

Passive Acoustic Monitoring for Marine Mammals at Site E in Onslow Bay, July – October 2012

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Abstract

A High-frequency Acoustic Recording Package (HARP; Wiggins and Hildebrand 2007) was deployed between July and October 2012 in Onslow Bay at Site E in 914 m. This HARP sampled at 200 kHz for 5 minutes of every 10 minutes and recorded for 81 days between 14 July 2012 and 2 October 2012. 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 blue whales, Blainville's beaked whales, Cuvier's beaked whales, Gervais' beaked whales, *Kogia* spp., Risso's dolphins, sperm whales, and unidentified delphinids were detected in the data.

Methods

The July – October 2012 Onslow Bay Site E HARP (Onslow Bay 07E) was deployed at 33.78666° N, 75.92915° W on 13 July 2012 (recording started on 14 July 2012) and recovered on 24 October 2012 (recording ended on 2 October 2012). The instrument location is shown in Figure 1. Bottom depth at the deployment site was approximately 914 m. A schematic diagram of the Onslow Bay 07E HARP is shown in Figure 2.

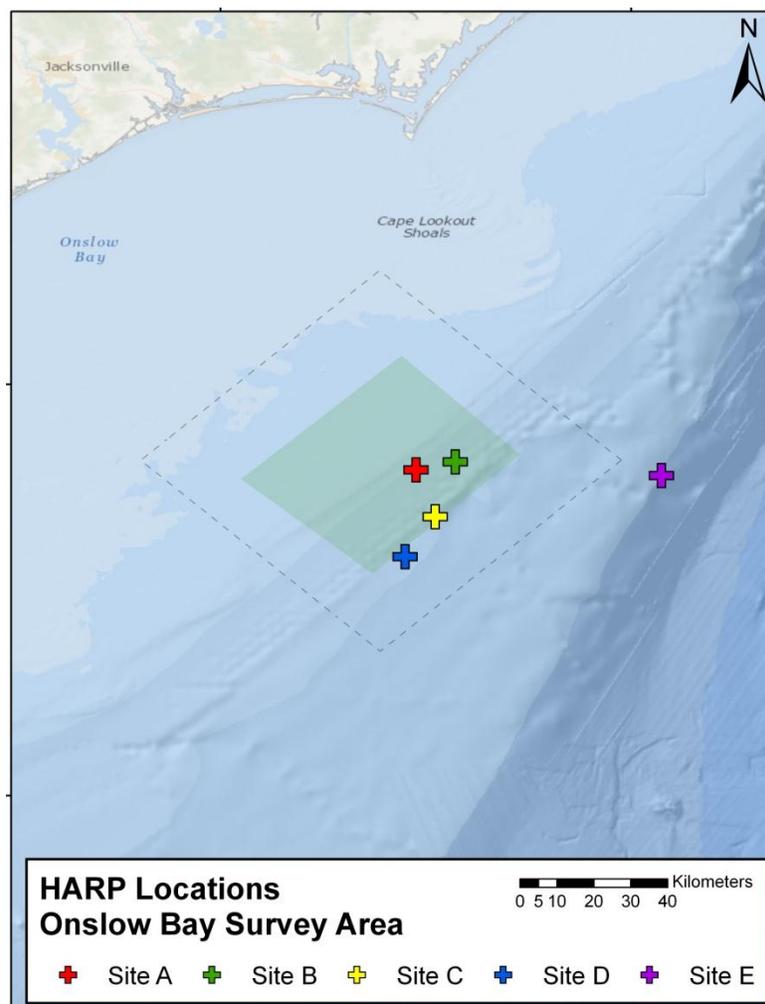


Figure 1. Location of HARP deployment sites in the Onslow Bay survey area. The location of the Onslow Bay 07E HARP is shown in purple.

Onslow Bay 07E HARP as deployed

Deployment: July 13, 2012
Recovery: October 24, 2012
Position: 33.78666 N
-76.929150 W
Depth: 914m

Depth below surface:

~887m

~903m – top of frame

Bottom Depth: 914m

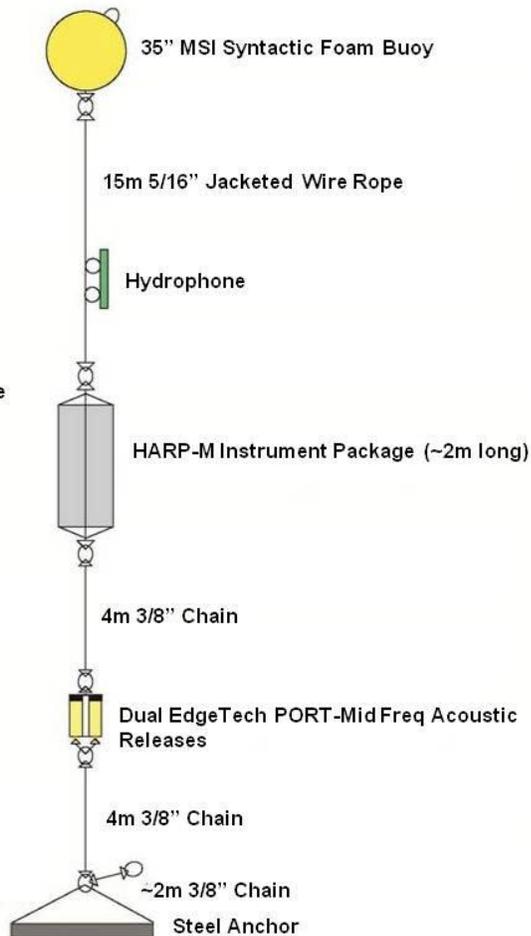


Figure 2. Schematic diagram showing details of the Onslow Bay 07E HARP. Note that diagram is not drawn to scale.

Data were acquired at a 200 kHz sampling rate for 5 minutes every 10 minutes during the Onslow Bay 07E deployment. This deployment provided a total of 1054.6 hours of data over the 81 days of recording.

The following methods are a summary of Debich *et al.* (2014). Members of the Scripps Whale Acoustics Lab manually scanned the data from the Onslow Bay 07E HARP deployment for marine mammal vocalizations and anthropogenic sounds (sonar, explosions, and shipping) using LTSAs. 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, Bryde's, fin, minke, North Atlantic right, and sei whale sounds were classified as low frequency; humpback whale calls, North Atlantic right whale gunshot calls, shipping, explosions, and mid-frequency active sonar were classified as mid-frequency; and the remaining odontocete and sonar sounds were considered high-frequency. Low-frequency sounds were analyzed in hourly bins; mid- and high-frequency sounds were analyzed in one-minute bins. Vocalizations were assigned to species when possible. Detections of most sounds were made by manually scanning LTSAs. Humpback whale call detection effort was automated using a power-law detector (Helble *et al.* 2012). After the generalized power-law algorithm was applied, a trained analyst verified the accuracy of the detected signals. Beaked whale clicks were detected with an automated method and then assigned to species by a trained analyst, described in detail in Debich *et al.* (2014). Unidentified odontocete clicks were also assigned to spectral patterns by a trained analyst, also further described in Debich *et al.* (2014). See Debich *et al.* (2014) for a more detailed description of analysis methods for the Onslow Bay 07E data set.

Results

Table 1 summarizes the detected and identified marine mammal vocalizations for the Onslow Bay 07E HARP deployment. Figures 3-10 show the daily occurrence patterns for the different marine mammal groups (classified to species when possible). Underwater ambient noise during this deployment is shown in Figure 11. Figure 12 shows the occurrence of mid-frequency active sonar.

Blue whale calls were the only mysticete calls detected. These calls were detected from late August through late September in 2012 (Figure 3).

Detected odontocete vocalizations included clicks and whistles (Figures 4-10). Most of these detections were assigned to the unidentified odontocete category (Figure 4), with clicks being divided into four main groups when possible based on spectral patterns. The unidentified odontocete vocalization category also included unidentified odontocete whistles <5 kHz, possibly related to killer whale occurrence (see Debich *et al.* 2014 for more details). Several click detections were assigned to beaked whales. Blainville's beaked whale clicks were detected (Figure 5), as were Cuvier's beaked whale clicks (Figure 6). There were significantly more Gervais' beaked whale detections than any other beaked whale. Detections for this species peaked in mid- to late September at Site E (Figure 7). Other detected odontocete vocalizations included *Kogia* spp. (Figure 8), Risso's dolphins (Figure 9), and sperm whales (Figure 10).

Table 1. Summary of detections of marine mammal vocalizations at Site E for July – October 2012. * 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 minute bins.

Species	Call type	Total duration of vocalizations (hours)*	Percent of recording duration*	Days with vocalizations	Percent of recording days
Blue whale	A and B calls	3	0.18	2	2.47
Unidentified odontocete	clicks, whistles	119.25	11.31	64	79.01
Blainville's beaked whale	clicks	0.93	0.09	2	2.47
Cuvier's beaked whale	clicks	0.87	0.08	3	3.70
Gervais' beaked whale	clicks	175.45	16.64	77	95.06
<i>Kogia</i> spp.	clicks	0.48	0.05	7	8.64
Risso's dolphin	clicks	12.38	1.17	10	12.35
Sperm whale	clicks	72.73	6.90	32	39.51

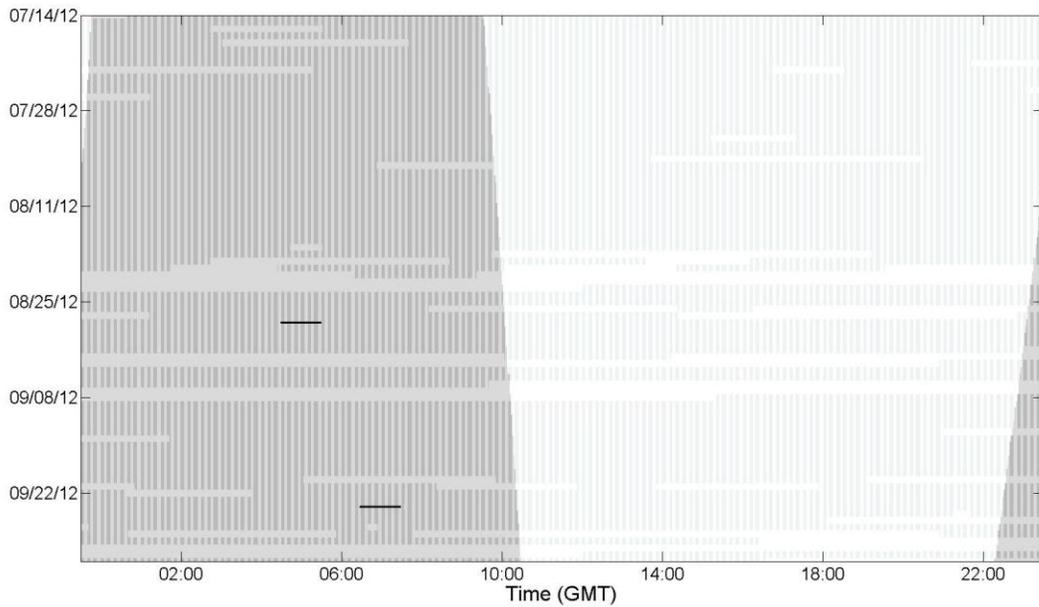


Figure 3. Blue whale Type A and B call detections (black bars) in hourly bins for the July – October 2012 Site E deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort, including times when masking may have occurred (shown in one-minute bins).

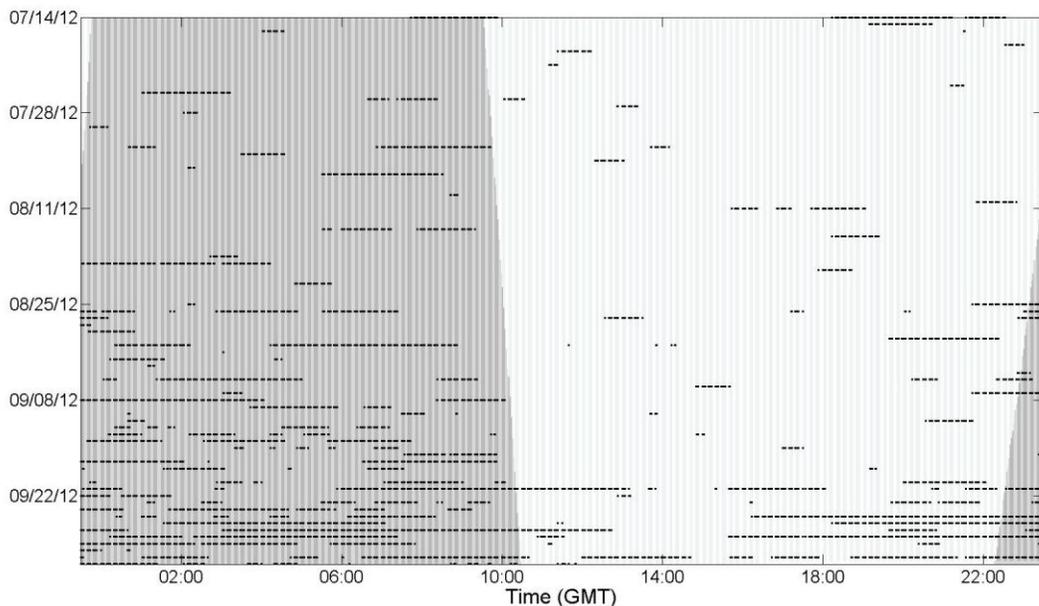


Figure 4. Unidentified odontocete vocalization detections (black bars) for the July – October 2012 Site E deployment. These detections also include clicks that were assigned to four spectral patterns based on spectral features. See Debich et al. (2014) for more details. Dark gray shading

indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

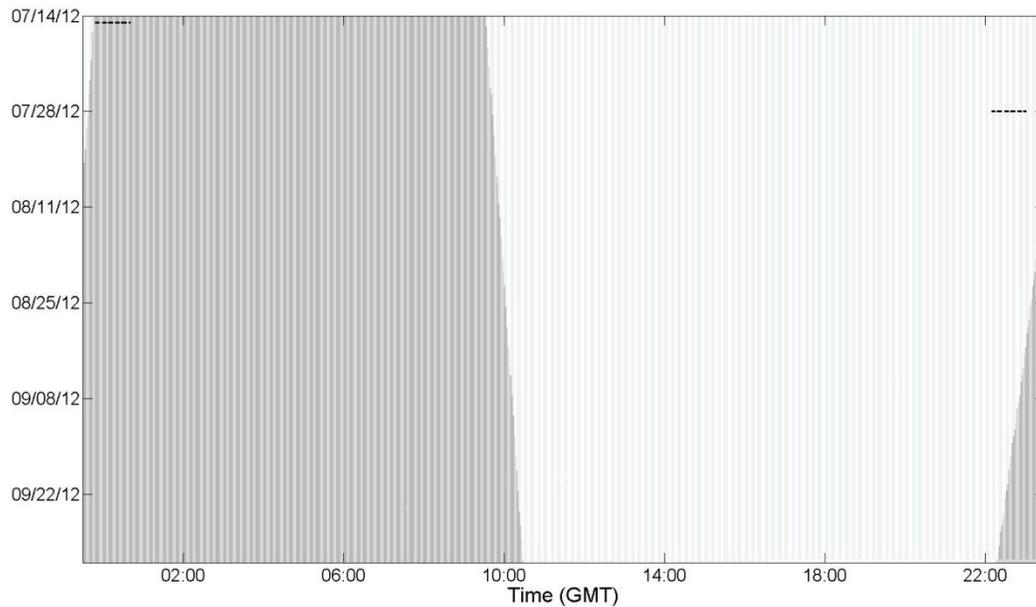


Figure 5. Blainville's beaked whale click detections (black bars) for the July – October 2012 Site E deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

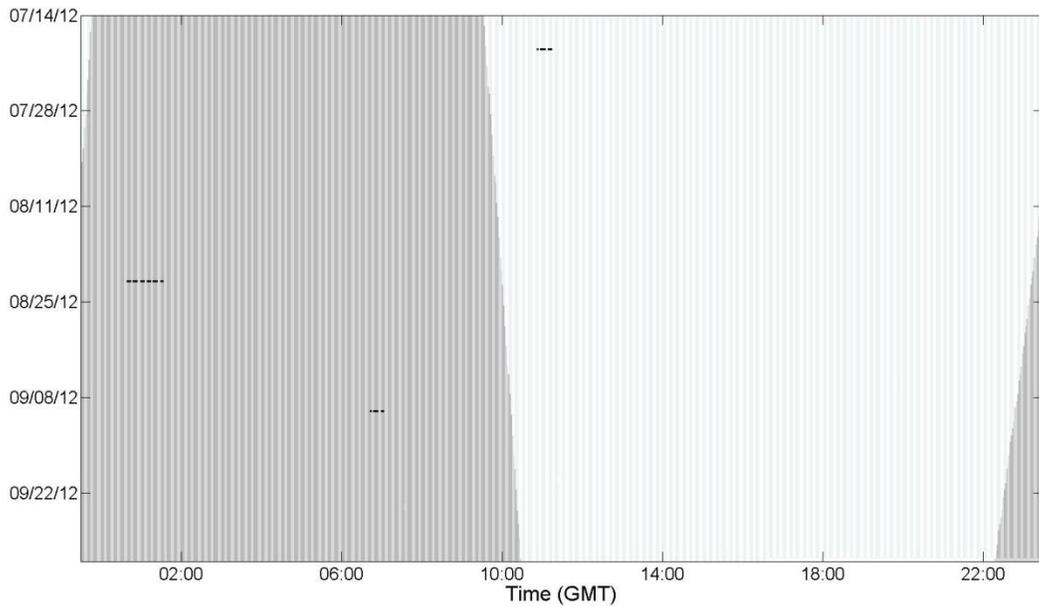


Figure 6. Cuvier's beaked whale click detections (black bars) for the July – October 2012 Site E deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

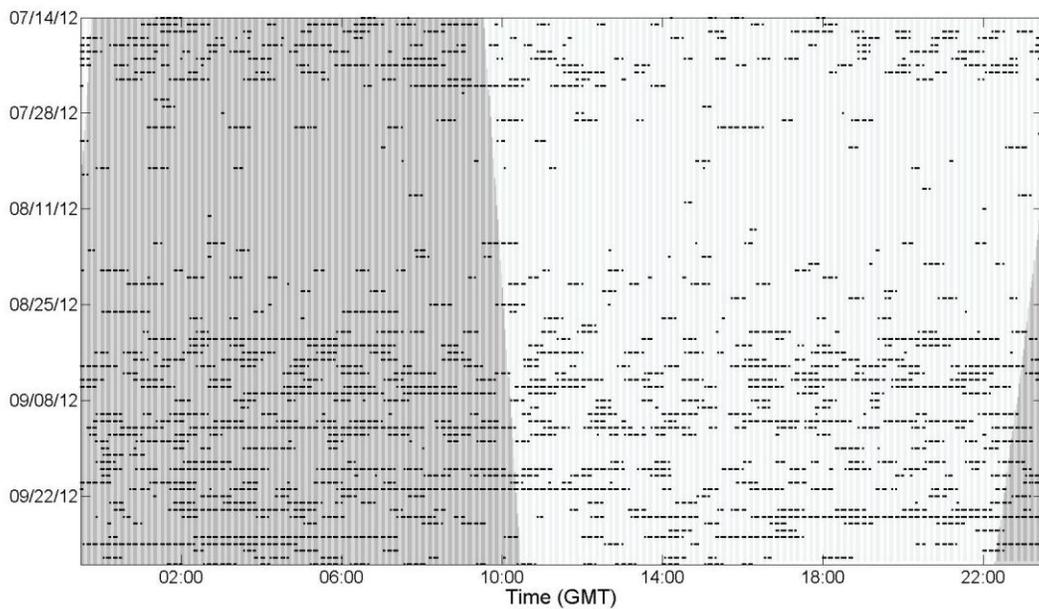


Figure 7. Gervais' beaked whale click detections (black bars) for the July – October 2012 Site E deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

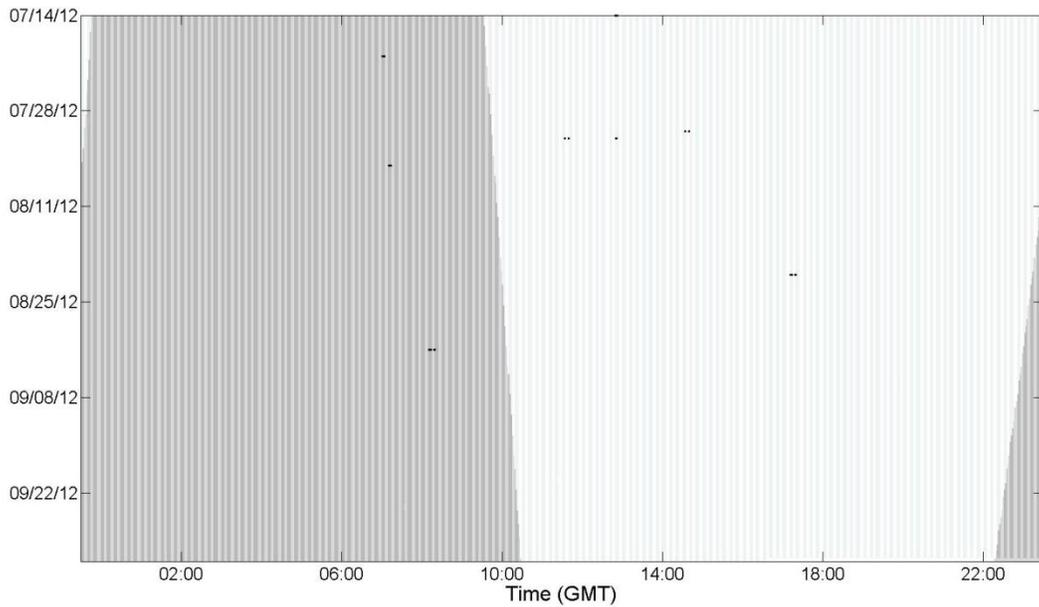


Figure 8. *Kogia* spp. click detections (black bars) for the July – October 2012 Site E deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

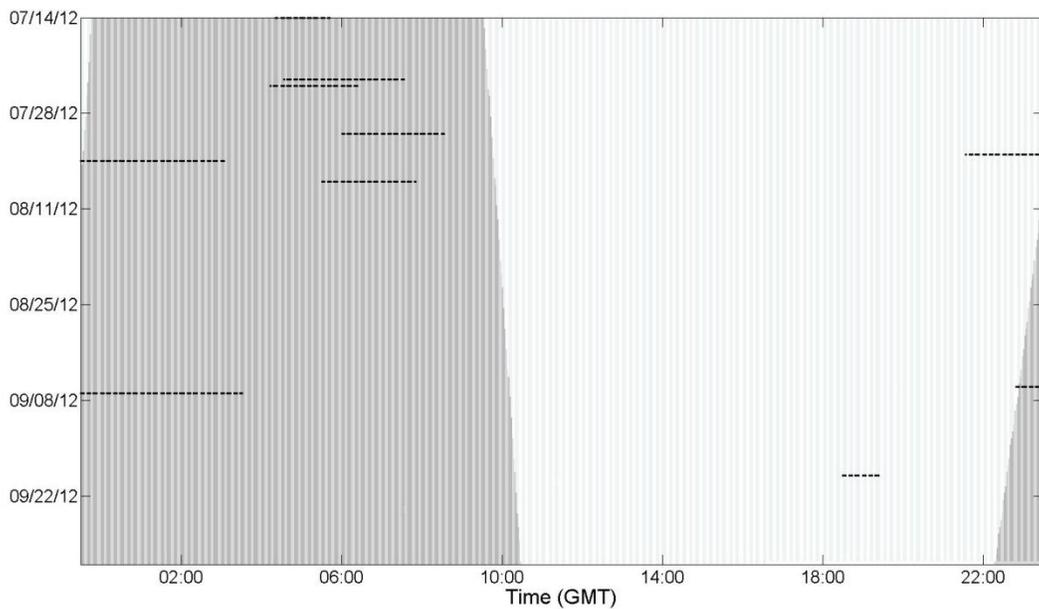


Figure 9. Risso's dolphin click detections (black bars) for the July – October 2012 Site E deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

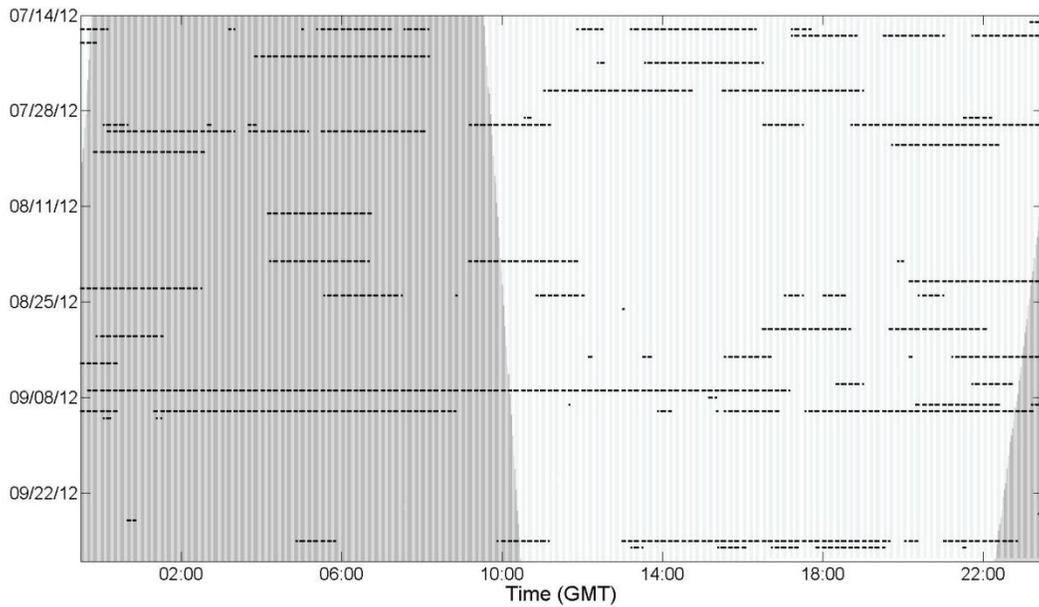


Figure 10. Sperm whale click detections (black bars) for the July – October 2012 Site E deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

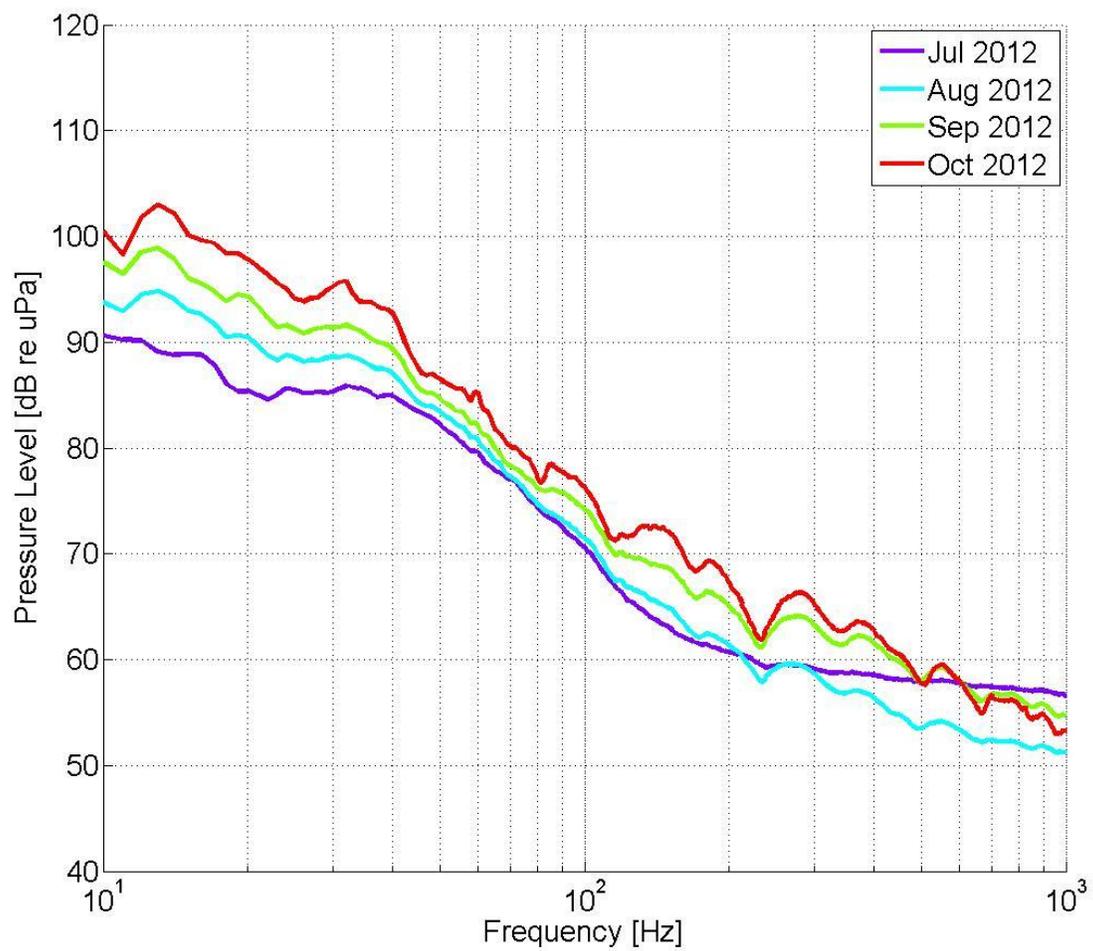


Figure 11. Monthly averages of ambient noise at Onslow Bay Site E for July – October 2012.

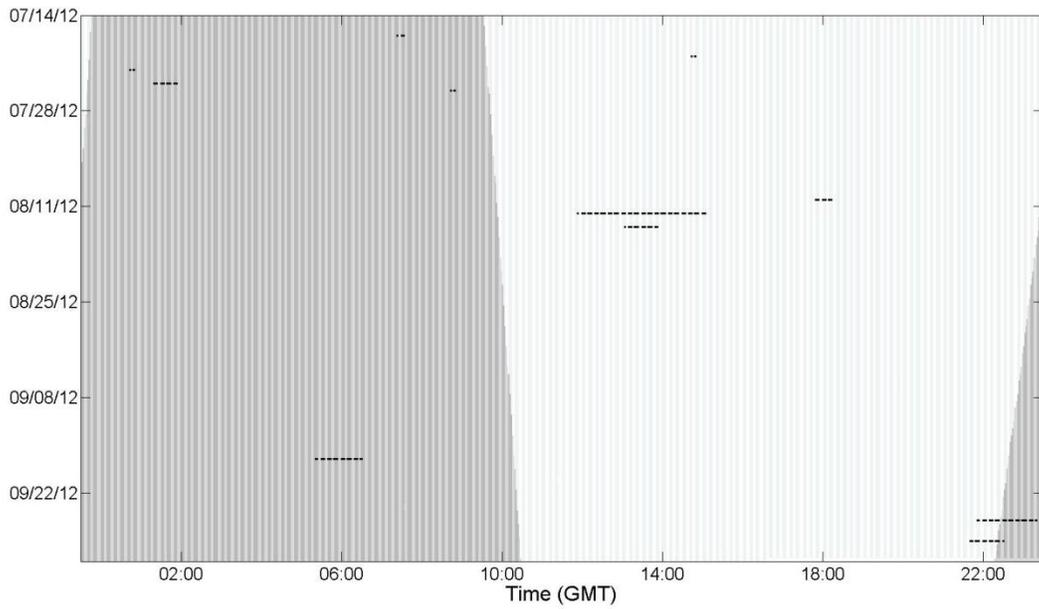


Figure 12. Mid-frequency active sonar (black bars) detected during the July – October 2012 Site E deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

References

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