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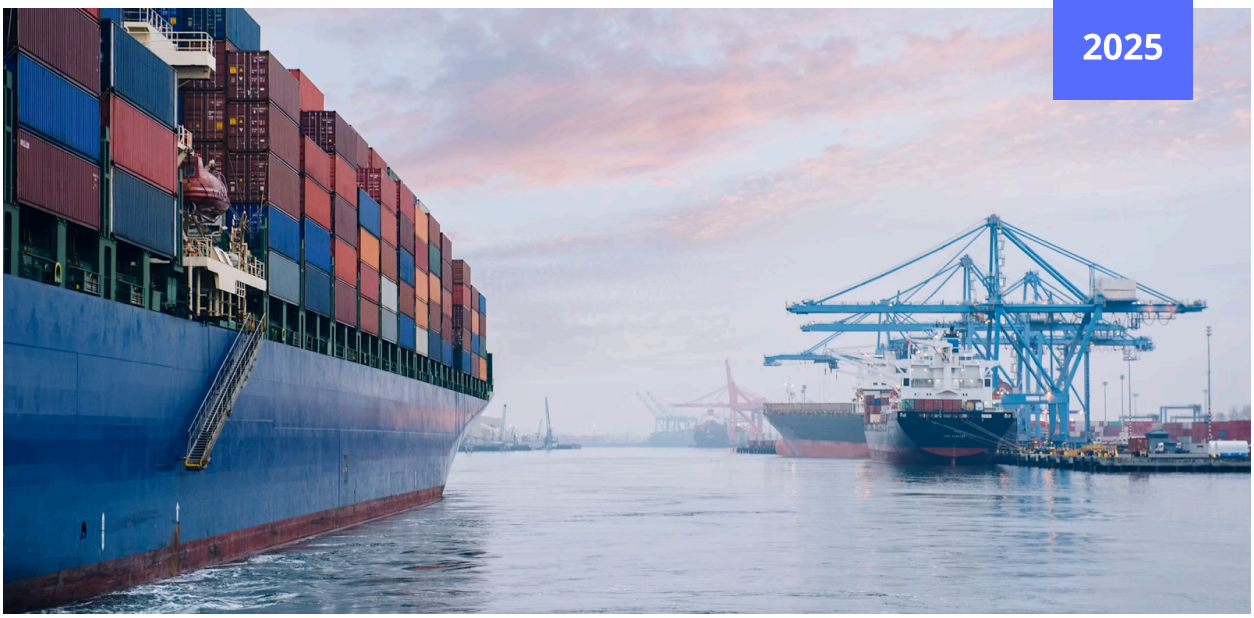

SETTING AND ATTAINING QUIETING OBJECTIVES FOR UNDERWATER RADIATED NOISE (URN) FROM VESSELS

GLOBAL ALLIANCE FOR MANAGING OCEAN NOISE (GAMeON)

Juliette A. Lee; Molly Reeve; Brandon L. Southall; Douglas P. Nowacek.; Michael Jasny; Regan Nelson; Leila Hatch

A REPORT ABOUT QUIETING WORKSHOP THREE

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Global Alliance for Managing Ocean Noise
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CITATION

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List of Abbreviations and Acronyms

BOEM	Bureau of Ocean Energy Management
DEMASK	Development and Evaluation of Noise Management Strategies to Keep the North Sea Healthy
ECHO	Enhancing Cetacean Habitat and Observation Program
EBP	Experience Building Phase
GAMeON	Global Alliance for Managing Ocean Noise
GEF	Global Environment Facility
GloNoise	The Global Partnership for Mitigation of Underwater Noise from Shipping
IMO	International Maritime Organization
JASCO	JASCO Applied Sciences
MEPC	Marine Environmental Protection Committee
NOAA	National Oceanic and Atmospheric Administration
NRDC	Natural Resources Defense Council
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
RWS	Rijkswaterstaat
SDC	Sub-Committee on Ship Design and Construction
SIO	Scripps Institute of Oceanography
UNDP	United Nations Development Programme
URN	Underwater Radiated Noise
UVNRT	Underwater Vessel Noise Reduction Targets

EXECUTIVE SUMMARY

The Global Alliance for Managing Ocean Noise (GAMeON) is an international partnership of action-minded scientists, managers, policy experts, and industry representatives fostering inclusive dialogues to fuel creative, workable solutions that will transform ocean noise management.

On May 20 and 21, 2025, GAMeON hosted a two-day workshop titled "Setting and Attaining Quieting Objectives for Underwater Radiated Noise (URN) from Vessels." This workshop fostered a productive setting for stakeholders to break down barriers and further development of data-informed and technologically advanced solutions. The workshop had two focal topics: (1) assessing current efforts in

support of URN target-setting; and (2) considering how to attain and implement quieting goals. It culminated in a panel discussion to identify and propose opportunities for actionable next steps.

This report provides insights from the workshop. A key focus of the discussions was how to effectively translate successful initiatives from regions with advanced URN management practices to other parts of the world facing similar challenges. Participants in the workshop emphasized the importance of overcoming obstacles to investment in noise management planning, underscoring the need for tailored strategies that bridge gaps between URN reduction techniques, target-setting, and energy efficiency objectives. By leveraging operational and planning tools, affected parties can work collaboratively to establish and achieve URN targets, ensuring that effective practices, which have been identified in some regions, can be adapted and implemented globally to enhance responsible marine resource management and the effective protection of the marine environment.

The report offers recommendations to the International Maritime Organization (IMO), specifically to help inform the IMO's Experience Building Phase for URN reduction, which was established at the 82nd meeting of its Marine Environment Protection Committee. GAMeON proposes four key deliverables to advance underwater noise management: (1) expanding targeted incentive programs to promote industry adoption of quiet design and operational noise reduction strategies; (2) developing a prioritized evidence gap map to guide research and regulatory action; (3) creating a decision-making framework for jurisdictions to set vessel-based acoustic and emissions benchmarks, with emphasis on species-specific and ecologically sensitive targets; and (4) fostering inclusive, multi-sectoral collaboration—particularly with IMO members and observors—to harmonize regulatory standards and embed capacity building across industry, government, and scientific communities.

INTRODUCTION

Multi-sectoral dialogues provide the capacity to address ocean quieting in a way that initiates actionable steps. Multi-sectoral mechanisms are the most effective at reconciling the ecological, governance, and social dimensions of an ocean challenge, in this case ocean quieting (Reimer et. al, 2020). Multi-sectoral management of ocean noise is complicated by the spatial and temporal scales of marine life functions (Schupp et al., 2019). Single sector and multi-sector management frameworks must be used in concert to maintain pace with changing ecological, governance, and social conditions (Schupp et al., 2019). By providing a setting for multi-sectoral dialogues, participants can overcome obstacles to multi-sectoral management by addressing the lack of information and how decisions made in one sector can impact another sector. Multi-sectoral dialogues build connectivity between sectors "in spatial, temporal, provisional, and functional dimensions" (Schupp et al., 2019) to collaboratively solve ocean noise.

GAMeON is developing responsible, modern, integrated, and informed solutions for managing anthropogenic ocean noise with three key actionable goals:

- Scan horizons to proactively identify emerging concerns and solutions;
- Map existing and emerging knowledge on ocean noise, technology, and policy; and
- Create inclusive dialogues and networks to collaboratively solve ocean noise issues globally.

The GAMeON Quieting Workshop Series intends to foster collaborative discussions among key, multi-sectoral attendees. Workshops focus on three key topics around the theme of practical approaches for reducing ocean noise: (1) offshore renewable energy development; (2) seismic exploration; and (3) underwater radiated noise from vessels. The sequential series will culminate with a symposium that will synthesize the current state of science and technology from the three workshops and will develop strategic, actionable next steps.

Background

URN from vessels has emerged as a critical concern, significantly affecting marine environments and the diverse life forms within them. As maritime traffic continues to increase from both shipping and offshore energy development, the noise produced —ranging from engines and propellers to onboard operations—creates complex acoustic environments in the oceans. This anthropogenic underwater noise can interfere with marine animals' communication, navigation, and foraging behaviors, particularly among species such as cetaceans, fish, and invertebrates that rely heavily on sound.

Research has shown that elevated noise levels can lead to stress responses in marine life, disrupt migratory patterns, and impair reproductive success. Furthermore, chronic exposure to high noise levels can result in habitat abandonment by sensitive species, thereby altering ecosystem dynamics.

Recognizing these impacts, researchers, policymakers, and maritime industries are increasingly focused on developing strategies to mitigate URN. This includes establishing guidelines for vessel design, operational practices, and implementing technological innovations to minimize noise emissions.
URN initiatives at the International Maritime Organization (IMO) have evolved significantly over the past two decades, focusing on mitigating the impacts of vessel noise on marine life through systematic target setting and collaboration among member states. Following a pivotal proposal in 2020 from Canada, the US, and Australia, the IMO adopted revised guidelines that took effect on October 1, 2023. These guidelines emphasize a cyclical noise management planning process that involves affected parties at various levels, including shipowners, operators, and maritime authorities, to establish measurable URN reduction targets based on thorough baseline assessments. The initiatives promote sharing best practices and lessons learned during an initial three-year experience-building phase, supported by an action plan to sustain URN discussions until 2026. This ongoing development underscores the IMO's commitment to fostering global cooperation in enhancing vessel energy efficiency and reducing underwater noise, ultimately seeking to protect marine ecosystems while ensuring effective implementation of strategies across diverse regions.

Objectives of the Workshop

- Assess Current Work in Support of Target Setting
    - To compile and evaluate existing initiatives aimed at evaluating targets for underwater radiated noise from vessels. This includes identifying key affected parties involved, reviewing ongoing studies, and understanding current best practices.
- Facilitate Cross-Jurisdictional Dialogue on Implementation Strategies
    - To encourage global collaborative discussion aimed at sharing approaches among underwater radiated noise target setting efforts. This includes sharing insights on regulatory differences, best practices, and challenges, with the goal of leveraging effective noise management strategies across jurisdictions.
- Develop submission for SDC 12 in January 2026
    - Develop an informational submission to the UN International Maritime Organization Sub-Committee on Ship Design and Construction (SDC) subcommittee's 12th meeting in January 2026 or Marine Environmental Protection Committee's (MEPC) 84th meeting in spring 2026 in support of the URN experience building phase (EBP) (on agenda for both meetings). The paper will provide insights from the workshop informing the application of the revised IMO guidelines, which includes steps taken by owner/operators to set objectives for URN reduction in vessel noise management plans, and the IMO's URN Action Plan action to "Share lessons learned through implementation of URN goal setting exercises".

Workshop Overview

A group of subject matter experts were selected based on a criteria of having equal representation across sectors: governmental or international organization, private / for-profit organization, non-governmental organization / not-for-profit organization, and academia / research (Table 1) with an expertise in URN. Recruiting experts across these different sectors to be informants was not even, thus there is an uneven number of participants for the sessions across sectors, as shown in Table 1. Having additional representation across different levels of organization (e.g. between and among individuals, groups, nation states, etc.) and operating at multiple spatial scales was important to gain a holistic understanding. Thus, participants were recruited from a global network of experts.

Table 1. Affected parties with subject matter expertise were invited to represent their sectors during the workshop's panel discussion. (Source: GAMeON, 2025)

Public / Governmental Organization / International Organization	Private / For Profit Organization	Not-for-Profit Organization	Academia / Research
Chilean Navy	Bureau Veritas	Maritime Blue	Duke University Marine Laboratory
European Maritime Safety Agency	International Chamber of Shipping	Natural Resources Defense Council (NRDC)	Scripps Institute of Oceanography (SIO)
International Maritime Organization (IMO)	JASCO Applied Sciences		Southall Environmental Associates
National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce	Noise Control Engineering, LLC		University of Southampton
Rijkswaterstaat (RWS) WVL, the Netherlands			
Transport Canada			
Bureau of Ocean Energy Management (BOEM), U.S. Department of the Interior			
Vancouver Fraser Port Authority			

Workshop Agenda

<u>Day 1 - May 20, 2025</u>
Opening Remarks

10:00-10:15 EST Welcome Remarks & Introduce GAMeON

Doug Nowacek, Duke University

Keynote Presentation

10:15-10:35 EST	Navigating the Future Together: Sharing Experiences with Setting and Attaining Quieting Objectives for Underwater Radiated Noise from Vessels *Leila Hatch, NOAA Office of National Marine Sanctuaries* *Brandon Southall, Southall Environmental Associates*

Session 1: Current Efforts Support Goal Setting

10:35-10:40 EST	Introduction of Panel 1 *Juliette Lee, Bureau of Ocean Energy Management*
10:40-11:50 EST	Quiet and Clean: Synergising Energy Efficiency and Underwater Radiated Noise Reduction in Shipping *Seyedvahid Vakili, University of Southampton*
10:50-11:00 EST	Data-Driven Solutions to Guide URN Reduction and Target Setting *Vanessa Zobell, Scripps Institution of Oceanography*
11:05-11:15 EST	Developing Systematic Approaches for Characterizing and Rating Ship Underwater Radiated Noise *David Hannay, JASCO*
11:15-11:25 EST	Quiet Sound: A collaborative, non-regulatory program to reduce the impacts to Southern Resident Killer Whales from large commercial vessels *Rachel Aronson, Maritime Blue*
11:30-11:40 EST	Advancing the development of Regional Noise Targets/ Management Approaches for Shipping Sector - An overview of work completed by ECHO Program Task Force, Southern British Columbia, Canada *Orla Robinson, Vancouver Fraser Port Authority*
11:40-11:50 EST	Support to shipowners' engagement towards URN related actions *Eric Baudin, Bureau Veritas*
11:50-12:15 EST	Questions and Answers *Juliette Lee, Bureau of Ocean Energy Management*

Session 2: Considerations for Attaining & Implementing Goals

12:30-12:35 EST	Introduction of Panel 2 *Molly Reeve, Bureau of Ocean Energy Management*

12:35-12:45 EST	Silent Running - Operationalizing Policies on Underwater Vessel Radiated Noise Management *Aurélie Cosandey-Godin, Transport Canada*
12:45-12:55 EST	OSPAR and the DEMASK Project *Niels Kinneging, RWS WVL, The Netherlands*
13:00-13:10 EST	A pragmatic approach to global URN reduction *Chris Waddington, International Chamber of Shipping*
13:10-13:20 EST	Quiet Vessel Design: Background and Processes *Jesse Spence, Noise Control Engineering, LLC*
13:20-13:30 EST	GloNoise Partnership Project *Sevtap Özdoğan, GloNoise, IMO, United Nations*
13:30-13:50 EST	Questions and Answers *Molly Reeve, Bureau of Ocean Energy Management*
13:50-14:00 EST	Transitional Remarks and Set up for Day 2 *Doug Nowacek, Duke University*

Day 2 - May 21, 2025
Session 3: Panel Discussion

11:00-11:15 EST	Recap of Day 1 & Introduction of Panel *Michael Jasny, NRDC*
11:15-12:40 EST	Panel Session *Regan Nelson, NRDC* *Michelle Sanders, Permanent Representative to the IMO from Canada* *Captain Lieutenant Commander Manuel Fuenzalida Lopez, Chilean Navy* *Ricardo Batista, IMO Secretariat* *Samy Djavidnia, European Maritime Safety Agency*

Closing Remarks and Next Steps

12:40-13:00 EST	Summary of key takeaways from the workshop including a discussion of future actions, collaborations, and potential follow-up workshops *Brandon Southall, Southall Environmental Associates* *Doug Nowacek, Duke University*

WORKSHOP SESSION I

Session 1, titled *Assessing Current Efforts in Support of URN Target Setting,* contained presentations by six leading underwater noise experts and was followed by a Q&A and discussions. These presentations provided an overview of the current capacity for URN target setting and recommendations on how the new information can be used in the regulatory context. A brief summary of the presentations is provided below.

Quiet and Clean: Synergising Energy Efficiency and Underwater Radiated Noise Reduction in Shipping
Seyedvahid Vakili, University of Southampton

This presentation explored the synergies between energy efficiency improvement and the reduction of URN from commercial vessels. Highlights included the Okeanos Foundation's targets to reduce URN and evaluated how projected trade growth impacts ambient noise levels. Through techno-operational analysis, the presentation identified energy efficiency measures—such as speed reduction, wind-assisted propulsion, and electrification—as co-beneficial solutions for both decarbonization and URN mitigation. The role of ports and regulatory frameworks were also discussed as critical in supporting these integrated strategies.

Data-Driven Solutions to Guide URN Reduction and Target Setting
Vanessa Zobell, Scripps Institution of Oceanography

The presentation from Scripps Institution of Oceanography (SIO) included an overview of the URN databases from around the United States in addition to current target setting analyses. The Scripps Machine Listening Lab at SIO has compiled tens of thousands of vessels underwater radiated noise (URN) measurements from Southern California and the Gulf of Mexico, making up the largest database of vessel URN signatures in United States waters. This data is used to provide analyses for the vessel speed reduction program, Protecting Blue Whales and Blue Skies program, in California, which saw a 4 decibel reduction in participating vessels. In addition, a URN model was created for source level prediction based on vessel types and operations in the Gulf of Mexico. Additionally, SIO is exploring URN thresholds for different size classes of vessels, by computing a variety of URN percentiles, with the 10th percentile of the URN measurements as the proposed target for noise reduction. SIO is continuing to collect URN measurements from the busiest shipping regions in the world to gather more ship types and operations to be used in vessel URN threshold identification. These data will be used to refine and add to existing models for United States vessels, and verify external models developed at other sites and in different countries.

Developing Systematic Approaches for Characterizing and Rating Ship Underwater Radiated Noise
David Hannay, JASCO

The presentation from JASCO Applied Sciences was an overview of the systematic approaches developed over the past decade for characterizing and rating ship URN. Collaborating primarily with the Vancouver Fraser Port Authority's ECHO program and Transport Canada, they have established a robust framework for measuring and modeling ship noise, based on empirical data from approximately 70,000 measurements of vessels transiting across cabled underwater listening stations. Their work has led to the creation of source level models and exposure assessment tools that evaluate the impact of ship noise on marine habitats. Recently, they developed a URN rating system based on frequency-weighted radiated noise levels, aligning measurement approaches across various ship classification societies to ensure comparability. Additionally, the Underwater Vessel Noise Reduction Targets (UVNRT) project initiated by Transport Canada outlines specific noise reduction targets, which are currently being tested in a pilot project with shipping companies. These efforts have resulted in a comprehensive data set that will soon be

released, offering vital insights for mitigating vessel noise and promoting collaboration among maritime parties on feasible quieting strategies for commercial ships.

Quiet Sound: A collaborative, non-regulatory program to reduce the impacts to Southern Resident Killer Whales from large commercial vessels
Rachel Aronson, Maritime Blue

Quiet Sound is a non-regulatory program in Washington aimed at mitigating the impact of large commercial vessels on the endangered Southern Resident Killer Whales. This initiative is a coalition that promotes voluntary measures to alleviate acoustic and physical disturbances in Washington state waters, recognizing that vessel noise may significantly affect the whales' ability to hunt and communicate. To address this, Quiet Sound implements voluntary vessel speed reduction measures in critical habitats, which have proven effective, successfully reducing underwater noise levels by up to 50%. As a result, the program has increased the availability of "quiet time" for the whales, or the time spent in environments with sound levels below 110 dB, enhancing their chances for communication and foraging.

Advancing the development of Regional Noise Targets/ Management Approaches for Shipping Sector - An overview of work completed by ECHO Program Task Force, Southern British Columbia, Canada
Orla Robinson, Vancouver Fraser Port Authority

In 2023, the ECHO Program established a Task Force to advance the development of regional noise targets and management strategies for the shipping sector, bringing together a diverse membership from the marine industry, government, scientific, and environmental non-governmental organization (ENGO) sectors from Canada, the US, and Europe. The Task Group has convened five workshops and meetings to evaluate various target-setting approaches and to review studies that may inform the selection of a reference year and appropriate animal-based metrics. Task Force members expressed a preference for focusing on the establishment of vessel-based noise accumulation targets that hold biological relevance. The Task Group also assessed a range of potential animal-based metrics to evaluate the effect changes to echolocation space, communication space, quiet time and broadband noise may have on the endangered Southern Resident Killer Whales. Looking ahead, potential next steps include selecting a reference year and defining roles and responsibilities for progressing the biologically relevant vessel-based noise accumulation target-setting approach.

Support to Shipowners' Engagement towards URN related Actions
Eric Baudin, Bureau Veritas Marine & Offshore

Bureau Veritas (BV) emphasized the broader regulatory landscape surrounding URN and outlined the key steps from the recent IMO guidelines that are recommended for shipowners. Acknowledging the challenges posed by non-mandatory frameworks at various levels, from the United Nations to classification societies, BV introduced two innovative products designed to incentivize shipowners in addressing URN comprehensively and managing it step-by-step within a dedicated framework. The Noise Ship Index serves as a critical tool for assessing and rating noise performance, while SmartURN simplifies and cuts-down drastically the cost of one of the primary steps—baselining a vessel's noise emissions. Together, these tools offer shipowners valuable scoring, ratings, and actionable insights, empowering them to quantify and enhance their noise performance and meet environmental targets effectively.

Q&A and Discussions

The presentations were followed by Q&A and discussions.

During the Q&A session, participants discussed the impacts of economic downturns on collaboration across sectors in the context of reducing vessel noise and its effects on marine life. Maritime Blue highlighted the benefits of multi-sectoral collaboration, emphasizing that creating a space for various subject matter experts to communicate has helped bridge silos and foster consensus around the need to reduce vessel impacts on Southern Resident Killer Whales. JASCO confirmed that an anonymized data set from the ECHO Program is available for research purposes, emphasizing the importance of maintaining ship confidentiality while fostering international collaboration. Several participants shared insights on incentivizing vessel operators to participate in voluntary noise reduction programs. For instance, Vancouver Fraser Port Authority noted that financial incentives, such as reimbursements for additional pilotage costs, significantly increased participation rates. Scripps Institute of Oceanography mentioned that the Blue Whales Blue Skies Program has shifted from financial incentives to public recognition, effectively maintaining engagement from shipping companies without monetary rewards. Lastly, an expert emphasized that the methodologies for implementing these initiatives are applicable globally, making them relevant for developing countries as well. The session concluded with an invitation for attendees to reach out to presenters for further data requests and discussions in future sessions.

WORKSHOP SESSION II

Session 2, titled *Considerations for Attaining and Implementing Goals,* contained presentations by five leading underwater noise experts and was followed by a Q&A and discussions. These presentations provided an overview of URN-related efforts that are currently underway globally and recommendations on how these efforts could be translated to other fora. A brief summary of the presentations is provided below.

Silent Running: Operationalizing Policies on Underwater Vessel Radiated Noise Management
Aurélie Cosandey-Godin, Transport Canada

As part of its commitment to marine conservation, Transport Canada is strengthening policies to reduce vessel-related underwater radiated noise (URN), with a focus on mitigating risks to Southern Resident Killer Whales. The presentation outlined a strategic blend of operational actions and long-term technical measures, including the development of ship-type-specific noise reduction targets to guide URN management planning. A key innovation is the use of ranking-based criteria—performance quartiles per vessel class, such as the quietest 25% of ships—supporting flexible implementation and benchmarking. These efforts are guided by extensive data from underwater listening stations and align with the IMO's revised guidelines. As part of a broader Pilot Project, Transport Canada is sharing data and target frameworks to support the IMO's URN Experience-Building Phase, aiming to foster quieter seas through scalable, evidence-based solutions.

OSPAR and the DEMASK Project
Niels Kinneging, RWS WVL, The Netherlands

The European Union, The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and the Development and Evaluation of Noise Management Strategies to Keep the North Sea Healthy (DEMASK) project strive to develop effective policies to reduce underwater noise. The EU has adopted threefold threshold values (considering noise level, together with spatial and temporal aspects). OSPAR has adopted a Regional Action Plan on Noise, that defines its ambitions to reduce noise in the next decade. Finally, the DEMASK project develops policy options for effective management of the underwater soundscape.

A Pragmatic Approach to Global URN Reduction
Chris Waddington, International Chamber of Shipping

The presentation from International Chamber of Shipping (ICS), discussed the opportunities for leveraging decarbonization efforts to achieve reductions in URN. The provided overview of global ambient URN levels emphasized the strong synergies between fuel efficiency measures and URN reduction. A referenced graph from a peer-reviewed study, Ross 1993, plotting ambient URN levels within the oceans against year, broadly reflects a general three-decibel per decade increase in ambient URN levels, yet recent analyses indicate that some regions are experiencing static or declining levels. The Okeanos Foundation's proposed global targets for URN reduction were also introduced, aiming to decrease shipping contributions to ambient noise in the 10 to 300 Hertz band. Notably, it was explained that approximately two-thirds of energy efficiency measures can simultaneously reduce URN, underscoring that energy efficiency efforts effectively serve as noise reduction strategies. An example from Maersk illustrated this relationship, where modifications to container ships resulted in significant reductions in low-frequency URN. The presentation concluded with several recommendations to raise industry awareness, improve URN measurement accessibility, and align incentive schemes with noise management plans, all aimed at formalizing a collaborative approach to managing and reducing URN while meeting greenhouse gas regulations. The emphasis was placed on adopting a pragmatic approach to facilitate measurable results and contribute to achieving global URN reduction targets.

Quiet Vessel Design: Background and Processes
Jesse Spence, Noise Control Engineering, LLC

URN from commercial vessels is generally caused by a combination of propeller cavitation and machinery noise. The physical mechanisms responsible for noise generation from cavitation and machinery are well understood. Various design tools exist and are commonly used to design propellers and predict propulsion performance. These same tools can be used to predict cavitation extents, which in turn can be used to predict URN. Similarly, various design tools are available and commonly used to predict URN from machinery and identify appropriate treatments. All of these tools can be implemented during a vessel's design stage to enable quieter vessel designs. However, the use of design tools to reduce URN will only happen if owners include URN as a design requirement. The new SNAME T&R 6-03 provides guidance to owners and others on practical approaches to implementing URN requirements in design specifications, following the IMO's URN Management Plan.

GloNoise Partnership Project
Sevtap Özdoğan, GloNoise, IMO, United Nations

The Global Partnership for Mitigation of Underwater Noise from Shipping (GloNoise Partnership) is a vital initiative led by the IMO in collaboration with the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF). The project, funded by GEF, commenced its implementation phase with the signing of the project document in December 2023 and is set to run for two years. It includes nine beneficiary countries, featuring six Lead Pilot Countries (LPCs): Argentina, Chile, Costa Rica, India, South Africa, and Trinidad and Tobago, alongside three Twinning Partner Countries: Georgia, Madagascar, and Malaysia.

The primary objective of the GloNoise Partnership is to support the implementation of revised IMO guidelines aimed at reducing underwater noise from commercial shipping, thereby mitigating its adverse impacts on marine ecosystems. This initiative will help developing countries enhance their capacity to comply with these guidelines, generate data to inform the IMO's policy discussions, and develop an online toolkit aimed at improving compliance with international regulations, as well as extensive outreach efforts that have engaged nearly 1,000 stakeholders across more than 50 countries.

The GloNoise Partnership aligns with global efforts to achieve the Sustainable Development Goals (SDGs), particularly SDG 14 (Life Below Water), as well as SDG 5 (Gender Equality), SDG 13 (Climate Action), and SDG 17 (Partnerships for the Goals). The initiative seeks to establish a global industry alliance to enhance collaboration between scientific communities, policymakers, and industry representatives. The need for effective communication of scientific findings and regulatory frameworks to support developing countries in implementing noise management measures was particularly highlighted. Looking ahead, the timeline for the toolkit's rollout is set for late 2025, with ongoing engagement and capacity development activities planned in pilot countries. This presentation underscored the project's commitment to fostering collaboration and increasing awareness of underwater noise impacts on marine environments.

Q&A and Discussions

The presentations were followed by Q&A and discussions. During the Q&A session, participants discussed strategies for incentivizing ship owners and operators to adopt updated design standards aimed at reducing underwater noise. Noise Control Engineering emphasized that challenges related to operational feasibility, costs, and the absence of specific underwater noise targets hinder realistic implementation of these standards. Noise Control Engineering also noted that incentives are preferred over regulations and that awareness-raising among ship owners is essential to spur demand for these design changes. RWS WVL echoed the need for awareness, highlighting that if ship owners are uninformed about noise reduction possibilities, it won't be prioritized in vessel design. The International Chamber of Shipping pointed out that misconceptions about the difficulty and costs of integrating noise reduction with energy efficiency measures contribute to resistance; clearer communication of the benefits, alongside established noise management plans, could alleviate these concerns.

Transport Canada addressed the challenges of establishing credible underwater noise targets, noting the ongoing efforts to analyze the variations in noise signatures of similar vessels as a foundation for informed discussions on design improvements. Participants also explored the interplay between improving energy efficiency and reducing underwater noise, stressing the importance of incorporating explicit noise reduction goals into vessel specifications. The discussion highlighted that a comprehensive approach is needed, balancing economic factors with environmental sustainability.

Members of the GAMeON Sounding Board (the Board) concluded the session, reiterating the value of multi-sectoral collaboration and innovative strategies, such as the "just in time" operational model (de Jong et al. 2020), which could simultaneously enhance efficiency and reduce underwater noise. The session underscored the importance of fostering partnerships and continuing dialogue to advance solutions for mitigating underwater noise from shipping, setting the stage for a productive follow-up panel discussion.

WORKSHOP SESSION III

Panel Discussion

Regan Nelson, Natural Resource Defense Council (moderator); Samy Djavidnia, European Maritime Safety Agency; Manuel Fuenzalida, Chilean Navy; Ricardo Batista, IMO Secretariat; Michelle Sanders, Transport Canada

The panel discussion, facilitated by the Natural Resource Defense Council, focused on the complexities surrounding underwater noise reduction targets in maritime contexts, building on the previous presentations. Panelists highlighted significant achievements and ongoing challenges in standardizing and

implementing effective policies to mitigate shipping noise, promoting clarity for policymakers and practitioners alike.

The European Maritime Safety Agency (EMSA) emphasized the Marine Strategy Framework Directive's requirements for EU Member States, highlighting the need to keep continuous (shipping) noise below the Level of Onset of Biological Effects (LOBE) to prevent harm to marine ecosystems. EMSA outlined the NAVISON project, which provides EU-wide harmonized data and includes a foresight module exploring future scenarios, providing Member States consistent evidence to plan and assess measures for achieving their goals (EMSA, 2025). Transport Canada discussed Canada's multifaceted approach to underwater noise management, particularly through the development of noise management plans that could serve as models for the international community. Transport Canada stressed integrating domestic initiatives into global discussions at the IMO.

The representative from the Chilean Navy discussed voluntary guidelines for mitigating underwater radiated noise impacts (from shipping) on biodiversity. He underscored the importance of capacity building in the Global South and highlighted the GloNoise partnership's role in targeting evidence-based strategies. Speed reduction enhances navigational safety and decarbonization, especially in sensitive areas.

The IMO Secretariat highlighted the organization's ongoing work on URN reduction, focusing on the revised URN guidelines from August 2023. The IMO Secretariat noted that the experience-building phase is midway through a three-year timeline, facing challenges in data gathering and knowledge assessment. The panelists discussed the importance of intentional design in shipbuilding to meet URN reduction goals and integrating greenhouse gas mitigation measures.

The conversation also turned to establishing “benchmarks” for URN targets which serves as an appraisal technique to categorize existing measures that achieve noise reductions for individual vessels, while remaining distinct from target-setting approaches. This distinction is crucial for refining strategies aimed at mitigating noise levels, with suggestions for potentially achievable decibel reductions of 5 dB for existing vessels and 10 dB for new builds. Panelists acknowledged the need for a solid baseline for measurements to achieve these benchmarks, considering varying uncertainty introduced by different measurement methods.

The panel discussion concluded by the Board highlighting the significant progress made in addressing underwater noise reduction and the collaborative spirit evident throughout the workshop. The Board expressed gratitude to the participants, emphasizing the importance of diverse geographic and institutional representation, which enriched the dialogue and fostered constructive exchanges of ideas. The discussions underscored the evolution of understanding around noise impact thresholds and the need for integrating benchmarks for effective underwater noise management. Feedback from attendees to refine future efforts was encouraged, emphasizing that the journey toward mitigating underwater noise is a shared responsibility that can benefit from continuous interaction and collaboration. GAMeON aims to build on the momentum created during this workshop, ensuring that the collective knowledge and experiences contribute to meaningful actions and strategies in the maritime sector.

CONCLUSION

Lessons Learned and Key Takeaways

Overall, the presentations indicated a need for collaborative efforts to overcome regional implementation barriers, share best practices, and further integrate underwater noise management into global governance frameworks. Four main themes emerged from the presentations:

1. **Availability of Scientific Data**: There is ample scientific research and data available for establishing noise reduction targets for commercial vessels. However, the selection of targets depends on managerial goals and available resources.
2. **Empirical Vessel-Based Targets**: Data-driven targets are being explored for various commercial ship types. Notably, Canada's empirical approach segmented vessel noise data into quartiles while SIO's approach identified the 10th percentile of vessel size classes per ship type, which helps identify the quietest ships and sets a practical ambition level. Such targets could potentially be adopted internationally, although privacy issues related to individual vessel data may pose challenges.
3. **Biologically-Based Targets**: Some regions, particularly in Europe, are developing noise targets tailored to specific marine species, guided by conservation needs. While these can provide localized management solutions, they are resource-intensive to create and implement compared to vessel-based targets.
4. **Incentive Systems for Implementation**: Various incentive programs have shown some success in fostering industry participation in noise management. While financial incentives can motivate compliance with operational measures, the integration of quiet design practices remains a challenge.

Underwater noise management requires collaboration of governmental and international organizations, private / for-profit organizations, non-governmental organizations / not-for-profit organizations, and academia / research. Technological innovation, research and development, and infrastructure such as ports play a vital role in URN mitigation through policies, incentives, and technological investments.

Technological solutions are available, but demand from industry is still lacking. There is no "one size fits all" solution co-benefitting energy efficiency and URN. To meet the Okeanos targets (reduction of 3 dB vessel-contributed URN in 10 years, 10 dB in 30 years), individual vessels must reduce source levels by up to 11.38 dB by 2050, especially considering projected trade growth. Investment in accompanying technology is needed, such as onshore power supply and onboard monitoring capacity.

More research and development is needed to enhance the animal-based approach. Mixing such approaches with the vessel-based approach can ensure that regional vessel-based noise accumulation targets link to biological references. Nonlinear and region-specific models are essential to predict long-term URN trends, especially considering the varying dynamics of coastal and deep-sea noise propagation. Industry has confirmed their interest in having baselines characterized to lower URN assessment costs.

There is a strong synergy between energy efficiency improvements and reductions in URN, offering dual benefits for climate action and marine biodiversity. GHG emission control and other operational constraints, specifically regarding speed reduction, are carefully considered. Multiple organizations from around the world have compiled large datasets of vessel URN measurements, spanning different ship types, regions, and operations. Compiling these datasets together to form a comprehensive database is necessary. From the compiled URN database, researchers and governments involved with the production of these datasets will be able to compute informed targets for vessel URN and spread the information to other regions without URN measurements. Operational strategies, such as speed reduction, route optimization, and technical measures, such as wind propulsion, energy saving devices, and air lubrication, are crucial for achieving both air emission and URN reduction.

The panel discussion reinforced the significance of collaboration, data sharing, and comprehensive strategies to address the challenges of underwater noise reduction. The panelists expressed a commitment to open knowledge exchange, emphasizing that continuous collaboration among maritime partners is

essential for effective noise management that aligns with broader environmental goals. In this context, regulators should also draw on all knowledge (including predictive modelling and observations) to inform decisions, identifying where further effort is needed and how to balance climate and environmental objectives.

Action Items and Recommendations

Moving forward, the Global Alliance for Managing Ocean Noise (GAMeON) recommends the following concrete and specific deliverables for specific parties, as identified by participants during the workshop:

1. *Expand incentive programs* to encourage industry adoption and realization of noise management targets. Prioritize financial incentives to boost compliance with operational noise reduction measures, while introducing specialized rewards or recognition schemes to promote the integration of quiet design practices. Reference class notations, quintiles from large measurement databases, performance benchmarks ((i.e., 5 decibel for retrofits and 10 decibel for new build reduction increments)) and reductions necessary for achieving global URN over decades as guides for setting objectives and evaluating progress.

2. *Support a global best practices forum* to assist jurisdictions in establishing empirical vessel-based targets, such as quartile segmentation and percentile-based benchmarks that consider species specifics and realize co-benefits for energy efficiency and air emission control. Encourage collaboration across jurisdictions to harmonize methodologies while addressing privacy concerns related to vessel-specific data. Support the creation of biologically-based targets by allocating resources towards understanding the consequences of vessel noise exposure in ecologically sensitive regions .

3. *Catalyze robust multi-sectoral discussions on URN target setting,* including strategic collaboration with member states and observers of the IMO, to harmonize information assets used to inform limits and set objectives while embedding capacity building across relevant sectors and throughout global regions. Prioritize inclusive dialogue that bridges invested communities to ensure scalable, cross-cutting implementation.

Contact Us

Should you have questions or interest in getting involved with GAMeON, reach out to GAMeON Secretariat Juliette Lee at juliette.lee@boem.gov.

REFERENCES

Appendix A: Workshop Participants and Sessions involved in

Name	Affiliation	Session 1	Session 2	Session 3
Rachel Aronson	Washington Maritime Blue	✓		
Richardo Batista	International Maritime Organization			✓

	Secretariat, Marine Safety Committee			
Eric Baudin	Bureau Veritas Marine & Offshore	✓		
Aurelie Cosandey-Godin	Transport Canada		✓	
Samy Djavidnia	European Maritime Safety Agency			✓
Manuel Fuenzalida	Chilean Navy/DIRECTEMAR			✓
David Hannay	JASCO Applied Sciences	✓		
Leila Hatch **	U.S. National Oceanic and Atmospheric Administration			
Michael Jasny *	Natural Resources Defense Council			
Niels Kinneging	RWS WVL, The Netherlands		✓	
Juliette Lee *	U.S. Bureau of Ocean Energy Management	✓		
Regan Nelson *	Natural Resources Defense Council			✓
Douglas Nowacek *	Duke University			
Sevtap Özdoğan	GloNoise, UN IMO		✓	
Molly Reeve	U.S. Bureau of Ocean Energy Management		✓	

Orla Robinson	Vancouver Fraser Port Authority	✓		
Brandon Southall **	Southall Environmental Associates, Inc.			
Jesse Spence	Noise Control Engineering, LLC		✓	
Seyedvahid Vakili	University of Southampton	✓		
Chris Waddington	International Chamber of Shipping		✓	
Vanessa ZoBell	Scripps Institute of Oceanography	✓		

* Denotes moderator, opener, or closer.
** Denotes keynote speaker.

Appendix B: Citations

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