

Acoustic and Visual Survey of Cetaceans at Palmyra Atoll

Trip report 10/2008

Palmyra, October 13 – November 2, 2008

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Summary

1. HARP Deployment/Recovery

On October 17, 2008, the 24ft Nature Conservancy launch vessel *Zenobia* approached the coordinates 05° 51.906' N, 162° 09.491' W (520m depth) where an autonomous instrument – referred to as a High-frequency Acoustic Recording Package (HARP) – was moored to the seafloor during deployment on May 26, 2008. Transmitting a series of acoustic commands allowed recovery of the HARP by releasing the ballast weight and subsequently floating the positively buoyant components to the sea surface. Approximately five months of acoustic data was acquired by the onboard datalogger, which allows for ecological monitoring of cetaceans in the surrounding area. The electronics and mooring hardware were appropriately refurbished or rebuilt, and the HARP was redeployed on October 21, 2008, off the S/SW outer reef at close proximity to the previous position (approximately 0.153 nautical miles S for greater depth) at coordinates 05° 51.777' N, 162° 09.385' W (599m depth).

Acoustic recording commenced on October 22, 2008, at 12am (GMT) and should continue for 220 days, or approximately seven months, until at which point the hard disks will fill up or the battery capacity will drop below the required voltage. The HARP instrument – including hydrophone, datalogger, battery, and acoustic release components – is configured into a miniature mooring with glass spheres (i.e. flotation) and barbell weights (i.e. ballast weight), so that hand deployment from a small vessel such as *Zenobia* is feasible (see Figure 1). Recording parameters are set to a sampling frequency of 200 kHz, with a recording duration of five minutes and recording interval of twenty minutes. The datalogger is supplied with 16 hard drives of 120 GB data storage capability each, adding up to a total of 1.92 TB of data per instrument deployment, while the battery packs offer an estimated 330 Amp-hours.

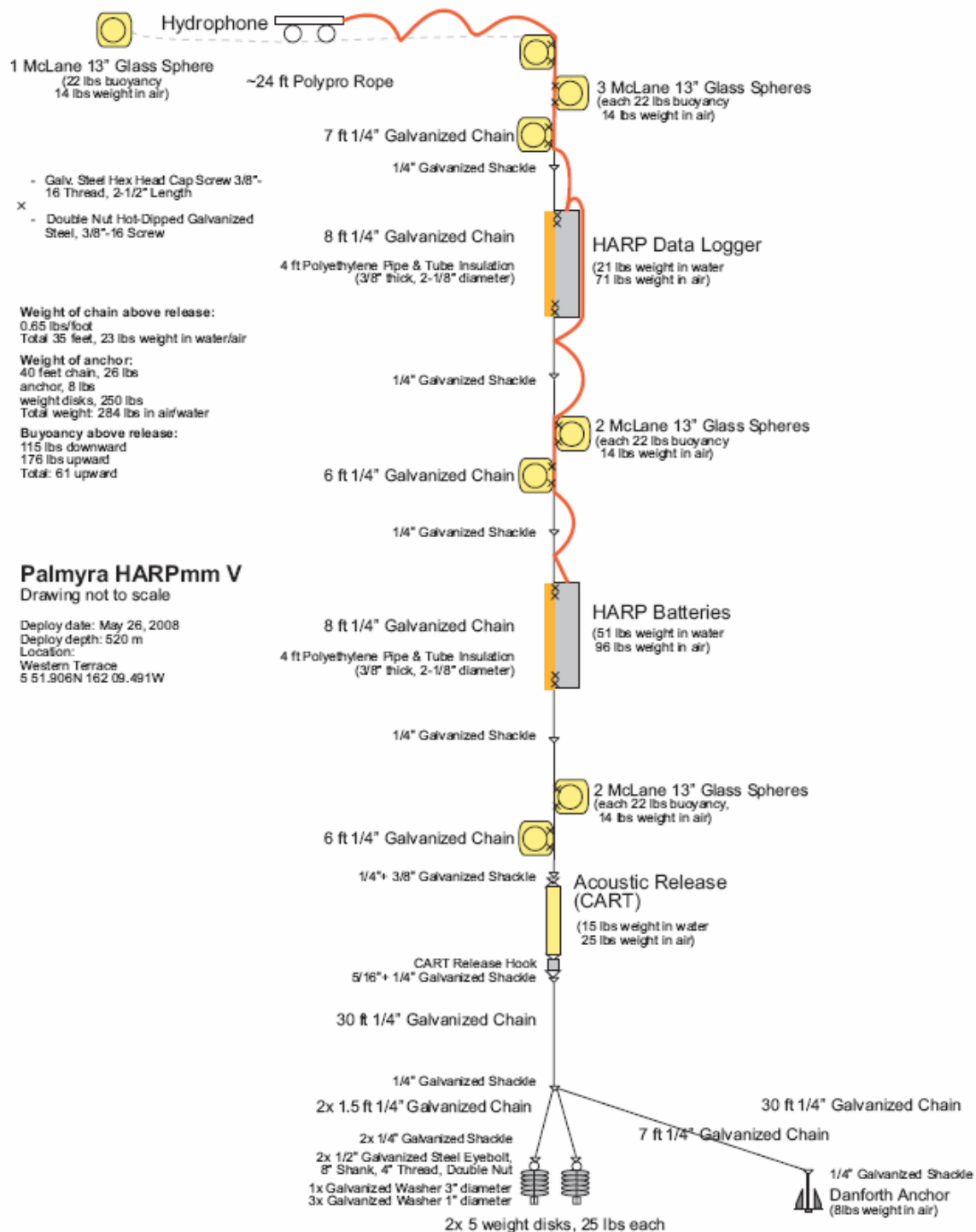


Figure 1 – Schematic of HARP seafloor instrument in miniature mooring configuration.

2. Cetacean Survey and Acoustic Recording

During the three week period on Palmyra Atoll, I had use of the 24ft launch vessel *Zenobia* for a total of 8 days dedicated to cetacean visual/acoustic surveys; the total survey time was approximately 65 hours. The weather conditions were usually poor, as we experienced over 20 inches of rain throughout October. Sea state most commonly varied between 3-5 on the Beaufort scale, and only once we experienced conditions comparable to Beaufort 1. Along with the boat captain Kydd Pollock, we managed to completely circle the atoll three times; in addition we conducted extensive survey work along the north shore where several bathymetric trenches are located (see Figure 2), five miles west of the outer reef where a seamount and spire are located (see Figure 3), and within the vicinity of the HARP seafloor instrument. Generally we spent less survey effort on the eastern side of the atoll due to prevailing currents and weather conditions.

For the acoustic survey we used a 4-channel hydrophone array streaming behind 80m of cable. Two channels recorded simultaneously with a sampling frequency of 192 kHz, one high-frequency channel sampled at 480 kHz, while the low-frequency channel could measure frequencies between 10 Hz – 2.5 kHz in the event we encountered large cetaceans. The hydrophone array was deployed once we left the channel and entered deeper waters, with survey speeds between 4-6 knots; the array was either towed or stationary depending on the cetacean behavior. For example, in the presence of melon-headed whales or beaked whales, the boat was stopped, the engine and echo sounder were turned off, and *Zenobia* drifted with the prevailing currents. Under normal circumstances, the array was towed 80m behind the boat over deep waters resulting in an approximate water depth of the hydrophones at 10-20 m depending on boat speed, but up to a maximum of 80m when the boat was fully stopped.

A substantial amount of survey time was spent during encounters with cetaceans; a total number of 41 encounters summed up to about 20 hours of sighting duration. There were 7 encounters with melon-headed whales (*Peponocephala electra*), 30 encounters with bottlenose dolphins (*Tursiops truncatus*), multiple encounters with spinner dolphins (*Stenella longirostris*), 1 encounter with short-finned pilot whales (*Globicephala macrorhynchus*), 1 encounter of an unidentified species of beaked whale (*Mesoplodon* sp.), and 1 distant sighting of an unidentified cetacean species. The term “re-sighting” was only used if a group of animals was seen again shortly after the initial sighting but not if maybe the same group of animals was seen later in the day or the next day, though most sightings were technically re-sightings of the same resident animals/groups on different days. As for population estimates, there were approximately 700-1000 melon-headed whales, 150-200 bottlenose dolphins, 100-150 spinner dolphins, and 30-40 pilot whales that we met around the atoll; there is insufficient data to estimate the beaked whale population. The numbers are stable in comparison to surveys conducted in 2006 and 2007, except this was the first time pilot whales were documented on a cetacean survey.

The group sizes of melon-headed whales were consistent with past surveys, where hundreds of whales are typically observed milling and socially interacting with each other. The animals were used to the presence of *Zenobia*; part of the group showed no interest in our presence and pursued their normal course of action, while others

approached the vessel curiously even during drift. Many individuals had freshly healed cookiecutter shark (*Isistius* sp.) bites. We observed the group to be both passive, mostly in the morning hours, as well as more active later in the day with mother-calf interactions, occasional spyhops, tailslaps, etc. The group was generally stretched in loose aggregation forming clusters of 2-10 individuals swimming very close to each other and interacting with each other. A few sightings were mixed with *Tursiops*. The melon-headed whales were always together in a single pod during all encounters, except one occasion where a smaller group was observed on the SE side and larger group on the NW side. Nevertheless, this species was only observed on the NW and SE side of the atoll always over deeper water (see Figure 5).

Regarding bottlenose dolphins, we encountered these animals most frequently, ranging from smaller groups of a few individuals to larger groups of 15-20, on one occasion up to 40 or more animals. These small and medium groups were stretched out all around the atoll (see Figure 4). Many individuals were fairly large and would usually approach the vessel to bowride; we observed a great deal of scarring and cookiecutter shark bites, suggesting they move further offshore to deep waters, perhaps at night to forage.

Spinner dolphins were always observed on the SW side as we exited the channel and began to enter deeper water (see Figure 4). During most encounters, they were hesitant to approach the vessel, and usually maintained a distance of at least 5m. On one occasion we observed a group of approximately 100 animals, while all other sightings were small groups.

On the last day of survey, we encountered a group of short-finned pilot whales, a species that has been known to be near Palmyra, but hadn't been documented or recorded by any previous cetacean survey (see Figure 6). The group size was approximately 30-40 individuals, including three large bulls. They were first sighted logging near the HARP instrument location (see Figure 5), and we followed in the SW direction for over an hour taking pictures and recording their vocalizations. Most of the group was engaged in short-period dives lasting only a few minutes; we eventually lost them during a longer dive as a rain squall moved in and left us with no visibility.

There was one sighting of an unknown species of beaked whale. According to Robert Pitman (NOAA), who surveyed Palmyra from August to September, 2008, this beaked whale is of the genus *Mesoplodon*, but they do not have obvious similarities with any known *Mesoplodon* species, so therefore might be the possible new species suggested in Dalebout et al, 2007. We concentrated much of our survey effort in areas with unique bathymetric features – such as the trenches (see Figure 2) and seamount (see Figure 3) – since these often appear to be the preferred foraging habitat of beaked whales. In the afternoon on the north shore, one individual was sighted porpoising once 7m off the bow before another long dive (see Figure 7). This made it impossible to obtain photos, but we did manage to record several bouts of echolocation click trains once we immediately shut off the boat engine and echosounder. Such acoustic data will be used as a ground-truth reference when analyzing long-term acoustic data from the HARP.

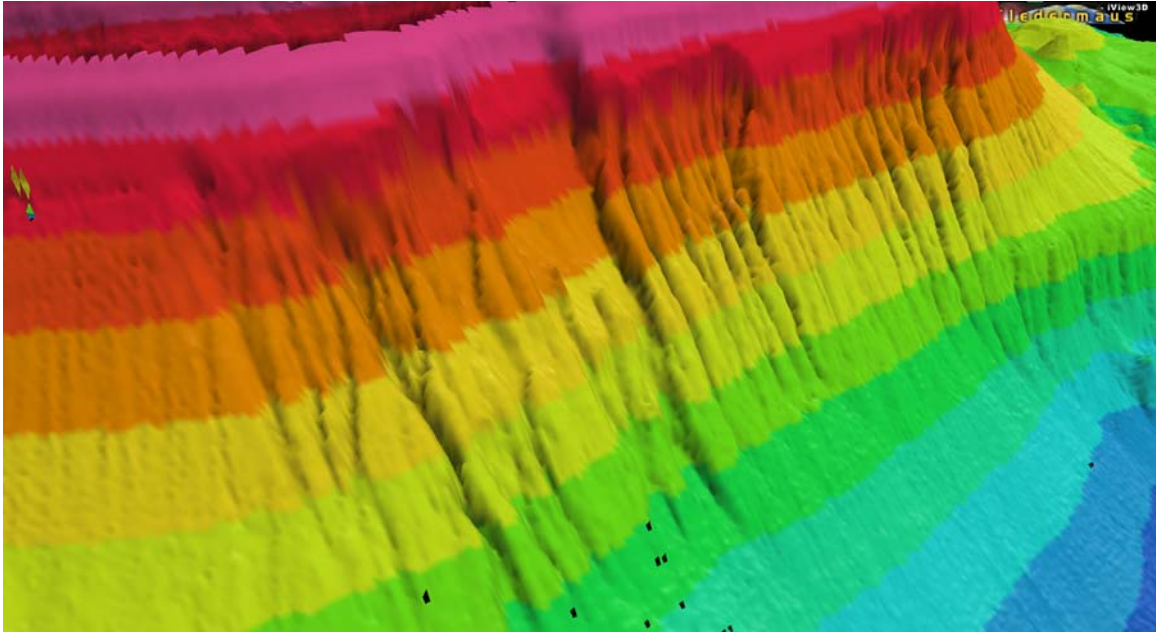


Figure 2 – Several trenches run parallel to each other on the N/NW side of the atoll, forming at around 500m depth and sloping down alongside the mountain to 1700m. Though variable in depth, the most substantial topographic features appear to contain 50m deep trenches.¹

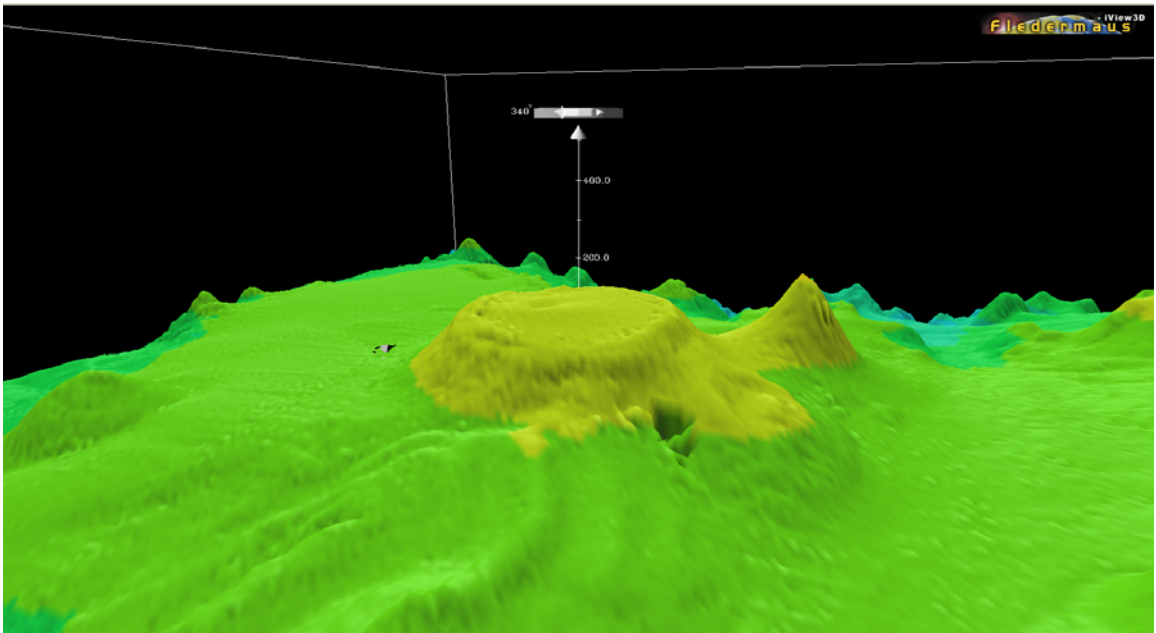


Figure 3 – The seamount and spire are located approximately five nautical miles west of the atoll's Western Terrace. The foot of the slope reaches 1400m depth, while the plateau and pinnacle shallow to nearly 1000m.¹

¹ Map imagery courtesy of NOAA Coral Reef Ecosystem Division, Pacific Islands Fisheries Science Center and the Pacific Islands Benthic Habitat Mapping Center, School of Ocean and Earth Science and Technology, University of Hawaii. Plotting with iView3D from IVS3D.

Sightings

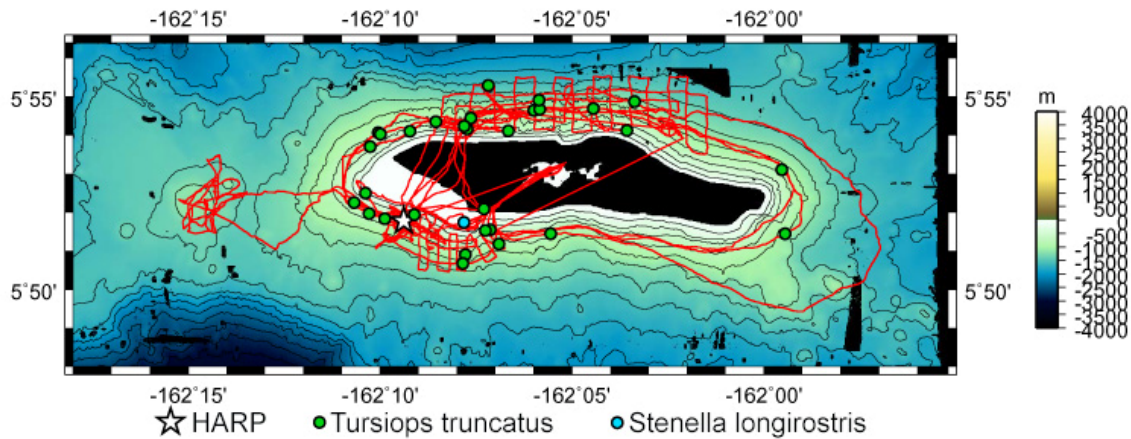


Figure 4 – Total survey effort (red) and delphinid sightings throughout October 13 to November 2, 2008. There were 30 encounters with bottlenose dolphins (*Tursiops truncatus*) around the atoll, and multiple encounters with spinner dolphins (*Stenella longirostris*) at the same location SW of the channel entrance.²

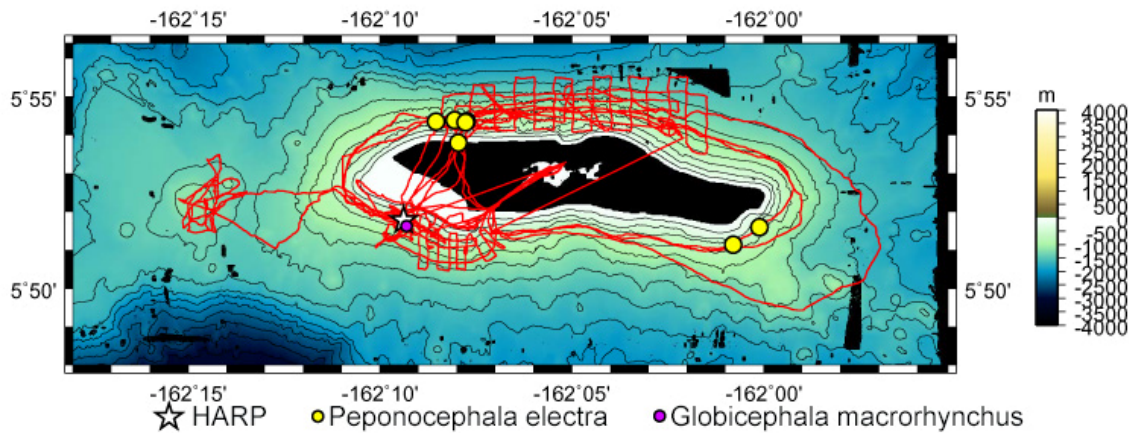


Figure 5 – Total survey effort (red) and 'blackfish' sightings throughout October 13 to November 2, 2008. There were 7 encounters with large groups of melon-headed whales (*Peponocephala electra*) NW and SE of the atoll, and one encounter with a group of short-finned pilot whales (*Globicephala macrorhynchus*) near the HARP site.²

² Map imagery courtesy of NOAA Coral Reef Ecosystem Division, Pacific Islands Fisheries Science Center and the Pacific Islands Benthic Habitat Mapping Center, School of Ocean and Earth Science and Technology, University of Hawaii. Plotting with GMT by Paul Wessel and Walter H. F. Smith.



Figure 6 – Visual confirmation of pilot whale encounter (photo credit: Kydd Pollock).

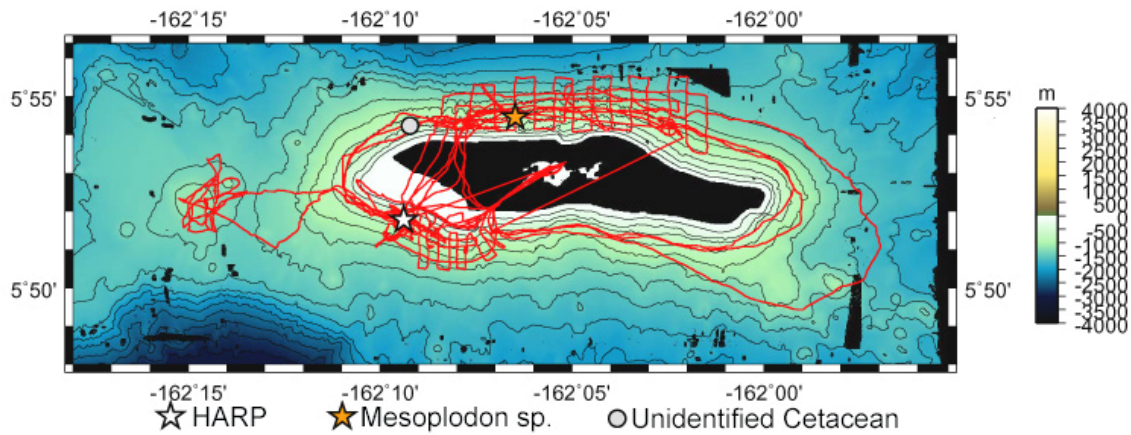


Figure 7 – Total survey effort (red) and beaked whale sightings throughout October 13 to November 2, 2008. There was a single encounter with the possibly new beaked whale species (*Mesoplodon sp.*) suggested by Dalebout et al, 2007. In addition, there was one sighting of an unidentified cetacean very distant to our vessel.²

Cited Literature:

Dalebout, M. L., C. S. Baker, et al. (2007). "A divergent mtDNA lineage among *Mesoplodon* beaked whales: molecular evidence for a new species in the tropical pacific?" *Marine Mammal Science* 23(4): 954–966.