THE INFLUENCE OF THE UPWELLING REGIME IN ROCKY SHORE BIOACOUSTIC SIGNATURE OFF CABO FRIO ISLAND

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INTRODUCTION

In coastal zones, snaps, clicks, pops and crackles produced by benthic fauna can be quite representative in the soundscape (Butler et al., 2017). These sounds can be caused simply by the movement of these organisms on the substrate, by the stridulation/friction of the hard parts of their bodies or water circulation (Simmonds and MacLennan, 2008). Thus, when many individuals are active in an environment, its sounds merge into a timed signal, producing a Rocky Shore Bioacoustic Signature (RSBS).

GOALS

Characterizing the Rocky Shore Bioacoustic Signature and to evaluate its relationship with upwelling phenomenon.

MATERIAL AND METHODS

The Cabo Frio region is recognized as one of the main points of occurrence of upwelling phenomenon on the Brazilian coast. This phenomenon is characterized by the outcropping of deep, cold (lower than 20°C) and nutrient-rich waters to the surface and increasing of the primary productivity (Calado et al., 2018), especially during spring and summer. This one along with other hydrodynamic features makes the site a unique biological environment (Ferreira, 2003).

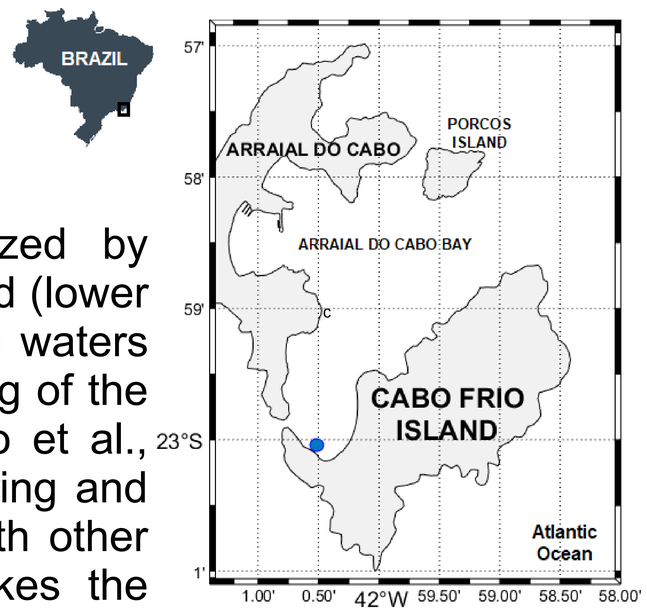

Figure 1 – Study area and acquisition system location (blue circle).

Acquisition system

- 1 regular tetraedron (1m);
- 4 hydrophones TP-1 (MarSensing);
- Sensitivity: -175 dB ref 1V/Pa;
- 24 bits, Fs of 52734 Hz;
- Duty cycle of 20%.
- Temperature: 1 each 10 min (Hobo pendant).

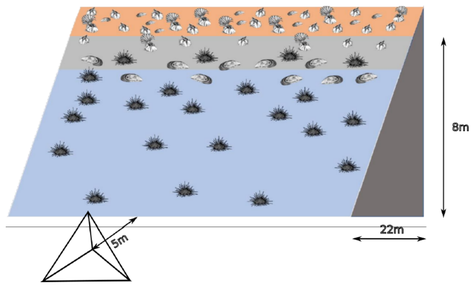

Figure 2 – Hydrophones relative position and some RSBS contributors.

RSBS TL @ 3days

- Transmission Loss (Bellhop);
- Three RSBS sources.

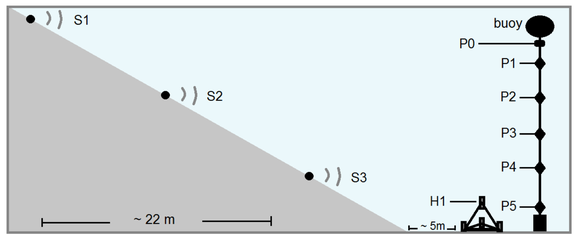

Figure 3 – Scenario for RSBS TL simulation.

RSBS level @ 82 days

- Three frequency bands: A (0.1-1.5kHz), B (1.5-8kHz), C (8-24kHz);
- RSBS amplitude (upwelling);
- Shapiro-Wilk test;
- Monte Carlo method;
- Mann-Whitney test
- Spearman correlation.

RESULTS AND DISCUSSION

RSBS level, i.e., average level of spectral density from data collected is showed in Figure 4.

- 17,453 minutes (~ 291 hours);
- High variability in band A (temporal transitoriness);
- Highest energy between 2.5 kHz and 7.5 kHz.

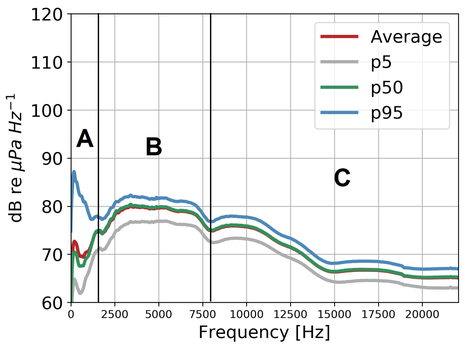

Figure 4 – RSBS average and percentiles of analyzed period.

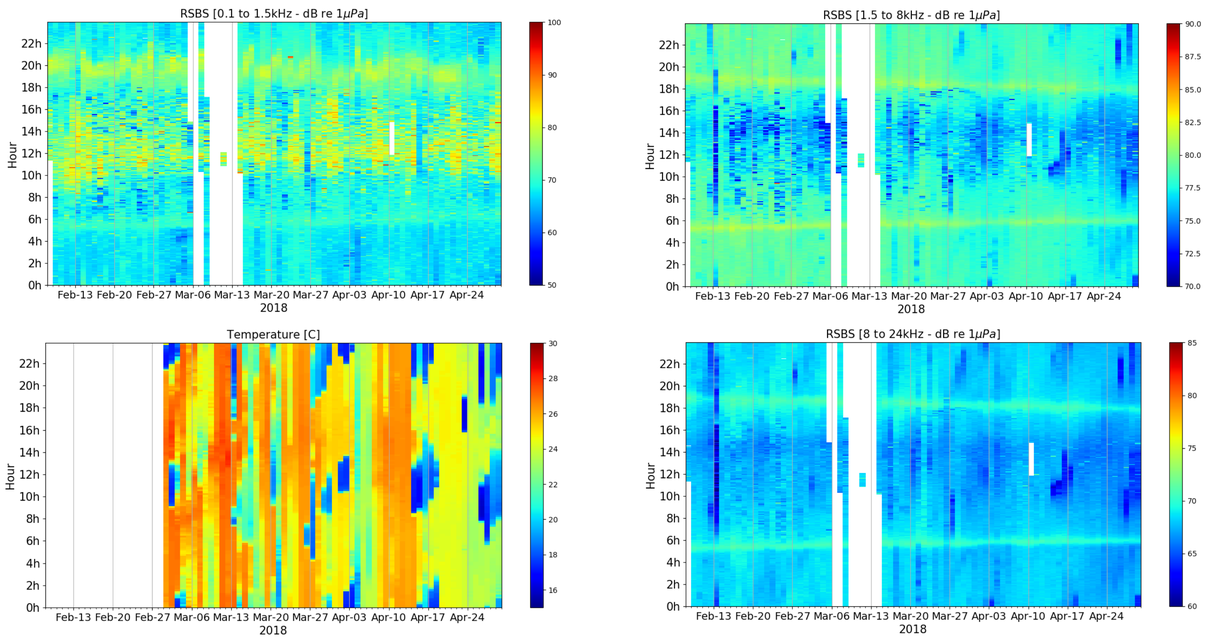

Figure 5 – RSBS during Feb12 to Apr 30, 2018 [Bands A, B and C] and Temperature.

- Invertebrates choruses (at Dawn and dusk) [Bands B and C];
- Fish choruses (after Dawn and Dusk) [Band A];
- Nautical tourism during daytime [Band A];
- Abiotic features;

RSBS/Band	A	B	C
Average	70.9 +- 4.5	77.8 +- 1.5	67.8 +- 1.2
Minimum	53.2	69.9	59.7
Maximum	97.7	85.8	72.3
RSBSxUPW	Corr: 0.09	Corr: 0.33	Corr: 0.51

RSBS level @ 82 days

- 36 upwelling events (840 min);
- RSBS average decay:
A:~10.5 dB, **B:**~3.0 dB, **C:**~2.8 dB.
- RSBS maximum decay:
A:~23.0 dB, **B:**~8.7 dB, **C:**~7.0 dB.
- RSBS average (p-value<0.05):
[upwelling ≠ NO upwelling].

RSBS TL @ 3 days

- 2 upwelling events;
- Upwelling created 2 layers;
- RSBS TL: ~ 4.0 dB;
- Acoustic barrier.

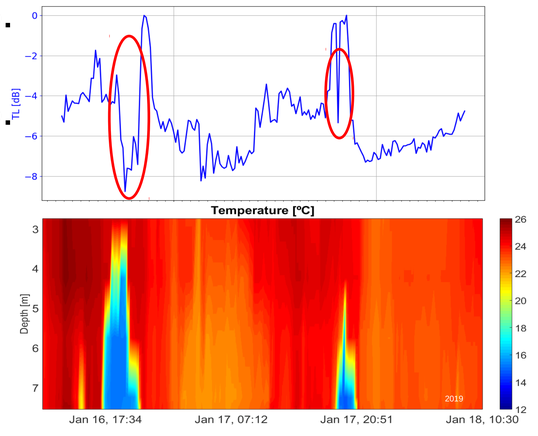

Figure 4 – RSBS average and percentiles of analyzed period.

CONCLUSIONS

There was significant difference between upwelling and no upwelling moments. Upwelling can break RSBS pattern and decrease it due to both RSBS SL (metabolic rate decreasing) and RSBS TL (acoustic barrier). This study can contribute to the understanding of organisms behavior and to the development of novel biotechnological applications.

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