

ABUNDANCE AND MOVEMENT PATTERNS OF BLAINVILLE'S BEAKED WHALES AT THE ATLANTIC UNDERSEA TEST AND EVALUATION CENTER (AUTEK)

Diane Claridge¹, Charlotte Dunn¹ and John Durban²

¹*Bahamas Marine Mammal Research Organisation*

²*NOAA Southwest Fisheries Science Center*

dclaridge@bahamaswhales.org, 1(242)366-4155

Background

Beaked whales are vulnerable to certain military sonars, but are difficult to observe at sea, presenting problems for mitigating the effects of sonar use. However, beaked whales possess individually-distinctive natural markings, enabling populations using the US Navy's Atlantic Undersea Test and Evaluation Center (AUTEK) to be monitored using photo-identification techniques. Additionally, we are using satellite telemetry to monitor the movements of individual beaked whales at AUTEK before, during and after sonar exercises. These projects are increasing our understanding of the spatial and temporal habitat use and abundance at AUTEK and will help to mitigate the effects of naval activities on these populations.

Objectives

The objectives of these studies were:

- 1) To photo-identify individuals within each beaked whale group to assess movement relative to individual and/or age/sex class and to aid in resighting of tagged animals post-tagging.
- 2) To deploy satellite dart tags before the May 2009 Submarine Commanders Course (SCC) to track the movements of beaked whales before, during and after the SCC and compare movement patterns with and without the presence of MFA tactical sonars.
- 3) To obtain biopsy samples from beaked whales using to contribute towards a study of their population structuring, and to examine possible genetic covariates for movement patterns.

Methods

Close approaches were made to groups of Blainville's beaked whales (*Mesoplodon densirostris*) to obtain high-quality photographs to allow individual identification and assignment of each whale to age and gender classes. We fit mark-recapture models to photo-identification data to estimate abundance and turnover of Blainville's beaked whales at AUTEK. Photo-

identifications were collected during 4 years (2005-2008) on AUTEK's Weapons Range, a 1500-km² area used for fleet readiness training, involving the regular use of mid-frequency active sonars. The majority of this effort occurred during BRS07 and BRS08.

The movement of individual whales was monitored by deploying "dart-tags" comprising a satellite transmitter (SPOT5 model, Wildlife Computers, Redmond, WA). The tag was held on the external surface of the whale, ideally near the base of the dorsal fin, by two barbed titanium darts which penetrated to a depth of 4.5 cm. Tags were deployed from distances of approximately 8 - 15 m using a black-powder rifle to project the tag on the end of a crossbow bolt, which fell away on contact with the whale. The tags were scheduled to transmit for six 2-hour periods each calendar day, and transmissions from the tag were recorded and processed using the ARGOS system (<http://www.argos-system.org/>). Received locations were filtered with a maximum swim speed of 3 m s⁻¹. Four tags were also programmed to record time-at-temperature data, as a proxy for dive depths.

Results

Thirty-six distinctively-marked whales were identified from high-quality photographs, with 12 whales seen in multiple years (median = 1, maximum = 4 years) (Figure 1).

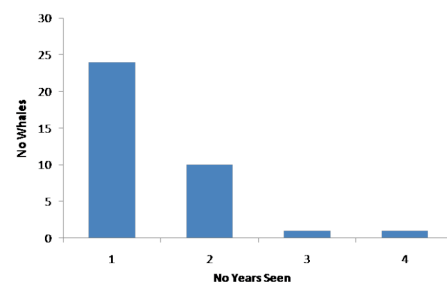


Figure 1. Number of years that individual Blainville's beaked whales were photo-identified on the AUTEK range (n=36).

Open- and closed-population mark-recapture models were used to estimate abundance and infer turnover at different temporal scales, and estimates were rescaled to account for whales that were not sufficiently distinct for between-year matches. The closed population model estimated a high probability of annual variation in catchability ($p = 0.84$) but provided little support for individual heterogeneity ($p = 0.05$). A Bayesian approach was used to analyze and convey uncertainty, resulting in a most probable abundance estimate of 62 whales using the Weapons Range over the 4-year period (75% highest probability interval [HPI] = 55-73). An open population model with varying annual catchabilities estimated a similar overall population size of 65 whales (75% HPI = 54-88) but also allowed estimation of an average annual abundance of 46 whales (75% HPI = 43-52). These estimates are notably higher than the instantaneous abundance estimated using passive acoustic monitoring on the Weapons Range (~25 whales)¹, and in combination they show increasing abundance with longer temporal durations. These differences imply turnover of individual whales on the range, and highlight the value of individual-based monitoring through photo-identification.

Satellite tags were deployed on four beaked whales in the Great Bahama Canyon: three Blainville's and one Cuvier's beaked whale (*Ziphius cavirostris*). Satellite telemetry data from a tag on an adult male Blainville's beaked whale provided 25 days of movement data in the area of the AUTECH range before, during and after an active sonar exercise during the SCC that took place 14-17 May 2009 (Figure 2).

There was evidence of differential movement related to the timing of the sonar exercise during the mini-war. During the 72 hours before the sonar exercise started, the mean distance from whale to the center of the AUTECH range was 36.9 km \pm 2.9 (s.d.) (Figure 3). The mean distance during the 72 hour sonar exercise was 53.9 km \pm 9.7 (s.d.), and returned to 29.3 km \pm 10.7 (s.d.) and 12.8 km \pm 4.3 (s.d.) from 0-72 and 72-144 hours after the exercise stopped.

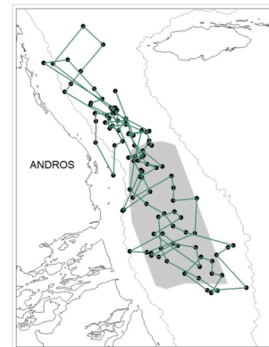


Figure 2. Track (green line between location dots) of a Blainville's beaked whale satellite tagged at AUTECH in May 2009. The shaded area indicates the extent of the hydrophone array of the AUTECH range and the 1000m depth contour is shown.

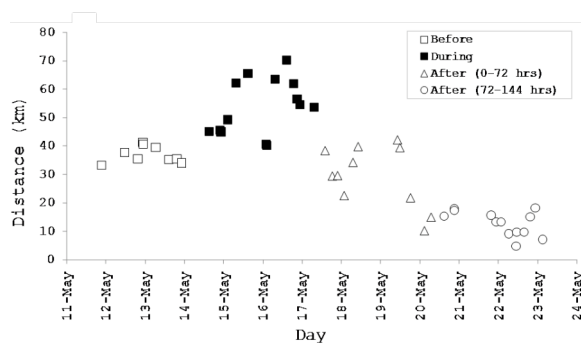


Figure 3. Distance of a tagged Blainville's beaked whale to the center of the AUTECH range as a function of date.²

These data support the interpretation based on passive acoustic monitoring that beaked whales swim several tens of kilometers away from sonar exercises and take several days to return after sonar transmissions cease². However, caution must be used in interpreting these data from just a single whale, highlighting the need to obtain further data on individual movements around sonar exercises. Monitoring movements of beaked whales during real sonar events will contribute to the development of effective mitigation measures to lessen impacts during military exercises.

Notes:

¹ Marques *et al.* 2009 Estimating cetacean population density using fixed passive acoustic sensors: An example with Blainville's beaked whales *J. Acoust. Soc. Am.*, 125 (4):1982-1994

² Tyack, P.L. *et al.* In prep. Beaked whales respond to simulated and actual Navy sonar. To be submitted to Science.