Biology and conservation of the franciscana (*Pontoporia blainvillei*) in the north of Rio de Janeiro State, Brazil

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ABSTRACT

This paper describes the interactions of the franciscana (*Pontoporia blainvillei*) with fisheries in the north of Rio de Janeiro State ($21^0$18'S-$22^0$25'S) and presents new information on its biology. A total of 181 dolphins were caught in gillnet fisheries in northern Rio de Janeiro from 1986-1999. The annual catch per unit effort (CPUE) values varied from 0.2-1.8 dolphins per gillnet fishing effort. Incidental captures were recorded throughout the year, usually less than 10 n.miles from shore, in depths less than 30m and in surface-set gillnets. There was no difference in the proportion of sexes (1 male:1.1 females). Males ranged from 66-130.0cm and 0-5 years and females from 74-147.5cm and 0-9 years. The predicted asymptotic length (using the Gompertz model) was 121.9cm for males and 145.6cm for females. Calving occurs throughout the year, with no seasonal pattern. Females attain sexual maturity at 3 years and 130.0cm in length and males at 2 years and 115.0cm. Individuals up to the age of three years represented 74% of the dolphins captured. Franciscana preferentially feed on the teleosts *Stellifer* sp., *Anchoa filifera*, *Pellona harroweri* and *Isopisthus parvipinnis*, measuring up to 10cm of length, and on the cephalopods *Loligo sanpaulensis* and *L. plei*. No internal parasites were observed. The barnacle *Xenobalanus globicipitis* was recorded on only one individual. Sightings were recorded in all seasons and 90% of them were obtained up to 5 n.miles from shore, in waters up to 15m deep. Around 70% of groups sighted consisted of up to five dolphins. Estimates of the population size and continuous gillnet fleet monitoring are required to conserve franciscana in the northern limit of its distribution range. The differences in the somatic, reproductive and genetic patterns of franciscana represent important aspects that may be used as evidence to best define their stocks. These variations may reflect the reduction of gene flow between populations, the allocation of resources between growth and reproduction and/or the influence of environmental features, such as water temperature and food availability.

KEYWORDS: FRANCISCANA; BIOLOGY; CONSERVATION; SOUTH ATLANTIC; BRAZIL

INTRODUCTION

The franciscana, *Pontoporia blainvillei* (Gervais and D'Orbigny, 1844), is restricted to the coastal Atlantic waters of South America from Itaúnas (~18°S), southeastern Brazil to Nuevo Gulf (~42°S), Argentina (Siciliano, 1994; Crespo *et al.*, 1998). The preferred habitat of the species is the upper continental shelf, within 30 n.miles from the coastline or depths of up to 30m (Praderi *et al.*, 1989).

Stock identity

Pinedo (1991) proposed at least two different forms of franciscana based on osteological differences: one found to the north (smaller animals) and the other to the south (larger animals) of Santa Catarina State (~29°S). Ramos *et al.* (2000a) presented data on age and growth of individuals from Rio de Janeiro State (~22°S) and found asymptotic lengths smaller than those found by Kasuya and Brownell (1979) for franciscanas from Uruguay (~34°S). This corroborates the study of Pinedo (1991) regarding the existence of at least two different phenotypic forms. Further, Ramos *et al.* (2000b) presented data on growth of franciscana collected in São Paulo State (~24°S) and found that they were smaller than individuals from Rio de Janeiro State (~22°S). Thus the existing morpholgical data support the existence of more than two stocks.

Secchi *et al.* (1998) analysed the mtDNA from 10 franciscanas of each of the geographic forms proposed by Pinedo (1991). Samples from Rio de Janeiro and Rio Grande do Sul States (~33°S) provided genetic evidence for at least two genetic populations. Recent studies on mtDNA analyses for franciscanas from Uruguay and Argentina were conducted by Lázaro and Lessa (2000) and Hamilton *et al.* (2000). These studies made comparisons with the results published by Secchi *et al.* (1998) and suggested the existence of one genetic population involving dolphins from Rio Grande do Sul State, Uruguay and Argentina. No haplotypes from these locations were shared with dolphins from Rio de Janeiro State, corroborating the hypothesis of at least two genetically distinct populations of franciscana. In addition, Zanelatto and Valsecchi (2000) presented preliminary results on the analysis of the mtDNA obtained from franciscanas collected in Paraná State (~25°S), an intermediate area between Rio Grande do Sul and Rio de Janeiro States. These results were also compared with those published by Secchi *et al.* (1998) and suggest that individuals from Paraná State are more similar to those from Rio Grande do Sul than to those from Rio de Janeiro State.

Fishery interactions

The franciscana has been affected by fisheries along its distributional range (e.g. Praderi *et al.*, 1989; Corcuera *et al.*, 1994; Pinedo, 1994; Siciliano, 1994; Secchi *et al.*, 1997). The assessment of the coastal fisheries impacts on franciscana populations and knowledge of its life history are essential for conservation and management (IWC, 1994).

The objective of this paper is to describe the interactions of the franciscana with fisheries and present new information on its biology in northern Rio de Janeiro, Brazil.

MATERIALS AND METHODS

Study area

The State of Rio de Janeiro has the third longest coastline (636km) in Brazil and is the third largest fish producer (Di Beneditto *et al.*, 1998). The geographic limits to its northern coast are Barra do Itabapoana (21°18'S) and Macaé (22°25'S) and the Paraíba do Sul River (the major river run off of Rio de Janeiro) is located in this area (Muehe and Valentini, 1998). The area offshore northern Rio de Janeiro

is known as Campos Basin (Fig. 1), where the shelf break is located from 40-60 n.miles from the coastline (Petrobras, 1993).

Gillnets are the only fishing gear responsible for incidental mortality of small cetaceans in northern Rio de Janeiro (Di Beneditto *et al.*, 1998) and Atafona (21°35'S) is the most representative harbour in terms of gillnet fishing effort.

Interactions with fisheries

Fishing effort

Fishing effort was calculated through monthly interviews with the master of each gillnet boat based in Atafona village. Information requested included: (1) gillnet dimensions; and (2) days of active fishing operations.

The gillnet fishing effort presented by Di Beneditto *et al.* (1998) for the same region and the effort calculated in this study were used to calculate annual catch per unit effort (CPUE) values for franciscanas in northern Rio de Janeiro.

Bycatches

Information on franciscana interactions with fisheries was collected through weekly interviews with fishermen on board each gillnet boat based in Atafona village. The following information was targeted when collecting data on franciscana mortality: (1) mortality area (distance from the coastline and depth); (2) gillnet position in the sea; (3) seasonality of occurrence; and (4) utilisation of the incidentally captured dolphins. The seasons were grouped into spring-summer (October to March) and autumn-winter (April to September) with high and low temperatures and rain, respectively.

Biological information

Growth and reproductive parameters of the franciscana in northern Rio de Janeiro were initially analysed by Ramos *et al*. (2000a) and they have been revised and updated in the present study. The total sample ($n = 117$) consisted of the 93 specimens analysed previously by Ramos *et al.* (2000a) between 1989 and 1998, 20 specimens collected between 1986 and 1988 (Museum of the Universidade de São Paulo – MUZUSP) and 4 specimens collected recently by the authors. Methodology followed that in Ramos *et al.* (2000a).

Length

The body length of all individuals, including foetuses, was measured along the longitudinal axis of the body from the tip of the upper jaw to the notch of the flukes (Norris, 1961).

Age

Age was estimated by counting the number of growth layers groups (GLGs - IWC, 1980) in the dentine and cementum. The previously described franciscana GLG pattern (Pinedo and Hohn, 2000; Ramos *et al.*, 2000a) was adopted, i.e. one complete dentinal GLG comprising one narrow, unstained layer and one stained broad layer; a fine darker layer demarcated the unstained layer of subsequent GLGs. In the cementum, one complete GLG comprised one narrow stained layer and one wide weakly stained layer. The method of obtaining decalcified thin and stained sections of the teeth followed the recommendations of Hohn *et al*. (1989) and IWC (1980). Foetal age was extrapolated through a combination of length at birth of 71cm, gestation period of 10.5 months and prenatal growth rate of 0.25cm/day

Growth

Growth was determined by fitting a non-linear Gompertz model to length-at-age data (Zullinger *et al.*, 1984) using *Curve Expert* 1.3 for Windows.

Maturity

Females with at least one corpus on the external surface of the ovary, pregnant (judged by the presence of foetus) or lactating (judged by the presence of milk in the mammary glands) were considered sexually mature. Males with sperm in the epididymis were considered sexually active (although see below). Individuals showing all epiphyses fused to vertebra were considered physically mature (Perrin and Reilly, 1984; Pinedo, 1995).

Feeding

Stomach contents of 89 franciscanas were analysed in order to investigate feeding habits. Undigested prey were measured and weighed. Teleost otoliths and cephalopods beaks were used to identify, quantify and estimate the length and weight of the prey species. Crustaceans were quantified and identified by the rostrum or telson and it was not possible to estimate their length and weight. The Index of Relative Importance (IRI; Pinkas *et al.*, 1971) was calculated to

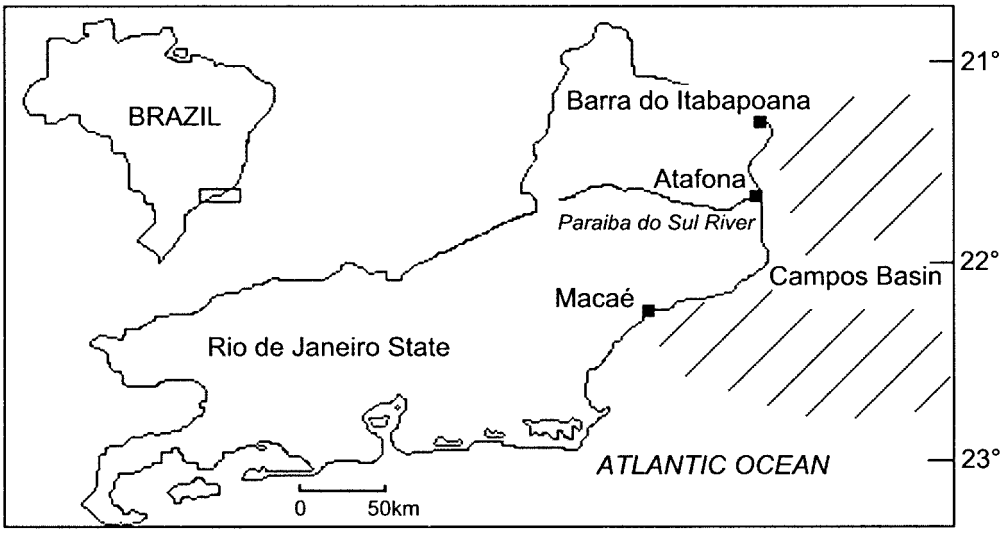

Fig. 1. Map of Rio de Janeiro State, indicating the geographic limits of the northern coast (Barra do Itabapoana and Macaé), Atafona village and Campos Basin area.

determine representative prey species; teleosts and cephalopods were considered as independent prey to reduce under or overestimation of their importance (Clarke, 1986).

Epizoics and parasites
The external body surface of 97 individuals and the internal organs (stomach, heart, lungs, kidneys and gonads) of 48 individuals were macroscopically examined in order to determine the presence of epizoics and parasites, respectively. The prevalence of infestation was calculated according to Bush *et al*. (1997).

Distribution and relative abundance
Three methods were used to obtain information on the distribution and abundance of franciscana: (1) nine boat cruises were carried out between Atafona and Macaé; (2) observations were made from a fixed platform in Atafona; and (3) sightings information provided by fishermen who operated along the Campos Basin was compiled. The cruises were conducted from a local fishing boat, and occurred monthly between April and December 1993 with each trip lasting 2-3 days. Transects were parallel to the coastline and located between 0.5 and 3.0 n.miles from the coast, in waters ranging from 5-12m deep. The fixed platform in Atafona was located on the beach, 1km away from the Paraíba do Sul River mouth and 20m away from the surf-zone. Observations took place from July 1994 to October 1997 and the sightings effort ranged from 12-24 days each month, totalling 796 days. Information on sightings [(1) group size; (2) sighting area (distance from the coastline and depth); and (3) seasonality of occurrence] was also obtained from 60 fishermen through monthly interviews. These fishermen represented 10% of the total fishermen based in Atafona village and they contributed sightings data between January 1995 and December 1998.

RESULTS AND DISCUSSION

Interactions with fisheries

Fishing gear
The gillnet locally called *caída* is the most commonly used in the study area (Fig. 2). Its position in the sea is determined by wind conditions and/or target species. If the wind is from the northeast, the net is usually surface-set, while with southwest or southerly winds it is bottom-set. The *caída* comprises approximately 20-22 panels and the total length of each net is 2.2-2.4km. Each panel is 110m long and has 25 small rounded floats (8cm in diameter) attached to the upper frameline and 24 200g leads in the lower frameline. When the net is set near the sea bottom, a stone of 8×8×8cm is attached to every eight leads, totalling three stones per panel. There are floats of 30×24×24cm for every six panels. The *caída* net stretched mesh size is 14cm, selecting species ranging from 40-80cm in length. Sharks (*Carcharhinus acronotus*, *C. plumbeus*, *C. brevipina*, *C. limbatus*, *Rhizoprionodon porosus*) and sciaenids (*Micropogonias furnieri*, *Cynoscion* sp.) are the main target species. Boats using the *caída* net operate along the Campos Basin from 1-40 n.miles offshore, in depths ranging from 6-70m. The fishing ground is usually defined by the target species (Di Beneditto *et al.*, 1998).

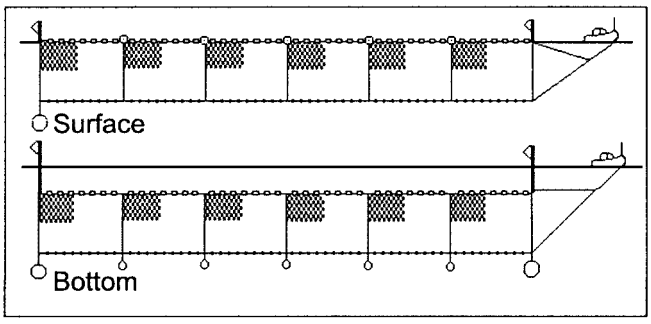

Fig. 2. Scheme of the surface and bottom-set gillnet used in northern Rio de Janeiro, locally called *caída*.

Effort
Data on the gillnet fishery in northern Rio de Janeiro were analysed by Di Beneditto *et al*. (1998) from 1987-88 and from 1990-1996. During the period mentioned above, approximately 60 boats used gillnets and their fishing area encompassed the Campos Basin. The authors estimated that the total gillnet fishing effort in each year was around 12,000km of net.

Since 1997, the number of gillnet boats operating along the Campos Basin has decreased to 50 boats. From this it has been assumed that the effort decreased by 19% and the total gillnet fishing effort in each year was around 9,700km of net, from 1997-1999.

Franciscana catches
The first record of franciscana in northern Rio de Janeiro was in June 1986, when three individuals were incidentally captured (Lodi *et al.*, 1987). From June 1987 to May 1988, Lodi and Capistrano (1990) monitored the gillnet fishery in Atafona village and recorded the entanglement of 20 franciscanas. From June 1988 to August 1989, the fishery was not monitored, but the incidental capture of two franciscanas was recorded (Di Beneditto *et al.*, 1990). In the subsequent years (September 1989 to December 1999), the gillnet operation was continuously monitored and 156 dolphins were recorded. A total of 181 dolphins were caught in gillnet fisheries in northern Rio de Janeiro from 1986-1999.

According to the interviews with fishermen, almost 75% of the incidental captures in northern Rio de Janeiro occurred within 10 n.miles from shore and in depths shallower than 30m. Although the gillnet fishery can operate up to 40 n.miles away from the coastline, this information suggests that the impact on the franciscana is greater when the fishery occurs closer to the coast. This has also been found in other areas, e.g. southern Brazil, Uruguay and Argentina (Praderi *et al.*, 1989; Corcuera *et al.*, 1994; Secchi *et al.*, 1997).

Around 55% of the captures occurred in surface-set nets while 29% were observed in bottom-set nets. It was not possible to obtain information on the position of the net for 16% of the captures. The predominance of captures in surface-set nets may be biased due to the prevailing local wind conditions, since the northeast wind is predominant in the study area (Martin *et al.*, 1998). Unfortunately, data on the relative fishing effort for surface and bottom-set gillnets are not available.

The capture data suggest that there is no seasonal variation in the occurrence of franciscana off northern Rio de Janeiro (52% in spring-summer and 48% in autumn-winter).

Blubber of incidentally captured franciscanas were used as shark bait in the longline fishery. Each individual provided around 30-40 pieces of bait, measuring 8×12cm. Since 1995, this fishery has become uncommon in the study

area. However, franciscana was never a target of the fishery and its usage as bait was occasional, following incidental capture.

CPUE analysis

In this study, the CPUE analysis considered the incidental capture of 166 franciscanas that occurred from 1987-88 and from 1990-1999. Until 1996 the annual fishing effort used in the CPUE analysis was 12,000km of net (Di Beneditto *et al.*, 1998), and from 1997-1999 the annual effort used was 9,700km of net.

The annual CPUE values varied from 0.2-1.8 dolphins per gillnet fishing effort, and the changes in the catch recorded in 1994 and 1999 are probably random or due to uncontrolled variables (Fig. 3). The CPUE values in northern Rio de Janeiro are lower when compared to other areas, e.g. southern Brazil (~ 31° - 32°S) (Secchi *et al.*, 1997), Uruguay (~ 34° - 35°S) (Crespo *et al.*, 1986) and Argentina (~ 36°-41°S) (Corcuera *et al.*, 2000).

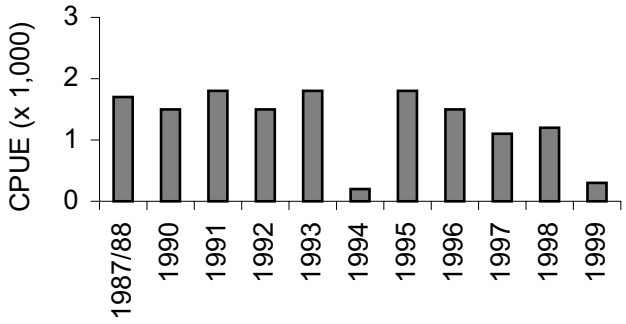

Fig. 3. Catch per unit of effort (CPUE x1,000) of franciscanas in northern Rio de Janeiro from 1987-1988 and from 1990-1999.

Biological information

Age, length and growth

No difference was observed in the ratio of males and females of franciscana (sex ratio 1:1.1), suggesting that there is no sexual segregation of the species in the area. The age ranged from two months to five years for males ($n = 62$) and zero (newborn) to nine years for females ($n = 57$). The oldest known female is 21 years (Pinedo, 1994) and male is 16 years (Kasuya and Brownell, 1979).

Males and females up to three years old represented 74% of the captures. Similar age structures have been observed for incidentally killed franciscanas in southern Brazil (50% - Pinedo, 1994; 81.3% - Ott, 1997), Argentina (64% - Corcuera *et al.*, 1994) and Uruguay (77.5% - Kasuya and Brownell, 1979). The age structure of the populations affected by the fisheries indicates a capture bias towards juveniles.

Franciscanas ranged in length from 66.0-130.0cm for males ($n = 62$) and from 74.0-147.5cm for females ($n = 57$). Length distributions (Fig. 4) were unimodal for males and bell-shaped for females. The largest male (130cm) and female (147.5cm) captured off Rio de Janeiro were substantially smaller than those taken in more southern areas. The largest male and female from Uruguay were 147cm and 171cm long, respectively (Kasuya and Brownell, 1979). In southern Brazil, the largest male and female were 152.0cm and 177.0cm, respectively (Pinedo, 1995).

Growth curves fitted to length-at-age data by a Gompertz model are presented in Fig. 5 and the estimated growth parameters are given in Table 1. The estimated asymptotic length of males was 121.9cm and that of females was

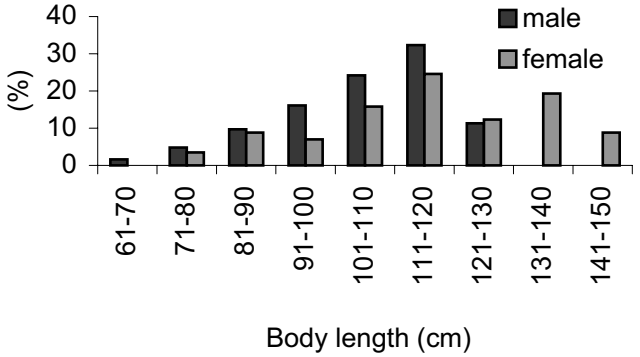

Fig. 4. Length distribution of males ($n = 62$) and females ($n = 57$) of franciscana incidentally captured in northern Rio de Janeiro.

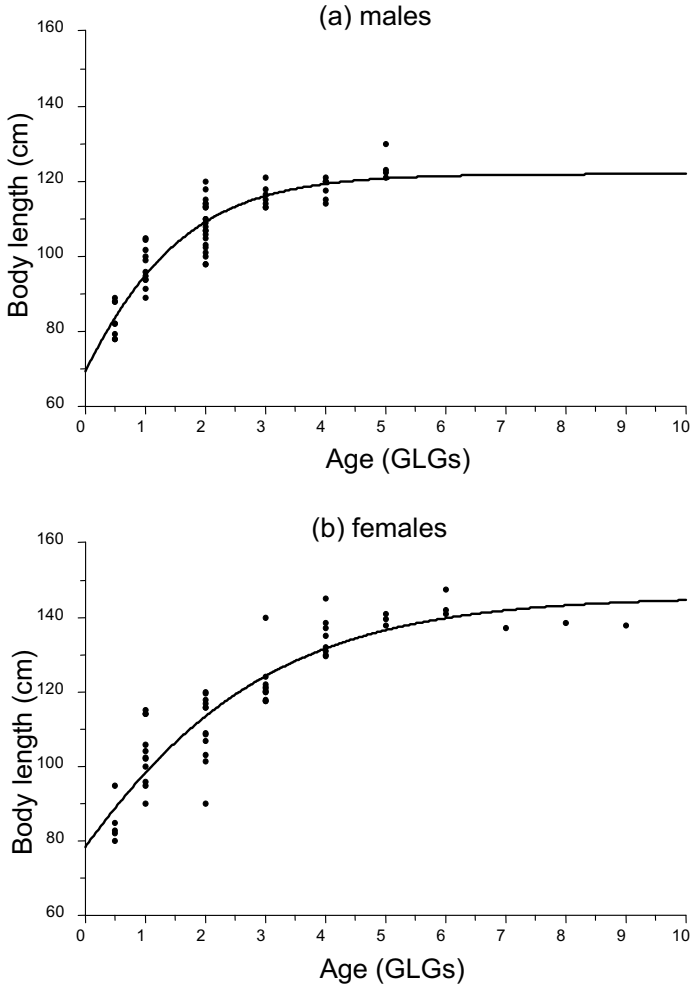

Fig. 5. Length-at-age data of 60 males (curve a) and 57 females (curve b) of franciscana incidentally captured in northern Rio de Janeiro. The solid line represents the predicted growth trajectory from the Gompertz model.

145.6cm. Although these values may represent further evidence of phenotypic differences, caution should be exercised given the under-representation of old animals in this sample.

The lengths of the nine foetuses ranged from 8.5-65.5cm and the estimated range of ages was 1.3-9.7 months. Body length of new-born (0 GLG) and calves (0.5 GLG) varied between 66.0 and 85.0cm. The limited information available suggests that calving may occur throughout the year and that seasonal breeding does not occur in northern Rio de Janeiro. This differs from the seasonal timing of births proposed for franciscanas from southern Brazil and Uruguay, which show

Table 1
Growth parameter values from the Gompertz growth model fitted to length-at-age data of franciscana incidentally captured in northern Rio de Janeiro State.

Sex	*n*	Age range (years)	Body length range (cm)	Asymptotic length (cm)	Correction factor	Growth rate constant	Correlation coefficient (r)
Male	60	0-5	66.0-130.0	121.9	-0.5764	0.815	0.93
Female	57	0-9	74.0-147.5	145.6	-0.4825	0.453	0.92

parturition occurring in the spring from September to December (Harrison *et al.*, 1981; Brownell, 1984; Pinedo *et al.*, 1989).

The youngest mature females were three years old. The length of mature females ranged from 130.0-147.5cm. Of the 15 mature females, 6 were pregnant, 4 lactating and 2 pregnant and lactating. Due to the testis size, it was not possible to observe macroscopically the sperm in the epididymis. Ramos *et al*. (2000a) had examined the relationship between the length of the testis and body length in the study area. They observed an increase in testis size when individuals attained approximately 115cm in length and reached the age of two. These results suggest that females attain sexual maturity at three years and about 130cm long and males at two years and about 115cm long.

Individuals from northern Rio de Janeiro reached sexual maturity at ages 2-3 years to that estimated for animals from Uruguay 2.7-3.0 years but at somewhat smaller lengths than those from Uruguay where males were about 130cm and females about 140cm (Kasuya and Brownell, 1979; Harrison *et al.*, 1981; Brownell, 1984).

Physical maturity was observed in males from 120-121cm in length (average of 120.5cm) and from 3-5 years. Whereas in females, the length and age varied from 138-147.5cm (average of 140.6 cm) and from 3-9 years old. The length at physical maturity was smaller than observed for animals from Uruguay (133.3cm for males and 150cm for females - Kasuya and Brownell, 1979).

Feeding

Eighty-five out of 89 dolphins examined contained food remains. The youngest specimen with contents in the stomach was a 79cm two-month old male, suggesting that it was already ingesting solid food.

Teleosts were recorded in 95% of the stomachs. Twenty species from six families were identified (Table 2). The number of species in each stomach varied from one to nine. All species are neritic and 55% of them are associated with estuarine areas (Menezes and Figueiredo, 1980). The franciscana appears to feed preferentially on *Stellifer* sp., *Anchoa filifera*, *Pellona harroweri* and *Isopisthus parvipinnis*. Backcalculation of prey lengths indicate that franciscana feed on individuals of up to 10cm in length. Observed feeding habits in other areas also reveal a preference for juveniles or small sized teleosts (Pinedo *et al.*, 1989; Ott, 1994; Bassoi, 1997).

Cephalopods were recorded in 66% of the stomachs. Loliginidae species *Loligo sanpaulensis*, *Loligo plei* and *Lolliguncula brevis*, were identified. The number of species in each stomach varied from one to three and the average

Table 2
Prey species of franciscana in northern Rio de Janeiro State.

	Density (per stomach)		Size (cm)		Biomass (g) (per stomach)		
Species	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	IRI
Teleosts							
Stellifer sp.	1-148	23.2 ± 33.8	1.8-5.1	2.9 ± 0.6	0.2-102.7	12.4 ± 19.0	1,629.3
Anchoa filifera	1-129	10.3 ± 22.0	4.0-7.6	6.1 ± 0.9	1.1-245.6	28.9 ± 50.4	1,368.4
Pellona harroweri	1-93	12.3 ± 20.8	2.0-9.6	4.3 ± 2.1	0.2-200.8	21.7 ± 40.6	1,137.2
Isopisthus parvipinnis	1-78	10.9 ± 17.9	1.7-8.4	5.0 ± 1.7	0.1-103.2	18.2 ± 24.8	1,029.3
Cynoscion jamaicensis	1-122	12.6 ± 26.9	2.8-13.8	4.5 ± 2.4	1.3-78.4	14.1 ± 20.4	429.8
Chirocentrodon bleekerianus	1-40	12.6 ± 11.8	5.6-8.7	7.3 ± 0.9	3.4-205.8	51.8 ± 52.6	408.5
Stellifer brasiliensis	1-29	6.7 ± 7.9	2.2-5.6	3.2 ± 0.8	0.5-29.3	6.4 ± 7.5	249.7
Sardinella brasiliensis	1-32	14.4 ± 12.9	4.4-11.1	5.9 ± 2.1	6.0-211.6	106.1 ± 86.8	161.6
Peprilus paru	1-13	3.3 ± 4.3	2.7-8.1	5.5 ± 1.6	1.5-249.2	35.0 ± 70.0	112.5
Stellifer rastrifer	1-27	9.9 ± 9.7	1.5-5.9	3.7 ± 1.5	0.4-88.7	27.6 ± 30.4	53.5
Odontognathus mucronatus	1-13	4.0 ± 4.0	3.9-11.9	8.0 ± 3.1	0.6-100.2	22.2 ± 32.8	36.4
Micropogonis furnieri	2-10	4.2 ± 2.7	3.9-7.0	6.1 ± 1.1	0.8-28.1	8.8 ± 7.9	25.1
Trichiurus lepturus	1-3	1.4 ± 0.7	11.3-36.7	24.8 ± 8.8	1.6-43.1	10.3 ± 13.3	20.5
Ctenosciaena gracilicirrhus	1-4	2.0 ± 1.4	2.8-7.4	4.3 ± 1.6	0.8-57.0	11.2 ± 20.6	14.2
Anchoviella lepidentostole	1-26	14 ± 12.5	5.6-6.8	6.3 ± 0.6	3.6-105.7	47.4 ± 52.6	12.2
Paralonchurus brasiliensis	1-3	2.0 ± 0.8	1.3-5.6	3.6 ± 1.8	0.3-4.5	2.5 ± 1.7	3.6
Porichthys porossisimus	1-2	1.5 ± 0.7	5.5-6.4	6.0 ± 0.6	2.4-3.1	2.8 ± 0.5	0.5
Cynoscion virescens	-	-	2.2-2.4	3.0 ± 0.7	-	-	0.4
Larimus breviceps	-	-	-	4.5	-	-	0.1
Macrodon ancylodon	-	-	-	4.7	-	-	0.1
Cephalopods							
Loligo sanpaulensis	1-75	15.3 ± 18.8	2.3-11.1	5.4 ± 1.9	1.1-815.9	128.1 ± 187.0	6,382.6
Loligo plei	1-32	6.6 ± 7.2	7.9-23.0	15.0 ± 4.0	14.1-2,415.1	473.1 ± 593.9	3,007.2
Lolliguncula brevis	1-11	3.4 ± 2.8	3.9-7.5	5.2 ± 1.0	4.9-89.8	34.7 ± 28.1	340.3

mantle length from 5.2-15.0cm. These cephalopods are also neritic and *L. brevis* is also associated with estuarine areas (Roper *et al.*, 1984). The species *L. sanpaulensis* and *L. plei* were the most representative in the diet of franciscana (Table 2).

Crustaceans were recorded in only 25% of the stomachs, which suggests that they are of lesser importance in the diet of the franciscana. Two species, *Artemesia longinaris* and *Xyphopenaeus kroyeri*, were identified.

In southern Brazil (30°S-33°S), franciscanas feed mainly on the teleost *Cynoscion guatucupa* and the cephalopod *L. sanpaulensis* (Pinedo *et al.*, 1989; Ott, 1994; Bassoi, 1997). Differences in the diet along its distribution may reflect differences in prey availability and, possibly, abundance.

In northern Rio de Janeiro, the main prey species of the franciscana are abundant throughout the year in coastal areas (Haimovici *et al.*, 1989; Di Beneditto *et al.*, 1998). In general, they have low commercial value or are considered as bycatch species in the local fisheries. Even when the franciscana prey is commercially valuable (e.g. *I. parvipinnis, L. sanpaulensis* and *L. plei*), the fishery targets larger individuals than those consumed by the franciscana (Costa and Haimovici, 1990; Di Beneditto *et al.*, 1998). A comparison between the diet of the franciscana and another small cetacean species common in the region, the tucuxi (*Sotalia fluviatilis*), indicates that they are coexisting with a low competition level for the trophic resources (Di Beneditto, 2000).

Epizoics and parasites

In the present study, 97 franciscanas were externally examined. Only the epizoic, the barnacle *Xenobalanus globicipitis* attached to the caudal fin was recorded and then for only one individual (intensity = 1, prevalence = 1.03%, total length of the epizoic = 48.3mm). This species has also been recorded on the body of franciscanas along the Uruguayan coast (Pinedo *et al.*, 1989).

None of the 48 dolphins examined in this study had parasites in their internal organs. Santos *et al.* (1996) analysed the same internal organs of 42 franciscanas incidentally captured in northern Rio de Janeiro and discussed the absence of parasites in this region, comparing this with the high prevalence of parasites found in franciscanas from other areas (Raga *et al.*, 1994; Andrade *et al.*, 1995). These authors suggested that the non-occurrence of parasites in franciscanas in northern Rio de Janeiro is due to a lack of suitable intermediate hosts or the lack of parasitism in such intermediate hosts. The results in this study corroborate Santos *et al.* (1996) regarding the absence of parasites in franciscana in the study area.

Distribution and relative abundance

Forty sightings of franciscanas were recorded by all combined methods in northern Rio de Janeiro. Group sizes ranged from 1-15 dolphins. In general, groups were small and 70% of them were composed of five dolphins or less. Sightings were made in areas near the coast and 90% of the total were obtained up to 5 n.miles away, in waters up to 15m deep. The frequency of occurrence of franciscana was 52.5% in the spring-summer period and 47.5% in the autumn-winter period.

Sightings of this species are difficult to record due to their small body size, small group size and the absence of aerial behaviour (Jefferson *et al.*, 1993; Bordino *et al.*, 1999). Group sizes of franciscana sighted in northern Rio de Janeiro follows the same pattern noted in other areas (Pinedo, 1994; Crespo *et al.*, 1998; Bordino *et al.*, 1999).

In Argentina, franciscana sightings near the coastline are frequent during spring and summer. In winter, groups usually move away from the coast (Bordino *et al.*, 1999). This pattern was not observed in northern Rio de Janeiro, where sightings close to the coastline were recorded throughout the year. Lack of seasonal variation in movement patterns may be related to two non-excluding factors: water temperature and prey availability. Sea surface temperature in the region (ranging from 21°18'S to 22°00'S) does not change substantially throughout the year, varying from 20-24°C (Muehe and Valentini, 1998; Souza *et al.*, 1998). This region corresponds to the area where the sightings of franciscana have been frequently recorded off northern Rio de Janeiro. Temperature changes of the water surface within the range of this species may affect the seasonality of occurrence in certain areas. Unlike northern Rio de Janeiro, there is a marked variation in sea surface temperature in Argentina and a possible consequent movement pattern as proposed by Bordino *et al.* (1999).

In addition, there may be variation in the availability and/or movement of the prey preferably consumed by franciscana throughout its distribution area. In northern Rio de Janeiro, the franciscana prey species are resident teleost and cephalopod resources that are abundant year round. This may be also related to the lack of seasonal variation in the franciscana movement pattern in the study area.

CONCLUSIONS

Estimates of the population size and continuous gillnet fleet monitoring are required to conserve franciscana in the northern limit of its distribution range.

The differences in the somatic, reproductive and genetic patterns of franciscana represent important factors that may be used as evidence to define their stocks for management purposes. These variations can reflect the reduction of gene flow between populations, the allocation of resources between growth and reproduction and/or the influence of environmental features, such as water temperature and food availability.

Further research, especially in Rio de Janeiro and Rio Grande do Sul States, is necessary to better understand the biological and conservation aspects regarding the franciscana.

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