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A STUDY OF THE VERTEBRAL COLUMN AND MEDIAN FIN OSTEOLOGY IN GOBIOID FISHES WITH COMMENTS ON GOBIOID RELATIONSHIPS

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ABSTRACT

Several osteological characters of the axial skeleton are surveyed in a broad assemblage of gobioid fishes comprising approximately 200 valid genera and over 500 valid species. The characters include: pattern of interdigitation of the spinous dorsal-fin pterygiophores with the neural spines of the vertebrae; vertebral number and distribution between precaudal and caudal vertebrae; number of epural bones; and number of anal fin pterygiophores anterior to the first haemal spine. All of these features show considerable stability at the generic level and appear useful in the characterization of groups. We have been able to place the large majority (about 95%) of the species examined by us into one of 32 groups on the basis of these characters. The groups are uneven in both size and position in the taxonomic hierarchy ranging from some comprising a single genus to one containing over 50 currently recognized genera. The nature of several of the characters renders their phylogenetic polarization impossible to defend, consequently 16 of the 32 groups are only phenetically united. All of the groups are proposed without formal designation as working hypotheses in need of corroboration or refutation. The geographic distribution of the groups and their constituent genera has been determined in 10 major marine faunal regions and these data are presented.

Progress in the higher classification of gobioid fishes has been greatly impeded by the large number of constituent species combined with a tendency in the group toward evolution by reduction. The classification of gobioids has primarily been based on external morphology with only limited information on internal characteristics. The selection at all taxonomic levels of appropriate outgroups is difficult and gobioids remain particularly troublesome to subdivide into monophyletic units of a size that can be systematically analyzed with some reasonable expectation of a satisfactory conclusion.

Miller (1973a) reviewed the tortuous history of gobioid classification and indicated that over the previous half century gobioids were variously divided into from four (Berg, 1940) to eight families (Jordan, 1923). Miller (1973a) concluded by recognizing only two families, the monotypic Rhyacichthyidae and the Gobiidae with seven subfamilies (Eleotrininae, Pirskeninae, Xenisthminae, Gobionellinae, Tridentigerinae, Gobiinae, and Kraemeriinae).

Only one comprehensive attempt to classify the gobioids has been put forward since Miller's 1973 scheme. Hoese (1984) divided the group into six families (Rhyacichthyidae, Eleotrididae, Xenisthmidae, Microdesmidae, Gobiidae, and Kraemeriidae). Springer (1983), in an important review of gobioid osteology and classification, defined the Gobioidei, called attention to the probability of paraphyly or polyphyly in several of Miller's groups, and noted that the Eleotrinae of Miller (=Eleotrididae of Hoese) is undefined by any synapomorphy.

Almost 20 years ago, while examining radiographs of American gobies for routine fin element counts, one of us (RSB) was struck by the intraspecific stability of the arrangement of the spinous dorsal-fin pterygiophores in relation to the vertebrae. The possible utility of this complex character in defining gobioid genera led to the accumulation of data on this, and several other axial skeleton characters, over the intervening years. The present data set results from combining similar data sets taken, largely independently, by the three of us.

We present here the results of this survey of several characters of the axial skeleton of gobioids from a sampling of about 200 valid genera and over 500 valid species. If Hoese's (1984) estimate that gobioids number approximately 270 valid genera and 1,500–2,000 valid species is close to reality, then our sample comprises nearly 75% of the genera and perhaps 30% of the species.

The nature of the characters comprising the data set, combined with the difficulty of selecting outgroups, makes defensible polarization of many of the character states impossible. Only one-half of the groupings suggested by our data are supported by synapomorphies. To those who may find the use of phenetically-identified groups disturbing, we reply that we view these groups as working hypotheses and afford them no taxonomic status at present. It is not the purpose of this paper to propose another classification of gobioids based on this limited character set. Rather, it is our aim simply to make these data available and to propose some phenetic groups where closer examination for evidence of monophyly seems in order.

METHODS

Because the data were collected over nearly 20 years, considerable effort was recently made to find and reconfirm the identification of the material radiographed in the early stages of this study. To this end approximately 80% of the material was reexamined. The number of misidentifications was low; therefore, we have retained in the data set those lots that were not reconfirmed unless we had reason to doubt their identity. Type material, especially that deposited at USNM, has been heavily utilized in this study, thus easing to some extent the problem of misidentification. Regardless, the state of gobioid systematics and our fallibility most likely insure that misidentifications remain.

In the use of generic names and the generic assignment of species we have tried to follow the most recent literature except in those groups under current study by one of us, in which case we have utilized the manuscript synonymies. For Indo-Pacific taxa we have adopted the generic synonomies of D. F. Hoese from a widely distributed, but unpublished, manuscript (cited throughout this paper as Hoese, 1985[1]) unless other recent published information was available or our data dictated otherwise. The use of unpublished synonymies was somewhat uncomfortable for us, however we felt that in many cases the existing literature utilized inappropriate names and the use of unpublished opinion was the lesser evil.

The majority of species were examined by radiography only. Approximately 20% of the species were examined from cleared and stained material. Data on about 50 additional species were taken from the literature, mostly from Akihito et al. (1984). The sample size for each species varies from 1 to over 50. Where possible, we have tried to gather data on two or more specimens from each lot of specimens used.

The following data were taken on each specimen: (1) spinous dorsal-fin pterygiophore formula, (2) number of precaudal and caudal vertebrae, (3) epural number, (4) ratio of number of finrays to number of underlying vertebrae, (5) number of anal-fin pterygiophores anterior to the first haemal spine, and (6) second dorsal and anal finray counts (collected for only about 60% of the specimens). Data were also recorded on various unique features apparent in several taxa. Several of our characters require discussion.

Dorsal Pterygiophore Formula (Figs. 1 and 2).—The spinous dorsal-fin pterygiophores of all gobioids have been reduced to a single element through the loss or fusion of the medial and distal segments. The base of each spine articulates with the dorsal surface of its supporting pterygiophore, the two thus being in supernumerary association in the sense of Johnson (1980). The first spine, therefore, has no serially associated pterygiophore. Each following spine is serially associated with the preceding pterygiophore but is supported by its supernumerary associate. This arrangement appears to be nearly universal among gobioids regardless of the number of spinous dorsal elements with rare exceptions as noted below, primarily in the microdesmids and periophthalmids. All subsequent references in this paper to a spinous dorsal-fin spine and its supporting pterygiophore imply the pterygiophore with which the spine is in supernumerary association unless otherwise noted.

The spinous dorsal-fin pterygiophore formula, here noted as DF, is modified from that introduced by Birdsong (1975). As in the original formula, the initial digit indicates the interneural space into

[1] Hoese. 1985. Recognized genera of Eleotrididae and Gobiidae. Unpublished.

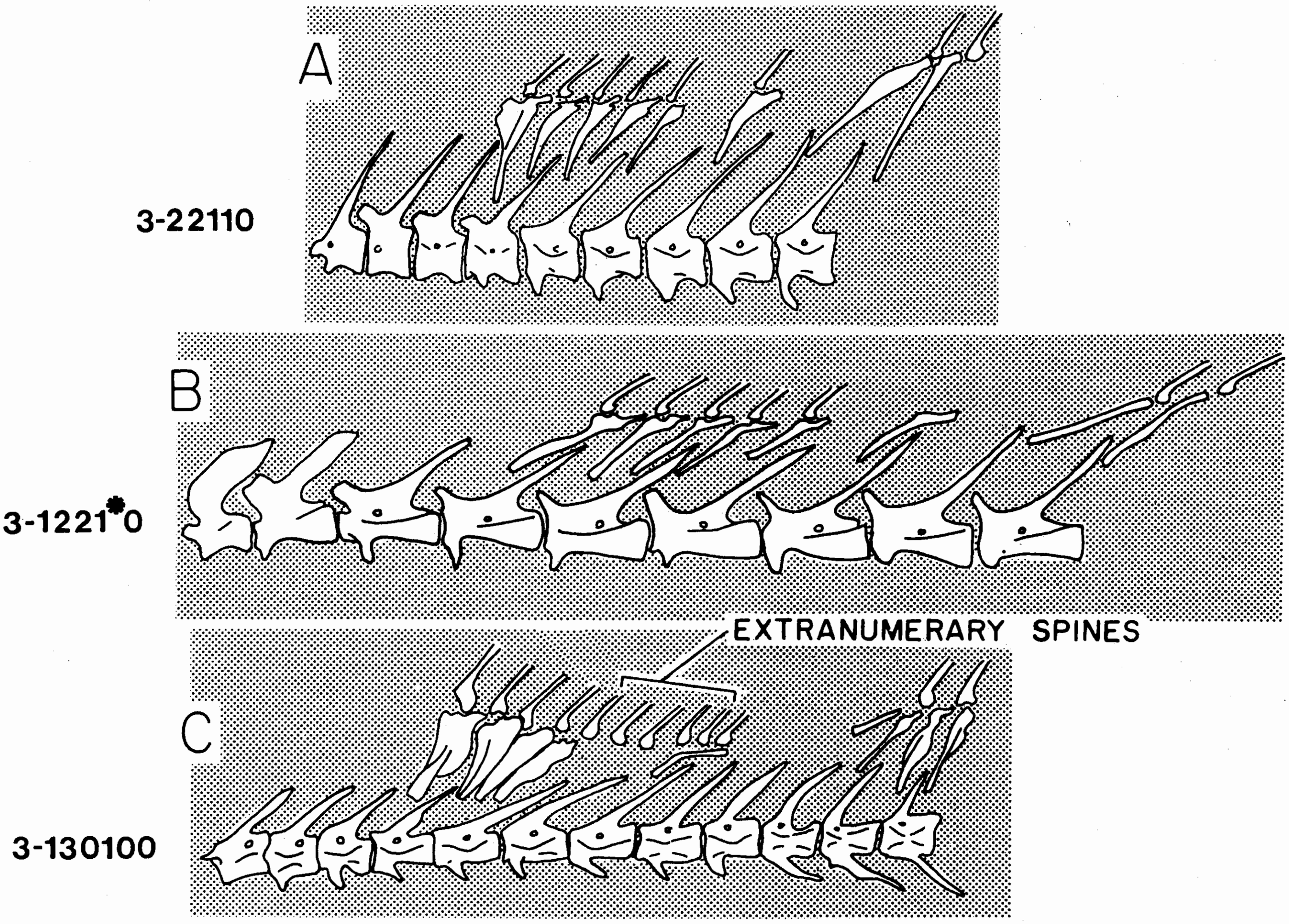

Figure 1. Anterior vertebrae and associated pterygiophores in selected gobioids illustrating the pterygiophore formula: A) *Istigobius*; B) *Pseudapocryptes*; and C) *Periophthalmus*.

which the first pterygiophore of the spinous dorsal fin inserts. The new system separates this starting position indicator from the remainder of the formula by a dash as opposed to setting off the remainder in parentheses. This modification reduces the notation by one character with no loss of information. The digits following the dash each represent an interneural space, starting with the one into which the first pterygiophore inserts, and the number is the number of pterygiophores inserting at that position. All interneural spaces from the origin of the first dorsal fin to the origin of the second dorsal fin are accounted for in the formula, hence the position of the first pterygiophore in the second dorsal fin may be deduced.

It has been called to our attention by G. David Johnson that recent percoid workers have conventionally considered the first interneural space to be anterior to the first neural spine, e.g., Potthoff (1980) and Olney et al. (1983). Birdsong (1975) and Akihito et al. (1984) both considered the first interneural space to lie between the first two neural spines when utilizing this character in gobioids. Over the past decade many authors have added the character to the routine list of diagnostic features used to define gobioid groups (Springer, 1978; 1983; Lachner and McKinney, 1978; 1979; Lachner and Karnella, 1978; Birdsong, 1981; Akihito et al., 1984; Murdy, 1985; Winterbottom and Emery, 1986), all following the convention of designating the space between the first two interneural spines as space number one. While it would be preferable to have a single convention, the wide usage of the "gobioid" convention compels us to remain with it to avoid further confusion.

Pterygiophores that support no associated spine are indicated by a superscript asterisk following the digit (Fig. 1B) whereas the original system used italicized numbers to indicate this condition. This change avoids the difficulty of discerning italicized numbers in most type fonts. An additional notation has been incorporated to describe the condition found in the Microdesmidae where a single spine-bearing pterygiophore may be inserted in each of up to 22 consecutive interneural spaces. To avoid a formula of cumbersome length, we denote this condition by the use of a parenthetically enclosed superscript number to indicate the number of consecutive interneural spaces into which a single pterygiophore inserts. For example, 3-21$^{(14)}$ describes the condition where the first two pterygiophores insert in interneural space 3 followed by 14 interneural spaces, each with a single pterygiophore. In those microdesmids in which the first pterygiophore has no associated spine the DF can be indicated, for example, as: 3-1*1$^{(15)}$. If the first pterygiophore bore a spine in this example, the formula would be written: 3-1$^{(16)}$.

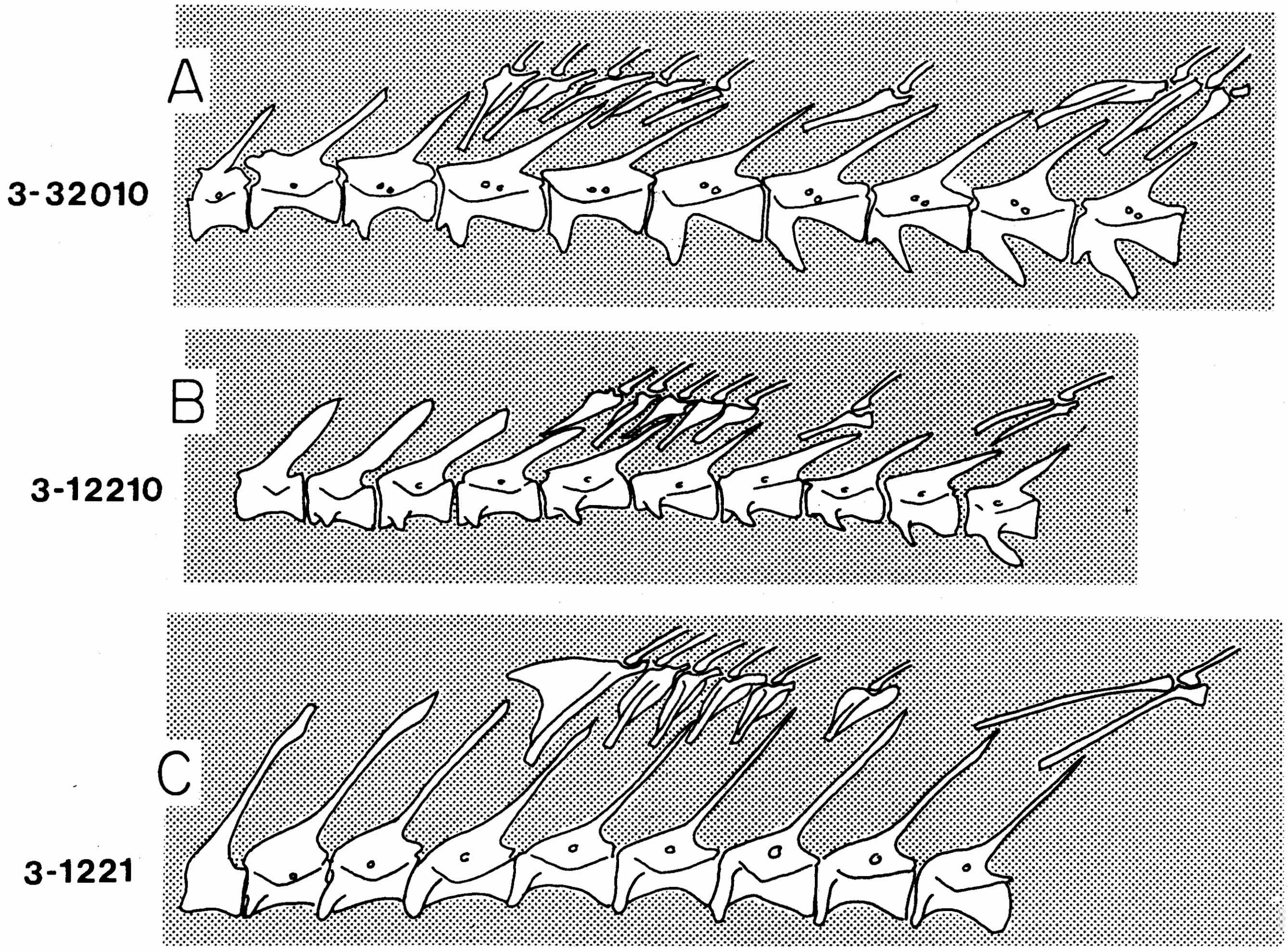

Figure 2. Anterior vertebrae and associated pterygiophores in selected gobioids illustrating the pterygiophore formula. A) *Ptereleotris*; B) *Erotelis*; and C) *Hypseleotris*.

Birdsong (1975) stated that predorsal bones are absent in gobioid fishes. Springer (1983) clarified Birdsong's terminology and appeared to support the contention that predorsals are lacking. Dawson (1968; 1974) described and illustrated "supraneural" bones in microdesmids where they are apparently characteristic of certain groups. The bones described by Dawson are obviously proximal pterygiophores without any associated spines and we have treated them as we would any other pterygiophore in the formulation of the DF notation for microdesmids. The homology of these bones with the predorsal bones of other perciforms remains to be demonstrated.

Three conditions that the formula does not describe merit mention. DF formulae ending in 0 indicate a vacant interneural space between the last pterygiophore of the first dorsal fin and the first pterygiophore of the second dorsal fin. Hoese (1984) noted that most eleotridids differ from gobiids in the nature of this "interneural gap." Two distinct conditions result in a DF formula ending in 0 (compare Fig. 2A, the gobiid type, with Fig. 2B, the eleotridid type). In almost all gobiid fishes with separate dorsal fins the first pterygiophore of the second dorsal fin occupies an interneural space to itself. In those eleotridid fishes that display an interneural gap (most do not), the first two pterygiophores of the second dorsal fin occupy the same interneural space, with a few notable exceptions. Hoese (pers. comm.) suggested that the eleotridid type interneural gap is the result of the posterior displacement of only the first pterygiophore of the second dorsal fin, while the gobiid type interneural gap seems to result from the posterior displacement of at least the first two second dorsal pterygiophores, if not the entire fin.

In the Periophthalmus Group extranumerary spines, i.e., additional spines unassociated with either serial or supernumerary pterygiophores, are often present in the first dorsal fin (Fig. 1C). The condition is an autapomorphy of the group and it seems inadvisable to further complicate the formula to account for it. Likewise, the condition in *Gobitrichonotus*, where one of two pterygiophores in a single interneural space bears no spine, is not accommodated by the system because the specific spineless pterygiophore is not indicated. Again, this condition was seen only in this bitypic genus and for simplicity seems best left unaccounted for by the system.

Special comment needs to be made of the most extensive use of a dorsal-fin pterygiophore formula to date, that of Akihito et al. (1984) who used a formula of their own design to describe the condition

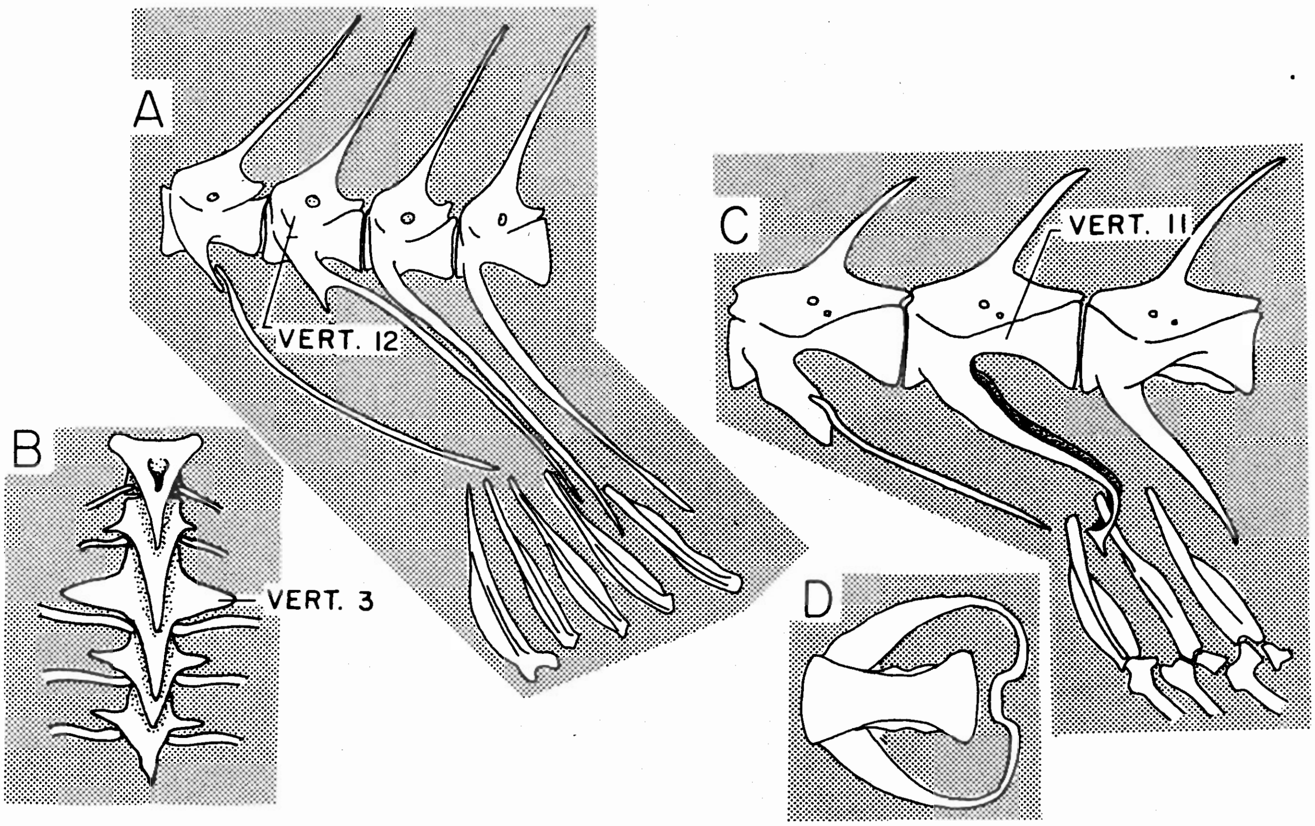

Figure 3. Vertebrae of selected gobioids: A) vertebrae 11–14 and associated anal-fin pterygiophores of *Dormitator*; B) vertebrae 1–5 (dorsal view) of *Butis*; C) vertebrae 10–12 and associated anal-fin pterygiophores of *Ptereleotris*; and D) vertebra 11 (ventral view) of *Ptereleotris*.

of all species of Japanese gobioids. Their formula, applied to the condition shown in Figure 1A, would be 3/II II I I 0/9, and is explained by Akihito et al. (1984) as " '3' shows the number of vertebrae before (which) the 1st pterygiophore of the 1st dorsal fin is inserted, each roman numeral shows the number of pterygiophores inserted between the neural spines, and '9' shows that the 2 pterygiophores of the 1st ray of the 2nd dorsal fin are mounted over the 9th vertebra." The formula of Akihito et al. (1984) is quite adequate to describe the pattern in most gobioids; however, we have remained with the system of Birdsong (1975), as here modified, because we feel it to be less cumbersome and more versatile.

Vertebral Number.—The vertebral number, "V," is expressed as precaudal vertebrae plus caudal vertebrae (including the terminal vertebral element) equals total vertebrae. Precaudal vertebrae are defined as those without a closed haemal arch. The determination of the first caudal vertebra is usually unequivocal; however, in a few species, when working from radiographs alone, it is difficult to determine the first closed haemal arch, i.e., the first caudal vertebra.

Epural Number.—*Rhyacichthys* possesses the plesiomorphic condition of three epurals whereas all other gobioids have either two or one; the reduction from 2 to 1 has probably occurred several times. Only rarely is difficulty encountered in determining epural number from radiographs and almost never from cleared and stained material. We use the notation "EPU" to denote epural number.

Number of Anal Pterygiophores Anterior to the First Haemal Spine (Fig. 3A, C).—This character, indicated in notation as "AP," can be determined without ambivalence if the first caudal vertebra is not in question. In a few cases the first haemal spine was found to fall directly over the tip of a pterygiophore. In such cases the pterygiophore in question was, by our convention, considered to be in advance of the haemal spine.

Ratio of Number of Finrays to the Number of Underlying Vertebrae.—The ratio produced by this character was rounded to the closest 1/2 of a whole number so that three character states were recognized: approximately 1:1, approximately 1.5:1, and approximately 2:1. This character was determined by examination of the second dorsal fin, but the anal fin usually exhibits a similar ratio.

Group Distributions.—The geographic regions referred to in the text are shown in Figure 4 and are defined as follows: Region 1, western Atlantic; Region 2, eastern Atlantic south of Cape Verde; Region 3, eastern Atlantic north of Cape Verde; Region 4, Indo-West Pacific including the Red Sea, but

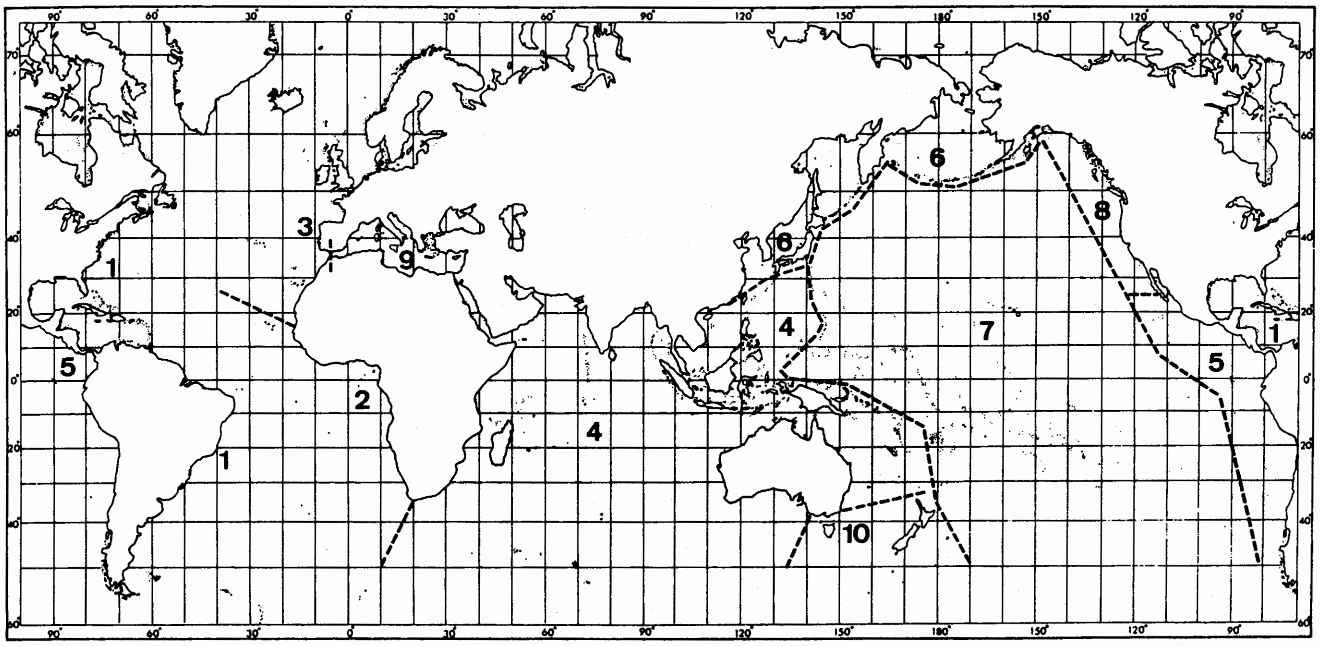

Figure 4. Distributional regions.

excluding southern Australia (Victoria, Tasmania) and New Zealand; Region 5, eastern Pacific south of 25°N on the outer coast of the Baja Peninsula and including all of the Gulf of California; Region 6, northwestern Pacific north of the Ryukyu Islands and the Tropic of Cancer on the coast of China; Region 7, Pacific Plate as defined by Springer (1982); Region 8, northeastern Pacific north of 25°N on the outer coast of the Baja Peninsula; Region 9, Mediterranean basin and associated drainages; and Region 10, southern Australia (the precise limits unknown) including at least Victoria, Tasmania, and New Zealand. The general limits of these regions conform to well established faunal regions, the boundaries of which were drawn from Briggs (1974), Springer (1982), and Walker (1960).

A list of the material used in this study appears in the appendix.

Putative Groups

The majority of genera examined in this study can be placed with a minimum of coaxing into one of the 32 groups described below. The groups are uneven in both size and position in the taxonomic hierarchy, ranging from those comprising a single genus to one containing over 50 currently recognized genera. For convenience we have organized the groups under the gobioid families and subfamilies recognized by Hoese (1984). Within the subfamilies the groups are ordered alphabetically. Groups defined by one or more synapomorphies are preceded by an asterisk and those phenetically united are preceded by a question mark. Likewise, in the tables, genera that are problematical in their association with a group are preceded by a question mark. With the exception of *Rhyacichthys,* we have generally refrained from designating monotypic groups and have placed unique species as "unassigned." Genera for which the data are too scanty for problematical placement, or simply cannot be characterized from our data, are also placed as unassigned.

Table 1. Character distribution in the Rhyacichthys Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Rhyacichthys	3-221220	(3)*†	12+16=28	(3)*	3	(3)*	4	(3)*
(region 4)	3-222100	(1)	11+17=28	(1)†				

* Includes data from Miller (1973).
† Includes data from Akihito et al. (1984).

Table 2. Character distribution in the Butis Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Butis	3-2211	(32)	11+15=26	(20)	2	(32)	3	(19)
(regions 4 and 7)			10+16=26	(6)			5	(6)
			13+13=26	(4)			2	(5)
			12+14=26	(1)			4	(1)
			13+14=27	(1)				
Gobiomorus	3-2211	(17)	12+14=26	(11)	2	(17)	6	(7)
(regions 1 and 5)			13+13=26	(6)			7	(6)
							5	(4)
?*Hannoichthys*	3-2211	(3)	10+16=26	(3)	2	(3)	2	(2)
(region 2)							3	(1)
?*Odonteleotris*	3-2211	(2)	12+16=28	(2)	2	(1)	4	(1)
(region 4)					3	(1)	5	(1)
?*Ophiocara*	3-2211	(9)	10+16=26	(9)	2	(9)	3	(9)
(regions 4 and 7)								
Oxyeleotris	3-2211	(8)	10+16=26	(6)	2	(8)	3	(7)
(region 4)			10+17=27	(1)			4	(1)
			12+14=26	(1)				
Prionobutis	3-2211	(8)	10+16=26	(5)	2	(8)	2	(5)
(region 4)			11+15=26	(3)			3	(3)

The stability of the characters comprising the data set varies among the species surveyed. The characters arranged by increasing variability are epural number, DF, vertebral number, and AP. In the recognition of groups we utilized the following criteria given in the order of their presumed reliability: (1) possession of synapomorphies, (2) phenetic similarity in characters with little variability, and (3) phenetic similarity in the pattern or range of variable characters.

Rhyacichthyidae

**Rhyacichthys Group* (Table 1).—*Rhyacichthys* is the sister group to all other gobioids and is defined by the disconnection of the interhyal from the hyomandibula (Springer, 1983), rotation of the pectoral radials and rays to a nearly horizontal orientation, and various other adaptations to fast flowing streams involving the pelvic fins and mouth. The genus possesses a number of plesiomorphies absent in all other gobioids (Springer, 1983). Among these are a lateral line canal that extends onto the body and 3 epurals. Most recent workers place *Rhyacichthys* in the monotypic family Rhyacichthyidae (Miller, 1973a; Springer, 1983; Hoese, 1976a; 1984). The single species, *R. aspro,* occurs in hill streams in the tropical eastern sector of Region 4, a distribution considered relictual by Miller (1973a).

Eleotrididae

?Butis Group (Table 2).—Enlarged parapophyses of the third vertebra (Fig. 3B) occur in all species for which we have data in the genera *Butis* (5 species), *Gobiomorus* (3 species), *Prionobutis* (1 species), and *Oxyeleotris* (1 species). D. F. Hoese (pers. comm.) informs us that *Oxyeleotris lineolata, O. aruensis,* and *O. nullipora* along with *Hannoichthys* do not have enlarged parapophyses. *Ophiocara* also lacks enlarged parapophyses and the condition in *Odonteleotris* is not known. All of these genera share the 3-2211 DF pattern common to the Butis Group.

Table 3. Character distribution in the Dormitator Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Batanga (region 2)	3-12211	(13)	11+16=27	(13)	2	(13)	4	(13)
Bostrychus (regions 4, 6; also listed in 2 by Miller, 1981)	3-22111* 3-2211*1* 3-22111*0	(1) (1) (1)	11+16=27	(3)	2	(3)	4	(3)
Dormitator (regions 1, 2, 5 and rarely 8)	3-12211 3-122110 3-21211 4-1221	(17) (2) (1) (1)	11+16=27 12+15=27 11+17=28	(14) (6) (1)	2	(21)	4	(21)
?*Guavina* (region 1, 5; also listed in 2 by Miller, 1981)	3-12211 4-12310 4-13210 5-3310	(4) (1) (1) (1)	11+16=27	(7)	2	(7)	3 4	(6) (1)
?*Kribia* (regions 2 and 9)	3-1221 3-2211 3-12210	(4) (1) (1)	11+16=27 12+15=27 12+16=28	(4) (1) (1)	2	(6)	4 2 3	(4) (1) (1)
Ophieleotris (region 4)	3-12210 4-2310	(3) (3)	10+15=25	(6)	2	(6)	5 4	(5) (1)

The group is distributed in fresh and brackish tropical waters of regions 1, 2, 4, 5, and 7 with representation in region 2 dependent upon the inclusion of *Hannoichthys.*

**Dormitator Group* (Table 3).—The Dormitator Group is defined by the strongly recurved first haemal spine that almost touches the second (Fig. 3A). This condition is well developed in all included genera except *Guavina* and *Kribia* where it is only slightly developed. The group is widespread in fresh and brackish waters in regions 1, 2, 4, 5, 6, and rarely in 8 and 9.

?Eleotris Group (Table 4).—The Eleotris Group is phenetically identifiable by the vertebral number of 10+15=25, DF=3-1221 or 3-12210, AP=2–3, and in lacking cephalic lateral-line canals. *Eleotris* is broadly distributed, however, all other constituent genera are quite limited in their ranges. *Belobranchus* and *Calumia* are endemic to region 4 and *Erotelis* is limited to the American tropics. *Calumia* is a coral reef inhabitant, the only eleotridid known from this habitat.

Table 4. Character distribution in the Eleotris Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Belobranchus (region 4)	3-1221	(7)	10+15=25 11+15=26	(6) (1)	2	(8)	2	(8)
Bunaka (region 4)	3-1221	(4)	10+15=25	(4)	2	(4)	3	(4)
Calumia (regions 4 and 7)	3-1221	(5)	10+15=25	(5)	2	(5)	2	(5)
Eleotris (regions 1, 2, 4, 5, 6, and 7)	3-1221 3-12210	(25) (12)	10+15=25	(37)	2	(37)	2 3	(24) (13)
Erotelis (regions 1 and 5)	3-12210 3-1221	(13) (3)	10+15=25	(16)	2	(16)	2	(16)

Table 5. Character distribution in the Gobiomorphus Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
*Gobiomorphus**	3-22110	(9)	11+17=28	(15)	2	(17)	3	(17)
(regions 4 and 10)	4-22210	(8)	12+17=29	(7)	1	(11)	2	(12)
	4-32100	(5)	12+18=30	(7)			4	(6)
	3-212110	(2)	12+19=31	(3)				
	4-32010	(2)	13+17=30	(2)				
	4-12211	(2)	12+16=28	(1)				
	4-12310	(1)						
	4-122110	(1)						
	4-222100	(1)						
	4-13210	(1)						
	3-122110	(1)						
	3-1221101	(1)						
Mogurnda	4-22110	(6)	15+16=31	(7)	2	(10)	5	(8)
(region 4)	4-222110	(3)	15+17=32	(2)	1	(1)	4	(1)
	4-2221110	(1)	14+17=31	(1)			6	(1)
	3-1212110	(1)	16+20=36	(1)			7	(1)
Philypnodon	3-122110	(12)	12+18=30	(10)	2	(9)	3	(5)
(regions 4 and 10)			12+19=31	(1)	1	(2)	4	(5)
							2	(1)

* Total vertebral count ranges from 26–31 according to McDowall (1975).

?Gobiomorphus Group (Table 5).—These fishes form a highly variable group that is identifiable by the gobiid-type interneural gap, a feature of limited distribution among gobioids with 6 branchiostegal rays. Most species lack a mesopterygoid and dorsal postcleithrum and some possess a single epural, all characteristics typical of gobiids (Birdsong, 1975; Hoese, 1984); however, in other features, e.g., 6 branchiostegal rays, they resemble eleotridids.

The genera of this group are most speciose in region 10, a region with a small gobioid fauna, but a few species also have limited distribution in the southern part of region 4.

**Hypseleotris Group* (Table 6).—This unusual group is unique among gobioids in its cyprinid-like body shape, greatly elongate body cavity, and high number of anal pterygiophores preceding the first haemal spine. The two included genera are similar in general skeletal structure but differ in the DF and total number of vertebrae. Both *Hypseleotris* and *Hemieleotris* are inhabitants of fresh and brackish water, the former in region 4 and the latter in region 5. The greatly disjunct distribution is not readily explainable.

?Micropercops Group (Table 7).—The Micropercops Group comprises two genera distributed in fresh to brackish waters along the Asian continent in regions 4 and

Table 6. Character distribution in the Hypseleotris Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Hemieleotris	3-2211	(9)	14+12=26	(12)	2	(15)	9	(9)
(region 5)	3-22110	(6)	15+11=26	(3)			8	(3)
							10	(3)
Hypseloetris	3-1221	(11)	14+11=25	(12)	2	(16)	10	(11)
(regions 4 and 7, Pacific plate margin)	3-12210	(7)	15+10=25	(5)	1	(2)	9	(6)
			14+12=26	(1)			11	(1)

Table 7. Character distribution in the Micropercops Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Micropercops	3-2121111*	(3)	16+16=32	(7)	2	(10)	6	(9)
(region 4)	3-221211	(2)	15+17=32	(1)			7	(1)
	3-121211	(2)	17+15=32	(1)				
	3-2112111	(1)						
	3-2121111	(1)						
	3-1221111	(1)						
Perccottus	3-122110	(1)	15+16=31	(1)	2	(2)	6	(2)
(region 6, USSR, fresh water)	3-121111	(1)	15+14=29	(1)				

* See text discussion.

6. The group is phenetically united by the similarity in vertebral number and arrangement and in having 7–9 first dorsal fin pterygiophores.

Xenisthmidae

**Xenisthmus Group* (Table 8).—This small group of fishes, all from region 4, was recently diagnosed by Springer (1983) on the basis of several synapomorphies, the most salient being the ossification of the rostral cartilage. The characters used in the present study, however, provide no additional support to ally *Xenisthmus* and *Tyson.* Hoese (1985[1]) indicated that *Kraemericus* Schultz, 1966 was a synonym of *Xenisthmus*; however, the type and only known specimen, *K. chapmani,* differs in DF pattern and epural number from all *Xenisthmus* examined by us, therefore we have listed it separately.

Gobiidae (Gobiinae)

**Acanthogobius Group* (Table 9).—The constituent genera are diagnosed by a DF pattern that, while displaying some variability, is unique among gobiids in the dominant pattern of 3-1221110. The genera also are similar in their high (for Gobiinae) vertebral number, typically 13–14+19–22=32–35. The genera are primarily distributed in region 6 with two (*Acanthogobius* and *Chaeturichthys*) also penetrating the cooler waters of region 4 along the China coast. *Acanthogobius flavimanus* has been introduced into Sydney Harbor (Hoese, 1973) and into region 8 in San Francisco Bay (Brittan et al., 1970).

**Astrabe Group* (Table 10).—While the species display considerable variability in the details of the characters surveyed in this study, they are diagnosed by reduced eyes (eye diameter usually less than 15% of head length) and the posterior dis-

Table 8. Character distribution in the Xenisthmus Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
?*Kraemericus** (region 4)	3-12210	(1)	10+17=27	(1)	1	(1)	2	(1)
Tyson† (region 4)	absent	(1)	13+13=26	(1)	1	(1)	1	(1)
Xenisthmus (region 4)	3-22110	(5)	10+16=26	(4)	2	(5)	2	(5)
			10+17=27	(1)				

* We have no information on the presence of xenisthmid synapomorphies. Placement here is based on Hoese's (1985[1]) opinion that *Kraemericus* = *Xenisthmus.*
† From Springer (1983).

Table 9. Character distribution in the Acanthogobius Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Acanthogobius	3-1221110	(9)	13+20=33	(5)	2	(9)	3	(3)
(regions 4, 6, and			13+19=32	(4)			2	(1)
introduced in 8)			12+19=31 (Akihito et al., 1984)					
Amblychaeturichthys	3-1221110	(2)	13+21=34	(1)	2	(2)	2	(1)
(region 6)			13+22=35	(1)			3	(1)
	3-2121110 (Akihito et al., 1984)							
Chaeturichthys	3-1221110	(2)	13+21=34	(1)	2	(2)	2	(2)
(regions 4 and 6)			13+27=40	(1)				
	3-2121110 (Akihito et al., 1984)							
Lophiogobius	3-1221110	(1)	13+22=35	(1)	2	(1)	2	(1)
(region 6)								
Pterogobius	3-1221110	(2)	14+20=34	(2)	2	(4)	4	(3)
(region 6)	3-1212110	(2)	15+19=34	(2)			3	(1)
	3-2121110 (Akihito et al., 1984)							
Sagamia	3-1221110	(1)	14+20=34	(2)	2	(2)	3	(2)
(region 6)	3-1212110	(1)						
Suruga	3-12211100	(1)	14+21=35	(1)	2	(1)	2	(1)
(region 6)	3-12211101 (Akihito et al., 1984)							

placement and reduction (or loss) of their spinous dorsal fin. For those with a spinous dorsal fin, the fin comprises three spines and the first pterygiophore falls in the sixth to eighth interneural space except in *Eutaeniichthys* where the first pterygiophore inserts in the tenth space. The group members are also similar in having vertebral counts of 30 or more.

All genera are restricted to region 6 with the exception of *Typhlogobius* from region 8. Most, except *Leucopsarion,* appear to be tidepool inhabitants (Akihito et al., 1984). The American genus *Typhlogobius* inhabits snapping shrimp burrows within tidepools (Eschmeyer et al., 1983).

?Bathygobius Group (Table 11).—The Bathygobius Group is united only on the basis of phenetic similarity and differs from the Priolepis Group and the Gobius Group primarily in vertebral number among the characters of this survey. The genus *Caffrogobius* is included here on the basis of our examination of a single specimen of *C. caffer* and one of *C. nudiceps.* D. F. Hoese (pers. comm.) informed us that *C. caffer* is the only species in the genus with V=11+16=27; all others presently assigned to *Caffrogobius* have V=10+17=27. The Bathygobius Group has a broad distribution in marine to freshwaters in all regions except 8 and 10. *Bathygobius* is broadly distributed in all tropical waters of the world and *Glossogobius* is widely distributed in regions 4 and 6 with extension onto the Pacific Plate, but the remaining genera show more restricted distributions. *Monishia* is limited to the western Indian Ocean and the Red Sea (Hoese and Winterbottom, 1979) and *Hetereleotris* occurs in region 4 with limited distribution in region 6. *Nematogobius* and *Gorogobius* are known only from region 2.

**Chasmichthys Group* (Table 12).—The group is diagnosed by the insertion of the first spinous dorsal-fin pterygiophore in interneural space 4 or 5 (rarely 6), a condition rarely encountered in gobioid fishes. The genera assembled in this group all display considerable inter- and intraspecific variability in the characters surveyed, but display an overall similarity in their patterns. All members have ele-

Table 10. Character distribution in the Astrabe Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Astrabe	6-111000	(1)	14+16=30	(2)	2	(2)	3	(2)
(region 6)	6-110000	(1)						
	6-11100		13+17=30 (Akihito et al., 1984)					
	6-20100 (Akihito et al., 1984)							
Clariger	8-111000	(3)	15+19=34	(5)	2	(9)	2	(6)
(region 6)	7-11100000	(2)	14+16=30	(2)				
	8-21000	(1)	14+19=33	(1)				
	8-201000	(1)	15+20=35	(1)				
	6-111000	(1)						
	6-110000	(1)						
	7-1110000		15+18=33 (Akihito et al., 1984)					
	7-21000		14+18=32 (Akihito et al., 1984)					
	7-20100 (Akihito et al., 1984)							
Eutaeniichthys (regions 4 and 6)	10-21000		22+17=39 (Akihito et al., 1984)					
?*Leucopsarion* (region 6)	absent	(3)	14+20=34	(3)	2	(3)	1	(3)
?*Luciogobius*	absent	(3)	14+17=31	(2)	2	(4)	1	(2)
(regions 4 and 6)	7-1000000	(1)	18+21=39	(1)			2	(2)
			20+22=42	(1)				
			15+15=30 (Akihito et al., 1984)					
			15+17=32 (Akihito et al., 1984)					
			17+21=38 (Akihito et al., 1984)					
			17+24=41 (Akihito et al., 1984)					
			18+18=36 (Akihito et al., 1984)					
			19+18=37 (Akihito et al., 1984)					
			19+22=41 (Akihito et al., 1984)					
Typhlogobius	7-201000	(2)	17+14=31	(3)	2	(5)	2	(5)
(region 8)	7-21000	(1)	17+15=32	(1)				
	6-21000	(1)	16+14=30	(1)				
	6-201000	(1)						

vated vertebral counts, most frequently 14–16+18–20=32–36. While the DF pattern is variable, the genera are relatively stable in the insertion of the first pterygiophore and in the number of dorsal-fin spines.

The Chasmichthys Group is restricted to regions 6 and 8 with limited and disjunct distribution in the northern Gulf of California (region 5). This constitutes a temperate northern Pacific distribution much like that of the Astrabe Group above. The constituent species appear about evenly divided between the eastern and western North Pacific with those from Japan occupying a variety of marine to freshwater habitats (Akihito et al., 1984) and the American species occupying habitats with mud bottoms and reduced salinities. At least four of the American genera, *Clevelandia, Quietula, Lepidogobius,* and *Gillichthys,* occupy burrows (Eschmeyer et al., 1983).

?Gobionellus Group (Table 13).—The Gobionellus Group comprises 10 genera and is phenetically identified by DF=3-12210, V=10+16=26, and EPU=2. The AP=2 in most genera. The group displays greater than usual variation in epural number with a single epural occurring as a variant in many species. One of us (F.L.P.) feels that among genera we exclude from this group, *Awaous* (based on characters associated with the free neuromasts) and *Evorthodus* (based on modifications of the fourth neural spine) are more closely related to members of the

Table 11. Character distribution in the Bathygobius Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Bathygobius								
(regions 1, 2, 3, 4,	3-22110	(31)	10+17=27	(31)	1	(31)	2	(27)
5, 6, 7, and 9)							3	(4)
Caffrogobius	3-22110	(2)	10+17=27	(1)	1	(2)	2	(2)
(regions 2 and 4)			11+16=27	(1)				
Glossogobius	3-22110	(19)	10+17=27	(18)	1	(19)	2	(14)
(regions 4, 6, and 7)			11+16=27	(1)			3	(5)
Gorogobius	3-22110	(2)	10+17=27	(2)	1	(2)	2	(1)
(region 2)							3	(1)
Heterelectris	3-22110	(2)	10+17=27	(2)	1	(2)	2	(2)
(regions 4 and 6)								
Lesuerigobius	3-22110	(7)	10+17=27	(7)	1	(7)	2	(6)
(regions 2, 3, and 9)							1	(1)
Monishia	3-22110	(2)	10+17=27	(2)	1	(2)	1	(2)
(region 4)								
Nematogobius	3-22110	(1)	10+17=27	(1)	1	(1)	2	(1)
(region 2)								

Gobionellus Group. It has also been suggested to us (D. F. Hoese, pers. comm.) that *Rhinogobius* and *Schismatogobius* may also be related to *Awaous*. These, and other genera with possible relationship to the Gobionellus Group, are discussed under the group in which they are placed in this scheme.

The group has a worldwide tropical and subtropical distribution and is found in regions 1, 2, 4, 5, 6, 7, and 8 (rarely). Although the group ranges from fresh to marine waters, the majority appear to prefer waters of reduced salinities.

?Gobiopterus Group (Table 14).—This group comprises four genera of small estuarine and freshwater gobies phenetically united by the 10+15=25 vertebral number, a count reported among gobiids as typical only in *Oxyurichthys visayanus* (Akihito et al., 1984) and some *Eviota* species (Lachner and Karnella, 1978, 1980). All species for which we have data possess two epurals; however, D. F. Hoese (pers. comm.) informed us that some species of *Gobiopterus* have a single epural. All constituent genera are restricted to region 4.

?Gobiosoma Group (Table 15).—The Gobiosoma Group is identified by the fusion of hypurals 1–2 with 3–4 and the terminal vertebral element, a feature unusual in gobioid fishes. The majority of included genera are also characterized by DF=3-221110, V=11+16–17=27–28, EPU=1, and AP=2. These features are shared by *Aruma, Barbulifer, Eleotrica, Enypnias, Ginsburgellus, Gobiosoma, Gobulus, Gymneleotris, Nes, Psilotris, Pycnomma,* and the Pacific representatives of *Chriolepis.* Atlantic members of *Chriolepis* and the Atlantic genus *Varicus* differ in having AP=1, suggesting that some generic reassignment of the species may be in order.

We include four genera in the Gobiosoma Group that possess the fused caudal elements, but differ in DF or vertebral number. The genus *Risor* differs in having a DF=3-230110 as the modal pattern. Two genera, *Pariah* and *Ophiogobius,* typically have 8 spines in the first dorsal fin with a pterygiophore arrangement of 3-2211110. Hoese (1976b) indicated an arrangement of "2-1-2-1-1-1" for *Ophiogobius.* Both *Pariah* and *Ophiogobius* possess elevated vertebral numbers, typically 12+17=29 and 13+19=32, respectively. *Evermannichthys* displays both intra-

Table 12. Character distribution in the Chasmichthys Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Chaenogobius	4-122110000	(2)	16+19=35	(3)	2	(9)	3	(9)
(region 6)	4-12111000	(2)	16+22=38	(2)				
	4-12211000	(2)	15+18=33	(2)				
	4-12121000	(1)	16+18=34	(1)				
	4-2120100	(1)	15+17=32	(1)				
	4-1211100	(1)						
	4-1220100		15+19=34 (Akihito et al., 1984)					
	4-1201000		14+18=32 (Akihito et al., 1984)					
	4-12201000		15+20=35 (Akihito et al., 1984)					
			17+21=38 (Akihito et al., 1984)					
Chasmichthys	4-1211100	(3)	14+19=33	(5)	2	(7)	2	(5)
(region 6)	4-1211000	(2)	15+18=33	(2)			3	(2)
	4-11211000	(2)						
	4-1220100		14+18=32 (Akihito et al., 1984)					
Clevelandia	5-1201000	(2)	15+21=36	(3)	2	(5)	2	(5)
(region 8)	5-1211000	(1)	15+20=35	(2)				
	5-1210000	(1)						
	5-2101000	(1)						
Eucyclogobius	5-2120100	(6)	16+18=34	(6)	2	(23)	3	(12)
(region 8)	5-212010	(2)	15+18=33	(5)	1	(13)	2	(8)
	5-21200100	(2)	15+19=34	(5)			4	(1)
	4-11120110	(1)	16+19=35	(4)				
	5-1111101*0	(1)	16+20=36					
	5-1220100	(1)						
	5-1221010	(1)						
	5-1211100	(1)						
	5-2111010	(1)						
	5-2111100	(1)						
	5-21200100	(1)						
	5-2121010	(1)						
	5-221101*0	(1)						
	6-212010	(1)						
Gillichthys	4-1220100	(2)	14+18=32	(4)	2	(4)	3	(3)
(regions 5 and 8)	4-2221000	(1)					2	(1)
	5-220100	(1)						
Ilypnus	4-1211000	(4)	14+19=33	(4)	2	(6)	2	(4)
(region 8)	4-1210100	(2)	14+20=34	(2)			3	(2)
Lepidogobius (region 8)	4-12211000	(3)	15+22=37	(3)	2	(3)	2	(2)
Quietula	4-1210100	(11)	14+19=33	(8)	2	(14)	2	(14)
(regions 5 and 8)	4-1211000	(2)	15+19=34	(3)			3	(3)
	4-2110100	(2)	15+18=33	(2)				
	4-1120100	(1)	14+20=34	(2)				
			13+20=33	(1)				

* See text discussion.

and interspecific variability in the dorsal pterygiophore pattern and, to a lesser extent, in vertebral number and arrangement. Birdsong (1975) suggested that the unusual variability of this species may be associated with its sponge dwelling habits.

Fusion of hypurals 1–4 to the terminal element is found outside the Gobiosoma Group in *Trimmatom* (Winterbottom and Emery, 1981), *Kraemeria* and *Kelloggella* (Gosline, 1955), Xenisthminae (Springer, 1983), Ptereleotrinae (D. F. Hoese, pers. comm.) and some species of *Gobiopterus, Eviota, Monishia* and *Gobiodon.* Based on other characters, none of these taxa appears to have a close relationship

Table 13. Character distribution in the Gobionellus Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Calamiana (region 4)	3-12210	(1)	10+16=26	(1)	2	(1)	3	(1)
*Ctenogobius** (regions 1, 2, 5, and rarely 8)	3-12210	(94)	10+16=26	(94)	2	(88)	2	(94)
	3-122100	(1)	10+15=25	(1)	1	(5)		
	3-1221	(1)	10+17=27	(1)				
Gnatholepis (regions 1, 2, 4, and 7)	3-12210	(6)	10+16=26	(6)	2	(3)	2	(6)
					1	(3)		
Gobionellus (regions 1, 2, and 5)	3-12210	(48)	10+16=26	(48)	2	(46)	2	(46)
							3	(1)
Mugilogobius (regions 4, 6, and 7)	3-12210	(18)	10+16=26	(18)	2	(16)	2	(11)
	3-113100†				1	(2)	3	(7)
Oligolepis (regions 4, 6, and 7)	3-12210	(20)	10+16=26	(21)	2	(18)	2	(22)
	3-12211	(1)	10+15=25	(1)	1	(3)		
	3-21210	(1)						
Oxyurichthys (regions 1, 4, 6, and 7)	3-12210	(34)	10+16=26	(34)	2	(33)	2	(34)
			10+15=25‡		1	(1)		
Pseudogobiopsis (region 4)	3-12210	(1)	10+16=26	(1)	2	(1)	2	(1)
Stenogobius (regions 4 and 7)	3-12210	(14)	10+16=26	(14)	2	(14)	2	(2)
Tamanka (region 4)	3-12210	(3)	10+16=26	(3)	2	(2)	2	(3)
					1	(1)		

* *Ctenogobius* sensu Pezold (1984).[2]
† Given for *Mugilogobius chulae* by Akihito et al. (1984), our data on 2 paratypes of this species shows a DF of 3-12210.
‡ Vertebral count given for *Oxyurichthys visayanus* by Akihito et al. (1984).

with members of the Gobiosoma Group and we suspect that caudal fusion has been derived more than once.

Four genera included in the Tribe Gobiosomini by Birdsong (1975) are here excluded from the Gobiosoma Group. These are *Microgobius, Bollmannia, Parrella* and *Palatogobius,* here phenetically associated as the Microgobius Group. They share the DF, V, EPU, and AP typical of the majority of the Gobiosoma Group but lack the caudal fusion. The validity of the Gobiosomini as originally proposed awaits corroboration.

The distributions of all members of this group are restricted to regions 1 and

Table 14. Character distribution in the Gobiopterus Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Brachygobius (region 4)	3-12210	(4)	10+15=25	(4)			2	(3)
							3	(1)
Gobiopterus (region 4)	3-12200	(10)	10+15=25	(10)	2	(5)	2	(10)
*Mistichthys** (region 4)	3-120000		10+15=25		2		2	
Pandaka (regions 4 and 6)	3-12210	(3)	10+15=25	(3)			2	(3)

* Data from TeWinkel (1935).

[2] Pezold, F. L. 1984. A revision of the gobioid fish genus *Gobionellus*. Ph.D. Dissertation, the University of Texas at Austin. Unpublished.

Table 15. Character distribution in the Gobiosoma Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Aruma	3-221110	(2)	11+16=27	(2)	1	(2)	2	(2)
(region 5)			11+16=27	(216) (Hoese, 1976b)				
			11+17=28	(267) (Hoese, 1976b)				
			12+15=27	(2) (Hoese, 1976b)				
			12+16=28	(91) (Hoese, 1976b)				
Barbulifer	3-221110	(2)	11+16=27	(2)	1	(2)	2	(2)
(regions 1 and 5)								
*Chriolepis**	3-221110	(6)	11+16=27	(6)	1	(6)	1	(3)
(regions 1 and 5)							2	(3)
Eleotrica	3-221110	(4)	11+16=27	(4)	1	(4)	2	(4)
(region 5)								
Enypnias	3-221110	(3)	11+16=27	(3)	1	(3)	2	(3)
(region 5)								
?*Evermannichthys*†	3-121110	(3)	15+20=35	(3)	1	(12)	2	(11)
(region 1)	3-121101	(1)	13+17=30	(2)			3	(1)
	3-122101	(1)	13+18=31	(2)				
	3-2111100	(1)	13+16=29	(1)				
	4-211100	(1)	12+16=28	(1)				
	4-21111101	(1)	12+17=29	(1)				
	4-1100000	(1)	14+17=31	(1)				
	4-21110000	(1)	16+19=35	(1)				
	4-21111*1*00	(1)						
	5-21110	(1)						
Ginsburgellus‡	3-221110		11+17=28 (Böhlke and Robins, 1968)					
(region 1)								
Gobiosoma§	3-221110	(44)	11+16=27	(46)	1	(48)	2	(46)
(regions 1 and 5)	3-212110	(3)	11+17=28	(1)				
	4-22110	(1)	12+15=27	(1)				
Gobulus	3-221110	(7)	11+16=27	(7)	1	(9)	2	(8)
(regions 1 and 5)	3-212110	(2)	11+17=28	(2)			1	(1)
Gymneleotris	3-221110	(2)	11+16=27	(2)	1	(2)	2	(2)
(region 5)								
Nes‡	3-221110		11+17=28	(3)				
(region 1)			12+16=28	(3) (Böhlke and Robins, 1968)				
?*Ophiogobius*¶	3-2211110	(2)	13+19=32	(2)	1	(2)	2	(2)
(region 5)	3-2121110		13+18=31 (Hoese, 1976b)					
?*Pariah*	3-2211110	(2)	12+17=29	(2)	1	(2)	2	(2)
(region 1)								
Psilotris	3-221110	(5)	11+16=26	(6)	1	(6)	2	(8)
(region 1)	3-122110	(1)						
Pycnomma	3-221110	(5)	11+16=27	(5)	1	(5)	2	(5)
(region 1)								
Risor	3-230110	(3)	11+17=27	(4)	1	(4)	2	(4)
(region 1)	3-221110	(1)						
*Varicus**	3-221110	(3)	11+16=27	(2)	1	(3)	1	(3)
(region 1)			11+17=28	(1)				

* See text discussion.
† Gilbert and Burgess (1986) give the following: *E. spongicola,* total vertebrae = 31–33 (modally 32), dorsal spines = 5–7 (modally 6); *E. metzelaari,* total vertebrae = 33–36 (modally 34), dorsal spines = 3–7 (modally 5).
‡ Genus not examined, inclusion based on literature information.
§ Our data are largely from the subgenera *Gobiosoma* and *Garmannia.* Böhlke and Robins (1968) indicated a typical count of 11+17=28 for the 20 species placed in the subgenera *Tigrigobius* and *Elacatinus.*
¶ The pterygiophore arrangement as stated by Hoese (1976b) was 2-1-2-1-1-1, we interpret this to equal our notation of 3-2121110.

Table 16. Character distribution in the Gobius Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Gobius (regions 2, 3, and 9)	3-22110	(9)	11+17=28	(8)	1	(9)	3	(5)
			11+16=27	(1)			2	(2)
							1	(2)
Mauligobius (regions 2 and 3)	3-22110	(2)	11+17=28	(2)	1	(2)	2	(1)
							3	(1)
Psammogobius (regions 2 and 4)	3-22110	(3)	11+17=28	(2)	1	(3)	3	(2)
			10+18=28	(1)			1	(1)
Thorogobius (regions 2 and 3)	3-22110	(11)	11+17=28	(11)	1	(11)	2	(11)
Vanneaugobius (region 3)	3-22110	(1)	11+17=28	(1)	1	(1)	2	(1)

5 with *Aruma, Eleotrica, Enypnias, Gymneleotris,* and *Ophiogobius* limited to region 5, and *Evermannichthys, Ginsburgellus, Nes, Pariah, Psilotris, Risor,* and *Varicus* limited to region 1. The Gobiosoma Group comprises nearly 75 species and dominates the gobioid fauna of the New World.

?Gobius Group (Table 16).—The group is composed of mostly temperate gobiids phenetically united by the combination of characters given in Table 16 and distinguished from the Bathygobius Group in typically having 11 precaudal vertebrae and 28 total vertebrae.

The group is most heavily represented in regions 2, 3 and 9 with *Psammogobius* occurring in the south temperate zone of regions 2 and 4 around Cape Agulhus (Smith, 1960; Penrith, 1976).

?Kelloggella Group (Table 17).—The group contains only *Kelloggella,* a genus of tiny gobiids united by the 11+15=26 vetebral count, rare among gobiids, and several rows of tricuspid teeth in each jaw. Tricuspid teeth also occur in the Sicydium Group, but based on other characters, seem likely to have been independently developed in *Kelloggella.* They are distributed in the marine waters of regions 4 and 7.

?Microgobius Group (Table 18).—The Microgobius Group is identified only by the combination of characters shown in Table 18, all of which are shared with the bulk of the Gobiosoma Group. The group differs from the Gobiosoma Group in lacking the fusion of the hypurals 1–2 with hypurals 3–4 and the terminal vertebral element.

**Pomatoschistus Group* (Table 19).—The group contains only *Pomatoschistus* and is diagnosed by the unique DF patterns of 3-122100 or 3-1221000. It appears similar in the characters surveyed in this study to the Acanthogobius Group described above. The group is restricted to regions 3 and 9.

Table 17. Character distribution in the Kelloggella Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Kelloggella (regions 4 and 7)	3-22110	(5)	11+15=26	(5)	1	(5)	1	(5)

Table 18. Character distribution in the Microgobius Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Bollmannia								
(regions 1 and 5)	3-221110	(48)	11+16=27	(49)	1	(49)	2	(49)
Microgobius	3-221110	(64)	11+16=27	(65)	1	(65)	2	(65)
(regions 1 and 5)	3-311110	(1)						
Palatogobius								
(region 1)	3-221110	(1)	11+16=27	(1)	1	(1)	2	(1)
Parrella								
(regions 1 and 5)	3-221110	(8)	11+16=27	(8)	1	(8)	2	(8)

?Priolepis Group (Table 20).—Fifty-four genera are presently assignable to the Priolepis Group. The group is diverse in its morphology and is phenotypically distinguished only by the combination of DF=3-22110, V=10+16=26, EPU=1, and AP=2. Species that vary from this combination are rare and usually differ in vertebral number or arrangement. In *Callogobius* the vertebral counts of 11+17=28 and 11+17=29 are apparently the norm for some species. Lachner and Karnella (1980) gave the typical vertebral counts in 31 species of *Eviota* as 10+16=26 (21 species), 10+15=25 (9 species), and 11+14=25 (1 species). *Barbuligobius,* tentatively included here, is said by Lachner and McKinney (1974) to have a typical vertebral count of 9+17=26, an arrangement that appears to be unique among gobioids. Yoshino (in Akihito et al., 1984) gave the dorsal fin formula as "3/III II I I 0/9" (=3-32110) in all 7 species of *Fusigobius* from Japan, but in contradiction listed the number of D_1 spines as 6. All *Fusigobius* material examined by us had 6 spines with DF=3-22110. Similarly, Yoshino and Yamamoto (in Akihito et al., 1984) attributed a dorsal fin formula of "3/I II I I 0/9" (=3-12110) to all species of *Gobiodon* and *Paragobiodon* from Japan, but in contradiction gave the D_1 for all as comprising 6 spines. All material of these two genera examined by us had 6 spines and DF=3-22110.

The Priolepis Group dominates the vast coral reef gobiid fauna of the Indo-Pacific and the Pacific Plate, perhaps comprising as many as 80% of the species. Russell (1983) listed 104 species of gobiids as occurring in the Capricorn-Bunker Island Group of the Great Barrier Reef. We have been able to assign 97 of these 104 species to one of our groups and 86 of them (89%) fall within our Priolepis Group. Similarly, Winterbottom and Emery (1986) obtained 90 gobiid species from coral reef areas of Chagos Archipelego in the central Indian Ocean of which 83 (92%) belong to the Priolepis Group.

In the western Atlantic the Priolepis Group shares dominance with the Gobiosoma Group; however, it still forms a prominent portion of the coral reef gobiid fauna. Starck (1968) listed 28 gobiid species from Alligator Reef off the Florida Keys. Of these, 13 species (46%) were members of the Priolepis Group.

Table 19. Character distribution in the Pomatoschistus Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Pomatoschistus	3-1221000	(3)	12+20=32	(3)	1	(3)	2	(4)
(regions 3 and 9)	3-122100	(3)	12+19=31	(1)				
			11+19=30	(1)				
			11+22=33	(1)				

Table 20. Character distribution in the Priolepis Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Acentrogobius (regions 4 and 7)	3-22110	(9)	10+16=26	(9)	1	(9)	2	(9)
Amblyeleotris (regions 4, 6, and 7)	3-22110	(9)	10+16=26	(9)	1	(9)	2	(8)
Amblygobius (regions 4 and 7)	3-22110	(5)	10+16=26	(5)	1	(5)	2	(5)
Amoya (region 4)	3-22110	(8)	10+16=26 10+17=27	(7) (1)	1	(7)	2	(7)
Asterropteryx (regions 4, 6, and 7)	3-22110	(9)	10+16=26	(9)	1	(9)	2	(9)
Aulopareia (region 4)	3-22110	(2)	10+16=26	(2)	1	(2)	2 3	(1) (1)
Austrolethops (region 4)	3-22110	(1)	10+16=26	(1)	1	(1)	1	(1)
?*Barbuligobius*§ (region 4)	3-22110		9+17=26 (Lachner and McKinney, 1974)					
?*Cabillus** (region 4)	3-22110		10+16=26 (Akihito et al., 1984)					
Callogobius (regions 4, 6, and 7)	3-22110	(17)	10+16=26 11+17=28 11+18=29 10+17=27 13+17=30 (Akihito et al., 1984) 11+15=26 (McKinney, 1980)	(9) (4) (3) (1)	1	(17)	2	(17)
Coryphopterus (regions 1, 5, and 8)	3-22110	(9)	10+16=26	(9)	1	(9)	2 1	(8) (1)
Cristatogobius (region 4)	3-22110 3-2211*0	(41) (1)	10+16=26	(23)	1	(57)	2	(57)
Cryptocentroides (regions 4 and 7)	3-22110	(17)	10+16=26 10+17=27	(16) (1)	1	(17)	2	(17)
Cryptocentrus (regions 4, 6, and 7)	3-22110	(10)	10+16=26	(10)	1	(10)	2	(10)
?*Ctenogobiops*§ (regions 4 and 7)	3-22110		10+16=26 (Akihito et al., 1984)					
Drombus (regions 4 and 7)	3-22110	(1)	10+16=26	(1)	1	(1)	2	(1)
Eviota†‡ (regions 4, 6, and 7)	3-22110	(6)	10+16=26 10+15=25 11+14=25 10+17=27 10+14=24 11+15=26 11+16=27	(353) (88) (12) (7) (1) (1) (1)	1	(6)	2	(6)
Exyrias (regions 4, 6, and 7)	3-22110	(5)	10+16=26	(5)	1	(5)	2	(5)
Favonigobius (regions 4, 6, and 10)	3-22110	(8)	10+16=26	(8)	1	(8)	2	(8)
?*Feia** (region 4)	3-22110		10+16=26 (Lachner and McKinney, 1979)					
?*Flabelligobius*§ (regions 4 and 6)	3-22110		10+16=26 (Akihito et al., 1984)					
Fusigobius† (regions 4, 6, and 7)	3-22110	(8)	10+16=26	(8)	1	(8)	2	(8)

Table 20. Continued

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Gladiogobius (regions 4 and 7)	3-22110	(5)	10+16=26	(5)	1	(5)	2	(5)
Gobiodon† (regions 4, 6, and 7)	3-22110	(7)	10+16=26	(7)	1	(7)	2	(7)
Gobiopsis (regions 4, 7, and 10)	3-22110	(4)	10+16=26	(4)	1	(4)	2	(4)
?*Hazeus*§ (region 6; also 4, D.F. Hoese, pers. comm.)	3-22110		10+16=26 (Akihito et al., 1984)					
?*Heteroplopomus*§ (region 6)	3-22110		10+16=26 (Akihito et al., 1984)					
Istigobius (regions 4, 6, and 7)	3-22110	(19)	10+16=26	(19)	1	(19)	2 3	(17) (2)
Lophogobius (regions 1 and 5)	3-22110	(10)	10+16=26	(10)	1	(10)	2	(10)
?*Lotilia** (region 4)	3-22110		10+16=26 (Akihito et al., 1984)					
?*Luposicya** (regions 4 and 6)	3-22110		10+16=26 (Akihito et al., 1984)					
Lythrypnus (regions 1, 5, and 8)	3-22110 3-22111	(10) (1)	10+16=26	(11)	1	(11)	2	(11)
Macrodontigobius (regions 4 and 7)	3-22110	(4)	10+16=26	(4)	1	(4)	2	(4)
Mahidolia (regions 4 and 6)	3-22110	(5)	10+16=26	(5)	1	(5)	2	(5)
Mangarinus (region 4)	3-22110	(5)	10+16=26	(5)	1	(5)	2	(5)
Myersina (region 4)	3-22110	(1)	10+16=26	(1)	1	(1)	2	(1)
Oplopomops (region 4)	3-22110	(1)	10+16=26	(1)	1	(1)	2	(1)
Oplopomus (regions 4 and 7)	3-22110	(6)	10+16=26	(6)	1	(6)	2	(6)
Opua (region 7)	3-22110	(1)	10+16=26	(1)	1	(1)	2	(1)
Parachaeturichthys (regions 4 and 6)	3-22110	(3)	10+16=26	(3)	1	(3)	2	(3)
Paragobiodon† (regions 4 and 7)	3-22110	(5)	10+16=26	(5)	1	(5)	2	(5)
?*Parkraemeria*§ (region 4)	3-22110		10+16=26 (Akihito et al., 1984)					
?*Pleurosicya*§ (regions 4 and 7)	3-22110		10+16=26 (Akihito et al., 1984)					
Porogobius (region 2)	3-22110	(3)	10+16=26	(3)	1	(3)	2	(3)
Priolepis (regions 1, 2, 4, 6, and 7)	3-22110 3-31110	(14) (1)	10+16=26	(15)	1	(15)	2	(15)
Psilogobius (regions 4 and 7)	3-22110	(4)	10+16=26	(4)	1	(4)	2	(4)
Signigobius (region 4)	3-22110	(1)	10+16=26	(1)	1	(1)	2	(1)
?*Silhouettea*§ (regions 4 and 6)	3-22110		10+16=26 (Akihito et al., 1984)					

Table 20. Continued

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
?*Stonogobiops*§ (regions 4, 6, and 7)	3-22110		10+16=26 (Akihito et al., 1984)					
?*Tenacigobius*§ (regions 4, 6, and 7)	3-22110		10+16=26 (Akihito et al., 1984)					
?*Tomiyamichthys*§ (regions 4 and 6)	3-22110		10+16=26 (Akihito et al., 1984)					
Trimma (regions 4, 6, and 7)	3-22110	(17)	10+16=26	(17)	1	(17)	2	(17)
Valenciennea (regions 4, 6, and 7)	3-22110	(14)	10+16=26	(14)	1	(14)	2	(14)
Vanderhorstia (regions 4, 6, and 7)	3-22110	(3)	10+16=26	(3)	1	(3)	2	(3)
Yongeichthys (regions 4 and 7)	3-22110	(5)	10+16=26	(5)	1	(5)	2	(5)

* See text discussion.
† See text discussion.
‡ Vertebral count largely from Lachner and Karnella (1978; 1980).
§ Genera taken from the literature that appear to fall into the Priolepis Group based on available information.

Significantly, 7 of the 15 non-Priolepis Group species are commonly found in inshore waters adjacent to Alligator Reef, but only one of the Priolepis Group members inhabits inshore waters.

Members of the group show a strong affinity toward the coral reef habitat; however, the characters that define the group appear to be of limited adaptive significance for a reef dwelling existence. We are thus led to postulate that at least the bulk of the Priolepis Group will eventually be demonstrated to be monophyletic.

The group is found in all regions except 3 and 9, with limited representation in regions 2, 8, and 10.

**Synechogobius Group* (Table 21).—This poorly known group, comprising perhaps a single species, is unique among gobiids in the high vertebral number (41–42) and the number and arrangement of spinous dorsal-fin pterygiophores (10–11, the last spineless). The two nominal species, *S. hasta* (Temminck and Schlegel, 1846) and *S. clarki* (Evermann and Shaw, 1927) have most frequently been referred to the genus *Acanthogobius* and, although quite distinct, appear phenetically most similar to the seven genera comprising our Acanthogobius Group.

(Oxudercinae)

**Boleophthalmus Group* (Table 22).—The group, comprising *Apocryptes, Boleophthalmus, Pseudapocryptes,* and *Scartelaos,* is unique among gobioids in having a DF pattern of 3-1221*0 (Fig. 1B). The group is distributed in mangrove and mudflat areas of regions 4 and 6.

Table 21. Character distribution in the Synechogobius Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Synochogobius	3-121211101*	(1)	16+25=41	(2)	2	(3)	2	(2)
(region 6)	3-122111101*	(1)	16+26=42	(1)			3	(1)
	3-2*21211011*0	(1)						

Table 22. Character distribution in the Boleophthalmus Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Apocryptes (region 4)	3-1221*0	(4)	10+16=26	(4)	2	(4)	1	(4)
Boleophthalmus (regions 4 and 6)	3-1221*0	(6)	10+16=26	(6)	2	(6)	1	(6)
Pseudapocryptes (regions 4 and 6)	3-1221*0	(7)	10+16=26	(7)	2	(7)	1	(7)
Scartelaos (regions 4 and 6)	3-1221*0 3-122100 (Akihito et al., 1984)	(6)	10+16=26	(6)	2	(7)	1	(7)

?Oxuderces Group (Table 23).—Three genera form this phenetically united group, *Oxuderces, Apocryptodon,* and *Parapocryptes.* These genera share with the Boleophthalmus Group a 2:1 ratio of fin elements to vertebra. The group is distinguished from all other groups with a DF of 3-12210 by having an AP=1.

The group is distributed in mangrove and mudflat areas in regions 4 and 6.

**Periophthalmus Group* (Table 24).—The group contains only the genera *Periophthalmus* and *Periophthalmodon* and is defined by a unique DF pattern (Fig. 1C). While the DF pattern of the Periophthalmus Group displays some variability, it is unique in the presence of 3 or 4 pterygiophores in the fourth interneural space. Most species also display the unique feature of extranumerary spines in the spinous dorsal fin. The group differs from both of the preceding groups in having a 1.5:1 fin element to vertebra ratio.

The Periophthalmus Group is distributed in regions 2, 4, 6 and 7, a pattern unique in gobioid fishes. We interpret the pattern to be essentially Indo-west Pacific with some extension onto the Pacific Plate and relictual representation in tropical west Africa.

(Amblyopinae)

**Gobioides Group* (Table 25).—This group of elongate fishes, all placed in *Gobioides,* is diagnosed by the unique DF of 3-12201. The group has been allied to the Taenioides and Trypauchen Groups that form the Amblyopinae of Hoese (1984); however, it differs from these in having a fin element to vertebra ratio of 1:1 and in features of the cephalic lateralis system. Pezold (unpub. MS), based primarily on the cephalic lateralis system, placed *Gobioides* as the sister group of *Gobionellus.*

The group is distributed in brackish to freshwaters of regions 1, 2, and 5.

?Taenioides Group (Table 26).—This small, phenetically united group of elongate

Table 23. Character distribution in the Oxuderces Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Apocryptodon (regions 4 and 6)	3-12210	(8)	10+16=26	(8)	2	(7)	1 2	(6) (2)
Oxuderces (regions 4 and 6)	3-12210	(26)	10+16=26 10+15=25	(25) (1)	2 1	(23) (2)	1	(26)
Parapocryptes (regions 4 and 6)	3-12210	(5)	10+16=26	(5)	2	(5)	1	(5)

Table 24. Character distribution in the Periophthalmus Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Periophthalmodon	3-1401000	(5)	10+16=26	(8)	2	(8)	1	(8)
(region 4)	3-1401*000	(1)						
	3-1301*000	(1)						
	3-2301*000	(1)						
Periophthalmus	3-1301*000	(7)	10+16=26	(15)	2	(15)	1	(15)
(regions 2, 4, 6, and 7)	3-230100	(4)						
	3-1311*00	(2)						
	3-1311*000	(1)						
	3-1401000	(1)						
	3-1300000 (Akihito et al., 1984)							

* See text discussion.

fishes shares many features with the Trypauchen Group, including the fin element to vertebra ratio of 2:1. The groups differ in the absence of the interneural gap in D_1 pterygiophore placement in the Trypauchen Group. All specimens in our sample are assignable to either *Taenioides cirratus, Odontamblyopus rubicundus* or *Brachyamblyopus multiradiatus* although the amount of variation leads us to suspect that *Odontamblyopus* may be more speciose. *Taenioides cirratus* is distinct in the absence of pleural ribs and the presence of an unusual Y-shaped second anal pterygiophore.

The group is distributed in brackish to freshwaters of regions 4 and 6 with limited extension onto the Pacific Plate (region 7).

**Trypauchen Group* (Table 27).—These are elongate mud-burrowing fishes, all but *Caragobius* possessing a blind pouch opening at the dorsal margin of the operculum. The group is diagnosed by a DF of 3-1221. The absence of the interneural gap is unique in the Trypauchen Group among gobiid fishes.

The group is distributed in estuarine waters of regions 4, 6, and 7 and, like the Taenioides Group, its distribution on the Pacific Plate is limited.

(Sicydiinae)

?Sicydium Group (Table 28).—The group is phenetically distinguished by the combination of characters given in Table 28 and differs from the Gobionellus Group in typically having a single epural. The genera *Lentipes, Sicydium, Sicyopterus, Stiphodon,* and *Sicyopus* correspond to the Sicydiinae of Hoese (1984), which he characterized as having "tongue fused to floor of mouth or free only at tip, highly modified jaw suspension, thickened and highly branched pelvic rays and fleshy pads at tips of pelvic spines." These genera, excepting *Sicyopus,* are also united by comb-like, tricuspid teeth on either the premaxilla and/or dentary and all have spatulate posterior pelvic processes (Fig. 5A). *Evorthodus* and *Awaous* are problematically associated with this group because, in addition to sharing the

Table 25. Character distribution in the Gobioides Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Gobioides	3-12201	(20)	10+17=27	(8)	2	(16)	2	(19)
(regions 1, 2, and 5)			10+21=31	(7)	1	(2)		
			10+16=26	(5)				

Table 26. Character distribution in the Taenioides Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Brachyamblyopus (regions 4 and 7)	3-12210	(2)	10+17=27	(2)	2	(2)	2	(2)
Odontamblyopus (region 4)	3-12210	(14)	10+24=34	(6)	2	(14)	2	(9)
			10+17=27	(4)			3	(5)
			10+20=30	(3)				
			10+23=33	(1)				
Taenioides (regions 4, 6, and 7)	3-12210	(5)	10+18=28	(2)	2	(5)	2	(5)
			10+19=29	(1)				
			10+20=30	(1)				
			10+21=31	(1)				

combination of characters given in Table 28, *Evorthodus* bears comb-like bicuspid teeth (in juveniles and females) whereas *Awaous* shares with the Sicydiinae (sensu Hoese) a spatulate posterior pelvic process, thickened and highly branched pelvic rays, and a fleshy (cartilaginous) tip on each pelvic spine. The Sicydiinae and *Awaous* are both known to occupy streams with considerable current. *Tukugobius,* a genus we have not assigned to a group, appears remarkably similar to *Awaous* in all features including the pelvic structure, but differs in DF and vertebral number. Further study to determine whether the striking similarities in pelvic structure are synapomorphic or homoplastic seems warranted.

The Sicydium Group is distributed in regions 1, 2, 4, 5, 6, and 7. All genera are successful invaders of fresh waters, some of these apparently with sea-run larvae (Herre, 1927; Montilla, 1931). The distribution of *Awaous* (freshwaters of regions 1, 2, 4, 5, 6, and 7) is quite remarkable as is the degree of morphological similarity among forms of *Awaous* from different continents and island groups.

Microdesmidae (Microdesminae)

**Microdesmus Group* (Table 29).—The Microdesmus Group is diagnosed by a continuous dorsal fin containing 12–22 spines in those we have examined. With the exception of the first 2–3 dorsal pterygiophores in a few species, the spine-bearing pterygiophores each insert into a separate interneural space. The group is further characterized by the development of a ventrally projecting process on the dentary near the symphysis and an elongate posterior pelvic process, features

Table 27. Character distribution in the Trypauchen Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Amblyotrypauchen (region 4)	3-1221	(1)	10+19=29	(1)	2	(1)	3	(1)
Caragobius (regions 4 and 7)	3-1221	(1)	10+19=29	(1)	2	(1)	6	(1)
Trypauchen (regions 4 and 6)	3-1221	(12)	10+24=34	(4)	2	(12)	4	(8)
			10+23=33	(3)			3	(4)
			10+25=35	(3)				
			10+19=29	(2)				
			10+26=36 (Akihito et al., 1984)					
Trypauchenichthys (region 4)	3-1221	(5)	10+21=31	(5)	2	(6)	3	(6)
	4-231	(1)	10+22=32	(1)				

Table 28. Character distribution in the Sicydium Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Awaous (regions 1, 2, 4, 5, 6, and 7)	3-12210	(18)	10+16=26	(18)	1	(18)	2	(18)
Evorthodus (regions 1 and 5)	3-12210	(15)	10+16=26	(15)	1	(16)	2	(16)
	3-13101	(1)	10+17=27	(1)				
Lentipes (region 7)	3-12210	(4)	10+16=26	(4)	1	(4)	2	(4)
Sicydium (regions 1 and 5)	3-12210	(12)	10+16=26	(12)	1	(12)	2	(12)
Sicyopterus (regions 4, 6, and 7)	3-12210	(14)	10+16=26	(14)	1	(14)	2	(14)
*Sicyopus** (region 4)	3-12210		10+16=26					
Stiphodon (regions 4 and 7)	3-12210	(20)	10+16=26	(20)	1	(19)	3	(14)
					2	(1)	2	(4)

* Not examined; based on information in Sakai and Nakamura (1979) and Akihito et al. (1984).

shared only with the Parioglossus and Ptereleotris Groups and used by Hoese (1984) to diagnose the Microdesmidae. The posterior pelvic process of *Ptereleotris* is illustrated in Figure 5B. A more typical gobioid pelvic as found in *Microgobius* is shown Figure 5C for comparison. All genera have 42 or more vertebrae and, except for *Paragunnellichthys,* apparently have poorly ossified frontal bones which fail to reach the median ethmoid in many species.

The spineless pterygiophores preceding the dorsal fin are very small and frequently not visible in radiographs. Since all of our data on this group came from radiographs, we think it quite likely that some of our DF formulae are in error due to the difficulty in discerning these spineless pterygiophores.

The group is distributed in the marine waters of regions 1, 4, 5 and 7.

(Ptereleotrinae)

?Parioglossus Group (Table 30).—The Parioglossus Group, along with the Ptereleotris Group that follows, compose the Ptereleotrinae of Hoese (1984). Both groups comprise reef dwelling, elongate, laterally-compressed gobies with a 2:1 fin element to vertebra ratio, separate pelvic fins, and a tendency for the first haemal spine to be distally recurved in an anterior direction (Fig. 3C, D). In addition to *Parioglossus,* the group contains *Nemateleotris* and *Oxymetopon.* The group is widespread in regions 4 and 7 with limited distribution in region 6.

**Ptereleotris Group* (Table 31).—This group is diagnosed by its unique DF pattern of 3-32010; however, it is obviously closely related to the Parioglossus Group. We follow Randall and Hoese (1985) in including *Ioglossus* within *Ptereleotris.*

Ptereleotris is broadly distributed in regions 1, 4, 5 and 7 with limited penetration into region 6.

Kraemeriidae

**Kraemeria Group* (Table 32).—This group contains only *Kraemeria* and *Gobitrichinotus* and constitutes the Family Kraemeriidae. The group is defined by having only three ossified pectoral radials (Gosline, 1955; Hoese, 1984) and 10 or fewer pectoral rays. *Gobitrichonotus* appears unique in lacking a spine on the

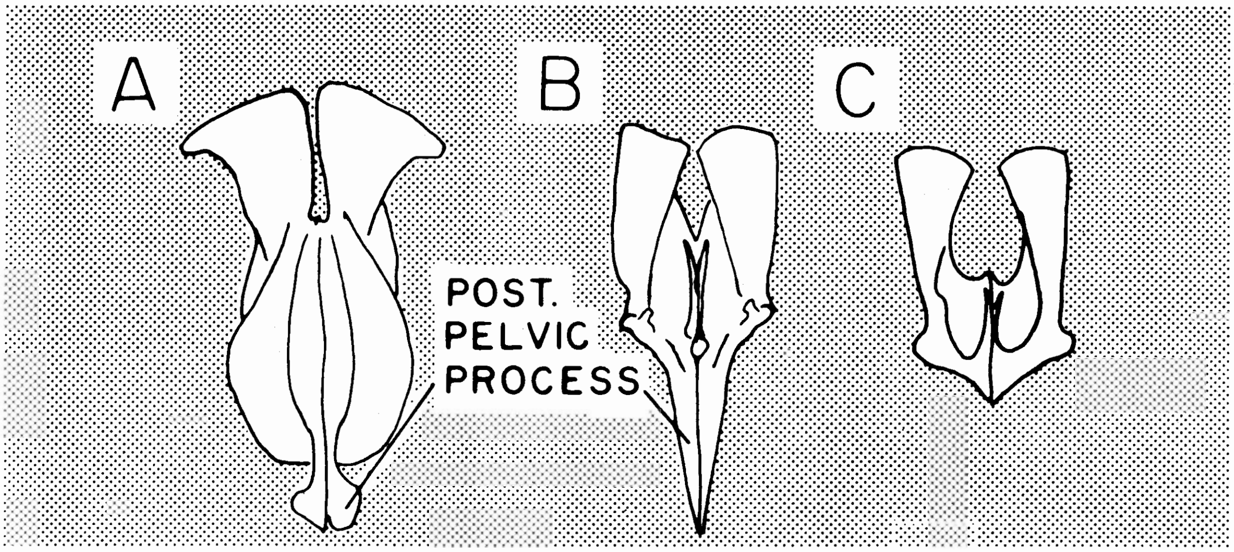

Figure 5. Pelvic bones in ventral view: A) *Sicydium*; B) *Ptereleotris*; and C) *Microgobius*.

first dorsal pterygiophore and differs strikingly from *Kraemeria* in vertebral number and arrangement. The species are distributed in the marine waters of regions 4 and 7, where they are apparently coralline sand burrowers.

Unassigned Genera (Table 33).—For reasons previously stated, 19 genera have not been assigned to a group. Some of these genera are distinctive in one or more of the characters surveyed here and deserve comment.

Fagasia contains three nominal species, all from region 4, of which we have examined only *F. diaphana.* This species displays an unusual DF pattern of 4-23000. Hoese (1985[1]) is of the opinion that the type species, *F. tutuilae* is a juvenile eleotridid, likely of some known genus.

Hoese (1984) suggested that *Leptophilypnus,* a Central American freshwater genus, may be related to *Gobiomorphus,* a group primarily distributed in southern Australia and New Zealand. The proposed relationship was based mainly on the presence of the gobiid-type interneural gap between the dorsal fins and the absence of a mesopterygoid. *Microphilypnus,* another Central and South American freshwater genus, also lacks a mesopterygoid and shares with *Leptophilypnus* and the Gobiomorphus Group the gobiid-type interneural gap. *Microphilypnus* is further characterized by an unossified ethmoid region, possibly a result of progenesis (a form of paedomorphosis favoring small size).

Parviparma, a monotypic genus from the fresh waters of the Philippines, possesses an unusual DF pattern of 4-3211*0 in the single specimen examined by us. It appears to be an eleotridid based on the form of the interneural gap.

Discordipinna, a monotypic genus containing only *D. griessingeri,* possesses a unique DF pattern in the placement of 4 pterygiophores in the third interneural space (Hoese and Fourmanoir, 1978, Fig. 2). The species is widely distributed in the marine waters of region 4.

Geographic Distribution of Putative Groups

Our data set comprises a large proportion of currently recognized gobioid genera, therefore, we take the opportunity here to comment on the gobioid fauna of the 10 zoogeographic regions we have used.

While predominately tropical in distribution, members of the suborder Gobioidei are found from above 60° north latitude to below 50° south latitude and

Table 29. Character distribution in the Microdesmus Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
*Cerdale**	3-1$^{(12)}$	(2)	20+25=45	(1)	1	(3)	3	(2)
(regions 1 and 5)	4-1$^{(13)}$	(1)	20+22=42	(2)				
	3-1*1$^{(12)}$ (Dawson, 1974)							
	3-1*1$^{(13)}$ (Dawson, 1974)							
	3-1*1*1*1*1$^{(12?)}$ (Dawson, 1974)							
	(Vertebrae 19–23+22–26=42–47 in Dawson, 1974)							
Clarkichthys†	3-21$^{(16)}$	(28)	22+24=46	(most)	1	(1)		
(region 5) All data from	3-21$^{(17)}$	(6)						
Dawson (1974)	3-21$^{(15)}$	(2)						
	(Vertebrae 21–23+23–25=45–47)							
Gunnellichthys	1-1$^{(21)}$	(4)	25+31=56	(2)	1	(4)	3	(3)
(regions 4 and 7)			24+32=56	(1)			4	(1)
			25+32=57	(1)				
	2-21$^{(18)}$		26+32=58 (Dawson, 1968)‡					
	2-121$^{(17–18)}$ (Dawson, 1968)‡							
	(Vertebrae 24–26+31–34=56–59 in Dawson, 1968 plus present data)							
Microdesmus	3-1*1$^{(15)}$	(1)	22+31=53	(1)	1	(5)	2	(2)
(regions 1 and 5)	3-1$^{(12)}$	(1)	20+39=59	(1)			0	(1)
	3-1$^{(13)}$	(1)	25+29=59	(1)			3	(1)
	3-1$^{(22)}$	(1)	22+39=61	(1)				
	4-1$^{(16)}$	(1)	30+34=64	(1)				
	3-1*1*1$^{(16)}$		27–28+20–21=47–48 (Dawson, 1972)					
	10-1$^{(12)}$		26+26=52 (Dawson, 1973)					
			21+29=50 (Dawson, 1977)					
			30–31+33=63–64 (Robins and Manning, 1958)					
			27–39+20–34=47–71 (Dawson, 1972)					
	(Vertebrae 20–39+20–39=47–71 from all sources cited above)							
Paragunnellichthys			25+29=54	(2)	1	(2)	2	(2)
(regions 4 and 7)	3-1$^{(20)}$ (Dawson, 1970)							
	3-1$^{(19–21)}$		25+27–29=52–54 (Dawson, 1969)					
	1-1$^{(16–18)}$		21+27–28=48–49 (Dawson, 1967)					

* DF formulae attributed to Dawson were devised by us from data contained in his work.
† Genus not examined by us.
‡ Dawson (1968) indicated that the first dorsal pterygiophore inserted in interneural space 3, but his figure 3 shows the insertion as space 2.

occupy a variety of habitats from mountain lakes to the edge of the continental shelf. The number of genera in our sample shared between the faunal regions is shown in Table 34. The total number of gobioid genera occurring in each region and the level of regional endemism based on both our material and literature accounts are shown in Table 35.

REGION 1 (western Atlantic) contains approximately 39 genera and more than

Table 30. Character distribution in the Parioglossus Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Nemateleotris (regions 4 and 7)	3-22110	(4)	10+16=26	(4)	1	(4)	1	(4)
Oxymetopon (region 4)	3-22110	(1)	10+16=26	(1)	1	(1)	1	(1)
Parioglossus (regions 4, 6, and 7)	3-22110	(16)	10+16=26	(16)	1	(15)	1	(16)

Table 31. Character distribution in the Ptereleotris Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Ptereleotris	3-32010	(14)	10+16=26	(14)	1	(13)	1	(9)
(regions 1, 4, 5, 6, and 7)							2	(2)

120 species distributed primarily in the Gulf of Mexico, West Indies, and Caribbean. At least two species of *Gobiosoma* and one of *Ctenogobius* extend above 40°N (Gordon, 1974). Two genera, *Gobiosoma* (Fowler, 1954) and *Chriolepis* (Menezes and Fiqueiredo, 1985), are reported below 30°S and one of us (F.L.P.) has records of *Ctenogobius* and *Gobionellus* near 30°S on the coast of Brazil. Ringuelet et al. (1968) did not list any gobioids from Argentina.

Our sample comprises 39 indigenous genera of which 9 (23%) are endemic. The gobioid fauna of region 1 shares its most recent common history with the fauna of region 5 with which it shares 26 genera. Although a few species are found in the temperate waters of region 1, no truly temperate gobioid fauna has been developed in the western Atlantic.

Among our groups only the Gobiosoma and Microgobius groups are distributed exclusively in the Americas (regions 1 and 5). The two groups are a significant portion of the New World gobioid fauna, together composing over 40 percent of the gobioid genera and perhaps as many as one half of the species.

The gobioid fauna of the Americas is also notable for those groups that are absent. The predominantly soft bottom groups, Oxuderces, Boleophthalmus, Periophthalmus, Taenioides, and Trypauchen, together comprising some 16 genera, are missing. Additionally, there is a dearth of the live bottom genera so well represented in the Indo-west Pacific. For example, of the 54 genera of the Priolepis Group in our sample, only 4 occur in the Americas.

REGION 2 (eastern Atlantic south of Cape Verde) contains approximately 28 genera of which 10 are endemic. The 40+ species reported by Miller (1981) are distributed primarily in the Gulf of Guinea. The southern extent of most species is about 17°S (Penrith, 1978); however, at least two genera, *Caffrogobius* and *Psammogobius,* extend around Cape Agulhus into region 4 (Smith, 1960; Penrith, 1976). Two gobiid genera, *Gnatholepis* and *Priolepis* (recorded as *Quisquilius*), are found as far west as Ascension Island (Lubbock, 1980), but Lubbock and Edwards (1981) did not report any gobioids from St. Paul's Rocks.

Region 2 has the most depauperate gobioid fauna of any tropical region and is dominated by members of the Gobius and Bathygobius groups. The gobioid fauna displays approximately equal affinities with the western Atlantic and the Indo-west Pacific.

Table 32. Character distribution in the Kraemeria Group

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Gobitrichinotus	3-1*2210	(2)	14+17=31	(3)	1	(4)	0	(2)
(region 4)	3-12120	(1)	14+16=30	(1)			1	(1)
	3-2*12010	(1)					2	(1)
	3-11111* (Akihito et al., 1984)							
Kraemeria	3-12110	(7)	10+16=26	(8)	1	(8)	1	(4)
(regions 4 and 7)	3-21111	(1)					2	(2)
							3	(2)

Table 33. Character distribution in unassigned genera

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Eleotrididae								
Fagasia	4-23000	(1)	10+15=25	(1)				
(region 4)								
Leptophilypnus	3-12210	(16)	10+16=26	(16)	2	(16)	3	(16)
(regions 1 and 5)								
Microphilypnus	3-22110	(3)	12+16=28	(3)	2	(4)	5	(2)
(region 1)	3-21210	(1)	13+15=28	(1)			9	(1)
Odontobutis	3-221111*	(2)	14+16=30	(3)	2	(7)	3	(5)
(regions 4 and 6)	3-2121111*	(2)	14+15=29	(2)			2	(1)
China§	3-131111	(1)	15+15=30	(2)			4	(1)
	3-122111	(1)						
	3-121111	(1)						
Japan†	4-212111*	(2)	14+17=31	(4)	2	(5)	3	(4)
	4-221111*	(1)	15+16=31	(1)			4	(1)
	4-221110	(1)						
	4-132100	(1)						
Parviparma	4-3211*0	(1)	11+15=26	(1)	2	(1)	2	(1)
(region 4)								
Tateurndina	3-122111	(1)	15+16=31	(1)	2	(1)	8	(1)
(region 4)								
Gobiidae								
Aphia	3-13100	(3)	10+17=27	(2)	1	(3)	2	(3)
(region 3)			10+18=28	(1)				
	3-1311* (Rojo, 1985)							
	3-2211* (Rojo, 1985)							
	3-1221* (Rojo, 1985)							
	3-2201* (Rojo, 1985)							
Discordipinna	3-4101*00	(1)	10+16=26	(2)	1	(2)	1	(1)
(regions 4 and 7)	3-4100	(1)					1	(1)
	3-4101*0 (Hoese and Fourmanior, 1978, fig. 2)							
Deltentosteus	3-22110	(1)	11+22=33	(1)			2	(1)
(region 3)								
Lethrops	7-2121000	(1)	16+20=36	(1)	2	(1)	3	(1)
(region 8)								
Neogobius	3-22110	(4)	12+22=34	(3)	1	(6)	3	(4)
(region 9)	3-31110	(2)	13+21=34	(3)			2	(1)
							1	(1)
Nesogobius	3-12211000	(5)	13+20=33	(4)	2	(9)	2	(6)
(region 10)	3-1122100	(1)	13+21=34	(2)	1	(1)	3	(3)
	3-11220100	(1)	12+21=33	(1)			1	(1)
	3-11320100	(1)	13+18=31	(1)				
	3-2120100	(1)	13+19=32	(1)				
	2-11220100	(1)	14+19=33	(1)				
	3-1221100		11+18=29 (D. Hoese, pers. comm.)					
	3-1222010 (D. Hoese, pers. comm.)							
	3-222010 (D. Hoese, pers. comm.)							
	3-221010 (D. Hoese, pers. comm.)							
Redigobius	3-12210	(18)	11+15=26	(8)	2	(12)	3	(16)
(regions 4, 6, and 7)			12+14=26	(7)			4	(2)
			11+16=27	(3)				
			10+16=26 (Akihito et al., 1984)					
Rhinogobius	3-22110	(8)	10+16=26	(9)	2	(8)	2	(4)
(regions 4 and 6)	3-13110	(1)	11+16=27‡		1	(1)	3	(4)
			11+17=28‡				4	(1)

Table 33. Continued

	DF	(N)	V	(N)	EPU	(N)	AP	(N)
Stigmatogobius (region 4)	3-12210	(7)	10+16=26 11+15=26	(5) (2)	2	(7)	1	(3)
Tridentiger (regions 4, 6, and introduced in 8)	3-22110 3-21210 3-22111	(6) (2) (1)	10+16=26 11+15=26	(8) (2)	2 1	(8) (1)	3 2	(7) (2)
Tukugobius (region 4)	3-221110 3-22111*0	(4) (2)	11+17=28	(6)	1	(6)	2	(6)
Vitraria (region 7)	3-122000 3-131000	(1) (1)	10+16=26	(2)	1	(2)	2	(2)
Vomerogobius (region 1)	3-2211000	(2)	11+16=27	(2)	1	(1)	2	(2)

* See text discussion.
† Vertebral count range 13–16 + 15–18 = 30–33 (Iwata et al., 1985).
‡ Vertebral count for *R. flumineus* from Hayashi (1984[3]).
§ Vertebral count range 14–16 + 14–16 = 29–31 (Iwata et al., 1985).

REGION 3 (northeastern Atlantic north of Cape Verde) has a gobioid fauna comprising about 12 genera and at least 23 species (Miller, 1973b;1984; Maitland, 1977; Wheeler, 1978), distributed primarily from the Iberian Peninsula to the British Isles. At least two species reach as far north as Iceland and the Norwegian coast (Wheeler, 1978). We can find no records of eleotridids from this region.

REGION 4 (Indo-west Pacific sensu Springer, 1982, but excluding southern Australia, Tasmania and New Zealand) contains approximately 149 genera (Dawson, 1973; Hoese, 1985[1]) and possibly more than 1,000 species. The region shares 50 and 57 genera with regions 6 and 7, respectively.

Nearly one half of our putative groups are restricted to the Indo-west Pacific area. The groups vary in the breadth of their distributions with: the Rhyacichthys and Xenisthmus groups restricted to region 4; the Kraemeria and Kelloggella groups distributed in 4 and 7; the Micropercops, Acanthogobius, Oxuderces, Boleophthalmus, and Gobiopterus groups distributed in regions 4 and 6; the Taenioides, Trypauchen, and Parioglossus groups found in regions 4, 6, and 7; and the Gobiomorphus Group distributed in regions 4 and 10. The Periophthalmus Group, primarily distributed in regions 4, 6, and 7, also has a limited but unusual occurrence in region 2. The Priolepis Group dominates the Indo-Pacific,

Table 34. Matrix of the number of gobioid genera in the sample shared between the regions

Regions	1	2	3	4	5	6	7	8	9	10
1	—	10	1	6	26	6	7	3	1	0
2	10	—	3	9	7	6	6	2	3	0
3	1	3	—	1	1	1	1	0	6	0
4	6	9	1	—	4	50	57	0	1	4
5	26	7	1	4	—	4	4	4	1	0
6	6	6	1	50	4	—	28	0	1	0
7	7	6	1	57	4	28	—	0	1	0
8	3	2	0	0	4	0	0	—	0	0
9	1	3	6	1	1	1	1	0	—	0
10	0	0	0	4	0	0	0	0	0	—

[3] Vertebral count for *R. flumineus* from Hayashi (in Akihito et al., 1984).

Table 35. Total gobioid genera in each region and levels of endemism based on materials examined and literature accounts

Regions	1	2	3	4	5	6	7	8	9	10
Total genera	39	28	12	149	35	62	64	12	27	9
Endemic genera	9	10	3	60	7	11	2	6	14	4
Percent endemic	23	36	25	40	20	18	3	50	52	44

but is also found in all regions except 3 and 9, usually in association with warm water, live-bottom habitats.

REGION 5 (eastern Pacific south of 25°N on the outer coast of Baja). Thirty-five gobioid genera with approximately 75 species are known from the region, most distributed along the Central American coastline. The region's gobioid fauna is closely allied to that of region 1 with which it shares 26 genera. Eight gobiids and two eleotridids reach Peru (Chirichigno, 1969). Only two gobiids reach Chile; one of these, *Ophiogobius jenynsi,* is reported from below 54°S (Navarro and Pequeno, 1979).

REGION 6 (northwest Pacific north of the Ryukyu Islands, but continentally, north of the Tropic of Cancer). The region contains approximately 62 gobioid genera distributed primarily in Japan, Korea and China. At least one gobiid, *Chaenogobius urotaenia,* extends north of 50° latitude reaching Sakhalin (Akihito et al., 1984). The relationships of gobioids from region 6 lie strongly with region 4 with which it shares 50 genera. Additionally, there appears to be a unique association with region 8 based on our Astrabe and Chasmichthys groups.

REGION 7 (Pacific Plate, *sensu* Springer, 1982). Approximately 64 gobioid genera and 175 species occur non-marginally on the Pacific Plate (Springer, 1982). Many gobioids are found in Micronesia, but the number diminishes as one moves southeast along the plate. Our data include 61 genera of which only 2 (3%) are endemic. The zoogeographic affinities of the gobioids of the region are with regions 4 and 6 with which it shares 57 and 27 genera, respectively.

REGION 8 (northeastern Pacific north of 25°N). Twelve genera and about 13 species of gobioids are indigenous to the region. Six genera are endemic. Four species (*Ilypnus gilberti, Gillichthys mirabilis, Lythrypnus dalli,* and *Quietula y-cauda*) apparently display disjunct distributions around the lower western Baja Peninsula and recur in the northern Gulf of California (Eschmeyer et al., 1983). *Coryphopterus nicholsi* and *Lepidogobius lepidus* are recorded from above 50°N (Eschmeyer et al., 1983). The Astrabe and Chasmichthys groups dominate region 8 and comprise two thirds of the common species of indigenous gobies. Both groups display a trans-north Pacific distribution (regions 6 and 8); however, the regions share no indigenous genera.

REGION 9 (Mediterranean and associated drainages). About 27 genera (13 monotypic) and more than 60 species are found in the fresh and marine waters of the region (Maitland, 1977; Miller, 1973b). Our sample contains only five genera, one of these endemic. We are aware of only one report of an eleotridid from region 9, that being *Eleotris nanus* (=*Kribia nana*) from the Nile River (Boulenger, 1901).

REGION 10 (southern Australia, Tasmania, and New Zealand). The southernmost limit of both gobiids and eleotridids is below 40°S in Tasmania (Hoese and Larson, 1980) and New Zealand (Ayling and Cox, 1982). The gobioid fauna of the cool temperate waters of region 10 is limited and distinctive. Of the nine gobioid genera reported from the region, our sample includes representatives of five, *Favonogobius, Gobiopsis, Gobiomorphus, Nesogobius,* and *Philypnodon. Nesogobius* is endemic to region 10 and *Gobiomorphus* and *Philypnodon* are most abundant there. Four other genera, *Arenigobius, Grahamichthys, Pseudogobius,* and *Tasmanogobius,* are reported from the area (Hoese and Larson, 1980; Ayling and Cox, 1982), of which all but *Pseudogobius* are endemic.

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APPENDIX

Materials Examined

Unexamined genera for which data have been drawn from the literature have been listed for reference. The number preceding each genus references the table containing data on that taxon. Institutional acronyms follow Leviton et al. (1985).

9 *Acanthogobius flavimanus,* CAS 52003 (4), USNM 71117 (1), USNM 71387 (1); *A. lactipes* USNM 45351 (1), USNM 71418 (1).
20 *Acentrogobius caninus* CAS 51065 (2), TCWC 3273.1 (3), USNM 90320 (1); *A. janthinopterus* TCWC 3274.7 (3).
9 *Amblychaeturichthys hexanema* USNM 49946 (1); *A. sciistius* SU 6458 (1).
20 *Amblyeleotris fasciata* USNM uncat., TeVega Cr. 7, Sta. 278 (4); *A. fontanesii* SU 26209 (1); *A. guttata* USNM 99045 (1); *Amblyeleotris* sp. CAS 52006 (2), CAS uncat., ex 52006 (1).
20 *Amblygobius albimaculatus* USNM uncat., Bruun Cr. 9, Sta. HA-16 (2); *A. nocturnus* USNM 123652 (2); *A. phalaena* TCWC 3270.2 (1).
27 *Amblytrypauchen fraseri* USNM 113197 (1); *A. madraspatensis* TCWC 3269.1 (3).
20 *Amoya moloanus* CAS uncat., Field No. 57-18A, Palau (3); *Amoya* sp. USNM 139345 (1).
33 *Aphia minuta* USNM 23024 (3).
22 *Apocryptes bato* AMS B.8205 (1), SU 33798 (2).
23 *Apocryptodon madurensis* CAS 27444 (1), NTM S.10649 (1), SU 30338 (1), USNM 160933 (2), USNM 44729 (1), USNM 90323 (1), USNM 99874 (2).
15 *Aruma histrio* USNM 167583 (2).
20 *Asterropteryx semipunctatus* USNM 150579 (2), USNM 15395 (2), USNM 161220 (1), USNM 161222 (2), USNM uncat., TeVega Sta. 88, Malaysia (2).
10 *Astrabe lacticella* USNM 71533 (3).
20 *Aulopareia janetae* USNM 119548 (1); *Aulopareia* sp. USNM 90321 (1).
20 *Austrolethops wardi* CAS 53759 (1).
28 *Awaous guineensis* SU 55635 (2), UMML uncat., P-281, Annabon Is. (5); *A. nelsoni* USNM 48836 (2); *A. stamineus* CAS 52267 (2); *A taiasica* SU 18573 (3), USNM 272622 (1); *A. transandeanus* CAS 42775 (2).
15 *Barbulifer pantherinus* USNM 167580 (2).
20 *Barbuligobius* (from Lachner and McKinney, 1974).
3 *Batanga lebretoni* USNM uncat., Field No. G. Bane 784, Ghana (3), USNM uncat., Field No. G. Bane 796, Ghana (2), USNM uncat., Field No. G. Bane 797, Ghana (4).
11 *Bathygobius andrei* USNM 133226 (3); *B. casamancus* UMML 15044 (2); *B. cocosensis* USNM 71400 (2); *B. cotticeps* USNM 50716 (1); *B. curacao* CAS 23311 (1); *B. cyclopterus* USNM 51777 (1); *B. exanthematosus* UMML 8512 (2); *B. fuscus* USNM 49919 (1), USNM 51780 (1), USNM 55277 (1), USNM 55280 (3), USNM 116117 (1); *B. lineatus* USNM 77510 (1); *B. petrophilus* USNM 272623(3); *B. ramosus* UMML uncat., Pac. Panama, Venado Beach (2); *B. soporator* TCWC 3275.1 (2), USNM 648 (2).
4 *Belobranchus belobranchus* USNM 263327 (5), USNM 269227 (3).
22 *Boleophthalmus boddarti* SU 33141 (1), USNM 12567 (2), USNM 139355 (2); *B. pectinrostris* USNM 139357 (1), USNM 179158 (1), USNM 86377 (1).
18 *Bollmannia boqueronensis* USNM 49366 (1), USNM uncat., Fish Hawk Sta. 6074 (3); *B. chlamydes* SU 489 (3), USNM 41142 (1), USNM 41158 (1), USNM 41489 (1), USNM 93825 (1); *B. communis* USNM 119873 (1), USNM 119881 (1), USNM 119883 (1), USNM 119884 (1), USNM 119888 (1), USNM 119889 (2), USNM 119890 (1); *B. litura* USNM 116365 (1), USNM 93797 (1); *B. macropoma* SU 81 (3); *B. marginalis* USNM 107284 (1), USNM 107285 (1); *B. ocellata* SU 76 (2), USNM 107286 (1); USNM 46695 (7); *B. pawneea* USNM 54803 (2); *B. stigmatura* SU 10 (3); *B. umbrosa* USNM 107288 (1), USNM 107289 (4), USNM 107290 (1).
3 *Bostrychus sinensis* USNM 46802 (1), USNM 57693 (1), USNM uncat., TeVega Cr. 6, Sta. 24 (1).
26 *Brachyamblyopus multiradiatus* USNM 272622 (2).
14 *Brachygobius sabanus* USNM 171752 (1); *B. xanthomelas* USNM 101226 (3).
4 *Bunaka canarensis* USNM 164456 (1); *B. gyrinoides* USNM 139332 (2).
2 *Butis amboinensis* USNM 51953 (1), USNM uncat., Fiji (3), USNM 272625 (3); *B. butis* ANSP 63023, 63039 (6), USNM 135895 (1), USNM 161168 (4), USNM 268461 (7); *B. gymnopomus* USNM 161176 (4), USNM 161177 (1); *B. melanopterus* USNM 87928 (2).
20 *Cabillus* (from Akihito et al., 1984).
11 *Caffrogobius caffer* USNM 93640 (1); *C. nudiceps* SU 31341 (1).
13 *Calamiana aliciae* USNM 119604 (1).

20 *Callogobius maculipinnis* USNM 202513 (1); *C. flavobrunneus* USNM uncat., Bruun Cr. 9, Sta. HA-2 (2); *C. mucosus* USNM 201673 (1); *C. okinawae* USNM 74558 (5); *C. tanagashimae* USNM 74557 (3); *Callogobius* sp. CAS 51057 (3), USNM 117322 (1).

4 *Calumia biocellata* USNM 236709 (1); *C. godeffroyi* USNM 224966 (1), USNM uncat., Bruun Cr. 9, Sta. HA-17 (1), USNM uncat., Bruun Cr. 9, Sta. HA-9 (2).

27 *Caragobius typhlops* USNM 126384 (1).

29 *Cerdale floridana* USNM 102050 (1); *C. ionthos* USNM 205072 (2).

12 *Chaenogobius annularis* USNM 49968 (2), USNM 71388 (2); *C. murorana* USNM 71445 (2); *C. urotaenia* CAS 52005 (2); *Chaenogobius* sp. USNM 105175 (1).

9 *Chaeturichthys stigmatias* SU 61210 (5), USNM 71416 (2).

12 *Chasmichthys dolichognathus* USNM 45353 (1), USNM 70754 (3); *C. gulosus* USNM 71439 (2).

15 *Chriolepis benthonis* UMML uncat., Field No. P-584 (1), USNM 47641 (1); *C. fisheri* SU 37262 (1); *C. lepidotus* USNM 211456 (1); *C. minutillus* USNM 48261 (1); *C. tagus* USNM 123232 (1).

10 *Clariger cosmuras* USNM 71430 (1), USNM 71392 (3); *C. exilis* USNM 68242 (1), USNM 74583 (2).

29 *Clarkichthys* (from Dawson, 1974).

12 *Clevelandia ios* USNM 132373 (1), USNM 132380 (4).

20 *Coryphopterus glaucofraenum* TCWC 3264.1 (2), UMML 4083 (1); *C. nicholsi* SU 48966 (2), USNM 29803 (1); *C. personatus* UMML 15580 (1), UMML 18841 (1), UMML 3528 (1).

20 *Cristatogobius* sp. CAS uncat., GVF Sta. 57-6, Palau (57).

20 *Cryptocentroides dentatus* CAS uncat., GVF Reg. No. 2170, Gulf of Thailand (17).

20 *Cryptocentrus cryptocentrus* MNHN 1166 (1); *C. filifer* CAS 52010 (1), UMMZ 142629 (1), USNM 49860 (1), USNM uncat., Bruun Cr. 9, Sta. HA-19 (1); *C. inexplicatus* SU 25500 (1); *C. malindiensis* USNM uncat Bruun Cr. 9, Sta. HA-2 (1); *C. obliquus* SU 29087 (1); *C. strigilliceps* CAS 52009 (1), USNM 220277 (1).

20 *Ctenogobiops* (from Akihito et al., 1984).

13 *Ctenogobius boleosoma* SU 1675 (8), TCWC 3266.1 (3), UMML 13613 (1), UMMZ 184680 (11); *C. claytoni* UMMZ 184456 (1), UMMZ 184472 (2), UMMZ 184609 (1); *C. fasciatus* UMMZ 199685 (1), UMMZ 147536 (1), UMMZ 180655 (3); *C. lepturus* MNHN 1967-416 (10); *C. manglicola* SU 3095 (1); *C. pseudofasciatus* ANSP 109179 (1), UMMZ 199544 (1); *C. saepepallens* ANSP 109180 (1), ANSP 86135 (1); *C. sagittula* UMMZ 172256 (10); *C. shufeldti* UMMZ 158292 (10); *C. smaragdus* UMML 733 (2), UMMZ 189754 (10); *C. stigmaticus* UMMZ 201445 (2); *C. stigmaturus* IU 6345 (1), UMMZ 189866 (10); *Ctenogobius* sp. USNM 214066 (1), USNM 226247 (2).

33 *Deltentosteus quadrimaculatus* MCZ 62871 (3).

33 *Discordipinna griessingeri* USNM 214889 (1).

3 *Dormitator cubanus* USNM 123234 (1), USNM 55668 (1); *D. latifrons* SU 55012 (1), USNM 123236 (2), USNM 7350 (1); *D. maculatus* ODU uncat., RSB-PAN-6, Pac. Panama (2), TCWC 3282.1 (2), UMML 5641 (2), USNM 15426 (2), USNM 192188 (2), USNM 641 (5), USNM 89359 (1); *D. microphthalmus* USNM 4953 (1).

20 *Drombus palackyi* USNM 51954 (1).

15 *Eleotrica cableae* USNM uncat., S.E. Pac. Biol. Oc. Prog. Cr. 19, Sta. HA-110 (4).

4 *Eleotris amblyopsis* USNM 114349 (4), USNM 226200 (1); *E. fusca* USNM 161114 (5), USNM uncat., TeVega Cr. 1, Sta. 24 (1); *E. isthmensis* USNM 79067 (3); *E. monteiri* UMML uncat., Field No. P-281, Annabon Is. (4); *E. picta* USNM 79061 (1); *E. pisonis* CAS 18579 (2), CAS 39109 (3), SU 52360 (2), UMML 2766 (1), USNM 106629 (1), USNM 192251 (2); *E. vittata* USNM 118791 (1); *Eleotris* sp. UMML 14258 (1), UMML uncat., Argosy Sta. 15, Pac. Panama (1), USNM 130662 (1), USNM 52082 (1), USNM uncat., TeVega Sta. 133, Madagascar (2).

15 *Enypnias aceras* USNM 81835 (1); *E. seminudus* UMML 23457 (2).

4 *Erotelis armiger* UMML uncat., RSB-PAN-3, Pac. Panama (7); *E. clarki* USNM 106508 (1); *E. smaragdus* SU 19339 (2), SU 24142 (1), UMML 10261 (2), USNM 164930 (1).

12 *Eucyclogobius newberryi* LACM 37380-1 (3), LACM 423391 (4), LACM 42343 (6), LACM 42658-4 (8).

10 *Eutaeniichthys* (from Akihito et al., 1984).

15 *Evermannichthys convictor* ANSP 111862 (1), ANSP 111863 (2); *E. metzelaari* ANSP 111869 (1), ANSP 112410 (3); *E. silus* ANSP 111866 (5).

20 *Eviota abax* USNM 71405 (3); *E. punctulata* USNM 224539 (1); *E. queenslandica* USNM 161211 (2).

28 *Evorthodus lyricus* CAS 50767 (1), CAS 52392 (3), CAS 52394 (3), ODU uncat., N.C. (1), TCWC 3283.1 (3), USNM 144040 (1); *E. minutus* UMML uncat., RSB-PAN-3, Pac. Panama (4).

20 *Exyrias belissimus* TCWC 3277.1 (1); *E. puntang* TCWC 3278.1 (2), USNM 160969 (1), USNM 62238 (1).
33 *Fagasia diaphana* USNM 144486 (2).
20 *Favonigobius aliciae* CAS 56374 (3); *F. reichei* SU 38598 (1), TCWC 3271.1 (3).
20 *Feia* (from Lachner and McKinney, 1979).
20 *Flabelligobius* (from Akihito et al., 1984).
20 *Fusigobius corallinus* USNM 202526 (1); *F. neophytus* SU 9010 (2), TCWC 3272.1 (3), USNM uncat., Bruun Cr. 9, Sta. HA-14 (2).
12 *Gillichthys detrusus* USNM 48127 (3); *G. mirabilis* USNM 132374 (1).
15 *Ginsburgellus* (from Böhlke and Robins, 1968).
20 *Gladiogobius ensifera* USNM 99042 (1), USNM 99043 (1), USNM uncat., Bruun Cr. 9, Sta. HA-16 (3).
11 *Glossogobius aglestes* USNM 51948 (1); *G. bicirrhosus* CAS 51058 (3), USNM 126396 (1); *G. giurus* CAS uncat., Palau, 11/15/56 (3), USNM 99732 (2); *G. koragensis* SU 25588 (1); *G. minutus* USNM 232954 (6); *G. vaisiganis* USNM 51774 (2).
13 *Gnatholepis anjerensis* USNM 126530 (2); *G. thompsoni* SU 8364 (1); *Gnatholepis* sp. TCWC 3267.2 (3).
20 *Gobiodon erythrospilus* USNM 119609 (2), USNM 196486 (2); *G. quinquestrigatus* SU 26717 (1), USNM uncat., Bruun Cr. 9, Sta. HA-12 (2).
25 *Gobioides africanus* BMNH 1939.7.12.33 (1); *G. ansorgii* BMNH 1909.10.29.110–112 (3), BMNH 1968.11.15.77 (1); *G. broussoneti* SU 21381 (1); USNM 233612 (4), ANSP 121256 (2); *G. grahamae* BMNH 1925.10.28.464 (1), BMNH 1925.10.28.465 (1), BMNH 1950.5.15.41 (1), BMNH 1959.3.17.161 (1); *G. peruanus* USNM 123616 (1); *G. sagitta* BMNH 1862.1.24.27.29 (3).
5 *Gobiomorphus australis* USNM 265059 (1), USNM 48816 (5), USNM 59966 (2); *G. basalis* USNM uncat., Acc. No. 244693, N.Z. (1); *G. breviceps* USNM uncat., Acc. No. 244693, N.Z. (2); *G. cotidianus* USNM 12599 (2), USNM uncat., Acc. No. 244693, N.Z. (2); *G. gobioides* USNM 83279 (1); *G. hubbsi* USNM 198507 (4), USNM uncat., Acc. No. 244693, N.Z. (3); *G. huttoni* USNM 198508 (5), USNM uncat., Acc. No. 244693, N.Z. (1); *Gobiomorphus* sp. ODU uncat., N.Z. (1), USNM 210751 (5), USNM 82723 (1), USNM uncat., ex USNM 198508 (1).
2 *Gobiomorus dormitor* SU 61392 (4); *G. lateralis* USNM 2435 (2); *G. maculatus* USNM 114230 (11).
13 *Gobionellus daguae* CAS 46150 (2), USNM 81839 (1), USNM 90316 (1), USNM 257680 (5); *G. liolepis* USNM 81836 (1), USNM 93175 (3); *G. microdon* UMMZ 179934 (9), USNM 130859 (1), USNM 48256 (1); *G. occidentalis* BMNH 1909.10.29.109 (1), SU 40435 (1), SU 40436 (1); *G. oceanicus* RMNH 4679 (1), UMML 2446 (1), UMMZ 173099 (4), UMMZ 199060 (6), UMMZ 209794 (2), USNM 123288 (2), USNM 49365 (1); *G. stomatus* SU 22212 (4), SU 22219 (1).
20 *Gobiopsis bravoi* CAS 33624 (3); *G. quinquecincta* USNM 90317 (1).
14 *Gobiopterus chuno* USNM 101303 (5), USNM 90312 (5).
15 *Gobiosoma bosci* ODU 69-14 (3), ODU 69-18 (10), ODU 70-5 (4), USNM 25314 (6), USNM 85813 (6), USNM uncat., Fla. (3); *G. chiquita* USNM 181285 (2), USNM 39634 (1); *G. polyporosum* USNM 24452 (1); *G. robustum* TCWC 3280.1 (3); *G. schultzi* USNM 121546 (1), USNM 121547 (5).
32 *Gobitrichonotus radiocularis* USNM 174949 (3), USNM 99549 (1).
16 *Gobius cobitis* USNM 198899 (1); *G. niger* SU 61441 (2), USNM 198892 (3); *G. paganellus* SU 1688 (2).
15 *Gobulus crescentalis* MCZ uncat., Pac. Panama, Field No. IR-116 (1), USNM 214508 (1), USNM 48258 (1); *G. hancocki* USNM 107192 (1); *G. myersi* ANSP uncat., Los Testigos Is. (2), UMML 4927 (1), USNM 107283 (1); *Gobulus* sp. ODU uncat., RSB-PAN-3, Pac. Panama (1), SIO 71-36 (1).
11 *Gorogobius nigricinctus* UMML uncat., Field No. P-258, Gulf of Guinea (1).
3 *Guavina guavina* SU 52357 (2), USNM 273723 (1), USNM 273725 (3); *G. micropus* USNM 123230 (1).
29 *Gunnellichthys grandoculis* USNM 65975 (1); *G. irideus* USNM 171757 (1); *G. monostigma* USNM 201383 (2).
15 *Gymneleotris seminuda* UMML 13663 (2).
2 *Hannoichthys africanus* SU 40431 (1); *Hannoichthys* sp. USNM 17970 (1).
20 *Hazeus* (from Akihito et al., 1984).
6 *Hemieleotris latifasciata* ANSP 71084, 71096 (6), USNM 226411 (4), USNM 79051 (2), USNM 79053 (1), USNM uncat., Panama (2).
11 *Hetereleotris diademata* USNM uncat., Bruun cr. 9, Sta. HA-1 (1); *H. zonata* USNM 10311 (1).
20 *Heteroplopomus* (from Akihito et al., 1984).

6 *Hypseleotris cyprinoides* USNM 161198 (1); *H. guntheri* ANSP 31675, 31691 (7), USNM 126606 (4), USNM 161201 (1), USNM 161204 (2), USNM uncat., Orig. No. Iowa St. Univ. 199539 (3), USNM uncat., TeVega Cr. 6, Sta. 250 (6); *H. leucisca* USNM 191299 (2); *H. modesta* USNM 161198 (1); *H. moncktoni* USNM 161205 (2); *Hypseleotris* sp. USNM 143781 (1), USNM 72582 (1).

12 *Ilypnus gilberti* USNM 132376 (4), USNM 40128 (2).

20 *Istigobius decoratus* TCWC 3277.2 (2); *I. ornatus* CAS 46503 (5), ODU uncat. (1), TCWC 3262.1 (3), USNM 55625 (3), USNM 87963 (1); *I. rigilius* TCWC 3263.1 (2), USNM 202507 (1), USNM 202540 (1).

17 *Kelloggella cardinalis* USNM 5178 (2); *K. nuda* USNM 124063 (1); *K. tricuspidata* USNM 117324 (1).

32 *Kraemeria bryani* USNM 116180 (2); *K. samoensis* USNM 166741 (5), USNM 51784 (1); *K. tonganensis* USNM 133945 (1).

8 *Kraemericus chapmani* USNM 114697 (1).

3 *Kribia kribensis* SU 63034 (1), SU 63035 (1), USNM 118789 (3), USNM 118790 (1).

28 *Lentipes concolor* USNM 214002 (1); *L. seminudus* CAS 55145 (3).

12 *Lepidogobius lepidus* USNM 27135 (3).

33 *Leptophilypnus fluviatilis* ANSP 122361 (7); *L. panamensis* USNM 79049 (3); *Leptophilypnus* sp. UMML uncat., RSB-PAN-3, Pac. Panama (8).

11 *Lesueurigobius koumansi* UMML 15781 (4), UMML 16403 (1); *L. sanzoi* UMML 16789 (1), UMML 17015 (1); *Lesueurigobius* sp. MCZ 62869 (1).

33 *Lethrops connectens* SIO 59-354-59A (1).

10 *Leucopsarion petersi* USNM 49965 (3).

9 *Lophiogobius ocellicauda* USNM 61168 (2).

20 *Lophogobius cristulatus* USNM 107294 (1); *L. cyprinoides* CAS 9765 (1), ODU uncat., RSB-PAN-6, Pac. Panama (6), UMML 13708 (1), UMML 4637 (1).

20 *Lotilia* (from Akihito et al., 1984).

10 *Luciogobius ama* USNM 62956 (1); *L. guttatus* USNM 71476 (1); *L. koma* USNM 62955 (1); *L. parvulus* USNM 62954 (1).

20 *Luposicya* (from Akihito et al., 1984).

20 *Lythrypnus crinitus* USNM 107281 (1); *L. crocodilus* USNM 17095 (1); *L. dalli* USNM 48255 (1); *L. mowbrayi* USNM 93677 (1); *L. nesiotes* UMML 12593 (2); *L. pulchellus* USNM 119902 (1); *L. spilus* UMML 8690 (3); *Lythrypnus* sp. USNM 107282 (1).

20 *Macrodontogobius wilberi* TCWC 3276.1 (3), USNM 116110 (1).

20 *Mahidolia mystacina* CAS 51063 (1), MNHN 2967 (1), RMNH 15260 (1), USNM 139361 (2).

20 *Mangarinus* sp. SU 60979 (5).

16 *Mauligobius maderensis* USNM uncat., S. of Cape Verde (2); *Mauligobius* sp. MCZ 62872 (2).

29 *Microdesmus dorsopunctatus* USNM 202426 (1); *M. hildebrandi* USNM 86547 (1); *M. intermedius* USNM 84301 (1); *M. lanceolatus* USNM 195976 (1); *M. longipinnis* USNM 64157 (1).

18 *Microgobius brevispinis* SIO 62-719 (4), UMML uncat., RSB-PAN-3, Pac. Panama (3); *M. crocatus* USNM 202587 (1); *M. curtus* UMML 23811 (1), UMML 23812 (1), UMML 23813 (1); *M. cyclolepis* SIO 64-875 (10); *M. emblematicus* SU 33208 (1); *M. erectus* UCLA W50-43 (2), UMML uncat., Field No. P-541 (3); *M. gulosus* USNM 25335 (15); *M. meeki* USNM 49367 (1); *M. miraflorensis* SU 6511 (1); *M. tabogensis* USNM 81844 (1).

7 *Micropercops dabryi* USNM 83982 (1); *Micropercops* sp. USNM 112474 (6), USNM 112475 (2), USNM 112508 (1).

33 *Microphilypnus* sp. USNM 270006 (4).

14 *Mistichthys* (from TeWinkel, 1935).

5 *Mogurnda adspersa* ANSP 89831 (6); *M. mogurnda* USNM 217283 (1), USNM uncat., Field No. M48-37, Australia (4).

11 *Monishia sordida* USNM 210404 (2).

13 *Mugilogobius abei* ANSP 26371–26375 (5), SU 30266 (2), USNM 49892 (1); *M. chulae* USNM 119645 (2); *M. fontinalis* USNM 51776 (1); *M. inhacae* USNM 112208 (1); *M. layai* USNM 202503 (1); *M. rambaiae* USNM 119646 (1); *M. zebrina* USNM 202515 (1); *Mugilogobius* sp. ANSP 152717 (3), ODU uncat., Pangasinan, P.I. (1), TCWC 3268.1 (2).

20 *Myersina* sp. SU 68942 (1).

30 *Nemateleotris magnifica* USNM 196360 (1), USNM 223283 (3), USNM 99044 (1); *Nemateleotris* sp. USNM uncat., Bruun Cr. 9, Sta. 24 (3).

11 *Nematogobius bibarbatus* USNM uncat., Undaunted Cr. 6801, Sta. 68-263 (1).

33 *Neogobius cephalarges* USNM 190124 (1); *N. fluviatilis* USNM 202644 (2); *N. kessleri* USNM 190124 (2), USNM 200216 (1).

15 *Nes* (from Böhlke and Robins, 1968).

33 *Nesogobius hinsbyi* USNM 272620 (9); *Nesogobius* sp. USNM 264969 (1).

26 *Odontamblyopus rubicundus* USNM 85845 (2), USNM 86025 (2), USNM 55634 (1), USNM 86380 (1); *Odontamblyopus* sp. ANSP 77022 (4), USNM 130431 (2), USNM 86955 (2).

2 *Odonteleotris* sp. MCZ 49560 (2).

33 *Odontobutis obscurus* USNM 86108 (1), USNM 71419 (5), USNM 84004 (1), USNM 86412 (5).

13 *Oligolepis acutipennis* UMMZ 100537 (10), USNM 139345 (1), USNM uncat., ex 257137 (1); *O. nijsseni* ZMA 115.270 (2); *O. stomias* USNM 257137 (4), USNM 51816 (1), USNM 99295 (1).

3 *Ophieleotris aporos* USNM 161075 (3), USNM 161064 (1), USNM 161096 (1), USNM uncat., TeVega Sta. 163, Madagascar (1).

2 *Ophiocara porocephala* SU 38579 (4), USNM uncat., Bruun Cr. 1, 3/22/63, Thailand (5).

15 *Ophiogobius jenynsi* USNM 176505 (1), USNM 197791 (1).

20 *Oplopomops diacanthus* USNM 116116 (1).

20 *Oplopomus oplopomus* ODU uncat., Pangasinan, P.I. (1), TCWC 3279.1 (1), USNM 139350 (2); *O. vergens* USNM 93209 (2).

20 *Opua nephodes* USNM 87419 (1).

23 *Oxuderces dentatus* AMS B.8336 (1), ANSP 63091 (1), ANSP 63092–3 (2), MNHN A-1822 (1), RMNH 12091 (1), RMNH 12092 (3), RMNH 12433 (1), RMNH 12570 (1), RMNH 17382 (1), SU 25524 (1), SU 61139 (1), USNM 119547 (1), USNM 85846 (2), USNM 86378 (2), USNM 86954 (1); *O. wirzi* AMS I.15557-299 (2), AMS IB.7146 (1), NTM S-10727-002 (3).

2 *Oxyeleotris lineolata* SU 25582 (4); *O. marmorata* CAS 49455 (2); *Oxyeleotris* sp. USNM 103362 (1), USNM 119618 (1).

30 *Oxymetopon compressus* ODU uncat., aquarium trade (1), USNM 243245 (1).

13 *Oxyurichthys lonchotus* UMMZ 196868 (1), USNM 126533 (1), USNM 50698 (1); *O. microlepis* UMML 14353 (3), UMMZ 100268 (5), UMMZ 100539 (5); *O. papuensis* SU 26335 (5); *O. stigmalophius* ANSP 144295 (1), ANSP 81855 (1), ANSP 81233 (1), UMML 3992 (1); *O. tentacularis* ODU uncat., Pangasinan, P.I. (1), TCWC 3281.1 (2); *Oxyurichthys* sp. CAS 51059 (5), CAS 51062 (3).

18 *Palatogobius paradoxus* UMML 23118 (1).

14 *Pandaka pygmaea* USNM 3734 (3).

20 *Parachaeturichthys polynema* USNM 49909 (1), USNM uncat., UM-SI Proj. 3818, Sta. 69-76 (2).

20 *Paragobiodon echinocephalus* USNM 177149 (1), USNM uncat., Bruun Cr. 9, Sta. HA-2 (2); *P. kerri* USNM 90319 (1); *P. lacunicola* USNM 66006 (1).

29 *Paragunnellichthys fehlmani* USNM 203832 (2).

23 *Parapocryptes serperaster* SU 61279 (1), USNM 86957 (3), USNM 119626 (2), USNM 11987 (1), USNM 11988 (1), USNM 86381 (1).

15 *Pariah scotius* ANSP 111855 (1), ANSP 111857 (1).

30 *Parioglossus formosus* USNM 119611 (1); *P. palustris* SU 36808 (1); *P. philippinus* USNM 119639 (1), USNM 119640 (4); *P. rainfordi* USNM 174260 (1); *P. raoi* SU 37149 (7); *P. taeniatus* USNM 245268 (1).

20 *Parkraemeria* (from Akihito et al., 1984).

18 *Parrella fusca* USNM 107295 (1); *P. ginsburgi* SU 46827 (5); *P. maxillaris* USNM 11901 (1); *P. spilopteryx* USNM 107293 (1).

33 *Parviparma straminea* SU 29701 (1).

7 *Perccottus glehni* USNM 105188 (1); *P. pleskei* USNM 77008 (1).

24 *Periophthalmodon freycineti* ROM 38686 (2), USNM 268460 (1); *P. schlosseri* USNM 161010-11 (5).

24 *Periophthalmus argentilineatus* USNM uncat., Field No. BBC-1730 (2); *P. barbarus* ALA uncat., Acc. No. 1078, Sierra Leone (3), USNM 88575 (1); *P. kalolo* TCWC 3261.2 (1), USNM 112908 (3), USNM 177189 (2), USNM 30663 (2), USNM uncat., Field No. RW 85-06 (1), USNM uncat., Field No. SP 78-22 (1); *P. modestus* USNM 50237 (4), USNM 57707 (1). *P. septemradiatus* USNM 119632 (2), USNM uncat., Borneo (4).

5 *Philypnodon grandiceps* SU 20421 (5), USNM 48820 (2); *P. nudiceps* SU 5797 (3); *Philypnodon* sp. USNM 175340 (1).

20 *Pleurosicya* (from Akihito et al., 1984).

19 *Pomatoschistus kneri* USNM 204677 (3); *P. microps* SU 32183 (2); *P. minutus* USNM 197561 (1).

20 *Porogobius schlegelii* USNM 263328 (3), SU 63028 (2).

20 *Priolepis aureoviridis* USNM 175013 (1), USNM 175014 (1); *P. borea* USNM 62953 (1); *P. cincta* USNM 62239 (1); *P. eugenia* USNM 106537 (2); *P. farcimens* USNM 50654 (1); *P. hipoliti*

UMML 8695 (2); *P. limbatosquamis* USNM 175012 (1); *P. nuchifasciata* USNM uncat., Australia (3); *P. semidoliata* USNM 160966 (1).

2 *Prionobutis koilomatodon* USNM 161233 (3), USNM uncat., Bruun Cr. 9, Sta. HA-4 (5).

16 *Psammogobius knysnaensis* USNM 153522 (2), USNM 93656 (1).

22 *Pseudapocryptes lanceolatus* SU 40081 (2), USNM 119987 (1), USNM 47987 (1), USNM 89497 (1), USNM 119636 (1), USNM 44770 (1).

13 *Pseudogobiopsis oligactis* USNM 61051 (1).

20 *Psilogobius mainlandi* ODU uncat., Hawaii (3), USNM 206174 (1).

15 *Psilotris alepis* USNM 123231 (1), USNM 197515 (1); *P. celsus* UMML 12926 (1), UMML 5393 (1); *Psilotris* sp. USNM 226371 (1).

31 *Ptereleotris calliura* UMML 18748 (2); *P. evides* USNM 196386 (3); *P. hanae* USNM 196663 (1); *P. helenae* USNM 63565 (2); *P. heteroptera* USNM 196372 (1); *P. lineopinnis* USNM uncat., Santo, New Hebrides (1); *P. microlepis* USNM 196384 (2); *P. zebra* USNM 99048 (1).

9 *Pterogobius elapoides* USNM 45327 (3); *P. virgo* USNM 71425 (1).

15 *Pycnomma roosevelti* USNM 107108 (1), USNM 108139 (1); *P. semisquamatum* SIO 65-273 (3).

12 *Quietula guaymasiae* USNM 59461 (3); *Q. y-cauda* CAS 41895 (5), IU 7771 (4), USNM 39637 (3), USNM 39642 (2).

33 *Redigobius balteata* CAS 51061 (5); *R. bikolanus* USNM 116113 (1), USNM uncat., Bruun Cr. 9, Sta. HA-22 (4); *R. dispar* CAS uncat., ex SU 38647 (2); *R. macrognathos* SU 38647 (3); *R. sternbergi* USNM 50536 (3).

33 *Rhinogobius giurinus* SU 4990 (1); *R. hadropterus* USNM 71420 (2); *R. similis* BMNH 1905.6.7.85 (1); *R. sowerbyi* USNM 76734 (2); *Rhinogobius* sp. USNM 123769 (1), USNM 179328 (2).

1 *Rhyacichthys aspro* ODU uncat., Philippines (1), SU 32758 (1).

15 *Risor* sp. USNM 190460 (3), USNM 92786 (1).

9 *Sagamia geneionema* USNM 59570 (1); *S. russulus* USNM 49872 (2).

22 *Scartelaos histophorusce* USNM 102537 (2), USNM 45060 (1); *S. tenuis* USNM 196294 (1), BMNH 1981.3.19:15–17 (3).

28 *Sicydium caguitae* USNM 49364 (1); *S. pittieri* IU 17437 (1), IU 17438 (2); *S. plumieri* UMML 1867 (2); *Sicydium* sp. UMML uncat., Argosy sta. 29, Pac. Colombia (2), USNM 226504 (2), USNM 276852 (2).

28 *Sicyopterus gymnauchen* USNM 109379 (1), USNM 51787 (1); *S. lacrymosus* USNM 135739 (1); *S. micrurus* USNM 276854 (3); *S. ouwensi* SU 61629 (2), USNM 109370 (2); *S. stimpsoni* USNM 55149 (1); *Sicyopterus* sp. USNM 276853 (3).

28 *Sicyopus* (from Sakai and Nakamura, 1979; and Akihito et al., 1984).

20 *Signigobius biocellatus* AMSI 18767-001 (1).

20 *Silhouettea* (from Akihito et al., 1984).

13 *Stenogobius genivittatus* CAS 51056 (4), CAS 52011 (3), USNM 99878 (1); *S. gymnopomus* RMNH 4552 (4); *S. laterisquamatus* ZMA 116.477 (2).

33 *Stigmatogobius sadanundio* USNM 263326 (4).

28 *Sicyopterus gymnauchen* USNM 109379 (1), USNM 51787 (1); *S. lacrymosus* USNM 135739 USNM 260937 (4); *Stiphodon* sp. USNM 143644 (4).

20 *Stonogobiops* (from Akihito et al., 1984).

9 *Suruga fundicola* SU 6614 (2).

21 *Synechogobius clarki* CAS 507 (1); *S. hasta* USNM 45332 (1), USNM 86346 (1).

26 *Taenioides cirratus* USNM 113195 (2), USNM 49830 (1); *Taenioides* sp. ANSP 63086 (1), ANSP 63087 (1).

13 *Tamanka siitensis* USNM 87128 (3).

33 *Tateurndina ocellicauda* AMNH 20222 (1).

20 *Tenacigobius* (from Akihito et al., 1984).

16 *Thorogobius angolensis* UMML 16740 (4), UMML 21337 (2), UMML 21456 (3), USNM 268482 (2).

20 *Tomiyamichthys* (from Akihito et al., 1984).

33 *Tridentiger obscurus* CAS 52013 (2); *T. trigonocephalus* USNM 71521 (6); *Tridentiger* sp. USNM 49403 (1).

22 *Trimma caesiura* USNM 51772 (1); *T. eviotops* USNM 116170 (3); *T. necopinna* USNM 177869 (1); *T. tevegae* USNM 203437 (4); *Trimma* sp. USNM 203312 (4), USNM 203313 (4).

27 *Trypauchen vagina* CAS 24193 (4), ODU uncat., Bombay Harbor (2), USNM 109695 (1), USNM 86958 (2); *T. wakae* USNM 49807 (1), USNM 49868 (2).

27 *Trypauchenichthys sumatrensis* USNM 211295 (6).

33 *Tukugobius carpenteri* TCWC 3267.1 (1), USNM 143819 (4); *Tukugobius* sp. USNM 179328 (1).

10 *Typhlogobius californiensis* USNM 27466 (1), USNM 34746 (4).
8 *Tyson belos* USNM 229985 (1).
20 *Valenciennea helsdingeni* USNM 59562 (2); *V. muralis* CAS 51060 (1), USNM 135709 (2), USNM 163698 (1); *V. sexguttatus* USNM 136693 (1), USNM uncat., Bruun Cr. 4B, Sta. RW-1 (2); *V. violifera* SU 8730 (3), USNM 161033 (1), USNM 51771 (1).
20 *Vanderhorstia ornatissima* CAS uncat., Ifaluk Atoll, Sta. 63 (1), USNM uncat., Bruun Cr. 9, Sta. HA-16 (2).
16 *Vanneaugobius pruvoti* MCZ 62870 (1).
15 *Varicus bucca* UMML uncat., Field No. G-897 (1), USNM 143022 (1); *V. marilynae* USNM 218406 (1).
33 *Vitraria clarescens* USNM 126696 (1), USNM 50655 (1).
33 *Vomerogobius flavus* USNM 203448 (2).
8 *Xenisthmus clarus* USNM 235710 (1), USNM 51773 (1), USNM 62242 (1); *Xenisthmus* sp. USNM 247387 (1).
20 *Yongeichthys criniger* SU 9425 (1), TCWC 3270.1 (3), USNM 119589 (1).