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Whalesuckers on spinner dolphins: an underwater view

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At Fernando de Noronha Archipelago in the tropical west Atlantic, spinner dolphins (*Stenella longirostris*) regularly congregate in a shallow bay where they engage in resting, social, and eliminative behaviours. The dolphins' congregation allowed underwater observations from close quarters of the whalesucker (*Remora australis*), an open-water fish species found attached to cetaceans only and whose habits remains thus poorly known. Whalesuckers were recorded year-round on the Fernando de Noronha spinners. Estimated size range of whalesuckers in 211 records was 4–52 cm in total length (TL). Number of fish per dolphin was 1–3, the most frequently recorded attachment place being the host's belly (78.2%). Ratio of whalesuckers to spinner dolphins was 1–1.8 (mean = 1.32; SD±0.47) over one year. Juvenile, recently recruited individuals (less than 10 cm TL) were recorded year-round. Whalesuckers occasionally fed on dolphin faeces, and thus would also be able to feed on plankton while riding the spinners. Cleaning of the host's wounds was recorded twice during the study. Adult fish side by side or close to each other were regarded as an indication of reproductive pairs. The association of the whalesuckers with a middle-sized, fast and social cetacean likely provide this remora with ride, food, increased opportunity for reproduction and mating place, and perhaps protection from fast predators such as sharks, tuna, and larger dolphins.

INTRODUCTION

Remoras or discfish (Echeneidae) attach themselves to varied types of marine vertebrates, including sharks and rays, bony fish, turtles, sirenians and cetaceans (Cressey & Lachner, 1970; Fertl & Landry, 1999, 2002; O'Toole, 2002). Remoras may benefit from this association in several ways, including transport, feeding opportunities, and protection from predators (e.g. Strasburg, 1959; Cressey & Lachner, 1970; Alling, 1985). Some remora species like *Echeneis naucrates* L. attach to a diverse array of hosts, whereas other species are more prone to attach to a particular host type. For instance, *Remora brachyptera* (Lowe) and *Remora osteochir* (Cuvier) live mostly attached within the gill chamber of billfish (Strasburg, 1959; Fertl & Landry, 2002; O'Toole, 2002). Another apparently specialized remora is the whalesucker, *Remora australis* (Bennett) which, as its vernacular names implies, lives attached to cetaceans (Rice & Caldwell, 1961; Radford & Klawe, 1965). Although the habits of several remora species are known in some detail (review in O'Toole, 2002), those of *R. australis* remain among the least known, likely due to the fact it attaches to cetaceans only and is thus rarely collected (e.g. Rice & Caldwell, 1961; Fertl & Landry, 2002) or studied from close quarters.

We report here on selected natural history features of whalesuckers associated to spinner dolphins, *Stenella longirostris* (Gray) at Fernando de Noronha Archipelago in the tropical west Atlantic. In the archipelago these dolphins regularly congregate in a shallow bay where they engage in resting, social, and eliminative behaviours (Silva Jr et al., 1996, 2005). The dolphin congregation and their resting and other behaviours allowed us to observe the whalesuckers underwater and from close quarters. As the whalesucker is regarded as an obligate cetacean associate (review in O'Toole, 2002), we hypothesized that this remora species would be found attached to spinner dolphins most of the year, and that it somehow benefits from the association. Besides general observations on the association between whalesuckers and spinner dolphins, we focused our study on four main questions: (1) are the whalesuckers present on the dolphins year-round? Our assumption was that they associate with their host year-round due to their specialised habits (O'Toole, 2002); (2) what are their commonest attachment places on the host? Our assumption was that places like belly would be the most common attachment sites due to possible hydrodynamic drag (see comments in Fertl & Landry, 2002 for cetaceans and Sazima & Grossman, in press, for marine turtles); (3) do the attachment places vary with the fish size-classes? Our assumption was that smaller fish attach to varied places, whereas the larger ones would be mostly on belly for the reason stated above; (4) are the dolphins able to dislodge the remoras by means of a particular behaviour? Our assumption was that dolphins are able to dislodge remoras from particular, sensitive areas (see Ritter, 2002 for this view for sharks). The purpose of the study is to obtain a general view of the whalesucker–dolphin association, and to gain some insight on what advantages the whalesucker may obtain from its association with the spinner dolphin, as well as the possible disadvantages for the host.

MATERIALS AND METHODS

The study was conducted at Fernando de Noronha Archipelago (03°50'S 32°24'W), about 345 km off the north-eastern coast of Brazil (see Carleton & Olson, 1999, for map and description). The underwater observation sessions were made at the Baía dos Golfinhos or Enseada do Carreiro de Pedra, a 15–25 m deep bay used by spinner dolphins for resting and social interactions (Silva-Jr et al., 1996, 2005; Lodi, 1998). The association between whalesuckers and dolphins was observed directly, photographed, and videotaped during snorkelling and passive diving over 61 days from January 2001 to June 2004. These are two little disturbing methods particularly suited for study of cetaceans and open water fish (Silva-Jr et al., 1996, 2005).

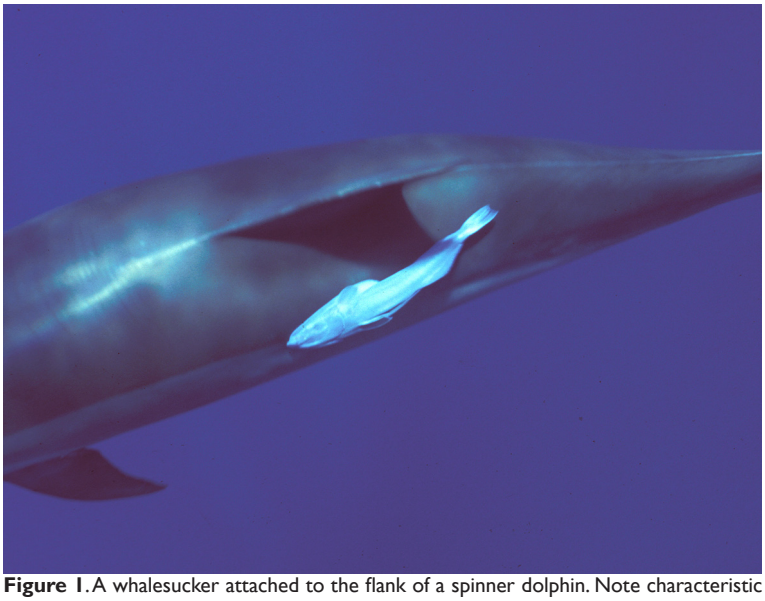

Figure 1. A whalesucker attached to the flank of a spinner dolphin. Note characteristic very long disc, body colour and profile, dimension and position of fins.

During underwater observational sessions of 10–90 min, 'focal animal' and 'all occurrences' samplings were used in 137 hours of direct observation in which all occurrences of specified actions, e.g. changing attachment place or feeding, over a given period were recorded (Altmann, 1974; Lehner, 1979). Direct underwater observations of remoras were done at close quarters (0.5–2 m), which allowed adequate identification and sampling of the fish habits. Data that did not fit within the above category were discarded from analyses. In addition to direct observation, we analysed 8 h of videotapes (see Silva-Jr et al., 2005). As the study site is a marine sanctuary and the dolphins are strictly protected, collection of any remora specimen for dietary or other analyses was not possible. Remoras were visually identified based on their external features (see e.g. Robins & Ray, 1986; Froese & Pauly, 2006). Problems with remora identification based on observations of a remote, free-swimming host and its passengers were noted by Fertl & Landry (2002), but mistaken identification is very unlikely with underwater observations at close quarters to this characteristic species (Figure 1).

Total length (TL) of whalesuckers was estimated visually against the dolphin individuals, whose sizes varied 75–187 cm TL (Silva-Jr et al., 1996; JMS-Jr, personal observation). The size of the smallest whalesuckers was estimated against the greater width of the hosts' pectoral flukes, which in our largest spinner dolphin (187 cm TL) measured 10 cm. Thus, we assumed that any fish smaller than its host's pectoral fluke width was smaller than 10 cm TL. Similar relationships were used to estimate the size of larger fish.

We established three total size (TL) classes for the whalesuckers recorded on spinner dolphins. The <10 cm TL class contains what we regard as recently recruited individuals (we found no fish smaller than 4 cm TL in our large sample, N=211); the 10–35 TL cm class probably contains immature individuals only; and the >35 cm TL class includes maturing to fully ripe fish (see Radford & Klawe, 1965 and Silva & Sazima, 2003 for size of mature females). Records were limited to days when at least 250 dolphins were present within the bay, a number judged minimal for this data collecting (Silva-Jr et al., 2005). The year of 2001, the most complete of our sampling periods, was chosen to estimate the ratio of whalesuckers to spinner dolphins. Daily dolphin numbers were assessed through direct counts of surfacing individuals as they entered the bay in the morning, sighted from a land-based observation post at the Baía dos Golfinhos (Silva-Jr et al., 1996).

Voucher photographs (paper copies and transparencies) and videotapes of whalesuckers and spinner dolphins are on file at the Centro Golfinho Rotador at Fernando de Noronha, and in the Museu de História Natural, Universidade Estadual de Campinas (ZUEC).

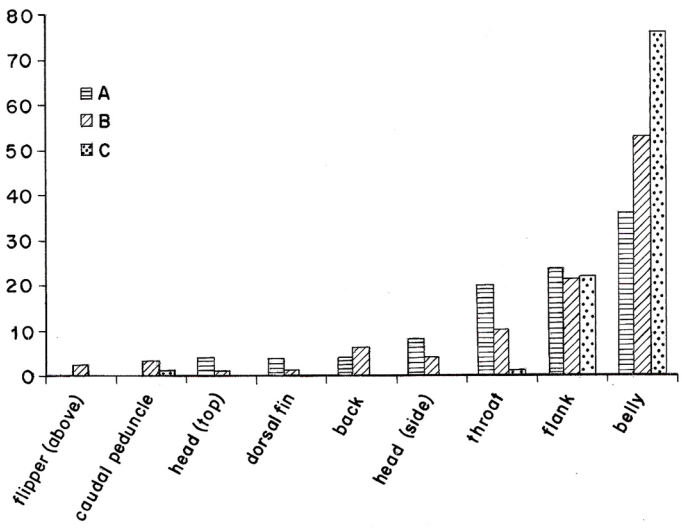

Figure 2. Frequency (in percent) of attachment places for three whalesucker size-classes on Fernando de Noronha spinner dolphins. Size-classes TL in cm: A <10; B=10–35; C >35.

RESULTS

A total of 211 records of whalesuckers attached to spinner dolphins was made throughout the study period. Whalesuckers were recorded year-round, including very

small juveniles (4–9 cm TL). The number of fish per dolphin with attached remoras was 1–3. The ratio of whalesuckers to spinner dolphins varied 1–1.8 (mean=1.32; SD±0.47) throughout the year of 2001. Colour of all size-classes (except for the smallest individual) varied from light grey to slate grey, the fin border slightly paler. The smallest fish seemed barred or blotched, although the light-shadow interference due to waves while close to water surface prevented a more precise assessment. Twenty eight individuals (63.6%) from the fish class larger than 35 cm TL (N=44) had their fins yellowish including the disc. Twenty two individuals (78.6%, N=28) with yellowish fins were attached side by side or close to a similarly-sized individual.

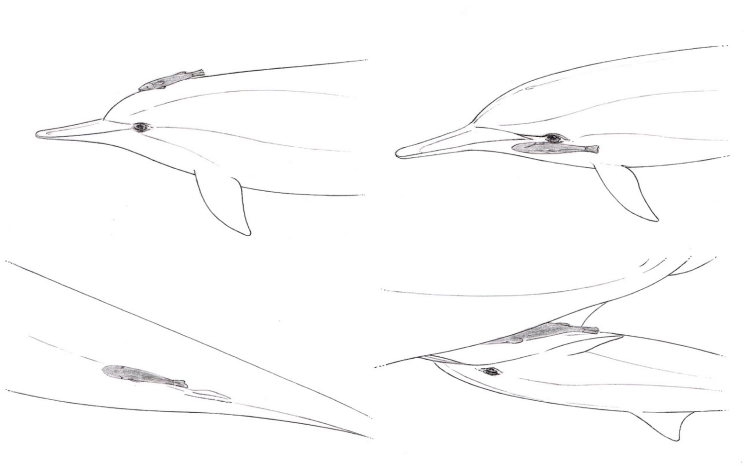

Figure 3. Four instances of whalesuckers' attachment places that may hamper a dolphin's habitual behaviour. The fish near a female's genital slit, as well as that on a male's throat prevented copulating while attached there. Based on photographs (fish rendered dark to contrast with host).

The most frequent attachment place of the whalesuckers was the host's belly (Figure 2). Uncommon attachment places were close to the blowhole, eye, and genitals (Figure 3). A female with a whalesucker attached close to her genital slit was unable to copulate while the fish remained there, and a male with a fish attached to his throat was unsuccessful in two successive copulation attempts. These uncommon attachment places occurred mostly with smaller whalesucker individuals (Figure 2).

The whalesuckers occasionally changed attachment sites and slid over their hosts, especially while the dolphins were cruising at low speed (resting). When approached closely, a whalesucker generally changed its attachment place and sought the dolphin's belly or the side opposite to the observer; this presumably protective behaviour was particularly evident for the smaller fish individuals.

Several instances of dolphins spinning (Figure 4) and their whalesucker being relocated from its previous place on the host's body were recorded. One videotaped sequence shows a whalesucker attached to the dolphin's fore back before its spinning; on re-entry in the water the fish was on the top of the host's flank and subsequently slid to the caudal peduncle.

The whalesuckers occasionally foraged on spinner dolphin faeces and/or vomits, detaching themselves to pick off particles and quickly returning to their host. Two instances of a whalesucker scrapping with its mouth at wounded and apparently fungus-infected places on the flank and caudal peduncle of slowly cruising (resting) dolphins were recorded during the study.

Figure 4. A spinner dolphin at the start of spinning from left to right, with a whalesucker attached to its left flank. Photograph by R. Lepage.

DISCUSSION

Records on size and colour variation in the present study agree with published accounts on the whalesucker (e.g. Rice & Caldwell, 1961; Radford & Klawe, 1965), except for the yellowish fins observed on most of the presumably adult individuals. One possible explanation for the yellowish tinge would be a trait related to reproductive and/or another physiological condition, but this remains to be verified.

There is no regularly gathered information on occurrence, incidence, attachment places, and size-classes of whalesuckers on cetaceans aside from a few anecdotal data taken mostly during whaling activities (e.g. Rice & Caldwell, 1961). In our study, the occurrence of very small individuals in all months indicates that recruitment occurs year-round. Our observation of an about 4 cm TL fish is in agreement with the report of the smallest whalesucker recorded on a dolphin, 46 mm TL (Gudger, 1926).

The swimming ability of most remora species rarely matches those of their hosts, especially the fast-moving billfish and dolphins (Cressey & Lachner, 1970). Two specimens of *Remora osteochir* 24 and 26 mm SL were found attached to a sailfish 24 mm SL (Cressey & Lachner, 1970), an indication that the association may occur early in the life of remoras and their hosts. Juveniles

of several pelagic fish frequently associate with floating mats of algae and other drifting objects (e.g. Gooding & Magnuson, 1967). We suggest that juvenile whalesuckers live associated to floating objects (see O'Toole, 2002 for remoras in general) and that spinner dolphins may acquire juvenile whalesuckers when close to flotsam while resting, investigating and/or playing with objects such as algae and small pieces of driftwood (see Norris & Dohl, 1980; Silva-Jr et al., 2005). A phylogenetic analysis of the behaviour of remoras and their relatives (O'Toole, 2002) strengthens our suggestion. Another recruitment type may occur when spinners approach whales (Silva-Jr et al., 2005), in which case the dolphins might acquire even adult whalesuckers.

As most whalesuckers, especially the larger individuals, were attached to the underside or the flank of the host, we presume that this position causes the least drag in these highly hydrodynamic and relatively small dolphins, a supposition also pointed out for cetaceans in general by Fertl & Landry (2002). Additionally, this position on the host may facilitate feeding by the whalesucker on the host's faeces and vomits (see Sazima et al., 2003). Although there is a view that a remora's attachment to a cetacean host does not hurt or leave scars (Fertl & Landry, 2002), we recorded a calf with most of the skin of the upper surface of its left flipper abraded due to the attachment of a whalesucker (see figure in Silva-Jr et al., 2005).

Some of the whalesucker's uncommon attachment places may impose stressful situations to the spinners. For instance, a fish attached below the eye hinders a clear view of the area below the dolphin, a situation that may facilitate a shark's undetected approach to an isolated individual (see interactions between spinner dolphins and reef sharks in Silva-Jr et al., 2005). Likewise, a whalesucker partly lying on the blowhole hinders the respiration of a dolphin when it surfaces to breathe. Attachments near a female's genital slit or a male's throat, particularly by larger remora, hamper copulation attempts (this paper).

A relationship between disc size versus fish length of five remora species and the type of attachment to several hosts indicates that the largest discs are found in those species which attach externally to the fastest hosts (Strasburg, 1959; O'Toole, 2002). The disc of the whalesucker is the largest amongst the remoras which attach externally to their hosts (see figures in O'Toole, 2002), a feature that may be related both to the swimming speed and the skin texture of its dolphin hosts. Additionally, spinners and several other dolphin species leap out of water, an additional strength exerted on the attached whalesucker. Movements such as spins and tail-over-head leaps most probably do not detach the whalesucker from a leaping dolphin (see Norris et al., 1994), unless the fish is stunned by a direct impact of the attachment place on the water surface. Even this being the case, the whalesucker may recover briefly and would attach itself to the nearest slowly cruising dolphin.

However, our study indicates that spinning dolphins are able to relocate a whalesucker from a presumably irritating place to a less sensitive one. A recent study on sharksuckers, *Echeneis naucrates* attached to blacktip sharks, *Carcharhinus limbatus* (Müller & Henle), demonstrates that this remora may be dislodged from a particular place of the host body to a less sensitive one due to rotational manoeuvres performed by the host (Ritter, 2002). At least some of the manoeuvres performed by spinner dolphins, such as spinning, lead to similar results (this study). Dolphins and manatees with remoras moving over their bellies would on occasions jerk or even roll over (Fertl & Landry, 2002), an indication that the fish may be irritating to the host.

Feeding on dolphin offal by whalesuckers is recorded rarely (Sazima et al., 2003; Silva-Jr et al., 2005) but this may be a habitual foraging mode, the more so since spinner dolphins commonly release their faeces and vomits over individuals at their rear within the group (Sazima et al., 2003; Silva-Jr et al., 2004). As spinner dolphins feed on squids, fish, and shrimps (Würsig et al., 1994; Silva-Jr et al., 1996), their faeces and vomits probably are a nutritive and energy-rich food source. Faeces-feeding is also recorded for two species of sharksuckers, *Echeneis naucrates* and *Echeneis naucratoides* Zuiew, attached to manatees, *Trichechus manatus* L. in Puerto Rico and Florida (Williams et al., 2003); although manatees feed on plants, the two mentioned remora species were feeding heavily on their hosts' faeces. Foraging on plankton by ram-feeding is recorded for the common remora, *Remora remora* (L.) (Clarke & Nelson, 1997), and whalesuckers probably are able to feed on this resource by simply opening its mouth to ram-filter while riding on spinner dolphins. Plankton is recorded as food of at least three remora species (Strasburg, 1959).

Although cleaning behaviour is recorded for the sharksucker, *E. naucrates* (e.g. Sazima et al., 1999) and inferred from the gut contents of other remora species (Szidat & Nani, 1951; Strasburg, 1959, Randall, 1967; O'Toole, 2002), our two records seem to be the first instance of actual cleaning of a cetacean by *Remora australis*. The finding of bits of sloughed-off whale epidermis in the gut contents of two whalesucker specimens (Rice & Caldwell, 1961) already pointed in this direction.

Cleaning by the whalesucker seems to be the only advantage to the spinner dolphin, for even the simple presence of this fish may constitute a hindrance to its host. A remora possibly interferes with the dolphin's swimming ability by producing a hydrodynamic drag (Fertl & Landry, 2002), hampers copulation while attached on particular body places (this paper), and even may pose a potential risk

face to predators like sharks (Silva-Jr et al., 2005). On the other hand, attachment to spinner dolphins seems advantageous to whalesuckers for several reasons: (1) riding or hitchhiking, an energy-saving behaviour (e.g. O'Toole, 2002); (2) feeding on dolphins' offal (Sazima et al., 2003), plankton, and skin tissue while cleaning the host (this paper); (3) increasing the chance to meet a reproductive partner due to the spinner's social habits (Silva-Jr & Sazima, 2003); and (4) increasing a potential protection from large predators, while on a fast and middle-sized host (Alling, 1985). Whalesuckers attached to large cetaceans such as whales would obtain riding, feeding, and reproductive advantages as well, but protection may be hampered by the large size and slow moving of this host type. The recent report of predation on sharksuckers, *Echeneis naucrates*, attached to humpback whales *Megaptera novaeangliae* (Borowski) by the rough-toothed dolphin, *Steno bredanensis* (Lesson), in the tropical west Atlantic (Wedekin et al., 2004) lends support to the above assumption.

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