



Introduction to underwater noise theme

Porpoises and underwater noise: effects and possible mitigation measures

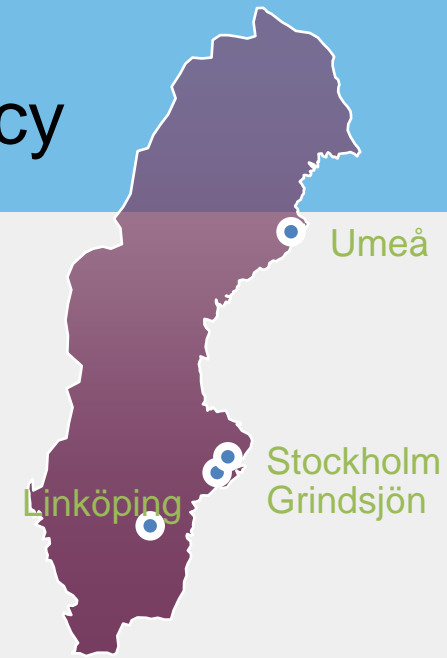
Torbjörn Johansson

Dept. Of Underwater Research
FOI – Swedish Defence Research Agency



FOI – Swedish Defence Research Agency

- Government Authority under the Dept. of Defence
- Financed through assignments – no standing grants
- 1000 employees, 800 scientists
- Both military and civilian customers
- Dept. of Underwater Research
 - 55 employees
 - Acoustics and electromagnetics in the sea
 - Theory, experiments, modelling, analysis, sensor design
 - Long experience of the underwater environment
 - Rapid growth in civilian market - underwater noise and its impact on the environment

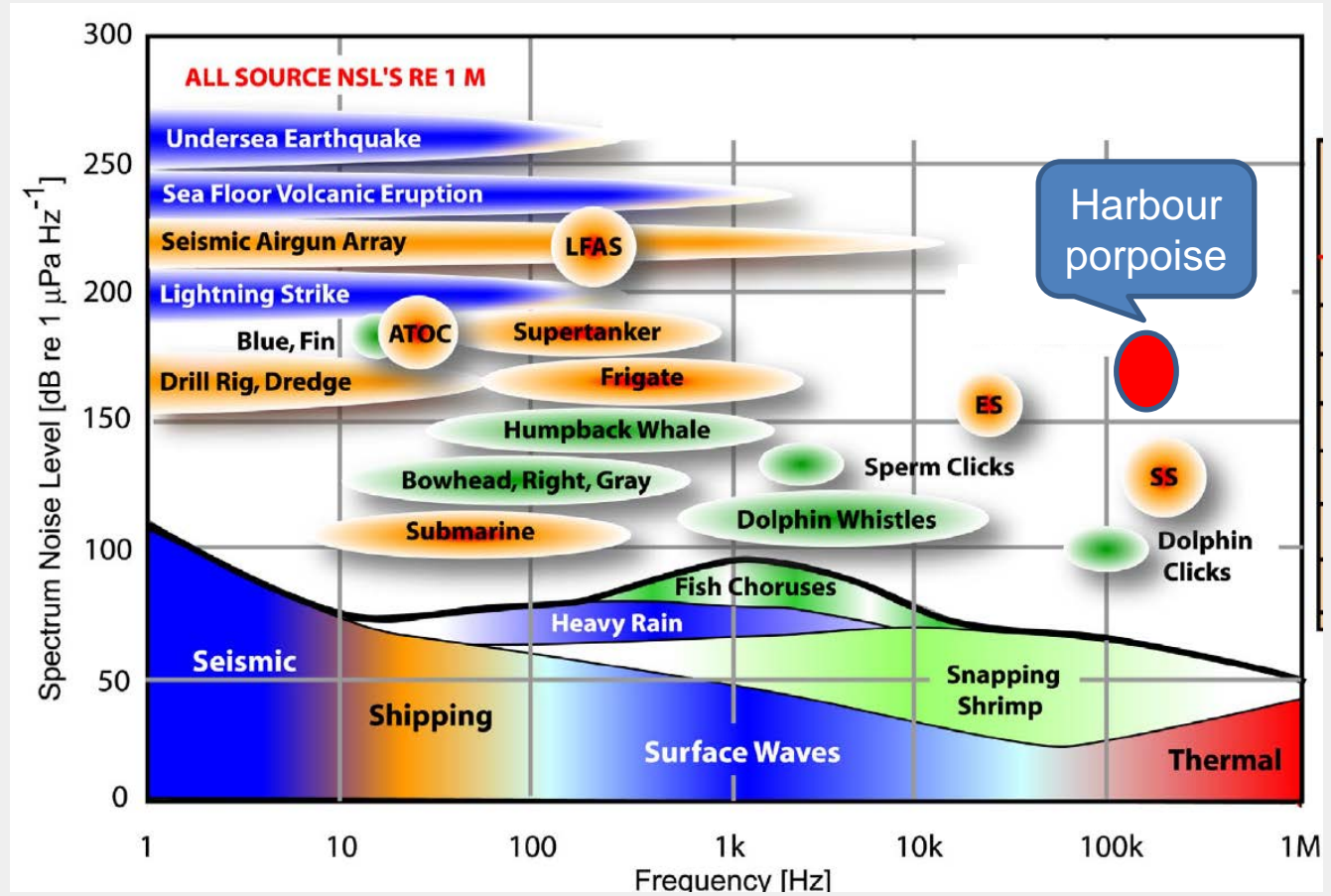


Marine Strategy Framework Directive

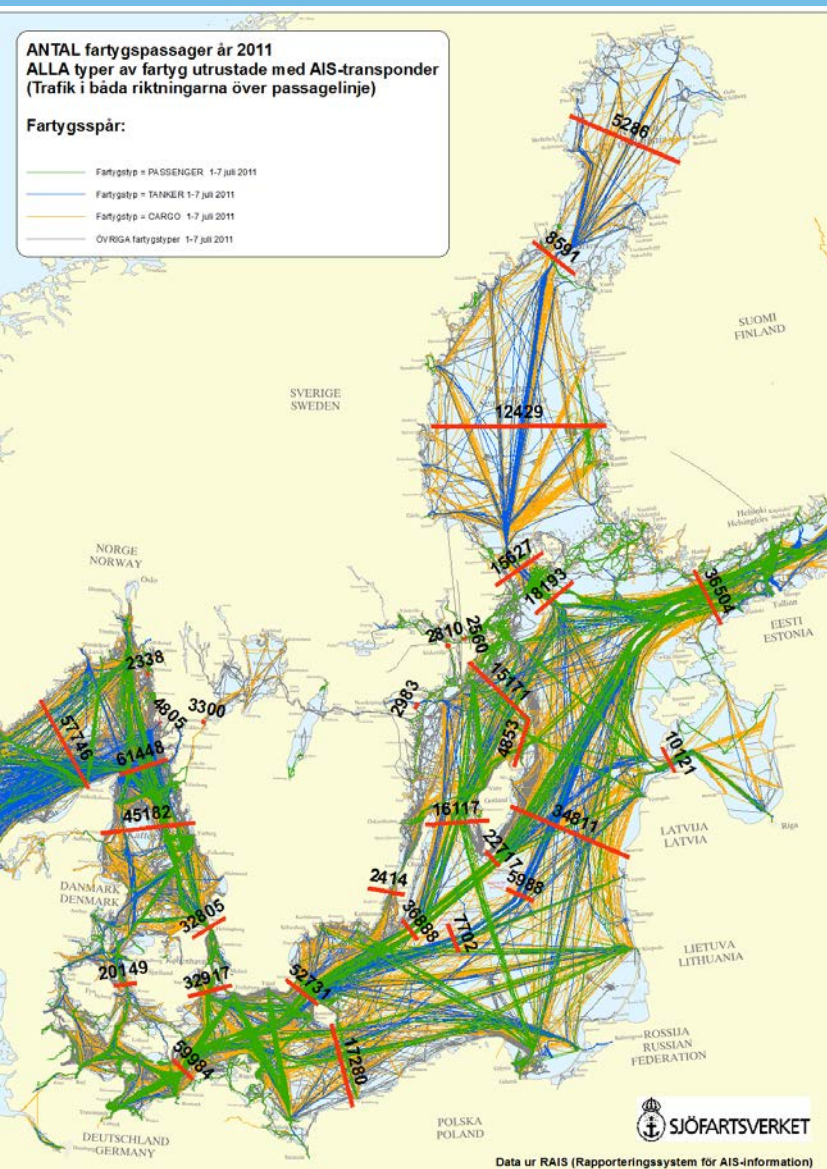
- 11 descriptors – strive to achieve Good Environmental Status (GES)
- Descriptor 11:
Introduction of energy (including **underwater noise**) does not adversely affect the ecosystem
- Two indicators in descriptor 11:
 - Levels of continuous low frequency noise (shipping)
 - Number of loud underwater transients (construction, seismic exploration)



Natural sound in the seas



Continuous anthropogenic noise



Transient anthropogenic noise

- Airguns
- Pile driving
- Explosions
- Fish finders
- Echosounders
- Military sonars



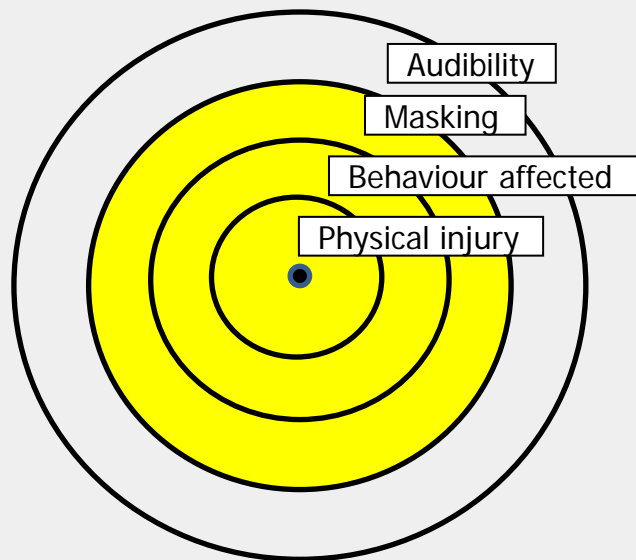
Underwater sound propagation (abridged)

- Sound in water vs. Sound in air
 - 5 times faster
 - Much less absorption
 - Reflections on seabed and sea surface

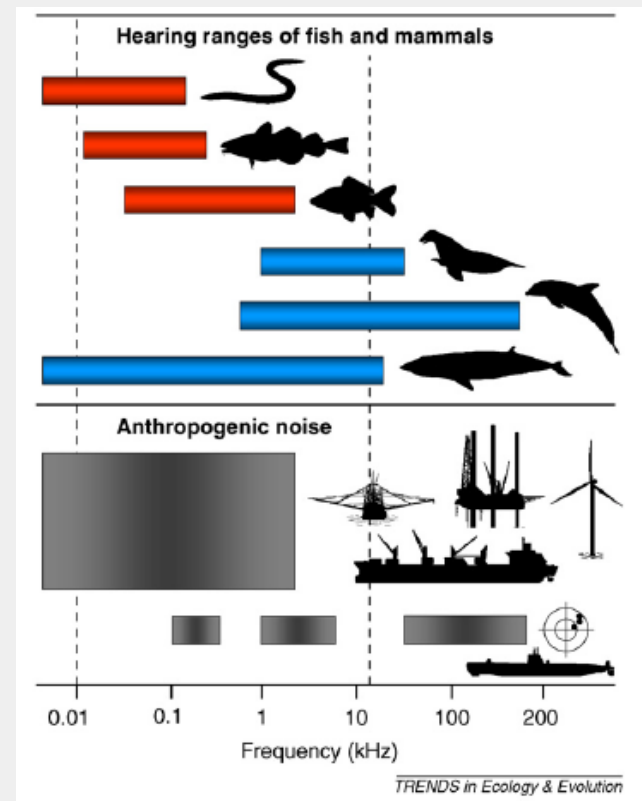


AUDIBILITY RANGE	On land	Under water
Traffic route	Motorway <i>a few km</i>	Shipping lane <i>100 km +</i>
Biological calls	Tiger roar <i>a few km</i>	Blue whale call <i>across oceans*</i>

Masking of calls




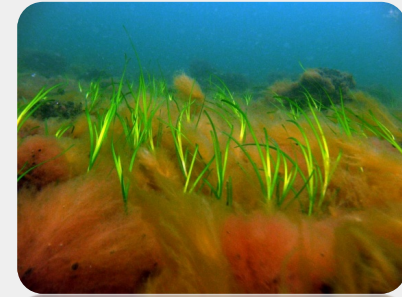
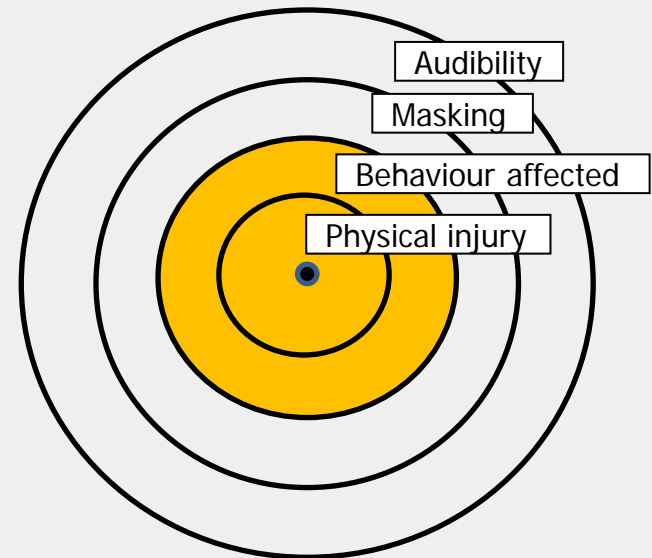
Richardson et al. (1995), "Marine mammals and noise"



Slabbekoorn et al 2010

Natural behaviour affected

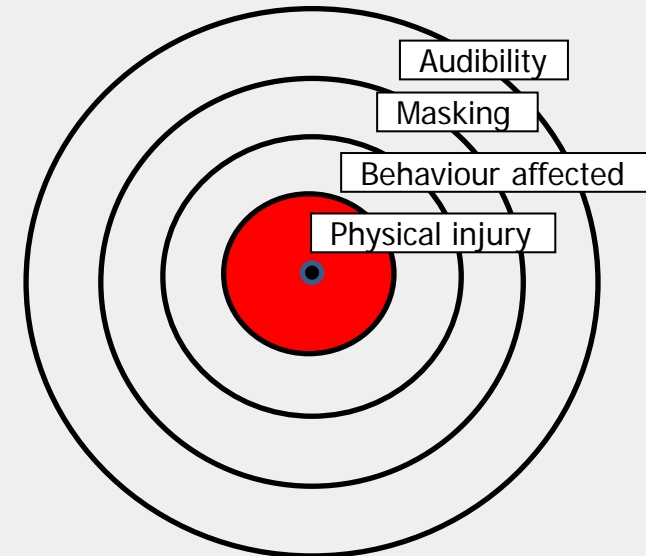
- Natural behaviour interrupted
 - Escape reactions*
 - Stress*
- 
- Animals may choose to stay in noisy areas if e.g. feeding, spawning, rearing young
 - Stress may affect reproductive rates
 - Porpoise behaviour can be affected by military sonars at ranges up to 20 km



Effects: physical injury



- Loud noise can cause temporary or permanent hearing damage
- Direct organ damage can occur at extreme levels
- Harbour porpoises may suffer temporary hearing damage at several km range from an airgun



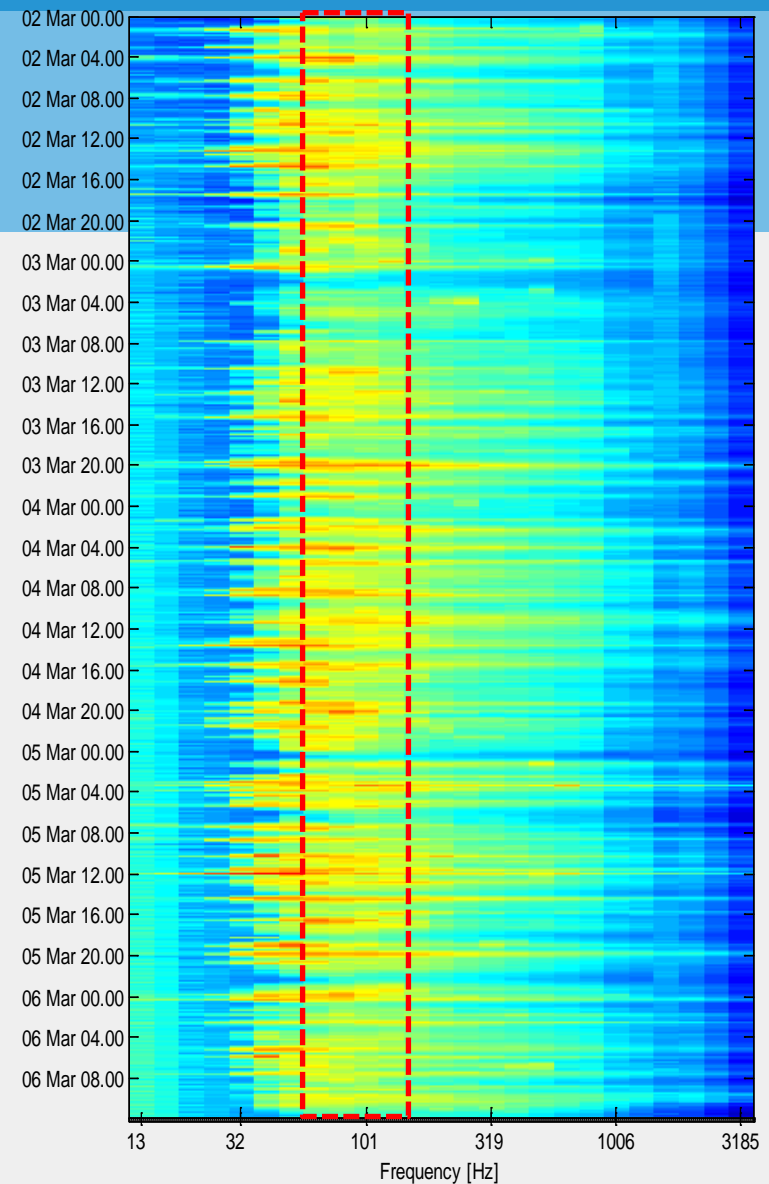
Mitigations – planning/policy

- Consider effects of noise on marine life when planning noisy activities at sea
 - Sensitive areas
 - Sensitive times
 - Species-specific approach
 - Marine Protected Areas (MPA)

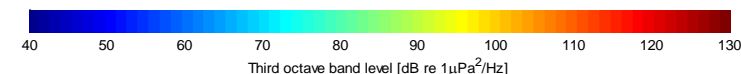


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Third octave band noise spectra near a shipping lane in the Baltic Sea (90 km SSW of Gotland)



Mitigations - design

- Shipping noise footprint reduction
 - Build quieter ships – propeller design, engine insulation
 - Optimise speed – running slower does not always mean less noise
- If you have to make noise
 - Restrict it
 - Make it on land rather than in the water
 - Use low impact sound sources
 - Scare animals away
 - Direct the noise towards the seabed
 - Stop it from escaping (bubble curtains)



Baltic Sea Information on the Acoustic Soundscape BIAS

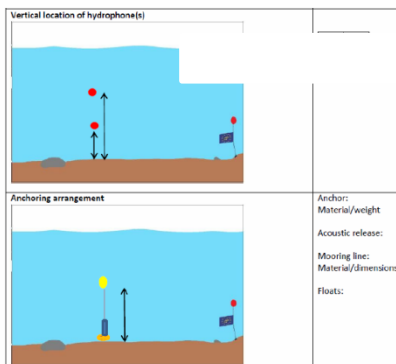


Sound record datasheet

BIAS B.10 Quality assurance. Sound record datasheet. DRAFT 4 April 2013

BIAS B.10 Quality assurance. Sound record datasheet. DRAFT 4 April 2013

BIAS		SOUND RECORD		QA datasheet	
BASIC INFORMATION:					
Record number			BIAS Standards used:		
Station number/name			Instrument		
Hydrophone number			Programming		
Calibration data			Anchoring		
			Data storage		
			Data postprocessing		
SD-card ID					
Rec. Start time	GPS UTC	Rec. End time	GPS UTC		
Raw data backup	Done by				
File name					
File size					
Processed data	Done by				
File name					
File size					
Deployment log sheet:			Recovery:		
Ship/Master:			Ship/Master:		
Cruise No:			Cruise No:		
Moorings No:			Moorings No:		
Date:			Date:		
UTC time:			UTC time:		
Lat:			Lat:		
Lon:			Lon:		
Wind speed/Direction:			Wind speed/Direction:		
Wave height/direction:			Wave height/direction:		
Ice conditions:			Ice conditions:		
Remarks:					
Moorings engineering:					



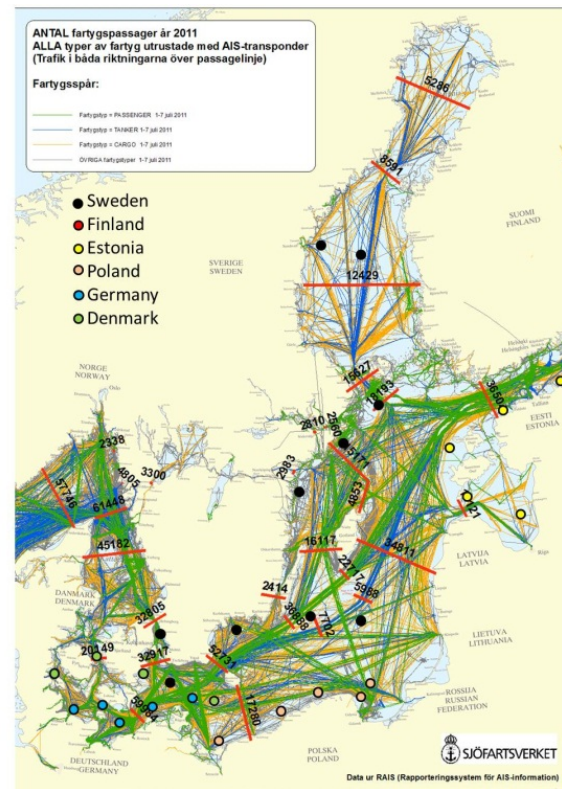
Main objectives:

To establish a regional handling of sound

To develop new standards for monitoring of continuous ambient noise

Develop management tools

A full year of measurements at 40 locations and establish a soundscape map

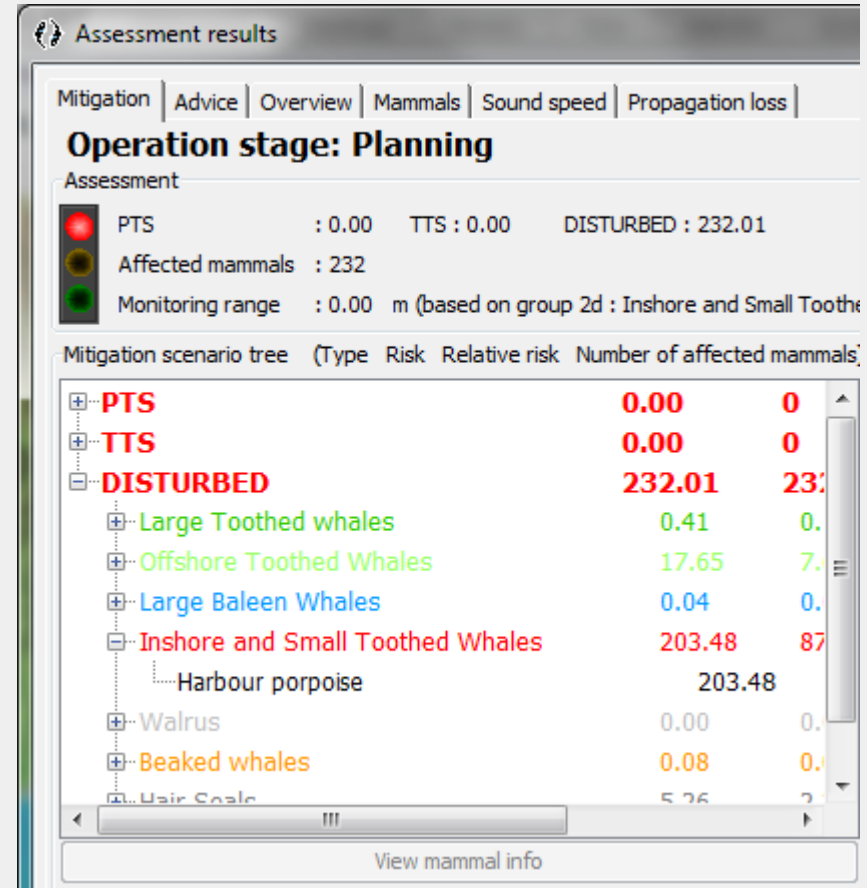
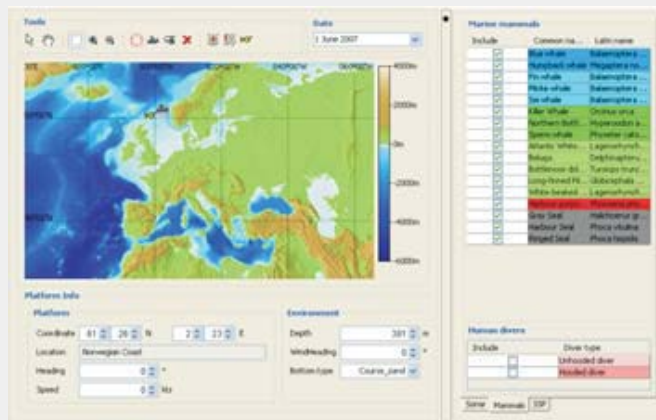


Partners: Finland, Lithuania, Estonia, Poland, Germany, Denmark and Sweden

Protection of Marine Mammals

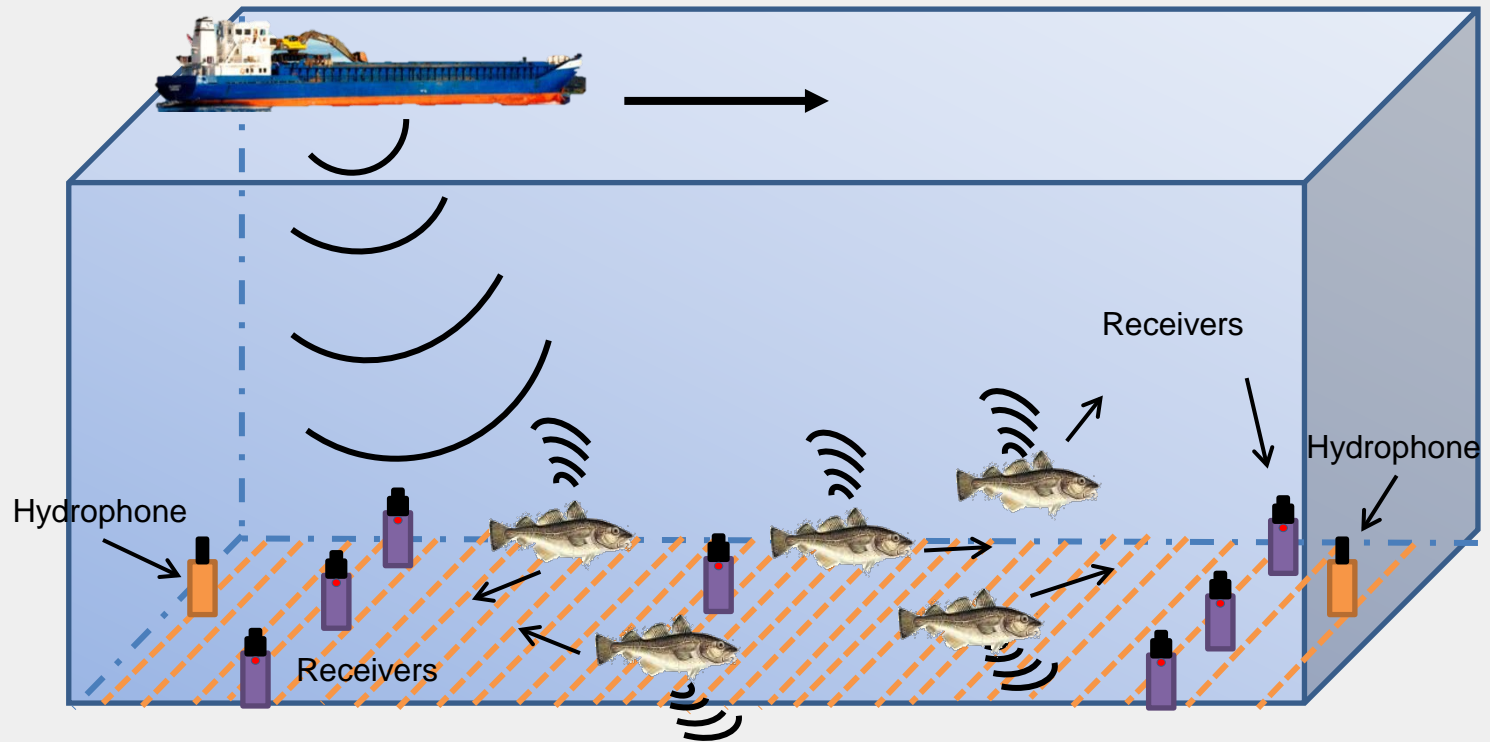
Multi-discipline project gathers knowledge and provides the Swedish Navy with tools, methods and policies for risk aware operation of active sonar

- Database, experiments, call detectors, impact analysis
- Evaluation of **risk assessment tools** for active sonar



AQUO – Achieve Quieter Oceans by Shipping Noise Footprint Reduction

- An EU FP7 project within the Sustainable Transport area
- Subtask 4.2 : displacement effects of shipping noise on fish



Swedish Agency
for Marine and
Water Management



Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences



Thank you!

- Questions?

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Ambient Underwater Noise
Levels at Norra Midsjöbanken
during Construction of the Nord
Stream Pipeline

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FOI R-3469-SE
ISSN 1650-1942

September 2012

<http://www2.foi.se/rapp/foir3469.pdf>

