FIN WHALE (*Balaenoptera physalus*) FEEDING GROUND IN THE COASTAL WATERS OF ISCHIA (ARCHIPELAGO CAMPANO)

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INTRODUCTION: The Archipelago Campano has been the object of a long term study on cetaceans since 1991. In such area from spring to autumn, in different periods, we have recorded almost regularly seven species of cetaceans: striped dolphin, *Stenella coeruleoalba*; bottlenosed dolphin, *Tursiops truncatus*; common dolphin, *Delphinus delphis*; Risso's dolphin, *Grampus griseus*; long finned pilot whale, *Globicephala melas*; sperm whale, *Physeter macrocephalus* and fin whale, *Balaenoptera physalus* (Mussi *et al.*,1998).
The analysis of our data from previous surveys carried out in this area has pointed out how the sightings of fin whale (*Balaenoptera physalus*) are generally higher during summer months, and this is in accordance with what has been observed by other researchers working in the Italian seas (Marini *et al*., 1991-1992; Zanardelli *et al*., 1992; Notarbartolo di Sciara *et al.* 1998).With the help of local fishermen, we concentrated our efforts in the waters surrounding the island of Ischia throughout 1996.
In the two following years it was possible to ascertain the presence of a large amount of fin whales in the zone between the islands of Ischia and Procida and the mainland coast in a comparatively small area (about 35 square miles) roughly corresponding to the submarine canyon of Cuma (Pennetta *et al.* 1998). It was possible to repeatedly observe the fin whale's feeding behaviour.

METHODS: The observation and research were carried out in the following periods: 16/7/96-19/8/96; 9/7/97-31/8/98; 3/7/98-19/8/98; on board of "Barbarian", a 15 metres long sail-boat fully equipped for high-sea navigation. The routes were chosen to optimise the sights and were determined daily on the basis of previous sightings, particular attention was paid to follow the bathymetrics. No trip was performed in conditions greater than sea state 5 (Beaufort). Shots were made using automatic cameras with objectives 70]200 mm/f:1-2,8 zoom, films Kodak ektacrome 200 Asa, with exposition time inferior to 1/250. To better describe the behaviour of fin whale we have defined three different typologies of swimming speed: (rest = speed < 1 kn; slow swim = speed >1/<3 kn; fast swim = speed >3 kn). Along with weather conditions (sea and wind), also distance from the coast and depth were recorded. Shots for individual identification were made only in July 1998; the characters employed are in accordance with the methods suggested by Agler *et al*., 1990 (dorsal fin shape, chevron, scars and nicks).

RESULTS: 102 outgoing have been carried out, 1616 nautical miles have been covered for a total of 892 hours of navigation during which we recorded 66 sightings of fin whale for a total amount of 94 individuals and 52,4 hours of direct observation. In the summertime the surface water temperature varied between 26.5°C and 24.2°C with an average temperature of 25.6°C ±0.7 SD. The average depth of the sighting point was 280 m (±193.8 SD; range 25/900); the average distance from the nearest coast was 5.6Km (±3.2 SD; range 0.6/13.1). Fin whales were followed for a period that varied between 1 minute and 244 minutes (average 48 minutes, ± 61 SD). The mean group size of fin whale was 1.5, with a highest number of 6 individuals observed at once; 69% of the sightings included a single individual, in the 8% of the sightings young individuals (length below 11m. Zanardelli *et al*.,

1992) were together with adults ones; on six occasions young individuals isolated were detected. During the month of July 1998, 12 individuals were photoidentified, 2 of which detected twice.
Ten defaecation episodes occurred during the feeding activity. The analysis of faecal material, according to what had been already observed (Orsi Relini *et al*., 1992; Relini *et al*., 1992-1997), has revealed the presence of crustacean exoskeletons belonging to the euphasiacean *Meganyctiphanes norvegica*. An indirect indication of the abundance of these euphasiaceans in the area can be some records of beach strandings detected in wintertime along the coasts of Ischia (Gambi, M.C. pers. comm.).
The mesopelagic crustacean euphasiacean *M. norvegica* is a key species in the pelagic trophic web, as it is also the main food for the fin whales in the Mediterranean sea (Forcada *et al.*, 1993; Orsi Relini *et al*., 1994) and it plays an important role in the feeding of other groups of cetaceans, such as odontocetes, as the *M. norvegica* is also food for squids and fishes which are preys of these marine mammals (Orsi Relini *et al*., 1994). The analysis of faeces of a single fin whale specimen revealed the occurrence, although with a scarce frequency and abundance, of vertebrae of fish larval stages (ichtyoplankton). Although fish larvae have been probably ingested together with euphasiaceans and possibly other planktonic organisms, this finding suggests that fin whale may integrate its diet with different "accessory" trophic resources.
Space connections, as a consequence of a high concentration of shared preys or of trophic levels depending on them, have been observed with several other species (Aguilar, 1985).
Odontocetes like striped dolphins and common dolphins have been frequently observed in the area, along with a large number of some pelagic fishes as *Mobula mobular*, *Thunnus* sp. and sea birds as *Calonectris diomedea*, *Puffinus puffinus* and *Laurus ridibundus.*
Feeding has been observed on 19 occasions, always in association with circle swim with flukes and tail surfacing (Friis *et al*., 1992; Armstrong *et al*., 1998). On four occasions bubble clouds have been noticed produced by the diving animals (Martin, 1996). We have observed the fin whales quickly stir their flukes while swimming their belly upwards in order to increase water turbulence. Most of the time spent on the surface by fin whales was at sunset (Friis *et al.*, 1992),which is probably associated with the vertical nyctemerial migrations of preyed euphasiaceans (Riedl, 1991); on these occasion they were seen to emerge, with the mouth open, with vertical lunges.
The fishery resources of the area are daily exploited by 20 trawling nets, 12 bottom gill nets for *Merluccius merluccius*, 10 encircling nets for *Scombersox saurus*, 8 small mesh drift nets for Scombridae, 5 bottom long lines and one purse seine.
In 41% of feeding sightings the whales were involved in opportunistic feeding from fishermen's gears: encircling nets and trawling nets.
While interacting with encircling nets the whales used to approach the boat seine swiftly swimming around it (Martin, 1996), trying to catch the fish escaped from the net; with trawling nets, whales use to follow the trawler's wake in order to profit from the movement of the net and from the fish coming out of the net itself.
It has also been observed that the whales spent a lot of time swimming round bottom gill nets, performing long dives (<6 minutes).

CONCLUSIONS: This research has enabled us to point up a significant presence of fin whale in the coastal waters of Ischia. The specific geomorphological characteristics of the area have been described by Pennetta (1998) who explain how the continental slope results to be incised by submarine canyons, of which the deeper one is that of Cuma.
These canyons seem to be the main reason of this concentration of fin whales in such a small area (35 square miles) so close to the island.
Morphostructures as submarine canyons increase the upwelling speed: in a specific case - study, in a submarine canyon the speed value increases from about 1m/day to about 30m/day (De Pippo, T. pers. comm.)

Recent circulation models in submarine canyons indicate that upwelling phenomena are typical along the canyon axis and over the downstream wall (Hickey, 1995; Signorini et al., 1997). Submarine canyons carved in the continental slope may also act as transport conduits to the waters of the deep ocean. Great accumulations of sediments and detritus have been observed on the floor of several submarine canyons in different oceans forming a persistent set of organic and inorganic debris (Vetter, 1995).

Both phenomena, sedimentation and hydrodynamics, helps to create a special habitat characterised by a great local density and diversity of benthic and pelagic fauna exceeding that of other habitats along the continental shelf and slope(Green *et al*., 1992; Gage and Tyler, 1992; Vetter, 1995).

This production enhancement is apparently projected into the food chain down to sea bird and mammals. For example, The Gully, a 1200 m deep, 12km wide submarine canyon off the Scottish coast, is the home range of a resident population of 200-300 bottlenosed whales, *Iperodonte ampullatus* (Faucher and Whitehead, 1992).

The presence of big pelagic predator (whales, common and striped dolphins, tuna), along with the daily taking made by a remarkable quantity of commercial fisheries, suggest a big concentration of food resources.

The direct observation, the convoluted courses, the circle swim, the bubble production, the defaecation episodes point out a foraging activity on the part of fin whales.

In spite of the high percentage of isolated individuals, the concentration of fin whales in such a small area urge us to think that they keep in contact through low frequency sounds (Notarbartolo di Sciara *et al.,* 1998). The decrease in the presence of fin whales at the end of summer in the west Mediterranean has been already observed. Many questions are open about the movement of mysticetes during winter months.

We hope that future researches may define the huge importance of the role played by submarine canyons at least in distribution and abundance of trophic resources of these marine mammals, as submarine canyons are an important habitat, were a particular pelagic assemblage can be found.

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