

# *Patera appressa* (Say, 1821), an introduced land snail in Ontario, Canada (Mollusca: Gastropoda: Polygyridae)

Robert G. Forsyth<sup>1\*</sup>, Michael J. Oldham<sup>2</sup> and Frederick W. Schueler<sup>3</sup>

1 Research Associate, New Brunswick Museum, 277 Douglas Avenue, Saint John, New Brunswick, Canada E2K 1E5

2 Natural Heritage Information Centre, Ministry of Natural Resources and Forestry, 300 Water Street, PO Box 7000, Peterborough, Ontario, Canada K9J 3C7

3 Bishops Mills Natural History Centre, 6 St. Lawrence Street, Bishops Mills, RR#2 Oxford Station, Bishops Mills, Ontario, Canada K0G 1T0

\* Corresponding author. E-mail: [rforsyth@mollus.ca](mailto:rforsyth@mollus.ca)

**Abstract:** The geographic distribution and habitat of *Patera appressa* (Say, 1821) in Canada are described. This is a North American land snail native to the southern Appalachians but it has been known, since 1994, from a cluster of sites in Trenton, City of Quinte West, Ontario, where it is presumably introduced. It may no longer be extant at any of the known Ontario sites.

**Key words:** introduced species, geographic distribution, Mollusca, Gastropoda, Polygyridae, Ontario, Canada

A major milestone in Canadian terrestrial malacology was reached with the publishing of the first book to attempt to describe and illustrate all introduced land snails and slugs in Canada (Grimm et al. 2010). However, because this book was predominantly an identification guide and due to space and other limitations, it did not include detailed distributional data. Among the species featured in the book was *Patera appressa* (Say, 1821) (Mollusca: Gastropoda: Polygyridae; Figure 1), which is known in Canada only from Trenton, City of Quinte West, Hastings County, Ontario (Figures 2 and 3).

*Patera appressa* is native to the southern Appalachians and specifically is known from southern Ohio, West Virginia, Virginia, eastern Kentucky, eastern Tennessee, North Carolina, and northeastern South Carolina, but there are additional records from other states as far west as Indiana and Oklahoma and north to Maryland (Hubricht 1985; Martin and Bergey 2013).

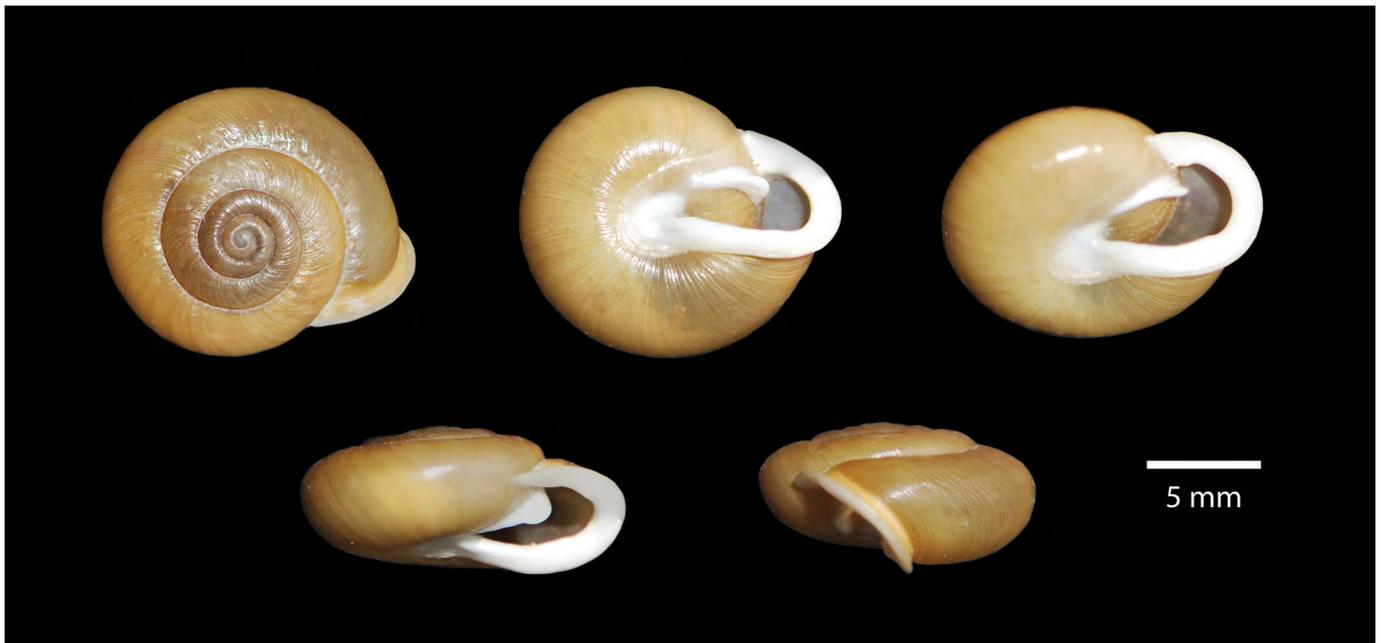
Although details of some collection events are now lost, we document as best as possible the known sites for *Patera appressa* at Trenton, City of Quinte West, Ontario, its only known location in Canada. We also clarify our reasons why we believe that this species is introduced to Canada. Among the many species of

introduced terrestrial molluscs in Canada, this species is notable because it is a native North American species. Finally, we infer that populations are declining or now extirpated, with no live snails found since 2006.

Specimens of *Patera appressa* were observed or collected on several occasions between 1994 and 2014. These collections have been deposited in the New Brunswick Museum (NBM), Saint John (New Brunswick), the Mollusc Collection of the Canadian Museum of Nature (CMNML), Gatineau (Quebec), and in the personal collection of RGF (Table 1). Although specimens were collected in 1994 by one of us (FWS) and given to the late F. W. Grimm, these were not located in his collection and it is possible he did not examine this material although he did identify the other molluscan collections from this project (Karstad et al. 1995). These have gone missing over the years since the species' initial discovery in Ontario.

Our identifications were made using the publications of Pilsbry (1940), Hubricht (1976), and Dourson (2010).

Relative to the majority of Canadian land snails, shells of *Patera appressa* are rather large (14–18 mm wide; Grimm et al. 2010). *Patera appressa* has a noticeably flattened spire and is pale brown (Figure 1). There are fine but rather coarse transverse wrinkle-like riblets over the whole shell surface but strongest on the apical surface of the whorls; these riblets are much weaker on the basal surface so that to the unaided eye, the base appears smooth. Microscopic rows of minute papillae are scarcely evident in the best preserved shells. The umbilicus is entirely sealed in adult shells by a prominent white callus. There is a long, slightly curved, white tooth on the parietal wall. The baso-columellar lip of the aperture bears a ridge-like callus that truncates before reaching the palatal lip. No teeth are present on the palatal lip (Grimm et al. 2010). Among native and introduced snails in Canada, *P. appressa* is distinctive



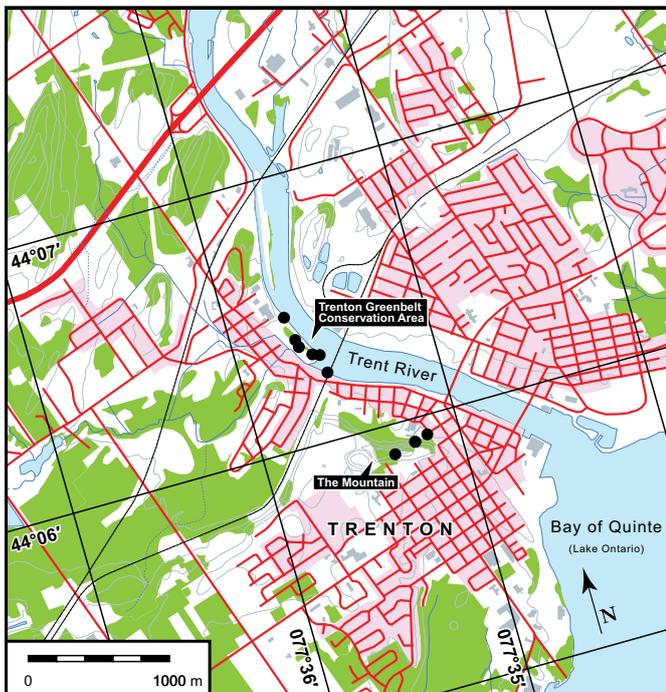
**Figure 1.** Five views of a shell of *Patera appressa*, from along the Trent River, Trenton, City of Quinte West, Hastings County, Ontario, Canada; NBM 009026; maximum diameter (width), 14.3 mm.

and unlikely to be confused with any other species. However, the Canadian polygyrids that most resemble *P. appressa* by presence of a closed umbilicus, a long parietal tooth and depressed form are *Infectarius inflectus* (Say, 1821), *Neohelix dentifera* (A. Binney, 1837) and *Xolotrema denotatum* (A. Férussac, 1821). The shell of *I. inflectus* differs from *P. appressa* by its smaller size and

by having a more prominent, tubercle-like basal tooth, as well as a palatal tooth; the shell surface is microscopically granular under a hirsute periostracum. *Neohelix dentifera* is somewhat larger than *P. appressa* (>19 mm; Pilsbry 1940), with a slightly higher spire and a shorter parietal tooth. *Xolotrema denotatum* is also larger (>18 mm; Pilsbry 1940), with a prominent palatal tooth and closely, microscopically papillose shell surface under a scaly periostracum.

One of us (MJO) gave specimens to the late F. Wayne Grimm for identification, who reported it as “*Patera cf. panselena* [sic]” (Grimm 1996), a southern Appalachian endemic restricted to West Virginia, western Virginia, and extreme southeastern Kentucky. Grimm apparently had done some anatomical work on this material but was uncertain about his identification and seems to have thought it related to, but not the same as, *P. panselenus* (Hubricht, 1976). However, he left no detailed notes or other evidence to support this hypothesis.

Pilsbry (1940) described and figured all taxa in the group then known. Hubricht (1976) described *Patera panselenus* (as *Mesodon*) and stated that it was most like *P. perigrapta* (Pilsbry, 1894) but with a more flattened shell and anatomically with a much shorter penis. Dourson (2010) described and figured all species in the group, including *P. perigrapta* and *P. appressa*. *Patera perigrapta* and *P. panselenus* have strong microscopic spiral striae; *P. laevior* (Pilsbry, 1940) has very weak spiral striae; and *P. appressa* has spiral rows of microscopic papillae (Pilsbry 1940; Hubricht 1976; Dourson 2010). We find that Canadian shells certainly do not exhibit the strong, deep spiral striae of *P. perigrapta* (see Pilsbry 1940: 755, Fig. 454d). In some of the best preserved shells we do



**Figure 2.** Trenton, Ontario, with sites (black dots) having geographic coordinate data mapped (see Table 1). The upper cluster of dots are within the Trenton Greenbelt Conservation Area; the lower cluster, on and near the northeast slope of The Mountain. Legend: red lines, roads; green, wooded areas; pink, residential areas; grey polygons, large buildings; blue, water.

see rows of microscopic papillae, but this character is difficult to see in the majority of our specimens, many of which are worn.

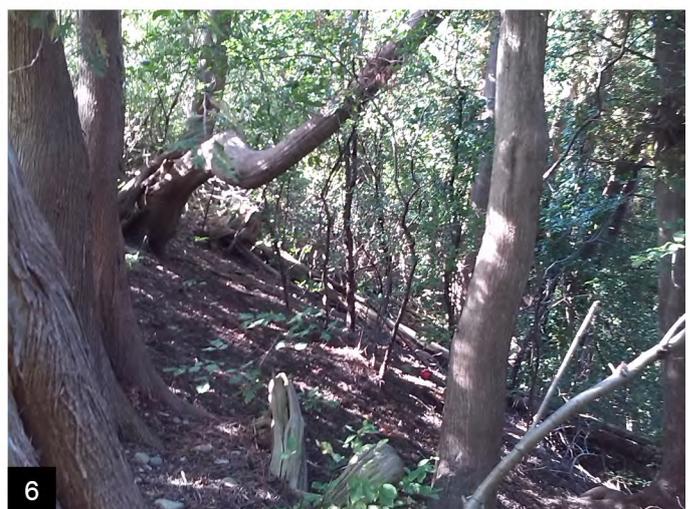
In Canada, *Patera appressa* is known since 1994 from at least 14 separate collecting events (frequently at the same sites) in Trenton, City of Quinte West, Hastings County, Ontario (Table 1) that could be regarded to represent two separate geographic locations.

The site described by Grimm as being on a “small island in [the] Trent River” (Table 1) probably refers to the original MJO site (TGCA, see below) because one has to cross a bridge to get to it, and we are doubtful that Grimm could have reached any of the actual islands in the Trent River. Grimm’s second site (Table 1, record 6) could be at the same place, but we have no way to know.

The majority of collections were made along the west shore of the Trent River, between County Road 33

(Water and Front streets) and the river (Figure 2), within Trenton Greenbelt Conservation Area (TGCA), mostly along the Jack Lange Memorial Walkway. The TGCA is characterized by very disturbed habitat, within an urban–industrial setting. *Patera appressa* was found in shrubby, disturbed areas, some with exposed concrete remains from the former industrial use of the site (Figures 3 and 4). Currently (2014), the site is a park, with a walking trail and mowed grass areas. Off-trail, the site remains much as it was in 1994, with shrubs and small trees, tall grass, and concrete “pavement”. The area is underlain by limestone bedrock.

The second location is ca. 800–1,000 m southeast on the northeast side of Trenton Mountain (“The Mountain” on 1:50,000 topographic maps (Centre for Topographic Information 2000), but called Mount Pelion locally), a drumlin hill park partially surrounded by residential neighbourhoods (Figures 2–6). Here, *Patera appressa*



**Figures 3–6.** Habitat of *Patera appressa* at Trenton. **3:** view from the top of The Mountain, looking north towards the Trenton Greenbelt Conservation Area (behind railway bridge in distance, left of the river). **4:** habitat of *Patera appressa* in one area (44.11017° N, 077.59061° W; September 2014) of the Trenton Greenbelt Conservation Area, showing concrete “pavement”. **5:** near top of The Mountain (44.10256° N, 077.58597° W; September 2014). The trees, predominantly Eastern White Cedar, behind the building are at the top of a steep slope where weathered *Patera appressa* shells were found in 2014. **6:** wooded slope on The Mountain (44.10256° N, 077.58597° W; September 2014), immediately below area shown in Figure 5. Weathered *Patera appressa* shells were found here in 2014.

**Table 1.** Records of *Patera appressa* in Ontario, Canada. All records are at Trenton, within the City of Quinte West, Hastings County, in generally one of two areas (when known): on or at the base of The Mountain and along the Trent River in the Trenton Greenbelt Conservation Area (TGCA).

Record #	Collection number or [field number]	Date	Collector(s)	Site	Habitat	Latitude	Longitude	Number of Specimens*	Comments
1	[FWS 94/026/bc] (whereabouts of specimens not known)	16 April 1994	FWS, J.H. Schueler	The Mountain	Steep cobbly/sandy slope, <i>Thuja occidentalis/Acer negundo</i> woods	44.10299	-077.58397	—	Live animals and shells common throughout slope; in one place clustered, alive and dead, on rocks and logs in such numbers as to cover most of the surface
2	CMNML 097148	4 May 1995	MJO, V. Brownell	TGCA	Open weedy field dominated by <i>Poa compressa</i> , scattered <i>Acer negundo</i> , <i>Rhus typhina</i>	44.11	-077.59	1	Single empty shell
3	RGF collection (MJO 16923)	11 May 1995	MJO	TGCA	Open weedy field dominated by <i>Poa compressa</i> , scattered <i>Acer negundo</i> , <i>Rhus typhina</i>	44.11	-077.59	20+	Live and dead
4	[MJO 18480] (whereabouts of specimens not known)	24 May 1996	MJO	TGCA	Park area on river, north of office, disturbed open area	44.11	-077.59	—	Live and dead
5	CMNML 097146	June 2000	F.W. Grimm	"Small island in Trent River" [TGCA?]	—	—	—	37	—
6	CMNML 097147	6 August 2000	F.W. Grimm	"Trenton"	—	—	—	2	—
7	NBM 009026	2 May 2006	MJO	TGCA	Shrubby disturbed area near river; under rocks and debris	44.10824	-077.58932	27	1 live; remainder dead
8	RGF collection	25 September 2008	Matt G. Keevil	TGCA	Exposed asphalt [sic; concrete] surrounded by thin soil	44.11085	-077.59158	72	Abundant; all dead shells
9a	RGF collection	25 September 2008	FWS	The Mountain	Steep cobble-sand slope, <i>Thuja/Acer negundo</i> woods; Snowberry – gravelly knoll on steep cobble-sand slope; <i>Thuja occidentalis/Acer negundo</i> woods; garbage	44.10299	-077.58397	55	Abundant; all dead shells
9b						44.10324	-077.58276		
10	NBM 009027	9 April 2011	MJO	TGCA	Disturbed scrubby ground near river	44.11293	-077.59214	57	Locally common, mainly empty shells
11	NBM 009028	24 April 2014	MJO	TGCA	Under debris and in disturbed ground and scrubby woods and forest along walking trail beside river	44.11192	-077.5928	20	Dead shells, some appearing fresh, common (hundreds seen), no live individuals found during ca. 1 hr search
12	NBM 009029	6 May 2014	MJO, B. Hewitt	TGCA	Disturbed ground	44.11135	-077.59172	30	Dead shells, some appearing fresh, common (hundreds seen), no live individuals found during ca. 1 hr search
13	RGF collection	16 September 2014	RGF	The Mountain	Cedar and deciduous woods; bare earth and needles with coarse woody debris; steep slope (Figure 6)	44.10256	-077.58597	11	Common; dead, weathered shells only
14	RGF collection	16 September 2014	RGF	TGCA	Disturbed; old industrial site; flat concrete pavement/foundations, shrubs (Figure 4)	44.11017	-077.59061	2	Scarce; dead, weathered shells only

\* These numbers may not reflect the degree of abundance of *Patera appressa* at a particular site and date, but rather, these numbers only document the quantity of specimens collected and now catalogued and vouchered in collections.

was found on a wooded slope with Eastern White Cedar (*Thuja occidentalis*) dominant. Quantities of garbage were noticed on some occasions (Table 1). The slope is steep, approaching 45 degrees.

Both of these sites would be classified as very disturbed (TGCA) to moderately to very disturbed (The Mountain) and had a mixture of native and introduced species (Table 2). At both sites, large numbers of *Patera appressa* shells have been found (Table 1), but abundance was not consistently recorded and numbers of specimens collected (or still in the collections available to us) may not accurately represent the abundance of the dead shells vs. living snails. Living snails were rarely found, except in the 1990s, with the last live individual collected in 2006 by MJO. In April 1994, at The Mountain on the only visit to the sites made during rainy weather, FWS noted dead shells and live animals clustered on rocks and logs in such numbers as to cover most of the surface.

Populations of introduced species are often characterized by large numbers of individuals, and the initial observations of this species at Trenton in 1994 and 1995, were that living snails were abundant. However, it is just as possible that the large number of old shells found at Trenton more recently were from several generations and not necessarily evidence of a huge population. Pearce (2008) suggests that shells may take 4–7 years to decompose to a state in which they are no longer identifiable and decomposition is even slower in limestone areas such as Trenton. Relatively large and sturdily constructed, shells of *P. appressa* are expected to remain in the environment for some time and the large number of dead shells could be cumulative of several generations and years. In recent years, fewer or no live snails and

fresh shells have been found at the sites. In the most recent collections, shells were quite weathered, suggesting that the animals have been dead for some time.

These two sites are the only places in Ontario and Canada where *Patera appressa* is known to occur. From the point of view of species' conservation, it is important to know the status of this population. If it were native, it would be of high conservation value, but if it were introduced, which is what we think, it has little conservation value.

It is also worthwhile to discount the possibility that Wayne Grimm was responsible for introducing this population. Although he is known to have intentionally introduced populations of snails as "experiments" (Örstan et al. 2011), he never told us (FWS, MJO) that he was responsible for the Trenton population and was very puzzled and quite interested in the population when material was sent to him for study by us (MJO).

*Patera appressa* is mainly a southern Appalachian species (Pilsbry 1940; Hubricht 1985). Outside of this natural range, an established introduced population was recently found in Oklahoma (Martin and Bergey 2013). Other populations, which we presume could represent introductions, were reported decades ago from Indiana and eastern Maryland (Cahn and Kemp 1929; Webb 1942; Jackson 1950; Grimm 1959, 1971). It was introduced to Bermuda prior to 1910 (Vanatta 1910; Pilsbry 1940), where populations continue to exist even today (Bieler and Slapcinsky 2000; Oldham and Forsyth unpublished data). Hubricht (1985), who did not distinguish between natural and introduced populations of this species, also recorded it from anthropogenic habitats (i.e., roadsides and urban areas). All of this information suggests a

**Table 2.** Terrestrial Mollusca, other than *Patera appressa*, found at The Mountain and the Trenton Greenbelt Conservation Area. "Y" means found; "Native" means to North America and Ontario.

Species	The Mountain	Trenton Greenbelt Conservation Area	Notes
<i>Anguispira alternata</i> (Say, 1816)	Y		Native
<i>Arion</i> sp.	Y		Introduced
<i>Cepaea nemoralis</i> (Linnaeus, 1758)	Y		Introduced
<i>Cochlicopa lubrica</i> (Müller, 1774)	Y	Y	Native but synanthropic
<i>Deroceras laeve</i> (Müller, 1774)	Y		Native
<i>Deroceras reticulatum</i> (Müller, 1774)	Y		Introduced
<i>Discus whitneyi</i> (Newcomb, 1864)	Y		Native
<i>Gastrocopta similis</i> (Sterki, 1909)		Y	Native
<i>Haplotrema concavum</i> (Say, 1821)	Y		Native
<i>Neohelix albolabris</i> (Say, 1817)	Y		Native
<i>Novisuccinea ovalis</i> (Say, 1817)	Y		Native
<i>Oxychilus</i> sp.		Y	Introduced
<i>Oxyloma</i> sp.		Y	Native
<i>Punctum minutissimum</i> (L. Lea, 1841)	Y		Native
<i>Pupilla muscorum</i> (Linnaeus, 1758)	Y	Y	Native/introduced? Synanthropic
<i>Pupoides albilabris</i> (C.B. Adams, 1841)		Y	Native
<i>Vallonia costata</i> (Müller, 1774)	Y	Y	Native but synanthropic
<i>Vallonia excentrica</i> Sterki, 1893	Y	Y	Native but synanthropic
<i>Vallonia pulchella</i> (Müller, 1774)	Y		Native but synanthropic
<i>Zonitoides arboreus</i> (Say, 1817)	Y		Native

strong propensity as a “tramp species”.

Grimm (1996) thought that the Canadian population represented an extremely disjunct and probably introduced species and it was treated as introduced by Grimm et al. (2010). Given that the presumed native U.S. range is over 600 km to the south, we also believe that *Patera appressa* is not native to Canada. The disturbed, highly modified habitats at Trenton also suggest this. It is also interesting that *P. appressa* has not been found elsewhere in Ontario, which suggests that its introduction was a unique event and that further dispersal did not occur. The apparent absence of living individuals or fresh snails in recent years suggests that this species may no longer be extant at the known sites, although there remains the possibility that live snails have lately gone undetected.

## ACKNOWLEDGEMENTS

Vivian Brownell, Jennifer Schueler, Matt Keevil, Ben Hewitt, and the late Wayne Grimm helped collect some of the specimens reported here. Jean-Marc Gagnon, Canadian Museum of Nature (Gatineau, Québec), provided RGF access to collections under his care, including Grimm’s collection, and helped with deposition of voucher specimens. Mary Sollows, New Brunswick Museum (Saint John, New Brunswick), facilitated the deposition of additional voucher specimens. We thank the reviewers, Timothy Pearce and Daniel Dourson, for their comments that helped improve this manuscript.

## LITERATURE CITED

- Bieler, R. and J. Slapcinsky. 2000. A case study for the development of an island fauna: recent terrestrial mollusks of Bermuda. *Nemouria* 44: 1–100. <http://biodiversitylibrary.org/page/45974319>
- Cahn, A.R. and J.T. Kemp. 1929. The terrestrial Mollusca of Turkey Run State Park, Indiana. *The Nautilus* 43(2): 66–68. <http://biodiversitylibrary.org/page/8515116>
- Centre for Topographic Information. 2000. Trenton, Ontario [map]. 7<sup>th</sup> edition. National Topographic System of Canada, 1:50,000, 31C/04. Ottawa: Natural Resources Canada.
- Dourson, D.C. 2010. Kentucky’s land snails and their ecological communities. Bakersville, NC: Goatslug Publications. [9] + 298 pp.
- Grimm, F.W. 1959. Land snails from Maryland and Virginia. *The Nautilus* 73(1): 21–22. <http://biodiversitylibrary.org/page/8515669>
- Grimm, F.W. 1971. Annotated checklist of the land snails of Maryland

- and the District of Columbia. *Sterkiana* 41: 51–57.
- Grimm, F.W. 1996. Terrestrial molluscs; 9 unpaginated PDF files on CD-ROM, in: I.M. Smith, Assessment of species diversity in the Mixedwood Plains Ecozone. Ecological Monitoring and Assessment Network (EMAN).
- Grimm, F.W., R.G. Forsyth, F.W. Schueler and A. Karstad. “2009” [2010]. Identifying land snails and slugs in Canada: introduced species and native genera. Ottawa: Canadian Food Inspection Agency. 168 pp.
- Hubricht, L. 1976. Five new species of land snails from the eastern United States. *Malacological Review* 9(1–2): 126–130.
- Hubricht, L. 1985. The distributions of the native land mollusks of the eastern United States. *Fieldiana, Zoology (new series)* 24: i–viii, 1–191. doi: [10.5962/bhl.title.3329](https://doi.org/10.5962/bhl.title.3329)
- Jackson, R.W. 1950. *Mesodon appressus* form *sculptior* Chadwick in Maryland. *The Nautilus* 64(2): 67. <http://biodiversitylibrary.org/page/8524332>
- Karstad, A., F.W. Schueler and L.A. Locker. 1995. A place to walk: a naturalist’s journal of the Lake Ontario Waterfront Trail. Toronto: Natural Heritage/Natural History. 159 pp.
- Martin, R.J. and E.A. Bergey. 2013. Growth plasticity with changing diet in the land snail *Patera appressa* (Polygyridae). *Journal of Molluscan Studies* 79(4): 364–368. doi: [10.1093/mollus/eyto33](https://doi.org/10.1093/mollus/eyto33)
- Örstan, A., J.L. Sparks and T.A. Pearce. 2011. Wayne Grimm’s legacy: a 40-year experiment on the dispersal of *Cepaea nemoralis* in Frederick County, Maryland. *American Malacological Bulletin* 29(1–2): 139–142. doi: [10.4003/006.029.0206](https://doi.org/10.4003/006.029.0206)
- Pearce, T.A. 2008. When a snail dies in the forest, how long will the shell persist? Effect of dissolution and micro-bioerosion. *American Malacological Bulletin* 26(1–2): 111–117. doi: [10.4003/006.026.0211](https://doi.org/10.4003/006.026.0211)
- Pilsbry, H.A. 1940. Land Mollusca of North America (north of Mexico). Volume 1, Part 2. The Academy of Natural Sciences of Philadelphia, Monographs 3: i–viii, 575–994, i–ix.
- Vanatta, E.G. 1910. Bermuda shells. *Proceedings of the Academy of Natural Sciences of Philadelphia* 62(3): 664–672. <http://www.jstor.org/stable/4063343>
- Webb, G.R. 1942. *Mesodon appressus* (Say) in Marion County, Indiana. *The Nautilus* 56(2): 61–62. <http://biodiversitylibrary.org/page/8284567>

**Authors’ contribution statement:** All three authors collected specimens and data. RGF confirmed the species’ determinations, wrote the text, collected data and specimens, prepared the maps and figures, and curated the specimens for deposition in CMN and NBM collections. MJO collected data and specimens and wrote the text. FWS collected data and specimens.

**Received:** December 2014

**Accepted:** February 2015

**Editorial responsibility:** Jesser Fidelis de Souza Filho