Underwater behaviors of short-finned pilot whales (*Globicephala macrorhynchus*) off Tenerife

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Non-acoustic communication behavior is widely spread among social delphinid species (Dudzinski 1996; Pryor 1990; Würsig *et al*. 1990). Such communication signals are expressed via physical or visual contact behavior (Dudzinski 1998), whereas body features themselves can have a signal function (Madsen & Herman 1980; MacLeod 1998). Species-typical behavior patterns that form the basic behavioral repertoire of a given species can be generally described and catalogued in an ethogram (Lehner 1987). Basic ethograms are required in order to pursue further behavioral analysis.

Short-finned pilot whales (*Globicephala macrorhynchus*) off Tenerife have been described to form social units (Heimlich-Boran 1993) and this species is generally believed to form matrilineal kinship groups (Kasuya & Marsh 1984). The non-acoustic behavior of short-finned pilot whales has been described by other authors almost completely based upon surface observations of behavioral activities, behavioral units and anecdotal behavioral sequences (a mixture of behavioral activities and units) (Shane 1995a, 1995c; Ritter 1996; Weller *et al*. 1996; Scheer *et al*. 1998; Scheer 1999; Migura & Meadows 2002). Behavioral observations of this species from underwater are limited to reports by Shane *et al*. (1993) and Shane (1995b), both describing an aggressive interspecific interaction between a short-finned pilot whale and a human swimmer off Hawaii. Shane (1994) further reports free-ranging short-finned pilot whales carrying dead sea lions (*Zalophus californianus*) from the under water perspective. Short-finned pilot whales off Tenerife are likely to use non-acoustic communicative behaviors within their group and presumably during meetings of different groups of

the same population. An ethogram describing underwater behaviors of free-ranging short-finned pilot whales is still missing. Our study describes underwater behaviors of this larger delphinid species. Preliminary behavioral underwater observations were made in February-March 1994 off the southwest coast of Tenerife, Canary Islands. Underwater behavioral observations of the present study were made August-September 1996 using the 6m, fiberglass-bottomed m/v *Caldéron* as a research platform. Short-finned pilot whales were encountered between 27°58'36" to 28°01'56"N and 16°42'21" to 16°50'50"W. An encounter is defined as a swim with one or more pilot whale/s in visual range underwater for 3 min or more (Dudzinski 1996, 1998). We entered the water only in situations when no other boats were in sight, and pilot whales showed synchronized, relatively stationary behavioral activities which were omnidirectional, resting, travel/resting or socializing (see Scheer *et al.* 1998 for definitions). We used masks, snorkels and fins during encounters. Behavioral observations were made using *ad libitum* and focal sampling methods (Altmann 1974; Martin & Bateson 1993). Pilot whale behaviors were described with respect to behavioral units (Dudzinski 1996, 1998). Each encounter was handled independently, though several encounters might occur during one observation day. We documented the encounter duration as well as the number of observers in the water (always consisting of one or more of the authors). During 14 encounters, two observers documented underwater behaviors simultaneously, during eight encounters three observers, and for two encounters only one. Observations were spoken into minicassette recorders immediately after each encounter. Each observer described behaviors he/she saw in his/her own words. Observers compared their behavioral descriptions and looked for matches. Only in cases of corresponding behavioral descriptions of certain behaviors among observers was that specific behavior categorized. Due to the absence of a systematic video-based documentation during all encounters, we counted during how many different encounters a distinct behavior was witnessed, regardless of the number of times it may have occurred in a particular encounter. Only during a limited number of encounters were we able to document behaviors using an underwater video and photo camera (Sony CCD V700E Hi8 video and Canon EOS 5 photo camera with a 1.8/50 mm lense, both in underwater housings). Over 27 days, we spent a total of 108 h and 46 min at sea (range 2 h - 6 h 20 min). Data were collected during a total of 24 underwater encounters with short-finned pilot whales, with a total duration of 5 h 04 min. Encounters lasted 3 - 42 min (mean 12.6 min). Fourteen of 24 encounters lasted less than 10 min. During these relatively short encounters, pilot whales immediately changed their behavior by increasing their swimming speed or changing swim directions in response to swimmers, thus preventing further observations. These behaviors were interpreted as avoidance. During 11 of 24 encounters we observed and documented behaviors as described in Table 1. During the other 13 encounters, behaviors as described in Table 1 could not be observed though observers had visual contact. During the latter encounters, pilot whales were synchronously resting or slowly travelling in a consistent direction but did not show behavioral units. In total, we categorized 17 intraspecific behavioral units (Table 1). Body contact occurred during 9 encounters ($n = 9$). The occurrences of the remaining 16 behaviors were as follows: nursing and defecation (both $n = 5$); bubble displays and spyhop (both $n = 3$); belly up, open mouth, penis erection and encircling (each $n = 2$); and finally belly aside, horizontal roll, vertical roll, tailslap, object dragging, belly-to-belly, mouth-to-mouth and rough housing (each $n = 1$). During situations in which individuals of a pilot whale group were socializing, it often occurred that behaviors as e.g. body contact, bubble displays or belly up were repeated more than once during a single encounter. Due to the absence of video-based documentation, we were not reliably able to determine the precise occurrence of behaviors during a single encounter and excluded this aspect from analysis. We were able to film and/or photograph 14 of 17 behaviors (except horizontal roll, vertical roll and mouth-to-mouth, see Table 1). Though many pilot whales

TABLE 1. — Descriptions of intraspecific behaviors among short-finned pilot whales observed from underwater. **#**, reflects the number of encounters in which the behavioral unit was witnessed, regardless of the number of times it may have occurred in a particular encounter.

Behavior	#	Description
Belly up	2	*Pilot whale turns its ventral side to the water surface. Often the belly is fully exposed out of the water*
Belly aside	1	*Pilot whale swims on its left or right side and one flipper is vertically directed towards the water surface. In some cases, half of the body inclusive of one flipper is exposed above the water surface*
Horizontal roll	1	*A complete roll along the vertical axis and parallel to the water surface*
Vertical roll	1	*A complete roll along the ventral axis and vertical to the water surface*
Bubble displays	3	*Pilot whale emits bubbles from the blowhole underwater. These can be single ones, a whole cloud or bubble trains*
Spyhop	3	*Pilot whale vertically lifts its head out of the water so that the eyes are completely in air, with a vertical re-entry*
Tailslap	1	*A slap with the ventral part of the tail or tailstock on the water surface. This behavior can be repetitive with short temporal intervals between slaps*
Open mouth	2	*The mouth is widely opened. Depending on the viewing angle teeth can be seen*
Penis erection	2	*A pilot whale has an erection*
Object dragging	1	*Objects (e.g. plant pieces, plastic debris) are being moved through the water by the mouth, pectoral fin, head or fluke. In some cases, several pilot whales handle the same object in row*
Defecation	5	*Pilot whale discharges faeces*
Encircling	2	*One pilot whale swims circles around another in a small radius and at relatively high speed.*
Belly-to-belly	1	*Two pilot whales are swimming belly-to-belly without touching each other.*
Body contact	9	*Physical contact between two or more pilot whales by several means, e.g. pectoral fin touches or rubbing body parts*
Mouth-to-mouth	1	*Two or more pilot whales position their rostrums towards each other. Sometimes with touching*
Nursing	5	*An infant touches with its rostrum the genital area of an adult female pilot whale (not implying milk transfer)*
Rough housing	1	*An adult pilot whale is striking a calf (head-to-head or the adult pilot whale strikes into the side of the calf). The function seems to be discipline*

had scars suggesting tooth-raking, we never observed this behavior directly. It remains unclear whether these scars result from intra- or intergroup interactions.

We showed that short-finned pilot whales produced a variety of non-acoustic underwater behaviors occurring during interactions with other pilot whale individuals. It might be possible that pilot whale social groupings have selective pressures to develop and use such behaviors. For future studies this initial ethogram can be developed into a search for communicative functionalities of behaviors relative to identity, sex and age.

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