

A Revision of the Indo-Pacific Fish  
Genus *Gobiopsis* with Descriptions  
of Four New Species  
(Pisces: Gobiidae)

ERNEST A. LACHNER  
and  
JAMES F. MCKINNEY

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## ABSTRACT

Lachner, Ernest A., and James F. McKinney. A Revision of the Indo-Pacific Fish Genus *Gobiopsis* with Descriptions of Four New Species (Pisces: Gobiidae). *Smithsonian Contributions to Zoology*, number 262, 52 pages, 7 figures, 11 plates, 8 tables, 1978.—The genus *Gobiopsis* Steindachner comprises ten species, four of which are described as new. Five monotypic genera are placed in the synonymy of *Gobiopsis*, namely *Pogonogobius* H. M. Smith, *Pipidonia* H. M. Smith, *Herreogobius* Koumans, *Barbatogobius* Koumans, and *Abranches* J.L.B. Smith. Salient characters of the genus include the following: a broad, depressed head with pug-nosed snout; head with barbels in particular positions; cutaneous papillae and cephalic sensory pore and canal systems interrelated; sensory pores large, some on tubes, slit-like and hooded; a fleshy midcheek fold; and a dark sickle-shaped mark at base of pectoral fin. The species we recognize in *Gobiopsis* are *Gobiopsis macrostoma* Steindachner, *Heteroleotris arenarius* Snyder, *Pipidonia quinquecincta* H. M. Smith, *Ctenogobius malekulae* Herre, *Macgregorella bravoii* Herre, and *Abranches pinto* J.L.B. Smith. The four new species are *G. angustifrons*, *G. aporia*, *G. canalis*, and *G. woodsi*, which are variously distributed in the Indo-Pacific region. Two species groups are defined. A key is given differentiating the species. Distributions of the species are plotted on maps. Drawings and photographs of the heads or bodies of all species are provided.

The genus is distributed along the tropical continental slopes of Africa, Asia, Australia, and major islands of the East Indies and Philippines; it has not been found in the Red Sea, the insular Indian Ocean areas, nor Oceania.

The various and elaborate development of cephalic sensory structures, the general body physiognomy including the depressed head and upturned snout, and the obliterative color pattern are, apparently, adaptations of subsurface dwelling species for preferred habitats of sandy, muddy, or coral-rubble areas.

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# A Revision of the Indo-Pacific Fish Genus *Gobiopsis* with Descriptions of Four New Species (Pisces: Gobiidae)

*Ernest A. Lachner*  
and *James F. McKinney*

## Introduction

This study is an extension of the survey of gobies having prominent head barbels reported by Lachner and McKinney (1974). Many of the nominal genera of Indo-Pacific barbeled gobies are infrequently encountered and their taxonomic status is poorly known. The various nominal species previously have been placed in genera as a convenience rather than from an understanding of their interspecific relationships. In our treatment of *Barbuligobius* (Lachner and McKinney, 1974:878) we observed similarities among nominal species that we referred to the genus *Pipidonia* H. M. Smith. Subsequently we have found additional genera and species referable to this genus and we have discussed these in our communications with our colleagues in many institutions over the world. We recently learned and now report that the genus *Pipidonia* is a synonym of *Gobiopsis* Steindachner (1861:291). The objectives of this paper are to redescribe the genus *Gobiopsis*, reallocate five nominal genera to its synonymy, rede-

scribe six valid nominal species in the genus and describe four new species.

At the time of our allocation of species to the genus *Pipidonia* (Lachner and McKinney, 1974:878) we did not include *Pogonogobius* H. M. Smith (1931:37; type species *Gobius planifrons* Day) because (1) we could not adequately assess Smith's generic description, (2) Smith did not compare the genus with *Pipidonia*, which he described as new in the same paper, (H. M. Smith 1931:39), and (3) we were unaware that type material of *Gobius planifrons* Day was extant.

After 1974, we obtained the putative type specimen of *Gobius planifrons* and determined that *Pipidonia* and *Pogonogobius* are congeneric. Our use of the name *Pipidonia* in preference to *Pogonogobius* in labeling collections and in correspondence was based on our actions (Lachner and McKinney, 1974) as first revisors. Also, the name *Pipidonia* had received greater usage in the literature, although both names had limited use.

ACKNOWLEDGMENTS.—For loans and exchanges of specimens and for providing information on material in their care, we thank the following individuals (for explanation of abbreviations see "Methods"): D. E. Rosen and C. L. Smith (AMNH); J. R. Paxton and D. F. Hoese (AMS); J. E. Böhlke and W. F. Smith-Vaniz (ANSP); P. J. Whitehead

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Detailed drawings of the heads were made by J. R. Schroeder. Ms. S. Karnella (NMNH) provided Figure 1. R. F. Gressey (NMNH) identified and provided information on parasitic copepods found on some specimens. M. F. Gomon (University of Miami) located specimens in the AMS collection. V. G. Springer (NMNH) provided habitat information for some collections.

#### METHODS

Methods and techniques of making and recording counts and mensurations are similar to those given by Lachner and McKinney (1974), with the following exceptions. The vertical fin rays of poorly preserved type and nontype specimens representing important historical or geographical material were counted from radiographs. The pectoral fin rays and barbels were counted on both sides when possible and are tabulated as separate counts. Counts of the segmented and branched caudal fin rays were taken from larger specimens that could be sexed externally. The horizontal or lateral scale count includes all rows from the dorsal insertion of the pectoral fin to the midbase of the caudal fin. The scales are smaller and often irregularly arranged anteriorly compared with those on the caudal peduncle. Some specimens have the body covered with a heavy mucous layer. These conditions made it practically impossible to repeat the same count for an individual specimen. Therefore, we have presented only the ranges of the scale counts by species.

**MEASUREMENTS.**—Proportional measurements were taken from specimens that could be sexed externally by examination of the genital papilla.

The straight line distance from the insertion of the pelvic fin spine to the origin of the anal fin was used in computations involved in Figure 3.

The postanal length was taken as a straight line measurement from the origin of the anal fin to the midbase of the hypural.

The lower jaw was measured from the extreme anterior midportion to its posterior tip.

The diameter of the orbit and the interorbital width are difficult to measure precisely because of the dense, fleshy tissue over these areas. Our measurements of these characters approximate the distances between the bony structures.

All counts and measurements were taken on the left side unless otherwise indicated.

Scales were taken from the middorsolateral area of the trunks of several specimens in determining scale morphology.

We follow the method of Birdsong (1975:137) in describing the relationship of the spinous dorsal fin pterygiophores with the underlying vertebrae.

**COLOR PATTERN.**—There is considerable individual variation in the color pattern of some species. Our description of the preserved coloration in such species is based on a number of specimens, segregated by sex and size groups, having a consistent pattern.

**EXTERNAL SENSORY STRUCTURES.**—Strong light, high magnification, and a fine jet of compressed air often facilitated examination of the sensory pores, barbels, and cutaneous papillae. The drawings of the heads in Plates 1–6, based on a single specimen primarily to show the head physiognomy and the patterns of the barbels and sensory pores, may not show the complete cutaneous papillae pattern. However, the salient papillae patterns described below are evident on these illustrations.

*Cephalic Sensory Pore and Canal System:* Location of the cephalic sensory pores is shown on the generalized drawing (Figure 1). Abbreviations used in Figure 1 and in descriptive portions of the text follow:

|      |                        |
|------|------------------------|
| AOT  | anterior otic          |
| AT   | anterior temporal      |
| IT   | intertemporal          |
| NA   | nasal                  |
| PITO | posterior interorbital |
| PT   | posterior temporal     |
| POP  | preopercular           |
| SOT  | supraotic              |

Specific pores in all of the species are located in approximately the same place. The pores of *Gobiopsis* are generally easy to observe in well preserved specimens because of their comparatively large oval or slitlike orifices and their encirclement by small, dense chromatophores. The posterior in-

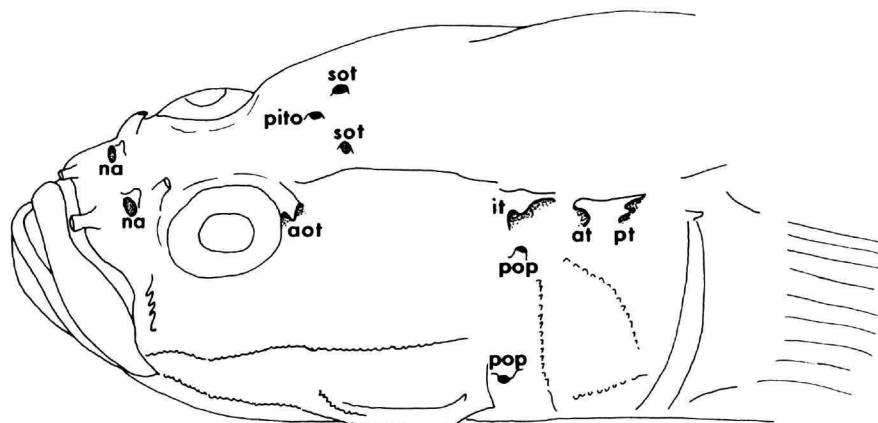


FIGURE 1.—Diagrammatic dorsolateral view of head of *Gobiopsis*, barbels and papillae omitted, showing cephalic sensory pores and canals found in various species (for explanation of abbreviations see "Methods").

terorbital and supraorbital pores open at the end of a tube, the orifice of which is covered by a well developed flap. The posterior interorbital and supraorbital pores are characteristically located more posteriorly on the head than are the same pores we described in *Barbuligobius* (Lachner and McKinney, 1974), but we adhere to the same terminology as used in that paper in lieu of more comprehensive comparative external and internal studies of this system in relation to the cranium in gobioid fishes.

**Barbels:** The larger barbels almost always occur in either clusters or rows on specific portions of the head (Figure 2). The mandibular barbels that are in rows are usually simple and elongated. Barbels on the snout are often clustered, complex structures. Some clusters are mounted on an elongate fleshy flap or fold. Others are mounted on fleshy stalks or circular bases, and these may be simple, bifid, or multifid. A bifid barbel was counted as one if the tip is divided into two parts but the divided portion is less than one-half its total length. If the division is more than one-half of the total length, it was counted as two. Barbels are difficult to find on old, dried, or poorly preserved specimens. Such specimens may have much tissue torn about the head, making an accurate barbel count impossible. The counts from specimens showing only evident barbels are shown in Table 3.

Terminology used to identify the important barbels follows.

**Chin (or mental):** a cluster of barbels, almost always 2, on each side at symphysis of lower jaw.

**Anterior gular:** a transverse medial group of barbels, frequently 2 or 3 in number, located just posterior to chin barbels on anterior hyoid area.

**Posterior gular:** usually an irregular group of 1-4 small barbels on midhyoid area, often absent.

**Intermandibular chin row:** simple, small to large, elongate barbels in a row on fleshy fold located mesad on lower jaw, numbering 1-8 on each side.

**Posterior mandibular row:** 1-6 simple barbels on posterior portion of dentary, one of which is terminally located on the bone.

**Postmandibular:** a single, simple elongate barbel on upper row of papillae posterior to rictus on preopercle.

**Anterior cheek tuft:** a cluster of 1-7, usually 3-5, barbels varying in size from small barbellike projections to some as large as those on chin, and mounted on a fleshy tuft at junction of midcheek skin fold and maxillary.

**Anterior internasal group:** a small group of barbels, usually 2-3 in number, often bifid, rarely trifold, at tip, bordering the maxillary, on each side of midline between anterior nares.

**Posterior internasal group:** usually a simple barbel, sometimes bifid, on each side of midline between posterior nares.

Small barbels, usually simple or bifid, are found on various parts of the head, particularly on the snout of certain species. Some of these are tiny,

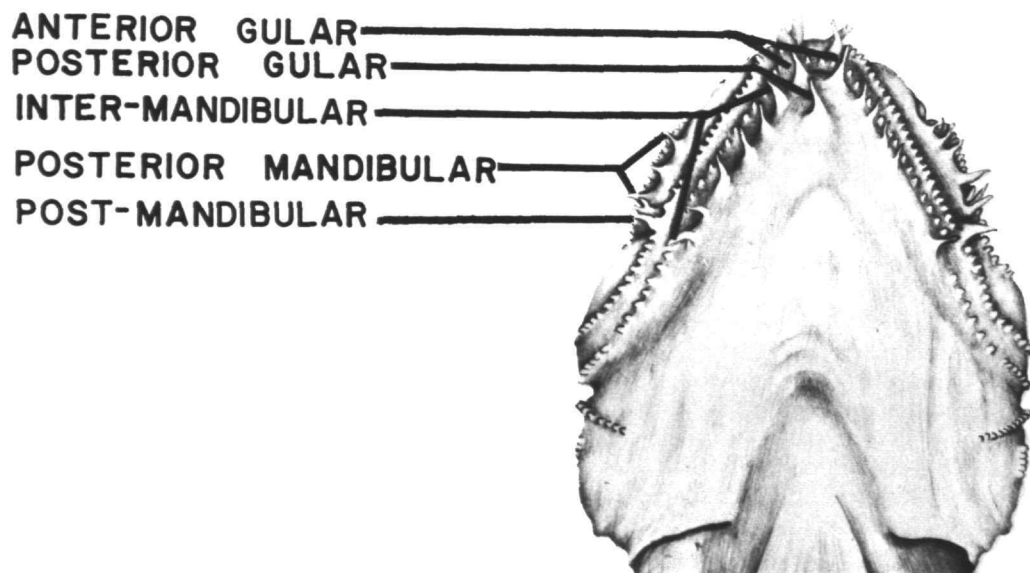
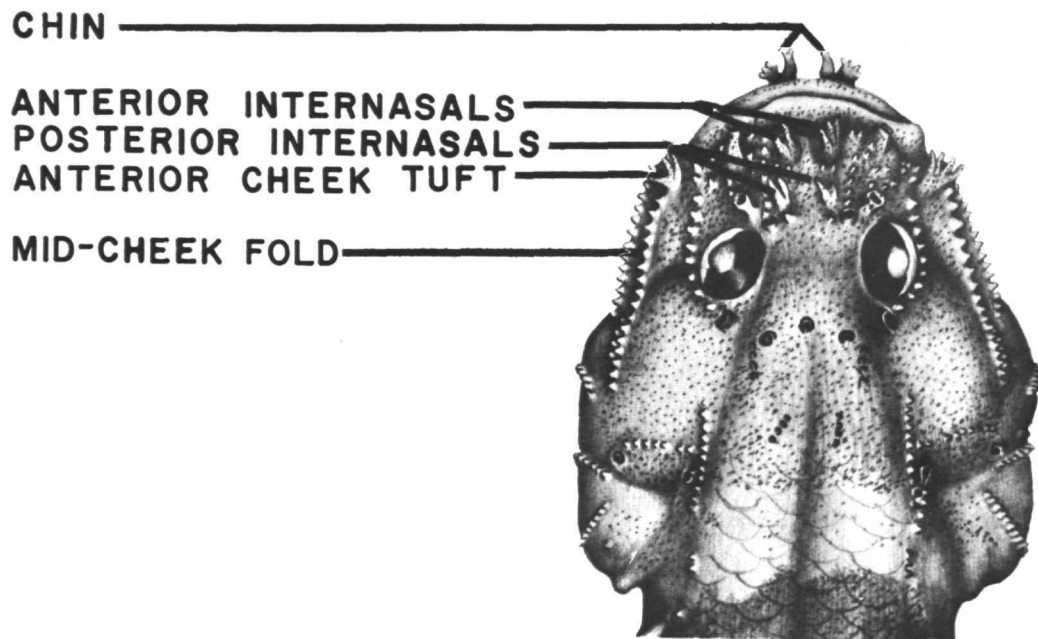


FIGURE 2.—Particular barbels or barbel groups found on species of *Gobiopsis*, dorsal and ventral views.



barbellike projections, often only slightly larger than a large papilla.

*Cutaneous Papillae System:* A general account of the gobioid papillae system is reviewed by Lachner and McKinney (1974:870). Because of erosion, drying, or incomplete development of papillae on any particular specimen, the papillae pattern in each species of *Gobiopsis* was determined by examining a number of specimens. In order to discuss and compare rows of papillae we have adopted terminology denoting their location. We do not imply that this terminology is adequate or suitable for other gobies. Identifiable rows of papillae in *Gobiopsis*, such as those on the cheek and the cheek fold, may not be homologous to those similarly located on other gobioid fishes that lack the fold.

The principle rows of papillae were examined and compared among the species. We reviewed the studies of various authors in respect to the terminology used to identify particular rows or series of papillae. At best, the alphanumeric symbols or abbreviated descriptive words employed by other workers are not entirely applicable to the cutaneous papillae system present in *Gobiopsis*; at the worst, such symbols serve no useful purpose. Comprehensive studies of gobioid sensory pore and papillae systems of many genera would be necessary to afford the possibility of developing a useful comparative terminology. Perhaps the highly adaptive nature of such sensory structures as the papillae, barbels, canals, and pores of gobioid fishes may obviate the possibility of any reasonably consistent terminology. Takagi (1963) describes and compares many papillae patterns and sensory pore and canal types among the gobioid fishes found in Japanese waters. This detailed work also includes an excellent review of the literature of these sensory structures but it illustrates the need for further analysis and interpretation of such sensory systems.

The following three rows of papillae are intimately associated with the cephalic sensory pore and canal system.

**Suborbital row:** commences at fleshy margin of snout, above the anterior cheek tuft, and continues under the eye, terminating at the AOT pore.

**Nasal row:** originates on tip of snout between the anterior nares and the anterior internasal barbel group and continues posteriorly to the nasal pore; continues posteriorly around the eye and is con-

fluent with the suborbital row when all of the sensory pores are absent (Plate 1) or terminates posteriorly at the sot pore when the nasal pore is absent (Plate 5).

**Lateral cephalic row:** three variations exist: (1) originates at the row of papillae encircling the eye and extends posteriorly to the end of the upper gill opening (Plate 1); (2) originates at the IT pore and extends posteriorly to or slightly beyond the upper gill opening (Plates 5, 6); or (3) originates at the IT pore and extends posteriorly to or slightly beyond the upper gill opening but is interrupted by the closed AT-PT canal (Plates 2-4).

Other rows or series of papillae not intimately associated with pores or canals follow.

**Secondary lateral cephalic row:** located just above and parallel to the lateral cephalic series (shown best in Plate 2*b*); originates midway between the AOT and IT pores and continues posteriorly to about the level of the upper gill opening, but is interrupted above the AT-PT canal; in a similar position when pores and canals are absent.

**Preopercular row:** a short, vertical row on upper preopercle that descends from the secondary lateral cephalic row to a level just anterior to the upper POP pore, or to a similar position when the POP pore is absent.

**Cheek rows:** there are four rows of papillae on the cheek below the suborbital row: the first row borders the cheek fold and originates at the anterior cheek tuft of barbels and extends posteriorly beyond the midpreopercle; the second row, of coarser and more widely separated papillae than those of the first row, lies beneath the cheek fold (or nearly so) and is about as long as the first row; the third row, short and with poorly developed papillae, begins at a point vertically below the posterior margin of the eye and extends posteriorly to about midpreopercle; the fourth row curves ventrally from the anterior cheek tuft, borders the upper jaw and extends posteriorly on the lower preopercle.

**Preoperculo-mandibular series:** consists of two parallel rows originating on the chin opposite the paired chin barbels, borders the lower jaw, extends posteriorly on the preopercular margin and ascends to about the lower preopercular pore, or to a similar area when pore is absent.

**Transverse snout row:** occurs on the fleshy edge of the snout bordering the labial groove, is almost

always developed between anterior cheek tufts, and is confluent in some species with the fourth cheek row.

Anterior nostril series: a row and sometimes other scattered papillae more or less encompassing the anterior nostril and the associated short barbels.

Posterior nostril row: a short, sometimes weak or obscure row posterior and mesad of the posterior nostril.

Postorbital row: a short row on the head behind the eye, extending posteriorly and mesially from just lateral to the sor pore, or from a similar position when pore is absent.

Occipital series: three short, more or less longitudinal rows on each side of head in the midoccipital area.

Opercular series: three unconnected rows arranged in an irregular triangle on the opercle, apparently present in most, if not all gobioid fishes.

Pectoral series: a cluster of short vertical, oblique, and horizontal rows present in the area above the base of the pectoral fin.

Trunk series: short, vertical rows of fine papillae extending from behind the base of the pectoral fin to the base of the caudal fin, each row about one to three scale rows in height and positioned on the anterior exposed portions of the scales; rows are staggered on the anterior trunk and sometimes on the belly; those on caudal peduncle are more regularly arranged on midside.

Caudal series: consists of three horizontal rows of fine papillae on the lower margin of the sixth and ninth, and upper margin of the twelfth segmented caudal fin rays; papillae rarely on the upper margin of thirteenth caudal fin rays.

PRESENTATION OF DATA.—In the descriptive accounts, the values given for meristic characters are followed by frequencies of counts in parentheses. The frequency that includes the holotypic value is italicized. Values for measurements, expressed in thousandths of the standard length (SL), include the mean, the range in parentheses, and the number of specimens measured.

Data in the section on material examined include the following: general geographic area; type status, if any; catalogue number; sex, for type specimens; number of specimens in the collection; standard length (SL), mm, in parentheses (range given if more than one specimen); specific locality; collector and/or field number; date collected.

Synonymies are based on examination of original specimens, an illustration, or adequate descriptive data.

ABBREVIATIONS.—Institutions and collections cited:

|      |  |
|------|--|
| AMNH | American Museum of Natural History, New York   |
| AMS  | Australian Museum, Sydney  |
| ANSP | Academy of Natural Science of Philadelphia   |
| BMNH | British Museum (Natural History), London   |
| BPBM | Bernice P. Bishop Museum, Honolulu   |
| CAS  | California Academy of Sciences, San Francisco; also houses collections formerly at Stanford University (SU), including the George Vanderbilt Foundation collections (GVF register numbers) |
| FMNH | Field Museum of Natural History, Chicago   |
| GVF  | See CAS  |
| KSHS | Kochi Senior High School, Kochi City, Japan  |
| NMNH | National Museum of Natural History, Smithsonian Institution, Washington, D.C.  |
| NMW  | Naturhistorisches Museum, Vienna   |
| RMNH | Rijksmuseum van Natuurlijke Historie, Leiden   |
| RUSI | Rhodes University, J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa  |
| SU   | See CAS  |
| USNM | Collections of the United States National Museum now in NMNH   |
| UZMK | Universitetets Zoologiske Museum, Copenhagen   |
| ZSIC | Zoological Survey of India, Calcutta   |

#### ANALYSIS OF CHARACTERS

The important characters useful in differentiating among the species and species groups are as follows.

CEPHALIC SENSORY PORE AND CANAL SYSTEM.—The pores in *Gobiopsis* are conspicuous and easily observed for study. The full complement is usually developed at about 18 mm SL, and sometimes at lesser sizes (*G. quinquecincta*, 15.2 mm SL). The presence of a particular pore or groups of pores is one of the important species characters of the genus. There is little variation in the occurrence of a particular pore within any species; most of the pores are either present or absent. Where variation occurs, the tendency is for reduction in the number of pores. We found no examples, among the adults and larger juveniles, of a particular pore being present even on one side in species where it is typically absent. In *G. pinto*, two specimens (27 and 30 mm SL) had the PITO pore but it was absent in seven larger specimens (35–51 mm SL).

The number, distribution, and variation in occurrence of the sensory pores in 608 specimens involving all of the species of *Gobiopsis* are given in Tables 1 and 2. Abbreviations for these pores are

defined in "Methods." The SOT pore was the most variable. In the most abundant species *G. quinquecincta*, where we analyzed the pore pattern in 402 specimens, the SOT pore was absent on both sides in only 7 specimens, or about 1.7 percent. In all the species, only three pores at particular sites were found to be developed as double structures and one pore as a triple structure. These anomalies were at the PITO, SOT, and IT pore sites. The absence of specific pores, such as the NA, PITO, SOT, or POP, aided in distinguishing one or more species. One species, *G. aporia*, never has any developed pores or vestiges thereof. Of the nine other species, the NA pores are absent only in *G. malekulae*, the PITO pore is absent in *G. malekulae* and *G. pinto*, and the two POP pores are always absent in *G. arenaria* and *G. malekulae*. There is a reduction of the paired POP pores in *G. canalis* from two to one. The presence of the AT and PT pores and canal, and the location of the NA pore anterior to the posterior nostril, rather than adjacent to or behind it, are characters unique to the *G. macrostoma* species group, which includes the species *G. macrostoma*, *G. canalis*, *G. pinto* and *G. woodsi*. The AT and PT pores were considered absent on one side of four specimens because the canal was incompletely developed.

Unlike the developmental conditions of sensory pores found in the goby genus *Gillichthys* by Barlow (1961) we found that the full species complement is attained at a small size, that the pattern and number of pores do not vary with increased size among the juveniles and adults, and that for any species the presence of a specific pore is extremely stable.

**CUTANEOUS PAPILLAE SYSTEM.**—The full papillae complement is attained at small sizes, thereby enhancing the usefulness of this character as a systematic tool. For example, some specimens of *G. aporia* develop the characteristic row of papillae encircling the eye at about 9 mm SL. In some species the rows of papillae are longer, finer, and more delicate than those of others, e.g., the cheek row on *G. macrostoma* (Plate 2*b*); such differences are of some aid in species recognition. But the most important diagnostic differences of the papillae system are the rows that are intimately associated with the occurrence of certain sensory pores. Four patterns were observed.

*Pattern 1:* No cephalic sensory pores; the nasal papillae row encircles eye and is confluent with the suborbital row; the primary lateral cephalic row

extends from behind eye to upper gill opening; occurs in one species, *G. aporia* (see Plate 1).

*Pattern 2:* NA and PITO pores absent, SOT pore present; the nasal papillae row terminates posteriorly at the SOT pore; the lateral cephalic papillae row originates at the IT pore and extends uninterrupted posteriorly to or slightly beyond the upper gill opening; occurs in one species, *G. malekulae* (Plate 5*a,b*).

*Pattern 3:* NA pore present; the nasal papillae row terminates at the NA pore; the lateral cephalic papillae row is similar to pattern 2; occurs in four species (the *G. quinquecincta* species group): *G. angustifrons*, *G. arenaria*, *G. bravoii*, and *G. quinquecincta* (Plate 6*a-d*).

*Pattern 4:* NA pore present; the nasal papillae row is similar to pattern 3; the lateral cephalic papillae row originates at the IT pore and extends posteriorly to or slightly beyond the upper gill opening but it is interrupted by the closed AT-PT canal; occurs in four species (the *G. macrostoma* species group): *G. canalis*, *G. pinto*, *G. macrostoma*, and *G. woodsi* (Plates 2*b*, 3*a,b*, 4*a,b*).

These patterns describe the ways in which the extent of development of the nasal and lateral cephalic rows of papillae separates the *G. macrostoma* and *G. quinquecincta* species groups as well as the species *G. aporia* and *G. malakulae*.

**BARBELS.**—The presence and number of barbels in particular groups or rows on the snout and laterally and ventrally on the head differ among the species. The mode, mean, range, and number of counts for barbels on specific locations of the head in all the species of *Gobiopsis* are given in Table 3. The barbels on the anterior cheek tuft are long to short, differing among the species. In *G. aporia*, *G. canalis*, *G. pinto*, *G. macrostoma*, and *G. woodsi* the lowermost barbel on the anterior cheek tuft is long and the others in the group are shorter, usually less than one-half the length of the lower barbel. The other five species have anterior cheek tuft barbels comparatively shorter and not differing in size as much as on the species listed above. There are elongate barbellike structures replacing the papillae on the first cheek row of *G. pinto*.

**MERISTIC CHARACTERS.**—The number of pectoral fin rays for the species of *Gobiopsis* are given in Table 4. The pectoral fin ray count ranges from 15 to 23 for the genus and the range of mean values among the species is 17.4 to 22.5. Several species



may be easily identified by this count. The *G. macrostoma* species group has a high pectoral fin ray count, almost always from 20 to 23, and the *G. quinquecincta* species group almost always has a low pectoral fin ray count, numbering 15 to 19.

The number of lateral scale rows varies considerably in some *Gobiopsis* (Table 5), particularly in species where the scales are smaller and more difficult to count. The range of the scale row counts for the genus extends from about 28 to 60. Nevertheless this character is useful in differentiating among several species. *G. angustifrons*, *G. arenaria*, *G. bravoii*, *G. malekulae*, *G. quinquecincta*, and *G. woodsi* are large-scaled forms, while *G. canalis* and *G. pinto* are the small-scaled species.

**MORPHOMETRIC CHARACTERS.**—The length of the pelvic fins is an important species group character; the length expressed as percent of distance from pelvic fin base to the origin of the anal fin is shown for eight species in Figure 3. The *G. macrostoma* species group has longer pelvic fins than the *G. quinquecincta* species group, as well as the species *G. aporia* and *G. malekulae*. Two species are not shown in Figure 3, *G. canalis* (values of 72 and 77 percent) and *G. malekulae* (values of about 50 percent).

The length of the lower jaw is also a species group character; the *G. macrostoma* group has moderate to long jaws and the *G. quinquecincta* group, as well as *G. aporia* and *G. malekulae*, have short jaws. There is considerable overlap in jaw length interspecifically, *G. woodsi* having an intermediate jaw length, about 13 to 18 percent of SL. The jaw is very short in *G. arenaria*, *G. malekulae*, and *G. quinquecincta* (about 10 to 13 percent of SL). *G. macrostoma* has the longest jaw, about 16 to 23 percent of SL. The largest species have the longest jaws. The length of the lower jaw is compared for species of the *G. macrostoma* group in Figure 4. Jaw length is also intraspecifically related to body length. There is an allometric increase in jaw length with increase in body length. In some species, especially *G. woodsi* (Figure 4), males have longer jaws than females.

The depth of the caudal peduncle expressed as percent of the postanal length is useful as a specific character in differentiating the deeper bodied forms (*G. angustifrons*, *G. bravoii*, and *G. quinquecincta*) from the slender form, *G. arenaria* (Figure 5).

The diameter of the orbit differs among the

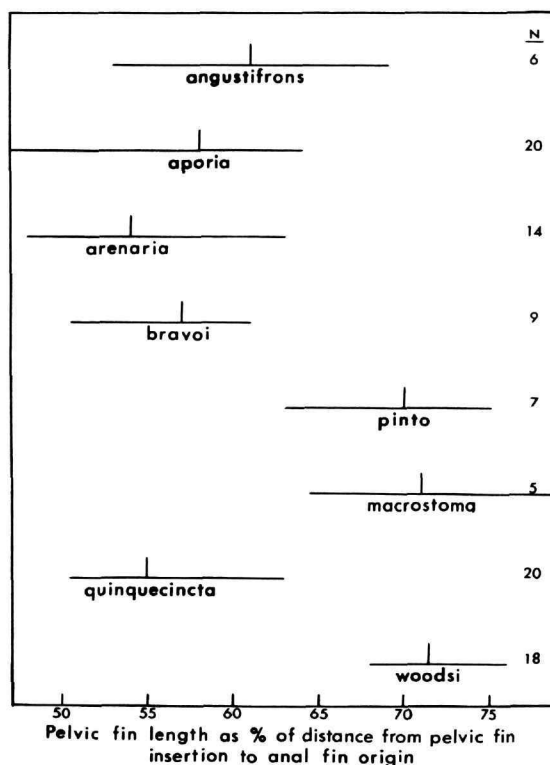


FIGURE 3.—Pelvic fin length as percent of distance from pelvic fin insertion to anal fin origin in eight species of *Gobiopsis* (horizontal lines represent ranges of percents; vertical lines mark means of percents; N = numbers of specimens).

species, and especially so in relation to the width of the interorbital dimension. The orbit diameter is equal to or less than the bony interorbital width in *G. bravoii*, but it is always greater than the bony interorbital width in the closely related species *G. angustifrons*.

**TYPE OF SCALES.**—There are ctenoid-scaled and cycloid-scaled species within *Gobiopsis*. The scales are strongly ctenoid in *G. macrostoma* and *G. woodsi*. A few scales on specimens of *G. quinquecincta* may bear ctenii, but most of the scales are cycloid. The other seven species have only cycloid scales.

**DENTITION.**—Males of *G. canalis*, *G. pinto*, and *G. woodsi* have enlarged, recurved canine teeth medially on inner row of upper jaw. The dentition of the jaws among all of the remainder of the species is fairly uniform, consisting of small, villiform teeth

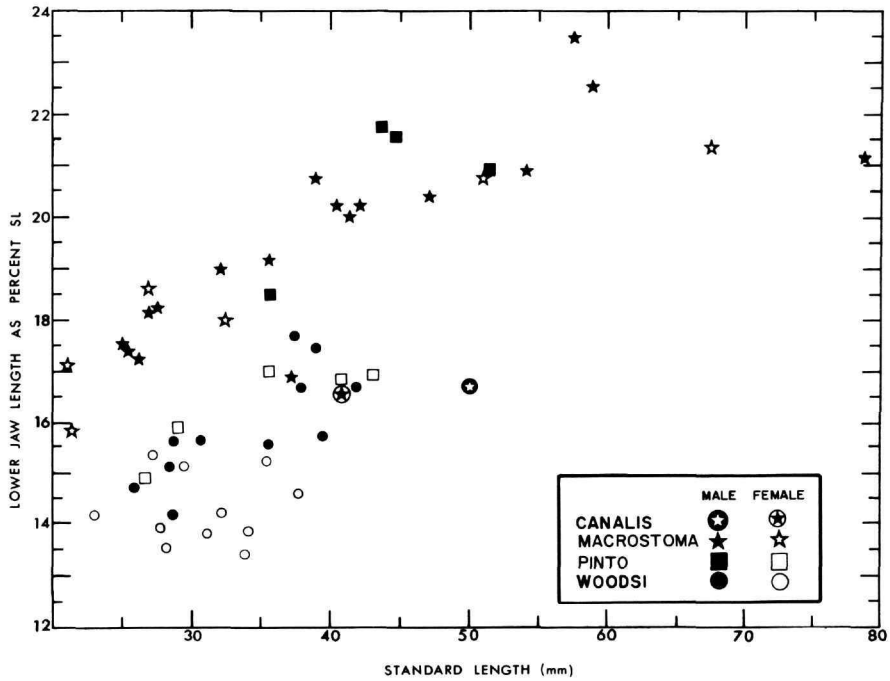


FIGURE 4.—Lower jaw length as percent of standard length versus standard length in four species of *Gobiopsis*.

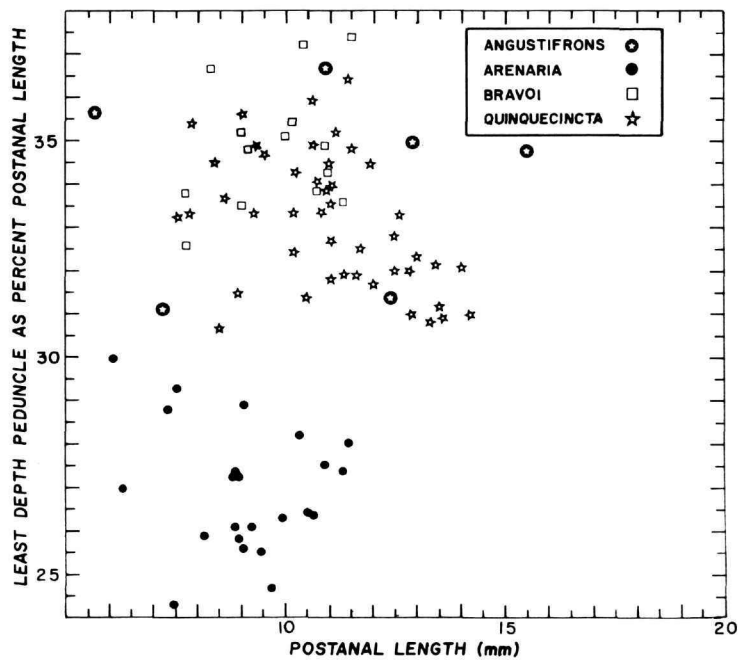


FIGURE 5.—Least depth of caudal peduncle as percent of postanal length versus postanal length in four species of *Gobiopsis*.

in patches, those of the outer row variously enlarged.

**COLORATION.**—The presence of distinct marks, bars, or saddles on particular areas of the head and trunk provide useful characters in distinguishing between species groups or among the species. The salient color patterns are summarized in Table 5.

A dark wedge at the base of the pectoral fin projects anteriorly and divides, or nearly so, the light basal area into upper and lower portions in the four species of the *G. macrostoma* group. The light basal area is undivided in the *G. quinquecineta* group as well as in *G. aporia* and *G. malekulae*.

A dark wedge present in some species on the preopercle descends dorsally from the head to the middle or lower preopercle. The wedge descends to the upper preopercle in *G. arenaria*. In *G. aporia*, *G. canalis*, *G. pinto*, *G. macrostoma*, and *G. woodsi* the dark wedge is obscured by dark mottling or it is not noticeably developed.

The coloration of the trunk of most species is a mixture of four dark saddles and dark mottling in varying degrees of development. The saddles are well developed in *G. arenaria*, are not obscured by dark mottling, and are strongly united laterally forming a prominent midlateral stripe. The saddles extend ventrally almost always as broad, unconnected conspicuous bars in *G. quinquecineta*. An extra (fifth) narrow saddle is present over the caudal peduncle in *G. angustifrons*, which aids in distinguishing it from the related *G. bravoii*. *Gobiopsis malekulae* is the only species that has a dark, uniform, midlateral stripe on the trunk and also lacks the typical, dark saddles.

### *Gobiopsis* Steindachner

- Gobiopsis* Steindachner, 1861:291 [type-species: *Gobiopsis macrostomus* Steindachner, 1861, by monotypy].  
*Pogonogobius* H. M. Smith, 1931:37 [type-species: *Gobius planifrons* Day, 1873, by original designation].  
*Pipidonia* H. M. Smith, 1931:39 [type-species: *P. quinquecineta* H. M. Smith, 1931, by monotypy].  
*Herreogobius* Koumans, 1940:139 [type-species: *Ctenogobius malekulae* Herre, 1935, by original designation].  
*Barbatogobius* Koumans, 1941:241 [type-species: *B. asanai* Koumans, 1941, by original designation].  
*Abranches* J.L.B. Smith, 1947:813 [type-species: *A. pinto* J.L.B. Smith, 1947, by original designation].

**DIAGNOSIS.**—First dorsal fin with six spines; teeth in jaws unicuspid; well developed, usually short barbels in specific areas on head (see "Methods"), typically in clusters on snout and side of head and in rows on ventral surface of head; a horizontal fleshy fold on midcheek area bearing a row of coarse papillae or barbellike structures; cephalic sensory pore system lacking the anterior interorbital and posterior otic pores; *POP* pores 2, 1, or 0 (cephalic pore system entirely absent in one species); sensory pores mostly conspicuous, round, oval or slitlike, some opening at end of raised, dark tubes, and some having well developed hoods; cutaneous papillae system well developed, consisting of moderate to coarse papillae, conspicuous horizontal rows on side of head and on chin; inner rays of pelvic fins joined to tips or nearly so, frenum fragile to moderately developed, forming a weak disc, the fin rays multibranched, not reaching anal opening; head broad, depressed; snout broad, pug-nosed, the lower jaw protruding; gape wide; coloration of trunk in most species with saddles, vertical bars, or variously mottled; a sickle-shaped dark mark on pectoral fin, near base, with an anterior wedge, or wedges in some species, that divides the light basal area.

**DESCRIPTION.**—The following characters are shared by all of the species of the genus *Gobiopsis*. Second dorsal fin rays I,9 to I,11; first dorsal fin free from second dorsal fin and about as high as second dorsal; anal fin rays I,8 to I,10; pectoral fin rays 16–23 (1 specimen with 15 on one side); segmented caudal fin rays 17 (1 specimen with 16); branched caudal fin rays 15–17 (rarely 16 or 18); horizontal scale rows about 30–60; nape with small, crowded, often deeply embedded scales, usually extending anteriorly to about a line connecting preopercular margins; nape scales obscure in some specimens up to 30 mm SL; small cycloid scales on belly, breast, and pectoral base, absent on cheek and opercle; scales on body in most species cycloid, cycloid and ctenoid in 3 species; scales highly eccentric, the anterior field large with well developed primary radii; anterior nostril at end of a conspicuous, bulbous tube, the posterior nostril at end of a somewhat shorter tube; posterior nostrils located close to most anterior portion of eye; tongue round, the tip free; gill opening moderate, extending ventrally to or slightly below a horizontal line intersecting lower base of pectoral fin; caudal fin somewhat longer than deep,



shorter than head length, the posterior margin round or nearly so; genital papilla in male tube-like, elongate, tapering, its length much longer than basal diameter; genital papilla in female round, bulbous, about as broad as long, the tip slightly bilobed.

Gillrakers on lower limb about 7–10, stout, short to rudimentary; upper limb with 0–3 rudiments.

Vertebrae 10+15(2), 10+16(366), 10+17(4); pterygiophore formula 3 (22110) in 370 specimens, 3 (221100) in 2 specimens.

Teeth of lower jaw in a villiform patch, in 3–4 rows at middle of jaw, reduced to 1–2 rows laterally; teeth in outer row largest, caninoid, about 2–3 times larger than teeth on inner rows; teeth of outer row separated by spaces about one-half to one tooth length in width; teeth of outer row on anterior third of jaw, numbering about 7–14 across the jaw; 1 or 2 stout; enlarged, posteriorly recurved canine teeth on inner margin of each side of lower jaw, the posterior one larger (apparently absent in one species); teeth in upper jaw in a villiform patch of 3–4 rows, the widest portion medially, the largest teeth caninoid in outer row, widely spaced and numbering about 9–25 across the jaw, the tooth at end of patch on each side is almost always enlarged, stout, recurved posteriorly and may be preceded by

a tooth intermediate in size and robustness between the terminal tooth and those of the caninoid row; upper jaw in males of some species with 1–3 enlarged, posteriorly recurved, fanglike canines on each side of symphysis behind innermost row; no vomerine or palatine teeth.

Cephalic sensory pores common to all of the species, except *G. aporia*, are the AOT and IT.

The following barbels are common to all of the species: chin, anterior internasals, posterior internasals, anterior cheek tuft, and the anterior gular. Additional barbels may be present among the species in other positions that we have identified.

The following rows of cutaneous papillae are present more or less uniformly among the species: secondary lateral cephalic, preopercular, cheek rows, preoperculo-mandibular, transverse snout, anterior nostril, posterior nostril, postorbital, occipital, trunk, and caudal. One species also has barbellike structures on the first and fourth cheek rows and the lateral preoperculo-mandibular row. Other rows of papillae are intimately associated with particular cephalic sensory pores or canals and vary by species.

Species small to moderate in size, mature specimens range from 25 to 80 mm SL.

HABITAT.—Bottom dwelling forms, associated with sand, mud, or loose coralline substrates.

### Key to the Species of *Gobiopsis*

1. Sensory pores on head absent; nasal papillae row confluent with suborbital row around eye; primary lateral cephalic row originates at row of papillae encircling eye (Sri Lanka to Australia) ..... *G. aporia*, new species
- Sensory pores on head present; nasal papillae row not confluent with suborbital row around eye; primary lateral cephalic row originates at or near intertemporal pore ..... 2
2. Anterior and posterior temporal pores present; nasal pore anterior to posterior nostril; number of pectoral fin rays almost always 20–23; light base of pectoral fin divided or nearly so by 1 or 2 dark wedges ..... 3
- Anterior and posterior temporal pores absent; nasal pore if present, adjacent to or behind posterior nostril; number of pectoral fin rays almost always 15–19; light base of pectoral fin not divided by a dark wedge ..... 6
3. One preopercular pore; preopercular canal connecting with the lateral cephalic canal; scales cycloid. (Persian Gulf and West India) ..... *G. canalis*, new species
- Two preopercular pores; preopercular canal incomplete, not connecting with the lateral cephalic canal; scales cycloid or ctenoid ..... 4
4. Scales cycloid, small, about 50–60 in lateral series; papillae on anterior portion of first cheek row (bordering cheek fold) replaced by a row of elongate, barbellike structures. (Mozambique) ..... *G. pinto* (J.L.B. Smith)
- Scales ctenoid, large or intermediate in size, about 30–50 in lateral series; mid-cheek fold with a row of papillae on edge ..... 5
5. Supraotic sensory pore absent; no barbels on posterior mandible; 1 chin barbel on each side; anterior cheek tuft with 1–3 (modally 1) barbels on each side; both sexes without enlarged, medial canine teeth on innermost tooth row of upper jaw; body not heavily mottled (Western India to Gulf of Thailand) ..... *G. macrostoma* Steindachner

Key to the Species of *Gobiopsis* (cont'd)

- Supraotic sensory pores almost always present (at least 1 present on 96 percent of specimens); posterior mandible with 2-5 barbels on each side; 2 or more chin barbels on each side; anterior cheek tuft with 3-6 (modally 5) barbels on each side; males with 2-6 medially located, enlarged canine teeth on innermost tooth row of upper jaw; body heavily mottled (Gulf of Mannar, India, and Gulf of Thailand) .....*G. woodsi*, new species
6. Nasal and posterior interorbital sensory pores absent; a row of course papillae on each side of head from margin of upper jaw to supraotic pore; trunk with a uniform, wide, dark midlateral stripe; a broad predorsal saddle connecting stripes on each side; other trunk saddles and body mottling absent (Philippines and New Hebrides) .....*G. malekulae* (Herre)
- Nasal and posterior interorbital sensory pores present; a row of papillae on each side of head from margin of upper jaw only to nasal pore; trunk with prominent saddles and/or highly mottled .....7
7. Preopercular pores absent; body slender, depth of caudal peduncle 24-30 percent of postanal length (Figure 5); dark wedge on head descends gently ventrally to upper preopercle, to about a line drawn from lower margin of eye to upper base of pectoral fin; dark trunk saddles joined at midbody, usually forming a continuous, more or less uniform, midlateral stripe, with narrow extensions below stripe; side of head and lower trunk usually pale, never mottled (Hong Kong to southern Japan) .....*G. arenaria* (Snyder)
- Two preopercular pores; body deep, depth of caudal peduncle 31-37 percent of postanal length; dark wedge on head descends sharply ventrally to lower preopercle, to about a line drawn from lower margin of eye to lower base of pectoral fin; dark trunk saddles when joined at midbody usually form a wavy or irregular lateral stripe, with broad extensions on lower body, or saddles not joined, extending ventrally as prominent bars, or body heavily mottled; side of head and lower trunk pale or mottled .....8
8. Dark trunk saddles extending ventrally as broad unconnected bars, or saddles sometimes weakly joined along midbody with narrow, irregular ventral extensions; cheeks and lower preopercle almost always pale; caudal fin mostly pale, sometimes lightly mottled; pectoral fin rays fewer, range 15-19, 55 percent of specimens with 17 or less (Southern India to Okinawa and Palau) .....*G. quinquecincta* (H. M. Smith)
- Males heavily mottled, the dark saddles obscured, or males, females, and juveniles with dark trunk saddles joined at midbody, forming a broad, wavy lateral stripe, with broad extensions on lower body; cheek, lower preopercle, and caudal fin mottled; pectoral fin rays 18-20 .....9
9. Head with many barbels, postmandibular barbel present, intermandibular row long, having 2-8 barbels on each side, anterior cheek tuft with 4-6 barbels, posterior gular barbels almost always present; eyes small, interorbital wide, diameter of orbit less than or equal to width of bony interorbital; narrow, well defined dark saddle on caudal peduncle absent (Okinawa to New Guinea) .....*G. bravoii* (Herre)
- Head with fewer barbels, postmandibular barbel absent, intermandibular row short, having 1-2 barbels on each side, anterior cheek tuft with 1-3 barbels, posterior gular barbels absent; eyes large, interorbital narrow, diameter of orbit always greater than width of bony interorbital; narrow, well defined dark saddle on caudal peduncle present (Celebes to Solomon Islands) .....*G. angustifrons*, new species

*Gobiopsis aporia*, new species

FIGURE 6; PLATES 1, 2a, 7a, 8a

DIAGNOSIS.—Sensory pores absent; nasal papillae row confluent with suborbital row around eye; primary lateral cephalic papillae row continuous from behind eye to upper gill opening; scales cycloid, 37-45 in horizontal series; postmandibular barbel and posterior gular barbels absent; jaw short; its length 13-16 percent of SL; dark wedge on head

obscured by mottling; light base of pectoral fin not divided by dark wedge; trunk with dark saddles and strongly mottled.

DESCRIPTION.—Dorsal fin rays VI-I,8(1), with 2 malformed pterygiophores and no associated external elements, VI-I,10(57); anal fin rays I,8(1), I,9(57), I,10,(1); pectoral fin rays 19(6), 20(55), 21(52), 22(3); pelvic fin rays I,5(27); segmented caudal fin rays 17(36); branched caudal fin rays 15(28), 16(7); lateral scale rows 37-45 (23); trans-

verse scale rows 18–22(23); predorsal scales 16–19(23).

Scales cycloid, no trace of ctenii, with 20–25 primary radii in anterior field and with few secondary radii; posterior field small, narrow, with about 12–15 short radii; focal area narrow to broad; primary radii in anterior field about 5–8 times longer than those of posterior field; some scales have the posterior field almost absent.

Vertebrae 10+16(54).

Measurements of features of the head and trunk for the holotype and means and ranges for selected male and female paratypes are given in Table 6.

A stout, robust species, the largest male 53 mm, the largest female 49 mm; trunk posterior to the pectoral area round to oval-shaped; fleshy interorbital wide, width about equal to length of snout and 1.5 times the diameter of orbit; lower jaw short, length about 13–16 percent SL; origin of second dorsal fin slightly posterior to vertical through midanal opening; depressed pectoral fin extends posteriorly to vertical from end of first dorsal fin, not reaching vertical through anal opening; pectoral fin longer than deep, moderately acute; pelvic fins short, extending posteriorly about 47 to 64 percent of distance from pelvic fin insertion to anal fin origin (Figure 3).

Number of teeth on outer row of upper jaw about 16–25, lower jaw about 8–10.

The absence of the cephalic sensory pore and canal system correlates with the greater development and elongation of certain rows of papillae (Plate 1); the nasal row is confluent with the suborbital row around eye, and the primary lateral cephalic row extends from behind eye to upper gill opening (Pattern 1).

Barbels (Table 3) in particular groups are generally intermediate in number; intermandibular barbels 1–3 (mean 2.05); posterior mandibular 2–6 (3.00); anterior cheek tuft 1–4 (2.55); anterior internasals 2–4 (2.50); posterior internasals 1–2 (2.60); the postmandibular and posterior gular barbels are absent. The barbels on the anterior cheek tuft are short to long, the lower one is longest and is preceded by one of intermediate size.

**COLOR IN PRESERVATION.**—Head and trunk heavily mottled light gray to dark brown. Mottling on head heaviest on border of upper jaw, on cheek and preopercle and on the head dorsally between and behind the eyes; mottling reduced in the occipital

area. Some fine mottling on chin; most of lower part of head including the branchiostegal area is pale to light color; dark wedge on the preopercle is obscured in larger specimens by the mottling but is evident in the smaller specimens, the wedge descending to about the middle portion of the preopercle, or slightly below (Plates 1–2a).

Light, fine to heavy, gray-brownish mottling of trunk obscures the heavy saddles. Four, wide, dark brown saddles on trunk, anterior one bridging upper bases of pectoral fins, fourth saddle passes through end of base of second dorsal fin; a very small, narrow mark passes over end of dorsal part of caudal peduncle. Saddles meet irregularly along body midline forming wavy band; a dark projection from the wavy band extends ventrolaterally between each saddle on side of body; a narrow dark bar at base of caudal fin sometimes irregular or wavy. Ventral portion of body pale or light. Heavy body mottling and strong saddles shown on Plate 7a.

Proximal portion of pectoral fin with a dark brown sickle-shaped mark beginning at upper base of fin and extending downward on upper two-thirds of fin; lower one-third of pectoral fin mostly clear, outer portion clear or slightly pigmented. Pelvic fins clear. Spinous dorsal fin with a small, dark spot at anterior base, a larger spot or band at midbasal portion extending up from saddle, and 2 rows of small dark spots on outer portion, remainder transparent. Second dorsal fin with a series of 3–4 horizontal rows of brown spots, remainder of fin clear. Caudal fin with a series of 6–7 reticulated or irregular vertical rows of brown spots, remainder of fin clear.

No sexual dichromatism observed. Juveniles have much less mottling; smaller specimens have little or no mottling, but the 4 saddles are very distinct and the bridging of the saddles laterally is weak, sometimes incomplete; remainder of the body of juveniles is light to pale. Small specimens, 9–10 mm, have the 4 conspicuous body saddles weakly or not joined along lateral portion of body, basal vertical bar on the caudal fin, a weak head wedge descending to about the middle of the preopercle, and scattered chromatophores on the head dorsally between and behind the eyes as well as some on the snout; 2–3 small dark spots on the midline of the belly, 1 behind the pelvic fins, 1 at its base, and about 6 spots in a series beginning behind the

origin of the anal fin and extending along the mid-ventral margin of the caudal peduncle to the lower caudal base.

**GEOGRAPHIC DISTRIBUTION.**—Occurs in the Indian Ocean only at Sri Lanka, widespread from Malaya and the East Indies eastward to eastern New Guinea and the northern Barrier Reef, and at one locality in the Ryukyus (Figure 6).

**ECOLOGY.**—The available field notes for collections of *Gobiopsis aporia* from Australia (C. L. Smith, Tyler), Indonesia (Springer), Ceylon (Iwamoto, Koenig) and the Gulf of Thailand (GVF stations) are similar in respect to habitat description. Most sites are depicted as areas of dead and live coral with interspersed coral rubble, rocks, and while, silty sand. V. G. Springer (pers. comm.) states that specimens of *G. aporia* killed with an ichthyocide at Karimundjawa (VGS sta 74-28) were found on white sand areas, but always near coral rubble. None of the collectors have indicated that they have seen live specimens. All specimens were taken with rotenone base poisons.

It is probable that individuals of *G. aporia* conceal themselves in the sand or among coral fragments in the substrate surface.

Specimens have been collected in relatively shallow areas of about 3 m or less, and also probably

have been taken in depths to 30 m, in clear to moderately turbid waters in areas of no current, or moderate or strong surge.

Eighty-one specimens of *G. aporia* were collected at 40 stations, 35 of which yielded 3 specimens or less. Mature males and females were collected together only at 3 stations. These data may indicate that *G. aporia* is not a gregarious species, and that it is not a common species at any locality.

**ETYMOLOGY.**—The specific name *aporia* is constructed from the Latin *a* (without) plus *porus* (a hole) and refers to the absence of the cephalic sensory pores for this species.

**MATERIAL EXAMINED.**—*Holotype*: USNM 209731, female 39.9, Ambon Island, Moluccas, off Tandjung Suli, over shallow coral reef, bottom of sand and coral, depth to 2.5 m, collected with rotenone by V. G. Springer and M. F. Gomon, *Rumphius* Exp. 1, sta SU-1, VGS 73-8, 11 Jan 1973.

*Paratypes*: 28 males, 30 females, and 12 immature specimens as follows.

**SRI LANKA**: USNM 209240, male (36.3), female (41.5) cleared and stained, Kalkudah Bay, Batticaloa District, T. Iwamoto sta 70-347, 9 Jun 1970; AMS I.18101-001, male (44.4), same data as USNM 209240; BPBM 20321, female (34.1), Kalkudah Bay, Iwamoto sta 70-344, 6 Jun 1970; USNM 211137, males (31.5–44.9), Trincomalee, center of second bay N of harbor, C. C. Koenig sta 69-136, 4 Apr 1970; ANSP 134200, male (32.9), same data as USNM 211137;

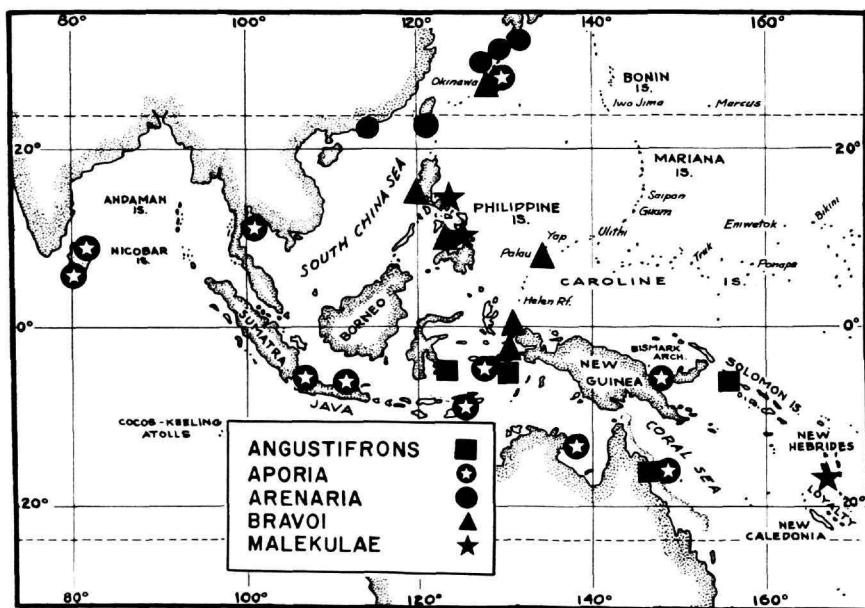


FIGURE 6.—Distributions of five species of *Gobiopsis*.

USNM 211138, females (29.9, 38.6), Passakudah Bay, Batticaloa District, Iwamoto sta 70-349, 10 Jun 1970; CAS 31497, female (33.2), same data as USNM 211138; ANSP 134201, females (32.0, 38.3), same data as USNM 211138; USNM 212293, immature (9.2), Hikkaduwa, 1 mile S of coral gardens, Koenig sta 69-100, 12 Feb 1970; USNM 212294, females (35.2, 37.8), 3 immature (9.0-20.9), Hikkaduwa, 1 mile S of resthouse, Koenig sta 69-103, 13 Feb 1970; USNM 212296, female (36.5), Weligama, 500 yards S of resthouse, Koenig sta 69-107, 15 Feb 1970; USNM 212298, females (31.6, 35.8), immature (11.3), Galle, SE end of bay, Koenig sta 69-108, 16 Feb 1970; BMNH 1976.2.5.1, female (34.0), same data as USNM 212298; FMNH 78751, female (35.8), same data as USNM 212298; USNM 212300, immature (9.3, 10.8), Weligama, cove S of resthouse, Koenig sta 69-106, 15 Feb 1970; AMS I.18492-001, female (36.4), Trincomalee, 08°37.7'N, 81°14.2'E, P. C. Heemstra sta 69-277, 29 Sep 1969.

GULF OF THAILAND: CAS 33628, female (36.0), Rayong Province, Toud-chin Bay on SE side of Ko Samet, 12°31'42"N, 101°26'57"E, GVF Reg. No. 2169, 22 Apr 1960; CAS 33629, females (26.1, 35.8), Rayong Province, Pra Sang Bay on NW point of Ko Samet, 12°34'41"N, 101°26'50"E, GVF Reg. No. 2171, 23 Apr 1960; CAS 33630, male (43.4), Chumphon Province, Pround Bay at SW corner of Goh Samed, 10°26'04"N, 99°17'33"E, GVF Reg. No. 2185, 17 May 1960.

INDONESIA: USNM 212000, immature (16.7, 21.4), Pulau Tikus, Pulau Seribu, ca. 05°51'S, ca. 106°34'E, VGS sta 74-35, 6 Apr 1974; USNM 211990, male (44.6), Pulau Ajer, Pulau Seribu, ca. 05°46'S, ca. 106°35'E, VGS sta 74-32, 4 Apr 1974; USNM 211984, females (32.7, 39.1), just N of Lesser Mendjangan I., Karimundjawa Islands, ca. 05°53'S, ca. 110°-25'E, VGS sta 74-30, 30 Mar 1974; USNM 211983, 10 males (32.4-49.3), 3 females (29.5-42.7), one cleared and stained, off SW coast of Karimundjawa, ca. 05°52'S, ca. 110°26'E, VGS sta 74-28, 29 Mar 1974; RMNH 15256, male (51.1), Timor, Wienecke coll., 1863.

NEW GUINEA: USNM 211136, female (36.5), S end Belian I., Madang, B. B. Collette sta 1478, 22 May 1970.

AUSTRALIA, ARNHAM LAND: USNM 211140, male (47.1), Yirrkalla, Northern Territory, near Cape Arnhem, Gulf of Carpentaria, R. R. Miller sta 48-21, Jul-Aug 1948; USNM 211152, male (41.7), probably taken with USNM 211140. QUEENSLAND: AMS I.19108-001, male (53.4), immature (14.5), Lizard Island, J. Paxton sta LZ 75-42, 17 Nov 1975; AMS I.18755-002, immature (10.4), Palfrey Island, Paxton sta LZ 75-4, 2 Nov 1975; AMS I.18767-003, male (47.4), Linnet Reef, Paxton sta LZ 75-52, 22 Nov 1975; AMNH 32962, immature (18.7), Little Hope Island, C. L. Smith sta 69-27, 20 Jan 1969. Endeavour Reef: USNM 209238, male (45.9), J. Tyler sta A-4, 5 Jan 1969; USNM 209247, male (49.6), Tyler sta A-5, 6 Jan 1969; ANSP 134202, male (52.0), female (47.3), same data as USNM 209247; USNM 209251, female (33.0), Tyler sta A-12, 13 Jan 1969; USNM 211139, female (49.0), Tyler sta A-3, 4 Jan 1969; USNM 211151, female (48.1), Tyler sta A-11, 11 Jan 1969; AMNH 32957, male (41.8), Smith sta 69-7, 6 Jan 1969; AMNH 32958, female (34.0), Smith sta 69-13, 13 Jan 1969; AMNH 32959, males (37.4, 39.2), Smith sta 69-16, 14 Jan 1969; AMNH 32960, male (48.3), Smith sta 69-19,

16 Jan 1969; AMNH 32961, female (42.8), Smith sta 69-18, 15 Jan 1969.

The following small specimens are given no type status.

RYUKYU ISLANDS: AMS I.18493-001, (23.6), Taketomi Island, Ishigaki, J. E. Randall, 24 May 1962.

AUSTRALIA, QUEENSLAND, Endeavour Reef: USNM 211149, (10.7), Tyler sta A-16, 15 Jan 1969; USNM 211150, (13.0, 14.2), Tyler sta A-11, 11 Jan 1969; AMNH 32963, (14.9), Smith sta 69-12, 11 Jan 1969; AMNH 32964, (10.8, 12.9, 13.8), Smith sta 69-16, 14 Jan 1969. Big Hope Island: USNM 209246, (14.3), Tyler sta A-33, 27 Jan 1969.

Specimen questionably assigned to *G. aporia*: AMNH 32965, (13.9), Endeavour Reef, Smith sta 69-19, 16 Jan 1969.

### *Gobiopsis canalis*, new species

FIGURE 7; PLATE 9a,b

*Barbatogobius asanai*.—Blegvad and Løppenthin, 1944:167, fig. 97 [Iranian Gulf].

DIAGNOSIS.—Sensory pores NA, PITO, AT, and PT present, 1 POP present, SOT absent; preopercular canal connects with lateral cephalic canal; scales cycloid, small, over 50 in horizontal series; intermandibular, posterior mandibular, postmandibular and posterior gular barbels absent; jaw moderate in length, about 16-17 percent of SL; dark head wedge not noticeably developed; light base of pectoral fin divided or nearly so by dark wedge; body moderately mottled, saddles not prominent.

DESCRIPTION.—Dorsal fin rays VI-1, 10(2); anal fin rays I,9(2); pectoral fin rays 22(2); 23(2); pelvic fin rays I,5(2); segmented caudal fin rays 17(2); branched caudal fin rays 15(2); lateral scale rows 50-55(2); transverse scale rows 23-24(2); predorsal scales 18-20(2).

Scales cycloid, with 12-20 primary radii in the anterior field and 2 or 3 secondary radii; posterior field small, narrow with about 10-15 tiny radii, some of which are barely discernible; focal area narrow, never broad; primary radii in anterior field much longer than those of posterior field, more than 20 times; some scales have posterior field almost entirely absent.

Vertebrae 10+16(2).

The following proportional measurements are given for the holotype (50.5 mm SL) followed by the value for the paratype (41.3 mm SL): head length 321, 341; snout length 83, 85; postorbital length 198, 208; greatest diameter of orbit 50, 53; bony interorbital width 59, 61; pectoral fin length



269, 278; pelvic fin length 232, 252; caudal fin length 257, 305; predorsal length 404, 414; greatest depth of body 174, 165; least depth of peduncle 121, 111; postanal length 390, 368; lower jaw length 166, 165; pelvic fin insertion to anal fin origin 323, 344.

Body moderately stout and deep; fleshy interorbital wider than length of snout and greater than diameter of orbit; lower jaw of moderate length 16–17 percent of SL; origin of second dorsal fin slightly posterior to vertical through anal opening; depressed pectoral fin reaches vertical through end of first dorsal, is somewhat longer than deep, the posterior margin rounded; pelvic fin not reaching anal opening, pelvic fin length as percent of distance from pelvic fin insertion to anal fin origin about 72 and 77.

Teeth on outer row of lower jaw number 10–12, the outer row of upper jaw 23–24. The inner row of the upper jaw of the holotype, a male, has 1–2 enlarged teeth on each side of the symphysis, absent in the female paratype.

The cephalic sensory pore and canal system is characterized by the presence of the AT and PT pores and the absence of the SOT and upper POP pores. The preopercular canal is complete to the lateral cephalic canal and joins it just anterior to the IT pore.

The cutaneous papillae system is pattern 4.

A characteristic feature of the barbels is the absence of four particular groups (Table 3), these being the intermandibular, posterior mandibular, postmandibular and posterior gular. Barbels of the posterior internasal group are sometimes absent. Anterior cheek tuft barbels number 1–4, and the anterior internasals 2–3. The lower barbel on the anterior cheek tuft is fairly long, considerably longer than others on the tuft.

**COLOR IN PRESERVATION.**—Our specimens were collected many years ago and are faded. The holotype was illustrated by Blegvad and Løppenthin (1944:168, fig. 97) showing the body saddles and the coloration of the pectoral fin fairly well developed. Our photographs of the same specimen, Plate 9a,b, depict the current state of preservation. The head shows concentration of chromatophores just posterior of the eyes; the dark wedge on the preopercle is only faintly visible; there are 4 brown saddles on the trunk, one before the first dorsal fin, one through the first dorsal, another through the second dorsal fin and one just at the end of the second dorsal; a faint small mark or spot is present poste-

rior to the last saddle and at the beginning of the first procurent caudal fin rays; the saddles are more or less joined along the midside of the body and there is some pigmentation ventrolaterally on the body; there is evidence of a weak mark at the base of the caudal fin and it appears to be more dense just above and below the midbasal area; the pectoral fin has a sickle-shaped mark near its base which is darkest on the upper portion, the lighter upper basal area is divided by the dark wedge that extends from the sickle-shaped mark, the area posterior to the dark sickle-shaped mark is followed by a fairly wide, light band in the midportion of the fin, approximately the outer half of the fin is pigmented pale to light brownish, enough to show the lighter band; the first dorsal fin has a white basal area anteriorly on the fin and another light area basally between the 5th and 6th spine, the remainder is brownish; the second dorsal fin has 4 to 5 brownish stripes separated by light to pale areas; the pelvic fin is clear to transparent with some scattered chromatophores and a concentration of chromatophores near the midbase of the pelvic fin on the lower part of the frenum; the middle portion of the anal fin is light brownish, the basal and outer portions are pale. The caudal fin has a series of 4–5 irregular vertical, brownish bands, the remainder of the fin is pale to clear.

**GEOGRAPHIC DISTRIBUTION.**—Known only from 2 localities, one in the Persian Gulf and the other from the southwest coast of India (Figure 7).

**ECOLOGY.**—The holotype was taken at a depth of 13 m by trawl, over a clay and sand bottom (Blegvad and Løppenthin, 1944:26).

**ETYMOLOGY.**—The specific name *canalis* is from Latin in reference to the unique extension of the preopercular canal from the lower POP pore dorsally to join the lateral cephalic canal.

**MATERIAL EXAMINED.**—*Holotype*: UZMK 01.9.1943,619, male (50.5) Persian Gulf, E of Hindarabi, 26°41'N, 53°46'E, depth 13 m, M/S *Rashgoo* sta 123, 9 Apr 1938.

*Paratype*: SU 40079, female (41.3), Calicut (now known as Kozhikode), India, collected by A. W. Herre, 14 Jan 1941.

### *Gobiopsis pinto* (J.L.B. Smith)

FIGURE 7; PLATES 3, 7c, 8c

*Abranches pinto* J.L.B. Smith, 1947:813 [type-locality: Ponte Mahone, Delagoa Bay, Mozambique]; 1949:331, fig. 909, pl. 72 [color]; 1959:211, pl. 121.



DIAGNOSIS.—Sensory pores NA, AT, and PT present, 2 POP pores, the PITO pore usually absent; papillae on anterior portion of first cheek row (bordering cheek fold) replaced by a row of elongate, barbel-like structures; scales cycloid, small, about 50–60 in horizontal series; 2–3 enlarged canines medially in inner tooth row of upper jaw of males; posterior mandibular, postmandibular, and posterior gular barbels absent; jaw moderate to long, about 15–22 percent of SL; dark head wedge not noticeably developed; light base of pectoral fin divided or nearly so by dark wedge; trunk uniformly dark or with faint saddles.

DESCRIPTION.—Dorsal fin rays VI–I, 10(2) VI–I, 11 (7); anal fin rays I, 9(9); pectoral fin rays 20(5), 21(11); pelvic fin rays I, 5(9); segmented caudal fin rays 17(9); branched caudal fin rays 15(6), 16(1), 17(2); lateral scale rows 50–60(9); transverse scale rows 20–26(9); predorsal scales deeply embedded or rubbed off in all specimens.

Scales cycloid, primary radii in anterior field about 16 with a few secondary radii; focal area broad; posterior field narrow with about 10 short radii; some scales have the posterior field barely discernible.

Vertebrae 10+16(9).

Head length 340 (328–356) 7; snout length 81

(75–91) 7; postorbital length 208 (190–227) 7; greatest diameter of orbit 50 (47–54) 7; bony interorbital width 53 (44–57) 7; pectoral fin length 251 (244–259) 6; pelvic fin length 224 (214–237) 7; caudal fin length 298 (278–325) 5; predorsal length 418 (410–424) 4; greatest depth of body 157 (134–175) 6; least depth of peduncle 105 (100–112) 7; postanal length 353 (333–369) 7; lower jaw length 177 (148–216) 7; pelvic fin insertion to anal fin origin 322 (306–340) 7.

Body stout, head broad, fleshy interorbital width about equal to snout length and about 1.5 times orbit diameter; lower jaw moderate to long, longer in larger specimens and apparently longer in males than females, 15–22 percent of SL (Figure 4); origin of second dorsal fin over anal opening; depressed pectoral fin almost reaching vertical through anal opening, longer than deep and moderately round; pelvic fins comparatively long, about three-fourths length of distance from pelvic fin insertion to anal fin origin (Figure 3); largest male 51.0 mm SL largest female 42.7 mm SL.

Number of teeth on outer row, upper jaw about 21, lower jaw 12–14; 2–3 enlarged, posteriorly recurved canines medially on inner tooth row of upper jaw of males.

The cephalic sensory pore and canal system is

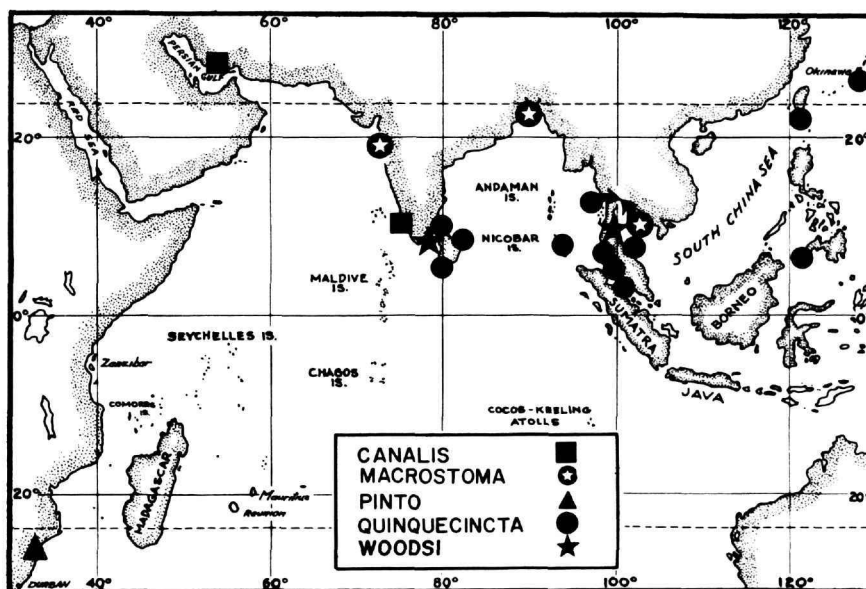


FIGURE 7.—Distributions of five species of *Gobiopsis*.

characterized (Tables 1, 2) by the presence of the *AT* and *PT* pores, the absence of the *SOT* pores, and the absence of the *PITO* pore in all but the 2 smallest specimens.

The cutaneous papillae system is pattern 4, except that the papillae are modified or replaced by elongate barbels on the anterior portion of the first cheek row (on border of cheek fold), to a lesser extent on the fourth cheek row, and beneath the jaw on the outer preoperculo-mandibular row.

The following barbel groups (Table 3) are absent: posterior mandibular, postmandibular, and posterior gular; the intermandibular row is sometimes absent or eroded away. The number of barbels in other groups are: intermandibular 0-3 (mean 1.33); anterior cheek tuft 1-3 (2.42); anterior internasals 1-2 (1.42); posterior internasals 1 (1.00). The lower barbel on the anterior cheek tuft is elongate, much longer than others on the tuft.

**COLOR IN PRESERVATION.**—Head and trunk more or less uniformly dark, the saddles weakly developed (Plates 7*c*, 8*c*); midportion of head behind the eye pale to light, a dark band traverses the occipital area; the dark wedge on preopercle obscure (Plate 3*b*); 4 faint saddles on trunk extend ventrally to midlateral portion, apparently not joining to form a wavy, lateral stripe; areas between saddles pale to light.

Light base of pectoral fin divided, or nearly so, by dark wedge arising from dark sickle-shaped mark on proximal portion of pectoral fin; sickle-shaped mark darkest on upper portion, the dark wedge almost obscure on some larger specimens, remainder of fin dusky to pale. Pelvic fin pale to transparent. Anterior basal portion of first dorsal fin clear, remainder dusky brown. Second dorsal fin with 3 faint oblique stripes, one on lower anterior portion, one through middle, and one on outer posterior portion, remainder pale, stripes not evident on most specimens. Anal fin pale. Caudal fin pale to dusky, some traces of faint, small spots, not visible on most specimens.

**GEOGRAPHIC DISTRIBUTION.**—Known only from Delagoa Bay, Mozambique (Figure 7).

**ECOLOGY.**—Described by J.L.B. Smith (1947:814; 1949:331) as occurring beneath stones in tide pools of muddy areas.

**MATERIAL EXAMINED.**—Males, 5 (35.2-51.0 mm SL); females, 5 (27.0-42.7 mm SL). MOZAMBIQUE: RUSI 197, holotype, male (35.2), Ponte Mahone, Delagoa Bay, J.L.B. Smith; RUSI

3019, 5 (29.7-51.0), from type-locality, Oct 1953; USNM 210414, (27.0, 41.1), same data as RUSI 3019; USNM 210405, 36.0), from type-locality, Aug 1948; UZMK, uncataloged, (50.1), Polana beach, Lourenco Marques, sand coast, Th. Mortensen's Java and S. Africa Exp., 1929-1930, 9 Mar 1929.

### *Gobiopsis macrostoma* Steindachner

FIGURE 7; PLATES 2*b*, 9*c*, *d*

- Gobiopsis macrostomus* Steindachner, 1861:291, fig. 6 [type-locality: Bombay].—Koumans, 1941:245 [from Steindachner, 1861].
- Gobiopsis macrostoma* Günther, 1861:548 [from Steindachner, 1861].—Day 1876:286 [from Steindachner, 1861]; 1889:252 [same data as Day, 1876:286].
- Gobius planifrons* Day, 1873:108 [type-locality: Bombay]; 1876:293, pl. 63: fig. 9 [Bombay]; 1889:264, [Bombay].
- Pogonogobius planifrons* H. M. Smith, 1931:37 [Paknam and Chantabun River, Siam]; 1945:520 [Paknam and Chantabun Estuary].—Fowler, 1935:161 [Paknam].—Koumans, 1941:246 [Bombay and Hingi Basin].
- Barbatogobius asanai* Koumans, 1941:242 [type-locality: Kosamba Creek near Bulsan, Western India].

**DIAGNOSIS.**—Sensory pores *NA*, *PITO*, *AT*, and *PT* present; 2 *POP* pores, *SOT* absent; only 1 chin barbel on each side; posterior mandibular, postmandibular, and posterior gular barbels absent; scales strongly ctenoid, size moderate, about 36-44 in horizontal series; jaw moderate to long, about 16-23 percent of SL; dark head wedge not noticeably developed; light to dusky base of pectoral fin divided or nearly so by dark wedge; trunk brownish with moderately dark saddles.

**DESCRIPTION.**—Dorsal fin rays VI-I, 10(24); anal fin rays I, 8(1), I, 9(23); pectoral fin rays 19(1), 20(16), 21(21), 22(7); pelvic fin rays I, 5(24); segmented caudal fin rays 17(10); branched caudal fin rays 15(9), 16(1); lateral scale rows 36-44(11); transverse scale rows 16-21(10); predorsal scales 14-20(8).

Scales strongly ctenoid, the anterior field with 15-19 primary radii; posterior field narrow, with about 4 short radii; scale highly eccentric, focal area moderate; ctenii on margin of posterior field number 18-25.

Vertebrae 10+16(23), 10+17(1).

Head length 340 (324-352) 5; snout length 82 (79-87) 5; postorbital length 213 (208-218) 5; greatest diameter of orbit 50 (44-52) 5; bony interorbital width 56 (51-62) 5; pectoral fin length 255 (251-260) 3; pelvic fin length 219 (195-236) 5; caudal fin length 297 (268-328) 3; predorsal length

408 (378–421) 5, greatest depth of body 172 (157–189) 4; least depth of peduncle 116 (109–121) 5; postanal length 388 (355–436) 5; lower jaw length 194 (159–234) 22; pelvic fin insertion to anal fin origin 310 (300–319) 5.

A large, robust species, the largest male 79.5 mm SL, the largest female 67.2 mm SL, a gravid female 32.4 mm SL. Head broad; snout rounded from above; trunk deep; fleshy interorbital wide, width almost equal to length of snout, about 1.5 times orbit diameter; lower jaw moderate to long, longer in larger specimens (Figure 4) 16–23 percent of SL; origin of second dorsal fin just posterior to vertical through anal opening; depressed pectoral fin extending to or posterior to anal opening but not reaching anal fin origin, moderately rounded and longer than deep; pelvic fins long, about three-fourths length of distance from pelvic fin insertion to anal fin origin (Figure 3).

Number of teeth on outer row, upper jaw about 20–22, lower jaw about 12–14. No evidence of recurved canine teeth medially on inner row of upper jaw in both sexes.

The cephalic sensory pore and canal system has the AT and PT pores and canal and lacks the SOP pores (Tables 1, 2).

The cutaneous papillae system is pattern 4. The cheek rows are long, reaching end of preopercle, and the papillae in the cheek rows as well as other rows on the head are typically smaller than those of other species of *Gobiopsis* (Plate 2*b*).

The groups of barbels not present are: posterior mandibular, postmandibular, and posterior gular; the intermandibular row is occasionally absent. The number of barbels in other groups are: intermandibular, 0–4 (mean 1.78); anterior cheek tuft 1–3 (1.41); anterior internasals 1–3 (1.32); posterior internasals 1–2 (1.10). The lower barbel on the anterior cheek tuft is very long, much longer than other barbels on the tuft and longer than those of most other species of *Gobiopsis*.

**COLOR IN PRESERVATION.**—Head and trunk of larger specimens more or less uniform brownish with traces of light and brown mottling, the trunk saddles faint to moderately developed; smaller specimens with well developed saddles and mottling on head and trunk, especially laterally on trunk. Head dorsally and laterally brownish, irregularly mottled in smaller specimens, the dark preopercular wedge obscure (Plate 2*b*), chin slightly

dusky and remainder of lower head and breast light to pale brown; trunk with 4 wide dark brown saddles, the first saddle bridging base of upper pectoral fins, a light transverse band precedes first saddle and a dark bar or saddle crosses the occipital area anterior to the light band; anterior portion of the fourth saddle touches the end of the second dorsal fin, a small saddlelike mark on end of caudal peduncle, at upper procurrent caudal rays; saddles in smaller specimens descend to midside or ventrolaterally on trunk in an anterior oblique direction, the saddles almost always not joining laterally and not forming a wavy lateral stripe, areas between saddles light, lower trunk uniform brownish, a dark, irregular vertical bar at base of caudal fin.

Light to dusky base of pectoral fin divided or nearly so on upper portion by dark wedge that extends forward from dark sickle-shaped mark on pectoral fin, lower base of pectoral fin in larger specimens uniformly dusky or with brownish mottling, remainder of fin with dark, elongate, irregularly arranged spots on rays and membranes appearing as wavy vertical bands; pelvic fins dusky, the interradial membranes dark in larger specimens, base of frenum with some pigment, pelvic fins clear to transparent in small specimens; first dorsal fin with 2 broad, dark bands separated by a light area, the outer portion of fin pale to light; second dorsal fin with dark and light markings arranged in 5–6 irregular stripes; anal fin with lower half dusky to brown, an irregular band on outer portion, the fin margin pale to white; caudal fin highly mottled with irregular brown and light spotting or marking, the brown spotting arranged in 5–6 irregular, vertical bands; coloration of fins on some larger specimens faint or obscure (Plate 9*c, d*).

**GEOGRAPHIC DISTRIBUTION.**—Known from 3 areas: the Bombay area and the Gangetic delta of India, and the northern Gulf of Thailand (Figure 7).

**ECOLOGY.**—Specimens from the Gulf of Thailand were taken over muddy and rocky bottoms in brackish water, some captured in bamboo stake traps (GVF Reg. No. 1592, 1593, 1595). H. M. Smith (1945:521) states that the species was found locally in brackish and fresh water.

**REMARKS.**—The three syntypes forming the basis of the description of *Gobiopsis macrostroma* (NNW 29593-95) were lost or overlooked since the time of

Steindachner's (1861:291) publication of the name, for no author known to us has indicated that he examined these specimens. Koumans (1941:245) followed Steindachner by placing *macrostoma* in the genus *Gobiopsis*, but Günther (1861:548) and Day (1876:286; 1889:252) placed the species in the genus *Gobius*. The latter authors may have been influenced in doing so by Steindachner's reference to Heckel's manuscript name for this species as *Gobius macrostomus*. Steindachner's description (or his figure 6 of the head) does not mention or show that this species has head barbels. On a recent world tour of museums examining gobioid types, D. F. Hoese of the Australian Museum called our attention to Steindachner's syntypes of *G. macrostoma* with the observation that they were most likely in our "*Pipidonia*" group of gobies because they had, among other features, the characteristic barbels on the head.

Because of the rediscovery, after more than a century, of the syntypes of *G. macrostoma*, which are the important specimens bearing on the nomenclature of this generic group, and because there are many unrecorded diagnostic characters that still can be seen on them (despite the fact that they are old, soft, and faded, making it difficult or impossible to record some of the important meristic counts and measurements), we give the following salient data pertaining to most of the diagnostic characters. These data are not listed in the descriptive account of the text or in the tables. The data for each character is given, in sequence, for the 48 mm male, 58 mm female, and the 61 mm male unless it is the same for all three: dorsal fin rays VI-I,10(3); anal fin rays I,9(3); pectoral fin rays 22-22 (right side-left side), 20-21, 20-21; pelvic fin rays I,5(3); branched caudal fin rays 15(3); segmented caudal fin rays, not obtainable, outer portion of most caudal fin rays broken off; lateral scale rows for the two largest specimens, based on a count of scale pockets or marks (all the scales are gone), about 40 or 41, about 38 or 39; predorsal scales for the two largest specimens about 17 and 19.

The cephalic sensory pore system is the same on the 3 syntypes and is as follows (P = present; A = absent): AT pores (P), PT pores (P), NA pores (P), PITO pore (P), SOT pores (A), AOT pores (P), POT pores (A), IT pores (P), POP pores (P, 2 on each side).

The following barbels on the head were clearly

observed with the specimens completely immersed in alcohol: chin or mental 1-1 (3 specimens); anterior gular 1-1 (3); intermandibular row about 3-4, 5-4, and 3-4; anterior cheek tuft 2-2, 2-1, 2-2, the lower barbel very long; anterior internasals 2-2, 1-1, 1-1; posterior internasals 1-1, 1-1, 2-2.

Vertebrae 10+16(3); pterygiophore formula 3 (22110) (3); jaw length as percent SL 19.8, 17.0, 19.6. The fleshy cheek fold is distended and resembles a fine, straight crease on the midcheek area. The cutaneous papillae of the head are entirely eroded away. Some of the dark pigmentation is present on the pectoral fin base but otherwise the color pattern is completely faded; the specimens are pale brown. Since the 3 syntypes agree closely in respect to the diagnostic specific characters we see no need in specifying one as a lectotype.

We regard ZSIC Reg. No. 97 as the putative holotype of *Gobius planifrons* Day. The label in the jar indicates that it is the specimen drawn in Day (1876: pl. 63: fig. 9). Day (1873:108) states that one specimen 4 inches long was obtained and later (1876:293) he refers to "Bombay, where the specimen figured (life-size) was obtained." Day's figure is 4 inches (101.6 mm) in total length, which is close to the present actual length of specimen No. 97. We conclude, therefore, that only one specimen was involved in his accounts of this species. Koumans (1941:247) listed a specimen he examined at the Indian Museum purchased from F. Day, which is probably the same specimen as ZSIC Reg. No. 97. We have not encountered any other specimen of *G. planifrons* attributable to Day.

The paratype of *Barbatogobius asanai* Koumans (ZSIC 5532/2, 54.6 mm SL) examined by us has strong ctenoid scales, a long jaw, and typical pore and barbel patterns of *G. macrostoma*. A.G.K. Menon provided data for the holotype and another paratype of *B. asanai* and these data also agree with those of *G. macrostoma*.

**MATERIAL EXAMINED.**—Males, 19 (25.7–79.5 mm SL); females, 8 (21.8–67.2); unsexed, 3 (36.0–50.0).

INDIA, west coast: NMW 29593-95, three syntypes of *Gobiopsis macrostomus* Steindachner, 2 males (48, 61), female (58), Bombay, Baron Hügel, 1839; ZSIC Reg. No. 97, putative holotype of *Gobius planifrons* Day, male (79.5), Bombay; ZSIC 5283/2, holotype of *Barbatogobius asanai* Koumans, unsexed (49.0), Kosamba Creek, Gujarat, India, J. J. Asana, May 1925; ZSIC 5532/2, paratypes of *B. asanai* Koumans, male (54.6), unsexed (36.0), same data as ZSIC 5283/2; ZSIC 1720, (ca. 50.0), shallow water near Bombay, T. S. Patrick

Stewart Townsend. East coast: ZSIC, uncataloged, (25.5) Gangetic delta.

THAILAND: USNM 119633, (57.7, 67.2), Chantabun Estuary, Southeastern Siam, H. M. Smith, 17 Jul 1928; ANSP 63125, (58.6), Paknam, 15 mi (24 km) SSE of Bangkok, R. M. deSchauensee, 28 Aug 1934; CAS 33614, (22.0, 50.5), rock jetty S of Chol Buri between Bangsaen and Chol Buri, GVF Reg. No. 1542, collection date unknown; CAS 33615, (26.4), Chantaburi Province, Mae Nam, Chantaburi River at Tha Chalaep harbor, GVP Reg. No. 1592, 24 Dec 1957; CAS 33616, 10 (21.8–47.3), rocky shore of south side of Goh Proet Island, GVF Reg. No. 1593, 25 Dec 1957; USNM 216191, 4 (27.7–42.6), 2 cleared and stained, same data as CAS 33616; CAS 33618, (26.3), Mae Nam, Welu River at Ban Klong Sone village, GVF Reg. No. 1595, 25 Dec 1957.

### *Gobiopsis woodsi*, new species

FIGURE 7; PLATES 4, 7b, 8b

DIAGNOSIS.—Sensory pores NA, PITO, AT, and PT present, the SOT pore almost always present, 2 POP pores; 2–5 posterior mandibular barbels present; anterior cheek tuft barbels modally 5; postmandibular and posterior gular barbels absent; scales strongly ctenoid, large, 30–36 in horizontal series; males with 2–5 enlarged canine teeth medially on inner row of upper jaw; jaw moderate in length, about 13–18 percent of SL; dark head wedge not evident; light base of pectoral fin divided or nearly so by dark wedge; coloration mottled, saddles not prominent.

DESCRIPTION.—Dorsal fin rays V–I, 10(2) the associated pterygiophore is present where the spine is absent, VI–I, 10(53), VI–I, 11(1); anal fin rays I, 8(1) with external element absent from third anal pterygiophore, I, 9(55); pectoral fin rays 18(1), 20(3), 21(50), 22(38); pelvic fin rays I, 5(34); segmented caudal fin rays 16(1), 17(44); branched caudal fin rays 14(1), 15(34), 16(8); lateral scale rows 30–36(25); transverse scale rows 15–19(24); predorsal scales 11–15(29).

Scales strongly ctenoid, highly eccentric; 10–16 primary radii in large anterior field; focal area broad; posterior field small but wide, with short radii numbering up to 14; 11–18 ctenii in 1 row on posterior margin.

Vertebrae 10 + 16(54).

Measurements for the holotype and paratypes are given in Table 7.

A species of moderate size and robustness, the largest male 42.3 mm, the largest female 37.7 mm. Among the species of *Gobiopsis*, *G. woodsi* appears

to show the greatest difference between sex and size, the males considerably exceeding the females in body length. Head moderately wide, trunk moderately deep; fleshy interorbital width about equal to snout length, slightly greater than diameter of orbit; lower jaw of moderate length (13–18 percent of SL), but jaw length related to body size (Figure 4), lower jaw increases with increase in body length, and apparently is longer in males than females for any size group; origin of second dorsal fin just posterior to vertical at anal opening; depressed pectoral fin just anterior to vertical at anal opening, pectoral fin longer than deep and rounded posteriorly; pelvic fin comparatively long, average length about 72 percent of distance from pelvic fin insertion to anal fin origin (Figure 3).

Number of teeth on outer row of upper jaw about 21, lower jaw 8–10; males with 2–5 enlarged posteriorly recurved canine teeth medially on inner row of upper jaw.

The cephalic sensory pore and canal system contains more pores than any other species of *Gobiopsis*. The AT and PT pores and canal are present and the SOT pores are almost always present (Tables 1, 2).

The cutaneous papillae system is pattern 4 (Plate 4). The papillae on the head are generally conspicuous, particularly those on the first and fourth cheek rows and on the outer preoperculo-mandibular row.

The following groups of barbels (Table 3) are absent; postmandibular and posterior gular; intermandibular row occasionally absent. The number of barbels in other groups are: intermandibular, 0–2 (mean 1.45); posterior mandibular 2–5 (3.05); anterior cheek tuft 3–6 (4.70); anterior internasals 2–5 (3.35); posterior internasals 1–2 (1.10). The lower barbel of the anterior cheek tuft is long, considerably longer than others of the tuft.

COLOR IN PRESERVATION.—Head and trunk mottled with light and dark brown markings, dorsally and laterally; head ventrally, breast and belly light. Saddles on trunk usually weakly developed (Plates 7b, 8b). Snout, lower jaw, cheek, preopercle, opercle, and head dorsally irregularly mottled in light and brown markings, dark preopercular head wedge not evident (Plate 4); a light band traverses head between upper opercular areas. The 4 typical dark trunk saddles present in most species of *Gobiopsis* are poorly defined in the larger specimens, 2 of which are divided by light blotches along the dorsal



midline, noticeably so in smaller specimens, forming 6 brown dorsal cross bars or saddles; the first saddle in the predorsal area traverses a wide area between the upper pectoral fins; the second dorsal saddle passes through the midportion of the first dorsal fin and extends onto the fin; the third saddle touches the end of the first dorsal fin and extends out on the tips of the posterior spines; the fourth saddle passes through the third and fourth rays of the second dorsal fin; the fifth saddle passes through the midportion (the sixth and seventh rays) of the second dorsal fin; the sixth saddle touches the last ray of the soft dorsal fin; the typical dark mark is present at end of caudal peduncle, at beginning of upper procurrent caudal fin rays. Trunk saddles join irregularly at midtrunk, and 6 projections extend downward from wavy stripe on ventrolateral part of anterior trunk, ventrally on caudal peduncle; base of caudal fin with an irregular spot deeper than wide.

Base of pectoral fin with large, light area, the lower two-thirds much wider than upper part; light base divided or nearly so by dark wedge extending anteriorly from dark sickle-shaped mark on proximal portion of pectoral fin, distal half of pectoral fin with dark brown spots arranged, more or less, in 3-5 wavy, vertical bands. Pelvic fin clear in smaller specimens, slightly dusky in larger specimens. First dorsal fin with three brownish marks separated by two light areas, the first is a spot at anterior base, the second is a bar through middle of fin from bases of the third, fourth, and fifth spines and the third is a bar extending from base of last spine to tips of fourth and fifth spines. Second dorsal fin with 5 brownish, oblique cross bars or spots, the first is a spot located basally at the first and second rays, the second is a bar that passes upward and forward from the bases of the third and fourth rays, the third, a bar, extends up and forward from the bases of sixth and seventh rays, the fourth bar extends up and forward from the last ray, and a fifth mark is at the outer tips of the last 6 rays. Anal fin clear in smaller specimens, slightly dusky in larger specimens. The caudal fin mottled, light and brown, the brown marks arranged in 3-4 irregular, wavy bars. Saddles and fin bars are more defined and the pattern is more intense on the smaller specimens.

**GEOGRAPHIC DISTRIBUTION.**—Known from 2 dis-

junct areas, southern India (Gulf of Mannar) and the northern Gulf of Thailand (Figure 7).

**ECOLOGY.**—Sand and living and dead coral are listed as bottom types in field notes of all 4 collections. At one collection site a "variety" of sponges was listed. Specimens were taken in depths up to 4-5 m.

**ETYMOLOGY.**—Named for Loren P. Woods, Curator of Fishes, FMNH, who collected all but 2 of the known specimens.

**MATERIAL EXAMINED.**—*Holotype*: USNM 212249, male (38.0), Musal Tivu (also known as Hare Island), N side, outer reef, Manauli Reef, across channel from Mandapam, Gulf of Mannar, India, collected over bottom of broken and live coral and sand by Loren P. Woods, sta 4, 2 Jan 1964.

*Paratypes*: 24 males and 32 females. USNM 211343, 3 males (23.9-42.3), 1 cleared and stained, 4 females (27.8-37.7), 1 cleared and stained, same data as USNM 212249; CAS 31498, male (30.7), female (33.7), same data as USNM 212249; FMNH 77048, 10 males (31.9-39.0), 12 females (29.3-36.2), same data as USNM 212249; USNM 211344, 3 males (28.4-39.5), 3 females (19.6-35.3), type-locality, L. P. Woods sta 7, Jan 1964; FMNH 77049, 6 males (29.0-38.8), 10 females (21.1-32.9), same locality as USNM 211344; FMNH 77050, female (34.0), Musal Tivu, 1 mile off NE tip, L. P. Woods sta 21, 22 Feb 1964; CAS 33631, male (29.1), female (26.8), Gulf of Thailand, Prachuap Khiri Khan Province, NW side of Goh Raed, 11°47'40"N, 99°49'30"E, GVF Reg. No. 2651, 19 Jun 1961.

### *Gobiopsis malekulae* (Herre)

FIGURE 6; PLATE 5

*Ctenogobius malekulae* Herre, 1935:423 [type-locality: Bushman Bay, Malekula Island, New Hebrides]; 1936:367, fig. 25 [New Hebrides].

*Herreogobius malekulae*.—Koumans, 1940:139 [New Hebrides].—1953b:145, fig. 34 [New Hebrides].

**DIAGNOSIS.**—Sensory pore SOT present, NA, PITO, AT, PT, and POP pores absent; a row of papillae from snout to SOT pore; trunk with a dark, wide, uniform midlateral stripe; only one trunk saddle; scales cycloid, 31-34 in horizontal series; barbels present in all defined positions except the posterior gular; jaw very short, about 10-11 percent of SL; dark head wedge descends to middle of preopercle; light base of pectoral fin not divided by dark wedge.

**DESCRIPTION.**—Dorsal fin rays VI-I,10(8); anal fin rays I,9(7), I,10(1); pectoral fin rays 16 (1), 17 (10); pelvic fin rays I,5 (5); segmented caudal fin rays 17(7); branched caudal fin rays 15(6); lateral scale



rows 31–34(3); transverse scale rows 15–17(2); predorsal scales 9–10(2).

Scales cycloid, primary radii in anterior field about 13–14; scale eccentric; focal area narrow; posterior field small with 9–10 short radii.

Vertebrae 10+16(7), 10+17(1); pterygiophore formula 3 (22110) in 7 specimens and 3 (221100) in 1.

Head length 294 (279–310) 4; snout length 67 (61–75) 4; greatest diameter of orbit 33 (30–35) 4; bony interorbital width 44 (43–45) 4; pectoral fin length 270 (262–275) 3; pelvic fin length 196 (188–205) 3; caudal fin length 284 (280–288) 2; predorsal length 381 (367–389) 4; greatest depth of body 157 (157) 2; least depth of peduncle 118 (117–118) 2; postanal length 362 (357–367) 2; lower jaw length 108 (100–115) 6; pelvic fin insertion to anal fin origin 361 (354–365) 3.

Apparently a small species, largest male 22.9 mm, largest female 23.0 mm. Body fairly slender, head moderately wide, fleshy interorbital width about 1.5 times diameter of orbit but less than length of snout; lower jaw very short, 10–11 percent of SL; origin of second dorsal fin just anterior to vertical from anal opening; depressed pectoral fin extending to about the vertical from end of base of first dorsal fin, pectoral fin longer than deep, the outer margin round to moderately acute; pelvic fins short, about one-half length of distance from pelvic fin insertion to anal fin origin.

Number of teeth on outer row, upper jaw about 13–15, lower jaw about 8.

The cephalic sensory pore and canal system is greatly reduced (Plate 5; Tables 1, 2) compared with these structures exhibited by the other species having pores. The NA and PTO pores, the AT and PT pores, and the POP pores, and the associated canals linking these pores are absent. The SOT pores are located close together near the midline, more so than on any other species. In smaller specimens of *G. malekulae* the SOT pores are more widely separated.

The cutaneous papillae system represents our *Gobiopsis* pattern 2 (Plate 5) which is characterized by having the nasal row continuous to the SOT pore. The lateral cephalic row originates at the IT pore and extends uninterrupted posteriorly to about the upper gill opening. The papillae of the second cheek row are coarse and more widely separated anteriorly than those of the other species.

The third cheek row is greatly reduced, having only 1 or 3 papillae. There is additionally a vertical row of 2 papillae as in *G. arenaria* at the mid-preopercular margin, above and disjunct, but in line with the outer preoperculo-mandibular row and more posterior and disjunct from the upper preopercular row.

The barbels in *G. malekulae* are comparatively well developed, only the posterior gular group is absent. The number of barbels in the groups are: intermandibular, 1–3 (mean 2.00); posterior mandibular 1–3 (2.63); postmandibular 1 (1.00); anterior cheek tuft 3–4 (3.56); anterior internasals 1–2 (1.18); posterior internasals 1 (1.00). The lower barbel on the anterior cheek tuft is not elongate but is about equal to or slightly longer than others on the tuft.

COLOR IN PRESERVATION.—Trunk with a prominent, dark lateral stripe located dorsolaterally anteriorly on trunk and laterally on caudal peduncle; stripe wide, greater than one-half depth of caudal peduncle; stripe begins at upper base of pectoral fin where it unites with the broad, predorsal saddle that extends between the upper pectoral fin bases; Herre (1936:367, fig. 25) does not show the predorsal saddle or barbels; trunk stripe terminates at base of caudal fin where it is somewhat constricted and confluent with the dark, deep bar at base of caudal fin, which is as deep as caudal peduncle; middorsal area posterior to predorsal saddle pale to slightly dusky, lacking saddles characteristic of other species of *Gobiopsis*. Head with dark mark from interorbital area to line between preopercular margins and descending laterally to midpreopercle as a dark head wedge; a light band on head between upper preopercular margins and upper edge of gill openings; snout slightly pigmented; margins of upper and lower jaws, chin, opercular area, breast, belly, and lower caudal peduncle below the dark lateral stripe, pale or light.

Pectoral fin with lower two-thirds light; sickle-shaped mark on upper pectoral fin does not divide the light base, but extends to upper fin base, remainder of fin clear; pelvic fin clear; first dorsal fin with a dark narrow stripe on lower portion of fin, remainder of fin clear; second dorsal fin with dark pigment on lower part of first 3 rays, remainder of fin clear; anal fin clear; caudal fin clear other than dark basal bar. Pigment on most of our specimens is greatly faded, including the wide, dark lateral trunk stripe.

**GEOGRAPHIC DISTRIBUTION.**—Known from the type-locality (New Hebrides) and from islands in the northern and southern Philippines. Koumans (1953a) reports this species from Misool in the Moluccas.

**ECOLOGY.**—Specimens from the *Albatross* stations in the Philippines came from tide pools and were collected with copper sulphate. The GVF collection from the Philippines was made with rotenone poison at a depth of 1 m on a sand bottom at edge of open sea, 10–15 m from shore at low tide.

**MATERIAL EXAMINED.**—Males, 2 (20.0–22.9); females, 3 (22.6–23.0); unsexed, 3 (14.4–18.0).

**PHILIPPINES:** CAS 33627, (23.0), Apo Island, 4 miles E of Zamboanguita town, Negros Oriental, 09°05'N, 123°16'E, GVF Reg. No. 2670, 11 May 1960; SU 40135, (15.1), Dumaguete, Negros Oriental, collected by A. W. Herre, 22 Dec 1936; USNM 135755, (18.0), Batan Is., *Albatross* Exp., 22 Jul 1909; USNM 135756, 3 (14.4–22.6), Maculabo Is., E of Luzon, *Albatross* Exp., 14 Jun 1909.

**NEW HEBRIDES:** FMNH 17385, holotype, male (22.9), Bushman Bay, Malekula Is., A.W.C.T. Herre, 4 Apr 1929; SU 24434, paratype, female (23.0), same data as FMNH 17385.

### *Gobiopsis arenaria* (Snyder)

FIGURE 6; PLATES 7d, 8d

*Heteroleotris arenarius* Snyder, 1908:100 [type-locality: Naha, Okinawa]; 1912:513, pl. 67: fig. 3.

*Pipidonia arenarius* Kamohara and Yamakawa, 1968:14, fig. 5 [Kikaijima, Japan].

**DIAGNOSIS.**—Sensory pores NA and PITO present, SOT almost always present, AT, PT, and POP absent; body slender, depth of caudal peduncle 24–30 percent of postanal length; scales cycloid, 33–36 in horizontal series; postmandibular barbel present, posterior gular barbels almost always present; jaw very short, its length about 10–13 percent of SL; dark wedge on head descends only to upper preopercle; light base of pectoral fin not divided by dark wedge; trunk with dark saddles joined at midbody, usually forming a continuous midlateral stripe with narrow extensions below stripe, head and trunk not mottled.

**DESCRIPTION.**—Dorsal fin rays VI–I,9(1), VI–I,10(17), VI–I,11(1); anal fin rays I,9(19); pectoral rays 17(17), 18(22), 19(2); pelvic fin rays I,5(21); segmented caudal fin rays 17(20); branched caudal fin rays 15(14), 16(2), 17(1); lateral scale rows 33–36(16);

transverse scale rows 13–17(14); predorsal scales 7–11(13).

Scales cycloid, primary radii in anterior field 13–14; scale eccentric; radii in posterior field short, numbering about 6–9; radii of anterior field converge broadly on a wide focal area.

Vertebrae 10+16(20), 10+17(1).

Head length 283 (260–299) 17; snout length 65 (59–73) 16; postorbital length 178 (164–187) 16; greatest diameter of orbit 41 (37–44) 16; bony interorbital width 39 (34–43) 12; pectoral fin length 249 (224–270) 15; pelvic fin length 188 (171–203) 14; caudal fin length 283 (255–308) 11; predorsal length 372 (357–391) 17; greatest depth of body 137 (121–159) 16; least depth of peduncle 102 (92–120) 23; postanal length 380 (357–399) 23; lower jaw length 119 (102–133) 12; pelvic fin insertion to anal fin origin 350 (314–380) 14. The latter measurement may be related to both sex and size; males (19.5–22.7 mm SL) have values ranging from 314 to 323 and females (22.5–30.1 mm SL) have values ranging from 332 to 380.

Body slender, snout from above pointy, head behind eyes narrow. A small species, largest male 25.2 mm SL, largest female 30.6 mm SL, a gravid female 25.2 mm SL. Trunk not deep, caudal peduncle narrow, least depth of peduncle about 24–30 percent of postanal length (Figure 5). Snout long, longer than width of fleshy interorbital; fleshy interorbital width somewhat greater than diameter of orbit; lower jaw short, about 10–13 percent of SL; origin of second dorsal fin slightly posterior to vertical at anal opening; depressed pectoral fin short, extending posteriorly to vertical from end of base of first dorsal fin, longer than deep, the margin rounded; pelvic fin short, shortest for the genus, about 54 percent length of distance from pelvic fin insertion to anal fin origin (Figure 3).

Number of teeth on outer row of upper jaw 14–17, on lower jaw 8–12.

The following cephalic sensory pores are absent: the POP, AT, and PT pores. The SOT pores are occasionally absent (Tables 1, 2).

The cutaneous papillae system is pattern 3. As in *G. malekulae*, there are 2 papillae in a vertical row at the midpreopercular margin, above and disjunct, but in line with the outer preoperculo-mandibular row and more posterior and disjunct from the upper preopercular row.

Barbels present in all defined positions except occasionally the posterior gular group is missing. The number of barbels, by particular groups, are: intermandibular, 1-3 (mean 2.30); posterior mandibular 2-4 (3.00); postmandibular 1 (1.00); posterior gular 0-2 (0.70); anterior cheek tuft 2-4 (3.26); anterior internasals 1-2 (1.45); posterior internasals 1-2 (1.35). Lower barbel on anterior cheek tuft is not elongate, but is about equal to or slightly longer than others on the tuft.

**COLOR IN PRESERVATION.**—Body strongly bicolored, the four prominent dark brown trunk saddles are in contrast with a predominately light colored body (Plates 7*d*, 8*d*).

Head from tip of snout to line between upper preopercular margins dark brown, more so behind the eyes, forming a broad, dark band that descends on the upper preopercle as a dark wedge; a light interopercular band between dark head band and first anteriormost dark trunk saddle, sometimes finely dusky; remainder of head whitish.

The 4 trunk saddles extend from the dorsal midline ventrally to about the midlateral body where they arc together and form a lateral stripe, and are joined from the upper pectoral fin base to base of caudal fin; 5 narrow branches of the dark brown arcs between the saddles extend ventrally to about the ventrolateral part of the body; the first saddle is largest, squarish, and occurs in the predorsal area from about the upper interpectoral area posteriorly to before the origin of first dorsal fin; the second saddle, one-half width of first saddle, passes through the posterior part of first dorsal fin; the third saddle, about as wide as second, passes through the anterior portion of second dorsal fin; the fourth, smallest saddle, about one-half as wide as third saddle, passes through the base of last ray of second dorsal fin; the light dorsal areas between the dark saddles have some fine, brownish mottling; base of caudal fin with a well developed, dark vertical bar confluent with midlateral stripe, equal to or less than diameter of orbit, and as deep as base of caudal fin; remainder of body ventrolaterally and ventrally light to whitish.

Pectoral fin with dark brown sickle-shaped mark on upper part of the fin, touching the upper basal portion; sickle-shaped mark not dividing the light pectoral base into two parts by a dark anteriorly directed wedge, remainder of pectoral fin light or clear; pelvic and anal fins light to transparent; first

dorsal fin with a small, dark basal spot between first two spines; another dark mark basally at fourth to sixth dorsal spines over second saddle; a dark basal mark on second dorsal fin between third to fifth rays over third saddle; a small, brownish basal spot on last ray of second dorsal fin over the fourth saddle; remainder of dorsal fins light to transparent; caudal fin primarily light with irregularly arranged, weak, brownish, elongate spots on rays. Definitive adult color pattern almost completely developed at 8 mm SL.

**GEOGRAPHIC DISTRIBUTION.**—Known from southern Japan, the Ryukyus, Taiwan, and Hong Kong (Figure 6). Koumans (1941:247) reported this species from the Andaman and Nicobar islands. We consider these to be erroneous records of *G. arenaria*; they probably represent specimens of *G. quinquecincta*. Our search of specimens did not reveal *G. arenaria* occurring west of Hong Kong. Koumans (1940:127, 130) placed *G. quinquecincta* Smith in the synonymy of *G. arenaria* which may account for these records. We were unable to obtain the specimens from these two islands studied by Koumans.

**ECOLOGY.**—The type-locality of *Heteroleotris arenarius* was characterized as "sandy pools" (Snyder, 1908:100). Collection sites listed in the material examined include tide pools, surge channels and rocky and coral reefs, but always with a bottom of rock or coral rubble. *Gobiopsis arenaria* is known from depths of 8.5 m. Most specimens were collected with ichthyocides.

**REMARKS.**—A small specimen, USNM 74581, paratype, 8.1 mm SL, from the type-locality, has no pores developed and we tentatively place it under *G. arenaria* because the dark body saddles are narrow and are in various stages of uniting laterally, whereas specimens of similar sizes of *G. quinquecincta* have broad saddles, forming broad bars not united laterally. The pectoral fin ray count of 17 is typical for *G. arenaria* and is low for the other species that have laterally connected saddles at small sizes, e.g., *G. aporia*, *G. angustifrons*, and *G. bravoii*. The dark head wedge, however, extends ventrally on the preopercle, which is not typical for *G. arenaria*.

Snyder (1908:100) gave the length for the holotype as 270 mm, an obvious error. The standard length is 20.1 mm.

MATERIAL EXAMINED.—Males, 6 (19.5–25.2 mm SL); females, 16 (19.2–30.6); unsexed, 3 (8.1–19.5).

JAPAN: USNM 74582, paratype, female (19.2), Tanega Shima, *Albatross* Exp. 1906; SU 21104, paratypes, male (21.9), unsexed (19.5), same data as USNM 74582.

RYUKYU ISLANDS: KSHS 6366, (30.1), Amami O Shima, Jul 1969; KSHS 9458, (29.8), Kikaiga Shima, Aug 1969; KSHS 9459, (24.4), same data as KSHS 9458; USNM 62237, holotype, male (20.1), Naha, Okinawa, *Albatross* Exp. 1906; USNM 74581, paratype, immature (8.1), same data as USNM 62237.

TAIWAN: USNM 209241, (19.5), bay between K'en-ting and Ta-yuan Shan, 21°55.5'N, 120°48'E, V. G. Springer sta 68-12, 1 May 1968; USNM 211141, (25.9), Ta-fan-lieh, V. G. Springer sta 68-6; 25 Apr 1968; USNM 211142, (16.4, 24.6), Ch'uan-fan-shih, V. G. Springer sta 68-21, 7 May 1968; USNM 211143, gravid female (25.2), SE tip of Taiwan, V. G. Springer sta 68-8, 27 Apr 1968; USNM 211144, (24.4, 24.8), Sha toa, NW of swimming beach, V. G. Springer sta 68-17, 5 May 1968; USNM 211145, 7 (22.3–28.9), 1 cleared and stained, cove SE of K'en-ting, S end of Taiwan, V. G. Springer sta 68-1, 22 Apr 1968; USNM 213530, (25.2), large cove on W side of southern tip of island, 21°55.0'N, 120°50.0'E, V. G. Springer sta 68-13, 2 May 1968.

HONG KONG: BPBM 18634, gravid female (27.7), SW side of Kau Sai Island, J. E. Randall and W. Chan, 22 Jun 1975; CAS 33625, (30.6), E shore of Shelter Island, 22°19'42" N, 114°17'56"E, GVF Reg. No. 1732, 24 Apr 1958.

### *Gobiopsis quinquecincta* (H. M. Smith)

FIGURE 7; PLATE 10

*Pipidonia quinquecincta* H. M. Smith, 1931:39, fig. 19 [type-locality: Island of Pipidon, Vogels Islands, W coast Malay Peninsula].

*Macgregorella indica* Herre, 1945:402 [type-locality: Krusadai Island, Gulf of Mannar, Pamban District, Madras Presidency, South India].

DIAGNOSIS.—Sensory pores NA and PITO present, SOT pore almost always present, 2 POP pores, the AT and PT pores absent; postmandibular and posterior gular barbels almost always present; anterior cheek tuft barbels modally 5; most scales cycloid but some with a few weak ctenii, size large, 29–37 in horizontal series; jaw very short, about 11–13 percent of SL; dark head wedge descends to middle or lower preopercle; light base of pectoral fin not divided by dark wedge; trunk with well developed unconnected bars, or saddles weakly united laterally.

DESCRIPTION.—Dorsal fin rays V–I, 10(2), both lack third dorsal fin spine and pterygiophore, VI–I, 9(8), VI–I, 10(132), VI–I, 11(7); anal fin rays I, 8(4), I, 9(136), I, 10(7); pectoral fin rays 15(1), 16(11), 17(70), 18(57), 19(8); pelvic fin rays I, 5(35); segmented caudal fin

rays 16(1), 17(128), 18(2); branched caudal fin rays 15 (103), 16(23), 17(4); lateral scale rows 29–37(14); transverse scale rows 13–16(10); predorsal scales 6–11(10).

Scales mostly cycloid, a few ctenoid scales on caudal peduncle; scale eccentric; primary radii in anterior field 13–16; radii of anterior field converge rather sharply forming a focal area moderately wide; radii in small posterior field 8–12, about one-sixth as long as those in anterior field.

Vertebrae 10+15(2), 10+16(167), 10+17(1).

Head length 284 (269–305) 16; snout length 71 (67–76) 8; postorbital length 179 (167–193) 16; greatest diameter of orbit 38 (34–45) 16; bony interorbital width 42 (38–48) 10; pectoral fin length 247 (223–269) 16; pelvic fin length 188 (175–209) 15; caudal fin length 248 (229–276) 12; predorsal length 373 (349–389) 16; greatest depth of body 147 (128–199) 16; least depth of peduncle 124 (117–130) 34; postanal length 374 (345–395) 34; lower jaw length 120 (112–128) 10; pelvic fin insertion to anal fin origin 354 (328–379) 16.

Body elongate, slender, the head not expanded when viewed from above (the expanded head shown in Plate 10*b* is atypical; this expansion is probably related to preservation); snout rounded, viewed dorsally; a species small to moderate in size, the largest male 36.4 mm SL, the largest female 36.2 mm SL; length of snout greater than fleshy interorbital width; fleshy interorbital width about 1.2 times diameter of orbit; length of lower jaw very short, 11–13 percent of SL; trunk not deep, but caudal peduncle deep, the least depth about 30.5–36.5 percent of postanal length (Figure 5); origin of second dorsal fin just anterior to vertical through anal opening; depressed pectoral fin short, not extending posteriorly to vertical from end of base of first dorsal fin, pectoral fin longer than deep, the posterior margin round; pelvic fin short, its length about 55 percent length of distance from pelvic fin insertion to anal fin origin (Figure 3).

Number of teeth on outer row of upper jaw 10–14, on lower jaw 7–9.

The AT and PT sensory pores are absent; the SOT pores are occasionally absent (Tables 1, 2). In a few specimens (5 specimens out of 401 examined) particular positions of pores may be occupied by double or triple sets of pores. The PITO pore position in 3 specimens was occupied by double but somewhat smaller than normal sized pores. The SOT pore

position was occupied on one specimen by a double set of pores and on another by a triple set of pores, all smaller than normal pores and adjacent to each other.

The cutaneous papillae system is pattern 3.

Barbels present in all defined positions except occasionally absent from the postmandibular and the posterior gular. The number of barbels on the anterior cheek tuft is high, ranging from 3 to 7 (mean 5.08). The number of barbels in other particular positions follows: intermandibular, 2-4 (2.67); posterior mandibular 2-5 (3.40); postmandibular 0-4 (0.92); posterior gular 0-3 (1.42); anterior internasals 1-4 (2.73); posterior internasals 1-3 (1.73). Lower barbel on anterior cheek tuft is not elongate, but is about equal to or slightly longer than others on the tuft.

**COLOR IN PRESERVATION.**—The typical color pattern consists of the dark broad head band just behind the eyes that descends laterally to the middle or lower preopercle; 4 prominent, wide, dark saddles or bars on trunk almost always descending to lower trunk; a deep, dark bar traversing base of caudal fin (Plate 10*a,b*).

Tip of snout posteriorly to interpreopercular area dark brown, more so behind eyes; pigment descending to middle or lower preopercle as a dark brown wedge; tip of lower jaw and cheeks with some pigmentation; nape, spanning the interopercular region to upper opercular area, is lightly pigmented in brown; head laterally and ventrally light colored with some scattered chromatophores.

First dorsal saddle square-shaped, beginning just before upper pectoral base and extending posteriorly to origin of first dorsal fin, the saddle descends to midbody, slightly below insertion of upper pectoral fin; second saddle almost as wide as first, passes through base of first dorsal fin, and descends on lower trunk somewhat obliquely and posteriorly as a wide, conspicuous dark brown bar, portions of which may extend onto belly; the third saddle, as wide as second, passes through anterior portion of second dorsal fin, and descends obliquely and posteriorly as a broad bar ventrally to the anal fin; the fourth saddle as wide as third or sometimes wider, passes through end of second dorsal and anterior peduncle and descends ventrally as a broad, oblique bar, to base of caudal peduncle; a deep, dark brown to black basal caudal bar, as deep as caudal base,

wider than diameter of orbit, with an enlarged mid-basal wedge, directed anteriorly; light areas between saddles dusky or mottled in heavy patches of brown; breast and belly light to whitish. The above color description pertains to the predominant pattern of collections from the Indian area shown in Plate 10*a,b*; these illustrations lack the heavy dark mottling usually present in the light dorsal areas.

Pectoral fin with a dark, slanting bar, touching upper base of fin and confluent with anterior part of first saddle, light area of pectoral base not divided into two parts by dark wedge extending from sickle-shaped pectoral mark, remainder of fin clear to slightly dusky; pelvic and anal fins light or transparent; first dorsal fin with a small, light spot at anterior base, remainder of fin black in area where saddle passes through it, the outer tips whitish; second dorsal fin with a small, light area at anterior base, two to three horizontal rows of elongate dark spots on rays, the basal portion of fin dark where third and fourth saddles pass through it, remainder of fin clear; caudal fin with some elongate, light brown spots on rays, irregularly arranged, but more concentrated in center part of fin, these spots usually weakly developed or not visible. A few specimens have smaller saddles, or an additional saddle (Plate 10*c*), and in a few specimens the saddles descend to the midbody where some are joined laterally.

Collections from the Gulf of Thailand have the dark head band almost always subdued or obscure. This band is almost always prominent in collections from India and Sri Lanka. In our large series of specimens examined from the Gulf of Thailand there was considerable variation in the trunk saddles. They were usually smaller and more irregularly shaped than on specimens from India. The saddles break up laterally on the midside of the body, where some may arc together and become partially joined (Plate 10*d*), sometimes not descending on lower body or in some specimens with small projections below the arcs. A few specimens may lack a saddle, or 2 saddles may be combined dorsally (Plate 10*e*). About 10 percent of the specimens from the Gulf of Thailand have some modification of the saddles laterally on the body, and most of the specimens have no caudal pigmentation. The subdued head band and the smaller and more irregular lateral bars in the Malaya collections may reflect a significant racial divergence.



The small specimens, CAS 33611, 8.1 mm SL, from Palau, and SU 68001, 8.5 mm SL, from the Philippines, have the typical color pattern of the adults. At these small sizes the preopercular wedge is well developed and descends well below the midline; the dark head bar is evident; the 4 trunk saddles are completely developed, barlike at the side of the body, descend to the ventral portion, and are uniform and regular in shape; the caudal bar is completely developed with the midbasal wedge; the dark, sickle-shaped pectoral mark is prominent as well as the dark areas of the first and second dorsal fins, where the saddles pass through the basal portion. Three small dark spots are present on the mid-ventral line, observed in other small specimens of other species of *Gobiopsis*; a very small spot is at the middle of the frenum; a larger, elongate spot in middle of belly and one at end of anal fin base.

The type specimen of *Macgregorella indica* Herre, SU 39855, possesses the typical broad saddlelike bars and mottling characteristic of other Indian collections.

**GEOGRAPHIC DISTRIBUTION.**—Known from southern India, Sri Lanka, Nicobar Islands, both sides of the Malay Peninsula, Mindanao, Taiwan, and Okinawa (Figure 7). A specimen, 8.1 mm SL (CAS 33611), from the Palau Islands, is identified as this species but not shown on the distributional map.

**ECOLOGY.**—Data available from collection sites in the Malacca Straits and the Gulf of Mannar suggest a similar habitat preference as that given for *G. aporia*, although no collections were made deeper than 4 m. L. P. Woods' field notes state "very abundant on dead coral". The holotype of *G. quinquecincta* was taken in a tide pool. The holotype of *Macgregorella indica* was taken "from coral" (Herre, 1945). The *Albatross* collections from the Philippines were made with dynamite in areas of coral, or sand and coral, at depths of about 2.4 to 6 m. The Gulf of Thailand specimens were taken over bottoms of coral or boulders and gravel.

**REMARKS.**—The species *G. quinquecincta* has been confused with *G. arenaria* in the literature by various authors. Tomiyama (1936:93) questionably placed *G. quinquecincta* in the synonymy of *G. arenaria* but examined no specimens. Koumans (1940:127, 130) examined the types of both of these species and considered them synonymous without

question. H. M. Smith (1945:519) recognized both forms but gave no critical characters to distinguish them. These species differ as follows: preopercular canal present in *G. quinquecincta*, absent in *G. arenaria*; the caudal peduncle is consistently deeper in *G. quinquecincta* than in *G. arenaria* (Figure 5); the dark wedge on head descends lower on the preopercle in *G. quinquecincta* than on *G. arenaria*; and the color pattern of the body of *G. quinquecincta* consists typically of dark bars, free from each other (Plate 10a) or weakly connected, whereas *G. arenaria* has dark dorsal saddles that join laterally (Plate 7d). Gravid females of *G. quinquecincta* were found ranging from 17.4 to 30.3 mm SL and from 25.2 to 27.7 mm SL for *G. arenaria*.

Numerous specimens taken in the Gulf of Mannar by Loren Woods had a species of copepod attached deeply into the body wall beneath the pectoral fin. The copepod, identified as *Peroderma petersi* Richardi (1881) by Roger F. Cressey, was originally recorded from a goby, *Gobius buccatus* Cuvier and Valenciennes. This parasite apparently has not been reported since the original description (Cressey, pers. comm.). We are unable to confirm the identity of the goby from which Richardi obtained the copepod.

We found this copepod in 5 of the 7 stations from the Gulf of Mannar as follows: station LW-3, copepods on 11 of 36 specimens; LW-5, 7 of 12 specimens; LW-7, 5 of 60 specimens; LW-8, 2 of 115 specimens, and LW-11, 4 of 210 specimens. The infestation occurred on small to large specimens of both sexes. No copepods were found on specimens of *G. woodsi* collected commonly in the same area where infestation was found for *G. quinquecincta*. At station LW-7, *G. woodsi* was captured with *G. quinquecincta*, yet 22 specimens of *G. woodsi* examined had no copepods. In over 800 specimens of *Gobiopsis* examined in this study, copepods were found only on *G. quinquecincta* from the Gulf of Mannar.

**MATERIAL EXAMINED.**—262 males, 330 females and 13 small unsexed specimens.

**SRI LANKA:** USNM 211350, 3 (25.5–34.8), Galle, sheltered inlet at park, L. P. Woods sta 22, 5 Mar 1964; FMNH 77057, 3 (29.9–32.2), same data as USNM 211350; USNM 212295, (14.6, 19.5), Weligama, E of resthouse, C. C. Koenig sta 69-105, 14 Feb 1970; AMS I.18494-001, (24.4, 29.8), Trincomalee, N side of Dutch Point, P. C. Heemstra sta 69-278, 30 Sep 1969.



INDIA, SE coast: SU 39855, holotype of *Macgregorella indica*, female (32.1), Krusadai I., Gulf of Mannar, Pamban District, Madras Presidency, A.W.C.T. Herre, 22 Jan 1941; SU 39928, (34.1), same data as SU 39855; USNM 211345, 10 (23.7–33.9), Musal Tivu, across channel from Mandapam, reef at W end, L. P. Woods sta 8, 16 Jan 1964; FMNH 77054, 105 (22.6–33.7), same data as USNM 211345; USNM 211346, 5 (27.6–36.2), Musal Tivu, N side, outer reef, L. P. Woods sta 7, Jan 1964; FMNH 77053, 55 (29.1–36.4), same data as USNM 211346; USNM 211347, 10 (9.2–35.6), Shingle I., S side of Pamban Pass, Kallaru Reef, L. P. Woods sta 11, 30 Jan 1964; FMNH 77055, 200 (19.2–34.5), same data as USNM 211347; USNM 211348, 5 (8.9–31.3), Musal Tivu, SW reef, L. P. Woods sta 13, 27 Jan 1964; FMNH 77056, 10 (9.5–28.4), same data as USNM 211348; USNM 211349, 6 (21.1–30.5), Musal Tivu, just inside SW point, L. P. Woods sta 3, 30 Dec 1963; FMNH 77051, 30 (23.5–29.0) same data as USNM 211349; USNM 211351, 5 (24.0–27.8), Musal Tivu, S side, L. P. Woods sta 5, 7 Jan 1964; FMNH 77052, 7 (24.4–28.0), same data as USNM 211351; FMNH 77058, 3 (29.5–31.1), Musal Tivu, N side outer reef, L. P. Woods sta 4, 2 Jan 1964.

NICOBAR ISLANDS; ZSIC F 7168/2 (15.2), no other data.

MALAY PENINSULA, west coast: USNM 90317, holotype, male (19.5), Pipidon I., Vogels Is., just S. of Phuket, Thailand, H. M. Smith, 10 Mar 1925; USNM 209239, (26.5), Pulo Jarak, Malacca Strait, 3°59'N, 100°06'E, Te Vega sta 71, 30 Oct 1963; USNM 214838, (20.2, 25.5), Pulo Tenga, Butang Is. 6°34'24"N, 99°27'36"E, Te Vega sta 88, 10 Nov 1963. East coast: USNM 211352, 20 (20.8–35.8), 3 cleared and stained, Gulf of Thailand, 8°26'N, 100°45'E, R. Bolin, 25 Jan 1960; CAS 28352, 101 (23.5–32.4), 3 cleared and stained, same data as USNM 211352; CAS 33613 (24.6) between Goh Larn and Goh Crok, head of Gulf of Thailand, 12°55'52"N, 100°48'09"E, GVF Reg. No. 1458, 23 Oct 1957; CAS 33617, 6 (23.9–32.8), S side of Goh Proet, GVF Reg. No. 1593, 25 Dec 1957; CAS 33626, (27.6, 28.4), Ko Kra, 8°26'N 100°45'E, GVF Reg. No. 2039, 26 Jan 1960.

PHILIPPINES: USNM 160749, 4 (17.4–22.2), Pilas I. SW of Mindanao, *Albatross* Exp., 12 Sep 1909; USNM 160750, (20.1), Tapiantana I., SW of Mindanao, *Albatross* Exp., 13 Sep 1909; SU 68001, (8.5), Catanduanes Province, Panay I., G. W. Barlow, 26 Jun 1953.

TAIWAN: USNM 211147, (22.5), about 2 km SW of Ta-fan-lich, SW end of Taiwan, V. G. Springer sta 68-7, 26 Apr 1968.

RYUKYU ISLANDS: BPBM 18709, (23.6), Okinawa, Yomitan tide pools, J. E. Randall, et al, 6 Jun 1975.

PALAU: CAS 33611, (8.1), reef off SW point of Nardueis I., 7°20'44"N, 134°35'08"E, GVF Reg. No. 811, 4 Sep 1956.

### *Gobiopsis bravoii* (Herre)

FIGURE 6: PLATES 6a,b, 11a,b,d

*Macgregorella bravoii* Herre, 1940:363, pl. 5 [type-locality: Nasugbu, Batangas Province, Luzon].—Koumans, 1953b: 390.

DIAGNOSIS.—Sensory pores NA, PITO and SOT present, 2 POP pores, AT and PT pores absent; head with many barbels, postmandibular barbel present, posterior gular barbels almost always present, the intermandibular row long, modally 7 barbels on each side, barbels of the anterior cheek tuft modally 5; head broad, eyes small, interorbital wide, diameter of orbit less than or equal to width of bony interorbital; scales, cycloid, 28–38 in lateral series; jaw short, its length about 12–16 percent of SL; dark head wedge descends to lower preopercle, obscured in large specimens; light base of pectoral fin not divided by dark wedge; trunk with 4 dark saddles joined at midbody, forming a wavy midlateral stripe, with broad extensions below stripe, head and trunk mottled.

DESCRIPTION.—Dorsal fin rays VI–I,9(1), VI–I,10 (22), VI–I,11(1); anal fin rays I,8(1), I,9(2), I,10(2); pectoral fin rays 18(11), 19 (32), 20(3); pelvic fin rays I,5(20); segmented caudal fin rays 17(15); branched caudal fin rays 15(11), 16 (4); lateral scale rows 28–38(8); transverse scale rows 12–17 (6); predorsal scales 9–12(3).

Scales cycloid; primary radii in anterior field 10–18; radii of anterior field converge rather sharply forming a focal area moderate to narrow in width; radii in posterior field short, 5–11; the posterior field in some specimens barely discernible.

Vertebrae 10+16(23).

Head length 314 (281–338) 9; snout length 83 (65–93) 9; postorbital length 190 (176–204) 9; greatest diameter of orbit 41 (36–47) 9; bony interorbital width 46 (43–54) 9; pectoral fin length 262 (243–283) 5; pelvic fin length 204 (176–221) 13; caudal fin length 251 (229–291) 7; predorsal length 398 (369–425) 9; greatest depth of body 173 (150–189) 9; least depth of peduncle 127 (121–136) 13; postanal length 359 (324–385) 13; lower jaw length 150 (124–164) 8; pelvic fin insertion to anal fin origin 354 (337–372) 13.

Species attaining an intermediate size for the genus, largest male 34.1 mm SL, largest female 32.3 mm SL, a gravid female 28.4 mm SL. Body stout, trunk deep, head broad (Plates 6a,b, 11d). Snout slightly longer than fleshy interorbital width; fleshy interorbital width about 1.5 times diameter of orbit; length of lower jaw short, 12–16 percent of SL, angle of jaw beneath vertical from about middle of eye; caudal peduncle deep, least depth 33.5–37.5 percent of postanal length (Figure 5); origin of

second dorsal fin over anal opening; depressed pectoral fin extends posteriorly to vertical from end of base of first dorsal fin, the length twice depth at base, the posterior margin moderately acute; pelvic fin short, averages about 57 percent of length of distance from pelvic fin insertion to anal fin origin (Figure 3).

Number of teeth on outer row of upper jaw about 14–16, on lower jaw about 8–10.

The AT and PT cephalic sensory pores are absent. A double IT pore on one side of one specimen was found and one specimen lacked the SOT pore on one side (Tables 1, 2).

The cutaneous papillae system is pattern 3 (Plate 6a,b).

Barbels present and comparatively well developed in all defined positions. The ranges and means for barbels in particular positions are: anterior cheek tuft 4–6 (4.93); intermandibular 2–8 (6.09); posterior mandibular 2–6 (3.43); postmandibular 1 (1.00); posterior gular 0–4 (2.14); anterior internasals 2–4 (3.00); posterior internasals 1–3 (2.29). Lower barbel on anterior cheek tuft not elongate, but about equal to or slightly longer than others on tuft.

**COLOR IN PRESERVATION.**—The predominant color pattern consists of 4 dark trunk saddles that arc and join at midbody forming a wavy midlateral stripe usually with broad projections from the stripe to the ventrolateral area (Plate 11b).

Head dorsally from tip of snout to interpreopercular line dark brown, mottled in larger specimens, forming a dark brown bar behind the eye that descends as a wedge to lower preopercle, wedge sharply defined in smaller specimens, obscure in larger specimens, brown coloration more intense behind the eyes; light band on head just posterior to brown bar traverses interopercular area, pale to slightly brown in smaller specimens and brownish pigmented or slightly mottled in larger specimens; cheek and tip of snout with some pigmentation in larger specimens, lower head pale.

First dark trunk saddle slightly wider than interorbital, extends from just before upper pectoral base to area before first dorsal fin and descends to level of upper base of pectoral fin; second saddle, somewhat narrower than first, passes through mid-base of first dorsal fin; third saddle, as wide as second, passes through anterior base of second dorsal; fourth saddle, narrower than third, passes through

end of base of second dorsal; the saddles arc and join laterally, just above midside of body, and usually broad projections from about the middle of the arcs descend ventrolaterally on belly and ventrally on caudal peduncle, projections often broken up into scattered, brown patches; a deep, dark brown bar at base of caudal, its depth equal to that of peduncle, the midportion broadened into a wedge, directed anteriorly and confluent with wavy lateral stripe; breast, belly, and lower peduncle pale; spaces between dark saddles dusky brown, sometimes mottled.

The holotype, a male, and the largest two paratypes, males, 29.4 and 31.7 mm SL, are heavily mottled, somewhat obscuring the weak saddles (Plate 11a,d). Other specimens of both sexes have well developed saddles, not appreciably obscured by mottling. The smaller specimens have little or no mottling, the dark head band and wedge, the trunk saddles, the wavy lateral stripe and its ventral projections, the basal caudal bar, the sickle-shaped pectoral mark and the dark marks on first and second dorsal fins are sharply defined.

The pectoral fin proximally with a sharp, dark brown sickle-shaped mark, touching upper pectoral base, and confluent with first dorsal saddle, the large light base not divided into two parts by dark wedge from sickle-shaped mark, some dark scattered spots on rays of upper and outer half of fin, often weakly developed or obscure, remainder of fin clear; pelvic and anal fins clear; first dorsal fin with a small dark spot at anterior base, midportion with dark area where it is traversed by second saddle, the outer portion of fin dusky to clear; second dorsal fin with a small, light anterior spot, two dark basal marks where the third and fourth saddles traverse the fin, a small dark basal spot between the two dark latter marks, the middle and outer part of fin with dark horizontal stripes formed by elongate spots on rays, remainder of fin clear; caudal fin with dark elongate spots on rays, irregularly arranged, diffuse in some specimens, almost obscure in smaller specimens.

**GEOGRAPHIC DISTRIBUTION.**—Known from Okinawa (questionable identification), 2 areas of the Philippines, off western New Guinea, the Moluccas, and Palau (questionable identification) (Figure 6).

**ECOLOGY.**—Taken in areas of dead and live coral interspersed with sand, sometimes taken in tide pools; depths of capture range from one-half to 5 m.

REMARKS.—A specimen from Palau, CAS 33612, a male, 20.5 mm SL, has all the characters of *G. bravoii* except in its color pattern and pterygiophore formula. The first dark trunk saddle is present and connected anteriorly with the wavy midlateral dark stripe, but the three posterior trunk saddles beneath the dorsal fins are absent. The deep, basal caudal bar is present. Remnants of the dark pigment in the dorsal fins, typical of other *bravoii*, are present. The pterygiophore formula is 3 (221100).

The specimen from Okinawa, USNM 132806, a male, 30.6 mm SL, has well defined saddles that extend to midline and arc and join, ventral projections on lower body, a sharp sickle-shaped bar on pectoral and a clearly outlined head bar and wedge. The body is distinctly bicolored, the dark saddles greatly contrast with the remainder of the light body. This specimen lacks the general pigmentation or mottling of all of our larger specimens. The physiognomy of the head also differs to some extent from our other material, but the head appears to be swollen or expanded. Thus, we allocate this specimen with some suspicion to *G. bravoii*.

MATERIAL EXAMINED.—8 males (26.2–34.1), 12 females (20.9–32.3), 3 unsexed specimens (11.8–16.1).

PHILIPPINES: SU 33120, holotype, male (31.1), Nasugbu, Batangas Province, Luzon, A.W.C.T. Herre, 11 Dec 1936; SU 33121, paratypes, males (29.4, 31.7), females (24.4, 26.3), same data as SU 33120; CAS 33619, (20.9), Ayuguitan area, 14 km N of Dumaguete, Negros Oriental, 09°27'N, 123°14'E, GVP Reg. No. 1598, 7 Apr 1958; CAS 33620, 3 (16.1–34.1), same locality as CAS 33619, GVF Reg. No. 1600, 19 Apr 1958; CAS 33621, (11.8, 29.9), same locality as CAS 33619, GVF Reg. No. 1602, 2 May 1958; USNM 216190, 4 (24.9–29.0), 2 cleared and stained, presumably Dumaguete Beach, Negros Oriental, GVF Reg. No. 1605, 7 Jun 1958; CAS 33623, (27.0, 27.7), Dumaguete Beach, Negros Oriental, 09°19'N, 123°19'E, GVF Reg. No. 1608, 8 Jun 1958; CAS 33624, 3 (25.9–26.2), ca. 9 km N of Dumaguete, Negros Oriental, 09°26'(or 27')N, 123°18'E, GVF Reg. No. 1623, date of collection unknown.

INDONESIA: USNM 211923, (14.3), ca. 3°35'S, ca. 128°36'E, SE tip of Haria Bay, Saparua, V. G. Springer sta 74-5, 5 Mar 1974.

NEW GUINEA: SU 28066, (22.9, 32.3), Waigiui, A.W.C.T. Herre.

The following specimens are tentatively identified as *G. bravoii*.

PALAU ISLANDS: CAS 33612, (20.5), Anguar Island, off southern corner of Ngatchab beach, 06°53'52"N, 134°07'58"E, GVF Reg. No. 1423, 21 Oct 1957.

RYUKYU ISLANDS: USNM 132806, (30.6), tide pool near Hiza Onna, Okinawa, J. R. Simon sta S-14, 8 Sep 1945.

### *Gobiopsis angustifrons*, new species

FIGURE 6; PLATES 6c,d, 11c,e

DIAGNOSIS.—Sensory pores NA, PITO, and SOT present, 2 POP pores present, AT and PR pores absent; head narrow, eyes large, interorbital narrow, diameter of orbit greater than width of bony interorbital; scales cycloid, 32–38 in lateral series; postmandibular and posterior gular barbels absent; jaw short, its length about 14–15 percent of SL; dark wedge on head descends to middle or lower portion of preopercle; light base of pectoral fin not divided by dark wedge; trunk with 5 prominent saddles and moderately mottled.

DESCRIPTION.—Dorsal fin rays VI–I, 10(13); anal fin rays I, 9(13); pectoral fin rays 18(16), 19(7), 20(2) pelvic fin rays I, 5(6); segmented caudal fin rays 17(5); branched caudal fin rays 15(5); lateral scale rows 32–38(5); transverse scale rows 16–19(5); predorsal scales 14–16(5).

Scales cycloid, highly eccentric; 28–32 primary radii in large anterior field; focal area broad; posterior field small, wide, with 17–20 short radii.

Vertebrae 10+16(6).

Measurements for the holotype and paratypes are given in Table 8.

Species moderate to large in size, the largest male 45.4 mm SL, the largest female 41.2 mm SL; body moderately elongate, head width moderate, snout moderate to sharp (Plates 6c,d, 11e), snout longer than fleshy interorbital; fleshy interorbital narrow, slightly less than diameter of orbit; length of jaw short, about 14–15 percent of SL; caudal peduncle deep, least depth about 31–37 percent of postanal length (Figure 5); origin of second dorsal fin over anal opening; the depressed pectoral fin extends posteriorly to vertical from end of base of first dorsal fin, the length greater than twice the depth at base, the posterior margin moderately acute; pelvic fin short, the length about 61 percent of length of distance from pelvic fin insertion to anal fin origin (Figure 3).

Number of teeth on outer row of upper jaw about 22, lower jaw about 12.

All described cephalic sensory pores for the genus are present except the AT and PR pores (Tables 1, 2).

The cutaneous papillae system is pattern 3 (Plate 6c,d).

The barbels of the postmandibular and posterior gular groups are absent. The number of barbels in

other particular groups are: intermandibular 1-2 (mean 1.56); posterior mandibular 2-5 (3.25); anterior cheek tuft 1-3 (1.70); anterior internasals 1-3 (1.25); posterior internasals 1 (1.00). The barbels of the anterior cheek tuft are short to moderately long, the lower one is longest and is preceded by one of the intermediate size.

**COLOR IN PRESERVATION.**—The dominant color pattern consists of 5 dark brown trunk saddles or crossbars that descend to the midlateral body where they join and form a wavy stripe (Plate 11c,e) extending from the base of the pectoral fin to base of caudal fin. Body moderately mottled dark brown.

Head dark brown from tip of snout posteriorly to the interpreopercular line, darker behind eye, where the color forms a transverse bar that descends as a wedge to middle or lower preopercle, bar moderately developed, sometimes diffuse or mottled and less intense than trunk saddles (Plate 6d); the interopercular band on head uniformly light in smaller specimens, mottled in larger specimens; tip of snout, cheek and lower preopercle dusky to mottled, some pigment on opercle, lower head pale. Cephalic sensory pores encircled by small, black tubes.

The first trunk saddle broad, extends from the upper interopercular area to the origin of first dorsal fin, descends laterally to upper base of pectoral fin; second saddle, almost as wide as first, traverses the first dorsal fin; third saddle slightly smaller than first, passes through anterior part of second dorsal fin; fourth saddle narrower than third, passes through posterior base of second dorsal fin; the fifth saddle or bar is narrow, just touches the procurvent rays of caudal fin, and separated by a light, round spot from the upper portion of the dark bar at base of caudal fin; all saddles descend to midside of body, where they arc and unite to form a wavy midbody stripe that extends from upper base of pectoral fin to base of caudal fin; broad, dark brown projections descend ventrolaterally on belly and ventrally on caudal peduncle; large light dorsal areas between saddles and between the arcs on the side of the body are mottled or with patches of brown; smaller specimens with saddles, midlateral arcs and ventral projections beneath arcs well developed, dark brown to brown, the mottling reduced or absent, resulting in a highly contrasting bicoloration. Base of caudal fin with a dark, vertical bar, as deep as base of fin, with an enlarged midbasal

portion, anteriorly directed and confluent with wavy midlateral stripe. Breast and belly pale to whitish, lower caudal peduncle brownish mottled.

Pectoral fin with dark, basal sickle-shaped mark, touches upper base of fin and confluent with first dorsal saddle; large, light basal portion of pectoral fin not divided by a dark, anteriorly directed wedge from the sickle-shaped mark; rays of pectoral fin with elongate dusky spots on outer portion, irregularly arranged, remainder of fin clear; pelvic fins clear; first dorsal fin with a small dark spot at base between first and second spines, a larger, light to whitish spot on basal portion between second and fourth spines, the midportion of fin dark where traversed by second saddle, the tips of spines with small dark spots in 2 rows, areas between dark spots are light to whitish; second dorsal fin with 5 dark spots between rays 1 and 2, 3 and 4, 5 and 6, 7 and 8, and 9 and 10; these dark spots are confluent with a larger dusky spot in the areas where the third and fourth saddles pass through base of fin, middle to outer parts of rays with dark elongate spots arranged in 3, more or less, horizontal rows, remainder of fin clear; anal fin with faint dusky spots in 3-4 horizontal rows, most of fin clear; caudal fin with irregularly arranged, elongate, dusky spots mostly on the rays, more evident on middle portion, areas between spots clear.

**GEOGRAPHIC DISTRIBUTION.**—Taken at Celebes, Ceram, Great Barrier Reef, and the Solomon Islands (Figure 6).

**ECOLOGY.**—Limited data suggest that *G. angustifrons* inhabits areas of coral rubble; the 3 Endeavour Reef collection sites that yielded specimens of *G. angustifrons* also contained *G. aporia*. The depth range of *G. angustifrons* is from 1 to 25 m. The specimens were taken with rotenone or dynamite.

**ETYMOLOGY.**—The specific epithet is taken from the Latin *angustus* (narrow) plus *frons* (forehead) and is used as a noun in apposition with the generic name.

**REMARKS.**—According to the labels in the jars and catalogue, the collections from the Celebes, USNM 99282, 99283, were taken at Great Tobeia Island on 15 December 1909. Published *Albatross* Station Records list a collection from Great Tobeia Island on 14 December and at Pendek Island on 15 December. We consider the Great Tobeia Island locality as the proper site and that the differences in dates resulted from an error in data transcription.

MATERIAL EXAMINED.—*Holotype*: USNM 213492, female (33.6), Endeavour Reef, Queensland, Australia, C. L. Smith sta 69-13, 13 Jan 1969.

*Paratypes*:

INDONESIA: USNM 99282, male (36.5), Celebes, Great Toba Island, *Albatross Exp.*, 14 Dec 1909; USNM 99283, male (33.8), same data as USNM 99282; AMS I.18469-152, male (40.8), Marsegoe Bay, W end of Ceram, J. Paxton, 1 Apr 1975.

AUSTRALIA: AMS I. 18805-001, male (43.4), female (22.9), unsexed (18.8), Sand Cay, N of Lizard Island, N Queensland, D. Hoese sta 75-15, 28 Jan 1975; USNM 213791, male (40.5), females (38.6, 41.2), same locality as AMS I. 18805-001, J. Paxton, sta LZ 75-70, 27 Nov 1975; USNM 211146, female (21.2), Endeavour Reef, Queensland, J. Tyler sta A-3, 4 Jan 1969; AMNH 32966, immature (16.1), same locality as USNM 211146, C. L. Smith sta 69-7, 6 Jan 1969.

SOLOMON ISLANDS: USNM 211148, male (45.4), Tautsina Island, E of Kieta Peninsula, Bougainville, *Te Vega* Cruise 6, sta 247, 11 Mar 1965.

### Summary and Remarks

Head barbels are present on diversely related gobioid fishes. At least 16 nominal genera among the Gobiidae have prominent barbels (Lachner and McKinney, 1974:876). Genera that we relegate to the synonymy of *Gobiopsis* are *Pogonogobius* H. M. Smith, *Pipidonia* H. M. Smith, *Herreogobius* Koumans, *Barbatogobius* Koumans and *Abranches* J.L.B. Smith. The salient diagnostic characters shared by the species of *Gobiopsis* are (1) a broad, depressed head with pug-nosed snout, (2) head barbels in characteristic positions, (3) a conspicuous cutaneous papillae system variously related to a differentiated cephalic sensory pore and canal system, (4) a well developed fleshy fold on midcheek area, (5) cephalic sensory pores generally large, some on tubes, slitlike and hooded, and (6) a dark sickle-shaped mark at base of pectoral fin.

Most of the other barbeled genera differ significantly from *Gobiopsis* in one or more of these and other characters. *Triaenopogon* Bleeker shares some characters with *Gobiopsis* in respect to the development of the barbels, sensory pores and in head shape but differs in having tricuspid teeth.

The genus *Macgregorella* Seale, a synonym of *Callogobius* Bleeker, had species referred to it that we place in *Gobiopsis* and others that are properly placed in *Callogobius* sensu stricto. There are no close relationships between *Gobiopsis* and *Callogobius*. *Callogobius* has no barbels, but has well

developed vertical and horizontal raised cirrose ridges of papillae on the head.

The genus *Feia* J.L.B. Smith was related to *Abranches* by J.L.B. Smith (1959:206). *Feia*, however, has no barbels or cheek fold.

Within *Gobiopsis* there are recognizable species groups. The *G. macrostoma* species group has the following characters: temporal canal present, nasal pore located anterior to posterior nostril, light base of pectoral fin divided by dark wedge, pelvic fins comparatively long, lower jaws generally long, and a high number of pectoral fin rays. The species included in this group are *G. canalis*, *G. pinto*, *G. macrostoma*, and *G. woodsi*.

The *G. quinquecincta* species group is characterized by no temporal canal; nasal pore located adjacent to or behind posterior nostril; light base of pectoral fin not divided by dark wedge; pelvic fins short; lower jaws usually short; and a low number of pectoral fin rays. The species included in this group are *G. angustifrons*, *G. arenaria*, *G. bravoii* and *G. quinquecincta*. *Gobiopsis malekulae* shares all the characters of the *G. quinquecincta* group except it has no nasal pore. *Gobiopsis aporia* agrees with the *Gobiopsis quinquecincta* species group except that it has no sensory pores and has a high number of pectoral rays.

The genus shows a strong affinity in its distribution for the tropical, continental, Indo-Pacific slopes of Africa, Asia, and Australia and the major insular areas of the East Indies and the Philippines. *Gobiopsis* is not known from the Red Sea, the insular areas of the Indian Ocean, nor from most of Oceania. The *G. macrostoma* species group is found only on the continental slopes of the Indian Ocean and the Gulf of Thailand. The species, except *G. woodsi*, prefer substrates of mud, silt, clay and sand and apparently avoid coralline areas. The *G. quinquecincta* species group plus *G. aporia* and *G. malekulae* occur in coral rubble areas and sand near coral reefs of the western Pacific Ocean and in similar areas westward to south India. These species are found about smaller insular areas as well as the larger islands and large land masses.

The fact that the species of *Gobiopsis* have not been observed alive and the consistency of the data recording the bottom type of the collection sites as sandy, muddy, or coral rubble habitats suggest a bottom dwelling existence in the surface substrate. The salient generic character such as the robust

body, the broad depressed head, the upturned snout, the mottled and obliterative color pattern, the variability and reduction in the number of pores, the development of hoods and flaps on the pores, and the presence of barbels and coarse papillae on the head are apparent adaptations to life in intimate association with the substrate.

Böhlke and Robins (1968:145) observed reductions in the cephalic sensory pore system similar to

those present in *Gobiopsis* among genera and species of hole-dwelling or strictly sponge-dwelling, seven-spined gobies of the western Atlantic Ocean. We concur with their statement that one should not relate or align, arbitrarily, groups of nonpored gobies or those with reduced pore systems without comprehensive analysis of other systematic characters and consideration of the adaptive trends within each character system.



## Tables

TABLE 1.—The number, distribution, and variation in occurrence of cephalic sensory pores in species of *Gobiopsis*; based on 608 specimens greater than 18 mm SL (N = number of specimens; 0 = pore absent; 1-1 = pore present on left and right sides; D = double pore; T = triple pore; see "Methods" for names of pores)

| Species                 | N   | Cephalic pores |      |     |     |     |     |     |     |
|-------------------------|-----|----------------|------|-----|-----|-----|-----|-----|-----|
|                         |     | NA             | PITO | SOT | AOT | IT  | AT  | PT  | POP |
| <i>angustifrons</i> ... | 12  | 1-1            | 1    | 1-1 | 1-1 | 1-1 | 0-0 | 0-0 | 2-2 |
| <i>aporia</i> .....     | 50  | 0-0            | 0    | 0-0 | 0-0 | 0-0 | 0-0 | 0-0 | 0-0 |
| <i>arenaria</i> .....   | 20  | 1-1            | 1    | 1-1 | 1-1 | 1-1 | 0-0 | 0-0 | 0-0 |
|                         | 2   | 1-1            | 1    | 0-0 | 1-1 | 1-1 | 0-0 | 0-0 | 0-0 |
|                         | 1   | 1-1            | 1    | 1-0 | 1-1 | 1-1 | 0-0 | 0-0 | 0-0 |
| <i>bravoi</i> .....     | 20  | 1-1            | 1    | 1-1 | 1-1 | 1-1 | 0-0 | 0-0 | 2-2 |
|                         | 1   | 1-1            | 1    | 1-1 | 1-1 | 0-1 | 0-0 | 0-0 | 2-2 |
|                         | 1   | 1-1            | 1    | 1-0 | 1-1 | 1-1 | 0-0 | 0-0 | 2-2 |
| <i>canalis</i> .....    | 2   | 1-1            | 1    | 0-0 | 1-1 | 1-1 | 1-1 | 1-1 | 1-1 |
| <i>macrostoma</i> ..... | 25  | 1-1            | 1    | 0-0 | 1-1 | 1-1 | 1-1 | 1-1 | 2-2 |
| <i>malekulae</i> .....  | 6   | 0-0            | 0    | 1-1 | 1-1 | 1-1 | 0-0 | 0-0 | 0-0 |
| <i>pinto</i> .....      | 7   | 1-1            | 0    | 0-0 | 1-1 | 1-1 | 1-1 | 1-1 | 2-2 |
|                         | 2   | 1-1            | 1    | 0-0 | 1-1 | 1-1 | 1-1 | 1-1 | 2-2 |
| <i>quinquecincta</i> .. | 355 | 1-1            | 1    | 1-1 | 1-1 | 1-1 | 0-0 | 0-0 | 2-2 |
|                         | 19  | 1-1            | 1    | 0-1 | 1-1 | 1-1 | 0-0 | 0-0 | 2-2 |
|                         | 15  | 1-1            | 1    | 1-0 | 1-1 | 1-1 | 0-0 | 0-0 | 2-2 |
|                         | 7   | 1-1            | 1    | 0-0 | 1-1 | 1-1 | 0-0 | 0-0 | 2-2 |
|                         | 3   | 1-1            | 0    | 1-1 | 1-1 | 1-1 | 0-0 | 0-0 | 2-2 |
|                         | 1   | 1-1            | 1    | 1-1 | 1-1 | 1-1 | 0-0 | 0-0 | 2-2 |
|                         | 1   | 1-1            | 1    | 1-0 | 1-1 | 1-1 | 0-0 | 0-0 | 2-2 |
|                         | 1   | 1-1            | 1    | 1-1 | 1-1 | 1-1 | 0-0 | 0-0 | 0-0 |
| <i>woodsii</i> .....    | 46  | 1-1            | 1    | 1-1 | 1-1 | 1-1 | 1-1 | 1-1 | 2-2 |
|                         | 3   | 1-1            | 1    | 0-1 | 1-1 | 1-1 | 1-1 | 1-1 | 2-2 |
|                         | 2   | 1-1            | 1    | 1-0 | 1-1 | 1-1 | 1-1 | 1-1 | 2-2 |
|                         | 2   | 1-1            | 1    | 0-0 | 1-1 | 1-1 | 1-1 | 1-1 | 2-2 |
|                         | 3   | 1-1            | 1    | 1-1 | 1-1 | 1-1 | 0-1 | 0-1 | 2-2 |
|                         | 1   | 1-1            | 1    | 1-1 | 1-1 | 1-1 | 1-0 | 1-0 | 2-2 |

TABLE 2.—Occurrence of particular cephalic sensory pores in species of *Gobiopsis* (P = present; P1 = 1 pore present; P2 = 2 pores present; A = absent; UA = usually absent; AP = almost always present; see "Methods" for names of pores)

| Species                 | NA | PITO | SOT | AT-PT | POP |
|-------------------------|----|------|-----|-------|-----|
| <i>angustifrons</i> ... | P  | P    | P   | A     | P2  |
| <i>aporia</i> .....     | A  | A    | A   | A     | A   |
| <i>arenaria</i> .....   | P  | P    | AP  | A     | A   |
| <i>bravoi</i> .....     | P  | P    | P   | A     | P2  |
| <i>canalis</i> .....    | P  | P    | A   | P     | P1  |
| <i>macrostoma</i> ..... | P  | P    | A   | P     | P2  |
| <i>malekulae</i> .....  | A  | A    | P   | A     | A   |
| <i>pinto</i> .....      | P  | UA   | A   | P     | P2  |
| <i>quinquecincta</i> .. | P  | P    | AP  | A     | P2  |
| <i>woodsii</i> .....    | P  | P    | AP  | P     | P2  |

TABLE 3.—Numbers of barbels in certain locations on the head in species of *Gobiopsis* (top row: the mode and, in parentheses, the mean; bottom row: the range and, in parentheses, the number of counts; all barbel groups, except the posterior gular, are paired bilaterally and the left and right sides are considered as separate counts)

| Species                 | Intermandibular    | Posterior mandibular | Postmandibular     | Posterior gular    | Anterior cheek tuft | Anterior internasal | Posterior internasal |
|-------------------------|--------------------|----------------------|--------------------|--------------------|---------------------|---------------------|----------------------|
| <i>angustifrons</i> ... | 2(1.56)<br>1-2 (9) | 3(3.25)<br>2-5 (8)   | absent             | absent             | 1(1.70)<br>1-3(10)  | 1(1.25)<br>1-3 (8)  | 1(1.00)<br>1 (10)    |
| <i>aporia</i> .....     | 2(2.05)<br>1-3(20) | 3(3.00)<br>2-6(20)   | absent             | absent             | 2(2.55)<br>1-4(20)  | 2(2.50)<br>2-4(20)  | 2(1.60)<br>1-2(20)   |
| <i>arenaria</i> .....   | 2(2.30)<br>1-3(20) | 3(3.00)<br>2-4(20)   | 1(1.00)<br>1 (20)  | 1(0.70)<br>0-2(10) | 3(3.26)<br>2-4(19)  | 1(1.45)<br>1-2(20)  | 1(1.35)<br>1-2(20)   |
| <i>bravoi</i> .....     | 7(6.09)<br>2-8(23) | 3(3.43)<br>2-6(28)   | 1(1.00)<br>1 (26)  | 3(2.14)<br>0-4(14) | 5(4.93)<br>4-6(28)  | 3(3.00)<br>2-4(28)  | 2(2.29)<br>1-3(28)   |
| <i>canalis</i> .....    | absent             | absent               | absent             | absent             | -(2.50)<br>1-4 (4)  | 3(2.75)<br>2-3 (4)  | -(0.50)<br>0-1 (4)   |
| <i>macrostoma</i> ..... | 2(1.78)<br>0-4(46) | absent               | absent             | absent             | 1(1.41)<br>1-3(46)  | 1(1.32)<br>1-3(46)  | 1(1.10)<br>1-2(46)   |
| <i>malekulae</i> .....  | 2(2.00)<br>1-3 (8) | 3(2.63)<br>1-3 (8)   | 1(1.00)<br>1 (12)  | absent             | 3(3.56)<br>3-4 (9)  | 1(1.18)<br>1-2(11)  | 1(1.00)<br>1 (12)    |
| <i>pinto</i> .....      | 1(1.33)<br>0-3 (6) | absent               | absent             | absent             | 3(2.42)<br>1-3(12)  | 1(1.42)<br>1-2(12)  | 1(1.00)<br>1 (12)    |
| <i>quinquecincta</i> .. | 3(2.67)<br>2-4(24) | 3(3.40)<br>2-5(25)   | 1(0.92)<br>0-1(26) | 1(1.42)<br>0-3(12) | 5(5.08)<br>3-7(26)  | 3(2.73)<br>1-4(26)  | 2(1.73)<br>1-3(26)   |
| <i>woodsii</i> .....    | 2(1.45)<br>0-2(20) | 3(3.05)<br>2-5(21)   | absent             | absent             | 5(4.70)<br>3-6(20)  | 3(3.35)<br>2-5(20)  | 1(1.10)<br>1-2(20)   |

TABLE 4.—Frequency distribution of numbers of pectoral fin rays in species of *Gobiopsis*

| Species                 | Pectoral fin rays |    |    |    |    |    |    |    |    | $\bar{x}$ |
|-------------------------|-------------------|----|----|----|----|----|----|----|----|-----------|
|                         | 15                | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |           |
| <i>angustifrons</i> ... |                   |    |    | 16 | 7  | 2  |    |    |    | 18.4      |
| <i>aporia</i> .....     |                   |    |    |    | 6  | 55 | 52 | 3  |    | 20.4      |
| <i>arenaria</i> .....   |                   |    | 17 | 22 | 2  |    |    |    |    | 17.6      |
| <i>bravoi</i> .....     |                   |    |    | 11 | 32 | 3  |    |    |    | 18.8      |
| <i>canalis</i> .....    |                   |    |    |    |    |    |    | 2  | 2  | 22.5      |
| <i>macrostoma</i> ..... |                   |    |    |    | 1  | 16 | 21 | 7  |    | 20.8      |
| <i>malekulae</i> .....  |                   | 1  | 10 |    |    |    |    |    |    | 16.9      |
| <i>pinto</i> .....      |                   |    |    |    |    | 5  | 11 |    |    | 20.7      |
| <i>quinquecincta</i> .. | 1                 | 11 | 77 | 62 | 9  |    |    |    |    | 17.4      |
| <i>woodsii</i> .....    |                   |    |    | 1  | -  | 3  | 50 | 38 |    | 21.3      |

TABLE 5.—Comparisons of several characters among the species of *Gobiopsis*

| Species                 | Scale: type, size     | Lateral scale rows | Dominant color pattern                        | Dark wedge on preopercle              | Light area at base of pectoral fin |
|-------------------------|-----------------------|--------------------|---|---------------------------------------|------------------------------------|
| <i>angustifrons</i> ... | cycloid large         | 32-38              | saddles, weak mottling                        | reaches middle to lower portion       | not divided by dark wedge          |
| <i>aporia</i> .....     | cycloid moderate      | 37-45              | saddles, strong mottling                      | obscured by mottling                  | not divided by dark wedge          |
| <i>arenaria</i> .....   | cycloid large         | 33-36              | saddles strongly united laterally             | restricted to upper preopercle        | not divided by dark wedge          |
| <i>bravo</i> .....      | cycloid large         | 28-38              | heavily mottled or saddles united laterally   | obscured or descends to lower portion | not divided by dark wedge          |
| <i>canalis</i> .....    | cycloid small         | 50-55              | saddles united laterally; lower trunk mottled | not noticeably developed              | divided or nearly so by dark wedge |
| <i>macrostoma</i> ..... | many ctenoid moderate | 36-44              | brownish, with moderate dark saddles          | not noticeably developed              | divided or nearly so by dark wedge |
| <i>malekulae</i> .....  | cycloid large         | 31-34              | uniform, wide lateral stripe; no saddles      | descends to middle of preopercle      | not divided by dark wedge          |
| <i>pinto</i> .....      | cycloid small         | 50-60              | uniformly dark to faint saddles               | not noticeably developed              | divided or nearly so by dark wedge |
| <i>quinquecincta</i> .. | some ctenoid large    | 29-37              | bars to weakly united saddles laterally       | reaches middle to lower portion       | not divided by dark wedge          |
| <i>woodsii</i> .....    | many ctenoid large    | 30-36              | highly mottled                                | absent or obscured by mottling        | divided or nearly so by dark wedge |

TABLE 6.—Proportional measurements of *Gobiopsis aporia* expressed in thousandths of the standard length (N = number of specimens)

| Character                                     | Holotype |           | Paratypes |    |           |      |    |  |
|---|----------|-----------|-----------|----|-----------|------|----|--|
|   | Female   | Males     |           |    | Females   |      |    |  |
|   |          | Range     | Mean      | N  | Range     | Mean | N  |  |
| Standard length (mm) .....                    | 39.9     | 31.5-52.0 | 41.9      | 13 | 29.5-49.0 | 37.7 | 16 |  |
| Head length .....                             | 298      | 292-327   | 310       | 12 | 296-325   | 309  | 14 |  |
| Snout length .....                            | 78       | 67-87     | 78        | 12 | 69-86     | 77   | 14 |  |
| Postorbital length .....                      | 183      | 183-202   | 195       | 12 | 184-205   | 195  | 14 |  |
| Greatest diameter of orbit ...                | 43       | 38-49     | 44        | 12 | 38-51     | 46   | 14 |  |
| Bony interorbital width .....                 | 45       | 40-49     | 45        | 10 | 39-48     | 44   | 10 |  |
| Pectoral fin length .....                     | 268      | 240-264   | 254       | 10 | 234-275   | 255  | 12 |  |
| Pelvic fin length .....                       | 208      | 187-220   | 206       | 11 | 186-226   | 207  | 14 |  |
| Caudal fin length .....                       | 281      | 227-324   | 272       | 10 | 233-335   | 279  | 12 |  |
| Predorsal length .....                        | 396      | 384-416   | 399       | 12 | 386-424   | 403  | 12 |  |
| Greatest depth of body .....                  | 155      | 127-189   | 160       | 12 | 154-190   | 171  | 10 |  |
| Least depth of peduncle .....                 | 108      | 108-122   | 116       | 13 | 101-123   | 109  | 16 |  |
| Postanal length .....                         | 366      | 344-386   | 363       | 11 | 335-386   | 364  | 14 |  |
| Lower jaw length .....                        | 153      | 134-160   | 149       | 10 | 130-151   | 143  | 11 |  |
| Pelvic fin insertion to anal fin origin ..... | 361      | 334-393   | 364       | 10 | 318-392   | 351  | 10 |  |

TABLE 7.—Proportional measurements of *Gobiopsis woodsi* expressed in thousandths of the standard length (N = number of specimens)

| Character                                     | Holotype | Paratypes |       |      |           |         |      |   |
|---|----------|-----------|-------|------|-----------|---------|------|---|
|   |          | Male      | Males |      |           | Females |      |   |
|   |          |           | Range | Mean | N         | Range   | Mean | N |
| Standard length (mm) .....                    | 38.0     | 23.9-41.9 | 34.4  | 10   | 26.4-37.7 | 31.7    | 10   |   |
| Head length .....                             | 316      | 305-334   | 313   | 10   | 294-330   | 311     | 10   |   |
| Snout length .....                            | 74       | 63-78     | 71    | 10   | 64-77     | 69      | 10   |   |
| Postorbital length .....                      | 195      | 184-203   | 195   | 10   | 180-196   | 191     | 10   |   |
| Greatest diameter of orbit ...                | 55       | 48-59     | 52    | 10   | 50-61     | 54      | 10   |   |
| Bony interorbital width .....                 | 47       | 39-54     | 46    | 10   | 38-45     | 42      | 10   |   |
| Pectoral fin length .....                     | 271      | 246-285   | 262   | 10   | 241-286   | 260     | 9    |   |
| Pelvic fin length .....                       | 242      | 222-238   | 232   | 10   | 224-246   | 234     | 10   |   |
| Caudal fin length .....                       | 280      | 289-313   | 302   | 10   | 273-348   | 305     | 9    |   |
| Predorsal length .....                        | 392      | 372-414   | 390   | 10   | 379-413   | 394     | 10   |   |
| Greatest depth of body .....                  | 174      | 134-192   | 155   | 10   | 149-172   | 159     | 9    |   |
| Least depth of peduncle .....                 | 124      | 102-122   | 112   | 10   | 99-112    | 106     | 10   |   |
| Postanal length .....                         | 384      | 356-390   | 373   | 10   | 344-409   | 373     | 10   |   |
| Lower jaw length .....                        | 161      | 141-176   | 159   | 10   | 135-153   | 143     | 10   |   |
| Pelvic fin insertion to anal fin origin ..... | 313      | 305-345   | 319   | 9    | 323-356   | 336     | 9    |   |

TABLE 8.—Proportional measurements of 6 specimens of *Gobiopsis angustifrons* expressed in thousandths of the standard length

| Character                                     | Holotype | Paratypes |          |        |       |      |
|---|----------|-----------|----------|--------|-------|------|
|   |          | Female    | Immature | Female | Males |      |
| Standard length (mm) .....                    | 33.6     | 16.1      | 21.1     | 33.8   | 36.5  | 45.4 |
| Head length .....                             | 321      | 323       | 332      | 296    | 307   | 308  |
| Snout length .....                            | 77       | 81        | 76       | 67     | 74    | 70   |
| Postorbital length .....                      | 202      | 205       | 204      | 180    | 195   | 189  |
| Greatest diameter of orbit ...                | 60       | 62        | 57       | 52     | 53    | 51   |
| Bony interorbital width .....                 | 42       | 50        | 47       | 38     | 47    | 42   |
| Pectoral fin length .....                     | 253      | 298       | 294      | 266    | -     | 267  |
| Pelvic fin length .....                       | 223      | 242       | 227      | 207    | 184   | 233  |
| Caudal fin length .....                       | 313      | 329       | 327      | -      | 293   | 311  |
| Predorsal length .....                        | 408      | 416       | 403      | 382    | 410   | 392  |
| Greatest depth of body .....                  | 190      | 205       | 171      | 151    | 162   | 161  |
| Least depth of peduncle .....                 | 119      | 124       | 104      | 114    | 123   | 119  |
| Postanal length .....                         | 324      | 348       | 341      | 367    | 353   | 341  |
| Lower jaw length .....                        | 152      | 143       | 142      | 142    | 151   | 145  |
| Pelvic fin insertion to anal fin origin ..... | 384      | 366       | 332      | 343    | 345   | 381  |

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## **PLATES**

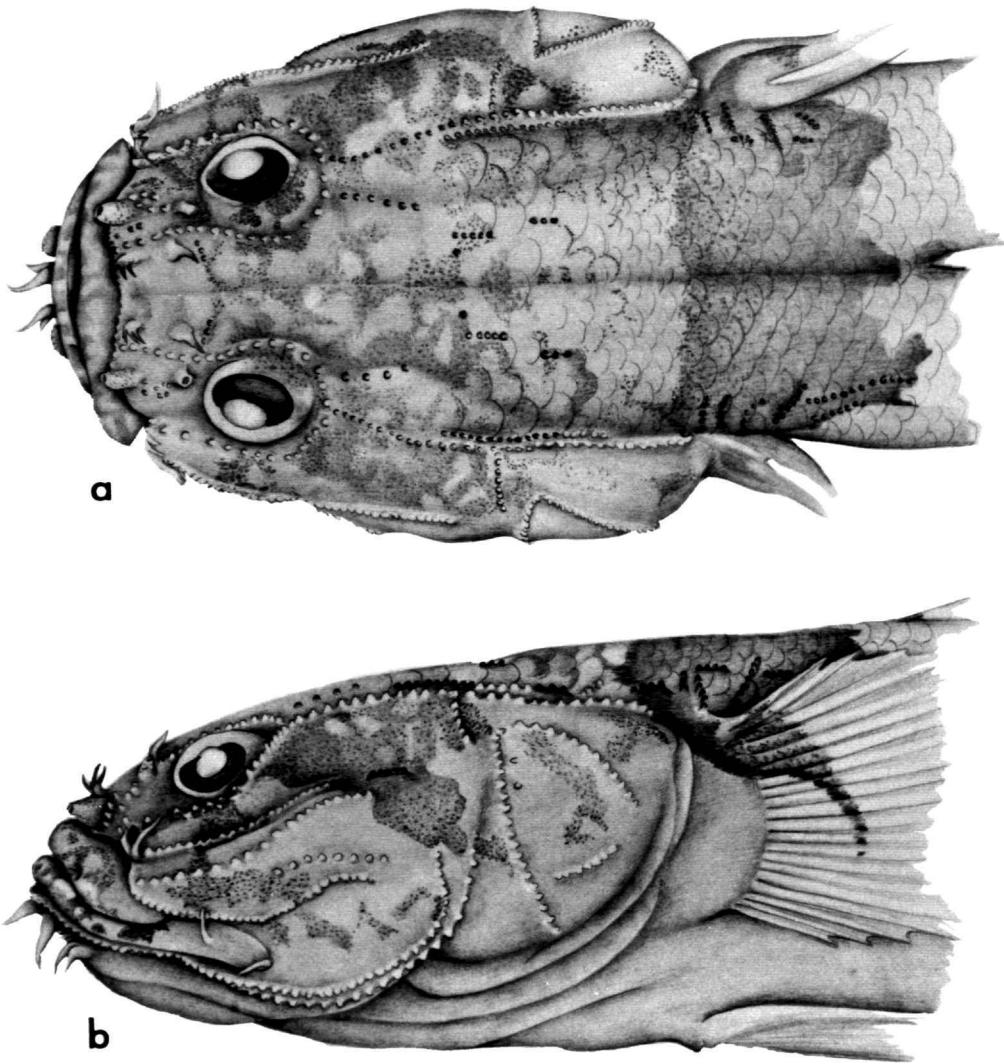
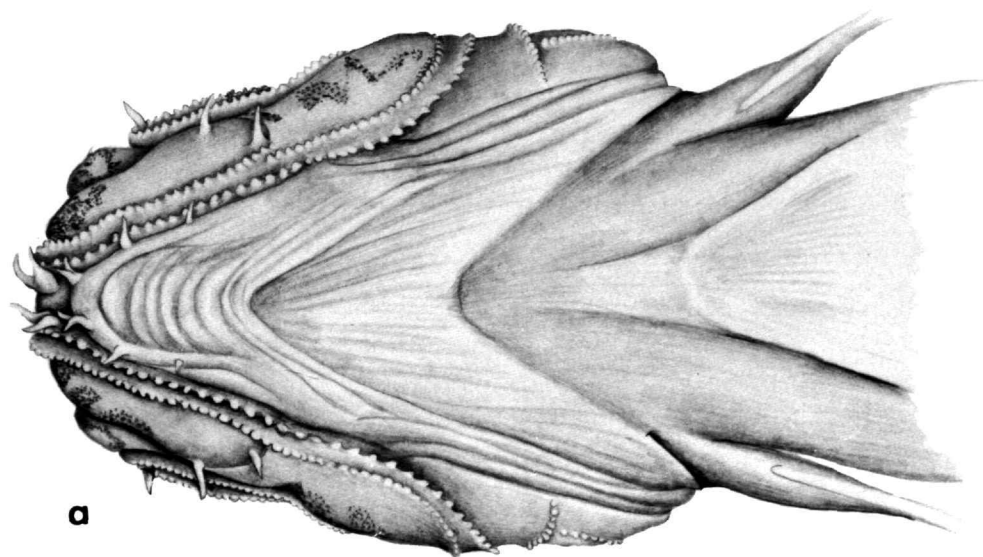
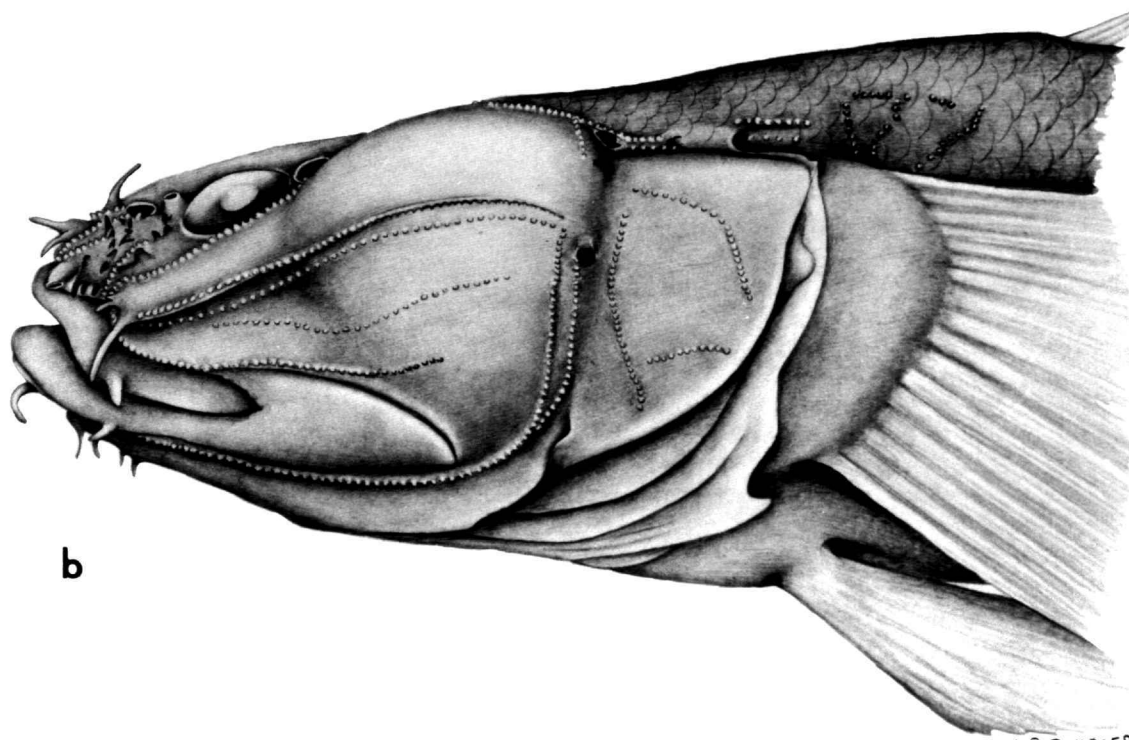


PLATE 1.—Details of the head of *Gobiopsis aporia*, USNM 209247, paratype, male, 49.6 mm SL:  
*a*, dorsal view; *b*, lateral view.

**a****b**

J. R. SCHROEDER

PLATE 2.—Details of heads of *Gobiopsis* species: *a*, ventral view of *G. aporia*, USNM 209247, paratype, male, 49.6 mm SL; *b*, lateral view of *G. macrostoma*, USNM 119633, male, 57.7 mm SL.

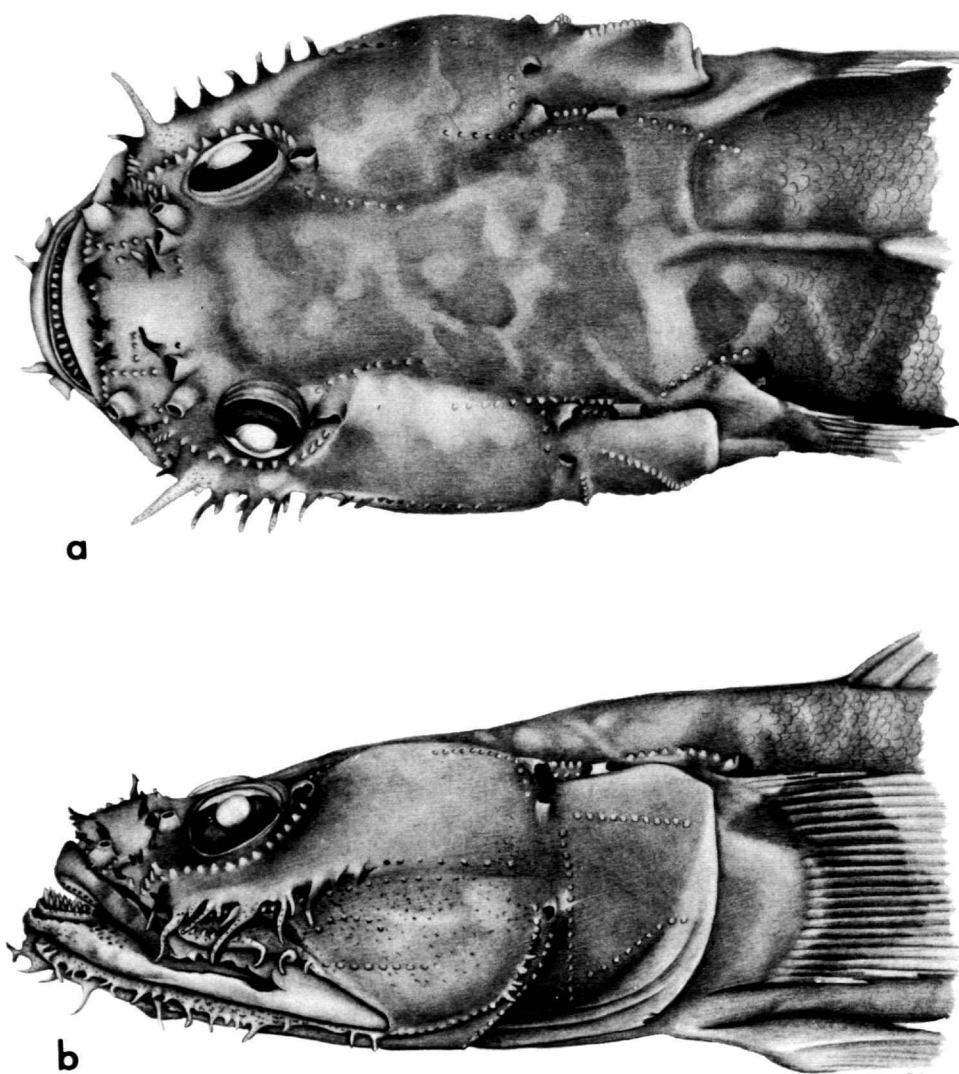
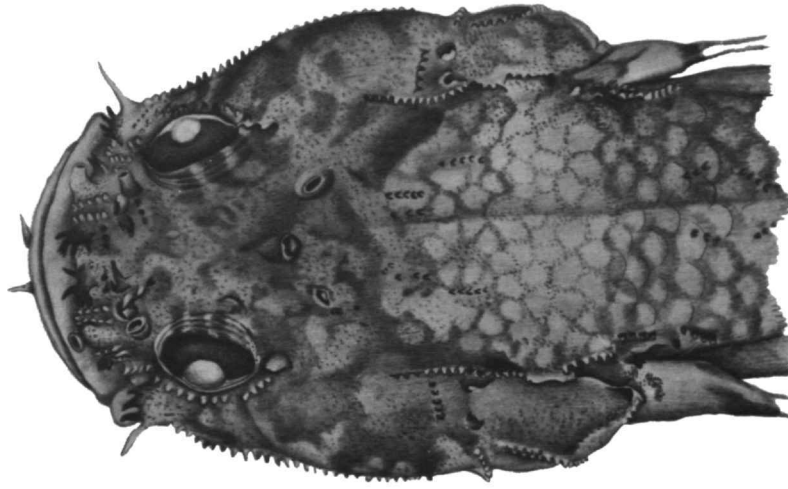


PLATE 3.—Details of the head of *Gobiopsis pinto*, RUSI 3019, male, 43.6 mm SL: *a*, dorsal view; *b*, lateral view.





**a**



**b**

V. R. SCHROEDER

PLATE 4.—Details of the head of *Gobiopsis woodsi*, USNM 211343, paratype, male, 42.3 mm SL: *a*, dorsal view; *b*, lateral view.

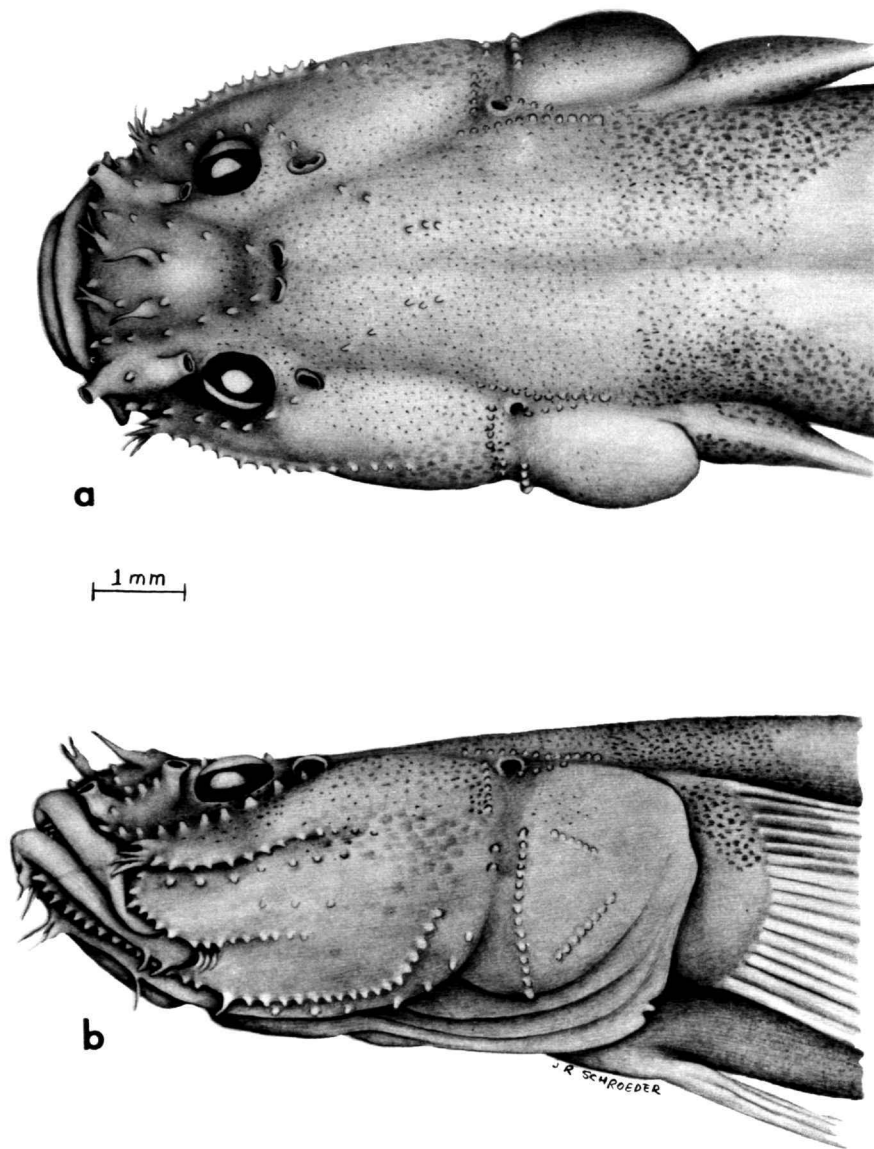


PLATE 5.—Details of the head of *Gobiopsis malekulae*, SU 24434, paratype, female, 23.0 mm SL:  
*a*, dorsal view; *b*, lateral view.

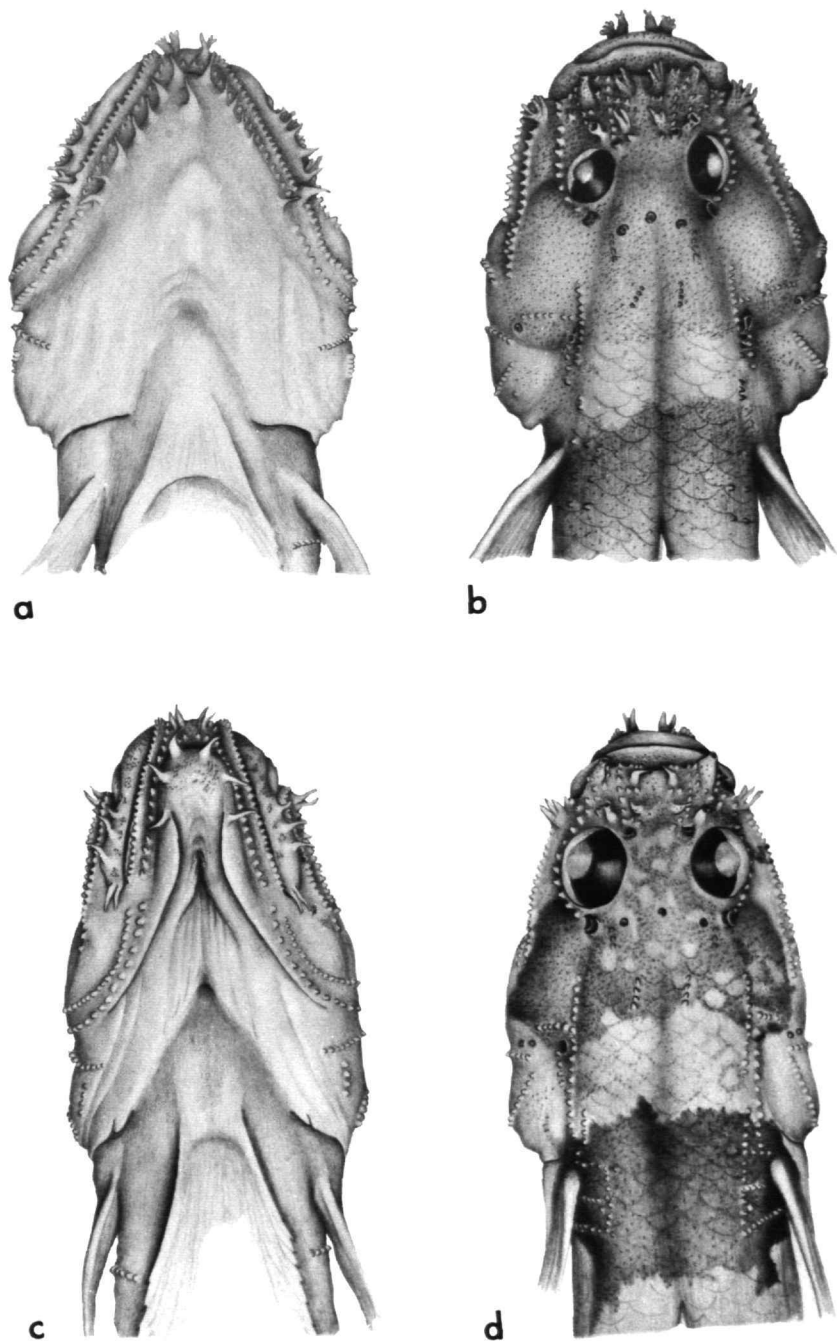


PLATE 6.—Details of heads of *Gobiopsis* species: *a*, ventral view of *G. bravoii*, SU 33120, holotype, male, 31.1 mm SL; *b*, dorsal view of *a*; *c*, ventral view of *G. angustifrons*, USNM 213492, holotype, female, 33.6 mm SL; *d*, dorsal view of *c*.

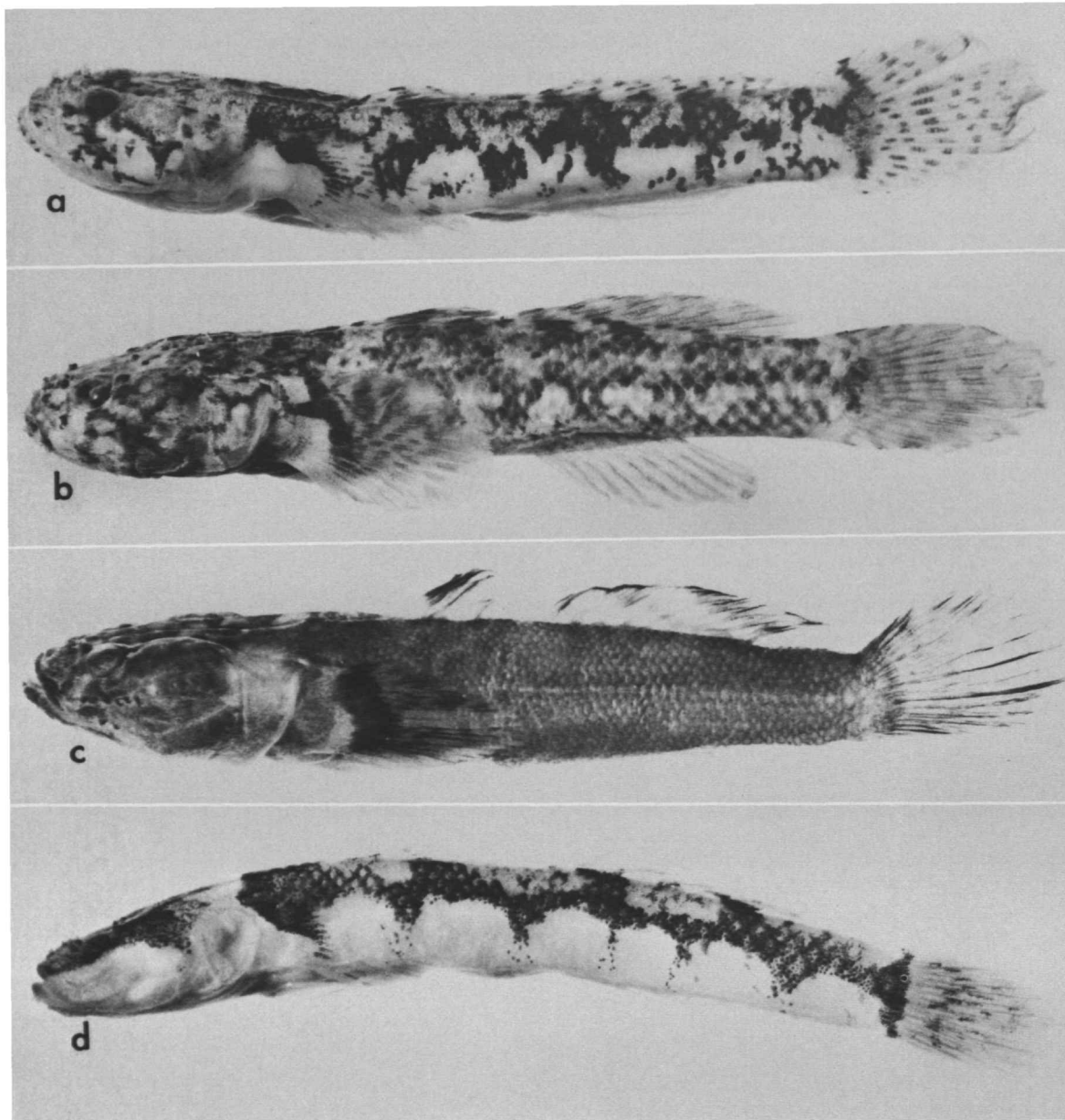


PLATE 7.—Species of *Gobiopsis*, lateral views: *a*, *G. aporia*, USNM 209731, holotype, female, 39.9 mm SL; *b*, *G. woodsi*, USNM 212249, holotype, male, 38.0 mm SL; *c*, *G. pinto*, RUSI 3019, 43.6 mm SL; *d*, *G. arenaria*, KSHS 9458, 29.8 mm SL.

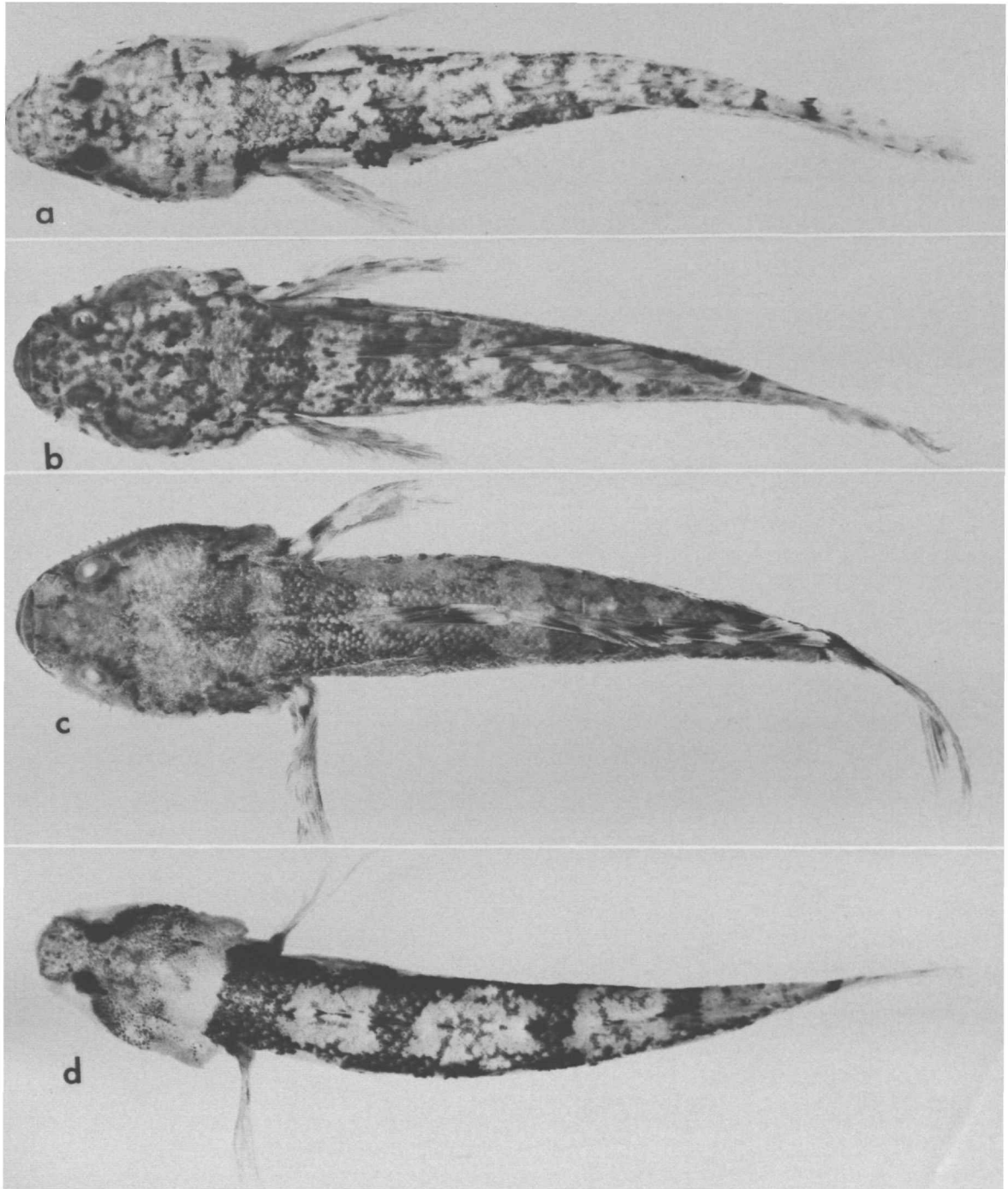


PLATE 8.—Species of *Gobiopsis*, dorsal views; same species and specimens as Plate 7.



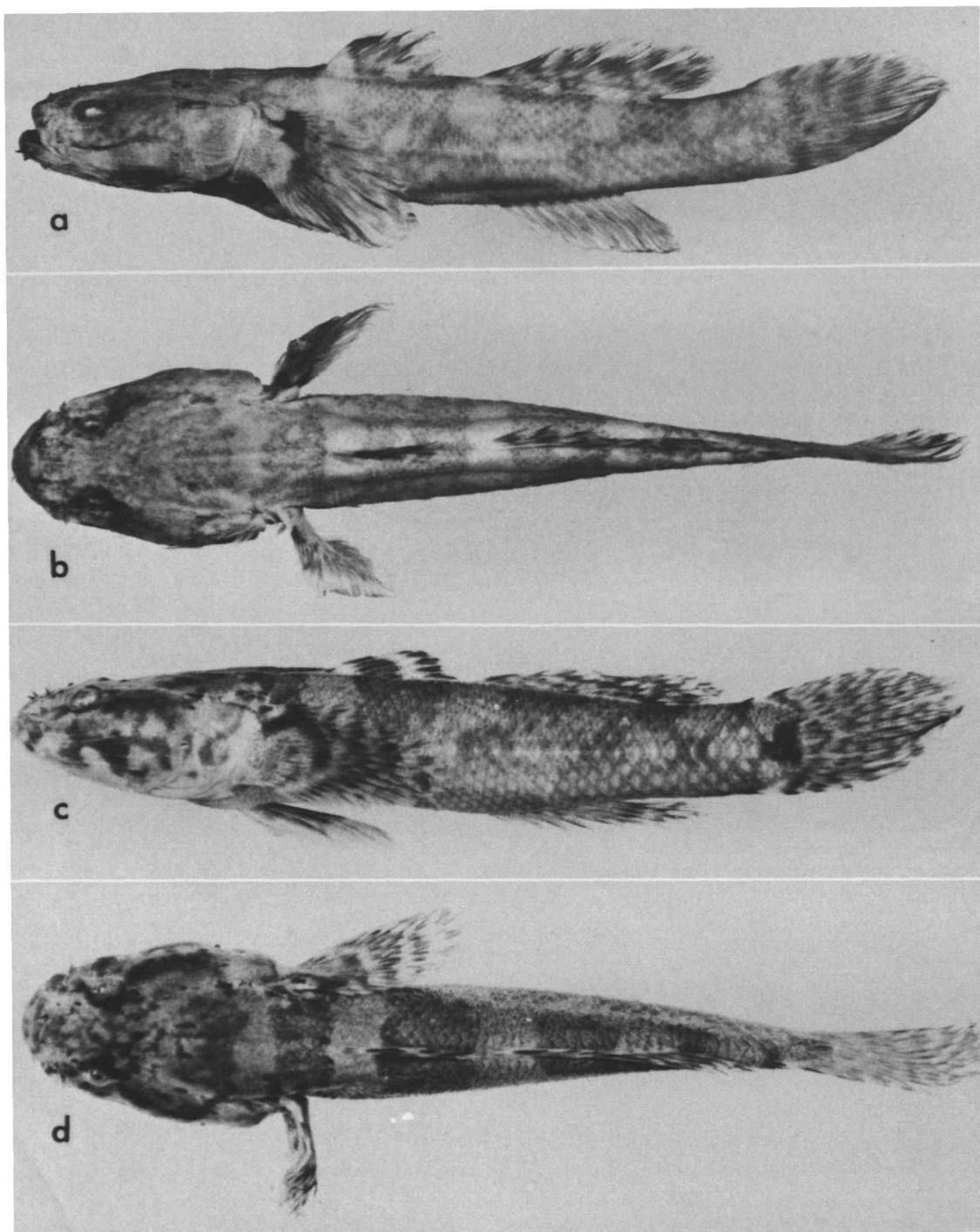


PLATE 9.—Species of *Gobiopsis*: a, *G. canalis*, lateral view, UZMK 01.9.1943, 619, holotype, male, 50.5 mm SL; b, dorsal view of a; c, *G. macrostoma*, lateral view, CAS 33616, 42.6 mm SL; d, dorsal view of c.

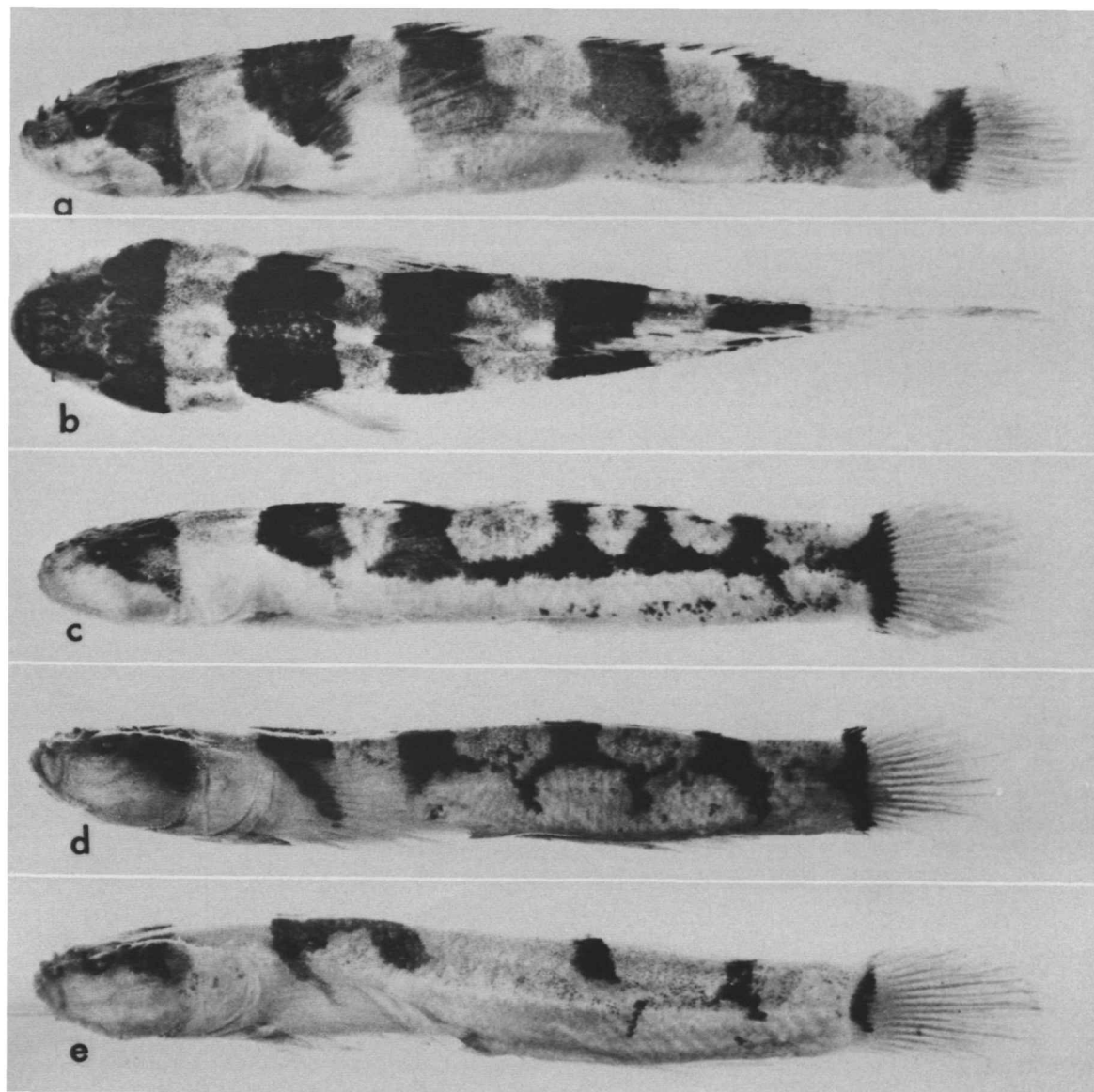


PLATE 10.—Extremes in color pattern of *Gobiopsis quinquecincta*: *a*, prominent saddles, lateral view, FMNH 77051, 27.3 mm SL; *b*, dorsal view of *a*; *c*, five saddles joined laterally on body, lateral view, FMNH 77051, 23.7 mm SL; *d*, saddles weakly joined laterally, lateral view, USNM 211352, 30.2 mm SL; *e*, saddles reduced, lateral view, USNM 211352, 28.6 mm SL.

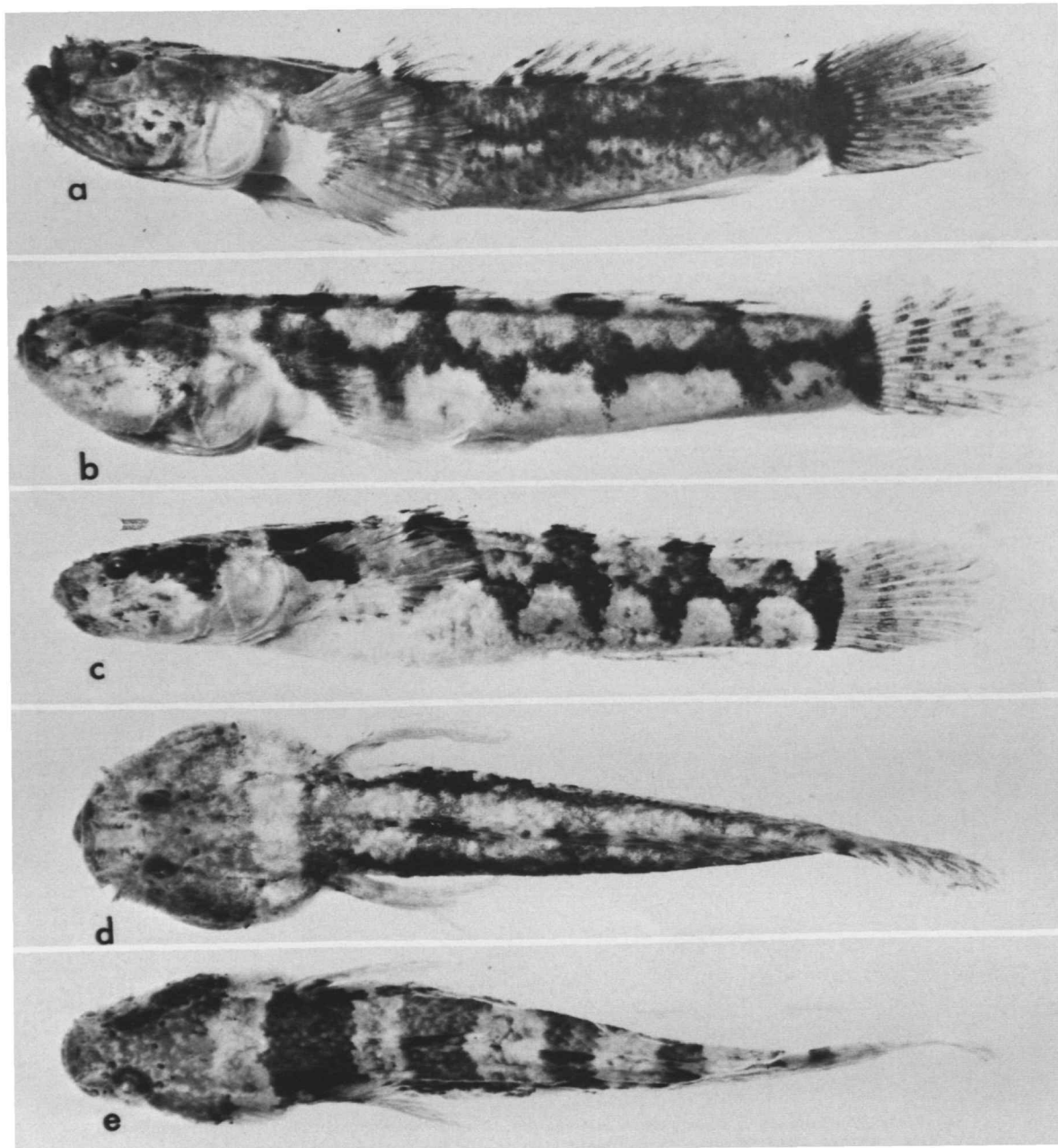


PLATE 11.—Color patterns in *Gobiopsis bravoii* and *G. angustifrons*: a, lateral view of *G. bravoii*, SU 33121, 31.7 mm SL; b, lateral view of *G. bravoii*, SU 33121, 26.3 mm SL; c, lateral view of *G. angustifrons*, USNM 213492, holotype, female, 33.6 mm SL; d, dorsal view of a; e, dorsal view of c.



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