Passive Acoustic Monitoring for Marine Mammals at Site A in Jacksonville, FL, August 2010 – January 2011

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Abstract

A High-frequency Acoustic Recording Package (HARP; Wiggins and Hildebrand 2007) was deployed between August 2010 and February 2011 in the Jacksonville, FL, survey area at Site A in 90 m. This HARP sampled at 200 kHz for 5 minutes of every 15 minutes and recorded for 153 days between 26 August 2010 and 25 January 2011. Long-Term Spectral Averages (LTSAs) were created for three frequency bands (10 Hz – 1000 Hz, 500 Hz – 5000 Hz, and 1 kHz – 100 kHz) and scanned for marine mammal vocalizations. Calls of fin whales, minke whales, possible sei whales, Risso's dolphins, and unidentified delphinids were detected in the data. A new call type, the "5-pulse" call, presumed to be produced by a mysticete, was also detected in the data.

Methods

The August 2010 – January 2011 Jacksonville Site A HARP (Jacksonville 05A) was deployed at 30.26819^{o} N, 80.20894^{o} W on 26 August 2010 (recording started on 26 August 2010) and recovered on 1 February 2011 (recording ended on 25 January 2011). The instrument location is shown in Figure 1. Bottom depth at the deployment site was approximately 90 m. A schematic diagram of the Jacksonville 05A HARP is shown in Figure 2.

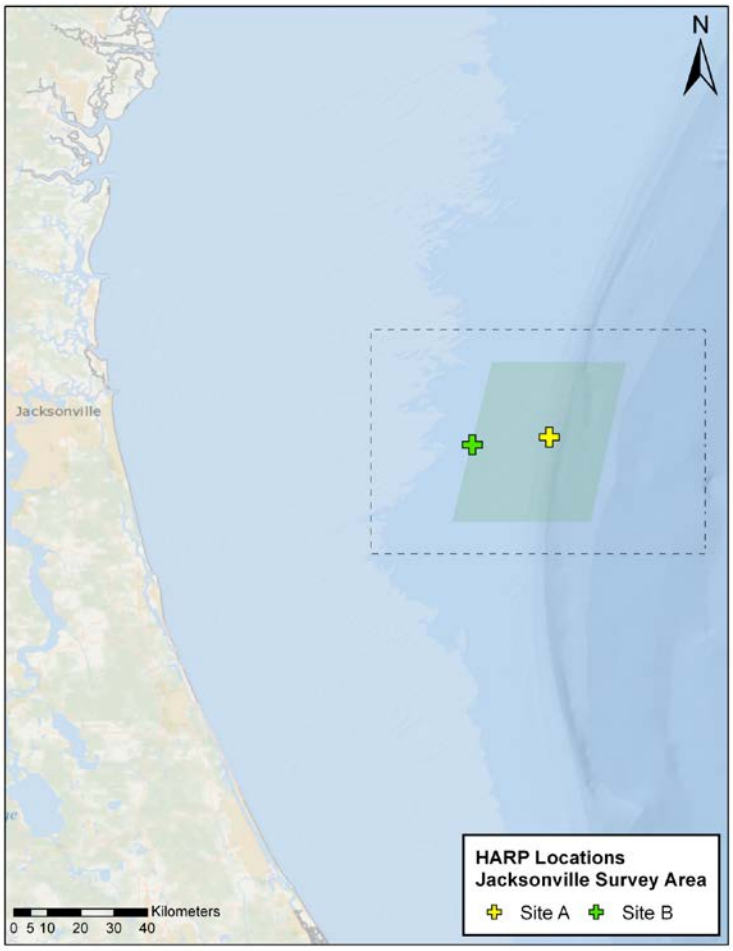

Figure 1. Location of HARP deployment sites in the Jacksonville survey area. The location of the Jacksonville 05A HARP is shown in yellow.

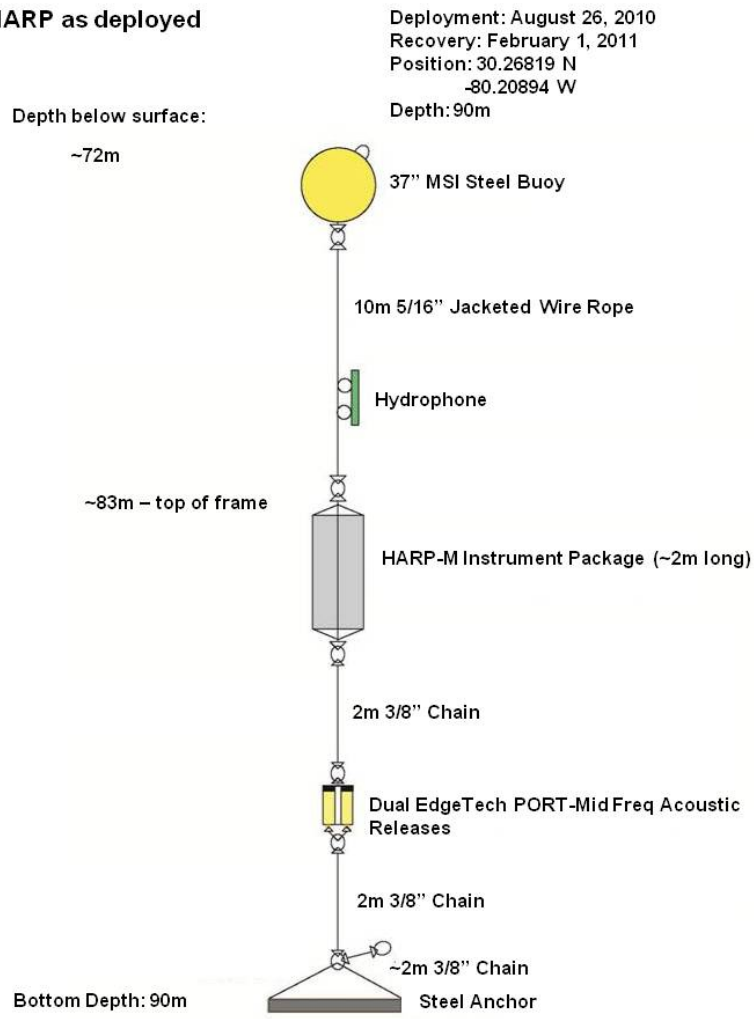

Figure 2. Schematic diagram showing details of the Jacksonville 05A HARP. Note that diagram is not drawn to scale.

Data were acquired at a 200 kHz sampling rate for 5 minutes every 15 minutes during the Jacksonville 05A deployment. This deployment provided a total of 1293.8 hours of data over the 153 days of recording.

The following methods are a summary of Debich *et al.* (2013). Members of the Scripps Whale Acoustics Lab manually scanned the data from the Jacksonville 05A HARP deployment for

marine mammal vocalizations and anthropogenic sounds (sonar, explosions, and shipping) using LTSAs. As a first pass for data analysis, segments of data that did not allow for further analysis due to disk malfunctions or strumming noise were identified. For Jacksonville 05A, there were gaps in the high-frequency data between 23 November 2010 22:48 and 24 November 2010 08:09 that could not be analyzed. For effective analysis of marine mammal and anthropogenic sounds, the usable data were divided into three frequency bands ((1) low frequencies, between 10 – 1000 Hz, (2) mid frequencies, between 500 – 5000 Hz, and (3) high frequencies, between 1 – 100 kHz). The resulting LTSAs had resolutions of 5 s in time and 1 Hz in frequency (for the data decimated by a factor of 100: 10-1000 Hz band), 5 s in time and 10 Hz in frequency (for the data decimated by a factor of 20: 500-5000 Hz band), and 5 s in time and 100 Hz in frequency (for the data not decimated: 1-100 kHz). Each LTSA was analyzed for the sounds of an appropriate subset of species or sources. Blue, fin, sei, Bryde's, and North Atlantic right whale and a subset of minke sounds were classified as low frequency; humpback, minke, shipping, explosions, and mid-frequency active sonar were classified as mid-frequency; and the remaining odontocete and sonar sounds were considered high-frequency. Low- and mid-frequency sounds were analyzed in hourly bins; high-frequency vocalizations were analyzed in one-minute bins. Vocalizations were assigned to species when possible.

Results

Table 1 summarizes the detected and identified marine mammal vocalizations for the Jacksonville 05A HARP deployment. Figures 3-5 and 7-9 show the daily occurrence patterns for the different marine mammal groups (classified to species when possible). Figure 10 shows the

occurrence of mid-frequency active sonar. Underwater ambient noise during this deployment is shown in Figure 11.

Fin whale 20-Hz calls were detected in mid- to late January (Figure 3). No fin whale 40-Hz calls were detected.

Minke whale slow-down/speed-up pulse trains were detected starting in December and continuing through the end of January (Figure 4). Minke whale regular pulse trains were only recorded in mid-January 2011 (Figure 4). The general occurrence of minke whale pulse trains in the winter months is similar to previous findings.

Downsweep calls similar to those ascribed to sei whales by Baumgartner *et al.* (2008) were detected in November and December (Figure 5).

The "5-pulse" call (Figure 6) was detected late October through early December (Figure 7). The 5-pulse call is presumed to be produced by a mysticete due to its character, prevalence, and intensity.

Detected odontocete vocalizations included clicks and whistles (Figures 8-9). Most of these detections (95%) were assigned to the unidentified odontocete category (Figure 8), with clicks being divided into five main groups based on spectral patterns (see Debich *et al.* 2013 for more details). In comparison to the Jacksonville 05B deployment which occurred during the same time period, rates of unidentified odotoncete detections were higher during the Jacksonville 05A

deployment. Only a few detections were assigned to Risso's dolphins, with detections from the end of August until the end of November as well as the middle of January (Figure 9). A nighttime diel pattern is suggested from these detections. A greater number of Risso's click detections was observed during the Jacksonville 05A data set than in previous data sets.

Table 1. Summary of detections of marine mammal vocalizations at Jacksonville Site A for August 2010 – January 2011 (Jacksonville 05A). *For mysticetes, total duration of vocalizations (hours) and percent of recording duration are based on data analyzed in hourly bins; for odontocetes, total duration of vocalizations (hours) and percent of recording duration are based on data analyzed in one-minute bins.

Species	**Call type**	**Total duration of vocalizations (hours)** *	**Percent of recording duration***	**Days with vocalizations**	**Percent of recording days**
Fin whale	20 Hz	39	1.09	6	3.92
Minke whale	pulse train (slow-down, speed-up)	105	2.95	14	9.15
Minke whale	pulse train (regular)	2	0.06	1	0.65
Possible sei whale	downsweep	2.52	0.22	2	1.31
Possible mysticete	5-pulse call	120	3.37	24	15.69
Unidentified odontocete	clicks, whistles, burst-pulses	788.45	60.94	151	98.69
Risso's dolphin	clicks	15.42	1.19	20	13.07

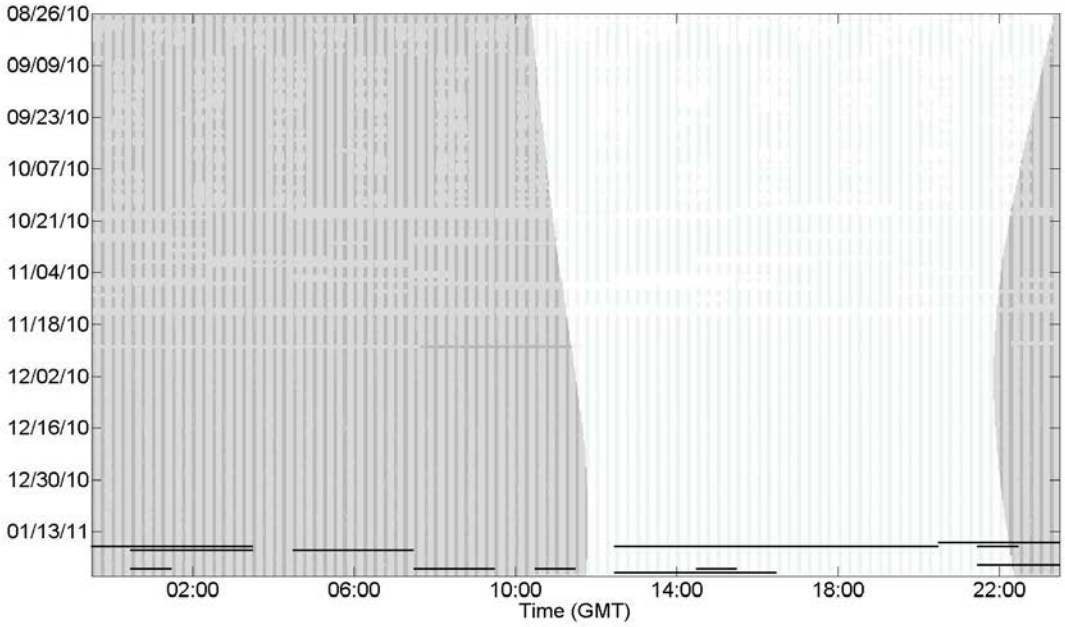

Figure 3. Fin whale detections (black bars) in hourly bins for the Jacksonville 05A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

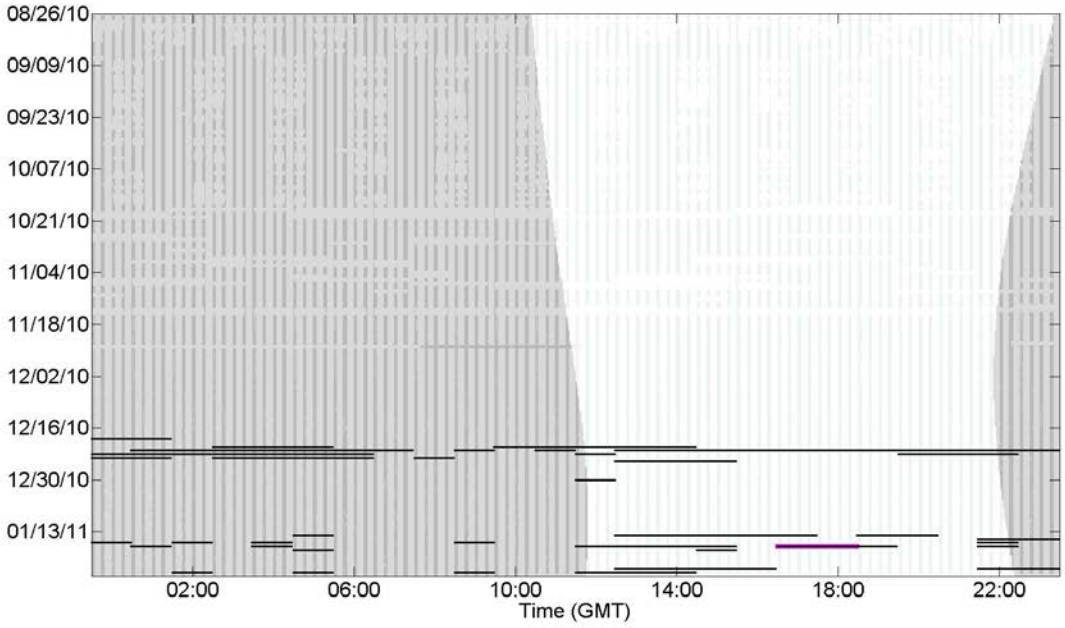

Figure 4. Minke whale slow-down/speed-up pulse train detections (black bars) and regular pulse train (pink bars) in hourly bins for the Jacksonville 05A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

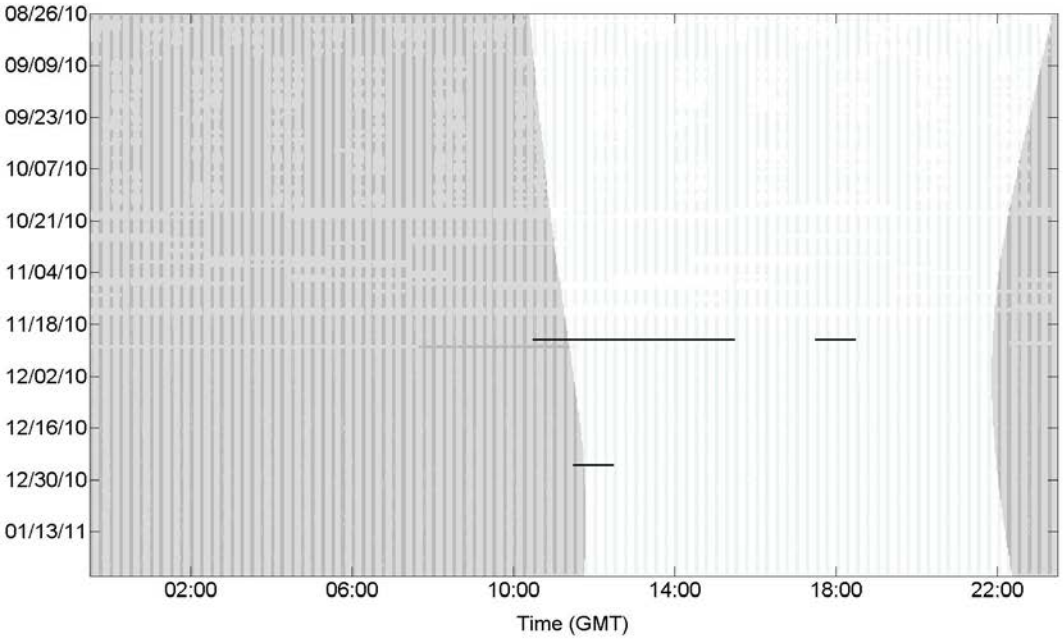

Figure 5. Hourly bins of downsweep detections (black bars) that may be produced by sei whales (Baumgartner *et al.* 2008) for the Jacksonville 05A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

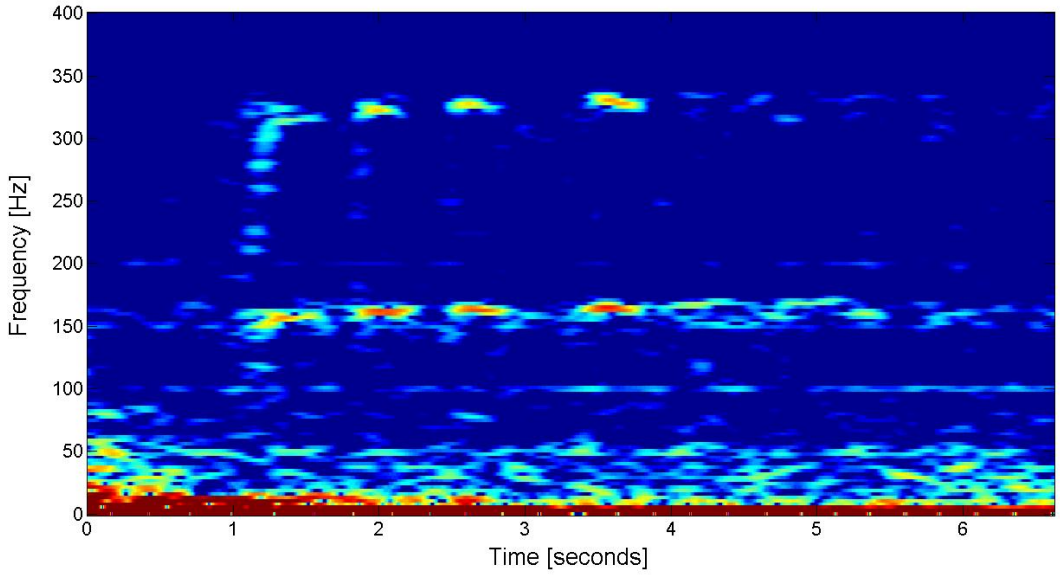

Figure 6. Spectrogram of a single 5-pulse call (750-point FFT, 98% overlap) recorded on 26 August 2010 at Site A.

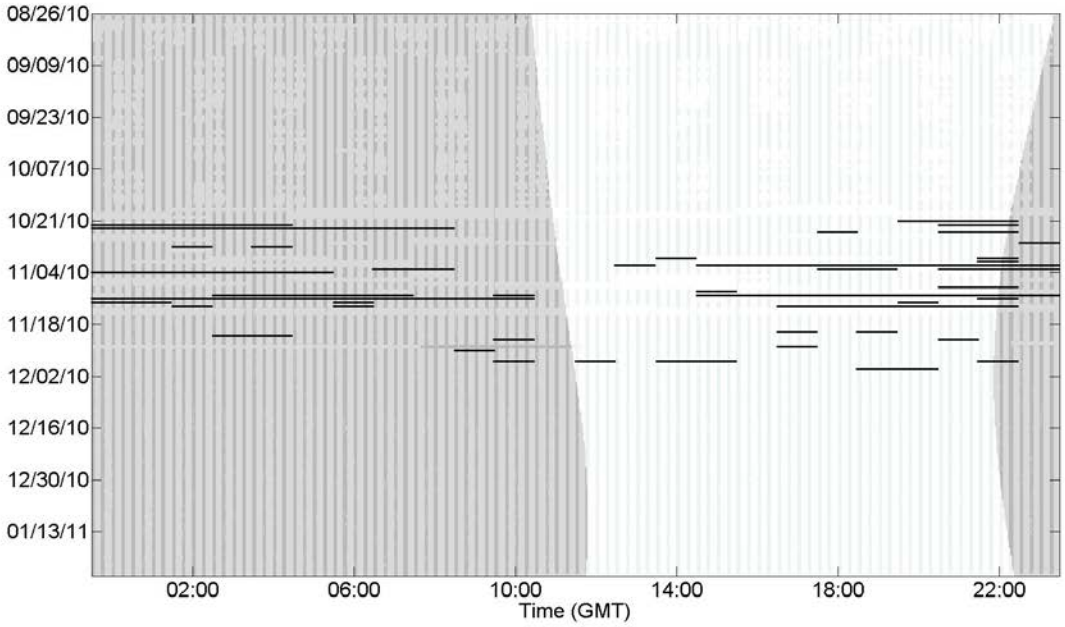

Figure 7. Hourly bins of 5-pulse call detections (black bars) that are likely produced by a mysticete for the Jacksonville 05A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort (detailed in Tables 1-2).

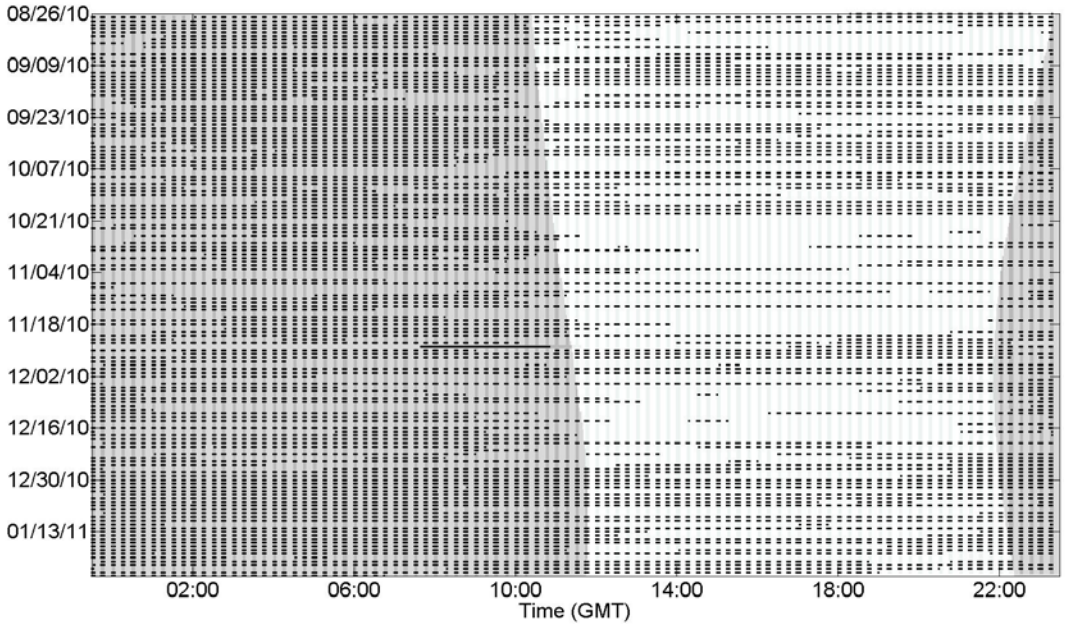

Figure 8. Unidentified odontocete vocalization detections (black bars) in one-minute bins for the Jacksonville 05A deployment. Dark gray shading indicates periods of darkness, determined

from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

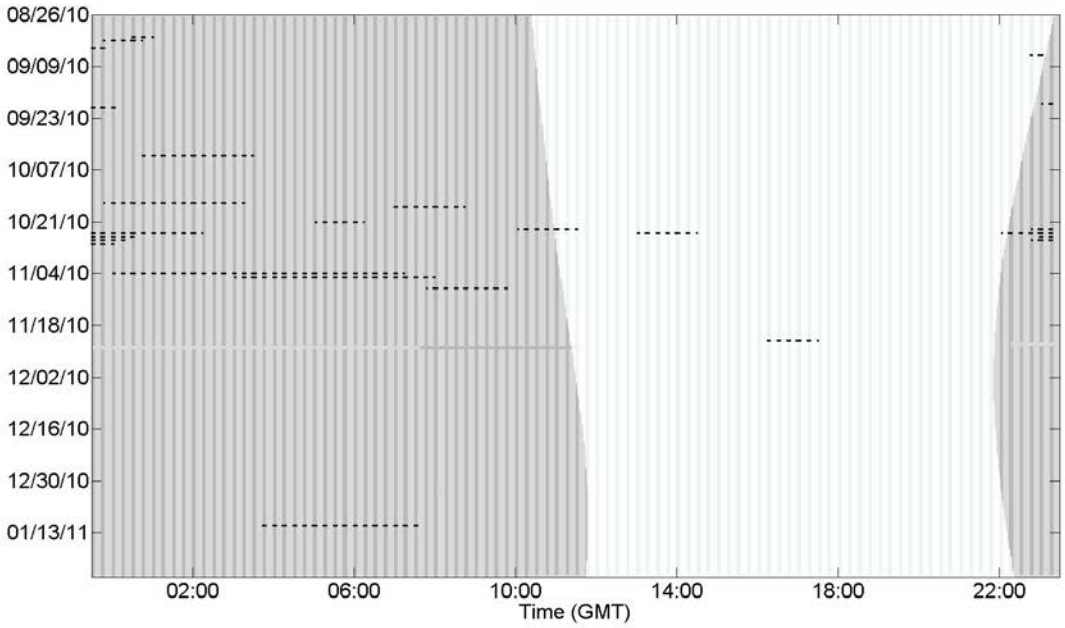

Figure 9. Risso's dolphin click detections (black bars) in one-minute bins for the Jacksonville 05A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

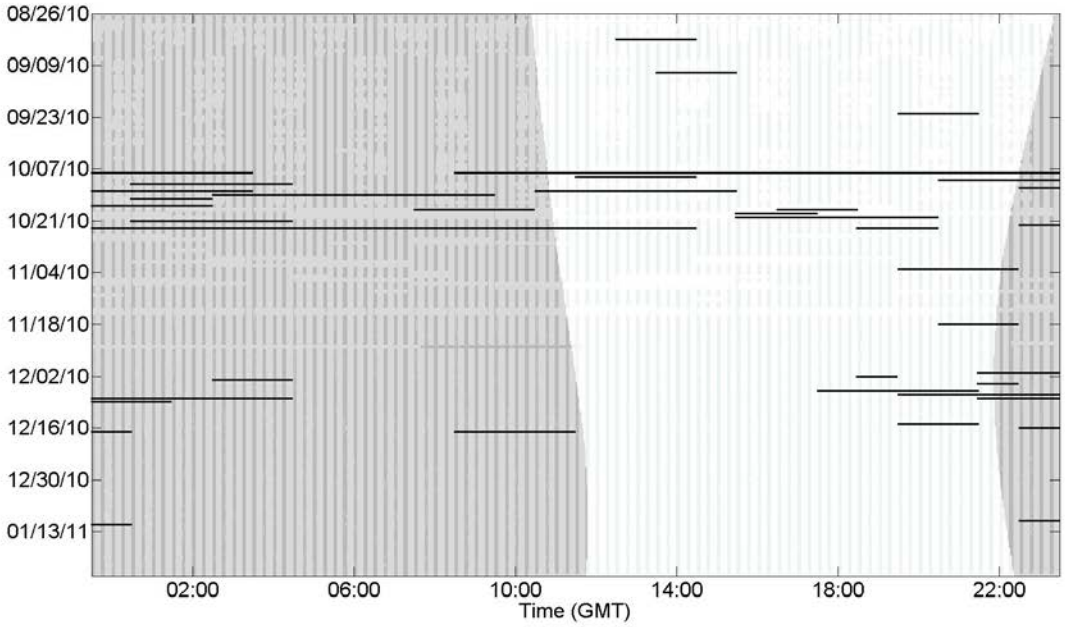

Figure 10. Mid-frequency active sonar (black bars) detected during the Jacksonville 05A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

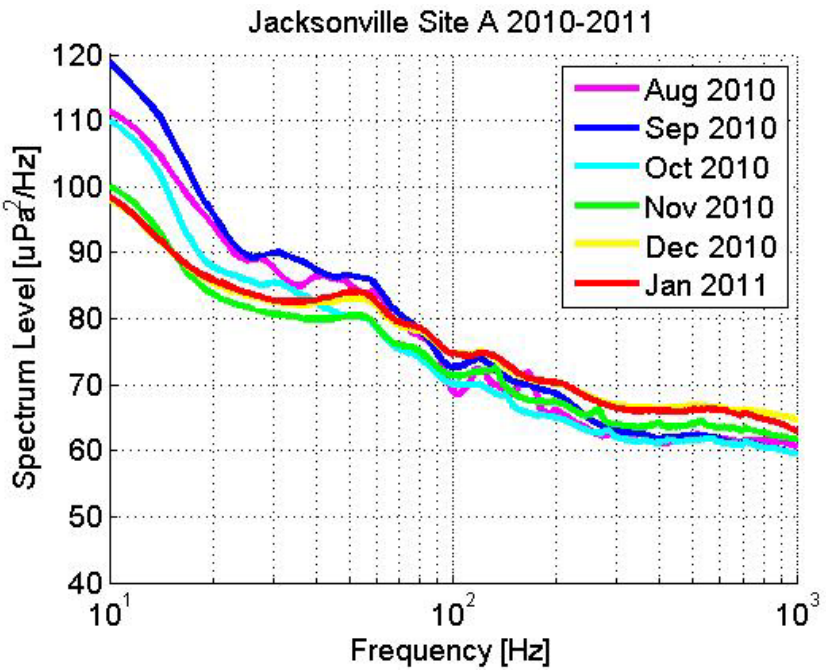

Figure 11. Monthly averages of ambient noise at Jacksonville Site A for August 2010 – January 2011.

References

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