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SHORT COMMUNICATION

Feeding aggregation and aggressive interaction between bottlenose (*Tursiops truncatus*) and Commerson's dolphins (*Cephalorhynchus commersonii*) in Patagonia, Argentina

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Abstract We report the first recorded interactions between bottlenose dolphin (*Tursiops truncatus*) and Commerson's dolphins (*Cephalorhynchus commersonii*). The diurnal behavioral patterns of bottlenose dolphins in Bahía Engaño, Argentina, were similar to those described for other coastal populations around the world. The majority of the feeding bouts were recorded near the mouth the Chubut River. When not feeding near the river, bottlenose dolphins generally swam along the coast, and interactions with Commerson's dolphins were recorded very close to the shore on two occasions during a 3-year period. In the first event, both species were feeding on a fish school. The second interaction was aggressive in nature, involving one juvenile and three adult bottlenose dolphins with several Commerson's dolphins. Two of the adult bottlenose dolphins attacked the Commerson's dolphins. We propose that the observed behavior represented defense of the juvenile bottlenose dolphin.

Keywords *Tursiops truncatus* · *Cephalorhynchus commersonii* · Interspecies interaction · Aggressive behavior · Feeding behavior

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The bottlenose dolphin (*Tursiops truncatus*) is one of the best known cetacean species. Reports on behavior, population dynamics and population structure, and interspecies interactions are readily found in the literature (for a review see Herman 1980; Shane et al. 1986; Leatherwood and Reeves 1990; Mann et al. 2000). Nevertheless, what is known about this behavior and interactions of this species with other cetaceans cannot easily be extrapolated from one population to another, and information from every observed interspecific encounter is important to understand the species's behavioral plasticity.

Recently, a group of bottlenose dolphins was discovered in the southern limit of its distribution range in the southwestern Atlantic. During research on Commerson's dolphins (*Cephalorhynchus commersonii*), groups of bottlenose dolphins were regularly sighted in Bahía Engaño, an open bay in northern Patagonia (Coscarella et al. 2003). This note describes the seasonal and daily behavioral patterns of free-ranging bottlenose dolphins in Bahía Engaño, including a report of two interspecific interactions with Commerson's dolphins.

Between February 1999 and December 2002, data on sighting and behavior of bottlenose dolphins in the study area were recorded during ongoing research on the behavior of Commerson's dolphins (Coscarella et al. 2003). Data were collected from a cliff top (21 m in height) using a spotting scope from a vantage point located about 3 km south of the Chubut river mouth (43°20′S, 65°02′W), near Rawson harbor. The area was scanned north to south every 30 min noting the date, scan start time, Beaufort sea state, behavioral state of the dolphins, and scan finishing time. Whenever possible, a group-follow protocol was performed to provide a continuous record, particularly noting interspecific interactions (Altman 1974; Mann 1999a). Sample sessions were carried out from dawn to dusk but were

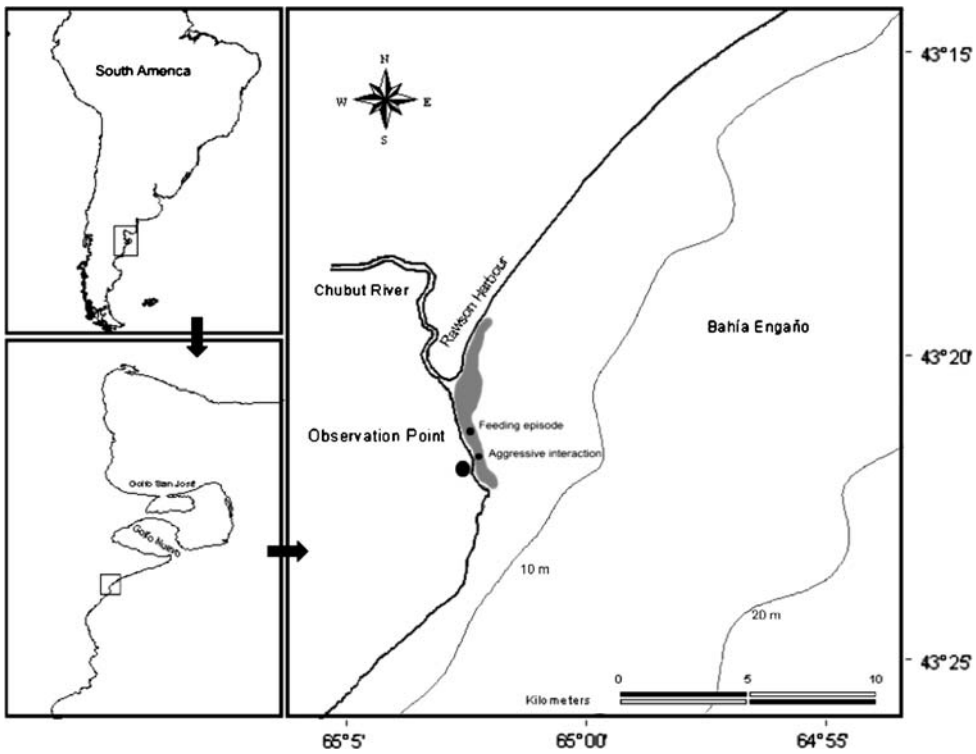

Fig. 1 Sampling area. The vantage point is located on a 21-m-high cliff; the *shaded area* is the area of movement of dolphins and the *points* inside the shaded area are the locations where each of the described episodes took place

interrupted when Beaufort sea state was above 3. Observations were performed year-round, yielding 540 h of total observation effort, of which 105 h were completed during winter, 197.5 h during autumn, 109.5 h during spring, and 128 h during summer. Observations were clumped together into 3-h periods, of which 94 h were completed between 08:00 and 10:59, 216 h between 11:00 and 13:59, 177 h between 15:00 and 16:59, and 53 h between 17:00 and 18:59. From the 1,081 scans performed, 91 scans were recorded with bottlenose dolphins distributed in 42 groups. Groups that were seen during the same day were considered as independent data points if a 2-h period passed between sightings. Surface behaviors of bottlenose dolphins were classified as traveling (persistent, directional movements), socializing (exhibition of "play," "rubbing," and aerial display behaviors), feeding ("milling" movement, accompanied by prolonged dives), and resting (slow movements generally lacking components of the other types of behavior described here) (sensu Shane et al. 1986).

Dolphins observed in the study area were found swimming behind the breaking waves, alongside the coast in water shallower than 10 m. Usually, dolphins were seen heading towards the river mouth while swimming in different formations, coming either from the north or south (Fig. 1).

Bottlenose dolphins did not change the frequency of their behaviors among seasons (chi-squared test, $P = 0.964$), performing all activities throughout the year (Fig. 2).

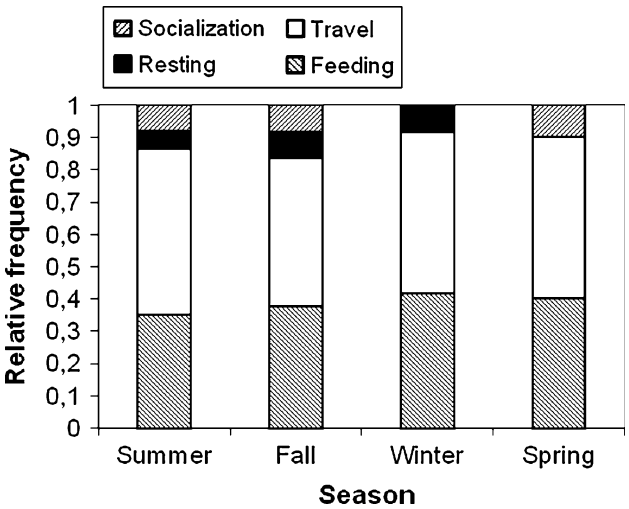

Fig. 2 The frequency of seasonal behavioral patterns by bottlenose dolphins in Bahía Engaño

The frequency distribution of different behaviors by bottlenose dolphins varied over the course of the day (Fig. 3). Groups that simultaneously displayed different behaviors were included in all relevant categories, such that Fig. 3 represents the frequencies of all observed behavioral categories rather than a time budget. The frequency of the behaviors changed among time blocks (chi-squared test, $p < 0.01$), suggesting a well-defined daily pattern. The frequency of traveling behavior was relatively

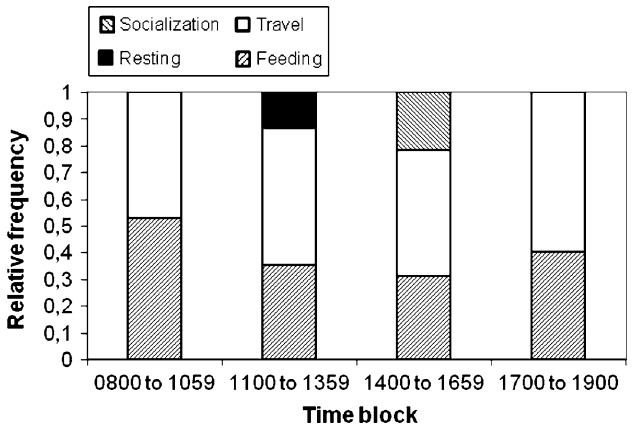

Fig. 3 The frequency of daily behavioural patterns by bottlenose dolphins in Bahía Engaño

similar throughout the day, accounting for 47.2% of the recorded activities for dolphins in the study area. Feeding steadily decreased from morning to afternoon, then peaked again in late afternoon. Feeding episodes accounted for 35.1% of the observations, of which 83% were recorded near the river mouth. Socializing and resting showed an inverse relation with feeding.

The observed pattern in this study was typical of coastal bottlenose dolphins and resembled the descriptions for the behavior of coastal bottlenose dolphins observed during the summer in the bay system of Galveston, Texas (Bräger 1993), and daily patterns reported in South Africa (Saayman et al. 1973) and Cardigan Bay, Wales (Bristow and Rees 2001). In contrast, Würsig and Würsig (1979) reported a completely different pattern in Golfo San José (a closed bay 250 km north of the Chubut River mouth), where dolphins rested in the morning, fed in deeper waters around mid-day, and then socialized and fed in the afternoon.

The majority of feeding episodes occurred near the river mouth, very close to the Rawson harbor. Sini et al. (2005) linked this preference for areas near harbors in bottlenose dolphins with prey availability in the area, suggesting that fish entering the river were a major food item. This may also be true for Bahía Engaño, where the Chubut River enters the bay. Diet information is lacking for this species in Patagonia and only the stomach contents from one beached dolphin have been examined in the area (Sánchez et al. 2002). The most important prey species found in the stomach content was a lamprey (*Geotria australis*), accounting for 91% of the stomach contents. *G. australis* is found in the Chubut river and undertakes massive down-river migrations (Azpelicueta et al. 2001), suggesting that bottlenose dolphins may use the area as a feeding ground.

One particular feeding episode took place on 26 May 2000, about 2 km south of the river, near shore and close to the observation point. Approximately 35 Commerson's dolphins were sighted at 10:40 local time. The Commerson's dolphins started to feed cooperatively and were joined shortly after by four adult bottlenose dolphins. During the whole episode, no evidence of aggression was observed between species. The dolphins were followed by a flock of about 15 terns (*Sterna* sp.), which hovered above them. The birds frequently plunge-dived close to the dolphins. This bout lasted until 10:56 when the Commerson's group started to disperse. The terns also flew away, and the bottlenose dolphins started to travel northward. The same group of bottlenose dolphins was seen again at 11:08, traveling in the same direction beyond the river mouth. This was the only time when both species were seen feeding together, and represented 0.1% of the total observation time.

Feeding associations between bottlenose dolphins and other species have previously been reported several times involving mixed groups of bottlenose and humpbacked dolphins (*Sousa chinensis*) feeding together (Corkeron 1990). Interactions between bottlenose dolphins and Atlantic spotted dolphins (*Stenella frontalis*) are well known and were studied in detail by underwater observations in the Bahamas (Herzing and Johnson 1997; Herzing et al. 2003). Affiliative aggregations were most common, but feeding episodes were also recorded (Herzing and Johnson 1997). The feeding aggregations reported by Clua and Grosvalet (2001) in the Azores were similar to the aggregations described here, with dolphins feeding cooperatively and birds hovering over them. In both cases, bottlenose dolphins joined feeding aggregations initiated by other species. Unlike our study, Clua and Grosvalet (2001) reported that bottlenose dolphins chased away the common dolphins (*Delphinus delphis*) and took temporary control of the feeding bout. We speculate that perhaps too few bottlenose dolphins were present to control the prey in the mixed-species feeding bout we observed. It remains unclear whether this feeding bout can be considered cooperative or not. The bottlenose dolphins were able to feed opportunistically on the fish school herded by Commerson's dolphins (Díaz López and Bernal Shirai 2007).

Usually, described feeding episodes involving bottlenose dolphins and other species are not cooperative in nature, and some end in aggressive interactions (Herzing and Johnson 1997; Clua and Grosvalet 2001). These aggressive interactions can occur after dolphins have interacted for some time (Herzing and Johnson 1997).

On 14 November 2001, an aggressive interaction between species was observed without prior feeding activity. At 14:38 local time, two adult bottlenose dolphins were sighted traveling from south to north behind the breaking waves. At 14:54, four bottlenose dolphins were

seen swimming with a group of approximately 30 Commerson's dolphins. The bottlenose group was comprised of three adults and one juvenile (about 3/4 the length of an adult and lighter in color). Bottlenose dolphins performed several head-slaps, leaps, back-slaps, and tail-slaps. Commerson's dolphins were swimming around the bottlenose dolphins, rubbing and performing leaps, head-slaps, tail-slaps, and bow-riding on the pressure waves created by swimming bottlenose dolphins. The bottlenose dolphins were mingled with the Commerson's dolphins, and each bottlenose dolphin had several Commerson's around it. At 15:19, all of the bottlenose dolphins started to swim fast northwards (toward the mouth of the river) accompanied by six to eight remaining Commerson's dolphins. At 15:22, the bottlenose dolphins split into two sub-groups, one comprised of an adult and the juvenile (the farthest from the Commerson's dolphins) and the other comprised of the remaining two adults with the six to eight Commerson's dolphins. The estimated distance between both bottlenose dolphin sub-groups was 50 m. While the first sub-group continued to swim fast towards the north, the second slowed its pace. At 15:23, one of the adult bottlenose dolphins from the latter group performed a behavior similar to that described by Shane (1990) as "kick-fishing." This dolphin hit a Commerson's dolphin that was swimming behind it with its flukes. The stroke was done in the air, during a Commerson's dolphin's leap. The other bottlenose dolphin swam very fast, frequently changing direction, chasing the other Commerson's dolphins. No biting or other obvious aggressive behavior was observed; however, only surface behaviors were recorded, and thus we cannot confirm whether underwater aggressive actions were occurring. At 15:25 both of the bottlenose dolphins in this sub-group reassumed traveling northward without the Commerson's dolphins. The observation finished at 15:26, when bottlenose dolphins disappeared from view. At 15:31, two bottlenose dolphins were sighted feeding in the river mouth, both adults, presumably the same two individuals that had previously interacted aggressively with the Commerson's dolphins. It is worth noting that during the scan conducted while this interaction took place, a total of 41 Commerson's dolphins were counted in the study area, and 30 of them were interacting with the bottlenose dolphins.

Before the aggressive event described in this work, instead of a feeding bout, both species showed social behaviors for about 25 min. During this period, bottlenose dolphins showed no sign of aggression until they shifted to traveling behavior, and the Commerson's dolphins continued to swim around them.

Regarding the aggressive interactions, Palacios (1996) reported a group of false killer whales (*Pseudorca crassidens*) and bottlenose dolphins attacking sperm whales (*Physeter macrocephalus*). Saayman and Tayler (1979) observed groups of humpbacked dolphins (*Sousa chinensis*) avoiding bottlenose dolphins, and Corkeron (1990) reported groups of bottlenose dolphins aggressively chasing lone humpbacked dolphins. Aggressive interactions also include the report of a bottlenose "pushing a spotted dolphin out of the water" (Herzing et al. 2003), similar to what we observed in this study.

Perhaps the most striking accounts of aggressive behavior involving bottlenose dolphins are the reports of infanticide on bottlenose calves and a harbor porpoise (*Phocoena phocoena*) killed during interactions with bottlenose dolphins (Ross and Wilson 1996; Patterson et al. 1998; Dunn et al. 2002). Patterson et al. (1998) suggested that the size of the harbor porpoise resembled that of bottlenose dolphin calves, which might partially explain this attack in relation to infanticide. The nature of infanticide is still unknown (Dunn et al. 2002). Commerson's dolphins are smaller than harbor porpoise, and if Patterson et al.'s (1998) hypothesis is correct, then perhaps these types of interactions could have contributed to the aggressive interactions we observed.

However, the aggressive interaction between bottlenose and Commerson's dolphins reported in this study area suggests that this behavior was not be related to infanticide, but rather to the defense of the juvenile present in the group of bottlenose dolphins. During the interaction recorded on May 26, no juvenile or calf was recorded and no visible aggressive interaction took place. On the other hand, during the aggressive interaction, the juvenile dolphin along with an adult (presumably the mother) clearly remained away from the Commerson's dolphins swimming in echelon formation, while the other adults in the group chased and attacked the Commerson's dolphins. This kind of defensive cooperative behavior has been reported in other species, such as sperm whales (Palacios 1996). Bottlenose dolphins assumed a defensive behavior during the attack of a tiger shark (*Galeocerdo cuvieri*) on a calf (Mann 1999b). To our best knowledge, this is the first reported defense of a young bottlenose dolphin from another species of dolphin.

It is worth noting that the interspecific interactions witnessed during this study took place very close to the shoreline, behind the breaking waves, in an area usually used by bottlenose dolphins, but seldom by Commerson's dolphins. Commerson's dolphins seem to prefer the 15-m-depth isobath, and in Bahía Engaño this is approximately 4 km away from the coast (Coscarella 2005). Since no mixed aggregations were sighted in the area usually used by Commerson's dolphins (Coscarella, pers. obs.), this suggests that interactions between these species might only take place in the study area when Commerson's dolphins get too close to the coast line. Due to the low frequency of interactions between these species, it is unclear how important these events are in the natural behavior of these

two closely occurring species, but different habitat preferences can be proposed as a working hypothesis for the infrequency of the interactions.

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