Shipping as a Source of Anthropogenic Underwater Sound

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SHIPPING ENABLES TRADE AND AFFECTS THE LIVES OF BILLIONS
90%
of internationally traded goods are transported by sea

MAERSK

Vessel characteristics

Container vessel lengths: 130 to 400 meters

Crew: 18 to 28 personnel

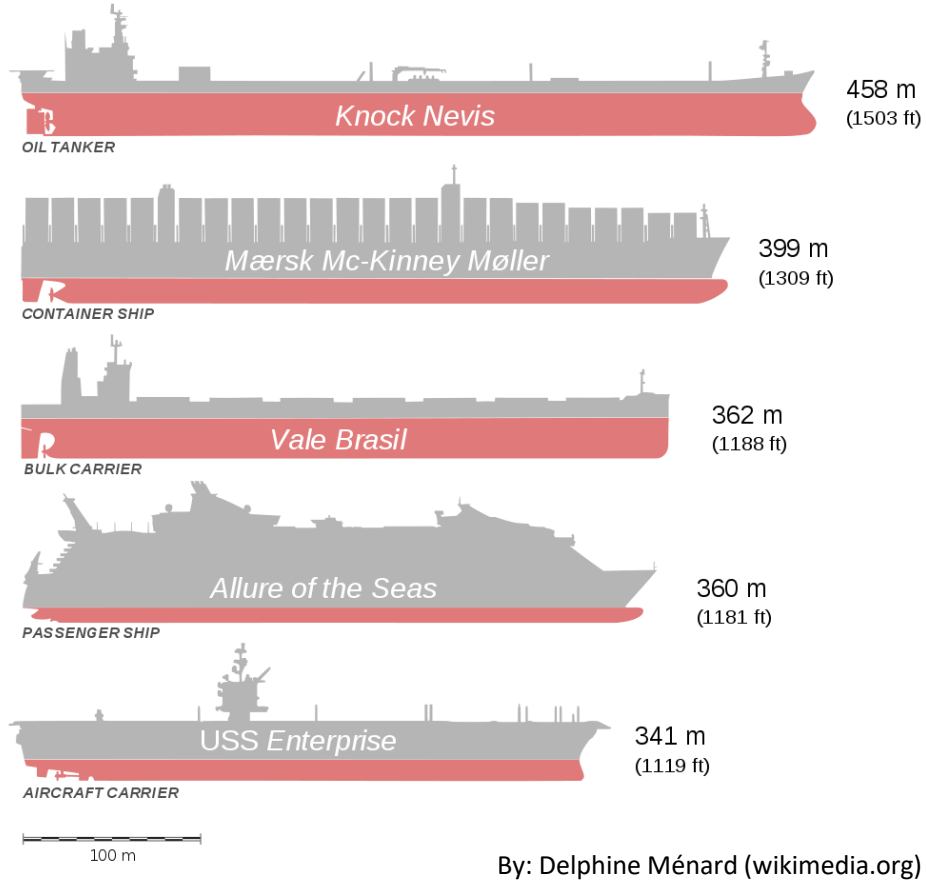
Speeds: Typically 12 - 18 knots

(22 – 33 kph or 14 - 21 mph)

Newer vessels are larger, higher capacity, and more energy efficient.

→ Fewer total transits and port calls

→ Quieter?



By: Delphine Ménard (wikimedia.org)

Gudrun Maersk

Built: 2005, Retrofitted: 2015

Size: 367 m x 43 m; max draft 15.9 m

Gross Tonnage: 98,648

Capacity: 11,078 TEU

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Sources of sound from commercial shipping

Cavitation related to propulsion systems is typically the dominant source of underwater noise

- Design and type
- Boss cap fins and ducting technologies
- Speed optimization and depth
- Cleaning and maintenance

Primary factors for vessels

- Propulsion system design, operations, cleaning and maintenance
- Flow around hull and Sea chests
  - Trim optimization
  - Bulbous bow design
  - Maintenance and cleaning
- Equipment noise and isolation
- Speed optimization
- Depth finders

Port operations and harbor craft are also sources of underwater sound.

“Radical Retrofits” to improve vessel energy efficiency

$1Billion project over 5 years, ~100 vessels

<u>Energy Efficiency & Environmental Technologies</u>

- New bulbous bow
- New propeller and propeller boss cap fins
- Engine de-rating
- Fuel flow meters

<u>Capacity Boost</u>

- Raise wheelhouse
- Upgrade lashing bridges and hatch covers
- Scantling draft evaluation

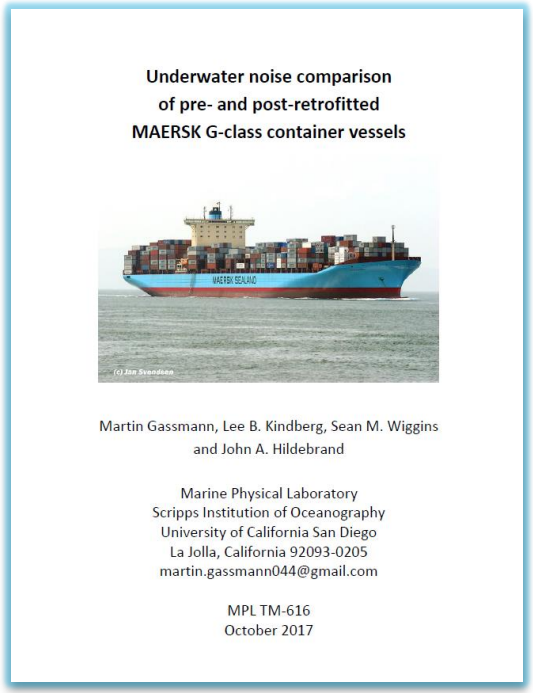
Reduced underwater noise generation related to the Radical Retrofit

- Scripps Institution of Oceanography has collected underwater sound data in the Santa Barbara Channel for over 10 years.
- Five Maersk vessels were evaluated before and after retrofit
- Source Sound Pressure Level (SPL) when corrected for vessel speed and draft is estimated to be:
  - 6 dB lower in the 8-100 Hz band
  - 8 dB lower in the 100-1000 Hz band

6 dB is 75%

- Conclusion: *"Reductions of ship source sound pressure level due to changes such as those employed by the radical retrofits may result in ocean-basin-wide noise reductions."*

http://cetus.ucsd.edu/Publications/Reports/GassmannMPLTM616-2017.pdf



Underwater noise comparison
of pre- and post-retrofitted
MAERSK G-class container vessels

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MPL TM-616
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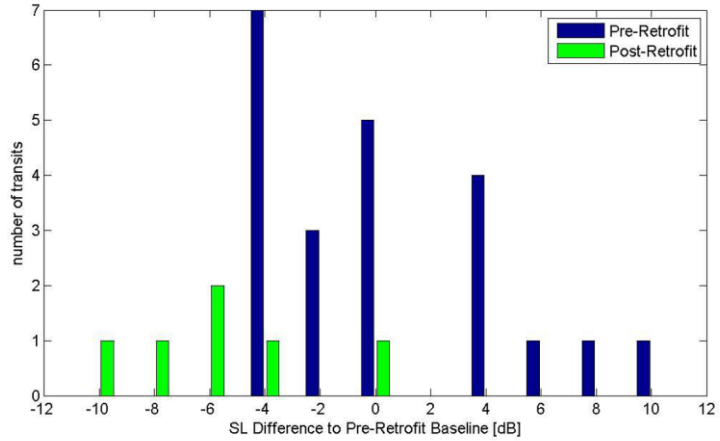
8-100 Hz Sound Pressure Levels



What have we learned?

- Vessel retrofits can reduce fuel consumption and related air emissions, and also may reduce underwater sound.
  - Both vessel equipment and operating factors should be considered in underwater sound programs.
  - Some technology approaches appear to offer win-win solutions.

- Significant expertise is required to analyze sound generation and impacts in real-world settings.
  - Consistent methodologies are essential

- This study is only a first step toward full understanding of anthropomorphic underwater sound generation from shipping and ways to manage and reduce resulting impacts on marine mammals.

Is there an optimum solution for both the environment and operations?

SAFE MANEUVERING	ENERGY EFFICIENCY	AIR EMISSIONS	GREENHOUSE GASES
PORT COMMUNITY CONCERNS	COSTS	ON TIME	MARINE MAMMALS

Thank you

Photo by Joan Lopez