Revision of the Sea Basses of the Genus *Diplectrum* (Pisces: Serranidae)

Stephen A. Bortone

September 1977
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Revision of the Sea Basses of the Genus Diplectrum (Pisces: Serranidae)

STEPHEN A. BORTONE

ABSTRACT

Twelve species of Diplectrum are recognized: three western Atlantic (D. formosum, D. bivittatum, and D. radiale) and nine eastern Pacific species (D. pacificum, D. conceptione, D. maximum, D. rostrum, D. labarum, D. eumelum, D. seturus, D. macropoma, and D. euryplectrum). All species are hermaphroditic and possess an ovarian sinus in the posteriormost gonadal area. Diplectrum osteological characters aid in defining the genus and in comparing its taxonomic status with Serranus. Definitions of the Serraninae and Serranidae are modified as a result of Diplectrum osteological characters. The genus is basically restricted to the warm tropical-subtropical coastal areas of the new world. Diplectrum bivittatum, however, often occurs at insular localities, and D. conceptione occurs in colder, temperate Peruvian waters. Diplectrum formosum is considered to have a northern subspecies, D. f. formosum, and a southern form, D. f. radians; D. bivittatum is also composed of two subspecies: D. b. bivittatum from South American and Caribbean areas and D. b. arcuatum from the Gulf of Mexico. An intermediate population occurs in the vicinity of southern Florida. Diplectrum radiale and D. pacificum are "geminate species" and similar morphologically. Diplectrum mexicanum is considered a junior synonym of D. macropoma.

INTRODUCTION

The genus Diplectrum is composed of nine Pacific (Rosenblatt and Johnson 1974) and three Atlantic species distributed in the tropical-subtropical areas of the Western Hemisphere. The species are colorful sea basses which bear an enlarged preopercle. All species thus far examined are considered to be synchronous hermaphrodites. Because of their small size (usually less than 300 mm) they are presently of little commercial importance, yet as they are abundant at some localities they may have potential as a food or industrial protein resource. Considerable confusion occurs in the literature because the genus has never been adequately defined. Species recognition has been difficult owing to inaccurate literature accounts and mislabeled museum material. Robins and Starck (1961) performed a preliminary investigation on the genus Serranus. This was the first major step in clarifying the subfamily Serraninae since the revision of the Serranidae by Jordan and Eigenmann (1890). Revisions of such genera will allow ichthyologists to begin assembling our knowledge and permit a system of order in the Serranidae (Smith 1971).

Herein is presented a systematic revision of the genus Diplectrum. The purposes of this paper are to define the genus, to make a preliminary evaluation of the status of the genus among the Serraninae, to describe the species recognized as associated with the genus, and to summarize our current knowledge of the life history and zoogeography of the species.

MATERIALS AND METHODS

Under the subsections entitled "Specimens examined" the following institutional abbreviations are used: BMNH, British Museum (Natural History); CAS, California Academy of Sciences; FMNH, Field Museum of Natural History; FSBC, Florida Department of Natural Resources; FSM, Florida State Museum; FSU, Florida State University; GCRL, Gulf Coast Research Laboratory; GMBL, Grice Marine Biological Laboratory; INP, Instituto Nacional de Pesca, Mexico; LACM, Los Angeles County Museum; MCZ, Museum of Comparative Zoology; MNHN, Museum National d'Histoire Naturelle; MZUSP, Museu de Zoologia da Universidade de São Paulo; RMNH, Rijksmuseum van Natuurlijke Historie; SIO, Scripps Institution of Oceanography; SOSC, Smithsonian Oceanographic Sorting Center; TABL, Tropical Atlantic Biological Laboratory; UA, University of Arizona; UCLA, University of California at Los Angeles; UCR, Universidad de Costa Rica; UMMIL, Rosenstiel School of Marine and Atmospheric Sciences, University of Miami; UNC, University of North Carolina, Institute of Marine Sciences; UPR, University of Puerto Rico; USNM, National Museum of Natural History, Washington, D.C.; UTMSI, University of Texas, Marine Sciences Institute; UW, University of Washington.

When complete information is available for specimens examined, the abbreviation for the museum is followed by its museum catalog number, followed by a comma, the number of specimens in the lot, and the range of standard length in millimeters in parentheses. Type material is labeled holotype, paratype, lectotype, or paralectotype immediately after the catalog number.
Uncataloged museum specimens are referred to by field numbers, cruise numbers, or other field data in place of catalog numbers.

All measurements were made with dial calipers and recorded to 0.1 mm, except standard, total, and fork lengths greater than 100 mm which were recorded to the nearest millimeter. Counts and measurements were made and recorded according to the methods of Hubbs and Lagler (1964) with the following additions and modifications: counts for cheek scale rows A, from the posteroventral angle of the eye downward and posteriorly toward the lower preopercular angle; counts for cheek scale rows B, from the posterior serrated upper arm of the preopercle downward and anteriorly to the distal corner of the maxillary (Ginsburg 1948); predorsal scale rows, immediately below the predorsal midline from the base of the first dorsal spine forward; gill rakers, counted on the left anteriormost arch and include all rudiments of gill rakers and tubercles; preopercular spur spines, counted between the upper and lower outside angles of the preopercular spur; only rays of the left pectoral fin were counted; all pseudobranch filaments were counted on the left side; interorbital width, as the least fleshy width of the interorbital area; cheek length, from the distal maxillary edge to the nearest border of the vertical preopercular arm; maxillary width, at the broadest part of the distal maxillary area; lacrimal width, from the anteroventral corner of the eye to the nearest anteroventral lacrimal edge; orbit width, the least distance between fleshy edges; lower jaw length, the length of mandible; pelvic origin to anus, distance from anterior pelvic fin base to base of anal spine; postanal length, from the anterior anal spine base posteriorly to the center of the hypural base.

Standard length (SL) is given in millimeters but all other measurements are presented in thousandths of SL. Data in the species accounts are presented in the following manner: character and mean value, followed in parentheses by standard deviation, range, and number of specimens. For meristic characters, the standard deviation and number of specimens are not included in the description but are found in the appropriate tables. Proportional measurements are presented only for specimens larger than 75 mm SL. Counts for meristic characters are presented for all fishes regardless of standard length.

Color descriptions were taken from live and/or preserved specimens and are indicated as such.

Osteological terminology generally follows that of Smith (1971), Monod (1968), and McAllister (1968), and the abbreviations used are as follows: AR, articular; B, branchiostegals; BB, 1-3, basibranchials; BO, basioccipital; BS, basiphenoid; CB, 1-5, ceratobranchials; CH, ceratohyal; CL, cleithrum; COR, coracoïd; CP, 1-4, pre-ural centrum; E, 1-3, epurals; ECT, ectopterygoid; EH, ephihyal; END, endopterygoid; EPO, epiotic; EXO, exoccipital; FR, frontal; H, hyoid; H, 1-V, hyurals; HA, haemal arch; HB, 1-3, hypobranchials; HS, haemal spine; GH, glossohyal; IC, intercalar; LAC, lacrimal; LE, lateral ethmoid; LH, lower hypohyal; MET, metapterygoid; PA, parietal; PAL, palatine; PAS, parasphenoid; PH, parhypurals; PRO, prootic; PT, posttemporal; PTO, pterotic; PTS, pterosphenoïd; QU, quadrate; R, radial; RA, retroarticular; SC, scapula; SCL, supracleithrum; SE, supraethmoid; SO, supraopercital; SS, subocular shelf; ST, stegural; SYM, symplectic; UH, upper hypohyal; V, vomer.

Osteological examination was conducted from radiographs on skeletons prepared by maceration, cleaning by dermestid beetles, soaking in ammonium hydroxide (Konnerth 1965), or staining with alizarin and clearing with trypsin. The method employed for clearing and staining was the procedure of Taylor (1967) but modified in that the staining was performed prior to clearing. Vertebrae counts were separated into precaudal and caudal by a plus sign. Method for counting dorsal fin supports followed that of Smith and Bailey (1961).

Specimens examined osteologically

**Diplectrum formosum.** North Carolina: Uncat., 17 (42-210). Florida Gulf: LACM 33007-1, 1 (205); LACM 33306-1, 1 (228); LACM 33306-3, 1 (210); LACM 33306-2, 1 (210); LACM 33308-1, 1 (164); Uncat., 3 (ad.).


**D. macropoma.** Panama: Uncat., 2 (115-117); UMML 26246, 2 (74-84); UMML 25075, 1 (62); UMML 25094, 2 (50-61).

**D. rostrum.** Bahia de Banderas, Mexico: SIO 65-160, 6 (61-105).

**D. conceptione.** Peru: USNM 213578 and 211385, 3 (89-100).

**D. maximum.** Baja California: SIO 62-106, 1 (juv.).

**D. scius.** Gulf of California: SIO 70-70, 1 (109); USNM 46571, 1 (paralectotype).


**D. labarum.** Golfo de Tehuantepec, Mexico: SIO 63-524, 4 (juv.).


**Serranus phoebe.** North Carolina: Uncat., 1 (53). Cuba: USNM 110279, 1. No locality: UMML 638, 2 (ad.).

**S. tabacarius.** Cuba: USNM 26662, 1 (ad.).

**S. tigrinus.** Cuba: USNM 110283, 1 (ad.).

**S. notcholpisus.** Carolina: Uncat., 3 (juv.).

**GENUS DIPLECTRUM HOLBROOK 1855**

Diplectron Troschel 1858:24 (improper emendation).

Halipercia Gill 1863:236 (type-species: Serranus bivittatus Valenciennes, by monotypy).

Troschel (1858:80) invalidly emended Diplectron as Diplectrum. This error was later copied by Canestrini (1860:303, 306). Vieillot (1816:50, as cited by Neave 1939:106) had earlier applied Diplectron as a genus to the class Aves. Berg (1895:45) wrongly considered the generic name of priority. The generic name Diplectron therefore thought names were preoccupied by Diplectron (Aves). Berg then applied the generic name Centropristis to formosus (= formosum) because of priority. The generic name Diplectron is to be retained for Pisces under Article 56a of the International Code of Zoological Nomenclature (International Commission of Zoological Nomenclature 1964).


All species are synchronous hermaphrodites. Ovarian tissue comprises the anterior portion of the gonadal lobes; testicular tissue present posteriorly in a broad band in varied patterns. Posteriorly and ventrally an “ovarian sinus” of possible accessory-gland function occurs.

Color pattern in the genus is varied but basically the snout and cheeks bear spots or lines of yellow, orange, or blue. Dorsal and caudal fins have a combination of orange and blue patterns of spots and stripes; either spots or stripes may be absent. Body is brown dorsally, pale ventrally, lateral body surface is traversed vertically with dark bars and horizontally, with two dark stripes. Portions of this pattern are of varied intensity and distinctness.

The genus is endemic to the western hemisphere and is generally found in continental coastal areas in tropical-subtropical life zones.

**OSTEOLEGY**

**General osteology of Diplectron**

(Figs. 1-5)

Vomer with a narrow chevron-shaped patch of villiform teeth. Villiform medially and short caniniform teeth laterally present in narrow bands on dentary and premaxillary bones. Glossohyal teeth absent. Villiform teeth present on palatines in a thin elongate patch. Lateral ethmoid with three facets for articulation (see Gosline 1966). Interorbital area narrow. Frontals with deep grooves dorsally leading from anterior edge and terminating in a large elongate midfrontal foramen. Dorsal junction of frontals a broadened surface. Top of cranium smooth, without ridges, area rounded or somewhat flattened. Epiotics with a single elongate narrow posttemporal facet. The facet not sharply delineated from remaining portion of epiotic by a ridge. Epiotic-parietalsupraoccipital surfaces lateral to the supraoccipital crest nearly flat. Parietal ridge low and short, terminating at

Figure 1.—Diplectron formosum, Florida; right lateral view of skull.
frontal border. Posterior frontal area with evidence of parietal-ridge extension forward and curving laterally, not a true ridge but as a corner on skull. Posttemporal fossae large. Pterotic "wings" elongate and broad. Supraoccipital crest short and low, extending posteriorly and ventrally to exoccipitals. Anteriorly, supraoccipital crest base only slightly expanded, terminating at posterior frontal edge. Intercalar with prominent posterior projection for articulation with posttemporal. Parasphenoid straight or nearly so. Prootic-basioccipital-parasphenoid area expanded as prominent otic capsule. Six subocular bones (Fig. 3). Subocular shelf composed of third and occasionally a portion of the fourth subocular bones. Predorsal fin supports thin and weakly developed, the formula (Smith and Bailey 1961) 0-0-0-2- or 0-0-2-. Vertebral column with 10 + 14 vertebrae. The eleventh vertebra bears the first haemal spine generally curving posteriorly, slightly flattened distally, but concave on proximal anteroventral surface (Fig. 4). Caudal fin type-Vb of Monod (1968). Ceratohyal with shallow, gently curved dorsal surface. Branchiostegals seven; 1½ on the ceratohyal, 1½ on the epihyal (Fig. 5). The first three attach ventrally to ceratohyal, remaining branchiostegals having lateral attachment. Operculum with three prominent points or projections posteriorly. Posttemporal serrate.

Preopercle forming nearly right angle between horizontal and vertical arms. Horizontal arm always serrate. Preopercular spur with many elongate spines and expanded in various shapes.

**Comparative osteology of Diplectrum spp.**

Skeletons of various preparations for all species of Diplectrum except D. radiale were examined. Figures of D. formosum were prepared and are presented for comparative purposes. Although D. formosum may be one of the more specialized species, comparison will be made on its osteological morphology and differences with other species will be noted. The basic osteology for the genus has been presented above and the only special osteological aspects are considered here.

Vomerine-teeth patch forms a broad wedge-shaped pattern in D. formosum. Diplectrum sciurus has a narrower triangular vomerine-tooth patch. The anterior parasphenoid bends slightly downward in D. formosum but is nearly straight for the other species. The lateral

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**Figure 2.**—*Diplectrum formosum*, 165 mm SL, North Carolina: 1) left lateral; B) ventral; and C) dorsal views of neurocranium. See text page 2 for abbreviations.

**Figure 3.**—*Diplectrum formosum*: A) jaw suspension, left lateral; B) suborbital bones above, right lateral; below, dorsal. See text page 2 for abbreviations.
Figure 4.—*Diplectrum formosum*: A) caudal complex, left lateral; B) 10th, 11th, and 12th vertebrae, left lateral. See text pages 5-6 for abbreviations.

Figure 5.—*Diplectrum formosum*: A) hypobranchial apparatus, left lateral; B) hypobranchial apparatus, dorsal; C) pectoral girdle, left lateral. See text pages 5-6 for abbreviations.
Parietal ridges are low in all species but slightly more developed in *D. maximum*, *D. eumelum*, and *D. pacificum*. *Diplectrum pacificum* and *D. maximum* show some evidence of a medial curl of the ridge near the frontal parietal borders. In *D. formosum* the supraoccipital crest originates at an abrupt angle, is higher, and its posterior edge approaches the exoccipitals at a low angle. In all other species of *Diplectrum* the crest originates at a low angle, its dorsal profile is nearly parallel to the central axis, and its posterior edge is at an abrupt angle. Also the supraoccipital stay (see Gosline 1966) is absent in *D. formosum*; its presence in other *Diplectrum* is variable between species. The stay is greatly reduced in *D. bivittatum*. In *D. labarum* the stay runs closely along the dorsal crest edge. In other *Diplectrum* the ridge is present, strong, and parallels the central axis. Anterior supraoccipital-crest base is not noticeably thicker in *D. formosum* but appears slightly thickened for all other *Diplectrum*. Predorsal formula is 0-0-0-2- for all *Diplectrum* (the third predorsal support may be missing in a few individuals) except in *D. bivittatum*, *D. conceptione*, and *D. euryplectrum* which have a formula of 0-0-2-. First haemal spine with a low protuberance on the posterior surface for *D. formosum*,

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**Figure 6.**—Squamation of cheek and serration of preopercle in species of *Diplectrum*: A) *D. formosum*, 143 mm SL, UMML 3314, Jacksonville, Fla.; B) *D. bivittatum*, 104 mm SL, UMML 12324, St. Augustine, Fla.; C) *D. pacificum*, 133 mm SL, USNM 183980, Gulf of California; D) *D. radiale*, 197 mm SL, UMML 28749, Trinidad; E) *D. rostrum*, 117 mm SL, CAS 25295, Colombia; F) *D. conceptione*, 145 mm SL, USNM 213478, Ecuador; G) *D. euryplectrum*, 122 mm SL.
D. biwittatum, and D. sciurus. Posterior haemal spine smooth in Diplectrum except in D. pacificum where the posterior haemal spine curve is somewhat exaggerated. Lacrimal very broad, broadest in D. formosum, except for D. sciurus which may be considered to have a narrow lacrimal width. The maxillary is thin, broadest toward middle in D. formosum. In other species it is broadest distally but the shaft is thick and somewhat spatulate. D. sciurus has a broad maxillary tip and the shaft is thin.

The subocular shelf is rectangular, somewhat more square in D. maximum, D. conceptione, and D. biwittatum. The shelf is generally restricted to the third subocular bone, but in some individuals the fourth flattens out medially to form the posterior shelf edge. The posttemporal is variously serrate in all species. Diplectrum biwittatum and D. maximum have the least developed serrae; D. conceptione has enlarged serrae; and fewer serrae are found in D. eumelum, D. euryleptrum, and D. labarum.

Preopercles vary (Fig. 6), however, the species can be placed in several morphological groups with regard to this character. With its broad spur and double cluster of spines, D. formosum forms a category by itself. A second group with broad preopercular spurs is composed of D.
euryplectrum, D. eumelum, and D. macropoma. Decidedly truncate preopercles are seen in D. labarum and D. sciurus. Diplectrum pacificum, D. radiale, and D. rostrum may be grouped together with narrow, truncate spurs. Diplectrum conceptione and D. maximum form a final group having a narrow spur with fewer spines. Diplectrum bicuittatum could justifiably be placed in either the D. pacificum or D. conceptione group.

In juveniles less than 75 mm SL the preopercular spur is not yet differentiated into the adult form. Figure 7 illustrates developmental changes in the preopercle for D. formosum. Preopercular spurs of smaller Diplectrum basically resemble the smallest D. formosum preopercular spur depicted.

**Notes on Serranus Osteology**

Owing to the obvious affinities of Serranus and Diplectrum some characters for the former genus are presented to clarify the latter. Inferences on relationships are made below. Only a few species and specimens of Serranus were examined, but a few obvious features are noted.

Vomer broad and U-shaped. Midlateral parietal ridges are prominent, extending upon the frontal area anteriorly and laterally. Epiotic bears two posterior projections and the posttemporal facet is broad. This facet is also sharply delineated from the remainder of the epiotic by an irregular ridge. Epiotic-parietal-supraoccipital area not flat, but irregular and uneven. A groove or longitudinal depression along the junction of the frontals. Pterotic “wings” short and narrow. Horizontal and vertical preopercular arms join at an obtuse angle and the preopercular spur is never developed. Lacrimal narrow, equal to or narrower than maxillary width. Predorsal fin support formula 0-0-0-2-, the interneurals strong. Lateral supraoccipital crest stay not close to distal crest edge.

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sal and anal fins with small wedges of scales . . . . ” [present only on anal fins of Diplectrum]; “16) Size moderate . . . probably never more than 200 millimeters in standard length.” [commonly reaching 200 mm SL or more in Diplectrum]; “17) No filamentous spines or rays . . . .” [D. labarum has filamentous spines]. Admittedly the above differences are minor, however, if osteological characters are considered, greater differences between these genera are apparent. In particular, these are the shape of the posttemporal facets of the epiotics, parietal ridge system, fusion line of frontals, preopercular spur shape and arm angle and width of lacrimal. The gonads are not similar in patterns of “territorial hermaphroditism.” Smith (1965) has depicted S. tigrinus (and I have observed this condition in S. fasciatus, S. pheobe, and S. notospilus) with a thin band of testicular tissue. All Diplectrum have a wide band of testicular tissue. Also, but tentatively, the presence of an “ovarian sinus” with possible accessory-gland function is apparently restricted in the Serraninae to Diplectrum (Borton in press a).

Serraninae is composed of a closely aligned morphological group of genera. Other workers attempted to separate these in keys with the character of pelvic fin origin in relation to pectoral fin (e.g., Norman 1966:227-228; P₂ below or behind P₁ for Serranus; P₁ in advance of P₂ for Diplectrum). Actually this character is variable and contributes little to the separation of these genera. Overall, the principal characters in distinguishing Serranus from Diplectrum are the obvious preopercular spur and the wide lacrimal bone of Diplectrum. Other previously mentioned characters may also be useful in separation.

On the basis of scale morphology, McCully (1961) suggested that Diplectrum spp. be placed in the genus Dules (= [in part] Serranus of Robbins and Starck 1961). The problem of the systematic position of Diplectrum and Serranus has not been resolved here. Further studies such as comparative osteology are needed on Serranus and other Serraninae to resolve this question. However, on the basis of present evidence, it is desirable to retain Diplectrum and Serranus as distinct genera.

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Diplectrum formosum is an apomorphic species with regard to its high scale meristics, the enlarged double preopercular spur, and other characters and may represent a long-separated phylogenetic line (Borton 1973); relationships of the remaining Diplectrum are not easily interpreted. Rather than retain Haliperca as a subgenus for a group of uncertain lineage and relationships, or establish more subgeneric names of equally tenuous status, the genus Haliperca is considered as a junior synonym of Diplectrum. Subgenera are not utilized for any species or species group at the present time. Further consideration of subgeneric status for major lineages may be necessary in the future when histological data on the gonads become available.

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**GONAD MORPHOLOGY**

All Diplectrum examined in this study were “synchronous hermaphrodites” as defined by Smith (1959, 1965) in a condition referred to as “territorial hermaphroditism” by D’Ancona (1952). The gonads of D. rostrum (Borton 1974), D. formosum (Borton 1971), and D. pacificum (Borton in press a) have been sectioned and determined to be ovotestes. In these three species, ovarian tissue appears yellow and granular, and testicular tissue appears as fine white tissue. The posteriormost region will be considered histologically in other works (Borton in press a) and the area is considered to be a region of possible accessory gland function. As a general structure it is termed an “ovarian sinus.” The structure is similar to the “oviducal pouch” described by Smith and Atz (1969) for Pseudogramma bermudensis but differs in many gross aspects. For instance in Diplectrum the pouch does not open into the body cavity. Smith (1965) used gross inspection to ex-
Decidedly truncate preopercles are seen in D. labracum and D. scirrus. Diplectrum pacificum, D. radiale, and D. ranarium may be grouped together with narrow, truncate spurs. Diplectrum conceptione and D. maximum form a final group having a narrow spur with fewer spines. Diplectrum bivittatum could justifiably be placed in either the D. pacificum or D. conceptione group.

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Differences have been emphasized in this initial osteological summary of Serranus. However, not a single character differences between the genera should serve as a means to define the genus Diplectrum, because most of the characters are either the same or nearly so. Therefore, I wish to stress the need for more conclusive osteological studies of Serranus.

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The genera Diplectrum and Serranus are variously similar in many morphological aspects; however, of 16 characters used by Robins and Starck (1961) to define the genus Serranus only four do not apply to Diplectrum; those four characters are: "11) Neural-line pores opening through tubes directed obliquely ...." (directed parallel to body lines in Diplectrum). Dor-
rays modally 15 or 17. Anterior dorsal fin elevated not parallel to dorsal profile .......................... 3

3a Second dorsal spine short, 1.7-2.1 into third. Preopercular spur square or rounded, its upper corner never pointed (Fig. 6D). Orbit length small, 71-95% SL. Pectoral rays modally 17. Cheek scale rows A, 9-12 (modally 10). Upper caudal lobe without an extended filament ..............................................  D. radiale

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4a Total gill rakers 30 or more on first arch. Maxillary width equal to, or greater than, lacrimal width ..............................  D. sciurus

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5a Anal rays 8. A dark lateral band of pigment along soft-dorsal-fin base. Vertical preopercular arm above spur not serrate .... D. euryplectrum

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6a Second, third, fourth, and occasionally fifth dorsal spines with tips extended as long black filaments (only on specimens larger than 75 mm SL) ......................  D. labarum

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9a Cheek scale rows A, 8-12. Cheek scale rows B, 10-14 ..............................................  10

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10a Snout with a distinct pale bar from the anterioventral corner of the eye, forward and downward to the anterioventral edge of the lacrimal. Soft dorsal fin with a distinct row of pale spots on upper half of membrane on a dark field. Gill rakers 22-25. Preopercular spur spines 7-11 (Fig. 6E) ...............  D. rostrum

10b Snout with a vague spot, not as a well-defined bar. Soft dorsal fin with 2-3 irregular rows of pale spots on a dark field. Gill rakers normally 15-22, occasionally 23 or 24. Preopercular spur spines 5-8 (Fig. 6C) ....  D. pacificum

11a Caudal peduncle depth 2.9-3.5 in head length. Snout with 3-5 distinct pale spots. Snout blunt. Length of posterior dorsal and anal rays nearly equal to length of anterior rays ..............................................  D. eumelum

11b Caudal peduncle depth 2.5-2.8 in head length. Snout without distinct pale spots or wavy cheek bar. Snout pointed. Length of posterior dorsal and anal rays much shorter than anterior rays ..............................................  D. macropoma

Diplectrum formosum (Linnaeus 1766)

Figures 1-5, 6, 7-8, 9, 10

Perca formosa Linnaeus 1766:488-489 (original description, Carolina); Gmelin 1788:1322 (copy of original description); Linnaeus 1789:1322 (copy of original description); Cuvier and Valenciennes 1828:230 [in synonymy with Haemulon formosum = Haemulon plumieri (Lacépède)]; Goode and Bean 1886:203 (type examined).

Serranus radians Quoy and Gaimard 1824:313-314, pl. 58, fig. 2 (original description, Brazil); Boulenger 1895:295-296 (catalog); Devincenzi 1924:223 (description).

Serranus fascicularis Valenciennes in Cuvier and Valenciennes 1828:245-246 (original description, Brazil); Cuvier 1829:139 (generic description); DeKay 1842:23 (description); Storer 1846:28-29 (general account); Canestrini 1860:306 (systematics); Poey 1866:195 (Cuba); Jordan and Gilbert 1882:534 (not seen); Jordan and Gilbert 1883:273 (Pensacola, Fla.); Goode 1884:410, pl. 163 (South Carolina); Goode 1887:46 (South Carolina); Diaz 1893:52 (synonymy).

Serranus irradians Valenciennes in Cuvier and Valenciennes 1828:244-245, pl. 30 (in part, original description, Brazil); Castelnau 1855:3 (color notes, Rio de Janeiro).

Diplectrum fasciculare Holbrook 1855:32-35, pl. 5, fig. 2 (generic description, South Carolina); Holbrook 1860:35-38, pl. 5, fig. 1 (South Carolina); Gill 1862:30 (southeast United States); Gill 1864:93 (name only); Poey 1868:282 (generic designation); Poey 1871:54
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amine the pattern of hermaphroditism in serranid fishes. This method is considered reliable for general morphological purposes.

Schematic gonad diagrams (Fig. 8) suggest overall similarity for the genus but also suggest certain morphological affinities among species. In general the anterior lobes of the U-shaped ovotestis are ovarian tissues consisting of a central lumen which is surrounded by lamelli. The testicular tissue is generally a wide, diagonal band more posterior in orientation dorsally. The postero-ventral portion of the ovotestis is composed of the “ovarian sinus.”

Morphologically there are several groups. One group consisting of *D. formosum*, *D. pacificum*, *D. radiale*, *D. rostrum*, *D. eurypectrum*, and *D. eumelum* (Fig. 8A, C, D, E, G, H) shows a schematic pattern with regard to shape and position of testicular and “ovarian sinus” areas. Another group of species which are similar to ovotestis morphology is *D. sciurus* and *D. labarum* (Fig. 8J, L). In these species the “ovarian sinus” portion is evident as in the first group but the testicular tissue is somewhat extended into rounded anterior lobes which begin to invade the ovarian tissue. *Diplectrum macropoma* (Fig. 8I) is in a group by itself in that no “ovarian sinus” region is visible grossly, yet the anterior testicular lobes are present as in the second group. A fourth group is composed of the remaining species: *D. bivittatum*, *D. conceptione*, and *D. maximum* (Fig. 8B, F, K).

Testicular tissue in this group is present in very evident anterior projections. Also the “ovarian sinus” region is more ventral and slightly more anterior in position.

No apparent gross morphological differences were found at the subspecific level between *D. b. arcuatum* and *D. b. bivittatum* or *D. f. formosum* and *D. f. radians.*

**KEY TO THE SPECIES OF DIPLECTRUM**

(for specimens larger than 75 mm SL)

1a Atlantic Ocean specimens ....................... 2
1b Pacific Ocean specimens ....................... 4
2a Preopercle with two clusters of spines radiating from upper and lower posterior corners (Fig. 6A). Scales small; cheek scale rows A, 9-16 (modally 11); cheek scale rows B, 12-18 (modally 16); 8-12 scales above lateral line. Pectoral rays modally 16. Spinous-dorsal-fin profile nearly parallel to dorsum . . . *D. formosum*

2b Preopercle with a single cluster of spines (Fig. 6B, D). Scales larger; cheek scale rows A, 12 or less; cheek scale rows B, 14 or less. Scales above lateral line, 9 or less. Pectoral

![Diagram of species of Diplectrum](image-url)
3a Second dorsal spine short, 1.7-2.1 into third. Preopercular spur square or rounded, its upper corner never pointed (Fig. 6D). Orbit length small, 71-95% SL. Pectoral rays modally 17. Cheek scale rows A, 9-12 (modally 10). Upper caudal lobe without an extended filament ........................................ D. radiale

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4a Total gill rakers 30 or more on first arch. Maxillary width equal to, or greater than, lacrimal width .................. D. sciurus

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5a Anal rays 8. A dark lateral band of pigment along soft-dorsal-fin base. Vertical preopercular arm above spur not serrate .. D. euryplectrum

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6a Second, third, fourth, and occasionally fifth dorsal spines with tips extended as long black filaments (only on specimens larger than 75 mm SL) ................... D. labarum

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8a Gill rakers 23-28. Preopercle with 2-4 very strong spines at its angle (Fig. 6F) .. D. conceptione

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9b Cheek scale rows A, 5-8. Cheek scale rows B, 7-10 ........................................... 11

10a Snout with a distinct pale bar from the anterioventral corner of the eye, forward and downward to the anterioventral edge of the lacrimal. Soft dorsal fin with a distinct row of pale spots on upper half of membrane on a dark field. Gill rakers 22-25. Preopercular spur spines 7-11 (Fig. 6E) ............. D. rostrum

10b Snout with a vague spot, not as a well-defined bar. Soft dorsal fin with 2-3 irregular rows of pale spots on a dark field. Gill rakers normally 15-22, occasionally 23 or 24. Preopercular spur spines 5-8 (Fig. 6C) .. D. pacificum

11a Caudal peduncle depth 2.9-3.5 in head length. Snout with 3-5 distinct pale spots. Snout blunt. Length of posterior dorsal and anal rays nearly equal to length of anterior rays ......................... D. eumelum

11b Caudal peduncle depth 2.5-2.8 in head length. Snout without distinct pale spots or wavy cheek bar. Snout pointed. Length of posterior dorsal and anal rays much shorter than anterior rays .......... .D. macropoma

**Diplectrum formosum (Linnaeus 1766)**

*Figures 1-5, 6, 7-8, 9, 10*

*Perca formosa* Linnaeus 1766:488-489 (original description, Carolina); Gmelin 1788:1322 (copy of original description); Linnaeus 1789:1322 (copy of original description); Cuvier and Valenciennes 1828:230 [in synonymy with *Haemulon formosum* = *Haemulon plumieri* (Lacépède)]; Goode and Bean 1886:203 (type examined).

*Serranus radians* Quoy and Gaimard 1824:313-314, pl. 58, fig. 2 (original description, Brazil); Boulenger 1895:295-296 (catalog); Devincenzi 1924:223 (description).

*Serranus fascicularis* Valenciennes in Cuvier and Valenciennes 1828:245-246 (original description, Brazil); Cuvier 1829:139 (generic description); DeKay 1842:23 (description); Storer 1846:28-29 (general account); Canestrini 1860:306 (systematics); Poey 1866:195 (Cuba); Jordan and Gilbert 1882:534 (not seen); Jordan and Gilbert 1883:273 (Pensacola, Fla.); Goode 1884:410, pl. 163 (South Carolina); Goode 1887:46 (South Carolina); Diaz 1893:52 (synonym).

*Serranus irradians* Valenciennes in Cuvier and Valenciennes 1828:244-245, pl. 30 (in part, original description, Brazil); Castelnau 1855:3 (color notes, Rio de Janeiro).

*Diplectrum fasciculare* Holbrook 1855:32-35, pl. 5, fig. 2 (generic description, South Carolina); Holbrook 1860:35-38, pl. 5, fig. 1 (South Carolina); Gill 1862:30 (southeast United States); Gill 1864:93 (name only); Poey 1868:282 (generic designation); Poey 1871:54
Figure 9.—A) *Diplectrum formosum*, 139 mm SL, (uncat.) northern Gulf of Mexico;  
B) *D. bivittatum*, 117 mm SL, UMML 16302, Venezuela;  
C) *D. pacificum*, 140 mm SL, USNM 183980, Gulf of California;  
D) *D. radiale*, 107 mm SL, UMML 16302, Venezuela;
Figure 9.—Continued.

E) *D. rostrum*, 131 mm SL, USNM 208197, Colombia;
F) *D. concepione*, 145 mm SL, USNM 213578, Peru;
G) *D. euryplectrum*, 63 mm SL, UMML 26251, Panama;
H) *D. eumelum*, 180 mm SL, USNM 213813, Colombia;
Figure 9.—Continued.

I) *D. macropoma*, 127 mm SL, USNM 213591, Colombia;
J) *D. labarum*, 135 mm SL, LACM 32094-1, outer Baja California;
K) *D. maximum*, 93 mm SL, SIO 64-63, outer Baja California;
L) *D. sciurus*, 109 mm SL, SIO 70-70, Gulf of California.
Diplectrum formosum Goode and Bean 1886:203 (examined type of Perca formosa); Jordan and Eigenmann 1890:397-398, pl. 65 (description and account); Henshall 1895:215 (Key West); Jordan and Evermann 1896:1204, 1207-1208 (systematics, synonymy); Smith 1896:175 (Florida); Evermann and Kendall 1900:75 (Florida); Fowler 1903:329 (color notes, Florida); Jordan and Thompson 1905:240-241 (color notes, Florida); Fowler 1907:263 (Florida); Smith 1907:282 (North Carolina); Jordan and Evermann 1923:398-399 (general account); Meek and Hildebrand 1925:472-474 (key, description, and synonymy); Fowler 1927:252 (Florida); Fowler 1929:453 (Florida); Borodin 1934:113 (Florida Keys); Gunter 1935:39, 40 (Louisiana); Bere 1936:608 (parasites); Fowler 1940a:14, fig. 20 (Florida); Fowler 1941a:770 (Rio de Janeiro); Fowler 1941b:86 (Florida); Galloway 1941:195 (Louisiana); Baughman 1944:89, 90 (Texas); Fowler 1945a:200, 310 (synonymy, southeast United States); Breder 1948:166 (general account); La Monte 1952:104 (popular account); Outdoor Writers Association of America 1955 (check list); Pearson 1952a (parasites); Hildebrand 1954:304 (Campeche); Hildebrand 1955:208, 221-223, tables 2-4 (Campeche); Joseph and Yerger 1956 (Florida); Briggs 1958:272 (distribution); Hoese 1958:331 (Texas); Micolinski 1958:355 (popular account); Robins 1958 (check list, Florida); Bailey et al. 1960:25 (check list); Springer and Woodburn 1960:34 (ecological data, Florida); Clem et al. 1961:726-766 (tissue culture); Durand 1961:46, 50 (ecological data, Guyana); Smith and Bailey 1961:361 (osteology); Tabb and Manning 1961:618 (Florida); Lowe 1962:695 (Guyana); Freihofer 1963:131, table 2 (neuroanatomy); Gabrielon and La Monte 1963:51 (popular account); Brandão 1964:19 (Brazil); Tyler 1964:9 (Florida); Anderson and Gehring 1965:table 12 (collection data, Florida); Bullis and Thompson 1965:44 (collection and distribution data); Christensen 1965 (Florida); Gunter and Hall 1965:31 (collection data, Florida); Moe and Martin 1965:138 (biological data, Florida); Roessler 1965:314, table 2 (ecological data, Florida); Bothmayer 1965:20, table A-1 (northern Gulf of Mexico); Cervigon 1966:321-323 (description, biology, Venezuela); Moe 1966:11, table 2 (Florida); Moe et al. 1966:32-33 (Florida); Stark and Davis 1966:320 (Florida); Anderson 1968:1-60 (trawl data from S. Atlantic coast of United States); Beaumariage 1968:8 (utilized for fish meal, Florida); Böhke and Chaplin 1968:267 (Bahamas); Randall 1968:76, fig. 87 (general account, Caribbean); Starck 1968:19 (Florida); Wolf and Quinbey 1969:298, table 8 (tissue culture); Bailey et al. 1970:34 (check list); Bortone 1970:1-55 (life history, Florida); Godcharles 1970:11 (Florida); Mago Leccia 1970:94 (Venezuela); Anonymous 1971:61-62 (popular account); Bearden and McKenzie 1971:13 (collection data, South Carolina); Bortone 1971a:1-27 (life history, Florida); Bortone 1971b:28 (behavior and color notes, Florida); Dahl 1971:224, fig. 295 (Colombia); Ewald et al. 1971:54 (Venezuela); Godcharles 1971:34, table 8 (collection data, Florida); Grimes and Mountain 1971:40-41 (Florida); Nahhas and Powell 1971:4 (parasites); Smith 1971:108 (synonymy); Swingle 1971:33 (Alabama); Bortone 1972:55 (life history, North Carolina); Mountain 1972:60 (collection data, Florida); Gallaway et al. 1972:89, 91 (key); Miller and Jorgenson 1973:310 (meristics); Cliburn 1973:18 (key); Dahlberg 1975:58, fig. 117 (Georgia); Walls 1975:169 (northern Gulf of Mexico).

Centropristis formosus Berg 1895:45-46 (synonymy, Uruguay).

Halipercus formosa Miranda-Ribeiro 1904:25 (Brazil); Miranda-Ribeiro 1915:29 (Brazil); Miranda-Ribeiro 1918:92-93 (Brazil).

Diplectrum formosum Jordan et al. 1930:318-319 (check list); Gunter 1941:195 (Louisiana); Baughman 1950:249 (Texas); Buller 1951:15 (southeast United States); Reid 1954:37-38 (life history, Florida).


I have not seen the type-specimen of D. formosum, but I accept the authority of Goode and Bean (1886:203) who examined the type at the Linnaean Society of London in Burlington House. They confirmed that the Linnaean type was what had been referred to on the eastern coast of the United States as D. fascicularis (= S. fascicularis Valenciennes in Cuvier and Valenciennes 1828:245-246).

Valenciennes (in Cuvier and Valenciennes 1828) also described Serranus iradians and although the description is of D. formosum the syntypes are of two species (i.e., MNHN A464, A461, 7018 are D. formosum; the other syntype MNHN 462 is D. radiale). MNHN A464 is designated the lectotype for Serranus iradians.

Diplectrum radiale (Quoy and Gaimard 1824:313-314, pl. 58, fig. 2) represents the first description of D. formosum from Brazil.

Diagnosis.—As an adult, D. formosum is easily recognized because it is the only Diplectrum whose preopercle has two centers of diverging spines. These form a double pointed spur consisting of upper and lower projections. Diplectrum formosum modally has 16 pectoral rays while D. biaculatum and D. radiale have 15 to 17 each respectively (Table 1). Also D. formosum possesses small scales. This is reflected in the species having the highest
mean scale numbers (Tables 2-7) of any Diplectrum. Juvenile D. formosum may be confused in general appearance with other Atlantic Diplectrum but eye size (small in D. formosum) and scale counts will separate the species. As an adult, D. formosum has the broadest lacrimal and narrowest maxillary bones.

Description.—Within D. formosum there are two morphological populations, a northern subspecies from coastal Gulf of Mexico and Atlantic North America and a southern subspecies from coastal Caribbean and Atlantic South America. The two forms are described separately for morphometric characters. Meristic character differences for both forms except gill raker counts are slight; therefore, these statistics are considered the same for both.

D. X, 12 (13); A, III, 7 (6-8); P., 15.95 (15-17); pored lateral-line scales, 49.76 (46-55); scale rows in lateral line, 76.78 (66-88); scales above lateral line, 9.38 (8-12); scale rows below lateral line, 21.36 (18-26); predorsal scale rows, 17.20 (14-22); cheek scale rows A, 11.77 (9-16); cheek scale rows B, 15.60 (12-18).

Northern form.—Gill rakers, 18.83 (17-22). Standard length, 140.4 (36.7, 77.6-220, 49). Total length, 1,340 (50.12, 1,241-1,451, 44); fork length, 1,191 (22.79, 1,136-1,308, 49); body depth, 275 (15.09, 250-318, 45); head length, 359 (12.58, 330-390, 49); postorbital length, 191 (8.34, 176-210, 49); snout length, 113 (8.77, 93-130, 48); lacrimal width, 59 (6.76, 45-70, 39); maxillary width, 26 (2.05, 22-29, 39); orbit length, 74 (6.42, 62-89, 49); orbit width, 59 (5.76, 48-72, 49); interorbital width, 74 (4.42, 64-82, 38); upper jaw length, 160 (7.10, 145-175, 49); lower jaw length, 179 (8.12, 154-198, 49); cheek height, 125 (9.85, 104-143, 49); cheek length, 128 (7.39, 115-145, 49); caudal peduncle depth, 134 (4.86, 122-146, 49); pectoral fin length, 235 (10.82, 207-257, 49); pelvic fin length, 216 (10.53, 185-238, 39); predorsal length, 349 (10.62, 321-368, 39); pelvic origin to lower jaw, 341 (13.29, 313-379, 32); pelvic origin to anus, 306 (24.09, 254-357, 49); postanal length, 402 (13.90, 374-428, 48). Dorsal spine height: first, 51 (6.40, 35-68, 46); second, 78 (7.19, 58-90, 48); third, 95 (7.36, 79-108, 45); fourth, 105 (8.89, 84-125, 46); fifth, 110 (8.58, 91-131, 43). Anal spine height: first, 25 (4.41, 16-37, 46); second, 47 (6.80, 35-65, 48); third, 70 (8.37, 50-92, 46).

Southern form.—Mean gill rakers, 22.01 (19-24). Standard length, 119.1 (28.1, 76-167, 50). Total length, 1,269 (17.77, 1,232-1,312, 46); fork length, 1,183 (12.80, 1,149-1,207, 50); body depth, 270 (16.06, 238-299, 50); head length, 362 (15.31, 329-394, 48); postorbital length, 192 (9.66, 173-214, 50); snout length, 101 (7.89, 84-121, 50); lacrimal width, 52 (5.59, 41-62, 36); maxillary width, 27 (2.09, 21-31, 37); orbit length, 83 (6.14, 71-94, 50); orbit width, 63 (5.71, 54-78, 50); interorbital width, 73 (5.18, 63-83, 47); upper jaw length, 160 (7.22, 141-174, 50); lower jaw length, 181 (7.00, 165-195, 50); cheek height, 119 (8.97, 98-135, 50); cheek length, 129 (6.50, 116-144, 50); caudal peduncle depth, 125 (5.28, 111-137, 50); pectoral fin length, 238 (7.81, 220-263, 50); pelvic fin length, 210 (9.57, 182-232, 49); predorsal length, 350 (10.20, 335-370, 37); pelvic origin to lower jaw, 342 (16.66, 318-382, 50); pelvic origin to anus, 314 (20.07, 276-353, 50); postanal length, 401 (312, 371-422, 50). Dorsal spine height: first, 53 (5.08, 37-66, 50); second, 79 (6.34, 61-90, 49); third, 100 (7.93, 82-114, 49); fourth, 110 (8.09, 91-125, 46); fifth, 113 (8.29, 94-133, 49). Anal spine height: first, 29 (3.55, 20-35, 49); second, 53 (7.84, 40-78, 49); third, 74 (7.67, 60-93, 50).

Preopercular spur with two clusters of diverging spines. The number of spur spines variable, from 6 to 15, but more often from 9 to 12 between upper and lower clustered tips. The southern form with slightly more

| Table 1.—Number of pectoral rays in Diplectrum species. |
|----------------|----------|--------|-------|-------|-------|-------|
| Species        | 14       | 15     | 16    | 17    | 18    | 19    |
| D. formosum    | 22       | 236    | 8     |       |       |       |
| D. biittatum   | 3        | 131    | 28    |       |       |       |
| Gulf of Mexico | 2        | 28     |       |       |       |       |
| S. Florida     | 3        | 145    | 129   |       |       |       |
| Caribbean      | 7        | 304    |       |       |       |       |
| South America  | 17       | 25     | 14    |       |       |       |
| D. radiale     | 11       | 104    | 14    |       |       |       |
| D. pacificum   | 6        | 29     | 4     |       |       |       |
| D. rostrum     | 5        | 7     | 1     |       |       |       |
| D. conceptione | 3        | 38     | 13    |       |       |       |
| D. maximum     | 4        | 67     |       |       |       |       |
| D. sciurus     | 2        | 47     | 85    |       |       |       |
| D. euryplectrum| 6        | 9     |       |       |       |       |
| D. labarum     | 28       | 9      |       |       |       |       |
| Outer Baja California | | | | | | |
| Gulf of California | | | | | | |
| Panama and Costa Rica | | | | | | |
| Total          | 30       | 43     | 1     |       |       |       |
| D. eumelum     | 1        | 95     | 3     |       |       |       |
| D. macropoma   | 3        | 130    | 21    |       |       |       |
Table 2.—Number of scale rows in lateral line of Diplectrum species and populations.

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18
In preservative the following differences between the northern and southern forms are noted: in the southern form lines on cheek and snout more wavy; dark brown vertical body bars broader, more intense, extending further ventrally; caudal spot larger than eye, extending below midcaudal peduncle line and vertical in orientation; blue lines on top of head and seven to nine body stripes not discernible; base of pectoral fin brown, not pale as in the northern form; blue dorsal fin lines tending to be more irregular, terminating in three, rather than four, stripes; caudal fin spots more irregular; definite dark brown spot dorsally on caudal peduncle.

Size.—The species attains a moderate size and 224 mm SL is the maximum size known.

Habits.—Diplectrum formosum is found in coastal areas over sand bottom at the base of reefs and upper edges of depressions in the substrate (Bortone 1971a). The species is recorded from depths of 1-80 m but is most often found at depths of 7-50 m. Larger adults tend to be found in deeper water while juveniles are more commonly taken from shallow water (Bortone 1971a).

Distribution.—Diplectrum formosum is a continental species found throughout the Gulf of Mexico, around peninsular Florida, and northward along the east coast of the United States to Chincoteague, Va. A record from a New York market (USNM 15844) is not confirmed to be from New York and most probably came from the North Carolina area as part of an exported fish catch. The species has been recorded from the Bahamas (Böhlke and Chaplin 1968:267). This is the only plotted literature record (Fig. 10) not verified in the present study. One specimen is from the Virgin Islands (FSBC 5393). The species is also found along the northern coast of South America, and southward to about São Paulo, Brazil. Literature accounts (e.g., Berg 1895:45-46; Cuvier and Valenciennes 1828:244-245) of the species occurring south to Uruguay cannot be confirmed at this time.

The northern form would include North American specimens examined. The southern form includes specimens from South America and the Virgin Islands. The type-locality is the Carolinas.
Variation.—Among meristic characters the number of gill rakers shows the most noticeable variation (Table 8). The northern form shows a mean of 18.83. There is slight variation at different localities with North Carolina specimens having a mean of 18.18, those in the Florida Keys with 19.31, and those off Yucatan with 19.80. This slight variation may be temperature induced. In the distribution of the species a sharp separation between southern and northern forms is also shown in mean gill raker count; from Venezuela southward higher mean counts increase from 21.67 to 22.48 in Brazil.

The northern subspecies has a considerably greater total length than the southern form, because of the elongate filamentous upper caudal lobe of the former. Snout length tends to be greater for the northern form, and eye size is generally larger in the southern form. All dorsal and anal spines measured tend to be slightly longer for the southern form. Color descriptions presented herein reflect discernible difference between the two forms. It cannot be established what significance the differences may have, however, until live southern form _D. farmosum_ are examined. The more exaggerated and earlier formed double-spur preopercle of the southern form _D. farmosum_ is also an important character for separating the subspecies.

Systematic comments.—The differences as well as similarities of the two forms are readily apparent. The question of separation of the two forms into different species seems at this point somewhat arbitrary in view of the obvious overlap in characters and lack of live specimens for color comparisons. It does seem, however, that the significance of these differences should be emphasized and recognized. Therefore it is recommended that the two forms be considered as subspecies: _D. formosum formosum_ (Linnaeus 1766), the northern form, and _D. formosum radians_ (Quoy and Gaimard 1824), the southern form.

Specimens examined.—A total of 352 specimens from 29 to 224 mm SL. NEW YORK: USNM 15844, 1 (145). VIRGINIA: USNM 143388, 1 (120). CAROLINAS: UNC 2687, 2 (192-200); UNC 194, 1 (82); UNC 6058, 27 (150-210); BMNH 207, 2 (167-224); GBML 70-113, 2 (187-109); GBML 67-1, 1 (125); MCZ 10255, 1 (196); MCZ 2860, 1 (178); MCZ 10254, 1 (292). JACKSONVILLE, FLA.: UNC 5225, 27 (68-175); SIO 65-522, 1 (167). S. FLORIDA. KEYS AND CUBA: USNM 4676, 2 (100-151); USNM 13057, 1 (153); UMMIL 2081, 4 (55-104); UMMIL 7778, 1 (83); UMMIL 17409, 1 (136); UMMIL 5185, 1 (57); FMNH 41665, 2 (165-168); UMMIL 3223, 15 (49-147); MCZ 45033, 1 (184); TABL (Key Biscayne, 13 Dec. 1967), 4 (55-72); CAS SU1422, 6 (65-169); FSBC 336, 5 (57-115); MCZ 2932, 1 (113); MCZ 2929, 1 (105); MCZ 21768, 1 (164); MCZ 21766, 1 (155); MCZ 21767, 1 (145); MCZ 21765, 1 (155); MCZ 38654, 1 (183); MCZ 2863, 2 (143-178); MCZ 46663, 1 (155); UMMIL 16240, 1 (80). EASTERN GULF OF MEXICO: UMMIL 2814, 1 (92); FMNH 33552, 1 (94); FMNH 33553, 1 (88); FSBC 2955, 7 (75-155); FSBC 4667, 7 (94-150); FSBC 6376, 17 (42-88); MCZ 45116, 1 (147); TABL (Sanibel Is., 14 Aug. 1959), 1 (68); MCZ 38656, 1 (197). NORTHERN GULF OF MEXICO: USNM 142852, 6 (29-45); FSU 17899, 4 (41-65); FSU 17890, 3 (81-95); FSU 14724, 1 (100); FSU 263, 2 (71-78); FSU 18508, 35 (33-93); MCZ 35111, 1 (184-198); UW 16762, 1 (124); UW 16648, 4 (95-116); USNM 155208, 2 (135-138); GCRL 812, 3 (94-107); GCRL 1213, 1 (137); GCRL 1444, 1 (72). TEXAS: USNM 143389, 1 (124). MEXICO: USNM 134192, 1 (167); FMNH 45476, 2 (155-162); MCZ 38, 1 (177); UPR LB776, 1 (140); GCRL 2981, 2 (102-107); UTIMS 923, 1 (155); UTIMS 924, 4 (66-130); UTIMS 919, 1 (124); UTIMS 916, 2 (51-84). VIRGIN ISLANDS: FSBC 5393, 1 (62). COLOMBIA: USNM 211406, 3 (150-157); USNM 211403, 3 (145-148). VENEZUELA: UNC (Cubagua, 11 Oct. 1971), 9 (109-167); MCZ 40942, 7 (52-92); MCZ 41088, 1 (160); UPR 2665, 3 (108-144); USNM (lat. 10°30’ N, long. 70°30’ W, 15 Nov. 1958), 5 (72-104);
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21
**Diplectrum bivittatum** (Valenciennes 1828)

*Figures 6, 8, 9, 11*

*Serranus bivittatus* Valenciennes in Cuvier and Valenciennes 1828:241-242 (original description, Martinique and Havana); Storer 1846:27 (general account); Gill 1863:236 (generic affinity with *Halipercia*); Poey 1866:185 (Cuba); Poey 1868:282 (description, Cuba); Boulenger 1895:297 (catalog).

*Centropristis bivittatus* Günther 1859:82 (catalog).

*Halipercia bivittatus* Poey 1871:52-54 (systematics).

*Serranus radialis* Jordan 1886:376 (in part, distribution); Jordan 1887:82 (catalog, West Indies); Metzelaar 1919:54-55 (synonymy, West Indies).

*Diplectrum radiale* Jordan and Eigenmann 1890:398-399 (in part, systematics); Jordan and Evermann 1896:1203-1205 (in part, systematics); Evermann and Marsh 1902:159 (Puerto Rico); Fowler 1907:263 (in part, distribution); Meek and Hildebrand 1925:472, 475-477, pl. 46, fig. 1 (systematics, Panama); Nichols 1929:255 (Puerto Rico and Virgin Islands); Jordan et al. 1930:318 (in part, check list); Longley 1932:286 (biology, Florida); Beebe and Tee-Van 1933:135-136 (description, Bermuda); Baughman 1950:249 (Texas); Briggs 1958:272 (in part, distribution); Caldwell and Caldwel 1964:16 (Colombia and Aruba); Randall 1968:73, 76, fig. 86 (description, Caribbean); Anonymous 1971:63-65 (popular account); Dahl 1971:225 (Colombia); Dahlberg 1975:58 (Georgia).

*Halipercia bivitta* Diaz 1893:52 (name only, misspelled).

**Diplectrum bivittatum** Longley and Hildebrand 1941:104-105 (field data, Florida); Ginsburg 1948:266-270 (systematics); Hildebrand 1955:208, 222-223, table 7 (systematics, Campeche); Bailey et al. 1960:25 (check list); Bullis and Thompson 1965:44 (field data); Roessler 1965:314, table 2 (field data, Florida); Caldwell 1966:40 (Jamaica); Moore et al. 1966:32 (Florida); Starck and Davis 1966:320 (Florida); Starck 1968:19 (Florida); Bailey et al. 1970:34 (check list); Gallaway et al. 1972:89 (key); Miller and Jorgensen 1973:310 (meristics); Dahlberg 1975:55 (Georgia); Walls 1975:168-169 (northern Gulf of Mexico).

*Diplectrum arcuatum* Ginsburg 1948:266-270 (original description, Gulf of Mexico); Baughman 1950:249 (Texas); Pearse 1952b (parasites); Hildebrand 1954:304 (Texas); Hildebrand 1955:224, table 7 (systematics, Gulf of Mexico); Briggs 1958:272 (distribution); Hootse 1958:331 (Texas); Bullis and Thompson 1965:44 (field data); Gunter and Hall 1965:31 (field data, Florida); Cervigon 1966:324 (name only); Swingle 1971:33 (Alabama); Franks et al. 1972:84 (Mississippi).

The species was described originally as *Serranus bivittatus* by Valenciennes in Cuvier and Valenciennes (1828:241-242) from two specimens (syntypes). In the absence of any designated holotype, MNHN 6988 (Martinique) is designated the lectotype. MNHN 5889 (Cuba) was not chosen as the lectotype as it is from the area of the intermediate population (see below) and is here considered the only paralectotype.

Early confusion in the literature regarding *D. bivittatum* probably was due to inclusion of its specific name under the synonymy of *D. radiale* by Jordan and Eigenmann (1890:399) because they considered *Serranus bivittatus* to be the young of *D. radiale*. It was not until Longley and Hildebrand (1941:104-105) that *D. bivittatum* was restored to specific status.

Ginsburg (1948:266-270) considered the Gulf of Mexico population to be a distinct subspecies. However, designation by Ginsburg (1948:268) as *D. arcuatum* and not as *D. b. arcuatum* led later authors incorrectly to accord specific status to Ginsburg's subspecies.

Figures by Meek and Hildebrand (1925:pl. 46, fig. 1) and Randall (1968:fig. 86) are labeled as *D. radiale* but actually depict *D. bivittatum*.

**Diagnosis.**—*Diplectrum bivittatum* in the Atlantic can be confused only with *D. radiale*. The problem becomes especially important in the area of sympathy along the northern and northeastern coasts of South America. *Diplectrum bivittatum* has a larger eye, lower number of pectoral rays, a longer second and shorter third dorsal spine (1.2-1.6 vs. 1.7-2.1, the second into the third) than *D. radiale*. Also, the preopercular structure is more pointed in *D. bivittatum* but definitely squared in *D. radiale*. The upper caudal lobe is often extended as a filament in *D. bivittatum* but never in *D. radiale*. Coloration and cheek scale rows A (mean 8.06 for *D. bivittatum* vs. 9.95) also separate the species.

**Description.**—Because of the systematic problems present in *D. bivittatum*, the two geographic forms from the Gulf of Mexico and Caribbean and an intermediate group from south Florida will each be described separately for morphometric characters. Meristic characters except numbers of pectoral rays, predorsal scale rows, and Gill rakers are virtually identical for all three groups and are presented under the description for the Gulf of Mexico specimens.
**Gulf of Mexico.**—D, X, 12; A, III, 7 (6-8); P., 15.16 (14-16); pored lateral-line scales 48.54 (44-51); scale rows in lateral line, 64.69 (54-75); scales above lateral line, 7.28 (6-9); scales below lateral line, 18.69 (16-22); predorsal scale rows, 12.76 (10-15); cheek scale rows A, 8.06 (7-9); cheek scale rows B, 11.86 (9-14); gill rakers, 22.03 (20-25).

**Standard length.** 91.38 (11.28, 75-125, 53). Total length, 1,304 (47.77, 1,231-1,440, 45);fork length, 1,169 (13.07, 1,143-1,203, 51); body depth, 267 (12.34, 237-296, 53); head length, 347 (8.13, 324-369, 53); postorbital length, 179 (5.76, 169-191, 53); snout length, 89 (6.01, 76-97, 50); cheek length, 117 (4.35, 109-128, 53); gill rakers, 22.03 (18-23).

**Fin length.** 229 (10.46, 219-273, 48); pelvic origin to lower jaw, 33 (3.94, 24-33, 47); posterior nostril, 33 (3.94, 24-33, 47); orbit length, 258 (11.43, 229-294, 22); pelvic fin length, 222 (10.29, 203-249, 53); predorsal scale rows, 14.18 (12-17); upper jaw length, 156 (3.80, 148-165, 53); lower jaw length, 176 (5.78, 158-188, 52); cheek height, 110 (5.70, 96-123, 53); cheek height, 117 (4.35, 109-128, 53); lower jaw length, 173 (5.05, 164-185, 51); maxillary width, 27 (1.89, 24-30, 13); orbit width, 71 (3.60, 65-82, 51); orbital fin pale orange, tips black. Pelvic fins pale yellow-orange with white anterior and posterior edges. Anal fin white at base and distal edge, pale yellow through median fin portion. Snout with narrow brown bar, and a narrow blue one beneath, below this a blue cheek stripe running upward from middle anterior lacrimal edge posteriorly to eye, passing under the orbit and across upper cheek. Another blue stripe below this on central cheek area. Opercle with pale greenish-yellow blotch. A thin blue line present on lower jaw and along upper maxillary. Pale blue spots on head with two pale blue chevrons above. Spinous dorsal fin with wavy blue bar at base, above this an orange bar, above this a blue bar, and distally an orange bar. Soft dorsal fin with irregular yellow spots along base. Above are two parallel longitudinal rows of pale blue spots on an orange field. Distal portion of fin with orange bar. Caudal fin with five or six orange spots in vertical rows on a pale blue field, upper lobe and edge orange, lower caudal blue. Upper pharyngeal region bright yellow. Posterior branchial surface with yellow and black blotches, medial opercular surface black.

**Color.**—The following color description is based on five live adult *D. biwittatum* collected at Pensacola, Fla. in the northern Gulf of Mexico in May 1973. Dorsum brown with copper tinge. Sides tan with evidence of two broad brown lateral stripes, the upper appearing to pass through eye and continuing as a brown bar on snout. A tendency for five or six blotches of more intensified pigment along lateral stripes. Lateral surface tan, ventral and lower lateral surface white, but each scale bearing a small yellow dot at base. Chest and throat white. A distinct caudal spot (equal to eye in size) appearing as an extension of midlateral stripe but separated from it. Pectoral fin pale orange, tips black. Pelvic fins pale yellow-orange with white anterior and posterior edges. Anal fin white at base and distal edge, pale yellow through medial fin portion. Snout with narrow brown bar, and a narrow blue one beneath, below this a blue cheek stripe running upward from middle anterior lacrimal edge posteriorly to eye, passing under the orbit and across upper cheek. Another blue stripe below this on central cheek area. Opercle with pale greenish-yellow blotch. A thin blue line present on lower jaw and along upper maxillary. Pale blue spots on head with two pale blue chevrons above. Spinous dorsal fin with wavy blue bar at base, above this an orange bar, above this a blue bar, and distally an orange bar. Soft dorsal fin with irregular yellow spots along base. Above are two parallel longitudinal rows of pale blue spots on an orange field. Distal portion of fin with orange bar. Caudal fin with five or six orange spots in vertical rows on a pale blue field, upper lobe and edge orange, lower caudal blue. Upper pharyngeal region bright yellow. Posterior branchial surface with yellow and black blotches, medial opercular surface black.
wedge-shaped white spots behind anterior spines. Anterior dorsal spine orange. Dorsal caudal peduncle with two dark brown spots bordered by white spots forming a longitudinal line. Dorsum brown-copper with a trace of olive-green pigment.

Orange and yellow pigments are pale to clear in preserved specimens, blue appears dusky. Upper medial opercular surface dusky, paler below; posterior branchial surface dusky.

Size.—*Diplectrum bivittatum* is a small species, the largest specimen recorded in the present study is 126 mm SL.

Habits.—*Dipllectrum bivittatum* has been captured at a wide range of depths from 2 to 110 m but most frequently at 15-80 m. In January-February 1973 I observed the species off Galeta Point, Panama, in 2-3 m of water. It appeared to be solitary and occurred over a clean coral-shell bottom at the base of reefs. This species is the most insular of all *Dipllectrum*, frequently taken in the Antilles. Starck (1968:19) listed *D. bivittatum* as being common at Alligator Reef, Fla. Gulf of Mexico specimens are found more often over a more mud-silt bottom than Caribbean and intermediate populations.

Distribution.—*Dipllectrum bivittatum* is found in the western Gulf of Mexico but terminates its northern Gulf of Mexico distribution near Pensacola, Fla. (Fig. 11). It occurs in the area of the Dry Tortugas, northern Cuba, southern Florida, and northward along the Florida east coast to lat. 29°43'N, long. 80°49'W near St. Augustine, Fla. Beebe and Tee-Van (1933:135-136) reported *D. bivittatum* (as *D. radiale*) from Bermuda. This record is not plotted as it could not be verified (W. Smith-Vaniz, Acad. Nat. Sci. Philadelphia, pers. commun.). The species is found at Jamaica, Puerto Rico, and throughout the Lesser Antilles. *Dipllectrum bivittatum* is also found off Central America, along the northern and southern coasts of South America, and terminates its southern distribution off Brazil at lat. 2°23'S, long. 40°31'W. The type-specimens are from Martinique and Havana, Cuba.

Variation.—Meristic and morphometric data confirm the existence of two reasonably distinct geographical subspecies. One subspecies is in the Gulf of Mexico and the other is found in the Caribbean and along the northern South American coast; an intermediate population occurs in the vicinity of Florida Keys, southern Florida, Tortugas, and northern Cuba (this general area referred to hereafter as S. Florida).

The Gulf of Mexico subspecies has a lower mean number of pectoral rays and predorsal scale rows, but a much higher mean gill raker count than the Caribbean and South American subspecies. The S. Florida population is intermediate for mean number of pectoral rays and gill raker count. The Gulf of Mexico subspecies has several morphometric characters differing from the Caribbean and South American subspecies (Table 9). The S. Florida population is intermediate in several characters, notably snout length, postorbital length, upper- and lower-jaw lengths, caudal peduncle depth, pectoral fin length, and dorsal spine height.

![Figure 11.—Distribution map for *Dipllectrum bivittatum* (circles); *D. maximum* (triangles); and *D. eugyplectrum* (squares). (Localities are based on the materials examined in this study.)](image-url)
### Table 9.—Mean proportional data in thousandths of standard length (SL) for *Diplectrum* species and populations.

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Specimens examined.—A total of 568 specimens from 22 to 126 mm SL. S. FLORIDA AND Keys: UMM 8804, 1 (63); UMM 10170, 1 (68); UMM 2595, 1 (88); UMM 3957, 6 (86-109); UMM 2081, 1 (109); UMM 10150, 5 (22-84); USNM 171201, 20 (73-119); TABL (Silver Bay Stn. 4329), 2 (33-53); TABL (Silver Bay Stn. 2384), 1 (47); FMNH 12324, 2 (90-104); FMNH 61315, 5 (105-118); USNM 4869, 3 (90-110); FSBC 799, 1 (103); FSBC 1583, 5 (57-90); FSBC 336, 11 (55-90); MNHN 5889, paratype, 1 (80); MCZ 10242, 1; UPR 2086, 1 (96). NORTHERN GULF OF MEXICO: FMNH 50726, 6 (82-90); GCRL 4208, 1 (81); GCRL 533, 2 (87-95); GCRL 35, 2 (81-90); GCRL 671, 1 (33); GCRL 2318, 1 (91, deformed snout); UW 16899, 3 (82-83); UW 16659, 3 (95-110); USNM 155177, 2 (81-100); USNM 129817, 1 (74); TABL 101472, 4 (69-97); TABL (Silver Bay Stn. 5004), 1 (105); FSM 5207, 7 (73-102); FMNH 59807, 5 (66-112); FMNH 16187, 1 (78); FMNH 16188, 1 (78); GCRL 276, 2 (87-91); USNM 144214, 1 (83); USNM 144213, 1 (117); USNM 155175, 2 (72-107). TEXAS: FMNH 5177, 4 (96-103); FMNH 40263, 3 (76-105); FMNH 45144, 2 (90-91); INP 1384, 1 (119); UMM 28700, 3 (89-108); UTIMS 926, 2 (30-37); UTIMS 1629, 2 (88-100); UTIMS 920, 1 (97); UTIMS 918, 1 (111); UTIMS 925, 4 (63-76); UTIMS 1483, 3 (30-81); UTIMS 1627, 2 (88-88); UTIMS 922, 37 (56-112); UTIMS 1024, 2 (101-105); CAS SU 50185, 1 (99); USNM 155176, 2 (80-85); USNM 144215, 9 (91-112); USNM 144216, 1 (80); USNM 155173, 1 (52); USNM 155174, 1 (96); USNM 118536, 1 (88); USNM 118535, 11 (90-97); UMM 15398, 2 (82-90); UMM 7749, 4 (33-33). YUCATAN: FSM 5209, 1 (97); UTIMS 917, 9 (90-97); UTIMS 921, 5 (64-125); USNM 188289, 20 (88-107). JAMAICA: LACM 5433, 1 (70); LACM 5434, 3 (99-108); LACM 6203, 8 (87-110); LACM 6204, 1 (72); LACM 6201, 16 (62-100); LACM 6200, 10 (62-123); LACM 6199, 23 (62-123); UMM 28699, 1 (90). PUERTO RICO AND ANTILLIES: UMM 7324, 1 (49); USNM 128262, 1 (109); UMM 7110, 1 (88); FMNH 64989, 2 (86-97); FMNH 64892, 4 (110-114); MNHN 6988, lecotype, 1 (108); BMNH 1904.7.2667, 1 (97); LACM 6764-1, 7 (46-88); LACM 6768-1, 22 (37-98); TABL (Oregon Stn. 2631), 1 (105); UPR 2713, 5 (67-81); UPR 2158, 1 (83); UPR 239, 1 (84); UPR 1029, 2 (76-84); UPR 1238, 1 (42); UPR 2692, 1 (92); UPR 2055, 1 (65); UPR 239, 1 (90); UPR 2330, 1 (44). BELIZE: TABL 105165, 2 (94-99); TABL 105164, 10 (86-112). HONDURAS: FMNH 64956, 4 (95-106); USNM 185143, 2 (96-99); TABL 105155, 11 (94-107); TABL 105156, 8 (86-103); TABL 105157, 7 (82-102); TABL 105158, 1 (96); TABL 105160, 30 (74-109). COSTA RICA: UCR 253-31, 2 (88-92); LACM 30729-5, 1 (103). PANAMA: UCR 226-4, 2 (103-114); FMNH 8392, 9 (44-62); FMNH 8393, 3 (31-40); MCZ 45530, 2 (31-64); UMM 23897, 5 (69-90); UMM 22007, 6 (90-103). VENEZUELA: RMNH 8448, 1; RMNH 8422, 1 (120); RMNH 9077, 1 (109); USNM (Oregon Stn. 4865), 6 (37-117);
Gill's (1863) generic interpretation. The species was included under the genus Haliperc by Miranda-Ribeiro (1915:29-30) at the inference of Gill's (1863) generic interpretation.

Diagnosis.—Diplectrum radiale is a species with a narrow preopercular spur and in the Atlantic can only be confused with D. bivittatum. Separation of these species is possible when one considers the relative height of the dorsal spines, especially the number of times the second spine fits into the third (1.7-2.1 for D. radiale, 1.2-1.6 for D. bivittatum). The eye is smaller for D. radiale. The mean number of pectoral rays and of cheek scale rows A is higher; the preopercle generally is more squared off in D. radiale and definitely more pointed in D. bivittatum at its upper angle.

Diplectrum radiale in the Atlantic is a "geminate species" with D. pacificum in the Pacific as defined by Jordan (1908). The species can be discriminated by several characters: notably the gill raker length, color pattern, and other characters considered under the diagnosis for D. pacificum.

Description.—D, X, 12 (13); A, III, 7; P1, 16.79 (16-18); pored lateral-line scales, 48.82 (47-52); scale rows in lateral line, 63.36 (54-71); scales above lateral line, 7.28 (6-9); scales below lateral line, 18.57 (15-21); predorsal scale rows, 15.25 (12-19); cheek scale rows A, 9.95 (9-12); cheek scale rows B, 11.73 (10-14); gill rakers, 18.25 (15-21).

Standard length, 136.97 (23.12, 84.4-168, 42). Total length, 1,248 (10.70, 1,222-1,276, 42); fork length, 1,179 (9.75, 1,160-1,207, 42); body depth, 264 (20.10, 218-302, 40); head length, 367 (19.54, 353-406, 42); postorbital length, 211 (16.61, 188-254, 42); snout length, 93 (8.33, 74-114, 42); lacrimal width, 48 (5.15, 40-57, 32); maxillary width, 27 (2.72, 22-30, 32); orbit length, 81 (5.55, 71-95, 40); orbit width, 65 (5.95, 54-79, 42); interorbital width, 70 (8.56, 54-83, 32); upper jaw length, 164 (12.41, 144-193, 42); lower jaw length, 180 (9.44, 160-208, 42); cheek height, 129 (11.98, 105-149, 42); cheek length, 118 (6.50, 107-132, 42); caudal peduncle depth, 125 (6.29, 107-132, 42); postanallength, 399 (11.45, 377-420, 42). Dorsal spine height: first, 43 (5.14, 33-54, 42); second, 64 (5.12, 55-72, 40); third, 118 (8.25, 104-136, 41); fourth, 128 (7.32, 114-144, 40); fifth, 126 (7.03, 110-137, 39). Anal spine height: first, 30 (4.06, 21-38, 42); second, 58 (5.87, 47-76, 42); third, 79 (7.35, 64-97, 42).

Preopercular spine square but narrow, bearing 5-10 elongate spines. Vertic and horizontal preopercular arms serrate. Anterior nostril with elongate nostril flap. Gill rakers short, the first at angle not reaching to base of third below. Scales present in a row along second anal spine. Chest scales not noticeably smaller and not em- bedded. Caudal lobes nearly equal in length, upper only slightly longer and never extended as a filament. Caudal fin margin nearly straight.

Color.—Color notes are from preserved specimens. Dorsum and lateral body surface light to medium brown, five to seven irregular dark vertical bars on lateral surface terminating before ventral region. Caudal spot distinct, equal to eye size. Ventral area white. Snout, head, and cheek gray-brown. Lower preopercle pale below. Maxillary gray-brown and paler distally. Lower jaw dusky at midline. Pectoral, anal, and pelvic fins pale. Caudal fin with three to four pale broad vertical bars bordered by darker bars of equal breadth. Two indistinct dark spots on dorsum of caudal peduncle, separated by a smaller pale spot. First and second dorsal spines dark. Spinous dorsal fin dusky, black at spine tips. Soft dorsal with two regular rows of pale spots on a dusky field. Soft dorsal ray tips and caudal ray tips black. Medial opercular surface black or dusky above, white below. Posterior branchial surface dusky.

Size.—The species attains a reasonably large size; 197 mm SL is the maximum size examined in the present study.

Habits.—Depth data indicate that D. radiale occurs in depths ranging from 20 to 80 m. Durand (1961) confirmed this depth distribution off the coast of Guyana. He took the species from sand-mud, and shell and sand-bottom types. Cervigon (1966) stated the species principally consumes crustaceans and small fish.

Distribution.—Diplectrum radiale is found in coastal areas of eastern and northeastern coasts of South America (Fig. 12). Its westernmost distribution along the Venezuelan coast is the Gulf of Venezuela. The species extends southward to São Paulo, Brazil. Literature records indicate the species occurring southward to Uruguay but this has not been confirmed. One specimen (BMNH 1904-3:15:24-5) was accompanied by a label which stated "St. Thomas." It was presumed that this meant St. Thomas Island in the Virgin Islands. Other than this record the species has not been taken from the Caribbean Antilles. It is possible that the locality is in error or that "St. Thomas" refers to a city on continental South America. The type-locality is Rio de Janeiro.

Variation.—No discernible geographic variation in meristic characters was observed for this species. There appears to be a slight (but statistically untested) trend of morphological variation in D. radiale. Northern specimens appear to have slightly larger heads and jaws than specimens from the southern parts of South America.

Specimens examined.—A total of 103 specimens from 64 to 197 mm SL. St. Thomas, BMNH 1904-3:15:24-5, 1 (174). Venezuela, Trinidad: UPR 1830, 1 (89); BMNH 1922-2:3:29, 1 (128); UMML 28757, 1 (166-166); UMML 28749, 2 (195-197); UMML...
Diplectrum pacificum
Meek and Hildebrand 1925

Figures 6, 8, 9, 15

Centropristis radiale Steindachner 1876:6 (in part, Panama).

Serranus radialis Jordan and Gilbert 1881:274 (Baja California); Jordan 1886:376 (Panama and Mazaltan); Jordan 1887:82 (in part, catalog); Boulenger 1895:297-298 (in part, catalog).

Diplectrum radiale Jordan and Bollman 1890:157-158, 181 (Panama); Jordan and Eigenmann 1890:398-399 (in part, systematics account); Evermann and Jenkins 1892:127-128, 142 (Gulf of California); Jordan 1895:451 (Sinaloa, Mexico); Jordan and Evermann 1896:1203-1205 (systematics); Gilbert and Starks 1904:97 (Panama); Fowler 1916b:409 (Panama); Osburn and Nichols 1916:163 (Baja California); Kumada 1927:39, pl. 6, fig. C (Mexico).

Diplectrum pacificum Meek and Hildebrand 1925:472, 477-478, pl. 46, fig. 2 (original description, Panama); Jordan et al. 1930:318 (check list); Breder 1936:24 (Pacific coast); Walford 1937:123 (general account); Seale 1940:20, 23 (Panama); Fowler 1944:262-263 (color notes); Hildebrand 1946:185 (key); Grey, 1947:140 (type catalog); Berdegue Anzar 1956:53, 264-265, fig. 183 (key and fishery data, Mexico); Orces 1959:81 (systematics, Ecuador); Gosline 1966:91-112 (systematics); Rosenblatt and Johnson 1974:178-191 (key, systematics); Chirichigno F. 1974:294-298 (key, Peru); Portone in press a (gonad morphology); Portone in press b (life history, Panama).

Diplectrum radiale Streets 1877:52-53 (systematics, Baja California).

Earlier authors considered D. pacificum as a Pacific Ocean representative of D. radiale. Meek and Hildebrand (1925) described the Pacific form as a new species and considered it distinct from D. radiale as they knew it. However, the specimen of D. radiale figured by them (Meek and Hildebrand 1925:pl. 46, fig. 2) is actually D. biwittatum. Nevertheless, D. pacificum and D. radiale are distinct species, qualifying as "geminate species" as defined by Jordan (1908).
Diagnosis.—*Diplectrum pacificum* is distinguished from other Pacific *Diplectrum* by a combination of characters which include: less than 30 total gill rakers; 7 anal rays; lack of extended tips on second, third, or fourth spines; lack of an enlarged second anal spine; a relatively high number of cheek scale rows A (8-12) and B (10-14); and a narrow preopercular spur.

*Diplectrum pacificum* could readily be confused with *D. rostrum*, another Pacific species. It can be differentiated from *D. rostrum* by the following characters: snout spot present in *D. pacificum* but not a distinct bar as in *D. rostrum*; the soft-dorsal-fin color patterns, total gill raker counts; orbit length and width, preopercle shape and other characters listed under diagnosis for *D. rostrum*.

It might readily be confused with its geminate Atlantic form, *D. radiale*. Separation of these species admitted is difficult but several discernible differences are evident. Meristically the number of gill rakers is higher for *D. pacificum* (20.25 vs 18.25), but other characters show a high degree of overlap and do not allow discrimination. Morphometrically there are no characteristic differences reliably separating these species but in general the eye is smaller for *D. pacificum*, the caudal peduncle deeper, the upper caudal lobe more elongate, and fins and spines tend to be longer in *D. pacificum*. Gill rakers are moderate in length in *D. pacificum* (the first at the angle reaching to the origin of the fourth below) and are short in *D. radiale* (the first not reaching to the base of the third, usually reaching only to the base of the second below).

In preservative there are color differences between the species which surely are more distinctive in fresh specimens but no satisfactory color data for living *D. radiale* exist. Caudal fin of *D. pacificum* with five or six thin, light caudal bands bordered by wider dusky bands; *D. radiale* bears four light bands equal in width to the dusky bands which border them. The soft dorsal fin bears several irregular rows of spots in *D. pacificum* but *D. radiale* has one or two rows of regularly spaced, larger spots.

Description.—D, X, 12 (13); A, III, 7 (8); P₁, 17.02 (16-18); pored lateral-line scales, 49.05 (47-51); scale rows in lateral line, 65.48 (58-74); scales above lateral line, 7.64 (6-9); scales below lateral line, 18.88 (16-21); predorsal scale rows, 14.85 (11-19); cheek scale rows A, 9.70 (8-12); cheek scale rows B, 12.21 (10-14); gill rakers, 20.25 (17-24).

Standard length, 150 (29.12, 101-211, 40). Total length, 1,289 (24.57, 1,242-1,354, 40); fork length, 1,178 (17.23, 1,128-1,229, 40); body depth, 275 (16.66, 240-327, 37); head length, 369 (12.13, 339-392, 39); postorbital length, 211 (9.54, 188-231, 40); snout length, 97 (6.82, 84-108, 40); lacrimal width, 49 (3.98, 39-56, 39); maxillary width, 27 (1.72, 24-31, 39); orbit length, 79 (6.66, 66-90, 40); orbit width, 63 (5.07, 53-71, 40); interorbital width, 70 (4.27, 63-77, 39); upper jaw length, 163 (6.15, 149-176, 38); lower jaw length, 176 (5.54, 163-189, 39); cheek height, 128 (6.77, 114-146, 40); cheek length, 118 (5.90, 108-133, 40); caudal peduncle depth, 129 (6.18, 115-142, 40); pectoral fin length, 244 (10.04, 218-268, 40); pelvic fin length, 195 (8.05, 176-212, 39); predorsal length, 359 (9.22, 341-378, 39); pelvic origin to lower jaw, 334 (10.93, 307-358, 28); pelvic origin to anus, 313 (20.23, 273-363, 40); postanal length, 406 (13.95, 364-428, 40). Dorsal spine height: first, 49 (5.83, 36-60, 39); second, 70 (5.80, 60-84, 37); third, 122 (6.42, 106-134, 38); fourth, 135 (7.33, 120-150, 40); fifth, 136 (6.98, 122-152, 39). Anal spine height: first, 33 (4.58, 21-44, 40); second, 60 (6.33, 47-72, 40); third, 80 5.62, 68-92, 39).

Preopercle with narrow spur bearing five to eight elongate spines (an occasional spine missing). Vertical and horizontal preopercular arms serrate. Anterior nostril with short flap. Upper caudal lobe noticeably longer than the lower. Caudal fin only slightly forked. Second anal spine as stout or more stout than third. Gill rakers moderate in length, first at angle reaching to base of fourth below. Chest scales smaller than lateral scales and slightly embedded.

Color.—Color notes were taken from live specimens from the Bay of Panama in January-February 1973. Dorsum green-brown with a copper cast. Ventral surface white. Sides of juveniles with two distinct lateral stripes, the lower passing through eye into snout. In adults lateral bars becoming disrupted by five or six vertical brown bars. Caudal spots distinct and equal to eye size. Lower lateral surface (area just above anus to midanal fin) with pink-orange blotch, about one-fourth body depth in height. Anal fin with white bars distally and proximally, the central portion of the fin yellow. Anterior and posterior edges of pelvic fin white, the central portion yellow. Pectoral fin pink-orange, occasionally a blue bar at its base. First and second dorsal spines dark blue-black, remainder of spines with orange tips. Spinous dorsal fin membrane clear at base, dusky brown through its central portion and pale blue above. Distal edge of soft dorsal fin orange. Remainder of membrane a pale blue field with irregular series of orange spots and blotches. These spots variable in shape and pattern between individuals; usually the anterior spots more rounded, posteriorly the spots elongate or fuse with other spots presenting a wavy-bar appearance. Upper caudal lobe bright orange, lower white. Two parallel orange stripes just below upper caudal lobe. Distal caudal ray tips black. Body of caudal fin with five to six pale orange bars separated by equally wide pale blue bars. Caudal fin base with small orange spots on pale blue background. Snout region with irregular elongate pale orange-yellow bar running from anterior snout to anterior orbit rim. Two or three pale orange-yellow spots below this, a thin similarly colored bar just below orbit rim, and a pale orange-yellow wavy cheek bar. The first snout bar irregular and not well delineated. Occasional spots of orange about preopercle and on the opercular-interopercular area bordering preopercular spur. Upper pharyngeal region bright yellow in adults. The medial opercular surface black above and white below. Posterior branchial region variable, black to clear. Dentary and...
maxillary pale blue, small spots of orange present on these bones.

Color is faded in preserved specimens but above pattern may be discernible with orange appearing pale and blue appearing dusky.

Size.—The largest specimen observed in the present study is 224 mm SL, however, Rosenblatt and Johnson (1974) recorded a specimen 226 mm SL.

Habits.—Diplectrum pacificum was collected from the Bay of Panama at many different localities. Juveniles (30-70 mm SL) were common in shallow water (2 m) over mud bottom. Adults were collected in deeper water (20-30 m) over mud-sand bottom. The species was abundant at certain localities and was usually taken with D. macropomana (Bortone in press b). Field-collection data from museum specimens indicate the species has been taken from water 0.1-90 m deep but appearing more frequently at 15-30 m. The shallowest depth record is about 0.1 m (UA66-69) from a tide pool near Puerto Peñasco, Gulf of California.

Distribution.—Diplectrum pacificum is found in the coastal areas of the Gulf of California (Fig. 12), northward along the outer Baja California coast of Bahia San Juanico (lat. 26°15'N, long. 112°28'W), along the Central American coast, and southward to Ecuador-Peru (lat. 3°15'S, long. 80°25'W). The type-locality is Los Islotes in the Bay of Panama.

Variation.—There is noticeable variation in the posterior branchial surface pigmentation. Southern populations tend to be more heavily pigmented in this body region. Northward along the extensive Mexican coast the degree of pigmentation decreases. Finally, populations of D. pacificum in the Gulf of California and outer Baja California are generally devoid of pigment. Geographical variation occurs with the number of scales in lateral line (Table 2); a trend from higher numbers to lower numbers occurs from north to south. It would appear that more concentrated studies on variation in D. pacificum are in order.

Species examined.—A total of 156 specimens examined from 25 to 224 mm SL. OUTER BAJA CALIFORNIA: LACM W55-92, 1 (131); USNM 125347, 2 (101-119); CAS SU 19107, 1 (160); SIO 60-296, 1 (142); LACM W52-195, 1 (223); USNM 167563, 2 (154-177); LACM 3667, 1 (115); SIO 65-175, 7 (97-108); SIO 64-78, 1 (182). GULF OF CALIFORNIA: USNM 165509, 2 (130-133); FMNH 62751, 4 (119-133); GCRL 2593, 5 (155-202); FMNH 63062, 2 (131-154); FMNH 63063, 2 (109-150); FMNH 57546, 1 (140); USNM 167562, 9 (122-190); LACM 9062-1, 1 (110); SIO 62-236, 10 (94-224); SIO 72-60, 8 (122-145); SIO 70-90, 4 (169-217); SIO 70-70, 1 (141); SIO 65-304, 2 (171-173); USNM 21684, 1 (134); USNM 21361, 1 (150); USNM 21411, 1 (185); USNM 163898, 13 (118-140); UA 66-69, 1 (81). CENTRAL MEXICAN COAST: LACM 30121-10, 1 (118); FMNH 70807, 6 (166-183); CAS (Acc. No. 1951-III-7), 1 (184); CAS 2327, 1 (68); INP LB-1341, 1 (164); SIO 65-164, 1 (69). GUATEMALA: UCR 463-48, 6 (125-173). COSTA RICA: LACM 9754-24, 5 (105-156); LACM 6917-12, 1 (133); LACM 30710-22, 1 (127); LACM 30713-6, 1 (144); LACM 30728-7, 1 (164); LACM 30713-7, 1 (156). PANAMA: SIO 64-365, 2 (103-109); SIO 63-205, 7 (76-189); SIO 69-386, 2 (113-120); LACM 31310-20, 2 (134-137); MCZ 64168, 6 (157-211); UMML 26229, 1 (197); UMML 25069, 4 (160-168); UMML 25068, 1 (160); UMML 26248, 1 (174); USNM 81756, holotype, 1 (72); USNM 80228, paratypes, 3 (33-46); LACM 6509-23, 17 (25-148); UP (6 Dec. 1971), 1 (165); USNM (Acc. No. 247715), 7 (120-149). COLOMBIA: USNM 211392, 1 (149); USNM 2113701 (125); USNM 211353, 1 (156); USNM 211382, 1 (143); USNM 211395, 1 (202); USNM 211400, 4 (124-162); USNM 211356, 1 (142); USNM 211380, 3 (180-189).

**Diplectrum rostrum** Bortone 1974

Figs. 6, 8, 9, 13


The species is not common within its range and perhaps some references pertaining to *D. pacificum* may in fact refer to *D. rostrum*.

Diagnosis.—*Diplectrum rostrum* is distinct from other species of *Diplectrum* in that it has two light bars on each side of the snout and by the unique marking on the soft dorsal fin which consists of a transverse row of seven to nine light spots on a dark field. Confusion with *D. pacificum* might arise because of the similar preopercle shape. However, these two species can easily be separated by the already mentioned color patterns; gill raker count, 20.25 (17-24) in *D. pacificum*, 23.44 (22-25) in *D. rostrum*; orbit length, 78.52 (66-90) in *D. pacificum* and 90.68 (81-100) in *D. rostrum*; cheek scale rows A, 9.70 (8-12) in *D. pacificum* and 8.52 (8-10) in *D. rostrum*. Also the caudal pigmentation is a series of dark and light bands in *D. pacificum* and a spotted (light on dark) pattern in *D. rostrum*. The preopercular spur tends to have a more rounded lower edge in *D. rostrum*. Other notable differences between *D. rostrum* and *D. pacificum* are: the caudal lobe tends to be more elongate in *D. rostrum* as evidenced by its greater total length (1,320 for *D. rostrum*, 1,289 for *D. pacificum*); *D. rostrum* has a shorter postorbital length (193.35 vs. 211.05); a larger orbital width (71.50 vs. 62.58) and a shorter caudal peduncle depth (120.92 vs. 129.32) than *D. pacificum*.

Description.—*D. X, 12 (13); A, III, 7 (8); P₁, 16.94 (16-18);* pored lateral-line scales, 49.00 (48-51); scale rows in lateral line, 64.62 (60-70); scales above lateral line, 7.54 (7-9); scales below lateral line, 16.76 (15-18); predorsal scales, 14.16 (12-16); cheek scale rows A, 8.52 (8-10); cheek scale rows B, 11.18 (10-12); gill rakers, 23.44 (22-25).

Standard length, 120.50 (21.78, 78.8-166, 26). Total length, 1,320 (23.08, 1,277-1,360, 25); fork length, 1,165 (13.13, 1,133-1,186, 26); body depth, 288 (16.15, 251-310, 26); head length, 369 (9.49, 354-388, 26); postorbital length, 193 (7.22, 183-206, 26); snout length, 103 (6.98, 88-117, 26); lacrimal width, 51 (4.14, 43-58, 26); maxillary width, 27 (2.21, 24-33, 26); orbit length, 91 (5.41, 81-100, 25); orbit width, 72 (3.92, 66-78, 25); interorbital width, 74 (6.89, 66-102, 26); upper jaw length, 164 (5.66, 150-173, 26); lower jaw length, 175 (5.75, 162-187, 26);
cheek height, 119 (6.24, 110-129, 26); cheek length, 122 (4.96, 112-129, 26); caudal peduncle depth, 121 (5.19, 109-130, 26); pectoral fin length, 257 (14.30, 233-292, 26); pelvic fin length, 214 (11.56, 186-237, 26); predorsal length, 360 (10.17, 342-385, 21); pelvic origin to lower jaw, 336 (14.46, 314-367, 19); pelvic origin to anus, 321 (20.32, 291-382, 24); postanal length, 397 (14.83, 369-421, 26). Dorsal spine height: first, 57 (6.81, 37-68, 26); second, 83 (7.80, 70-94, 24); third, 129 (9.12, 113-150, 25); fourth, 143 (8.05, 130-159, 23); fifth, 145 (8.92, 130-162, 25). Anal spine height: first, 32 (4.02, 19-37, 26); second, 59 (5.57, 46-66, 26); third, 80 (5.85, 66-89, 26).

Preopercle with narrow spur bearing 7-11 spines at angle. Upper spur edge somewhat squared off, lower edge more rounded. Vertical and horizontal preopercular limbs serrate. Caudal fin slightly forked, the upper lobe extending further posteriorly than lower lobe, almost as a filament. Chest scales not embedded but reduced in size anteriorly. Anterior nostril with elongate flap. Gill rakers moderately long, the first at the angle reaching to fifth below.

Color.—Characteristic color patterns remain discernible in preserved specimens. Snout gray-brown with two lighter bands, perhaps pinkish in fresh specimens (J. E. McCosker, pers. commun.), passing from anterior orbital edge forward to anterior lacrimal edge. Cheeks with somewhat less distinct wavy bar of lighter pigment. Soft-dorsal-fn membrane bearing color pattern consisting of seven to nine light spots on dark field which traverses fin laterally. Distal edge of fin not pigmented but a lightly pigmented band near base of fin. Dorsal spines tipped with black. Caudal peduncle blotch equal to eye size, but irregular in outline. Dorsal surface of caudal peduncle with two dark spots separated by a lighter spot. Caudal fin bearing series of small light spots on dark background. Lateral body surface with five to seven indistinct darkened vertical bars appearing darker dorsally. The lateral body surface also traversed by an indistinct midlateral stripe.

Size.—The species is of medium size; a maximum of 166 mm SL recorded in the present study.

Habits.—Virtually nothing is known of the habits of D. rostrum except what could be ascertained from collection data. It has been collected at depths ranging from 13 to 80 m and does not appear to be abundant anywhere.

Distribution.—Collection data indicate that D. rostrum occurs on the western side of the Gulf of California; at Bahia de Banderas, Mexico; Puntarenas, Costa Rica; Gulf of Panama; the Galapagos Islands; and along the northwest coast of South America (Fig. 13). The species ranges from lat. 23°34.3'N, long. 110°23.9'W along the outer Baja California Sur to lat. 3°39'S, long. 80°41'W in the south.

Variation.—No significant morphological or meristic variation was noted for this species except for number of scale rows above the lateral line. A group of northern specimens (from Bahia de Banderas northward) had a mean value of 63.10 for scale rows above the lateral line while the southern group had a mean value of 67.08 for
about the nature of this variation.

70-62.

FMNH 41433, 1 (166).

Specimens examined.—A total of 36 specimens from 60 to 166 mm SL. OUTER BAJA CALIFORNIA: SIO 64-867, paratype, 1 (132). GULF OF CALIFORNIA: LACM 64-64, 4 (62-128); SIO 65-349, paratypes, 2 (98-137); SIO 65-257, paratype, 1 (126); SIO 65-285, paratype, 1 (103); SIO 65-304, paratype, 1 (113); UA 67-65-3, 1 (142); INP LB 1816, 1 (148); USNM 125347, 1 (71); UA 67-121-1, 2 (63-72); SIO 70-62, paratype, 1 (71). BAHIA DE BANDERAS, MEXICO: SIO 65-160, 6 (60-104). COSTA RICA: LACM 30714-12, 2 (134-142). PANAMA: USNM (lat. 7°33’N, long. 78°11’W). 1. COLOMBIA: USNM 208199, paratype, 1 (87); USNM 208198, paratype, 1 (144); CAS 15296, paratype, 1 (145). ECUADOR: USNM 208196, holotype, 1 (131); USNM 208197, paratypes, 5 (100-130); CAS 15295, paratype, 1 (117). GALAGAPÓS: FMNH 41433, 1 (166).

Diplectrum conceptione (Valenciennes 1828)

Figures 6, 8, 9, 12

Serranus conceptionis Valenciennes in Cuvier and Valenciennes 1828:246 (original description, Concepción, Chile); Guichenot 1848:148-149 (description and color notes, Chile); Boulenger 1895:296-297 (catalog); Porter 1909:8 (Chile).

Plectropoma paytensis Lesson 1830:233-244 (original description, Peru); Günther 1859:165 (catalog).

Serranus conceptionis Lesson 1830:236 (Chile).

Centropristis conceptionis Günther 1859:84 (catalog).

Diplectrum conceptione Jordan and Eigenmann 1890:397-399 (systematics); Abbott 1900:349 (Callao, Peru); Delfin 1901:62-63 (Chile and Peru); Evermann and Radcliffe 1917:75-76 (in part, Peru); Fowler 1945b:217 (Peru); Fowler 1945c:78 (Chile); Hildebrand 1946:185, 186-187 (description, Peru); Orces 1951:304 (Ecuador, as cited by Koepke 1963); Mann F. 1954:65, 81, 223 (description, economics, Chile); Koepke 1963:241 (synonymy, Peru); Chirichigno F 1974:294-298, fig. 576 (key, Peru); Rosenblatt and Johnson 1974:178-191 (key, systematics).

Hemilutjanus paytensis Jordan and Eigenmann 1890:345 (systematics).

Diplectrum conceptione was described from a single specimen by Valenciennes in 1828. Since that time only slight confusion has resulted regarding the correct identity of the species. Lesson (1830:233-244) described a new species, Plectropoma paytensis, from a drawing. He did not believe that Valenciennes (Cuvier in Lesson’s interpretation) had described the species. It would appear from the species description of Lesson that he may have been referring to D. conceptione but several doubts exist concerning the inclusion of Lesson’s species in the synonymy. First, Lesson was aware of the Serranus conceptionis description by Valenciennes (Lesson 1830:236). The collection label indicates Lesson collected the specimen so therefore why did he state that P. paytensis had been overlooked by Cuvier? Second, Lesson stated that the species is common near Paita, Peru, but others (Mann F. 1954:223; Hildebrand 1946:187) imply D. con-
third spine and first soft anal ray. Also, small scales along base of anterior soft dorsal rays. Second anal spine more stout than third. Caudal fin nearly straight.

Color.—Color description is from preserved specimens. Pelvic fin, ventral edge light, pale along medial base and edge, body of fin appearing dusky, with dark pigment mainly on interradial portions. Pectorals with line of dark pigment along the dorsal edge of each ray, no pigment interradially. Anal fin pale. Caudal fin dusky to dark. Spinous dorsal membrane dusky, distal edge of membrane white with black at extreme distal edge. Base of spinous dorsal less dusky than body of membrane. Soft dorsal fin with a broad pale distal margin, a darker band below, and below this a dusky field bearing a group of irregular light spots fusing into diagonal bars. This pattern of light spots and bars quite variable and occasionally appearing only as spots or only as horizontal light bars on the soft dorsal. Caudal spot present but indistinct and smaller than orbit. Ventral portion of body light brown. Dorsum medium brown, bases of soft dorsal rays black. Lateral body surface with nine indistinct dusky vertical bars terminating above midventral line. Evidence of interconnecting midlateral stripes on body. Lateral and medial opercular surfaces black. Posterior branchial cavity black. Slight evidence of small indistinct spots of light pigment on lacrimal area, about five in number, and may interconnect. Lower premaxillary border with dark edge, remainder of premaxillary dusky. Center tip of lower jaw dusky. No evidence of pigment in upper pharyngeal area.

The following color description of live *D. conceptione* is quoted from Evermann and Radcliffe (1917:75-76): “Color in life: Back and upper part of sides dark olive green, but with three pale horizontal stripes; one, from just above pectoral to just beneath lateral line on peduncle; a second, from level of eye, and beginning a short distance posterior to eye, to upper part of peduncle; a third, at a corresponding distance above the second; a darker mottling on the sides gives an indistinct effect of cross-barring, especially on upper part of sides; sides, below lowest stripe, dusky, greenish with much gold; below white with a tinge of orange along median line of belly; head above olive with reddish spots, orange on lower part of sides; under side of opercle with jet black and gold; skin posterior to fourth gill blue-black; caudal mostly reddish orange, ventral margin pale; dorsal light olive with large spots of bright orange; a little black on tips of membrane between dorsal spines; pectorals olivaceous; ventral mixed dusky olive and orange; anal mostly white, but with some orange on membrane between consecutive rays.”

Size.—Maximum size of specimens examined is 169 mm SL.

Habits.—The species seems to prefer fairly deep water with only one collection of specimens from 13 m and the remainder from 33 to 80 m deep. Little is known of the habits of this species.

Distribution.—*Diplectrum conceptione* is limited in its distribution to the coasts of Ecuador, Peru, and Chile in the eastern Pacific (Fig. 12). The northernmost locality is at lat. 3°15'S and its southern limit is also the type locality at Concepcion, Chile (lat. 37°S).

Variation.—Most material examined of this species is from the same general area off the coast of Peru; therefore, no variation was discernible over the species range.

Specimens examined.—A total of 230 specimens from 69 to 169 mm SL. ECUADOR: USNM 213574, 72 (96-136); USNM 211418, 1 (135); USNM 211414, 1 (96). PERU: USNM 213583, 60 (69-161); USNM 213582, 15 (92-138); USNM 211371, 1 (144); USNM 211390, 2 (119-129); USNM 213578 + 211385, 69 (89-169); USNM 77549, 1 (94); USNM 77541, 1 (111); USNM 127969, 1 (137); CAS SU 6293, 5 (136-159). CHILE: MNHN 7925, holotype, 1 (102).

*Diplectrum maximum* Hildebrand 1946

Figures 6, 8, 9, 11

*Diplectrum conceptione* Evermann and Radcliffe 1917:75-76, pl. 7, fig. 2 (in part, figure and one text description is of *D. maximum*, Peru).

*Diplectrum maximum* Hildebrand 1946:185-187, fig. 42 (original description, Paita, Peru); Orces 1951:304 (not seen, Ecuador); Orces 1959:81 (*D. maximum* possibly a subspecies of *D. pacificum*); Rosenblatt and Johnson 1974:178-191 (description of juveniles, Baja California); Chirichigno F. 1974:294-298, fig. 577 (key, Peru).

*Diplectrum pacificum* maximum Koepke 1963:241 (Peru).

The larger specimen described and figured by Evermann and Radcliffe (1917:75-76, pl. 7, fig. 2) is USNM numbers 77549 and 77541, respectively. Koepke (1963:241) appears to have accepted the suggestion of Orces (1959:81) that *D. maximum* may be a subspecies of *D. pacificum*. Orces (1959:81) indicated they were closely aligned because of similar number of scales on the “preopercle” (i.e., cheek) and the caudal fin shape. The indiscriminate acceptance of the suggestion by Orces seems to have led to the recognition of an invalid subspecies of *D. pacificum*.

Diagnosis.—*Diplectrum maximum* is the largest of all known *Diplectrum*, reaching 302 mm SL. It can be distinguished from *D. conceptione* by its lower mean total gill raker count, 19.28 (17-21), as opposed to 25.28 (23-28) for *D. conceptione*; cheek scale rows A tend to be higher, 10.07 (9-11) than those of *D. conceptione*, 8.49 (7-10); and the preopercle of *D. conceptione* bears two to four
strong spines while that of *D. maximum* is in the shape of an elongate bony flap bearing four to eight longer and thinner spines. The species also can be separated on the basis of color patterns described below. Confusion with *D. pacificum* should not occur due to the distinctive preopercular shape of *D. maximum*. Also the second anal spine is notably stout and nearly equal (longer in juveniles) in length to the third in *D. maximum*, but the second anal spine is much shorter than the third in *D. pacificum*.

**Description.**—D, X, 12; A, III, 7; P., 16.93 (16-17); pored lateral-line scales, 49.36 (48-50); scale rows in lateral line, 66.33 (61-72); scales above lateral line, 8.47 (7-10); scales below lateral line, 21.13 (18-25); predorsal scale rows, 16.43 (14-20); cheek scale rows A, 10.07 (9-11); cheek scale rows B, 11.47 (10-13); gill rakers, 19.28 (17-21). 

Owing to the unusual nature of the size disparity involved with this species and because so few specimens were available for examination it was decided to present the data for each character in the following manner: character data for the eight larger specimens of *D. maximum*, 245.38 mm SL (32.56, 205-302, 8) followed immediately by character data for the seven smaller specimens, 64.43 mm SL (17.31, 45.9-93.2, 7); data for larger specimens are separated from data for smaller specimens by a hyphen. Total length, 1,245 (16.77, 1,221-1,270, 8) - 1,224 (20-21, 1,191-1,248, 6); fork length, 1,178 (13.09, 1,162-1,200, 8) - 1,189 (14.15, 1,168-1,207, 7); body depth, 285 (19.38, 257-319, 7) - 257 (13.99, 241-276, 7); head length, 363 (4.74, 354-369, 8) - 361 (7.20, 350-373, 7); postorbital length, 211 (3.73, 203-214, 8) - 189 (2.16, 187-192, 7); snout length, 102 (2.82, 98-106, 8) - 91 (6.34, 80-98, 7); lachrymal width, 54 (3.01, 50-59, 8) - 33 (3.56, 28-39, 7); maxillary width, 30 (2.25, 26-32, 8) - 25 (2.45, 31-38, 7); orbit length, 67 (3.36, 62-72, 8) - 99 (7.03, 87-108, 7); orbit width, 50 (4.10, 46-57, 8) - 76 (6.85, 66-87, 7); interorbital width, 72 (3.31, 67-76, 8) - 73 (3.30, 70-78, 7); upper jaw length, 159 (6.27, 149-167, 8) - 158 (5.19, 152-168, 7); lower jaw length, 173 (6.75, 168-180, 8) - 181 (1.91, 179-184, 7); cheek height, 130 (4.78, 121-134, 8) - 98 (5.71, 87-105, 7); cheek length, 97 (5.18, 87-103, 8) - 111 (5.59, 106-122, 7); caudal peduncle depth, 124 (4.10, 120-130, 8) - 118 (1.80, 116-121, 7); pectoral fin length, 234 (6.58, 225-242, 8) - 230 (7.21, 222-239, 7); pelvic fin length, 202 (7.77, 198-212, 8) - 196 (13.86, 175-209, 7); predorsal length, 352 (10.50, 336-370, 8) - 366 (10.05, 349-374, 6); pelvic origin to lower jaw, 340 (14.21, 326-371, 8) - 337 (9.88, 320-344, 5); pelvic origin to anus, 322 (22.94, 295-352, 8) - 286 (15.14, 255-301, 7); postanal length, 403 (13.54, 380-419, 8) - 406 (11.07, 389-420, 7). dorsal spine height: first, 66 (7.49, 54-76, 8) - 77 (4.80, 73-82, 5); second, 83 (9.85, 67-96, 8) - 95 (7.98, 84-105, 5); third, 128 (9.01, 117-144, 7) - 132 (6.56, 125-143, 6); fourth, 137 (11.63, 115-154, 8) - 146 (6.68, 133-153, 6); fifth, 135 (10.08, 118-150, 8) - 140 (2.88, 137-144, 6). Anal spine height: first, 41 (3.74, 36-46, 8) - 56 (8.10, 45-70, 7); second, 68 (2.83, 64-72, 8) - 91 (4.30, 85-98, 7); third, 74 (4.07, 68-80, 8) - 85 (5.21, 81-94, 7).

Preopercle with a notable elongate shape bearing four to eight elongate spines at its angle. Vertical and horizontal preopercular arms serrate. Second anal spine very strong, much stronger than third. First gill raker at the angle reaching to the base of the fourth below. Anterior nostril with elongate flap. Rows of small scales along third anal spine, first anal ray, and first and second membranous portions of soft-dorsal-fin base. Thoracic scales smaller, slightly embedded. Caudal fin nearly truncate.


Color description for smaller preserved specimens: lateral body surface with two wide brown horizontal stripes, a narrower stripe of light pigment between these brown stripes. Below the middorsal brown stripe, a row of 8-10 pale or white blotches. White spots above and below the lateral band on caudal peduncle. White predorsal stripe extending to interorbital area. Ventral body surface white. Dark pigment on first through fifth spinous dorsal membranes. Anterior base of pectoral dusky. Dorsal spines with black tips. Upper pharyngeal area slightly pigmented.

**Habits.**—Nothing is known of the habits of *D. maximum*. The larger specimens came from deeper water (70-128 m) but the smaller specimens were from shallow water (1-7 m). The species attains considerable size (302 mm SL) and may prefer cooler waters of the subtropics.

**Distribution.**—Two areas of distribution are noted (Fig. 11): the northern group of smaller specimens with northernmost distribution lat. 24°44.35°N, long. 111°58.4 W in Bahia de Magdalena; the southern group of larger specimens found along the Peruvian-Ecuador coast having as its southernmost point of distribution Lobos de Tierra, Peru. The type-specimens are from Paita and Lobos de Tierra, Peru.

**Variation.**—The small sample sizes and the disjunct distribution of specimen size did not allow for satisfactory studies on variation for this species. However, the few meristic data available do not indicate any obvious variations between the two known distribution centers.
Specimens SIO fi2-106, to (RO). Size differences in the two populations considered. Examination of additional material (presently unavailable) spinous dorsal fin membrane. While this character is lacking in adults of D. maximum, there is evidence of some, but less intensified, pigmentation on this fin. Rosenblatt and Johnson (1974) suggested there can be no further speculation as to an ontogenetic or genetic explanation for this noted variability until additional material is available.

There is some question concerning the species integrity of D. maximum because of the extreme geographical and size differences in the two populations considered. Examination of additional material (presently unavailable) of intermediate size and parts of its range may warrant reevaluation of the present scope of D. maximum.

Specimens examined.—A total of 15 specimens from 46 to 302 mm SL. OUTER BAJA CALIFORNIA: SIO 62-726, 2 (46-50); SIO 62-106, 1 (69); SIO 62-706, 2 (74-75); SIO 64-63, 1 (93); SIO 64-869, 1 (50). ECUADOR: USNM 213581, 2 (260-275). PERU: USNM 77624, holotype, 1 (241); USNM 77688, paratype, 1 (222); USNM 200373, 1 (302); USNM 213809, 2 (205-243); USNM 211407, 1 (215).

**Dipl ectrum sciurus** Gilbert 1892

*Figures 6, 8, 9, 10*

*Dipl ectrum sciurus* Gilbert 1892:550-551 (original description, Gulf of California; Jordan and Evermann 1896:1203-1204 (systematics); Osburn and Nichols 1916:162 (Baja California); Jordan et al. 1930:318 (check list); Walford 1937:123 (general account); Rosenblatt and Johnson 1974:178-191 (key, systematics). *Serranus sciurus* Boulenger 1895:298 (catalog).

The USNM has three syntypes listed as designated by Gilbert: USNM 46630 (an 87-mm-SL specimen in good condition) is here designated the lectotype in the absence of any known designated holotype; USNM 46571 (an incomplete skeleton) and USNM 125348 now become paralectotypes.

**Diagnosis.**—*Dipl ectrum sciurus* is immediately recognized by its numerous and elongate gill rakers (the first reaching almost to the base of the 12th below). The species also has the least caudal peduncle depth, least lacrimal width, and greatest maxillary width of any *Dipl ectrum*. It is the only *Dipl ectrum* whose maxillary width is consistently greater than its lacrimal width as an adult. The upper- and lower-jaw lengths are also the least of any *Dipl ectrum*. The species has the least cheek height and least postanal length. The species has eight anal rays which separates it from all other *Dipl ectrum* except *D. eurypectrum* and outer Baja populations of *D. labarum*. Again the high number of gill rakers for *D. sciurus* facilitates identification.

**Description.**—D, X, 12 (11-13); A, III, 8 (7); P, 16.96 (16-18); pored lateral-line scales, 49.18 (47-52); scale rows in lateral line, 70.76 (63-79); scales above lateral line, 8.17 (7-10); scales below lateral line, 19.18 (17-21); predorsal scale rows, 15.48 (12-19); cheek scale rows A, 7.66 (6-9); cheek scale rows B, 13.44 (12-17); gill rakers, 36.64 (32-41).

Standard length, 95.04 (10.40, 76.8-116, 33). Total length, 1,263 (16.78, 1,228-1,298, 33); fork length, 1,172 (11.94, 1,149-1,201, 32); body depth, 269 (13.15, 245-296, 33); head length, 356 (9.87, 333-376, 33); postorbital length, 186 (5.99, 171-198, 33); snout length, 89 (5.08, 79-97, 33); lacrimal width, 27 (2.43, 23-33, 33); maxillary width, 36 (2.58, 30-41, 33); orbit length, 92 (4.31, 84-100, 33); orbit width, 78 (4.28, 71-90, 33); interorbital width, 79 (3.70, 70-84, 33); upper jaw length, 142 (5.69, 130-159, 33); lower jaw length, 172 (6.68, 159-191, 33); cheek height, 95 (3.40, 86-103, 33); cheek length, 122 (3.47, 116-129, 33); caudal peduncle depth, 105 (3.39, 98-112, 33); pectoral length, 254 (10.90, 234-275, 33); pelvic length, 211 (6.31, 194-224, 33); predorsal length, 343 (7.73, 330-361, 32); pelvic origin to lower jaw, 351 (9.20, 331-366, 30); pelvic origin to anus, 336 (16.79, 302-363, 32); postanal length, 372 (8.82, 355-388, 33). Dorsal spine height: first, 62 (5.61, 53-74, 32); second, 88 (5.95, 80-101, 31); third, 125 (9.93, 110-157, 32); fourth, 142 (9.54, 125-167, 32); fifth, 146 (9.42, 129-166, 33). Anal spine height: first, 31 (3.75, 24-40, 32); second, 59 (6.06, 47-73, 33); third, 86 (6.44, 76-99, 32).

*Dipl ectrum sciurus* is a highly specialized member of the genus with a high number of elongate gill rakers, broad maxillary, narrow lacrimal, and short upper and lower jaws. Distal tip of maxillary arm not exceeding midpoint of eye on a vertical plane. Preopercle somewhat square in outline bearing a single cluster of 5-10 enlarged spines on spur. Vertical and horizontal preopercular arms serrate. Second anal spine as strong as third. Distally the maxillary very broad and spatulate. Lacrimal wedge-shaped, broadest anteriorly. Anterior nostril with low flap perhaps absent in some specimens. Opercular scales small. Chest scales present and well developed. Caudal fin slightly forked, upper lobe extending further posteriorly than lower.

**Color.**—Color notes are based on preserved specimens. Dorsum and lateral body surfaces light brown. Lateral body surface with two wide brown longitudinal stripes irregularly interrupted by light brown flecks. Eight to ten brown indistinct vertical bars along sides, extending about four-fifths the body depth down the sides. Ventral surface pale. Premaxillary dusky, like lower jaw at midline. Top of head dark brown. Caudal fin with irregular pattern of small, pale blotches on dusky background. Upper caudal edge pale, the lower tending to be dusky. Anal, pectoral, and ventral fins pale. Spinous dorsal fin with three rows of large, irregular, pale blotches on darker field. Blotches present along the distal edge, midlaterally, and along base of spinous dorsal fin membrane. Soft dorsal with two midlateral rows of pale blotches on darker field. Often blotches fusing together
to form a wavy, pale bar. Distal, soft dorsal edge clear. No apparent cheek or snout bars on preserved specimens. Caudal peduncle spot present but small, irregular in outline, appearing as intensified portion of midlateral body bar. Upper pharyngeal, medial opercular, and posterior branchial surfaces lacking pigment.

Gilbert (1892:550-551) stated that a light blue line ran just below the orbit and that the soft dorsal and caudal fins bore yellow spots surrounded by pale blue.

Size.—The species is small in size, reaching no longer than 137 mm SL in the present study.

Habits.—The extreme modifications of the jaws, gill rakers, and lacrimal area suggest that *D. sciurus* may have different feeding habits than other *Diplectrum*. Although no data are yet available, the species probably feeds on small crustaceans and generally may live just off the bottom as opposed to the benthic habits known for the other species. The species has been taken at depths ranging from 25 to 100 m. The few data available do not indicate any depth preference.

Distribution.—*Diplectrum sciurus* is found almost exclusively along the coastal areas of the Gulf of California (Fig. 10). It does occur along the outer Baja California to lat. 24°35'S, long. 112°05'W near Bahia de Magdalena. The type-locality is lat. 31°22'00"N, long. 114°07'00"W from the upper Gulf of California.

Variation.—The species does not show any obvious geographical variation due to its limited distribution.

Specimens examined.—A total of 201 specimens from 67 to 137 mm SL. GULF OF CALIFORNIA: USNM 46530, lectotype, 1 (87); USNM 125348, paratype, 1 (92); USNM 46571, paratype, 1 (incomplete, disarticulated skeleton); LACM 8825-7, 79 (68-98); LACM 8824-7, 22 (84-116); LACM 8839-4, 5 (94-99); LACM 8834-1, 1 (98); CAS W 53-93, 1 (104); CAS SU 53100, 1 (105); FMNH 26274, 1 (90); CAS W 59-17, 4 (77-103); SIO 60-120, 17 (120-137); SIO 70-225, 28 (100-123); SIO 68-71, 36 (67-110). OUTER BAJA CALIFORNIA: CAS SU 243, 3 (92-97).

*Diplotrema euryplectrum*

Jordan and Bollman 1890

(Figures 6, 8, 9, 11)

*Diplotrema euryplectrum* Jordan and Bollman 1890:157-158 (original description, Galapagos; Jordan and Eigenmann 1890:397-398 (review); Jordan and Evermann 1896:1203, 1206 (systematic account); Gilbert and Starks 1904:98 (Panama); Meek and Hildebrand 1925:472, 474 (Panama); Jordan et al. 1930:318 (check list); Walford 1937:124 (general account); Hildebrand 1946:184 (key); Chirichigno F. 1974:294-298 (key, Peru); Rosenblatt and Johnson 1974:178-191 (key, systematics).

*Diplotrema macropoma* Gilbert and Starks 1904:97-98 (in part, misidentified, Gulf of California).

Diagnosis.—This species is easily recognized by the broad spur at the preopercular angle, eight anal rays (rarely seven or nine) and a dark band of pigment on the soft-dorsal-fin base. It has the greatest fork length, head length, postorbital length, eye diameter, interorbital width, upper- and lower-jaw length, cheek height and length, and pelvic-origin-to-lower-jaw dimensions of any *Diplectrum*. It is a distinct species but juveniles of *D. euryplectrum* might possibly be confused with juveniles of *D. labarum*. Except for a population of *D. labarum* from outer Baja California which has a high proportion of individuals with eight anal rays they could normally be separated on this character alone. Scales tend to be smaller in *D. euryplectrum* than in *D. labarum* (Tables 2-7). Also, total number of gill rakers is higher in *D. euryplectrum* (23.68, 21-27) and lower in *D. labarum* (21.52, 19-24). The only other species having eight anal rays is *D. sciurus* but this species is easily distinguished by the high total gill raker count.

Description.—D, X, 12 (13); A, III, 8 (7-9); P, 17.62 (16-18); pored lateral-line scales, 48.77 (46-52); scale rows in lateral line, 64.12 (56-73); scales above lateral line, 7.71 (7-10); scales below lateral line, 17.81 (15-20); predorsal scales, 13.73 (10-18); cheek scale rows A, 7.97 (5-10); cheek scale row B, 10.49 (8-13); gill rakers, 23.68 (21-27).

Standard length, 111.62 (13.75, 76.8-143, 39). Total length, 1.260 (15.56, 1.217-1.293, 36); fork length, 1.193 (12.92, 1.155-1.222, 38); body depth, 291 (1.278, 261-313, 38); head length, 423 (12.99, 384-449, 39); postorbital length, 241 (10.47, 215-264, 39); snout length, 103 (7.96, 91-117, 39); lacrimal width, 46 (3.89, 39-53, 20); maxillary width, 36 (1.96, 32-39, 20); orbit length, 102 (4.74, 90-111, 39); orbit width, 84 (4.78, 72-93, 39); interorbital width, 88 (5.89, 78-98, 20); upper jaw length, 189 (6.00, 174-198, 39); lower jaw length, 206 (5.95, 198-222, 39); cheek height, 141 (6.15, 127-158, 39); cheek length, 130 (5.69, 117-143, 30); caudal peduncle depth, 106 (4.65, 98-116, 37); pectoral fin length, 256 (9.98, 235-276, 39); pelvic fin length, 212 (9.41, 188-224, 22); predorsal length, 375 (9.10, 363-392, 20); pelvic origin to lower jaw, 131 (11.21, 345-397, 35); pelvic origin to anus, 309 (23.32, 268-368, 38); postanal length, 374 (10.22, 356-397, 38). Dorsal spine height: first, 60 (8.90, 42-80, 37); second, 87 (7.34, 71-104, 34); third, 118 (9.36, 102-138, 34); fourth, 132 (9.29, 117-162, 32); fifth, 137 (7.63, 124-154, 31). Anal spine height: first, 32 (4.77, 25-44, 37); second, 62 (6.94, 49-77, 37); third, 82 (7.24, 70-100, 36).

Preopercle with wide broad spur, bearing 6-12 spines. Vertical preopercular arm generally lacking serrae with only a few near base at dorsal point of spur. Head large, caudal peduncle shallow. Gill rakers moderately long and slender, the first at the angle reaching to the fifth below. Gill filaments long. Anterior nostril bears elongated flap. Scales absent on anal fin base. Chest scales not noticeably reduced in size. Caudal fin straight without elongated filament. Second anal spine as strong as third. Scales somewhat deciduous.

Color.—The following color description is based on


Size.—The largest specimen examined was 163 mm SL.

Habits.—Diplectrum euryplectrum is found in waters of the eastern Pacific from 15 to 150 m deep. However, the species appears to be more commonly taken from 60 to 90 m depth and is abundant at some localities. The species does not seem to prefer shallow coastal areas.

Distribution.—The species is found along the tropical-subtropical eastern Pacific coast, in the Gulf of Californi-

Diplectrum labarum
Rosenblatt and Johnson 1974

Figures 6, 8, 9, 14

Diplectrum macropoma Gilbert and Starks 1904:97-98 (in part, misidentification).


Gilbert and Starks (1904:97-98) stated they obtained D. macropoma from outer Baja California in 1889 at Albatross Stn. 3039 and this collection was cataloged as CAS SU 47 under the identification of D. macropoma. This collection, in fact, contained D. euryplectrum, D. eumelum, D. labarum, and D. macropoma.

Diagnosis.—Diplectrum labarum is distinguishable as an adult from other species of Diplectrum by the elongate, filamentous tips on the second, third, and fourth (occasionally the fifth) dorsal spines. Juveniles of this species might be confused with juvenile D. euryplectrum but may be separated by the number of anal rays (eight in D. euryplectrum, seven in most populations of D. labarum). Juvenile D. labarum might also be confused with juvenile D. eumelum. Diplectrum labarum tends to have higher scale meristics (Tables 3-7), especially in number of cheek scale rows B (10.61, 9-12 in species C; 8.41, 7-10 in D. eumelum).
Description.—D, X, 12 (11-13); A, III, 7 (8); P₁, 16.61 (16-18); pored lateral-line scales, 48.14 (47-49); scale rows in lateral line, 58.94 (51-66); scales above lateral line, 6.98 (6-9); scales below lateral line, 16.93 (14-19); predorsal scale rows, 13.62 (11-17); cheek scale rows A, 7.34 (6-9); cheek scale rows B, 10.61 (9-12); gill rakers, 21.52 (19-24).

Standard length, 116.64 (33.50, 78.4-188, 37). Total length, 1,271 (21.25, 1,232-1,311, 35); fork length, 1,179 (15.76, 1,142-1,211, 37); body depth, 291 (23.43, 257-341, 35); head length, 381 (11.36, 364-410, 37); orbit width, 76 (5.58, 67-90, 37); pectoral fin length, 349 (8.87, 326-365, 32); pelvic origin to anus, 346 (18.53, 250-270, 36); orbit width, 33 (1.82, 28-37, 36); orbital length, 95 (7.34, 85-115, 37); lacrimal width, 42 (5.47, 33-54, 37); maxillary length, 1,271 (21.25, 1,232-1,311, 37); body depth, 291 (23.43, 257-341, 35); head length, 381 (11.36, 364-410, 37); orbit width, 76 (5.58, 67-90, 37); interorbital width, 77 (4.38, 69-86, 36); upper jaw length, 176 (8.03, 157-197, 37); lower jaw length, 194 (7.47, 175-209, 36); cheek height, 128 (10.09, 108-147, 37); cheek length, 121 (5.13, 111-132, 37); caudal peduncle depth, 117 (4.50, 110-131, 37); pectoral fin length, 250 (13.42, 221-270, 36); pelvic fin length, 203 (9.70, 175-221, 37); predorsal length, 363 (9.43, 347-390, 36); pelvic origin to lower jaw, 349 (8.87, 326-365, 32); pelvic origin to anus, 346 (18.53, 318-376, 34); postanal length, 378 (12.72, 351-401, 34). Dorsal spine height: first, 61 (10.87, 36-84, 35); second, 140 (22.52, 99-186, 29); third, 170 (20.34, 129-204, 30); fourth, 165 (11.60, 147-187, 30); fifth, 151 (11.18, 127-175, 32). Anal spine height: first, 39 (4.92, 28-51, 37); second, 69 (7.70, 56-82, 37); third, 91 (7.96, 75-106, 37).

Second, third, and fourth (occasionally the fifth) dorsal spines with elongate filamentous tips. Tips developing gradually during ontogeny beginning about 60 mm SL and increasing in proportion to standard length thereafter. Elongate filaments occasionally broken but spines bearing dark pigment their entire length. Preopercle squared, broader than in D. sciurus but not quite as broad as in D. euryplectrum. Enlarged spines, usually about 8-13 in number, occurring on spur. Vertical and horizontal preopercle arms serrate. Anterior nostril with translucent; ventrals pale to dusky.
**Diplectrum eumelum**
Rosenblatt and Johnson 1974

Figures 6, 8, 9, 14, 15

*Diplectrum macropoma* Jordan and Eigenmann 1890: 397-398 (key, description); Jordan and Evermann 1896:1203, 1205-1206 (systematics); Gilbert and Starks 1904:97-98 (in part, Panama and Gulf of California); Walford 1937:123-124 (key, systematics); Meek and Hildebrand 1925:472, 475 (key, systematics, Panama); Orces 1959:81 (description, Ecuador). *Diplectrum eumelum* Rosenblatt and Johnson 1974:178-191, fig. 1B (original description, coastal eastern Pacific).

The description given by Jordan and Eigenmann (1890:397-398), although vague in many respects, can nevertheless be attributed to *D. eumelum* and not to *D. macropoma*. Meristic and proportional data presented could be assigned to either species, however, the color description depicting the snout with "... four or five pale blotches ..." (Jordan and Eigenmann 1890:397) clearly indicates *D. eumelum*. Later publications, it appears, merely followed the error of Jordan and Eigenmann (1890).

Gilbert and Starks (1904:97-98) recorded this species from Magdalena Bay, outer Baja California, from Albatross Stn. 3039. These specimens are now cataloged as *D. macropoma*, CAS SU 47, but examination of this lot revealed that *D. macropoma, D. labarum, D. euryplectrum, and D. eumelum* were taken at that station. Walford (1937:123-124) and Orces (1959:81) presented data for size and color of *D. macropoma* which can only be attributed to *D. eumelum*.

**Diagnosis.** — *Diplectrum eumelum* is immediately recognized by the distinct series of three to five pale (orange in live specimens) spots on the snout and lacrimal area. It has large scales which separate it meristically (Tables 2-7) from other *Diplectrum* except *D. macropoma*. *Diplectrum eumelum* differs from *D. macropoma* on the basis of its color pattern, and size (*D. macropoma* is usually no greater than 140 mm SL). Caudal-peduncle-depth-to-head ratio is 1:3.2 for *D. eumelum* and 1:2.7 for *D. macropoma*. The posteriormost dorsal and anal rays are as long as each fin's respective anterior rays in *D. eumelum* and shorter than each fin's respective rays for *D. macropoma*. The snout is blunt for *D. eumelum* and more pointed for *D. macropoma*. The number of pseudobranch filaments is tentatively a character which may separate these species (Fig. 15) but consideration must be given to the standard length of specimens.

Juvenile *D. eumelum* might be confused with juveniles of *D. labarum* but color patterns and meristics (especially cheek scale rows B) will separate these forms.

**Description.** — D, X, 12 (13); A, III, 7 (8); P, 17.02 (16-18); pored lateral-line scales, 48.63 (45-52); scale rows in lateral line, 57.42 (48-64); scales above lateral line, 6.39 (5-9); scales below lateral line, 15.54 (13-17); predorsal scale rows, 11.46 (10-15); cheek scale rows A, 5.98 (5-7); cheek scale rows B, 8.41 (7-10); gill rakers, 19.55 (18.22).

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Figure 14.—Distribution map for *Diplectrum eumelum* (open circles); and *D. labarum* (closed circles). [Localities are based on the materials examined in this study.]
Description.—D, X, 12 (11-13); A, III, 7 (8); P1, 16.61 (16-18); pored lateral-line scales, 48.14 (47-49); scale rows in lateral line, 58.94 (51-66); scales above lateral line, 6.98 (6-9); scales below lateral line, 16.93 (14-19); predorsal scale rows, 13.62 (11-17); cheek scale rows A, 7.34 (6-9); cheek scale rows B, 10.61 (9-12); gill rakers, 21.52 (19-24).

Standard length, 116.64 (33.50, 78.4-188, 37). Total length, 1.271 (21.25, 1.232-1.311, 35); fork length, 1.179 (15.76, 1.142-1.211, 37); body depth, 291 (23.43, 257-341, 35); head length, 381 (11.36, 364-410, 37); postorbital length, 204 (10.24, 184-227, 37); snout length, 99 (6.95, 85-115, 37); lacrimal width, 42 (5.47, 33-54, 37); maxillary length, 33 (1.82, 28-37, 36); orbital length, 95 (7.34, 78-110, 37); orbit width, 76 (5.58, 67-90, 37); interorbital width, 77 (4.39, 69-86, 36); upper jaw length, 176 (8.03, 157-197, 37); lower jaw length, 194 (7.47, 176-209, 36); cheek height, 128 (10.09, 108-147, 37); cheek length, 121 (5.13, 111-132, 37); caudal peduncle depth, 117 (4.50, 110-131, 37); pectoral fin length, 250 (13.42, 221-270, 36); pelvic fin length, 203 (9.70, 175-221, 37); predorsal length, 363 (9.47, 347-390, 36); pelvic origin to lower jaw, 349 (8.87, 326-365, 32); pelvic origin to anus, 346 (18.53, 318-376, 34); postanal length, 378 (12.72, 351-401, 34).

Dorsal spine height: first, 61 (10.87, 36-84, 35); second, 140 (22.52, 99-186, 39); third, 170 (20.34, 129-204, 30); fourth, 165 (11.60, 147-187, 30); fifth, 151 (11.18, 127-175, 32). Anal spine height: first, 39 (4.92, 28-51, 37); second, 75-106, 37); third, 91 (7.96, 75-106, 37).

Second, third, and fourth (occasionally the fifth) dorsal spines with elongate filamentous tips. Tips developing gradually during ontogeny beginning about 60 mm SL and increasing in proportion to standard length thereafter. Elongate filaments occasionally broken but spines bearing dark pigment their entire length. Preopercle squared, broader than in D. sciurus but not quite as broad as in D. euryplectum. Enlarged spines, usually about 8-13 in number, occurring on spur. Vertical and horizontal preopercle arms serrate. Anterior nostril with narrow line of brighter orange running just at the margin tipped posteriorly with reddish orange; pectorals transparent; ventrals pale to dusky.

Size.—The species attains a maximum size of 212 mm SL.

Habits.—Depth records from collection data indicate that D. labarum has been captured at depths ranging from 25 to 160 m. However, the species seems to be taken more often at depths of 40-120 m. Nothing is known of the life history aspects of D. labarum.

Distribution.—Diplectrum labarum occurs in the Gulf of California and northward along outer Baja California to a limit at lat. 27°07.3'N, long. 114°08.3'W and southward along the Central American coast to the Perlas Islands in the Gulf of Panama (Fig. 14). The type-locality is Bahia de Banderas, Jalisco, Mexico.

Variation.—Rosenblatt and Johnson (1974) noted a discernible variation in the number of anal rays. They observed that populations of D. labarum along the outer Baja California (from Almejas Bay northward) had a significantly greater number of individuals with eight anal rays (mean 7.12) than those populations southward of Almejas Bay along the Baja (7.04) or through the remainder of its range (7.02). In this study 18% of the specimens examined (94) from the outer Baja California coast had eight anal rays. Only 6% of all other D. labarum examined from other localities (50) had eight anal rays. Rosenblatt and Johnson (1974) were unable to substantiate their hypothesis that this variation was induced by environmental variables.

Other recognizable differences are seen in the mean number of scale rows in lateral line for D. labarum (61.27 for Gulf of California and 55.87 for Panama and Costa Rica specimens). Slight but recognizable differences are observed in the mean number of pectoral rays in the population from outer Baja (17.00), Gulf of California (16.24), and Panama and Costa Rica (16.97).

Specimens examined.—In addition to those listed by Rosenblatt and Johnson (1974); a total of 630 specimens from 34 to 212 mm SL. OUTER BAJA CALIFORNIA: LACM 33329-1, 1 (82); LACM 32094-1, 1 (135); CAS SU 47, 4 (70-88). GULF OF CALIFORNIA: LACM 8841-4, 1 (107); LACM 8834-4, 9 (84-130); LACM 8839-5, 15 (88-188); LACM 8834-3, 3 (106-173); LACM 8924-6, 9 (79-172); UA 67-59-6, 2 (66-76); UA 70-29-7, 1 (126); UA 67-58-3, 3 (65-88). MEXICO: CAS 4853, 1 (57).
**Diplectrum eumelum**
Rosenblatt and Johnson 1974

Figures 6, 8, 9, 14, 15

*Diplectrum macropoma* Jordan and Eigenmann 1890: 397-398 (key, description); Jordan and Evermann 1896:1203, 1205-1206 (systematics); Gilbert and Starks 1904:97-98 (in part, Panama and Gulf of California); Walford 1937:123-124 (key, systematics); Meek and Hildebrand 1925:472, 475 (key, systematics, Panama); Orces 1959:81 (description, Ecuador).

*Diplectrum eumelum* Rosenblatt and Johnson 1974:178-191, fig. 1B (original description, coastal eastern Pacific).

The description given by Jordan and Eigenmann (1890:397-398), although vague in many respects, can nevertheless be attributed to *D. eumelum* and not to *D. macropoma*. Meristic and proportional data presented could be assigned to either species, however, the color description depicting the snout with "... four or five pale blotches..." (Jordan and Eigenmann 1890:397) clearly indicates *D. eumelum*. Later publications, it appears, merely followed the error of Jordan and Eigenmann (1890).

Gilbert and Starks (1904:97-98) recorded this species from Magdalena Bay, outer Baja California, from Albatross Stn. 3039. These specimens are now cataloged as *D. macropoma*, CAS SU 47, but examination of this lot revealed that *D. macropoma*, *D. labarum*, *D. euryplectrum*, and *D. eumelum* were taken at that station. Walford (1937:123-124) and Orces (1959:81) presented data for size and color of *D. macropoma* which can only be attributed to *D. eumelum*.

**Diagnosis.**—*Diplectrum eumelum* is immediately recognized by the distinct series of three to five pale (orange in live specimens) spots on the snout and lacrimal area. It has large scales which separate it meristically (Tables 2-7) from other *Diplectrum* except *D. macropoma*. *Diplectrum eumelum* differs from *D. macropoma* on the basis of its color pattern, and size (*D. macropoma* is usually no greater than 140 mm SL). Caudal-peduncle-depth-to-head ratio is 1:3.2 for *D. eumelum* and 1:2.7 for *D. macropoma*. The posteriormost dorsal and anal rays are as long as each fin's respective anterior rays in *D. eumelum* and shorter than each fin's respective rays for *D. macropoma*. The snout is blunt for *D. eumelum* and more pointed for *D. macropoma*. The number of pseudobranch filaments is tentatively a character which may separate these species (Fig. 15) but consideration must be given to the standard length of specimens.

Juvenile *D. eumelum* might be confused with juveniles of *D. labarum* but color patterns and meristics (especially cheek scale rows B) will separate these forms.

**Description.**—D, X, 12 (13); A, III, 7 (8); P, 17.02 (16-18); pored lateral-line scales, 48.63 (45-52); scale rows in lateral line, 57.42 (48-64); scales above lateral line, 6.39 (5-9); scales below lateral line, 15.54 (13-17); predorsal scale rows, 11.46 (10-15); cheek scale rows A, 5.98 (5-7); cheek scale rows B, 8.41 (7-10); gill rakers, 19.55 (18.22).
Standard length, 151.63 (47.92, 81.0-233, 41); total length, 1,279 (15.74, 1,241-1,310, 39); fork length, 1,187 (14.00, 1,156-1,212, 40); body depth, 286 (18.54, 232-321, 35); head length, 387 (11.96, 369-412, 41); postorbital length, 221 (12.21, 200-266, 41); snout length, 99 (7.29, 87-118, 39); lacrimal width, 48 (4.05, 40-56, 40); maxillary width, 33 (1.85, 28-36, 40); orbit length, 86 (7.73, 72-102, 40); orbit width, 72 (7.93, 56-93, 40); interorbital width, 70 (3.80, 64-79, 36); upper jaw length, 171 (5.52, 160-180, 41); lower jaw length, 184 (6.15, 166-196, 40); cheek height, 129 (7.87, 110-143, 41); cheek length, 121 (5.31, 110-134, 41); caudal peduncle length, 122 (5.10, 110-133, 40); pectoral fin length, 267 (7.89, 244-285, 40); pelvic fin length, 201 (10.09, 175-223, 41); predorsal length, 369 (8.44, 353-382, 36); pelvic origin to lower jaw, 339 (9.47, 316-361, 33); pelvic origin to anus, 314 (13.11, 286-343, 36); postanal length, 402 (10.38, 380-421, 36). Dorsal spine height: first, 50 (5.69, 39-66, 36); second, 74 (5.80, 61-86, 36); third, 121 (8.45, 107-142, 36); fourth, 132 (20.37, 118-147, 38); fifth, 133 (7.54, 119-146, 36). Anal spine height: first, 29 (4.88, 21-36, 41); second, 60 (9.38, 48-83, 41); third, 83 (9.21, 69-107, 41).

*Diplectrum eumelum* has broad spur at preopercular angle bearing 8-14 elongate spines. Vertical and horizontal preopercular arms serrate. Anterior nostril with elongate flap. Single row of scales along posterior edge of second anal spine. Caudal fin without elongate filament but upper lobe noticeably longer than lower. Chest scales not reduced or embedded. Gill rakers short, the first at the angle not reaching past base of the third below. Pseudobranch filaments numerous, 28-35 in adults.

**Color.**—Color notes are from two adult specimens taken from the Gulf of Nicoya, Costa Rica, 28 June 1973. The specimens had been on ice for 24 h before examination. Dorsum gray-brown, paler ventrally. Ventral surface white with copper tinge more laterally. Lateral body surface with gold flecks. Some evidence of five to six indistinct, thin, dusky ventral bars becoming paler ventrally. Somewhat intensified cluster of black pigment in series of large midlateral blotches. Spinous dorsal fin pale blue along base, body of fin pale orange. Distally each interspinous membrane bears a scalloped-shaped pale orange wedge. Distal portion of spines tipped with black and orange. Soft dorsal with blue field bearing series of wavy, orange diagonal lines. Posteriorly, the wavy bars interrupted to present spotted pattern, pale orange on pale blue. Anal white at base becoming blotted with pale orange-yellow distally. Snout with three to five orange spots in row. These becoming more irregular posteriorly, the last in series as elongate bar traversing cheek in a wavy pattern terminating at lower distal portion of preopercular spur. Irregular arrangement of orange spots also present on preopercles and opercles. Distal premaxillary edge with orange pigment line. Distal maxillary with small orange blotch.

Color notes from preserved specimens: preserved specimens show similar pattern but pale blue appearing as gray and orange as pale or clear. Caudal peduncle spot distinct, dark, and as large as eye but oriented vertically. Caudal fin with numerous pale spots in vertical row on dusky field. Distal caudal ray tips black. Medial opercular surface black like the posterior branchial cavi-
ty. Chest and branchiostegal region pale. Anterior nasal flap pale. Each lateral body scale with dark pigment at base giving lateral surface appearance of being marked by X's. Upper pharyngeal area with dark pigment. Pelvic and pectoral fins dusky, pigment running along ray edge.

Size.—The species is large, reaching at least 234 mm SL as observed in the present study.

Habits.—The two adults (209-228 mm SL) from the Gulf of Nicoya on 28 July 1973 had enlarged gonads but the ovaries did not contain ripe eggs. Stomachs were empty. Available collection depth data show that the species is taken from 15 to 100 m but most often from depths of 50 to 90 m.

Distribution.—Diplectrum eumelum is infrequently taken within its range which extends northward off the outer Baja California at Bahia Magdalena (Fig. 14), into the Gulf of California, and southward along the eastern Pacific coast to Ecuador (lat. 2°29'S, long. 80°59'W). It is also found at the Galapagos Islands.

Variation.—No obvious variation in characters was discernible for D. eumelum throughout its distribution.

Specimens examined.—In addition to those listed by Rosenblatt and Johnson (1974), a total of 130 specimens from 40 to 234 mm SL OUTER BAJA CALIFORNIA: UCLA W55-78, 1 (87); CAS SU 47, 6 (47-121); LACM W52-195, 1 (216); GULF OF CALIFORNIA: UCLA W62-61, 8 (72-107); SAN SALVADOR: CAS 4761, 1 (54); COSTA RICA: LACM 30719-3, 2 (160-188); UCR 323-15, 1 (165); PANAMA: USNM (lat. 6°44'N, long. 77°33'W, 8 Dec. 1967), 2 (146-149); USNM (Gulf of Chiriqui, 29 Mar. 1963), 4 (136-188); CAS SU 1409, 2 (98-145); UMMIL 25694, 2 (96-156); UMMIL 26555, 2 (150-163); USNM 41481, 5 (40-93); UMMIL 26150, 1 (142); UMMIL 26252, 1 (130); COLOMBIA: USNM 211393, 12 (75-123); USNM 211391, 1 (150); USNM 211381, 1 (205); USNM 212381, 7 (173-213); USNM 213588, 19 (100-170); ECUADOR: USNM 213808, 10 (191-234); USNM 211396, 1 (186); GALAPAGOS ISLANDS: UCLA W53-12, 2 (42-78).

**Diplectrum macropoma** (Günther 1864)

Figures 6, 8, 7, 13, 15

Centropristis macropoma (Jordan 1864:145) (original description, Panama); Günther 1869:409, pl. 65, fig. 1 (redescription and figure, Panama).

Diplectrum macropoma. Jordan and Bollman 1890:157-158, 181 (Panama); Gilbert and Starks 1904:97 (in part, Panama and Gulf of California); Jordan et al. 1930:318 (check list); Hildebrand 1946:185 (key); Berdegue A. 1956:53, 264-265 (key, fishery data, Mexico); Chirichigno F. 1974:294-298, fig. 574 (key, Peru); Rosenblatt and Johnson 1974:178-191, fig. 1C (key, systematics).

Diplectrum mexicanum Hildebrand 1948:13-15, fig. 6 (original description, Gulf of California); Bortone in press b (life history, Panama).

The taxonomic confusion of *D. macropoma* with *D. eumelum* has already been discussed under the heading of the latter. References by Jordan and Bollman (1890), Jordan et al. (1930), and Hildebrand (1946) may have actually referred to *D. eumelum*, but there is no way to determine this positively from data presented by those authors.

Günther (1864:145) described *Centropristis macropoma* from three specimens collected by Dow and Salvin from the Pacific coast of Panama. The same description reappeared accompanied by a figure (Günther 1869:409, pl. 65, fig. 1). Hildebrand (1948:13-15, fig. 6) described *Diplectrum mexicanum* based on one specimen from the Gulf of California. Examination of the syntype (designated as the lectotype in the absence of a holotype) of *Centropristis macropoma* (BMNH 1864-1.26:426, labeled as *Serranus macropoma* and hereafter referred to as a *Diplectrum*) and a comparison with the holotype of *Diplectrum mexicanum* (USNM 46518) assures me that the two species are synonymous.

The most notable characters used by Günther to designate *D. macropoma* were: the long spines at the preopercular angle graduating to a serrated preopercular arm; six rows of cheek scales; and a distinct notch between the spinous and soft portions of the dorsal fin. Other characters more clearly noted from his figure and from the syntype include: dark pigment (not discernible in a pattern) on the distal half of the dorsal fin; deep body (3.7 in SL); and an angular snout. The characteristics of *D. mexicanum* presented by Hildebrand (1948) include: deep body (3.2 in SL); angular snout; and six cheek scale rows. The figure also depicts a preopercular structure similar to that described and figured by Günther (1864, 1869).

Hildebrand's specimen was collected in 1889 and the fact that he did not describe any dorsal fin pigmentation could be owing to its loss during prolonged preservation. Current examination also shows a lack of dorsal fin pigmentation. A comparison of other meristic and morphometric data indicate no apparent specific differences.

Jordan and Eigenmann (1890:397-398) and Meek and Hildebrand (1925:475) gave accounts of *D. macropoma* which are apparently not of this species but of *D. eumelum*. Later, Hildebrand considered *D. mexicanum* as distinct from *D. macropoma* as understood by Meek and Hildebrand.

Diagnosis.—*Diplectrum macropoma* has large scales and, therefore, scale counts tend to be low for this species (Tables 2-7). These characters should separate it from other species of *Diplectrum* except *D. eumelum* which it closely resembles. *Diplectrum macropoma* has pale yellow markings on its snout but these are inconspicuous in live material and nonexistent in preserved specimens. *Diplectrum macropoma* has a more pointed snout, a proportionally lower number of pseudobranch filaments (Fig. 15), and the posterior dorsal and anal rays are considerably shorter than the anterior rays. These characters all differ for *D. eumelum*. Other differences are noted under the diagnosis for *D. eumelum*.
Confusion with *D. labarum* might occur but *D. macropoma* has none of its anterior spines elongated and the mean caudal peduncle depth is considerably greater than that of *D. labarum* (138.51 as opposed to 117.11 for *D. labarum*). *Diplectrum macropoma* has the greatest body depth, caudal peduncle depth, predorsal length, and postanal length of any *Diplectrum*.

**Description.—** D. X, 12 (11-13); A, III, 7; P, 17.12 (16-18); pored lateral-line scales, 48.09 (44-51); scale rows in lateral line, 53.86 (48-63); scales above lateral line, 6.32 (5-7); scales below lateral line, 14.60 (11-18); predorsal scale rows, 13.96 (10-18); cheek scale rows A, 6.27 (5-8); cheek scale rows B, 8.53 (7-10); gill rakers, 19.93 (17-24).

Standard length, 107.39 (13.74, 90.6-140, 41). Total length, 1.083 (28.13, 1.260-1.350, 26); fork length, 1.190 (9.30, 1.175-1.207, 25); body depth, 306 (14.64, 273-338, 39); head length, 367 (8.30, 353-391, 41); postorbital length, 202 (6.12, 194-216, 41); snout length, 96 (6.39, 82-106, 41); lacrimal width, 41 (2.28, 36-47, 36); maxillary width, 35 (3.05, 30-43, 36); orbit length, 87 (4.43, 79-97, 41); orbit width, 73 (4.94, 64-85, 41); interorbital width, 67 (4.03, 59-77, 36); upper jaw length, 163 (6.10, 148-177, 41); lower jaw length, 182 (5.85, 165-191, 41); cheek height, 119 (4.56, 112-135, 41); cheek length, 118 (4.25, 107-140, 41); caudal peduncle depth, 139 (4.31, 128-147, 41); pectoral fin length, 265 (8.93, 246-281, 41); pelvic fin length, 196 (9.06, 175-210, 36); predorsal length, 382 (9.90, 366-410, 33); pelvic origin to lower jaw, 348 (11.77, 333-373, 27); pelvic origin to anus, 296 (13.04, 269-318, 37); postanal length, 411 (15.51, 387-456, 40). Dorsal spine height: first, 46 (5.33, 35-63, 40); second, 67 (5.62, 54-79, 39); third, 130 (9.87, 109-154, 40); fourth, 142 (10.47, 122-158, 21); fifth, 144 (10.31, 126-155, 20). Anal spine height: first, 32 (3.78, 23-38, 41); second, 59 (5.70, 47-69, 41); third, 90 (6.29, 73-101, 40).

Preopercular spur broad, with 8-13 elongate spines. Vertical and horizontal arms serrate. Distinct flap present along third anal spine and first anal ray. Scales large but notably smaller in predorsal area. Scales not embedded. Posteriormost soft dorsal and anal rays. Second anal spine slightly more stout than first at angle not reaching past the fourth below. Scales large but notably smaller in predorsal area. Scales present along third anal spine and first anal ray. Caudal lobes unequal, upper being longer but tip not produced as a filament. Caudal fin only slightly forked. Chest scales not embedded. Posteriormost soft dorsal and anal rays short, nearly 1.5 into longest respective soft dorsal and anal rays. Second anal spine slightly more stout than third. Pseudobranch filaments few, 20-30 in adults (Fig. 15).

**Color.—** Color notes were taken from numerous *D. macropoma* from the Bay of Panama, January-February 1973. Dorsum pale copper to pale brown. Venter white, almost silvery. Sides in smaller specimens (60 mm SL) with two dark brown stripes, uppermost running through eye onto snout. Larger specimens with two lateral bands interrupted by pale pigment and appearing indistinct in outline. Dark snout bar yellow in larger specimens. Pectoral fin pale reddish-orange, pelvic fin pale orange. Anal fin white at base and distally; a wide pale yellow lateral band through the center of fin. Caudal fin bright reddish orange on upper lobe, pale gray or white on lower. Body of caudal fin with five to six vertical rows of small orange spots on pale blue field. Caudal spot distinct; as large as eye, oval shaped, oriented laterally (an extension of lateral stripe) in small specimens; vertical in orientation in larger specimens. Spinous dorsal fin white, becoming pale gray distally. Spine tips orange. Soft dorsal rays tipped with orange. Body of fin with two rows of distinct round orange spots on pale blue field. Below this, fin clear to base. Chest and branchiostegal membranes white. Upper medial opercular surface black, area below yellow. POSTERIOR BRANCHIAL AREA BLACK WITH YELLOW LINING. Upper pharyngeal region yellow with sparse gray-blue flecks. Dorsal surface of eye blue-black, yellow laterally, and white below. Smaller specimens with dark spot on caudal peduncle dorsal disappearing in larger specimens. Maxillary gray-brown, dentary white. Lower opercular surface metallic blue-green. Three to four pale, indistinct yellow spots on snout, the uppermost elongate. Snout spots fade quickly, barely discernible. Color in preserved specimens shows a similar pattern as above but all colors have faded. The venter appears silvery, dorsum tan with evidence of brown lateral indistinct bars. Caudal spot larger than eye and vertical in orientation. Soft dorsal fin with appearance of wide dark band above and pale or clear bar below.

**Size.—** *Diplectrum macropoma* is a small species not exceeding 144 mm SL (Rosenblatt and Johnson 1974).

**Habits.—** In the Bay of Panama (10-15 km east of Naos Island) I collected the species from about 20 to 30 m over an open mud and sand bottom along with *D. pacificum* (Bortone in press b). *Diplectrum macropoma* was abundant at this locality with about 50 being obtained in each 20-min tow with a 10-m otter trawl at night. The species has been recorded to occur at depths ranging from 9 to 80 m but is more frequently taken at depths of 20-40 m.

**Distribution.—** *Diplectrum macropoma* is found in the Gulf of California; northward on the outer Baja California to at least lat. 24°27'N, long. 111°59'W; and southward along the eastern Pacific coast to the Ecuador-Peruvian border at lat. 3°39'S, long. 80°41'W (Fig. 13). The species was also taken at the Galapagos Islands. The type-locality is the Pacific coast of Panama (Günther 1864).

**Variation.—** Examination of meristic data indicates some variation in *D. macropoma* with regard to the mean number of predorsal scale rows (Table 5). Gulf of California (13.81), Panama (14.96), and Colombia (12.92) populations all show different means for this character.

**Specimens examined.—** OUTER BAJA CALIFORNIA: CAS SU 47, 2 (113-113); SIO 64-807, 1 (29). GULF OF CALIFORNIA: USNM 46518, 1 (95); USNM 183977, 2 (128-140); SOSC (Choya Bay, Mexico, 14 Feb. 1969), 1 (141); SIO 68-72, 24 (54-114); CAS W 59-14, 26 (36-102); INP 6601, 7 (97-129); FMNH 62743, 8 (38-135); UA 67-74-3, 3 (45-50); UA 67-72-2, 1 (120); SIO 62-75, 1 (128); USLA W52-45, 12 (110-138); SIO 70-141,
The genus *Diplectrum* is restricted to the western hemisphere (Rosenblatt 1967) and, in general, is found in coastal areas of tropical-subtropical regions. Ekman (1953) has termed groups with this distribution pattern as "endemic amphi-American thermophiles." The generic distribution closely parallels other groups such as the decapod crustacean genus *Mithrax*, the penatularian genus *Renilla* (Ekman 1953) and numerous fish genera such as *Centropomus* (Fraser 1956), *Calamus* (Randall and Caldwell 1966), *Haemulon* (Courtenay 1961), and *Mycteroperca* (Smith 1959). *Diplectrum* has affinities for continental coastal areas but *D. biuvittatum* is commonly present in the Antillean Archipelago.

Six of the nine Pacific species have a fairly continuous coastal distribution which encompasses nearly the entire Panamanian province (i.e., the Eastern Pacific Zoogeographic Region of Briggs (1974)). Of these six, only *D. euryplectrum* and *D. maximum* are not found in the Gulf of California. *Diplectrum maximum* is unique (Fig. 11) in that its northern population is separated by a long geographical range from its southern population. As stated previously, only juveniles were taken at the northern locality. Although the larval life history of some serranids may be relatively long (Smith 1959), the vast distance involved does not allow for transport of larvae or juveniles from the southern population (Rosenblatt and Johnson 1974). Most assuredly this deepwater species will be found as adults much further north of its southern population.

*Diplectrum sciurus* is almost restricted to the Gulf of California. Although its movement out of the Gulf may be hindered by geographical and hydrological barriers (Walker 1960), its extreme morphological adaptations related to feeding (i.e., long and numerous gill rakers) give credence to the hypothesis of a restricted distribution owing to competitive interaction.

*Diplectrum conceptione* is outside the Panamanian province in the Peruvian-Chilean province of Briggs (1974). It is the only nonthermophilic species in the genus. This species' southernmost limit at Conception, Chile (the type-locality) could be explained by possible mislabeling by early collectors. Its northern limit is governed by rapid temperature changes caused by a westward turn of the Peru Current near Punta Aguja, Paita, Peru. This temperature block is formidable during "El Nino" years (Rosenblatt and Walker 1963).

Four species of *Diplectrum* have been recorded from the Galapagos Islands (i.e., *D. euryplectrum*, *D. ros- trum*, *D. macropoma*, and *D. eumetelum*). The fauna of the Galapagos Archipelago represents a unique zoogeographical situation (Rosenblatt and Walker 1963). Although comparative material is scarce, there seem to be no significant taxonomic differences between Galapagos and mainland conspecific representatives. This suggests a nonisolated gene pool for Galapagos *Diplectrum*. Larvae may periodically invade the islands from the Panamanian province during "El Nino" years when current patterns seem to favor this transport mechanism (Rosenblatt and Walker 1963). Briggs (1974) has also indicated the currents which flow toward the Galapagos Islands from the Panama area during February through April may be important in explaining the similarities in marine inshore fauna between the Galapagos and Panamanian province. It may be significant to note the absence of *D. conceptione*, a Peruvian-Chilean province species. Currents would seem to favor its movement to the Galapagos (Rosenblatt and Walker 1963), yet its absence may be due to competitive exclusion or simply inadequate sampling.

Hubbs (1960) has stated that the northern boundary for the Panamanian province is not abrupt. Northern limits for Pacific *Diplectrum* support this statement. Magdalena Bay (lat. 24.5°N) is the northern limit for five of eight Pacific species recorded from the outer Baja California. Magdalena Bay is considered a northern boundary for the eastern Pacific tropical fish fauna (Rosenblatt 1967). Hubbs (1960) indicated that rapid temperature changes in this area are due to insolation and upwelling. This is a plausible reason for *Diplectrum* northern distribution limits in this area. Two species go beyond the above faunal boundary and one of these (*D. labarum*) extends to Bahia Asuncion (lat. 27°N). It would be reasonable to expect *Diplectrum* to extend further north of the Panama-San Diegoan province boundary, especially when local weather conditions favor northern movement of warm-water species.

In the western Atlantic, the northern limit for the Carolina Province water is Cape Hatteras, N.C. (Briggs 1974). From collection data it appears Cape Lookout (110 km southwest of Cape Hatteras) is the northernmost area of abundance for *D. formosum*. The one locality record from Chincoteaque, Va. (lat. 38°N) apparently occurred at a time during favorable weather conditions. *Diplectrum biuvittatum* (from the intermediate population) is probably limited more by favorable reef habitat than temperature along the southeast U.S. coast. Presumably the species occurs at deep patch reefs at higher latitudes than it is currently known.

Southern limits for Atlantic *Diplectrum* have been reported in the literature to be Montevideo, Uruguay. This southern distribution limit cannot be confirmed as yet. Montevideo (i.e., Rio del Plata) is certainly considered a zoogeographic boundary (Ekman 1953) and Briggs (1974) considered this area as the southernmost boundary of the Eastern South American Region. However, the present study indicates a slightly more
northern boundary for S. Atlantic Diplectrum near São Paulo and Rio de Janeiro. This area is also considered a boundary by Ekman (1953), and Briggs (1974) attributed the presence of this boundary to a cooling of the Brazil current.

Diplectrum formosum, with its two subspecies, presents an interesting distribution pattern. The northern form (D. f. formosum) is almost restricted to continental North America. Except for a single record from the Virgin Islands, the southern form is essentially restricted to continental South America. The vast expanse of Caribbean Sea with its Antillean Island chain (i.e., West Indian Province of Briggs (1974)), appears to have been a formidable barrier to the species distribution which led to considerable genetic isolation. Conceivably the species may have lacked the competitive ability of other reef-dwelling serranids and was therefore not able to occupy or use the Antilles coast for its habitat.

Diplectrum bifvittatum presents us with two geographical populations herein considered subspecies. The Gulf of Mexico form (D. b. arcuariurn) seems restricted to areas of the Gulf with characteristically “soft” bottom (i.e., mud or sand; Lynch 1954:fig. 19). The absence of D. b. arcuariurn from the west peninsular Florida coast and the coast of the Yucatan Peninsula, both characterized by limestone and coral substrates, attests to this premise. Diplectrum bifvittatum with its distribution in the Antilles is apparently capable of surviving at reef as well as coastal localities. The intermediate form of the two recognized subspecies must be considered by itself zoogeographically. Because the apparent ranges for the two subspecies do not actually overlap, an explanation must be offered for the existence of the S. Florida population. Gulf currents may favor a larval drift of the northern Gulf of Mexico form to the south Florida area, especially during summer months (Leiper 1954; Nowlin 1971). Larval transport across the mouth of the Gulf from Yucatan is not probable in view of these currents (Leiper 1954; Nowlin 1971). General circulation in the Caribbean and Antilles areas favors a northwest drift of larvae from these areas to south Florida. Another possible explanation for the existence of an intermediate form of the two subspecies is that the intermediate form represents a third subspecies, almost completely isolated from the Gulf and excluded by an unknown factor from the southern form. The first view is the most favored. Further studies on these forms will help resolve this question.

Both D. formosum and D. radiale terminate their distribution along the northern coast of South America at or near the Gulf of Venezuela. The significance of this distribution pattern is important when considering the amphi-American distribution of Diplectrum and particularly the very close “geminate” relation D. radiale has with D. pacificum.

It is reasonable to postulate that in view of the obvious affinity of the two species, D. radiale may at one time have had a distribution which included the Atlantic side of Panama and Colombia. There is general agreement that the latest transoceanic passage available to marine species occurred during the late Pliocene (Simpson 1950). Considering the present distribution of the geminate pair, the Colombian “gap,” open from middle Eocene to late Eocene or late Oligocene (Smith 1971), may have served as the last area and time for passage.

If this is true, then relative selective differences between D. radiale and D. pacificum have been small. A test for this hypothesis, assuming the species are indeed distinct, would be to perform comparative in situ life history studies of the two species. Rosenblatt (1967) has suggested that morphological diversity and genetic changes may not be clearly related.

Diplectrum thus portrays an almost classic case of a distribution limit, approaching lat. 25°N and 5°S (except for D. conceptione) along the coastal east Pacific, due to cold-water current “squeeze” (Rosenblatt 1967). The Atlantic warm-water gyres have allowed the genus to assume the classic warm-water distribution which is essentially from lat. 35°N to 35°S.

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