



Middle Pleistocene gurnard (Teleostei, Triglidae) remains from the Crotone Basin, Southern Italy

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KEY WORDS - Teleostei, Triglidae, *Aspitrigla cuculus*, Pleistocene, Crotone Basin, Italy.

ABSTRACT - An incomplete neurocranium of a gurnard is described from the middle Pleistocene shoreface deposits of the San Mauro Marchesato area, in the Crotone Basin, southern Italy. The specimen is characterized by having several features that support its assignment to the extant triglid species *Aspitrigla cuculus*, including the presence of an elongate and narrow preorbital portion of the neurocranium, the structure, ornamentation, and relative development of the cranial bones, and the greatly reduced interorbital width. The material documented in this paper is the first representative of the species *A. cuculus*, and more generally of the genus *Aspitrigla*, recorded up to date as fossil. Based on its ecological requirements, the occurrence of *A. cuculus* in the Pleistocene of the San Mauro Marchesato area seems to be consistent with the results of the paleoenvironmental interpretation derived from the stratigraphic and sedimentological studies.

RIASSUNTO - [Resti di triglide (Teleostei, Triglidae) nel Pleistocene medio del Bacino di Crotone, Italia meridionale] - Viene qui illustrato un neurocranio incompleto attribuibile alla famiglia Triglidae, proveniente dai depositi di shoreface del Pleistocene medio affioranti nell'area di San Mauro Marchesato, nel Bacino di Crotone. Il reperto presenta numerosi caratteri che ne consentono l'attribuzione alla specie *Aspitrigla cuculus*, tra cui la presenza di una porzione preorbitaria del neurocranio stretta ed allungata, la morfologia, l'ornamentazione e lo sviluppo relativo delle ossa craniali, e la ridotta distanza interorbitaria. Il reperto descritto nella presente nota costituisce la prima segnalazione della specie *A. cuculus*, e più in generale del genere *Aspitrigla*, nel registro fossile. La presenza di *A. cuculus* nel Pleistocene dell'area di San Mauro Marchesato sembra essere in perfetto accordo con la recente interpretazione paleoambientale derivante da studi a carattere stratigrafico e sedimentologico.

INTRODUCTION

On a global scale, the Crotone Basin represents one of the most complete and best-developed Pleistocene marine sedimentary record observable in the outcrop (Massari et al., 2002). The development and excellent preservation of these deposits resulted from the synergistic effect of differential tectonic subsidence and high rates of sediment supply (Massari et al., 1999). Recent extremely detailed biomagneto- and litho-stratigraphic studies performed on the Pleistocene deposits outcropping in the San Mauro Marchesato area allowed a highly resolved correlation with the standard oxygen-isotope scale, providing a strong evidence of the preservation of the signature of global eustasy (Rio et al., 1996). Trace fossils, microfossils, and invertebrates are rather abundant in the exposed sequences, while the occurrence of vertebrate remains is still not documented. The purpose of this paper is to describe the first marine vertebrate from the Pleistocene deposits of the territory of San Mauro Marchesato. The vertebrate material consists of an incomplete neurocranium of a teleost fish. A detailed osteological analysis of this fossil unequivocally indicates that it is a triglid.

Triglids, commonly known as gurnards, are a moderately diverse group of marine fishes that includes ten genera with more than 70 species. These fishes are benthic on soft bottoms, occurring from coastal waters to depths of 500 m along continental and insular shelves of tropical and temperate seas. Triglids are characterized

by having free pectoral rays that are used for searching food on the substrate. The fossil record of the Triglidae is poor and scarcely informative of their evolutionary history. Otoliths attributed to this family appear to be present since the Eocene (see Patterson, 1993), although the earliest skeletal remains date back to the Lower Oligocene (see, e.g., Leriche, 1910). As far as the Mediterranean Neogene is concerned, rare articulated skeletons have been described from the Messinian diatomites of Algeria and Sicily (Arambourg, 1925; 1927; Leonardi, 1959), while otoliths are relatively common in Plio-Pleistocene deposits (see Landini & Sorbini, 2005).

GEOLOGICAL SETTING

The Calabrian arc (Fig. 1) is a composite terrane characterized by progressive southeastward displacement produced by the interplay of passive subduction of the Ionian crust and backarc extension due to asthenosphere upwelling and convection in the Tyrrhenian basin (see Van Dijk, 1994).

The Crotone Basin is a forearc basin located in the Ionian portion of the Calabrian arc (Zecchin et al., 2004). The depositional history of this basin has been characterized by a primarily extensional tectonic regime, with several compressional or transpressional phases (Van Dijk, 1991; Massari et al., 2002). The sedimentary infill of the Crotone Basin has been investigated in detail



Fig. 1 - Sketch map of Italy. The asterisk indicates the location of San Mauro Marchesato.

(e.g., Roda, 1964; Massari et al., 1999, 2002). The succession consists of Serravallian to middle Pleistocene shelf, slope and lagoonal claystones and marls, and shoreface and deltaic sandstones and conglomerates.

In the Crotona Basin, the Pleistocene tectonic phases (compression, strike-slip faulting, extension, isostatic adjustments) led to the origin of small sub-basins, one of which is located in the San Mauro Marchesato area. A well-developed, cyclothemic, upper-Lower to middle Pleistocene succession is present in this sub-basin, showing a general shallowing trend from slope mudstones to marginal marine and continental deposits. Five stratigraphic units arranged in two groups (Cutro group, San Mauro group) can be recognized in the Pleistocene succession of the San Mauro Marchesato sub-basin (Rio et al., 1996).

The San Mauro group is characterized by a wide diversity of lithotypes, ranging from outer-shelf muds to fluvial conglomerates. The whole group shows a general back-stepping to progradational vertical stacking pattern of the sedimentary cycles, probably in response to a long-term trend of regional subsidence (Massari et al., 1999).

The fossil documented herein was collected from a rich fossiliferous horizon included in the shoreface sandstones outcropping close to the village of San Mauro Marchesato. These shoreface sandstones can be assigned to the lower portion of the uppermost unit (San Mauro 3) of the San Mauro group, which is correlated to the middle Pleistocene *Pseudoemiliania lacunosa* Zone (see Massari et al., 1999, 2002). Based on a detailed correlation between the physical cycles of the whole succession and the global oxygen-isotope curve, it is possible to define the age of the fossiliferous deposits between the substage 18.3 and the stage 17, approximately between 0.70 and 0.65 Ma.

MATERIAL AND METHODS

The specimen is deposited in the Museo di Geologia e Paleontologia of the Università di Padova (IGUP), Italy. It consists of an incomplete neurocranium exposed in dorsal view (Fig. 2). The fossil is partially included in a sandstone matrix with bones that appear white. It has been examined using a Leica MS5 stereomicroscope. Measurements were taken with a dial calliper, to the nearest 0.1 mm.

SYSTEMATICS

Subdivision TELEOSTEI *sensu* Patterson & Rosen, 1977
Order PERCIFORMES *sensu* Johnson & Patterson, 1993
Family TRIGLIDAE Risso, 1926

Remarks - The Triglidae has been traditionally regarded as a member of the order Scorpaeniformes, a heterogeneous group of fishes that includes more than 1400 marine and freshwater species circumglobally distributed. Although the monophyly of this order has been questioned by many authors (see e.g., Freihofer, 1963; Quast, 1965; Greenwood et al., 1966; Eschmeyer, 1969; Johnson, 1993; Johnson & Patterson, 1993), the limits and composition of the Scorpaeniformes have remained relatively stable over the years (Gill, 1888; Matsubara, 1943; Washington et al., 1984; Shinohara, 1994; Imamura & Shinohara, 1998). Scorpaeniform taxa, as traditionally considered, share a posterior extension of the third infraorbital bone that reaches back across the preopercle, the suborbital stay, which has been interpreted as a typical scorpaeniform synapomorphy. Two additional synapomorphies, presence of a parietal lateral-line canal and presence of a swimbladder muscle have been proposed to corroborate evidence for a monophyletic scorpaeniforms (see Johnson, 1993; Shinohara, 1994), but their validity has not been convincingly demonstrated (Imamura, 1996; Imamura & Yabe, 2002). Recently, based on morphological evidence, the scorpaeniforms have been classified as a perciform suborder (Scorpaenoidei; Johnson & Patterson, 1993; Mooi & Gill, 1995), while molecular studies suggested that they are not monophyletic (Miya et al., 2001, 2003; Chen et al., 2003). Smith & Wheeler (2004) conclusively demonstrated that the scorpaeniform assemblage is widely polyphyletic. Because of this confused scenario and following the recommendations by Johnson & Patterson (1993) and Mooi & Gill (1995), the Triglidae is considered here as a perciform family, closely related to the Peristediidae, Hoplichthyidae, and Platycephalidae (see Imamura, 2004).

Genus *Aspitrigla* Fowler, 1925

Aspitrigla cuculus (Linnaeus, 1758)
(Fig. 2a-b)

Material - IGUP 29704; incomplete, partially exposed neurocranium included in a sandstone matrix.

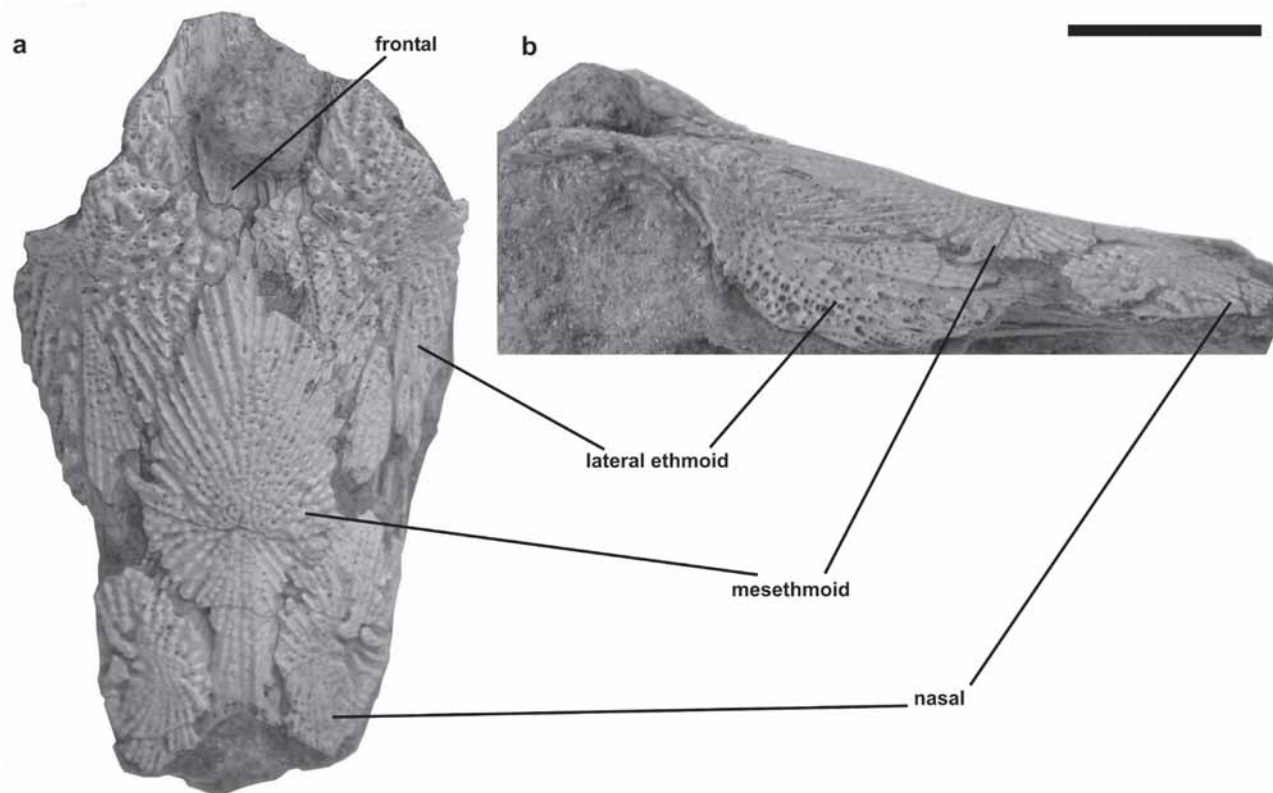


Fig. 2 - *Aspitrigla cuculus* (Linnaeus, 1758) from the Pleistocene of Croton Basin. IGUP 29704. a) Dorsal view; b) right side, lateral view. Scale bar = 10 mm.

Measurements (mm) - Maximum length of the specimen: 43.5; maximum width: 24; interorbital width: 8.9.

Description - The specimen consists of the preorbital and interorbital portions of the neurocranium (Fig. 2). The skull roof is narrow, with a straight profile. The preorbital sector is elongate and slender, its length approximately twice its width. The bones are thick and large. Their external surface is characterized by a heavy rugosity. It is ornamented with pits and minute denticles arranged in ridges that radiate from the ossification centres of the bones. These denticles are disposed at right angles to the direction of the ridges. The broad development of such an ornamentation confers a granular texture to the external surface of the skull roof. The anterior margin of the neurocranium is concave and gently arcuate. Because of the excellent preservation of the fossil, it is possible to clearly distinguish the margins and structure of the bones, among which the nasals, mesethmoid, lateral ethmoids, and a small part of the frontals can be recognized. The nasals are subrectangular in outline. The mesethmoid is very large and elongate, diamond-shaped. Its anterior process separates the two nasal bones. The lateral ethmoids are rather large. These bones do not meet in the midline, apparently separated by both the posterior tip of the mesethmoid and the anteriormost part of the frontals. The interorbital width is highly reduced, smaller than what appears to be the

orbit diameter. The interorbital region is depressed, with a central pronounced groove, which starts approximately at the level of the posterior fourth of the lateral ethmoid. Deep grooves for the lateral-sensory canal are well exposed on the nasals and lateral ethmoids.

DISCUSSION

Taxonomic placement

Although the Triglidae has been traditionally considered as a natural assemblage (Gill, 1888; Regan, 1913), the monophyletic status of this extremely derived group of fishes has been demonstrated in the last few years (Imamura, 1996, 2004). The characterization of the Triglidae proposed by Imamura (e.g., 2004) is primarily based on myological features (adductor arcus palatini situated on the medial margin of the endopterygoid; flexor ventralis externus present; intrinsic muscle present), as well as on the structure of the infraorbital bones. Therefore, the osteological features that define the family Triglidae cannot be observed on the specimen because of inadequate preservation. However, the specimen shows the salient features that unquestionably support its placement within the family Triglidae, including the structure and ornamentation of the head bones (see Allis, 1909). Fishes of the family Triglidae are characterized by a peculiar structure of the head, which appears to be entirely encased in robust and highly ornamented bony

plates. The arrangement and external texture of the neurocranial bones of IGUP 29704 fit well the condition characteristic of the triglids (Allis, 1909).

According to Miller & Richards (1991), the triglids can be separated into three basic groups, mostly based on meristic features. More recently, Richards & Jones (2002) provided a cladistic attempt to resolve the relationships among triglid genera, and recognized three tribes, Prionotini, Pterygotriglini, and Triglini. The phylogenetic analysis performed by Richards & Jones (2002) was based on several morphological characters that cannot be observed on IGUP 29704 because of its incompleteness. However, despite the inadequate preservation of the fossil material, the relative proportions of the neurocranium appear to be useful for a more detailed taxonomic assignment (see, e.g., Richards, 1968, 1997; Richards & McCosker, 1998; Richards et al., 2003). In particular, a detailed comparative study of the neurocrania of extant taxa, has revealed that the elongate and narrow snout (= preorbital portion of the neurocranium), the greatly reduced interorbital width, and the structure and relative development of the cranial bones strongly support the inclusion of the Pleistocene fossil within the range of the extant species *Aspitrigla cuculus* (see Richards, 1968), to which it is tentatively referred. The neurocranium of other triglid taxa is characterized by shorter and wider snout, a different arrangement of bones, and a larger interorbital width (see, e.g., Richards, 1968; Miller & Richards, 1991).

In his review of Eastern Atlantic and Mediterranean triglids, Richards (1968) considered *Aspitrigla* as a subgenus of *Chelidonichthys* without a comprehensive morphological definition of this genus. His use of generic and subgeneric names "...is for the sake of convenience...", and several authors have continued to recognize *Aspitrigla* at the generic level (Tortonese, 1975; Hureau, 1986). Therefore, pending a convincing systematic study of the Triglidae based on a complete anatomical analysis, it is reasonable to consider *Aspitrigla* as a valid genus. The definition of the exact composition of the genus *Aspitrigla* is rather problematic

to interpret. According to some authors (e.g., Hureau, 1986), two species, *A. cuculus* and *A. obscurus*, should be included within this genus. These two species only share similar modified lateral-line scales, but show many differences in meristic and morphological features (see Richards, 1968) that strongly support their separate generic assignment. For this reason, the genus *Aspitrigla* is considered herein as monotypic, solely represented by the species *A. cuculus* (see also Santos et al., 1997).

Concluding remarks

The gurnard *Aspitrigla cuculus* is an Eastern Atlantic species distributed from British Isles to Mauritania, including the Mediterranean, Black Sea, Azores, and Madeira (see Fig. 3). In the western Mediterranean Basin, this species is extremely common at depths between 10 and 150 m where it feeds on benthic crustaceans and small fishes (e.g., Moreno-Amich, 1992). Therefore, its occurrence in the sandstones of the uppermost unit of the San Mauro group is consistent with shoreface depositional environment defined by the stratigraphic and sedimentological studies of the exposed successions (e.g., Rio et al., 1996; Massari et al., 1999, 2002).

The specimen described herein is the first documented representative of the species *A. cuculus*, and more generally of the genus *Aspitrigla*, in the fossil record. Moreover, the record of *A. cuculus* in sediments of middle Pleistocene age from San Mauro Marchesato area extends our knowledge of the Mediterranean Pleistocene triglid diversity, which was, up to the present, only relative to two still extant species, *Chelidonichthys lucernus* and *Lepidotrigla cavillone* (see Girone et al., 2006).

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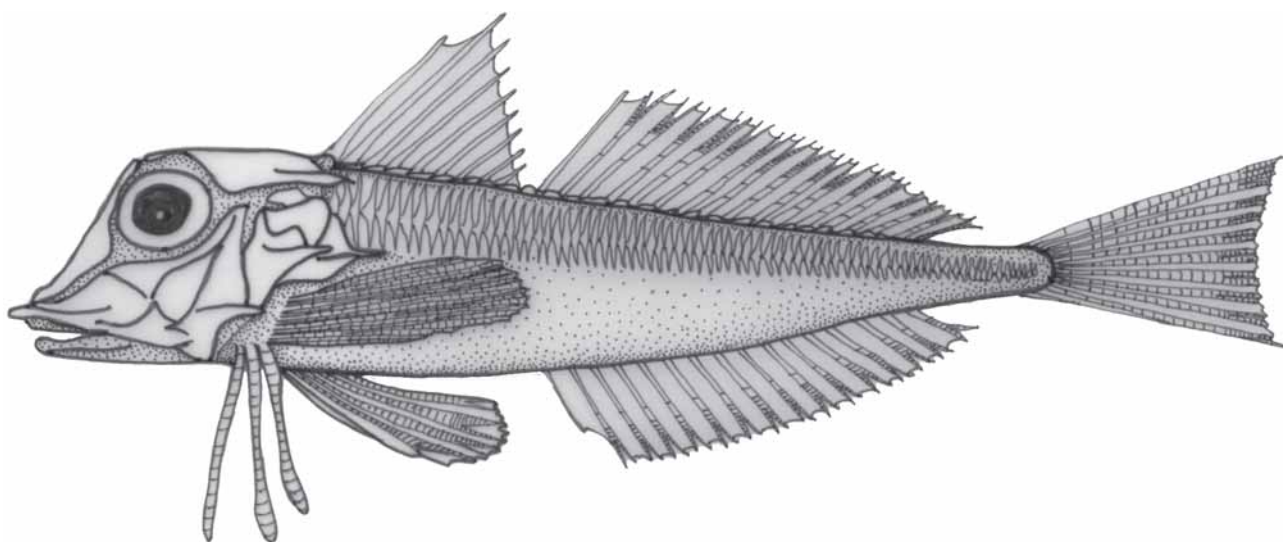


Fig. 3 - *Aspitrigla cuculus* (Linnaeus, 1758). Tyrrhenian Sea, personal collection, 256 mm Standard length.

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