LAND MOLLUSKS OF NORTHEASTERN UNITED STATES AND SOUTHEASTERN CANADA

Lowell L. Getz¹, Lyle F. Chichester², and John B. Burch³

CONTENTS

Introduction	227
Acknowledgements	230
Classification and List of Species	230
Key Characters	235
Key to Families	239
Key to Species	241
Family Carychiidae	241
Family Cochlicopidae	241
Family Haplotrematidae	241
Family Pupillidae	242
Family Strobilopsidae	250
Family Hygromiidae	251
Family Helicidae	252
Family Succineidae	253
Family Punctidae	254
Family Vallonidae	256
Family Vitrinidae	258
Family Euconulidae	267
Family Mesodontidae	267
Family Philomycidae	272
Family Limacidae	274
Family Arionidae	277
References	281
Index to Species	284

INTRODUCTION

The terrestrial molluscan fauna of northeastern United States and southeastern Canada is relatively depauperate in comparison to elsewhere in eastern North America. There are approximately 75 species of land snails and slugs native to the region. Another 20 species have been introduced by human activities, some of which have become abundant in natural habitats (Chichester and Getz, 1971, 1973).

¹Department of Animal Biology, University of Illinois, Urbana, Illinois 61802 U.S.A.

²209 Chestnut Spring Way, Williamston, South Carolina 29697 U.S.A.

³Division of Mollusks, University of Michigan Museum of Zoology, Ann Arbor, Michigan 48109 U.S.A.

The terrestrial molluscan fauna of eastern North America is most abundant and diverse in the southern Appalachian Mountains. In excess of 200 species are native to that region. The southern Appalachians were not subjected to glaciation during the Pleistocene Epoch, as was much of the region to the north and northwest, and thus served as a refugium for terrestrial snails, as well as for other groups of plants and animals.

The extreme elevational gradients and dissected topography of the southern Appalachians allowed for differentiation and survival of species with varying physiological and ecological requirements. The great diversity of vegetation types, including trees, shrubs, and herbaceous species (Whittaker, 1956) and the prevalence of bedrock rich in calcium carbonate (Clark, 2001), an essential component of snail shells (Hotopp, 2002; Skeldon. 2007), contributed to the abundance of species of terrestrial snails and slugs in the southern Appalachians. Herbaceous vegetation and leaf litter form the primary source of food for mollusks (Mason, 1970); dead leaves and especially the associated fungal growth provide an abundant source of food for mollusks (Burch, 1955, 1956). The diversity of snails in the southern Appalachians is closely correlated with diversity of tree species (Getz and Uetz, 1994).

Following release of the northern Appalachians from glacial ice approximately 15,000 years ago, species of plants and animals dispersed outward from the southern Appalachian refugium. Less vagile species, such as terrestrial mollusks, have been slow in moving northward to northeastern United States and southeastern Canada. Not only are postglacial factors involved in the lesser diversity of the terrestrial mollusk fauna of the northern Appalachians, but geology of the region is also a factor. The bedrock of much of the northeast is low in calcium carbonate, which contributes to the paucity of the terrestrial snail fauna of the region. Tree species are also less diverse than in the southern Appalachians, providing fewer food niches for snails.

The only key to identification of species of terrestrial mollusks of the northeast is Burch's (1962) out-of-print "How To Know The Eastern Land Snails." Because Burch's key covers all of eastern North America, including the southern Appalachians, use of the key to identify snails of the northeast involves eliminating species found only in the more southern regions, thus adding difficulty to the identification process. By restricting coverage to the species found only in the six New England states (Connecticut, Massachusetts, Rhode Island, Maine, New Hampshire, and Vermont), as well as extreme northeastern New York and southeastern Canada, we greatly simplify the identification process.

We have included in our key only native species and introduced species that have become "naturalized", *i.e.*, commonly found in natural habitats. We do not include species found primarily associated with glass ("green") houses or nursery farms. The keys in this handbook are based on collections made at over 700 localities in the New England states. The snail specimens were deposited in the mollusk collections of the University of Michigan Museum of Zoology and the slug specimens were deposited in the Natural History Museum of the University of Connecticut.

Most species of snails of the northeast are very small; few of the larger species found further south occur in this region. Collecting small species requires concerted effort and searching in specific sites. The most productive place to search for small species is under the loose bark of decaying fallen trees. Such fallen trees should be in the stage of decay where the bark will lift off easily, exposing the wood of the log and the underside of the slabs of bark. The exposed wood of the log and the underside of the slabs of bark are usually rich in fungal growth. This is the microhabitat of many small species. Scraping away the leaf litter from the base of tree trunks, stumps, and around stone walls will expose both small and large species. The underside of large rocks and small fallen limbs that are loosely embedded in the soil and leaf litter also may harbor small species. Most introduced slugs and snails are associated with disturbed habitats, *i.e.*, roadsides, cemeteries, campsites, lawns, flower beds, gardens, and places where debris has been dumped. Observations of slime trails across patio blocks and sidewalks will provide an indication as to where to search for slugs at night.

Taxonomic Trends

There have been a number of recent taxonomic revisions at the family, genus and species levels. These revisions have been based upon anatomical studies, especially those involving the digestive system and the fine structure of the reproductive system, and molecular studies such as those involving mitochondrial DNA analyses.

Because the characteristics upon which most of these revisions are based are not externally observable, the unequivocal identification of some species is difficult or impossible without dissection. This is particularly true for the majority of introduced European slugs. Descriptions and diagrams of the reproductive systems of some of the slugs are available in Chichester and Getz (1973, and on web site http://hdl.handle.net/2142/8773).

It is beyond the scope of this key to incorporate the defining characters for these recent changes or to provide for the precise identification of sibling (cryptic) species. Some relevant papers are referenced for those interested in pursuing the classification in more detail.

The genus *Deroceras* (including the two species found in the northeast, *Deroceras leave* and *Deroceras reticulatum*) is removed by some from the family Limacidae and placed into its own family, Agriolimacidae (Watson and Dallwitz, 2005). Configuration of the digestive track is the primary means of distinguishing between the two families. The intestine of Agriolimacidae (*Deroceras*) has four folds, with two backwardly directed loops, whereas that of Limacidae has six folds, with three backwardly directed loops (Pilsbry, 1948). To differentiate between the two families, therefore, requires dissection. Because *Deroceras* is readily distinguished from the other genera of Limacidae solely on external traits, we leave *Deroceras* in Limacidae.

The family Succineidae is complex with a large number of described species for each of the genera (Pilsbry, 1948; Hoagland and Davis, 1987). The systematics of the three genera found in the northeast (*Succinea, Oxyloma*, and *Catinella*) have yet to be analyzed using modern DNA tools. We therefore relegate all individuals of each genus to the most characteristic species of each.

Although there are a number of species of *Philomycus* and *Pallifera* (Philomycidae) in North America, only two species of each genus appear to be present in the northeast (Branson, 1968; Hubricht, 1953; Fairbanks, 1989; Martin, 2000).

Two cryptic species of the introduced *Arion subfuscus* complex (*A. subfuscus* and *A. fuscus*) have been identified in Europe (Pinceel *et al.*, 2004). Mitochondrial DNA analyses have suggested the former may be subdivided into five divergent mtDNA lineages (*A. subfuscus* S1–S5; Pinceel *et al.*, 2005a, b). These authors further showed that *A. subfuscus* S–1 is the lineage that has become established in northeastern United States. Because of the potential for multiple introductions, however, DNA analyses will be necessary to clarify the taxonomic status of the morphologically diverse North American populations.

Allozyme analyses of populations of the introduced *Arion fasciatus* complex first concluded that *Arion fasciatus*, *A. circumscriptus*, and *A. silvaticus* in North American were monomorphic species. More recent analyses of the complex in Europe suggested that each "species" consists of a number of genotypes (strains) that regularly co-occur and which raises the question about the validity of the three described "species" (Backeljau *et al.*, 1997; Jordaens *et al.*, 2000). That the three species seem to be easily distinguished in North America may be a result of founder effects. DNA analyses will be necessary to determine the true taxonomic status of North American populations.

The introduced *Arion intermedius* has been found to display considerable variation in Europe, with the potential for interbreeding with other species of *Arion* (Backeljau *et al.*, 1992; Quinteiro *et al.*, 2005; Reise *et al.*, 2001). The taxonomic implications for North American populations have not been investigated, however.

The introduced *Arion hortensis* also is a complex that includes cryptic species (Iglesias and Speiser, 2001) and other variants. Some of these have been reported from North America

(Davies, 1977, 1979; Pearce and Bayne, 2003; Forsyth, 2004; Hotopp and Pearce, 2006). As is true for the other introduced *Arion*, analyses of North American populations are needed to determine the taxonomic status of the species complex.

ACKNOWLEDGEMENTS

We thank Ms. Stephani Schaefer (SS) for making most of the drawings in this key. Her skills in depicting the key characters of the snails and slugs were an invaluable contribution to this work. Other drawings by John Burch [JB] and Art Cushing [AC] were taken from Burch (1962); three were taken from Baker [FB] (1939) and one was rendered by Lyle Chichester [LC]. The field work upon which the key is based was supported in part by NSF Grant GB 4306X (LLG) and a NASA Fellowship (LFC).

CLASSIFICATION AND LIST OF SPECIES (after Burch and Jung, 1988)

Subclass Pulmonata Cuvier, 1817 Order Acetophila Férussac [Basommatophora Keferstein, in part] Superfamily Auriculoidea Férussac, 1821 Family Carychiidae Jeffreys, 1829 Genus Carychium Müller, 1774 (Carychium minimum Müller, 1774) *C. exiguum* (Say, 1822) Order Geophilia Férussac, 1812 (= Stylommatophora Schmidt, 1856) Suborder Orthurethra Pilsbry, 1900 Superfamily Cochlicopoidea Pilsbry, 1900 Family Cochlicopidae Pilsbry, 1900 [Cionellidae Clessin, 1879] Genus Cochlicopa Férussac, 1821 [= Cionella Jeffreys, 1829] (Helix hubricus Müller, 1774) C. lubrica (Müller, 1774) Superfamily Pupilloidea Turton, 1831 Family Vallonidae Morse, 1864 Genus Planogyra Morse, 1864 (Helix asteriscus Morse, 1857) P. asteriscus (Morse, 1857) Genus Vallonia Risso, 1826 (Vallonia rosalia Risso, 1826 = Helix costata Müller, 1774) V. costata (Müller, 1774) V. pulchella (Müller, 1774) Genus Zoogenetes Morse, 1864 (Helix harpa Say, 1824) Z. harpa (Say, 1824) Family Pupillidae Turton, 1831 Subfamily Pupillinae s.s. Genus Pupilla Leach (in Fleming), 1828 (Pupa marginata Draparnaud, 1801

= *Turbo muscorum* Linnaeus, 1758)

P. muscorum (Linnaeus, 1758)

Genus Pupoides Pfeiffer, 1854 P. albilabris (Adams, 1841) Subfamily Gastrocoptinae Pilsbry, 1918 Genus Gastrocopta Wollaston, 1878 (Pupa acarus Benson, 1856) G. armifera (Say, 1821) G. contracta (Say, 1822) G. pentodon (Say, 1821) G. tappaniana ("Ward" C.B. Adams, 1842) G. corticaria (Say, 1816) Subfamily Vertigininae Pilsbry, 1918 Genus Columella Westerlund, 1878 (Pupa inornata Michaud, 1831) C. edentula (Draparnaud, 1805) Genus Vertigo Müller, 1774 (Vergio pusilla Müller, 1774) V. bollesiana (Morse, 1865) V. elatior Sterki, 1894 V. gouldi (Binney, 1843) V. nylanderi Sterki, 1909 V. modesta (Say, 1824) V. morsei Sterki, 1894 V. ovata Say, 1822 V. perryi Sterki, 1905 V. pygmaea (Draparnaud, 1801) V. tridentata Wolf, 1870 V. ventricosa (Morse, 1865) Family Strobilopsidae Pilsbry, 1918 Genus Strobilops Pilsbry, 1893 (Helix labyrinthica Say, 1817) S. aenea Pilsbry, 1893 S. affinis Pilsbry, 1893 S. labyrinthica (Say, 1817) Suborder Heterurethra Pilsbry, 1900 Superfamily Succinoidea Beck, 1837 Family Succineidae Beck, 1837 Genus Catinella Pease, 1871 C. avara (Say, 1824) Genus Oxvloma Westerlund, 1885 (Succinea hungarica Hazay, 1880) *O. retusa* (Lea, 1834) Genus Succinea Draparnaud, 1801 (Helix putris Linnaeus, 1758) S. ovalis (Say, 1817)

Suborder Sigmurethra Pilsbry, 1900 Infraorder Holopodopes H.B. Baker, 1962 232

Superfamily Rhytidoidea Pilsbry, 1895 Family Haplotrematidae Baker, 1925 Genus Haplotrema Ancey, 1881 (Selenites duranti Newcomb, 1864) H. concavum (Say, 1821) Infraorder Aulacopoda Pilsbry, 1896 Superfamily Arionoidea Gray (in Turton), 1840 Family Punctidae Morse, 1864 (Endodontidae auct.) Subfamily Punctinae Morse, 1864 Genus Punctum Morse, 1864 (Helix minutissimum Lea, 1841) P. minutissimum (Lea, 1841) Subfamily Discinae Thiele, 1931 Genus Anguispira Morse, 1864 (Helix alternata Say, 1817) A. alternata (Say, 1817) Genus Discus Fitzinger, 1833 (Helix ruderatus Férussac, 1821) D. cronkhitei (Newcomb, 1865) D. patulus (Deshayes, 1830) D. rotundatus (Müller, 1774) Subfamily Helicodiscinae "Pilsbry" Baker, 1927 Genus Helicodiscus Morse, 1864 (Helix lineata Say, 1817 = Planorbis parallellus Say, 1821) H. parallelus (Say, 1821) Family Philomycidae Gray, 1847 Genus Pallifera Morse, 1864 (Philomycus dorsalis Binney, 1842) P. dorsalis (Binney, 1842) P. ohioensis (Sterki, 1908) Genus Philomycus Rafinesque, 1820 (Philomycus flexuolaris Rafinesque, 1820) P. flexuolaris Rafinesque, 1820 P. carolinianus (Bosc, 1802) Family Arionidae Gray (in Turton), 1844 Subfamily Arioninae Binney, 1864 Genus Arion Férussac, 1819 (Limax ater Linnaeus, 1758) A. subfuscus (Drapaarmaid, 1805) A. intermedius (Normad, 1852) A. ater (Linnaeus, 1858) A. hortensis Férussac, 1819 A. fasciatus complex A. fasciatus (Nilsson, 1822) A. circumscriptus Johnston, 1828 A. silvaticus Lohmander, 1937 Superfamily Limacoidea Rafinesque, 1815 Family Limacidae Rafinesque, 1815 Subfamily Limacinae Lamarck, 1801

Genus Limax Linnaeus, 1758

L. maximus Linnaeus, 1758 L. flavus Linnaeus, 1758 Genus Lehmannia Heynemann, 1861 L. valentiana (Férussac, 1823) Genus Deroceras Rafinesque, 1820 (Limax gracilis Rafinesque, 1820 = Limax leavus Müller, 1774) D. leave (Müller, 1774) D. reticulatum (Müller, 1774) Superfamily Oleacinoidea Adams, 1855 Family Vitrinidae Fitzinger, 1833 (Zonitidae Mörch, 1864) Subfamily Vitrininae s.s. Fizinger, 1833 Genus Vitrina Draparnaud, 1801 (Helix pellucida Müller, 1774) V. limpida Gould, 1850 Subfamily Gastrodontinae Tyron, 1866 Genus Striatura Morse, 1864 (Helix milium Morse, 1859) S. milium (Morse, 1859) S. ferrea Morse, 1864 S. exigua (Stimpson, 1850) Genus Zonitoides Lehmann, 1862 (Helix nitidus Müller, 1774) Z. arboreus (Say, 1817) Z. nitidus (Müller, 1774) Subfamily Zonitinae Mörch, 1864 Genus Glyphyalinia Martens, 1892 (Helix indentata Say, 1824) G. indentata (Say, 1823) G. rhoadsi (Pilsbry, 1899) G. burringtoni (Pilsbry, 1928) G. binneyana (Morse, 1864) G. electrina (Gould, 1841) Genus Mesomphix Rafinesque, 1819 M. inornatus (Say, 1921) *M. cupreus* (Rafinesque, 1831) Genus Hawaiia Gude, 1911 (Helix kawaiensis Pfeiffer, 1854 = Helix minuscula Binney, 1840) H. minuscula (Binney, 1840) Genus Oxychilus Fitzinger, 1833 (Helix cellarius Müller, 1774) O. cellarius (Müller, 1774) O. draparnaldi (Beck, 1837) O. alliarius (Miller, 1822) Genus Paravitrea Pilsbry, 1898 (Helix capsella Gould, 1851) P. multidentata (Binney, 1840)

Family Euconulidae Clessin 1879 (Helicarionidae Bourguignat, 1883, emend.) Subfamily Euconulinae Baker, 1928

Genus Euconulus Reinhardt, 1883 (Helix fulva Müller, 1774) E. chersinus (Say, 1821) E. fulvus (Müller, 1774) Subfamily Gastrodontinae Tryon, 1866 Genus Ventridens Binney, 1863 V. intertexus (Binney, 1841) V. ligera (Say, 1821) V. suppressus (Say, 1829) Infraorder Holopoda Pilsbry, 1896 Superfamily Mesodontoidea Tryon, 1866 Family Mesodontidae Tryon, 1866 (Polygyridae Pilsbry, 1895) Subfamily Mesodontinae s.s. Genus Mesodon Rafinesque (in Férussac), 1821 (Helix thyroidus Say, 1816) M. sayanus (Pilsbry, 1906) M. thyroidus (Say, 1817) M. zaletus (Binney, 1837) Genus Stenotrema Rafinesque, 1819 (Stenotrema convexa Rafinesque, 1831 = Helix stenotrema Pfeiffer, 1842) S. fraternum (Say, 1824) S. leai (Binney, 1840) S. hirsutum (Say, 1817) Subfamily Triodopsinae Pilsbry, 1940 Genus Triodopsis Rafinesque, 1819 (Triodopsis lunula Rafinesque, 1831 = Helix tridentata Say, 1816) T. albolabris (Say, 1817) T. dentifera (Binney, 1837) T. denotata (Férussac, 1821) T. tridentata (Say, 1816) Genus Allogona Pilsbry, 1939 A. profunda (Say, 1821) Family Hygromiidae Tryon, 1866 (= Helicellidae Wenz, 1923) Subfamily Hygromiinae Tryon, 1866 Genus Hygromia Risso, 1826 H. hispida (Linnaeus, 1758) H. striolata (Pfeiffer, 1828)

Family Helicidae Rafinesque, 1815 Genus *Cepaea* Held, 1837 *C. hortenis* (Müller, 1774) *C. nemoralis* (Linnaeus, 1758)



Figure 1— Shell terminology and surface sculpture. Above (a): a, striae (indented spiral lines); b, lirae (raised spiral lines); c, ribs, riblets (raised transverse lines); d, wrinkles; e, puncta or pits; f, papillae or granules. Below (b): a, transverse or growth lines; b, spiral lines or striae. (From Burch, 1962).



Figure 2— Shell terminology: a, shell with whorls increasing gradually in size; b. sutures slightly indented; c, sutures strongly indented; d. crenulate sutures; e., whorls rapidly increasing in size; f, flattened whorl; g, shouldered whorl; h, moderately shouldered whorl; i, rounded whorl; j, sunken spire; k, last whorl not descending in front, *i.e.*, not deflected; l, last whorl descending in front, *i.e.*, deflected; m, globose shell; n, depressed shell; o, strongly depressed shell; p, discoidal shell; q, doubly carinate periphery; r, carinate periphery, s, angular periphery; t, round periphery; u, dextrally (to the right) whorled shell; v, sinstrally (to the left) whorled shell. (From Burch, 1962).



Figure 3— Shell terminology: a, umbilicate shell; b, perforate shell; c, imperforate shell; d, method of measuring shell and umbilicus diameters; e, method of counting whorls; f, straight outer lip; g, curved outer lip; h, lip retracted to the suture; i, truncate columella; j, straight columella; k, straight (not reflected) lip; l, reflected lip. (From Burch, 1962).



Figure 4 — Apertural terminology for Stenotrema. (From Burch, 1962).



Figure 5— Diagnostic characters of slugs: a, generalized slug; b-r, see key. (From Chichester & Getz, 1973).



Figure 6— Terminology of pupillid teeth (From Burch 1962, after Pilsbry).



Figure 7- Terminology of strobilopsid teeth (From Burch, 1962, after Pilsbry).



Figure 8— Genital aperture (Succinea ovalis) (From Burch, 1962).

KEY TO FAMILIES

1a. Shell present	
1b. Shell absent	
2a Shell succiniform	SUCCINFIDAE
2b. Shell not succiniform.	
3a. Shell dome or beehive shaped	4
3b. Shell not dome or beehive shaped	
4a. Shell diameter greater than 8 mm	VITRINIDAE (Ventridens)
4b. Shell diameter less than 8 mm	5
5a. Lip reflected	STROBILOPSIDAE
5b. Lip not reflected	.EUCONULIDAE (Euconulus)
	_
6a. Shell pupilliform	
6b. Shell not pupilliform	
7a. Lip reflected, thickened and shell length less than 2.5	mmCARYCHIIDAE
7b. Lip not thickened or if thickened, shell length greater	than 4 mmPUPILLIDAE

8a. Shell fusiform or spindle-shaped	COCHLICOPIDAE
8b. Shell heliciform	9
9a. Shell diameter greater than 5 mm and lip reflected9b. Shell diameter less than 5 mm or if greater than 5 mm, lip n	
10a. Lip not thickened; normally banded shell10b. Lip thickened; shell not banded (except <i>Allogona</i>)	HELICIDAE MESODONTIDAE
11a. Shell diameter greater than 13 mm.11b. Shell diameter less than 13 mm.	
12a. Shell with reddish splotches12b. Shell without reddish splotches	PUNCTIDAE (Anguispira) 13
13a. Umbilicus width greater than 1/5 shell diameter13b. Umbilicus width less than 1/5 shell diameter	HAPLOTREMATIDAE VITRINIDAE (in part)
14a. Shell globose, or if flattened with a reflected lip; shell	l diameter less than 3 mm VALLONIDAE
14b. Shell flattened, lip not reflected; size variable	
15a. Shell with spiral lirae or riblets15b. Shell without spiral lirae or riblets	
16a. Shell diameter greater than 3 mm16b. Shell diameter less than 3 mm	PUNCTIDAE (in part) 17
17a. Spire depressed17b. Spire slightly elevated	VITRINIDAE (in part) PUNCTIDAE (<i>Punctum</i>)
18a. Umbilicus width greater than 1/5 shell diameter18b. Umbilicus width less than 1/5 shell diameter	HAPLOTREMATIDAE19
19a. Columellar margin reflected; shell diameter greater th	nan 7 mm
19b. Columellar margin not reflected; shell diameter variab	HYGROMIIDAE bleVITRINIDAE (in part)
20a. Mantle covers more than 2/3 of the back20b. Mantle covers less than 1/2 of the back	PHILOMYCIDAE
21a. Breathing pore in posterior half of mantle21b. Breathing pore in anterior half of mantle	LIMACIDAE ARIONIDAE

KEY TO SPECIES

Family CARYCHIIDAE

Carychium exguum is the only member of the family to occur in the northeast.

Length, 1.8–2.0 mm; about 4.5 whorls. Shell transparent, whitish; two lamellae which extend spirally upward along the collumellar axis as an ascending shelf, one large and conspicuous at the aperture, one small and less conspicuous, revolving below the large lamella. Animal whitish, almost translucent.

Southeastern Canada and New England, south to Alabama, west to Colorado and southwestern New Mexico.

Family COCHLICOPIDAE

Cochlicopa lubrica is the only member of this family in the northeast.

Length, 5.0–7.5 mm; 5.5–6.0 whorls. Very smooth, glossy, almost translucent shell. Lip not reflected, thickened on inside the aperture. No teeth. Aperture subvertical, normally ovate.

Southeastern Canada and New England south to South Carolina, west to Iowa, Alaska, and southern Arizona.

Family HAPLOTREMATIDAE

Haplotrema concavum is the only member of this family in the northeast.

Shell very depressed. Glossy, greenish-yellow to white. Very fine spiral lines. Umbilicus deep and widely open. Aperture almost round or slightly elliptical, the upper margin flat or slightly depressed. Carnivorous, feeding on other snails.

Southeastern Canada and New England south to Florida, west to Iowa, Missouri, and Arkansas.



Haplotrema concavum (Say)



Carychium exiguum (Say)



Cochlicopa lubrica (Müller)

Family PUPILLIDAE

1a. Lip strongly reflected and thickened.....Pupoides albilabris

Length, 4.2–5.0 mm; 6–6.5 whorls. Dark cinnamon. Shell elongate, tapering to apex; often coated with dirt. Minutely perforate; aperture oval. Angular lamella in form of a callus in outer angle of aperture; no other aperture teeth. Lip thickened and widely reflected.

Southeastern Canada and New England, south to the Gulf States, west to North Dakota and Arizona.



Pupoides albilabris (Adams)

1b. Lip only slightly reflected or not at all; lip not thickened			2
2a. Aperture without teeth			3
2b. Aperture with at least one tooth	••••		4
	P	.11	

3a. Lip slightly reflected.....Pupilla muscorum

Length, 2.8–4.0 mm; 5.5–7.5 whorls. Shell perforate. Aperture normally toothless, but may have one or more teeth. Palatial fold is small in shells with teeth. Lip slightly reflected.

New England south to New Jersey, west to Oregon, Alaska, Texas, and Northern Arizona.



Pupilla muscorum (Linnaeus)

3b. Lip not reflected......Columella edentata

Length, 1.7–2.5 mm; 5.5–6.5 whorls. Dark cinnamon, sometimes with whitish streaks. Cylindrical shell, tapering slightly towards apex. Shell perforate; aperture obliquely rounded, usually no teeth. Lip not reflected.

Southern Canada from Labrador to British Columbia, south to, Alabama, west to Iowa and Oregon.



Columella edenata (Draparnaud)

4a.]	Notch on outer margin of lip (genus Vertigo)	.5	5
4b.	Outer margin of lip without a notch1	17	1

5a. Lower palatal fold very long, extending far back into shell.......Vertigo milium

Length, 1.4–1.8 mm; 4.5–5.0 whorls. Dark amber-chestnut. Weakly striated. Lower palatal fold exceptionally longer, extending far back into shell. Aperture with six teeth.

Southeastern Canada, south to the Florida Keys, west to South Dakota and Arizona.





Vertigo milium (Gould)

6a. Lower palatal folds far back in aperture, emerging only to inner end of upper palatal fold; deep impressions in back of shell over the palatal folds.......Vertigo nylanderi

Length, 1.6–1.7 mm; 4.5–5.0 whorls. Acute apex. Angular and subcollumellar lamellae poorly developed. Aperture with six teeth. Lower palatal lamella located deep within aperture; deeper immersion of long lower palatal fold than in V. gouldi and V. bollesiana.

Southeastern Canada and northern New England.



Vertigo nylanderi Sterki

6b. Lower palatal folds not deep-seated; no deep impression on back of shell.......7

7a. Three distinct teeth.7b. Four or more teeth.	
8a. Teeth well-developed	Vertigo tridentata

Length 1.8–2.3 mm; about 5 whorls. Ovate to tapering oblong. Aperture narrow. Three white teeth. Absence of basal and angular teeth distinguishes it from other *Vertigo* species. Southeastern Canada and New England, south to West Virginia, west to Minnesota and Texas.



Vertigo tridentata Wolf

8b.	Teeth reduced	
9a.	Shell height more than 2 mm.	Vertigo modesta

Length, 2.2–2.7 mm; 4.5–5.5 whorls. Dark olive-brown. Distinct growth lines on middle whorls, weak on others. Typically four teeth in aperture, in form of a cross; sometimes only three and other times five teeth. Teeth white.

Southeastern Canada and New England, west to California and Arizona.





Vertigo modesta (Say)

Length, 1.5–1.6 m; about 4.5 whorls. Dark olive-buff. Ovate shell. Three (infrequently 4) brownish teeth.

Southern New England.





Vertigo perryi Sterki

10a. Four teeth form a cross in aperture (palatal tooth very small)...Vertigo modesta



Vertigo modesta (Say)

10b. Teeth do not form a cross in aperture	11
11a. Six or more teeth11b. Fewer than six teeth	
12a. Shell more than 2.5 mm long	Vertigo morsei

Length, 2.7–3.0 mm (largest species of genus); 6.0-6.5 whorls. Auburn to chestnut-brown. Shell cylindrical. More whorls (6) than *V. ovata* (5). Whorls slowly increase in size. Aperture small and rounded, with 8-9 teeth. Middle of outer lip deeply indented.

Southeastern Canada and New England, south to Florida Keys, west to Alaska, Oregon, and Arizona.





Vertigo morsei Sterki

12b. Shell less than 2.5 mm long......Vertigo ovata

Length, 2.2–2.3 mm; 4.5–5.0 whorls. Auburn to dark brown. Last whorl relatively large. Palatal folds, columellar or lamellae, well-developed. Smaller than *V. moresi*.

Southeastern Canada and New England, south to Florida Keys, west to Washington and Arizona.





Vertigo ovata Say

3a. Distinct crest behind lip	go pygmaea
-------------------------------	------------

Length, 1.8–2.0 mm; 5 whorls, the last whorl with a strong, light-colored crest a short distance behind the lip. Auburn-chestnut brown (darker than *V. gouldi*). Aperture truncate basally. Southeastern Canada and New England south to Virginia, west to Ohio.



Vertigo pygmaea (Draparnaud)

13b. No crest behind lip.....14

14a. Parietal lamella significantly larger than other teeth......Vertigo ventricosa

Length 1.7–2.0 mm; 4.0–4.5 whorls. Aperture semi-circular, with 4–5 poorly developed teeth. Differs from *V. ovata* by smaller size and absence of angular lamella. Southeastern Canada and New England, west to Michigan and Illinois.





Vertigo ventricosa (Morse)

14b. Parietal lamella not significantly larger than other teeth......15

15a. Striae well-developed......Vertigo gouldi

Length, 1.5–2.1 mm; 4.5–5.5 whorls. Light-brown to chestnut brown. Well-developed striae (distinguishes from other species of *Vertigo*). Growth lines prominent, especially on next to last whorl. Crest behind lip, but less strong than in *V. pygmaea*. Parietal lamella and palatal folds well-developed.

Southeastern Canada and New England, west to Michigan, southern Illinois, Colorado and Arizona.



Vertigo gouldi (Binney)

15b.	Striae	weak	 	 	 	 16

16a. Shell tapering, with an acute apex; shell 2.1–2.2 mm long......Vertigo elatior

Length, 2.1–2.2 mm; about 5 whorls. Shell tapered from apex to body whorl. Five well-developed teeth in aperture. Larger and more elevated than *V. ventricosa*.

Southern Canada and northern New England west to Montana.



Vertigo elatior Sterki

16b. Shell ovate, apex obtuse; shell 1.5 mm long......Vertigo bollesiana

Length, 1.5 mm; 4.5–5.0 whorls. Amber-brown to cinnamon color. Apex obtuse. Weak striae (distinguishes from *V. gouldi*). Growth lines prominent. Shell minutely perforate. Aperture with five teeth.

Southeastern Canada and New England, south to Virginia, west to Indiana and Michigan.





Vertigo bollesiana (Morse)

17a. Shell large, 3.0–4.8 mm long	
17b. Shell less than 2.5 mm long	
e	
18a. Single, small parietal tooth	Pupilla muscorum

Length, 2.8–4.0 mm; 5.5–7.5 whorls. Shell perforate. Aperture normally toothless, but may have one or more teeth. Palatal fold small and tubercular. Lip slightly reflected. New England south to New Jersey, west to Oregon and northern Arizona.



Pupilla muscorum (Linnaeus)

18b. Several large teeth in aperture......Gastrocopta armifera

Length, 3.0–4.8 mm; 6.5–7.5 whorls. Shell paraffin-white. Shell oblong-shaped. Faint irregular growth lines. Perforate. Lip thin (in contrast to *G. contracta*), weakly reflected. Teeth large. Southeastern Canada and New England, south to Florida, west to Colorado and New Mexico.



Gastrocopta armifera (Say)

19a. Seven to nine teeth in aperture	20
19b. Fewer than five teeth in aperture	21

20a. Shell ovate-conic......Gastrocopta tappaniana

Length, 1.6–2.0 mm; 4–5 whorls. Clear corneous, whitish or gray. Spire more oval than in *G. pentodon*. Numerous very small aperture teeth (differ from others); only one tooth on the parietal wall. Larger and more oval than *G. pentodon*.

Southeastern Canada and New England, south to Georgia and Alabama, west to South Dakota and Arizona.

248



Gastrocopta tappaniana (Adams)

Length, 1.5-1.8 mm; about 5 whorls. Transparent whitish or corneous. Spire more tapered than *G. tappaniana*. Numerous very small aperture teeth; usually six on the columellar, basal, and other margins; one simple parietal tooth. Lower-palatal fold usually not as long as that in *G. tappaniana*. Lip teeth on a white callous rim.

Eastern Canada and New England south to central Florida, west to Colorado, Texas and Arizona.



Gastrocopta pentodon (Say)

21a. Aperture almost filled with large teeth......Gastrocopta contracta

Length, 2.2–2.5 mm; about 5.5 whorls. Conical form. Spire tapering, with irregular growth lines. Aperture triangular. Very large lamella that nearly fill the aperture. Angulo-parietal lamella joins the outer lip. Lip thickened (in contrast to *G. armifera*).

Southeastern Canada and New England, south to southern Florida, west to South Dakota and Texas.



Gastrocopta contracta (Say)

Length, 2.5 mm; 5.5 whorls. Translucent white. Very reduced, barely developed aperture teeth; only two very small teeth (angulo-parietal and columellar lamella).

Southeastern Canada and New England, south to central Florida, west to Minnesota and Louisiana.



Gastrocopta corticaria (Say)

Family STROBILOPSIDAE

1a. Outer edge of body whorl angular; spire slightly depressed......Strobilops aenea

Width, 2.4–2.8 mm; about 5.5 whorls. Light to dark brown. Periphery of body whorl angular; base flattened below periphery. Ribs well-developed. Narrowly umbilicate. Two parietal lamellae.

Southern New England, south to central Florida, west to Michigan, Missouri and Arkansas.



Strobilops aenea Pilsbry

1b. Outer edge of body whorl rounded; spire more elevated......2

2a. Ribs poorly developed on base of shell......Strobilops labyrinthica

Width, 2.3–2.5 mm; about 5.5 whorls. Chestnut-brown. Periphery of body whorl rounded. Small umbilicus. Two parietal lamellae visible in aperture; do not form an uniform curve as in *S. affinis*. Lip reflected.

Southeastern Canada and New England, south to Georgia and Alabama, west to Minnesota and Arkansas.



Strobilops labyrinthica (Say)

2b. Ribs well-developed on base of shell......Strobilops affinis

Width, 2.7–2.8 mm; about 6.0 whorls. Periphery of body whorl rounded. Wider umbilicus than in *S. anena* and *S. laybrinthica*. Larger with spire somewhat less convex than *S. labyrinthica*. Only one parietal lamella (forms an uniform curve) emerges from the shell. Southern New England, south to Alabama, west to Ohio, Illinois and Oklahoma.





Strobilops affinis Pilsbry

Family HYGROMIIDAE

Width, 7–9 mm; 5.0–6.0 whorls. Shell pale cinnamon-brown. Rounded whorls. Shell hirsute, often retained as adults. Slightly smaller the *H. striolata*. Aperture rounded.

Introduced from Europe; found in scattered localities in southeastern Canada and eastern New England.



Hygromia hispida (Linnaeus)

Width, 10–11 mm; 5–6 whorls. Tawny-olive or brownish-olive buff, often with pale band at the obtusely angular periphery. Hirsute as young, but loses hairs as adults. Aperture obtuse. Introduced from central Europe; found locally in southeastern Canada and New England.



Hygromia striolata (Pfeiffer)

Family HELICIDAE

1a. Lip dark.....Cepaea nemoralis

Width, 22–34 mm; about 5 whorls. Yellow, olive-red with 1–5 reddish-brown bands. Whorls rounded. Aperture ovate-lunate. Lip reflected; lip dark brown to almost black. Larger than *C. hortensis*.

Introduced from central and western Europe; found in scattered localities throughout North America.



Cepaea nemoralis (Linnaeus)

1b. Lip white.....Cepaea hortensis

Width, 16–21 mm; about 5 whorls. Yellow with 1–5 reddish-brown bands. Lip whitish. Smaller than C. *nemoralis*.

Introduced from central and northern Europe; found in scattered sites in southeastern Canada and northern New England.



Cepaea hortensis (Müller)

Family SUCCINEIDAE

1a. Shell spire about as long as shell aperture......*Catinella avara* (= *C. vermata*)

Length 7–13 mm; 2.5–3.5 whorls. Pale yellow-olive. Very thin shell. Aperture elongate-ovate. Sharp lip.

Southern Canada from Newfoundland to British Columbia south to the Gulf States and Arizona.



Catinella avara (Say)

1b. Shell spire much shorter than shell aperture......2

2a. Shell aperture broadly oval; margin of genital aperture conspicuously swollen...Succinea ovalis

Length, 6–26 m; 2.5–4.5 whorls. Shell pale horn, gray, greenish-yellow to polished white. Lip sharp. Aperture ovate, less narrow than in *Oxyloma retusa*.

Southeastern Canada and New England, south to Alabama, west to North Dakota and Louisiana.



Succinea ovalis Say

2b. Shell aperture narrowly oval; margin of genital aperture not swollen......Oxyloma retusa

Length, 7.5–20 mm; 2.5–4.5 whorls. Pale horn, yellow to reddish yellow. Shell very thin. Aperture narrowly ovate, much longer than in *Succinia ovalis*.

Western New England, south to southern Pennsylvania, west to Montana and Ohio.



Oxyloma retusa (Lea)

Family PUNCTIDAE

1a. Shell with spriral lirae; shell diameter less than 4 mm.....Helicodiscus parallelus

Width, 3.2–3.5 mm; 4.0–4.5.0 whorls. Pale yellow with a pale greenish cast. Upper surface flat or only slightly convex. Numerous well-developed spiral lirae. Broadly umbilicate. Typically two pairs of small conical teeth in the outer and basal walls (sometimes one pair, rarely three pairs or none). One pair usually visible in the aperture.

Southeastern Canada and New England, south to Alabama, west to Michigan, Iowa and Arkansas.



Helicodiscus parallelus (Say)

1b. Shell without spiral lirae; shell diameter variable......2

2a. Shell diameter less than 2 mm.....Punctum minutissimum

Width, 1.1–1.3 mm; 3.5–4.5 whorls. Pale brown to corneous. Minute. Delicate spiral striae. Umbilicate, 1/4–1/3 diameter of shell.

Southeastern Canada and New England, south to Florida, west to Oregon and New Mexico.



Punctum minutissimum (Lea)

Width, 15–30 mm; 4.5–6.5 whorls. Shell horn-colored with numerous dark reddish-brown blotches. Large shell (18–30 mm). Well-developed rib-like striae. Deep umbilicus, about 1/5-1/4 diameter of shell.

Southeastern Canada and New England, south to Alabama, west to South Dakota and Kansas.



Anguispira alternata (Say)

4a. Shell with dark brown or reddish brown splotches......Discus rotundatus

Width, 6 mm; 6 whorls. Yellowish-brown with distinct reddish blotches (other two *Discus* species have uniform color). Umbilicus very wide and deep, but smaller than *D. patulus*. Periphery of last whorl sometimes subangular and slightly shouldered. Well-developed riblets. Introduced from Europe; occurs throughout New England.



Discus rotundatus (Müller)

5a. Umbilicus over 1/2 shell diameter; shell with coarse ribs......Discus patulus

Width, 7–8 mm; about 5.5 whorls. Shell uniform cinnamon-brown color. Shell depressed. Well-developed riblets. Broadly umbilicate (more than 1/2 shell diameter) and deeply concave on underside, wider than other *Discus* species.

Southeastern Canada and New England, south to Florida and Alabama, west to Michigan, Iowa and Arkansas.



Discus patulus (Deshayes)

5b. Umbilicus 1/3 shell diameter; shell with fine ribs......Discus cronkhitei

Width, 5–7 mm; 3.5–4.5 whorls. Color uniform light-tannish-brown; differs from *D. rotundatus* in this character. Spire depressed. Smaller than *D. patulus*. Well-developed riblets. Umbilicus about 1/3 width of shell.

Throughout northern North America, southeastern Canada and New England, south to Maryland, west to British Columbia, Washington and northern California.



Discus cronkhitei (Newcomb)

Family VALLONIDAE

Southeastern Canada and New England, west to Alaska and Colorado.



Zoogenetes harpa (Say)

1b. Shell flattened......2

2a. Lip not thickened and reflected......Planogyrus asteriscus

Width, 1.7–2.0 mm; about 3.5 whorls. Color light to dark brown. Very flat low spire. First whorls smooth; sharp ribs on last whorl (differs from all other species by these three traits). Wide umbilicus, 1/3 diameter of shell. Prominent, rounded aperture. Lip not reflected.

Southeastern Canada and New England, west to Michigan.



Planogyrus asteriscus (Morse)

2b. Lip thickened and reflected	 	 3

3a. Shell smooth......Vallonia pulchella

Width, 2.0–2.5 mm; 3.0–3.5 whorls. Shell smooth. Glassy white shell. Body whorl not angled downward at aperture. Umbilicus 1/4 diameter of shell. Lip reflected and thickened. Southern Canada and New England, south to Missouri and Kentucky, west to the Rockies.



Vallonia pulchella (Müller)

3b. Shell ribbed......Vallonia costata

Width, 2.5 mm; about 3.5 whorls. Color gray or pale yellow-corneous. Smaller than *Planogyra*. Shell with distinct ribs on the last whorls. Lip reflected and thickened. Umbilicate. Body whorl angles downward at aperture.

Southeastern Canada and New England, south to Virginia, west to Michigan, Ohio and northern Illinois.



Vallonia costata (Müller)

Family VITRINIDAE

Shell very thin, fragile and transparent; 2–3 rapidly increasing whorls, first whorl with barely perceptive spiral pits. Very large aperture, larger than rest of shell in side view. Body of animal large in respect to shell; cannot completely withdraw into shell. Shell very narrowly perforate or imperforate.

Southeastern Canada and New England, south to Pennsylvania, west to Michigan.



Vitrina limpida Gould

1b. Shell with more than three whorls; whorls increase in size more slowly; shell thicker.	2
2a. Shell cone-shaped.2b. Shell not cone-shaped; more flattened.	3 4
3a. Shell surface glossy	igera

Width, 11.0–15.6 mm; 6–7 whorls. Pale yellowish-horn colored. Shell with poorly developed striae; surface glossy. Without apertural teeth.

New York and western Vermont and Massachusetts, south to Florida, west to Michigan and Oklahoma.



Ventridens ligera (Say)

Width, 8–20 mm; 5.0–6.5 whorls. Yellowish-horn to olive buff colored; base whiter than rest of shell. Shell with well-developed spiral striae. Without apertural teeth. Umbilicus small, 1 mm or almost closed.

New York and western New England, south to Florida, west to Michigan and Texas.



Ventridens intertexus (Binney)

4a. Shell diameter	greater than 16 mm.	5
4b. Shell diameter	less than 16 mm	6

5a. Spire elevated......Mesomphix cupreus

Width, 22.0–28.5 mm; 4.5–5.0 whorls. Tan-olive to honey-yellow colored. Umbilicus distinct, wider than that of M. *inornatus*.

New England, south to Georgia and Alabama, west to Illinois and Arkansas.





Mesomphix cupreus (Rafinesque)

5b. Spire depressed......Mesomphix inornatus

Width, 16.5–21.0 mm; 5 whorls. Perforate. Smaller umbilicus than *M. cupreus*. New England, west to Indiana and Kentucky



Mesomphix inornatus (Say)

6a. Whorls distinctly increasing in size; last whorl distinctly larger than	
the penultimate whorl	7
6b. Whorls increasing in size very slowly; only last whorl larger than	
penultimate whorl1	4

7a. Perforate (umbilicus almost invisible)......Glyphyalinia indentata

Width, 4.7–7.1 mm; 4.5–5.0 whorls. Shell corneous, highly polished, with distinct, widely and equally spaced, radiating lines. No umbilicus, but the umbilical region deeply indented.

Southeastern Canada and New England, through middle states, west to Washington and Arizona.



Glyphyalinia indentata (Say)

7b. Umbilicate	8
8a. Shell with radiating indented lines.8b. Shell without radiating indented lines.	
9a. Shell diameter 4.5 mm or more9b. Shell diameter less than 4.4 mm	10
10a. Axial grooves many, closely spaced; umbilicus less than 1/5 the	

shell diameter......Glyphyalinia rhoadsi

Width, 4.5–5.3 mm; 4.0–5.0 whorls. Radiating lines similar to *G. indentata*; differs from other *Glyphyalinia* (especially *G. electrina*) by having distinct lines. Differs from *G. indentata* by having a well-developed umbilicus.

Maine, south to North Carolina, west to Michigan.



Glyphyalinia rhoadsi (Pilsbry)

Width, 4.6–5.2 mm; 3.5–4.5 whorls. Shell faint yellowish or pale greenish. No spiral striae. Larger than *G. binneyana*. Differs from *G. burrington* and *G. rhoadsi* by having a round, wide, and deep umbilicus.

Eastern Canada and throughout the United States.



Glyphyalinia electrina (Gould)

11a. Spiral striae beaded; shell buff......Glyphyalinia burringtoni

Width, 3.9–4.0 mm; about 4.5 whorls. Buffy, glossy semi-translucent. Radial grooves not as widely spaced as in *G. rhoadsi*. Umbilicate.

Southern New England, New York, and Pennsylvania, south to West Virginia.



Glyphyalinia burringtoni (Pilsbry)

Width, 3.5–4.3 mm; 3.5–4.0 whorls. Shell nearly colorless with greenish tinge. Smaller than *G. electrina*. Differs from *G. rhoadsi* in having radial grooves less widely spaced.

Southeastern Canada and New England, south to Pennsylvania, west to Washington and California.



Glyphyalinia binneyana (Morse)

12a. Shell diameter more than 12 mm.....Oxychilus draparnaldi

Width, 12.0–16.5 mm; 5.0–5.5 whorls. Shell highly polished, semi-translucent amber or pale yellowish; animal dark blue-black or blue-gray. Much larger than *O. cellarius* and *O. al-larius*. More openly umbilicate than *O. cellarius* and *O. allarius*. Whorls rounded at periphery. Fine, irregular growth lines. Carnivorous, feeding on immature insects, among other small invertebrates.

Introduced from Europe; occurs throughout North America.



Oxychilus draparnaldi (Beck)

Width, 6.0–7.0 mm; 4.0–4.5 whorls. Amber or pale yellowish; animal darkly pigmented. Shell transparent, dark body shows through. Spire depressed, discoidal appearance. Gives off a distinct garlic odor when handled.

Introduced from Europe; occurs throughout North America.



Oxychilus alliarius (Müller)

Width, 9 mm; 5 whorls. Animal light gray colored, darker above with a pale foot sole (differs from *O. allarius*). Broadly lunate aperture, more so than the other two *Oxychilus species*. Introduced from Europe; occurs throughout North America.



Oxychilus cellarius (Müller)

14a. Shell diameter greater than 4 mm	15
14b. Shell diameter less than 4 mm	18

15a. Tooth present in aperture (of adults)......Ventridens suppressus

Width, 5.4–7.8 mm; 5.5–7.0 whorls. Shell depressed. Narrowly umbilicate (1/9–1/8th shell diameter). Apertural teeth.

New York and western New England, south to Virginia, west to Michigan and Kentucky.



Ventridens suppressus (Say)

16a. Shell dull, with coarse striae.....Zonitoides limatulus

Width, 4.3–5.0 m; about 4.5 whorls. Greenish-white shell, not transparent. Shell greatly depressed. Conspicuous parallel surface sculpture, especially on top of shell (differs from *Z. arboreus* and *Z. nitidus*). Very wide (1/4-1/3 shell diameter), shallow umbilicus.

Eastern New York, south to Pennsylvania, west to Illinois and Missouri.



Zonitoides limatulus (Binney)

16b.	Shell glossy,	weak sculpture	

17a. Shell diameter less than 6 mm; animal pinkish.....Zonitoides arboreus

Width, 5–6 mm; 4.5–5.0 whorls. Yellowish-horn-colored shell; translucent. Differs from *Z. nitidus* in being smaller, having a more depressed spire, a flatter base of shell, spiral striae more faint, a smaller umbilicus, and a more oval aperture.

Throughout North America, south through Mexico, into Central America.



Zonitoides arboreus (Say)

17b. Shell diameter greater than 6 mm; animal black.....Zonitoides nitidus

Width, 6–7 mm; 4.5–5.0 whorls. Very shiny semi-transparent olive-yellowish colored shell; animal black. Gradually widening whorls. Surface sculpture absent. Base of shell rounded. Aperture rounded to ovate. Large deep umbilicus.

New England across the northern tier of states to South Dakota, Washington and California.



Zonitoides nitidus (Müller)

18a. Teeth present in aperture (may be far back in shell, visible through bottom of shell.....*Paravitrea multidentata*

Width, 2.5–3.0 mm; 6 whorls. Corneous smooth glossy. Shell depressed. Very small, rounded umbilicus. Two to four rows of very small whitish teeth radiating from the umbilicus (can be seen through the shell) within the base of the last whorl.

Maine, south to North Carolina, west to Michigan and Arkansas.



Paravitrea multidenata (Binney)

18b. No teeth in aperture	19
19a. Shell smooth	21
19b. Shell with riblets	

20a. Riblets widely spaced and high; shell diameter greater than 2 mm...Striatura exigua

Width, 2.2–2.4 mm; about 3.5 whorls. Corneous to greenish. Depressed shell; distinct spiral and conspicuous, widely spaced riblets. Widely open umbilicus (greater than 1/3 of shell diameter).

Southeastern Canada and New England, south to Pennsylvania, west to Minnesota.



Striatura exigua (Stimpson)

Width, 1.5 mm; 3.0–3.5 whorls. Shell corneous yellow to gray; animal white, with dark spots on head and tentacles. Broadly umbilicate (1/3 diameter of shell). Riblets less distinct and closer (almost run together) than in *S. exigua*.

Southeastern Canada and New England, south to West Virginia, west to Michigan and Kentucky.



Striatura milium (Morse)

21a. Shell imperforate......Guppya sterkii

Width, 1.2–1.3 mm; 3.5–4.0 whorls. Very small, adults barely 1 mm in diameter. Yellowish-translucent. Spire more depressed than in *Euconulus*; base of shell flattened. Periphery rounded. Minute spiral striae. Imperforate.

New York, south to Florida, west to Ohio and Louisiana.



Guppya sterkii (Dall)

Width, 2.0–2.8 m; 3.5–4.5 whorls. Very small, 1 mm.

Shell pale gray whitish. Spire depressed, base flattened. Shell smooth; very close growth lines gives shell a silky appearance. Umbilicate; umbilicus 1/3 diameter of shell. Aperture round. Throughout North America, including Canada, Alaska and the Aleutian Islands.



Hawaiia miniscula (Binney)

22b. Shell corneous, translucent; umbilicus 1/5 shell diameter......Striatura ferrea

Width, 2.5–3.4 mm; 3.5–4.0 whorls. Shell grayish translucent; animal dark blue or black. Outer whorl enlarges rapidly. Striae and riblets lacking. Umbilicus small.

Southeastern Canada and New England, south to North Carolina, west to Michigan and Kentucky.



Striatura ferrea Morse

Family EUCONULIDAE

1a. Four to six whorls; whorls large.....Euconulus fulvus

Width, 3.1–3.4 mm; 4.5–6.0 whorls. Cinnamon to pale brown. Glossy, thin fragile shell. Minutely perforate or imperforate. Lip thin, dilated at columellar margin. Throughout North America, north of North Carolina to Texas.



Euconulus fulvus (Müller)

1b. Six to eight whorls; whorls small......Euconulus chersinus

Width, 2.4–3.4 mm; 6.0–8.0 whorls. Differs from *E. fulvus* by having spire more elevated, being less glossy, and having more numerous and more narrow body whorls (6–8 vs 4–6); finer striae on last whorl; more narrow aperture.

Southern New England south to southern Atlantic states, west to Illinois, Michigan and Texas.





Euconulus chersinus (Say)

Family MESODONTIDAE

1a. Umbilicus imperforate	2
1b. Perforate or open umbilicus	4
2a. Shell diameter less than 12 mm; aperture a long, narrow slit	11
2b. Shell diameter greater than 12 mm; aperture oval	3

3a. Parietal tooth absent

Width, 17.6–45.3 mm; 5–6 whorls. Shell spire more depressed than *M. zaleta*. Parietal tooth absent or weakly developed. Lip widely reflected. Imperforate.

Southeastern Canada and New England, south to Georgia and Gulf States (in uplands, not coastal plain), west to Mississippi River and Oklahoma.



Triodopsis albolabris (Say)

3b. Parietal tooth present	9
4a. No teeth in aperture	10
4b. At least one tooth present in aperture	5
5a. Umbilicus perforate; one tooth (parietal)	6
5b. Umbilicus widely open; more than one tooth	7

6a. Shell diameter greater than 13 mm; parietal tooth short......Mesodon thyroides

Width, 15–31 mm; 5.0–5.5 whorls. Shell yellowish-green; may be glossy. Variable in size. Parietal tooth present in most specimens, but varies in size from large and distinct to an indistinct bump, to completely absent. Umbilicus distinct, half covered by reflected columellar lip.

Southeastern Canada and New England, south to Gulf States, west to Minnesota, eastern Nebraska and eastern Texas.





Mesodon thyroides (Say)

6b. Shell diameter less than 13 mm; parietal tooth long.......Stenotrema fraternum

Width, 7.8–11.4 mm; 5–6 whorls. More loosely coiled than *S. leai*. Surface of shell rougher than that of *S. leai*. Last whorl may have short hair. Small umbilicus; imperforate or narrowly perforate. Aperture relatively open. Lip widely reflected and smooth; basal lip narrowly reflected.

Southeastern Canada and New England, south to Georgia, west to Minnesota, Missouri and Oklahoma.



Stenotrema fraternum (Say)

7a. Lip with a long marginal lamina.....Triodopsis denotata

Width, 19.0–25.6 mm; about 5.5 whorls. Shell covered with short stiff hair. Parietal tooth long, almost length of aperture. Imperforate. Umbilical callus. Palatal tooth short. Basal margin thickened and blade-like.

Western New England, south to North Carolina, west to Michigan and Mississippi.



Triodopsis denotata (Férussac)

8a. Three teeth; parietal tooth long and curved......Triodopsis tridentata

Width, 11.7–25.3 mm; 5–6 whorls. Shell light green to pale cinnamon-buff. Spire depressed. Shell smooth; no hair. Shell twice as wide as high. Distinct umbilicus, 1/7 width of shell. Distinct, compact parietal tooth and two relatively small palatal and basal teeth on the peristome.

Southeastern Canada and New England, south to Georgia, west to Michigan, Illinois and Mississippi.

Getz et al.



Triodopsis tridentata (Say)

8b. Two teeth; parietal tooth short......Mesodon sayanus

Width, 19.4–27.0 mm; about 5.5 whorls. Shell thin. Widely umbilicate, 1/7 diameter of shell. Distinct tooth on parietal wall; small tooth on the collumellar margin.

Southeastern Canada and New England, south to North Carolina, west to Michigan, Kentucky and Tennessee.



Mesodon sayanus (Pilsbry)

9a. Shell depressed......Tridopsis dentifera

Width, 20.0–30.5 mm; 5.0–5.5 whorls. Pale olive. Shell depressed, more so than *T. albolabris* and *M. zaletus* (much more so than *M. zaletus*). Differs from *T. albolaris* by having a well-developed parietal tooth. Shell thinner than that of both *M. zaletus* and *T. albolarbris*. Imperforate.

Southeastern Canada and New England, south to South Carolina, west to Pennsylvania.



Triodopsis dentifera (Binney)

Width, 19–31 mm; 5.5–6.0 whorls. Shell more globose (elevated) than *T. albolabris*. Very large, distinct parietal tooth, obliquely set; absent or very weakly developed in *T. albolabris*. Lip widely reflected. Imperforate.

Southeastern Canada and New England, south to Alabama, west to Wisconsin, Oklahoma, and Arkansas.



Mesodon zaletus (Binney)

10a. Shell unbanded......Mesodon thyroides

Width, 15–31 mm; 5.0–5.5 whorls. Shell yellowish-green; may be glossy. Variable in size. Parietal tooth present in most specimens, but varies in size from large and distinct to an indistinct bump, to completely absent. Umbilicus distinct, half covered by reflected columellar lip.

Southeastern Canada and New England, south to Gulf States, west to Minnesota, eastern Nebraska and eastern Texas.



Mesodon thyroides (Say)

10b. Shell with reddish-brown bands......Allogona profunda

Width, 19–34 mm; about 5.5 whorls. Shell heavy. Spire depressed. Typically with wide dark brownish-red horizontal bands; bands faded or absent in some specimens. Distinguished from all of the mesodontids by deep open umbilicus, 1/5 diameter of shell. Distinct swelling on lower peristome, near umbilicus.

Southeastern Canada and New England, south to Alabama, west to Minnesota, Nebraska, Kansas and Mississippi.



Allogona profunda (Say)

11a. Basal lip with a median notch; shell subglobose......Stenotrema leai

Width, 6.1–9.4 mm; 5.5–6.5 whorls. Tannish-brown to cinnamon buff. More tightly coiled than *S. fraternum*. Shell smooth. Distinct umbilicus, much more open than that of *S. fraternum*. Lip widely reflected and smooth. Aperture relatively open. Basal lip narrowly reflected. Parietal tooth shorter than that of *S. fraternum*.

Western New England and New York, south to Virginia, west to South Dakota and Texas.



Stenotrema leai (Binney)

Width, 6.2–11.0 mm; 5.0–5.5 whorls. Tan to cinnamon buff. Shell with short hairs. Basal lip wide, with a small, distinct notch mid-way along its length. Parital tooth long and wide, almost closing the aperture. Aperture a narrow slit.

Southeastern Canada and New England, south Alabama, west to Missouri, Kansas and Mississippi.



Stenotrema hirsutum (Say)

Family PHILOMYCIDAE

1a. Head covered by anterior lip of mantle; slime milky when animal irritated;	
adults more than 35 mm long	.2
1b. Head not covered by anterior lip of mantle; slime clear when animal is irritated;	
adults less than 35 mm long	.3

Extended body length of adults, 70 mm to more than 100 mm. The mantle covers the entire body, including the head. Mantle ground color is tan. There are two longitudinal, mid-dorsal rows, or less commonly one row, of black or dark brown spots or blotches. Between the rows there frequently is a brown band, darker than the tan background color.

Widely distributed in eastern North American forests.



Philomycus carolinianus (Bosc)

This species is very similar to the *P. carolinianus* in size, appearance and distribution. Historically, it has been treated as a subspecies or variant of that species. Externally it is distinguished from that species by the presence of one dorsal and two lateral rows of black or dark brown spots or blotches.



Philomycus flexuolaris Rafinesque

Extended body length of adults less than 35 mm. The mantle is similar to that of *P. dorsalis* except the color is tan to light grey and there is no dorsal line of black spots. Margins of the foot sole are red at least anteriorly.

Widely distributed in forests of the northeast.



Pallifera ohioensis (Sterki)

Extended body length of adults less than 20 mm. The mantle covers all but the head of the animal. Mantle ground color is bluish grey, usually with a mid-dorsal line of dots extending over most of the mantle. Foot sole white.

Widely distributed in eastern North American forests.



Pallifera dorsalis (Binney)

Family LIMACIDAE

1a. "Tail" truncated when viewed from the side. Posterior margin of mantle	
rounded when viewed from above. Nucleus of concentric whorl of ridges	
centered on the right side of mantle	.2
1b. "Tail" pointed when viewed from the side. Posterior margin of mantle	
obtusely angular when viewed from above. Nucleus of concentric whorl of ridges	
on mantle centered on dorsal mid-line	.3

2a. Slime milky when animal is disturbed. Breathing pore pale bordered. Extended length of adults more than 30 mm......Deroceras reticulatum

Extended body length of adults, 45–50 mm; body more robust than that of *Deroceras laeve*. Dorsal keel short, but distinct. Breathing pore surrounded by white border. Body color varies from almost solid black through mottled black or brown to light tan or grayish white. Black or brown pigment in the valleys between the tubercles. Sides normally paler than the dorsum. Mantle located more anteriorly in fully extended animals than in *Deroceras laeve*. Slime clear in undisturbed animals; milky white and very sticky in disturbed animals.

Introduced from Europe. Records from throughout Canada and United States.



Black form



Light tan form

Mottled black or brown form



Grayish white form

Deroceras reticulatum (Müller)

Small slug, extended length of adults, 25 mm. Body color varies from light brown through light gray to black. Black, irregular spots or reticulation may be present on body. Border of breathing pore dark. When animal is extended, mantle appears almost centrally located; long neck. Slime clear and watery.

Native to most of North America, including Canada, United States, and Mexico. Also, introductions from Europe that are intermixed and most likely interbred with native slugs.



Black form

Light gray form

Deroceras laeve (Müller)

3a. Mantle bears at least one pair of dark longitudinal bands...Lehmannia valentiana

Extended body length, 60 mm. Keel very weakly developed or absent. Breathing pore surrounded by a whitish area. Body color light brown dorsally, fading gradually to light tan laterally. Mantle with a pair of gray to black lateral bands and usually a single, less defined mid-dorsal band. Foot sole whitish. Slime is clear.

Native to Iberian Peninsula; introduced throughout Europe. Introductions in North America associated with greenhouses and in gardens and lawns (in Illinois).



Lehmannia valentiana (Férussac)

3b. Mantle bears black or yellow spots or blotches or no markings at all......4

4a. Slime yellow. Mantle yellow spotted. Extended length of adults less than 100 mm *Limax flavus*.

Extended body length of adults 70–100 mm. Body color varies from yellowish gray to green. In adults. the body has yellow spots or irregular blotches. Lateral lines absent. Tentacles blue. Foot sole pale yellowish. Slime is yellow.

Introduced from Europe. Recorded from scattered sites throughout North America.



Limax flavus Linnaeus

Very large slugs; extended body length of adults, 100–200 mm. Dorsal keel extends less than half the distance between the posterior margin of the mantle and the "tail." Keel slightly crenate. Body color is some shade of gray or brown; numerous dark spots, blotches, or stripes in a variable pattern; there are no regular mantle bands. Tentacles uniformly brown. Foot sole is whitish gray. Slime is clear.

Introduced from Europe. Populations recorded throughout most of North America.



Body lines interrupted

Body lines forming solid line

Limax maximus Linnaeus

Family ARIONIDAE

1a. Tubercles conically shaped with hyaline apices when animal contracts; adults less than 25 mm long when contracted......Arion intermedius

Extended body length of adults less than 25 mm. When contracted, living animal has one to several conical, hyaline projections on each tubercular ridge. Lateral bands, if present, faint. Right mantle band surrounds the breathing pore. A row of black dots anteriorly, just above the foot fringe, is often present. Body color gray to yellowish gray. Foot sole yellow.

Introduced from Europe. In North America records from isolated sites from southeastern Canada south to Rhode Island, Connecticut, and New York. May be locally abundant.



Arion intermedius (Normand)

1b. Tubercles not conically shaped and without hyaline apices when animal contracts; adults more than 25 mm long when contracted	2
2a. Foot fringe wide and bears numerous dark vertical lines, at least posteriorly; lateral dark bands present or absent	3

Largest *Arion* species; extended body length of adults may exceed 150 mm. Adults lack lateral bands. When present in young, mantle bands located closer to the dorsal midline than in other species of *Arion*; right mantle band above the breathing pore. Tubercles elongate and prominent. Foot fringe wide; dark or brightly colored, with prominent vertical dark lines. Adult color varies from yellow to reddish brown to black. Foot sole is gray. Slime usually clear.

Introduced from Europe. Recorded from Newfoundland, Quebec, Maine, Connecticut, Michigan, Washington, and Oregon in North America. More abundant in northwestern than northeastern United States.



Arion ater (Linnaeus)

A large slug, extended body length of adults may exceed 80 mm. Typically with a black band on each side of body and mantle; bands faint or absent in some specimens. Lower boundary of the right mantle band usually diffusely surrounds the breathing pore. Well-developed foot fringe has distinct vertical dark lines, at least posteriorly. Foot sole is whitish gray. Slime is yellow or orange when animal is irritated.

Introduced from Europe. Abundant throughout natural habitats from Southeastern Canada, south to New York and Pennsylvania. Records from northern Virginia and southeastern Michigan.

Color form 1. Dorsum dark reddish brown to black. Upper boundary of lateral band or entire band masked by dark ground color.

Color form 2. Dorsum brown to brownish gray, mottled with black pigment. Area above lateral bands lighter brown so that bands appear much darker and more distinct than in other color forms.

Color form 3. Dorsum and sides yellow or orange; only indications of dark pigment are reticulations between the lateral margins of the mantle and foot fringe.

Color form 4. Dorsum light brown to brownish yellow; lateral bands usually very faint.



Arion subfuscus (Draparnaud)

The *A. hortensis* complex comprises three species: *A. distinctus, A. hortensis* and *A. owenii*. At least the first two species have been introduced into North America. To differentiate the species it is necessary to dissect the reproductive system which is beyond the scope of this key. The following description applies to the complex.

Slender; extended body length of adults, 40 mm. Lateral bands are very dark and lower on the body than in other species of *Arion*. Right mantle surrounds the breathing pore. Dorsal body color is blue-black to black in immatures; adults, brownish-black. Body just above lateral bands light-colored; animals appear to have a pair of light bands just above the dark lateral bands.

Introduced from Europe and England. Recorded from isolated localities from southeastern Canada, Pennsylvania, Maine and Connecticut in the eastern United States and in Washington and California in the western United States.



Arion hortensis Férussac complex

Extended body length of adults, 40–50 mm. Mid-dorsal ridge is usually conspicuous even in adults. Dorsal body ground color light gray, becoming slightly lighter just dorsal to the black body bands. Mid-dorsal portion of the mantle is gray, fading to pale grayish yellow just above the mantle bands. Immediately below each lateral body band is a yellow or orange band of about the same width as the black body band. Sides of the foot and sole are white.

Introduced from Europe into most of Canada and the United States. It is the most widely distributed of all the introduced arionids.



Arion fasciatus (Nilsson)

Extended body length of adults, 40 mm. Lateral bands broad and darkly pigmented. Because the area just above the lateral bands is lightest in color there appears to be a pair of light bands present between the dark mid-dorsum and the dark lateral bands. Dorsum has a distinctly chocolate brown tinge, although apparently there is no brown pigment present. Body sides are slightly paler than the dorsum. Valleys between the lateral tubercles darkly pigmented, producing a distinctly reticulated appearance. Foot fringe dark spotted almost to the extent of being lineolate. Foot sole pale yellowish white. Slime is clear.

Scattered populations throughout Canada and the United States, including southeastern Canada and northeastern United States. Much less common than *A. fasciatus*.



Arion silvaticus Lohmander

There are two color forms of this species in the northeast. The more common black form has an extended adult body length of 40 mm. The dorsal and lateral ground color is gray. The dorsum including the mantle is distinctly flecked with black markings of various shapes and sizes. When fully contracted the animal appears almost black. Lateral black body bands are present. Sides not darker than the area immediately above the bands. Foot sole is bluish-white. Slime clear. The brown form is identical to the black form except that brown pigment replaces the black pigment. Both color forms may be present at a single location.

Scattered populations of this species occur throughout Canada and the United States, including the southeastern Canada and northwestern United States. It is much less common than *Arion fasciatus*.



Arion circumsciptus Johnston

REFERENCES

- BACKELJAU, T., DE BRITO, C.P., REGINA M., TRISTÃO DA CUNHA, R.M., FRIAS MARTINS, A.M. & DE BRUYN, L. 1992. Colour polymorphism and genetic strains in *Arion intermedius* from Flores, Azores (Mollusca: Pulmonata). *Biological Journal of the Linnean Society*, 46: 131–143.
- BACKELJAU, T., DE BRUYN, L., DE WOLF, H., JORDAENS, K., VAN DONGEN, S. & WINNEPEN-NINCKX, B. 1997. Allozyme diversity in slugs of the *Carinarion* complex (Mollusca, Pulmonata). *Heredity*, 78: 445–451.
- BAKER, F.C. 1939. Fieldbook of Illinois Land Snails. Illinois Natural History Survey Manual No. 2, Urbana, IL. pp 1–166.
- BRANSON, B.A. 1968. Two new slugs (Pulmonata: Philomycidae: *Philomycus*) from Kentucky and Virginia. *The Nautilus*, 81: 127–133.
- BURCH, J.B. 1955. Some ecological factors of the soil affecting the distribution and abundance of land snails in eastern Virginia. *The Nautilus*, 69: 62–69.
- BURCH, J.B. 1956. Distribution of land snails in plant associations in eastern Virginia. *The Nautilus*, 70: 60–62.
- BURCH, J.B. 1962. How To Know The Eastern Land Snails. Wm. C. Brown, Dubuque, IA. pp 1-214.

- BURCH, J.B. & JUNG, Y. 1988. Land snails of the University of Michigan Biological Station Area. *Walkerana*, 3 (9): 1–177.
- CHICHESTER, L.F. & GETZ, L.L. 1971. Introduced European slugs. The Biologist, 53: 118-127.
- CHICHESTER, L.F. & GETZ, L.L. 1973. The terrestrial slugs of northeastern North America. *Sterkiana*, 51: 11–42. [Also on web site: http://hdl.handle.net/2142/8773]
- CLARK, S.H.B. 2001. Birth of the Mountains. U.S. Geologic Survey.
- DAVIES, S.M. 1977. The *Arion hortensis* complex, with notes on *A. intermedius* Normand (Pulmonata: Arionidae). *Journal of Conchology*, 29: 173–187.
- DAVIES, S.M. 1979. Segregates of the *Arion hortensis* complex (Pulmonata: Arionidae), with the description of a new species, *Arion owenii. Journal of Conchology*, 30: 123–127.
- FAIRBANKS, H.L. 1989. The reproductive anatomy and taxonomic stats of *Philomycus venustus* Hubrick, 1953 and *Philomycus bisdosus* Branson 1968 (Pulmonta: Philomycidae). *The Nautilus*, 103: 20–23.
- FORSYTH, R.G. 2004. Land snails of British Columbia. Royal British Columbia Museum Handbook. Royal BC Museum, Victoria, pp. 1–88.
- GETZ, L.L. & UETZ, G. 1994. Species diversity of terrestrial snails in the southern Appalachians. Malacological Review, 27: 61–74.
- HOAGLAND, K.E. & DAVIS, G.W. 1987. The succineid snail fauna of Chittenango Falls, New York: taxonomic status with comparisons to other relevant species. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 139: 465–526.
- HOTOPP, K.P. 2002. Land snails and soil calcium in central Appalachian mountain forest. *Southeastern Naturalist*, 1: 27–44.
- HOTOPP, K.P. & PEARCE, T.A. 2006. Land Snails of Pennsylvania. Carnegie Museum of Natural History, Pittsburgh, PA, USA, http://www.CarnegieMNH.org/mollusks/palandsnails
- HUBRICHT, L. 1953. Three new species of Philomycus. The Nautilus, 66: 78-80.

IGLESIAS, J. & SPEISER, B. 2001. Distribution of *Arion hortensis* s.s. and *Arion distinctus* in northern Switzerland. *Journal of Molluscan Studies*, 67: 209–214.

- JORDAENS, K., GEENEN, S., REISE, H., VAN RIEL, P., VERHAGEN, R. & BACKELJAU, T. 2000. Is there a geographical pattern in the breeding system of a complex of hermaphroditic slugs (Mollusca: Gastropoda: Carinarion)? *Heredity*, 85: 571–579.
- MARTIN, S.M. 2000. Terrestrial snails and slugs (Mollusca: Gastropoda) of Maine. *Northeastern Naturalist*, 7: 33–88.
- MASON, C.F. 1970. Food, feeding rates and assimilation in woodland snails. Oecologia, 4: 358-373.
- PEARCE, T. A. & BAYNE, E.G. 2003. Records of the *Arion hortensis* species complex in Delaware and Pennsylvania, eastern United States. *Veliger*, 46: 362–363.
- PILSBRY, H.A. 1948. Land Mollusca of North America (North of Mexico). The Academy of Natural Sciences of Philadelphia, No. 3, Vol. 2, Part 2. Pp. 521–1113.
- PINCEEL, J., JORDAENS, K., VAN HOUTTE, N., WINTER, A. J. & BACKELJAU, T. 2004. Molecular and morphological data reveal cryptic taxonomic diversity in the terrestrial slug complex *Arion subfuscus/fuscus* (Mollusca, Pulmonata, Arionidae) in continental north-west Europe. *Biological Journal of the Linnean Society*, 83: 23–38.
- PINCEEL, J, JORDAENS, K., VAN HOUTTE, N., BERNON, G. & BACKELJAU, T. 2005a. Population genetics and identity of an introduced terrestrial slug: *Arion subfuscus* s.l. in the north-east USA (Gastropoda, Pulmonata, Arionidae). *Genetica*, 125: 155–171.
- PINCEEL, J., JORDAENS, K. & BACKELJAU, T. 2005b. Extreme mtDNA divergences in a terrestrial slug (Gastropoda, Pulmonata, Arionidae): accelerated evolution, allopatric divergence and secondary contact. *Journal of Evolutionary Biology*, 18: 1264–1280.
- QUINTEIRO, J., RODRÍGUEZ-CASTRO, J., CASTILLEJO, J., IGLESIAS-PIÑEIRO, J. & REY-MÉNDEZ, M. 2005. Phylogeny of slug species of the genus *Arion*: evidence of monophyly of Iberian endemics and of the existence of relict species in Pyrenean refuges. *Journal of Zoological Systematics* and Evolutionary Research, 43: 139–148.
- REISE, H., ZIMDARS, B., JORDAENS, K. & BACKELJAU, T. 2001. First evidence of possible outcrossing in the terrestrial slug *Arion intermedius* (Gastropoda: Pulmonata). *Hereditas*, 134: 267–270.

- SKELDON, M.A. 2007. Terrestrial gastropod responses to ecosystem-level calcium manipulation a northern hardwood forest. *Canadian Journal of Zoology*, 85: 994–1007.
- WATSON, L. & DALLWITZ, M.J. 2005. The families of British non-marine mollusks (slugs, snails and mussels). Version: 10th April 2007, http://delta-intkey.com.
- WHITTAKER, R.H. 1956. Vegetation of the Great Smoky Mountains. Ecological Monographs, 26: 1-80.

INDEX TO SPECIES

Allogona profunda	271	Hyg
Anguispira alternata	254	Hyg
Arion ater	278	
Arion fasciatus	280	Lehi
Arion hortensis	279	Lim
Arion intermedius	277	Lim
Arion circumscriptus	281	
Arion silvaticus	280	Mes
Arion subfuscus	278	Mes
		Mes
Carychium exiguum	241	Mes
Catinella avara (vermata)	253	Mes
Cepaea hortensis	252	Oxy
Cepaea nemoralis	252	Oxy
		Ōxy
Cochlicopa lubrica	241	Ōxy
Columella edenata	242	2
		Pall
Deroceras laeve	275	Pall
Dereceras reticulatum	274	Par
Discus cronkhitei	256	Phil
Discus patulus	255	Phil
Discus rotundatus	255	Plar
		Pun
Euconulus chersinus	267	Pup
Euconulus fulvus	267	Pup
Gastrocopta armifera	248	Sten
Gastrocopta contracta	249	Sten
Gastrocopta corticaria	250	Sten
Gastrocopta pentodon	249	Strie
Gastrocopta tappaniana	248	Strie
Glyphyalinia binneyana	261	Strie
<i>Glvphvalinia burringtoni</i>	261	Stro
<i>Glvphvalinia electrina</i>	261	Stro
<i>Glvphvalinia indentata</i>	260	Stro
Glvphvalinia rhoadsi	. 260	Suce
Guppva sterkii		
		Trio
Haplotrema concavum	241	Trio
Hawaiia miniscula		Trio
Helicodiscus parallelus	254	Trio
r		

Hygromia hispida	251
Hygromia striolata	251
Lehmannia valentiana	276
Limax flavus	276
Limax maximus	276
Mesodon sayanus	270
Mesodon thryroides2	68/270
Mesodon zaletus	271
Mesomphix cupreus	259
Mesomphix inornatus	259
Oxychilus alliarius	262
Oxychilus cellarius	262
Oxychilus draparnaldi	262
Oxyloma retusa	253
Pallifera dorsalis	274
Pallifera ohioensis	273
Paravitrea multidenata	264
Philomycus carolinianus	273
Philomycus flexuolaris	273
Planogyrus asteriscus	256
Punctum minutissimum	254
Pupilla muscorum2	42/248
Pupoides albilabris	242
Stenotrema fraternum269	
Stenotrema hirsutum	272
Stenotrema leai	272
Striatura exigua	265
Striatura ferrea	266
Striatura milium	265
Strobilops aenea	250
Strobilops affinis	251
Strobilops labyrinthica	250
Succinea ovalis	253
Triodopsis albolabris	268
Triodopsis dentifera	270
Triodopsis denotata	269
Triodopsis tridenata	269

Index to Species (continued)

Vallonia costata	257
Vallonia pulchella	257
Ventridens intertexus	258
Ventridens ligera	258
Ventridens suppressus	263
Vertigo bollesiana	247
Vertigo elatior	247
Vertigo gouldi	246
Vertigo milium	243
Vertigo modesta	244
Vertigo morsei	245
Vertigo nylanderi	243

Vertigo ovata	
Vertigo perryi	
Vertigo pygmaea	
Vertigo tridentata	
Vertigo ventricosa	
Vintrina limpida	
Zonitoides arboreus	
Zonitoides limatulus	
Zonitoides nitidus	
Zoogenetes harpa	