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Geographic variation in *Poecilia* Bloch and Schneider, 1801 (Teleostei: Poeciliidae), with descriptions of three new species and lectotypes for *P. dovii* Günther, 1866 and for *P. vandepolli* van Lidth de Jeude, 1887

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Abstract

The South American species with the vernacular name "mollies" are analyzed and three new species of the genus *Poecilia* are described and figured, viz., *P. boesemani* n. sp. from Trinidad, *P. koperi* n. sp. from Venezuela and Colombia, and *P. wandae* n. sp. from Lake Maracaibo. Thirteen species of *Poecilia* are presently recognized from the northeastern part of South America and adjacent islands, viz., six mollies (including *P. vivipara* and *P. caucana*), five micropoeciliids, *P. heterandria* and the guppy (*P. reticulata*). Two different populations in both *P. koperi* and *P. wandae* are recognized, based on variation in pigmentation. From the type series of *P. dovii* Günther, 1866 and *P. vandepolli* Van Lidth de Jeude, 1887 lectotypes are selected. Four subspecies of *P. gillii* are defined as morphologically distinct and geographically correlated populations.

Poecilia reticulata, *P. heterandria*, and the micropoeciliids *P. bifurca*, *P. parae*, *P. picta*, *P. branneri* and *P. minima* are not considered, whereas *P. laurae* remains a species inquirendae. A geocline in characters of the species of *Poecilia* is recorded and a possible evolution is discussed.

Keywords: Alpha-taxonomy, intraspecific variation, *Poecilia*

Introduction

This paper seeks to extend our biogeographical knowledge of the genus *Poecilia* Bloch & Schneider, 1801 and describe four species from the southern area of distribution of this genus. Whereas poeciliids constitute a dominant part of the Central American fish fauna, this is not the case in South America. Miller (1983) constructed a key and checklist for the Mexican species, but there are none for the species of *Poecilia* in Colombia and Venezuela. Specimens of the species herein described as new, viz., *P. koperi*, *P. boesemani* and *P. wandae*, were previously misidentified as either *P. vivipara* Bloch & Schneider, 1801; *P. sphenops* Valenciennes, 1846 (Regan, 1913: 1013; Price, 1955: 18; Boeseman, 1960: 122); *P. vandepolli* van Lidth de Jeude, 1887 (de Beaufort, 1940: 111; Schultz, 1949: 84, 97- 99; Feltkamp and Kristensen, 1969); or merely mentioned as 'unidentified species' (Rosen & Bailey, 1963: 48).

Methods

Some 17 lots of *Poecilia vandepolli*, including the type series of *P. vandepolli vandepolli* and *P. v. arubensis*, have been re-examined to establish standardized data for the descriptions presented in the present paper. From the type series, a lectotype is selected. Meristic data and inner jaw dentition were examined with a binocular microscope with a maximum magnification of 50x. The vernier calipers used record distances to 0.1 mm. Of all lots, the average of the measurements and counts are given, to provide a detailed analysis of the population structure. These averages are compared to a similar study (Feltkamp and Kristensen, 1969) and to the data of *P. vivipara* and of *P. gillii*.

In the description of the new species, proportional morphometric values (Table I) are recorded in thousandths of the standard length (SL), following Miller (1975). The small size of *P. wanda* made measurements difficult and some are therefore omitted. Meristic data follow Hubbs and Lagler (1947). In the type series of *P. wanda*, all specimens have damaged caudal fins; therefore, the count given is an estimate. Terms concerning the shape of inner jaw dentition follow Garman (1895). Melanophore pigmentation of preserved specimens and gonopodial structures are also recorded (Figures 1 to 4).

The combined data are used to evaluate relationships between the newly described species. A key to the species is provided in Appendix 3 of this thesis.

Abbreviations

- A = anal fin rays
- BS = scales around the body
- CPD = Least depth of the caudal peduncle
- CPS = scales around the caudal peduncle
- D = number of dorsal fin rays
- G = gonopodial ray
- LLS = lateral scales
- P = Pelvic fin rays
- PS = Predorsal scales
- SL = standard length

Systematics

The genus *Poecilia* is defined by the shape of gonopodial ray 4p, which has six to fourteen unserrated distal segments, followed by dorsally serrated subdistal segments (cf. Miller, 1975). The genus *Poecilia* consists of several ill-defined subgenera. A more detailed analysis is in progress.

In the subgenus *Poecilia*, ventral spine-like serrae are present on the third gonopodial ray. Gonopodial rays 4a and 4p are very similar, as are rays 5a and 5p. The *P. sphenops* species group has terminal segments of gonopodial ray 4a and of gonopodial ray 4p close to each

other, giving the gonopodium a sharp appearance. The members of this species group are moderately sized to large, with nuptial specimens usually larger than 35 mm SL. The members of the *P. caucana* species group are defined by the relative thickness of gonopodial ray 4p versus 4a. The tips of these rays are split, making the gonopodium blunt. Nuptial specimens are less than 35 mm SL.

Poecilia vivipara Bloch & Schneider, 1801

Poecilia vivipara Bloch & Schneider, 1801: 452, pl. 86 Fig. 2 (type locality: Surinam).

Poecilia surinamensis Humboldt & Valenciennes, 1821: 158 (type locality: Surinam, French Guyana, Brazil).

Poecilia unimaculata Humboldt & Valenciennes, 1821: 158 (type locality: Brazil, Rio de Janeiro).

Poecilia schneideri Humboldt & Valenciennes, 1821: 159 (type locality: Surinam).

Neopoecilia holacanthus Hubbs, 1924: 11 (type locality: Puerto Rico, introduced).

Material.- West Indian Antilles: ZMA 120.384 (22), St. Lucia, freshwater pool, + 1km west from Fort Vieux, coll. J.H. Stock, 20-II-1974.

Guyana: BMNH 1974. 10. 10. 527-619 (7 out 93), Georgetown, Seawall trench, no date; CAS 59364 (12), Georgetown trenches, C. H. Eigenmann 1908; CAS (SU) 21784 (2), same data as CAS 59364; USNM 66278 (2), same data as CAS 59364; ZMA 100. 629 (2), same data as CAS 59364; ZMA 119. 912 (3), East Coast Demerara, Turkeyen, drainage canal, coll. M. Tamessar, 28-I-1987; ZMA 119. 913 (6), East Coast Demerara, Bel Air, stagnant ditch, coll. M. Tamessar, 28-I-1987; ZMA 119. 917 (4), East Coast Demerara, Industry, shallow pool, coll. M. Tamessar, 28-I-1987; ZMA 121.005 (5), Guyana, coll. F. Vermeulen, no date; ZMA 121.007 (15), Guyana, coll. F. Vermeulen, 1992; ZMA 121.009 (5), Guyana, coll. F. Vermeulen, 1992.

Surinam: MNHN B. 932 (5 syntypes of *P. surinamensis*), Surinam River, Levailant, no date; MNHN 4391 (48 syntypes of *P. surinamensis*), Cayenne, Rousseau, no date; MNHN B. 918 (60), without exact locality, Duvernoy, no date; RMNH 18516 (2), Surinam, coll. J.Th. Noordijk, august 1887; ZMA 105.332 (2), Paramaribo-west, garden canals, coll. H. Nijssen, 12-XII-1966; ZMA 106.757 (16), Marowijne River, coastal plain on Tijgerbank, west of mouth, coll. H. Nijssen, 1-IV-1966; ZMA 115.118 (45), Surinam district, Lagoon 7 & 8, 05°59'N, 54°49'W, coll. M. P. Panday, 22-IV-1974; ZMA 115.121 (20), same data as ZMA 115.118; ZMA 119.908 (6), Surinam River, pool near beach at Braampunt, coll. I. Kristensen, 14-III-1960; ZMA 121.000 (4), Paramaribo, Mason Street, polluted trench, coll. F. Vermeulen & W. Suyker, 24-III-1991.

French Guiana: USNM 121833 (9), Cayenne, Carriera Guila, S. F. Yolles 1945; USNM 121834 (2), Cayenne, Pont Magie, S. F. Yolles 1945; USNM 121835 (9), Cayenne, Ruisseau

de l'institute-eau douce, S. F. Yolles 1945; USNM 149938 (4), Cayenne, S. F. Hildebrand 1945.

Brazil: RMNH 2724 (2 syntypes of *P. unimaculata*), Rio de Janeiro, coll. Delalande, no date; ZMA 100. 628 (1), Brazil, coll. Moesch, 1884; ZMA 116. 210 (14), Rio Grande do Norte, Rio Açu (Rio Assu), downstream of Macau, coll. R. Boddeke, 10-I-1979.

Diagnosis. A. 8; D. 7; C. 16-18; LLS 24-26; CPS 16. *Poecilia vivipara* frequently has side spot midway body, a unique character in the subgenus. The gonopodium has no extruding hooks or spines, gonopodial ray 4a with serrae on dorsal surface.

Description.- Medium sized species, mature males smaller than 50 mm and females smaller than 60 mm. The body is truncate and displays dark stripes on the sides. The caudal and dorsal fins have black markings, with broad yellow margins. The caudal fin has black margins, at the base broader than at the terminal end. There is some variation in the presence or absence of the medium spot at the side of the body. No extensive records are available of the extent of this variation. In the populations in which it is present, the blotch is also prominent in young specimens. The gonopodium is figured in Miller (1975), the dorsal serrae on ray 4a are unique within the subgenus.

Distribution.- *Poecilia vivipara* is found in coastal habitats from Venezuela to Argentina. It is also found on some islands of the Lesser Antilles.

Remarks.- Garman (1895) diagnosed this species and its synonyms. He also noted and explained the obvious aberrant figure in the original description. Hubbs (1926) synonymized *Neopoecilia holacanthus*, correcting his misidentification.

Poecilia mexicana Steindachner, 1863

Poecilia mexicana Steindachner, 1863: 178, pl. 4, fig. 1, 1a (type locality: Mexico, Orizaba).

Poecilia thermalis Steindachner, 1863: 181, plate 4, fig. 3, 3a (type locality: Central America, warm springs).

? *Gambusia* (?) *modesta* Troschel, 1865: 105 (type locality: Mexico).

? *Gambusia* (?) *plumbea* Troschel, 1865: 106 (type locality: Mexico).

Poecilia chisoyensis Günther, 1866: 342 (type locality: River Chisoy, Vera Paz).

Poecilia dovii Günther, 1866: 344 (in part; type locality: Mexico; lectotype is *P. gillii*).

Poecilia limantouri Jordan & Snyder, 1900: 116-117, 129-131 (type locality: Tampica, Tamaulipas, Mexico).

Mollienesia sphenops vantynei Hubbs, 1935: 11, plate 2, fig. 1 (type locality: Guatemala, Uaxactum, Rio Hondo).

Mollienesia sphenops macrura Hubbs, 1935: 12, plate 2, fig. 2-3 (type locality: Guatemala, Rio San Pedro de Martir).

Mollienesia sphenops altissima Hubbs, 1936: 239, plate 9, fig. 1-3 (type locality: Mexico, Yucatan Peninsula, Miramar Spring).

Mollienesia sphenops melanistia Hubbs, 1937 (type locality: Mexico, Tamaulipas, Arroyo Marmoleyo).

Material. Barbados: BMNH 1970.1.29:1 (1) Barbados, coll. R. Heath, no date; RMNH 24814 (55), rivulet near Three Mills (13°10'N, 59°27'W), coll. I. Kristensen, 13.6.1961; RMNH 24804 (6), rivulet at Three Mills (13°10'N, 59°27'W), coll. I. Kristensen, 13.6.1961; RMNH 24809 (5), rivulet near Three Mills (13°10'N, 59°27'W), coll. I. Kristensen, 13.6.1961.

Diagnosis. A. 9; D. 9-10; C. 18-22; LLS. 26-27; CPS. 18.

Description.- *Poecilia mexicana* is rather variable in its morphometric features. This is a truncate, torpedo shaped species in northern Mexico but ranges to high, laterally flatted specimens at the eastern range of the Yucatan Peninsula. While the northern populations possess deeply blue pigmented bodies, alpha-males of the Yucatan populations have a more copper-red body. The fin pigmentation is also varying, from black basic halves with an orange outer area (in northern populations) to a black and yellow reticulate pattern (on the Yucatan Peninsula). Between these extremes a geocline is found.

In the Barbados material, both males and females have considerable variation in their pigmentation, especially the specimens from RMNH 24804 have many spots on their body, which is probably why they were separated from the other lots. Females have nine anal fin rays, some females have 10 dorsal fin. The membranous hook on gonopodial ray 3 is extremely small, without a bony spine. Several specimens have 20 caudal fin rays, whereas all specimens have 18 scales around the caudal peduncle. The one specimen from the British museum collection (BMNH 1970.1.29:1) also agrees with the meristic data of *P. mexicana*.

The diagnostic features of *P. mexicana* mostly agree with the nominal subspecies *P. gillii gillii* (see below), with the exception of the number of scales around the caudal peduncle (18 versus 16 in *P. gillii*).

Distribution.- *Poecilia mexicana* occurs on the Atlantic coast of Central America, from the Texas border, through Yucatan into Guatemala and Costa Rica. The population found on Barbados are probably escaped aquarium specimens, which is confirmed by their abnormal variability in body pigmentation.

Poecilia gillii (Kner & Steindachner, 1864)

Xiphophorus Gillii Kner and Steindachner, 1864: in Kner & Steindachner, 1865: 25 (type locality: Panama, Rio Chagres); *Poecilia gillii*; Günther, 1868: 395; *Poecilia sphenops gillii*; Hubbs, 1953: 145.

Poecilia mexicana [non Valenciennes, 1863]; Poeser, 1992: 86 (misidentification).

Poecilia thermalis [non Steindachner, 1863] Günther, 1866: 341 (type locality: San Salvador, warm springs).

Poecilia dovii Günther, 1866: 344 (in part: type locality: Lake of Nicaragua).

Platypoecilus mentalis Gill, 1876: 335 (type locality: Isthmus of Panama).

Poecilia Boucardi Steindachner, 1876: 386 (type locality: Colon, Panama).

Poecilia cuneata Garman, 1895: 179, plate V (type locality: Colombia, Gulf of Uraba, Turbo); *Poecilia sphenops cuneata*; Hubbs, 1926b: 77.

Poecilia salvatoris Regan, 1907: 65, plate 14, fig. 2-3 (replacement name for *P. thermalis* Günther, 1866).

Platypoecilus tropicus Meek, 1907: 146 (type locality: Costa Rica, Turrialba).

Poecilia tenuis Meek, 1907: 147 (type locality: Costa Rica, Tiribi).

Poecilia caudata Meek, 1909: 209-210 (type locality: Costa Rica, Turrubares)

Poecilia spilonota Regan, 1908: 460 (type locality: San José, Costa Rica).

Lembesseia parvianalis Fowler, 1949: 267-269 (type locality: Africa, Congo system, Oka).

Mollienesia sphenops petersi Schindler, 1956: 1-4, fig. 1 (type locality: Honduras, lake Yojoa).

Material. Nicaragua: Lectotype of *P. dovii* (BMNH 1863.12.16.77, Lake of Nicaragua, coll. captain J. W. Dow, no date). 5 Paralectotypes of *P. dovii*, (BMNH 1863.12.16.78-92, same data as BMNH 1863.12.16.77).

Costa Rica: 4 Syntypes of *P. spilonota* (BMNH 1907.2.11.44-50, San José, coll. P. Bidley, no date).

Panama: NWM 21608 (1 syntype of *Xiphophorus Gillii*), Rio Chagres, Panama, no further data. MCZ 29433 (10), 1 mile south of Panama City, coll. USFC Steamer Albatross (Alex. Agassiz), 23-X-1904; MCZ 33847 (10), ca. 9°43'N 79°43'W, between Gorgona and Matachin, collected before 1930; MCZ 54068 (10), small tributary of main stream on left about 0.75 km upriver of bridge, Bayano drainage, probably Rio Canita, Panama, coll. W.L. Fink & K.E. Hartel, 1-IV-1978; USNM 050368 (14), Panama, coll. C.H. Gilbert; USNM 64764 (17), Folks R. Swamp, Cristobal, coll. A.H. Jennings, 4-VIII-1909; USNM 65618 (15), 1 mile south of Panama city, coll. Str. Albatross, 23 X-1904; USNM 78837 (27), Upper Trinidad, coll. Meek & Hildebrand, 7-III-1911; USNM 247529, (24) canals in banana field, Bocas Province, California, coll. Loftin, 2-IX-1962; USNM 247531, (44) Rio Gaurumo, Bocas Province, coll. Loftin, 18-IV-1963; USNM 247432 (10 of 50), Canal zone, behind fort Clayton, residential area, coll. Loftin & Tyson, 19-IV-1962; USNM 247436, (6) Bocas del Toro, Esendo de Vereguas island, coll. J. Legler, 14-V-1962; USNM 247548, (35) San Blas, small river opposite to Mulatupo island, coll. Loftin & Evermann, 2-XII-1962; USNM 247550, (18) San Blas, Rio Acla, coll. Loftin, 16-XII-1962; USNM 293473, (10 of 51) 9°14' N, 78°58' W, Rio Tearbles, Bayano drainage, Panama province, coll. W.C. Sternes et al., 25-II-1985; USNM 293476, (23) 9°28'N 79°3'W, Comarca Kuna Yala, Rio Mandinga, coll. W.C. Sternes et al., 5-III-1985; USNM 293494 (42), Panama province, Rio Frijoles, above

pipeline rd., N. of Gamboa (Rio Chagres drainage, Atlantic side), coll. W.C. Sternes et al., 26-II-1985.

Colombia: 2 Syntypes of *P. cuneata* (MCZ 6458, Turbo, Gulf of Uraba, Colombia, coll. T. Barbour, no date); 3 Syntypes of *P. cuneata* (USNM 120285, same data as MCZ 6458); 5 Syntypes of *P. Boucardi* (MCZ 32959, San Pablo (Aspinwall (Colon), Quebrada San Pablo), coll. Hassler Expedition (Steindachner & Mr. Boucard), VII-1872); BMNH 99.3.15.27-29 (3), Monkey Hill, Colon, coll. Dr. H. Festa, no date.

Additional material from Nicaragua and Panama in Poeser (1992), from El Salvador in Poeser (1995).

Diagnosis. A. 9; D. 9-10; CPS 16; LLS 26-29. This species is very similar to *P. mexicana*. The most recent checklist (Miller, 1983) was uncertain about the separate status of *P. gillii*. Therefore, I have included an elaborate description of this species.

Description.- All examined type material is consistent with these meristic data. Over its extensive range, however, *P. gillii* shows considerable variation in body shape and in dorsal fin color, and moderate variation gonopodial features. These geographically correlated variations reflect intraspecific diversification, justifying taxonomic separation, i.e., division in subspecies. Carr & Giovannoli (1950: 17-18) reported the live colors of *P. gillii* and the sympatric *P. marcellinoi* Poeser, 1995 from Honduras: "One male with yellow spots, a black blotch at the caudal base and spotted dorsal and caudal fin, and one female with black spotted sides (= *P. marcellinoi*). One female with yellow spotted sides, and a male with golden-orange blotches, with a black blotch on the dorsal base and rest of fin orange (= *P. gillii*)."

Poecilia gillii salvatoris is reported from El Salvador, where males from most populations are reported to have red dorsal fins (Hildebrand, 1925). This prompted Miller (1994) to redescribe *P. salvatoris* Regan, 1907 although all other characters are as found in the present study for *P. gillii*. Poeser's (1995) redescription of *Poecilia salvatoris* agrees with the diagnosis of *P. salvatoris* by Regan (1908), with the exception of the number of anal fin rays. Regan (1908: 104) mentioned 8-9 anal fin rays; however, examination of 14 of his syntypes did not yield any specimen with eight anal fin rays, so Regan's account is probably erroneous. In the preserved material, no trace of red was found in the dorsal fins. The red finned western Central American populations are here considered as a subspecies, viz., *P. gillii salvatoris*.

Villa (1982) gave a key to the genus *Poecilia* in Nicaragua, in which he recognized three species, viz., *P. gillii*, *P. sphenops*, and "an undescribed species with unicuspid teeth". He mentioned (p. 134, translated from Spanish):

P. gillii: "Unicuspid inner teeth, incomplete supraorbital system, preorbital pores free, 26-28 (modally 27) lateral scales, 16 scales around caudal peduncle, 28-30 (modally 30) vertebrae. Guatemala, El Salvador, to Panama".

P. spec.: "Unicuspid inner teeth, complete supraorbital system, free preorbital pores, 28-30 (modally 29) lateral scales, 18 scales around caudal peduncle, 28-30 (modally 30) vertebrae.

Rio Ulya (Honduras), Lagunas Apoyeque and Xiloa, lake Managua and Nicaragua, and Rio Sapoa & Frio, Tilaran region, Costa Rica”.

P. sphenops: “Tricuspid inner teeth, incomplete supraorbital pores, preorbital pores hidden, 26-28 (modally 27) lateral scales, 16-18 scales around caudal peduncle, 28-30 (modally 29) vertebrae. Guatemala and El Salvador, Atlantic side of Honduras, Nicaragua including the Great Lakes”.

Villa’s diagnosis of *P. sphenops* fits the description of *P. marcellinoi* Poeser, 1995 (tricuspid inner teeth, 16 scales around the caudal peduncle). His description of *P. gillii* is accurate. His figure of *P. gillii*, however, shows 9 transverse scales on the caudal peduncle, which is a diagnostic character of *P. mexicana*. I suspect he used the wrong figure. The undescribed species might very well be *P. mexicana*. The apparently aberrant number of lateral scales (also mentioned by Bussing [1987]) is than explained by character displacement (cf. Poeser, 1995).

Poecilia gillii appears to be nearly the only species of *Poecilia* present in Costa Rica. Meek (1914: 116-117) placed all Costa Rican taxa in the synonymy of *Platypoecilus tropicus* (= *P. gillii*) as follows: “The inland or fresh-water forms of this species or variety found in Costa Rica are very variable, and as a result several species have from time to time described. ... The females and many males of these inland forms usually have a black spot at the base of the middle dorsal rays, On many specimens from salt and brackish water some of the scales have a dark spot which forms lines along the rows of scales. ... On many of the males, especially from larger streams, the basal half of the caudal is black, or with black blotches; on some of these the basal half of the dorsal is also black.” Specimens with a black basal half of the caudal fin, formerly described as *P. caudata* Meek, 1909, are in the present paper recognized as a subspecies, viz., *P. gillii caudata*.

Bussing (1987) identified most of the Costa Rican populations as *P. gillii*. He gave the following description (translated from Spanish): “Body with yellow spots, in some females these spots are black. Scales in a lateral series 26-28, mostly 27. Three orbital pores in one line. In the males sometimes a large dorsal fin, with black spots or blotches at the base. Caudal fin with spots, blotches or solid black pigmentation. Some males with orange in their caudal fin. Other fins yellow, head and body bluish. Note: some males have a red dorsal. Large species, up to 105 mm.” Males possessing a red dorsal fin are *P. gillii salvatoris*. Bussing also recorded *P. mexicana*, in a much lower frequency (i.e., three populations from over fifty in total, widely apart from each other [Bussing, 1987: 144, map 20]). His diagnosis for this species is: “Very much like *P. gillii*. Yellow spots on body, black in some females. 28-30 (modally 29) lateral scales, and three orbital pores, forming a triangle. Dorsal and caudal spotted, rest of fins yellow. It is also a large species, up to 110 mm.” Both *P. gillii* and *P. mexicana* are illustrated in his paper. His diagnoses of *P. gillii* and *P. mexicana* correspond with the account of Villa (1982) (see above). Surprisingly, Bussing did not record any population *P. marcellinoi*.

Hubbs (1926, 1953) considered *P. sphenops* in Panama either *P. sphenops cuneata* (cf. Hubbs, 1926), or *P. s. gillii* (cf. Hubbs, 1953). Examination of Panamanian populations confirms earlier findings of profound morphometrical differences, as well as constant meristic data, in all Panamese populations. A conspicuous reduction of the gonopodial spine on ray 5 is noted. In populations near Costa Rica (Bocas del Toro district of Panama) the spine is distinct. In populations near Colombia (i.e., the San Blas area) it is reduced or absent, like in *P. koperi* (Fig. 4a). This shift in character expression from west to east is not accompanied by meristic changes. Although some populations contain poorly pigmented, slender specimens, while other populations manifest heavily pigmented, stout specimens, all specimens have nine anal fin rays, nine (or rarely ten in the San Blas district) dorsal fin rays, 16 scales around the caudal peduncle, 18 scales around the body, and 26 to 29 scales in a lateral series. The consistency of these counts suggests that all populations belong to the same species.

Because the missing spine is of taxonomical significance this form is named *P. gillii cuneata* Garman, 1895. The populations of *P. gillii* from Panama examined in the present study are partly sympatric with *P. marcellinoi* like in El Salvador (Poeser, 1995). Poeser (1992) reported a male with an aberrant gonopodium from Nicaragua (GCRL 6697), identified then as *P. mexicana mexicana*. Re-examination of my notes proved that the identification and locality was wrong. The sample containing this male was GCRL 8748, viz., *P. gillii cuneata* from Panama.

The only synonym of *P. sphenops* in Rosen & Bailey (1963) from Nicaragua is *P. dovii* Günther, 1866. *Poecilia dovii* was considered synonymous with *P. sphenops* by Regan (1908). Since the type material of *P. dovii* contained specimens from *P. mexicana* (i.e., with 18 scales around the caudal peduncle), as well as from *P. gillii* (i.e., with 16 scales around the caudal peduncle), it is only partially alluded to the synonymy of *P. gillii*. In honor of captain J. W. Dow, the lectotype is selected from the lot he collected himself in Nicaragua, which is *P. gillii*. Günther (1866) mentioned that *P. dovii* occurred only in Guatemala and Mexico. However, since the type locality includes Nicaragua, this country should be included in the range of distribution. The specimens from Lake Amatitlán (BMNH 1865.6.10.13-15) are not registered in the British Museum as syntypes, and these were not studied.

Rosen & Bailey (1963) considered *Lembesseia parvianalis* a synonym of *P. sphenops*. However, since *L. parvianalis* has unicuspid inner teeth, Miller (1983) placed it in the synonymy of either *P. mexicana* or *P. gillii*. Based on the original description, in which 8 transverse scales on the caudal peduncle are illustrated, I assign it to the synonymy of *P. gillii*. Fowler's (1949) record is important for its taxonomical value. The *P. sphenops* group, if raised to generic level, would become *Lembesseia* (with *L. surinamensis* (= *P. sphenops*) as type species).

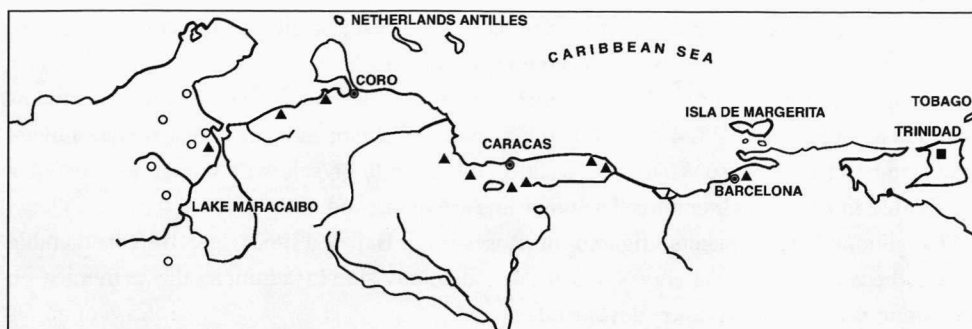


Figure 1. Distribution of the species described as new in this paper. Open circles (near Lake Maracaibo) *Poecilia wandae*; closed triangles (from Lake Maracaibo to Barcelona) *P. koperi*; closed square (Trinidad) *P. boesemani*

Distribution. *Poecilia gillii* is recorded from the Pacific coast of Guatemala to the Atlantic coast of Colombia. In northern regions, from Guatemala to Costa Rica, it is represented by the subspecies *P. gillii salvatoris*. The subspecies *P. gillii caudata* occurs in Costa Rica, whereas *P. gillii gillii* is present in Panama. The South American populations, as well as adjacent populations in Panama, are considered to be *P. gillii cuneata*. The type locality of *P. cuneata* was "Turbo, Gulf of Darien, Panama". However, examination of several detailed maps did not show the stated locality. The nearest village with that name is near the Gulf of Uraba, an extension of, and sometimes also so-called, Gulf of Darien, in Colombia. I presume that this is the right type locality.

Poecilia caucana (Steindachner, 1880)

Girardinus caucanus Steindachner, 1880: 87, plate 4, figure 4, 5 (type locality: Colombia, Caceres); *Allopoecilia caucana* Hubbs, 1924: 11.

Material. Colombia: UMMZ 186317 (51), Depto. Cordoba, Tierra Alta, Rio Sinu, coll. W. Moberley & K. Adler, 1965.

Venezuela: UMMZ 186931 (54), Rio Monay, coll. F. F. Bond, 1938; UMMZ 186934 (24), Quebrada Goajira, F. F. Bond, 1938; UMMZ 186937 (44), Rio Bucares, coll. F. F. Bond, 1938; USNM 86264 (4), Valera, Trujillo, coll. H. Pitteir, 1923; USNM 121677 (33), Rio Motatan, 4 km above Motatan, coll. L.P. Schultz, 25-III-1942.

Panama: USNM 293444, (7), Rio Meteti, Darien Province, 40 km NNW of Yaviza, coll. W.C. Sterns et al., 24-II-1985; USNM 293574, (10), Rio Peresinico, Darien Province, coll. B. Chernoff, J. Lundberg, L. McDade, 23-II-1985.

Diagnosis. A. 8; D. 7-8; C. 18-22; LLS. 26-27; CS. 16; CPS. 14. *Poecilia caucana* is a small to medium sized species, characterized by a black band in its dorsal fin. The gonopodium has ray 4p with broader rays than ray 4a.

Description.- This is one of the smaller species of the genus. The largest specimens examined are a female of 37.4 mm SL and a male of 27.2 mm SL. The dorsal fin has a black transverse band at the base. This fin is usually milky white or yellow, although also red fins are reported in aquarium literature. The other fins are unmarked.

The gonopodial characters, figured in Rosen and Bailey (1963), are of considerable interest, because gonopodial ray 4p is thicker than ray 4a. In addition, the extremity on gonopodial ray 5 is more weakly developed.

Distribution.- Atlantic slopes of Panama, Colombia and Venezuela.

Poecilia vandepolli van Lidth de Jeude, 1887

Poecilia Vandepolli van Lidth de Jeude, 1887: 137, Pl. 2, Figs. 4 and 5 (type locality: Curaçao).

Poecilia Vandepolli arubensis van Lidth de Jeude, 1887: 138, Pl. 2, Figs. 6-10 (type locality: Aruba).

Lectotype.- Curaçao: RMNH 5155, adult male, Curaçao, coll. Neervoort and v.d. Poll, no further data.

Paralectotypes.- RMNH 33843 (4), same data as RMNH 5155.

Material.- Aruba: RMNH 5156 (6 syntypes of *P. Vandepolli arubensis*), Aruba, coll. Neervoort and v.d. Poll, no further data. See also tables below, details in Poeser (1992).

Diagnosis. A. 8-9; D. 7-8; C. 16; LLS. 26-27; CPS. 16. Several specimens have humeral blotches, anterior to the position of the side spot in *P. vivipara*. Like *P. vivipara*, the gonopodium lacks extrusions, but gonopodial ray 4a never has dorsal serrae.

Description. *Poecilia vandepolli* is reported to have specimens with orange on the ventral side of the body, yellow specimens with blue sides and grayish brown specimens in the same population (Feltkamp and Kristensen, 1969). Speckled specimens, allegedly only occurring in Venezuelan populations (Feltkamp and Kristensen, 1969), also appear on Curaçao. The pigmentation at the base of the dorsal fin forms a blotch, in addition to dark spots. The body sometimes has a humeral blotch, positioned more anteriorly than the blotch in *P. vivipara*. The females tend to be paler than males.

The gonopodium, figured in Poeser (1992), is like that of *P. vivipara*, with the exception of the serrae on ray 4a. When fully developed, a little membranous bulge is found on gonopodial ray 3, covering extruding serrae.

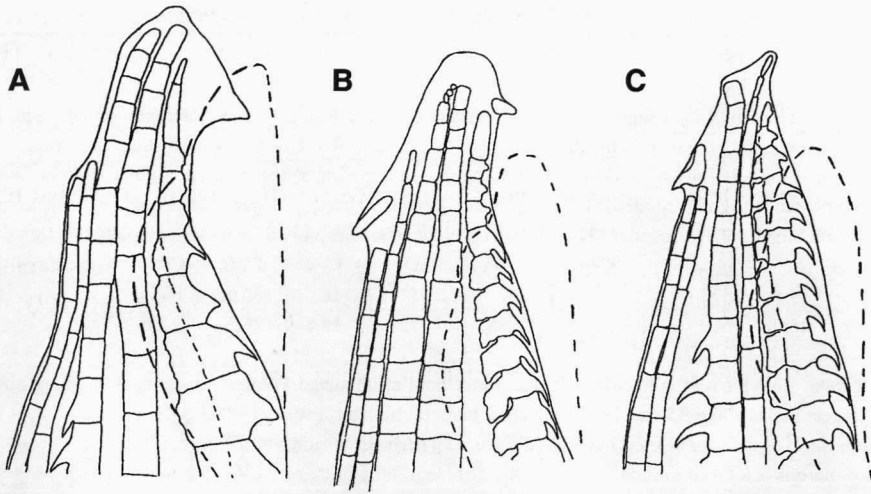


Figure 2. Gonopodia of the species described as new in this paper. A. *Poecilia koperi*; B. *P. boesemani*; C. *P. wandae*

Description of the types.- The lectotype is a mature male, 27.3 mm SL. It has 8 dorsal fin rays and 16 scales around the caudal peduncle. Several scales in the lateral series are missing and the caudal fin is damaged, so no further meristic data are given. Gonopodial ray 3 has a long terminal segment, the hood is short. An extremely short extrusion, like a small hook, is present. Gonopodial ray 4a is unmodified, ray 4p has eight distal segments unmodified, followed by serrated segments. Gonopodial ray 5a is one segment longer than 5p. Subdistal ventral modifications occur on ray 5a. The largest female paralectotype, 47.5 mm SL, has about 25 scales in a lateral series (this number is not accurate because some scales are missing). It has nine dorsal fin rays and nine anal fin rays, the caudal fin is damaged.

The specimens in the type series from Aruba are much smaller. The largest male, 22.0 mm SL, has a gonopodium like the lectotype, with seven distal unmodified segments on gonopodial ray 4p and no trace of a hook on ray 3. It has 8 dorsal fin rays, 16 scales around the caudal peduncle and about 24 scales in a lateral series (this number is not accurate because some scales are missing). The caudal fin is damaged. This male has a pigmented band basely in the dorsal fin and a pigmented humeral blotch. The largest female in this lot, 26.5 mm SL, has eight anal fin rays and nine dorsal fin rays. The caudal fin is damaged. 16 Scales are found around the caudal peduncle and 27 in a lateral series.

A detailed examination of 15 populations was made to establish morphometric and meristic variations. Some 12 lots were examined from Aruba, and three lots from Curaçao.

Distribution.- *Poecilia vandepolli* occurs naturally in all kinds of waters of the Netherlands West Indies (Aruba, Curaçao, and Bonaire). It is introduced on St. Maarten/St. Martin (Poeser, 1992).

Table I. Meristic and morphometric data on several populations of *Poecilia vandepolli***Aruba**

ZMA 100.600. The fish were caught in a small freshwater stream, Rooi Prins at 'Plantage Fontein'. The lot contains small specimens, of which the largest male (20.7 mm SL) has an unclear humeral spot. The gonopodium of this male is fully developed. The bodies are olive brown, without any additional pigmentation. Dorsal fin pigmentation lightly spotted, darker in males than in females. (Three additional small males are without a humeral blotch.) Eight females (22-31 mm SL), eight subadults and 30 juveniles complete this lot.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	19,4	575	175	-	8	16	25,5	15
Females	26,0	610	156	8,8	7,5	15,8	26,1	15,6

ZMA 100.606. This lot was collected in a freshwater pool at 'Plantage Fontein'. It contains medium sized specimens, largest males about 35 mm SL with a clear humeral blotch (at scale 5 of LLS) and a large dorsal fin that reaches the base of the caudal fin. The dorsal fin has a large anterior blotch at the base.

In this lot there is a total of six males with humeral blotch, all adults, of which two males do not possess a blotch, 14 females (30-48 mm SL), eight subadults and 30 juveniles.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	34,6	551	207	-	8,3	18	26,3	16
Females	43,3	613	173	9	8	16,4	26,5	16

ZMA 100.607 is a sample from a small pool of freshwater at 'Fontein Plantage'. Only one fully grown male (without blotch) is present, with one fully grown female. It further contains three subadults and five juveniles.

	SL	pred	CPd	A	D	C	LLS	CPS
Male	33,6	533	162	-	8	17	25	16
Female	41,9	616	159	9	8	17	27	16

ZMA 100.608, again from a small freshwater pool at 'Fontein Plantage'. Two males in this sample have a blotch, viz., the largest and the smallest males. One male is without blotch. One large female is present, together with one small female. 12 Juveniles.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	30,9	581	200	-	8	17	26,3	16
Females	34,0	611	170	9	8	16	27	15

ZMA 102.212. Pool at the well 'Rooi Prins'. Males in this lot have faded humeral blotches. The largest males have the dorsal fins to caudal base, with an anterior blotch at the base.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	30,6	588	180	-	8	16	26	16
Females	33,1	653	171	9	7,8	18	26	15,7

ZMA 120.413. 'Spaans Legioen'. 54 Small, dark specimens, of which 22 are males, 25 are females, six subadults and one juvenile. No characteristic coloration can be observed. Dorsal fins and anal fins are damaged.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	23,7	602	184	-	-	17,7	26,3	16
Females	26,4	607	177	-	-	16	25,7	15,7

ZMA 120.414. This lot is from 'Rooi Awa Marga', which is a slow stream. One small male with a completely developed gonopodium is present, with five small females and five juveniles.

	SL	pred	CPd	A	D	C	LLS	CPS
Male	16,0	563	163	-	8	16	25	16
Females	21,6	602	153	8	7	16,5	25,5	16

ZMA 120.415. Salinja master, caught at an abandoned saltpan (24 g Cl/l). the sample contains five males, three females, three subadults and 3 juveniles. The scales of these specimens are white and hard, probably caused by the high salinity.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	24,7	633	167	-	8	16	26	16
Females	25,8	627	149	9	7,5	15,5	26	16

ZMA 120.422. Salinja master, east. Again the abandoned saltpan (6 g Cl/l). Nine males, of which the two largest were very dark. These two specimens are not recorded in the table. 19 Females are found, of which one has many irregularly positioned spots. Eight subadults and four juveniles complete this lot.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	22,8	598	172	-	8	16	26	16
Females	23,3	638	149	8,7	8	15,7	26,5	15,8

ZMA 120.423. 'Bron Rooi Prins' pool. It contains sixteen males, twenty-three females and 4 subadults.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	31,0	606	187	-	8	16	25,3	16
Females	35,8	627	172	9	8	18	25,8	16

ZMA 120.425. 'Salinja Balashi'. 9 Males, fifty-eight females, eighteen subadults and 2 juveniles. This population has some extra-ordinary features. The population consists of more or less colorless specimens. The males are few in number, and one specimen seems of intermediary sex, i.e., does not have his gonopodium fully developed while being large enough. The other eight males are normally developed. Many females only have eight anal fins.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	22,0	562	187	-	8	16	25	16
Females	29,3	616	169	8,3	7,8	16,6	26,3	16

ZMA 120.437. 'Fontein pond'. Seven males, six females, five subadults and one juvenile.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	32,5	577	190	-	7,7	16,7	25,7	16
Females	27,5	626	144	9	8	16,7	27,5	16

Curaçao

ZMA 100.603. Zaquito. A note in bottle reads: males with orange-red dorsal fins, orange-red gill-areas, ventral sides and caudal fins. On the sides 3 to 6 rows of orange-red spots.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	30,7	510	168	-	8	16	25	14,5
Females	29,7	622	163	8,2	7,8	16	25,8	15

ZMA 123.465. 5 km SWS of Willemstad, from a tidal pool. The complete population was poisoned, and contains more males than females. 48 Males, of which some have more than one humeral blotch. All males are heavily pigmented, i.e., are speckled. Some have rows of black spots on the caudal peduncle. 36 Females, 3 subadults, 1 juvenile.

	SL	pred	CPd	A	D	C	LLS	CPS
Males	38,4	506	171	-	8	16	26,3	17,5
Females	39,4	581	155	8,9	7,9	16	26,6	16,9

ZMA 123.466. Hato. 127 mainly black or dark brown specimens.

	SL	pred	CPd	A	D	C	LLS	CPS
Male	31,3	474	180	-	8	16	26	17
Females	30,2	674	164	8,5	8	16	25,5	16

Averages of morphometric and meristic data

Aruba

	SL	pred	CPd	A	D	C	LLS	CPS
Males	26,8	580,8	181,2	-	8,0	16,5	25,7	15,9
Females	30,7	620,5	161,8	8,8	7,8	16,5	26,3	15,8

Curaçao

	SL	pred	CPd	A	D	C	LLS	CPS
Males	33,5	496,7	173,0	-	8,0	16,0	25,8	16,3
Females	33,1	625,7	160,7	8,5	7,9	16,0	26,0	16,0

Poecilia koperi, new species

Poecilia vivipara (non Bloch & Schneider, 1801); De Beaufort, 1940: 111.

Poecilia sphenops (non Valenciennes, 1846); Regan, 1913: 1013 (in part).

Poecilia sphenops vandepolli (non Van Lidth de Jeude, 1887); Schultz, 1949: 84, 97-99 (in part).

Poecilia sphenops cuneata (non Garman, 1895); Hubbs, 1926: 77

Holotype.- Adult male (Fig. 3a), UMMZ 223343, Venezuela, Rio Curipe at Higuero, coll. F.F. Bond, 2-V-1938.

Allotype.- Adult female, UMMZ 223344, same data as UMMZ 223343.

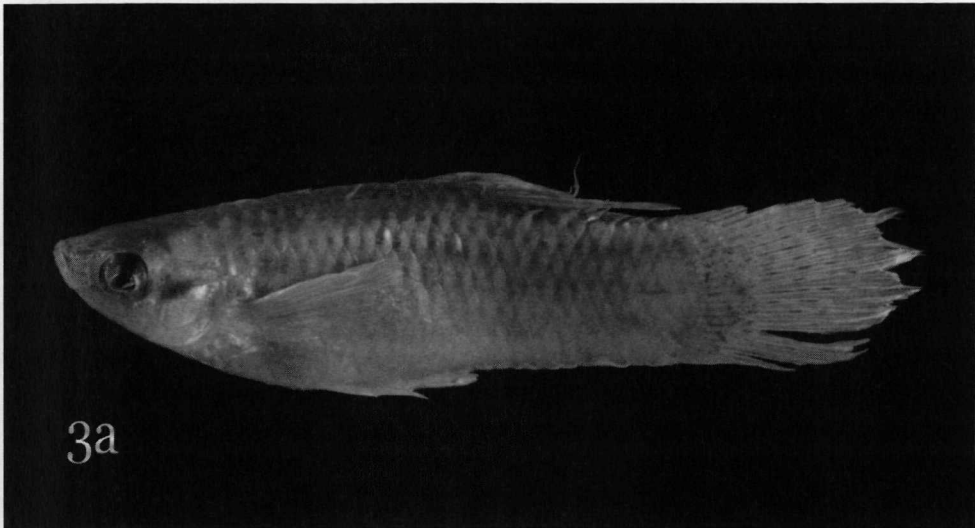


Figure 3a. Holotype of *Poecilia koperi*



Figure 3b. Allotype of *Poecilia koperi*

Material. BMNH 1909.2.25: 53-56 (5), Venezuela, coll. Arnold, no date; UMMZ 200738 (15 of 123), 2 km N of Ocumare, lagoon on flats near mouth of Rio Cumboto, coll. F.F. Bond, 5-I-1938; UMMZ 200740 (15 of 57), Rio Guaiguaza, 3 km W of Porto Cabello, 2 km from mouth of river, coll. F.F. Bond, 15-I-1938; UMMZ 200744 (12), Rio Sanchon, 5 km W of Tavorda, 10 km W of Porto Cabello, coll. F.F. Bond, 26-I-1938; UMMZ 200753 (15 of 430),

Lagunita, 5 km W of Coro, Estado Falcon, coll. F.F. Bond, 19-III-1938: UMMZ 200755 (15 of 115), Falcon, Laguna del Rio Capatárida, at mouth, 5 km N of Capatárida, coll. F.F. Bond, 2-III-1938; UMMZ 200760, (15 of 152), Falcon, Coastal lagoons, 15 km N of Maracaibo, coll. F.F. Bond, 6-IV-1938; UMMZ 200761 (13 of 202), same data as UMMZ 223343; UMMZ 200762 (15 of 80), Estado de Miranda, Lagunita de Tacarigua, at Tacarigua, 85 km E of Caracas on the coast, near the boca, coll. F.F. Bond, 3-II-1939; UMMZ 200764 (28), Boca del Rio Cumboto, 2 km NW of Ocumare; ZMA 109.206 (6), La Goajira, Rio Calancala, San Antonio, coll. P. Wagenaar- Hummelinck, 17-I-1937; ZMA 119.909 (30), Paraguana Estangue de Moruy, coll. P. Wagenaar- Hummelinck, 18-II-1937; ZMA 119.910 (15), Paraguana, Estangue de Santa Ana, coll. P. Wagenaar- Hummelinck, 16-II-1937; ZMA 120.885 (4), 2 km N of Barcelona, Rio Guanta, coll. P. Wagenaar- Hummelinck, 1936.

Colombia: BMNH 1899.3.15: 24-26, (2), Colombia, coll. H. Festa, no date.

Diagnosis. A. 8 (rarely 9); D. 8 (rarely 7); LLS. 25-26; BS. 18; CPS. 16; PS. 11-13

Poecilia koperi is a medium sized species of the *Poecilia sphenops* complex (cf. Miller, 1983), distinguished from *P. gillii cuneata* only by the reduced number of fin rays in the dorsal and anal fin. From the other subspecies of *P. gillii* it is distinguished by gonopodial characteristics.

Descriptions. *Poecilia koperi* has unicuspid inner teeth. The largest specimens examined are a female of 56.2 mm SL. and a male of 47.0 mm SL.

Holotype. Adult male, 38.5 mm SL. Body deep, sides depressed. Upper part of body with two dark horizontal rows of dark spots, less conspicuous ventrally. Body brown, dorsally darker than ventrally. Caudal fin with black spots, pigment on membrane between rays. Dorsal fin reaching caudal base, pigmented like caudal fin. Unicuspid inner teeth.

Meristic data: 26 scales in lateral series, 12 predorsal scales, 16 scales around caudal peduncle, and 18 scales around body. Pectoral fins with 16 rays, dorsal fin rays 8, caudal fin rays 17. Last segment gonopodial ray 3 with extruding spine (Fig. 2a), two subsequent segments without serrae, nine segments with ventral processes, other segments with serrae on both sides. Ray 4a without serrae, 4p with ten distal segments unserrated, followed by ten segments with dorsal serrae. Rays 5a and 5p without spines, seven segments shorter than 4p. Hood present, not reaching tip.

Allotype.- Adult female, 40.6 mm SL. Body with spots like holotype, fins with indistinct pigmentation. Dorsal fin short, reaching halfway from base of first ray to caudal fin base. Caudal fin rays 16, anal fin rays eight. Other counts like the holotype.

The gonopodium (Fig. 2a) is like the gonopodium of *P. gillii cuneata*. The fleshy hood nearly reaches the tip. Gonopodial ray 3 has two or three weakly serrated terminal segments. Other segments with ventral serrae and irregular dorsal extrusions. Membranous hook on the edge of the last segment. Gonopodial ray 4a is without serrae, with long segments. Gonopodial ray 4a possesses seven to eleven unserrated distal segments, others segments have dorsal serrae. This ray is somewhat shorter than ray 4a. Gonopodial ray 5a and 5p have long

unserrated segments, ending at fourth to seventh segment of ray 4p, counting from tip (Figure 2a).

Distribution. *Poecilia koperi* occurs in coastal areas from the Peninsula de Araya, Venezuela to the eastern part of Colombia (Fig. 1).

Etymology. This species is named after my friend Michel Koper, with whom discussions have helped to keep my thinking flexible.

Remarks. Two geographically separated color morphs exist in this species. The pigmentation of the body of specimens east of Coro consists of two or three horizontal rows of spots, which are less conspicuous ventrally. The body becomes darker dorsally, as opposed to the lighter ventral side. The unpaired fins are moderately pigmented, i.e., they only have spots on the membrane between rays. Dorsal fin reaches to the base of the caudal fin. The populations west of Coro (i.e., in the Maracaibo basin) are more intensely pigmented. The males have about 10 distinct vertical stripes from halfway the body to the caudal base. The scales on the body have pigmented margins. The base of the caudal fin is covered with scales, which are irregularly pigmented. The caudal fin has longitudinal spots, the dorsal fin has a median blotch from the base to halfway the fin, distally replaced by dark spots. The females are pigmented like the males, with fainter stripes on body. The fins in the females are without spots and the snout is less pointed. Meristic data and gonopodium are identical in the two populations, although Maracaibo populations never have seven dorsal fin rays, nor nine anal fin rays.

Schultz' (1949: 97) record of *P. vivipara*, partly based on de Beaufort's (1940) account, is partly erroneous; re-examination of the specimens mentioned by de Beaufort (1940: 111) in ZMA revealed that this material is *P. koperi*.

Poecilia boesemani, new species

Poecilia sphenops (non Valenciennes, 1846); Regan, 1913: 1013 (in part); Price, 1955: 18; Boeseman, 1960: 122.

Holotype.- RMNH 21543, adult male, Trinidad, Port of Spain, Maraval River, coll. M. Boeseman, 27-VII-1954.

Allotype.- RMNH 32428, adult female, same data as RMNH 21543.

Diagnosis. A. 8; D. 8-9; LLS. 27; BS. 20; CPS. 16; PS. 13-16. The meristic data differ from all examined South American species of *Poecilia*.

Description. *Holotype*: male, 43.8 mm SL. The body does not have a distinct pigmentation pattern. The dorsal fin is angular, with dark spots on the membranes between the rays. These spots form two regular horizontal lines. In the caudal fin, a vertical line of similar spots is found on the posterior part.



Figure 4a. Holotype of *Poecilia boesemani*



Figure 4b. Allotype of *Poecilia boesemani*

The dorsal fin has 10 rays, the caudal fin has 18 fin rays. Pectoral fin with 16 rays, 20 scales around the body, 16 scales around the caudal peduncle, 27 scales in a lateral series. The holotype misses one or two predorsal scales, so the exact number is unknown. All head pores are visible. The gonopodium is like *P. mexicana* (Fig. 2b, see Miller, 1975), i.e., with a spine in the membranous hook on gonopodial ray 3. Inner jaw teeth unicuspid or possibly subtricuspid (Garman, 1895; Miller, 1975).

The allotype is a female, 47.8 mm SL. The morphology and pigmentation are like in the holotype, without spots in the caudal fin. The anal fin has 8 rays, the dorsal fin contains 9 rays, the pectoral fin 13 rays. All other counts are identical to the those of the holotype.

Distribution. This species is known only from its type locality (Fig. 1).

Etymology. This species is named after Dr. Marinus Boeseman, emeritus curator of the ichthyological collection of the National Museum of Natural History, Leiden (RMNH), who collected the specimens.

Poecilia wandae, new species

Holotype.- USNM 121683, adult male, Venezuela, Maracaibo basin, hot spring, creek tributary to Rio Mechango, 20 km above bridge, coll. L.P. Schultz, 21-III-1942.

Allotype.- USNM 326142, adult female, same data as USNM 121683

Material. USNM 121669 (4), Cano, 1/2 mile W of Sinamaica, coll. L.P. Schultz, 11-III-1942; USNM 121670 (3), Rio Socuy, 3 km above mouth, coll. L.P. Schultz, 24-II-1942; USNM 121671 (42), Cienago del Guanavana, about 10 km N of Sinamaica, coll. L.P. Schultz, 11-III-1942; USNM 121672 (12), Rio San Juan, 12 km S of Rosario, coll. L.P. Schultz, 26-II-1942; USNM 121673 (1), Rio San Ignacio, about 20 km S of Rosario, coll. L.P. Schultz, 26-II-1942; USNM 121674 (1), Rio Negro, below mouth of Rio Yasa, coll. L.P. Schultz, 2-III-1942; USNM 121675 (27), Lago Tule, about 75 km W of Maracaibo, coll. L.P. Schultz, 1-III-1942; USNM 326143 (261), same data as USNM 121683.

Diagnosis. D. 5-7; A. 6- 8; C. (probably) 14-16; LLS. 24-26; PS. 11-13; BS. 16; CS. 14. This species is very much like *P. caucana*, differing in reduced meristic and gonopodial characteristics.

Description. *Poecilia wandae* is a small species, nuptial males ranging from 13 to 22 mm SL. Most specimens have a brownish body with 7 to 10 vertical stripes extending from caudal peduncle to halfway along the body. Sometimes a longitudinal stripe over lateral line. The dorsal fin has a median basal blotch and a black margin, whereas the other fins are unmarked. *Poecilia wandae* has an elongated body, with a compressed head. Females have fewer vertical stripes. Gonopodial ray 3 at the tip with 1 or 2 unserrated elements, all other segments of this ray are serrated on both sides (Fig. 2c). The fleshy hood reaches the tip. Gonopodial ray 4a has long, unserrated segments, with the last segment pointing downwards, while 4p has 7-8 square unserrated elements at the tip and last segment pointing upwards. The tip is split. Gonopodial rays 5a and 5p are unserrated and do not reach the tip. Gonopodial ray 5p has a retrorse spine, which is more weakly developed at the end of ray 5a.



Figure 5a. Holotype of *Poecilia wanda*



Figure 5b. Allotype of *Poecilia wanda*

Description of the types.- The holotype is a male, 20.6 mm SL. The body has seven vertical stripes, from the middle of the body to the middle of the caudal peduncle, in combination with a reticulate pigmentation pattern that is dorsally darker than ventrally. The dorsal fin reaches halfway from base of its last ray to base of the caudal fin. The caudal fin is clear, whereas the dorsal fin has a median basal blotch and has a dark margin. The allotype is a female, 23.1 mm SL. Pigmentation and scale counts are like the holotype. It has six dorsal fin rays and eight anal fin rays. The caudal fin is damaged.

The meristic data are like *P. caucana*. There are 25 scales in a lateral series, no more than 14 scales around the caudal peduncle and 16 scales around the body. Unfortunately, the caudal fins and the dorsal fins are damaged. *Poecilia wandae* resembles *P. caucana* also in gonopodial characters. Gonopodial ray 3 has the first two segments unserrated, all other segments serrated on both sides. The fleshy palp covers the tip. Gonopodial ray 4a has unserrated segments, with the last segment bending down. Gonopodial ray 4p with its seven distal segments unserrated. The last segment bends upwards, splitting the tip. Gonopodial rays 5a and 5p are unserrated, both do not reach the tip, and both have a spinous retrorse extremity. Proportional body measurements in Table I.

Distribution. This species is known from several river systems west of the Maracaibo basin (Fig. 1).

Etymology. This species is named after my Portuguese friend Vanda Marisa Freitas de Leite, who wishes to be called Wanda.

Remarks. Some specimens of the population from the Rio San Juan/Rio Negro drainage are pale, without any specific marking with the exception of two specimens. One female had a distinct black spot on the caudal base and another spot on the left side of the body under the dorsal fin. Another female had a similar spot on the left side at the upper margin of the caudal base. The number of specimens available was too limited to decide whether these latter populations are specifically distinct or only color morphs of *P. wandae*.

Discussion

The South American species of *Poecilia* inhabit mostly peripheral habitats, i.e., coastal areas or islands. *Poecilia sphenops* and *P. vandepolli* do not occur on the Venezuelan mainland (Poeser, 1992; present study), despite earlier reports (Schultz, 1949; Feltkamp and Kristensen, 1969). In the present paper seven species from the northeastern part of South America are recorded, of which one species, *P. gillii* (Kner and Steindachner, 1864), also occurs in Central America, and one species, *P. vivipara*, occurs from the Orinoco drainage and the Lesser Antilles to Argentina. The re-examination of the populations of *P. vandepolli* confirmed the variation in characters in this species, whereas examination of the Colombian and Venezuelan populations of mollies confirmed my earlier conclusions (Poeser, 1992) that the Venezuelan population are neither *P. sphenops* nor *P. vandepolli*. The third new species recorded in this paper is more related to *P. caucana*. Comparisons with Central American mollies revealed that, generally speaking, the species of *Poecilia* manifest a geocline in body size and a decrease in meristic characters from north to south. *Poecilia mexicana*, naturally occurring on the Atlantic side of Mexico, has unicuspid inner teeth, nine dorsal fin rays, nine anal fin rays, 18 scales around the caudal peduncle, and two spines at the tip of the gonopodium. Genetic data of *P. mexicana* from Vera Cruz, and of Costa Rican populations (labeled "*P. gillii*") are identical (Brett & Turner, 1983, p. 136: cluster map of NEI identity values). The reason to separate *P. mexicana* from *P. gillii* is the observation of Bussing (1987), who could tell them apart (see Appendix 3, key to the species). This observation is

supported indirectly by the descriptions given by Villa (1982), who also mentioned two unicuspid species, viz., one with about 27 scales in a lateral series, one with about 29 scales in a lateral series. Although 29 scales in a lateral series is not typical for *P. mexicana*, Bussing (1987) nevertheless considered these distinct populations as such. The alternative explanation would be that *P. gillii* is a subspecies of *P. mexicana*, and the specimens with 29 scales in a lateral series is another, possibly new, species. *Poecilia gillii* has been reported to obtain the size of over 100 mm SL (Bussing, 1987). In contrast to its variable body shape (cf. Meek, 1914, Meek and Hildebrand, 1916), the meristic data are fairly constant. From El Salvador (Poeser, 1995), through Nicaragua (Villa, 1982) and Costa Rica (Bussing, 1987) to Panama and Colombia (present study), it has nine anal fin rays, nine or ten dorsal fin rays, 16 scales around the caudal peduncle, and modally 27 scales in a lateral series. The only significant change in characteristics is a reduction of the spine found on gonopodial ray 5p. The disappearance of this noticeable character might be influenced by environmental agents, e.g., the change in water quality between Central America and South America. The body size of the investigated specimens was always much less than 100 mm SL.

The next species in the observed geocline is *P. koperi*. *Poecilia koperi* differs from *P. gillii* in the number of dorsal and anal fin rays (8 versus 9 in *P. gillii*). The reduction of gonopodial extremities is complete in *P. koperi*.

Table II. Geocline in meristic characters in *Poecilia*

Species	Range	A.	D.	CPS.	Gonopodial tip
<i>P. mexicana</i>	Atlantic coast from Texas to Costa Rica	9	9 or 10	18	spine on ray 3, 5
<i>P. gillii gillii</i>	Pacific coast from Guatemala to Panama	9	9 or 10	16	spine on ray 3, 5
<i>P. g. cuneata</i>	Panama and the Atlantic coast of Colombia	9	9 or 10	16	spine on ray 3
<i>P. koperi</i>	Colombia and Venezuela	8	8	16	spine on ray 3
<i>P. vivipara</i>	Venezuela to Argentina	8	7	16	no spines

The trend in reduction of meristic characters is continued in *P. vivipara*, which has 7 dorsal fin rays. In addition to this difference, *P. vivipara* has a median positioned humeral blotch and serrae on gonopodial ray 4a, unique characters in the subgenus. The seemingly smooth geocline is discontinuous in discontinuous areas, i. e., on islands. *Poecilia boesemani*, which occurs on Trinidad, has a reduced body size, less anal fin rays and less scales around the caudal peduncle than *P. mexicana*, whereas the number of dorsal fin rays and the gonopodial characters are similar. Price (1955: 7, 18) and Boeseman (1960: 122) presumed that *P. boesemani* was an introduced aquarium strain with the vernacular name 'Liberty molly'. *Poecilia boesemani* resembles western populations of *P. sphenops* in fin pigmentation and general morphology (Schultz and Miller, 1971). The inner jaw dentition, however, is unicuspid versus tricuspid in *P. sphenops*. *Poecilia boesemani* differs from most Central American species in the number of anal fin rays (8 versus 9 in the other species), in the number of scales around the caudal peduncle (mostly 18 in the other species) and in regard to female pigmentation (rows of black spots in *P. sphenops* and in *P. mexicana*). *Poecilia*

boesemani resembles *P. butleri*, another widely distributed Mexican species, in the number of anal fin rays; it differs in dorsal fin pigmentation (distinct basal blotch in *P. butleri* (cf. Schultz and Miller, 1971). Furthermore, *P. boesemani* and *P. butleri* are geographically the most separated species. *Poecilia boesemani* differs from *P. koperi* and *P. vandepolli* in the presence of distal spines on both gonopodial rays 3 and 5. Boeseman's (1960, p. 122) observation that "it lacks a distal retrorse segment on gonopodial ray 5", is erroneous (Fig. 4b). *Poecilia vandepolli*, occurring on the Dutch Lesser Antilles, also has a reduced body size, less dorsal fin rays, 16 scales around the caudal peduncle, and gonopodial characteristics like *P. vivipara*. It also has a humeral blotch, although it is found more anteriorly than in *P. vivipara*.

The observed geocline trend is abruptly pronounced in both *P. caucana* and *P. wandae*. *Poecilia wandae* is superficially like *P. caucana*, resembling it in scale counts, pigmentation and gonopodial structures. It differs in the number of anal fin rays (always 8 in *P. caucana*), dorsal fin rays (7 or 8 in *P. caucana*), and in the absence of a membranous hook on gonopodial ray 3. The gonopodia of both species agree in several internal structures (Rosen & Bailey, 1963: 62, fig. 25B), confirming their relationship. Rosen & Bailey (1963) reported that this 'undescribed species', viz., *P. wandae*, is osteologically like *P. caucana*, as well as the Hispaniolan species of *Poecilia*, viz., *P. elegans*, *P. dominicensis* and *P. hispaniolana*, and "the smaller species of the *P. sphenops* group". Unfortunately, they did not specify which species in the *P. sphenops* group they referred to. This observation suggests that the osteological evidence represent a primitive state. Furthermore, from their gonopodial structures it was suggested that *P. caucana* is related to the species of *Limia* of Hispaniola, and to the Central South American species of *Pamphorichthys* (Rosen, 1975; Rauchenberger, 1989). This places the origin from an ancestral species of *P. caucana* and *P. wandae* in South America at 80 to 70 Mya. (Pitman et al., 1990: fig. 2.5C). During this period, Hispaniola was situated between North and South America, as part of the great Arc of Proto-Greater Antilles. Members of the genus *Poecilia* probably also entered South America after the completion of the Andean uplift and the formation of the Panamanian Landbridge, i.e., about 4 Mya. (Pitman et al., 1990: fig. 2.5 F). However, the morphological differences, i.e., the diversion from the "molly-geocline", osteological and gonopodial characteristics linked these two species with Hispaniolan and South Brazilian species, suggest a separate status for *P. caucana* and *P. wandae*. The overall similarities in gonopodial structures, however, warrant their present inclusion in *Poecilia*.

Venezuela is divided into four distinct biogeographical regions, viz., the Maracaibo basin, Trinidad, the drainage of the Rio Orinoco, and the islands of the Lesser Antilles. Only two species occur in more than one district, viz., *P. caucana* (along the Atlantic coast from Panama to the delta of the Rio Orinoco) and *P. reticulata* (which is absent from the Maracaibo district northward). In the Rio Orinoco, *P. picta* and *P. vivipara* have their northernmost mainland extension. *Poecilia vandepolli* and *P. boesemani* are endemic species on islands of the Lesser Antilles. They seem relict populations, captured probably during a

recent glacial period when the sea level was lowered and an ancestral species could colonize the islands, now known as the Lesser Antilles. *Poecilia wanda*e may have originated from an endemic form of *P. caucana* from Lake Maracaibo. As stated above, meristic characters in *P. koperi* link between the *P. sphenops* species group in Central America (formerly the genus *Mollienesia* LeSueur, 1821, sensu Regan [1913]) and *P. vivipara* (*Poecilia* s. s.).

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