

**Passive Acoustic Monitoring for Marine Mammals at Site A
in Onslow Bay, October 2007 – January 2008**

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Abstract

A High-frequency Acoustic Recording Package (HARP; Wiggins and Hildebrand 2007) was deployed between October 2007 and May 2008 in Onslow Bay at Site A in 162 m. This HARP sampled at 200 kHz for 5 minutes of every 10 minutes, with the exception of the period from January 1 – 16, 2008, when it recorded continuously due to an instrumentation malfunction, and recorded for 98 days between 10 October 2007 and 16 January 2008. Long-Term Spectral Averages (LTSAs) were created for two frequency bands (10 Hz – 1000 Hz and 1 kHz – 100 kHz) and scanned for marine mammal vocalizations. Calls of blue whales, fin whales, minke whales, possible sei whales, *Kogia* spp., Risso's dolphins, sperm whales, and unidentified delphinids were detected in the data.

Methods

The October 2007 – May 2008 Onslow Bay Site A HARP (Onslow Bay 01A) was deployed at 33.79138° N, 76.52382° W on 9 October 2007 (recording started on 10 October 2007) and recovered on 27 May 2008 (recording ended on 16 January 2008). The instrument location is shown in Figure 1. Bottom depth at the deployment site was approximately 162 m. A schematic diagram of the Onslow Bay 01A HARP is shown in Figure 2.

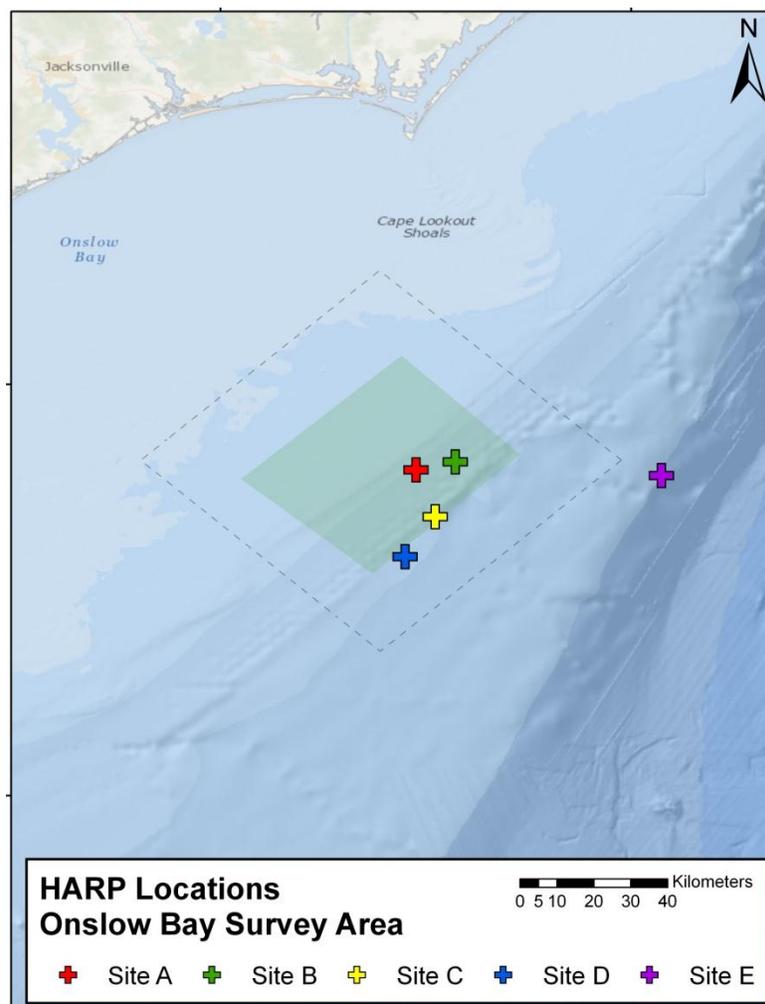


Figure 1. Location of HARP deployment sites in the Onslow Bay survey area. The location of the Onslow Bay 01A HARP is shown in red.

Onslow Bay 01A HARP as deployed

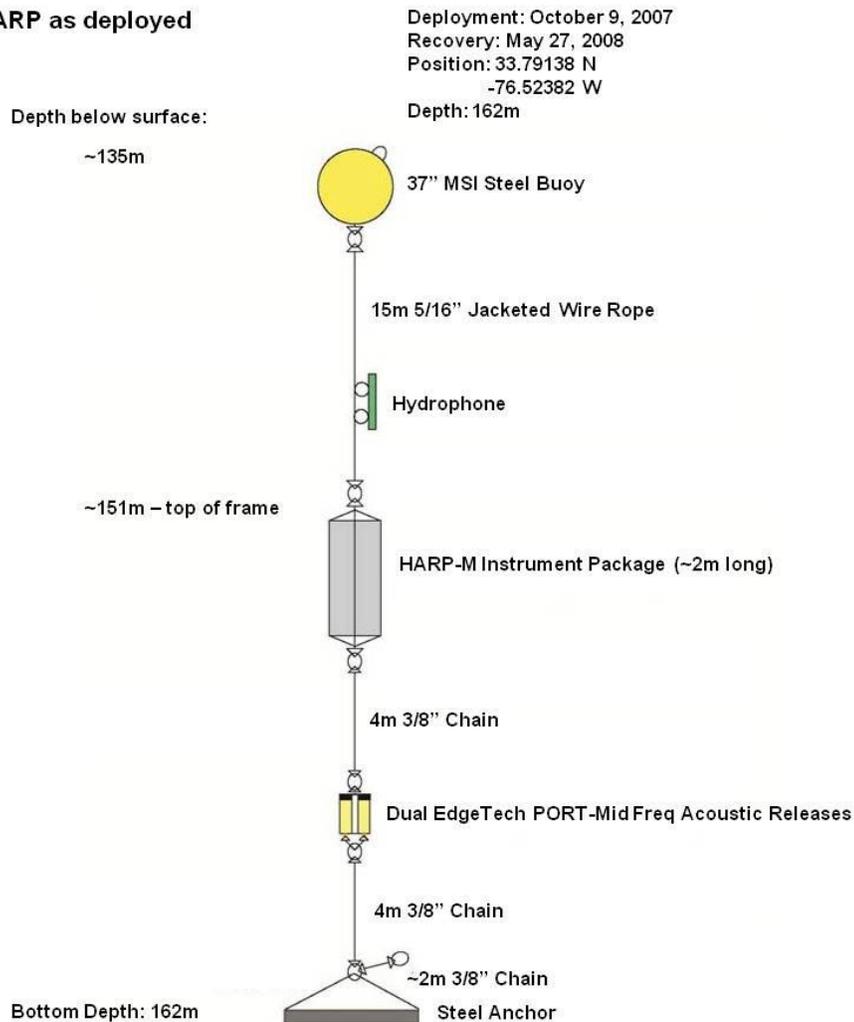


Figure 2. Schematic diagram showing details of the Onslow Bay 01A HARP. Note that diagram is not drawn to scale.

During the Onslow Bay 01A deployment, data were acquired at a 200 kHz sampling rate. The HARP recorded five minutes out of every 10 minutes, with the exception of the period from January 1 – 16, 2008, when it recorded continuously due to an instrumentation malfunction. This deployment provided a total of 1461.5 hours of data over the 99 days of recording. The data collected were manually scanned for marine mammal vocalizations using *Triton*

(Hildebrand Lab at Scripps Institution of Oceanography, La Jolla, CA). The effective frequency range of the HARP (10 Hz – 100 kHz) was divided into two parts for this manual review: 10-1000 Hz and 1-100 kHz. The resulting Long-Term Spectral Averages (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) and 5 s in time and 100 Hz in frequency (for the original data: 1-100 kHz band). LTSAs that were decimated by a factor of 100 were inspected for sounds produced by mysticetes. Non-decimated LTSAs were inspected for odontocete whistles, clicks, and burst-pulses as well as mid-frequency active sonar. The presence of vocalizations and mid-frequency active sonar was determined in one-minute bins, and vocalizations were assigned to species when possible.

Results

Table 1 summarizes the detected and identified marine mammal vocalizations for the Onslow Bay 01A HARP deployment. Figures 3-10 show the daily occurrence patterns for the different marine mammal groups (classified to species when possible). Figure 11 shows the occurrence of sonar. Underwater ambient noise during this deployment is shown in Figure 12.

Blue whale calls (Type A) were present on only one day in November (Figure 3).

Fin whale 20-Hz pulses were present on 4 November 2007 and between 15 December 2007 and 5 January 2008 (Figure 4).

Minke whale pulse trains (mainly slow-down pulse trains, but some regular pulse trains) were detected between 26 November 2007 and 15 January 2008, with most detections occurring between late December and mid-January (Figure 5).

Downsweeps similar to those ascribed to sei whales by Baumgartner *et al.* (2008) were detected on 26 December 2007 and between 11 January and 14 January 2008, with most detections occurring on 13 January 2008 (Figure 6).

Detected odontocete vocalizations included clicks, whistles, and burst-pulses (Figures 7-9). Most of these detections (95.8%) were assigned to the unidentified odontocete category (Figure 7). *Kogia* spp. were present on only one day during the Onslow Bay 01A deployment (Figure 8). Risso's dolphins were detected mainly in December and January, with a stronger nocturnal presence (Figure 9). Sperm whales were on seven days during the deployment (Figure 10).

Table 1. Summary of detections of marine mammal vocalizations at Onslow Bay Site A for October 2007 – January 2008 (Onslow Bay 01A).

Species	Call type	Total duration of vocalizations (hours)	Percent of recording duration	Days with vocalizations	Percent of recording days
Blue whale	A calls	0.05	0.003	1	1.01
Fin whale	20 Hz	4.18	0.29	7	7.07
Minke whale	pulse train (slow-down, speed-up, regular)	13.42	0.87	16	16.16
Possible sei whale	downsweep	2.71	0.18	5	5.05
Unidentified odontocete	clicks, whistles, burst-pulses	352.48	24.12	94	94.95
<i>Kogia</i> spp.	clicks	0.03	0.002	1	1.01
Risso's dolphin	clicks	8.93	0.61	10	10.10
Sperm whale	clicks	5.92	0.40	7	7.07

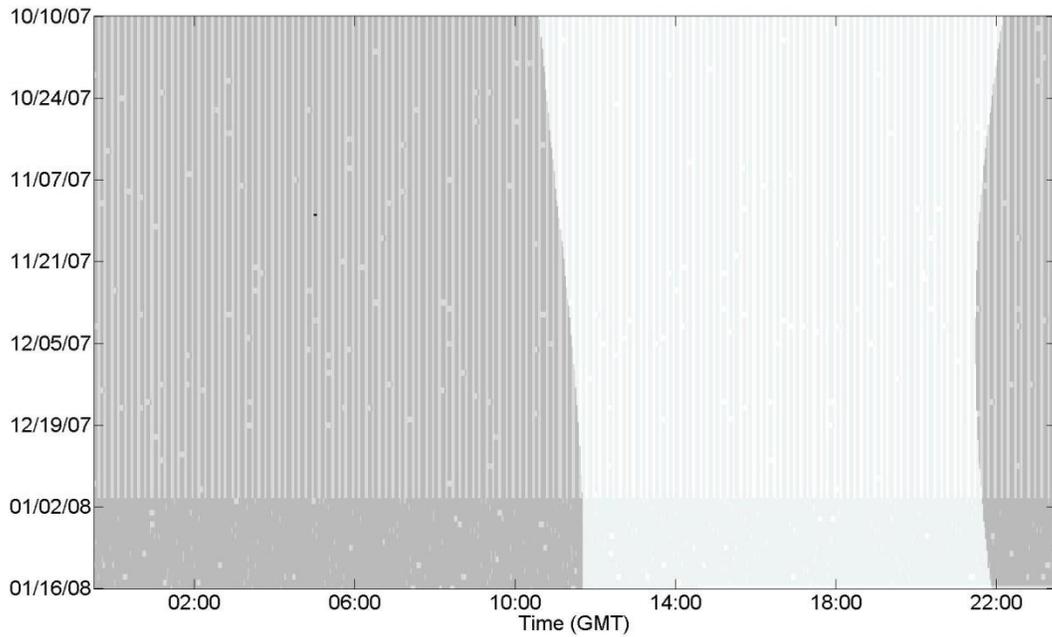


Figure 3. Blue whale Type A call detections (black bars) for the Onslow Bay 01A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

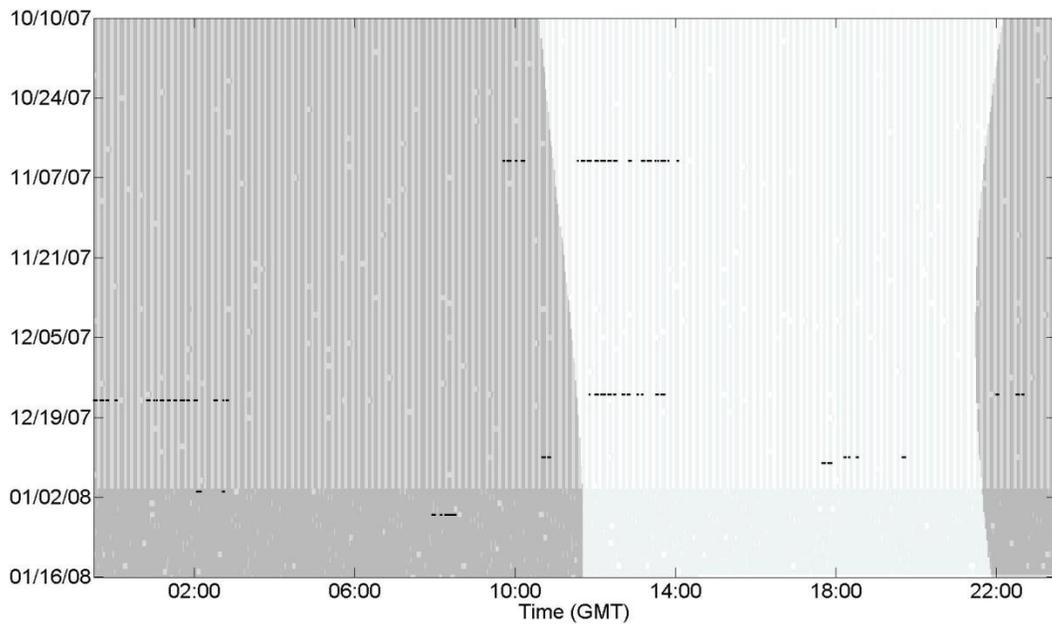


Figure 4. Fin whale 20-Hz pulse detections (black bars) for the Onslow Bay 01A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

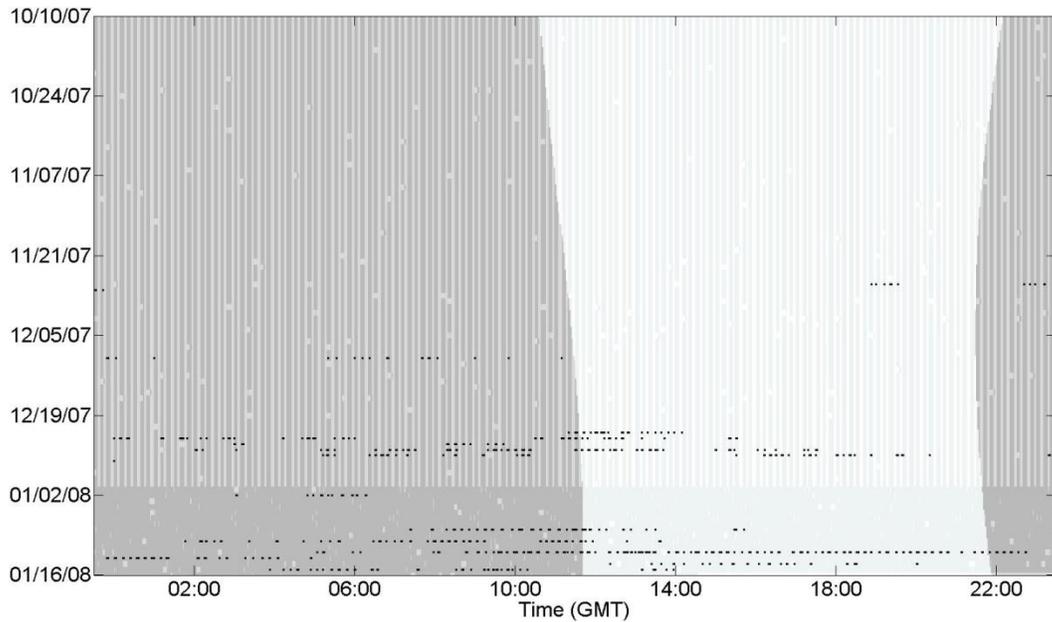


Figure 5. Minke whale detections (black bars) for the Onslow Bay 01A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

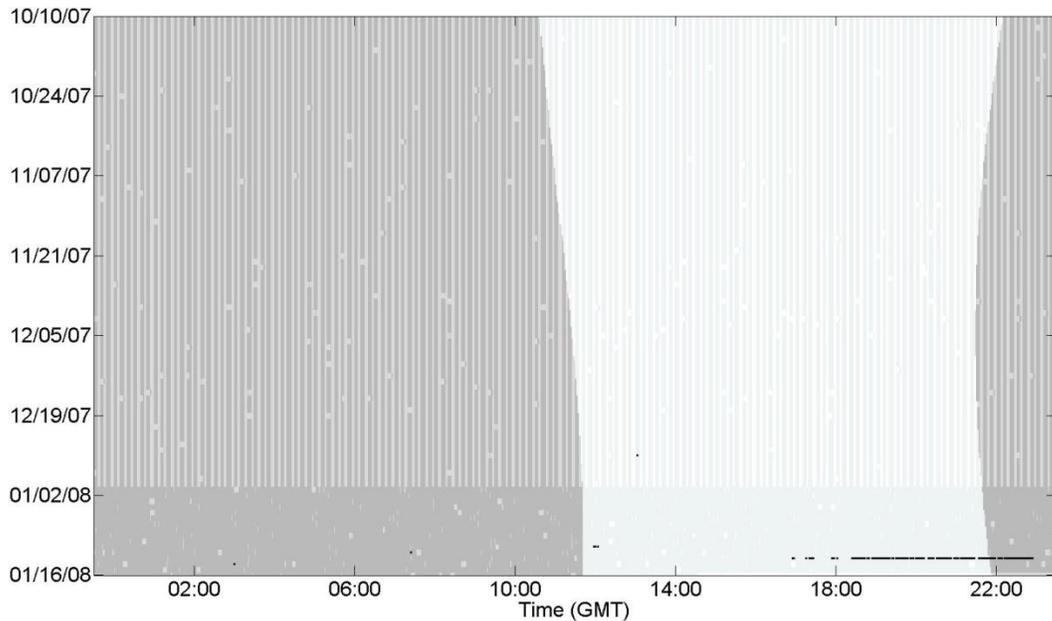


Figure 6. Downsweep detections (black bars) that may be produced by sei whales (Baumgartner *et al.* 2008) for the Onslow Bay 01A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

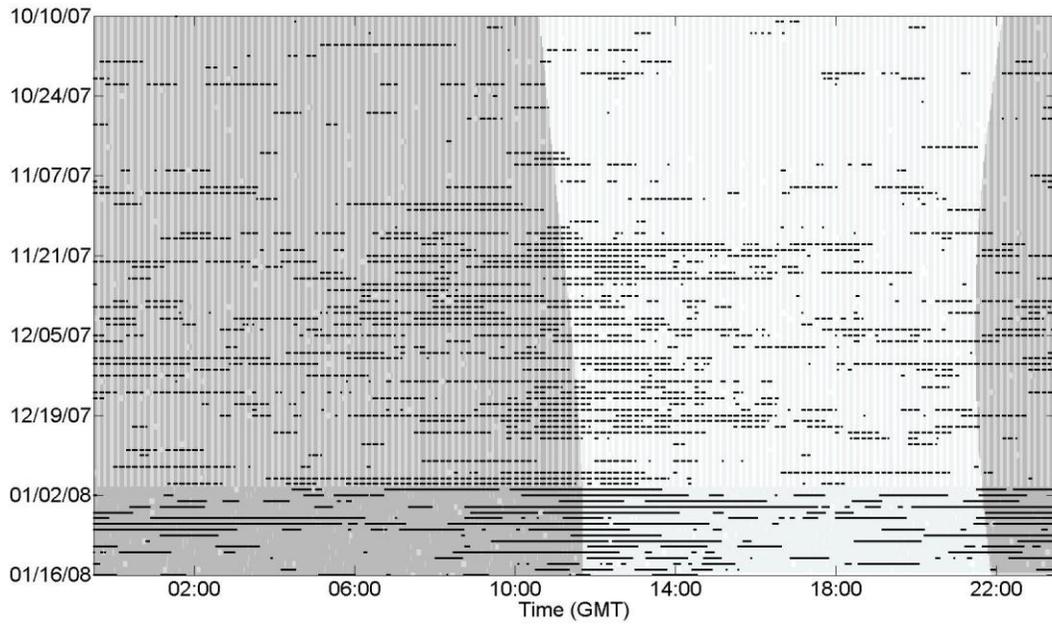


Figure 7. Unidentified odontocete vocalization detections (black bars) for the Onslow Bay 01A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

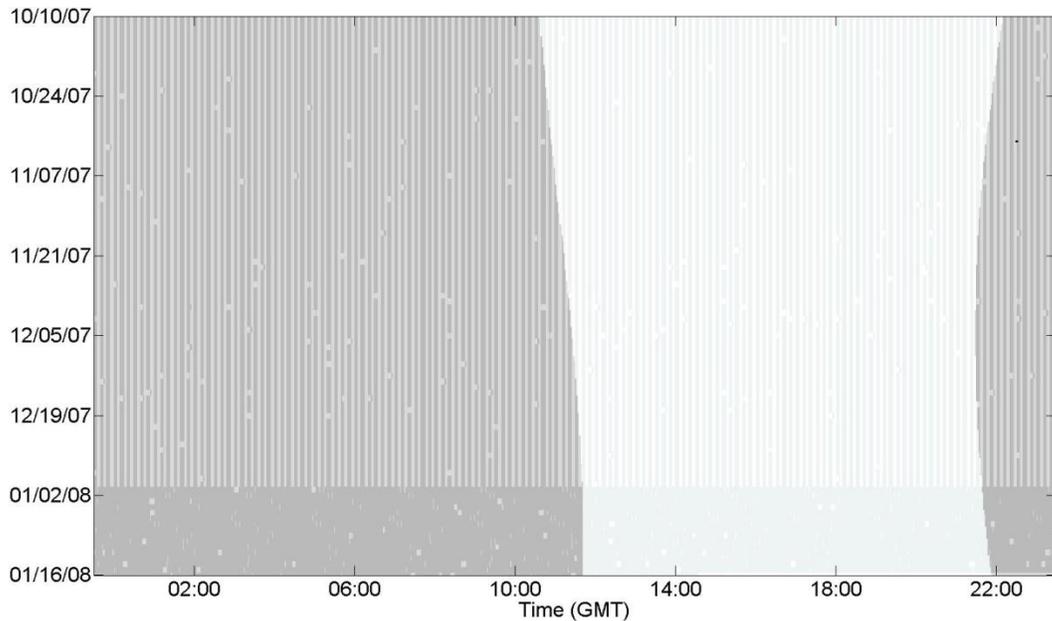


Figure 8. *Kogia* spp. click detections (black bars) for the Onslow Bay 01A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

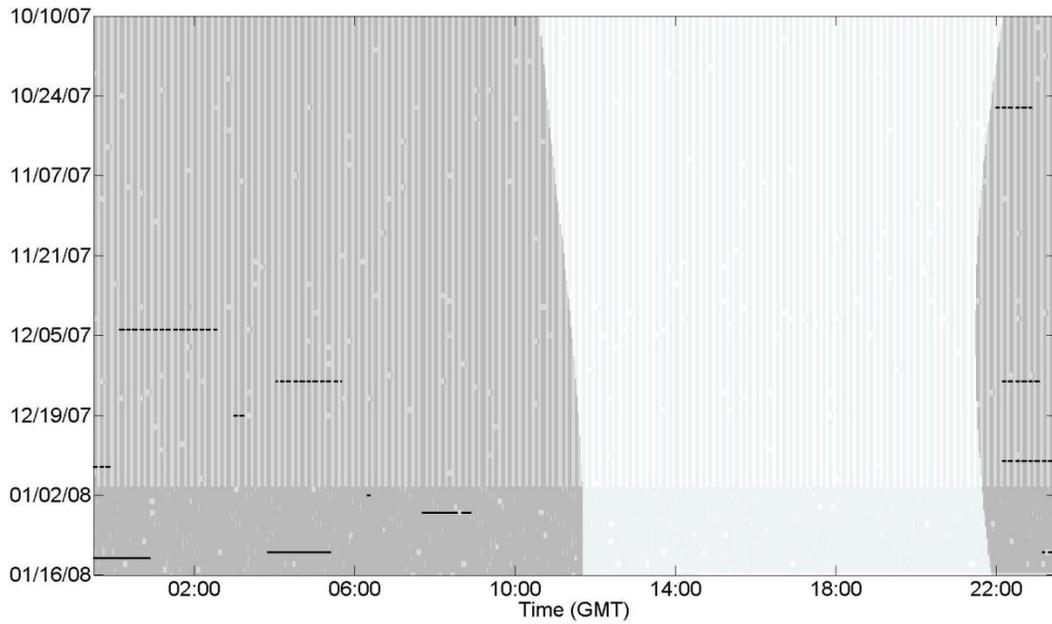


Figure 9. Risso's dolphin click detections (black bars) for the Onslow Bay 01A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

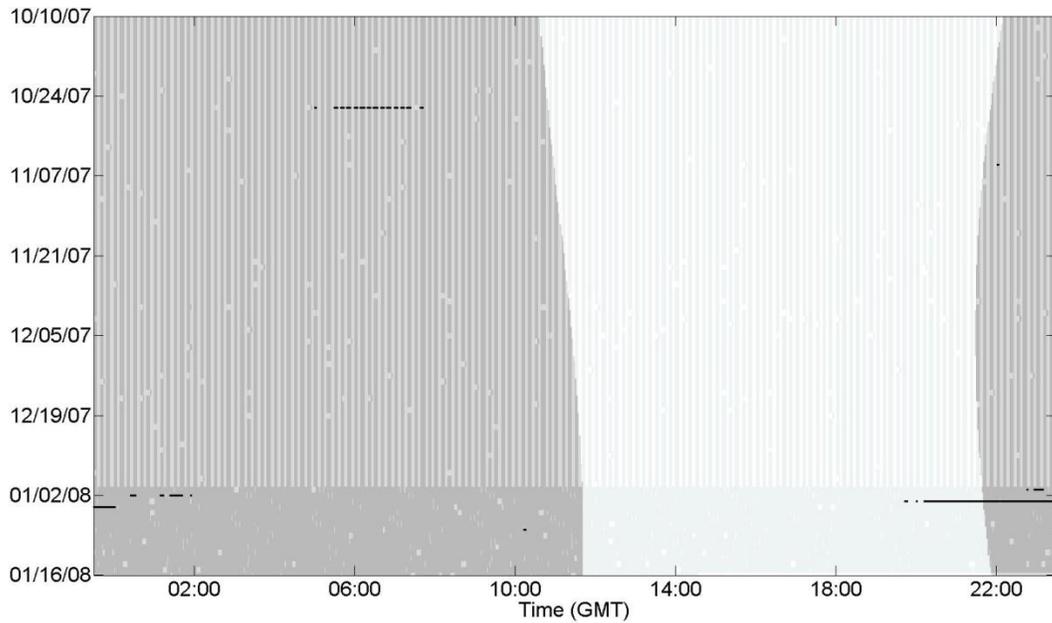


Figure 10. Sperm whale click detections (black bars) for the Onslow Bay 01A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

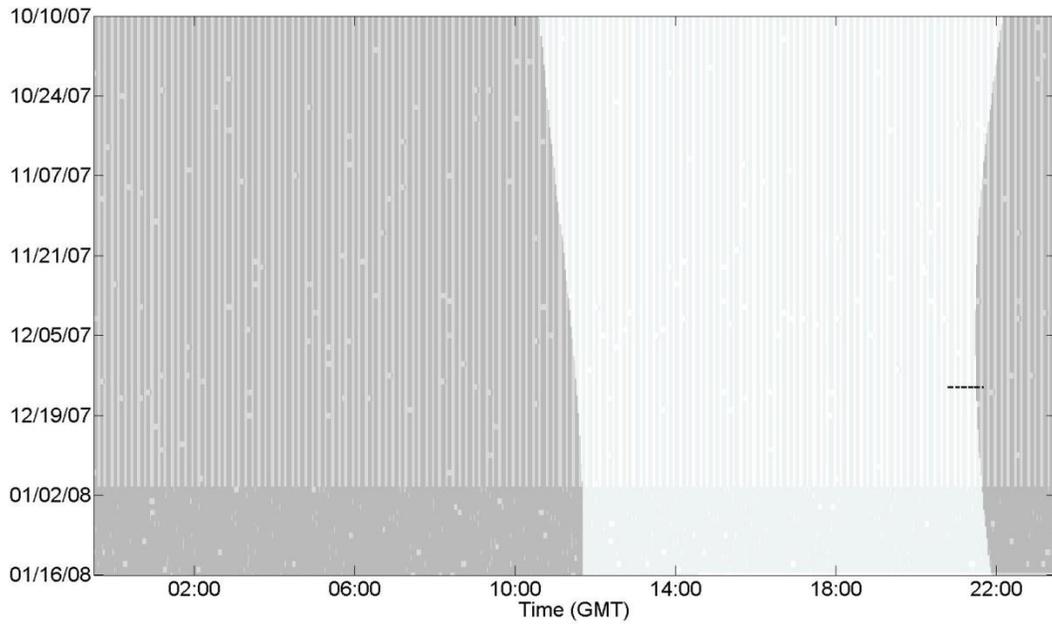


Figure 11. Mid-frequency active sonar (black bars) detected during the Onslow Bay 01A deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

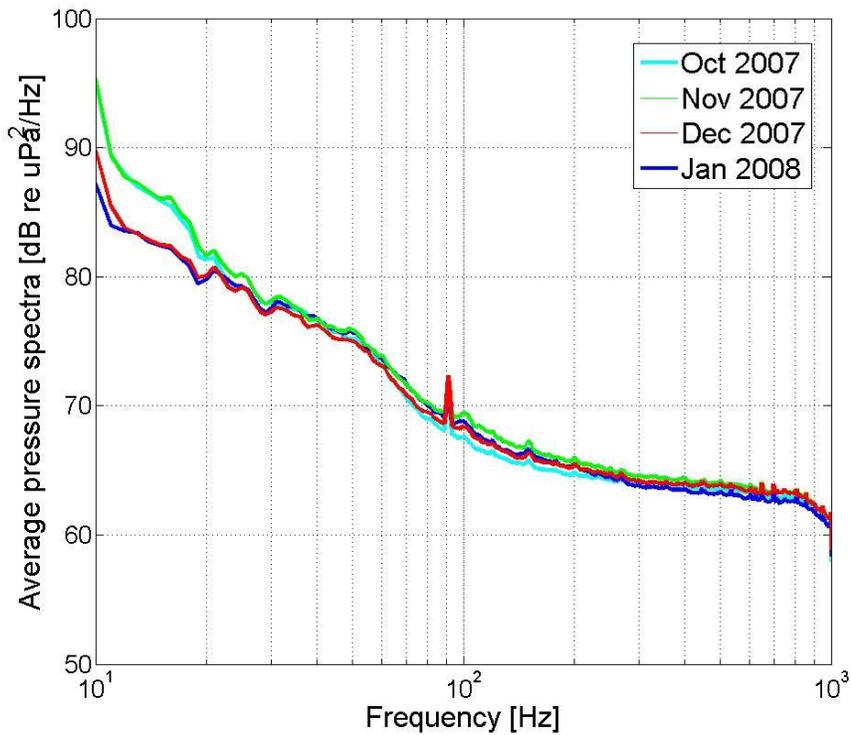


Figure 12. Monthly averages of ambient noise at Onslow Bay Site A for October 2007 – January 2008.

References

Baumgartner, M.F., S.M. Van Parijs, F.W. Wenzel, C.J. Tremblay, H.C. Esch, and A.M. Warde. 2008. Low frequency vocalizations attributed to sei whales (*Balaenoptera borealis*). *Journal of Acoustical Society of America* **124**: 1339-1349.

Wiggins, S.M. and J.A. Hildebrand. 2007. High-frequency Acoustic Recording Package (HARP) for broad-band, long-term marine mammal monitoring. In: *International Symposium on Underwater Technology 2007 and International Workshop on Scientific Use of Submarine Cables & Related Technologies 2007*: 551-557. Tokyo, Japan: Institute of Electrical and Electronics Engineers.