Context-specific vocalizations in captive beluga whales (*Delphinapterus leucas*)

Laura Hovind, Kelly Korzeniewski, Patrice Paolucci, and Michael Noonan
Canisius College, Buffalo, New York, USA

Introduction

It is clear that Beluga Whales, like most cetaceans, are highly vocal, producing dozens of distinct call types. When attempting to discern the significance of such acoustic signals, it is sometimes useful to correlate the occurrence of sounds with behaviors observed visually. In this way, it can be determined if certain vocalizations are primarily associated with specific activity states, motivations, or social circumstances.

However, belugas characteristically inhabit the waters of the high arctic in areas where sustained observations by humans prove to be nearly impossible. In order to overcome this difficulty, this study sought to correlate the production of call types with visually observed behaviors in a captive population of belugas where sustained observations were possible.

Methods

Our subjects were 12 adult belugas (5 male, 7 female), collected in the wild (Chukchi Sea), and held in captivity at Marineland of Canada (Niagara Falls, Ontario).

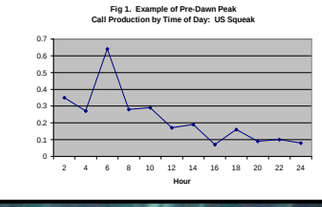
Observations were made from simultaneous video/hydrophone recordings during nine separate 24 hour epochs. The occurrence of each of 32 call types was recorded during the entirety of those samples (12,960 minutes total). In addition, four distinct states of motion and two types of social interactions were tallied on a minute-by-minute basis during daylight hours only (6,065 minutes total). A Factor Analysis was used to assess the extent to which these various measures were associated. In addition, Pearson correlations were used to specifically assess the relationships among the video-derived activity states, social interactions, and each of the call types. Finally, ANOVAs were employed to assess the rates of occurrence of each call type as a function of time of day.

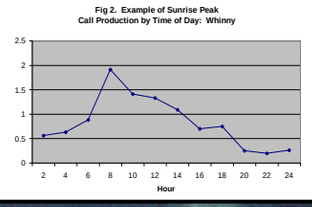
Table One
Factor Analysis: Call Types and PCA Coefficients

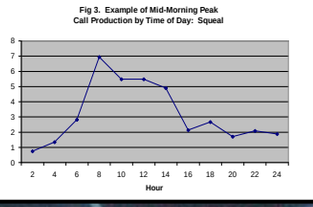
Acoustic Factor One		Acoustic Factor Two		Acoustic Factor Three		Acoustic Factor Four	
Drills Plsd Fst	0.75	Laugh	0.84	Notes Rising	0.94	Whistle Slide	0.82
Clicks Low	0.67	SLS Pulsed	0.78	Notes Varied	0.87	Whistle Flat	0.73
SLS	0.59	Squeal	0.63	Whinny	0.73	Cricket	0.65
Whinny Down	0.58	Huff	0.53	Rasp. High	0.55	Fish	0.63
Rasp. Low	0.57	Moan	0.50	Rasp. Pulsed	0.50	Rasp. Low	0.45
Mark	0.54	Knock	0.50	Knock	0.32	Whinny Down	0.43
Rasp. High	0.53	SLS	0.49	Heave	0.31	Cow Quack	0.41
Drills Plsd Sing.	0.51	Drain Glug	0.49			Knock	0.39
Clicks High	0.51	Clicks High	0.41			Squeal	0.35
Knock	0.46	Clicks Low	0.40			Huff	0.32
Canary	0.43	Cow Quack	0.36				
SLS Pulsed	0.42	Canary	0.32				
Can't Hear	0.40	Rasp. Pulsed	0.31				
Cow Quack	0.37						
Rasp. Pulsed	0.32						

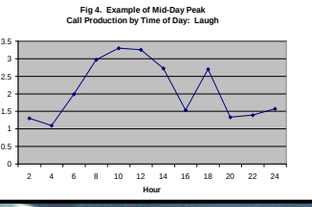
Table Two
Correlation Coefficients: Acoustic Factors by Activity State

	Acoustic Factor One	Audio Factor Two	Audio Factor Three	Audio Factor Four
Swimming	r = 0.13 ns	r = 0.20 p = .05	r = 0.38 p < .001	r = 0.04 ns
Resting	r = -0.56 p < .001	r = -0.52 p < .001	r = -0.27 p = .01	r = -0.55 p < .001
Slow Vert Movement	r = -0.40 p < .001	r = -0.36 p < .001	r = -0.38 p < .001	r = -0.41 p < .001
Touching	r = -0.09 ns	r = -0.04 ns	r = 0.29 p <.01	r = -0.13 ns
Bubbling	r = 0.26 p < .02	r = 0.29 p < .01	r = 0.42 p < .001	r = -0.13 ns









Results

Our factor analysis revealed significant weighting on four components, reflecting the fact that certain calls were produced in association with other specific calls. Table One summarizes these findings.

All four audio composite variables (made up of those calls that factored together in Table One) correlated negatively with both resting and slow vertical movements. Only one of those audio factors (Audio Factor 3) correlated significantly and positively with active swimming, bubbling, and social touching. See Table Two.

The rate of occurrence of most call types (25 of 32) also differed significantly with time of day. Four peaked just before dawn. Nine calls had clear peaks of production at sunrise. Two call types peaked significantly during mid-morning, and ten peaked at mid-day. Figures 1-4 provide illustrative examples.

Discussion

Clearly the occurrence of certain call types is associated in time with the production of certain other ones. We interpret the heavy weighting in our factor analysis as suggestive of four separate motivational/emotional states in the animals. It is interesting that one group of vocalizations factored with (and was correlated with) swimming. It is equally interesting that no vocalizations were associated with the resting state. Perhaps most significantly, most of the vocalization types had a pattern of being produced primarily at certain times of day, with the specific pattern varying among the call types. We feel that each of these lines of evidence suggests that different call types are associated with different functional roles.

We submit that the paradigm employed here has the potential to reveal the functional significance of the different beluga call types. We hope that future studies of this type continue to add to our understanding of vocalizations in this species.

Acknowledgements

This work would not have been possible without the hospitality and support of John Holer and the wonderful staff at Marineland of Canada.

Contact Information

Address correspondence to:

Michael Noonan, PhD
Animal Behavior, Ecology, and Conservation
Canisius College
2001 Main Street
Buffalo, NY, 14208, USA
noonan@canisius.edu