Atti Soc. tosc. Sci. nat., Mem., Serie A, 102 (1995)
pagg. 101-104, figg. 3

G. BIANUCCI

A NEW RECORD OF BALEEN WHALE FROM THE PLIOCENE OF TUSCANY (ITALY)

Abstract - In Summer 1995 the Museo di Storia Naturale e del Territorio of the University of Pisa ran the excavation of an new cetacean fossil. This specimen has been discovered from Pliocene very shallow water deposits in a clay quarry near Empoli (Tuscany, Italy). The fossil, still partially englobed in sediment, is probably an undescribed taxon of the family Balaenidae (Mysticeti). The discovery of a pelagic whale in a shallow water environment suggests a long drifting of the carcass after death or, alternatively, the stranding of the still living animal trapped in the bay. After the decomposition of the soft tissue, the skeleton was probably disassociated and partially dispersed by currents. The quick burial prevented its complete destruction.

Key words - Cetacea, Mysticeti, Pliocene, Italy, Tuscany, Systematic, Taphonomy.

Riassunto - *Un nuovo ritrovamento di balena nel Pliocene della Toscana (Italia).* Nell'estate del 1995, il Museo di Storia Naturale e del Territorio Certosa di Calci dell'Università di Pisa, ha condotto lo scavo di un nuovo fossile di cetaceo. Tale esemplare è stato scoperto in una cava di argilla vicino a Empoli, in depositi pliocenici di acque basse. Il fossile, ancora parzialmente inglobato nel sedimento, appartiene probabilmente ad un nuovo taxon della famiglia dei Balaenidae (Mysticeti). Il ritrovamento di una balena pelagica in acque basse suggerisce un lungo trasporto dopo la morte della carcassa galleggiante o, in alternativa, lo spiaggiamento dell'animale rimasto intrappolato nella baia ancora vivo. Dopo la decomposizione delle parti molli, lo scheletro fu probabilmente dissociato e parzialmente disperso dalle correnti. Il rapido seppellimento ne impedì la completa distruzione.

Parole chiave - Cetacea, Mysticeti, Pliocene, Italia, Toscana, Sistematica, Tafonomia.

INTRODUCTION

In this paper a new cetacean fossil from Pliocene sediments of Tuscany is reported. The discovery locality is a clay quarry about five kilometres to southwestern of Empoli, near Casenuove village (Fig. 1). The fossil has been discovered by some members of the Gruppo Paleonlotologico «C. De Giuli» of Castelfiorentino. In summer 1995 the Museo di Storia Naturale e del Territorio, of the University of Pisa ran the excavation with the coordination of the Author.
The fossil, still partially englobed in the sediment, belongs to the family Balaenidae, a group of Cetacea Mysticeti today represented by the Greenland right whale *(Balaena mysticetus)* and the Black right whale *(Eubalaena glacialis).* With regard to the fossil records, although this family is reported since the lower Miocene (Cabrera, 1926), it is relatively frequent only from the late Miocene and the Pliocene. Most records are from Belgium (Van Beneden, 1880), Italy (Capellini, 1873, 1876, 1902, 1904; Pilleri, 1987; Trevisan, 1941a, 1941b) and west coast of North America (Barnes, 1976). In particular, two significant remains from Italy are the skull of *Balaena montalionis* and *Balaenula astensis,* housed in the Museum of the University of Pisa. An almost complete skeleton of Balaenidae has been recently collected from Ponte a Elsa (Pisa) (Borselli and Cozzini, 1992), not far from Casenuove.
In the same quarry, at the same stratigraphical horizon, the remains of two tapirs (Mammalia, Perissodactyla) were previously found. Dominici *et al.* (1995) described these two fossils and, on the basis of their record, referred the sediments to the lower Pliocene. These Authors carried out also a detailed facies analysis of the Casenuove outcrop and, on the basis of the sedimentary structures and molluscan assemblages, they interpreted the environment where the two tapirs were buried as an interdistributary very shallow bay.

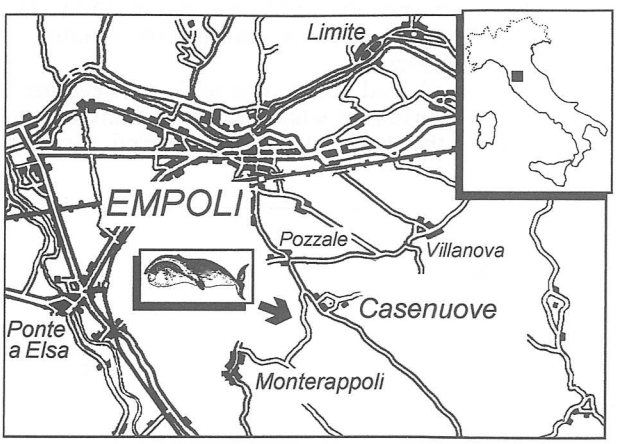

Fig. 1 - Geographical location of the fossil whale studied in this paper.

THE CETACEAN RECORD

The fossil remain is represented by a partial and disarticulated skeleton consisting of the incomplete skull, the

Dipartimento di Scienze della Terra, Università di Pisa - Via S. Maria, 53 - 56126 Pisa (Italy).

The bones of the incomplete skull are partially disassociated. They consist of the occipital, the incomplete left squamosal, the ?right maxilla, the left premaxilla and some fragmentary bones that probably represent portions of right frontal and left maxilla. On the basis of the size of the preserved skull bones and the complete right mandible, the condilobasal length of the skull is extimated to be about 280 cm.
The occipital is very damaged in its posterior part but the supraoccipital shows a well preserved anterior margin. The occipital shield is half circle-shaped, and is less antero-posteriorly elongated than in living Balaenidae. It differs from the occipital shield of the Balaenopteridae and some Cetotheriidae which is triangle or trapezoidal-shaped.
The left zygomatic process of the squamosal is almost transverse to the long axis of the skull and ventrally directed, as in other Balaenidae. Compared with the zygomatic process in the genus *Balaena,* it is less robust, while is similar than to in *Eubalaena.*
The left premaxillae is very narrow and straight distally and widens proximally, at the level of the nasal fossa. The lateral margin of this proximal portion of the premaxilla is very convex, in dorsal view.
The ?right maxilla is narrow and shows an unusually posteriorly directed lateral process.
Compared with the living Balaenidae, the left premaxilla and the ?right maxilla are not very arched, in lateral view. Nevertheless, the deformation suffered during the diagenetic process might have attenuated this character.
The complete right mandible is 264 cm long. It is relatively robust even if thins and flattens anteriorly. It shows an evident curvature, in dorsal view. As in the other Balaenidae, on the posterior portion of the mandible, the coronoid process is very reduced and the condile is postero-dorsally oriented
The half circle-shaped occipital shield, the zygomatic process of the squamosal which is almost transverse to the long axis of the skull and ventrally directed, the mandible whit very reduced coronoid process and postero-dorsally oriented condile allow the assignement to the family Balaenidae (Mysticeti).
This specimen might belong to an undescribed taxon of Balaenidae by having small anterior extension of the occipital shield and a peculiar shape of maxilla. Nevertheless, its detailed study and precise systematic assignement will be possible only after the complete restoration.

Taphonomy

As mentioned above, this partial skeleton of whale was buried in an interdistributary very shallow bay. This is not the habitat of the Balaenidae that live in the open sea. Two hypothesis can be advanced to justify its presence in this environment:
1) The whale arrived accidentally in the shallow water where it lost the orientation and was trapped in the bay. The stranding caused the death of the animal. This hypothesis is possible even if the death for stranding is relatively rare, considering the other many possible cause of death.
2) The whale died in the open sea and subsequently the carcass was transported by currents in the swallow water where it stranded. Some Authors (Allison *et al.* 1991; Martill, 1991; Shäfer, 1972; Slijper, 1962) examined the taphonomic history of whale carcasses. They observed that, even if most whale sink after death, their carcasses may be refloated by decay gas. Besides, some whales, as the right whales (closely related to the Pliocene whale here examined) float immediately after death. In both cases the carcasses are drifting for a long time before they disintegrate and sink to the sea floor. Shäfer (1972) suggested that in relatively small ocean basin, as the North Sea, the carcasses generally reach a beach before their complete destruction. Near the coast the body may refloat and drift by the tidal current before its sedimentation. A similar history might be happened to the Balaenidae of

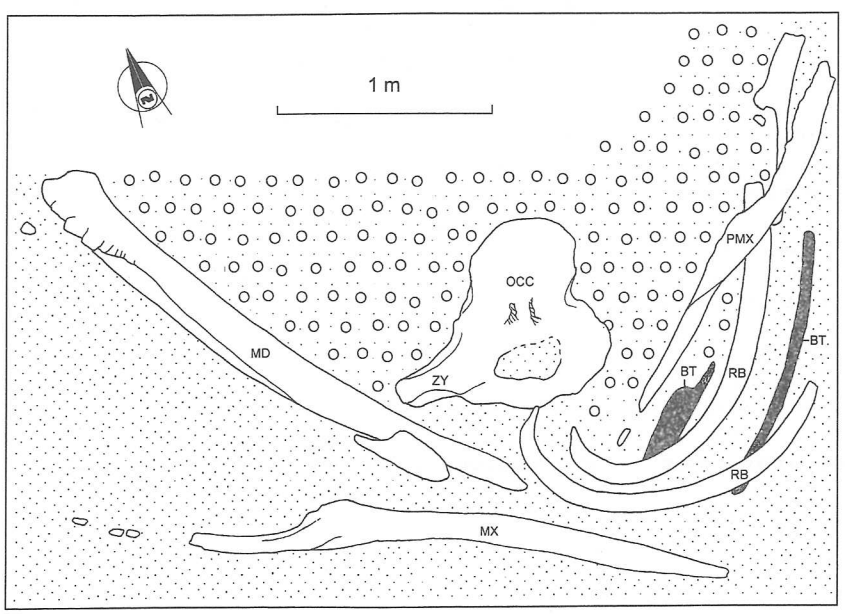

Fig. 2 - Map of disarticulated and disassociated fossil skeleton of Pliocene baleen whale. Casenuove, near Empoli (Tuscany, Italy). Area with thin dots: silts; area with dots and circles: coarse sands and bioclasts. BT = branch of tree, MD = mandible, MX = maxilla, OCC = occipital, PMX = premaxilla, RB = rib, ZY = zygomatic process of the squamosal.

Casenuove. In fact, the carcass might arrive at the coast from the open sea in a short time because the Mediterranean in the Pliocene (as today) was not a very wide basin. The Pliocene coast of Tuscany, very indented and edged with islands (Ambrosetti *et al.*, 1979), might acted as «trap» for the carcasses transported by currents.
In the shallow water the carcass here examined probably refloated, partially disarticulated and subsequently stranded in a sheltered bay. In this environment the complete decay of the soft tissue occurred and only a partial skeleton was preserved.
Finally, the shallow water currents caused the disarticulation, the disassociation and the horizontal dispersion of the bones. Probably in the meantime, a quick burial preserved the bones from the destruction.
Some bones together with two branches of a tree (that probably were trapped) are juxtaposed (Fig. 2). On the whole the bones show an apparently chaotic reorientation that is probably consequence of their different shape and their mutual obstruction. Nevertheless, two principal directions almost at right angle are observed, as generally observed in water transported bones (Behrensmeyer, 1990, 1991). These two directions are the same observed in the disposition of the remains of the two tapirs by Dominici *et al.* (1995).
It is possible that other bones of the whale were dislocated by the current relatively far from those collected. In particular, the massive vertebrae might be suffered a shorter transport from the original place of stranding of the whale.
There are coarse sands and bioclasts (molluscs and crustaceans) on one side of the whale skeleton. Among the molluscs, *Ostrea edulis, Cerastoderma edule, Conus* sp., *Potamides tricinctus, Hadriania truncatula,* and *Natica tigrina,* are relatively frequent. The crustaceans are represented by fragments of crab skeletons and barnacle shells; among the latter, several complete shells and isolated plates of *Chelonibia testudinaria* have been collected. It is possible that near the whale bones there was a carapace of marine turtle, because *Chelonibia testudinaria* today lives only on these reptiles (Zullo, 1986).
The presence of coarse sands and bioclasts just on one side of the whale skeleton may have been due to the hydraulic barrier actions of the bones. Considering the location of these deposits and the orientation of the bones, presumably the stronger current flowed southeastward.
Figure 3 summarized the possible taphonomic history of the whale. The dashed lines indicate hypothetical alternative ways. The death in shallow water or the swift transport from the open sea may have prevented the disarticulation of the skeleton before its stranding. In that case the lack of part of skeleton was only caused by the transport and dispersion of the current in the sea floor, after the decay of soft tissue.
Other taphonomic characters, such as abrasion, cracking and breakage of the bones (cf. Behresmeyer, 1991; Martill, 1991) will be examined when the fossil have will be completely cleared of the sediment.

Conclusion

The preliminary study of the fossil whale skeleton from Casenuove, still partially englobed in the sediment and no restored, allows to formulate some hypotheses concerning its systematic assignement and taphonomic history:
– The relatively large skeleton (length of skull about 280 cm) shows some distinctive characters of the family Balaenidae and, on the basis of some peculiar features, it belongs probably to a new taxon.
– The presence of this pelagic whale in shallow water deposits suggests a long drifting of the carcass from the open sea after death, or, alternatively, the stranding of the animal still living trapped in the bay.
– The disassociation and the hydraulic orientation of the preserved skeleton indicate a limited current transport after the stranding and after the complete decay of the soft tissue.
– The location of the coarse sands and bioclasts around the skeleton and the orientation of the bones indicate the presence of currents flowing mainly southeastward.
– The final dispersion of the bones was probably contemporaneous to the quick burial that preserved the remains from the destruction.

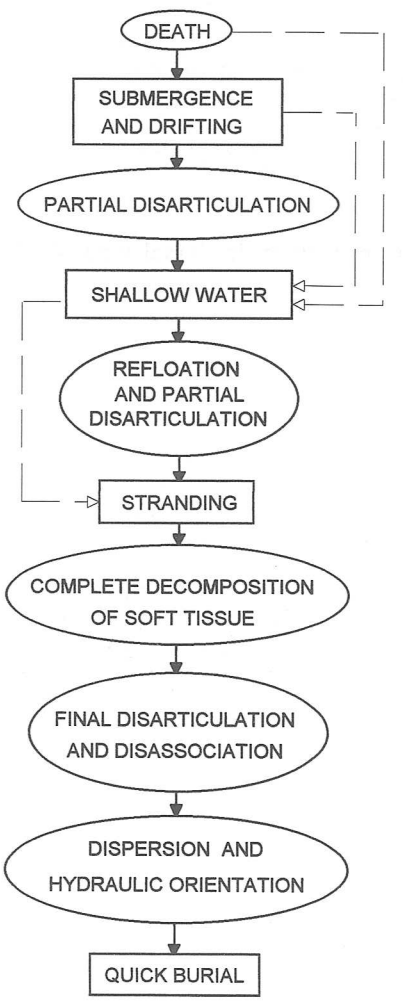

Fig. 3 - Hypothetical and schematic taphonomic history of the fossil whale. For explications see text.

ACKNOWLEDGEMENTS

Thanks are due to Prof. M. Franzini, Director of the Museo di Storia Naturale e del Territorio of the University of Pisa, who supported the collection of this fossil cetacean and gave me the permission to study it. I am grateful to Prof. W. Landini for useful critical comments on the manuscript and suggestions. I thank Dr. L. Ragaini who identified the molluscan fauna.

REFERENCES

Allison, P.A., Smith, C.R., Kukert, H., Demining, J.W. and Bennett, B.A, 1991. Deep-water taphonomy of vertebrate carcasses: a whale skeleton in the bathyal Santa Catalina Basin. Paleobiology, 17(1): 78-89.

Ambrosetti, P., Carboni, M.G., Conti, M.A., Costantini, A., Esu, D., Gandin, A., Girotti, O., Lazarotto, A., Mazanti, R., Nicosia, U., Parisi, G. and Sandrelli, F., 1979. Evoluzione paleogeografica e tettonica nei bacini tosco-umbro-laziali nel Pliocene e nel Pleistocene inferiore. Mem. Soc. Geol. it., 19: 573-580.

Barnes, L.G., 1976. Outline of eastern North Pacific fossil cetacean assemblages. Syst. Zool., 25 (4): 321-343.

Behrensmeyer, A.K., 1990. Taphonomy. Transport-hydrodynamics. Bones. In: Briggs D.E.G. and P.R. Crowther (Eds.), Palaeobiology. A synthesis. Blackwell Scientific Publications, Oxford, 232-235.

Behrensmeyer, A.K., 1991. Terrestrial Vertebrate Accumulations. In: P.A. Allison and D.E.G. Briggs (Eds.), Taphonomy. Releasing the data locked in the fossil record. Plenum Press, New York , 291-335.

Borselli, V. and Cozzini, F, 1992. Il recupero di un cetaceo fossile in località Ponte a Elsa (Pisa). Museol. sci., 8: 9-22.

Cabrera, A., 1926. Cetáceos fósiles del Museo de la Plata. Rev. Mus. La Plata, Buenos Aires, 29: 363-411.

Capellini, G., 1873. Sulla balena etrusca. Mem. R. Acc. Sci. Ist. Bologna, ser. 3, 3: 1-21, 3 pls.

Capellini, G., 1876. Sulle balene fossili toscane. Mem. R. Acc. Sci. Ist. Bologna, ser. 5, 9: 47-55.

Capellini, G., 1902. Balene fossili toscane. I. *Balaena etrusca.* Mem. R. Acc. Sci. Ist. Bologna, ser. 5, 9: 759-778.

Capellini, G., 1904. Balene fossili toscane. II. *Balaena montalionis.* Mem. R. Acc. Sci. Ist. Bologna, ser. 6, 1: 47-55, 1 pl.

Dominici, S., Rook, L., Benvenuti, M. and Abbazzi, L., 1995. Tapir remains in paralic deposits of Pliocene age in Lower Valdarno (Tuscany, Italy): facies analysis and taphonomy. Geobios, 18: 131-135.

Martill, D.M., 1991. Bones as stone: the contribution of vertebrate remains to the lithologic record. In: S.K. Donovan (Ed.), The processes of fossilization. Belhaven Press, London, 270-292.

Pilleri, G., 1987. The Cetacea of the Italian Pliocene. With a descriptive catalogue of the specimens in the Florence Museum of Paleontology. Vammalan Kirjapaino oy Vammala (Finland), 160 pp., 68 pls.

Shäfer, W., 1972. Ecology and paleoecology of marine environments. Oliver & Boyd, Edinburg, 568 pp.

Slijper, E.J., 1962, Whales. (English translations). Hutchinson & Co., London, 475 pp.

Trevisan, L., 1941a. Una nuova specie di *Balaenula* pliocenica. Palaeont. ital., 40: 1-13.

Trevisan, L., 1941b. Revisione dei resti di balene fossili del Museo geopaleontologico di Pisa. Atti Soc. tosc. Sci. nat., 49: 3-10.

Van Beneden, P.J., 1880. Description des ossement fossiles des environs d'Anvers. Part 2, Cétacés, Genres: *Balaenula, Balaena* et *Balaenotus.* Ann. Mus. R. Hist. nat. Belgique, ser. Pal., 7: 1-87.

Zullo, V.A., 1986. Quaternary barnacles from the Galápagos islands. Proc. Calf. Acad. Sci., 44 (5): 55-66.

(ms. pres. il 6 marzo 1996; ult. bozze il 20 giugno 1996)