

RESIGHTINGS AND BEHAVIOR OF FALSE KILLER WHALES (*PSEUDORCA CRASSIDENS*) IN COSTA RICA

False killer whales are the least known large-sized globicephalines. They have been sighted mostly in pelagic areas (*e.g.*, Wade and Gerrodette 1993), with few reports from nearshore waters (*e.g.*, Stacey and Baird 1991). False killer whales are known to be gregarious, and it has been suggested that they form strong social bonds in the wild (Stacey and Baird 1991). However, photoidentification of false killer whales has not been attempted due to the difficulties of studying an infrequently sighted species at sea. In addition, although studies on behavior in captivity have been conducted (*e.g.*, Brown *et al.* 1966), behavioral observations of free-ranging killer whales have been necessarily brief (Pilleri 1967, Perryman and Foster 1980, Connor and Norris 1982, Au and Pitman 1988, Pitman and Ballance 1992, Palacios and Mate 1996). This note reports resightings and behavioral observations of false killer whales made during studies on dolphin ecology at Golfo Dulce and Isla del Coco, Costa Rica, and from a cetacean survey in the Pacific Ocean off Costa Rica.

Golfo Dulce (GD, center at 08°30'N, 83°16'W) is an estuarine embayment on the southern Pacific coast of Costa Rica. The gulf is about 50 km long and 10-15 km wide, with a maximum depth of 215 m. Isla del Coco (IC, center at 05°32'N, 87°04'W) is an isolated volcanic island located approximately 500 km southwest of Costa Rica. The island is small (23-km circumference) and is surrounded by a narrow shelf.

A small vessel (< 5 m) powered by an outboard engine was used to find and follow dolphins and other marine mammals in both study areas. Surveys in Golfo Dulce were conducted from September 1991 through December 1992 (326 d). At Isla del Coco they were conducted from February 1993 to August 1993 and from November 1993 through July 1994 (296 d). In addition, the R/V *Odyssey* (28-m ketch) with a small inflatable boat (< 5 m) conducted marine mammal surveys at Isla del Coco (8 d) and throughout the Pacific Ocean off Costa Rica (54 d) from February 1995 to April 1995.

When false killer whales were sighted, they were followed for as long as

Table 1. Parameters used to define the behavior of false killer whales.

1. Distance	The maximum distance observed between subgroups. A subgroup was defined as the number of individuals surfacing together within one body length of each other.
2. Orientation	Yes—All or most subgroups were heading in the same general direction. No—Otherwise.
3. Number of individuals per subgroup	Subgroup with the most individuals.
4. Speed of travel	Based on surfacing pattern of each subgroup. Stationary—Subgroups remained motionless at the surface. Slow—Subgroups did not create a wake while surfacing. Medium—Subgroups made a wake while surfacing. Fast—Subgroups porpoised.
5. Diving	Yes—Subgroups dived as a group. Synchronous—Subgroups dived at the same time. Asynchronous—Subgroups did not dive at the same time. No—Subgroups did not dive as a group or did not dive at all.
6. Formation of the group	Geometric shape of the group in relation to the direction of movement. Abreast—Wider than long. Other—Not wider than long.
7. Leaping	Yes—Present. No—Absent.
8. Number of associated seabirds	Number of associated seabirds flying or feeding within two body lengths (approximately 10 m) of the whales per min of observation.

possible to obtain dorsal fin photographs, which were used to identify individuals (Würsig and Jefferson 1990) and to record previously defined behavioral parameters (Table 1). Observations that included data for all eight parameters were considered one behavioral bout; a change in any of the parameters initiated a new bout. Cluster analysis was used to define behavioral states based on four parameters (distance, orientation, speed, and diving) that explained, according to factor analysis results, most of the variability in the data (70 bouts from 12 groups).

Fifteen sightings of false killer whales were made in Golfo Dulce and at Isla del Coco. In 13 of those sightings, group-size estimates and behavioral observations were possible. Average group size was 16.0 individuals ($n = 13$), with a range of 13–14 individuals in Golfo Dulce and 5–34 at Isla del Coco. Sixteen individuals were identified in Golfo Dulce and 50 at Isla del Coco. No photographic resightings were made between study areas; however, several individuals were resighted within each study area. In Golfo Dulce, two individuals were resighted after an 11-month span. At Isla del Coco, 22 individuals were resighted 1–4 times, spanning periods of 1–730 d. In all cases, resighted individuals were observed with previous associates (Table 2).

Table 2. Photographic identification of individual false killer whales.

Golfo Dulce		Isla del Coco										
ID#	7/12/91	12/11/93	ID#	25/3/93	31/3/93	7/1/94	29/1/94	30/1/94	31/1/94	28/2/94	10/4/95	14/4/95
CRPC01	█		CRPC17	█								█
CRPC02	█		CRPC18	█								
CRPC03	█		CRPC19	█						█		
CRPC04	█	█	CRPC20	█						█		
CRPC05	█		CRPC21	█	█					█		
CRPC06	█		CRPC22	█						█		
CRPC07	█		CRPC23	█						█		
CRPC08	█		CRPC24	█						█		
CRPC09	█		CRPC25	█						█		
CRPC10	█		CRPC26	█						█		
CRPC11	█	█	CRPC27	█						█		
CRPC12	█		CRPC28	█						█		
CRPC13	█		CRPC29	█						█		
CRPC14	█		CRPC30		█					█		
CRPC15	█		CRPC31		█					█		
CRPC16	█		CRPC60							█		
			CRPC61							█		
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			CRPC32			█				█		
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			CRPC57			█				█		
			CRPC58			█				█		
			CRPC59			█				█		

?= questionable ID

Five behavioral states were defined. They were interpreted as follows: (1) travel, (2) foraging, (3) directional feeding at the surface, (4) directional feeding at depth, and (5) non-directional feeding (Table 3). Traveling whales moved in the same direction in relatively tight groups that dived synchronously. During foraging, there were larger distances between subgroups, and asynchronous dives, leaps, and number of associated seabirds increased in frequency. Feeding bouts were identified based on the presence of either fish at the surface or feeding seabirds near the whales. Directional feeding at the surface was characterized by high-speed activity, leaps, and absence of dives. During directional feeding at depth, whales remained in one place, or slowly headed in one direction, while diving in large subgroups. Finally, non-directional feeding included back and forth movement of individuals heading in different directions and diving asynchronously. False killer whales were observed feeding on fish, unidentified in the field, in both study areas.

The whales were observed for 6 h 24 min at Isla del Coco and 5 h 48 min in Golfo Dulce. Whales in both study areas generally swam parallel to shore and did not enter small bays. At Isla del Coco they moved in tighter, abreast formations and with more individuals per subgroup than in Golfo Dulce. In addition, whales at the island dived more frequently and leaped less often than their counterparts in the Gulf. Eleven of the 12 groups observed at Isla del Coco were found in waters deeper than 46 m and more than 450 m from shore. In contrast, groups in Golfo Dulce were observed in waters as shallow as 9 m and as close as 10 m to shore.

Photoidentification promises to be a valuable technique to study false killer whale social structure. Natural markings were evident on nearly all the well-photographed whales, and they remained easily recognizable for at least two years. Preliminary association patterns (Table 2) suggest that individuals visiting Isla del Coco could be classified into as few as two groups. Resighting data support the idea that certain whales maintained stable associations over the two-year study period. In this respect, false killer whale groups appeared more similar to the relatively stable groups found in short-finned pilot whales, *Globicephala macrorhynchus* (Shane and McSweeney 1990), than to the highly cohesive pod structure observed in killer whales, *Orcinus orca* (Bigg 1982, Bigg *et al.* 1990). However, a clear insight into the group composition of false killer whales must await increased sampling.

Most behavioral states appeared to be food-related. Thus, the presence of false killer whales in Golfo Dulce and at Isla del Coco may be regarded as the visit of foraging groups. Differences in the three feeding-related behavioral states were presumably related to location of prey in the water column. Overall, the whales traveled in tight subgroups, while foraging and feeding took place in scattered, smaller associations. This pattern is similar to the one described for small dolphins (Norris and Dohl 1980), long-finned pilot whales (*Globicephala melas*, Brown and Norris 1956; Norris and Prescott 1961), and killer whales (Jacobsen 1986).

No other cetaceans were observed during most false killer whale sightings in either study area. However, at Isla del Coco, 5 whales were observed chasing

Table 3. Behavioral states of false killer whales.

Behavioral state	Obs. time (min)	No. of bouts	Distance between ind/sg (m)	Orientation	Ind. per sg.	Speed	Diving	Formation	Leaps	No. assoc. seabirds (per min)
Travel	124	16 IC = 16 GD = 0	5-50	Yes	4.9	Medium	Yes—Synchronous	Abreast	No	0.5
Foraging	173	19 IC = 13 GD = 6	100	Yes	2.9	Medium	Yes—Asynchronous	Abreast	Yes	7.4
Directional feeding at depth	28	9 IC = 9 GD = 0	50-75	Yes	4.0	Stationary/ Slow	Yes—Asynchronous	Abreast/ Other	No	18.9
Directional feeding at surface	171	16 IC = 12 GD = 4	75-100	Yes	2.7	Fast	No	Abreast	Yes	3.1
Non-directional feeding	46	10 IC = 8 GD = 2	25-100	No	3.4	Slow/Medium/ Fast	Yes—Asynchronous	Other	No	9.7

Notes: Description of behavioral categories are found in Table 1.

a large (*ca.* 300 individuals) group of bottlenose dolphins (*Tursiops truncatus*), a species that is regularly seen at the island (Acevedo-Gutiérrez, in press). False killer whales are considered opportunistic feeders that consume diverse prey (Stacey and Baird 1991), including small dolphins (Perryman and Foster 1980); yet bottlenose dolphins have not been considered one of their prey items. The whales were undoubtedly chasing the dolphins, which interrupted feeding to flee and scatter as described for other dolphins while being pursued by false killer whales (Perryman and Foster 1980); however, the short duration of our observation does not allow any conclusion about predation. Although the two species have been observed previously in mixed-species groups and interacting in a non-aggressive or cooperative manner (Scott and Chivers 1990; Palacios and Mate, in press), we interpret our observation as of an aggressive encounter.

False killer whales were occasional visitors to both Golfo Dulce and Isla del Coco; however, they were more frequent in the latter location. These findings are consistent with the prevalent view that the false killer whale is an oceanic species with occasional incursions into nearshore waters (Stacey and Baird 1991; Odell and Miller, in press). However, several questions arise from the results herein reported: Do individual false killer whales travel between Golfo Dulce and Isla del Coco? Are there indeed differences in the behavior of groups between the study areas? Are interspecific interactions with other cetacean species of a variable nature? How do individual association patterns vary with time? Further data from photoidentification and behavioral studies will help to answer these questions.

ACKNOWLEDGMENTS

Funding was provided by the Marine Mammal Research Program, Texas A&M University at Galveston, and the Whale Conservation Institute in Lincoln, MA; in Golfo Dulce: Earthwatch-Center for Field Research; at Isla del Coco: Parque Nacional Isla del Coco and The Netherlands Embassy in Costa Rica. AA was supported by fellowships from Texas A&M University, International Women's Fishing Association, and Houston Underwater Society. Logistic support was provided in Golfo Dulce by the Golfito Research Station of the Universidad de Costa Rica and at Isla del Coco by Parque Nacional Isla del Coco, Okeanos Aggressor, and Undersea Hunter. The Servicio de Parques Nacionales, Costa Rica, issued permits #01-91 and #08-95 to work at the island. For assistance during sightings we thank Y. Camacho, K. Dudzik, L. Gonzalez, K. Lebo, E. Lundin, and the R/V *Odyssey* crew: I. Kerr, K. Anthon, I. Kenneil, J. Lane, H. Peckham, C. Rogers, B. Spellman, R. Stumpft and V. Weisse. D. Odell and K. Miller kindly made their "in press" paper available to us. Constructive criticism was provided by D. Fertl, J. R. Heimlich-Boran, D. Weller, B. Würsig, and one anonymous reviewer. This is contribution No. 51 of the Marine Mammal Research Program, Texas A&M University at Galveston.

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