3S Symposium // 27th October 2015 // St-Andrews, UK



Comparing behavioral responses of cetaceans to naval sonar versus killer whale sound playbacks



Introduction

3S aim: to investigate the <u>potential disturbance</u> effects of naval sonar on cetaceans' behavior.

What is a disturbed behavior in cetaceans?

Need for a reference model of natural high-level disturbance

Predation risk



Anti-predator behavior

Biologically costly but selected by evolutionary processes.

Represents a yardstick to assess the level of disturbance induced by anthropogenic stimuli.



Killer whale

potential predator of other cetacean species Jefferson *et al.* 1991; Morell 2011

Acoustic stimuli exposure



VS.



Anti-predator behavior = reference model of natural high-level behavioral disturbance

Similar reactions ?

Comparing behavioral responses to sonar versus KW playbacks in order to assess the level of disturbance induced by sonar

Studied species

Sperm whale



(Physeter macrocephalus)



Long-finned pilot whale (Globicephala melas)

Humpback whale (Megaptera novaeangliae)

3S Protocol

Tagging



Baseline



Sonar exposure LFAS (1-2kHz)



Killer whale playback



Controls (CTRLs):

- Silent vessel path (no-sonar CTRL)
- Noise playback



Tag recovery

Behavioral measurements

- Horizontal movement
- Surface social behavior
- Dive profile
- ACOUSTICS (foraging & social sounds)

Study 1: Sperm whale

Killer whale = potential predator (at least for calves in breeding grounds)

Responses to KW playback and to CTRL noise playback:

Dive profile of tagged animal sw10_150a



- > Interruption of the foraging activity in response to KW sound playbacks.
- Initiation of a social behavior (grouped with other whales).

Example From 3S technical report

Dive profile of sw09_141a and indication of social sounds production:

Zoom on response to LFAS sonar

Zoom on response to KW playback



- Wiggle in the dive profile.
- Increase of social sounds.

- Shallower and shorter dive.
- Increase of social sounds.
- Grouped with 3 more whales.

Study 1: Sperm whale Summary

	Sperm whale		
	KW	LFAS	
Alteration of foraging	yes	yes	
Horizontal avoidance	yes	yes	
Social response	7	É	
Magnitude of the response (duration, severity, consistency)		>	

Good match between responses to sonar and KW playbacks.



Killer whale = potential predator (mostly for calves)

Responses to KW playback and to CTRL noise playback



Study 2: Humpback whale



Example From 3S2 technical report

Dive profile of mn12_171a with indication of feeding activity (•)



Interruption of feeding in response to sonar and to KW playback.

Study 2: Humpback whale Summary

	Humpback whale				
	KW	LFAS			
Alteration of foraging	yes	yes			
Horizontal avoidance	yes	yes			
Social response	-	-			
Magnitude of the response (duration, severity, consistency)					

Very good match between responses to sonar and KW playbacks.

Study 3: Long-finned pilot whale



Killer whale = potential predator and/or competitor for food

Responses to **KW playback** and to **CTRL noise playback**:



Track of gm10_158d.

turn towards the KW sound source.

Aggregation of animals in response to KW sounds.

Study 3: Long-finned pilot whale



Response to LFAS (1-2kHz)









Study 3: Long-finned pilot whale Summary

	Long-finned pilot whale		
	KW	LFAS	
Alteration of foraging	-	yes 33%	
Horizontal avoidance	- (attraction) 80%	yes 50%	
Social response	≠ strategies		
Magnitude of the response (duration, severity, consistency)		>	

Very low match between responses to sonar and KW playbacks.

1 - Consistency of the responses:

Anti-predator responses are species-specific and overall more consistent within species than responses to sonar.

2 - Concordance between reactions to sonar and KW playbacks:

The level of concordance between responses to sonar and to killer whale playbacks vary across species => higher for species having a greater predation risk by killer whales.

	Pilot Whale	Sperm Whale	Humpback Whale
Match between responses to KW and sonar	LOW	MEDIUM	HIGH
	low	Predation risk by K	high W

Our observations support that for SW and HW, LFAS sonar-induced disturbance is comparable to the disturbance caused by the presence of a predator.

Limits:

• Behavioral responses may vary according to various factors: behavioral context (foraging, mating, etc.), age, gender, body condition, group size and composition (e.g. presence of calf), source characteristics, etc.

> Perspectives:

We can expect anti-predator behavior to be a **good predictor of responsiveness to sonar** for particularly sensitive species.

Futur research: applying similar approach on Minke whales and beaked whales.

Project partners











Forsvarets forskningsinstitutt





Research fundings













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