

INTERACTIONS WITH FISHERIES: MODALITIES OF OPPORTUNISTIC FEEDING FOR BOTTLENOSE DOLPHINS AT LAMPEDUSA ISLAND (ITALY)

D. S. Pace¹, M. Pulcini² and F. Triossi¹

¹Associazione OCEANOMARE, Via delle Gondole 109 – 00121 Roma, Italy (dpace@telethon.it)

²Via Vitellia 15/B, Roma, Italy

INTRODUCTION Interactions between various cetacean species and fisheries in the Mediterranean Sea are reported in some geographic areas, although most data are sparse and difficult to evaluate.

Since 1996, a population study on bottlenose dolphin (*Tursiops truncatus*) has been conducted in Lampedusa Island (Italy). One of the primary focus of the research trips in the 1997-1999 period was to monitor the interactions between a) dolphins and trawls, and b) dolphins and aquaculture facilities, in order to assess degree and nature of these relationships and eventual threats for the animals.

MATERIALS AND METHODS Boat and land-based surveys and photo-identification techniques were used to examine movements and behaviour of individuals over a three-months summer period (July-September each year, from 1996 to 2000). Land-based observations lasting three hours were made from the two island's higher places (Albero Sole, NW and Capo Grecale, NE) at fixed times, both in the morning (07:00-10:00) and in the afternoon (17:00-20:00).

Dolphins number, position, estimate behaviour and direction of movement were recorded onto data sheets. Using a 4,5 inflatable powered outboard, boat-based surveys were made trying to homogeneously cover the 4 zones we divided the area in and within 6 miles around the island. However, the northern part was rarely accessible due to the awful sea conditions. 35 mm cameras equipped with 35-80 mm, 70-210 mm and 60-300 mm lens were utilised for photo-identification purposes. Instantaneous, focal group and *ad libitum* sampling methods were used to assess dolphins' behavioural activity (Altmann, 1974; Mann, 1999), using both a videocamera and a tape voice recorder.

RESULTS A total number of 281 sightings (188 boat-based and 53 land-based) was recorded during the five-years study, 104 of them concerning the dolphins-trawls interaction and 44 in association with a submerged cage for aquaculture (Fig. 1). Bottlenose dolphins have been documented in association with trawling operations in all parts of the study area (significant prevalence in zone 2; ANOVA $F=3,8$; $gdl=3$; $p=0,04$), with a number of 86 recognizable individuals involved. The entire catalogue consists of 140 photoidentified animals. Four different behavioural phases were observed during the animals' interaction with trawls (see Fig. 2 and Tab. 1). Twenty mother-calf pairs were observed during the interactions with trawls, showing behavioural phase 1 only.

The opportunistic relationship with the coastal fish farm located at 35 m. in the NE part of the Island (near Cala Calandra) involved 40 photoidentified animals. Highly repeated behavioural sequences in relation with the fish farm were observed. Feeding fishes possibly attracted by the favourable environment in the proximity of the cage was the most frequent activity seen, followed by a milling-like behaviour, socializing, moving away, mixed behaviours and resting (see Fig. 3).

Twenty six photoidentified individuals appeared to be implicated in both kind of interactions, spending a considerable amount of time associated with trawls or cage, and decreasing natural feeding activities.

In 1999 an adult individual was found dead near the cage. The carcass' examination revealed that the animal presented evident lesions near rostrum, suggesting a possible collision with a boat. The constant bottlenose dolphins' presence near the fish farm, in fact, attracted an incredible number of tourist boats in the area, often producing dangerous conditions for the animals' safety.

CONCLUSIONS The association of bottlenose dolphins with trawls and cage indicates the behavioural plasticity of these animals to capitalize on human activities. These feeding patterns may be beneficial in that they reduce time required to forage and provides the animals with an easier way to obtain food. Engines on trawlers produce a characteristic sound when changes stages of operation, probably attracting the animals and allowing the development of peculiar behaviours for each phase. The hypotheses that this process raised high levels of efficiency in this population, as exemplify by the highly structured behavioural phases, is supported by the fact that any catch was seen or reported by fishermen during the five-years observational period.

As for the opportunistic interaction with the fish farm, mainly consisting of feeding preys in the proximity of the cage, it is important to note that the animals spend a considerable amount of time in a "milling-like" behaviour, probably being attracted to potential food that is clumped or patchy in distribution. In addition, the observation of some mother-calf pairs associated to trawling boats and fish farm suggested that bottlenose dolphins could have learned the advantages of following and feeding in conjunction with trawls as well as remaining near the cage. In

this respect, it has been speculated that the calves may learn this foraging behaviours by observation and participation.

While this study has provided a baseline data set relating to the Lampedusa Island population, it is important to maintain a scientific monitoring of bottlenose dolphins interactions with human activities in order to accumulate significant information to be used for the conservation management of the species in the coastal zones.

ACKNOWLEDGMENTS We thank Raffaella Tizzi, Marco Melodia, Marco Andreini, all the volunteers and people who participate to the logistic work, and the local fishery community. We also thank CTS-Environmental Department, Informa S.r.L. and Rimini's Dolphinarium for their grant support. Special thanks to the Italian Coast Guard.

REFERENCES

- Altmann, J. 1974. Observational study of behavior: Sampling methods. *Behaviour* 49: 227-267.
- Antonelli M., Franciosi R., Pezzi G., Querci A., Ronco G. P. & Vezzani F. 1988. Paleogeographic evolution and structural setting of the northern side of the Sicily Channel. *Mem. Soc. Geol. It.* 41: 141-157.
- Bearzi G., Notarbartolo di Sciara G. & Politi E. 1997. Social ecology of bottlenose dolphins in Kvarneric (northern Adriatic Sea). *Mar. Mamm. Sci.* 13(4): 650-668.
- Bel'kovich V.M., Agafonov A.V., Yefremenkova O.V., Kozarovitsky L.B. and Kharitonov S.P. 1991. Dolphin herd structure. In *Dolphin societies*. (K.Pryor and K.S. Norris eds.) University of California Press, pp. 17-78.
- Corkeron P.J., Bryden M.M. & Hedstrom K.E. 1990. Feeding by bottlenose dolphins in association with trawling operations in Moreton Bay, Australia. In *The Bottlenose Dolphin* (S. Leatherwood & R.R. Reeves, eds), Academic Press, San Diego, pp. 329-336.
- Fertl D. & Leatherwood S. 1998. Cetaceans interactions with trawls: a preliminary review. *J. Nortw. Atl. Fish Sci.* 22: 219-248.
- Leatherwood S. 1975. Some observations of feeding behavior of bottlenose dolphins (*Tursiops truncatus*) in the northern Gulf of Mexico and *Tursiops* (cf *T. gilli*) off southern California. *Mar. Fish. Rev.* 37(9): 10-16.
- Norris K.S. & Prescott 1961. Observations on Pacific cetaceans of Californian and Mexican waters. *Univ. Calif. Publ. Zool.* 63(4): 291-402.
- Mann J. 1999. Behavioural sampling methods for cetaceans: a review and critique. *Mar. Mammal Sci.* 15(1): 102-122.
- Pace D. S., Pulcini M. & Triossi F. 1999. *Tursiops truncatus* population at Lampedusa Island (Italy): preliminary results. In *European Research on Cetaceans*, Proc. 12th Ann. Conf. ECS, Monaco, 20-24 January 1998 (Eds. P. G. H. Evans and E.C.M. Parsons), pp 165 169.
- Pulcini M., Triossi F. & Pace D.S. 2002. Distribution, habitat use and behavior of bottlenose dolphin at Lampedusa Island: results of five-years survey. In *European Research on Cetaceans*, Proc. 15th Ann. Conf. ECS, Rome, April 2001, *in press*.
- Scott M.D., Wells R.S. & Irvine A.B. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. In *The Bottlenose Dolphin* (S. Leatherwood & R.R. Reeves, eds), Academic Press, San Diego, pp. 235-244.
- Shane S.H. 1990. Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. In *The Bottlenose Dolphin*, (S. Leatherwood & R.R. Reeves, eds), Academic Press, San Diego, pp. 245-265.
- Wells R.S. 1991. The role of long-term study in understanding the social structure of a bottlenose dolphin community. In *Dolphin societies: Discoveries and Puzzles* (K.S. Norris & K. Pryor, eds.), Berkeley: University of California Press, pp. 199-225.
- Würsig B. 1984. Aspects of the natural history of bottlenose and dusky dolphins. *Nat. Geograph. Res. Rep.* 1975: 759-769.
- Würsig B. 1986. Delphinid foraging strategies. In *Dolphin cognition and behavior: a comparative approach* (R.J. Schusterman, J.A. Thomas & F.G. Wood, eds), Lawrence Erlbaum Associates, Hillsdale and London, pp. 347-359.

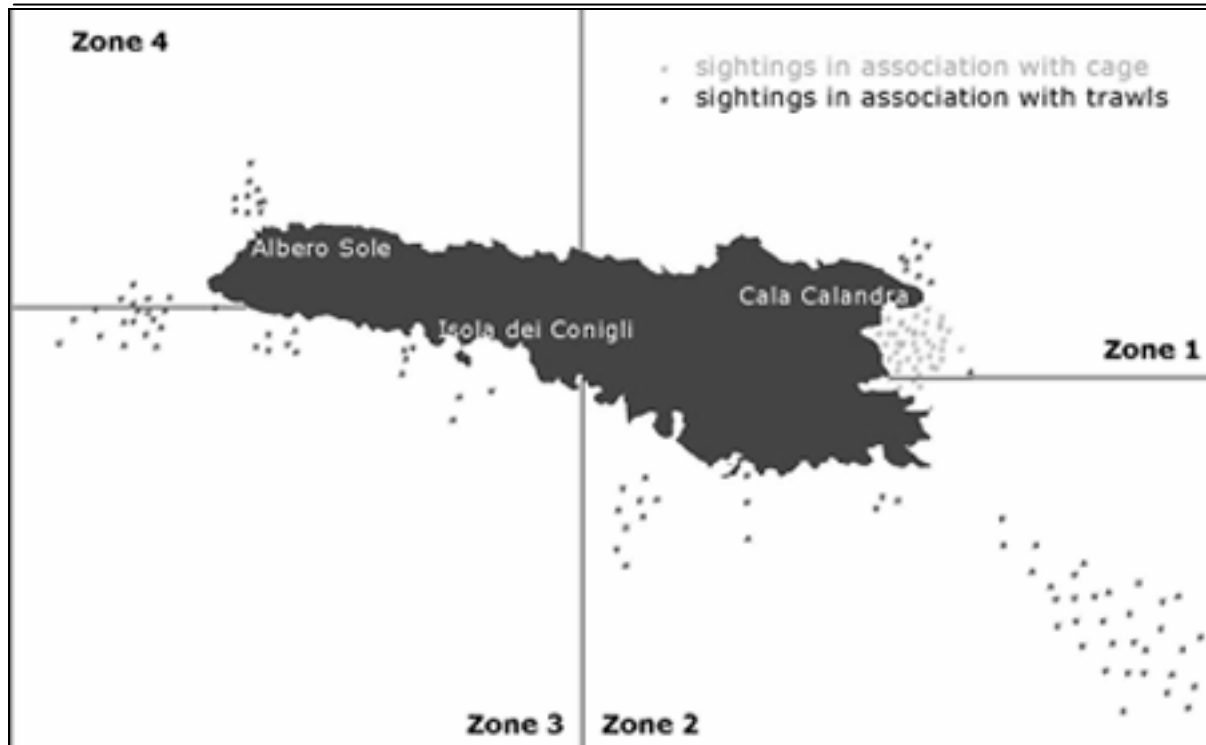


Fig. 1. Total sightings of bottlenose dolphins in association with trawls and fish farm.

Table 1. *Tursiops truncatus* behavioural phases in association with trawls

DESCRIPTION		PHASE DURATION (minutes)	RESPIRATORY PATTERN	DIVE DURATION RANGE
PHASE 1	following the trawls at a distance of 100-200 m. while the net is in	about 100	highly standardized and generally characterized by 5-6 short surfacings followed by a dive lasting about 4 minutes	2-6 minutes
PHASE 2	feeding on the net while it is hauling in, close to the boat, at a distance of less than 30 m.	about 5	quite irregular, with rapid surfacings and short dives	8-30 seconds
PHASE 3	waiting for the net withdraw and trash fish while swimming close to the boat	about 15	more regular, with surfacings every 15-30 seconds	15-30 seconds
PHASE 4	feeding of trash fish discarded at the end of a trawl	about 5	irregular, with rapid surfacings to catch the floating fishes	5-10 seconds

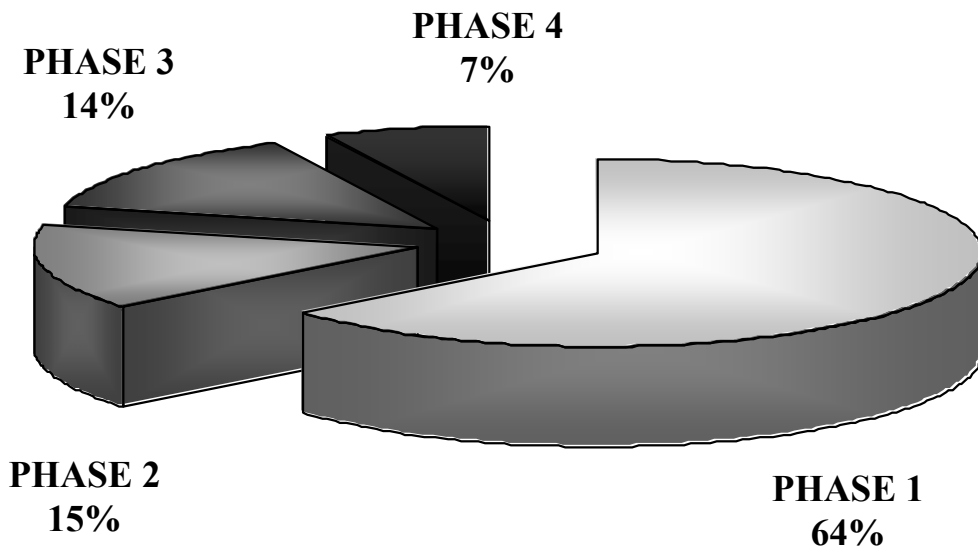


Fig. 2. Total frequency of *Tursiops truncatus* behavioural phases in association with trawls.

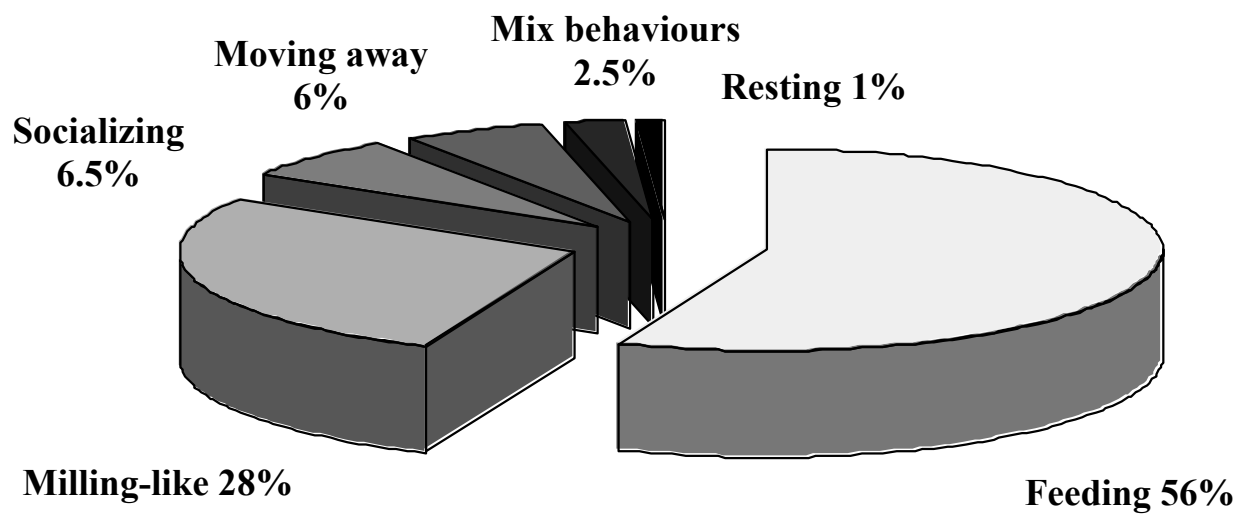


Fig. 3. Total frequency of *Tursiops truncatus* behavioural elements in association with cage