THE SKULL OF THE MEDITERRANEAN SPECIES OF BLENNIUS L., 1758
(A COMPARATIVE ANATOMICAL STUDY)
(FISSES, BLENNIIDAE)

by

COSTAS PAPACONSTANTINOU
Institute of Oceanographic and Fisheries Research - Greece

1. INTRODUCTION

The genus Blennius (Greek c.m. saliera) in the Mediterranean Sea comprises 19 species which are found along the coasts in the mediolitoral and infralittoral zones. They have many common morphological characters which make difficult to establish their classification and exact phylogenetic relations. Therefore the systematics of the genus Blennius will have to be based on anatomical, histological and biochemical characters.

2. MATERIAL AND METHODS

The skeleton of the skull and the pectoral girdles of the material studied were cleared on the one hand by using TAYLOR'S (1967) enzyme method and on the other hand the tissues were removed by dissection and then cleared by NaOH. Before clearing took place, one specimen from each species was radiographed.

The drawing of the various bones was made after photographing the specimens and tracing off the well visible characters. The less visible characters were drawn with the use of a stereoscope.

The nomenclature of bones is based on that of STARKS as modified by SPRINGER (1968).

All the studied material which is referred to, here, is kept at the Natural History Museum of Genoa (Italy).

The standard length in mm (in brackets), the sex, place of origin and the number of entry in the catalogue of the above Museum is noted on each sample.

Blennius basillatus: Tunis, 1 male (137) - 44828. Blennius camemi: Genoa, 2 male (53-40), 1 female (50) 44829. Blennius fluviatilis: Ligurian, 1 male (82), 1 female (67.5) 44830. Blennius gattorugine: Genoa, 4 male (140-135-120-40), 3 female (140-125-20) 44831. Blennius

127
3.1. Neurocranium

3.1.1. Roof of the Skull

The parietals of the studied breams are joined to each other for their entire length along the dorsal midline of the skull (Blechnia fluviatilis) or only along the anterior border of the bone (Blechnia gatrarogina). Other species present intermediate joints.

The parietals in the Blechnia gatrarogina (Fig. 1) are parallel-sided, and contact each other for a very short distance along the anterior border, thus reforming the lateral margins of the supratemporal foramen. Each parietal crest is formed along the joining line of the parietal and the corresponding supraoccipital. These, one from each side of the skull, meet each other on the dorsal midline of the skull and the anterior border of the parietal, forming the lateral walls of the supratemporal foramen. Each supratemporal canal of the intersem- sary system passes through the corresponding parietal crest. The canals are directed ventrolaterally in the skull and continue in the canal which passes through the big arm of the lateral extrascapular.

The frontal canal of the interseminary system, starts from the supratemporal foramen and passes through the frontal crest which is formed on the dorsal midline of the skull and along the line which joins the two frontals. The frontal canal ends in the frontal foramen. The infraorbital canal of the interseminary system passes through the circumorbital bones and ends in the frontal foramen. The periorbit sen- sory canal ends in the infraorbital canal below the dermopsenonotic. Also from the above foramen starts the supraorbital canals, each on either frontal and extends to the respective nasal bone.

Blechnia sanguineolentus is the only species the parietals of which are separated by the supraoccipital. This bone is triangular and large.
situated at the dorsoptoposterior part of the skull and extends above the foramen magnum and up to the posterior part of the orbit (Fig. 2). The anterior extension of the supraoccipital increases with the age of the specimen. SPRINGER (1968) described and illustrated a respective form in *Andamia heteroptera* adding that this form is probably found in young specimens.

Different forms of canals of the latero-sensory system of the dorsal surface, appear in *Blennius sanguinolentus* due to the special formation of the bones in the area of the skull.

Recapitulating, the last species is different to the others which have been studied, on the following characters (a) the parietals are separated by the supraoccipital (b) has no supratemporal foramen, (c) the latero-sensory system has two frontal canals which start from the frontal foramen, pass through each corresponding frontal bone and finally meet the supratemporal canal.

The formed frontal crest along the longitudinal midline of the dorsal surface of the skull in the *Blennius basiliacus* is very fine and high (its height is about half of that of the skull).

Sexual dimorphism is observed in the *Blennius parvus* as far as the height of the frontal and parietal crest is concerned. The frontal parietal crests are higher in the males than in the females. A possible,
but to a lesser extent, sexual difference is observed and in the Blennius flavusitis.

3.1.2. Circumorbitalia bones

The studied species of the genus Blennius have five circumorbital bones. This is also true for the monotype genus of Coryphoblennius. One specimen of the Blennius ocellaris had six circumorbital bones on the one side and five on the other. This phenomenon appears to be common enough between the blenniids. A similar case is reported by Springer (1968) for Enchelyopus sp. and Andamia heteroptera.

The smallest of the circumorbital bones is the dermoosphenotic. The size of the lachrymal varies widely between species and could be triangular or trapezoid. Paralleloid nuchymal bones have only been found in Coryphoblennius galerita.

3.1.3. Skull base

Ethmoid region

The ethmoid region in the Blenniidae is strongly developed and occupies the anterior part of the skull. Its basic function is the protection of the olfactory nerves from the compressions that take place during the movement of the jaws. These movements cause the premaxillary process to change place on the vertical surface of the median ethmoid, thus neutralizing the pressures exerted on them. Due to this the development of the ethmoid region is in direct relationship with the food and in extension with the biotope. The Salartini which are herbivores have a smaller median ethmoid than other blenniids.

The median ethmoid of all specimens studied of the genus Blennius, except Blennius ocellaris, has a flat anterior face and is trapezoidally shaped. The dorsalmost margins of the bone extend into a concavity which is formed by the anterovenal extensions of each frontal.

A crest is formed, in the bigger species, along the joints of the lateral and median ethmoids.

In the Blennius ocellaris the median ethmoid has no flat anterior face, but a triangular-shaped eminence. Its base has two concave fossae which touch each other. Each of the above fossae is the upper limit of movement of the distal ends of the corresponding premaxillary process.

In the Bleniidae, as in many Perciformes, there is a sphere of cartilage (rostral cartilage) attached to the posterior edges of the dis-
tal ends of the premaxillaries. The function of the above cartilage, which is missing in the Nemophilinae (SPRINGER 1968) is to ease the movement of the premaxillary process on the median ethmoid.

In some species of Blenniidae, ossification of the rostral cartilage is observed thus forming a small spherical bone. HARRINGTON (1955) suggests the name kinethmoid for a bone which is found in the Cyprinidae at the same place where the ossification of the rostral carilage takes place in the Blenniidae. SPRINGER (1968) used the name kinethmoid for the bone which is formed from the ossification of the rostral cartilage. The function of the kinethmoid in the Blenniidae is different to that in the Cyprinidae. The kinethmoid of the cyprinoids takes part in the mechanism for protrusion of the premaxillaries in contrast to the blenniids which do not have this mechanism (SPRINGER 1968). The function of the kinethmoid in the Blenniidae must be similar to that of the rostral cartilage.

SPRINGER reports the existence of the kinethmoid in the following species of the genus Blennius: Blennius marmoratus, Blennius cristatus, Blennius conoeaei and Blennius gattorugine. In the present study no kinethmoid was observed in the specimens of Blennius gattorugine and Blennius conoeaei. A careful examination of fresh specimens confirmed the existence of rostral cartilage in both the above species.

Fig. 3. Type of joints of the bones in the ethmoid region of the genus Blennius. A-Type: Blennius testuccularis, B-Type: Blennius schoen., C-Type: Blennius gattorugine. a. process containing the ethmoid cartilage, b. median ethmoid, c. lateral ethmoid, d. vomer.

The bones of the ethmoid region on the anterior surface of the skull appear in two forms of joints (Fig. 3).

(1) The ventral margin of the median ethmoid is bounded by the dorsal surface of the vomer. Thus, the lateral ethmoids cannot be joined together. These are joined to the lateral surface of the me-
dian ethmoid and to the vomer. These last two bones form the walls of one median fossa which contains the ethmoid cartilage (Type: \textit{Blennius testucloris}).

Species: \textit{Blennius testucloris}, \textit{Blennius luximini}, \textit{Blennius rouxi}, \textit{Blennius ocellaris}, \textit{Blennus flavatilis} and \textit{Coryphoblennius galaris}.

\textit{Bleniurus ocellaris} and \textit{Bleniurus flavatilis} have no such fossa.

(2) The lateral ethmoids are joined together along the space which is enclosed by the ventral surface of the median ethmoid and the dorsal surface of the vomer. Depending on the position of the median fossa which contains the ethmoid cartilage, in relation to the median ethmoid, we may distinguish two types of joint of the ethmoid region.

(a) The median ethmoid and the vomer take part in the formation of the walls of the above fossa, thus not allowing the direct joining of the lateral ethmoids (Type: \textit{Blennius sphæra}).

Species: \textit{Blennus sphæra}, \textit{Blennius sanguinolentus}, \textit{Blennus rigulus}, and \textit{Blennus pentecus incognitus},

(b) The median ethmoid does not take part in the formation of the walls of the above fossa in question (Type: \textit{Blennius gatorunique} Species: \textit{Blennius gatorunique}, \textit{Blennus baniliscus} and \textit{Blennius parv}.

\textbf{Spænoid region}

In the species studied of the genus \textit{Blennmius}, the dorsal margin of the parapneuroid wings is joined to the ventral margin of the posterior part of the frontal bones. This kind of joint hinders the pteropneuroid to take part in the formation of the posterior margin of the orbit.

\textit{Sprung} (1959) accepted the above joining as being typical for \textit{Blenniidae}. Later though (1965), he reported a few exceptions, some of which seem to be variation exhibited by individual specimens, such as, \textit{Blennus cristatus}, \textit{Blennus canicrensis}, \textit{Hypurina chilimnus}, \textit{Scardichthys gigan}. In these species, the pteropneuroid on one or both sides of the skull, separates the frontal from the parapneuroid, thus taking part in the formation of the posterior margin of the orbit.

\textit{Thiel} (1965) mentions the above formation for \textit{Blennius gatorunique} as well, but this was not found by us.

In the \textit{Coryphoblennius galaris} the pteropneuroid is situated between the frontal and parapneuroid and does not allow contact between them. The pteropneuroid extending anteriormost, takes part in the formation of the posterior margin of the orbit (Fig. 2). The above character cannot yet be considered as typical character of the

132
genus Coryphoblemmus, because this joining may possibly be exhibited by individual specimens. In the genus Rhinula (Springer 1948) the pterosphenoid separates the frontal from the parapenial.

Thus, the joining of the above three bones (frontal, pterosphenoid, parapenialoid) cannot be used as a differentiating character between Clinidae and Blenniidae. In the genus Coryphoblemmus the parapenialoid enters into the orbit to a greater extent than in the species of the genus Blemmus.

The size of the pterosphenoid varies greatly between the studied species. For example, that of the Blemmus tentacularis is the largest and that of the Blemmus acominatus the smallest.

3.14. Otic and labyrinth region

From the Blemmus species studied, the supraparietal takes part in the formation of the dorsalmost margin of the foramen magnum in the Blemmus basiliscus and Blemmus fasciatus. In the rest of the species the above margin is formed by the exoccipital which are joined between them above the foramen magnum.

The genus Blemmus, like all others of the Blenniidae family, has only one pair of L-shaped lateral extrascapular. Each of these is situated in such a way so that the free end of the lateral extrascapular groove (big arm) is in contact with the ventral opening of the supratemporal intersensory canal. The other end of the above groove touches the opening of the pterotic intersensory canal. Thus, the two main sensory canals of the skull (pterotic and supratemporal) meet each other. They then continue their course through the lateral extrascapular canal (small arm) in the posttemporal bone under the name of posttemporal intersensory canal.

The lateral extrascapular are independent in all of the studied species, except that of Blemmus basiliscus, in which synostosis with the pterygoid bones was observed. In this species the free margins of the pterygoid and parietal blade (Fig. 5) are joined to the anteroverentralmost part of the epotic process and to the epotic crest respectively, thus covering the epotic cavity. Springer (1948) reports parietal synostosis of the lateral extrascapular with the pterygoid in the genus Ecsenius, Picroceresites and with the parietal in the genus Rhinula.

In the Blemmus trigloides and Coryphoblemmus galera the small arm of the lateral extrascapular is joined to the margin of the pterygoid blade and to the ventromost part of the epotic process. The margins of the epotic and parietal blade extending posteriorly are joined to the anterior surface of the epotic process and the epotic crest respectively, thus covering the epotic cavity. The above cover, dorsally, and
the big arm of the lateral extrascapular, ventrally, form a canal, the free end of which, extends up to the supratemporal canal of the laterosensory system. The other end extends up to the pterotic laterosensory canal. A similar formation of the lateral extrascapular bones has been observed by SPRINGER (1965) in many genera of the Bleenmiidae family.

In the Blemius spinosus, Blemius flaviatilis and Blemius parvus the lateral extrascapular is partly independent and joins to the anteriorventralmost part of the epiotic process and the free margin of the pterotic and parietal blade. The big arm is canal-shaped and not groove-shaped. One specimen of the Blemius parvus had the same form as that of Blemius triglidies.

For the other species which show an independent extrascapular, it must be added that sometimes the lateral extrascapular groove of the young specimens as well as of some older ones, is canal-shaped.

---

Fig. 6. Blemius pottorupina, lateral view of skull, preoral and pelvic girdles and fins (mode, St. 125mm).

NORMAN (1943) separated the Blenniidae family into two subfamilies (Blenioideae and Salariaeae) based on the form of the jaws and teeth. Similarly, based on external morphological characters, divided the genus Blennius (polyporphic genus) into three subgenera (Blenius, Salaria and Lipophrys) considering as typical species the genus of *Blenius oscillans*. He also suggested the formation of the genus Coryphoblennius in which he included the *Blenius gastera* (monotypic genus). Most of the other workers accepted his suggestions.

The *Blenius* species studied, have a caniform tooth on each dental and premaxillary. Those on the dentaries are more developed than those on the premaxillaries. The caniforms are bigger than the incisives, sometimes twice as big and turned towards the back. The *Blenius pannorogine* is the only species which has no teeth on either jaw and the *Blenius sanguinolentus* and *Blenius cristatus* lack these on the premaxillaries. A few specimens had two caniforms of different size on each premaxillary.

The incisives of the genus *Blenius*, rigid and strong, are situated next to each other without diastema. In the *Coryphoblennius gastera* the incisives are soft and movable without diastema.

The number of incisives in each species increases greatly with the age of the specimen. SPRINGER (1959a, 1967) reports a similar change in the number of teeth in *Chaunaxates bocquianus* and *Hypoblenius mordax* and RADUL (1946) in *Hyaloblennius assimilis*. STENTZ (1950) assumed an equivalent change in the number for *Blenius parvus* in the Palestinian coast.

A marked increase in the number of incisives with age, in both the dentaries and premaxillaries, was observed in all the *Blenius* species studied.

In the *Blenius fluviatilis* sexual dimorphism was also observed. Sexual dimorphism as to the presence of caniforms was observed by SPRINGER (1968) in *Gomphoblennius herzi*. *Blenius oscillans* and *Blenius normani* are the only blemmids in which the dentaries are joined between them by a suturing joint. The premaxillary process in the *Blenius pannorogine* (typical species) is joined weakly to the body of the premaxillaries. This process ascends up to the middle of the anterior surface of the median ethmoid during the movements of the mouth. In the *Blenius oscillans* each premaxillary process appears as one bone with the body of the corresponding maxillary (synostesis). The above process is relatively receded in size and ascends up to the corresponding fossa of the anterior surface of the median ethmoid during the movements of the mouth, 136
In the above mentioned differences between Blennius ocellaris and the other species, we should add the described different formation of the median ethmoid, as well as the absence of the fossa which contains the ethmoid cartilage, itself doubtful. Truly, the destruction of the cartilages by the various acids and bases during the cleaning of the skull makes impossible the confirmation of the presence of this cartilage in the position of the missing fossa.

The above differences, as well as the absence of the latero sensory supracleithrum canal support the view that the genus Blennius, based on the rules of international nomenclature, should include only the species Blennius ocellaris and that other species, so far considered as belonging to the genus Blennius, should comprise a new genus. But the change of name of a large number of species which for so long have been known to belong to the above genus, will create confusion. Thus, the matter remains open and we accept, for the present at least, the existing situation.

ACKNOWLEDGMENTS

I wish to thank Prof. ENRICO TORTONESE, Director of the Museum of Natural History, of Genova, for providing the facilities of the laboratory for the completion of this study and for many helpful discussions. Also, I wish to extend my thanks to Mr. G. GABRIELIDES for the assistance in translating it in English.

SUMMARY

The skull anatomy of 13 species of the genus Blennius and of Coryphoblennius galerita have been studied in detail. This study has resulted in 3 different forms of joints of the ethmoid zone bones (Blennius tentacularis, Blennius sphincis and Blennius gattorugine). The supracleithral bone separates the parietal ones completely, thus, changing the order of the neurocranium sensitive channel. The lateral extrascapular bones are independent with the exception of (a) Blennius basiliscus, where synostosis with the pterotic bone is observed, (b) Blennius trigloides and Coryphoblennius galerita in which they are completely joined to the pterotic blade and the epiotic process and (c) Blennius sphincis and Blennius glaucoater, in which they are partly joined to the pterotic and epiotic blade and process. The upper premaxillary process is connected weakly with the premaxillaries. Blennius ocellaris is an exception in which they are connected very strongly. This species is very well discriminated from other Blen-


Received Sept. 23, 1976

139