FOSSIL FISHES FROM THE INTER-TRAPPEAN BEDS OF SURENDRANAGAR DISTRICT, SAURASHTRA*

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ABSTRACT

The present paper gives for the first time a detailed account of the fossil fishes from the Inter-trappean beds of Bamanbor and Ninamia Surendranagar District, Saurashtra. This study has revealed the presence of two new genera Horacleupea and Palaeopristolepis represented here by one species of each. The other remaining form, Perca sp. cf. P. angusta Agassiz is based on skeletal remains. The Inter-trappean beds yielding this fish fauna are considered to be of freshwater lacustrine nature and of Palaeocene or perhaps Lower Eocene age.

INTRODUCTION

The earliest record of fossil remains from the Inter-trappean beds of Bamanbor and Ninamia is by Fedden who in 1884 (p. 99) had reported the presence of some fragmentary fish skeletons in these beds.

Vertebrate fossil fauna recorded from the Inter-trappean beds of the Deccan Trap Series is rather meagre and till now is known to consist of only a tortoise Hydrapsis (Platemys) leithei (Carter) (Carter, 1857; p. 116); three species of frogs, Indobatrachus pusillus (Owen) (Owen, 1847; p. 224), I. trivialis Chiponkar (1940, p. 801; Pl. I, Fig. I) and I. malabaricus Verma (1965, p. 182) from the Frog Beds of Bombay; and a few fish scales (Hora, 1938 a, 1938 b) from Inter-trappean beds of Madhya Pradesh.

The present study of the fossil fishes is, therefore, a very important addition to the fossil vertebrata of the Inter-trappean beds of the Deccan Trap Series.

* A preliminary note on these fishes has already appeared in Current Science, Vol. 42 (No. 12).

181
This material was collected by the author during his field work in 1970 to 1972 in the Surendranagar District. All these specimens are deposited in the collection of the M.A.C.S.

**Co-ordinates of the Localities referred to in the Text**

- Bamanbor 22° 25′ ; 71° 1′
- Deothan 22° 20′ ; 77° 34′
- Mewasa 22° 17′ 30″ ; 71° 15′
- Wankaner 22° 33′ ; 71° 1′
- Chotila 23° 37′ ; 80° 39′ 30″
- Kheri 22° 22′ ; 77° 20′
- Ninama 22° 18′ ; 71° 20′

**DISCUSSION**

Out of the three fossil fishes reported here the two new genera, *Horaclupea* and *Palaeopristolepis* being new cannot by themselves indicate an age precisely but the affinities they bear towards genera already known can be of some guidance. Thus *Horaclupea* seems to be closely related to the less deep species of the genus *Diplomystus* Cope (1877) coming from the Soissonian (Lower Eocene) of Green River Shales in Wyoming, U.S.A. (Cope, 1884). Also *Horaclupea* *intertrappea* from these two Inter-trappean horizons has a great similarity with *Horaclupea geei* (Hora, 1937) from the Eocene Saline Series of the Salt range of Pakistan, and therefore, indicates Eocene age for the Inter-trappean beds of the present area.

We have *Perca* sp. cf. *P. angusta* closely allied to *Perca angusta* Agassiz (1833-44) from Eocene of Monte Bolca. Thus its presence supports an Eocene age for these beds.

The remaining species, *i.e.*, *Palaeopristolepis feddeni*, is a percoid fish. The first percoid fish to appear is said to be the serranid *Prolates heberti* (Gervais) from the Montian of Paris Basin (Leriche, 1906; pp. 138-39). Thus they begin their history in the beginning of Eocene and not in Upper Cretaceous as was considered by Berg (1947, p. 473).

Perhaps even an earlier record of the percoid fishes would be the occurrence of *Eoserranus hislopi* Woodward (1908) from (the so-called) Lameta bed at Dongargaon. Because of its locally infra-trappean and post Gondwana position, Hughes, Hislop and Crookshank (Hora, 1938 b) consider it to be Lameta, but the interpretation given by Matley (1922, p. 106) is very likely to be correct so that the *Eoserranus hislopi* bearing bed of Dongargaon may be infra-trappean in position and inter-trappean in age. This interpre-
Fossil Fishes from Inter-Trappean Beds of Surendranagar

...tation of Matley gains support from the observation of the present author in his area where the Inter-trappean bed of Bamanbor passes laterally towards Wankaner, a distance of approximately 50 km, where it is obviously in its field position infra-trappean and is seen resting with a distinct unconformity directly on the Dhrangadhra Formation (equivalent of the Umias of Kutch). Thus here is a case where an inter-trappean bed extends laterally, so as to overlap the flow beneath it and comes to rest directly on a much older rock formation. No doubt such cases could be imagined occurring in other regions also, but field observations are lacking on this point.

Thus percoid fishes suggest base of Palaeocene to be the lower age limit for the rocks containing them, and same may be the age for the so-called Lameta bed of Dongargaon and the Inter-trappean beds occurring in the vicinity of Ninama and Bamanbor, i.e., the present area.

*Perca* sp. cf. *P. angusta* indicates Eocene as the age for these beds, whereas the presence of the genus *Horaclupea* reduces this span to Soissonian (Lower Eocene).

These facts taken together indicate a Palaeocene or Lower Eocene age for the Inter-trappean beds at Ninama and Bamanbor, and consequentially for the associated Lava flows of the Deccan Trap Series in this area.

*Palaeoecology and Palaeogeography.*—The present day pristolepid fishes are restricted to freshwaters in India, East Indies and Malayan Archipelago (Berg, 1947; p. 476). Thus it will be safe to assume that the beds in which the present fish fauna is found fossil are freshwater deposits. The clupeoid fishes can also be restricted to freshwater conditions (Berg, *op. cit.*, p. 421). Therefore, freshwater conditions were probably also the habitat of *Horaclupea intertrappea*.

Now, if the huge thickness more than 35 m of the Inter-trappean beds of Bamanbor and Ninama are considered and if due regard is given to their lateral extension and the great thickness with undulating surfaces on which they were deposited, it appears reasonable to imagine that these beds were of lacustrine conditions originating out of confined river systems.

The Ninama deposit occurs at a level higher than that of Bamanbor. Therefore, Ninama area perhaps had a contributory river system draining...
into that of Bamanbor. The geographic vicinity allows such a supposition. This also explains why the base of the Inter-trappean bed—which in all probability is a continuous one—from Mewasa to Wankaner through Chotila and Bamanbor, a distance of nearly 50 km, has different contour values for the local basal portions.

Such an explanation would account also for the occurrence of the same species, *Horaclupea intertrappea* in the Inter-trappean beds at Ninama and Bamanbor, the bases of which are separated by a level difference of about 80 m.

The other possible explanation to consider as an alternative would be that there are two different inter-trappean beds, and the occurrence of the same species of fish, *Horaclupea intertrappea* at these two Inter-trappean levels could be explained as due to migration from the lower horizon at Bamanbor to some area, not yet located, and its return to the same old area at a later time to appear in the next higher Inter-trappean bed at Ninama.

**SYSTEMATIC DESCRIPTION**

Order : Clupeiformes
Family : Clupeidae
Sub-family : Clupeinae
Genus : *Horaclupea* gen. nov.
Type species : *Horaclupea intertrappea* sp. nov. (*vide infra*).

*Diagnosis.*—Small clupeoid fishes with fairly large head and laterally much compressed, fusiform body; Maxilla strong, supported by two supramaxillary bones; Gape very short, not narrow; number of branchiostegals not known; Fins small to moderate in size; Pectoral fins originating above the ventral border and pelvic fins almost opposite to the dorsal; caudal fin deeply forked; Vertebrae 30–35 in number; presence of ventral keeled scutes well indicated. Scales, anal fin and dentition not known.

*Remarks.*—When compared with the genera like *Clupea* Linnaeus, *Scombroclupea* Kner and *Histirothrissa* Woodward—which belong to family Clupeidae and to which a few fossil species are assigned (Woodward, 1901)—the present genus differs in having only 30–35 vertebrae in contrast with 45–60 in case of the above mentioned genera.
Pseudoberyx Pictet and Humbert, a genus described from Upper Cretaceous of Mount Lebanon (Pictet and Humbert, 1866; p. 32, Pl. II, Figs. 4-6) appears to be closely comparable with the present genus in having small-paired fins, large head and further in having vertebrae about 30. It differs from the present genus in being more deep and consequently having a more fusiform and less elongate appearance. Also the skull of Pseudoberyx is shorter and anteriorly triangular, which in case of the present genus is elongate and oval. Moreover the generic definition of Pseudoberyx involves the necessity of presence of pectinate scales, while the scales are altogether unknown in case of the present genus.

The present genus is still more allied to the genus Diplomystus Cope (1877, p. 808), known to occur in the Upper Cretaceous of Mount Lebanon, Istria, Italy and Brazil; Eocene of Wyoming and Brazil; early Tertiary of Spanish Guinea; Oligocene of the Isle of Wight and Miocene of Sarkeui. Forms closely allied to the fossil forms of Diplomystus are represented in the present-day rivers of New South Wales and Chili (Zittel, 1932, p. 155); The present genus differs from Diplomystus in having an oval head instead of a rather triangular one, in being less deep and having no dorsal scutes from occipital to dorsal fin, so characteristic of the genus Diplomystus.

Clupea geei Hora (1937, p. 189, Text-Figs. 1–3, Pl. XV, Figs. 4–6) reported from the Eocene Saline Series of Salt Range (Pakistan) is to be transferred to this genus since it has a fairly large and oval head a compressed fusiform body, very short gape, small-paired fins and a small size with the number of vertebrae 30–35.

The name Horaclupea is given after Late Dr. S. L. Hora, formerly Director of the Zoological Survey of India and a noted Indian Ichthyologist.

Classification.—Since the ventral keeled scutes are well indicated by some of the specimens belonging to this genus, its lower jaw with dentary is not flared outwards, mouth is terminal, anal fin is short with less than 30 rays and the maxilla is supported by two supra-maxillae, the present genus is placeable under family Clupeidae and Subfamily Clupeinae.

The key given by Woodward (1901, p. 128) for identifying fossil genera of the subfamily Clupeinae is given here, slightly modified by adding the number of vertebrae in each case; and is given here for ready reference.
1. Vertebrae 40–50, a few finlets behind the anal fin ..........  
   Scombroclupea Kner.

2. Vertebrae 34–46, no finlets ..........  
   Clupea Linn.

3. Vertebrae 45–60, no finlets, dorsal ridge-scales between occiput and dorsal fin ..........  
   Diplomystus Cope.

4. Vertebrae 30–35, no dorsal ridge scales ..........  
   Horacleupea Borkar.

Horacleupea intertrappea sp. nov.

(Pl. VII, Figs. 1–2; Text-Fig. 1)

Material : 10 specimens.

Holotype : BM 8/70.

Dimensions :

<table>
<thead>
<tr>
<th>Specimen No.</th>
<th>BM 8/70</th>
<th>BM 10/70</th>
<th>BM 12/70</th>
<th>BM 2/72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length of the body</td>
<td>(in mm)</td>
<td>32</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Length of the caudal fin</td>
<td>(in mm)</td>
<td>5</td>
<td>5</td>
<td>?</td>
</tr>
<tr>
<td>Length of the vertebral column</td>
<td>(in mm)</td>
<td>19</td>
<td>18.5</td>
<td>19</td>
</tr>
<tr>
<td>Depth of the body</td>
<td>(in mm)</td>
<td>8</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Length of the head</td>
<td>(in mm)</td>
<td>8</td>
<td>?</td>
<td>8</td>
</tr>
</tbody>
</table>

Description.—Out of the 10 specimens in the author's collection, which are otherwise well preserved, scales, dentition and the anal fin are not preserved on any of the specimens. The pelvic, dorsal and caudal fins are preserved tolerably well.

The body is laterally compressed, fairly fusiform, and slightly elongate.

The head is fairly large and elongately ovate in outline. The state of preservation is good enough to enable detection of the deep and narrow opercle and sub-opercle. Preopercle is expanded only to a little extent. There is enough indication of a strong maxilla supported by two supra maxillaries.
Dentary does not flare outwards with the result that the jaws are almost equal and the mouth is terminal. The gape is very short and does not reach the orbit. The branchiostegals are present but only as very feeble impressions and though on none of the specimens could they all be counted, they are definitely more than 20.

The number of vertebrae is about 32, out of which 15 are thoracic and the remaining caudal.

All the fins are small in size. The pectorals originate above the ventral border and consist of 14 rays. The dorsal fin and pelvic fins are exactly in opposite positions. The dorsal fin has 8 rays. While the number of rays in the pelvic fins could not be counted. The anal fin is not preserved in any of the specimens. The caudal fin is deeply forked with 22 or 24 rays.

Remarks.—The less deep species belonging to the allied genus Diplomystus Cope, viz., D. humilis Cope (1884, p. 77, Pl. IX, Fig. 8; Pl. X, Fig. 4), D. altus Cope (1884, p. 79, Pl. XVII, Fig. 2) and D. analis Cope (1884, p. 75, Pl. VII, Fig. 4; Pl. VIII, Fig. 3; Pl. X, Fig. 2), coming from Green River Beds of Soissonian (Lower Eocene) age of Wyoming, are very similar to the present species and Horacupea geei (Hora). It may be mentioned here that these Eocene species, which are less deep than the other species of this genus coming from the same or other geological horizons are in fact more similar to the two species of Horacupea. However, these species of Diplomystus differ from the present species in having less elongate skull, dorsal ridge scales from occiput to the dorsal fin and much greater length.

The Clupea geei described by Hora from the Saline Series of the Salt Range, Pakistan (Hora, op. cit.) is strongly similar to the present species, the only point of difference being that the Salt Range species has about half the
size of the present species, more elongate skull and number of rays in various fins different as shown below:

<table>
<thead>
<tr>
<th>Name of the fin</th>
<th>No. of rays in</th>
<th>Present species</th>
<th>H. geei (Hora)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectoral</td>
<td>14</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Dorsal</td>
<td>8</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Pelvic</td>
<td>?</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Anal</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Caudal</td>
<td>22–24</td>
<td>?</td>
<td></td>
</tr>
</tbody>
</table>

Hora has explained the small size of *Horaclupea geei* on the basis that the clupeoid fishes are gregarious and often enter estuaries in vast shoals. Some species are known to breed in estuaries, and at the time of breeding season a large number of young forms swarm in these areas (Hora, 1937; pp. 188–89). Further, he has suggested that these young fossil clupeoids from the Eocene of the Saline Series perhaps represent the young stage of *Clupea ilisha* (Ham.) the well known anadromous fish of India.

Now that the number of vertebrae in *Clupea geei* as remarked earlier is 30–35, it does not belong to the genus *Clupea* Linn., and therefore imagining it to represent young stage of *Clupea ilisha* becomes out of place.

Further, taking it for granted that it represents young stage of some species at a place where breeding took place, there is no reason why only young forms would be preserved and not any of the adult ones. After breeding, there is a chance that the adults would die and the young ones would swim away. Therefore the adults are as much likely to be fossilised in these parts and not the young ones only‡. Taking all these factors into consideration, supported by the fact that *H. intertrappea* is also a small species of fish, it is only reasonable to say that *Horaclupea* as a genus consists of small clupeoid fishes.

‡ In case of the allied genus *Diplomytus*, the youngs and the adults are recorded to have been preserved together (Cope, 1884).
Occurrence.—Cherty shales in the Inter-trappean beds at Ninama and Bamanbor.

Order : Perciformes
Family : Percidae
Genus : *Perca*

*Perca* sp. cf. *P. angusta* Agassiz  
(Pl. VII, Fig. 3)

Material : One specimen.

Figured specimen : BM 3/72.

Remarks.—This form is represented in the present collection by a single fragmentary skull. The postero-dorsal portion of the skull is lost. The opercle is triangular. The subopercle is elongate and horizontally disposed. The orbit, maxilla and dentary are damaged. The branchiostegals 6 (perhaps 7) in number, are broken. The pre-maxilla is preserved nicely and is narrow. The nearest ally of this form could only be found in *Perca angusta* Agassiz (1833-44, Vol. IV, p. 7, Pl. XI, Figs. 1-3) coming from the Eocene of Monte Bolca.

Since the available solitary specimen does not show any of the details such as fins or scales, etc., the above noted points with respect to the head help in placing this specimen in the genus *Perca*, and being more likely to be comparable to *Perca angusta* Agassiz though its identification with, or distinctness from this species cannot be ascertained.

Occurrence : Cherty shales in the Inter-trappean bed at Bamanbor.

Family : Pristolepidae.
Genus : *Palaeopristolepis* gen. nov.
Type species : *Palaeopristolepis feddeni* sp. nov. (vide infra).

Diagnosis.—Fishes with percoid skeleton and distinctly pristolepid scales; body oblong and compressed with two dorsal fins united together with spinous portion anterior to, and much longer than the soft portion; Pectoral fins small; Pelvic fins moderate with no spines; Anal fin homocercal and rounded; Skull imperfectly known.

Remarks.—The nearest ally to this form is the living genus *Pristolepis* Jerdon met with in the fresh waters of the plains and hills of Malabar, Siam, Burma and Malay Archipelago (Day, 1889; p. 84); though to a less extent, the present genus is also related to the living genus *Badis* Bleeker met with in
fresh waters of hills and plains of Burma (Day, 1889; p. 80). All these three
genera, *Palaeopristolepis*, *Badia* and *Pristolepis* have oblong and compressed
body, two dorsal fins united, 3 spines in anal fins and have pristolepid scales.

The present material in its somewhat unsatisfactory state of preservation,
especially in the head region, is doubtfully distinguishable from the present-
day genera *Badis* and *Pristolepis*. The specimens under study are from Lower
Eocene period or perhaps even earlier than that; while, the above-mentioned
two present-day genera have no fossil representatives anywhere in the Tertiary
period. It is, therefore, thought safe under these conditions to erect a new
genus as proposed above to accommodate the present fossil material rather
than place it under one of these two genera which undoubtedly appear closest
to the specimens under consideration. Such a step would avoid any possible
confusion that may arise especially when the time gap to be bridged is so
vast as the entire Tertiary period.

*Classification.*—The present genus belongs to the family *Pristolepidae* of
the superfamily *Percoidae* since its scales are of moderate size, with the nucleus
subapical in position and fairly large in size, the radii are complete and con-
verge inside the nucleus.

*Palaeopristolepis feddeni* sp. nov.

*(Pl. VII, Figs. 4–8; Text Figs. 2–5)*

*Material* : 9 specimens.

*Syntypes* : BM 32/72, BM 1/71.

*Description.*—This form is represented by nine specimens, none of them
showing a complete individual. Out of these nine specimens, two (WR 6/71,
BM 32/72) are only pelvic fins, five specimens (BM 1/71, BM 3/70, BM 1/72,
BM 14/71, WR 24/71) consist of vertebrae with spines and sometimes with
ribs and/or fins, the remaining two specimens (BM 32/72, BM 33/72) contain
the skull and are counterparts of each other, neither of them having the skull
preserved completely.

As can be gathered from the two specimens containing fragmentary
skull, the opercle is triangular, supported by a subopercle which is not very
large. The preopercle is narrow and extended to only a very little extent.
The eye is not very large. The jaw is in closed position and no comments
can be offered regarding the maxilla or dentary, except that the maxilla appears
to be strong.
The body in general is compressed and oblong. The pectoral fins originate almost immediately posterior of the opercle and consist of 14 rays. The two dorsal fins are united together, the anterior being spinous and the posterior soft. The anterior dorsal fin has about 10 spines, posterior being with 12 soft rays. The pelvic fins are moderate in size, with 12 rays. The anal fin has three spines anteriormost in position and about 6 soft rays. The caudal fin is only fairly large with hypurals and has about 14 principal rays; it is rounded in shape.
The number of vertebrae is 22 to 25; 9 or 10 of them are thoracic, remaining ones being caudal.

The scales are distinctly pristolepid and are $2 \text{ mm} \times 2.5 \text{ mm}$ in size. They are circular with small subapical nucleus. 9 to 11 complete radii converge in the nucleus. Due to their overlapping one another, the apical ctenoid portion is seen in only a few of the scales. Lateral line seems to be absent.

Remarks.—The pristolepid scales described and figured by Hora (1938 b, p. 282, Text-Figs. 12 b, Pl. XVII, Fig. 1) are subquadruate as against circular nature of the scales of the present species.

There are two other types of pristolepid scales in the author's collection, the comparison with them is given under their description elsewhere.

Occurrence.—Cherty beds in the Inter-trappean bed at Bamanbor.

ACKNOWLEDGEMENTS

The present work was carried out under the guidance and supervision of Dr. G. W. Chiplonkar for which I am indebted to him. Dr. G. B. Deodikar, Director, M.A.C.S., has obliged me by providing the necessary facilities. The Director-General, Geological Survey of India very kindly allowed me access to their Central Library and type specimens. Dr. M. V. A. Sastry and his colleagues in the Palaeontology Division, Geological Survey of India, have been helpful with their comments. I am much thankful to Dr. A. G. K. Menone, Dr. B. S. Chauhan and Dr. K. K. Tiwari, all of Zoological Survey of India, for their valuable suggestions in connection with taxonomic work. Thanks are also due to Dr. S. L. Jain, Indian Statistical Institute, Calcutta, for his helpful suggestions. My colleagues Dr. R. M. Badve, Mr. P. M. Tapaswi, Mr. D. A. Joshi and Mr. M. A. Ghare were helpful during the field work and also otherwise.

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EXPLANATION OF PLATE VII

Figs. 1–2: Horaclupea intertrappea gen. et sp. nov.
1. Holotype (specimen No. BM 8/70), × 3.
2. Same, × 1.

Fig. 3: Perca sp. cf. P. angusta Agassiz

Figs. 4–8: Palaeopristolepis feddeni gen. et sp. nov.
4. A few scales on syntype (specimen No. BM 1/71), × 3.
5. One of the scales in Fig. 5, enlarged, × 20.
6. Paratype (specimen No. BM 3/70), × 1.
7. Syntype (specimen No. BM 32/72), × 1.
8. Syntype (specimen No. BM 1/71), × 1.