

Identifying Land Snails and Slugs in Canada

Introduced Species and Native Genera



F. WAYNE GRIMM, ROBERT G. FORSYTH, FREDERICK W. SCHUELER & ALETA KARSTAD



Canadian Food
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d'inspection des aliments

Canada

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By F. Wayne Grimm, Robert G. Forsyth, Frederick W. Schueler,
and Aleta Karstad

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Front cover: *Cepaea nemoralis*, the Grovesnail, Manitoulin Island, Ontario.

Back cover: *Limax maximus*, the Giant Gardenslug.

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Oxychilus draparnaudi
(Victoria, B.C.)

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Robert Forsyth ©: photographs and illustrations on pages iv, 2, 4, 6, 10, 12, 35, 37 (*Carychium minimum*), 38, 39, 41, 42 (*Cochlicopa lubrica*), 44, 46, 48, 50, 51, 52 (not *Gastrocopta contracta*), 55, 57, 58, 59, 61 (*Helicodiscus parallelus*), 62, 63 (*Striatura pugetensis*), 64, 67 (*Aegopinella nitidula*), 68, 69, 70, 74, 75, 78, 79, 103, 104, 114, 115, 116, 118, 120, 122, 123, 124, 125, 126 (not *Neobelix spp.*), 128, 129, 130, 131, 141, 142, 143, 144 (not *O. lactea*), 145, 146 (*Polygyra septemvolva*), plate 8 (in part), and all illustrations in the keys and glossary.

Aleta Karstad ©: colour paintings of slugs, Plates 1–7, and illustrations on pages 37 (*Mediappendix*), 42 (*Pupilla muscorum*), 52 (*Gastrocopta contracta*), 60, 61 (*Lucilla singlyana*), 65, 67 (*Glyphyalinia indentata*), 72, 73, 76, 80, 82, 85, 86, 88, 90, 93, 95, 97, 98, 99, 100, 101, 102, and photographs on plate 8 (in part).

Judy Courteau ©: photographs on pages: 63 (*Ventridens ligera*), 126 (*Neobelix albolabris* and *N. dentifera*), and 146 (*Hygromia cinctella* and *Monacha cantiana*).

Mary Sollows ©: photograph of crawling *Arianta arbustorum*, page 7.

Andrzej Wiktor ©: illustration on page 14.

Design and layout by Robert Forsyth.

Preface

This book was conceived in 2000 as a focus for the late F. Wayne Grimm, then Curator of Invertebrates at the now defunct Eastern Ontario Biodiversity Museum in Kemptville, Ontario. The book was to have described the introduced snails and slugs of northeastern North America on the basis of Wayne's long experience, with Fred Schueler as editorial co-author and Aleta Karstad as illustrator. A manuscript was underway by the spring of 2005 when the Canadian Food Inspection Agency (CFIA) agreed to support the project, with the scope changed to include all of Canada. We are grateful to Doug Parker and the CFIA for supporting this project and the curation of Wayne's collection. After Wayne's death in June 2005, Robert Forsyth joined Fred and Aleta in completing the manuscript for publication. Occasionally throughout the species accounts, the reader will notice places where records are credited to Wayne: these are species introductions mentioned only in the original manuscript of this book, for which no specimens or detailed documentation have been found.

We thank Matt Keevil for curating Wayne's collections and Judy Courteau for organizing his papers and taking on various other tasks. Jeff Nekola provided us with some unpublished results of his research on pupillids and vertiginids. Michael Oldham (Natural Heritage Information Centre, Ontario Ministry of Natural Resources) provided us with a complete set of his correspondence with Wayne Grimm.

We thank Andrzej Wiktor (Museum of Natural History, Wrocław University, Poland) for generously allowing us to adapt his figure showing the general internal body plan of a slug (page 14); this figure originally appeared in *Fauna Polski* (Wiktor 1989). Mary Sollows (New Brunswick Museum) photographed the live *Arianta arbustorum* on page 7. Some illustrations of slugs were painted from live animals collected by Judy Courteau, Bill Leonard (Olympia, Washington), and Jane Bendera (Langley, B.C.), or from photographs provided by Kristiina Ovaska (Victoria, B.C.) and Barbara Nitz (Munich, Germany). Jean-Marc Gagnon (Canadian Museum of Nature) and Claire Healey (Royal Ontario Museum) allowed access to their collections and/or loaned specimens to us. Isabelle Picard (Sherbrooke, Quebec) shared her knowledge of the occurrence of introduced species in Quebec.

For reviewing the manuscript, we thank Timothy Pearce (Carnegie Museum of Natural History, Pittsburgh, Pennsylvania), Donald McAlpine (New Brunswick Museum), Alexander Suvorov (Sherbrooke, Quebec), Ulrich Schneppat (Chur, Switzerland), and CFIA Ottawa Plant and Seed Laboratories biologists (Doug Parker, Hume Douglas and Bruce Gill).

This book describes and illustrates 39 species of land snails and slugs that are known to be introduced to Canada and have, or have had, reproducing, feral populations out-of-doors. Greenhouse aliens are not included in the species accounts unless they also occur, and can survive, outside. Some common greenhouse aliens are included in the Appendix, which also includes species that are commonly intercepted, as well as species of interest to regulatory agencies. *Patera appressa* is included as introduced from the United States, though we cannot be sure that it is not native to the vicinity of Trenton, Ontario. A few species (*Cepaea hortensis*, *Vallonia excentrica* and *V. pulchella*) are native to part of Canada but have been introduced elsewhere. With these four exceptions, all the feral introduced species — in gardens, along roadsides, in clearings, around farms or in other disturbed habitats — are European in origin.

Keys are included to native and introduced genera of land snails and slugs. A diagnosis of native genera, with lists of native species, are also included and accompanied by illustrations of representative species.



Cepaea nemoralis, Grovesnail (Mayne Island, B.C.).

Introduction

What are Snails and Slugs?

Snails and slugs are invertebrates — animals without a spinal cord. They belong to the large group of unsegmented soft-bodied animals known as molluscs, from the Greek *mollis*, meaning “soft”, but most have some type of shell that encloses the body. With about 93,000 species (Haszprunar 2001) in marine, freshwater and terrestrial habitats, molluscs are second only to the arthropods in numbers of species. Malacologists — zoologists who study molluscs — divide the phylum Mollusca into seven or eight subdivisions known as classes. Terrestrial snails and slugs belong to the largest class, Gastropoda. The word gastropod comes from Greek meaning “stomach-foot”, and refers to the prominent muscular organ of locomotion (the foot) on the ventral surface of the body.

The terms snail and slug describe the two main body shapes of terrestrial gastropods. Snails are those species having a coiled shell into which the animal can mostly or wholly retract. A typical gastropod shell is a hollow, spiral tube of calcium carbonate and an outer layer called the periostracum (consisting of conchiolin), which is secreted around the aperture by the mantle. It is a non-living structure (like a fingernail) that is enlarged as the animal grows and is not shed, growing in the shape of a logarithmic spiral.

Slugs are snails in which the shell has been much reduced or entirely lost, and the derivation of a slug-like body form has evolved in several distantly related groups of gastropods. In most slugs in this book, the shell is a flattened internal structure, without coils. The cap-shaped shell of Earshell Slug (*Testacella haliotideae*) has a tiny, but conspicuous coil. Arions (*Arion* spp.) have only a few isolated internal granules but no shell, and the native Jumping-slugs (*Hemphillia* spp.) have a flat shell that is partially exposed. All species of the Philomycidae completely lack shells.

All gastropods have a well-defined head that bears tentacles. Most of the terrestrial gastropods in Canada have two sets of tentacles: a shorter lower pair (sensory) which serve to ‘smell’ and a longer upper pair (ocular) with eyespots at the tips that sense dark and light.



A native species, *Vespericola columbianus*, Northwest Hesperian (Alice Arm, B.C.).

When the ocular tentacles are absent, the eyes are at the base of the sensory tentacles.

Located at the front head is the mouth. The mouth opens into the buccal mass that contains a radula — in its typical form a corneous ribbon armed with numerous rows of microscopic teeth. The radula is an organ that is unique to molluscs. Using a back and forth motion it rasps away particles of food. Behind the head on the dorsal surface is the mantle. The mantle secretes the shell and envelops the visceral mass, forming a sort of ‘lung’ in air-breathing gastropods. In slugs, the mantle is a raised area behind the head that usually covers the shell (if present). In some slugs the mantle is much enlarged and may cover a majority or the entire dorsal surface of the body. On the right lower edge of the mantle of air-breathing snails and slugs is the pneumostome, the hole that opens into the pulmonary cavity. Opening on the head behind the right tentacles is the orifice (or orifices) of the reproductive system. Nearly all gastropods in this book have one genital pore, except for the family Ellobiidae, which has separate male and female openings.

The skin of these animals excretes mucus, or slime, which prevents the skin from drying out, aids in transportation, and defensively, acts as a deterrent to predators.

Where they live

The distribution of native species in Canada is determined by climatic, geological and biological factors, and the regions have their own assemblage of native species. Except perhaps in the north where it is too cold for many species to survive, the presence of introduced snails and slugs has been largely influenced by chance, although climate and availability of food and shelter are probably important factors. For example, the Furrowed Helicellid (*Trochulus striolatus*) is very common in southern Ontario and east, but has only recently been found at one place in British Columbia (Forsyth 2008). Some ‘gaps’ in distributions, such as this one, are probably real but cannot be

distinguished from gaps in the survey effort, which have been sparse and irregular. We encourage investigation and provide basic instructions on how to study and collect land snails and slugs on page 11.

Land snails and slugs live in practically all terrestrial habitats, including forests, grasslands, tundra, alpine slopes, marshes, and on open ground. Unlike most native species, introduced snails and slugs are usually encountered in disturbed sites (“modified habitats”) and are frequently common in gardens, old fields and pastures, campsites, and along railways and roads. Some introduced species have penetrated further into relatively undisturbed woodland habitat and, for example the slugs *Arion* and *Deroceras* are frequently common around campsites in British Columbia’s forests.

Movement and Dispersal of Introduced Snails and Slugs

In general, land snails and slugs are thought of as slow-moving, thus, giving rise to expressions like “sluggish” and “snail mail”, and for probably most species, this is true — they travel at literally a snail’s pace.

The prominent feature of all land snails and slugs is their muscular foot, which with the aid of mucus propels them by a series of wave-like muscular contractions that move down the length of the sole. These contractions can be seen by looking at the underside of an animal that is crawling on a piece of glass. Mucus secreted from the sole of the foot serves as lubrication. Slime trails often show the animals’ paths; following a fresh trail will usually lead one to its source. Because the production of mucus requires water as well as proteins and salts, movement is inefficient when compared with that of other terrestrial animals, and during hot, dry times, animals are usually sedentary and may aestivate for up to months at a time.

Mucus also serves as a medium for chemical communication between individuals. It can repel predators, and some species can suspend themselves on a rope-like mucus thread. The Bananaslug (*Ariolimax columbianus*) can secrete a strong, elastic thread of mucus from the tip of its tail to descend from vegetation. For a different purpose, Giant Gardenslugs (*Limax maximus*) hang suspended from a mucus thread while copulating.

On its own, a large slug or snail likely does not move more than several metres during its whole life, and a tiny species may move just centimetres. Natural dispersal is mostly by passive means: mammals and birds may carry eggs or adult snails and slugs stuck in their fur or feathers; strong winds may blow tiny species or floodwaters may wash animals downstream; and gravity helps roll snails downhill to colonize new ground.

Many species of land snails and slugs have spread throughout the world in historical times. Only Antarctica remains uncolonized. The most successful invaders are those that are synanthropic; in other words they tend to associate with humans, even in their native lands. Probably all introduced species now established in Canada have come

here by accident, and the potential for movement of species between countries continues to be great because of high levels of international trade and travel. Internationally, or at home in your neighbourhood, it is easy to transport eggs and adult snails and slugs inadvertently with living plants and associated soil, in shipping containers, or in garden refuse. Even the bottom of a tent can move slugs from one campsite to another.

Canadians first began noticing introduced snails and slugs in the 1880s (Forsyth 2004). The mode and timing of most gastropod introductions to Canada are not known, and while most species in this book came from Europe, we do not know the precise origins of the Canadian populations. However, it is believed that some of the larger land snails (e.g., the Grovesnail, *Cepaea nemoralis*, and White-Lip Gardensnail, *C. hortensis*) have been intentionally imported (or more likely transported locally) and set free for the novelty of establishing colonies of these colourful snails. This practise is strongly discouraged — and importation of most species is illegal — because introduced species may become serious plants pests, and because any introduced species compromises the biogeographic integrity (or distinctiveness) of the area where it comes to live.

However, even repeated introductions, intentional or not, do not necessarily result in well-established or widespread populations. The Copse Snail, (*Arianta arbustorum*) is widespread in northern Europe and has been intercepted by customs inspectors on plants from Europe 25 times since 1963, but it is known to be established only in a few tiny colonies in Newfoundland, New Brunswick, and Toronto (McAlpine *et al.* 2009).

Impacts of Introduced Snails and Slugs

There are few native land snails and slugs that are serious plant pests; most natives are small and feed primarily on dead vegetation, fungi, algae, lichens, and soil particles and almost exclusively live in natural areas such as forests.

Some introduced terrestrial molluscs, especially slugs, are economically important because they are pests of plants, attacking a variety of crops and plants. They have voracious appetites and can colonize new places rapidly. Of the introduced gastropods in Canada, perhaps the most widespread and important pest is the Grey Gardenslug (*Deroceras reticulatum*). Godan (1983) and South (1992) review the damage caused by these terrestrial gastropods and discussed their control. Many introduced spe-



Deroceras reticulatum, Grey Fieldslug on potato plants (Smithers, B.C.).



*Arianta
arbustorum*,
Copse Snail
(St John, New
Brunswick)

cies in Canada are probably either too small or too localized to be serious pests.

Aside from being plant pests, alien species can disturb natural ecosystems and compete with or prey on native species (Cox 1999). In the tropics there were ill-advised schemes that introduced predatory snails such as the Rosy Wolfsnail (*Euglandina rosea*) to combat the invasion of the aggressive Giant African Snail (*Lissachatina fulica*) and other species. In the end, the predatory snails found the native fauna to be tasty as well and are responsible for extinctions of native snails (Civeyrel and Simberloff 1996, Lydeard *et al.* 2004).

In Canada, the impact of most introduced snails and slugs on native species and habitats is little-known, but alien species may become very abundant if they have generalist food requirements, wide habitat tolerance and efficient dispersal. In Nova Scotia slugs are a threat to endangered species of lichens (Cameron, in press). It is possible that the more predatory species of Glass-Snails (*Oxychilus* spp.) may reduce populations of small native snails through predation (Frest and Rhodes 1982). In general, introduced species could be more prolific and displace native species (Rollo 1983), but not much is known about the interactions between native and introduced gastropods in Canada.

Some species, like the Grovesnail (*Cepaea nemoralis*) are highly visible and widespread but not regarded as major plant pests. However, some settled environments in Canada are so saturated with introduced plants, earthworms, and other invertebrates that the ecological effects of any single species cannot be assessed without thorough study, and maybe not even then.

Surviving winter cold and summer drought

All the introduced species here (except some in the Appendix) came from areas with temperate climates, and while each survives cold and drought, little is known about how they do this. During cold weather animals hibernate in sheltered sites; during times of drought, they aestivate. It is not understood why, but the chances for over-winter survival of native Idaho Forestsnails (*Allogona ptychophora*) increase when shells are positioned with the aperture upwards during aestivation (Carney 1966). Snails frequently retract deeply into their shells, and during hibernation and aestivation their heart rate, breathing and metabolism are greatly reduced (Barker 2001).

The Meadow Slug (*Deroceras laeve*) and introduced Grovesnail (*Cepaea nemoralis*) tolerate freezing for at least short periods, while introduced *D. reticulatum* and *Arion* spp. do not survive freezing (Storey *et al.* 2007; K. & J. Storey, personal communication). No one knows to what extent northern distribution is limited by tolerance to freezing. Some native species, including the Meadow Slug that occurs north to Iqaluit on Baffin Island, are capable of surviving in places with intensely cold winters and cool, short summers.

During summer droughts, snails and slugs bury themselves or find shelter under objects and in cracks in order to escape the heat and prevent water loss. Tiny species descend within the leaf litter and humus layers to seek moisture (Locasciulli and Boag 1987), and slugs can reduce evaporation by huddling together. Snails may seal the aperture of the shell with a dried mucus sheet, called an epiphragm, which is hardened with calcium in some species. Revival is swift once water becomes available. While different kinds of animal inactivity generally share many properties, it is not known how similar the biochemical mechanisms of aestivation and hibernation are in terrestrial gastropods, and the diversity of these mechanisms among different taxa has scarcely been studied (Storey 2002).

Reproduction and life history

Reproduction in land snails and slugs is interesting stuff! Pulmonate gastropods are normally simultaneously hermaphroditic, which means that each individual has both male and female reproductive organs and can produce both sperm and eggs. The normal pattern is for these hermaphrodites to mate with another individual of their species and cross-fertilize (Barker 2001). In some groups, such as *Deroceras*, there can be elaborate courtship behaviours involving circling of the partners while touching or biting each other and secreting pheromones (Barker 2001, Reise 2007). There may be structures and glands in the penis that when everted aid in species recognition and help in selecting a suitable mate (Barker 2001).

In some groups, there may be a partial or complete loss of the male reproductive organs, making such individuals functionally female. Individuals without

male genitalia are said to be aphyallic. The Meadowslug (*Deroceras laeve*) is an example of a species that has mostly aphyallic individuals in a population, and reproduction is thought to be almost entirely by self-fertilization (Jordaens *et al.* 2006, Lebovitz 1998). Other examples of selfing species include Black Gloss (*Zonitoides nitidus*), some Arion (*Arion* spp.), and Glossy Pillar (*Cochlicopa lubrica*) (Forsyth 2004). Self-fertilization is likely a useful strategy when finding a mate may be difficult when the population density is low or when individuals are separated by great distances or inhospitable habitats (Jordaens *et al.* 1998). Self-fertilization will allow for a founding individual to establish a population or for the density of a population to be increased. In some extreme cases, an individual of a species that is normally thought to be exclusively cross-fertilizing will self as a last resort if a mate has not been available for some time (Selander and Kaufman 1973).

Most snails and slugs are oviparous and lay eggs, either singly or in clusters. Eggs are deposited where they are protected from desiccation: in the surface layer of soil, under pieces of wood, or in leaf litter. Eggs are oval to spherical, clear or opaque and white or pale yellow, and soft or hardened with calcium. Some snails are ovoviviparous, meaning that the eggs are retained protected in the parent until after they hatch. Examples of ovoviviparous species are the introduced Chrysalis Snail (*Lauria cylindracea*) and native Boreal Top (*Zoogenetes harpa*) and Moun-tainsnails (*Oreohelix* spp.) (Forsyth 2004).

The life spans of snails and slugs are varied, although we know little about this aspect of the biology of most species. The Chrysalis Snail (*Lauria cylindracea*) lives for up to five years, unlike most small species that are generally believed to hatch, mature, reproduce and die all within about one year's time (Heller 1990, Heller *et al.* 1997). A medium-sized species, the Waxy Glass-Snail (*Aegopinella nitidula*) is a biennial species, maturing in its second year (Mordan 1978). Some snails, like the large, West Coast native, Pacific Sideband (*Monadenia fidelis*), may live for at least eight years, but especially long lived species might survive to be over 15 or nearly 20 years old (Walton 1970).

Defence

The primary means used by snails to avoid predation is their ability to retract deeply into their shell. Unable to contract into a protective shell, slugs must rely on self-defence and fleeing. Examples of defensive actions by slugs include the contraction of the body in combination with a twisting-rocking motion of Chocolate and Black Arions (*Arion rufus* and *A. ater*); autotomy or self-amputation of the tail in the native Taildroppers (*Prophysaon* spp.); the lifting and lashing of the tail in Giant Gardenslugs (*Limax maximus*) and native Jumping-Slugs (*Hemphillia* spp.); and the production of copious amounts of mucus (Barker 2001). By fouling the mouthparts of predatory

carabid beetles, secretions of sticky mucus by slugs make predation by carabid beetles difficult (Deyrup-Olsen *et al.* 1986). The mucus of Bananaslugs (*Ariolimax columbianus*) is also known to cause tingling of the lips in humans (B. Merilees, personal communication).

For more information of the form, function and life history of terrestrial gastropods, see Barker (2001), Runham and Hunter (1970), Solem (1974), and South (1992).



Arion rufus, Chocolate Arion (Goldstream, Vancouver Island).

How to Study Land Snails and Slugs

Collecting

Collecting specimens and depositing them as vouchers in a natural history museum is strongly encouraged because these specimens allow for verification and further study by future investigators. For specimens to be useful, they must be associated with data including, at least, the location and date where they were found, and the name of the collector (see below). In the field, snails can be collected into vials or other containers, keeping large and small shelled animals, and predatory species separate for sorting later. Slugs are best kept in their own containers with some leaves or other material. Never leave paper labels inside containers with live specimens because most snails and slugs eat damp paper!

Dead shells intended for the collection can simply be washed and allowed to dry before storage. Tiny shells are best stored in glass shell vials, available from scientific supply companies, or in empty gel capsules from natural foods and drug stores. Larger snails and gel caps holding tiny specimens can be stored in boxes or self-closing (zip-style) plastic bags.

If live large-bodied snails are collected and only the shell is wanted (but see below), they can be boiled and the body removed with a pin and discarded. Small-bodied snails can simply be placed in isopropyl or ethyl alcohol for a few days, removed, and then allowed to dry. The tissues will dry out without an odour.

While preserving the shells can be worthwhile and rewarding, there will be times when it is more desirable to keep a 'wet' collection of specimens in alcohol. Keeping both the soft parts and shells are strongly encouraged and needed for taxonomic work. Preserving the tissues of snails, and especially slugs, requires special treatment. To avoid the distortion and contraction caused by placing live animals directly into alcohol, use carbonated water to narcotize and drown the animals. The animals will die quickly, produce less mucus than if drowned in regular water, and be more relaxed. Once dead, they must be preserved in alcohol. If necessary, a solution of 70% isopropyl alcohol will work, but tissues will harden making dissection more difficult. A solution of 70% ethanol is better. After the initial fixation in 70% ethanol, the solution should be re-

placed before storage in an air-tight vial or jar. It is both unnecessary and damaging (to you and the specimen) to use formalin! Specimens preserved in ethanol also are suitable for extraction of DNA, which has been used to confirm species that show only slight or ambiguous morphological characters.

Data and Record Keeping

Just as important as making collections is the keeping of records. Collection data and field observations should be kept in a book, on file cards, and/or in an electronic database. The data required varies with need, but the minimum data in all cases are the name of the geographic feature where the specimens were found; the distance from, or other relationship to, the nearest city, town, or village; the region, county, or district; the province or territory; the date collected; the habitat type; and the collector's name. We nearly always use topographic maps or a hand-held global positioning system receiver (GPS) to get geographic coordinates of the sites we visit. Because gastropods do not move around much, and newly introduced colonies are often small, precise locations can be important for revisits to sites where collections were made. Additional data may include notes on associated plants and animals, weather conditions, soil moisture, and time of day. If supplied with the same field data, photographs can be an important tool to document species.

For collectors wishing to start a collection, a system of numbering that will streamline data recording and prevent the mix-up of all-important data is encouraged. A unique number given to each collection site on one date is very useful. To each bag or box of shells or alcohol-preserved animals should be added a label that includes the primary field data as well as the identification of the specimen or specimens. For labels, it is important to use a durable, acid-free paper; pencil or permanent waterproof/alcohol-proof ink is required for hand-written labels. Labels can also be generated using a laser printer on the same high-quality paper.

Hygromiidae	1415
<i>Xerolenta obvia</i> (Menke, 1828)	
Canada: Ontario: City of Kawartha Lakes: Bethany: trail at Hwy 7A. 44°10'56.7"N, 78°33'55.4"W. Station 2008-124.	
Abundant, aestivating on grasses, herbs and ground; along roadsides and along trail.	
R. Forsyth, A. Karstad, F. Schueler & J. Courteau collectors, 25 August 2008.	

An example of a specimen label, and specimen, ready for the collection.



Reporting Your Finds

There are many opportunities for dedicated and careful investigators to discover introduced species, and we hope that this book sparks interest for further study. Our knowledge of introduced gastropods in Canada is fragmentary, partially because many species can exist in isolated colonies whose locations cannot be predicted from the character of the landscape or habitats, and because of the impossibility of anyone visiting all places in the country. This guide therefore is not the final word on introduced snails and slugs in Canada, and we encourage people to become involved and report their discoveries of introduced land snails and slugs firstly to the CFIA but also to local or provincial natural history museums.

Identifying Snails and Slugs

A hand lens of 10–20× magnification or a low-power microscope is useful to view the smaller species in this book and to see fine details.

With practice, almost all genera of snails and slugs in Canada can be identified by external characters of the shell or body. However, it is important to have adult, well-preserved shells. Immature specimens may not show certain adult characters necessary for the keys to work and may not be easily recognizable by the descriptions and figures. Unfortunately, the recognition of adults is difficult in some cases and can only be learned by experience in some cases. Snail shells with a thickened or flared apertural lip are considered adult, and with a few exceptions in this book, shells with denticles inside the aperture are also adult. Worn or faded shells likewise can cause difficulties in determination of species. These and juvenile specimens will become recognizable with practice and experience and by comparison with correctly identified mature specimens.

The identification of slugs can be more difficult for beginners. Genera can mostly be recognized by the size and general form of the animal, character of the mantle, presence of a keel along the back, position of the pneumostome, placement of the shell (if present or visible), colour and stickiness of the mucus, and skin texture. While living slugs are best for observing external body characters (skin pigmentation quickly fades in alcohol), dead or preserved animals may be required for the necessary dissections to identify species.

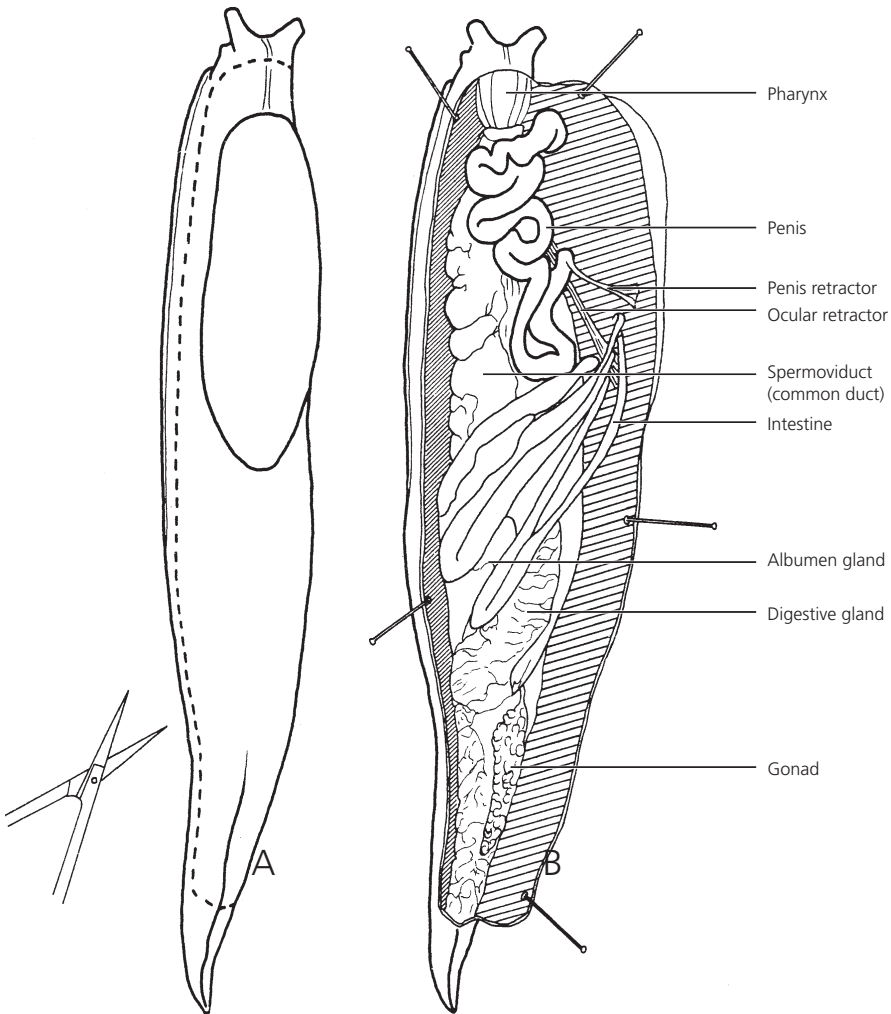
Preserving and dissecting slugs

Dissection is necessary to identify with confidence several genera and species in this book, and in most cases, the most informative internal organ system are the genitalia. Other organ systems are beyond the scope of this guide.

After drowning and preserving in alcohol (see p. 11), animals can be dissected using tools appropriate for small dissections, including a small scalpel and/or iridectomy

scissors, fine-tipped forceps, pins, and a dissecting dish filled with water or alcohol. Dissection is relatively simple for slugs: a shallow incision through the skin along the left side of the body, just above the sole and across the head and tail, will allow for the lifting of the mantle and the rest of the dorsal skin to reveal the internal organs.

For snails, the body must first be removed from their shells, a relatively simple procedure for the family Succineidae (p. 37), which will probably require dissection to identify genera. Other snails may require that they be boiled and the body removed with a pin.



Dissection of slugs is best done by cutting along the left side of the body (A). The body's skin can be lifted to reveal the internal organs (B). Adapted from Wiktor (1989).

Unless the animal is sexually immature, the genitalia will generally be quite evident on the body's right side behind the head. A notable exception might be specimens of the Meadow Slug (*Deroceras laeve*), which can partially or fully lack male genitalia, even as adults. Dissections should be attempted only on adult animals because immature individuals will not have fully developed their reproductive organs.

Scientific and Common Names

In the preceding sections we have already used two names for species. In zoology, formal names of animals follow rules established by the International Commission on Zoological Nomenclature (ICZN). The primary unit of biological entities ("kinds" of animals) are species, and while there are different ways to define what a species is, the traditional definition is that a species a group of individuals capable of breeding in natural conditions with each other but not with other such groups. In practice, this determination is difficult and zoologists usually use differences in morphology — both of the shell and the soft tissues — as a reflection of reproductive and evolutionary isolation.

Names of species of molluscs (and all animals) are formed by two words in combination: the genus name and the species epithet. Genera (plural of genus) are groups of related species and they may have hundreds, dozens, a few, or but a single species.

Consider the Brown Gardensnail, *Cornu aspersum*: this species name is composed of *Cornu*, the genus, and *aspersum*, the species epithet. Both genus and species names are italicized since they are based on, or treated as, Latin or Greek. Genera are always capitalized, while species epithets are not, even when derived from the name of a person (e.g. *ingersollii*, for the American naturalist and explorer Ernest Ingersoll) or place (*cantiana* from Cantium, Latin for the English county of Kent). Geographically based names more often use the suffix *-ensis* or *-ense* (*vancouverense*). As a form of shorthand, once the name of a species has been written out in full (*Cornu aspersum*), the generic name can be abbreviated to a shorter form (*C. aspersum*).

Often included as part of the name of an animal, especially in technical literature, is the author who first described the species and the date it was described. The Danish naturalist Otto Frederick Müller described *Cornu aspersum* in 1774, so the name can be written *C. aspersum* (Müller, 1774). The parentheses around the author and date signify that the species was originally described in another genus, in this case as *Helix aspersa*.

Also in our example, with the change of the genus from *Helix* to *Cornu*, the ending of the species epithet has changed (*aspersa* became *aspersum*). This is because the gender (masculine, feminine or neuter) of the species epithet must match that of the genus name according to the rules of Latin.

Many species also have common or vernacular names. These are often local names given by people using their own language. Unlike scientific names, which uniquely apply to a single species, common names may not. For most land snails and slugs in Canada, common names are not really established in the vernacular sense, but in this book, we mostly accept and use the common names proposed by the American Fisheries Society (Turgeon *et al.* 1998). For species not appearing in that publication, we have used English common names from European or other literature, sometimes translating them into English from other European languages.

In biology, the word synonym has a special meaning that is more precise than the standard dictionary definition. Here, it is a different name used for the same biological entity (species, genus, etc.). Synonyms are the different names used by various authors over time for the same entity. To dive into the literature on a particular species it is often useful to know its synonyms.

Literature

There is much literature on the introduced land snails and slugs in Canada. For the most part, these introduced species are mentioned along with native ones in local checklists, ecological studies and similar short papers that are scattered in biological and malacological journals. The most important reference on the terrestrial molluscs of Canada is the monograph by Pilsbry (1939, 1940, 1946, 1948). For western species there is *Land Snails of British Columbia* by Forsyth (2004).

The most useful guides for introduced European species include: Adam (1960), Backhuys (1975), Cameron (2003), Cameron *et al.* (1983), Ellis (1969), Kerney (1999), Kerney and Cameron (1979, 1999), and Likharev and Rammelmeier (1962). Publications by Barker (1999) on introduced land snails and slugs in New Zealand, and the guide to native and introduced slugs of California (McDonnell *et al.* 2009) are both helpful.

As an introduction to the Canadian literature, the following list is provided but is not meant to be exhaustive. Most of these are short journal papers without descriptions.

General references: Burch (1962), Chichester and Getz (1973), Dall (1905), Dundee (1974), Hubricht (1985), La Rocque (1953), Pilsbry (1939, 1940, 1946, 1948), Turgeon *et al.* (1998).

Alberta: Berry (1922), Boag and Wishart (1982), Van Es and Boag (1981).

British Columbia: Berry (1922), Cameron (1986), Forsyth (1999, 2004).

Manitoba: Beetle (1960), Hanham (1899), Wayne (1959).

New Brunswick: Clarke *et al.* (1968), Dimelow (1962), La Rocque (1961a).

Newfoundland and Labrador: Brooks (1936), Brooks and Brooks (1940), La Rocque (1961b), Oughton (1940).

Northwest Territories: (see Pilsbry 1939–1948).

Nova Scotia: Davis (1985, 1992).

Nunavut: Oughton (1940), Pilsbry (1946, 1948).

Ontario: Grimm (1996), Oughton (1948), Robertson and Blakeslee (1948).

Prince Edward Island: Vanatta (1914).

Saskatchewan: Russell (1952).

Quebec: La Rocque (1962), Mozley (1934).

Yukon Territory: (see Pilsbry 1946, 1948).

How to Use this Book

About the Keys

To help with identification of genera, separate keys to snails and slugs are provided. These use mostly external morphological characters of shells and animals. They were written with only Canadian species in mind, so they may not work for other areas.

Format of the Genus and Species Accounts

The systematics of the Gastropoda have undergone much revision in recent years and there are now several proposed classifications. For the families of gastropods used here, we have opted to follow the classification of Bouchet *et al.* (2005). For taxa below the family level, we have consulted the works of Falkner *et al.* (2002), Schileyko (1998–2007), publications on individual families, genera or species, and the classic monograph by Pilsbry (1939, 1940, 1946, 1948).

Name. Each full species account begins with the scientific name and a suggested common name, discussed on page 15.

Description and comparisons with similar species. The main characters used to recognize the species, as well as comparisons with similar species, are given.

The descriptions of genera and species are brief and meant to highlight the most important features needed for identification. Except where noted, the characters given are for adults. We purposely keep the terminology to a minimum and as non-technical as possible. Specialized terms are defined in the Glossary (page 133).

Distribution. The native range is described, followed by the introduced occurrences of the species in Canada. Also included is additional information on other regions where the species has been introduced, but we anticipate that this information will be incomplete for some species. When we say that a species was “known to Wayne Grimm” this means that the record was mentioned in the original draft of the manuscript, but that the surviving co-authors do not know the basis for it. That is to say, no specimens identified as such by Wayne have been located, nor has a population been found at the site mentioned when a search has been made (though in many cases there was no search made). We mention Wayne’s unsupported records because he was an

experienced observer of terrestrial molluscs, of which there have been few in Canada. While these records must be considered hypothetical at best, they may lead to future discoveries at a time when non-native species and the loss of native biodiversity are of increasing concern.

Habitat and ecology. We have summarized known habitat and ecological information for each species.

Synonyms. Most European species have many synonyms, but fortunately relatively few are in recent use. To save space and avoid burdening the user, we have in most cases limited the synonyms that we list to those names commonly appearing in the North American literature. For more complete lists of synonyms for European species, consult Kennard and Woodward (1926) or publications listed in the Selected References.

Selected References. Most of the introduced species included here have a relatively large body of published literature. We include here only a selection of the most useful and accessible literature, and we do not normally include literature that is not in either English or French.

About the Appendix

The Appendix (page 141) includes 20 species of snails that have not become established in Canada but are commonly intercepted in shipments from other countries, used in the pet-trade or imported as food species, or are found (exclusively) in greenhouses.

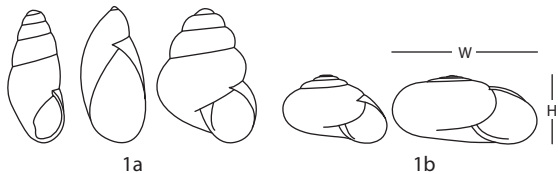
Keys to Genera of Introduced and Native Land Snails and Slugs in Canada

KEYS TO SNAILS

By snails, we mean terrestrial gastropods with an external, coiled shell into which the animal can mostly or entirely retract. The keys are suitable only for fully mature specimens (see page 13). Juvenile and subadult individuals usually have shells that lack many of the diagnostic characters (apertural denticles, a thickened, flared or recurved lip, etc.). Genera that appear only in the Appendix are not included.

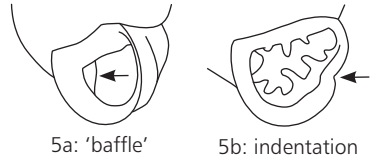
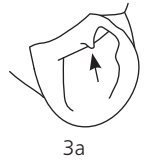
A key to slugs begins on page 32.

- 1a Height of shell > width 2
- 1b Height of shell ≤ width 3
- 2a Aperture with one or more denticles Key A (p. 22)
- 2b Aperture without denticles Key B (p. 23)
- 3a Width < 6 mm (whorls 3–3½ or more) Key C (p. 24)
- 3b Width ≥ 6 mm Key D (p. 27)



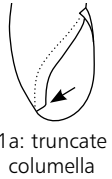
KEY A: Height of shell > width and aperture with one or more denticles

- 1a Shell colourless or whitish. 2
- 1b Shell yellow, brown, or grey-brown when fresh 3
 - ◆ **Caution!** Shells may erode to white.
- 2a 2–8 apertural denticles present; parietal and angular teeth (in most species) united into a forked, bilobed or sinuous denticle VERTIGINIDAE: *Gastrocopta* (p. 52)
- 2b 1–2 apertural denticles present on the parietal and columellar wall; lip sometimes with a denticle-like callus. Shell tapering-elongate to spindle-shaped, sometimes more-or-less subcylindrical ELLOBIIDAE: *Carychium* (p. 35)
- 3a Angular denticle usually connected to the upper part of the lip by a callus. No other well-developed denticles are usually present although there may be a bulging callus on the outer lip 4
- 3b Angular denticle, if present, not connected to the upper part of the lip by a callus. Usually at least 4 denticles present (parietal, columellar and 2 palatals), but up to 9 denticles in some. Four or more denticles is the usual number for species of the genus *Vertigo*; some species and populations have shells with fewer (0–3) denticles 5
- 4a Shell elongate, with spire elongate-conic and distinctly tapering. Angular denticle callus-like, low and inconspicuous PUPILLIDAE: *Pupoides*, in part (p. 44)
- 4b Shell subcylindrical to short ovate, with the spire obtuse. Angular denticle usually well-formed LAURIIDAE: *Lauria* (p. 45)
- 5a Maximum height ≤ 4 mm, pupa-shaped. Palatal denticle, when present, single. Columella (with or without a denticle) with a ‘baffle’ behind the columella (visible with difficulty). Palatal lip never with indentation PUPILLIDAE: *Pupilla*, in part (p. 43)
- 5b Maximum height ≤ 3 mm, variously shaped. Palatal denticles usually 2, but sometimes 1, 3 or more, or absent. Columella (usually with 1 or more denticles) without the ‘baffle’ behind the columella. Palatal lip evenly curved, with a straightened area or weak or strong indentation VERTIGINIDAE: *Nearctula*, *Vertigo* (p. 53)



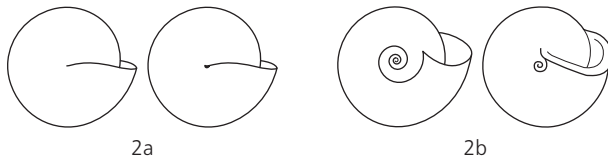
KEY B: Height of shell > width and aperture without denticles

- 1a Shell very slender, colourless but weathering to white. Columella truncate below FERUSSACIIDAE: *Cecilioides* (p. 54)
 - 1b Shell not as slender, usually yellowish through brown but weathering to grey or white. Columella not truncate as in 'a' 2
 - 2a Shell with regularly-spaced, lamellar axial ribs VALLONIIDAE: *Zoogenetes* (p. 51)
 - 2b Shell without lamellar axial ribs. 3
 - 3a Aperture height $\geq \frac{1}{2}$ height of shell. Shell relatively large, thin, with few whorls (about 3); elongate-ovate to squatter ovate with the whorls rapidly enlarging in calibre SUCCINEIDAE: *Mediappendix*, *Novisuccinea*, *Oxyloma*, *Succinea*, *Succinella* (p. 37)
 - 3b Aperture height $< \frac{1}{2}$ height of shell. Shells smaller: maximum height < 6 mm, with more whorls; subcylindrical to turreted, not as in 'a' 4
 - 4a Outer lip with a pinkish or whitish rib inside. Shell nearly smooth and very glossy COCHLICOPIDAE: *Cochlicopa* (p. 42)
 - 4b Outer lip thin, except in *Pupilla* and *Pupoides*, which have microscopic but clear axial threads or striae 5
 - 5a Spire clearly tapering; apex pointed . . . PUPILLIDAE: *Pupoides*, in part (p. 44)
 - 5b Spire with sides (at least the middle whorls) usually approximately parallel and apex domed 6
 - 6a Outer lip narrowly flared and at least slightly thickened inside. Crest usually present PUPILLIDAE: *Pupilla* (p. 43)
 - 6b Outer lip neither flared nor thickened inside. Crest absent VERTIGINIDAE: *Columella* (p. 51)
- ◆ **Caution!** Juveniles of other genera (but especially other Vertiginidae) will key out here.



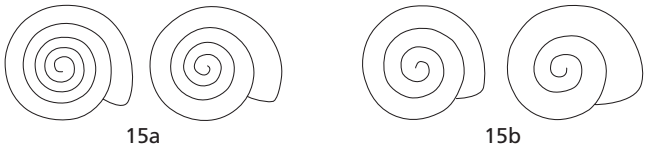
Key C: Height of shell \leq width; adult shell (3–3½ or more whorls) < 6 mm

- 1a Whorls few ($\leq 3\frac{1}{2}$), rapidly enlarging *and* aperture capacious ($\approx \frac{1}{2}$ the ‘area’ of the shell in apertural view). Animal large in relation to the size of the shell, and when extended, with a lobe of the mantle extending up onto the upper shell surface VITRINIDAE: *Vitrina*, in part (p. 78)
- 1b Whorls mostly more ($4\frac{1}{2}$ –6), but if whorls fewer ($2\frac{1}{2}$ – $3\frac{1}{2}$), then aperture not nearly so large. Mantle without a conspicuous lobe extending onto the upper shell surface 2
- 2a Umbilicus absent *or* pin-prick-like and nearly closed and not clearly showing whorls within it 3
- 2b Umbilicus narrow to broad: wide enough to show at least some whorls within . . 6



- 3a Umbilicus tiny, pin prick-like 4
- 3b Umbilicus absent PRISTILOMATIDAE: *Pristiloma*, in part (p. 74)
- 4a Shell depressed. Sculpture of regularly spaced axial grooves. Aperture subovate OXYCHILIDAE: *Glyphyalinia*, in part (p. 67)
- 4b Shell conical. Sculpture of axial threads or weak axial wrinkles. Aperture narrow, crescent-shaped 5
- 5a Maximum width > 2 mm (whorls $4\frac{1}{2}$ –6) . . . EUCONULIDAE: *Euconulus* (p. 65)
- 5b Maximum width 1.0–1.3 mm (whorls $3\frac{1}{2}$) . . . EUCONULIDAE: *Guppya* (p. 65)
- 6a Apertural lip thickened 7
- 6b Apertural lip thin (but may be flared). 8
- 7a Aperture with 1–2 long parietal denticles. Umbilicus narrow. Shell conical or beehive-shaped. Brown. Strong axial ribs bluntly rounded STROBILOPSIDAE: *Strobilops* (p. 47)
- 7b No apertural denticles. Umbilicus broad: $\approx \frac{1}{3}$ width or greater. Shell depressed, white, light grey or grey-brown. Axial ribs lamellar or without ribs VALLONIIDAE: *Vallonia*, in part (p. 48)
- 8a Umbilicus approximately $\frac{1}{3}$, or greater than, the width of the shell 9
- 8b Umbilicus \leq approximately $\frac{1}{4}$ width 15

- 9a Shell with widely, more-or-less regularly spaced lamellar *or* rounded axial ribs, at least above the periphery 10
- 9b Shell smooth or with sculpture different (without axial ribs) 12
- 10a Axial ribs rounded. Maximum width ≤ 6 mm . . . DISCIDAE: *Discus*, in part (p. 59)
- 10b Axial ribs lamellar. Maximum width to 3.5 mm 11
- 11a Brown. Apertural lip not flared VALLONIIDAE: *Planogyra* (p. 47)
- 11b White or pale greyish or grey-brown. Apertural lip flared outward
. VALLONIIDAE: *Vallonia*, in part (p. 48)
- 12a Surface with strong raised spiral threads. Denticles usually present inside the last whorl (but difficult to see). HELICODISCIDAE: *Helicodiscus* (p. 61)
- 12b Surface smooth or with microscopic axial striae. No denticles inside the last whorl 13
- 13a Surface with complex sculpture consisting of microscopic spiral striae and sinuous axial riblets GASTRODONTIDAE: *Striatura*, in part (p. 63)
- 13b Shell smooth (with a waxy sheen) or nearly smooth, with close, incremental striae only 14
- 14a Surface smooth with a waxy sheen HELICODISCIDAE: *Lucilla* (p. 62)
- 14b Surface with uneven but distinct incremental striae
. PRISTILOMATIDAE: *Hawaiiia* (p. 73)
- ◆ **Caution!** These two genera and the two Canadian species, *Lucilla singleyanus* and *Hawaiiia minuscula*, are exceedingly difficult to distinguish.
- 15a Whorls slowly expanding (tightly coiled) 16
- 15b Whorls regularly to rapidly expanding 19



- 16a Umbilicus $\approx \frac{1}{4}$ width of the shell. Finely, spirally striate
. THYSANOPHORIDAE: *Microphysula* (p. 131)
- 16b Umbilicus $\leq \frac{1}{6}$ width of the shell. No spiral sculpture. 17
- 17a Regularly, strongly striate near the between the suture and periphery. Inside on the base of the last whorl with 1–3 rows of denticles (of 5–6 denticles each) or simple barriers, visible through the shell wall
. PRISTILOMATIDAE: *Paravitrea* (p. 73)

- 17b Smoothish or lightly striate. No rows of denticles or barriers inside the last whorl 18
- 18a Translucent yellowish-brown. Umbilicus very small, about $\frac{1}{10}$ of shell width PRISTILOMATIDAE: *Pristiloma*, in part (p. 74)
- 18b Translucent white or clear-colourless. Umbilicus $\approx \frac{1}{6}$ of shell width PRISTILOMATIDAE: *Vitrea* (p. 75)
- 19a Microscopic, lamellar axial riblets. Seen at high enough magnification these are in two size classes 20
- 19b Sculpture different 21
- 20a Maximum width ≤ 2.4 mm. Major (microscopic) axial riblets widely spaced, with 3 or 4 minor riblets in between. PUNCTIDAE: *Paralaoma* (p. 58)
- 20b Maximum width ≤ 1.4 (rarely 1.8) mm. Microscopic axial riblets closely spaced, with ≤ 2 minor riblets in between PUNCTIDAE: *Punctum* (p. 58)
- 21a Shell shining, with axial grooves, mostly widely spaced (other axial striae may be present in addition to these grooves) 22
- 21b Shell dull to shining, smoothish or striate, but not with widely spaced, incised axial grooves. 23
- 22a Axial sculpture of distinct, incised, well-spaced grooves and finer axial wrinkles OXYCHILIDAE: *Glyphyalinia*, in part (p. 67)
- 22b Axial sculpture of crowded, rounded axial wrinkles and incised grooves similar to those above in 'a' but weaker OXYCHILIDAE: *Nesovitrea* (p. 68)
- ◆ **Caution!** These genera may be difficult to distinguish at first without practice. However, the likely most frequently encountered species of *Glyphyalinia* in Canada is *G. indentata*, which has a tiny umbilicus compared to *Nesovitrea* spp.
- 23a Dull, lead-grey. Maximum width ≤ 2.5 mm. Initial whorl of the apex with microscopic spiral striae GASTRODONTIDAE: *Striatura*, in part (p. 63)
- 23b Shining to silky or dull; amber to brown. Shell larger 24
- 24a Viewed apically, width of the last whorl $\approx 2 \times$ width of the penultimate whorl. Animal without a garlicky odour GASTRODONTIDAE: *Zonitoides* (p. 64)
- 24b Viewed apically, width of the whorl $> 2 \times$ width of the penultimate whorl. Animal emits a garlicky odour in some species (*O. alliaris*) OXYCHILIDAE: *Oxychilus*, in part (p. 69)

Key D: Height of shell \leq width and adult shell width \geq 6 mm

- 1a Capacious and whorls few ($\leq 3\frac{1}{2}$). Very thin-shelled, glassy, colourless to pale greenish VITRINIDAE: *Vitrina*, in part (p. 78)
- 1b Not as in 'a' 2
- 2a Umbilicus absent, wholly sealed by a callus or an extension of the columellar lip 3
- 2b Umbilicus present, but may be very small, or very narrow and occluded by the columellar lip 16
- 3a Parietal denticle present 4
- 3b Parietal denticle absent 10
- 4a Aperture clearly with 3 denticles: a parietal, a basal (which may be long and ridge-like), and a clearly developed palatal. 5
♦ **Caution!** If there is a 'thickening' of the lip in place of a well-defined palatal denticle use couplet 'b'.
- 4b Aperture not as in 'a'; with one denticle (parietal) or two denticles (parietal and basal) 6
- 5a Basal denticle long, ridge-like. Mature width > 19 mm POLYGYRIDAE: *Xolotrema* (p. 130)
- 5b Basal denticle rather tubercular. Mature width to 8–12 mm POLYGYRIDAE: *Inflectarius* (p. 125)
- 6a Aperture narrow and more-or-less directed basally and basal lip with a notch POLYGYRIDAE: *Stenotrema* (p. 128)
- 6b Aperture usually broader (but may be narrow) and usually not so strongly directed basally. Basal lip without a notch 7
- 7a Shell small: maximum width < 8 mm. Periostracum hairy. British Columbia POLYGYRIDAE: *Cryptomastix*, in part (p. 124)
- 7b Shell larger: maximum width > 15 mm. Periostracum not hairy. Southeastern Ontario and southwestern Quebec 8
- 8a Parietal long and curved, joined to the umbilical callus POLYGYRIDAE: *Patera*, in part (p. 127)
- 8b Parietal denticle somewhat shorter, not joined to the umbilical callus. 9
- 9a Shell depressed; without brown spiral bands POLYGYRIDAE: *Neohelix*, in part (p. 127)
- 9b Shell globular; with narrow spiral brown bands POLYGYRIDAE: *Webbhelix*, in part (p. 130)

10a	Lip appressed to the base of the shell (not projecting)	
	.....	HELICIDAE: <i>Cepaea</i> (p. 104)
10b	Lip projecting for most of the distance on the base of the shell (except sometimes near the umbilical callus)	12
12a	Baso-columellar lip more-or-less straightened (or slightly concave), often with a low protuberance	13
12b	Baso-columellar lip curved	14
13a	Maximum width < 20 mm	POLYGYRIDAE: <i>Patera</i> , in part (p. 127)
13b	Maximum width ≥ 20 mm	POLYGYRIDAE: <i>Neohelix</i> , in part (p. 127)
14a	Elevated heliciform. Yellowish to brownish, usually with a few spiral bands that may be interrupted by paler streaks	HELICIDAE: <i>Cornu</i> , in part (p. 115)
14b	Depressed-heliciform. One colour or with narrow reddish brown spiral bands only	15
15a	Maximum width > 20 mm. With narrow reddish brown spiral bands	
	.....	POLYGYRIDAE: <i>Webbhelix</i> , in part (p. 130)
15b	Maximum width < 17 mm. Not banded	
	.....	POLYGYRIDAE: <i>Mesodon</i> , in part (p. 126)
16a	Parietal denticle present	17
16b	No parietal denticle	23
17a	Aperture with three denticles: a parietal, a basal, and a <i>clearly developed</i> palatal	
	.....	POLYGYRIDAE: <i>Triodopsis</i> (p. 129)
	♦ Caution! If there is a weak ‘thickening’ of the lip in place of a well-defined palatal denticle use couplet ‘b’.	
17b	Aperture not as in ‘a’; with one denticle (parietal) or two denticles (parietal and basal)	18
18a	Western: British Columbia only	19
18b	Southeastern Ontario and east	20
19a	Last whorl strongly contracted behind the outer lip. Parietal denticle variable: weak to prominent, tubercular to long and curved	
	.....	POLYGYRIDAE: <i>Cryptomastix</i> , in part (p. 124)
19b	Last whorl not strongly contracted behind the outer lip. Parietal denticle consists of a very small, low callus	POLYGYRIDAE: <i>Allogona</i> , in part (p. 123)
20a	Aperture very narrow (in apertural view), narrowed significantly by the parietal denticle	POLYGYRIDAE: <i>Euchemotrema</i> (p. 125)
20b	Aperture broader	21

- 21a Umbilicus open. Basal lip with a small, rather sharply tubercular denticle *and* surface sculpture of sharp, close-spaced threads
 POLYGYRIDAE: *Appalachina* (p. 123)
- 21b Umbilicus partly covered but not fully closed by the basal lip. Basal denticle absent, blade-like or swollen. Surface nearly smooth or lightly striate
 POLYGYRIDAE: *Mesodon*, in part (p. 126)
- 22a Outer lip expanded or thickened, if only slightly, and often recurved for much of its length. In some genera lip ‘drooping’ at the shoulder 23
- 22b Outer lip not expanded and not thickened and not recurved for much of its length nor ‘drooping’ at the shoulder (but last whorl may descend before the aperture) 34
- ◆ **Test:** Run a finger over the last whorl (in the direction of the shell’s coiling) and out past the apertural lip. You should not feel a protruding, sharp edge (like a trumpet bell).
- 23a Spire nearly flat. Umbilicus broad. Lip above shoulder of the last whorl clearly ‘drooping’ or just a little straightened (see p. 57) 24
- 23b Spire more elevated. Umbilicus narrower, or nearly closed. Lip not as in ‘a’
 25
- ◆ **Caution!** The last whorl may descend in front of the aperture, but the lip does not ‘droop’.
- 24a Surface beaded: spiral striae intersect axial riblets forming beads, at least on the spire or around the umbilicus. British Columbia
 HAPLOTREMATIDAE: *Ancotrema* (p. 57)
- 24b Surface not beaded: minute spiral striae are present but these do not form beads. British Columbia and southern Ontario and Quebec
 HAPLOTREMATIDAE: *Haplotrema* (p. 57)
- 25a Periostracum usually closely hairy (if not worn off) 26
- 25b Periostracum never hairy 27
- 26a Basal and outer lip generally broadly expanded. Width, 10–17 mm
 POLYGYRIDAE: *Vespericola* (p. 129)
- 26b Lip only narrowly expanded, mostly basally. Width ≤ 12 mm
 HYGROMIIDAE: *Trochulus*, in part (p. 118)
- 27a Umbilicus narrow, chink-like, > ½ covered by the columellar lip 28
- 27b Umbilicus more open, ≤ ½ covered by the columellar lip 29
- 28a Yellowish, usually with 1–5 darker spiral bands that are interrupted by irregular paler axial streaks HELICIDAE: *Cornu*, in part (p. 115)
- 28b Brown or yellowish, usually with a single peripheral spiral band and many small pale flecks HELICIDAE: *Arianta* (p. 103)

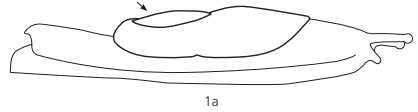
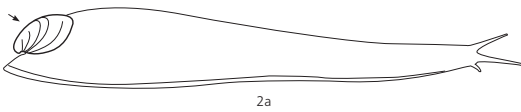
- 29a Lip, including the outer lip, broadly flared and flat-faced 30
- 29b Lip narrowly expanded and not much flared, and if thickened, then bluntly rounded 31
- 30a Ontario only *and* basal lip with a low denticle-like callus; *or* British Columbia only (and scarcely with the callus). POLYGYRIDAE: *Allogona*, in part (p. 123)
- 30b Ontario only *and* without a denticle-like callus
. POLYGYRIDAE: *Mesodon*, in part (p. 126)
- 31a Inside the aperture, behind the lip with an inner ridge, at least basally . . . 32
- 31b No inner ridge inside the lip 33
- 32a Pale: creamy white, often flushed with light brown near the aperture. Umbilicus tiny HYGROMIIDAE: *Monacha* (p. 117)
- 32b Medium to dark brown (but occasionally pale coloured). Umbilicus $\geq \frac{1}{6}$ of shell width HYGROMIIDAE: *Trochulus*, in part (p. 118)
- 33a Greyish-white to pale brown, suffused with brown and typically with several spiral bands, including on the base
. OREOHELICIDAE: *Oreohelix*, in part (p. 62)
- 33b Usually banded with brown-black, chestnut-brown, and yellow
. MONADENIIDAE: *Monadenia* (p. 122)
- 34a With clear, well-formed ribs or riblets. 35
- 34b Without ribs or riblets, or axial sculpture irregular, not well-formed 36
- 35a Maximum width < 8 mm DISCIDAE: *Discus*, in part (p. 59)
- 35b Maximum width > 10 mm DISCIDAE: *Anguispira*, in part (p. 59)
- 36a Aperture with basal teeth, *or* with a broad, internal basal callus
. GASTRODONTIDAE: *Ventridens* (p. 63)
- 36b Aperture without teeth or a basal callus 37
 ♦ **Caution!** *Mesomphix* has a very low whitish callus inside the aperture, but this is not limited to the base. *Ventridens* lacking teeth but having the basal callus have a relatively high conical spire; in *Mesomphix* the spire is always much lower.
- 37a Surface dull, thick-shelled and opaque, usually with spiral bands 38
- 37b Surface rather shining, silky or with a waxy sheen, relatively thin-shelled, rather translucent, without spiral bands 40
- 38a Shell very depressed-heliciform; spire very low and only a little elevated
. HYGROMIIDAE: *Xerolenta* (p. 120)
- 38b Shell generally more elevated; spire more elevated 39

- 39a Periphery rounded or sometimes a little angular. Aperture usually subovate. Last whorl, behind the aperture, frequently descending
 OREOHELICIDAE: *Oreobelix*, in part (p. 62)
- 39b Periphery always rounded. Aperture deeply rounded. Last whorl not descending behind the aperture DISCIDAE: *Anguispira*, in part (p. 59)
- 40a Maximum width \geq 20 mm; spire moderately elevated to distinctly conical
 OXYCHILIDAE: *Mesomphix* (p. 68)
- 40b Maximum width \leq 16 mm; spire variable, but quite flat in species approaching the upper limit of this size range. 41
- 41a Whorls rapidly enlarge in width: last whorl at least twice the width of the penultimate whorl (in apical view) 42
- 41b Whorls less rapidly enlarge in width: last whorl not quite twice the width of the penultimate whorl (in apical view)
 GASTRODONTIDAE: *Zonitoides*, in part (p. 64)
- 42a Umbilicus tiny: pin-prick-like . . . OXYCHILIDAE: *Glyphyalinia*, in part (p. 67)
- 42b Umbilicus \approx $\frac{1}{6}$ of the width of the shell 43
- 43a Shell with a waxy sheen; close, microscopic spiral striae present
 OXYCHILIDAE: *Aegopinella* (p. 66)
- 43b Shell very glossy to only somewhat shining (on account of coarse incremental striae); no spiral striae OXYCHILIDAE: *Oxychilus*, in part (p. 69)

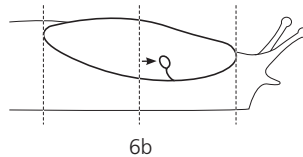
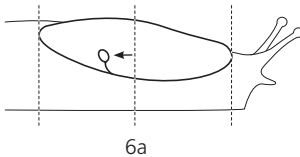
KEY TO SLUGS

By slugs, we mean terrestrial molluscs with the shell entirely internal or absent, or if external, then either mostly embedded in the mantle or ear-shaped and located at the tip of the tail.

- 1a Shell at least partially exposed, either plate-like, embedded in a visceral hump, or ear-shaped (with a small sub-spiral nucleus) at the tip of the tail 2
- 1b Shell altogether absent or internal and hidden. Internal shell plate-like, consisting of a few irregular granules 3
- 2a Shell ear-shaped, at the tip of the tail. Introduced, in gardens and greenhouses TESTACELLIDAE: *Testacella* (p. 55)
- 2b Shell plate-like and mostly embedded in a well-developed 'visceral hump' near the longitudinal middle of the animal. Forests of British Columbia BINNEYIDAE: *Hemphillia* (p. 101)



- 3a Mantle very large, covering $\frac{3}{4}$ or more of the dorsal surface of the animal . . 4
- 3b Mantle smaller, $\leq \frac{1}{2}$ of the length of animal 6
- 4a Mantle not reaching the tip of the tail. Southeast British Columbia ARIOLIMACIDAE: *Magnipelta* (p. 100)
- 4b Mantle reaching the tip of the tail. Eastern Canada 5
- 5a Maximum length < 30 mm PHILOMYCIDAE: *Pallifera* (p. 101)
- 5b Maximum length > 50 mm . . . PHILOMYCIDAE: *Philomycus*, *Megapallifera* (p. 101)
- 6a Pneumostome in the anterior half of the mantle 7
- 6b Pneumostome either in the posterior half or near middle of the mantle. . . . 8



- 7a Tail usually with an oblique constriction that marks the site of autotomy (and on the sole sometimes as a dark, transverse line). No caudal mucus pore. British Columbia only ANADENIDAE: *Prophysaon* (p. 99)
- 7b Tail without an oblique constriction, as above. Caudal mucus pore present. Introduced throughout southern Canada ARIONIDAE: *Arion* (p. 89)
- 8a Body exceptionally long and narrow when crawling (30–40 mm long by 3–5 mm wide). Pale grey or white with darker head and tentacles BOETTGERILLIDAE: *Boettgerilla* (p. 87)
- 8b Not as slender as in ‘a’ 9
- 9a Mantle skin granular, smooth, wrinkled, or lumpy, but without concentric folds or ridges. 10
- 9b Mantle skin with a pattern of concentric folds or fingerprint-like ridges 12
- 10a Mantle with a U-shaped groove. Keel complete, extending all the way forward to the mantle. Introduced to parts of southern Canada MILACIDAE: *Milax* (p. 77)
- 10b Mantle without a groove. Keel absent or, when present, not extending forward to the edge of the mantle. Native to coastal British Columbia 11
- 11a Body small: length < 15 mm. No caudal mucus gland. Tail without keel. Pale grey or tan, with pale blue flecking, dark gray or brown spots and blotches and a series of grey or brown stripes along grooves on the tail ANADENIDAE: *Kootenaia* (p. 99)
- 11b Body large: length up to about 260 mm. Caudal mucus gland present. Tail with keel (not quite reaching the mantle). Typically yellowish to olive or blackish, frequently spotted with black, or sometimes all white ARIOLIMACIDAE: *Ariolimax* (p. 100)
- 12a Concentric mantle ridges centred on the midline. Dorsal keel long (about ¼ of the body length). 13
- 12b Concentric mantle ridges centred on the right side. Dorsal keel short AGRIOLIMACIDAE: *Deroceras* (p. 84)
- 13a Mantle with dark longitudinal bands or rows of dark spots. Mucus watery LIMACIDAE: *Lebmannia* (p. 79)
- 13b Mantle without longitudinal bands; if spotted or mottled, then not clearly in rows. Mucus sticky LIMACIDAE: *Limacus*, *Limax* (p. 81)

Genus and Species Accounts

Phylum Mollusca: Class Gastropoda

Family Ellobiidae

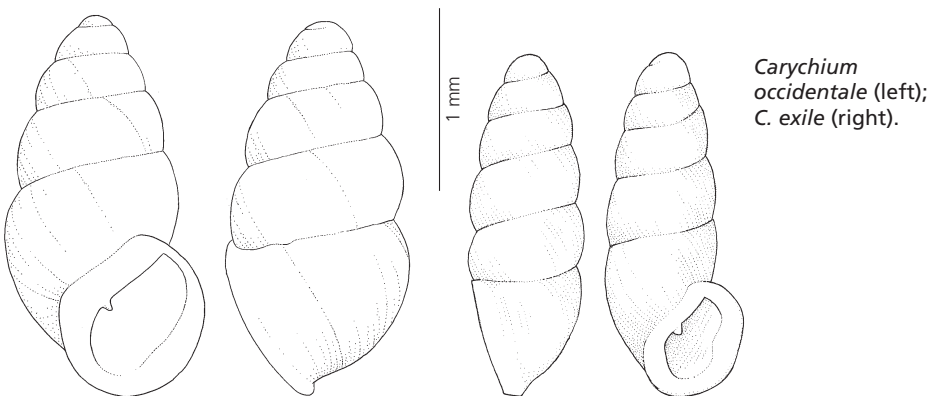
Genus *Carychium*

Shell minute (maximum height, about 2 mm), elongate-tapering or spindle-shaped, white or nearly colourless. Surface smooth or ribbed-striate. Aperture with one or two fold-like columellar and parietal denticles. Columellar ‘denticle’ continues internally as a spiral ridge around the columella. Lip thin or thickened, expanded, and with or without a palatal denticle.

This is a Holarctic genus with over 20 species in North and Central America, across Eurasia and in Southeast Asia. There are at least four native and one introduced species in Canada:

- Carychium exiguum* (Say, 1822), Obese Thorn Native
- Carychium exile* H.C. Lea, 1842, Ice Thorn Native
- Carychium minimum* Müller, 1774, Herald Thorn Introduced
- Carychium nannodes* Clapp, 1905, File Thorn Native
- Carychium occidentale* Pilsbry, 1891, Western Thorn Native

Selected references: Forsyth (2004), Nekola and Barthel (2002), Pilsbry (1948).



***Carychium minimum* Müller, 1774:** Herald Thorn

Shell minute (mature height, 1.5–1.8 mm), spindle-shaped, translucent white or clear when fresh, with faint incremental striae. Whorls about 4. Outer lip thickened, slightly flared, and with a median denticle-like swelling; viewed from the side, the lip is clearly sinuous. Parietal wall with a conspicuous ‘denticle’ that continues internally around the columella as an evenly curved spiral ridge; below it, there is another smaller denticle-like fold present on the columella.

The native North American *Carychium* species have more slender shells that lack the strong denticle-like swelling on the outer lip. *C. minimum* is also similar to another European species introduced to the U.S., *C. tridentatum* (Risso, 1826), Dentate Thorn, but that species has a proportionally more slender shell, with five whorls.

Animal white with tiny black eye spots at the base of the single pair of slender tapering tentacles. As for other members of the family, there is a tubular proboscis.

Distribution: *C. minimum* is widespread throughout Europe, and east into Siberia.

Records of *C. minimum* in North America are few and scattered. The species is common in stream drift of the Grand River in southern Ontario, and we believe that it has naturalized here. It was found in a retail nursery at Cobble Hill on southern Vancouver Island in 2001 but may not yet be established in British Columbia. In the United States, *C. minimum* is recorded from San Francisco, California, in the 1970s and more recently from Cortland Co., New York. There is an old record of the species from Quincy, Massachusetts; however, the specimens were later re-identified as *C. tridentatum* (see Roth 1982a).

Habitat: In greenhouses and nurseries out of doors it clings to the undersides of pots. In Europe, this is primarily a marsh and wetland species, and like other species of *Carychium*, requires permanently moist conditions. We expect that the species will be found living in wetlands and marshes in southern Ontario.

Synonyms: There are no synonyms in recent usage, but some older publications did not always distinguish between the two European species, *C. minimum* and *C. tridentatum*.

Selected references: Cameron (2003), Forsyth (2004), Forsyth *et al.* (2008), Kerney (1999), Kerney and Cameron (1979, 1999), Roth (1982a), Schueler and Forsyth (2009).

Family Succineidae

The family Succineidae is easily recognized from all other terrestrial snails in this book and perhaps could be confused with some genera of the aquatic family Lymnaeidae (especially *Pseudosuccinea columella* (Say, 1817) and some *Galba* (formerly *Fossaria*); see Clarke 1981). Identification of succineid genera and species is difficult owing to the general lack of diagnostic shell characters, poorly known species, and variability in morphology. Without investigating characters of the reproductive system, identifications to genera and certainly species should, at best, be considered tentative. We include brief diagnoses of genera and on the next page highlight the important characters of the reproductive system, but do not distinguish among species.

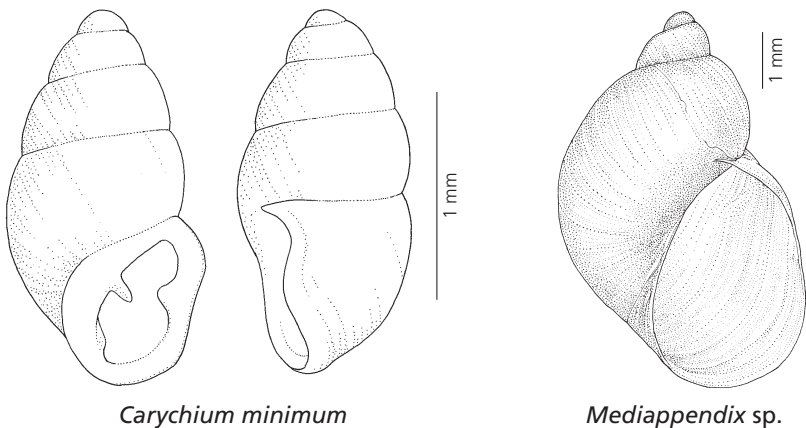
Genus *Mediappendix*

Shell small (maximum height, 13 mm), subovate, translucent, thin-shelled, more-or-less coarsely wrinkled, and pale green- or yellow-brown. In general these are small, short-spined succineids, more rotund than *Oxyloma* or *Succinea*. Until recently our species were placed in *Catinella*, which however is a separate genus. For anatomical distinctions between genera of Succineidae, see the next page.

This is a North American genus with about 15 poorly known species. This genus is probably distinct from the European genus *Catinella*, which has been used for our species. In Canada, there is at least one species, which may be a complex of several related species:

Mediappendix vermeta (Say, 1829), Suboval Ambersnail Native

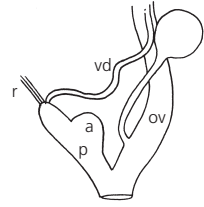
Selected references: Pilsbry (1948), Schileyko (2007).



Comparison of Reproductive Systems of the Genera of Succineidae in Canada

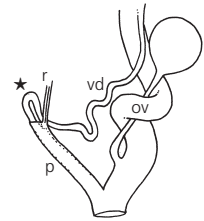
Mediappendix

- Penial sheath absent
- Penis retractor (r) attached to penis (p) and sometimes also to the vas deferens (vd)
- Penial appendix (a) large, blunt, midway along the length of the penis
- Epiphallus absent
- Vas deferens (vd) short
- Oviduct (ov) without 360° twist



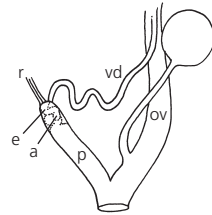
Novisuccinea

- Penial sheath present enclosing most of the penis (p), but penis projecting from the sheath as a free loop (★)
- Penial retractor (r) attached to the penis sheath
- Penial appendix absent
- Epiphallus absent
- Vas deferens (vd) long
- Oviduct (ov) twisted around the duct of the bursa copulatrix (bc)



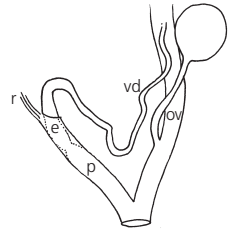
Oxyloma

- Penial sheath present — entirely enclosing the penis (p)
- Penial retractor (pr) attached to the penis sheath
- Penial appendix present (a) near end, but inside penial sheath
- Epiphallus (e) straight, sinuous or tightly convoluted inside the penial sheath
- Vas deferens (vd) of moderate length, not much convoluted
- Oviduct (ov) without 360° twist



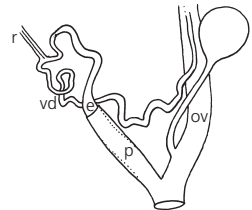
Succinea

- Penial sheath present — entirely enclosing the penis (p)
- Penial retractor (pr) attached to the penis or its sheath
- Penial appendix absent
- Epiphallus (e) partially or fully external of the penial sheath; not tightly convoluted
- Vas deferens (vd) long, more-or-less convoluted
- Oviduct without 360° twist



Succinella

- Penial sheath present — entirely enclosing the penis (p)
- Retractor attached to vas deferens, distant from the end of the penis
- Penial appendix absent
- Epiphallus (e) not well differentiated from the penis; partially enclosed inside the penial sheath
- Vas deferens very long, convoluted
- Oviduct without 360° twist



Genus *Novisuccinea*

Shell small to medium-sized (maximum height, 25 mm), elongate-ovate, translucent, thin. Shells are generally more rotund than species of *Oxyloma* or *Succinea*. These are more upland than wetland snails.

This genus may contain about eight species in North America and the Russian Far East to central Asia, although another source suggests about 20 species. There are at least two species in Canada, both of which are often classified as *Succinea*:

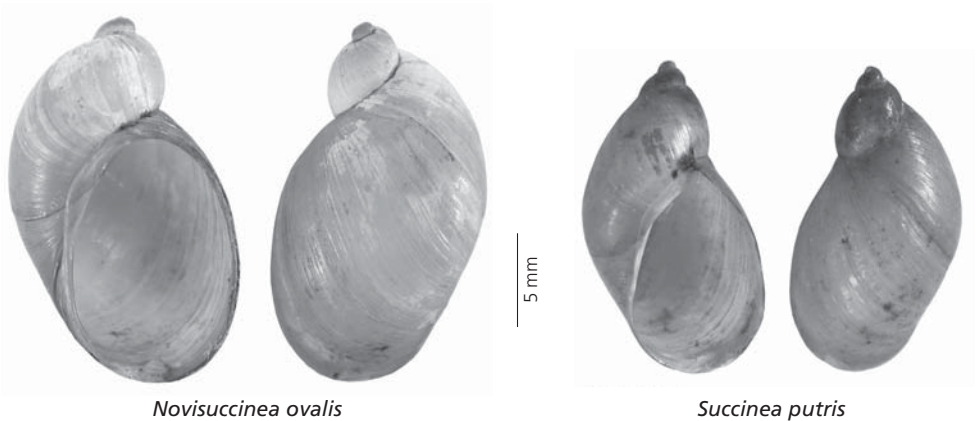
- Novisuccinea ovalis* (Say, 1817), Oval Ambersnail Native
- Novisuccinea strigata* (L. Pfeiffer, 1882), Striate Ambersnail Native

Selected references: Gusarov (1999), Hoagland and Davis (1987), Pilsbry (1948).

Genus *Oxyloma*

Shell small to medium-sized, elongate or elongate-ovate, translucent, thin. Shells are generally more elongate than *Succinea* or *Oxyloma*. The species are more closely associated with wetland habitats than *Novisuccinea*.

A Holarctic genus with approximately 30 species or subspecies worldwide, it is represented in Canada by perhaps seven species. According to Wayne Grimm, *Oxyloma pfeifferi* is introduced to Canada, and lives in marshes along the eastern shore of Lake Ontario and in Newfoundland. We have not confirmed this, and further investigation is warranted.



<i>Oxyloma decampi</i> (Tryon, 1866), Marshal Ambersnail	Native
<i>Oxyloma groenlandicum</i> (Møller, 1842), Ruddy Ambersnail	Native
<i>Oxyloma hawkinsii</i> (Baird, 1863), Boundary Ambersnail	Native
<i>Oxyloma nuttallianum</i> (I. Lea, 1841), Oblique Ambersnail	Native
<i>Oxyloma peoriense</i> (Wolf, 1894), Depressed Ambersnail	Native
<i>Oxyloma pfeifferi</i> (Rossmässler, 1835), Pfeiffer European Ambersnail . . .	Perhaps introduced
<i>Oxyloma retusum</i> (I. Lea, 1834), Blunt Ambersnail	Native

Selected references: Cameron (2003), Gusarov (1999), Hoagland and Davis (1986), Kerney and Cameron (1979, 1999), Pilsbry (1948), Quick (1933), Schileyko (2007).

Genus *Succinea*

Shell small to medium-sized (maximum height, 17 mm), elongate-ovate, translucent, thin. Shells are shaped more like *Novisuccinea* than *Oxyloma*. See page 38 for anatomical distinctions between genera of Succineidae.

This is a genus of about 10 species distributed across the Holarctic realm. There are at least three species in Canada. Wayne Grimm identified *Succinea putris* species from Sydney, Nova Scotia, near Grimsby, Ontario, and near Quebec City, but we are unable to confirm this, and further study is needed. Hoagland and Davis have suggested that *S. putris* is a complex of related species with some species found in North America.

<i>Succinea wilsonii</i> I. Lea, 1864, Golden Ambersnail	Native
<i>Succinea putris</i> (Linnaeus, 1758), European Ambersnail	Introduced
<i>Succinea indiana</i> Pilsbry, 1905, Xeric Ambersnail	Native

Selected references: Cameron (2003), Gusarov (1999), Kerney and Cameron (1979, 1999), Pilsbry (1948), Quick (1933), Schileyko (2007).

Genus *Succinella*

Shell small (maximum height, 9 mm), elongate-ovate, thin-shelled, translucent, pale amber brown or green-white. Spire narrow, turreted, and whorls as many as 4½. The genus is best recognized from other succineids by internal anatomy; see page 38 for anatomical distinctions between genera of Succineidae.

Once generally treated as a synonym or subgenus of *Succinea*, *Succinella* is now usually considered to be a separate, valid genus. There is a single species that has a wide distribution throughout much of Europe and western and central Siberia. This species is believed to be introduced to Canada:

<i>Succinella oblonga</i> (Draparnaud, 1801), Small Ambersnail	Introduced
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Selected references: Cameron (2003), Gusarov (1999), Kerney and Cameron (1979, 1999), Quick (1933), Schileyko (2007), Schileyko and Likharev (1986).



Succinella oblonga

***Succinella oblonga* (Draparnaud, 1801):** Small Ambersnail

Shell small (maximum height, 9 mm), elongate-ovate; spire narrow, turreted; pale amber brown to green-white. Whorls as many as 4½. Species of *Mediappendix*, and the European *Catinella*, appear very similar but are distinguished from *Succinella oblonga* by their reproductive anatomy.

The animal is dark grey with a translucent, grey sole.

Distribution: *S. oblonga* is widespread in much of Europe, north to Scandinavia, and ranges east to central Siberia.

In Canada what we believe is this species has been found along Hwy 12 north of Brooklin, Durham Regional Municipality, Ontario. Wayne Grimm first identified this species from specimens collected in 1974, although no details of this discovery were ever published. Our survey of the location in 2008 found many empty shells, establishing that the population persists today. It is quite possible that *S. oblonga* is more widespread but under-recorded due to the difficulty with species identification in this family.

Habitat and ecology: In Canada, empty shells were found in a roadside ditch, and living animals were first collected from under logs and in leaf litter of a brushy garden. In its native Europe, snails live in damp, typically open places on muddy substrates that tend to dry out, such as along streams, in ditches, on floodplains and in marshes.

Synonym: *Succinea oblonga* (Draparnaud).

Selected references: Grimm (1976), Cameron (2003), Gusarov (1999), Kerney (1999), Kerney and Cameron (1979, 1999), Quick (1933), Schileyko (2007), Schileyko and Likharev (1986).

Family Cochlicopidae

Genus *Cochlicopa*

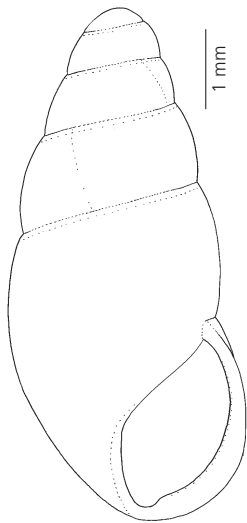
Shell small (mature height, 5–8 mm), subcylindrical, elongate, very glossy and smooth; translucent yellow-brown. Aperture ovate, without denticles but with the lip bearing a rib-like thickening inside. No umbilicus.

Holarctic, with about six to eight species worldwide, *Cochlicopa* is represented in Canada by at least three species. Additionally, *C. nitens* (Gallenstein, 1848) and *C. repentina* Hudec, 1960 have been recognized from Canada by Wayne Grimm (see Karstad *et al.* 1995) and the U.S. (Hubricht 1985), but we are reluctant to identify North American specimens with European species that are themselves controversial. Studies on the genetics of this genus have thus far focused on European populations.

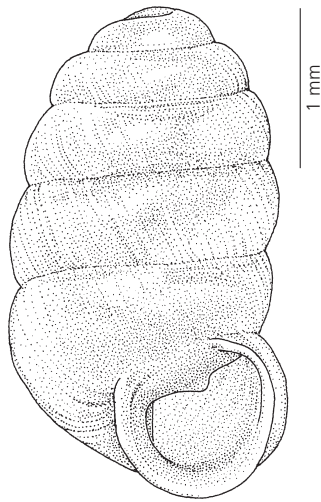
Cochlicopa lubrica and *C. lubricella*, while generally considered native, are frequently synanthropic and common in disturbed habitats, and some of their lineages may prove, upon genetic analysis, to be introduced. *Cionella* is a synonym.

- Cochlicopa lubrica* (Müller, 1774), Glossy Pillar Native
- Cochlicopa lubricella* (Porro, 1838), Thin Pillar Native
- Cochlicopa morseana* Doherty, 1878, Appalachian Pillar Native

Selected references: Armbruster (1997), Armbruster and Bernhard (2000), Kerney and Cameron (1979, 1999), Pilsbry (1948), Schileyko (1998a).



Cochlicopa lubrica



Pupilla muscorum

Family Pupillidae

Genus *Pupilla*

Shell minute (maximum height, 4 mm), elongate-ovate or subcylindrical, brown or grey-brown, with fine silky striae. Aperture rounded, with 0–4 denticles. Lip expanded and frequently thickened inside by a rib-like callus. On the last whorl there is a variably developed crest behind and paralleling the lip.

There are 40 or more species in Eurasia, North America, Australia and Africa. Three species occur in Canada. One of these, *Pupilla muscorum* is frequently synanthropic in southern Ontario and Quebec, and these populations are thought to be introduced.

Pupilla blandii Morse, 1865, Rocky Mountain Column Native
Pupilla hebes (Ancey, 1881), Crestless Column Native
Pupilla muscorum (Linnaeus, 1758), Widespread Column Native and introduced

Selected references: Pilsbry (1948), Schileyko (1998a).

***Pupilla muscorum* (Linnaeus, 1758):** Widespread Column

Shell minute (mature height, 3–4 mm), subcylindrical or ovate, opaque, brown or grey-brown. Lip white, expanded. Parietal denticle present, tubercle-like, but frequently absent. Juvenile shells without any apertural denticles. Crest generally strongly developed and usually paler than the rest of the shell.

Lauria cylindracea (p. 45) differs by having an angular denticle (in a different position than the parietal denticle of *Pupilla*) joined by a callus to the outer lip; by lacking a prominent crest; and by the presence of apertural denticles in juvenile individuals. The crest of *P. hebes* is generally less pronounced and usually about the same colour as the rest of the shell. The rare, western *P. blandii* has three apertural denticles, which include a somewhat longish denticle deep within the basal aperture.

Distribution: This species is generally thought to be Holarctic, but a study on the genetics of this group suggests that populations around the Great Lakes are introduced from Europe, while northern populations (Newfoundland and the north shore of the Gulf of St Lawrence to Hudson Bay) represent a separate species.

Habitat and ecology: Around the Great Lakes *P. muscorum* is often abundant in disturbed habitats such as roadsides, vacant lots, abandoned quarries, old fields and concrete culverts, although they also may inhabit less disturbed calcareous cliff, glade, and grassland sites. *P. muscorum* is ovoviviparous; in snails from southern Poland, reproduction was found to occur year round, with most fully formed young snails being released by the parent in June to August. These snails were found to reach maturity in their second or third year.

Selected references: Cameron (2003), Ellis (1969), Kerney (1999), Kerney and Cameron (1979, 1999), Nekola and Coles (in review), Pilsbry (1948), Pokryszko (2001).

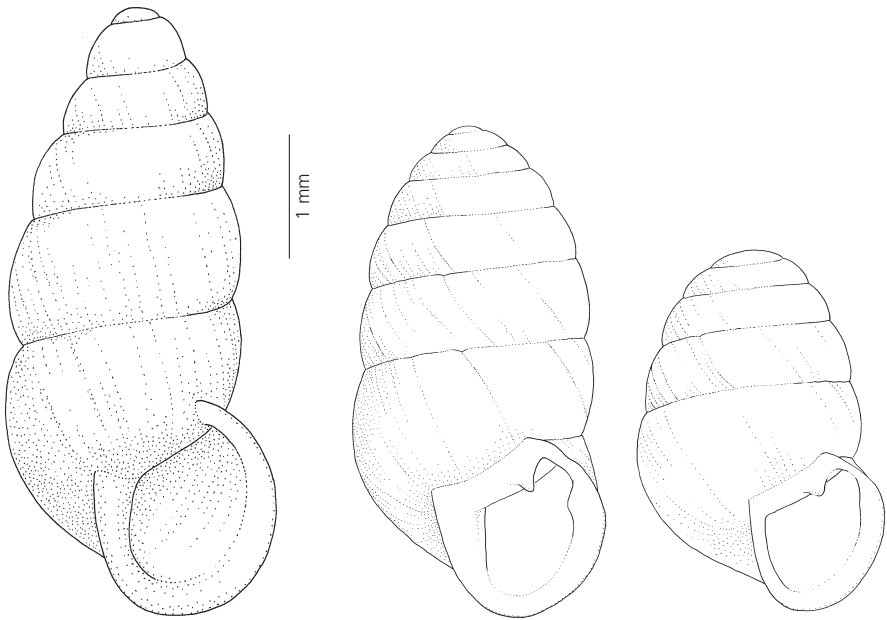
Genus *Pupoides*

Shell minute (mature height, 3–6 mm), elongate and with a clearly tapering spire, brown, with fine incremental striae. Aperture ovate, with lip abruptly flared outwards. A single parietal denticle is present in our species.

There are more than 40 species in Asia, Africa, North America, South America and Australia. Only one species occurs in Canada:

Pupoides albilabris (C.B. Adams, 1841), White-Lip Dagger Native

Selected references: Pilsbry (1948), Schileyko (1998a).



Pupoides albilabris

Lauria cylindracea

Family Lauriidae

Genus *Lauria*

Shell minute (maximum height, 4.5 mm), ovate-cylindrical or elongate-ovate, grey to brown. Aperture rounded with the lip expanded and with a parietal and columellar denticle. Shells of juveniles with an elongate spiral ridge-like denticle on the parietal wall and, visible only through the shell wall, a series of basal denticles.

There are at least two or three species, with many forms. These are native to western and southern parts of Europe, Asia Minor, and south and eastern Africa. One species has been introduced into Canada:

Lauria cylindracea (Da Costa, 1778), Chrysalis Snail Introduced

Selected references: Barker (1999), Manganelli *et al.* (1990), Schileyko (1998a).

***Lauria cylindracea* (Da Costa, 1778):** Chrysalis Snail

Shell minute (mature height, 3–4.5 mm), subcylindrical or ovate, opaque, pale brown or grey-brown. Lip white and broadly expanded. In adults, apertural denticles variable: parietal wall almost always with a prominent angular denticle that is usually linked to the outer lip by a callus; columella normally without a denticle in adults; and outer lip sometimes thickened to suggest a low palatal denticle. Juvenile shells with a series of small elongate ridge-like denticles visible through the basal shell wall, a distinct spiral ridge on the columella, and a narrow spiral ridge on the parietal wall.

This species is most similar to *Pupilla muscorum*, and other species of *Pupilla*, but differs by lacking the crest on the last whorl behind the outer lip. In *Pupilla* the parietal denticle, if present, is not connected to the outer lip and juveniles lack all traces of denticles inside the aperture and last whorl.

The body of the animal is translucent white or pale grey with the head darker grey, especially dorsally and on the tentacles. The ocular tentacles are stubby.

Distribution: *L. cylindracea* has a very broad distribution. In Western Europe it lives mostly west of the Rhine and occurs north to coastal Scandinavia. Its range extends east to Latvia, Ukraine, the Caucas Mountains, and to the Caspian Sea; it is found all around the Mediterranean region, including North Africa, east to Greece and through Turkey to Lebanon and Israel. It also lives on the Azores and Madeira in the mid-Atlantic. This species is introduced to South Africa, St Helena, New Zealand, Reunion, Jamaica and Canada. It was reported in Jamaica (as a new species) over 150 years ago.

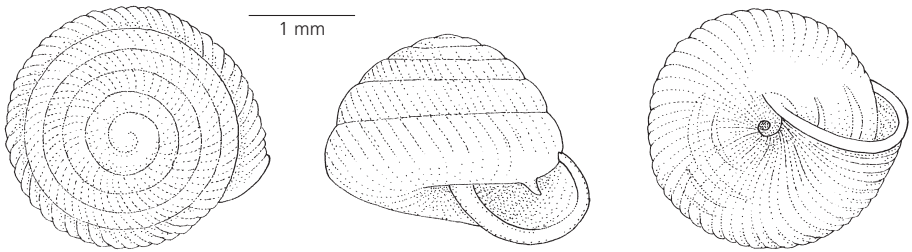
In Canada, this is a common snail around Victoria, British Columbia, and at least on

some of the nearby Gulf Islands. Wayne Grimm said that this species occurs in south-eastern Ontario greenhouses, but we have not seen his specimens to verify this.

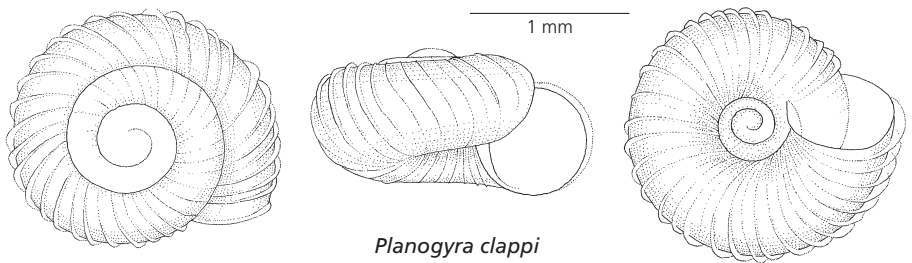
Habitat and ecology: These snails live in gardens and parks and on wasteland. They shelter in crevices of stone and brick walls, in garden waste and under plant debris, stones, flower pots, wood and ivy. In Europe the species also lives in woods, open rocky areas and rock walls, hedgerows and grasslands.

These are ovoviviparous snails, and during times of drought it is thought that the release of the free-crawling young is delayed. Also during drought these snails use mucus to glue the broad flat face of the apertural lip to a surface. A study of animals in Israel has shown that they can live up to five years and are relatively long-lived for a small snail.

Selected references: Arad *et al.* (1998), Barker (1999), Cameron (2003), Ellis (1969), Forsyth (1999, 2004), Heller *et al.* (1997), Kerney (1999), Kerney and Cameron (1979, 1999), Mienis (1994).



Strobilops labyrinthicus



Planogyra clappi

Family Strobilopsidae

Genus *Strobilops*

Shell minute (maximum width, 2.8 mm), dome-shaped or conical, brown, with regular axial riblets. Aperture with elongate, spiral parietal denticles visible and extending back into the last whorl; basal wall of shell with additional elongate denticles inside the last whorl and hidden from view.

There are about ten species and subspecies of *Strobilops* in North and South America. The Asian species, formerly placed in *Strobilops*, belong to other genera. There are probably three species in Canada:

- Strobilops aeneus* (Pilsbry, 1926), Bronze Pinecone Native
- Strobilops affinis* (Pilsbry, 1893), Eightfold Pinecone Native
- Strobilops labyrinthicus* (Say, 1817), Maze Pinecone Native

Selected references: Pilsbry (1948), Schileyko (1998a).

Family Valloniidae

Genus *Planogyra*

Shell minute (maximum width, 2.2 mm), nearly discoid, brown, sculptured by a series of thin, widely spaced lamellar ribs and striae. Aperture rounded, without denticles, and with the lip simple. Umbilicus very wide, about 1/3 of the width of the shell.

There are two native North American species, both of which occur in Canada, as well as another species living in the Russian Far East.

- Planogyra asteriscus* (Morse, 1857), Eastern Flat-Whorl Native
- Planogyra clappi* (Pilsbry, 1898), Western Flat-Whorl Native

Selected references: Pilsbry (1948), Schileyko (1998a).

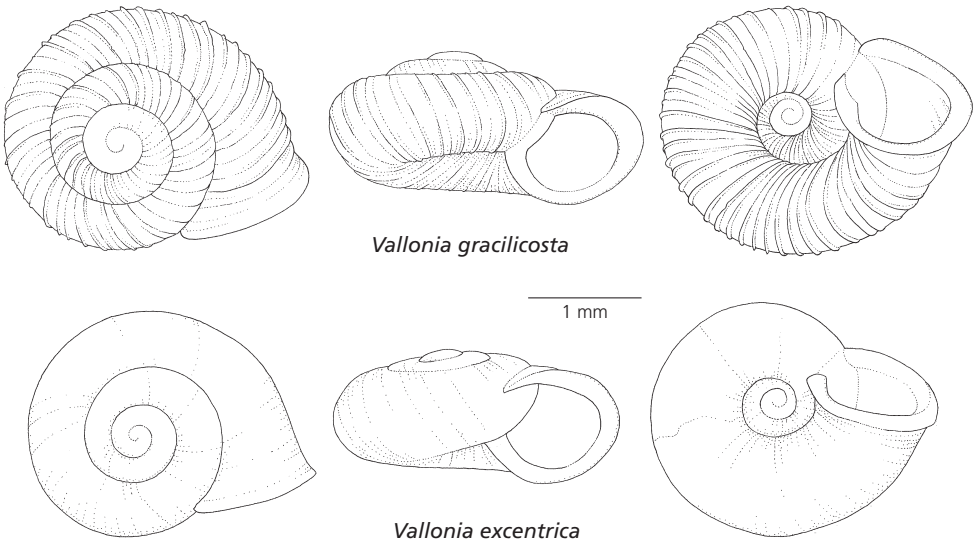
Genus *Vallonia*

Shell minute (mature width, 1.9–4 mm), depressed-heliciform to nearly disc-shaped, white or grey, lightly striate or sculptured by a series of thin, more-or-less regularly and widely spaced axial riblets and finer incremental striae. Aperture rounded and without denticles. Lip flared outward, with some species having a well-developed rib-like thickening inside. Umbilicus broad, about 1/4–1/3 of the width of the shell.

There are about 40 species and subspecies in North America, Eurasia and Africa. Eight species occur in Canada; all are believed to be native, but two species — *Vallonia excentrica* and *V. pulchella* — are thought to be introduced into British Columbia. These and *V. costata* are frequent synanthropic snails in parts of Canada where they are abundant on calcareous ground or around concrete.

- Vallonia costata* (Müller, 1774), Costate Vallonia Native
- Vallonia cyclophorella* Sterki, 1892, Silky Vallonia Native
- Vallonia excentrica* Sterki, 1893, Iroquois Vallonia Native (introduced to B.C.)
- Vallonia gracilicosta* Reinhardt, 1883, Multirib Vallonia Native
- Vallonia parvula* Sterki, 1893, Trumpet Vallonia Native
- Vallonia perspectiva* Sterki, 1893, Thin-Lip Vallonia Native
- Vallonia pulchella* (Müller, 1774), Lovely Vallonia Native (introduced to B.C.)
- Vallonia terraenovae* Gerber, 1996, Terre-Neuve Vallonia Native

Selected references: Barker (1999), Forsyth (2004), Gerber (1996), Pilsbry (1948), Schileyko (1998a).



***Vallonia excentrica* Sterki, 1893:** Iroquois *Vallonia*

Shell minute (maximum width, 2.2 mm), depressed-heliciform, shining, white. Surface with irregular axial striae and wrinkles. In apical view, the final portion of the last whorl increases rapidly but the lip does not strongly expand outward. Umbilicus open and slightly eccentric (not round).

The animal is white. Tiny black eyespots dot the tips of the ocular tentacles.

This species and *V. pulchella* are very similar and difficult to tell apart. The shell of *V. excentrica* is slightly smaller than *V. pulchella*, the apertural lip does not have the sharp outward expansion, and the shell and umbilicus are less round and more eccentric. It is sometimes difficult to know whether certain individuals are *V. pulchella* or *V. excentrica*. A recent study of the genetics of four species of *Vallonia* has demonstrated that species identification of *V. excentrica* and *V. pulchella* can sometimes be arbitrary and misleading. Molecular evidence suggests that *V. excentrica* is only a loose arrangement of individuals with similar shells.

The other *Vallonia* species in Canada have more-or-less evenly spaced, lamellar ribs, and are usually readily distinguished from *V. pulchella* or *V. excentrica* by these ribs. *V. excentrica* and *V. pulchella* can be further recognized from other *Vallonia* species by the final portion of the last whorl, which continues on the same plane and does not curve downward behind the lip. This character will be useful to distinguish between the unribbed *V. pulchella* and *V. excentrica* and old, shells of ribbed *Vallonia* that have had the delicate ribs worn off.

Distribution: This is a widespread Holarctic species that occurs across all of Europe and northern Asia, south to North Africa, and also in India and China. It is introduced to Australia, Africa, Mauritius, Madagascar and North America. In North America, the species occurs south to Mexico. Although native to central and eastern Canada, we consider populations of this species in the western United States and British Columbia to be introduced.

Habitat and ecology: *V. excentrica* lives in gardens, wasteland, pastures, and potted nursery stock. It can frequently be found along the edges of concrete sidewalks and under broken concrete. Often, but not exclusively, it lives in dry, calcareous habitats. In New Zealand, snails averaged 48 days to reach maturity and once mature quickly laid eggs. Presumably most animals are aphyllid, which suggests that self-fertilization is the predominant mode of reproduction. Eggs are laid singly in plant detritus on the soil surface.

Selected references: Barker (1999), Cameron (2003), Ellis (1969), Forsyth (1999, 2004), Gerber (1996), Hubendick (1950, 1953), Kerney (1999), Kerney and Cameron (1979, 1999), Korte and Armbruster (2003), Pilsbry (1948).

***Vallonia pulchella* (Müller, 1774):** Lovely Vallonia

Shell minute (maximum width, 2.5 mm), depressed-heliciform, shining, white. Surface with irregular axial striae and wrinkles. In apical view, the final portion of the last whorl increases regularly, then the lip expands strongly outward at nearly a right-angle. Umbilicus open and slightly eccentric (not round).

The pigmentation of the animal is the same as for *V. excentrica*.

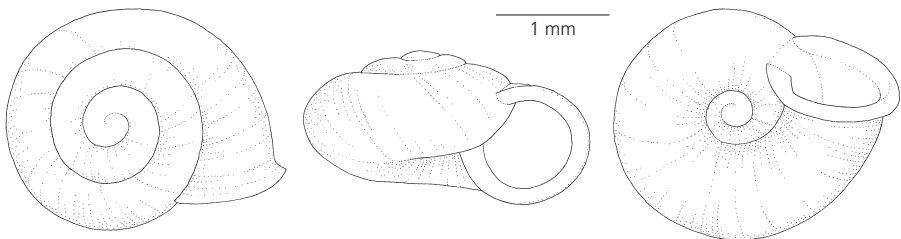
This species is most similar to *V. excentrica*, but the shell is slightly larger, the apertural lip expands outward more strongly (at nearly a right-angle), and the shell and umbilicus are more nearly round.

See *V. excentrica* for a comparison with other species in the genus.

Distribution: *V. pulchella* is Holarctic with a wide distribution. Like the previous species, it occurs throughout Europe and northern Asia, south to North Africa, India and China. In the southern hemisphere, this species is certainly introduced to Australia, South Africa, Mauritius and Madagascar. In the Americas, *V. pulchella* is known as far south as Guatemala. Although native to Central and Eastern Canada, we consider populations of this species in the western U.S. and British Columbia to be introduced.

Habitat and ecology: This species lives in the same habits as *V. excentrica*: in gardens, wasteland, and potted nursery stock, and likely has a similar life history.

Selected references: Cameron (2003), Ellis (1969), Forsyth (2004), Gerber (1996), Kerney (1999), Kerney and Cameron (1979, 1999), Korte and Armbruster (2003), Pilsbry (1948).



Vallonia pulchella

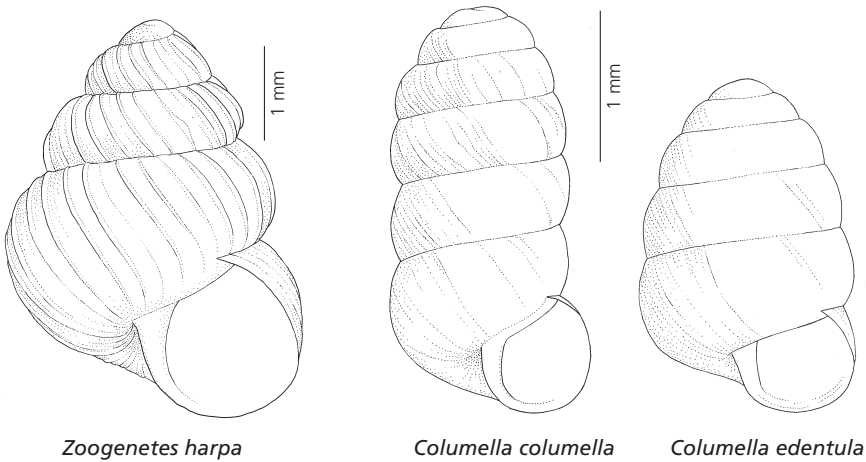
Genus *Zoogenetes*

Shell minute (maximum height, 3.3 mm), ovate-conic, dark brown, thin-shelled, and sculptured by a series of thin, widely spaced lamellar riblets and incremental striae. Aperture rounded without denticles and with the lip simple.

There is a single circumboreal and montane species:

Zoogenetes harpa (Say, 1824), Boreal Top Native

Selected references: Forsyth (2004), Pilsbry (1948), Schileyko (1998b).



Family Vertiginidae

Genus *Columella*

Shell minute (maximum height, 3.5 mm), more-or-less cylindrical, yellow- to red-brown, nearly smooth or with fine incremental striae. Aperture without denticles and lip simple. There is no crest behind the lip on the last whorl.

This is a Holarctic genus with perhaps seven species. There are perhaps three species in Canada:

Columella columella (G. von Martens, 1830), Mellow Column Native

Columella edentula (Draparnaud, 1805), Toothless Column Native

Columella simplex (Gould, 1840), Simple Column Native

Selected references: Pilsbry (1948), Pokryszko (1987, 1990), Schileyko (1998b).

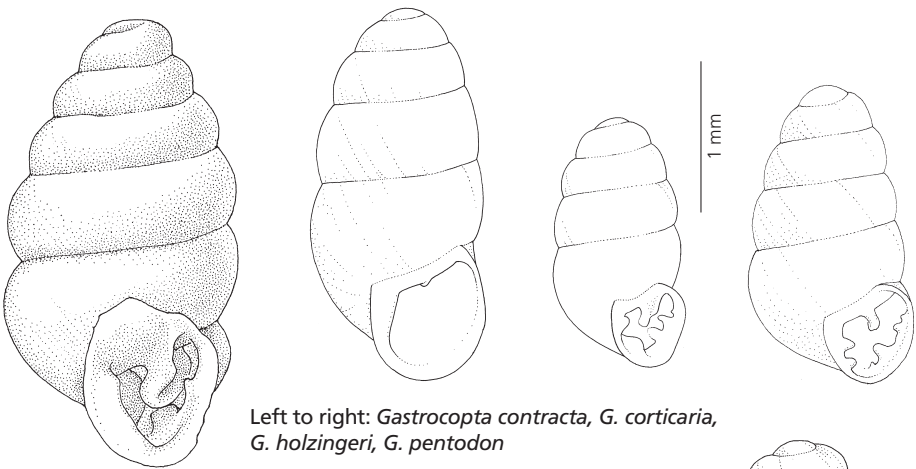
Genus *Gastrocopta*

Shell minute (maximum height, 4.5 mm), ovate-conical or subcylindrical, nearly smooth, and colourless, white, grey, or pale yellow-brown. Aperture with a few to many denticles that are well-developed and nearly fill the aperture in some species. Lip thin, flared.

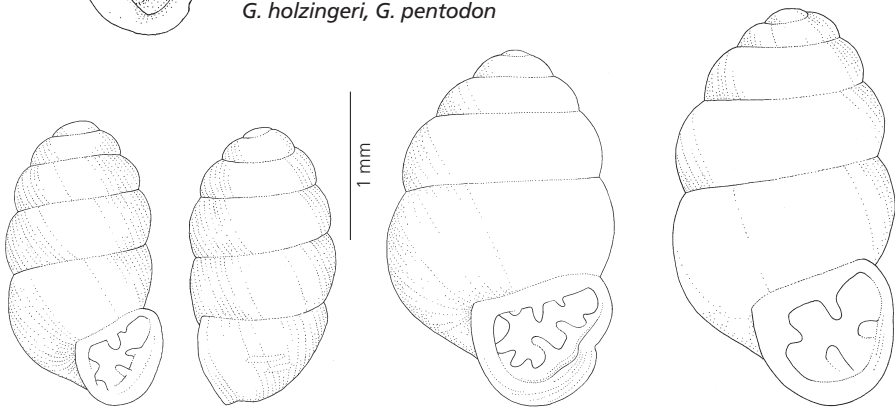
This is a widespread genus with some 100 species or subspecies in North, Central and South America, Asia, Australia, Pacific islands, and Africa. Seven species live in Canada:

- Gastrocopta armifera* (Say, 1821), Armed Snaggletooth Native
- Gastrocopta contracta* (Say, 1822), Bottleneck Snaggletooth Native
- Gastrocopta corticaria* (Say, 1816), Bark Snaggletooth Native
- Gastrocopta holzingeri* (Sterki, 1889), Lambda Snaggletooth Native
- Gastrocopta pentodon* (Say, 1822), Comb Snaggletooth Native
- Gastrocopta similis* (Sterki, 1909), Great Lakes Snaggletooth Native
- Gastrocopta tappaniana* (C. B. Adams, 1842), White Snaggletooth Native

Selected references: Pilsbry (1948), Schileyko (1998b).



Left to right: *Gastrocopta contracta*, *G. corticaria*, *G. holzingeri*, *G. pentodon*



Left to right: *Vertigo arthuri* (two views), *V. ovata*, *V. andrusiana*

Genera *Vertigo* and *Nearctula*

Shell minute (mature height, 1.4–3 mm), ovate, subcylindrical or conic-ovate, smooth or weakly to regularly striate; yellow- to red-brown. Aperture with typically 4–9 denticles but in some species denticles can be reduced or altogether lacking. Lip flared outward or not and a little thickened in some species. A crest behind the lip on the last whorl may be variously developed or absent.

The genus *Vertigo* is Holarctic and has over 50 species. In Canada there are at least 20 species. All the species listed below are usually considered as native to North America, but J. Nekola (personal communication) believes that *V. pygmaea*, which is restricted to anthropogenic habitats, is an early introduction to eastern North America. The native *Vertigo ovata* is sometimes found on nursery stock.

Nearctula is a west coast endemic genus (or subgenus of *Vertigo*) with species distributed from British Columbia to Baja California. There are eight species and subspecies of *Nearctula* with at least one species occurring in southwestern B.C.

<i>Nearctula</i> species (<i>Vertigo rowelli</i> of authors), Threaded Vertigo	Native
<i>Vertigo alpestris</i> Alder, 1838, Tundra Vertigo	Native
<i>Vertigo andrusiana</i> Pilsbry, 1899, Pacific Vertigo	Native
<i>Vertigo arthuri</i> E. von Martens, 1882, Callus Vertigo	Native
<i>Vertigo binneyana</i> Sterki, 1890, Cylindrical Vertigo	Native
<i>Vertigo bollesiana</i> (Morse, 1865), Delicate Vertigo	Native
<i>Vertigo clappi</i> Brooks & Hunt, 1936, Cupped Vertigo	Native
<i>Vertigo columbiana</i> Pilsbry & Vanatta, 1900, Columbia Vertigo	Native
<i>Vertigo cristata</i> Sterki in Pilsbry, 1919, Crested Vertigo	Native
<i>Vertigo elatior</i> Sterki, 1894, Tapered Vertigo	Native
<i>Vertigo gouldii</i> (A. Binney, 1843), Variable Vertigo	Native
<i>Vertigo hubrichti</i> Pilsbry, 1934, Hubricht Vertigo	Native
<i>Vertigo milium</i> (Gould, 1840), Blade Vertigo	Native
<i>Vertigo modesta</i> (Say, 1824), Cross Vertigo	Native
<i>Vertigo morsei</i> Sterki, 1894, Six-Whorl Vertigo	Native
<i>Vertigo nylanderi</i> Sterki, 1909, Deep-Throat Vertigo	Native
<i>Vertigo oughtoni</i> Pilsbry, 1948, Nunavut Vertigo	Native
<i>Vertigo ovata</i> (Say, 1822), Ovate Vertigo	Native
<i>Vertigo paradoxa</i> Sterki in Pilsbry, 1919, Mystery Vertigo	Native
<i>Vertigo perryi</i> Sterki, 1905, Olive Vertigo	Native
<i>Vertigo pygmaea</i> (Draparnaud, 1801), Pygmy Vertigo	Introduced?
<i>Vertigo tridentata</i> Wolf, 1870, Honey Vertigo	Native
<i>Vertigo ventricosa</i> Morse, 1865, Five-Tooth Vertigo	Native

Selected references: Pilsbry (1948), Schileyko (1998b).

Family Ferussaciidae

Genus *Cecilioides*

Shell minute (maximum height, 6 mm), very slender, thin-shelled, smooth, transparent and colourless but weathering to white. Spire elongate; apex bluntly rounded. Aperture narrow. Columella concave and distinctly truncate below.

This is a widespread genus with more than 40 species in central and southern Europe, Africa, southern Asia, the Caribbean and South America. One species is introduced to Canada:

Cecilioides acicula (Müller, 1774), Blind Awlsnail Introduced

Selected references: Barker (1999), Pilsbry (1946), Schileyko (1999).

***Cecilioides acicula* (Müller, 1774):** Blind Awlsnail

Shell minute (maximum height, 5.5 mm), elongate, very slender, transparent colourless when alive but white when dead. Whorls about 5, slightly convex in profile and nearly smooth. Columella truncate at its base.

No other snail in Canada is similar to *C. acicula*. However, a second species in North America, the Obtuse Awlsnail, *C. aperta* (Swainson, 1840) — found in Florida, Texas, the West Indies, and Hawaii and introduced into greenhouses in New Jersey — differs by having a less truncate columella, more convex whorls, and a thickened parietal callus.

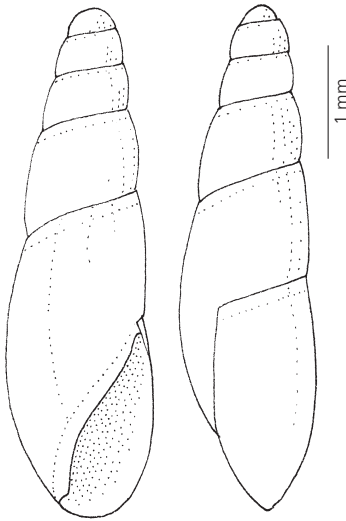
The body is entirely white. There two pairs of tentacles, but eyes are absent, and these snails are blind.

Distribution: This is a native of Mediterranean Europe but is also widespread in Western and Central Europe, North Africa, Arabia and Central Asia.

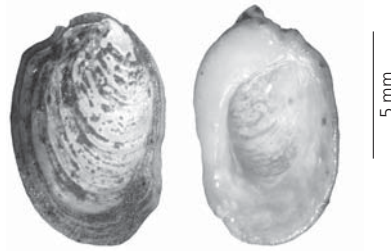
In Canada *C. acicula* is known from drift debris of the Grand River in southern Ontario and Bowmanville Creek east of Toronto. This species is introduced to central and northwest Europe, the Azores and Canary Islands, South Africa, New Zealand, Australia, Argentina, Bermuda, Barbados, Hawaii and the mainland United States and Canada. In the continental U.S., *C. acicula* is known from Florida, Maryland, New Jersey, Pennsylvania, New Mexico, Texas and California.

Habitat and ecology: *C. acicula* is largely subterranean, living up to two metres or more underground. It is a calciphile, and snails have been frequently found associated with bones in the graves in cemeteries and archaeological sites, and in pastures, swales, gardens and caves. The diet of this species is thought to include fungi and possibly fine roots. Snails lay eggs singly in the soil.

Selected references: Barker (1999), Cameron (2003), Ellis (1969), Forsyth *et al.* (2008), Kerney (1999), Kerney and Cameron (1979, 1999).



Cecilioides acicula



Shell of *Testacella haliotideia*

Family Testacellidae

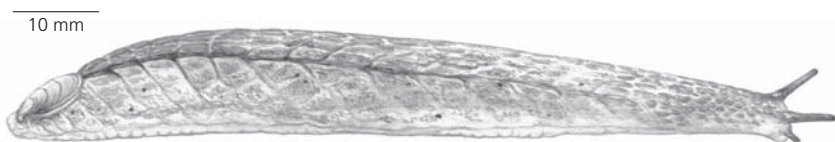
Genus *Testacella*

Large slugs (maximum length, 120 mm), characterized by having a small, cap-like, external shell on the posterior end of the body. Body broadest near the posterior end and narrowing toward the head. A pair of branched grooves extend forward on the back of the animal from the anterior edge of the shell.

There are about six species originally from the Mediterranean region; introduced to northwest Europe, North America, New Zealand and Australia.

Testacella haliotideia Draparnaud, 1801, Ear-Shell Slug Introduced

Selected references: Barker (1999), Cameron *et al.* (1983), Quick (1960), Schileyko (2000).



Testacella haliotideae

***Testacella haliotideae* Draparnaud, 1801: Ear-Shell Slug**

Plate 1

A large (maximum length, 100 mm), pale brown to creamy white slug. Shell (page 55) external on the posterior end of the animal; 7 mm long, cap- or ear-shaped, and with brown periostracum, which is usually much eroded. A pair of branching dorsal grooves extends forward from a point immediately beneath the shell. Sole creamy white to grey-white.

A similar species, *T. scutulium* G. B. Sowerby, 1821, the Shield Slug, has usually has a pale orange (rather than white) sole, and the dorsal grooves converge in front of the edge of the shells, rather than immediately beneath the edge. *T. scutulium* was found by Wayne Grimm in Ontario, although he did not elaborate where and we are unable to confirm his record.

Distribution: Western Europe and western Mediterranean region, including North Africa and the eastern Atlantic islands. In Canada, this species is introduced, but not commonly encountered, in British Columbia, Nova Scotia and Ontario. In the United States it is known from Oregon and Wisconsin, but likely is more widespread. It is also introduced to Cuba, New Zealand and Australia.

Habitat and ecology: *T. haliotideae* lives in gardens, and in Ontario, was found in greenhouses by Wayne Grimm. These unusual slugs are mostly subterranean during the day, burrowing to over one metre deep in soft soil in gardens, especially during drought and periods of cold weather. *T. haliotideae* feeds underground on earthworms, but at night and in wet weather will come to the surface and also prey on centipedes, snails and other slugs.

The eggs, which are laid underground, are elliptical and 7 mm long. These rarely observed slugs apparently take about 18 months to mature but may live for five to six years.

Selected references: Barker (1999), Ellis (1969), Cameron *et al.* (1983), Forsyth (2004), Hanna (1966), Kerney (1999), Kerney and Cameron (1979, 1999), McDonnell *et al.* (2009), Quick (1960).

Family Haplotrematidae

Genus *Ancotrema*

Shell medium-sized (maximum width, 27 mm), depressed-heliciform, straw yellow or yellow-brown. Spire low, nearly flat. Whorls about 6, sculptured with spiral striae and axial riblets forming beads where they intersect. Apertural lip, on the shoulder, with a down-turned edge. Aperture without denticles. Umbilicus broad, about ¼ of the width of the shell. Compare with *Haplotrema*, with which *Ancotrema* species are frequently confused.

Two species live in forests of British Columbia:

- Ancotrema hybridum* (Ancey, 1888), Oregon Lancetooth Native
- Ancotrema sportella* (Gould, 1846), Beaded Lancetooth Native

Selected references: Forsyth (2004), Pilsbry (1946), Roth (1991), Schileyko (2000).

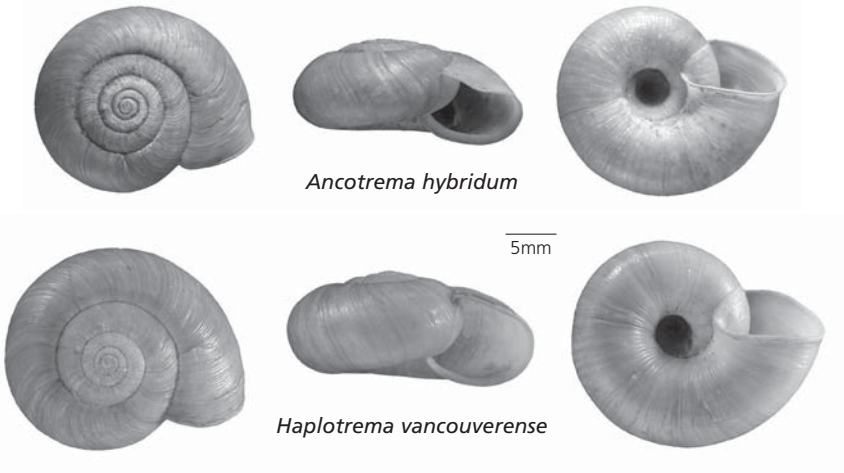
Genus *Haplotrema*

Shell medium to large (maximum width, 32 mm), similar to *Ancotrema* but species in Canada have shells without the distinctive beaded sculpture of *Ancotrema* that is formed by the intersection of the axial riblets by spiral striae. Compare with *Mesomphix*.

Two forest-dwelling species occur in Canada, one from southern Ontario and Quebec and one from British Columbia:

- Haplotrema concavum* (Say, 1821), Grey-Foot Lancetooth Native
- Haplotrema vancouverense* (L. Lea, 1839), Robust Lancetooth Native

Selected references: Pilsbry (1946), Roth (1991), Schileyko (2000).



Family Punctidae

Genus *Paralaoma*

Shell minute (maximum width, 2.4 mm), depressed-heliciform, silky, shining, brown. Whorls 3½–4, with close, microscopic axial riblets, spiral striae, and larger lamellar ribs. Lip thin, simple. Umbilicus open.

The genus is probably almost cosmopolitan, with the best known species, *Paralaoma servilis*, now known from many places worldwide. This is the only species in Canada, where it is known from B.C. Although generally a ‘weedy’ species, there are records from remote areas in B.C., Alaska and elsewhere that suggest this is native. In North American literature, the species is usually called *Punctum conspectum*; *Paralaoma caputspinulae* is another synonym.

Paralaoma servilis (Shuttleworth, 1852), Pin-Head Spot Native

Selected references: Falkner *et al.* (2002), Forsyth (2004), Pilsbry (1946), Roth (1986, 1987).

Genus *Punctum*

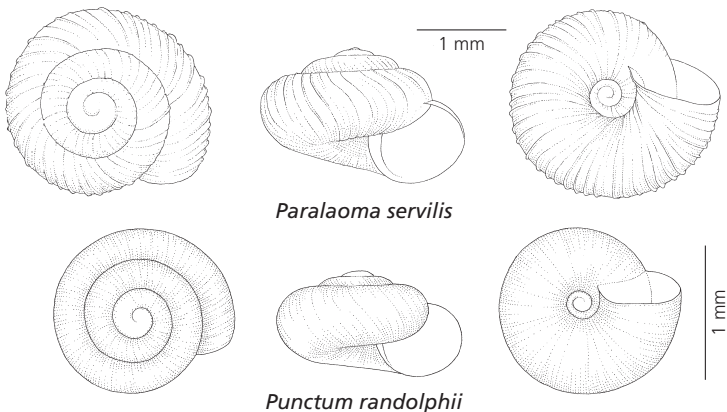
Shell minute (mature width, 1–2 mm), depressed-heliciform, silky, shining, brown. Whorls 3½–4, with close, microscopic axial riblets and spiral striae. Aperture without a denticle in Canadian species; lip thin, simple. Umbilicus open.

There are at least nine species in this genus, which occurs throughout the Holarctic realm and in Hawaii. At least two litter-dwelling species occur in Canada:

Punctum minutissimum (I. Lea, 1841), Small Spot Native

Punctum randolphii (Dall, 1895), Conical Spot Native

Selected references: Pilsbry (1946), Schileyko (2002).



Family Discidae

Genus *Anguispira*

Shell medium to large (maximum width, about 30 mm), depressed to heliciform, yellow-brown or dark brown with either two spiral bands or alternating pattern of red-brown blotches. Whorls 4½–6, rounded or keeled at the periphery; nearly smooth with incremental striae only or sculptured by prominent axial ribs. Aperture without denticles. Lip thin and simple. Umbilicus open.

This is a North American genus, with some 13 species, most of which are eastern. Two forest-dwelling species are native to parts of Canada: *Anguispira kochi* has disjunct populations in B.C. and the Lake Erie islands of Ontario; *A. alternata* is more generally distributed over southeastern Canada and the Maritimes.

Anguispira alternata (Say, 1817), Flamed Tigersnail Native
Anguispira kochi (L. Pfeiffer, 1846), Banded Tigersnail. Native

Selected references: MacMillan (1940), Pilsbry (1948), Schileyko (2002).



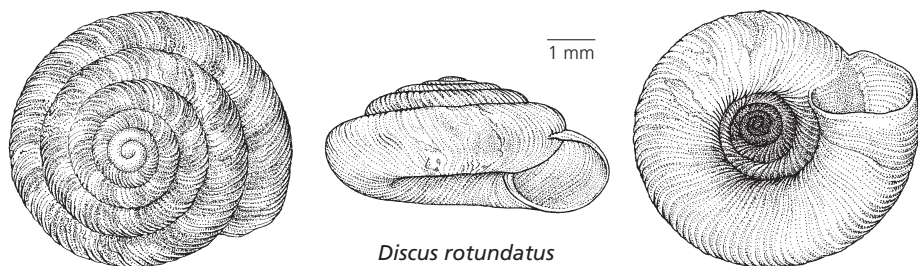
Genus *Discus*

Shell small (maximum width, 7 mm), depressed-heliciform, ribbed, red- to yellow-brown or grey-brown with reddish spots. Apertural lip simple. Umbilicus open, usually rather broad.

This genus has a Holarctic distribution with perhaps 20 species. There are five species found in Canada, of which four are native and one is introduced:

Discus catskillensis (Pilsbry, 1896), Angular Disc Native
Discus patulus (Deshayes, 1830), Domed Disc Native
Discus rotundatus (Müller, 1774), Rotund Disc Introduced
Discus shimekii (Pilsbry, 1890), Striate Disc Native
Discus whitneyi (Newcomb, 1864), Forest Disc Native

Selected references: MacMillan (1940), Pilsbry (1948), Schileyko (2002).



***Discus rotundatus* (Müller, 1774):** Rotund Disc

Shell small (mature width, 5.5–7.2 mm), depressed-heliciform, opaque, dull, grey or pale yellow-brown with distinct, regularly spaced red-brown blotches. Whorls 4½–6, rather tightly coiled, sculptured with numerous, evenly spaced axial riblets that are weaker below the periphery. Last whorl rather angular at the periphery. Aperture without denticles. Umbilicus large, about ⅓ of the width of the shell.

The animal is blue-grey or blue-black dorsally and on the tentacles and paler on the sides of the foot.

Unlike native species of *Discus*, this species is marked by red-brown blotches on the apical surface of the shell. In this respect it more resembles the native *Anguispira alternata* (p. 59), a much larger, snail with more rapidly enlarging whorls.

Distribution: This is a common species from southern Scandinavia and Northern Scotland to Algeria, and from Spain and Ireland to Ukraine. It also occurs on the mid-Atlantic islands of Madeira and the Azores. The species is introduced to Istanbul, Turkey.

In Canada *D. rotundatus* lives in the Ottawa and Toronto areas, in Newfoundland, and possibly Montreal. It was collected at Esquimalt, Vancouver Island in the 1950s, but there are no recent observations of this species in British Columbia. It has been introduced to parts of the United States, including New Jersey, New York, Massachusetts, California and Washington State. Colonies are usually sporadic but may consist of many individuals.

Habitat and ecology: In Europe this is a common snail in woodlands and hedgerows, on wasteland and in gardens, where they shelter in shaded, humid places such as under stones, in old walls, and decaying logs. These snails feed on decaying plant material and soil. Eggs are laid singly or in small groups of fewer than five.

Selected references: Cameron (2003), Dundee (1974), Ellis (1969), Forsyth (2004), Kerney (1999), Kerney and Cameron (1979, 1999), Kuźnik-Kowalska (1999), Örstan (2003), Roth (1982b), Umiński (1962).

Family Helicodiscidae

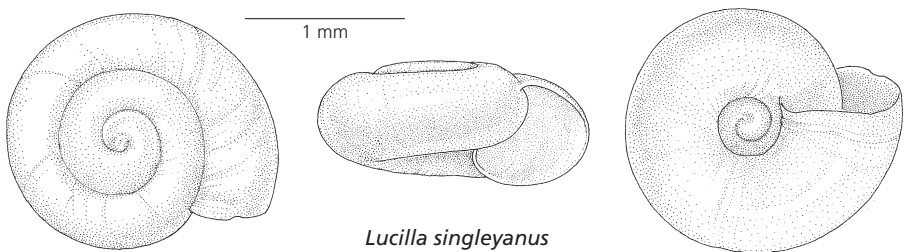
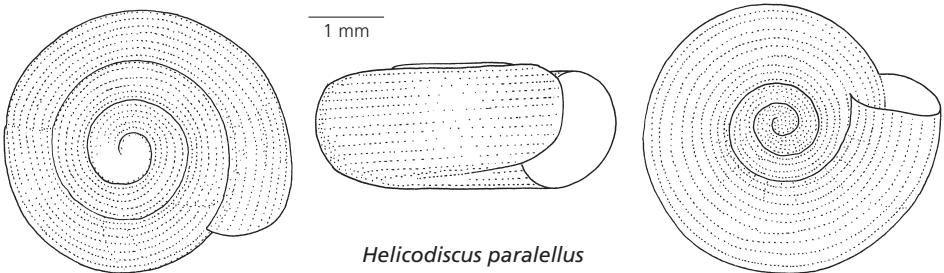
Genus *Helicodiscus*

Shell minute (mature width, 3–5 mm), discoid; spire flat or only slightly elevated; brown. Whorls very closely coiled and slowly enlarging, spirally threaded. Pairs of denticles usually present in the last whorl, both in adults and juveniles, but may not be visible inside the aperture. Umbilicus very broad and shallow.

There are 20 species in North America, with at least two species native to Canada, from Manitoba east to Newfoundland. *H. parallelus* has been found introduced to several greenhouses in Western Europe.

- Helicodiscus parallelus* (Say, 1817), Compound Coil Native
- Helicodiscus shimeki* Hubricht, 1962, Temperate Coil Native

Selected references: Hubricht (1962), Kerney and Cameron (1979, 1999), Pilsbry (1948), Schileyko (2002).



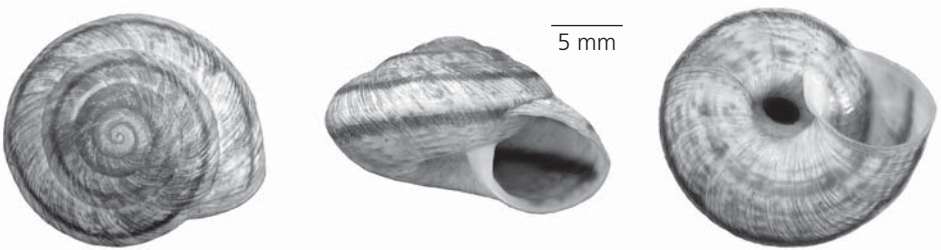
Genus *Lucilla*

Shell minute (maximum width, 3 mm), flattened, but spire usually slightly elevated; pale yellow-brown or grey. Whorls rather closely coiled and slowly enlarging. Surface nearly smooth, without conspicuous spiral threads. Denticles inside the last whorl absent. Umbilicus about $\frac{1}{3}$ of the width of the shell. Species of this genus are very difficult to distinguish from *Hawaiiia* (p. 73)

This genus has perhaps five species in North America and Europe. *Hebetodiscus* is a synonym, and the species have also been placed in *Helicodiscus* by some authors. There is one species in Canada (Ontario only):

Lucilla singleyanus (Pilsbry, 1889), Smooth Coil Native

Selected references: Falkner *et al.* (2002), Pilsbry (1948), Schileyko (2002).



Oreohelix strigosa

Family Oreohelicidae

Genus *Oreohelix*

Shell medium-sized (maximum width, 9–28 mm), heliciform, opaque, white-grey to brown-grey, suffused or banded with brown in most, sculptured by irregular wrinkles and axial striae. Whorls 4–6, convex or with a peripheral keel. Aperture rounded or subovate, without denticles. Umbilicus open.

There are some 80 species and subspecies of *Oreohelix*, a genus of western and central North American ovoviviparous snails. Two species, with several forms, live in south-eastern British Columbia, the Rocky Mountains and Foothills of Alberta and the Cypress Hills of southeastern Alberta /southwestern Saskatchewan.

Oreohelix strigosa (Gould, 1846), Rocky Mountainsnail Native

Oreohelix subrudis (Reeve, 1854), Subalpine Mountainsnail Native

Selected references: Forsyth (2004), Pilsbry (1939), Schileyko (2006a).

Family Gastrodontiidae

Genus *Striatura*

Shell minute (maximum width, 3 mm), depressed-heliciform, with a low spire; pale yellow-brown or grey, with intricate microscopic axial and spiral striae. Umbilicus very broad in most.

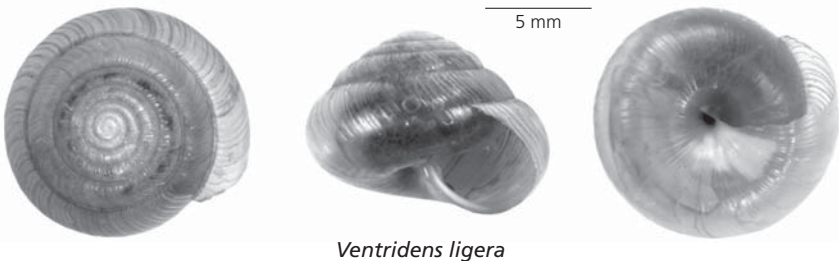
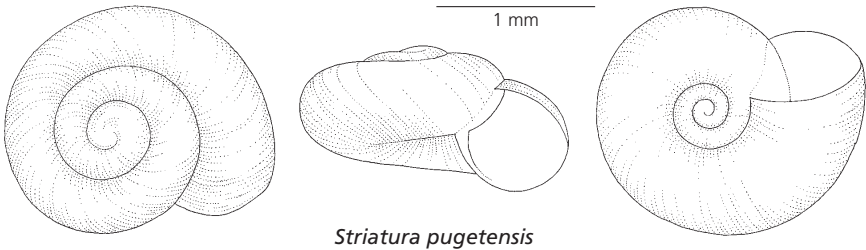
This genus has about seven species in North America and Hawaii and one in Japan and Maritime Russia. There are four species living in Canada:

- Striatura exigua* (Stimpson, 1850), Ribbed Striate Native
- Striatura ferrea* Morse, 1864, Black Striate Native
- Striatura milium* (Morse, 1859), Fine-Ribbed Striate Native
- Striatura pugetensis* (Dall, 1895), Northwest Striate Native

Selected references: Pilsbry (1946), Schileyko (2003a).

Genus *Ventridens*

Shell small to medium-sized (maximum width, 10 mm), depressed to conic-heliciform, thin, dull or shining; yellow-brown to brown. Spire conical. Whorls about 5–8, sculptured with growth and sometimes spiral striae. Lip thin, simple. Juvenile shells with denticles that may or may not persist into the adult stage; last whorl with a white callus or 1–2 denticles basally; some species with several palatal denticles as well. Umbilicus small to tiny, or altogether closed.



There are 21 species in temperate eastern North America, with three species in Canada:

- Ventridens intertextus* (A. Binney, 1841), Pyramid Dome Native
- Ventridens ligera* (Say, 1821), Globose Dome Native
- Ventridens suppressus* (Say, 1829), Flat Dome Native

Selected references: Pilsbry (1946), Schileyko (2003a).

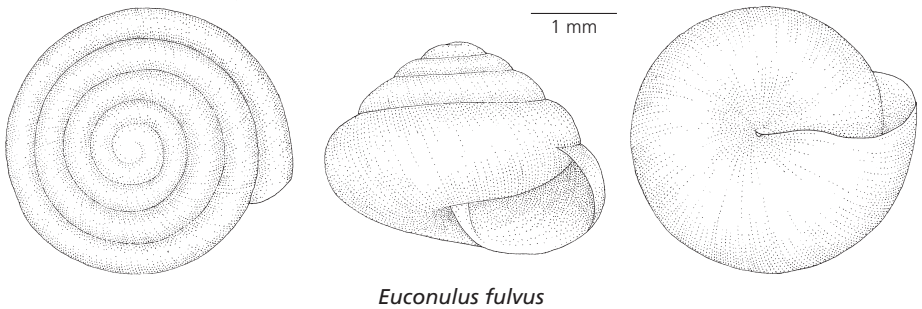
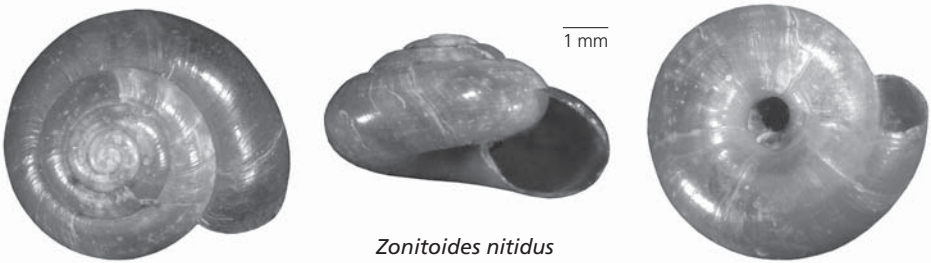
Genus *Zonitoides*

Shell small (maximum width, 6 mm), depressed, thin and shining; brown. Spire conical, low. Surface with irregular incremental striae and sometimes exceedingly weak, microscopic spiral striae. Lip thin, simple. Umbilicus open.

Zonitoides has about 10 species throughout the Holarctic realm and extending south into the New World tropics. One species (*Z. arboreus*) has been introduced to many tropical and temperate places worldwide. There are two widely distributed species in Canada:

- Zonitoides arboreus* (Say, 1817), Quick Gloss Native
- Zonitoides nitidus* (Müller, 1774), Black Gloss Native but synanthropic

Selected references: Barker (1999), Forsyth (2004), Pilsbry (1946), Schileyko (2003a).



Family Euconulidae

Genus *Euconulus*

Shell minute (maximum width, 3.5 mm), conical or bee-hive-shaped, brown, shining or silky, and with numerous, close-spaced microscopic axial threads and finer spiral striae. Aperture crescent-shaped; lip simple. Umbilicus pit-like.

Holarctic, with perhaps five or more species. There are perhaps three species in Canada:

- Euconulus fulvus* (Müller, 1774), Brown Hive Native
- Euconulus praticola* (Reinhardt, 1883), Marsh Hive Native
- Euconulus polygyratus* (Pilsbry, 1899), Fat Hive Native

Selected references: Forsyth (2004), Pilsbry (1946), Schileyko (2002).

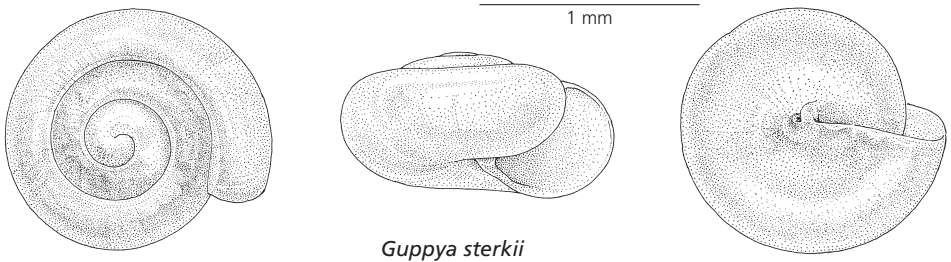
Genus *Guppya*

Shell minute (maximum width, 1.3 mm in the Canadian species), similar to *Euconulus* in form but with spire lower and smooth or spirally striate and without dense axial threads of that genus.

This is a genus of between four and six species that are distributed over tropical and subtropical America. There is a single species, *G. sterkii*, ranging north in temperate eastern North America. In Canada, *G. sterkii* is known only from southern Ontario.

- Guppya sterkii* (Dall, 1889), Northern Granule Native

Selected references: Pilsbry (1946), Schileyko (2003a).



Family Oxychilidae

Genus *Aegopinella*

Shell minute to medium-sized (mature width, 4–15 mm), depressed, rather thin and slightly translucent but not shining; brown or colourless. Whorls 4–5 whorls, somewhat flattened above. Surface appearing nearly smooth, but microscopically reticulate. Umbilicus open, about $\frac{1}{6}$ of the width of the shell.

This is a genus of nine European species. One of these is introduced to Canada:

Aegopinella nitidula (Draparnaud, 1805), Waxy Glass-Snail. Introduced

Selected references: Kerney and Cameron (1979, 1999), Schileyko (2003a).

***Aegopinella nitidula* (Draparnaud 1805):** Waxy Glass-Snail

Shell small (mature width, 8–10 mm), depressed-heliciform; yellow-brown but more opaque and whiter area around the umbilicus; with a waxy lustre, not glossy. Surface appearing almost smooth, but under high magnification, both weak axial and spiral striae are barely evident. Aperture subovate; without denticles. Lip thin. Umbilicus about $\frac{1}{6}$ of the width of the shell.

Shells of this species are similar to *Zonitoides nitidus* and *Z. arboreus*, but these are smaller and lack the conspicuous opaque area around the umbilicus. The shells of species of *Oxychilus* are glossier. *Nesovitrea* and *Glyphyalinia* species are smaller and are differently sculptured, having widely spaced regular indented axial grooves.

The animal is dark blue-grey with a slight blue tinge dorsally, paler sides and tail, and a pale sole.

Distribution: *A. nitidula* ranges over northwest Europe, north to coastal Norway, south to Spain. In North America, the species is currently only known from Vancouver and its suburb of Burnaby, where it is a fairly common snail.

The species may also be in southern Ontario: Wayne Grimm had identified a snail collected in 1973 from along the Saugeen River in southern Ontario as this species. We have not been able to confirm this record.

Habitat and ecology: In the Vancouver area *A. nitidula* lives in unkempt gardens and disturbed habitats, living in leaf litter and under stones, garbage, logs, ivy and other dense vegetation. In Europe, it is common in deciduous and coniferous woodlands, moist grasslands, along river banks, and in hedgerows, as well as on wasteland and in gardens.

British studies found that the species is biennial, maturing in its second year. The diet

consists mostly of dead plant material, but these snails also prey on small snails, slugs, and earthworms.

Synonym: *Retinella nitidula* (Draparnaud).

Selected references: Ellis (1969), Cameron (1982, 2003), Forsyth (2004), Forsyth *et al.* (2001), Kerney (1999), Kerney and Cameron (1979, 1999), Mordan (1978).

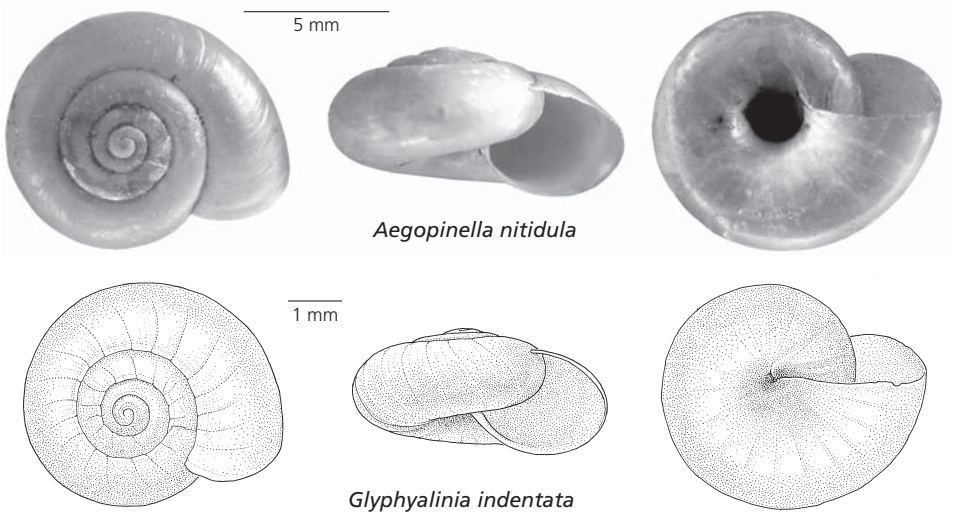
Genus *Glyphyalinia*

Shell small to medium-sized (mature width, 5–12 mm), depressed-heliciform, thin, translucent, shining. Whorls 4–7, pale, yellow-brown to brown. Sculptured with more-or-less well-spaced axial grooves, and (in most species) spiral striae. Aperture subovate. Lip thin, simple. Umbilicus present, moderately wide to small and occluded by the columellar lip. Compare especially with *Nesovitrea* (next page).

This speciose genus is distributed from eastern temperate North America south to Central America. There are about 27 species and subspecies, with three living in Canada:

- Glyphyalinia indentata* (Say, 1823), Carved Glyph Native
- Glyphyalinia rhoadsi* (Pilsbry, 1899), Sculpted Glyph Native
- Glyphyalinia wheatleyi* (Bland, 1883), Bright Glyph Native

Selected references: Pilsbry (1946), Schileyko (2003a).



Genus *Mesomphix*

Shell medium to large (mature width, 12–35), depressed heliciform, opaque, yellow-to green-brown or brown. Whorls 4½–5, nearly smooth or with axial striae. Aperture deeply rounded. Lip thin. Umbilicus narrow.

Mesomphix is distributed from temperate eastern North America south to Central America; there are 14 species in North America alone. Two species live in forests of southern Ontario and Quebec:

- Mesomphix cupreus* (Rafinesque, 1831), Copper Button. Native
- Mesomphix inornatus* (Say, 1821), Plain Button. Native

Selected references: Pilsbry (1946), Schileyko (2003a).

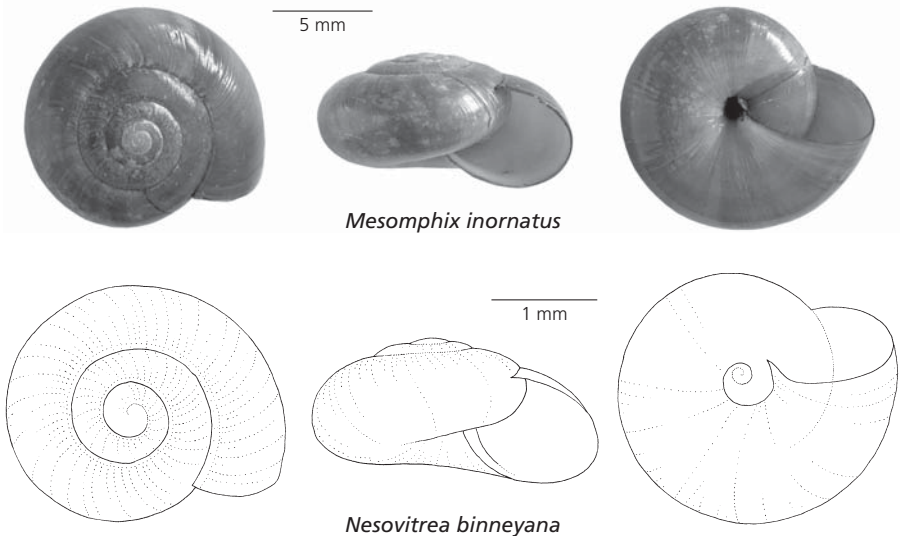
Genus *Nesovitrea*

Shell small (maximum width, 5 mm), depressed, thin, translucent, shining. Whorls 4–5, colourless to pale green-yellow or yellow-brown. Sculptured with more-or-less well-spaced axial grooves. Spiral striae absent or exceedingly weak. Aperture subovate. Lip thin, simple. Umbilicus present. Compare with *Glyphyalinia* (p. 67).

This is a genus of at least nine species in the Palearctic and Nearctic regions and Hawaii. In Canada there are two widespread species:

- Nesovitrea binneyana* (Morse, 1864), Blue Glass Native
- Nesovitrea electrina* (Gould, 1841), Amber Glass Native

Selected references: Pilsbry (1946), Schileyko (2003a).



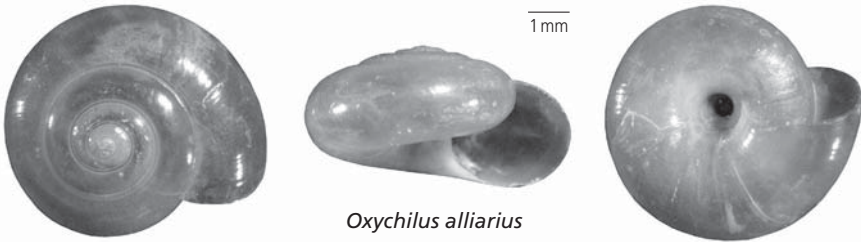
Genus *Oxychilus*

Shell small to medium-sized (mature width, 6–16 mm), depressed, translucent yellow-to red-brown, shining. Spire low conical or almost flat. Surface nearly smooth with weak incremental striae only. Lip thin, simple. Umbilicus small in most.

Oxychilus has over 100 species in the western Palaearctic. There are three species introduced into Canada:

Oxychilus alliarius (Miller, 1822), Garlic Glass-Snail Introduced
Oxychilus cellarius (Müller, 1774), Cellar Glass-Snail Introduced
Oxychilus draparnaudi (Beck, 1837), Dark-Bodied Glass-Snail Introduced

Selected references: Barker (1999), Lloyd (1970c), Schileyko (2003a).



***Oxychilus alliarius* (Miller, 1822):** Garlic Glass-Snail

Shell small (maximum width, 8 mm), depressed-heliciform, with the spire slightly raised, glossy, translucent, pale red-brown or amber brown, but slightly paler and more opaque around the umbilicus. Surface nearly smooth, with fine incremental striae. Apertural lip thin. Umbilicus small, about $\frac{1}{6}$ – $\frac{1}{4}$ of the width of the shell.

This species is distinguished from *O. cellarius* and *O. draparnaudi* by its smaller size, more raised spire, and characteristics of the animal (see below). *Zonitoides nitidus* and *Z. arboreus* are similar but have stronger sculpture of striae and wrinkles.

The animal is blue-black or blue-grey in colour and has a strong garlic-like odour when irritated. The edge of the mantle lacks the black edge of *O. navarricus helveticus* (Blum, 1881), the Swiss Glass-snail, a species that may also be present in southern Ontario. *O. navarricus helveticus* may have been found once by Wayne Grimm in 1973, on a wet, overgrown roadside near the Saugeen River in southern Ontario, but we are unable to confirm this record.

Distribution: This species is native to Western Europe and is now widespread around the world, including Greenland, North America, South Africa, South America, Australia, and New Zealand.

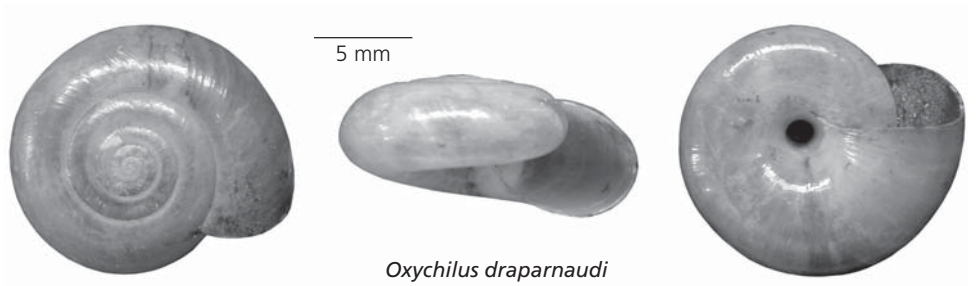
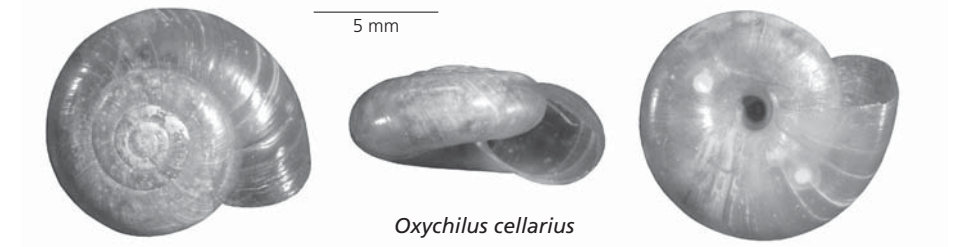
In Canada, this species is known from British Columbia, southern Ontario, Quebec, Nova Scotia, and likely other provinces. In B.C. it is a common snail in the Vancouver area, in the Lower Fraser Valley, on Vancouver Island, and in the Queen Charlotte Islands.

Habitat and ecology: *O. alliarius* is gregarious, living in gardens, around farms, and on wasteland. Animals shelter under dead vegetation, stones, wood, and debris. Wayne Grimm observed this species in greenhouses in Ontario. In Europe, this is a generalist species living in moist litter in woods, fields, hedgerows, and wasteland and is tolerant of acidic soils.

This species feeds largely on dead and living plant material, but part of its diet also includes small snails and their eggs.

The strong garlicky odour is a defensive adaptation. A gland near the pneumostome secretes viscous brown mucus that emits the odour. An English study found that hedgehogs rejected *O. alliarius*, preferring instead other *Oxychilus* that do not produce the odour.

Selected references: Barker (1999), Cameron (2003), Dundee (1974), Ellis (1969), Forsyth (1999, 2004), Giusti and Manganeli (2002), Kerney (1999), Kerney and Cameron (1979, 1999), Lloyd (1969, 1970a, 1970b, 1970c), Pilsbry (1946).



***Oxychilus cellarius* (Müller, 1774):** Cellar Glass-Snail

Shell small (mature width, 7–12 mm), depressed-heliciform, with the spire nearly flat, very glossy, translucent, pale amber brown, but slightly paler and more opaque around the umbilicus. Nearly smooth. Apertural lip thin. Umbilicus small, about 1/6 of the width of the shell.

The animal is pale blue-grey with a darker head and tentacles. Tiny brown flecks edge the side of the foot, and dense brown flecks encircle the pneumostome.

This species, intermediate in size between *O. alliarius* and *O. draparnaudi*, is most similar to the latter in that the spire is nearly flat. The shell of this species, besides being smaller than *O. draparnaudi*, is glossier and smoother, and the animal is also paler. Unlike *O. alliarius*, there is no garlicky odour.

Distribution: *O. cellarius* is native to western and central Europe and is now widely introduced to North and South America, South Africa, Australia, New Zealand and the Philippine Islands. In Scandinavia the species is synanthropic and predominantly near the coast, which suggests that it is introduced there. It also lives on the Azores in the Atlantic.

This species is widespread throughout most of temperate eastern North America and along the Pacific Coast north to British Columbia. It has also been found in Ontario, Quebec, New Brunswick, and Nova Scotia.

Habitat and ecology: *O. cellarius* is common in moist, shady places, such as under rocks, wood and vegetation, in gardens and on wasteland, and other disturbed habitats. Natural habitats in Europe include forests and cliff faces. These snails are omnivores, consuming tender green plants, dead plant material, fungi, carrion, and faeces, and preying on snails, slugs (and their eggs), sowbugs, and earthworms. The species is said to have an annual life cycle in England.

Selected references: Barker (1999), Cameron (2003), Dundee (1974), Ellis (1969), Forsyth (1999, 2004), Giusti and Manganelli (1997), Kerney (1999), Kerney and Cameron (1979, 1999), Lloyd (1970c), Pilsbry (1946), Rigby (1963).

***Oxychilus draparnaudi* (Beck, 1837):** Dark-Bodied Glass-Snail

Shell medium-sized (mature width, 11–16 mm), depressed-heliciform, with the spire nearly flat, somewhat glossy, translucent, pale amber brown or brown, and slightly paler and more opaque around the umbilicus. Incremental lines and wrinkles evident. Last whorl rapidly enlarging. Apertural lip thin. Umbilicus small, about 1/6 of the width of the shell.

O. cellarius has a smaller, more polished shell, and the animal is paler. Animals of *O. alliarius* are dark-bodied like *O. draparnaudi* but shells are smaller when adult and with more slowly expanding whorls. The body, including the mantle, is dark blue-black. The head and tentacle are blue-grey. Unlike *O. alliarius*, this species does not produce a garlicky odour when disturbed.

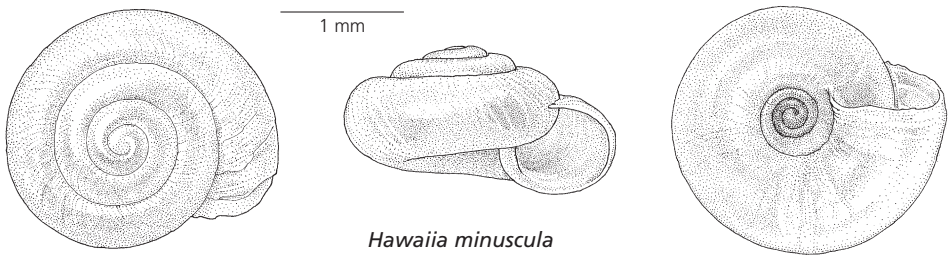
Distribution: *O. draparnaudi* is native to Western Europe and the Mediterranean region. It is introduced to Russia, southern and North Africa, parts of Asia, Australia, New Zealand, and North America. In Canada this is a common species in southern Ontario and southwestern British Columbia and is also known from Quebec, New Brunswick, Nova Scotia, and Newfoundland.

Habitat and ecology: This species lives in sheltered, shaded places in gardens, along roadsides, and in some regions, such as southern Ontario, it is found in woodlands. Snails are gregarious under plants, wood and debris. In southern England, populations are strongly synanthropic but in the south are also present in wilder habitats, including woodlands, on sea cliffs, and around rocky outcrops.

Like other *Oxychilus* species, this is an omnivore, feeding on plants, roots, faeces, earthworms, fungi, and snails and slugs. It is often described as an aggressive predator that is capable of reducing populations of native snails. A population in France was reported to have an annual life cycle, although another source indicates that the species reaches maturity in two years.

Synonym: *Oxychilus lucida* (Draparnaud).

Selected references: Barker (1999), Cameron (2003), Dundee (1974), Ellis (1969), Forsyth (1999, 2004), Frest and Rhodes (1982), Giusti and Manganelli (1999), Kerney (1999), Kerney and Cameron (1979, 1999), Pilsbry (1946).



Family Pristilomatidae

Genus *Hawaiiia*

Shell minute (maximum width, 3 mm), depressed-heliciform, translucent white, grey-white or colourless, shining. Spire conical; whorls 3–3½. Fine incremental striae. Umbilicus moderately broad. Compare with *Lucilla* (p. 62), with which it is practically indistinguishable.

This genus, consisting of a few species, occurs across central and eastern North America and also northeastern Asia. Outside of these areas, one species, *H. minuscula*, is introduced to many places worldwide including Hawaii, the Caribbean, and greenhouses in Europe. While this species is considered native to Canada, it is decidedly synanthropic.

Hawaiiia minuscula (A. Binney, 1841), Southeastern Gem Native

Selected references: Pilsbry (1946), Schileyko (2003a).

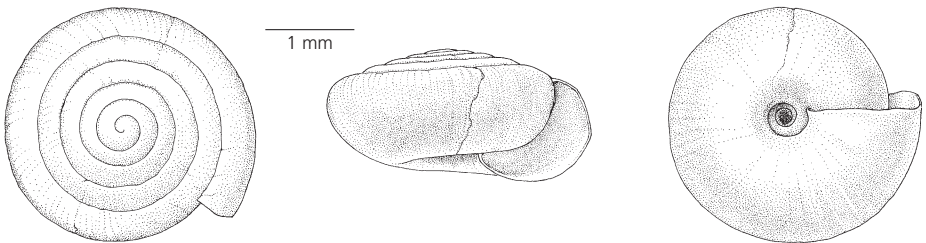
Genus *Paravitrea*

Shell minute to small (mature width, 3–7 mm), depressed-heliciform or nearly discoid, spire nearly flat or slightly conical; whorls closely coiled; shell colourless or pale yellow-brown, very thin-shelled, translucent, shining; Lip thin, simple. There are rows of denticles or ridge-like barriers, placed at intervals inside the last whorl; these are reduced or absent in adults and may not be visible inside the aperture. Umbilicus present.

There are about 41 species of *Paravitrea* in the eastern temperate and subtropical parts of North America. At least one species lives in Canada, in the region from southern Ontario east to Nova Scotia:

Paravitrea multidentata (A. Binney, 1840), Dentate Supercoil Native

Selected references: Pilsbry (1946), Schileyko (2003a).



Paravitrea multidentata

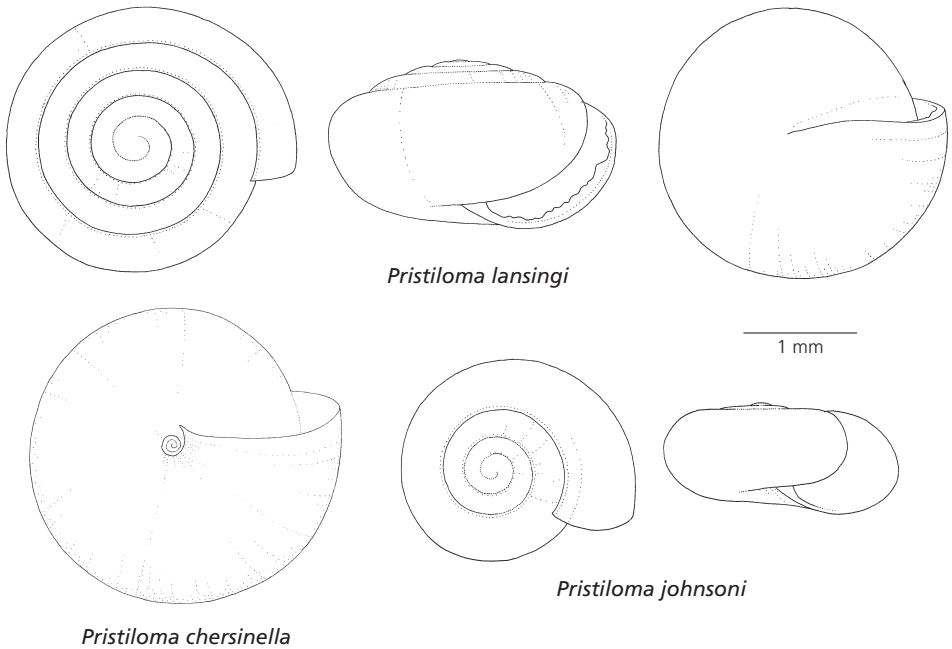
Genus *Pristiloma*

Shell minute (mature width, 3–5 mm), depressed-heliciform or discoid, spire nearly flat to conical, with whorls closely coiled in most; clear, white or yellow- to red-brown, smooth or with axial riblets, shining, thin-shelled, translucent, and shining. Lip thin, simple, but with a denticulate rib present inside the aperture in one Canadian species (*P. lansingi*). Umbilicus absent in most, but narrowly open in one of our species (*P. chersinella*).

There are eight species in western North America, from the Arctic south to California, and one species in the Russian Far East and Japan. Five forest-dwelling species occur in British Columbia:

- Pristiloma arcticum* (Lehnert, 1884), Northern Tightcoil Native
- Pristiloma chersinella* (Dall, 1866), Black-Foot Tightcoil Native
- Pristiloma johnsoni* (Dall, 1895), Broadwhorl Tightcoil Native
- Pristiloma lansingi* (Bland, 1875), Denticulate Tightcoil Native
- Pristiloma stearnsii* (Bland, 1875), Striate Tightcoil Native

Selected references: Forsyth (2004), Pilsbry (1946), Schileyko (2003a).



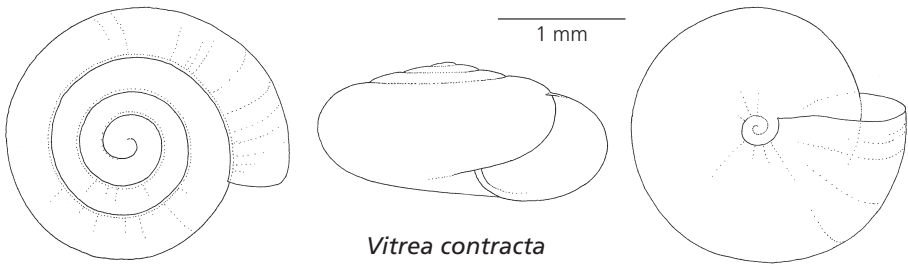
Genus *Vitrea*

Shell minute (maximum width, 5.3 mm), depressed-heliciform or nearly discoid, translucent white or colourless, shining. Spire flat to low-conical; whorls 4–7. Nearly smooth with weak incremental striae. Umbilicus narrow or altogether closed. There are no denticles or barriers inside the last whorl as in *Paravitrea*.

This genus is native to Europe and North Africa with some 50 or more species. There is one species introduced to Canada:

Vitrea contracta (Westerlund, 1871), Contracted Glass-Snail Introduced

Selected references: Barker (1999), Schileyko (2003a).



***Vitrea contracta* (Westerlund, 1871):** Contracted Glass-Snail

Shell minute (maximum width, 2.6 mm), thin, shining, translucent, colourless or opaque white (in dead shells). Spire low, showing about 4½, nearly smooth, tightly coiled whorls; with weak incremental striae. Aperture narrowly crescent-shaped and without denticles inside. Umbilicus small, about ¼ of the width of the shell.

Among the native Canadian snails, *V. contracta* is most similar to species of *Paravitrea* and *Pristiloma*. *Paravitrea multidentata* (p. 73), a native of northeastern North America, is pinkish in colour and has radial barriers or clusters of small denticles inside the last whorl; the whorls are also more tightly coiled. Most species of *Pristiloma* have pale red-brown or yellow-brown shells without an umbilicus. *V. crystallina* (Müller, 1774), the Crystal Snail, not yet known from North America but introduced to New Zealand, is larger (maximum width, 4 mm), with a slightly broader last whorl and less round (more eccentric) umbilicus.

The body is pale tan to ivory white. The ocular tentacles are translucent with black eye spots.

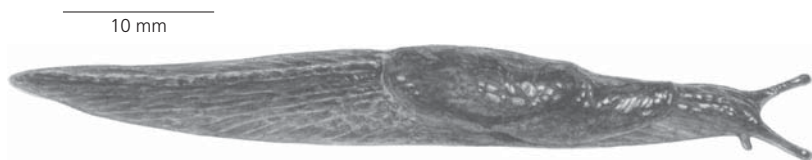
Distribution: *Vitrea contracta* is a widespread species across Europe from Iceland and Scandinavia south to the Iberian Peninsula and east to Ukraine and Greece. It is also found in Asia Minor and North Africa.

It was likely first collected in Canada from the Rosedale Ravine in Toronto in 1953. While the species has not been found there recently, we suspect that there are still populations present in the Toronto area or perhaps elsewhere in southern Ontario. In British Columbia, *V. contracta* is common around Metro Vancouver, on southern Vancouver Island north to Nanaimo, and on some of the smaller islands in the Strait of Georgia. A single shell was found in 2004 in the village of Queen Charlotte on Graham Island (Queen Charlotte Islands). In the United States, it has been reported from California and Washington State.

Habitat: In British Columbia this species has been found in gardens and open wasteland, under ivy, in leaf litter, and under rocks and logs. In Europe, these snails live in grasslands and woodlands, around cliffs, in caves, in scree slopes, and in stone walls. The species is often associated with dry, calcareous habitats.

A related species, *V. crystallina*, is an omnivore, eating detritus and preying on other small snails.

Selected references: Forsyth (1999, 2004), Cameron (2003), Kerney (1999), Kerney and Cameron (1979, 1999), Roth (1977), Roth and Pearce (1984).



Milax gagates

Family Milacidae

Genus *Milax*

Large slugs (maximum length, about 70 mm), with the pneumostome behind the midline of the mantle. Mantle finely granular, with a U-shaped groove that opens backwards. Keel extending the entire length of the tail. Shell internal and consisting of a thin, ovate, white plate.

The genus consists of 12 species ranging from the British Isles east to the Caucasus Mountains. There is at least one introduced species in Canada:

Milax gagates (Draparnaud, 1801), Greenhouse Slug Introduced

Selected references: Barker (1999), Pilsbry (1948), Schileyko (2003a), Wiktor (2001a).

***Milax gagates* (Draparnaud, 1801):** Greenhouse Slug Plate 1

A large (maximum length, 50–60 mm) slug, brown or dark grey. Keel prominent, conspicuously truncate. Sole grey-white. Rim of the pneumostome not pale but the same colour as the surrounding skin. Mucus clear.

Another species, *M. nigricans* (Philippi, 1836), the Black Keel-Slug — said to be introduced to Ontario by Wayne Grimm but unconfirmed — differs by its usually deep black colour and anatomical features. A related species, *Tandonia budapestensis* (Hazay, 1881), the Budapest Slug, has been recently found in Washington, D.C. and Philadelphia (Reise *et al.* 2006). *T. budapestensis* is a more slender slug, with pale-coloured keel, and that when at rest, often curls its body into a ‘C’ shape.

Distribution: *M. gagates* is native to the coastal western Mediterranean region, the Canary Islands, and perhaps western Europe. Its spread north in Europe has been aided by humans, and it has certainly been introduced to northern European countries, including Germany, Scandinavia and Finland.

In Canada this species was found in Nova Scotia in the early 1960s. Wayne Grimm found it in greenhouses near Ottawa, but we have not seen specimens to confirm this. The species is also unconfirmed from British Columbia, where it was said to have been introduced. Populations in the United States are scattered, but this species is known from New England to Florida and west along the Gulf Coast to Louisiana; it is also present on the west coast in California and Washington State. Elsewhere it has been introduced to Mexico, South America, Bermuda and several other islands in the Atlantic and Pacific oceans, New Zealand, Australia, Japan and South Africa.

Habitat and ecology: *M. gagates* lives mainly in gardens and greenhouses where introduced. Where native, these slugs are found under cover in open woods, thickets, and coastal headlands. They are often subterranean and live in hollows in the soil, or under vegetation and leaf litter. It can be a serious pest in gardens, fields, and greenhouses because it feeds on seedlings and root vegetables. However, it is intolerant of freezing temperatures and requires shelter to over-winter and may not be well adapted to the Canadian climate. Activity patterns of a New Zealand population suggest that this species has a six-month life cycle there.

Selected references: Barker (1999), Ellis (1969), Fox (1962), Hanna (1966), Kerney (1999), Kerney and Cameron (1979, 1999), Pilsbry (1948), Quick (1960), Wiktor (1987).

Family Vitrinidae

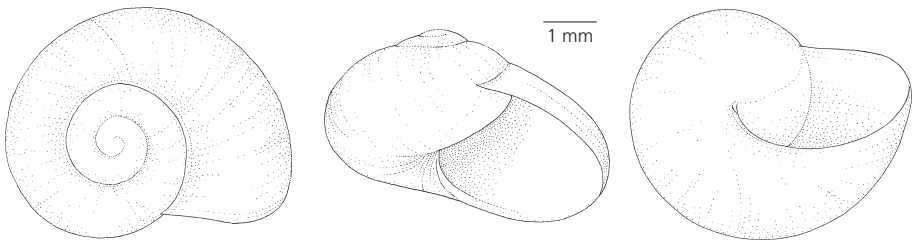
Genus *Vitrina*

Shell small (maximum width, 6 mm), very thin, translucent, shining, colourless or very pale green-yellow. Whorls 3 or 3½, rapidly enlarging so that the spire is small in comparison to the last whorl. Aperture very large. No umbilicus. The animal is large but can retract into its shell. When crawling, a conspicuous lobe of the mantle extends over the upper surface of the shell.

Vitrina is Holarctic and has only a few species. In Canada there are two native boreal-alpine species. Both of these occur in open habitats and may be sometimes be found in association with introduced snails and slugs.

- Vitrina angelicae* Beck, 1837, Eastern Glass-Snail Native
- Vitrina pellucida* (Müller, 1774), Western Glass-Snail Native

Selected references: Forcart (1955), Forsyth (2004), Pilsbry (1946), Schileyko (2003b).



Vitrina pellucida

Family Limacidae

Genus *Lehmannia*

Medium-sized to large slugs (maximum length, about 80 mm), thin-skinned and watery, with the pneumostome positioned in the posterior half of the mantle. Mantle with a pattern of concentric ridges. Keel short but weakly developed. Shell internal, plate-like.

The genus consists of 16 species in Europe and North Africa. Two species occur in Canada:

- Lehmannia marginata* (Müller, 1774), Tree Slug Introduced
- Lehmannia valentiana* (Férussac, 1822), Threeband Gardenslug Introduced

Selected references: Barker (1999), Schileyko (2003b), Wiktor (2001a).

***Lehmannia marginata* (Müller, 1774):** Tree Slug

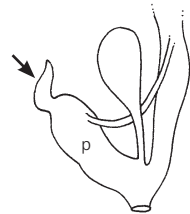
A large slug (maximum length, 60–80 mm), thin-skinned and somewhat translucent, tan to greyish tan with a dark smudge down the middle of the back and conspicuous dark lateral bands. Mucus watery.

This species most closely resembles *L. valentiana* whose longitudinal lines on the sides are comparatively more ventral, and whose habits are more synanthropic. The species are best distinguished anatomically: in *L. marginata* the penial appendix is tapering, while that of *L. valentiana* is cylindrical or slightly bulbous. *L. marginata* also differs

Comparison of the Genitalia of *Lehmannia* Species in Canada

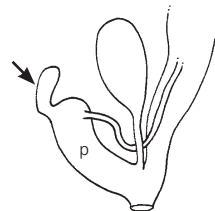
Lehmannia marginata

- Penis (p) with the appendix (at arrow) tapering



Lehmannia valentiana

- Penis (p) with the appendix (at arrow) cylindrical or slightly bulbous



from *L. valentiana* by having a specialized radula (beyond the scope of this guide — see Chichester and Getz 1973).

Distribution: This species is native to Europe and ranges north to southern Scandinavia, south to the Iberian Peninsula and east to Lithuania, Poland, and Ukraine. It has been introduced to Australia and Newfoundland.

This species has been known from the island of Newfoundland for many years and was first recorded there in the 1930s. Although there are reports in the literature of this species from other places in North America, all of these appear to be misidentified *L. valentiana* (see below).

Habitat and ecology: In the wild these slugs prefer exposed habitats on vertical surfaces, such as cliffs and tree trunks. These slugs feed almost exclusively on lichens, which accounts for the specialized radular teeth.

Synonyms: *Limax marginatus*, but see the next species.

Selected references: Brooks (1936), Brooks and Brooks (1940), Cameron *et al.* (1983), Ellis (1969), Kerney (1999), Kerney and Cameron (1999), Van Regteren Altena (1950).



Lehmannia valentiana

Lehmannia valentiana

(Férussac in Férussac & Deshayes, 1822): Threeband Gardenslug

Plate 2

A large slug (maximum length, about 70 mm), thin-skinned and somewhat translucent, pale yellow-grey to pale yellow-violet, usually with a brown or grey lateral band on either side of the body (and sometimes with another set of weaker bands below these) and mantle also banded. The bands may be much paler in some individuals than others. Sole pale grey. Mucus watery, clear.

This species is most similar to *L. marginatus* (see above). *Deroceras*, *Limax*, and *Limaculus*, which all have the fingerprint-like ridges on the mantle, differ by lacking bands on the mantle and by anatomical characters. For a comparison of the genitalia of the two *Lehmannia* species in Canada, see p. 79.

Distribution: Although native to the Iberian Peninsula, the Azores and Madeira (and generally around the Mediterranean), this species has now spread through much of Europe, east to Romania and north to Scandinavia.

This species is frequently encountered living out-of-doors on southern Vancouver Island and in Metro Vancouver. In Manitoba and Ontario the species is usually found living in greenhouses, but one individual was found in 2008 in an abandoned quarry in Grenville County near Ottawa.

L. valentiana is also introduced to South America, South Africa, Australia, New Zealand, several southern Pacific islands, China, and the United States. In the U.S., the species is known from the southeastern states, plus Kansas, New York, Michigan, New Jersey, Massachusetts, Pennsylvania, Missouri, Oklahoma, Ohio, Colorado, Arizona, California, Washington and Hawaii. Many of these occurrences, especially from the northeastern states, are in greenhouses.

Habitat and ecology: *L. valentiana* lives in gardens or on disturbed ground, and as already mentioned, is common in greenhouses. In New York, where *L. valentianus* was well established by 1960, the species was nevertheless closely associated with greenhouses but still could survive out-of-doors. These quick-moving slugs are often gregarious and shelter in dark, moist places under boards and other cover. In Victoria this species is common in backyard compost bins. It has now apparently infiltrated forested habitats in the southeastern U.S.

Synonyms: *Limax valentianus* (Férussac), *Limax poiriei* Mabille. In most older North American literature, *Lehmannia valentiana* was mistaken for *Lehmannia marginata*.

Selected references: Barker (1999), Forsyth (2001, 2004), Kerney (1999), Kerney and Cameron (1979, 1999), Pilsbry (1948, as *Limax marginatus*), Waldén (1962).

Genera *Limax* and *Limacus*

Large (length to 200 mm) slugs having a mantle marked with fine concentric grooves, a pneumostome behind the mid-line of the mantle, and a keel only near the end of the tail. The two genera are separated from each other by anatomical characters, but the species of *Limax* and *Limacus* in this book are distinguishable by their outward appearance. Shell internal, plate-like. Illustrated on next page.

The genus *Limax* has about 15 species native to Europe, with at least one species introduced to Canada; *Limacus* (sometimes treated only as a subgenus of *Limax*) is native to Western Europe and the Mediterranean region and has two species.

Limacus flavus (Linnaeus, 1758), Yellow Gardenslug Introduced
Limax maximus Linnaeus, 1758, Giant Gardenslug. Introduced

Selected references: Barker (1999), Pilsbry (1948), Schileyko (2003b), Wiktor (2001a).

A large slug (maximum length, 75–100 mm); pale yellow with grey mottling. Mantle also mottled with grey. Sole yellow. Tentacles blue tinged. There is a short keel in the tail region. Mucus clear or yellow.

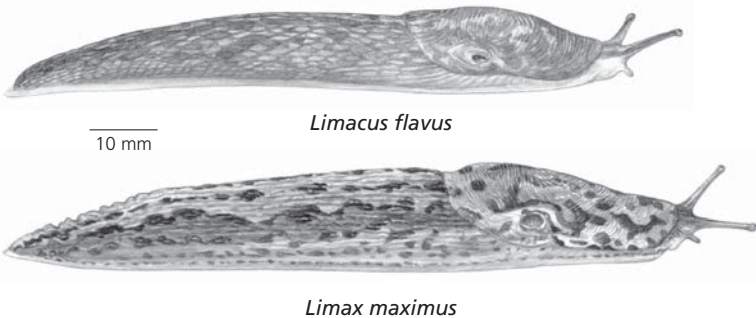
Distribution: *L. flavus* is now widespread in Europe but probably originated in the Mediterranean region and certainly has been introduced in historical times to northern and eastern Europe, including southern Scandinavia, the Baltic States, Ukraine and European Russia. The species is also established outside of Europe, in South Africa, Ghana, Japan, China, Australia, New Zealand, several south Pacific islands, the United States, and Canada.

L. flavus is apparently rare in southwestern British Columbia and the only verified record from the province known to us was in a suburban garden on the Saanich Peninsula, near Victoria. In Ontario this species was found by Wayne Grimm in greenhouses but, while we have little reason to doubt that the species occurs in Ontario, we have not seen any specimens. In the United Kingdom where there is an excellent and long-established network of terrestrial mollusc ‘recorders’, the species is probably under-reported due to its secretive, nocturnal habits, even though it is large and gregarious.

Habitat and ecology: This species lives in gardens and greenhouses and on wasteland; in Europe it is also reported from cellars, crevices of walls, outhouses, damp basements, farmyards, and woodlands. These slugs eat root vegetables and other green and decaying plant material, lichen, and fungi. It is said to occasionally climb trees at night to feast on fruit. This species shows strong homing behaviour, with individuals returning after each foray to a particular spot.

Synonym: *Limax flavus* Linnaeus.

Selected references: Barker (1999), Cameron *et al.* (1983), Chelazzi *et al.* (1988), Ellis (1969), Forsyth (2004), Hanna (1966), Kerney (1999), Kerney and Cameron (1979, 1999), Pilsbry (1948), Quick (1960).



A large slug (maximum length, 100–200 mm), yellowish grey or light brownish grey, usually heavily spotted with black or dark brown, which often coalesce to form irregular lateral bands; mantle with large blackish spots, and with a fine finger-print-like pattern of grooves and ridges. Tentacles reddish brown. Pneumostome behind the midline of the mantle. Keel on about the last $\frac{1}{3}$ of the tail. Mucus clear.

This species is larger than *Limacus flavus*, without yellow spots, and the tentacles are tinged with red.

Distribution: *L. maximus* is probably native to the region surrounding the Mediterranean, including North Africa. It is widespread in Europe and occurs east to Turkey, European Russia, and the Caucasus Mountains. Records from northern and eastern European countries, from Scandinavia and the Baltic states, east to the Ukraine are introductions. Outside of Europe it is introduced to South Africa, Australia and New Zealand, South America, Mexico, the United States, and Canada. In the U.S., *Limax maximus* is known from Hawaii, southeast Alaska, Arizona, Washington, Oregon, California, Kansas, Maryland, Arizona, Utah, Texas, and Colorado.

This is a common introduced species in British Columbia where it occurs along the south coast and in the central Cariboo (north to Quesnel), Okanagan and Kootenay regions. It is widespread in southern Ontario (north to the Bruce Peninsula, and east to the Thousand Islands), and is found in Montreal, but is believed to be rare and scattered in the Maritime Provinces and Newfoundland.

A similar species, *Limax cinereoniger* Wolf, 1803, the Ash-Black Slug, was said by Wayne Grimm to be found in a garden and cellar in Wolfville, Nova Scotia. We have not, however, been able to confirm that this species occurs, or once lived, in Canada.

Habitat and ecology: This is another common species in gardens, along roads, in wooded areas adjacent to human settlement, on wasteland, and in other disturbed habitats. *L. maximus* eats mostly dead vegetation and fungi, but roots, fruit, and leafy crops form a small part of their diet.

This species, like *Limacus flavus*, shows homing behaviour and returns during the day to a specific spot under debris, stones, wood or vegetation. They are largely nocturnal and emerge at night and during wet weather. Mating is also at night, and copulation concludes with the paired, intertwined bodies being suspended by a 'rope' of mucus from an overhang. Individuals can live for three to four years.

Selected references: Barker (1999), Barker and McGhie (1984), Cameron *et al.* (1983), Ellis (1969), Forsyth (2004), Hanna (1966), Kerney (1999), Kerney and Cameron (1979, 1999), Kew (1901), Pilsbry (1948).

Family Agriolimacidae

Genus *Deroceras*

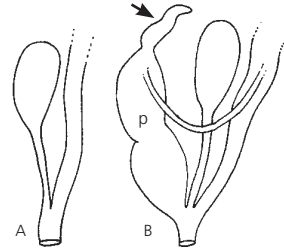
Medium-sized slugs (maximum length, 45 mm), either thick-skinned or thin-skinned and watery. Mantle with concentric ridges with the nucleus of these lying to the right of the midline above the pneumostome. Tail obliquely truncate; keel on tail only present at the posterior end. Mucus watery or thick and sticky, and clear or milky-white. Shell internal, plate-like. Dissections to examine the reproductive system are required to identify species that are indistinguishable by external characters.

This large genus of slugs comprises about 120 species across Eurasia and North America, south to the Central American tropics. The centres of diversity is in the Mediterranean

Comparison of the Genitalia of *Deroceras* species in Canada*

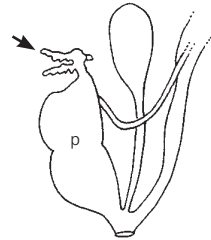
Deroceras laeve

- Genitalia aphyallic (A) or Euphallic (B)
- Penis (p), when present, with a simple appendix (at arrow)



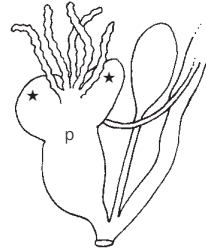
Deroceras reticulatum

- Penis (p) with an irregularly branched appendix (at arrow)



Deroceras panormitaum

- Penis (p) strongly bilobed (★), with a cluster of 4–6 slightly crimped, finger-like structures



**Deroceras hesperium*, a native, poorly understood west coast species, is not included, but the genitalia look similar to a euphallic *D. laeve*. See Pilsbry (1948) and Wiktor (2000) for more information.

near region, and in North America there are few native species, but among them is the nearly cosmopolitan *D. laeve*. This is a small, dark brown to blackish species with clear mucus and simple genitalia. Aside from living in natural habitats *D. laeve* is also strongly synanthropic, which suggests that some populations may be introduced.

- Deroceras hesperium* Pilsbry, 1944, Evening Fieldslug Native
- Deroceras laeve* (Müller, 1774), Meadow Slug (Plate 3) Native; also introduced?
- Deroceras panormitanum* (Lessona & Pollonera, 1882), Longneck Fieldslug. Introduced
- Deroceras reticulatum* (Müller, 1774), Grey Fieldslug Introduced

Selected references: Barker (1999), Pilsbry (1948), Reise (2007), Schileyko (2003b), Wiktor (2000).

***Deroceras panormitanum* (Lessona & Pollonera, 1882):**

Longneck Fieldslug

Plate 3

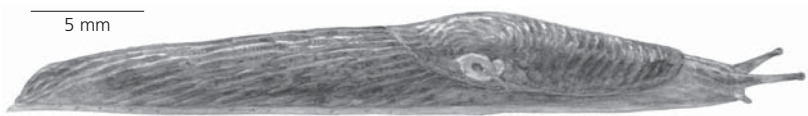
A medium-sized slug (maximum length, 30–40 mm), brown to grey-brown, sometimes with small darker flecks. Skin thin, rather translucent. Mucus clear. The ‘neck’ is long, and when the animal is fully extended, it is up to ½ to ⅓ of the entire length.

This species, which could be confused with *D. laeve*, is best distinguished by its internal anatomy. The end of the penis is decidedly two-lobed and has cluster of 4–6 slightly crimped, finger-like appendages. The lining of the visceral cavity is also darkly pigmented.

Distribution: Originally a native to Mediterranean Europe, *D. panormitanum* is now widespread and occurs north to Scandinavia and east as far as Poland. The species is widely introduced to North America and is now common on the Pacific Coast from southern B.C. to California. Elsewhere in Canada, it has been reported from Ontario



Deroceras laeve



Deroceras panormitanum

and Quebec. It was found in 1994 near Kingston, Ontario by Wayne Grimm. *D. panormitanum* is now widely introduced around the world, including Australia, New Zealand, South Africa, and parts of South America.

Another species, *D. sturanyi* (Simroth, 1894), the Hammer Fieldslug, was said to be living in southern Ontario greenhouses by Wayne Grimm. We have been unable to verify these identifications. The species looks most like *D. laeve* and *D. panormitanum* but is characterized by its swollen, hammer-shaped penis that lacks an appendix or other appendages.

Habitat and ecology: These slugs are found in gardens, in greenhouses, on wasteland, and in other disturbed habitats. They feed on decaying and green plant material and can be a pest. This species moves rapidly for a slug. They exhibit strong intraspecific aggression by way of tail lashing, biting and cannibalism, even when food is available. Reproduction is year round in Britain and New Zealand.

Synonyms: *Agriolimax caruanae* Pollonera, *Deroceras caruanae* (Pollonera).

Selected references: Barker (1999), Cameron *et al.* (1983), Forsyth (2004), Giusti and Manganelli (1990), McDonnell *et al.* (2009), Kerney (1999), Kerney and Cameron (1979, 1999), Pilsbry (1948), Quick (1960), Reise *et al.* (2006), Van Goethem and De Wilde (1985), Wiktor (2000, 2001b).

***Deroceras reticulatum* (Müller, 1774):** Grey Fieldslug

Plate 3

A medium-sized slug (maximum length, 35–50 mm), grey, cream-coloured, or slightly pink-grey, usually with darker brown or grey flecks; sometimes darkly pigmented or nearly without darker flecks. Thick-skinned and opaque; strongly reticulate. Mucus thick and sticky, and becoming milky when the animal is irritated.

This species is distinguished from the native *D. laeve* and *D. panormitanum* by its larger size, thicker skin, pale greyish colour, slower movements, and its ability to produce sticky, milky-coloured mucus when bothered.

Distribution: *D. reticulatum* is now nearly cosmopolitan due to introductions. This is an extremely widespread and common species. It is ubiquitous in agricul-

5 mm



Deroceras reticulatum

tural areas of southern Canada, and there are scattered records in settlements and campsites through the boreal forest. It is found north to the clay belts of Ontario and Quebec.

Another similar species, *D. agreste* (Linnaeus 1758), the Field Slug, was said by Wayne Grimm to be thriving in a brushy, sparsely forested woodlot in Ottawa in 1975. We are able to confirm this record. Pale forms of *D. reticulatum* are not separable from *D. agreste* on the basis of external appearance; the latter species has a simple, rather than branched penial appendix.

Habitat and ecology: *D. reticulatum* is likely the most serious plant pest in North America, eating live plant material. The species is ubiquitous and generally abundant in fields and gardens, but also in practically every other anthropogenic habitat, including roadsides, forest campsites, and wasteland. It is rarely found in completely undisturbed habitats. Toads, frogs, shrews, and ground beetles are known predators. Slugs mate and reproduce year round. This species has an annual life cycle: eggs or very young animals survive through winter, hatch in spring, and animals reproduce through late summer and autumn, then die.

Synonyms: *Agriolimax reticulatus* (Müller), but in much of the older literature, this species was not always differentiated from *Deroceras agreste* (or *Agriolimax agrestis*).

Selected references: Barker (1999), Cameron *et al.* (1983), Ellis (1969), Forsyth (2004), Getz (1959), Hanna (1966), Kerney (1999), Kerney and Cameron (1979, 1999), McDonnell *et al.* (2009), Pilsbry (1948), Quick (1960), Wiktor (1989, 2000). In addition to these references, there is a large body of literature due to its economic importance as a pest species.

Family Boettgerillidae

Genus *Boettgerilla*

Small, pale coloured slugs (maximum length, 40 mm), with the body exceptionally slender and worm-like in form. Keel present along the entire length of the tail. Mantle with a groove along the right side. Shell internal, plate-like, and somewhat irregular in shaped.

This genus comprises two, largely subterranean species, which are native to the Caucasus Mountains. One species, *B. pallens*, is now widely introduced by humans across Western Europe and has recently been found in Canada and South America.

Boettgerilla pallens Simroth, 1912, Wormslug. Introduced

Selected references: Reise *et al.* (2000), Schileyko (2003b), Wiktor (1989).

A medium-sized, very slender slug (maximum length, 30–40 mm), translucent and pale, yellow-grey, grey, or blue-grey slug; back, mantle, and head darker grey; sole of foot yellow-grey. Tail with a keel extending from the mantle to the tip of the tail. Juveniles are paler than adults and almost white.

The unusual combination of pale colour and extremely slender form of this burrowing slug is not exhibited by any other species, including other burrowers.



Boettgerilla pallens

Distribution: This species, native to the Caucasus Mountains of southeastern Europe, is now widely introduced over much of Central and Western Europe north to coastal Scandinavia and southwest to the Pyrenees. Its spread has been remarkably quick, within the last few decades.

Outside of Europe, *B. pallens* has only recently been discovered on southern Vancouver Island and in the Vancouver area. It has also recently been found in Colombia (South America).

Habitat and ecology: This peculiar slug lives in gardens, greenhouses, semi-wild city parks, and nurseries, where it burrows deep into loose soil (down to 60 cm) and travels through earthworm burrows. It feeds on fungi, tender roots, decaying vegetation, carrion, and eggs of other gastropods. In Europe it has also successfully penetrated forests and other natural habitats.

Selected references: Forsyth (2004), Cameron *et al.* (1983), Colville *et al.* (1974), Gunn (1992), Hausdorf (2002), Kerney (1999), Kerney and Cameron (1979, 1999), Reise *et al.* (2000).

Family Arionidae

Genus *Arion*

Small to large slugs (maximum length 15–250 mm), with the mantle granular, the pneumostome forward of the midline of the mantle. No keel, except in juveniles of *Arion fasciatus* and related species. The shell consists of a few irregular granules inside the body, or is entirely absent.

The Palearctic genus *Arion* is comprised of some 20 or more species, with a number of these now widely spread throughout the world. As a rule, *Arion* species can be difficult to identify. There are sibling species that may not be separable by outward appearance. For convenience, these are treated as species groups here. It is strongly encouraged that the specialist literature (see Suggested References) be used when making identifications. As an introduction to the group, we first key out species and species groups using readily observed external characters (see opposite), then discriminate among closely similar species by genital characters.

Four species groups and another non-grouped species (altogether eight or nine species) are introduced into Canada:

Arion intermedius (Normand, 1852), Hedgehog Arion Introduced

Arion ater group:

Arion ater (Linnaeus, 1758), Black Arion Introduced; needs confirmation

Arion rufus (Linnaeus, 1758), Chocolate Arion Introduced

Arion fasciatus group:

Arion circumscriptus Johnston, 1828, Brown-Banded Arion Introduced

Arion fasciatus (Nilsson, 1823), Orange-Banded Arion Introduced

Arion silvaticus Lohmander, 1937, Forest Arion Introduced

Arion hortensis group:

Arion distinctus Mabille, 1868, Dark-Face Arion Introduced

Arion hortensis Férussac, 1819, Garden Arion Introduced

Arion subfuscus group:

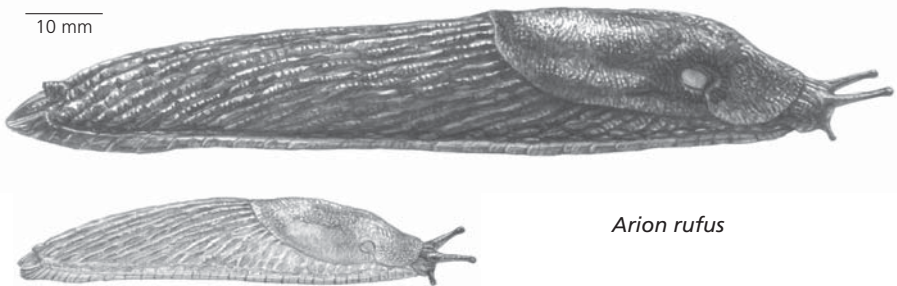
Arion subfuscus (Draparnaud, 1805), Dusky Arion Introduced

Selected references: Barker (1999), Kerney and Cameron (1979), Schileyko (2007), Wiktor (1989). The key by Cameron *et al.* (1983) is particularly useful for field identifications.

Initial Key to *Arion* Species or Species Groups Using Field Characters*

- 1a Adult slugs about 15 mm when extended. Tubercles on back having soft points. Skin pale yellow-grey with head and tentacles darker grey. Lateral bands usually faint *Arion intermedius*
- 1b Adults > 20 mm long when extended. Tubercles without points, as in 'a', but more elongate and bluntly rounded. Skin variously pigmented, with or without lateral bands 2
- 2a Body bell-shaped (∩) in cross-section when contracted 3
- 2b Body less bell-shaped and tubular (⊔) in cross-section when contracted *Arion hortensis* group
- 3a Adults > 70 mm long. Black, orange or brown; lateral bands not present in adults. Tubercles very coarse. Responds to disturbance with a twisting and rocking motion *Arion ater* group
- 3b Adults < 70 mm. Grey, orange or brown; lateral bands usually strongly marked. Tubercles finer. No twisting-rocking motion 4
- 4a Skin generally grey or brown-grey, often with a yellow flush. Body mucus colourless. Capable of contracting into nearly a hemispherical shape (seen laterally) *Arion fasciatus* group
- 4b Skin generally brown, rusty orange or red-brown, or rarely yellowish. Body (and foot) mucus yellow or orange. Incapable of contracting into a hemispherical shape *Arion subfuscus* group

*This key may not correctly identify juvenile individuals.



ARION ATER GROUP

***Arion ater* (Linnaeus, 1758):** Black Arion

***Arion rufus* (Linnaeus, 1758):** Chocolate Arion

Plate 4

Large, thick-skinned slugs (mature length, 100–200 mm); black, shades of brown, or orange. Young individuals are paler and often with darker lateral bands. Body, when contracted, very highly arched. Tubercles large and coarse. No keel. Foot fringe red, orange, yellow or grey and strongly marked by black or dark brown vertical bars. Sole all black or black with a light central band. Mucus clear.

As a group these slugs are recognized from other *Arion* by their robustness, colour and coarse granulation. Juveniles are problematic because they show colours and banding more often associated with smaller *Arion* species. *A. rufus* and *A. ater* are best separated by differences in their reproductive organs.

Distribution: These species are native to Western and Central Europe, with *A. rufus* originally more southern and *A. ater* more in the north. In Britain they apparently interbreed, and *rufus* is frequently treated as a subspecies of *A. ater*.

Outside of Europe, the *A. ater* group is introduced to North America. Here, until quite recently, all slugs fitting the description were called *A. ater*, so the distribution of the separate species of the group is poorly known. Scattered populations on the island of Newfoundland, in Quebec City, Sherbrooke, Montreal and environs, and in New England and northern New York were attributed to *A. ater*, but could be *A. rufus* instead.

There are well established populations along the Pacific Coast of North America, and in British Columbia and California there is only *A. rufus*. An individual, presumably *A. rufus*, was found in a residential neighbourhood in Canmore, Alberta, in 2008 (D. Lepitzki, personal communication).

Two additional, similarly large-bodied *Arion* species, *A. lusitanicus* Mabille, 1868 (Spanish Arion) and *A. flagellus* Collinge, 1893 (Durham Arion) were identified from Ontario by Wayne Grimm but have not been confirmed: *A. lusitanicus* was found near Kingston, Ontario, and in the Rosedale Ravine, Toronto, and in Quebec City and Montreal; and *A. flagellus* was said to occur in a single colony north of the Central Experimental Farm on Carling Avenue in Ottawa.

Habits and ecology: These slugs live in sheltered gardens, along roadsides and on wasteland, sometimes in large numbers. These and other species of slugs are frequently encountered at campgrounds in B.C. parks, having been transported there most probably on camping equipment such as tents. These are serious plant pests, readily devouring living plant material. They also consume decaying vegetation, fungi, faeces, and carrion.

Presumably as a means of defence, these slugs (both *Arion rufus* and *A. ater*) will contract into a high spherical form and twist and rock from side to side when disturbed. This behaviour is unknown for any other species of *Arion*. Reproduction is year round; they are annual or biennial.

Selected references: Cameron *et al.* (1983), Chichester and Getz (1973), Dundee (1974), Evans (1986), Forsyth (2004), Kerney (1999), Kerney and Cameron (1979, 1999), McDonnell *et al.* (2009), Quick (1947, 1960).

Comparison of the Genitalia of *Arion ater* and *A. rufus*

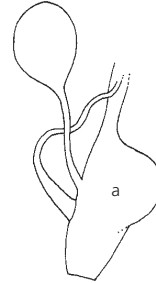
Arion ater

- Atrium (a) more slender and symmetrical



Arion rufus

- Atrium (a) larger, fatter and asymmetrical



ARION FASCIATUS GROUP

Arion fasciatus (Nilsson, 1823): Orange-Banded Arion

Plate 5

Arion circumscriptus Johnston, 1828: Brown-Banded Arion

Plate 4

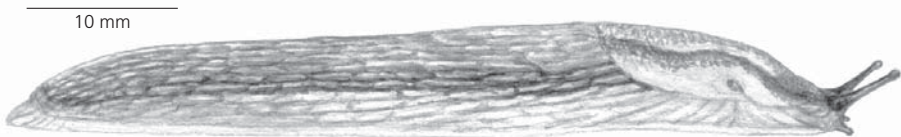
Arion silvaticus Lohmander, 1937: Forest Arion

Medium-sized slugs (mature length, 30–40 mm); grey overall: grey above, fading to grey-white on the sides below dark lateral bands. Mantle grey (with dark spots in *A. circumscriptus*). Body bell-shaped when contracted. A row of enlarged, paler tubercles on the tail emulate a keel. Foot fringe pale. Sole white. Mucus colourless or yellow.

The size, colouration, and row of enlarged tubercles that form a ‘false keel’ serve to distinguish this group of *Arion* slugs from others in this book. Species belonging to the *A. fasciatus* group are best separated by differences in their reproductive organs (next page). External pigmentation of the animals has been used in the past to distinguish these species, but a study in Europe has found that diet can affect the pigmentation of these slugs, which means that anatomical characters remain the most reliable means of separating these species. The dark black speckles present on the mantle of *A. circumscriptus* are still believed unique within the species group. However, recent work on the genetics of the group has given support for the idea that there is but one species (*A. fasciatus*).

Distribution: Species of the *Arion fasciatus* group are widely introduced to North America. Records were not always distinguished to species and only may be recorded as “*A. fasciatus*”.

All three species of the group are found in Ontario, Quebec, all of the Maritime provinces and Newfoundland, and judging by the literature, all are widespread in the temperate eastern U.S. Only *A. silvaticus* and *A. circumscriptus* are currently known from British Columbia, where the latter species is common in southern areas of the province. Slugs that were possibly *A. circumscriptus* were seen around the town site in Waterton Lakes National Park, Alberta, in 2008.



Arion fasciatus

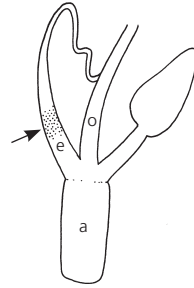
Habitat and ecology: These slugs live in disturbed habitats, such as gardens and weed lots and have penetrated natural areas. Like other members of the genus, they are pests, capable of doing much damage to crops and gardens. The species of the *Arion fasciatus* group reproduce predominantly by self-fertilization.

Selected references: Cameron *et al.* (1983), Chichester and Getz (1973), Dundee (1974), Geenen *et al.* (2006), Jordaens *et al.* (2002), Kerney (1999), Kerney and Cameron (1979, 1999), McDonnell *et al.* (2009), Pilsbry (1948), Rollo and Wellington (1975), Quick (1960).

Comparison of the Genitalia of the *Arion fasciatus* group

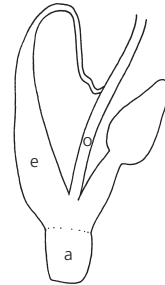
Arion circumscriptus

- Epiphallus (e) pigmented (arrow)
- Oviduct (o) relatively narrow
- Atrium (a) long, narrow, flattened in cross-section



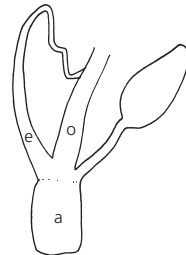
Arion fasciatus

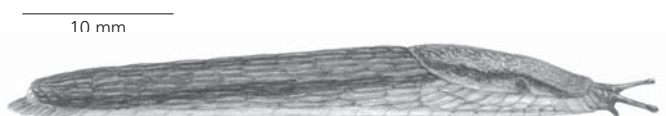
- Epiphallus (e) unpigmented but thick
- Oviduct (o) relatively narrow
- Atrium (a) short, nearly circular in cross-section



Arion silvaticus

- Epiphallus (e) unpigmented, relatively narrow
- Oviduct (o) relatively broad
- Atrium (a) of moderate length, flattened in cross-section





Arion distinctus

ARION HORTENSIS GROUP

***Arion hortensis* Férussac, 1819:** Garden Arion

***Arion distinctus* Mabile, 1868:** Dark-face Arion

Plate 5

Medium-sized slugs (maximum length, 25–35 mm), dark grey or blue-grey but sometimes with a brown tint. Lateral bands dark, with the right band usually surrounding the pneumostome. Tentacles blue-black or slightly red-grey. Body, when contacted, rounded rather than bell-shaped. No keel. Sole bright orange or yellow. Mucus yellow or pale orange-yellow.

The dark bluish pigmentation, the bright yellow mucus, and the rounded rather than bell-shaped cross-section distinguish species in this group from other *Arion* species in Canada. Although there can be some slight differences in pigmentation, species of this group (also including *A. owenii* Davies, 1979 and *A. occultus* Anderson, 2004, neither of which are known to be introduced) are best distinguished by their reproductive anatomy (see p. 96).

Distribution: Species of this group are found in western and southern Europe, but because of the individual species have only been recognized fairly recently, their ranges are still poorly known.

There are many literature records of “*Arion hortensis*” from North America, including Newfoundland, the Maritimes, Quebec, Minnesota, Michigan, Ohio, New York, Pennsylvania, Maryland, New Jersey, and New England, Washington and British Columbia. Most of these pre-date the recognition of multiple species in the *A. hortensis* group. In Canada, *A. distinctus* is verified from near Vancouver, southern Vancouver Island, near Ottawa and Kingston, and Halifax. In the U.S., it is known from California, and Pennsylvania. It also is found in New Zealand. *A. hortensis* is confirmed from the Vancouver area, as well as Michigan, Delaware and Pennsylvania.

Habitat and ecology: These slugs are common in sheltered, damp places in gardens, on wasteland, along overgrown roadsides, and in well-drained, shaded floodplains, living under plants, debris, in matted grass and in leaf litter. These slugs, like other *Arion* in this book, eat crop vegetables and can be serious pests. Both species reproduce by cross-fertilization. In England, mating occurs mostly during the fall and winter for *A. hortensis*, and predominately in the spring and summer for *A. distinctus*.

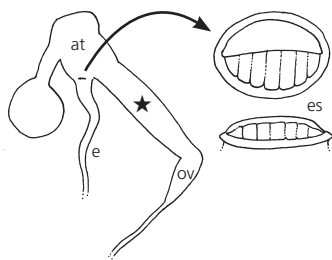
Synonyms: For *Arion hortensis*: *A. hortensis* sp. 'r' of Kerney and Cameron (1979). For *A. distinctus*: *Arion hortensis* sp. 'a' of Kerney and Cameron (1979).

Selected references: Anderson (2004), Backeljau (1985), Backeljau and Maquet (1985), Backeljau and van Beeck (1986), Barker (1999), Cameron *et al.* (1983), Davies (1977, 1979), De Wilde (1983, 1986), Forsyth (2004), Kerney and Cameron (1979, 1999), McDonnell *et al.* (2009), Pearce and Bayne (2003), Roth (1982a). There is also a large body of literature that pre-dates the separation of the species.

Comparison of the Genitalia of the *Arion hortensis* group in Canada*

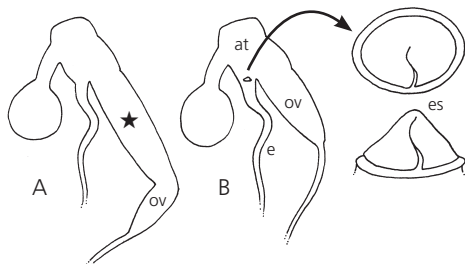
Arion hortensis

- Epiphallus structure (es)[†] flap-like, not completely covering the opening of the epiphallus. It is possible to look into the epiphallus (e) from the atrium (at) and see the membranes
- Oviduct (ov) tripartite, having a fleshy section (★)



Arion distinctus

- Epiphallus structure (es) conical — somewhat mushroom cap-shaped) — and covering the entire opening of the epiphallus
- Oviduct tripartite (A), having a fleshy section (★) or bipartite (B) without this additional section



*Adapted from Davies (1977) and Backeljau (1985). Not included are *A. owenii* and *A. occultus*, which are not known to be introduced to Canada.

[†] This is sometimes called the *verge*. It is located inside the atrium, and partially or fully covers the opening of the epiphallus.



Arion intermedius

***Arion intermedius* Normand, 1852:** Hedgehog Arion

Plate 5

A small slug (maximum length, 15–20 mm), pale yellow-grey, with the head and tentacle darker grey and either with or without faint lateral bands on the tail and mantle. Body, when contracted, not bell-shaped in cross-section. The tubercles on the back form soft, sharp points, when the animal is contracted. There is no keel. Foot fringe inconspicuous: pale and narrow. Sole, and mucus, yellow or pale orange-yellow.

The combination of its small size, pale yellowish colour, and characteristic tubercles are useful characters for recognition. Do not confuse adults of *A. intermedius* with juveniles of other *Arion* species that may have similarly pigmented skin.

Distribution: This species is native to Western Europe and occurs north to coastal Scandinavia and Iceland, south to the Iberian Peninsula and Italy, and east to Poland.

A. intermedius is common in southwest Ontario. It is also common in British Columbia, where it lives around Vancouver, Victoria and along the east coast of Vancouver Island and in the Queen Charlotte Islands. It is also introduced to several U.S. states, (including Washington, Idaho, Montana, California, New Mexico, Illinois, Maine, Maryland, New York and Hawaii), Colombia, Polynesia, New Zealand and North Africa.

Habitat and ecology: Like other introduced *Arion* in Canada, it can be found in moist, sheltered places in gardens, roadsides, fields, wasteland, thickets, hedgerows, and floodplains. This species was until recently thought to reproduce strictly by self-fertilization, but cross-breeding does (very rarely) occur. In New Zealand the species is known to have an annual life cycle.

Selected references: Bacheljau *et al.* (2008), Barker (1999), Cameron *et al.* (1983), Chichester and Getz (1973), Dundee (1974), Forsyth (2004), Kerney (1999), Kerney and Cameron (1979, 1999), McDonnell *et al.* (2009), Pilsbry (1948), Quick (1960), Reise *et al.* (2001).

ARION SUBFUSCUS GROUP

***Arion subfuscus* (Draparnaud, 1805):** Dusky Arion

Plate 5

Medium-sized slugs (maximum length, 50–70 mm), grey-brown to orange-brown, with dark brown lateral bands. Right lateral band usually surrounding the pneumostome. Body, when contacted, is rounded rather than bell-shaped. Tubercles elongate

and relatively small. No keel. Sole grey-white. Mucus pale yellow, orange, or rarely colourless.

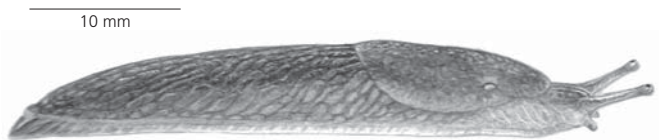
The rather large size, frequently orange pigmentation, yellow mucus, tubular (not bell-shaped) body, and inability to contract much serves to distinguish this group of *Arion* species from others in this book.

What was considered a single species, *A. subfuscus*, has recently been recognized to be a complex of at least two cryptic species: the true *A. subfuscus* and another species, *A. fuscus* (Draparnaud, 1801). The species are morphologically distinguished by the relative position of their genitalia relative to the digestive gland.

Distribution: These slugs live in Western Europe, including southern Scandinavia. The ranges of these two species are therefore poorly known. *A. subfuscus* is common and well-established in North America. This species was first found here in the vicinity of Boston in 1842. In Canada, *A. subfuscus* is known from British Columbia, Manitoba, Ontario and Quebec, east to the Maritime provinces, and Newfoundland. In the United States, it is found from New England south to North Carolina, Wisconsin, the Pacific Northwest, and California. Using DNA analysis, eastern U.S. populations were determined to be *A. subfuscus*; the same study did not find *A. fuscus* in any of the sampled North American populations.

Habitat and ecology: These slugs live in gardens, fields, thickets, and on wasteland. In some regions — in the eastern boreal forests from Manitoba to the Maritime Provinces, and throughout the northeastern United States — this species has penetrated into wild forested habitats, giving rise to the suggestion that it may be native to North America. *A. subfuscus* eats fungi, green plants, carrion, and faeces. It is considered a pest and damages crops and garden plants.

Selected references: Cameron *et al.* (1983), Forsyth (2004), Garrido *et al.* (1995), Kerney (1999), Kerney and Cameron (1979, 1999), McDonnell *et al.* (2009), Pilsbry (1948), Pinceel *et al.* (2004, 2005), Quick (1946, 1960).



Arion subfuscus



Prophysaon andersonii

Family Anadenidae

Genus *Prophysaon*

Medium-sized to large slugs (maximum length, 100 mm or more); pneumostome in front of the midline of the mantle. Mantle granular. Tail not sharply keeled. No mucus gland at the tip of the tail. Animal capable of self-amputation (autotomy) of the posterior end of the tail; this is usually marked by an oblique indentation and sometimes by a line on the sole of the foot. Shell plate-like and internal.

Restricted to western North America, from the Aleutian Islands, Alaska south to central California and east to northern Idaho, this genus has at least nine species, with four species occurring in Canada west of the continental divide:

- Prophysaon andersonii* (Cooper, 1872), Reticulate Taildropper (Plate 7). Native
- Prophysaon coeruleum* Cockerell, 1890: Blue-Grey Taildropper Native
- Prophysaon foliolatum* (Gould in A. Binney, 1851), Yellow-Bordered Taildropper . . . Native
- Prophysaon vanatta* Pilsbry, 1948, Scarletback Taildropper Native

Selected references: Forsyth (2004), Pilsbry (1948), Schileyko (2007).

Genus *Kootenaia*

Small slugs (maximum length, 9–14 mm), pneumostome a little posterior to the midline of the mantle. Mantle about ½ of the length of the body; with lumps and wrinkles. Tail not keeled. No mucus gland at the tip of the tail. No indentation and/or line on tail, as in *Prophysaon* (marking the the site of autotomy). Shell plate-like and internal. Not figured.

One species lives in western North America. It was originally described from northern Idaho but has since been discovered in southeastern British Columbia (K. Ovaska, personal communication) and in western Montana.

- Kootenaia burkei* Leonard, Chichester, Baugh & Wilke, 2003, Pygmy Slug. Native

Reference: Leonard *et al.* (2003).

Family Ariolimacidae

Genus *Ariolimax*

Large slugs (maximum length, 260 mm), typically olive green, yellow-brown or black, frequently spotted with black but sometimes all white. Pneumostome behind the mid-line of the mantle. Mantle very finely granular. Tail keeled most of its length, but keel not quite reaching the mantle. Pit-like mucus gland, usually filled with a plug of mucus, at the tip of the tail. Shell plate-like and internal.

The well-known bananaslugs of the Pacific Coast of North America from Alaska to California, this genus has three species (and a couple of subspecies), with one species in Canada:

Ariolimax columbianus (Gould in A. Binney, 1851), Pacific Bananaslug (Plate 6) . . . Native

Selected references: Forsyth (2004), Mead (1943), Pilsbry (1948), Schileyko (2007). There is also a substantial body of literature on the ecology and biology of *A. columbianus* and other species.

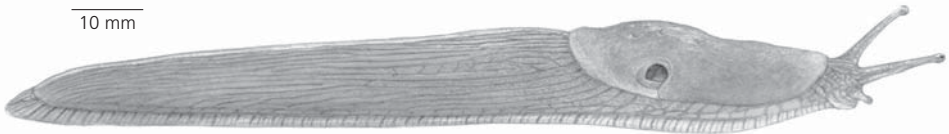
Genus *Magnipelta*

Large slugs (maximum length, 80 mm), tan mottled with black. Mantle large, covering most of the dorsal surface; granular. Tail not keeled.

There is only one species, an uncommon regional endemic that ranges from southern British Columbia southeast into eastern Washington, northern Idaho and western Montana:

Magnipelta mycophaga Pilsbry, 1953, Magnum Mantleslug (Plate 6) Native

Selected references: Forsyth (2004), Pilsbry (1953), Pilsbry and Brunson (1954), Schileyko (2007).



Ariolimax columbianus

Family Binneyidae

Genus *Hemphillia*

Medium-sized slugs (maximum length, 30–60 mm), with mantle prominent and body raised into a visceral ‘hump’. Shell plate-like, embedded in and mostly covered by the mantle. Pneumostome behind the midline of the mantle. Tail with a mucus gland at the tip and sometimes a fleshy protuberance.

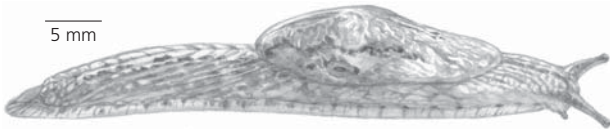
There are seven forest-dwelling species, which live in an area from southern B.C. to Oregon and east to western Montana.

- Hemphillia camelus* Pilsbry & Vanatta, 1897, Camel Jumping-Slug (Plate 6) Native
- Hemphillia dromedarius* Branson, 1972, Dromedary Jumping-Slug Native
- Hemphillia glandulosa* Bland & W.G. Binney, 1872, Warty Jumping-Slug Native

Selected references: Branson (1972), Forsyth (2004), Ovaska *et al.* (2002), Pilsbry (1948), Schileyko (2007).



Magnipelta mycophaga



Hemphillia camelus

Family Philomycidae

Genera *Pallifera* and *Megapallifera*

Medium to large slugs (maximum length, 30–100 mm). Mantle covering most of the dorsal surface of the animal but not near the head. Shell absent. *Pallifera* are small slugs, to about 30 mm long; *Megapallifera* are larger. Additionally, these genera are separated by a few internal anatomical characters.

There are nine species in eastern North America, with three of these living in Canada:

- Megapallifera mutabilis* (Hubricht, 1951), Changeable Mantleslug Native
- Pallifera fosteri* F.C. Baker, 1939, Foster Mantleslug Native
- Pallifera dorsalis* (A. Binney, 1842), Pale Mantleslug (Plate 7). Native

Selected references: Hubricht (1951), Pilsbry (1948), Schileyko (2007).

Genus *Philomycus*

Medium-sized to large slugs (maximum length, about 75 mm). Mantle covering the entire of the dorsal surface of the animal, including over the head region. Shell absent.

This is an eastern North American genus with species living from southeastern Canada to Florida and west to Texas. There are eight species in total, with four species reported from Canada:

- Philomycus batchi* Branson, 1968, Dusky Mantleslug Native
- Philomycus carolinianus* (Bosc, 1802), Carolina Mantleslug Native
- Philomycus flexuolaris* Rafinesque, 1820, Winding Mantleslug Native
- Philomycus togatus* (Gould, 1841), Toga Mantleslug (Plate 7). Native

Selected references: Fairbanks (1986), Pilsbry (1948), Schileyko (2007).



Pallifera dorsalis



Philomycus togatus

Family Helicidae

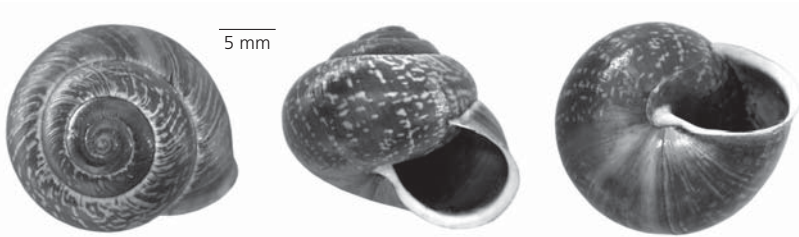
Genus *Arianta*

Shell large (maximum width, 28 mm), heliciform, brown with light flecks and darker spiral bands. Surface nearly smooth, with incremental striae, fine spiral striae and faintly malleate. Aperture without denticles. Umbilicus not quite closed so that there remains a narrow slit.

This genus is native to much of Europe and has about six species and subspecies. The most widespread species in Europe has been introduced to Canada:

Arianta arbustorum (Linnaeus, 1758), Cope Snail Introduced

Selected references: Gittenberger (1991), Schileyko (2006a).



Arianta arbustorum

Arianta arbustorum (Linnaeus, 1758): Cope Snail

Shell large (mature width, 20–28 mm), heliciform, opaque, brown, with numerous light speckles, and with one band just above the periphery. Surface nearly smooth, but under magnification with fine spiral striae and faintly malleate. Lip white, expanded and slightly flared. Umbilicus nearly closed by an expansion of the columellar lip, leaving just a narrow slit.

The two *Cepaea* species in this book (pp. 104 and 113) are similar in size and shape but normally have a completely closed umbilicus, and there is no light speckling on the shells.

The animal is dark grey.

Distribution: *A. arbustorum* is widespread in Europe from the Iberian Peninsula north to Scandinavia, and Iceland, and east to the Ukraine.

In Canada *A. arbustorum* is known from 10 localities in Newfoundland, several sites in Saint John, New Brunswick, and a ravine in Toronto. Populations of these snails are normally quite local, but may consist of many individuals. This species was first recorded in Canada from Newfoundland in 1885.

Habitat and ecology: In Europe, this is a common, polymorphic species in moist woods, hedgerows and sea cliffs, and also lives in the Alps at higher altitude. It usually is associated with tall vegetation, such as nettles, or lives amid leaf litter. In Canada, the species lives in wooded ravines, gardens, and along railway lines.

Synonym: *Helix arbustorum* (Linnaeus).

Selected references: Buria and Stahel (1983), Ellis (1969), Kerney (1999), Kerney and Cameron (1979, 1999), McAlpine *et al.* (2009). See Baur (2007) for a review of the reproductive biology and an extensive bibliography on this species.

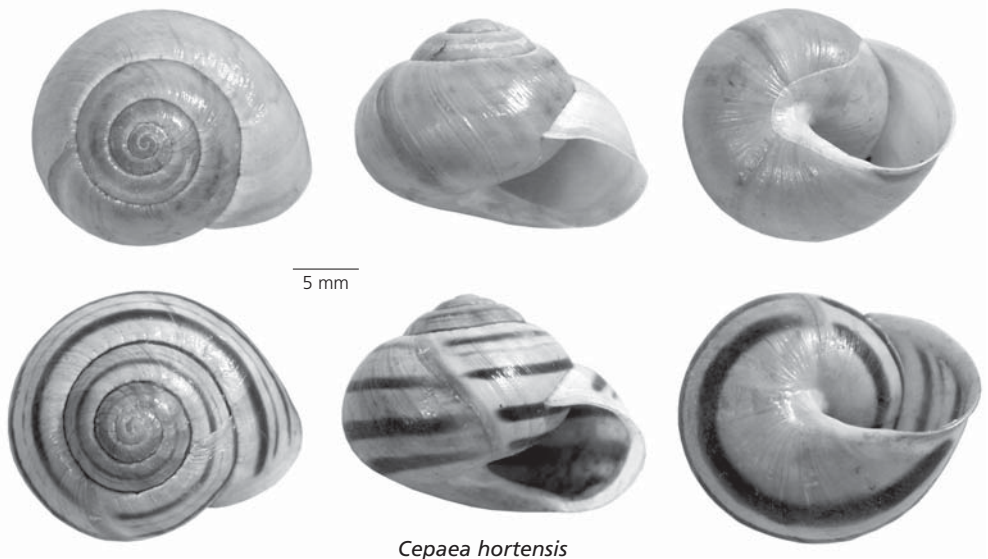
Genus *Cepaea*

Shell large (maximum width, about 25 mm), heliciform, bright yellow, orange, or brown, and without bands or with 1–5 darker spiral bands. Surface smooth and shining, with incremental striae only. Aperture without denticles. Umbilicus entirely closed in adults.

This genus contains four species that live in Western and Central Europe, east to the Caucasus, and with one species also along the eastern seaboard of North America. There are two species in Canada: the introduced *Cepaea nemoralis* and the Atlantic coastal *C. hortensis*, which is now believed to be native. Because this last species is introduced to eastern Ontario it is described here in more detail.

Cepaea hortensis (Müller, 1774), White-Lip Gardensnail Native/introduced
Cepaea nemoralis (Linnaeus, 1758), Grovesnail Introduced

Selected references: Kerney and Cameron (1979, 1999), Pilsbry (1939), Schileyko (2006a). For an extensive bibliography on polymorphism in *Cepaea*, see Cook (1998).



Family Testacellidae

1



Testacella haliotideae, p. 56

Family Milacidae

$\times 2$



Milax gagates, p. 77

Family Boettgerillidae

$\times 2.5$



Boettgerilla pallens, p. 88

2

Family Limacidae



Lehmannia valentiana, p. 80



Limacus flavus, p. 82



Limax maximus, p. 83

Family Agriolimacidae

3



Deroceras laeve, p. 85



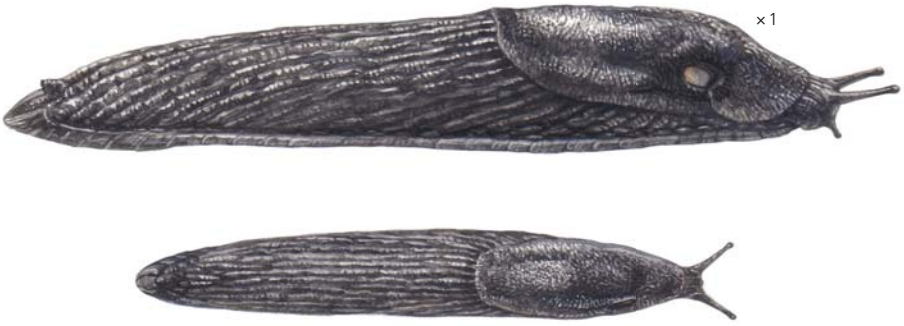
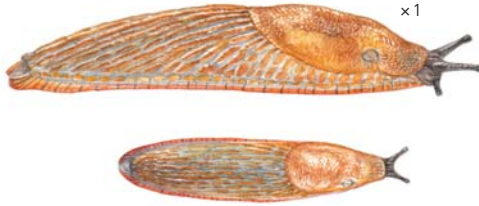
Deroceras reticulatum, p. 86



Deroceras panormitanum, p. 85

4

Family Arionidae



Arion rufus (orange and black forms), p. 91



Arion circumscriptus, p. 93

Family Arionidae

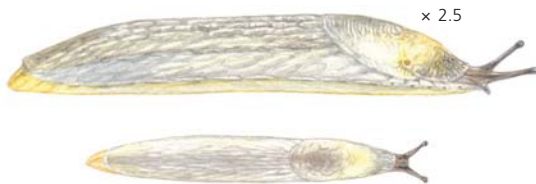
5



Arion fasciatus, p. 93



Arion distinctus, p. 95



Arion intermedius, p. 97



Arion subfuscus, p. 97

6

Family Ariolimacidae



Ariolimax columbianus, p. 100



Magnipelta mycophaga, p. 100

Family Binneyidae



Hemphillia camelus, p. 101

Family Anadenidae

7



Prophysaon andersonii, p. 99

Family Philomycidae



Pallifera dorsalis, p. 102



Philomycus togatus, p. 102

Family Helicidae



x 1.25



Cepaea hortensis, p. 113



x 1.25



Cepaea nemoralis, p. 113

Shell large (mature width, 15–25 mm), heliciform, opaque, somewhat shining, bright yellow to pink-brown, with 1–5 blackish or dark brown spiral bands that may be coalesced or altogether absent. Surface smooth, with weak incremental striae only. Lip slightly thickened, flared; baso-columellar lip straightened. Lip white (or very rarely with a slight pale purple or purple-brown flush). Umbilicus closed in adults by the columellar lip.

Shells of this species differ from *Cepaea nemoralis* by their slightly smaller size and the pale apertural lip. Long dead shells of *C. nemoralis* may sometimes be confused with *C. hortensis* if the apertural lip has become chalky and faded. *Arianta arbustorum* (p. 103) has a narrow umbilical chink, is marked with microscopic spiral lines, and has light flecks and markings arranged in axial rows; the baso-columellar lip is also slightly curved, not straight.

Distribution: Widespread in Western Europe, north to Scandinavia and Iceland, south to the Iberian Peninsula and east to the Ukraine. The species was thought by some authors to be a pre-Columbian introduction by Vikings, but excavations from a cave on the Gaspé Peninsula pre-date the Viking era. In North America *Cepaea hortensis* is now believed to be native along the Atlantic coast from the Gulf of St Lawrence south to Long Island, New York. It is widely distributed along the Gulf of St Lawrence and abundant on Anticosti Island. In the Maritimes and New England populations are seldom far from the coast.

It is included in this book because the species has been introduced into eastern Ontario, at least by the late F.W. Grimm. Persisting colonies, all with a substantial proportion of unbanded yellow shells, have recently been found in Ottawa and in an alvar near Almonte, Ontario.

Habitat and ecology: A calciphile, preferring relatively open vegetated habitat.

Synonym: *Helix hortensis* (Müller).

Selected references: Ellis (1969), Hubricht (1985), Kerney (1999), Kerney and Cameron (1979, 1999), Pearce and Olori (2004), Pilsbry (1939).

Shell large (mature width, 15–25 mm), heliciform, opaque, somewhat shining, bright yellow, orange, or brown, with 1–5 darker brown bands that may be coalesced or altogether absent. Surface nearly smooth. Apertural lip reflected; baso-columellar lip thickened and straightened. Apertural lip purple-brown. Umbilicus closed.

The body of the animal is yellowish-grey or dark grey.

C. hortensis is usually smaller and has a white reflected lip. *Arianta arbustorum* (p. 103)

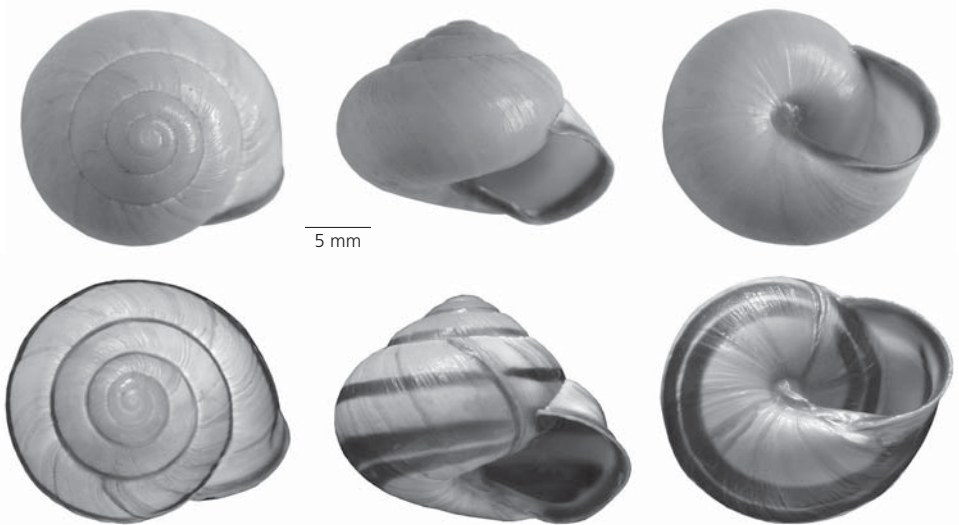
has a narrow umbilical perforation and is marked with light flecks.

Distribution: Widespread in Western Europe, this species occurs north to southern Sweden, south to the Iberian Peninsula, Hungary and Italy, and east to Poland and the Baltic States.

C. nemoralis is now widely introduced to the United States and parts of southern Canada. In B.C., this species is common in the Metro Vancouver and the Lower Fraser Valley, on Vancouver Island, and in the Okanagan. The species has recently (2008) turned up for the first time in Smithers, north-central B.C. In Ontario, populations are well established on Manitoulin Island and the Bruce Peninsula. It is widespread south and west of a line between southern Georgian Bay and Scarborough, and increasingly sporadic through Ontario east of this line. Elsewhere in Canada, *C. nemoralis* is known from southern Quebec, Nova Scotia, and Newfoundland.

Habitat and ecology: These snails live under plants and other shelter in gardens, parks, fencerows, weedy roadsides and railways, and old fields. In Europe the species is also lives at elevation up to 1800 m. It frequently enters urban and other woodlands from adjacent anthropogenic habitats. Animals frequently climb up tree trunks (but are not strictly arboreal) and have been observed up to 4 m above the ground.

Where found in large numbers they may consume much dead vegetation. In turn these snails are eaten by frogs, cardinals, jays, crows, and small mammals. Mating occurs in spring, and eggs are laid from June to August. Snails may live up to 7–8 years.



Cepaea nemoralis

C. nemoralis is frequently intercepted on nursery stock and transported between places this way. Because shells are large and brightly coloured, animals are often kept as pets and transported or deliberately introduced to new areas.

Synonym: *Helix nemoralis* (Linnaeus).

Selected references: Ellis (1969), Forsyth (2004), Hanna (1966), Jones *et al.* (1977), Kerney (1999), Kerney and Cameron (1979, 1999), Schueler (2008), Whitson (2005), Williamson (1979). The ecological and genetic factors controlling colour patterns of *Cepaea nemoralis* were the subject of many studies; see for example, Jones *et al.* (1977) and Cook (1998).

Genus *Cornu*

Shell large (maximum width, 40 mm), heliciform, pale brown or straw yellow, most with darker, brown spiral bands that are interrupted by irregular, pale creamy-white markings. Aperture and outer lip white. Surface with incremental striae and usually malleate. Aperture without denticles. Umbilicus normally closed in adults.

This is *Cryptomphalus* of some recent authors, but other authors have argued that the correct name to use is *Cornu*. There is one, circum-Mediterranean species introduced to Canada:

Cornu aspersum (Müller, 1774), Brown Gardensnail Introduced

Selected references: Barker (1999), Schileyko (2006a).



Cornu aspersum

***Cornu aspersum* (Müller, 1774):** Brown Gardensnail

Shell large (mature width, 27–40 mm), heliciform, pale brown or straw yellow, most with darker, brown spiral bands that are interrupted by irregular, pale creamy-white markings. Surface with malleate sculpture, growth striae, wrinkles, and microscopic spiral striae. Aperture large, rounded, and without denticles. Apertural lip white, only slightly thickened and recurved. Umbilicus normally closed in adults, but occasionally remaining open as a narrow slit.

The body of the animal is olive-grey with coarse tubercles.

By size, colour, shape, and texture, this species is unlike most species in this book (but compare with *Helix* spp. in the Appendix, page 143); the most similar species, *Helix pomatia*, has a more globular, thicker and thus more opaque shell that lacks the irregular pale markings, and the apertural lip is brown, not white.

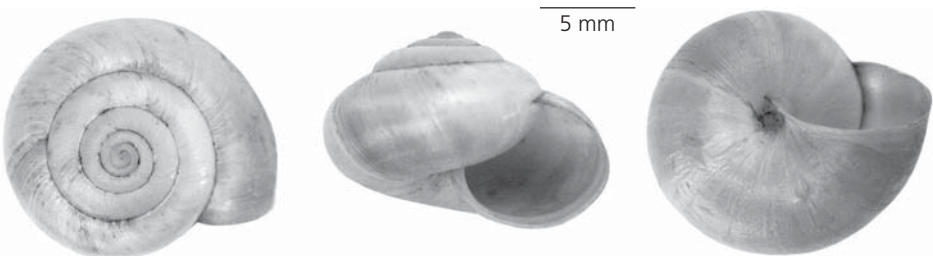
Distribution: *C. aspersum* is native to the Mediterranean and Black Sea region, but was widely introduced to various parts of Europe and North Africa in ancient and historical times. It is now found from North Africa to Scotland and the Netherlands, and from the Atlantic islands of the Azores, Madeira and the Canary Islands to Russia, Turkey, and Israel. Beyond these regions, *C. aspersum* is now established in temperate North and South America, Central America and the Caribbean, southern Africa, East Asia, Oceania, Mauritius, Reunion, and Australia. In the United States, it has been found in California, Hawaii, Idaho, Louisiana, Maine, Massachusetts, Michigan, New York, South Carolina, Texas, Utah, Virginia, and Washington State.

This species is not widespread in Canada. Sporadic populations occur infrequently on southern Vancouver Island and Greater Vancouver, and while it was reported from Halifax, Nova Scotia in the 1850s, it has not been found there since. In the 1970s it was discovered in Newfoundland, but we do not know much about this record or if it persists there today.

Habitat and ecology: In Canada, *C. aspersum* lives in gardens and on wasteland in cities, living under vegetation. Snails feed on both living and dead plant material. This species is not especially cold tolerant but may be pest in greenhouse operations. It survives, but apparently does not flourish, around Victoria, B.C.

Synonyms: *Helix aspersa* (Müller), *Cantareus aspersus* (Müller), *Cryptomphalus aspersus* (Müller).

Selected references: Barker (1999), Davis (1993), Ellis (1969), Forsyth (1999, 2004), Hanna (1966), Herbert and Kilburn (2004), Kerney (1999), Kerney and Cameron (1979, 1999).



Monacha cantiana

Family Hygromiidae

Genus *Monacha*

Shell medium-sized (maximum width, 20 mm), slightly depressed-heliciform, thin-shelled, pale yellow-brown to almost white, often with the lip and final portion of the last whorl with a pale red-brown or brown flush. Surface slightly shining, weakly axially striate glossy, and finely malleate. Aperture without denticles. Lip thin, slightly expanded, and bordered inside by a narrow rib. Umbilicus narrow.

Monacha cantiana (Montagu 1803), Kentish Gardensnail . . . Introduced; not established?

Selected references: Schileyko (2006b).

***Monacha cantiana* (Montagu, 1803):** Kentish Gardensnail

Shell medium-sized (mature width, 16–20 mm), slightly depressed-heliciform, creamy white but becoming flushed with pale brown towards the aperture. Periphery rounded. Apertural lip only slightly expanded and thin-edged but bordered inside by a narrow pink or white rib. Umbilicus small.

The animal is pale, cream or tan, darker on the head, and with greyish brown tentacles.

A related species, *M. cartusiana* (Müller, 1774), the Cartusian Snail (Appendix, p. 146), has recently been found in Delaware and Illinois and differs by its smaller shell with a narrower umbilicus. *Trochulus striolatus* (p. 119) is smaller and flatter and usually darker shelled, although pale, ‘whitish’ individuals are often encountered.

Distribution: This species was probably native to the western Mediterranean region, but now lives throughout much of England and in coastal areas from northwest France to Germany.

In the 1890s this species was found, apparently in the thousands, along the cliff near the Plains of Abraham and below the citadel in Quebec City. To our knowledge, the species has not been recently found there. In the literature there is also reference to this species having been found at Hamilton, Ontario, but this appears to be erroneous.

Habitat and ecology: In Europe, this is a species characteristic of wasteland, commonly along roads and railways, in quarries and the margins of old fields, and is more often associated with well-drained, calcium-rich places. It does not live in woods. In England, clusters of 60–90 eggs are laid between June and September, juveniles hatch after two weeks, and snails mature after one year.

Synonyms: *Helix cantiana* (Montagu), *Fruticicola cantiana* (Montagu).

Selected references: Chatfield (1968), Hanham (1897, 1899), Kerney (1999), Kerney and Cameron (1979, 1999), Pilsbry (1948).

Genus *Trochulus*

Shell small to medium-sized (maximum width, 14 mm), depressed-heliciform, tan to dark brown (sometimes paler), coarsely striate with periostracal hairs at least in juveniles and persisting on adults of some species. Spire variable: low to conical. Lip thin and basally a little expanded. Aperture without denticles but with a rib-like callus, especially near the basal lip. Umbilicus narrow.

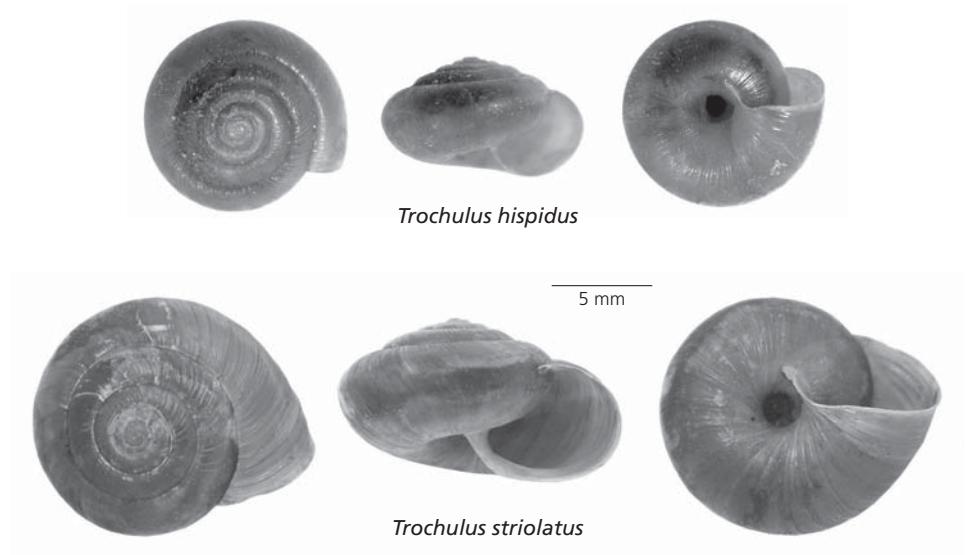
Trochulus has at least 12 species, with two species in Canada. Until recently, the name *Trichia* has been in common use but is now replaced by *Trochulus*.

Trochulus hispidus (Linnaeus, 1758), Hairy Helicellid. Introduced
Trochulus striolatus (C. Pfeiffer, 1828), Furrowed Helicellid Introduced

Selected references: Pfenninger *et al.* (2005), Pilsbry (1939), Schileyko (1978, 2006b).

***Trochulus hispidus* (Linnaeus, 1758):** Hairy Helicellid

Shell small to medium-sized (mature width, 6–12 mm), depressed-heliciform, opaque, tan or darker brown. Last whorl with the periphery evenly convex. Surface with weak incremental striae; periostracum usually with hairs persisting in adults, at least around the umbilicus. Lip slightly flared and a little thickened, especially basally. Aperture without denticles, but basal lip with a narrow ridge inside. Umbilicus small.



Shells of this species differ from *T. striolatus* in being smaller, less keeled, and by usually having at least a few hairs remaining, especially inside the umbilicus.

Animals are brown, with a darker head and tentacles.

Distribution: This is a common, wide ranging species in Europe, from Scandinavia to the Iberian Peninsula and east to the Ural Mountains of Russia. It is a well-established introduction in eastern North America.

T. hispidus is now widespread in southeastern Ontario and Quebec, New Brunswick, and Nova Scotia. In the United States it is known from Maine, Massachusetts, Michigan and New York.

T. hispidus shows much variation, and in England and France another species, *T. sericeus* (Draparnaud, 1801), is now believed distinct. Wayne Grimm thought that “*T. plebius*” — probably what is now regarded as *T. sericeus* — is present in southern Ontario, western Quebec, and northern New York State, but we have not found specimens so identified.

Habitat and ecology: *T. hispidus* is a generalist that lives in open, overgrown roadsides and gardens, but has also moved into woods, at least peripherally. It has been found inside greenhouses in the Czech Republic.

This species is (approximately) an annual, maturing and reproducing within one year, with the population peaking in the fall. These snails feed on dead plant material.

Synonyms: *Hygromia hispida* (Linnaeus), *Trichia hispida* (Linnaeus), *Hygromia hispida tonsilis* Pilsbry.

Selected references: Cameron (1982), Ellis (1969), Forcart (1962), Horsák *et al.* (2004), Kerney (1999), Kerney and Cameron (1979, 1999), Pilsbry (1939), Schileyko (1978).

***Trochulus striolatus* (C. Pfeiffer, 1828):** Furrowed Helicellid

Shell medium-sized (mature width, 10–14 mm), depressed-heliciform, opaque, tan to dark brown. Pale ‘whitish’ individuals are frequent. Last whorl with the periphery slightly keeled and with a weak pale band. Surface with incremental striae; periostracum without hairs in adults. Lip slightly flared and a little thickened, especially basally. Aperture without denticles, but basal lip with a narrow ridge inside. Umbilicus small.

This species differs from *Trochulus hispidus* in being large, hairless in adults, and with a slight peripheral keel marked by a paler band.

Animals are brown, darker on the head and tentacles.

Distribution: In Europe this species is distributed from the British Isles, through northern France, the Netherlands, northern Switzerland, southern Germany, and east to Hungary and Slovakia. Populations are discontinuous and subspecies are recognized by some authors.

In Canada *T. striolatus* is introduced to southern Quebec, southern Ontario, Newfoundland and Nova Scotia. The species was recently found at Revelstoke, British Columbia, but is not yet known from elsewhere in the west. It is also known from Maine, Massachusetts, and New York.

Habitat and ecology: In Britain this is a common species on wasteland, along roadsides, the edges of fields, in quarries, under walls, and in gardens. In England, it lives in semi-natural and old woods only in the south. In southern Ontario, it is often abundant in similar disturbed and semi-natural habitats and is occasionally in alvars and floodplain forests. Large quantities of shells are present in stream drift.

This species feeds on dead vegetation and perhaps may damage seedlings.

Synonyms: *Hygromia rufescens* of authors, *Hygromia striolata* (C. Pfeiffer), *Trichia striolata* (C. Pfeiffer).

Selected references: Forsyth (2008), Kerney (1999), Kerney and Cameron (1979, 1999), Oughton (1938), Pilsbry (1939), Schileyko (1978).

Genus *Xerolenta*

Shell medium-sized (maximum width, 20 mm), depressed-heliciform, bright white or grey-white, usually with brown spiral bands. Surface with weak, fine incremental striae. Aperture without denticles. Last whorl descending somewhat. Lip thin, simple, only a little expanded near the umbilicus. Umbilicus broad.

This is a European genus having about five species; one of these is introduced to Canada:

Xerolenta obvia (Menke, 1828), Heath Snail Introduced

Selected reference: Schileyko (2006b).



***Xerolenta obvia* (Menke, 1828):** Heath Snail

Shell medium-sized (maximum width, 20 mm), depressed-heliciform, spire low; opaque, dull to slightly shining, white or grey-white with a single broad brown spiral band above the periphery and up to 6 paler, less distinct bands below that may be interrupted or coalesced. Rarely without bands. Initial whorls at the tip of the spire brown. Surface smooth with weak, irregular growth lines. Last whorl descending towards the aperture. Lip thin and simple. Aperture without denticles. Umbilicus large, $\frac{1}{4}$ – $\frac{1}{3}$ of the width of the shell, and elliptical.

This species is distinct and unlikely to be confused with any other in Ontario.

Distribution: Unlike most introduced species here, this is not a Western European species. Rather, it occurs in Asia Minor through central Europe east to Ukraine, and south to the Balkan Peninsula. In the west, it ranges as far as southern France.

X. obvia is known in Canada only in south-central Ontario. It was first discovered in 1969 near Bethany (City of Kawartha Lakes) and was presumed to have lived there for many years. This population still exists and recently (since 2006) several additional populations were found nearby (Peterborough County and the City of Kawartha-Lakes).

In the U.S. the species was discovered in 2001 in a Canadian Pacific rail yard in Detroit, Michigan. Populations can be large, sometimes covering several hectares, and may contain thousands of individuals.

Habitat and ecology: *X. obvia* is a calciphile and lives in dry, open, grassy places along roads and railways and in old fields. In Europe it also lives around ruins and in vineyards and is largely synanthropic there as well, occurring in the same dense aggregations as North American populations. Snails are often observed in the thousands, both on the ground and aestivating on the stems of plants. They feed on dead and decaying plant material.

A study in Greece found that this species lives for one to two years, depending on the climatic conditions, and die soon after reproducing.

Synonym: *Helicella obvia* (Menke).

Selected references: Grimm and Wiggins (1974), Kerney and Cameron (1979, 1999), Lazaridou and Chatziioannou (2005), Robinson and Slapcinsky (2005).

Family Monadeniidae

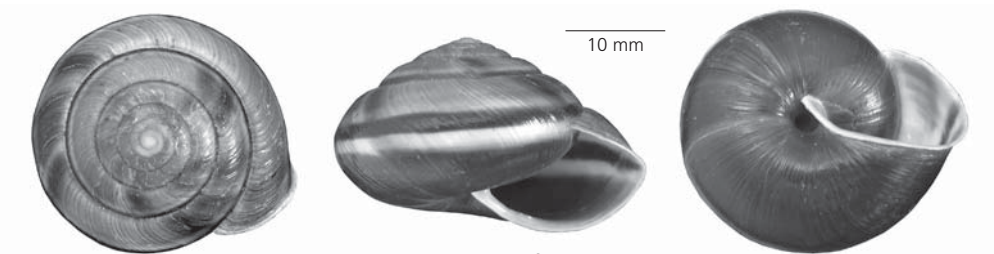
Genus *Monadenia*

Shell large (maximum width, about 35 mm), heliciform, usually brown, with lighter and darker spiral bands. Lip slightly thickened and a little expanded. Umbilicus open, but small for the size of the shell.

There are about 14 species, plus additional subspecies, along the west coast of North America, from B.C. to California, with one species occurring along on Vancouver Island and the adjacent mainland of British Columbia:

Monadenia fidelis (Gray, 1834), Pacific Sideband Native

Selected references: Forsyth (2004), Pilsbry (1939), Roth and Sadeghian (2003), Schileyko (2004).



Monadenia fidelis



Allogona profunda

Family Polygyridae

Genus *Allogona*

Shell large (maximum width, 33 mm), heliciform or depressed-heliciform; straw yellow to pale brown or grey; banded in one species (*A. profunda*). Surface sculptured with incremental striae and sometimes malleate; microscopic spiral lines usually present. Lip white, broadly expanded, with a flat face; baso-columellar lip usually with a weak denticle or low callus. A low parietal denticle, not much more than a callus, is rarely present in *A. ptychophora*. Umbilicus open.

There are four species in this genus, with one eastern species that just barely extends north into southern Ontario. The other *Allogona* all live in the west, from southern B.C. to Oregon and east to Montana. In total, three species live in Canada:

- Allogona ptychophora* (Brown, 1870), Idaho Forestsnail Native
- Allogona profunda* (Say, 1821), Broad-Banded Forestsnail Native
- Allogona townsendiana* (I. Lea, 1838), Oregon Forestsnail Native

Selected references: Emberton (1995), Forsyth (2004), Pilsbry (1940), Schileyko (2006a).

Genus *Appalachina*

Shell large (maximum width, 27 mm), depressed-heliciform, yellow-brown and with a silky sheen. Surface with close, even axial threads. Aperture with a small, tubercular parietal denticle and baso-columellar denticle. Umbilicus small, partially obstructed by the columellar lip.

There are two species in this exclusively eastern North American genus; one lives in Canada from southeastern Ontario to New Brunswick and Nova Scotia:

- Appalachina sayana* (Pilsbry in Pilsbry & Ferriss, 1906), Spike-Lip Crater Native

Selected references: Emberton (1991, 1994), Pilsbry (1940), Schileyko (2006a).



Genus *Cryptomastix*

Shell small to medium-sized (mature width, 6.5–16 mm), heliciform or depressed-heliciform, glossy or matte, yellow-brown to dark brown. Aperture with a parietal denticle in most species. Lip either thin and expanded but not recurved, or if thickened, then expanded and strongly recurved. Umbilicus narrowly open or (in *C. germana*) tiny and mostly concealed by the columellar lip.

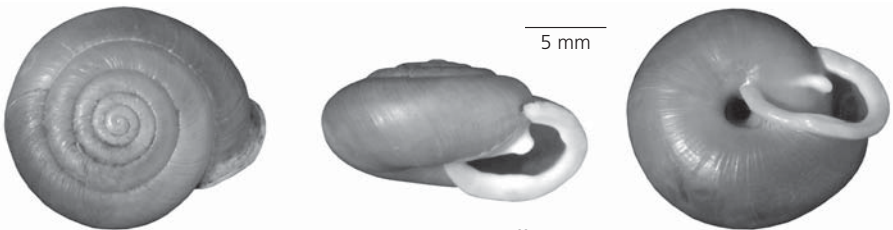
Cryptomastix has about 14 named species and subspecies in western North America from southern British Columbia to Oregon and east to Montana. There are at least three species in Canada (all in British Columbia):

- Cryptomastix germana* (Gould in A. Binney, 1851), Pygmy Oregonian Native
- Cryptomastix devia* (Gould, 1846), Puget Oregonian Native
- Cryptomastix mullani* (Bland & Cooper, 1861), Coeur d’Alene Oregonian Native

Selected references: Emberton (1995), Forsyth (2004), Pilsbry (1940), Schileyko (2006a).



Cryptomastix germana



Cryptomastix mullani



Euechemotrema fraternum

Genus *Euchemotrema*

Shell small (maximum width, 11 mm), depressed-heliciform or conic, yellow-grey to brown. Last whorl rounded or angular at the periphery. Surface with weak incremental striae. Periostracum may have hairs, but these are usually lost in adults. Aperture narrow; parietal denticle large, long and curved; lip thickened, not notched basally as in *Stenotrema* spp. (p. 128). Umbilicus open or almost closed in Canadian species.

There are five species in eastern North America, with two living in Canada from southern Ontario east to New Brunswick and Nova Scotia:

- Euchemotrema fraternum* (Say, 1824), Upland Pillsnail Native
- Euchemotrema leaii* (A. Binney, 1841), Lowland Pillsnail Native

Selected references: Emberton (1995), Pilsbry (1940), Schileyko (2006a).

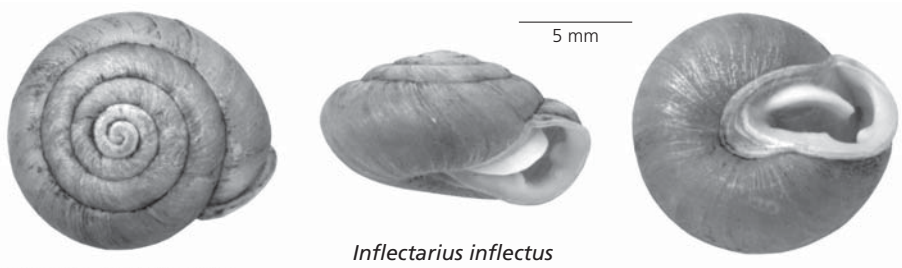
Genus *Inflectarius*

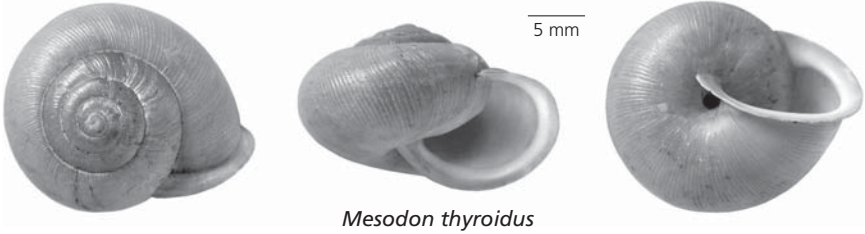
Shell medium-sized (maximum width, 16 mm), depressed-heliciform, yellow-brown. Surface lightly striate, with granules and a scaly periostracum. Aperture with a long, curved parietal denticle; lip with two denticles, one basal and one palatal, which may be diminished or absent. Umbilicus closed.

There are 10 or 11 species in eastern North America, with one native species found only in southern Ontario:

- Inflectarius inflectus* (Say, 1821), Shagreen. Native

Selected references: Emberton (1991, 1995), Pilsbry (1940), Schileyko (2006a).





Mesodon thyrooidus

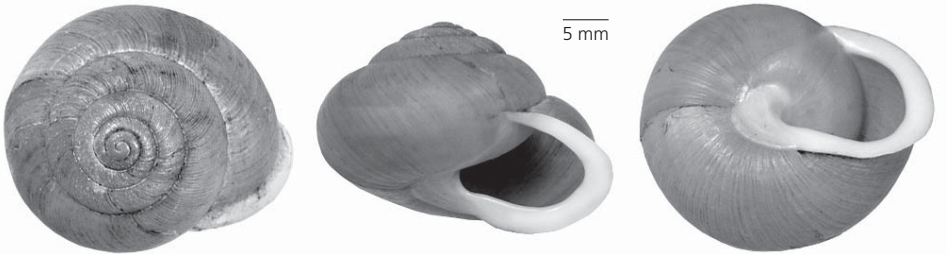
Genus *Mesodon*

Shell large (maximum width, 31 mm), depressed or heliciform, pale straw-yellow to pale brown. Surface with low, axial threads, and minute spiral striae. Apertural denticles absent, or a small parietal denticle present. Umbilicus small to narrow.

There are 12 species in eastern North America. Four of these occur in central Canada:

- Mesodon clausus* (Say, 1821), Yellow Globelet Native
- Mesodon mitchellianus* (I. Lea, 1839), Sealed Globelet Native
- Mesodon thyrooidus* (Say, 1817), White-Lip Globe Native
- Mesodon zaletus* (A. Binney, 1837), Toothed Globe Native

Selected references: Emberton (1991, 1995), Pilsbry (1940), Schileyko (2006a).



Neohelix albolabris



Neohelix dentifera



Patera pennsylvanica

Genus *Neohelix*

Shell large (mature width, 20–40 mm), depressed-heliciform or heliciform, yellow- to red-brown. Surface striate with microscopic spiral striae. Periostracum smooth. Aperture without denticles, with a parietal denticle, and/or sometimes with a callus on the basal lip near the columella. Lip flared. Umbilicus closed.

A genus of 14 named species in eastern North America, with two species (and perhaps several more undescribed ones) in Canada.

Neohelix albolabris (Say, 1817), Whitelip Native

Neohelix dentifera (A. Binney, 1837), Big-Tooth Whitelip Native

Selected references: Emberton (1988, 1995), Pilsbry (1940), Schileyko (2006a).

Genus *Patera*

Shell large (mature width, 15–27 mm), heliciform to strongly depressed, and tan or pale brown. Last whorl rounded or somewhat angular at the periphery. Surface with spiral striae or rows or papillae. Aperture with, or in fewer species without, a long parietal denticle; basal lip with a long ridge; outer lip without denticles. Lip thickened and recurved. Umbilicus closed.

This is a genus of 13 species distributed from Ontario south through the eastern United States to Florida. Two species occur in southern Ontario:

Patera appressa (Say, 1821), Flat Bladetooth Introduced

Patera pennsylvanica (Green, 1827), Proud Globelet Native

Selected references: Emberton (1991, 1995), Pilsbry (1940), Schileyko (2006a).

***Patera appressa* (Say, 1821): Flat Bladetooth**

Shell large (mature width, 14–18 mm), depressed-heliciform, spire low; pale brown. Surface with growth striae and with faint, microscopic spiral striae in places. Umbilicus entirely sealed by a prominent white callus. Apertural dentition: parietal wall bearing a white, slightly curved, elongate denticle; baso-columellar lip with a ridge-like callus that is truncate before reaching the palatal lip. No denticles on the palatal lip.

The body is graphite grey.

The combination of its much flattened form with the entirely closed umbilicus, long parietal denticle, and ridge-like baso-columellar callus serve to distinguish this species from all other Canadian members of its family. It superficially resembles *Triodopsis tridentata*, but that species is openly umbilicate, and has two prominent palatal denticles. *P. pennsylvanica* lacks a parietal denticle, has a higher spire and the last whorl is more markedly descending at the aperture. Of the several other species of *Patera* that



Patera appressa

are similar (not *P. pennsylvanica*), none are known to occur north into Canada. *Xolotrema denotatum* (p. 131) has a similarly flattened shell, but there is a small denticle-like swelling on the outer lip.

Distribution: This species occurs in the southern Appalachians and parts of the Ohio and James River drainages, southern Virginia, West Virginia, and eastern Kentucky. In Canada, *P. appressa* is known from several localities along the Trent River in Trenton, Ontario. We consider these populations introduced.

Habitat and ecology: This species lives in brushy thickets and forest edges on calcareous soils, roadsides and in urban weed lots. In the United States it is often found on talus and in cracks on limestone cliffs. Along the Trent River, *P. appressa* lives in highly disturbed urban escarpment woods and on a naturalized urban park. These snails feed on decaying vegetation and fungi.

Synonym: *Mesodon appressus* (Say).

Selected references: Hubricht (1985), Pilsbry (1940).

Genus *Stenotrema*

Shell small (maximum width, 6.5 mm), depressed-heliciform and with a rounded last whorl in Canadian species, or lens-shaped and last whorl sharply keeled; pale to dark brown. Surface with incremental striae. Periostracum hairy in most. Aperture strongly constricted by the large parietal denticle. Lip thickened, basally it is notched or with a denticle. Umbilicus closed or narrow.



Stenotrema barbatum

This is an eastern North American genus, ranging from southern Ontario to the Gulf of Mexico, and having at least 26 species. *Stenotrema* is represented in Canada by probably only one species:

Stenotrema barbatum (Clapp, 1904), Bristled Slitmouth Native

Selected references: Emberton (1995), Pilsbry (1940), Schileyko (2006a).

Genus *Triodopsis*

Shell medium-sized to large (maximum width, about 18 mm), depressed-heliciform, yellow-brown. Periostracum without hairs. Aperture with three denticles (parietal, basal and palatal) in most species, or palatal denticle absent. Lip expanded, broad-faced. Umbilicus open.

Distributed across eastern North America from southern Ontario and Quebec south in the United States to the Gulf Coast states, west to Texas, the genus consists of about 27 species, with two species living in Canada:

Triodopsis tridentata (Say, 1817), Northern Threetooth Native

Triodopsis vulgata Pilsbry, 1940, Dished Threetooth Native

Selected references: Emberton (1988, 1995), Pilsbry (1940), Schileyko (2006a).

Genus *Vespericola*

Shell medium-sized to large (maximum width, 20 mm), heliciform, rather thin-shelled, yellow- to red-brown. Periostracum with dense short hairs. Parietal denticle absent in Canadian shells. Lip flared and broad-faced. Umbilicus partly concealed by the expanded columellar lip.



Triodopsis vulgata

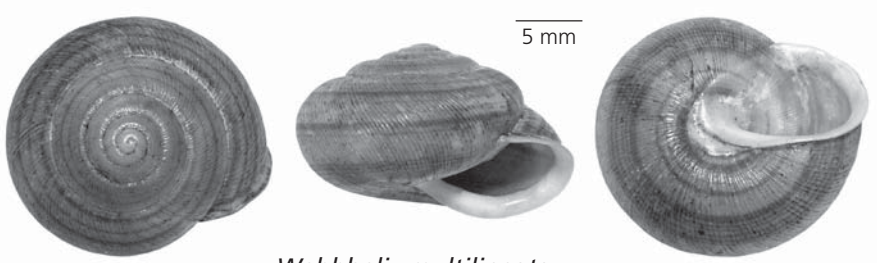


Vespericola columbianus

A genus of 20 named species and additional unnamed species from the west coast of North America from the Gulf of Alaska to central California, there is one species in Canada where it is common along the coast of British Columbia:

Vespericola columbianus (I. Lea, 1838), Northwest Hesperian Native

Selected references: Emberton (1995), Forsyth (2004), Pilsbry (1940), Roth and Miller (1993), Schileyko (2006a).



Webbhelix multilineata

Genus *Webbhelix*

Shell large (mature width, 20–30 mm), depressed-heliciform, rather thin-shelled, yellow- to olive-tan, with darker brown or red-brown spiral bands in most. Surface rather glossy, with fine sculpture of axial striae and weak microscopic spiral striae. Periostracum not hairy. Aperture without denticles or with a low parietal denticle. Lip flared. Umbilicus absent.

There are one or two species in central North America. In Canada *Webbhelix multilineata*, is native to southeastern Ontario.

Webbhelix multilineata (Say, 1821), Striped Whitelip Native

Selected references: Emberton (1988, 1995), Schileyko (2006a).

Genus *Xolotrema*

Shell similar to *Triodopsis* (p. 129), but with the basal lip having a long blade-like denticle, ending in a shallow notch where it joins the outer arc of the lip. Periostracum with short, stiff hairs.

This genus consists of five species in eastern North America. There is Canadian species, which is restricted to a small part of southeastern Ontario:

Xolotrema denotatum (Férussac, 1821), Velvet Wedge Native

Selected references: Emberton (1988, 1995), Pilsbry (1940), Schileyko (2006a).

Family Thysanophoridae

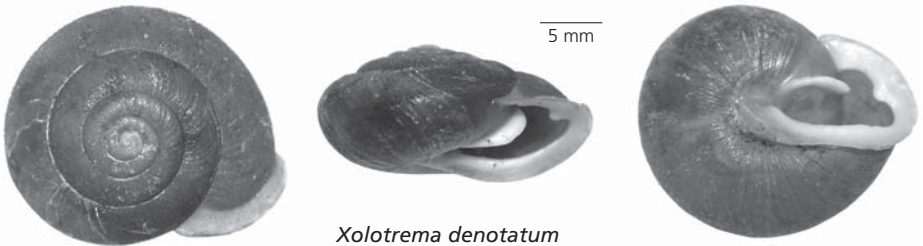
Genus *Microphysula*

Shell small (width to 5 mm), nearly discoid, translucent white or colourless. Spire low and whorls closely coiled. Nearly smooth but with microscopic axial and spiral striae. Umbilicus open.

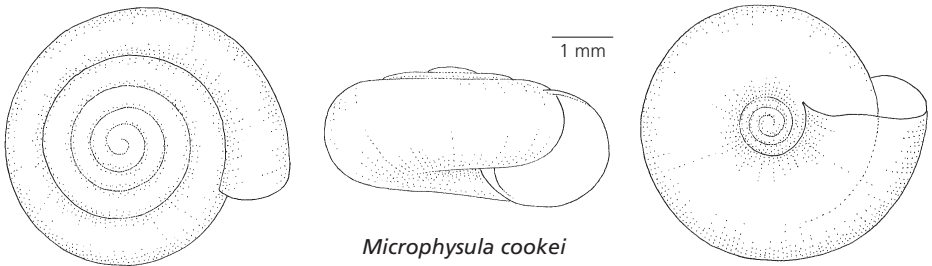
There are two species of *Microphysula*. Both are restricted to western North America from Alaska to the southwestern U.S. states.

- Microphysula cookei* (Pilsbry, 1922), Vancouver Snail Native
- Microphysula ingersollii* (Bland, 1875), Spruce Snail Native

Selected references: Forsyth (2004), Pilsbry (1940), Schileyko (2006a).



Xolotrema denotatum



Microphysula cookei

Glossary

Angular (adj.): Having an angle, not rounded. **Figure 1.**

Angular denticle (n.): A denticle on the parietal wall, above the parietal denticle (if present) and more-or-less in or near the 'angle' formed by the parietal wall and upper portion of the outer lip. This is above and usually smaller than the parietal denticle when that is present. **Figure 5.**

Apertural (adj.): In, of or near the aperture.

Aperture (n.): The opening in a spirally coiled shell through which the animal extends and retracts [=“mouth”]. **Figure 1.**

Apex (n.): The tip of the spire (pointed, bluntly rounded, or rarely, broken off) that is first formed. **Figure 1.**

Apical (adj.): At or of the apex.

Atrium (n.): The chamber to which the oviduct, penis (or epiphallus) and spermathecal duct are connected to, and which itself is connected to the outside by way of the genital pore. **Figure 2.**

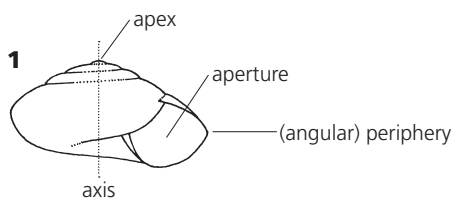
Axial (adj.): Approximately in the same direction as the axis of the coiling of a shell and more or less perpendicular to the spiral and parallel to the lip of a snail shell. Usually used to describe the direction of sculptural elements (ribs, striae, etc.) [=collabral].

Axis (n.): The imaginary line around which the whorls of a coiled shell are formed. **Figure 1.**

Basal (adj.): Of or at the base, the lower part of the shell.

Basal denticle (n.): A denticle on the basal lip. **Figure 5.**

Base (n.): The 'lower' surface of a snail shell.



Beaded (adj.): Cut into small, rounded protuberances. **Figure 11.**

Bursa copulatrix (n.): A sac-like structure of the genital system that receives and absorbs excess spermatozoa and other reproductive products for reabsorption [=spermatheca, seminal receptacle]. **Figure 2.**

Bursa copulatrix duct (n.): The duct of the bursa copulatrix. **Figure 2.**

Calciphile (n.): An organism requiring large amounts of free calcium ions (adj.: calciphilic).

Caudal mucus pore (n.): A pore at the end of the tail in some slugs having spongy tissue. Mucus excreted elsewhere along the body accumulates in the pore for absorption. [=caudal mucus gland, caudal pit]. **Figure 7.**

Columella (n.): The central pillar or column formed by the inner walls of the whorls, through which the axis of the shell passes; either hollow (shell with an umbilicus) or solid.

Columellar (adj.): Pertaining to the columella.

Columellar baffle (n.): A more or less vertical, ridge-like projection hidden well behind the columella in some Pupillidae and related groups.

Columellar denticle (n.): A denticle on columella. **Figure 5.**

Common duct (n.): A part of the reproductive tract proximal to the division of the genitalia into male and female tracts [=spermoviduct, hermaphroditic duct]. **Figure 2.**

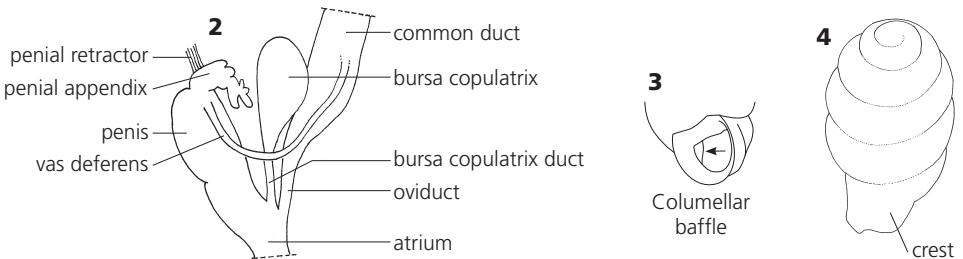
Conic (adj.): Approximately in the shape of a cone.

Crest (n.): A ridge, or thickened area, on the last whorl behind and parallel to the apertural lip, typically set off from the lip by a constriction. **Figure 4.**

Denticle (n.): A tooth-like shelly projection usually inside the aperture, or less commonly inside the last whorl. Denticles are named by their position; that is: parietal, angular, palatal, basal, columellar and subcolumellar; see **Figure 5.**

Depressed (adj.): Flattened (apex to base).

Depressed-heliciform (adj.): Heliciform, with the spire lower. **Figure 9.**



Discoid (adj.): Coiled in a flat plane (or nearly so) so that the spire scarcely protrudes from the apical surface of the shell.

Epiphallus (n.): A dilated distal portion of the vas deferens in which the spermato-phore is secreted.

Foot (n.): The long, ventral muscular organ of gastropod locomotion.

Foot fringe (n.): The edge of the foot, when set off from the rest of the foot by a conspicuous constriction [=skirt]. **Figure 7.**

Genital pore (n.): The opening on the anterior right side of the body leading into the reproductive system [=genital aperture]. **Figure 7.**

Granular (adj.): Covered with granules.

Granule (n.): A small raised surface feature somewhat like a large grain of sand. **Figure 11.**

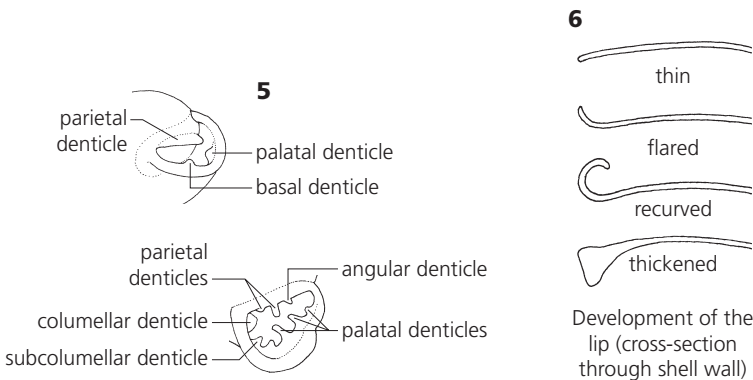
Height (n.): The greatest dimension of a shell along the line of axis from the apex to the base [=shell length]. **Figure 12.**

Heliciform (adj.): Having the general form of a 'typical' land snail shell, like that of a *Helix*, *Cornu*, etc. **Figure 9.**

Holarctic (n.): The biogeographic region consisting of both the Palaearctic and Nearctic realms. (adj.): Native to the Holarctic realm.

Incremental striae (n.): Narrow lines on the surface of a shell, *here both incised and raised*, that are created by the gradual addition of shell material as a result of growth [=axial lines/striae, radial lines/striae, growth lines].

Keel (n.): The longitudinal ridge present on the tail of some slugs (**Figure 7**). A sharp angle at the periphery of a shell [=carina].



Lamellar (adj.): Thin and flat, here used to describe axial ribs. **Figure 11.**

Length (n.): The measurement of an animal from head to the tip of tail. This is taken in life with the animal in a non-contracted state. **Figure 12.**

Lip (n.): The edge around the aperture of the shell [=peristome], **Figure 10.** It may be thin, flared, reflected or thickened; **Figure 6.**

Malleate (adj.): Dimpled, like a piece of metalwork beaten with a hammer.

Malleation (n.). Surface ornamentation consisting of numerous small, shallow dents, like a piece of hand-beaten metalwork. **Figure 11.**

Mantle (n.): A fold of the body wall lining and secreting the shell in shell-bearing molluscs; it is wholly exposed in slugs. **Figure 7.**

Mucus (n.): A viscid, slippery secretion of the skin that aids in locomotion, defence, and moisture retention.

Nearctic (n.): The biogeographic region including all of North America and the northern, non-tropical part of Mexico; (adj.) native to the Nearctic realm.

Ocular (adj.): Of the eye. Ocular tentacles bear eyes; **Figure 7.**

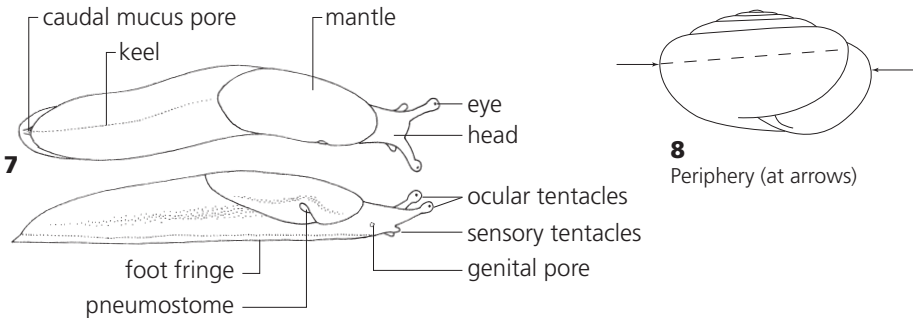
Outer lip (n.): The portion of the lip between the suture and the base [=palatal lip]. **Figure 10**

Ovate (adj.): More-or-less egg-shaped in outline.

Oviduct (n.): The female duct through which eggs pass from the common duct to the atrium. **Figure 2.**

Oviparous (n.): Producing eggs that mature and hatch after being expelled from the body.

Ovoviparous (adj.): Producing eggs that are hatched within the body, so that the young are born alive.



Palatal denticle (n.): A denticle on the outer (palatal) lip. **Figure 3.**

Palaearctic (n.): The biogeographic region including Europe, northern Asia and North Africa. (adj.): Native to the Palaearctic realm.

Parietal (n.): That part of the wall of a coiled shell formed by the shell wall of the preceding whorl.

Parietal denticle (n.): A denticle on the parietal. **Figure 5.**

Penial appendix (n.): An outgrowth from the proximal part of the penis, sometimes branched [=penial flagellum, penial caecum]. **Figure 2.**

Penial retractor (n.): The muscle that retracts the exerted penis. **Figure 2.**

Penial sheath (n.): A covering of connective tissue that partially or wholly covers the penis and/or epiphallus.

Periostracum (n.): A thin, protective membrane of an organic protein (conchiolin) on the exterior of most shells, sometimes forming hairs, scales or wrinkles.

Periphery (n.): The outermost part of the whorl furthest from the axis of a spiral shell. The periphery may be above, below, or at the midline of the whorl. **Figure 8.**

Pneumostome (n.): A hole on the right side of the mantle, into the pulmonary cavity, through which the animal breathes. [=breathing pore]. (Through the same hole in some species, or through a separate pore located close to pneumostome, excreta are expelled.) **Figure 7.**

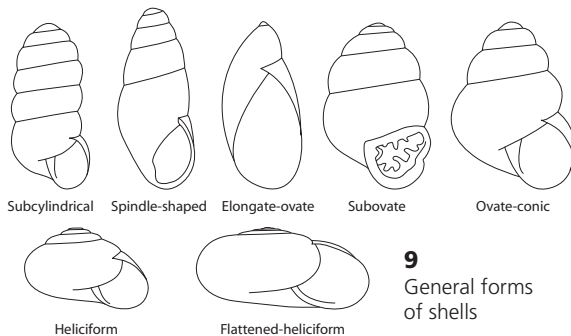
Recurved (adj.): Curved or bent back, as at the edge of the apertural lip. **Figure 6.**

Radula (n; pl.: **Radulae**): A feeding organ of most molluscs, generally consisting of rows of minute teeth arranged on an elastic membrane covering a tongue-like organ.

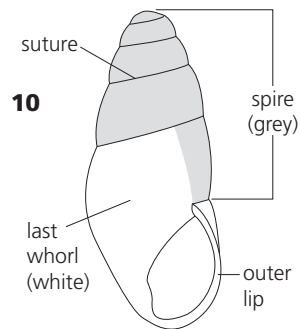
Radular (adj): Of or on the radula.

Rib (n.): A long, narrow ridge-like element of surface ornamentation. **Figure 11.**

Riblet (n.): A small rib.



9
General forms
of shells



10

Sculpture (n.): The raised and indented surface ornamentation on a shell. **Figure 11.**

Shoulder (n.): That part of the whorl directly below the suture and above the periphery.

Simple (adj.): Said of the apertural lip; without denticles, or being thickened or flared.

Sinuous (adj.): Gracefully curved, in two or more directions, somewhat like an ‘S’.

Spiral (adj.): In the direction of the coiling of the shell.

Spire (n.): All whorls of a coiled shell except for the last. **Figure 10.**

Stria (n.; pl. **Striae**): A narrow, incised line (almost always used in plural). **Figure 11.**

Striate (adj.): Having striae.

Subcylindrical (adj.): Approximately cylindrical. **Figure 9.**

Subovate (adj.): Approximately egg-shaped **Figure 9.**

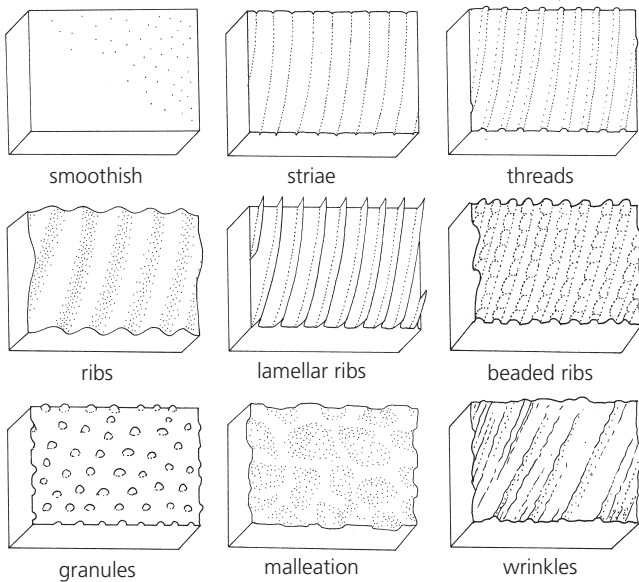
Suture (n.): The continuous seam between two adjacent whorls of a coiled shell. **Figure 10.**

Synanthropic (n.): Ecologically associated with human beings (n.: **synanthrope**).

Tentacle (n.): One of a pair of more or less slender, contractile or retractile, sensory organs on the head of a snail or slug. **Figure 7.**

Thread (n.): A narrow, raised, usually spiral, sculptural element. **Figure 11.**

Truncate (n.): Having the end (abruptly) squared off.



11 Surface sculpture of snail shells

Tubercle (n.): A swelling, hump or knob on the animal's body; mostly used in plural form.

Tubercular (adj.): Having tubercles, or tubercle-like in form.

Umbilicate (adj.): Having an umbilicus.

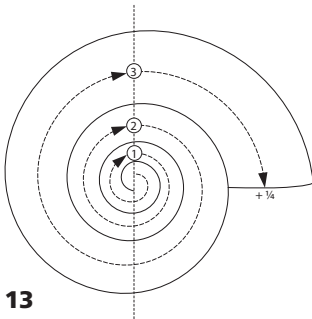
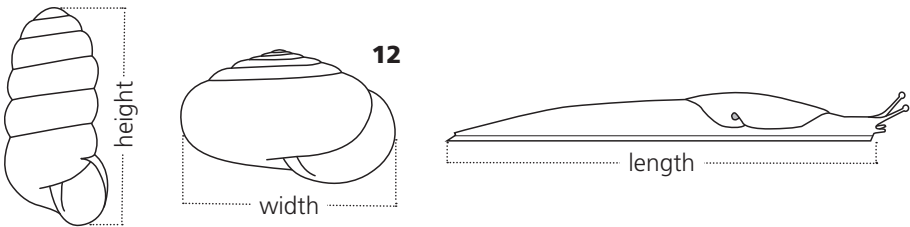
Umbilicus (n.): The hole, indentation or depression on the base in some spiral shells that is formed by the inner surfaces of the whorls. **Figure 14.**

Vas deferens (n.): The narrow duct connecting the common duct to either the penis or epiphallus. **Figure 2.**

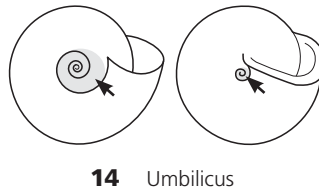
Whorl (n.): A coil of the shell, **Figure 10.** Whorls are counted to the nearest one-quarter turn, as in **Figure 13.**

Width (n.): The maximum dimension of a shell taken perpendicular to the axis of a coiled shell. [=diameter, breadth]. **Figure 12.**

Wrinkles (n., pl.): Irregular furrows and ridges, usually axial in orientation, describing shell sculpture. **Figure 4.**



13
Method to count whorls



14 Umbilicus

Appendix: Commonly Intercepted Species

The list below is not exhaustive, but it includes most of the commonly intercepted species, as well as those few species that can be legally imported live into Canada for the pet or food trade.

Subulinidae

Rumina decollata (Linnaeus 1758): Decollate Snail

This species and *Rumina saharica* Pallary, 1901, are widely distributed around the Mediterranean. *Rumina* have been intercepted frequently in shipments of plants from southern European locales. Scattered populations of *R. decollata* are now found from Virginia to Florida and west to Texas, Mexico, the West Indies and China. These snails are voracious predators, feeding on other snails.

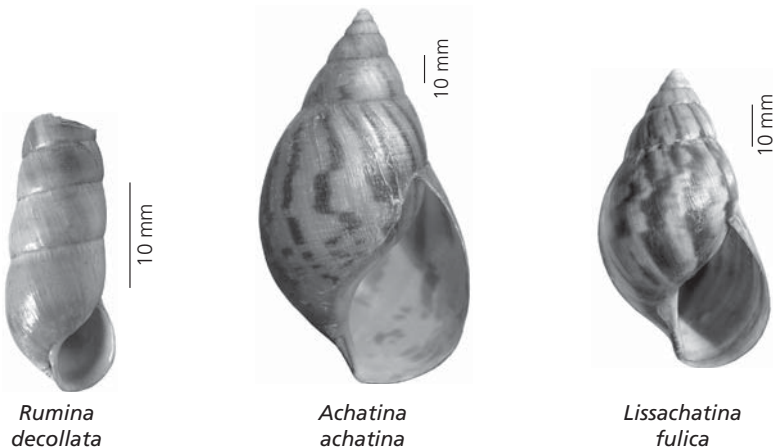
Achatinidae

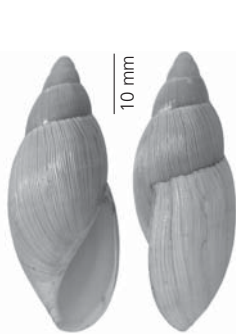
Lissachatina fulica (Bowdich, 1822): Giant African Snail

Achatina achatina Linnaeus, 1758: Agate Snail

Archachatina marginata (Swainson, 1820): Giant African Snail (not figured)

These large, attractive African snails are popular as pets and are often smuggled into Canada with shipments of exotic reptiles. They are commonly eaten in many African countries.





Euglandina rosea



Cochlicella acuta

Oleacinidae

Euglandina rosea (Férussac, 1821): Rosy Wolfsnail

This species, native to coastal North Carolina south to Florida, and west along the Gulf Coast to Texas and northern Mexico, is now widely introduced to Hawaii, other islands in the Pacific and Indian oceans, Japan, Bermuda, the Bahamas and California. These warm-climate snails are sometimes intercepted coming into Canada. In Hawaii, French Polynesia and other places, the introduction — often intentional to try to control *Lissachatina fulica* — of these aggressive predators has caused, or is implicated in, the decline and extinction of many native species of land snails.

Cochlicellidae

Cochlicella acuta (Müller, 1774): Pointed Snail

This is another circum-Mediterranean snail that is sometimes intercepted. This species is usually associated with open, calcareous coastal dune habitats.

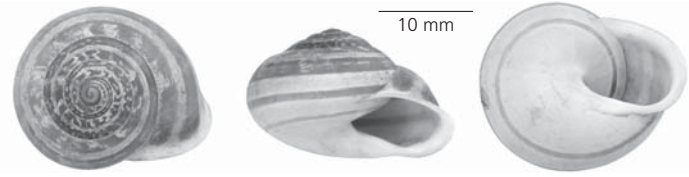


Cantareus apertus

Helicidae

Cantareus aperta (Born, 1778): Green Gardensnail

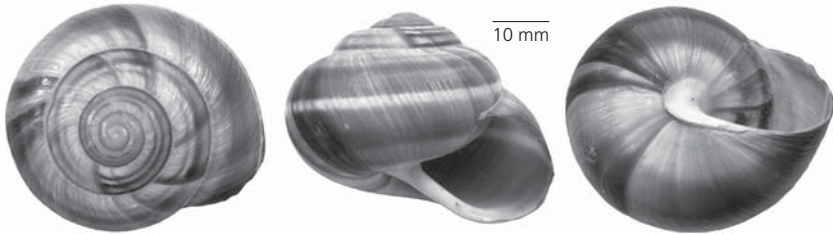
Another species typical of the Mediterranean region, and sometimes intercepted in shipments of plants from Europe, it lives mostly in shrub land, gardens and near cultivated fields.



Eobania vermiculata

***Eobania vermiculata* (Müller, 1774): Chocolate-Band Snail**

Frequently known as *Otala vermiculata*, this is a common circum-Mediterranean. Together with *Otala lactea*, it is the only terrestrial snail that is permitted for live import into Canada. They are cultivated for food.



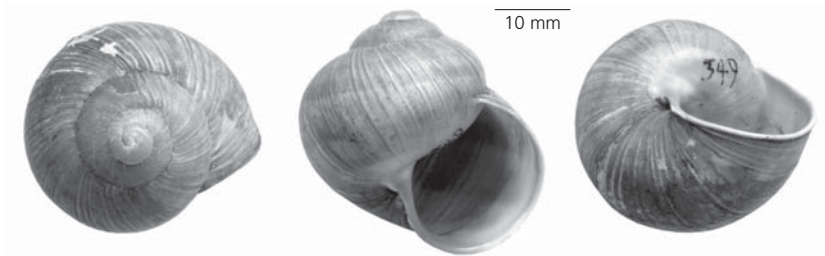
Helix lucorum

***Helix lucorum* Linnaeus, 1758: Vineyard Snail**

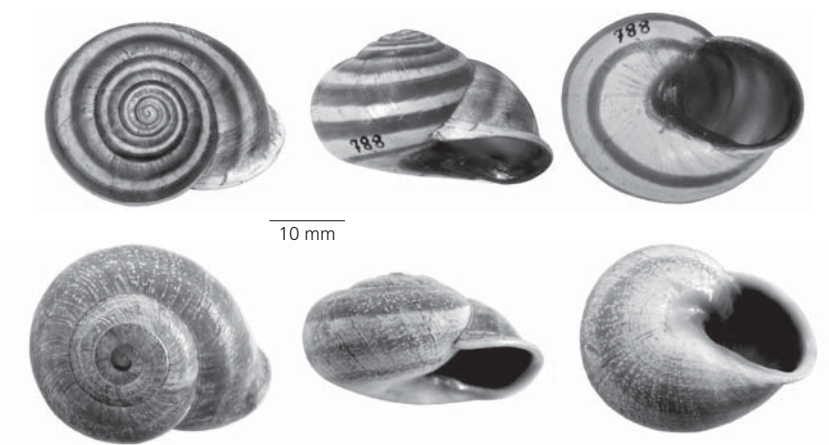
This is a large, edible species of *Helix* from eastern and southern Europe, Turkey and the Near East. It has been intercepted on occasion.

***Helix pomatia* Linnaeus, 1758: Roman Snail**

This is another large, edible snail. It is predominantly a central and southeastern European species but also is found west to England and France and north to southern Scandinavia. This species is often farmed for food. It is frequently intercepted.



Helix pomatia



Otala lactea (above), *O. punctata* (below)

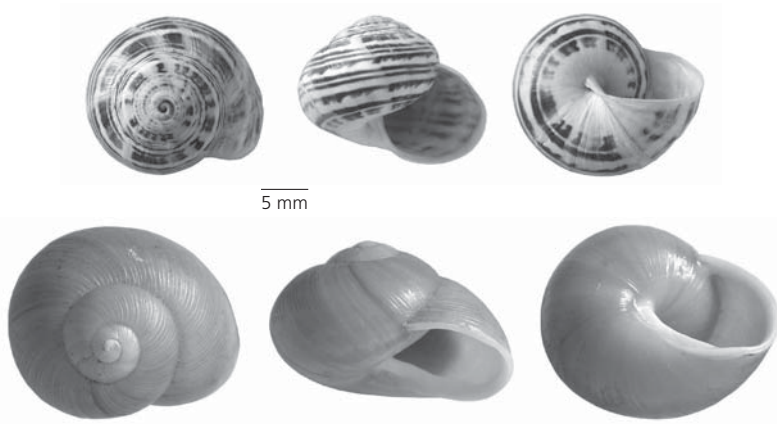
Otala lactea (Müller, 1774): Milk Snail

Otala punctata (Müller, 1774): Dotted Milk Snail

These two species are often confused. *Otala lactea* has a dark apertural lip while that of *Otala punctata* is white. *O. lactea* and *Eobania vermiculata* are the only terrestrial snails that are permitted for live import into Canada for use as food.

Theba pisana (Müller, 1744): White Gardensnail

This is a common circum-Mediterranean species that is frequently intercepted in plant shipments. It lives in dry, exposed, typically coastal, calcareous habitats. Shells are highly variable in markings.

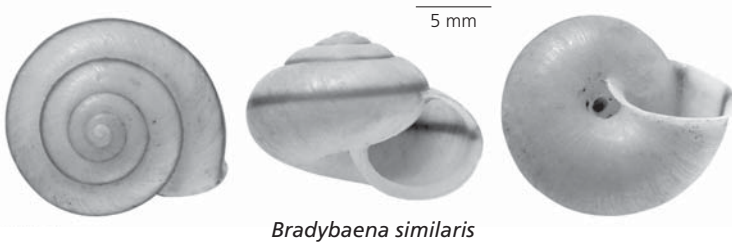


Theba pisana (above), *Zachrysis provisoria* (below)

Pleurodontidae

Zachrysia provisoria (L. Pfeiffer, 1858): Cuban Landsnail

This was originally a Cuban species but is now introduced and established in south Florida and around the Caribbean. It is occasionally intercepted on imported live plants from the southeastern United States.



Bradybaenidae

Bradybaena similaris (Rang, 1831): Asian Trampsnail

This tropical snail, native to Asia, is now widely introduced throughout the tropics and subtropics. It is frequently intercepted on plants from the southeastern U.S. The shells of some individuals lack the brown band.

Hygromiidae

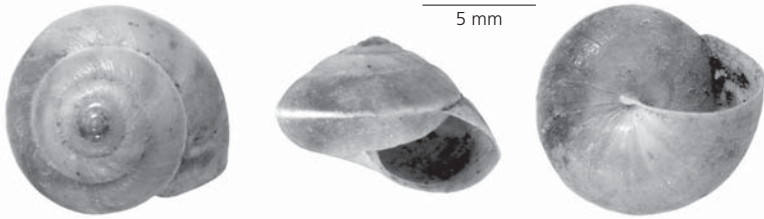
Candidula intersecta (Poiret, 1801): Wrinkled Helicellid

Cerņuella virgata (Müller 1774): Maritime Gardensnail

These two species have been intercepted from Europe. They are native to western Europe and the Mediterranean region. There are several similar and difficult to distinguish species of hygromiids from the same area.



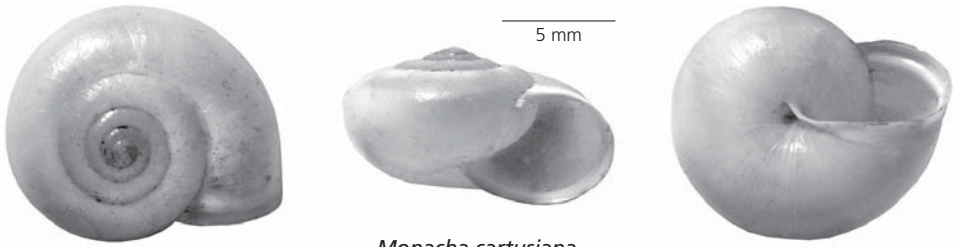
Candidula intersecta (above), *Cerņuella virgata* (below)



Hygromia cinctella

Hygromia cinctella (Draparnaud, 1801): Keeled Helicellid

H. cinctella is a distinctive Mediterranean species with a sharp keel at the periphery of the shell. It has become established in Britain, Hungary and Austria.



Monacha cartusiana

Monacha cartusiana (Müller, 1774): Chartreuse Snail

This species is native to southern and south-central Europe, and is now introduced to England and the Low Countries. It has recently been found in Chicago, Illinois, and Wilmington, Delaware.



Polygyra septemvolva

Polygyridae

Polygyra septemvolva (Say, 1818): Florida Flatcoil

This species has been intercepted on plants coming from the United States. These are native to Florida and other southeastern coastal areas of the U.S. There is a similar appearing species, the Southern Flatcoil, *P. cereolus* (Mühlfeld 1816), and several other southern polygyrid snails that have been, or could be, transported north on live plants.

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About the Authors and Illustrators

F. Wayne Grimm (21 June 1941 – 8 June 2005) was born in Philadelphia, Pennsylvania, and grew up in Baltimore, Maryland. His mother was Eugenia Stanley Grimm of West Virginia. His father was Frank Gustav Grimm of Baltimore, commercial artist and director at Maryland Historical Society. On a Westinghouse Scholarship for Science, Wayne attended Michigan State University.

Wayne began his studies of terrestrial gastropods in 1954 and in his youth was mentored by Leslie Hubricht, an eminent amateur malacologist and prolific collector. Between 1959 and 1976 he published approximately 25 zoological papers, mostly on molluscs, in *The Canadian Field-Naturalist*, *The Nautilus*, *Bulletin of American Malacological Union*, and several other journals.

In the early 1970s Wayne immigrated to Canada from the United States and deposited most of his mollusc collection, up to about 1975, in the National Museum of Canada (now Canadian Museum of Nature) in Ottawa, where he worked in the museum's design and display department.

After several years occupied with other interests, Wayne returned to malacology around 1990. He concentrated on the snails and insects of limestone alvars near his home in eastern Ontario. Wayne surveyed alvars in the Great Lakes Basin for the Nature Conservancy and summarized his knowledge of the fauna of this region in *Terrestrial Molluscs of the Mixedwood Plains Ecozone* (1996).

From 1999 to his death he was Curator of Invertebrates at the Eastern Ontario Biodiversity Museum (EOBM), where his accounts of invertebrates and their study were an inspiration to visitors. He began writing this book at the EOBM, and was working on assembling data for a monographic revision of the fauna of Canada. His work at the EOBM, and on this book, was funded by generous support from Franklin Ross and Donna Richoux.

His death left a major gap in Canadian malacology because, while his field experience was continental and his knowledge was encyclopedic, he had not published much in his later years. Shortly before his death his papers and most of his recent collections

were moved to the Bishops Mills Natural History Centre for storage and curation when the EOBM closed. Wayne's recent collections are now being transferred permanently to the Canadian Museum of Nature.

Wayne once wrote, "Finding snails in secret places engages all of one's faculties, especially when one is committed to understanding them. Knowing the snails of an area means that one knows the whole history and general ecology." This book, begun by Wayne, is dedicated to his memory.

Aleta Karstad is a natural history author and illustrator whose books include *Canadian Nature Notebook* (1979), *North Moresby Wilderness: Cumsbewa Head Trail* (1990), and *A Place to Walk: A Naturalist's Journal of the Lake Ontario Waterfront Trail* (1995). Her paintings of unionid mussels appeared in Arthur Clarke's *Freshwater Molluscs of Canada* (1981). Aside from the day-to-day management of the project, Aleta contributed the watercolours of the slugs and some of the drawings for this book.

Frederick W. Schueler, Ph.D., is a general naturalist broadly interested in the spread of introduced species in Canada. His contribution to this book has been mostly exploratory field work, data management, and editing the text.

Robert G. Forsyth is a self-trained malacologist who has been studying terrestrial molluscs since 1990. He is a Research Associate with the Royal British Columbia Museum, Victoria, and a co-chair of the Molluscs Species Specialist Subcommittee of Committee on the Status of Endangered Wildlife in Canada (COSEWIC). He has authored or co-authored several papers on introduced molluscs in Canada and one book, *Land Snails of British Columbia* (2004). Robert helped complete the original manuscript, and wrote genus and species accounts, keys, parts of the introduction, and glossary. He also contributed many drawings and photographs for this book.

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Notes

Notes



In a country where native land snails are mostly inconspicuous and secretive, the vast majority of the slugs and land snails encountered in settled areas are unwelcome aliens from Europe. These introduced species include the tomato-destroying Fieldslugs, ghostly subterranean Wormslugs, brilliantly coloured Grovesnails and garlic-scented Glass-snails. Some introductions have scarcely spread from where they were introduced, while others are now ubiquitous over large areas of Canada.

Based on the field work of the late Wayne Grimm and Robert Forsyth's knowledge of the fauna, this book describes and illustrates 41 alien species now established in Canada. For each species, the distribution, habitat and often fascinating ecology is described, and the reader is introduced to the often extensive literature. To help distinguish introduced species from the diverse native fauna, 56 native genera are also described and illustrated, and keys to all genera are included.