

Underwater Bubbling in Beluga Whales (*Delphinapterus leucas*): Rates and Temporal Patterns of Production

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Introduction

Although the production of underwater bubbles has been documented in a number of cetacean species, an understanding of this category of behavior in terms of ecological, cognitive, and social contexts is only beginning to emerge. The present study focuses on the production of underwater bubbling in a captive population of beluga whales (*Delphinapterus leucas*), with the goals of characterizing the extent of bubble production as a function of age and sex, and of assessing the extent of temporal patterns within and across individuals.

Methods

The subjects of this investigation were 44 captive beluga whales housed at Marineland of Canada (Niagara Falls, Ontario). Simultaneous observations of multiple whales were made via underwater viewing windows by multiple observers using a focal-animal paradigm.

Analyses focused on four types of data:

- rate of bubble production as a function of age and sex
- the temporal pattern of bubble production within whales
- variation in bubble production across days
- the degree of inter-whale synchrony

Results

In all, 11,858 bubbling events were recorded over 4,646 minutes of observation (approximately 0.58 bubbles per minute per whale). Four basic findings were evident:

- Bubbles were produced by both males and females, and by both adults and juveniles, with a significant three-way interaction among sex, age, and bubble type (Figure 1).
- Short inter-bubble intervals were more numerous, and intermediate inter-bubble intervals less numerous, than that which would be expected by chance (Figure 2).
- There were more days with a low number of bubbles and with a high number of bubbles than that which would be expected by chance (Figure 3).
- On average, 9.8% of bubbles produced by one whale were matched with a bubble by a second whale, exceeding that which would be expected by chance. This synchrony was greater among males (both adults and juveniles) than among females, and greater for mother-calf pairs than for unrelated female-calf pairs (Figure 4).

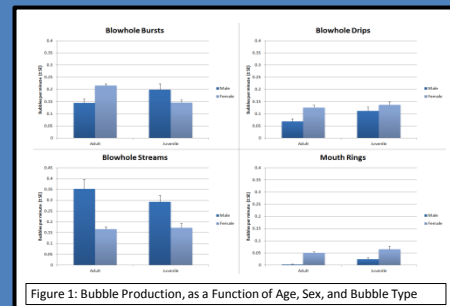


Figure 1: Bubble Production, as a Function of Age, Sex, and Bubble Type

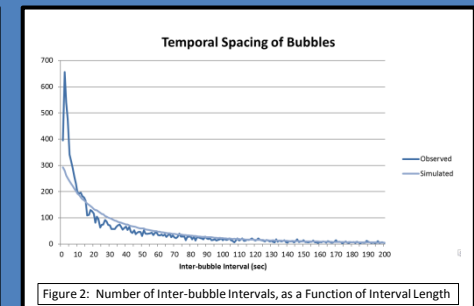


Figure 2: Number of Inter-bubble Intervals, as a Function of Interval Length

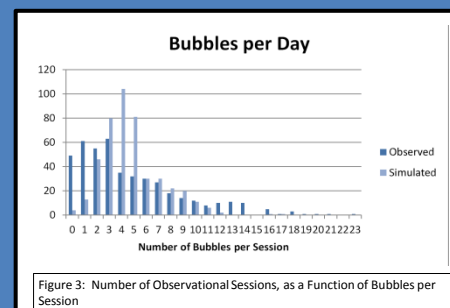


Figure 3: Number of Observational Sessions, as a Function of Bubbles per Session

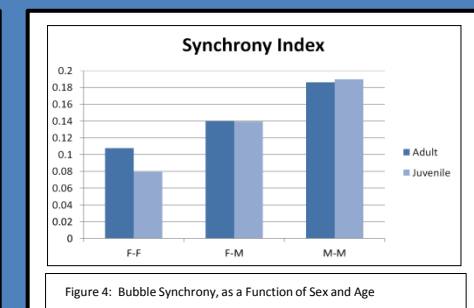


Figure 4: Bubble Synchrony, as a Function of Sex and Age

Discussion

At the very least, the present findings confirm that underwater bubbling is a common and widespread behavior in the beluga whale.

The observed distribution of within-whale, inter-bubble intervals revealed two patterns. First, the high number of short intervals indicates that the bubbling by individual whales tends to occur in short temporal clusters. Second, the low number of intermediate intervals conforms to the notion of a refractory period, likely associated with the need to surface for breaths.

That the distribution of bubble production per session by all whales exceeds that which would be predicted by chance at both the high- and low- levels suggests that each pool's overall population goes in and out of bubble blowing moods.

The degree of short-term inter-whale synchrony appears to be reflective of the social relationships in beluga groups. This synchrony was highest for mother-calf pairs – combinations for which it could be argued the social bonds are strongest. That the synchrony is next strongest for adult male-adult male pairs is compatible with the strong male-male affiliations that are observed both in the wild and in captivity. That such synchrony is weakest among adult females is similarly compatible with the absence of stable female-female affiliations that is typical of this species.

Acknowledgements

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