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FEEDING ECOLOGY OF THE FRANCISCANA (*PONTOPORIA BLAINVILLEI*) IN MARINE AND ESTUARINE WATERS OF ARGENTINA

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Abstract – Stomach contents of 110 franciscanas (*Pontoporia blainvillei*), from northern Argentina were analysed in order to improve our knowledge about the feeding habits of this species and to better characterise the lactation period. The samples included calves, juveniles and adults of both sexes. Evidence of predation by franciscanas is seen at a very young age (2.5-3 months), with a transition diet composed by both milk and solid food, mainly represented by crustaceans. Weaning seems to begin by April, when franciscanas are about 6-7 months old. Franciscanas inhabiting two different habitats were analysed in this study: a brackish water estuary and an adjacent marine coastal system. The diet of *Pontoporia blainvillei* in northern Argentina was composed by a total of 26 prey species: 20 teleosts, 4 crustaceans and 2 cephalopods. Based on the Index of Relative Importance (IRI) the main prey species were *Cynoscion guatucupa*, *Micropogonias furnieri*, *Loligo sanpaulensis* and *Urophycis brasiliensis*. Estuarine franciscanas preyed mainly on *Micropogonias furnieri* (dominant species), *Cynoscion guatucupa*, *Odonthestes argentinensis* and *Macrodon ancylodon*, while dolphins from marine areas preyed mainly on *Cynoscion guatucupa* (dominant species), *Loligo sanpaulensis* and *Urophycis brasiliensis*. Our results confirm that franciscanas prey mainly on juvenile fish (< 8cm) and small loliginid squids, in close agreement with previous results obtained in southern Brazil and Uruguay. Qualitative and quantitative differences observed in the diet of dolphins from each habitat emphasise the need to discriminate between samples from different habitats and environmental parameters.

Resúmen – Se analizaron 110 contenidos estomacales de franciscanas (*Pontoporia blainvillei*) provenientes de la costa norte de Argentina, para extender en conocimiento sobre su dieta y caracterizar la lactancia. Las muestras incluyeron cachorros, juveniles y adultos de ambos sexos. Las primeras etapas de predación se inician a muy temprana edad (2,5-3 meses), presentando una dieta de *transición* compuesta tanto por leche como por presas sólidas, principalmente crustáceos; el destete se iniciaría a partir de abril, a una edad estimada entre 6 y 7 meses. Las franciscanas estudiadas provienen de dos habitats diferentes: un área estuarial de baja salinidad y la region marina adyacente. La dieta de *Pontoporia blainvillei* de Argentina estuvo compuesta por un total de 26 especies: 20 teleósteos, 4 crustáceos y 2 cefalópodos. Basados en el Indice de Importancia Relativa (IIR), las presas más importantes fueron *Cynoscion guatucupa*, *Micropogonias furnieri*, *Loligo sanpaulensis* y *Urophycis brasiliensis*. Las franciscanas provenientes del área estuarial predaron principalmente sobre *Micropogonias furnieri* (especie dominante), *Cynoscion guatucupa*, *Odonthestes argentinensis* y *Macrodon ancylodon*, mientras que los delfines marinos predaron sobre *Cynoscion guatucupa* (especie dominante), *Loligo sanpaulensis* y *Urophycis brasiliensis*. Nuestros resultados confirman que la franciscana preda sobre peces juveniles (< 8cm) y pequeños calamares Loliginidae, coincidiendo con resultados previos obtenidos en el sur del Brasil y Uruguay. Las diferencias cualitativas y cuantitativas observadas en la dieta de cada uno de las áreas analizadas, nos sugieren que los futuros estudios sobre ecología trófica de la franciscana deberían discriminarse de acuerdo al origen de los ejemplares y a la tipificación del ambiente.

Keywords: Franciscana, feeding ecology, incidental captures, estuary, lactation.

Introduction

The study of diet and food habits of marine mammals are important, not only to understand the biology of this group, but also to evaluate their role in marine ecosystems and quantify the interaction with fisheries. In the case of the franciscana (*Pontoporia blainvillei*) these studies are of particular interest because interactions with fisheries are widely recorded (e.g. Brownell, 1989; Praderi *et al*., 1989; Corcuera, 1994; Pinedo, 1994; Secchi *et al*., 1997) and many prey items are of commercial importance and subject to overfishing (Bastida *et al*., in press).

Because of their small size, early reproduction and limited energy stores (Brownell, 1989), franciscanas probably must limit their movements to areas where food resources are concentrated. Feeding ecology studies are fundamental to expand our knowledge of the dynamics between *Pontoporia* and their prey. Most of the studies performed on *Pontoporia* are based on juveniles and adults incidentally killed in gillnets (e.g. Bassoi, 1997; Ott, 1994), with limited information available for calves because they are rarely entangled (e.g. Secchi *et al*., 1997). As a consequence, the lactation period and the development during the first year of life is still one of the least known aspects of the life history of franciscana. The frequent record of calves in northern Argentina (Bastida *et al*., 1996; Loureiro *et al*., 1996) allowed us the opportunity to study the feeding ecology of *Pontoporia* calves and examine the ontogenetic variation in their diet.

The main objectives of the present study were to qualify and quantify in detail the diet of franciscanas from the northern coast of Argentina, where two distinct habitats are found: the wide La Plata River estuary and the adjacent marine coastal area. The lactation period and the transition to solid feeding was characterised and compared with feeding habits of juveniles and adults. A comparison between both habitats was of particular interest to determine if those habitats influenced the feeding habits of franciscanas.

Material and Methods

We analysed 110 stomach contents of franciscanas from the northern coast of Argentina. The dolphins were incidentally killed in gillnets or found stranded in the external area of the Rio de la Plata estuary and the southern marine area from 1992 to 2000 (Figure 1; Table 1). For each specimen

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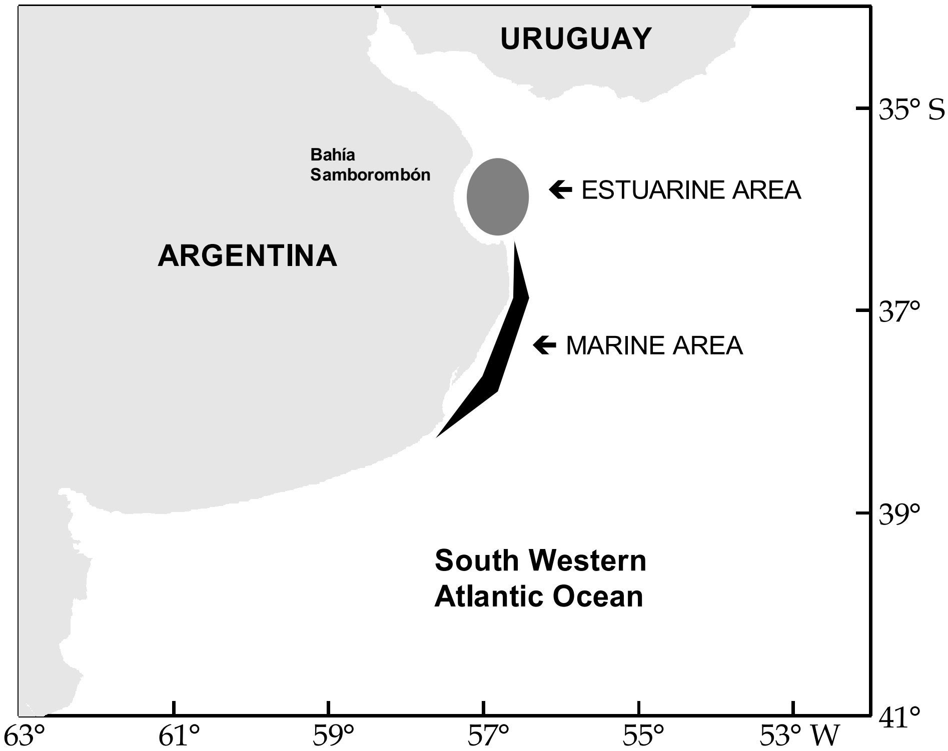

Figure 1. Map of the study site, with indication of estuarine and marine areas.

Table 1. List of stomach contents of the franciscanas analysed in the present study. Juveniles and adults are discriminated between animals from marine (M) and estuarine (E) habitats.

Sex	Suckling Calves	Transition Calves	Weaned Calves	Juveniles and Adults (M/E)	Total
Males	14	8	8	29 (11/18)	59
Females	8	5	4	22 (10/12)	39
Undetermined	--	1	2	9 (6/3)	12
Total	22	14	14	60 (27/33)	110

sex, body weight and external measurements were taken following Norris (1961).

Stomachs, including all the chambers, were excised and frozen for later analysis. A total of 4768 otoliths (= 3143 specimens), 722 cephalopod mandibles (*beaks;* 460 specimens) and remains of 428 crustaceans were found. Prey items were identified to the lowest possible taxon with the aid of a laboratory reference collection (Grupo de Mamíferos Marinos, Universidad Nacional de Mar del Plata, Argentina). Identification efficiency was high, as 95% of the otoliths, 99% of the beaks and 96% of the crustacean remains were identified.

Relative prey importance was determined by the Frequence of Occurrence (FO%, the percentage of stomach contents in which a prey taxon occurred), Numerical Abundance (N%, the percentage of occurrences of each prey taxon from a tally of occurrences from all prey taxa found) and Biomass (W%, the percentage of biomass contributed by each prey to the total biomass). The Index of Relative Importance (IRI) of Pinkas *et al.* (1971), with the Castley *et al.* (1991) volumetric modification (IRI = [(N%+W%) * FO%]), was computed and later recalculated as the Percentage IRI, following Cortés (1997).

Reconstituted biomass of fish was calculated from otolith length-fish length and length-weight curves developed by Grupo de Mamíferos Marinos (Universidad Nacional de Mar del Plata, Argentina) and from the literature (Table 2).

The franciscanas studied were classified into four categories, according to feeding regime:

1. Suckling Calves: those dolphins with only traces of milk found in the stomachs. Within this category different subcategories were considered according of the presence and absence of umbilical cord (neonates and non-neonates). As umbilical cord in rehabilitated calves is lost within 48 to 72 hours (Loureiro *et al.*, 1996), we estimated these calves to be less than one

week old. In our study we only considered as newborns those dolphins found alive and with traces of milk in their stomach, in order to avoid including possible aborted foetuses.

2. Transition Calves: those dolphins with both traces of milk and solid food items macroscopically found in the stomachs. The term *transition* was applied assuming that these animals were in the transition stage between lactation and the onset of solid food intake.
3. Weaned Calves: those franciscanas less than one year old (total length ≤ 105cm; Kasuya and Brownell, 1979) that consumed only solid prey.
4. Juveniles and Adults: those dolphins older than one year, in which only solid food remains were found.

For the assessment of body condition, total blubber weight and liver weight of incidentally killed or stranded franciscanas were recorded and expressed as a percentage of body weight (Fat and Liver Indexes). The Relative Index of Body Condition (Kn) of Le Cren (1951) was calculated:

$$Kn = Wo/We$$

where

Wo = Recorded Body Weight (kg)
We = Estimated Body Weight (kg) from the length-weight curve.

For this study we estimated the length-weight curve from 41 franciscanas incidentally captured in the area. The Maximum Blubber Thickness and the Maximum Body

Table 2. Otolith-length, length-weight and otolith-weight regression used in the present study to calculate prey biomass.

Teleosts	Regressions	N=	r^2	Size Range (cm)	Source
Micropogonias furnieri	TL= -3.327+20.328OL	48	0.918	25-67	Present study
	$W=4.340e^{-6}TL^{3.157}$	77	0.997		
	$W=0.053OL^{3.283}$	77	0.994		
Cynoscion guatucupa	TL= -3.217+19.133OL	44	0.977	6-19	Present study
	$W=2.282e^{-5}TL^{2.8375}$	44	0.997		
	$W=0.0895OL^{2.8480}$	44	0.992		
Odonthestes argentinensis	TL= 12.485+38.171OL	25	0.977	8-17	Present study
	$W=9.029e^{-6}TL^{3.0155}$	24	0.990		
	$W=0.0846OL^{2.8687}$	15	0.954		
Macrodon ancylodon	TL= -69.177+28.267OL	15	0.980	11-30	Present study
	$W=11.444e^{-6}TL^{3.3038}$	10	0.991		
	$W=0.0005OL^{5.1370}$	6	0.980		
Paralonchurus brasiliensis	TL= -24.228+25.294OL	29	0.968	10-20	Present study
	$W=3.713e^{-8}TL^{4.0426}$	29	0.978		
	$W=0.3018OL^{1.8704}$	34	0.967		
Urophycis brasiliensis	TL= -97.681+36.94OL	5	0.978	10-38	Present study
	$W=1.6434TL^{2.8736}$	7	0.971		
	$W=1.4841OL^{7.8950}$	7	0.879		
Mugil platanus	TL=17.072+23.872OL	44	0.994	4-7	Present study
	$W=2.885e^{-6}TL^{3.3346}$	21	0.989		
	$W=0.3018OL^{2.2465}$	19	0.968		
Engraulis anchoita	TL= 2.36817 + 3.56 OL	79	0.70	--	Koen Alonso *et al.*, 1998
	$W= 0.0025TL^{3.353}$	81	0.93		
Stromateus brasiliensis	$TL= 3.042OL^{1.159}$	51	0.98	--	Koen Alonso *et al.*, 1998
	$W= 0.0006418TL^{3.917}$	63	0.98		
Loligo sanpaulensis	ML= -0.330613+57.4299URL	394	0.859	2-19	Pineda *et al.*, 1996
	ML= -9.31512+63.6316LRL	414	0.885		
	LnW= 2.04038+(2.4808*lnURL)	359	0.879		
	LnW=1.88113+(2.8300*lnLRL)	371	0.904		

References: (TL) Total length (mm); (OL) Otolith length (mm); (W) Weight (g); (ML) Mantle Length (mm), (URL) Upper Rostral Length (mm); (LRL) Lower Rostral Length (mm).

Circumference were measured from a group of calves, in order to assess the evolution of these parameters during the lactation period.

Association patterns between prey frequency, sex, habitat and time period were verified by hierarchical log-linear analysis (Agresti, 1990). Time periods were set as two 4-year segments (1993-96 and 1997-2000), whereas marine and estuarine were considered as two distinct habitats. To prevent biases from franciscanas of unknown sex, only stomach contents from 51 solid diet dolphins with confirmed sex were included in this analysis. Five prey species with IRI higher than 2% and/or Frequencies of Occurrence above 20% were selected and, due to their estenohaline nature, the absolute frequency of cephalopods in estuarine areas were considered as structural zeros in the models. The statistical significance of the goodness-of-fit of the different log-linear models was computed by the maximum likelihood ratio Chi-square statistic.

Normality and homoscedasticity were tested by Shapiro-Wilk's W and Levene tests and, in the case of body condition indices, the arcsine of the square root of these proportions were used to fulfil the statistical assumptions (Zar, 1984).

Results

Size range of the franciscanas studied

The size of the franciscanas studied ranged from 56.8 to 169.5cm, although 95% of the dolphins were less than 140cm (Figure 2). No differences in length were detected between sexes (Males: Mean=103.5cm; SD=24.52; n=73; Females: Mean=106.6cm; SD=25.52; n=46; t = -0.66; df=117; p=0.51) or between franciscanas belonging to estuarine or marine areas (Estuarine: Mean=113.6cm; SD=18.00; n=43; Marine: Mean=103.1cm; SD=28.70; n=69; Mann-Whitney U=1170.5; p=0.06). Incidentally captured franciscanas were significantly larger than those found stranded (Incidentally captured: Mean=113.7cm; SD=16.80; n=80; Stranded: Mean= 82.8cm; SD=26.29; n=32; Mann-Whitney U=378.5; p<0.01).

Suckling calves ranged from 56.8 to 76.5cm, with a weight range of 2.9-8.7kg. Neonates were less than 69 cm long (Mean=64.5cm; SD=4.38; n=15) and weighed less than 3.8 kg (Mean=3.5kg; SD=0.67; n=14); non-neonates ranged from 72.3 to 76.5cm in length (Mean=74.5cm; SD=1.42; n=7) and 4.0 to 8.7kg in weight (Mean=5.5kg; SD=1.85; n=7), with no overlap between both subcategories.

Transition calves ranged from 78 to 94cm (Mean= 86.4cm; SD= 5.6; n=14) and 8.3 to 11.5kg (Mean=9.8kg; SD=1.1; n=9). Weaned calves were longer than 97cm (Mean=102.5cm; SD=2.50; n=12) and weighed 13-17kg (Mean=14.7kg; SD=0.80; n=9). Juveniles and adults ranged from 105.2 to 169.5cm (Mean=120.5cm; SD=12.73; n=76) and 17 to 36.5kg (Mean=21.1kg; SD=5.47; n=33).

Body Condition and Weight

The length-weight relationship for incidental captured franciscanas was estimated as: Body weight (kg) = 0.0005 Body Length (cm) $^{2.2222}$ (r^2 = 0.9256; SD=2.4611; n=41; Figure 3).

The overall fat content (Fat Index) of the franciscanas studied oscillated between 23.4 and 49.2% (Mean=34.6%; SD=6.92%; n=27; Table 3). No differences were found between origin, sex, habitat or feeding regime (Multifactor ANOVA F=2.9472; df=9, 10; p=0.0537), but if only the feeding habits is considered as a factor, the sharp decrease of the Fat Index after weaning resulted in highly significant differences between suckling, transition and weaned franciscanas (ANOVA F=7.7052; df=2, 24; p<0.01).

The Relative Index of Body Condition (Kn) varied from 0.61 to 1.39 (Mean=0.97; SD=0.18; n=73), with highly significant differences found between categories (Multifactor ANOVA F=5.4269; df=13, 45; p<0.01). *Post-hoc* comparisons indicated that the main differences were due to the highly significant lower values of Kn found in stranded suckling calves *versus* the high values found in incidentally captured suckling and weaned

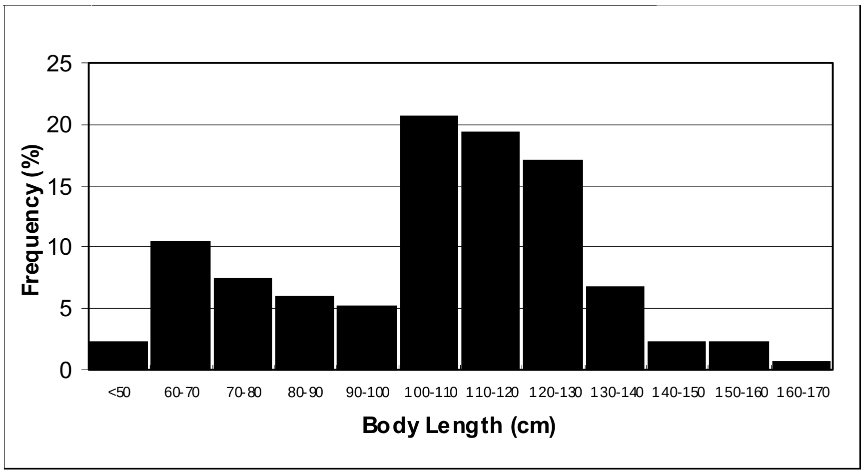

Figure 2. Length frequency distribution of the franciscanas studied.

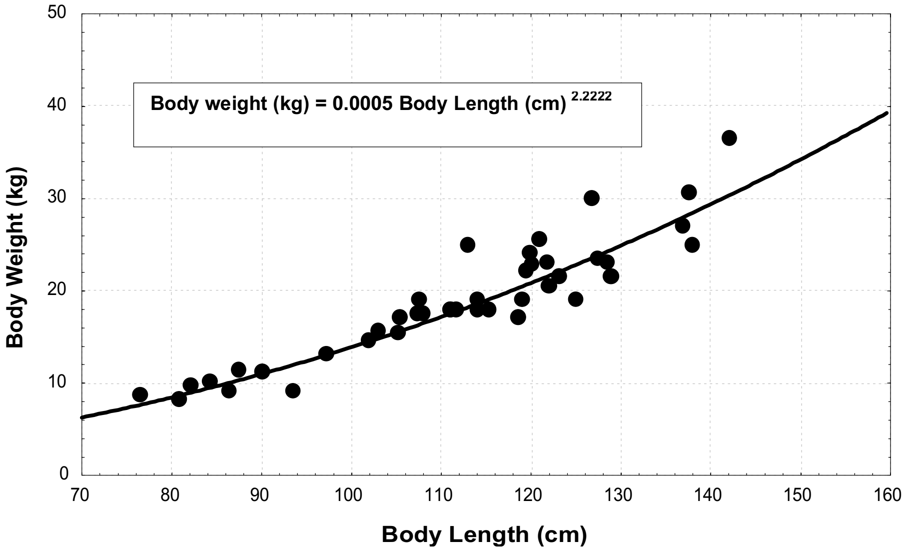

Figure 3. Length-weight relationship in incidentally captured franciscanas from Argentina.

Table 3. Indexes of Body Condition in franciscanas from northern Argentina, expressed as mean ± standard deviation (n=).

Category	Fat Index (%)	Liver Index (%)	Body Condition Index (Kn)
Incidentally Captured	37.1 ± 5.87 (10)	2.62 ± 0.52 (14)	1.028 ± 0.120 (41)
Stranded	33.1 ± 7.26 (17)	2.34 ± 0.53 (26)	0.732 ± 0.174 (26)
Males	35.5 ± 7.48 (19)	2.31 ± 0.43 (28)	0.915 ± 0.198 (48)
Females	32.4 ± 5.18 (8)	2.78 ± 0.65 (13)	0.908 ± 0.214 (25)
Marine	36.0 ± 7.80 (13)	2.61 ± 0.59 (19)	0.848 ± 0.219 (39)
Estuarine	30.2 ± 6.33 (7)	2.35 ± 0.58 (15)	0.999 ± 0.155 (24)
Suckling Calves	40.7 ± 4.97 (6)	2.51 ± 0.57 (10)	0.682 ± 0.143 (21)
Transition Calves	39.1 ± 8.03 (4)	2.20 ± 0.16 (4)	0.995 ± 0.122 (9)
Weaned Calves, Juveniles and Adults	31.3 ± 5.24 (17)	2.41 ± 0.56 (26)	1.021 ± 0.119 (41)

franciscanas. When independent analyses were performed within stranded and incidentally killed franciscanas, no significant differences between areas, sexes and feeding categories were found (Stranded F=2.4091; df=4, 18; p=0.087; incidentally killed F=1.2732; df=8, 27; p=0.298).

The relative weight of liver (Liver Index) fluctuated between 1.5 and 4% (Mean= 2.5%; SD=0.55%; n=41), also with significant differences between categories (Multifactor ANOVA F=2.3274; df=9, 23; p=0.0494) due to higher values found in females.

Significant differences in the maximum body circunsference and blubber thickness were found between suckling, transition and weaned calves (Table 4).

Table 4. Variation in the Maximum Blubber Thickness (cm) and Maximum Body Circumference (cm) during the first year of life in franciscanas from Argentina. Values expressed as mean ± standard deviation (n=); differences analysed by one-factor ANOVA.

Characteristic	Suckling Calves	Transition Calves	Weaned Calves	Differences
Maximum Blubber Thickness	1.53 ±0.47 (13)	2.75 ±0.35 (2)	2.53 ±0.38 (4)	** (F=12.15; df=2,16; p<0.01)
Maximum Body Circumference	37.52 ±5.85 (17)	56.20 ±2.63 (5)	62.78 ±1.86 (5)	** (F=64.11; df=2,24; p<0.01)

Lactation chronology and transition to solid feeding

Suckling calves were found from early October to early February, although they were more frequently found from November onwards (Figure 4). Mean record date was 12 December (± 34 days), ranging from 2 October to 7 February. Transition calves were recorded from December onwards, being more common in February (Figure 4); mean record date was 4 February (± 26 days), with a period extending from 18 December to 15 April, after which no franciscanas with traces of milk were recorded.

Diet Composition

In franciscanas from the northern coast of Argentina, we identified as prey a total of 20 teleosts, 2 cephalopods and 4 crustacean species (Appendix I). The number of prey species increased with dolphin age, with juveniles and adults typically preying upon twice as many species as transition and weaned calves (Figure 5).

Forty-four percent of the franciscana calves analysed presented only milk in their stomachs, whereas 28% had a transition diet (milk plus solid food) and the rest (28%) had exclusively solid prey remains. No juveniles with milk traces were found.

Crustaceans were the most frequent and abundant prey in transition calves, followed by fish and cephalopods (Table 5). For post-weaning franciscanas, fish become the most frequent and abundant group, and cephalopods also become more important. The diet of juveniles and adults was also composed primarily of fish, whereas cephalopods and crustaceans increase in importance. The teleost family Sciaenidae was found to be the predominant prey.

In both transition and weaned franciscana calves the striped weakfish, *Cynoscion guatucupa* and the white croaker,

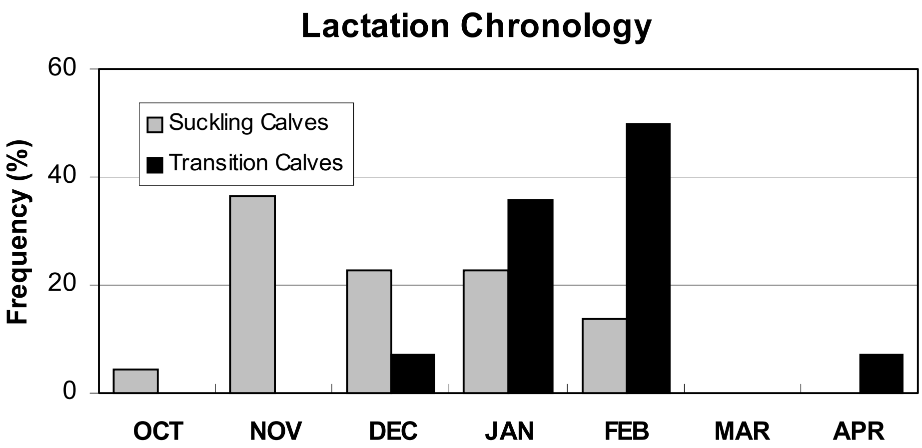

Figure 4. Monthly records of suckling and transition franciscana calves.

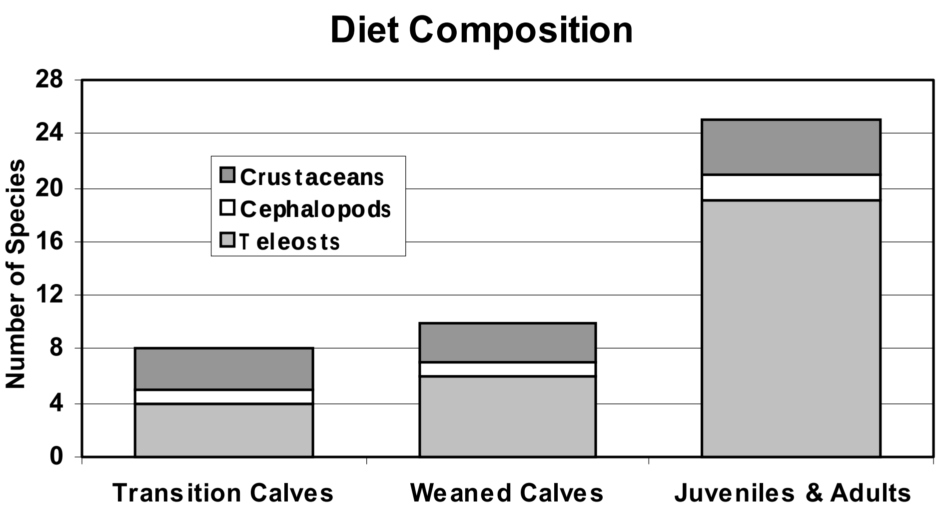

Figure 5. Number of prey species taken by franciscanas of different ontogenic categories.

Table 5. Absolute number (n=), numerical abundance (N%), frequency of occurrence (FO%), biomass (W%), absolute (IRI) and percentage Index of Relative Importance (IRI%) of prey of franciscanas from northern Argentina.

PREY ITEMS	'TRANSITION' CALVES (n=14)			WEANED CALVES (n=14)			POOLED JUVENILES & ADULTS (n=60)					
	n=	N%	FO%	n=	N%	FO%	n=	N%	FO%	W%	IRI	IRI%
TELEOSTS	**36**	**10.4**	**71.4**	**263**	**90.4**	**100.0**	**2844**	**80.5**	**96.9**	**72.0**	**14780.3**	**92.2**
Micropogonias furnieri	2	0.6	25.0	133	45.7	50.0	500	14.1	40.9	24.3	1574.3	20.4
Cynoscion guatucupa	29	8.4	50.0	69	23.7	83.3	1637	46.3	60.6	23.8	4250.8	55.2
Odonthestes argentinensis				37	12.7	16.7	198	5.6	13.6	6.7	167.5	2.2
Macrodon ancylodon							17	0.5	10.6	6.7	76.7	1.0
Paralonchurus brasiliensis	4	1.2	12.5	16	5.5	33.3	127	3.6	19.7	2.3	116.9	1.5
Urophycis brasiliensis				3	1.0	33.3	116	3.3	24.2	7.4	258.9	3.4
Mugil platana							9	0.3	7.6	0.1	2.5	0.0
Engraulis anchoita				5	1.7	33.3	28	0.8	24.2	0.4	29.8	0.4
Stromateus brasiliensis							7	0.2	3.0	0.2	1.1	0.0
Umbrina canosai							125	3.5	15.2			
Lycengraulis olidus							4	0.1	4.5			
Pomatomus saltatrix							2	0.1	3.0			
Ramnogaster arcuata							9	0.3	3.0			
Percophis brasiliensis							1	0.1	1.5			
Sparus pagrus							11	0.3	7.6			
Trachurus lathami							49	1.4	1.5			
Pogonias cromis							2	0.1	1.5			
Raneya fluminensis							1	0.1	1.5			
Anchoa marini							1	0.1	1.5			
Leptonotus blanvillanus	1	1.0										
CEPHALOPODS	**1**	**0.3**	**12.5**	**16**	**5.5**	**16.7**	**443**	**12.5**	**30.8**	**28.0**	**1248.3**	**7.8**
Loligo sanpaulensis	1	0.3	12.5	16	5.5	16.7	441	12.5	30.3	28.0	1227.5	15.9
Octopus tehuelchus							2	0.1	1.5			
CRUSTACEANS	**181**	**52.5**	**85.7**	**9**	**3.1**	**50.0**	**238**	**6.7**	**49.2**			
Artemesia longinaris	3	0.9	12.5	1	0.3	16.7	197	5.6	28.8			
Peisos petrunkievitchi	9	2.6	12.5	7	2.4	33.3	24	0.7	15.2			
Peneidae	4	1.2	25.0	1	0.3	16.7	7	0.2	10.6			
Neomysis americana	135	39.1	25.0				6	0.2	1.5			
Pleoticus muelleri							4	0.1	1.5			
Calanoid Copepods	30	8.7	25.0									
OTHERS	**128**	**37.1**	**25.0**	**3**			**8**					
Nereid Polychaetes	128	37.1	25.0	3	1.0	50.0	8	0.2	10.6			
TOTAL	**346**			**291**			**3533**					

continued...

Table 5. Absolute number (n=), numerical abundance (N%), frequency of occurrence (FO%), biomass (W%), absolute (IRI) and percentage Index of Relative Importance (IRI%) of prey of franciscanas from northern Argentina.

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PREY ITEMS	MARINE JUVENILES & ADULTS (n=27)						ESTUARINE JUVENILES & ADULTS (n=33)					
	n=	N%	FO%	W%	IRI	IRI%	n=	N%	FO%	W%	IRI	IRI%
TELEOSTS	**1520**	**71.3**	**96.7**	**51.2**	**11844.8**	**71.9**	**1324**	**94.4**	**97.1**	**100.0**	**18876.2**	**100.0**
Micropogonias furnieri	44	2.1	16.1	1.3	54.6	0.4	456	32.5	62.9	55.4	5526.4	66.8
Cynoscion guatucupa	1208	56.7	83.9	36.3	7798.0	60.7	429	30.6	40.0	7.0	1503.2	18.2
Odonthestes argentinensis	39	1.8	3.2	0.8	8.5	0.1	159	11.3	22.9	14.6	593.0	7.2
Macrodon ancylodon		0.0	3.2	0.0	0.0	0.0	17	1.2	17.1	15.8	291.1	3.5
Paralonchurus brasiliensis	52	2.4	16.1	1.2	58.7	0.5	75	5.3	22.9	3.9	210.8	2.5
Urophycis brasiliensis	73	3.4	25.8	10.8	368.3	2.9	43	3.1	22.9	2.7	132.9	1.6
Mugil platana	2	0.1	6.5	0.1	1.3	0.0	7	0.5	8.6	0.1	5.5	0.1
Engraulis anchoita	24	1.1	38.7	0.6	68.3	0.5	4	0.3	11.4	0.2	5.1	0.1
Stromateus brasiliensis	4	0.2	3.2	0.1	0.8	0.0	3	0.2	2.9	0.3	1.5	0.0
Umbrina canosai	7	0.3	6.5				118	8.4	22.9			
Lycengraulis olidus	3	0.1	6.5				1	0.1	2.9			
Pomatomus saltatrix	1	0.0	3.2				1	0.1	2.9			
Ramnogaster arcuata	1	0.0	3.2				8	0.6	2.9			
Percophis brasiliensis	1	0.0	3.2									
Sparus pagrus	10	0.5	12.9				1	0.1	2.9			
Trachurus lathami	49	2.3	3.2									
Pogonias cromis							2	0.1	2.9			
Raneya fluminensis	1	0.0	3.2									
Anchoa marini	1	0.0	3.2									
Leptonotus blanvillanus												
CEPHALOPODS	**443**	**20.8**	**66.7**	**48.8**	**4639.5**	**28.1**	**0**	**0.0**	**0.0**	**0.0**		
Loligo sanpaulensis	441	20.7	64.5	48.8	4483.4	34.9						
Octopus tehuelchus	2	0.1	3.2									
CRUSTACEANS	**165**	**7.7**	**43.3**				**73**	**5.2**	**57.1**			
Artemesia longinaris	147	6.9	32.3				50	3.6	25.7			
Peisos petrunkievitchi	10	0.5	6.5				14	1.0	22.9			
Peneidae	4	0.2	12.9				3	0.2	8.6			
Neomysis americana							6	0.4	2.9			
Pleoticus muelleri	4	0.2	3.2									
Calanoid Copepods												
OTHERS	**3**	0.1					**5**					
Nereid Polychaetes	3	0.1	9.7				5	0.4	11.4			
TOTAL	**2131**						**1402**					

Micropogonias furnieri, were the prey most frequently found, followed by the longfin inshore squid, *Loligo sanpaulensis*, the Argentine stiletto shrimp, *Artemesia longinaris* and the shrimp, *Peisos petrunkevitchi*. By contrast, the mysid *Neomysis americana* was frequently found in transition calves, but was virtually absent after weaning.

The main prey species (FO% and N%) for juveniles and adults were *C. guatucupa*, *M. furnieri*, *L. sanpaulensis*, *A. longinaris* and the silverside, *Odonthestes argentinensis*, constituting more than 80% of the prey ingested and the diet biomass (Table 5). The Brazilian codling, *Urophycis brasiliensis* and king weakfish, *Macrodon ancylodon* complemented this group, comprising about 14% of the diet biomass. The Index of Relative Importance confirms the above findings as *M. furnieri, C. guatucupa* and *L. sanpaulensis* were the most important prey species of franciscanas from northern Argentina (IRI> 90%; Table 5).

Prey Size

Prey size was estimated for the most important prey items in the diet of franciscanas. The range of fish size was similar for dolphins from estuarine and marine areas, with a major predation on specimens from 40 to 60mm (Total Length) in the marine area, and 40-80mm in estuarine areas (Figure 6). Most of the fish preyed in both areas weighed less than 5g (Figure 7). Sixty percent of the cephalopods showed a mantle length of 40-80mm (Figure 8), with 50% having values of less than 10g (Figure 9).

Diet Variation

Log-linear models revealed highly significant associations between prey frequency and habitat, but no association was found with years and sexes (Table 6).

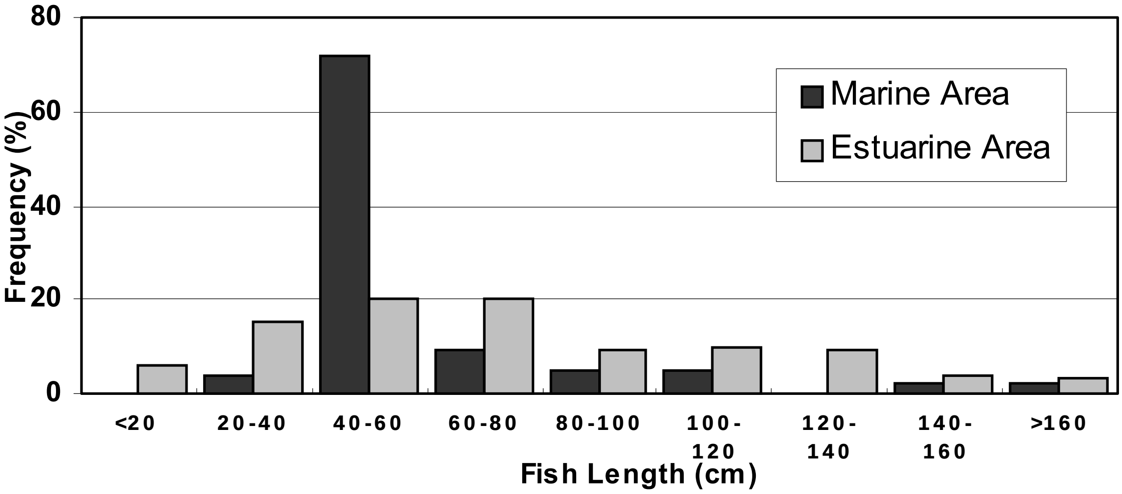

Figure 6. Length frequency distribution of fish prey eaten by franciscanas.

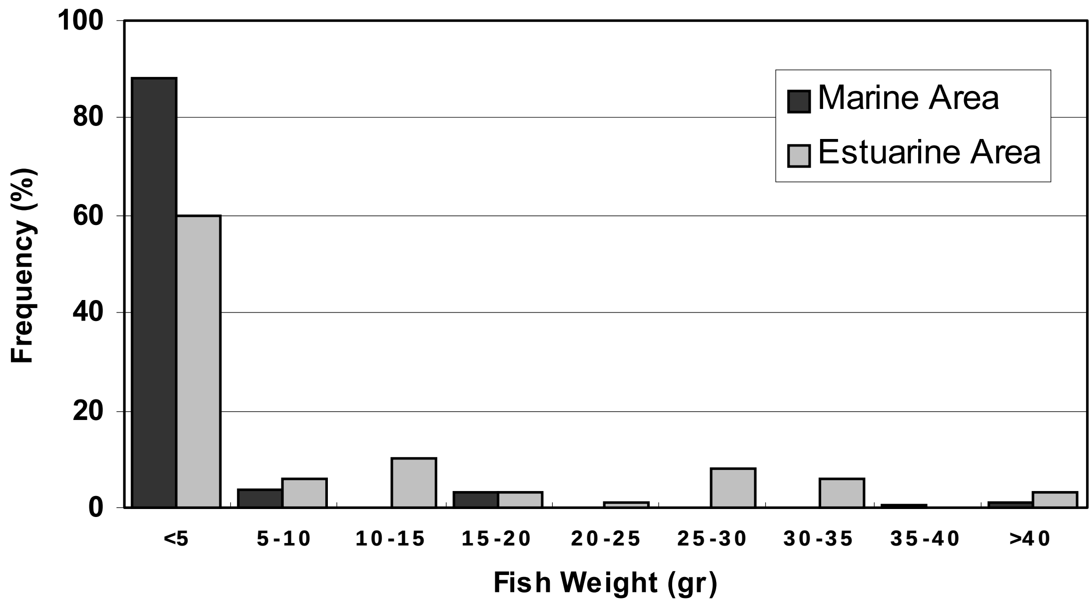

Figure 7. Weight frequency distribution of fish prey eaten by franciscanas.

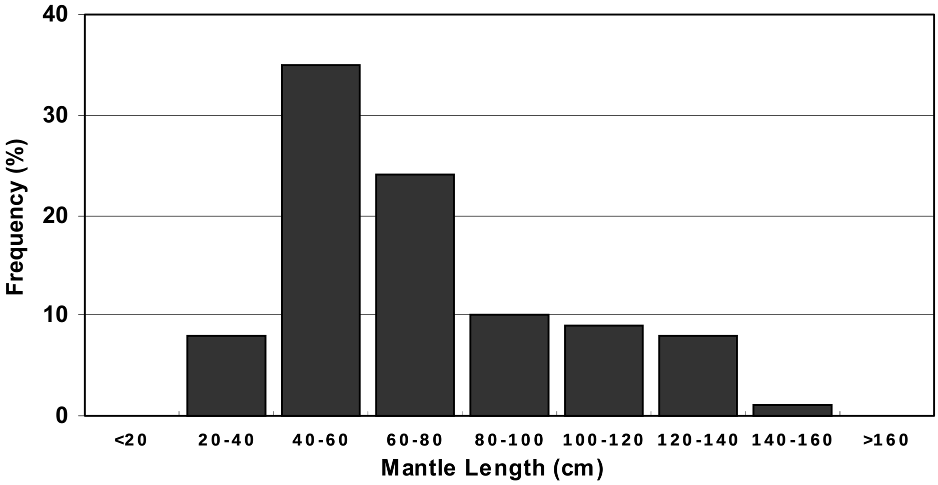

Figure 8. Mantle length frequency distribution of squid prey eaten by franciscanas.

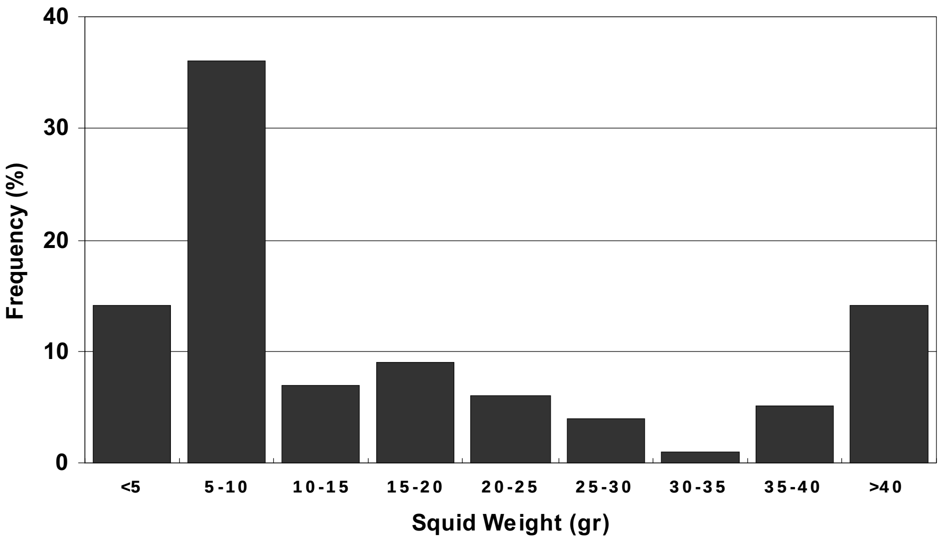

Figure 9. Weight frequency distribution of squid prey eaten by franciscanas.

Table 6. Associations (likelihood-ratio) between time period, habitat, sex and prey frequency. Statistical tests used were from a hierarchical log-linear analysis of a contingency table of time period (2 levels), habitat (2 levels), sex (2 levels) and prey (5 levels).

Effect	d.f.	Chi-Square	P
Period x Habitat	1	0.095	0.758
Period x Sex	1	1.381	0.240
Period x Prey	4	2.577	0.631
Habitat x Sex	1	1.489	0.222
Habitat x Prey	4	24.011	< 0.001
Sex x Prey	4	3.361	0.499
Period x Habitat x Sex	1	3.438	0.064
Period x Habitat x Prey	4	4.546	0.337
Period x Sex x Prey	4	2.468	0.650
Habitat x Sex x Prey	4	0.768	0.943

The most important prey species in the marine area were *C. guatucupa*, *L. sanpaulensis* and *U. brasiliensis*, accounting for 89.8% of the total (Table 5). Though the shrimp *A. longinaris* was likely an important prey species, it was not possible to estimate its contribution by biomass from the exoskeletons recovered. The most important feature of the estuarine area was the absence of cephalopods, due their estenohaline habits. For dolphins in the estuarine area, *M. furnieri* was clearly the most important prey, whereas *O. argentinensis*, *M. ancylodon,* the drum, *Paralonchurus brasiliensis* and *C. guatucupa* sum a total of 31.4% (Table 5). With the exception of the latter, the other species were not important in the marine area.

Of the total 24 species found in the diet of franciscanas from northern Argentina, the species richness in the marine area was slightly higher than in the estuary (23 *vs* 17). Although there was a lower number of prey species in estuarine waters, no significant differences were found in the mean number of prey species per stomach content between both areas (3.20 ± 1.729 *vs* 3.87 ± 1.224; t= -1.766; p=0.082; df=58).

The combination of major prey taxa found in franciscana stomachs was also different in both areas, with a higher proportion of the combinations *teleosts-cephalopods* or *teleosts-cephalopods-crustaceans* in the marine area. Estuarine dolphins mainly showed only teleosts or the combination *teleosts-crustaceans* as prey (Table 7).

Although not significant, there was a tendency to record *L. sanpaulensis* and *Paralonchurus brasiliensis* more frequently in males, *A. longinaris*, *U. brasiliensis* and *U. canosai* in females (Table 8). *M. furnieri* and *C. guatucupa* were equally recorded in both sexes. No differences were found between sexes when comparing the mean number of prey species per stomach, neither for fish only (ANOVA; F= 0.6311; df= 2, 57; p= 0.5356) nor for all the prey species included (ANOVA; F= 0.5199; df= 2,55; p= 0.5975) (Table 9).

Table 7. Occurrence of different prey combinations in franciscana stomach contents from marine and estuarine habitats.

Prey Combination	Marine Habitats	Estuarine Habitats
Only Cephalopods	3.7%	---
Only Crustaceans	3.7%	3.0%
Only Fish	7.4%	36.4%
Cephalopods and Crustaceans	---	---
Cephalopods and Fish	37.0%	---
Crustaceans and Fish	18.5%	60.6%
Crustaceans, Cephalopods and Fish	29.6%	---

Table 8. Sexual differences in the frequence of occurence (%) of selected prey species.

Prey Species	Marine		Estuarine	
	Males	Females	Males	Females
M.furnieri	15.4	16.7	63.2	69.2
C.guatucupa	76.9	83.3	52.6	30.8
P.brasiliensis	30.8	8.3	36.8	7.7
U.brasiliensis	23.1	41.7	21.1	30.8
U. canosai	7.7	8.3	10.5	46.2
L.sanpaulensis	76.9	50.0	0.0	0.0
A. longinaris	23.1	58.3	21.1	30.8

Table 9. Mean number of prey species found per stomach content, expressed as mean ± standard deviation (n=).

Prey Species	Males	Females	Undetermined	Overall
Teleosts	2.82 ± 1.59 (28)	2.43 ± 1.42 (21)	2.44 ± 1.25 (9)	2.62 ± 1.44 (58)
All prey items	3.79 ± 1.82 (29)	3.50 ± 1.41 (22)	3.11 ± 1.62 (9)	3.58 ± 1.64 (60)

Estimation of the minimum number of stomach contents required for analysis

In feeding ecology studies, prey importance and richness are usually estimated without an assessment of the minimum number of samples required to support the conclusions. We retrocalculated the minimum number of samples required to properly describe the diet of franciscanas from northern Argentina, choosing randomly an increasing number of stomachs contents and estimating the cumulative frequency of the prey species found (Pierce and Boyle, 1991). In the case of prey importance, we selected only those species with IRI higher than 2%.

In the present set of stomach contents, ten to fifteen franciscana stomachs were necessary to account for the majority (~ 80%) of the most important prey; as the diet from the marine habitat showed fewer number of important prey species (3 *vs* 5), it would require less than 10 samples (Figure 10). When we calculated the number of stomachs contents required to account for the 80% of the total number of prey species in the diet, we found that we should analyse 20-30 stomach contents (Figure 10).

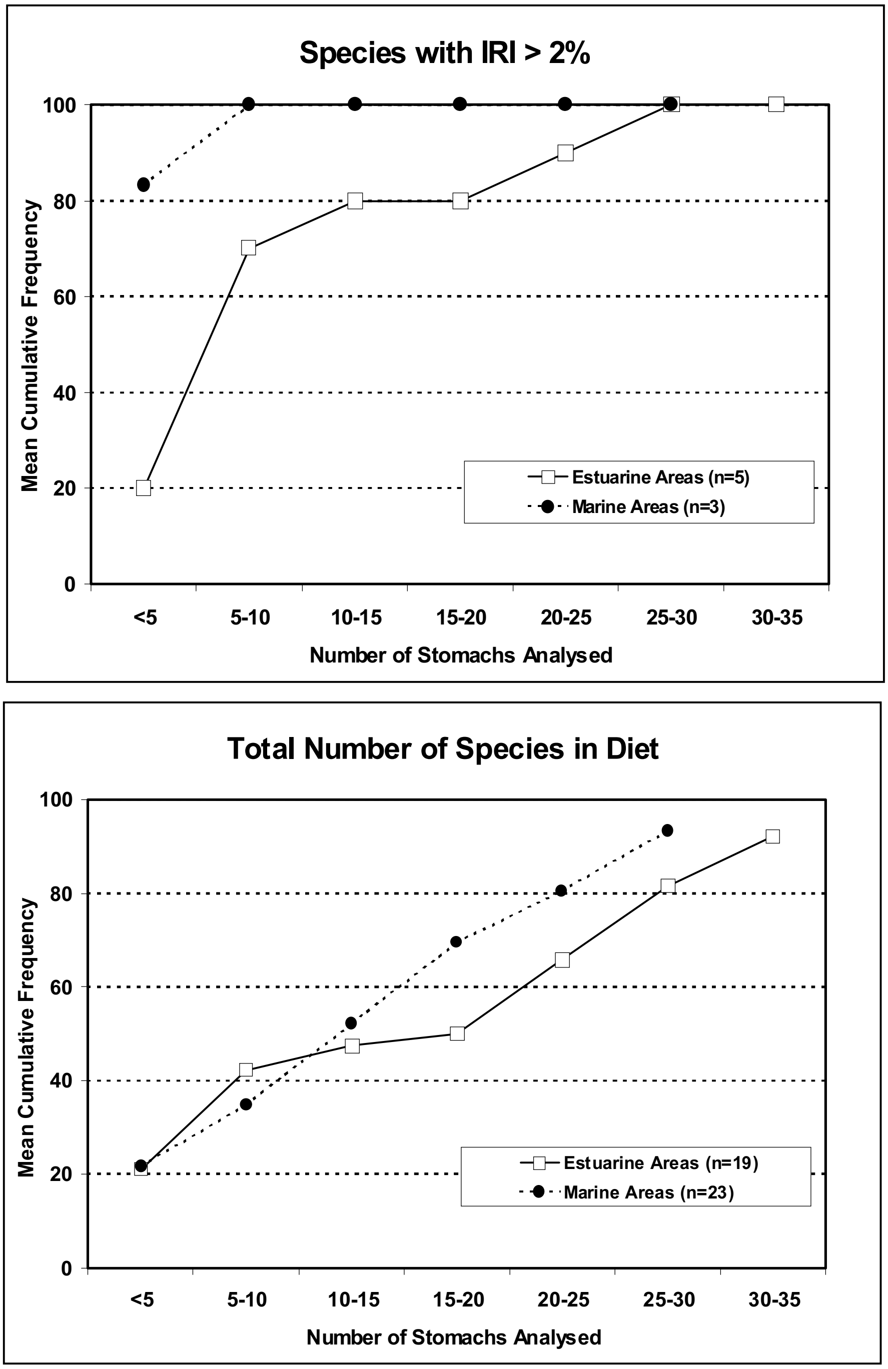

Figure 10. Estimated number of stomachs required for prey importance and richness analysis.

Discussion

Pontoporia blainvillei is the South American cetacean with the earliest references on diet (Burmeister, 1867; Lahille, 1905; Cabrera and Yepes, 1940). During the last few decades this species has been the subject of an increasing number of feeding studies (Fitch and Brownell, 1971; Pinedo, 1982; Praderi, 1984, 1986; Perez Macri, 1987; Bastida *et al.*, 1992; Ott, 1994, 2000; Perez *et al.*, 1996; Bassoi, 1997; Di Beneditto *et al.*, 1998; Oliveira *et al.*, 1998; Bassoi *et al.*, 2000), which have helped to establish a baseline of qualitative data throughout most of their distribution. More recently there has been a growing tendency to develop quantitative studies, which are fundamental in future studies on energetic requirements. The present paper updates the information on franciscana's diet in northern Argentina, interprets differences in feeding habits between marine and estuarine habitats and gives an insight on early stages of predation.

Lactation and transition to solid diet

The frequent live strandings of newborn calves in the northern coast of Argentina allowed us to study in detail the first year of life and the lactation period, two of the least known aspects of the life history of franciscanas. Calving season extends for approximately 4 months, from early October to February, with most occurrences in November. This period coincides with the proposed calving season in Uruguay and southern Brazil (Harrison *et al.,* 1981; Brownell, 1984; Pinedo *et al.,* 1989; Danilewicz and Secchi, 2000).

Considering the time elapsed between the recording dates of newborn and transition calves, we found a consistent period of 2.5 months in both the earliest (2 October *vs* 18 December) and latest (7 February *vs* 15 April) records. Thus, we estimated that the onset of solid food intake is approximately between 2 and 3 months of age, when the calves exceed 75cm in length and 8kg of weight. This age coincides with that suggested by Kasuya and Brownell (1979) and Brownell (1989). Di Beneditto and Ramos (2000) reported milk and solid remains in 4 calves longer than 78cm, coinciding with teeth eruption.

Our results confirm a gradual weaning in franciscana calves, with a suggested feeding independence when calves exceed 95cm in length and 13kg in weight. This could take place in April, when calves are about 7 months old. Such a lactation strategy agrees with the suggestions of Kasuya and Brownell (1979) and Pinedo and Hohn (2000), who stated that the intake of solid food early in life and the corresponding assimilation of calcium are responsible for the conspicuous boundary layers between initial GLGs found in franciscana teeth. Another clear indication of early predation by franciscanas are the detectable concentrations of mercury and cadmium transferred via fish and cephalopods, found by Gerpe *et al.* (2002) in franciscana calves from the same region.

The age at which franciscanas start taking solid food might help to explain why they get entangled in gillnets. An analysis of the lengths of franciscanas entangled in northern Argentina suggests that the critical period is the range 75-80cm, when entangled animals outnumber those of strandings, coinciding with the initial stages of predation by transition calves (Figure 11).

The diet of both transition and weaned calves was found to be less species rich than older animals. The solid diet of transition calves from both habitats was more similar to the diet of estuarine juveniles and adults, suggesting certain dependence of calves on brackish habitats during the transition to solid feeding. An important prey species during this period was the mysid *N. americana,* which is very abundant in Bahía Samborombón and also a major constituent of other species' diet in the Rio de la Plata estuary, such as *M. furnieri* (FO%=55%, Sánchez *et al.*, 1991) and *M. ancylodon* (FO%=88.8%, Leta, 1987). The Argentine

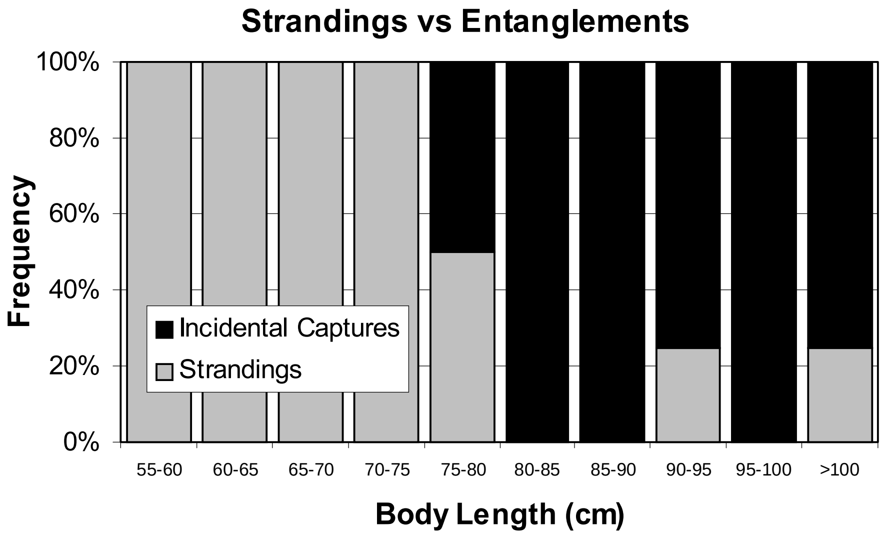

Figure 11. Proportion of incidental catches and strandings of franciscana calves, discriminated by body length (cm).

red shrimp, *Pleoticus muelleri*, and *A. longinaris* are also frequently eaten by juvenile franciscanas in southern Brazil (Bassoi, 1997; Bassoi *et al.*, 2000) and a high incidence of euphausiids characterise the transition diet of harbour porpoises from the Gulf of Maine (Smith and Read, 1982; Gannon *et al.*, 1998). Smith and Read (1992) suggested that these calves eat crustaceans while mothers are feeding on euphausiid predators, a strategy that is likely to occur with *Pontoporia* and *Neomysis*.

In contrast, the prey species composition of post-weaning calves from both habitats resembles that of juvenile and adult franciscanas from marine habitats. Moreover, all prey species eaten by weaned calves were present in marine diets. Complementary foraging in estuarine areas should not be excluded, due to the important presence of *M. furnieri.*

In newborn franciscanas, blubber represented approximately 40% of the body weight, a percentage that decreases with trophic independence. Kamiya and Yamasaki (1974) recorded an overall mean of 30.1%, with a decrease between young (35.8%) and adults (25.5%). Caon and Fialho (1999) also reported decreasing fat contents from calves (33.9%) to juveniles (29.7%) and adults (24.3%) in dolphins from southern Brazil. Blubber thickness and body circumference showed a clear increase after predation, suggesting an important growth in weight during the early months of life in *Pontoporia.* Blubber thickness coincided with the 1.8-2.2cm range reported by Brownell and Ness (1970).

Juvenile and Adult Diet

The diet of *P. blainvillei* in northern Argentina was composed of 20 teleosts, 3 crustaceans and 2 cephalopod species, a wider prey spectrum than that of previous studies (Perez Macri, 1987; Bastida *et al.*, 1992; Perez *et al.*, 1996). The most important prey species were *C. guatucupa, M. furnieri, L. sanpaulensis* and *U. brasiliensis.*

The present study included franciscanas from two major habitats: an estuarine area, characterised by highly variable salinity, shallow and calm waters and soft bottom with high organic matter content; and a marine area, with high and more stable salinity, exposed beachfront and deeper sandy bottom with reduced organic content (Martin *et al.*, 1999). Differences in diet between these habitats were sometimes not only qualitative, but also quantitative, as the same prey could have different distribution and abundance in these areas.

The estuarine diet was composed predominantly by *M. furnieri* followed by *C. guatucupa, O. argentinensis* and *M. ancylodon*, whereas the marine diet was dominated by *C. guatucupa* followed by *L. sanpaulensis* and *U. brasiliensis.* The shrimps *A. longinaris* and *P. muelleri* and the teleost *Paralonchurus brasiliensis*, which have not been found in the diet of franciscanas from Argentina in previous studies, are now reported as prey of *Pontoporia* in this area.

The inverse importance of *C. guatucupa* and *M. furnieri* found in estuarine or marine waters is mainly due to the biological characteristics of these species. *C. guatucupa* juveniles are distributed in high concentrations in the coastal marine area (Cordo, 1986a; Cousseau *et al.*, 1986), becoming easily available to *Pontoporia.* In the estuarine area (mainly in Bahía Samborombón) dense schools of juvenile *M. furnieri* are found during the first 2-3 years of life (Cotrina, 1986; Cousseau *et al.*, 1986; Lasta, 1995; Nion, 1997; Macchi *et al.*, 1996; Acha *et al.*, 1999), becoming the main target species for franciscanas of this area. White croaker is the most important constituent of the Bahía Samborombón fish community, with numerical abundance and biomass representing nearly 80% and 65% respectively (Lasta, 1995). Both *C. guatucupa* and *M. furnieri* have reproductive peaks in spring and early summer, but whereas white croakers spawning concentrations are near the bottom salinity front in the inner part of the Rio de la Plata estuary, striped weakfish spawning area is close to the surface salinity front in the boundary with the open ocean (Macchi *et al.*, 1996; Macchi, 1998; Macchi and Acha, 1998; Acha, 1999).

The dominance of *C. guatucupa* and, to a lesser degree, of *M. furnieri, L. sanpaulensis* and *A. longinaris*, coincide with the franciscana's diet reported by Praderi (1984) for Uruguay. Perez *et al.* (1996) recorded a low richness diet in franciscanas incidentally killed in marine waters off Puerto Quequén (Argentina), being also *L. sanpaulensis* the most important (IRI) of the nine prey species, followed by the horse mackerel, *Trachurus lathami*. The striking case of the midshipman, *Porichthys porosissimus,* and the large head hairtail, *Trichiurus lepturus,* are still the main difference in the diet of franciscanas from Uruguay and Argentina. *P. porosissimus* was one of the most important prey item in Uruguay (Fitch and Brownell, 1971; Praderi, 1984) and, although its distribution overlaps with that of franciscanas in Argentina, it has yet to be recorded as prey in this area. It is probable that feeding or spawning *P. porosissimus* concentrations are important in Uruguay, and very accessible to *Pontoporia.* The same seems to be the case of *T. lepturus,* absent in the diet of franciscanas in Argentina but frequently reported as prey in waters off Uruguay (Fitch and Brownell, 1971; Praderi; 1984). Temporal differences (circa 20-30 years) between the studies in Uruguay and Argentina might also explain the difference, pointing out the need to update feeding studies in some areas where franciscanas are frequently recorded.

The diet of franciscanas in northern Argentina is very similar to that reported for southern Brazil (Pinedo, 1982; Ott, 1994, 2000; Bassoi, 1997; Bassoi *et al.*, 2000). There, the most important preys are *C. guatucupa*, *P. brasiliensis*, *T. lepturus, P. porosissimus, U. brasiliensis, M. furnieri* and *L. sanpaulensis*. However, a higher number of cephalopod species is recorded, including the octopuses, *Argonauta nodosa* and *Eledone gaucha*, and the squid, *Loligo plei*, which are not found in Argentina and Uruguay.

Bassoi (1997) and Bassoi *et al.* (2000) found that a lower number of prey species were reported in autumn, with a clear predominance of *T. lepturus* and a higher frequency of *A. nodosa*. Engraulids were more frequently found in winter. They conclude that no differences could be drawn in the diet of franciscanas from northern and southern Rio Grande do Sul State, Brazil, and that the franciscana was an opportunistic feeder. Unlike Pinedo (1982), no sex differences were detected in the predation of cephalopods. Pinedo (1997) reported no temporal qualitative differences in the diet of franciscanas from southern Brazil between 1976-1993.

Di Beneditto *et al.* (1998) reported that the teleost families Sciaenidae, Trichiuridae, Batrachoididae, Stromateidae, Ariidae, Clupeidae and Engraulidae occurred in 95% of the stomach contents of franciscanas from Rio de Janeiro (Brazil), whereas 87% of them consumed loliginid cephalopods. In Paraná (Brazil), Oliveira *et al.* (1998) found a total of 9 teleost families, with *Isopisthus parvipinnis*, *Cynoscion microlepidotus*, *P. brasiliensis* and *Cetengraulis edentulus* being the most frequent prey. The most important cephalopod was *L. plei* and, to a lesser extent, *L. sanpaulensis*.

Our results suggest that a minimum of ten stomachs is necessary to address the majority of the prey species of franciscanas from northern Argentina. Da Silva (1983) showed that, for *Inia geoffrensis,* 18 stomachs represented over 97% of the prey species reported and, for *Sotalia fluviatilis*, only 5% of new prey species were recorded after 12 stomachs had been analysed. Considering these results, caution should be taken when drawing conclusions from a limited number of stomach contents analysed.

The present study thus offers a more complete survey of the diet of *Pontoporia* in northern Argentina, with the analysis of both the lactation period and the diet of juveniles and adults. Gradual weaning was confirmed for *Pontoporia*, with early predation on crustaceans and fishes, whereas the lactation period was estimated to last 6-7 months. As reported for southern Brazil and Uruguay, franciscanas in northern Argentina prey on juvenile fish and small squids, being the target species basically the same in this area. The qualitative and quantitative differences between marine and estuarine habitats suggest that future studies should include a discrimination between samples of different habitats and environmental characteristics.

The effects of commercial fisheries are the main concern for the future of franciscanas in northern Argentina, as the most important fish prey (*M. furnieri, C. guatucupa* and *M. ancylodon*) showed early symptons of overfishing (Cordo, 1986a; b). A reduction in the occurence of *M. furnieri* and *M. ancylodon* in the diet of franciscanas from southern Brazil, as a probable consequence of stock depletion, was recently detected by Bassoi and Secchi (2000).

A comprehensive approach to franciscana conservation and management should include cooperative projects among researchers from Brazil, Uruguay and Argentina. In light of the results from this study, we recommend that dietary differences in these areas be re-examined and that the existing data on feeding be interpreted at the species levels, if possible. We also suggest that future reports on franciscana diet identification and quantification be standardised. These procedures will facilitate future assessments of energetic requirement of franciscanas and the evaluation of potential impacts on the stocks.

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APPENDIX I

List of prey species found in franciscanas from northern Argentina. English, Spanish and *Portuguese* common names are in brackets.

FISH	
Class Osteichthyes	
Order Clupeiformes	
Family Engraulidae	
Engraulis anchoita Hubbs and Marini, 1935	(Argentine anchovy, Anchoíta, *Anchoita*)
Anchoa marinii Hildebrand, 1943	(Anchovy, Anchoa, *Manjubinha*)
Lycengraulis grossidens (Aggassiz, 1829)	(River anchovy, Anchoita de Río)
Family Clupeidae	
Ramnogaster arcuata (Jenyns, 1842)	(Mojarrita)
Order Gadiformes	
Family Phycidae	
Urophycis brasiliensis (Kaup, 1858)	(Brazilian codling, Brótola, *Abrótea*)
Order Ophidiiformes	
Family Ophidiidae	
Raneya fluminensis Miranda Ribeiro, 1903	(Raneya)
Order Atheriniformes	
Family Atherinidae	
Odonthestes argentinensis (Valenciennes,1835)	(Silverside, Pejerrey, *Peixe-rei*)
Order Sygnathiformes	
Family Syngnathidae	
Leptonotus blainvilleanus Eydoux and Gervais, 1837	(Piperfish, Aguja)
Order Perciformes	
Family Pomatomidae	
Pomatomus saltatrix (Linné, 1758)	(Bluefish, Anchoa de Banco, *Enchova*)
Family Carangidae	
Trachurus lathami Nichols, 1920	(Rough scad, Surel, *Xixarro*)
Family Sparidae	
Sparus pagrus Linné, 1758	(Red porgy, Besugo)
Family Scienidae	
Cynoscion guatucupa (Cuvier, 1830)	(Striped weakfish, Pescadilla de Red, *Pescada Olhuda*)
Macrodon ancylodon Schneider, 1801	(King weakfish, Pescadilla Real, *Pescadinha*)
Micropogonias furnieri (Desmarest, 1823)	(White croaker, Corvina Rubia, *Corvina*)
Paralonchurus brasiliensis (Steindachner, 1875)	(Drum, Córvalo, *Maria Luiza*)
Pogonias cromis (Linné, 1766)	(Black drum, Corvina Negra, *Miraguaia*)
Umbrina canosai Berg, 1895	(Argentine croaker, Pargo Blanco, *Castanha*)
Family Mugilidae	
Mugil platanus Gunther, 1880	(Mullet, Lisa, *Tainha*)
Family Percophidae	
Percophis brasiliensis Quoy and Gaymard, 1824	(Brazilian flathead, Pez Palo, *Tira-vira*)
Family Stromateidae	
Stromateus brasiliensis Fowler, 1906	(Butterfish, Palometa Moteada, *Pampo-pintado*)
CRUSTACEANS	
Class Malacostraca (SubClass Eumalacostraca, SuperOrder Eucarida)	
Order Decapoda	
Family Paneidae	
Artemesia longinaris Bate, 1888	(Argentine stiletto shrimp, Camarón, *Camarão Serrinha*)
Family Solenoceridae	
Pleoticus muelleri (Bate, 1888)	(Argentine red shrimp, Langostino, *Camarão Santana*)
Family Sergestidae	
Peisos petrunkevitchi Burkenroad, 1945	(Shrimp, Camaroncito)
Order Mysidacea	
Family Mysidae	
Neomysis americana (Smith 1873)	(Mysid)
MOLLUSKS	
Class Cephalopoda	
Order Teuthoidea	
Family Loliginidae	
Loligo sanpaulensis Brakoniecki, 1984	(Longfin inshore squid, Calamarete, *Lula*)
Order Octopoda	
Family Octopodidae	
Octopus tehuelchus D'Orbigny, 1834	(Tehuelche octopus, Pulpito, *Polvo*)

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