

Lifelong Patterns of Sound Production in Two Seals

Supplementary Tables

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Supplementary Table 1

(A) Summary of equipment used over a 19-y period to record the underwater vocalizations produced by one captive male Pacific harbor seal (Sprouts; *Phoca vitulina*). High-quality recordings were obtained for 16 y within this period. For each year, the hydrophone, recorder, sampling rate, and analysis parameters are provided. (B) Summary of equipment used over an 11-y period to record the in-air vocalizations produced by one captive female northern elephant seal (Burnyce; *Mirounga angustirostris*). High-quality recordings were obtained for 6 y within this period. For each year, the microphone, recorder, sampling rate, and analysis parameters are provided.

A. Pacific harbor seal – Sprouts				
Year	Microphone/hydrophone	Recorder	Sampling rate (Hz)	Analysis parameters
1998-1999	NUWC H-56 (Naval Undersea Warfare Center, Rhode Island, USA) 10 Hz to 65 kHz, -171 dB re 1 V/ μ Pa	Computer sound card	11,025/22,050/48,000	FFT size: 1,024/2,048/4,096 Hann Window Filter bandwidth: 15.5/15.5/16.9 Hz
2000-2006	ITC 1042 (International Transducer Corporation, California, USA) 1 Hz to 100 kHz -200 dB re 1 V/ μ Pa	Sony TCD-D8 digital audiotape recorder (Sony Corporation of America, New York, USA)	22,050/44,100	FFT size: 2,048/4,096 Hann Window Filter bandwidth: 15.5/15.5 Hz
2007	ITC 1042	Marantz PMD-660 portable digital recorder (D&M Holdings, Inc., Kawasaki, Japan)	44,100	FFT size: 4,096 Hann Window Filter bandwidth: 15.5 Hz
2008	Reson TC4032 (Reson A/S, Slangerup, Denmark) 10 Hz to 80 kHz -170 dB re 1 V/ μ Pa	Marantz PMD-660	48,000	FFT size: 4,096 Hann Window Filter bandwidth: 16.9 Hz
2008	ITC 1042	Marantz PMD-660	48,000	FFT size: 4,096 Hann Window Filter bandwidth: 16.9 Hz
2009	Reson TC4032	Sound card of COMPAQ Presario V6000 Laptop	96,000	FFT size: 8,192 Hann Window Filter bandwidth: 16.9 Hz
2010	ITC 1042	Brüel & Kjær 2250 sound analyzer (Brüel & Kjær A/S, Nærum, Denmark)	48,000	FFT size: 4,096 Hann Window Filter bandwidth: 16.9 Hz
2011	ITC 1042	Fostex FR2 Field Memory Recorder (Fostex Company, Tokyo, Japan)	48,000	FFT size: 4,096 Hann Window Filter bandwidth: 16.9 Hz
2012-2014	ITC 1042	Brüel & Kjær 2250	48,000	FFT size: 4,096 Hann Window Filter bandwidth: 16.9 Hz
2015-2017	Reson TC4032	Brüel & Kjær 2270	48,000	FFT size: 4,096 Hann Window Filter bandwidth: 16.9 Hz
B. Northern elephant seal – Burnyce				
2000-2005	Neumann KMR 82i condenser shotgun microphone with Rycote suspension and windscreen (Georg Neumann GmbH, Berlin, Germany) 20 Hz to 20 kHz 21 mV/Pa	Sony TCD-D8 digital audiotape recorder	48,000	FFT size: 4,096 Hann Window Filter bandwidth: 16.9 Hz
2009	Neumann KMR 82i condenser shotgun microphone with Rycote suspension and windscreen	Fostex FR2 Field Memory Recorder	48,000	FFT size: 4,096 Hann Window Filter bandwidth: 16.9 Hz
2011	Brüel & Kjær 4189 free-field microphone 6 Hz to 20 kHz 50 mV/Pa	Brüel & Kjær 2250	48,000	FFT size: 4,096 Hann Window Filter bandwidth: 16.9 Hz

Supplementary Table 2

Published data describing (A) male Pacific harbor seal underwater vocalizations and (B) female northern elephant seal in-air vocalizations. Mean values are reported for all acoustic measurements. When provided by the authors, standard deviation (SD) is given, and range is noted in parentheses. All frequency parameters are reported in Hz, and all duration parameters are reported in s. The number of animals recorded and recording location are also noted for each study. General descriptions of these vocalizations are provided when available.

A. Pacific harbor seal – Sprouts										
Call type	Sample size (Number of calls analyzed)	Recording location	Peak frequency ± SD (Range)	Mean frequency ± SD (Range)	Minimum frequency ± SD (Range)	Maximum frequency ± SD (Range)	Total duration ± SD (Range)	Duration of pulsed portion ± SD (Range)	Description	Reference
Roar	484	Point Lobos, CA, USA	547 (313-1,100)	--	--	3,000	4.2 (1.8-10.9)	--	Little tonal quality, occasionally showing some harmonics; sounds like an animal roaring	Hanggi & Schusterman, 1994
Roar	207	Moray Firth, UK	--	665	--	--	--	--	Loud and pulsed burst sound, the amplitude of which fades in and out at the start and end of the call	Van Parijs et al., 1997
Roar	> 300	Moray Firth, UK	650 ± 8	--	255 ± 6	1,313 ± 78	4.8 ± 0.4	--	Calls vary individually and geographically	Van Parijs et al., 2000a
Roar	790	Moray Firth, UK, and northwest Orkney, UK	647 ± 5	--	314 ± 6	--	6.5 ± 0.3	2.9 ± 0.2	--	Van Parijs et al., 2000b
Roar	96	Eastern/western Atlantic Ocean and eastern Pacific Ocean	380 ± 1	--	60 ± 10	--	8.3 ± 3.1	3.5 ± 1.6	Pulsed	Van Parijs & Kovacs, 2002
Roar	120	Norway, Sweden, and Scotland	280 ± 74	--	--	2,000	15.0 (5.8-23.9)	--	Broadband frequency range with abrupt increase in intensity toward the end	Bjorgesæter et al., 2004
Roar	484	Glacier Bay National Park and Preserve, AK, USA	119 ± 8 (98-147)	--	78 ± 10 (50-104)	--	4.8 ± 1.1 (2.0 -9.1)	3.0 ± 1.0 (0.9-7.1)	--	Mathews et al., 2017

B. Northern elephant seal – Burnyce										
Call type	Sample size (Number of calls analyzed)	Recording location	Peak frequency	Mean frequency	Minimum frequency	Maximum frequency	Total duration	Duration of pulsed portion	Description	Reference
Pup attraction call	--	San Nicolas Island, CA, USA	500-1,000	--	--	--	(0.0-2.0)	--	Harmonics	Bartholomew & Collias, 1962
Threat	--	San Nicolas Island, CA, USA	< 700	--	--	--	3+ s	--	Sounds like a human vomiting	Bartholomew & Collias, 1962
Pup attraction call	--	Año Nuevo State Park, CA, USA	600-1,000	--	--	--	--	--	High-frequency warbling sound	Le Boeuf, 1972
Threat	--	Año Nuevo State Park, CA, USA	< 700	--	--	--	--	--	Loud, prolonged, low-frequency rasping noise	Le Boeuf, 1972

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