Measuring interactions between Common Bottlenose Dolphin (*Tursiops truncatus*) and artisanal fisheries in the Ligurian Sea

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INTRODUCTION – Interactions between foraging common bottlenose dolphin (*Tursiops truncatus*) and artisanal fisheries are widely reported in all Mediterranean Sea. However, it is not always clear what constitutes an "interaction" and to what extent damages to fishing nets are due depredation by dolphins. First observations carried out in the eastern Ligurian Sea are here described, both by an on board monitoring of the net conditions before and after each fishing operation and by collecting acoustics data during the night. While a passive acoustic device replaces cetacean observation from the boat, depredations are documented by specific damages observed on the net.

MATERIALS & METHODS – An ecological acoustic recorder (EAR) prototype[1], named Mod EAR, was adapted to be easily located and removed on a set net (Fig. 1). The Mod EAR was programmed to record 30 seconds every 3 minutes at 50 kHz sample rate for 12 hours, from 7 pm to 7 am, first on a trammel net and later on a gill net, following the fishermen's fishing schedule, between April and September 2010 in front of Chiavari harbour (Fig. 2). Net conditions were observed before and after every fishing operation and fishes landed during sets were identified and counted as number of individuals. Interactions have been described like rips with distinctive shape (holes with hanging strip) surely due to dolphins depredation actions, as argued by local fishermen and as observed in other areas[2] (Fig. 3). Total catches with and without depredation damages are shown as principal species mean number per fishing operation (Net features: mesh = 10, length = approx. 700 meters, high = 3 meters). Fisherman used more than 1 net per night, but only the first fishing operation could be monitored.

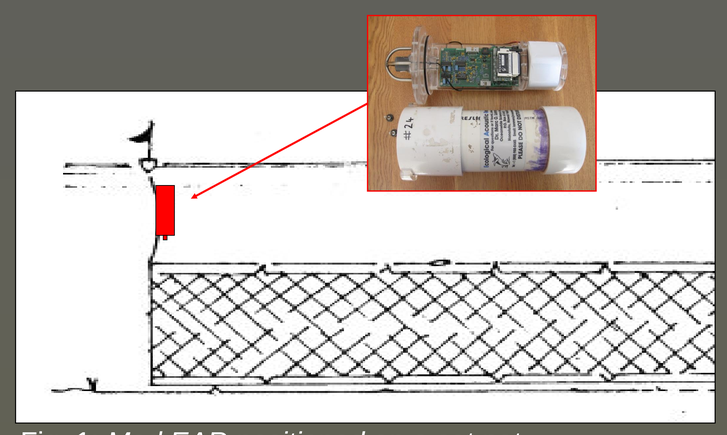

Fig. 1: *Mod EAR positioned on a set net.*

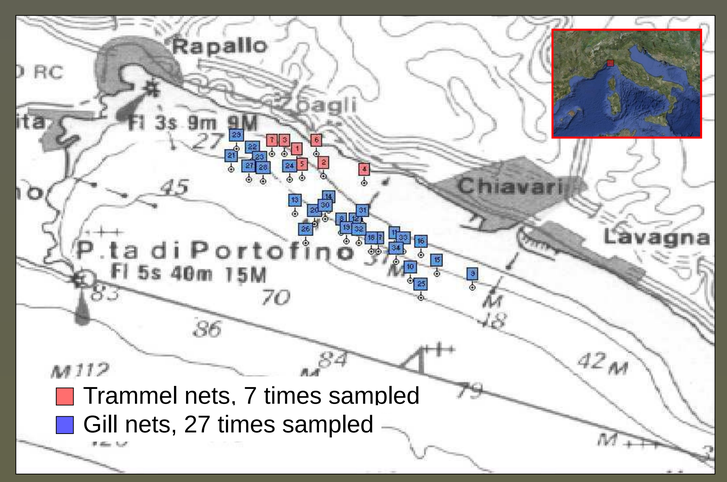

Fig. 2: *study area and set net location.*

RESULTS – 4217 different sounds were recorded and classified in 4 classes: 1) engines vessels (64% of the total amount); 2) biological sounds, but different from cetacean (28%); dolphins sounds, including all vocalization types produced by dolphins (5%) and other (3%). Between dolphins sounds, "click trains" were the most present category (64%), followed by "whistles" (19%) and "whistles and clicks" (17%). Dividing the whole time recorded per night in 3 hours intervals, dolphins seem to be more present in the first two fractions: 7.00 – 10.00 pm and 10.00 pm – 1.00 am. (Fig.4). Dolphins resulted in proximity of the nets during 21 of 34 fishing operations (Fig.5) with a 37.5 minutes mean time (5.2% of the net immersion time). Damages were found in 4 cases, marked with a red asterisk in Fig.5, corresponding to 11.8% of all fishing operations. In 3 of these 4 events, dolphin presence was recorded also acoustically (2/7, 20/7 e 17/8), whereas during the 6/5 session, there were no acoustic detections.

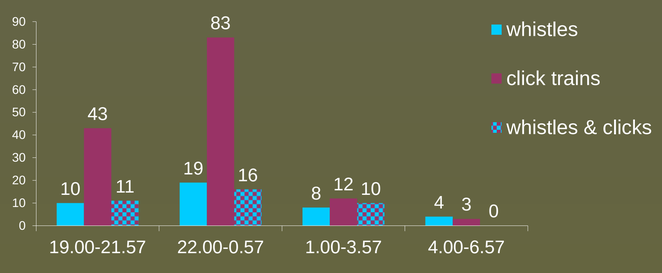

Fig. 4: *number of dolphins acoustic detections per 3 hours interval.*

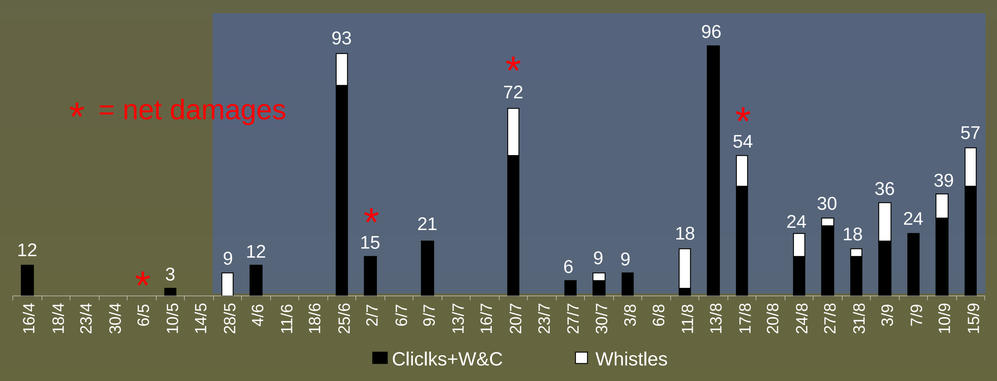

Fig. 5: *minutes of dolphins presence per fishing operation (black columns = hunting behaviour; blue bottom = fishing with gill nets).*

Fig. 3: *net damages due to dolphins depredation observed in the study area (A) compared with literature[2] (B, C).*

Considering fishing with gill nets, during 24 operations no interactions were observed, while in 3 damages appeared (Tab. 1). When damages were observed *Mullus* spp. and *A. cuculus* were missing; *M. merluccius, Diplodus* spp., *O. melanura* and *S. scombrus* appeared decreased, while *B. boops, D. labrax* and *S. aurata* appeared increased. Moreover, a mean loss of 4 individuals was observed, i.e. 14% of catch reduction.

Catches / Date	*Scomber scombrus* *	*Boops boops* *	*Mullus spp.*	*Diplodus spp.*	*Merluccius merluccius* *	*Oblada Melanura* *	*Sparus aurata* *	*Dicentrarchus labrax* *	*Aspitrigla cuculus*	Other	Tot
28/5 – 15/9	120	113	107	86	80	66	55	46	29	51	753
Mean	***5,00***	***4,71***	***4,46***	***3,58***	***3,33***	***2,75***	***2,29***	***1,92***	***1,21***	***2,13***	***31,38***
St. Dev	***7,22***	***4,53***	***6,28***	***2,92***	***2,71***	***2,49***	***1,71***	***1,41***	***2,13***	***1,75***	***-***
02/07/10	0	22	0	2	3	0	4	2	0	3	36
20/07/10	14	0	0	2	0	7	2	5	0	2	32
17/08/10	0	3	0	0	5	0	5	0	0	0	13
tot	***14***	***25***	***0***	***4***	***8***	***7***	***11***	***7***	***0***	***5***	***81***
Mean	***4,67***	***8,33***	***-***	***1,33***	***2,67***	***2,33***	***3,67***	***2,33***	***-***	***1,67***	***27***
St. Dev	***8,08***	***11,93***	***-***	***1,16***	***2,52***	***4,04***	***1,53***	***2,52***	***-***	***1,53***	***-***

Tab. 1. *Gill net: average composition of the commercial product, in absence (24 days) and presence (3 days) of dolphins interactions. Asterisks indicate fish species strictly related with bottlenose dolphin feeding habits in the area, as confirmed by studying stomach contents of killed specimens[4].*

DISCUSSION & CONCLUSIONS

Considering "interaction" when dolphins are present around a fishing net (400 meters for Lauriano *et al*., 2004)[3], seems to be a very generic criterion, however never applicable during the night. Acoustic monitoring resulted very effective and seems to lead through a better comprehension of the dolphins behavior around the nets, distinguishing between explorative and communicative sounds (Fig.5). Nevertheless, even a long dolphins presence around the nets, not always means interaction: the interaction must be noticed and measured by an on board observer. Overall, true interactions resulted less numerous than expected only if considering dolphins presence and hunting around the nets.

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