

# Stabilizing selection on the variability of spacing of *Lobodon carcinophaga* (crabeater seal) postcanine teeth for successful filter-feeding foraging strategies



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## ABSTRACT

Pinnipeds, the group that includes true seals, eared seals, and walruses, generally display highly variable tooth spacing. Previous studies have credited this variability to the typical pinniped feeding mechanism, a combination of suction feeding and pierce feeding known as the “grab-and-gulp” method, which does not require precise dental occlusion. However, the crabeater seal (*Lobodon carcinophaga*) is unique among pinnipeds as an obligate filter-feeder with a diet consisting of mainly krill. The distinct sieve-like postcanine teeth feature high-cusplation and intricate trellis-like morphology, which allows *L. carcinophaga* to effectively strain small krill from the water. We hypothesize that there is a strong selective pressure from this feeding ecology for postcanine occlusion in the crabeater seal. To test the variability in crabeater seal tooth spacing compared to that of generalist bearded seals (*Erignathus barbatus*), we measured the tooth gaps between the postcanine teeth of 21 adult specimens of *L. carcinophaga* and 11 adult specimens of *E. barbatus*. We then performed an F test of equal variance on these two datasets in R. We found that crabeater seal tooth gaps are significantly less variable in spacing than those of bearded seals. This result supports our hypothesis that there is a strong stabilizing selection for lower variability in tooth spacing of *L. carcinophaga*. Our work demonstrates that differential feeding ecologies can significantly impact morphological variation in pinniped dentition.

## RESEARCH QUESTION

Is there stabilizing selection for less spatial variability in the postcanine teeth of the filter-feeding specialist *Lobodon carcinophaga* than in the “grab-and-gulp” feeder *Erignathus barbatus*?



*L. carcinophaga* postcanine tooth (left)<sup>1</sup> and *E. barbatus* postcanine tooth (right)



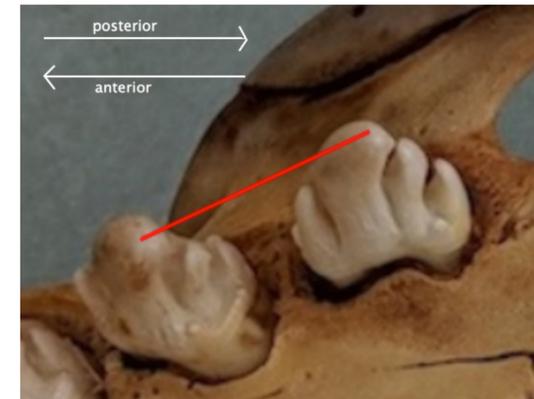
Crabeater seal in Pléneau Bay, Antarctica<sup>2</sup>

## HYPOTHESIS

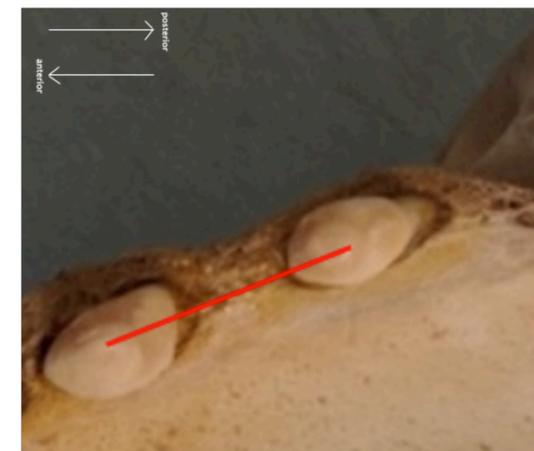
The postcanine teeth of *L. carcinophaga* are less variable in spacing than those of *E. barbatus* since crabeater seals, which specialize in filter-feeding, are less likely to survive ecological pressures with unevenly spaced teeth than are bearded seals.

## METHODS

1. Used the Phylonimbus software to collect linear measurements between the primary cusps of the postcanine teeth of both specimens of *L. carcinophaga* and *E. barbatus*.
2. Performed an F-test of equal variances using the var.test command in base R to compare the variances of the linear measurements of *L. carcinophaga* and *E. barbatus*.



Landmarking schema shown on upper dentition of *L. carcinophaga*



Landmarking schema shown on upper dentition of *E. barbatus*

## RESULTS

The p-value from the F-test was  $<0.01$  ( $p = 0.000005307$ ) and thus the variances are statistically significantly different.

## CONCLUSIONS

1. *L. carcinophaga* postcanine tooth spacing is less variable than *E. barbatus* postcanine tooth spacing.
2. The lower variability in postcanine tooth spacing in *L. carcinophaga* than in *E. barbatus* may be attributed to stabilizing selection from natural selective processes for lower spatial variability in postcanine teeth in the filter-feeding specialist, *L. carcinophaga*, than in the grab-and-gulp feeder, *E. barbatus*.

## FUTURE DIRECTIONS

1. Measure the postcanine tooth gaps in *Hydrurga leptonyx* (leopard seal) skulls and compare the variability in tooth spacing in this species, which primarily uses both filter feeding and grip-and-tear feeding modes, to the variability in tooth spacing in *L. carcinophaga* and *E. barbatus*.
2. Measure the tooth gaps of these three species in person (not with photos).

## Acknowledgements

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## References

- <sup>1</sup>Hocking, D. P., Marx, F. G., Fitzgerald, E. M. G., & Evans, A. R. (2017). Ancient whales did not filter feed with their teeth. *Biology Letters*, 13(8), 1–4 <https://doi.org/10.1098/rsbl.2017.0348>
- <sup>2</sup>Quinn, Liam, 2011. *Wikimedia Commons*