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A new *Triodopsis juxtidentis* subspecies (Gastropoda: Pulmonata) from West Virginia, U.S.A.

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The Appalachian Mountains of North America hold a unique diversity of land snails, including those within the family Polygyridae genus *Triodopsis*. West Virginia has ten or more representatives of the genus (Hubricht, 1985), displaying variations upon the conchological theme of a depressed heliciform shape with a reflected peristome bearing three lamellae. However, it remains unclear whether all of the recognized variants on this theme represent species as commonly defined. In the case of the *Triodopsis juxtidentis* (Pilsbry, 1894) subgroup as defined by Emberton (1988)—*T. juxtidentis*, *T. discoidea* (Pilsbry, 1904), *T. neglecta* (Pilsbry, 1899), and *T. pendula* Hubricht, 1952—no penial morphology or allozyme differences are known (Emberton, 1988). Conversely, mitochondrial DNA analysis that included five *T. juxtidentis* specimens suggests this putative species is not monophyletic (Perez *et al.*, 2014). Rampant variation in shell morphology among *Triodopsis* species creates further taxonomic and identification challenges. Without additional supporting evidence for species-level differences, such as anatomical and genetic analyses, a conservative taxonomic approach is to recognize regionally distinct forms as subspecies. A unique form from the upper Bluestone River watershed is described here as *Triodopsis juxtidentis robinae* subsp. nov.

Family Polygyridae (Pilsbry, 1895)

Genus *Triodopsis* Rafinesque, 1819

***Triodopsis juxtidentis* (Pilsbry, 1894)**

***Triodopsis juxtidentis robinae* subsp. nov.**

Diagnosis. Shell distinguished by a relatively wide peristome, markedly constricted behind; an aperture periphery that is more triangular rather than round or oval, tallest just to the right of its attachment to the body whorl, with the palatal edge not high and round, widest below an imaginary horizontal midline (viewed with spire up, in the plane of the aperture), wider than tall; a strong parietal lamella that is curved toward the palatal denticle, not pointing above or below (for the three distinct shell accretions on the peristome, here “lamella” refers to that on the parietal wall, while “denticle” refers to those on the palatal and basal walls); a palatal denticle that is often (but not always) wide at the distal end, with the apex of the denticle pointing inward of the parietal lamella; and a basal buttress with a denticle that is deeper than wide, transverse upon the buttress. No other described taxon has a triangular aperture along with a parietal lamella pointing at the palatal denticle and a basal denticle upon a buttress.

***Triodopsis juxtidentis robinae* subsp. nov.**

Type locality. Brush Creek Preserve, The Nature Conservancy, Mercer County, West Virginia, U.S.A.; on and in leaf litter on steep forested slopes of Brush Creek above its confluence with the Bluestone River.

Holotype. CM103371, U.S.A. West Virginia, Mercer County, Brush Creek Preserve, Timothy A. Pearce, 1 October 2007. Shell (Figure 1) on a steep rocky slope with a mixed eastern hemlock (*Tsuga canadensis* L.(Carr.))-hardwood forest canopy, on the east side of Brush Creek above its confluence with the Bluestone River (within 10m of UTM, NAD83, 17S, 0494625, 4147911).

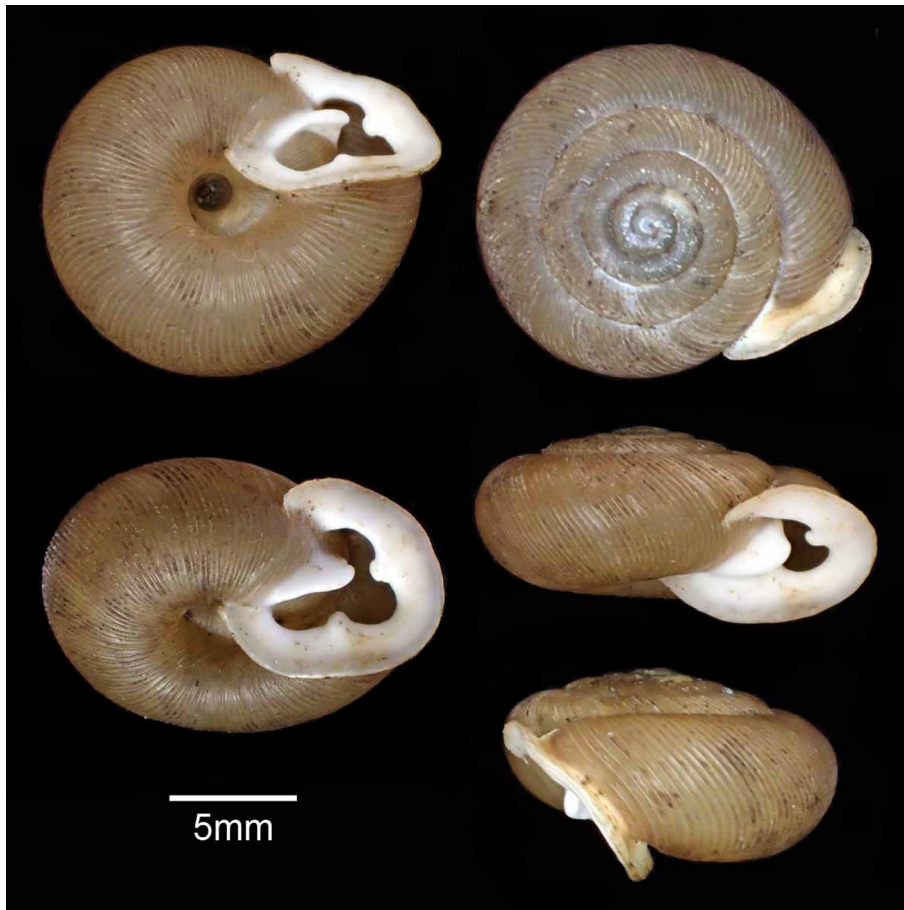


FIGURE 1. Shell of *Triodopsis j. robiniae* subsp. nov. holotype from Brush Creek, Mercer Co., West Virginia (CM103371). Photographed by Charles F. Sturm.



FIGURE 2. View of the aperture and basal denticle of *Triodopsis j. robiniae* subsp. nov. holotype (CM103371). Photographed by Charles F. Sturm.

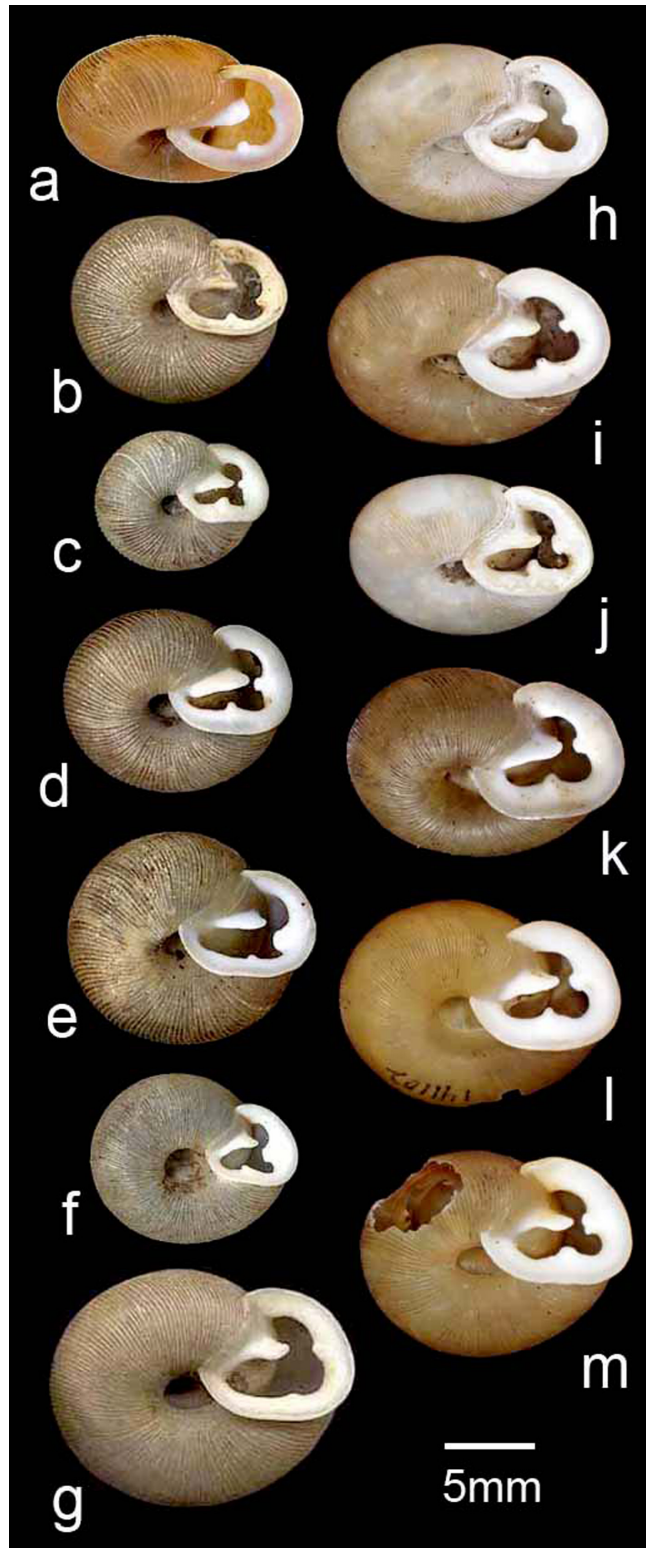


FIGURE 3. Comparison of seven *Triodopsis* species shells (left) to a series of six *Triodopsis j. robiniae* subsp. nov. shells (right). The *Triodopsis* species representatives have similar shells to the new subspecies or are geographically near. To the left, from top to bottom, are: a, *T. juxtidentis*, Durham, NC, 11 August 2008 (W. Frank, personal collection); b, *T. juxtidentis* also from Durham Co., NC (H.G. Lee, personal collection); c, *T. rugosa* from Logan Co., WV (FMNH264690); d, *T. anteridon* from Wyoming Co., WV (FMNH264768); e, *T. picea* from Pocahontas Co., WV (FMNH266426); f, *T. pendula* from Iredell Co., NC (FMNH266352), and g, *T. discoidea* from Crawford Co., IN (H.G. Lee, personal collection). To the right are paratype h, *Triodopsis j. robiniae* subsp. nov. from Brush Creek (CM97548); paratypes i, j, Brush Creek (CM97549; two shells); k, the holotype from Brush Creek (CM103371); paratype l, Pipestem State Park (CM141101); and paratype m, Brush Creek (CM85754). Adapted from Frank and Lee (2014), with permission, and with photography of *Triodopsis j. robiniae* subsp. nov. specimens by Charles F. Sturm.

Paratypes. CM97548, five shells from the west side of Brush Creek close to its confluence with the Bluestone River, Kenneth P. Hotopp and Brett Freedman, 3 August 2005; CM97549, five shells from mesic forest among cliffs on the west side of Brush Creek near the type locality, Kenneth P. Hotopp and Brett Freedman, 3 August 2005 (within 50m of UTM, NAD83, 17S, 0494627, 4147741); CM141101, five shells from hardwood forest near a hillside spring at Pipestem State Park, Kenneth P. Hotopp and Kenneth R. Hotopp (Sr.), 19 September 2008 (within 50m of UTM, NAD83, 17S, 0500316, 4152917); CM141102, five shells from mixed forest upon sandstone talus at Pipestem State Park, Kenneth P. Hotopp and Kenneth R. Hotopp (Sr.), 19 September 2008 (Figure 3; within 50m of UTM, NAD83, 17S, 0498866, 4154255); CM85754, one live specimen on a steep, wooded slope at the foot of a cliff above a ravine, east side of Brush Creek, Timothy A. Pearce and Alice W. Doolittle, 1 October 2007, (within 10m of UTM, NAD83, 17S, 0494866, 4147454).

Additional material. Daniel C. Dourson, personal collection, 16 shells from cliffline at Brush Creek, Jeffrey J. Hajenga, 12 March, 2013; Daniel C. Dourson, personal collection, 16 shells from forest at Brush Creek, Jeffrey J. Hajenga, undated; Daniel C. Dourson, personal collection, 5 shells from forest at Sand Branch, Jeffrey J. Hajenga, 13 October, 2013; CM103371, one immature shell from mixed forest, southeast side of junction of Brush Creek with Bluestone River, Timothy A. Pearce, 1 October 2007 (within 10m of UTM, WGS84, 17S, 0494625, 4147911); CM85754, five broken shells from a steep, wooded slope at the foot of a cliff above a ravine, east side of Brush Creek, Timothy A. Pearce and Alice W. Doolittle, 1 October 2007 (within 10m of UTM, NAD83, 17S, 0494866, 4147454).

Etymology. The subspecific name *robinae* is in honor of my wonderful wife, Mary “Robin” Robertson Gorrell, originally of Clarksburg, West Virginia, on the year of our 25th wedding anniversary.

Distribution. Forested slopes of the Bluestone River Valley and tributaries in Mercer and Summers Counties, West Virginia, U.S.A.

Description. Shell (Figures 1,2) 7.7mm tall (paratypes 7.0–9.0mm; measured from apex to lowest point on shell with axis vertical) x 14.7mm wide (paratypes 13.1–17.6mm; measured including the peristome), height:width 0.49 (paratypes 0.45–0.58); umbilicus open, 3.2mm wide (paratypes 2.3–4.2mm; measured at the whorl suture immediately behind the peristome to the suture on the farthest side of the umbilicus), umbilicus:width 0.20 (paratypes 0.17–0.24); whorls 5.2 (4.75–5.5; counted along a tangent starting parallel with the beginning of the apical suture, following Pilsbry [1939]); color light brown to reddish-brown. Protoconch and juvenile whorls with fine growth wrinkles, subsequent whorls with growth wrinkles and fine, regular ribs, approximately 3.5 ribs/mm (paratypes 3.5–4.5) on final quarter whorl; sculpture becoming minutely papillose, primarily at the suture and final whorl; final whorl inflated near the end, the suture rising upon the wall of the penultimate whorl, then abruptly descending and well-constricted behind the aperture. Aperture widely reflected, white, 7.5mm tall (outside distance, measured on plane of aperture; paratypes 5.9–7.8mm) x 8.5mm wide (outside distance, measured from columellar edge of basal peristome to farthest palatal limit; paratypes 6.8–9.1mm), broadly triangular (viewed in the plane of the aperture), with the triangle’s apex usually to the right of the point at which the peristome meets the body whorl, and widest below an imaginary horizontal midline; peristome slightly-to-moderately dished and projecting forward at the top edge, with parietal, basal and palatal lamellae, often nearly straight along its basal edge; a light parietal callus at the aperture. Parietal lamella narrow, slightly to strongly curved toward the palatal denticle, its umbilical end sometimes continuous with the basal peristome; palatal denticle variable, usually wide at the distal end but sometimes pointed, and pointing inward behind parietal lamella; interdenticular sinus usually a defined semicircle; basal denticle deeper than wide, set perpendicular to the aperture upon a horizontal buttress (Figure 2), the buttress usually taller to the palatal side of the tooth. Body of animal gray with dorsal surface of upper tentacles darker.

Morphological comparisons and final remarks

Comparisons. *Triodopsis* species illustrations and descriptions that were used for comparison are those in Pilsbry (1940), MacMillan (1949), Hubricht (1952, 1958), Emberton (1988), Dourson (2010), Lee (2011), and Frank and Lee (2014), in addition to shells in the author’s personal collection and at the Carnegie Museum of Natural History. Comparisons are made with southern West Virginia *Triodopsis* species having shells most similar to the new taxon, and to *Triodopsis juxtidentis* subgroup species, which have aperture and denticle positions relatively similar to the new taxon. The shell of *Triodopsis j. robinae* subsp. nov. is unlike that of *T. juxtidentis* in that the aperture of *Triodopsis j. robinae* subsp. nov. is less round and more triangular, with its apex farther to the right of the attachment to the body whorl, and widest nearer the base (Figure 3). The umbilicus is relatively wider, and the peristome is more widely reflected. The parietal lamella points at the palatal denticle and not above, as is sometimes the case in *T. juxtidentis*. In relation to *T.*

rugosa Brooks and MacMillan, 1940 and *T. anteridon* (Pilsbry, 1940) the shell of *Triodopsis j. robiniae* subsp. nov. is larger, the triangular aperture is more depressed, and the palatal denticle is not buttressed below. Compared with *T. picea* Hubricht, 1958, the aperture of *Triodopsis j. robiniae* subsp. nov. is more triangular and more broadly reflected. Compared with *T. pendula* the shell of *Triodopsis j. robiniae* subsp. nov. is larger, the peristome is not as dished, and the parietal lamella points at the palatal denticle, not above. *Triodopsis pendula* occurs geographically nearest to *Triodopsis j. robiniae* subsp. nov. in southwest Virginia (Hubricht, 1985). In comparison to *T. discoidea*, or *T. neglecta* (not shown), the aperture of *Triodopsis j. robiniae* subsp. nov. is more triangular, and not as tall and rounded toward the palatal side. A basal buttress is present, unlike *T. discoidea*. *Triodopsis discoidea* and *T. neglecta* occur farther to the west of *Triodopsis j. robiniae* subsp. nov., *T. discoidea* nearest in Kentucky and Ohio and *T. neglecta* beyond in Missouri and Arkansas (Hubricht, 1985).

Variation. Individual shells of *Triodopsis j. robiniae* subsp. nov. vary in overall shape, with wider diameter and more loosely-coiled shells often being more depressed. The aperture in smaller shells may be more crowded, with the palatal denticle and peristome coming close to the parietal lamella, and the interdenticular sinus somewhat collapsed (Fig. 3, j). The parietal lamella may become abruptly higher at its distal (palatal) point, or increase in height more regularly. The palatal denticle is variable, from wide at the tip (either blunt or angular), to triangular (Figure 3, h). This denticle sometimes has an indentation, giving the superficial appearance of a divided tooth (Figure 3, m). The basal buttress may be uneven at its top edge, suggesting a tiny denticle to the palatal side of the basal denticle (Figure 3, j, l).

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