



MANGROVE ASSOCIATE GOBIES (TELEOSTEI : GOBIOIDEI) OF INDIAN SUNDARBANS

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INTRODUCTION

The gobioid fishes are distributed throughout the temperate and tropical zones of the world. They occur in fresh to hyper saline waters, in mud, sand as well as reef habitats. Some species have a very wide distribution, while a few are markedly localized. Most species are cryptic bottom dwelling carnivores that usually feed on small benthic invertebrates. Abundance in number of species, intraspecific morphological diversity and interesting habitat, behaviour and adaptations make them a subject of great biological importance. Most of the gobioid fishes found in the Sundarbans are mangrove associates, particularly the mudskippers are characteristic of any mangrove habitat.

The Sundarbans is known as the world's largest mangrove ecosystem. Mangroves are well known as transition from the marine to freshwater and terrestrial ecosystems. They provide critical habitat for numerous species of fishes and crustaceans that are adapted to live, reproduce and spend their juvenile lives among the tangled mass of roots, known as pneumatophores, that grow upward from the anaerobic mud to get the trees' supply of oxygen. However, it is difficult to say which species are confined to the mangroves and are not occurring in other habitats (Macnae, 1966). Hence, the total habitat is taken into consideration to study this peculiar group of fish.

Our knowledge of these fishes of Bengal (pre-partitioned) dates from Hamilton (1822) who described 16 gobioid species from the lower reaches of the River Ganga. Later, Annandale (1907), Hora (1933, 1935 a, b), and others contributed significantly to the fishes of Hugli-Matla estuarine system. The monumental work of Koumans (1941) gives a vivid account of gobioid fishes of India that incorporates a number of species from lower Bengal. Chatterjee (1978) studied the gobioid fishes of the Gangetic delta and described a new genus and new species (Chatterjee and Mishra 2013). Talwar *et al.*, (1992) and Mukherjee (1995) further contributed to the wealth of gobioid fauna of West Bengal and the Hugli-Matla estuaries.

The present study aims at giving an account of the mangrove associate gobioid fishes of the Indian Sundarbans, where inundation and exposure occur twice in every block of 24 hours. This work incorporates the review of the gobioid fishes occurring in the region. The current status of species is mostly following Froese and Pauly (2013) and Eschmeyer (2013). The gobioid classification in to subfamilies is in accordance with Nelson (2006). The identification keys provided here are meant for Indian Sundarbans only and that may not be suitable for other geographic regions.

MATERIAL AND METHODS

The largest part of the material, on which the present work is based, is housed in the National

Zoological Collections of the Zoological Survey of India (Z.S.I.), Kolkata. The collections include a large number of gobioid fishes collected by Sir F. Day, A. W. Alcock, N. Annandale, S. L. Hora, and others, which include a number of type specimens. Most of the specimens on which F. P. Koumans based his monumental work (Koumans, 1941) are also preserved in the Z.S.I. These specimens include several collections from the adjoining areas of Sundarbans. All specimens included in Mukherjee (1995), housed in Z.S.I., were re-examined and used for the present work. It is also supplemented by recent collections of gobioid fishes during 2007-08 from the various locations of Sundarbans. The study area is shown in fig.1 and a satellite picture of the Sundarbans is also shown in fig.2. Recent collections were made from the following places. Garmin 12 channel GPS was used to mark the latitude and longitude of the places surveyed. The places surveyed recently and their GPS points are as follows:

Gosaba	22°09.924' N; 88°47.819' E
Sajnakhali	22°07.485' N; 88°49.809' E
Dobanki	21°59.368' N; 88°45.259' E
Haldibadi	21°43.547' N; 88°46.966' E
Chamta	21°51.667' N; 88°54.831' E
Khatuajhuri	22°03.293' N; 88°59.356' E
Burirdhabri	22°04.653' N; 89°01.730' E
Jhila	22°11.393' N; 88°57.543' E
Neti Dhopani	21°55.219' N; 88°44.759' E
Dobanki	22°59.368' N; 88°45.259' E
Sudhanyakhali	22°06.058' N; 88°48.075' E
Basanti	22°12.167' N; 88°42.660' E
Jharkhali	22°01.127' N; 88°40.935' E
Sonakhali	22°12.259' N; 88°42.655' E
Canning	22°19.184' N; 88°40.471' E

Abbreviations of names of the organizations used in this work:

SDCMBRI Susama Devi Chowdhurani Marine Biological Research Institute, Sagar Island

ZSI	Zoological Survey of India
ZSI-ASB	Asiatic Society of Bengal collections, now housed in the Zoological Survey of India, Kolkata
ZSI-SFRS	Sundarban Field Research Center, ZSI, Canning collections

The Sundarbans

The Sundarbans can be defined as a group of islands starting from the mouth of river Hughly on the west and extending upto the river Meghna in the east, covering four districts, two from West Bengal viz. North 24-Parganas, South 24-Parganas districts; and two from Bangladesh, viz., Khulna and Barishal districts. The Indian Sundarbans at the apex of Bay of Bengal (latitude 21°13'- 22°40' N. and longitude 88°03'- 89°06' E.) is located on the southern fringe of the state of West Bengal, covering the major portions of North and South 24-Parganas districts. The region is bordered by Bangladesh in the east, the Hughly river in the west, Dampier-Hodges line in the north and Bay of Bengal in the south. As regards the total area of Sundarban forests, a number of estimations are found in literatures (Dey, 2006). In a recent estimation by the Forest department, it has been stated that 4,264 sq. km. forest persists within Indian Territory and 4,109 sq. km. in Bangladesh. With considerable degree of marine characteristics in the major portion of the ecosystem, the important morphotype of the deltaic Sundarbans are beaches, mudflats, coastal dunes, sand flats, estuaries, creeks, inlets and mangrove swamps. The mangrove environment can be differentiated into four forest types, viz., Tidal Swamp Forests, Saline Water Type Mixed Forests, Brackish Water Type Mixed Forests, and Palm-Swamp Type. Though it is very difficult to define the mangrove fauna as a whole, Ekman (1935) stated that the mangrove fauna is characterized by its low species diversity represented by large populations. Macnae (1966) observed that it is difficult to say which species are confined to the mangrove and are not occurring in other habitats. On the other hand, same species may be available in various mangrove ecosystems within the same ecological region.

Main Flora and fauna : There are 64 plant species in the Sundarbans with the capacity to withstand estuarine conditions and saline inundation as a result of tidal effects. Some of them are listed here: *Excoecaria agallocha*, *Heritiera fomes*, *Ceriops decandra*, *Ceriops tagal*, *Phoenix paludosa*, *Sonneratia alba*, *Avicennia* spp., *Rhizophora apiculata*, *Rhizophora mucronata*, *Xylocarpus granatum*, *Nypa fruticans*, *Bruguiera* spp. etc. The invertebrate faunal diversity of Indian Sunderbans, as enumerated by Mandal and Nandi (1989), comprised one species of Porifera, 5 Cnidaria, 1 Ctenophora, 5 Rotifera, 2 Nematoda, 2 Chaetognatha, 3 Ectoprocta, 1 Brachiopoda, 2 Echiura, 1 Sipuncula, 48 Annelida, about 170 Crustacea, 155 Insecta, 35 Arachnida, 94 Mollusca, and 14 Echinodermata. In addition to Royal Bengal Tiger, the vertebrate fauna comprise 58 species of mammals, around 248 bird species and 55 species of reptiles as per 2004 census. Although the Census report includes only 47 species of fishes from the Indian part of the Sundarbans, Mandal and Nandi (1989) gives a list of about 140 species that include only 14 species of gobioid fishes. Mangrove associate gobies are generally represented by aquatic and semi-aquatic communities adapted at stress conditions.

Gobioids of Bangladesh Sundarban: As there is no physical, climatic or any other natural barrier in Sundarbans between India and Bangladesh, it can be presumed that similar composition of mangrove associate gobies are available in Bangladesh side of Sunderbans. Only 27 species of Gobioid fishes so far recorded from Bangladesh (Rahman, 1989; Ahmed, 1991), out of which *Eleotris lutea* Day, *Acentrogobius caninus* (Valenciennes), *A. cyanomos* (Bleeker), *Awaous grammepomus* (Bleeker), *A. guamensis* (Valenciennes), *Eugnathogobius oligactis* (Bleeker), *Exyrias puntang* (Bleeker), *Oxyurichthys microlepis* (Bleeker) and *Periophthalmus barbarus* Linnaeus have not been recorded from Indian side of Sunderban. The other 18 species are mentioned in the text. Reports of *Ophiocara porocephala* (Valenciennes) (Kapoor *et al.*, 2002) and *Boleophthalmus dussumieri* Valenciennes (Talwar and Jhingran, 1991) from Bangladesh waters are unconfirmed.

TAXONOMIC ACCOUNT

The suborder Gobioidi belongs to the Class Actinopterygii (ray-finned fishes) and the Order Perciformes. Gobies are primarily marine fishes, also found in brackish and freshwater environments. The characteristics of the gobioid fishes (Miller, 1973) are as follows. Body without lateral line canal, but with only exposed neuromast organs (pit organs). Head generally with sensory canal-pores. Oculoscapular lateral line canal, when present, may or may not extend over snout before nostrils, preopercular canal with 2-5 primary pores, or often absent; horizontal section of preopercular canal at best very short, distant from angle of jaw and usually lacking. Scales with only peripheral ctenii consistently developed, sometimes cycloid or absent. Five to 7 branchiostegal rays. The suborder Gobioidi is grouped under nine families (Nelson, 2006), of which only two families are found to occur in the Sunderbans.

FAMILY ELEOTRIDAE

Body elongate, scales small to moderate. Two dorsal fins separate or connected only at their bases. First dorsal fin comprises 6 flexible spines; second with one spine and 8 or 9 rays. Anal fin with one spine and 6 to 9 rays. Ventral fins separate either completely to the base or almost to it. Body without lateral line canal, only exposed neuromast organs (pit organs). Head usually with sensory canal pores. Six branchiostegal rays.

Key to genera

1. (a) A single spine at preopercular margin .. *Eleotris*
(b) No spine at preopercular margin 2
2. (a) Serrated ridges on head; head flat *Butis*
(b) No serrated ridges on head.....3
3. (a) Scales small, 40 or more in longitudinal series*Odonteleotris*
(b) Scales moderate, less than 40 in longitudinal series 4
4. (a) Sensory canal pores on snout, interorbital and posterior margin of preoperculum; pit organs in longitudinal and transverse lines *Ophiocara*
(b) Sensory canal pores only on posterior margin of preoperculum; pit organs in only longitudinal lines *Ophieleotris*

Genus Butis Bleeker**Key to species:**

- 1 (a) Maxillary not extending beyond anterior margin of eye; caudal fin black with a light margin dorsally*Butis butis*
 (b) Maxillary extending up to middle of eye; caudal fin uniformly black*Butis melanostigma*

Butis butis (Hamilton)

1822. *Cheilodipterus butis* Hamilton, *Fish. Ganges*: 57, 367 (Ganges river below Calcutta).

1991. *Butis butis*: Talwar and Jhingran, *Inland Fishes of India*, 2: 973.

Material examined: 1 ex., Gosaba (Sundarbans), 02.iv. 2008, T. K. Chatterjee and party, ZSI-SFRS uncat.

Distribution: Widespread in sheltered waters of tropical Indian and West Pacific including Bangladesh. It is known to enter estuaries.

Butis melanostigma (Bleeker)

1849. *Eleotris melanostigma* Bleeker, *Verh. batav. Genoot. Kunst. Wet.*, 22: 23 (Indonesia).

1991. *Butis melanostigma*: Talwar and Jhingran, *Inland Fishes of India*, 2: 974.

Material examined: 8 ex., Calcutta, no date, Asiatic Society of Bengal coll., ZSI ASB Cat. 246; 3 ex., Calcutta, no date, Asiatic Society of Bengal coll., ZSI ASB Cat. 247; 1 ex., Haldibari (Sundarbans), 27.iii.2008, T. K. Chatterjee and party, ZSI-SFRS uncat.

Distribution: In brackish waters of eastern India, Bangladesh, Myanmar, Thailand and Indo-Australian Archipelago.

Genus : Eleotris Bloch and Schneider**Key to species:**

1. (a) Lateral series scales 60-68*Eleotris fusca*
 (b) Lateral series scales 40-55*Eleotris melanosoma*

Eleotris fusca (Forster)

1801. *Poecilia fusca* Forster, in Bloch and Schneider, *Syst. Ichthyol.*: 453 ("Oriadea insulae rivulis" = Pacific Islands).

1991. *Eleotris fusca* (Bloch and Schneider): Talwar and Jhingran, *Inland Fishes of India*, 2: 975.

Material examined: 3 ex., Uttarbhag, Lower Bengal, 06.ix.1934, S.L. Hora, ZSI F-5649/2; 1 ex.,

Uttarbhag, Lower Bengal, 1934, S.L. Hora, ZSI F-5610/2; 1 ex., Edward's creek, Fraserganj, 11.viii.1974, T.K. Chatterjee, ZSI F-7254/2.

Distribution: Red Sea and east coast of Africa, India, Bangladesh to French Polynesia in the Pacific, Ryukyu Islands in north to New Caledonia in south.

Eleotris melanosoma Bleeker

1852. *Eleotris melanosoma* Bleeker, *Natuurk. Tijdschr. Ned.-Indie.*, 3: 705 (Wahai, Western Sumatra, Indonesia).

1991. *Eleotris melanosoma*: Talwar and Jhingran, *Inland Fishes of India*, 2: 977.

Material examined: 1 ex., off Jambu Island (Gangetic delta), 07.ix.1974, T.K. Chatterjee, ZSI F 7382/2.

Distribution: Indo-Pacific- from east coast of Africa to Society Islands in the Pacific, north to Japan.

Remarks: This species has been recorded for the first time from the Gangetic delta by Chatterjee (1978).

Genus Odonteleotris Gill**Odonteleotris macrodon (Bleeker)**

1853. *Eleotris macrodon* Bleeker, *Verh. batav. Genoot. Kunst. Wet.*, 25: 104, p1. 2, fig. 1 (Hooghly river at Calcutta).

1991. *Odonteleotris macrodon*: Talwar and Jhingran, *Inland Fishes of India*, 2: 978.

Material examined: 1 ex., Sagar Island, no date, A. Khuda-Buksh, ZSI F-7384/2; 4 ex., Calcutta, no date, F. Day, ZSI ASB Catal. 253.

Distribution: Estuaries and rivers of India, Myanmar, Malaysia and Indonesia.

Remarks: No specimen could have been collected in recent past.

Genus : Giuris Sauvage**Giuris margaritacea (Valenciennes)**

1837. *Eleotris margaritacea* Valenciennes, in Cuvier & Valenciennes, *Hist. nat. poiss.*, 12: 240 (Vanikoro Island, Santa Cruz Islands, South-Western Pacific).

1991. *Ophieleotris aporos*: Talwar and Jhingran, *Inland Fishes of India*, 2: 979.

Material examined: 1 ex., Sundarban delta (Bengal), no date, collector unknown, ZSI F-7383/2.

Distribution: Freshwaters and estuaries of India; Madagascar; Indonesia to the Philippines, Northern Australia, Fiji and Palau.

Remarks: No specimen could have been collected in recent past. IN literature, this species was known as *Ophieleotris aporos* (Bleeker, 1854) till Hoese (2006) considered it with treating genus *Ophieleotris* Aurich, 1938 as a Junior synonym of *Giuris* Sauvage, 1880.

Genus *Ophiocara* Gill

Ophiocara porocephala (Valenciennes)

1837. *Eleotris porocephala* Valenciennes, in Cuvier and Valenciennes, *Hist. nat. poiss.*, 12: 237 (Seychelles; New Ireland, Bismarck Archipelago).

1991. *Ophiocara porocephala*: Talwar and Jhingran, *Inland Fishes of India*, 2: 980.

Material examined: 1 ex., Bakkhali, 08.ix.1974, T.K. Chatterjee, ZSI F-7252/2; 3 ex., Edward's creek, Fraserganj, 11.ix.1974, T.K. Chatterjee, ZSI F-7255/2.

Distribution: Throughout the temperate Indo-Pacific, except Far East Pacific, usually in cloudy water.

Family : **GOBIIDAE**

Body oblong to elongate, eel-like in some. Two dorsal fins, separate or connected at their bases, the second dorsal fin is longer than the first dorsal fin. Ventral fins typically united forming a disc-like structure, basal membrane present or absent. Body with ctenoid or cycloid scales. Teeth simple, in upper jaw in one to several rows. Body without lateral line canal, only exposed neuromast organs (pit organs). Head usually with sensory canal pores and cutaneous papillae. Five branchiostegal rays.

Key to genera

- 1. (a) A single confluent fin formed of the dorsal, caudal and anal fins; eyes greatly reduced (Amblyopinae).....2
- (b) Two dorsal fins, separate or connected at base only, not confluent with caudal; eyes prominent 9

- 2. (a) No groove on the upper gill cover 3
- (b) A small groove on the upper gill cover which has a blind end 6
- 3. (a) Chin and lower jaw with barbels; canine present4
- (b) No barbel on chin and lower jaw; canine absent5
- 4. (a) Pectoral fin length about 70% of head length*Odontamblyopus*
- (b) Pectoral fin length about 30% of head length *Taenioides*
- 5. (a) Chin with pores; pectoral fin rays not more than 25 *Caragobius*
- (b) Chin without pore; pectoral fin rays about 40 *Pseudotrypauchen*
- 6. (a) Fang-like canines present; some patch of scales on head *Amblyotrypauchen*
- (b) No fang-like canines on jaws; head naked7
- 7. (a) Ventral fins separated to the base; ventral fin with one small outer ray and 3 branched rays*Trypauchenichthys*
- (b) Ventral fins united or emarginated; ventral fin with one undivided ray and 5 branched rays 8
- 8. (a) Ventral fins united to form an adhesive disc; belly scaled *Trypauchen*
- (b) Ventral fins united but emarginate posteriorly; belly without scales*Paratrypauchen*
- 9. (a) Lower jaw with only a single row of teeth; eyes located mostly dorsally (Oxudercinae)10
- (b) Lower jaw with two or more rows of teeth; eyes mostly lateral 18
- 10. (a) Base of second dorsal fin short, segmented rays in second dorsal fin less than 15; pectoral fin base muscular 11
- (b) Base of the second dorsal fin much longer, segmented rays in second dorsal fin 20 or more; pectoral fin base not muscular 12
- 11. (a) Teeth in upper jaw uniserial *Periophthalmus*
- (b) Teeth in upper jaw biserial *Periophthalmodon*
- 12. (a) Free lower eyelid present 13
- (b) Free lower eyelid absent 14
- 13. (a) Teeth in lower jaw pointed; chin with barbels*Scartelaos*
- (b) Teeth in lower jaw notched; chin without barbels*Boleophthalmus*

14. (a) First dorsal fin with V spines 15
 (b) First dorsal fin with VI spines 16
15. (a) Dorsal and anal fin with 23 or less total elements; scales in longitudinal series about 100 *Apocryptes*
 (b) Dorsal and anal fin with 26 or more total elements; scales in longitudinal series about 200 *Pseudapocryptes*
16. (a) Longitudinal scale rows less than 60; anal fin with 23 or less elements *Apocryptodon*
 (b) Longitudinal scale rows more than 60; anal fin with 24 or more elements 17
17. (a) Prominent canine teeth on each side of upper jaw symphysis; head length more than 24% of standard length *Oxuderces*
 (b) No prominent canine teeth on each side of upper jaw symphysis; head length less than 24% of standard length *Parapocryptes*
18. (a) Anterior interorbital pores paired or head pores absent; pelvic frenum usually present, simple, not folded forward (Gobionellinae) 19
 (b) A single anterior interorbital pore present or head pores absent; if 2 pores present, pelvic frenum folded forward and a fleshy lobe present around each spine (Gobiinae) 24
19. (a) Shoulder girdle under gill cover with distinct finger-like flaps; gill membrane fused together forming a free fold across isthmus *Awaouichthys*
 (b) Shoulder girdle under gill cover smooth or with minute bump 20
20. (a) Head pores absent 21
 (b) Head pores present 22
21. (a) Head papillae in transverse pattern; body without scales below dorsal fin; transparent or yellowish translucent *Gobiopterus*
 (b) Head papillae in longitudinal pattern; body fully scaled; body with dusky bands or spots *Brachygobius*
22. (a) Only one pair of pores or no pore present on snout 23
 (b) Two pairs of pores present on snout 24
23. (a) Mucous canal on cheek in longitudinal rows only; lateral canal over opercle present; body colour variable *Hemigobius*
 (b) Mucous canal on cheek with some transverse rows radiating from eye; body distinctly spotted *Stigmatogobius*
24. (a) Cheek with large scales; a violet streak below eye *Gnatholepis*
 (b) Cheek naked; no streak below eye *Oligolepis*
25. (a) Barbels present 26
 (b) Barbels absent 27
26. (a) Barbels present only on chin *Parachaeturichthyes*
 (b) Barbels present on chin, snout and sides of head *Gobiopsis*
27. (a) Upper pectoral fin rays free and silky 28
 (b) Upper pectoral fin rays not free and silky 29
28. (a) A curved canine tooth present on each side of lower jaw *Istigobius*
 (b) No curved canine tooth on each side of lower jaw *Bathygobius*
29. (a) Caudal fin longer than head; predorsal scales 6 to 9 *Drombus*
 (b) Caudal fin not longer than head; predorsal scales 12 to 30 29
30. (a) Scales small, more than 100 scales on lateral series *Amblyeleotris*
 (b) Scales moderate, less than 40 scales on lateral series 30
30. (a) Head depressed; snout pointed *Glossogobius*
 (b) Head compressed; snout obtuse *Acentrogobius*
- Subfamily: AMBLYOPINAE
- Body elongate, with both dorsal fin joined by membrane. Dorsal and anal fins confluent with caudal fin. Usually pink or purple in colour.
- Genus *Amblyotrypauchen* Hora
- Amblyotrypauchen arctocephalus* (Alcock)
1890. *Amblyopus arctocephalus* Alcock, *Ann. Mag. nat. Hist.*, Ser. 6, 6 (36): 432 (Off Máhánaddi Delta and off Vizagapatam coast, India).
2003. *Amblyotrypauchen arctocephalus*: Murdy, *Proc. Biol. Soc. Wash.*, 116 (2): 330.
- Material examined*: 1 ex., Sandheads, Mouth of R. Hughly, 26 fms, no date, P. V. Fraser, ZSI F-10819/1 (holotype of *Amblyotrypauchen fraseri* Hora).
- Distribution*: Indo-West Pacific; India; and the South China Sea.

Genus *Caragobius* Smith and Seale*Caragobius urolepis* (Bleeker)

1852. *Amblyopus urolepis* Bleeker, *Natuurk. Tijdschr. Ned.-Indie*, **3**: 581 (Palembang, Sumatra).
1991. *Brachyamblyopus urolepis*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 982.
2003. *Caragobius urolepis*: Murdy and Shibukawa, *Zootaxa*, **301**: 5, fig. 1-2, tab. 1-2.

Material examined: No material from Sunderbans examined.

Distribution: India to the Philippines. Oceania: Papua New Guinea.

Remarks: Koumans (1941) examined specimens from the lower Bengal in the Indian Museum collections, but presently the specimens are not traceable.

Genus *Odontamblyopus* Bleeker*Odontamblyopus rubicundus* (Hamilton)

1822. *Gobioides rubicundus* Hamilton, *Fish. Ganges*: 37, 365; p1. 5, fig.9 (Estuaries of Ganges).
1991. *Odontamblyopus rubicundus*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 983.

Material examined: 4 ex., Matlah River, Dec. 1916, S. W. Kemp, ZSI F-5296/2; 2 ex., Sundarbans, no date, J. T. Jenkins, ZSI F-5296/2; 3 ex., Ichamati River, no date, A. Alcock, ZSI 13290-13291 & 13293.

Distribution: Eastern Africa to the Pacific, including India and Bangladesh.

Genus *Paratrypauchen* Murdy*Paratrypauchen microcephalus* (Bleeker)

1860. *Trypauchen microcephalus* Bleeker, *Act. Soc. Indoneerl.*, **8**: 62 (Sungi-Dugri, Borneo).
1991. *Ctenotrypauchen microcephalus*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 987.
2008. *Paratrypauchen microcephalus*: Murdy, *Aqua*, **14**(3):118.

Material examined: 1 ex., mouth of Hooghly River, no date, R. M. Daly, ZSI -11614; 1 ex., Mutlah River, Sundarbans, 17.xi.1909, collector unknown, ZSI F-5444/2; 1 ex., Kakdwip, 10.iii.1985, B.P. Halder & P. Mukherjee, ZSI F-8155/2; 1 ex., Kakdwip, 06.iv.1987, B.P. Halder &

P. Mukherjee, ZSI F-8108/2 (last two specimen labelled as *Trypauchenichthys typus* Bleeker).

Distribution: Widespread in Indo-Pacific.

Remarks: This species has been assigned to the genus *Ctenotrypauchen* Steindachner by many authors (Menon and Chatterjee, 1977; Talwar and Jhingran, 1991) in the past. However, *Paratrypauchen* differs noticeably from *Ctenotrypauchen* in the absence of a prominent serrated frontal crest and in lacking scales on the abdomen (Murdy, 2008).

Genus *Pseudotrypauchen* Hardenberg*Pseudotrypauchen multiradiatus* Hardenberg

1931. *Pseudotrypauchen multiradiatus* Hardenberg, *Treubia*, **13** (3-4): 418, fig. 8 (Bagan Si Api Api, Sumatra, Indonesia).
1953. *Brachyamblyopus multiradiatus*: Koumans, *Fish. Indo-Aust. Archip.*, **10**: 267.
2002. *Pseudotrypauchen multiradiatus*: Murdy and Shibukawa, *Mar. Freshw. Res.*, **53**(2): 255; fig. 1-2.

Material examined: 1 ex., Sandheads, mouth of Hooghly River, 17.vi.1885, A. Millner, ZSI 11336; 3 ex., mouth of Hooghly River, 1929, 'Lady Fraser' coll., ZSI F-5308/2;

Distribution: Mouth of the Hooghly river, and Sumatra.

Genus *Taenioides* Lacepede

Key to species

1. (a) Dorsal and anal fins continuous with the caudal, caudal fin pointed 2
- (b) Dorsal and anal fins separated from the caudal, by a deep notch, caudal fin rhomboid *Taenioides cirratus*
2. (a) Vertical fins black, pre-anal distance more than 40% of standard length *Taenioides buchanani*
- (b) Vertical fins yellowish, pre-anal distance less than 40% of standard length *Taenioides anguillar*

Taenioides anguillar (Linnaeus)

1758. *Gobius anguillar* Linnaeus, *Syst. Nat.* (ed. 10) **1**: 264 (China).
1991. *Taenioides anguillar*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 984.

Material examined: 3 ex., Uttarbhadra, 23.ii.1934, S. L. Hora, ZSI F-5547/2; 1 ex., Uttarbhadra, no date, S. L. Hora, ZSI uncat.; 1 ex., Calcutta, no date, F. Day, ZSI F-2116.

Distribution: River mouths on the Asian Coast from India, to China, and New Guinea.

***Taenioides buchanani* (Day)**

1873. *Amblyopus buchanani* Day, *Proc. Zool. Soc. Lond.*, 1873 (1): 110 (Calcutta and Moulmein).

1991. *Taenioides buchanani*: Talwar and Jhingran, *Inland Fishes of India*, 2: 985.

Material examined: 1 ex., Sagar Island, 1977, A. Khuda-Buksh, ZSI F-7352/2; 1 ex., Burirdabri (Sundarbans), 26.iii.2008, T. K. Chatterjee and party, ZSI-SFRS uncat.

Distribution: East coasts of India, Bangladesh and Myanmar.

***Taenioides cirratus* (Blyth)**

1860. *Amblyopus cirratus* Blyth, *J. Asiat. Soc. Beng.*, 29 (2): 147 (probably Hooghly river at Calcutta).

1991. *Taenioides cirratus*: Talwar and Jhingran, *Inland Fishes of India*, 2: 985.

Material examined: 8 ex., Fraserganj, 05.09.1974, T. K. Chatterjee, ZSI F-7360/2; 1 ex., Calcutta, no date, F. Day, ZSI 2072.

Distribution: Indo-Australian archipelago, East coast of Africa to India including Andaman-Nicobar Islands, Bangladesh, to New Guinea and Australia, north to Japan.

Genus *Trypauchen* Valenciennes

***Trypauchen vagina* (Bloch and Schneider)**

1801. *Gobius vagina* Bloch and Schneider, *Syst. Ichthyol.*: 73 (Tranquebar, India).

1991. *Trypauchen vagina*: Talwar and Jhingran, *Inland Fishes of India*, 2: 988.

Material examined: 1 ex., Matlah River, 1916, S. W. Kemp, ZSI F-5291/2; 1 ex., mouth of Hooghly River, date unknown, R.I.M.S. 'Investigator' coll., ZSI F-5361/2; 3 ex., Calcutta, no date, F. Day, ZSI 2105-2107.

Distribution: Persian Gulf, Pakistan, India including Nicobar Islands; Bangladesh, Sri Lanka, Thailand, Vietnam, Malaya, China and Taiwan.

Remarks: This has been described as *Gobioides ruber* in Hamilton (1822) from estuary below Calcutta [Kolkata] (Murdy, 2006).

Genus *Trypauchenichthys* Bleeker

***Trypauchenichthys sumatrensis* Hardenberg**

1931. *Trypauchenichthys sumatrensis* Hardenberg, *Treubia*, 13 (3-4): 146, 417; fig. 7 (Sumatra, Indonesia).

2008. *Trypauchenichthys sumatrensis*: Murdy, *Aqua*, 14 (2): 62; fig. 2 A-B; tab.1-3.

Material examined: 1 ex., Sand heads, mouth of Hooghly river, 1928, P.V. 'Lady Fraser' coll., ZSI 11536; 3 ex., Sand heads, mouth of Hooghly river, 1927, P.V. 'Lady Fraser' coll., ZSI F 5228/2; 1 ex., Sand heads, mouth of Hooghly river, 1928, P.V. 'Lady Fraser' coll., ZSI F 5613/2.

Distribution: India (mouth of Hooghly River) and Indonesia (Sumatra).

Remarks: Mukherjee (1995: 386) reported *Trypauchenichthys typus* Bleeker as first record from India. The specimens examined and found to have I, 5 elements in the ventral fin, hence are not *Trypauchenichthys* species, which have I, 3 elements only. With noticed absence of fang-like teeth and scales on head and belly, the specimens of Mukherjee (1995) are considered as *Paratrypauchen microcephalus* (Bleeker). Hora (1924) has also mistaken this species as *Trypauchensis typus* Bleeker (Talwar and Jhingran, 1991).

Subfamily OXUDERCINAE

Body elongate; eyes located dorsally; dorsal fins separated by a gape; dorsal and anal fins separated from caudal fin; lower jaw typically with a single row of teeth.

Genus *Apocryptes* Valenciennes

***Apocryptes bato* (Hamilton)**

1822. *Gobius bato* Hamilton, *Fish. Ganges*: 40, 365; p1. 37, fig 10 (estuaries of Ganges).

1991. *Apocryptes bato*: Talwar and Jhingran, *Inland Fishes of India*, 2: 951.

Material examined: 7 ex., Hooghly river, 13 miles down Nawadwip ghat, 26.v.1953, Hooghly

Survey, ZSI F-248/2; 2 ex., Hoogly river, near Nilmahal, 08.v.1954, Hooghly Survey, ZSI F-4972/2; 3 ex., Hoogly river, near Uporhat, 12.v.1954, Hooghly Survey, ZSI F-4974/2; 1 ex., Matlah River, Canning, 29.v.1977, B.C. Goswami, ZSIF-7355/2.

Distribution: Indian mainland, Bangladesh and Myanmar.

Genus *Apocryptodon* Bleeker

Apocryptodon madurensis (Bleeker)

1849. *Apocryptes madurensis* Bleeker, *Verh. batav. Genoot. Kunst. Wet.*, **22**: 35 (Strait Madura).

1991. *Apocryptodon madurensis*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 952.

Material examined: No material from Sunderbans examined.

Distribution: India, East Indies, Thailand, Philippines, north to Japan.

Remarks: Koumans (1941: 278) examined specimens from Port Canning and Uttarbhag, Lower Bengal in the Indian Museum collections, but the specimens are presently not traceable.

Genus *Boleophthalmus* Valenciennes

Key to species

1. (a) Lateral body with dark spots or oblique bands, first dorsal fin grayish with blue spots *Boleophthalmus boddarti*
- (b) Lateral body without spots or bands, first dorsal fin purplish with black spots *Boleophthalmus dussumieri*

Boleophthalmus boddarti (Pallas)

1770. *Gobius boddarti* Pallas, *Spicilegium Zool.*, **1** (8) :11; pl. 2, figs. 4-5 (Indian Ocean).

1991. *Boleophthalmus boddarti*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 954.

Material examined: 14 ex., canal near Forest Range Office, Fraserganj, 05.ix.1974, T. K. Chatterjee, ZSI F-7362/2; 1 ex., canal at Bakkhali, Fraserganj, 08.ix.1974, T. K. Chatterjee, ZSI F-7251/2.

Distribution: India, Bangladesh, Thailand, Malaysia to New Guinea, north to China; also reported from Persian Gulf.

Remarks: *Gobius plinianus* described by Hamilton (1822) is referred to be this species (Rahman, 1989; Murdy, 1989).

Boleophthalmus dussumieri Valenciennes

1837. *Boleophthalmus dussumieri* Valenciennes, in Cuvier and Valenciennes, *Hist. nat. poiss.*, **12**: 207, pl. 354 (Bombay, India).

1991. *Boleophthalmus dussumieri*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 954.

Material examined: 2 ex., Jambu Island, 07.ix.1974, T. K. Chatterjee, ZSI F-7385/2;

Distribution: West coast of India, Baluchistan, Iraq and Pakistan. Probably occurs in Bangladesh.

Remarks: This has been first recorded from Eastern India by Chatterjee (1978: 164). Later, Talwar and Jhingran (1991) have reported it as common in Gangetic delta.

Genus *Oxuderces* Eydoux and Souleyet

Oxuderces dentatus Eydoux and Souleyet

1842. *Oxuderces dentatus* Eydoux and Souleyet, *Zoologie*, **1** (2): 182; p1. 8, fig. 2 (Macao, China).

1991. *Oxuderces dentatus*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 955.

Material examined: 2 ex., Jambu Island (from a shallow depression at the muddy bank of China River mouth), 07.ix.1974, T.K. Chatterjee, ZSI F 7391/2.

Distribution: India (Gangetic delta, West Bengal; Tamil Nadu), Indonesia, Thailand, Macao and China.

Remarks: This has been recorded first from Gangetic delta by Chatterjee (1981). This is a very rare species. The third author could have examined two more specimens collected from Sagar Island only recently (during May, 2010).

Genus *Parapocryptes* Bleeker

Parapocryptes serperaster (Richardson)

1846. *Apocryptes serperaster* Richardson, *Rep. Br. Ass. Advmt. Sci., 15th meet.* (1845): 206 (Macao, China).

1991. *Parapocryptes serperaster*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 957.

Material examined: 1 ex., a canal near Forest Range Office, Fraserganj, 05.ix.1974, T.K.Chatterjee, ZSI F-7361/2; 1 ex., Sagar Island, 1977, A. Khuda-Buksh, ZSI F-7351/2; 1 ex., Port Canning, 01-09.vii.1930, R. Hodgart, ZSI F-5624/2.

Distribution: Coasts of tropical Indo-Pacific: India, Myanmar, Malaysia, Indonesia, and China; entering tidal rivers.

Remarks: Mukherjee (1995) reported *Parapocryptes macrolepis* (Bleeker), which is now considered as a junior synonym of *Parapocryptes serperaster* (Richardson) (Murdy, 1989).

Genus *Periophthalmus* Bloch and Schneider

Key to species

1. (a) Basal membrane or frenum of pelvic fins absent; two halves of pelvic fins separate, not joined by membrane; first dorsal fin margin concave; thin silvery bars ventrally on sides*P. argentilineatus*
- (b) Basal membrane or frenum of pelvic fins weakly to moderately developed; two halves of pelvic fins joined by membrane to some extent; first dorsal fin margin not concave; no thin silvery bars ventrally on sides2
2. (a) Pelvic frenum prominent; first dorsal fin spines usually X or less; longitudinal scales usually less than 70 *P. novemradiatus*
- (b) Pelvic frenum vestigial; first dorsal fin spines usually XI or more; longitudinal scales usually more than 70*P. kalolo*

Periophthalmus argentilineatus Valenciennes

1837. *Periophthalmus argentilineatus* Valenciennes, in Cuvier and Valenciennes, *Hist. nat. poiss.*, **12**: 191 (Moluccas, Indonesia).
1953. *Periophthalmus vulgaris* Eggert: Koumans, *Fish. Indo-Aust. Archip.*, **10**: 210.
1993. *Periophthalmus argentilineatus*: Kottelat *et al.*, *Freshw. Fish. west. Indonesia Sulawesi*: 148, pl. 69.

Material examined: Not examined.

Distribution: Hughli-Matla estuary (West Bengal), Andhra Pradesh, Andamans; Myanmar, Thailand, Java and Australia.

Remarks: Mukherjee (1995: 367) reported it from Falta near 'Kella' as *P. vulgaris* Eggert, a junior synonym (Murdy, 1989), based on one example collected on 25.03.1985.

Periophthalmus kalolo Lesson

1830. *Periophthalmus kalolo* Lesson, *Voy. 'Coquille' Zool.*, **2**(1): 146 (Offack Harbor, Waigiou).
1935. *Periophthalmus koelreuteri kalolo*: Eggert, *Zool. Jahrb. Syst.*, **67**(1-2): 76.
1991. *Periophthalmus koelreuteri*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 965.
1993. *Periophthalmus kalolo*: Kottelat *et al.*, *Freshw. Fish. west. Indonesia Sulawesi*: 149, pl. 69.

Material examined: 1 ex., mouth of River Hooghly, Sundarbans, 1911, S. W. Kemp, ZSI 5431/2 (registered as *Periophthalmus koelreuteri*).

Distribution: Mangroves from eastern Africa to Polynesia.

Remarks: In current parlance of nomenclature, *Periophthalmus koelreuteri* (Pallas) is relegated to synonymy of *P. barbarus* (Linnaeus), an Atlantic species (Murdy, 1989). *P. barbarus* is unlikely to occur in our region. Barman *et al.*, (2007: 148), following Koumans (1953), considered the Indian species referred as to this name should be known as *P. kalolo* Lesson. Records of *P. barbarus* from Sundarbans of Bangladesh (Ahmed, 1991) may possibly referable to this species. Mukherjee (1995: 366) reported *Periophthalmus malaccensis* Eggert from Gosaba as the first record from India. The third author examined his specimen (ZSI F-8073/2) and confirmed that he was erroneous in identifying *Periophthalmus kalolo* specimens as *Periophthalmus malaccensis*. Interestingly, he has not collected any specimen of *Periophthalmus kalolo* from the region.

Periophthalmus novemradiatus (Hamilton)

1822. *Gobius novemradiatus* Hamilton, *Fish. Ganges*: 47, 366, Pl. 2, fig. 14 (Uttarbhadra, Ganges delta).
2009. *Periophthalmus novemradiatus*: Jaafar, Perrig and Chou. *Zool. Sci.*, **26**: 309; fig.1-5; tab.1-2.

Material examined: 10 ex., Chamta (Sundarbans), 28.iii.2008, T. K. Chatterjee and party, ZSI-SFRS uncat; 3 ex., Jharkhali, 22.iv.1984, B.P. Halder & P. Mukherjee, ZSI F-8019/2; 4 ex., Bakkhali khal, 04.iii.1987, B.P. Halder & P. Mukherjee, ZSI F-8094/2; 2 ex., Bakkhali, 07.iii.1987, B.P. Halder & P. Mukherjee, ZSI F-8059/2.

Distribution: Asia: India, Myanmar, Thailand, Malaysia, Indonesia, the Philippines and Bangladesh.

Remarks: *Periophthalmus pearsei* Eggert, described from Port Canning, is relegated to synonymy of this species (Murdy, 1989). Koumans (1941) has stated of examining specimens from Calcutta, Lower Bengal, Uttarbhag and Sunderbans. Mukherjee (1995: 356) reported *Periophthalmus chrysospilos* from Hughly-Matla estuary and recorded specimens from Basanti, Kakdwip and Saptamukhi river. On re-examination, it is found to be erroneous identification of *Periophthalmus novemradiatus*.

Genus *Periophthalmodon* Bleeker

Key to species

1. (a) Ventral fins totally united, basal membrane well developed *P. schlosseri*
- (b) Ventral fins nearly separated, basal membrane absent *P. septemradiatus*

Periophthalmodon schlosseri (Pallas)

1770. *Gobius schlosseri* Pallas, *Spicilegium Zool.*, 1 (8): 3, pl. I, figs. 3-4 (Ambon Island, Moluccas Islands, Indonesia).

1989. *Periophthalmodon schlosseri*: Murdy, *Rec. Aust. Mus., Suppl.*, 11: 28.

Material examined: 3 ex., Sonakhali, 17.i.1987, B.P. Halder & P. Mukherjee, ZSI F-8003/2; 1 ex., Pergumti, 09.ix.1984, B.P. Halder & P. Mukherjee, ZSI F-8039/2.

Distribution: Mudflats in India, Bangladesh, Indonesia, the Philippines, Malaysia; Queensland and Fiji.

Remarks: Mukherjee (1995: 363) reported 3 ex. from Sonakhali and 1 ex. from Jharkhali. Mandal and Nandi (1989) has also included it in the fauna list of Sundarban.

Periophthalmodon septemradiatus (Hamilton)

1822. *Gobius septemradiatus*: Hamilton, *Fish. Ganges*: 46 (Ganges, India).

1989. *Periophthalmodon septemradiatus*: Murdy, *Rec. Aust. Mus., Suppl.*, 11: 29-30.

Material examined : 2 ex., Uttarbhag, 23.v.1934, S. L. Hora, ZSI F-5655/2; 2 ex.,

Uttarbhag, 1934, S. L. Hora, ZSI F-5754/2; 1 ex., Uttarbhag, no date, S. L. Hora, ZSI F-7236/2 (registered as *Periophthalmodon tredecemradiatus*); 1 ex., Bakkhali, 076.iii.1985, B.P. Halder & P. Mukherjee, ZSI F-8133/2 (labeled as *Periophthalmodon tredecemradiatus*).

Distribution: India including Andamans; Bangladesh, Myanmar, Thailand and Sumatra.

Remarks: Talwar and Jhingran (1991: 962) treated this species as *Periophthalmodon tredecemradiatus* (Hamilton), whereas, Murdy (1989: 30) designated the neotype of *P. septemradiatus* and considered *P. tredecemradiatus* as its synonym.

Genus *Pseudapocryptes* Bleeker

Pseudapocryptes elongatus (Cuvier)

1816. *Gobius elongatus* Cuvier, *Regne animal* (ed. 1), 2: 255 (Tranquebar, Tamil Nadu).

1991. *Pseudapocryptes lanceolataus* (Bloch and Schneider): Talwar and Jhingran, *Inland Fishes of India*, 2: 958.

1995. *Pseudapocryptes elongatus*: Ferraris, *Copeia*, 1995 (4): 984 (status discussed).

Material examined: 2 ex., Port Canning, 01-09.vii.1930, R. Hodgart, ZSI F-5619/2; 2 ex., Uttarbhag, 1934, S. L. Hora, ZSI F-5820/2; 2 ex., Edward's creek, Fraserganj, 11.ix.1974, T. K. Chatterjee, ZSI F-7158/2 (all registered as *Pseudapocryptes lanceolataus*); 1 ex., Pergumti, 09.ix.1984, B.P. Halder & party, ZSI F-8042/2 (labeled as *Pseudapocryptes borneensis*).

Distribution: Indo-Pacific: India, Bangladesh to Tahiti and north to China. Found in mudflats of estuaries and the freshwater tidal zone of rivers.

Remarks: The present name is considered as a replacement name for *Eleotris lanceolatus* Bloch & Schneider, 1801, preoccupied in *Gobius* by *Gobius lanceolatus* Bloch, 1783 [synonym of *Gobionellus oceanicus* (Pallas 1770)] (Ferraris, 1995). *Gobius changua* described by Hamilton (1822) from estuaries of Ganges is referred to be this species (Murdy, 1989). *Pseuda cryptes borneensis* (Bleeker) has been recorded from Pergumti and Sonakhali in Sunderbans (Mukherjee, 1995). The specimens used by Mukherjee (1995) has been examined and

found that the specimens contain 30 anal fin rays, small eyes, about 6.8 times in head length and the membrane of first dorsal fin reaches first ray of second dorsal fin. This combination of characters goes close with *P. elongatus*, but not with *P. borneensis* (Bleeker).

Genus *Scartelaos* Swainson

Scartelaos histophorus (Valenciennes)

1837. *Boleophthalmus histophorus* Valenciennes, in Cuvier and Valenciennes, *Hist. nat. poiss.*, **12**: 210 (Bombay, India; Suarte, Ganges River).

1991. *Scartelaos histophorus*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 960.

Material examined: 15 ex., Gosaba, 13.iii.1917, J. Southwell, ZSI F-5406/2; 1 ex., Sagar Island, 24.vi.1975, A. Das, (uncat. specimen in SDCMBRI); 3 ex., Jharkhali, 21.i.1987, B.P. Halder & P. Mukherjee, ZSI F-8001/2; 2 ex., Jharkhali, 24.vi.1986, B.P. Halder & P. Mukherjee, ZSI F-8083/2; 1 ex., Bakkhali, 07.iii.1989, B.P. Halder & P. Mukherjee, ZSI F-8157/2; 2 ex., Goenkakhali, 21.iii.1985, B.P. Halder & P. Mukherjee, ZSI F-8139/2; 2 ex., Basanti, 21.vi.1986, B.P. Halder & P. Mukherjee, ZSI F-8082/2.

Distribution: Mudflats from Pakistan, India, Bangladesh to Indonesia, the Philippines, Australia, north to Japan.

Remarks: Hamilton (1822) described this as *Gobius viridis* from Ganges River estuary. But since the name is preoccupied by *Gobius viridis* Otto 1821, it is considered objectively invalid (Murdy, 1989).

Subfamily: GOBIONELLINAE

Both dorsal fins separate; dorsal and anal fins not joined to caudal fin; lower jaw with more than one row of teeth; paired interorbital pores present or head pores entirely absent; if absent, pelvic frenum present, or body mostly scaly, or barbels absent.

Genus: *Awaouichthys* Chatterjee

Awaouichthys menoni Chatterjee

2013. *Awaouichthys menoni* Chatterjee, in Chatterjee and Mishra, *Rec. Zool. Surv. India*. **112** (4) : 56 (Fraserganj, Sundarbans, West Bengal).

Material examined : 1 ex., (Holtype), Patibonia Island, near Fraserganj, 11.ix.1974, T.K. Chatterjee, ZSI F-7377/2; 3 ex. (Paratype), Podibonia Island, near fraseranj, ii.ix.1974, T.K. Chatterjee, ZSI F 7378/2.

Distribution : Podibonia Island, near fraseranj in the Gangetic delta, West Bengal.

Remarks : This species was first described by Chatterjee (1978) in his doctoral thesis and also appeared in Mandal and Nandi (1989), Talwar *et. al.*, (1992) and Sanyal *et. al.*, (2012). However, it was formally described in Chatterjee and Mishra (2013) in order to make it available as per the provisions laid down in the International code of Zoological Nomenclature.

Genus *Brachygobius* Bleeker

Brachygobius nunus (Hamilton)

1822. *Gobius nunus* Hamilton, *Fish. Ganges*: **54**, 366 (Ganges estuary below Calcutta).

1991. *Brachygobius nunus*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 930.

Material examined: 10 ex., Edward's creek, Fraseranj, 11.ix.1974, T.K. Chatterjee, ZSI F-7156/2.

Distribution: East coasts of Africa to the Pacific, including India and Bangladesh.

Remarks: *Gobius alcockii*, described from Port Canning and Calcutta (Annandale, 1906), is considered as a synonym of this species (Larson, 2001).

Genus *Gnatholepis* Bleeker

Gnatholepis cauerensis (Bleeker)

1853. *Gobius cauerensis* Bleeker, *Natuurk. Tijdschr. Ned.-Indie*, **4**: 269 (Cauer, a village on the southwestern coast of Sumatra, 4°44' S, 103°15' E).

2007. *Gnatholepis cauerensis cauerensis*: Randall and Greenfield, *Zool. Med.*, **81**: 303.

Material examined: 16 ex., Fraseranj coast, 09.ix.1974, T.K. Chatterjee, ZSI F-7390/2 (registered as *Acentrogobius cauerensis*).

Distribution: South Africa and Seychelles to Indonesia, the Philippines, east to Hawaii and Society Islands.

Remarks: This was the first record from east coast of India by Chatterjee (1978); other Indian

records were from Andamans (Koumans, 1941) and Lakshadwip (Jones and Kumaran, 1980).

Genus *Gobiopterus* Bleeker

Gobiopterus chuno (Hamilton)

1822. *Gobius chuno* Hamilton, *Fish. Ganges* : 53 (Ganges estuary below Calcutta).

1991. *Gobiopterus chuno*: Talwar and Jhingran, *Inland Fishes of India*, 2: 967.

Material examined: No specimen from Sunderbans examined.

Distribution: India, Bangladesh, Thailand and Singapore.

Remarks: This is originally described from Ganges estuary below Calcutta [Kolkata]. Koumans (1941) too has not examined any specimen specifically from Sunderban region, but Mandal and Nandi (1989) included it in the faunal list of Sunderban.

Genus *Hemigobius* Bleeker

Hemigobius hoevenii (Bleeker)

1851. *Gobius hoevenii* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 2: 426 (Sambas, western Borneo, Indonesia).

1991. *Stigmatogobius hoevenii*: Talwar and Jhingran, *Inland Fishes of India*, 2: 946.

1999. *Hemigobius hoevenii*: Larson, *Rec. Mus. Art Galler. North. Territ.*, 15: 25; fig.1-6.

Material examined: 3 ex., Edward's creek, Frasersganj, 11.ix.1974, T.K. Chatterjee, ZSI F-7256/2.

Distribution: India- Gangetic delta and Andamans; West Pacific- Thailand, Hong Kong, Malaysia, Singapore, Philippines, Borneo, New Guinea and northern Australia. Inhabit seas, mangrove estuaries and freshwaters.

Remarks: Chatterjee (1980: 229) recorded this species for first time from Gangetic delta.

Genus *Oligolepis* Bleeker

Oligolepis acutipennis (Valenciennes)

1837. *Gobius acutipennis* Valenciennes, *Hist. nat. poiss.*, 12: 80 (Malabar, India).

1991. *Oligolepis acutipennis*: Talwar and Jhingran, *Inland Fishes of India*, 2: 939.

Material examined: 2 ex., Uttarbhag, 27.ii.1934, S.L. Hora, ZSIF-224/2.

Distribution: East coasts of Africa, to India including Andamans, Sri Lanka, through Indonesia, to Rukyu Islands; Philippines to New Hebrides. In Seas and muddy Estuaries.

Genus *Stigmatogobius* Bleeker

Stigmatogobius sadanundio (Hamilton)

1822. *Gobius sadanundio* Hamilton, *Fish. Ganges*: 52, 366 (Ganges estuary near Calcutta).

1991. *Stigmatogobius sadanundio*: Talwar and Jhingran, *Inland Fishes of India*, 2: 949.

Material examined: 1 ex., Edward's creek, Frasersganj, 11.ix.1974, T.K. Chatterjee, ZSI F-7157/2; 2 ex., Dobanki, 31.iii.2008, T.K. Chatterjee and party, ZSI-SFRS uncat.; 1 ex., Sonakhali, 02.iv.2008, T.K. Chatterjee and party, ZSI-SFRS uncat.

Distribution: India, Bangladesh, Sri Lanka, Thailand, Malay Peninsula to Fiji Islands and Indo-Australian archipelago. Very common in fresh and brackish waters.

Subfamily GOBIINAE

Dorsal fins separate with a gape; dorsal and anal fins not confluent with caudal fin; lower jaw with more than one row of teeth; usually a single interorbital pore present; if absent, pelvic frenum absent, or body mostly naked, or barbels present.

Genus *Acentrogobius* Bleeker

Acentrogobius viridipunctatus (Valenciennes)

1837. *Gobius viridipunctatus* Valenciennes, *Hist. nat. poiss.*, 12: 62 (Bombay).

1991. *Acentrogobius viridipunctatus* : Talwar and Jhingran, *Inland Fishes of India*, 2: 926.

Material examined: 1 ex., Hooghly River, no date, Pulta Survey coll., ZSI F-1979/2.

Distribution: Africa; India including Andamans, Bangladesh, Thailand, China, Hong Kong, Indo- Australian archipelago, Philippines, Ryukyu Island. In seas and estuaries.

Genus *Amblyeleotris* Bleeker

Amblyeleotris gymnocephala (Bleeker)

1853. *Gobius gymnocephalus* Bleeker, *Natuurk. Tijdschr. Ned.-Indie*, 4: 473 (East Indies, probably Batavia).

1991. *Cryptocentrus gymnocephalus*: Talwar and Jhingran, *Inland Fishes of India*, 2: 933.

2005. *Amblyeleotris gymnocephala*: Larson and Lim. *A Guide to Gobies of Singapore*: 66.

Material examined: 1 ex., Jambu Is., Gangetic delta, 07.ix.1974, T. K. Chatterjee, ZSI F-7381/2.

Distribution: Tamil Nadu (India), Mergui Achipelago (Myanmar), Thailand, Jakarta, Hongkong. Inhabits holes in the sandy floor.

Remarks: Chatterjee (1978) first recorded this species from the Gangetic delta.

Genus *Bathygobius* Bleeker

Bathygobius fuscus (Ruppell)

1828. *Gobius fuscus* Ruppell, *Atl. Reise N. Afr. Fische*: 137 (Red Sea).

1991. *Bathygobius fuscus*: Talwar and Jhingran, *Inland Fishes of India*, 2: 929.

Material examined: 1 ex., Bakkhali coast, 06.ix.1974, T. K. Chatterjee, ZSI F-7224/2; 1 ex., a canal near Forest Range Office, Fraserganj, 05.ix.1974, T. K. Chatterjee, ZSI F-7387/2; 2 ex., Fraserganj, 09.xii.1965, K. V. Surya Rao & S. Ahmed, ZSI F-4950/2.

Distribution: Widespread throughout Indo-Pacific including the Red Sea and Hawaii.

Genus *Drombus* Jordan and Seale

Drombus globiceps (Hora)

1923. *Ctenogobius globiceps* Hora, *Mem. Indian Mus.*, 5 : 744; figs. 24-25 (Chilika Lake, Orissa).

1991. *Acentrogobius globiceps*: Talwar and Jhingran, *Inland Fishes of India*, 2: 924.

1993. *Drombus globiceps*: Kottelat et al., *Freshw. Fish. west. Indonesia Sulawesi*: 143.

Material examined: 1 ex., a canal near Forest Range Office, Fraserganj, 05.ix.1974, T. K. Chatterjee, ZSI F-7388/2 (registered as *Acentrogobius globiceps*).

Distribution: India (Gangetic delta, Chilika Lake and Ennore backwaters), Java, Borneo, Papua New Guinea and probably also Singapore.

Genus *Istiogobius* Whitley

Istiogobius ornatus (Ruppell)

1830. *Gobius ornatus* Ruppell, *Atlas Reise N. Afr. Fische*: 135 (Massawa, Eritrea, Red Sea).

1941. *Acentrogobius ornatus*: Koumans, *Mem. Indian Mus.*, 13 (3): 231.

1985. *Istiogobius ornatus*: Murdy and Hoese, *Indo-Pacif. Fish.*, (4): 9.

Material examined: 9 ex. (male), Fraserganj coast, 09.ix.1974, T. K. Chatterjee, ZSI F-7375/2; 7 ex. (female), Fraserganj coast, 09.ix.1974, T. K. Chatterjee, ZSI F-7375/2.

Distribution: Coastal waters in the entries of Indo-Pacific region excluding Hawaii.

Remarks: This is first recorded from the Gangetic delta by Chatterjee (1978: 238).

Genus *Glossogobius* Gill

Glossogobius giuris (Hamilton)

1822. *Gobius giuris* Hamilton, *Fish. Ganges*: 51, 366, pl. 33, fig. 15 (Ganges River).

1991. *Glossogobius giuris*: Talwar and Jhingran, *Inland Fishes of India*, 2: 936.

Material examined: 1 ex., Port Canning, 1-9.vii.1930, R. Hodgart, ZSI F-5624/2; 1 ex., mouth of Hooghly River, date unknown, R.I.M.S. "Investigator" coll., ZSI F-5365/2; 1 ex., Uttarbhadra, 1935, S. L. Hora, ZSI F-5312/2; 3 ex., Gosaba (Sundarbans), 02.iv.2008, T. K. Chatterjee and party, ZSI-SFRS uncat.; 1 ex., Haldibari (Sundarbans), 26.iii.2008, T. K. Chatterjee and party, ZSI-SFRS uncat.

Distribution: Throughout India, Bangladesh, Pakistan, Myanmar, Sri Lanka, East and South Africa, Mauritius, Malaya, Malay archipelago, Thailand, China, Japan, Philippines, Melanesia, Polynesia, Australia.

Remarks: Akihito and Meguro (1974) discussed the systematic status of *G. giuris* and other related species. This is a species known to inhabit marine, brackish as well as freshwater habitats, even at highlands.

Genus *Gobiopsis* Steindachner

Gobiopsis macrostoma Steindachner

1860. *Gobiopsis macrostomus* Steindachner, *Sber. Akad. Wiss. Wien*, 42 (2): 291; p1. I, fig. 6 (Bombay).

1941. *Gobiopsis macrostoma*: Talwar and Jhingran, *Inland Fishes of India*, 2: 937.

Material examined: 1 ex., Sagar Is., Gangetic delta, 10.viii.1975, A. Chowdhury, SDCMBRI uncat.

Distribution: East coasts (Hoogly estuary, Godavari estuary and Porto Novo) and west coasts of India, Bangladesh and Thailand.

Genus *Parachaeturichthys* Bleeker

Parachaeturichthys polynema (Bleeker)

1853. *Chaeturichthys polynema* Bleeker, *Verh. batav. Genoot. Kunst. Wet.*, 25: 44, figs. 4, 4a-b (Nagasaki, Japan).

1991. *Parachaeturichthys polynema*: Talwar and Jhingran, *Inland Fishes of India*, 2: 943.

Material examined: 1 ex., mouth of River Hooghly, Jan 1923, 'P. V. Lady Fraser' coll., ZSI F-5582/2; 1 ex., locality unknown (possibly mouth of River Hooghly), Jan 1928, P. V. 'Lady Fraser' coll., ZSI F-5586/2.

Distribution: East coast of South Africa, coasts of India, Vietnam, China, Japan, Ambon, and North-eastern and Western Australia.

DISCUSSION

Though the ecological conditions of the habitats are different, it is to be remembered that in some cases, the same species is found in more than one habitat, as there are no rigid limits of demarcation. Where two or more species of these gobioid fishes share the same habitat, such as *Eleotris fusca*, *Butis butis* and *Brachygobius nunus*; or *Odontamblyopus rubicundus* and *Apocryptes bato*, their feeding habits are different and therefore, there is no competition for food. This results in a perfect ecological segregation of the different species (Hora, 1935 b).

The main ecological factor in the Gangetic delta is the ebb and flow of the tides. The aquatic gobies cannot withstand desiccation for long though they can live out of water for a shorter or longer period depending upon the humidity of the air and the dampness of the soil. Of the semi-aquatic gobies, *Pseudapacryptes elongatus* is the best adapted to withstand drought, while the others can endure drought conditions only for a short period. *Periophthalmus* and *Periophthalmodon* can live for long period in damp situations. Both

the semi-aquatic and terrestrial species have developed the power of breathing atmospheric air. It may be pointed here that Hora (1935b) treated *Stigmatogobius sadanundio* under semi-aquatic forms, as this species is capable of breathing atmospheric air, even though it is not seen to come out of water.

In the species taking up a hole-dwelling habit (e.g. *Odontamblyopus rubicundus*, *Pseudapocryptes elongatus*), reduction in the size of air-bladder (Hora, 1941) and loss of sensory canal-pores on head are noticed. Degeneration of eyes and elongation of vertical fins are other remarkable features. For the borrowing forms (e.g. *Pseudapocryptes*, *Odontamblyopus* and *Apocryptes*) the nature of soil is an important factor. Soil in the Genetic delta contains a high water holding capacity and a fair amount of decomposed organic matter. This renders the soil porous and light for borrowing operations and the organic matters also provide nutrition to a number of mud-eating gobies.

The organs of aerial respiration are developed in connection with the buccal cavity and the gill-chambers. In the semi-aquatic and terrestrial species, the gill chambers have well developed pouches for storage for air and the gill-covers are specially modified to keep the openings tightly closed.

The survival value of terrestrial habit of the mudskippers can be well appreciated by observing their behaviour. Stebbins and Kalk (1961) discuss the role of terrestrial habit with special reference to *Periophthalmus*, in the process of evolution. In the environment under tidal influence, twice every twenty-four hours the aquatic habitat is reduced to disconnected pools and narrow channels, chances of a fish of getting trapped in an exposed location are considerable. Fishes are very often trapped after the tide recedes. Many of such isolated pools are situated far from the tide channels. The fishes are even trapped in very shallow depressions, some of which are about 2 cm deep. Chatterjee (1977) made some observations on the behaviour of the mudskippers at Fraserganj in Sundarbans.

When isolated, the threat of predation, overheating, suffocation and desiccation would be greatly increased. Under such conditions a premium would place on structural and functional changes that would make an animal adapted to terrestrial habitat. As proposed by Romer (1933) for the ancestors of amphibians, an important factor in the evolution of terrestrial habit of periophthalmids is probably, the survival value of locomotion on landing avoiding the chances of getting trapped in drying pools (Stebbins and Kalk, (1961). Other factors are possibly, the feeding opportunities on land and avoidance of interspecific competition (Pearse, 1929, 1933, Stebbins and Kalk, 1961). Inger (1952) thinks that feeding opportunities on land are decisive. From the above facts, it is evident that the mud-skippers have, thus, freed themselves from some of the limitations imposed by the aquatic habitat, yet at the same time have retained many of the features of their earlier mode of life.

SUMMARY

The present study aims at giving a preliminary account of the mangrove associate gobioid fishes of the Indian Sundarbans, where inundation and exposure occur twice in a day. This work incorporates the review of the gobioid fishes occurring in the region. Further, this work includes five species which were recorded first time from this biome by the first author, viz., *Eleotris melanosoma* Bleeker, *Gnatholepis caurensis* (Bleeker), *Gobiopsis macrostoma* Steindachner, *Hemigobius hoevenii* (Bleeker) and *Istiogobius*

ornatus (Ruppell). Earlier reports of *Pseudapocryptes borneensis* (Bleeker) and *Trypauchenichthys typus* Bleeker were found to be erroneous after re-examination and the identity is reassigned to *Pseudapocryptes elongatus* (Cuvier) and *Paratrypauchen microcephalus* (Bleeker) respectively. Similarly records of *Periophthalmus chrysospilos* and *Periophthalmus malaccensis* also based on mistaken identity. This work dealt with 45 species belonging to 37 genera under the families Eleotridae and Gobiidae found in Indian Sundarbans. Keys to the genus and species and their distributions for each species are provided. Ecology and adaptation of these gobioid fishes in Sunderbans is also discussed.

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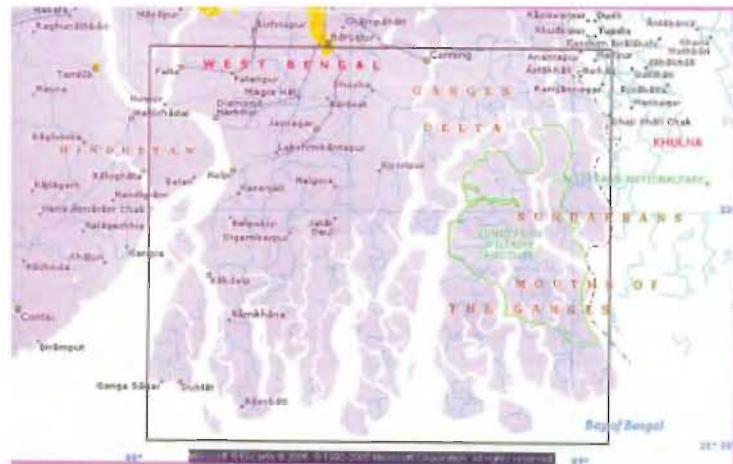


Fig. 1: Map of Sundarbans showing the study area



Fig. 2: Satellite picture of Sundarbans
(source: <http://en.wikipedia.org/wiki/Sundarban>)



Fig. 3: Most abundant mudskipper, *Boleophthalmus boddarti*, in Sundarbans