

DIET AND FEEDING BEHAVIOR OF FIN AND BRYDE'S WHALES IN THE CENTRAL GULF OF CALIFORNIA, MEXICO

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ABSTRACT

The diet and feeding behavior of fin whales (*Balaenoptera physalus*) and Bryde's whales (*B. edeni*) was studied in the central Gulf of California, México, during 3,100 hours of research from 1983-1986. Fin whales were only observed feeding on invertebrates, primarily the euphausiid *Nyctiphanes simplex* (n=30 feeding events). Bryde's whales fed on small schooling fish, such as the Pacific sardine (*Sardinops sagax*) in 88.6% of feeding events and on invertebrates in the remaining 11.4% (n=88 feeding events). Both species formed feeding aggregations. Within feeding aggregations fin whales spent 60-80% of their time in feeding groups of 2-4 whales, but Bryde's whales did not form feeding groups.

RESUMEN

La dieta y el comportamiento alimenticio de los rorcuales comunes (*Balaenoptera physalus*) y los rorcuales de Bryde (*B. edeni*) se estudio en la región central del Golfo de California durante 3,100 horas de observación de 1983 a 1986. Los rorcuales comunes se observaron comiendo unicamente de invertebrados, principalmente el eufáusido *Nyctiphanes simplex* (n=30 observaciones de alimentación). Los rorcuales de Bryde se alimentaron de cardúmenes de peces pequeños, tales como la sardina del Pacifico (*Sardinops sagax*) en 88.6% de las observaciones de alimentación y de invertebrados en el 11.4% restante (n=88 observaciones de alimentación). Ambas especies formaron agregaciones de alimentación. Dentro de las agregaciones de alimentación los rorcuales-comunes estuvieron el 60-80% del tiempo en grupos de alimentación de 2 a 4 ballenas, a diferencia de los rorcuales de Bryde quienes no formaron grupos de alimentación.

Until the 1970's, knowledge of the diet and feeding ecology of mysticete whales was limited to analysis of distribution data and stomach contents (e.g. Nemoto and Kawamura 1977). In areas with no history of modern commercial whaling, such as the Gulf of California, México, there has been little if any information available on mysticete diet and feeding ecology.

In the last twenty years, observational studies have provided information on the diet and

foraging behavior of humpback whales, *Megaptera novaeangliae*; gray whales, *Eschrichtius robustus*; minke whales, *Balaenoptera acutorostrata*; and bowhead whales, *Balaena mysticetus* (Jurasz and Jurasz 1979; Hain *et al.* 1982; Oliver *et al.* 1984; Würsig *et al.* 1984; D'Vincent *et al.* 1985; Hays *et al.* 1985; Hoelzel *et al.* 1989). However, there have been fewer observational studies on the larger whales in the genus *Balaenoptera*, perhaps because they are relatively more pelagic, spend

>60 fin whales feeding. From an 8 m boat we radio-tagged one of these fin whale and watched it feed at the surface for six hours. We continuously recorded its surface behavior and interactions with 9-11 associated feeding whales (eight of which were individually identified).

Two key words are defined following Wilson (1975). Aggregation: a number of individuals gathered in the same place but without obvious internal organization or cooperative behavior. Group: a set of organisms that remain together for a period of time while interacting with one another to a distinctly greater degree than with other conspecifics. Thus, there can be groups within an aggregation.

RESULTS

Diet. When the prey of Bryde's whales was identified as fish by direct observation, Bryde's

whales were associated with piscivorous aggregations in 12 of 15 feeding events (80%) and were never associated with planktivorous aggregations. When the prey of fin whales was identified as euphausiids by direct observation, the whales were associated with planktivorous aggregations in 6 of 7 feeding events (86%), and never associated with piscivorous aggregations. Thus, the composition of mixed species feeding aggregations appears to be a relatively good indicator of prey type.

During the study Bryde's whales were primarily piscivorous and fin whales were only seen feeding on invertebrates (Figure 1). This pattern remains significant even if only data from direct observation and analysis of fecal samples is used (fin whale 0 fish : 15 invertebrate feeding events, $P < 0.005$ binomial probability test; Bryde's whale 19 fish : 9 invertebrates, $P < 0.005$).

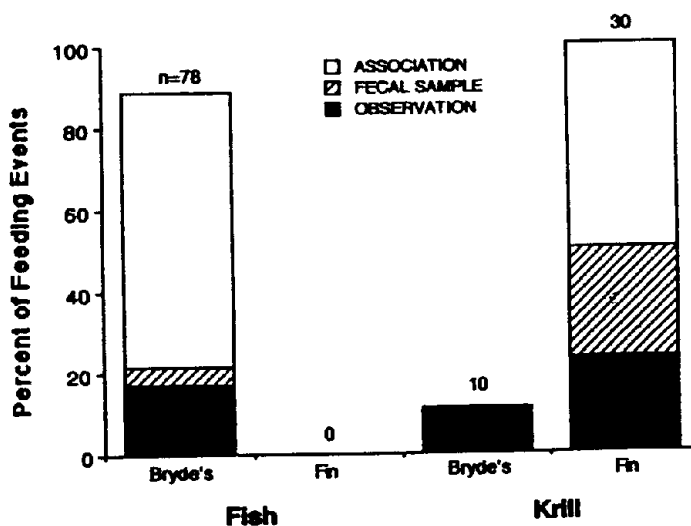


Figure 1. Percentage of 88 Bryde's and 30 fin whale feeding events in the Gulf of California, México, where the prey was either fish or krill (large zooplankton). Prey type was determined by direct observation of prey engulfed in feeding lungs and examination of fecal samples for fish scales and bones or euphausiid body parts. Prey type was inferred when whales were feeding in mixed species aggregations with either planktivores or piscivores (see methods). Fish were primarily Pacific sardines (*Sardinops sagax*) or thread herring (*Opisthonema libertate*). Krill was primarily the euphausiid *Nyctiphanes simplex*.

that the radio-tagged fin whale spent alone or in a group during 6 hrs. of feeding.

The lead whale was to the right of the trailing whale in 91.5% of the fin whale feeding groups ($n=35$, $P < 0.0005$, one tailed binomial test) for which the position of each individual was recorded, but only in 60% of the traveling fin whale groups ($n=7$, $P > 0.25$).

The mean estimated distance between the radio-tagged fin whale and the other whale(s) in the feeding group was less when it lunged ($n=28$ lunges, $\text{mean}=7 \text{ m} \pm \text{1SD}=5.4$) than when it surfaced to breathe without making a feeding lunge ($n=87$ surfacings, $\text{mean}=17 \text{ m} \pm 9.9$; $t_2=4.56$, $d.f.=93$, $P < 0.001$).

The composition of feeding groups was not stable; instead, membership and size changed frequently during feeding events. The radio-tagged fin whale had >8 different feeding partners

during the 6 hrs. we observed it feeding (Figure 3). Repeated identifications of individual group members within large feeding aggregations also demonstrate that feeding group composition was dynamic: during a feeding event, only 13 of the 45 groups (28.9%) remained intact between identifications. Only four groups had the same membership composition on all identifications during one feeding event, and one member of three of these groups was identified on a later date either alone or paired with a different whale.

Bryde's whale feeding behavior. Bryde's whales formed feeding aggregations of 2-15 whales (Tershy 1992), but were not observed in coordinated feeding groups, even though individuals occasionally passed within 50 m of each other. Instead, each whale appeared to respond independently to the movements of its prey.

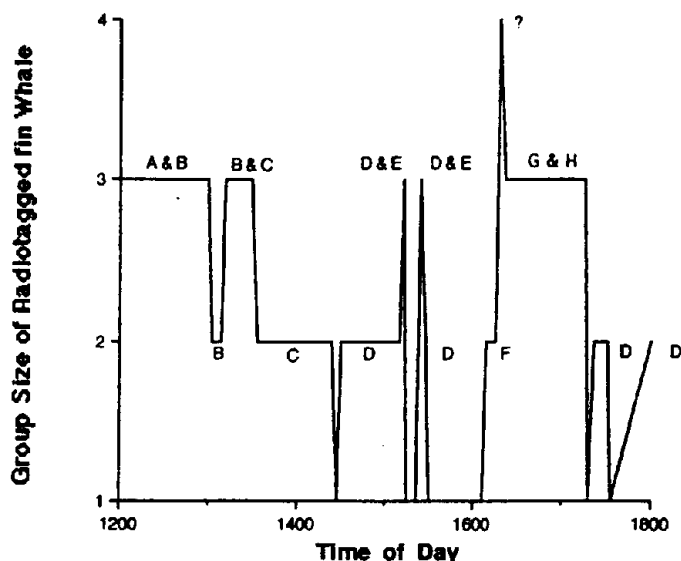


Figure 3. The group size and composition for a radio-tagged fin whale "Archie" observed feeding at the surface for 6 hours. Data were collected at 5 min. intervals during this time. "Archie" had 8 or more different feeding partners (A through H and three unidentified partners). From 12:00 - 12:55 "Archie" fed in a group with whales A and B. At 13:00 whale A left the group and "Archie" fed with whale B. At 13:10 whale C joined "Archie" and whale B, and so on until 18:00.

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