

Bite Me: Using Cookie-cutter Shark Bite Scars to Estimate Age of Blainville's Beaked Whales in Hawaiian Waters



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Why is this important?

Blainville's beaked whales are well-studied in Hawai'i^{1,2} and in several other areas but information on life history is limited.

Earlier work in Hawai'i³ found that:

- individuals acquire cookie-cutter shark bite scars as they age at a mean rate of 0.68 scars/year (SD=0.16, n=3 individuals)
- some scars remain visible for at least 21 years²

To determine whether scar acquisition rates could be used to estimate age, we compared estimates from scarring to those derived from sighting histories and relative size of individuals, for individuals seen over longer time spans (median=9.9, max=17.5 years, n=17 individuals).

What we did

We quantified the number of individually identifiable scars within an Area of Interest (Aoi, Figure 1) three times the width and height of the dorsal fin, centered beneath the fin. Aoi was measured using ImageJ.

We also calculated area covered by scars (measured using ImageJ)⁴ but found that rates were unrealistically low due to overlapping scars, and variation in scar size and degree of re-pigmentation (results not presented).

Age estimates based on scarring rate were compared to estimates derived from sighting histories (e.g., presence of calves or erupted teeth indicating maturity, relative size when first seen, span of years seen) to evaluate which provides more realistic age estimates.

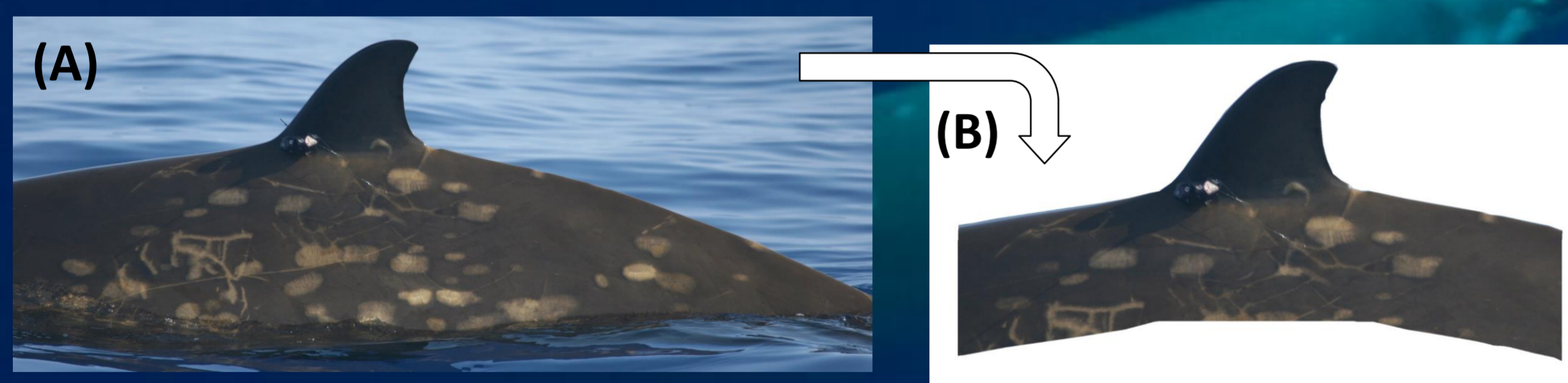


Figure 1. (A) Adult male HIMd020. (B) Processed image showing Aoi for quantifying scars

Scar acquisition rates were calculated separately for left and right sides using the longest span of encounters with good/excellent quality photos. Acquisition rates were then averaged for a population acquisition rate which was applied to estimate age (Table 1).

References

¹Baird, R.W. 2019. Behavior and ecology of not-so-social odontocetes: Cuvier's and Blainville's beaked whales. In: *Ethology and Behavioral Ecology of Toothed Whales and Dolphins, the Odontocetes*. Springer.

²Baird, R.W. 2016. *The lives of Hawai'i's dolphins and whales: natural history and conservation*. University of Hawai'i Press, Honolulu, Hawai'i.

³McSweeney, D.J., R.W. Baird and S.D. Mahaffy. 2007. Site fidelity, associations and movements of Cuvier's (*Ziphius cavirostris*) and Blainville's (*Mesoplodon densirostris*) beaked whales off the island of Hawai'i. *Marine Mammal Science* 23:666-687.

⁴Coomber, F., A. Moulins, P. Tepsich, and M. Rosso. 2016. Sexing free-ranging adult Cuvier's beaked whales (*Ziphius cavirostris*) using natural marking thresholds and pigmentation patterns. *Journal of Mammalogy* 97: 879-890.

What we found

- Age estimates using scar acquisition rates were substantially lower (range 3-23 years) than those based on information from re-sighting histories (Table 1).

Table 1. Comparison of age estimates from sighting histories versus those from scar acquisition rates

ID	Side	Span years	Acquisition rate of individually counted scars (scars/ year)	Minimum estimated age (years)	
				Based on life history (span of years seen, erupted teeth, calf presence), relative size	Based on individually counted scars
HIMd001	R	12.5	0.64	23.6	11.6
HIMd007	L	14.5	1.79	32.6	14.7
HIMd007	R	17.3	1.50	32.6	9.3
HIMd020	L	5.3	1.69	18.3	8.5
HIMd022	L	4.2	2.15	21.7	4.6
HIMd025	L	17.2	0.93	30.9	10.9
HIMd025	R	17.4	1.09	30.9	10.9
HIMd035	R	5.0	1.60	18.0	14.7
HIMd036	L	13.1	0.84	26.8	4.6
HIMd055	R	10.8	0.37	22.8	6.2
HIMd061	R	9.0	1.00	29.4	10.1
HIMd066	L	5.4	0.55	20.1	14.7
HIMd121	R	4.9	2.24	14.9	9.3
HIMd127	R	3.4	1.46	24.5	6.2
HIMd147	R	9.0	1.22	13.9	1.5
HIMd150	L	7.8	0.51	15.1	2.3
HIMd155	L	6.8	0.58	21.7	5.4
HIMd207	L	3.0	0.99	15.2	10.1
HIMd223	L	3.0	2.98	6.0	0.8
HIMd223	R	3.0	1.65	6.0	0.0
Mean (SD)		8.73	1.29 (0.68)		

Implications

- While initially appearing promising, age estimation based on scar acquisition rates appears strongly negatively biased, likely due to a combination of scar fading and overlap, which could obscure new scars.
- Scarring visible on individuals in underwater photos (see background photo) appears more dense ventrally and in areas outside the Aoi; further analysis can determine whether repositioning the Aoi can more accurately estimate age.
- Reasons for individual variability in acquisition rates (SD=0.68) such as sex or whether individual scarring rate varies with age should be explored, to help refine this method.

Acknowledgements

We thank all of the individuals that have contributed photos of this species with special thanks to Dan McSweeney, Deron Verbeck and Colin Cornforth. Funding for field work during which photos were taken primarily came from the National Marine Fisheries Service (PIFSC, SWFSC) and the US Navy (ONR). Background photo © Deron Verbeck/iamaquatic.com. Special thanks to Shelby Yahn for assisting with ImageJ methods.

Poster presented at the World Marine Mammal Conference, Barcelona, Spain, December 2019