

Temporal Rates of Occurrence in Captive Orca Vocalizations: Infradian, Circadian, and Ultradian Patterns

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Introduction

The behaviors of many animal species are characterized by rhythmic patterns. Such patterns often inform questions pertaining to adaptive advantages and/or physiological processes which underlie the timing of behavior.

The goal of this investigation was to look for evidence of rhythmic periodicity in the vocalizations of the captive killer whale population under study at Marineland in Niagara Falls, Canada.

Methods

Utilizing hydrophones permanently installed in the orca pools at Marineland of Canada, we recorded sounds on a 24-hour basis (except during the 4 summer months when our recordings were limited to 7-9 am). Using the Observer™ software package we recorded the time of each call "syllable" over 880 hours, evenly spaced over a one year period.

Results

The seven whales in our sample produced an average of 234 vocal syllables per hour. Additionally, the temporal rate of occurrence of the vocalizations showed at least three rhythmic patterns:

Ultradian. Within each day, the orcas characteristically varied between periods of calling and periods of silence (see Fig. 1). Based upon an analysis of 20 samples, we calculate that the mean period of this cycle is 19.7 minutes in duration.

Circadian. Figure 2 presents the distribution of calls over an average 24-hour period. There was a marked increase between 1 am and 7 am as opposed to other periods of the day.

Infradian/Annual. Figure 3 presents the distribution of calls over the 12 month study period. We note two peaks in call production, one in mid summer and one in early winter.

Discussion

We are inclined to offer three speculative accounts of the rhythmicity that we observed, each in turn associated with a separate underlying mechanism:

We wonder whether the short, ultradian cycle in call emission, reflects physiological processes such as physical fatigue in vocal apparatus and/or the necessity of the whales to periodically attend to other needs.

We wonder whether the circadian pattern simply reflects a shift from visual to auditory modalities as the primary social contact mechanism during nighttime.

We wonder whether the marked variation in vocalization rate over the seasons reflects an underlying reproductive cyclicity and/or migratory restlessness.



Fig 1. Example of Periodic Calling Bouts

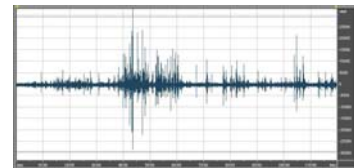


Fig 2. Vocalizations by Time of Day

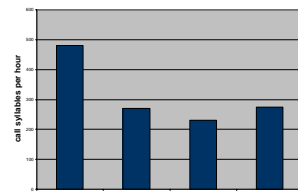
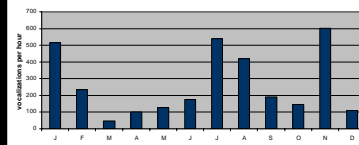


Fig 3. Vocalizations by Month



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