Effect of vessel traffic on Commerson's dolphin (*Cephalorynchus commersonii*) in Bahia San Julian, Patagonia, Argentina.

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ABSTRACT

There has been a considerable increase in shipping activities in Patagonia in the last decade. This work evaluates the potential effects of vessel traffic on the Commerson`s dolphin (*Cephalorhynchus commersonii*) population of Bahia San Julián (49º 14´ S, 67º 36´ W). During January-February 2000 and 2001, land-based and boat-based observations were made. Group cohesion, group size and vessel-dolphin distance under different intensities and nautical traffic types were measured. The absence of vessels sailing in the bay was considered as the control situation. No significant differences were found in any of the variables analysed, neither in the number of vessels nor in the power of the engines or the type of activity performed by the vessels. The levels of nautical activity in this area do not seem to have affected the analysed behaviour variables of the Commerson`s dolphin population in the Bahia San Julián region of Argentina.

KEYWORDS: COMMERSON'S DOLPHIN, *CEPHALORHYNCHUS* COMMERSONII, WHALE WATCHING, DISTURBANCE, GROUP COHESION, GROUP SIZE

INTRODUCTION

The effect of vessel traffic on cetaceans has been the aim of several workshops in the last years (IFAW, Tethys Research Institute and Europe Conservation, 1995; IFAW, WWF and WDCS, 1997; IFAW, 1999 and 2000).
However, studies of this problem are scarce and centred on big whales (see Richardson *et al*., 1995). Only recently has the effect of tourist activities on free-ranging small delphinids been taken into account (Acevedo, 1991; Janik & Thompson, 1996; Bejder *et al.*1999; Lasage *et al*., 1999; Allen & Read, 2000; Frohoff, 2000; Nowaced & Wells, 2001; Gregory & Rowden, 2001).
Generally to evaluate the possible disturbance caused by the traffic of vessels, changes in behaviour are verified (Richardson *et al*., 1995). The different behaviour associated to a stimulus are considered as short term reactions, easier to detect and to relate with the impact of human activity than the long term reactions (IFAW *et al*., 1995). The short term answers in odontocete include changes in the diving pattern, breathing rate, swimming speed (Frohoff, 2000), or alter their group interactions (Patterson, 1988).
There is a general tendency in most cetaceans to avoid vessels in movement, with a great individual variety of responses within and among species particularly while they reproduce, feed or migrate. Consequently, it is recommended that one should evaluate in each case and species, the biggest quantity in/of possible impact factors (IWC, 1986).
In Patagonia the short term reactions of the Southern Right Whale (*Eubalaena australis*) were recorded (Arias, 1995a and 1995b; Rivarola *et al*., 1996) and for Commerson's dolphins (*Cephalorhynchus commersonii*)(Coscarella *et al*., 2003). Although the nautical activities such as the cetacean-watching, increase every year (Iñiguez *et al*., 1998; Hoyt, 2001) there is no evaluation plan to accompany this phenomenon.
Commerson`s dolphins (*Cephalorynchus commersonii*) are exposed to dolphin-watching in four areas of the Argentine coast: Bahia Engaño in Chubut Province, Ría Deseado, Ría Gallegos and Bahia San Julian in Santa Cruz province (Iñiguez *et al*., 1998; Iñíguez and Tossenberger, 1999; Hoyt, 2001, Coscarella *et al.,* 2003).
The nautical activities in Bahia San Julián Bay are touristic, sport type and of artisanal fishing.

Since 1993 there has only been one nature trip operator which includes dolphin watching sailing from November to April with its top activity in January. This dolphin watcher uses a 8.10m long vessel with two 150 HP outboard engines, making a 10nm journey of 1.5 h two to four times a day (Iñíguez *et al*., 1999).
The objective of this study is to evaluate the potential impact of the vessel traffic on the population of Commerson`s dolphins of Bahia San Julián, Argentina; characterizing the nautical activity developed in the area and verifying changes in group interactions such as group dispersion and group size under different intensities and vessel traffic types.

METHODS

From 1996 the general behaviour of a resident population of Commerson´s dolphins inhabiting Bahia San Julian was studied.
The present investigation took place in the waters of Bahia San Julián, Patagonia, Argentina (49º14´S, 67º36´W). The interior bay is 20 km length and 238 km^2 of surface, with semidiurnal tides with an average height of 7m. Their waters are turbid (visibility <1m) and cold (surface water temperature in summer season of 14ºC).
A study area with a 4.31 km^2 surface was selected. This area is the normal route of vessels and one of the areas mainly used by Commerson`s dolphins (Iñiguez *et al*., 2000).
To make the identification of the groups easier, the area was divided into quadrats. These quadrats were divided into three zones, each zone extending approximately 100m offshore following de Haro and Iñíguez (1997). Due to the small size of this species (1.5 m), dolphins at a distance of more than 300m approximately of our position were not considered.
Land-based and boat-based observations during January-February 2000 and 2001 were carried out. Our sightings were made with a BHO ≤ 2, from 0900 to 1900 h. The coastal data was recorded with binoculars 10 x 50. The pier of San Julian was used as an observation platform.
The sampling methodology was scanning (Altmann, 1974; Mann, 1999) with intervals of 3 minutes. The time assigned to the intervals responds to the diving patterns and times of immersion of the species (de Tezanos Pinto, 2000). Also here our observations were repeated every 3 minutes for the time of data collecting.
The onboard information was taken from a vessel of 5.2m length with 55 HP outboard engine, according to the methodology of focal pod (Altmann, 1974; Mann, 1999) with intervals of 1 minute.

At considerable distances cetaceans detect and react to the auditory stimuli produced by vessels (Richarson *et al*., 1995) and given the characteristics of the bay, the situation of potential impact to all events where some nautical activity was developed to engine in any point of the bay.
To characterize the traffic vessel we recorded the number of engine vessels sailing at the same time (no vessel as control situation, 1 vessel, 2 or ≥3 vessels); vessel's power (smaller engines or similar to 70 HP, bigger engines more than to 70 HP) and vessel types (dolphin-watching vessel and sport or artisanal fishing vessels). The election of 70HP was taking randomly based on the engine power already have in Bahia San Julian.
The variables group dispersion, group size and vessel-dolphin distance was measured.
The group dispersion was the existent distance between each one of the individuals of a group. The measure unit was the "dolphin-length" (1 DL = 1.5m) with binocular observation from the platform. The term group included individuals at a smaller distance than 10 DL between them developing the same general behaviour (Iñiguez *et al*., 2000). The group size observed from the platform was measured as well as the vessel-dolphin distance in DL.
The distribution of group dispersion and of group size were analysed by means of Kolmogorov-Smirnov`s test (Zar, 1996).
Analysis of Deviance with one or more factors and covariables were carried out (Crawley, 1993) to detect the factors that affect the variables group dispersion and group size. It was considered as negative effect when they registered significant changes of a variable against a factor. This analysis was also applied to detect significant differences between fieldworks. Spearman`s correlations were used to evaluate the possible relationship between pod dispersion and vessel-dolphin distance (Zar, 1996).
Summary statistics were performed using SPSS v.7.5 (SPSS Inc.) Significance for all statistical test was set at P = 0.005.

RESULTS

During our study period of 58 days, there were 1760 observations from platform and 403 Commerson´s dolphins groups were recorded. In addition 300 sightings from 54 pods were collected from our vessel.
We recorded a total of 94 vessel movements. The dolphin-watching activity covered 44.68% of the total traffic (n = 42), while 55.32% related to sport vessels and artisanal fishing (n = 52). 60.64% of the vessels had engines smaller

than 70 HP (n = 57), while 39.36% engines were greater than 70 HP (n = 37). The registered maximum power was 150 HP and the maximum number of engines per vessel was two; both values belonging to the tourist vessel. We considered that this vessel as having anthropic activities of low magnitude. The highest number of vessels recorded in one interval of time was 5 (n = 1), all navigating in the proximities of one group, in an approximate radius of 200 to 500 m at 10 minutes period. The most frequent number of vessels present in the area in each watching was one, representing 48.14% of the analyzed intervals (n = 194).

The pod dispersion was adjusted to a Poisson distribution (Z = 0.89, P = 0.39). It did not present significant differences to the factor power of the vessel ($\chi 2 = 1.59$, P = 0.207, n = 106), nor to the factor number of vessels ($\chi 2 = 2.2$, P = 0.138, n = 218). No significant differences were observed in relation to the factor dolphin-watching vessel ($\chi 2 = 0.005$, P = 0.945, n = 133), nor between fieldworks (P = 0.317, n = 218).

Pods with calves had significantly smaller values of group dispersion ($\chi 2 = 0.67$, P = 0.10, n = 82) than those groups without calves ($\chi 2 = 0.15$, P = 0.03, n = 136). The group dispersion of the groups with calves were not affected by the different factors arising from the nautical traffic analysed in this study.

Due to the distribution of their frequency and since the size of the pod is a positive and whole count variable, the Poisson distribution was assumed with subdispersion (Ridourt and Demétrio, 1992).

Group size did not present significant differences arising from the factor power of the vessel ($\chi 2 = 0.042$, P = 0.873, n = 193), or from the number of vessels sailing in the bay ($\chi 2 = 0.652$, P = 0.885, n = 406). Nor was it modified by the factor dolphin-watching vessel ($\chi 2 = 0.008$, P = 0.929, n = 280). There were no significant differences between fieldworks (P = 0.537, n = 406).

Spearman`s correlation between group dispersion / vessel-dolphin distance was not significant (r = 0.226, n = 29, P > 0.05). The most frequent pair of values was 2:0 (vessel-dolphin distance: pod dispersion) (n = 7). A positive reaction of the dolphins was observed as they were frequently attracted by the vessels. The groups came closer to the vessels in movement or when stopped, whether the engines were on or off. Commerson's dolphins swim from the vessel at distances ranging from 0.2 m to 20 m approximately (n = 54), swimming or diving before its wake, sides or bow.

DISCUSSION

Group dispersion was not affected by the number of vessels or by their engine power. The opposite view was expressed by Bejder *et al.* (1999) when they observed a decrease in the group dispersion of Hector`s dolphin (*Cephalorhynchus hectorii*) in the presence of vessels. This may be partly due to the difference in the intensity and frequency of the vessel traffic in the analysed area or to the broadest definition degree with the one that the authors measured variable this, using digital theodolite tracking. With Sperm whales (*Physeter macrocephalus*) it was observed that pods are dispersed and then split up into smaller pods, in this way varying group dispersion and group size in front of the vessel traffic (IFAW, 1995). Frohoff (2000) considers group dispersion as a behavior related to the stress produced by the interaction with the vessels.

It was observed that group dispersion of the groups with calves is smaller or less frequent with groups which have no calves. This dispersion was not affected by any of the factors arising from the analysed nautical traffic. This may occur as a form of adults protection towards their calves. None of the factors analysed in this study resulted in changes in the group size. Acevedo (1991) did not detect behaviour changes arising from vessel traffic in the population of bottlenose dolphins (*Tursiops truncatus*) of Ensenada de la Paz, Mexico. Allen and Read (2000) neither observed behaviour changes. Janik and Thompson (1996) noted changes in respiratory patterns in *T. truncatus* in response to dolphin-watching vessel to other types of vessel traffic. Dolphin-watching vessels did not sail in the same way as other types of vessel travelling for longer periods and usually following the dolphins.

There was no evidences which demonstrated any link between dolphin-watching vessels distance and Commerson´s group dispersion. We consider that this establishes a positive reaction of this species towards this vessel, since it does not vary its group composition according to the distance from any vessels. Analysing the number of vessels, the reduced number and low power of engines and the absence of fast vessels, we can suggest that the frequency and intensity of vessel traffic in Bahia San Julián is low. It can also be speculated that the produced acoustic stimulus is of small magnitude. Another important aspect is the absence of dead individual Commerson´s dolphin registrations or those mutilated by collision with vessels, contrary to the incidents recorded in some odontocetes populations (Wells and Scott, 1997; Visser, 1999).

According to the bibliography, Commerson´s dolphins generally present a positive reaction towards moving vessels, within few meters of their bands, bow and stern (Leatherwood *et al*., 1988; Goodall *et al*., 1988; Iñiguez, 1988 and 1991; Iñiguez and Tossenberger, 1995).
From the photo-identification studies carried out on this population since 1996 (Iñiguez *et al.*, 2000), we can deduce that the Bahia San Julian resident population is exposed to similar levels of disturbance as those found during the last 6 years. We believe that the individuals are used these anthropic activities of low magnitude and so did not show measurable changes here in the analysed scale. As recorded by Richardson *et al*. (1995) cetaceans can hear the sound of a vessel's engines even at considerable distances. Our study shows that distance was not the only factor that determined the extent of the audio stimulus of the engine sound but it must also be taken into account the topography and other physical features of the Bay.
Studies carried out in the population of Ria Deseado recorded changes caused by the great increase of the vessel traffic registered from 1986 up to 1991, disappearing when the vessel traffic decreased (Iñíguez and Tossenberger, 1995). For Commerson's dolphins of Bahia Engaño, a higher travelling behaviour previous to boat approach may be considered an altered behaviour (Coscarella *et al.,* 2003). It has been reported that Hector´s dolphins left areas of high nautical traffic although Hector´s dolphins were attracted by vessels in areas of low traffic (Slooten and Dawson, 1988). In our study area, in spite of being a location frequently used by Commerson´s dolphins and within the forced path of vessels there was no groups displacement suggesting a low disturbance intensity. Another possible explanation is that due to the speed and manoeuvrability of this species, the individuals could easily avoid the vessels in case of disturb. As the bay is a large sea area, the individuals have the option of moving to non traffic areas.
Bejder *et al*. (1999) postulate that most of the impacts caused by ecotourist activities like dolphin watching, are accumulative more than catastrophic for Hector´s dolphin. Slooten and Dawson (1988) suggest that, except in areas with intense traffic, it seems unlikely that vessels affect the behaviour and distribution of this species. These same interpretation was found in our study of Commerson´s dolphins within the registered activity levels.
The cetacean-watching activities in Argentina are not adequately regulated (Coscarella *et al*., 2003), existing only for the southern right whale in Golfo Nuevo, Peninsula Valdes. In view of the growth of cetacean-watching and of the increase in port traffic experienced in some areas inhabited by the Commerson`s dolphins, it is recommended that for the conservation of this species, nautical traffic as an activity that should be periodically evaluated and regulated.
Our study is the first systematic evaluation of the potential effects of vessel traffic on the Commerson`s dolphin at Santa Cruz province. This contribution can be considered as base for future analysis for this and other species of small cetaceans in Argentine waters.

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