Photo by J. Aschettino under permit #16239

Tracking the Offshore and Migratory Movements of Humpback Whales in Hawaii

E. Elizabeth Henderson[1], Jessica Aschettino[2], Mark Deakos[2], Gabriela Alongi[3], Tara Leota[4], Dan Engelhaupt[2]

1. Navy Marine Mammal Program, SSC Pacific, San Diego CA 2. HDR, Virginia Beach, VA 3. National Marine Mammal Foundation, San Diego CA 3. Kauai Sea Riders, Kauai. HI

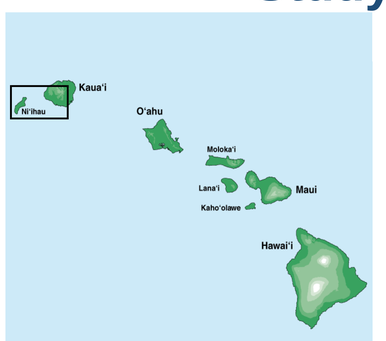
Photo by J. Aschettino under permit #16239

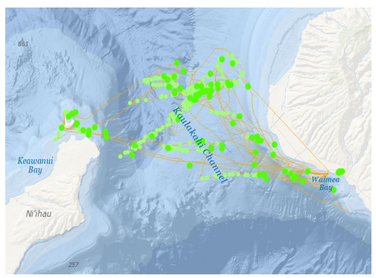
Abstract

In order to better understand the behavior of humpback whales (*Megaptera novaeangliae*) in the deeper waters of their Hawaiian breeding grounds west of Kaua'i, seven presumed males (based on behavior) were satellite tagged using LIMPET-configured SPLASH tags in late March 2017. Two were considered sub-adults based on size, one travelling alone and the other part of a sub-adult pair. Of the five presumed adults, three were part of a pair, of which one pair joined up with a competitive group immediately after being tagged. The other two males were challengers within the same competitive group. All tagged whales were traveling away from Kaua'i when encountered, heading west towards the island of Ni'ihau, where they spent some time circling. One tag stopped transmitting while the whale was near Ni'ihau, while one whale remained in the vicinity of Ni'ihau for at least seven days. At least five whales continued to travel west/northwest, with directed travel over deep water while circling or milling over shallow seamounts starting at Kau'la Rock. Four of the tags stopped transmitting while the whales were at or near these seamounts. One whale reached the island of Nihoa and continued traveling northwest. This behavior differs from humpback whales tagged off Kaua'i in March and April of 1995, when four of six tagged whales visited other Main Hawaiian Islands to the southeast, and the other two whales traveled almost due north towards Alaska (Mate et al. 1998). Although sample size for both studies is small, these differences may indicate a shift in migratory timing, with whales migrating north earlier in 2017 than in 1995 and more closely following the archipelago than was previously observed. The whales' dive and travel behavior will be analyzed in more detail to shed new light on the movement patterns of humpback whales in offshore waters.

Mate, B. R., R. Gisiner and J. Mobley. 1998. Local and migratory movements of Hawaiian humpback whales tracked by satellite telemetry. Canadian Journal of Zoology 76:863–868.

Study Area





Small-boat effort tracklines in yellow, with sighting and resighting positions in green

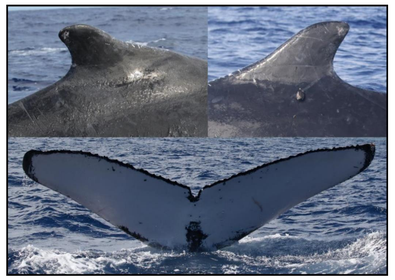
Methods

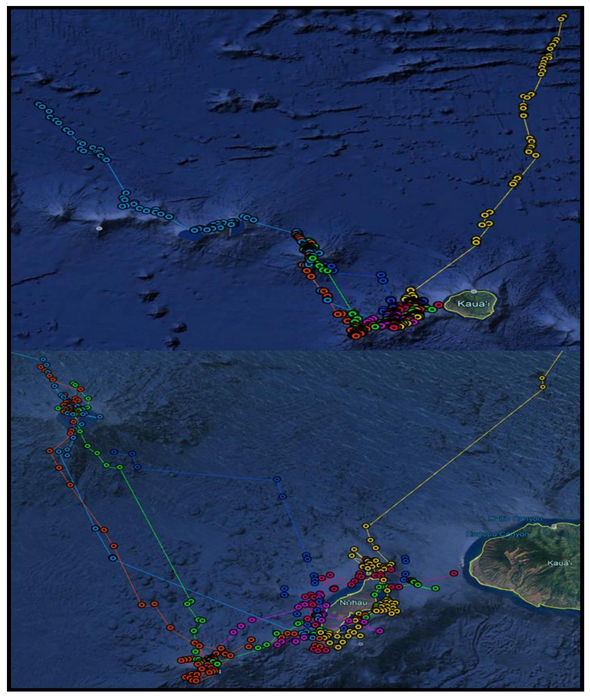
- 8 days of effort March 17 – 24, 2017
  - 7m RHIB
- Satellite tagging and photo-identification
  - Wildlife Computers MK10 LIMPET configured tags
  - Argos Satellite location data filtered with Douglas Filter
- Estimated travel speeds, directivity, straight line and cumulative distance
- Evaluated track behavior states and state-switching using Bayesian partitioning method
- Analyzed dive behavior for dive counts, depth, duration, relationship to bathymetry and diel periodicity

Results

Photo-Identification

- 85 individual dorsal fins
  - 4 resights
  - 2 within-days
  - 2 on different days
- 58 individual flukes
  - 2 resights
  - Both on different days





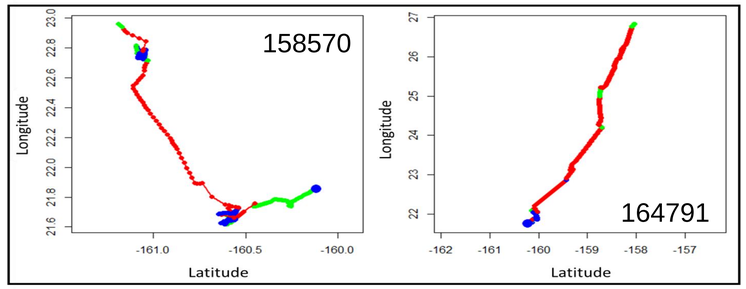
Satellite-Derived Tracks

- 7 whales tagged
  - All probable males
  - 4 adults, 3 sub-adults
  - Encountered in competitive pods, dyads and solitary, all traveling east to west
- All spent time at Niihau, 5 continued W and NW, 1 went NNE

Tag ID	Age Class	# Days transmitted	Median ± SD Speed (km/h)	Cumulative Distance (km)	Straight-line Distance (km)	Mean Daily Distance (km/day)	Directivity Index
158569	A	2.3	2.8 ± 3.5	143.5	46.4	63.5	0.3
158570	SA	6.0	2.4 ± 4.5	379.2	166.9	62.8	0.4
158571	SA	8.1	3.6 ± 3.2	826.4	548.8	102.5	0.7
164790	A	3.0	4.0 ± 6.3	295.9	156.0	100.3	0.5
164791	SA	12.3	2.0 ± 2.7	816.2	582.5	66.6	0.7
164792	A	2.3	3.3 ± 2.6	166.0	19.8	73.1	0.1
164793	A	1.6	3.7 ± 3.0	226.5	113.0	142.5	0.5

Behavior State Model

- Optimal behavior state model found 3 states based on distance traveled between time-interpolated points
  - Slow, non-directed Area Restricted Search (ARS) in shallow water over seamounts and near islands
  - Faster, directed travel in deep open waters

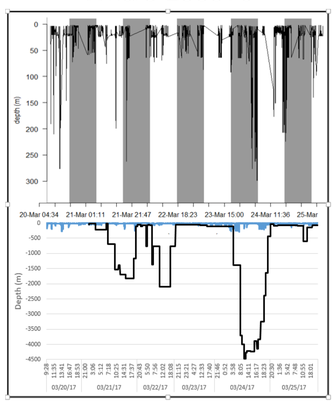


Dive Results

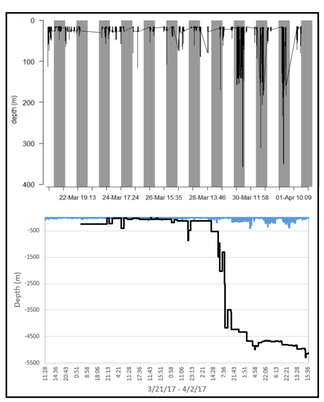
- Dive depth correlated significantly with seafloor depth
  - Shallow dives over seamounts and near islands
    - Some dives used full extent of available water column
      - Possible opportunistic foraging?
- Deep dives in deep open waters
  - Deepest dives occurred at night

Tag ID	Number Dives	Mean Duration (min)	Mean ± SD Depth (m)	Max Depth (m)	% Daytime Dives
156869	154	7.6	32.0 ± 8.9	358.5	42.3%
158670	280	9.7	34.8 ± 10.6	297.5	51.2%
158671	370	20.4	29.5 ± 7.36	238.5	50.7%
164790	264	11.7	29.2 ± 7.2	172.0	47.0%
164791	286	25.3	38.7 ± 8.89	395.5	44.0%
164792	80	29.6	38.0 ± 8.3	287.5	52.8%
164793	77	20.9	31.9 ± 8.8	238.5	70.3%

Whale 158570



Whale 164791



Top plots: Dive profile with daytime hours as white bars and nighttime hours as gray bars
Bottom plots: Blue lines are the same dive profiles, with associated seafloor depth in black