



The role of industry in managing the impacts of underwater noise on marine life

Frank Thomsen

Agenda

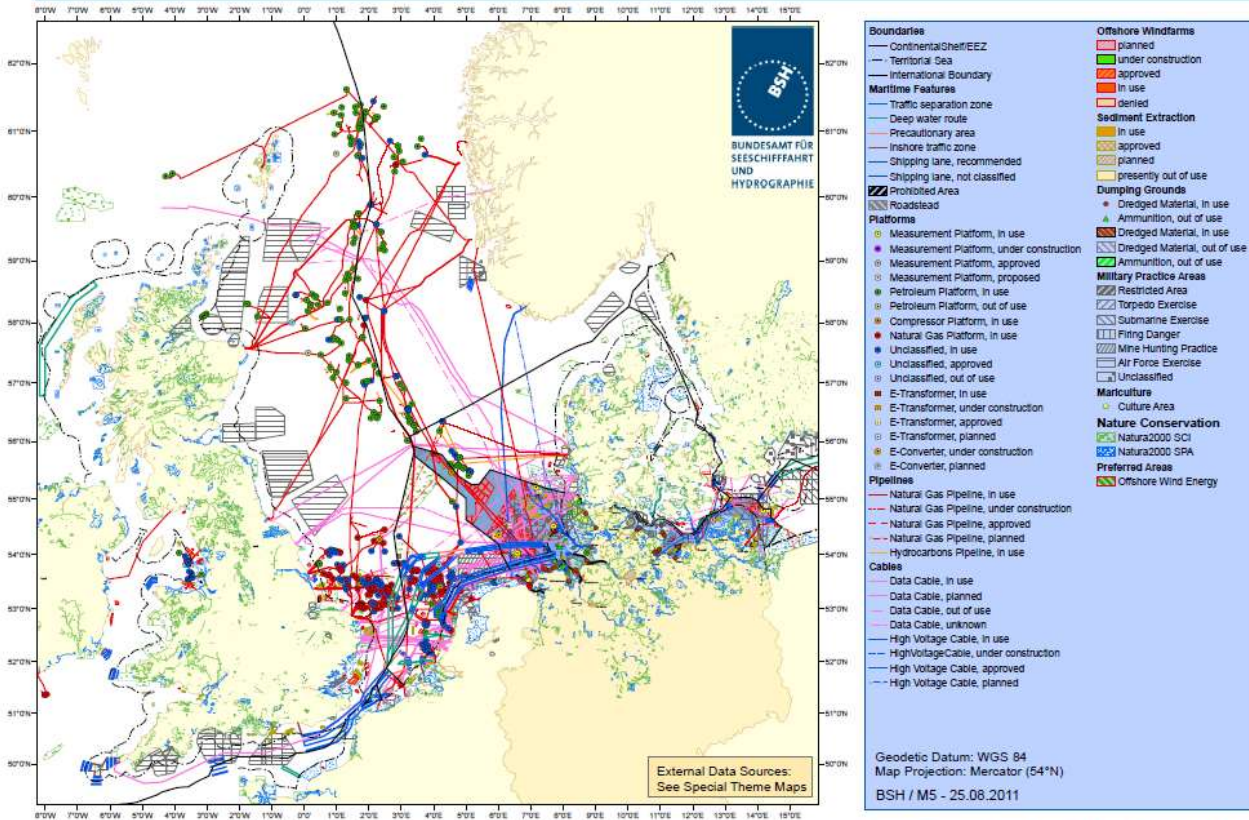
- Industry noise and marine life
- Case study dredging: the work of CEDA and WODA
- Conclusions

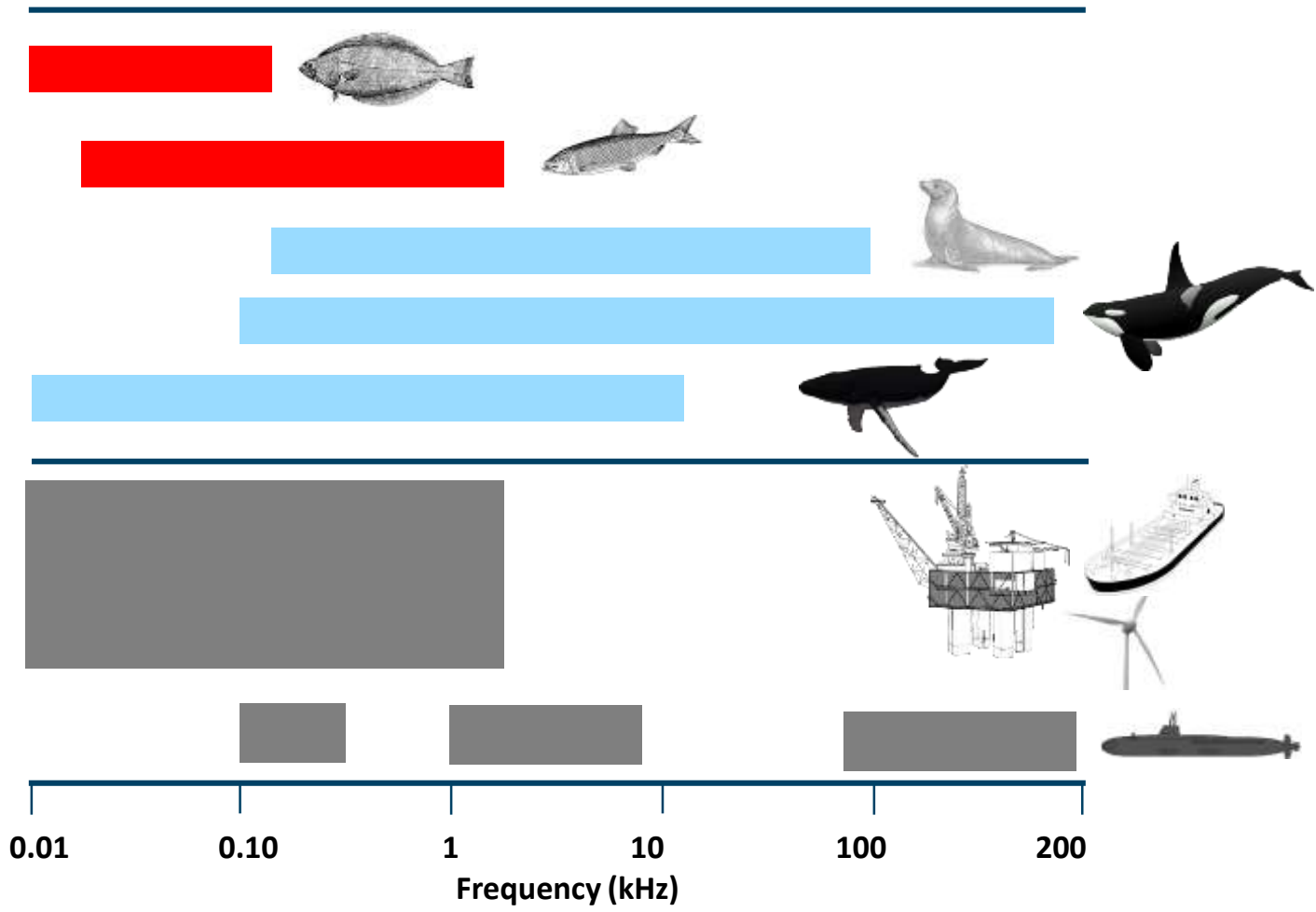
Marine industries



Review by OSPAR 2009

North Sea: Existing and Perspective Uses and Nature Conservation

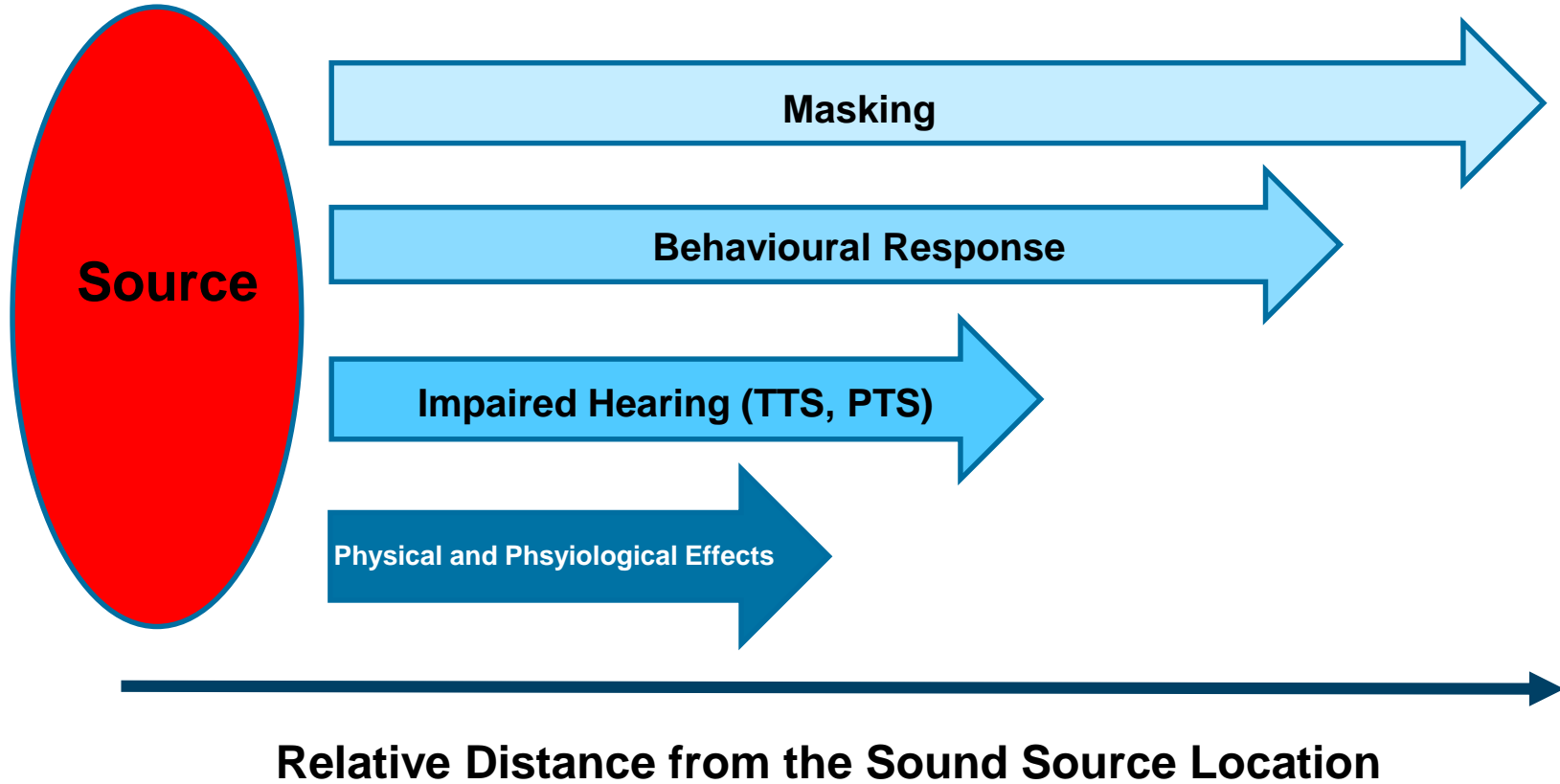




Impulsive and continuous noise



(MSFD; Tasker et al. 2010)



Major issues



- Displacement due to behavioural response to high intensity impulsive sound (e.g. pile driving)
- Reduction of communication space due to increase in ambient noise (shipping, dredging)
- Physiological changes indicating a stress response due to increase mainly of ambient noise (shipping)

(see OSPAR 2009; Tasker et al. 2010; UN 2018)



Independent, non-profit, professional organizations

Exchange of knowledge and experience on all aspects of dredging and marine construction

- WODA – World Organization of Dredging Associations
- WEDA - Western Dredging Association serving the Americas
- CEDA - Central Dredging Association serving Europe, Africa and ME
- EADA - Eastern Dredging Association serving the Asian and Pacific region

Expert Groups on Underwater Sound



CEDA Position Paper – 7 November 2011

CEDA
Central Dredging Association

Underwater Sound In Relation To Dredging

The Central Dredging Association is committed to environmentally responsible management of dredging activities and this paper – produced by the CEDA Environmental Committee – seeks to inform those parties concerned about sounds produced by dredging.

Dredging is an activity that is carried out for many purposes. The dredging process can simply be described as the extraction of sediment from a river, river to lake bed and the loading and transport of the extracted sediment and silt to a placement site elsewhere. Dredging is commonly applied for:

- Construction and maintenance of ports and waterways, lakes and other watercourses.
- Rehabilitation of river beds
- Flood and storm protection and erosion control by maintaining river flows and by reinforcing banks.
- Extraction of mineral resources from underwater deposits, particularly sand and gravel, to provide raw materials for the construction industry, and
- Environmental remediation of contaminated sediments.

This dredging provides many benefits to society with the goal of sustainable development while protecting natural resources and quality of life.

Objectives

Like many other activities, dredging produces underwater sound. However, the issue of underwater sound in aquatic life has received little attention within the scientific community, with stakeholders and the general public.

In this paper we will:

- 1) Summarize the effects of sound on aquatic life in the ocean
- 2) Describe in detail the underwater sounds generated by various components of the dredging process
- 3) Summarize what is known about potential effects of dredging sounds
- 4) Identify options for managing dredging-related sound, and
- 5) Provide conclusions and an outline of future areas of research.

Bottom 20 Sound (or Aquatic Life)

What is sound? – It can be described as a moving wave in which particles of the medium are forced together and then apart. This causes changes to pressure that propagate with the speed of sound.

The speed of sound in water is more than five times faster than in air and attenuation is also much less in water compared to air. Thus, water is a ideal medium for sound propagation.

Sounds can be described in terms of their intensity, which is measured or expressed as decibels (dB) (pink or frequency [in Hertz or kilohertz]) and their duration (in seconds or milliseconds).

Intensity of underwater sound – Both the natural environment and man can produce underwater sound. Natural sources of sound can be vocalizations of marine life – eg the click-whale range of humpback whales in the coupling of singing. Wind, rain, waves, and other volcanic and seismic activity all contribute to ambient sounds in bodies of water.

Human-induced sound comes from construction of marine infrastructure (including dredging) and industrial activities such as drilling or aggregate extraction (including dredging), shipping, military activities using various types of sonar, geological exploration using seismic surveys, and a variety of other activities.

Anthropogenic sound sources can be broadly divided into high intensity impulsive sources, such as pile driving, and low intensity but more continuous sources like shipping and dredging. It has to be noted here that the dredging fleet represents 0.1% of the world-wide shipping fleet.

Human activities in the aquatic environment have intensified since the last century and research has indicated that ambient sound has been increasing in some regions too. While ambient sound levels are the result of both natural and anthropogenic sources, it is the latter we have control over since these can be managed.

Use of sound (in marine life) – The sound created by well-maintained, many machine systems can be a variety of purposes.

Technical Guidance on:
**Underwater Sound In
Relation to Dredging**
June 2013

WODA
World Federation of Dredging Associations

Central Dredging Association
Dutch Dredging Association
Western Dredging Association

<http://www.dredging.org/>, special thanks to Anna Csiti

Dredging



Excavation of sediment from a sea, river or lake bed and the handling and transport of the excavated sediments and soils to a placement site elsewhere

- Construction and maintenance of ports and waterways, dikes and other infrastructures
- Reclamation of new land
- Flood and storm protection and erosion control by maintaining river flows and by nourishing beaches
- Extraction of mineral resources from underwater deposits, particularly sand and gravel, to provide raw materials for the construction industry
- Environmental remediation of contaminated sediments.

Dredger types and noisy activities

- Cutter suction dredgers (CSD),
- trailing suction hopper dredgers (TSHD),
- grab dredgers (GD)
- backhoe dredgers (BHD)

Activities generating sound:

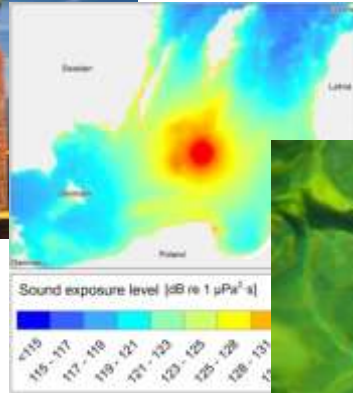
- Dredging excavation
- Dredging vessels during transport
- Dredged material placement



Risk Based Approach to Noise Assessment



What is the problem?



How far does the sound spread and how many animals are in range of the sound?



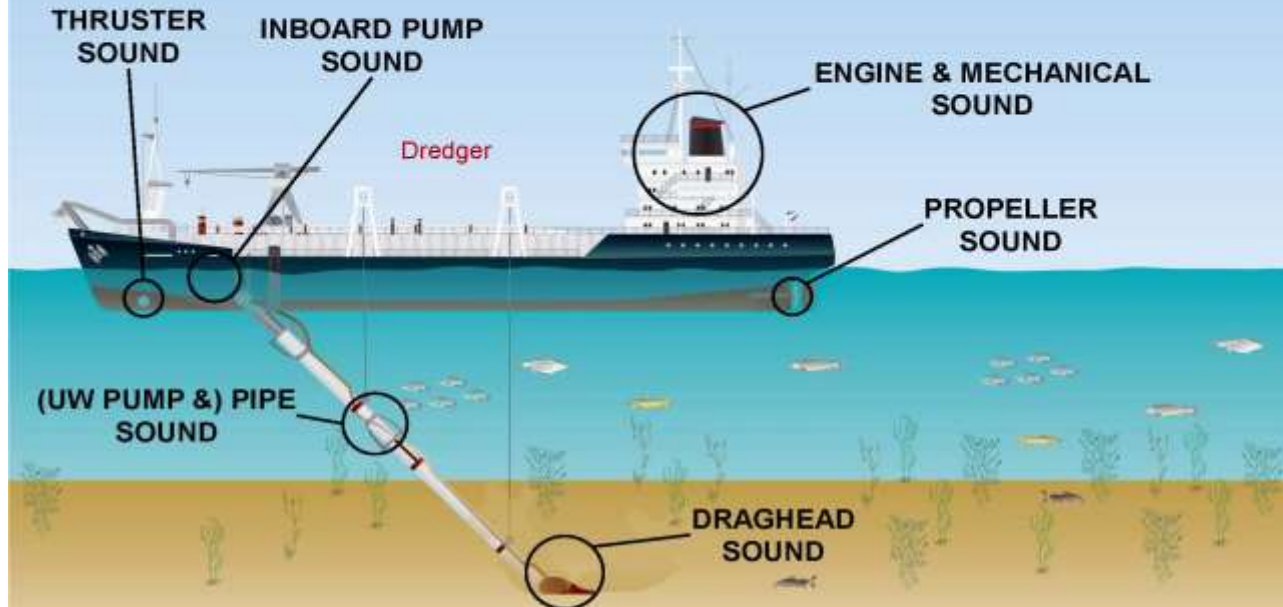
How do they react to the sounds?



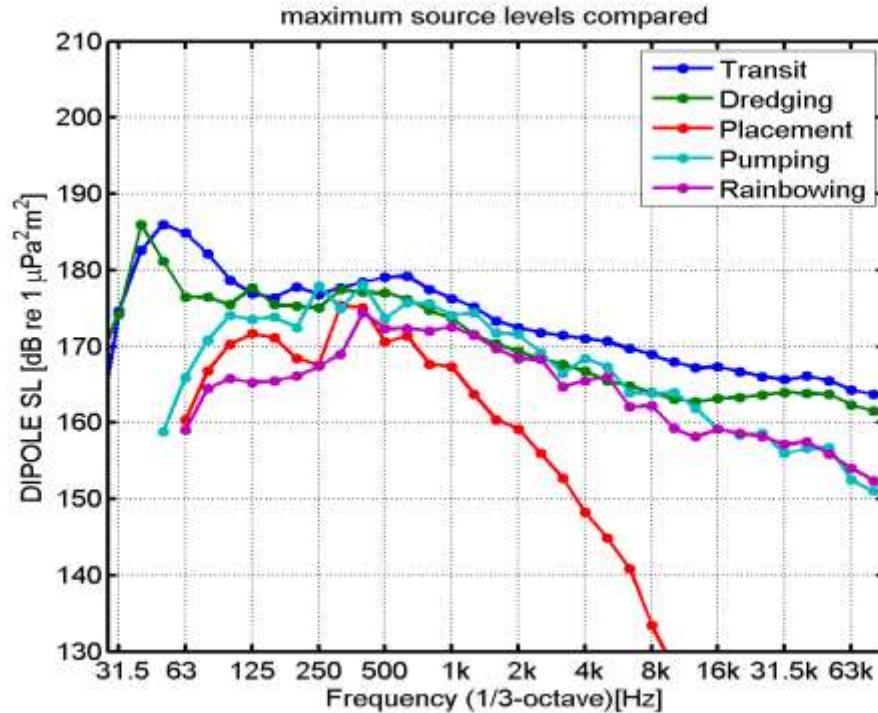
How can we mitigate impacts?

Trailing Suction Hopper Dredger

Sound Sources

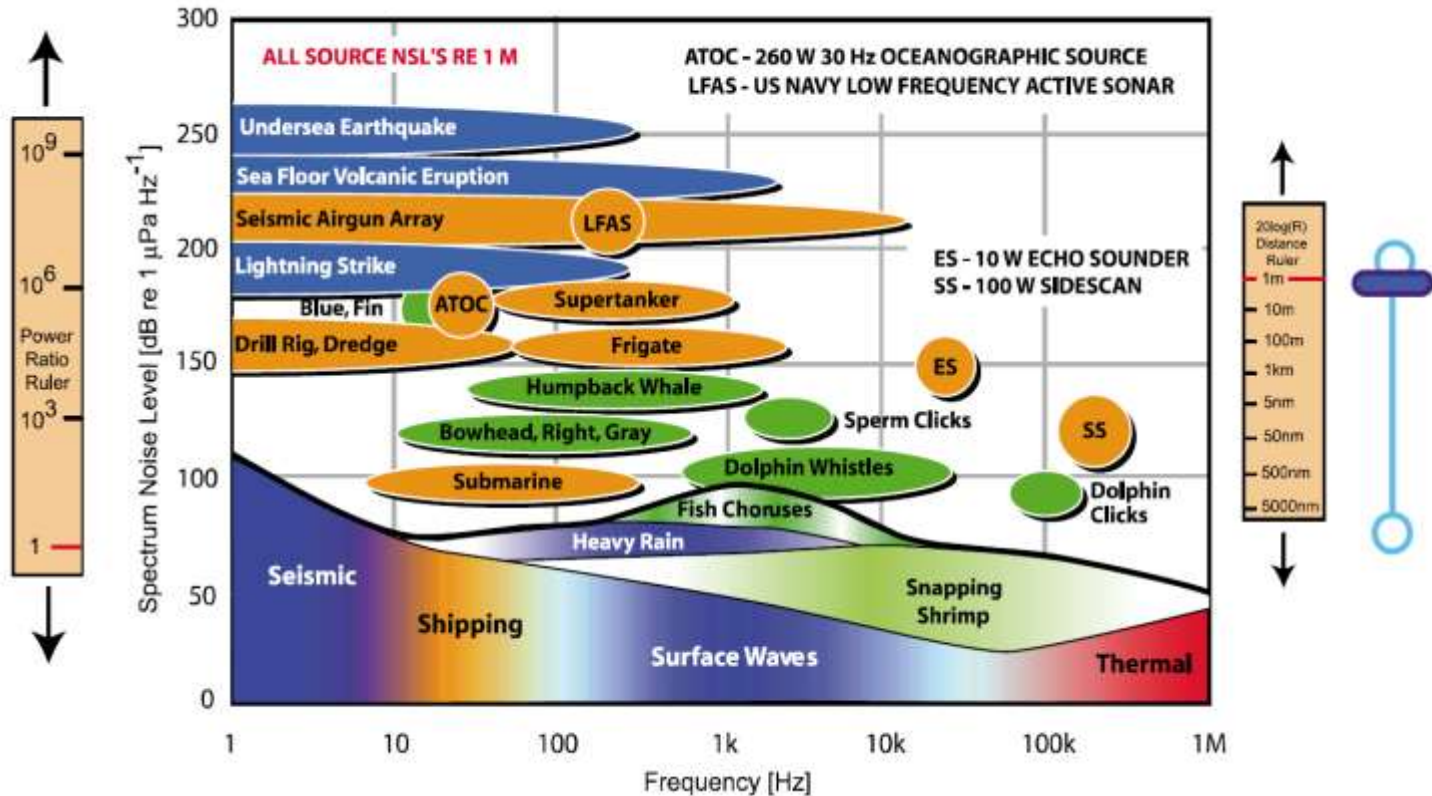


Dredging sound



De Jong et al. 2009 Maasvlakte 2, Port of Rotterdam

How does dredging compare?



Documented effects of dredging



- Gray, bowhead and minke whales avoid areas of dredging activity
- Bottlenose dolphin presence declined during harbor construction including dredging
- Harbour porpoises leave areas during sand extraction. The reactions were relatively short term however

(Review by Todd *et al.* 2015)

Hearing loss, injury



- TTS studies in some marine mammal and fish species
- Depending on sound type and acoustic dose
- Cumulative exposure important

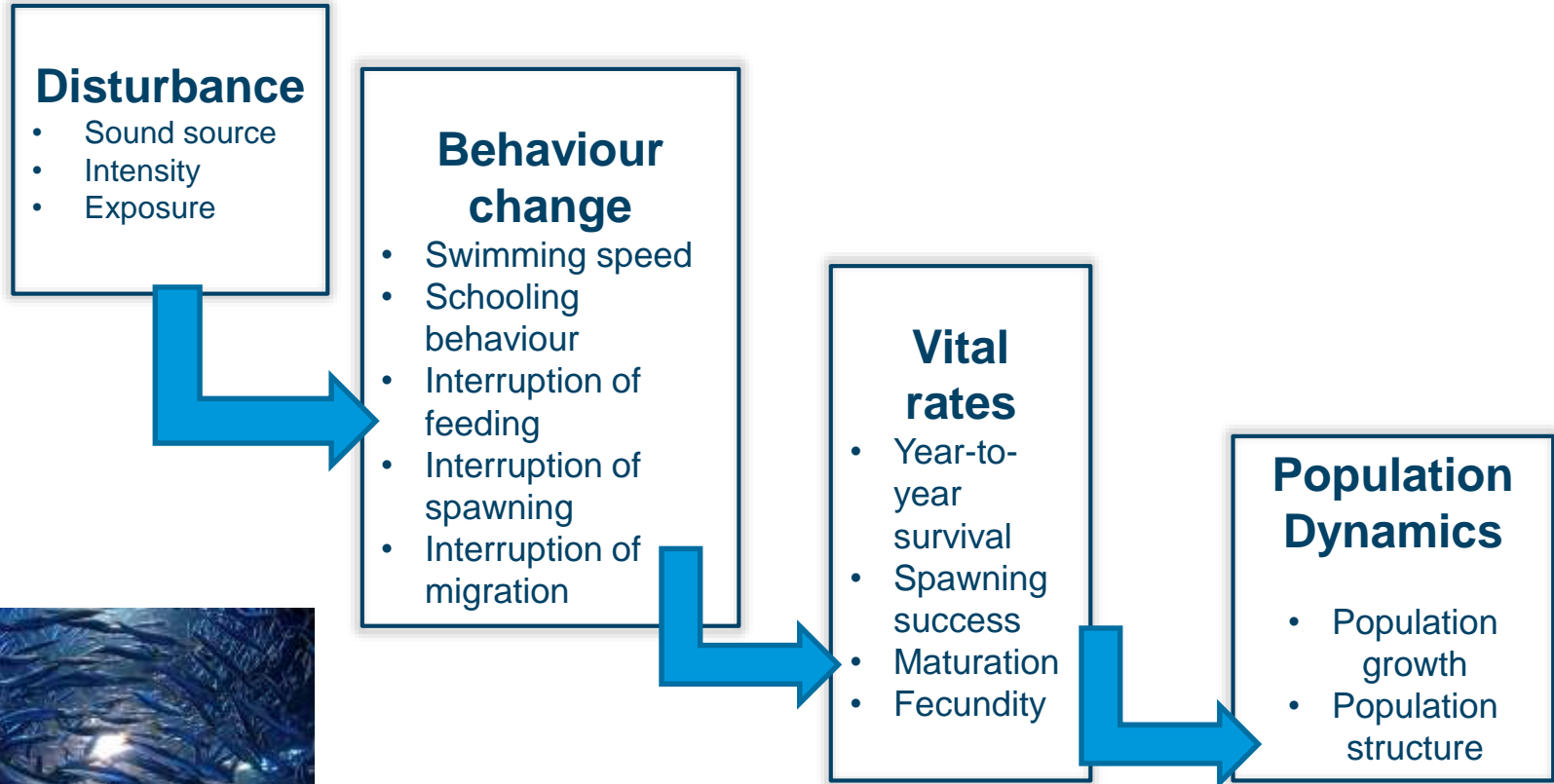
Summary of CEDA / WODA



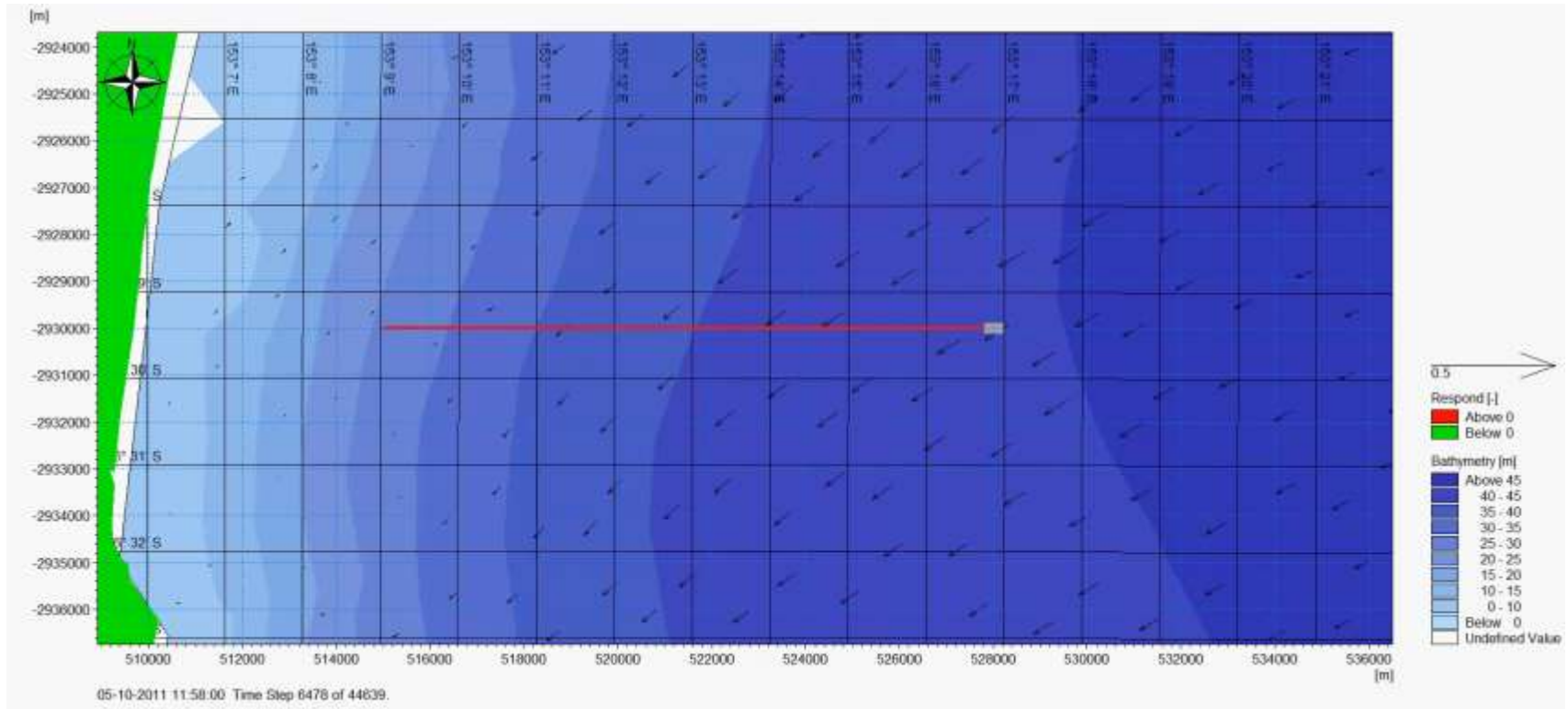
- Dredging comprises lower sound pressure levels compared to other activities (e.g. pile driving)
- Behavioural impacts and masking possible
- TTS to consider at long exposures
- Injury unlikely



PCAD Framework



Sound response model illustration



Take home



- Marine industries emit a variety of sounds
- Some key issues have been identified
- Marine industry impacts can be managed using a risk based approach
- WODA and CEDA are good examples for information transfer into society
- Some key issues can be tackled using new methods (e.g. ABM)