



Environmental acoustic impact & Work permits / Diplomatic Clearances

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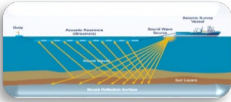
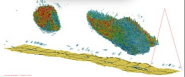
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Sound risk assessment of scientific cruises

- Qualification of the risk
- Quantification of the acoustic impact on marine mammals
- Thresholds Risks Definition & Brief History
- Risk assessment methodology
- Example of a fishery stock survey cruise



Frequency of the Sources

$f < 100 \text{ Hz}$	$100 \text{ Hz} < f < 1 \text{ kHz}$	$1 < f < 10 \text{ kHz}$	$10 < f < 100 \text{ kHz}$	$f > 100 \text{ kHz}$
	Seismic sources			
	Sparkers			
	Marine Traffic			
	Marine mammals			
			Sounders mapping & Water column 	
		Military Sonar		
		Sub-bottom Profilers 		 



Qualification of the risk

The risk is not systematic, it depends on:

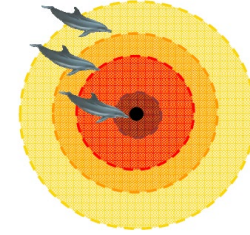
- the shape and content of the transmitted signal (frequency, duration, amplitude, directivity),
- the marine species considered, the individual characteristics of the animals present (age, sex, habitat, activity, etc.),
- and environmental conditions (distance, water height, topography ...).



Quantification of the acoustic impacts on marine mammals



- Behavioural impact
- Physiological direct effects
- Non-Direct physiological effects



Thresholds Risks Definition & Brief History

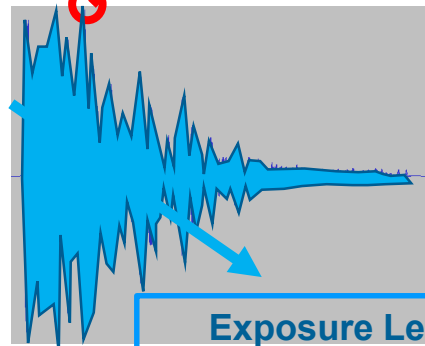
- 1997 : First thresholds defined by NMFS

SPL = 180/160 dB → Physiological Impact / behavioral

**Pressure Level
(SPL)** = Peak
amplitude

But, do not take into account...

- Signal nature (impulsive, continuous, etc)
- Signal characteristics
- Auditory sensitivity



**Exposure Level
(SEL)** = Cumulated
energy

- 2007 : Southall et al; integration of dual approaches: SEL & SPL

and is regularly updated according to the scientific knowledge

Hearing Group	
Low-Frequency Cetaceans (LF)	
Mid-Frequency Cetaceans (MF)	
High-Frequency Cetaceans (HF)	



Thresholds risks Definition

- **2018: NOAA/NMFS: TTS and PTS Onset,**
- TTS onset: temporary hearing impairment (~soft hearing fatigue)
- PTS Threshold = TTS of 40 dB = permanent impairment onset

Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects

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Non impulsive signal

Marine Mammal group	Physiological Threshold	
	TTS	PTS
LF cetaceans	Stationary Source	Mobile Source
HF cetaceans		
VHF cetaceans		
New thresholds and criteria published by NOAA end of 2024, under integration		

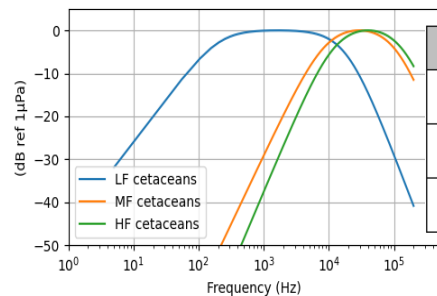
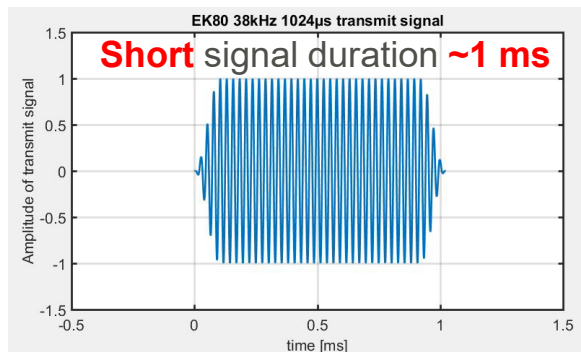
TTS (Temporary Threshold Shift) & **PTS** (Permanent Threshold Shift) for a non-impulsive sound; SPL_{pk} : dB re μPa @ 1m and SEL_{cum} : dB re $\mu Pa^2/s$. Ref.: NOAA, 2018

Sound risk assessment methodology (for single beam echosounder)

Knowing acoustic characteristics of
sound sources



Cetacean auditory sensitivity and
tolerable thresholds

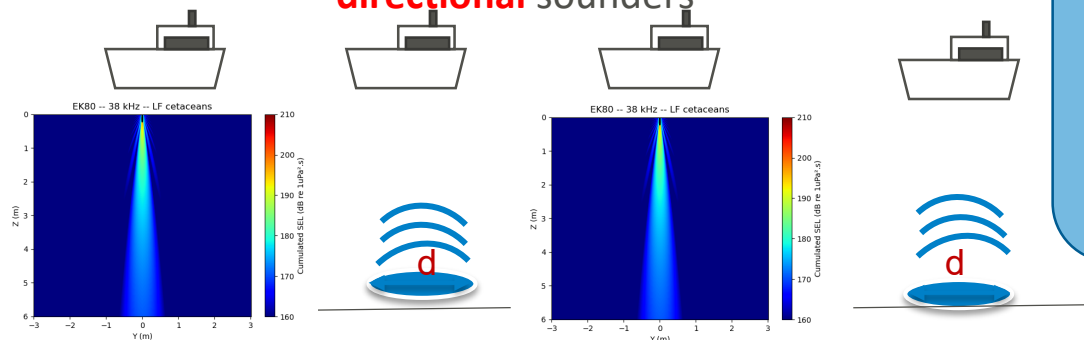


Hearing Group	PTS Onset Thresholds Non-impulsive
Low-Frequency Cetaceans (LF)	SEL _{cum} : 199 dB
Mid-Frequency Cetaceans (MF)	SEL _{cum} : 198 dB
High-Frequency Cetaceans (HF)	SEL _{cum} : 173 dB

+

Numerical calculation

- Continuously **moving (8 knots)**
- **directional** sounders

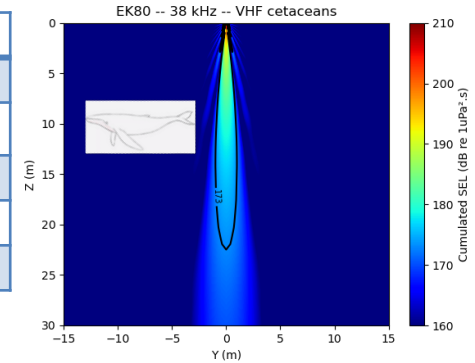


Ping rate : 1 ping/s

Sound produced 0,1% of
the time of the campaign

Example of a fishery acoustic campaign

	EK80-18	EK80-38	EK80-70	EK80-120	ME70
Frequency (kHz)	18	38	70	120	90
Sound Level (dB re. 1μPa @ 1m)	227	230	226	220	216
Pulse length (ms)	1.024				
Repetition rate (s)	0.35				
Angular beamwidth (°)	11	7			120 x 3



PTS thresholds	Potential impact distances		
	LF cetaceans	HF cetaceans	VHF cetaceans
EK80-18	0.5 m	1 m	14 m
EK80-38	0.3 m	1 m	23 m
EK80-70	0.1 m	0.7 m	13 m
EK80-120	0.0 m	0.2 m	5 m
ME70	0.0 m	0.2 m	4 m

	Maximum number of pings over TTS threshold potentially received		
	LF cetaceans	MF cetaceans	VHF cetaceans
EK80-18	1	1	5
EK80-38	1	1	5
EK80-70	1	1	3
EK80-120	1	1	1
ME70	1	1	1

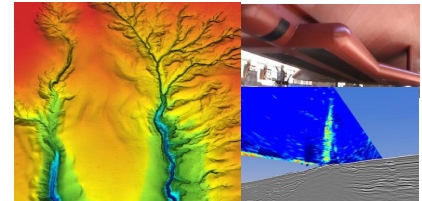
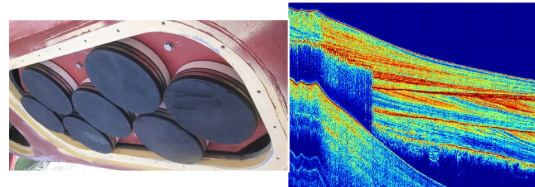
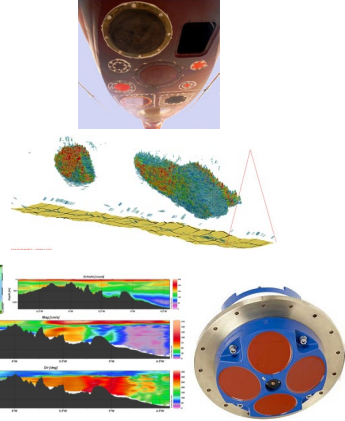
Fishery acoustic surveys do not present any physiological danger for marine mammals potentially encountered

Scientific fields and associated equipment

- Frequency of the sources
 - Several types of acoustic equipment
 - About seismic equipment
- ➔ Mitigation protocols

Campaigns with likelihood risk low

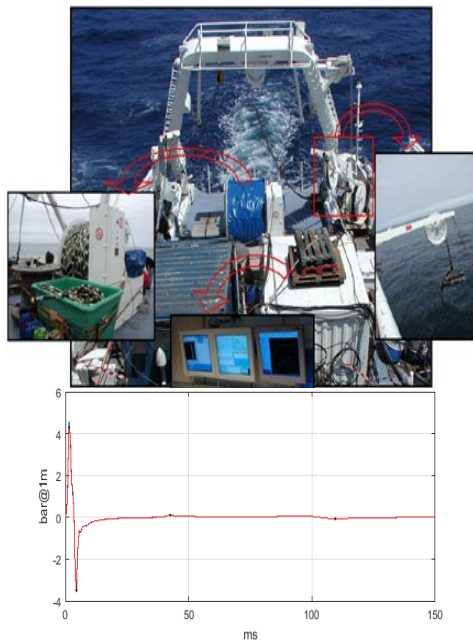
- **Fisheries** surveys (single and multibeam echosounders)
- Physical **oceanography** cruises (Doppler current meters)
- **Mapping** cruises (bathymetric multibeam sounders)
- Marine **geoscience** cruises (sediment and multibeam sounders)



Several type of seismic

High-Resolution Seismic/ Class 2

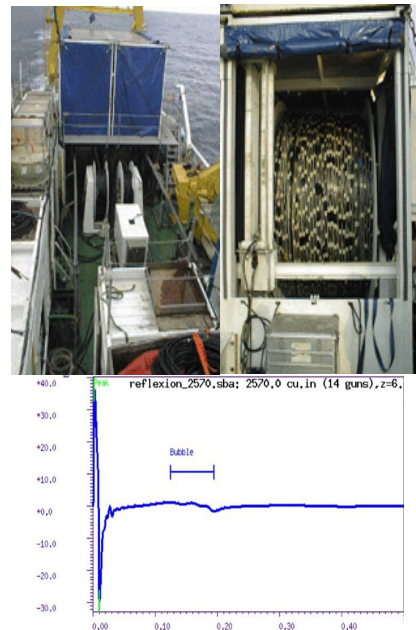
$V < 500$ cu.in



→ different impacts

Heavy Seismic Source/ **Class 1**

$V > 500$ cu.in



Factor of 10 in acoustic pressure = 20 dB = factor 100 in power

For HEAVY Seismic
vol > 500cu.in

Marine Mammal Management Plan

→ to limit acoustic impact risks on marine mammals

- IFREMER has drawn up and adopted since 2011 a MMMP, applied during some works at sea involving high noise levels.
- Last update in 2019:
 - Sea turtles are now part of the species concerned
 - Campaigns at periods of low biological activity
 - Visual monitoring protocol (MMOs)
 - Acoustic monitoring protocol (PAM operators)
 - Definition of an alert area and an exclusion zone
 - Pre-watch period and Soft start
 - Possibility of immediate shutdown of sound emissions



	Marine Mammals	Turtles
Exclusion Zone (m)	500 m	100 m

How the authorities handle the issue

- Reminder of several examples :
 - ❖ Spanish waters
 - ❖ Italian waters
 - ❖ French waters
- The reasons exposed and consequences

Analysis of the reasons :

- An apparent lack of knowledge and ability to analyse properly the real impact on the mammals, leading to extreme precautions :

Since **2021**, the clearance for our scientific operations in Italian, Spanish waters and even in some French waters have been subject to certain environmental « conditions » issued by the Ministry of Environment (MITECO, ...) of those countries.

One specific aspect of that concern is about the use **acoustic equipment** (in general) and the **mitigation measures** which are requested to « minimise » their impact on the marine environment.

Indeed, it seems that the consideration on the levels of reference or requirements are significantly different from a country to another and have been « **fluctuating** » over the years, sometimes even for recurring cruises (i.e. for identical operations, equipment, vessels, periods)

Analysis of the reasons :

- A divergence of point of view on the thresholds considered by the authorities :

Despite the demonstration attempted by Ifremer on the characteristics of the cruise, **in movement by nature**, the Permanent Threshold Shift (PTS) is applied for calculation of the acoustic impact instead of Temporary Threshold Shift (PTS)

- Some EIA (Environmental Impact Assessment) are really expensive (between 60 k€ up to 90 k€ each) without any grant to receive the Dip clear at the end.
- Regular and stronger pressures from several environmental associations and media:
We know that local authorities are permanently under pressure of some environmental associations (not all!) that are however **not** fully aware of the real impact, and deeply use the media and social networks in order to shame and bannish such scientific cruises.

Consequences

- ➔ As a result we had to **cancel some operations and even full cruises** when we were unable to achieve the work in full compliance with this unusual recommendations.
- ➔ Worst, in French waters, **the work permit duly received by the authority was then cancelled by legal decision** under the pressure of local environmental association. This impacted directly the cruise, together with the social benefits awaited.
- ➔ Even for a « routine » fishery cruise, nowadays we should sometime deploy MMOs and PAM !
- ➔ Despite all our attempts of communications and demonstrations, today there's no real improve to converge to an European harmonized consideration.

WHAT ABOUT YOU ?



**FLOTTE
OCÉANOGRAPHIQUE
FRANÇAISE
PAR L'IFREMER**



Thank you