Passive Acoustic Monitoring for Marine Mammals at Site C in Onslow Bay, November 2009 – April 2010

Lynne Hodge and Andrew Read

Duke University Marine Laboratory
135 Duke Marine Lab Road
Beaufort, NC 28516

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

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Abstract

A High-frequency Acoustic Recording Package (HARP; Wiggins and Hildebrand 2007) was deployed between November 2009 and April 2010 in Onslow Bay at Site C in 335 m. This HARP sampled at 200 kHz for 5 minutes of every 15 minutes and recorded for 163 days between 8 November 2009 and 20 April 2010. 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, humpback whales, possible sei whales, *Kogia* spp., Risso's dolphins, sperm whales, and unidentified delphinids were detected in the data.

Methods

The 2009-2010 Onslow Bay Site C HARP (Onslow Bay 04C) was deployed at 33.67784^{o} N, 76.47689^{o} W on 8 November 2009 (recording started on 8 November 2009) and recovered on 19 June 2010 (recording ended on 20 April 2010). The instrument location is shown in Figure 1. Bottom depth at the deployment site was approximately 335 m. A schematic diagram of the Onslow Bay 04C HARP is shown in Figure 2.

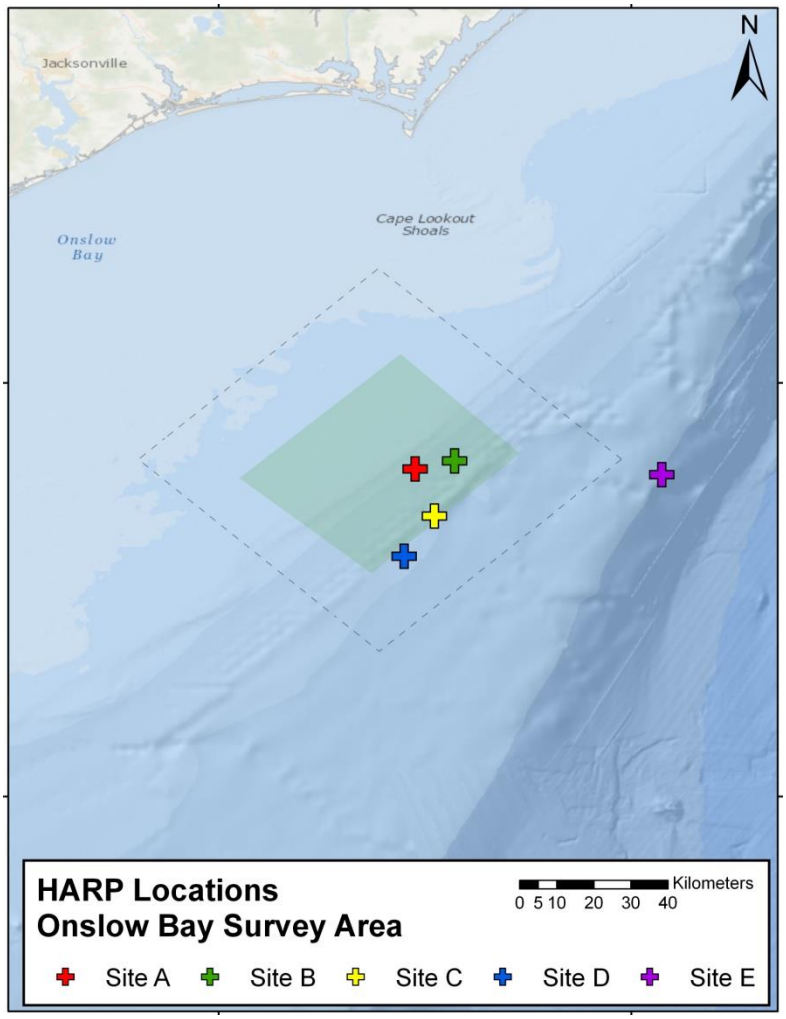

Figure 1. Location of HARP deployment sites in the Onslow Bay survey area. The location of the Onslow Bay 04C HARP is shown in yellow.

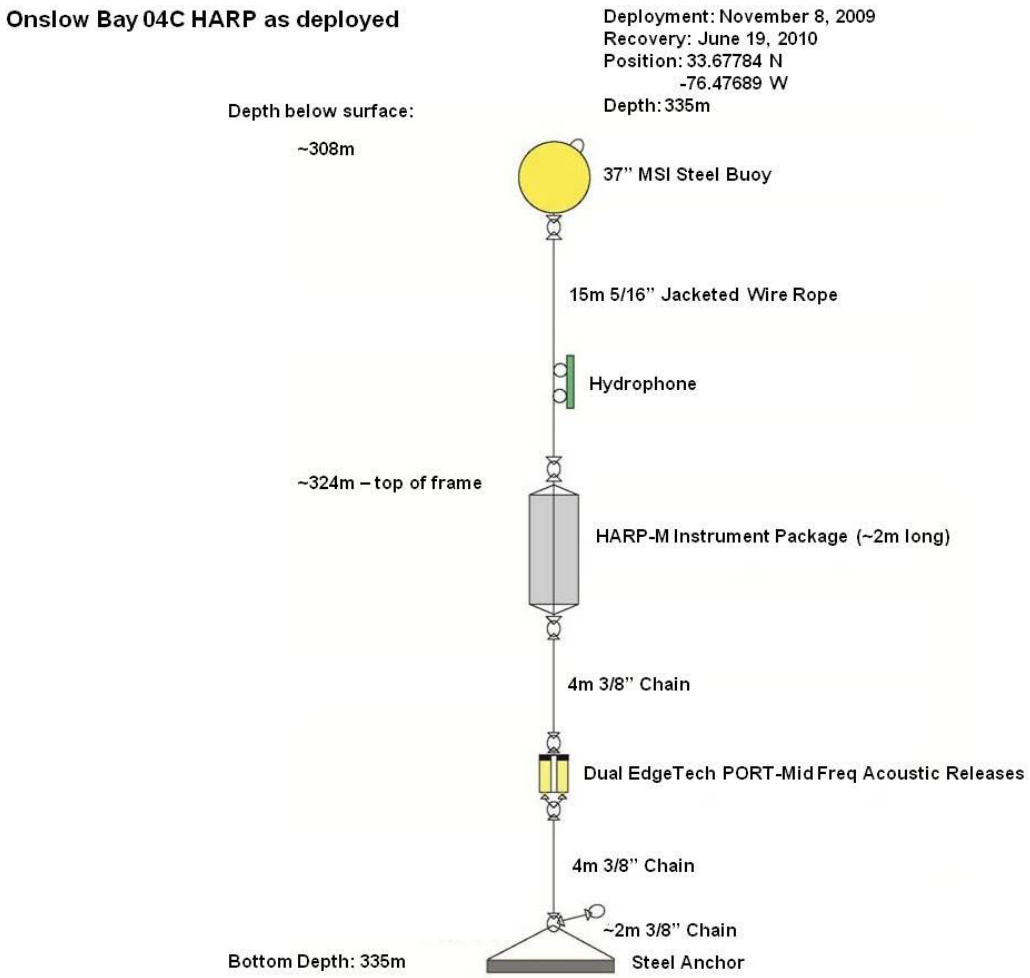

Figure 2. Schematic diagram showing details of the Onslow Bay 04C HARP. Note that diagram is not drawn to scale.

Data were acquired at a 200 kHz sampling rate for 5 minutes every 15 minutes during the Onslow Bay 04C deployment. This deployment provided a total of 1389.8 hours of data over the 164 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 04C HARP deployment. Figures 3-11 show the daily occurrence patterns for the different marine mammal groups (classified to species when possible). Figure 12 shows the occurrence of mid-frequency active sonar. Underwater ambient noise during this deployment is shown in Figure 13.

Blue whale calls were present on one day in November and one day in January (Figure 3).

Fin whale 20-Hz pulses were present throughout the deployment period, with most detections occurring between January and March (Figure 4).

Minke whale pulse trains (mainly slow-down pulse trains, but some regular pulse trains and a few speed-up pulse trains) were detected throughout the deployment period (Figure 5). Peaks in pulse train calls occurred from mid-December through the mid- to late March.

Humpback whale calls were detected on a single day, April 18, 2010 (Figure 6). The timing of these detected calls corresponds to the northern migration of this species from the breeding grounds to feeding grounds.

Downsweeps similar to those ascribed to sei whales by Baumgartner *et al.* (2008) were detected between 18 November 2009 and 12 March 2010, with most calls occurring in November and December (Figure 7).

Detected odontocete vocalizations included clicks, whistles, and burst-pulses (Figures 8-11). Most of these detections (94.8%) were assigned to the unidentified odontocete category (Figure 8). *Kogia* spp. were present on only six days during the 2009-2010 Site C deployment (Figure 9), which is consistent with the sporadic occurrence found during previous deployments. Risso's dolphins were also detected throughout the deployment with a slightly stronger nocturnal presence, again agreeing with earlier findings (Figure 10). Sperm whales were detected mainly between February and April, during both day and night (Figure 11).

Table 1. Summary of detections of marine mammal vocalizations at Onslow Bay Site C for November 2009 – April 2010 (Onslow Bay 04C).

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 (mainly A)	0.25	0.02	2	1.22
Fin whale	20 Hz	96.52	6.94	78	47.56
Minke whale	pulse train (slow-down, speed-up, regular)	50.75	3.44	96	58.54
Humpback whale	variable	1.23	0.08	1	0.61
Possible sei whale	downsweep	5.13	0.35	16	9.76
Unidentified odontocete	clicks, whistles, burst-pulses	283.68	20.41	162	98.78
Kogia spp.	clicks	0.33	0.02	6	3.66
Risso's dolphin	clicks	3.37	0.24	10	6.10
Sperm whale	clicks	8.18	0.59	18	10.98

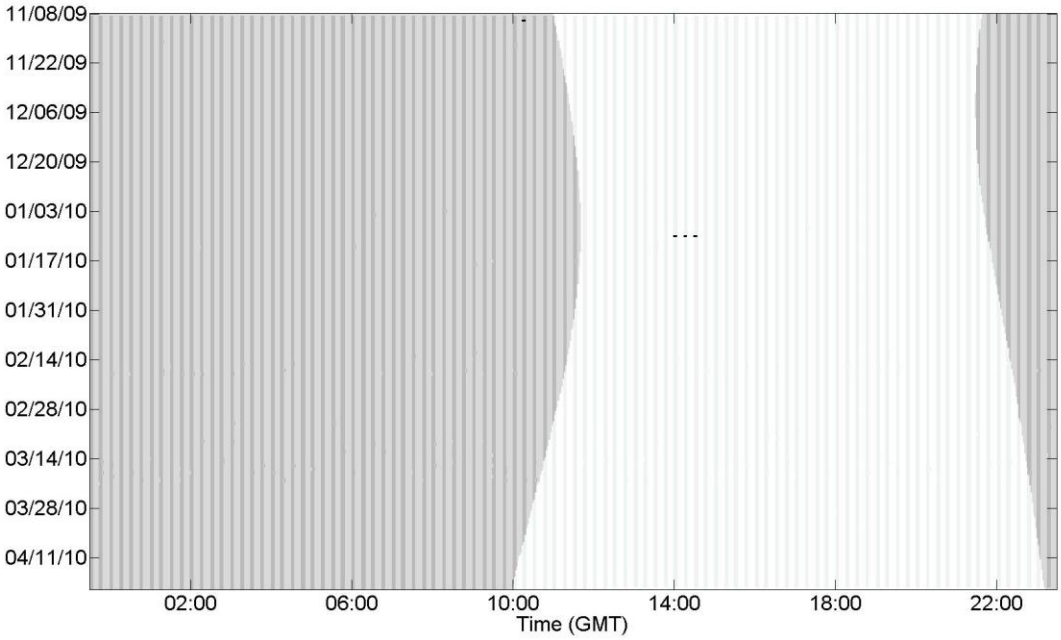

Figure 3. Blue whale Type A and B call detections (black bars) for the Onslow Bay 04C deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

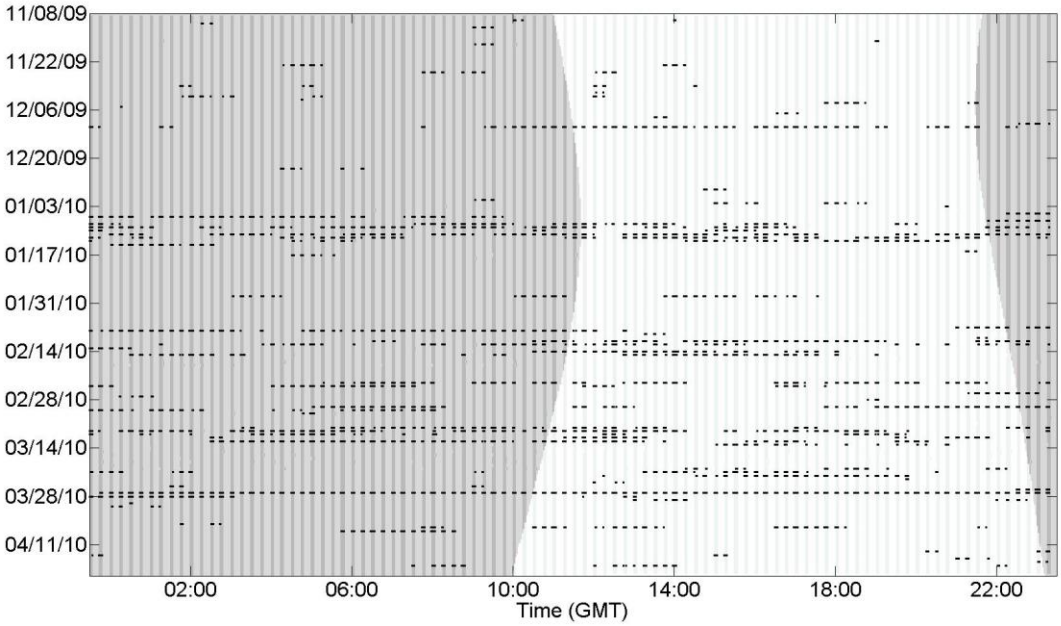

Figure 4. Fin whale 20-Hz pulse detections (black bars) for the Onslow Bay 04C deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

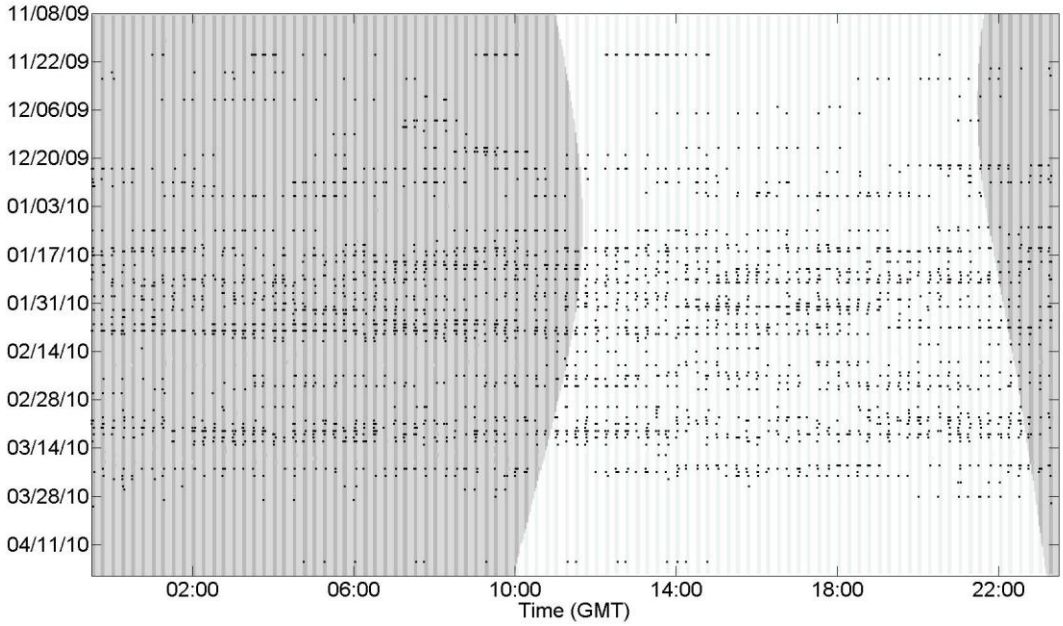

Figure 5. Minke whale detections (black bars) for the Onslow Bay 04C deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

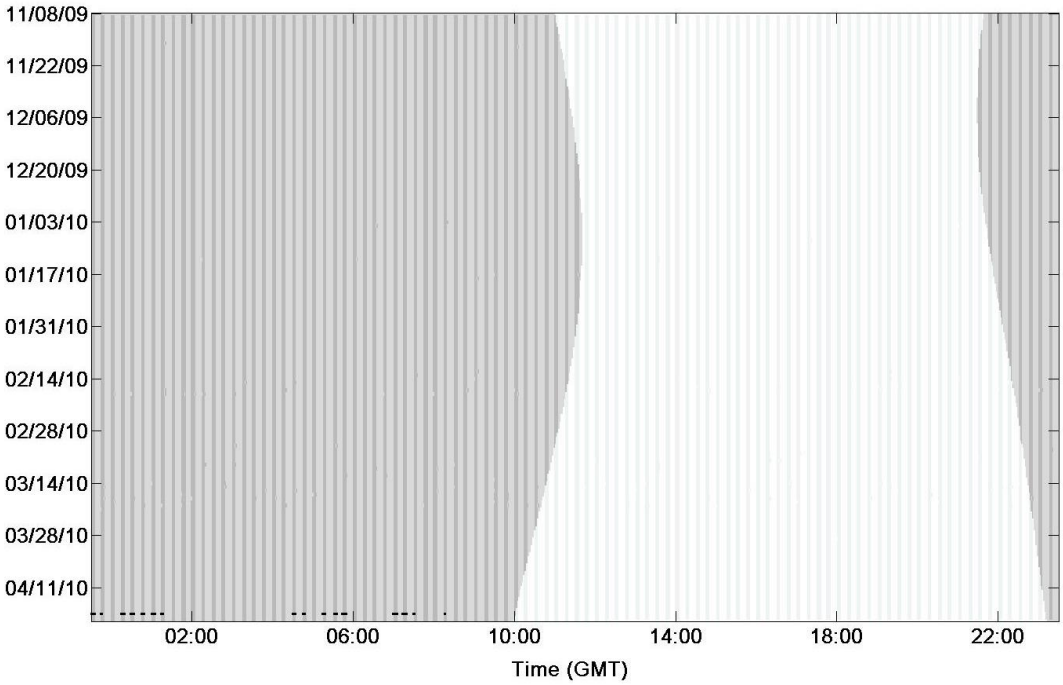

Figure 6. Humpback whale detections (black bars) for the Onslow Bay 04C deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

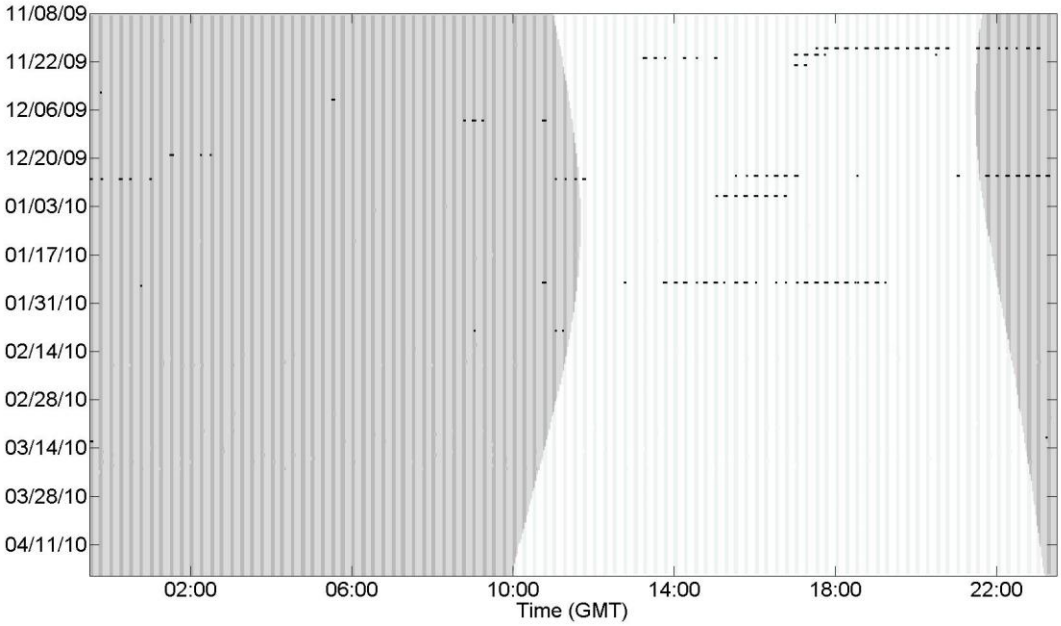

Figure 7. Downsweep detections (black bars) that may be produced by sei whales (Baumgartner *et al.* 2008) for the Onslow Bay 04C deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

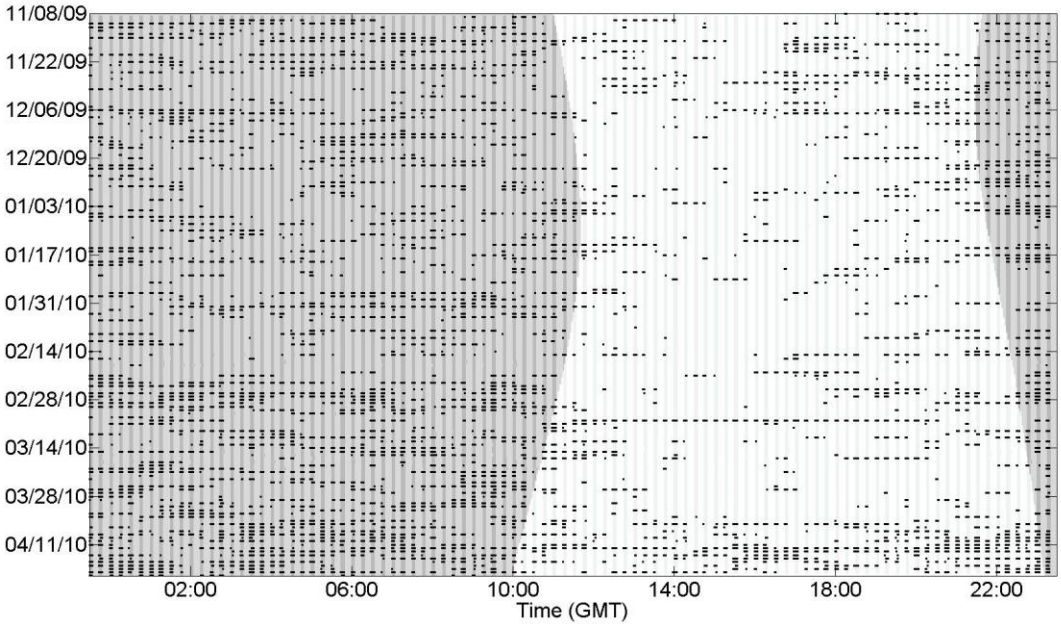

Figure 8. Unidentified odontocete vocalization detections (black bars) for the Onslow Bay 04C deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

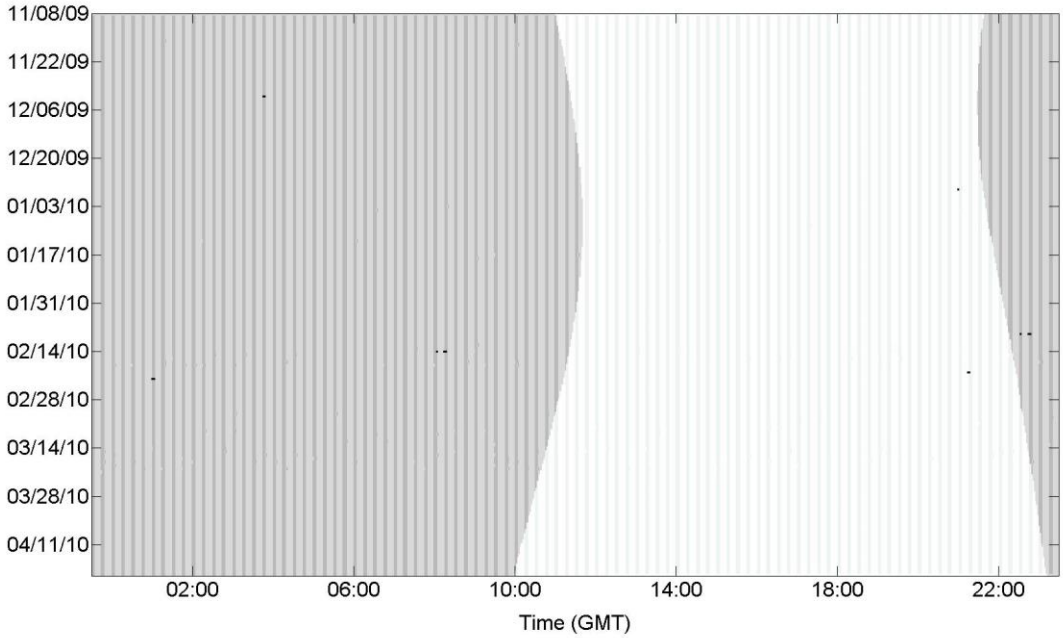

Figure 9. *Kogia* spp. click detections (black bars) for the Onslow Bay 04C deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

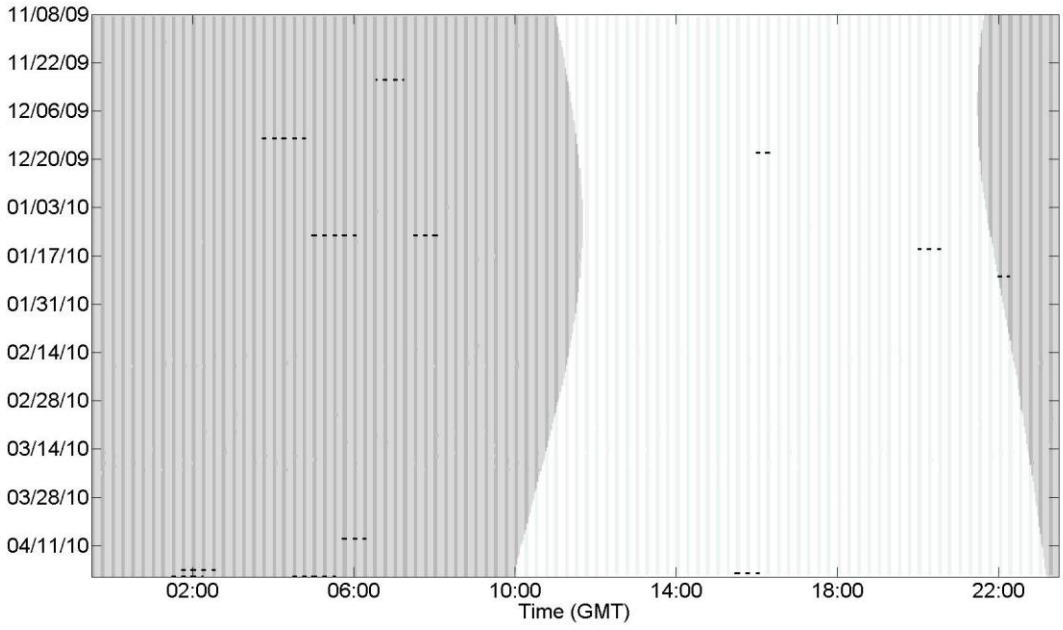

Figure 10. Risso's dolphin click detections (black bars) for the Onslow Bay 04C deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

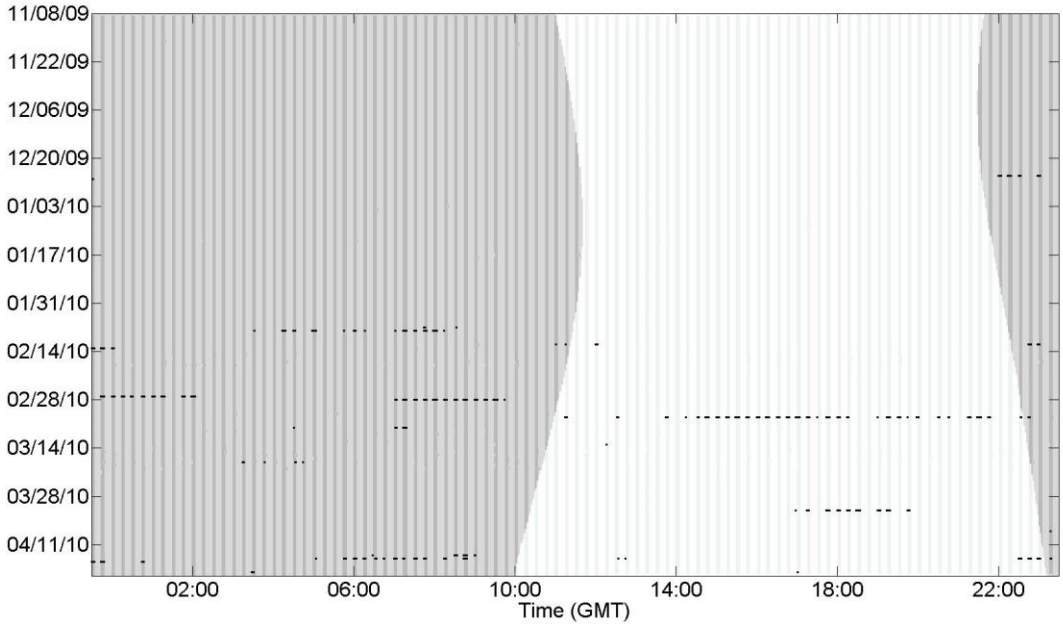

Figure 11. Sperm whale click detections (black bars) for the Onslow Bay 04C deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

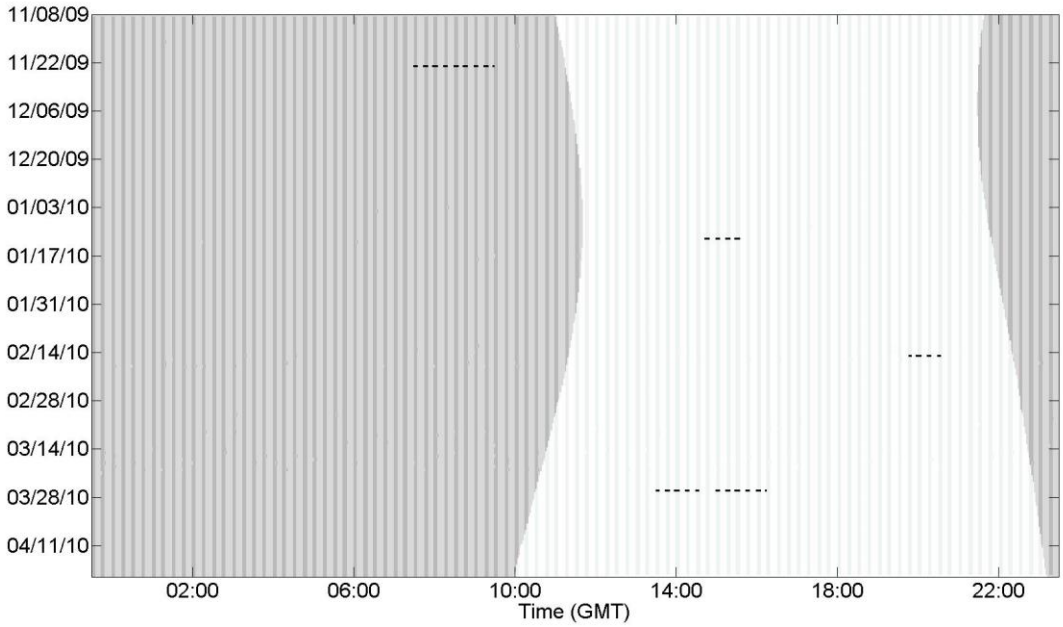

Figure 12. Mid-frequency active sonar (black bars) detected during the Onslow Bay 04C deployment. Dark gray shading indicates periods of darkness, determined from the U.S. Naval Observatory (http://aa.usno.navy.mil). Lighter shading indicates recording/analysis effort.

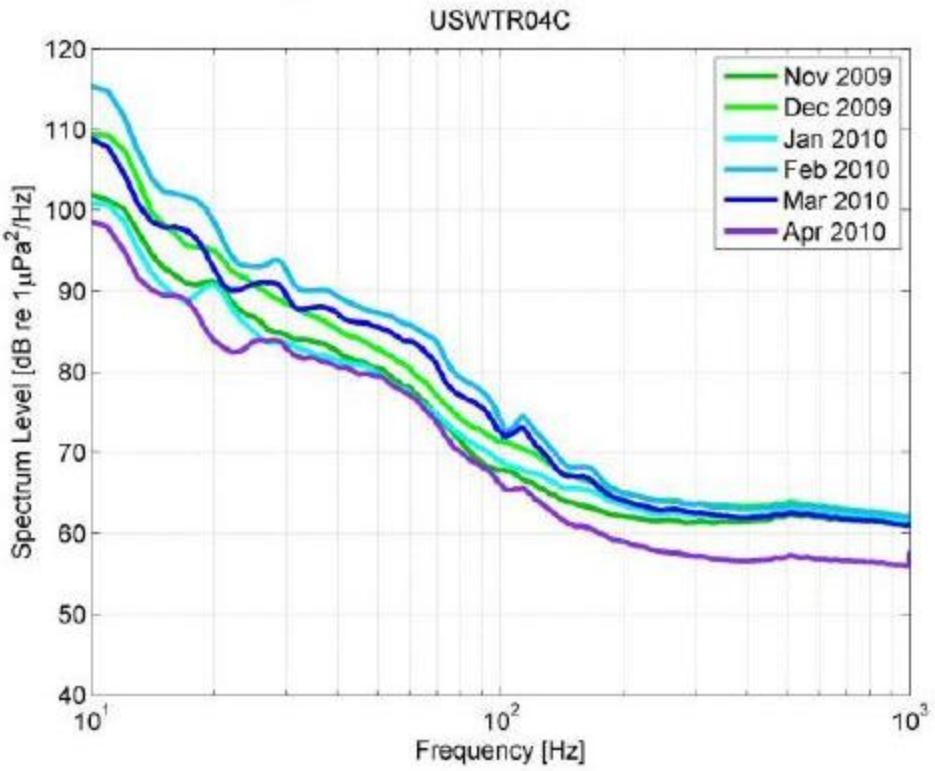

Figure 13. Monthly averages of ambient noise at Onslow Bay Site C for November 2009 – April 2010. Figure from Appendix A4 of Wiggins 2015.

References

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