Final Report

Identifying priority areas for the conservation of bottlenose dolphins (Tursiops truncatus) inhabiting the Patos Lagoon estuary, southern Brazil.

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INTRODUCTION

The bottlenose dolphin, *Tursiops truncatus*, occurs in both tropical and temperate oceans (Kenney, 1990) of the world, inhabiting mainly coastal waters (Bastida *et al.*, 2007). There are records of bottlenose dolphins in Brazil from Jericoacoara (02°47'S - 40°30'), northeastern Brazil (Alves-Júnior *et al.*, 1996) to Rio Grande do Sul (~33^{o}45'S), the southernmost Brazilian state. In southern Brazil, this species is found associated with river mouths and estuaries (Simões-Lopes, 1995).

In Rio Grande do Sul state, a small population of approximately 85 bottlenose dolphins (Dalla Rosa, 1999; Fruet *et al.*, 2007) inhabits the Patos Lagoon estuary (Figure 1) year round and has been studied since the mid 1970s, though not continuously. The area is used for all the population vital activities such as feeding, socializing, reproduction and resting (Figure 2) (Möller 1993; Dalla Rosa, 1999).

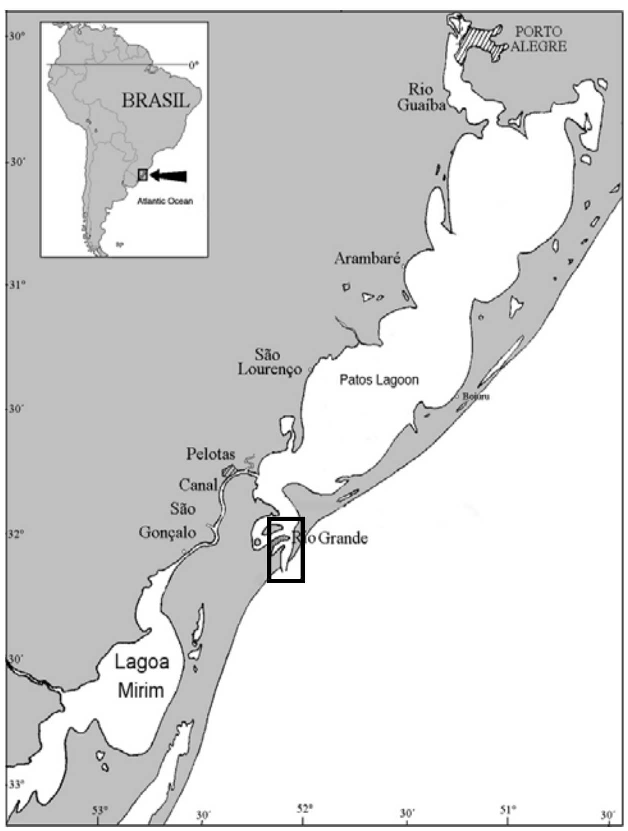


Figure 1. Location of the Patos Lagoon Estuary (rectangle).

Figure 2. Some activities registered during boat surveys in 2006. Photographs: Pedro Fruet.

The Patos Lagoon estuary is a highly productive region and an important feeding and nursing area for many commercially valuable fish species (Haimovici *et al.*, 2006). This area is characterized by an extensive traffic of both fishing and cargo vessels and other port activities (*e.g.* dredging). Since early 1980, as the estuarial fishing resources became scarce, artisanal gillnetting intensified in coastal adjacent areas (Figure 3) (Reis *et al.*, 1994).

Until 2002 bycatch was suspected to be a minor problem to this bottlenose dolphin population. However, during the last few years, there was a great increase in the number of dolphins found dead on the beach, many of which presenting evidences of being caught in fishing nets (*e.g.* net marks on the flukes and/or mutilated body parts) (Figure 4) (see also Fruet *et al.*, 2005).

Figure 3. Example of an extensive fishing day on the study area.

Distribution patterns together with behavioural data of a population can describe the habitat use, which is an important tool that has been used to delimit critical areas for the conservation of cetaceans (*e.g.* Ingram & Rogan, 2002; Hastie *et al.*, 2004; Parra *et al.*, 2006; Ribeiro *et al.*, 2007). Critical areas are defined as areas regularly used by a group, population or species to perform activities essential for survival and maintaining a healthy population growth rate (Hoyt, 2005). These essential tasks include feeding, breeding, calving and resting.

The information on the distribution and habitat preferences for this bottlenose dolphin population will be important to elaborate tentative guidelines to orientate the Brazilian Agency for Environment (IBAMA) in designing local conservation plans aiming at minimizing this fishing related impact as well as others sources of potential impact (*e.g.* vessel traffic, turism, pollution) that might affect this small population.

The identification of priority areas where fishing activities is regulated or banned can be a product of this project if current level of bycacth our suspicious that this small resident population is been impacted due to unsustainable levels of bycatch is proved unsustainable. For example, a sanctuary or marine protected area could be established based on information about preferential habitat of dolphins and fisheries distribution patterns (*e.g.* Dawson & Slooten, 1993; Clement, 2005). Moreover, if the proposed conservation strategies were based on scientific data, if enforced, they are more likely to reduce the number of dolphins annually killed in fishing operations.

Figure 4. Photographs of individuals showing evidences of fishing related mortality.

OBJECTIVES

The aims of this project were to:

1- Investigate the habitat use patterns of the bottlenose dolphin (*Tursiops truncatus*) population in order to identify critical habitats:

1a - Determine distribution patterns of the dolphins along the study period;

1b - Identify habitat characteristics that might influence the distribution of the dolphins.

2- Determine distribution and intensity of the artisanal gillnetting occurring in the Patos Lagoon estuary and adjacent coastal waters.

3- Identify areas and seasons of higher potential overlap between fishing and dolphin distribution along the year.

METHODS

Study area

Located along the coast of Rio Grande do Sul state, southern Brasil, the Patos and Mirim Lagoons (Figure 1) form one of the largest lagoon complexes of the world. The lagoon drainage basins covers 201,626km^2 and is connected to the ocean in the extreme southern part of Patos Lagoon by a single narrow channel (0.5 – 3km wide) fixed by two jetties about 4km long (Seeliger *et al.*, 2004). The estuarial area is restricted to the southern portion of the Patos Lagoon (aproximately 10 % of the total area), and is characterized by coastal shallow bays (0 – 5 meters deep) and by a dredged deep channel (maximum depth of 18m) (Bonilha & Asmus, 1994) (Figure 5).

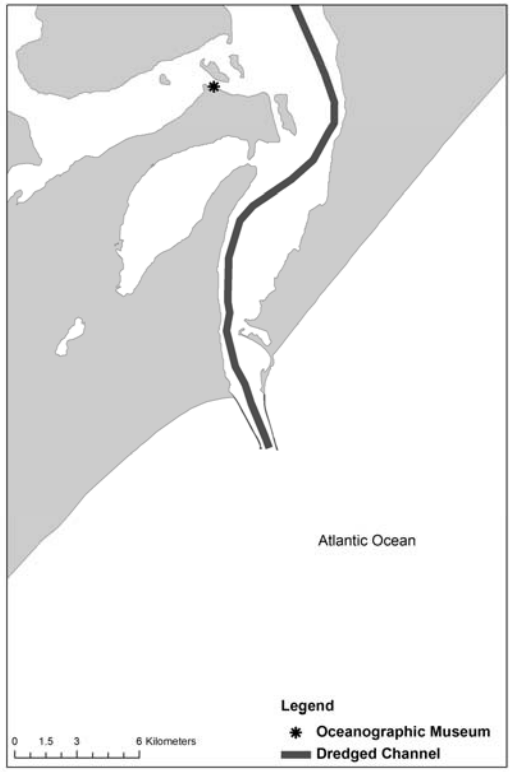


Figure 5. Map showing the dredged channel in the estuary.

Wind patterns and fluvial discharge controls the circulation, salinity distribution and water levels inside the estuary and on the coastal adjacent areas (Garcia, 1998). These patterns are seasonal and frequently represented by strong wind from northeastern (NE) quadrant between September and April and from southwestern (SW) quadrant between May and October. NE quadrant wind favors fluvial discharge and SW quadrant wind cause a stream inversion leading to a rise of the water level in this area. Low and high water temperature and salinity are associated with high fluvial discharge and NE quadrant wind, and low fluvial discharge and SW quadrant wind, respectively. However, strong fluvial discharge periods together with SW winds cause a vertical stratification with penetration of bottom salt water (Niencheski & Baumgarten, 1998).

The Patos Lagoon estuary and the adjacent marine system are connected biologically (life cicle of many invertebrate and fishes depends on both system) and through abiotic factors such as the increase of nutrients due to the fluvial discharge (Abreu & Castello, 1998). This strong connection between the estuary and the adjacent coastal area contributes to the high produtivity (Abreu & Castello, 1998), and make this area very important ecologically and socio-economically.

Survey Design

Surveys were taken place onboard an aluminum boat equipped with a 60 hp outboard engine, VHF radio and a depth sounder (Figure 6). Inside the estuary zig-zag transects were made to cover a larger area within a day and the start point was alternated between the mouth of the estuary (32º10.92´S 052º4.65´W) and Ponta do Retiro (31º58.81´S 052º3.78´W).

Figure 6. Researchers aboard the aluminum boat during dolphin sighting.

On the coastal adjacent area, transects were perpendicular to the isobaths to ensure that all depths were surveyed homogeneously (Buckland *et al.*, 2001). This coastal area was divided into two sub-areas, north and south to the estuary mouth, where 10 parallel transects were placed at each subarea (Figure 7). Each transect was two kilometers apart and approximately 5km long (from the coastline towards the open sea), covering depths between 1 and 14 meters. The starting position of each survey was also alternate between the transect lines which were the closest or the most distant to the estuary mouth.

The three sub-areas (estuary, north and south coastal adjacent areas) were covered on different days. For safety reasons, transects were limited to areas over 1m deep.

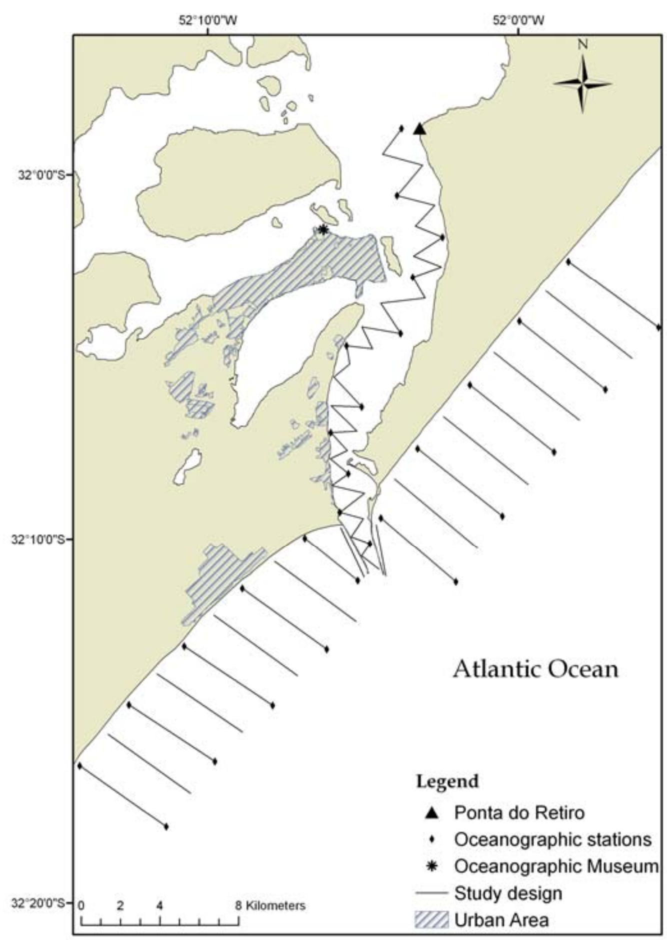


Figure 7. Map of the study area, including the transect lines and the points where the environmental variables were measured (oceanographic stations).

Data collection

Each survey was conducted by one observer, one data recorder and the boat driver. The observer was responsible for searching for dolphins, the data recorder and the driver were responsible for counting the fishing nets. Surveys were conducted in calm sea conditions (Beaufort scale 3 or less) aiming at reducing the probability of missing dolphins.

Habitat Variables: Each subarea had pre-defined oceanographic stations (Figure 5), at the both end of every another transect line, where information on the physical and chemical variables were taken. The variables measured were: transparency (Secchi disk), depth (echo-sounder), superficial and deep water temperature (mercury thermometer attached to the Nansen bottle) and salinity (refractometer) (Figure 8).

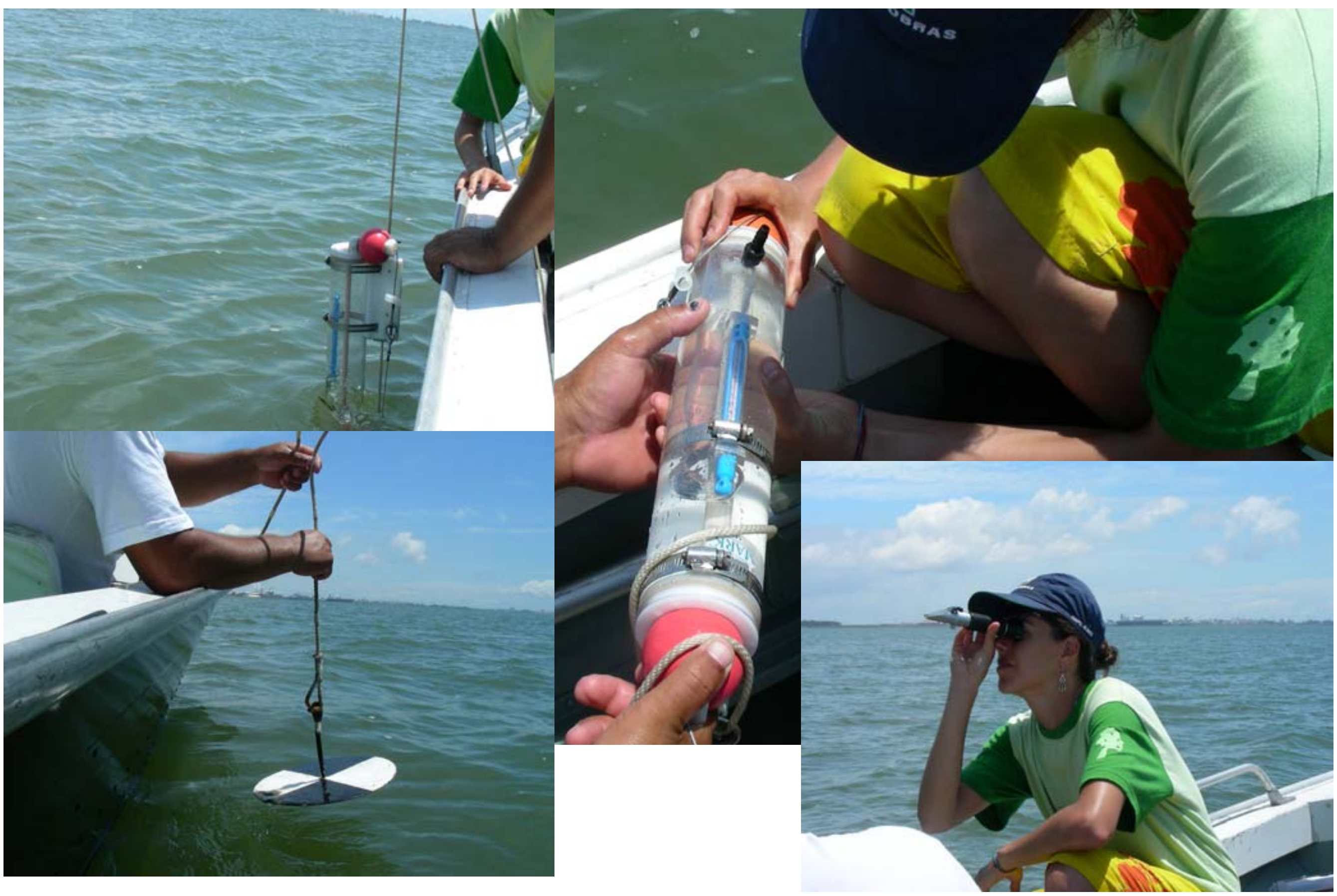


Figure 8. Oceanographic sampling during the surveys.

Dolphin Sightings: Whenever a dolphin or group of dolphins were sighted, time, group size, composition and behaviour were recorded before approaching. Then, the boat approached the group to record the position and depth. Once data were collected the searching effort for new groups were resumed as quickly as possible (Figure 9). A group of dolphins was defined as dolphins with relatively cohesion that were involved in similar behavioural activities (*e.g.* Shane, 1990). The composition of the group was defined as adults, juveniles, calves and neonates. Neonates were identified trough at least 3 of these features: body size less than half the size of the proximate adult, floppy dorsal fin, rostrum-first sufacing and visible fetal folds (Thayer *et al.* 2003).

Figure 9. Researchers leaving a dolphin group to resume the searching effort.

Fishing nets: The number of buoys and flags (used by the fishermen in this area to mark the fishing-nets position) were counted when searching for dolphins in order to optimize survey effort. Furthermore, it allowed us to collect information useful to identify areas of near real-time overlap between dolphin and fishing net distribution. Because it is difficult to count number of nets during days of very extensive fishing effort (as shown in Figure 4), a pair of flags or buoys were considered to represent one net (Figure 10).

Figure 10. Example of a flag used to mark the fishing nets position.

Data Analyses

The number of dolphins or nets seen divided by the number of kilometers searched was used as an index of density (encounter rate). Encounter rates (ER) were used to indicate the areas mostly used by the dolphins and fisheries. Each subarea was split into areas close to and distant from the estuary mouth (Figure 11). The year was separated into two periods: warm, defined as those six months with higher mean sea surface temperature (November-April) and cold as those months with lowest mean sea surface temperature (May – September) (Figure 12). Kruskal-Wallis (H) was used to test the null hypothesis that the ER is the same between sub-areas and periods.

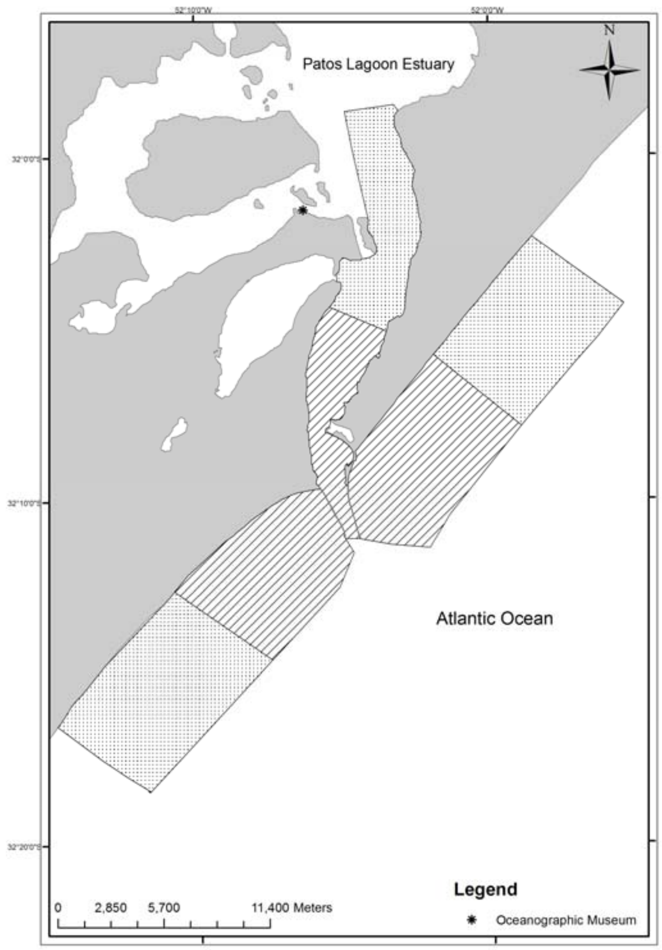


Figure 11. Map of the study area showing the sub-areas separated by areas close (striped) and distant (small dots) from the estuary mouth.

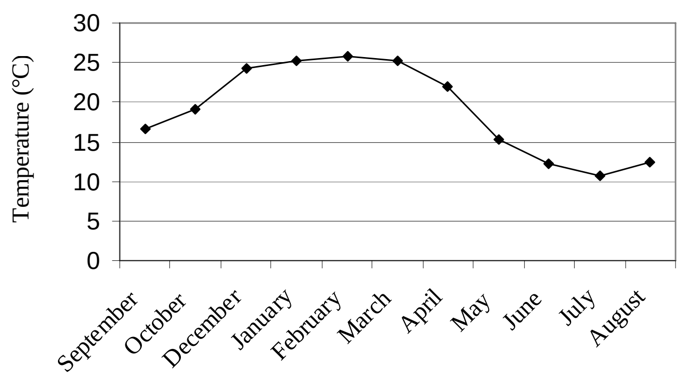


Figure 12. Mean monthly sea surface temperature from September 2006 to August 2007.

An ANOVA test was used to verify the null hypothesis that the number of individuals within a group was the same between sub-areas and periods.

The relationship between environmental variables and dolphin distribution was investigated using a Pearson correlation test. For this, the mean value of the variables (temperature, salinity, transparency) was compared to the dolphin ER on each subarea (estuary close and distant, south close and distant and north close and distant to the estuary mouth) for each survey.

To test the correlation between dolphins on the adjacent coastal areas and the distance from the coast and from the jetties a Spearman test was used. For that, the distance from the coast was separated into ten 0.5km wide bins (from 0 to 5km) and the distance from the jetties into eight 2.5km wide bins (from 0 to 20km). A 5% significance level was adopted for all tests.

RESULTS

Between September 2006 and August 2007 we surveyed 1923.1km (99.23 h of survey effort) within our study area and sighted a total of 114 schools of bottlenose dolphins. Survey effort was not uniformly distributed across the study area and seasons because of environmental conditions (Table 1 and Figure 13).

Table 1. Information on survey effort and encounter rates. Encounter rate (ER) Standard error (Se).

Areas	Number of surveys		Km surveyed	Number of groups	ER ; Se
	Cold	Warm			
Estuary	13	11	1050.415	75	0.28 ; 0.23
South	4	5	481.498	16	0.17 ; 0.24
North	2	5	391.183	23	0.34 ; 0.23
TOTAL	40		1923.1	114	

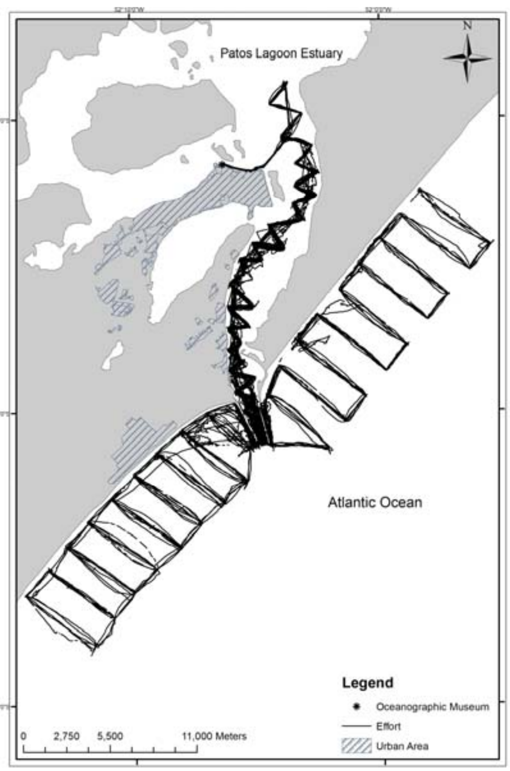


Figure 13. GPS track lines of the effort made during the search for dolphins in the study area.

The predominant behaviour of dolphins at initial sighting was feeding, followed by traveling and socializing (Figure 14). Resting was not recorded probably due to a low occurrence or because the surveys were restricted to periods of daylight as seen on previous behaviour studies (Möller, 1993; Mattos, 2002).

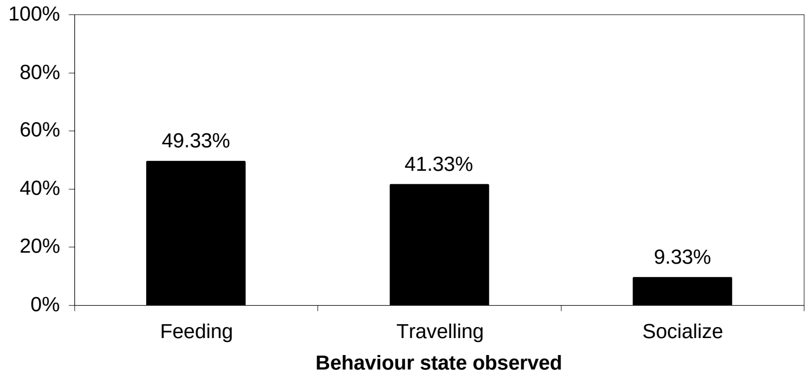


Figure 14. Proportion of observed behavioural states.

Spatial and Temporal Patterns

Dolphin groups were found in all surveys on the north coastal area, 66.7% on the south coastal area and 83.3% on the estuary area. Number of individuals within a group varied from one to 20 and was not significantly different between areas ($F = 1.58$, $p = 0.21$) (Figure 15) and seasons (cold and warm) (Table 2). Groups composed of less than 10 individuals were most frequently observed. Calves were seen all year round; however neonates were recorded only between November and early March, indicating a well marked reproductive seasonality.

Table 2. Mean group size of dolphins on each area and periods. Standard error (Se).

Areas	**Mean**	**Se**
Estuary	4.1	3.4
South	5.0	4.9
North	5.6	3.9
Period		
Cold	4.8	4.1
Warm	4.4	13.3

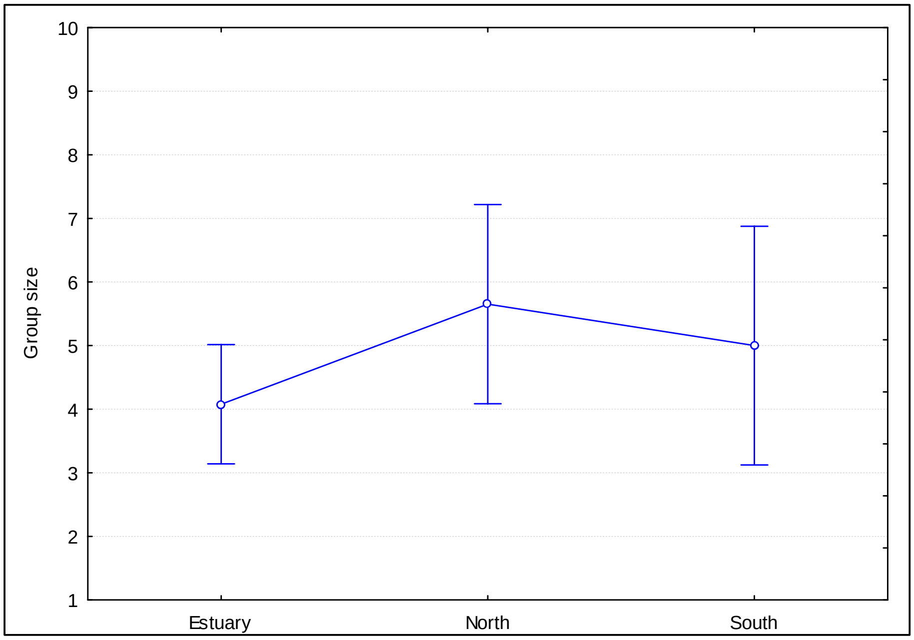
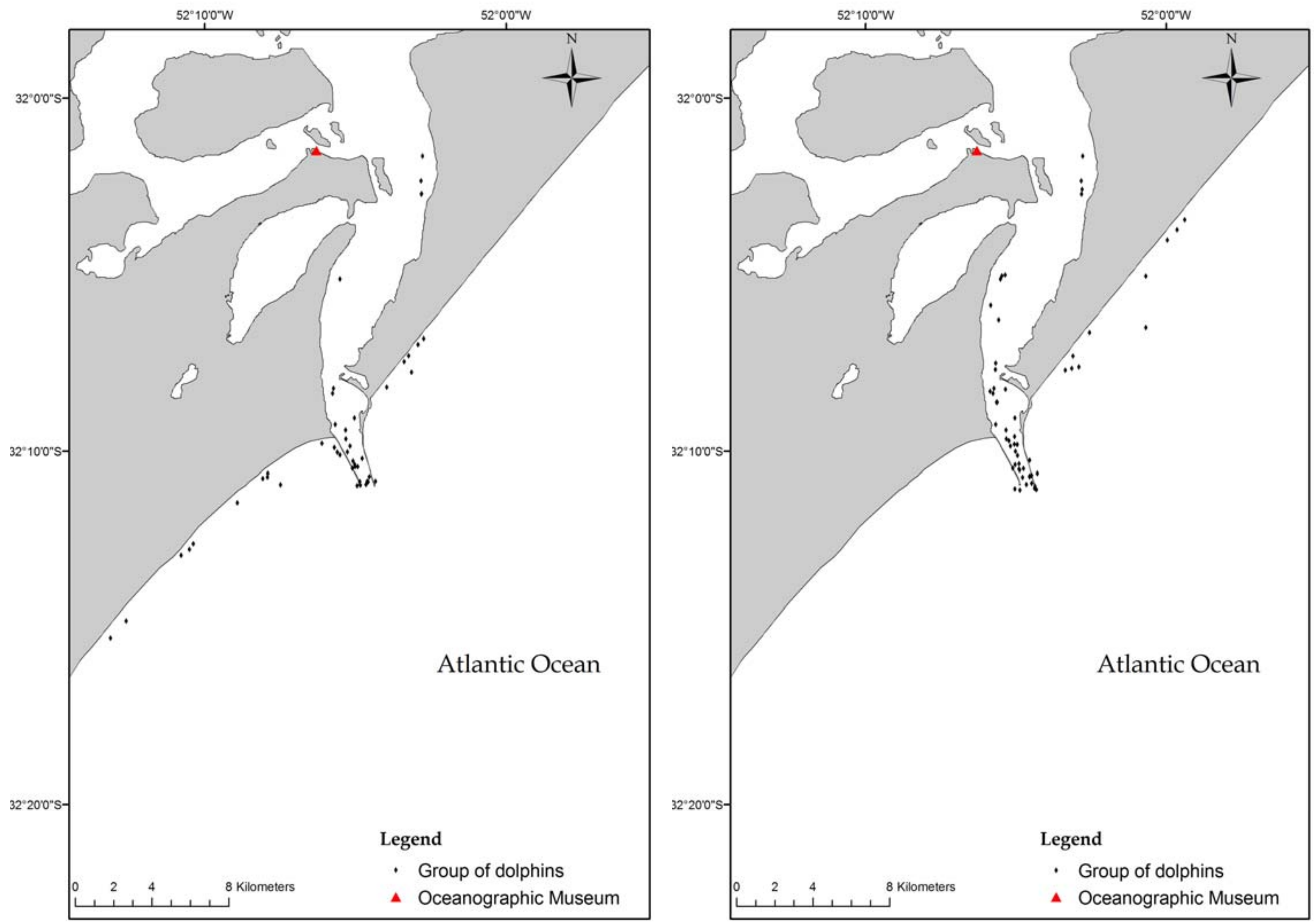


Figure 15. Mean group of 0.95 confidence interval for each area.

The encounter rate (ER) of dolphins was higher inside the estuary than in the north and south adjacent areas (Table 2), though differences were non-significant ($H = 2.28$; $p = 0.32$). When comparing warm and cold months for each area, ER was significantly different in the South area where it was higher during cold months ($H = 6.0$; $p < 0.05$) (Figure 16). This indicates that the dolphins did not use the south area evenly through the seasons and might be due to the higher fishing effort in the South area during warm months (see below).

Mean ER was higher in areas close to (mean=0.4; Se=0.38) than distant (mean=0.13; Se=0.13) from the estuary mouth ($H=17.59$; $p <0.05$). This pattern shows that dolphins prefer areas close to the estuary mouth regardless of season (cold months: $H=4.78$; warm months: $H=13.34$; $p <0.05$) (Figure 15 and Table 3).



A B

Figure 16. Dolphin groups distribution during cold (A) and warm (B) months.

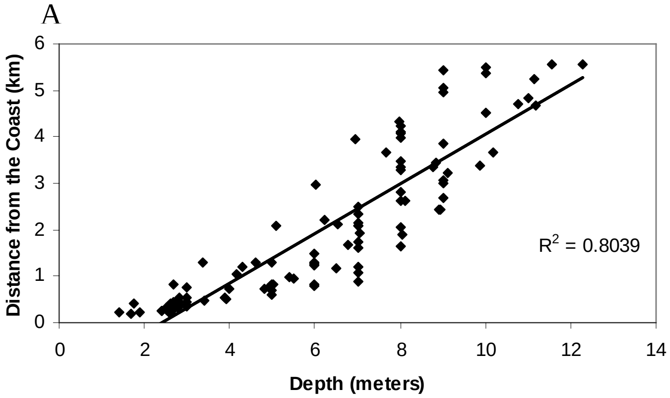
Table 3. Mean encounter rate (ER) and standard errors (Se) for areas close to and distant from the estuary.

	Cold		Warm	
	Mean ER	Se	Mean ER	Se
Areas Close	0.31	0.30	0.49	0.44
Areas Distant	0.17	0.35	0.09	0.15

***Depth and Distance from Coast*:** The area inside the estuary and the coastal areas have different bathymetric characteristics, so they were treated separately. Inside the estuary, the depth varies from 0 to 20 meters where the deep part is the dredged channel (Figure 5). The mean depth where the groups of dolphins were found was 11.4 meters (Se = 4.6), this may indicate that dolphins, when inside the estuary, prefer deep water as observed by Hastie (2003) on Moray Firth, Scotland. This pattern can also be explained by the fact that the dolphins had a high ER near the mouth of the estuary where most of the available habitat is the dredged channel.

On coastal adjacent areas, depth increases with the distance from the coast line (Figure 17A). Surveys were taken place from 0 up to 13 meters of depth. The mean value of depth where groups of dolphins were found was 5.0 meters (Se = 3.6). This value is probably overestimated as several sightings were made near the entrance of the estuary, which is delimited by two 4-5km long jetties. Therefore, when dolphins leave or enter the estuary they necessarily need to swim across relatively deep waters. If we exclude the first two lines adjacent to the jetties, the mean depth where groups were found is 3.4 meters (Se = 1.6). Dolphins were found mostly within 1km from the coastline (Figure 17B). A Spearman test showed a significant correlation between number of dolphins and the distance from shore (r_s = -0.08; p = 0.004).

***Distance from the Jetties*:** Even though there is a trend in decreasing the number of dolphins as distance increases (Figure 18), dolphins probably use areas beyond the study area as this coastal species usually make long along-shore trips (*e.g.* Balance, 1990; Wood, 1998). Correlation between number of dolphins and distance from the jetties was non-significant (r_s = 0.6; p>0.05).



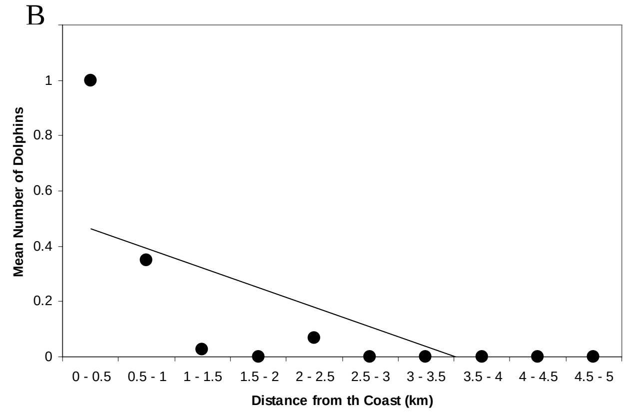


Figure 17. A- A dispersion graphic showing depth increase with distance from the coast. B- Mean number of dolphins seen on each class of distance from the coast.

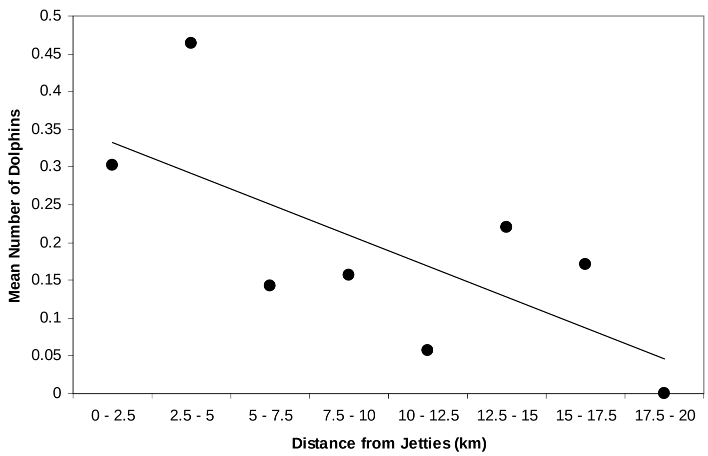


Figure 18. Mean number of dolphins seen in each strip of distance from the jetties.

Temperature, Salinity and Transparency**:** During this year we detected the same trends on the temperature, salinity and transparency variables that Niencheski & Baumgarten (1997) described for this area. The higher temperature, salinity and transparency occurred during the warmer months on the three subareas (Figures 19 and 20). A Pearson test showed non-significant correlation between each variable and the number of dolphins ($p>0.05$), suggesting that these variables do not directly affect dolphin's distribution.

The environmental variables and their potential effect on prey distribution probably had a major influence on the spatial distribution of the dolphins, as seen on others delphinid populations (*e.g.* Hastie *et al.*, 2004; Parra *et al.*, 2006). The preference for certain areas for foraging (the main activity observed in this study) is probably related to the fact that some topographic characteristics might increase the chances of prey capture (*e.g.* Hastie *et al.*, 2005).

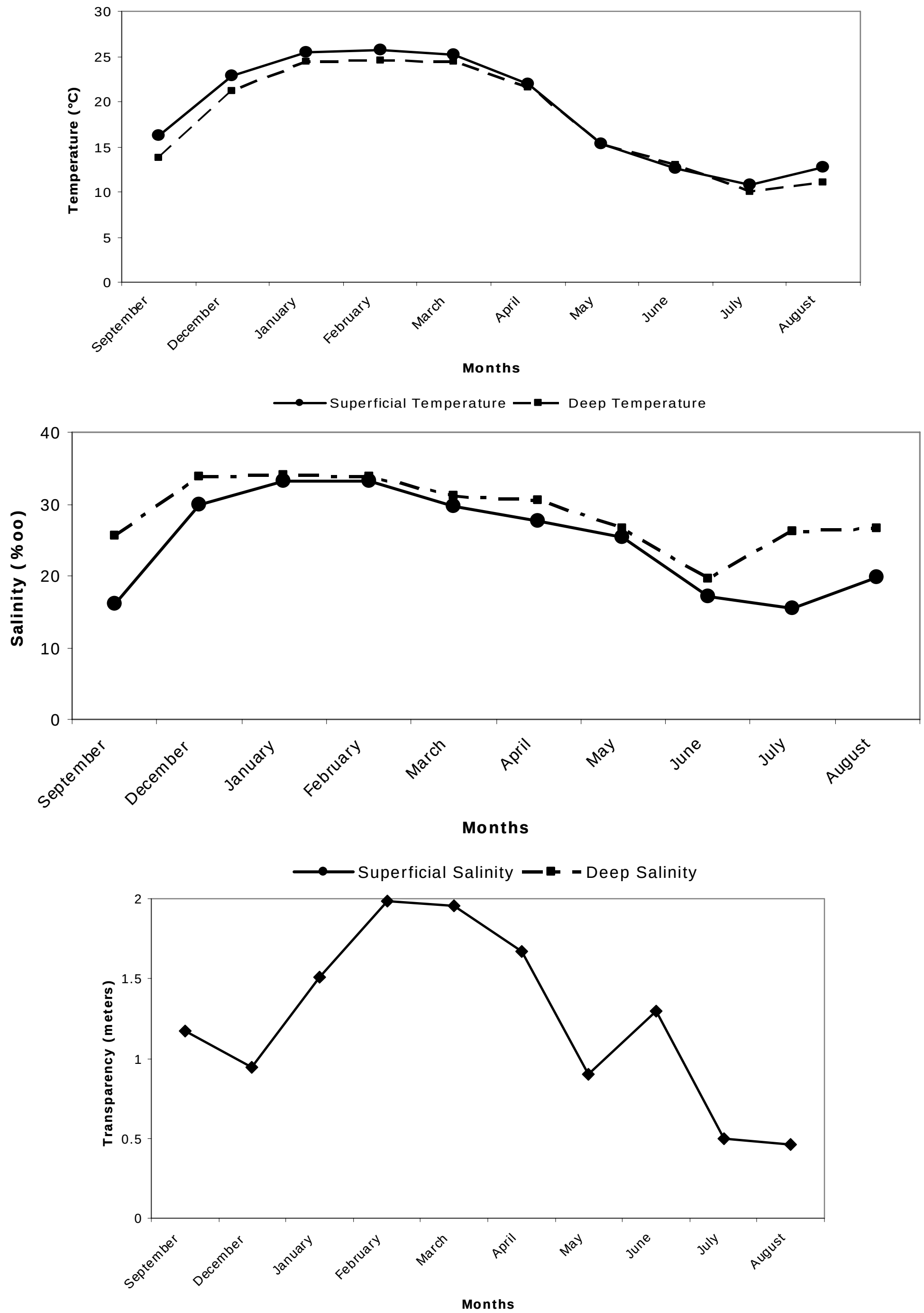


Figure 19. Mean temperature, salinituy and transparency during the surveys on the coastal areas.

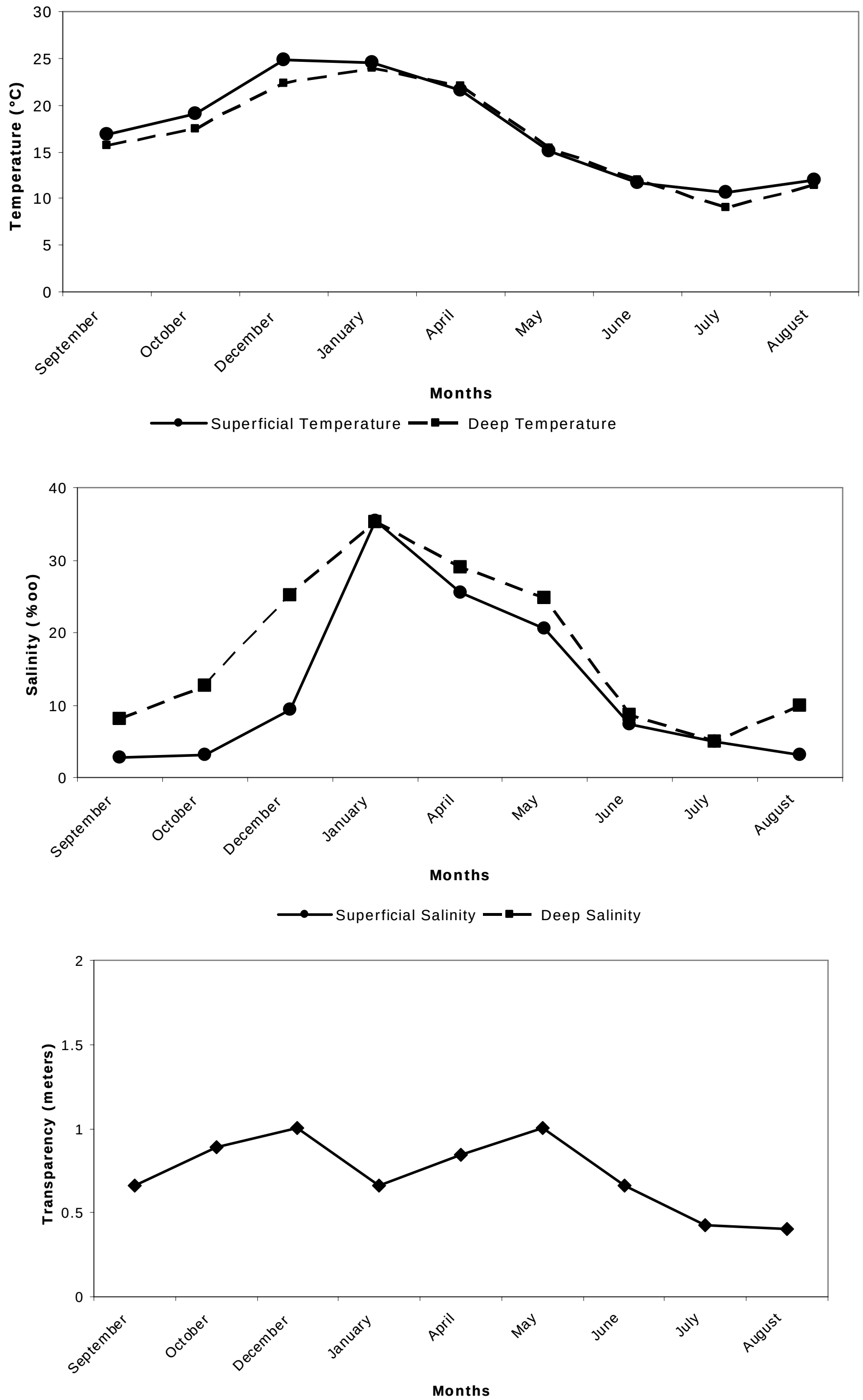


Figure 20. Mean temperature, salinituy and transparency during surveys inside the estuary.

Artisanal gillnet fishery

During this study 425 bouys and flags were counted and the encounter rate was higher inside the estuary (mean = 0.67, Se = 1.13) than in the north (mean = 0.14, Se = 0.5) and south (mean = 0.25, Se = 0.45) sub-areas. This pattern was not significant different between cold (mean = 0.28, Se = 0.45) and warm seasons (mean = 0.64, Se = 1.1). When comparing net ER between areas close to and distant from the estuary mouth, difference was significant only for the south area. ER in the area close to (mean = 0.44, Se = 0.21) was significantly higher than the area distant from the estuary (mean = 0.06, Se = 0.04) ($H = 4.2$, $p < 0.05$). The distribution of gillnets showed a significant negative correlation with the distance from the jetties ($r_s = -0.9$, $p < 0.05$) and from the coastline ($r_s = -0.9$, $p < 0.05$). Gillnets are placed mainly in areas up to 2.5km from the coastline and 10km from the jetties (Figures 21 and 22).

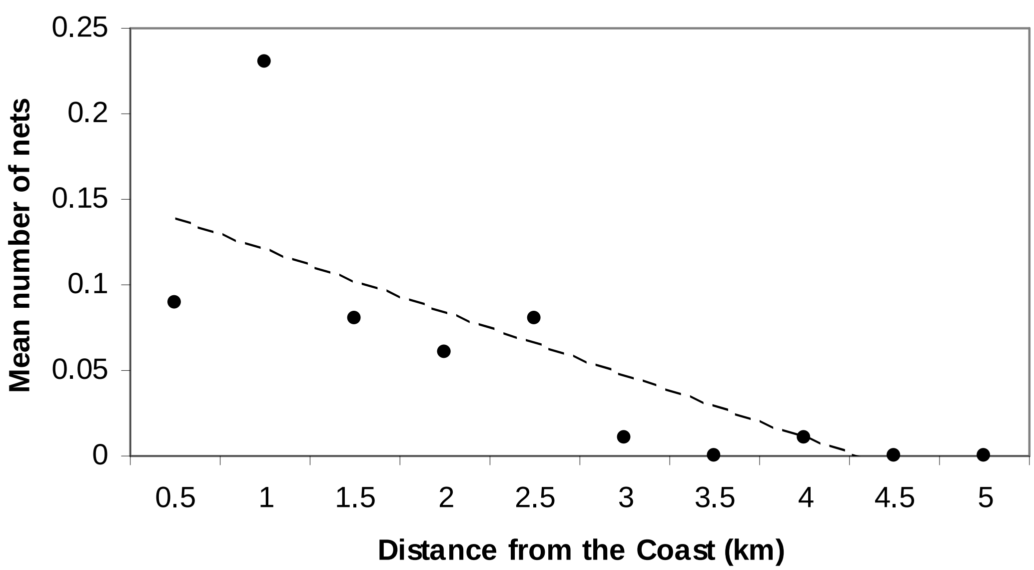


Figure 21. Mean number of gillnets on each class of distance from the coast.

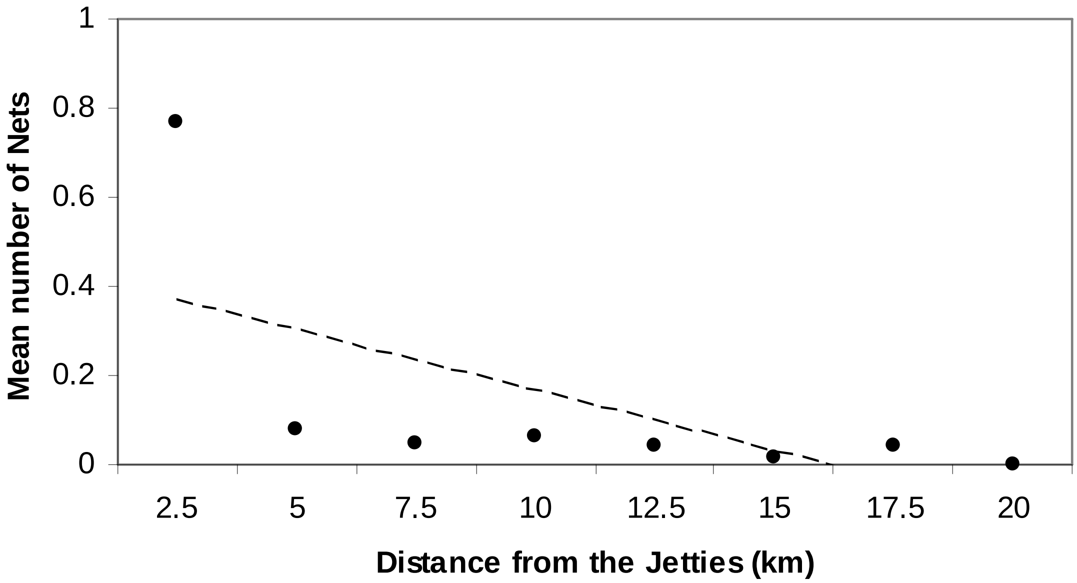


Figure 22. Mean number of gillnets on each class of distance from the jetties.

Overlap between artisanal gillnet fishing and bottlenose dolphins

Eventhough the Spearman correlation was not significant ($p>0.05$) when tested between mean number of dolphins and nets for each subarea and period (Figures 23 and 24), an overlap was observed on the distribution of dolphins and gillnets. In the estuary, both areas (close and distant from the mouth) are used for fishing, while the dolphins seem to prefer the area close to the estuary mouth. In the coastal areas, dolphins use areas closer to the coastline (most sightings were made up to 1km from shore) than the fisheries (distributed mostly up to 2.5km from shore). When distance from the jetties is considered, artisanal fisheries tend to occur closer (up to 5km to the jetties) than the dolphins.

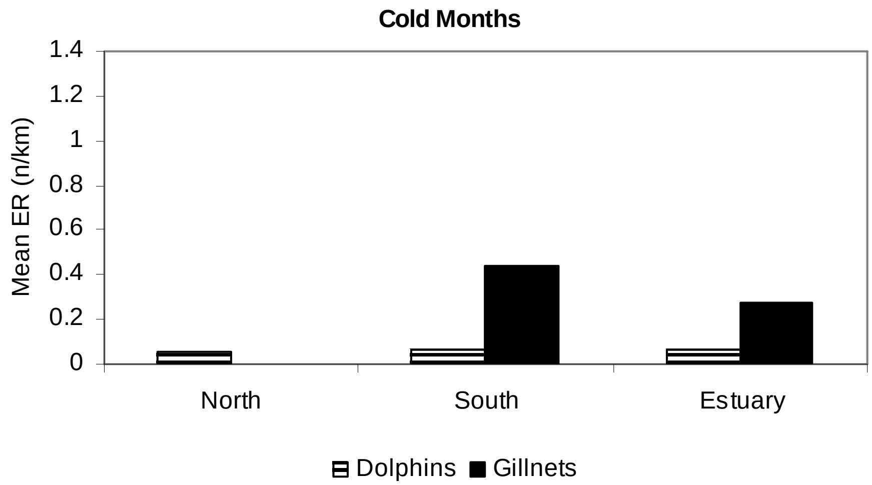


Figure 23. Mean ER of dolphins and gillnets in each sub-area during cold months.

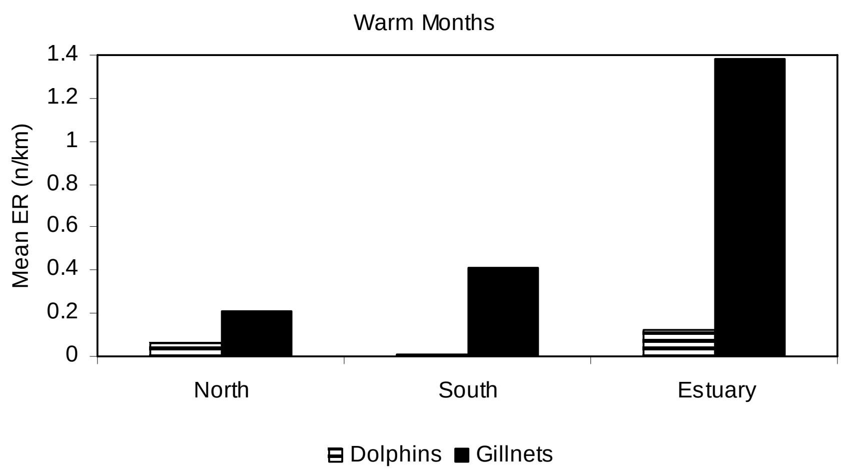


Figure 24. Mean ER of dolphins and gillnets in each sub-area during warm months.

CONCLUSIONS

- The Patos Lagoon bottlenose dolphin population has a seasonal reproduction period;
- Feeding was the predominant behavior during the study period;
- The dolphin encounter rates (ER) were not significantly different among the three sub-areas;
- ER was higher in areas close to than distant from the estuary mouth in both warm and cold periods;
- Dolphins tend to concentrate in deep waters when inside the estuary;
- In coastal adjacent areas, dolphins are found mostly within 1km from the coastline;
- Temperature, salinity and transparency variables do not directly affect dolphin’s distribution;
- Artisanal gillnets are set mainly in areas up to 2.5km from the coastline and 10km from the jetties on the adjacent coastal area;
- Inside the estuary, both areas (close to and distant from the mouth) are used for the fishing activities, whereas the dolphins concentrate close to the estuary mouth;
- In coastal areas dolphins are rarely seen beyond 1km from shore and ER decreases with distance from the estuary whereas the fishing nets are set up to 2.5km and mostly up to 5km from the jetties.

RECOMMENDATION

If the number of dolphins annually killed due to interactions with fisheries is proved to be unsustainable (as suggested in Fruet *et al.*,2005), we recommend banning gillnet fishing operations on the following areas (Figure 22):

- *inside the estuary*: area close to the estuary mouth;
- *north and south adjacent coastal areas*: up to 1km from the coastline. Although our study area was restricted to approximately 20km from the jetties, it is likely that bottlenose dolphin distribution pattern remains similar beyond the surveyed area. Possible local variation along the coast, however, cannot be discarded. Therefore, before proposing an extension of the area closure, further studies on bottlenose dolphin distribution along the coast are highly recommended..

This protected area should not affect much the artisanal fisheries as more than 50% of the areas normally used will remain available. Potential bycatch of other non-target and endangered species however, should be considered.

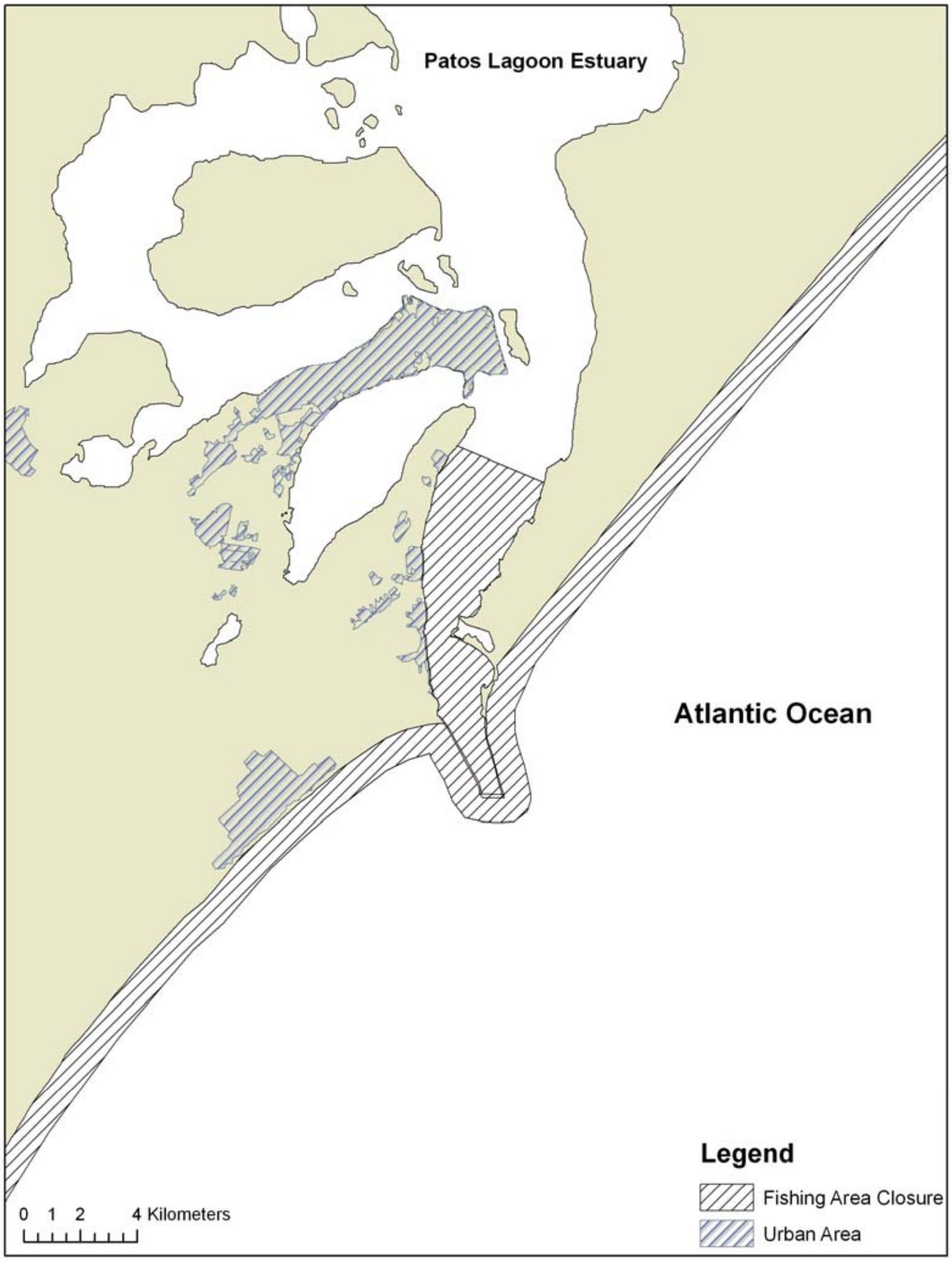


Figure 25. Proposed area for banning gillnet fishing.

REFERENCES

ABREU, P.C. & CASTELLO, J.P., 1998. Interações entre os Ambientes Estuarino e Marinho. *Os Ecossistemas Costeiro e Marinho do Extremo Sul do Brasil,* eds U. Seeliger, C. Odebrecht & J.P. Castello, pp 199 - 203.

ALVES-JÚNIOR, T.T., ÁVILA, F.J.C., DE OLIVEIRA, J.A., FURTADO-NETO, M.A.A. & MONTEIRO-NETO, C. 1996. Registros de cetáceos para o litoral do estado do Cear·, Brasil. *Arquivos de Ciências Marinhas*, Fortaleza, 30(1-2): 70-83.

BALANCE, L.T. 1990. Residence patterns, group organization and surfacing associations of bottlenose dolphins in Kino Bay, Gulf of California, Mexico. *The Bottlenose Dolphin*, eds S. Leatherwood & R R Reeves, pp 267 – 283.

BASTIDA, R., RODRÍGUEZ, D., SECCHI, E. R. & DA SILVA, V. (2007). *Mamíferos acuáticos de Sudamerica y Antartida*. Vazquez Mazzini Editores. Buenos Aires. 366pp.

BONILHA, L., & M. ASMUS. 1994. Modelo ecológico do fitoplâncton e zooplâncton do estuário da Lagoa dos Patos, RS. *Academia de Ciências do Estado de São Paulo* 87(1):347–362.

BUCKLAND, S.T., ANDERSON, D.R., BURNHAM, K.P., LAAKE, J.L., BORCHERS, D.L. & THOMAS, L. 2001. Introduction to distance sampling. Oxford University Press, Oxford.

CLEMENT, D.M. 2005. Distribution of hector¥s dolphin (*Cephalorhynchus hectori*) in relation to oceanografic features. Dissertation of Doctor of Philosophy. University of Otago, Dunedin, New Zealand. 269pp.

DALLA ROSA, L. 1999. Estimativa do tamanho da população de botos, *Tursiops truncatus*, do estuário da Lagoa dos Patos, RS, a partir da foto-identificaõ de indivíduos com marcas naturais e da aplicação de modelos de marcação-recaptura. *Masters Thesis*. Fundação Universidade Federal do Rio Grande.

DAWSON, S.M. & SLOOTEN, E. 1993. Conservation of Hector´s dolphins: The case and process which led to the establishment of the Banks Peninsula Marine Mammal Sactuary. *Aquatic Cons.* 3: 207 – 221.

FRUET, P. F., SILVA, K. G., SECCHI E. R., MENEZES, R. B., DI TULLIO, J. C., MONTEIRO, D. S., MEHSEN, M. & ESTIMA S. C. 2005. Temporal trend in the bycatch of botllenose dolphins, *Tursiops truncatus*, from a small resident population in southern Brazil. Paper *SC/57/SM8 presented to IWC meeting*. Ulsan, South Korea, May/June, 2005.

FRUET, P.F., DI TULLIO, J.C., SECCHI, E.R., & KINAS, P.G. 2007. Life history aspects of a small resident population of bottlenose dolphins, Tursiops truncatus, inhabiting the Patos Lagoon estuary, southern Brazil. XVII *Biennial Conference on the Biology of Marine Mammals*. Cape Town. África do Sul.

GARCIA, C.A.E. 1998. O ambiente e a Biota do estuário da Lagoa dos Patos: caracterÌsticas hidrográficas. *Os Ecossistemas Costeiro e Marinho do Extremo Sul do Brasil*, eds U. Seeliger, C. Odebrecht & J.P. Castello, pp 18 – 20.

HAIMOVICI, M., VASCONCELLOS, M., KALIKOSKI, D.C., ABDALAH, P., CASTELLO, J.P. & HELLEBRANDT, D. 2006. Diagnóstico da pesca no litoral do estado do Rio Grande do Sul. Pages 157-180. *In:* Isaac V.J., Martins, A.S., Haimovici, M., Andriguetto Filho, J.M. (Eds). *A Pesca Marinha e Estuarina do Brasil no iníÌcio do século XXI: Recursos, tecnologias, aspectos socioeconômicos e institucionais*. Editora Universitária.

HASTIE, G.D., BARTON, T.R., GRELLIER, K., HAMMOND, P.S., SWIFT, R.J., THOMPSON, P.M., WILSON, B. 2003. Distribution of small cetaceans within a candidate Special Area of Conservation; implications for management. *J.Cetacean Res. Manage*, 5(3):261 – 266.

HASTIE, G.D., WILSON, B., WILSON, L.J., PARSONS, K.M. & THOMPSON, P.M. 2004. Functional mechanisms underlying cetacean distribution patterns: hotspots for bottlenose dolphins are linked to foraging. *Marine Biology*. 144: 397-403.

HASTIE, G.D., SWIFT, R.J., SLESSER, G., THOMPSON, P.M. & TURRELL, W.R. 2005 Environmental models for predicting oceanic dolphin habitat in the northeast Atlantic. *ICES Journal of Marine Science* 62, 760-770.

HOYT, E., 2005. Marine Protected Areas for Whales, Dolphins and Porpoises: A World Handbook, Earthscan. 384pp.

INGRAM, S.N. & ROGAN, E. 2002. Identifying critical areas and habitat preferences of bottlenose dolphins *Tursiops truncatus*. *Marine Ecology Progress Series* 224: 247-255.

KENNEY, R. D. 1990. Bottlenose dolphins off northeastern United States. Pages 369-386 in Leatherwood, S. and Reeves, R.R. (Eds). *The bottlenose dolphin.* Academic Press, San Diego, CA.

MATTOS, P. H. 2003. Ecologia comportamental e distribuição do boto, *Tursiops truncatus*, no estuário da Lagoa dos Patos, RS, Brasil. *Monography*. Fundação Universidade Federal do Rio Grande, Rio Grande, RS, Brasil.

MOLLER, L. M. 1993. Observações sobre o comportamento e a ecologia do boto *Tursiops truncatus* no estuário da Lagoa dos Patos, RS, Brasil. *Monography*. Fundação Universidade Federal do Rio Grande, Rio Grande, RS, Brasil.

NIENCHESKI, L.F. & BAUMGARTEN, M.G. 1998. Química Ambiental. *Os Ecossistemas Costeiro e Marinho do Extremo Sul do Brasil*, eds U. Seeliger, C. Odebrecht & J.P. Castello, pp 21 – 25.

PARRA, G.J., CORKERON, P.J. & MARSH, H. 2006. Population sizes, site fidelity and residence patterns of australian snubfin and ind-pacific humpback dolphins:

implications for conservation. *Biological Conservation* 129: 167-180.

REIS, E.G., VIEIRA, P.C., DUARTE, V.S. 1994. Pesca artesanal de teleósteos no estuário da Lagoa dos Patos e costa do Rio Grande do Sul. *Atântica*. 16:69-86.

RIBEIRO, S., VIDDI, A.F., CORDEIRO, J.L., FREITAS, T.R.O. 2007. Fine scale habitat selection of Chilean dolphins (*Cephalorhynchus eutropia*): interactions with aquaculture activities in southern ChiloÈ Island, Chile. *J. Mar. Biol. Ass. U.K.*, 87, 119–128.

SEELIGER, U., CORDAZZO, C. & BARCELLOS, L. 2004. Areias do albardão: um guia ecológico ilustrado do litoral no extremo sul do Brasil. *Econscientia.* (Eds).

SHANE, S.H., 1990. Behaviour ecology of the bottlenose dolphin at Sanibel island, Florida. *The Bottlenose Dolphin,* eds S. Leatherwood & R R Reeves, pp 245 – 265.

SIMÕES-LOPES, P. C. 1995. Ecologia comportamental do delfim, *Tursiops truncatus* (Montagu, 1821), durante as interaÁ_es com a pesca artesanal de tainhas (Mugil spp) no Sul do Brasil. Phd Thesis. Pontificia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brasil.

THAYER, V.G., READ, A.J., FRIEDLAENDER, A.S. COLBY, D.R., HOHN, A.A., MCLELLAN, W.A., PABST, D.A., DEAROLF, J.L., BOWLES, N.I., RUSSEL, J.R. & RITTMASTER, K.A. 2003. Reproductive seasonality of western Atlantic bottlenose dolphins of North Carolina, U.S.A. *Marine Mammal Science*, 19(4):617-629.

WOOD, C.J. 1998. Movement of bottlenose dolphins around the south-west coast of Britain. *J. Zool., Lond*, 246, 155-163.

FINANCIAL REPORT

The table below represents the amount received and spended.

Materials	Amount Received	Amount Received (local money)	Amount Spended
1- Fuel	£ 3225.6	12026.17	8398.87
2- Motor oil	£ 76.80	286.3374	286.34
3- Batteries	£ 12.84	47.87204	47.87
4- Food	£ 384	1431.687	981.15
5- Boat pilot	£ 672	2505.452	1774.76
6- Boat maintenance	£ 200	745.6704	745.67
7- Water sampler field kit	£ 264.89	987.6031	0.00
8-Depth and temperature recorder	£ 40.4	150.6254	0.00
9- Mac Book Pro	£ 0	0	5940.00
Total	£ **4876.53**	R$ 18181.42	18174.67