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Mortality of Franciscanas, *Pontoporia blainvillei*, in Coastal Gillnets in Southern Brazil: 1994-1995

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ABSTRACT

The franciscana, *Pontoporia blainvillei*, is endemic to the coastal waters of the central western South Atlantic where it is perhaps the most impacted cetacean species. Its restricted distribution makes it vulnerable to anthropogenic activities and incidental captures in coastal gillnets seem to be the greatest threat to the species' survival. During 1994 we monitored the landings of 37 boats, which correspond to about 25% of the total coastal gillnet fleet of the port of Rio Grande (comprising of 140-150 vessels in total) At least 97 dolphins were captured by the monitored boats. In 1995, however, a strong reduction in fishing effort occurred and captures of only ten dolphins were reported. These captures occurred in nets set for sciaenids and pomatomids. The size of nets varied from 800-11,000m in length and from 2.5-14.0m in depth with 9.0-16.0cm stretched mesh, depending on the target species. Nets were classified according to the type of operation as: passive (set gillnets) used to catch white croaker, *Micropogonias furnieri*, and striped weakfish, *Cynoscion guatucupa*; and as active ('run-around' gillnets) used to catch bluefish, *Pomatomus saltatrix*. Of the captures for both years ($n = 107$), 56 dolphins were male (71% juveniles) and 51 were female (59% juveniles). Captures were predominant between 20 and 30m of depth. Using Student t-test, no significant differences at a 5% level were found in the mean depth of captures between sexes ($p = 0.052$), reproductive status ($p = 0.226$), and between warm and cold months ($p = 0.191$). The estimated catch per unit of effort (CPUE) for passive and active nets in 1994 was 0.0066 dolphins×(1,000m of net×day)$^{-1}$ and 0.0038 dolphins×(operation×day)$^{-1}$, respectively. By extrapolation, an annual capture of about 460 franciscanas by the Rio Grande coastal gillnet fleet was estimated. The lack of abundance estimates, the unknown stock structure and the regular mortality of the species in gillnets (particularly immature animals) are reasons for concern.

KEYWORDS: FRANCISCANA; INCIDENTAL CAPTURE; GILLNETS; SOUTH ATLANTIC; AREA-BRAZIL; CONSERVATION

INTRODUCTION

The franciscana, *Pontoporia blainvillei*, is the smallest and the only marine member of the platanistoid dolphins. It is endemic to coastal central Atlantic waters off South America (Fig. 1) and is perhaps the cetacean most affected by human activities, mainly incidental captures, in this area (Praderi *et al.*, 1989; Secchi *et al.*, 1995). Pinedo (1991) proposed, based on osteological differences, two different forms of franciscana, one found to the north and the other to the south of Santa Catarina State, southern Brazil. Variation in the mitochondrial D-loop DNA between these two forms was found to support this view, suggesting the existence of at least two populations or management stocks (Secchi *et al.*, 1996).

A number of factors raise conservation concerns about this species (1) its restricted distribution (only 25° in latitude, from the central coast of Brazil to the central coast of Argentina); (2) its apparent vulnerability to incidental captures and the lack of reliable estimates of total bycatches; (3) the lack of information about its abundance and stock structure; (4) the vulnerability of its coastal/estuarine habitats to degradation by pollutants, boat traffic and overfishing. The Workshop on Conservation and Biology of the Platanistoid Dolphins recommended that franciscana be listed as 'Vulnerable' (Perrin and Brownell, 1989). However, since it is only suspected that this species has been seriously depleted, many researchers consider this dolphin as 'Insufficiently Known' (Klinowska, 1991). Although the species has complete legal protection in Argentina and Brazil (but not in Uruguay), serious threats to the species still remain, the most significant of which appears to be incidental captures in coastal gillnets throughout most of its range (Praderi *et al.*, 1989; IWC, 1994).

Knowledge of captures of franciscanas have existed for at least 30 years. Since the late 1960s incidental catches of franciscanas have been reported in gillnet fisheries in Uruguayan waters (e.g. Van Erp, 1969; Pilleri, 1971; Brownell, 1975; Praderi, 1984). Nowadays, incidental captures have been reported from many areas along the franciscana's distribution. In Uruguay, between 1974 and 1985, at least 2,444 franciscanas were taken in the shark fishery, although because of a decline in the fishery, captures have been decreasing since 1979 (Brownell, 1989). Along the Rio Grande do Sul State coast (29°20'S, 33°45'S), southern Brazil, from 1976-1987 and from 1992-1993, at least 1,085 and 88 dolphins, respectively, were found dead (Pinedo, 1994). Monitoring of incidental captures in Argentina began in 1985 and it is believed that captures may be greater than those reported for Uruguay (Perez-Macri and Crespo, 1989).

In the past, data on incidental mortality of the franciscana along the southern Brazilian coast were obtained solely from stranded carcasses (e.g. Pinedo, 1994). However, in 1992, information began to be obtained through the monitoring of fisheries by the authors from the southern portion of the Rio Grande do Sul State (32°08'S, 52°05'W). Most Brazilian fish production is from this region and the Port of Rio Grande is its most important fishing facility. Fishermen from most of the monitored boats reported that franciscanas have been captured occasionally (Secchi *et al.*, 1994). Given the regular incidental mortality of this species and the concerns about its status listed above, monitoring effort was continued in 1994 and 1995.

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The main purpose of this paper is to estimate a catch per unit of effort (CPUE) value for each gillnet type, use this to obtain an approximate estimate of the number of dolphins caught in 1994 and to provide a framework for future studies using CPUE information. In addition, data on frequency distribution by total length; proportion of sexes and reproductive status; and the differences in the mean depth of captures between sexes, reproductive status and between cold and hot seasons are presented.

MATERIALS AND METHODS

The fleet and the fishing area

The coastal gillnet fleet based in Rio Grande comprises about 140-150 boats (data obtained by the authors during the study period) which may remain at sea from 1-4 days (see Table 1). The fleet generally operates between the lighthouses of Mostardas (31°13'S) and Sarita (32°38'S), in waters from 10-30m deep. These isobaths occur about 2.5-35 n.miles from the coast off Sarita Lighthouse and 0.5-10 n.miles off Mostardas Lighthouse. Most fishing effort is concentrated between these two points, in waters subject to the influence of the Patos Lagoon estuary (Fig. 1).

Table 1

Characteristics of the coastal gillnet fleet of the Rio Grande Port (data obtained in 1994).

Target species	Fleet size (boats)	Boat size (m)	Trip length (days)	Operation length (hrs)	Season length (months)
Croaker/weakfish	≠145	12-16	1-4	≠12	8-10
Bluefish	≠100	12-16	1-3	≠1-4	1-2

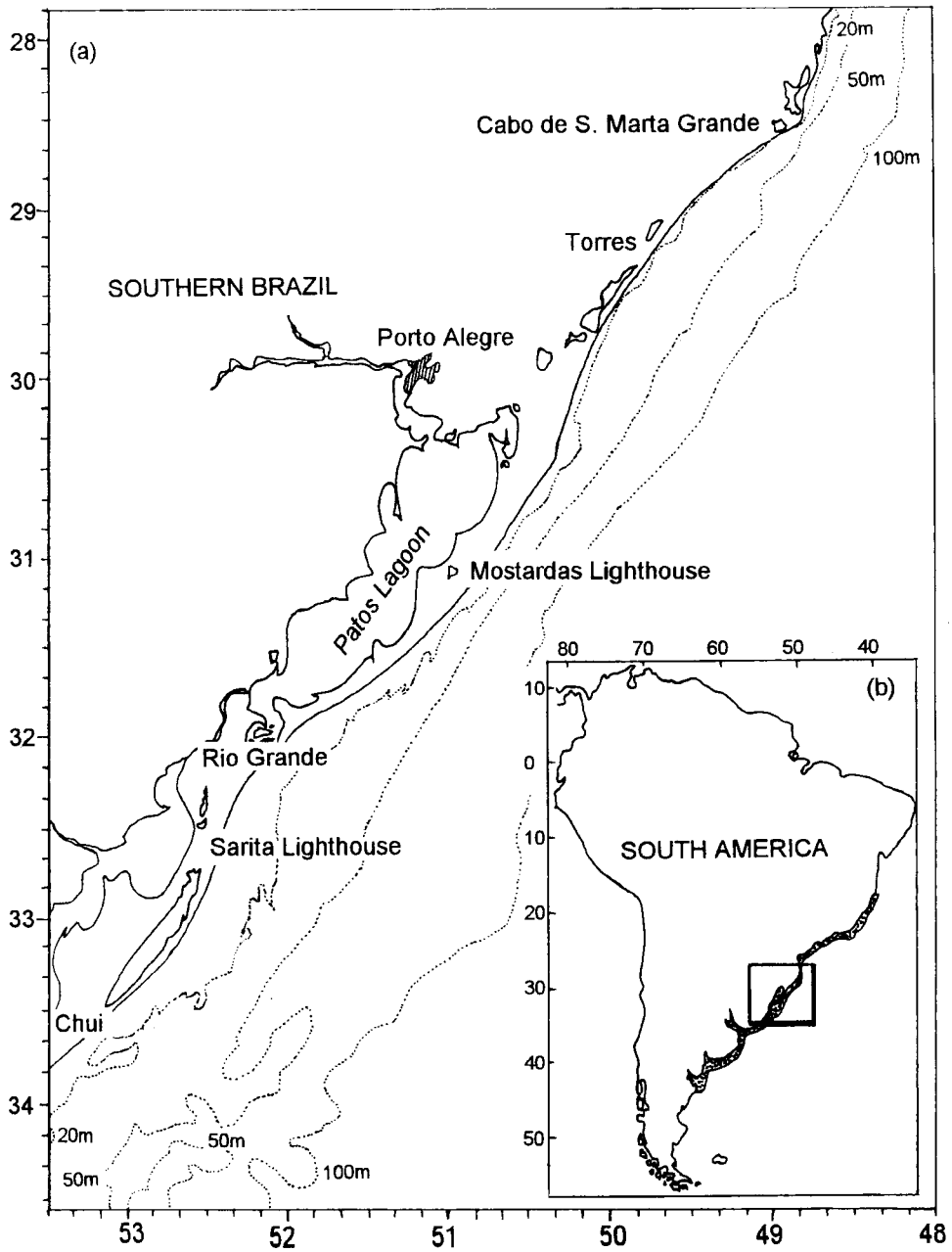

Fig. 1. The main fishing area of the Rio Grande coastal gillnet fleet, from Mostardas Lighthouse to Sarita Lighthouse (a). Shaded areas represent the geographical distribution of franciscana, *Pontoporia blainvillei*, in the western South Atlantic (b) (adapted from Pinedo *et al.*, 1989).

Net sizes vary according to the target species (bluefish, *Pomatomus saltatrix*, striped weakfish, *Cynoscion guatucupa* and white croaker, *Micropogonias furnieri)*. The characteristics of the nets used are summarised in Table 2 (see also Reis, 1992).

For the purpose of the analysis in this paper, nets have been classified into two types: those that are passive in nature (bottom gillnets set for sciaenids), which are used by the whole fleet; and those employed in an active fashion such as the 'run-around' gillnets (locally called *cerco*, used for pomatomids), which are used by about 75% of the fleet. In the latter fishery, the fishermen search for schooling bluefish and, after finding them they run the net around the school. However, unlike purse seining, the bottom of the 'run around' net is not closed after entrapping the fish and thus it operates as a gillnet. This fishery is sometimes used in a passive fashion, but the duration of the operation is much shorter (about one third to one sixth) than passive net settings, which may last almost 12 hours each fishing day and covers the entire water column with net. On average, monitored boats spent two to three days at sea, with generally one effective day of fishing. The number of fishing trips was about six per month. In 1994, the white croaker and striped weakfish fisheries (passive nets) occurred year round, excluding July, when fishermen directed their efforts towards the bluefish fishery (active fishery) and April, when fishermen repaired their nets.

Table 2

Characteristics of the fishing gear of the coastal gillnet fleet based on the Rio Grande Port. Data obtained in 1994.

Target species	Net length (m) average (range)	Net width (m) average (range)	Stretched mesh (cm)
Croaker	5,435 (3,000-11,000)	3.0 (2.0-4.0)	14.0-16.0
Weakfish	5,435 (3,000-11,000)	3.0 (2.0-4.0)	9.0
Bluefish	800-4,000	6.0-14.0	9.0

Data collection

In previous years we have informally interviewed fishermen about interactions between cetaceans and fisheries and made them aware of the importance of their cooperation in improving our knowledge of franciscanas. This helped us to identify those fishermen who were most willing to cooperate with the present study. They provided reasonable information on their experience of interactions with cetaceans and were therefore considered trustworthy for providing information on captures. Given the coastal shallow water habits of the franciscana, it was decided to monitor only the coastal fleet which operates in shallower waters. Initially, around 25% of this fleet was monitored. However, in 1995 we reduced the number of monitored boats to about 5% of the fleet and it was decided to work only with those fishermen judged to be most trustworthy. During 1994, data on location of operations, net characteristics and effort were systematically collected through twice-a-week informal interviews and by means of standardised data sheets distributed to each monitored boat. Every dolphin captured by these boats was brought in to us. Morphometrics, sex and the presence of natural marks of each were recorded. Material for stomach content, contamination, age class, reproductive status and genetic analyses were also collected. The locations of the captures were plotted on a nautical chart in order to identify areas where capture occurred.

Statistics

Statistical analysis was performed using only the information obtained directly from fisheries. Since it was expected to find differences in the mean depth of captures between sexes, reproductive status, and cold (austral autumn/winter) and warm (austral spring/summer) seasons, the one-tailed *t*-test was used to investigate the following hypotheses: (1) the mean depth of capture is higher for males than for females; (2) the mean depth of capture is higher for adults than for juveniles; and (3) the mean depth of capture is higher during cold months than during warm months. Males and females were considered adults when their total lengths exceeded 131 and 140cm, respectively, following Kasuya and Brownell (1979). Visual examination of the gonads helped in identifying reproductive status when the size of the animals was close to the above limits. CPUE analysis was performed only on dolphins captured during 1994. Fisheries were atypical in the year of 1995 and changes in effort were difficult to monitor (see discussion). CPUE is expressed here as the number of dolphins captured per 1,000 linear metres of net $\times$ day (franciscana $\times$ {1,000m of net $\times$ day}$^{-1}$) in the case of passive nets, and the number of dolphins captured per operation $\times$ day (franciscana $\times$ {operation $\times$ day}$^{-1}$) in the case of active nets.

RESULTS

During 1994 the monitored boats landed 97 franciscanas incidentally caught in coastal gillnets set for sciaenids and pomatomids. Four of these dolphins were not included in CPUE analysis because they were captured by an oceanic boat that was incidentally operating in coastal waters. From a total of 93 dolphins, 78 were captured in passive gillnets and 15 in active 'run-around' gillnets. In 1995, the number of incidentally caught dolphins decreased sharply and only ten animals were brought in by fishermen, nine of which were caught in passive gillnets. From the total captured animals ($n = 107$), 56 were males, 71% of which were juveniles, and 51 were females, 59% of which were juveniles. Seven were pregnant females (14%) (Figs 2 and 3).

Gillnets set for white croaker: Fifty-one franciscanas were brought in from 27 different boats (about 18% of the total fleet). Twenty-nine dolphins (56.86%) were female and 22

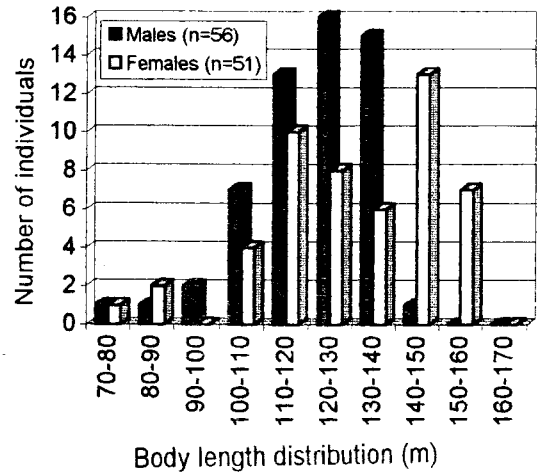

Fig. 2. Body length distribution of male/female *P. blainvillei* incidentally caught in Rio Grande do Sul State, southern Brazil 1994/1995.

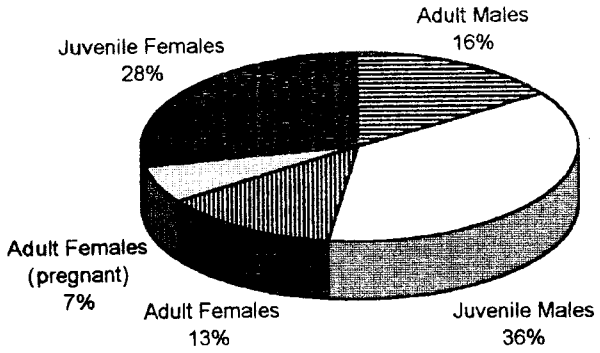

Fig. 3. Proportion between sexes and reproductive status of *P. blainvillei* incidentally caught in Rio Grande do Sul State, southern Brazil 1994/1995 ($n = 107$).

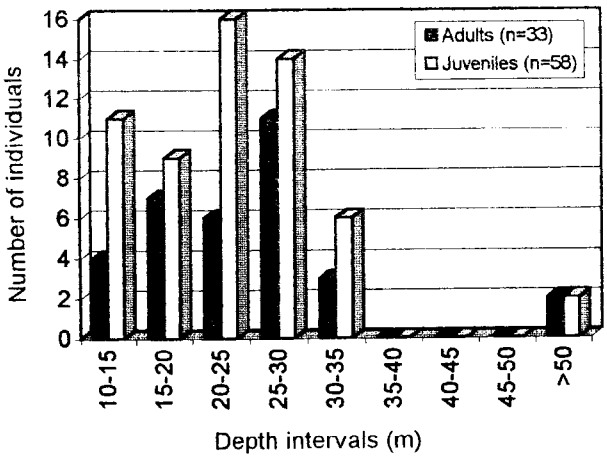

Fig. 5. Depth distribution of adult/juvenile *P. blainvillei* incidentally caught in Rio Grande do Sul State, southern Brazil 1994/1995.

(43.14%) were male. These catches occurred in waters 10-35m deep, with the exception of two animals taken by the same boat in waters of about 55m deep.

Gillnets set for striped weakfish: Forty franciscanas were brought in by 26 different boats (about 17% of the total fleet). Sixteen dolphins (40%) were female and 24 (60%) were male. The captures occurred in waters between 18-32m deep, except for two dolphins taken in waters 57m deep.

Gillnets set for bluefish: Sixteen franciscanas were brought in by 11 different boats (10% of the total fleet). Six dolphins (37.50%) were female and 10 (62.50%) were males. Catches occurred in waters 12-30m deep.

The observed overall mean depth of captures were generally comparable among the different fisheries. However, it was slightly higher for males (25.2m) than for females (22.0m). The mean depth of capture was also higher for adults (25.0m) than for juveniles (23.5m), and higher during cold months (24.7m) than during warm months (22.9m) (Figs 4, 5 and 6 respectively). However, according to the one-tailed p-value of each tested hypothesis ($p = 0.052$; $p = 0.226$; and $p = 0.191$, respectively), the differences found at a 5% level were insignificant.

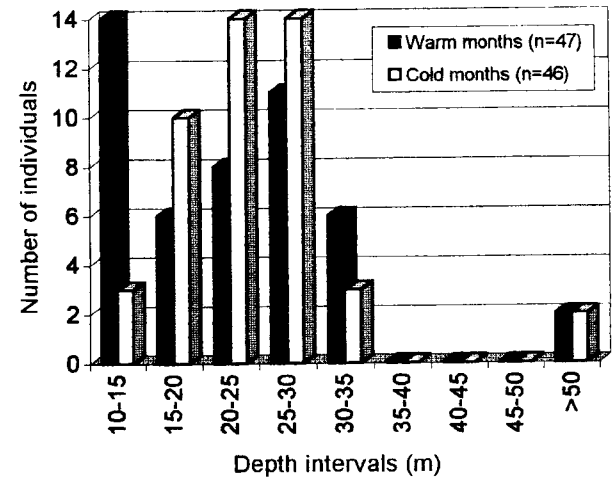

Fig. 6. Depth distribution of *P. blainvillei* incidentally caught in Rio Grande do Sul State, southern Brazil, by season 1994/1995.

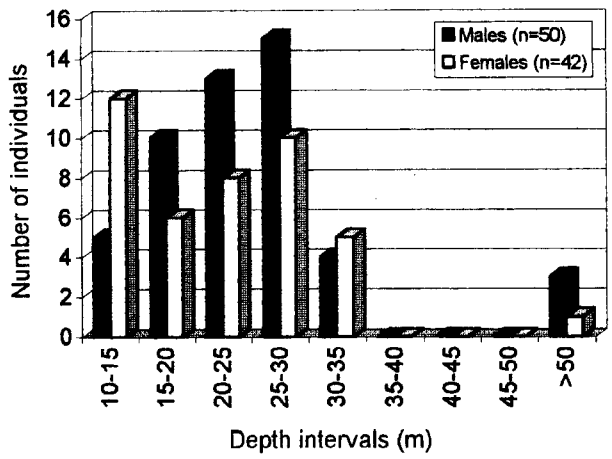

Fig. 4. Depth distribution of male/female *P. blainvillei* incidentally caught in Rio Grande do Sul State, southern Brazil 1994/1995.

The CPUE estimate for passive gillnets was about 0.0066 franciscana×(1,000m of net × day)$^{-1}$. Assuming a constant probability of incidental capture for the whole coastal fleet (total effort of 157.6×10^3m of net per day) and extrapolating it to the whole study period (ten months), the number of dolphins caught in passive gillnets was about 312 animals per year. The CPUE estimate for 'run-around' gillnets was 0.0038 franciscana × (operation × day)$^{-1}$, based on the 15 dolphins brought in by fishermen. If we also assume the same probability of incidental captures for the whole coastal fleet and follow the same pattern of extrapolation as mentioned above (total effort of about 218 operations per day, where each boat makes six fishing trips a month) and considering the short bluefish fishing season (only one month per year), the yearly number of franciscanas captured in active gillnets was approximately 149.

DISCUSSION

Limitations of the analysis

There are a number of potential limitations associated with CPUE analyses (e.g. IWC, 1989) and in addition, given that no comparative data are available, it is difficult to evaluate the precision of our estimate of 461 dolphins captured in 1994. For example, in addition to the general problem of the

representativeness of the monitored boats, it is possible that our source of data (fishermen) is biased towards a lower number of dolphins than were actually captured, since the fishermen are known to have consumed dolphins in one way or another. In our study area, franciscanas are usually discarded at sea but a few fishermen use the oil to waterproof boats and the meat is sometimes used for feeding dogs and even rarely for human consumption (Secchi *et al.*, 1994; 1995). Nevertheless, the estimate is high enough to warrant concern even in the absence of abundance estimates for franciscana. Pinedo (1994) reported that 919 dolphins were found washed ashore from 1976 to 1987 in the same area of study and suggested an average of about 84 animals caught per year. However, this estimate must be considered a minimum estimate because not all netted carcasses reach the beaches e.g. they may be blown offshore, get eaten by sharks and/or sink. Thus, beach monitoring alone tends to underestimate captures and should only be used to complement the information obtained from systematic monitoring of the fisheries.

Comparisons with CPUE values for passive gillnets

Corcuera *et al.* (1994) recalculated the value obtained by Perez-Macri and Crespo (1989) in Necochea, Argentina for the year of 1984 and found a CPUE about 39 times higher than the estimates presented here for 1994. CPUE data from later years (1988 and 1989) estimated by the same authors were, however, about two times higher and three times lower, respectively, than our estimates for 1994. The large discrepancies in the CPUE values found by Corcuera *et al.* (1994) for 1984 and 1988/89 and our estimate are difficult to explain and may be associated with some sampling bias or change in abundance and/or distribution of franciscanas. On the other hand, the relatively small variation between our CPUE value and the 1988/89 values of Corcuera *et al.* (1994), are more reasonable and may indicate a fluctuation in the relative abundance of franciscana between these two areas, at least on a seasonal basis.

Several researchers have stated that gillnets of 30-34cm stretched mesh size (set for sharks and black drum, *Pogonias cromis*) appear to be the most dangerous gear for franciscanas in Uruguay and Argentina (Praderi, 1984; Crespo *et al.*, 1986; Perez-Macri and Crespo, 1989; Praderi *et al.*, 1989). All captured dolphins reported in this study were taken in gillnets with mesh size much smaller, ranging from 9.0-16.0cm which, therefore, also appears to be dangerous. In southern Brazil, large mesh gillnets for shark fisheries are usually set in waters beyond the 30m isobath, where franciscanas are apparently less abundant (Moreno *et al.*, 1994 and Secchi *et al.*, 1995).

Most of the animals reported here were caught in waters near the mouth of the Patos Lagoon. This area of apparent high captures coincides with the area where the greatest fishing effort is placed. According to Haimovici *et al.* (1996), sciaenids are the most abundant fish on the continental shelf of southern Brazil, and the adjacent waters of the Patos Lagoon are important nursery grounds for several species of sciaenid throughout the year. Coincidentally, sciaenidae is the most important fish family in the diet of the franciscana in southern Brazil (Pinedo, 1982; Ott, 1995). Thus, the high abundance of sciaenids (approximately 81% in weight of the bony fish in the region; Haimovici *et al.*, 1996), represents both an important fishing resource for the local fleet (Haimovici *et al.*, 1989; Reis, 1992) and a large food resource for franciscanas. As a consequence, the marked bycatch mortality of franciscana in the area is probably a function of the extensive fishing effort and a relatively higher abundance of franciscana in the same area.

Most of the franciscanas (86%) were caught in waters less than 30m deep (<30 n.miles from the coast); only 13 animals were captured in deeper waters. The capture of four animals in waters >50m occurred in the northern study area (Mostardas Lighthouse), where the 30m isobath is relatively close to shore. However, given the lack of significant differences in the mean depth of capture between sexes, adults and juveniles, or between cold and hot seasons, it is premature to attempt to identify areas or seasons which represent less risk for capturing females and immature animals. Nevertheless, it does appear that females and young animals tend to occur in shallower waters. We suggest that those areas where franciscanas are known to have been captured be used as focal areas in order to develop approaches for determining the abundance of the species.

One possible explanation for the reduction in the franciscana bycatch in 1995 was the decrease in the fishing effort. The new Free Market Agreement in southern South America, called 'MERCOSUL' (adopted on 1 January 1995), allows the import of fish fillets from Uruguay, Argentina and sometimes from Chile at very low prices (almost the same price as uncleaned Brazilian fish). This led to a drop in the local fish prices, thus decreasing fishermen's profits. This, plus the depletion of fish, resulted in a strong reduction in the coastal gillnet fishing effort. Some fishermen halted fishing operations during most of the first semester of 1995, while others changed the gillnets used to catch sciaenids (less valued fishes) for trawl nets used for flatfish and shrimps (higher value), and/or moved to fishing grounds in deeper waters, where fish schools were more commonly found in that period. All this is likely to reduce the franciscana bycatch. However, this decrease in the fishing effort was probably atypical and it may soon return to the usual levels. Thus it is suspected that a higher mortality of franciscana, such as that estimated for 1994, is likely to recur.

The predominance of juveniles in franciscana incidental capture has been attributed to a bias created by fishermen discarding larger and heavier animals which are more difficult to handle (e.g. Corcuera *et al.*, 1994 for Argentinian waters). However, since the nets in our study region are hauled up mechanically, the above suggestion is unlikely. This is corroborated by Pinedo (1994), who reported that about 50% of the franciscana carcasses collected on the beach corresponded to animals at or before the age of sexual maturation. Thus, this predominance may occur due to a greater capability of the adults to detect nets and/or their greater efficiency in avoiding them. The possibility that the species has been overexploited in southern Brazil cannot be rejected, although the lack of abundance estimates and the uncertainty of stock structure make it difficult to assess the impact of incidental captures on the population level (see also Corcuera *et al.*, 1994).

Urgent management actions are needed to minimise the effects of incidental captures on franciscana populations or even to prevent the species from collapsing. We therefore stress the need to identify sites where captures are highest on both a spatial and a temporal basis. Bycatch mortality should be determined as accurately as possible using direct monitoring where practical; the value of CPUE is limited due to the intrinsic uncertainties and potential bias of the method. This can be partially solved by keeping accurate records on the variability of effort throughout the fishing season. It also requires researchers working in different regions to compare CPUE estimates on a regular basis using standardised units

of effort. The possibility of using CPUE data as an indicator of relative abundance in selected study areas to identify temporal trends should be investigated. In addition, methods (such as acoustic deterrents) should be tested in an attempt to reduce incidental catches. Finally, a simulation approach should be used to examine the possible impact of various levels of incidental catches of franciscana and various levels of fishing effort (see Ricker, 1975; Sparre *et al.*, 1989; Mangel, 1993; Givens *et al.*, 1994; Cortés, 1995).

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