

# Movements and habitat preferences of a Bryde's whale (*Balaenoptera edeni*) satellite-tagged in southern California

B.A. Lagerquist, D.M. Palacios, L.M. Irvine, C.E. Hayslip, and B.R. Mate

Oregon State University Marine Mammal Institute, Hatfield Marine Science Center, Newport OR 97365  
 barblagerquist@oregonstate.edu



## Background

Bryde's whales (*Balaenoptera edeni*) in California are considered part of the Eastern Tropical Pacific stock, which includes whales in the eastern part of the Tropical Pacific as well as those in the Gulf of California (Carretta et al. 2016). Sightings and acoustic recordings of Bryde's whales off southern California have increased in the past decade (Kersey et al. 2012, Smutla et al. 2012). At least seven sightings of Bryde's whales have been documented off southern/central California between 1991 and 2010 (Smutla et al. 2012). This may represent a northward range expansion related to warming ocean temperatures associated with oceanographic events such as El Niño and climate change (Smutla et al. 2012).

We tagged a female Bryde's whale (mother with calf) off southern California in July 2015 as part of a U.S. Navy-funded project to assess large whale movements, home range, and habitat use in relation to Navy Training and Testing areas off the U.S. West Coast.

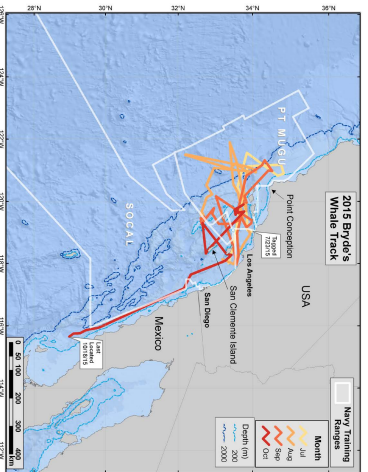
## Methods



- An Argos satellite-monitored radio tag (Wildlife Computers SPOT5) was deployed on a Bryde's whale mother with a calf off Point Mugu, California on 23 July 2015.
- Tagging occurred during the sighting of 8 Bryde's whales, including three mother/calf pairs, on 23 and 24 June.
- A Bayesian switching state-space model (SSM) was applied to the Argos locations to create a regularized track (1 location per day) and estimate movement behavior.
- Kernel home ranges (HR, 90% isopleths) and core areas (CA, 50% isopleths) were created for the portion of the SSM track inside the U.S. Exclusive Economic Zone (EEZ) and all portions of HRs and CAs that overlapped land were removed.
- The Environmental Research Data Access Program (ERDDAP) was used to obtain oceanographic and seafloor relief data for each SSM location. We obtained the median value for these variables within a box defined by the 95% credible limits in the longitude and latitude of the location. Distance to the nearest point on shore was also computed for each SSM location.

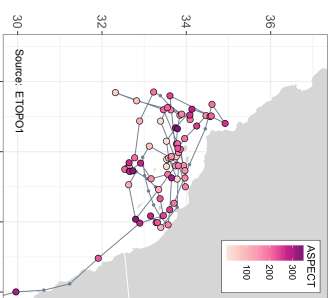
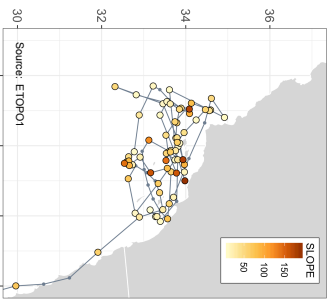
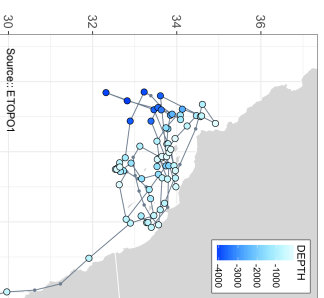
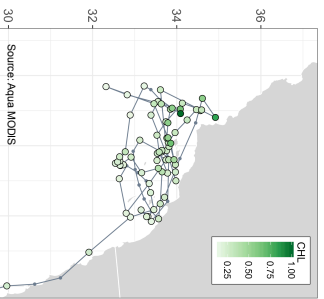
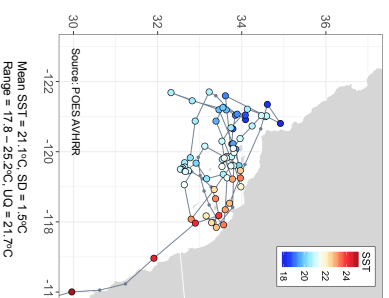
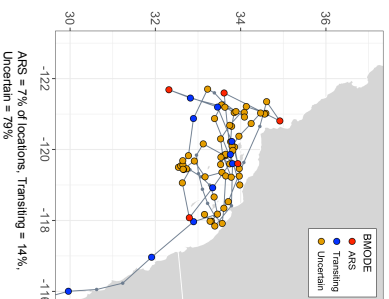
## Results

The Bryde's whale was tracked for 86.7 days and a total distance of 4,587 km. Its average speed between Argos locations was 3.2 km/h (SD = 2.78 km/h; range 0.1 – 11.4 km/h).

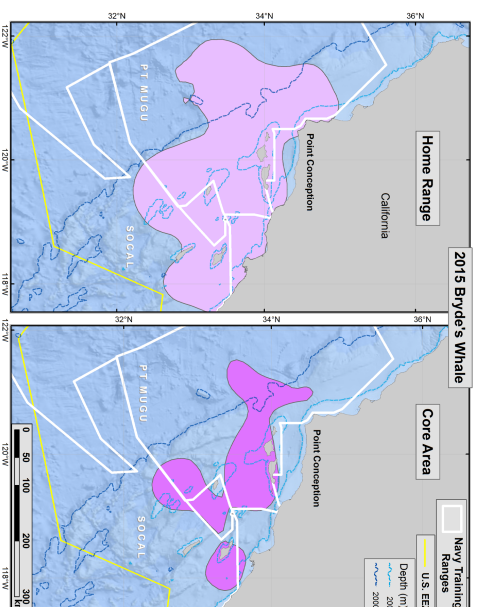


Most of the animal's movements were over the continental slope, ranging from Point Conception to San Clemente Island, with occasional forays over the deep-ocean basin (mean distance to shore = 56 km, SD = 45 km, range = 4 – 228 km, upper quartile [UQ] = 88 km).

The Bryde's whale spent 67% of the total tracking period (60 d) within the U.S. Navy's Point Mugu Sea Range (PT MUGU), and 24% (22 d) within the Navy's Southern California Range Complex (SOCAL). Locations occurred in PT MUGU in July, August, September, and October and in SOCAL predominantly in October.



The Bryde's whale was in a wide range of oceanographic and seafloor relief conditions during its tracking period. SST was coldest and CHL was highest at the western edge of the Santa Barbara Channel. The majority of locations were in waters < 500 m depth and over steep, southwest-facing slopes.



The Bryde's whale's HR (64,814 km<sup>2</sup>) extended from the California/Mexico border to just north of Point Conception, California, out to approximately 200 km offshore. The CA (24,225 km<sup>2</sup>) occurred throughout much of the HR and extended out to approximately 190 km offshore.

## Conclusions

This study is the first to present habitat characteristics and home range information for a Bryde's whale in southern California waters during summer and fall.

While this Bryde's whale was tagged within 10 km of shore off Point Mugu, southern California, the animal traveled extensively throughout the Southern California Bight over its 87-day tracking period and occupied a variety of coastal and oceanic habitats.

California waters were influenced by both the North Pacific marine heat wave and El Niño during the summer/fall of 2015 (McClatchie et al. 2016) and the associated influx of fish species typically found further south likely contributed to the Bryde's whale's occurrence in this area.

The information presented here documents the extended presence of a Bryde's whale throughout the entire Southern California Bight in the summer/fall of 2015 and highlights the need for managers to consider this species in conservation strategies, especially as climate conditions change.

## Acknowledgements

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