Chapter - 7

SUMMARY

In order to study the systematic and phylogenetic position of three subfamilies viz. Schizothoracinae, Cyprininae and Rasborinae, the osteology of twelve Indian cyprinoids has been undertaken. Of these, seven species of the subfamily Schizothoracinae viz., Schizothorax richardsonii, Diphylichthys maculatus, Schizopygopsis stoliczkae, Ptycoparbus contrastris, Schizothoracichthys micropogon, Schizothoracichthys esocinus and Schizothoracichthys labiatus are mainly the representatives of the Palaearctic fauna, confined to the Indus drainage system in the Western Himalayas; two members of subfamily Cyprininae; viz., Labeo dero and Garra lemae and two of the subfamily
Rasborinae viz., *Aspidoparia morar* and *Rasbora daniconius* inhabit the lower Himalayas. *Schismatorhynchus nukta*, a cyprinine genus, is a representative of South India.

An endeavour has been made to justify the position of the subfamily Schizothoracinae of the family Cyprinidae on the basis of osteological characters. These characters have been compared to those of the subfamilies Cyprininae and Rasborinae. A workable key to these subfamilies and species, on the basis of osteological characters, has been enumerated. An evolutionary tree has also been drawn to show the position of the subfamily Schizothoracinae; only such osteological characters have been taken into account which remain constant within the subfamily viz., the preethmoid, the supra-ethmoid, the ethmoid, the frontal, the parietal, the autosphenotic, the autopterotic, the opisthotic, the basioccipital, the maxillary and the premaxillary, the lower jaw, the ceratobranchial, the urohyal and the girdles. These bones are modified in various directions in relation to the environment and are adaptations to the respective needs of the animal. The diagnostic features of the various subfamilies are as follows:
Subfamily Schizothoracinae

1. The supraethmoid is well developed and takes part in the formation of dorsal roofing of the neurocranium, thus adding to the total length of the skull. Its notch is small, sharp and narrow.

2. Lateral ethmoid forms the anterodorsal part of the orbit and lateral processes are laterally directed.

3. Two pairs of preethmoids are present, each pair occupying the anterolateral portion of the prevomer.

4. Pharyngeal process of the basioccipital is long and pointed.

5. Frontals are elongated bones.

6. Supraorbital is small, bordering only the anterior 1/3rd part of the frontal.

7. Epiotic crest is high and sometimes produced into a spine-like projection posteriorly.

8. Supraoccipital spine is single and thin.

9. Autosphenotic is long, shelf-like and much of its part is visible dorsally, thus taking part in the dorsal roofing of the skull.

10. Opisthotic may be present or absent.
11. The rostral process of the maxillary is prominently developed and points medioanteriorly or anteriorly.

12. The hyomandibular head bears two articular facets.

13. A set of three rod-like basibranchials is present.

14. Dorsal rib on each side of the first vertebra is approximately 60% in length to that of the complex vertebra.

15. The parapophysis of the fourth vertebra of either side is either ventrally directed or slightly horizontally directed. It may bear an anterior extension and its tip is moderately expanded.

16. Coraco-cleithral fenestra is narrow and usually small. Only the cleithrum takes part in pectoral symphysis.

17. Lateral fenestra of the basipterygial plate is nearly 40% in depth of the basipterygium.

Subfamily Cyprininae

1. The supraethmoid is well developed, but always inclined at an angle. The notch is short and sharp or it may be absent.
2. Lateral ethmoid forms the anterodorsal part of the orbit and the lateral process of the lateral ethmoid is always bifurcated.

3. One pair of preethmoids is present, each one occupying usually the posterolateral portion of the prevomer.

4. Pharyngeal process of the basioccipital is small and may be bifurcated at its tip.

5. Frontals are wide bones.

6. Supraorbital is moderately developed and extends up to half the length of the orbit.

7. Epiotic crest is low.

8. Supraoccipital spine is a plate-like, double-ridged structure.

9. Autosphenotic small but bears a long, anterolaterally directed, prominent process. Very small part of the autosphenotic takes part in dorsal roofing of the skull.

10. Opisthotic always absent.

11. Rostral process of the maxillary well developed and points medially.

12. The hyomandibular head bears one articular facet;
sometimes two articular facets are present, separated by a very narrow groove.

13. A set of two umbrella-shaped basibranchials is present.

14. Dorsal rib on each side of the first vertebra is long and approximately equals in length to that of the complex vertebra or slightly falls short of it.

15. The parapophysis of the fourth vertebra is ventrally directed or horizontally directed and may bear a prominent posterior extension, the anterior extension is always absent.

16. Coraco-cleithral fenestra is moderately developed, coracoid may take part in the formation of the pectoral symphysis.

17. Lateral fenestra of the basipterygial plate is more than 50% deep as compared to the length of the basipterygium.

Subfamily Rasborinae

1. The supraethmoid is small, straight and takes part in the dorsal roofing of the skull. The notch of the supraethmoid is well developed and may be shallow
or wide extending up to 40 to 50% deep in it.

2. Lateral process of the lateral ethmoid is very small.

3. One pair of preethmoids is present, each one occupying the anterolateral portion of the prevomer.

4. Pharyngeal process of the basioccipital may be long and pointed or it may be well developed and plate-like.

5. Parasphenoid is long, thin, strut-like bone, with a well developed orbitosphenoid septum.

6. Supraorbital is long, extending the total length of the orbit and touching the autosphenotic of its side.

7. Epiotic crest is low.

8. Supraoccipital spine is pointed and spine-like.

9. Autosphenotic is very small and slightly visible dorsally.

10. Opisthotic is always absent.

11. Rostral process of the maxillary is reduced.

12. Hyomandibular head bears two articular facets which may be separated by a deep groove.

13. A set of three rod-like basibranchials is present.
14. Dorsal rib of the first vertebra is extremely reduced and is about 30% in its length to that of the complex vertebra.

15. The parapophysis of the fourth vertebra is feeble and ventroanteriorly directed. Its tip is pointed.

16. Coraco-cleithral fenestra is wide and cleithrum alone takes part in the formation of pectoral symphysis.

17. Lateral fenestra of the basipterygial plate is deep and extends more than 50% deep to the length of the basipterygium.

From the above mentioned osteological characters of the three subfamilies under report, it can be concluded that the subfamily Schizothoracinae, which has its origin near the subfamily Rasborinae, can also be considered as primitive on the basis of following characters:

1. Presence of opisthotics
2. Presence of three rows of teeth in some of its primitive forms like Schizothorax and Schizothoracin-chthys.

The subfamily Rasborinae can be considered as the most primitive amongst the three due to the following
1. Shallow or wide notch of the supraethmoid, suggesting its double origin.
2. Large supraorbitals touching the autosphenotics.
3. Three rows of pharyngeal teeth.

The subfamily Cyprininae can be considered as slightly advanced than the two, having its origin slightly above them. It resembles Rasborinae and Schizothoracinae in having only three rows of pharyngeal teeth and in majority of other characters, it shows advancements.

The studies on Cyprininae show that *Garra lamta* is highly advanced amongst hill-stream forms. The advancement of *Garra lamta* over others is justified by the fact that in *Garra lamta*, most of the bones show either characteristic fusion or reduction in processes of various bones. The various characters which can be considered towards its adaptation to torrential currents of water are the compressed form of the skull, small branchial aperture and widened out branchiostegal rays, reduced size of Weberian ossicles and reduced coraco-cleithral fenestra...
of the pectoral girdle and the lateral fenestra of the basipterygial plate. Due to its great diversion of characters from the other cyprinine genera studied, a new subfamily Garrinae has been resurrected for reception.

*****