CHAPTER 25

Taxonomy of Fishes of the Family Balistidae in India

Abstract

The fishes of the family Balistidae are popularly known as trigger fishes and distributed along the Indian and the Pacific Oceans, though certain species are restricted to particular regions. In India, these fishes are abundant in the Gulf of Mannar, Palk Bay, off Maharashtra and Gujarat coast, off Kerala, Andaman and Lakshadweep Islands. The recent trend in exploitation for human consumption and export and the fast increasing demand for these fishes in live condition for aquarium purpose warrant knowledge on taxonomy and distribution in space and time of the individual species for formulating strategies for sustaining yields and addressing the issues of biodiversity conservation. They feed mainly on zooplankton, molluscs, sponges and other associated fauna and the schooling behaviour is directly correlated to its grazing and grabbing nature. Added to this balistids have preference to coral reef habitat for feeding during their younger stages. The coral reefs and sand beds along the coast serve as the feeding ground for them and juveniles migrate to these grounds for feeding. It is also to be noted that trawl catch was constituted exclusively by 8-32 cm fishes, with total absence of small juveniles and mature fishes. Descriptions of the species of the genera viz. *Abalistes*, *Balistapus, Zenodon, Canthidermis, Melichthys, Pseudobalistes, Parabalistes, Rhinecanthus* and *Sufflamen* were done.

Introduction

Exploitation of marine living resources for food is an age-old practice but this exploitation was largely restricted to near shore regions in the sea. The improvements in the capabilities of exploitation during the past half a century have helped in increasing harvests of living resources from the coastal waters as well as deeper regions of the sea. The rapid increase in the human population and the consequent increased demand for protein-rich seafood, have led to the exploitation of marine fisheries resources to their optimum levels in most cases. Fisheries resources being renewable, managing them on a sound scientific basis is essential to harvest maximum sustainable economic yields on a continual basis, year after year. The basis for such a management is knowledge of the dynamics of every species that contribute to the fishery. The tropical seas, however, unlike their counterparts in the temperate regions, are inhabited by a large number of species. In many cases the species live together sharing the same habitat and food. Several families are represented by several genera and several closely resembling species and any non-selective (or the least selective) gear exploits a large number of species in one haul. If these species are not correctly differentiated, there is a likelihood of treating two or

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more closely resembling species as one species, in detailed biological studies like growth, spawning, fecundity etc., leading to erroneous conclusions. A sound knowledge of the taxonomy of the fishes contributing to the fishery and the capability to identify them to species level correctly therefore plays a vital role. As the biological characteristics are known to be different between species and as they form the basis for studies on stock assessment of exploited resources, the capability to distinguish species effectively is of immense value, without this all species-oriented studies do not lead to any meaningful results. Moreover, in recent years there is increasing concern on the protection of the environment and conservation of biodiversity and the issues of marine biodiversity cannot be addressed effectively without a proper understanding of the species constituting to the biodiversity. This is particularly serious in the tropical ecosystems where a multiplicity of species from lower invertebrates to higher vertebrates inhabits the same ecosystem in certain assemblages. Hence, the value of taxonomic studies in fisheries research is invaluable; it is a prerequisite for any detailed study on species and ecosystem.

Growth of fish taxonomy in India can be traced back to the late 18th century, when European scientists and British Officers of the East India Company, particularly medical doctors, began to collect and describe Indian fishes. Bloch (1795) is one of the pioneers in the field of taxonomy of Indian fishes.

The nineteenth century saw several publications on Indian fishes. Among them are the publications of Schneider in Bloch and Schneider (1801), Lacepede (1798 - 1803), Hamilton (1822), Cuvier and Valenciennes (1828 – 1849), Sykes (1839), Gunther (1860, 1872, 1880) and several publications of Dr. Day (1865-1877) culminating in the “Fishes of India." (Day 1875, 1878) and the “Fauna of British India” (1889).

During the twentieth century, subsequent to Chaudhuri (1912, 1916) and Raj (1916, 1941), the significant taxonomic contributions of Hora and his coworkers (1920-1951) based on collections made during extensive surveys in India and the neighbouring countries provide the basis for more intensive studies on different groups/families. Most of these works pertain to freshwater fishes. The reports of the new species of fishes discovered in India were also published in the various journals and the information is scattered. Misra (1962) consolidated the available information on important species and published “An aid to identification of the common commercial fishes of India and Pakistan”. Later he continued his work and published in 1976 “The fauna of India and Adjacent countries (Pisces)” in three volumes. Jones and Kumaran (1980) published descriptions of over 600 species of fishes from Lakshadweep. Recently, Talwar and Jhingran (1991a, 1991b) published descriptions of a total of 930 species of inland (fresh and brackishwater) fishes of India, including all species known till date.

As on date, a total of about 2500 species of fish are known from India (Talwar and Jhingran 1991a) of which about 1570 are truly marine. While the work of Talwar and Jhingran (1991a, 1991b) largely fulfils the long felt need of the workers on inland fishes, a similar treatment on the Indian marine fishes is yet to be made. Consequently the workers, perforce, refer to either the publication of Day (1878), which needs to be updated, or some regional publications (as those of Munro, 1955; Smith and Heemstra, 1986 etc), which do not contain all species known from the country till date, resulting in most cases, in inaccurate identifications. While there is

an urgent need for a comprehensive publication on Indian marine fishes also, the taxonomic studies carried out in recent years on certain groups have shown that there is considerable scope for work in this area because the earlier species descriptions were made on single or a few specimens and did not take intraspecific variation into account thus leading in certain instances to `recognition' of different stages in the life history of a particular species as belonging to different species (as in the case of *Caranx melampygus* Cuvier and *Caranx stellatus* Smith, see Berry, 1968) or creation of new species on the basis of certain abnormal specimens of a species (*Cirrhinus chaudhryi* Srivastava, 1968) and to a lot of confusion on the identity of the species in many instances. In this connection it is worthwhile to quote the following:

1. Leaders in many fields of biology have acknowledged their total dependence on taxonomy (Mayr, 1969:6)

2. The extent to which progress in ecology depends upon accurate identification, and upon the existence of a sound systematic groundwork for all groups of animals, cannot be too much impressed upon the beginner in ecology. This is the essential basis of the whole thing; without it the ecologist is helpless, and the whole of his work may be rendered useless (Elton, 1947, as cited by Mayr, 1969:6)

There have been very few taxonomic revisions of families or genera of marine fishes of India (flatfishes of different families by Norman, 1927, 1928, 1934 and Menon, 1977; Scombridae by Jones and Silas, 1962a, 1962b, 1962c; Mugilidae by Sarojini, 1962a, 1962b; Clupeioids by Whitehead, 1965, 1973, 1985; Trichiuridae by James, 1967; Leiognathidae by James, 1978; Chirocentridae by Luther, 1968; Mullidae by Thomas, 1969; Sphyraenidae by De Sylva, 1975; Syngnathidae (genus *Hippichthys*) by Dawson, 1976; Scorpaenidae (Choridactylinae) by Eschmeyer 1969; Platycephalidae by Murty, 1982; Callionymidae by Ronald, 1983; Sciaenidae by Lal Mohan, 1972, 1982 and Trewavas, 1977; genus *Nemipterus* (Nemipteridae) by Russell, 1986. etc.,) resulting in the nonavailability of comprehensive work (of a family or genus) incorporating all species described by and discovered subsequent to Day (1878) which could help workers to carry out their work satisfactorily and without difficulty and to address the research needs in the biodiversity conservation efficiently. Though this problem, to some extent, has been solved by the work of Weber and De Beaufort (1911-1962) and the `Fish identification sheets' issued by FAO (Fischer and Whitehead, 1974; Fischer and Bianchi, 1984), there is still need to provide adequate descriptions of genera and species of a large number of families such as Balistidae and to sort out nomenclatural issues in many cases.

The fishes of the family Balistidae unlike a large number of other teleosts do not form a major fishery any where along their distribution range. Further, these fishes until very recently were not used for human consumption even at places where they occur in catches regularly. As the major interest in research has been on the commercially important fishes, no significant research effort has been paid to any aspect of these fishes. A large number of research workers starting from Linnaeus (1758) (Linnaeus, 1758; Bloch, 1786; Bonnaterre, 1788; Mungo Park, 1797; Lacepede, 1798; Bloch and Schneider, 1801; Latreille, 1804; Shaw, 1804; Tilesius, 1820; Quoy and Gaimard, 1824; Ruppell, 1828, 1835,1852; Lay and Bennett, 1830; Swainson, 1839: Berry and Bladwin, 1966; David, 1966; Moore, 1967; Randall and Klausewitz, 1973; Randall *et.*

*al.,*1978; Fedoryako, 1981; Matsuura, 1980, 1981; Tyler, 1980; Eschmeyer and Herald, 1983; Randall and Steene, 1983; Whitehead *et. al*., 1986; Robin and Ray, 1986; Smith and Heemstra, 1986; Sazonov and Galaktionova, 1987; Matsuura and Shiobara, 1989; Hutchins, 1997; Randall and Bruce, 1998) carried out taxonomic work from different regions of the world. A review of these works reveals that:

1. The species were described on the basis of one or few specimens, hence did not take into account the possible intraspecific variation with growth,

2. A large number of inconsistencies occur in the nomenclature,

3. A comprehensive taxonomic revision of the family is not available from the Indian ocean region,

4. There has not been any taxonomic research in India after Day (1878),

5. The absence of regional works on these fishes resulted in misidentification of different species by different workers,

A critical study of the available species in the range of their distribution shows that the descriptions were rather cursory depending mainly on colour, shape and such others but did not take into account certain morphological characters (scales, nostrils, ventral flap, pelvic spine etc.) or anatomy, resulting in inadequate definition of species.

So far as the Balistids are concerned, the total lack of taxonomic work has been the stumbling block to the fisheries scientists and fishery managers. However in the recent years there has been some demand for these fishes for human consumption and these fishes have been contributing to seasonal fishery in certain pockets along Indian coasts.

Another issue that has emerged in recent years is the one pertaining to marine biodiversity conservation and management and in this respect top priority attention is given to the coral reef ecosystems which are under the severe threat of degradation and, Balistids are an integral part of the coral reef ecosystems. Without strong taxonomic database on the various organisms inhabiting the ecosystem, issues pertaining to sustainable utilization of the living resources and biodiversity conservation cannot be effectively addressed.

The present study on the taxonomy of the Balistids of India is not only an attempt to provide adequate descriptions of all known species from the country, but also to sort out various issues relating to genera, nomenclature and synonymies.

Material and methods

In addition to the collections from Mumbai, Veraval, Chennai, Mandapam, Kilakarai, Tuticorin, Vizhinjam, Colachel, Kanyakumari and Minicoy (Fig.1), specimens in the collections of Zoological Survey of India (ZSI), Kolkatta and those in the reference collection Museum of the

Central Marine Fisheries Research Institute (CMFRI) at Cochin and Mandapam were also examined.

Soon after collection, the fresh colour and pigmentation of the specimens were recorded at the landing centre and photographs taken. The specimens were then injected with 5% formalin and brought to the laboratory in containers filled with 5% formalin for detailed studies. In the laboratory, the specimens from different localities were preserved separately and all relevant biometric data taken. After taking the biometric data, the belly was cut open to note the sex.

In taking the meristic and morphometric data, the methodology of Hubbs and Lagler (1958) was followed; all the linear measurements were made in the median longitudinal axis (Fig.2). Examination of the nasal apertures and the counts of lateral line scales, arrangement and morphology of the scales on the cheek, body, abdomen, caudal peduncle and fin rays counts were made under a binocular stereo zoom microscope.

For uniformity, pectoral fin rays, gill rakers and, morphology and arrangement of scales on cheek, body, abdomen and caudal peduncle, were recorded from the left side only. The abbreviations of Hubbs and Lagler (1958) were followed for various meristic characters. In the case of Dorsal, it is cited as 'D'. The number of spines are shown in upper case Roman numerals, unbranched rays in lower case Roman numerals and branched rays by Arabic numerals (for example D. III, i, 31-36 means the first dorsal fin has three spines and the second dorsal fin has one unbranched ray and thirty one to thirty six branched rays). The number of Pectoral rays shown as P.i, 11-12, meaning the presence of one unbranched ray on the upper side of the pectoral fin and eleven to twelve branched rays. The count of caudal fin rays includes all the branched rays plus two unbranched rays, one above and the other below. The method of counting scales from origin of the second dorsal to base of anal is shown in Fig.3. A. The anterior and posterior margin of first dorsal spine is described in same figure. The lateral line is interrupted in some species, consisting of anterior curved portion and the posterior straight portion, in such cases the range of lateral line scales in the anterior portion is given first followed by posterior portion. In most of the species the lateral line is continuous. The teeth and spines in the ventral flap, are described with suitable figures. The scales on cheek, body, abdomen and caudal peduncle were studied using stereo zoom microscope under different magnification, which ranged from 5x – 20x, (Fig. 3.B); the marked area indicates the position of the scales which were studied. To study the arrangement, shape and morphology of the scale. Photographs taken during the study were arranged in the figures given at the end of the species description of each species. After this initial study, scales with skin were dissected out and boiled in 5% KOH solution for 5 minutes to separate the scales from tissue and study its shape and arrangement of protuberances. For this the scales were first examined under the stereo zoom microscope and later the scales were treated in 1% osmium tetra oxide and coated with gold in the gold spatter for observing under scanning electron microscope. The observations were made in the Hitachi H600 electron microscope having an H6010-A scanning electron microscope attachment, in magnification of 100x and 200x.

The nasal apertures were also studied under similar magnifications; the figures of these are presented in the species description of each species. The number of gill rakers present on the

C- shaped gill arches is given in Arabic numerals. In trigger fishes, the upper and lower limbs of gill arches cannot be distinguished.

Attempts were made to collect adequate number of specimens of each species. However as already stated, the landings of Balistids are poor and only two species (*Sufflamen fraenatus* and *Zenodon niger*) are common. For the rest of the species only a few specimens could be collected. Hence in the case of seven species, the descriptions were made on the basis of less than thirty specimens.

The descriptions of species were made on the basis of specimens collected from one locality and such specimens were indicated in "Material examined". The specimens collected from other localities were used for comparison and supplementing the description and such material was indicated in the "Additional material examined". The frequency distribution of meristic characters together with estimated values of mean, standard deviation and standard error are given for all species.

Colour description was always based on fresh specimens. Specimens of certain species were not available in fresh condition; in such cases colour descriptions were made from formalin-preserved specimens.

Results and discussion

Certain terms used for the description of shape of body, teeth and fins are as follows: rhomboid, oval, rectangular, concave, convex and diamond shaped. For describing scales the following terminologies were used.

1. Anterior margin: - embedded part, anterior margin of the scale (Fig. 4.A)
2. Posterior margin: - exposed part, posterior margin of scale when scale is on fish. (Fig.4.A)
3. Protuberances: - a projection on the scale surface which is ridge-like (Fig.4.B), round (Fig.4.C), spiny antrose or retrose (Fig.4.D & E).

Body shape

The fishes of the family Balistidae have a laterally compressed body. Most of the species have rhomboid or an oval shaped body, where as some have an oval-elongate body.

Second dorsal and anal fin

The unpaired fins, second dorsal and the anal fins display symmetry in these fishes. The shapes are species specific. These fins can be divided into two types based on the height, 1) fins with height less than half the depth of the body; 2) fins with height more than half the depth of the body. The fins belonging to the first category are mostly rectangular, transparent, thick at base thin at the top with different types of outer borders, which range from straight (Fig.5.A), convex (Fig.5.B), elevated at the anterior (Fig.5.C) and wavy edged (Fig.5.D). The rays in these fins are almost of the same length except in some cases the anterior rays are the longest compared to the other rays "elevated at the anterior". In case of "convex" the middle rays are the longest.

The fins belonging to the second type have a concave upper border (Fig.5.E) with the base being thick and upper margin thin, in some case wavy, the anterior longest ray gives a appearance of a separate lobe, posterior most rays being less than half the length of the first ray.

Teeth

Balistids have two types of teeth, arranged in two separate rows on the upper jaw. The inner row consisting of three teeth, which is pear shaped to rectangular shaped having thin and sharp edge, placed in the interdental gap of the outer teeth. The outer row has four teeth, the first teeth are flat and projects outside. The lower jaw has a single row of four teeth.

Based on the shape of the first and second teeth of the upper and lower jaws, five types have been identified. They are as follows: 1) The first and the second teeth conical (Dagger shaped), with tips pointed and directed inward (Fig.6.A). 2) The first and the second teeth rectangular with the tip convex towards the inside (Fig.6.B). 3) The first teeth of the upper jaw rectangular but teeth of lower jaw rectangular with a concave tip, the second teeth caniniform and orange coloured (Fig.6.C). 4) The first teeth of upper jaw conical with pointed tip diverging outside, the first teeth of the lower jaw also conical with the tip diverging towards the inside, rest of the teeth of both jaws with a rectangular base, with a conical projection, towards the anterior. (Fig.6.D). 5) All the teeth of upper jaw rectangular with serrated edge (Fig.6.E). The teeth of the lower jaw symmetrical to upper jaw, but directed inwards.

Nasal aperture

The nasal apertures – anterior and posterior, are situated in small depression along the anterior border of the eye. The anterior nasal aperture has different shapes, which is species specific but the posterior aperture is similar in all species. Based on the shape of the anterior nasal aperture five types have been identified. 1) Funnel shaped with edges decurved and a lobe towards the posterior (Fig.7.A). 2) Dome shaped with a pore at the tip (Fig.7.B). 3) Tube like with an irregular edge, in some it is a short tube, which is directed forward (Fig.7.C). 4) The anterior nasal aperture has a circular flap bend over the circular opening (Fig.7.D). 5) Dome shaped with a circular opening, guarded by a fleshy cone from inside (Fig.7.E).

Gills

Trigger fishes have 4 pairs of gills, supported on C- shaped branchial arch. The outer most branchial arch possesses gill rakers. Based on the shape they are divided into five types. 1) Slender, hyaline, pointed and elongated (Fig.8.A). 2) Short and conical with pointed tip (Fig.8.B). 3) Blunt with globular protuberances towards inside (Fig.8.C). 4) Pointed with bristles towards the inside (Fig.8.D). 5) Blunt tipped, hyaline, serrated towards the inside (Fig.8.E).

Scales

a) Morphology

In trigger fishes scales on body and caudal peduncle are diamond-shaped where as scales on cheek and abdomen are rhomboid, rectangular, square or round shaped with the round edges. These scales have a dorsal exposed part called posterior margin and a ventral basal plate called

anterior margin (Fig.4.A). The anterior margin forms anterior part of the basal plate, which is embedded in the dermis. Based on the position of the scale on the body, the width of the anterior margin varies. It is widest in the scales found on the body and narrowest on the scales on cheek. The posterior margin consists of horizontal or vertical rows of ridges, round protuberances, antrose spines or retrose spines. Arrangement and type are species specific. At the centre of the posterior margin is present the central canal (minute pore). The morphology and arrangement of scales on cheek, body, abdomen and caudal peduncle are described below.

i) Cheek

These scales have "<" shaped anterior margin. The posterior margin is elevated from the anterior margin. The width of the anterior margin is equal to the posterior margin in most of the cases, wherever there is a change, it is mentioned. Cheek scales are of seven types:

Type I

The scales are rhomboid, diamond or rectangular shaped. The anterior margins are "**<**" or "**L**" shaped, thin and smooth. The width of the anterior margin is half of the posterior margin. The posterior margin is rhomboid and consists of 3-8 vertical rows of round protuberances (Fig.9.A).

Type II

The scales are diamond shaped. The anterior margin is "**<**" shaped, thin and have horizontal ridges. The posterior margin diamond shaped and consists of 3-5 vertical rows of horizontal ridges (Fig.9.B).

Type III

The scales are round, square, diamond or rectangular shaped. The anterior margin is "**<**", "**[**" or "**C**" shaped, thin at the anterior most edges and thick posteriorly. Width of the anterior margin is twice that of posterior margin. The posterior margin is square, rhomboid or round having round protuberances and transverse ridges, which are arranged in 3 -5 vertical rows. In round scales the posterior margin is not very clearly demarcated (Fig.9.C).

Type IV

The scales are pentagonal, hexagonal or round in shape. The anterior margin is thin "**<**" or "**(**" shaped. The posterior margin is rhomboid with "**<**" or "**l**" shaped 5-8 vertical rows having horizontal ridges at the anterior first row and round protuberances as well as ridges in subsequent posterior rows (Fig.9.D).

Type V

The scales are diamond or rhomboid shaped, anterior-posteriorly compressed and dorso-ventrally elongated. The anterior margin is thin having horizontal ridges. The width of the anterior margin is half that of the posterior margin. The posterior margin is rhomboid having 3-5 vertical rows of small to large round protuberances (Fig.9.E).

Type VI

Some of the scales are rectangular or rhomboid; few are anterior-posteriorly compressed and dorso-ventrally elongated, have a smooth surface and covered with a thin skin when found on the fishes, especially occupying fleshy groove. The anterior margin is thin. The width of the anterior margin is one-fourth that of the posterior margin. The posterior margin is rhomboid having 1- 4 vertical rows of small round protuberances and ridges; some the scales have a smooth surface with shallow depressions and ridges (Fig.9.F).

Type VII
The scales are diamond, rhomboid, round or triangular. The anterior margin is thin with few ridges. The width of the anterior margin is half that of the posterior margin in some and in others it is one-fourth that of the posterior margin. The posterior margin is rectangular, square or rhomboid having 3 - 8 vertical rows of round protuberances arranged in "<" or "**I**" shaped vertical rows. (Fig.9.G).

ii) Body
In body scales, the width of the anterior margin is equal to that of the posterior margin. The anterior margin is "<" shaped. The posterior margin is diamond shaped. Body scales are of five types:

Type I
The anterior margin is thin and smooth. The posterior margin is slightly elevated from the anterior margin and has ridges on the first row with a large round protuberance at the middle of the scale. Round protuberance is arranged in 2-7 vertical rows (Fig.9.H).

Type II
The anterior margin is thick. The posterior margin has 5 - 10 vertical rows of round protuberances; the anterior most rows of round protuberances are small followed by larger protuberances (Fig.9.I).

Type III
The scales are diamond or rectangular shaped with round edges. The anterior margin thick. The posterior margin has 5 - 10 vertical rows of ridges tapering towards the posterior; the anterior most rows of ridges are large (Fig.9.J).

Type IV
The anterior margin is thick. The posterior margin has 3-5 vertical rows of retrose spines (Fig.9.K).

Type V
The anterior margin is thin. The posterior margin is having 3-5 vertical rows of ridges (horizontally placed) (Fig.9.L).

iii) Abdominal
The scales on the abdomen are diamond or rhomboid shaped, with round edges. The anterior margins are "<" shaped, thin anteriorly with smooth surface. The width of anterior margin is

equal to that of the posterior margin. The posterior margin is diamond shaped. They are of three types:

Type I
The posterior margin is rhomboid having 3-4 oblique rows of protuberances. The protuberances are either horizontal ridges or ridges which tapers towards the posterior or ridges which tapers towards the anterior or round protuberances. In some the posterior margin has horizontal ridges on the first row, followed by 3-5 rows of round protuberances (Fig.9.M).

Type II
The posterior margin is rhomboid having a round posterior edge. These scales have horizontal ridges on the first row followed by 3-5 oblique rows of round protuberances (Fig.9.N & O).

Type III
The posterior margin is rectangular or square shaped, having 3-5 oblique rows of round protuberances. At the anterio-ventral corner is present a round protuberance slightly larger than the other protuberances (Fig.9. P-R).

iv) Caudal peduncle
Posterior margin slightly elevated from the anterior margin in case of scales on the caudal peduncle. Diamond shaped, with round edges. The anterior margin is smooth, "<" shaped, thin anteriorly and thick posteriorly. The width of anterior margin equal to the width of the posterior margin. The posterior margin is diamond shaped. These scales are of five types:

Type I
The posterior margin has 3-4 rows of horizontal ridges at the middle and 3 -5 horizontal rows of round protuberance on both sides of the ridges (Fig.9.S).

Type II
The posterior margin has 5 - 10 vertical rows of round protuberances; the anterior most row has a large round protuberance at the middle (Fig.9.T).

Type III
The posterior margin has 10 - 20 horizontal rows of ridges with 3- 4 ridges at the centre slightly elevated and at the anterior of these ridges is present a pointed round protuberance (Fig.9.U).

Type IV
The posterior margin has 3-5 vertical rows of round protuberances with the anterior most rows having a ridge at the centre, which tapers towards the anterior (Fig.9.V).

Type V
The posterior margin has 3-5 vertical rows of horizontal ridges tapering towards the posterior and an antrose spine at the middle. Where as in others there are 5-8 horizontal rows of ridges tapering towards the posterior (Fig.9.W).

f) Type VI
The posterior margin is having 3-5 vertical rows of round protuberances. (Fig.9.X).

b) Arrangement
Examination of the scales on cheek, body, abdomen and caudal peduncle revealed that the general pattern of arrangement were similar between species in case of scales on the body, abdomen and caudal peduncle. Arrangement of scales on cheek varies among species.

i) Cheek scale
There are three types of arrangement of scales on cheek:

Type I
The rhomboid scales arranged in vertical rows, anteriorly and obliquely at the posterior (Fig.10.A).

Type II
The rhomboid to square scales is arranged in horizontal rows. The type of scales in horizontal row varies. a) The scales are square at the anterior and rhomboid to rectangular posteriorly. b) The scales are square at the anterior, with some triangular scale in between and rhomboid scale posteriorly. c) The scales are completely rectangular (Fig. 10.B).

Type III
The square and rhomboid scales are arranged in horizontal rows with wide transverse fleshy horizontal grooves (the horizontal grooves also possess rectangular, rhomboid and elongated scales which is completely covered by a thick skin). In this type of arrangement there are three types. a) Scales at the anterior irregular shaped, posteriorly rhomboid with horizontal grooves. b) Scales at the anterior covered by skin, posteriorly 3-5 horizontal rows of square and rectangular scales; in between the posterior rows are present horizontal grooves. c) Scales covered by skin anteriorly, posteriorly horizontal rows of square scales are present with wide horizontal fleshy grooves (Fig.10.C).

i) Body
The diamond scales are arranged in vertical rows (Fig.10.D).

ii) Abdomen
The scales are arranged in oblique rows. There are two types of scales on the abdomen, rhomboid and rectangular (Fig.10.E).

iii) Caudal peduncle
The diamonds shaped scales are arranged in transverse rows (Fig.10.F).

c) Ultra structure
The analysis of the transverse sections of the body scales under the scanning electron microscope revealed that the scale consists of 4 layers, the upper most layer is glassy, just below is a perforated layer, followed by a vascular area consisting of transverse and longitudinal

canals; the fourth layer is the thickest and opaque. These four layers are well demarcated at the anterior and middle portions of the posterior margin, but the posterior portion of the posterior margin is highly compressed and the layers not well demarcated (Fig.11.A-F). The gross morphology is very similar to that of the ganoin scale (Sire, 1989). Since peg like extensions are not found in these scales, (which is the character of the ganoin scales) these scales cannot be classified as ganoin. Hence they are classified as palaeoniscoid scales, which are also found in fishes of the family Polypteridae (Bond, 1979). The anterior margins and posterior margins are different characteristically between species.

i) Anterior margin

The anterior margin of the scales are of 5 types, based on the type of protuberances it possess, (ridges, pits, and network of fibres).

Type I (Ridges)

The anterior margin has horizontal ridges, which are arranged in many semicircular rows (Fig.12.A).

Type II (Pits)

The anterior margin has many pits arranged in transverse rows. All the pits have many pores (Fig.12.B).

Type III (Ridges and circular protuberances)

The anterior portion has many round protuberances, with ridges in between. The arrangement varies in some species with horizontal ridges at the anterior part arranged in different layers (placed one above the other) and round protuberances and pits posteriorly (Fig.12.C).

Type IV (Fibre and pits)

The anterior margin has a network of thin fibres. Between these fibres are present many minute pits (Fig.12.D). In some the fibrous network is made up of broad fibres with very few pits, circular and shallow. In few others the fibrous network is marginal but the pits are large and almost circular.

Type V (Round, triangular, ridge like protuberances, grooves and pits)

The anterior margin consists of horizontal ridges and round, triangular protuberances (Fig.12.E). In some the ridges are arranged in semicircular rows and between rows are present shallow grooves.

ii) Posterior margin

The posterior margin is also of four different types. The protuberances of the posterior margin include, horizontal ridges, ridges tapering towards the posterior, retrose spine, round and cones. These protuberances are arranged on the perforated layer.

Type I (Horizontal ridges and pointed conical protuberance)

The posterior margin has horizontal ridges and conical pointed protuberances. The horizontal ridges occupy the anterior row (Fig.12.F).

Type II (Horizontal ridges and retrose spines protuberance)
The posterior margin has horizontal ridges and retrose spines; the former occupies the first row (Fig.12.G).

Type III (Horizontal ridges like protuberance)
Ridge like protuberances are arranged on few vertical rows (Fig.12.H)

Type IV (Round protuberance)
Round protuberances are arranged in 3-5 vertical rows (Fig.12.I)

Nine genera of the family Balistidae were studied not only to provide adequate descriptions of twelve known species from the country but also to sort out various issues relating to genera, nomenclature and synonymies.

1. *Balistapus Tilesius, 1820*
2. *Zenodon (Ruppell, 1835) Swainson, 1839*
3. *Rhinecanthus Swainson, 1839*
4. *Melichthys Swainson, 1839*
5. *Canthidermis Swainson, 1839*
6. *Parabalistes Bleeker, 1866*
7. *Pseudobalistes Bleeker, 1866*
8. *Sufflamen Jordan, 1916*
9. *Abalistes Jordan and Seale, 1906*

Genus *Balistapus* Tilesius, 1820

(Type species *Balistapus capistratus* Tilesius, 1820)

Diagnosis

Anterior nostril conical with pore at the tip. Groove before eye absent. Scales on cheek rhomboid, arranged in vertical rows. Body scales have retrose spines. Caudal peduncle short and deep, with two rows of antrose spines. Ventral flap absent. Caudal fin truncate.

2.5.1.1 *Balistapus undulatus* (Mungo Park, 1797)

Balistes undulates Mungo Park, 1797, p.37.
Balistes undulatus Day, 1878, p.691.
Balistapus undulatus Jones and Kumaran, 1980, p. 672, fig.572.

Material examined: 12 specimens from Lakshadweep, (8 females, 3 males, 1 indeterminate,) ranging from 41 to 277 mm TL, 11 specimens from Lakshadweep, CMFRI-LA-F. Reg. No. 154/478, ranging from 98 to 254 mm TL, one specimen from Lakshadweep, Reg. No. 565, of length of 191 mm TL.

Additional material examined: Three specimens from Tuticorin, (2 females, 1 male) of lengths 204, 240, 274 mm TL (Fig. 13.A.), one specimen from Nicobar, ZSI. Reg. No. F 6028/2, of length of 212 mm TL, Three specimens no locality mentioned, ZSI Reg. No. 8899

(Fig.13.F.), No.2737 (Fig. 13.E.), of lengths 127, 170,177 mm TL, one specimen from Andaman, ZSI Reg. No. 2256, of length of 167 mm TL, collected by Dr. F. Day (Fig. 13.D.).

Description
D. III, i, 24–26; P. i, 11–13; ventral spines 11–24; A. i, 22-23; C. ii, 10; gill rakers 30-33; number of scales from origin of second dorsal to base of anal 16–20; lateral line scales 32–36; scales round the caudal peduncle 7–11.

Body deep, rhomboid. Head profile, straight. Lips broad thick, continuous at the corner. Interorbital straight. First spine, stout, laterally elliptical, third spine ¼ the length of first spine. Nasal apertures placed in two separate shallow depressions (Fig.14. A). The first teeth of upper and lower jaw conical with pointed tips diverging outside, other three teeth rectangular with the upper side conical on one side (Fig.14. B).

There are four to five large scales, rectangular with edges round, above pectoral base, arranged in an rectangular region, smaller scales, few, arranged at its periphery. The gill rakers hyaline with blunt edges and hairy bristle like projection (Fig.14.C). The second dorsal and anal fin profile convex, transparent. Pectoral round.

Scales on cheek are rhomboid, having 3-8 vertical rows of round protuberances (Fig. 14. D & Fig. 15.A). Body scale, with 2 - 4 vertical rows of retrose spines (Fig. 14.E & Fig.15.B). The ultra structure of the anterior portion of the body scale has pits and ridges (Fig.15. E –G) and the posterior portion has retrose spines (Fig.15. H - J). Scales on abdomen are rhomboidal and rectangular, with 3-4 oblique rows of ridges (Fig.14.F & Fig.15.C). Caudal peduncle has two types of scales 1) Diamond shaped scales with antrose spine at the anterior middle and 5-8 horizontal rows of ridges. 2) Diamond shaped scales with ridges and retrose spines arranged in 2 –4 vertical rows (Fig.14.G & Fig. 15.D).
Ventral spine 11 – 24 pointed. Pelvic spine, short, blunt and spinules blunt.

Colour
Fish green, with 13–14 orange, curved oblique bands, originating just anterior to eye, below first dorsal, space between first dorsal and second dorsal. The bands end at anus, base of anal and at base of caudal. Inter orbital has 7–8 orange transverse bands. The anterior part of cheek has orange dots (male) or bands (female). Lower lip is orange upper lip black. Just above upper lip is an orange band followed by blue and orange band. Just below lower lip is blue band followed by a orange and blue band, which merge at the corner of the mouth forming orange, blue, orange and blue band which extend ventrally towards anus. The first dorsal dull yellow, with triangular black blotch at the tip. Second dorsal, anal and pectoral fins have orange ray, base of rays blue and membrane transparent. Caudal orange.

Colour of the preserved specimens: The formalin-preserved specimens dark brown. Just above upper lip are present two yellow bands and just below lower lip is a yellow band, which merges at corner of the mouth and form two yellow bands, which extend ventrally towards anus. A triangular black blotch at the tip of first dorsal, membrane transparent. The second

dorsal, anal, and pectoral fin have yellow rays, membrane transparent. Caudal yellow. The alcohol preserved specimens also have a similar colour.

Remarks

1) This species is rare in catches along the east coast of India and only three specimens could be collected.
2) The specimens of 20 mm length are metallic brown dorsally and silvery ventrally (Fig.13.B). In those of 40 mm length, the body is green with orange undulating lines laterally (Fig.13.C).

2. Genus Zenodon (Ruppell, 1835) Swainson, 1839

(Type species *Xenodon niger*, Ruppell, 1835)

Diagnosis

Nostrils short tubes. Groove before eye present. Scales on cheek rhomboid with round protuberances and ridges. Body scales and caudal peduncle scales have round protuberances and ridges and a large spherical protuberance at the anterior middle of these scales. Caudal peduncle longer than deep, laterally elliptical. Ventral flap present. Caudal lunate with lobes produced.

The genus *Xenodon* was erected by Ruppell (1835) with *Xenodon niger* Ruppell (1835) as the type species. Swainson (1839) gave the name *Zenodon* to this genus and ascribed it to Ruppell (1835); he (Swainson, 1839) apparently treated this as the subgenus of *Capriscus*. In 1848 Gistel erected another genus: *Odonus* for *Xenodon niger* Ruppell, 1835. Ruppell 1852 gave the genus name *Erythrodon* to his *Xenodon* (1835) with the remark that the genus name *Xenodon* was already available in Amphibia and therefore preoccupied. Kaup (1855) described the genus *Pyrodon* for *Xenodon niger* Ruppell, 1835 and ascribed the authorship to Ruppell. He also treated *Zenodon niger* Swainson, 1839 as synonym of this species.

***Zenodon niger* (Ruppell, 1835)**

Xenodon niger Ruppell, 1835, p.53, *pl*. 14, fig. 3.
Balistes erythrodon Day, 1878, Part IV, p.692.
Odonus niger Jones and Kumaran, 1980, p. 664, fig.565.

Material examined: 54 specimens from Colachel, (31 females, 23 males) ranging from 147 to 346 mm TL (Fig. 16A), 7 specimens from Vizhinjam, (3 females, 4 males) ranging from 209 to 300 mm TL, 32 specimens from Vizhinjam, (indeterminate) ranging from 100 to 128 mm TL.

Additional material examined: Four specimens from Tuticorin, (2 females, 2 males) of lengths 217,275,299,304 mm TL, 23 specimens from Minicoy, (3 females, 20 males) ranging from 190 to 273 mm TL, 9 specimens from Chennai, (indeterminates) ranging from 102 to 118 mm TL, one specimen from Mumbai, (female) of length of 158 mm TL, three specimens from Vizhinjam, CMFRI - F. Reg. No. 154/440, of lengths 114,159,162 mm TL (Fig. 16.C), one specimen from Trivandrum, ZSI. Reg. No. F 2611/2, 130 mm TL (Fig.16. D), one specimen from Madras, ZSI. Reg. No. 8063, of length of 366 mm TL, collected by Dr. F. Day, (Fig.16. E), one specimen from Andaman, ZSI. Reg. No. 7250, TL 164 mm (Fig.16. F).

Description

D. III, i, 31–36; P. i, 10–14; ventral spines 9–23; A. i, 26-30; C ii, 10; gill rakers 30-33, number of scales from origin of second dorsal to base of anal 10–14; lateral line scales 21-32 + 13-18; scales round the caudal peduncle 9–12.

Body rhomboid. Head profile straight, with a jetting chin. Mouth superior, lips thin and narrow. Interorbital convex. Groove longer than orbit, deep at the centre, shallow at anterior, broad towards posterior, directed downwards. First dorsal spine, short, stout, blunt, anterior margin broad, with small protuberance and large blunt protuberances at the tip. Third spine ¼ the length of first spine. Nostrils placed in two separate depressions (Fig.17. A). The first tooth on the upper jaw rectangular and the second one caniniform and rest rectangular. The first tooth of the lower jaw is nearly concave on the upper side, with one side longer than the other (Fig. 17.B).

There are 3-5 scales in a triangular region above pectoral. Gill opening vertical. Gill rakers, thin, with pointed tip (Fig. 17.C). The anterior most rays in the second dorsal and anal are longer giving the appearance of a lobe, at the anterior side. The fins are thick, having serrated edge.

Scales on cheek have first row of ridges and followed by 4-8 rows of round protuberances (Fig. 17.D & Fig. 18.A). Body scales and scales on caudal peduncle have a large spherical protuberance and first row of ridges, followed by 5-9 vertical rows of round protuberances (Fig. 17. E & G & Fig. 18. B & D). The ultra structure of the anterior margin of the body scale has round pits (Fig. 18.E-G) and the posterior margin has round protuberances with pointed tip (Fig. 18.H-J). scales on abdomen rhomboid arranged in oblique rows with first row of ridges and followed by round protuberances arranged in 4-6 oblique rows (Fig. 17.F & Fig. 18.C).

Ventral spines arranged in two rows between the rudimentary pelvic spine and anus. The spines are pointed, in adult and bifid in juveniles (Fig. 17.H). Pelvic spine is movable, with many spinules.

Colour

Fishes above 100 mm length**:** The body and fins violet. Cheek with two bands one of which dark blue and other light blue, starting from the edge of the mouth and extending till the gill opening. The second dorsal, anal and caudal fins are dark blue.

Fishes below 100 mm length**:** Body blue, cheek with three bands which extend between mouth and gill opening; the upper and lower bands is light blue and middle band black. One band connecting the tip of snout to eye. The caudal, second dorsal and anal edged white.

Colour in the preserved specimens: The formalin preserved specimens are dark brown with a black band on cheek starting from the edge of the mouth and ending at branchial opening. Similar colour pattern are observed in alcohol preserved specimens.

Remarks: Fishes above 190 mm exhibit sexual dimorphism. In males the lobes of lunate caudal fin are long and blunt. In females the lobes are short and pointed (Fig. 16. B).

Genus *Rhinecanthus* Swainson, 1839

(Type species *Rhinecanthus ornatissimus* Lesson, 1831, Zoologie, v. 2 p.114.)

Diagnosis

Anterior nostril tube like, directed forward. Groove before eye absent. Scales on cheek anteriorly square, posteriorly rectangular and rhomboid, with triangular scale in-between, arranged horizontally, having round protuberance. Body scales with ridges and retrose spines. Caudal peduncle equally long and deep, laterally elliptical, consists of 3-5 rows of antrose spines. Caudal rounded with lobes produced dorsally and ventrally.

Swainson (1839) erected the subgenus *Rhinecanthus* under the genus *Balistes,* with the following characters "First dorsal spine thick, obtuse, serrated or tuberculated; caudal fin rounded; pelvis with spine but no rays".

Swain (1888) designated *Rhinecanthus ornatissimus* (Lesson, 1831) as the type species. Bleeker (1866) treated *Rhinecanthus* as a synonym of subgenus *Balistapus* Tilesius (1820). Whitely (1930) also considered *Rhinecanthus* as a subgenus of *Balistapus* Tilesius (1820). Fraser-Brunner (1935) elevated this subgenus to genus since he observed that:
"With the exclusion of *Balistapus undulatus* these fishes form a very well-marked and sharply defined genus a salient feature being the pronounced rectangular form and rather long straight snout".

Further he added:

"Third spine minute, caudal peduncle much constricted with numerous small spines in 2-4 rows".

Smith (1986) summarised the genus character as:
"No groove before eye, enlarged plates behind gill opening, soft dorsal and anal low, 3rd dorsal spine very small, spines on caudal peduncle, cheek fully scaled, teeth unequal, notched, caudal peduncle with 3-5 rows of small spines".

1. The distinctive characters put forward by Fraser-Brunner (1935) are valid to distinguish the two genera *Balistapus* and *Rhinecanthus* and they cannot be considered as synonyms.

2. Characters like nasal apertures, arrangement and morphology of scales on cheek, abdomen, caudal peduncle and body were not previously used for bringing out the variation between these two genera.
3. The genus *Rhinecanthus* can be redefined as

> "Scales on cheek square anteriorly, rhomboid posteriorly and triangular in between having round protuberance. Nasal aperture is a narrow tube directed forward, posterior nasal aperture circular. Body scales with 3 - 4 vertical rows of ridges or retrose spines. Caudal peduncle cylindrical with 2-5 rows of black antrose spines."

***Rhinecanthus aculeatus* (Linnaeus, 1758)**

Balistes aculeatus Linnaeus, 1758, p.328.
Balistes aculeatus Day, 1878, p.690.
Rhinecanthus aculeatus Jones and Kumaran, 1980, p. 674, fig.573.

Diagnosis
The anterior nostril is a tube directed forward with a "V" shaped flap at the opening. Scales on cheek square anteriorly, rhomboid posteriorly, arranged horizontally. Body scale with ridges and retrose spine. Caudal peduncle equally long and deep, laterally elliptical, with 3 rows of antrose spines. Ventral flap present. Caudal round with dorsal and ventral lobes produced.

Material examined: 22 specimens from Minicoy, (14 females, 5 males, 3 indeterminate) ranging from 38 to 181 mm TL, 12 specimens from Kiltan, (10 Females, 2 Males) ranging from 94 to 162 mm TL, 9 specimens from Agatti, (9 Females) ranging from 105 to 215mm TL, (Fig.19.D), one specimen from Lakshadweep Islands, (Female) of length of 118 mm TL, one specimen from Kavaratti, (Female) of length of 203 mm TL, five specimens from Kavaratti, CMFRI Reg. No. LA-F-154/480, of lengths 121, 143, 147, 160, 162 mm TL, (Fig. 19.B), four specimens from Minicoy, CMFRI Reg. No. LA – F- 154/480, of lengths 93, 128, 137, 195 mm TL, one specimen from Kalpitti, CMFRI Reg. No LA-F-154/480, of length of 175 mm TL, one specimen from Suheli, CMFRI Reg. No LA-F-154/480, of length of 108 mm TL, two specimens from Agatti, ranging CMFRI Reg. No.LA-F-154/480, of lengths 105,133 mm TL.

Additional material examined: 1 specimen from Andaman, ZSI Reg. No. 2253, of length of 191 mm TL, collected by Dr. F. Day (Fig. 19.C).
Description

D. III, i, 22-26; P. i, 10-13; ventral spines 8-14; A. i, 19-23; C. ii, 10; gill rakers 16-19; number of scales from origin of second dorsal to base of anal 14-17; lateral line scales 20-47; scales round the caudal peduncle 9-12.

Body rhomboid. Head profile, straight, prominent chin. Eye placed high. Upper lip fleshy, soft, broad and covers the lower lip. Lower lip is broad and thin. inter orbital flat. First dorsal spine compressed laterally, anterior broad with small spinules at base and blunt large spinules at tip.

Third spine minute. The anterior and posterior nostrils placed in separate depressions (Fig.20.A). All the teeth rectangular with the upper side straight but one side slightly longer than other (Fig.20.B).

There are 3-5 scales in a rectangular region above pectoral, each of these scales are engraved with longitudinal ridges. Gill opening oblique. Gill rakers have broad base, short, hyaline, blunt tipped and having globular protuberance towards the inside (Fig. 20.C). Second dorsal and anal short, thin, rectangular with edges round. Caudal round with lobes produced dorsally and ventrally in fishes having TL of 150- 200 mm and round in fishes having TL of 40 – 100 mm. Pectoral fin rounded.

The scales on check have round protuberances arranged in 3-8 rows vertically (Fig. 20.D & Fig.21.A). The body scales have 3 - 4 vertical rows of ridges and blunt retrose spines (Fig. 20.E & Fig. 21.B). The ultra structure of the anterior margin of the body scale shows round and triangular projections arranged in semicircular rows (Fig. 21.E-G) and the posterior margin has blunt retrose spines (Fig. 20.H-J). The scales on abdomen are rhomboidal arranged obliquely, with round protuberances arranged in 3-5 oblique rows (Fig. 20.F & Fig.21.C). The caudal peduncle has two type of scales 1) scales having 3-5 rows of antrose spines and also an antrose spine at the anterior middle. 2) Scales having 3-5 vertical rows of blunt retrose spines (Fig.20.G & Fig. 21.D).

Ventral flap is narrow, translucent, supported by ventral spines (Fig. 20.H) Pelvic spine, stout broad with 3 to 4 rows of sharp ridges at the centre and small spinules dispersed all over the spine with stellate spines at the posterior edges.

Colour

Body dorsally brown and ventrally white. Inter orbital with 4 bands of blue and three black bands. At the center of the body is a dark brown to black blotch, from which two black bands, meets the base of the second dorsal and anal. From base of anal arises 4 white bands, which meet the central black blotch. Three blue lines extend from interorbital bands and ends till the base of pectoral, between these lines are two bands anterior one light brown and posterior one black. Lips yellow, just above upper lip a blue and yellow band is present which reach the base of the pectoral crossing the cheek. On the caudal peduncle are arranged 3 rows of black antrose spines, which are placed on a white patch. Caudal fin, second dorsal, anal and pectoral fins transparent with light pink color. Pelvic spine pink. Anus surrounded by dark blue ring (Fig. 19.A).

Colour in the preserved specimens: Formalin preserved specimens have light brown, the interorbital with a dark brown band with 3 slightly darker bands at the anterior. Brown band starting from the eye reach the branchial aperture. A dark brown blotch occupies the centre of the body from which originates 2 bands towards dorsal base and two bands towards anal base. Four white bands originating from anal base reaches the central blotch. Except for the first dorsal which is dark brown rest of fins are light brown. The antrose spines at caudal peduncle black (Fig. 19.D).

Alcohol preserved Specimen has light brown color with four white bands arising from base of anal reaches the center of the body. Inter orbital has 4 white bands which are placed between 3 dark brown band. Two white bands originating from the interorbital area reaches the base of the pectoral. Another white band is found at the center of the caudal peduncle, on which 3 rows of spine (dark brown) is placed. The lips surrounded by white band (Fig. 19.C).
Remarks: In Minicoy these fishes are found in the sandy, coral area of the lagoon, hiding in the corals.

***Rhinecanthus echarpe* (Lacepede, 1798)**

Balistes echarpe Lacepede, 1798, p.333, 352.
Balistes rectangulus Day, 1878, p.691.
Rhinecanthus rectangulus Jones and Kumaran, 1980, p. 674, fig.573.

Diagnosis
Nostrils anterior tube directed forward. Groove before eye absent. Scales on cheek square at the anterior and rectangular at the posterior with triangular scale in between, arranged horizontally, with round protuberance. Body scales with blunt retrose spines. Caudal peduncle equally long and deep with 4-5 rows of antrose spines arranged horizontally. Ventral flap present. Caudal round with lobes produced dorsally and ventrally.

Material Examined: 2 specimens from Minicoy, (1 male) of lengths 152, 165 mm, TL (Fig. 22.A).

Additional material examined: 1 specimen from Malay Archipelago, ZSI Reg. No. 2252, of length of 179 mm TL, collected by Dr. F. Day (Fig. 22.B).

Description

D. III, i, 22-24; P. i, 12-13; ventral spines 11-12; A. i, 19-20; C. ii, 10; gill rakers 17-20; number of scales from origin of second dorsal to base of anal 16-19; lateral line scales 35-49.

Body rhomboid, head profile straight with a prominent chin. Eye placed high. Interorbital straight. Lips thick, fleshy, continuous at the corner, the upper lip covers the lower lip, which is thin and flat. First dorsal spine long, stout, laterally compressed, anteriorly broad with short ridges at the base and long ridges at tips, small spinules present on the lateral side. Third spine minute and less than ¼ the first spine. Nostrils slightly elevated (Fig. 23.A). The teeth are rectangular with the upper side straight with one side slightly elevated (Fig. 23.B).

Two rectangular and a triangular scale placed above the base of the pectoral. Gill opening oblique. Gill rakers are short, blunt, hyaline and having hairy projection towards the inside (Fig. 23.C). The second dorsal and anal fin rectangular and anteriorly elevated, edges round and transparent. Pectoral rounded.

Scales on cheek have 3-8 vertical rows of small round protuberance (Fig. 23.D & Fig.24.A). Body scale has 5-6 horizontal rows of blunt retrose spines (Fig. 23.E & Fig. 24.B). The ultra structure of the anterior margin of the body scale shows a network of fibers and circular depressions (Fig. 24.E-G) and the posterior margin has blunt retrose spines and ridges (Fig.24.H-J). Scales on abdomen are rhomboid with round protuberances arranged in 3-5 oblique rows (Fig.23.F & Fig.24.C). Scales on caudal peduncle are of two types 1) wedge shaped scales with an antrose spine at the anterior middle and 1-2 vertical rows of ridges, 2) diamond shaped scales having 4-5 vertical rows of ridges (Fig. 23. G & Fig. 24D).

The ventral spines are laterally compressed, arranged in a single row with spines from both sides alternating (Fig.23.H). Pelvic spine rectangular with many antrose spinules at the anterior and retrose spinules at the posterior. This pelvic spine has two portions the anterior fixed portion and posterior movable portion.

Colour
The fish is uniformly brown. A black band at the interorbital, which has three white bands, one at the anterior middle and the posterior. A wide black band extending from eye to the base of anal passes through the base of pectoral base. A black band occupies the caudal peduncle, which is triangular, bordered with white. The first dorsal black. Pectoral and caudal transparent with a brown ting. Second dorsal and anal transparent.

Colour of preserved specimen: Body uniformly light brown, brown band at the interorbital. A brown band originates from eye and reaches to anal base, passing through the pectoral base. Caudal peduncle has triangular brown band. First dorsal fin black. Second dorsal and anal fin transparent pectoral and caudal brown (Fig. 22.A).

Genus *Melichthys* Swainson, 1839

(Type species *Balistes ringens* Osbeck, 1765.)

Diagnosis
The anterior nostril conical with a circular opening at the tip. Groove before eye. Scales on cheek rectangular to diamond shaped, arranged in vertical rows and having horizontal ridge. Body scales with horizontal ridges. Caudal peduncle deeper than long, laterally elliptical having 6 - 8 rows, of horizontal ridges. Ventral flap absent. Caudal truncate.

***Melichthys indicus* Randall and Klausewitz, 1973**

Melichthys indicus Randall and Klausewitz, 1973, p.57-69, fig.5.
Balistes ringens Bleeker, 1860, p. 69.
Melichthys niger Jones and Kumaran, 1980, p. 666, fig.567.

Material examined: 23 specimens from Minicoy, (15 females, 7 male) ranging from 155 to 210 mm TL.

Additional material examined: 1 Specimen from Lakshadweep, CMFRI Reg. No. 554, 200 mm TL (Fig. 25.B) collected by Jones and Kumaran.

Description
D. III, i, 30-34; P. i, 13-14; ventral spines 0–26; A. i, 26-29; C ii, 10; gill rakers 26-28; number of scales from origin of second dorsal to base of anal 19–24; lateral line scales 30–77; scales round the caudal peduncle 12–18.

Body oval, deep. Head profile, convex with a prominent chin. Lips flat, thin. Inter orbital straight. Groove equal to orbit, deep at the centre, shallow at anterior, broad towards posterior, directed downwards. First dorsal spine short, stout, blunt, laterally compressed. Anterior base has long ridges, and at the middle are present small round protuberances, which spread laterally, tip has large round protuberances. Third dorsal spine, less than ¼ the length of first spine. Nostrils placed in a shallow depression, anterior nostril has a semicircular flap on the opening (Fig.26.A). The teeth are rectangular with a convex upper side (Fig. 26.B).

Four to five large scales, thin, engraved and arranged in a rectangular region above pectoral base. Gill opening vertical. The gill rakers are thin, hyaline with pointed tips (Fig. 26.C). The second dorsal, and anal fins are thick at base and thin towards the tip, anteriorly elevated and posteriorly short with edges round, with a rectangular shape and convex profile. Pectoral fin rounded, black.

Scales on cheek have 3–4 vertical rows of horizontal ridges (Fig.26.D & Fig. 27.A). Body scales have 3-5 vertical rows of transverse ridges (Fig.26.E & Fig. 27.B). The ultra structure of the anterior margin of the body scale shows broad fibres and circular depressions (Fig. 27.E-G) and the posterior margin has ridges (Fig. 26.H-J). Scales on abdomen are rectangular and rhomboid with short ridges arranged in 3-5 vertical rows (Fig. 26.F & Fig. 27.C). Scales on caudal peduncle have 10-20 horizontal ridge and 3-4 short pointed and blunt ridges at the centre (Fig. 26.G & Fig. 27.D).

The ventral spines are very short and pointed in few specimens, in others the spines are absent and the region is thickened (Fig. 26.H). Pelvic spine short blunt.

Colour

Body black. Second dorsal and anal fin base has a white band. A blue band is seen just at the centre of cheek passing obliquely downward up to the ventral portion of cheek. Six blue lines radiate from the eye in six different directions dorsally (Fig. 25.A).

Colour of the preserved specimens: Formalin preserved specimens are brown. First dorsal, second dorsal, anal fins are white. Caudal and pectoral fin are brown with edges brownish white. An oblique streak on cheek is reddish brown (Fig. 25.B).

Taxonomic Note: According to Randall and Klausewitz (1973)

> "This species resembles *M. niger* in colouration-particularly in preservative- and has been confused with it by a number authors. In its caudal shape, counts, and weakly developed ridges along posterior scale rows, however it is closer to *vidua*".
>
> "All of our specimens have come from the Indian Ocean, SANZO's specimens from the southern Red Sea. In the belief that the species may be confined to this ocean (including the western Indo-Australian Archipelago and the southern Red Sea), we have named it *indicus*".

Jones and Kumaran described *Melichthys niger* from the Lakshadweep archipelago (CMFRI specimen Reg. No.554). On examination it was found that, this specimen was *Melichthys indicus* Randall and Klausewitz, 1973. Thus *Melichthys niger* of Jones and Kumaran becomes the synonym of *Melichthys indicus* of Randall and Klausewitz, 1973.

Genus *Canthidermis* Swainson, 1839
(Type species: - *Canthidermis oculatus* Gray, 1830.)

Diagnosis
Anterior nasal funnel shaped. Groove present. Scales on cheek square at the anterior, posteriorly rhomboid with some triangular scale in between arranged horizontally with fleshy row in between. Body scales with ridges and a large ridge at the anterior middle. Caudal peduncle, longer than deep, laterally elliptical, 8-10 rows of scales with blunt ridges at the centre, arranged horizontally. Ventral flap absent. Caudal double lunate.

2.5.5.1. *Canthidermis maculatus* (Bloch, 1786)

Balistes maculatus Bloch, 1786, p.25,pl. 151.
Balistes maculatus Day, 1878, p.687.
Canthidermis rotundatus Jones and Kumaran, 1980, p. 665, fig.566.

Material examined: 23 specimens from Vizhinjam, (12 females, 11 males) ranging from 220 to 369 mm TL(Fig.28.A & B).

Additional material examined: 1 specimen, from Bay of Bengal, ZSI. Reg. No. 11882, of length of 162 mm TL, (Fig.28.F), 2 specimens, from Madras coast, ZSI Reg. No. 13748, 13750, of lengths 113, 98 mm TL, (Fig.28.D & E) , 2 specimens, from Sand Head, ZSI Reg. No. 8164, 8165, of lengths 70 - 86 mm TL, (Fig. 28.C).

Description
D. III, ii, 21–26; P. i, 13 –14; ventral spines 0 –12; A. i, 18 –22; C. ii, 10; gill rakers 19-23; number of scales from origin of second dorsal to base of anal 16–20; lateral line scales 48 –70; scales round the caudal peduncle 11–15.

Body elongated. Head profile, convex, with a prominent chin. Lips broad at centre and narrows at edges. Interorbital convex. Groove equal to eye diameter, narrow and deep anteriorly and broad posteriorly, connected to nasal depression by narrow groove. First dorsal spine pointed, anteriorly with large spinules on tip, compressed and smooth laterally. Third spine ¼ the length of first spine. Nostrils placed in a shallow depression with blunt round protuberances bordering the depression (Fig. 29.A). The teeth of the upper jaw is rectangular with conical edge, the teeth of the lower jaw is rectangular with a conical upper side (Fig. 29.B).

Scales above the base of pectoral absent. The Gill rakers are short and do not project above the edge of the branchial arch, the tip is pointed (Fig. 29.C). Second dorsal and anal fins highly elevated anteriorly and short posteriorly. Pectoral fin rounded.

Scales on cheek have round protuberances and ridges arranged in vertical rows (Fig. 29.D & Fig. 30.A). Body scale with large ridge at the anterior middle (narrow posteriorly) and with many ridges and round protuberances. (Fig. 29.E & Fig. 30.B). The ultra structure of the anterior margin of the body scale shows round depressions and a network of fibres (Fig. 30.E-G) and the posterior margin has blunt round protuberances (Fig. 30.H-J). Scales on abdomen rectangular to rhomboid shaped with many ridges and round protuberances arranged in 3-6 oblique rows (Fig. 29.F & Fig. 30.C). scales on caudal peduncle have ridge (tapering towards posterior and pointed) at the anterior middle and ridges and round protuberances arranged in horizontal rows (Fig. 29.G & Fig. 30.D).

Ventral flap is reduced. The ventral spines are modified into a single row of modified scales, present at the ventral side and each scale has many spines directed back wards giving a comb like appearance (Fig. 29.H). Pelvic spine is movable, short, flat, thick and blunt, with small, blunt minute protuberance.

Colour

The whole fish is dark brownish black. Three types of colour pattern was recorded in the specimens collected from Vizhinjam area,

1. Body brownish black with dash like white spots, which becomes round on the head and caudal area.
2. Body brownish black with white round spots, spread all over the body.
3. Body brownish black light brown ventrally.

Colour of the preserved specimens: Formalin preserved specimens have dark brown with white spots, in some cases it is without spots. Alcohol preserved specimens have light brown colour.

Taxonomic note

According to Fedoryako (1981) in Pacific and Indian oceans there are 5 species of *Canthidermis, viz., C. willughbeii* (Lay and Bennet, 1839), *C. maculatus* (Bloch, 1786), *C. rotundatus* (Proce, 1822), *C. sufflamen* (Mitchill, 1815), and a fifth species *C. villosus (new)* collected from Gulf of Aden.

Fedoryako (1981) observed that *C. villosus* and *C. rotundatus* have same number of fin rays, number of gill rakers and armature of trunk scales. He indicated the differences as, presence of branched dermal protuberances on scales, relatively smaller number of transverse rows of trunk scales, different length/depth ratio of the caudal peduncle and colouration of body and fins.

In case of *C. maculatus*, the author has mentioned that the number of rays of second dorsal and anal fins differs slightly in the limits of variability and these fins are shorter compared to Moore (1967) description. It differs from *C. rotundatus* and *C. villosus* due to smaller number of fin rays and gill rakers, a greater number of small spinules on the trunk scales mottled body colouration.

C. rotundatus is different from *C. maculatus* because of difference in scale armature on the trunk, number of fin rays and gill rakers while longer specimens of *C. rotundatus* and *C. maculatus*, has a longer second dorsal fin, a taller anal, pre-anal distance was less in former. But *C. rotundatus* was similar to *C. villosus* and *C. sufflamen* except that the latter has a greater number of transverse rows of scales, body depth and height of second dorsal and anal fins in comparison to *C. maculatus*. The fin ray counts of all the species are given in the table 1.

Table 1. The fin ray counts of different species of *Canthidermis*

	Second dorsal	Anal	Pectoral	Standard length (mm)
C. maculatus	23-26	21-23	13-15	50-100
C. willughbeii	23-24	21-22	13-14	90-131
C. rotundatus	25-27	22-23	14-16	39-111
C. villosus	24-26	22-23	14-15	71.7-177.7
C. sufflamen	23-25	20-22	13-15	20-300(Moore, 1967)

Berry and Baldwin (1966) observed that,

> "The synonym of this species has been confused because identifications and names based on small specimens (as "*rotundatus"* Proce and "*oculatus*" Gray) have not been recognized as co specific with larger, more elongate specimens (as "*maculatus*" Bloch, w*illughbei*i, Lay and Bennet and "*longirostris*" Tortonese). As the body length increases there is a proportional decrease in head length, eye diameter, body depth and first dorsal spine length and a proportional increase in length of the lobes of the anal and caudal fins".

1. From the above table it can be observed that the fin counts of *C. maculatus*, *C. willughbeii*, *C. rotundatus* and *C. villosus* falls within a narrow range and cannot be used for differentiating between species.
2. Fedoryako collection consists of narrow length range, having length ranges of 50-177.7 mm, except for *C. maculatus*, represented by a large sample, but smaller length groups.
3. Berry and Baldwin (1966) and Matsuura (1981) observed that, the three species of Swainson (1839) i.e. *Canthidermis angulosus* (Quoy and Gaimard, 1824), *Canthidermis gaimardii*

(Swainson, 1839) and *Canthidermis oculatus* (Gray, 1831) are synonyms to *Canthidermis maculatus* (Bloch, 1786). They also established that *Balistes maculatus* (Gmelin, 1879) and *Balistes aureolus* (Richardson, 1845) of Gunther (1870) is also a synonym of *Balistes maculatus* (Bloch, 1786).

4. Some observations made on *Canthidermis maculatus* collected from west coast of India and Minicoy islands showed that 3 different colour patterns exist, i) uniform brownish black dorsally and light brown ventrally, ii) uniform brownish black with round white spots well distributed on the body, iii) brownish black body with white longitudinal dashes distributed on the body. The regression graphs drawn using data of various morphometric measurements on standard lengths revealed low relationship, suggesting that *Canthidermis maculatus* has high degree of variability in case of body colour and certain morphological characters.
5. Thus it is concluded that, *C. willughbeii* (Lay and Bennet, 1839), *C. rotundatus* (Proce, 1822), *C. villosus* Fedoryako, 1981 are junior synonym of *C. maculatus* (Bloch, 1786).

Genus *Parabalistes* Bleeker, 1866

(Type species *Parabalistes chrysospilus* Bleeker, 1866 = *Balistes chrysospilus* Bleeker,1853.)

Diagnosis

The anterior nostril ridge-like, with a circular opening at the top. Groove before eye. Scales on cheek absent anteriorly, posteriorly transverse rows of square scales are present with wide fleshy rows in between. Body scales have spherical protuberances. Caudal peduncle is short and deep, with round protuberances, arranged horizontally. Caudal truncate with filamentous rays on the upper and lower lobes.

The subgenus *Parabalistes* was erected by Bleeker (1866) with the following characters, 1) head profile obtuse, convex. 2) Rostrum naked, scales arranged in rows with some longitudinal gaps in between on the cheek. 3) Longitudinally 45 scales. 4) Caudal peduncle without spines. 5) Second dorsal and anal elevated anteriorly and angulated, caudal rounded with marginal lobes produced.

Herre (1924) mentioned that this genus is not distinctive enough to be considered as a separate genus in the family Balistidae and included *fuscus* in the genus *Balistes*.
Fraser – Brunner (1935) and Matsuura (1980) treated this subgenus as a synonym of genus *Pseudobalistes*.

Characters like i) scales on cheek are horizontally arranged, with shallow fleshy groove in between, ii) the soft dorsal and anal are elevated anteriorly and angulated, iii) caudal peduncle without spines, iv) caudal truncate with filamentous rays in the upper and lower lobes, make this genus very distinct from the other genera of family Balistidae.

Balistes fuscus of Bloch and Schneider (1801) and *Parabalistes chrysospilus* of Bleeker (1866) are synonym (Herre, 1924).

The specimen recorded from the Lakshadweep archipelago and another specimen at the CMFRI museum, collected from south west coast of India conforms to the species description *Balistes*

fuscus of Bloch and Schneider (1801) and *Parabalistes chrysospilus* of Bleeker (1866). Some of the distinctive characters of these specimens are used for redefining the genus as:

> " Anterior nostril ridge-like, with a circular opening at the top. Groove before eye. Scales on cheek absent anteriorly, posteriorly transverse rows of square scales are present with wide fleshy rows. Body scales diamond shaped, having spherical protuberances. Caudal peduncle is short and deep with diamond shaped scales arranged in horizontal rows, with round protuberances. Caudal truncate with filamentous rays on upper and lower lobes."

Thus *Parabalistes* is a valid genus and monotypic.

***Parabalistes fuscus* (Bloch and Schneider, 1801)**

Balistes fuscus Bloch and Schneider, 1801, p.471.
Balistes fuscus Day, 1878,p.690.

Material examined: One specimen from Agatti, (male) 145mm TL (Fig.31.A).

Additional material examined: One specimen from south west coast of India, CMFRI Reg. No. 1025, 362mm TL (Fig.31.B).

Description
D. III, i, 25; P. i, 12; Ventral spines 11; A. i, 22; C. ii, 10; number of scales from origin of second dorsal to base of anal 22; Lateral line scales 51; round the caudal peduncle 15.

Body oval, deep. Head profile convex, chin prominent. Lips, thick, fleshy, broad, and continuous at corner. Interorbital straight. Groove, shallow, equal to orbit, directed downwards. First dorsal spine, long, stout, tip pointed. Laterally compressed smooth. Third spine ¼ the length of first spine. Nostrils placed in depression, with a thin translucent "C" shaped flap on the anterior opening (Fig.32.A). The first teeth of the upper jaw conical with the tip pointed and diverging outside. The first teeth of the lower jaw conical with pointed tip. The other teeth are rectangular with conical upper edge (Fig. 32.B).

Few large and small-scale form a cluster, arranged on a depressed rectangular area above the base of pectoral. Gill opening vertical. The anterior rays of the second dorsal fin and anal fin are long and the posterior rays shortest thus making the fin elevated anteriorly and short posteriorly, fin profile concave. Pectoral fin rounded.

Scales on cheek are of two type i) scales with round protuberances and ridges arranged in 1- 4 vertical rows ii) scales of the fleshy rows (covered by skin) have shallow depressions and ridges and smooth surface (Fig.32.C). Body scales with vertical rows of spherical protuberances arranged in 5 - 10 vertical rows, with the anterior most row having the larger protuberances (Fig.32.D). Scales on abdomen rhomboid which are arranged in oblique rows, each scale has ridges on the first row and round protuberances in 3-5 oblique rows (Fig. 32.E). Scales on caudal peduncle have short round blunt protuberances arranged in 3-5 vertical rows (Fig.32.F).

Ventral flap, narrow, supported by hyaline spines (Fig.31.G). Rudimentary pelvic spine movable with many pointed and blunt glassy protuberances.

Colour
Formalin preserved fish whitish-brown, with horizontal wavy or undulating brown bands. First dorsal fin brown. Second dorsal anal fin whitish-brown with undulating brown bands. Caudal fin whitish-brown with brown vertical bands, pectoral translucent. Lips white.

Remarks: This species was recorded from Agatti Island for the first time (Lakshadweep archipelago).

2.5.7. *Pseudobalistes* Bleeker, 1866

(Type species Pseudobalistes viridescens Bleeker, 1866 = Baliste verdatre Lacepede, 1798)

Balistoides Fraser-Brunner, 1935, p.662.
Type species *Balistes viridescens* Bloch and Schneider, 1801

Diagnosis

Nasal apertures in a depression, anterior nasal conical with an opening at the tip. Groove before eye. Scales on cheek, absent at the anterior, posteriorly 5-6 horizontal rows of small rectangular to square scales with fleshy grooves between these scale rows. Body scales have spherical protuberances. Caudal peduncle with 5-6 horizontal rows of antrose protuberance. Caudal round with lobes produced.

Bleeker (1865) published the drawings together with their names *Balistes* (*Pseudobalistes*) *flavimarginatus* as plate CCXVIII Fig.3 and *Balistes* (*Pseudobalistes*) *viridescens* plate CCXXIV Fig.3 in *Atlas Ichthyologique.*

In 1866 he (Bleeker) published the description of subgenus *Pseudobalistes* and designated *Pseudobalistes viridescens* Bleeker, as the type species. The description of *Balistes viridescens* was first published by Bloch and Schneider (1801) and Bleeker's *Pseudobalistes viridescens* is co specific with this.

Fraser-Brunner (1935) erected the genus *Balistoides* with the same type species as that of *Pseudobalistes*, hence *Balistoides* Fraser-Brunner, 1935 is a junior synonym of *Pseudobalistes*, Bleeker, 1866, though none of the authors including Fraser-Brunner, 1935 mentioned it. Jordan (1917) believed that *Balistes* (*Pseudobalistes*) *flavimarginatus* Ruppell (1829) as the type species of *Pseudobalistes* apparently because this name together with its figure appeared first in *Atlas Ichthyologique* of Bleeker (1865). However in about one year of publication of *Atlas Ichthyologique* a revision of Family Balistidae was published by Bleeker (1866) where in he has described the genus and designated the type species. Hence the impression of Jordan (1917) that *Balistes* (*Pseudobalistes*) *flavimarginatus* is type of *Pseudobalistes* is invalid.

Thus it is concluded that the type species of *Pseudobalistes* of Bleeker (1866) is *Pseudobalistes viridescens* (Bleeker, 1866) = *Balistes viridescens* (Bloch and Schneider, 1801) and since the type of *Balistoides* of Fraser-Brunner (1935) also *Balistes viridescens* (Bloch and Schneider, 1801), it becomes the junior synonym of *Pseudobalistes.*

***Pseudobalistes viridescens* (Bloch and Schneider, 1801)**

Balistes viridescens Bloch and Schneider, 1801, p. 477.
Balistes viridescens Day, 1878, p.689.
Balistoides viridescens Jones and Kumaran, 1980, p.668, fig.569.

Diagnosis
Nostrils placed in depression surrounded by spinules, anterior nostril dome shaped with a circular opening at the top. Groove before eye. Scales on cheek square at the anterior and rectangular towards the posterior, arranged in 5-6 horizontal rows with fleshy rows in between. Caudal peduncle equally long and deep, laterally elliptical, having spherical protuberances or antrose spines arranged in 4-5 rows. Ventral flap absent. Caudal fin round.

Material examined: One specimen from Kalpeni, of length of 139 mm TL, 9 specimens from Minicoy, (1 female, 5 males and 3 indeterminates) ranging from 43 to 474 mm TL, (Fig.33.D), Five specimens from Lakshadweep Islands, CMFRI-LA-F. Reg. No. 154/475, of lengths 56, 82, 107, 235, 308 mm TL.

Additional material examined: Six specimens from Tuticorin, (4 females, 2 males) of lengths 287, 370, 370, 422, 450, 527 mm TL, (Fig.33.C), three specimens from Kelakarai, (3 females) of lengths 83, 141, 326 mm TL, (Fig.33.B), one specimen from Mandapam, (female) of length of 316 mm TL, (Fig.33.A), Two specimens from Gulf of Mannar, CMFRI – F. Reg. No. 154/ 699, of lengths 105,155 mm TL.

Description
D. III, i, 21–26; P. i, 13–14; ventral spines 6–14; A. i, 22-23; C. ii, 10; Gill rakers 30-35; number of scale from origin of second dorsal to base of anal 11–15; lateral line scale 38–49; round the caudal peduncle 10–12.

Body oval, deep. Head profile, convex. Inter-orbital straight. Lips thick cylindrical, broad. Groove, longer than orbit, narrow at the anterior, broad and shallow towards posterior, with some minute sharp protuberances. First dorsal spine with small protuberances, third spine less than ¼ length of first spine. A thick "C" shaped flap covers the circular opening of anterior nostrils (Fig.34. A). The first teeth of the upper jaw conical with pointed tip diverging outside. The first teeth of the lower jaw conical with pointed tip. Other teeth are conical with a broad base (Fig.34. B).

Few scales arranged just above the base of pectoral are small, round and engraved. Gill opening oblique. The gill rakers are elongated, hyaline, pointed and laterally compressed (Fig.34. C).

The second dorsal and anal fins are anteriorly elevated and posteriorly round having serrated edge. Pectoral fin round.

Square and rectangular scales on cheek have spherical protuberances arranged in 4-6 vertical rows (Fig.34.D & Fig.35.A). Body scales have vertical rows of spherical protuberances arranged in 4-9 rows. Fresh specimens have a dark central blotch (Fig. 34.E & Fig.35.B). The ultra structure of the anterior margin of the body scale has irregular shaped projections and long ridges (Fig.35. E –G) and the posterior margin has round protuberances (Fig.35. H - J). Rectangular and rhomboid scales on abdomen have spherical protuberances arranged in oblique rows (Fig.34.F & Fig.35.C). There are two types of scales on caudal peduncle i) scales with 4-6 rows of spherical protuberances, ii) scales with a large spherical protuberance or antrose spine at the anterior middle of the scales with 3-5 vertical rows of spherical protuberance (Fig.34. G & Fig.35.D).

The ventral flap is absent. Ventral spines are transparent, elongate, thick and blunt in adults, the spines are thick, short and hyaline having pointed tips in juveniles (Fig. 34. H). Pelvic spine is movable, club shaped fully decorated with hyaline spinules, edges are stellate.

Colour

Variation in colour pattern (fresh specimens) was observed in specimens collected from south east coast (Kelakarai, Mandapam and Tuticorin) and Minicoy.

(1) **Kelakarai**

Body Olive green. **Body scales** dark green patch at the center. **Cheek** orange, with black and white band above upper lips. A dark longitudinal blotch originates at the inter-orbital to base of pectoral. **First dorsal fin** orange with few darker patches. **Second dorsal and anal fins** orange, bordered with black band. **Caudal** orange, bordered with black band. Pectoral orange (Fig. 33.B).

(2) **Mandapam**

Body Yellow. **Body scales** with a dark brown patch at the center. **Cheek** bright yellow, just above upper lip reddish brown, pink and black band. Breast pink. A dark longitudinal blotch originates at the inter-orbital to base of pectoral. **First dorsal** brown, with a pink patch at the base. **Second dorsal and anal fin** yellow, bordered with a black band. **Caudal fin** yellow, bordered with a broad black band (Fig. 33.A).

(3) **Tuticorin**

Body bright yellow. **Body scales** brown-green colour at the center. **Cheek** orange, just at the edge of the mouth greenish yellow band, upper lip brown, lower lip pink. Just above upper lip dark brown and white band. Longitudinal blotch from inter-orbital to base of pectoral, breast pink. **First dorsal fin** brown. **Second dorsal and anal fin** brown, dark brown band at edges and base. **Caudal** yellow, with dark brown band at edges. **Pectoral fin** yellow, with orange brown edges (Fig. 33.C).

(4) **Minicoy**

Body yellow. **Body scales** brown-green at the center. **Cheek** yellow, upper lip black, lower lip pink just above upper lip a white, black and a narrow white band. Longitudinal blotch from inter-orbital to base of pectoral, breast white. **First dorsal fin** yellow. **Second dorsal and anal fin** Yellow, black band at edges and base. **Caudal** yellow, with black band at edges. **Pectoral fin** yellow, with black edges. A white-yellow blotch at caudal peduncle (Fig. 33.D).

Colour of the preserved specimens: Body Brown, body scale with a black blotch at the enter. Longitudinal blotch from inter-orbital to base of pectoral.

Remarks: The fishes collected from Kelakarai, Mandapam, Tuticorin and Minicoy Islands**,** showed some variations in the colour pattern. These fishes were very rare in the catches and only 27 specimens could be collected during the study period.

2. *Pseudobalistes flavimarginatus* (Ruppell, 1828)

Balistes flavimarginatus Ruppell, 1828, p. 33.
Balistes flavimarginatus Day, 1878, p.690.
Pseudobalistes flavimarginatus Jones and Kumaran, 1980, p. 671, fig.571.

Diagnosis
Anterior nostril, in a depression, dome shaped with a circular opening at the top, Groove before eye. Scales on cheek absent anteriorly, posteriorly square arranged horizontally in 5-6 narrows rows with fleshy rows in between. Body scales with spherical protuberances. Caudal peduncle longer than deep with 4-5 rows of sharp ridge or blunt spherical protuberances. Caudal truncate with lobes produced.

Material examined: One specimen from Minicoy, (female) of length of 233 mm TL, two specimens from Minicoy, of lengths 273, 233 mm TL, four specimens from Minicoy, (3 females, 1 male) of lengths 271, 324, 429, 435 mm TL, (Fig. 36.A), four specimens from Minicoy, CMFRI-F. Reg. No. 154/447, of lengths 123, 160, 160, 287 mm TL, one specimen from Agatti, CMFRI-LA-F. Reg. No. 154/443, of length of 317 mm TL, (Fig.36.D), one specimen from Minicoy, CMFRI Reg. No. 2251, of length of 183 mm TL,

Additional material examined: Two specimens from Tuticorin, of lengths 484, 490mm, TL, (Fig.36.B), one specimen from Mandapam, (female) of length of 345 mm TL, (Fig. 36.C) one specimen from Andaman, ZSI Reg. No. 2251, of length of 183 mm, TL, collected by Dr. F. Day (Fig.36.E).

Description
D. III, i, 24-25; P. i, 13-14; ventral spines 8-13; A. i, 23-24; C. ii, 10; Gill rakers 29-31; number of scales from origin of second dorsal to base of anal 12-14; lateral line scales 44-51; round the caudal peduncle 10-11.

Body oval. Head profile convex. Lips broad, thin and narrow at the center. Interorbital convex. Groove, straight, equal to orbit, narrow and shallow towards anterior, deep and broad posteriorly. First dorsal spines strong, stout, laterally compressed, broad. Numerous spinules, at the anterior portion with larger spinules at tip. Anterior nostril covered by a "C" shaped flap. Posterior nostril circular and placed slightly elevated from the anterior nostril, (Fig. 37.A). The first teeth of the upper and lower jaw conical with pointed tip, tips diverge in case of upper jaw. The other teeth are rectangular elongated with the upper end conical towards one side (Fig.37.B).

Scales above the pectoral base is arranged in an irregular fashion having round, rectangular and hexagonal shapes. Gill opening vertical. The gill rakers are elongated, blunt tipped, laterally flat, with rough inner edge (Fig.37.C). The second dorsal and anal is elevated anteriorly and short and rounded posteriorly with a wavy edge. Pectoral fin rounded.

Scales on the cheek are of two types i) scales on cheek with 1- 4 vertical rows of spherical protuberances with few ridges. ii) scales covered by skin with smooth surface and shallow depressions and ridges (Fig.37.D & Fig.38.A). Body scales, with a dark blotch at the center and have 5 – 6 vertical columns of spherical blunt protuberances (Fig. 37.E & Fig.38.B). The ultra structure of the anterior margin of the body scale has network of fibers (Fig.38. E –G) and the posterior margin has round protuberances (Fig. 38. H - J). Scales on abdomen have ridges on the first row followed by 3-5 oblique rows of round protuberances (Fig.37.F & Fig.38.C). There are two types of scales on caudal peduncle i) scales with spherical or sharp ridges at the anterior middle of the scale. ii) Scale with spherical protuberance arranged in 3-4 vertical rows (Fig.37.G & Fig. 38.D).

The anterior ventral spines are transparent, elongated; posterior spines are broad and pointed (Fig.37.H). The ventral pelvic spine is rectangular and laterally elliptical with large number of blunt protuberances.

Colour

Variation in colour pattern (fresh specimens) was observed in specimens collected from south east coast (Mandapam and Tuticorin) and Minicoy.

(1) **Minicoy**

Body grey, upper and lower lips orange. **Cheek**, orange, with dorsally lighter and ventrally darker. **First dorsal** brown. **Second dorsal, Anal and caudal fins** have red, grey and a narrow orange band at the edge. **Pectoral** yellow bordered with orange (Fig. 36.A).

(2) **Tuticorin**

Body dark brown. Upper and lower lips pink. **Cheek** dorsally dark brown ventrally orange. **First dorsal** black. **Second dorsal, anal and caudal fins** have orange and grey band at the edge. First and last ray of second dorsal, anal and caudal fin bright red (Fig. 36.B).

(3) **Mandapam**

Body yellow. Upper and lower lips are orange. **Cheek** is orange, dorsally lighter and ventrally darker. **First dorsal** brown. **Second dorsal, anal and caudal fins** have red, grey and narrow orange band at the edge. **Pectoral** yellow bordered with orange (Fig. 36.C).

Colour of the preserved specimens: The whole fish is brown (Fig.36.D).

Remarks: The fishes collected from Mandapam, Tuticorin and Minicoy Islands, showed some variations in the colour pattern. These fishes were very rare in the catches and only 14 specimens could be collected during the study period.

2.5.7. 3. *Pseudobalistes conspicillum* (Bloch and Schneider, 1801)

Balistes conspicillum Bloch and Schneider, 1801, p.474.
Balistes conspicillum Day, 1878, p.689.
Balistoides conspicillum Jones and Kumaran, 1980, p.670, fig.570.

Diagnosis
Nostrils in a shallow depression, anterior nostril conical with a circular opening at the top. Groove before eye. Scales on cheek diamond shaped, obliquely arranged at the anterior and vertical posteriorly. Body scales with spherical protuberances. Caudal peduncle equally deep and long cylindrical, having two rows of spherical protuberances. Ventral flap absent. Caudal round.

Material examined: One specimen from Lakshadweep, CMFRI. Reg. No. CMFRI-LA-F-154/476, of length of 282 mm TL (Fig. 39).

Description
D. III, i, 25; P. i, 13; ventral spines 20; A. i, 21; C. ii, 10; number of scales from origin of second dorsal to base of anal 21; lateral line scales 57; round the caudal peduncle 11.

Body oval. Head profile, dorsally concave, ventrally convex. Lips, thick, cylindrical. Eye placed high. Inter-orbital straight. Groove equal to orbit, narrow towards the anterior, broader and deep towards the posterior, parallel to head profile. First dorsal spine broad, blunt, with small protuberances at the anterior portion. Third spine, less than ¼ the length of first spine. Opening of the anterior nostril covered by a "C" shaped thick flap.

Rectangular scales placed in a rectangular area just above pectoral base. Gill opening vertical. Second dorsal and anal fins, have a convex profile. The length of anal fin base is half to that of second dorsal fin base; both the fins are translucent Pectoral fin round.
Scales on cheek have 3–4 vertical rows of round protuberances (Fig.40.A). Body scales with a spherical pointed protuberance at the anterior middle and 4-6 vertical rows of round protuberances (Fig.40.B). Scales on abdomen rectangular or rhomboid arranged in oblique rows with round protuberances also arranged in oblique rows (Fig.40.C). Scales on caudal peduncle are of two types i) scales with a large spherical protuberance at the anterior middle of the scale and round protuberances, ii) scales with round protuberances arranged in vertical rows (Fig.40.D).

Ventral spines 20 in number arranged in a single row with the spines from either side alternating. Each spine is a triangular projection arising from the lateral side of an elongated rectangular scale (Fig. 40.E). Rudimentary pelvic spine short stout has minute spinules.

Colour
Formalin preserved fish, dark brown. Lips pink, behind lips pink followed by a circular whitish-brown ring. Whitish-brown band below eye. First dorsal fin black. Second dorsal and anal fin pink and translucent. Caudal brown edge blackish - brown. Ventrally 6–7 circular to hexagonal whitish-brown patches arranged in three rows. Caudal peduncle has broad whitish-brown streak (Fig.39).

.
***Sufflamen* Jordan, 1916**
(Type species *Balistes capistratus* Shaw, 1804 = *Balistes fraenatus* Latreille,1804)

Diagnosis
Anterior nasal aperture dome shaped with a circular opening or tube directed forward. Scales on cheek rectangular or square or rhomboid with round protuberances. Groove before eye. Body scale with blunt retrose spine. Caudal peduncle equally long and deep. Caudal peduncle with five to eight rows spherical protuberances or antrose spines. Caudal emarginate or lunate.

2.5.8. 1. *Sufflamen fraenatus* (Latreille, 1804)
Balistes fraenatus Latreille, 1804, p.74.
Balistes mitis Day, 1878, p.689.
Balistes verres Gilbert and Stark, 1904, p.153, fig. 49.

Diagnosis
The nostrils placed in a circular depression, anterior nostril dome shaped with an opening at the tip. Scales on cheek rectangular arranged in horizontal rows with round protuberances. Groove before eye. Body scales have round protuberances. Caudal peduncle equally deep and long, have 5-10 rows of spherical protuberance. Caudal lunate with lobes produced.

Material examined: 30 specimens from Colachel, (17 females, 13 males) ranging from 156 to 291 mm TL, 30 specimens from Vizhinjam, (18 females, 12 males) ranging from 184 to 334 mm TL (Fig. 41.A), 29 specimens from Vizhinjam, (indeterminate) ranging from 85 to 118 mm TL, two specimens from Vizhinjam, CMFRI Reg. No. 154/441 and 442, (male and indeterminate) of lengths 120,166 mm TL (Fig. 41. D).

Additional material examined: Eight specimens from Tuticorin, (3 females, 5 males) ranging from 203 to 292 mm TL, three specimens from Chennai, (indeterminate) of lengths 94, 96, 102 mm TL, one specimen from Akyab bazaar, ZSI Reg. No. 10622, 182 mm TL (Fig.41.C) one specimen from Travancore, coast ZSI Reg. No. F 4160/1, 205 mm TL.

Description
D. III, i, 28–32; P. i, 13–15; ventral spines 9–21; A. i, 25-29; C. ii, 10; gill rakers 25-30: number of shield from origin of second dorsal to base of anal 21–28; lateral line shields 41-50 + 22–27; round the caudal peduncle 13–17.

Body rhomboid. Head profile straight with a prominent chin. Eye placed high. Inter orbital convex. Groove longer than orbit, deep, narrow at anterior, broader at posterior. First spine stout laterally compressed smooth, anteriorly flat with minute spinules, which are broad and blunt towards tip. Anterior nostril has a fleshy cone like projection from the inside at the opening (Fig.42.A). The first teeth of the upper and lower jaw conical with pointed tip, other teeth rectangular with upper side uneven (Fig. 42.B).

Enlarged scales arranged on a loose membrane above the base of pectoral. Gill opening oblique. Gill rakers narrow, elongated, with pointed and fragile tip (Fig.42.C). The second dorsal and anal is anteriorly elevated and posteriorly rounded. Fins are thick at base thin at tips. Pectoral round.

Scales on cheek have round protuberances arranged in 6-9 vertical rows (Fig.42. D & Fig.43.A). The body scales have ridges on the first row and 3-6 vertical rows of blunt retrose spines (Fig.42. E & Fig.43.B). The ultra structure of the anterior margin of the body scale has irregular shaped projections (Fig.43. E–G) and the posterior margin has first row of ridges and retrose spines (Fig.43. H-J). The scales on Abdomen are rectangular with the first row of ridges and 3-6 oblique rows of round protuberances (Fig. 42.F & Fig.43.C). Scales on caudal peduncle have a spherical protuberance at the anterior middle of the scale and 4-6 rows of ridges and blunt retrose spines (Fig.42. G & Fig. 43.D).

Ventral flap present with hyaline pointed spines (Fig.42.H). Pelvic spine movable.

Colour
Body brown, abdomen yellow. Iris golden when fresh. Lips pink to red in colour. Yellow or grey band above upper lip, white band below the lower lip together form a complete circle around mouth. In some specimens a lateral pink or red or white band originates at the edge of the mouth up to base of pectoral across the cheek. The first dorsal black. Second dorsal and anal are black at the base and yellowish or transparent at outer margin. Pectoral yellow. Caudal dark brown to black (Fig.41.A).

Colour of the preserved specimens: Body brown. White band below lower lip. Another white band across cheek originating from edge of mouth up to base of pectoral, in case of male (Fig.41.C & D).

Remarks: A yellow band above upper lips, in case of male and grey in case of female. A horse bridle like band around mouth and cheek, which extends till base of pectoral, which is present in male. It is white in immature males but pink to red in mature male.

Taxonomic Note
Gilbert and Stark (1904) described *Balistes verres* and observed

> " We describe as new the species that has commonly been referred to as *B. capistratus* on the Pacific coast of Central America. *B. capistratus* was probably based on east Indian material but we have had for comparison specimens from the Hawaii Islands only. From this *B. verres* differs in having smaller scales and a greater number of dorsal and anal rays. Specimens from Panama and Mazatlan have the scales 58 - 65; the dorsal has 30-32 rays and anal 28 or 29. Five specimens of *B. capistratus* from Hawaii have 50 or 51 oblique series of scales (counted from the upper end of gill opening); the dorsal has 29 or 30 rays; the anal has 25-27 rays. Caudal fins of the Hawaiian specimen are truncate, with outer rays not produced. The caudal is noticeably lunate in the Panama and Mazatlan specimens."

According to Berry and Baldwin (1966)

> " *Sufflamen verres* is closely related to *S. fraenatus* (Latreille) [= *S. capistratus* (Shaw) = *S. mitis* (Bennett)] which ranges from Hawaii westward to South Africa. The two species are very closely similar in Morphology and in adult pigmentation. Specimens of *S. fraenatus* from the central Pacific have lower number of soft rays (about D. 28-30, A. 24-26) than *S. verres*; but a specimen of *S. fraenatus* (ANSP 101164) from South Africa, at western extreme of the range, has D. 31 and A. 27, very similar to *S. verres*".

The meristic characters of *Sufflamen fraenatus* of west coast of India and *Sufflamen verres* Pacific coast of Central America are given in the following table.

The meristic characters of *Sufflamen fraenatus* and *Sufflamen verres*	*Sufflamen fraenatus* n.90 (south west coast of India)	*Sufflamen verres* n 60 (Pacific coast of central America) Berry and Baldwin (1966)	*Sufflamen verres* n 6 (Pacific cost of central America) Gilbert and Stark (1904)
Dorsal	III, 30-33	III. 30-33	III. 30-32
Anal	27- 30	27-30	28-29
Pectoral	14-15	14-15	
Caudal	12	12	

The species cannot be distinguished with the help of meristic characters.

The caudal fin shape cannot be considered as marked variation as believed by Gilbert and Stark (1904), because the specimens in different length groups show different caudal fin shapes. The smaller (80-200 mm) length groups have truncate caudal fin and the larger length groups (250-300 mm) have lunate caudal fin, specimens above 300 mm have double lunate caudal fin.

The sexual dimorphism in *Sufflamen verres* was observed by Berry and Baldwin (1966) from the eastern Pacific. A similar observation was made from east coast of India. A detailed study on the sexual dimorphism revealed that the immature males have white bridle like band and maturing and mature males have pink and bright red band.

Thus it is clear that both the species *S. fraenatus* and *S. verres* are similar and *S. verres* should be considered as a junior synonym of *S. fraenatus*.

2.5.8. 2. *Sufflamen chrysopterus* (Bloch and Schneider, 1801)

Balistes chrysopterus Bloch and Schneider, 1801, p.466.
Balistes chrysopterus Day, 1878, p.688.
Sufflamen chrysoptera Jones and Kumaran, 1980, p.667. Fig. 568.

Diagnosis

The anterior nasal aperture is dome shaped with a tube at the tip. Scales on cheek rectangular at the anterior, arranged obliquely, diamond at the posterior, arranged vertically. Groove before eye. Body scales have retrose spines. Caudal peduncle equally long and deep with 8–9 rows of antrose spines. Caudal truncate.

Material examined: Two specimens from Kavaratti, (1 male, 1 indeterminate) of lengths 155, 154 mm TL, three specimens from Minicoy, (2 females, 1 indeterminate) of lengths 52, 82, 110 mm TL, (Fig.44.A), two specimens from Lakshadweep, CMFRI Reg. No. F4124/1, of lengths 112,154 mm TL.

Additional material examined: One specimen from Minicoy ZSI Reg. No. F 4124/1. 154 mm TL, (Fig.44.B).

Description
D. III, i, 26–27; P. i, 12; ventral spines. 11–17; A. i, 23-25; C. ii, 10; gill rakers 20- 24; number of scales from origin of second dorsal to base of anal 15–18; lateral line scales 25-60; round the caudal peduncle 11–13.

Body rhomboid. Head profile straight with a prominent chin. Lips thick fleshy and broad, continuous at the corner. Interorbital straight. Groove longer than orbit, narrow at anterior, broader deep towards posterior spiny protuberances present in the groove. First dorsal spine stout, short, blunt, laterally flat and smooth. Minute protuberances at the anterior flat surface, which are round at the bottom, ridges at the mid portion and large ridges at the tip. Nostrils placed in a shallow depression (Fig. 45.A). All the teeth rectangular with the upper side serrated (Fig. 45.B).

Two enlarged rectangular scales arranged opposite to each other and numerous smaller scales arranged in a mosaic fashion in a rectangular area just above the base of pectoral. Gill opening oblique. Gill rakers narrow, hyaline, elongated; with pointed tips and minute blunt protuberances towards the inside (Fig. 45.C). Second dorsal and anal fin are short and have a convex profile. Pectoral round.

The scales on cheek have ridges and round protuberances arranged in 4–5 vertical rows (Fig.45. D & Fig.46.A). Body scales have blunt retrose spines arranged in 3-6 vertical rows (Fig.45. E & Fig.46.B). The ultra structure of the anterior portion of the body scale has irregular shaped projections (Fig. 46. E –G) and the posterior portion has blunt retrose spines (Fig. 46. H - J). The scales on abdomen are rectangular with ridges and blunt retrose spines arranged in 3-5 oblique rows (Fig.45.F & Fig.46.C). Caudal peduncle laterally elliptical. Scales on caudal peduncle are of two types i) scales with an antrose spine at the anterior middle and 3-5 vertical rows of blunt retrose spines and ridges ii) scales have blunt retrose spines and ridges arranged in 3-6 vertical rows (Fig. 45.G & Fig.46.D).

Ventral flap broad at the anterior and narrow posteriorly. Ventral spines 11–17 are short, pointed, and transparent (Fig.45.H).

Colour
Fish dark reddish blue, with yellow lips. First dorsal dark brown. Second dorsal and anal light yellow to brown, translucent. Caudal brown with the edges white a white crescent at the posterior. Just above the lips a blue band which extends from corner of mouth to the pectoral base across cheek. A narrow bright blue band originates behind the eye and meets the pectoral base (Fig.44.A).

Colour of the preserved specimen: The whole fish is brown caudal has a white crescent at the posterior edge (Fig.44.B).

***Abalistes* Jordan and Seale, 1906**
(Type species *Balistes stellaris* Bloch and Schneider, 1801 = *Balistes stellatus* Lacepede, 1798)

Diagnosis
Anterior nostril funnel shaped. Scales on cheek rhomboid, arranged in vertical rows, have round protuberances. Grove before eye. Body scales with spherical and round protuberances and ridges. Caudal peduncle depressed dorso-ventrally, longer than deep. Caudal peduncle has 3-4 rows of ridges. Caudal double lunate.

1. *Abalistes stellatus* (Lacepede, 1798)
Balistes stellatus Lacepede, 1798, p. 350.
Balistes stellatus Day, 1878, p.687.

Material examined: Ten specimens from Colachel, (2 males, 8 females) ranging from 158 to 411 mm TL, (Fig.47.A), seven specimens from Vizhinjam, (2 males, 5 females) ranging from 201 to 287 mm TL, (Fig.47.C).

Additional material examined Eleven specimens from Tuticorin, (7 males, 4 females) ranging from 260 to 425 mm TL (Fig.47.B), 2 specimens from Madras, ZSI. Reg. No. 2254 and 2717,

of lengths 135, 166 mm TL (Fig.47.D & F) collected by Dr. Day, one specimen from Bay of Bengal, ZSI. Reg. No. F603/2, of length of 246 mm TL, (Fig. 47.E).

Description
D. III, i, 25-26; P. i, 13-14; ventral spines 5-13; A. i, 23-25; C. ii, 10; gill rakers 29-33; number of scales from origin of second dorsal to base of anal 14-18; lateral line scales 29-68; scales round the caudal peduncle 9-12.

Body oval, head profile, convex dorsally, straight ventrally, chin prominent. Lips thick, cylindrical. Inter-orbital straight and broad. Groove before eye, deep longer than orbit, directed downwards. Nostrils, placed in a shallow depression with the anterior nostril (funnel shaped) having curved edges and a small lobe towards the posterior (Fig. 47.A). First dorsal spine, cylindrical, slender, pointed. Third spine ¼ the length of first spine. All the teeth are conical with pointed tip (Fig.48.B).

Enlarged scales (rectangular with edges round), five to six, arranged in an oval area at the base of pectoral. In 200-300 mm length groups enlarged scales are fused together, in 80–150 mm length groups the enlarged scales are attached on a flexible membrane. The gill rakers are hyaline, elongated with pointed tips (Fig.48.C). Second dorsal and anal, rectangular, with serrated edge. Pectoral round.

Scales on cheek have 3-8 vertical rows of round protuberances (Fig.48. D & Fig. 49.A). Body scales have a large spherical protuberance at the anterior middle. Ridges from the anterior most row followed by round protuberance arranged in 2-7 vertical rows (Fig.48. E & Fig.49.B). The ultra structure of the anterior margin of the body scale has ridges arranged in rows (Fig.49. E–G) and the posterior margin has first row of ridges and round protuberances (Fig.49. H-J). Scales on abdomen rectangular or rhomboid, arranged obliquely and have ridges (Fig.48. F & Fig.49.C). Scales on caudal peduncle have a transverse ridges at the centre and 3 -5 horizontal rows of round protuberance (Fig.48. G & Fig. 49.D).

Ventral flap wide supported by many pointed, elongated, hyaline, slender ventral spines. Two rows of retrose spines arranged on the flap (Fig. 48. G). Pelvic spine short, moveable, broad, cylindrical decorated with spinules. Few larger spinules are arranged at the anterior portion directed backwards and some are also arranged laterally and posteriorly.

Colour
Dorsally olive green with bluish-white spots, ventrally white, with few narrow green bands obliquely. Iris gold. Upper lip grey and lower lip white. A white streak present on the middle of the body. First dorsal fin with 5-7 parallel yellow bands and a black blotch at the tip. Second dorsal and anal fins have yellow bands which are arranged parallel to body, pectoral fin yellow. Four white blotch, first blotch anterior to first dorsal fin, second blotch between first and second dorsal fin, third blotch exactly at the middle of second dorsal fin, fourth blotch on caudal peduncle. Caudal fin brown.

Colour of the preserved specimens: The whole body golden brown, with prominent white spots dorsally. Four white blotches, one at the origin of the first dorsal, second blotch between

first dorsal and second dorsal, third blotch at the middle of the second dorsal, fourth blotch on the caudal peduncle. White streak at the lateral middle. Fins brown.

Remarks

The Body shape of the figure in Histoire Naturelle of Lacepede (1798) (plate 15, figure1) does not exactly represent the species but gives a rough shape of the fish. Few white dots are seen scattered dorsally but lacks the prominent four white blotches and a white streak at the middle of the body. The caudal is shown as forked but this fishes from Indian seas have double lunate caudal.

Bleeker in his Atlas Ichthyology (1865) has brought out colour patterns of this fish in minute details. But few of the bands, which originate below eye and at the corner of the mouth was not present in the specimens caught from our region.

Taxonomic note: The genus is monotypic and the description of genus given by Jordan and Seale (1906) and species description of Bloch and Schneider (1801) conform to the specimens of this species (this species is rare) collected from the southeast and west coast of India.