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RESEARCH ARTICLE

LAND SNAILS AND SLUGS FROM A SUBURBAN YARD IN FAIRFAX COUNTY, VIRGINIA

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ABSTRACT

Land snails and slugs (Gastropoda: Caenogastropoda and Pulmonata) were surveyed in a suburban yard in Fairfax County, Virginia. Twenty-three species were documented from a 0.10 ha lot. *Discus rotundatus* is documented for the first time in Virginia. *Opeas pyrgula*, *Paralaoma servile*, and *Pupilla muscorum* are documented for the second time in Virginia and for the first time in Fairfax County.

Keywords: New state record, non-native species, urban habitat.

INTRODUCTION

During the coronavirus pandemic of 2020, I found myself spending more time in my yard than I had in the past 22 years. While pulling weeds along the edge of my concrete sidewalk, I discovered a pupillid land snail. Curious as to what species it might be, I brought it indoors for closer examination. I was surprised to find that it was *Pupilla muscorum*, a species that was not found at any National Park sites near the District of Columbia (Steury & Pearce, 2014), even though part of one of these parks is only two km from my home. This discovery led me to begin a more thorough inventory of the land snails and slugs of my suburban yard, the results of which are discussed below.

MATERIALS AND METHODS

Study Site

The study site is a 0.10 ha (0.246 acre) suburban yard located at 8316 Woodacre Street in Alexandria, Virginia. It is located on the Coastal Plain in Fairfax County. The home on this site was built in 1964 and occupies about one-fourth of the lot. The remaining area is covered in April and May by non-native turf grasses and various non-native weeds, especially, Indian strawberry (*Duchesnea indica* [Andrews] Teschem.), white clover (*Trifolium repens* L.), purple deadnettle (*Lamium purpureum* L.), common dandelion (*Taraxacum officinale* F.H. Wigg), common chickweed (*Stellaria media* [L.] Vill.), mouse-ear chickweed (*Cerastium* L. sp.), and corn speedwell (*Veronica arvensis* L.). Two weedy native species, slender yellow woodsorrel (*Oxalis dillenii* Jacq.) and dooryard violet (*Viola sororia* Willd.) are also common. Herbicides are not used on the site, nor is it fertilized. A fence row along the western boundary of the study site contains a row of mature trees including one red maple (*Acer rubrum* L.), two willow oaks (*Quercus phellos* L.), and six sweetgum (*Liquidambar styraciflua* L.). Leaf litter accumulates along the base of the fence row under the trees. A young red cedar (*Juniperus virginiana* L.) grows on north side of the house and a mature southern magnolia (*Magnolia grandiflora* L.) and a Chinese holly (*Ilex cornuta* Lindl. & Paxton) on the south side. The house is surrounded on three sides by azalea cultivars (*Rhododendron* L.). A decomposing brush pile that has been accumulating for about 20 years is located in the northwest corner of the lot.

Seven cover boards made of tile (n=2, 30.5 cm x 30.5 cm), plywood (n=2, 0.9 m x 0.9 m), or cardboard (n=3, 0.9 m x 0.9 m) were placed in various locations at the study site including, under leaf litter along the fence row, under the southern magnolia, near the brush pile, and in turf grass. The boards were left in place during April and May 2020. Cover boards placed in turf grass were moved to other turf grass locations every two weeks, while the other cover boards were left in place for the duration of the study. The underside of each board was examined for land snails and slugs three times per week. At least one voucher specimen was collected for each species observed, except for *Philomycus carolinianus*, which was documented with a photographic voucher (Fig. 1). Three juvenile slugs were captured and reared in captivity on a diet of carrots, cauliflower, and lettuce (see entry for *Limax maximus* in the list of species below). Specimens are deposited at the Carnegie Museum of Natural History (CMNH) in Pittsburgh, Pennsylvania. A tally was kept of the number of each species observed on each day. When a total of 30 individuals was observed for a species it was recorded as common during the month. Cover board data was supplemented by general searches in leaf litter, by examining logs pulled from the bottom of the brush pile, and by pulling Indian strawberry and other yard weeds to examine exposed soil in the lawn. Daytime surveys were aided by the use of 3.5 x eyeglasses, a 5 x magnifying glass, and a 16 x doublet. Leaf litter was not collected for sorting indoors, a method that may have produced additional specimens of small species. New state and county records are based on reviews of Dundee (1974), Hotopp et al. (2013), Hubricht (1985) and other literature cited in the list of species. Specimens were identified using several sources including Burch (1962), Eversham (2018), Hotopp et al. (2013), Kerney & Cameron (1979), Nature Spot (2020), Nekola & Coles (2010), Nekola et al. (2015), and Pilsbry (1948).



Figure 1. *Philomycus carolinianus* (Bosc) photographed in Fairfax County, Virginia, in a suburban yard at 8316 Woodacre Street, Alexandria, on 1 May 2020.

RESULTS AND DISCUSSION

Twenty-three species were documented from the study site including 16 species of snails and seven slugs. Thirteen species (56.5%) (7 snails and 6 slugs) found at the study site are non-native species. The most commonly observed species at the study site were the non-native slugs *Ambigolimax valentiana* and *Deroceras reticulatum*, the non-native snail *Discus rotundatus*, and the native snail *Triodopsis juxtidentis*. *Discus rotundatus* is reported for the first time in Virginia, which documents a slight southern range extension from the District of Columbia (Steury & Steury, 2011). *Opeas pyrgula*, *Paralaoma servilis*, and *Pupilla muscorum* are documented from only one other Virginia county (or city), and for the first time in Fairfax County by this study (Hotopp et al., 2013; Steury & Pearce, 2014). Steury & Pearce (2014) did not report *Pupilla muscorum* or *Opeas pyrgula* among the 64 gastropod species documented from nearby national parks in the District of Columbia, Arlington and Fairfax Counties and City of Alexandria, Virginia, or Charles and Prince Georges Counties, Maryland. This survey of a 0.10 ha urban yard contained 35.9% of the number of gastropod species found in more than 2600 ha of nearby national park property. Only three species were found in May that were not documented in April.

The study demonstrates that some species preferring urban environments are likely underrepresented in biodiversity studies. Urban yards (at least those free of pesticides and fertilizers) provide habitat for several native and naturalizing species of snails and slugs and may be as proportionally biodiverse in other invertebrate taxa. The percentage of non-native species, compared to the entire gastropod fauna of an area, may be higher in some disturbed urban environments than in natural areas found in national parks. However, a study of the land snail fauna of 61 yards in Oklahoma (Bergey & Figueroa, 2016) reported that only 39.1% (9 of 32 snail species) were non-native. The same study reported the highest snail species richness in any yard to be 14 species (2 less than recorded in this study).

LIST OF SPECIES

Familial nomenclature and taxonomic order follow Bouchet & Rocroi (2005), except for Cionellidae, which follows Roth (2003). Generic and species names are listed alphabetically and

follow Perez & Cordeiro (2008) and Turgeon et al. (1998). The number of specimens collected and the CMNH catalog number is given for each species. The number of individuals observed in April and May is listed if specimens were documented during the month. Taxa with more than 30 observations in a month are listed as “common.” The habitat where each taxon was observed is given. Non-native species are marked with an asterisk.

Family Cionellidae

**Cochlicopa lubrica* (Müller) – (4; CMNH 173967); April (13), May (14); lawn, under southern magnolia, leaf litter, brush pile, under shrubs near house. Kerney & Cameron (1979) describe *Cochlicopa lubrica* as a Holarctic species. However, it is likely that shells reported as *Cochlicopa lubrica* in North America are a mix of native and exotic species, with the native north American race being undescribed (Nekola, 2004). Almost certainly, all material from urban habitats in northeastern North America are the introduced European *Cochlicopa lubrica* and thus represent exotics (Jeff Nekola, pers. comm. 2020).

Family Pupillidae

**Pupilla muscorum* (Linnaeus) – (Fig. 2); (6; CMNH 173968); April (6), May (2); lawn. This species was previously documented in Virginia only from Frederick County (Hotopp et al., 2013). It is a non-native snail of European origin (Hotopp et al., 2013). It was not found at any national park sites near the District of Columbia (Steury & Pearce, 2014). Of the six specimens deposited at CMNH, three specimens possessed the parietal denticle sometimes found in this species, while the other three specimens lacked a denticle in the aperture.



Figure 2. *Pupilla muscorum*, collected in Fairfax County, Virginia, suburban yard at 8316 Woodacre Street, Alexandria, on 17 April 2020. Hash marks are in millimeters.

Family Strobilopsidae

Strobilops labyrinthicus (Say) – (3; CMNH 173969); April (5), May (1); under southern magnolia, brush pile.

Family Valloniidae

**Vallonia* cf. *excentrica* Sterki – (5; CMNH 173975); April (1), May (4); lawn. The aperture of this species is reflected toward the inner side, as in these five shells. However, it is difficult to distinguish from maturing shells of *Vallonia pulchella* Müller which has a lip that is reflected toward the outside of the shell as an adult. Both species have been reported from Fairfax County (Hotopp et al., 2013). *Vallonia pulchella* is the more common urban species on the East Coast (Jeff Nekola, pers. comm. 2020). *Vallonia excentrica* is clearly an exotic in North America, even though it was included by Hubricht (1985) in his range maps of native species. There are no pre-European fossils of *V. excentrica* and it is strictly limited to anthropogenic habitats (Jeff Nekola, pers. comm. 2020).

Family Vertiginidae

Gastrocopta contracta (Say) – (2; CMNH 173974); April (2), May (1); brush pile.

**Vertigo pygmaea* (Draparnaud) – (Fig. 3); (1; CMNH 173973); May (1); lawn. *Vertigo pygmaea* is probably not a native North American animal (Nekola & Coles, 2010).



Figure 3. *Vertigo pygmaea* collected in Fairfax County, Virginia, suburban yard at 8316 Woodacre Street, Alexandria, on 1 May 2020. This form of *V. pygmaea*, which lacks the crested callus on the palatal wall, resembles *Vertigo gouldii* (A. Binney) in the orientation of the primary teeth in the aperture, however, the two species are distinguished by the deeper depression on the outer shell surface over the palatal lamellae, the lack of a small basal lamella, and the less distinct shell striae present in *V. pygmaea*. Length 1.9 mm.

Family Subulinidae

**Opeas pyrgula* Schmacker and Boettger – (Fig. 4); (3; CMNH 173972); April (1), May (4); leaf litter. *Opeas pyrgula* was previously documented in Virginia only from Chesapeake City, in the southeastern corner of the Commonwealth. This snail is an Asian species naturalized in North America along the Gulf and Atlantic Coasts from Texas north to Pennsylvania (Hotopp et al 2013). This record extends its previously published range 226 km (140 mi) northward in Virginia, however there is also an older museum record at CMNH (catalog number 132762) of *O. pyrgula* from the City of Alexandria, collected on 30 November 2013, by Timothy Pearce.



Figure 4. *Opeas pyrgula* collected in Fairfax County, Virginia in a suburban yard at 8316 Woodacre Street, Alexandria, on 11 April and 15 May 2020. Hash marks are in millimeters.

Family Punctidae

**Paralaoma servilis* (Shuttleworth) – (3; CMNH 173976); April (1), May (2); lawn. This species has been reported as native to New Zealand (Brooks, 1999) and possibly Australia (Price & Webb, 2006), however, it is limited to anthropogenic sites in New Zealand and it is highly likely that those populations are themselves exotic (Jeff Nekola, pers. comm. 2020). The most likely origin for this species is western North America where *P. servilis* is found in native habitats from the Mexican border north to Anchorage, Alaska, and there are other closely related species in the Mexican highlands (Jeff Nekola, pers. comm. 2020). The first North American record east of the Mississippi River was documented from the City of Alexandria, Virginia (Steury & Pearce, 2014). These specimens are the first records for Fairfax County. Since its discovery in Virginia, photographs that are apparently of this species and with unverified geographical provenance have been uploaded to the iNaturalist website from sites reportedly in Alabama, Florida, Georgia, New

York, Ohio, Pennsylvania, and South Carolina (iNaturalist 2020). Jeff Nekola (pers. comm. 2020) has collected it in Boone, North Carolina.

Punctum minutissimum (I. Lea) – (1; CMNH 173977); May (1); brush pile. This species may be more common than reported. Due to its minute size, it could be easily overlooked using the collection methods employed during this study. At just over one mm at maturity, it is one of North America's smallest land snails.

Family Discidae

Discus rotundatus* (Müller) – (Fig. 5); (8; CMNH 173978); April (common), May (common); brush pile, lawn, under shrubs near house. **NEW STATE RECORD. *Discus rotundatus* is native to western and central Europe (Kerney & Cameron, 1979) and northern Africa (Algeria) (Pilsbry, 1948). In North America, it has been collected in Canada in British Columbia, Newfoundland, Nova Scotia, and Ontario and in the United States in California, Idaho, Massachusetts, Maine, New Jersey, New York, Pennsylvania, Vermont, Washington, and the District of Columbia (Dundee, 1974; Hanna, 1966; NatureServe, 2020; Pearce, 2008; Steury & Steury, 2011).



Figure 5. *Discus rotundatus* collected in Fairfax County, Virginia, in a suburban yard at 8316 Woodacre Street, Alexandria, on 3 April 2020. Two shells showing left, ventral view, and right, dorsal view. Hash marks are in millimeters.

Family Gastrodontiidae

Ventridens ligera (Say) – (2; CMNH 173979); April (14), May (12); lawn, leaf litter.

Zonitoides arboreus (Say) – (10; CMNH 173980); April (19), May (23); leaf litter, brush pile, under southern magnolia, under shrubs near house.

Family Pristilomatidae

Hawaiia minuscula (A. Binney) – (10; CMNH 173985); April (29), May (14); lawn, leaf litter, brush pile, under southern magnolia, under holly.

Family Zonitidae

Glyphyalinia indentata (Say) – (2; CMNH 173984); April (14), May (9); lawn, leaf litter, under shrubs near house.

Family Limacidae

**Ambigolimax valentiana* (Férussac) – (2; CMNH 173983); April (common as juveniles), May (common); all habitats. This slug is native to the Iberian Peninsula of Europe (Roth and Sadeghian 2006) and formerly placed in the genus *Lehmanna*. Another synanthropic species, *Ambigolimax nyctelius*, is externally indistinguishable from this species and must be separated from it through analysis of their mtDNA barcoding gene, COI (*A. nyctelius*, n = 18 and *A. valentianus*, n = 11) (Vendetti, 2018). *Ambigolimax nyctelius* has only been reported in North America in Los Angeles County, California (2018) and in Washington, D.C. in 1960 (Quick, 1960). DNA barcoding of many slugs externally similar to *A. valentiana* from the Washington D.C. area may reveal that the cryptic species *A. nyctelius* is still present on the East Coast. *Ambigolimax valentiana* was the most commonly encountered slug during this study. As many as 39 individuals were observed during a single event under a 30.5 cm x 30.5 cm coverboard. These slugs were typically found huddled together, in groups of 4–7, rather than evenly distributed as were individuals of the other slug species found during this study.

**Limax maximus* Linnaeus – (Fig. 6); (2; CMNH 173982); April (8), May (15); under southern magnolia, under shrubs near house; leaf litter; lawn. This slug of European origin is the largest in the study area, reportedly reaching lengths of up to 20 cm (Kerney & Cameron, 1979). In the study area, juveniles of this species were often similar to each other in appearance, possessing broad,



Figure 5. *Limax maximus*, juvenile, found in Fairfax County, Virginia, in a suburban yard at 8316 Woodacre Street, Alexandria, on 3 April 2020. White arrow shows location of pale horseshoe shaped marking on the posterior edge of the mantle.

dark, lateral bands, a pale keel, and a pale horseshoe shaped mark on the posterior edge of the mantle (Fig. 5). Three juveniles with these markings were reared in captivity and all three developed into the more typical form a *L. maximus* with a spotted mantle.

Family Agriolomacidae

**Deroceras reticulatum* (Müller) – (1; CMNH 173981); April (common), May (common); all habitats. This slug, abundant at the study site, is introduced from Europe (Kerney and Cameron 1979). When stroked with a blade of grass it often produces a milky white mucus on its dorsal surface.

Family Arionidae

**Arion* cf. *hortensis* Férussac – (1; CMNH 173986); April (5), May (10); leaf litter, under southern magnolia, under holly, lawn. This slug represents a species complex of European origin consisting of *A. hortensis*, *Arion distinctus*, and *Arion owenii* (Kerney & Cameron, 1979) that can only be distinguished with certainty through dissection of mature adults, however *A. distinctus*, and *A. owenii* have not yet been documented in Virginia (Hotopp et al., 2013). The dorsal and lateral surfaces of these specimens were black (*A. hortensis* is typically the darkest of the three species [Kerney & Cameron, 1979]). The sole was light grey when clean, but at the slightest disturbance these slugs produced a copious, orange mucus that made the light grey sole appear orange. Kerney & Cameron (1979) describe the sole of *A. hortensis* as orange or yellow. This species was more common at this study site than at nearby national park sites, where only one specimen was found (Steury & Pearce, 2014).

**Arion intermedius* (Normand) – (1; CMNH 173987); April (1), May (1); lawn. This is another slug introduced from Europe (Kerney & Cameron, 1979). It is the smallest slug in the study area, reaching only two cm at maturity. In this specimen, the dorsal and ventral sides are white and the head and tentacles are a contrasting blue-grey. The sole is pale grey when clean and was observed to produce a yellowish mucus around the periphery, and clear mucus in the middle, these eventually mixing to make the sole appear yellowish.

**Arion* cf. *subfuscus* (Draparnaud) – (1; CMNH 173988); May (1); crawling on sidewalk in early morning after nighttime rain. *Arion fuscus* (Müller) a species reportedly widespread in Europe and North America, is not certainly distinguishable from *A. subfuscus* by examination of external features (Eversham 2018), but it is not reported from the Mid-Atlantic area (Hotopp, 2013). This specimen measured 6.0 cm at full stretch and had orange body mucus. The sole mucus is reported by Eversham (2018) to be clear, as it appeared to be in this specimen. Interestingly, this species was abundant at nearby National Park sites (Steury and Pearce 2014), but only one specimen was found during this study.

Family Philomycidae

Philomycus carolinianus (Bosc) – (Fig. 1). May (1); brush pile. This was the only native slug found at the study site. Although difficult to discern in Fig. 1, the dark elongated spots, oriented in

two parallel lines along each side of the dorsal center band, were clearly present. This character, coupled with a lack of lateral banding, separates this species from other Virginian *Philomycus*. Due to apparent rarity at the study site, only a photographic voucher (Fig. 1) was obtained for this species.

Family Polygyridae

Mesodon thyroideus (Say) – (1; CMNH 173989); April (1); leaf litter.

Triodopsis juxtidentis (Pilsbry) – (4; CMNH 173990); April (common), May (common); all habitats.

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