



Exploring Geographic Variations and Assessing Effects of Dolphin-Watching Boats on Whistle Emissions of Common Bottlenose Dolphins in Coastal (Algarve) and Estuarine (Sado) Populations of Portugal.

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Introduction

This study aims to provide a quantitative analysis of common bottlenose dolphin (*Tursiops truncatus*) whistles recorded in two distinct areas of Portugal. Based on previous research, we hypothesize that whistle parameters and whistle rates differ between the two areas and may vary depending on the presence or absence of tourist boats (Fig.1).

Methodology

Data were collected from May 2023 to December 2024. The species' whistles were recorded in different contexts and categorized according to the key activities observed at the surface, such as travelling, socialising, and foraging (Fig.2). The group size was estimated by direct counts of the individual dolphins and later average calculation. The sound emissions were analyzed using the software Raven Pro 1.6.5 (Cornell Lab of Ornithology, NY). The whistle rates were obtained by dividing the number of whistles by the number of minutes of each sample and by the group size.



Fig.2 - Activity Patterns of *Tursiops truncatus* in the Algarve and in the Sado.

Whistle rates were higher without dolphin-watching boats, in both locations: 1.2 whistles/min/dolphin. Additionally, 42% of whistles recorded in the presence of boats in the Algarve and 62% in Sado exhibited poor signal-to-noise ratios (Fig. 4).

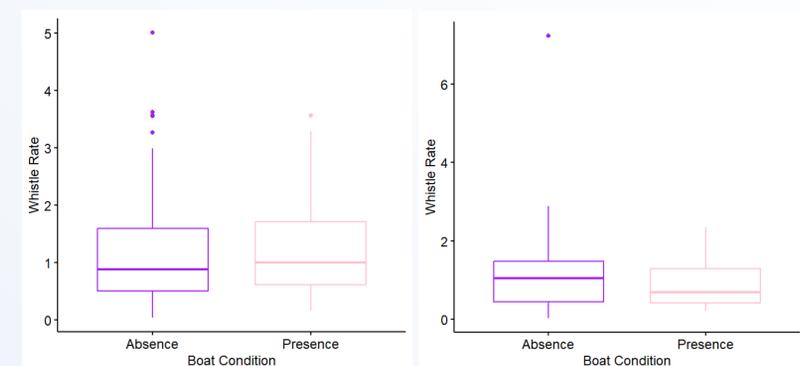


Fig. 4 – Whistle Rate x Boat Presence/Absence in the Algarve (left) & in the Sado (right)

The Mann-Whitney U Test showed that, in the Algarve, dolphins increased minimum and peak frequencies (*). In the Sado, no significant differences were found (Tab.2).

Area	Duration (s)	Whistles Parameters (Mean)					N
		Minimum Freq. (kHz)	Maximum Freq. (kHz)	Delta Freq. (kHz)	Peak Freq. (kHz)	Inflection point (n)	
Algarve	Presence	0.6232	8553 *	14389	5836	11049*	3
	Absence	0.6659	7077	14339	7264	10196	4
Sado	Presence	0.5046	6566	13531	6966	8669	2
	Absence	0.6411	5626	12232	6606	8307	3

Tab.2 – Means for the whistle's parameters x Boat Presence/Absence:

Results

In the Algarve, 3983 whistles were recorded in 66 hours of fieldwork, with the highest rates during Feeding (2.6 whistles/min/dolphin) and Foraging (1.6 whistles/min/dolphin) behaviors. In the Sado Estuary, 1454 whistles were recorded in 18 hours of fieldwork. Socializing (1.5 whistles/min/dolphin) and Foraging (0.9 whistles/min/dolphin) behaviors showed the highest rates, while Feeding behavior was not observed in this area. During traveling behavior, whistle rates were lower in both locations.

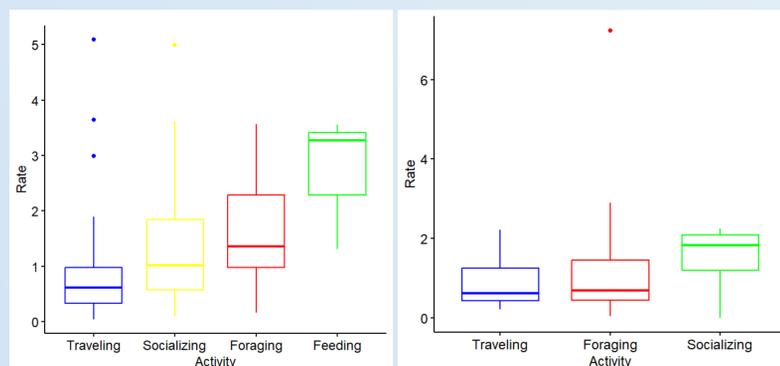


Fig. 3 – Whistle Rate in the Algarve (left) & in the Sado (right)

The Mann-Whitney U test revealed statistically significant differences in all whistle frequency parameters between the two locations, suggesting geographic variation in whistle emissions between the populations (Tab. 1).

Area	Whistles Parameters (Mean)					
	Duration (s)	Minimum Freq. (kHz)	Maximum Freq. (kHz)	Delta Freq. (kHz)	Peak Freq. (kHz)	Inflection point (n)
Algarve	0.6581	7331	14348	7019	10344	3
Sado	0.6053	5896	12659	6763	8413	4

Tab.1 – Means for the whistle parameters

Discussion

Common bottlenose dolphins show whistle emission variations possible in response to social context and boat disturbance:

- Increased whistle rates during social interactions and feeding, both in the Sado Estuary and Algarve, highlight their role in group coordination.
- Lower rates during travel may reflect reduced acoustic needs due to close proximity.
- Boat presence was linked to higher whistle frequencies — likely strategies to avoid acoustic masking.
- This study underscores the importance of assessing possible effects, relevant for conservation, of antropogenic noise and the pressures of boat traffic to costal populations of odontocetes.

Acknowledgments

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