status and hunting regions that take from each stock.

Stock	2022 Abundance from Model (CI)	Stock Trend in Model	Stock Status from model**	Hunting Regions
Smith Sound (SS)	16,300 (5,510-44,500)	Stable	Not Depleted	Etah, Grise Fiord, Uummannaq, Disko Bay
Jones Sound (JS)	12,700 (6,790-23,900)	Stable	Not Depleted	Etah, Grise Fiord, Uummannaq, Disko Bay, Pond Inlet (spring and fall), Baffin Island Central (spring and fall)
Inglefield Bredning (IB)	2,630 (1,640-3,940)	Declining	Depleted	Qaanaaq, Grise Fiord (spring and fall), Uummannaq, Disko Bay, Pond Inlet (spring and fall), Baffin Island Central (spring and fall)
Melville Bay (MB)	1,250 (412-2,730)	Declining	Depleted	Upernavik, Disko Bay, Uummannaq
Somerset Island (SI)	45,500 (32,100-67,500)	Increasing	Not Depleted	Central Canadian Arctic, Uummannaq, Disko Bay, Arctic Bay (spring and fall), Pond Inlet (spring and fall), Baffin Island Central (spring and fall), Baffin Island South (spring, fall, and winter), Grise Fiord (spring and fall)
Admiralty Inlet (AI)	19,400 (14,800-24,700)	Declining	Not Depleted	Arctic Bay, Pond Inlet, Baffin Island Central (spring and fall), Baffin Island South (spring, fall, and winter), Disko Bay, Uummannaq, Central Canadian Arctic (spring and fall)
Eclipse Sound (ES)	11,400 (8,530-15,100)	Stable	Not Depleted	Pond Inlet, Disko Bay, Arctic Bay, Central Canadian Arctic, Baffin Island Central (spring and fall), Baffin Island South (spring, fall, and winter), Uummannaq
East Baffin Island (EB)	10,600 (6,760-16,500)	Stable	Not Depleted	Baffin Island Central, Baffin Island South

** Depleted Status determined as the (median abundance in 2022)/(median equilibrium population size with no hunting) < 60%.

The WG reviewed available research on **climate change** effects on the narwhal stocks in West Greenland and the Canadian Arctic Archipelago which suggest that although narwhals may be able to adapt their migration patterns, there is an overall predicted loss of suitable habitat. The WG agreed that these impacts cannot be incorporated into the model at this time as the mechanisms that connect environmental change to narwhal stock dynamics are not known. However, the precautionary approach can be used to justify an increase in the probability of meeting the management objective in the allocation model above 0.7 or 0.8 to protect narwhal stocks. In order to monitor for climate change the WG recommends narwhal age class data be collected from aerial photos, and sightings of narwhals in new areas be reported to assess distribution changes.

The Eclipse Sound narwhal stock is exposed to new levels of anthropogenic disturbances through the presence of shipping vessels and icebreakers travelling to and from the **Baffinland Mary River mine**. The WG agreed that the decline in abundance estimates for Eclipse Sound show that the increased anthropogenic activities appear to have already impacted the narwhal stock, which will likely result in narwhal abandonment of the area. Impacts may not be limited to the area, as vessels will pass through transboundary Baffin Bay waters that include habitat for the small narwhal stock in Melville Bay. In case of a declining narwhal population in Eclipse Sound the ongoing assessment will need to be

updated more frequently to ensure that catches in both Greenland and Canada are maintained at sustainable levels.

The JWG provided catch advice to be forwarded to the JCNB, which is the responsible body for providing management advice on narwhal and beluga for (West) Greenland and East Canada. To maintain a 70% probability for population increase in *West Greenland* and an 80% probability for population increase in *Eastern Canada* the assessment recommended an annual landed catch which is dependent on the division of catch between hunting regions. The JWG recommended alternative optimal catch allotments (columns O1, O2, etc.) for each hunting region based on the size of the landed catches allowed for Upernavik, which can be found in the Executive Summary of the JWG 2021 report (SC/28/07).

Recommendations for Narwhal by the JWG 2021, also endorsed by SC28

New Recommendations for Conservation and Management

- Use of the allocation model by Canada for recommending sustainable narwhal catches using either model or PBR-based estimates. Use of the model-based estimates is recommended as this would ensure compatibility with catch recommendations for Greenland.
- Collect length information and samples (e.g., blubber, skin, reproductive organs, information on presence of foetus, whether there is milk in the mammary glands of females).

New Recommendations for Research

- Further research should be undertaken to investigate the stock structure and abundance in Smith Sound.
- A sensitivity analysis should be conducted to determine how soft zeros in the allocation matrix could impact small or isolated narwhal stocks.
- A new survey in Melville Bay and Inglefield Bredning should be conducted as soon as possible, due to the critical situation for these stocks.
- It should be resolved if there is sufficient genomic resolution for stock discrimination in Baffin Bay narwhals (as has been found for narwhals in East Greenland).

Discussion

The SC acknowledged the work done by the JWG and the QSG in revising the abundance estimates and agreeing on the best way of correcting abundance estimates for monodontids. It **agreed** with the management advice regarding sustainable removals in West Greenland and Canada given by the JWG, and **endorsed** all the recommendations for conservation and management, and for research. It expressed its concerns about the situation of this species which is and will be strongly affected by climate change, because of its narrow and very specific ecological niche. The SC also expressed its hopes that the allocation model would be adopted by Canada to provide advice for sustainable removals.

A question was asked why the aggregations in Inglefield Bredning and Melville Bay, which had previously been assessed to be more stable, were now considered declining on the basis of the same survey data. The rapporteurs explained that this was mainly due to the updated abundance estimates using compatible correction factors over time. All surveys were now corrected by using the correction factors agreed by the QSG which are based on more solid data than the original corrections, but led to lower abundance estimates. The recommended allowable catches for these stocks are therefore lower than previously.

It was noted that it is mainly the sustainable catches from the small and declining narwhal aggregation in Melville Bay that are limiting the sustainable catches in all other hunting areas in West Greenland, except for Inglefield Bredning and Etah. The reason for this is that only about 10% of the narwhals that are taken in Uummannaq, and about 20% of the narwhals that are taken in Disko Bay, may come from the summer aggregation in Melville Bay. The majority of the remaining narwhals in the catches in Uummannaq and Disko Bay are from the larger summer aggregations in Canada, so that the sum of the sustainable catches across the Disko Bay, Uummannaq, and Melville Bay areas is much larger if narwhals are caught in Disko Bay and Uummannaq instead of in Melville Bay.

11.1.4 Updates

Lydersen informed that The Norwegian Polar Institute (NPI) instrumented 2 narwhals with satellite-transmitters and collected biopsies from 12 narwhals on the East Greenland coast (around 79°N) in August 2021 as part of a Norwegian-Greenlandic-Russian collaboration. This work was performed from a helicopter.

Further updates were available in the form of submitted For Information documents. A recent study estimated marine mammal hotspots in the Greenland and Barents Seas based on biotelemetric tracking devices deployed on 13 species, including narwhal (document SC/28/FI20).

11.2 BELUGA

11.2.1 Review and status of active requests (R-3.4.11)

R-3.4.11 (standing) asks the SC "To update the assessment of both narwhal and beluga, noting that new data warrant such an exercise."

This work is done within the context of the Joint Working Group (JWG) with the JCNB, which met in December 2021, and the Ad hoc Working Group on Narwhals in East Greenland (NEGWG), which met in October 2021.

11.2.2 Belugas in East Greenland

Summary

The Ad hoc Working Group on Narwhals in East Greenland was asked to also evaluate the knowledge available to developing management advice for belugas in East Greenland.

Increased sightings of belugas have been reported in East Greenland. Preliminary results of genomic analysis in belugas indicate a high degree of population subdivision, and many stocks appear to be genetically distinct. It is presently unknown to which stock belugas in East Greenland should be related, but samples from three individuals are currently being examined for genetic relatedness to adjacent stocks. Despite large survey efforts no population of belugas has been identified in East Greenland. There is currently insufficient information to conduct an assessment in East Greenland, and there is no evidence to conclude that a hunt would be sustainable.

Catch Recommendation for Beluga from the NEGWG 2021 and endorsed by SC28

Belugas in East Greenland should remain fully protected, as there is insufficient information to perform an assessment.

Additional Recommendations for Beluga of the NEGWG 2021 and endorsed by SC28

- That belugas in East Greenland remain fully protected, as there is insufficient information to perform an assessment of belugas in East Greenland.
- That documentation of hunter observations of belugas in East Greenland is collected in a structured manner, including photographs or video footage of the animals, information on where and when the sighting took place, and how many individuals were seen.
- That any by-catch of belugas in East Greenland be documented in the Special Reports.
- That, in case of live by-caught belugas in East Greenland, all efforts should be made to release the animal.
- That additional samples be taken from all dead by-caught belugas, besides the already mandatory information (date and location of the by-catch, sex, presence/absence of a foetus). This additional information includes skin biopsy sample, length, a tooth, girth measurements, whether there is milk in the mammary glands of females.

Discussion

The SC expressed its appreciation for the additional work done by the NEGWG on belugas and **endorsed** the recommendations presented.

11.2.3 NAMMCO-JCNB Joint Working Group

Summary

The Terms of Reference for this meeting regarding belugas were to: a) review advice on beluga stocks in West Greenland, the North Water stock and West Greenland stock from the 2020 JWG meeting, including landings and seasonal closures for belugas; and c) assess the impacts of climate change on narwhal and beluga movements, distribution, population dynamics, habitat and hunt methods, timing and location.

Assessment of belugas was finalised at JWG 2020, endorsed by the MCC and implemented by Greenland for 2021. No new assessment was developed at the JWG 2021.

For belugas, the MCC did not endorse the recommendation of the JWG that in West Greenland there should be seasonal closures and no hunt south of 65˚, stating that more research was required to assess whether such measures would be effective in restoring stocks in the area. The JWG elaborated, documented and referenced several studies to support its previous recommendation.

The JWG assessed the impacts of climate change on beluga management. Species Distribution Models based on satellite-tagged belugas spanning 27 years predicted habitat loss of belugas in the Canadian and Greenlandic management areas. The JWG agreed more data was needed to clarify connections between beluga distribution and other variables (i.e., body condition and climate changes). The JWG discussed the possibility of modifying existing assessment methods by increasing the variance and adding an error term incorporating environmental cues into the populations models but decided that the models would not be accurately improved. The JWG recommended that the proportion of calves, juveniles and adults be collected for future surveys and used as information of changes in the age structure through time.

Catch Recommendation for Beluga from the JWG 2021 and endorsed by SC28

Reiterated

- Implement the following seasonal closures:
  - Northern (Uummannaq, Upernavik, Savissivik): June through August
  - Central (Disko Bay): June through October
  - Southern (South of Kangaatsiaq): May through October
- In the area south of 65°N, no hunting of beluga be allowed at any time. The WG rejected the MCC request for further research on the effectiveness of this closure noting that beluga populations have shown sustained growth in areas with much greater vessel traffic than SW Greenland and that the habitat changes resulting from climate change are similar to a previous warming period in the 1920's when belugas were caught in large numbers. These observations provide sufficient support for this closure.

Additional Recommendations for Beluga by the JWG 2021 and endorsed by SC28

Recommendations for Conservation and Management:

New

- Collect length information and samples (e.g., blubber, skin, reproductive organs, information on presence of foetus, whether there is milk in the mammary glands of females, a tooth)

Recommendations for Research:

Reiterated

- A summer survey of the High Arctic beluga population.
- Revise assessment model for beluga in relation to data available from Canada.
- If samples from the fall hunt in Qaanaaq become available, a genetic analysis should be performed for possible stock assignment.
- Determine summer grounds and seasonal movements and distribution of the proposed North Water stock.

New

- Genetic data and/or microchemistry data that could show new stocks or mixing of existing stocks should be obtained.
- Genomic analysis should be performed on samples from Igloolik and Taloyoak.

Discussion

Hansen informed that the JWG was also requested to hold a workshop to exchange information on effective tagging practises for belugas. The JWG agreed that such a workshop was desirable, but that a larger range of experts should be invited. The JWG suggested this workshop to not be limited to

tagging belugas, but also include narwhals. It was suggested to wait with the organisation of this workshop.

The SC **endorsed** the recommendations for conservation and management and the recommendations for research on beluga in West Greenland made by the JWG.

11.2.4 Updates

Lydersen informed the SC that *Polar Research*, the scientific journal of the NPI, had published a special issue "Beluga whales: knowledge from the wild, human care and Traditional Ecological Knowledge" in 2021.

Zabavnikov informed the SC that in the coastal zone near the Kola Peninsula in the Russian Federation, a total of 67 belugas were recorded in July 2021 during a study on king crab. In 2020, during the annual joint Russian-Norwegian ecosystem survey in the Barents Sea, a large beluga aggregation of approximately 2,000 individuals was recorded on October 8, at position 78°46´N, 45°39´E. This aggregation was shaped in a narrow strip with a length of around 7 km and moving northward.

Further updates were available in the form of submitted For Information documents. A recent study estimated marine mammal hotspots in the Greenland and Barents Seas based on biotelemetric tracking devices deployed on 13 species including beluga (document SC/28/FI20). A review of the ecology and status of beluga whales in Svalbard became available in 2021 and compiles information on their diet, genetics, behaviour and vocal repertoire (document SC/28/FI28). Through genetic analyses, Skovrind and colleagues (2021) showed that past climate fluctuations seem to have influenced the present circumpolar phylogeography and demographic history of beluga whales (document SC/28/FI29).

11.3 DOLPHINS

11.3.1 Review and status of active requests (R-3.9.6)

R-3.9.6 (pending) The SC was asked to carry out assessments of these species but to date insufficient information has been available on stock delineation, distribution, abundance and biological parameters to initiate the work. The Committee endorsed the plan of the SC to proceed with the assessments once the above-mentioned studies have been completed.

Several species of dolphins are found in the NAMMCO area, of which the two *Lagenorhynchus* species are the most common and exploited species. Series of abundance data now exist for all areas either by species or for the two species grouped (NAMMCO 2020).

At the 2019 Annual Meeting, in response to the SC enquiring whether performing an assessment of dolphin species was a priority, the MCC reiterated that it remained a valid request that has the same level of priority as assessments of other species from which there were removals. The Faroe Islands welcomed that there was now a better basis, including more data, for proceeding with the assessments of small cetaceans, particularly the white-sided dolphin (*Lagenorhynchus acutus*).

SC27 received an update on the information available in each member country to perform an assessment and answer this request. Although some data was still lacking, SC27 agreed to tentatively schedule a working group meeting for 2023. SC28 **reiterated** this schedule (see under section 11.3.2) and **recommended** that a detailed review of the available information in all member countries should be compiled with the help of the Secretariat and presented to SC29.

The SC **agreed** that this was important, especially considering the large hunt that had happened in the Faroe Islands in 2021. The SC also **agreed** that it would be important to look at the effect of removing whole groups or family groups in terms of genetic diversity and social knowledge, and **recommended** this be included in the ToR of the Dolphin WG.

11.3.2 Dolphins Working Group

A Dolphin Working Group is scheduled for 2023 in the work plan.

The SC agreed that more information than ever from the NAMMCO areas now exists on the *Lagenorhynchus* species, in particular the availability of abundance estimates for all areas. However, the analysis of data to determine life history parameters was still not completed in the Faroe Islands. A genetic study, by the University of Edinburgh, based on live samples and strandings of both Atlantic white-sided dolphins and white-beaked dolphins (*Lagenorhynchus albirostris*) from the Faroe Islands, Iceland and Norwegian waters as well as other locations of the Northeast Atlantic was on its way. A fine-scale population structure study was ongoing for white-sided dolphins (with 40,000 single nucleotide polymorphisms from 92 white-sided dolphins), with also an existing dataset for white-beaked dolphins. Gose and Brownlow (2021) had presented a review of the available data and samples for different analyses, as well as ongoing studies to the ASCOBANS AC26.

Information on other dolphin species, which were little or not hunted by member countries, was still very sparse. The SC **agreed** therefore that a Dolphin WG should concentrate on the status review and the assessment, when possible, of *Lagenorhynchus* species. Considering the data in the pipeline, the SC considered any status review of the genus in 2022 as premature. The dolphin WG was kept on the planning for 2023 and all member countries should provide a detailed review of available information and data to SC29. The SC also **agreed** that *Lagenorhynchus* sp. would be added to the agenda of the Harbour Porpoise WG planned in 2022, so that the WG could evaluate the quality of the available data with regards to performing an assessment and identify knowledge gaps that should be filled in before a WG in 2023 (see section 11.4.2).

11.3.3 Updates

Mikkelsen informed that samples of white-sided dolphins were collected from the large kill in 2021, that will be included in a reanalysis of data on age, gender, life history and diet from 2001–2009. Also, samples will be delivered for the genetic study conducted by the University of Edinburgh mentioned above. Annual average catch for the last ten years was 264, from 0 up to the 1,423 dolphins, corresponding to the unique drive of September 2021, representing by far the highest number of any cetacean taken in one drive. The hunt is opportunistic, not an annual event, and interests for hunting the species is low in some whaling districts.

Ugarte informed the SC that in Greenland, until recently, both white-beaked and white-sided dolphins had the same name in Greenlandic. At the request of the GINR scientists, the Greenland's language commission agreed about giving a different name. White-sided dolphins are called "*aarluarsuk*", as before, and white-beaked dolphins are now called "*aarluarsuk qaqortumik siggulik*". From 2021, the reporting forms have one line for each species, so hunters can report yearly catches for the two species separately. Most catches in Greenland are of white-beaked dolphins, but white-sided dolphins are also caught, especially in South Greenland. As the animal are shot by rifle, the struck-and-lost rate might be extremely high. The hunting of smaller odontocetes is not regulated in Greenland except for narwhal and belugas.

Víkingsson informed that several studies have been or were conducted in Iceland on the social organisation of groups based on an 11-year photo-ID catalogue (Bertulli et al. 2021). A study on stable isotope to look at food web dynamics and based on individuals by-caught in the cod fisheries and strandings was also conducted.

Zabavnikov provided an update of the three vessel surveys that were carried out in the Barents Sea by the Russian Federation in 2021: the annual joint-Russian-Norwegian winter ecosystem trawl-acoustic survey on bottom fish stock assessment (MS TAS) in February – March; the international ecosystem survey in the Northern Seas (IES) in April – May; the annual joint Russian-Norwegian ecosystem survey in the Barents Sea (BESS) in August – September. During these surveys, in the areas of interest for PINRO (for MS TAS and IES – southwestern part of the Barents Sea, and BESS – part of the Barents Sea

to east from 33°E and from Kola Peninsula to 79°N) a total of 1,783 white-beaked dolphins were recorded. This was mostly during MS TAS, where 1,109 individuals were sighted in a local aggregation in the Murmansk Bank South-Western Slope. All these individuals were moving in a northeastern direction in a narrow shape of 300-700 m wide and approximately 7.5 km long. This coincided with the highest-density of recorded capelin.

11.4 HARBOUR PORPOISE

11.4.1 Review and status of active requests (R-3.10.1)

R-3.10.1 (Ongoing)"The Council noted that the harbour porpoise is common to all NAMMCO member countries, and that the extent of current research activities and expertise in member countries and elsewhere across the North Atlantic would provide an excellent basis for undertaking a comprehensive assessment of the species throughout its range. The Council therefore requested the SC to perform such an assessment, which might include distribution and abundance, stock identity, biological parameters, ecological interaction, pollutants, removals and sustainability of removals."

The SC is progressing with this task and SC26 completed the assessment for West Greenland in 2019. SC26 also provided recommendations for the other areas regarding the data needed to conduct such assessments and gave advice on how to obtain reliable information.

The BYCWG had progressed on its delivery of by-catch estimates for Iceland (lumpsucker fishery) and Norway (coastal commercial gillnet fisheries) (see section 9.1.2). Abundance estimates for Iceland (2007 survey) and the Faroe Islands (2010 survey), are dated and there is an urgent need for update. A new harbour porpoise survey is planned for 2023 in Iceland. In addition, an abundance estimate based on a new genetic method (close-kin relationship) has been developed in recent years and results are expected in late 2022 or early 2023. New data is available from Norway on biological parameters and health assessments from its by-catch related programme which is now completed.

The SC considered that sufficient data was now available to conduct an assessment for Norway, which is scheduled for 2022: For Iceland it was better to wait for the survey result from 2023, and the assessment is now scheduled for 2024.

11.4.2 Harbour Porpoise Working Group

The SC **recommended** that the Harbour Porpoise Working Group (HPWG) meet in 2022 to proceed with the assessment for Norway. The HPWG was also tasked to review the availability of data for conducting assessment on *Lagenorhynchus* sp. and pilot whale and advise on the necessary steps before these assessments could be conducted.

The SC agreed that Mikkelsen should continue as Chair of the HPWG. The terms of reference for the HPWG 2022 were defined the following:

a) Conduct an assessment of the sustainability of the removals of harbour porpoise in Norway and b) Identify knowledge gaps and needs for further research; c) Assess impacts from non-hunting related anthropogenic stresses (pollution, climate change, noise etc).

Additionally, the SC decided that this WG should:

d) review the information available on the genus *Lagenorhynchus* in the NAMMCO area and advise on how progressing towards and preparing of an assessment of the species in 2023; e) review the information available on pilot whales in the NAMMCO area and advise on how progressing towards and preparing of an assessment of the species in 2023.

11.4.3 Updates

SC27 noted that the recommendation formulated by SC26 and endorsed by the MCC at its 2021 meeting that "*catch statistics for harbour porpoise in West Greenland be validated to address the*

identified issue of significant underreporting and that there be an annual landed catch of no more than 2,629 animals [in West Greenland]". The SC28 was updated that this work had not been completed and the catch recommendation not yet been implemented.

11.5 PILOT WHALE

11.5.1 Review and status of active requests (R-3.8.6)

R-3.8.6 (ongoing) asks the SC "To continue work to complete a full assessment of pilot whales in the North Atlantic and provide advice on the sustainability of catches, as soon as necessary further information becomes available, with particular emphasis on the Faroese area and East and West Greenland. In the short term, the SC was requested to provide a general indication of the level of abundance of pilot whales required to sustain an annual catch equivalent to the annual average of the Faroese catch in the years since 1997."

The second part of the request was answered by SC19, in 2012 on the basis of the abundance estimates generated by TNASS 2007. The request should be fully answered through the meeting of the Pilot Whale Working Group originally planned for 2022 and aiming at assessing the sustainability of the Faroese and Greenlandic hunts. See further information under section 11.5.2.

11.5.2 Pilot Whale Working Group

Mikkelsen informed SC that samples for age and life history analysis, to be integrated in a full assessment, have been collected for some years and that analytical work is still ongoing. A large number of teeth are available for ageing, and the analytical process has now started. Ovaries have also been collected over several years and analysis of these will be performed in parallel with the ageing work. A series of abundance estimates and a trend analysis are now also available (Pike et al 2019ab, 2020).

Satellite tracking of pilot whales to assess movements and distribution and the recruitment area for the drive hunt has been ongoing for several years and in total tracking data for 10 pods over the period 2000–2020 had now been obtained. The intention is that the results of this tracking data will be reviewed prior to the planned WG meeting.

The SC **agreed** to delay the WG on pilot whale assessment for a further year to allow for the completion of the age determination and other analyses in the Faroes. The SC **urged** the Faroe Islands to provide the support necessary to achieve these different analyses, so an assessment of pilot whales can be completed both in the Faroe Islands and Greenland, two areas where the species is regularly hunted. The last, and only, full assessment of the impact of the Faroese pilot whale drive hunt was carried out in 1992, while there has not yet been an assessment of the impact of the Greenlandic hunt.

The SC **strongly underlined** that it is also essential that the Faroese pilot whale tracking data are analysed and reviewed prior to a planned WG meeting as it will inform the possible recruitment area of the hunt, which was a stumbling point in the 1992 assessment. Only hypotheses could then be formulated, while it was at the same time recognised as the cornerstone for identifying the impact of the Faroese drive fishery on the pilot whale population. The results of the tracking data are also essential for the planning of NASS 2024, as they form the basis for designing the coverage of the Faroes survey strata, which is planned to increase coverage in areas of high pilot whale utilisation, see also section 14.

SC28 agreed to reschedule the PWWG for 2023 on the basis of the updates received. The SC **recommended** that the analyses of both the biological and the tagging data be duly completed and forwarded to the PWWG.

11.5.3 Updates

Iceland informed that there has been an increase over several years in the reporting of pilot whale strandings, including several mass strandings. However, greatly increased traffic of tourists along the Icelandic coastline in the same period may have contributed to the increase in reported strandings. Various samples have been collected by the MFRI from the animals, and different studies are going on. A master study assessing the level of cortisol and pollutants in mass stranded specimens has just been completed.

11.6 NORTHERN BOTTLENOSE WHALE

11.6.1 Review and status of active requests (R-1.7.11)

R-1.7.11 (ongoing)asks the SC "To develop estimates of abundance and trends as soon as possible once the survey has been completed, with the primary target species (fin, minke and pilot whales) as a first priority, and secondary target species as a second priority."

Estimates for all possible species from the 2015 NASS survey had been generated and published. SC27 recommended that a single estimate for the whole NAMMCO management area would be generated for bottlenose whales (*Hyperoodon ampullatus*) through re-stratification and recalculation.

The SC was informed that Norway is progressing with this work, and it would be updated with sighting data from last year's survey, when a high number of bottlenose whales was sighted in the Jan Mayen area. The SC looked forward to seeing this result.

11.6.2 Updates

Víkingsson informed the SC on a collaboration between University of Iceland and the University of St. Andrews, investigating the presence and density of bottlenose whales in the Jan Mayen area by using acoustic monitoring. An update on this project will be provided at the next SC meeting.

11.7 BEAKED WHALES

No update was presented for this species at SC28.

11.8 BLUE WHALE

Updates on blue whales (*Balaenoptera musculus*) were provided in the form of submitted For Information documents. A recent study estimated marine mammal hotspots in the Greenland and Barents Seas based on biotelemetric tracking devices deployed on 13 species including blue and fin whales (document SC/28/FI20). In SC/28/FI30, Ahonen and colleagues (2021) provided novel long-term baseline information on blue and fin whale calls in the Northeast Atlantic high Arctic region, from hydrophones deployed in the Fram Strait and north of the Svalbard Archipelago.

11.9 BOWHEAD WHALE

Updates on bowhead whales were provided in the form of submitted For Information documents. A recent study estimated marine mammal hotspots in the Greenland and Barents Seas based on biotelemetric tracking devices deployed on 13 species including bowhead whales (document SC/28/FI20). Recent work on bowhead whale genetics from Svalbard reveal high genetic diversity despite extreme historical catch levels and suggests genetic isolation from other populations for the past 68,782 years (document SC/28/FI31).

11.10 COMMON MINKE WHALE

No research or management updates were presented for this species at SC28.

11.11 FIN WHALE

Updates on fin whales were provided in the form of submitted For Information documents. New information is available on the autumn movements of fin whales from Svalbard, revealing that some individuals might remain at high latitudes during the winter months instead of migrating southwards (document SC/28/FI44). For additional updates on fin whales, see section **Error! Reference source not found.**.

11.12 HUMPBACK WHALE

Updates on humpback whales were provided in the form of submitted For Information documents. A recent study estimated marine mammal hotspots in the Greenland and Barents Seas based on biotelemetric tracking devices deployed on 13 species including humpback whales (document SC/28/FI20).

11.13 KILLER WHALE

The NEGWG 2021 discussed the suggestion from the communities in East Greenland that killer whales could be regulated (i.e., culled or killed) as a measure to help protect the narwhals and concluded the following. "The WG does not consider the cull of killer whales an effective protection measure for narwhals due to the lack of clear evidence of killer whale predation on narwhals. The WG underlined the current advice from NAMMCO that the killer whale hunt in Greenland should be regulated in a precautionary way as there is currently insufficient information to perform an assessment of the sustainability of the harvest."

Ugarte provided an update on killer whales in Greenland (document SC/28/23).

Summary

Interviews with hunters carried out in 2021 confirm that killer whales have been seen about every other year in Qaanaaq, Northwest Greenland for the last several decades. There, killer whales are seldom hunted because, according to some hunters, they are beneficial for the narwhal hunt, as killer whales drive narwhals to inshore areas where they are easier to catch. In the rest of Greenland, killer whales are generally seen as unwanted competitors for hunters and as a conservation threat for other species. Killer whales were rare in East Greenland until 2009, but since then, catches have been reported every year in Tasiilaq, Southeast Greenland, including at least two animals landed in 2021. As something unusual, in 2001 killer whales were also hunted outside Ittoqqortoormiit and Kangerlussuaq, in Central East Greenland. In West Greenland, about one killer whale group is caught each year, but the catches are spread over a large area, so there go several years between sightings in the different regions. In Nuuk, Southwest Greenland, tour operators had fully booked whale watching trips for nearly a week while killer whales were in the fjord in November 2021, until the killer whales were shot by hunters. This conflict of interests created a national debate through media and social media. Despite awareness about recommendations by health authorities of avoiding killer whale products because of the high levels of contaminants, consuming and selling meat and mattak is still part of the motivation for hunting killer whales. Other motivations include preserving hunting culture and the culling of killer whales to avoid competition with hunters and protect prey species. Out of three hunting events where the number of killer whales that died and sank was reported, 4 whales were landed and 9 sank, confirming that loss rates are high. The number of killer whales in Greenland is unknown, but it is possible that the killer whales seen in West Greenland belong to the same population as killer whales seen in Arctic Canada during summer. A recent publication estimates that 135-190 killer whales visit the Canadian Arctic during summer (Lefort et al 2020). Tissue samples from one killer whale caught in Nuuk and two caught in Ittoqqortoormiit will be used for genetical analyses.

Discussion

Greenland is currently the only NAMMCO member state with direct takes of killer whales. In other member states, killer whales are sometimes taken as by-catch, for instance in pelagic fishery for

mackerel and herring. Consistent documentation of the struck-and-loss is needed for the Greenland catches, and the SC emphasized that killer whales do not represent a risk to narwhals in East Greenland due to their offshore distribution in comparison to the more coastal narwhals. Dedicated research effort is needed to understand the stock discreteness around Greenland and the relation to abundance estimates obtained in Canada and the North Atlantic. Reference was made to a recent study by Jourdain et al. (2021), which discussed the potential of a large North Atlantic stock supplying the smaller local abundance of killer whales observed along the coast of Northern Norway (document SC/28/FI43).

The SC is not able to generate advice on sustainable catch levels of killer whales in Greenland due to the absence of data and is deeply concerned that continued harvest may risk the local presence of killer whales in some areas.

The SC was informed that a world conference on killer whales is being planned for April 2023 (Spain) and a sub-group will focus on the North Atlantic killer whales. The SC **recommended** that NAMMCO becomes involve in the organisation of the North Atlantic part of the Conference.

11.14 SEI WHALE

No research or management updates were presented for this species at SC28.

11.15 SPERM WHALE

No research or management updates were presented for this species at SC28.

12. MANAGEMENT PROCEDURES

12.1 PRECAUTIONARY APPROACH (NEW R-1.6.7)

R-1.6.7 (new)asks the SC "To explain how and at what level the precautionary approach is, or can be, integrated into advice provided by the SC for use in conservation and management, with a particular focus on depleted stocks."

The SC tasked the JWG to initiate the process of addressing this request. In response to this, a principle-based approach to setting management objectives for removals of cetaceans and pinnipeds was drafted at the JWG 2021 and was presented to the SC by Hansen.

Summary

Of the principles of the Rio Declaration that the Nuuk Declaration (NAMMCO, 2017) acknowledges, 4 principles were found appropriate for the NAMMCO purpose including the right to development, the use of the precautionary approach where lack of full scientific certainty shall not be used as a reason for postponing measures to prevent environmental degradation, supporting indigenous/local knowledge in the achievement of sustainable development. The principles were elaborated as objectives for management of marine resources, where states commit themselves to the conservation and sustainable use of marine living resources.

Hobbs et al. in collaboration with the JWG developed seven general principles incorporating a precautionary approach when managing small-cetaceans and pinnipeds. They proposed that NAMMCO consider adopting something comparable to the principles listed below for sustainable management of small cetaceans and pinniped stocks.

1. Sustainable management actions should be to maintain or restore stocks at levels ideally above 60% of their equilibrium in the absence of anthropogenic removals, disturbance, and resource competition.
2. Stocks that are depleted below 60% should be managed to increase so that they can recover to the 60% level in a reasonable time period.

3. Stocks that are small (<1,000 individuals or <400 reproductive age females) require greater protection due to threats inherent to small populations, such as loss of genetic diversity, greater vulnerability to demographic and environmental variation including catastrophic events, decreased potential for growth, and management uncertainties such as unknown levels of struck and loss and underreporting. Management of small stocks should take these factors into account to allow for recovery and avoid a significant risk of extirpation or extinction. Small stocks should be fully protected from exploitation unless a data-based assessment is able to recommend a sustainable hunt.
4. Management decisions should be based on the best available science, which may include hunter and user data and observations.
5. Where the best available science is insufficient the precautionary approach shall be widely applied, particularly for small stocks. Lack of scientific certainty shall not be used as a reason for postponing measures to prevent the further depletion or extirpation of a stock. With greater uncertainty more caution is required.
6. Noting that the long-term value of a healthy stock far exceeds the short-term economic value of further depletion or extirpation, economic concerns should not delay or prevent the recovery of a small or depleted stock.
7. Acknowledging that halting all hunting of a stock may not be sufficient to promote recovery of a depleted or small stock, additional management actions such as establishing protected areas of critical habitat, e.g., closing areas to hunting, fishing and vessel traffic, may be considered.

Discussion

The SC acknowledged the need for a principle-based approach to providing management advice for different species groups, in particular for small stocks, and welcomed the JWG effort in starting to develop such an approach.

It was noted that a review of the principle-based harvest management within ICES will be conducted as part of the benchmarking process of harp seals, and that it is valuable to homogenise approaches.

The SC **agreed** that the development of a principle-based approach requires careful consideration and needs further discussion. The 7 principles suggested by the JWG provided good reference points for continuing such discussion at the next SC meeting.

13. ABUNDANCE ESTIMATE AND ASSESSMENT TABLES

Due to time constraints, the SC did not consider the updated abundance and assessment tables. The Secretariat will contact the scientists responsible for the surveys and the areas to clarify any remaining issues.

14. NASS SURVEY 2024

SC26 nominated a NASS survey planning group including Hansen (GL, Chair), Mikkelsen (FO), Nils Øien (NO) and Víkingsson (IS). SC27 had agreed that 2024 was the most appropriate year for a coordinated survey and a draft proposal outlining the plan for a coordinated survey was submitted to Council 28. Council 28 supported the plan for this 2024 coordinated survey, but asked the SC to look into the possibilities of using combined survey platform with fish surveys.

The NASS planning group had met once since Council 28 and elaborated on the survey plans (Document SC/28/22)

Discussion

The SC was informed that although no final decision was made on the survey procedures yet, double platform procedures would be used in all part of the survey, both by ships and planes. The repartition

of aerial and ship-based survey effort might be reorganised, but both type of platforms would be used where they traditionally have been.

The SC noted the importance of progressing swiftly with the planning, considering the experience from previous surveys. It also underlined the necessity for the Faroese pilot whale tracking data to be analysed, as they form the basis for designing the planned intensified coverage of the Faroese survey strata. The intensified coverage aims at reducing variance in the abundance estimate and therefore producing more robust abundance estimates to be used in assessment, see also section 11.5.2.

15. FUTURE WORK PLANS

The work plan for the next three years was reviewed and amended based on the updates and information presented at this meeting. The Coastal Seals Working Group meeting was moved from 2022 to 2023 to allow for the completion of the analysis in Norway and include the abundance estimates that will be generated by the Icelandic grey seal survey in October 2022. The Pilot Whale Working Group meeting was delayed from 2022 to 2023 to allow for the analysis of biological samples and tagging data to be completed. The Harbour Porpoise Working Group in 2022 would focus on harbour porpoise in Norway, while harbour porpoise in Iceland would be dealt with in 2024 to wait for the Icelandic survey targeting harbour porpoise planned in 2023. The 2022 HPWG would also review the information available for an assessment of the *Lagenorhynchus* sp. and pilot whales and the work needed to prepare such assessments.

The agreed schedule for 2022 is presented below, with provisional suggestions for 2023 and 2024.

2022	2023	2024
Working Groups: - Bearded seal (Jointly with CAFF/CBMP in June) - Harbour porpoise (Norway) (+ review of *Lagenorhynchus* sp. and pilot whale available data) - By-catch (Spring) - JWG/WS on disturbance (November)	**Working Groups:** - Harp & hooded seals - Dolphins - Coastal seals - Pilot whale - Narwhal in East Greenland - Ringed seal (tentatively)	**Working Groups:** - Walrus - Large Whale Assessment - Harbour porpoise (Iceland)
Other: - MINTAG: development and testing - NASS planning - Harp & hooded seals Benchmark Meeting (December 5 – 9)) - Ringed seal (Ltd, fall)	**Other:** - MINTAG: testing and field work - NASS planning - Beluga tagging workshop	**Other:** - MINTAG: field work and analysis - NASS planning and survey

16. BUDGET 2022-2023

The SC budget for 2021 was of NOK 171,500, including expenses for one face-to-face WG meeting (BYCWG). The SC expenses for 2021 amount to NOK 149,321 and include the expenses related to two face-to-face WGs meetings (NEGWG, JWG) and the honorarium for one WG Chair.

The budget 2022 and the forecast budget 2023 for the SC adopted by Council 28 are respectively NOK 324,000 and 200,000. Following the present SC workplan proposal, the forecast expenses for 2022 and 2023 are NOK 224,000 and 397,500 respectively.

The budget and accounting for the NASS and MINTAG projects are kept separate from those of the SC, under their specific items in the budget of the Commission. They are therefore not included in the numbers given above.

17. NAMMCO SCIENTIFIC PUBLICATIONS UPDATE

17.1 VOLUME 12 UPDATE

The volumes of the Scientific Publications series have typically been species-based, around particular NAMMCO meetings that take place. As there was no such clear topic for 2020, it was decided that volume 12 would be based on an open call for submissions. Submissions were welcomed from across all disciplines (e.g., biology, economics, and law) relevant for the conservation and management of marine mammals in the North Atlantic. The deadline for submissions was initially October 1, 2021, but due to the COVID-19 situation this was extended to December 31, 2021. In total 1 workshop report, 5 research articles, and 2 notes, were submitted. The workshop report was published in 2021, and the first research article was published in January 2022. The remaining articles and notes are currently in review and are aimed to be published later in 2022.

17.2 VOLUME 13 PLANNING

Due to limitations in time this was not discussed and left open for e-mail discussion.

18. ELECTION

Mikkelsen's term as Chair of the SC will end at the closure of the 29th Council Meeting in 2022. An election was held for the new Chair and Vice-Chair. Rosing-Asvid (GL) was elected as the new SC Chair, and Granquist (IS) was elected as the new Vice Chair. The SC congratulated Rosing-Asvid and Granquist on their new roles. Since the 29th meeting of the Council has been postponed to September, Mikkelsen and Rosing-Asvid would Co-Chair in the interim period.

19. OTHER BUSINESS

Greenland has been the host for the 27th and 28th SC meetings, but as these meetings took place online, the SC **agreed** that Greenland would remain the host for the next meeting. This meeting was agreed to take place in the last week (23 ï 27) of January 2023. The SC expressed it hopes that by then it will be possible to meet in person again.

20. RECOMMENDATIONS

Recommendations in green were made by SC28, recommendations in black are recommendations forwarded by the WGs to the SC and endorsed by SC28.

20.1 CATCH RECOMMENDATIONS

Greenland

- Zero catches of narwhals in all three management areas in Southeast Greenland *(Strongly reiterated).*
- Belugas in East Greenland should remain fully protected, as there is insufficient information to perform an assessment of belugas in East Greenland.
- Implement the following seasonal closures for the hunt of belugas in West Greenland *(reiterated):*
    - Northern (Uummannaq, Upernavik, Savissivik): June through August
    - Central (Disko Bay): June through October

    - Southern (South of Kangaatsiaq): May through October
- In the area south of 65°N in West Greenland, no hunting of beluga be allowed at any time *(reiterated).*
- That the killer whale hunt in Greenland should be regulated in a precautionary way, as there is currently insufficient information to perform an assessment of the sustainability of the harvest (*reiterated NAMMCO advice).*

20.2 RECOMMENDATIONS FOR CONSERVATION & MANAGEMENT

By-catch

Iceland

- To continue efforts towards improving species identification by both inspectors and fishermen and encourage collecting DNA samples and taking photos of by-caught seals in 2022 to validate inspector reports and calculate the rate of misidentification by fishermen, so this could be corrected for.
- To support the analysis of DNA samples to assess rates of species misidentification through the provision of necessary funding.
- To include a field for target species in the logbook as well as other ways to distinguish these coastal and offshore [cod and Greenland halibut] fisheries for monitoring by-catch.
- To closely monitor and follow the by-catch in the Greenland halibut gillnet fishery.

Norway

- To continue improving the monitoring of by-catch rates and accurate species identification through the implementation of REM systems, habitat preference models, and photographs.
- that in the Norwegian CRF, the collection of the lower jaw of seals becomes a mandatory term in the boat contract.

Bearded seal

Greenland

- That the catch data be made available in such a way that the origin of the catch can be attributed to smaller areas than those reported now (West and East Greenland and Svalbard).

Narwhal

Greenland

- That a community-based biopsy programme of live narwhals be established, given that hunters report seeing narwhals regularly. This would generate information on the rate of encounters and provide samples for stock structure analysis.
- That additional information be collected from any hunted narwhals in West and East Greenland (if a narwhal hunt goes ahead despite the WG's strong recommendations for 0 catches in all management areas of East Greenland) besides the already mandatory information (length, sex, date and location of the catch, presence/absence of a foetus). This additional information includes: a skin biopsy sample, the type of the animal according to the three categories described by hunters, photograph of the back, girth measurements, information for females whether there is milk in the mammary glands.
- That shipping activities from large vessels (including cruise ships) in the summering grounds along the East Greenland coastline be regulated to avoid negative impacts on the narwhal populations, as narwhals are sensitive to noise and these small populations are particularly sensitive to impacts from disturbance.
- That the effects of climate change be reduced and mitigated to protect the narwhal's habitat, as climate change is probably causing increased habitat fragmentation of narwhal stocks and a drastic reduction of their winter ranges.

Beluga

Greenland

- That belugas in East Greenland remain fully protected, as there is insufficient information to perform an assessment of belugas in East Greenland.
- That documentation of hunter observations of belugas in East Greenland is collected in a structured manner, including photographs or video footage of the animals, information on where and when the sighting took place, and how many individuals were seen.
- That any by-catch of belugas in East Greenland be documented in the Special Reports.
- That, in case of live by-caught belugas in East Greenland, all efforts should be made to release the animal.
- That additional samples be taken from all dead by-caught belugas in East Greenland, and all caught belugas in West Greenland, besides the already mandatory information (date and location of the by-catch, sex, presence/absence of a foetus). This additional information includes skin biopsy sample, length, a tooth, girth measurements, whether there is milk in the mammary glands of females.

20.3 RECOMMENDATIONS FOR RESEARCH

By-catch

Iceland

- That the largest of the upper Confidence Interval from Punt et al. (2020) and the by-catch reported in the logbook be used by the CSWG as a preliminary minimum by-catch estimate for seals in the Icelandic cod and Greenland halibut fisheries.

Norway/Iceland

- To compare the pingers used in the trials conducted in Norway and Iceland to investigate similarities and differences in their deterrent signals.

Norway

- To investigate the value of using habitat preference models for apportioning seal species in the generation of by-catch estimates.

Bearded seal

Greenland

- That the data on local abundance in Greenland be analysed and made available to the Bearded Seal WG.

Harp seal

Norway

- That a survey of harp seal pup production be carried out as soon as possible in the White Sea and adjacent Barents Sea waters *(reiterated).*

Narwhal

Greenland

- That, for examining the impact of climate change on life history parameters, life history data be collected from non-depleted stocks of narwhals in West Greenland and Canada, where climate change is also expected to have an impact.
- That different approaches to counting narwhals in the fjords be further examined, but only to the extent that new approaches will be compatible with the existing time-series.
- That, although the planning of surveys should be done in collaboration with the hunters, the survey methodology (including the design of the track lines) continues to be done according

to internationally accepted survey standards, to ensure that abundance estimates derived from the survey can be accepted by NAMMCO and used in the assessment.
- That definitions be developed for what constitutes small stocks, depleted stocks and stocks at risk of extirpation, and that frameworks for advice and management then be articulated for what actions should be taken for these different categories.
- That further research should be undertaken to investigate the stock structure and abundance in Smith Sound.
- That a sensitivity analysis should be conducted to determine how soft zeros in the allocation matrix could impact small or isolated narwhal stocks.
- That a new survey in Melville Bay and Inglefield Bredning should be conducted as soon as possible, due to the critical situation for these stocks.
- That it should be resolved if there is sufficient genomic resolution for stock discrimination in Baffin Bay narwhals (as has been found for narwhals in East Greenland).

Beluga

Greenland

- To conduct a summer survey of the High Arctic beluga population.
- To revise the assessment model for beluga in relation to data available from Canada.
- That if samples from the fall hunt in Qaanaaq become available, a genetic analysis should be performed for possible stock assignment.
- To determine summer grounds and seasonal movements and distribution of the proposed North Water stock.

New

- Genetic data and/or microchemistry data that could show new stocks or mixing of existing stocks should be obtained.
- Genomic analysis should be performed on samples from Igloolik and Taloyoak.

20.4 PROCEDURAL RECOMMENDATIONS

By-catch

- That the By-Catch WG continue and progress in its assessments of the by-catch risk in the different fisheries

Environmental and Ecosystem Issues

- That a workshop be held by the JWG to assess the anthropogenic impacts on marine mammals of activities associated to both the Mary River project in Canada as well as the mining activities in Wolstenholme Fjord.
- That R-1.1.8 is a two-fold request and should be separated as such. 1) "*In addressing the standing requests on ecosystem modelling and marine mammal fisheries interaction, to extend the focus to include all areas under NAMMCO jurisdiction*." 2) "*In the light of the distributional shifts seen under T-NASS 2007, the SC should investigate dynamic changes in spatial distribution due to ecosystem changes and functional response*".

Harp and Hooded seal

- That the reference to the planned survey in 2007 is removed from the ongoing request R-2.1.9, as several surveys had been conducted since 2007.

Ringed seal

- That R-2.3.1 be rephrased to not only refer to disturbance and pollution but also climate change as this likely represents the biggest threat to ringed seals.

Harbour Porpoise

- That the Harbour Porpoise Working Group (HPWG) meet in 2022 to proceed with the assessment for Iceland and Norway.

Dolphins

- That a detailed review of the available information on *Lagenorhynchus* sp. in all member countries should be compiled with the help of the Secretariat and presented to SC29.

Pilot Whale

- That the analyses of both the biological and the tagging data be duly completed and forwarded to the PWWG.

Killer Whale

- That NAMMCO become involved in the organisation of the North Atlantic part of the World Conference planned for April 2023 in Spain.

21. MEETING CLOSE

The Chair thanked all the participants for their input to the discussions. Special thanks were addressed to Heleen Middel, the interim Scientific Secretary, and the Secretariat for the work done in preparation for and during this meeting. The SC thanked the Chair for his efficient guiding through the agenda of this online meeting.

The meeting was closed at 16:50 CET on Friday January 28, 2022.

A draft report was accepted before the close of the meeting on January 28, 2022. After a period of editing and formatting by the Secretariat, a new version was circulated on February 11, 2022. The final report was accepted on February 16, 2022.

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APPENDIX 1: AGENDA

1. **Welcome from the Chair & Opening Remarks**
2. **Adoption of Agenda**
3. **Appointment of Rapporteurs**
4. **Review of Available Documents and Reports**
   - 4.1. National and annual progress reports
     - 4.1.1. Updates from observers
   - 4.2. Working group reports
   - 4.3. Other reports and documents
5. **Updates from Council**
   - 5.1. General comments
   - 5.2. Endorsed SC work plan
6. **Collaboration between SC Members**
   - 6.1. MINTAG Project
   - 6.2. Other collaborations
7. **Interactions with other organisations**
   - 7.1. ASCOBANS
   - 7.2. CAFF
   - 7.3. ICES
   - 7.4. IUCN
   - 7.5. IWC
   - 7.6. JCNB
   - 7.7. Other
8. **Website Updates & Quality Review**
9. **Environmental/Ecosystem Issues**

9.1. Marine Mammal / Fisheries Interactions
- 9.1.1. Review and status of active requests (R-1.1.5, R-1.1.8)
- 9.1.2. By-Catch Working Group
- 9.1.3. Consumption of resources by marine mammals

9.2. Multi-species approaches to management and modelling
- 9.2.1. Review and status of active requests (R-1.2.1)

9.3. Environmental issues
- 9.3.1. Review and status of active requests (R-1.5.3, R-1.5.4)

10. **Seals & Walrus Stocks – Status and Advice to the Council**
    - 10.1. Bearded seal
      - 10.1.1. Review and status of active requests (R-2.7.1)
      - 10.1.2. Bearded Seal Working Group
      - 10.1.3. Updates
    - 10.2. Ringed seal
      - 10.2.1. Review and status of active requests (R-2.3.1, R-2.3.3)
      - 10.2.2. Ringed Seal Working Group.
      - 10.2.3. Updates
    - 10.3. Harbour seal
      - 10.3.1. Review and status of active requests (R-2.5.2)
      - 10.3.2. Coastal Seals Working Group
      - 10.3.3. Updates
    - 10.4. Grey seal
      - 10.4.1. Review and status of active requests (R-2.4.2)
      - 10.4.2. Coastal Seals Working Group
      - 10.4.3. Updates
    - 10.5. Harp and Hooded seals

- 10.5.1. Review and status of active requests (R-2.1.9)
- 10.5.2. Harp and Hooded Seals Working Group
- 10.5.3. Updates
- 10.6. Walrus
  - 10.6.1. Review and status of active requests (R-2.6.3)
  - 10.6.2. Updates

11. Cetacean Stocks – Status and Advice to the Council

- 11.1. Narwhal
  - 11.1.1. Review and status of active requests (R-3.4.11)
  - 11.1.2. Narwhals in East Greenland Working Group
  - 11.1.3. NAMMCO-JCNB Joint Working Group
  - 11.1.4. Updates
- 11.2. Beluga
  - 11.2.1. Review and status of active requests (R-3.4.11)
  - 11.2.2. Belugas in East Greenland
  - 11.2.3. NAMMCO-JCNB Joint Working Group
  - 11.2.4. Updates
- 11.3. Dolphins
  - 11.3.1. Review and status of active requests (R-3.9.6)
  - 11.3.2. Dolphins Working Group
  - 11.3.3. Updates
- 11.4. Harbour porpoise
  - 11.4.1. Review and status of active requests (R-3.10.1)
  - 11.4.2. Harbour Porpoise Working Group
  - 11.4.3. Updates
- 11.5. Pilot whale
  - 11.5.1. Review and status of active requests (R-3.8.6)
  - 11.5.2. Pilot Whale Working Group
  - 11.5.3. Updates
- 11.6. Northern bottlenose whale
  - 11.6.1. Review and status of active requests (R-1.7.11)
  - 11.6.2. Updates
- 11.7. Beaked whales
- 11.8. Blue whale
- 11.9. Bowhead whale
- 11.10. Common minke whale
- 11.11. Fin whale
- 11.12. Humpback whale
- 11.13. Killer whale
- 11.14. Sei whale
- 11.15. Sperm whale

12. Management Procedures (NEW R-1.6.7)

13. Abundance / Assessment / Conservation status tables

14. NASS 2024

- 14.1. Active requests (R-1.7.11)
- 14.2. Planning

15. Future Workplans

16. Budget 2022-23

17. NAMMCO Scientific Publications Update

- 17.1. Volume 12 update
- 17.2. Volume 13 planning

18. Election

19. **Any Other Business**
20. **Review of Report**
21. **Meeting Closure**

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APPENDIX 3: LIST OF DOCUMENTS

Working Documents

Doc. No.	Title	Agenda item
SC/28/01a	Draft Agenda	2
SC/28/01b	Draft Agenda Annotated	2
SC/28/02	Draft List of Participants	1
SC/28/03	Draft List of Documents	4
SC/28/04	List of Requests to SC from Council	Several
SC/28/05	Report from the By-Catch Working Group	9.1.2
SC/28/06	Report from the Narwhals in East Greenland Working Group	11.1, 11.2
SC/28/07	Report from the NAMMCO-JCNB Joint Working Group on Narwhal & Beluga	11.1, 11.2
SC/28/08	Scherdin et al. – Bearded seals in the North Atlantic: a review of recent knowledge available to inform stock assessments.	10.1
SC/28/09	Joint NAMMCO-CAFF Bearded Seal WS – update from the Secretariat	10.1
SC/28/10	Hobbs et al. – A principle based approach to setting management objectives for removals of small cetaceans and pinnipeds.	12
SC/28/11a	Participation Report - IUCN World Conservation Congress 2021	7.4
SC/28/11b	Posters presented at IUCN Congress 2021	7.4
SC/28/12	ICES Activities 2021	7.3
SC/28/13	NAMMCO website information on Narwhal	8
SC/28/14	NAMMCO website information on Beluga	8
SC/28/15	NAMMCO website information on Fin Whales	8
SC/28/16	NAMMCO website information on Humpback Whales	8
SC/28/17	Abundance Estimates Overview Tables	13
SC/28/18	Assessment Overview Tables	13
~~SC/28/19~~	~~Conservation Status Tables~~	~~13~~
SC/28/20	SC Accounts and Budget	16
SC/28/21	Annual Report from the MINTAG project	6.1
SC/28/22	Updated proposal for NASS 2024	14
SC/28/23	Killer Whales in Greenland	11.13

For Information Documents

Doc. No.	Title	Agenda item
SC/28/NPR/FO-2020-2019	National Progress Report 2020-2019 – Faroe Islands	4.1
SC/28/NPR/FO-2021	National Progress Report 2021 – Faroe Islands	4.1
SC/28/NPR/GL-2020-2019	National Progress Report 2020-2019 – Greenland	4.1
SC/28/NPR/IS-2020-2019	National Progress Report 2020-2019 – Iceland	4.1
SC/28/NPR/NO-2020-2019	National Progress Report 2020-2019 – Norway	4.1
SC/28/NPR/NO-2021	National Progress Report 2021 - Norway	4.1
SC/28/NPR/JP-2021	National Progress Report 2021 – Japan a. Large Cetaceans b. Small Cetaceans c. Satellite Telemetry Experiments d. Management Procedures for North Pacific Common Minke whales	4.1
SC/28/NPR/RU	National Progress Report 2021 – Russian Federation	4.1
SC/28/NPR/CA-2020-2019	National Progress Report 2020-2019 – Canada	4.1
SC/28/APR/MA-2021	National Progress Report 2021 – Makivik	4.1
SC/28/FI01	Report of SC 27 (2021)	Several
SC/28/FI02	Annual Reports	Several
SC/28/FI03	NAMMCO 28 Report of Council	Several
SC/28/FI04	NAMMCO 28 Report of Management Committees (MCJ + MCC + MCSW)	Several
SC/28/FI05	Chauvat, C. M., Aquino, J., & Granquist, S. M. (2021). Visitors' values and perceptions of seal watching management in Northwestern Iceland. Journal of Sustainable Tourism, 1-20.	9.3, 10.3
SC/28/FI06	Aquino, J.F., Burns, G.L and Granquist, S.M. (2021). A Responsible Framework for Managing Wildlife Watching Tourism. Ocean and coastal management. 210(11):105670	9.3, 10.3, 10.4
SC/28/FI07	Rößler, H., Tougaard, J., Sabinsky, P. F., Rasmussen, M. H., Granquist, S. M., & Wahlberg, M. (2021). Are Icelandic harbor seals acoustically cryptic to avoid predation? JASA Express Letters, 1(3), 031201.	10.3
SC/28/FI08	Spaan, K. M., van Noordenburg, C., Plassmann, M. M., Schultes, L., Shaw, S., Berger, M., Heide-Jørgensen, M.P., Rosing-Asvid, A., Granquist, S.M., Dietz, R., Sonne, C., Roos, A., Benskin, J.P. (2020). Fluorine mass balance and suspect screening in marine mammals from the Northern Hemisphere. Environmental Science & Technology, 54(7), 4046-4058.	9.3

SC/28/FI09	Punt, A. E., Siple, M., Sigurðsson, G. M., Víkingsson, G., Francis, T. B., Granquist, S. M., ... & Zerbini, A. N. (2020). Evaluating management strategies for marine mammal populations: an example for multiple species and multiple fishing sectors in Iceland. Canadian Journal of Fisheries and Aquatic Sciences, 77(8), 1316-1331.	9.1
SC/28/FI10	Baylis, A. M., Þorbjörnsson, J. G., dos Santos, E., & Granquist, S. M. (2019). At-sea spatial usage of recently weaned grey seal pups in Iceland. Polar Biology, 42(11); 2165–2170. DOI:10.1007/s00300-019-02574-5	10.4
SC/28/FI11	Granquist, S. M. (2021). The Icelandic harbour seal (*Phoca vitulina*): Population estimate in 2020, summary of trends and the current status. (HV 2019-36). Reykjavík: Marine and Freshwater Research Institute.	10.3
SC/28/FI12	Granquist, S.M. and Hauksson, E. (2019). Population estimate, trends and current status of the Icelandic harbour seal (*Phoca vitulina*) population in 2018 [Landselstalning 2018: Stofnstærðarmat, sveiflur og ástand stofns]. Marine and Freshwater Research Institution, HV 2019-36. Reykjavík 2019. 22pp.	10.3
SC/28/FI13	Granquist, S.M. and Hauksson, E. (2019). Aerial census of the Icelandic grey seal (*Halichoerus grypus*) population in 2017: Pup production, population estimate, trends and current status [Útselstalning 2017: Stofnstærðarmat, sveiflur og ástand stofns]. Marine and Freshwater Research Institution, HV 2019-02. Reykjavík 2019. 19 pp.	10.4
SC/28/FI14	ICES 2021 Workshop on estimation of Mortality of Marine Mammals due to Bycatch (WKMOMA) – Executive Summary	9.1
SC/28/FI15	ICES 2021 Working Group on Bycatch of Protected Species (WGBYC) – Executive Summary	9.1
SC/28/FI16	ASCOBANS Intersessional Working Group Report – Overcoming Challenges to Protect Beaked Whales in the Northeast Atlantic	11.7
SC/28/FI17	ASCOBANS Action Points and Recommendations from the 26th Meeting of the Advisory Committee	7.1
SC/28/FI18	Routti, H., Harju, M., Lühmann, K., Aars, J., Ask, A., Goksøyr, A., ... & Lydersen, C. (2021). Concentrations and endocrine disruptive potential of phthalates in marine mammals from the Norwegian Arctic. Environment International, 152, 106458.	9.3
SC/28/FI19	Palomino-González, A., Kovacs, K. M., Lydersen, C., Ims, R. A., & Lowther, A. D. (2021). Drones and marine mammals in Svalbard, Norway. Marine Mammal Science.	9.3
SC/28/FI20	Hamilton, C. D., Lydersen, C., Aars, J., Biuw, M., Boltunov, A. N., Born, E. W., ... & Kovacs, K. M. (2021). Marine	10, 11

	mammal hotspots in the Greenland and Barents Seas. Marine Ecology Progress Series, 659, 3-28.	
SC/28/FI21	Bengtsson, O., Hamilton, C. D., Lydersen, C., Andersen, M., & Kovacs, K. M. (2021). Distribution and habitat characteristics of pinnipeds and polar bears in the Svalbard Archipelago, 2005–2018. Polar Research, 40, 10-33265.	10
SC/28/FI22	Llobet, S. M., Ahonen, H., Lydersen, C., Berge, J., Ims, R., & Kovacs, K. M. (2021). Bearded seal (*Erignathus barbatus)* vocalizations across seasons and habitat types in Svalbard, Norway. Polar Biology, 44, 1273-1287.	10.1
SC/28/FI23	Tryland, M., Lydersen, C., Kovacs, K. M., Rafter, E., & Thoresen, S. I. (2021). Serum biochemistry and haematology in wild and captive bearded seals (*Erignathus barbatus*) from Svalbard, Norway. Acta Veterinaria Scandinavica, 63(1), 1-7.	10.1
SC/28/FI24	Andersen, M., Kovacs, K. M., & Lydersen, C. (2021). Stable ringed seal (*Pusa hispida*) demography despite significant habitat change in Svalbard, Norway. Polar Research, 40.	10.2
SC/28/FI25	Kovacs, K. M., Citta, J., Brown, T., Dietz, R., Ferguson, S., Harwood, L., ... & Lydersen, C. (2021). Variation in body size of ringed seals (*Pusa hispida hispida*) across the circumpolar Arctic: evidence of morphs, ecotypes or simply extreme plasticity? Polar Research, 40.	10.2
SC/28/FI26	Kunisch, E. H., Graeve, M., Gradinger, R., Haug, T., Kovacs, K. M., Lydersen, C., ... & Bluhm, B. A. (2021). Ice-algal carbon supports harp and ringed seal diets in the European Arctic: evidence from fatty acid and stable isotope markers. Marine Ecology Progress Series, 675, 181-197.	10.2, 10.5
SC/28/FI27	Vacquié-Garcia, J., Lydersen, C., Lydersen, E., Christensen, G. N., Guinet, C., & Kovacs, K. M. (2021). Seasonal habitat use of a lagoon by ringed seals *Pusa hispida* in Svalbard, Norway. Marine Ecology Progress Series, 675, 153-164.	10.2
SC/28/FI28	Lydersen, C., & Kovacs, K. M. (2021). A review of the ecology and status of white whales (*Delphinapterus leucas*) in Svalbard, Norway. Polar Research, 40.	11.2
SC/28/FI29	Skovrind, M., Louis, M., Westbury, M. V., Garilao, C., Kaschner, K., Castruita, J. A. S., ... & Lorenzen, E. D. (2021). Circumpolar phylogeography and demographic history of beluga whales reflect past climatic fluctuations. Molecular Ecology.	11.2
SC/28/FI30	Ahonen, H., Stafford, K. M., Lydersen, C., Berchok, C. L., Moore, S. E., & Kovacs, K. M. (2021). Interannual variability in acoustic detection of blue and fin whale calls	11.8, 11.11

	in the Northeast Atlantic High Arctic between 2008 and 2018. Endangered Species Research, 45, 209-224.	
SC/28/FI31	Bachmann, L., Cabrera, A. A., Heide-Jørgensen, M. P., Shpak, O. V., Lydersen, C., Wiig, Ø., & Kovacs, K. M. (2021). Mitogenomics and the genetic differentiation of contemporary *Balaena mysticetus (Cetacea*) from Svalbard. Zoological Journal of the Linnean Society, 191(4), 1192-1203.	11.9
SC/28/FI32	K.M. Kovacs, S. Belikov, P. Boveng, G. Desportes, S. Ferguson, R. Hansen, K. Laidre, G. Stenson, P. Thomas, F. Ugarte, D. Vongraven. (2021). 2021 State of the Arctic Marine Biodiversity Report (SAMBR) Update: 2021 State of the Arctic Marine Biodiversity Report (SAMBR) update: Marine Mammals. Technical Report. Conservation of Arctic Flora and Fauna International Secretariat: Akureyri, Iceland.	7.2
SC/28/FI33	Aoki, K., Isojunno, S., Bellot, C., Iwata, T., Kershaw, J., Akiyama, Y., López, L.M.M., Ramp, C., Biuw, M., Swift, R., Wensveen, P.J., Pomeroy, P., Narazaki, T., Hall, A., Sato, K., & Miller, P.J.O. (2021). Aerial photogrammetry and tag-derived tissue density reveal patterns of lipid-store body condition of humpback whales on their feeding grounds. Proceedings of the Royal Society B 288: 20202307. https://doi.org/10.1098/rspb.2020.2307	9
SC/28/FI34	Kershaw, J.L., de la Vega, C., Jeffrey, R.M., Frie, A.K., Haug, T., Mahaffey, C., Mettam, C., Stenson, G., Smout, S. (2021). Compound-specific isotope analyses of harp seal teeth: tools for trophic ecology reconstruction. Marine Ecology Progress Series, 678: 211–225. https://doi.org/10.3354/meps13867	9
SC/28/FI35	Solvang, H.K., Haug, T., Knutsen, T., Gjøsæter, H., Bogstad, B., Hartvedt, S., Øien, N. & Lindstrøm, U. (2021). Distribution of rorquals and Atlantic cod in relation to their prey in the Norwegian high Arctic. Polar Biology 44: 361-382. https://doi.org/10.1007/s00300-021-02835-2.	9
SC/28/FI36	Vogel, E.F., Biuw, M., Blanchet, M.-A., Jonsen, I.D., Mul, E., Johnsen, E., Hjøllo, S.S., Olsen, M.T., Dietz, R. & Rikardsen, A. (2021). Killer whale movements on the Norwegian shelf are associated with herring density. Marine Ecology Progress Series 665: 217-231. https://doi.org/10.3354/meps13685	9
SC/28/FI37	Biuw, M., Øigård, T.A., Nilssen, K. T., Stenson, G., Lindblom, L., Poltermann, M., Kristiansen, M. & Haug, T. (2022). Recent harp and hooded seal pup production estimates in the Greenland Sea suggest ecology-driven declines. NAMMCO Scientific Publications 12. https://doi.org/10.7557/3.5821	17.1

SC/28/FI38	Basran, C. J., Sigurðsson, G. M. (2021). Using Case Studies to Investigate Cetacean Bycatch/Interaction Under-Reporting in Countries With Reporting Legislation. *Frontiers in Marine Science.* https://doi.org/10.3389/fmars.2021.779066	9.1.2
SC/28/FI39	Hammond, P.S., Francis, T.B., Heinemann, D., Long, K.J., Moore, J.E., Punt, A. E., Reeves, R.R., Sepúlveda, M., Sigurðsson, G.M., Siple, M.C., Víkingsson, G., Wade, P.R., Williams, R., Zerbini, A.N. (2021). Estimating the Abundance of Marine Mammal Populations, 8. https://doi.org/10.3389/fmars.2021.735770	Several
SC/28/FI40	Lefort, K.J., Matthews, C.J.D., Higdon, J.W., Petersen, S.D., Westdal, K.H., Garrowy, C.J., Ferguson, S.H. (2020). A review of Canadian Arctic killer whale (*Orcinus orca*) ecology. Canadian Journal of Zoology 98: 245-253. dx.doi.org/10.1139/cjz-2019-0207	11.13
SC/28/FI41	Ringed Seal COSEWIC Assessment and Status Report – Canada	10.2
SC/28/FI42	O'Corry-Crowe, G., Suydam, R., Quakenbush, L., Smith, T.G., Lydersen, C., Kovacs, K.M., Orr, J., Harwood, L., Litovka, D. & Ferrer, T. (2020). Group structure and kinship in beluga whale societies. *Scientific Reports,* 10. https://doi.org/10.1038/s41598-020-67314-w	12 & 11.3
SC/28/FI43	Jourdain, E., Goh, T., Kuningas, S., Similä, T., Vongraven, D., Karoliussen, R., Bisther, A., Hammond, P.S. (2021). Killer whale (Orcinus orca) population dynamics in response to a period of rapid ecosystem change in the eastern North Atlantic. *Scientific Reports*. DOI: 10.1002/ece3.8364	11.13
SC/28/FI44	Lydersen, C., Vacquié-Garcia, J., Heide-Jørgensen, M.P., Øien, N., Guinet, C. & Kovacs, K.M. (2020). Autumn movements of fin whales (Balaenoptera physalus) from Svalbard, Norway, revealed by satellite tracking. *Scientific Reports,* (10). https://doi.org/10.1038/s41598-020-73996-z	11.11

APPENDIX 4: JAPAN PROGRESS REPORT 2021 – SUMMARY

The Progress Report 2021 by Japan consisted of four parts: SC/28/NPR-JP a) on large cetacean, SC/28/NPR-JP b) on small cetaceans, SC/28/NPR-JP c) on satellite tagging experiments (2021), and SC/28/NPR-JP d) on management procedures for North Pacific common minke whales. SC/28/PR-JP a) and b) summarized the following research projects/activities: 1) collection of biological data and samples from commercial hunting of small cetaceans; and from commercial whaling on common minke, Bryde's and sei whales in Japan's Exclusive Economic Zone (EEZ). These data and samples are being analyzed in contribution to the stock assessment and management of large and small cetaceans in the North Pacific; 2) dedicated sighting surveys for large and small cetaceans under the programs Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A) in the Southern Ocean, International Whaling Commission-Pacific Ocean Whale and Ecosystem Research (IWC-POWER) in the North Pacific (mainly in the central North Pacific) and eight national sighting survey programs in the western North Pacific Ocean. These programs involved sighting activities, oceanographic and marine debris surveys, and photo-ID, biopsy sampling and satellite tagging for small and large whale species; 3) DNA register and molecular monitoring in the retail market for large whales; and 4) records and analyses (mainly on population genetic structure) of by-catches and stranding including small and large cetaceans. Several research institutes and universities participated or contributed to the research in each project. The biological samples and data collected using both lethal and non-lethal techniques in the period mentioned above are being used in analyses relevant to the research objectives of each research project/activity. A total of 15 scientific documents for large cetacean and their environment were published in peer-reviewed journals in 2021 while six papers were published on small cetaceans in 2019-2020.

SC/28/NPR/JP-2021(c) presented the progress in technical development and results of satellite tagging experiments conducted by the Institute of Cetacean Research (ICR) during 2020/21. The tagging experiments are conducted to respond questions on the habitat and stock structure of large whales. In the Antarctic, satellite-monitored tags were deployed on the Antarctic minke and fin whales in the Atlantic and Indian sectors in the austral summer season 2020/21. Ten Antarctic minke and seven fin whales were tagged. Antarctic minke whales showed wide longitudinal movements, and one individual showed a northward migration in the Indian sector starting in April. Tagged fin whales in Antarctic waters did not show remarkable longitudinal nor latitudinal movements. Eight fin and 18 sei whales were tagged in the Okhotsk Sea and the North Pacific. Three fin whales moved between the Okhotsk Sea and the western North Pacific. In the central-eastern North Pacific one individual moved southward from August. Sei whales showed a movement pattern suggesting feeding activities. Preliminary experiments on diving pattern using Argos satellite transmitting tags were conducted on fin whales in the Okhotsk Sea and fin and humpback whales in the Antarctic. The development of satellite tagging technology as well the application of tagging to respond ecological and stock structure questions in large whales are current areas of collaboration between NAMMCO and Japanese scientists.

SC/28/NPR/JP-2021(d) presented a brief outline of the data and procedures used by Japan to calculate catch limits for sustainable commercial whaling of western North Pacific common minke whales. The calculations were made by a Japan RMP Team (JRT) in line with the IWC's Revised Management Procedure (RMP), based on the Norwegian Catch Limit Algorithm (CLA) computer code and for a tuning level of 0.6. The calculation by the JRT was reviewed by an international team of experts. The application of the CLA was based on the best and latest scientific information on stock structure, which is essential to define management areas, catch history series and estimate abundance. The calculation process took into account data and assumptions used in the assessment of this species by the IWC Scientific Committee. Catch limit calculated by the CLA was examined for its robustness to several source of uncertainty by the Implementation Simulation Trials (ISTs). SC/28/NPR/JP-2021(d) deals only with data and procedure issues. Details of the calculations and result for common minke whales and other species can be found in separate documents. Japan's implementation of the RMP will continue

in the future to be based on the best available science; hence catch limits will be revised from time to time to reflect the latest scientific information.