POSSIBLE CORRELATION BETWEEN SEX GENDER AND LONG-TERM ASSOCIATION IN A BOTTLENOSE DOLPHIN POPULATION IN THE EASTERN LIGURIAN SEA (NORTH-WEST MEDITERRANEAN SEA)

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INTRODUCTION – The common bottlenose dolphin (*Tursiops truncatus,* Montagu, 1821) social structure is considered to be a "fission-fusion" society in which animals form and break-up associations between individuals that may be stable in time and space (Würsig and Würsig, 1977). A preliminary study by Carnabuci *et al.*. (2009) indicates Eastern Ligurian Sea (North-West Mediterranean Sea) like an interesting area where to investigate in deep individuals relationships for this species. Previous studies in Sarasota, U.S.A. (Wells *et al.*., 1987) and Shark Bay, Australia (Smolker *et al.*., 1992) stated that coastal bottlenose dolphins tend to associate closely with individuals of the same gender, but with diverse male-female association in both regions. Besides, studies in Moray Firth, Scotland (Wilson *et al.*., 1999) and Shannon Estuary, Ireland (Ingram, 2000) showed only female-calf strong associations, with little evidence of long term male associations.
The aim of this study is to investigate bottlenose dolphin social behaviour in Ligurian waters, adding sex gender as a possible association factor.

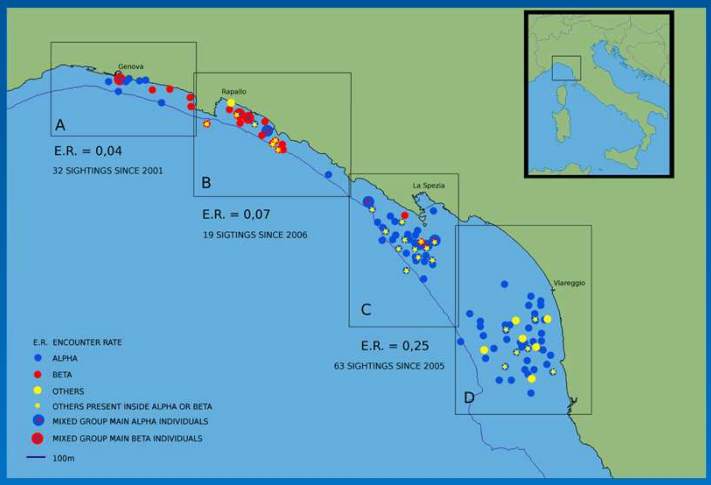

FIG. 1- Study area. Dots and stars mark sightings where at least one individual included in the study was spotted.

MATERIALS AND METHODS – Data were collected between 2001 and 2009 in the area amongst Genova (Liguria) and Viareggio (Lucca, Tuscany), performing daily surveys using a 5 meters rigid inflatable boat (Acquario di Genova) and a 13 meters sailing catamaran (CE.TU.S). Surveys were realized only when sea state was less than Beaufort 4.
The study area was divided in 4 zones: A, B and C (all in Liguria) and D (in Tuscany) (Fig 1). Photo-identification mark-recapture technique was applied to study population composition and structure. Only for animals recaptured at least 5 times by the Acquario di Genova research unit in the Ligurian waters, was calculated the Association Coefficient (CoA).
Two individuals were considered associated when found at the same time in the same sighting. For sex identification, both long-term association with calves and photographs of the animal genital region during jumps were used. For data analysis was used Socprog 2.4 by Whitehead (2009). CoA was calculated using Half Weight Index (HWI), according to Cairns and Schwagger (1987) for this kind of studies and an association matrix was created. In order to investigate if the association between individuals were not random, the matrix was permuted 20.000 times, as suggested by Manly (1995) and Bejder *et al.*. (1998). The results were visualized with a cluster using the average-linkage method. In order to investigate spatial behaviour, a comparison between Acquario di Genova and CE.TU.S. catalogues was performed and sightings of the animals recaptured 5 or more times were plotted with GRASS GIS.

RESULTS – 622 surveys were carried out in zones A, B and C. Over 244 individuals, 46 resulted captured at least 5 times and were used to calculate the CoA. Encounter Rate (E.R.) was calculated as N/T, with N = number of sightings and T = time on-effort – time observing the animals (in hours). The higher E.R. is 0.25 (C zone).
Cluster analysis reveals two groups can be clearly distinguished: Alpha (Blue) and Beta (Red) (Fig. 2). Both groups have a clear temporal and spatial separation (Fig. 1). 3 individuals (Yellow) seem to wander between Alpha and Beta. Alpha consists of 21 individuals. This group is less cohesive than Beta with an average CoA of 0.51; the dyad with the higher index (25-53) has a CoA = 0.77. Beta is constituted by 22 animals and presents a stronger average CoA than Alpha (0.80), with a CoA > 0.8 for 11 animals. Beta is more present in A and B with only 7 individuals sighted in C and none in D.
When sighted in A and B, groups with Beta individuals are generally bigger (Avg = 16.474; S.D. = 10.616) than groups with Alpha (Avg = 9.154; S.D. = 11.689). On the contrary, in C, Alpha individuals form more dynamic groups, from few animals to 20 or more; Beta individuals form smaller groups than in A and B (Fig. 3).
Applying permutation test, standard deviation of the real association matrix (S.D. = 0.23308) is significantly higher than random (SD = 0.00001). Adding sex as class variable, female-female associations show the highest difference (Tab. 1).

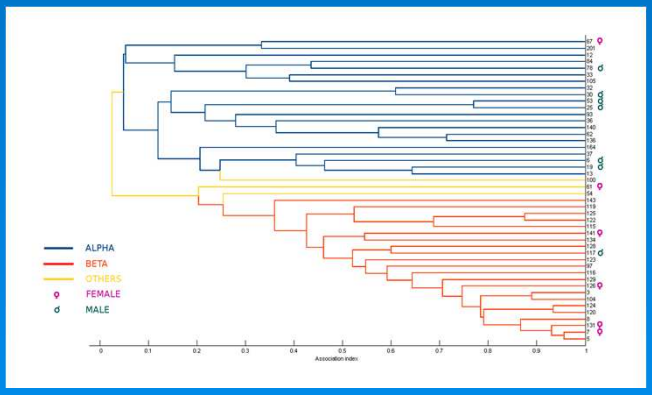

FIG 2. – Cluster analysis using HWI CoA and average-linkage method.

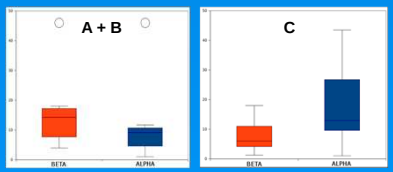

FIG 3. – Alpha and Beta groups dimensions per zones (median analysis).

	REAL S.D.	RANDOM S.D.
M-M	0,19107	0,00001
M-F	0,15772	0,00001
F-F	0,32221	0,00002

TAB. 1 – Random permutation test using sex gender as class variable.

DISCUSSION – Beta is a very cohesive group that seems to prefer zone B and secondarily zone A, but does not seem to be a resident group in the area. In fact, sightings of Beta individuals are not regular, but seem to have a certain periodicity with frequent movements inside and outside the study area (this feature could explain the high association indexes). On the contrary, Alpha seems to be resident in C and D with much more dynamic associations.
The distribution analysis per gender (considering all the animals in the catalogue) confirms a prevalence of females in zone B, while in zone C males and females are both sighted.
This apparent contradiction may be explained by figure 4. Analysing gender recaptures along time, it is possible to observe an opposite trend in B and C zones (Fig. 4): in B females are recaptured more times than males, in C it is the opposite. The higher amount of recaptures of males in C could be due to a longer resident attitude of this gender in the area. However this is not conclusive considering the low data sample.

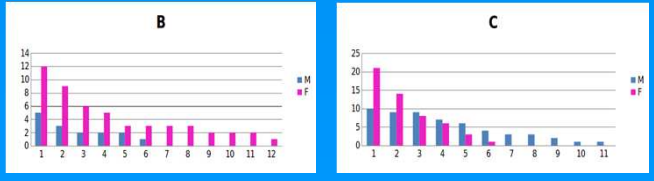

FIG. 4 – Males and females recaptures along time in zones B and C.

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