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Revision of the American *Pupisoma* species (Gastropoda: Pupilloidea)

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Abstract

The American species of *Pupisoma* Stoliczka (Gastropoda: Pupilloidea) are revised. Five species are recognized. *Pupisoma puella* Hylton Scott has been synonymized with *P. dioscoricola* (C. B. Adams). This species occurs from southern USA through the Caribbean and Central America to the Galapagos Islands and to southern Brazil and northern Argentina. *Pupisoma galapagorum* Pilsbry, *P. bailyi* Pilsbry, and *P. latens* Hylton Scott have been synonymized with *P. comicolense* H. B. Baker. This species is distributed from Mexico to the Galapagos Islands, southern Brazil, and northern Argentina. *Pupisoma costulata* sp. n. from Andean forests in Colombia is described as new. The range of *P. macneilli* (Clapp) extends from southern USA through the Caribbean and Central America to southern Brazil and northern Argentina. A neotype has been designated for *P. mediamericanum* Pilsbry. *Pupisoma michoacanense* Pilsbry is a synonym of this species. This species occurs from Mexico to Colombia and on Jamaica.

Keywords: America, distribution, Gastropoda, Pupilloidea, *Pupisoma*, systematics

Introduction

Pupisoma Stoliczka, 1873 is a circumtropical genus of usually arboreal species. The higher systematics of the Pupilloidea and, hence, the systematic position of *Pupisoma* is uncertain. *Pupisoma* has been placed in the Vertiginidae (Pilsbry 1920, 1935; Baker 1935a), Valloniidae (Thiele 1931; Zilch 1959; Falkner 1974; Schileyko 1998) or in a separate family (Iredale 1940). None of these classifications is based on a phylogenetic analysis.

The taxonomy and distribution of the American *Pupisoma* species have been revised and summarized by Pilsbry (1920). Later, additional taxa have been described by Baker (1928), Pilsbry (1934), and Hylton Scott (1960). The anatomy of some of the American *Pupisoma* species has been examined by Baker (1928) and Tillier (1980).

With the exception of *Pupisoma dioscoricola* (C. B. Adams, 1845), the most widespread species, only a few records have been published, although some species are common from southern USA to southern Brazil and northern Argentina. In the following study, the American *Pupisoma* species are revised and their distribution is summarized.

Material and methods

The material on which this study is based is kept in the following collections: Academy of Natural Sciences, Philadelphia (ANSP); Field Museum of Natural History, Chicago (FMNH); Florida Museum of Natural History, Gainesville (FLMNH); Museu de Zoologia da Universidade de São Paulo (MZUSP); Nationaal Natuurhistorisch Museum, Leiden (NNM); Senckenberg-Museum, Frankfurt a. M. (SMF); Universidad Nacional de Colombia, Instituto de Ciencias Naturales, Santafé de Bogotá (UNAL); Zoologisches Museum der Universität Hamburg (ZMH).

If geographical coordinates were not specified on the labels of the material, they were usually taken from the databases of the US Board on Geographic Names, namely data of localities in the USA from the Geographic Names Information System (<http://geonames.usgs.gov/domestic/index.html>) and data of localities elsewhere from the GEONet Names Server (<http://gnswww.nga.mil/geonames/GNS/index.jsp>).

The counting of shell whorls (exactness 0.25) follows Kerney and Cameron (1979, p 13). The measurements were taken with an ocular micrometer (precision 0.05 mm). Morphometric similarities between the measured specimens were visualized with principal component analysis (PCA) on the correlation matrix with varimax rotation using SPSS 13.0.

Systematics

Pupisoma Stoliczka, 1873

Pupisoma Stoliczka 1873, p 32. Type species (by original designation): *Pupa lignicola* Stoliczka, 1871.

Diagnosis

Shell ovate, globose-conical or conical; apex obtuse; aperture truncate-rounded, usually edentate, rarely with a short parietal lamella and a low columellar tooth; peristome slightly or not expanded, not thickened; columellar margin dilated; umbilicus usually narrow.

Remarks

Pilsbry (1920) divided *Pupisoma* into three groups, *Pupisoma* sensu stricto including the species with ovate, pitted-granose shells, an unnamed group including the species with globose-conic, pitted-granose shells, and *Ptychopatula* including the species with globose-conic shells with spiral lines. Falkner (1974) included the second group into *Ptychopatula* because of the similar shell shape. Tillier (1980) separated *Ptychopatula* as a distinct genus because the male copulatory organs of *P. dioscoricola*, the type species of *Ptychopatula*, are “reduced” and its kidney is shorter than in *P. comicolense* H. B. Baker and *P. mediamericanum* Pilsbry (see Baker 1928), which belong to Pilsbry’s (1920) second group. Schileyko (1998) separated *Ptychopatula* also as a distinct genus for the “turbinate” species, but mentioned neither the spiral lines of the shell nor the supposedly diagnostic anatomical characters. He figured *P. bailyi* Pilsbry, which does not have spiral lines and which is here considered a synonym of *P. comicolense*, as a *Ptychopatula*, but listed *P. comicolense* and *P. mediamericanum* as *Pupisoma* sensu stricto species. He erroneously synonymized *Imputepla* Iredale, 1937 and *Parazoogenetes* Habe, 1956 which are based on species with distinct spiral

lines that are usually considered to belong to *Ptychopatula* (see e.g. Vermeulen and Raven 1998) with *Pupisoma* sensu stricto. Moreover, the appendix of *P. orcula* (Benson, 1850), the type species of *Parazoogenetes*, is also smaller than in *P. comicolense* and *P. mediamericanum* and also has no retractor muscle (Habe 1956).

The relationships of the second group of Pilsbry's classification, which includes the American species with the exception of *P. dioscoricola* (C. B. Adams), are still uncertain. They should not be included in *Ptychopatula*, because they differ from that group in having a large penial appendix with retractor (Baker 1928) and in the absence of distinct spiral lines (the long kidney of *P. comicolense* and *P. mediamericanum* should not be overvalued, because it might simply be a consequence of the higher whorl count of these species; the kidney of *P. macneilli* (Clapp) might be shorter). Whether they are closely related to the Old World *Pupisoma* sensu stricto species which are anatomically unknown is questionable. An alternative possibility would be that *Pupisoma* is polyphyletic and that the American group is neither related to *Pupisoma* sensu stricto nor to *Ptychopatula*, but is closely related to the American *Bothriopupa* Pilsbry which it resembles except in the lack of dentition of the aperture (see Pilsbry 1920). Because of these uncertainties *Pupisoma* is retained preliminarily in the wide sense.

***Pupisoma (Ptychopatula)* Pilsbry, 1889**

Ptychopatula Pilsbry 1889a, p 191. Type species (designated by Pilsbry 1889b, p 62): *Helix caeca* Guppy, 1868 (= *Helix dioscoricola* C. B. Adams, 1845).

Imputepla Iredale 1937, p 305. Type species (by original designation): *Helix circumlitum* Hedley, 1897.

Parazoogenetes Habe 1956, p 111. Type species (by monotypy): *Helix orcula* Benson, 1850.

Diagnosis

Shell with distinct spiral lines and penis with small appendix without retractor.

***Pupisoma (Ptychopatula) dioscoricola* (C. B. Adams, 1845)**

(Figures 1, 2, 6)

Helix dioscoricola C. B. Adams 1845, p 16.

Helix punctum Morelet 1851, p 9.

Helix caeca Guppy 1869, p 241.

Pupisoma americanum Möllendorff 1899, p 91 [partim].

Pupisoma dioscoricola insigne Pilsbry 1920, p 39, Plate 4 Figures 6–8.

Pupisoma puella Hylton Scott 1960, p 29, Figures 7–9.

Helix -: Binney 1884, p 113, Plate 5 Figure L (according to Pilsbry 1920, p 37).

Helix dioscoricola: L. Pfeiffer 1848, Plate 30 Figures 29–32; L. Pfeiffer 1849, p 240.

Helix (Comulus) dioscoricola: Tryon 1886, p 174, Plate 53 Figures 46, 47.

Microphysa (?) *dioscoricola*: Binney 1890, p 196, Plate 2 Figure 5, Plate 3 Figure 6.

Thysanophora dioscoricola: Pilsbry 1894, p 57; Dall and Simpson 1901, p 379; Pilsbry and Brown 1910, p 517; Hinkley 1920, p 39.

Pupisoma dioscoricola: Pilsbry 1920, p 36, Plate 4 Figures 1–5; Vanatta 1923, p 66, 67, 69; Pilsbry 1926a, p 103; Vanatta 1928a, p 21; Baker 1935b, p 88; Goodrich and van der Schalie 1937, p 30; Pilsbry 1948, p 1007, Figure 528(1–5); van der Schalie 1948, p 37, Map 13; Hylton Scott 1960, p 25, Figures 1, 2; Wilson 1960, p 137; Burch 1962, p 49, Figure 90; Branson and McCoy 1963, p 108; Thompson 1967, p 232; Smith 1971, p 7;

Quintana 1982, p 73; Hubricht 1985, p 12, Map 98; Ramirez 1991, p 5; Correa Sandoval 1997, p 138, 140; Pérez and López 2002, p 100, Plate 15; Pérez and López 2003, p 417.

Pupisoma (Ptychopatula) dioscoricola: Haas 1937, p 10, Plate 1 Figure 24 [partim]; Haas 1960, p 16 [partim]; Baker 1961, p 33; Chase and Robinson 2001, p 42.

Ptychopatula dioscoricola: Paul and Donovan 2005, p 120, Figure 7a, Plate 25 Figures 1, 3, 4.

Helix punctum: Fischer and Crosse 1872, p 228, Plate 12 Figure 1; Martens 1892, p 131, Plate 7 Figure 3.

Helix (Microconus) punctum: Tryon 1887, p 53, Plate 9 Figure 7.

Thysanophora punctum: Pilsbry 1894, p 57.

Helix caeca: Dall 1889, p 25, Plate 1 Figure 9; Suter 1900, p 335, Plate 3 Figures 1–3.

Helix (Acanthinula) caeca: Tryon 1887, p 55, Plate 9 Figure 23.

Patula (Ptychopatula) caeca: Pilsbry 1889a, p 200; Pilsbry 1889b, p 62.

Thysanophora caeca: Pilsbry 1894, p 57, Plate 16 Figure 4; Baker 1914, p 632; Clapp 1918, p 75, Plate 8 Figure 3; Lange de Morretes 1949, p 136.

Thysanophora dioscoricola caeca: Rhoads 1899, p 45.

Pupisoma dioscoricola insigne: Baker 1925, p 2; Pilsbry 1926b, p 78; Vanatta 1928b, p 66; Bequaert and Clench 1936, p 65; Arias 1955, p 160; Basch 1959, p 12; van Regteren Altena 1960, p 49; Correa Sandoval, García-Cubas Gutiérrez and Reguero Reza 1998, p 14; Correa Sandoval 2000, p 8; Correa Sandoval and Rodríguez Castro 2002, p 235; Correa Sandoval 2003, p 512; Correa Sandoval and Salazar Rodríguez 2005, p 59.

Ptychopatula dioscoricola insigne: Tillier 1980, p 54, Figures 45, 46, 49–52.

Pupisoma puella: Quintana 1982, p 74

Pupisoma (subgenus?) *minus*: Haas 1960, p 16, Plate 1 Figure B [non Pilsbry 1920].

Pupisoma minus: Oliveira and Almeida 1999, p 20, Figure [non Pilsbry 1920].

Type material examined

Pupisoma dioscoricola insigne Pilsbry: lectotype (design. Baker 1962, p 11): USA, Texas: Brownsville, 25°54'N, 97°30'W (ANSP 109013); paralectotypes: Mexico, San Luis Potosí: Valles Falls, 22°01'N, 99°04'W (ANSP 141390); Choy cave, 22°18'N, 99°05'W (ANSP 141391 partim).

Pupisoma americanum Möllendorff: lectotype (design. Haas 1937, p 10): Ecuador, Azuay: Cuenca, 2°53'S, 78°59'W (SMF 10697); paralectotypes: Ecuador, Azuay: Cuenca, 2°53'S, 78°59'W (SMF 10698 partim).

Other material examined

Mexico, Coahuila: 10 km SW of Zaragoza, 1100 m altitude (alt.), 28°N, 100°W (FLMNH 211796). Tamaulipas: Sabinas, 23 km NNW of El Limón, 60 m alt., 23°01'N, 99°05'W (FLMNH 159224); Sierra Cucharas, 10 km W of Gomez Farias, 960 m alt., 23°03'01"N, 99°12'30"W (FLMNH 190999 partim); 1 km WNW of Esperanza, 300 m alt., 23°38'N, 98°21'36"W (FLMNH 317136); Salto Del Tigre State Park, 30 km W of Santa Engracia, 350 m alt., 23°59'54"N, 99°20'48"W (FLMNH 317093); Sierra De Tamaulipas, 7 km NW of Piruli, 350 m alt., 23°N, 98°W (FLMNH 189710 partim); 9 km W of Gomez Farias, 700 m alt., 23°N, 99°W (FLMNH 200155). San Luis Potosí: Tamazunchale, 21°16'N, 98°47'W (FLMNH 35460); Ciudad Valles, 21°59'N, 99°01'W (FLMNH 40040); 6 km W of El Naranjo, 340 m alt., 21°N, 98°W (FLMNH 200115 partim). Queretaro: 2 km E of

Jalpan, 780 m alt., 21°12'59"N, 99°27'38"W (FLMNH 200731). Hidalgo: 5 km SE of Pas Flores, 340 m alt., 20°N, 99°W (FLMNH 268668 partim). Veracruz-Llave: 5 km ENE of Cuauhtémoc, 75 m alt., 17°06'59"N, 94°51'10"W (FLMNH 211354); 1 km NW of Atoyaquillas, 7 km NNW of Paraje Nuevo, 750 m alt., 18°N, 96°W (FLMNH 190939 partim); Cerro de Las Palmas, 1 km E of Berlin, ca 4 km N of Cordoba, 980 m alt., 18°N, 96°W (FLMNH 190859 partim). Puebla: 1.6 km NE of Chietla, 1400 m alt., 18°31'N, 98°35'W (FLMNH 35458); Tepexic near Necaxa, 675 m alt. (ANSP 256459, voucher to Baker 1930); below Necaxa, 900 m alt., 20°13'N, 98°00'W (ANSP 256460, voucher to Baker 1930). Tabasco: Teapa, 17°33'N, 92°57'W (FLMNH 35455). Yucatán: Tikúl, 20°24'N, 89°32'W (FLMNH 19412, voucher to Thompson 1967). Guerrero: 1.3 km N of Playa Majahua, 50 m alt., 17°47'58"N, 101°44'11"W (FLMNH 200185); 2 km NNE of Punto Troncones, 50 m alt., 17°N, 101°W (FLMNH 211721); 5 km E of Naranjito, 480 m alt., 18°04'18"N, 101°48'52"W (FLMNH 200683); 2 km E of Naranjillo, 430 m alt., 18°04'32"N, 101°45'33"W (FLMNH 200672 partim); 3 km E of Naranjillo, 350 m alt., 18°N, 101°W (FLMNH 211741 partim). Oaxaca: Bosque Natural de Temascal, 1 km SW of Cedral, 100 m alt., 18°23'N, 96°29'W (FLMNH 159487 partim); 1.5 km SE, 1 km NE of La Selva Uno, 100 m alt., 18°26'28"N, 96°30'10"W (FLMNH 200483 partim).

Bahamas: San Salvador Island, French Bay Pier, S coast, 11.1 km SSW of Cockburn Town, 4 m alt., 24°N, 74°W (FLMNH 246602); Little Abaco Island, 0.4 km E of Foxtown, 26°N, 77°W (FLMNH 39155 partim).

Cuba: La Estrella Morro, 20°06'N, 75°55'W (FLMNH 138749); Cárdenas, 23°02'N, 81°12'W (ANSP 160512).

Jamaica: Mandeville, 18°02'N, 77°30'W (ANSP 101399, voucher to Pilsbry and Brown 1910); Stony Hill, Saint Andrew 18°05'N, 76°48'W (ANSP 104491, voucher to Pilsbry 1920); 0.5 km W of Troy, 427 m alt., 18°15'N, 77°37'W (FLMNH 116008); 1.2 km N of Good Hope House, 100 m alt., 18°25'N, 77°41'W (FLMNH 210130 partim); Montego Bay, 18°28'N, 77°55'W (ANSP 101398, voucher to Pilsbry 1920); Orange Hill, Montego Bay (ANSP 104493, voucher to Pilsbry 1920).

Haiti: 2 km W of Saud d'Eau, 440 m alt., 18°N, 73°W (FLMNH 32776); San Lorenzo, S side of Samana Bay, 19°10'N, 73°00'W (ANSP 44672).

Dominican Republic: Bani, 65 m alt., 18°20'N, 70°23'W (FMNH 175643, 175649); Cambita near San Cristobal, 35 m alt., 18°27'N, 70°12'W (FMNH 175616, 175651); Medina near San Cristobal, 18°32'N, 70°08'W (FMNH 175648); Villa Trina near Boca (FMNH 175644).

Puerto Rico: canyon of Rio Grande de Arecibo, about 10 miles S of town (ANSP 256069, voucher to Baker 1961); Island of Vieques, 18°N, 65°W (ANSP 982, voucher to Tryon 1886).

Virgin Islands: St Thomas Island, Nadir Estate, 0.3 km SW of junction of Highways 30 and 32, 18°19'N, 64°52'W (FLMNH 119889).

Netherlands Antilles: St Eustatius Island, Base of White Wall, 17°N, 62°W (FMNH 64300, voucher to Haas 1960).

Belize: Vaca Plateau, Caracol Archeological Monument, 600 m alt., 16°45'48"N, 89°06'06"W (FLMNH 198424 partim); 10 km SE of Benque, 300 m alt., 16°59'48"N, 89°04'24"W (FLMNH 207355 partim); 0.8 km NE of Benque Viejo del Carmen, 100 m alt., 17°30'00"N, 89°08'18"W (FLMNH 146324 partim); 5.4 km W of Nuendorf, 100 m alt., 17°N, 88°W (FLMNH 207203).

Guatemala: 2.5 km NE of Puente Chixoy, 810 m alt., 15°21'32"N, 90°39'10"W (FLMNH 189992 partim); 8 km SE of Lanquin, 350 m alt., 15°32'43"N, 89°56'49"W

(FLMNH 190121 partim); 4 km W of Lanquin, 330 m alt., 15°34'37"N, 90°01'06"W (FLMNH 190098 partim); 2 km WNW of Lanquin, 300 m alt., 15°34'38"N, 89°59'19"W (FLMNH 190074 partim); 10 km NNW of Camajo Grande, 680 m alt., 15°41'27"N, 91°55'58"W (FLMNH 190439 partim); 2 km SW of Nenton, 600 m alt., 15°47'52"N, 91°45'42"W (FLMNH 190480 partim).

Honduras: Choluteca, 13°18'N, 87°11'W (FLMNH 34841 partim); Silca, 600 m alt., 14°48'37"N, 86°32'32"W (FLMNH 212213 partim); Agua Azul, 1300 m alt., 14°55'N, 87°58'W (FLMNH 34833); Magua Cave, 15 km SSW of Gualaco, 940 m alt., 14°56'30"N, 86°07'30"W (FLMNH 194342 partim); 5 km NNW of Rio Tinto, 2 km NNE of Campo Nuevo, 500 m alt., 14°57'08"N, 85°42'35"W (FLMNH 194503, 212139 partim); 20 km NE of Copán, Rio Maria, 640 m alt., 14°N, 87°W (FLMNH 221035); 0.5 km SE of Cerron, 28 km SW of Villanueva, 350 m alt., 15°10'15"N, 88°06'27"W (FLMNH 224407); 24 km E of Jocón, 260 m alt., 15°22'08"N, 86°59'36"W (FLMNH 212052); 2.6 km SW of La Brea, 100 m alt., 15°45'39"N, 86°00'08"W (FLMNH 211988 partim); 7 km ENE of La Brea, 100 m alt., 15°N, 85°W (FLMNH 221338 partim); 11.5 km SW of Francia, 50 m alt., 15°N, 85°W (FLMNH 221435); 21 km WSW of Olanchito, 150 m alt., 15°N, 86°W (FLMNH 221208 partim); 13.6 km NE of Jocón, 260 m alt., 15°N, 86°W (FLMNH 221269); Roatán Island, 1.6 km E of West Bay Beach, 100 m alt., 16°16'54"N, 86°35'29"W (FLMNH 224534 partim); Roatán Island, 2.5 km N, 3.0 km E of Oak Ridge, 250 m alt., 16°24'53"N, 86°20'24"W (FLMNH 224483);

Nicaragua: 4 km N of Masatepe, 733 m alt., 11°N, 86°W (FLMNH 34828 partim); 4 km SSW of Tuma, 700 m alt., 13°N, 85°W (FLMNH 34831 partim, 34834).

Costa Rica: 14.1 km S of Palmar Norte, 233 m alt., 8°N, 83°W (FLMNH 34838); Turrialba, 667 m alt., 9°54'N, 83°41'W (FLMNH 34836); Santa Ana, 1433 m alt., 9°56'N, 84°11'W (FLMNH 34821 partim); San Isidro del General, 2100 m alt., 9°59'N, 84°01'W (FLMNH 34837 partim); 0.8 km NNW of Colonia Carmona, 10°00'N, 85°15'W (FLMNH 34820); Puerto Jesus, 10°07'N, 85°16'W (FLMNH 34807 partim); Nicoya, 10°09'N, 85°27'W (FLMNH 34829); Santa Cruz, 10°16'N, 85°35'W (FLMNH 34822); La Lola, 47.2 km W of Limón, 10°N, 83°W (FLMNH 34835 partim); 16.7 km ESE of Santa Cruz, 10°N, 85°W (FLMNH 34830); 11.7 km E of Bahia Tamarindo, 10°N, 85°W (FLMNH 34827 partim); 4.2 km S of Nicoya, 10°N, 85°W (FLMNH 34812); 10 km S of Nicoya, 10°N, 85°W (FLMNH 34819); La Lola, 47.2 km W of Limón, 10°N, 83°W (FLMNH 34835 partim).

Panama: Tonosi, 7°24'N, 80°27'W (ANSP 162450); Capira, 8°45'N, 79°53'W (FMNH 63723 partim); Pedro Miguel, 9°01'N, 79°37'W (ANSP 161817; FMNH 63722); Juan Mina, 9°10'N, 79°39'W (ANSP 45261; FMNH 63721, vouchers to Pilsbry 1926a); Allee Creek, Barro Colorado, 9°N, 79°W (FMNH 73509).

Colombia, La Guajira: La Goajira Peninsula, 2 km S of Rio Hacha, 11°N, 72°W (FMNH 296624).

Venezuela, Lara: 3.7 km E and 4.7 km N of Tamaca, 680 m alt., 10°N, 69°W (FLMNH 133190). Carabobo: 2 km S of Borburata, 100 m alt., 10°26'00"N, 67°58'16"W (FLMNH 246509); 2 km N of Petanemo, 10 m alt., 10°27'13"N, 67°55'12"W (FLMNH 246502 partim).

Trinidad and Tobago, Tobago Island: 1 km S of Crown Point Airport, 10 m alt., 11°08'55"N, 60°50'13"W (FLMNH 226690); Union Village, 80 m alt., 11°12'23"N, 60°45'14"W (FLMNH 226801); 0.9 km NE Belle Garden, 30 m alt., 11°14'01"N, 60°35'46"W (FLMNH 226771); 3.7 km NE of Roxborough, 280 m alt., 11°16'25"N, 60°35'15"W (FLMNH 226730). Trinidad Island: 5.0 km SSW of Fyzabad, Morne Daisy

Village, 10 m alt., 10°11'54"N, 61°35'15"W (FLMNH 227142); Point Radix, 7.0 km NE of Mayaro (Pierreville), 3 m alt., 10°20'11"N, 60°59'23"W (FLMNH 226909 partim); St Augustine, 10°39'N, 61°24'W (FMNH 65415, voucher to Haas 1960); Port of Spain, 10°39'N, 61°31'W (ANSP 140635); Point Gourde, 110 m alt., 10°40'23"N, 61°37'47"W (FLMNH 226490); 8.1 km ENE of Maraval, near Contaro, 100 m alt., 10°42'58"N, 61°28'38"W (FLMNH 226253); 1.1 km S Santa Cruz, 100 m alt., 10°43'06"N, 61°28'39"W (FLMNH 227218); 2.0 km NE La Platonía, Gasparillo Village, 100 m alt., 10°43'33"N, 61°27'36"W (FLMNH 227188); Trinidad (SMF 150031, 259325).

Suriname: Tambaredjo, 5°50'N, 55°33'W (NNM, voucher to van Regteren Altena 1960).

Brazil, Amazonas: Manaus, 03°07'S, 60°02'31"W (ANSP 139135, voucher to Pilsbry 1926b). Ceará: Serra de Baturité, 4°15'S, 39°05'W (ANSP 109342, voucher to Baker 1914). São Paulo: São Paulo, 23°32'S, 46°37'W (ANSP 141386, voucher to Pilsbry 1920). Rio Grande do Sul: Taquara del Mundo novo, 29°39'S, 50°47'W (SMF 55285 partim).

Argentina, Salta: Lumbreira, 25°14'S, 64°50'W (FMNH 216318). Tucumán: San Miguel de Tucumán, park of the institute M. Lillo, 430 m alt., 26°49'S, 65°13'W (SMF 164128, 275438 partim).

Shell (Figures 1, 2)

Globose-conical; apex obtuse; body whorl with unequal growth lines crossed by fine incised spiral striae, sometimes with additional low riblets; upper whorls irregularly granulated; corneous; shining; subtranslucent; 2.5–3.25 inflated whorls separated by a deep suture; body whorl slightly descending towards the aperture, basally rounded; aperture truncate-rounded, edentate; peristome neither expanded nor reflexed nor thickened; columellar margin triangularly dilated, more or less covering the narrow umbilicus. Shell measurements and ratios are listed in Tables I and II.

Remarks

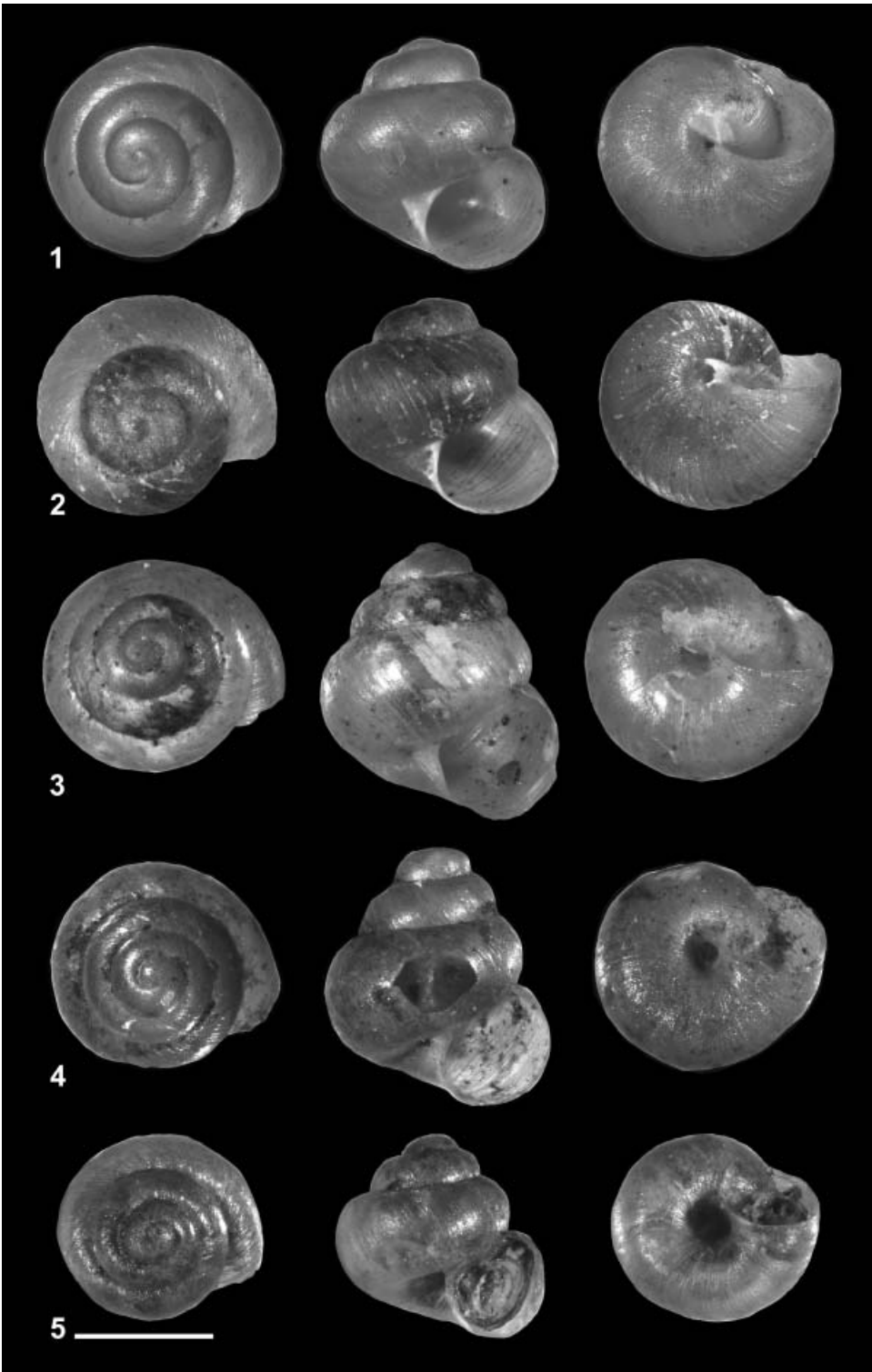
Pupisoma dioscoricola can easily be distinguished from the other American *Pupisoma* species by its distinct spiral striae and its larger first whorls.

Möllendorff (1899) and Haas (1937) failed to note that there are two species among the type series of *P. americanum* Möllendorff, 1899. The lectotype designated by Haas (1937) and some of the paralectotypes belong to the form of *P. dioscoricola* with distinct riblets, later called *P. dioscoricola insigne* Pilsbry, 1920, the other paralectotypes belong to *P. macneilli*. Specimens with distinct riblets occur scattered throughout the range of *P. dioscoricola* and sometimes even sympatrically with the typical form. Therefore, the form with distinct riblets cannot be considered a geographical subspecies.

Pupisoma puella Hylton Scott, 1960 was based on a single specimen which differs from *P. dioscoricola insigne* supposedly in the more regular spacing of the riblets. Hylton Scott (1960) separated *P. puella* from *P. dioscoricola insigne* mainly because of the great distance between the type locality of the latter in Texas and the occurrence of the former in Argentina. However, specimens with distinct riblets occur also in the intervening regions, e.g. also in Guyana and Ecuador. There is no reason to consider *P. puella* to be specifically distinct.

The anatomy of *P. dioscoricola* has been described by Tillier (1980).

The specimens recorded as *P. dioscoricola* from Dog Island by Haas (1960) do not belong to *Pupisoma*.



Pilsbry (1920) has already questioned whether *P. orcula* (Benson, 1850), that is distributed throughout the Old World tropics from Africa to East Asia, Australia and even to some Pacific islands, can be separated from the American *P. dioscoricola* (see also Solem 1989). A comparison of American specimens with material from Africa also did not reveal any conchological differences. Thus, *P. orcula* (Benson, 1850) can be considered a synonym of *P. dioscoricola* unless future genetic studies show that Old World and New World populations form separate units.

Distribution (Figure 6)

Pupisoma dioscoricola is a circumtropical species (given that *P. orcula* is a synonym). *Pupisoma dioscoricola* originated probably in the Old World, because all other *Ptychopatala* species are restricted to the Old World tropics. However, given its wide distribution in the Americas, it is unlikely that *P. dioscoricola* has been introduced into the New World only by humans.

Pupisoma dioscoricola is one of the most widespread snails in tropical and subtropical America occurring from the southern USA through the Caribbean and Central America to the Galapagos Islands and to southern Brazil and northern Argentina. It is most frequent in lowland forest, but has been found up to 2100 m altitude.

Pupisoma (Pupisoma) Stoliczka, 1873

Diagnosis

Shell without distinct spiral lines and penis with large appendix with retractor.

***Pupisoma (Pupisoma?) comicolense* H. B. Baker, 1928**

(Figures 3–5, 7)

Pupisoma comicolense Baker 1928, p 224, Plate 15 Figures 4–7.

Pupisoma galapagorum Pilsbry 1934, p 114, Plate 16 Figures 7–9.

Pupisoma bailyi Pilsbry 1934, p 116, Plate 24 Figure 15.

Pupisoma latens Hylton Scott 1960, p 26, Figures 3–6.

Pupisoma comicolense: Baker 1930, p 3, Plate 7 Figures 1, 2.

Pupisoma galapagorum: Baker 1963, p 201.

Ptychopatala bailyi: Schileyko 1998, p 96, Figure 106.

Pupisoma mediamericanum: Pilsbry 1920, p 42 [partim, non Pilsbry 1920]; Baker 1930, p 4 [partim, non Pilsbry 1920].

Type material examined

Pupisoma comicolense Baker: paralectotypes: Mexico, Puebla: below Necaxa, 900 m alt., 20°13'N, 98°00'W (ANSP 256464); Hidden Valley below Necaxa, 950 m alt. (ANSP 256463); Salto Chico near Necaxa, 1160 m alt. (ANSP 256462).

Figures 1–5. *Pupisoma* spp., shells. (1, 2) *Pupisoma (Ptychopatala) dioscoricola* (C. B. Adams, 1845): (1) 1.2 km N of Good Hope House (FLMNH 210130 partim); (2) Ecuador: Cuenca (lectotype of *P. americanum*: SMF 10697). (3–5) *Pupisoma (Pupisoma?) comicolense* H. B. Baker, 1928: (3) Mexico: Necaxa (paralectotype of *P. comicolense* Baker: ANSP 256464); (4) Mexico: Cuernavaca (holotype of *P. bailyi* Pilsbry: ANSP 156099); (5) Argentina: San Miguel de Tucumán (SMF 275438). Scale bar: 1 mm.

Table I. Shell measurements (in mm).

| | n | D | | | D2W | | | H | | | da | | | ha | | | W | | |
|--|----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| <i>Pupisoma dioscoricola</i> (C. B. Adams); 0.8 km NNW of Colonia Carmona | 20 | 1.50 | 1.85 | 1.68 | 1.15 | 1.30 | 1.23 | 1.30 | 1.90 | 1.55 | 0.75 | 0.90 | 0.81 | 0.75 | 0.90 | 0.80 | 2.5 | 3.0 | 2.7 |
| <i>Pupisoma comicolense</i> H. B. Baker; below Necaxa | 20 | 1.45 | 1.80 | 1.62 | 0.90 | 1.00 | 0.97 | 1.50 | 2.05 | 1.71 | 0.75 | 0.90 | 0.79 | 0.75 | 1.00 | 0.86 | 3.25 | 3.75 | 3.41 |
| <i>Pupisoma comicolense</i> H. B. Baker; La Calera 0.5 km towards Bogotá | 20 | 1.55 | 1.90 | 1.68 | 0.95 | 1.05 | 1.00 | 1.70 | 2.35 | 1.92 | 0.70 | 0.90 | 0.76 | 0.80 | 1.05 | 0.89 | 3.25 | 3.75 | 3.4 |
| <i>Pupisoma comicolense</i> H. B. Baker; Moniquira 5.4 km towards Arcabuco | 10 | 1.45 | 1.70 | 1.57 | 0.95 | 1.05 | 1.01 | 1.50 | 2.05 | 1.74 | 0.65 | 0.80 | 0.72 | 0.75 | 0.95 | 0.86 | 3 | 3.75 | 3.3 |
| <i>Pupisoma comicolense</i> H. B. Baker; Pisac 0.5 km towards Colquepata | 10 | 1.25 | 1.50 | 1.35 | 0.90 | 1.00 | 0.96 | 1.50 | 1.75 | 1.61 | 0.55 | 0.70 | 0.61 | 0.70 | 0.95 | 0.79 | 2.75 | 3.25 | 3.1 |
| <i>Pupisoma costulata</i> sp. n.; La Calera 0.5 km towards Bogotá | 10 | 1.50 | 1.70 | 1.60 | 0.90 | 0.95 | 0.92 | 1.95 | 2.35 | 2.15 | 0.65 | 0.70 | 0.69 | 0.65 | 0.75 | 0.71 | 4.25 | 5 | 4.7 |
| <i>Pupisoma macneilli</i> (Clapp); various localities | 20 | 1.05 | 1.40 | 1.20 | 0.75 | 0.90 | 0.82 | 1.10 | 1.45 | 1.29 | 0.45 | 0.55 | 0.51 | 0.55 | 0.70 | 0.62 | 2.75 | 3.5 | 3.1 |
| <i>Pupisoma mediamericanum</i> Pilsbry; various localities | 30 | 1.15 | 1.45 | 1.29 | 0.75 | 0.90 | 0.83 | 1.30 | 1.70 | 1.51 | 0.50 | 0.70 | 0.58 | 0.55 | 0.80 | 0.67 | 3.25 | 4.0 | 3.6 |
| <i>Pupisoma mediamericanum</i> Pilsbry; 5.8 km NE of Matagalpa | 20 | 1.40 | 1.55 | 1.47 | 0.80 | 0.95 | 0.89 | 1.50 | 1.80 | 1.64 | 0.60 | 0.70 | 0.66 | 0.65 | 0.80 | 0.73 | 3.25 | 3.75 | 3.5 |

D, shell diameter; D2W, diameter of the first two whorls; da, diameter of the aperture; H, shell height; ha, height of the aperture; W, number of whorls; Min, minimum; Max, maximum.

Table II. Ratios of shell measurements.

| | n | D/H | | | H/ha | | | da/ha | | |
|--|----|------|------|------|------|------|------|-------|------|------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| <i>Pupisoma dioscoricola</i> (C. B. Adams); 0.8 km NNW of Colonia Carmona | 20 | 0.97 | 1.19 | 1.09 | 1.63 | 2.11 | 1.93 | 0.94 | 1.13 | 1.00 |
| <i>Pupisoma comicolense</i> H. B. Baker; below Necaxa | 20 | 0.87 | 1.03 | 0.95 | 1.75 | 2.25 | 1.99 | 0.8 | 1.13 | 0.93 |
| <i>Pupisoma comicolense</i> H. B. Baker; La Calera 0.5 km towards Bogotá | 20 | 0.79 | 0.94 | 0.88 | 1.89 | 2.39 | 2.15 | 0.78 | 0.89 | 0.85 |
| <i>Pupisoma comicolense</i> H. B. Baker; Moniquira 5.4 km towards Arcabuco | 10 | 0.83 | 1.00 | 0.90 | 1.82 | 2.17 | 2.03 | 0.76 | 0.93 | 0.84 |
| <i>Pupisoma comicolense</i> H. B. Baker; Pisac 0.5 km towards Colquepata | 10 | 0.81 | 0.87 | 0.84 | 1.84 | 2.29 | 2.04 | 0.73 | 0.87 | 0.78 |
| <i>Pupisoma costulata</i> sp. n.; La Calera 0.5 km towards Bogotá | 10 | 0.68 | 0.82 | 0.75 | 2.79 | 3.31 | 3.05 | 0.93 | 1.08 | 0.98 |
| <i>Pupisoma macneilli</i> (Clapp); various localities | 20 | 0.85 | 1.04 | 0.93 | 1.85 | 2.33 | 2.08 | 0.71 | 0.92 | 0.83 |
| <i>Pupisoma mediamericanum</i> Pilsbry; various localities | 30 | 0.76 | 1.00 | 0.86 | 2.00 | 2.46 | 2.25 | 0.77 | 1.00 | 0.87 |
| <i>Pupisoma mediamericanum</i> Pilsbry; 5.8 km NE of Matagalpa | 20 | 0.83 | 0.94 | 0.90 | 2.00 | 2.43 | 2.24 | 0.81 | 1.00 | 0.91 |

D, shell diameter; da, diameter of the aperture; H, shell height; ha, height of the aperture; Min, minimum; Max, maximum.

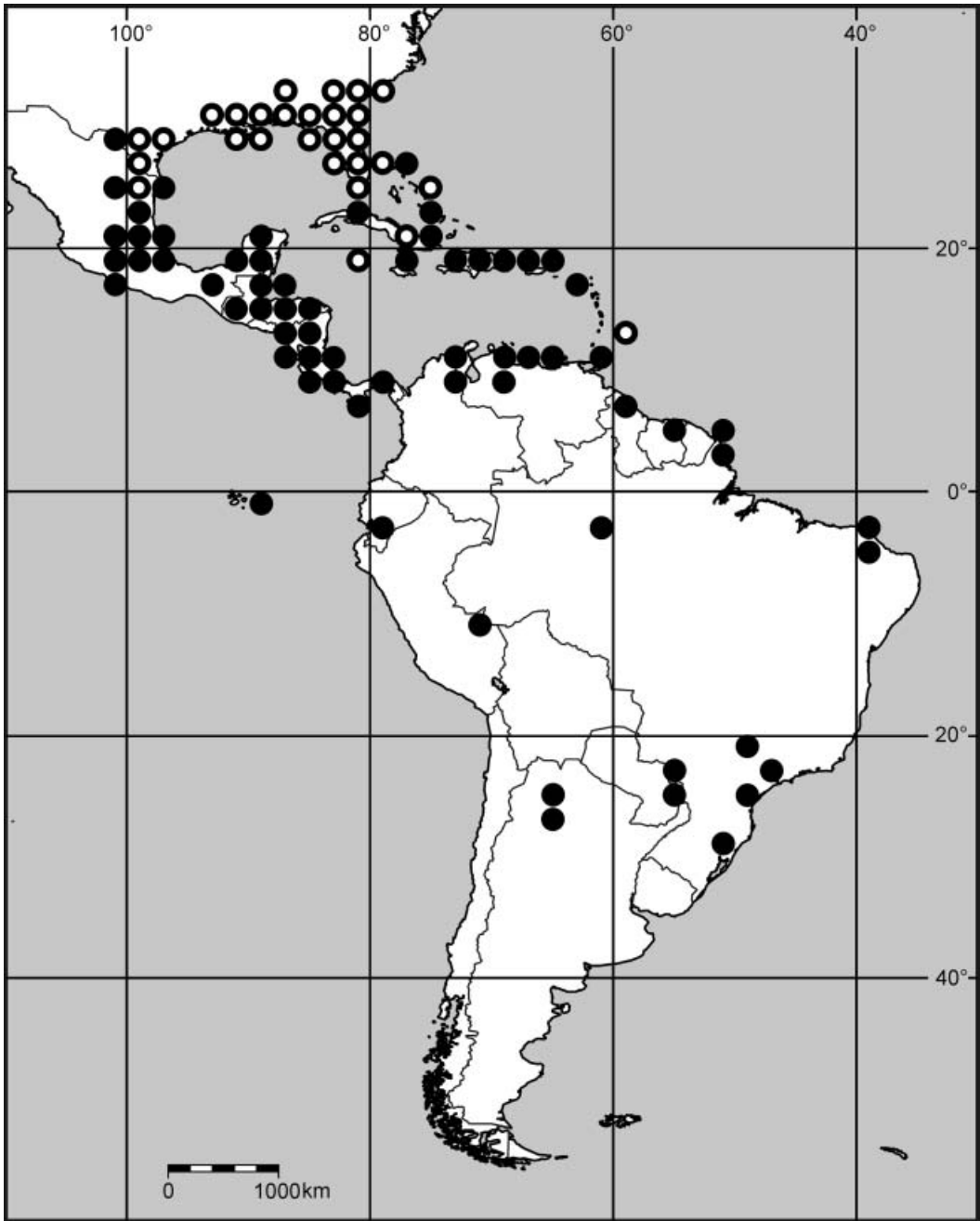


Figure 6. Distribution of *Pupisoma (Ptychopatula) dioscoricola* (C. B. Adams, 1845) (2°-grid). Empty symbols indicate records that have not been checked.

Pupisoma bailyi Pilsbry: holotype: Mexico, Morelos: Cuernavaca, 18°55'N, 99°15'W (ANSP 156099).

Pupisoma galapagorum Pilsbry: lectotype (design. Baker 1963, p 201): Ecuador, Galapagos: Isla San Cristóbal, Wreck Bay towards Progreso (ANSP 152716).

Pupisoma latens Hylton Scott: paratype: Argentina, Córdoba: Cabana, 700 m alt., 31°13'S, 64°22'W (SMF 171794).

Pupisoma mediamericanum Pilsbry: former paralectotype: Mexico, Veracruz-Llave: 150 m above Orizaba, 18°51'N, 97°06'W (ANSP 28270 partim).

Other material examined

Mexico, Nuevo León: Cerro Peña Nevada, 1 km S of La Encantada, 2860 m alt., 23°53'48"N, 99°47'58"W (FLMNH 226374); 13.5 km S of Zaragoza, 2070 m alt., 23°56'06"N, 99°43'10"W (FLMNH 226404); 3 km ESE of La Cienega, 1720 m alt., 25°22'00"N, 100°13'15"W (FLMNH 159195 partim); 2.5 km WNW of La Cienega, 1350 m alt., 25°22'34"N, 100°14'55"W (FLMNH 159204). Tamaulipas: 28 km WNW of Ocampo, 920 m alt., 22°56'01"N, 99°30'52"W (FLMNH 200764 partim). San Luis Potosí: Ciudad Valles, 21°59'N, 99°01'W (FLMNH 35461); 4 km W and 4 km S of Valle de San Francisco, 2630 m alt., 22°04'06"N, 100°38'42"W (FLMNH 283833 partim); 5.5 km ESE of Valle de San Francisco, 1940 m alt. (FLMNH 283978 partim). Puebla: below Intake gorge near Necaxa, 800 m alt., 20°13'N, 98°00'W (ANSP 256465); Oak valley above Necaxa, 1375 m alt. (ANSP 256469 partim, voucher to Baker 1930). Chiapas: 17 km NW of Teopisca, 2290 m alt., 16°38'32"N, 92°32'16"W (FLMNH 190530); 2.3 km S of La Trinitaria, 1767 m alt., 16°N, 92°W (FLMNH 35457 partim); 7.5 km N of Bochil, 1533 m alt., 17°N, 92°W (FLMNH 35454).

Honduras: Cerro Santa Barbara, ca 2 km N of Huatosa, 1450 m alt., 14°52'30"N, 88°08'00"W (FLMNH 242786 partim); Cerro Santa Barbara, ridge above El Cedral, 2800 m alt., 14°54'55"N, 88°07'35"W (FLMNH 242651); Magua Cave, 15 km SSW of Gualaco, 940 m alt., 14°56'30"N, 86°07'30"W (FLMNH 194342 partim); 1 km NW of El Cedral, Cerro Santa Barbara, 1800 m alt., 14°58'N, 88°01'W (FLMNH 221090, 221093); Agalta National Park, 6 km NW of Catacamas, 1300 m alt., 14°N, 85°W (FLMNH 221508 partim).

Costa Rica: Tapanti, 1433 m alt., 9°46'N, 83°46'W (FLMNH 34810 partim); Volcan Barba, 2.7 km N of San Jose de la Montana, 1933 m alt., 10°08'N, 84°06'W (FLMNH 34824); Volcan Barba, 2.7 km N of San Jose de la Montana, 2300 m alt., 10°08'N, 84°06'W (FLMNH 34839 partim); Volcan Poas, 1.5 km W of Poasito, 2300 m alt., 10°11'N, 84°13'W (FLMNH 34823); 11.7 km E of Bahia Tamarindo, 10°N, 85°W (FLMNH 34827 partim); 10 km S of Nicoya, 10°N, 85°W (FLMNH 34825 partim); San Gerardo de Dota, 2311 m alt., 9°32'49"N, 83°48'39"W (FLMNH 310096).

Panama: Copete Trail, Finca Lerida, Boquete, Chiriqui, 2400 m alt., 8°N, 82°W (FMNH 86350); Copete Trail, Finca Lerida, Boquete, Chiriqui, 2440 m alt., 8°N, 82°W (FMNH 86409); Casita Alta, Finca Lerida, Boquete, Chiriqui, 2200m alt., 8°N, 82°W (FMNH 86360); Spring near Casita Alta, Finca Lerida, Boquete, Chiriqui, 2100 m alt., 8°N, 82°W (FMNH 86486); 6.4 km above Cerro Punta, Chiriqui, 2000 m alt., 8°N, 82°W (FMNH 73725).

Colombia, Boyacá: gorge above Villa de Leiva, single trees, W slope, 2340 m alt., 05°37'15"N, 73°31'03"W (ZMH 4110); Moniquira 5.4 km towards Arcabuco, disturbed forest rest near quarry Cantera el Porvenir in La Roca, 2150 m alt., 05°50'58"N, 73°32'47"W (ZMH 4160); Barbosa 5 km towards Arcabuco, forest near quarry El Cairo in Vereda Pueblo Viejo, 1840 m alt., 05°53'55"N, 73°35'08"W (ZMH 4176). Cundinamarca: La Calera 0.5 km towards Bogotá, farm Las Cabrerías, Vereda San Rafael, Andean forest, 2820–2840 m alt., 04°42'30"N, 73°58'20"W (UNAL; ZMH 4015, 4030; 4062); La Calera,

S of Entrada Fabrica de Cemento Samper, degraded Andean forest, NW slope, 2750 m alt., 04°43'15"N, 73°56'46"W (ZMH 4078); Bogotá towards Tunja, Alto del Sisga, Andean forest, N slope, 2890 m alt., 05°04'58"N, 73°44'42"W (ZMH 4101). Distrito Capital: Bogotá, forest near brook above Escuela Militar de Caballeria, 2750–2790 m alt., 04°41'15"N, 74°01'33"W (ZMH 4238, 4318).

Peru, Amazonas: Leymebamba 9.5 km towards Balsas, 06°43'52"S, 77°48'57"W (ZMH 37943); Balsas, Rio Maranon bridge 20 km towards Leymebamba, 06°50'47"S, 77°57'44"W (ZMH 37933). Ancash: 7 km NE of San Marcos, 2720 m alt., 9°S, 77°W (FLMNH 243158); Chavín de Huantar, 3200 m alt., 9°35'S, 77°15'W (FLMNH 243159); Pampama (N of Chiquian), 3300 m alt., 10°07'42"S, 77°09'24"W (ZMH 37944). Cuzco: Santa Maria 3 km towards Ollantaytambo, 1270 m alt., 13°00'S, 72°37'W (ZMH 4453); Paucartambo 41 km towards Pillcopata, 2770 m alt., 13°11'S, 71°37'W (ZMH 4458); Lamay 1 km towards Calca, 2980 m alt., 13°21'S, 71°56'W (ZMH 4609); Pisac 0.5 km towards Colquepata, 3010 m alt., 13°25'S, 71°51'W (ZMH 4544); Huayllatamba, 3600 m alt., 13°32'S, 71°42'W (ZMH 4526).

Brazil, Rio Grande do Sul: Taquara del Mundo novo, 29°39'S, 50°47'W (SMF 55285 partim).

Argentina, Tucumán: San Miguel de Tucumán, park of the institute M. Lillo, 430 m alt., 26°49'S, 65°13'W (SMF 275438 partim); Cerro San Javier, km 17, 26°S, 65°W (FMNH 216319 partim); Horco Molle, 750 m alt. (FMNH 216620). Córdoba: Cabana, 700 m alt., 31°13'S, 64°22'W (SMF 171795).

Shell (Figures 3–5)

Globose-conical or oblong-conical; apex obtuse; with irregular growth lines, without incised spiral striae; corneous; usually brightly shining; subtranslucent; 2.75–3.5 inflated whorls separated by a deep suture; body whorl hardly or slightly descending towards the aperture, basally rounded; aperture truncate-rounded, edentate; peristome neither expanded nor reflexed nor thickened; columellar margin slightly dilated, hardly or partly covering the umbilicus; umbilicus taking 2–15% of the shell breadth. Shell measurements and ratios are listed in Tables I and II.

Remarks

Pupisoma comicolense differs from *P. mediamericanum* in the on-average larger (diameter of the first two whorls of *P. comicolense* 0.90–1.05 mm; diameter of the first two whorls of *P. mediamericanum* 0.80–0.95 mm), smoother shell (see also *P. mediamericanum*).

Specimens with 3.5 whorls are oblong-conical, whereas specimens with three or fewer whorls are globose-conical. In oblong-conical specimens the umbilicus usually takes less than 10% of the shell breadth, whereas in the globose forms it can be wider. *Pupisoma latens* Hylton Scott, 1960 from Argentina is such a globose form with a comparatively wide umbilicus. In an extreme form from San Miguel de Tucumán the umbilicus occupies 11–15% of the shell breadth. The identity of the widely umbilicated forms from Argentina with *P. comicolense* should be checked with molecular genetic markers. Preliminarily, they are considered to be conspecific with *P. comicolense*, because there are apparently intermediate specimens between the extreme forms. No constant conchological differences have been found between *P. galapagorum* Pilsbry, 1934 from the Galapagos Islands, *P. bailyi* Pilsbry, 1934 from Mexico, and *P. comicolense*.

Pupisoma comicolense occurs sympatrically with *P. dioscoricola*, *P. macneilli*, *P. mediamericanum*, and *P. costulata*.

The anatomy of *P. comicolense* has been described by Baker (1928).

Distribution (Figure 7)

Pupisoma comicolense is distributed in Central and South America from Mexico to the Galapagos Islands, southern Brazil, and northern Argentina. It is most frequent at medium and higher altitudes. Its altitudinal range extends from about 100 to 2600 m altitude.

***Pupisoma (Pupisoma?) costulata* sp. n.** (Figures 8, 13)

Type material examined

Holotype: Colombia, Cundinamarca: La Calera 0.5 km towards Bogotá, farm Las Cabreras, Vereda San Rafael, Andean forest, 2830–2840 m alt., 04°42'30"N, 73°58'20"W (ZMH 37621, leg. B. Hausdorf, 11 March 2000, measurements: D=1.6 mm, D2W=1.0 mm, H=2.2 mm, da=0.75 mm, dh=0.75 mm). Paratypes: Colombia, Distrito Capital: Bogotá, forest near brook above Escuela Militar de Caballeria, 2750 m alt., 04°41'15"N, 74°01'33"W (ZMH 4319). Cundinamarca: La Calera 0.5 km towards Bogotá, farm Las Cabreras, Vereda San Rafael, Andean forest, 2830–2840 m alt., 04°42'30"N, 73°58'20"W (ANSP; FLMNH; FMNH; NNM; SMF; UNAL; ZMH 4031, 4063); Bosques de Torca, Andean forest, W slope, 2800 m alt., 04°49'18"N, 74°01'07"W (ZMH 4331). Boyacá: Villa de Leiva, oak forest near Manantiales de Iguaque, W slope, 2600 m alt., 05°41'15"N, 73°28'53"W (ZMH 4198).

Shell (Figure 8)

Conical; apex obtuse; teleoconch with coarse growth-wrinkles, without incised spiral striae; corneous; shining; subtranslucent; 4.25–5 moderately inflated whorls separated by a deep suture; body whorl slightly descending towards the aperture, basally flattened; aperture truncate-rounded, edentate; peristome neither expanded nor reflexed nor thickened; columellar margin slightly dilated, partly covering the narrow umbilicus. Shell measurements and ratios are listed in Tables I and II.

Diagnosis

Pupisoma costulata differs from all other *Pupisoma* species in the conical shell with more whorls, a flattened base, and coarse growth-wrinkles. In shell shape and size it is most similar to *P. mediamericanum*.

Remarks

Pupisoma costulata occurs sympatrically with *P. comicolense*. The range of *P. costulata* overlaps that of *P. mediamericanum*, the conchologically most similar species.

Etymology

The species is named after its finely ribbed (Latin *costulatus*, used as an adjective) shell.

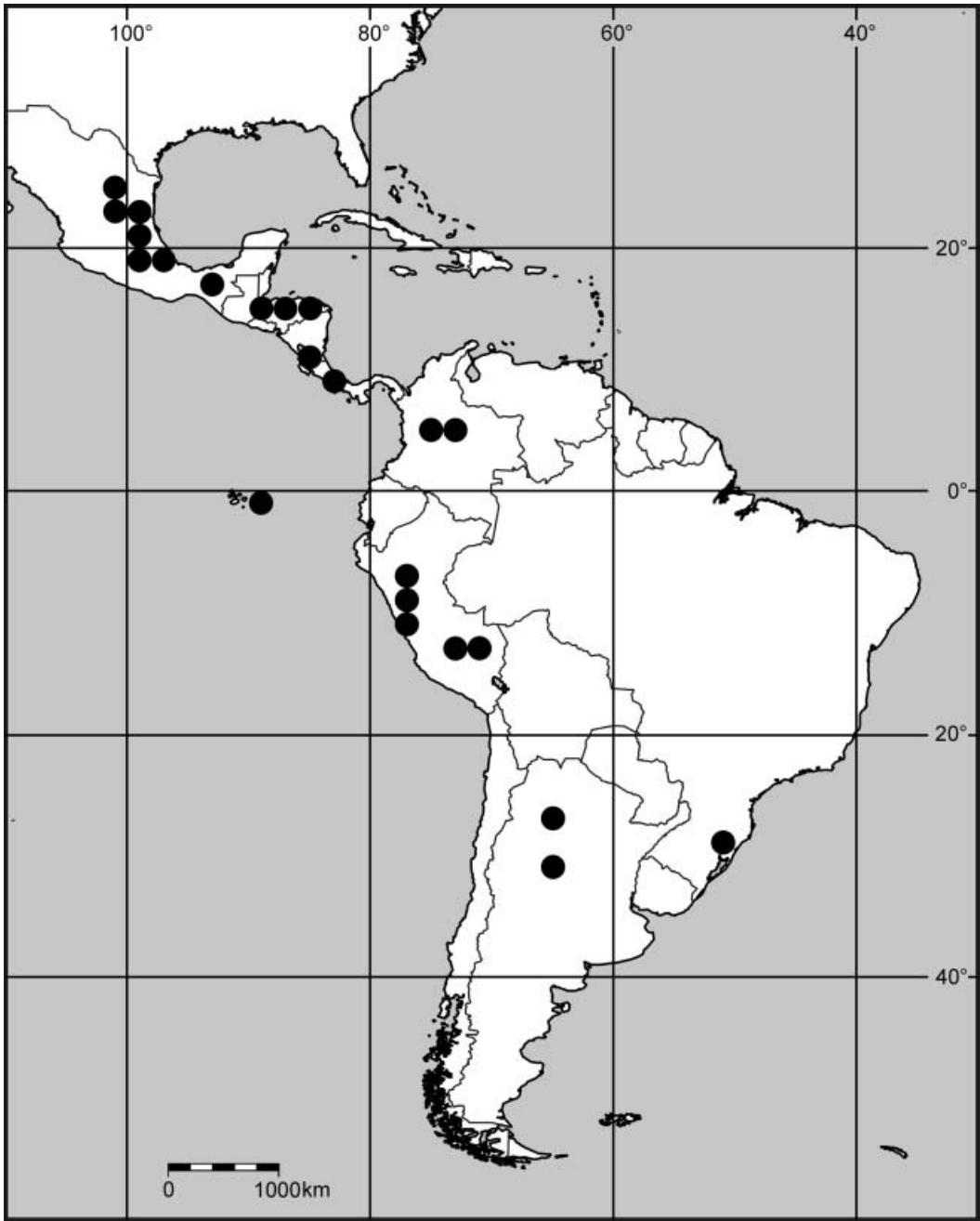
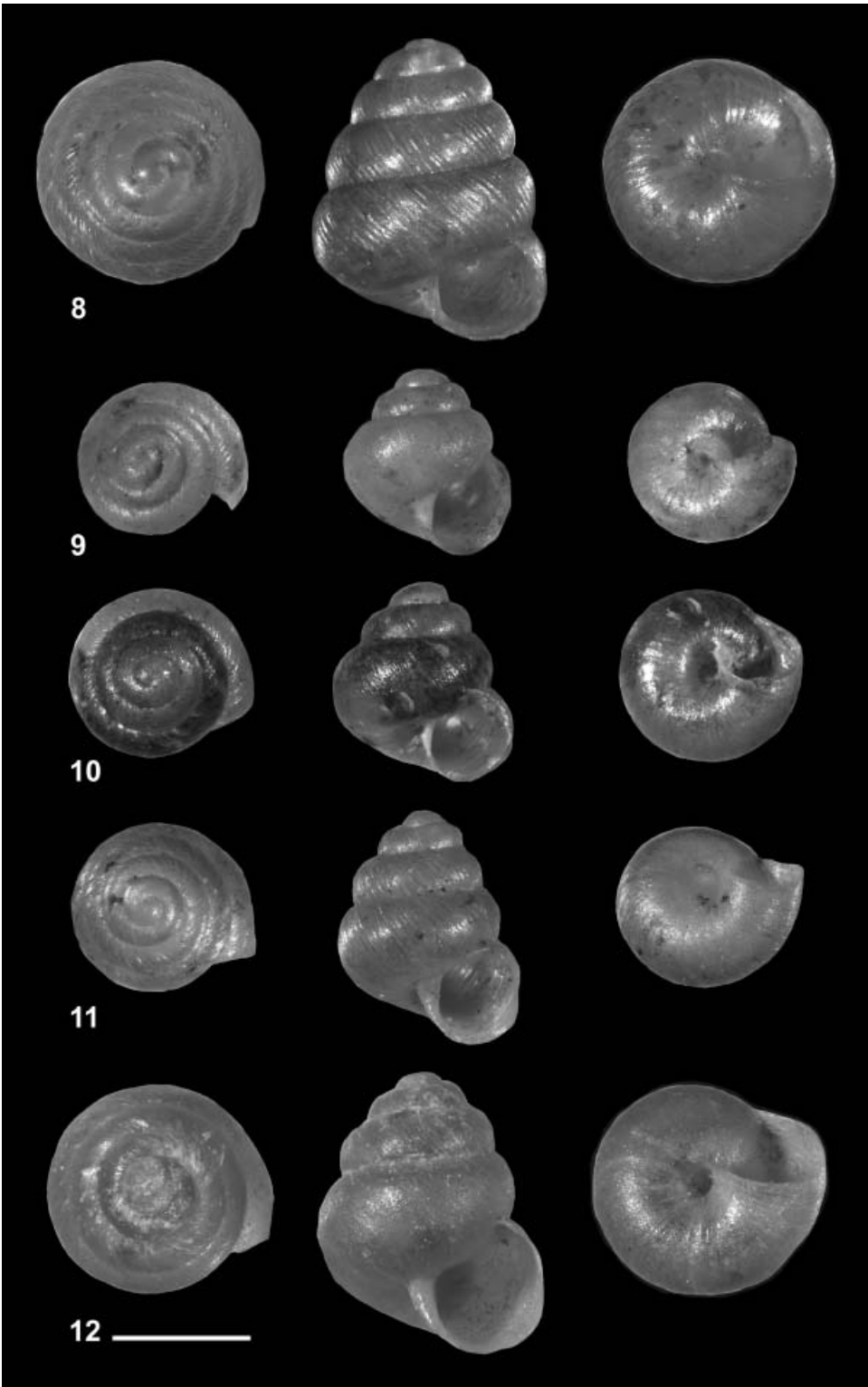


Figure 7. Distribution of *Pupisoma* (*Pupisoma?*) *comicolense* H. B. Baker, 1928 (2°-grid).

Type locality

Colombia, Cundinamarca: La Calera 0.5 km towards Bogotá, farm Las Cabreras, Vereda San Rafael, Andean forest, N slope, 2840 m alt., 04°42'30"N, 73°58'20"W.



Distribution (Figure 13)

Pupisoma costulata is known from Andean forests at 2600–2840 m altitude in the Departamentos Cundinamarca and Boyacá and the Distrito Capital in Colombia.

Pupisoma* (*Pupisoma*?) *macneilli (Clapp, 1918)

(Figures 9–10, 14)

Thysanophora macneilli Clapp 1918, p 74, Plate 8 Figure 1.

Pupisoma minus Pilsbry 1920, p 40, Plate 4 Figures 9, 11.

Pupisoma macneilli: Pilsbry 1920, p 41, Plate 4 Figure 15; Pilsbry 1948, p 1010, Figure 538(15); Burch 1962, p 49, Figure 92; Hubricht 1985, p 12, Map 99.

Ptychopatula macneilli: Paul and Donovan 2005, p 120, Figure 7b, Plate 24 Figures 3, 4, Plate 27 Figure 5.

Pupisoma minus: Vanatta 1923, p 65, 66; Vanatta 1928a, p 21; Pilsbry 1948, p 1008, Figure 538(9–11); van der Schalie 1948, p 36, Map 12; Pilsbry 1953, p 165; van Regteren Altena 1960, p 49; Burch 1962, p 49, Figure 91; Correa Sandoval, García-Cubas Gutiérrez, and Reguero Reza 1998, p 14; Correa Sandoval 2003, p 512; Correa Sandoval and Salazar Rodríguez 2005, p 59.

Pupisoma americanum: Möllendorff 1899, p 91 [partim, non Möllendorff 1899].

Thysanophora dioscoricola: Clapp 1918, p 75, Plate 8 Figure 2 [non C. B. Adams 1845].

Pupisoma (*Ptychopatula*) *dioscoricola*: Haas 1937, p 10 [partim, non C. B. Adams 1845].

Type material examined

T. macneilli Clapp: syntypes: USA, Alabama: Magazine Point 13 km N of Mobile, 30°44'N, 88°03'W (ANSP 128335).

Pupisoma minus Pilsbry: lectotype (design. Baker 1962, p 14): USA, Florida: Snapper Creek south of Coconut Grove, 25°42'N, 80°15'W (ANSP 113399).

Pupisoma dioscoricola insigne Pilsbry: paralectotype: Mexico, San Luis Potosí: Choy cave, 22°18'N, 99°05'W (ANSP 141391 partim).

Pupisoma americanum Möllendorff paralectotypes: Ecuador, Azuay: Cuenca, 2°53'S, 78°59'W (SMF 10698 partim).

Other material examined

Mexico, Coahuila: 7.3 km SSE of Norias, 1500 m alt., 26°27'49"N, 101°34'12"W (FLMNH 268583). Nuevo León: Santiago, 3 km ESE La Cienega, 1720 m alt., 25°22'00"N, 100°13'15"W (FLMNH 159195 partim). Tamaulipas: 36 km WNW of Ocampo, 1500 m alt., 22°56'28"N, 99°33'36"W (FLMNH 200768 partim); Salto Del Tigre, 16 km W of Santa Engracia, 24°N, 99°W (FLMNH 191035). San Luis Potosí: 3.5 km ENE of Alimitos, 1340 m alt., 21°57'07"N, 100°11'56"W (FLMNH 200237 partim); Canoas 21°59'N, 100°22'W (ANSP 164398, voucher to Pilsbry 1953); 6 km W of El Naranjo, 340 m alt., 21°N, 98°W (FLMNH 200115 partim); 6 km SW of Ahuacatlan,

Figures 8–12. *Pupisoma* spp., shells. (8) *Pupisoma* (*Pupisoma*?) *costulata* sp. n., Colombia: La Calera 0.5 km towards Bogotá (holotype ZMH 37621). (9, 10) *Pupisoma* (*Pupisoma*?) *macneilli* (Clapp, 1918): (9) USA, Florida: Snapper Creek S of Coconut Grove (lectotype of *P. minus* Pilsbry: ANSP 113399); (10) Colombia: gorge above Villa de Leiva (ZMH 4437). (11, 12) *Pupisoma* (*Pupisoma*?) *mediamericanum* Pilsbry, 1920: (11) Mexico: 150 m above Orizaba (neotype ANSP 28270b); (12) Nicaragua: 4 km N of Masatepe (FLMNH 34826). Scale bar: 1 mm.



Figure 13. Distribution of *Pupisoma (Pupisoma?) costulata* sp. n. (2°-grid).

1700 m alt., 21°N, 99°W (FLMNH 159599); 5.5 km ESE of Valle de San Francisco, 1940 m alt. (FLMNH 283978 partim). Tabasco: 5 km SE of Tapijulapa, 110 m alt., 17°26'06"N, 92°44'41"W (FLMNH 190690 partim). Querétaro: 6 km SW of Pinal de Amoles, 2560 m alt., 21°N, 99°W (FLMNH 268718). Hidalgo: 5 km SE of Pas Flores, 340 m alt., 20°N, 99°W (FLMNH 268668 partim); 8.5 km S of Jacala, 1460 m alt.,

21°01'N, 99°11'W (FLMNH 268630 partim). Veracruz-Llave: San Bartolo, 850 m alt., 18°56'36"N, 96°55'42"W (FLMNH 337112 partim); 4 km N of San Rafael Caleria, 1100 m alt., 18°57'54"N, 96°56'24"W (FLMNH 341573 partim); 1 km NW of Atoyaquillas, 7 km NNW of Paraje Nuevo, 750 m alt., 18°N, 96°W Paraje Nuevo (FLMNH 190939 partim); 4 km ESE of Cordoba, 800 m alt., 18°N, 96°W (FLMNH 159369 partim); Cerro de Las Palmas, 1 km N of San Mateo, 3 km NE of Cordoba, 910 m alt., 18°N, 96°W (FLMNH 190893). Oaxaca: 6 km SW of Santa Maria Chimalapa, 200 m alt., 16°51'05"N, 94°44'36"W (FLMNH 211444 partim); 0.5 km N of La Joya de Santa Maria, 100 m alt., 17°52'44"N, 96°01'45"W (FLMNH 200528 partim); 3.5 km SW of Bethania, 100 m alt., 17°53'52"N, 96°01'04"W (FLMNH 200509, 200513 partim); Bosque Natural de Temascal, 1 km SW of Cedral, 100 m alt., 18°23'N, 96°29'W (FLMNH 159487 partim); 1.5 km SE, 1 km NE of La Selva Uno, 100 m alt., 18°26'28"N, 96°30'10"W (FLMNH 200483 partim); 1 km SE of Aseradero, 100 m alt., 18°30'22"N, 90°30'10"W (FLMNH 200462 partim). Chiapas: Ruinas de Chinkultic, 32 km E of La Trinitaria, 1340 m alt., 16°N, 92°W (FLMNH 190641 partim).

Jamaica: Mandeville, 18°02'N, 77°30'W (ANSP 8228, voucher to Pilsbry 1920); Red Hills Road Cave near Diamond (collection Paul, vouchers to Paul and Donovan 2005); 0.5 km W of Troy, 467 m alt., 18°15'N, 77°37'W (FLMNH 23060 partim); 1.2 km N of Good Hope House, 100 m alt., 18°25'N, 77°41'W (FLMNH 210130 partim).

Dominican Republic: Bani, 65 m alt., 18°20'N, 70°23'W (FMNH 175647); 6 km SE of Polo, 940 m alt., 18°N, 71°W (FLMNH 210108); 13 km NW of Hondo Valle, 1400 m alt., 18°N, 71°W (FLMNH 210109); Casabito, Cordillera Central, 19°02'N, 70°31'W (FMNH 175650); Colonia, Cordillera central, 1000 m alt. (FMNH 175645, 175646, 175652, 175654).

Belize: 1 km W of San Felipe, 75 m alt., 16°07'18"N, 88°54'42"W (FLMNH 207720 partim); 1 km S of Aguacate, 100 m alt., 16°09'12"N, 89°05'54"W (FLMNH 207862 partim); Punta Gorda, 16°09'N, 88°49'W (FLMNH 135217); Vaca Plateau, Caracol Archeological Monument, 600 m alt., 16°45'48"N, 89°06'06"W (FLMNH 198424 partim); 10 km SE of Benque, 300 m alt., 16°59'48"N, 89°04'24"W (FLMNH 207355 partim); 10 km SE of Benque, 350 m alt., 17°01'00"N, 89°06'12"W (FLMNH 207375 partim); 1 km N of Black Rock, 120 m alt., 17°03'12"N, 89°04'00"W (FLMNH 207496 partim); 0.8 km NE of Benque Viejo del Carmen, 100 m alt., 17°05'N, 89°08'18"W (FLMNH 146324 partim); 7.9 km SE of San Ignacio, 110 m alt., 17°07'N, 89°03'42"W (FLMNH 146267 partim); Rockville Quarry, Gracy Rock Hill, 17°23'18"N, 88°27'06"W (FLMNH 207329); 3.2 km S August Pine Ridge, 17°57'N, 88°44'W (FLMNH 134967);

Guatemala: Antigua, 14°34'N, 90°44'W (FLMNH 34842 partim); Guatemala City, 14°N, 90°W (FLMNH 34832); 11 km W of Languin, 1000 m alt., 15°33'29"N, 90°04'02"W (FLMNH 190144 partim); Chamá, 15°37'N, 90°33'W (ANSP 141389, voucher to Pilsbry 1920); 10 km NNW of Camajo Grande, 680 m alt., 15°41'27"N, 91°55'58"W (FLMNH 190439 partim).

Honduras: Ruinas de Copán, 14°51'N, 89°08'W (FLMNH 213242); Cerro Santa Barbara, 2.5 km N of Huatosa, 1200 m alt., 14°52'43"N, 88°09'28"W (FLMNH 242827); Cerro Santa Barbara, 2.5 km N of Huatosa, 750 m alt., 14°54'33"N, 88°10'25"W (FLMNH 242845); 6.5 km NW of Catacamas, Cerro Murullo, 1000 m alt., 14°53'14"N, 85°56'28"W (FLMNH 194408); 6 km N of Catacamas, 1000 m alt., 14°53'19"N, 85°54'43"W (FLMNH 194444 partim); 5 km NNW of Rio Tinto, 2 km NNE of Campo Nuevo, 500 m alt., 14°57'08"N, 85°42'35"W (FLMNH 212139 partim); Bacarron Canyon, 16 km WSW of Catacamas, 500 m alt., 14°57'59"N, 85°42'54"W (FLMNH

212107); 17 km N of Santa Barbara, 1200 m alt., 14°N, 88°W (FLMNH 213205); 0.5 km SE of Cerron, 28 km SW of Villanueva, 350 m alt., 15°10'15"N, 88°06'27"W (FLMNH 224403 partim); 2.6 km SW of La Brea, 100 m alt., 15°45'39"N, 86°00'08"W (FLMNH 211988 partim); 21 km WSW of Olanchito, 150 m alt., 15°N, 86°W (FLMNH 221208 partim); 22 km WSW of Olanchito, 150 m alt., 15°N, 86°W (FLMNH 221209 partim); 20 km NE of Yoro, 800 m alt., 15°N, 87°W (FLMNH 221303); Utila Island, Brand Hill, 2.6 km N of Utila, 16°07'07"N, 86°53'08"W (FLMNH 224457); Roatán Island, 0.5 km E of West Bay Beach, 10 m alt., 16°16'30"N, 86°35'49"W (FLMNH 224555); Roatán Island, 1.6 km E of West Bay Beach, 100 m alt., 16°16'54"N, 86°35'29"W (FLMNH 224534 partim); Roatán Island, 2.5 km N, 4.3 km E of Oak Ridge, 16°24'55"N, 86°19'52"W (FLMNH 224499).

Costa Rica: Puerto Jesus, 10°07'N, 85°16'W (FLMNH 34807 partim); Cueva de Venado, 2 km NW of Venado, 350 m alt., 10°33'14"N, 84°46'08"W (FLMNH 212088); La Lola, 47.2 km W Limón, 10°N, 83°W (FLMNH 34835 partim); 11.7 km E of Bahía Tamarindo, 10°N, 85°W (FLMNH 34827 partim).

Panama: Capira, 8°45'N, 79°53'W (FMNH 63723 partim); Barro Colorado Island, AVA-3, 9°N, 79°W (FMNH 73629, 73701).

Colombia, Boyacá: gorge above Villa de Leiva, single trees, W slope, 2340 m alt., 05°37'15"N, 73°31'03"W (ZMH 4437); Moniquira 16.7 km towards Arcabuco, primary Andean forest, W slope, 2500 m alt., 05°48'11"N, 73°29'05"W (ZMH 4120); Moniquira 5.4 km towards Arcabuco, disturbed forest rest near quarry Cantera el Porvenir in La Roca, 2150 m alt., 05°50'58"N, 73°32'47"W (ZMH 4150); Barbosa 5 km towards Arcabuco, forest near quarry El Cairo in Vereda Pueblo Viejo, 1840 m alt., 05°53'55"N, 73°35'08"W (UNAL; ZMH 4175).

Venezuela, Carabobo: 2 km N of Petanemo, 10 m alt. (FLMNH 246502 partim).

Trinidad and Tobago, Tobago Island: 1.2 km NE of L'Anse Fourmi, 230 m alt., 11°18'46"N, 60°36'34"W (FLMNH 227227); 4.2 km NW of Speyside, 330 m alt., 11°19'34"N, 60°32'19"W (FLMNH 227252). Trinidad Island: Point Radix, 7.0 km NE Mayaro (Pierreville), 3 m alt., 10°20'11"N, 60°59'23"W (FLMNH 226909 partim); 5.6 km S of La Veronica, 70 m alt., 10°39'40"N, 61°22'13"W (FLMNH 226259); 5 km S of Chaguaramas, Point Gourde, 10 m alt., 10°40'22"N, 61°37'04"W (FLMNH 226548); Point Gourde, 5.0 km S Chaguaramas, 80 m alt., 10°40'28"N, 61°37'32"W (FLMNH 230210 partim); 2.0 km NE La Platonía, Gasparillo Village, 100 m alt., 10°43'33"N, 61°27'36"W (FLMNH 227189); 11.3 km SW of Maracas Bay Village, 273 m alt., 10°43'40"N, 61°29'37"W (FLMNH 226294); Grande Riviere River, bridge area at Paria Main Road, 10 m alt., 10°49'43"N, 61°02'39"W (FLMNH 226867); 10 km NE of Diego Martin, Blue Basin Falls area, 150 m alt., 10°N, 61°W (FLMNH 226530); 5.8 km N of Aripo Village, 520 m alt., 10°N, 61°W (FLMNH 226601).

Suriname: Tambaredjo, 5°50'N, 55°33'W (NNM, voucher to van Regteren Altena 1960).

Ecuador, Morona Santiago: 2 km W of Patuca, 400 m alt., 2°40'S, 78°13'W (FLMNH 139060).

Perú, Cuzco: Santa Maria 3 km towards Ollantaytambo, 1270 m alt., 13°00'S, 72°37'W (ZMH 4454).

Brazil, Paraná: São João de Triunfo near Palmira, 700 m alt., 25°41'S, 50°12'W (FLMNH 29432).

Paraguay, Guairá: Villarrica, 25°45'S, 56°26'W (SMF 165525, 165526).

Argentina, Tucumán: Cerro San Javier, km 17, 26°S, 65°W (FMNH 216319 partim).

Shell (Figures 9, 10)

Globose-conical; apex obtuse; with distinct growth lines and irregular impressions, sometimes with periostracal riblets, especially on the upper whorls, without incised spiral striae; corneous; dully shining; subtranslucent; 2.75–3.75 inflated whorls separated by a deep suture; body whorl slightly descending towards the aperture, basally rounded; aperture truncate-rounded, edentate; peristome neither expanded nor reflexed nor thickened; columellar margin slightly dilated, hardly or partly covering the umbilicus; umbilicus taking 4–15% of the shell breadth. Shell measurements and ratios are listed in Tables I and II.

Remarks

Pupisoma macneilli differs from *P. mediamericanum* in the on-average lower shell with a wider umbilicus and fewer whorls. It differs from *P. comicolense* in the smaller (diameter of the first two whorls: 0.75–0.90 mm; in *P. comicolense*: 0.90–1.05 mm), dully shining shell with distinct growth lines and irregular impressions.

No constant differences were found between *P. minus* Pilsbry, 1920, the type locality of which is in Florida, and *P. macneilli* (Clapp, 1918) described from Alabama. Thus, I agree with Hubricht (1985) that these nominal species are synonyms.

Pupisoma macneilli occurs sympatrically with *P. dioscoricola*, *P. comicolense*, and *P. mediamericanum*.

The specimens recorded as *P. minus* from St Eustatius by Haas (1960) are *P. dioscoricola*.

Distribution (Figure 14)

The range of *P. macneilli* extends from the southern USA through the Caribbean and Central America southwards to southern Brazil and northern Argentina. It is most frequent at medium and higher altitudes. Its latitudinal range extends from about 100 to 2600 m altitude.

***Pupisoma (Pupisoma?) mediamericanum* Pilsbry, 1920**

(Figures 11, 12, 15)

Pupisoma mediamericanum Pilsbry 1920, p 42, Plate 4 Figures 16, 17 [partim].

Pupisoma michoacanense Pilsbry 1920, p 40, Plate 4 Figure 12.

Pupisoma mediamericanum: Baker 1928, p 223, Plate 15 Figures 1–3; Baker 1930, p 4, Plate 7 Figures 1, 2 [partim]; Baker 1963, p 201.

Pupisoma minus: Pérez and López 2002, p 103, Plate 20 [partim?, non Pilsbry 1920].

Ptychopatala sp. b: Paul and Donovan 2005, p 120, Figure 7d, Plate 25 Figure 2, Plate 26 Figure 2.

Type material examined

Pupisoma mediamericanum Pilsbry: neotype (design. nov.): Mexico, Veracruz-Llave: 150 m above Orizaba, 18°51'N, 97°06'W (ANSP 28270b); former paralectotypes: Mexico, Veracruz-Llave: 150 m above Orizaba, 18°51'N, 97°06'W (ANSP 28270 partim); Guatemala: Chamá, 15°37'N, 90°33'W (ANSP 45727).

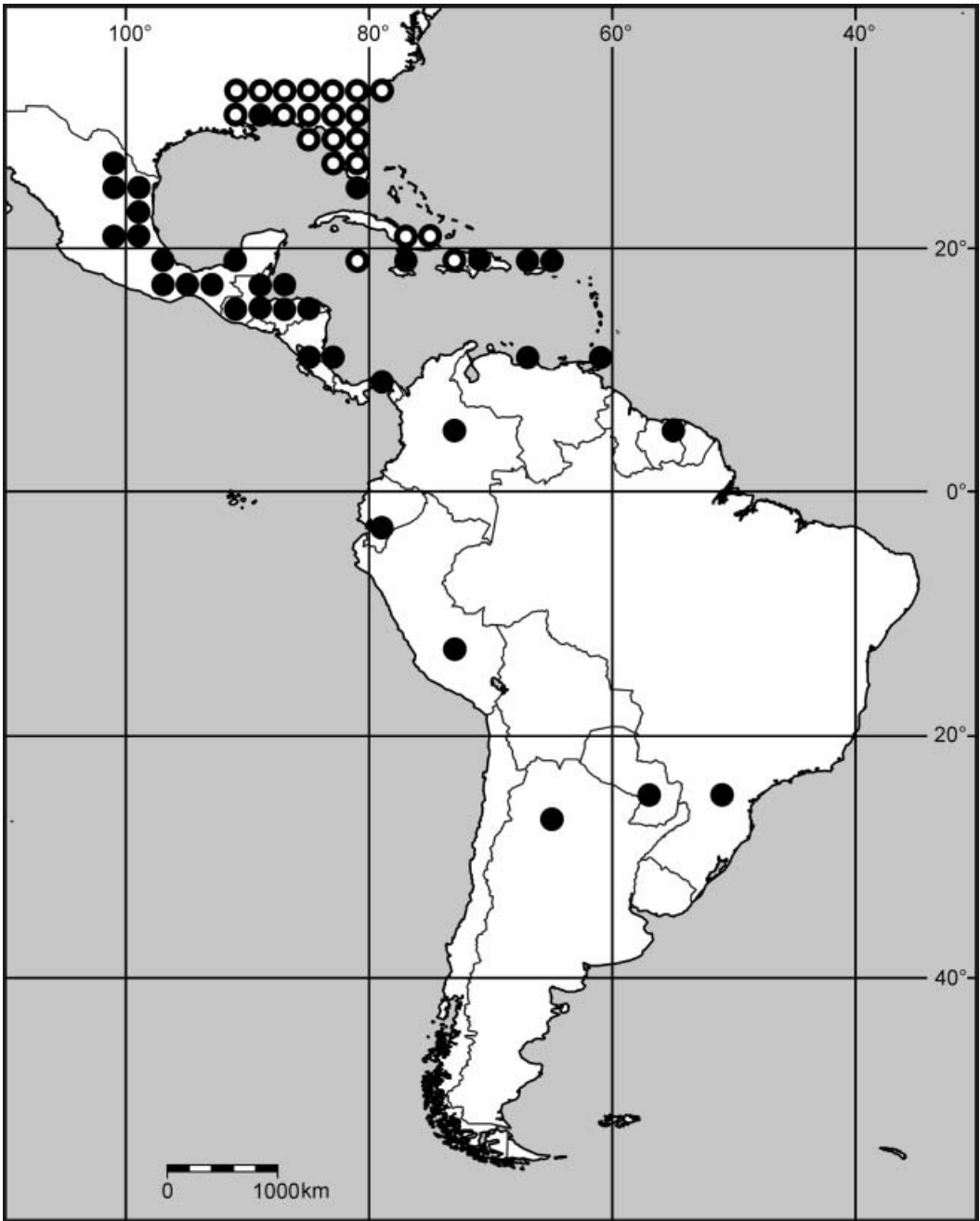


Figure 14. Distribution of *Pupisoma (Pupisoma?) macneilli* (Clapp, 1918) (2°-grid). Empty symbols indicate records that have not been checked.

Other material examined

Mexico, Nuevo León: 7.5 km NW of Zaragoza, 1700 m alt., 23°59'26"N, 99°49'00"W (FLMNH 226390); Santiago, 3 km ESE of La Cienega, 1720 m alt., 25°22'00"N,

100°13'15"W (FLMNH 159195 partim). Tamaulipas: 28 km WNW of Ocampo, 920 m alt., 22°56'01"N, 99°30'52"W (FLMNH 200764 partim); Sierra Cucharas, 10 km of Gomez Farias, 960 m alt., 23°03'01"N, 98°12'30"W (FLMNH 190999 partim); Reserva Biologica El Cielo, 10 km W of Gomez Farias, 1050 m alt., 23°04'12"N, 99°11'18"W (FLMNH 317047); 9 km W of Gomez Farias, 700 m alt., 23°N, 99°W (FLMNH 200153 partim). San Luis Potosí: 3.5 km ENE of Alimitos, 1340 m alt., 21°57'07"N, 100°11'56"W (FLMNH 200237 partim); 6 km W of El Naranjo, 340 m alt., 21°N, 98°W (FLMNH 200115 partim); 4 km W and 4 km S of Valle de San Francisco, 2630 m alt., 22°04'06"N, 100°38'42"W (FLMNH 283833 partim); Valle de Las Fantastas, 32.5 km W Santa Catorina, 2900 m alt. (FLMNH 210110). Queretaro: 5.5 km SW of Ahuacatlan de Guadalupe, 1170 m alt., 21°11'21"N, 99°34'16"W (FLMNH 200709 partim). Hidalgo: 8.5 km S of Jacala, 1460 m alt., 21°N, 99°W (FLMNH 268630 partim). Veracruz-Llave: 5 km ENE of Cuauhtémoc, 75 m alt., 17°06'59"N, 94°51'10"W (FLMNH 211355); 2 km SW of Plan Arroyo, 100 m alt., 17°14'15"N, 94°37'30"W (FLMNH 211414); 1 km NE of Comalapa, 470 m alt., 18°42'N, 96°53'W (FLMNH 81801); Sumidero, 1100 m alt., 18°55'N, 97°00'W (ANSP 256467, voucher to Baker 1930); San Bartolo, 850 m alt., 18°56'36"N, 96°55'42"W (FLMNH 337112 partim); Santa Rosa, 2.5 km ESE of San Rafael Caleria, 1200 m alt., 18°57'30"N, 96°55'54"W (FLMNH 337145); 4 km N of San Rafael Caleria, 1100 m alt., 18°57'54"N, 96°56'24"W (FLMNH 341573 partim); 1 km NW of Atoyaquillas, 7 km NNW of Paraje Nuevo, 750 m alt., 18°N, 96°W (FLMNH 190939 partim); 4 km ESE of Cordoba, 800 m alt., 18°N, 96°W (FLMNH 159369 partim); Cerro de Las Palmas, 1 km E of Berlin, 4 km N of Cordoba, 980 m alt., 18°N, 96°W (FLMNH 190859 partim); 3 km SSW of Fortin de las Flores, 1000 m alt., 18°N, 97°W (FLMNH 159337). Puebla: Peñuela, 800–900 m alt., 19°57'N, 98°06'W (ANSP 256466, voucher to Baker 1930); limestone cliffs and talus below Necaxa, 900 m alt., 20°13'N, 98°00'W (ANSP 256471 partim); Old Canal near Necaxa, 1500 m alt. (ANSP 256471 partim); Tenango Hills 3 km S of Necaxa, 1450 m alt. (ANSP 256470); Twin Peaks valley above Necaxa, 1520 m alt. (ANSP 256468); Oak valley above Necaxa, 1375 m alt. (ANSP 256469 partim, 256472). Tabasco: 5 km SE of Tapijulapa, 110 m alt., 17°26'06"N, 92°44'41"W (FLMNH 190690 partim). Oaxaca: 6 km SW of Santa Maria Chimalapa, 200 m alt., 16°51'05"N, 94°44'36"W (FLMNH 211444 partim, 211445); 1 km S of Usila, 100 m alt., 18°02'09"N, 96°33'32"W (FLMNH 211234); 1 km SE of Aseradero, 100 m alt., 18°30'22"N, 90°30'10"W (FLMNH 200462 partim); 3 km S of Acatlan, Aseradero, 100 m alt., 18°30'25"N, 96°42'05"W (FLMNH 189758). Chiapas: 6 km NW of Comitán, 760 m alt., 16°16'42"N, 92°09'26"W (FLMNH 190545); 12 km SSW of La Mendoza, 1480 m alt., 16°37'03"N, 92°02'47"W (FLMNH 190508); 14 km S of Ocosingo, 1110 m alt., 16°48'48"N, 92°07'44"W (FLMNH 190657); Ruinas de Chinkultic, 32 km E of La Trinitaria, 1340 m alt., 16°N, 92°W (FLMNH 190641 partim); 2.3 km S of La Trinitaria, 1767 m alt., 16°N, 92°W (FLMNH 35457 partim).

Jamaica: 0.5 km W of Troy, 467 m alt., 18°15'N, 77°37'W (FLMNH 23060 partim); 12.6 km N of circle at Albert Town, 18°N, 77°W (FMNH 196301); Red Hills Road Cave near Diamond (collection Paul, vouchers to Paul and Donovan 2005, only Pleistocene).

Belize: 1 km W of San Felipe, 75 m alt., 16°07'18"N, 88°54'42"W (FLMNH 207720 partim); Vaca Plateau, Caracol Archeological Monument, 600 m alt., 16°45'48"N, 89°06'06"W (FLMNH 198424 partim); Vaca Plateau, 12.5 km NE of Caracol, 510 m alt., 16°51'12"N, 89°03'54"W (FLMNH 207441); 10 km SE of Benque, 300 m alt., 16°59'48"N, 89°04'24"W (FLMNH 207355 partim); 10 km SE of Benque, 350 m alt., 17°01'00"N, 89°06'12"W (FLMNH 207375 partim); 1 km N of Black Rock, 120 m alt.,

17°03'12"N, 89°04'00"W (FLMNH 207496 partim); 0.8 km NE of Benque Viejo del Carmen, 100 m alt., 17°05'00"N, 89°08'18"W (FLMNH 146323); 7.9 km SE of San Ignacio, 110 m alt., 17°07'N, 89°03'42"W (FLMNH 146267 partim).

Guatemala: Antigua, 14°34'N, 90°44'W (FLMNH 34842 partim); Petén, 100–200 m alt., 14°37'N, 90°17'W (FLMNH 234110); 0.5 km E Sacapulas, El Quiche, 1200 m alt., 15°17'N, 91°05'W (FMNH 206268); 5 km W of Aguacatan, 1910 m alt., 15°20'44"N, 91°23'03"W (FLMNH 190232); 17.5 km NW of Tactic, 1330 m alt., 15°21'29"N, 90°25'25"W (FLMNH 189857 partim); 2.5 km NE of Puente Chixoy, 810 m alt., 15°21'32"N, 90°39'10"W (FLMNH 189992 partim); 6 km W of Chixoy, 760 m alt., 15°21'33"N, 90°42'22"W (FLMNH 190214); 1.5 km SE of (San Juan) Chamelco, 1300 m alt., 15°24'20"N, 90°18'28"W (FLMNH 189878); 8 km SE of Lanquin, 350 m alt., 15°32'43"N, 89°56'49"W (FLMNH 190121 partim); 2 km ESE of Cojaj, 1250 m alt., 15°33'25"N, 90°06'56"W (FLMNH 190016 partim); 11 km W of Lanquin, 1000 m alt., 15°33'29"N, 90°04'02"W (FLMNH 190144 partim); 4 km W of Lanquin, 330 m alt., 15°34'37"N, 90°01'06"W (FLMNH 190098 partim); 2 km WNW of Lanquin, 300 m alt., 15°34'38"N, 89°59'19"W (FLMNH 190074 partim); 30 km S of Puerto Barrias, 8.5 km ENE of turn-off to Cayuga, 50 m alt., 15°34'46"N, 88°40'05"W (FLMNH 190614); 9 km W of Lanquin, 890 m alt., 15°35'03"N, 90°03'20"W (FLMNH 190049); 14 km N of Coban, 990 m alt., 15°36'20"N, 90°19'43"W (FLMNH 189926); Las Escobas, 60 m alt., 15°41'05"N, 88°33'36"W (FLMNH 190593); 2 km SW of Nenton, 600 m alt., 15°47'52"N, 91°45'42"W (FLMNH 190480 partim).

Honduras: Silca, 600 m alt., 14°48'37"N, 86°32'32"W (FLMNH 212213 partim); Cerro Santa Barbara, 2 km N of Huatosa, 1450 m alt., 14°52'30"N, 88°08'00"W (FLMNH 242786 partim); 6 km N of Catacamas, 1000 m alt., 14°53'19"N, 85°54'43"W (FLMNH 194444 partim); 7.1 km SSE of Santa Barbara, 840 m alt., 14°53'24"N, 88°12'14"W (FLMNH 242745); Magua Cave, 15 km SSW of Gualaco, 940 m alt., 14°56'30"N, 86°07'30"W (FLMNH 194342 partim); Agalta National Park, 6 km NW of Catacamas, 1300 m alt., 14°N, 85°W (FLMNH 221508 partim); 4.9 km SE of Santa Barbara, 460 m alt., 14°N, 88°W (FLMNH 242818); 2 km E of San Luis de Planes, 1250 m alt., 14°N, 88°W (FLMNH 221046); 0.5 km SE of Cerron, 28 km SW of Villanueva, 350 m alt., 15°10'15"N, 88°06'27"W (FLMNH 224403 partim); 11.5 km SW of Francia, 50 m alt., 15°N, 85°W (FLMNH 221436); 3 km WSW of La Brea, 100 m alt., 15°N, 85°W (FLMNH 221190); 7 km ENE of La Brea, 100 m alt., 15°N, 85°W (FLMNH 221338 partim).

Nicaragua: 4 km N of Masatepe, 733 m alt., 11°N, 86°W (FLMNH 34826, 34828 partim); 5.8 km NE of Matagalpa, 12°N, 85°W (FLMNH 34840); 4 km SSW of Tuma, 700 m alt., 13°N, 85°W (FLMNH 34831 partim).

Costa Rica: Tapanti, 1433 m alt., 9°46'N, 83°46'W (FLMNH 34810 partim); Santa Ana, 1433 m alt., 9°56'N, 84°11'W (FLMNH 34821 partim); San Isidro del General, 2100 m alt., 9°59'N, 84°01'W (FLMNH 34837 partim); Volcan Barba, 2.7 km N of San Jose de la Montana, 2300 m alt., 10°N, 84°W (FLMNH 34839 partim); 4.2 km S of Nicoya, 10°N, 85°W (FLMNH 34808); 10 km S of Nicoya, 10°N, 85°W (FLMNH 34825 partim); Descamparados, 1333 m alt. (FLMNH 34809, 34811).

Colombia, Boyacá: Villa de Leiva 5.8 km towards Gachantiva, dry forest La Cabrera in Vereda La Sabana, 2170 m alt., 05°40'31"N, 73°32'15"W (UNAL; ZMH 4211).

Shell (Figures 11, 12)

Conical; apex obtuse; with irregular growth lines, without incised spiral striae, some populations with riblets, especially on the upper whorls; corneous; dully shining;

subtranslucent; 3.25–4 inflated whorls separated by a deep suture; body whorl hardly descending towards the aperture, basally rounded; aperture truncate-rounded, edentate; peristome neither expanded nor reflexed nor thickened; columellar margin dilated, partly covering the usually narrow umbilicus; umbilicus taking 0–8% of the shell breadth. Shell measurements and ratios are listed in Tables I and II.

Remarks

Pupisoma mediamericanum differs from *P. macneilli* in the on-average higher shell with a narrower umbilicus and more whorls. Note, however, that the umbilicus of specimens of *P. mediamericanum* with more than 3.5 whorls can become moderately wide. *Pupisoma mediamericanum* differs from *P. comicolense* in the on-average smaller (diameter of the first two whorls of *P. mediamericanum* 0.80–0.95 mm; diameter of the first two whorls of *P. comicolense* 0.90–1.05 mm), more distinctly striated shell. Especially in southern Central America there are large forms of *P. mediamericanum* which are difficult to distinguish from *P. comicolense*. The spire of *P. comicolense* becomes broader more quickly than that of *P. mediamericanum* so that *P. comicolense* is initially more globular, whereas *P. mediamericanum* is more conical.

Pilsbry (1920) cited “Type and paratypes” of *P. mediamericanum* Pilsbry from Orizaba (ANSP 28270), but did not note any characteristics of the “type” and did not indicate the “type” in the collection (P. Callomon, ANSP, in litt.). He mentioned also a second sample from Chama, Guatemala. Baker (1963) designated a lectotype from the sample ANSP 28270 from Orizaba and mentioned “Third set of dimensions” to characterize the lectotype. However, the third set of dimensions given by Pilsbry (1920) refers to a specimen from Chama. The specimen labelled as lectotype of *P. mediamericanum* Pilsbry (ANSP 28270a) is not a *Pupisoma* and its measurements (D=1.25 mm, H=1.35 mm) are smaller than any of the measurements given by Pilsbry (1920) for *P. mediamericanum*. Obviously, this specimen cannot be the lectotype of *P. mediamericanum* Pilsbry and it is even unlikely that it belonged to the type series of *P. mediamericanum*. It must have been mixed up with the true lectotype. The latter is missing. The two paralectotypes of *P. mediamericanum* Pilsbry from Chama (ANSP 45727) and three of the four paralectotypes from Orizaba (ANSP 28270) belong to the species figured as *P. mediamericanum* by Pilsbry (1920, Plate 4 Figures 16, 17) and identified with *P. mediamericanum* by Baker (1928, 1930). However, one of the paralectotypes from Orizaba (ANSP 28270) belongs to *P. comicolense*. Thus, the designation of a neotype is necessary to stabilize the use of the name *P. mediamericanum* Pilsbry. I designate one paralectotype from Orizaba (ANSP 28270b) as neotype. The qualifying conditions specified in Art. 75.3 of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 2000) are fulfilled: the designation of a neotype is necessary to clarify the taxonomic status of the name *P. mediamericanum* Pilsbry, 1920 (Art. 75.3.1); the characters differentiating *P. mediamericanum* from related taxa are specified above (Art. 75.3.2); the neotype is figured (Figure 11) and measured (D=1.3 mm, D2W=0.75 mm, H=1.7 mm, da=0.6 mm, dh=0.7 mm) (Art. 75.3.3); the specimen labelled as lectotype of *P. mediamericanum* cannot be the lectotype, the lectotype has been mixed up and lost, all existing type material in the ANSP has been examined (Art. 75.3.4); the neotype is conspecific with the species from Chama figured as *P. mediamericanum* by Pilsbry (1920, Plate 4 Figures 16, 17) and identified with *P. mediamericanum* by Baker (1928, 1930); thus it is likely that it is also conspecific with the lectotype designated by Baker (1963) (Art. 75.3.5); the neotype is a

paralectotype from the original type locality (Art. 75.3.6); the neotype is property of the Academy of Natural Sciences, Philadelphia (Art. 75.3.7).

According to Pilsbry (1920, p 43), *P. michoacanense* from Morelia in Michoacán, Mexico, differs from *P. mediamericanum* in the lack of pitting of the surface, the lack of distinct riblets and the fewer whorls. Unfortunately, the holotype of *P. michoacanense* is lost. Distinct riblets, especially on the upper whorls, are present in some populations (e.g. in the type series of *P. mediamericanum* from Orizaba). However, most populations of *P. mediamericanum* are sculptured only by irregular growth lines. Probably, *P. michoacanense* has been based on a specimen of *P. mediamericanum* without distinct riblets. The measurements given by Pilsbry (1920) fall within the variability of *P. mediamericanum*.

Pupisoma mediamericanum occurs sympatrically with *P. comicolense*, *P. dioscoricola*, and *P. macneilli*.

The anatomy of *P. mediamericanum* has been described by Baker (1928).

Distribution (Figure 15)

The range of *P. mediamericanum* extends from Mexico to Colombia. It occurs also on Jamaica. It is most frequent at medium altitudes. Its altitudinal range extends from 75 to 2900 m altitude.

Concluding remarks

A principal component analysis of the shell measurements of the 160 *Pupisoma* specimens summarized in Tables I and II has been made to visualize the morphometric similarities between the examined species (Figure 16). The two first components account for 90.7% of the variance. The first component is highly correlated with the size measurements (shell diameter, diameter of the first two whorls, diameter of the aperture, shell height, height of the aperture), whereas the second component is highly correlated with the number of whorls. The analysis shows that the species as delimited in this revision can be readily distinguished based on these measurements. The only problem is the delimitation of *P. macneilli* and *P. mediamericanum*. These two species differ in the width of the umbilicus which is not considered in the taken measurements.

Key to the American *Pupisoma* species

- 1. Shell with fine incised spiral striae, usually slightly depressed (D/H=0.97–1.19, mean 1.09), diameter of the first two whorls large (1.15–1.30 mm, mean 1.23) *P. dioscoricola*
- Shell without distinct incised spiral striae, globose-conical or conical (D/H=0.68–1.04), diameter of the first two whorls small (0.75–1.05 mm) 2
- 2. Shell with coarse growth-wrinkles, conical (D/H=0.68–0.82, mean 0.75), with more whorls (4.25–5, mean 4.7). *P. costulata*
- Shell without coarse growth-wrinkles, globose-conical (D/H=0.76–1.04), with less whorls (2.75–4) 3
- 3. Shell larger (diameter of the first two whorls = 0.90–1.05 mm, mean 0.99 mm) *P. comicolense*
- Shell smaller (diameter of the first two whorls = 0.75–0.95 mm) 4



Figure 15. Distribution of *Pupisoma (Pupisoma?) mediamericanum* Pilsbry, 1920 (2°-grid).

- 4. Shell lower (height=1.10–1.45 mm, mean 1.29 mm), with fewer whorls (2.75–3.5, mean 3.1), umbilicus wider *P. macneilli*
- Shell higher (height=1.30–1.80 mm, mean 1.56 mm), with more whorls (3.25–4.0, mean 3.6), umbilicus narrower *P. mediamericanum*

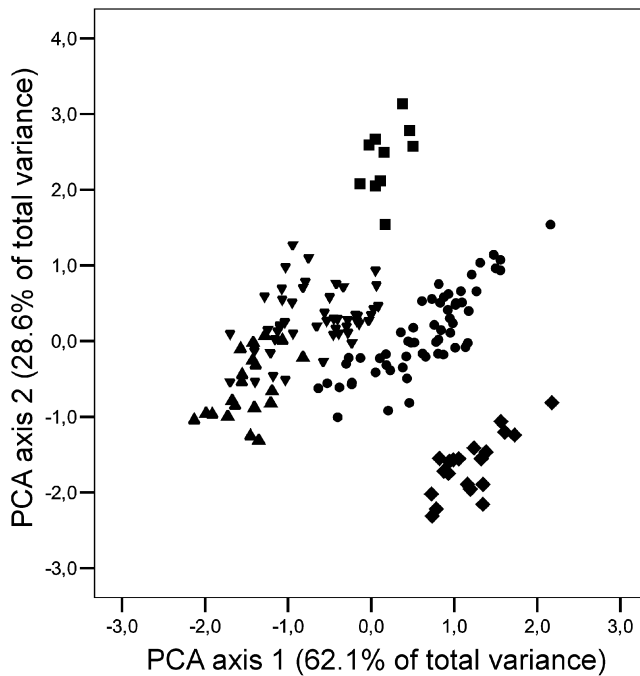


Figure 16. Principal component analysis (PCA) of the shell measurements of *Pupisoma (Ptychopatala) dioscoricola* (C. B. Adams, 1845) (◆), *Pupisoma (Pupisoma?) comicolense* H. B. Baker, 1928 (●), *Pupisoma (Pupisoma?) costulata* sp. n. (■), *Pupisoma (Pupisoma?) macneilli* (Clapp, 1918) (▲), and *Pupisoma (Pupisoma?) mediamericanum* Pilsbry, 1920 (▼).

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