

Fishes of the Genus *Eviota* of
the Red Sea with Descriptions of
Three New Species
(Teleostei: Gobiidae)

ERNEST A. LACHNER
and
SUSAN J. KARNELLA

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ABSTRACT

Lachner, Ernest A., and Susan J. Karnella. Fishes of the Genus *Eviota* of the Red Sea with Descriptions of Three New Species (Teleostei: Gobiidae). *Smithsonian Contributions to Zoology*, number 286, 23 pages, 11 figures, 2 tables, 1978.—The genus *Eviota* Jenkins comprises small, tropical marine gobies, occurring in the Indo-Pacific region from the Red Sea to the Hawaiian Islands. Six species are reported for the Red Sea, three of them described as new: *E. guttata*, *E. pardalota*, and *E. zebrina*. The other three species are *E. distigma* Jordan and Seale, *E. prasina* (Klunzinger), and *E. sebreei* Jordan and Seale. *Eviota viridis* (Waite) and *E. verna* Smith are placed in the synonymy of *E. prasina*, and *E. stigmatopteron* Smith is synonymized with *E. distigma*.

Characters describing the genus are presented. A key is given and meristic data are tabulated that differentiate the species. All of the species are illustrated by photographs or a drawing. A diagnosis of each species is included.

Eviota pardalota is apparently endemic to the Red Sea; *E. guttata* is only known from the Red Sea and the Gulf of Oman. *Eviota distigma*, *E. prasina*, *E. sebreei*, and *E. zebrina* are Red Sea inhabitants that are wide-ranging, with somewhat similar distributions in the Indo-Pacific region. The six species occurred together only in the Gulf of Aqaba. The distribution of certain species in the Red Sea as shown by our data may be related to collecting effort and practices and perhaps to certain natural conditions.

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Contents

	<i>Page</i>
Introduction	1
Methods	2
Abbreviations	6
Acknowledgments	6
Genus <i>Eviota</i> Jenkins	6
Key to Species of <i>Eviota</i> Found in the Red Sea	7
<i>E. distigma</i> Jordan and Seale	7
<i>E. guttata</i> , new species	9
<i>E. pardalota</i> , new species	11
<i>E. prasina</i> (Klunzinger)	13
<i>E. sebreei</i> Jordan and Seale	14
<i>E. zebrina</i> , new species	15
Discussion	20
Literature Cited	23

Fishes of the Genus *Eviota* of the Red Sea with Descriptions of Three New Species (Teleostei: Gobiidae)

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Introduction

The biota of the Red Sea has been a topic of study for several hundred years and interest continues. This large, tropical, nearly inland sea of the Indo-Pacific region harbors an interesting fish fauna that is a prime subject for much study by systematists, ecologists, and zoogeographers. As in many other areas of the tropical Indo-Pacific region, the systematics of the fishes of the Red Sea are insufficiently understood to treat comprehensively such subjects as speciation, endemism, and zoogeographical relationships.

In our revisionary studies of the genus *Eviota*, we have examined and studied thousands of specimens from the Red Sea to the Hawaiian Islands in order to evaluate possible divergences within species over this broad range. Of the 23 nominal species and 2 nominal subspecies that we allocate to the genus *Eviota*, we currently recognize 22 species as valid. The nominal species *E. stigma* Smith is placed in the synonymy of *E. distigma* Jordan and Seale, and *E. viridis* (Waite) and *E. verna* Smith are placed in the synonymy of *E.*

prasina (Klunzinger). Two nominal subspecies, *E. viridis queenslandica* Whitley and *E. viridis inutilis* Whitley, are elevated to the species level. In addition to these 22 species, we have found about 45 new species. Many of these species are wide-ranging, occurring from island groups in Oceania westward to the Indian Ocean and some are found in the Red Sea. Some species exhibit populational divergence in various segments of their ranges, the magnitude of which must be further analyzed. Some species appear to be endemic in island groups or to larger areas such as the Red Sea.

We report first on the Red Sea segment of our study because all of the available collections from this area are analyzed, and we have completed a comprehensive analysis of all of the nominal forms.

This study includes six species of *Eviota* from the Red Sea, three of which are new: *E. pardalota*, apparently a Red Sea endemic and represented by 28 specimens; *E. guttata*, represented by 153 specimens from the Red Sea and one specimen from the Gulf of Oman; and *E. zebrina*, represented by more than 800 specimens and occurring from the Red Sea, widely in the Indian Ocean, and eastward to western Australia and the Great Barrier Reef.

Klunzinger described the first species of *Eviota* as *Eleotris prasinus* from Koseir, Red Sea, in 1871 (p. 481). We have examined about 900 specimens

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of *E. prasina* that were taken from the Red Sea eastward to Japan and the Lord Howe and Norfolk Islands. The other two species of *Eviota* occurring in the Red Sea, *E. sebreei* and *E. distigma*, were described from the Samoan Islands by Jordan and Seale (1906) and are now known by several hundred specimens in our study material from widely distributed localities in the Indo-Pacific region.

METHODS.—We follow the methods of Lachner and McKinney (1974, 1978) in taking and recording meristic and other data with the following exceptions.

Pectoral Fin Rays: The uppermost ray is considered the first ray of the pectoral fin, and those below are numbered consecutively. The simple or unbranched rays are recorded separately from the branched rays.

Pelvic Fin Rays: The fourth ray is always branched and these branches extend laterally in one direction (Figure 1); the total count of the number of branches on the fourth ray includes the terminal portion as one (Table 1). The number of segments between the branches of the fourth fin ray were counted, excluding the segment at the base of each branch; the frequency of each count between the consecutive branches was recorded and the data are summarized in Table 1. The fifth pelvic fin ray is never branched; the length of the fifth ray is expressed in tenths of the length of the fourth ray; when the ray is barely visible with the aid of a microscope (perceptibly less than one-tenth the length of the fourth ray), it is termed a rudiment (R). The pelvic fins lack a frenum; the membrane joining the fifth rays is always short and weakly developed; the membranes connecting the first four fin rays are considered to be well developed when the membranes extend beyond the bases of the first branches; they are considered to be reduced when they are slightly developed and do not extend to the bases of the first branches.

First Dorsal Fin Elongation: The lengths of the filamentous dorsal spines were measured along the dorsal midline in a depressed position. The filamentous development of the first dorsal spines is usually variable, not being present in all specimens of a given sex.

Dorsal-Anal Fin Ray Formula: The combination of the second dorsal fin ray and the anal fin ray



FIGURE 1.—Diagrammatic view of ventral aspect of left pelvic fin of *Eviota pardalota*, female: a, small fifth fin ray about one-tenth length of fourth fin ray, reduced membrane between fin rays, total of 7 branches on fourth fin ray, and segments between consecutive branches from first branch to tip of fourth fin ray number 3,2,2,3,2 (see "Methods" for counting procedure). Pelvic fin of *E. sebreei*, male: b, long fifth fin ray about six-tenths length of fourth fin ray, membrane between fin rays well developed, total of 16 branches on fourth fin ray, and no segments between consecutive branches of fourth fin ray.

counts for each specimen was recorded as a unit of data and is summarized for six species in Table 1.

Scales: The transverse scale row count was taken from the origin of the second dorsal fin downward and posteriorly obliquely to include all horizontal rows to the anal fin. The data for scale morphology was recorded from samples taken from the middorsolateral trunk area.

Cephalic Sensory Pore System: The six species found in the Red Sea have three different pore patterns, designated as 1, 2, and 6. Pore pattern 1, which has the most pores in the system for the genus *Eviota*, is illustrated in Figure 2a and this

TABLE 1.—Meristic data for six species of *Eviota* occurring in the Red Sea

Species	Number of branches on fourth pelvic fin ray															
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
<i>distigma</i> ...		4	5	9	6	3	1									
<i>guttata</i> ...			5	7	8	4										
<i>pardalota</i> ...		1	2	3	4	5	3									
<i>prasina</i> ...	2	7	13	38	32	29	18	3	1	1	1					
<i>sebreei</i> ...								1	3	2	10	3	3	1	-	1
<i>zebrina</i> ...		2	4	11	3	1	3	1								

Species	Number of segments between consecutive branches of fourth pelvic fin ray						Length of fifth pelvic fin ray in tenths of fourth ray; A, absent; R, rudiment										
	0	1	2	3	4	5	6	A	R	1	2	3	4	5	6	7	8
<i>distigma</i> ...		23	68	28	6					7	25	5					
<i>guttata</i> ...		14	87	18	1						35	3					
<i>pardalota</i> ...		36	62	7	3					8	20						
<i>prasina</i> ...		278	487	121	19	1	2			191	41						
<i>sebreei</i> ...	311	2												2	4	18	2
<i>zebrina</i> ...		22	68	37	8	1	2			2	35	3					

Species	Second dorsal fin elements					Anal fin elements				Pectoral fin elements							
	I,7	I,8	I,9	I,10	I,11	I,6	I,7	I,8	I,9	14	15	16	17	18	19		
<i>distigma</i> ...	3	45	3														
<i>guttata</i> ...		3	36						11	42		2	16	30	2		
<i>pardalota</i> ...	2	26								37	1	2	12	23	1		
<i>prasina</i> ...		5	158	78	1			2	2	26		3	25	88	85	25	1
<i>sebreei</i> ...		3	26	2					1	91	2	3	25	88	85	25	1
<i>zebrina</i> ...	1	38	94	3					36	99	6	3	20	31	37	9	

Species	Dorsal-anal fin ray formula, excluding spines											Total number of vertebrae				
	7/6	7/7	7/8	8/6	8/7	8/8	9/7	9/8	9/9	10/8	10/9	11/9	25	26	27	
<i>distigma</i> ...			1	1	-	7	33	1	2					1	20	2
<i>guttata</i> ...							3	-	34	1					15	
<i>pardalota</i> ...	1	1	-	1	25										12	
<i>prasina</i> ...						3	-	45	1	32	1	1			23	
<i>sebreei</i> ...						3	-	24	1	1	1				7	
<i>zebrina</i> ...		1	-	-	9	1	1	25							19	1
Red Sea		1	-	-	8											

pattern is found in *E. distigma*, *E. guttata*, and *E. pardalota*. Pore pattern 2 (Figure 2b) is similar to pattern 1 but lacks the intertemporal pore and occurs in *E. prasina* and *E. zebrina*. Pore pattern 6, compared with pattern 1, lacks the nasal tubes and pores and the posterior interorbital and intertemporal pores. The anterior otic pore is positioned higher on the head. This pattern (Figure 2c) is found in *E. sebreei*.

Abbreviations for the respective pores follow: paired nasals, NA; anterior interorbital, AITO; posterior interorbital, PITO; paired supraotics, SOT; paired anterior otics, AOT; paired intertemporals, IT; paired upper and lower preoperculars, POP.

Cutaneous Papillae System: This system is very difficult to observe, even with the high power of a microscope and staining procedures, because the pores are often eroded away on poorly preserved or older specimens. The system is incompletely developed on many specimens and the papillae are difficult to detect because the species of *Eviota* are very small, often maturing at less than 15 mm SL. The papillae are small and fragile, unlike the papillae of many other gobies. The patterns are described in most species from a few specimens where the papillae were obvious and well developed. These specimens were selected after examination of most of the available collections. We observe three patterns of the papillae system for

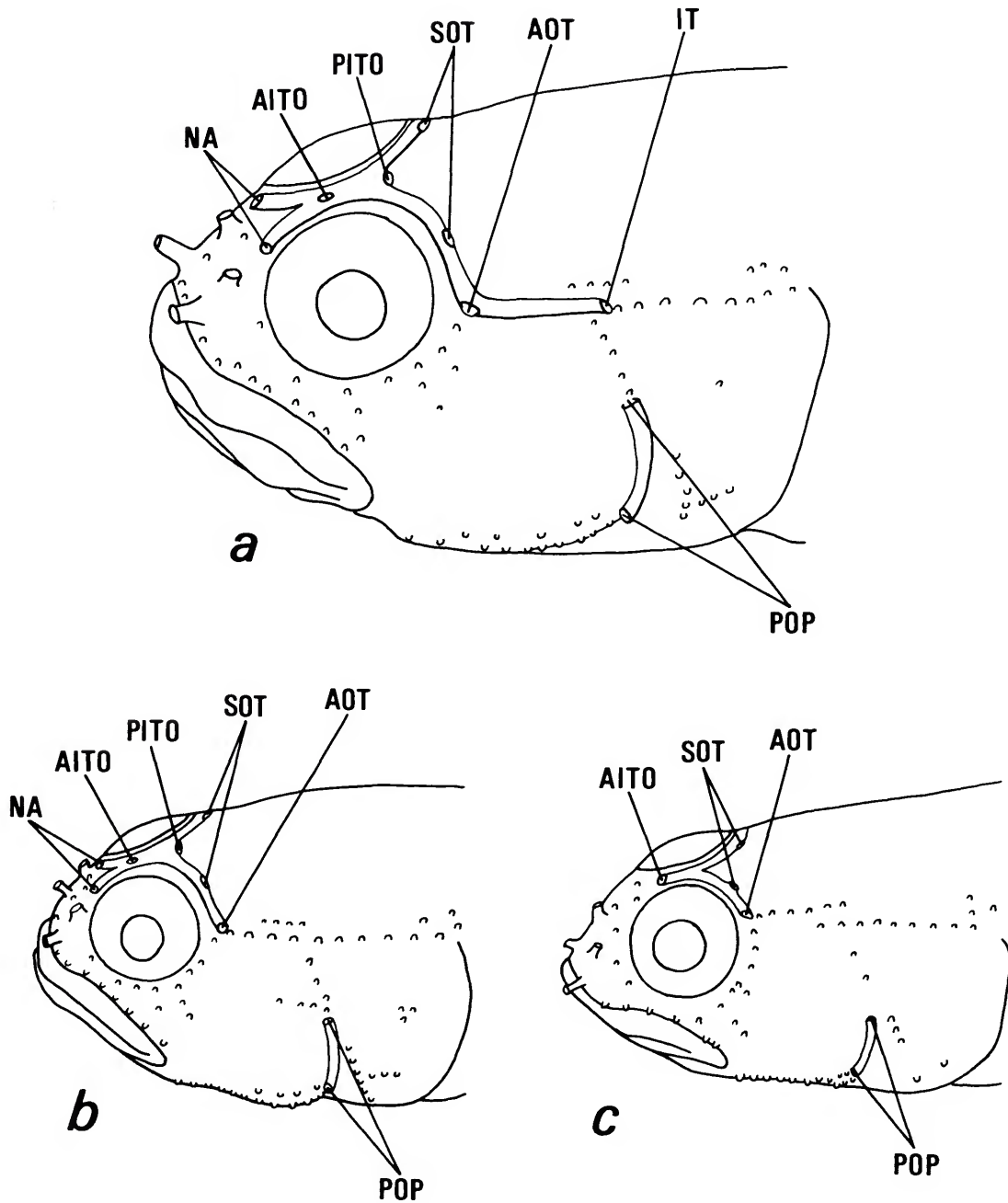


FIGURE 2.—Diagrammatic views of three patterns of cephalic sensory pore system and cutaneous papillae system in *Eviota*: *a*, pore pattern 1 and papillae pattern A, typical of *E. guttata* (see "Methods" for descriptions of these patterns); *b*, pore pattern 2 and papillae pattern B, sketched from *E. zebrina*; *c*, pore pattern 6 and papillae pattern C, sketched from *E. sebrei*.

the Red Sea species that are correlated with particular sensory pore systems. Cutaneous papillae system A is associated with pore pattern 1 (Figure 2a), papillae pattern B (Figure 2b) with pore pattern 2, and papillae pattern C (Figure 2c) with pore pattern 6.

The salient differences among the papillae systems occur in the development of the anterior lateral cephalic rows. When the IT pore is present (pore pattern 1), the upper and lower lateral cephalic rows are absent between the AOT and IT pores (papillae pattern A). When only the IT pore is absent (pore pattern 2), the lower lateral cephalic row is continuous with the suborbital row and extends from the AOT pore posteriorly to the upper end of the opercle (papillae pattern B). In pore pattern 6 the AOT is positioned higher on the head, and the upper lateral cephalic row of papillae is developed anteriorly, confluent with the suborbital row, and extends posteriorly to about the area where the IT pore occurs in other species (papillae pattern C).

Genital Papilla: The papilla is elongate in adult males and fimbriated in the males of some species; adult females have a bulbous and short papilla (Figure 3). Specimens were usually sexed by examination of the genital papilla. Smaller, unsexed

specimens with incompletely developed genital papillae and gonads were termed juveniles.

Color in Preservation: In many species of *Eviota* a series of dark spots occur along the ventral midline and are usually associated with dark subcutaneous bars on the posterior trunk. The pigment forming the subcutaneous bars is internal except where it becomes integrated with the ventral or sometimes dorsal midline spots. When referring to these bars, we number the first bar as the one passing through the origin of the anal fin or nearly so, and those posterior to this bar are numbered consecutively. The descriptions of the nominal species contain only an abbreviated account of the salient color pattern because a comprehensive treatment is included in our revisionary study. Our color descriptions and key color characters are based on relatively recent collections and well-preserved specimens. Most *Eviota* fade rapidly when preserved in about 70 percent ethyl alcohol, thus poorly preserved or older specimens may reveal little of the characteristic color pattern.

Material Examined: All of the examined collections of the new species are listed in the sections, "Material Examined." For the nominal species, we list the type specimens examined and the nontype collections for only the Red Sea because these

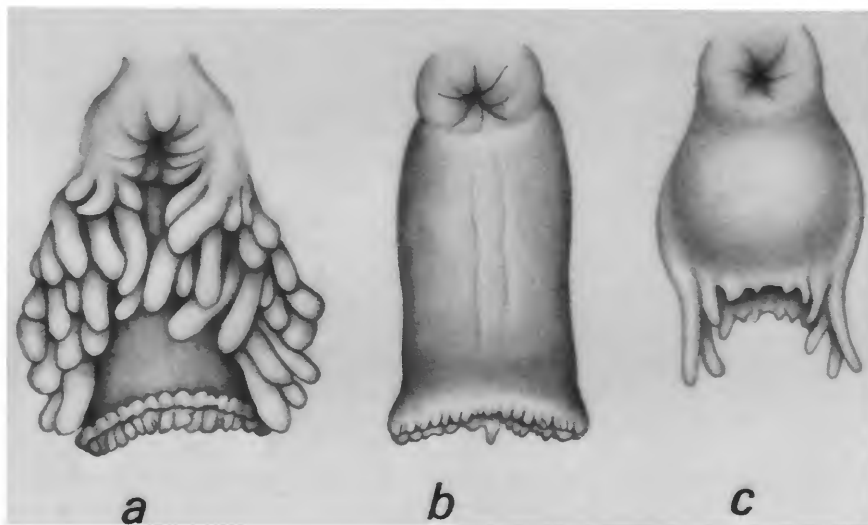


FIGURE 3.—Examples of three types of genital papillae in mature *Eviota*: a, fimbriate condition in male *E. prasina*; b, nonfimbriate condition in male *E. guttata*; c, bulbous papilla of female *E. prasina*.

species are wide-ranging as far eastward as Oceania and are represented by many specimens that we will report on in our revisionary study.

Under each species the length of the specimens refers to the standard length (SL) in mm. The catalog number is followed by the total number of specimens in the collection, size range, number of males (maximum size of males), number of females (maximum size of females), and pertinent locality data.

The underscored item in certain characters refers to the count obtained for the holotype.

The prints of Figures 4*b*, 7, 8*b*, and 10*a* were bleached to eliminate dark and irregular backgrounds. This may deceive the viewer in respect to some outlines of certain fins, such as the elongate pelvic fin in Figures 4*b* and 8*b*.

ABBREVIATIONS.—The following abbreviations are used to designate institutions and collections cited:

AMNH	American Museum of Natural History, New York
AMS	Australian Museum, Sydney
ANSP	Academy of Natural Sciences, Philadelphia
BPBM	Bernice P. Bishop Museum, Honolulu
CAS	California Academy of Sciences, San Francisco; also houses collections formerly at Stanford University (SU), including the George Vanderbilt Foundation collections (GVF register numbers)
FMNH	Field Museum of Natural History, Chicago
GVF	see CAS
HUJ	Hebrew University, Jerusalem
NFIS	Natur-Museum und Forschungs-Institut Senckenberg, Frankfurt
RUSI	Rhodes University, J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa
SU	see CAS
UMMZ	University of Michigan, Museum of Zoology, Ann Arbor
USNM	former United States National Museum, collections in National Museum of Natural History, Smithsonian Institution, Washington, D.C. (NMNH)
WAM	Western Australian Museum, Perth

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Hoese (AMS); B. Hutchins (WAM); R. K. Johnson (FMNH); W. Klausewitz (NFIS); H. K. Larson (AMS); J. E. Randall (BPBM); C. L. Smith (AMNH); M. M. Smith (RUSI); W. F. Smith-Vaniz (ANSP); P. M. Sonoda (CAS); and R. Winterbottom (previously at RUSI).

Figures 3 and 6 were drawn by J. R. Schroeder; photographs in Figures 4*b*, 7*a*, 8*b*, and 10*a* were taken by K. B. Sandved (NMNH); and the manuscript was critically read by R. S. Birdsong and J. E. Böhlke.

Genus *Eviota* Jenkins

Eviota Jenkins, 1903:501 [type-species: *Eviota epiphanes* Jenkins, 1903, by monotypy and original designation].

Allogobius Waite, 1904:176 [type-species: *Allogobius viridis* Waite, 1904, by monotypy].

Eviotops J.L.B. Smith, 1956:825 [type-species: *Eviotops infulatus* Smith, 1956, by monotypy and original designation].

Small, tropical, marine Indo-Pacific gobies, most species maturing under 20 mm SL; (females of one species mature at 9 mm SL and represent the smallest known species among fishes); pectoral fin rays branched or unbranched; pelvic fins separated, a fine, fragile membrane joining bases, frenum absent; pelvic fin elements I,4 or I,5, the fifth element a small rudiment in some species or a simple, unbranched ray; fourth ray of pelvic fin multi-branched, the lateral branching often fringelike; trunk usually with dark subcutaneous vertical bars, often integrated with dark spots along ventral midline posterior to origin of anal fin; first dorsal fin with six spines, one or more of which is elongate or filamentous in males of many species, elongate in females of some species, and in some species there is no elongation in either sex; scales ctenoid, moderate to large, less than 30 scale rows in the lateral series, absent on head, nape, and base of pectoral fin; cephalic sensory pore system variously developed or absent; cutaneous papilla system weakly developed, the papillae fine and fragile; gill opening narrow; fine, pointed teeth in villiform patches in both jaws, with several enlarged teeth anteriorly in both jaws; genital papilla in males elongate, fimbriate in some species, simple and bulbous in females; vertebrae typically 25 or 26; pterygiophore formula 3(22110) (Birdsong, 1975:137); geographical distribution, Red Sea eastward to the

Hawaiian Islands and the eastern Tuamotu Archipelago, northward to the main islands of Japan, southward to the southern Great Barrier Reef and

the Norfolk and Lowd Howe Islands. An evaluation of some of these generic characters was given by Larson (1976:501).

Key to Species of *Eviota* Found in the Red Sea

1. Pectoral fin rays not branched; vertebrae 252
Some pectoral fin rays always branched; vertebrae 263
2. Cephalic sensory pore system reduced, lacking the nasal, posterior interorbital and intertemporal pores; fifth pelvic fin ray one-half length of fourth pelvic ray or larger; the large dark spot at base of caudal rays just touching caudal peduncle; caudal fin lacking dark oblique bars *E. sebreei*
Cephalic sensory pore system nearly complete for *Eviota*, lacking the intertemporal pore; fifth pelvic fin ray reduced, always one-fourth or less than the length of the fourth pelvic fin ray; the large dark spot mostly at end of caudal peduncle, just touching the base of the caudal fin rays; caudal fin with dark oblique bars *E. zebrina*, new species
3. Intertemporal cephalic sensory pore absent; genital papilla of male fimbriate; five subcutaneous spots on ventral midline posterior of anal fin origin *E. prasina*
Intertemporal cephalic sensory pore present; genital papilla of male not fimbriate; six or seven subcutaneous spots on ventral midline posterior of anal fin origin4
4. Head and trunk dappled with fine dark spots, lacking large dark spots the size of the pupil; dorsal-anal fin formula almost always I,9/1,8 *E. guttata*, new species
Head and trunk with some large dark spots or clusters of chromatophores about the size of the pupil; dorsal-anal fin formula usually I,8/I,8 or I,8/I,75
5. Cheek, opercle, and lower head with prominent dark spots equal in intensity to those dorsally on head; base of pectoral fin with two large dark spots in both sexes; a series of dark spots, sometimes saddle-shaped, along dorsal midline from nape to the procurrent caudal fin rays; caudal fin with a series of 4-5 irregularly arranged small spots on most branched fin rays; no well-developed subcutaneous spot on midcaudal peduncle; dorsal-anal fin formula almost always I,8/I,7 *E. pardalota*, new species
Cheek, opercle, and lower head lacking spots or spots faintly developed; base of pectoral fin with two large dark spots present in males, absent or weakly developed in females; dark spots along dorsal midline weakly developed or absent; caudal fin lacking prominent dark spots; a well-developed subcutaneous dark spot on midcaudal peduncle, 2-3 scale rows in advance of base of caudal fin, over subcutaneous bar; dorsal-anal fin formula usually I,8/I,8 *E. distigma*

Eviota distigma Jordan and Seale

FIGURE 4

Eviota distigma Jordan and Seale, 1906:389, fig. 79 [type-locality: Pago Pago, Samoa].

Eviota stigmatopteron Smith, 1958:141, fig. 2, pl. I: fig. H [type-locality: Aldabra; incorrectly listed in publication as Mahé, Seychelles].

MATERIAL EXAMINED.—More than 300 specimens from 90 collections taken from the Red Sea eastward to islands of Oceania; size range 6.7–20.3, largest male 20.3, largest female 18.6; smallest gravid female 11.5. Only type specimens and Red Sea material are listed below.

Lectotype: SU 8710 (ca. 13.1), male; Samoa, Pago Pago, 1902, D. S. Jordan.

Paralectotypes: USNM 51767, 4 (11.3–12.1), 2 males (12.1), 2 females (11.6); Samoa, Pago Pago, 1902, Jordan and Kellogg.

Holotype of *Eviota stigmatopteron* Smith: RUSI 260 (15.6), male; Aldabra, 13 Nov 1954, Sey 2956.

Nontype Material: GULF OF SUEZ: USNM 216575, 5 (9.6–16.0), 3 males (15.5), 2 females (16.0); 27 Sep 1969, V. G. Springer, 69–29. GULF OF AQABA: FMNH 83849, 1 (11.6), juv.; Elat, coll. 1972?, J. Sohn, sta 16. BPBM 18273, 1 (13.9), female; 1 km N of Fiord, 26 Sep 1974, J. E. Randall. Collections by V. G. Springer in 1969: USNM 216583, 7 (7.1–14.4), 2 juv., 1 male (13.2), 4 females (14.4); 15 Jul, 69–1. USNM 216578, 1 (10.9), male; 21 Jul, 69–6. USNM 216581, 1 (13.8), male; 23 Jul, 69–7. USNM 216582, 3 (13.9–14.9), 2 males (14.9), 1 female (13.9); 29 Jul, 69–8. USNM 216574, 1 (11.2), male; 8 Sep, 69–23. ETHIOPIA (collections by V. G. Springer, 1969): USNM 216573, 1 (14.7), male; 9 Aug, 69–10. USNM 216577, 1 (13.0), female; 13 Aug, 69–13. AMS I.20059–001, 3 (12.1–15.1), 1 juv., 1 male (15.1), 1 female (12.7); 12 Aug, 69–12.

DIAGNOSIS.—Pectoral fin rays 10–15 almost always branched; spinous dorsal fin elongate or filamentous in males; fifth pelvic fin ray small or rudimentary, usually about one-tenth the length of the

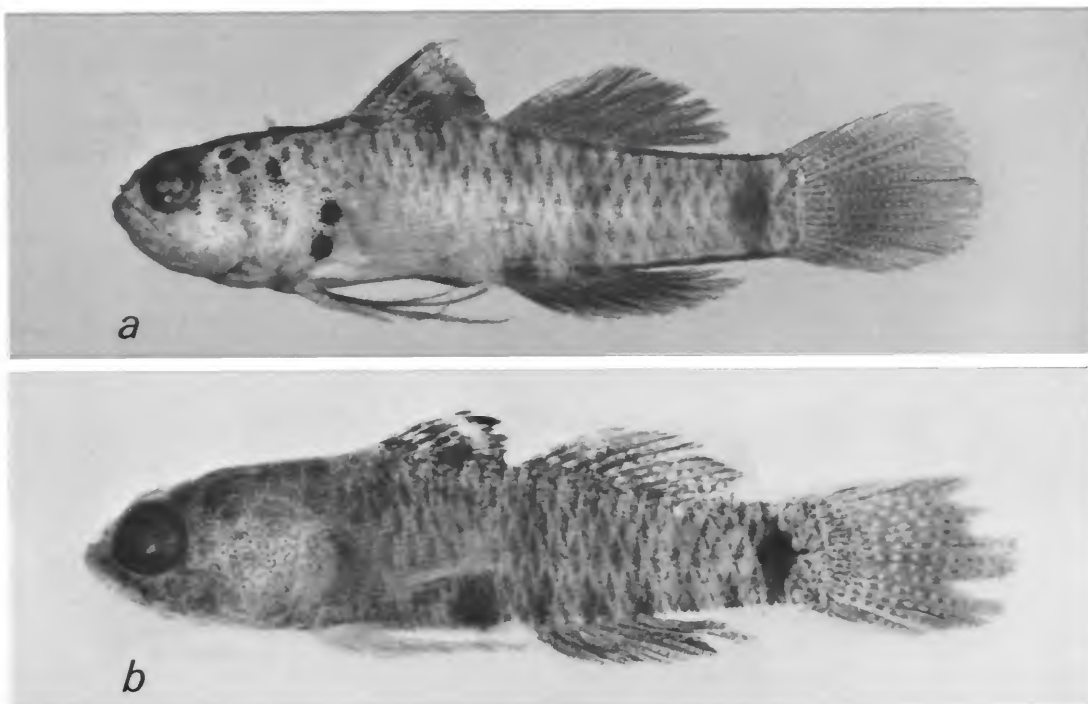


FIGURE 4.—*Eviota distigma*: a, USNM 216576, male, 14.6 mm SL, from Palmyra, Line Islands; b, ANSP 138924, female, 10.5 mm SL, from the Seychelles.

fourth pelvic fin ray; males with 2 dark conspicuous spots on base of pectoral fin, absent or faintly developed in females.

DESCRIPTION.—Data for certain meristic characters over the range of this species are summarized in Table 1. Other data follow: pelvic fin membrane well developed; branched caudal fin rays 12(4), 13(16), 14(7), 15(1); segmented caudal fin rays 16(2), 17(50); lateral scale rows 22(4), 23(30), 24(7), 25(1); transverse scale rows 5(3), 6(11). Scales with about 21–29 ctenii, 10–13 primary radii.

First 3 dorsal spines of males may be elongate, the first 2 filamentous and the first usually longest, the maximum length not exceeding end of depressed second dorsal fin; no spinous dorsal elongation in females; pelvic fins moderately long, usually reaching the origin of the anal fin or extending beyond it; breast scaleless.

The cephalic sensory pore system as in pattern 1. Cutaneous papillae system as in pattern A.

Genital papilla in male not fimbriate, moderately broad and long, sometimes reaching base of

first anal fin ray, and occasionally flared at tip; female papilla bulbous, reaching at most to anal spine, the tip with 4–6 fingerlike projections.

Gravid females range in size from 11.5–14.5 mm SL.

Vertebrae 10(23) precaudal and 15(1), 16(20), 17(2) caudal, total 25(1), 26(20), and 27(2).

COLOR IN PRESERVATION.—Two dark spots on base of pectoral fin in males, faint or obscure in females; head and nape dorsally with large dark spots in males about size of the pupil or larger, weaker in females, occasionally spots form transverse bars on nape; cheek and opercle with faint spots only; a dark subcutaneous spot on caudal peduncle about 3 scale rows anterior to base of caudal fin; 6 dark spots on ventral midline from anal fin origin posteriorly to base of caudal fin; scale pockets heavily pigmented; spinous dorsal fin brownish or with 1–3 dark bands, more pronounced in females; second dorsal, anal, and caudal fins dark with varying amounts of small, light spots on the rays.

GEOGRAPHIC DISTRIBUTION.—This species ranges from the Red Sea to Oceania and eastern Australia, but it is not represented in our study material from Sri Lanka eastward through the Indonesian and Philippine Islands to New Guinea, except for one specimen from Saparua Island, Indonesia.

REMARKS.—The extant original material consists of five specimens at the National Museum of Natural History (USNM 51767) and one at the California Academy of Sciences (SU 8710). Jordan and Seale (1906:390) listed 14 specimens from Apia and Pago Pago, Samoa, and state that the "type" (USNM 51767) was from Pago Pago, five-eighths of an inch long. The jar bearing the number 51767, however, contains five specimens and these were entered in the register 8 January 1905, prior to publication. The single specimen at CAS bears the same field data as the USNM specimens. We consider these six specimens syntypes, and because they are nearly the same length, the "type" specimen referred to by Jordan and Seale is not identifiable. We designate as the lectotype a male (SU 8710), about 13.1 mm SL, for the following reasons: a tag labeled "Drawn" is with the SU specimen, and the original illustration, Figure 79, was labeled "Type"; from the color description and illustration, we determined that the type was a male, and of the six original specimens, three are males and two are females of this species, and one specimen in the USNM series is a male of another unidentifiable species of *Eviota*; two of the three males have a typical anal fin ray count of I,8, one of which is the SU specimen, the other specimen has a count of I,7; of these two specimens, the existing color pattern, particularly the first dorsal fin, of the SU specimen agrees most closely with Figure 79.

The unidentifiable specimen of *Eviota* removed from the syntypic series of *E. distigma*, recataloged as USNM 216467, has the following characters differing from *E. distigma*: D. VI–I, 9; IT pore absent; and the second neural spine flared at outer portion.

Eviota distigma has four branched pelvic fin rays and a rudimentary or small, simple fifth one—not five branched rays as shown in Figure 79.

We find no major differences between the Red Sea and Indian Ocean specimens, including the type material of *E. stigmapteron* Smith, compared with those of Oceania.

Clark (1968:5,6) reported *E. stigmapteron*, herein synonymized with *E. distigma*, and *E. prasina* from the Red Sea. We examined part of Clark's study material of *E. stigmapteron* (HJ E62/514, 3 specimens) and allocated it to *E. pardalota*. Another specimen was not examined by us (HJ E62/4323).

Eviota guttata, new species

FIGURES 2a, 3b, 5

MATERIAL EXAMINED.—152 specimens from several localities in the Red Sea and 1 in the Gulf of Oman, totaling 72 males, 38 females, and 43 juveniles; size range 8.1–18.5; largest male 17.4, largest female 18.5, smallest gravid female 13.0.

Holotype: USNM 218013 (15.8), female; Red Sea, Ethiopian naval base, Massawa, 12 Aug 1969, V. G. Springer 69–12.

Paratypes: ETHIOPIA (collected in coastal and insular localities by V. G. Springer in 1969): USNM 218014, 8 (13.1–16.2), 3 juv., 3 males (15.4), 2 females (16.2); same data as holotype. USNM 218015, 5 (12.1–15.0), 2 juv., 3 males (15.0); Melita Bay, ca. 15°15'N, ca. 39°49'E, 13 Aug, VGS 69–13. USNM 218016, 5 (12.3–17.3), 2 juv., 3 males (17.3); Isola Dellemm, E of Ras Coral, 15°30.5'N, 39°54'E, 7 Aug, VGS 69–9. CAS 40598, 9 (11.8–15.8), 4 juv., 4 males (15.8), 1 female (14.8); Sciumma I., 15°32'31"N, 40°00'00"E, 9 Aug, VGS 69–10. USNM 218017, 31 (11.0–17.0), 14 juv., 11 males (17.0),

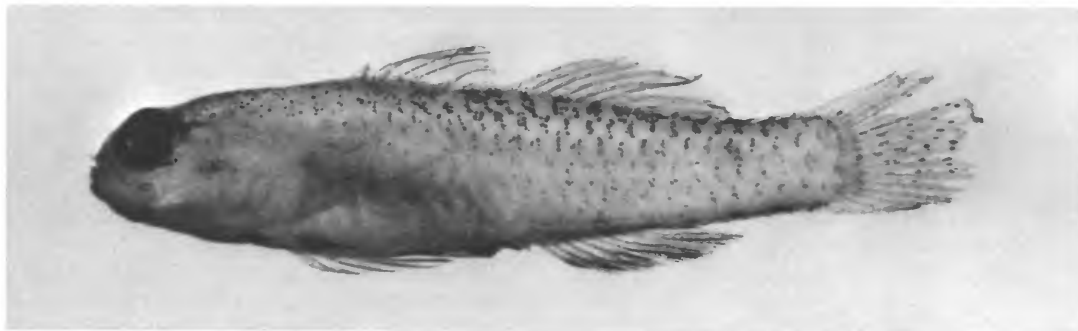


FIGURE 5.—*Eviota guttata*, holotype, female, 15.8 mm SL, from the Red Sea.

6 females (15.4); off Harat I., 16°08'N, 39°26.5'E, 14 Aug, VGS 69-14. USNM 218018, 10 (10.8-15.3), 8 juv., 1 male (15.3), 1 female (14.0); Difnein I., 16°36'N, 39°20'E, 15 Aug, VGS 69-15. GULF OF AQABA: USNM 218019, 16 (13.1-17.3), 7 males (17.3), 9 females (16.8); N of Ras Burqa, 23 Jul, VGS 69-7. USNM 218020, 1 (16.8), male; N of Ras Burqa, 5 Sep, VGS 69-21. USNM 218021, 15 (12.7-16.9), 1 juv., 12 males (16.9), 2 females (15.8); Marsa Muqabila, 29 Jul, VGS 69-08. ANSP 138900, 7 (11.1-14.2), 1 juv., 3 males (14.2), 3 females (13.7); Marsa Muqabila, 17 Jul, VGS 69-3. USNM 218022, 1 (15.0), male; Bay at El Himeira, 16 Jul, VGS 69-2. USNM 218023, 27 (8.1-17.4), 6 juv., 14 males (17.4), 7 females (12.9); Bay at El Himeira, 19 Jul, VGS 69-4. AMS I.20060-001, 11 (11.1-15.5), 1 juv., 5 males (15.5), 5 females (13.5); Bay between Marsa Mokrah and El Himeira, 15 Jul, VGS 69-1. USNM 218024, 5 (11.0-16.0), 1 juv., 4 males (16.0); between Marset Mahash el Ala and Marset Abu Samra, 2 Sep, VGS 69-18.

Neotype Material: USNM 218025, 1 (18.5), female; Gulf of Oman, S of Sidab, Muscat, 5 Mar 1977, W. F. Smith-Vaniz and J. E. Randall.

DIAGNOSIS.—Pectoral fin rays 4-17 may be branched, 11-14 always branched; spinous dorsal fin elongate and filamentous in males; fifth pelvic fin ray small, one-tenth or two-tenths length of fourth fin ray, almost always one-tenth; head and trunk dorsolaterally and caudal fin dappled or finely speckled.

DESCRIPTION.—Dorsal fin rays VI-I,8(3), VI-I,9(36); anal fin rays I,8(37), I,9(1); pectoral fin rays 15(2), 16(12), 17(23), 18(1); pelvic fin rays I,4 $\frac{1}{10}$ (35), I,4 $\frac{2}{10}$ (3); fourth ray of pelvic fin with an average of 7.5 branches, ranges 6-9; number of segments between consecutive branches of fourth pelvic fin ray averages 2.1, ranges 1-4; pelvic fin membrane well developed; branched caudal fin rays 11(6), 12(6), 13(1); segmented caudal fin rays 16(2), 17(41), 18(1); lateral scale rows 22(1), 23(8), 24(7); transverse scale rows 6(2), 7(8).

The scale structure is similar to that described for *E. zebrina*. There are 7-11 primary radii and 0-3 secondary radii in the anterior field; posterior margin of scale with a single row of 19-27 ctenii.

Spinous dorsal fin elongation occurs in males only, spines I-III may be filamentous, the first longest, extending to base of seventh ray of second dorsal fin. Depressed pelvic fin rarely extending beyond origin of anal fin. Breast scaleless.

The cephalic sensory pore system is pattern 1. The cutaneous papillae system represents pattern A.

Genital papilla in male lacks fimbriations, the tip slightly fringed and concave, length of papilla

extends to base of first anal fin ray; female with a short, bulbous papilla, not extending beyond anal spine and with 4 fingerlike projections at each side of tip.

Vertebrae 10(15) precaudal and 16(15) caudal, total 26.

COLOR IN PRESERVATION.—This species lacks outstanding color marks. The notable pattern consists of small dark spots on the dorsal midline of the trunk, numbering about 12-15; the series also extends forward on nape and occipital area as 3 marks along midline that may be diffuse and broken up into widely scattered chromatophores; trunk, mostly dorsolaterally, with fine dark speckling, the pigmentation in some specimens limited to scale pockets; small dark spots on membrane of caudal fin, usually about 5-7 along length of rays, remainder of caudal fin clear.

Head with short, weak horizontal bar, about at level of SOT pore, a similar small bar at about middle of preopercle, and a faint incomplete vertical mark from eye to rictus; snout with faint pigmentation, chin with weak spots or chromatophores, the most prominent spot along the midline posterior to gular area. Anterior lower portion of trunk and lower head unpigmented.

Seven weak to moderate spots along ventral midline from origin of anal fin to procurvent caudal fin rays, the first 6 largest, more pronounced, and associated with very weak, inconspicuous subcutaneous bars, the seventh spot questionably with a subcutaneous bar, the fifth and sixth bars possibly connected in middle region of trunk; 3 subcutaneous bars in belly region broaden to form dusky patches laterally, bars do not meet ventrally.

Spinous dorsal fin with a dusky horizontal band at or near base, some light brown pigmentation on spines, remainder of fin clear. Second dorsal fin has scattered brown speckling, mostly on membrane, remainder of fin clear. Anal fin uniform dusky brown, except basal area that is somewhat paler, and with a narrow clear margin. Rays of pectoral fin are bordered with fine dark chromatophores, remainder of fin clear. Pelvic fin clear. End of caudal peduncle with a narrow vertical bar composed of fine, dark pigment spots.

GEOGRAPHIC DISTRIBUTION.—Known from two areas of the Red Sea, the Gulf of Aqaba and the coastal waters and islands of Ethiopia, and from one locality in the Gulf of Oman.

ETYMOLOGY.—The specific name *guttata* is from the Latin word *gutta*, meaning "dappled" or "speckled," in reference to the numerous fine spots on the upper head, trunk, and caudal fin of this species.

Eviota pardalota, new species

FIGURES 1a, 6, 7

Eviota stigmatopteron Clark, 1968:6 [in part].

MATERIAL EXAMINED.—31 specimens from several localities in the Red Sea, totaling 11 males, 12 females, 8 juveniles; size range 9.1–18.8; largest male 18.8, largest female 17.4, no gravid females found.

Holotype: USNM 218006 (17.4), female; Gulf of Suez, E-tur, N of Sharm el Sheikh; 27 Sep 1969, V. G. Springer 69–29.

Paratypes: USNM 218007, 3 (11.4–17.4), 2 juv., 1 male

(17.4); same data as holotype. ETHIOPIA (coastal and insular areas): ANSP 138901, 2 (10.3, 13.2), juv.; Sheikh el Abu, W of S end of Harat I., 14 Aug 1969, V. G. Springer 69–14. USNM 218008, 2 (11.3, 12.0), females; mouth of Melita Bay, 13 Aug 1969, V. G. Springer 69–13. CAS 40597, 7 (12.6–16.0), 1 juv., 2 males (15.3), 4 females (16.0); Ethiopian naval base, Massawa, 12 Aug 1969, V. G. Springer 69–12. USNM 218009, 1 (13.3), male; Isola Delemme, E of Ras Coral, 7 Aug 1969, V. G. Springer 69–9. GULF OF AQABA: USNM 191717, 1 (18.8), male; Elat, 5–9 Sep 1960, E. Clark. USNM 218010, 1 (14.4), male; between Marsa Mokrakh and El Himeira, 15 Jul 1969, V. G. Springer 69–1. AMS I.20061–001, 1 (14.4), female; N of Ras Burqa, 23 Jul 1969, V. G. Springer 69–7. USNM 218011, 7 (10.5–18.3), 1 juv., 4 males (18.3), 2 females (16.2); Marsa Muqabila, 29 Jul 1969, V. G. Springer 69–8. USNM 218012, 2 (12.6, 16.3), juv. and male; N of Ras Burqa, 5 Sep 1969, V. G. Springer 69–21.

Nontype Material: HUY E62/514, 3 (9.1–13.5), 1 juv., 2 females (13.5); Dahlak Archipelago, Entedebir, 7 Apr 1962, E. Clark.

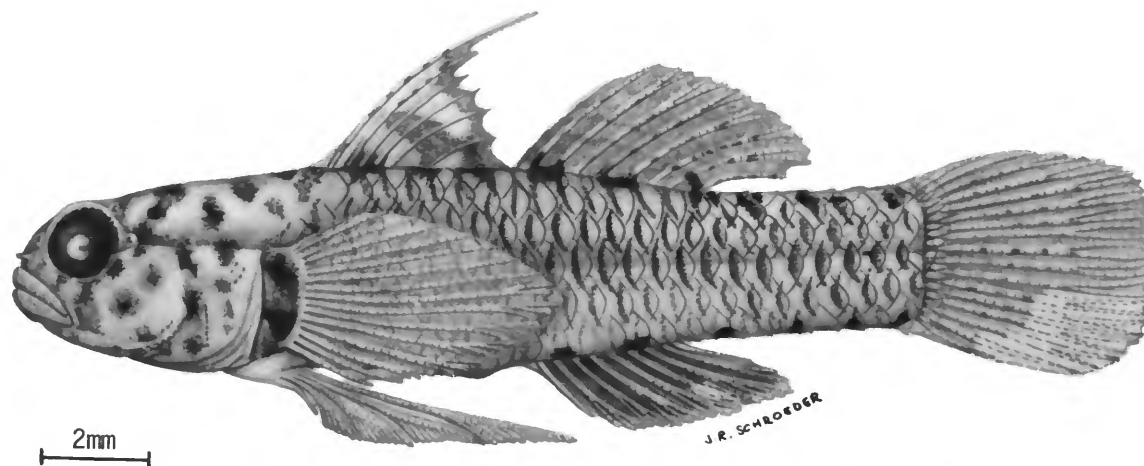


FIGURE 6.—*Eviota pardalota*, holotype, female, 17.4 mm SL, from the Red Sea. (Drawn by J. R. Schroeder.)



FIGURE 7.—*Eviota pardalota*, USNM 218011, female, 16.2 mm SL, from the Red Sea.

DIAGNOSIS.—Pectoral fin rays 3–16 may be branched, 10–14 always branched; spinous dorsal fin elongate or filamentous in both sexes, longer in males; fifth pelvic fin ray small, one-tenth length of fourth ray or rudimentary; head with large dark spots, about the size of the pupil, nape with similar spots or transverse bars; 2 large dark spots on fleshy base of pectoral fin; a series of dark spots on trunk along the dorsal and ventral midlines.

DESCRIPTION.—Dorsal fin rays VI–I,7(2), VI–I,8(26); anal fin rays I,6(2), I,7(26); pectoral fin rays 15(19), 16(9); pelvic fin rays I,4 + a rudiment (8), I,4 $\frac{1}{10}$ (20); fourth ray of pelvic fin with an average of 8.1 branches, ranges 5–10; number of segments between consecutive branches of the fourth pelvic fin ray averages 1.8, ranges 1–4; pelvic fin membrane reduced; branched caudal fin rays 13(4), 14(5); segmented caudal fin rays 17(27); lateral rows 23(1), 24(21); transverse scale rows 5(1), 6(21).

The scale structure is similar to that described for *E. zebrina*. There are 8–14 primary radii and 1–2 secondary radii in the anterior field; posterior margin of scale with a single row of 19–28 ctenii.

Both sexes may have elongate and filamentous first and second dorsal fin spines, the first usually longer; spines I–II may reach end of base of second dorsal fin in males, and in females both spines may extend to base of third dorsal fin ray. Pelvic fin long, always extending beyond origin of anal fin. Breast scaleless.

The cephalic sensory pore system is pattern 1 and the cutaneous papillae system represents pattern A.

Genital papilla in male without fimbriations, the tip slightly fringed, its length extending just beyond anal fin spine; female with short, bulbous papilla, not extending beyond anal fin spine and with 4 fingerlike projections at each side of tip.

Vertebrae 10(12) precaudal and 16(12) caudal, total, 26.

COLOR IN PRESERVATION.—Head with dark spots (about the size of pupil) dorsally, laterally, and ventrally those on occipital area darker, larger, and sometimes joined to form transverse bars; spots ventrally on head small and weak; cheek with about 4 circular spots and a prominent vertical bar from eye to rictus; snout with moderate to weak spotting and faint pigmentation; spots crowded dorsally on head immediately behind eyes.

Predorsal area on trunk has 2–3 short, transverse dark bars, the posteriormost bar sometimes seg-

mented into 2 lateral spots and the posterior bars sometimes connecting laterally.

Two dark spots, about the size of pupil, on upper and lower fleshy base of pectoral fin, weak scattered chromatophores between spots.

A series of 10 spots along dorsal midline from about base of second spine of first dorsal fin to procurrent rays of caudal fin, the first to third spots passing onto base of spinous dorsal fin, and the fourth to sixth spots passing onto second dorsal fin, leaving clear spaces between spots.

A series of 6 dark spots along ventral midline from origin of anal fin to procurrent caudal fin rays, spots 1–2 adjacent to anal fin, spots 3–6 on caudal peduncle; spots 1–5 are associated with vertical subcutaneous bars extending dorsally on trunk.

Scales laterally over most of trunk with heavily pigmented scale pockets.

Pectoral fin rays with fine dark chromatophores, the membrane clear. Pelvic fins clear. Two weak to moderately developed dark spots on each side of anterior base of pelvic fins. First dorsal fin with 3 broad, oblique, bandlike marks, extending upward from the first 3 dorsal midline trunk spots, more or less joined in midsection of fin, leaving clear areas between dark basal spots. The filamentous dorsal spines have small dark spots to tip. Second dorsal fin dusky, the spine and rays with small dark spots in a linear series of 3–4 rows, usually poorly developed. Anal fin uniformly dusky with a narrow, clear margin; area at base of anal fin between midline spots pale. Caudal fin dusky with a series of 4–5 irregularly arranged small spots on most branched rays, moderately developed. Weak vertical bar at base of fin rays.

Five weak to moderately developed subcutaneous bars aligned with the ventral midline spots, and a weak sixth bar on lower trunk above the sixth spot; third and fourth bars merge along midline and form a single bar on upper trunk; fifth bar widens at midline and may be divided at midline but is single above and below. Three weak, wide subcutaneous bars on belly region, not joined along ventral midline, posteriormost just lateral of anal aperture.

GEOGRAPHIC DISTRIBUTION.—A species endemic to the Red Sea, taken at three general localities: the Gulf of Aqaba, Gulf of Suez, and the coastal and insular areas of Ethiopia.

ETYMOLOGY.—The specific name *pardalota* is

from the Greek word *pardos*, meaning "spotted like a leopard," in reference to the numerous body spots characterizing this species.

REMARKS.—One specimen (HUI E62/4323) reported as *E. stigmateron* by Clark (1968:6) was not seen by us.

Eviota prasina (Klunzinger)

FIGURES 3*a,c*, 8

Eleotris prasinus Klunzinger, 1871:481 [type-locality: Koseir, Red Sea].—Clark, 1968:5 [in part].

Allogobius viridis Waite, 1904:177, pl. 23: fig. 3 [type-locality: Lord Howe Island].

Eviota verna Smith, 1958:139, fig. 1, pl. I: J-L [type-locality: Aldabra].

MATERIAL EXAMINED.—908 specimens from 96 collections taken from the Red Sea eastward to Japan in the north and Lord Howe and Norfolk Islands to the south; size range 7.0–30.9, largest male 30.9, largest female 26.5, smallest gravid female 10.9. Only type specimens and Red Sea material are listed below.

Lectotype: NFIS 1693 (11.6), female; Koseir, Red Sea, C. B. Klunzinger.

Syntypes of *Allogobius viridis* Waite: AMS I. 5880–5884, 15 (19.9–30.5), 8 males (30.5), 7 females (24.6); Feb 1903, Waite and McCulloch.

Holotype of *Eviota verna* Smith: RUSI 255 (18.6), male; Aldabra.

Nontype Material: GULF OF AQABA: USNM 191716, 1 (14.8), female; Elat, 5–9 Sep 1960, E. Clark. ANSP 83366, 2 (14.3, 16.1), males; Elat, 26 Apr 1950, H. Steinitz 2050. HUI E62/39, 1 (14.7), male; Elat, 4 May 1960. USNM 218003, 7 (8.5–15.5), 2 juv., 4 males (15.5), 1 female (10.9); Marsa Muqabala, 29 Jul 1969, V. G. Springer 69–8. AMS I.20061–002, 2 (11.8, ca. 14.0), males; Ras Burqa, 23 Jul 1969, V. G. Springer 69–7. DIFNEIN ISLAND: USNM 218004, 2 (13.2, 13.7), 1 juv., 1 male (13.7); S shore Ethiopia, 15 Aug 1969, V. G. Springer 69–15. SOUTHERN END OF SINAI PENINSULA: BPBM 18343, 1 (14.6), male; Ras Muhammed, 19 Sep 1974, J. E. Randall. DAHLAK ARCHIPELAGO: HUI E62/3678g, 4 (11.7–14.3), females; Um Aabak, 6 Apr 1962, E. Clark. HUI E62/507, 39 (7.0–14.9), 17 juv., 10 males (14.9), 12 females (13.8); Entedebir, 7 Apr 1962. HUI E62/4313, 25 (8.0–15.6), 3 juv., 13 males (15.6), 9 females (14.5); Entedebir, 7 Apr 1962. ZUBAIR ISLAND: USNM 218005, 12 (10.9–15.2), 6 males (15.2), 6 females (14.0); 30 Sep 1967, E. Clark.

DIAGNOSIS.—Pectoral fin rays branched, usually the eleventh through the sixteenth; spinous dorsal fin elongate or filamentous in males; fifth pelvic fin ray usually absent, rudimentary when present; genital papilla in male highly fimbriate; a dark, circular to chevron-shaped spot on middle of caudal peduncle, about 3 scale rows from caudal fin base;

usually 2 weak to moderately developed dark spots laterally on occipital area, obscure or intense in some localities; 2 weak spots usually on pectoral fin base; 5 dark subcutaneous spots on ventral midline posterior of anal fin origin.

DESCRIPTION.—Data for certain meristic characters over the range of this species are summarized in Table 1. Other data follow: pelvic fin membrane reduced; branched caudal fin rays 11(1), 12(31), 13(31), 14(6); segmented caudal fin rays 16(4), 17(90); lateral scale rows 23(15), 24(73), 25(2); transverse scale rows 6(16), 7(40), 8(3). Scales with about 27–35 ctenii, 11–16 primary radii.

First dorsal spine in males filamentous, maximum length when depressed, to base of seventh dorsal ray, second spine rarely elongate; no spinous dorsal elongation in females; pelvic fins usually extending just anterior to origin of anal fin; breast scaleless.

The cephalic sensory pore system as in pattern 2. The cutaneous papillae system as in pattern B.

Genital papilla in male highly fimbriate along lateral edges, the tip moderately indented and fringed, papilla extends to first anal spine; female papilla bulbous, reaching at most to anal spine, the tip with 4–6 fingerlike projections.

Gravid females range in size from 10.9 to 22.6 mm SL.

Vertebrae 10(24) precaudal and 16(23) caudal, total 26(23).

COLOR IN PRESERVATION.—The prominent color pattern of the species (Figure 8 *a–c*) consists of a dark caudal peduncle spot, usually 2 occipital spots, and 2 weak pectoral spots; small weak spots on dorsal midline, often obscure; cheek and predorsal areas often spotted or with scattered chromatophores; outer four-fifths of first dorsal fin usually dark; second dorsal fin dusky to dark; anal fin dark, more so than second dorsal fin; caudal fin dusky with fine spots mostly in upper basal portion; scale pockets with weak dark margins; 5 dark spots along ventral midline of posterior trunk integrated with subcutaneous bars. The black marks on the membrane of the spinous dorsal fin (Figure 8*a*) are well developed and commonly present in the Red Sea and Japanese collections, infrequently present elsewhere.

GEOGRAPHIC DISTRIBUTION.—Aside from the collections listed above for the Red Sea, this species is widely distributed in the western Indian Ocean, Sri Lanka, Gulf of Thailand, Indonesia, New

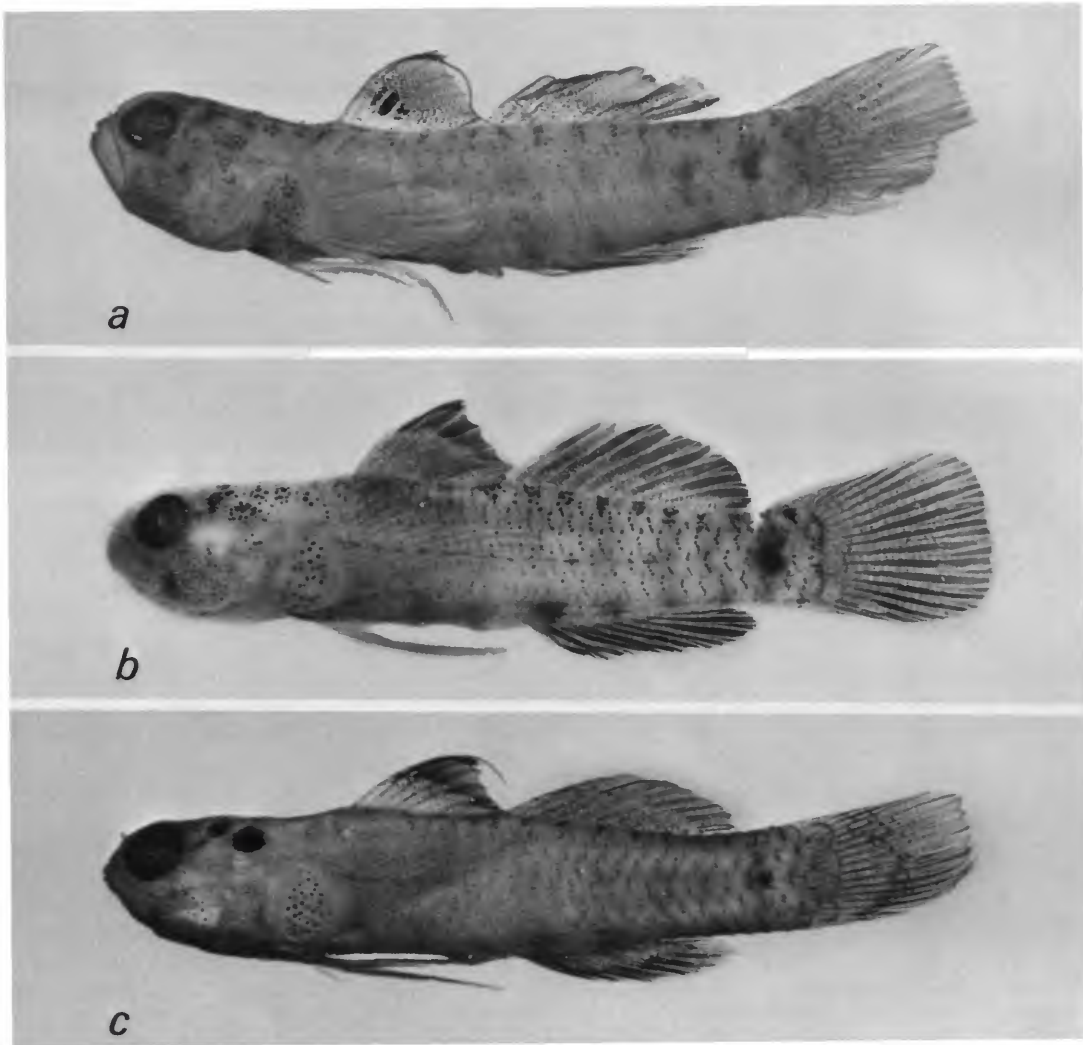


FIGURE 8.—*Eviota prasina*: a, ANSP 83366, male, 16.1 mm SL, from the Red Sea; b, ANSP 138925, male, 15.2 mm SL, from the Seychelles; c, RUSI 2276, male, 13.6 mm SL, from Mauritius.

Guinea, northward to Japan, and southward in the Lord Howe and Norfolk Islands, but absent on the Great Barrier Reef.

REMARKS.—We recognize five geographic populations of this species, restricted more or less to the following localities: Red Sea, western Indian Ocean, Indonesia to the Philippine Islands, South China Sea to Japan, and Lord Howe and Norfolk Islands. These populations differ in certain meristic and color characters but the low level of differ-

entiation does not merit subspecific recognition. A comprehensive analysis of this problem will be treated in our revisionary study.

Eviota sebreei Jordan and Seale

FIGURES 1b, 2c, 9

Eviota sebreei Jordan and Seale, 1906:390, fig. 80 [type-locality: Apia, Samoa Islands].

MATERIAL EXAMINED.—140 specimens from 47 collections

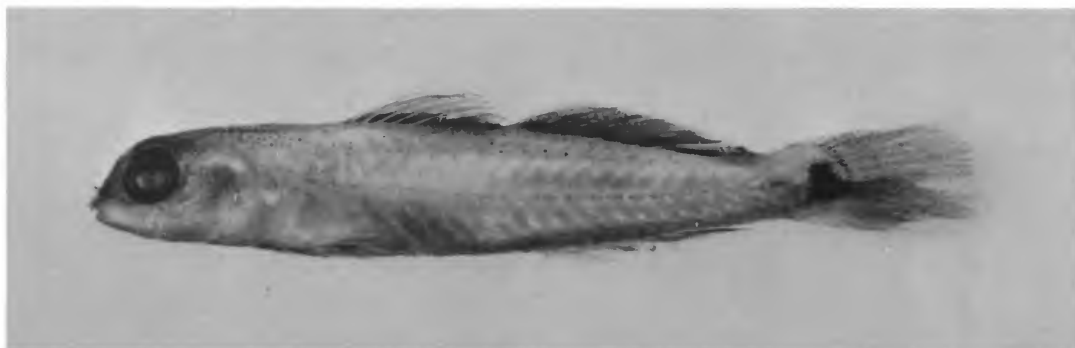


FIGURE 9.—*Eviota sebreei*, USNM 218054, male, 14.7 mm SL, from St. Brandon Shoals.

taken from the Red Sea eastward to islands of Oceania; size range 7.3–20.4; largest male 20.4, largest female 19.8; smallest gravid female 11.6. Only the holotype and Red Sea material are listed below.

Holotype: USNM 51765 (13.5), male; Samoa Islands, Apia, 1902, Jordan and Kellogg.

Nontype Material: RED SEA (Gulf of Aqaba, collected by V. G. Springer): USNM 213855, 1 (17.0), male; El Himeira, 16 Jul 1969, 69–2. USNM 213856, 2 (8.6, 9.0), juv.; Marsa Muqabila, 17 Jul 1969, 69–3. USNM 213857, 1 (13.6), female; Ras Burqa, 21 Jul 1969, 69–6. USNM 213858, 1 (16.6), male; Marsa Muqabila, 29 Jul 1969, 69–8. USNM 213859, 9 (12.0–14.1), 3 juv., 6 males (14.1); El Himeira, 8 Sep 1969, 69–23. CAS 40596, 2 (12.5, 12.0), male, female; El Himeira, 9 Sep 1969, 69–24.

DIAGNOSIS.—A slender species, body elongate, not deep, the snout pointed, more conical than most other *Eviota*; pectoral fin rays not branched; spinous dorsal fin not elongate; rays of pelvic fins highly fringed; the fifth pelvic fin ray well developed, about seven-tenths length of the fourth ray; nasal pores and sensory canals absent, AITO present, opening anteriorly, PITO absent; a large dark basicaudal spot, the lower portion streaking to tip of caudal fin.

DESCRIPTION.—Data for certain meristic characters over the range of the species are summarized in Table 1. Other data follow: pelvic fin membrane well developed; branched caudal fin rays 10(5), 11(18); segmented caudal fin rays 17(29); lateral scale rows 23(18), 24(6); transverse scale rows 6(10), 7(3). Scales with about 16–22 ctenii, about 10–12 primary radii.

Second or third dorsal spine longest, just slightly longer than first spine; pelvic fins almost always extend to origin of anal fin or slightly beyond; breast scaleless.

Cephalic sensory pore system as in pattern 6. Cutaneous papillae system as in pattern C.

Genital papilla in male simple, elongate, sometimes reaching base of second anal fin ray, tapering gently, and slightly bilobed at tip; bulbous papilla of female longer than in most species, usually reaching beyond anal fin origin, occasionally to base of second anal fin ray.

Vertebrae 10(1), 11(6) precaudal and 14(6), 15(1) caudal, total 25.

COLOR IN PRESERVATION.—The prominent color marks are a large dark spot at base of caudal fin, the lower portion extending posteriorly to margin of fin as a streak; a dark horizontal band at base of spinous dorsal fin; and a dark second dorsal fin as shown in Figure 9.

GEOGRAPHIC DISTRIBUTION.—In addition to the collections listed above from the Red Sea, this species has been taken from the Indian Ocean, Sri Lanka, southern Indonesia, Western Australia, Great Barrier Reef, and islands of Oceania.

Eviota zebрина, new species

FIGURES 2b, 10, 11

MATERIAL EXAMINED.—824 specimens from 13 major localities, totaling 348 males, 205 females, 271 juveniles; total range 7.1–19.0; largest male 19.0, largest female 17.4, smallest gravid female 10.8.

Holotype: USNM 218026 (15.9), male; Seychelle Islands, Curieuse I., 23 Feb 1964, J. E. Böhlke, F-64.

Paratypes: SEYCHELLE ISLANDS (collected by J. E. Böhlke in 1964): CURIEUSE ISLAND: USNM 218027, 22 (8.2–15.3), 2 juv., 14 males (15.3), 6 females (13.0); same data as holotype. ANSP 138902, 15 (7.1–15.3), 7 juv., 4 males (15.3), 4 females (12.5); 24 Feb, F-66. BEACON ISLAND: ANSP 138903, 4

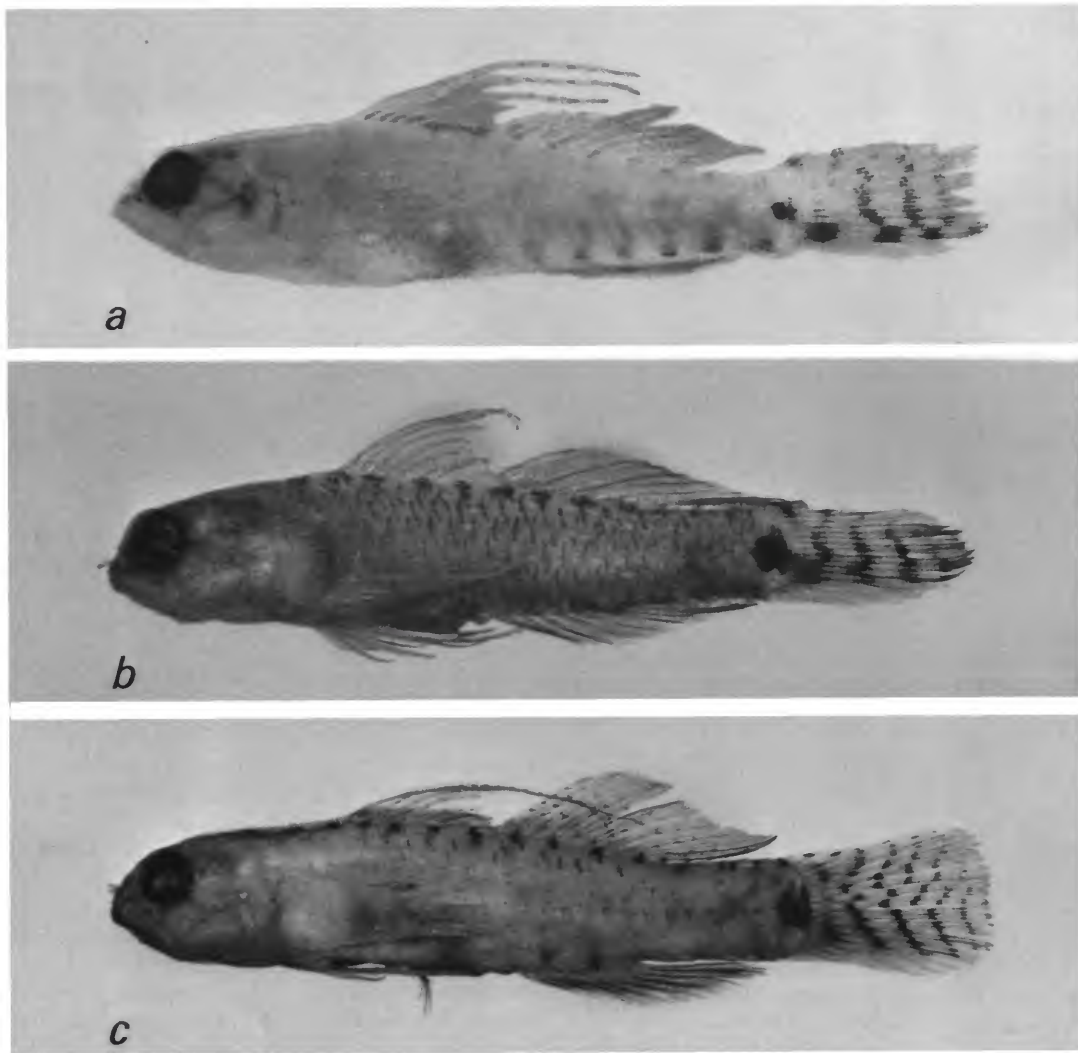


FIGURE 10.—*Eviota zebrina*: a, USNM 218034, male, 13.2 mm SL, from the Red Sea; b, ANSP 138909, male, 13.3 mm SL, from the Seychelles; c, WAM P25608-036, male, 18.0 mm SL, from Western Australia.

(8.4–13.4), 1 juv., 2 males (13.4), 1 female (12.5); 3 Feb, F-18. PRASLIN ISLAND: ANSP 138904, 18 (8.0–14.6), 6 juv., 5 males (14.6), 7 females (13.0); 22 Feb, F-59. ANSP 138905, 28 (8.1–15.0), 10 juv., 12 males (15.0), 6 females (13.2); 22 Feb, F-61. FAON ISLAND: ANSP 138906, 99 (7.6–18.1), 31 juv., 43 males (18.1), 25 females (14.6); 29 Jan, F-11. CAS 40599, 31 (8.2–16.3), 8 juv., 15 males (16.3), 8 females (15.3); 28 Jan, F-10. ANSP 138907, 5 (8.6–16.7), 2 juv., 1 male (16.7), 2 females (11.6); 24 Jan, F-3. MAHÉ: ANSP 138908, 33 (8.5–16.1), 7 juv., 19 males (16.1), 7 females (14.4); 11 Feb, F-44. ANSP 138909, 29 (8.0–14.3), 15 juv., 9 males (14.3), 5 females (13.9);

15 Mar, F-114. ANSP 138910, 11 (11.9–16.3), 7 males (16.3), 4 females (13.9); 9 Feb, F-36. ANSP 138911, 1 (12.9), female; 8 Feb, F-35. AMS I.20062-001, 13 (8.5–18.7), 4 juv., 5 males (18.7), 4 females (13.2); 2 Feb, F-17. ANSP 138912, 1 (12.2), female; 10 Feb, F-37. ANSP 138913, 1 (12.3), male; 15 Feb, F-52.

Nontype Material: RED SEA: USNM 218028, 1 (16.2), male; Jeddah Harbor, 10 Apr 1977, W. F. Smith-Vaniz. USNM 218029, 1 (12.1) male; Strait of Jubal, Ras Muhammad, 28 Sep 1969, V. G. Springer 69-30. BPBM 20379, 1 (10.9), male; Sudan, Suakin Harbor, 12 Oct 1964, J. E. Randall. GULF OF

AQABA: USNM 218030, 3 (13.0-16.5), 2 males (16.5), 1 female (14.3); Bay between Marsa Mokrah and El Himeira, 15 Jul 1969, V. G. Springer 69-1. USNM 218031, 23 (8.4-15.3), 7 juv., 9 males (15.3), 7 females (14.0); El Himeira, 16 Jul 1969, V. G. Springer 69-2. USNM 218032, 6 (8.1-11.4), 3 juv., 3 males (11.4); Marsa Muqabila, 17 Jul 1969, V. G. Springer 69-3. USNM 218033, 6 (8.8-11.2), 2 juv., 1 male (11.2), 3 females (10.7); El Himeira, 19 Jul 1969, V. G. Springer 69-4. USNM 218034, 167 (8.7-16.3), 36 juv., 91 males (15.8), 40 females (16.3); El Himeira, 8 Sep 1969, V. P. Springer 69-23. USNM 218035, 106 (8.2-14.9), 50 juv., 28 males (14.4), 28 females (14.9); El Himeira, 9 Sep 1969, V. G. Springer 69-24. FMNH 83851, 2 (11.1-12.9), 1 juv., 1 male (12.9); Elat, 1972, J. Sohn. FMNH 83850, 1 (14.6), male; Elat, 1972, J. Sohn, no. 16. BPBM 13428, 1 (16.1), male; El Himeira, 9 Jun 1972, J. E. Randall. INDIAN OCEAN: ST. BRANDON SHOALS (collected by V. G. Springer in 1976): USNM 218036, 18 (8.1-17.1), 7 juv., 9 males (17.1), 2 females (15.0); 2 Apr, VGS 76-5. USNM 218037, 5 (12.0-14.1), 3 juv., 1 male (13.1), 1 female (14.1); 4 Apr, VGS 76-8. USNM 218038, 4 (15.0-17.2), males; 6 Apr, VGS 76-10. USNM 218039, 1 (11.9), juv.; 8 Apr, VGS 76-12. USNM 218040, 7 (11.3-19.0), 1 juv., 4 males (19.0), 2 females (13.7); 11 Apr, VGS 76-18. USNM 218041, 1 (13.8), juv.; 12 Apr, VGS 76-19. USNM 218042, 21 (12.6-18.7), 7 juv., 8 males (18.7), 6 females (16.1); 12 Apr, VGS 76-20. USNM 218043, 1 (16.0), female; 14 Apr, VGS 76-22. CHAGOS ARCHIPELAGO: USNM 218044, 1 (15.4), female; Diego Garcia Atoll, 23 Jun 1967, H. A. Fehlmann 67-17. SRI LANKA: USNM 218045, 2 (9.4-15.4), 1 juv., 1 male (15.4); Trincomalee, 1 Oct 1969, P. C. Heemstra 69-280. USNM 218046, 3 (12.4-16.9), males; Korali Pattu, Passakudah Bay, 10 Jun 1970, T. Iwamoto 70-349. USNM 218047, 1 (14.1), male; Trincomalee, 3 Apr 1970, C. C. Koenig 69-133. USNM 218048, 1 (11.8), female; Trincomalee, 4 Apr 1970, C. C. Koenig 69-135. USNM 218049, 2 (14.5, 15.5) males; Trincomalee, 4 Apr 1970, C. C. Koenig 69-136. USNM 218050, 27 (8.0-16.9), 12 juv., 8 males (13.9), 7 females (16.9); Trincomalee, 6 Apr 1970, C. C. Koenig 69-141. USNM 218051, 3 (12.6-14.9), 1 male (12.6), 2 females (14.9); Trincomalee, 8 Apr 1970, C. C. Koenig 69-143. USNM 218052, 1 (16.8), male Hikkaduwa, 12 Feb 1970, C. C. Koenig 69-100. WESTERN AUSTRALIA: AMNH 36905, 1 (17.4), female; Port Hedland, 13 Apr 1969, D. Rosen 1969-75. WAM P25819-028, 1 (18.1), male; South Muiron I., 8 Jun 1977, Hutchins and Trendall, MUR-77-009. WAM P25608-036, 2 (18.0, 16.1), male and female; Dampier Arch., Kendrew I., 23 Oct 1974, G. R. Allen. GREAT BARRIER REEF, QUEENSLAND, AUSTRALIA (collected by J. Tyler and C. L. Smith in 1969): ENDEAVOUR REEF: AMNH 36906, 1 (10.8), juv.; 6 Jan, S69-7. AMNH 36907, 1 (11.8), juv.; 13 Jan, S69-14. AMNH 36908, 3 (10.6-15.1), 2 juv., 1 male (15.1); 14 Jan, S69-16. ANSP 138915, 4 (9.8-15.6), 1 juv., 2 males (15.6), 1 female (13.9); 4 Jan, TSA-3. ANSP 138916, 6 (9.7-13.3), 3 juv., 1 male (13.0), 2 females (13.3); 6 Jan, TSA-5. ANSP 138917, 17 (10.0-14.1), 6 juv., 4 males (13.8), 7 females (14.1); 11 Jan, TSA-11. ANSP 138918, 2 (11.2, 11.9), juv.; 13 Jan, TSA-12. ANSP 138919, 14 (8.8-14.6), 10 juv., 1 male (14.6), 3 females (14.2); 14 Jan, TSA-15. ANSP 138920, 3 (11.8-14.8), 1 juv., 1 male (14.8), 1 female (14.5); 15 Jan, TSA-16. ANSP 138921, 2 (13.4, 14.2), 1 juv., 1 male (14.2); 16 Jan, TSA-17. LITTLE HOPE ISLAND: AMNH 36909, 1 (14.9), male; 19 Jan,

S69-23. AMNH 36910, 9 (8.6-16.7), 5 juv., 3 males (15.3), 1 female (16.7); 20 Jan, S69-25. AMNH 36911, 2 (12.9, 13.8), juv. and female; 20 Jan, S69-26. USNM 218053, 7 (9.2-19.0), 2 juv., 3 males (19.0), 2 females (14.9); 21 Jan, S69-28. AMNH 36912, 1 (9.8), juv.; 21 Jan, S69-30. ANSP 138914, 6 (12.0-18.0), 1 juv., 2 males (18.0), 3 females (16.2); 3 Jan, TSA-2. BIG HOPE ISLAND: ANSP 138922, 8 (10.8-17.0), 4 juv., 3 males (17.0), 1 female (14.3); 19 Jan, TSA-21. ANSP 138923, 3 (13.6-14.7), 1 juv., 1 male (14.7), 1 female (14.1); 19 Jan, TSA-22. ONE TREE ISLAND: AMS I.20063-001, 1 (12.8), male; 24 Nov 1969, F. Talbot 412.

DIAGNOSIS.—Pectoral fin rays not branched; spinous dorsal fin elongate or filamentous in both sexes, longer in males; fifth pelvic fin ray inconspicuous, usually one-tenth length fourth ray; midbase of caudal fin with a dark spot and short vertical bar; caudal fin with 3-4 dark, wavy, narrow vertical bars; spinous dorsal fin with a dark, narrow horizontal band near base.

DESCRIPTION.—Dorsal fin rays VI-1,7(1), VI-1,8(38), VI-1,9(96), VI-1,10(3); anal fin rays I,7(36), I,8(89), I,9(6); pectoral fin rays 14(3), 15(20), 16(31), 17(37), 18(9); pelvic fin rays I,4 + a rudiment (2), I,4 $\frac{1}{10}$ (35), I,4 $\frac{2}{10}$ (3); fourth ray of pelvic fin with an average of 7.4 branches, range 5-11; number of segments between consecutive branches of the fourth pelvic fin ray averages 2.3, ranges 1-6; pelvic fin membrane usually intermediate in development but sometimes reduced or well developed; branched caudal fin rays 11(19), 12(6), 13(2); segmented caudal fin rays 16(1), 17(39); lateral scale rows 21(1), 22(8), 23(13), 24(2); transverse scale rows 5(3), 6(8).

Scales ctenoid, eccentric, the radii converge on a broad focal area in posterior field; anterior field with 7-10 primary radii, 1-3 secondary radii; posterior margin of scale with a single row of 23-27 ctenii.

Dorsal fin spines I-IV may be filamentous in males, the first spine longest, reaching the procurvent caudal fin rays when depressed. Females usually without elongation of the dorsal fin spines but occasionally the first spine may be slightly filamentous, extending to the base of the second dorsal fin ray. Pelvic fin almost always extends beyond origin of anal fin. Breast scaleless.

The cephalic sensory pore system as in pattern 2. The cutaneous papillae system as in pattern B, the important aspect being the continuous lateral cephalic row (Figure 2b).

Genital papilla in male without fimbriations, the

tip slightly bifurcate, elongate, and reaching base of second anal fin ray; female with short, bulbous papilla, not extending beyond anal fin spine, and with 2-3 fingerlike projections at each side of tip.

Vertebrae 10(20) precaudal and 15(19), 16(1) caudal, total 25(19), 26(1).

COLOR IN PRESERVATION.—The wide geographical range of this species, extending from the Red Sea to the Great Barrier Reef, and the fact that certain specific color marks show variation over this range necessitate describing separately each salient color mark or fin pattern and its variation among several localities. Unless stated otherwise the general color pattern described is inclusive of specimens from the type-locality.

Dark Dorsal Midline Spots: Typically 3 spots along midline in occipital-nape area and 10-12 (usually 11-12) spots on trunk midline, the first occurring just before spinous dorsal fin and extending to just before procurrent caudal fin rays. The occipital-nape spots and the first trunk spot widen to form transverse bars in some specimens from Sri Lanka and the Great Barrier Reef. All collections from Australia have 13 trunk spots, and those on specimens from the Great Barrier Reef are enlarged and saddlelike.

Dark Ventral Midline Spots: Typically 6 subcutaneous spots, occurring along ventral midline from about the base of the second anal fin ray to end of caudal peduncle. The third to the fifth spots usually with surface pigmentation. The sixth spot is usually weak and sometimes a weak, small seventh spot is present. The subcutaneous bar, upward from the sixth spot, extends obliquely forward. The bars extending upward from spots 1-5 branch along middle of trunk becoming Y-shaped or H-shaped marks; they merge to form a continuous but irregular subcutaneous midtrunk band. The Seychelles and Red Sea collections have 6 ventral spots, St. Brandon collections number 6-7 (usually 7), and all other collections have 7 spots. The spots are very weak or obscure in St. Brandon collections and prominent in the Red Sea and all Australian collections.

Head Marks: A dark horseshoe-shaped mark on snout, extending from anterior portion of eye, encircling anterior nostril, then passing posteriorly to upper portion of eye mesad to nasal sensory pores. Two dark, short, bilateral postocular bars extend posteriorly on head, dorsally to occipital area. Bars

on each side may join posteriorly and consist of a loose aggregate of chromatophores or are uniform pale to dark brown. The horseshoe-shaped snout mark is weakly developed in collections from the Seychelles, St. Brandon, and Western Australia. The postocular bars are weak in collections from the Seychelles, St. Brandon, and the Great Barrier Reef and are replaced in Western Australia by uniformly scattered brown chromatophores. Specimens from Sri Lanka have a distinct dark bar from eye to rictus, passing onto lower jaw and forward to its tip.

Basicaudal Spot: A dark circular spot at end of midcaudal peduncle, barely touching a narrow, vertical dark bar at base of caudal fin rays. The circular spot is smaller than the pupil in Red Sea specimens and it is equal to or, more commonly, larger than the pupil in all other specimens. The circular spot may be deeper than wide in some specimens, particularly those from the Seychelles and St. Brandon. The vertical bar is as deep or deeper than diameter of spot and it may be separated from spot by a narrow clear area or joined to it.

Dark Oblique Caudal Fin Bars: A series of about $3\frac{1}{2}$ - $4\frac{1}{2}$ narrow wavy oblique bars in adults, reduced to 3 bars in some smaller specimens, and up to $5\frac{1}{2}$ bars in Western Australia. Bars weak to moderately developed, the first and second may be enlarged ventrally, the first widest, may equal width of basicaudal spot and may emerge slightly with it; bars fainter on upper part of fin. Bars may be broken into segments, the first one commonly broken near middle portion, the upper section sometimes absent, lower portion of first bar sometimes joining upper portion of second (Sri Lanka), bars often greatly divided into several sections (all of Australian collections). Basal portion of bars of Red Sea collections enlarged, forming spots, the first largest; slight enlargements also observed in specimens from the Seychelles and Western Australia. A dusky streak on lower half of caudal fin from its base to the tip, but excluding a narrow portion of the lower margin, occurs on St. Brandon specimens and on a few from the Red Sea. The oblique bars are weakly developed in specimens from St. Brandon and they are prominent in Australian localities.

Spinous Dorsal Fin: A dark, narrow band near base of fin, the remainder of membrane pale; a

series of small dark spots on filaments and outer portions of spines, absent basally.

Second Dorsal Fin: Light to moderately dusky, lower portion in some darker; 4–5 small spots on rays in a horizontal linear series, poorly developed or absent in many areas, conspicuous in specimens from Sri Lanka and Australia.

Anal Fin: Dusky, usually darker than second dorsal fin and with a narrow, pale margin.

Scale Pigmentation: The scale pockets are weakly pigmented except in Australian collections, where the pigmentation is heavy.

Specimens from St. Brandon were consistently pale colored, except for the very dark basicaudal spot. Specimens from this locality also have slender bodies, more so than in all other localities.

COLOR IN LIFE.—The following color data taken from a transparency of a male, 18.1 mm SL, WAM P25819–028, from Western Australia: a prominent reddish orange bar from lower eye to rictus and another mark from anterior eye to tip of anterior nostril; a diffuse pinkish orange area on opercle, extending slightly onto preopercle and base of pectoral fin; upper base of pectoral fin with weak, diffuse yellow orange color.

Subcutaneous bars and marks on the head and body consist of a prominent, dark horizontal bar from lower, posterior edge of eye to preopercle; 4 transverse bars on predorsal region; 12 dark spots, with some orange pigmentation, along dorsal midline of trunk, from origin of first dorsal fin to caudal fin; 7 dark spots on ventral midline from origin of anal fin to caudal fin; variously shaped darkish marks, some H-shaped, along midportion of trunk; belly dark.

Prominent yellow spots above and below dark, circular basicaudal spot; a light, somewhat circular area precedes dark basicaudal spot; a series of yellow, horizontally elongate spots on membrane between the rays of the caudal fin, alternating with dusky areas; the dark oblique bars on caudal fin, characteristic of preserved specimens, are weakly developed in this specimen; body more translucent than in preserved specimens; pigmentation of dorsal and anal fins similar to that of preserved specimens.

GEOGRAPHIC DISTRIBUTION.—Known from the Gulf of Aqaba and Red Sea eastward to the Great Barrier Reef, but not yet known from Indonesia, Philippine Islands, and Oceania (Figure 11).

ETYMOLOGY.—The specific name *zebrina* (NL), meaning “zebra-marked” or “striped,” is in reference to the dark oblique bars on the caudal fin.

REMARKS.—There are notable differences among populations from several localities. There is considerable divergence in the Red Sea collections as compared to all other areas, both in meristic characters and in specific color marks. The meristic differences involve the number of dorsal, anal, and pectoral fin rays, and these data are separated by localities in Table 2. All Red Sea specimens had an anal fin ray count of I,7, whereas the Indo-Australian specimens had counts of I,7–I,9, of which 72% had I,8–I,9. A character index, involving the summation of the dorsal and anal fin ray counts for each specimen, separated fewer of the specimens from these two areas than the number of anal fin rays. The Red Sea specimens also differed in having a smaller basicaudal spot, usually slightly smaller than the diameter of the pupil, whereas the spot on specimens from other localities was equal to or larger than the pupil. The lower portions of the first three bars on the caudal fin are enlarged, primarily on the first bar, and form spotlike marks. A dusky streak along the lower portion of the caudal fin is occasionally developed.

The characters described for the Red Sea population are shared variously by specimens from other localities. Some localities have specific color marks that are either poorly developed or they are not present in the Red Sea population, making it difficult with our present material to recognize subspeciation divergence within this species. The following important color differences are noted among the various localities.

1. Seychelles: The bars on the lower caudal fin are sometimes enlarged.

2. St. Brandon: The lower caudal fin typically has a well-developed dusky streak; most of the salient color marks characteristic of other populations are pale, with the exception of the prominent, dark basicaudal spot; the body is not as deep compared with specimens from other localities.

3. Sri Lanka: A well-developed dark bar of moderate intensity from eye to rictus is present, which is incompletely developed or absent in specimens from other localities; small dark spots, arranged in linear series, are present on the second dorsal fin; dark, transverse occipital-nape bars are present.

4. Western Australia: The second dorsal fin, as

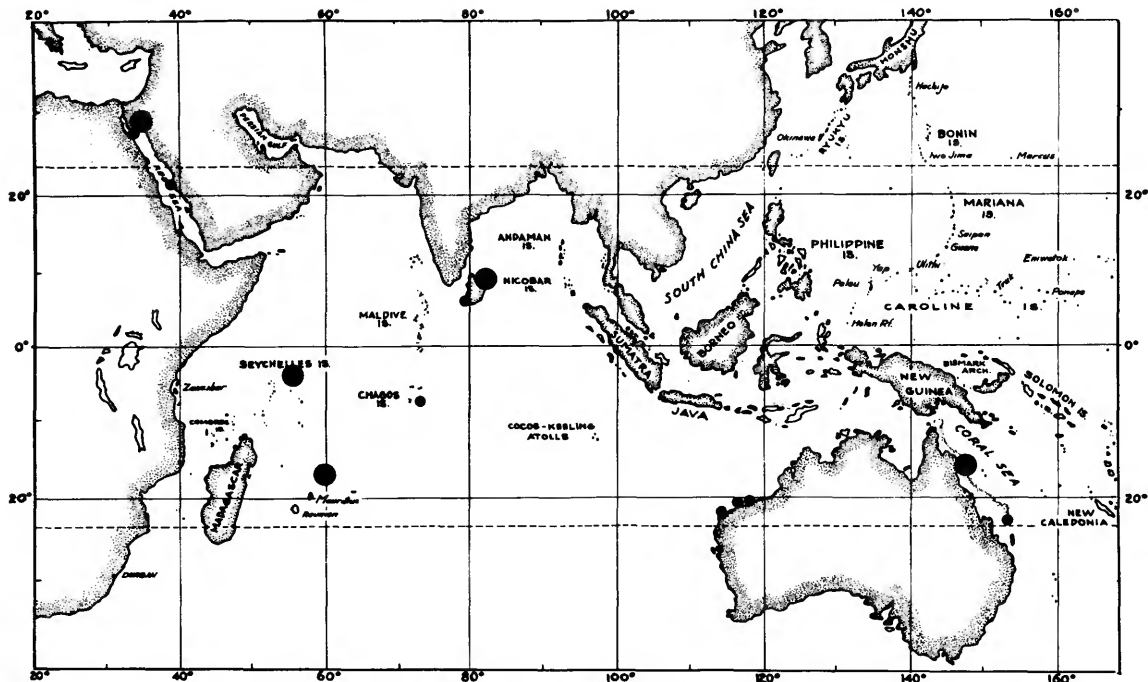


FIGURE 11.—Geographic distribution of *E. zebrina*. (Small dark circles=1-5 specimens, large dark circles=more than 30 specimens.)

in Sri Lanka collections, has the series of spots; these specimens also have a higher number of wavy bars on the caudal fin (up to $5\frac{1}{2}$), which are frequently broken up into irregular sections, and sometimes enlarged on the lower portion to form spots.

5. Great Barrier Reef: As in Western Australia the second dorsal fin has a series of spots on the rays and membranes, and the caudal fin has a high number of bars that are frequently broken up; the

transverse occipital-nape bars present in Sri Lanka specimens are developed here.

Discussion

At this time we find no combination of characters that indicates natural groups among the described and undescribed species of *Eviota*. All such arrangements appear to lead to artificial groupings. The species of *Eviota* that occur in the Red Sea are variously related among themselves and to other

TABLE 2.—Meristic differences in three characters among several geographic localities of *E. zebrina*

Localities	Second dorsal fin				Anal fin			Pectoral fin				
	1,7	1,8	1,9	1,10	1,7	1,8	1,9	14	15	16	17	18
Red Sea.....	1	29	2		30			3	15	7		
Seychelles....		3	25			23	1	4	11	6		
St. Brandon...		4	17		3	17			7	5	1	
Chagos.....			1			1			1			
Ceylon.....		1	25	3		26	5		2	11	7	
W. Australia..			4			4				4		
Barrier Reef..		1	20		3	18			4	11	1	

Eviota occurring elsewhere in the Indo-Pacific region. Almost all of the species of *Eviota* are small, and we have no knowledge of how such small fishes became distributed in space and time. *Eviota pardalota*, an apparent Red Sea endemic, and *E. guttata*, found in the Red Sea and Gulf of Oman, have branched pectoral fin rays and 26 vertebrae. They share these characters with *E. distigma* and *E. prasina*, species found in the Red Sea and elsewhere, widely in the Indo-Pacific region. Many other species of *Eviota* that do not occur in the Red Sea also share these characters. Three of the Red Sea species, *E. distigma*, *E. pardalota*, and *E. prasina*, share important specific color marks, such as the two dark spots on the pectoral fin base, the dark dorsal spots along the midline, and the pigmentation and coloration of the fins. *Eviota prasina* differs, however, in having a reduced sensory pore system and a fimbriate genital papilla, whereas *E. distigma* and *E. pardalota* have complete pore patterns for the genus and lack fimbriate genital papillae. *Eviota distigma* further has a color pattern noticeably differentiated between the sexes. The sensory pores and cutaneous papillae development in *E. guttata* are similar to those of *E. distigma* and *E. pardalota*, but the color pattern is greatly reduced, having no outstanding color marks. *Eviota sebreei* and *E. zebrina*, the two Red Sea species with simple pectoral fin rays and that possess 25 vertebrae and are wide-ranging elsewhere in the Indo-Pacific region, also share specific color marks, such as the dark, prominent basicaudal spot and a dark bar at base of first dorsal fin. They differ, though, in the extent of development of such important characters as the sensory pore system and the fifth pelvic fin ray.

The genus *Eviota* is known from eight general areas in the Red Sea: the Gulf of Aqaba, Gulf of Suez and the Strait of Jubal, Koseir on the Egyptian coast, Suakin on the Sudan coast, the Dahlak Archipelago, the Ethiopian coast and offshore islands, the island of Zubair, and Jeddah Harbor on the Arabian coast. The genus has not been taken in the narrow southern portion of the Red Sea or in the Gulf of Aden. Its absence in these waters and elsewhere in the Red Sea may be related, in part, to several factors, such as adverse ecological conditions, insufficient collecting, or inadequate collecting techniques. The preferred habitat of *Eviota* is

among coral reefs and rubble and the immediate sandy areas, in relatively shallow water less than 30 m in depth. The Red Sea has not been comprehensively sampled for fishes because of its large size and the lack of an integrated study by the many countries that nearly surround it. Most of the *Eviota* represented in our study collections were captured by the use of ichthyocides. After poisoning, many specimens fall among the coralline rubble and because of their small size are not seen. Sometimes they are not picked up because they are mistaken for young fish stages, or because it is too time-consuming to handle such small forms individually. Of the eight general Red Sea localities where *Eviota* was collected, only the Gulf of Aqaba had all six species represented. This Gulf probably has received the greatest collecting effort of all the Red Sea areas and our collections of *Eviota* may reflect this effort.

We recognize that the above factors are involved in our distributional data; however, certain patterns appear among several species that may indicate some biological preference. Some of the differences in the geographic distributions of the six species in the Red Sea may be a natural condition. *Eviota sebreei*, widely distributed in the Indo-Pacific region, is only known in the Red Sea from the Gulf of Aqaba (6 collections totaling 16 specimens). The other three species of *Eviota* that have wide distributions over the Indo-Pacific, *E. distigma*, *E. prasina*, and *E. zebrina*, were collected in three or more localities in the Red Sea and were taken in greater numbers than *E. sebreei*. *Eviota distigma* is represented in 11 collections (25 specimens) from the Gulf of Aqaba, Gulf of Suez, and the Ethiopian area. *Eviota prasina* is represented in 12 collections (97 specimens) mostly from two areas: Dahlak Archipelago (3 collections totaling 68 specimens) and the Gulf of Aqaba (5 collections). A few other specimens are from the Ethiopian area (1 collection), Strait of Jubal (1 collection), Koseir (lectotype), and Zubair Island (1 collection). *Eviota zebrina* was taken from three localities, but almost all of the specimens were from the Gulf of Aqaba (9 collections, 315 specimens), and only one specimen from the Strait of Jubal, one from the Sudan coast, and one from Jeddah Harbor. *Eviota pardalota*, an apparent endemic species, is known from 11 collec-

tions (31 specimens) from three general areas: the Gulf of Aqaba, Gulf of Suez, and the coastal and insular area of Ethiopia. *Eviota guttata* appeared in six collections (69 specimens) from the coastal and insular localities of Ethiopia and in eight collections (83 specimens) from the Gulf of Aqaba, and

only one specimen from the Gulf of Oman. Of 15 collecting stations in the Gulf of Aqaba, one species was taken alone at three stations, two species occurred together at seven stations, three species at two stations, four species at two stations, and five species at one station.

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Front matter (preceding the text) should include: **title page** with only title and author and no other information, **abstract page** with author/title/series/etc., following the established format, **table of contents** with indents reflecting the heads and structure of the paper.

First page of text should carry the title and author at the top of the page and an unnumbered footnote at the bottom consisting of author's name and professional mailing address.

Center heads of whatever level should be typed with initial caps of major words, with extra space above and below the head, but with no other preparation (such as all caps or underline). Run-in paragraph heads should use period/dashes or colons as necessary.

Tabulations within text (lists of data, often in parallel columns) can be typed on the text page where they occur, but they should not contain rules or formal, numbered table heads.

Formal tables (numbered, with table heads, boxheads, stubs, rules) should be submitted as camera copy, but the author must contact the series section of the Press for editorial attention and preparation assistance before final typing of this matter.

Taxonomic keys in natural history papers should use the aligned-couplet form in the zoology and paleobiology series and the multi-level indent form in the botany series. If cross-referencing is required between key and text, do not include page references within the key, but number the keyed-out taxa with their corresponding heads in the text.

Synonymy in the zoology and paleobiology series must use the short form (taxon, author, year:page), with a full reference at the end of the paper under "Literature Cited." For the botany series, the long form (taxon, author, abbreviated journal or book title, volume, page, year, with no reference in the "Literature Cited") is optional.

Footnotes, when few in number, whether annotative or bibliographic, should be typed at the bottom of the text page on which the reference occurs. Extensive notes must appear at the end of the text in a notes section. If bibliographic footnotes are required, use the short form (author/brief title/page) with the full reference in the bibliography.

Text-reference system (author/year/page within the text, with the full reference in a "Literature Cited" at the end of the text) must be used in place of bibliographic footnotes in all scientific series and is strongly recommended in the history and technology series: "(Jones, 1910:122)" or ". . . Jones (1910:122)."

Bibliography, depending upon use, is termed "References," "Selected References," or "Literature Cited." Spell out book, journal, and article titles, using initial caps in all major words. For capitalization of titles in foreign languages, follow the national practice of each language. Underline (for italics) book and journal titles. Use the colon-parentheses system for volume/number/page citations: "10(2):5-9." For alinement and arrangement of elements, follow the format of the series for which the manuscript is intended.

Legends for illustrations must not be attached to the art nor included within the text but must be submitted at the end of the manuscript—with as many legends typed, double-spaced, to a page as convenient.

Illustrations must not be included within the manuscript but must be submitted separately as original art (not copies). All illustrations (photographs, line drawings, maps, etc.) can be intermixed throughout the printed text. They should be termed **Figures** and should be numbered consecutively. If several "figures" are treated as components of a single larger figure, they should be designated by lowercase italic letters (underlined in copy) on the illustration, in the legend, and in text references: "Figure 9 \underline{b} ." If illustrations are intended to be printed separately on coated stock following the text, they should be termed **Plates** and any components should be lettered as in figures: "Plate 9 \underline{b} ." Keys to any symbols within an illustration should appear on the art and not in the legend.

A few points of style: (1) Do not use periods after such abbreviations as "mm, ft, yds, USNM, NNE, AM, BC." (2) Use hyphens in spelled-out fractions: "two-thirds." (3) Spell out numbers "one" through "nine" in expository text, but use numerals in all other cases if possible. (4) Use the metric system of measurement, where possible, instead of the English system. (5) Use the decimal system, where possible, in place of fractions. (6) Use day/month/year sequence for dates: "9 April 1976." (7) For months in tabular listings or data sections, use three-letter abbreviations with no periods: "Jan, Mar, Jun," etc.

Arrange and paginate sequentially EVERY sheet of manuscript—including ALL front matter and ALL legends, etc., at the back of the text—in the following order: (1) title page, (2) abstract, (3) table of contents, (4) foreword and/or preface, (5) text, (6) appendixes, (7) notes, (8) glossary, (9) bibliography, (10) index, (11) legends.

