

Pectoral fin preference during contact in Commerson's dolphins (*Cephalorhynchus commersonii*)

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Abstract

The Commerson's dolphin, *Cephalorhynchus commersonii*, is well documented as having saw-toothed serrations on the leading edge of, primarily, its left pectoral fin. However, the function of these serrations, which apparently develop with sexual maturity and are more often exclusively on the left in males than in females, had not heretofore been explored. In this captive study of six mature Commerson's dolphins—two males and four females—instantaneous scan samples were taken once every ten seconds for 24 minutes per session in 220 sessions (for 31,680 scans, 88 hours of observation). 'Pec touches'—contact between the leading edge of one animal's flipper and any part of the body of another animal—were observed in 946 of these scans. 907 (96%) of these were performed by the two males. Of these 907 observations, 853 (94%) involved the male's serrated left pectoral fin. This preferential use of the left flipper was consistent across their full range of partners (male or female) and regardless of arousal state (i.e. involving genital or non-genital contact). These results suggest that flipper serrations may, in part, serve to enhance tactile stimulation during social contact and, further, that this may reflect a gender-specific adaptation.

Introduction

The Commerson's dolphin, *Cephalorhynchus commersonii*, is a small black and white dolphin distributed around southern Chile, southern Argentina, and the Falkland and Kergulen Islands (e.g. see Brownell, 1974; Aguayo, 1975). It is most often sighted in coastal areas near the mouths of bays and estuaries and is typically found in small groups of nine or fewer (Mermoz, 1980; Leatherwood, Kastelein & Miller, 1988). Almost nothing is known about adult social behavior in this animal (although see Cornell, Antrim, Asper & Pincheira, 1988; Gewalt, 1990). For comprehensive reviews of what

is known of their biology, see the edited volume by Brownell & Donovan (1988) as well as Goodall (1994).

One of the distinguishing characteristics of the Commerson's dolphin is the frequent occurrence of saw-toothed serrations on the leading edge of one or both of its pectoral fins or 'flippers'. First briefly described by Norris (1967, cited in Goodall *et al.*, 1988), these serrations were analyzed and discussed in detail by Goodall, Galeazzi, Sobral & Cameron (1988; see also Goodall, 1994). These serrations are fairly evenly-spaced indentations that form a double row along the leading edge of the dolphin's fin. They extend from about two-thirds of the distance from the base of the fin to the end of its rounded tip. Slightly lighter than the rest of the black flipper, the serrated tissue is 'extremely hard and horny' (Goodall *et al.*, 1988).

Such serrations apparently first appear around two years of age, and become fully developed as the animal reaches physical maturity. In their examination of 72 Commerson's dolphins that were either stranded or incidentally caught in fishing nets, Goodall and her colleagues (Ibid) found that, in 30 adult specimens, 90% exhibited serrations on their left fins. In four of these adults, serrations were also found on the right pectoral fin, but only when they existed to a greater degree on the left. In the same study, 52% (12/23) of the subadults examined also exhibited serrated left pectoral fins; only one subadult had serrations on both fins. The remaining 19 younger individuals had smooth fins. In addition, males were more likely to display serrations on only one side (the left) than females were.

Similar serrations have been observed in other species of this genus, specifically *Cephalorhynchus hectori* (Baker, 1978; Sooten & Dawson, 1988) and *Cephalorhynchus heavisidii* (Best, 1988). Rough leading edges are also occasionally observed on the pectoral fins of species such as *Delphinus*, *Lagenorhynchus*, and *Tursiops* (Goodall, *et al.*, 1988). In addition, raised tubercles are occasionally found on the leading edge of flippers in *Phocoena spinipinnis*

Table 1. Subjects and fin preference in scans involving pec touch

Name	Age class	Gender	Serrated fin	#Scans w/pec touch by this animal	% Left fin used
Juan	adult	M	Left	469	97%
Crocker	subadult	M	Left, slight right	438	90%
Oreo	adult	F	None	13	N.A.
Betsy	adult	F	None	4	N.A.
Toni	adult	F	Both	2	N.A.
Cookie	subadult	F	None	20	N.A.

(Brownell & Praderi, 1985) and *P. phocoena* (Goodall *et al.*, 1988). However, *Cephalorhynchus* appears to be the only genus in which such serrations are characteristic of pectoral fin morphology.

The possible functions of these serrations have not previously been investigated. However, Goodall *et al.* (1988) proposed five hypotheses regarding their use. These functions include: (1) tactile stimulation during social caressing, (2) as an aggressive 'weapon' or dominance signal, (3) creating bioluminescent trails to guide others, (4) foraging on the sandy ocean floor and (5) facilitating 'assisted swimming' by calves with adults. In this study of captive Commerson's dolphins, conducted at Sea World of San Diego, almost no aggression was observed, no sand was present on the bottom of the tank from which the animals could feed, there was no bioluminescence in the water, and the mother of the only calf present during the study had no serrations on her fins. We did, however, frequently observe pectoral fin contact between these animals. Plus, as Goodall *et al.* (1988) report (citing W. E. Evans & L. H. Cornell, pers. comm.), the animals involved would, at times 'vibrate' their fins during such contact. If pectoral fin serrations are indeed used to enhance tactile stimulation, we would predict that individuals displaying left-flipper serrations should engage in pectoral fin contact more often with their left flipper than with their right. This study was designed to test that hypothesis.

Methods

Subjects

The subjects of this study were six mature Commerson's dolphins (see Table 1). Three of these animals—the adult male Juan and two adult females Oreo and Betsy—were from a group of six originally captured in the Straits of Magellan in 1983 (see Leatherwood & Cornell, 1985; Joseph, Antrim & Cornell, 1987; Cornell *et al.*, 1988). Another adult female, Toni (born July 1988), was the daughter of Betsy. The two subadults in the group—the male Crocker (born June 1995) and the female Cookie (born September 1995)—were

the son and daughter of Betsy and Oreo, respectively. Following Lockyer *et al.* (1988) we are considering adults to be at least six years of age and subadults to be younger than that, but nearly full sized. The animals were housed indoors in a concrete and glass-walled pool measuring 13 × 13 × 4 m. All six animals were examined by Sea World Care staff in order to determine the presence or absence of pectoral fin serrations.

Procedure

After passing inter-observer reliability tests on a pre-established ethogram and data-collection protocol, pairs of observers collected data in 24-min sessions using an instantaneous scan-sampling technique. At alternating twenty-second intervals, each observer recorded the behavior of a focal animal and its proximity to, and contact with, any other individual(s). Thus, a pair of observers working together generated data every 10 s for 24 min. As a part of a larger behavioral study on a variety of social interactions, pectoral fin contact—hereafter called 'pec touch'—was one of the behaviors recorded. A 'pec touch' was defined as contact between the leading edge of one animal's flipper and any part of the body of another animal. We recorded whether the right or left flipper was involved, and which animal played which role in each contact. Although we report pec touches in terms of which animal's flipper was involved, it is important to note that the other animal in the dyad often appeared to take the initiative in such interactions, rubbing its body along the flipper of the first. (This common, delphinid interaction has been called 'taking a rub' by Samuels *et al.*, 1989.) We also recorded whether the dolphin's fin was vibrating, and if genital contact was being made.

Results

In 31,680 scans (88 h of observation in 220 24-min sessions), 946 pec touches were recorded. Due to the fact that only 39 (4%) of these involved the pectoral fin of any of the four females, those data were eliminated from the following statistical analysis. The remaining 907 observations involved the

Table 2. Distribution of pec touches by males

Contacted by Juan's fin			Contacted by Crocker's fin		
	#Scans	% Left fin		#Scans	% Left fin
Crocker	134	93%	Juan	199	87%
Oreo (elder)	254	99%	Oreo (elder)	19	95%
Betsy (elder)	66	100%	Betsy (elder)	26	95%
Toni	3	100%	Toni	73	95%
Cookie	12	100%	Cookie	121	93%
All females	335	99%	All females	239	93%

pectoral fins of the two males, either contacting one another or making contact with one of the females.

The adult male, Juan, who has serrations on his left pectoral fin only, was observed to pec touch in 469 scans (see Table 1). 97% (457) of these involved his left pectoral fin. This preferential use was undoubtedly statistically significant (Chi square=211.11, $P<0.001$). The subadult male, Crocker, who is heavily serrated on his left pectoral fin and has slight serrations on his right, was observed to pec touch on 438 scans. 90% (396) of these involved his left pectoral fin. This preferential use is also statistically significant (Chi square=143.05, $P<0.001$). Although Crocker was observed to use his right pectoral fin slightly more often than Juan did (in 10% versus 3%, respectively, of their scans involving pec touches), this difference is not significant (Chi square=2.20, N.S.). Of the 907 scans involving pec touches by the males, 23 (17 by Juan and 6 by Crocker) involved contact with the genitals of the other animal. 96% (22) of these involved the left, more serrated fin. Similarly, the males were observed to vibrate their fins during pec touches in 62 scans (Juan 41, Crocker 21), and 92% (57) of these involved contact with the left pectoral fin.

This preferential use of the left flipper by the males was also consistent across their full range of partners (see Table 2). Both males were slightly more likely to use their left flipper during pec touches involving females than during those involving the other male: Juan, 99% to females, 93% to other male; Crocker, 94% to females, 87% to other male. However, in neither case is this difference significant (Juan: Chi square=0.50, N.S.; Crocker: Chi square=1.10, N.S.). This difference may be attributable to the fact that, in general, social interactions between the males were more variable (in terms of the range of activities, relative body positions, etc.) than between either male and the females (see Johnson *et al.*, forthcoming).

In his interactions with the females only, Juan was observed to make pectoral fin contact on the

greatest number of scans (254) with his long term, co-captured associate, Oreo (see Table 2). His next most frequent female partner was the other co-captured adult, Betsy (in 66 scans). Toni and Cookie, who were born at Sea World, were observed as his partners during pec touches in only 3 and 12 scans, respectively. Thus, on 96% of the scans in which Juan made pectoral fin contact with a female, one of the elder females was involved.

The subadult male, Crocker, showed the reverse pattern in his pec touches with the females. He was least frequently observed to pec touch the elder females Oreo and Betsy—in 19 and 26 scans respectively—and to more frequently pec touch Toni and Cookie—in 73 and 121 scans, respectively. Thus, in contrast to Juan, in only 19% of the scans in which Crocker made contact with a female was it with one of the elder females. This difference between the males in relation to the elder females is statistically significant (Chi square=146.9, $P<0.001$). In addition, Juan was overall observed to pec touch the females significantly more often (on 335 or 72% of his relevant scans) than was Crocker (on 239 or 55% of his relevant scans. Chi square=17.44, $P<0.01$). As a necessary corollary to this, Crocker was observed to pec touch Juan on significantly more scans (199) than Juan was observed to pec touch Crocker (134). Note that since the number of sessions in which each male was the focal animal was equal ($N=54$), and since both males were available to interact with others when any other animal was the focal, the above frequencies for the males are directly comparable.

Discussion

In this study, in over 90% of the scans in which either of the two males were observed to pec touch another animal, this behavior was performed with the most-serrated, left flipper. This preferential use of the left pectoral fin by the males was consistent regardless of partner or level of arousal (as indicated by vibration of the pectoral fins or by genital

contact). These data support the hypothesis that these serrations may serve a tactile function in such social interactions.

We believe that the pec touches observed in these animals can generally be considered affiliative interactions. Most occur in the context of sustained, side-by-side swimming and in the absence of any aggression. In addition, the distribution of observations of pec touches by the males suggests that this behavior may also be indicative of the privileges of rank. That is, the adult male appeared to have preferential access to the two older, reproductive, and presumably dominant females (both of whom have had offspring by him). Plus, between the males, the subadult was observed to make pec contact with the adult on significantly more scans than the adult contacted him, suggesting that the younger animal may, at least at times, have been courting the dominant male's favour with this behaviour. In each of the above situations, pec touches seem to serve a function similar to that of 'grooming' in primates (see Jolly, 1985; Samuels *et al.*, 1989).

In contrast to our findings involving the males, only 4% of all the scans involving pec touches involved the pectoral fin of a female. While this is an interesting result in its own right—since such striking gender differences in social contact have not, to our knowledge, been reported in other delphinid species—it suggests that a social function may not be the only one served by these serrations. Alternatively, since male Commerson's are more likely to have serrated fins, and especially to be serrated on only the left fin, than the females, perhaps this trait has an adaptive function primarily in the males.

In their original paper on serrations, Goodall *et al.* (1988) reported that 100% of the adult males they examined were serrated on their left fins (and only 6% on both fins), while only 57% of the adult females were serrated on their left fins (and 43% on both fins). In addition, 43% of the adult females (versus 0% of the adult males) were not serrated on either fin. Their examination of subadults also suggests that males develop the serrations earlier than females, since 64% of the subadult males were serrated while only 14% of the subadult females were. Our small captive population actually reflects this distribution fairly well, since our adult male is heavily serrated on his left fin only and our adult females are serrated on neither or both fins (see Table 1). Similarly, our subadult male is heavily serrated while our subadult female—who is only three months younger than he is—is unserrated. While work with such a small group cannot be used to make definitive claims for the population as a whole, the combination of a morphological and a behavioral difference between males and females

suggests that further research into a possible gender-based adaptation may be warranted.

When a strong side bias in behavior is observed, and especially when it is associated with a morphological asymmetry, the possibility of brain lateralization may be considered. Lateralization has been suggested on the basis of behavior and morphology in other species of dolphins, including *Tursiops truncatus*, *Delphinus delphis* and *Stenella plagiodon*. For example, behaviorally, these animals show a tendency to swim in a counter-clockwise direction when first placed in captivity, indicating a functional dominance of the right hemisphere (Caldwell, Caldwell & Siebenaler, 1965; Ridgway, 1986, 1990). Studies of cortical surface area in these species have also revealed that the right hemisphere is slightly larger in these animals (Ridgway & Brownson, 1979, 1984). Newly-captured Commerson's dolphins have also been reported to swim 'mostly counterclockwise' (Gewalt, 1990). While brain morphology has not, to our knowledge, been examined in this species, it does show, to a 'moderate' degree (Ness, 1967), the cranial asymmetry that is characteristic of odontocetes (Howell, 1930). Whether this asymmetry reflects a hemispheric brain difference in the Commerson's dolphin, and whether there is any difference in the sexes in this respect, is unknown. However, the strong left pectoral fin bias that we observed does suggest a right hemisphere dominance for this behavior, at least in the males.

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