

The nature and rate of vocalisation by southern right  
whales (*Eubalaena australis*), and the evidence for  
individually distinctive calls

by

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SUMMARY

Southern right whale vocalisations recorded in Walker Bay, South Africa, between June and November 1999, were analysed to investigate the acoustic repertoire, the relationship between calling behaviour and whale presence, the proportions of vocal and silent whales, and of recorded calls from unseen whales, and the evidence for vocal individuality. This marks the first study of right whale vocalisation in South African waters.

A simple matrix system with the axes acoustic contour and onset frequency described twelve call types. Analysis of call use over time indicated that some calls, as well as broadband *gunshots*, clustered strongly in bouts of differing lengths, and that their relative use varied over the season; the repertoire and its classification was compared with other accounts of right whale vocalisation [*chapter one*]. A generalised linear model explained the variation in the overall call rate in terms of the numbers of whales present, month and wind direction. The overall call rate, for each month and in all wind conditions, rose with increasing whale numbers to a plateau at between ten and fifteen whales, and then declined as whale numbers rose further, suggesting that the social motivation for vocalising was progressively reversed. An inverse linear relationship between call rate per whale and whale abundance was clearly demonstrated over the whole season, indicating that call rates were unreliable as an indicator of whale numbers [*chapter two*].

A dual-axis, three-element hydrophone array suspended at 5m from floating buoys was designed to assign whale vocalisations to calling whales. The array was calibrated with an overall mean error of 3°. Bearings to calling whales were calculated using correlelograms, and compared with the observed positions of whales. On average 31% of *low up* (upwardly inflected) calls and 11% of *medium and high down* (downwardly inflected) calls came from whales not sighted from the boat; up to just under half of the whales sighted from the boat were silent. This indicates the importance of integrating visual and acoustic data when estimating whale numbers [*chapter three*].

In characterising individuality in vocalisations, we used cluster analysis of acoustic properties of whale calls to derive the Euclidean distances (a measure of similarity) between each possible pair of calls within a continuous recording session. Calls clearly from different whales (distant call pairs) were more dissimilar than calls possibly from one whale ('close' call pairs), lending support to the hypothesis of vocal individuality. The similarity between 'close' *up* calls was greatest when the calls were within 0.5 minutes of each other, and declined progressively, up to a separation of 6.5 minutes, as the likelihood of both calls being from one whale declined, indicating individual bout-calling. *Medium and high down* (downwardly inflected) calls, associated with surface active groups (SAGs), and thought by other researchers to be produced by the focal female, were more similar within any given SAG than when compared across SAGs. This evidence strongly suggests that southern right whales produce individually distinctive vocalisations [*chapter four*].

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## ACRONYMS

CPW	call rate per whale
DVV	difference between variable values
FD	frequency domain
FFT	fast Fourier transform
GLM	generalised linear model
OCR	overall call rate
TD	time domain
WT	wavelet transform