A first estimate of franciscana (*Pontoporia blainvillei*) abundance off southern Brazil

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ABSTRACT

The franciscana, *Pontoporia blainvillei*, is endemic to the western South Atlantic Ocean and is perhaps one of the most threatened small cetacean species in this region. This paper presents a first abundance estimate for the coastal waters of Rio Grande do Sul State (southern Brazil) and Uruguay. In March 1996, an aerial survey was conducted along the Rio Grande do Sul State coast. Thirty-four franciscanas (29 groups) were recorded leading to a mean density estimate of 0.657 individuals/km^2 (95% CI: 0.516 to 0.836) for the study area (435km^2) after applying a correction factor for submerged dolphins. This corresponds to an estimated abundance of 286 franciscanas (95% CI: 225 to 364). The study area represents only 0.7% of the suggested distribution of the stock. The paper discusses possible management implications of this study in the light of reported incidental mortality estimates for this region. Further surveys covering a larger area are recommended in order to obtain more reliable abundance estimates for the stock.

KEYWORDS: FRANCISCANA; WESTERN SOUTH ATLANTIC; ABUNDANCE; SURVEY-AERIAL; CONSERVATION; INCIDENTAL CAPTURE

INTRODUCTION

The franciscana (*Pontoporia blainvillei*) is a small cetacean endemic to the western South Atlantic Ocean, ranging from Itaúnas (18°25′S-30°42′W), Espírito Santo, Brazil (Moreira and Siciliano, 1991) to Golfo Nuevo (42°35'S-64°48′W), Península Valdés, Argentina (Crespo *et al.*, 1998). Its distribution, restricted to shallow (< 30m) waters roughly within 55km of shore (Pinedo *et al.*, 1989; Secchi and Ott, 1997), makes it particularly vulnerable to anthropogenic activities. Continued incidental mortality throughout most of its range (e.g. Praderi *et al.*, 1989) means that the franciscana can be considered one of the most threatened small cetacean species in western South Atlantic Ocean. Although incidental mortality levels have been recently estimated for some areas (e.g. Praderi, 1997; Secchi *et al.*, 1997; Kinas and Secchi, 1998; Ott, 1998), their population impact remains unknown because of the uncertainties about stock structure and the lack of abundance estimates. These topics have been considered research priorities for this species by several meetings, workshops and action plans carried out during the last two decades (e.g. Perrin *et al.*, 1989; Crespo, 1992; Reeves and Leatherwood, 1994). Despite some progress in studies about stock discreteness (Pinedo, 1991; Aznar *et al.*, 1995; Andrade *et al.*, 1997; Secchi *et al.*, 1998; Secchi, 1999), no efforts have been directed towards abundance estimates; only preliminary data on local relative density have been obtained in Baia Anegada, Argentina (Bordino and Tausend, 1998).

This paper reports on a pilot study to estimate franciscana abundance from aerial surveys. The study refers to a putative stock occurring along the coast of Rio Grande do Sul State (southern Brazil) and Uruguay (the RS/URU stock as defined by Secchi, 1999), for which there are also recent data on annual incidental mortality.

METHODS

Study area

The survey was conducted along the southern Rio Grande do Sul State coast (32°08'S to 32°25'S; Fig. 1). The study area was chosen based on previous studies of strandings (Pinedo, 1986; Danilewicz *et al.*, 1996) and incidental catches (Secchi *et al.*, 1997; Ott, 1998). Those reports present high indices of franciscana mortality indicating that the species is relatively common in the area. This open coast is characterised by a broad gently sloping continental shelf, with a 30m isobath running about 37km from the shoreline. The area is influenced by the large amount of continental runoffs from the Lagoa dos Patos, which results in high productivity and turbid waters close to shore.

Survey design and field work

Eight aerial surveys were carried out from 4 to 8 March 1996 (Table 1) with a high-wing single engine aircraft *Cessna B-182*. Flights were located to the south of Cassino beach, between the shoreline and a maximum distance of 9.3km from the coast, a logistical constraint imposed by the single engine aircraft. This corresponds to a boundary approximately at the 15m isobath.

Four people travelled on each flight: the pilot, one recorder and one observer on each side of the plane. The aircraft flew at a constant altitude of 150m at about 150km/h,

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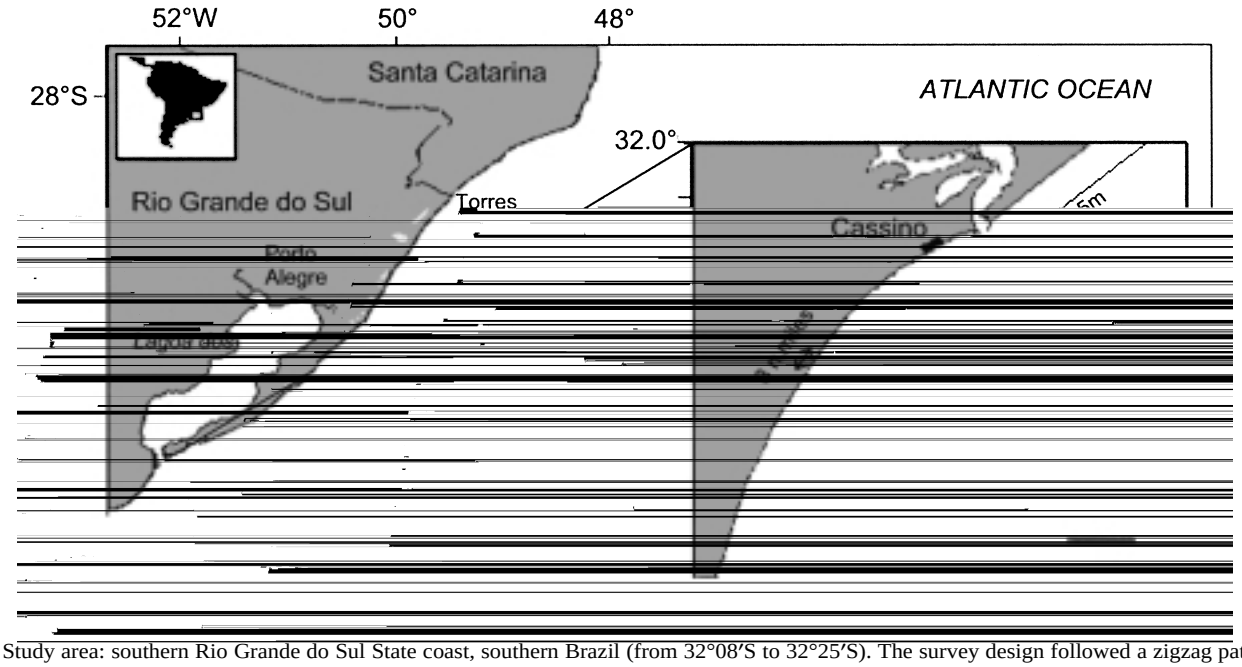

Fig 1. Study area: southern Rio Grande do Sul State coast, southern Brazil (from 32°08′S to 32°25′S). The survey design followed a zigzag pattern from the coastline to the 15m isobath.

with small variations due to the direction and strength of the wind. A blind strip of 109.2m (i.e. 54.6m to each side of the transect line) occurred below the plane as it did not have bubble windows. For each recorded animal or group, the declination angle was measured abeam with an inclinometer in order to calculate the distance of the sighting from the transect line. The distance of $x = 0$ from the transect line was considered to occur at a perpendicular distance of 54.6m and all other distances rescaled accordingly.

The survey design followed a zigzag pattern, crossing a surface area of about 435km^2. The first flight consisted of 14 9.3km transects totalling 129.8km. The other flights consisted of 20 9.3km transects totalling 185.2km. Due to differences in observers' experience, only one side of the aircraft was considered in density calculations for some flights (Table 1). All flights were carried out in the same area and are considered as replicates. Surveys were performed with calm seas (Beaufort below 3) and mostly with clear or partly cloudy skies. Under favourable weather conditions, two surveys were carried out each day, one in the morning and another in the afternoon (Table 1).

Table 1

Number of franciscanas and groups per survey in the southern Rio Grande do Sul State coast. [a] = morning; [b] = afternoon, * = 1 observer.

Replicate	Date	No. groups	No. animals	Length of 'leg' (km)
1	4 March[a]	4	4	129.8
2*	5 March[a]	4	4	185.4
3	5 March[b]	8	9	185.4
4	6 March[b]	3	3	185.4
5*	7 March[a]	1	1	185.4
6	7 March[b]	4	6	185.4
7*	8 March[a]	2	2	185.4
8*	8 March[b]	3	5	185.4

Detection probability (g_0)

A fundamental assumption of line-transect theory is that all animals on the trackline are seen. This is clearly not true and in this study the probability of detecting a franciscana was estimated following the approach of Barlow *et al.* (1988) for harbour porpoises (*Phocoena phocoena)*:

$$g_0 = \Pr(\text{dolphin is visible} | \text{dolphin is on transect line}) = \frac{s+t}{s+d}$$

where:

s is the average time a franciscana is at the surface;
d is the average time a franciscana is submerged; and
t is the time window during which the franciscana is within the visual range of an observer.

For completeness, is considered to be 1 if $t > d$.

Density estimates

Franciscana density (D) was estimated using standard distance sampling methods (Buckland *et al.*, 1993). Data were analysed with the program DISTANCE 2.2 (Laake *et al.*, 1996). Three potential detection functions were initially considered: uniform, half-normal and hazard-rate, together with various adjustment terms. Models were compared with likelihood ratio tests and Akaike information criteria (AIC). Density estimates were made for the model with the smallest AIC.

Each flight was taken as a replicate (Buckland *et al.*, 1993). The density estimate for replicate i is given as:

$$\hat{D}_i = \frac{n_i \cdot \hat{f}(0) \cdot \hat{E}_i(s)}{2 \cdot c_i \cdot L_i \cdot \hat{g}_0} \quad \text{for } i = 1, 2, \ldots, r \qquad (1)$$

where $r = 8$ is the total number of replicates (flights) and $c_i = 1$ or 0.5 if both or only one side of the i-th transect line were taken into account. The inclusion of c_i was necessary to exclude data from inexperienced observers. The detection probability $f(0)$ was estimated from all data combined.

The variance estimate of the pooled and uncorrected ($g_0 = 1$) densities D_u was calculated using DISTANCE 2.2. For the corrected densities $\hat{D} = \hat{D}_u \hat{g}_0^{-1}$, variance estimates were calculated with equation (2) obtained by the delta method (Seber, 1982)

$$V(\hat{D}) = \hat{g}_0^{-2} \cdot \left(V(\hat{D}_u) + \hat{D}^2 \cdot V(\hat{g}_0) \right) \qquad (2)$$

Population abundance estimates were obtained by multiplying the density estimates by the area of 435km^2 covered in the survey.

RESULTS

Detection probability

Values of *s*, the average time spent at the surface (1.2s ± 0.4s) and *d*, the average time spent submerged (21.7s ± 19.2s) were obtained from Bordino *et al.* (1999) while *t*, the time window during which an animal was in visual range, was measured directly from floating bodies (e.g. sea gulls, large dead catfish and dead franciscanas). The value, 7*s*, corresponds to a distance of about 292m. The estimates for g_0 resulted in a correction factor of 0.358 (±0.069), where the standard error was calculated following the delta method (Seber, 1982) by assuming *s* and *d* to be uncorrelated.

Abundance estimation

Thirty-four franciscanas (in 29 groups) were recorded (Table 1). Most of the sightings (74%) occurred beyond the 10m isobath (the outer limit of the surveyed area was around the 15m isobath). Group size, considering all the sightings, ranged from one to three with an average of 1.16 (95%CI: 1.0 to 1.37).

Data were taken as clustered and ungrouped. The re-scaled perpendicular distances were left-truncated in order to correct for the peak of observations away from zero distance as a consequence of observation bias. In this way, the required shoulder close to zero distance could be fitted. After truncation, 20 groups remained in the final dataset. Although Buckland *et al.* (1993) recommended removal of the most extreme distances to avoid the inclusion of outliers, we decided to set $w = 205.2$m (the largest observed measurement) to avoid further reduction of the already small data set.

In Table 2 a summary of different model functions and adjustment terms are given. For each, only the best alternative based on likelihood ratio tests is listed. According to their AIC values, the best fit is obtained with a uniform detection function and a cosine series adjustment of order one (Fig. 2). That is, given $w = 205.2$ and $a = 0.820114$, the detection function is

$$g(x) = \frac{1}{w} + a\cos\left(\frac{\pi x}{w}\right) \qquad (3)$$

Density and abundance estimates are given in Table 3 for uncorrected data ($g_0 = 1$) and after correcting for the probability of missing submerged dolphins. After correction, a density estimate of 0.657 animals/km^2 was obtained which results in an estimate of 286 franciscanas (95% CI: 225-364) for a simple extrapolation to the area covered by the study.

Table 2

Summary of AIC values for different models for fitting the detection function for ungrouped but clustered data with re-scaled perpendicular distances left-truncated at 70.2m and $w = \infty$.

Key	Adjustment	AIC
Uniform	-	196.21
	Cosine	**188.90**
	Simple polynomial	193.16
Half-normal	-	189.76
	Cosine	191.74
	Hermite polynomial	191.75
Hazard rate	-	190.46
	Cosine	192.46

Table 3

Summary table of densities and population size estimates before and after correction for submerged dolphins. The area considered is of 445km^2. Degrees of freedom for confidence interval calculations are 17, 14 and 14 for $\hat{D}_S$, $\hat{D}$ and $\hat{N}$ respectively. Last line refers to extrapolations (see Discussion section)

	Estimate	% CV	95% Confidence Interval	
Uncorrected ($g_0 = 1$)				
$\hat{D}_S$	0.196	25.03	0.116	0.330
$\hat{D}$	0.235	28.46	0.129	0.428
$\hat{N}$	102	28.46	56	186
Corrected ($g_0 = 0.358$)				
$\hat{D}_S$	0.547	31.61	0.448	0.669
$\hat{D}$	0.657	34.47	0.516	0.836
$\hat{N}$	286	34.47	225	364
$\hat{N}_{64045}$	42,078	-	33,047	53,542

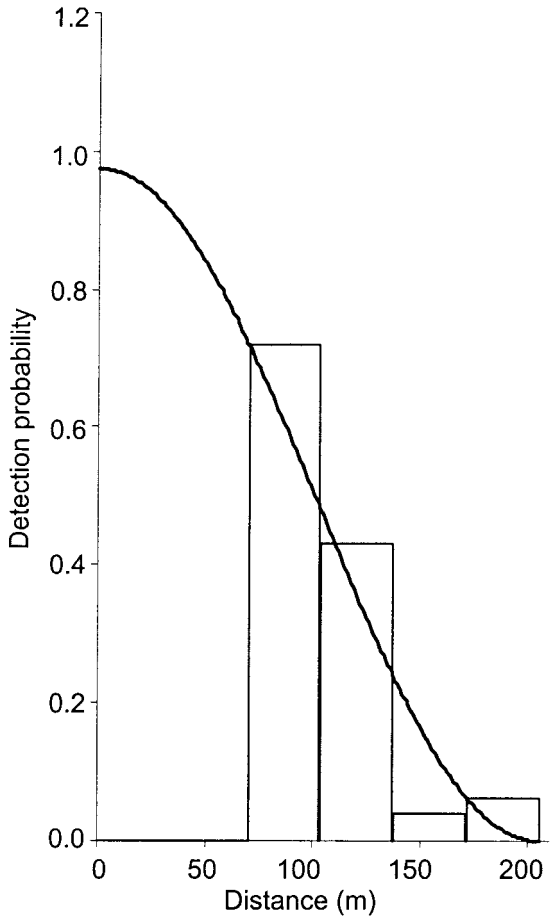

Fig. 2. Frequency distribution of perpendicular distances to sightings for fraciscana dolphin. The continuous curve represents the best fit function (see text).

DISCUSSION

Analysis

Unusually for such surveys, the data fitted best to a function that effectively represents a strip transect survey. This may be a consequence of (1) the fact that the distance data had to be left-truncated, probably because of the inexperience of some observers whose search strategy did not reflect the necessary concentration of effort near the trackline and (2) because there was a 109.2m blind strip directly under the plane.

Whilst it is clear that correction must be made for animals missed along the trackline, the method used here is necessarily approximate. In particular, this is because the limited data used (Bordino *et al.*, 1999) refer to a different stock and time. As the data were not collected during the survey itself, we were, in addition, unable to take into account observer differences.

Estimates

Although 34 franciscanas were sighted during the 8 flights, the species has several behavioural and physical characteristics that make it difficult to observe at sea from either aerial or boat surveys (Perrin *et al.*, 1989). They spend little (about 4%) time at the surface and expose the body without conspicuous splashes (Bordino and Thompson, 1997; Bordino *et al.*, 1999). Although aggregations of up to 15 individuals have been reported (Monzón and Corcuera, 1991; Junín and Castello, 1994; Crespo *et al.*, 1998); franciscanas usually swim alone or in small groups of 2-4 dolphins (data from a variety of sources: anecdotal reports by fishermen; opportunistic sightings - Di Beneditto *et al.*, 1996; systematic observations - Bordino *et al.*, 1999; and this study). Finally, its small body size (no longer than 1.7m) and colour pattern (similar to the colour of the turbid waters of much of its range) make observing individuals or groups difficult.

An aerial survey was chosen for this study primarily because of (a) the availability of a plane and (b) reports that engine noise was probably responsible for franciscanas avoidance of boats (pers. obs. of the authors and report by Pinedo *et al.*, 1989). No franciscana sightings have been reported from over 130 cruises of experienced observers onboard fishing vessels in coastal waters of the northern Rio Grande do Sul State, despite the fact that this region contains areas of high incidental captures of the species (GEMARS[1], pers. obs.).

Extrapolation of abundance estimates

Two criteria have been suggested for determining offshore borders to the franciscana distribution (Pinedo *et al.*, 1989): (a) the area out to the 30m isobath; and (b) the area out to 55km distance from the coast. In the absence of detailed information, we have considered that the 30m isobath is the most appropriate border given the depth distribution of incidentally caught franciscanas in the region (Secchi *et al.*, 1997; Ott, 1998) and the limited distributional data available (Secchi and Ott, 1997).

Whilst information on abundance is intrinsically interesting, it is also essential for assessing the potential impact of incidental mortality in gillnet fisheries. A simple extrapolation of the density estimate for the study area to the total postulated distribution range results in an estimate of some 42,000 franciscanas (95% CI from 33,047-53,542).

The total postulated area (*ca* 64,000km^2) includes the coastal waters (to 30m isobath) from Rio Grande do Sul and Uruguay. The northern and southern limits were considered as the political borders between the Rio Grande do Sul and Santa Catarina States and between Uruguay and Argentina, respectively (Secchi, 1999). These tentative borders are based partially on knowledge about parasites (Aznar *et al.*, 1995; Andrade *et al.*, 1997), osteology (Pinedo, 1991) and mtDNA sequences (Secchi *et al.*, 1998; Lázaro, 2000) as well as incidental capture locations (see Praderi, 1997; Secchi *et al.*, 1997; Kinas and Secchi, 1998; 1999; Ott, 1998).

It is important to note that the extrapolated estimate must be used with caution as it is based on a small fraction of the coastline which represents only 0.7% of the possible distribution area and there is very limited information on the relative density of this species within its range. However, these estimates are of value in beginning to attempt quantitative simulations in demographic studies.

Possible status of the franciscana

The conservation status of the franciscana is unknown given the lack of good data on stock identity, abundance and incidental mortality. In an attempt to begin to assess its status, we have tentatively combined the estimates obtained here with the available data on the annual incidental mortality for the Rio Grande do Sul State and Uruguayan coasts. Pooled data on the franciscana's bycatch (see Praderi, 1997; Secchi *et al.*, 1997; Ott, 1998; Kinas and Secchi, 1999) resulted in annual incidental mortality estimates ranging from about 550 to 1,500 franciscanas (Secchi, 1999). Combining these values with the upper and lower confidence limits of abundance for the large area indicates that somewhere between 1.1% and 3.5% of the stock is being removed each year by the coastal gillnet fishery. However, there are other sources of fishing mortality on franciscanas in this region. For example, if the catches of a target fish species for the oceanic gillnet fleet is low, effort moves to shallower waters with the operations becoming an additional source of franciscana bycatch (see Secchi *et al.*, 1997). In southern Brazil, trawlers operate both in deep offshore and shallow coastal waters. To date no records of franciscanas killed in trawls exist. Although there has been a lack of effective monitoring effort for this fleet, informal talks with fishermen suggest that catches rarely occur (hence the focus of monitoring effort on the coastal gillnet fleet).

The IWC Scientific Committee (Donovan and Bjørge, 1995) has noted that incidental mortality estimates of 1% of estimated population size are sufficient to 'raise a flag of concern' over the status of small cetacean population and that catches of 2% may not be sustainable, based on estimated maximum net productivity rates of 4% or less (e.g. Caswell *et al.*, 1998). Despite the uncertainties in the

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REFERENCES

Andrade, A., Pinedo, M.C. and Pereira, J., Jr. 1997. The gastrointestinal helminths of the franciscana, *Pontoporia blainvillei*, in southern Brazil. *Rep. int. Whal. Commn* 47:669-73.

Aznar, F.J., Raga, J.A., Corcuera, J. and Monzon, F. 1995. Helminths as biological tags for franciscana *Pontoporia blainvillei* (Cetacea, Pontoporiidae) in Argentinian and Uruguayan waters. *Mammalia* 59(3):427-35.

Barlow, J., Oliver, C.W., Jackson, T.D. and Taylor, B.L. 1988. Harbor porpoise, *Phocoena phocoena*, abundance estimation for California, Oregon, and Washington: II. Aerial surveys. *Fish. Bull.* 86(3):433-44.

Bordino, P. and Tausend, P. 1998. Avistabilidad y estimación preliminar de densidad del delfin franciscana *Pontoporia blainvillei* en Bahia Anegada, Argentina. VIII Reunião de Trabalho de Especialistas em Mamíferos Aquáticos da América do Sul. 25-29 October 1998. Olinda, Brazil. (Abstract) p.28. [In Spanish].

Bordino, P. and Thompson, G. 1997. Patrones comportamentales y estacionales de buceo del delfin franciscana, *Pontoporia blainvillei*, en Bahia Anegada, Argentina. Paper DT13 presented to III Taller para la Coordinación de la Investigación y la Conservación de la Franciscana en el Atlántico Sudoccidental. 26-28 November 1997. Buenos Aires, Argentina. [In Spanish].

Bordino, P., Thompson, G. and Iñíguez, M. 1999. Ecology and behaviour of the franciscana (*Pontoporia blainvillei*) in Bahía Anegada, Argentina. *J. Cetacean Res. Manage.* 1(2):213-22.

Buckland, S.T., Anderson, D.R., Burnham, K.P. and Laake, J.L. 1993. *Distance Sampling: Estimating Abundance of Biological Populations*. Chapman and Hall, New York and London. xii+446pp.

Caswell, H., Brault, S., Read, A.J. and Smith, T.D. 1998. Harbor porpoise and fisheries: an uncertainty analysis of incidental mortality. *Ecol. Appl.* 8:1226-38.

Crespo, E.A. 1992. Report of the workshop. Workshop for the Coordination of Research and Conservation of the Franciscana Dolphin (*Pontoporia blainvillei*) in the Southwestern Atlantic, 25-28 September 1992, Buenos Aires. Presented to UNEP, Nairobi, Kenya. (unpublished). 30pp.

Crespo, E.A., Harris, G. and González, R. 1998. Group size and distributional range of the franciscana, *Pontoporia blainvillei*. *Mar. Mammal Sci.* 14(4):845-9.

Danilewicz, D., Ott, P., Martins, M., Oliveira, L. and Susin, L. 1996. Registro de cetáceos (Mammalia:Cetacea) para o litoral norte do Rio Grande do Sul (1991-1995). XXI Congresso Brasileiro de Zoologia, 5-9 Fevreiro, Porto Alegre. (Abstract) p.252. [In Portuguese].

Di Beneditto, A.P., Ramos, R. and Lima, N.R.W. 1996. Observações de *Pontoporia blainvillei* no norte do Rio de Janeiro ($21^{0}35$'S-$22^{0}10$'S), Brasil. VII Reunión de Trabajo de Especialistas en Mamíferos Acuáticos de América del Sur. 22-25 Octubre 1996. Vina del Mar, Chile. (Abstract) p.39. [In Portuguese].

Donovan, G.P. and Bjørge, A. 1995. Harbour porpoises in the North Atlantic: edited extract from the Report of the IWC Scientific Committee, Dublin 1995. *Rep. int. Whal. Commn* (special issue) 16:3-25.

Donovan, G.P. and Gunnlaugsson, T. 1989. North Atlantic Sightings Survey 1987: report of the aerial survey off Iceland. *Rep. int. Whal. Commn* 39:437-41.

Hiby, A.R. and Lovell, P. 1998. Using aircraft in tandem formation to estimate abundance of harbour porpoise. *Biometrics* 54:1280-9.

Junin, M. and Castello, H.P. 1994. Avistajes costeros de franciscana, *Pontoporia blainvillei*, en la Provincia de Buenos Aires. VI Reunião de Trabalho de Especialistas em Mamíferos Aquáticos da América do Sul. 24-28 October 1994, Florianópolis, Brazil (Abstract). p.55. [In Portuguese]

Kinas, P.G. and Secchi, E.R. 1998. Modelling truncated data to estimate incidental kills of franciscana, *Pontoporia blainvillei*, by gillnets. *Rep. int. Whal. Commn* 48:533-6.

Kinas, P.G. and Secchi, E.R. 1999. Modelling truncated data to estimate incidental kills of franciscana, *Pontoporia blainvillei*, by gillnets. ICES/SCOR Symposium on Ecosystem Effects of Fishing, 16-19 March 1999, Montpellier, France. (Abstract) p.51.

Laake, J.L., Buckland, S.T., Anderson, D.R. and Burnham, K.P. 1996. *DISTANCE User's Guide V 2.2*. Colorado Cooperative Fishery and Wildlife Research Unit. Colorado State University, Fort Collins, Colorado. 82pp.

Lázaro, M. 2000. Utilización de marcadores moleculares para el análisis de la variación genética y estructura poblacional de la franciscana (*Pontoporia blainvillei*). Technical paper 19. p.58-61. UNEP/CMS. Report of the Third Workshop for Coordinated Research and Conservation of the Franciscana Dolphin (*Pontoporia blainvillei*) in the Southwestern Atlantic. 26-28 November 1997, Buenos Aires, Argentina. 122p.

Monzón, F. and Corcuera, J. 1991. Franciscana *Pontoporia blainvillei*. pp. 16-22. *In:* H.L. Cappozzo and M. Junin (eds). Estado de conservación de los mamíferos marinos del Atlantico Sudoccidental. Informes y Estudios del Programa de Mares Regionales del PNUMA 138.

Moreira, L.M. and Siciliano, S. 1991. Northward extension range for *Pontoporia blainvillei*. Ninth Biennial Conference on the Biology of Marine Mammals, 5-9 December 1991, Chicago, Illinois (Abstract) p.48.

Ott, P.H. 1998. Análise das capturas acidentais de *Pontoporia blainvillei* (Gervais e D'Orbigny, 1844) (Cetacea, Pontoporiidae) nas comunidades pesqueiras do litoral norte do Rio Grande do Sul, Sul do Brasil. Masters Thesis, Pontifícia Universidade Católica do Rio Grande do Sul, Porte Alegre. 120pp. [In Portuguese]

Perrin, W.F., Brownell, R.L., Zhou, K. and Liu, J. (eds.). 1989. *Occasional Papers IUCN Species Survival Commission*. No. 3. *Biology and Conservation of the River Dolphins*. IUCN, Gland, Switzerland. v+173pp.

Pinedo, M.C. 1986. Mortalidade de *Pontoporia blainvillei, Tursiops gephyreus, Otaria flavescens* e *Arctocephalus australis* na costa do Rio Grande do Sul, Brasil, 1976-1983. Prim. Reu. Trab. Exp. Mam. Acuát. Am. Sur (Actas). pp.187-199. [In Portuguese]

Pinedo, M.C. 1991. Development and variation of the franciscana, *Pontoporia blainvillei*. Doctoral Thesis, University of California, Santa Cruz. 406pp.

Pinedo, M.C., Praderi, R. and Brownell, R.L. 1989. Review of the biology and status of the franciscana, *Pontoporia blainvillei*. pp. 46-51. *In:* W.F. Perrin, R.L. Brownell, K. Zhou and J. Liu (eds). *Biology and Conservation of the River Dolphins. Occas. Pap. IUCN SSC 3*.

Praderi, R. 1997. Análisis comparativo de estadísticas de captura y mortalidad incidental de *Pontoporia blainvillei* em Uruguay durante 20 años. II Encontro sobre Coordenação de Pesquisa e Manejo da Franciscana. 22-23 October 1994. Florianópolis - Brazil. (Actas). pp.42-53. [In Spanish].

Praderi, R., Pinedo, M.C. and Crespo, E.A. 1989. Conservation and management of *Pontoporia blainvillei* in Uruguay, Brazil and Argentina. *In:* W.F. Perrin, R.L. Brownell, K. Zhou and J. Liu (eds). *Biology and Conservation of the River Dolphins. Occas. Pap. IUCN SSC 3*. pp. 52-56.

Reeves, R.R. and Leatherwood, S. (eds.). 1994. *Dolphins, Porpoises, and Whales: 1994-1998 Action Plan for the Conservation of Cetaceans*. IUCN, Gland, Switzerland. 92pp.

Seber, G.A.F. 1982. *The Estimation of Animal Abundance and Related Parameters*. 2nd Edn. Charles Griffin and Company Ltd., London. i-xvii+654pp.

Secchi, E.R. 1999. Taxa de crescimento potencial intrínseco de um estoque de franciscanas, *Pontoporia blainvillei* (Gervais and D'Orbigny, 1846) (Cetacea, Pontoporiidae) sob o impacto da pesca costeira de emalhe. Masters Thesis, Fundação Universidade Federal do Rio Grande, Rio Grande. 152pp. [In Portuguese]

Secchi, E.R. and Ott, P.H. 1997. The depth factor determining the distribution and abundance of franciscana, *Pontoporia blainvillei*, as demonstrated by a CPUE index approach. Paper DT18 presented to III Taller para la Coordinación de la Investigación y la Conservación de la Franciscana en el Atlántico Sudoccidental. 26-28 November 1997. Buenos Aires, Argentina.

Secchi, E.R., Zerbini, A.N., Bassoi, M., Dalla Rosa, L., Moller, L.M. and Rocha-Campos, C.C. 1997. Mortality of franciscanas, *Pontoporia blainvillei*, in coastal gillnetting in southern Brazil: 1994-1995. *Rep. int. Whal. Commn* 47:653-8.

Secchi, E.R., Wang, J.Y., Murray, B.W., Rocha-Campos, C.C. and White, B.N. 1998. Population differentiation in the franciscana (*Pontoporia blainvillei*) from two geographic locations in Brazil as determined from mitochondrial DNA control region sequences. *Can. J. Zool.* 76:1,622-7.