

Satellite telemetry results indicate an open-ocean population of sperm whales (*Physeter macrocephalus*) in Hawaiian waters

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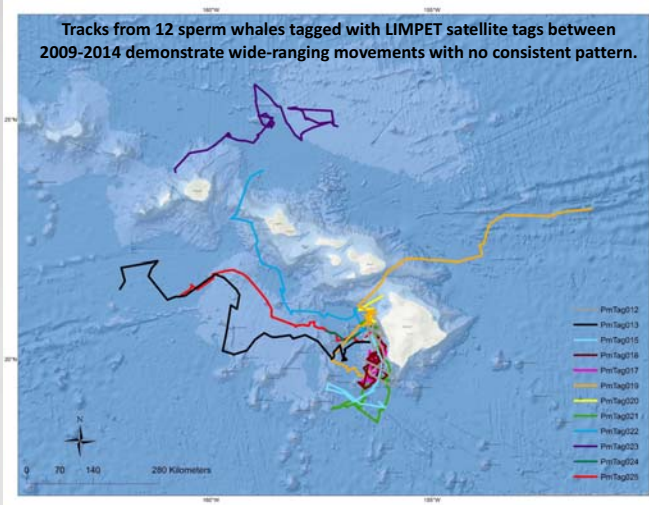
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IN HAWAIIAN WATERS, at least 11 of 18 species of odontocetes have island-associated, resident populations. Sperm whales are sighted throughout Hawaiian waters, and groups are comprised of females and juveniles. Around the main Hawaiian Islands, they make up < 2% of odontocete sightings.

We used satellite tag data to assess whether sperm whales in Hawai'i are part of an open-ocean or island-associated population. Analyses were limited to one individual per group. Individuals were tracked from 6.1-14.4 (median=12.7) with a mean travel distance of 719km (range=406-983) and a grand median of 4,476m (range of max=4,746-5,755). Grand median distances from tagging locations and shore were 133km (range of max=102-515) and 82km (range of max 49-378), respectively.

All sperm whales were associated with seamounts at some point during the tracking period, although seamounts are numerous throughout the area. Although there is still much to

learn about the biological effects of current-topography interactions, seamounts have been identified as areas of increased biological productivity due to a number of factors such as localized upwellings and the formation of eddies [1]. Eddies are also formed from the interaction between the Hawaiian Islands and the winds and currents. These eddies may concentrate prey [2]. A preliminary visual examination of eddies in relation to whale tracks was conducted to evaluate movement in relation to eddy occurrence.



Tracks from 12 sperm whales tagged with LIMPET satellite tags between 2009-2014 demonstrate wide-ranging movements with no consistent pattern.

Conclusions

Although tag transmissions were relatively short, results indicate movements are wide-ranging with no consistent pattern or particular association with the islands, suggesting sperm whales in Hawai'i are part of a broadly-ranging population that likely extends across much of the central tropical Pacific.

A preliminary inspection of movements in relation to eddies suggests that at least some sperm whales may utilize cold core cyclonic eddies (sea surface height < 0.65 m), presumably for foraging.

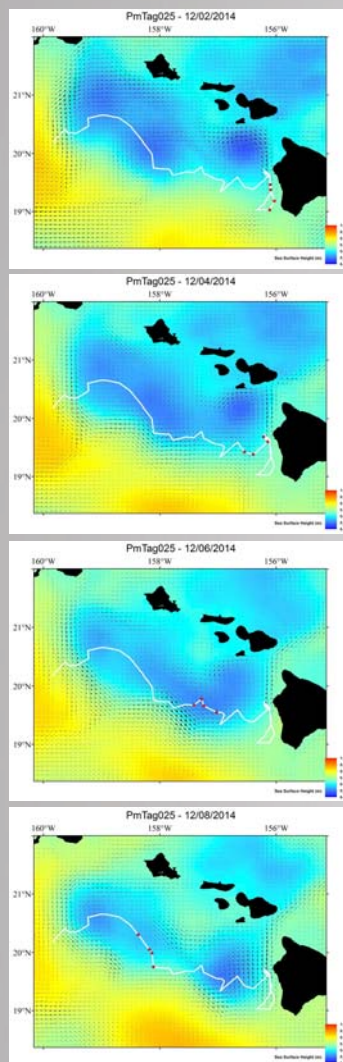
Deployment information and results from ArcGIS analysis of sperm whale LIMPET satellite tag data after processing through Douglas Argos-filter v.8.5.

| Tag # | Group | Tagging Date | # Days of Data | Distance Travelled (km) | Distance from Deployment (km) | | Distance to Shore (km) | | | Depth at Transmission (m) | | |
|-----------|-------|--------------|----------------|-------------------------|-------------------------------|-----|------------------------|--------|-----|---------------------------|--------|------|
| | | | | | median | max | min | median | max | min | median | max |
| PmTag012 | 1 | 20 NOV 2009 | 9 | 456 | 20 | 102 | 4 | 18 | 51 | 941 | 2853 | 4819 |
| PmTag013 | 2 | 11 APR 2010 | 14 | 945 | 948 | 514 | 36 | 136 | 251 | 3709 | 4471 | 4746 |
| PmTag015 | 3 | 8 DEC 2010 | 6 | 406 | 113 | 142 | 14 | 87 | 139 | 2086 | 4642 | 5070 |
| PmTag016 | 4 | 20 NOV 2011 | 13 | 635 | 57 | 104 | 8 | 30 | 77 | 2012 | 3897 | 4885 |
| PmTag017* | 4 | 20 NOV 2011 | 10 | 503 | 61 | 96 | 5 | 32 | 75 | 1693 | 4045 | 4777 |
| PmTag019 | 5 | 16 MAY 2013 | 14 | 983 | 86 | 515 | 10 | 56 | 378 | 960 | 4623 | 5755 |
| PmTag020* | 5 | 23 MAY 2013 | 1 | 120 | 25 | 52 | 10 | 19 | 49 | 777 | 2583 | 4088 |
| PmTag021 | 6 | 27 OCT 2013 | 14 | 702 | 135 | 192 | 5 | 73 | 151 | 1226 | 4626 | 5045 |
| PmTag022 | 7 | 1 NOV 2013 | 8 | 650 | 201 | 388 | 9 | 68 | 125 | 2300 | 4484 | 4888 |
| PmTag023 | 8 | 9 OCT 2014 | 14 | 924 | 234 | 328 | 35 | 172 | 217 | 2442 | 4476 | 4842 |
| PmTag024* | 9 | 30 NOV 2014 | 5 | 141 | 66 | 105 | 14 | 59 | 109 | 2565 | 4366 | 4764 |
| PmTag025 | 9 | 30 NOV 2014 | 11 | 771 | 105 | 401 | 5 | 96 | 175 | 1643 | 4313 | 4901 |

* removed from further analyses

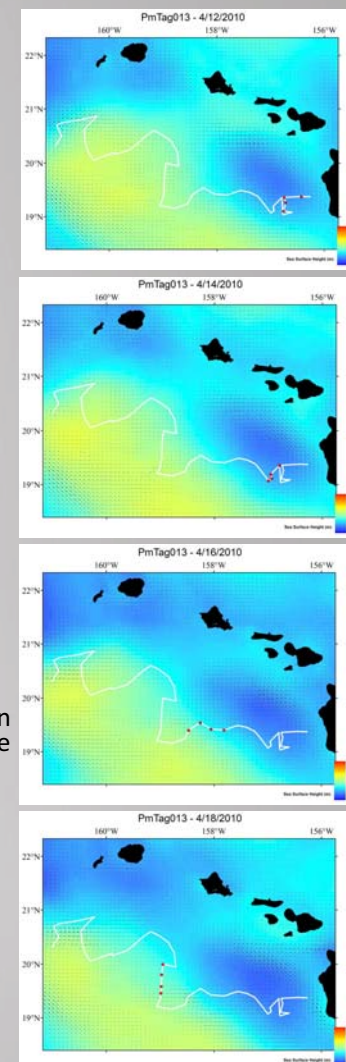
References

- [1] Boehlert, G.W. and A. Genin. 1987. A review of the effects of seamount on biological processes. Washington DC American Geophysical Union Geophysical Monograph Series 43:319-334.
- [2] Seki, M.P., et al. 2002. Hawaiian cyclonic eddies and blue marlin catches: The case study of the 1995 Hawaiian International Billfish Tournament. J. Oceanography 58:739-745.



A sample of days of daily sea surface height (m) & currents (vectors) from the HYCOM regional model in relation to the track from PmTag025. The track was derived from a Switching State-Space Model (6-hr time step). Red circles designate whale positions on the day coinciding with the HYCOM raster model.

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A sample of days of daily sea surface height (m) & currents (vectors) from the HYCOM regional model in relation to the track from PmTag013. The track was derived from a Switching State-Space Model (6-hr time step). Red circles designate whale positions on the day coinciding with the HYCOM raster model.