Incidental by-catch of short-beaked common dolphins (*Delphinus delphis*) in the pair trawler fishery off north-western Spain

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ABSTRACT

The number of short-beaked common dolphins *Delphinus delphis* captured annually by the fleet of pair trawlers operating off Galicia (north-western Spain) and the operational factors influencing by-catch was assessed through the placement of observers onboard the trawlers. Hauling time, fishing depth and season were identified as the key factors involved in the incidental by-catch. Dolphins were more vulnerable to trawling at night, during the stratified season and when they were over the break of the continental platform than under any other condition. The sex ratio of the by-caught dolphins was highly skewed in favour of males; late immatures and early adults dominated the catch of both sexes. The annual by-catch in 2001-2002 was estimated at 38 (95% CI: 0-103) dolphins in the wind-mixed season and 289 (95% CI: 185-414) in the stratified season. This level of by-catch is considered unsustainable and could be significantly reduced if the operation of the trawlers is restricted to waters deeper than 250 m.

Key words: short-beaked common dolphin, incidental catch, by-catch, trawling, north-western Atlantic

INTRODUCTION

Exploitation of marine ecosystems is causing a rapid depletion of top predators worldwide (Pauly *et al.*, 1998; Jackson and Sala, 2001; Myers and Worm, 2003). Small cetaceans are not an exception, but in most cases not because of direct exploitation but because of unsustainable incidental by-catch (Waring *et al.*, 1990; Perrin *et al.*, 1994).

Common dolphins (*Delphinus* spp.) are found in all major ocean basins with the exception of the high-latitude Arctic and Southern oceans (Heyning and Perrin 1994; Perrin 2002; Jefferson *et al.*, 2008; Jefferson *et al.*, 2009). Until recently, all common dolphins worldwide had been assumed to represent a single panglobal species, *Delphinus delphis*, but Heyning and Perrin (1994) showed that at least in the eastern North Pacific two different species were represented by long- and short-beaked forms. Although the taxonomic status of the long-beaked populations elsewhere is unclear (Natoli *et al.,*2006; Pinela *et al.*, 2008), available evidence indicates that only the short-

beaked common dolphin (*Delphinus delphis*) occurs in the Atlantic north to 30ºN latitude, although some differentiation appears to exist between the eastern and western populations (Natoli *et al.*, 2006; Jefferson *et al.*, 2009).

Short-beaked common dolphins represent the bulk of the small cetacean by-catch incidentally taken by fishermen in the eastern Atlantic (Goujon 1996; Tregenza *et al.*, 1997; Morizur *et al.*, 1999; López *et al.*, 2003) and in the adjoining regions of the western Mediterranean (Silvani *et al.*, 1999; Tudela *et al.*, 2005). The high levels of by-catch reported in the some areas (Goujon 1996; Tregenza *et al.*, 1997; Silvani *et al.*, 1999; López *et al.*, 2003; Tudela *et al.*, 2005; ICES 2005) have raised concern about the future of the population and have led to a ban of driftnets in the European Union. However, population estimates in the eastern Atlantic only exist for a few areas (Goujon 1996; Hammond *et al.*, 2002; López *et al.*, 2003) and the trend of populations is unknown.

Galicia (north-western Spain) is one of the most important fishing areas in the world. López *et al.* (2003) used a questionnaire-based survey to estimate the number of cetaceans captured annually by the fishing fleet whose port base was Galicia, and concluded that 1,629 small dolphins, probably most of them short-beaked common dolphins, were captured annually. Although the incidental capture of a marine mammal in a trawl fishery is considered to be a rare event (Morizur *et al.*, 1999; Gonzalvo *et al*,. 2008), the questionnaire-based survey conducted by López *et al.* (2003) identified pair trawling as one of the fishing gears most often involved in the capture of small cetaceans. Such high level of catches was confirmed by onboard observers monitoring a few fishing operations (López *et al.*, 2003), but the method used (a questionnaire-based survey) was not able to precise the actual magnitude and biological significance of by-catch in the area. This was not only because of the uncertainty about the actual species identity of the small dolphins captured by the pair trawlers, but also because the figures arising from questionnaire-based surveys are usually highly biased and the confidence intervals are too wide (Lien *et al.,*1994). This was the case for the survey by López *et al.* (2003), in which the confidence interval so large (539 to 3,536) that prevents any robust conclusion. Furthermore, the operational factors influencing or determining the incidental capture could not be ascertained.

This paper aims to assess the actual number of short-beaked common dolphins captured annually by the pair trawling fleet operating off Galicia and to identify the most influential operational factors affecting the by-catch.

MATERIAL AND METHODS

The region and the fishery

The coastal waters off Galicia are characterized by the presence of filaments of cool upwelled water, which collectively form a coastal transition zone between the shelf and the open ocean waters (Haynes *et al.*, 1993). Following the onset of seasonal upwelling off Iberia in either May or June, filaments begin to develop in July or August. By September, they have grown to lengths of 200 km, but quickly disappear with the cessation of upwelling caused by favourable winds in October. From May to September the water remains stratified (Herrera *et al.*, 2008). As a consequence, the waters off Galicia present two major seasons: wind-mixed (May to September) and stratified (October to April).

Upwelling promotes a high productivity and, as a consequence, this mass of waters is one of the most important fishing regions in the Atlantic and receives about

1,000,000 fishing trips annually (López *et al.*, 2003). Most of this fishing consists of gillnets and traps, but the highest rates of cetacean by-catch have been reported for offshore gillnets and offshore trawling (López *et al.*, 2003). Pair trawlers have been operating off Galicia since the mid 1980s and mainly target blue whiting (*Micromesistius poutassou*), with mackerel *(Scomber scomber*), hake (*Merluccius merluccius*) and horse mackerel (*Trachurus* spp.) as secondary targets. Each pair trawler tows a 200 m long net with a 90m x 30 m mouth opening. The net is towed over the seabed in areas ranging 125-700 m deep, corresponding to the deeper shelf and the upper and mid slope. In the early 2000's, the fleet was composed of 14 paired boats, Riveira being their port base throughout most of the year although in summer some pairs tend to move to La Coruña, 150 km northward.

Study design

A preliminary questionnaire-based survey covering the skippers of all the boats in the fishery was conducted in March and July 2001. Photographs of bottlenose dolphins (*Tursiops truncatus*), short-beaked common dolphins (*Delphinus delphis*), stripped dolphins (*Stenella coeruleoalba*), harbour porpoises (*Phocoena phocoena*) and long-finned pilot whales (*Globicephala melas*) were shown to the fishermen for species identification.

The survey included the following questions:

- Which dolphin species did you capture in the past year?
- How many dolphins did you capture in the past year?
- In which months of the year did you capture dolphins?
- At what time of the day did you capture dolphins?

Parallel and posterior to these interviews, onboard observers were placed onboad trawlers and they monitored 891 fishing operations from March 2001 to December 2003. Sampling was discontinuous from March 2001 to July 2002, during which period three surveys were conducted: March-April 2001, July 2001and July 2002. Sampling was continuous from August 2002 to December 2003, when observers based at Riveira shifted daily among 12 of the pairs. Reports from onboard observers included: data, time, latitude, longitude and depth at net set and haul, and number of dolphins captured in each tow. The species and sex of each bycaught dolphin were determined onboard by the observer; teeth were collected for age determination. The skippers of the vessels in the fleet operating without an onboard observer were interviewed daily during the surveys to identify any incidental by-catch. Dolphins incidentally by-caught by vessel without an onboard observer were brought to the harbour, where an skilled observed identified the species, determined their sex and collected teeth for age determination.

Age determination

Soft tissues around the teeth were allowed to decompose in water and, once cleaned, the teeth were stored dry. In the laboratory, the teeth were decalcified in Rapid Bone Decalcifier for the Preparation of Histological Material (RDO), a commercially prepared mixture of acids, for 2-8 hours depending on tooth volume. Teeth were then longitudinally sectioned in a freezing microtome, stained with hematoxylin, blued in weak ammonia solution, and mounted onto gelatine-coated slides. Age was determined by counting growth layer groups (GLG) in dentine, assuming that each GLG

corresponded to 1 year. More detail of the techniques used can be found in Lockyer (1995a, 1995b).

Data treatment and statistics

The survey was designed to sample the wind-mixed and the stratified seasons throughout several years and, in this way, to cover all fishing scenarios. However, on November 13th 2002 the sinking of the tanker *Prestige caused* an oil spill which introduced and unexpected variability in the monitoring program. As a consequence, four contrasting sampling periods had to be considered: wind-mixed conditions before and after the oil spill, and stratified conditions before and after the oil spill. Although catch per unit effort was calculated for each period, an estimate of the number of dolphins captured seasonally by the whole fleet was calculated only for the wind-mixed and stratified seasons before the oil spill (see below).

The total number of by-caught short-beaked dolphins and the total number of capture events were used to calculate the average number of dolphins per capture event; bootstrap was used to calculate the 95% confidence interval of the average number of dolphins per capture event because the data did not distribute randomly. The probability of capturing at least one short-beaked dolphin in a tow in a particular season was calculated from the number of surveyed fishing operations and the number of capture events; the 95% confidence interval of that probability was calculated following Fowler et al (1998).

The number of short-beaked common dolphins captured seasonally by the whole fleet was calculated multiplying the probability of a capture event per fishing day, the average number of dolphins per capture event and the number of fishing days for the whole fleet. However, this procedure ignores the variability in the average number of dolphins per capture event and the uncertainty about the actual probability of a capture event. This can be solved randomising the data as follows: First, the numbers of short-beaked dolphins in each capture event were randomised to generate 1,000 simulated data sets, each consisting of 35 capture events, which is the actual number of capture events detected throughout the study. The average number of short-beaked dolphins involved in each capture event was then calculated for each simulated data set. In this way, the variability in the number of short-beaked dolphins per capture event was incorporated to the final estimate. In a second step, the number of capture events that took place each season was randomized to create 1,000 simulated surveys for each season. These simulated surveys consisted each in 136 fishing days for the wind-mixed season and 300 fishing days for the stratified season, as the actual surveys. The resulting number of capture events in each simulated survey was then multiplied by the actual fishing effort (fishing days x vessel number) in each season (1,862 vessel-day in the wind-mixed season and 1,400 vessel-day in the stratified period) to generate, for each season, a data set consisting of 1,000 estimates of the number of capture events experienced by the whole fleet. In this way, the uncertainty about the probability of a capture event is incorporated to the final estimate. The total number of capture events experienced by each of the 1,000 simulated fleets was then multiplied by the average number of dolphins per capture event, selected randomly from the corresponding simulated data set. Bootstrap was applied to the resulting 1,000 estimates of the total number of short-beaked common dolphins captured seasonally by the whole fleet to calculate the 95% confidence interval.

RESULTS

Most of the 28 interviewed skippers (21 or 75%) declared to have captured at least one small cetacean in the previous year. Most of the by-caught cetaceans were short-beaked common dolphins (123 individuals), followed by unidentified dolphins (8 individuals), bottlenose dolphins (7 individuals) and striped dolphins (1 individuals). Skippers said that dolphins were usually captured during the stratified season (Fig. 1) and most often at night (74% of the capture events).

Table 1 summarizes the surveyed and reported fishing trips, as well as the observed and reported capture events. Onboard observers surveyed 891 fishing trips from March 2001 to December 2003. Most of the fishing trips surveyed by onboard observers involved just a single tow, but 53 (5.95%) of them involved a second tow. A second tow was less frequent in the wind-mixed season (4.09% of the surveyed fishing trips) than in the stratified season (7.18% of the surveyed fishing trips). The first tow usually started between 4:00 and 6:00 am in both seasons and lasted on average 8.9 hours (Fig. 2), thus operating most of the time under day light conditions except at the very beginning of each tow. The second tow usually started between 17:00 and 18:00 pm and lasted on average 5.8 hours (range: 0.6-8.4 hours), thus operating at night during the final hours. The average depth of the tows was 299.43 ± 120.73m throughout the study (Fig. 3) and corresponded to the upper slope, although the first tow was deeper than the second one (first tow: 303.1 ± 120.2m; second tow: 224.8 ± 107.8m; $t=3.054$, $df=455$; $p=0.002$). The average depth of the fishing grounds also changed seasonally and in relation to the *Prestige* oil spill. Before the oil spill, the fleet exploited slightly deeper fishing grounds in the stratified (392.9± 147.9m) than in the wind-mixed season (338.5 ± 91.8m). After the accident, the fleet operated roughly at the same depth in the wind-mixed season (294.0 ± 84.8m), but moved to shallower fishing grounds in the stratified season (265.5 ± 110.0m).

Onboard observers witnessed 29 capture events, all of them involving short-beaked common dolphins. All the dolphins were free within the cod end, without any entanglement. Most of the capture events happened during day light hours (75.9%), a hardly surprising result because 93.3% of the surveyed tows were hauled during light hours (Fig. 2). However, nocturnal capture occurred more often than expected (Chi-square=13.426, $df=1$, $p<0.001$). The tows capturing at least one dolphin were much shallower than that those not capturing dolphins (Fig. 3) (average depth of not capturing tows=303.6 ± 121.0 m; average depth of capturing tows=203.1 ± 62.1 m; $t=6.551$, $df=24,365$, $p<0.001$), but they did not differ in duration (duration of tows capturing dolphins= 9.4 ± 2.6 hours; duration of tows not capturing dolphins= 8.7 ± 2.3 hours; $t=0.507$, $df=453$, $p=0.612$). The occurrence of dolphins in the fishing area was a poor predictor of a capture event, as dolphins were not observed in any of the 29 fishing operations resulting in a capture event but were observed in 38 of the 845 fishing operations not resulting in a capture event. The average depth of the areas were observers sighted short-beaked common dolphins was 398 ± 138m.

Fishermen reported the by-catch of other 886 fishing trips throughout the same period, representing six additional capture events (Table 1). The cetaceans captured in five of those events were brought to the harbour and identified by observers as common dolphins. The small cetacean captured in the sixth capture event was not bring to the harbour and hence remained unidentified, although it is thought not to be a common dolphin in agreement with the description of the fishermen. This dolphin has not been considered in further analysis.

Most of the observed and reported capture events of short-beaked common dolphins involved one or two individuals but there were events involving up to fifteen individuals (Fig. 4). As a result, the average number of short-beaked dolphins captured in an event was 2.3 (95% CI: 1.5-2.6). The sex ratio of the by-caught short-beaked dolphins was highly skewed in favor of males (51 males: 28 females) and was statistically different form 1: 1 (Chi-square=6.128, df=1, p=0.013). Such an unbalanced sex ratio was caused by two all-male, mass capture events occurring on July 2001 and including seven and fifteen short-beaked common dolphins respectively. The average age of the males was 13.4 ± 4.4 years (n=49) and that of the females 11.5 ± 4.8 years (n=26) (Fig. 5). Interestingly, the average age of the males captured in the two all-male, mass capture events was lower than the average age of males: 9.6 ± 4.2 years and 7.4 ± 3.2 years.

The probability of capturing at least one common dolphin in one fishing day was much higher in the stratified than in the wind-mixed season, as revealed by the combination of surveyed and reported fishing trips and capture events both (Fig. 6). This seasonal pattern did not change after the *Prestige* oil spill, although the probability of a capture event during the stratified season declined slightly. When the probability of a capture event before the *Prestige* oil spill was combined with the fleet size, the number of fishing trips in each season and the averaged number of short-beaked dolphins in a capture event, the total number of short-beaked common dolphins captured by the fleet was 38 (95% CI: 0-103) in the wind-mixed season and 289 (95% CI: 185-414) in the stratified season.

DISCUSSION

Most of the research about the incidental by-catch of common dolphins has focused on gillnets (Perrin *et al.*, 1994; Ferrero and Walker, 1995; Tregenza *et al.*, 1997; Silvani *et al.*, 1999; Tudela *et al.*, 2005; Rogan and Mackey 2007). Morizur *et al.* (1999) conducted the first specific study aimed at quantifying marine mammal by-catch in a European trawl fishing operation and their results showed that off Western Europe the pelagic trawlers captured short-beaked common dolphins and others species of small cetaceans in 4.8% of the tows. The present study indicates a similar rate of cetacean by-catch for pair trawlers targeting blue whiting off Galicia and confirms that almost all the cetaceans incidentally captured by that fleet are short-beaked common dolphins.

Trawlers concentrate food in an otherwise patchy environment. At least, 16 species of cetaceans are known to take advantage of this fact and to feed in association with trawlers in different regions of the world (Fertl and Leatherwood 1997). However, this association does not lead necessarily to a high level of by-catch. For instance, bottlenose dolphins (*Tursiops truncatus*) frequently interact with bottom trawlers off the Balearic Archipelago (western Mediterranean) but a huge survey effort failed to reveal any incidental capture (Gonzalvo *et al.*, 2008). Conversely, short-beaked common dolphins were seldom observed to interact with trawlers in the eastern Atlantic, but the by-catch rate was found to be relatively high in some operations (Morizur *et al.*, 1999; this study).

A high by-catch rate associated to a low rate of interaction is perhaps an artefact caused by sea conditions in the Atlantic, where the sea-state is seldom less than 2 and, hence, the ability of onboard observers to detect dolphins is extremely limited (Morizur *et al.*, 1999). However, it may be also the consequence of differences in the way how the various dolphin species interact with trawlers and the reasons why they are incidentally captured. In the particular case of short-beaked common dolphins, they are

seldom observed scavenging the discarded fish (Morizur *et al.*,1999), which suggests that, instead, they tray to take advantage of the fish trapped in the net, as reported for the short-beaked dolphins interacting with purse-seiners off northern Portugal (Wise *et al.*, 2007).

Morizur *et al.* (1999) suggested that the incidental capture of dolphins by pelagic trawlers happened close or during hauling because: (i) the dolphins were not entangled in the lines or the net, but they were usually found free within the lighting bag, (ii) the dolphins showed a high body temperature, thus revealing a relatively recent death, and (iii) there was no correlation between tow duration and dolphin by-catch (Morizur *et al.*, 1999). Similarly, the dolphins incidentally caught by the pair trawlers surveyed off Galicia were neither entangled nor there was a relationship between tow duration and the probability of by-catch, thus indicating that they were by-caught because they failed to abandon the gear when the net was hauled. However, most of the dolphins interacting with the trawlers are probably not caught, as the average pod size of short-beaked common dolphins in the eastern Atlantic is 10.8 individuals (Hammond *et al.*,2002), whereas the average number of short-beaked dolphins involved in a capture events in trawl fishing is about two (Morizur *et al.*, 1999; this study).

Quite commonly, vulnerability to fishing gear is highly dependent on sex and age of the dolphins. Thus, the sex ratio is usually male-biased, not only in trawl fisheries (Morizur *et al.*, 1999; this study) but also in gillnet and other fisheries (Ferrero and Walker, 1995; Rogan and Mackey, 2007; Westgate and Read, 2007; but see Silvani *et al.*, 1999). This suggests that sexual segregation occurs either within the schools or in the use of habitat, or that there is sex-related variation in vulnerability to by-catch. However, the actual reasons for such a rather consistent bias are poorly known. Calves and early juveniles also appear to be more vulnerable to gillnets than adults (Ferrero and Walker, 1995; Silvani *et al.*, 1999; Rogan and Mackey, 2007), but this was not true for the pair trawlers operating off Galicia, that captured mainly late juveniles and early adults. Remarkably, the males involved in the two all-male mass capture events reported here were younger than average, and clearly younger than the age at first maturity of male short-beaked common dolphins in the eastern Atlantic (Murphy *et al.*, 2005). Furthermore, the above mentioned mass capture events happened both in July, during the apparent peak of the reproductive season of the short-beaked common dolphin in the eastern Atlantic (Murphy *et al.*, 2005). These observations suggest that bachelor groups of immature males are formed during the breeding season and that these schools might be more vulnerable to pair trawlers than those of mixed age and sex.

Whatever the reason why short-beaked common dolphins interacting with trawlers are by-caught, in this study we found three operational factors to significantly influence the by-catch rate of pair trawlers. The most obvious factor was depth, as all captured dolphins came from sets made in waters shallower than 300 m. Short-beaked common dolphins prefer areas of high relief and most of the sightings of this species during the surveys were on the break of the continental shelf and on the upper slope, in areas ranging from 183 to 585 m. However, dolphins were captured over a much narrower depth range (128-294 m), which indicates a higher vulnerability around the shelf break. Perhaps it is just a coincidence, but the net used by pair trawlers is about 200 m long and, hence, when hauled over the shelf break it intercepts the whole water column, a fact that may reduce the chance to escape.

Time of the day was the second operational factor involved in dolphin capture. Morizur *et al.* (1999) and López *et al.* (2003) reported that all the captured events witnessed by observed onboard trawlers operating in the north-eastern Atlantic occurred

during the night. The skippers of the pair trawlers operating off Galicia also declared that dolphin by-catch was more frequent during the night. However, most of the capture events observed by us occurred in daylight conditions, but this appears to be the result of the fact that most of the surveyed tows hauled the net during the day. When the frequency of nocturnal capture events was compared with that of nocturnal tows, vulnerability of dolphins was clearly more vulnerable to by-catch at night.

The third factor that influenced by-catch was seasonality, as the by-catch rate was significantly higher during the stratified season, both before and after the *Prestige* oil spill. As the fleet of pair trawlers operates deeper in the stratified season and the hours of operation do not change seasonally, the higher by-catch rate observed in the stratified season is unlikely to be caused by operational factors, but may reflect changes in the distribution and/or behaviour of the short-beaked common dolphins. Interestingly, the stratified season overlaps with the reproductive season of the species in the north-eastern Atlantic (Murphy *et al.*, 2005), and this may also reflect a higher vulnerability of short-beaked common dolphins to incidental capture.

The probability of a capture event did not decline significantly after the *Prestige* oil spill, despite the profound impact that the event had on the shelf communities of the region (Serrano *et al.*, 2006; Martínez-Gómez *et al.*, 2009). This appears to confirm the proposed low vulnerability of short-beaked common dolphins to oil spills (Ridoux *et al.*, 2004).

The above reported data indicate that the by-catch rate could be highly reduced if the vessels would slightly modify their operating way. From an operationa perspective, regulation of fishing hours and seasonal closures would in principle be easy to implement in this fleet but it is unlikely that the involved fishermen would accept them because the catch of the target species would dramatically reduce. Conversely, a ban to operate in waters shallower than 250 meters is more likely to be more acceptable to the fleet, as the average depth of the tows is 299 meters and the target species, the blue whiting, is indeed more abundant in the deeper waters of the slope that on the shelf (Fariña *et al.*, 1997; Serrano *et al.*, 2008).

Reducing the incidental by-catch of short-beaked common dolphins off Galicia is not only easy, but also necessary. Despite estimates on abundance of dolphins in the area are only approximate, the annual pair trawler by-catch before the *Prestige* oil spill (327 individuals) was much higher than the safety level (160 individuals) proposed for the area, though on a rather uncertain basis, by López *et al.*, (2003). Indeed, the short-beaked common dolphins off Galicia belong to a much larger population inhabiting the north-eastern Atlantic (Natoli *et al.*, 2006) and hence their fates are linked. Abundance estimates for the species in this huge area are sparse (Goujon, 1996; Hammond *et al.*, 2002; López *et al.*, 2003), but ICES (2005) recently calculated that the annual by-catch rate for the population inhabiting the Celtic Sea and the Gulf of Biscay ranged 0.7% - 4.1%, with removals exceeding 2% being likely to be unsustainable. Although driftnets have been banned by the European Union to reduce the by-catch of small cetaceans, the popularization of pair trawlers as an alternative fishing method may also result in high levels of by-catch.

Moreover, the impact of pair trawl on the population may be enhanced by the higher vulnerability of late juveniles or early adult to this fishing gear, in sharp contrast with diftnets, which capture mainly calves and early juveniles (Ferrero and Walker, 1995; Silvani *et al.*, 1999; Rogan and Mackey, 2007). In common dolphins, adult survival has been found to be the single demographic parameter with the highest effect on the dynamics of populations in the north-eastern Atlantic, with a much smaller influence of calf survival (Fifas *et al.*, 1998). The low sensitivity of the population

dynamics to juvenile mortality may explain the persistence of a apparently healthy populations in regions with high rates of driftnets by-catch. Conversely, late immature and early adults are the most valuable individuals in the population, as they combine a low mortality rate with a high reproductive potential (Fifas *et al.*, 1998) and hence an increase in the mortality rate of this age classes is expected to have a higher impact on the dynamics of the population.

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Table 1: Summary of the fishing trips and the captured events surveyed and reported during the study.

	Before *Prestige*		After *Prestige*	
	Wind-mixed	Stratified	Wind-mixed	Stratified
Fishing trips				
Surveyed	73	137	275	406
Reported	63	163	472	188
Total	136	300	747	594
Capture events				
Surveyed	0	9	5	15
Reported	1	4	1	0
Total	1	13	6	15

Figure 1: Monthly variations of the number of pair trawler skippers declaring the incidental capture of small cetaceans off Galicia in 2001.

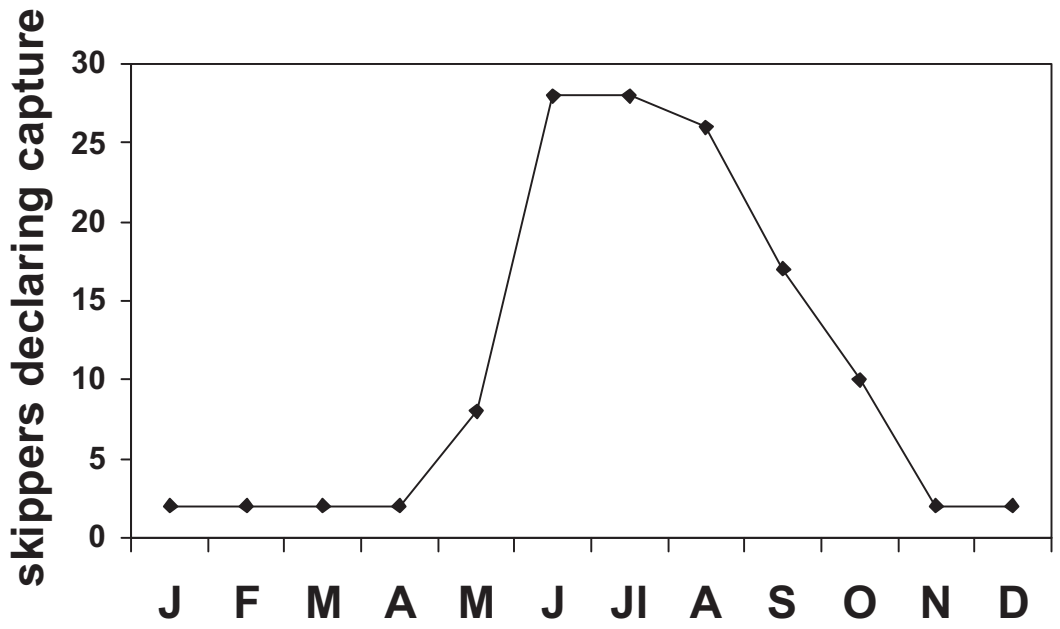

Figure 2: Setting (top panel) and hauling time (bottom panel) of the tows in the pair trawler fishery off Galicia under different oceanographic conditions.

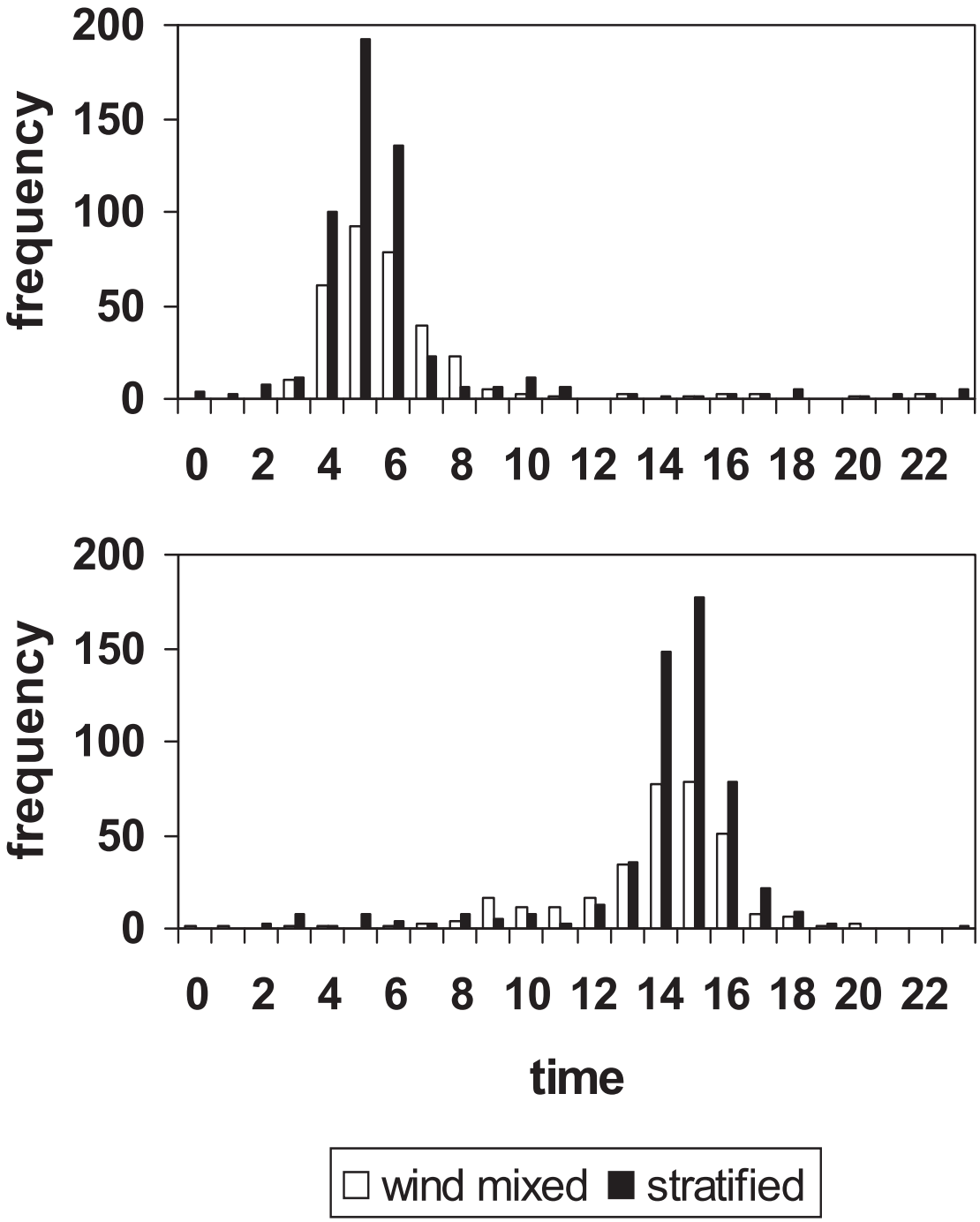

Figure 3: Depth of the tows capturing and not capturing short-beaked common dolphins off Galicia.

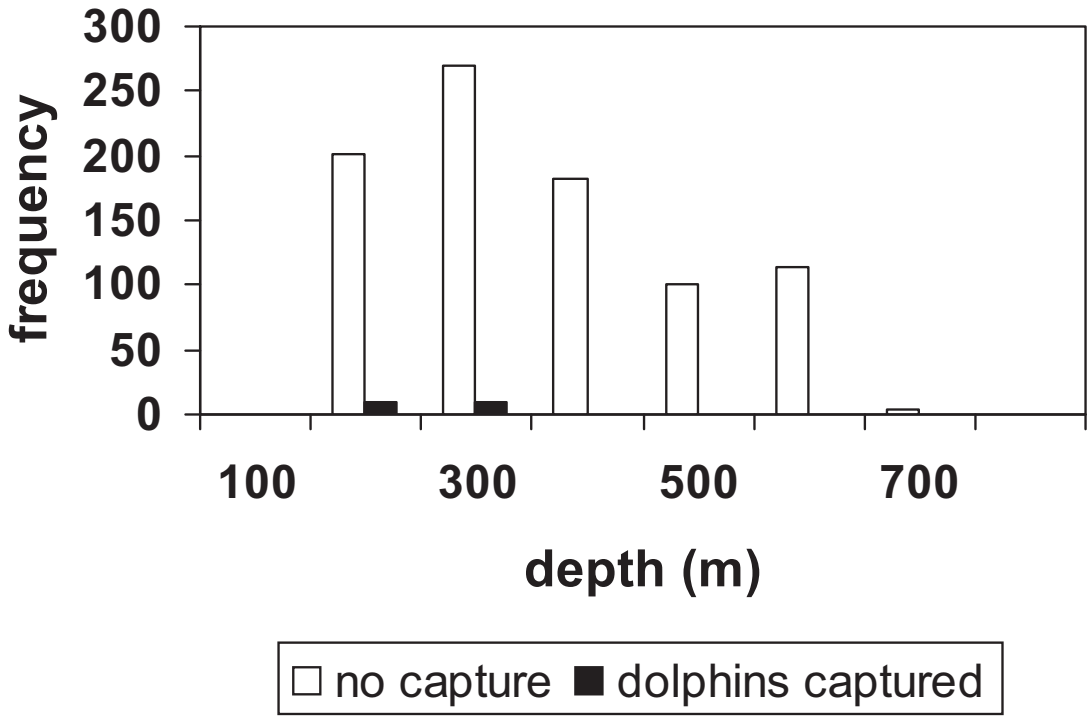

Figure 4: Group size of the capture events of short-beaked common dolphins by pair trawlers off Galicia.

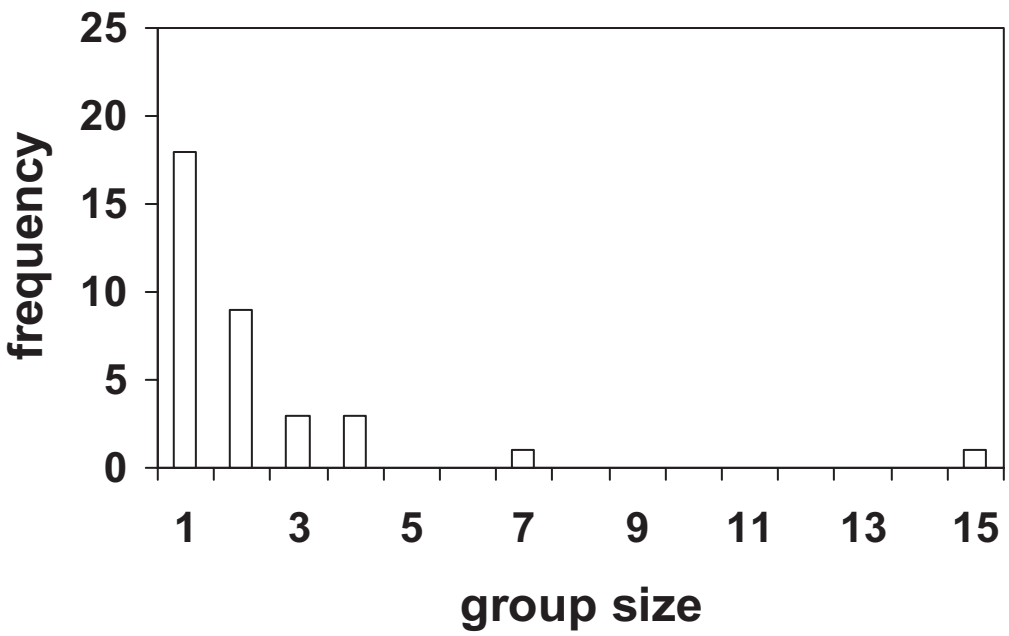

Figure 5: Age distribution of the short-beaked common dolphins incidentally caught by pair trawlers off Galicia.

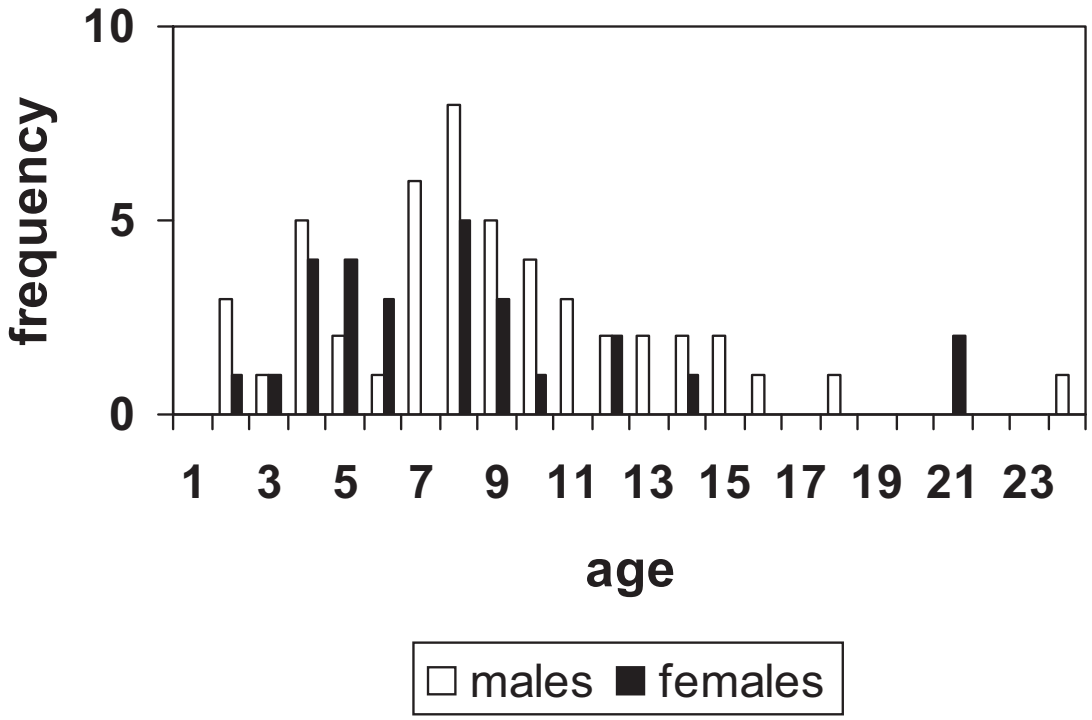
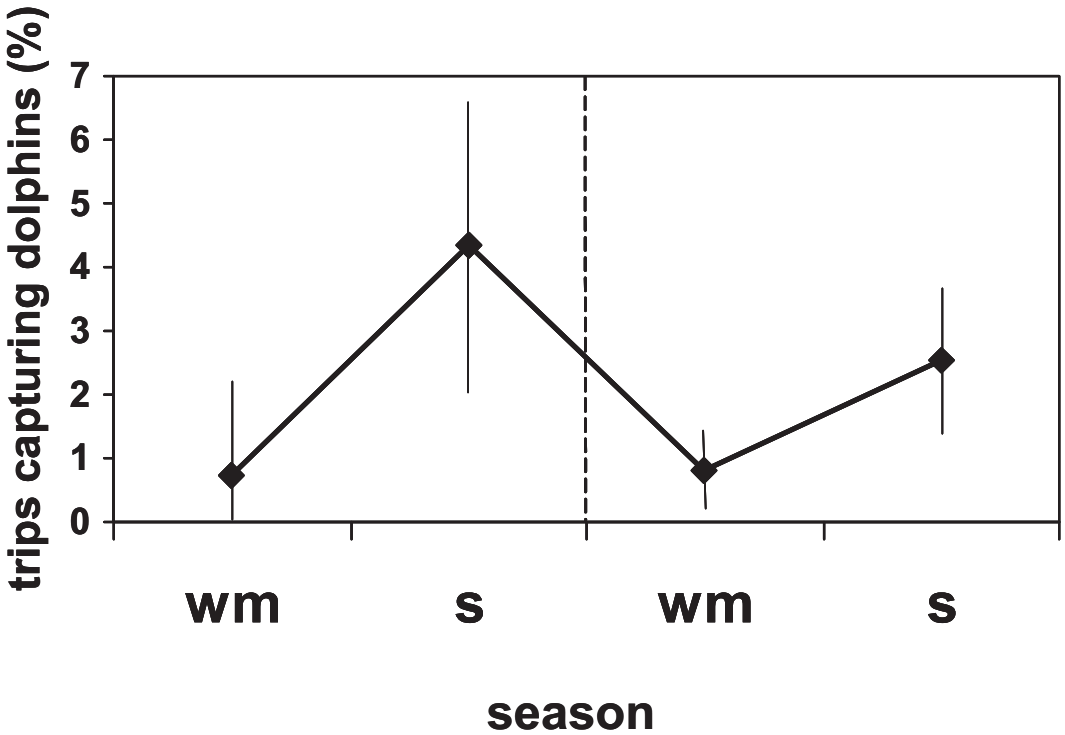
Figure 6: Seasonal distribution of the by-catch rate before (left to the dashed line) and after the *Prestige* oil spill (right to the dashed line).