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# Review of self-initiated behaviors of free-ranging cetaceans directed towards human swimmers and waders during open water encounters

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Open water encounters of swimming and wading humans with wild cetaceans have increased worldwide. Behaviors being self-initiated by cetaceans during encounters and addressed towards humans still have received little study and their structure and function mostly remain unclear. This study reviews the scientific literature describing such behaviors. Unhabituated, habituated, lone and sociable and food-provisioned cetaceans from 10 odontocete and one mysticete species were reported to show altogether 53 different behaviors which were affiliative (33 behaviors), aggressive/threatening (18) and sexual (2) in nature. Behaviors are listed in an ethogram. Due to varying research designs, observational biases cannot be excluded and comparability of results is sometimes hindered. Aggressive/threatening behaviors were reported mainly for food-provisioned and lone and sociable dolphins and these might be responses to inappropriate human behaviors. Sexual behaviors were only described for lone and sociable dolphins.

**Keywords:** human–dolphin interactions; ethogram; swim-with-dolphin programs; whale watching

## 1. Introduction

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-dream to encounter a whale or dolphin directly in its natural habitat and during swim encounters. Though there is a vast popular belief that cetaceans are friendly and peaceful animals, in the past free-ranging cetaceans were reported to aggressively interact with human swimmers and even injure or kill them (Santos, 1997; Shane, Tepley & Costello, 1993).

From the environmental management perspective, these encounters have to be investigated in order to reduce the likelihood of potentially dangerous aggressive interactions (IFAW, Tethys & Europe Conservation, 1995; Samuels, Bejder & Heinrich, 2000).

Next to swim programs during which human swimmers encounter captive and trained dolphins in restrained enclosures (Brensing, 2003; Kyngdon, Minot & Stafford, 2003; Samuels & Spradlin, 1995; Trone, Kuczaj & Solangi, 2005), swim-with-dolphin programs in open waters enable human swimmers and divers to encounter free-ranging cetacean individuals or groups. At least 20 unhabituated, habituated, lone and sociable as well as food-provisioned (including semi-provisioned) cetacean species were reported to be encountered by human swimmers on a regular basis (Samuels, Bejder & Heinrich, 2000; Samuels, Bejder, Constantine & Heinrich, 2003). In shallow waters, human waders interact with food-provisioned animals which closely approach the coastline. Food-provisioned cetaceans are defined by Samuels & Bejder (2004) as those which are habituated to in-water interactions through regular provisioning of food by humans. Samuels and colleagues (2000, 2003) defined unhabituated cetaceans as animals which have infrequent contact with humans as well as having long-term exposures to swimmers but still show disturbance reactions in response to them. They further defined habituated cetaceans as individuals which have had sustained interactions with human swimmers on a regular basis without pursuit by humans or any form of food-provisioning and show no signs of disturbance in response to human actions. Lone and sociable dolphins are characterized as animals which have a mostly solitary lifestyle, are habituated to humans and human activity and establish social bonds with certain human individuals sometimes for many years (see Lockyer, 1990, for a review). For all these categories, it depends on the willingness of the target species to spatially approach and stay with swimmers, to terminate an encounter, or to categorically avoid approaching humans and stay out of sight.

The systematic record of interactive and self-initiated behaviors of cetaceans directed towards humans is still in its infancy and restricted by a variety of methodical problems. Cetaceans can swim rapidly, roam over long distances through a vision-limited underwater habitat and often disappear from the water surface for longer periods. Though cetaceans have physical characteristics to be individually identified and sexed, the photo- or video-based identification procedure is relatively elaborate and the instantaneous recognition on site is a hard issue. Much information is anecdotal and data was often obtained opportunistically. Some studies had a different research focus and reported interactions were rather a by-product. Researchers observed interactions from different research platforms (boat- or land-based or from underwater). From the surface an observer can

detect behaviors only in the upper water column or directly at the surface whereas certain behaviors can be observed solely from underwater. As further pointed out by Mann (1999), reviewing a large sample of cetacean behavioral field studies, researchers have not made optimal use of available methodology. Due to the lack of reliable sampling methods for a large proportion of those studies she reviewed, observational biases potentially arise and comparability of results between studies is hindered. So far, there is no widely accepted behavioral catalogue or ethogram available for human-cetacean encounters, which is being consistently and *a priori* used by different researchers. This review is aimed at providing a current descriptive and comparative overview of interactive behaviors self-initiated by free-ranging cetaceans and directed towards human swimmers, divers and waders, or shown in close proximity to them.

## 2. Methods

Twenty-six peer-reviewed scientific research reports, books and technical reports which have been published from 1985 to 2004 were accounted for review. All behavioral interactions of cetacean individuals or groups with tourists and/or researchers in open water environments were considered. Open water encounters are defined coincidences taken place in waters which are saline and tide-effected (Orams, 1999). However, encounters taken place in restricted enclosures such as “semi-captive” sea-water facilities with dolphins being kept in fenced areas were excluded. Furthermore, descriptions of human-dolphin fishing cooperatives, where dolphins and fisherman cooperatively established fishing techniques during which free-ranging dolphins herd fish into the fishermen’s nets and benefit by obtaining a partial catch (Domning, 1991; Pryor, Lindbergh, Lindbergh & Milano, 1991), were also excluded. Though the latter encounters occur with free-ranging animals and in open water habitats, they did not take place for recreation. Humans further encounter food-provisioned animals from shore or boat (fish is thrown from a wharf or dinghy into the water or dolphins are being fed by hand by humans which are not in the water) and by wading from the beach into < 1.5 m deep waters where they do not snorkel or dive with them (Mann & Smuts, 1999; Orams, 1994; Orams, 1995). Only Samuels & Bejder (2004) described food-provisioned encounters where animals were fed from vessels while human swimmers are in the water. For this review, only interactive behaviors addressed towards humans being positioned in the water (while freely swimming or wading) were catalogued. Behaviors addressed towards people positioned on a wharf or boat were excluded.

An encounter is defined as a swim with one or more cetacean/s in visual range underwater (approximately < 20 m) for 15 s or more. Interactive behaviors towards human swimmers were defined as behaviors initiated by a cetacean individual or group and directed towards a swimmer within a human swimmer body length (< 2 m) to approximately 20 m range. Herzing & Johnson (1997) documented mixed species activities and categorized these as foraging, aggressive (including sexual behaviors) and affiliative. Thus the authors assume that animals produce interspecific behaviors which are similar to those used during intraspecific interactions. Other researchers noted that wild dolphins addressed behaviors towards people during interspecific in-water interactions which they also used during social intraspecific interactions (Frohoff & Packard, 1995; Herzing & White, 1998). Pryor (1973) noted that captive dolphins responded to humans as if they were dolphins. For this review it is assumed that cetaceans address behaviors towards humans similar to those they use during (social) interactions with conspecifics. Behaviors were categorized as (1) "affiliative" when there were no signs of threat or aggression and when behaviors were apparently positive in nature and mutually beneficial (2) "aggressive/threatening" when they were negative in nature and put swimmers at health risk (3) "sexual" when they were sexual in nature and put humans at health risk as well. For the following, the term "human swimmer" refers to snorkelers and/or divers whereas a wader is still in contact with the ground and does not swim freely in the water column.

Interactive behaviors might vary between species, populations and locations. To address these variations and to make data from different studies comparable, reports were reviewed with respect to sampling method, type of observation platform, overall observation effort, total numbers and durations of encounters, frequency of behaviors, number of different encounter groups, individual identification, group compositions and behavioral context. The numbers of humans during encounters, as well as their behavior, are given when available. Behavioral descriptions from encounters with unhabituated, habituated, lone and sociable and food-provisioned cetaceans each were catalogued separately. When a given species was studied at different geographical locations, behaviors were listed site-specific.

### 3. Results

The scientific literature reported altogether 53 different behaviors self-initiated by unhabituated, habituated, lone and sociable and food-provisioned cetaceans (Table 1) from 10 odontocete and 1 mysticete species. Of these, 33 behaviors were affiliative, 18 aggressive/threatening and 2 sexual in nature.

**Table 1.** Overview of behavioral descriptions from the scientific literature reporting self-initiated affiliative, aggressive/threatening and sexual behaviors of free-ranging cetaceans directed towards humans

Behavior	Description	Source/s
<b>Affiliative</b>		
Belly up	Individual is positioned beneath a swimmer and horizontal to the water surface. Swimmer and individual show little or no movement. The ventral side of the body is directed upwards.	Bloom, 1991; Scheer, Hofmann & Behr, 2004
Bubble release	An individual releases bubbles while in close proximity to the swimmer.	Birtles, Arnold & Dunstan, 2002; Bloom, 1991; Carwardine, 1994; Scheer, Hofmann & Behr, 2004; Shane, Tepley & Costello, 1993
Close approach	A cetacean closely (approximately > 0.5m–5m) and frontally approaches a human swimmer. During this approach, the ventral or the dorsal body part can be orientated towards the water surface. It might further happen that the animal is sending click vocalizations apparently directed towards the swimmer during such an approach though an approach might also occur without clicks. The head is orientated towards the swimmer. This behavior is alternatively described as scouting.	Birtles, Arnold & Dunstan, 2002; Bloom, 1991; Carwardine, 1994; Dudzinski, 1998; Dudzinski, Frohoff & Crane, 1995; Frohoff & Packard, 1995; Frohoff, Kinsman, Rose & Sheppard, 2000; Constantine & Baker, 1996; Johnson & Norris, 1994; Lockyer & Morris, 1986; Müller, Battersby, Buurman, Bossley & Doak, 1998; Ritter, 2002; Ritter & Brederlau, 1999; Scheer, Hofmann & Behr, 2004; Shane, Tepley & Costello, 1993; St. John, 1991; Stone & Yoshinaga, 2000
Direction adaptation	One or more cetacean/s change/s its/their projected swimming track (at the surface, horizontal to the surface) and adapt it towards swimmer/s. The individual or group keep/s up greater distances (> 5–20m) than during close approaches.	Carwardine, 1994; Frohoff & Packard, 1995; Ritter, 2002; Ritter & Brederlau, 1999; Scheer, Hofmann & Behr, 2004; Stone & Yoshinaga, 2000
Echolocation	An individual emits click vocalizations in close proximity to swimmers. Clicks are apparently directed towards the swimmer/s.	Carwardine, 1994; Dudzinski, 1998; Dudzinski, Frohoff & Crane, 1995; Johnson & Norris, 1994; Lockyer & Morris, 1986; Scheer, Hofmann & Behr, 2004; St. John, 1991
Encircling	An individual swims around a swimmer in circles once or several times in a defined and small radius.	Birtles, Arnold & Dunstan, 2002; Dudzinski, 1998; Johnson & Norris, 1994; Lockyer & Morris, 1986; Müller, Battersby, Buurman, Bossley & Doak, 1998; Scheer, Hofmann & Behr, 2004; St. John, 1991

(Continued)

Table 1. (Continued)

Behavior	Description	Source/s
Escorting	Human swimmer leaves the encounter individual or 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.	Scheer, Hofmann & Behr, 2004
Eye contact	Swimmer and individual have eye contact with each other while in close proximity (< 5m).	Frohoff & Packard, 1995; Scheer, Hofmann & Behr, 2004; Shane, Tepley & Costello, 1993; St. John, 1991
Feeding area approach	Individual or group regularly approach a distinctive area where food is being handed out by humans. This area can be offshore or coastal. The approach is apparently motivated in order to obtain food.	Connor & Smolker, 1985; Mann & Smuts, 1999; Orams, 1994; Orams, 1995; Orams, Hill & Baglioni, 1996; Samuels & Bejder, 2004
Give-and-take-play	Individual takes an object from and then returns it to the outstretched arm of the swimmer.	Frohoff, Kinsman, Rose & Sheppard, 2000; St. John, 1991
Hand feeding	Individual swims towards a human to take fish being held by a human hand or feeds on a fish being thrown in the water by a human.	Dudzinski, Frohoff & Crane, 1995; Mann & Smuts, 1999; Orams, 1994; Orams, 1995; Orams, Hill & Baglioni, 1996; Samuels & Bejder, 2004
Hauling	Individual hauls voluntarily a swimmer through the water. Swimmer holds on to the dorsal fin or fluke while being hauled, or holds to an object which then is being hauled by the individual (e.g. a chain).	Dudzinski, Frohoff & Crane, 1995; Lockyer & Morris, 1986; Müller, Battersby, Buurman, Bossley & Doak, 1998; St. John, 1991
Headrise	Individual rises its head slightly out of the water that the eye is above the water surface, apparently to view a swimmer. In contrast to a spyhop, the head is horizontally or slightly vertical orientated to the water surface.	Birtles, Arnold & Dunstan, 2002
Headup	Individual rises its head nearly vertical out of the water during food begging behaviors and clearly directed towards the (potential) feeder. The mouth can be opened or closed. In contrast to a spyhop, this behavior is clearly food-orientated.	Samuels & Bejder, 2004
Herding	Individual herds a marine animal (e.g. manta ray or small shark) towards the swimmer/s.	St. John, 1991

(Continued)

**Table 1.** Overview of behavioral descriptions from the scientific literature reporting self-initiated affiliative, aggressive/threatening and sexual behaviors of free-ranging cetaceans directed towards humans (Continued)

Behavior	Description	Source/s
Initiate contact	Individual initiates physical contact with swimmer in a non-aggressive gentle way mainly with its rostrum or sometimes with other body parts.	Bloom, 1991; Dudzinski, Frohoff & Crane, 1995; Müller, Battersby, Buurman, Bossley & Doak, 1998; Santos, 1997; St. John, 1991
Milling around swimmer	Individual or group swims in visual proximity to the swimmer. Individual or group is not in a stationary position in relation to the swimmer/s but moves in differing directions for longer periods.	Constantine & Baker, 1996; Frohoff, Kinsman, Rose & Sheppard, 2000; Ritter, 2002
Mimicry	An individual's imitation of swimmer movements, postures or vocalizations.	Dudzinski, 1998; Dudzinski, Frohoff & Crane, 1995; Frohoff, Kinsman, Rose & Sheppard, 2000
Object release	An individual apparently plays with an object (plastic fragment, seaweed) and releases it very close in front of a swimmer whereas it does not seem to be motivated to initiate a give-and-take-play.	Johnson & Norris, 1994
Object touching	Individual tolerates touching by objects being held and moved by the swimmer.	Müller, Battersby, Buurman, Bossley & Doak, 1998
Parallel swimming	One or more individual/s swim/s parallel to the swimmer while in close proximity to him. Individual/s synchronize/s its/their swimming speed.	Frohoff & Packard, 1995; Ritter & Bredertlau, 1999
Remain near swimmer	An individual or group remain/s in close proximity to the swimmer. The animal/s show/s little or no movement.	Birdles, Arnold & Dunstan, 2002; Dudzinski, Frohoff & Crane, 1995; Müller, Battersby, Buurman, Bossley & Doak, 1998; Scheer, Hofmann & Behr, 2004; Shane, Tepley & Costello, 1993; Stone & Yoshinaga, 2000
Remain near feeder	Individual/s remain/s stationary in front of a human apparently in order to receive food handouts. Human wades through a low water level or swims freely in the water column.	Orams, 1995; Samuels & Bejder, 2004

(Continued)



Table 1. (Continued)

Behavior	Description	Source/s
Rostrum nodding	Individual moves its rostrum rapidly up and down. In contrast to jaw claps, this behavior is not accompanied by jaw movements.	Orams, 1995
Sink down	While in close distance to the swimmer, the individual slowly sinks downwards while positioned vertical to the water surface.	Scheer, Hofmann & Behr, 2004; Shane, Tepley & Costello, 1993
Speed adaptation	Swimmer/s and individual/s match their swimming velocity. The individual or group continues its synchronous travelling behavior and does not change its projected swimming track. The individual or group stays at or close to the water surface and shows slow swimming speed. In contrast to parallel swimming, the individual/s keep/s a greater distance to the swimmer/s.	Carwardine, 1994; Frohoff & Packard, 1995; Scheer, Hofmann & Behr, 2004
Spyhop	An individual lifts its head vertically out of the water so that the eyes are completely in air, with a vertical re-entry in close proximity to the swimmer.	Birtles, Arnold & Dunstan, 2002; Dudzinski, Frohoff & Crane, 1995; Shane, Tepley & Costello, 1993;
Surface rolls	Individual rolls around its longitudinal body axis while in close proximity to the swimmer.	Birtles, Arnold & Dunstan, 2002
Tolerate touching	An individual is being physically touched by a human and seems to tolerate this contact. It does not show an immediate disturbance or avoidance reaction.	Bloom, 1991; Dudzinski, 1998; Dudzinski, Frohoff & Crane, 1995; Frohoff, Kinsman, Rose & Sheppard, 2000; Lockyer & Morris, 1986; Mann & Smuts, 1999; Müller, Battersby, Buurman, Bossley & Doak, 1998; Orams, 1995; Samuels & Bejder, 2004; Santos, 1997; Santos, Rosso, Siciliano, Zerbini, Zampirolii, Vicente & Alvaranga, 2000; Shane, Tepley & Costello, 1993; St. John, 1991
Vocalizing	Individual/s vocalize/s while in close proximity to the swimmer. The authors did not further specify the type of vocalization and thus these sounds could also be whistles, calls or clicks.	Bloom, 1991; Dudzinski, Frohoff & Crane, 1995; Frohoff, Kinsman, Rose & Sheppard, 2000; Frohoff & Packard, 1995

(Continued)

**Table 1.** Overview of behavioral descriptions from the scientific literature reporting self-initiated affiliative, aggressive/threatening and sexual behaviors of free-ranging cetaceans directed towards humans (Continued)

<b>Behavior</b>	<b>Description</b>	<b>Source/s</b>
Water squirting	Individual squirts with water from its mouth towards a swimmer.	Frohoff, Kinsman, Rose & Sheppard, 2000
Whistling/Calling	Individual/s emit/s whistle/s or call/s while in close proximity to the swimmer/s.	Dudzinski, Frohoff & Crane, 1995; Scheer, Hofmann & Behr, 2004
Zig zagging	An individual is zig-zagging back and forth in front of a swimmer.	Johnson & Norris, 1994
<b>Aggressive/threatening</b>		
Biting	Individual bites a human. This behavior is shorter in duration than grabbing a human's body part.	Bloom, 1991; Lockyer & Morris, 1986; Orams, 1995
Breaching	Individual breaches on or very close to the swimmer in a forceful way.	Bloom, 1991
Couple splitting	Individual splits a human swimmer pair spatially from each other by forcefully manoeuvring between the swimmers and prevent them from spatial reunions.	Bloom, 1991
Defecation	Individual/s defecate/s in close proximity to the swimmer.	Bloom, 1991
Ducking	Individual ducks swimmer underwater using its whole body in a forceful way.	Bloom, 1991
Fluke slap	Individual slaps with its fluke on the water surface while in close proximity to the swimmer.	Dudzinski, Frohoff & Crane, 1995; Frohoff & Packard, 1995; Samuels & Bejder, 2004
Grabbing	An individual aggressively grabs a swimmer's body part or gear with its mouth for a while.	Bloom, 1991; Shane, Tepley & Costello, 1993
Headshake	An individual, positioned stationary parallel to the water surface or moving underwater, rhythmically shakes its head and adjacent body part from the left to the right while directed with the melon towards the swimmer.	Carwardine, 1994; Scheer, Hofmann & Behr, 2004; Shane, Tepley & Costello, 1993

(Continued)

Table 1. (Continued)

Behavior	Description	Source/s
Head jerk	Single and quick deliberate movement of the individual's head in response to touching attempts by humans. This might occur above the water surface in response to touching attempts by waders or underwater with swimmers. In contrast to a headshake, a head jerk is just a single and very short movement apparently in order to avoid physical contact with a human.	Frohoff, Kinsman, Rose & Sheppard, 2000; Mann & Smuts, 1999
Hitting	Individual hits a swimmer with its body flanks, tail, flipper, melon or rostrum which can also be lethal for the swimmer.	Bloom, 1991; Dudzinski, Frohoff & Crane, 1995; Frohoff, Kinsman, Rose & Sheppard, 2000; Lockyer & Morris, 1986; Mann & Smuts, 1999; Orams, 1995
Jaw clap	An individual open and closes its jaws which produces a slapping noise underwater whereas the head is being rapidly moved up and down.	Bloom, 1991; Carwardine, 1994; Frohoff, Kinsman, Rose & Sheppard, 2000
Jerky body movement	Individual moves its body in a jerky and rigid manner in front of a human during food handout contexts.	Orams, 1995
Leaping	Individual leaps over swimmer.	Dudzinski, Frohoff & Crane, 1995; Müller, Battersby, Buurman, Bossley & Doak, 1998; Samuels & Bejder, 2004; St. John, 1991
Open mouth	An individual is opening its mouth so that the teeth can be seen, apparently in order to threaten a human during non-feeding contexts.	Birtles, Arnold & Dunstan, 2002; Bloom, 1991; Frohoff, Kinsman, Rose & Sheppard, 2000; Lockyer & Morris, 1986; Orams, 1995; Samuels & Bejder, 2004; Shane, Tepley & Costello, 1993
Pulling	A swimmer's body part or swimming gear is being grabbed by an individual with its mouth and pulled aggressively vertically or horizontally through the water.	Bloom, 1991; Shane, Tepley & Costello, 1993

(Continued)

**Table 1.** Overview of behavioral descriptions from the scientific literature reporting self-initiated affiliative, aggressive/threatening and sexual behaviors of free-ranging cetaceans directed towards humans (Continued)

Behavior	Description	Source/s
Pushing	Individual shoves and nudges a swimmer or wader with its rostrum forcefully during general interactions and during attempts to get fish handouts, respectively	Bloom, 1991; Dudzinski, Frohoff & Crane, 1995; Frohoff, Kinsman, Rose & Sheppard, 2000; Lockyer & Morris, 1986; Müller, Battersby, Butrman, Bossley & Doak, 1998; Orams, 1995; Orams, Hill & Baglioni, 1996
Rostrum nodding	Individual moves its rostrum rapidly up and down. In contrast to jaw claps, this behavior is not accompanied by jaw movements.	Orams, 1995
S-shaped posture	An individual, positioned in front of a swimmer, flexed its body from side to side and up and down while showing an arched back.	Johnson & Norris, 1994
<b>Sexual</b>		
Genital rub	Individual rubs its genitals at the swimmer.	Dudzinski, Frohoff & Crane, 1995
Penis rubbing	Individual rubs its erected penis at swimmer.	Bloom, 1991; Lockyer & Morris, 1986; St. John, 1991

### 3.1 Unhabituated cetaceans

Among altogether 6 reports 2 studies (Carwardine, 1994, for short-finned pilot whales, *Globicephala macrorhynchus*, off Tenerife; Stone & Yoshinaga, 2000, for Hector's dolphins, *Cephalorhynchus hectori*, off New Zealand) were anecdotal. Scheer, Hofmann & Behr (2004) reported 13 affiliative and 1 aggressive/threatening behaviors during focal underwater group follows using an *ad libitum* sampling method. The authors observed encounters with short-finned pilot whales over two field seasons. One to three swimmers entered the water when pilot whales showed milling, socializing or travel/rest group behavior. The mean encounter duration was 14.1 min (range: 3–44 min;  $n = 35$ ; total encounter time: 8 h 15 min). Due to the absence of a video-based underwater recording system, the authors quantified behaviors by adding 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. Affiliative behaviors were predominant in variety and frequency whereas aggressive/threatening ones were low in occurrence (Table 2). Carwardine (1994) added 1 aggressive/threatening behavior observed from underwater. For the same species Shane, Tepley & Costello (1993) reported interactive behaviors resulting from a single encounter with 5 adult short-finned pilot whales off Hawaii. The authors analysed a 3 min underwater video sample documenting a cutout of the encounter. Though pilot whales addressed a variety of 7 affiliative behaviors (one male also tolerated physical contact initiated by the human swimmer) towards the swimmer, the encounter was dominated by the life-threatening and aggressive behaviors initiated by a single male. The detailed video analysis gave frequencies of behaviors (Table 2). Ritter (2002) used an *ad libitum* sampling method during boat-based and underwater group follows of rough-toothed dolphins (*Steno bredanensis*) off La Gomera. One to two swimmer/s entered the water when the focal group interacted with the boat and the animal showed no wary behavior. Maximum encounter length ranged 9–12 min ( $n = 21$ ). For 7 encounter attempts the animals avoided human swimmers. The animals addressed 3 solely affiliative behaviors towards swimmers. Ritter & Brederlau (1999) observed swimmer encounters with dense beaked whale (*Mesoplodon densirostris*) groups off La Gomera using focal group and time sampling methods. Observations were made boat-based and from underwater. The authors documented 8 encounters (mean duration: 4.4 min; range: 1–11 min) with two groups (composed of adult males and females, juveniles and calves) during two different sightings. One to six swimmer/s entered the water when groups stayed close to the boat or approached it. Though the animals sometimes terminated the encounter after a while, they also addressed 4 affiliative behaviors towards the swimmers.

**Table 2.** Overview of behaviors self-initiated by unhabituated cetacean individuals or groups and directed towards human swimmer. See Table 1 for further descriptions of behaviors. For *Globicephala macrorhynchus* frequencies of behaviors are given in brackets (see results for further explanations)

Species	<i>Cephalorhynchus</i>	<i>Globicephala</i>		<i>Steno</i>	<i>Mesoplodon</i>
	<i>hectori</i>	<i>macrorhynchus</i>	<i>macrorhynchus</i>	<i>bredanensis</i>	<i>densirostris</i>
Location/s	New Zealand	Tenerife	Hawaii	La Gomera	La Gomera
Behaviors					
<b>Affiliative</b>					
Belly up		x (3)			
Bubble release		x (15)	x (2)		
Close approach	x	x (22)	x (4)	x	x
Closed eye		x (8)			
Direction adaptation		x (14)		x	x
Echolocation		x (23)			
Encircling		x (8)			
Escorting		x (4)			
Eye contact		x (18)	x (2)		
Milling around swimmer				x	
Parallel swimming					x
Remain near swimmer	x	x (7)	x (1)		x
Sink down		x (1)	x (1)		
Speed adaptation		x (16)			
Spyhop			x (4)		
Tolerate touching			x (1)		
Whistling/Calling		x (15)			
<b>Aggressive/threatening</b>					
Grabbing			x (2)		
Headshake		x (2)			
Jaw clap		x (1)			
Open mouth			x (3)		

### 3.2 Habituated cetaceans

Altogether 5 studies described interactive behaviors of habituated cetaceans across 5 species (Table 3). Habituated animals have been approached by humans for many years in the context of commercial whale watching activities. Johnson & Norris (1994) gave anecdotal descriptions for spinner dolphins (*Stenella longirostris*) off Hawaii and reported altogether 5 affiliative and 1 aggressive/threatening behaviors. Constantine & Baker (1996) gave information on two species in New Zealand waters: for bottlenose (*Tursiops truncatus*) and common dolphins (*Delphinus delphis*). The authors analysed 163 swim attempts during a 12-months research

**Table 3.** Overview of behaviors self-initiated by habituated cetacean individuals or groups and directed towards human swimmer. See Table 1 for further descriptions of behaviors

Species	<i>Tursiops truncatus</i>		<i>Stenella frontalis</i>		<i>Delphinus delphis</i>	<i>Stenella longirostris</i>	<i>Balaenoptera acutorostrata</i>
	Bahamas	New Zealand	Bahamas	New Zealand		Hawaii	East Australia
Behaviors							
<b>Affiliative</b>							
Bubble release							x
Close approach	x	x	x	x		x	x
Direction adaptation	x						
Echolocation			x			x	
Encircling			x			x	x
Eye contact	x						
Headrise							x
Milling around swimmer		x		x			
Mimicry			x				
Object release						x	
Parallel swimming	x						x
Remain near swimmer	x						x
Speed adaptation	x						
Spyhop							x
Surface rolls							x
Tolerate touching			x				
Vocalizing	x						
Zig zagging						x	
<b>Aggressive/threatening</b>							
Fluke slap	x						
Open mouth							x
S-shaped posture						x	

period using a focal group follow protocol. Swimmers did not enter the water during feeding, resting or travelling behavior and when the encounter group contained calves. Though the authors' main research focus was to study behavioural reactions of dolphins in response to different boat approach and swimmer placement strategies, they observed common dolphins to show 2 affiliative behaviors.

The mean encounter duration was 5.3 min (range: 0.22–14.45 min;  $n = 29$ ). Common dolphins avoided human swimmers during 11 out of 29 swim attempts. Bottlenose dolphins off New Zealand were reported to show 2 affiliative behaviors during encounters lasting 4.2 min on average (range: 0.14–20.00 min;  $n = 134$ ). Bottlenose dolphins avoided swimmers during 30 out of 134 swims. The authors gave two case reports of encounters with common and bottlenose dolphins. During these human swimmers slapped on the water surface with their swim paddles which elicited avoidance reactions. For bottlenose dolphins off the Bahamas, Frohoff & Packard (1995) reported 7 affiliative and 1 aggressive/threatening behaviors. During a 12-months study they used a boat-based video documentation. During 72 dolphin sightings they filmed 12 h of in-water encounters. One to four swimmer/s entered the water when dolphins approached their research vessel. Dudzinski (1998) used focal-animal, all-occurrence and underwater video-based behavioral sampling methods for encounters with Atlantic spotted dolphins (*Stenella frontalis*) off the Bahamas. She gained data from 1992–1995 with 4–5 field days per season. She reported ‘inquisitive’ activities including 5 affiliative interactive behaviors. ‘Inquisitive’ behavior represents 9.7 % of overall behavioural activities and is predominantly initiated by same sex and age groups. Birtles, Arnold & Dunstan (2002) are the only authors who reported interactive behaviors between human swimmers and a baleen species, the dwarf minke whale (*Balaenoptera acutorostrata*) in Australian waters. From boat-based and underwater (partially video-documented) observations, they gained data from 59 encounters (lasting > 1 h; mean encounter duration range: 1.3–1.8 h) over a 5-year period. When minke whales approached the vessel by themselves (animals differed in size; less approaches by mother/calf pairs), swimmers entered the water and positioned themselves along two ropes. The authors reported altogether 9 interactive behaviors but made some contradictory statements on their nature. For example, they listed the behaviors ‘bubble blasts’ as a friendly behavior but also as a potential threat display. Because the authors generally stated that they never experienced any sign of aggression, for this review 8 of their behaviors (except ‘open mouth’) were listed as affiliative ones. It is interesting to note that the authors described a behavior during which an old female made contact with her snout against a video camera. It is assumed that this might be the result of de-sensitisation.

### 3.3 Food-provisioned bottlenose dolphins

Six reports concern interactive behaviors initiated by bottlenose dolphins during food-provisioned encounters with human swimmers and waders at 3 locations (Table 4). For all locations, a group of dolphins has learned to accept (hand-)feeding by humans. Food-provisioned animals all belonged to populations with a majority of individuals which do not accept feeding by humans. Bottlenose dolphins off



Western Australia (Monkey Mia) were reported to self-initiate 3 affiliative and two aggressive/threatening behaviors which they addressed towards human waders in a controlled provisioning area (Connor & Smolker, 1985; Mann & Smuts, 1999). Mann & Smuts (1999) used focal animal group follows and *ad libitum* behavioral sampling methods during land- and boat-based observations of mother/calf food-related interactions with waders. The most aggressive mother was reported to show 23 aggressive behaviors from which 9 were addressed towards humans over a two-month observation period. At Tangalooma (Eastern Australia) bottlenose dolphin adult males, females and calves were observed during food-provisioning interactions with 20–80 human waders on a daily basis (Orams, 1994; Orams, 1995; Orams, Hill & Baglioni, 1996). During 175 video-documented and land-based observations over a 12-month research period, the authors used an *ad libitum* sampling method and described 4 affiliative and 6 aggressive/threatening behaviors. Samuels & Bejder (2004) used focal animal follows and *ad libitum* sampling methods and found 5 affiliative and 2 aggressive/threatening behaviors for bottlenose dolphin interactions off Florida. During 5 boat-based observation days the authors gained 6 h 32 min from 9 focal follows of a juvenile animal of unknown sex and 1 animal of unknown sex and age.

**Table 4.** Overview of behaviors self-initiated by food-provisioned bottlenose dolphins directed towards human swimmers and waders. See Table 1 for further descriptions of behaviors

Species	<i>Tursiops truncatus</i>		
	West Australia	East Australia	Florida
Behaviors			
<b>Affiliative</b>			
Feeding area approach	x	x	x
Hand-feeding	x	x	x
Head up			x
Remain near feeder		x	x
Tolerate touching	x	x	x
<b>Aggressive/threatening</b>			
Biting		x	
Fluke slap			x
Head jerk	x		
Hitting	x	x	
Jerky body movement		x	
Leaping			x
Open mouth		x	
Pushing		x	
Rostrum nodding		x	

**Table 5.** Overview of behaviors self-initiated by lone and sociable dolphins directed towards human swimmer. See Table 1 for further descriptions of behaviors. For *Tursiops truncatus* there are two columns for english locations: the first describes the behavioral repertoire of a solitary dolphin named 'Freddie' off the coast of Amble (Bloom, 1991), the second the behavior of a dolphin named 'Percy' off the coast of Cornwall (Lockyer & Morris, 1986)

Species	<i>Tursiops truncatus</i>				<i>Sotalia fluviatilis</i>		<i>Delphinapterus leucas</i>
	England	England	Bahamas	New Zealand	Belize	Brazil	Eastern Canada
Behaviors							
<b>Affiliative</b>							
Belly up	x						
Bubble release	x						
Close approach	x	x	x	x	x		x
Echolocation	x	x	x		x		
Encircling	x		x				
Eye contact			x				
Give-and-take-play			x				x
Hand feeding					x		
Hauling		x	x	x	x		
Herding			x				
Initiate contact	x		x	x	x		
Milling around swimmer							x
Mimicry					x		x
Object touching				x			
Remain near swimmer				x	x		
Spyhop					x		
Tolerate touching	x	x	x	x	x	x	x

(Continued)

Table 5. (Continued)

Species	<i>Tursiops truncatus</i>					<i>Sotalia fluviatilis</i>		<i>Delphinapterus leucas</i>
	England	England	Bahamas	New Zealand	Belize	Brazil	Brazil	Eastern Canada
Vocalizing	x				x			
Water squirting								x
Whistling					x			
<b>Aggressive/threatening</b>								
Biting	x	x						
Breaching	x							
Couple splitting	x							
Defecation	x							
Ducking	x							
Fluke slap					x			
Grabbing	x							
Head jerk								x
Hitting	x	x	x		x		x	x
Jaw clap	x							x
Leaping			x		x			
Open mouth	x	x		x				x
Pulling	x							
Pushing	x	x		x	x			x
<b>Sexual</b>								
Genital rub								x
Penis rubbing	x	x	x					

### 3.4 Lone and sociable dolphins

Altogether 8 studies reported interactive behaviors initiated by lone and sociable dolphins and addressed towards human swimmers and divers. There were altogether 3 species involved at 8 locations (Table 5). It can be generalized that most animals were confronted with inappropriate touching attempts of humans which were sometimes responded to with aggressive behaviors by dolphins. Except for two studies (Müller, Battersby, Buurman, Bossley & Doak, 1998; Santos, Rosso, Siciliano, Zerbini, Zampirolii, Vicente & Alvaranga, 2000) all reports documented aggressive behaviors addressed towards humans resulting in severe injuries with one lethal outcome. Furthermore, most studies reported an increase of aggressive and sexual behaviors addressed towards humans during the course of the observation periods. Dudzinski, Frohoff & Crane (1995) reported 11 affiliative, 4 aggressive/threatening and 1 sexual behavior for an adult female bottlenose dolphin off Belize. The authors collected data opportunistically from underwater or the surface during 10 days over a 2-year research period. Out of a total of 7 h 40 min of direct observations, the authors gained 30 min underwater video material. During a 2-year research period, Müller, Battersby, Buurman, Bossley & Doak (1998) observed a subadult female bottlenose dolphin in New Zealand waters using boat-based focal animal and all-occurrence sampling methods. They observed 7 affiliative and 2 aggressive/threatening behaviors. Bloom (1991) described behaviors of an adult male bottlenose dolphin off England resulting from opportunistic boat-based and underwater observations over a 4-year period. The author reported 6 affiliative, 12 aggressive/threatening and 1 sexual behaviors. Lockyer & Morris (1986) observed behaviors initiated by an adult male bottlenose dolphin also in waters off England from 1981–84. Opportunistic surface and underwater observations together with interviews resulted in descriptions of 5 affiliative, 4 aggressive/threatening and 1 sexual behaviors. The interactive behaviors of a male bottlenose dolphin off the Bahamas is reported by St. John (1991), describing 9 affiliative, 2 aggressive/threatening and 1 sexual behaviors. Observations were made over a 2-year period. For two lone and sociable beluga whales (*Delphinapterus leucas*) off eastern Canada (subadult female and juvenile male), Frohoff, Kinsman, Rose & Sheppard (2000) reported 6 affiliative and 5 aggressive/threatening behaviors. The authors video-documented behaviors from the surface and underwater during a 3-month study. Santos (1997) described an adult male solitary bottlenose dolphin off Brazil injuring altogether 29 bathers with one person dying from internal bleedings. Next to this the author described only 2 interactive behaviors: one was affiliative and the other aggressive/threatening in nature. Santos, Rosso, Siciliano, Zerbini, Zampirolii, Vicente & Alvaranga (2000) reported only 1 affiliative behavior for a solitary tucuxi (*Sotalia fluviatilis*) off Brazil resulting

from 48 days of land-based and 3 days of boat-based opportunistic observations over a 2-year study period.

#### 4. Discussion

Behaviors being self-initiated by cetaceans and addressed towards humans still have received little study and their structure and function mostly remain unclear. This review showed that unhabituated, habituated, food-provisioned and lone and sociable free-ranging cetaceans across different species and at different geographical locations self-initiated a variety of behaviors directed towards human swimmers and waders. Most behaviors addressed towards human swimmers can also be observed during intraspecific interactions (e.g. Dudzinski, 1996; Herzing, 1996; Shane, 1990). Though this review categorized interactive behaviors as affiliative, aggressive/threatening and sexual, it might be that distinct behaviors being similar in structure could have context-depending functions. This aspect is not addressed by any of the studies being reviewed here.

For unhabituated cetaceans altogether 17 affiliative and 4 aggressive/threatening behaviors were described. Four out of 6 studies applied reliable sampling methods to make data comparable and gave further data on sampling size, encounter lengths and the behavior of cetaceans before an encounter was initiated (Ritter, 2002; Ritter & Brederlau, 1999; Scheer, Hofmann & Behr, 2004; Shane, Tepley & Costello, 1993). Though measured differently, 2 studies on short-finned pilot whales showed that certain behaviors occurred more often than others (Scheer, Hofmann & Behr, 2004; Shane, Tepley & Costello, 1993). It remains unclear why only Hawaiian pilot whales showed such aggressive and life-threatening behaviors but one explanation could be that the swimmer off Hawaii initiated physical contact. Swimmers off Tenerife did not initiate contact with pilot whales. As for Tenerife, human swimmers off La Gomera also applied a code of conduct and remained passive and avoided physical contacts during encounters. This might explain why the authors solely observed affiliative behaviors during encounters with rough-toothed dolphins and dense beaked whales. However, this might be the result of a low sample size for both studies. Overall unhabituated cetaceans were reported to predominantly address affiliative behaviors towards swimmers though aggressive/threatening behaviors can sometimes occur.

Habituated cetaceans were reported to show altogether 18 affiliative and 3 aggressive/threatening behaviors. Only one study describes spinner dolphin behaviors without giving further information on methodology and sample size (Johnson & Norris, 1994). Bottlenose dolphins were studied at two locations (New Zealand and the Bahamas) by different researchers. Though both studies

have a relatively large sample size, bottlenose dolphins off the Bahamas were reported to show more affiliative behaviors and an aggressive/threatening one. The New Zealand study had a different research focus (see results) which might explain these differences. Dudzinski (1998) quantified 'inquisitive' behavior by Atlantic spotted dolphins as an activity pattern but did not quantify distinct behaviors. Spotted dolphins were reported to tolerate touching by humans but did not seemingly respond with aggressive/threatening behaviors. The most extensive variety of behaviors were reported by Birtles, Arnold & Dunstan (2002) for dwarf minke whales also showing a large sample size. In contrast to unhabituated cetaceans, habituated whales and dolphins are regularly encountered by vessels and human swimmers. One might argue that as a result of harassment more aggressive/threatening behaviors occur with habituated cetaceans than for unhabituated ones but this cannot be confirmed here.

Cetaceans being regularly food-provisioned by humans might become dependent on these food resources. Orams, Hill & Baglioni (1996) showed that food-provisioned bottlenose dolphins increased the occurrence of a so-called 'pushy' behavior (a forceful contact behavior) addressed towards human waders when more dolphins are simultaneously present in the feeding area. The increase in pushing behavior could be the result of a decrease of available food items per individual and dolphins responded to this by begging for food more forcefully. Three out of 6 studies used reliable sampling methods and gained a larger sample size (Mann & Smuts, 1999; Orams, Hill & Baglioni, 1996; Samuels & Bejder, 2004). Four of the altogether 5 reported affiliative behaviors (Table 4) were food-related and thus not described for encounters with unhabituated, habituated and lone and sociable cetaceans. Furthermore and in contrast, food-provisioned animals were described to show 9 different aggressive/threatening behaviors. All studies reported dolphins to tolerate touching by humans which could result in harassment. Because food-provisioned dolphins might rely on regular food supplies, they did not avoid human contact but responded aggressive/threatening to inappropriate human behaviors (such as touch of eyes or blowhole, tease with objects or fish, splashing).

For lone and sociable dolphins most behaviors were found. Next to altogether 20 affiliative and 14 aggressive/threatening behaviors, 2 sexual behaviors were solely reported here. Though the 8 research reports used different sampling methods, sample sizes for most studies (except Santos, 1997) were relatively high. The increase in behavioral variation for lone and sociable dolphins in contrast to unhabituated, habituated and food-provisioned cetaceans might be the result of a higher observation effort and/or differences in research foci. On the other hand, lone and sociable dolphins seemingly compensate their demand to have social contacts by interacting with humans instead of conspecifics. Human contact seems to represent

a social network for them. In this context, it is likely that dolphins produce generally more and varying behaviors during encounters with human swimmers. In addition to food-provisioned animals, all studies on lone and sociable dolphins reported the animals to tolerate touching. Again, inappropriate human behaviors might explain the large number of aggressive/threatening behaviors.

The results and assumptions of this review should be regarded with caution. Due to differences in sample sizes and sampling methods observational biases potentially arise and comparability of results between studies is hindered. Though there were many studies describing behaviors qualitatively, only two studies gave frequencies of occurrences for distinct behaviors. It might be that reports did not describe the whole behavioral repertoire for a specific species and location and certain behaviors occurred but were not reported. To make encounters more predictable and manageable, it is essential to know the quality and quantity of behaviors which might occur during interactions. For example, swimmers who have little or no encounter experience are in danger to misinterpret behaviors (e.g. they might not recognize threatening behaviors which could end up in violent and injuring behaviors), and thus they can be prepared before swim contacts are initiated. Swimmers and waders might be trained to recognize affiliative, aggressive/threatening or sexual behaviors in order to continue or terminate their encounter, respectively. However, this review shows a somewhat minimum variety of behaviors which can occur during human-cetacean in-water encounters. Researchers might use this ethogram *a priori* for future studies.

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