

VOCALIZATION AND COORDINATED FEEDING BEHAVIOR OF THE HUMPBACK WHALE IN SOUTHEASTERN ALASKA

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ABSTRACT

Coordinated feeding behavior of the humpback whale (*Megaptera novaeangliae*) was observed over a 3-day period in southeastern Alaska. Using distinctive identification markings on the flippers, we verified that each whale maintained a constant position and spatial relationship within the group during feeding maneuvers. A uniform vocalization, with a fundamental frequency of approximately 500 Hz, was closely associated with the initiation of the cooperative feeding behavior. A final, linearly ascending vocalization preceded simultaneous surfacing in the vertical

PRODUCTIVITY

At the southwest tip of Admiralty Island in southeastern Alaska (57°27'N, 133°51'W) an 8-km-wide strait separates two deep basins, Chatham Strait and Frederick Sound. The strong upwelling generated by this shoaling results in productive surface layer due to the increased nutrient supply. In this productive area, a pod of humpback whales (*Megaptera novaeangliae*) fed on euphausiids (*Euphausia pacifica*) and herring (*Clupea*) over a three-day period.

When first observed, the whales of the pod were swimming at the surface, with mouths agape and ventral pleats extended engaged in lateral lunge-feeding (Jurasz and Jurasz, 1979; Watkins and Shevill, 1979; Hain *et al.*, 1982). We followed the pod for over an hour to photograph the ventral surface of their flukes for individual identification purposes (Katona *et al.*, 1979). The whales remained in a group during this period, independently lateral lunge-feeding on euphausiids with no apparent synchronization or cooperation within the pod. Recordings of vocalizations were made with a Nakamichi 681 ZX tape recorder, with an Ithaco 257AM preamplifier and a Clevite CH-17U hydrophone with a combined frequency response ± 3 decibels (db) from 20 hertz (Hz) to 22 kilohertz (kHz). Aside

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from "grunts", very little vocalization was evident while the whales were surface swimming or lateral lunge-feeding. The limited vocalizations of humpback whales on feeding grounds have been reported by other researchers (Perkins and Whitehead, 1977; Thompson *et al.*, 1977).

A different feeding strategy was then initiated by the pod; all of the whales submerged, a single ring of bubbles 20-m in diameter appeared on the surface, and seven of the eight whales surfaced simultaneously within the ring of bubbles in a vertical lunge-feeding manner. The bubbles continued to emerge for about 15 s, until the remaining member of the pod surfaced after apparently completing the bubble "net." Whether the bubble net was used to concentrate the prey or simply enclose naturally occurring concentrations of prey is uncertain; however, curtains of bubbles can form an effective barrier to schooling fish (Bates and VanDerWalder, 1964).

After about 1 h of coordinated feeding on euphausiids, the whales began to feed on a large school of herring (approximately 200 m in diameter) which had moved into the area. The whales appeared to utilize the vertical lunge-feeding strategy, but this was not part of the repertoire. Humpback whales have been reported employing bubble nets for herring, and Jurasz and Jurasz (1977) reported that the net diameter is larger than that used for euphausiids.

The diameter of the bubble nets varied from 10 to 15 m, and feeding bouts lasted from 5 to 15 s. Over the 3-day observation period, feeding was interspersed with resting periods during which there was no surface feeding activity observed.

The systematic feeding on euphausiids with the bubble net and on herring with the bubble net seemed to be highly organized and structured. In the 130 vertical lunge-feeding maneuvers which were recorded with still and motion picture cameras, the feeding group of humpback whales always surfaced simultaneously. The whales had distinctive pigmentation markings which were used to verify that each whale maintained a consistent relationship within the group during the feeding activity (Fig. 3).

We recorded a uniform vocalization (Fig. 4) when the humpback whales initiated their cooperative vertical lunge-feeding behavior. The vocalization, heard only while the entire group was submerged, was 45 to 58 s in duration and began about 90 s prior to their surfacing. These phonations consisted of a distinct series of narrow bandwidth tones which were mostly constant in amplitude and slightly ascending and modulated in frequency. The vocalization ended with a drop and then upward sweep in frequency. The fundamental frequency was approximately 500 Hz, with multiple associated harmonics perceptible until they disappeared in the background noise above 8 kHz. The drop reached 400 Hz with an upward sweep to 800 Hz. These tonal segments were each 3 s long. After this initial series of tonal segments, and an 11- to 14-s pause, a final vocalization of about 6 s preceded the vertical lunge-feeding

maneuver. This last vocalization differed from the previous tonal segments in that it ascended linearly from 450 Hz to 600 Hz. In one instance the final vocalization was omitted and the whales surfaced without an devious group structure.



Fig. 1. The physical orientation of the group of eight humpback whales (*Megaptera novaeangliae*) feeding on herring. Whales #1 and #2 maintained a vertical position throughout the lunge-feed, with Whale #1 rising higher than #2. Whale #1 was the largest of the group. (Illustration by Robert J. Western.)

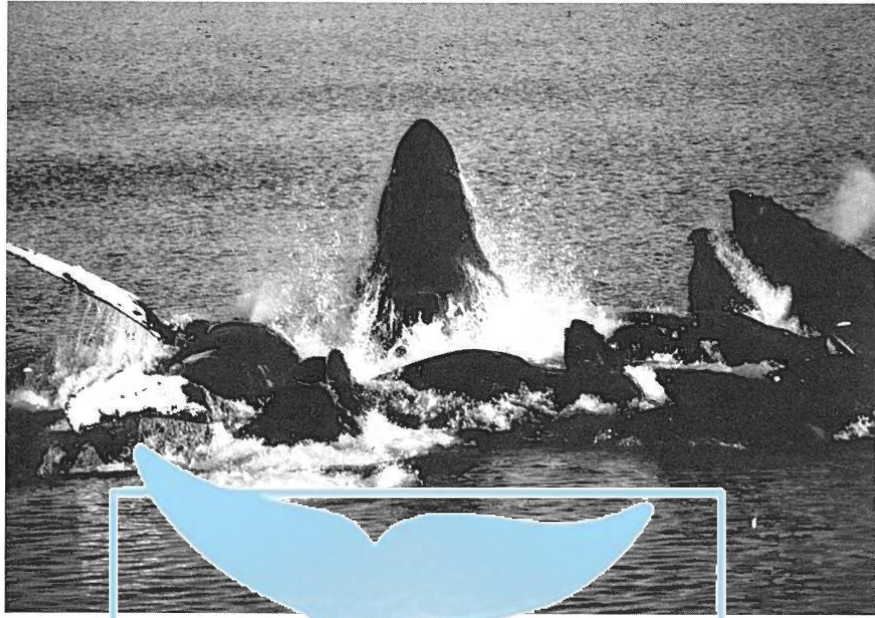


Fig. 2. The group of eight humpback whales lunge-feeding. 9 August, 1983.



Fig. 3. The group of eight humpback whales lunge-feeding, 11 August, 1983.

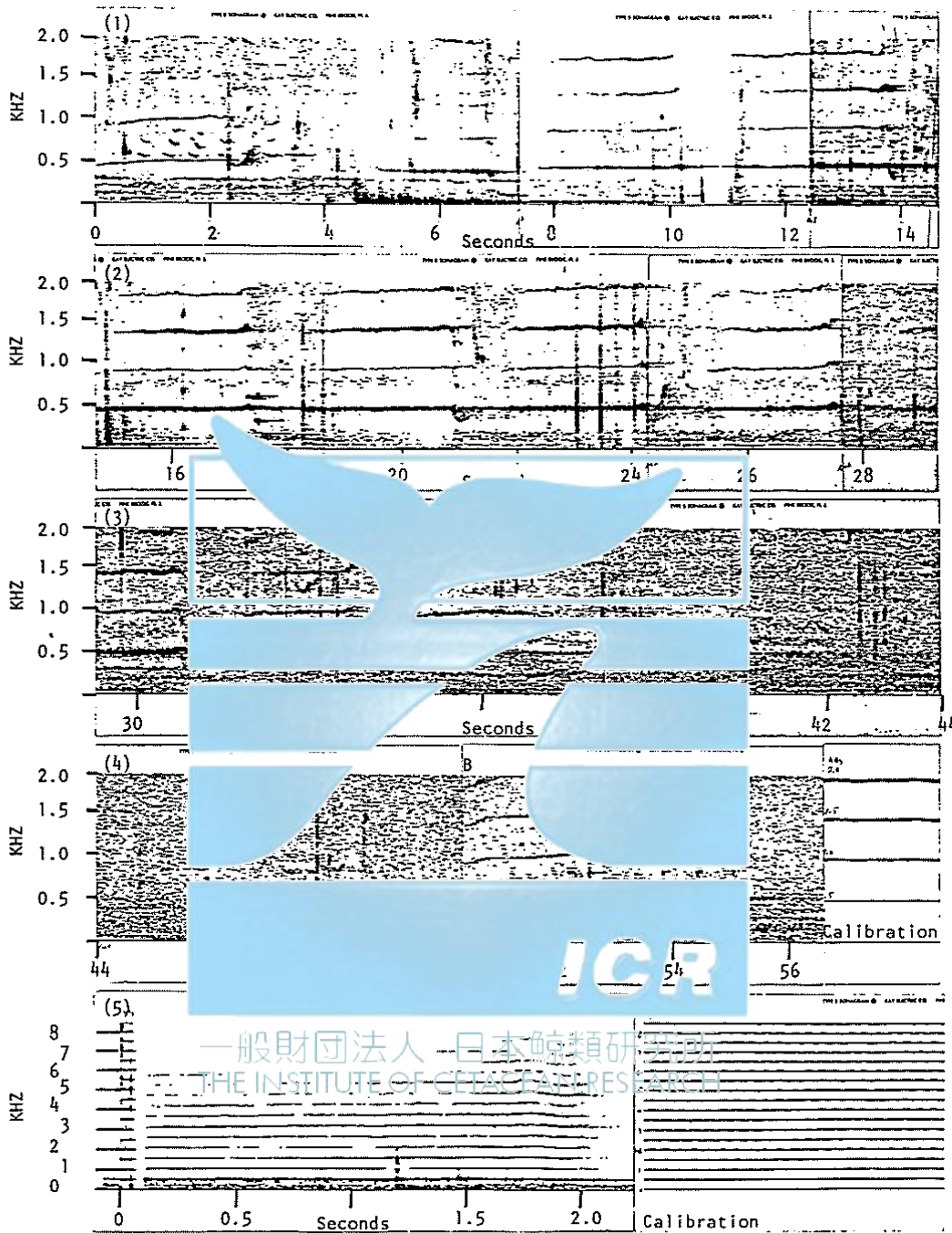


Fig. 4. Spectrographic representation of humpback whale vocalizations. Graphic representation of the vocalizations was obtained by playing the sounds through a Kay sonograph spectrum analyzer (model 7029A). Graphs 1 through 4 represent total sequence recorded prior to each vertical lunge-feeding maneuver, filter bandwidth 11.2 Hz. Graph 5 represents a portion of the final vocalization which begins at B on graph 4 (B) showing harmonics up to 8 kHz, filter bandwidth 45 Hz. Extraneous vocalizations most clearly represented are Steller's sea lions (A) (*Eumetopias jubatus*).

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Apparent cooperative feeding behaviors associated with vocalizations have been reported for killer whales (*Orcinus orca*) preying on schooling fish (Steiner *et al.*, 1979). Jurasz and Jurasz (1979) observed apparent cooperative feeding in humpback whales in which breathing and surfacing were coordinated. They also recorded a uniform vocalization during feeding behaviors involving more than one whale, but only when the prey species was herring. This vocalization began with a "buzzing pattern" which was not present in our recordings. Annual changes in humpback whale vocalizations on the breeding grounds have been demonstrated (Winn and Winn, 1978; Winn *et al.*, 1981), and vocalizations on the feeding grounds may also vary from year to year. Our observations of the humpback whale feeding behavior closely corroborate those of others (Jurasz and Jurasz, 1979; Watkins and Schevill, 1979; Hain *et al.*, 1982), but we document for the first time the spatial orientation of individual whales and demonstrate the cooperative nature of the feeding behavior.

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