

**A NEW SPECIES OF VIVIPAROUS HALFBEAK,
DERMOGENYS BISPINA (TELEOSTEI: HEMIRAMPHIDAE)
FROM SABAH (NORTH BORNEO)**

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ABSTRACT. - The genus *Dermogenys* Kuhl & van Hasselt in van Hasselt, 1823, is a group of small viviparous, atherinomorph fishes distributed throughout fresh and brackish waters of southeast Asia. *Dermogenys bispina* is distinguished from all other species of *Dermogenys* by: mature males with thick, unsegmented, dorsally curved spiculus; presence of second set of smaller spines on distal tip of spiculus; and females with melanophores directly anterior to anal fin arranged into wide U extending anteriorly, on either side of genital papilla, to level of the anus. As part of an ongoing revision of *Dermogenys* and the closely related nominal genus *Nomorhamphus*, undescribed species in both genera have been discovered. This paper describes a new species of *Dermogenys*, *D. bispina*, from Sabah (North Borneo). Results from previous histological surveys of the gonads of both males and females suggest that this new species may have a close phylogenetic relationship to populations from southern Kalimantan, Sumatra, Palawan, Culion, and the southwestern arm of Sulawesi [Sulawesi Selatan].

KEYWORDS. - Viviparous halfbeak, new species, *Dermogenys*, *Nomorhamphus*, internal fertilization.

INTRODUCTION

The genus *Dermogenys* Kuhl & van Hasselt in van Hasselt, 1823, is a group of small, viviparous, atherinomorph fishes distributed throughout fresh and brackish waters of southeast Asia. Mature males have anal-fin rays one through seven modified into an andropodium, presumably to orient the elongate genital papilla of the male near the female gonopore during internal fertilization (Brembach, 1976; Meisner & Burns, 1997a). Within the andropodium,

it is the second anal-fin ray that is most noticeably modified, the terminal segment of which is termed the spiculus (Brembach, 1976). Variation in shape and segmentation of the spiculus may be useful in hypothesizing species limits within the viviparous halfbeaks.

While examining fishes at the Zoologisches Staatsmuseum in Munich in 1991, the second author found material of a species of *Dermogenys* from Sabah with a distinctive U-shaped mark around the urogenital area. Extensive additional material collected by Robert F. Inger (Inger & Chin, 1962) was borrowed from the Field Museum of Natural History. The first author is revising *Dermogenys* and the closely related nominal genus *Nomorhamphus* and has discovered a number of undescribed species in both genera (Meisner, 1998). Currently, there appears to be 12 species in *Dermogenys*, of which five are undescribed. Several of these species, including the one from Sabah, have been identified as *D. pusilla* Kuhl and van Hasselt because of the confusion caused by the broad application of this name (Mohr, 1936; Brembach, 1991) in museum collections and throughout the aquarium literature.

In the first revision of *Dermogenys*, Mohr (1936) recognized four of the then 10 nominal species, placing three species in synonymy with *D. pusilla*, the type species of the genus. Since Mohr's revision, seven additional species and three subspecies have been described. In a subsequent revision, Brembach (1991) recognized 10 nominal species and three subspecies. In that revision, the name *D. pusilla* was applied to several populations that appeared to have consistent differences in the spiculus (Kottelat, 1992). The purpose of this paper is to describe the species from Sabah.

MATERIAL AND METHODS

Anatomical descriptions of the andropodium follow Brembach (1976) and Meisner & Burns (1997a). The term andropodium implies that it functions as an intromittant organ. It should be noted, however, that the anal fin probably does not function directly in the transfer of sperm, but rather acts to orient the elongate genital papilla toward the female gonopore (Meisner & Burns, 1997a). For convenience, however, the anterior five to seven anal-fin rays that become thickened and curved posteriorly are collectively referred to as the andropodium (Fig. 1). In some species, there is a distinct "knee", the geniculus, that is formed at the point of curvature along the second ray. A pair of spines is present distally on this ray. The spiculus refers to the terminus of the second anal-fin ray distal to the spines (Fig. 1). Counts were made from cleared and stained preparations and radiographs. Each dorsal- and anal- fin ray was counted as a separate element. Precaudal vertebrae begin with the anteriormost vertebra and end with the posteriormost vertebra without a hemal spine. Caudal vertebrae begin with the first vertebra with a hemal spine and include the hypural plate. Measurements were made with digital calipers to the nearest 0.1 mm and follow Anderson & Collette (1991). Morphometric ranges are listed in Table 1. Institutional abbreviations follow Leviton et al. (1985) except, ZRC (Zoological Reference Collection, Raffles Museum of Biodiversity Research, National University of Singapore). Characters are listed in the species description roughly according to their position along the anterior-posterior axis of the body; reproductive characters are listed last. Counts for the holotype are enclosed in square brackets.

Dermogenys bispina, new species

(Figs. 1-4; Table 1)

Dermogenys pusillus not of van Hasselt 1823. — Herre, 1944 (in part, specimens from British North Borneo, CAS 133611, CAS 133488). — Inger, 1955 (characters, biology, collection report).— Inger & Chin, 1962: 152-154 (characters, biology, FMNH specimens).

Material examined. - **SABAH.** 175 specimens from 17 collections (20.2-50.1 mm SL). Holotype - ZRC 40391 (male, 24.9) Danum Valley, Sg. Malua; Tan & Goh; Oct.1996.

Only collections containing adult males are designated paratypes.

Paratypes - Out of ZRC 40391 (2 females 35.5-40.4), collected with holotype. ZRC 37643 (3 females, 35.2-43.7, 4 males, 23.8-26.2). Kinabatangan basin at Safoda, Kg. Batu Pateh; Lim et al.; Apr.1994. ZSM 27562 (4 females, 41.7- 48.6, 3 males, 26.3 -31.2) outskirts of Sandakan; Kettner, Krummenacher & Witte; 1988. FMNH 51693 (13 females, 23.7-48.6, 10 males, 22.5-30.7, 4 undet.); East Coast Residency, Kinabatangan Dist.; tributary of the Little Kretam River (Sungei Gana) just above Nipa belt; Inger RFI 103 113; 12 May.1950. FMNH 44898 (3 females, 35.8-30.3, 3 males, 28.0-29.5); Sandakan Dist., mile 8, North Rd; Fisheries Department, Colony of North Borneo; 1950. FMNH 44899 (1 female, 35.0, 1 male, 23.9); Kinabatangan Dist., Lake Bilit; Tubb; 1949. FMNH 68412 (3 females, 28.0-39.3, 1 male, 25.3); Kinabatangan Dist.; Dermakot Camp, unnamed stream crossing railroad trace; Inger & Chin RFI 1141-9; 25 Apr.1956. FMNH 68413 (1 male, 24.4); Kinabatangan Dist., Dermakot Camp; Chin RFI 1242-3; 30 Apr.1950. FMNH 68415 (1 male, 29.2); Tawau Dist., Kalabakan, Sungei Marikut; Inger RFI 1728-34; 16 Jun.1956. FMNH 101114 (2 females, 25.3-44.8, 3 males, 25.4 -30.1); Sandakan Dist., Tenosa, near SKAN; Tubb; 1947. FMNH 51696 (3 females, 30.7-49.2, 1 male, 21.1); Kinabatangan Dist., forest rib. of Kretam Kechil; Inger RFI 122; 1950. USNM 345500 (11 females, 27.7-46.2, 7 males, 20.2-28.5, 3 undet., 2 males cleared and counterstained); East Coast Residency, Kinabatangan Dist., Pinang River, trib. of Little Kretam River; Inger & Jones RFI 64-72; 10 May 1950. FMNH 68414 (2 males, 27.4-28.4); Tawau Dist., Palau Sebatik; Inger RFI 1420; 28 May.1956. CAS 133488 (10 females, 28.0-50.1, 4 males, 28.9-34.0, 2 females, 1 male cleared and counterstained); Sandakan Dist., Gum-Gum River; Herre; 11 Apr.1938. CAS 133611 (n=69, females, 29.7-49.5, males, 21.9-31.9, 2 females, 2 males cleared and

Table 1. Morphometrics for A. male holotype of *Dermogenys bispina* (ZRC 40391) B. 12 female paratypes of *Dermogenys bispina*; and D. seven male paratypes of *Dermogenys bispina*. Standard length is expressed in mm; measurements 3-10 are expressed as percentages of standard length.

	A	B	C
Standard length	24.9	35.2-49.8	23.8-31.9
Standard length/ Lower jaw length	6.9	6.1-8.1	5.5-6.8
Upper jaw length/ Upper jaw width	1.6	1.4-1.7	1.4-1.6
Snout to Pectoral fin length	35.3	32.7-35.2	33.6-37.3
Snout to pelvic Fin length	59.8	60.7-65.2	57.8-64.6
Head Length	30.5	27.5-31.0	28.5-34.2
Body depth at Pectoral fin	10.4	9.3-13.5	10.2-12.2
Body depth at Pelvic fin	9.6	9.6-13.5	10.3-12.2
Orbital length	5.9	4.2-5.8	4.9-6.4
Interorbital width	6.0	4.6-6.4	5.7-7.1

counterstained); Sandakan Bay drainage, Kabili R.; Herre; 29 Jan. 1937. ZSM 27540 (1 female, 30.3, 2 males, 26.2, 1 undet.); road from Kota Kinbalu to Sandakan, larger stream between Telupid and 42 km before intersection with road to Beluran; Kettner, Krummenacher, and Witte; 11 Mar. 1988.

Other Material Examined. - SABAH. — 23 specimens from nine collections (26.4-48.4 mm SL). FMNH 51691 (7 females, 33.9-48.4); East Coast Residency, Kinabatangan Dist., fork of east and west Gaja, in west fork, trib. of Kretam Kechil R.; Inger RFI 170-174; 22 May. 1950. FMNH 51695 (3 undet.); Kinabatangan Dist., clear water trib. of Kretam Kechil; Inger RFI 115; 12 May. 1950. FMNH 51694 (2 females, 35.4-45.0, 1 undet.); Kinabatangan Dist., near mouth of Kretam Kechil R.; Inger RFI 56-57, 9 May. 1950. FMNH 51699 (1 female, 45.8, 1 undet.); Kinabatangan Dist., mouth of Pinang River, a trib. of Little Kretam River, Inger RFI 197-198, 26 May. 1950. FMNH 101113 (1 female, 43.2); Sandakan Dist., mile 5 North Road; Tubb, 1947. FMNH 51697 (2 females, 26.4 - 37.7); Sandakan Dist., Sapagaya Forest Reserve, trib. of Sapagaya River; Inger RFI 478-489; 20 Jul. 1950. FMNH 44897 (1 female, 27.4); Kinabatangan Dist., Mintak; Tubb; 1949. FMNH 51698 (1 female, 43.5); East Coast Residency, Kinabatangan Dist., Little Kretam River, mouth of Ayer Terjun; Inger RFI 73-75; 10 May. 1950. FMNH 44896 (3 females, 29.9-47.3); Sandakan Dist., mile 5 North Road and/or Tenosa, near SKAN, Tubb, 1947. BUSUANGA ISLAND. — 69 specimens from 1 collection. USNM 138667 (n=69, females, 29.2-55.6, males, 31.8-36.7); Paugauron River, Port Caltour; *Albatross*; 1908.

Diagnosis. - *Dermogenys bispina* (Figs. 1 & 2) is distinguished from all other species of *Dermogenys* by: mature males with thick, unsegmented, dorsally curved spiculus; presence of second set of smaller spines on distal tip of spiculus (Fig. 1); and females with melanophores directly anterior to anal fin arranged into wide U extending anteriorly, on either side of genital papilla, to level of anus (Fig. 3).

Description. - Slender-bodied (body depth at pectoral fin base 9.3-13.5% SL); sexually dimorphic with females larger than males (largest mature female, 55.6 mm; male, 36.7 mm); precaudal vertebrae 21-23 [22]; caudal vertebrae 17-19 [18]; total vertebrae 39-42 [40]; predorsal scales 25-34; lower jaw elongate (6.1-8.1 times in SL) (Fig. 2); upper jaw longer than wide (width 1.4-1.7 times in length); biserial or triserial conical oral teeth; teeth on lower jaw not extending past the anterior margin of upper jaw; row of uniserial teeth on

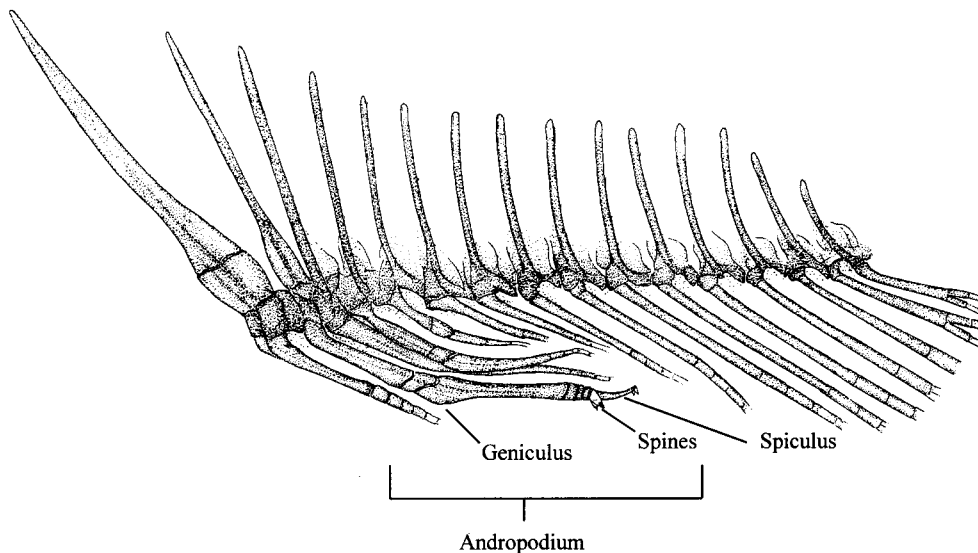


Fig. 1. Diagrammatic representation of the modified anal-fin ray (andropodium) of *Dermogenys bispina*, new species, paratype, USNM 345500, 28.5 mm SL, Sabah, Penang River. Middle radials absent, ossified distal radials and cartilage not illustrated; bone stippled.

upper jaw extending medially in concave row from outer rows of teeth to point at about one half the length of premaxilla (dentigerous bar of Greven et al., 1997a,b); gill rakers reduced, tear-drop shaped, 1-3 teeth; branchiostegal rays 10-11; lacrimal rounded; pectoral fin pointed, reaching pelvic-fin origin in males; pectoral-fin rays 11-12; pelvic fin closer to pectoral than caudal fin base; second anal-fin ray in males with 6-7 segments proximal to spines; geniculus present beginning at segment three which is greatly elongate; thick, unsegmented, dorsally curved spiculus; second set of smaller spines on distal tip of spiculus; both sets of spines with cap of bone at distal tip; genital papilla in females elongate, pigmented; anal-fin rays 15-17 [15]; dorsal fin origin over anal-fin ray 6 or 7 [7]; dorsal-fin rays 9-11 [11]; caudal fin oval; fifth hypural partially separated from dorsal hypural plate; large spermatozeugmata; threadlike sperm nuclei (Downing & Burns, 1995); type II form of halfbeak viviparity (Meisner & Burns, 1997b).

Color In Alcohol. - (Fig. 2) Background color tan/brown; thin diffuse midlateral stripe from opercle to caudal fin; diffuse spot anterior to pectoral fin; males with black pigment on posterior dorsal-fin rays; some males with black pigment on lateral surfaces of elongate genital papilla; in females, melanophores directly anterior to anal fin arranged into a wide U extending anteriorly on either side of genital papilla to level of anus (Fig. 3).

Etymology. - *bispina* from the Latin bi (two) and spina (spine) in reference to the diagnostic second set of paired spines at the distal tip of the spiculus.

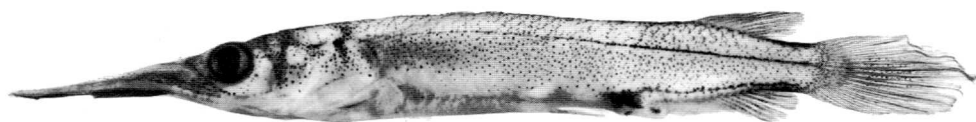


Fig. 2. Photograph of the holotype of *Dermogenys bispina*, new species, ZRC 40391 (male, 24.9 mm SL) Danum Valley, Sg. Malua, Sabah.

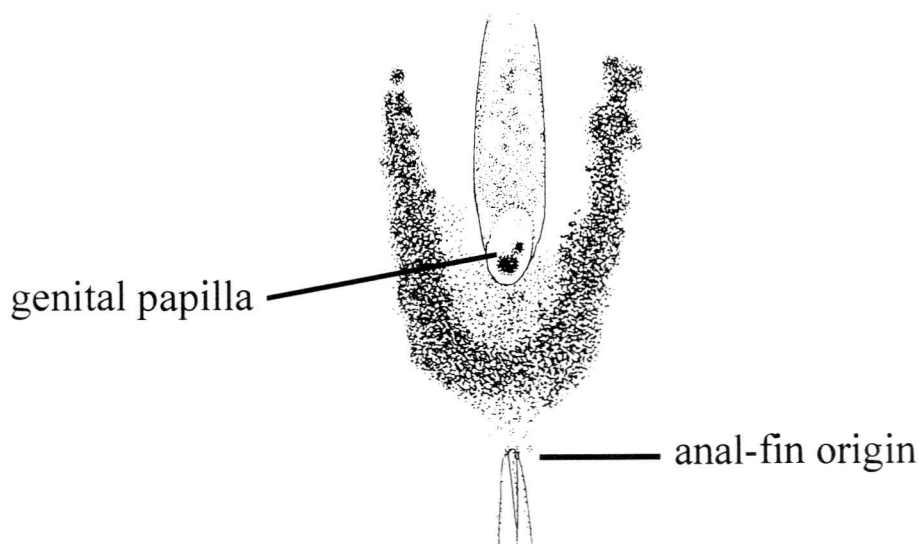


Fig. 3. *Dermogenys bispina*, new species, ZRC. uncat., female, 39.8 mm SL, Sabah, Danum Valley. Ventral view to show pigmentation around urogenital papilla.

Distribution. - Distributed throughout the rivers of Sabah which drain east into the Sulu Sea and on the Philippine island of Busuanga (Fig. 4). Three other species of *Dermogenys* are found allopatrically on the island of Borneo.

Ecology. - As is true of several other species of *Dermogenys*, *D. bispina* is most abundant in slightly brackish water but moves upstream into turbid freshwater (Inger & Chin, 1962). *Dermogenys bispina* lives in small streams or in large rivers, where they may be seen swimming at the surface near the banks (Inger & Chin, 1962).

In eight stations where *D. bispina* was collected, a total of 53 other species were recorded (summarized from Inger's field notes at FMNH). Four species were collected at four of these eight stations: two minnows, *Nematabramis everetti* and *Puntius sealei*, and the catfishes, *Hemibagrus nemurus* (Bagridae), and *Clarias teijsmanni* (Clariidae). Seven species were taken at three of the eight stations, 16 at two of the eight. As with other species of *Dermogenys*, *D. bispina* feeds largely on insects that fall into the water. Stomachs of two specimens examined by Inger & Chin (1962) contained ants, one contained a spider. Ants were found in most specimens that we have dissected.

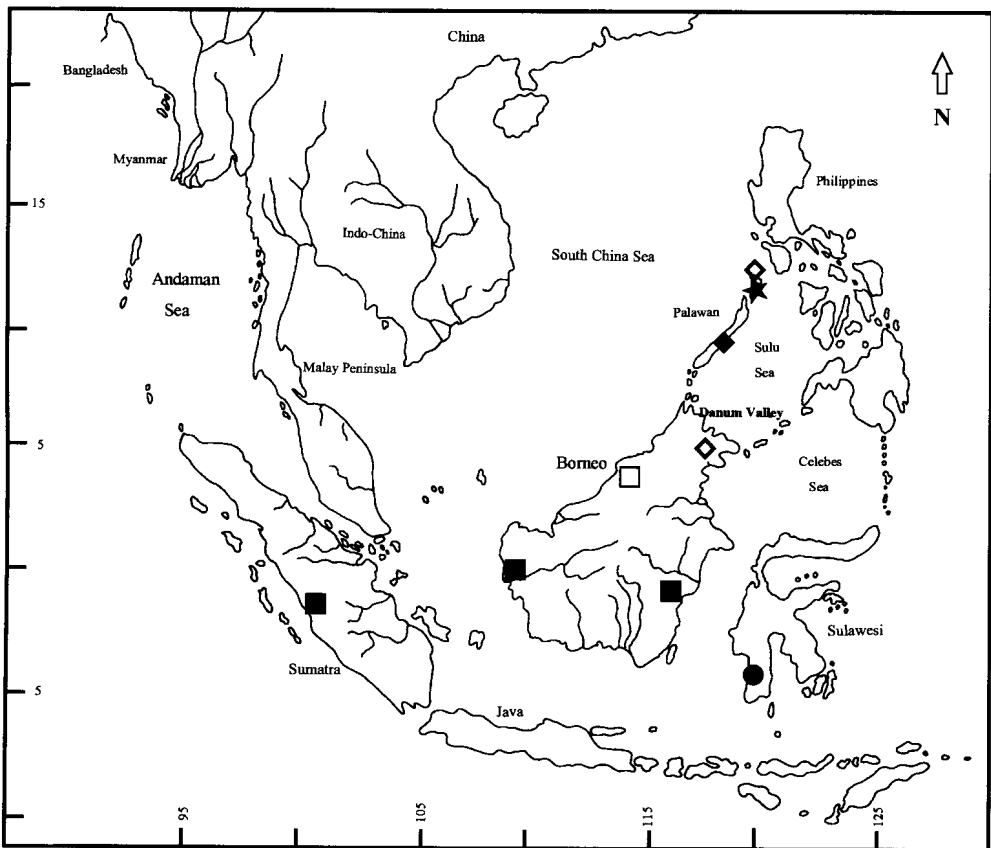


Fig. 4. Map of southeast Asia showing the type locality of *Dermogenys bispina*, new species, Danum Valley, Sabah, and the geographical distribution of *Dermogenys bispina*, new species, and closely related species of *Dermogenys*. Open diamond, *D. bispina*; open square, undescribed species from Brunei; solid diamond, undescribed species from Palawan; solid star, undescribed species from Busuanga; solid square, *D. sumatrana*; filled circle, *D. orientalis*.

Reproductive Biology. - *Dermogenys bispina* has the type II form of halfbeak viviparity described by Meisner & Burns (1997b), who listed it as *Dermogenys* sp. (Sabah). Viviparity in this species is characterized by the presence of superfetation as noted by Inger & Chin (1962) and Meisner & Burns (1997b) who found up to three broods present in a single ovary. *Dermogenys orientalis* and four other populations of *Dermogenys* thought to represent undescribed species from Kalimantan, Sumatra, Palawan, and Culion, also have the type II form of halfbeak viviparity (Meisner & Burns, 1997b). In this form of halfbeak viviparity, development is entirely intrafollicular, embryos have expanded belly sacs and little yolk reserves are present. Ova without visible embryos measured 0.4-0.6 mm in diameter and the smallest eggs containing embryos 0.9-1.2 mm (Inger & Chin, 1962). The largest embryos measured 14.0 mm and had the lower jaw slightly longer than the upper.

Histological analysis of the testes reveal that these six populations of halfbeaks with the type II form of viviparity also have large sperm bundles and threadlike sperm nuclei (Downing & Burns, 1995). *Dermogenys bispina* and two undescribed species from the southwestern Philippines islands of Palawan and Culion share a cap of bone on the proximal spines on the second anal-fin ray in males

Relationships. - Within the Hemiramphidae, the more widely distributed *Dermogenys* has been placed as the sister group to another viviparous genus *Nomorhamphus* which, as currently constituted, is restricted to the island of Sulawesi (Collette, 1995). The monophyly of *Dermogenys* + *Nomorhamphus* is supported by modifications of the anal fin in males (Collette, 1995) and the even distribution of spermatid nuclei around the periphery of the spermatocysts (Downing & Burns, 1995). As in *Dermogenys*, the taxonomy of *Nomorhamphus* remains confused (Kottelat, 1992). Meristic and morphometric data have been of little utility in hypothesizing species limits. Consequently, considerable emphasis has been placed on variation in the spiculus, particularly within *Dermogenys*. However, despite detailed descriptions of the spiculus for many species (Brembach, 1991), the taxonomy and phylogeny of *Dermogenys* remains unresolved.

In an attempt to find new characters for use in a phylogenetic revision of these genera, the testes of many populations of *Dermogenys* were recently examined histologically (Downing & Burns, 1995). In that study, the morphology of the sperm bundles described for populations of *Dermogenys bispina* (identified as *D. pusilla*) was identical to those observed in *D. orientalis* from southwest Sulawesi and populations from eastern Kalimantan, Java, Vietnam, Thailand, Burma, and Bangladesh (most also identified as *D. pusilla*). These findings suggest that *D. bispina* may have a closer relationship to these populations of *Dermogenys* than to those distributed throughout Sulawesi and elsewhere throughout the Philippines. Additional support for this relationship was discovered in the study of ovarian structure which found that embryonic development in these species is entirely intrafollicular (Meisner & Burns, 1997b). These findings support earlier suggestions that *Dermogenys*, as currently constituted, may be paraphyletic.

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