

A Note on Cetacean Bycatch in Pelagic Driftnetting off Southern Brazil

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ABSTRACT

Studies on cetacean-fishery interactions in Brazil have increased notably in recent years but data concerning pelagic driftnet operations have remained limited. Information on this kind of fishery has been collected through interviews with fishermen and ship-owners from the ports of Ubatuba (22°53'S, 45°08'W) and Itajaí/Navegantes (26°54'S, 48°39'W) or through personal observation during seven trips conducted in 1995 (1) and 1997 (6) onboard fishing vessels. Boats using driftnets are known to operate from nine localities along the southern Brazilian coast. The fishing area spans from ~21°S to 33°45'S in waters ranging from 47-3,600m in depth. Fishing effort is higher in spring and summer than in autumn and winter due to the distribution and availability of target species. The driftnet fleet operating from Ubatuba is composed of about 20 boats, 6-18m long, with 6-8 fishermen per boat; net panels are 50m long and 12-13m in height; number of panels ranges from 67 (3,350m long net) to 78 (3,900m long net); and stretched mesh sizes vary from 10-40cm. In the neighbouring ports of Itajaí and Navegantes, there are around 90 boats, 13 to 27m in length, with 10-15 men per boat, net panels are 25-120m long and 4.5-27m high; stretched mesh sizes range from 14-40cm. The pelagic driftnet fishery in southern Brazil is focused on sharks (families Sphyrnidae and Carcharinidae). Incidentally caught species include cetaceans, marine turtles and manta rays (Mantidae). Cetacean species captured (and numbers recorded) are *Megaptera novaeangliae* (unknown), *Physeter macrocephalus* (4), *Kogia simus* (1), *Globicephala melas* (15), genus *Delphinus* (2), *Tursiops truncatus* (1), *Stenella frontalis* (5), *S. longirostris* (2-4), *S. clymene* (1) and *S. coeruleoalba* (1). The driftnet fishery may be an important cause of cetacean mortality. Therefore a systematic study must be carried out in order to evaluate the impact of this activity on the species that occur in Southern Brazil.

KEYWORDS: ATLANTIC OCEAN; INCIDENTAL CATCHES; FISHERIES; GILLNETS; HUMPBACK WHALE; SPERM WHALE; PYGMY SPERM WHALE; PILOT WHALE; COMMON DOLPHIN; BOTTLENOSE DOLPHIN; ATLANTIC SPOTTED DOLPHIN; SPINNER DOLPHIN; CLYMENE DOLPHIN; STRIPED DOLPHIN

INTRODUCTION

Interactions with fishery activities are perhaps the major conservation threat to cetaceans throughout the world. Among the wide variety of fishing gear, gillnets may have the greatest impact on cetacean populations (see Perrin *et al.*, 1994). Pelagic fleets, operating surface gillnets, also known as driftnets¹, are an acknowledged cause of important marine mammal mortality (Northridge, 1991) and are of particular concern because they are relatively less known and more difficult to monitor than other more coastal-operating fleets.

In Brazil, knowledge on cetacean-fishery interactions has increased notably in recent years since it was first reported about 35 years ago (Carvalho, 1961; 1963). Most of the information available was obtained through descriptive surveys based on the coastal fishery (e.g. Lodi and Capistrano, 1990; Simões-Lopes and Ximenez, 1993; Siciliano, 1994) which have shown that several species found in coastal waters off Brazil die entangled in fishing gear. Systematic surveys have recently started in some localities along the Brazilian coast, focussing on the two possibly most affected coastal species, the franciscana, *Pontoporia blainvillei* (e.g. Moreno *et al.*, 1994; Secchi *et al.*, 1997) and the tucuxi, *Sotalia fluviatilis* (Capistrano *et al.*, 1992). Additional information on cetacean incidental

catches is available for the pelagic longline fishery, but it seems that mortalities are minimal in this sort of gear (Basso *et al.*, 1996).

Although cetacean-fishery interactions have recently been reviewed in Brazil (Pinedo, 1994; Siciliano, 1994), only very limited data on pelagic driftnetting was available at that time. The present paper reports on this fishing technique and includes information about the fishing fleet and gear as well as incidentally captured species.

METHODS

Information on the driftnetting fleet and gear was obtained from boats operating from Ubatuba (22°53'S, 45°08'W, State of São Paulo - SP) and Navegantes/Itajaí (26°54'S, 48°39'W, State of Santa Catarina) through interviews with ship-owners and fishermen. Information on cetacean bycatch was opportunistically collected during seven trips aboard fishing vessels (one from Itajaí in 1995 and six from Ubatuba in 1997) or collected by fishermen. Unless, otherwise noted, data on the fishing gear and fleet operating from the port of Itajaí/Navegantes was compiled from the unpublished report by Kotas *et al.* (1995). In addition, literature containing information on the pelagic fleet using surface gillnets along the southern Brazilian coast and that which reports cetacean interactions in this kind of fishery, were reviewed.

¹The term 'driftnet' is used here as defined by Nédélec (1982).

DESCRIPTION OF THE FISHERY

Fishing area

The fishing area spans from the coast of Espírito Santo (ES) (~21°S) to the coast of Rio Grande do Sul (RS) (33°45'S) (Fig. 1).

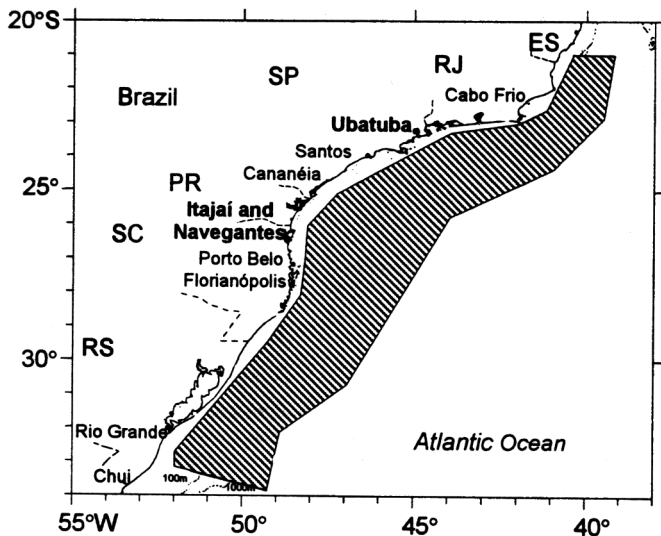


Fig. 1. Approximate area where driftnet fishing boats operate in southern Brazil. (Ports surveyed in this study are in bold).

Target species

The pelagic driftnet fishery in southern Brazil is focused on sharks, which represent about 98% of the catches. Hammerhead sharks (*Sphyrna lewini* and *S. zygaena*, Family Sphyrnidae) are the main target followed by sharks of the families Carcharhinidae (*Carcharhinus leucas*, *C. limbatus*, *C. obscurus*, *C. longimanus* and *Prionace glauca*) and Lamnidae (*Isurus oxyrinchus*). Other fish occasionally taken include billfishes of the families Istiophoridae (*Istiophorus albicans*), Xiphiidae (*Xiphias gladius*), scombrid fish (*Auxis thazard*, *Katsuwonus pelamis*, *Sarda sarda* and *Thunnus albacares*) and the dolphin fish (*Coryphaena hippurus*). Other commercially non-valuable or legally protected species such as manta rays (family Mantidae) and marine turtles are also taken but are discarded at sea.

Variation in fishing operations

The fishing season and effort vary temporally, reflecting the migratory behaviour of the target species' and their availability in the fishing area. In general, effort is higher in spring and summer than in autumn and winter because some species of pelagic sharks, particularly Sphyrnidae, are more abundant in the fishing area during warmer months. In addition, fishing effort also changes as a function of the landings. That is, if the results of the catches are profitable early in the season, the fishing effort increases in the following months. By contrast, if the catch levels are low, the effort in pelagic waters is reduced either by replacing driftnets by bottom set gillnets or by temporarily stopping fishing operations.

Fishing ports, fleet and gear

In southern Brazil, fishing vessels using driftnets are known to operate from at least nine ports along the southern Brazilian coast (Table 1, Fig. 1). The total number of fishing boats operating from all these localities is unknown. More

detailed information is available from the ports of Ubatuba (SP) and Itajaí/Navegantes (SC), where at least 112 boats operate this kind of gear.

Table 1

Ports known to have driftnetting fishing boats operating from Southern Brazil (see also Santos and Ditt, 1994; Kotas *et al.*, 1995).

Locality	Coordinates
State of Rio de Janeiro (RJ)	
Cabo Frio	2°53'S, 42°01'W
State of São Paulo (SP)	
Ubatuba	23°23'S, 45°08'W
Santos	23°56'S, 46°19'W
Cananéia	25°00'S, 47°55'W
State of Santa Catarina (SC)	
São Francisco do Sul	26°14'S, 48°38'W
Itajaí - Navegantes	26°54'S, 48°39'W
Porto Belo	27°09'S, 48°33'W
Florianópolis	27°35'S, 48°33'W

Ubatuba

The fleet operating gillnets from Ubatuba is estimated at some 34 wooden boats (Tiago *et al.*, 1995). Although the exact number of vessels operating driftnets is unknown, a preliminary survey has revealed that at least 21 boats are using this kind of gear. The driftnet fishery is essentially artisanal. Most boats have a magnetic compass and a VHF radio as basic equipment; a few may have radar, a satellite navigation system and/or an echosounder (see also Tiago *et al.*, 1995). Driftnetters from Ubatuba do not carry hydraulic power block winches so the nets are hauled out by hand. Fishing trips range from 8-15 days, usually 50-100 n.miles from the coast, in general between 21°S and 26°S. Information on the size of boats, crew and nets are given in Table 2.

Table 2

Boat and net characteristics of the driftnet fishery operating from Ubatuba and Itajaí/Navegantes.

	Ubatuba	Itajaí/Navegantes
Boat size (m)	6-18	13-27
Crew size	6-9	10-15
Panel length (m)	50	25-120
Panel height (m)	12-13	4,5-27
Number of panels per net	67-78	35-120
Total net length (m)	3,350-3,900	1,250-7,500
Mesh size (stretched) (cm)	10-40	14-40

The captured fish are kept fresh in ice. There is no processing plant in Ubatuba and the fish are transported by land to the main market in São Paulo (SP). Shark fins are dried and exported to the Asian market, in particular China, Hong Kong, Korea and Taiwan.

Itajaí and Navegantes

An estimated 130 fishing boats using gillnets operate from this port. The size of the fleet operating driftnets is seasonally variable because some boats use driftnets during warm months but bottom set gillnets in coastal waters in the cold season. A total of 91 boats were operating driftnets by March 1997, the end of the austral summer season.

The fleet operating from Itajaí and Navegantes is better equipped than that of Ubatuba. Details are given in Table 2. Despite the presence of some steel vessels, most boats are made of wood. They carry VHF and UHF radios, radar, echosounder and satellite navigation systems as standard equipment. In general, the driftnetting fleet operates from Santos (23°56'S) to Chuí (33°45'S) along the continental shelf and slope in waters ranging from 47-3,600m in depth. Some boats go farther north to the coast of Rio de Janeiro and Espírito Santo and may fish in international waters up to 260 n.miles from the coast. Trips last from 8-27 days, depending on the catches. Trips longer than 30 days may occur but these are rare. Nets are set by the afternoon (1500-1800hrs) and are hauled out early in the morning (0430-0630hrs) with the aid of power blocks. The fish captured are kept in ice and are brought to plants in the port, where they are processed. Shark fins are again exported to the Asian market.

CETACEAN BYCATCH

Ten species have been reported in interactions with driftnet fisheries off southern Brazil (Table 3). Most cetaceans, particularly small odontocetes, are found dead in the nets and are discarded at sea. However, large whales are sometimes released alive. Small dolphins (e.g. *Delphinus sp.* and *Stenella spp.*) are brought aboard but large animals (e.g. *Globicephala* and *Physeter*) are kept alongside the boat for disentanglement. Cetaceans are disentangled either by cutting nets and/or flukes and flippers.

Table 3

Cetacean species taken in the pelagic driftnet fishery in southern Brazil.

Common names	Scientific names
Humpback whales	<i>Megaptera novaeangliae</i>
Sperm whales	<i>Physeter macrocephalus</i>
Dwarf sperm whales	<i>Kogia simus</i>
Long-finned pilot whales	<i>Globicephala melas</i>
Common dolphins	Genus <i>Delphinus</i> ¹
Bottlenose dolphins	<i>Tursiops truncatus</i>
Atlantic spotted dolphins	<i>Stenella frontalis</i>
Spinner dolphins	<i>Stenella longirostris</i>
Clymene dolphins	<i>Stenella clymene</i>
Striped dolphins	<i>Stenella coeruleoalba</i>

¹The existence of at least two distinct species (short-snouted, *Delphinus delphis*, and the long-snouted common dolphins, *D. capensis*) has been recently proposed (Heyning and Perrin, 1994). The authors suggested only the occurrence of the long-snouted species along the South American eastern coast but rostral ratios of sexually or physically mature common dolphins collected in Brazil also suggest the occurrence of *D. delphis* (Martins *et al.*, 1995). Considering that additional studies are necessary to verify the presence of the latter along the South American Atlantic coast and that the identity of the specimens taken by the pelagic driftnet fleet is unknown, common dolphins will be treated as genus *Delphinus* in this report.

Captures were observed in four out of the seven monitored trips. One dolphin only was captured in each of three trips and two individuals were taken during another trip. According to fishermen, the capture of more than one individual in the same trip is common (Table 4 and see also Santos and Ditt, 1994) and, sometimes, in the same set. This suggests that the number of cetaceans captured in pelagic driftnets off southern Brazil is not negligible.

Large cetaceans

Although no captures were observed during the present survey, two species of large cetaceans, humpback and sperm whales, have been mentioned in interactions with driftnet

fishery operations in southern Brazil. Fishermen identify humpback whales based on body colouration and the long flippers. Sperm whales are recognised by their large size, shape and size of the heads and dorsal ridge. Fishermen state that humpback whales occasionally get entangled when fishing takes place off the coast of Rio de Janeiro and Espírito Santo and that sperm whales are taken in offshore waters in the southern portion of the fishing area. Individuals of both species are commonly released alive, in most cases with pieces of net still attached to their body. Whales found dead are frequently calves and juveniles (a judgement made based on their relatively small size). According to Soto *et al.* (1996), four sperm whales were taken together off the coast of Santa Catarina by a boat operating from Itajaí, but three were released alive.

Small odontocetes

Eight small cetacean species have been incidentally caught in pelagic driftnetting. Details of documented, observed or reported captures were collected for five species and are presented in Table 4. In addition, boats operating from Itajaí have captured 1 dwarf sperm whale, 14 long-finned pilot whales, 2 common dolphins, 1 Atlantic spotted dolphin, 1 Clymene dolphin and 1 striped dolphin off the coast of Santa Catarina and Rio Grande do Sul (Soto *et al.*, 1996).

DISCUSSION

Although surface gillnets are known to cause significant cetacean mortality throughout the world (e.g. Perrin *et al.*, 1994), their use is relatively recent in Brazil, where it seems to be increasing. The present study summarises the available data on cetacean bycatch in driftnet fisheries for the southern portion of the coast, but this type of gear has also been used in other areas such as the northeastern Brazilian coast to capture sharks, tuna and tuna-like fishes (F. Hazin, pers. comm.). Although cetaceans have been accidentally killed in this region, species taken and fishery characteristics are unknown.

The fleet operating driftnets is widely distributed along the southern Brazilian coast. There is some information available from the ports of Ubatuba and Itajaí/Navegantes, but boats using this kind of gear also operate from other non-surveyed ports. The size and characteristics of the fleets operating from these localities need to be investigated. Fishing vessels using driftnets cover large distances while searching for fishing grounds. As a consequence, it is relatively common that a boat departing from one port enters another one for landing and refuelling, thus monitoring a fleet only from its home port is inadequate. Fishing effort is irregular and seasonally variable in southern Brazil. Besides being composed of both rudimentary and relatively modern boats of different sizes, autonomy and fishing capacities, the fishing fleet changes its gear due to seasonal shifts in the distribution of target species. In addition, variation in the number of boats operating driftnets can be expected from time to time as a consequence of an increase or decrease in the fishery production. The effects of these changes are not known but certainly affect species composition and the number of cetaceans killed. A decrease in the driftnetting effort reduces the capture of oceanic species, but the mortality of coastal cetaceans are likely to be raised when driftnets are replaced by bottom setnets.

The characteristics of the fishing fleet operating from Itajaí/Navegantes are different from that of Ubatuba. The

Table 4

Records of small cetacean entanglements in pelagic driftnets off the southern Brazilian coast. SC=Santa Caterina; RJ=Rio de Janeiro; and RS=Rio Grande do Sul. I/N=Itajaí/Navegantes and U=Ubatuba.

Date	Species	TL (cm)	Sex	Depth (m)	Locality	Fleet	Reference
May 1990	<i>G. melas</i>				Off Southern Brazil		Zerbini <i>et al.</i> (1993)
16 Aug. 1993	<i>S. frontalis</i> ¹				Off SC	I/N	Present study
20-22 Aug. 1993	<i>G. melas</i> ¹				Off RS	I/N	Present study
20-22 Aug. 1993	<i>G. melas</i> ¹		F		Off RS	I/N	Present study
20-22 Aug. 1993	<i>G. melas</i> ¹		F		Off RS	I/N	Present study
22 Aug. 1993	<i>Delphinus</i> sp.				Off RS	I/N	Present study
Jan. 1994	<i>S. longirostris</i> ²				Off RJ	U	Santos and Ditt (1994)
2 Aug. 1995	<i>longirostris</i> ²	130	F		30°02'S, 46°17'W	I/N	Present study
6 Jan. 1997	<i>S. frontalis</i> ^{1,3}	185	F	120	25°17'S, 45°29'W	U	Present study
9 Jan. 1997	<i>S. frontalis</i> ^{1,3}	135	F	101	25°00'S, 45°21'W	U	Present study
4 Jul. 1997	<i>T. truncatus</i> ³			78	23°54'S, 44°42'W	U	Present study
27 Sep. 1997	<i>S. frontalis</i> ³	145	F	58	23°26'S, 44°26'W	U	Present study

¹Individuals taken in the same trip. ²Possibly three dolphins were captured. ³Individuals recorded by onboard-observers.

size of the boats, nets, fishing capacities and autonomy clearly show that the effort and the impact on cetacean populations is higher than that of Ubatuba. In addition, the fleet from Itajaí/Navegantes covers a wider area and operates in deeper waters. This suggests that the composition of the bycatches may also be different.

Ten cetacean species have been recorded captured in driftnetting operations. Their distribution and abundance are poorly known in southern Brazil. The information available has been primarily obtained through opportunistic onboard observations (see compilation by Pinedo *et al.*, 1992 and Pinedo, 1994). Systematic sightings surveys have recently been conducted in this region and have provided additional information on the relative abundance of some species (Zerbini *et al.*, 1997). Although inshore sightings are available, these surveys have primarily covered the outer continental shelf and slope (depths varying from 100-1,800m), approximately the same area where driftnet fishing boats have been operating.

Fishermen reported that fishery interactions with humpback whales have been recorded off Rio de Janeiro and Espírito Santo and with sperm whales in offshore waters in the southern portion of the fishing area. These regions coincide with the areas where both species have been most frequently observed in southern Brazil. In the study conducted by Zerbini *et al.* (1997) all humpback whale sightings were recorded along the coast of Rio de Janeiro and Espírito Santo in water depths varying from 38-990m. In addition, whales showing signs of entanglement in gillnets have been found washed ashore in this area (Siciliano, 1996). Not only driftnets but also bottom set gillnets have been used in the region (Lodi and Capistrano, 1990), therefore it is not possible to conclude in which kind of fishery these specimens were captured. However, the former is certainly an important cause of mortality. Despite the sighting effort in pelagic waters along the entire southern coast, the sperm whale has only been recorded south of 28°S in waters deeper than 850m (Castello and Pinedo, 1986; Simões-Lopes and Ximenez, 1993; Zerbini *et al.*, 1997). Information regarding the distribution of pygmy sperm whales in Brazil is limited, being restricted to the strandings of two individuals (Pinedo, 1987; Zanelatto and Guiera, 1994). Given the oceanic habit of this species (Leatherwood and Reeves, 1983), it is more likely to be when the fishery operates far offshore.

In southern Brazil, long-finned pilot whales inhabit oceanic waters over the outer continental shelf and slope and

have been sighted in waters deeper than 120m as far north as about 28°S (Castello and Pinedo, 1986; Pinedo, 1994; Zerbini *et al.*, 1997). Less information is available for the short-finned pilot whale (*G. macrorhynchus*) but the species may have been recorded as far south as São Paulo (Schmiegelow and Paiva-Filho, 1989). Preliminary observations suggest that pilot whales are probably the species most frequently taken by the driftnet fishery. To date, only the long-finned species have been recorded in the fishery catches but it is possible that the short-finned pilot whale is also captured. An increasing number of strandings of *G. melas* in southern Rio Grande do Sul was associated with the increased longline fishing effort in southern Brazil (Pinedo, 1994). However, the capture of cetaceans in this kind of fishery is relatively infrequent and, when observed, the animals are often released alive (E.R. Secchi, pers. comm.). In contrast, long-finned pilot whale mortality in driftnets may be significant considering the relatively high number of records and low monitoring effort observed in this study. Therefore, if the high mortality of *G. melas* reported by Pinedo (1994) is in fact a consequence of interactions with fishery activities, it is likely that pelagic driftnetting is the major cause.

The species of oceanic dolphins (Delphinidae) captured in driftnets are common in Southern Brazil. This region is part of the southern range of the tropically/subtropically-distributed species of the genus *Stenella* (Atlantic spotted, spinner and Clymene dolphins; see Perrin *et al.*, 1987; Perrin and Gilpatrick, 1994; Perrin and Mead, 1994). The Atlantic spotted dolphin has been observed in both coastal and offshore waters (depths ranging from 20-1,000m) as far south as 30°S (Santos and Siciliano, 1994; Lailson-Brito Jr *et al.*, 1996; Moreno *et al.*, 1996; Zerbini *et al.*, 1997). The latter authors suggested that this is possibly the most abundant cetacean species in the area. Spinner dolphins have been recorded in coastal waters off São Paulo (Daniel *et al.*, 1992) but occur primarily in oceanic waters from 150-1,500m (Secchi and Siciliano, 1995; Zerbini *et al.*, 1997). The individual captured by a driftnet fishery at 30°02'S, 46°17'W (Table 3, coast of Rio Grande do Sul) extended the known range of the species in the west South Atlantic Ocean by approximately 250 n.miles. Three records of Clymene dolphins are available for the southern Brazilian coast; one stranding in Rio Grande do Sul (Simões-Lopes *et al.*, 1994) and two sightings over the outer shelf and slope (140 and 1,390m) (Zerbini *et al.*, 1997). Given their wide

distribution and high relative abundance, Atlantic spotted dolphins are possibly taken in great numbers throughout their range in southern Brazil. On the other hand, spinner and Clymene dolphins may be more susceptible to captures when the fishery operates in deeper waters.

The driftnet fishing area overlaps the range of other tropical and temperate dolphins species. Information on striped dolphins is limited to a few strandings and one sighting (Pinedo and Castello, 1980; Ott and Danilewicz, 1997) but bottlenose and common dolphins have been frequently sighted along the southern Brazilian coast. *T. truncatus* is frequently observed in estuaries and coastal waters in this region (e.g. Castello and Pinedo, 1977; Möller *et al.*, 1994) but sightings in more oceanic areas have been recorded as far south as 27°S between depths of 40-250m (Gomes, 1986; Zerbini *et al.*, 1997). Simões-Lopes (1996) has suggested the existence of an offshore stock based on differences in colour patterns between coastal dolphins and those sighted in more oceanic waters. Common dolphins are usually observed off Rio Grande do Sul and Santa Catarina in waters ranging from 70-2,500m in depth (e.g. Castello and Pinedo, 1986; Secchi and Vaske, 1992; Zerbini *et al.*, 1997). In addition, this species is found in the shallower waters and bays along the coast of São Paulo and Rio de Janeiro (Lodi *et al.*, 1996; Zerbini *et al.*, 1997).

Another 12 cetacean species are thought to occur in the area where fishing takes place (Pinedo *et al.*, 1992) and therefore are also potentially vulnerable to driftnets. In addition, marine turtles have also been accidentally captured in this kind of gear. Intentional capture of cetaceans and marine turtles is prohibited by federal law in Brazil. Because of this, even though captures are accidental, most fishermen are not confident in sharing information on the bycatches or bringing specimens for examination. In many cases they disclaim any knowledge concerning the capture of these animals. To date, there is no information concerning the use of carcasses for consumption (human or animal) or as bait in other types of fishery.

The incidental mortality of cetaceans in fishery operations is a matter of concern. From the limited information available regarding driftnet usage and statistics on cetacean entanglements, it is evident that more data are necessary in order to evaluate fishing effort and cetacean mortality in southern Brazil. In addition, cetacean abundance, stock identity and life history are still poorly known in this region. Therefore, it is strongly recommended that a long-term survey be conducted cooperatively with researchers working in different geographic regions and with other incidentally taken species (e.g. marine turtles) in order to cover the whole fishing fleet and to obtain a broader spectrum of information on the bycatches. The ports where boats operating driftnets are based (for landing and refuelling) should be monitored with the purpose of obtaining the following information:

- (1) species composition and estimates of cetacean bycatch;
- (2) accurate data on fishing operations (including fishing areas and season) and gear (following the guidelines given in IWC, 1994) from the different ports;
- (3) temporal variation in fishing effort;
- (4) specimens and biological samples for stock identity and population parameter analysis.

This study must be conducted along with an assessment of the abundance of the species distributed in the region where the fleet operates. This is essential for future proposals to reduce bycatch and to manage cetacean populations in southern Brazil.

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