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

Trends in deep ocean ambient sound pressure level from 2003 to 2021

Submitted by ASEF, ICS and BIMCO

SUMMARY

Executive summary:	This document is submitted in support of the experience-building phase (EBP) of *Revised guidelines for the reduction of underwater radiated noise from shipping to address adverse impacts on marine life* (MEPC.1/Circ.906/Rev.1). Reference is made to a recently published study that analyses long-term measurements from hydrophones installed in the deep ocean where, for the period 2003 to 2021, a downward trend is found in low-frequency ambient sound pressure level within four of the six sites studied, i.e. representing a large proportion of the world's oceans. However, it is noted that the installed hydrophones do not cover the North Atlantic and, therefore, the trend for this significant area of shipping activity is not determined by this study. Support for further research into the causes of the observed decline in ambient sound pressure level is suggested, notably by considering carrying out similar studies at regular intervals to confirm actual levels going forward.
Strategic direction, if applicable:	1
Output:	1.16
Action to be taken:	Paragraph 18
Related documents:	MEPC 83/6 and MEPC.1/Circ.906/Rev.1

Introduction

1 The *Revised guidelines for the reduction of underwater radiated noise from shipping to address adverse impacts on marine life* (MEPC.1/Circ.906/Rev.1) (Revised URN Guidelines) took effect on 1 October 2023 and since then, the Revised URN Guidelines have been within an experience-building phase (EBP).

2 During the EBP, on MEPC's request, SDC is collating experience relating to the implementation of the Revised URN Guidelines and other relevant information that may, in due course, influence IMO's policy towards underwater radiated noise (URN) reduction.

3 This document is submitted in support of the EBP and makes reference to a recently published study that analyses long-term measurements from hydrophones installed in the oceans of the world. The findings from the study include the identification of the trends in deep ocean ambient sound pressure level for most sea areas from 2003 to 2021.

Background

4 The link between increasing levels of ambient sound pressure level with the growth in world trade and shipping activity was first attributed to the work of researcher Donald Ross, according to different citations. Ross was active in developing techniques for the quietening of US submarines and was a prolific writer of technical documents on URN, which are often quoted in the current debate.

5 The graph in figure 1, below, is taken from an article by Ross and demonstrates a consistent upward trend for ambient sound pressure level within the world's oceans for the period from 1958 to 1975 of about 0.55 decibels per year.

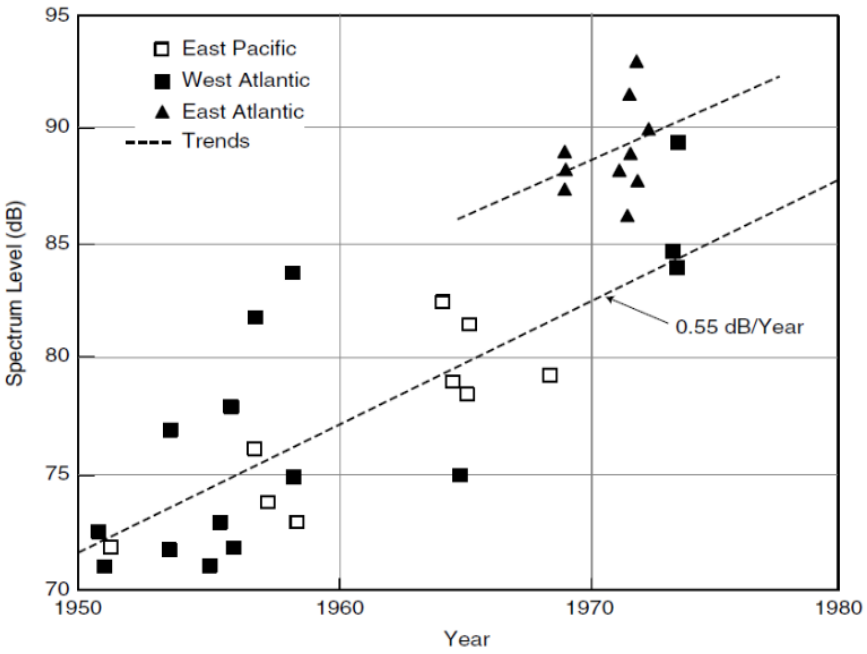

Figure 1: Long-term trend for low-frequency ambient levels for the period 1958 – 1975.
Source: Ross, 1993, courtesy of the Acoustics Bulletin.

6 Other studies for discrete sea areas for the period from 1950 to the end of the last century have also shown a continuation of this upward trend.

7 However, studies for both northern and southern ocean areas, for the early part of the twenty-first century, have shown a flattening of the increase and, in some areas, an actual decreasing trend in low-frequency ambient sound pressure level, i.e. at the frequencies most closely associated with shipping activity. For further details, please see table II within the document referenced in paragraph 10 below.

Publication of the more recent study

8 In June 2025, a team from JASCO Applied Sciences, the UK National Physical Laboratory, and the University of St Andrews published the results of their extensive analysis of the deep ocean hydrophone data from the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO).

9 The world map shown in figure 2 gives the locations of the CTBTO hydrophones, covering a large proportion of the world's oceans.

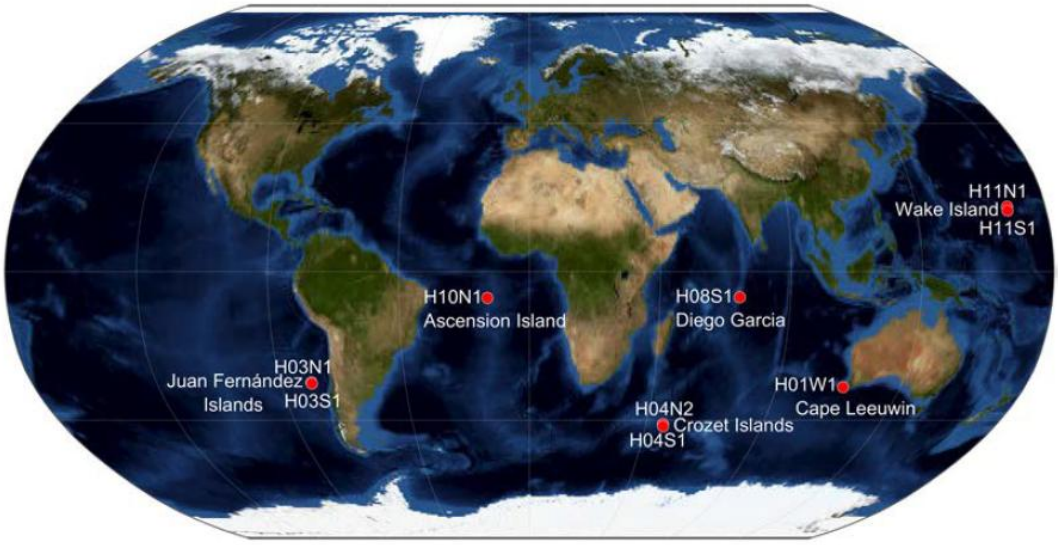

Figure 2: Locations of the CTBTO hydrophones

10 Owing to copyright constraints, the study report is only available for purchase here. Notwithstanding, for the reasons given below, it is the co-sponsors' opinion that the study results provide a highly relevant context to the URN debate and to future consideration on further development of the URN regulatory framework.

11 The abstract to the study publication is reproduced below:

> "We analyze ocean ambient sound from a global network of hydrophones installed and maintained by the Comprehensive Nuclear-Test-Ban Treaty Organization. We process acoustic data from nine hydrophones across six hydroacoustic stations distributed across five oceans: North Pacific, South Pacific, South Atlantic, Indian, and Southern oceans, for up to 19 consecutive years between 2003 and 2021. We identify dominant natural and anthropogenic sources for all six stations and observe long-term trends at four of them. Out of 20 statistical tests, 15 identified a significant downward trend in sound pressure level. Possible causes of these decreasing trends include a global recession in 2016, the COVID-19 pandemic in 2020, five major earthquakes between 2004 and 2012 (with none in 2013–2021), and a steadily increasing sea surface temperature, which decreases the sea surface critical angle and hence the contribution from near-surface sources (e.g., shipping) to sound pressure level."

12 Between 2003 and 2021, the study found that a consistent decline in 10 to 100 Hz ambient sound pressure level of about 0.1 to 0.3 decibels per annum had been seen by the hydrophones at the following locations:

.1 Cape Leeuwin;

.2 Diego Garcia;

.3 Ascension Island; and

.4 Wake Island.

13 The conclusions presented are valid for the areas covered in the study, and do not imply that discrete areas of the world and certain coastal areas are not continuing to see increases in sound pressure level. The Arctic, for example, remains an area of concern.

14 Nevertheless, the study findings are considered significant as, for the first time, an enduring and consistent downward trend has been observed in deep ocean ambient sound pressure level, across a large proportion of the deep ocean.

The causes of the downward trend

15 The study team identified several possible causes of the downward trend, and in particular, the increasing surface temperature of the sea attributable to global warming.

16 However, for certain sea areas, it is the view of the authors of the study that the warming of the surface water only explains about half of the decline in sound pressure level.

Key points for the EBP

17 The study shows a recent and consistent downward trend in low-frequency sound pressure level across a large proportion of the world's oceans, and the co-sponsors suggest that the following are key points for the EBP:

.1 The downward trend cannot be fully explained by the rise in sea surface temperature, and it is likely that other factors are contributing. Further research to establish the full causes would be beneficial. Noting the strong linkage between energy efficiency and URN, possibly the 31 to 37% reduction in carbon intensity between 2008 and 2023 could be a contributing factor as reported by the Organization in document MEPC 83/6 (Secretariat) and illustrated by figures 4 and 5 below (MEPC 83/6, paragraph 18). Most of this reduction in carbon intensity can be attributed to improvements in efficiency and speed reduction. Owing to this, a positive impact on the reduction of the ambient sound pressure level can be inferred.

.2 The CTBTO data is freely available to research organizations, and the study team advised that repeating the study at a future date would amount to about three man-months of work.

.3 The study team has also advised the co-sponsors that the dominant sound sources for Cape Leeuwin and Ascension are not shipping but natural sources, such as earthquakes and baleen whales, and non-shipping-related anthropogenic sound (airguns for seismic surveys). Therefore, to gauge the impact of shipping on ambient sound pressure levels going forward, the key CTBTO hydrophones to focus on would be those where shipping is considered the most dominant source, i.e. Wake Island (north and south triplets) and possibly Diego Garcia, where the possible prominence of shipping noise has not been ruled out.

.4 As previously noted, there are no CTBTO hydrophones within the North Atlantic. Coverage of this area should also be included in the scope of a future study, with possible data contribution by countries bordering the Eastern Atlantic, who are also meeting their URN monitoring obligations under the European Union's Marine Strategy Framework Directive.

.5 Alongside forecasting ambient URN through to 2050, this approach would be a practical and affordable way of monitoring actual levels of ambient sound pressure levels going forward.

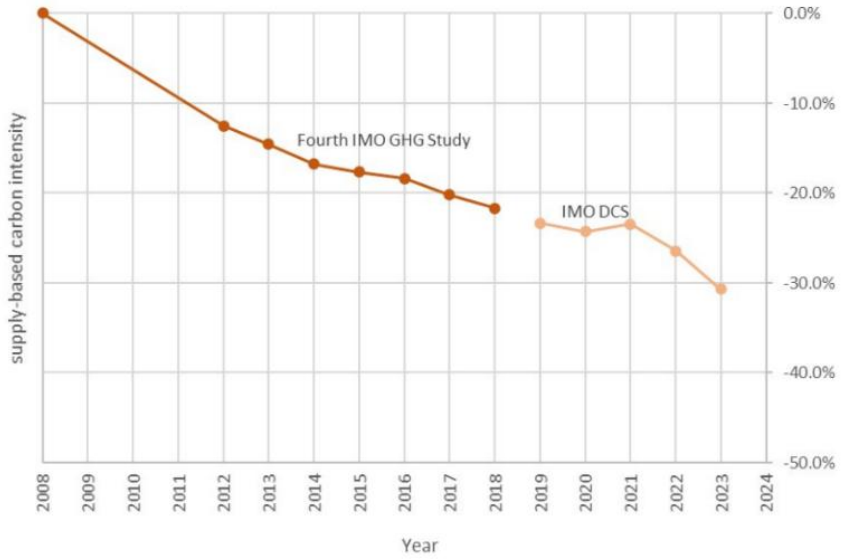

Figure 4: Supply based (AER) carbon intensity of international shipping 2008-2023
(MEPC 83/6, paragraph 18, figure 1)

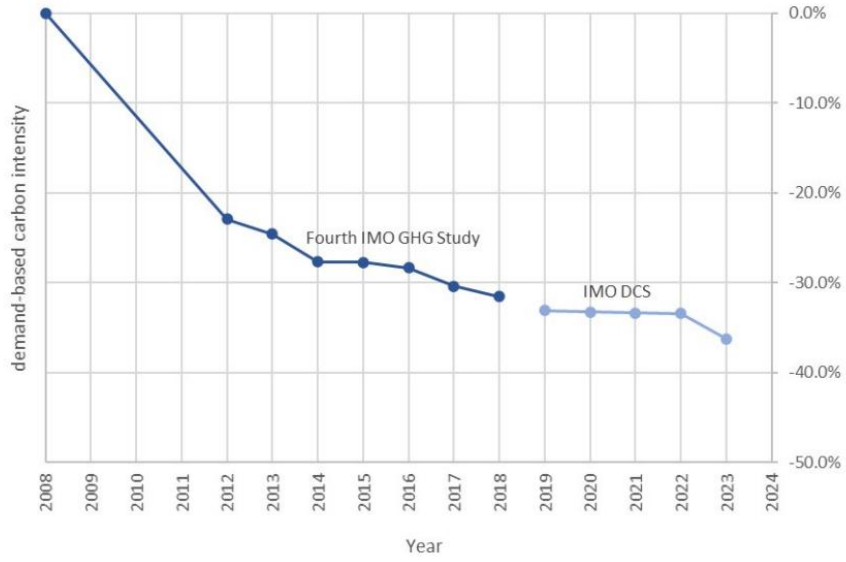

Figure 5: Demand based (EEOI) carbon intensity of international shipping 2008-2023
(MEPC 83/6, paragraph 18, figure 2)

Actions requested of the Sub-Committee

18 The Sub-Committee is invited to note the information within this document and to take the following actions:

.1 support further research into the causes of the reported decline in deep ocean ambient sound pressure level. When considering IMO's further regulatory developments on URN reduction, it is important to fully understand the key contribution factors; and

.2 support similar studies making use of the CTBTO data and other data sources for the North Atlantic. At a reasonable cost, these could be conducted at regular intervals, e.g. aligned with the regular IMO GHG studies. Such an approach would reveal the long-term trends in ambient sound pressure level and would inform the Sub-Committee of the appropriate level of any further measures to reduce URN.