TURN DOWN THE VOLUME

Our Proposals to Save Marine Life From Underwater Noise Pollutions

Strangers

모의IMO총회
The Mock IMO Assembly

Contents

Section 1

BACKGROUND

Whales are **dying**

▪ Why are Whales Dying?

.

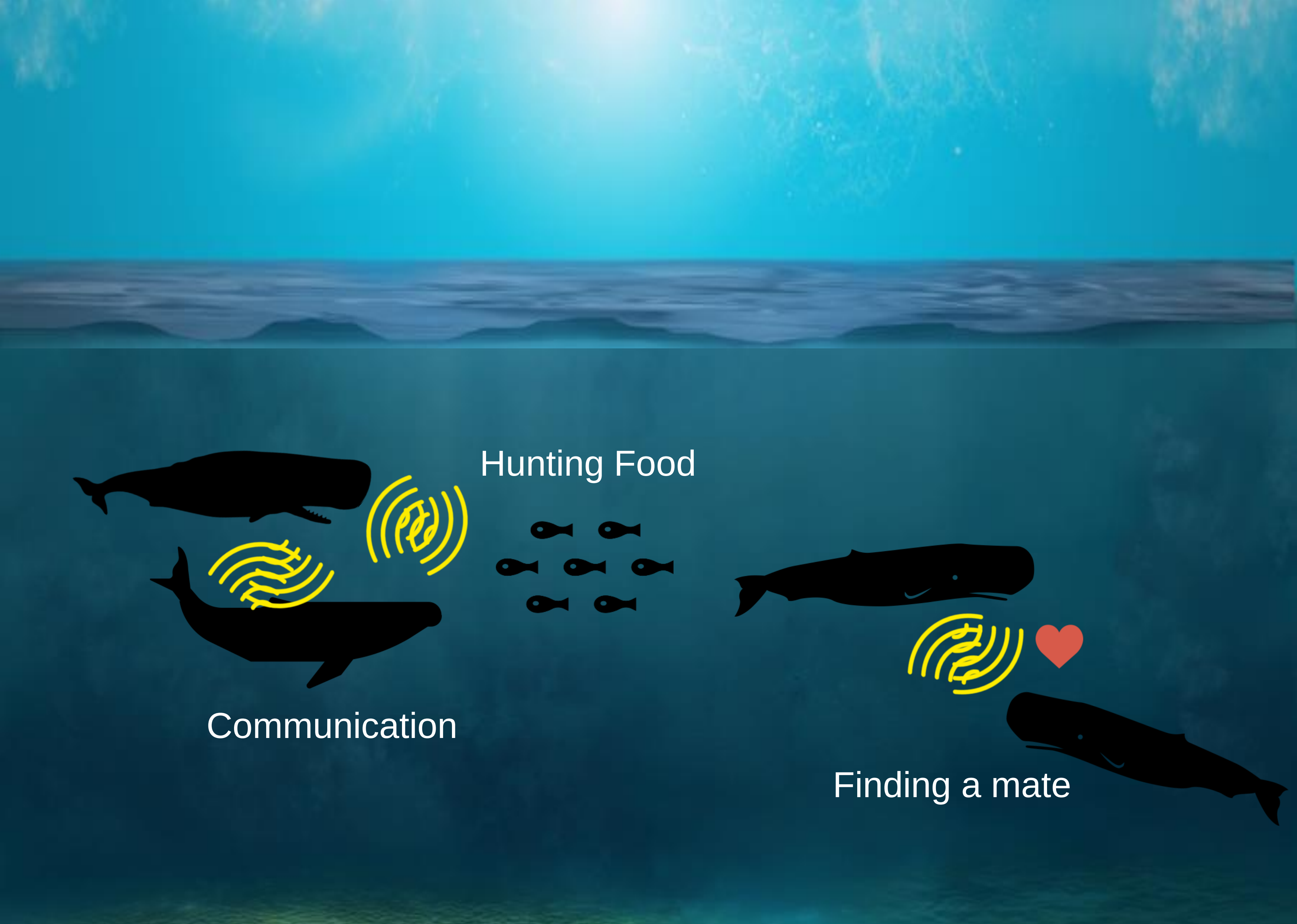
There are several environmental factors that cause the death of whales.

Oil pollution

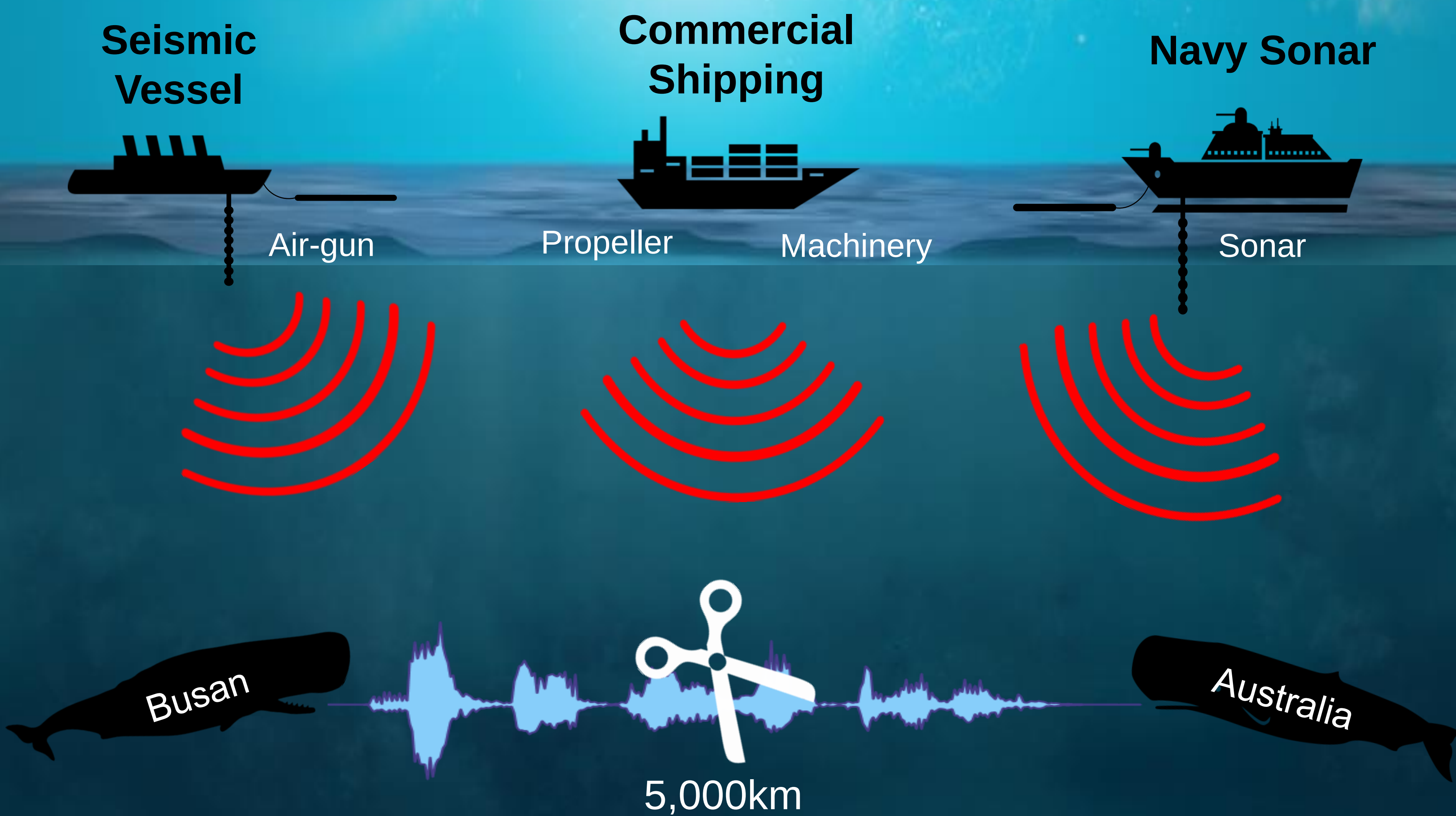
Climate change

Trash pollution

Underwater Noise Pollution



Breaking the Silence : how our noise pollution is harming whales, IFAW Australia, 2013

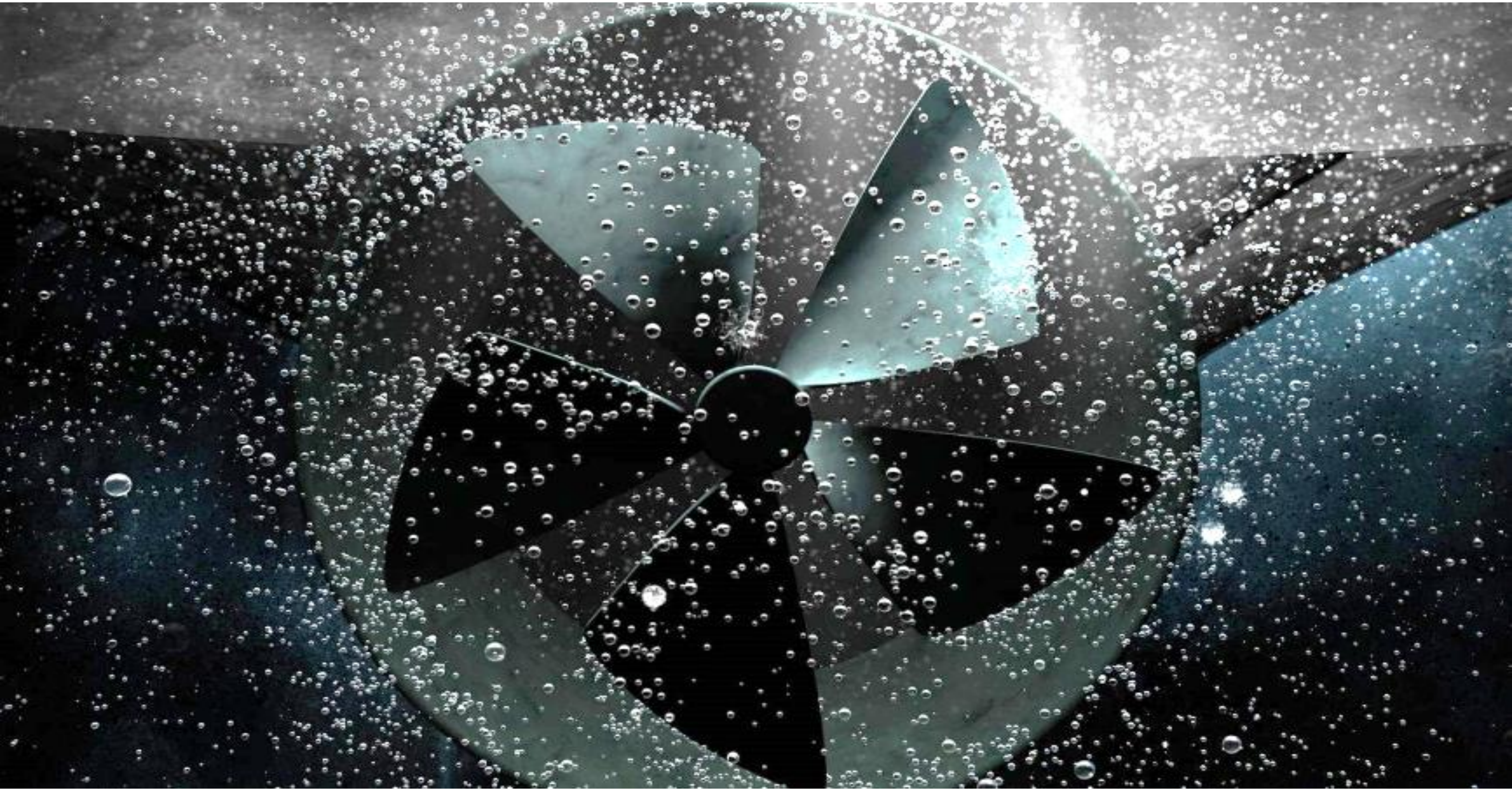


Breaking the Silence : how our noise pollution is harming whales, IFAW Australia, 2013

Around 60,000 commercial ships travel the world’s oceans at any given time

http://www.ics-shipping.org/shipping-facts/shipping-and-world-trade

▪ Propeller Cavitation

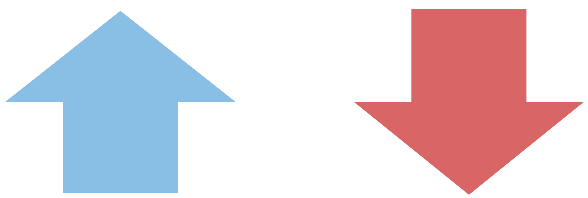


▪ Propeller Cavitation

Rapid formation and collapse of vapor bubbles within a liquid.

Bernoulli's theorem

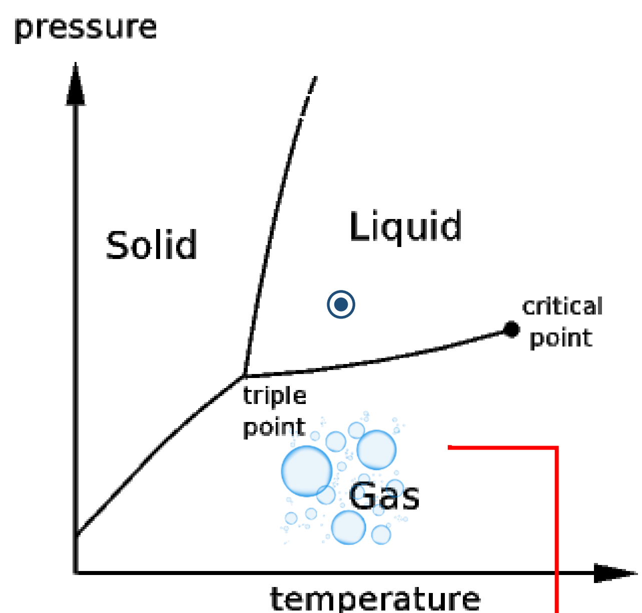
$$p + \frac{1}{2}\rho v^2 + \rho g z = \underline{\underline{const.}}$$



Velocity

Pressure

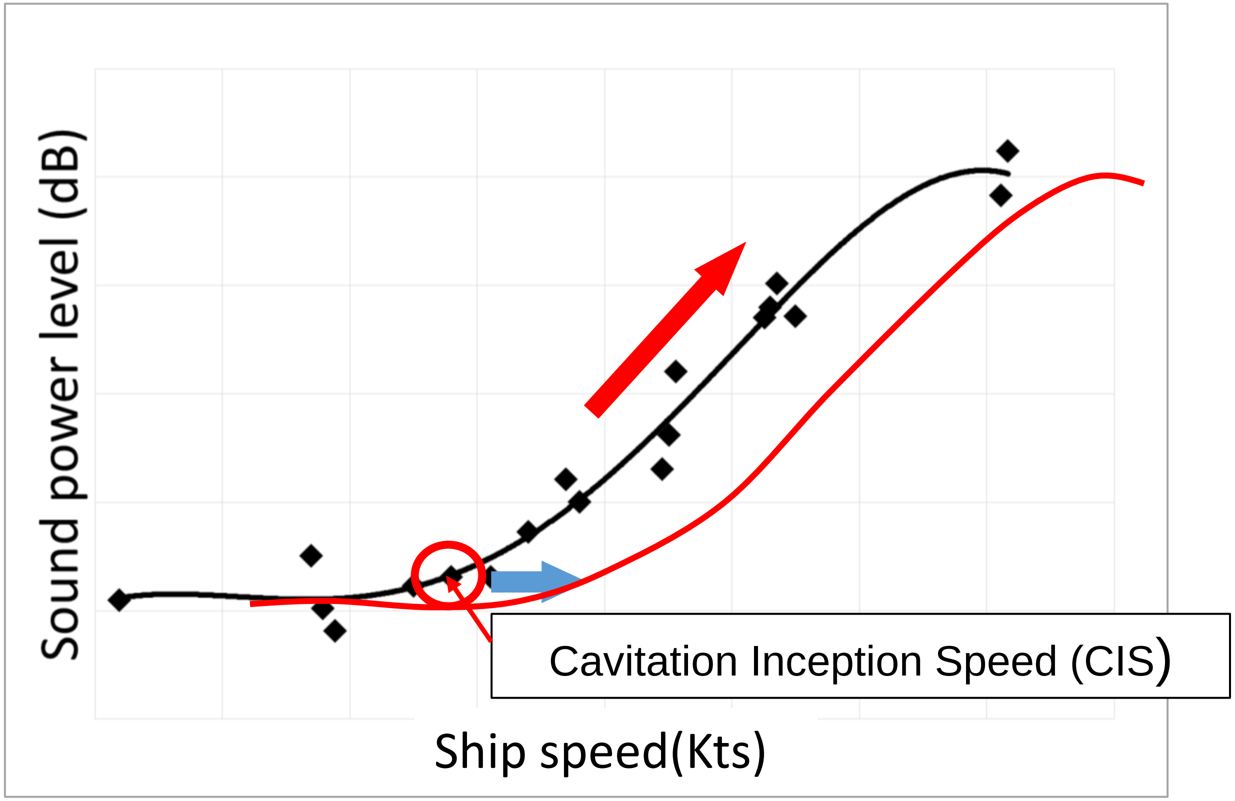
Triple point



Cavitation occurs.

▪ Propeller Cavitation

Sound power level surges when the speed of the ship exceeds CIS



Y. S. Na, “A study on the improvement of cavitation inception speed for naval propellers”, Ph.D. Dissertation, Department of naval architecture and ocean engineering, Chungnam National University, Korea, p58-62, (2005)

Section 2

SOLUTIONS

▪ Propeller Design

Guidelines for propeller design
MEPC.1/Circ.833, Annex 7.2.1 (4th,July, 2014)

7 Design considerations

7.1 The largest opportunities for reduction of underwater noise will be during the initial design of the ship. For exist … meet the underwater noise performance achievable by … ues are therefore primarily intended for consideration f… an also be given to existing ships if reasonable and prac… l has a negligible influence on radiated noise, the hull fo… the propeller. For effective reduction of underwater nois… dapted to each other. These design issues should be con… consideration of ship safety and energy efficiency.

- Blade outline
- Angle of attack
- Materials
- Pitch/diameter ratio

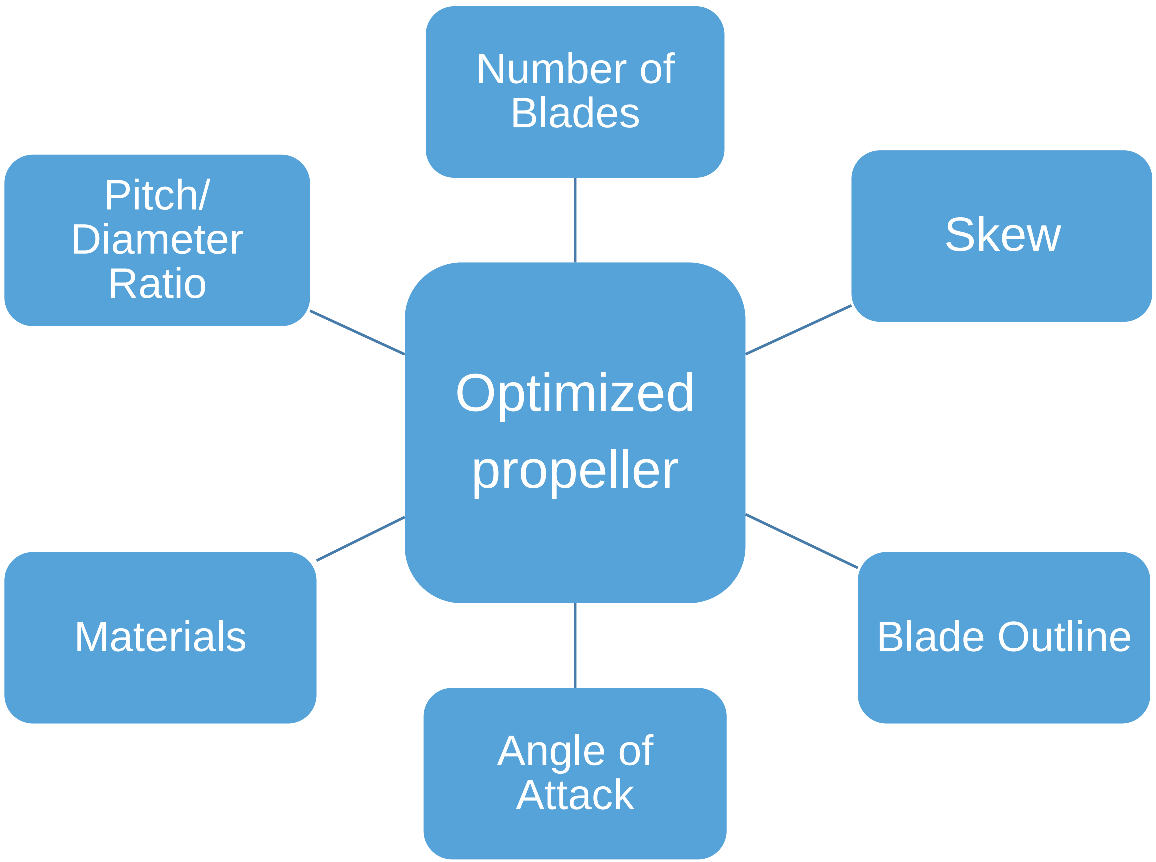
+

7.2 ***Propellers***

7.2.1 Propellers should be designed and selected in order to reduce cavitation. Cavitation will be the dominant radiated noise source and may increase underwater noise significantly. Cavitation can be reduced under normal operating conditions through good design, such as optimizing propeller load, ensuring as uniform water flow as possible into propellers (which can be influenced by hull design), and careful selection of the propeller characteristics such as: diameter, blade number, pitch, skew and sections.

▪ Propeller Design

6 factors Affecting Propeller cavitation

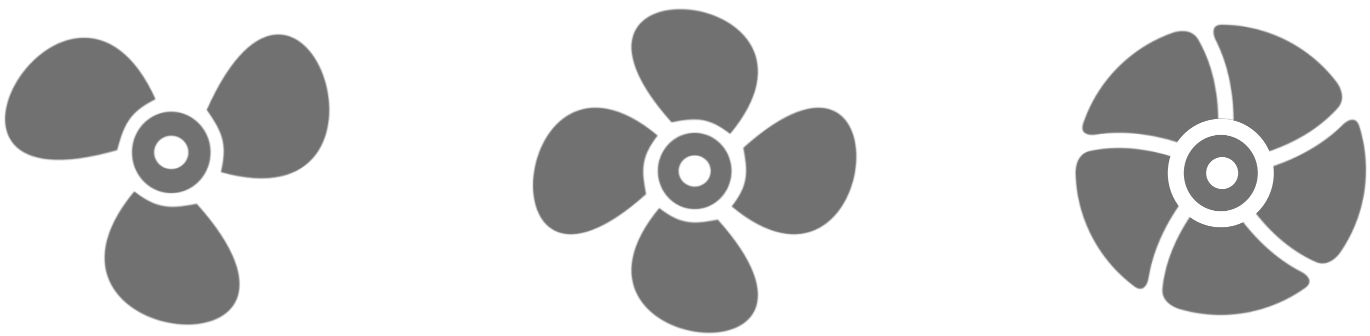


Marine Insight, Propeller factors: http://www.marineinsight.com

Propeller Design

6 factors Affecting Propeller cavitation

1 Number of Blades



3 blades

4 blades

5 blades

The less blades

The most common

The more blades

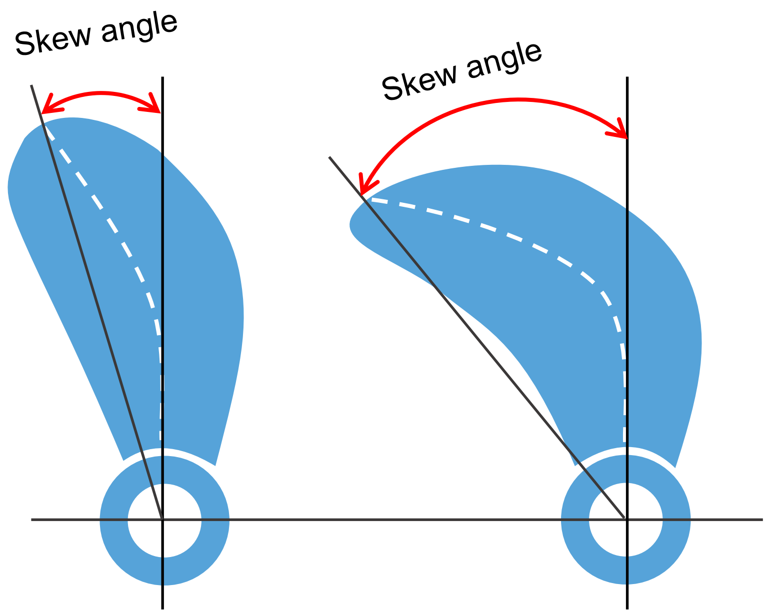
It must be always selected with a variety of factors.

own

Propeller Design

6 factors Affecting Propeller cavitation

2 Skew



- Less than 50 °

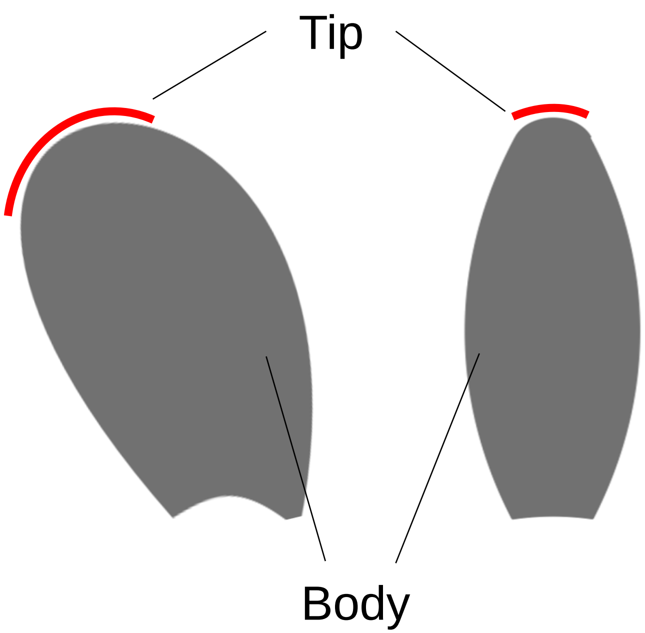
- Supplementation

  - Thickness
  - Flexible matrix composite

▪ Propeller Design

6 factors Affecting Propeller cavitation

3 Blade Outline

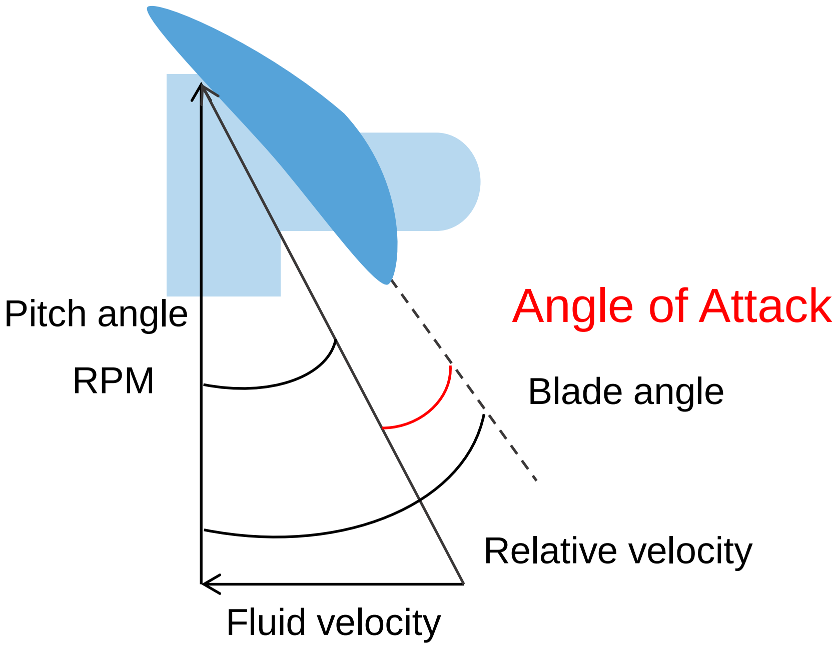


- Smooth fluid flow
- Consideration of propulsion efficiency

Propeller Design

6 factors Affecting Propeller cavitation

4 Angle of Attack



- Sheet cavitation
- Bubble cavitation
- Face cavitation

Unstable Noise
+
Propeller erosion

Propeller Design

6 factors Affecting Propeller cavitation

5 Materials   6 Pitch / Diameter Ratio

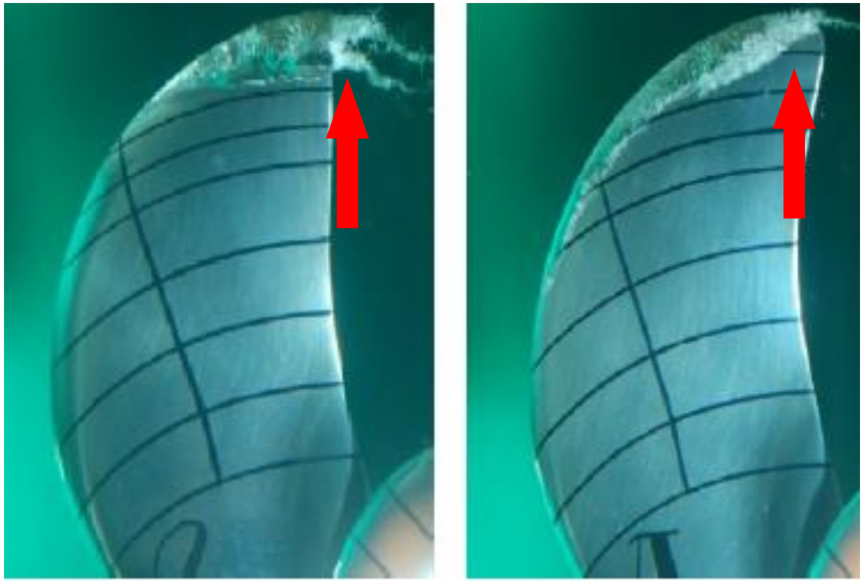
Wear, Damage   Repair   Flexible matrix composite

Lee, Sang-Gab, et al. "Enhanced manufacturing and performance analysis of flexible composite propeller." *Journal of the Society of Naval Architects of Korea* 49.6 (2012): 521-527.

Technologies

Vortex generator

- Attached to front hull of propeller
- Control fluid flow
- Improving propulsion efficiency, Vessel noise and vibration reduction



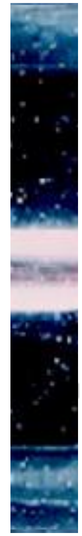
Choi, Jung-Eun, et al. "Computational prediction of speed performance for a ship with vortex generators." Journal of the Society of Naval Architects of Korea 46.2 (2009): 136-147.

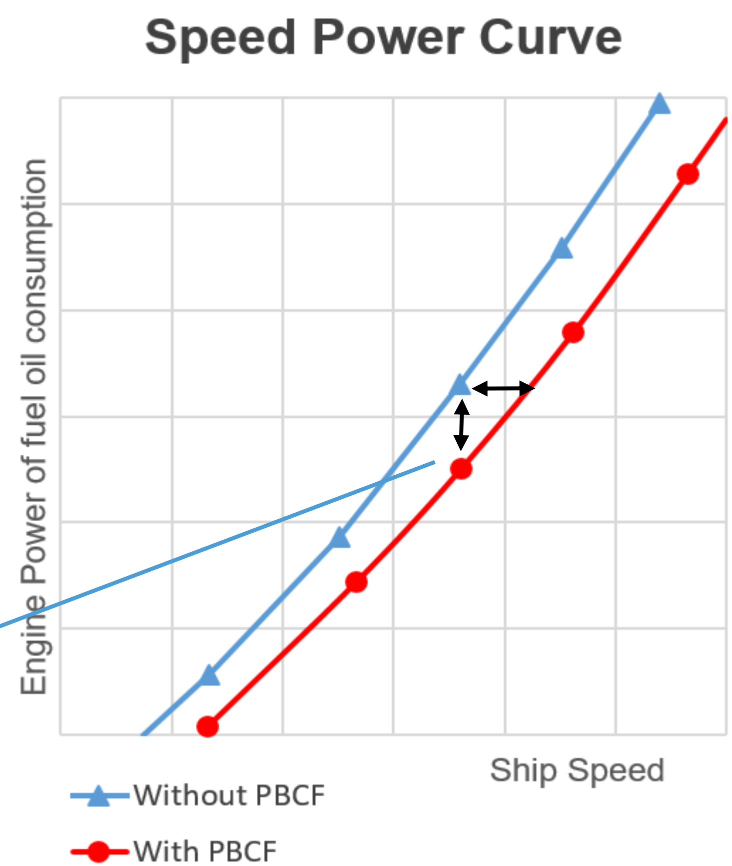
Technologies

ESD – PBCF (Propeller Boss Cap Fins)

- Energy absorbing from the back of propeller
- Removal of hub vortex cavitation

Boosts speed by 2 %
Save 5% of the fuel





[PBCF-efficiency evaluation]

Jo, H. S., et al. "Performance Analysis of PBCF Propeller." *Journal of the Korean Society of Marine Engineering* (2010): 451-454.

Section 3

CONCLUSION

▪ Proposal to IMO

Specify propeller design with 6 factors

Simple technologies on exiting ships should be included.

CIS and SPL should be recorded in the document.

▪ Amendments to MEPC.1/Circ.833

GUIDELINES FOR THE REDUCTION OF UNDERWATER NOISE FROM COMMERCIAL SHIPPING TO ADDRESS ADVERSE IMPACTS ON MARINE LIFE

7.2 ***Propellers***

7.2.1 Propellers should be designed and selected in order to reduce cavitation. Cavitation will be the dominant radiated noise source and may increase underwater noise significantly. Cavitation can be reduced under normal operating conditions through good design, such as optimizing propeller load, ensuring as uniform water flow as possible into propellers (which can be influenced by hull design), and careful selection of the propeller characteristics such as: diameter, blade number, pitch, skew and sections.

Blade outline, Angle of attack, material should be considered in this part.
Each element should be presented with specific criteria in subcategories.

Amendments to MEPC.1/Circ.833

GUIDELINES FOR THE REDUCTION OF UNDERWATER NOISE FROM COMMERCIAL SHIPPING TO ADDRESS ADVERSE IMPACTS ON MARINE LIFE

9 Additional technologies for existing ships

In addition to their use for new ships, the following technologies are known to contribute to noise reduction for existing ships:

.1 design and installation of new state-of-the-art propellers;

.2 installation of wake conditioning devices; and

.3 installation of air injection to propeller (e.g. in ballast condition).

+ .4 installation of a vortex generator or cap and fin which can be easily mounted outside the hull

Readily available technologies for existing ships should be included in this guideline.

▪ Amendments to MEPC.282(70) ANNEX 10

2016 GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)

1 Ship particulars

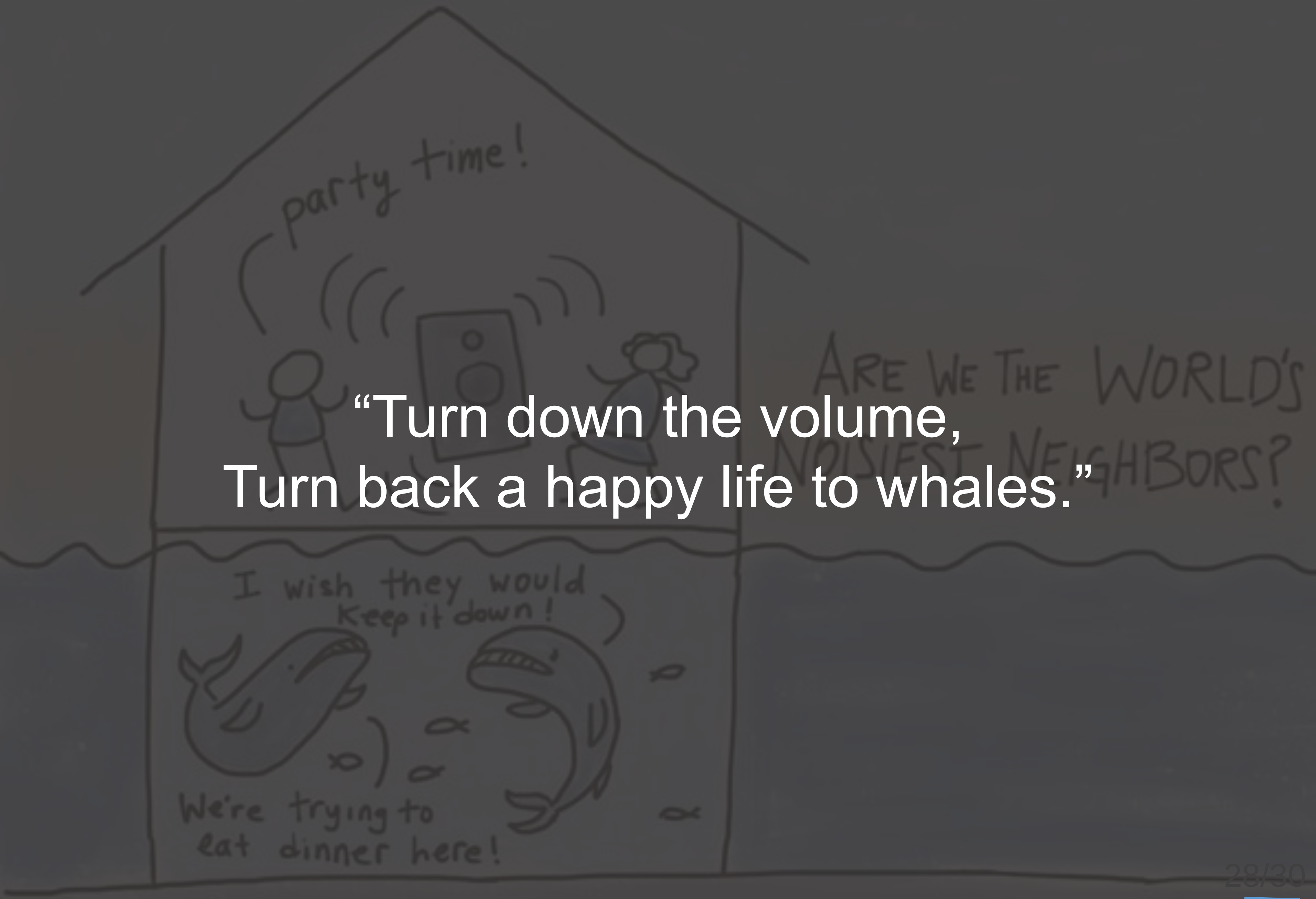
Name of ship	
IMO number	
Company	
Flag	
Ship type	
Gross tonnage	
NT	
DWT	
EEDI (if applicable)	
Ice class	
CIS & SPL	

Date of revision	Revised provision

3 **Ship engines and other fuel oil consumers and fuel oil types used**

CIS and SPL caused by cavitation have to be filled out in this SEEMP form.

	Engines or other fuel oil consumers	Power	Fuel oil types
1	Type/model of main engine	(kW)	
2	Type/model of auxiliary engine	(kW)	
3	Boiler	(...)	
4	Inert gas generator	(...)	



"Turn down the volume,
Turn back a happy life to whales."

References

[1] Y. S. Na, “A study on the improvement of cavitation inception speed for naval propellers”, Ph.D. Dissertation, Department of naval architecture and ocean engineering, Chungnam National University, Korea, p58-62, (2005)

[2] MEPC.1/Circ.833, Annex 7.2.3 (4^{th},July, 2014)

[3] MEPC.282(70) ANNEX 10

[3] Breaking the Silence : how our noise pollution is harming whales, IFAW Australia, 2013

[4] Sonic Sea : Impacts of Noise on Marine Mammals, IFAW

[5] Marine Insight, Propeller factors: http://www.marineinsight.com

[6] Jo, H. S., et al. "Performance Analysis of PBCF Propeller." Journal of the Korean Society of Marine Engineering (2010): 451-454.

[7] Lee, Sang-Gab, et al. "Enhanced manufacturing and performance analysis of flexible composite propeller." Journal of the Society of Naval Architects of Korea 49.6 (2012): 521-527.

[8] Choi, Jung-Eun, et al. "Computational prediction of speed performance for a ship with vortex generators." Journal of the Society of Naval Architects of Korea 46.2 (2009): 136-147.

[9] Underwater noise - the overlooked catastrophe, https://www.oceancare.org/

[10] http://e-marineeducation.com/en/construction-materials-for-ship-propeller/

Thank you