

Stomach contents of delphinids from Rio de Janeiro, southeastern Brazil

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Abstract

This study presents an analysis of the stomach contents of six species of Delphinidae: 6 *Tursiops truncatus*, 6 *Stenella frontalis*, 3 *Steno bredanensis*, 1 *Lagenodelphis hosei*, 1 *Delphinus capensis* and 1 *Pseudorca crassidens*, from the open coastal areas of Rio de Janeiro State (21°35'S–23°10'S), southeastern Brazil. The carcasses of four stranded and 14 accidentally captured dolphins were collected from 1991 to 1999 and their stomachs were separated to be analysed. Otoliths, mandibles and spines of bony fishes and squid beaks were used to identify the prey species and to calculate the original length and weight. At least 12 fish species and two squid species, with coastal distribution and which are abundant all year round, were distinguished from examination of the stomachs. *S. frontalis* can be considered primarily a teuthophagous species, while *T. truncatus* appears to be preferentially ichthyophagous. The differences in the diet of these two sympatric species could reflect distinctive energy demands, foraging efficiency, and/or movement patterns. The data indicate that the delphinids examined during this study may move onto the continental shelf of southeastern Brazil to capture prey and can be considered opportunistic predators, feeding on those most abundant species.

Key words: delphinids, stomach contents, diet, bony fishes, squids, southeastern Brazil.

Introduction

Little is known about the diet of delphinids in Brazilian waters (Pinedo, 1982; Borobia & Barros, 1989; Schmiegelow, 1990; Emerim *et al.*, 1996). This

study presents an analysis of the stomach contents of six bottlenose dolphins (*Tursiops truncatus*), six Atlantic spotted dolphins (*Stenella frontalis*), three rough-toothed dolphins (*Steno bredanensis*), one Fraser's dolphin (*Lagenodelphis hosei*), one long-beaked common dolphin (*Delphinus capensis*) and one false killer whale (*Pseudorca crassidens*) from the open coastal areas of Rio de Janeiro State (21°35'S–23°10'S), southeastern Brazil (Figure 1).

Material and Methods

The carcasses of four stranded and 14 accidentally captured dolphins were collected from 1991 to 1999 (Table 1). During the dissection, stomachs were separated and their contents rinsed in a sieve to recover the remains. Undigested prey were measured and weighed whenever possible. Fish otoliths and squid beaks were used to identify the prey species and to calculate the original length and weight, according to Bastos (1990) and to the identification collections at the Universidade Estadual do Norte Fluminense and Universidade do Rio Grande.

For each stomach, the maximum number of either left or right otoliths and upper or lower beaks, was used as an indication of the total number of fish and squid prey, respectively. Mandibles and spines of bony fishes were used for the species identification and counted.

The age of the examined dolphins was estimated by counting the number of growth layer groups (GLGs) in the dentine (Table 1) (Perrin & Myrick, 1980). The method of decalcified thin and stained section of the teeth for optical microscope were used following the recommendations of Hohn *et al.* (1989). The growth layers were counted at the



Figure 1. Rio de Janeiro State, southeastern Brazil, where the examined delphinids were collected.

Table 1. Biological data on delphinids accidentally captured in fisheries or stranded along the coasts of southeastern Brazil from 1991 to 1999.

Species	Museum/ field code	Collection date	Body length (cm)	Sex	Age (GLGs)	Stomach content	Remarks
<i>Stenella frontalis</i> (n=6)	MN53652	Jun-92	170	F	3	solid food	accidentally captured
	BB183	Dec-96	146	F	?	solid food	accidentally captured
	MN53654	Jun-97	163	M	5	solid food	accidentally captured
	MN53655	Jun-97	157	M	4	solid food	accidentally captured
	MN53656	Jun-97	159	F	3	solid food	accidentally captured
	MN53657	May-99	198	F	?	solid food	stranded alive
<i>Tursiops truncatus</i> (n=6)	MN53657	Sep-91	162	F	0	milky substance	accidentally captured
	MN53658	Jun-92	237	M	4	solid food	accidentally captured
	MN53659	Jun-92	200	M	1	solid food	accidentally captured
	MN53660	Jun-92	184	M	1	solid food	accidentally captured
	MN53661	Oct-96	166	F	0	milky substance	accidentally captured
<i>Steno bredanensis</i> (n=3)	MN52810	May-96	295	?	11	solid food	stranded
	MN53647	Jul-92	172	M	0	milky substance	accidentally captured
	MN53648	Aug-92	250	F	6	solid food	accidentally captured
	MN50106	Sep-94	263	M	18	solid food	stranded
<i>Delphinus capensis</i> (n=1)	MN53650	Oct-96	154	F	1	milky substance	accidentally captured
<i>Lagenodelphis hosei</i> (n=1)	AC003	Sep-99	220	M	?	solid food	stranded alive
<i>Pseudorca crassidens</i> (n=1)	MN53651	Jul-92	179	F	0	milky substance	accidentally captured

MN=Museu Nacional; F=female; M=male; GLGs=growth layer groups.

mid-longitudinal sections. Only the complete layers were considered in counting for age determination.

Results

The stomach contents of six species of Delphinidae were analysed. Of the 18 samples available, 13 contained solid food remains (fish and/or squid),

while the remaining five contained only a milky substance, which was assumed to be milk. All the suckling dolphins were less than one year-old, except for the *Delphinus capensis* (Table 1).

At least 12 fish species and two squid species were distinguished from examination of the stomachs (Table 2). These prey live in coastal habitats and some of them are associated with estuarine areas.

Table 2. Food items retrieved from *Stenella frontalis*, *Tursiops truncatus*, *Steno bredanensis* and *Lagenodelphis hosei* stomachs from the coasts of southeastern Brazil from 1991 to 1999.

Species	Museum/ field code	Stomach contents				
		Prey species	No.	Size range (cm)	Mean size \pm SD (cm)	Total weight (g)
<i>Stenella frontalis</i>	MN53652	<i>Peprilus paru</i>	1	14.4	—	149.8
		<i>Isopisthus parvipinnis</i>	3	10.8–11.4	11.1 \pm 0.3	35.4
		<i>Loligo plei</i>	25	5.1–13.5	7.2 \pm 2.7	308.1
	BB183	<i>Raneya fluminensis</i>	1	11.0	—	9.5
		<i>Loligo plei</i>	40	2.1–17.0	8.1 \pm 3.9	1,043.0
	MN53654	<i>Loligo plei</i>	19	3.5–21.9	9.6 \pm 5.6	525.8
	MN53655	<i>Orthopristis ruber</i>	1	16.4	—	90.8
		<i>Loligo plei</i>	24	5.7–15.3	8.8 \pm 2.5	420.5
	MN53656	<i>Orthopristis ruber</i>	3	16.5–18.8	17.8 \pm 1.2	301.6
		<i>Loligo plei</i>	7	7.0–22.0	12.2 \pm 5.3	274.0
	MN55367	<i>Cynoscion guatucupa</i>	4	14.0–25.2	21.0 \pm 5.3	443.6
		<i>Ariosoma opisthophthalma</i>	4	12.9–42.0	28.9 \pm 12.5	162.8
		<i>Trichiurus lepturus</i>	1	98.1	—	580.4
		<i>Loligo sanpaulensis</i>	3	4.5–6.9	5.7 \pm 1.2	32.5
		<i>Loligo plei</i>	3	7.6–16.8	12.8 \pm 4.7	115.6
<i>Tursiops truncatus</i>	MN53658	<i>Porichthys porosissimus</i>	23	12.8–22.1	16.6 \pm 2.3	1,012.6
		<i>Conodon nobilis</i>	5	9.1–11.9	10.7 \pm 1.3	170.3
		<i>Loligo plei</i>	1	23.4	—	137.8
	MN53659	<i>Porichthys porosissimus</i>	4	12.5–18.4	15.2 \pm 2.5	136.7
		<i>Conodon nobilis</i>	13	7.3–13.7	10.7 \pm 2.2	466.8
		<i>Raneya fluminensis</i>	3	6.4–13.3	11.1 \pm 4.1	18.3
		<i>Pagrus pagrus</i>	4	—	—	—
	MN53660	<i>Diplodus argenteus</i>	5	—	—	—
		<i>Porichthys porosissimus</i>	5	10.8–16.9	13.7 \pm 2.5	129.7
	MN52810	<i>Conodon nobilis</i>	1	10.9	—	34.9
		<i>Raneya fluminensis</i>	3	9.6–12.5	10.9 \pm 1.5	13.1
		<i>Trichiurus lepturus</i>	37	63.0–122.6	90.7 \pm 15.7	18,722.7
		<i>Micropogonias furnieri</i>	1	18.2	—	56.3
		<i>Orthopristis ruber</i>	2	5.9–18.1	12.0 \pm 8.6	102.3
	<i>Steno bredanensis</i>	MN53648	<i>Loligo plei</i>	10.0	—	19.6
MN50106		<i>Trichiurus lepturus</i>	3	—	—	—
<i>Lagenodelphis hosei</i>	AC003	<i>Trichiurus lepturus</i>	1	—	—	—
		<i>Loligo sanpaulensis</i>	5	2.6–6.9	4.3 \pm 1.9	29.7
		<i>Loligo plei</i>	4	5.1–6.9	6.0 \pm 1.0	25.6

Around 83% of the fish species recovered from the dolphin stomachs were demersal, while the squids can be considered semipelagic.

Discussion

In general, the prey species depth range is up to 100 m and they are abundant all year round in the study area (Figure 1) (Figueiredo & Menezes, 1978; Menezes & Figueiredo, 1980; Haimovici *et al.*, 1989).

The stomach content analysis indicated that *S. frontalis* can be considered primarily a teuthophagous species (Table 2). The preference for

squids as food item is in agreement with previously published data on the genus *Stenella* in the Mediterranean Sea (Duguay *et al.*, 1979) and eastern Pacific Ocean (Robertson & Chivers, 1997).

Emerim *et al.* (1996) analysed three stomach contents of *S. frontalis*, collected in southern Brazil ($\sim 28^{\circ}$ S), and reported the presence of squids (family Loliginidae) and fishes (*Trichiurus lepturus* and *Cynoscion guatucupa*). At Atafona village ($21^{\circ}35'S$), where the stomachs of five *S. frontalis* analysed during this study were collected, the fishermen had already observed the nocturnal presence of 'spotted dolphins' (*cf.* genus *Stenella*) close to their boats, feeding on squids. The nocturnal

feeding behaviour of spotted dolphins was reported by Richard & Barbeau (1994) in the Gulf of Mexico.

T. truncatus from southeastern Brazil appears to be preferentially ichthyophagous, preying upon species living near the sea-bottom (Table 2). This was reported by Pinedo (1982) for *T. truncatus* inhabiting southern Brazilian coastal waters (~32°S). Studies on the food habit of *T. truncatus* from the Indian River Lagoon (Barros, 1993) and Sarasota Bay (Barros & Wells, 1998), Florida, U.S., indicated that these animals are ichthyophagous, while other studies in the adjacent open beaches of the Gulf of Mexico showed that they may also prey on squid (Barros & Odell, 1990).

Barros (1993) suggested that the feeding habits of *T. truncatus* in protected areas could differ from those living in more open coastal habitats. All dolphins analysed in our study preyed on coastal species, which could reflect their inshore habits.

Only the fish *T. lepturus* was recorded for the two samples of *S. bredanensis* with solid food remains in their stomachs (Table 2). This small cetacean is usually described as an oceanic species (Jefferson *et al.*, 1993); however, records of sightings and accidental captures in the Brazilian waters, suggest also a coastal habit in this region (Ott & Danilewicz, 1996; Di Benedetto *et al.*, 1998).

Only squids were recognised in the stomach of *L. hosei* (Table 2). Given the oceanic habits of this dolphin (Jefferson *et al.*, 1993) and the coastal distribution of the squids *Loligo sanpaulensis* and *Loligo plei* present in its stomach content, it is likely that these prey were taken when the dolphin approached the coast before stranding. This was also proposed by Santos & Haimovici (1998) for four *L. hosei* stranded along the coasts of southern Brazil (30°S–32°S) and by Zerbini & Santos (1997) for a *Feresa attenuata* stranded on São Paulo State coast (24°S), southeastern Brazil.

For the first time, the food items of *S. frontalis*, *T. truncatus*, *S. bredanensis* and *L. hosei* from the southeastern Brazilian coast are described. Our data indicate that the Delphinidae species examined during this study may move onto the continental shelf of southeastern Brazil to capture prey and can be considered opportunistic predators, feeding on those most abundant species (see also Pinedo & Rosas, 1989; Zerbini & Santos, 1997). Opportunistic feeding behaviour seems to be a general feature of delphinids (Sekiguchi *et al.*, 1992; Robertson & Chivers, 1997). In the study area, data on the accidental capture in gillnets support the hypothesis that *S. frontalis* and *T. truncatus* are sympatric species (Di Benedetto *et al.*, 1998). Then, the differences in the diet of these delphinids could reflect distinctive energy demands, foraging efficiency, and/or movement patterns.

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