

**Passive Acoustic Monitoring for Marine Mammals at Site D  
in Onslow Bay, July 2010 – February 2011**

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Individual technical reports of other HARP deployments are available at:  
<http://www.navymarinespeciesmonitoring.us/reading-room/>

## **Abstract**

A High-frequency Acoustic Recording Package (HARP; Wiggins and Hildebrand 2007) was deployed between July 2010 and February 2011 in Onslow Bay at Site D in 338 m. This HARP sampled at 200 kHz for 5 minutes of every 10 minutes and recorded for 210 days between 30 July 2010 and 24 February 2011. 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 odontocetes were detected in the data.

## Methods

The 2010-2011 Onslow Bay Site D HARP (Onslow Bay 05D) was deployed at  $33.58065^{\circ}$  N,  $76.55015^{\circ}$  W on 29 July 2010 (recording started on 30 July 2010) and recovered on 10 June 2011 (recording ended on 24 February 2011). The instrument location is shown in Figure 1. Bottom depth at the deployment site was approximately 338 m. A schematic diagram of the Onslow Bay 05D HARP is shown in Figure 2.

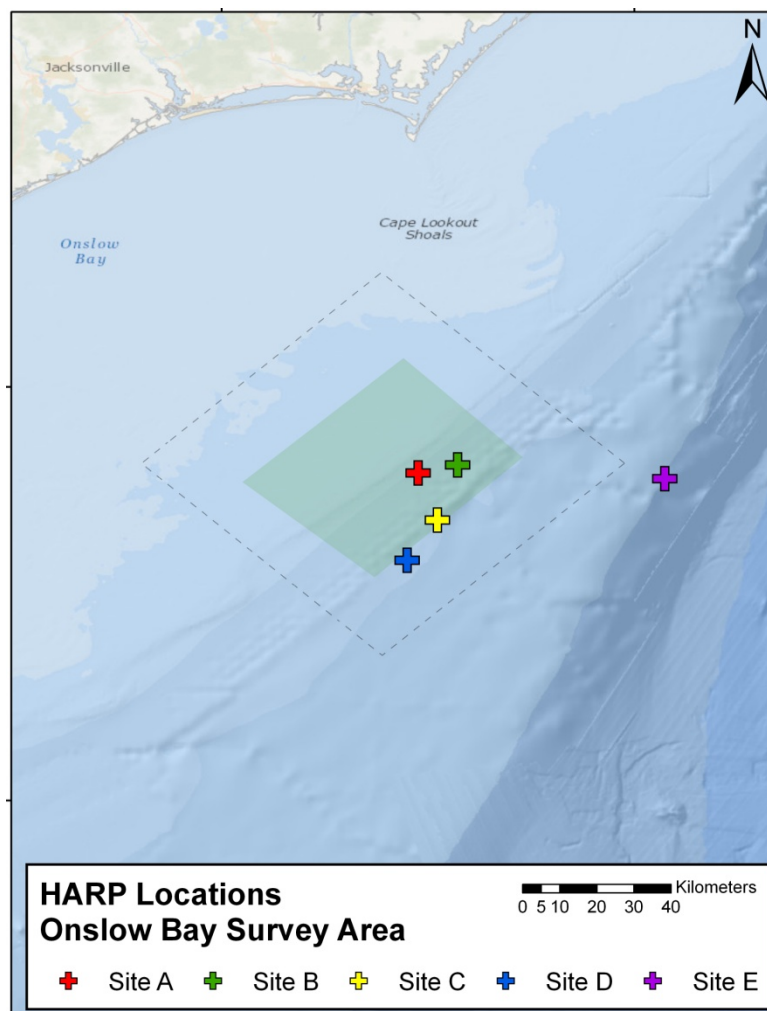


Figure 1. Location of HARP deployment sites in the Onslow Bay survey area. The location of the Onslow Bay 05D HARP is shown in blue.

## Onslow Bay 05D HARP as deployed

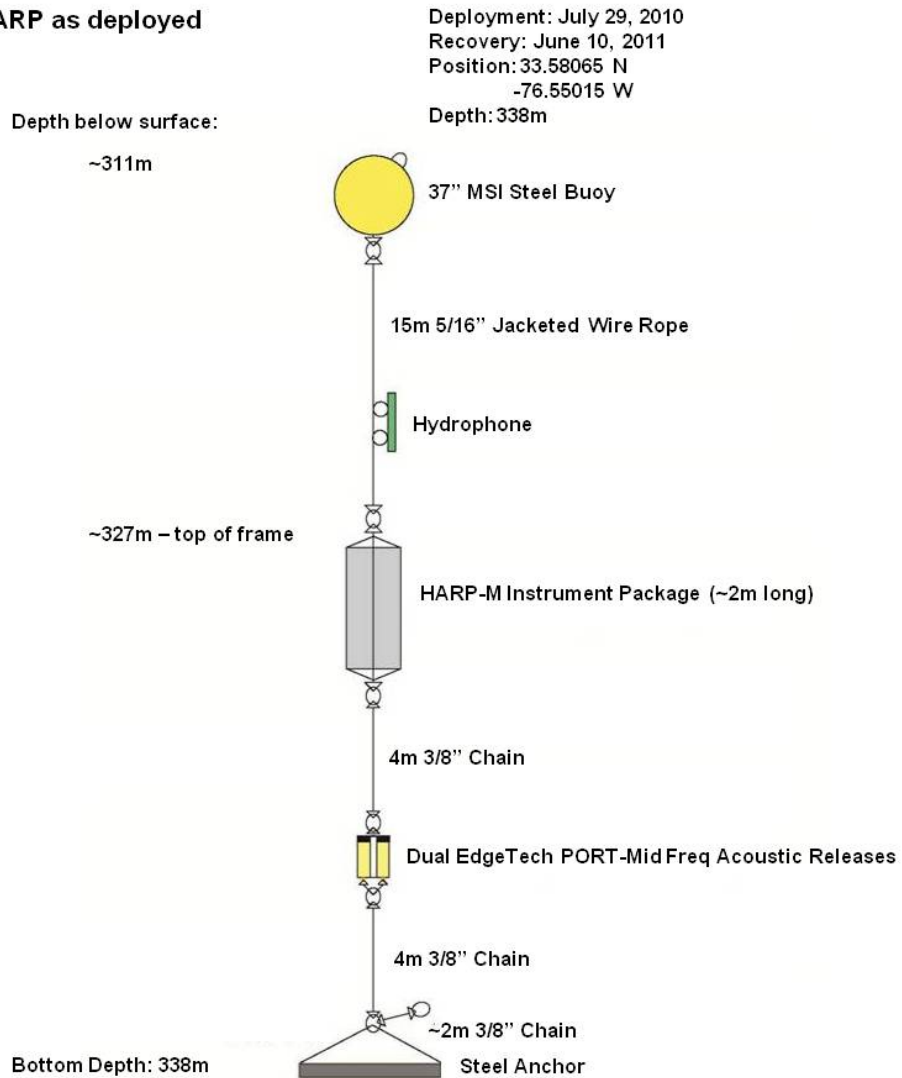


Figure 2. Schematic diagram showing details of the Onslow Bay 05D HARP. Note that diagram is not drawn to scale.

Data were acquired at a 200 kHz sampling rate for 5 minutes every 10 minutes during the Onslow Bay 05D deployment. This deployment provided a total of 2733.9 hours of data over the 210 days of recording. The data collected were manually scanned for marine mammal vocalizations using the “logger” version of *Triton* (v1.81.20121030; 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. Analysis methods for this dataset were consistent with Onslow Bay datasets USWTR01A, 02B, 03A, 04A, 04C, and 05D.

## **Results**

Table 1 summarizes the detected and identified marine mammal vocalizations for the Onslow Bay 05D 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 mid-frequency active sonar. Underwater ambient noise during this deployment is shown in Figure 12.

Blue whales were present primarily from August 2010 to mid-February 2011 (Figure 3), although most detections occurred before the end of December. Type A and B blue whale calls were detected, mainly as song but also occasionally as individual calls.

Fin whale 20-Hz pulses were present between the end of August and mid-September 2010 and between the end of October 2010 and February 2011 (Figure 4). Peaks in detections occurred between December and February, which is similar to previous findings of peaks between January and March.

Minke whale pulse trains (mainly slow-down pulse trains) were detected between mid-November 2010 and the last day of the recording period, 24 February 2011 (Figure 5). Peaks in pulse train calls occurred from the end of December through the end of February, similar to the previous findings of peaks between January and March for earlier deployments.

Downsweeps similar to those ascribed to sei whales by Baumgartner *et al.* (2008) were detected on 16-17 October 2010 and between 13 November 2010 and 17 February 2011 (Figure 6). The general occurrence of this call type is similar to previous findings in Onslow Bay.

Detected odontocete vocalizations included clicks, whistles, and burst-pulses (Figures 7-10). Most of these detections (93%) were assigned to the unidentified odontocete category (Figure 7). Unlike during the 2010-2011 Site A deployment which occurred at the same time as this Site D deployment, there was no pattern of longer-duration and clustered unidentified odontocete vocal events during late night to early morning between November and January (Figure 7). *Kogia* spp. clicks were present on only three days during the 2010-2011 Site D deployment (Figure 8), which is consistent with the sporadic occurrence found during previous deployments. Risso's dolphins were detected throughout the deployment with more detections at night, again agreeing with earlier findings (Figure 9). Sperm whales were detected between August and early

September and between the end of December and mid- February, during both day and night (Figure 10).

### *Data Gaps*

There were a few (14) five-minute segments of data that were not analyzed due to hard drive issues. These segments were not analyzed either because they were missing (skipped during the recording process) or the hard drive recorded the sound incorrectly (see Figure 13). These segments were removed from the analysis effort.



Table 1. Summary of detections of marine mammal vocalizations at Onslow Bay Site D for July 2010 – February 2011 (Onslow Bay 05D).

<b>Species</b>	<b>Call type</b>	<b>Total duration of vocalizations (hours)</b>	<b>Percent of recording duration</b>	<b>Days with vocalizations</b>	<b>Percent of recording days</b>
Blue whale	A and B calls (mainly A)	72.45	2.65	103	49.05
Fin whale	20 Hz	105.37	3.85	64	30.48
Minke whale	pulse train (slow-down, speed-up, regular)	149.10	5.45	83	39.52
Possible sei whale	downsweep	6.02	0.22	24	11.43
Unidentified odontocete	clicks, whistles, burst-pulses	632.9	23.15	208	99.05
<i>Kogia</i> spp.	clicks	0.10	0.004	3	1.43
Risso's dolphin	clicks	30.3	1.11	46	21.90
Sperm whale	clicks	18.43	0.67	34	16.19

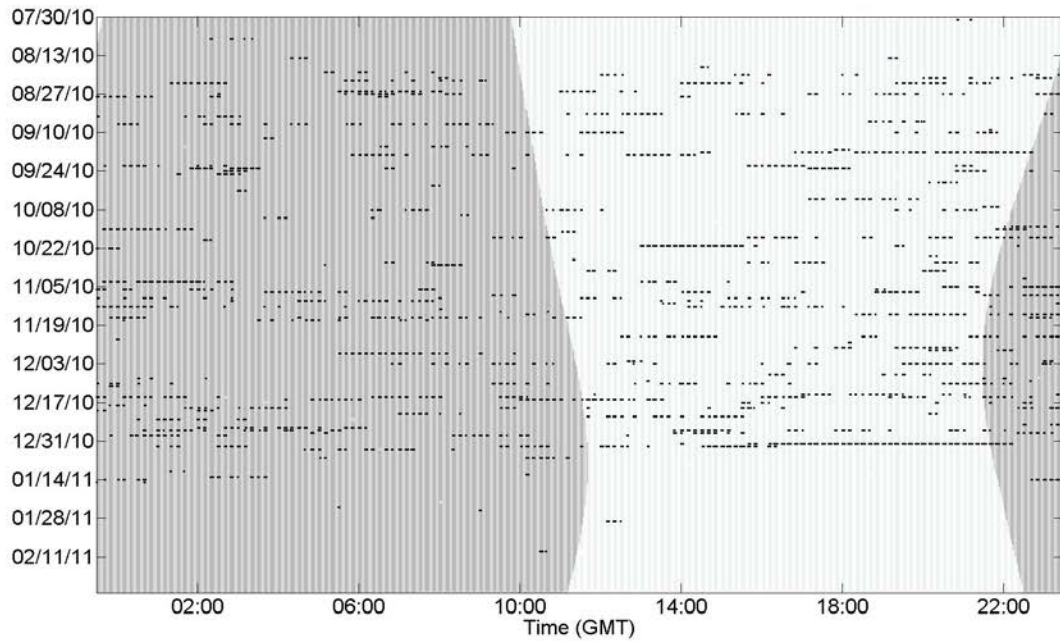


Figure 3. Blue whale Type A and B call detections (black bars) for the 2010-2011 Site D deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

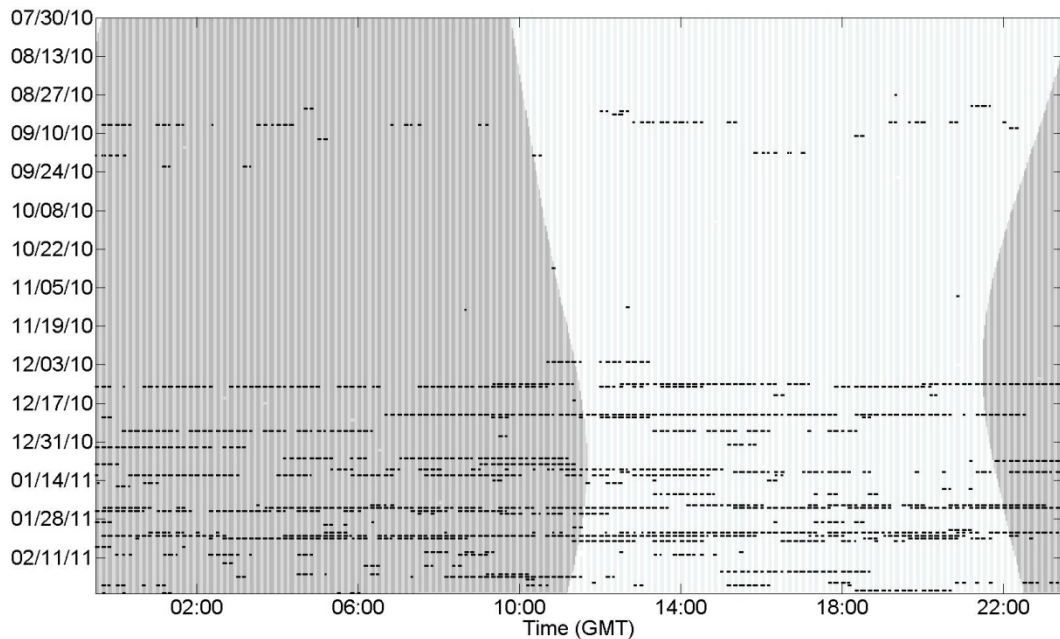


Figure 4. Fin whale 20-Hz pulse detections (black bars) for the 2010-2011 Site D deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

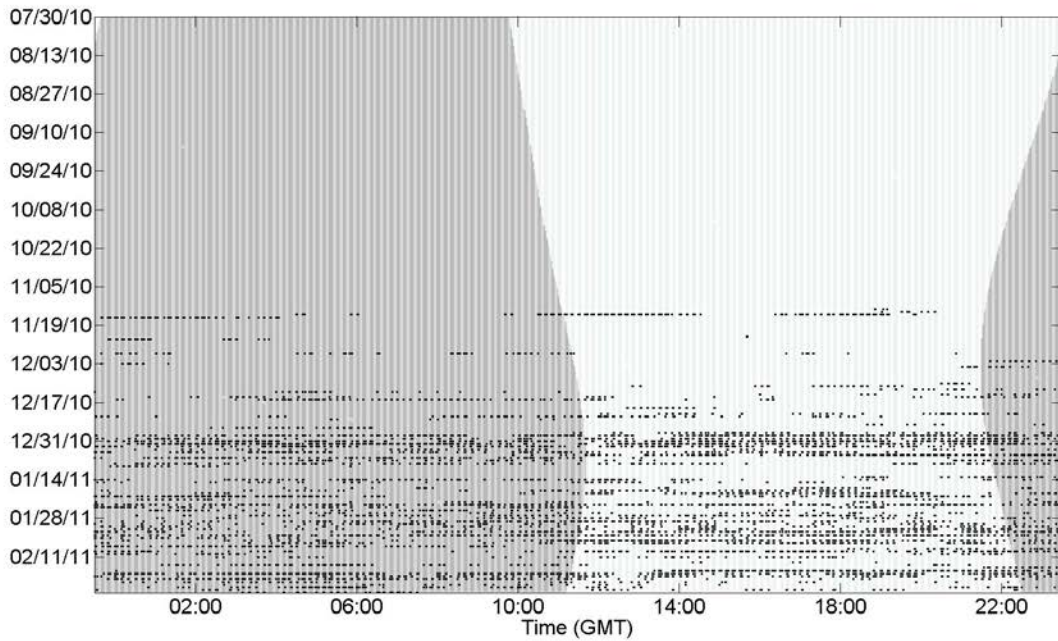


Figure 5. Minke whale detections (black bars) for the 2010-2011 Site D deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

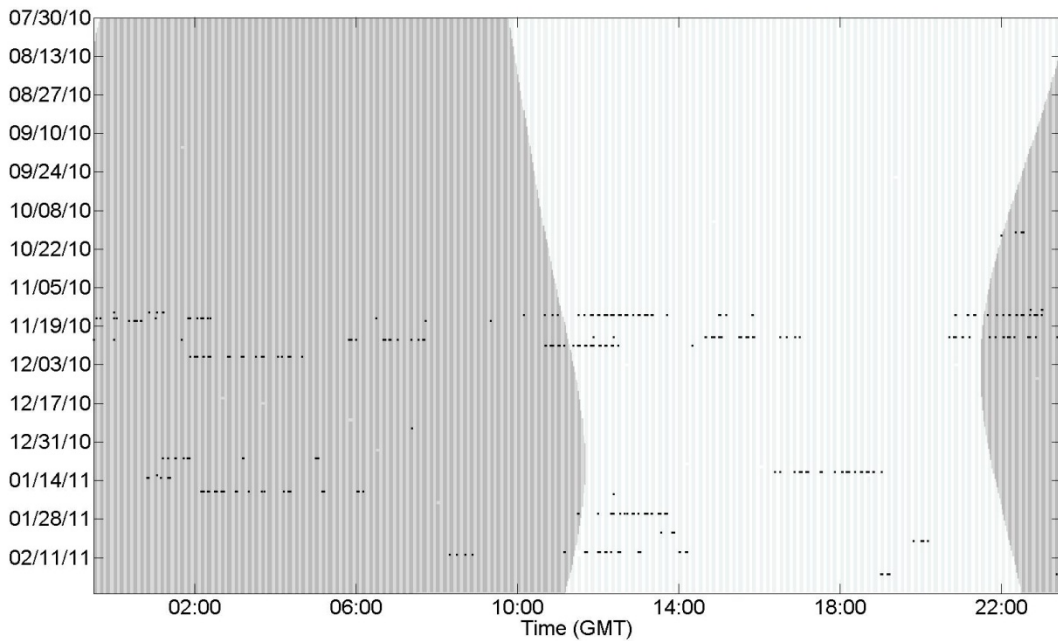


Figure 6. Downsweep detections (black bars) that may be produced by sei whales (Baumgartner *et al.* 2008) for the 2010-2011 Site D deployment. Dark gray shading indicates periods of

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

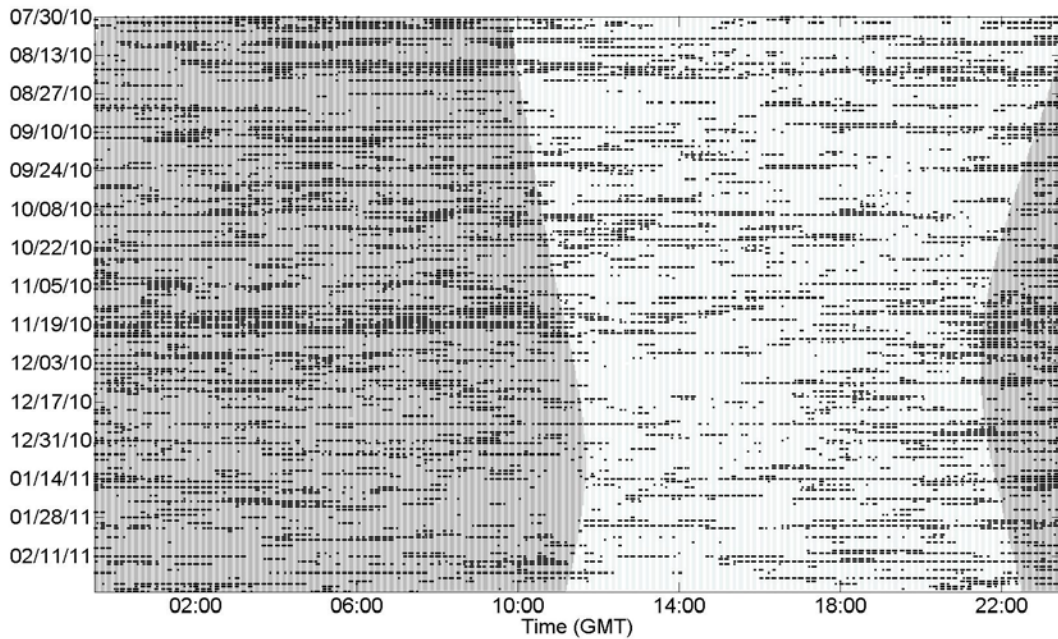


Figure 7. Unidentified odontocete vocalization detections (black bars) for the 2010-2011 Site D deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

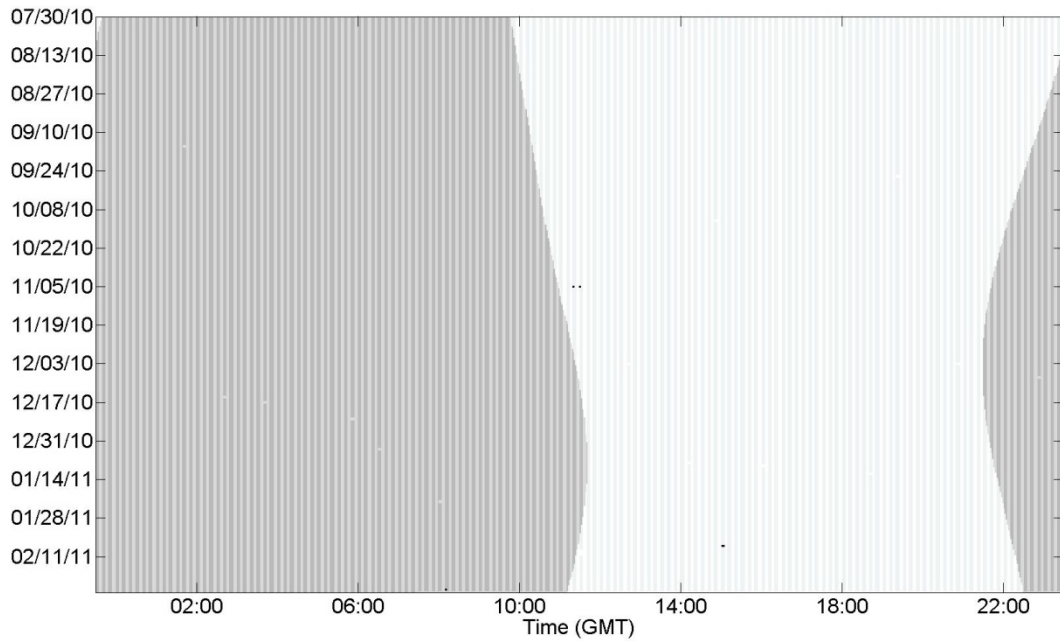


Figure 8. *Kogia* spp. click detections (black bars) for the 2010-2011 Site D deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

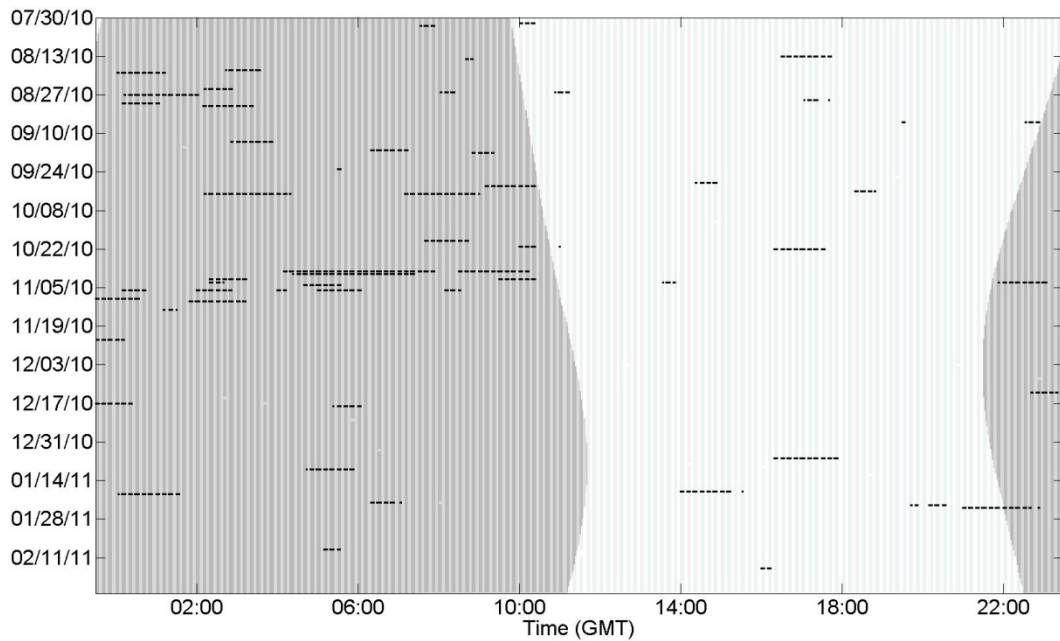


Figure 9. Risso's dolphin click detections (black bars) for the 2010-2011 Site D deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

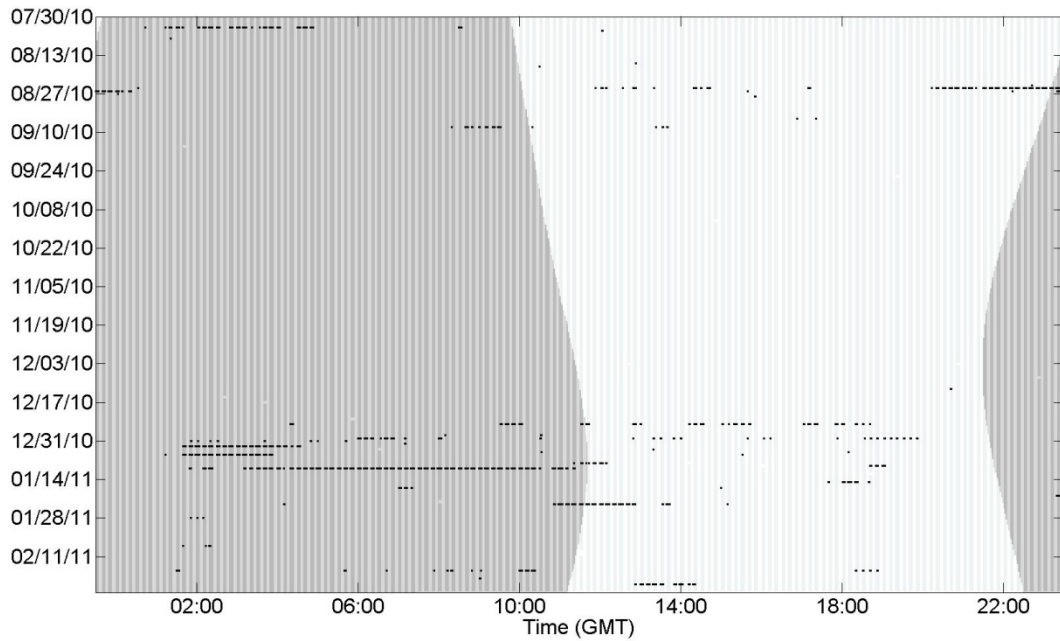


Figure 10. Sperm whale click detections (black bars) for the 2010-2011 Site D deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

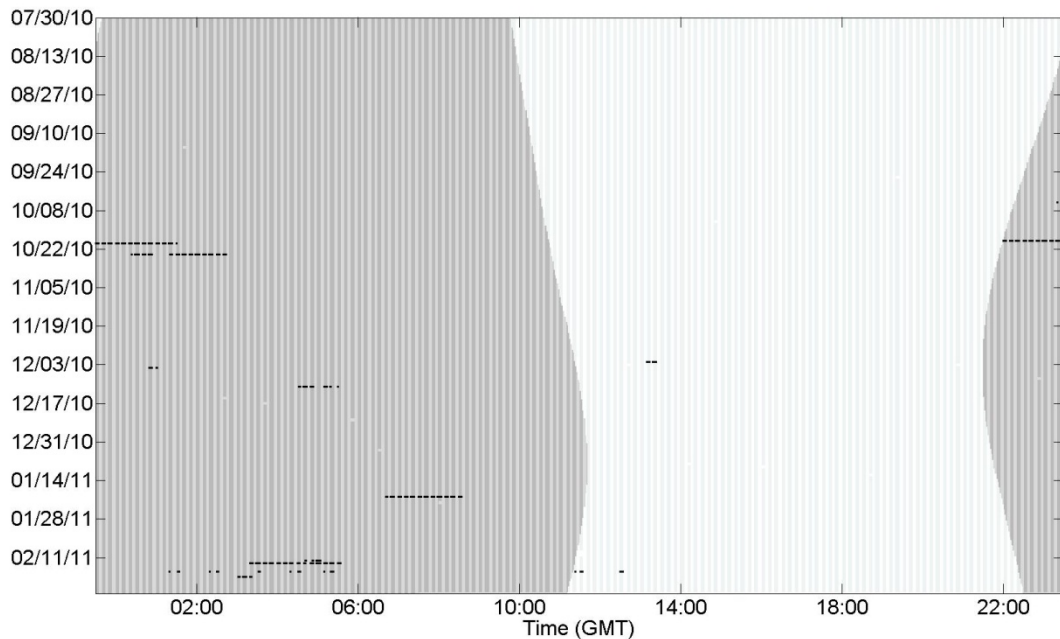


Figure 11. Mid-frequency active sonar (black bars) detected during the 2010-2011 Site D deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (<http://aa.usno.navy.mil>). Lighter shading indicates recording/analysis effort.

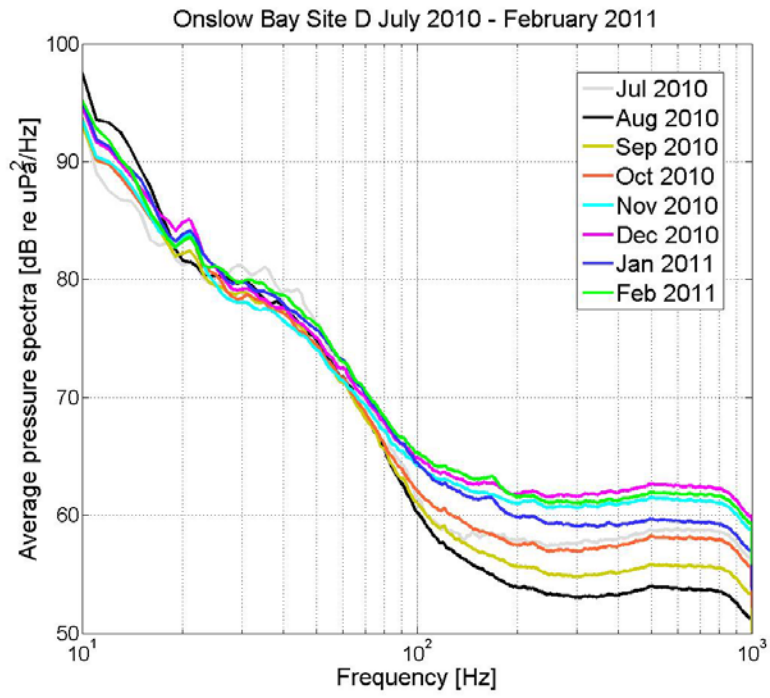


Figure 12. Monthly averages of ambient noise at Onslow Bay Site D for July 2010 – February 2011.



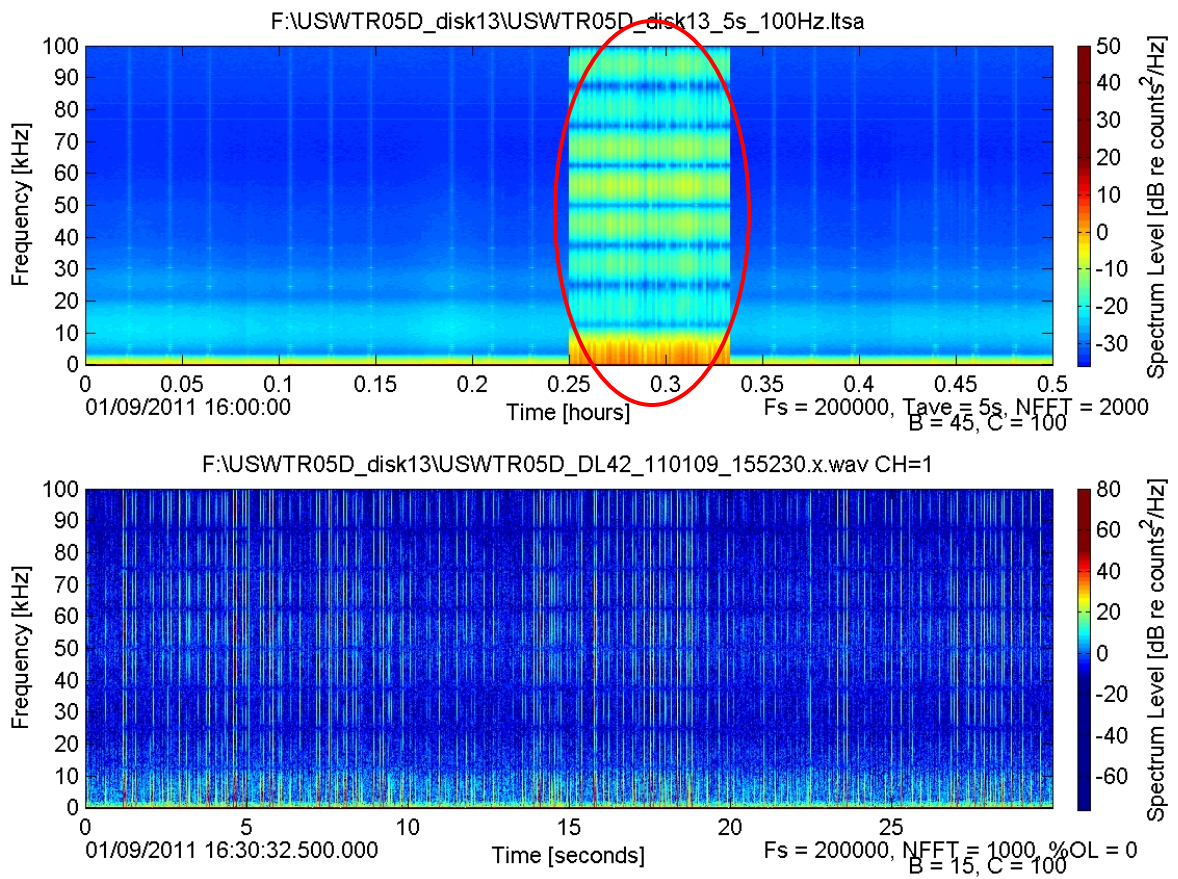


Figure 13. Red oval in LTSA (top) shows an example of a five-minute segment when there was an issue recording sound to the hard drive. The spectrogram (bottom) shows the resulting data, which was not usable for analysis of marine mammal vocalizations.



## 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.