The Effects of Noise on Aquatic Life:
Seismic survey risk assessment on common
dolphins in the south-western coast of Portugal

Giulia Spadoni, Ricardo Duarte, Cristiano Soares, Marc Fernandez and Sérgio M. Jesus
SiPLAB – University of Algarve
Contact: gspadoni@ualg.pt

ASCOBANS Common Dolphin meeting
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Main objective:
Assessing the risk from seismic survey on local communities in the selected area
Presentation content divided into three main topics:

- **Noise**
- **Species**
- **Risk**
- **Seismic survey**: oil and gas exploration

- The case of the **coast of Portugal**

- Environmental conditions for **wind energy** exploration

Wind farm (source: TebNad/Shutterstock.com)  
Seismic survey experimental setup (source: Kukreja et al. 2017)  
Oil and gas exploration concessions in the Portuguese coast (source: www.geoexpro.com)
Light seismic survey

- **Light seismic survey**: wind farm installation
- **Shallow water** environment
- **Sparkers** (since they are the most used)
- **GEO-Source 200** as reference*

*Developed by GEO Marine Survey Systems, Netherlands
Seismic survey modeling

- Location: **Setúbal** [Lat: 38.2; 38.6] x [Lon: -9.3; -8.5]

- **Challenging bathymetry**\(^1\) of the area: (1km x 1km resolution)

- Period: **January** and **June 2019**

- **Sound speed profiles** calculated from Temperature and Salinity profiles\(^2\)

- Assumed typical **seabed** parameters\(^3\)(sediment layer + rocky semi-infinite sub-bottom)

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\(^1\)GEBCO database: https://www.gebco.net/

\(^2\)Source: CMEMS-Copernicus Marine Service

\(^3\)C. Soares, F. Zabel, and S. M. Jesus, “A shipping noise prediction tool”, 2015
Seismic survey modeling (cont...)

- **GEO-Source200 Sparker**: frequency range **300 - 1000Hz**
- **Source level**: 220dB
- **Depth**: 1m; **firing interval**: every 5sec
- **Analyzed area**: 50km² [-8.92;-8.87]x[38.34;38.42]
- **Source movement**: lawn-mower pattern
- For modelling, receivers placed at: 5, 15, 30, 50, 75, 100m depth
Noise Maps

- Results expressed as SPL;
- Extremely high dB (185dB in some areas);
- Influence of the bathymetry (250m);
- Larger spread in January (seasonal).
Modeling the Portuguese coast’s biodiversity

- Biodiversity in Portugal: **cetaceans**

- **Target species: common dolphin**;

- Chosen as a representative of the small cetaceans and MF/HF cetaceans;

- **Maximum Entropy model** developed for the entire Portuguese coast.

[biodiversityinformatics.amnh.org/open_source/maxent/]
Modeling inputs for Maxent

Observations data


B. **SeaEO tours** [2018 – 2019]

C. **Marlimitado** [2005 – 2020]

Environmental layers

- **Terrain variables**: Depth; Seabed slope.

- **Oceanographic variables**: (2005 - 2020) Sea Surface Temperature (SST); Chlorophyll-a; Standard Deviation of the Chlorophyll-a.
Modeling inputs for Maxent

1. https://www.ncei.noaa.gov/maps/bathymetry/

NOAA, ETOPO 1 Global Relief Model
Calculated on QGIS 3.18
Copernicus Marine System
Copernicus Marine System

1  https://www.ncei.noaa.gov/maps/bathymetry/
3  https://cds.climate.copernicus.eu/cdsapp#!/dataset/satellite-ocean-colour?tab=overview
Habitat Suitability Maps

- High HS values along all the coast of Portugal;

- **Summer** season presents the highest HS values;

- Areas with **low depth**.
• Zoom from previous maps for the region of **Setúbal**

• Higher habitat quality in **June** than in January;

• Higher in areas with **low depth**;

• Higher near Comporta and Cabo Espichel.
• **Typical approaches:** Erbe 2014\(^1\), Merchant 2018\(^2\), Verling 2021\(^3\)

• **Applied methodology:** Erbe 2014

• The Effects of Noise on Aquatic Life: “Assessing Risk of Noise Pressure on Marine Life Using Bayes Estimator”

\(^1\)Erbe et al., PLoS ONE, 9:3, 1-10, 2014
\(^2\)Merchant et al., Conservation Letters, 11(3):e12420
\(^3\)Verling et al., Marine Policy, 134, 2021
• **Risk analysis: temporal and spatial variation**
  
  ➢ **Habitat Suitability** higher in June and in costal areas
  
  ➢ **Noise** less dissipated in June and higher values in shallow waters

• Sensitivity until the bathymetric line of 250m: ecological importance

• **Comporta** and **Cabo Espichel**
To conclude

- Sound propagation and species distribution depend on the season;

- They have an influence on risk;

- **Evaluation of the HS** before starting a seismic campaign recommended;

- Months less “harmful” than others

**Upcoming publications:** *Common dolphin’s shipping noise risk assessment on the Portuguese coast.*
THANK YOU FOR THE ATTENTION!

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