IMPROVING THE COMPARATIVE DISTRIBUTION PICTURE FOR RISSO'S DOLPHIN AND LONG-FINNED PILOT WHALE IN THE MEDITERRANEAN SEA

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INTRODUCTION Risso's dolphins (*Grampus griseus)* and long-finned pilot whales (*Globicephala melas)* are two mainly teutophageous delphinids in the Mediterranean Sea. Nowhere abundant, *Grampus griseus* is present all year round, off French continental coasts (Gannier, 1999; Bompar, 1997), whereas *Globicephala melas* is a migratory species. Pilot whales movement between regions is probably very seasonal : south to north in spring and north to south in autumn. Therefore, from July to November, they are mainly seen in the Ligurian-Provencal basin, from where they are absent during winter (Gannier, 1998).
The distribution of delphinids is usually described using the "distance to the coastline" (Dcoast) and "bottom depth" variables. So, we tried to improve their comparative distribution picture by using the "distance to the 200m isobath" (D200).

MATERIAL AND METHODS Data have been collected in GREC database, from small boat dedicated surveys, during summer, from 1989 to 2000. Surveys were conducted in the whole Mediterranean sea with a more important effort in the western basin. Boat moved on random linear tracks, either on pre-determined or weather-dependent routes. Three to four observers shared a 180° sector in front of the boat. Once cetaceans were detected, the position of the vessel and relative position of animals were recorded. Binoculars were used to confirm species identification and, from 1994 onwards, the distance and the bearing of the animals from the vessel. Sixty sightings of Risso's dolphins and 38 of long-finned pilot whales were used for the study.
The distance to the coastline "Dcoast" and distance to the 200m isobath "D200" variables were calculated using Oedipe GIS (Massé and Cadiou, 1994). Dcoast corresponded to the shortest distance to the coastline and D200 to the shortest distance to the 200m isobath. Histograms of sighting frequencies were done for both species in order to compare the distribution picture given by each variable. Then, both variables were also compared using Levene's statistical test of homogeneity of variance after Kolmogorov-Smirnov's test showed that both distributions were not normal.

RESULTS For Risso's dolphins, average Dcoast was 28.9km (SE=4.19) with a range of 0.7 to 147km (CV=14.5%). Risso's dolphins distribution was bimodal and dissymmetrical: 86 % of sightings were done within 40km from the coastline (Fig. 1). Also, the maximum frequency (21.7 %) was obtained in the 5-10km interval, then decreasing gradually. Then, a secondary mode was found with 4 isolated sightings, located at a distance of more than 110km from the shore. Risso's dolphins had a very wide distribution: they were seen in western and eastern Mediterranean, in northern as well as southern areas (Fig 3).
The average of D200 was 20.4km (SE=3.93; CV=19.2%). This was also a bimodal distribution (Fig. 2). In the first mode, most of the sightings were grouped close to the 200m isobath: over 82% of sightings were within 30km from this isobath. Moreover, a maximum frequency of 31.7% was located in the 0-5km interval. Unlike the previous distribution picture obtained with the Dcoast variable, this maximum frequency formed a peak of abundance in the Risso's dolphins distribution, showing that this species had an affinity for the continental slope. But four isolated sightings secondary mode were still present far from the 200m isobath. This secondary mode was in itself causing an increase of variance. Removing those 4 isolated sightings, Levene's test showed that variances for the Dcoast and D200 variables were significantly different ($p = 0.012$).

Dcoast : variance = 323.64; mean =21.70km
D200 : variance = 158.26; mean = 13.08km

Variance for D200 was significantly lower than for Dcoast, when the secondary mode of isolated sightings was discarded. Risso's dolphins distribution was better described by "distance to the 200m isobath" variable.

For long-finned pilot whales, average Dcoast was 40.8km (SE=4.16) with a range of 3.3 to 149 km (CV = 10.2%). Unlike Risso's dolphins, long-finned pilot whales distribution picture was unimodal (Fig 4). Sightings were located further from the coastline than Risso's dolphins ones: 68.5 % were in the 20-50km interval. Also a peak of 34.2 % of sightings appeared for the 30-40 km interval. Most sightings were also obtained in two areas of the western basin (Liguro-Provençal and Alboran region) (Fig. 6). The distribution of long-finned pilot whales was well described using the Dcoast variable.
The average of D200 was 32.5km (SE=4.19; CV=12.9%). Using the D200 variable, the distribution picture of long-finned pilot whale was similar to using Dcoast (Fig. 4 and 5). 73.7 % of sightings were done in the 10-40 km interval and a peak of frequency (36.8 %) was present in the 20-30 km interval. The distribution did not appear visually to be better described by the new variable. Levene's Test on homogeneity of variance is not significant (p=0.914).
Dcoast : variance = 647.40; mean = 40.8km
D200 : variance = 683.85; mean = 32.5km
Hence, the "distance to the 200m isobath" was not a better descriptor than the Dcoast variable for the long-finned pilot whales distribution.

DISCUSSION D200 variable gave a better image of Risso's dolphins summer distribution, showing it is highly linked to the shelf break; several authors showed *Grampus griseus* had a clear affinity for the continental slope (Fabbri *and al*., 1992; Gannier A. and Gannier O., 1994; Di Méglio *and al.*, 1999). This affinity may be explained by their diet, known to be composed of various species of cephalopods including benthic ones (Würtz *et al*, 1992), which are abundant on the continental slope. Also, we saw that Risso's dolphins may be travelling during all seasons, a nomad strategy of feeding (Casacci and Gannier, 2000). Although they stay most of the time along the continental slope for feeding, they may travel long distance over the Mediterranean Sea (Fig. 3). This strategy of moving is well adapted to a feeding resource present everywhere but nowhere abundant in permanence. The fact that a secondary distribution mode had to be discarded from our analysis showed however that Risso's dolphin ecology is more complex than usually thought, as also illustrated by new seasonal distribution results (Laran *et al*. 2002, this volume).
Although the D200 variable appears not to give a better image of the long-finned pilot whales distribution, it has permitted us to underline their affinity for both deep slope and open water (Gannier, 1998). Pilot whales move seasonally from a large area to another one. They don't have a widespread distribution like Risso's dolphins. In summer, long-finned pilot whales are mainly located off the Liguro-Provencal coasts (Fig 6), where the continental shelf is narrow, and Alboran Sea (Cañadas and Sagarminaga, 2000). Their distribution in precise regions might be explained by their diet, probably less diversified than Risso's dolphins one (Orsi Relini and Garibaldi, 1992) and linked to areas of higher primary production.

CONCLUSION With this study we improved the distribution picture of Risso's dolphins by using the distance to the 200m isobath variable. The major advantage of this variable is that it takes depth into account, allowing to compare dolphin distribution between regions with different continental shelf extents. We showed that the nomad *Grampus griseus* are mainly linked to the continental slope, whereas the migratory *Globicephala melas* show a better affinity for the deep water. This example shows that the choice of a suitable descriptor strongly influences cetacean distribution results.

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REFERENCES

BOMPAR J.M., 1997. Winter presence of Risso's dolphin, *Grampus griseus*, in the western part of the Ligurian Sanctuary. Pp. 164-166. In: *European Research on Cetaceans* - 11. Proc. 11th Ann. Conf. ECS, Straslund,

Germany, 10-12 Mar, 1997. (Eds. P. G. H. Evans, E. C. M. Parsons and S. L. Clark). European Cetacean Society, Kiel, Germany. 314 pp.

CAÑADAS A. and SAGARMINAGA R., 2000. The northeastern Alboran Sea, an important breeding and feeding ground for the long-finned pilot whale (*Globicephala melas*) in the Mediterranean Sea. *Marine Mammals Science* 16(3): 513-530.

CASACCI C. and GANNIER A., 2000. Habitat variability and site fidelity of the Risso's dolphin in the north-western Mediterranean: defining home range for a nomad. Pp. 19-22. In : *European Research on Cetaceans* - 14. Proc. 14th Ann. Conf. ECS, Cork, Ireland, 2-5 April, 2000 (P. G. H. Evans, R. Pitt-Aiken and E. Rogan). European Cetacean Society. 400pp

DI-MEGLIO N., DAVID L. and BEAUBRUN P., 1999. Spatio-temporal distribution of Risso's dolphin, *Grampus griseus* (Cuvier, 1812), in summer in the north-western Mediterranean sea. Pp. 195-200. In: *European Research on Cetaceans* - 13. Proc. 13th Ann. Conf. ECS, Valencia, Spain, 5-8 April, 1999 (Eds. P. G. H. Evans, .J. A. Raga, and J. Cruz). European Cetacean Society, Kiel, Germany. 484 pp.

FABBRI F., GIORDANO A. and LAURIANO G., 1992. A preliminary investigation into the relationship between the distribution of Risso's dolphin end depth. Pp. 146-151. In: *European Research on Cetaceans* - 6. Proc. 6th Ann. Conf. ECS, San Remo, Italy, 20-22 February, 1992. (Ed. P. G. H. Evans). European Cetacean Society, Cambridge, England. 254 pp.

GANNIER A., 1998. Variation saisonnière de l'affinité bathymétrique des Cétacés dans le bassin liguro-provençal. *Vie et milieu*, 48 (1) : 25-34.

GANNIER A. and GANNIER O., 1994. Abundance of *Grampus griseus* in the north western Mediterranean. Pp. 99-102. In: *European Research on Cetaceans* - 8. Proc. 8th Ann. Conf. ECS, Montpellier, France, 2-5 Mar, 1994. (Ed. P. G. H. Evans) European Cetacean Society, Lugano, Switzerland, 288 pp.

LARAN S., GANNIER A., and BOURREAU S., 2002. Preliminary result on seasonal variation of cetacean population in the Mediterranean sanctuary. *This volume*.

MASSE J. and CADIOU Y., 1994. *Œdipe – Manuel Utilisateur*. IFREMER, 38 p. + annexes.

ORSI RELINI L. and GARIBALDI F., 1992. Feeding of the pilot whale, *Globicephala melas*, in the Ligurian Sea : a preliminary note. Pp. 142-145. In: *European Research on Cetaceans* - 6. Proc. 6th Ann. Conf. ECS, San Remo, Italy, 20-22 February, 1992. (Ed. P. G. H. Evans). European Cetacean Society, Cambridge, England. 254 pp.

WÜRTZ M., POGGI R. and CLARKE MR., 1992. Cephalopods from the stomach of a Risso's dolphin (*Grampus griseus*) from the Mediterranean. *J. mar biol. Ass.* U.K. 72 : 861-867.

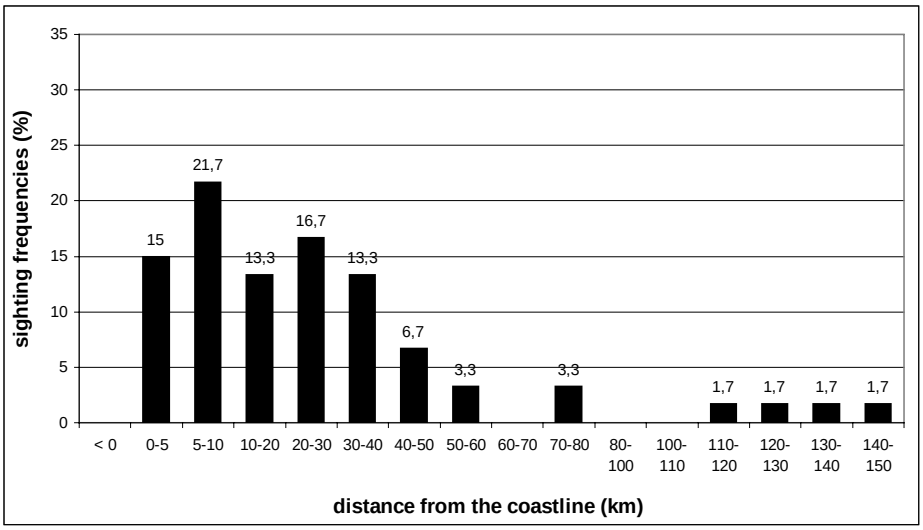


Fig. 1 : Sighting frequencies of Risso's dolphins according to the distance from the coastline.

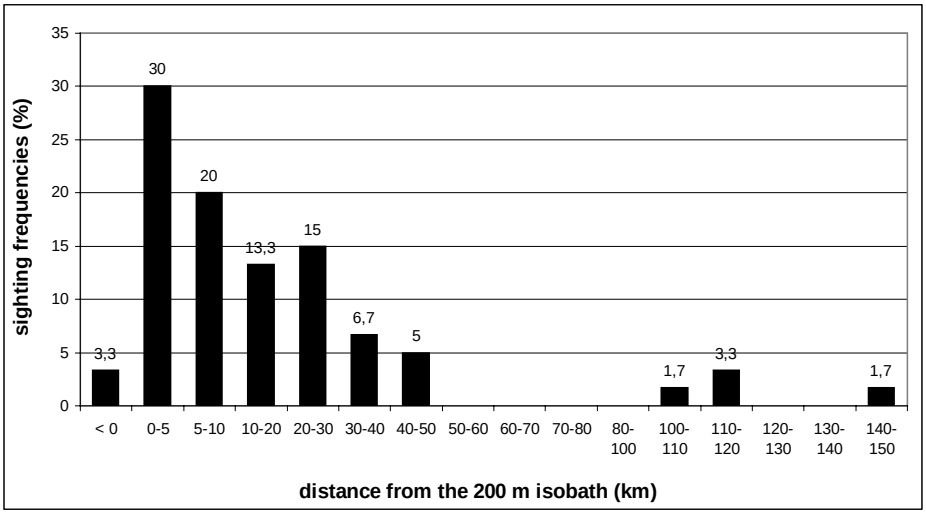


Fig. 2 : Sighting frequencies of Risso's dolphins according to the distance from the 200m isobath.

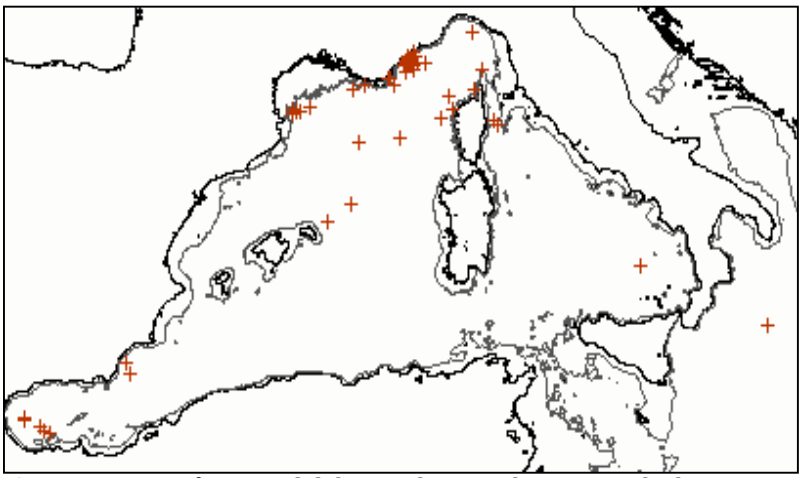


Fig 3 : Location of Risso's dolphins sightings. The 200m isobath is represented.

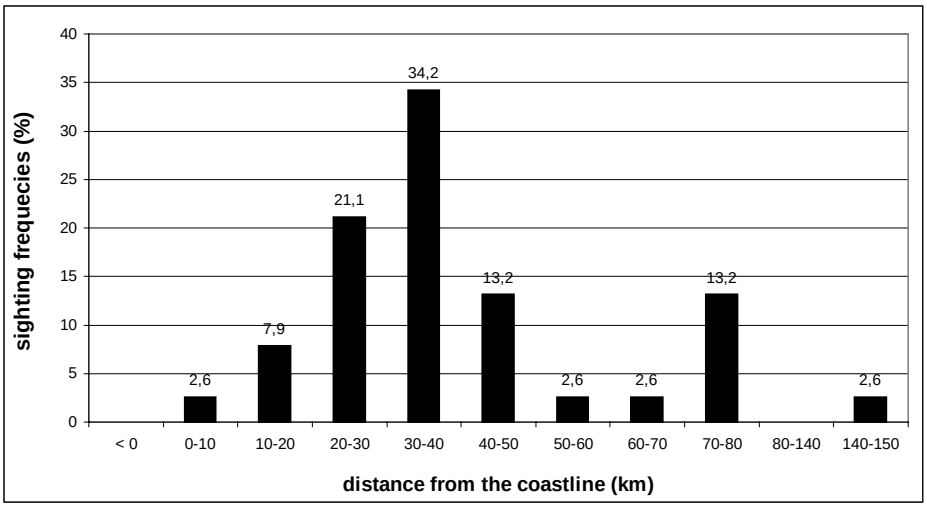


Fig. 4 : Sighting frequencies of long-finned pilot whales according to the distance from the coastline.

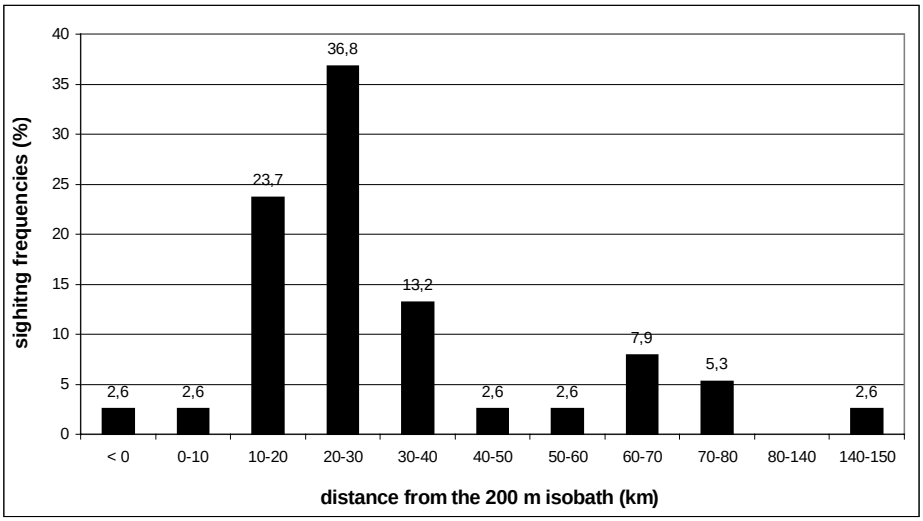
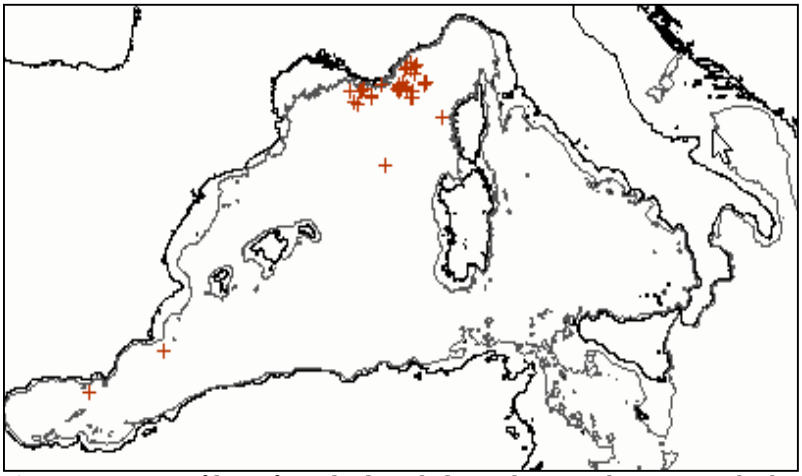


Fig. 5 : Sighting frequencies of long-finned pilot whales according to the distance from the 200m isobath.



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