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# EXPERIENCE-BUILDING PHASE FOR THE REDUCTION OF UNDERWATER RADIATED NOISE FROM SHIPPING

## Spatio-temporal information on Arctic whale migration routes for consideration in voyage planning and other measures to reduce the impacts of underwater radiated noise on marine life

**Submitted by WWF**


**SUMMARY**

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| *Executive summary:* | This document provides new spatio-temporal information on Arctic whale migratory routes to support the uptake of measures as per section 6 of the *Revised guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine life.* |
| *Strategic direction, if applicable:* | 1 |
| *Output:* | 1.16 |
| *Action to be taken:* | Paragraph 24 |
| *Related documents:* | MEPC.1/Circ.906/Rev.1, MEPC.1/Circ.907, MEPC 82/17/Add.1 MEPC 80/17, MEPC 83/INF.31. |


1 At its eightieth session, the Marine Environment Protection Committee (MEPC) approved the *Revised guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine life* (MEPC.1/Circ.906, Revised Guidelines) and disseminated the *Guidelines for underwater radiated noise reduction in Inuit Nunaat and the Arctic* (MEPC.1/Circ.907) for utilisation by interested parties. The Committee also encouraged Member States and international organisations to submit lessons learned and best practices on implementation of the Revised Guidelines by MEPC 85 (MEPC 80/17, paragraph 10.4) and in support of the Action Plan for the Reduction of Underwater Noise from Commercial Shipping (further: Action Plan) (MEPC 82/17/Add.1).

2 Section 6 of the Revised Guidelines includes approaches for reducing underwater radiated noise from ships, including operational measures on routeing, speed and sail time in important habitats of noise-sensitive species. It includes recommendations to "[review] information on national and international designated protected areas" and to consider "routeing measures to avoid national and international designated protected areas including well-known habitats or migratory pathways" (pp.8-9).

3 Specific to polar waters, Chapter 11 of the Polar Code states that the shipmaster shall consider a route through polar waters that takes into account, inter alia "current information and measures to be taken when marine mammals are encountered relating to known areas with densities of marine mammals, including seasonal migration areas; and current information on relevant ships' routing systems, speed recommendations and vessel traffic services relating to known areas with densities of marine mammals, including seasonal migration areas" (paragraph 11.3).

4 To advance implementation of the Revised guidelines and facilitate the adoption of shipping measures, spatio-temporal information on important habitats needs to be made available to shipmasters and operators (see also Action Plan, task G). This document provides information in the form of maps of migratory corridors for three species of whales found only in the Arctic and known to be sensitive to underwater radiated noise.

**Background**

5 A healthy Arctic Ocean is vital for nature and for Arctic Indigenous Peoples, many of whom rely on the ocean and marine mammals for food security, culture and livelihoods.

6 The Arctic region is experiencing a substantial rise in shipping. Between 2013 and 2023, the number of vessels operating in the Arctic, as defined by the International Code for Ships Operating in Polar Waters (Polar Code), increased by 37 percent, and the total distance sailed more than doubled[1]. More ship traffic is resulting in a rapid increase in underwater noise emissions in the Arctic Ocean[2].

7 A recent report (*Underwater Noise in the Arctic: Understanding impacts and defining management solutions, phase* II) by the Protection of the Arctic Marine Environment (PAME) working group of the Arctic Council explored current and future shipping and associated underwater noise across the Arctic Ocean[3] (further: 2025 PAME underwater noise report). The findings of this study were submitted to MEPC 83 (MEPC 83/INF.31).

8 Under a business-as-usual scenario, increased ship traffic and diminished sea-ice extent and thickness are projected to lead to higher levels of underwater radiated noise across the Arctic Ocean, including in high seas areas. On average, underwater radiated noise levels are predicted to be 5 decibels (dB) higher in 2030 than in 2019[3]. An increase of 3 dB corresponds to a doubling of sound pressure, meaning that, on average, the sound pressure level in the pan-Arctic would nearly quadruple by 2030.

[1] Protection of the Arctic Marine Environment (PAME) – Arctic Shipping Status Report #1.
[2] Jalkanen, J.P., Johansson, L., Andersson, M.H., Majamäki, E. and Sigray, P., 2022. "Underwater noise emissions from ships during 2014–2020". Environmental Pollution, 311, p.119766
[3] PAME. (2025). Underwater Noise in the Arctic: Understanding Impacts and Defining Management Solutions.

9 A growing body of research demonstrates the sensitivity and potential impacts of shipping and underwater radiated noise for Arctic whales. Narwhals and beluga whales display extreme sensitivity to ship noise from long distances and at volumes below ambient sound levels[4,5]. Effects of shipping on narwhals include reduced feeding and elevated physiological and hormonal stress levels[6,7]. Bowhead whales are at high risk of being struck by ships, causing death or severe injuries[8]. Population-level impacts on Arctic whales are likely if shipping is not carefully managed in their habitats[9].

10 There is a need for ship masters, ship operators and Member States–including Arctic Ocean coastal States–to implement measures to reduce underwater radiated noise from shipping in important habitats of Arctic marine mammals, including whales.

**Migratory (blue) corridors of Arctic whales**

11 Important habitats for Arctic marine mammals include seasonal migratory routes, or so-called "blue corridors", of whales. Three species of whale live year-round in the Arctic Ocean: narwhals *(Monodon monoceros*)*,* beluga whales (*Delphinapterus leucas*) and bowhead whales (*Balaena mysticetus)*. In addition, thousands of whales from more temperate and tropical regions spend summer in the Arctic Ocean, making the Arctic region a life support system for one quarter of the world's whale species.

12 Every spring and autumn, 21 populations of Arctic whales migrate between winter and summer habitats. These migrations are vital for survival, ensuring the whales have year-round access to prey, safety from predators, and safe places to raise young.

13 In 2024, the WWF Global Arctic Programme created a geo-spatial database and associated maps of the locations of these corridors across the entire Arctic Ocean, based on publicly available scientific and expert information from peer-reviewed scientific papers, white papers, agency reports and other grey literature[10] (Fig. 1).

[4] Tervo, O.M., Blackwell, S.B., Ditlevsen, S., Garde, E., Hansen, R.G., Samson, A.L., Conrad, A.S. and Heide-Jørgensen, M.P., 2023. Stuck in a corner: Anthropogenic noise threatens narwhals in their once pristine Arctic habitat. *Science Advances*, *9*(30), p.eade0440.

[5] Martin, M.J., Halliday, W.D., Storrie, L., Citta, J.J., Dawson, J., Hussey, N.E., Juanes, F., Loseto, L.L., MacPhee, S.A., Moore, L. and Nicoll, A., 2023. Exposure and behavioral responses of tagged beluga whales (Delphinapterus leucas) to ships in the Pacific Arctic. *Marine Mammal Science*, *39*(2), pp.387-421.

[6] Williams, T.M., Blackwell, S.B., Tervo, O., Garde, E., Sinding, M.H.S., Richter, B. and Heide-Jørgensen, M.P., 2022. Physiological responses of narwhals to anthropogenic noise: A case study with seismic airguns and vessel traffic in the Arctic. *Functional Ecology*, *36*(9), pp.2251-2266.

[7] Watt, C.A., Simonee, J., L'Herault, V., Zhou, R., Ferguson, S.H., Marcoux, M. and Black, S., 2021. Cortisol levels in narwhal (Monodon monoceros) blubber from 2000 to 2019. *Arctic Science*, *7*(3), pp.690-698.

[8] Wang, B., Zhao, L., Lu, T., Li, L., Li, T., Cong, B. and Liu, S., 2025. Global Hotspots of Whale–Ship Collision Risk: A Multi-Species Framework Integrating Critical Habitat Zonation and Shipping Pressure for Conservation Prioritization. *Animals*, *15*(14), p.2144.

[9] Tervo, O.M., Blackwell, S.B., Ditlevsen, S., Conrad, A.S., Samson, A.L., Garde, E., Hansen, R.G. and Mads Peter, H.J., 2021. Narwhals react to ship noise and airgun pulses embedded in background noise. *Biology Letters*, *17*(11), p.20210220.

[10] https://www.arcticwwf.org/newsroom/reports/online-report-methodology-arctic-blue-corridors/

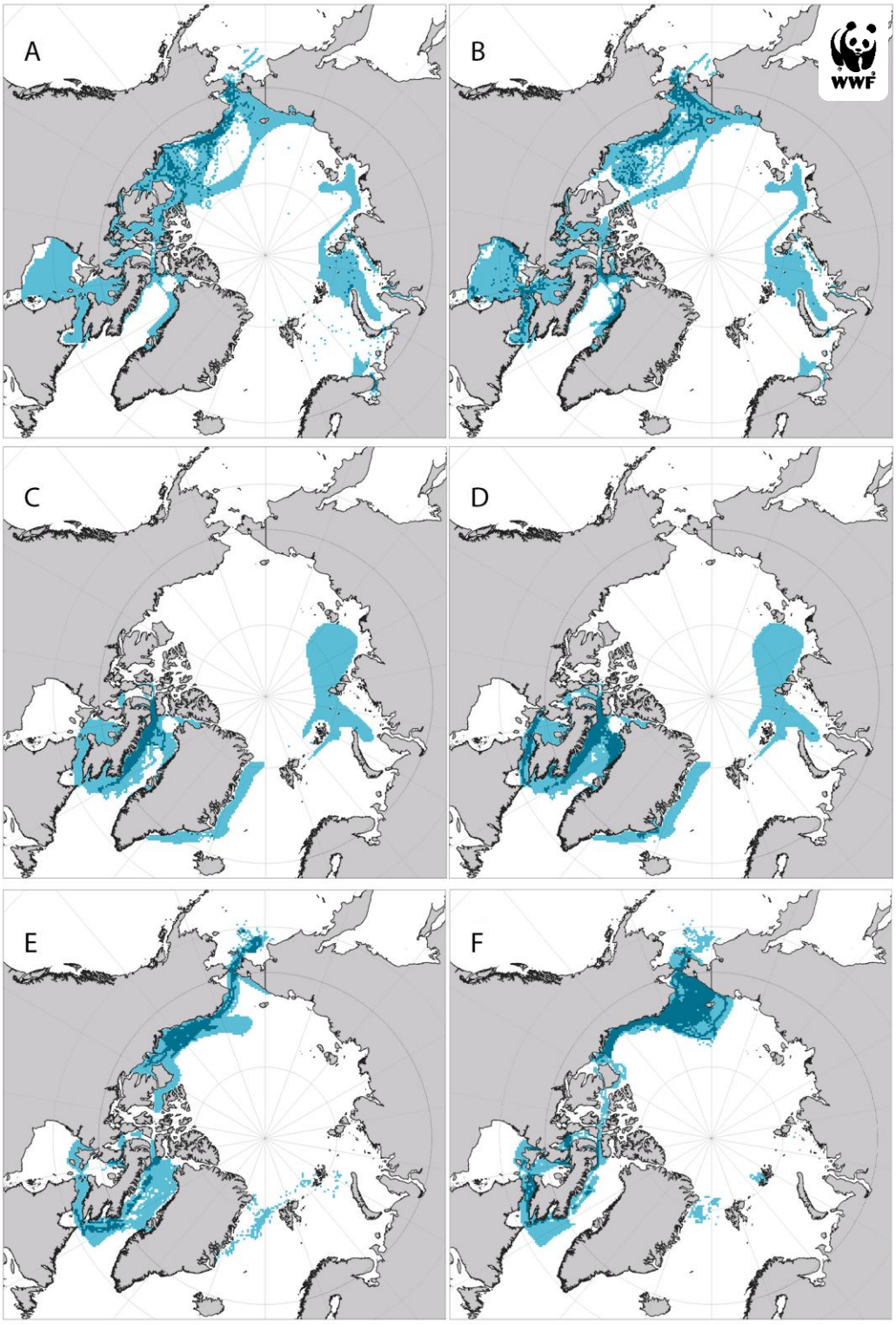


Figure 1. Migratory corridors for three Arctic whale species: beluga whale (A = spring, B = autumn), narwhal (C = spring, D = autumn) and bowhead whale (E = spring, F = autumn). White colour; no knowledge of migratory corridor or not within species' known geographical distribution, light blue; at least one source of evidence for presence of migratory corridor, dark blue; multiple sources of evidence for presence of migratory corridor.

**Migratory corridors and ship traffic**

14 WWF overlaid ship traffic information with migratory corridors to determine the presence of ships and assess possible interactions with migrating whales (Fig. 3). WWF also identified narrow passages, known as migration bottlenecks, that are used by both ships and whales, resulting in a heightened risk of collisions and exposure of whales to underwater radiated noise (Fig. 4).

15 The ship classes present in two migration bottlenecks with high concentrations of migrating whales – the Bering Strait (Russia/USA) and Hudson Strait (Canada) – during the autumn migration period were dominated by vessels carrying general, dry bulk, or liquid bulk cargo, as well as towing/pushing tugs under 2,000 GT (Fig. 2).

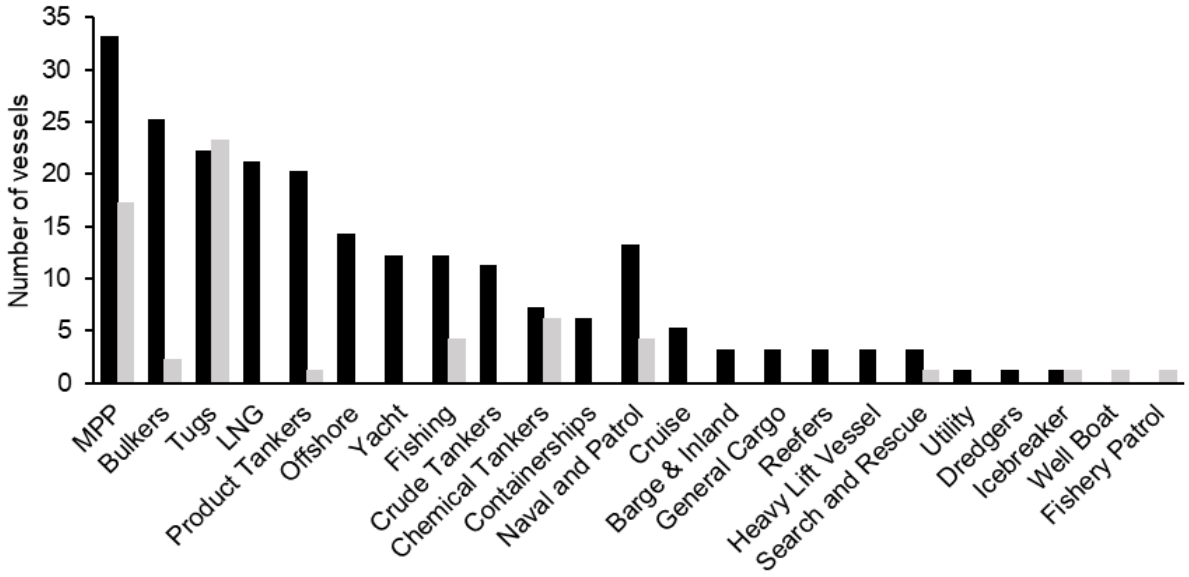


Figure 2. Ship classes present in two migration bottlenecks (Bering Strait, black, Hudson Strait, grey) during the autumn migration period for Arctic whales.

16 The majority of vessels (approximately 75%) operating within both bottlenecks during the autumn migration period travelled at speeds exceeding 10 knots. A notable proportion also operated at speeds above 15 knots: 34 vessels (15% of all ships) in the Bering Strait and 25 vessels (40% of all ships) in Hudson Strait, according to Global Fishing Watch. Of the 34 high-speed vessels in the Bering Strait, 14 were LNG carriers, whereas in Hudson Strait, 12 of the 25 vessels travelling at 15 knots or more were multipurpose product (MPP) cargo.

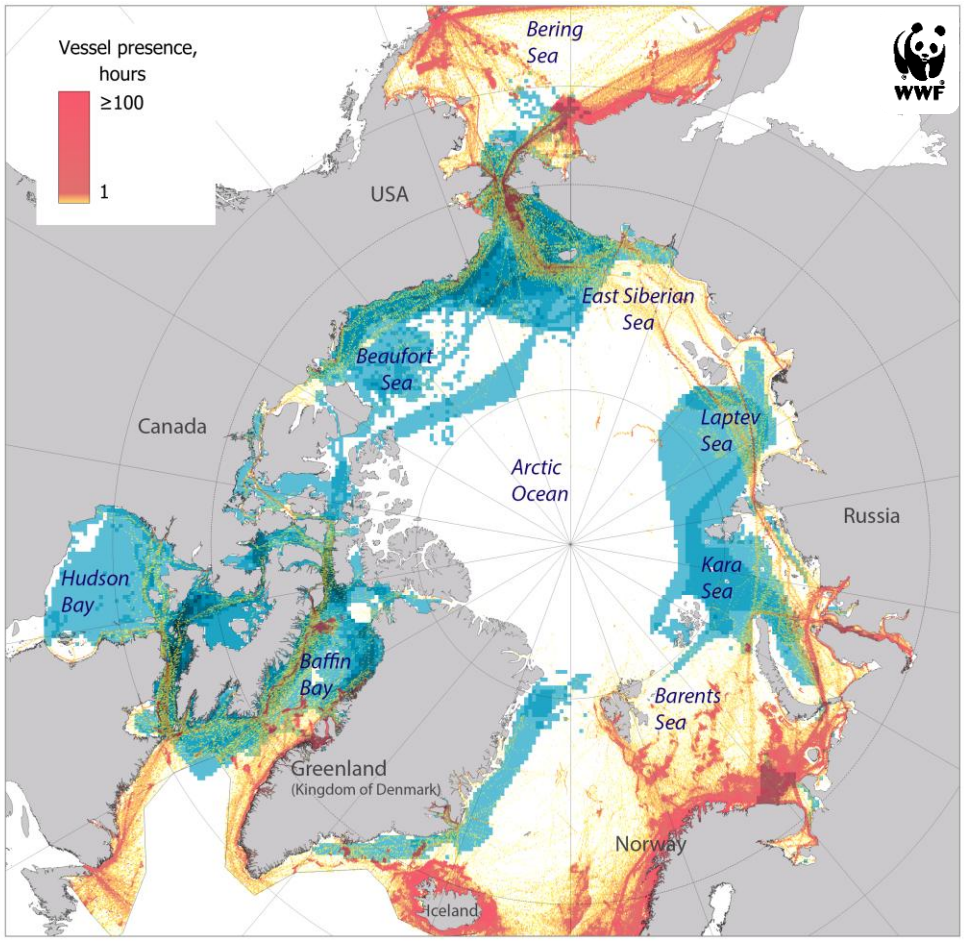


Figure 3. Shipping activity in Arctic whale migratory corridors during the autumn migration period. Corridors for all three Arctic whale species are depicted in blue. Ship traffic is shown as a heatmap of vessel presence, derived from AIS positions transmitted by ships operating within the Arctic Large Marine Ecosystems (LMEs)[11]. The dataset includes all vessel types for the period September–November 2024, as provided by Global Fishing Watch. Darker tones indicate longer cumulative vessel presence per 0.1° pixel: dark brown represents more than 100 hours, while yellow corresponds to about one hour.

[11] https://oaarchive.arctic-council.org/server/api/core/bitstreams/ee735351-a39d-40b9-8b9d-620ed8519ede/content

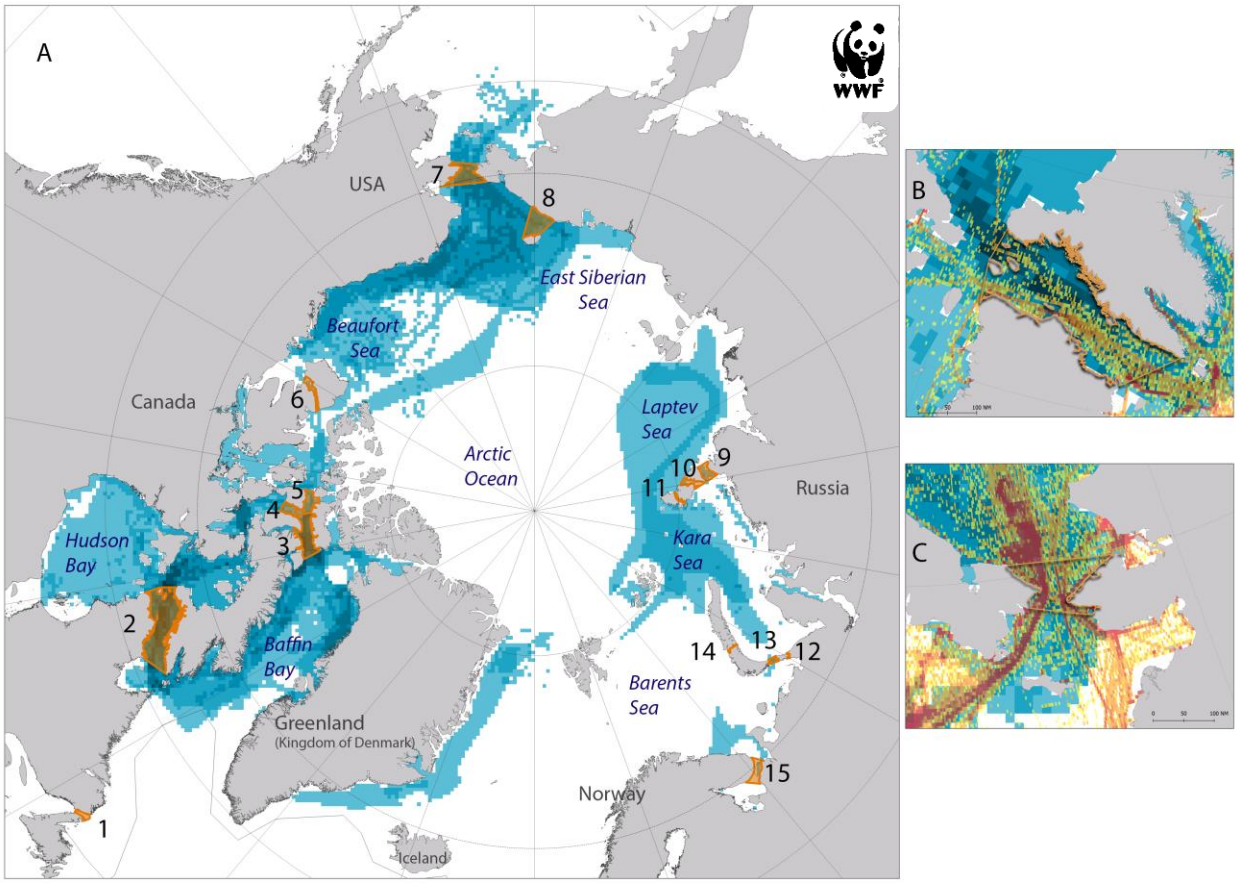


Figure 4. (A) Autumn migratory corridors for all three Arctic whale species (blue) and migration bottlenecks (orange, numbered) across the Arctic Ocean. Migration bottlenecks are situated in the maritime zones of Canada (1: Strait of Belle Isle, 2: Hudson Strait, 3: Lancaster Sound, 4: Prince Regent Inlet, 5: Barrow Strait, 6: Prince of Wales Strait), the maritime zones of Russia (7: Bering Strait, 8: Long Strait, 9: Vilkitsky Strait; 10: Shokalsky Strait, 11: Red Army Strait, 12: Yugorsky Strait, 13: Kara Strait, 14: Matochkin Strait, 15: Gorlo (White Sea Throat), and the maritime zones of the United States (7: Bering Strait). The overlap of ship traffic with migratory corridors is depicted in the migration bottlenecks of (B) Hudson Strait and (C) the Bering Strait during Autumn 2024.

## Measures to consider in migratory corridors

17 Several measures can help reduce or mitigate the effects of underwater radiated noise in the Arctic Ocean. The potential effectiveness of measures such as ship speed reduction, routeing adjustments, and ship-based noise reduction technologies was modelled in the 2025 PAME Underwater Noise Report, with findings and associated guidance presented in MEPC 83/INF.31.

18 Two operational measures that could be taken by shipmasters and operators are: (1) routeing ships away from migratory corridors, or, if rerouteing is not possible, (2) reducing speed to 10 knots or less. The speed of 10 knots is below which propeller cavitation–the main source of underwater noise–occurs for many ships[12], and at which the risk of fatal collisions between ships

[12] Leaper, R.C. and Renilson, M.R., 2012. A review of practical methods for reducing underwater noise pollution from large commercial vessels. *International Journal of Maritime Engineering*, *154*(A2).

and large whales is significantly reduced[13]. These measures need only be applied during times of the year when migratory corridors are active, typically for two to three months in spring and autumn.

19 Place-based and regulatory measures adopted by Member States in migratory corridors can inform voyage planning and help create a "level playing field" for ship operators. The following paragraphs outline potential approaches for national and international consideration to mitigate noise impacts and enhance Arctic whale conservation.

20 Member States should consider adopting shipping measures in the Arctic that build on the practice within IMO to safeguard whales from the adverse impacts of shipping, such as: the mandatory Ship Reporting System (SRS) and the recommendatory seasonal Area To Be Avoided (ATBA) for North Atlantic right whales along the United States east coast;[14] and the recommendatory speed restriction adopted as an Associated Protective Measure (APM) for whales in the North-Western Mediterranean Sea Particularly Sensitive Sea Area (PSSA).[15] Consideration should also be given to integrating dynamic management features into such measures, building on existing State practice[16].

21 Member States should consider developing IMO proposals for such measures. Arctic coastal States are particularly well-positioned to take the lead in developing such proposals, working collaboratively with other Member States, Arctic Indigenous Peoples, industry associations, and other intergovernmental and non-governmental organisations.

22 Arctic coastal States should also consider implementing similar measures within their marine internal waters and territorial seas, and to seek endorsement or approval of such measures by IMO where desirable or appropriate.

23 In considering and developing measures, WWF invites Member States, shipmasters and operators to make use of the spatio-temporal information on migratory corridors of Arctic whales provided here. Further, dialogue is encouraged on ways to incorporate this and other spatial information on important areas for noise-sensitive species into voyage planning tools, using formats that can be updated with new and additional knowledge sources, including Indigenous Knowledge.

**Action requested of the Sub-Committee**

24 The Sub-Committee is invited to note the information provided in this document.

[13] Vanderlaan, A.S. and Taggart, C.T., 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. *Marine mammal science*, *23*(1), pp.144-156.
[14] Res. MSC.85(70), 7 December 1998; MSC 85/26, 19 December 2008; NAV 54/25, 14 August 2008.
[15] Res. MEPC.380(80), 7 July 2023.
[16] E.g. the 'dynamic shipping zones' in the Gulf of St. Lawrence – which are Canadian marine internal waters – in which mandatory temporary speed restrictions can be activated in case of the detection of North Atlantic right whales.