

MICRO TELEOST REMAINS FROM THE MIOCENE OF INDIA

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ABSTRACT

Eighteen species of Miocene teleosts belonging to six families and eleven genera are described from the Baripada beds (Orissa), Kutch and Kathiawar (Gujarat). There are four new species of teleosts viz. *Cybium biconvexa*, *Sparus agarwali*, *Dentax compressa* and *Dentax constrictus*. The Miocene teleosts are dominated by the family Sparidae and have been found to be closely similar to the Miocene teleosts described from Portugal and Africa.

PREVIOUS WORK

Fossil teleosts from the Miocene of India were reported as early as 1939 by Hora, when he described the spines of *Arius* and teeth of *Trichiurus* and (?) *Scomber* from the Baripada Beds. After that Rao (1956) recorded the occurrence of *Arius* from gypseous shales of Matanomadh, Kutch. Prasad (1966, 1974) for the first time reported a few teleosts teeth from Kathiawar. Since then no report of fossil teleost from Kathiawar has been made. Mohanti (1966) recorded the teeth of *Sphyræna* from the Baripada beds. Later on Bhalla and Dev (1975) reported the occurrence of teeth belonging to *Sphyræna* and *Trichiurus* in association with foraminifera and shark teeth from the arenaceous limestones of the Baripada beds. Shani and Misra (1975) described a number of teleost teeth along with a large number of elasmobranchs teeth from the Miocene beds of Matanomadh and Lakhpat, Kutch.

INTRODUCTION

The present paper deals with a systematic description of fossil teleosts from the Miocene beds of Baripada (Orissa) on the eastern coast and, Kutch and Kathiawar (Gujarat) on the western coast of Indian subcontinent. Prior to present work only sporadic occurrences of the fossil teleosts had been recorded.

In Orissa, the Baripada beds are exposed along Burbhalang River valley at three localities viz., Usurdihi (86°43'38" : 21°53'43"), Satpautia (86°40'54" : 21°51'58") and Mukurmatia (86°43'24" : 21°50'36") covering a distance of 20 kms from north to south. Of the above three localities, only samples from Usurdihi have yielded fossil teleosts. The yellow and yellowish brown arenaceous limestones lying above the green to greyish shales (lowermost unit of the Baripada beds) have

yielded prolific microremains of teleosts. This limestone is 1.5 m thick with the thickness decreasing south-wards and passing upward into a greyish to bluish-white shale.

In Kutch, the grey coloured gypseous shales at Matanomadh (23°33" : 68°58") and arenaceous shales at Lakhpat (23°49" : 68°27") in the southwestern part have yielded a number of teleost teeth. These shales are about 4 m and 3.5 m thick at Matanomadh and Lakhpat, respectively.

The fossil teleosts from Kathiawar have been obtained from the Lower Miocene unconsolidated conglomerates of Akwara (72° 11' 20" : 21° 44' 56") with the thickness varying from 30 cm to 60 cm at Gogha coast and the fossiliferous limestones lying below the Ossiferous Conglomerate of Piram Island (72°21'04" : 21°53'58").

All types and figured specimens have been deposited in Lucknow University Vertebrate Palaeontology (L.U.V.P.) Museum, Geology Department, Lucknow University.

SYSTEMATIC DESCRIPTION

<i>Class</i>	Osteichthyes
<i>Subclass</i>	Actinopterygii
<i>Superorder</i>	Teleosti
<i>Order</i>	Ostariophysi
<i>Suborder</i>	Siluroidei
<i>Family</i>	Ariidae
<i>Genus</i>	<i>Arius</i> CUVIER and VALENCIENNES, 1840

Arius sp.

(Pl. I—1A & 1B)

Material : L.U.V.P. 5045, Pectoral spine.

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Description : The spine is robust and the sigmoidally curved shaft is laterally compressed. The width of the spine is more towards the proximal end than the distal end. Towards the proximal end there are condylar facets and towards the posterior border there is a deep median fossa which continues as a groove. On the anterior edge, backwardly directed serrations are present. Serrations on the posterior border are worn out. Very faint longitudinal striations are seen on the surface of the shaft.

Remarks : The specimen described here closely resembles with the pectoral spine described by Hora (1939) from Balasore. But in Hora's specimen only the proximal portion is preserved and it is devoid of any ornamentation and serrations on its edges. It differs from *Arius kutchensis* described by Sahni and Misra (1975) from the Eocene of Kutch in its very small size and not having strong longitudinal striations.

Order Acanthopterygi
Suborder Sphyrnoidei
Family Sphyracidae
Genus *Sphyracna* BLUGH and SCHNEIDER, 1801.

Sphyracna sp.
 (Pl. I—2)

Material : L.U.V.P. No. 5069 and a few unnumbered teeth.

Description ; L.U.V.P. 5069 is a long and conical tooth. The crown is slightly compressed with rounded margins and a smooth surface. Basal section of the crown is elliptical without an opening for the pulp cavity.

The above characters suggest that L.U.V.P. 5069 may be a laniary tooth of the premaxilla.

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Suborder Scombroidea
Family Scombridae
Genus *Scombramphodon* WOODWARD, 1901

Scombramphodon sp.
 (Pl. I—3)

Material : L.U.V.P. No. 5084, sagittal section of a tooth.

Description : The only tooth (L.U.V.P. 5084) in the collection is large and conical. The external surface of the crown possesses vertical striations which are denser towards the apex. The apex is slightly inclined towards the inner margin. In the sagittal section, a central pulp cavity of large diameter is present which is surrounded by osteodentine. The canal narrows down towards the apex of the crown.

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Genus *Cybium* CUVIER, 1829.
Cybium biconvexa sp. nov.
 (Pl. 10, figs. 4-6)

Etymology : 'Biconvexa' refers to biconvex basal section of tooth.

Material : Holotype—L.U.V.P. 1013, an isolated tooth ;

Paratype—L.U.V.P. 11180.

Diagnosis : Conical and laterally compressed teeth are distinguished from *C. angustidens* described from the Eocene of Africa which has parallel lateral edges curving sharply towards apex of tooth. Lateral edges in *C. biconvexa* sp. nov. closely resemble *C. serraheiroi* described from the Miocene of Portugal and *C. bottei* described from the Miocene of Italy but differ in having a biconvex basal section in contrast to the former two species which have hexagonal and plano-convex basal sections, respectively.

Description : L.U.V.P. 1013 is larger than L.U.V.P. 11180. Both the teeth are conical and laterally compressed with sharp lateral edges which bear very fine serrations 10-12 per millimeter. In L.U.V.P. 1013, height/width ratio is more than one while, in L.U.V.P. 11180 height and width are nearly equal. The surface of the crown possesses longitudinal striations limited at the crown's base. Basal section of the crown in both L.U.V.P. 1013 and L.U.V.P. 11180 is biconvex and opening for pulp cavity is absent.

Remarks : L.U.V.P. 11180 was first described by Sahni and Misra (1975) from the lower Miocene arenaceous shales of Lakhpat, Kutch as *Cybium* sp. and this was first fossil report of *Cybium* from the Indian subcontinent. On the basis of its characteristic biconvex basal section, L.U.V.P. 11180 has been designated as *Cybium biconvexa* sp. nov. However, L.U.V.P. 1013 is a first report of any teleost (bony) fish from Kathiawar.

It is significant to note that no fossil record of *Cybium* are available from the east coast of Indian subcontinent and except as discussed above, *Cybium* has not been reported from the west coast of Indian subcontinent. Although four species of *Cybium* viz., *C. commersonii*, *C. guttatus*, *C. kuhli* and *C. interruptus* are found presently in Bay of Bengal and Arabian sea. Fossil teeth of *Cybium* has been reported from the Miocene beds of Portugal, Italy (Jonet, 1967) and Eocene of Nigeria (White, 1926) but no records are available from New Zealand and Australia.

The above evidences suggest that during early Tertiary period (Eocene to Miocene) *Cybium* flourished only in western Arabian Sea, Mediterranean Sea and Atlantic Ocean. It probably migrated to Bay of Bengal and Pacific Ocean only in later part of Tertiary period.

Horizon and Locality : Miocene fossiliferous limestones below the Ossiferous Conglomerate of Piram Island

and Lower Miocene arenaceous shales of Lakhpat, Kutch.

Suborder Trichiuroidei
Family Trichiuridae
Genus *Trichiurus* LINNAEUS, 1758.

Trichiurus sp.
(Pl. 1—7)

Material : L.U.V.P. 5083, a single tooth.

Description : Lower Miocene limestones of Baripada, Orissa.

Description : L.U.V.P. 5083 is a large and laterally compressed tooth. Its basal part is short and vertical while the apical part is strongly curved making an obtuse angle. The inner margin of the crown has a distal barb in its upper part while the outer margin is smooth. The internal face of the crown has a median groove on its lower part but the external surface is smooth. The pulp cavity is absent.

Remarks : L.U.V.P. 5083 has been found similar to the *Trichiurus* described by Hora (1937, p. 213, Text-fig. 9) from district Balasore, Orissa. The comparison with *Trichiurus oshosunensis* described by White (1926, p. 65, pl. 16, fig. 14-20) from the Eocene of Nigeria reveals that the crown in L.U.V.P. 5083 is straight and large in comparison to *T. oshosunensis* which has narrow crown with recurved apex.

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Order Acanthopterygi
Suborder Percoidei
Family Sparidae
Genus *Sparus* LINNE, 1758.

(Syn. *Chrysophrys* CUVIER, 1829)

Sparus cinctus AGASSIZ, 1839

(Pl. I—8-9)

Material : L.U.V.P. 5078, L.U.V.P. 5081 and 14 unnumbered teeth.

Description : L.U.V.P. 5081 is strong, large and cylindrical tooth while L.U.V.P. 5078 is small and hemispherical tooth. L.U.V.P. 5081 can be very well divided into 2 parts—The basal portion which is high, thick and circular and the apical one less high, narrower with a rounded apex. The apex is slightly inclined towards the inner margin. The outer margin is convex. The apical and basal parts of the crown are separated by a pronounced furrow. In the basal section, which is circular, a central cavity is seen.

In L.U.V.P. 5078 the hemispherical crown is lower than L.U.V.P. 5081. The basal part is short and circular while the apical part is high and not separated by the furrow as in L.U.V.P. 5081. The basal section is circular and central cavity is absent.

Judging from the characters of the crown, L.U.V.P. 5078 may be a lateral tooth and L.U.V.P. 5081 may represent a canine of *Sparus cinctus*.

Remarks : The specimens described have been found similar with the *Sparus cinctus* described by Jonet (1975, Text-fig. 2, pl. 1, fig. 2 to 7 and pl. 2, fig. 1).

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Sparus auratus LINNE, 1758

(Pl. I—10-11)

Material : L.U.V.P. 5101 and L.U.V.P. 5102.

Description : The crown in L.U.V.P. 5101 is a sub-cylindrical shaft, surmounted by a conical cap with flattened apex. The apical part of the crown is separated by a constriction with the basal part. The surface in the conical part of the crown is smooth, while the remaining surface is rough. The basal section is circular with an opening for pulp cavity surrounded by thick wall. In L.U.V.P. 5102 which is an incomplete sagittal section, a median cavity of diamond shaped is present at the base which narrows further upwards in the shape of a canal. The pulp cavity is surrounded by a thick wall of pseudo-dentine (replaced dentine).

The characters of the crown of L.U.V.P. 5101 suggest that the tooth may be any of the intermediate teeth.

Horizon and locality : Lower Miocene limestones of Baripada, Orissa.

Sparus agarwali sp. nov.

(Pl. I—12-13)

Etymology : For Prof. S. K. Agarwal, Geology Department, Banaras Hindu University, Varanasi.

Material : Holotype—L.U.V.P. 5105, an isolated tooth.

Diagnosis : The present specimen is very similar to *S. auratus* but differs in having its apical part of the shaft conical and inclined towards inner margin. The basal part of the shaft is much wider than the upper part in contrast to *S. auratus* described from the Miocene of Portugal where the apical and basal parts of the shaft are marked by a pronounced furrow all round the shaft. The furrow is absent in *S. auratus*.

Description : L.U.V.P. 5105 is subcylindrical in its basal part while strongly conical in upper part. The height of the basal part is more than the apical part. On the apical part there is a conical cap inclined towards its inner margin of the shaft. The basal section of the shaft is circular with a central cavity surrounded by thick walls.

Horizon and locality : Lower Miocene limestones of Baripada, Orissa.

Genus *Pagellus* CUVIER and VALENCIENNES, 1830.

Pagellus sp.

(Pl. 1—14)

Material : L.U.V.P. 5064 and a few unnumbered teeth.

Description : L.U.V.P. 5064 consists of a cylindrical shaft which narrows towards apical part and then terminate as a cone. The apex is inclined towards the inner margin of the shaft. The apical part makes an obtuse angle with the basal part. The inner margin of the crown is gently concave while the outer margin is regularly convex.

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Genus *Pagrus* CUVIER, 1817
Pagrus robustus JONET, 1975
(Pl. I—15-16)

Material : L.U.V.P. 5072 and L.U.V.P. 5070 ; isolated teeth.

Description : L.U.V.P. 5072 is with a smooth cylindrical shaft which is massive and stout. The height of the basal part of the tooth is nearly equal to its diameter of its basal section. The apical part is subconical with flattened apex. Basal section of the crown is circular with a central pulp cavity surrounded by thick radial wall consisting of osteodentine (dentine with bone cells).

In L.U.V.P. 5070 the apical part of the crown is slightly inclined towards its inner margin. The profile of tooth suggests it to be any of the intermediate teeth.

Remarks : L.U.V.P. 5072 was found to be identical with the *P. robustus* described and figured by Jonet (1975, page 151, Pl. II, fig. 39) and may be an anterior "molar".

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Pagrus sp.
(Pl. I—17-19)

Material : L.U.V.P. 5067, L.U.V.P. 5082 and L.U.V.P. 5092 ; isolated teeth.

Description : L.U.V.P. 5082 is a globular tooth with an enameloid cap. The basal part of the crown is separated from the apical part by a furrow. The diameter of the apical part is more than the basal part. Basal section of the crown is sub-circular with a central pulp cavity surrounded by a thick wall.

In L.U.V.P. 5067 the crown is a cylindrical shaft in the basal part and conical in the apical part with a flattened apex. A faint constriction is present between the basal and apical part. Basal section is elliptical with the central pulp cavity surrounded by walls.

L.U.V.P. 5092 is a sagittal section in which a central, narrow pulp canal is present. The canal is surrounded by osteodentine (dentine with bone cells) which is overlain by a thin layer of dentine.

The characters of the crown suggest that L.U.V.P. 5082 may be a "molar" tooth while L.U.V.P. 5067 may

be an intermediate tooth and L.U.V.P. 5092 may be an anterior "molar".

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Genus *Diplodus* RAFINESQUE, 1810
(=*Sargus*, KLEIN CUVIER, 1817)
Diplodus laticonus, DAVIS 1888
(Pl. II—1-2)

Material : L.U.V.P. 5068 and L.U.V.P. 5071 and few unnumbered teeth.

Description : The teeth are broad, chisel-shaped to spatulate and incurved. The crown of the teeth can be distinguished into two parts separated by a pronounced cavity—one basal part which is wide and cream-coloured and the apical part which is larger than wide and with a transversely flattened apex. In L.U.V.P. 5068 the crown is straight while it is incurved in L.U.V.P. 5071. The root is nearly as wide as the crown (L.U.V.P. 5068) and marked by a constriction. In L.U.V.P. 5071 the constriction is pronounced. Crown as well as root are devoid of any ornamentation.

In sagittal section the teeth are solid without any pulp cavity. On their apex and the margins, the thick dentine covering is present while the remaining part of teeth is full of orthodentine (denser form of dentine).

L.U.V.P. 5068 seems to represent an incisor of the symphysis while L.U.V.P. 5071 may be any of the intermediate teeth as suggested by the shape of the crown.

Remarks : Teeth described in the present work are identical with the *Sargus laticonus* described by Chapman (1918) from the Miocene of Newzealand (Pl. VII, fig. 3-7).

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Diplodus jomnitanus VELENCIENNES, 1844
(Pl. II—3)

Material : L.U.V.P. 5072(a) and 5072(b) and few unnumbered teeth.

Description : The teeth are solid, large and slightly compressed. The height of the subtriangular crown is more than its width and it is inclined towards its inner margin. The outer margin is slightly convex while the inner is gently concave. The external surface is feebly concave. The root, partly preserved in L.U.V.P. 5072(a) is nearly as wide as the crown.

Remarks : *Diplodus jomnitanus* described by Jonet (1975) from the Miocene of Portugal (Pl. I, fig. 23) is identical with the L.U.V.P. 5072(b) described in the present work. Besides, *Diplodus jomnitanus* has also been described by Leriche (1957) from the Neogene of Britain and France. L.U.V.P. 5072(a) is identical to the anterior teeth (Pl. IV, fig. 19) described by Leriche (1957).

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Diplodus sp.
(Pl. II—4-5)

Material : L.U.V.P. 5073, L.U.V.P. 5074, L.U.V.P. 5080 and many unnumbered specimens.

Description : The teeth are small and broad. The shape of the crown is subtriangular to near quadrangular. The crown is divisible into two parts—the basal one is very wide and cream-coloured. The height of the basal part is less than its width and the apical part is strong with transversely flattened apex. Root is strong and nearly as wide as crown. In one of the unnumbered specimen the height of the root is more than the double the height of the crown. In L.U.V.P. 5080 the stout root is separated with the crown by a constriction. The surface of the root as well as of the crown is devoid of any ornamentation.

In sagittal section (L.U.V.P. 5074) the teeth are solid, consisting of orthodentine except on the apex and margin of the crown where there is a thick cover of dentine.

Horizon and Locality ; Lower Miocene limestones of Baripada, Orissa.

Family Denticidae
Genus *Dentex* CUVIER, 1817.

Dentex sp.
(Pl. II—6-9)

Material : L.U.V.P. 4550, L.U.V.P. 5082, L.U.V.P. 5065, L.U.V.P. 5067 and many unnumbered isolated teeth.

Description : The teeth are of varying size, which are cylindro-conical with pointed apex. L.U.V.P. 4550 and few unnumbered specimens are very large while L.U.V.P. 5062, L.U.V.P. 5065 and L.U.V.P. 5067 are very small. The crown is curved towards its inner margin and on its surface it bears fine longitudinal striations. The basal face of the crown is circular with a central pulp cavity. The convexity is surrounded by pseudodentine which is radially arranged. In one of the unnumbered specimen the apical part of the crown is more conical than the basal part.

Remarks : The species described here resembles very much with the teeth described and figured by Jonet (1955, Pl. I and II) as *Dentex* sp.

Horizon and Locality : Lower Miocene unconsolidated conglomerates from Akwara, Bhavnagar and Lower Miocene limestones of Baripada, Orissa.

Dentex compressa sp. nov.
(Pl. II—10)

Etymology : 'Compressa' refers to compressed nature of tooth.

Material : Holotype—L.U.V.P. 5066, an isolated tooth.

Diagnosis : The species closely resembles with the *Dentex fossilis* Jonet (1975), but the apical half of the tooth is largely compressed laterally and basal half is cylindrical in the new species. The characteristic shape of tooth distinguishes it from all the teeth described and figured by Jonet (1975, Pl. I and II). The pointed apex of the crown towards the inner margin with fine striations on its surface and a central pulp cavity in L.U.V.P. 5066 indicate that the specimen is *Dentex*.

Description : The tooth is of median size and strong. The crown can be divided into two parts which are separated by a thin collar. The basal part is stout, cylindrical and wide, while the upper part is laterally compressed with pointed apex. The apex is inclined towards inner margin. Very fine longitudinal striations are present on the apical part of the crown. The outer margin is gently convex. The basal section presents a circular shape with a central cavity.

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Dentex constrictus sp. nov.
(Pl. II—11)

Etymology : 'Constrictus' refers to narrow nature of the pulp cavity.

Material : Holotype—L.U.V.P. 5104, a sagittal section of the tooth.

Diagnosis : The well preserved sagittal section of the tooth closely resembles with the sagittal section of *Dentex fossilis* figured by Jonet (1975, Text-fig. 3c) but the narrow pulp cavity with thick pseudodentine and dentine distinguishes it from *Dentex fossilis*. In all the other species of *Dentex* the base of the pulp cavity is always wide narrowing across abruptly from the middle of the crown. In the present species the continuous pulp cavity with almost uniform thickness is present and it is very narrow, the character making it different from its allied species.

Description : In the sagittal section, a narrow but continuous pulp cavity is visible in the centre. The pulp canal is surrounded by a thick pseudodentine which is thicker at the base. Pseudodentine is in turn surrounded by a layer of dentine which is fairly thick. The surface of the crown is smooth.

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa.

Order Tetradontiformes
Suborder Plectognathi
Family Diodonitidae
Genus *Diodon* LINNAEUS, 1758

Diodon sp.
(Pl. II—12-13)

Material : L.U.V.P. 5061, L.U.V.P. 11095, L.U.V.P. 11510 and many unnumbered isolated dental plate.

Description : The dental plates range in size from 5 mm to 2.5 cm in their long diagonal and consists of oval lamellar plates. These lamellar plates are divided into symmetrical halves by a vertical plane and each half is of subtriangular shape. In L.U.V.P. 5061 the vertical plane is deep and wide while in L.U.V.P. 11095 and other unnumbered specimens it is slightly elevated. The number of lamellar plates are four in L.U.V.P. 5061 and five in L.U.V.P. 11095. The lamellae are thick. The dimension of the lamellar plate increases basally. The edges of the lamellae are smooth but slightly irregular in L.U.V.P. 11095. The upper surface of the dental plate is uniform and smooth while in L.U.V.P. 11510 the surfaces are slightly depressed. On the anterior side of each dental plate there are number of teeth. In L.U.V.P. 5061 only two to three teeth are present while there are nine teeth in L.U.V.P. 11095 and six teeth in L.U.V.P. 11510. The teeth are arranged in transverse rows which are convex. The median teeth are larger than the marginal ones. In L.U.V.P. 5061 the teeth are oval but polygonal in L.U.V.P. 11510.

Remarks : The record of fossil *Diodon* so far from India is meagre and in the present day Indian Ocean is represented by *Diodon hystrix*, flourishing in Bay of Bengal. Dental plates of *Diodon* have earlier been recorded by Lydekker (1886) from Ramri Island, Burma and by Nair (1945) from Nicobar Island. Sahni and Misra (1975) were the first to record dental plates of *Diodon* sp. from the gypseous shales (Lower Miocene) of Matanomadh and arenaceous shales of Lakhpat, Kutch, on the west coast of Indian subcontinent suggesting that *Diodon* had spread throughout the Indian Ocean during the Tertiary period.

L.U.V.P. 5061 from the Baripada beds closely resembles with *D. sinhaleyus* described by Deraniyagala (1952, 1969) from the Malu Member of Sri Lanka but differs in having a smaller size and smooth edges of lamellae. L.U.V.P. 5061 is further found to differ from *D. foleyi* reported from the Eocene of Ramri Island (Lydekker, 1886) in its smaller size and convexity of wear

and *Diodon* sp. figured by Leriche (1957, Pl. IV, fig. 36) in having a smooth upper surface of the lammelar plate.

Horizon and Locality : Lower Miocene limestones of Baripada, Orissa and Lower Miocene arenaceous shales of Lakhpat and gypseous shales of Matanomadh, Kutch.

DISCUSSION

On the basis of Micro teleost remains an attempt has been made to review the Miocene teleost fauna of Indian subcontinent with a view to establish the relative abundance and to up date the occurrence of Miocene fossil teleosts on the eastern and western coast of Indian subcontinent, to study the interrelationship of various genera and families, to revise their taxonomy, to establish the relationship with the Miocene teleosts described from Portugal and Africa and to interpret the results from the viewpoint of palaeoecology.

A close study of the fossils described in the present work reveals that the teleosts group is best represented in the Baripada fauna on the east coast followed by Kutch on the western coast. In Kathiawar the representation of teleosts is very poor (Table 1). However, further work in Kathiawar area may reveal more information.

The teleost fauna described above was recovered alongwith the large number of elasmobranchs (Mehrotra *et al.*, 1973) from Baripada, Kutch and Kathiawar. But it was found that the elasmobranchs are in greater abundance in comparison to teleosts. This is attributed to the fact that the teeth of elasmobranchs are periodically shed and replaced by the same individual and thus abundantly preserved as fossils. On the contrary, the remains of teleosts could be preserved only under conditions of quiet sedimentation.

A comparison of fossil teleosts reports from the Miocene beds of Indian subcontinent with those flourishing in the present day Indian ocean reveals interesting inferences. During the Miocene period the teleosts constituted only less than 25% of the total fish fauna while their representation in the present day seas is more than 90%. The data is based on the present day catch composition of the east and west coasts of Indian subcontinent (Prasad, 1969 ; Jhingran, 1977). The high percentage of teleosts in the present day catches of both east coast and west coast unlike the very low percentage during the Miocene may be due to the fact that the teleosts are mainly deep water forms and demand very quiet and favourable conditions of deposition while elasmobranchs are mainly pelagic forms thriving below 20°C and because of proximity to shore lines have better conditions of preservation as fossils.

Like the fossil elasmobranchs the problem of synonymy in fossil teleosts too, had been a focal point. To cite an

Measurements of new species (in millimeters) :

Name of the species	Specimens	Height of the crown	Width of the crown
<i>Cybium biconvexa</i>	L.U.V.P. 1013	20	10
	L. U.V.P. 11180	15	9
<i>Sparus agarwali</i>	L.U.V.P. 5105	26	18
<i>Dentex compressa</i>	L.U.V.P. 5066	41	17
<i>Dentex constrictus</i>	L.U.V.P. 5104	45	16

Table 1. Occurrence of various Teleost species in Baripada, Piram Island, Gogha Coast and Kutch.

Sl.	Families, genera and species	Baripada	Piram Island	Gogha Coast	Kutch
		<i>Family Sparidae</i>			
1.	<i>Sparus cinctus</i>	+			
2.	<i>S. auratus</i>	+			
3.	<i>S. agarwali</i> sp. nov.	+			
4.	<i>Pagellus</i> sp.	+			
5.	<i>Pagrus robustus</i>	+			
6.	<i>Pagrus</i> sp.	+			
7.	<i>Diplodus laticonus</i>	+			
8.	<i>D. iomnitanus</i>	+			
9.	<i>D. spp.</i>	+			
10.	<i>Dentex</i> sp.	+			
11.	<i>Dentex compressa</i> sp. nov.	+			
12.	<i>Dentex constrictus</i> sp. nov.	+			
		<i>Family Scombridae</i>			
1.	<i>Scrombramphodon</i> sp.	+			
2.	<i>Cybiium biconvexa</i> sp. nov.				+
		<i>Family Diodontidae</i>			
1.	<i>Diodon</i> sp.	+			+
		<i>Family Trichiuridae</i>			
1.	<i>Trichiurus</i> sp.	+			
		<i>Family Sphyraenidae</i>			
1.	<i>Sphyraena</i> sp.				+
		<i>Family Ariidae</i>			
1.	<i>Arius</i> sp.	+			

instance, the names *Sparus* Linne, 1758 and *Chrysophyrus* Cuiver, 1829 have produced considerable taxonomic problems. But because of common usage the former has been given priority over the latter. Similarly the genus *Sargus* Cuvier, 1817 has been put under the synonymy of *Diplodus* Rafinesque, 1810.

Teleost fauna described in the present paper has been found closely similar to the fauna described from the Miocene of Portugal (Jonet, 1975) and Africa (White, 1926) indicating a faunal similarity along the mediterranean axis.

Teleost fishes are widely distributed in the Atlantic,

Pacific, Indian and Mediterranean seas and nearly all the teleost genera described here inhabits the present day Indian Ocean. *Arius* is one of the commonest siluroid occurring in seas and estuaries of the tropical regions ascending to tidal influence and even enter fresh water. *Trichiurus* though typical of tropical seas may be found in the vicinity of land. They follow some ocean currents and have been reported from temperate zones. The ecological evidences are suggestive of near shore, warm, shallow marine environment for the Miocene beds present on the east coast and west coast of Indina subcontinent.

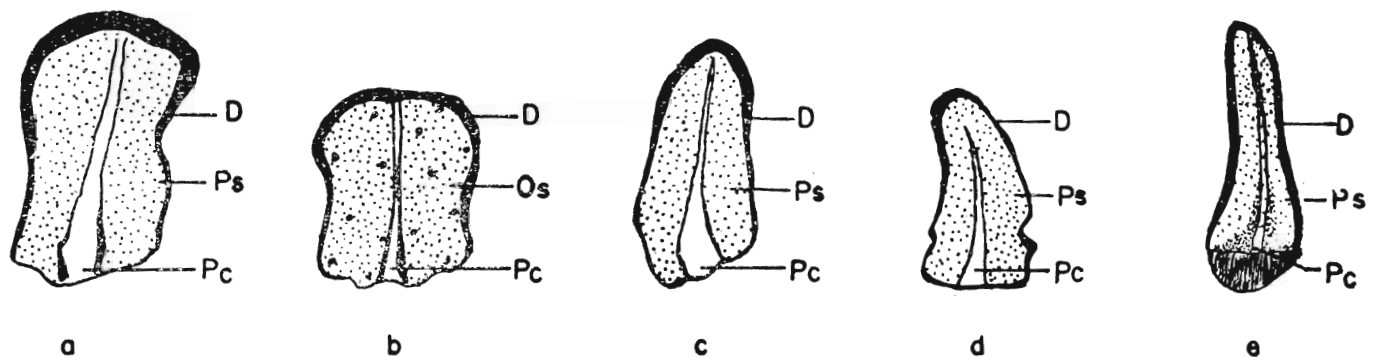


Fig. 1. Sagittal Sections

- a—*Sparus auratus*
 b—*Pagrus* sp.
 c & d—*Dentex* sp.
 e—*Dentex constrictus* sp. nov.
 Pc—Pulp Cavity; D—Dentine; Osteodentine; Pseudodentine.

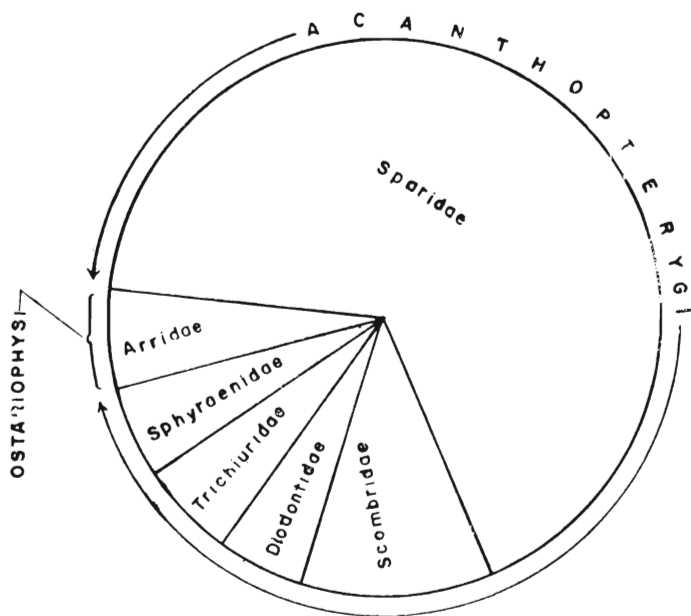


Fig. 2. Relative abundance of teleost families in Baripada, Piram, Kathiawar and Kutch.

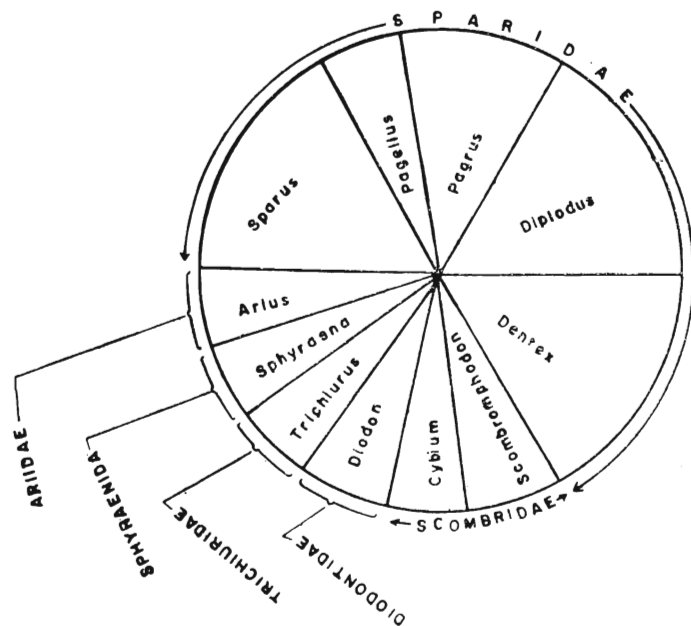


Fig. 3. Relative abundance of various teleost genera in Baripada, Piram, Kathiawar and Kutch.

Relative abundance of various teleost families occurring during the Miocene period of Indian subcontinent shows that the family Sparidae was dominant among teleosts. The study of teleost genera in the localities investigated shows that the genera *Sparus*, *Diplodus* and *Dentex* were equally common during the Miocene period (Figs. 2 & 3).

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EXPLANATION OF PLATES

PLATE I

- Arius* sp.
 1A. L.U.V.P. 5054, dorsal view $\times 1.5$
 1B. Ventral view $\times 1.5$
Sphyaena sp.
 2. L.U.V.P. 5069, dorsal view $\times 40$
Scombramphodon sp.
 3. L.U.V.P. 5084, Sagittal Section $\times 80$
Cybium biconvexa sp. nov.
 4A. L.U.V.P. 1013, dorsal view $\times 3$
 4B. Ventral View $\times 3$
 4C. Lateral View $\times 3$
 5A. L.U.V.P. 11176, dorsal view $\times 2.5$
 5B. Basal View $\times 2.5$
 6A. L.U.V.P. 11180, dorsal view $\times 3$
 6B. Basal view $\times 3$
Trichiurus sp.
 7. L.U.V.P. 5083 $\times 125$
Sparus cinctus Agassiz.
 8. L.U.V.P. 5081 $\times 150$
 9. L.U.V.P. 5078 $\times 160$
Sparus auratus Linne
 10. L.U.V.P. 5101 $\times 250$
 11. L.U.V.P. 5102, Sagittal Section $\times 250$
Sparus agarwali sp. nov.
 12. L.U.V.P. 5105 $\times 200$
 13. L.U.V.P. 5105b $\times 225$
Pagellus sp.
 14. L.U.V.P. 5064 $\times 150$
Pagrus vobustus
 15. L.U.V.P. 5072 $\times 135$
 16. L.U.V.P. 5070 $\times 120$
Pagrus sp.
 17. L.U.V.P. 5082 $\times 180$
 18. L.U.V.P. 5067 $\times 175$
 19. L.U.V.P. 5092, Sagittal Section $\times 175$

PLATE II

- Diplodus laticonus* Davis
 1. L.U.V.P. 5071 $\times 350$
 2. L.U.V.P. 5068 $\times 310$
Diplodus jomniganus Valenciennes
 3A. L.U.V.P. 5072 $\times 200$
 3B. L.U.V.P. 5072b $\times 200$
Diplodus sp.
 4. L.U.V.P. 5075 $\times 125$
 5. L.U.V.P. 5080 $\times 300$
Dentex sp.
 6A. L.U.V.P. 4550a $\times 1.25$
 6B. L.U.V.P. 4550b $\times 1.25$
 7. L.U.V.P. 5063 $\times 2.40$
 8A. L.U.V.P. 5065a, Sagittal Section 90
 8B. L.U.V.P. 5065 b, Sagittal Section $\times 240$
 9. L.U.V.P. 5067 $\times 120$
Dentex constrictus sp. nov.
 10. L.U.V.P. 5066 $\times 60$
Dentex construcus sp. nov.
 11A. L.U.V.P. 5104, external view $\times 50$
 11B. L.U.V.P. 5104a Sagittal Section $\times 60$
Diodon sp.
 12A. L.U.V.P. 5061, Occlusal view $\times 2$ Anterior view $\times 2$
 12B. Anterior view $\times 2$
 13A. L.U.V.P. 11510, Occlusal view $\times 2$
 13B. Anterior view $\times 2$



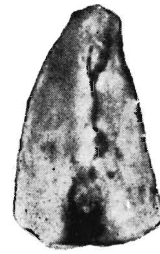
1A



1B



2



3



4A



5A



5B



6A



6B



7



4B



4C



8



9



10



11



12



13



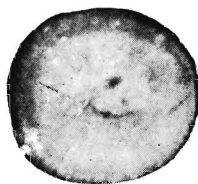
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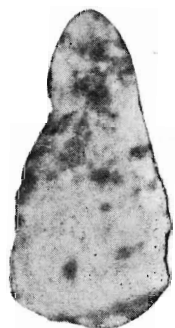
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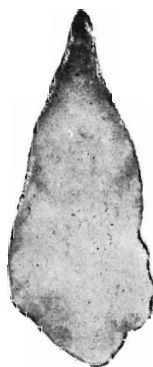
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1



2



3A



3B



4



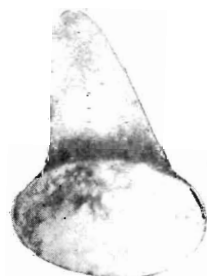
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6A



6B



7



8A



8B



9



10



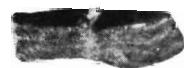
11A



11B



12A



12B



13A



13B