Ethogram of selected behaviors initiated by free-ranging short-finned pilot whales (*Globicephala macrorhynchus*) and directed to human swimmers during open water encounters

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Abstract

In order to establish an ethogram of interactive behaviors initiated by free-ranging short-finned pilot whales (Globicephala macrorhynchus) and directed to human swimmers, we initiated encounters with non-habituated pilot whale groups during open water encounters southwest of Tenerife, Canary Islands, over two field seasons (1996 and 2001). Human swimmers followed a precautionary set of rules during approaches. Encounters ranged in duration from 3 to 44 min (M = 14.1 min ± SD = 7.6; n = 35). We describe 11 interactive behaviors and compare them with previously described interactive behaviors reported in the scientific literature on the same and other toothed whale species. In contrast to other researchers focusing on reports of aggressive behaviors initiated by free-ranging as well as captive short-finned pilot whales, we observed with one exception ("headshake") apparently affiliative and non-aggressive behaviors during this study. Several interactive behaviors were found to match descriptions from other researchers observing the same as well as other toothed whale species. During this study, swimmers behaved carefully and the number of swimmers was low. We strongly recommend to follow the code of conduct based upon the methodology described in the paper, e.g., low numbers of swimmers and no contact initiations by swimmers during human–pilot whale interactions, in order to reduce the likelihood of potentially dangerous aggressive interactions.

Keywords: *ethogram, Globicephala macrorhynchus, human–dolphin interactions, short-finned pilot whales, whale-watching*

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Encounters of humans with living cetaceans have quantitatively increased worldwide, mainly in the context of commercial whale watching activities (Hoyt 1995, 2001). In addition to observations of free-ranging cetaceans from land, air or boat, for many humans it has become a life's dream to encounter a whale or dolphin directly in the water. Swim programs with free-ranging toothed whale groups (Frohoff and Packard 1995; Dudzinski 1996; Frohoff 1996; Constantine and Baker 1997; Samuels and Bejder 1998; Bejder, Dawson and Harraway 1999; Colborn 1999; Forest 1999; Stone and Yoshinaga 2000; Constantine 2001), solitary odontocetes (Bloom 1991; St John 1991; Dudzinski, Frohoff and Crane 1995; Santos 1997; Müller et al. 1998a; Frohoff et al. 2000; Santos 2000; for a review see also Lockyer 1990; pers. obs.), and captive delphinids (Frohoff and Packard 1995; Samuels and Spradlin 1995; Brensing, Linke and Todt 2003; Kyngdon, Minot and Stafford 2003) have been described. Some researchers have opportunistically described single or a small set of interactive behaviors occurring during encounters between human swimmers and divers and cetaceans (Johnson and Norris 1994; Frohoff and Packard 1995; Ritter 1996; Constantine and Baker 1997; Dudzinski 1998; Müller et al. 1998b; Ritter 1999; Stone and Yoshinaga 2000; Brensing, Linke and Todt 2003). For short-finned pilot whales (*Globicephala macrorhynchus*), Shane, Tepley and Costello (1993) and Carwardine (1994) both described a set of in-water interactions with humans off Hawaii and Tenerife, respectively, where each description resulted from a single open water encounter. Defran and Pryor (1980) gave a note on interactions with captive short-finned pilot whales.

Species-typical behavior patterns that form the basic behavioral repertoire of a given species can be described and catalogued in an ethogram (Lehner 1987). Basic ethograms are required in order to pursue further behavioral analysis. With the exception of some delphinid species (killer whales: Martinez and Klinghammer 1978; Atlantic spotted and bottlenose dolphins: Weaver, 1987; Dudzinski 1996; Herzing 1996; Müller et al. 1998b; short-finned pilot whales: Hofmann, Scheer and Behr in press), cetacean ethograms are still unavailable. Furthermore, species-specific partial ethograms solely describing interactive behaviors inititiated by cetaceans and directed to human swimmers are generally missing. We initiated this study to establish one such partial ethogram for short-finned pilot whales.

Following the definitions of Samuels, Bejder and Heinrich (2000), short-finned pilot whales off Tenerife, Canary Islands, are not habituated to encounters with human swimmers. Only infrequent in-water interactions have occurred in the past (Heimlich-Boran et al. 1994; pers. obs). Samuels, Bejder and Heinrich (2000) argue that research on swimming with unhab-

ituated cetaceans provides a first step to understand the short-term impacts on the animals. The authors recommended the following necessary further research steps: a) a focus on details of these interactions and reponses to swimmers, and b) collection of baseline data before initiation of new swim programs (see also the report by IFAW, Tetleys Research Institute and Europe Conservation 1995). Such studies have yet to be conducted.

Methods

Behavioral observations were made in August to September 1996 and June to July 2001. In 1996 we used the 6m m/v *Caldéron* with a fiberglass bottom as a research platform. In 2001 we used the fiberglass-bottomed, 10m s/v *Delfin* with an auxiliary diesel engine. During both field seasons, short-finned pilot whales were observed and encountered around 27°58‘36“ to 28°01‘56“N and 16°42‘21“ to 16°50‘50“W in deep waters (>500m to ca. 1.500m).

Only in situations when no other boats were in sight, and the pilot whales showed synchronized, relatively stationary behavioral activities such as milling, resting, travel/resting or socializing (for definitions, see Scheer 1999), did one to three of the authors enter the water. Encounters were only inititated during calmer sea states. An encounter is defined as a swim with one or more pilot whale/s in visual range underwater (<20 m) for 3 min or more (Dudzinski 1996, 1998). Behavioral observations underwater were made using the *ad libitum* method (Martin and Bateson 1993; Mann 1999). Interactive behaviors towards human swimmers were defined as behaviors initiated by a pilot whale and directed towards a swimmer within a human swimmer body length (~ 2 m) to 20 m range. We used masks, snorkels and fins during encounters; scuba gear was not used as bubbles released from it might have resulted in irritation and/or avoidance—some toothed whales have been shown to use bubble displays for communication (Pryor 1990; Marten et al. 1996; pers. obs.) and foraging (Fertl and Wilson 1997). Furthermore, bubbles might influence echolocation capabilities, possibly provoking irritation and/or avoidance behavior.

We established a set of precautionary rules during encounters and interactions with pilot whales. First of all, swimmers (which were always one to three of the authors) had to enter the water slowly with as little noise as possible. When pilot whales were within visual contact, swimmers had to stop any forward swimming movement and observe the first immediate reaction. When pilot whales departed from an area, this was interpreted as avoidance, and when pilot whales did not reapproach the swimmer/s of their own accord, we finished the approach and re-entered the boat. When pilot whales tolerated swimmers and stayed within visual contact, the

observer/s decreased their distances to a minimum of one human body length while holding arms close to the body. Touching or any effort to make direct contact was avoided. When pilot whales initiated close approaches (≤ one body length), the observer/s remained passive initially, and during the course of the encounter closely swam with certain group individuals at close distances (≥ one body length). The encounter was finished when a) the whales left the swimmers by increasing their swimming velocity or changing direction in order to avoid the swimmers, b) the swimmers were not able to keep up, c) the swimmers had to leave the water in order to rest, or d) any of the swimmers had the impression the group was being harassed by approaching or passing vessels and/or further vessels maneuvering in close proximity to the observed group (<100 m) (from personal observations we found that group individuals appeared to be stressed during these contexts: they breathed less often, stayed close together as well as underwater, and seemed to avoid swimmer encounters) after encounters had been already initiated.

The encounter duration was measured from the time a swimmer left the boat and entered the water to the time when swimmers left the water and re-entered the boat. At the beginning and at the end of each encounter there was almost no visual contact between the swimmer/s and the pilot whale/s. The time from when swimmers entered the water to when the swimmers established visual contact was generally less than one minute. Swimmers took less than two minutes to leave the water and enter the boat once the decision was made to end an encounter. During encounters, the skipper maneuvered the boat (by sailing and without further motor use) close to the encounter group (< 50 m) in order to keep distances to swimmers at a minimum. The time swimmers needed to snorkel to and from the focal encounter group (without visual underwater contact with one or more pilot whale/s) was subtracted from each encounter duration.

Behaviors were photo-documented using a Canon EOS 5 analogue SLR camera with a Canon EF 50mm/1.8 lens, both in UK underwater housing. During several encounters, a professional cameraman video-documented encounters and interactive behaviors using a Sony VX1000 mini-DV video camera with an Amphibico underwater housing. Due to the absence of a permanent video-based documentation, we counted the number of encounters during which a distinct behavior was witnessed, regardless of the number of times it may have occurred in a particular encounter. Observations were recorded using mini-cassette recorders directly after a swimmer left the water.

Results

During 27 days at sea in 1996, we spent a total of 108 h and 46 min (range: 2 h to 6 h 20 min). During 10 days at sea in 2001, we spent a total of 53 h 19 min (range: 3 h 10 min to 6 h 53 min). Thus, the overall effort was 37 days at sea, totaling 162 h 5 min. We encountered short-finned pilot whales for a total of 8 h 15 min during 35 encounters. Encounters showed a mean duration of 14.1 min ($SD \pm 7.6$) and a range of 3 to 44 min.

During encounters, we observed 11 different interactive behaviors that short-finned pilot whales initiated and directed to human swimmers (Table 1 and Figure 1). With the exception of the behaviors "belly aside" and "escorting," behaviors were (sometimes partially) photographed and/or video-documented. We never observed aggressive behaviors directed towards any swimmer, although we observed pilot whales adressing aggressive behaviors within the presence of, and toward, other pilot whales: slaps, body slamming, headbutting, rough housing, open mouth and biting. The only behavior which might be a potentially aggressive behavior is "headshake," which could be interpreted as a potential threat display towards swimmers (as observed for Atlantic and bottlenose dolphins during interspecific agonistic/aggressive interactions: Herzing 1996). Though pilot whales sometimes approached swimmers at a relatively high speed, these fast approaches seemed to be affiliative or neutral and were not followed by any aggressive or avoidance behavior.

The frequency of occurrences of behaviors was as follows: "speed adaptation" (occurring during 16 encounters; $n = 16$), "direction adaptation" ($n = 14$), "frontal approach" ($n = 13$), "belly up approach" ($n = 9$), "closed eye" ($n = 8$), "encircling" ($n = 8$), "belly aside" ($n = 7$), "escorting" ($n = 4$), "belly up" ($n = 3$), "headshake" ($n = 2$), and "sink down scan" ($n = 1$). There were some behaviors which occurred regularly at the beginning of an encounter; these were "direction adaptation" and "speed adaptation." They were often followed by closer approach behaviors such as "belly up approach," "encircling" and "frontal approach," whereas "belly aside," "belly up" and "headshake" occurred later during longer encounters. After the behavior "sink down scan," the whale returned to its original swimming track. "Closed eye" can be observed during relatively calm interactions without further close approaches: the whale group is temporarily stationary or slowly traveling along its projected track. "Escorting" always occurred at the end of the encounter when a swimmer left the water.

Table 1. Descriptions of behaviors initiated by short-finned pilot whales during open-water encounters and directed to human swimmers.

Behavior	Description
Sink down scan	A pilot whale is positioned vertical to the water surface. The distance to the water surface is <2 m. The ventral side of the body is orientated towards the swimmer. The pilot whale establishes eye contact with both eyes and simultaneously is emitting echolocation clicks, sometimes bubbles from the blowhole. The pilot whale slowly sinks downwards during this sequence, with a constant distance to the swimmer of more than two swimmer body lengths and up to 20 m.
Belly up	A pilot whale is positioned beneath a swimmer and horizontal to the water surface. Swimmer and whale show little or no movement. The ventral side of the body is directed upward enabling eye contact with both eyes. The distance to the swimmer is less than two swimmer body lengths and remains constant. We observed no vocalization.
Belly up approach	A pilot whale frontally approaches a swimmer from a distant position (5–20 m) with a horizontal and dorsal orientation to the water surface. While reaching a close proximity to the swimmer (less than two swimmer body lengths), the whale turns belly up and emits clicks towards him. The whale glides along the whole body axis of the swimmer (distance to the swimmer is ≤ one body length) who is lying motionless at the water surface. While in the ventral position towards the swimmer, the whale has stereoscopic eye contact with him.
Belly aside	A pilot whale is lying with little or no movement next to the human swimmer at the water surface with the belly positioned sideward towards the swimmer. The distance to the swimmer is one body length. Flipper and one eye of the left or right body axis are above the water surface. We observed no vocalization.
Closed eye	A swimmer closely approaches a pilot whale which is positioned motionless at or horizontally to the water surface. The whale has a closed eye on the side of the body orientated toward the swimmer. Swimmer can closely approach and stay (less than one swimmer body length) without provoking avoidance. No vocalization.
Direction adaptation	One or more pilot whale/s change their projected swimming track (at the surface, horizontal to the surface) and adapt it towards swimmer/s. The whale or whale group keep a distance of >5–20 m. Sometimes individuals emit bubbles, echolocation clicks, calls or pulsed sounds.
Encircling	A pilot whale approaches a swimmer from a distance (5–20 m) and then swims around him in circles several times. The radius is small (< two swimmer body lengths). The whale is positioned at the water surface during ist circle track, has eye contact with the swimmer and sometimes emits bubbles, call and other pulsed vocalizations.
Escorting	Swimmer leaves the pilot whale group e.g. to approach the vessel in order to leave the water. One or more individual/s follow/s the swimmer on his track. Sometimes whales emit clicks and have eye contact with the swimmer. Whales closely appoach the research vessel (>one swimmer body lengths). *continued…*

Table 1. *...continued*

Frontal approach	A pilot whale frontally approaches a swimmer parallel to the water surface with the whale only a few centimeters submerged with the melon directed towards the swimmer. The swimmer is floating at the water surface. Often the whale emits clicks at high repetition rates and turns to the left or right while entering a one body length proximity to the swimmer. After changing their track to the left or right, whales have eye contact with the swimmer and emit bubbles and call vocalizations.
Headshake	A pilot whale, positioned stationary and parallel to the water surface, rhythmically shakes its head and adjacent body part from the left to the right while positioned with the melon in front of a swimmer (less than two swimmer body lengths). The whale emits bubbles and call/pulsed vocalizations and has eye contact.
Speed adaptation	Swimmer/s match/es the pilot whale's swimming velocity. The group continues its synchronous travelling behavior and does not change their projected swimming track. The whale group stays at or close to the water surface and shows slow swimming speed. Swimmers can approach to a distance of one swimmer body length.

Figure 1. Illustrations of behaviors initiated by short-finned pilot whales during open water encounters and directed to human swimmers. For further descriptions of the illustrated behaviors, see Table 1.

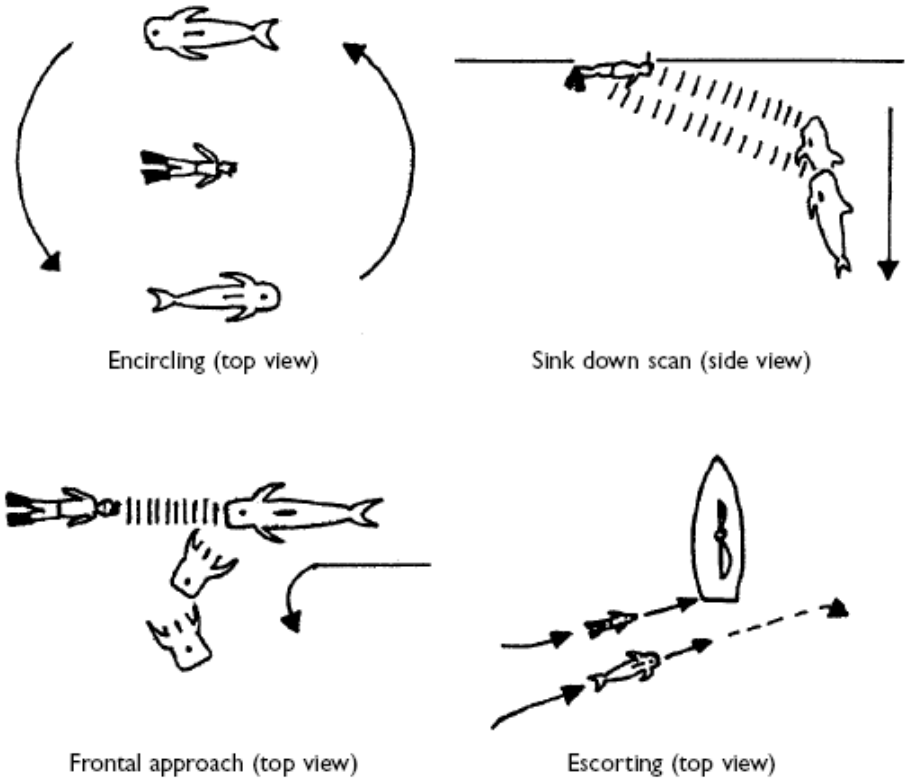
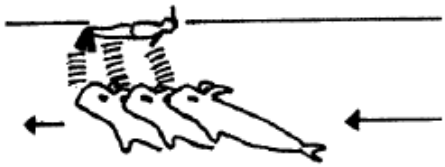


Figure 1. continued

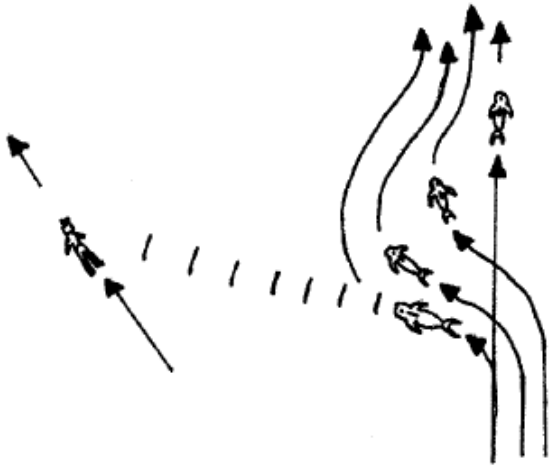


Belly up approach (side view)

Headshake (top view)

Belly up (side view)

Belly aside (top view)



Direction adaptation (top view)

Discussion and Conclusions

We found that short-finned pilot whales demonstrate a variety of interactive behaviors directed towards swimmers or within close proximity to them. We can not confirm a behavior described by Carwardine (1994), who reported that a free-ranging short-finned pilot whale "jaw-clapped" towards the author swimming in the waters off Tenerife. We have never observed this behavior during our encounters. A report by Shane, Tepley and Costello (1993), describing a human–pilot whale encounter, focused on aggressive interaction between a lone swimmer and a single whale (though other pilot whale group members were within visual sight). The comparative value of this report is restricted because it did not aim to describe interactive behaviors in genera, but focused on the description of aggressive interaction. Nevertheless, Shane, Tepley and Costello (1993) reported several behavioral sequences for Hawaiian short-finned pilot whales matching our "speed adaptation" and "direction adaptation." The authors further described: "... Notch sink vertically ...," a behavior which might match our "sink down scan," though it remains unclear whether "Notch" positioned his ventral body side towards the human swimmer (enabling a stereoscopic view) and whether the whale was echolocating at her simultaneously. Shane, Tepley and Costello (1993) continued to describe, "The next scene shows Notch continuing to swim up and toward Costello at a rapid pace." This behavior could match our "frontal approach" (see also Figure 1, p. 333), though the authors do not mention whether "Notch" was echolocating towards the swimmer. Shane, Tepley and Costello (1993) further reported that the whale established eye contact and emitted bubbles, which also occurred during several of our behaviors. We can not confirm any of the aggressive and life-threatening behaviors described by Shane, Tepley and Costello (1993) (e.g., "... he [the whale] opens his mouth and grabs her [the human swimmer's] inner left thigh," as well as "...and Costello is struggling in Notch's mouth"). We never observed aggressive behaviors directed towards any swimmer (except "head-shake" which might be a threat display), although we observed pilot whales adressing aggressive behaviors towards other pilot whales, and these are the same as, or similar to, aggressive behaviors reported by other researchers on other cetacean species (bottlenose dolphins: Shane 1990; Atlantic spotted dolphins: Herzing 1996, Dudzinski 1998). Shane (1995) argued that the aggressive behaviors observed in pilot whales off Hawaii were provoked by the human swimmer who stopped petting the whale: the whale responded with aggressive interactions. Mann and Smuts (1999) reported that human interactions with dolphins at Monkey Mia included touching. These dolphins

were also observed to aggressively hit people (with their flipper, tail or jaw) and to threaten them. It might be a tendency that free-ranging dolphins being touched sometimes reply with hits or other aggressive behaviors towards people. The absence of aggressive behaviors in our study could be explained by the absence of any kind of touching or touching attempts by the swimmers. Thus, we strongly recommend that interacting swimmers should avoid initiating contacts with pilot whales. Finally, with captive short-finned pilot whales, one study reported, "Other characteristics of pilot whale behavior included [...] progressively more violent attacks on humans entering the tank." These interactions, described by Defran and Pryor (1980) occurring in an artificial setting, are not explained in detail; thus, a comparison with our observations as well as those made by Shane, Tepley and Costello (1993) is not possible. Nevertheless, these observations emphasize the potential danger which could arise from encounters with this species. During the current study, swimmers behaved carefully and swimmer number was low. We do not know how pilot whales might react when swimmers behave less carefully and/or when far more people are in the water.

Behaviors initiated by free-ranging dolphins and directed towards human swimmers have been opportunistically reported by other authors, and some behavioral descriptions from this study match descriptions from these. Except for the reports mentioned above, all further studies deal with other odontocete species. Several behaviors described by other researchers match our "direction adaptation" and "speed adaptation" (several species: Ritter 1996, Ritter and Brederlau (1999); bottlenose dolphins: Frohoff and Packard 1995; bottlenose and common dolphins: Constantine and Baker 1997; Hector's dolphins: Stone and Yoshinaga 2000; captive bottlenose dolphins: Brensing, Linke and Todt 2003). Our "encircling" behavior has been reported in three other studies (several species: Ritter 1996; spinner dolphins: Johnson and Norris 1994; Atlantic spotted dolphins: Dudzinski 1998; captive bottlenose dolphins: Brensing, Linke and Todt 2003). Several authors reported approach behaviors (Atlantic spotted dolphins: Dudzinski 1998; Hector's dolphins: Stone and Yoshinaga 2000; several species: Ritter 1996, Ritter and Brederlau 1999; bottlenose and common dolphins: Constantine and Baker 1997; captive bottlenose dolphins: Brensing, Linke and Todt 2003), but it remains unclear whether these behaviors match our "frontal approach" or "belly up approach."

Generally, it seems that certain interactive behaviors initiated by toothed whales towards swimmers are similar to those reported in other species and at other geographic locations. This apparantly corresponds with similarities in toothed whale morphology and primary sensory modes. It is

generally accepted that among toothed whale species vision and echolocation are both used for close- and long-range orientation. Morphological location of sound production and perception mechanisms as well as the placement of the eyes are relatively similar across toothed whale species. Explorative and interactive behaviors using these senses during approaches by human swimmers would thus appear similar across species.

In an area just a few miles further northwest, off La Gomera, for the same species Ritter (1996) reports a mean encounter duration of 4.26 min ($n = 29$), with a range of 1 to 14 min. During our study, short-finned pilot whales showed a mean encounter duration of 14.1 min with a range of 3 to 44 min ($n = 35$). With respect to other cetacean species off La Gomera, Ritter (1996, 2002) and Ritter and Brederlau (1999) reported encounter durations were about 10 min or less (bottlenose dolphins: 1 to 7 min [M = 3.4 min]; rough-toothed dolphins: 1 to 12 min [M = 3.63 min]; Atlantic spotted dolphins: 1 to 6 min [$M = 3.64$ min]; Blainville beaked whales: 1 to 11 min [$M = 4.44$ min]; sei whales: 3 min [$M = 3$ min]). These differences might result from a) differences in criteria for establishing encounters (we only initiated encounters during selective behavioral contexts) resulting in a higher "success rate" during this study, b) behavior of human swimmers within visual contact (our code of conduct might decrease avoidance reactions), c) the number of swimmers in the water (with a maximum of three swimmers during our study), and d) differences in sampling methodology with regard to measurements of encounter durations (detailed descriptions of determining encounter durations are absent for the cited reports). Frohoff (1996) described mean encounter durations of 14 min with Atlantic spotted dolphin adult female/juvenile groups and 15.66 min with mixed groups of the same species, both off the Bahamas. The data from Frohoff (1996) with habituated dolphins nearly match our data, although these short-finned pilot whales were not habituated to human swimmers. There is also data on encounter durations from a study on a solitary bottlenose dolphin (Dudzinski, Frohoff and Crane 1995) reporting ranges of 25 to 90 min. However, we think that data resulting from encounters with solitary dolphins are not comparable with data from non-habituated individuals or groups. Solitary dolphins are mostly habituated to human swimmers, are in some cases fed by humans, and often establish social bounds with certain human individuals, sometimes for many years. Human contact seems to represent a social network for solitary dolphins, while free-ranging short-finned pilot whales presumably have their own social network (Kasuya and Marsh 1984; Heimlich-Boran 1993).

This partial ethogram is the first of its kind. We describe interactive behaviors initiated by short-finned pilot whales and directed to human swimmers. The descriptions can be used for detailed behavioral analysis of human–short-finned pilot whale in-water encounters oceanwide, also in the context of whale watching management as stated by Samuels, Bejder and Heinrich (2000) and IFAW, Tethys Research Institute and Europe Conservation (1995). Furthermore, our behavioral descriptions enable comparisons with ethograms on other captive and free-ranging cetacean species being encountered by human swimmers.

Acknowledgements

This field study was authorized by the Canary Islands government. The Viceconsejería de Medio Ambiente and GESPLAN S.A. kindly provided the m/v *Caldéron* as a research platform in 1996. We thank Tomás de Azcárate y Bang, Erika Urquiola Pascal, Juan Luis Rodriguez Luengo and Rogelio Herrera for administrative and logistic support. Manuel Louro Agraso, Juan Ramon Padilla Sanz, Carlos Goméz, Emilio Sanchez Amador and Pedro Diaz Lorenzo were excellent skippers and of further assistance many times. Thanks to the German NGO Projekt CONTEXT for providing financial and logistical support for the 1996 field study. We want to thank Trevor Spradlin (NOAA/NMFS, Office of Protected Ressources) and Dr. Amy Samuels (Woods Hole Oceonographic Institution) for giving constructive comments on early manuscripts of this publication, and two anonymous reviewers gave valuable comments to improve the quality of this publication.

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