

# Circadian rhythms in rates of occurrence of beluga whale vocalizations

## (*Delphinapterus leucas*) in captivity

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### Introduction

The goal of this investigation was to look for evidence of circadian periodicity in the vocalizations of captive beluga whales in an effort to shed light on their functional significance.

### Methods

Utilizing hydrophones (Offshore Acoustics) permanently installed in the beluga pool at Marineland of Canada, we recorded sounds 24 hours per day onto VHS video tape. There were four adult males and eight adult females in the 1 million gallon pool (40 m X 20 m X 10m).

We identified 24 distinct call "syllables", and using the Observer™ software package we recorded the time of each vocalization over nine separate 24-hour epochs, evenly spaced out over a 5-month period.

These data were then combined across days and collapsed into successive 30 min periods. The frequency for each syllable produced by our group of belugas was then calculated separately for each 30 min period as the number of calls recorded divided by the total number of minute-long epochs observed.

### Results

The circadian patterns for representative call syllables are presented in the eight panels at right.

Generally, most vocalizations show a similar pattern of increases and decreases throughout the day.

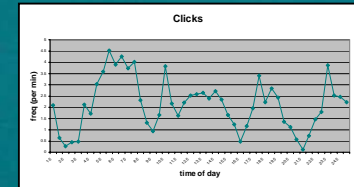
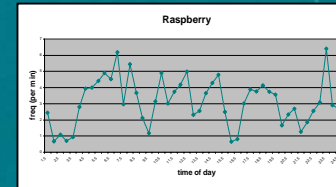
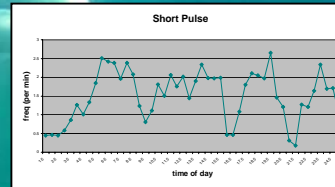
Beyond that short term pattern, we place our calls into three categories:

Steady production. The production of some call types (e.g., Short Pulses, Raspberry, Clicks) appears to take place at a steady rate throughout the day. That is, the peaks of the shorter rhythm appear to reach about the same level over the 24 hour day.

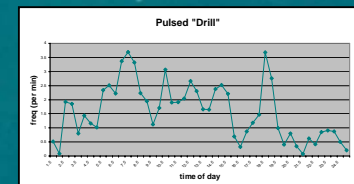
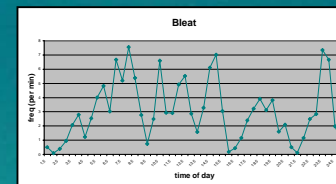
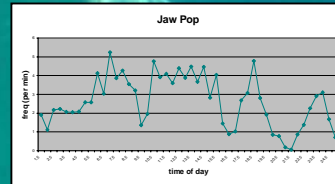
Daytime production. The peaks of other call types (e.g., Jaw Pops, Drills, Bleats) are concentrated during daylight hours.

Early morning production. Still other call syllables (e.g., Rising Notes, Whistles) show a distinct peak of occurrence in the early morning hours with a clear decrease in frequency as the day progresses.

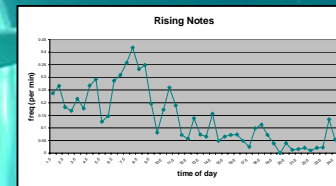
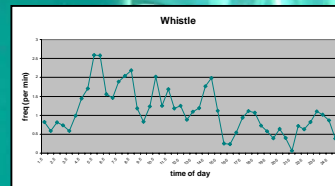
### Cluster 1



### Cluster 2



### Cluster 3



### Discussion

We feel that the similar infradian pattern revealed for most calls is probably an artifact of captivity because the periodic decreases in vocal activity appear to coincide with periods of feeding and training carried out by the human caretakers.

Beyond that, we tentatively hypothesize functional significance to the different call syllables based upon the three circadian patterns revealed. Calls which are produced at a steady rate throughout the 24 hour period (e.g., brief pulses) may serve the function of contact calls facilitating group cohesion. Calls that peak just before feeding times (bleats, drills, jaw pops) are likely associated with arousal and/or aggressive interactions. Calls which peak in early morning hours, and seem to be least affected by the superimposed feeding schedule (whistles and rising notes), are likely to be associated with other behavioral/motivational states—perhaps reproductive activity.

### Acknowledgements

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