



Beaked whale strandings in relation to military exercises: a comparison between the Canary and Hawaiian Islands

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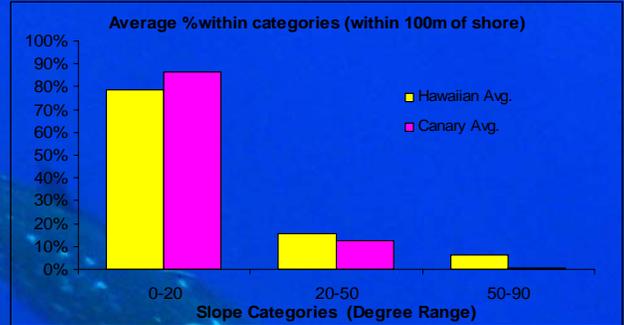
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Background and purpose of the study

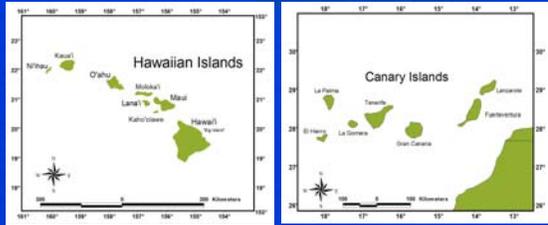
Mass stranding events of beaked whales have occurred in association with naval exercises, with two species most affected, Cuvier's and Blainville's beaked whales. Six events have been recorded in the Canary Islands involving naval exercises over 20 years. Regular naval exercises occur in Hawai'i involving mid-frequency sonar use, and both species are resident to the area, yet no beaked whale mass strandings have been reported there. The question is, **can we conclude that beaked whales have not been impacted in Hawai'i, or are there factors that might influence the likelihood of a moribund or dead beaked whale stranding or being detected?**

There are a number of factors that could explain this difference, including differences in density of beaked whales, frequency or type of naval activity, and factors that influence the likelihood of dead or moribund animals stranding, or being found, once stranded. No quantitative information is available on beaked whale densities or naval activities, so here **we investigate whether beaked whales may be less likely to strand on a beach or are less likely to be detected if stranded, in the two areas.**

Steeper and less accessible coastlines in Hawai'i are likely to reduce the probability of animals stranding or being detected



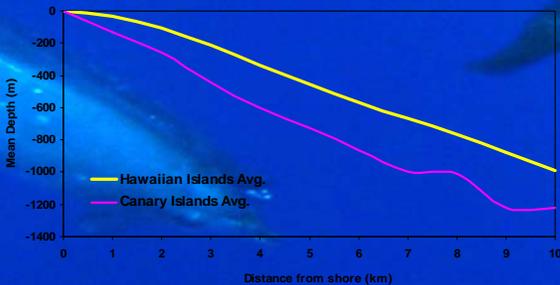
The Hawaiian Islands have a higher proportion of shorelines with steep slopes limiting shoreline accessibility



Higher human population density (in relation to amount of land area and length of shoreline) likely increase the probability of a stranded whale being detected and reported in the Canary Islands

	Land area (km ²) per km of shoreline	# people per km ² land area	# people per km shoreline
Hawaiian Islands Average	13.0	72.9	944
Canary Islands Average	6.8	264.3	1792
Hawaiian : Canary % Difference	191%	28%	53%

There is deeper water (i.e., beaked whale habitat) closer to shore in the Canary Islands. Moribund or dead animals may be more likely to strand if they are closer to land



There is more suitable habitat (water >650 m deep) for beaked whales near shore in the Canary Islands

	Percent area of suitable habitat (>650 m) within various distances from shore			
	0-3 km	0-6 km	0-10 km	10-20 km
Hawaiian Islands Average	6.3%	16.5%	29.2%	79.8%
Canary Islands Average	10.6%	24.4%	36.0%	82.1%
Hawaiian : Canary % Difference	59.2%	67.4%	81.2%	97.2%

Acknowledgements

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References

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Salinity, water temperature, currents, fringing coral reefs, and scavengers, may all influence the likelihood of strandings occurring or being detected

	Average Salinity (pss)	Average Water Temperature (°C)	Average Ocean Currents (cm/s)
Hawaiian Islands	34.5 - 35	25 - 26	25
Canary Islands	36.8	21	10 - 15

- Higher salinity=increased buoyancy, therefore a whale may be more likely to float
- Increased water temperatures could speed up decomposition
- Faster ocean currents likely carry a dead or moribund whale out to sea faster
- Fringing coral reefs are extensive and numerous in Hawai'i, while very few are found in the Canary Islands, possibly preventing an animal from coming into shore
- Higher scavenger presence (sharks) has been suggested for Hawai'i, and more scavengers would lead to carcasses being consumed prior to detection and stranding

Why this study is important

All of the variables analyzed in this study suggest beaked whales are less likely to strand or be detected in Hawai'i. Therefore, we cannot conclude from the lack of strandings that there have been no impacts on beaked whales as a result of anthropogenic activities in Hawai'i.