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Evolution and Taxonomy of Catfishes of India

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Siluroids have imperfect palaeonotological evidence and the past history of these catfishes are practically unknown. Catfishes are known from various stages of tertiary period. In the absence of sufficient knowledge in the palaeonotology of these fishes, it is considered worth while taking embryological evidence in considering the evolution of the various siluroid families. The studies on six families, Schilbeidae, Bagridae, Heteropneustidae, Clariidae, Plotosidae and Ariidae, have shown a distinct trend in the evolution of the ethmoid region of the chondrocrania. Based on these chondrocranial characters, it is concluded that *Plotosus* appears to be the most primitive among the living siluroids and that other members may have evolved from an ancestor similar to *Plotosus* and *Ailia* appears to be the most specialised member of the group. The detailed inter-relationships and the line of evolution of the catfishes are discussed in the paper.

Key Words : Siluroidei, Evolution, Chondrocranial characters, Taxonomy

The siluroids have imperfect palaeontological evidence and the past history of these catfishes is less known like other ostariophysine members. In the discussion of the ancestry of the bony fishes, Romer (1945) stated that "appearance of bony fishes in the geological record is dramatically a sudden one. There are no traces of the group in the silurian and only a few fragments which may be of lower Devonian age. In the middle Devonian they appear full-fledged and diversified and at once dominate the scene". Further he is of the opinion that *Clupea* (Herrings) particularly the tarpon are among the most primitive of living isospondyls—the suborder clupeoides. An early side branch of the primitive teleost stock is the order ostariophysi which comprises the Cyprinoids, siluroids and characins. Catfishes are known from various stages of the tertiary period. The origin of this order is practically unknown.

Fossils of some of the isolated members of siluroides have been reported by various authors. Woodward (1889) and Newton (1889) have described the fossils of *Bucklandium diluvii* from London Clay of Isle of Sheppey and *Arius bartoni* from Eocene beds of Barton respectively. Regan (1909, 1911) and Bhimachar (1933) have discussed the osteological and external features in relation to the evolution of catfishes. Romer (1945) has given a list of fossils of siluroids occurring in different geological periods viz., *Rhineastes* from

Eocene to Oligocene, Felichthys from Miocene to recent (both belong to the family Ariidae), *Rita* Bleeker, *Mystus* Scopoli, *Hetarobagrus* Bleeker and *Bagrus* (Bagridae) from Pliocene and Pleistocene beds to recent. Fossil of a new species of *Arius kutchensis* has been described by Rao (1956) from the Eocene strata of India. Jayaram (1957) has discussed the line of evolution of the Bagridae and other families based on some osteological and palaeontological characters.

In the absence of sufficient knowledge in the palaeontology of these fishes, it is worthwhile taking the embryological evidence, in considering the possible line of evolution of the various siluroid families. In this connection de Beer (1937) stated that "the chondrocranium is not a relic, but a functional structure progressing in evolution along its own lines", in the course of the present studies on the development of skull in catfishes, the development of chondrocranium (Srinivasachar 1956, 1957 1959, 1961) of the following members belonging to six families in the group siluroidea have been studied:

1. *Silonia* }
2. *Pangasius* } Family Schilbeidae
3. *Ailia* }
4. *Rita* }
5. *Mystus* } Family Bagridae
6. *Heteropneustes* (Heteropneustidae)
7. *Clarias* (Clariidae)
8. *Plotosus* (Plotosidae)
9. *Arius* (Ariidae)

The development of chondrocranium of various members of siluroids studied exhibits a progressive variation particularly in the ethmoid region. The chondrocranium of these members reveal the following primitive features:

(*a*) the reduction of the floor for the nasal sacs,

(*b*) the fusion of the hyomandibula and quadrate cartilage, and

(*c*) the independent origin of the anterior part or the pterygoid process of the pterygoquadrate bar.

The fusion of the quadrate and hyomandibula has been noticed among other teleosts in *Clupea*-isospondyl. The independent chondrification of pterygoid process has been noticed in *Amia* (Pehrson 1972), *Clupea* (Wells 1922), *Ophicephalus* (Srinivasachar 1953) and in all the siluroid members studied. Jarvik (1954) considers that the processus pterygoideus corresponds to the pars autopalatine and the independent ossifications of the pars autopalatine have been noticed in Acanthodians (Jaekel 1906) and coelacanthids.

In the chondrocranium of *Plotosus* (Srinivasachar 1959) the nasal sacs are completely devoid of any cartilaginous covering. The solum nasi which is developed as lateral extension from the ethmoid plate forming the floor for the nasal sac is completely absent. The absence of the floor for nasal sac has also been noticed in selachians and Dipnoans (de Beer 1937). An anterior extension of the lamina orbitonasalis forming the lateral wall of the nasal sacs observed in most of the other teleosts and also in other siluroids studied, is reduced to a very short stump in *Plotosus*. A nasal septum in a strict sense is absent. The pterygoid process chondrifies independently and remains so throughout the development of the chondrocranium. The hyomandibula and quadrate are completely fused and this condition has been noticed in all the siluroids studied, as also observed in the primitive isospondyle fish, *Clupea* (Wells 1922). All the above characters show that *Plotosus* is a primitive form among the group siluroidea. Further the orbital cartilages are rod-like which is a unique feature among the siluroids. However, in all the other siluroids studied the orbital cartilages are massive plate-like cartilages and this character of the chondrocranium is a specialised feature of the siluroids.

In the ethmoid region, the extension of the solum nasi at the floor of nasal sacs show progressive variation among the siluroids studied. In *Arius*, which appears to have branched off in a different direction from the ancestral 'stock, has a very small lateral extension of the ethmoid region in the posterior region only. Next in the series are *Heteropneustes* and *Clarias* where the solum nasi extends to about one third the region of the nasal sacs and the anterior extensions from the lamina orbitonasales are also reduced. In the members of Bagridae studied, *Rita* appears to be more primitive than *Mystus* and in both cases the solum nasi extends to about half the length of the ventral region of nasal sacs. And finally in the family Schilbeidae i.e., *Silonia, Pangasius, Ailia* which appear to be more specialised than all the members of the siluroids studied show that the solum nasi forms the complete floor for the nasal sac and the anterior extension of the laminae orbitonasales are also well developed forming the lateral boundary of the nasal sacs. In the case of *Ailia* the nasal alar cartilages have been noticed on the dorsal side of the nasal sacs, which could be considered as the roofing cartilages of the nasal sacs. Thus in *Ailia*, which appears to be highly specialised among the Schilbeidae the nasal sacs are protected more or less on all sides, ventrally by solum nasi, laterally by anterior extension of lamina orbitonasalis, medially by the nasal septum and dorsally by the nasal alar cartilages.

Therefore it may be concluded that *Plotosus* appears to be the most primitive among the living siluroids and that the other members may have evolved from an ancestor similar to *Plotosus* and *Ailia* appears to be the most specialised member. On the basis of the above evidences the probable lines of evolution may be represented as follows:

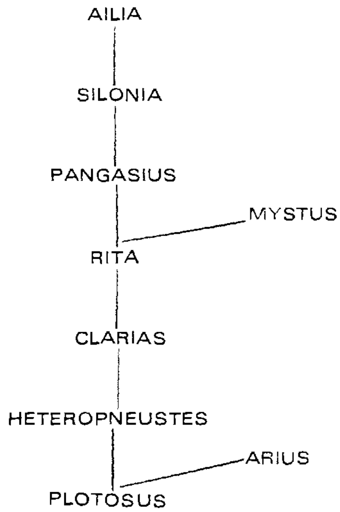

Diagram of the arrangements and relationships of the siluroid fishes studied

It appears that *Arius* has branched off quite early from an ancestor similar to *Plotosus* and shows certain specialisation in the chondrocranium like the presence of distinct nasal septum and the complete fusion of the pterygoid process with the quadrate hyomandibula which are unique among the siluroids. These specialisations might have been possible by the long age through which they have survived. Bhimachar (1935) after considering the adult skull characters has also come to the conclusion that *Plotosus* is a primitive member of the siluroid group. However, he has stated that *Arius* is a more specialised member, but as stated above though the member is not in the direct line of evolution but might have deviated from the main stock fairly early in the geological history.

The primitive nature of *Plotosus* has been further evidenced by the fact, that the ampullae of Lorenzini (Berg 1947) which are peculiar only to selachians have been noticed in *Plotosus*. Finally on account of the evidences stated above, it may be said that the siluroids in general might have taken their origin from an ancestor similar to *Plotosus* and not by a member of Bagridae as stated by Regan (1922) and Jayaram (1957).

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