ISSN: 0073—4381

ICHTHYOLOGICAL BULLETIN

of the

J. L. B. SMITH INSTITUTE OF ICHTHYOLOGY
GRAHAMSTOWN, REPUBLIC OF SOUTH AFRICA

NUMBER 46 MAY 1982

SERRANID FISHES OF TANZANIA AND KENYA

by

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Abstract

Morgans, J.F.C. 1982. Serranid Fishes of Tanzania and Kenya. *Ichthyological Bulletin of the J.L.B. Smith Institute of Ichthyology,* No. 46, 00 pages, 7 plates.

Forty-three species of serranid fishes from Tanzania and Kenya are described and distinguished. Notes on the food, gonad condition, internal parasites, changes with growth, underwater observations of live fish, habitat, and coloration of live or fresh specimens are given for most species. Synoptic synonymies are given for each species, but no attempt was made to resolve taxonomic problems that required examination of type-specimens.

Contents

EDITORS' NOTE: The work here presented was completed in 1965. Although the author does not take into account papers published after 1965, we believe that the present paper contains much useful and original information on these poorly known species. As the author is not in a position to make extensive revisions of his work, we decided that it would be better to offer the work as is, than to allow this research not to be published. A more comprehensive taxonomic treatment of these same species will soon be published by P.C. Heemstra and J.E. Randall.

SERRANID FISHES OF TANZANIA AND KENYA

by

J.F.C. Morgans

Introduction

This paper arises from work done over six years while the author was on the staff of the now defunct East African Marine Fisheries Research Organization (EAMFRO) in Zanzibar.

Data derive principally from fishes caught by handlines from M.V. "Research" and M.V. "Manihine" off Tanzania in shallow water, and down to over 120 m on the North Kenya Banks (Morgans, 1964). I utilise, chiefly, cruise records dating from the start of 1954 (Cruise 61) to the end of 1959 (Cruise 167). Prior to cruise 61 most records are useless from the point of view of this work due to difficulties then experienced with identification although, for certain unmistakable species, the earlier records are utilised. In addition, many visits to the Zanzibar fish market resulted in obtaining a balanced impression of what species were caught by the local fishermen and produced several species not taken on our cruises. A great deal of spearfishing, and a little work with trammel nets, with explosives and with poisons, broadened appreciation of the ecology of the serranids invaluably.

Almost invariably, all fishes caught were individually identified, weighed, measured (TL and SL) and examined for stomach contents, gonad condition and parasites by whichever EAMFRO fisheries scientist conducted the cruise. Because our different interests caused cruises to have different emphasis most records used for this paper were made by me.

Many of the large groupers had threadlike gonads that could not reasonably be regarded as "spent" and it is clear that gross examination of gonads revealed an incomplete picture of sexual matters. Smith (1959) comments on hermaphroditism of different types in serranids from Bermuda.

Serranid fishes form a large, regular and valuable part of the catch of fishermen along the coastline of tropical east Africa. None has a reputation for being poisonous. Those of economic importance range in mass from less than half a kilogram to giants of over two hundred kilograms. The fishing projects of EAMFRO and visits to the market showed that there were many different species being harvested and that no one species, or small group of species, dominated the catch.

At once we met trouble with identification of these fishes. We wished to study their biology because of their economic importance, but an essential prerequisite was to be sure of identification of each species. No book or scientific paper conveniently lists all the serranid fishes of the region. The reasonably comprehensive literature available at EAMFRO revealed confusion of species and their classification has been very variably treated.

Three frequently confused species were first disentangled (Morgans, 1958) and another three later (Morgans, 1965). This paper lists the species taken by EAMFRO and those that are recorded by others off East Africa. Species of the latter group are obviously rare, or very localised, as are many of those recorded by us. Patchy, and often sparse, distribution is one of the characteristics of these fishes of which another is the tendency for several species to resemble one another closely in coloration (together a fascinating field for study of speciation). Such characteristics demand familiarity if species are to be correctly distinguished from one another, requiring considerable effort by one worker. It has been impossible for me to examine type-specimens and consequently identifications are made from the literature. Perhaps the author could be allowed the plea that future workers in the Serranidae bear in mind that only confusion can arise if a well described species, however rare, is wrongly treated as a junior synonym.

The work of EAMFRO was restricted to the coastline and islands of Tanzania and Kenya which appear to possess a broadly similar complement of benthic fishes, despite marked patchiness, and to a lesser degree this applies to Madagascar and its nearby islands. North of the equator one still finds many of the fishes characteristic of the more southerly tropical coastline but it seems that the fish fauna changes progressively around the margin of the Arabian Sea and eastwards. The Red Sea has rather a specialised fauna with many species in common with the more southerly African coastline and with the Arabian Sea. Thus the fauna characteristic of east Africa, within the Tropic of Capricorn, becomes slowly diffuse in the easterly and northerly directions. But, in the south, it dies away rapidly along the coast of Natal, a death coincident with the disappearance of reef corals and influenced by cooler water. When fishing deeper than 60 m, the stratification of waters (Newell, 1957) influences what may be caught because the East African Coastal Current extends deep in the South-East Monsoon and shallow in the North-East Monsoon (Morgans, 1959, 1962, 1964) and the Arabian Sea Water beneath is markedly colder.

A collection of some 180 rock cods was kept at EAMFRO, in Zanzibar, and known as the "Serranid Collection". The catalogue numbers were prefixed by "S" to distinguish these from the General Collection. After the revolution in Zanzibar, EAMFRO suffered hard and complicated times: apparently the fish collections were subjected to dilution with rain water, drying out and attack by cockroaches and rust. The specimens in bottles, together with specimens received on permanent exchange from Dr L.P. Schultz, of the Smithsonian Institution, were sent to the Smithsonian in 1966. What could be rescued of the specimens in tanks was sent to me and forwarded to the J.L.B. Smith Institute of Ichthyology, Grahamstown, together with a collection of tiny juveniles, sealed in plastic sheet, that the author took personally from Zanzibar.

Methods

In the descriptions that follow, repetition of information available in standard texts is avoided where possible. Counts and data obtained from my own

specimens ("Specimens Examined") are given and use of records from cruises, spearfishing and the fish market in Zanzibar is indicated by the designation "Field".

In the synonymy of well-known species needless repetition is avoided by referring to standard works, the synonymy of which I accept in the main: this is indicated by "ETC". While I have seen no type-specimens, the synonymy of each species attempts to define more precisely my concept of that species.

The terminology here is as previously defined (Morgans, 1958):

Total length (TL): from anterior end of fish, with mouth shut, to posterior end of longest caudal rays, with tail opened. (N.B., this includes the protruding lower jaw, or chin).

Standard length (SL): from anterior end of fish, with mouth shut, to base of median caudal rays.

Head length (HL): from anterior end of fish, with mouth shut, to posterior extremity, fleshy or bony, of opercular flap, measured parallel to longitudinal axis of fish.

Snout: from anterior end of upper jaw, with mouth shut, to nearest point on bony rim of orbit.

Eye diameter: measured dorso-ventrally across bony margin of orbit.

Interorbital: least distance between dorsal bony rim of orbits.

Postorbital head (PH): from posterior bony rim of orbit to posterior extremity, fleshy or bony, of opercular flap, (N.B., seldom, if ever, in this line parallel to the longitudinal axis of the fish).

Depth: greatest dorso-ventral measurement of body excluding fins.

Caudal peduncle length: from below last dorsal ray to base of middle caudal rays.

Gill-raker and Gill-filament lengths: measured on the first gill arch.

Gill-rakers (GR): a formula states number of rudiments and of rakers on upper limb of first gill arch, indicates single raker at angle of arch, and gives number of rakers and rudiments on lower limb of arch, in that order. A hyphen indicates variability; figures in brackets are atypical, *e.g.* 4-8, (2-) 3-4/1/9,5-6.

Dentition: a formula states above a line the number of circumferential rows or series, of teeth at front of upper jaw and at side of upper jaw opposite anterior end of bony expansion of premaxilla: below the line are similar data for lower jaw, the number of series at side being counted opposite anterior end of the fleshy expansion. The fish is assumed to be facing to left of the reader, *e.g.*, $\frac{8\text{-}9,4\text{-}5.}{7\text{-}8,2\text{-}3.}$

Canines: enlarged caniniform teeth are indicated as above.

Palatine series (Pal.): the greatest number of longitudinal series of teeth along the palatine bones.

Scale series (Sc.): The number of series of scales counted along or adjacent to course of lateral line from upper insertion of opercular flap to base of caudal rays. The number of transverse scales series is given as a ratio, with the number above the line indicating the number of scales in most direct series from base of last dorsal spine to lateral line; below the line is the number of scales in most direct series from anus to lateral line, e.g., $130\ \frac{15}{30}$

Subfamily Epinephelinae

Maxilla with supplemental bone. Dorsal fin with 7-11 (rarely 12) spines, neither divided nor deeply notched although soft-rayed part may be much higher than spiny part. Most teeth depressible; usually a few canines at front of each jaw. Teeth present on vomer and (except *Anyperodon)* on palatines. Axillary process above base of pectoral fin; none at base of pelvics. Body typically with ctenoid scales (cycloid in large adults of most species); scales on head cycloid. Scales more or less embedded, extending on to bases of vertical fins, often with auxiliary scales.

This subfamily is very large and contains all typical rock cods of these waters. The genera are closely related, and the species of each have only slight morphological differences but well marked differences in coloration.

Gracila albomarginata (Fowler & Bean, 1930) was reported from east Africa by Smith (1954c), but as no specimens were examined during the present study, the species is omitted from further consideration here. See Smith (1954c) and Randall (1964) for descriptions of this species.

Key to Genera of Epinephelinae

1a. Dorsal fin spines 7-8 ..... *Plectropomus*
1b. Dorsal fin spines 9 2
1c. Dorsal fin spines 11-12 4
2a. One or more canine teeth each side of lower jaw in addition to those near symphysis; caudal fin lunate ..... *Variola*
2b. No canines at sides of lower jaw; caudal fin not lunate 3
3a. Caudal fin truncate or nearly so; no longitudinal body stripes ..... *Aethaloperca*
3b. Caudal fin obviously rounded; (caudal truncate in *C. polleni,* body with blue and yellow longitudinal stripes) ..... *Cephalopholis*
4a. Palatines toothless; body compressed ..... *Anyperodon*
4b. Palatines toothed; body robust 5
5a. Lateral-line tubes branched, with 4-6 strong radiating ridges; interorbital exceptionally broad and flat; scales cycloid ..... *Promicrops*
5b. Lateral-line tubes simple (at most bifurcate), without strong radiating ridges; interorbital not exceptionally broad and flat; scales cycloid or ctenoid ..... *Epinephelus*

Genus *Plectropomus* (Cuvier) Oken, 1817

Some comments are necessary on Boulenger's (1895 : 159) summary of generic characters.

In the two species described below the scales of the body are plainly ctenoid in the young but progressively lose the cteni with growth (and even acquire an emarginate distal margin) to become cycloid in adult. There tend to be large canine teeth anterolaterally in upper jaw and in mandible, but in upper jaw they are fewer and smaller. Opercular spines poorly developed in comparison with other ephinepheline fishes and lowest of the usual three is rudimentary or absent. Anal spines only "feebly" evident but are quite typically spinous: the first two buried, but not very flexible,

nor feeble in the sense that the spines of blenniid fishes, for example, are feeble.

1a. Adult red, brown or yellow, usually with wedge-shaped cross-bars and with blue spots; juvenile (without bars and blue spots) with pale spots and a black patch between 1st and 5th dorsal spines; body depth 84-86% of head (incl. chin) .... *P. maculatus*

1b Always purplish brown, without cross-bars and without blue spots (pale spots present as part of the pattern of marbling); body depth 88-90% of head (incl. chin) ..... *P. marmoratus*

Plectropomus maculatus (Bloch, 1790)

Plectropoma maculatum: Klunzinger, 1870: 689 (or 21). Barnard 1925-27: 469. Roux Estève, 1956: 70. (*Partim*) Williams, 1956: 21.

Plectropoma pessuliferum: Fowler, 1904: 520, P1.17 (Upper fig.).

Plectropomus maculatus: (?) Jordan, Tanaka & Snyder, 1913: 152. Roughley, 1951: 45. Baissac, 1953: 211. (*Non*) Wheeler & Ommanney, 1953, table opp. pg. 56 and Fig. in P1.3. Munro, 1955: 109: P1.18, Fig. 287 (after Bleeker). (?) Smith, 1955 (b): 689. Fourmanoir, 1957: 143, Figs. 105 and 105 *bis*. Talbot, 1958: 748, P1.20 (juv) *ETC.*.

Paracanthistius maculatus: Fowler, 1928: 172.

Plectropoma melanoleucum: Baissac, 1956: 361.

SPECIMENS STUDIED: EAMFRO. General Collection Nos. 290, 292, 294 and Field. Sizes: 274-490 mm TL; 230-415 mm SL; (no recorded masses). Size range noted by EAMFRO: 36-105 cm TL; 30-90 cm SL; mass 0.7-18.1 kg. Roughley (1951) says it reaches about 22 kg.

DESCRIPTION: D. VIII,11; A III,8; Pect. i,16; GR ?6, 2/1/6, 3-4 + +. Sc. c.136 $\frac{21\text{-}23}{51\text{-}52}$ (no. 292 only).

Dentition $\left|\frac{4,3}{3\text{-}4,2}\right.$ canines $\left|\frac{1,0(\text{-}1)}{1\text{-}2,\ 2\text{-}4}\right.$ pal. 2.

Proportions in Table 1.

First two anal spines only discovered by dissection. Gill-raker rudiments are spiny nearest angle of arch but degenerate to mere bosses, or plates, further away and cannot be properly counted. Scale series of smallest fishes can be counted, but in fishes >30 cm SL scales are rather buried in places, and arrangement is confusing, so that counts have little meaning. Smallest fish with markedly ctenoid scales on body except antero-dorsally and on head where they are cycloid. With growth cteni disappear (and posterior edge of scale generally becomes emarginate) so that body scales of fishes of >40 cm SL are virtually all cycloid (a few feebly ctenoid scales may be found in the shadow area of the pectoral fin or beneath the caudal peduncle).

Difficult to count series of teeth because of very small size, rather irregular arrangement and obscuration by membranes of mouth, particularly anteriorly where teeth at the symphyses are buried by papillose foldings.

Front nostril very narrowly oval, oblique, with flap on posterior margin: hind nostril oval (sub-circular in small fishes) and without flaps. Preopercle margin with fine serrations and three downwardly directed or antrorse spines on lower edge; preopercle margin of small fishes covered by skin except for the tips of antrorse spines. Caudal margin truncate or slightly emarginate.

CHANGES WITH GROWTH. Change from ctenoid to cycloid scales (mentioned above). Number of canines at side of mandible appears to increase. Interorbital increases and eye decreases relative to SL so that proportion of eye to interorbital decreases with growth.

COLOUR. Small juveniles coloured differently to adult (see key above) as described by Boulenger (1895) and Talbot (1958). In life: Two common patterns (i) red, with blue spots and with four or five dark cross-bars which may be very strongly marked or very faint (cf. Smith 1954a, P1.106, lowest Fig. 417), (ii) bright yellow, or pinkish yellow or greyish yellow with some blue spots and strongly marked, black, wedge-shaped cross-bars (cf. Smith 1954a, P1.106, uppermost Fig. 417). Further details of colouration given by Playfair (1866), Boulenger (1895) and by Talbot. Our specimen No. 294 is variety (i) and Nos. 290 and 292 are variety (ii) which may be referred to as variety *melanoleucus* Lacépede.

Many seen underwater and freshly decked, and nearly all fall easily either into variety (i) (*i.e.*, *P. maculatus s.s.*) or into variety (ii) (*i.e.*, *P. maculatus* var. *melanoleucus*). There are occasional intermediate or pseudo-hybrid forms and I have observed change from one colour form into another (Talbot 1958). The persistent occurrence of "browns" and "greys" in descriptions is puzzling and probably due to post-mortem influence of light and, perhaps, heat. Serranids that are left in the sun usually darken (become "browner") on the exposed side and often become lighter ("greyish") on the underside, particularly where there is much mucus.

Colour in formalin: variety (i) becomes brown with darker brown spots and dashes; cross-bars are black, if present. Variety *melanoleucus* appears écru, drab yellow or off-white, with black wedges and specimens available show no spots at all (whether they originally had blue spots or not one cannot say).

UNDERWATER OBSERVATIONS. Variety (i) appears pinky-grey; usually cross-bars scarcely noticeable and spots only visible at a distance of a few feet. Var. *melanoleucus* appears off-white or yellow with conspicuous black wedges. The former is found amongst coral or sand and is commoner than var. *melanoleucus* which is apparently always found in close proximity to coral (I cannot remember seeing it over sandy bottoms) and which does not seem to be found as large as red variety.

Possibly *P. maculatus* adopts the form of var. *melanoleucus* (cf. zebra markings) when inhabiting nooks and crannies of corals, but changes to the red form when cruising over sand. This may be corroborated by my supposition of an apparent loose correlation of colour variety with size for it is commoner for large rock cods to cruise fearlessly in the open and for small ones of that species to frequent the protection of corals.

This species, trusting or inquisitive at first, becomes educated to the dangers of spearfishermen very quickly, in the course of one long sortie. A powerful fighter when shot and a 10 kg fish can break an 8 mm spear in open water by a flick of its body if the spear lodged in bone.

BIOLOGY. 119 fishes recorded between cruise 64 (when this species was first distinguished in the records from *P. marmoratus* Talbot) and cruise 167. Only 30 caught by handline; 49 shot underwater, 39 taken by trolling and 1 by basket trap. The species was taken by handline on the bottom at least as deep as 14 m. All specimens taken by trolling were the blue-spotted red variety and probably all taken from the ship by handline. Unfortunately colour varieties have not always been specified in cruise logs and the following information applies to the species generally.

19% males and 71% females, the remainder being indeterminate. Maturation seems to occur at 2.8-3.2 kg (50-52 cm SL). Only three males showed any activity of the gonad; a fair number of females were in various stages of ripeness, one ripe-running in January and another probably ripe-running in December. Evidence shows gonad activity from November to March with spawning from December to February. A very notable feature is the inactivity, or dormancy, of all gonads during the Southern Monsoon but, surprisingly, large fishes of both sexes may also be found dormant during breeding season.

36% had food in the stomach. No instance of eversion of the stomach and no evidence of vomiting (such as presence of food in mouth). Food was exclusively fish including *Caranx elacate*, *Zanclus cornutus*, *Lethrinus variegatus*, *Sygnathus sp.*, *?Callyodon* sp., a flying fish, holocentrids, wrasses and an eel.

Only seven (6%) were recorded as containing much fat and they were scattered through the Southern Monsoon, i.e. in the time of sexual dormancy. Sexual dormancy and fatness are not necessarily correlated for in the very similar *P. marmoratus* fatness was only recorded in the Northern Monsoon (see below). 14% had parasites in the gonads and 3% had parasites in mesenteries of gut.

DISTRIBUTION. Local: Apparently all reefs from Kilwa in the south to Pemba I. in the north and presumably the reefs further north. Elsewhere: Madagascar and Mozambique Channel northwards to the Red Sea. Comoros, Aldabras, Mauritius, Seychelles, Sri Lanka, E. Indies and probably the western Pacific generally from Australia to Japan.

REMARKS. One of the commercially important serranids. The top and bottom colour Figs. 417 in Plate 106 in Smith 1954a are good (but Fig. 417 in Plate 17 is poor). Illustrations in Fourmanoir (1957) are good. There is a fine underwater colour photo of the blue-spotted red variety, taken at Assumption I. by Cousteau (Nat. Georgr. Mag., 109(2), Feb. 1956: 161). *P. leopardus* (Lacepède) is probably a junior synonym of *P. maculatus*, as is held by Rüppell (1835), Boulenger, *etc*. It is likely that Fowler's description (1928) includes *P. marmoratus*.
Local name: "Njombo".

Plectropomus marmoratus Talbot, 1958

(Partim) Plectropomus maculatus: Williams, 1956: 21 ("V. babonne").

Plectropomus marmoratus Talbot, 1958: 751, Pl.21, *ETC.*,

SPECIMENS STUDIED. EAMFRO General Collection Nos. 286, 287 (Paratype), 293, 295 (head only) and Field. Sizes: 40-89 cm TL; 335-75 cm SL; (no recorded masses except that largest fish No. 295 weighed 10 kg). Size range noted by EAMFRO: 47-80 cm TL; 38, 5-67 cm SL; mass 1.4-7.7 kg.

DESCRIPTION. The following counts were made: D VIII,10-11; A III,8; Pect. i,15-17; GR ?7, 1/1/1-6,2-4 + +. Sc. (confused). Dentition $\left|\begin{matrix}4\text{-}6,4\text{-}5\\4\text{-}6,\ 2\end{matrix}\right.$ Canines $\left|\begin{matrix}1,0(\text{-}4)\\1,2\text{-}4\end{matrix}\right.$ pal. 2-4. Proportions in Table 1.

All with cycloid scales whose arrangement is too confusing to make counts worthwhile as with *P. maculatus* of similar size (q.v.).

CHANGES WITH GROWTH. Presumed that scales change from ctenoid to cycloid as in *P. maculatus*. No evidence of increase in number of canine teeth, but seems to be slight increase in other dental counts excepting the constant presence of two series at side of mandible. Strong indication that gill rakers on lower part of first arch degenerate to rudiments as the fish grows larger. Eye decreases relative to SL but, unlike *P. maculatus*, the interorbital remains proportionally constant to SL. Snout becomes longer relative to head.

COLOUR. In life: (after Talbot, 1958) "body colour purplish chocolate above to pink on belly, with distinct, irregular, pale marbling ... anal and pelvic (of) body colour, blue or purple tipped".

Colour in formalin: Dark brown with slightly paler marbling. Blue or purple of edges of anal and pelvic fins become brown.

UNDERWATER OBSERVATIONS. Frequents coral reefs. Easily identified by colouration. Not a notable fighter when speared.

BIOLOGY. Between cruise 64 (when this species first differentiated from *P. maculatus*) and cruise 67, 59 fishes recorded: 12 taken by handline, 8 by trolling, and 39 speared underwater. Not caught deeper than 10 m.

32% were males and 54% females, others indeterminate. Maturation seems to occur about 2.7 kg (52cm SL) for males and 1.8 kg (40cm SL) for females. A male ripe (probably ripe-running) in December and another ripe-running in February; this latter taken with a ripe-running female. Gonad activity occurs from September to February and spawning between December and February.

51% had food in the stomach, others empty. No instance of stomach eversion or of vomiting. Food exclusively fish, viz. parrot fishes (including *Callyodon sordidus*), wrasses, holocentrids, acanthurids, a trigger fish and a juvenile *Sphyraena* sp.

Only nine (15%) recorded as containing much fat, in October, December, January and April, i.e. during the Northern Monsoon and inter-monsoon periods. (Contrast *P. maculatus* which was only found to be fat in the Southern Monsoon). 3% of all had parasites of gonad (including *Philometra* sp. — Nematoda) and 7% had parasites of gut mesenteries.

DISTRIBUTION. Local: Apparently all reefs from Kilwa in the south to Lamu in the north. Elsewhere: Comoros (Fourmanoir 1954), Aldabras, Farquhars, Amirantes, Seychelles, Mauritius (St Brandon), Chagos (Wheeler & Ommanney 1953, *fide* Talbot).

REMARKS. This commercially important species is often present in the market. Delicious in flavour though spoils quickly.

I agree with my former colleague, Dr Talbot, that this fish is specifically different from *P. maculatus* with which it has long been confused due to the variations in coloration that *P. maculatus* can exhibit. However *P. marmoratus* has a very constant coloration; it is clearly not a different sexual variety of *P. maculatus*, nor a different ecotype. It inhabits the same environment as *P. maculatus*, though perhaps is less inclined to leave the immediate protection of corals; it eats the same sort of food and breeds at the same time of year; it does not grow as big. Morphologically the two species are virtually indistinguishable; although Table 1 shows slight differences in proportional changes that accompany growth, they require proof by statistical treatment of more species.

The middle colour figure 417 in Smith (1954a, Pl.106) and that in Wheeler & Ommanney (Fig.2 in Pl.3) are good. Local name: "Njomo". Known in the Seychelles as "Vieille babonne".

Genus *VARIOLA* Swainson, 1839

1a. Pelvic fins not reaching anus; longest anal rays shorter than 25% SL: margins of caudal, soft dorsal and anal fins white ..... *V. albimarginata*

1b. Pelvic fins reach 1st anal spine; longest anal rays longer than 29% SL; margins of caudal, soft dorsal and soft anal fins bright yellow ..... *V. louti*

Variola albimarginata Baissac, 1953

(Plate 1)

Variola sp. Wheeler & Ommanney, 1953, Table opposite page 56 "croissant queue blanc".

Variola albimarginata Baissac, 1953: 214. Baissac, 1956b: 395. Morgans, 1956: 18, Fig.2.

SPECIMENS STUDIED: S 29, S 81 and Field. Sizes: 34-41 cm TL; 18-32 cm SL; mass 0.1-0.7 kg.

DESCRIPTION. D IX, (12-) 14 (S 81 is aberrant); A III, 8; Pect. i,17(-18) (one side of S 29 is aberrant). GR5,2/1/8,4 (S 81 only). Sc. c.120-130 $\frac{10\text{-}11}{c.37}$.

Dentition $\left|\frac{9,c.8}{8\text{-}10,2}\right.$ canines $\left|\frac{0\text{-}1,0}{1\text{-}2,1\text{-}2}\right.$ pal. 4-5.

Central opercular spine almost equidistant from upper and lower spines, a little nearer to lower. Central and lowest both projecting slightly, acute; uppermost rather rudimentary. (opercular spines show no difference to those of *V. louti* S 28 & S 57).

Teeth of outer row of upper jaw caniniform, much smaller than canines but distinctly larger than inner depressible teeth. Most teeth of jaws and palatines very small indeed, difficult to count.

COLOUR. Margin of tail narrowly opaque white, in contrast to the bright yellow broader margin of *V. louti*. Posterior margins of soft dorsal and anal fins more colourless than white, without trace of yellow. Slightly different tone of red of this species, compared to that of *V. louti*, only apparent when the two are side by side. Inconspicuous traces of longitudinal yellow streaks on side of body behind pectoral fin. Spots poorly defined, greyish blue or dull blue (best defined and bluest on head).

BIOLOGY. From cruises 61 to 167 two specimens taken by handlines from 4-40 m (Baissac, 1953 records 40-90 m.); the larger a nearly ripe female (November) and its stomach contained two small fishes. Uncommon or rare.

DISTRIBUTION. Local: Zanzibar, Mafia I. Elsewhere: Rodriguez, Mauritius, Chagos.

REMARKS. Regarding preserved specimens: although Baissac correctly mentions the impossibility of distinguishing *V. albimarginata* from *V. louti* by differences in colour, the various proportions tabulated above might serve; the proportions used in the key for the pelvic and anal fins are less likely than others to be affected by damage in handling.

Variola louti (Forsskål, 1775)

(Plate 1)

Variola louti: Fowler & Bean, 1930: 203 *ETC*. Weber & de Beaufort, 1931: 12 *ETC*. Fowler, 1934: 455. Smith, 1949: 192, pl.17, fig. 426. Baissac, 1953: 214. Schultz, 1953: 361, pl.28, figs.a,b. Wheeler & Ommanney, 1953: 36 & table opp. page 56, pl.3, fig.1. Munro, 1955: 109, pl.18, fig. 289 (after Bleeker). Randall, 1955: 58. Roux-Estève & Fourmanoir, 1955: 197. Smith 1955b: 689. Morgans, 1956: 18, fig. 2. Roux-Estève, 1956: 68. Williams, 1965: 20. Fourmanoir, 1957: 145, pl. 7B.

SPECIMENS STUDIED. S 28, S 57 and Field. Sizes: 29-45 cm TL; 22-32 cm SL; mass 0.1-0.7 kg. Size range noted by EAMFRO: 26-71 cm TL; 19. 5-56 cm SL; mass 0.1-4.7 kg.

DESCRIPTION. D IX,14; A III,8; Pect. i,17-18. (Gills removed at sea). Sc. c.120-130 $\frac{11\text{-}12.}{c.41}$

Dentition $\left|\frac{8\text{-}10,7\text{-}8}{7\text{-}8,2}\right.$ canines $\left|\frac{1\text{-}3,1\text{-}3}{1\text{-}2,1\text{-}3}\right.$ pal. 4-7.

Proportions in Table 2.

UNDERWATER OBSERVATIONS. Often observed in 2-4 m over coral brash. Appears very grey; spots can be made out at close range.

BIOLOGY. From cruises 1 to 167 over 232 fishes, most taken by handlines although four taken trolling, seven by spearfishing, one by trammel nets and one by explosions. Of common occurrence; may be taken at any depth to 70 m.

Of those that could be sexed 61% were female and 28% male. Maturity seems to occur about 325 mm SL (mass 0.5-0.7 Kg). Possibly a few spawn at any time of year but, generally, sexual ripeness becomes pronounced after September and the major spawning period is likely to be between December and February. Only two males showed ripening of the gonads, both in September.

It is not possible to know what proportion of this species vomits after being caught, but complete eversion of stomach unusual. 39% had stomach contents. Commonest foodstuff was fish including ?*Canthigaster valentini* twice, ?*Pseudapeneus pleurotaenia*, *Chaetodon* sp. and *C. trifascialis*, *Myripristis* sp., ?*Caesio* sp. and various small acanthurids, scarids, scorpenaeids, ?priacanthids, epinephelids and monacanthids. Crustacea occasionally found including the crabs *Myra fugax* and ?*Plagusia* sp., the shrimp *Saron marmoratus* and the stomatopod *Pseudosquilla oxyrhyncha* (rare) and *Odontodactylus syllarus*. A small octopus found once and pebbles twice. Clearly this

species is predatory on small fishes and crustacea *etc.* close to or on the bottom. A 1.4 kg specimen in October had much fat; it was probably male.

Most fishes heavily infested with parasites in mesenteries of gut and in gonads but flesh perfectly wholesome. 76% had parasites in gut mesenteries and 23% in gonads: chiefly nematodes (anisakine larvae) and cestodes (*Otobothrium* sp. larvae and tetrarhynch larvae), but adult acanthocephala (*Rhadinorhynchus* sp.) also found. Cavity of alimentary tract not conspicuously infested.

DISTRIBUTION. Local: Reefs of Tanzania and Kenya and on the North Kenya Banks. Elsewhere: Natal to the Red Sea, Comoros, Aldabras, Madagascar, Mauritius, Reunion, Seychelles, India, Sri Lanka, E. Indies, Philippines, Micronesia, Melanesia, Polynesia.

REMARKS. Although easily identified in the field *V. louti* is obviously very variable. An underwater photo in the National Geographic Magazine, *109*(2), 1956 taken by Luis Marden. Local name at Lamu is "Tele".

Wheeler's findings (*loc. cit.*) for 79 fishes from the Seychelles *etc.* are in general agreement as to foodstuffs and breeding. He presumes that sexual "maturity is reached at the end of the fourth year of life".

The species has no reputation off east Africa for being poisonous to my knowledge, despite such a reputation elsewhere (Fish & Cobb 1954: 13).

Aethaloperca rogaa (Forsskål, 1775)

Cephalopholis rogaa. Fowler & Bean, 1930. 233 *ETC*.. Smith, 1949: 191, fig. 420. Fourmanoir, 1954: 214. Roux-Estève & Fourmanoir, 1955: 197. Roux-Estève, 1956: 69. Fourmanoir, 1957: 149.

Epinephelus rogaa. Weber & de Beaufort, 1931: 24 *ETC*. (?) *Epinephelus* sp. Wheeler & Ommanney, 1953, "Vieille marmite" and/or "Vieille cuisinier", table opp. page 56.

Aethaloperca rogaa. Smith, 1955a: 310. Munro, 1955: 110, pl.18, fig. 290 (after Smith).

SPECIMENS STUDIED. S 27, S 93 and Field. Sizes: 216-450 mm TL; 182-375 mm SL; mass 0.2-2.0 kg. Size range noted by EAMFRO: 216-483 mm TL; 182-406 mm SL; mass 0.2-2.1 kg.

DESCRIPTION. D IX,16 (S 27) and D VIII, 18 (S 93) (Usual count for dorsal fin is IX, 17-18). A III,9. Pect. i,17. GR. 7,2/1/9,4 (removed from S27).

Sc. 90-104 $\frac{11\text{-}12.}{33\text{-}39.}$ Dentition $\left|\frac{7\text{-}8,6\text{-}7}{5\text{-}10,\ 2}\right.$ pal. 2-3.

Fowler & Bean give Sc. 96-100 $\frac{22\text{-}23.}{29\text{-}44.}$ Weber and de Beaufort give Sc. 100-115 $\frac{11\text{-}13}{43\text{-}48}$ and Smith states "Tr. about 20 above". Scales easily counted and apparent discrepancies presumably due to different choices of where counts made, in addition to natural variation. Some descriptions of dentition confusing for similar reasons.

CHANGES WITH GROWTH. Smaller specimen had 5-6 series of teeth (most teeth very small) at front of lower jaw and the larger specimen had 9-10 series. Other dental counts were almost identical.

COLOUR. The scarlet inside mouth and gill covers is a striking feature. Juveniles may have, in addition to the white edging of soft dorsal and caudal fins, half a white cross-bar on either side of belly. Pectoral fin of juvenile is more orangey-brown than adult's red-brown. In formalin, quickly becomes dark brown and the scarlet inside buccal cavity becomes off-white.

UNDERWATER OBSERVATIONS. Frequents shallow water where it typically inhabits holes in coral heads: hugs the coral and constantly moves in and out of holes. Easy to shoot.

BIOLOGY. Only five fishes taken by handline, and six by spearfishing but it commonly appears in the market. Taken down to 34 m.

Only one male indentified, 69% definitely female. Seems to mature about 345 mm SL (mass 1.4 kg) and there are indications that it may spawn any time of the year.

50% had stomach contents. 33% contained small fishes (including *Pempheris* sp.) and 17% contained *Pseudosquilla* sp.. A fish in January had much fat in mesenteries; although weighing 2 kg the gonad had degenerated and could not be sexed.

54% heavily parasitised by nematodes (especially Anisakine larvae) in gut mesenteries and 27% had a fair number of parasites of the gonads (principally Anisakine larvae but also a protozoan infection).

DISTRIBUTION. Local: Mafia and Zanzibar Islands, but no doubt inhabits shallows of entire region. Elsewhere: E. African coastline from Delagoa Bay to Red Sea. Comores, Madagascar, Aldabras. Persian Gulf, Sri Lanka, Philippines.

REMARKS. Colour shown in Rüppell's plate (1828: pl.26, fig.1) is far too black for our fishes, and body is too shallow: the figure is poor, though recognisable. Very much deeper fish (depth less than 2½ times in SL), with much steeper head profile, than *G. albomarginata* (see Smith 1949, fig. 420) from which is also distinguished by usually 17-18 dorsal fin rays.

Genus *Cephalopholis* Bloch & Schneider, 1801

This genus contains a variety of small and medium-sized rock cods that are mostly brightly and beautifully coloured, particularly in reds and blues. Sometimes called "coral cods", the term is appropriate on account of their bright colours and habitat, which is perhaps always within or next to coral.

As with species of *Epinephelus*, so those of *Cephalopholis* are differentiated chiefly by coloration which is always unmistakable, even when preserved, so long as not faded to oblivion. Morphologically species differ only slightly and the range of variation of each, though small, is sufficient to blurr differences confusingly. Species have sometimes been split into several sub-genera and genera but, however such divisions are made, the network of affinities is crudely broken. They form a well circumscribed genus that needs no sub-division.

Twelve species recorded from these waters, seven found by us (I was able to examine another from specimens obtained by exchange).

Editors' note: *Cephalopholis hemistictus* (Rüppell, 1828) is apparently endemic to the Red Sea and Persian Gulf. Records from Zanzibar (Boulenger, 1895) and South Africa (Barnard, 1925-27; Smith, 1949)

are presumably based on misidentifications.

Keys to species usually use a combination of coloration and morphology. Unfortunately changes take place in both colour and pattern after death and after preservation.

Boulenger's key (1895: 165-167) is primarily morphological but our measurements and counts show significant differences that cause it to fail in several places for east African fishes. The key of Weber & de Beaufort (1931: 15-16) also serves poorly. A key that chiefly utilises coloration is that of Fowler & Bean (1930: 207), which does not include all the species found here.

Below is offered one key for identification of fresh fishes chiefly by colour, and another for long preserved (discoloured) fishes entirely based on morphology. With regard to scale counts, transverse counts are normally easy and constant, provided that the position where they are counted is strictly defined. Longitudinal counts are more subject to personal idiosyncrasy and to variation.

Key to Identification of Fresh Fishes

1a. Caudal fin with oblique bars (usually 2) 2
1b. Caudal fin without oblique bars (Fourmanoir, 1957: Fig. 107, shows oblique bars on caudal of *C. pachycentron*, but I have never found this an obvious characteristic.) 3
2a. Caudal bars red or brown, usually 2 blotches on caudal peduncle ..... *C. leopardus*
2b. Caudal bars white, no blotches on peduncle ..... *C. urodelus*
3a. Body with longitudinal lines (sometimes reduced or absent in *C. boenack*) and no blue spots 4
3b. Body without extensive longitudinal lines; with blue spots in most species 5
4a. Caudal fin truncate; 9 anal rays ..... *C. polleni*
4b. Caudal fin rounded; 8 anal rays .... *C. boenack*
5a. Bright pink, vermilion or red; cross-bars absent or faint 6
5b. Red-brown, brown or blackish; usually with pronounced cross-bars 9
6a. No spots; head with blue reticulation; fins with brown margin ..... *C. sonnerati*
6b. Blue spots on body and or head; fins pale 7
7a. Spots only on head, nape and below spiny dorsal ..... *C. aurantius*
7b. Spots on head, body and vertical fins 8
8a. Body with about 6 dark blotches dorsally ..... *C. sexmaculatus*
8b. No dark blotches dorsally on body .. *C. miniatus*
9a. Anal fin rays 8; 9-10 digitate gill-rakers (including one at angle) on lower limb of first arch ..... *C. pachycentron*
9b. Anal fin rays 9; 7 digitate gill-rakers (including one at angle) on lower limb ..... *C. argus*

Key for Preserved Specimens

1a. Anal fin with 8 rays 2
1b. Anal fin with 9 rays 3
2a. Scales above lateral-line 18-22; body with dark longitudinal lines ..... *C. boenack*
2b. Scales above lateral-line 9-10; body uniformally dark brown or with obscure dark vertical bars .. .. *C. pachycentron*
3a. Caudal fin truncate ..... *C. polleni*
3b. Caudal fin rounded 4
4a. More than 110 scales longitudinally, 12 or more from last dorsal spine to lateral line .... *C. sonnerati*
4b. Less than 110 scales longitudinally, 11 or less from last dorsal spine to lateral line 5
5a. Scales from anus to lateral line 23-25 .... *C. leopardus*
5b. Scales from anus to lateral line 26-39 6
6a. Palatine teeth in 5-6 series; 7 digitate gill-rakers (including one at angle) on lower limb of first arch ..... *C. argus*
6b. Palatine teeth in 2-4 series; 8-10 digitate lower-limb rakers (including one at angle) 7
7a. Scales from anus to lateral-line 26-31 8
7b. Scales from anus to lateral-line 31-39 9
8a. Longest pectoral ray 95-106 % of postorbital head length ..... *C. aurantius*
8b. Longest pectoral ray 107% of postorbital length ..... *C. urodelus*
9a. Scales from last dorsal spine to lateral line 7-8 .. .. *C. sexmaculatus*
9b. Scales from last dorsal spine to lateral line 9-10 . ..... *C. miniatus*

***Cephalopholis leopardus* (Lacepède, 1802)**
(Plate 1)

Cephalopholis leopardus: Fowler & Bean, 1930: 217 *ETC.*. Baissac, 1953: 216. Schultz, 1953: 365, pl. 30A. Randall, 1955: 57. Smith, 1955a: 310. Fourmanoir, 1957: 147.
Epinephelus leopardus: Weber & de Beaufort, 1931: 33 *ETC.*.
Enneapterygius leopardus: Whitley, 1951: 64.
Cephalopholis sp. ("No. 109"). Fourmanoir, 1954: 214.

SPECIMENS STUDIED. S 71, S 97/1, S 97/2, S 97/3, S 97/4. Sizes 108-152 mm TL; 87-125 mm SL; mass 28-71 gm.

DESCRIPTION. D IX,14; A III, 9-10; Pect. i,16 (-17); GR 6 (-7), 2/1/8-10, 4-7; Sc. 75-90 $\frac{6\text{-}7}{25}$. Dentition $\left|\frac{7\text{-}9,6\text{-}7}{7\text{-}9,\ 3}\right.$ pal. (2-) 3. Proportions in Table 3.

Two specimens obtained from Bikini (USNM. 141816) with D IX,14; A III,9. Pect. i,16; GR 6,2/1/10,5. Sc. 83-98 $\frac{7}{23}$. Dentition $\left|\frac{6\text{-}7,\ 7}{6\text{-}7,2\text{-}3}\right.$ pal. 3. Proportions in Table 3.

COLOUR. In life: Diffuse pinky-red spots all over the body, breast, belly, cheeks, lips and bases of all fins. Snout and nape rather dusky. Dorsally there are darker areas, slightly suggesting upper parts of the cross-bar pattern so common in rock cods, but there are no cross-bars. Two red-brown blotches on caudal peduncle, anterior one large, posterior small. Eye golden red. Buccal cavity white. Caudal with oblique, red-brown line dorsally, ventrally an oblique dark red line; the lines do not meet on the fin. Inside each line is a paler band; outside each the fin is dusky with colourless web. Dorsal fin translucent in middle zone and pink marginally, the whole overlaid with duskiness anteriorly. Anal fin rather like dorsal, but with peripheral band of dusky-white. Pectorals pink-spotted at base, the rest pinky-orange.

Colour in formalin: Colours change to greys and white but pattern remains and is completely diagnostic. The most important change is that lower oblique

bar on caudal almost, or completely, disappears. The pink spots become whitish, surrounded by grey reticulations, this being most marked anteriorly, but occasionally disappearing altogether. There is no conspicuous stripe from eye to opercular extremity; but there is a blotch or spot, at opercular extremity which gradually fades. In addition to features in key, this species is distinguished from *C. urodelus* by absence of the pair of black spots on lip opposite canines at front of jaw.

BIOLOGY. Four specimens taken by explosion on coral at 6 m, the other from market. Uncommon but not rare. One contained a crab, another crustacean remains. Three-quarters had parasites in the mesenteries of the gut including tetrarhynch larvae in cysts (cestoda), especially *Callotetrarhynchus gracilis* (Rud.).

DISTRIBUTION. Local: Zanzibar and Mafia Islands, among corals. Elsewhere: Comoros, Aldabras, Mauritius, Red Sea. India, E. Indies, China, Micronesia, Melanesia, Australia, Polynesia.

REMARKS. I am indebted to a personal communication from M. Fourmanoir for identifying his *Cephalopholis sp. "No. 109" with C. leopardus*.

Our specimens closely resemble that shown in Schultz's plate except that his specimen shows faint cross-bars. Day's (1878-88) p1.6, fig.4 is a good likeness save that the two black blotches on the caudal peduncle are not shown.

One specimen was sent to the U.S. National Museum of Natural History.

Cephalopholis urodelus (Schneider, 1801)

Cephalopholis urodelus: Fowler & Bean, 1930: 214, *ETC.*. *Baissac, 1953: 216: Schultz, 1953: 368, p1.31B. Randall, 1955: 56.*
Epinephelus urodelus. Weber & de Beaufort, 1931: 27, *ETC.*.

SPECIMENS STUDIED. No local specimens. Two specimens obtained from Bikini Id. in the Pacific Marshall Ids group.

DESCRIPTION. D IX, 15; A III, 9; Pect. i (16-) 17; GR 5-7, 1-2/1/7-9; 3-5 Sc, 73-89 $\frac{8\text{-}9}{28\text{-}30}$.

Dentition $\left|\frac{6\text{-}9,6\text{-}8}{5\text{-}8,\ 3}\right.$ pal. 4. Proportions in Table 3.

Boulenger (1895) gives Sc. 95-115 $\frac{8\text{-}10}{35\text{-}40}$ and Fowler & Bean (1930) give Sc 90-93 $\frac{17\text{-}18}{28\text{-}30}$. Such counts depend largely on whereabouts they were made; my counts of the Bikini specimens can be truly compared with my counts of other species.

COLOUR. In life: Schultz states: "Background colouration purplish to orange-brown, pale spots orange to brownish orange; white streaks sometimes pale bluish. Occasionally four to six reddish brown vertical bars occur on sides."

Colour in formalin: Nondescript light brown or grey without large spots or blotches or cross-bars. Some small white spots on lower part of head. Median part of caudal dark brown, with an oblique white bar above and below, outside each of which the caudal is pale brown. Larger fish with distinct dark spot on lip at each side of front of lower jaw opposite the canines.

BIOLOGY. Schultz states this species common among coral heads, in surge channels and in lagoons. Seems definitely rare in east African waters.

DISTRIBUTION. The only recent record is that of Baissac from Mauritius but there are old records from Zanzibar, Mauritius and the Seychelles. India, E. Indies, Philippines, Micronesia, Melanesia, Australia, Polynesia.

REMARKS. The supposed variety *erythraeus* is probably a separate species; although Fowler & Bean include it in their synonymy they state: "all (of their many specimens) have the white oblique bands on the caudal, a character by which the species may easily be distinguished".

The plates in Playfair & Günther (1866) and in Sauvage (1891) show no colour pattern and are thus rather useless. Schultz's plate shows elaborate markings.

Cephalopholis polleni (Bleeker, 1868)

Epinephelus polleni: Boulenger, 1895: 182, *ETC.*.
Cephalopholis virgatus: Fourmanoir, 1954: 214. Fourmanoir, 1957: 148, p1.8B.

SPECIMENS STUDIED. None.

DESCRIPTION (After Boulenger, 1895) D IX, 15; A III,9; lower GR 17; Sc. 130-135 $\frac{10\text{-}11}{45\text{-}47}$. 2-3 series of teeth at sides of mandible.

Day (1879-88) and Sauvage (1891) give Sc. 115-120 while Fourmanoir (1957) gives Sc. c. 125.

SIZE RANGE. To 34 cm (Boulenger, 1895)

COLOUR. Boulenger (1895): "reddish, with pale blue, dark-edged, somewhat wavy longitudinal lines, which extend on the soft dorsal, anal and caudal". Fourmanoir (1957): "yellow, with a dozen longitudinal lines of brown-green".

DISTRIBUTION. Comoros, Reunion, Mauritius, ? Madras. Though not yet found along the E. African coastline it is very likely present.

REMARKS. Apart from apparent differences in colour Fourmanoir's "*C. virgatus*" differs in no important respect from *C. polleni* which was recorded from Mauritius and nearby long ago. Fourmanoir (1954) notes the resemblance to *C. boenack* and his photo shows caudal fin to be truncate.

Sauvage (1891) usefully quotes Bleeker's comparison of this species with "*Epinephelus formosus*" (= *C. boenack*). Sauvage states: "D XI. 16" which is presumably a slip of the pen for "D. IX 16".

Cephalopholis boenack (Bloch, 1790)

Cephalopholis boenack: Fowler & Bean, 1930: 230, fig. 10, *ETC.* Baissac, 1953: 217. Munro, 1955: 110, p1.18, fig. 291 (after Bleeker).
Epinephelus boenack: Weber & de Beaufort, 1931: 20, fig. 6, *ETC.*

No specimens were collected in the course of this study. See references above, for descriptions of this species.

Cephalopholis sonnerati (Valenciennes, 1828)

Cephalopholis sonnerati: Fowler & Bean, 1930: 213 *ETC.*. Fowler, 1934: 455. Smith, 1949: 191, p1. 16, fig. 421. Baissac, 1953: 215. Fourmanoir, 1954: 214. Randall, 1955: 55.

Smith, 1955: 310.
Epinephelus sonnerati: Weber & de Beaufort, 1931: 25, *ETC.*. Copley, 1952: 90, fig. 62.
Enneacentrus sonnerati: Munro, 1955: 111, pl.18, fig. 295 (after Day).

SPECIMENS STUDIED. S 19 and Field. Sizes: 465 mm TL; 380 mm SL; mass 1.6 kg. Size range noted by EAMFRO: 280-570 mm TL; 230-470 mm SL; mass 0.2-3.4 kg. I have not seen records of larger ones except for Copley's comment "they go to 30 pounds" (13.7 kg) which is difficult to credit.

DESCRIPTION. D IX, 15; A III, 9; Pect. i 18; GR 6,2/1/10,4; Sc 112-115 $\frac{12}{40\text{-}41}$. Dentition $\left|\frac{9,7}{7\text{-}8,2}\right.$ pal. 6-7. Proportions in Table 3.

COLOUR. In life: brilliant vermilion with or without leprous ("whitish") blotches, no dark spots, blotches or cross-bars. The lower parts of head and anterior parts of body usually show blue reticulation, but this often reduced and occasionally absent. Soft fins usually brown-edged, but not invariably.

Colour in formalin: Colour very quickly changes to rather uniform yellowish-brown, with dark grey reticulation anteriorly, and dark edged fins.

BIOLOGY. 105 fishes taken from Cruises 61 to 167 by handlines and another, the smallest, procured from Zanzibar market. Not characteristic of very shallow reefs and not observed whilst spearfishing. It frequents banks at 36-100 m and has been taken within the main thermocline beneath the East African Coastal Current; has been taken as shallow as 10 m. 52% female and 14% male, the rest could not be sexed. Sexual information is confused but females appear to mature at about 0.9 kg. (28 cm SL) and males at about 1.4 kg. (34 cm SL): it seems there are two spawning seasons, from April to May, and again in October (coinciding with rainy seasons).

Examination of foodstuffs is bedevilled by the fact that this fish usually everts its stomach after capture, this having occurred in 57%; only 12% of the others contained food suggesting that vomiting was common. Seven stomachs contained fishes (including one small eel and small *Anthias cichlops*): five contained crustacea (including the shrimp *Parapandalus* sp., the crab *Thalamita sp. and the stomatopod Odontodactylus syllarus*). Much fat was recorded for some fishes in May and others in November (coincident with the rainy season).

Often parasitised by anisakine larvae (*Nematoda*) and encysted tetrarhynch larvae (including *Otobothrium* sp. (*Cestoda*); 30% had these in mesenteries of gut, 16% within gonads.

DISTRIBUTION. Local: almost all records from the north Kenya banks but also from Malindi Bank, Zanzibar and Mafia Islands. Elsewhere: E. African coast from Natal to southern Arabia. Comoros, Aldabra, Madagascar, Reunion, Mauritius, Seychelles. India, E. Indies, Philippines, Micronesia, Melanesia, Australia, Polynesia.

REMARKS. The colour plate in Smith (1949) is excellent. Day's (1879-88) figure is a good likeness but that of Playfair & Günther (1866), showing no markings, is rather useless and in addition the fish appears distorted (too elongate).

It is worth mention that specimen S 19 was measured before preservation at 495 mm TL, 415 mm SL; after preservation it measured 465 mm TL and 380 mm SL. There seems to be evidence of shrinkage for many other species in preservative.

We have never found difficulty with identification of this species in the field despite confusions suggested by the synonymy.

Cephalopholis aurantius (Valenciennes, 1828)

Cephalopholis aurantius: Fowler & Bean, 1930: 208, *ETC.*. Smith, 1949: 191, fig. 422. Baissac, 1953: 215. Fourmanoir, 1957: 147.
Epinephelus aurantius: Weber & de Beaufort, 1931: 32, *ETC.*. Wheeler & Ommanney, 1953, table opp. page 56.
Enneapterygius aurantius: Whitley, 1951: 64.

SPECIMENS STUDIED. S 2, S 10/1, S 10/2, S 11, S 13/1, S 13/2, S 14 and Field. Sizes: 163-230 mm TL; 135-188 mm SL; mass 0.1-0.2 kg. Size range noted by EAMFRO: 85-250 mm TL; 71-210 mm SL; mass 28-227 gm. Weber & de Beaufort report to 300 mm. Identification of the 333 mm fish that Fowler & Bean (1930: 209) maintain to be this species seems doubtful.

DESCRIPTION. D IX, 15; A III, 9; Pect. i,16-17; GR 6,1-2/1/8-9, c.6; Sc. Sc. 78-108 $\frac{7\text{-}9}{26\text{-}29}$. Dentition $\left|\frac{8\text{-}10,7\text{-}8}{6\text{-}8\ 3}\right.$ pal. 3-4. Proportions in Table 3.

Boulenger (1895) separates from *C. sonnerati* in his key (p. 166) by the lesser number of scales, which is valid although our counts are different: and from *C. argus* by an apparently longer pectoral fin relative to head-less-chin, which feature is unsuitable for diagnosis because pectorals of our specimens are of rather similar length to those of *C. argus* (see Table 3).

COLOUR. In life: Easily distinguished from *C. sonnerati* by dullness of its red or orange colour and duskiness present on head, particularly dorsally, combined with blue spots on head.

Colour in formalin: Blue spots fade to "white", distinguishable from the dusky-brown background coloration of head.

It is odd that blue spots of *C. aurantius* should change to "white" on preservation whereas blue spots of *C. miniatus*, *C. sexmaculatus*, etc. should change to dark brown.

BIOLOGY. From Cruise 61 to 167, 56 specimens were assessed and many others used for bait. Mostly caught by handlines, one trapped and many others taken by explosions. Certainly quite common on shallow, sandy or brash bottoms with weed patches (where associated with many *Lethrinella variegatus* (Val.)) and may be taken as deep as 36 m.

Gonads gave scanty information but 46% were female and 3% male. Females seemed to mature at 155 mm TL; 130 mm SL., mass 57 gm and there is a suggestion of spawning around April or May.

Only one fish had stomach contents, crab remains. Only one had many parasites of the gut mesenteries i.e. encysted larval tetrarhynchs (Cestoda).

DISTRIBUTION. Local: Mafia, Latham and Zanzibar Islands. Presumably coastal throughout east African waters. Elsewhere: from Delagoa Bay to southern Arabia. Northern Madagascar, Mauritius, Seychelles, E. Indies, Philippines, Australia.

Smith's figure (after Bleeker) is a reasonable likeness although body depth rather great compared to our specimens which, furthermore, do not have the submarginal dark band on the caudal, as figured.

Nothing seen resembling variety *indelebilis* Fowler (1904).

Cephalopholis sexmaculatus (Rüppel, 1828)

(Plate 2)

Cephalopholis sexmaculatus: Fowler & Bean, 1930: 229, *ETC.*. Baissac, 1953: 517.
Cephalopholis gibbus Fourmanoir, 1954: 215. Fourmanoir, 1957: 147, pl. 8B.

SPECIMENS STUDIED. S 112, S 117, S 135. Sizes: 272-360 mm TL; 225-290 mm SL.; mass 312-725 gm.

DESCRIPTION. D IX,15-16; A III,9; Pect. i,17. GR 5-7, 1-2/1/8-9, 4-6; Sc. 98-110 $\frac{7\text{-}8}{31\text{-}36}$. Dentition $\left|\frac{6\text{-}7,7}{6\text{-}7,2}\right.$ pal. 2-3. Proportions in Table 4. According to Fourmanoir (1957) reaches 400 mm (Comoros).

COLOUR. In life: Scarlet with small blue spots and blackish blotches dorsally, four at base of dorsal fin extending on to it and two on top of caudal peduncle. Blue spots only very conspicuous on head and upper anterior part of body: arrangement variable, several may coalesce to produce short blue lines, particularly about eye and mouth: on body they tend to coalesce confusedly. Vertical fins with blue spots and soft parts with very narrow blue or blackish margins. Pectorals and pelvics bare of spots or with only 2 or 3 spots on former. Pectorals pink and web transparent, so pale as to appear almost colourless. Soft part of pelvic with narrow blue margin. Dorsal fin slightly dusky, but not other fins.

Compared with *C. miniatus* (S 113), obtained at the same time as S 112, the following features were noted. *C. sexmaculatus* a duller red with none of the orange or flame colour so characteristic of *C. miniatus*. Pectorals of *C. sexmaculatus* pink, not orangey-red. Blue spotting was much less conspicuous; spots duller, smaller, more numerous, closer with tendency to coalesce; similar distribution on both species but *C. sexmaculatus* had none on lower lip (save for two dark marks on chin near symphysis) and spotting did not extend to breast and belly (see plate 2).

Colour in formalin: Background changes to off-white and blue spots and dark marginal lines of fins become dark brown so are very much more conspicuous than in fresh fish. Most body spots not clearly separated, coalesce confusedly. Characteristic dorsal blotches remain dark.

BIOLOGY. Specimens from market, none other seen. Fourmanoir (1957) says they frequent coral bottoms at 30-72 m. Two females and one male; the gonads not ripe, smallest fish immature. Stomachs empty in two; smallest fish contained the shrimp *Periclimenes elegans* (Paulson). Each had many parasites of the gut mesenteries including anisakine larvae (Nematoda) and encysted tetrarhynch larvae including *Callotetrarhynchus gracilis* (Cestoda: Tetrarhynchidae).

DISTRIBUTION. Local: Zanzibar. Elsewhere: Comoros, Mauritius, Red Sea, E. Indies, Society Is..

REMARKS. Rüppel (1828) very adequately distinguishes the species from *C. miniatus* though his fin-counts are odd. I cannot agree with Klunzinger (1870) who considers this species to be a variety of *C. miniatus*. The key in Fowler & Bean (p. 207) is poor in respect of our specimens the cross-bars of which were so faint as only to be discovered in the photograph of the largest two (and lost since preservation): of course the "7" anal rays, in the key, is a misprint for 9.

Fourmanoir overlooked this species when he described *C. gibbus,* his plate of which shows *C. sexmaculatus*. Apparently the species has some fishery value in the Comoros.

Specimen S 117 sent to Dr L.P. Schultz, Smithsonian Institution.

Cephalopholis miniatus (Forsskål, 1775)

(Plate 2)

Cephalopholis maculatus: Seale & Bean, 1907: 235, fig. 5.
Cephalopholis formosana: Tanaka, 1911: 24, pl.7, fig. 22. Okada, 1955: 202, fig. 186.
(*Partim*) *Cephalopholis miniatus*: Tanaka, 1929: 913 (*non* pl. 184, fig. 504).
(*Non*) *Cephalopholis miniatus*: Okada, 1955: 203, fig. 187.
Cephalopholis miniatus: Fowler & Bean, 1930: 210, fig.8 *ETC.*. Fowler, 1934: 455. Smith, 1949: 192, (*non* pl.16, fig. 423). Baissac, 1953: 216. Schultz, 1953: 369, pl.31C. Fourmanoir, 1954: 214. Smith, 1955: 310. Fourmanoir, 1957: 146.
Epinephelus miniatus: Weber & de Beaufort, 1931: 30, *ETC.*. Copley, 1952: 84, pl.5. (*non* "Vieille Rouge" of Seychelles). Wheeler & Ommanney, 1953: opp. p.56.
Enneacentrus miniatus: Munro, 1955: 110, pl.18, fig. 294 (after Day).

SPECIMENS STUDIED. S 32, S 35, S 51, S 103, S 113 and Field. Sizes: 32-37 cm TL; 26-30 cm SL; mass 0.5-0.9 kg. Size range noted by EAMFRO: 130-395 mm TL; 105-330 mm SL; mass 57 gm — 0.9 kg. Weber & de Beaufort Report to 410 mm.

DESCRIPTION. D IX, (14-) 15; A III,9; Pect. i, 17; (except S 51 had D.IX,13; A III,8; Pect. i,18). GR 5-6, 1-2/1/7-9, 4-7; Sc. 88-102 $\frac{9\text{-}10}{32\text{-}36}$. Dentition $\left|\frac{7\text{-}9,7\text{-}9}{7\text{-}8,2\text{-}3}\right.$ pal. 3-4. Proportions in Table 4.

COLOUR. In life: Vermilion with sky blue spots all over body, fins and lower lip; spots absent from underside of lower jaw, along centre line of breast and belly, and the main area of pectoral fins. Pelvic fins without spots, or only a few: spots absent from triangular parts of the web of the spinous dorsal fin. Spots demarcated by faint or strongly marked grey or black circles; without tendency to coalesce. Soft dorsal, anal and caudal fins with slight duskiness, especially distally. Pectoral fin very orangey-red especially distally. No cross-bars or black blotches. Eye reddish-silver.

Colour in formalin: Off-white with clearly marked and well-separated dark brown spots on head, body and fins. (For pattern see above).

BIOLOGY. From cruises 61-167, 32 fish were taken, three others bought at market. Most caught by handline, 9 obtained by explosives and 3 shot. Quite common amongst corals from shallows to 22 m.

14% female, 8% male, maturity seemed to occur at 310 mm TL, 250 mm SL, mass 0.5 kg. Spawning season indeterminate.

13% everted stomachs and probably more vomited,

without eversion for only 19% of the remainder had stomach contents, all of which were fishes (including one apogonid). One fish had much fat in February.

Parasites common and comprised the larvae of Anisakinae (Nematoda), *Callotetrarhynchus gracilis* (Cestoda) and Acanthocephala. 56% had parasites of gut mesenteries and 16% parasites of gonads.

DISTRIBUTION. Local: E. African coast from Natal to the Red Sea. Elsewhere: Comoros, Aldabra, Seychelles, Mauritius. India, E. Indies, Philippines, Formosa, Bonin, Marshalls.

REMARKS. Although synonymy above shows acceptance, in the main, of that of Weber & de Beaufort they are wrong in omitting "*C. maculatus* Seale & Bean, 1907" which they place with "*Epinephelus maculatus* (Bloch)". Excluded from acceptance of Fowler & Bean's synonymy is "*Epinephelus melas* (not Peters) Gilchrist & Thompson, 1909".

Keys of Boulenger (1895), of Fowler & Bean and of Smith (1949) serve well but that of Weber & de Beaufort is not good for our specimens which have pectorals of a length intermediate between the dichotomy of the key.

Rüppell's (1828 pl.26, fig. 3) colour illustration very good, but pectoral fin too short relative to postorbital head (shown as short as in *C. argus*). Illustrations in Day (1878-88, pl.6, fig. 2), Tanaka (1911) and Schultz easily recognisable, as in Seale & Bean (1907) which interesting in showing coalescence of many blue spots. The fish figured by Tanaka (1929) is almost certainly *C. argus,* as supported by his text; his synonymy confuses several species. Okada (1955) reproduces this figure (p. 203) as *C. miniatus*: his textual description is most confusing and apart from the "fresh red" characteristic ground colour, cannot apply to *C. miniatus*. Smith's (1949) plate is *C. argus*.

Specimen S 32 sent to U.S. National Museum of Natural History.

Cephalopholis pachycentron (Valenciennes, 1828)

Cephalopholis pachycentron: Fowler & Bean, 1930: 220, Fig. 9, *ETC.*. Smith, 1954a: 504, pl. 102 (fig. 425a). Munro, 1955: 110, pl. 18, fig. 293 (after Bleeker). Smith, 1955a: 310. Fourmanoir, 1957: 149, fig. 107.
Epinephelus pachycentrum: Weber & de Beaufort, 1931: 19, *ETC.*.

SPECIMENS STUDIED. S 3, S 40, S 52, S 75, S 134 and Field. Sizes: 56-173 mm TL. 47-140 mm SL, mass approximately 14-85 gm. Size range noted by EAMFRO: 47-185 mm TL, 38-150 mm SL, mass 7-113 gm. Weber & de Beaufort report to 215 mm.

DESCRIPTION. D IX, 15-17; A III, 8; Pect. i, 15 (-17); GR (5-)6, 2/1/8-9, 5-7; Sc. 86-92 $\frac{9\text{-}10}{29\text{-}30}$. Dentition $\left|\frac{6\text{-}7,5}{5\text{-}6,2}\right.$ pal. 2-3. The very juvenile fishes (S 75 & S 134) tended to have a couple of scales more and a row of teeth less on each count.

Proportions in Table 4.

CHANGES WITH GROWTH. Slight increase in body depth: scale counts decrease, and dental counts increase slightly.

COLOUR. In life: Very dark, reddish-brown with slight indications of up to 7 cross-bars. All specimens remarkably constant in colouration, none with blue dots on head as mentioned by many. Caudal fin with very narrow, pale margin.

Colour in formalin: Drab brown with faint cross-bars. Blackish spot between upper two opercular spines (in fresh fish this spot is scarcely discernible). In some specimens margins of soft dorsal, soft anal and upper and lower parts of caudal fins are extra dark, suggesting a dorsal and a ventral oblique bar converging posterior to the caudal.

BIOLOGY. Rarely obtained by handline: specimens collected chiefly by explosives and poisoning in corals from surface to 6 m (mostly amongst *Acropora* spp.): some small specimens trawled at 6-40 m, and others from market.

No commercial value. Two specimens had crustacean remains in stomachs. None showed ripeness of gonads.

DISTRIBUTION. Local: Zanzibar and Mafia Islands. Elsewhere: E. African coast from Delagoa Bay to Zanzibar, Comoros, Aldabras, North-east Madagascar, India, E. Indies, Philippines, China, Melanesia, Queensland.

REMARKS. Smith's plate is a good illustration of the species as found here. Fowler & Bean's figure and that of Bleeker, reproduced by Munro, are scarcely appropriate to this region because they show spotting on the head. Fourmanoir's figure, in comparison to our specimens, exaggerates the cross-bars and dorsal and ventral oblique bars which, here, are faintly marked, if present. He appears to corroborate that blue spots are absent from the species in east African waters. The blackish opercular spot described above is neither shown in any of the illustrations nor seems to be mentioned.

Cephalopholis argus (Bloch & Schneider, 1801)
(Plate 2)

(*Partim*) *Cephalopholis miniatus*: Tanaka, 1929: 913, pl. 184, fig. 504. Smith, 1949: 192, pl. 16, fig. 423. Okada, 1955: 203, fig. 187 (after Tanaka).
Cephalopholis argus: Fowler & Bean, 1930: 226, *ETC.*. Smith, 1949: 192, text fig. 425 (?*non* pl.16, fig. 425). Baissac, 1953: 217. Schultz 1953: 367, pl.30B,pl. 31A. Fourmanoir, 1954: 214. Munro, 1955: 110 (? *non* pl. 18, fig. 292, after Day). Randal, 1955: 54. Roux-Estève & Fourmanoir, 1955: 197. Smith, 1955a. 310. Roux-Estève, 1956: 69. Fourmanoir, 1957: 148.
Epinephelus argus: Weber & de Beaufort, 1931: 28, *ETC.*. Pietschmann, 1939: 186, fig. 4. Copley, 1952: 85, 90 (fishes 120 and 137).

SPECIMENS STUDIED. S 33, S 56, S 104 and Field. Sizes: 270-340 mm TL; 224-283 mm SL; mass 0.3-0.5 kg. Three specimens obtained from Gilbert Island (USNM. 167489) 77-253 mm TL. Sizes range noted by EAMFRO: 270-4000 mm TL: 224-335 mm SL; mass 0.3-0.9 kg. Weber & de Beaufort state that it reaches 430 mm.

DESCRIPTION. D IX,16; A III,9. Pect. i,16; GR 10,1/1/6,10 (S. 104 only); Sc. 95-110 $\frac{9\text{-}10}{33\text{-}36}$. Dentition $\left|\frac{8\text{-}9\ ,\ 9}{9\text{-}10,2\text{-}3}\right.$ pal. 5-6. Gilbert Ids. specimens: D IX,16; A III,9; Pect. i,16; GR 8-10, 1/1/6, 9-11; Sc 95-100 $\frac{10\text{-}11}{29\text{-}30}$. Dentition $\left|\frac{8\text{-}9,7\text{-}8}{7\text{-}9,\ 3}\right.$ pal. 4-5 (largest fish). Teeth of smallest specimen not counted. Gilbert Island specimens are smaller than ours, and in the growth series represented by combining them, dental counts increase with growth. Proportions in Table 4.

CHANGES WITH GROWTH. Increase in number of all teeth series. There are changes in the lengths of certain features relative to standard length: most marked is decrease in relative length of second anal spine: lengths of third anal spine and of longest dorsal spine also decrease and, less markedly, relative length of pectoral fin, and of body depth.

COLOUR. In life: Body purplish brown becoming paler posteriorly except for 5 or 6 vertical cross-bars. Virtually all of head, body and fins, including undersides of head, breast and belly, with brilliant, rather irridescent blue-green spots (colour fades to pale blue after a while) each conspicuously ringed with black. Only unspotted regions are the deep orange triangular parts of web of spiny dorsal, and distal quarter of outer surface of pectorals which is deep orangey-red beneath duskiness, (inner surface is usually completely spotted). Spotting on snout may be obscured by general duskiness. Margins of vertical fins narrowly edged with white.

Colour in formalin: Sombre, especially anteriorly, with or without indistinct vertical cross-bars on flanks. Spotted virtually all over with black spots or black rings with pale centres. Margins of vertical fins narrowly white-edged.

BIOLOGY. A few specimens taken on cruises by handline, others by spearfishing and explosives. Commonly seen in market. Frequents shallow coral down to 20 m. Of 12 records 8% were male and 58% female: only S 104 showed ripeness, a female of 270 mm TL; 224 mm SL; mass 0.3 kg, which was "nearly ripe" in January.

None everted the stomach on capture and 58% had stomach contents. Commonest food was fish (including wrasses) and some contained crustacea (including the shrimp *Saron Marmoratus*).

There was only one instance of parasitic worms (Nematoda, Anisakine larvae) among gut mesenteries.

DISTRIBUTION. Local: Mafia and Zanzibar Islands. Elsewhere: E. African coast from Natal to Red Sea. Comoros, Aldabras, Mauritius, Persian Gulf, Sri Lanka, E. Indies, Philippines, China, Micronesia, Polynesia, Society Is., Northern Australia, Hawaii, etc..

REMARKS. There seems to have been considerable and unnecessary confusion between this species and *C. miniatus*. Both fresh and preserved specimens are readily distinguished by coloration. In addition to criteria mentioned in the key above, a useful feature is that underside of mandible of *C. argus* is fully spotted whilst that of *C. miniatus* is devoid of spots (in both, the lower lip is spotted).

Smith's (1949) black and white text fig. 425 not typical of our specimens but matches exactly Schultz' plate 31A. On the other hand Smith's colour fig. 425 (pl.16) is quite unlike specimens here and, although it tallies with some descriptions (e.g. Rüppell) of *C. argus*, it may be *C. nigripinnis* (Valenciennes, 1828).

The matter of cross-bars crops up frequently in the literature, sometimes in keys to identification. There are no cross-bars on east African *C. miniatus* (fresh or preserved) while *C. argus* always shows them when fresh, but they disappear after preservation. The key of Fowler & Bean (p. 207) thus fails for our preserved specimens: also, line "h^2 Anal rays 7" is erroneous since there are 9 anal rays.

Boulenger's (1895) key identifies *C. argus* well and distinguishes it from similar species chiefly by the shorter pectoral fin relative to length of head-less-chin. Boulenger states the pectoral length to be 60-67% of head-less-chin and our six specimens show it to be even shorter, i.e. 53-60%. This important criterion is obscured in the key of Weber & de Beaufort, which falls back on the relative lengths of the anal spines to distinguish between *C. argus* and *C. miniatus,* whereas in our specimens the second anal spine of *C. argus* is only subequal to the third (Table 4).

Specimen S 56 sent to the U.S. National Museum of Natural History.

With no local reputation for being poisonous, although reputedly mildly toxic in the Pacific (Fish & Cobb, 1954: 13).

Anyperodon leucogrammicus (Valenciennes, 1828)

Anyperodon leucogrammicus: Fowler & Bean, 1930: 293. Weber & de Beaufort, 1931: 81, fig. 9, *ETC*.. Schultz, 1953: 360, pl.27. Randall, 1955: 57. Smith, 1955a: 310. Steinitz & Ben Tuvia, 1955: Fourmanoir, 1957: 159, fig. 113.

SPECIMENS STUDIED. S 30, S 34 and Field. Sizes: 340-373 mm TL; 282-309 mm SL; mass approximately 0.5 kg. Size range noted by EAMFRO: 310-455 mm TL; 256-385 mm SL; mass 170 gm - 1 kg. Grows to 520 mm (Boulenger 1895).

DESCRIPTION. D XI (-XII), 15; A III,9; Pect. i,15-16, (Gill rakers removed at sea); Sc. 119-123 $\frac{14}{35\text{-}36}$. Dentition $\left|\frac{7\text{-}9,7\text{-}8}{6\text{-}7,\ 2}\right.$ pal. 0. Proportions (% SL): depth 27-29, postorbital head 24-26, longest pectoral ray 17-18, longest pelvic ray 15.

A specimen from Bikini (USNM. 141957) with D XI,15; A III,9; Pect. i,15; GR (left side) c.7,2/1/9, c.5; (right side) c.10,1/1/8, c.6 (several rakers deformed, rudiments difficult to distinguish); Sc. c.134 $\frac{14\text{-}15.}{38}$ Dentition $\left|\frac{7,c.8}{6\text{-}7,2}\right.$ pal. 0. Proportions (% SL) depth 29, postorbital head 25, longest pectoral ray 18, longest pelvic ray 16.

Longitudinal scale counts difficult due to confusion of scales: transverse counts are simple. Dental counts rather difficult due to confusion of teeth and small size. Teeth of outer row in upper jaw are, in our specimens, no larger than those of inner rows: in Bikini specimen they are a little larger and stouter, but still very reduced compared to the comparative sizes of these teeth in other Epinephelines.

COLOUR. In life: Brown or olive with large rust-coloured spots. Longitudinal bars or streaks on young.

Colour in formalin: Brownish with "white" spots on upper parts of head and body and on web of spiny dorsal fin. "White" longitudinal bars or streaks in young. Fins pale.

BIOLOGY. Only four fishes obtained from Cruises 61 to 167, two by handlines, two by spearfishing, but species fairly common amongst shallow coral and a few frequently in market. Not taken deeper than 20 m. No interesting breeding information. Stomachs of

two that were shot contained fish remains. One had a few parasites (larvae of *Callotetrarhynchus gracilis* — Cestoda) in mesenteries of gut.

DISTRIBUTION. Local: Mafia and Zanzibar Islands. Elsewhere: E. African coast from Comoros to the Red Sea. Madagascar, Aldabra, Seychelles, E. Indies, Micronesia.

REMARKS. The best illustration is Schultz' plate (photos). Negligible commercial value.

Promicrops lanceolatus (Bloch, 1790)

Promicrops lanceolatus: Fowler & Bean, 1930: 297, fig. 24, *ETC.*. Smith, 1949: 198, pl.19, fig. 452 (2 stadia). Roughley, 1951: 43, pl.13 (after Fraser-Brunner). Munro, 1955: 111, pl.18 (after Bleeker). Smith, 1955: 310. Baissac, 1956a: 361. Whitley, 1951: 61, fig. 7 (juv).
Epinephelus lanceolatus: Weber & de Beaufort, 1931: 70, *ETC.*. Copley, 1952: 87. Hatchell, 1954: 21, fig. on p.25.
Serranus lanceolatus: Pakistan, 1955: vi, 25.

SPECIMENS STUDIED. S 60. 215 mm TL; 170 mm SL.

DESCRIPTION. D XI,15; A III,8; GR 7,2/1/8,7; Sc. (confused) $\frac{11\text{-}12.}{36\text{-}38}$ Dentition $\left|\frac{5\text{-}6,4}{4,\ 2}\right.$ No canines, pal. 4. Proportions in Table 5: it is emphasised that this is a very small juvenile and the interorbital span, characteristically so very great in big fishes, is here of the same order of size as the species in Table 6.

Scales cycloid, many buried; lateral line tubules branched into 2,3 or 4 arms. Upper opercular spine rudimentary; central projecting and sharp; lower rudimentary; opercular angle obtuse; upper margin very convex. Preopercle margin naked of skin, finely serrate, the angle not produced and no concavity in the profile. Interorbital broad and flat. Front nostril circular, the flap much larger than the aperture; hind nostril ovoid, without flap. Maxilla reaches well beyond hind margin of eye; naked of scales.

REMARKS. It is strange, in view of the frequent mention of this species in the literature, that the varied resources and considerable effort of EAMFRO yielded no more than the one specimen (and that very juvenile, from the defunct Chukwani fish ponds on Zanzibar Island).

It is probable that huge specimens have been confused with *Epinephelus tauvina* and *E. tukula*.

Epinephelus fasciatus (Forsskål, 1775)

Epinephelus fasciatus: Gilchrist & Thompson, 1909: 223. Tanaka, 1929: 903, pl.183, figs. 499, 500, pl.184, fig. 502. Weber & de Beaufort, 1931: 58, *ETC.*. Smith, 1949: 195, pl.18, fig. 436. Baissac, 1953: 219. Schultz, 1953: pl.30C. Fourmanoir, 1954: 215. Okada, 1955: 201, fig. 185 (after Jordan, Tanaka & Snyder). Smith, 1955: 310. Fourmanoir, 1957: 150.
Serranus fasciatus: Fowler, 1925: 223. Fowler & Bean, 1930: 263, *ETC.*. Fowler, 1934: 458. Wheeler & Ommanney, 1953: 56.
(*Partim*) *Epinephelus fasciarus* (*sic*): Hatchell, 1954: 21, fig. on p. 23.

SPECIMENS STUDIED. S. 1/1 & 1/2 and Field. Sizes: 201-236 mm TL, 164-193 mm SL; mass approximately 7 gm. Size range noted by EAMFRO: 150-320 mm TL, 125-265 mm SL; mass 28-454 gm.

DESCRIPTION. D XI,16; A III,8; Pect. i,18; GR 3-4, 3-5/1/10-11, 5-6 totals: 24-25; Sc. 116-118 $\frac{11\text{-}12.}{34}$ Dentition $\left|\frac{8\text{-}9,4\text{-}6}{7\text{-}9,\ 2}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}2}\right.$ pal. 6-8. Proportions in Table 5.

Scales ctenoid except antero-dorsally; many auxiliary scales. Upper opercular spine rudimentary; central equidistant between upper and lower; central and lower spines projecting, very acute; opercular angle acute; upper margin straight. Preopercular margin naked or covered by skin, serrate, the angle scarcely produced; a very slight concavity in the profile. Upper limb of gill-arch very short, rakers very flattened, finely spiny. Interorbital flat. Nostrils close, circular, front nostril with long flap. Inner teeth small, outer teeth much larger. Maxilla extends to hind margin of eye; naked or with small buried scales.

COLOUR. In life: Very distinctive; red, with broken vertical cross-bars; black triangles at tips of dorsal fin spines.

BIOLOGY. Commonly taken by handline in certain localities down to 20 m but extending as far as 55 m. Of the 79 specimens examined for sex, a mere 9% were identifiable as male, with 72% female. Maturity appeared to occur in males at approximately 215 m TL; 175 mm SL; mass 110 gm and in females at 190 m TL; 160 mm SL; mass 115 gm. Breeding appears to occur between December and March, but the many records yielded very inconclusive evidence.

Stomachs were often everted, even from 20 m depth, and only 37% contained food, which included crabs, squillids, ophiuroids and a small octopus as well as fish remains.

Very few had parasites of the gut.

DISTRIBUTION. Local: recorded by us off the islands of Pemba, Zanzibar, Mafia and Latham, etc.. Elsewhere: widespread Indo-Pacific.

REMARKS. Of no fisheries value except as bait.

The colour illustration in Smith (1949) is very good. Schultz (1953) shows the underwater appearance very well except that it omits the "skull cap" that is so marked a feature underwater.

Epinephelus grammatophorus Boulenger, 1903.

Epinephelus grammatophorus Boulenger, 1903: 64, pl.3. Gilchrist & Thompson, 1909: 222. Barnard, 1925-27: 480. Smith, 1949: 195, p.l.18, fig. 434. Copley, 1952: 88. Fourmanoir, 1954: 215. Fourmanoir, 1957: 151. Blanc & Postel, 1958: 368, 370, 373.
Serranus rivulatus: Fowler, 1925: 224.

SPECIMENS STUDIED. S 44/1 and 44/2 and Field. Sizes: 267-352 mm TL; 215-290 mm SL; mass 0.2-0.7 kg. Size range noted by EAMFRO: 240-430 mm TL; 200-355 mm SL; mass. 0.1-1.1 kg.

DESCRIPTION. D XI,16-17; A III,8; Pect. i, 16-17; GR 4,3/1/8-9, 4-5, totals 21; Sc. 92 $\frac{10\text{-}11.}{29\text{-}31}$ Dentition $\left|\frac{6\text{-}7,4}{5\text{-}6,2}\right.$ canines $\left|\frac{1}{1\text{-}2}\right.$ pal. 3-4. Proportions in Table 5.

Scales ctenoid, buried antero-dorsally. Upper opercular spine rudimentary; central equidistant between upper and lower (may point obliquely upwards); central and lower spines projecting, acute; opercular angle acute, level with top margin of orbit; upper margin straight or slightly concave, parallel to longitudinal axis of fish *i.e.*, very elevated. Preopercular margin naked, finely serrate with enlarged serrae at angle (which is produced); a slight concavity

in profile. Gill rakers longish in the angle and shorten markedly away from it; thin; spiny on front face. Interorbital slightly concave. Nostrils close, small, circular; the front with a large flap on posterior margin. Teeth biserial for most of length of mandible; canines rather small. Palatine teeth widely spaced. Maxilla narrow, reaches to or beyond hind margin of eye; naked.

COLOUR. In life: Distinctive dusky pink; the head, lips and throat notably pink. Bright red half-moons on base of pectorals. Blue veins on cheek. Five dusky cross-bars on body, the two above anal fin confluent, only separated by a V dorsally.

Colour in formalin: Colour rapidly lost, especially red and yellow. Lines on head remain as dull brownish lines and become over-emphasised compared with their appearance when fresh. Cross-bars become faint and only four are recognisable.

BIOLOGY. Commonly taken by handline on the North Kenya Banks from 35-120 m, seemingly in any month. Records show that this species (as also *E. praeopercularis* and *E. flavocaeruleus*) may persist on its chosen grounds even in the presence of the colder water beneath the main thermocline (Morgans 1959, 1962, 1964). Of the 145 specimens examined for sex, a mere 8% were identifiable as male, with 70% female. Maturity appeared to occur in males at 310 mm TL; 255 mm SL; mass 0.5 kg; and in females at 265 mm TL; 220 mm SL; mass 0.2 kg. No male was found other than "unripe", while some females in stages between "ripening" and "spent" were recorded in the following months — January, April, May, August, September, October and November.

Stomachs were usually everted and, if not, were usually empty suggesting that vomiting was common. Recorded contents were small fishes (including the "goldfish" *Cyprinocirrhites polyactis* and an eel) and crabs.

Quite a few guts were parasitised with tetrarhynch cysts, larvae of *Lacistorhynchus tenuis*, anisakine larvae and adult *Rhadinorhynchus* sp. Except for the last, the same parasites were commonly found in the gonads as well as larvae of *Pterobothrium* sp. and *Callotetrarhynchus gracilis*, and the nematode *Philometra* sp.

DISTRIBUTION. Local: North Kenya Banks, off north Pemba.

REMARKS. A preserved specimen can resemble *E. praeopercularis* at first glance but the fresh fish is distinctive. As with *E. praeopercularis*, *E. grammatophorus* is typical of the North Kenya Banks, only once recorded by us elsewhere. It seems to occupy there the ecological niche that *E. fasciatus* has in shallower waters around the islands and shoals further south. Of neglibile fisheries value except as bait.

The colour illustration in Smith (1949) is excellent: that of Boulenger (1903) is a good likeness of preserved specimens.

Epinephelus caeruleopunctatus (Bloch, 1790)

Serranus caeruleo-punctatus: Fowler & Bean, 1930: 276, figs. 18, 19, *ETC*.. Fowler, 1934: 458 (?).
Epinephelus caeruleopunctatus: Jordan, Tanaka & Snyder, 1913: 158. Weber & de Beaufort, 1931: 66, *ETC*.. Smith, 1949: 198, pl.18, fig. 450. Baissac, 1953: 220. Munro 1955: 113, pl.19 (after Bleeker). Randall, 1955: 54. Smith, 1955: 310.
Epinephelus hoevenii: Whitley 1932: 281, pl.2.
(Partim) Epinephelus caeruleopunctatus: Copley 1952: 86.
(?) *Epinephelus caeruleopunctatus*: Fourmanoir 1957: 155, pl.9B.

SPECIMENS STUDIED. S 15, S 64, S 136/1, S 136/2, S 139, S 154, S 159/1 and Field. Sizes: 101-495 mm TL; 80-415 mm SL; mass 14 gm — 1.8 kg.

DESCRIPTION. D XI,16; A III,8; Pect. i,17 (-18); GR 4-6, 1-2/1/5-8, 4-8; Sc. 93-107 $\frac{12\text{-}14.}{30\text{-}34}$

Dentition $\left|\frac{6\text{-}11,3\text{-}11}{4\text{-}9\ ,2\text{-}4}\right.$ canines $\left|\frac{0\text{-}2}{1\text{-}3}\right.$ pal. 2-3.

Gill rakers variable in degree of development, seemingly independently of growth. Scales strongly ctenoid. Teeth fine, canines insignificant: all dental counts increase with growth. Front nostril small, round, with prominent tubular flap; rear nostril larger, round or ovoid, without flap. Central opercular spine rather nearer lowest, both projecting, acute: highest opercular spine inconspicuous, above lowest, or more anterior. Opercular flap acute in that a line from most prominent part of lower margin to posterior tip makes less than a right angle with a line from most prominent part of upper margin to posterior tip. Preopercular margin finely serrate. Caudal rounded.

Proportions in Table 6.

COLOUR. In life: Various shades of olive-brown to purplish brown (possibly progressing from former to latter with growth) with many small and medium sized spots of pale sulphur-yellow on head and body, except beneath mouth and on breast: belly with small spots. All dorsal, anal and pectoral fins spotted as body, also proximal part of caudal fin; pelvics unspotted. Fins rather dusky, the soft dorsal, caudal and anal narrowly white edged. Usually traces of 3-5 blackish blotches dorsally on body, darkest posteriorly so that darkest on caudal peduncle. Sometimes faint cross-bars distinguishable leading from dorsal blotches. No large, pale blotches noted in fishes positively identified. Dark "moustache" in maxillary groove.

Colour in formalin: Fades to pale, off-white colour, showing only faintest signs of paler spots and dorsal blotches. Apical triangles of web of spiny dorsal not conspicuously dark. "Moustache" conspicuous.

BIOLOGY. While EAMFRO records have confused this with *E. summana* the combined records give little information on breeding and merely indicate that commonest food is fish. *E. caeruleopunctatus* had fish in one stomach and the shrimp *Periclimenes elegans* (Paulson) in another, together with a dozen protozoan cysts. Fourmanoir says found on coral from 20-65 m.

DISTRIBUTION. Local: Zanzibar. Elsewhere: from Natal to Red Sea. Madagascar, Aldabras, Mauritius, Malabar, Sri Lanka, Japan, Gilbert I., Great Barrier reef.

REMARKS. Boulenger's criterion regarding shape of opercular flap divides this species neatly from *E. summana*. Our specimens of these closely related species also unequivocally separated by number of dorsal and pectoral fin rays: and fact that highest opercular spine of *caeruleopunctatus* is situated more

anteriorly relative to others than in *summana*. We postulate that in colouration *summana* lacks yellow spots and possibily lacks even faint black dorsal blotches: *caeruleopunctatus* possibly lacks the large, pale blotches characteristic of *summana* var. *tumilabris*.

Playfair's (1866) figures are excellent, opercle shape and dorsal ray count agree with criteria above. Figure and description of "*tumilabris*" in Day (1878-88) clearly fit criteria of *caeruleopunctatus*. Drawings in Fowler and Bean show obtuse opercular angle. Fourmanoir's plate shows what appears to be *summana* var. *tumilabris* in colour pattern, and opercle seems rather obtuse.

Epinephelus summana (Forsskål, 1775)

Serranus summana: Fowler & Bean, 1930: 280, figs. 20, 21, *ETC.*.
Epinephelus summana: Weber & de Beaufort, 1931: 54, *ETC.*. Smith, 1949: 198. fig. 449. Schultz, 1953: 338. Whitley, 1954: 25. Roux-Estève & Fourmanoir, 1955: 197. Smith, 1955: 310. Roux-Estève, 1956: 69. Fourmanoir, 1957: 156, fig. 110.
(*Partim*) *Epinephelus caeruleopunctatus*. Copley, 1952: 86.

SPECIMENS STUDIED. S 43, S 89/1, S 89/2 and Field. Sizes: 155-275 mm TL; 125-225 mm SL; mass 57-340 gm. EAMFRO records that confuse this with *E. caeruleopunctatus* list several fishes of over 55 cm TL; about 2.7 kg.

DESCRIPTION. D XI,15; A III,8; Pect. i,15; GR 5-7, 2-3/1/7-9, 5-8; Sc. 96-101 $\frac{c.11}{28\text{-}30}$.

Dentition $\left|\frac{6\text{-}7,4\text{-}6}{4\text{-}5,\ 2}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}3}\right.$ pal. 2-3.

Scales strongly ctenoid. Teeth fine, canines insignificant. Front nostril small, round with prominent tubular flap: hind larger, round or ovoid, without flap. Central opercular spine rather nearer lowest, both projecting and acute: highest inconspicuous, usually more posterior than lowest, sometimes to above central spine. Opercular flap obtuse in that a line from most prominent part of lower margin to posterior tip makes an angle greater than 90° with a line from most prominent part of upper margin to posterior tip. Preopercular margin finely serrate. Caudal rounded.

Proportions in Table 6.

COLOUR. In life: Variable grey or greyish brown with many small spots of pale grey or blue-grey. No cross-bars. Some specimens have an overlying pattern of pale, or leprous blotches. Fins as body. Sometimes, if not always, a narrow white margin to soft dorsal, caudal and anal fins, and membrane of spinous dorsal extra dark peripherally. Conspicuous dark "moustache" in maxillary groove.

Colour in formalin: Fades to pale, off-white colour, pattern gradually disappearing except for the dark moustache.

BIOLOGY. (see comments under *E. caeruleopunctatus*). Common about shallow reefs.

DISTRIBUTION. Local: probably throughout coast of east Africa. Elsewhere: Madagascar, Aldabras, Seychelles; Red Sea, Java, Bikini, Australia.

REMARKS. Comments under *E. caeruleopunctatus* (*q.v.*) show that there are three perhaps four, diagnostic morphological characters for separation of these closely related species. Whether or not the dorsal rays ever truly exceed 15 cannot be said, but literature (e.g. Günther, 1859) not infrequently mentions 16 rays. Fourmanoir's sketch is atypical of our specimens in respect of opercle shape and arrangements of opercular spines.

Sauvage (1891) says that *E. rivulatus* C. & V., taken at Madagascar, resembles *E. summana* in colouration: his figure shows opercular angle of *E. rivulatus* to be acute, and upper opercular margin very straight, which may be differentiating criteria.

The radiograph of Forsskål's holotype in Klausewitz and Nielsen (1965, pl.19) shows 15 dorsal fin rays, as with our specimens. They remark (p.18) that "This species is not identical to *Epinephelus summana* in Schultz (1953, p.338)".

Epinephelus flavocaeruleus (Lacepède, 1802)

(?) *Epinephelus suitonis*: Tanaka, 1916: 402, pl.109, fig. 331.
(?) *Epinephelus flavocaeruleus*: Tanaka, 1929: 912, pl.184, fig. 503 (*non* fig. 427).
Serranus flavocaeruleus: Fowler & Bean, 1930: 244, *ETC.*. Fowler, 1934: 457.
Epinephelus flavocaeruleus: Weber & de Beaufort, 1931: 35, *ETC.*. Smith 1949: 195, pl.17, fig. 433. Baissac, 1953: 217. Wheeler & Ommanney, 1953: 56, pl.2, fig.1. Munro, 1955: 112, pl.19, fig. 301 (after Day). Randall, 1955: 53. Williams, 1956: 21. Fourmanoir, 1957: 156. Morgans, 1964, pl.6.
(*Partim*) *Epinephelus flavocaeruleus*: Copley, 1952: 90.
(? *Partim*) *Epinephelus areolatus*: Baissac, 1956a: 361.
Epinephelus sp.: Fourmanoir, 1957: 157, pl.9C.

SPECIMENS STUDIED. S 5, S 36, S 69 and Field. Sizes: 196-675 mm TL; 162-565 mm SL; mass 0.1-5.4 kg. EAMFRO records: 89 cm TL; 76 cm SL, mass 12.7 kg.

DESCRIPTION. D XI, (16-) 17; A III,8; Pect. i, 18; GR 2-3,6-7/1/12-13, 3-4, totals 24-27; Sc. 131-135 $\frac{18\text{-}20.}{43\text{-}48.}$ Dentition $\left|\frac{8\text{-}12,4\text{-}9}{5\text{-}10,2(\text{-}3)}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}2}\right.$ pal. 2-6.

Depth 36.8-38.9% SL. Highest dorsal spine 13. 0-13.8% SL, equal to, or fractionally shorter than longest dorsal ray. Other proportions in Table 7.

Dorsal fin well elevated, 3rd and 4th spines longest, after which spines progressively become distinctly shorter, so that there is a moderate notch before soft dorsal fin; anterior dorsal rays not conspicuously longer than those posteriorly. Caudal truncate or slightly emarginate. Body scales ctenoid except antero-dorsally. Patch of small (cycloid) scales on maxillary. Three opercular spines, highest rudimentary; central nearer lowest, projecting, acute; lowest may or may not project. Upper and lower opercular margins make just under a right angle with each other, but opercular extremity acute because of concavity in lower margin: upper margin slightly concave for most part, or nearly straight. Preopercle margin naked, finely serrate, usually with enlarged serrae at angle; above angle is a slight or negligible concavity. Interorbital very convex. Nostrils close together, front one with marked flap and its aperture about half diameter of hind nostril. Teeth small, poorly differentiated, series increasing with growth. Except in small fishes, antero-ventral edge of maxilla is sharply stepped where it curves to form the distal expansion. Maxilla reaches to below centre or hind margin of eye.

CHANGES WITH GROWTH. Changes in colour are well known; principal change is progressive loss of bright golden yellow that covers so large a proportion of juveniles. Dental counts increase. Snout

lengthens relative to SL and the following structures shorten: pectoral and pelvic fins, all anal spines.

COLOUR. In life: Juveniles are dark blue and golden yellow (Smith's plate). In fishes about 575 mm TL; 495 mm SL; mass 3.2 kg the yellow areas reduced to small regions of head and dorsal fin, and caudal may be narrowly white-edged; Adults are purplish brown (Wheeler's plate) and free of all traces of spots, dark blotches and cross-bars. Large fishes often, but not always, exhibit on being decked, superimposed leprous markings that consist of greyish blotches of irregular definition and shape and of all sizes; these normally become dull, and disappear wholely or in part after death.

Colour in formalin: Yellow parts become bleached, blue and purplish parts become drab, leprous markings disappear.

BIOLOGY. From cruise 61 to 167, 54 specimens were taken by handline fishing at the bottom, one by trolling and two from market. Uncommonly taken by trolled lures although Williams records another instance. Fairly common species, often found in the market in small numbers. It seems that up to about 40 cm TL; (1.4 kg) it frequents shallow reefs and thereafter goes to deeper grounds, being taken down to 100 m; has been taken within, and below, the main thermocline beneath the East African Coastal Current.

No males recorded, at least 84% female. Females mature around 60 cm TL; 50 cm SL; mass 4.1 kg. Definitely a major spawning season in November-December and probably a minor one in July-August. An occasional ripening fish found in February and March and some spent fishes in March and April, but general sexual activity then was definitely low.

Over half everted stomachs and only 40% of others had stomach contents. Half the food consisted of small and largish fishes (including an eel and, extraordinarily enough, *Lactoria cornutus* with its formidable spines). Shrimps and small octopuses or squids occasionally found and the following found once each: sponge, a calappid crab, *Odontodactylus ? hanseni* and *Thalia democratica*.

Fishes with much fat not found. Only 4% had parasitised gonads (including anisakine larvae — Nematoda), only 9% had parasitised gut mesenteries (including *Acanthocheilus* sp. larvae — Nematoda and larval tetrarhynch cysts — Cestoda). S 69 had the isopod *Argathona* sp. in a nostril.

DISTRIBUTION. Local: Mafia Island, Zanzibar Island, North Kenya Banks; reefs and banks presumably throughout the coast. Elsewhere: E. African coast from Natal to Arabia; Madagascar, Bourbon, Reunion, Rodriguez, Mauritius, Seychelles; India, Sri Lanka, Andamans, E. Indies, Formosa, China; Queensland, New South Wales, Micronesia.

REMARKS. Literature mentions the possible presence of close-set, blackish dots dorsally and laterally but such dots are not characteristic of our fishes: possibly Tanaka's (1916 & 1929) specimens are an extreme example of this feature. The drawings of Boulenger (1895) and Day (1878-88) corroborate the shallowness of the notch, or concavity, above preopercle angle; and the comparative uniformity in length of dorsal and anal fin rays. The leprous blotch pattern is of identical nature to that of *E. leprosus* and some *Cephalopholis sonnerati*. Fishes of a given length may vary considerably in mass.

Epinephelus leprosus Smith, 1955

(*Partim*) *Epinephelus flavocaeruleus*: Copley, 1952: 90.
Epinephelus sp: Fourmanoir, 1954: 216, no. 122, pl.6, fig.2.
Epinephelus leprosus Smith, 1955: 310, pl.1A. Smith, 1957: 121. Fourmanoir, 1957: 150, pl.8C. Morgans, 1964, pl.6.
(*Partim*) *Epinephelus areolatus*: Baissac, 1956a: 361.

SPECIMENS STUDIED. S 70/1, S 70/2 and Field. Sizes: 655-665 mm TL; 550-560 mm SL; mass 4.5-5.9 kg. EAMFRO records. 60-80 cm TL, 50-68 cm SL, mass 2.7-9.1 kg.

DESCRIPTION. D XI,16; A III,8; Pect. i,18; GR ?,?/1/11-14, 2-4, totals on lower limb of first arch (excluding raker at angle) 14-16; Sc. 132-134 $\frac{16\text{-}19}{47\text{-}48}$. Dentition $\left|\frac{9\text{-}10,6\text{-}7}{6\text{-}7,\ 2}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}2}\right.$ pal. 4-5.

Depth 36.1-37.1% SL, longest dorsal spine 11.1-12.0% SL, longest dorsal ray 14.3-14.7% SL. Other proportions in Table 7.

Dorsal fin well elevated with well marked notch; anterior dorsal fins rays longest, distinctly longer than longest dorsal spines. Caudal truncate. Body scales ctenoid except antero-dorsally: maxilla with patch of small (cycloid) scales, almost buried. Central opercular spine nearer to lowest; both projecting, acute; uppermost spine rudimentary, most anterior. Angle between upper and lower margins of operculum just less than a right angle, upper margin rather concave, or virtually straight. Preopercle edge not notably naked of skin, very finely serrate, serrae at angle not much larger; concavity above angle very well marked. Interorbital very convex. Nostrils close together, front with flap and about half diameter of the hind. Antero-ventral margin of maxilla with a step where it expands distally; maxilla reaches variably to between front and hind margins of eye, but not beyond.

COLOUR. In life: Body brown, paler ventrally (becomes darker on exposure); lower half of head, breast and belly with small scattered spots of rich reddish-brown colour. Fins dark and unspotted except for base of pectoral fin. On capture shows vivid overlying pattern of irregular blotches that are greyish or whitish; they become less vivid after death and usually, but not always, disappear. No trace of cross-bars or dark blotches.

Our specimens are much less spotted than that figured by Smith (1955), possibly a feature of growth.

BIOLOGY. Twenty-eight taken by handlining at the bottom down to 90 m between cruises 61 and 167. Moderately common on the North Kenya Banks but seems rare elsewhere. Only 7% identified as male and they were "mature, unripe": 89% identified female. Females certainly mature at 62 cm TL; 50 cm SL; mass 3.6 kg and possibly at smaller size. Ripening and nearly ripe fishes taken on four cruises in November-December which is clearly the period of peak sexual activity: probably a minor peak occurs around August. Appears sexually inactive from March to April.

Stomachs everted in 43%, only three fishes (19% of the rest) had stomach contents: undoubtedly vomiting had frequently occurred. Food consisted of small fishes and crabs.

7% had parasites in gonads (including encysted tetrarhynch larvae — Cestoda). 7% had parasites in gut mesenteries (anisakine larvae — Nematoda, and encysted larvae of *Callotetrarhynchus gracilis* — Cestoda). One had an isopod, *Argathona c.f. similis*, in one nostril.

DISTRIBUTION. Local: Mafia I., Pemba I., North Kenya Banks. Elsewhere: Mozambique, Madagascar, Comoros, Aldabras, Providence group, Amirantes.

REMARKS. Smith (1955) records from 6-9 m depth. Excellent eating. The Plate in Morgans (1964) shows this together with *E. flavocaeruleus* of same size.

Epinephelus modestus Gilchrist & Thompson, 1909
(Plate 3)

Epinephelus modestus Gilchrist & Thompson, 1909: 218. Barnard, 1925-7: 481.
Serranus modestus: Fowler, 1925: 224.

SPECIMENS STUDIED. S 128 (head and gills only); S 132/1 and 132/2 (only gill retained); and Field. Sizes: 104-137 cm TL; 88-115 cm SL; mass 19.0-40.8 kg.

DESCRIPTION. D XI,14-15; A III,9; Pect. i, 17-17; GR 6-8, 2-3/1/9-11, 3-5 totals 23-25; Sc. 126-146 $\frac{17\text{-}23}{39\text{-}42}$. Dentition $\left|\frac{9\text{-}15,6\text{-}9}{7\text{-}11,3\text{-}4}\right.$ canines $\left|\frac{0\text{-}1}{0\text{-}2}\right.$ pal. 5-8.

Proportions in Table 7.

Spiny dorsal fin not very elevated, longest dorsal spines a little shorter than longest dorsal rays. Caudal slightly rounded. Body scales strongly ctenoid, well exposed, completely buried only on mid-line of belly; many auxiliary scales; scales continue onto bases of caudal, dorsal and anal fins. Preorbital, lips, skin of maxilla, and small areas of snout naked. Skin not copiously mucilaginous. Three opercular spines, centre nearer lowest; centre and lowest project, acute; highest rudimentary and the most anterior. Opercular extremity acute owing to adjacent concavity of lower margin, but general line of lower margin is about at right angles to upper margin; upper margin almost straight. Preopercle margin naked, very finely serrate with slightly larger serrae at angle; concavity above the angle moderate, or slight. Gill rakers short, stout, spiny anteriorly, rakers grading into rudiments so that it is difficult to distinguish them. Interorbital convex. Nostrils close together, front circular with flap on posterior margin; hind obliquely or transversely ovoid, major diameter about four times front nostril, without flap. Dental counts difficult; most teeth fine, small, but outer row of teeth of upper jaw conspicuously caniniform in contrast to teeth within; canines small, inconspicuous, if present. Maxilla extends to hind margin of eye, antero-ventral margin with distinctly prominent step where it expands distally (not a spiniform process as in *E. undulosus*.

COLOUR. In life: Rosy slate or chocolate brown, throat and hidden membranes of head pinkish grey; eye nondescript silvery. No bars, spots, blotches, marginal coloured bands or conspicuous moustache streak.

BIOLOGY. All taken by deep longlining on Malindi Banks in November and December (two on cruise 144, two on cruise 165). The latter hooked at 125-175 m (over bottom at 180 m), which is below major thermocline. All were females in sexual inactivity, largest seemed spent. Stomachs of three were everted, that of other empty. Gut mesenteries of largest fish contained anisakine larvae (- Nematoda) and tetrarhynch cysts (- Cestoda).

DISTRIBUTION. Local: Malindi Banks (Kenya). Elsewhere: Natal, Pondoland.

REMARKS. Some resemblance to *E. undulosus*, but *E. modestus* distinguished by fewer dorsal fin rays and rounded tail. Depth is less than for *E. flavocaeruleus* and *E. leprosus*, from each of which *E. modestus* differs in other proportions (Table 7). Colouration wrong for fishes of similar size of *E. tauvina* complex and hind nostril too large. Depth too great, and too many scales, for this to be an unusual colour variety of *E. tukula*; differs from *E. jayakari* in many features. Rare.

I am indebted to Dr P.C. Heemstra, of the J.L.B. Smith Institute of Ichthyology, for identifying this species from my manuscript description.

Epinephelus praeopercularis Boulenger, 1887
(Plate 3)

(*Partim*) *Serranus morrhua*: Day, 1878-88 (suppl.): 780.
Epinephelus praeopercularis Boulenger, 1895: 207, pl.5. Barnard, 1925-27: 476. Copley, 1952: 90.
(?) *Epinephelus morrhua*: Gilchrist & Thompson, 1909: 217.
Serranus praeopercularis: Fowler, 1934: 456.
(*Partim*) *Epinephelus morrhua*: Smith, 1949: 196, pl.18, fig. 438.
Epinephelus morrhua: Hatchell, 1954: 21, fig. 23.

SPECIMENS STUDIED. S 109, S 110, S 111 and Field. Sizes: 415-624 mm TL; 345-514 mm SL; mass 0.8-3.6 kg.

DESCRIPTION. D XI, 14-15; A III, 8; Pect. i, 17; GR 6-8, 1-2/1/8-9, 5-7, totals 24-25; Sc. 127-131 $\frac{16\text{-}17}{43\text{-}44}$. Dentition $\left|\frac{5\text{-}7,4\text{-}5}{5\text{-}6,\ 2}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}2}\right.$ pal. 2.

See Table 8 for measurements.

Body considerably compressed laterally. Dorsal fin well elevated, scarcely notched, longest spines 3rd or 4th 25-36% of head-less-chin (= head length of Boulenger, 1895); spines project notably beyond fin's web. Caudal slightly rounded, almost truncate. Body scales ctenoid except antero-dorsally; maxilla with many, few or no tiny cycloid scales. Three opercular spines, highest rudimentary, most anterior; central spine equidistant or slightly nearer lowest, central and lowest projecting, acute. Opercular angle acute, upper margin straight. Preopercle edge naked on upper part or covered by skin, very finely serrate, serrae slightly larger at angle; slight or moderate concavity above angle. Gill rakers short, moderately spiny. Interorbital convex. Nostrils close together; front circular with flap; rear circular or obliquely oblong, about twice diameter of front one without flap. Almost whole length of lower jaw has well developed teeth in two distinct series, inner teeth

longer; teeth at sides of upper jaw very fine except for outermost series; canines prominent. Antero-ventral edge of maxilla curves smoothly to distal expansion: maxilla extends to below centre of eye.

CHANGES WITH GROWTH. Dental counts at front of lower jaw and all round upper jaw increase slightly. Third and last dorsal spines become shorter. Oblique dark lines become progressively broken and disappear, starting posteriorly (see below).

COLOUR. In life: Body silvery pale brown with dark brown oblique bars across head and continued more or less onto body where they branch and become broken into dots and dashes. Lines most developed in smallest specimen (415 mm TL) and arrangement as follows: (i) one rather broad line following maxillary recess, continuing onto preopercle; (ii) second starting at lowest part of orbit and crossing preopercle margin just above concavity to continue onto operculum; (iii) third from posterior edge of orbit, across operculum at level of lowest opercular spine onto body just above pectoral fin, behind which it branches dichotomously into two dashed lines that curve gently up across the body to end posteriorly on caudal peduncle; (iv) fourth from upper posterior margin of orbit across operculum just above opercular extremity and on to body, where it dichotomises below fourth dorsal spine to give dashed lines that curve up and end below posterior rays of dorsal fin. Lines disappear from body in fishes greater than 450 mm TL and largest fish only showed four oblique bars on head. Distal part of web of spiny dorsal fin bright gold: soft dorsal white-edged with inner band of yellow. In fishes smaller than 450 mm TL caudal is white-edged; in fishes smaller than 415 mm TL margins of the soft dorsal, caudal and anal are conspicuously pale blue, translucent.

Colour in formalin: Fishes become drab, oblique lines less distinct, pale blue margins of fins of small fishes are lost.

BIOLOGY. From cruises 61 to 167, 19 specimens taken by handline at bottom in 95-130 m where it seemed quite common. Probably not present in surface water layer (the East African Coastal Current) (Morgans, 1962).

10% identified as males and 53% as females. Maturity seems at 415 mm TL. Too little information to deduce spawning seasons but November-December seems likely.

78% everted stomach on capture, only one contained food viz. 1 tiny fish (*Bregmaceros maclellandi*) and crustacean remains. 44% had parasites of gonads (including *Porrocaecum* sp. larvae and *Philometra* sp. — Nematoda) and 56% had parasites in gut mesenteries (anisakine larvae — Nematoda, larvae of *Callotetrarhynchus gracilis* and other tetrarhynchs — Cestoda, and *Rhadinorhynchus* sp. — Acanthocephala).

DISTRIBUTION. Local: only the North Kenya Banks. Elsewhere: Pondoland, Natal, Muscat, Persian Gulf.

REMARKS. Our specimens match exactly the excellent colour plate of the larger fish in Smith (1949).

As Tanaka (1927: 709) comments, many species seem to have been wrongfully combined with *E. morrhua*. The arrangement of the curved lines and dots appears to be specific at given sizes.

Epinephelus cometae Tanaka, 1927
(Plate 3)

(*Partim*) *Epinephelus morrhua*: Jordan & Richardson, 1910: 454, fig. 11.
Epinephelus cometae Tanaka, 1927: 704, pl.159, fig. 445 and pl.160, fig. 447.

SPECIMEN STUDIED. S 94; 560 mm TL; 462 mm SL; mass 3.6 kg.

DESCRIPTION. D XI,15; A III,8; Pect. i,16; GR 5,3/1/8, c.8; Sc. c.125 $\frac{14\text{-}15.}{41}$. Dentition $\frac{c.7,4}{c.7,2}$ canines $\frac{1\text{-}3}{1}$ pal. 4. See Table 8 for measurements.

Caudal slightly rounded or truncate. Body scales strongly ctenoid except in extreme antero-dorsal region, everywhere conspicuously projecting beyond skin, virtually no auxilliary scales. Skin of maxilla with few or no scales. Uppermost opercular spine rudimentary, central equidistant, it and lowest projecting, acute. Opercular angle acute, upper margin of operculum straight or slightly concave. Upper part of preopercle margin covered by skin, lower part naked, finely serrate, angle not produced and usual concavity in profile absent. Gill rakers short, not very thick, with longish spines on anterior edge. Interorbital slightly convex. Nostrils extremely close together, front roughly circular with largish flap on posterior margin, hind much larger, obliquely ovoid, without flap. Teeth at side of lower jaw in two series for only a small proportion of jaw length; outer row of teeth of upper jaw largish, teeth of inner rows at side tiny; upper canines quite large. Antero-ventral margin of maxilla with a steep step where maxilla expands distally; maxilla extends almost to hind margin of eye.

COLOUR. In life: Noted during cruise as "golden brown with darker brown markings" by Dr Wheeler.

Colour in formalin: Drab brown with darker brown bands and dots as follows: (i) one, broad and diffuse, from maxillary recess to preopercle angle; (ii) second, from lower posterior rim of orbit across middle preopercle edge to opercle, this starts narrow and progressively broadens; (iii) third, from hind margin of orbit, broad and diffuse, crosses opercle edge below opercular extremity onto body, where it runs approximately longitudinally, then dichotomises so that two broad branches curve upwards to end below front and hind dorsal fin rays respectively; (iv) fourth, very broad and diffuse, from hind margin of orbit curves upwards across nape in front of dorsal fin; (v) below and posterior to band (iii) there is a broken, broad fifth band parallel to it; (vi) between bands (iii) and (iv) is a broad sixth band running from above opercular extremity to disappear below middle of spinous dorsal fin. Between bands are many round spots, but underparts of fish unspotted. Dr Wheeler made a sketch of this fish on deck showing a vertical bar on the side of the caudal peduncle.

BIOLOGY. From 117-125 m by handline. Rare. Male, mature unripe. Stomach everted.

DISTRIBUTION. Local: deep water north of Zanzibar Island. Elsewhere: Japan.

REMARKS. Our specimen shows banding that exactly matches Tanaka's fig. 445 but shows, in addition, many spots between the bands. Differs from our *E. praeopercularis* in following respects: (a) it shows very conspicuous bands and dots on the body (*E. praeopercularis* of this size shows none); (b) bands are broad; (c) pair of bands that run down and forward from below soft dorsal fin converge and cross operculum well below opercular angle (above, in *E. praeopercularis*); (d) caudal peduncle is deeper and shorter; (e) nostrils much larger; (f) pelvic fin is longer.

Possibly *E. heniochus* Fowler, 1904, from Sumatra is identical. The fish of Jordan and Richardson is *E. cometae*, (as stated by Tanaka) and so their synonymy is inapplicable: their figure, too, shows no spots between bands.

Mr V.T. Hinds, Fisheries Officer, Aden, sent a very clear photograph of a different species, probably *E. morrhua* (Valenciennes, 1833) which I have not seen in east African waters. His fish differs from *E. cometae* in (i) the oblique bands being broader, and "hollow", i.e. like curved railway lines, lacking heavy pigmentation between the "rails": (ii) second band curves from behind opercle to juncture of spinous and rayed dorsal fins: (iii) third band, dropping from rayed dorsal, bifurcates, with a short arm ceasing near anal fin, and a longer arm curving forwards to the belly: (iv) fourth band crosses caudal peduncle rather obliquely.

Epinephelus undulosus (Quoy & Gaimard, 1824)
(Plate 4)

(*Non*) *Serranus undulosus*: Günther, 1859: 143. Kner, 1865-67: 24.
Serranus undulosus: Fowler & Bean, 1930: 242, *ETC.*.
Epinephelus undulosus: Weber & de Beaufort, 1931: 36, *ETC.*. Munro, 1955: 112, pl.19 (after Bleeker).

SPECIMENS STUDIED. S 37, S 47/1, S 47/2, S 68, S 107 and Field. Sizes: 411-715 mm TL; 346-590 mm SL; mass 1.4-5.4 kg.

DESCRIPTION. D XI,18-19; A III,8; Pect. i, 17-18; GR 0,12-14/1/21-22, 0-1, totals 34-38; Sc. c. 148-155 $\frac{17\text{-}22}{39\text{-}45}$ Dentition $\left|\frac{5\text{-}10,3\text{-}6}{5\text{-}7,\ \ 2}\right.$ canines $\frac{1\text{-}2}{1\text{-}2}$ pal. 2-6. See Table 8 for measurements.

Dorsal fin moderately elevated, third spine longest and sometimes second and fourth equal it. Caudal truncate or emarginate. Body scales markedly ctenoid except for small area antero-dorsally: auxiliary scales mostly absent. Skin notably non-mucilaginous. Operculum with a well marked projecting spine that usually somewhat angled obliquely downwards; below this is a small spine that usually projects slightly, and above it rudiments of a third spine; central spine slightly nearer lowest. Posterior angle of opercle acute: upper margin straight, or very slightly concave, neatly inserted to head without as prominent a fold as usual for *Epinephelus*. Preopercle margin naked, rather sinuate, finely serrate with few enlarged serrae at angle. Gill rakers notably well developed for *Epinephelus*, long, slender and finely spiny on inner faces terminally: virtually no rudiments. Interorbital very convex. Nostrils close together, small: front circular, with low flap; hind usually larger, ovoid, without proper flap but sometimes with skinny fringe. Most teeth very fine, canines and teeth of outer row of upper jaw comparatively larger but still small. A 411-mm TL specimen (S 107) has a marked forwardly-directed knob, or projection hidden beneath lip, on antero-ventral edge of maxilla, where profile curves to form distal maxillary expansion. In larger fishes this process more strongly developed and appears as a blunt spine (Plate 4).

Three small specimens of *E. undulosus* from Wadge Bank, off southern India, kindly sent by Mr S. Sivalingam of the Department of Fisheries, Ceylon: 262-308m TL, 216-254 mm SL; preserved mass 227-382 gm; D XI, 18; A III, 8; Pect. i, 18; GR 3-4. 9-11/1/18-19, 1-2 totals 34-36. Scales (many missing from longitudinal series $\frac{15\text{-}17}{37\text{-}40}$. Dentition $\left|\frac{4\text{-}6,3}{3\text{-}5,2}\right.$ canines $\left|\frac{0\text{-}2}{0\text{-}2}\right.$ pal. 2-3. See Table 8 for measurements.

Size range: Largest seen by us is 73 cm TL, 62 cm SL; 6.4 kg.

CHANGES WITH GROWTH. Our specimens show no definite proportional changes; only definite change seems to be increase in number of all dental series except for those at side of mandible. Canines do not disappear.

If the small Indian specimens are considered together with ours then the increase of most dental counts with growth is accentuated, especially those at front of jaws. Also apparent (Table 8) that most proportional measurements change a little, the most conspicuous being ratio of eye to interorbital. Other changes are: prolongation of sharp step in profile of the antero-ventral edge of maxilla into a prominent spiniform process; development of the few gill raker rudiments into rakers; change in profile of upper posterior margin of opercle from concave to straight; progressive emargination of caudal from truncate.

COLOUR. In life: Rosy grey or purplish grey, darkest dorsally and posteriorly, palest ventrally. No trace of cross-bars or dark blotches. All have golden brown speckles on top and sides of head and on antero-dorsal parts of body: speckles smallest dorsally and posteriorly (diameter about 1 mm, often rather oblong) and largest on cheek and upper lip (diam. about 2.5 mm, circular). Fishes of less than 55 cm TL have speckle pattern continued much further onto body, and elaborated so that they become united postero-dorsally on head, and antero-dorsally on body, into a series of parallel, narrow, broken lines that run obliquely upwards at a small angle to axis of fish; the lines branch irregularly. Eye pale gold. Underside of head pinky-white. No moustache streak in maxillary groove. Fins coloured basically as body but spiny dorsal may be yellowish and paired and anal fins milky: sometimes fins are dusky marginally but no clearly defined dark, or white, marginal bands.

The Indian specimens are bleached but Mr Sivaligam writes as follows: "The description of the colour of dots of your specimens agrees with ours. Specimens

from trawler catches — preserved in ice at about 32°F have a slight greenish tinge added on to the golden brown dots. The younger specimens have small dots and dashes of the same colour arranged in oblique lines on the anterior upper half of the body. As they grow older the lines seem to break up into dots and they gradually disappear starting from the posterior ventral aspect. But the dots on the head do not seem to disappear up to about 500 mm. I did not get a chance to examine in detail any specimen less than 250 mm or more than 500 mm."

Colour in formalin: Changes to pale drab, speckles remain distinct.

BIOLOGY. From cruise 61 to 167 all 111 specimens taken by handlining at sea bed. One of the common species of the North Kenya Banks at 24-90 m, known nowhere else along coast of Tanzania.

64% female, 22% male, remaining 14% unsexable by superficial examination. Only three males contained sperm, impossible to deduce size of maturity. Females probably mature at 55 cm TL; 46 cm SL; mass 2.2 kg. Only ripe-running female was in August, when ripe and nearly-ripe fishes also obtained. Two November cruises each caught many nearly-ripe and ripening fishes. One infers a major breeding season in early December with another in August although more data required (The biology of the fishes of the North Kenya Banks is discussed in Morgans, 1964).

Reasonable catches did not always correlate with approaching sexual ripeness.

Over half had everted stomachs and a large proportion of the remainder had undoubtedly vomited without eversion (food found in mouth and gills). Commonest foodstuff was a variety of small fishes (including *Anthias taeniatus*, *Parapriacanthus guentheri*, *Dipterygonotus leucogrammicus, Engraulis japonicus, Synodus* spp., *Bathysauropsis* sp. and an eel). Smallish crustacea were also common, particularly stomatopods (*Odontodactylus syllarus, O. hanseni, Squilla gonypetes* and *Pseudosquilla ciliata,* in that order of abundance) and prawns (viz. *Rhynchocinetes cf. durbanensis, Metapenaeopsis quinquedentatus* and *M.? dalei*). On certain cruises many fishes of the North Kenya Banks were eating thaliaceans, this species was among them in taking *Thalia democratica* and ? *Pyrosoma* sp.: one record of a pteropod, *Cavolinia tridentata var. platea.*

One fish showed clear evidence, on basis of degree of digestion, of having taken three separate meals. The first consisted of 8 *Parapriacanthus guentheri,* the second of 2 *Engraulis japonicus* and the third of *P. guentheri* and 2 *Dipterygonotus leucogrammicus.*

No fish contained body fat in notable quantity. 4.5% had parasitised gonads (including anisakine larvae — Nematoda); 7% had parasites in gut mesenteries (including anisakine larvae, larvae of *Callotetrarhynchus gracilis* — Cestoda, and adult *Rhadinorhynchus* sp. — Acanthocephala).

DISTRIBUTION. Local: North Kenya Banks only. Elsewhere: Arabia, India, Sri Lanka, E. Indies, Philippines, China, Melanesia. A fish of the banks, not of reefs.

REMARKS. There are several discrepancies between our specimens and descriptions in literature. Since ours are larger one must assume some differences due to size, despite comments above that there is but little change. The chief discrepancies are those of caudal shape (described in Günther 1859 as "rounded") and of the colour of the dots (often described as "bluish"). However, identification seems good, as reinforced by Mr Sivaligam's comments, quoted above. Often seen in imports from Somalia.

It is interesting that we took such a limited size range. Comments were made (Morgans 1959, 1962, 1964) with regard to its fisheries value and unusual distribution locally. Rather unusual an Epinepheline in not being a reef fish; as a bank fish at the south-westerly limit of its distribution it is interesting that it lives here in the surface water layer (the East African Coastal Current) and not in the underlying Arabian Sea Water. Appears related to *E. longispinis*, if the anterior spiniform process on the maxilla is relevant. In some aspects suggests affinity to *Parascorpis typus* Bleeker, and its non-slimy character is unusual for *Epinephelus.* Very good to eat. Known at Lamu (N. Kenya) as "Seyu", a name applied at Malindi to *E. tauvina.*

Epinephelus longispinis (Kner, 1865)
(Plate 4)

Serranus longispinis Kner, 1865-7: 27, pl.2, fig. 2. Playfair & Günther, 1866: 10.
(*Partim*) *Epinephelus maculatus*: Boulenger, 1895: 211. Weber & de Beaufort, 1931: 47.
(*Partim*) *Epinephelus fario*: Tanaka, 1927: 726 (*non* pl.162, fig. 451). Fowler & Bean, 1930: 249.
(?*Partim*) *Epinephelus fario*: Smith, 1949: 197, pl.19, fig. 444.

SPECIMENS STUDIED. S 25, S 67, S 79, S 98, S 114, S 131, S 161 and Field. *Sizes*: 130-540 mm TL, 103-450 mm SL; mass 57 gm — 2.2 kg; EAMFRO records: to 545 mm TL, 460 mm SL, and 2.7 kg.

DESCRIPTION. D XI,17; A III,8; Pect. i,17; GR 4-5, 4/1/10-11, 4-5, totals 23-25; Sc. 110-116 $\frac{11\text{-}14.}{33\text{-}39}$ Dentition $\left|\frac{5\text{-}10,3\text{-}6}{3\text{-}5,\ \ 2}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}2}\right.$ pal. 3-7. See Table 9 for measurements.

Dorsal fin well elevated. Caudal rounded-truncate. Body scales strongly ctenoid; in juveniles very clearly to be seen everywhere except just behind opercle and around belly, where they tend to be buried. When fishes exceed 40 cm TL scales tend to be more obscured by skin so that counts are difficult. Only two opercular spines, both projecting, usually acute, upper more posterior in position (highest of usual three spines found in *Epinephelus* is absent). Extremity of operculum acute, upper margin straight or slightly concave.

Gill-rakers comparatively long, well segregated from rudiments, very uniform in count. Interorbital narrow, slightly convex or flat. Front nostril slightly smaller than hind. Canines small. Each patch of palatine teeth club shaped, many more series posteriorly than anteriorly. In small fishes, antero-ventral edge of maxilla curves smoothly to give distal expansion; in fishes over 40 cm TL the smooth curve becomes an abrupt step, bearing a protruding knob or blunt spiny process, hidden by the fold of lip (Plate 4).

CHANGES WITH GROWTH. Number of series of teeth around mouth increases except at side of mandible. Palatine teeth series increase. Third dorsal spine, while remaining characteristically long, becomes

relatively shorter with age as do longest pectoral and pelvic fin rays. Anterior edge of maxilla produces a knobbed process (see above).

COLOUR. In life: Yellow-brown (turning to purplish-brown on prolonged exposure to light) with rich red-brown spots of unique shape and arrangement. On head and anterior part of body they are rounded, but half way along flank they progressively become obliquely oval, and in region of caudal peduncle they become crescentic: anteriorly spots widely separated, roughly arranged in obliquely transverse rows, but spots become progressively closer to one another in posterior regions of body; anteriorly they are clearly marked, progressively becoming indistinct posteriorly. Throat, breast and belly may or may not possess diffuse spots. Rarely any indication of crossbars, never dark dorsal blotches. Almost invariably a narrow black moustache at edge of maxillary groove. Pectoral and pelvic fins always notably spotted, other fins usually lack spots except for spots occasionally situated distally on soft dorsal, or in upper posterior corner of caudal fin. Fins usually darker brown than body. Dorsal fin membrane bright golden yellow at spine tips ("yellow flags"); margin of soft dorsal, and upper part of caudal often tinted bright orange or yellow: pectorals often yellowish.

Colour in formalin. Such yellow tints as may have been present disappear: fish becomes dark brown, with darker brown spots and moustache.

BIOLOGY. From cruises 61 to 167, 27 specimens taken by bottom fishing, one obtained by trolling a small lure and four from market. Far from rare, may be taken from shallows to 63 m and has been taken within the main thermocline beneath the East African Coastal Current. 56% female, 6% male, others indeterminate. Ripening gonads in August to November and a spent female in April, numbers too small to allow deductions on spawning season.

Although 33% everted the stomach on capture, over half of the rest had food in stomach. Considerable variety: crustacea commonest, especially crabs (including *Medaeus granulosus* and *Grapsus longitarsus*) and stomatopods (*Odontodactylus southwelli* and *O. scyllarus*). The following occurred once each: small fishes, small squid, piece of hard polzoon, pelecypod flesh (with byssus). Fishes with much fat noted in April 1958. Parasites uncommon but present in three fishes (anisakine and tetrarhynch larvae and encysted larvae of *Otobothrium* sp.).

DISTRIBUTION. Local: Mafia, Zanzibar, Pemba, off Shimoni and off Lamu. Elsewhere: Madras.

REMARKS. Seemingly unique in character of spotting and for this reason alone should never be confused with another. Kner's figure is extremely good except that it seems to minimise the progressive crowding together of spots in region of caudal peduncle. (In my Plate 4 progressive crowding of spots can be seen although in the fish photographed spots indistinct on caudal peduncle). Other diagnostic features: rounded-truncate tail, very high 3rd and 4th dorsal spines, possession of only 2 opercular spines, straight or slightly concave upper margin of opercle.

Kner's description, together with his figure, unmistakable yet Boulenger (1895) makes *longispinis* a junior synonym of *maculatus* Bloch (= *fario* Thunberg) with spotting of a different type. Playfair's record of *longispinis* at Zanzibar is eminently reasonable and it is peculiar that authors split it into *maculatus — fario* and *bleekeri — coromandelicus*. *E. longispinis* may be a synonym of *gaimardi* Bleeker.

The spiniform process on the anterior edge of the maxilla (Plate 4) has not been described before and may indicate affinity with *E. undulosus*.

Specimen S 100 sent to the U.S. National Museum of Natural History.

Note on *Epinephelus fario* (Thunberg, 1893)

Epinephelus fario, including *E. maculatus* (Bloch), recorded from east African coast north of Pondoland by Smith (1949), from Aldabras by Smith (1955), from Mauritius by Baissac (1953), etc., and one would suppose it to have been found during six years work based on Zanzibar. However, no fish was seen resembling that figured in colour by Smith (1949), nor like the clear drawings of Jordan & Richardson (1910) and Tanaka (1927), nor like the drawing in Day (1878-88). (These drawings differ so that they could represent different species).

Literature on the *fario* complex is confusing beyond words; many descriptions are inadequate so that recourse must be made to examination of type-specimens. Another example of the danger of inadequate descriptions coupled with the inclination of many authors to form catch-all species.

Epinephelus areolatus (Forsskål, 1775)

(Plate 5)

(*Non*) *Serranus areolatus*: Klunzinger, 1870: 7 (675). Day, 1878-88: 12, pl.1, fig. 4.
(*Non*) *Epinephelus areolatus*: Sauvage, 1891: 74. Smith, 1949: 197, pl.18, fig. 446. Fourmanoir, 1954: 215. Baissac, 1956a: 361. Fourmanoir, 1957: 154: fig. 109.
Serranus areolatus: Fowler & Bean, 1930: 246, fig. 12 *ETC.*. Fowler, 1934: 457.
Epinephelus areolatus: Weber & de Beaufort, 1931: 37, fig. 5, *ETC.*. Blegvad, 1944: 82. Hatchell, 1954: 21, fig. on p.23. Munro 1955: 113. pl.19, fig. 304 (after Day).
(? *non*) *Serranus areolatus*: Copley, 1952: 81.
(? *non*) *Epinephelus areolatus*: Baissac, 1953: 218. Smith, 1955: 310.

SPECIMENS STUDIED. S 84, S 92. Sizes: 130-255 mm TL; 105-210 mm SL; mass 28-227 gm.

DESCRIPTION D. XI,15-16; A III,8; Pect. i, 17-18; GR 3-4, 4-5/1/13,2, totals 23-24; Sc. 121-134 $\frac{15\text{-}19.}{39\text{-}46}$ Dentition $\left|\frac{7\text{-}8,4}{5\text{-}6,2}\right.$ pal. 2-3. Measurements in Table 8.

Dorsal fin of moderate height, not deeply notched, third spine longest, about as long as longest dorsal ray. Caudal slightly rounded. Scales strongly ctenoid on body, cycloid on nape and head; exposed skin of maxilla completely scaly. Uppermost opercular spine rudimentary, central spines equidistant or slightly nearer lower; central and lower projecting, acute. Angle between upper and lower margins of operculum rather less than a right angle; upper margin sinuate. Preopercle margin serrate with enlarged and projecting serrae at angle. Interorbital convex (flat in juvenile). Front nostril circular, with large flap on posterior margin; rear nostril similar size, circular or ovoid, without flap. Antero-ventral edge of maxilla

curves smoothly to distal expansion; maxilla reaches to or beyond centre of eye.

CHANGES WITH GROWTH. Of our two specimens, the larger consistently had shorter fin spines and rays.

COLOUR. *Post mortem:* Greyish with brown dots all over head, body and fins except for narrow strip beneath jaw, breast and belly; dots not sharply circumscribed, about 1-2 mm diameter; on body spaced as far apart as their diameters, closer together on head but do not form an hexagonal reticulation anywhere. Margins of soft dorsal and caudal fins white; margin of anal dusky. Distal three-quarters of pectoral fins unspotted, translucent, almost colourless. Edge of maxillary groove with dark moustache streak. Eye dull gold overlaid with red-brown.

BIOLOGY. Smaller fish taken by handline in a few metres at Nyange Reef, off Zanzibar: larger from Zanzibar market. Neither possessed well developed gonads. Stomach of the larger was empty, that of the smaller everted with fish bones in the mouth.

DISTRIBUTION. Local: Zanzibar. Elsewhere: seemingly widespread in Indo-Pacific region.

REMARKS. Rare. No illustration matches our specimens closely. Correct identification is doubtful for the complexities of the *E. areolatus* synonymy are beyond my resources. Blegvad's comments are interesting. Klausewitz and Nielsen (1956) comment on Forsskål's *"Perca tauvina* (?)" (No. 23) that it is "probably the type of *P. areolatus*" although there is apparent confusion of the specimen and its labelling. Their plate 10 is close to, or identical with, what I regard as *E. chlorostigma* (see below).

Epinephelus chewa Morgans, 1965

Epinephelus chewa Morgans 1965: 267-270, pl.9D.

DESCRIPTION. D XI,15; A III,8; Pect. i,18 (-19); GR 6-8, 1-2/1/7-9, 8-11, totals 26-28; Sc. 98-109 $\frac{11\text{-}13.}{30\text{-}32}$ Dentition $\left|\frac{6\text{-}10,6\text{-}9}{6\text{-}10,3\text{-}4}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}2}\right.$ pal. 4-8. Head (including chin) 44.6 — 46.6% SL, postorbital head 27.9-29.2% SL.

REMARKS. No further information on this rare species, one of the *E. tauvina* complex. Characterised by having cycloid scales, 3-4 series of teeth at side of mandible, maxilla extending well beyond posterior margin of eye, preopercle angle covered by skin: evenly spotted all over the head and body with well marked spots of rich red-brown colour which in anal, caudal and soft dorsal fins aggregate in a quasi-hexagonal reticulation, these fins being narrowly white-edged: faint cross-bars of the *E. tauvinia* pattern are present.

Epinephelus malabaricus (Bloch & Schneider, 1801)

Serranus malabaricus: Fowler & Bean, 1930: 289, fig. 23 (juv.).
Epinephelus malabaricus: Morgans, 1965: 264-7, pl.9A, B, C.

DESCRIPTION. D XI,15 (-16); A III,8; Pect. i, (18-) 19; GR 5-7, 2 (-3)/1/7-10, 4-7, totals (22-) 23-25; Sc. 97-120 $\frac{11\text{-}14.}{32\text{-}34}$ Dentition: juveniles $\left|\frac{5\text{-}6,2\text{-}4}{4\text{-}5,\ 2}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}2}\right.$ pal. 2-5; adults $\left|\frac{5\text{-}8,3\text{-}6}{4\text{-}7,\ 2}\right.$ canines $\left|\frac{0\text{-}2}{1\text{-}2}\right.$ pal. 4-5.

REMARKS. No further information on this member of the *E. tauvina* complex. Characteristics shared with *E. tauvina*: scales ctenoid, 2 series of teeth at side of mandible, maxilla extending to posterior margin of eye, angle of preopercle naked, caudal fin not white-edged. Distinguished from *E. tauvina* by having orange coloured spots with diffuse margins, approximately 3-6 mm diameter, spaced apart at distances less than their diameters (sometimes confluent on cheeks): eye brownish.

Epinephelus tauvina (Forsskål, 1775)

Serranus tauvina: Fowler & Bean, 1930: 287.
Epinephelus tauvina: Morgans, 1965: 258-264, pl.7 and 8.

DESCRIPTION. D XI,(14-) 15; A III,8; Pect. i, (17-) 18-19; GR: juveniles 7-8,2 (-3)/1/8-9, 5-7 totals (24-) 25-27; adults 5-8, 1-9/1/6-9, 1-7 totals (19-) 25-27; Sc. 104-114 $\frac{13\text{-}15.}{32\text{-}35}$ Dentition: juveniles $\left|\frac{5\text{-}6,3\text{-}4}{4\text{-}5,\ 2}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}2}\right.$ pal. (3-) 4 (-5); largest adults $\left|\frac{6\text{-}22,3\text{-}17}{5\text{-}18,2\text{-}9}\right.$ canines $\left|\frac{0\text{-}1}{0\text{-}1}\right.$ pal. 4-13.

REMARKS. No further information. Spots are 1.5-4 mm diam., dark brown (blackish), sharply defined, spaced wider than their diameter. In sizeable fishes the eye is a vivid gold.

Forsskål's *Perca tauvina* is pictured by Klausewitz & Nielsen (1965) and is of similar size to *E. tauvina* S 59 in Morgans (1965) pl.7A with which there is reasonable correspondence. Randall (1964) comments on the holotype. Not specimen 23, *"Perca tauvina* (?)" in Klausewitz & Nielsen (see my comments above under *E. areolatus*).

Epinephelus tukula Morgans, 1958

Epinephelus tukula Morgans, 1958: 651-4, pl.17 and 19.

SPECIMENS STUDIED. (subsequent to original description). Seven fishes from cruises 154-168, 860-1390 mm TL; 735-1205 mm SL; mass 10.9-c.47 kg.

DESCRIPTION. D XI, (13-) 15; A III, 8 (-9); Pect. i, 19; GR 4-8 (-11), 1-2 (-3)/1/5-8, (5-) 7-10 (-11) totals (23-) 24-26 (-30); Sc. (117-) 121-135 $\frac{14\text{-}15}{35\text{-}36\ \text{(many buried)}}$ Dentition $\left|\frac{9\text{-}14(\text{-}16),(3\text{-})7\text{-}14}{8\text{-}14,\ \ 3\text{-}6}\right.$ canines $\left|\frac{0(\text{-}3)}{0)\text{-}3)}\right.$ pal. 4-10.

With age, this species seems to gain more teeth series especially palatine.

The additional specimens more than double the number of fishes for which measurements are available. Table 7 presents the revised data in a manner comparable to Table 1 of Morgans (1958) and it is perhaps surprising that no less than eight measurements are still of diagnostic value for *E. tukula* in comparison to the species of that paper. It is astonishing that so variable a feature as the proportion of the eye to interoribtal could be of diagnostic help: in fact a graph of this ratio relative to SL shows that, for fishes of 58-76 cm SL, *E. fuscoguttatus* has a ratio some 25% greater than *E. tukula* at any given SL. Counts of dorsal fin spines and rays, of pectoral fin

rays, and of gill rakers are summarised in Table 10.

BIOLOGY. One of the new specimens was found to be a ripe female (955 mm SL), with many large, transparent ova, in July, so reinforcing an earlier record of a ripe female in July.

Identified parasites of the gut mesenteries include: *Poecilancistrum* sp. larvae and tetrarhynch cysts (Cestoda) and Ascarid larvae (Nematoda). A nematode *Contracaecum cornutum*, occurred in one stomach.

REMARKS. The new specimens came from Latham Island. In addition, two tiny fishes S 143 (120 mm SL) and S 150 (175 mm SL) are thought possibly to be juveniles of this species: they were collected from low tide pools, amongst coral rocks, on Zanzibar Island at Mazizini Beach and Mbweni Point.

Grey or slate coloured, with a pattern of black blotches, of regular outline, on body: hexagonal reticulation on the fins (and about the mouth in smaller fishes). No small spots on body. Giant fishes become uniform slate-purple or black.

Morgans (1958) differentiated *E. tukula* from *E. microdon* and *E. fuscoguttatus*, species of the "hexagonal reticulation" complex, chiefly because of Playfair's descriptions of varieties of "*E. dispar*" (Playfair & Günther, 1866). Yet, morphologically *E. tukula* cannot be distinguished unequivocally, except by colouration, from *E. tauvina* and *E. malabaricus*, fishes of the *E. tauvina* complex. (Possibly the postorbital head is relatively somewhat shorter in *E. tukula*).

Lateral line very poorly differentiated on wet fish, more visible on a superficially dry fish, or one left standing until the mucilage develops and jellifies. Tubules of lateral line scales neither raised nor prominent, some branched (bifurcated) tubules may be found. Body scales strongly ctenoid, with many auxiliary scales.

Undoubtedly giant fishes have been confused with *E. tauvina* and *Promicrops lanceolatus*.

One specimen, sent to U.S. National Museum of Natural History.

Epinephelus fuscoguttatus (Forsskål, 1775)

Epinephelus fuscoguttatus: Morgans, 1958: 644-7, pl.17. Randall, 1964: 289-294, figs. 10, 11. Postel, 1967, colour plate.

DESCRIPTION. D (X-) XI, 14 (-15); A III, (7-) 8; Pect. i, 18 (-19) (seven fishes); GR 5-9, (1-) 2/1/8-10, (5-) 9-10 totals 24-27 (-28); Sc. 120-130 $\frac{13\text{-}15(\text{-}16)}{35 \text{ (many buried)}}$. Dentition $\left|\frac{5\text{-}9,2\text{-}7}{4\text{-}7,2\text{-}3}\right.$ pal. 2-4.

Counts of dorsal and pectoral fin rays, and gill rakers are summarised in Table 10.

REMARKS. The few specimens taken since Morgans (1958) yielded no significant further information.

Characteristically with a concavity in the profile just behind interobital, and with a great depth of head/body in front of dorsal fin: reddish brown markings on creamy background, head and soft fins strongly reticulated, body spotted and with irregularly shaped blotches of which those dorsally are notably darker (especially above caudal peduncle).

Randall (1964) discusses the species in considerable detail and establishes a neotype shown in his plate (fig. 10) in which the "L" shaped dark blotch just below the front of the soft dorsal fin (*vide* Morgans, 1958: 646) is clearly evident: this blotch was found to be almost invariably present in our specimens. The same blotch shows in his plate (fig. 11) of the holotype of *Serranus lutra* C. & V., which he holds to be a junior synonym: it is also shown in Postel's superb colour plate. Randall's gill raker count (p. 290) 17-20 on the lower limb of the first arch may be compared to the count of (15-) 16-17 (-18) in my Table 10.

With no poisonous reputation locally although reputedly strongly toxic in parts of the Pacific (Fish & Cobb, 1954: 13).

Specimens S 17, S 54/3 and S 125/4 sent to U.S. National Museum of Natural History.

Epinephelus microdon (Bleeker, 1856)

Epinephelus dispar s.s.: Morgans, 1958: 647-651, pl.17, 18. Postel, 1967, colour plate.
Epinephelus microdon: Randall, 1964: 290-1, figs. 8 and 9.

DESCRIPTION. D XI, 14-15; A III, (7-) 8; Pect. i, (15-) 16; GR 3-6, 2-3/1/8-9, 4-6 totals (19-) 22-24 (-25); Sc. 96-113 $\frac{12\text{-}14}{\text{c.33-35 (many buried)}}$

Dentition $\left|\frac{5\text{-}8,3\text{-}5}{4\text{-}6,2\text{-}3}\right.$ pal. 2-4. Counts of dorsal and pectoral fin rays and gill rakers plus rudiments summarised in Table 10.

REMARKS. The few specimens taken since Morgans (1958) yielded no significant further information.

Clearly marked with a dull brown, or bronzy brown, fine hexagonal reticulation over head, body and fins, with superimposed dark blotches of rather regular outline; dark "moustaches" in the maxillary groove and, which is unusual, in the premaxillary groove.

I feel I must follow Randall (1964) because east African fishes so closely resemble the fish from Phoenix Islands pictured by him and attributed to *E. microdon*. However, the pattern of blotches on the far eastern specimen is unknown to me, so distant to the west, where the blotches are characterised as "each of regular outline like dirty finger prints" (Morgans, 1958, p.656). Randall's gill raker count (p. 291) of 15-16 on lower limb of first arch may be compared to the count of (13-) 14-15 in my Table 10. Postel's colour plate is superb.

No local reputation for being poisonous although reputedly strongly toxic in parts of the Pacific (Fish & Cobb, 1954: 13).

Specimen S 38 sent to the U.S. National Museum of Natural History.

Epinephelus chlorostigma (Valenciennes, 1828)
(Plate 5)

Epinephelus chlorostigma: Tanaka, 1927: 737, pl. 163, fig. 453. Weber & de Beaufort, 1931: 39, *ETC.*. Blegvad, 1944: 83. Smith, 1949: 197. Baissac, 1953: 222. Munro, 1955: 113, pl.19, fig. 305 (after Chevey). Okada, 1955: 198, fig. 182 (after Jordan, Tanaka & Snyder). Baissac, 1956a: 361.
Serranus chlorostigma: Fowler & Bean, 1931: 252, *ETC.*. Fowler, 1934: 458.
(*Partim*) *Epinephelus areolatus*: Smith, 1949: 197, pl.18, fig.446.

(?) *Serranus areolatus*: Copley, 1952: 81.
Epinephelus areolatus: Fourmanoir, 1957: 154, fig. 109.

SPECIMENS STUDIED. S 48/2, S 53, S 91, S 115, S 116 and Field. Sizes: 141-590 mm TL, 114-500 mm SL; mass 35 gm — 2.2 kg. EAMFRO records: to 63 cm TL, 53 cm SL, and 2.7 kg.

DESCRIPTION. D XI,16-18; A III,8; Pect. i,17; GR 4-5, 4-5/1/11-14, 2-4 totals 23-27; Sc. 107-139 $\frac{15\text{-}17}{35\text{-}48}$. Dentition $\frac{5\text{-}9,3\text{-}6}{4\text{-}7,\ 2}$ canines $\frac{1\text{-}2}{1\text{-}2}$ pal. 2-6. Measurements in Table 8.

A very laterally compressed rock cod. Dorsal fin moderately elevated, not deeply notched, third or fourth dorsal spines longest, equal to longest dorsal rays. Caudal slightly rounded in fishes smaller than 165 mm TL. becoming truncate or slightly emarginate in larger fishes (note, colour pattern exaggerates the impression that caudal fin emarginate). Body scales ctenoid except antero-dorsally; exposed skin of maxilla almost all covered with minute cycloid scales. Highest opercular spine rudimentary, most anterior; central spine virtually equidistant or slightly nearer lowest; central and lowest projecting, acute. Margins of operculum make less than a right angle; upper margin straight or slightly concave. Preopercle margin usually entirely naked, serrate, angle produced by several very enlarged serrae, no real concavity in profile if angle be regarded as so produced. Gill rakers fairly long and slender, whole of anterior face of each with fine spines. Interorbital convex (slightly in juveniles). Nostrils close, circular, hinder only fractionally larger; front with a large flap on posterior margin. Outer teeth at sides of lower jaw tiny; teeth of outer row of upper jaw of moderate size, teeth of inner rows tiny. Canines small. Antero-ventral edge of maxilla slopes smoothly to distal expansion; maxilla reaches to or beyond centre of eye.

CHANGES WITH GROWTH. Seemingly gill raker, scale and dental counts (with conspicuous exception of number of series at side of lower jaw) increase slightly. Slightly rounded tail of juvenile smaller than 165 mm TL becomes truncate, or slightly emarginate, in larger fishes. Eye, and nearly all fin spines and rays, become proportionally smaller with growth as does size of eye relative to head-less-chin, and to interorbital.

COLOUR. In life: Bright golden-brown spots separated by a fine, white hexagonal reticulation cover all head, body and fins with exception of underparts that are plain off-white or grey (often rosy). Fins show a certain blackness of spots; median part of caudal (but not uppermost and lowermost tips) is conspicuously white-edged, sometimes with a black band proximally to white band; soft dorsal may be narrowly white-edged. (Freshly caught fishes may show bluish margins instead of white, but the blue turns to white after a while). Distal triangles of spiny dorsal fin membranes translucent, almost free of markings. Juveniles may show faint superimposed oblique cross-bars, and a moustache streak (*e.g.* S 91) along edge of maxillary groove.

During cruise 127 two varieties were hooked together on one line. One (S 116) with very yellow-brown hexagonal spots, and bright yellow or orangey rounded spots in premaxillary and maxillary recesses, on breast and under mouth (where is no reticular pattern). The other variety (S 115) with dark brown hexagonal spots, smaller and closer than in commoner variety and lacking bright yellow spots under mouth and breast.

Colour in formalin: Colour slowly fades, remaining longest on the fins owing to their greater duskiness originally. The yellow spots on underside of head in the one variety mentioned rapidly become white, whiter than the grey background surrounding them.

BIOLOGY. Between cruises 61 and 167, 74 specimens taken by handlining, one by trammel net and five from Zanzibar market. Common; juveniles being taken in the shallows and adults down to 110 m, sometimes definitely below the main thermocline beneath the East African Costal Current.

13% male, 50% female. Gonads of latter suggested maturity attained about 31 cm TL, 25 cm SL, mass 227 gm. Ripe gonads scarce (found only in February, June and August) and one cannot deduce a breeding season.

47% with everted stomachs, 79% of others empty. The few stomachs that contained anything held small fishes (including *Anthias taeniatus* and a small eel) and crustacea (including the stomatopods *Squilla* sp. and *Odontodactylus scyllarus*, and a small crab).

33% parasitised in gonads (chiefly by anisakine larvae, also *Philometra* sp. adults and *Porrocaecum* sp. larvae — Nematoda, and *Rhadinorhynchus* sp. adults — Acanthocephala). 21% had parasites in other mesenteries of body cavity (chiefly anisakine larvae but also *Porrocaecum* sp. larvae — Nematoda, and *Callotetrarhynchus gracilis* larvae — Cestoda).

DISTRIBUTION. Local: coast of Tanzania and Kenya. Elsewhere: apparently widespread Indo-Pacific.

REMARKS. Specimens were received from Aden for identification (apparently the local name there is "kulkul") and many dried specimens appear amongst fishes imported from Somaliland. Colour plate of *"E. areolatus"* in Smith (1949) is excellent. This species used to be referred to in EAMFRO records as *E. areolatus* under which species comments were made, above, on a wrongly labelled fish of Forsskål's collection.

Epinephelus dictiophorus (Bleeker, 1856)
(Plate 6)

Epinephelus dictiophorus: Boulenger, 1895: 216. Weber & de Beaufort, 1931: 50.
Serranus dictiophorus: Fowler, 1928: 178.

SPECIMENS STUDIED. S 85, S 99, S 138. Sizes: 137-425 mm TL; 111-348 mm SL; mass 35 gm — 0.6 kg.

DESCRIPTION. D XI,17 (-18); A III,8; Pect. i, 17 (-16); GR (4-) 5,3/1/9 (-10), 4-6 totals 23; Sc. 96-101 $\frac{12}{33\text{-}34}$. Dentition $\frac{6\text{-}7,3\text{-}5}{4\text{-}6,\ 2}$ canines $\frac{1}{1\text{-}2}$ pal. 3-5. Measurements in Table 9.

Dorsal fin well elevated with moderate notch; third or fourth spines longest, about as long as longest dorsal rays; rays of very similar length; dorsal fin membrane terminating in little fleshy protruberances

or "flags" just behind tips of spines. Caudal rounded. Body scales ctenoid except anterodorsally, not buried on belly; skin of maxilla naked or with patch of small cycloid scales. Three opercular spines, equidistant; highest may or may not project, central and lowest projecting, very acute. Opercular angle acute, extremity higher than top of eye; upper opercular margin straight or slightly sinuate, parallel to long axis of fish. Preopercle margin naked, finely serrate, serrae larger ventrally; usually angle is not produced and with negligible concavity above it (but one fish bears rather large serrae at angle which is produced and has above it a fair concavity). Gill-rakers and rudiments distinct, rakers thin with short spines on anterior edges. Interorbital slightly convex or rather flat. Nostrils close together, circular, front about half diameter of hind and bearing flap. Teeth biserial for most of length of madible: upper teeth tiny except for outer row; canines small. Antero-ventral edge of maxilla slopes smoothly to distal expansion; maxilla reaches to or beyond centre of eye.

CHANGES WITH GROWTH. Dental counts at front of mandible and at side of upper jaw seemingly increase. Some proportions alter: relative decrease in size of eye, interorbital becomes relatively broader, some fin spines and rays become shorter (Table 9). Some changes in coloration (see below).

COLOUR. In life: Adult: Body and upper posterior head region closely marked with yellow-brown spots separated by greyish lines; spots often indistinct and interspaces do not form a definite hexagonal reticulation everywhere. Belly and underside of caudal peduncle very indistinctly marked. Snout, cheek, lips and breast with smaller reddish-brown spots against pinkish-grey background. Edge of maxillary groove with narrow black streak. Eye silvery gold overlaid with brown. A slightly darkened, inconspicuous blotch above caudal peduncle; no cross-bars. Spiny dorsal marked much as body; other fins with large, round dark-brown spots on grey background, spots being largest and tinged with orange on soft dorsal and upper parts of caudal fin.

Smallest specimen showed no trace of hexagonal reticulation on body which bore many poorly distinguished yellow-brown spots. Four faint but definite cross-bars present and all fins markedly yellowish.

In formalin: Yellowness rapidly disappears. Body spotting slowly fades but spots on fins and moustache streak remain conspicuously black.

BIOLOGY. Largest specimen taken by bottom fishing at 90 m; others from Zanzibar market, smallest obviously caught by beach seining. Largest a ripening female (taken October), stomach empty. Both others vomited food which included: 1 juvenile *Calappa hepatica*, 1 stomatopod and a gastropod. One with parasitic isopod *Argathona cf. similis*, in nostril.

DISTRIBUTION. Local: Zanzibar, Pemba. Elsewhere: Seychelles, Celebes, ?Hawaii.

REMARKS. Very distinctive colouration. Rare.

Epinephelus hexagonatus (Bloch & Schneider, 1801)
(Plate 6)

(*Partim*) *Serranus hexagonatus*: Günther, 1859: 140, var. "A". Playfair & Günther, 1866: 10, var. "b" (? vars. c & d). Klunzinger, 1870: 15. Day, 1878-88: 14, (*non* pl.2, fig. 3 = *merra*).
(?) *Serranus hexagonatus*: Kner, 1865: 25. Pakistan, 1955: 25 & vi.
(?) *Epinephelus hexagonatus*: Sauvage, 1891: 511.
(*Partim*) *Epinephelus merra*: Boulenger, 1895: 241, var. B. Tanaka, 1927: 747, (*non* pl.164, fig. 457 = *merra*). Weber & de Beaufort, 1931: 64. Smith, 1949: 196, (*non* p.18, fig. 439 = *merra*). Copley, 1952: 88. Munro, 1955: 113 (*non* pl.19, fig. 307 = *merra*). Roux-Estève, 1956: 70.
(*Partim*) *Serranus merra*: Fowler, 1928: 181. Fowler & Bean, 1930: 268, ? *partim* fig. 16 (*non* fig. 17 = *spilotoceps*).
(?) *Epinephelus melanostigma*: Schultz, 1953: 348, fig. 54.
Epinephelus hexagonatus: Schultz, 1953: 355, pl.26 B. Fourmanoir, 1957: 155.
(*Partim*) *Epinephelus hexagonatus*: Randall, 1955: 51.

SPECIMENS STUDIED. S 83/1, S 130. Sizes: 196-200 mm TL; 160-167 mm SL; mass 113-142 gm.

DESCRIPTION. D XI,15-16; A III,8; Pect. i, 17-18; GR 3-4, 3/1/11-12, 5, totals (23-25); Sc. c.97 $\frac{9\text{-}11}{28\text{-}30}$. Dentition $\left|\frac{6\text{-}7,\ 5}{6\text{-}7,2\text{-}3}\right.$ canines $\left|\frac{1}{1}\right.$ pal. 3. Measurements in Table 11.

Scales strongly ctenoid, not easy to count. Acute angle between upper and lower margins of operculum. Opercular spines equidistant, projecting acute, highest most anterior. Canines very distinct: teeth of outer row of upper jaw enlarged. Antero-ventral edge of maxilla forms the distal expansion by a smooth steep curve, no irregular step.

Size range: Fourmanoir (1957) gives to 350 mm. Largest EAMFRO specimen of this species or *E. spilotoceps* (records are confused) is 50 cm TL, mass 0.9 kg.

COLOUR. In life: Honey-comb reticulation of red-brown spots covers entire fish except for snout, interorbital and cheeks which plain brown; pectoral fins only faintly, and not entirely, spotted. Spots on fins may be ocellate. Bright, pale triangles are conspicuous at the "knot" positions of reticulation. Four black dorsal blotches usually present, largest under last dorsal spines, two small ones under soft dorsal fin, one forming saddle on caudal peduncle. Blotches usually faint in freshly decked fishes, progressively becoming darker; show variable development (posterior ones sometimes scarcely present, as in S 83/1, see plate). Fins without duskiness or noticeable white edging except that membrane blackened at tips of dorsal spines to make small "flags". No dark "moustache".

In formalin: Colour pattern fades but remains distinctive with important difference that bright, pale triangles of reticulation "knots" disappear entirely.

BIOLOGY. EAMFRO records scanty and confused with *E. spilotoceps*. Fourteen specimens of the combined species taken by handlining in shallow water next to coral reefs, except for one specimen from a low-tide pool. Only one nearly ripe (October). Stomach contents were crabs (including *Thalamita picta*), small fishes and squid. Anisakine larvae (Nematoda) found in mesenteries of two.

DISTRIBUTION. Local: Latham I. Elsewhere: presumably most of coast of east Africa from Mozambique Channel and Comoros northwards. Eastward to Micronesia (Marshalls & Gilberts): Günther's records suggest to China and Fiji.

REMARKS. *E. hexagonatus* distinguished from *E. spilotoceps* by criteria listed under that species; both

differentiated from *E. merra* by their lesser body depth (Table 11), usual presence of black dorsal blotches and absence of an abrupt little step in the curve of antero-ventral edge of maxilla where it expands distally. Subtle differences in colouration are nevertheless valid e.g. spots on breast and belly and 1½-2 times diameter of dorsal spots; reticulation between spots antero-dorsally is much finer than in *merra*; whole pattern of body reticulation usually has less contrast and definition, to use photographic terms, compared to *merra*.

Kner's identification of *hexagonatus* is regarded as correct by Playfair who adds that it is distinguished from *gilberti* by shorter pectoral fins: this not always so in our specimens (Table 11).

Variable intensity and development of dorsal blotches weakens Schultz's (1953) separation of species of *hexagonatus* complex as Randall's (1955) remarks corroborate. Randall finds that total gill raker plus rudiment counts segregate western Pacific specimens of *E. hexagonatus* and *E. merra* but this is not true for our specimens: perhaps such counts are influenced by fish size and/or geographic distribution. Our specimens exactly match some received from Bikini (USNM. 141892) though largest of these has total gill-raker + rudiment count of 21. Two paratypes of *E. melanostigma* Schultz (USNM 148966) received suggest it is a variety of *E. hexagonatus*, linking it to *E. spilotoceps*. Randall (1955) considers *melanostigma* and *spilotoceps* to be junior synonyms of *hexagonatus*.

Epinephelus spilotoceps Schultz, 1953
(Plate 6)

(*Partim*) *Epinephelus merra*: Boulenger, 1895: 241, var. C (*non* vars. A & B)
(*Partim*) *Serranus merra*: Fowler & Bean, 1930: 268, ? *partim* figs. 16, 17.
Epinephelus spilotoceps Schultz, 1953: 357, figs. 56, 57.
(*Partim*) *Epinephelus hexagonatus*: Randall, 1955: 51, table 2.

SPECIMENS STUDIED. S 8/1, S 8/2, S 83/3, S 105. Sizes: 238-308 mm TL; 195-248 mm SL; mass 170 gm — 0.5 kg.

DESCRIPTION. D XI, 15; A III, 8; Pect. i, 16-17; GR 3-5, 2-3/1/10,5 totals 21-23; Sc. c. 100 $\frac{9\text{-}10.}{28.30.}$ Dentition $\left|\frac{6\text{-}8,5}{6\text{-}8,3}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}2}\right.$ pal. 4. Measurements in Table 11.

Description exactly as for *E. hexagonatus*.

COLOUR. In life: Red-brown honey-comb reticulation covers entire fish except occasionally for extreme end of pectoral fin. The hexagonal spots become small, and concentrated in colouration, anteriorly so they appear on snout, interorbital region and around eye as scattered, dark spots. Four black blotches dorsally as in *E. hexagonatus*, variable as in that species. Fins not notably dusky but membranes at tips of dorsal fin spines darkened, giving appearance of small black flags. No white margins to fins though edge may be narrowly colourless. No dark "moustache" in maxillary groove.

In formalin: Fades but remains distinctive.

BIOLOGY. Small reef fish, not uncommon. Our scanty records are confused with *E. hexagonatus* under which head a few comments made above.

DISTRIBUTION. Local: Latham I., Zanzibar. Elsewhere: Seychelles, Moluccas, Micronesia.

REMARKS. This would be here regarded as a variety of *E. hexagonatus* but for Dr Schultz, who has seen many specimens of the *hexagonatus* complex. He kindly sent two *E. spilotoceps* from the Marshalls (USNM 154209) with which our specimens agree in every respect, except ours have fewer total gill-rakers + rudiments (largest fish USNM 154 209 possessing 25 in agreement with counts made by Randall). However, plate 6 shows that three fishes taken together by us at Latham Island, photographed fresh (after refrigeration), made an almost perfectly graded series from *E. hexagonatus* to *E. spilotoceps*.

Fresh specimens distinguished from *E. hexagonatus* by absence of bright triangular spots at the "knots" of hexagonal reticulation: this feature disappears on preservation when *E. spilotoceps* only distinguished by presence of dark spots on snout and interorbital, and very definitely spotted pectoral fin. Differences between *E. hexagonatus*, *E. spilotoceps* and *E. merra* mentioned under the first species.

Fig. 16 of *"S. merra var. stellans"* in Fowler & Bean exactly matches a small juvenile of *E. spilotoceps* received from Kwajalein (USNM 154209).

Boulenger (1895) refers *S. foveatus* C. & V. and *S. reevesii* Richardson, to the synonymy of *E. merra*.

Specimen S 83/2 sent to Dr L.P. Schultz, Smithsonian Institution.

Epinephelus merra Bloch, 1793
(Plate 6)

(Partim) Serranus hexagonatus: Günther, 1859: 141, var. B. Playfair & Günther, 1866: 10, var "a". Day, 1878-88: 14, pl.2, fig. 3 (= *merra*).
(?) *Epinephelus merra*: Sauvage, 1891: 511. Baissac, 1953: 220. Koumans, 1953: 222. Wheeler & Ommanney, 1953: 56. Fourmanoir, 1954: 215. Roux-Estève & Fourmanoir, 1955: 197. Smith, 1955: 310.
(Partim) Epinephelus merra: Boulenger, 1895: 241, var. A (*non* var. B, C). Tanaka, 1927: 747: pl.164, fig. 457 (= *merra*). Weber & de Beaufort, 1931: 64. Smith, 1949: 196, pl.18, fig. 439 (= *merra*). Copley, 1952: 88. Munro, 1955: 113, pl.1.19, fig. 307 (= *merra* after Day). Roux-Estève, 1956: 70.
Epinephelus merra: Gilchrist & Thompson, 1909: 221. Barnard, 1925-27: 49. Schultz, 1953: 343, pl.25A. Randall, 1955: 51. Fourmanoir, 1957: 153.
Serranus merra: Fowler, 1925: 222.
(Partim) Serranus merra: Fowler, 1928: 181. Fowler & Bean, 1930: 268.

SPECIMENS STUDIED. S 7, S 12, S 72, S 90, S 118. Sizes: 163-278 mm TL; 130-225 mm SL; mass 64-340 gm.

DESCRIPTION. D XI,16; A III,8; Pect. i,16; GR 4, 2-3/1/(6-) 9,6 (-9) totals 22-23; Sc. 106-115 $\frac{9\text{-}10.}{28\text{-}30}$ Dentition $\left|\frac{6\text{-}9,4\text{-}5}{5\text{-}6,\ 2}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}3}\right.$ pal. 3 (-4). Measurements in Table 11.

Scales strongly ctenoid, sometimes difficult to count. Acute angle between upper and lower margins of operculum. Opercular spines equidistant, lower two projecting, acute: highest most anterior. Canines small but conspicuous. Teeth of outer row of upper jaw enlarged. Antero-ventral edge of maxilla forms small but abrupt step at distal expansion.

Size range: EAMFRO records to 30 cm, Fourmanoir (1957) states 40 cm.

CHANGES WITH GROWTH. Changes in colour pattern of soft fins mentioned below, those of juveniles being spotted, not reticulated. Number of spots on body increases with growth, spots staying roughly the same size.

COLOUR. In life: Exceptionally strongly marked honeycomb reticulation of red-brown spots separated by yellowish lines covers entire fish, spots becoming paler, wider spaced and more diffuse in outline ventrally, but those on breast and belly scarcely larger than those dorsally. Sometimes differential darkening gives effect of 4 or 5 cross-bars but black dorsal blotches never present. Fins spotted in continuation of body design but with smaller spots, becoming more crowded peripherally in soft fins, hexagonal reticulation becoming correspondingly fine in larger fishes; but in juveniles spots on soft fins, though smaller than those on body, are so condensed and widely spaced as to replace adult reticulation by a polka dot pattern. Dorsal spines not conspicuously flagged with dark fin webs. Fins not dusky nor margins differentially coloured; no maxillary "moustache".

Colour in formalin: Fades, remains distinctive.

BIOLOGY. Normally uncommon, no doubt inhabits in fair numbers the crevices of coral reefs. Ours taken down to 10 m by handline, spearfishing and explosion in staghorn coral (*Acropora formosus*).

DISTRIBUTION. Local: Zanzibar Island. Elsewhere: E. African coast from Natal probably to the Red Sea. Comoros, Madagascar, Mascarene Islands. E. Indies, Philippines, Melanesia, Micronesia, Polynesia, E. Australia, China.

REMARKS. Many descriptions undoubtedly confuse *hexagonatus, spilotoceps, merra* and others (such as *megachir* and *gilberti*). Distinguished from *hexagonatus* and *spilotoceps* by criteria given under former.

With no local reputation for being poisonous although reputedly moderately toxic in Samoa (Fish & Cobb, 1954: 13).

Specimen S 106 sent to U.S. National Museum of Natural History.

Epinephelus gilberti (Richardson, 1842)

(Partim) Serranus gilberti: Günther, 1859: 148.
Serranus cylindricus Günther, 1859: 151, pl. 11A. Playfair & Günther 1866: 11.
(Non) Serranus gilberti: Bleeker, 1877, vol. 8, pl.331, fig.3. (*fide* pl.19, fig. 311 in Munro, 1955). Day, 1878-88: 746.
Epinephelus cylindricus: Sauvage, 1891: 75, pl.8. Fourmanoir, 1954: 215.
Epinephelus gilberti: Boulenger, 1895: 220. Barnard, 1925-27: 479. Copley, 1952: 88.
(Partim) Epinephelus merra: Tanaka, 1927: 747, (*non* pl.164 = *merra*).
Serranus gilberti: Fowler, 1928: 179.
(?) *Serranus gilberti*: Fowler & Bean, 1930: 254.
(Partim) Epinephelus megachir: Weber & de Beaufort, 1931: 45. Smith, 1949: 196 (*non* pl.17, fig. 440).
(Partim) Epinephelus macrospilos: Smith, 1954: 506, pl.19, fig. 440a (= *gilberti*).
(?) *Epinephelus macrospilos*: Smith, 1955: 310.

SPECIMENS STUDIED. S 9, S 20, S 31/1, S 121, S 129. Sizes: 166-495 mm TL; 134-405 mm SL; mass 57 gm — 1.7 kg.

DESCRIPTION. D XI,16 (-17); A III,8; Pect. i, (17-) 18; GR (3-) 5, 2-4/1/9-10, 4-5 totals 23-23; Sc. 95-105 $\cdot \frac{11\text{-}14}{33\text{-}35}\cdot$ Dentition $\left|\frac{5\text{-}8,3\text{-}6}{4\text{-}6,\ 2}\right.$ canines $\left|\frac{1\text{-}2}{1\text{-}2}\right.$ pal. 2-4. Measurements in Table 11.

Most scales cycloid, or degenerate ctenoid, but in shadow of pectoral fin most are ctenoid; some fishes (e.g. S 20, S 129) almost entirely ctenoid. Opercular spines equidistant, lower two projecting, acute; highest slightly forward of, or slightly behind, lowest. Opercular flap ends acutely. Nostrils subequal, front with flap. Teeth of outer series of upper jaw only slightly enlarged. Antero-ventral edge of maxilla rises in a steep slope to form distal expansion.

CHANGES WITH GROWTH. Number of series of teeth all round upper jaw, and at front of lower jaw, increases as does palatine series. Likely that interorbital widens relative to SL and seems certain that dorsal fin spines and rays shorten. Coloration hardly alters although small fishes have notably dark pectoral, pelvic and anal fins. Number of polygonal spots across body increases, possibly regularly (spots scarcely becoming larger).

COLOUR. In life: Distinctively marked fish of dark brown, or greenish brown, broken into polygonal spots by a narrow network of lines. Spots so formed of various sizes (relatively large, exceeding diameter of eye in small fishes) and colour intensity may be especially dark in places dorsally. Virtually the whole of the body and fins spotted except that distal half of outer surface of pectoral fin obscured by duskiness and margins of soft dorsal and caudal fins are white. Soft dorsal and caudal fins strongly yellowish, or golden. Edge of maxillary groove has short, narrow black streak or moustache.

Colour in formalin: The very noticeable and characteristic golden tints of the soft dorsal and caudal fins quickly disappear but rest of colour pattern persists strongly.

BIOLOGY. Between cruises 61 and 167, 13 specimens taken by handline, one shot; two from Zanzibar market. Not uncommon around coral reefs to about 20 m. Two-thirds female, possibly breeding in first quarter of the year.

Crabs (including *Calappa gallus*) the commonest food. Small fishes taken twice, a squid once. No gut parasites noted: parasitic isopods (larval *Gnathia* sp.) found in mouth of one.

DISTRIBUTION. Local: Mtwara, Mafia I., Latham I., Zanzibar I., Pemba I., Malindi. Elsewhere: Comoros, Madagascar. India, E. Indies, Australia, Polynesia.

REMARKS. Specimens closely match descriptions of *S. cylindricus* in Günther (1859) and *E. gilberti* in Boulenger (1895) and, although we did not find *E. megachir* (Richardson), it and *E. gilberti* appear distinct species though frequently confused. (Plates of *cylindricus* missing from EAMFRO copies of Günther and of Sauvage). Colour plate of *"E. macrospilos"* in Smith (1954) typically representative of our specimens of *E. gilberti*.

Strange that Bleeker's (1877) plate of *"S. gilberti"* should be reproduced by Munro (1955) as *E. malabaricus*, and by Smith (1949) as *E. megachir* (which appears correct). *S. gilberti* in Fowler & Bean reads like *macrospilos*: criteria in their key are relevant to

gilberti. Since *E. macrospilos* lacks a reticular pattern (spots being rounded and well separated) it should not be drawn into the confusion of species possessing honeycomb markings.

E. megachir may be present off E. Africa but must be rare: Baissac (1953) records it at Mauritius.

Specimen S 31/2 sent to U.S. National Museum of Natural History.

Note on *Epinephelus macrospilos* (Bleeker, 1855):

Smith (1954) records *E. macrospilos* from Natal to the central tropical Indo-Pacific but his coloured plate shows *E. gilberti*, throwing doubt on records of *E. macrospilos* from Aldabra (Smith, 1955).

Fourmanoir (1957) records *E. macrospilos* (Bloch) (*sic*) from Mozambique Channel and Baissac (1953) from Mauritius. We have never seen a fish here resembling the specimen of *E. macrospilos* (USNM 141882) from Bikini, sent by Dr Schultz, in which the spots are so separated as to give no suggestion of hexagonal reticulation.

Boulenger (1895), Randal (1955) and others consider *E. macrospilos* a junior synonym of *E. corallicola* (C.V.) of which nearest record is Mauritius (Baissac, 1956).

Genus *DERMATOLEPIS* Gill, 1861

Boulenger (1895) recognises *Dematolepis* as a subgenus of *Epinephelus*, and in his generic diagnosis states "Lower opercular spine absent"; this not always true of E. African specimens (*vide* Playfair, 1866: 11 and Smith, 1954c: 931 for *D. striolatus*); and notes below under *D. striolatus var. aldabrensis*. More accurately, opercular spines reduced, inconspicuous, lowest often absent.

Smith gives further features of genus and not only states: "A single opercular spine" but also: "Caudal rounded". Latter feature certainly not generic because *var. aldabrensis* has subtruncate tail.

1a. Caudal rounded; longest pectoral rays about 24% SL; 7-8 series of teeth at front of upper jaw; body with dots and longitudinal dashes ..... *D. striolatus*

1b. Caudal subtruncate; longest pectoral rays 18-19% SL; 10-12 series of teeth at front of upper jaw; body with dots, no dashes ..... *D. striolatus var. aldabrensis*

Dermatolepis striolatus (Playfair, 1866)

(Plate 7)

Serranus striolatus Playfair, 1866: 11, pl.3, fig.2.
Epinephelus striolatus: Boulenger, 1895: 257.
Dermatolepis striolatus: Smith, 1954c: 931, pl.33B. Smith, 1955a: 310.

SPECIMENS STUDIED. S 101. Size: 425 mm TL; 340 mm SL; mass 1.1 kg.

DESCRIPTION. D XI,19; A III,9; Pect. i,17; GR 3,5/1/11,3; Sc. c. 126-129 $\frac{20}{43\text{-}45}$. Dentition $\left|\frac{7\text{-}8,5}{6,\ 2}\right.$ pal. 3-4. Measurements in Table 12.

Gill raker at angle of first gill arch equal to or fractionally longer than filaments opposite, not so long as longest filaments.

Many auxiliary scales, precise scale counts almost impossible: scales just behind pectoral axil (in "shadow" of fin) ctenoid, although majority are cycloid. (No record of ctenoid scales hitherto).

Another undescribed feature is a well developed fleshy fold, or process, above axil of pectoral fin (as in *Epinephelus*).

Hind margin of preopercle finely denticulate beneath skin. Only two opercular spines ("lowest" absent), upper rudimentary, lower projecting, blunt on one side of fish and sharp on other. Upper margin of operculum very convex, curving almost to same vertical line as posterior point of opercular flap (which very low, near pectoral fin). Front nostril tiny, circular, with flap: hind small, ovoid.

Very full description given by Smith (1954c) from 10 specimens 31-49 cm TL.

COLOUR. In life: Rich orange-brown, with dark brown or blackish spots and short oblique or longitudinal bars all over. Background with pale irregular blotches of varied size distributed all over body (sometimes described as "ocellations"): blotches extremely well marked or scarcely present (cf. leprous markings of *Epinephelus leprosus* Smith and *E. flavocaeruleus* (Lacep.).

Colour in formalin: Persistent pattern as above but dull brown.

BIOLOGY. Smith states: "rare ... in sheltered rather turbid waters". S 101 shot amongst corals in clear, shallow water off Zanzibar Town, a sheltered locality. Gonads tiny and stomach empty.

DISTRIBUTION. Local: Zanzibar and Pemba Islands, E. African coast from 14°10'S to 3°10'S. Elsewhere: Aldabras, Muscat.

REMARKS. Compared with *var. aldabrensis* in "Remarks" under latter. Figure in Playfair appears rather distorted. No commercial value due to rarity.

Dermatolepis striolatus var. aldabrensis Smith 1955

(Plate 7)

Dermatolepis aldabrensis. Smith, 1955a: 311, pl.1B. Fourmanoir, 1957: 158.

SPECIMENS STUDIED. S 80, S 86 and Field. Sizes: 825-850 mm TL; 690-720 mm SL; mass 10.3 — 10.5 kg.

DESCRIPTION. D XI, 18-19; A III, 9-10; Pect. i, 17; GR 3-5, 2-5/1/9, 4; Dentition $\left|\frac{10\text{-}12,8\text{-}10}{8,\ 3\text{-}5}\right.$ pal. 4-5. Measurements in Table 12.

All filaments on first gill arch longer than gill rakers with possible exception of raker at angle. Scale counts a waste of time due to scales buried. No ctenoid scales even in pectoral "shadow".

Prominent fleshy process above axil of pectoral fin.

Hind margin of preopercle lacks projecting denticles, profile concave at lower part. No projecting opercular spines, but traces of two or three are present showing central spine nearer lowest, if this present. Upper margin of operculum very convex, curving almost to same vertical line as most posterior point of opercular flap (which situated very low, near pectoral fin). Front nostril a longitudinal slit on one side of S 86, oblong on other; circular in S 80: hind

nostril ovoid or transversely oblong.

COLOUR. In life: In general, rich reddish brown with dark spots all over head, body and fins. Light and dark mottlings may be present.

Whole of head and body spotted excepting small breast area anterior to pelvics and narrow strip along belly. Spotting on body close set, regular in size of spots and spacing. Spots obscurely arranged in irregularly curved lines, never coalesce as continuous bars or lines, each spot at centre of roundel having a central dark-brown eye ("spot" proper), a corona of lighter-coloured reddish-brown, the whole surrounded by narrow ring of yellowish-brown. Central spot about 3-6 mm in diameter (not always circular), distance between centres of roundels about 6-9 mm, roundels less developed on breast and sides of belly (where only central spots show). On head, roundels small and less distinct, anteriorly only central spots present (very small). Membranes of recesses of premaxilla and maxilla not extra dark (no "moustache"). In one discarded specimen upper parts of head and nape heavily obscured by dark spinach green colouration.

Body markings extend onto vertical fins progressively less distinctly. Pectoral fins marked as body for proximal third, distal two-thirds unspotted, plain brown. Pelvic fins vaguely spotted. Pale blotches ("ocellations") of life quickly disappear.

Colour in formalin: Persistent as above but in dull browns.

UNDERWATER OBSERVATIONS: Striking because of colouration, pattern of pale blotches very marked, groups of roundels bleached almost to nothing except for central spots. A dozen or more roundels are concerned in each blotch so that the pale, leprous blotches are about 4-5 cm across and oblong, not circular. Narrowness of the body, especially in comparison to depth, very striking in contrast to sub-circular section of most rock cods.

Showed a tendency to shoal: on one occasion at least 8 seen about a metre apart, and they moved across sea bed, in and out of corals together. Smaller groups showing same shoaling tendency were sighted on other occasions. Otherwise underwater behaviour much as other rockcods of similar size i.e. trustful until educated to the gun, then elusive.

BIOLOGY. From cruises 61-167, three taken by spearfishing, two by handline. Rare, of patchy distribution, only seen and taken at the one isolated island. Has been fished from coral and brash bottoms down to 15 m. Three males, two females, none showed signs of ripeness. Three had empty stomachs, two had fish remains (including ? *Priacanthus hamrur*). Gonad of one male had a protozoan infection and same fish had attached to its anus an *Echeneis naucrates* (sucker fish).

DISTRIBUTION. Local: Latham Island (approximately 7°S; 40°E). Elsewhere: Comoros, Aldabras.

REMARKS. The marine ichthyologists of the J.L.B. Smith Institute of Ichthyology consider *Dermatolepis aldabrensis* to be the large (male?) adult of *D. striolatus*. This is based on two specimens — the photograph of a large undoubted *aldabrensis* from Sodwana Bay, and a 51 cm fish speared off Durban by Arland Read (RUSI 11500) showing both the black spots of *aldabrensis* and the light areas of *striolatus* (Pl. 7). However I record the variety separately to aid assessment of its status when a wider range of specimens available. Smith (1955a) states: "very closely related to *D. striolatus* (Playfair), 1866, but differing markedly in the colouration and in other minor details." I have observed the pale blotch pattern (Smith's "ocellation" in respect of *D. striolatus*) on this variety too. In coloration chief differences are: the absence of longitudinal dashes or bars from *var. aldabrensis* and lesser development after death of pale blotch pattern; truncate; or sub-truncate, caudal of *var. aldabrensis* an obvious demonstration of tendency of fin rays to be shorter in that variety (also shown by shorter pectoral, anal and longest dorsal fin rays) (Table 11). Smith's proportional measurements of pectoral and pelvic fins of both varieties corroborate the above, but apparent differences in other proportions disappear when our specimens considered with his. The apparently greater dental counts of this variety are no doubt simply due to the very much greater size of the specimens.

No commercial value due to rarity. Palatable, but not very delectable, possibly due to large size.

Specimen S 86 sent to the U.S. National Museum of Natural History.

Subfamily GRAMMISTINAE

Grammistes sexlineatus (Thunberg, 1792)

Grammistes sexlineatus: Fowler & Bean, 1930: 311, *ETC*.. Weber & de Beaufort, 1931: 4, fig. 1. Fowler, 1934: 461. Smith, 1949: 190, pl.16, fig. 418. Copley, 1952: 91. Baissac, 1953: 212. Schultz, 1953: 385, pl.32A. Fourmanoir, 1954: 214. Morrow, 1954: 807, pl.25, fig. 2B. Munro, 1955: pl.18, fig. 286 (after Jordan & Seale). Randall, 1955: 59. Fourmanoir, 1957: 145.

SPECIMENS STUDIED. S 151/1 & 151/2. Size: 123-4 mm TL; 99 mm SL; mass 35 gm.

DESCRIPTION. D VI + I,14 and D VII,13; A I,9; (without dissection). Pect. i,14; GR 4,2/1/7,7; Sc. 71-74 $\frac{12\text{-}14}{36\text{-}40}$. Dentition $\left|\frac{4\text{-}6,5}{5\text{-}7,2}\right.$ pal. 3.

The degree of subdivision of dorsal fin obviously very variable for in one specimen it is divided into a spiny and soft fin, with one spine between; in the other, fin is merely deeply notched.

Schultz seems responsible for discovering the anal spines of which he says there are two. Fourmanoir (1957) reports "A.III 8-11". Our specimens each have the low count of 14 pectoral rays. Flap under chin small and pointed like a goatee beard. Skin very slimy.

COLOUR. In life: Black, dark brown or brown-violet with longitudinal yellowish stripes on body and head, not on fins. Schultz (1953) gives details of changes of stripes with growth. Fins pinkish.

DISTRIBUTION. Local: Natal to Red Sea. Elsewhere: Comoros, Aldabras, Madagascar, Mauritius, Seychelles. India, Sri Lanka, E. Indies, Western Pacific.

REMARKS. Rare and of no commercial value: Smith says flesh is bitter: his figure is in colour. Morrow's figure of tiny juvenile.

Subfamily LIOPROPOMINAE

Genus *CHORISTISTIUM* Gill 1862

(Partim) Chorististium. Fowler & Bean, 1930: 185. Smith, 1954b: 861. *Ypsigramma* Schultz, 1953: 372.

Fowler & Bean, and Smith, place the species *susumi* and *swalesi* in the genus *Chorististium* but Schultz (1953) places them in separate genera. According to Böhlke (1956) the former is *Chorististium susumi* and the latter may or may not be congeneric. The chief difficulty is degree of subdivision of dorsal fin the matter confused by statement of Fowler & Bean, under diagnosis of genus *"Chorististium"*, that: "Dorsals (are) well separated". The dorsal fins are, in fact, separated by several rows of scales in *C. susumi* but in *swalesi* dorsal is merely notched to the base (see Schultz's plate 32B).

Chorististium spp. bear little resemblance to other serranids and Smith obviously favours removal from Serranidae.

The two species in east African waters may be separated as follows:

A. 7-9 narrow, longitudinal dark lines along body ..... *C. susumi*

B. 4 broad, longitudinal dark lines along body ..... *C. africanum* Smith, 1954 (See Smith, 1954b for an account of this species).

Chorististium susumi Jordan & Seale, 1905

Chorististium susumi: Fowler, 1928: 172 (copied). Fowler and Bean, 1930: 185. Smith, 1954b: 862, pl.27, fig. C.

Ypsigramma susumi: Schultz, 1953: 376-7, table 34. Smith, 1955: 310.

Ypsigramma lineata Schultz, 1953: 375, fig. 59.

SPECIMEN STUDIED. S 137. Size 72 mm TL; 61 mm SL.

DESCRIPTION. D V+I, 12; A III,8; Pect. i,14; GR 4,2/1/8, 3-4; Sc. 45 $\frac{4}{14}$. Dentition $\left|\frac{9\text{-}10,c.7}{c.7,\ 3}\right.$ pal. 3(-4). Depth 28% SL.

Presence of only V spines in the first dorsal fin, in place of usual VI, is noted. Spine before second dorsal fin and first anal spine, tiny and concealed by scales. Skin covering second and third dorsal spines (and fourth to lesser degree) much thickened distally giving these spines a club-shaped appearance (perhaps a sexual characteristic). Gap between dorsal fins corresponds to 9-10 transverse rows of scales.

Pectoral axil without fleshy process but skin rather wrinkled and full; adjacent scales scarcely abnormal in shape. Pelvic axil without scaly process but one or two of scales elongated and pointed more than neighbours. Body scales markedly ciliated or ctenoid except in region of nape.

Nostrils widely separated, anterior with a rather long, tubular, skinny projection. No canines; inner teeth of jaws depressible; inner (hinder) vomerine teeth only slightly larger than outer; dentate palatine area very elongate and narrow. Caudal rounded-truncate without trace of forking.

Predorsal scale count omitted because it is not straightforward, liable to personal idiosyncracy.

COLOUR. In life: (After Smith): pink or red with 7-9 longitudinal dark green stripes along body, some of which extend to orbit; fins and lips vivid red.

Colour in formalin. Pink (or red) fades to non-descript pale yellowish-brown, fins becoming almost white except for caudal that is dark brown in our specimen. Longitudinal lines change to dark brown and seem very persistent.

DISTRIBUTION. Local: E. Africa from Mozambique (15°S) to southern Kenya (4°S), Zanzibar, Pemba. Elsewhere: Aldabras, Philippines, Marshalls, Samoa.

REMARKS. Smith (1954b) gives very full notes. Schultz (1953) differentiates *C. lineata* from *C. susumi* by minor differences of colour pattern and tiny differences in transverse and predorsal scale counts, and in gill raker counts. Our specimen intermediate: it fits *lineata* in Schultz' excellent key, with further elaboration that lowest of the five brown lines each side of caudal peduncle is, on each side, dichotomously branched so that there are six brown lines on each side of peduncle more posteriorly. But uppermost line on each side of body joins its fellow immediately behind dorsal fin to continue as a single line above caudal peduncle in the way Schultz describes (p. 379) for *susumi*, lowest pair of lines each side similarly join to form single, median line beneath caudal peduncle.

Our specimen suggests that *C. lineata* is a junior synonym, in agreement with Randall (1955: 59) who examined the holotype of *susumi*. Randall thought that *C. broaki* (Schultz) likely to be juvenile *C. susumi*, and Smith also considers *C. pallidum* Fowler (1938) to be a juvenile of *C. susumi*.

S 137 taken by explosives in *Acropora hyacinthus* at about 6 m depth by my colleague, Dr Talbot, who sent one or more specimens to Professor J.L.B. Smith, who identified them.

Incertae sedis

Genus *DINOPERCA* Boulenger, 1895

Boulenger overlooked in his original description of the genus, and in description of *D. queketti* (1903), criteria that could be of generic value: the specimen below lacked an axillary process to either pectoral or pelvic fins, and all teeth were firmly fixed i.e. non depressible.

Dinoperca seems to have most affinity to *Stereolepis*, to *Acanthistius** and, in lesser degrees, to *Centrogenys* and *Liopropoma*.

Dinoperca queketti Boulenger, 1903

Dinoperca queketti Boulenger, 1903: 63, pl.2. Barnard, 1925-27: 490. Copley, 1952: 91.

(Partim) Dinoperca petersii: Smith, 1949: 199. fig. 454.

SPECIMEN STUDIED. S 108. 445 mm TL; 370 mm SL; mass 1.7 kg.

DESCRIPTION. D XI,18; A III,13; Pect. i,17; GR 1,15/1/25,1; Sc. 86-90 $\frac{15\text{-}16}{c.24\text{-}25}$. Dentition $\left|\frac{6,8\text{-}10}{4\text{-}5,\ 1}\right.$ pal. 5-6.

* Dr F.H. Talbot, formerly of the South African Museum, kindly examined *A. sebastoides* and informed me there were no axillary processes to pectoral or pelvic fins.

No axillary process to pectoral or pelvic fins. No barbels or papillae beneath chin. Nostrils close together, near to eye, front an oblique slit, hind an oblique oval. Interorbital very convex. Upper and central opercular spines project very slightly, acute; lowest spine very rudimentary, virtually absent. Vertical preopercle edge concave, finely serrate. Distal termination of maxilla concave in profile (as in Boulenger's figure). Scales strongly ctenoid, nowhere buried. Teeth not depressible; dental series difficult to count due to fineness and arrangement; in each jaw all but those of outer row are very fine as are palatine; vomerine teeth in a broad chevron, or crescentic patch; no canines. Caudal damaged, apparently truncate. Colour: plain black all over.

BIOLOGY. The only specimen seen underwater or otherwise, obviously rare. Shot at the isolated island of Kanyika, near Lamu (northern Kenya) among caves of coral-rock (living reef-corals virtually absent).

Female, mature, far from ripe. Stomach empty.

DISTRIBUTION. Local: northern Kenya. Elsewhere: Natal.

REMARKS. I am hesitant to consider this species synonymous with *D. petersii* (Day). Boulenger's plate and Smith's figure (*non D. petersii*) are excellent. Although very common off Natal, of no value off Tanzania or Kenya.

Acknowledgements

I thank Dr L.P. Schultz (Smithsonian Institution, Washington, U.S.A.) for generous cooperation and particularly for exchanging specimens. The late Professor J.L.B. Smith (Rhodes University, S. Africa), Dr F.H. Talbot (formerly of the South African Museum, Cape Town) and Dr A.C. Wheeler (British Museum of Natural History) were most generous in responding immediately to my requests to check certain details in specimens accessible to them. I am indebted to Dr S. Prudhoe (British Museum of Natural History) for determinations of parasites: and to my former colleagues Dr A J. Bruce (for determinations of crustacea found in fish stomachs), Dr F. Williams and Dr F.H. Talbot (who always took care to assay the serranids amongst the fishes taken on their cruises). Finally, I am grateful to Prof. M.M. Smith for encouraging completion of this work and Dr P.C. Heemstra for kind help with the manuscript.

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TABLE 1. Measurements and proportions of *Plectropomus* spp.; data that appear to change with growth are in parentheses.

	maculatus	*marmoratus* Paratype No. 287	*marmoratus*
Number of specimens (TL in mm)	3 (274 – 490)	1(545)	4 (400 – 890)
Standard length (mm)	230 – 415	462	335 – 750
	% of SL	% of SL	% of SL
Depth (eviscerated fish)	28.5 – 29.1	29.2	29.2 – 30.1
Head	33.4 – 33.9	32.9	32.0 – 33.1
Head less chin	32.0 – 33.0	31.4	30.0 – 32.1
Snout	9.8 – 10.3	10.8	10.4 – 11.3
Interorbital	(4.8 – 6.0)	5.4	5.1 – 5.4
Vertical eye diameter	(4.3 – 5.1)	4.5	(3.7 – 4.8)
Postorbital head	18.5 – 19.0	18.4	17.5 – 19.1
Least preorbital	4.3 – 5.1	4.8	4.8 – 5.5
Snout to end of maxilla	14.4 – 15.1	15.4	(15.2 – 16.4)
Depth caudal peduncle	12.0 – 12.4	13.0	12.6 – 13.1
Length caudal peduncle	19.2 – 20.0	20.8	18.8 – 20.8
Max. diam. front nostril	0.65 – 0.84	0.87	0.87 – 0.92
Max. diam. rear nostril	0.87 – 1.01	1.08	1.08 – 1.47
1st dorsal spine	3.6 – 4.8	4.1	3.9 – 4.1
3rd dorsal spine	7.8 – 8.9	8.4	8.4 – 9.3
Last dorsal spine	6.5 – 8.4	6.9	6.9 – 7.5
Longest dorsal spine	7.8 – 8.9	8.4	8.4 – 9.3
Longest dorsal ray	10.9 – 13.2	11.0	(10.1 – 12.0)
Longest pectoral ray	14.7 – 16.2	14.1	14.1 – 15.2
Longest pelvic ray	13.0 – 15.5	13.2	13.2 – 14.6
Longest anal ray	12.3 – 14.1	13.0	13.0 – 13.5
1st anal spine	1.7 – 2.4	1.5	1.5 – 1.8
2nd anal spine	3.4 – 3.5	2.3	2.3 – 3.2
3rd anal spine	6.5 – 8.6	5.9	5.9 – 6.4
Longest gill-raker	1.7 – 2.4	1.5	1.1 – 2.1
Gill filaments at angle	1.3 – 2.2	2.2	2.2 – 2.7
Longest gill filaments	2.6 – 2.9	3.0	3.0 – 3.5
Eye/Interorbital	(72 – 105%)	84 %	(70 – 89%)
Body Depth/Head + Chin	84 – 86%	89 %	88 – 90%
Snout/Head + Chin	29 – 31%	33 %	31 – 36%
Longest gill filament/3rd anal spine	35 – 44%	52 %	51 – 52%

TABLE 2. Measurements and proportions (in % SL) of *Variola* spp.. Proportions of inter-specific diagnostic value are in italics.

	V. albimarginata	*V. louti*
Number of specimens (TL in mm)	2 (230 – 410)	2 (290 – 450)
Standard length (mm)	180 – 320	220 – 320
Depth	32.9 – 33.3	29.6 – 32.8
Longest dorsal ray	*16.9 – 17.2*	*20.0 – 23.1*
Longest anal ray	*22.2 – 24.4*	*29.6 – 30.0*
Longest pelvic ray	*20.9 – 22.8*	*25.0 – 27.8*
Longest caudal ray	*30.3 – 33.9*	*36.8 – 45.0*
Median caudal rays	17.8 – 18.8	17.2 – 17.3

TABLE 3. Measurements and proportions of *Cephalopholis* spp. "Head (less chin)" = "length of head" of Boulenger (1895). Bottom line is longest pectoral fin ray length in percent of postorbital head length; other measurements are in % SL.

	leopardus USNM 141816 Bikini Is.	*leopardus* E. Africa	*urodelus* USNM 141826 Bikini Is.	*sonnerati*	*aurantius*
Number of specimens (TL)	2 (103 – 144)	5 (108 – 152)	2 (156 – 205)	1 (465)	7 (163 – 230)
Standard length (mm)	84 – 117	87 – 125	128 – 170	380	135 – 188
Depth	36.9 – 37.7	34.3 – 38.0	32.9 – 34.3	39.5	31.0 – 34.1
Head (less chin)	42.8 – 42.8	41.5 – 45.4	38.3 – 39.4	36.9	37.0 – 40.0
Postorbital head	25.6 – 26.2	24.7 – 27.3	23.4 – 24.7	22.4	23.4 – 25.9
Longest dorsal spine	13.7 – 14.1	13.6 – 15.0	12.3 – 12.5	10.0	10.7 – 12.0
2nd anal spine	16.3 – 17.9	13.6 – 18.2	14.8 – 15.3	8.4	12.3 – 14.9
3rd anal spine	14.5 – 15.5	12.9 – 15.5	13.3 – 14.7	9.7	11.8 – 15.3
Longest dorsal ray	18.0 – 18.5	16.8 – 18.4	15.6 – 17.0	16.8	15.9 – 17.0
Longest anal ray	18.8 – 19.1	17.2 – 19.6	18.0 – 18.8	19.2	14.6 – 18.5
Longest pectoral ray	26.5 – 27.4	25.6 – 28.8	25.0 – 26.5	21.6	22.4 – 25.3
Longest pelvic ray	19.7 – 19.7	19.2 – 20.1	17.6 – 18.7	20.8	17.0 – 18.4
Pectoral ray/postorbital	103 – 104	100 – 116	107	97	95 – 106

TABLE 4. Measurements and proportions of *Cephalopholis* spp.; data that change notably with growth are in parentheses. "Head (less chin)" = "length of head" of Boulenger (1895). Bottom line is longest pectoral fin ray length in percent of postorbital head length; other measurements are in % SL.

	sexmaculatus	*miniatus*	*pachycentron*	*argus* USNM 167489 Gilbert Is.	*argus* E. Africa
Number of specimens (TL)	3 (272 – 360)	5 (320 – 370)	5 (56 – 173)	3 (77 – 253)	3 (270 – 340)
Standard length (mm)	225 – 290	260 – 300	47 – 140	62 – 210	224 – 283 mm
Depth	35.5 – 36.6	32.7 – 35.4	32.0 – 37.9	(32.9 – 34.1)	(30.8 – 31.2)
Head (less chin)	39.6 – 40.0	35.6 – 37.8	39.1 – 42.6	39.4 – 40.5	38.8 – 39.6
Postorbital head	23.1 – 24.1	21.7 – 23.5	23.4 – 25.0	24.2 – 25.0	24.8 – 26.1
Longest dorsal spine	10.7 – 11.7	9.2 – 11.4	13.6 – 13.9	(10.0 – 12.9)	(9.2 – 10.0)
2nd anal spine	11.1 – 12.2	10.0 – 11.7	16.4 – 21.4	(10.0 – 16.1)	(8.2 – 9.8)
3rd anal spine	11.1 – 12.2	10.8 – 11.7	15.4 – 18.1	(10.5 – 14.5)	(8.9 – 10.0)
Longest dorsal ray	15.5 – 15.8	16.3 – 17.3	14.9 – 18.1	15.7 – 17.7	14.5 – 15.9
Longest anal ray	15.8 – 16.6	17.4 – 20.0	18.6 – 21.3	16.2 – 24.2	17.0 – 18.3
Longest pectoral ray	24.9 – 26.5	24.0 – 25.3	26.6 – 28.7	(21.4 – 24.2)	(21.2 – 22.3)
Longest pelvic ray	16.4 – 18.0	18.7 – 20.6	19.6 – 20.8	13.0 – 17.7	15.9 – 16.1
Pectoral ray/postorbital	108 – 111	106 – 111	111 – 117	86 – 100	82 – 89

TABLE 5. Measurements and proportions (in % SL) of *Promicrops lanceolatus, Epinephelus fasciatus* & *E. grammatophorus.*

	P. lanceolatus	*fasciatus*	*grammatophorus*
Number of specimens (TL)	1 (215)	2 (201 – 236)	2 (267 – 352)
Standard length (mm)	170	164 – 193	215 – 290
Depth	34.2	33.7 – 34.1	33.4 – 33.5
Head	43.5	41.5 – 43.5	42.8 – 44.8
Head less chin	40.8	39.6 – 41.5	41.4 – 42.1
Snout	7.0	7.3 – 8.3	7.9 – 8.1
Interorbital	6.5	4.3 – 5.4	4.1 – 4.2
Vertical eye diameter	6.5	8.3 – 8.5	7.2 – 8.4
Postorbital head	29.4	23.2 – 24.9	24.7 – 25.5
Least preorbital	1.8	3.0 – 3.4	3.3
Snout to end of maxilla	17.6	17.1 – 19.7	19.0 – 19.1
Depth caudal peduncle	12.9	10.9 – 11.6	11.4 – 11.6
Length caudal peduncle	6.5	8.5 – 10.4	8.4 – 9.0
Max. diam. front nostril	0.9	0.6 – 0.8	0.7
Max. diam. rear nostril	1.2	0.9 – 1.0	0.7 – 0.9
1st dorsal spine	4.7	4.9 – 5.7	5.9 – 6.0
3rd dorsal spine	9.4	11.6 – 12.4	12.4 – 14.0
Last dorsal spine	10.3	11.0 – 11.4	9.0 – 10.2
Longest dorsal spine	10.3	12.2 – 13.5	13.1 – 14.0
Longest dorsal ray	17.6	13.4 – 14.5	13.4 – 14.9
Longest pectoral ray	23.5	21.8 – 22.0	21.4 – 22.8
Longest pelvic ray	17.6	17.1 – 18.7	15.5 – 17.2
Longest anal ray	18.2	17.1	14.8 – 15.3
1st anal spine	5.3	5.5 – 6.2	4.8 – 5.1
2nd anal spine	10.0	12.2 – 13.0	9.0 – 10.7
3rd anal spine	11.2	11.9 – 12.8	8.6 – 11.6
Longest gill raker	2.9	2.7 – 3.4	3.4 – 3.7
Gill filaments at angle	3.2 – 3.8	2.1	2.1 – 2.6
Longest gill filaments	4.1	2.6 – 2.7	2.8 – 3.0

TABLE 6. Measurements and proportions (in % SL) of *Epinephelus caeruleopunctatus* and *E. summana*.

	caeruleopunctatus	*summana*	*summana*
Number of specimens (TL)	6 (101 – 495)	1 (245)	3 (155 – 275)
Standard length (mm)	80 – 415	200	125 – 225
Depth	29.2 – 33.9	30.5	32.0 – 32.9
Head	39.8 – 42.4	41.0	43.4 – 43.5
Head less chin	37.8 – 40.6	40.0	41.4 – 42.2
Snout	6.8 – 8.4	8.5	8.2 – 8.9
Interorbital	2.8 – 3.7	4.0	3.3 – 4.0
Vertical eye	6.3 – 8.7	8.5	8.0 – 9.2
Postorbital head	23.1 – 24.9	24.0	25.0 – 25.3
Least preorbital	1.3 – 2.4	2.0	2.2 – 2.3
Snout to end of maxilla	15.0 – 17.4	17.5	18.4 – 18.7
Depth caudal peduncle	10.1 – 20.0	11.5	11.2 – 11.6
Length caudal peduncle	8.6 – 10.0	10.5	8.6 – 8.9
Longest gillraker	1.7 – 2.4	2.3	2.4 – 2.6
Gill filaments at angle	2.2 – 3.0	2.5	2.3 – 2.7
Longest gill filaments	2.5 – 3.2	2.8	2.6 – 3.1

TABLE 7. Measurements and proportions of *Epinephelus* spp. Proportions that change notably with age in parentheses. Proportions that appear to be useful for distinguishing the species in italics (e.g. those of *E. tukula* can profitably be compared to Table 1 in Morgans (1958). *Only smallest fish measured. + Includes measurements of another specimen (S 128).

	flavocaeruleus	*leprosus*	*modestus*	*tukula*
Number of specimens (TL)	3 (196 – 610)	2 (655 – 665)	2 (1085 – 1370)	13 (675-1390)
Standard length (mm)	162 – 520	550 – 560	910 – 1150	580 – 1205
	% SL	% SL	% SL	% SL
Depth	36.8 – 38.9	36.1 – 37.1	*35.0 – 35.4*	27.3 – 33.2
Head	38.5 – 39.4	39.3 – 39.5	39.6 – 41.3	38.0 – 41.8
Head less chin	36.3 – 38.5	37.5 – 37.8	–	–
Snout	(8.3 – 11.0)	9.8 – 10.2	12.1 – 12.6	*9.6 – 11.8*
Interorbital	6.8 – 7.9	6.4 – 6.7	(7.5 – 9.0)	*6.7 – 9.3*
Vertical eye diameter	5.1 – 7.4	4.8 – 5.1	4.9 – 5.3	*4.2 – 5.0*
Postorbital head	22.2 – 24.2	22.5 – 23.3	23.0 – 24.2	*23.2 – 24.2*
Least preorbital	3.4 – 4.9	4.5 – 5.5	4.9 – 5.6	2.5 – 3.7
Snout to end of maxilla	*17.5 – 18.5*	*15.2 – 16.4*	*18.8 – 19.0*	17.3 – 19.4
Depth caudal peduncle	10.8 – 11.7	11.3 – 11.5	*10.3*	10.1 – 11.6
Length caudal peduncle	11.1 – 11.7	11.6 – 12.0	*12.6 – 13.2*	10.8 – 12.9
Max. diam. front nostril	0.6 – 0.7	0.5 – 0.6	0.5 – 0.6	—
Max. diam. rear nostril	1.1 – 1.3	1.3 – 1.5	2.2 – 2.4	1.2 – 1.5
1st dorsal spine	5.0 – 6.8	5.0 – 5.8	4.1 – 4.4	3.0 – c.5.0
3rd dorsal spine	*13.0 – 13.8*	*11.1*	10.1 – 11.3	7.1 – 9.6
Last dorsal spine	8.1 – 11.4	6.9 – 8.6	7.8 – 9.0	5.8 – 8.0
Longest dorsal spine	*13.0 – 13.8*	*11.1 – 12.0*	10.8 – 11.3	7.6 – 9.8
Longest dorsal ray	*13.0 – 14.2*	*14.3 – 14.7*	*11.9 – 12.4*	*10.5 – 12.6*
Longest pectoral ray	(17.5 – 22.2)	17.5 – 18.0	16.9 – 18.5	15.1 – 18.8
Longest pelvic ray	(*16.7 – 19.8*)	*15.9 – 16.0*	12.6 – 14.3	12.6 – 20.4
Longest anal ray	14.4 – 16.8	15.5 – 15.6	12.2 – 14.0	*12.0 – 14.3*
1st anal spine	(2.9 – 4.9)	2.7 – 3.0	3.3 – 4.2	1.9 – 3.4
2nd anal spine	(5.4 – 9.9)	4.6 – 5.7	5.8 – 6.9	3.2 – 5.2
3rd anal spine	(7.5 – 12.3)	7.6 – 8.0	7.5 – 8.2	5.3 – 7.1
Longest gillraker	4.3*	–	1.3 – 2.4	–
Gill filaments at angle	2.8*	–	3.1 – 3.4	–
Longest gill filaments	3.7*	–	3.8 – 4.1	–
Snout/postorbital head	37 – 47%	43 – 44%	47 – 52 + %	*41 – 50%*
Eye/interorbital	65 – 109%	75%	(55 – 71 + %)	(29 – 75%)
Rear nostril/eye	(15 – 25%)	26 – 29%	35 – 49 + %	26 – 37%
Longest dorsal ray/ longest dorsal spine	*100 – 102%*	*119 – 133%*	*110 + %*	(119 – 162%)

TABLE 8. Measurements and proportions of *Epinephelus* spp. (Conventions as in Table 7). *Specimens damaged.

	praeopercularis	*cometae*	*undulosus*	*undulosus* (India)
Number of specimens (TL)	3 (415 – 624)	1 (560)	5 (411 – 715)	3 (262 – 308)
Standard length (mm)	345 – 514	462	346 – 590	216 – 254
	% of SL	% of SL	% of SL	% of SL
Depth	31.1 – 33.5	34.2	33.0 – 34.1	32.7 – 33.6
Head	43.0 – 44.0	44.9	38.2 – 39.0	39.4 – 40.6
Head less chin	40.6 – 42.0	42.6	36.4 – 37.4	38.0 – 39.4
Snout	9.7	11.7	9.2 – 10.6	8.8 – 10.6
Interorbital	6.4 – 7.4	7.1	7.2 – 7.7	6.2 – 6.7
Vertical eye diameter	6.2 – 7.4	6.7	5.2 – 5.5	6.6 – 6.9
Postorbital head	22.8 – 25.1	24.4	21.7 – 22.5	22.1 – 22.4
Least preorbital	3.3 – 3.9	4.3	4.3 – 4.6	3.7 – 4.4
Snout to end of maxilla	17.1 – 19.1	19.5	16.3 – 16.8	17.7 – 18.1
Depth caudal peduncle	10.2 – 10.7	*11.5*	9.7 – 10.4	11.0 – 11.1
Length caudal peduncle	11.6 – 12.0	*9.5*	10.0 – 11.9	11.0 – 11.6
Max. diam. front nostril	0.6 – 0.8	*1.3*	0.7 – 0.9	–
Max. diam. rear nostril	1.2 – 1.4	*2.2*	1.0 – 1.2	–
1st dorsal spine	6.0 – 6.7	*4.3*	5.0 – 5.3	4.9 – 5.1
3rd dorsal spine	(10.9 – 13.9)	*8.9*	9.8 – 12.1	11.8 – 13.8
last dorsal spine	(7.8 – 9.6)	7.6	7.9 – 8.3	8.7 – 10.2
Longest dorsal spine	10.9 – 14.4	11.9	9.8 – 12.1	11.8 – 13.8
Longest dorsal ray	c.13.4*	15.2	10.6 – 13.5	12.6 – 13.3
Longest pectoral ray	20.0 – 21.6	22.8	15.6 – 17.4	19.0 – 19.5
Longest pelvic ray	15.6 – 15.7	*18.2*	17.0 – 18.2	19.0 – 20.0
Longest anal ray	c.16.0*	17.5	13.3 – 14.0	15.0 – 17.7
1st anal spine	4.5 – 5.1	5.0	2.3 – 2.7	2.8 – 3.1
2nd anal spine	7.8 – 9.5	8.4	4.6 – 6.1	6.6 – 7.4
3rd anal spine	9.1 – 10.0	8.6	7.8 – 7.9	7.9 – 8.3
Longest gill-raker	2.4 – 3.1	2.6	4.3 – 4.9	4.6 – 5.3
Gill filaments at angle	2.1 – 2.7	2.2 – 2.4	2.3 – 2.8	2.3 – 2.7
Longest gill filaments	3.3 – 3.5	3.5	3.2 – 3.3	3.0 – 3.5
Eye/interorbital	84 – 116%	94%	67 – 76%	100 – 107%

TABLE 9. Measurements and proportions of *Epinephelus* spp. (Conventions as in Table 7).

	longispinis	*areolatus*	*chlorostigma*	*dictiophorus*
Number of specimens (TL)	7 (130 – 540)	2 (130 – 255)	5 (141 – 590)	3 (137 – 425)
Standard length (mm)	103 – 450	105 – 210	114 – 500	111 – 348
	% SL	% SL	% SL	% SL
Depth	29.2 – 32.0	*33.8 – 37.1*	31.6 – 32.9	32.2 – 33.3
Head	38.9 – 40.2	39.1 – 41.8	37.6 – 40.4	39.8 – 43.0
Head less chin	26.6 – 38.6	38.1 – 39.1	34.4 – 38.6	38.1 – 41.0
Snout	7.3 – 9.3	7.6 – 10.5	8.1 – 11.1	7.5 – 8.7
Interorbital	3.4 – 4.6	*4.3 – 4.8*	5.3 – 6.7	(4.5 – 5.7)
Vertical eye diameter	5.6 – 6.6	6.9 – 8.6	(4.8 – 8.8)	(5.7 – 8.1)
Postorbital head	21.9 – 24.3	21.0 – 21.9	20.4 – 21.5	21.5 – 22.1
Least preorbital width	2.2 – 4.2	2.9 – 4.3	2.2 – 4.8	3.2 – 4.0
Snout to end maxilla	16.5 – 17.5	–	14.8 – 17.8	14.5 – 16.0
Depth caudal peduncle	10.0 – 11.9	10.7 – 11.4	11.0 – 12.2	11.2 – 11.4
Length caudal peduncle	9.5 – 12.2	10.0 – 10.9	11.0 – 12.2	10.4 – 10.9
Max. diam front nostril	–	0.5	0.5 – 0.7	0.4 – 0.5
Max. diam rear nostril	–	0.5	0.6 – 0.8	0.7 – 1.0
1st dorsal spine	6.8 – 8.8	7.4 – 7.6	2.8 – 6.3	(5.2 – 7.2)
3rd dorsal spine	(*13.3 – 17.5*)	*14.3 – 16.2*	(12.0 – 14.0)	13.9 – 17.6
Last dorsal spine	7.8 – 13.1	10.7 – 12.4	(6.6 – 12.3)	9.3 – 12.2
Longest dorsal spine	(13.3 – 17.5)	*14.3 – 16.2*	12.0 – 14.1	14.5 – 17.6
Longest dorsal ray	12.7 – 16.8	13.3 – 16.2	(11.0 – 14.9)	(13.5 – 16.7)
Longest pectoral ray	(21.3 – 25.2)	20.0 – 21.9	19.0 – 22.8	22.4 – 25.2
Longest pelvic ray	(17.3 – 20.4)	20.0	(15.0 – 20.2)	19.4 – 21.6
Longest anal ray	–	14.3 – 17.1	(13.2 – 19.3)	18.7 – 19.2
1st anal spine	–	4.3 – 6.7	(2.2 – 6.1)	(3.4 – 6.3)
2nd anal spine	–	8.6 – 11.4	(5.2 – 12.3)	(8.3 – 13.5)
3rd anal spine	–	10.5 – 12.4	(7.4 – 13.1)	9.3 – 13.5
Longest gill-raker	3.4 – 4.1	3.8	3.3 – 3.8	3.1 – 3.3
Gill filaments at angle	2.0 – 2.6	1.9 – 2.6	2.2 – 2.7	2.4 – 2.7
Longest gill filaments	2.7 – 3.3	2.9 – 3.3	3.0 – 3.6	2.9 – 3.2
Eye/interorbital	135 – 180%	*145 – 200%*	(75 – 167)%	(100 – 180)%

TABLE 10. Numbers of specimens with various counts of dorsal and pectoral fin rays, and of gill-rakers plus rudiments on first gill arch for *Epinephelus tukula*, *E. fuscoguttatus* and *E. microdon*.

Species	Fin Rays		Gill-Rakers + Rudiments		
	Dorsal	Pectoral	Upper Limb	Lower Limb	Total
	13 14 15	15 16 17 18 19	5 6 7 8 9 10	13 14 15 16 17 18	19 20 21 22 23 24 25 26 27 28
tukula	1 2 16	7	1 1 1 1 4	2 1 2 2 1	2 4 1 0 0 1
fuscoguttatus	12 2	8 1	3 2 1 1	1 3 2 1	2 0 5
microdon	2 3	1 3	1 1 2 1	1 2 2	1 0 0 2 2

TABLE 11. Measurements and proportions (in % SL) of *Epinephelus* spp. (Conventions as in Table 7).

	hexagonatus	*spilotoceps*	*merra*	*gilberti*
Number of specimens (TL)	2 (196 – 201)	3 (238 – 308)	5 (163 – 278)	5 (166 – 495)
Standard length (mm)	160 – 167	195 – 248	130 – 225	134 – 405
Depth	30.6 – 31.9	29.0 – 29.8	*32.9 – 35.0*	27.2 – 30.6
Head	38.8 – 39.5	41.0 – 43.2	38.4 – 42.5	37.9 – 43.0
Head less chin	38.1 – 38.3	40.0 – 40.7	37.4 – 41.0	36.6 – 41.3
Snout	6.0 – 6.3	7.6 – 7.7	6.7 – 8.7	6.7 – 9.4
Interorbital	3.0 – 3.1	3.6 – 4.0	3.7 – 4.2	(1.9 – 4.2)
Vertical eye diameter	7.8 – 8.1	7.1 – 7.7	6.4 – 7.7	5.4 – 7.1
Postorbital head	23.1 – 23.9	24.6 – 25.0	23.1 – 25.6	23.7 – 25.7
Least preorbital	2.1 – 2.2	2.1 – 2.4	*2.7 – 3.1*	*3.0 – 4.2*
Snout to end of maxilla	18.0 – 18.7	16.9 – 18.6	16.9 – 18.1	15.7 – 17.9
Depth caudal peduncle	11.9 – 12.0	10.7 – 10.9	10.7 – 11.5	10.4 – 11.4
Length caudal peduncle	10.2 – 10.6	10.3 – 10.8	9.2 – 10.2	9.1 – 10.4
3rd dorsal spine	–	–	–	(12.1 – 14.8)
Last dorsal spine	–	–	–	–
Longest dorsal spine	–	–	–	(12.3 – 14.8)
Longest dorsal ray	–	–	–	(13.7 – 17.8)
Longest pectoral ray	21.6 – 21.9	19.0 – 22.2	21.9 – 25.0	19.6 – 23.2
Longest gill-raker	2.4 – 2.5	2.8 – 3.1	*1.9 – 2.4*	2.9 – 3.7
Gill filaments at angle	2.2 –	2.1 – 2.6	2.3 – 3.2	1.5 – 2.5
Longest gill filaments	3.0 – 3.1	2.8 – 3.0	2.7 – 3.2	2.9 – 3.0

TABLE 12. Measurements and proportions (in % SL) of *Dermatolepis striolatus*, *D. striolatus var. aldabrensis* and *Dinoperca queketti*.

	D. striolatus	*D. striolatus var. aldabrensis*	*Dinoperca queketti*
Number of specimens (TL)	1 (425)	2 (825 – 850)	1 (445)
Standard length (mm)	340	690 – 720	370
Total length	125.0	118.0 – 119.4	120.0
Depth	40.3	36.9 – 38.9	40.6
Head	38.2	31.8 – 32.0	36.5
Head-less-chin	34.0	30.6 – 33.3	34.1
Snout	7.9	8.3 – 8.4	8.1
Interorbital	3.4	4.3 – 4.6	6.8
Vertical eye diameter	5.0	4.9.	8.6
Max. diam front nostril	0.3	0.4 – 0.6	1.3
Max. diam. rear nostril	0.9	0.7 – 1.0	1.3
Postorbital head	22.4	21.6 – 22.0	17.8
Least preorbital width	3.2	3.5 – 3.6	2.7
Snout tip to end of maxilla	14.7	14.8 – 15.2	14.8
Depth caudal peduncle	12.6	11.8 – 12.0	13.5
Length caudal peduncle	10.9	12.3 – 12.5	21.6
1st dorsal spine	6.2	3.6 – 4.9	1.6
3rd dorsal spine	12.3	8.1 – 9.4	6.8
Last dorsal spine	9.1	6.9 – 7.5	5.9
Longest dorsal spine	12.3	8.1 – 9.4	7.8
1st anal spine	3.5	2.4 – 2.5	3.8
2ne anal spine	7.9	4.3 – 4.8	6.8
3rd anal spine	8.5	4.9 – 6.7	8.6
Longest dorsal ray	19.7	13.0 – 13.3	22.7
Longest anal ray	22.3	15.5 – 15.9	22.1
Longest pectoral ray	24.1	18.4 – 18.6	21.6
Longest pelvic ray	19.1	13.8 – 15.9	20.0
Longest gill-raker	2.6	2.6 – 3.1	4.6
Gill filaments at angle	2.5	3.1 – 3.2	3.5
Longest gill filaments	3.2	3.9 – 4.2	4.6

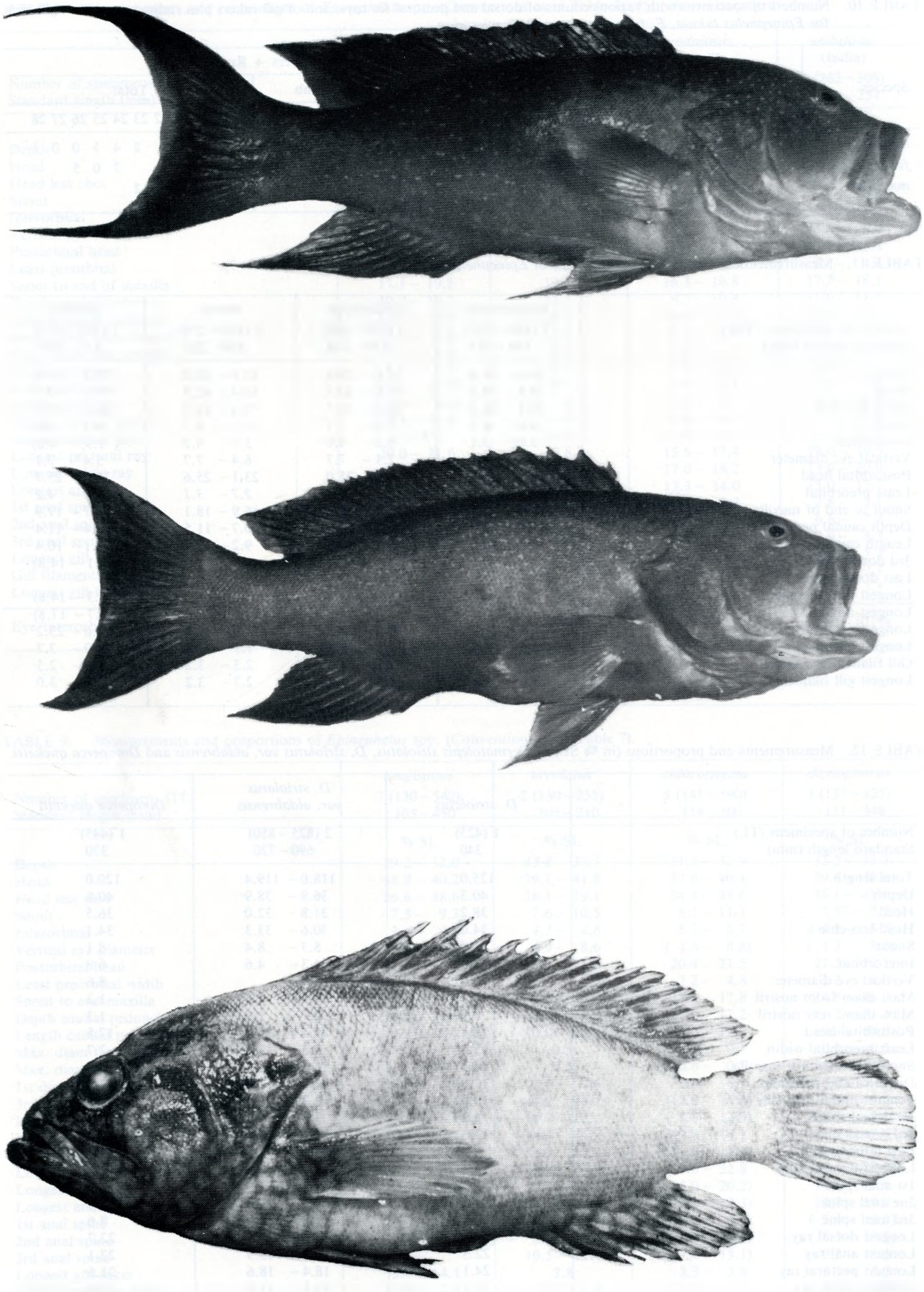

Plate 1. Top figure, *Variola louti*, S28, 32 cm SL. Middle figure, *V. albimarginata*, S29, 32 cm SL. Bottom figure, *Cephalopholis leopardus* S71, 126 mm SL; photographed after ten days preservation during which all pink changed to grey.

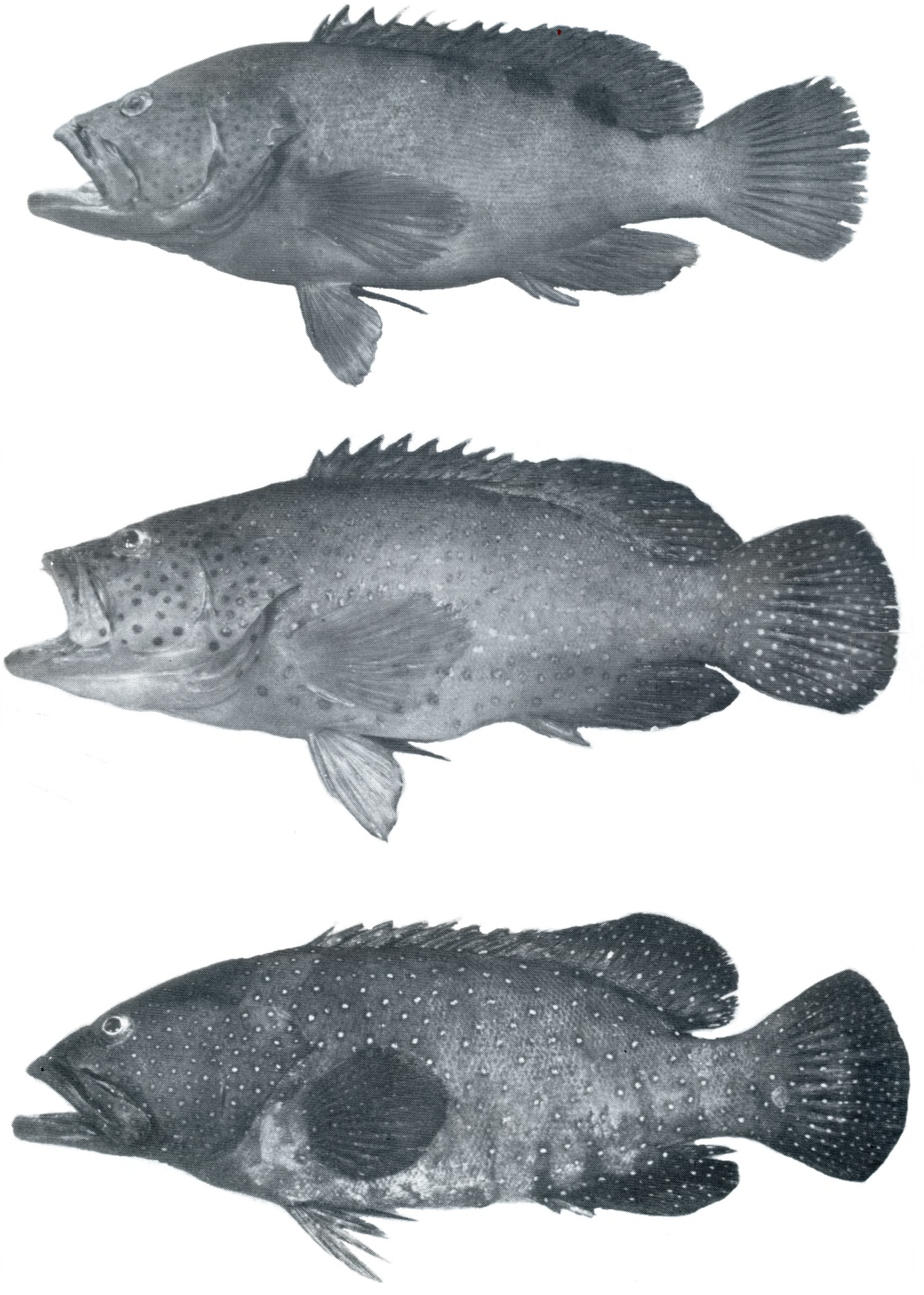

Plate 2. Top figure, *Cephalopholis sexmaculatus*, S112, 285 mm SL. Middle figure, *C. miniatus*, S113, 287 mm SL. Bottom figure, *C. argus*, S104, 225 mm SL (margins of soft dorsal, anal and caudal fins are narrowly white).

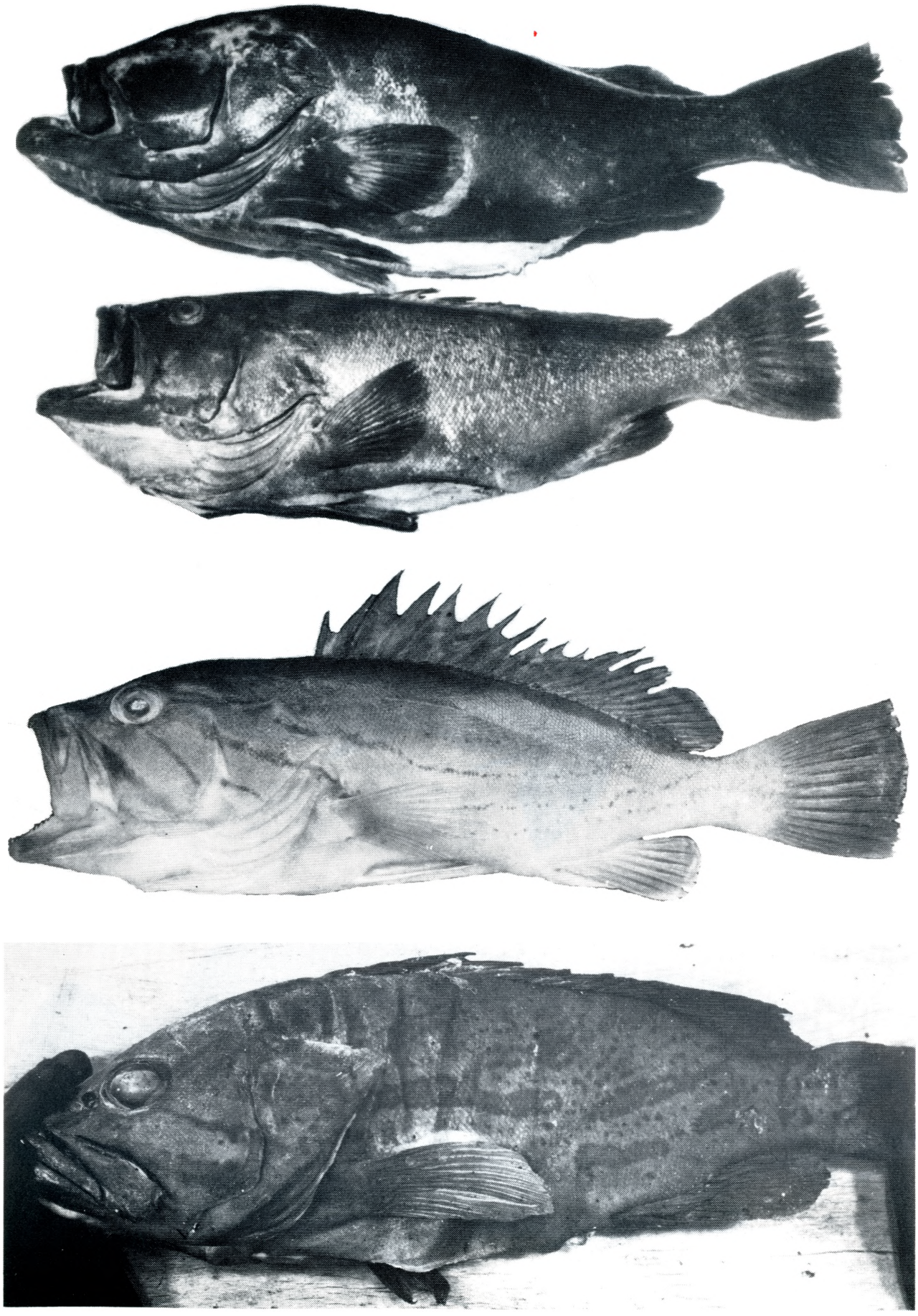

Plate 3. Upper pair, *Epinephelus modestus*: above, S132/1, 115 cm SL; below, S132, 91 cm SL. Middle figure, *E. praeopercularis*, S111, 35 cm SL. Bottom figure, *E. cometae*, S94, 51 cm SL.

Plate 4. Top figure, *Epinephelus undulosus*, S68, 455 mm SL (guts removed). Middle figure, *E. longispinis*, S67, 445 mm SL (guts removed). Bottom figures: Spiniform (right) and stepped (left) processes on maxilla of *E. undulosus* (right) and *E. longispinis* (left).

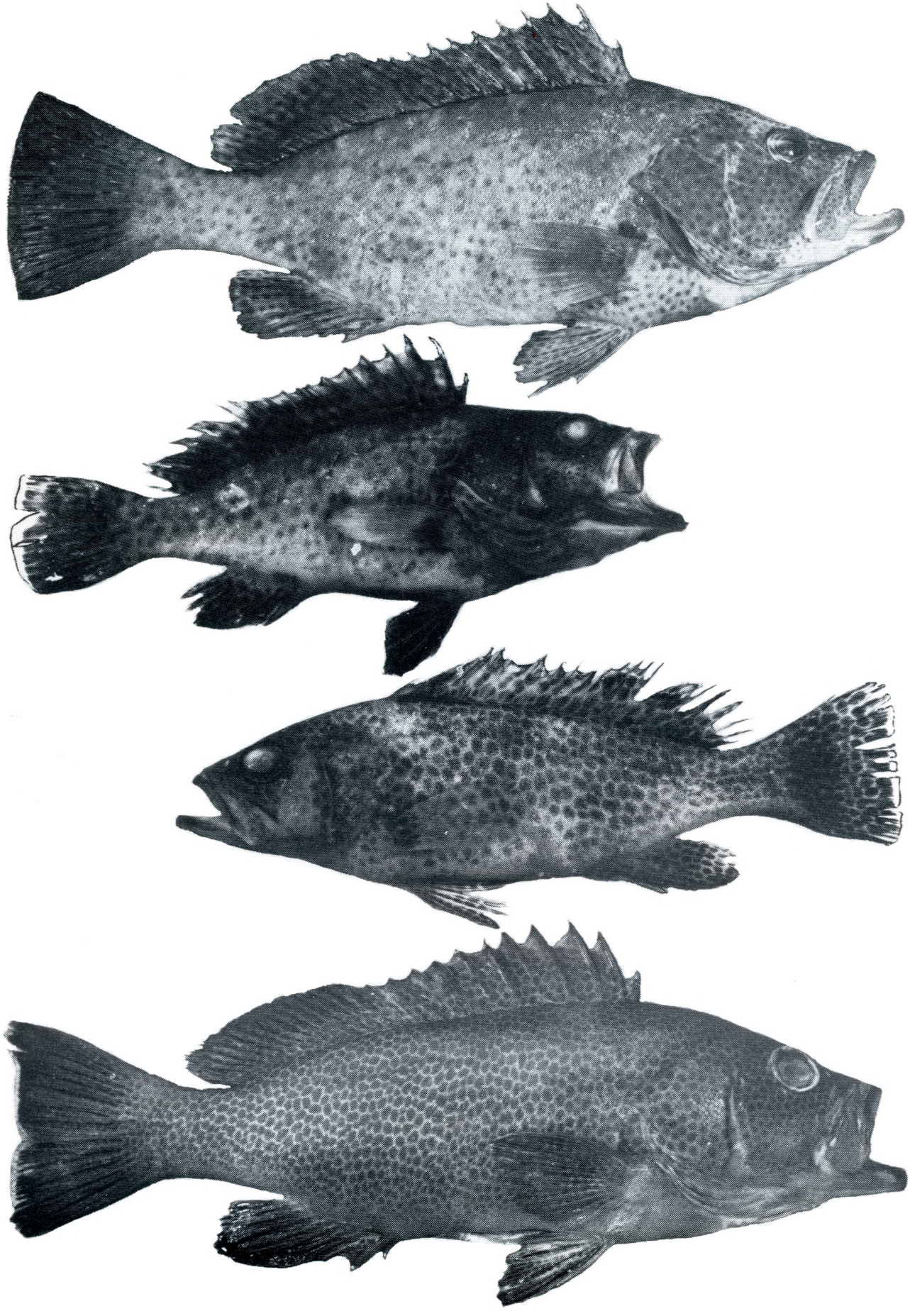

Plate 5. Upper pair, *Epinephelus areolatus*: above, S84, 214 mm SL (photographed stale but before preservation); below, S92, 105 mm Sl. Lower pair, *E. chlorostigma*: above, S91, 117 mm SL; below S65, 33 cm SL (guts removed).

Plate 6. Top figure, *Epinephelus dictiophorus*, S85, 284 mm SL, fresh specimen. Middle pair: above, *E. hexagonatus*, S83/1, 165 mm SL; below, *E. spilotoceps*, S105, 215 mm SL (guts removed). Bottom figure, *E. merra*, S106, 225 mm SL (guts removed).

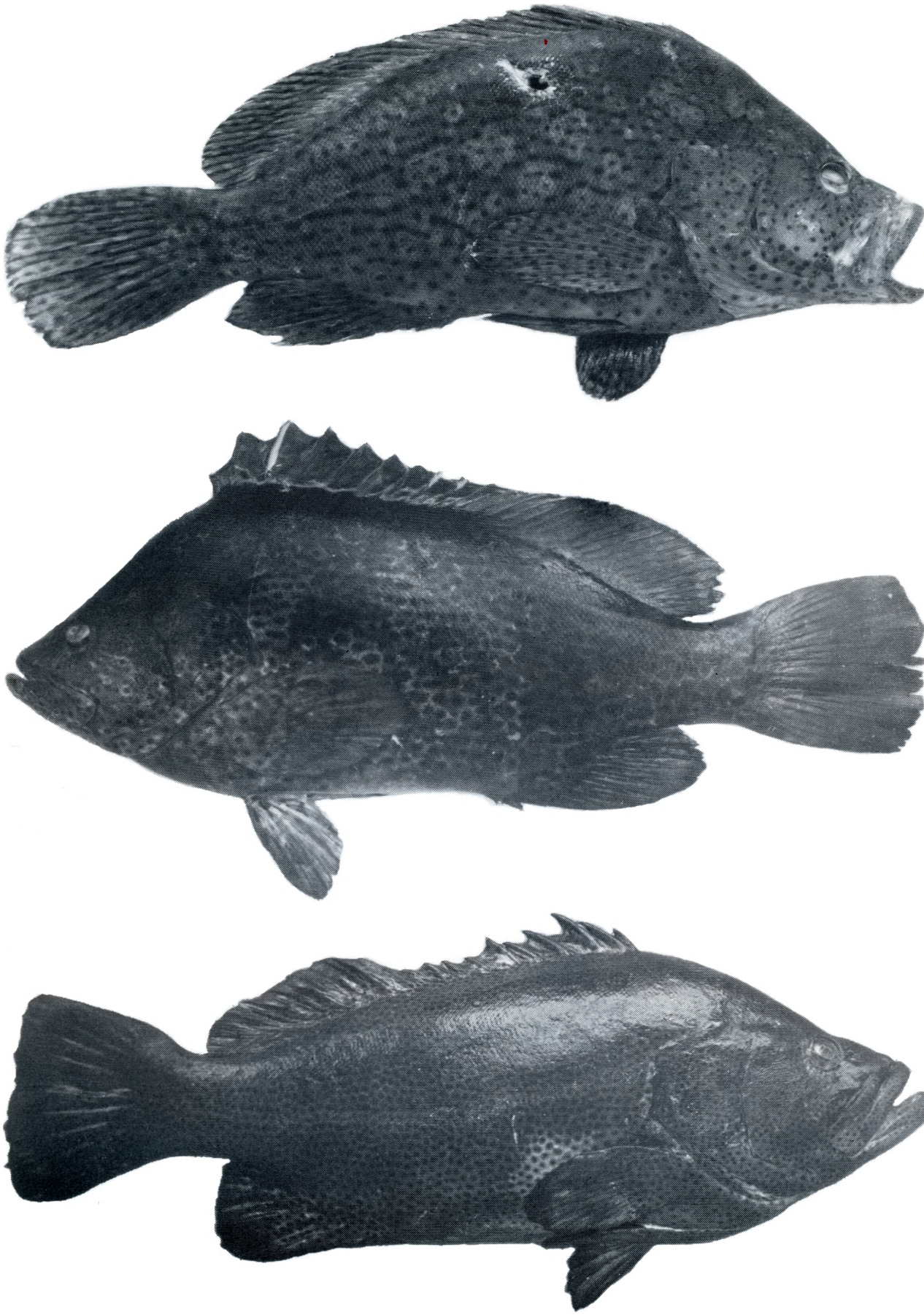

Plate 7. Top figure, *Dermatolepis striolatus*, S101, 34 cm SL (photographed after preservation, showing spear wound). Middle figure, *D. striolatus*, RUSI 11500, 51 cm SL. Bottom figure, *D. striolatus var. aldabrensis*, S80, 73 cm SL.