Click and burst pulse proprieties of wildbottlenose dolphin in the Central Mediterranean Sea

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Introduction

Bottlenose dolphins, like other dolphins, produce pulsed acoustic emissions that vary widely in duration, inter-pulse interval, and spectral composition (Au, 1993). In the Mediterranean Sea, studies of the acoustic production of *Tursiops truncatus* are scarce and consider whistles (Lopez, 2011) or clicks but using only a 32 kHz sampling rate. Pulsed signals could be used to identify some dolphin species (Baumann-Pickering *et al.*, 2010), and further studies should be focused on this direction because the new advances in field and autonomous long-term recordings with higher sampling frequencies allow the use of clicks to identify dolphins to the species level. We must consider that for each species, we can find different click types that could have different temporal and frequency parameters. The recording of clicks can be influenced both by environmental factors (e.g., the presence of a reflecting surface and the orientation of the dolphins with respect to the hydrophone) and by the fact that dolphins can produce different click types by their acoustic source structures. All these aspects should be considered when comparing the clicks from different species.

In this study, we present the results of measurements of temporal and spectral parameters of wild Mediterranean bottlenose dolphin pulsed signals (burst clicks and echolocation clicks), considering the inter-click interval and the number of clicks per train as classification factors.

Materials and Methods

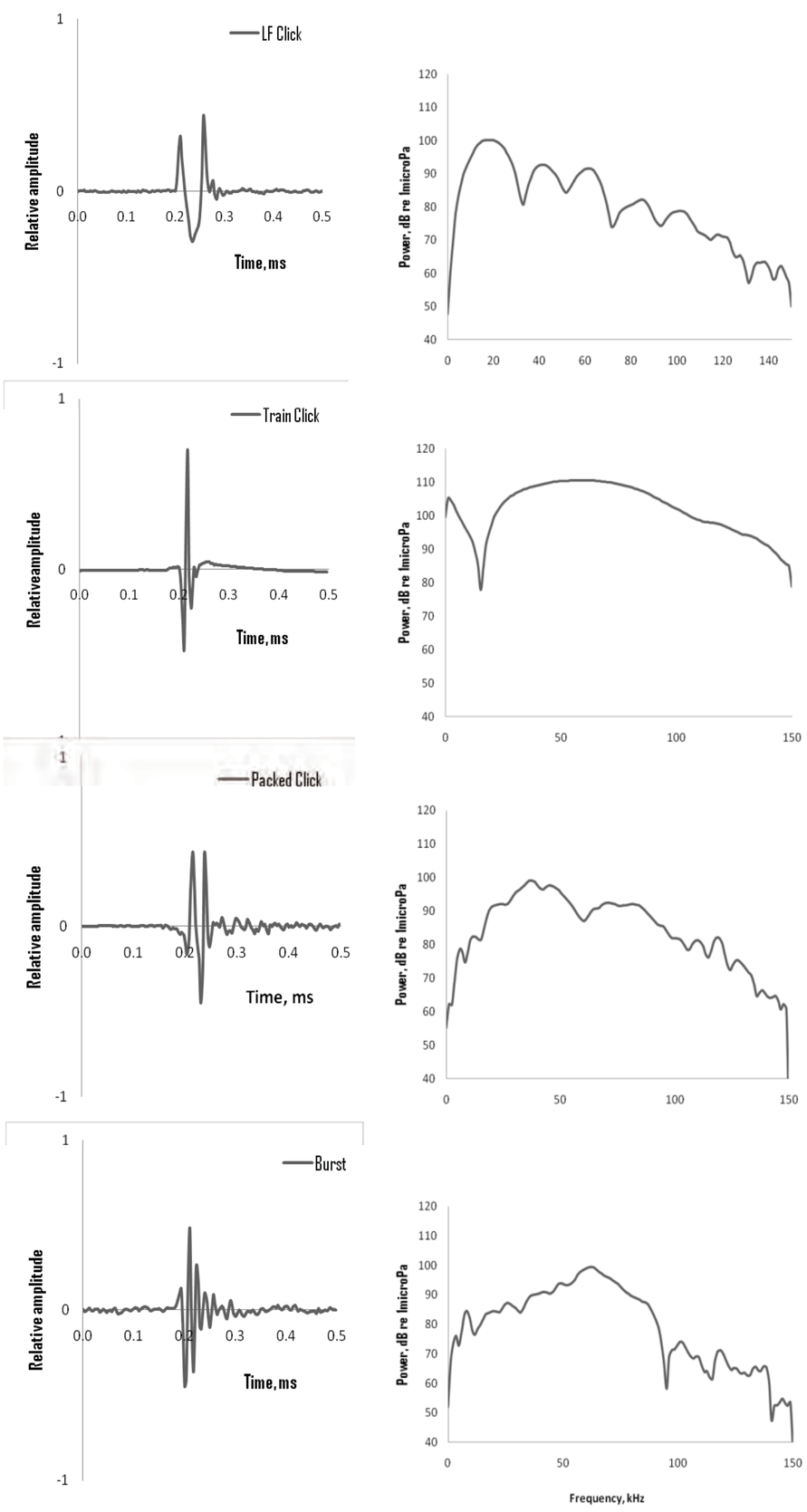
Data were collected in the Sicilian Channel during 27 surveys (summers of 2011 and 2012). Sightings of bottlenose dolphin (n=167) occurred from 1 km to 50 km from the coast and with a bathymetry in the range of 30 to 200 meters.

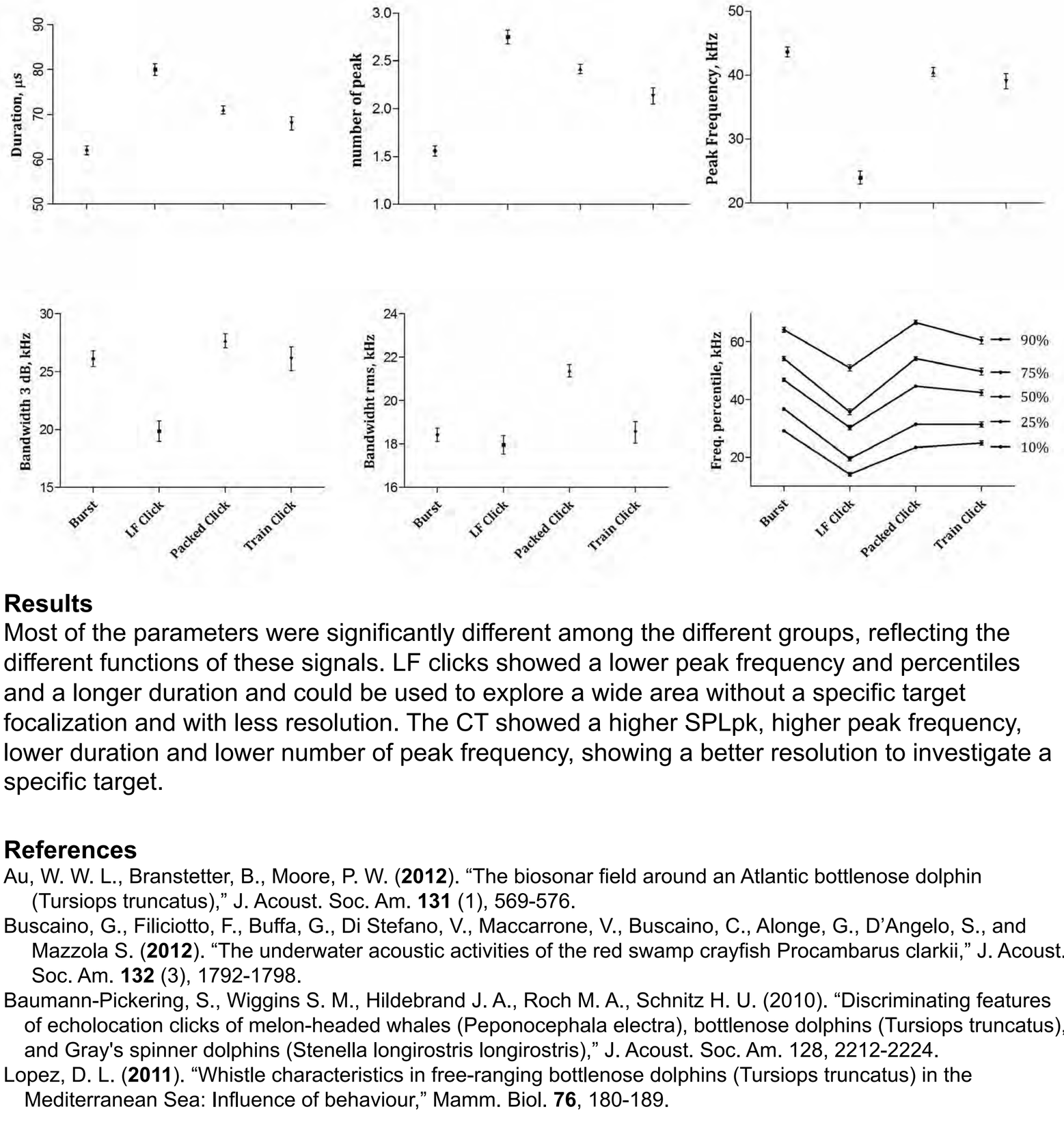
The acoustic signals were recorded using a calibrated hydrophone (8104, B&K, sensitivity of -205.6 dB re 1V/1µPa ± 4.0 dB in the 0.1 Hz to 80 kHz frequency band) connected to a digital acquisition card (USGH416HB, Avisoft Bioacoustics, set at 40 dB gain) managed by dedicated Avisoft Recorder USGH software. The signals were acquired at 300 kilosamples s^{-1} at 16 bits. Based on the inter-click interval and on the total number of clicks per train, we grouped these signals into the following four click categories:

Low-Frequency click (LF): single clicks without a regular pulse rate; **Train Click (TC)**: clicks with an interclick interval of 0.0345-0.1428 s (10-90 percentile); **Packed Clicks (PC)**: clicks with an interclick interval of 0.0020-0.0055 s (10-90 percentile) and a significantly lower number of clicks per train with respect to the burst category (mean ± standard deviation: 14.9 ±9.8); **Burst**: clicks with an interclick interval of 0.0017 to 0.0049 s (10-90 percentile).

We used a modified MATLAB code developed to automatically identify and characterize the high-frequency pulsed signals (Buscaino *et al.*, 2012). This code operates the following four steps: (1) the signal condition; (2) identifying signals that surpassed a given threshold; (3) oversampling eight times and (4) measuring the principal acoustic features of the identified signals:

SPLpk; signal duration; the 1°, 2°, and 3° peak of frequency; number of peaks frequency; bandwidth; centroid frequency; and the 10%, 25%, 75%, and 90% percentiles of the power spectrum distribution.





Results

Most of the parameters were significantly different among the different groups, reflecting the different functions of these signals. LF clicks showed a lower peak frequency and percentiles and a longer duration and could be used to explore a wide area without a specific target focalization and with less resolution. The CT showed a higher SPLpk, higher peak frequency, lower duration and lower number of peak frequency, showing a better resolution to investigate a specific target.

References

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