

A new land snail of the genus *Gastrocopta* from Nicaragua (Pulmonata: Vertiginidae), and its relationship to species from northeastern South America

Fred G. Thompson¹ and S. J. Al López²

¹Florida Museum of Natural History, University of Florida, Gainesville, Florida 32611 U. S. A.

²Malacological Center, Universidad de América Central, P. O. Box A-90, Managua, Nicaragua

Abstract: *Gastrocopta (Immersidens) gularis*, sp. nov., is described from the submesic Pacific coastal region of western Nicaragua and Costa Rica. It is closely related to species described from regions of similar habitats in northern South America.

Key words: terrestrial Gastropoda, Vertiginidae, *Gastrocopta*, Nicaragua, Pulmonata, *Immersidens*

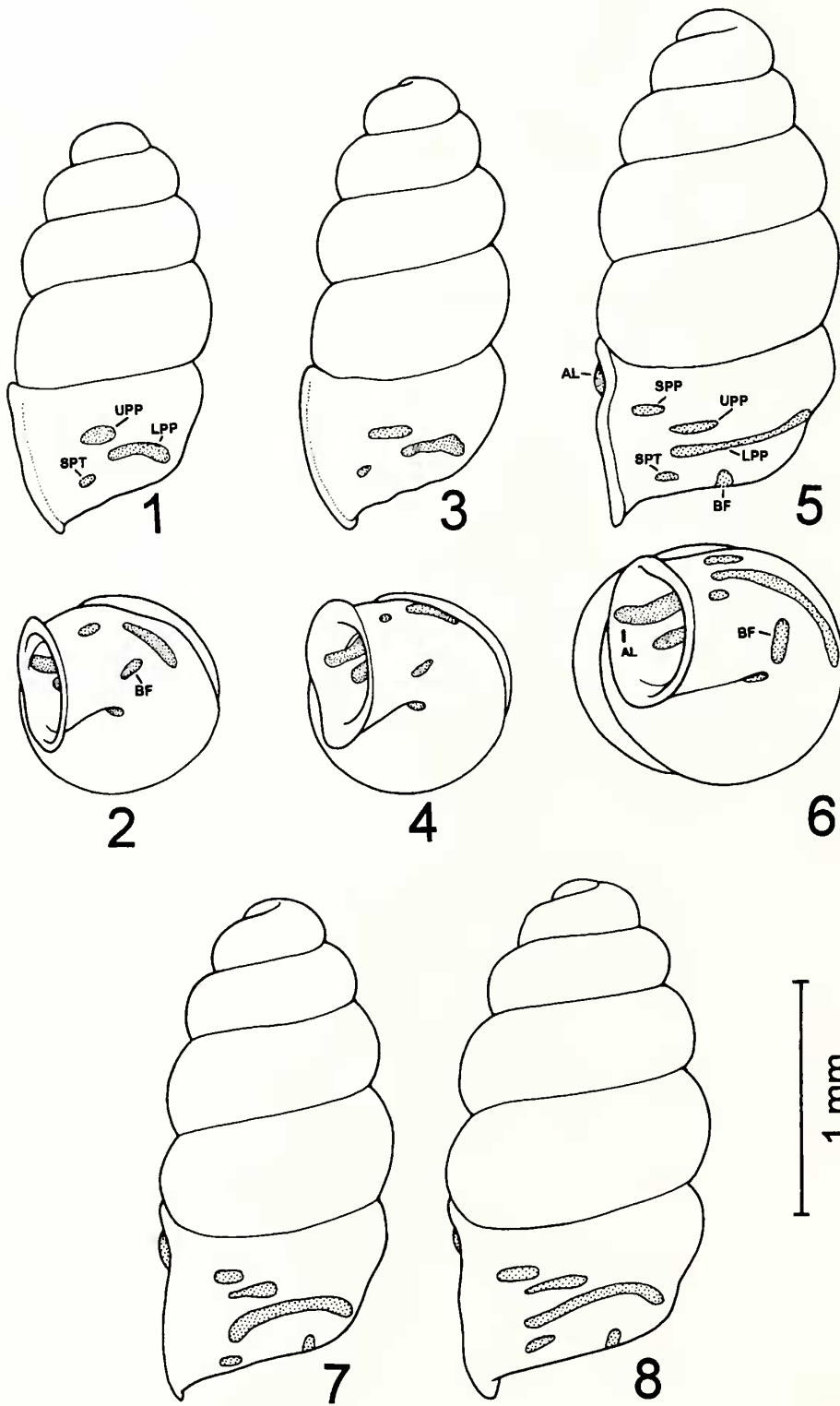
The vertiginid landsnail fauna of Central America is not well documented. Those species that have been reported from the region belong to species groups that are widespread in North America and the West Indies. The new *Gastrocopta* described herein is of particular interest because it belongs to a species group otherwise found in lowland submesic habitats in northeastern South America. Acronyms used for museum specimens cited in this paper are explained under Acknowledgments.

Gastrocopta (Immersidens) gularis, sp. nov. (Figs. 5-8, 15-19, 21, 25)

Diagnosis. A species of the subgenus *Immersidens* Pilsbry and Vanatta, 1900, by virtue of having the parietal and angular lamellae unite internally to form a configuration resembling the Greek letter lambda (λ) in shape, the basal fold is transverse to the opening, and the palatal plicae are not born on a callous ridge. It is most closely related to species from northern South America because of the absence of an exterior ridge parallel to the peristome, and the heavy development of the angular-parietal lamella. It is most similar to *Gastrocopta colombiana* Pilsbry, 1921, from which it differs by its larger, stockier shell, its slightly lower whorl-count, its stronger aperture dentition, the straight anterior half of the lower palatal plica which is not strongly arched toward the base of the whorl, and the more posteriorly located basal fold.

Description. Periostracum light brown. Aperture white. Shell elongate-tapered in shape, about 0.46-0.52

times as wide as long. Aperture height about 0.36-0.40 times the length of the shell. Spire obtusely rounded at apex. Last whorl slightly wider than penultimate whorl; without an external callus or ridge parallel to peristome; with a very shallow external longitudinal impression about 1/4 whorl long, parallel to and overlying the larger of the palatal folds. Mature shell with 4.8-5.3 evenly rounded whorls that are separated by a deep suture. Columellar wall of last half-whorl vertically flattened and nearly straight longitudinally. Umbilicus with a small, narrow, elliptical perforation that is sufficiently wide to permit visibility of the previous whorl. Shell nearly smooth, sculptured with weak, irregular, incremental growth threads that are most developed along the suture. Aperture trapezoidal in shape, about 0.77-0.87 times as wide as high; vertical in lateral profile. Peristome thin, complete across parietal wall where it is narrowly attached to preceding whorl; broadly expanded and reflected; narrowest at palatal-parietal corner. Internal barrier consisting of seven deeply immersed teeth. An additional tubercle can be present in some specimens. The parietal and angular lamellae are strong and parallel with a deep trough between them. Their bases form a coalesced buttress, and they boldly protrude basely half-way across the internal opening. The angular lamella projects slightly ahead of the peristome in lateral profile (Figs. 5, 7-8, 16-17, 25) where it flexes toward the right. It extends almost from the margin of the peristome to deep within the aperture, and it is highest just before it unites with the parietal lamella. The parietal lamella begins deeper within the aperture. It is low anteriorly and is highest posterior to where the angular lamella joins it. Its inner end curves



Figs. 1-8. Outline drawings of *Gastrocopta* showing the positions of the internal lamellae and plicae. Figs. 1-4. *G. hummelincki* (UF 246549). Figs. 5-8. *G. gularis*, sp. nov.; Figs. 5-6, holotype (UF 247775); Figs. 7-8, paratypes (UF 247776); note the relatively obese shape and the forward projection of the angular lamella in Figs. 5, 7-8. (AL, angular lamella; BF, basal fold; LPP, lower palatal plica; SPP, superior palatal plica; SPT, subpalatal plica; UPP, upper palatal plica).

strongly toward the outer wall. The columellar lamella is equally strong and extends outward almost to the parietal lamella. Deep within the aperture and at the edge of the columella it makes a right-angle bend toward the base of the shell. The basal fold lies deep within the aperture. It is high, flat-topped, and radial in alignment, transverse to the aperture. The palatal wall bears three parallel plicae (Figs. 5, 7-8): the suprapalatal, upper palatal, and lower palatal. The suprapalatal plica is small, tubercular, and lies just within the aperture. The upper palatal plica is more elongate and lies below and slightly receded to the suprapalatal plica. The lower palatal plica lies on the middle of the palatal wall and underlies the external furrow. It is straight or slightly gibbous, highest at its anterior end, and extends internally for about 1/4 of a whorl where it is slightly enlarged again. A small subpalatal tubercle is usually present anterior to the lower plica and slightly below it, as in the holotype. Shell measurements are given in Table 1.

Type material and locality. Nicaragua, Dept. Managua, Lago de Xiloa (12°14' N, 86°20' W). Holotype: UF 247775. Paratypes: UF 247776 (18); UCA 94:54 (42), same data as the holotype. The holotype of *Gastrocopta gularis* is illustrated in outline drawings to show the shape of the shell and the relative positions of the apertural lamellae (Figs. 5-6). It is not illustrated with SEM micrographs because to do so would require gold plating of the specimen.

Lago de Xiloa is an irregularly circular lake of volcanic origin approximately 2.5 km in diameter. It is on the Chiltepe Peninsula, 12 km northwest of Managua City and along the southwestern side of Lago de Managua. Lago de Xiloa was once inundated as part of Lago de Managua, but it became isolated as water levels subsided. The two lakes are now separated by a distance of 1 km. The type locality is at the western end of Lago de Xiloa in an area partly covered with a patch of submesic tropical savanna. Brush-fires occasionally scar the area. Human activity is reduced to transient hunters and fishermen. *Gastrocopta gularis* was found under leaf and rock cover in a mixture of soil and pumice gravel characteristic of the lake shore. All specimens were collected close to the water at the lower part of the sloping shore of the lake.

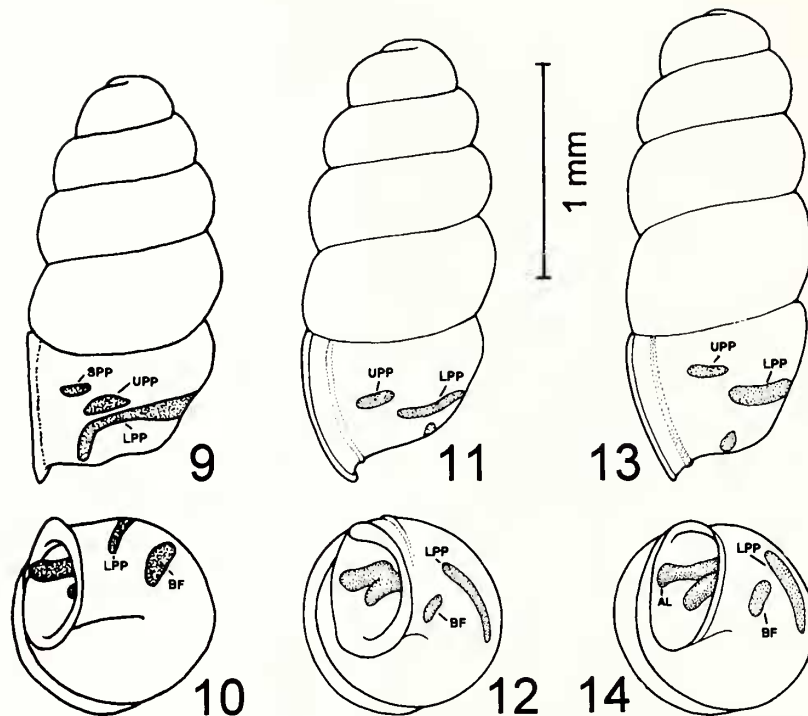
Other gastropods found at the type locality were: *Gastrocopta servilis servilis* (Gould, 1843), *G. pellucida hordeacella* (Pilsbry and Vanatta, 1900), *G. gemnizens* Pilsbry, 1917, *Pupisoma dioscoricola* (C. B. Adams, 1845), *P. sp.*, *Bothriopupa tenuicens* (C. B. Adams, 1841), *Beckianum beckianum* (Pfeiffer, 1846), *B. sinistrum* (Martens, 1898), *Lamellaxis gracile* (Hutton, 1834), *L. micra* (Orbigny, 1835), *Subulina octona* (Bruguière, 1792), *Opeas pumilum* (Pfeiffer, 1822), *Leptinaria sp.*, *Cecilioides consobrinus veracruzensis* Crosse and Fischer, 1877, *C. aperta* (Swainson, 1840), *Euglandina cumingi* (Beck,

1837), *Miradiscops sp.*, *Orthalicus ferussaci* (Martens, 1863), *Bulimulus corneus* (Sowerby, 1833), *Drymaeus multilineatus* (Say, 1925), *Succinea cf. guatemalensis* Morelet, 1849, *Guppya gundlachi* (Pfeiffer, 1839), *Hawaiiia minuscula* (Binney, 1840), *Glyphyalinia paucilirata* (Morelet, 1841), *Praticolella griseola* (Pfeiffer, 1841), *Thysanophora caecoides* (Tate, 1870), and *T. sp.* These species are common in the submesic Pacific zone of Nicaragua. Specimens of all of these species are deposited in both the Universidad de América Central and the Florida Museum of Natural History.

Distribution. Submesic regions of southwestern Nicaragua and northwestern Costa Rica. COSTA RICA.- Prov. Guanacaste: Area de Conservación Guanacaste, Parque Nacional Santa Rosa, Sector Argelia, banks of the Río Nisperal, 85°39'25" N, 10°48'33" W, 50 m alt. (INBIO 1480405); Area de Conservación Guanacaste, Parque Nacional Santa Rosa, 2.5 km N Estación Argelia, 10°47'50" N, 85°39'15" W, 20 m alt. (INBIO 1480357); Area de Conservación Tempisque, Parque Nacional Palo Verde, Sector Palo Verde, Sendero Guayacán, 10°21'02" N, 85°21'08" W, 50 m alt. (INBIO 1474875, UF 244467). NICARAGUA.- Dept. Boaco: Las Canoas, 12°31'36" N, 85°52'50" W (UCA 92:93). Dept. León: Lago Asososca, 12°26' N, 86°40' W (UCA 94:47). Dept. Managua: Platanal, 12°27'15" N, 86°05'34" W (UCA 95:89); Tamarindo, 12°29'30" N, 86°05'25" W (UCA 95:57). Dept. Masaya: Lago Apoyo, 11°55' N, 86°03' W (UCA 93:87). Dept. Matagalpa: Dario, 12°43' N, 86°12' W (UCA 93:46A; UF 247777).

Remarks. *Gastrocopta gularis* belongs to the subgenus *Immersidens* Pilsbry and Vanatta, 1900. Various species of *Immersidens* occur in South America. Other species occur in the southwestern United States, Mexico, and Guatemala. The subgenus is characterized by having the parietal and angular lamellae unite internally to form a configuration resembling the Greek letter lambda (λ) in shape. The basal fold is transverse to the opening, and the palatal plicae are not borne on a callous ridge.

Gastrocopta gularis is similar to *G. colombiana* Pilsbry, 1921, *G. humellincki* Haas, 1960, and *G. iheringi* (Suter, 1900), which are South American species. They are alike in shape, size, number of whorls, the lack of an external crest behind the peristome, the brusque aperture dentition, the parallel alignment and heavy structure of the parietal-angular lamella complex, and the shape of the columellar lamella. They differ from each other by aspects of shell shape and aperture dentition as discussed below. They contrast with North American species of *Immersidens* by the heavy construction and parallel alignment of the parietal-angular lamella, as opposed to the weaker construction and the more open λ -shaped configuration of the parietal-angular lamellae. The heavy downward-turned columellar



Figs. 9-14. Outline drawings of *Gastrocopta* showing the positions of the internal lamellae and plicae. Figs. 9-10. *G. colombiana* (FMNH 65394). Figs. 11-12. *G. d. dalliana* (SBMNH 71098). Figs. 13-14. *G. d. bilamellata* (SBMNH 71213). (AL, angular lamella; BF, basal fold; LPP, lower palatal plica; SPP, superior palatal plica; UPP, upper palatal plica).

lamella is also unique, except for the appearance of a similar but weaker development of this trait in the North American *G. dalliana bilamellata* (Sterki and Clapp, 1909), which occurs in Arizona, Chihuahua, and Sonora (Bequaert and Miller, 1973; Naranjo-Garcia, 1991) (Figs. 13-14).

Gastrocopta colombiana (Figs. 9-10; Table 2) is found along the Caribbean coastal region of Colombia. It was described from Puerto Colombia, Dept. Atlántico, Colombia (Pilsbry, 1921). It is a slightly smaller and more slender species than *G. gularis*. It has a slightly higher whorl-count. Its aperture dentition is similar to that of *G. gularis*, but weaker. Also, the anterior half of the lower palatal plica is strongly arched toward the base of the whorl

so that its forward end lies almost transverse to the base of the whorl. The basal fold is more anteriorly located than it is in *G. gularis*.

Gastrocopta hummelincki is from Margarita Island, Venezuela. In *G. hummelincki*, the angular lamella does not extend to the edge of the parietal lip. A suprapalatal plica is usually absent (Figs. 1, 3). When present, it is a low narrow tubercle just inside the peristome (Figs. 21-22). The species has a single, short, deeply immersed upper palatal plica (Figs. 1, 3). The lower palatal plica is relatively short, deeply immersed within the aperture, and is weakly arched toward the base. The subpalatal plica is short and compressed-tubercular. It is nearly aligned with the lower

Table 1. *Gastrocopta gularis*, sp. nov. Measurements (in mm) based on 19 specimens. Measurements are converted to mm from ocular micrometer units. Ratios are based on micrometer units. (ApH, aperture height; ApW, aperture width; SD, standard deviation; SH, shell height; SW, shell width).

	SH	SW	ApH	ApW	whorls	SW/SH	ApH/SH	APW/APH
Holotype	2.31	1.09	0.83	0.69	5.3	0.47	0.40	0.83
Paratypes (N = 18)								
min.	2.11	1.06	0.76	0.66	4.70	0.46	0.35	0.77
max.	2.57	1.22	0.92	0.76	5.30	0.52	0.40	0.87
Mean	2.27	1.10	0.83	0.70	5.09	0.49	0.37	0.84
SD	0.13	0.05	0.04	0.03	0.19	0.02	0.03	0.04

Table 2. *Gastrocopta columbiana* Pilsbry, 1921. Measurements (in mm) based on 11 specimens (FMNH 65394). Measurements are converted to mm from ocular micrometer units. Ratios are based on micrometer units. (ApH, aperture height; ApW, aperture width; SD, standard deviation, SH, shell height; SW, shell width).

	SH	SW	ApH	ApW	whorls	SW/SH	ApH/SH	APW/APH
min.	1.91	0.96	0.73	0.66	5.20	0.45	0.33	0.80
max.	2.27	1.02	0.83	0.73	5.60	0.52	0.96	0.96
Mean	2.10	1.00	0.78	0.69	5.35	0.48	0.37	0.89
SD	2.27	1.10	0.83	0.70	5.09	0.49	0.37	0.84

palatal plica from which it is separated by a gap (Figs. 1, 3). The short tubercular basal fold of *G. hummelincki* is oblique in orientation (Figs. 2, 4, 21-22), and not transverse as in other species of *Immersidens*. Shell measurements are given in Table 3.

Haas (1960) incompletely described *Gastrocopta hummelincki*, and his illustrations do not show sufficient detail for critical comparisons. He correctly identified the upper palatal plica, but he failed to describe its length or its location relative to its distance from the lip. The structure referred to as the basal fold is the lower palatal plica. The structure Haas called the lower palatal plica is actually the transverse basal fold.

Pilsbry (1916: 101-102, pl. 17, fig. 16) provided an excellent description and illustration of *Gastrocopta iheringi*. This species has a rimate umbilical perforation that occludes visibility of the previous whorl. The aperture is elongate-oval in shape. The peristome is narrow and is discontinuous across the parietal wall in adult specimens. The parietal lamella is highest where it is joined by angular lamella, and is aligned between the upper and the lower palatal plicae. The upper and lower palatal plicae are short and lamellar. The upper palatal plica is posterior to the lower palatal plica. The lower palatal plica is short and is compressed-tubercular in shape. The basal fold is about twice as long as in *G. gularis* and lies transverse to the aperture.

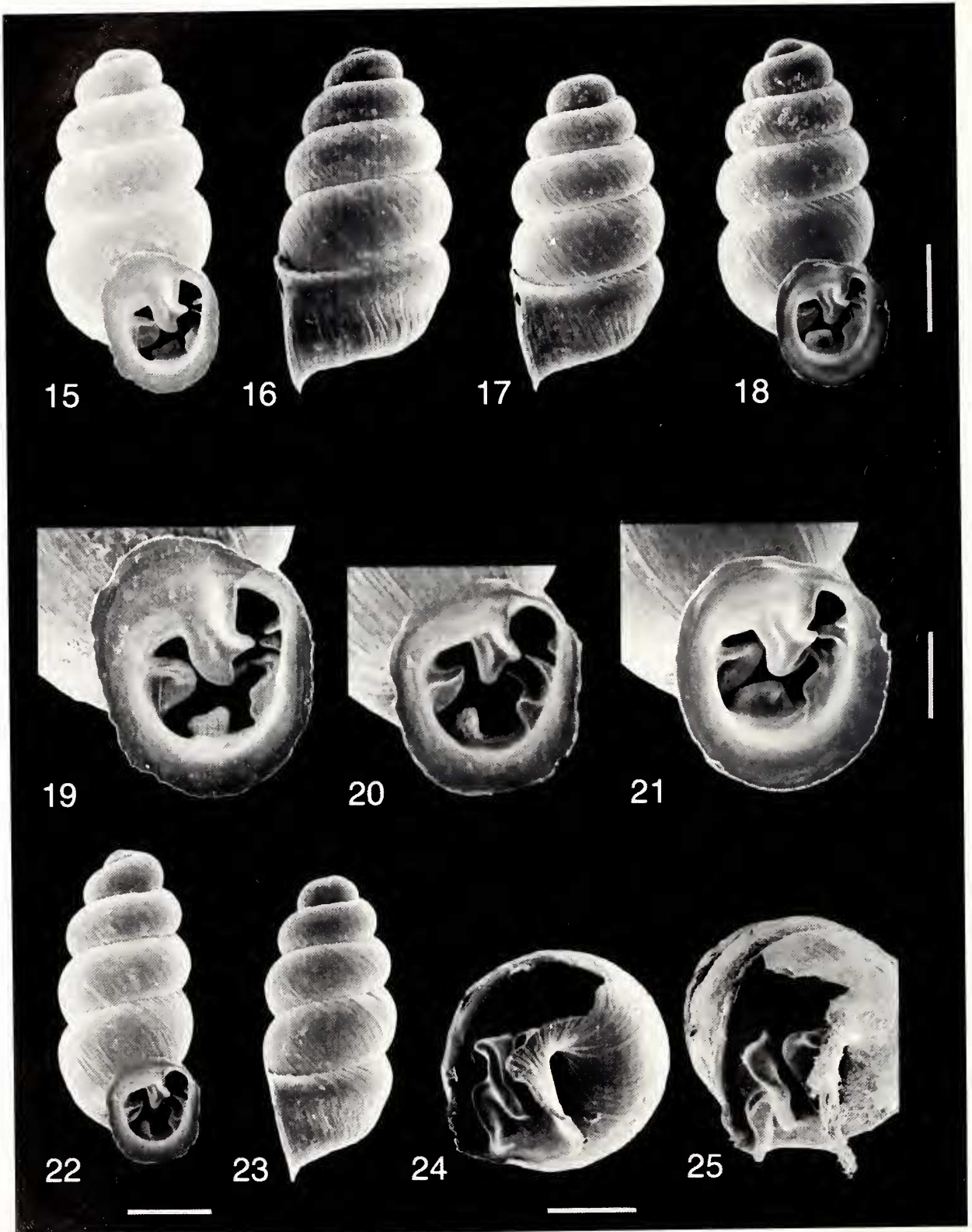
Gastrocopta iheringi occurs in southeastern Brazil (Suter, 1900). Other country records are doubtful. Richards and Hummelinck (1940: 11) reported *G. iheringi* from several Caribbean islands off the Venezuelan coast, including Margarita Island, as well as several localities from the

mainland. These same specimens were reported upon by Haas (1960). Specimens recorded by Richardson and Hummelinck from Margarita Island are *G. hummelincki* (see Haas, 1960: 16). I have examined the specimens that they and Haas recorded from Dept. La Guajira, Colombia (FMNH 65273, FMNH 65393, FMNH 65394). They are *G. colombiana*. Specimens recorded by these authors from Isla Chacachacare, Trinidad (FMNH 65389) apparently are an undescribed species of *Gastrocopta*. Arias (1955: 144-145) also recorded *G. iheringi* from Venezuela, following the earlier report by Richards and Hummelinck. Arias quoted Pilsbry's description of *G. iheringi*, but he did not describe or illustrate any of his specimens from Venezuela. Critical examination of these specimens is necessary to confirm the occurrence of *G. iheringi* in Venezuela. However, its occurrence there is doubtful.

Gastrocopta dalliana bilamellata from Arizona and Sonora is similar to *G. gularis* in having the posterior edge of the columellar lamella curved downward. The columellar lamella is horizontal in *G. d. dalliana* (Sterki, 1898). Aside from the configuration of the columellar lamella in *G. d. bilamellata*, *G. dalliana* and its subspecies have little in common morphologically with *G. gularis*. Their shells are nearly cylindrical, they have an external crest behind the peristome, their aperture dentition is much weaker, their parietal-angular lamellae are broadly λ -shaped, and their lower palatal plica is short and deeply immersed (Figs. 13-14). Similarities between *G. d. bilamellata* and *G. gularis* in the curvature of the columellar lamella must be considered convergent. Other characters, including the external post-labial crest in *G. d. bilamellata* indicates a closer relationship of that species to other North American

Table 3. *Gastrocopta hummelincki* Haas, 1960. Measurements (in mm) based on 10 specimens (UF 246549). Measurements are converted to mm from ocular micrometer units. Ratios are based on micrometer units. (ApH, aperture height; ApW, aperture width; SD, standard deviation, SH, shell height; SW, shell width).

	SH	SW	ApH	ApW	whorls	SW/SH	ApH/SH	APW/APH
min.	1.78	1.83	0.59	0.53	4.50	0.46	0.32	0.80
max.	2.01	2.01	0.73	0.63	4.90	0.49	0.37	0.99
Mean	1.92	0.91	0.67	0.59	4.76	0.47	0.35	0.89
SD	0.07	0.04	0.03	0.03	0.13	0.01	0.02	0.04



Figs. 15-23. Scanning electron micrographs of *Gastrocopta* shells. Figs. 15-19, 21, 25. *G. gularis*, sp. nov. Figs. 15-17, 19, 25, Paratypes (UF 247776). Figs. 18, 21, specimen from Costa Rica (UF 244467); note the forward projection of the angular lamella in Figs. 16, 17, and 25. Figs. 20, 22, 23. *G. hummelincki*, specimens from Margarita Island, Venezuela (UF 246549). Scale = 0.25 mm (19-21, 24-25); 0.5 mm (15-18, 22-23).

Immersidens.

Gastrocopta gularis, *G. colombiana*, and *G. hummelincki* form a group of closely related species that is ecologically deployed at low-elevation submesic zones in Central America and Caribbean coastal South America. The closest phylogenetic relationship of this species-group appears to be with other South American *Immersidens*.

Etymology. The species name *gularis* is from the Latin, *gula*, and alludes to the obstructed throat of the aperture.

SPECIMENS EXAMINED

Gastrocopta colombiana Pilsbry, 1921

COLOMBIA. Dept. La Guajira: 1 km S of Río Hacho (FMNH 65273, 12 specimens); NE of Río Hacho (FMNH 65396, 3 specimens); 2 km S of Río Hacho (FMNH 65394, 41 specimens).

Gastrocopta dalliana dalliana (Sterki, 1896)

UNITED STATES. Arizona: Cochise Co., Ransey Canyon, Huachuca Mountains (SBMNH 71098, numerous specimens).

Gastrocopta dalliana bilamellata (Sterki and Clapp, 1909)

UNITED STATES. Arizona: Pima Co., Tanque Verde Creek, NE of Tucson (SBMNH 71213, numerous specimens).

Gastrocopta hummelincki Haas, 1960

VENEZUELA. Est. Nueva Esparta: Margarita Island, SE of Valle (ANSP 177413, 14 specimens); Basa del Piache, SE of Valle (FMNH 65270 [holotype], ANSP 178108, 1 specimen); S of La Fuente, Paraguachi (FMNH 65274, 5 specimens); Cerro de Mármoles, E of Guantamare (FMNH 65272, 11 specimens); El Cerrito, E of La Asunción (FMNH 65276, 16 specimens); Morro Grande de Tamarindo (FMNH 65275, 1 specimen); 7 km E of Robledal (11°03.0'N, 64°19.4'W) (UF 246558, ca. 100 specimens); Fuentidueño, 2.2 km S of San Juan (11°00.7'N, 63°55.5'W) (UF 246549, ca. 100 specimens); Punta Curichicual, 4.4 km SE of Boca de Pozo (10°57.6'N, 64°20.8'W) (UF 246557, 1 specimen); 1 km S of San Francisco (11°00.8'N, 64°17.5'W) (UF 246565, ca. 200 specimens). Est. Sucre: Morro de Esmeranda, W of Carúpano (ANSP 177410, 14 specimens).

Gastrocopta iheringi (Suter, 1900)

BRAZIL. Est. Rio Grande do Sul: Bollaxa (ANSP 22940, 1 specimen).

Gastrocopta sp.

TRINIDAD AND TOBAGO. Chacachacare Island (FMNH 65389, 5 specimens).

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LITERATURE CITED

- Arias, S. 1955. Los Pupillidae (Pulmonata, Stylommatophora: Orthurethra) colectados en Venezuela septentrional. *Memoria de La Sociedad de Ciencias Naturales La Salle* 15:140-169.
- Bequaert, J. C. and W. B. Miller. 1973. *The Mollusks of the Arid Southwest with an Arizona Check List*. University of Arizona Press, Tucson. xvi + 271 pp.
- Haas, F. 1960. Caribbean land molluscs: Vertiginidae. *Studies on the Fauna of Curaçao and other Caribbean Islands* 10:1-17, pls. 1-5.
- Naranja-Garcia, E. 1991. Present status of the micromollusks of northern Sonora, Mexico. *American Malacological Bulletin* 8:165-171.
- Pilsbry, H. A. 1916-1918. Pupillidae (Gastrocoptinae). *Manual of Conchology*, ser. II, 24: i-xii, 1-380, pls. 1-49.
- Pilsbry, H. A. 1920-1921. Pupillidae (Vertiginae, Pupillinae). *Manual of Conchology*, ser. II, 26: i-iv, 1-254, pls. 1-24.
- Richards, H. G. and P. W. Hummelinck. 1940. Land and freshwater mollusks from Margarita Island, Venezuela. *Notulae Naturae* 62:1-16.
- Suter, H. 1900. Observacoes sobre alguns caracões terrésteis do Brazil. *Revista do Museu Paulista* 4:329-337, pl. 3, figs. 8, 8a.

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