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*Publication date:*  
2013

*Document version*  
Submitted manuscript

*Citation for published version (APA):*

Larsen, O. N., & Reichmuth, C. (2013). Proximal mechanisms for song production in male Pacific walruses. Abstract from XXIV International Bioacoustics Congress , Pirenópolis, Brazil.

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## Proximal mechanisms for song production in male Pacific walruses

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The underwater songs of male walruses during the breeding season have been noted to possess some of the most unusual features that have been observed among mammalian sounds. In contrast to the more guttural vocalizations of most other carnivores, their acoustic displays have impulsive and metallic features more similar to those found in industrial work places than in nature. The patterned knock and bell sounds that comprise male songs are not thought to be true vocalizations, but rather, sounds produced with structures other than the larynx and vocal tract. To determine how male walruses produce and emit impulsive and metallic signals, we conducted a series of *in situ* studies with two captive adult male Pacific walruses (*Odobenus rosmarus divergens*) that were trained for voluntary participation in bioacoustic research. Through a combination of methods including palpation, microphone and hydrophone recording, endoscopic video recording, and ultrasound scanning, we confirmed the probable anatomical origins of knock and bell sounds and gained a mechanistic understanding of how these sounds are generated within the body and transmitted to the environment. In the two individuals examined, the source of the knock sounds was collision of teeth and gums during rapid adduction of the jaws, while bell sounds were produced by movement of the tongue inducing a sudden pressure release in the inflated pharyngeal sacks. These pathways for sound production are illustrated with acoustic and video data and considered with respect to the unique biology of this species.

**Financial Support:** Supported in part by the Danish Council for Independent Research | Natural Sciences grant 10-093073 to ONL.

