

COLORADO DIVISION OF WILDLIFE

A Field Guide to the
**Freshwater Mollusks
of Colorado**



by Mardy Nelson Harrold
and Dr. Robert P. Guralnick

Illustrations by Leigh Anne McConnaughey

Second Edition

COLORADO DIVISION OF WILDLIFE
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August, 2010



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This field guide is dedicated to
Dr. Shi-Kuei Wu

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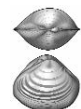
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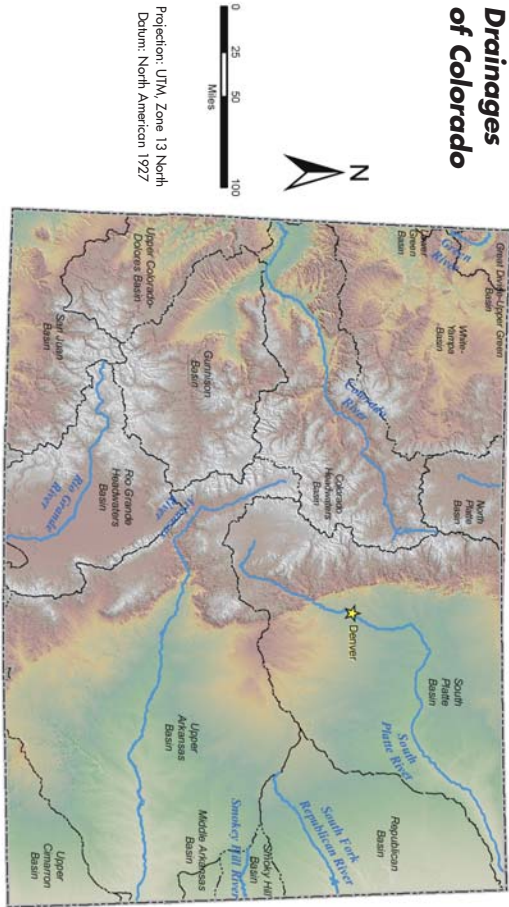
Forward

Perhaps at no time in Colorado's natural history have its aquatic mollusks been under so much pressure. Mollusks have been forced to adapt to or retreat from habitat alterations by water diversions and land use changes. Pollution and water quality changes continue to take their toll. Deliberate or accidental introductions of non-native fishes and the loss of native fish species has in some cases increased predation on mollusks while, in the case of Unionid mussels, either changed or eliminated potential hosts for their glochidia. Non-native mollusks that are invasive species such as New Zealand mudsnails or zebra and quagga mussels add further pressure through competition.

Still more crises loom to threaten the survival of native aquatic mollusks in Colorado. In the past two decades shipping technology and the dropping of trade barriers have combined to allow a worldwide expansion of many invasive aquatic species which threaten the natural order on every continent. The New Zealand mudsnail is only one example of a host of invasive ecology-altering mollusks, fishes, invertebrates, and plants that could profoundly change Colorado's aquatic environment in the near future.

Recently, Colorado resource managers have had to contend with the invasion of two Caspian dreissenid mussels (zebra and quagga mussels). They have the capacity to permanently change water quality and habitat. They are one of a few species with the ability to completely crash the aquatic food web. By sheer numbers they smother native Unionids and displace other native mollusks.

Major River Drainages of Colorado



INTRODUCTION

Mollusks are a familiar and diverse group of invertebrate animals that includes snails, clams, slugs, squids, and octopi. They are abundant in almost all marine, freshwater, and terrestrial habitats. About 50,000 living and 60,000 fossil species have been described and more may be discovered, as researchers survey remote areas. Colorado is home to over 40 species of native aquatic mollusks.

Purpose of this Guide

The purpose of this guide is to assist both field biologists and the public in identifying and gathering information about freshwater mollusks in Colorado. Mollusks, particularly species found in this state, often go unnoticed because people are unaccustomed to looking for them and because many are so small that they look like particles of gravel or sand.

Freshwater mollusks have become the most endangered group of animals in North America (Williams et al, 1993), but the status of Colorado's species is not clear. Freshwater mollusk conservation depends upon reliable and accurate information, including correct species identification. While the University of Colorado Museum and Colorado Division of Wildlife maintain historic records of mollusks found in Colorado, additional information is needed.

This field guide will enable readers to identify, at least to the family level, most mollusks observed in Colorado's aquatic habitats. Everyone's observations are welcome. To report

The vast majority of aquatic scientists and virtually none of the public sector know anything at all about aquatic mollusks. Perhaps they go unnoticed because there are so few physical and biological analogies between these invertebrates and human beings. Because of this inability to relate, it is my fear that the disappearance of our native mollusks will go unnoticed and unrecorded.

Until recently efforts to inventory the state's mollusks have been largely the work of a few dedicated academics. The Colorado Division of Wildlife, the agency charged with protection of mollusks, has joined in these efforts, although more charismatic wildlife still draw the great majority of funds and attention. This book will greatly aid field biologists and other concerned citizens in efforts to identify, inventory, and protect our mollusk populations before it is too late.

Peter Walker



Colorado Division of Wildlife

sightings, contact the Colorado Division of Wildlife online (<http://wildlife.state.co.us/WildlifeSpecies/Profiles/MollusksAndCrustaceans/Mollusks.htm>) or call at (303) 297-1192. Over time, mollusk observations across the state will provide information regarding habitat quality, changes in species abundance, and population trends.

What are Mollusks?

The diversity in size, shape and life histories of mollusks is astounding, but they all share a common body plan. Mollusks usually have a muscular foot and soft bodies enveloped by a body wall called a mantle. The mantle folds around the mollusk's body, creating a cavity which houses either gills or an empty space which functions as a primitive lung. Glands in the mantle secrete shells of calcium carbonate. These shells are layered with an outer covering called the periostracum.

Mollusks can have one shell (gastropods), two shells (bivalves), eight shells (marine chitons), or no shell (slugs). Except for bivalves, mollusks also have a head and a tongue-like organ—a radula. While most species of mollusks have distinct male and female individuals, many are hermaphroditic, meaning one individual has both male and female reproductive organs.

How to Use This Guide

The Table of Contents provides illustrations of the general shell shape for each taxonomic family. Compare your specimen to the diagrams, and turn to the section which best

represents your animal. Each section includes a description and illustration of the family, as well as general biological and ecological information. Following the family overview, each known species of the family is described, arranged in alphabetical order according to the specie's scientific (Latin) name. The common name is included in parentheses. Photographs and descriptions of the species follow. For size comparison, a scale is included on the lower margin of an enlarged photo, and a true-to-size photo of the species is placed beside a U.S. dime.

It is important to note that individual specimens may look different from the photographs presented in this guide and may vary from the shape, size, color, and other characteristics described. There is great diversity within genera. Shell shape and appearance may change in response to the environment, and species vary over time due to genetic changes.

Current taxonomy for each species is listed and is based on shell morphology, reproductive structures and, in a very few cases, genetic information. Species taxonomy will no doubt change as genetic relationships are clarified through ongoing molecular and morphological studies.

Invasive Species

Non-native, invasive mollusk species are included in this guide. Invasive species are non-native organisms that have a harmful effect on the natural resources and the human use of those resources. They negatively impact the natural resources by out-competing native mollusk populations for food, space and other resources. They also negatively impact our fish and

plant populations. They disrupt the human use of our aquatic resources by restricting the flow of water for municipal, industrial or agricultural use. They also impair water based recreation such as angling, boating, swimming and beaching. There are little to no effective control measures for the invasive mollusks mentioned in this guide. Preventing their introduction is our only defense. Once these invasive are introduced to a new water body there is typically no way to control them and the perpetual maintenance required to mitigate their impacts have cost billions of dollars in other states. There are currently very few invasive mollusks in Colorado, but those that are present are among the worst known to North America. A few examples are below but more complete information can be found on their species pages.

Asian clams (*Corbicula fluminea*) were first documented in the South Platte River in Colorado in 1993. Since then their range has expanded to include the Arkansas River, San Juan River, and Colorado River basins (Cordeiro et al, 2007).

New Zealand mudsnails (*Potamopyrgus antipodarum*) were first detected in Colorado in Boulder Creek in 2004 and subsequently have been detected in the South Platte River below Elevenmile dam and in the Green River in Dinosaur National Monument.

Recently, zebra mussels (*Dreissena polymorpha*) and quagga mussels (*Dreissena rostriformis bugensis*) have been identified in eight Colorado lakes and reservoirs. These invasive mussels are well known throughout the USA and Europe for being the worst invasive species due to the high dollar costs associated with mitigating impacts in perpetuity to maintain natural systems and keep water moving to

municipalities, farms and industry. In 1988, zebra and quagga mussels were first introduced into the Great Lakes in the ballast water of large transoceanic ships coming from Europe. Since that time, the species has made its way across the waterways of North America by hitchhiking on recreational and commercial watercraft. For this reason, the State of Colorado has implemented a mandatory boat inspection program to prevent mussels from being transported by boats within the state and to prevent additional mussels from entering the state. Colorado lakes and reservoirs testing positive for zebra and or quagga mussels (as of May 2010) include Grand Lake, Granby, Jumbo or Julesburg, Pueblo, Shadow Mountain, Tarryall, and Willow Creek reservoirs. Biologists consider Blue Mesa Reservoir "suspect" for the presence of quagga mussels. These small bivalves cause serious economic impacts by clogging water storage and supply infrastructure and altering water quality. Their damaging impacts to native mussel, clam and fish populations are well documented throughout the country. For more information about zebra or quagga mussels, or other aquatic invasive species, please visit <http://wildlife.state.co.us/WildlifeSpecies/Profiles/InvasiveSpecies/ZebraandQuaggaMussels.htm>.

Collecting

Collection of living organisms from the wild is discouraged and is often illegal. Observing these animals in their natural environment can be both interesting and rewarding. If possible, take photos and obtain a precise location of your sighting (i.e. latitude and longitude or UTM) for submission to appropriate agencies.



GASTROPODS

There are more gastropods than any other kind of mollusk. Gastropods—slugs and snails—are primarily marine animals that have successfully invaded freshwater and terrestrial habitats.

Most gastropods have a single spiral coiled shell (snails), but some have a reduced shell or none at all (slugs).

Most snails can retract into their shell for protection. Some snails can close their shells by means of a “trap door”, or **operculum**. Members of this group are called prosobranchs. Prosobranchs have ciliated gills for respiration on the inner surface of the mantle. The cilia beat and cause a continuous stream of water to pass over the gills. Prosobranchs are not hermaphroditic; they are distinct male and female individuals. There are only a few freshwater prosobranchs in Colorado.

Snails without an operculum are called **pulmonates**. Pulmonates do not have gills. Instead, the thin membrane that lines the empty space of the mantle cavity functions like a primitive lung. These snails

obtain air at the water’s surface or utilize dissolved oxygen in the water. Some of the pulmonates can seal their aperture or opening with mucus during times of environmental stress. Most pulmonate gastropods are hermaphroditic, meaning that individuals have both male and female reproductive organs. This feature allows them to mate with any other individual of their species. This reproductive mode also provides a way for pulmonates to self-fertilize if mating with another individual is not an option. Unlike marine gastropods which usually release sperm and eggs into the water column, freshwater gastropods cannot risk losing sperm and eggs in a rapid stream flow. Thus, self-fertilization or delivering sperm sacs to another snail are reproductive adaptations to freshwater systems.

All gastropods go through a process called “torsion” during their larval stage. The gastropod’s body rotates 180° inside its shell and places the mantle cavity, including the anus, over the head and mouth. There has been considerable speculation about the evolutionary advantages and origins of this remarkable twist.

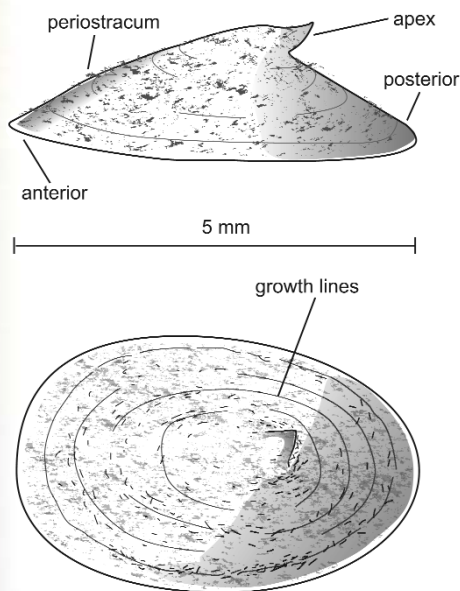
Most snails have a muscular foot which allows them to move slowly by creeping. In some gastropods, a modified foot allows for swimming or burrowing. Most gastropods have a well-developed head, eyes, and one or two pair of tentacles containing many nerve ganglia. The head of each snail contains a mouth with a radula. The radula is a ribbon containing rows of teeth that are very strong and can scrape algae from surfaces for feeding.

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

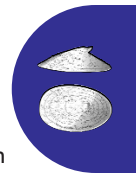
Family: Acroloxidae



The family Acroloxidae is represented by only 10 species world-wide. A relic from previous ice ages, this family is limited to high mountain lakes in North America. It has been found in isolated locations in Colorado, Montana, and Canada. The only representative in Colorado, *Acroloxus coloradensis*, is very rare.

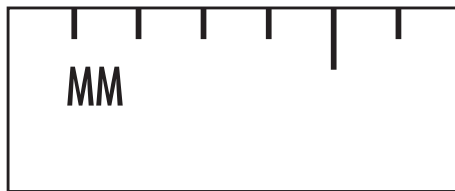
Gastropods in the Family Acroloxidae are unusual, because their shells lack spirals and twists. Their cone-shaped shells do have a small spire near the top (**apex**) that leans to one side. Their shells resemble those of marine limpets, but molecular studies on their soft tissue indicate that these marine and freshwater look-alikes are not related. Acroloxidae also look similar to another freshwater family, Ancyliidae, but are not closely related.

All Acroloxidae are very small—usually 4 to 7 mm in length. They are grazers, using their **radulae** (ribbons of teeth) to scrape algae from rocks and plants. Acroloxidae are hermaphroditic and lay yellowish masses of 2 to 3 eggs that cling to rocks or plant stems and leaves.



Acroloxus coloradensis

(Rocky Mountain capshell)



Acroloxus coloradensis, magnified to show detail.
(Photo by Andrew Hicks)

DESCRIPTION

Shell is delicate and limpet-like, with a slightly greater width at the anterior end. Apex has a spiny appearance and leans slightly toward the posterior end. Shell measures 4 to 7 mm in length and 2 to 3½ mm in width. Shell color is yellowish brown with variegated spots.

HABITAT

Species is restricted to high mountain lakes in the Rockies. It has been found in several localities in Colorado: Boulder County, Rocky Mountain National Park, and both Routt and Roosevelt National Forests. Due to its minute size, it is difficult to find and may exist in other habitats. Believed to be a relict population from the last ice age, it is found in similar habitats in isolated spots in Montana and British Columbia. Capshells cling to vegetation, submerged wood, or other larger mollusks.

NOTES

Species is hermaphroditic with cross-fertilization. *Acroloxus coloradensis* is very rare and is designated as a species of special concern by the Colorado Division of Wildlife.

Phylum: Mollusca

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Acroloxiidae

Genus: *Acroloxus*

Species: *Acroloxus coloradensis*
(Henderson 1930)

Acroloxus coloradensis
and dime, actual size.

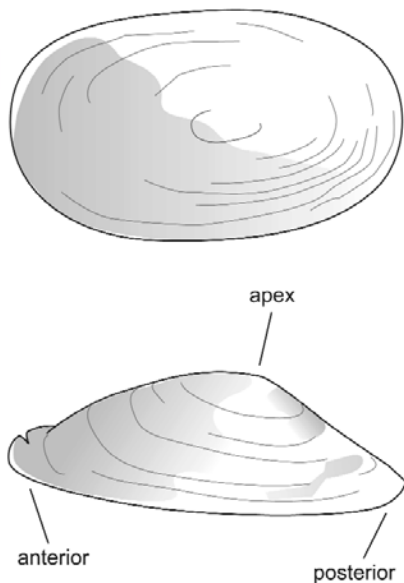


Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Ancyliidae



Ancyliids have world-wide distribution, and are found in a large range of habitats. At this time, it is uncertain how many distinct species of ancyliids exist. Taxonomic differences are being determined by molecular research on soft tissue and by utilizing scanning electron microscopy to identify different shell features of these tiny gastropods.

The cone-shaped shells of ancyliids are similar in appearance to marine limpets and species of Acroloxidae described earlier. The thin shell is round or oval in shape with a blunt apex instead of a tiny spire. Ancyliids range in size from 2 mm to 8 mm, and are brownish to very light tan, a good camouflage for their habitat.

Most ancyliids are found in the quiet water of lakes and ponds, and in slow moving backwaters of rivers. They are often attached to cattail stems, leaves, rocks, or other objects in the water. Some species prefer clinging to rocks in fast-moving rivers and streams, but those are the exception. Because they are so small and difficult to see, it is useful to feel for tiny bumps on the larger leaves of aquatic plants, and then use a hand lens to identify these little animals. All ancyliids are hermaphroditic.



Ferrissia fragilis (fragile ancyloid)



Ferrissia fragilis, magnified to show detail.

DESCRIPTION

Limpet-like shell is very small, fragile, oval, and up to 5 mm in length, with sides nearly parallel. The posterior of the shell (from apex to margin) is shorter with a concave slope and the anterior side is longer with a convex slope. Apex is raised, but not pointed, and leans to the right side of the shell. Shell is light colored.

HABITAT

Not much is known about *Ferrissia fragilis*, but it has been found in a lake in Yuma County, Colorado. It attaches to vegetation or rocks and scrapes its food from the surface of these objects.

NOTES

More research is needed on this species.

Phylum: Molluska

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Ancyliidae

Genus: *Ferrissia*

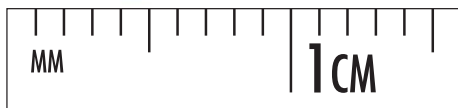
Species: *Ferrissia fragilis*
(Pilsbry and Ferriss
1907)



Ferrissia fragilis and dime,
actual size.



Ferrissia rivularis (creeping ancyloid)



Ferrissia rivularis, magnified to show detail.

DESCRIPTION

Limpet-like shell is small, up to 7 mm in length, 4 mm in width, and 3 mm in height, with parallel sides. Shell ranges in thickness, depending on environmental conditions, but is extremely fragile. Shell has a convex anterior slope and gently concave posterior slope. Apex is flattened

and leans slightly to the right. Shell color is light with faint radial striations (stripes).

HABITAT

Clings to rocks in rapid rivers, and has also been observed attached to mussel shells. Found in the Arkansas, Colorado, Platte, Rio Grande, and Yampa River drainages.

NOTES

This mollusk is extremely rare. If you think you have found this species, please report your sighting as indicated on page 2 of this guide.

Phylum: Mollusca

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Ancyliidae

Genus: *Ferrissia*

Species: *Ferrissia rivularis*
(Say 1817)



Ferrissia rivularis and dime, actual size.



Ferrissia walkeri

(cloche [cloaked] ancyloid)



Ferrissia walkeri, magnified to show detail.
(Photo by Peter Walker)

DESCRIPTION

Limpet-like shell is very small, thin, oval and 5 to 6 mm in length, 3 to 5 mm in width. The anterior end and left side of the shell is convex; the posterior and right side slightly concave. Apex is flattened and is closer to the posterior. Shell is light in color with distinct radial striations (stripes) on the apex.

HABITAT

Inhabits standing water, and has been found in a reservoir in Fremont County, Colorado, and in the Yampa River drainage.

NOTES

Uncommon in Colorado. This species is monitored by the Colorado Natural Heritage Program.

Phylum: Mollusca

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Ancyliidae

Genus: *Ferrissia*

Species: *Ferrissia walkeri*
(Pilsbry and Ferriss
1907)



Ferrissia walkeri and dime,
actual size.

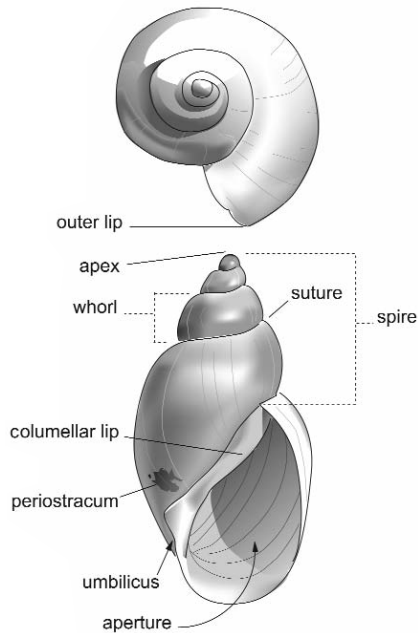


Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Lymnaeidae



Lymnaeids are found world wide, and show great diversity in the northern U.S. and Canada. There are seven species in Colorado, found both in eastern and western parts of the state. They range in shape from coiled and narrow with a tall spire to rounded and full (globose) with a pointed apex.

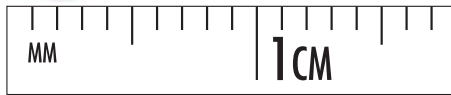
All lymnaeids are **dextral**, meaning the shell's aperture (opening) is on the right side, when the apex is pointing up. The columellar lip (lip of aperture near inside column) often curves outward. Shells are thin and fragile, and the **periostracum** (outer covering) is dark to light tan. Being pulmonates, lymnaeids do not have an operculum ("trap door"). They sometimes need to surface in order to refresh the air supply in their pulmonary cavity.



Lymnaeidae live in a variety of habitats, including lakes, swamps and even spring-fed ditches. Lymnaeids, as with most pulmonate gastropods, are hermaphroditic, but cross-fertilization is not uncommon. Fertilized eggs are deposited underwater in gelatinous, oval masses, and are found attached to sticks or rocks.

Fossaria bulimoides

(prairie fossaria)



Fossaria bulimoides, magnified to show detail.

DESCRIPTION

Medium sized shell, 6 to 10 mm in length. Shell morphology varies, but shell is sturdy and surface is smooth. Spire conical, with large, distended body whorls. Aperture oval with columellar lip folded back into the umbilical area. Shell is light to dark tan, but may be dull to shiny.

HABITAT

Lives in shallow water with muddy ooze, or among semi-aquatic plants close to shores of streams, ponds, lakes, and seasonal pools. Observed mainly in the Arkansas and Platte River drainages on the plains and the Colorado River drainage on the Colorado Plateau. Some seen in Rio Grande, Saguache, and Yampa River drainages as well.

NOTES

This snail is popular in the aquarium trade. It is also one of several Lymnaeids thought to be an intermediate host for a species of liver fluke.

Phylum: Mollusca

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Lymnaeidae

Genus: *Fossaria*

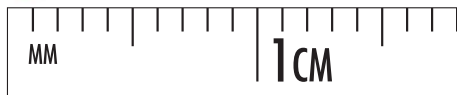
Species: *Fossaria bulimoides*
(L. Lea 1841)



Fossaria bulimoides and dime, actual size.



Fossaria obrussa (golden fossaria)



Fossaria obrussa, magnified to show detail.

DESCRIPTION

Shell medium sized, up to 17 mm in length. Shell morphology varies, but shell is sturdy and surface has a coarse curved growth line. Spire elongate and conical in shape with 4 to 7 rounded whorls; 4 is most common. Elongated, oval aperture is half the length of the shell.

HABITAT

Lives in shallow, mud-bottomed water. Commonly distributed in the Arkansas, Colorado, Platte, Republican, Rio Grande, San Juan, and Yampa River drainages, in the plains, mountain belt, and plateau.

NOTES

Much variability in shell morphology.

Phylum: Molluska

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Lymnaeidae

Genus: *Fossaria*

Species: *Fossaria obrussa*
(Say 1825)



Fossaria obrussa and dime, actual size.



Lymnaea (Radix) auricularia (big-eared radix)



Lymnaea (Radix) auricularia, magnified to show detail.

DESCRIPTION

Adult shell medium sized, 14 to 24 mm in length, thin and fragile with large, round (globose) body whorl and very short spire. Surface smooth or with a slightly hammered (malleated) appearance. Broad, ear-shaped aperture. Pale tan to dark brown in color.

HABITAT

Found in lakes, ponds, and slow moving waters with dense vegetation. *Lymnaea auricularia* is widely distributed in North America. In Colorado, it is found in the Colorado, Platte, Rio Grande, and San Juan River drainages, mostly in mountain belts and the Colorado Plateau.

NOTES

This snail was introduced from Europe and northern Asia. Although it is not native, it is not known to be a pest.

Phylum: Mollusca

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Lymnaeidae

Genus: *Lymnaea*

Species: *Lymnaea (Radix) auricularis*
(Linnaeus 1758)



Lymnaea (Radix) auricularia
and dime, actual size.



Lymnaea (Stagnicola) caperata (wrinkled marsh snail)



Lymnaea (Stagnicola) caperata, magnified to show detail.

DESCRIPTION

Adult shells are medium to large, 30 to 55 mm in length. Fairly thick shell; with coarse vertical lines or ridges on the spire and raised "hairs" on the periostracum. Aperture is oval. Shell color varies from light tan to black.

HABITAT

Found in almost all freshwater habitats across Colorado, although rare in the mountains. It can also be found in ditches and pools that dry up in summer.

NOTES

One of the most common mollusks in Colorado.

Phylum: Molluska

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Lymnaeidae

Genus: *Lymnaea*

Species: *Lymnaea (Stagnicola) caperata*
(Say 1829)



Lymnaea (Stagnicola) caperata
and dime, actual size.



Lymnaea (Stagnicola) elodes (marsh pond snail)



Lymnaea (Stagnicola) elodes, magnified to show detail.

DESCRIPTION

Shell medium to large, up to 32 mm or more in length, fragile to sturdy. Spire is an elongated cone shape. Spiral bands are sometimes present. Number of whorls varies, usually there are 7. Aperture less than half the length of shell and shaped like a half-moon. Columellar lip strongly twisted. Shell yellowish brown to dark brown in color.

HABITAT

Found in all perennial freshwater habitats. Found in the Platte River drainage and others on the eastern plains as well as in drainages in the mountains and western plateau of Colorado.

NOTES

Inhabits both quiet and fast water habitats. Common in Colorado.

Phylum: Molluska

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Lymnaeidae

Genus: *Lymnaea*

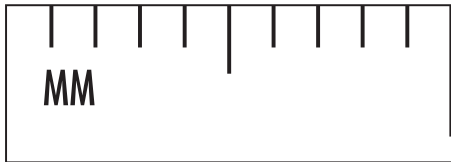
Species: *Lymnaea (Stagnicola) elodes*
(Say 1821)



Lymnaea (Stagnicola) elodes and dime, actual size.



Lymnaea parva (pygmy fossaria)



Lymnaea parva, magnified to show detail.

DESCRIPTION

Adult shell is very small, 3 to 6 mm, usually with 5 whorls. No spiral striae, but surface is rough. Aperture is half the length of shell and is oval. Distinct umbilicus.

HABITAT

Found in nearly all Colorado drainages.

NOTES

Lymnaea parva is an amphibious species that lives out of the water on mud flats most of the time.

Phylum: Mollusca

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Lymnaeidae

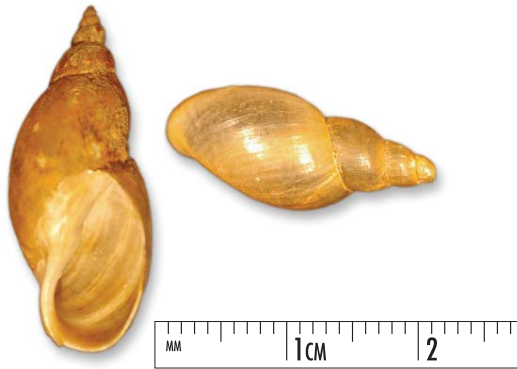
Genus: *Lymnaea*

Species: *Lymnaea parva*
(Lea 1841)



Lymnaea parva and dime, actual size.

Lymnaea (Stagnicola) stagnalis (swampy lymnaea)



Lymnaea (Stagnicola) stagnalis, magnified to show detail.

DESCRIPTION

Shell is large, up to 40 mm or more in length, thin and fragile. Spire is sharply pointed, with 6 or 7 whorls. Spire surface shiny with malleated (hammered) appearance. Aperture is usually half the length of shell. Columellar lip twisted outward.

HABITAT

Lives in warm, shallow ponds, lakes and marshes. Found only in mountainous portions of the Arkansas, Colorado, and Rio Grande River drainages.

NOTES

Lymnaea stagnalis slides along the bottom and is a grazer and scavenger. It can create a slime rope for crawling to the surface for air.

Phylum: Molluska

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Lymnaeidae

Genus: *Lymnaea*

Species: *Lymnaea (Stagnicola) stagnalis*
(Burch 1979)



Lymnaea (Stagnicola) stagnalis and dime, actual size.

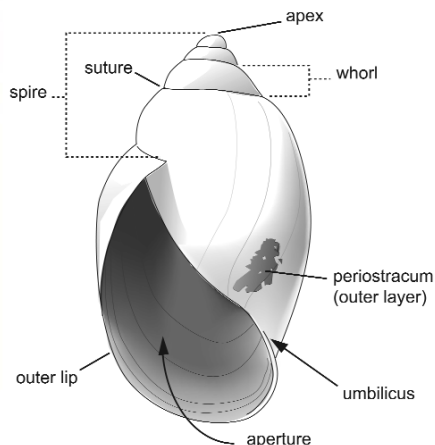


Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Physidae



Physids are the most abundant and widespread of North American gastropods. They are thought to be mainly New World gastropods, as only a few species occur in Eurasia and Africa. Some researchers propose that the Eurasian physids might be invasive snails that came from North America. Recent research indicates that Colorado probably has only three distinct physid species.

North American physids are pulmonates and lack an operculum. Their shells are similar to lymnaeids, but with an important difference: Physids are **sinistral**, or “left handed”. The aperture or opening is on the left side when the apex is pointing up. Also, physid spires are not as elongated as those of the lymnaeids.

Physids are highly adaptable and diversified and may be found in all types of habitats. Some species seem to be resistant to pollution. Species are difficult to identify based on shell characters alone, as environmental factors influence morphology. As needed research is completed on Physidae genera and species, there will likely be changes in both number and nomenclature of species.

Physids are hermaphroditic, but many use cross fertilization as a reproductive strategy. Egg masses are deposited on firm substrate. Color and size of individual eggs varies.



Aplexa elongata

(lance aplexa)



Aplexa elongata, magnified to show detail.

DESCRIPTION

Medium-sized shell, up to 20 mm in length. Spindle-shaped spire with glossy, smooth surface and up to 6 body whorls. Aperture is half the length of the shell, elongate and oval, and narrowing to a point. Body is highly pigmented; mantle does not protrude over the shell.

HABITAT

Found in seasonal drainages. Not common in Colorado. Recently found in Echo Canyon Reservoir, Archuleta County.

NOTES

The Eurasian species *Aplexa hypnorum* is thought to be identical to *Aplexa elongata*. In some literature, these names are used interchangeably.

Phylum: Mollusca

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Physidae

Genus: *Aplexa*

Species: *Aplexa elongata*
(Say 1821)

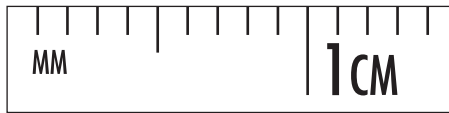


Aplexa elongata and dime, actual size.



Physa (Physella) acuta

(tadpole physa or
European physa)



Physa (Physella) acuta, magnified to show detail.

DESCRIPTION

Medium sized, generally up to 19 mm in length and 14 mm in width. Shell is smooth and egg-shaped with a pointed spire and 4 to 6 whorls. Aperture is large and narrows at the top. Shell color varies from light yellow to brownish.

HABITAT

Physa acuta is found anywhere there is water below 10,500 feet, from drainage ditches and polluted ponds, to swamps and mountain streams.

NOTES

Because they are so common, *Physa acuta* are sometimes called the “pigeons of freshwater” or “the fruit flies of malacology.” This group probably represents many species that are named incorrectly because of variations in shell morphology.

Phylum: Molluska

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Physidae

Genus: *Physa*

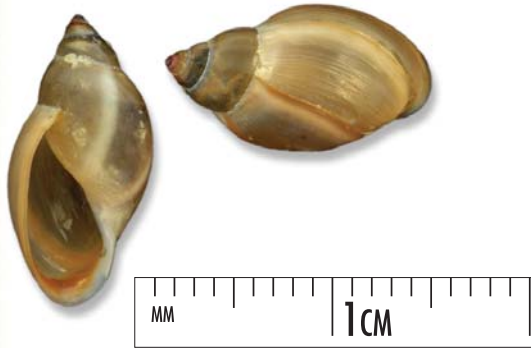
Species: *Physa (Physella) acuta*
(Draparnaud 1805)



Physa (Physella) acuta and dime,
actual size.



Physa (Physella) gyrina (tadpole physa or pouch snail)



Physa (Physella) gyrina, magnified to show detail.

DESCRIPTION

Shell medium sized, about 20 mm in length. Spire relatively tall with 5 to 6 whorls. Shell is elliptical in shape, with smooth surface and fine spiral striae and growth lines. A lighter growth band may indicate a different thickness of shell. Aperture is oval. Outer lip round, may have callus (rough deposit). Shell color brownish.

HABITAT

Found statewide in Colorado, especially in the plateau and mountain belt. *Physa (Physella) gyrina* is able to adapt to a wide range of environmental conditions. It has been found in flooded habitats and can withstand polluted water. It utilizes surface air if water has low oxygen content.

NOTES

Physa (Physella) gyrina is an extremely variable species with many names.

Phylum: Mollusca

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Physidae

Genus: *Physa*

Species: *Physa (Physella)*

gyrina
(Say 1821)



Physa (Physella) gyrina and dime, actual size.

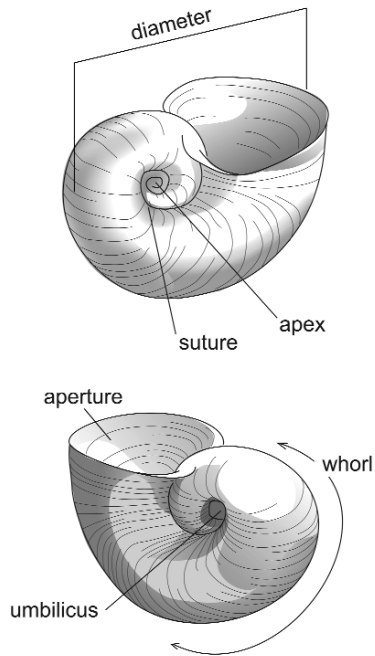


Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Planorbidae



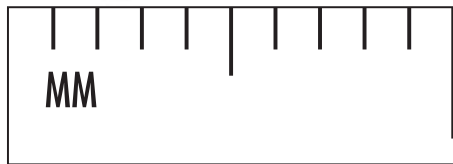
These familiar looking gastropods have the classic snail shape. Members of the planorbid family are found worldwide and distributed throughout North America and Colorado. Shell morphology is quite diverse. The name “Planorbidae” is descriptive of the general shape, which is coiled on one plane and flattened like a disk (**discoidal, planispiral**). Rather than having a pronounced spire like lymnaeids or physids, the spire is sunken into the central depression. If the planorbid snail were crawling away from you, the sunken spire and apex would be on its left side, and the umbilicus on its right (see illustration). Shells are very small to medium in size and do not have opercula.

Planorbids are found in a variety of habitats, from springs to ponds to large lakes, in fast to still water. Most are found in lakes or ponds and prefer a firm mud substrate with decaying vegetation, a favored food item. Not much is really known about planorbids, as this group has not been studied extensively.

All are hermaphroditic and can self- or cross-fertilize. Gelatinous egg masses are sausage shaped, contain yellowish eggs, and are deposited on rocks or firm, underwater debris.



Gyraulus circumstriatus (disk gyro)



Gyraulus circumstriatus, magnified to show detail.

DESCRIPTION

Shell very small, up to 5 mm in diameter. Planispiral (flattened), with 4 to 5 whorls, slowly increasing in size. Shell surface is smooth and glassy, with fine striae on periostracum and deep sutures

between whorls. Aperture oval. Shell semi-transparent, looks almost the same from both sides.

HABITAT

A “weedy” species found in lakes, ponds and reservoirs with abundant vegetation. Mostly seen in western Colorado.

NOTES

Common in Colorado. A magnifying lens is needed to see shell features.

Phylum: Molluska

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Planorbidae

Genus: *Gyraulus*

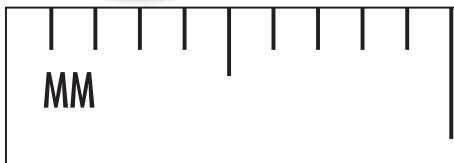
Species: *Gyraulus circumstriatus*
(Tryon 1866)



Gyraulus circumstriatus and dime, actual size.



Gyraulus parvus (ash gyro)



Gyraulus parvus, magnified to show detail.

DESCRIPTION

Shell small, up to 7 mm in diameter. Planispiral shell not completely flattened; with 4 rounded whorls that enlarge rapidly and a flat spire that hides first 2 whorls. Wide umbilicus on opposite side

shows all whorls. Shell surface smooth and glossy, semi-translucent, brownish.

HABITAT

Occurs throughout Colorado in shallow ponds and backwaters that are choked with vegetation. *Gyraulus parvus* clings to vegetation. Found in perennial and seasonal waters on the plains and in montane areas.

NOTES

The shell of this species is thicker than *Gyraulus circumstriatus*, but they are quite similar.

Phylum: Mollusca

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Planorbidae

Genus: *Gyraulus*

Species: *Gyraulus parvus*
(Tryon 1866)



Gyraulus parvus and dime, actual size.



Helisoma anceps (two-ridge ramshorn)



Helisoma anceps, magnified to show detail.

DESCRIPTION

Medium-sized planorbid shell, up to 22 mm diameter and 12 mm in height. Shell is fairly strong with 4 to 5 whorls. There is a distinctive ridge (**carina**) on

the upper surface of the body whorl and another around the umbilicus, on the opposite side. Umbilicus is deep. Ear-shaped aperture may have a red band.

HABITAT

Species is common in lower elevations in eastern and western Colorado. Found in lakes, rivers, and streams, among vegetation and in various substrates.

NOTES

Helisoma anceps is thought to burrow into the substrate and can survive long dry periods.

Phylum: Molluska

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Planorbidae

Genus: *Helisoma*

Species: *Helisoma anceps*
(Menke 1830)



Helisoma anceps and dime,
actual size.



Helisoma subcrenatum (rough ramshorn)



Helisoma subcrenatum, magnified to show detail.

DESCRIPTION

Shell medium to large, up to 32 mm in diameter and less than 10 mm in height. Planispiral shell usually reddish brown with loosely coiled whorls that increase rapidly in size. No distinctive carina. Sutures between whorls are

deep, and spire is sunken. Round aperture with inner lip coated with **callus** (calcareous deposit from mantle).

HABITAT

Found in most river drainages, mainly in montane and western plateau areas in Colorado. Species lives in permanent lakes, ponds, swamps, rivers, and creeks and occurs among vegetation.

NOTES

Recent studies indicate *Helisoma subcrenatum* is not as plentiful as it was in Colorado two decades ago.

Phylum: Mollusca

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Planorbidae

Genus: *Helisoma*

Species: *Helisoma subcrenatum*
(Carpenter 1857)



Helisoma subcrenatum and dime, actual size.



Helisoma (Planorbella) trivolvis (marsh ramshorn)



Helisoma (Planorbella) trivolvis, magnified to show detail.

DESCRIPTION

Small planispiral shell, 10 to 20 mm in diameter and 5 mm in height. The upper side has a distinctive ridge (carina); suture is not deep; spire is sunken. The underside has an open (not hidden) umbilicus with a deep suture. The whorls increase rapidly

in size. The aperture is round above and flat below. Inner lip has thin callus deposit.

HABITAT

Found in the Arkansas, Platte, and Republican River drainages in almost every kind of habitat; in shallow, quiet waters as well as lakes and rivers. Also found in ditches and cattle ponds.

NOTES

Helisoma (Planorbella) trivolvis is more common at lower elevations in western and eastern Colorado.

Phylum: Molluska

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Planorbidae

Genus: *Helisoma*

Species: *Helisoma*
(Planorbella)
trivolvis
(Say 1817)



Helisoma (Planorbella) trivolvis and dime, actual size.



Promenetus exacuous (sharp sprite)



Promenetus exacuous, magnified to show detail.

DESCRIPTION

Very small shell, 4 to 5 mm in diameter and 1½ mm height; planispiral and extremely flattened on upper and lower sides. Periphery of shell has a distinctive sharp carina and the aperture is flattened and carinated. Spire sunken

on top, with wide umbilicus on bottom. Surface is smooth, and tan to brownish in color.

HABITAT

Found in protected waters of lakes, ponds, and marshes.

NOTES

Records indicate *Promenetus exacuous* is only found in the Front Range of Boulder County in the Platte River drainage. Whether this is evidence of decline or sampling bias is not known. It was not found at all in a recent survey.

Phylum: Mollusca

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Planorbidae

Genus: *Promenetus*

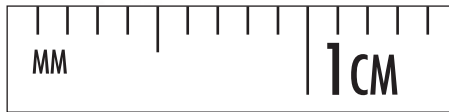
Species: *Promenetus*
exacuous
(Say 1821)



Promenetus exacuous and dime, actual size.



Promenetus umblicatellus (Umbilicate sprite)



Promenetus umblicatellus, magnified to show detail.

DESCRIPTION

Shell is very small, 4 to 5 mm in diameter and 1 to 1½ mm in height. Planispiral shape; upper and lower sides flattened. Aperture is oval with thin lip and callus showing. Surface is smooth.

HABITAT

In the past, *Promenetus umblicatellus* has mostly been found in mountainous areas of Saguache Creek, and the Colorado and Platte River drainages, with very few observations in the Republican River drainage on the eastern plains. Species prefers high altitude lakes, creeks, ditches, and sloughs.

NOTES

It is very difficult to tell the two *Promenetus* species apart. Neither were found in recent surveys, indicating additional research is needed to verify if extirpation has occurred.

Phylum: Molluska

Class: Gastropoda

Sub class: Pulmonata

Order: Basommatophora

Family: Planorbidae

Genus: *Promenetus*

Species: *Promenetus umblicatellus*
(Cockerell
1887)



Promenetus umblicatellus and dime, actual size.

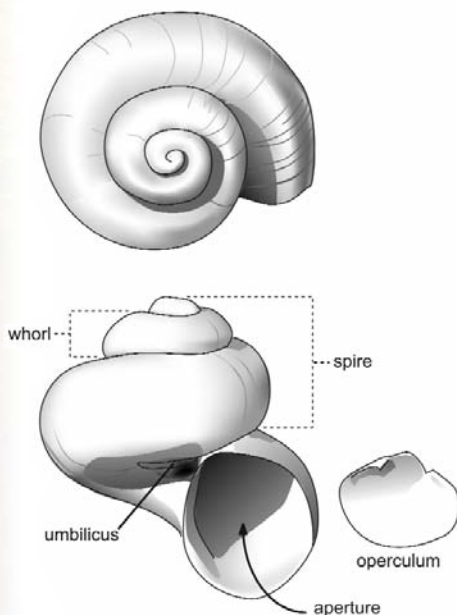


Class: Gastropoda

Sub class: Prosobranchia

Order: Mesogastropoda

Family: Valvatidae



Valvatids are prosobranch snails, those that have an operculum, a “trap door,” to cover the aperture of the shell. This family is one of two naturally occurring freshwater prosobranch genera in Colorado, and is represented by a single species. Valvatidae occur in cold, clean lakes and rivers in the northern hemisphere.

Valvatidae shells are quite small, 4 to 8 mm, and sturdy. The spire is of medium height with the opposite side having a deep umbilicus. The whorls increase in diameter as they descend from the spire. The aperture is round and the operculum, rarely found by shell collectors, is multi spiral, circular, and translucent. Sometimes opercula are used to identify valvatid species.

**Snail-case micro-caddis,
Helicopsyche borealis:**

The aquatic larva of this tiny caddis fly (Order Trichoptera) disguises itself by spinning a web-based spiral case in the shape of a valvatid snail and adorns the case with a mosaic of dark grains of sand. These 1 to 5 mm encased insect larvae are found throughout the Northern Hemisphere in cool running waters.

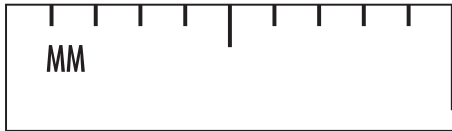


Helicopsyche borealis,
magnified to show detail.
(Photo by Peter Walker)



Valvata sincera

(Mossy valvata)



Valvata sincera, magnified to show detail.

DESCRIPTION

Shell is small, 4 to 5 mm, with up to 4½ whorls. While not as flattened as the planorbids, the medium-height spire has deep sutures and the umbilicus on the opposite side is deep. The aperture is

round with a translucent operculum. The distinctive shell is sturdy and yellowish brown in color.

HABITAT

Found in western Colorado in the headwaters of the Rio Grande, San Juan, White, and Yampa River drainages. *Valvata sincera* has also been reported in large and small high altitude lakes, ditches, and streams on the western plateau, on muddy substrates or rocks.

NOTES

Mossy valvata is extremely rare.

Phylum: Molluska

Class: Gastropoda

Sub class: Prosobranchia

Order: Mesogastropoda

Family: Valvatidae

Genus: *Valvata*

Species: *Valvata sincera*
(Say 1824)



Valvata sincera and dime, actual size.

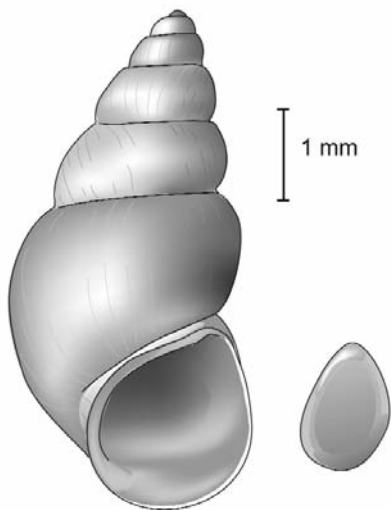


Class: Gastropoda

Sub class: Prosobranchia

Order: Mesogastropoda

Family: Hydrobiidae



Hydrobiids are found in most types of freshwater environments. This family of prosobranch snails includes over 100 genera that are found world wide—in temperate as well as tropical climates. Only two Hydrobiid species have been found in Colorado. One is exceedingly rare and the other is a recent invasive that has caused much concern among river watchers, scientists, fishermen, and people whose businesses are in the water recreation industry.



All Hydrobiids have very small, dark, coiled shells with round operculae. Shells are generally up to 4 mm in height and 2 mm in width. The spire has 4 whorls and can be slightly flattened in some species. The aperture is dextral (opens to the right).

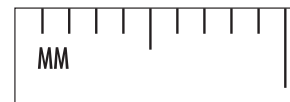
Hydrobiid snails have distinct sexes, and are **parthenogenic**, meaning that females produce eggs without any apparent involvement of males. It is known that reproduction is sexual at some point and that females can store sperm for a long time, however more research is needed to understand this process.

***Cionella lubrica*, glossy pillar:**

Just as physid snails occasionally venture onto land, the tiny glossy pillar, a terrestrial snail, sometimes ventures into aquatic habitat. Called "*Cochlicopa lubrica*" by some authors, this dextral native pulmonate can be mistaken at a glance as a New Zealand mudsnail, but closer examination shows a shell that is more blunt and less tapered. Glossy pillars for the most part inhabit moist terrestrial habitats often in the vicinity of streams.

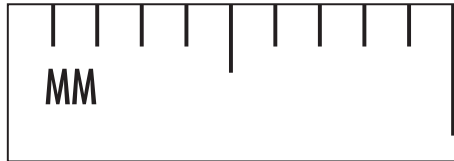
Cionella lubrica, magnified to show detail.

(Photo by Andrew Hicks)



Amnicola limosa

(mud amnicola or pond snail)



Amnicola limosa, magnified to show detail.

DESCRIPTION

Shell small, 4 to 5 mm in length, with four rounded whorls and a blunt spire. Right sided (dextral) aperture with a black operculum.

HABITAT

Grazes on algae. Widespread throughout eastern North America, from Canada to Florida. *Amnicola limosa* was found in 2002 in eastern Colorado in a slow-moving, shallow creek with a silty bottom and bullrushes present. Collections made in 2008 and 2009 confirm the presence of a population of this species in the state fish hatchery at Durango on the Animas River in southwest Colorado.



NOTES

Because this species is quite rare in the Western high plains, further study is needed to confirm population identification.

Phylum: Mollusca

Class: Gastropoda

Sub class: Prosobranchia

Order: Mesogastropoda

Family: Hydrobiidae

Genus: *Amnicola*

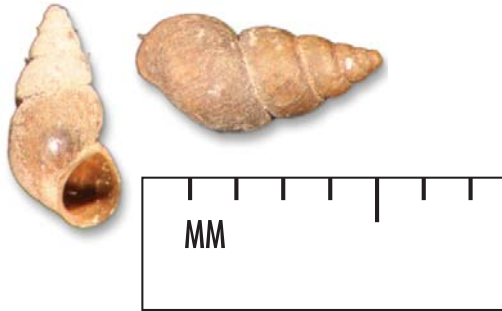
Species: *Amnicola limosa*
(Say 1817)



Amnicola limosa and dime, actual size.

Potamopyrgus antipodarum (New Zealand mud snail; NZMS)

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Potamopyrgus antipodarum, magnified to show detail.

DESCRIPTION

Shell is small, usually 5 mm in length and 1 ½ mm in width. Dark tan to brown.

HABITAT

NZMS is a distinctly freshwater species. Preferred habitat is swift, clean streams, but NZMS can tolerate dry, hot periods and even water with high saline content. They are sometimes eaten by fish, but pass unharmed through the

fish's digestive system with operculum closed tight, and are deposited with waste.

These voracious gastropods graze upon algae-covered rocks to the detriment of native species of larval insects and snails that use the same food source. By sheer numbers they are able to eat much of the available food in any area they populate. By reducing food sources, NZMS reduce the fish populations that feed on native snails and insect larvae.



(Photo by Elizabeth Brown, Colorado Division of Wildlife)



NOTES

Potamopyrgus antipodarum is an invasive species everywhere in Europe and North America. As of 2010, NZMS is known to occur in Arizona, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming and British Columbia. Within Colorado, NZMS were first detected in Boulder Creek in 2004 and subsequently have been detected in the South Platte River below Elevenmile dam and in the Green River in Dinosaur National Monument. Humans have inadvertently transported this gastropod from one pristine fishing stream to another, as the snails can cling to boots, waders, boats, dogs and gear. It is imperative that anglers keep all gear clean and dry in between each use. Up to date instructions for preventing the spread of NZMS on angling equipment can be found at <http://wildlife.state.co.us/WildlifeSpecies/Profiles/InvasiveSpecies/NewZealandMudsnail.htm>. The snails occasionally stick to birds and wildlife, but humans seem to be the

major vector. Once in a new environment, it reproduces rapidly by parthenogenesis, with broods as large as 60 to 70+. Education and research regarding the effects of NZMS on native populations is ongoing. **The State Aquatic Nuisance Species Law requires that any information regarding the known or suspect locations of NZMS is reported to the CDO by calling (303) 291-7362 or emailing ReportANS@state.co.us within 48 hours.**



Phylum: Molluska

Class: Gastropoda

Sub class: Prosobranchia

Order: Mesogastropoda

Family: Hydrobiidae

Genus: *Potamopyrgus*

Species: *Potamopyrgus antipodarum*

(J.E. Gray 1853)



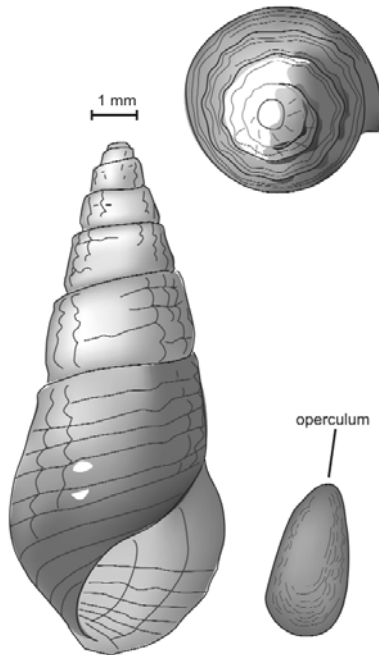
Potamopyrgus antipodarum and dime, actual size.

Class: Gastropoda

Sub class: Prosobranchia

Order: Caenogastropoda

Family: Thiaridae

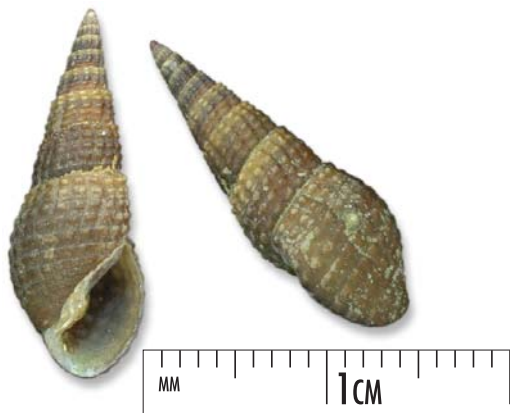


Thiarids are Old World tropical snails that have expanded their range over the planet mainly by means of the aquarium trade. Only one species has been found in Colorado, and it is isolated in warm springs. Invasions have also occurred in some states with warmer climates, mainly Texas, Arizona, and Florida, where competition with native species is problematic.

Thiarids have an operculum with a small nucleus that expands in concentric circles. The nucleus can be central or off to one side. There are many genera with similar shells. Thiarids in general have separate sexes but, like Hydrobiids, are often parthenogenic.



Melanoides tuberculata (red-rimmed melania)



Melanoides tuberculata, magnified to show detail.

DESCRIPTION

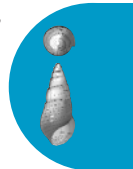
Shell slender and high spired, up to 30 to 40 mm in height, with vertical ribs and spiral threads. Spire is pointed and usually twice the length of the aperture or more. The aperture is dextral (right sided). Operculum has nucleus very close to the base. Color is reddish brown, mottled with rust colored spots.

HABITAT

Found in two mountain hot springs in Colorado. This tropical invader is limited to warm water, and can't expand its range on its own to new hot springs. It is not spreading in Colorado.

NOTES

It is an invasive species introduced by humans in the aquarium trade, first sold as the "Philippine Horn of Plenty" snail by aquarists in 1937 in Florida. This snail is known to crowd out native species in the Gulf States. *Melanoides tuberculata* is known to be the intermediate host for the trematode (liver fluke) *Centrocestus formosanus*, which is often fatal to small native fishes.



Phylum: Molluska

Class: Gastropoda

Sub class: Prosobranchia

Order: Mesogastropoda

Family: Thiaridae

Genus: *Melanoides*

Species: *Melanoides tuberculata*
(Müller 1774)



Melanoides tuberculata and dime, actual size.

BIVALVES

There are approximately 15,000 species of bivalves, a class which includes clams, mussels, oysters and scallops. Most bivalves are marine, but ten to 15 percent occur in fresh water, and these are either mussels or clams.

All bivalves have two shells or valves, and a laterally flattened body. The valves are joined at the top (dorsal edge) by a hinge. Each half of the hinge has a number of tooth-like structures and corresponding indentations. These interlock and help hold the two valves in place. Two strong adductor muscles on the inner surface of the valves close the shells while springy ligaments allow the bivalve to open when the adductor muscles relax. The hinged portion is the oldest part of the shell. It is called the **umbo** (*pl*: **umbones**) or beak because it bulges, and the shell grows from this area. The umbo, along with other shell characteristics is often used for identification and classification of bivalves.

Within the shell is a soft layer of tissue called the **mantle**, which secretes the three layers of the shell: the outer layer (periostracum), the middle (calcareous prismatic) layer, and the pearly, inner (nacreous) layer. The mantle also encases gills (if present).

Bivalves are unique among the mollusks because they do not have a distinct head region or a radula for feeding. Almost all are **suspension** or **filter** feeders and either push water through the mantle cavity with the help of little hairs (**cilia**) or by using siphons that stick out of the valves during feeding. The incurrent siphon brings water and suspended particles inside the shell, and the excurrent siphon sends water and unwanted particles back outside. Either way, water is washed over the gills, which are used for feeding as well as respiration. A sticky mucus covers the gills, and small organisms and organic material become trapped in the mucus. Cilia and two small organs called **palps** help carry food to the mouth.

Most bivalves have a muscular “foot” at their front (ventral) end that can be extruded and used to burrow or move. Most spend their lives in one place, burrowed into sand or mud (**infaunal**) or—less commonly—attached to harder substrates.

While smaller than marine species, freshwater mussels are large enough to have been an important

food source of early Native Americans. Many shell piles or middens have been found at archaeological sites near rivers, streams, and lakes in North America. Historically, freshwater mussels and clams were exploited commercially for the button industry, depleting many species, especially in southeastern United States. Now, most of the remaining commercial harvest goes



to Asia, where cultured pearls are made using spheres of freshwater bivalve shells as “seeds”.

Freshwater mussels are in grave decline in many states, including Colorado. In 1989 Dr. Shi Kuei Wu, of the University of Colorado Museum, reported that the “mussel fauna of Colorado is in critical condition because of polluted industrial effluent and agricultural impoundment of river water.” Some mussel species are adapting to new environments, and many are now surviving in man-made reservoirs and spring-fed lakes throughout the state.

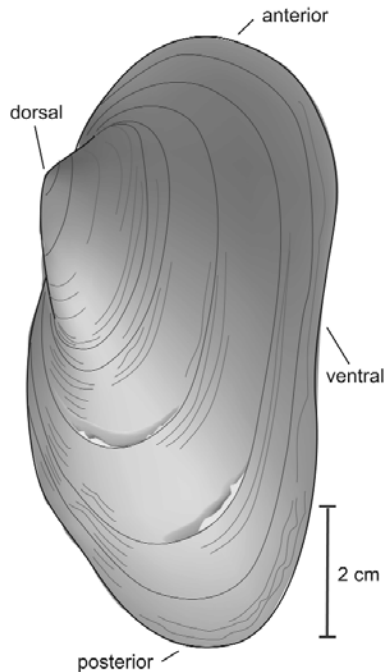
Bivalve reproduction varies greatly and will be discussed for each family. Because of the enormous variety of sizes, shapes, surface sculpturing, and colors, shell characteristics are of great importance in the identification and classification of bivalves.

Class: Bivalvia

Sub class: Paleoheterodonta

Order: Unionidea

Family: Unionidae

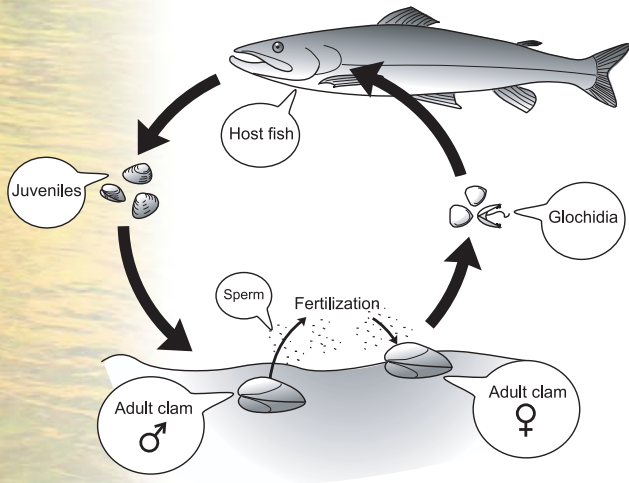


Members of this family are commonly called freshwater mussels, and North America has the most diverse group in the world. They are sometimes mistaken for clams and vice versa. Most unionids reside in the midwest and southeastern areas of the United States in rivers, lakes, and streams. The Rocky Mountains generally serve as the western boundary of their range. The number of unionid species has declined in Colorado and throughout the rest of the continent. It is crucial to gather information about the remaining species, so their decline or return can be documented.

Factors attributed to the decline of freshwater mussels include: construction of dams prohibiting movement of fish hosts, toxic waste in rivers and lakes, impoundment of water for agriculture causing subsequent water levels in reservoirs, non-native invasive species introductions, and overharvesting of these mollusks in the early part of the 20th century. Some species of unionids are stable and surviving. Originally, mussels inhabited river systems in the west, but now most are found in lakes and man-made reservoirs, showing their ability to adapt to changing conditions.

Unionids are large, ranging from 30 mm to 250 mm in length, and vary in color and shape. Most are oval and elongate, but some have depressions in their shells and can even appear triangular. Some mussels

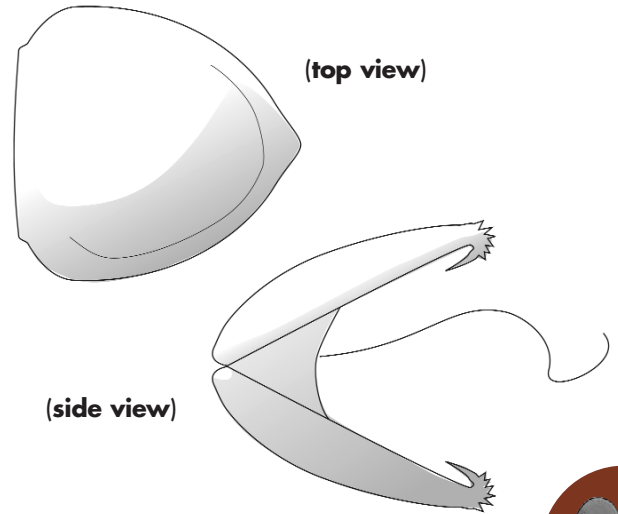




have sculpturing on their shells, which can be helpful for identification.

Freshwater mussels are **gonochoristic**, or have separate sexes. The males release sperm into the water and a small percentage of released sperm find their way into the incurrent siphon of females. Eggs develop into parasitic larvae (**glochidium**) in pouches called **marsupia**.

Glochidium



At the glochidial stage, the young mussels are expelled from the mother's body through the excurrent siphon and must quickly find a fish host and attach to its gills or fins. Glochidia cannot swim, so many are lost at this stage. The lucky ones stay attached to their host fish until they are strong enough to drop off and find a place in the substrate to grow into adults. Some mussels have a specific host, but others are not as picky, and will attach to any fish that comes along.

Anodonta grandis grandis (giant floater)

DESCRIPTION

A large mussel, measuring up to 190 mm in length. Elongated and oval with rounded valves (shells) and quite fragile. Umbo has 2 to 4 bumps, and the inside of the hinge has no teeth. Pearly finish inside shell may have a slight tint of gray, pink or yellow. Variation in shells is influenced by temperature and depth of water.

HABITAT

This species may still be found on the eastern plains of Colorado in the Arkansas and Platte River basins, but is more likely to be found in man-made reservoirs and newer lakes. It is not found in mountain streams or lakes because of extreme temperature and water flow fluctuations. Requires relatively quiet waters and suffers greatly if water levels decrease enough to expose the shells



Anodonta grandis grandis, shown smaller than actual size.



and bodies. The creation of new lakes and reservoirs may have produced a refuge for this species, as natural habitats have been widely altered and disturbed.

NOTES

“Giant floater” or *Anodonta grandis* *grandis* is a generalist in the choice of fish hosts for the glochidia (larvae) to cling to. It seems that any fish will do, which is good news for its survival. This mussel is limited to the places where fish can go, thus there is little chance of expanding to new habitats.

Anodonta grandis grandis
and dime, actual size.



Phylum: Molluska

Class: Bivalvia

Sub class: Paleoheterodonta

Order: Uniionidea

Family: Unionidae

Genus: *Anodonta*

Species: *Anodonta grandis*,
grandis (Say 1829)



Anodontoidea ferussacianus (cylindrical papershell)

DESCRIPTION

Shell moderate in size, up to 106 mm in length, 47 mm in width, and 52 mm in height. The anterior part of the shell is rounded while the posterior has a blunt point. There is a little indentation or pinch in the middle of the ventral margin, opposite the hinge (dorsal) side. The umbo is not pronounced and the outer shell layer (periostracum) is greenish to dark brown. There are no teeth inside the hinge. Both valves are equally rounded. The nacre or pearly coating inside the shell is white and slightly iridescent, adding to its delicate appearance.

HABITAT

Found in mud or sandy substrate of lakes and quiet streams. Recently found in only two locations, indicating a reduction in habitat and resulting reduction in populations. This was once the most



Anodontoidea ferussacianus, shown smaller than actual size.



common unionid species in Colorado, but historical environments have been altered dramatically in the last 100 years, especially the South Platte River drainage.

NOTES

Anodontooides ferussacianus utilizes a very few particular host fish species to which the glochidia (larvae) can cling while developing. Host fish species must also be maintained and protected so that this freshwater mussel can survive. Colorado fishes potentially utilized as hosts for the glochidia of the cylindrical papershell, *Anodontooides ferussacianus*, include largemouth bass, *Micropterus salmoides* (Watters, 1995; O'Dee and Watters, 1998), bluegill, *Lepomis macrochirus* (Watters, 1995), black

Anodontooides ferussacianus
and dime, actual size.



crappie, *Pomoxis nigromaculatus* (Hove et al, 1995), common shiner, *Luxilus cornutus*, Iowa darter, *Etheostoma exile*, and white sucker, *Catostomus commersoni* (Fuller et al, 1978).

Phylum: Mollusca

Class: Bivalvia

Sub class: Paleoheterodonta

Order: Unioniidea

Family: Unionidae

Genus: *Anodontooides*

Species: *Anodontooides ferussacianus*
(Lea 1834)



Unio merus tetralasmus (pond horn)

DESCRIPTION

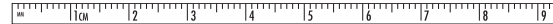
Have a thicker, stronger shell than the other mussels found in Colorado. Size is medium to large, up to 110 mm in length, 60 mm in height and 40 mm in width. The umbones are rounded and the periostracum is smooth except for a narrow ridge on the sloped posterior end. Color varies from gray-green to yellow-brown and is lighter in the center. Hinge is very long and black; nacre (pearly finish inside valves) is silver to bluish white. This species has “teeth” on the inside of the hinge area on both valves, which differentiates it from other Colorado unionids.

HABITAT

Unio merus tetralasmus has been found on the muddy bottoms of lakes or small streams.



Unio merus tetralasmus, shown smaller than actual size.



NOTES

Last sighting was a right shell found in 2001 near Lamar, Colorado, in a semi-arid climate. The species is included in this list in the hope that someone may find a population while exploring the rivers and lakes of Colorado. It may be extirpated here, but still exists in the Midwestern and Southeastern United States.

The pond horn is a reproductive specialist, meaning that the fish host for its glochidia (larvae) is of great importance. There is only one fish that the larvae attach to, the golden shiner (*Notemigonus crysoleucas*), a small fish used mostly as bait. If this fish is not available to *Unio merus tetralasmus*, its broods cannot survive. It has been thought that during

Unio merus tetralasmus
and dime, actual size.



dry seasons, *Unio merus tetralasmus* could **aestivate**, or become inactive and could seal shut in order to survive drought conditions. This has never been confirmed, but is worthy of research if this rare species can be located.

Phylum: Mollusca

Class: Bivalvia

Sub class: Paleoheterodonta

Order: Unionidea

Family: Unionidae

Genus: *Unio merus*

Species: *Unio merus*
tetralasmus
(Say 1831)

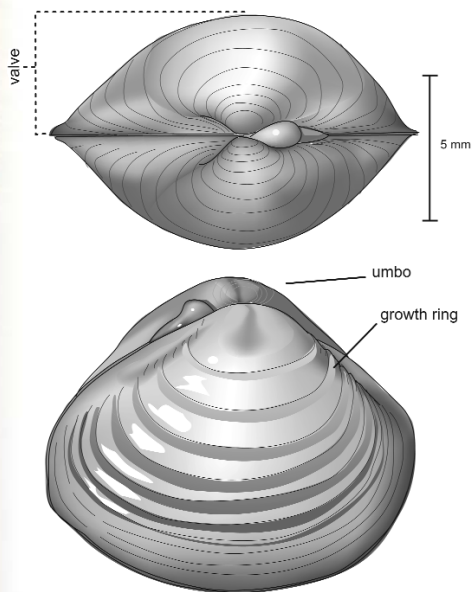


Class: Bivalvia

Sub class: Heterodonta

Order: Veneroidea

Family: Corbiculidae



This freshwater family is native to Asia, Australia and Africa, but the *Corbicula*, or Asian clam, is invasive in Europe and North America. There are two main groups of Corbiculidae: *Batissa*, with large, heavy shells, and *Corbicula*, which is much smaller. Only the *Corbicula* have been found in Colorado. Both groups have varying colors of outer shells (**valves**), and most have purplish **nacre** (pearly inside layer). The Asian *Corbicula* has distinctive ridges on both shells.

Corbiculids are generally gonochoristic (separate sexes), but hermaphrodites exist and are capable of self-fertilization. Most are brooders, and they release offspring when the young are large enough to sink to the substrate. It is thought that juveniles produce sticky byssal threads to allow anchoring in currents and also to entangle themselves on the feet of wading birds and mammals for transportation to another site.

The *Corbicula* are often found living in sand in shallow rivers, while the *Batissa* genus inhabits coastal estuarine waters. Members of the *Corbicula* group live in large clusters, with densities up to 20,000 individuals per square meter, making them a pest in water systems and a threat to native species.

More research is needed to look at variation within this family to determine if there is indeed only one species in North America.



Corbicula fluminea (Asian clam)



Corbicula fluminea, magnified to show detail.

DESCRIPTION

Adults can reach 50 to 65 mm in length, although 25 mm is typical. Shell is oval, but not elongated, and is deep on the hinge side. The periostracum (outer layer of shell) has well-defined, thick growth rings and varied coloration. Older clams have a darker colored periostracum, younger clams lighter brown or tan. Juveniles may also have a purplish stripe in the umbo area. Nacre is white with some luster.

HABITAT

Corbicula has experienced great success in North America and is moving through Colorado rapidly. Asian clams were first detected in the South Platte River in Colorado in 1993 and have since expanded their range to include the Arkansas River, San Juan River and Colorado River basins (Cordeiro et al, 2007). They prefer fast moving water because currents provide food for these suspension feeders.

NOTES

The Asian clam invasion in North America has created problems for power plants and water canals because large numbers of clams block water intake valves. They also compete with native bivalves for food, and competition increases as Asian clam populations explode.

Corbicula fluminea is used in Asia as a food source and may have been cultivated in the United States. It is also used for fish bait—probably another way it has been spread throughout North America. It is sold in the aquarium trade as “pygmy clam”, or “golden clam.”



Corbicula fluminea and dime, actual size.

Phylum: Molluska

Class: Bivalvia

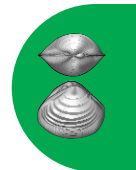
Sub class: Heterodonta

Order: Veneroidea

Family: Corbiculidae

Genus: *Corbicula*

Species: *Corbicula fluminea*
(Müller 1774)

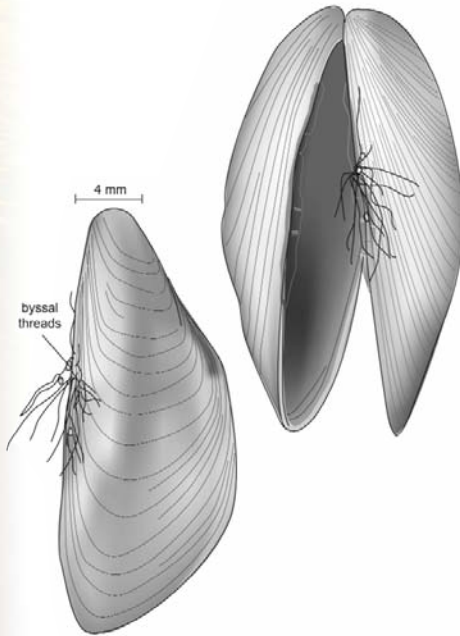


Class: Bivalvia

Sub class: Heterodonta

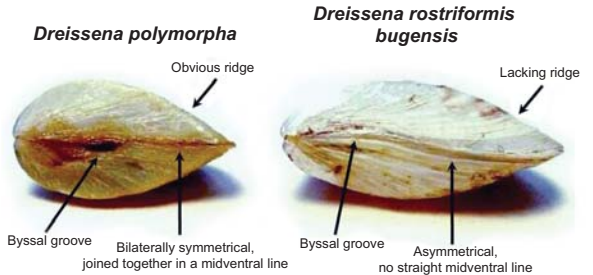
Order: Veneroidea

Family: Dreissenidae



The family Dreissenidae is not native to North America, but are included here because one genus, *Dreissena*, has invaded and impacted the Great Lakes and river systems of the entire United States.

Dreissenids have hinged shells without hinge teeth. Somewhat triangular in shape, they have sharply pointed umbones. The shell is bent, with a distinctive inside curve and an outward curve on the opposite side. The sturdy shells



(Photo by U.S. Geological Survey)

Dreissena polymorpha
(Actual size is 15 mm)

Dreissena bugensis
(Actual size is 20 mm)



- Sits flat on ventral side
- Triangular in shape
- Color patterns vary
- Topples over, will not sit flat on ventral side
- Rounder in shape
- Usually have dark concentric rings on shell
- Paler in color near the hinge

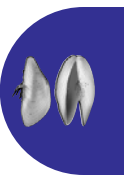
(Photo by U.S. Geological Survey)

range in size from 25 to 40 mm, with yellowish to brown or grayish color patterns. Some have stripes on the outer shells (periostraca).

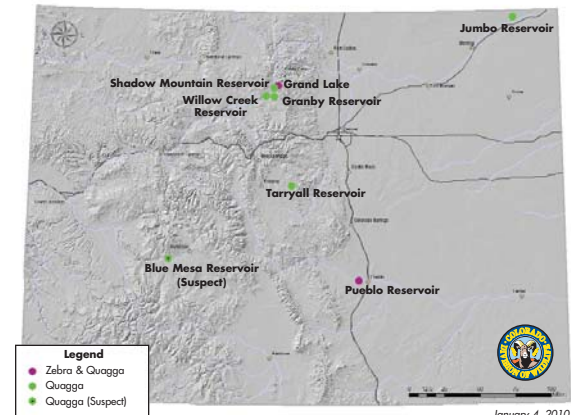
These freshwater mussels have complex gills, and are able to filter large amounts of water as they intake phytoplankton when feeding. By filtering all the particles from the water, they are known to increase visibility at the expense of all other animals that feed on suspended materials. They need well-oxygenated waters and can attach to any semi-hard surface by using byssal threads which are secreted by the mantle. No native species has byssal threads and can truly attach to surfaces. They are usually found in reservoirs, lakes, canals and rivers. There are some genera in Europe that can tolerate brackish waters.

This family consists of prolific reproducers, as they spawn into the water column and release free-floating planktonic larvae, called **veligers**, that remain in the water column for some time before undergoing metamorphosis and settling out of the water onto substrate.

In 2008, the State of Colorado passed the Aquatic Nuisance Species (ANS) Act which instituted a mandatory watercraft inspection and decontamination program to prevent the overland transport and introduction of invasive mussels and required reporting of Dreissenids and other ANS to the CDOW. All trailered watercraft must be inspected prior to launching in any waters of Colorado if they are coming in from out of state, leaving a positive water or if it is required by the lake/reservoir's owner or manager. For more information, visit <http://wildlife.state.co.us/Fishing/MandatoryBoatInspections.htm>.



Zebra and Quagga Mussels in Colorado



Dreissena polymorpha (zebra mussel)



Dreissena polymorpha, magnified to show detail.
(Photo by Lauren Livo and Steve Wilcox)

DESCRIPTION

Medium sized, 25 to 40 mm wide, and half as long across. Nearly triangular in shape, with sharply pointed umbones. Periostricum has alternating lighter yellowish colors with darker browns. Smooth shells are actually striped in color, hence the common name zebra mussel. Deeply curved margins give the shell a bent appearance. Congregate in large numbers.

HABITAT

Native to the Black, Caspian, and Aral Seas, zebra mussels were first detected in the USA in the Great Lakes Region near Lake St. Clair in 1988. They are believed to have been introduced in the ballast water or on anchors of transoceanic vessels. Over the next 10 years they expanded their range to include almost every Eastern state by moving through the natural flow of water and by hitchhiking overland on recreational and commercial watercraft and equipment. First documented in the West in 2007 and in Colorado in 2008, zebra mussels are now found in Grand Lake and Pueblo Reservoir. Similar to the Great Lakes, in both Colorado locations they are co-habiting with quagga mussels, which are found in five additional reservoirs including Granby, Jumbo, Shadow Mountain, Tarryall, and Willow Creek.

They can be found in reservoirs, lakes, canals, and rivers attached to a semi-hard substrate by byssum (byssal threads). They will also attach in great numbers to native benthic organisms including large unionid bivalves, fouling the shells, reducing food supplies, and causing the death of many larger mussels.



NOTES

Zebra mussels and quagga mussels have had the greatest economic impacts of any invasive species in North America. By attaching and clogging pipes, they cost the United States billions of dollars annually in damage and maintenance to municipal, industrial and agricultural water supplies. These invasive mussels have the ability to disrupt the food web at two levels by removing the base of the food chain through filtration and by attaching to native organisms preventing their ability to respire and feed, ultimately smothering them to death. For these reasons, zebra mussels are one of the few species with the ability to entirely crash the aquatic food web. In addition, they impair all forms of water based recreation including fishing, swimming and boating; and can result in costly repairs to recreational and commercial watercraft by clogging engines and intakes. Researchers, boaters and anglers can help to stop the spread of invasive mussels by keeping all watercraft,

equipment, and gear clean and dry in between each and every use.

The State Aquatic Nuisance Species Law requires that any information regarding the known or suspect locations of zebra mussels are reported to the CDOW by calling (303) 291-7362 or emailing ReportANS@state.co.us within 48 hours.

Phylum: Molluska

Class: Bivalvia

Sub class: Heterodonta

Order: Veneroidea

Family: Dreissenidae

Genus: *Dreissena*

Species: *Dreissena polymorpha*
(Pallas 1771)



Dreissena polymorpha
and dime, actual size.




Dreissena bugensis (Quagga mussel)



Dreissena bugensis, magnified to show detail.
(Photo by U.S. Geological Survey)

DESCRIPTION

Medium sized, up to 4 cm across. The quagga mussel, *Dreissena bugensis*, is rounder in shape than *Dreissena polymorpha* or zebra mussel. The quagga mussel has a rounded carina between the dorsal and ventral surfaces, rather than the more bent or triangular appearance of the zebra mussel. The



quagga shell is often larger than that of the zebra, but there is much variation and overlap in color between the two species. Usually quagga mussels have dark concentric rings on their shells, and the two valves are asymmetrical, whereas zebra mussel valves are symmetrical. One way to tell the two species apart is to stand them both up on their ventral sides. The one that topples over is the quagga mussel.

HABITAT

Dreissena bugensis is indigenous to rivers, canals, and reservoirs in the Dnieper River tributaries in Eastern Europe. They were first discovered in the American Great Lakes (Erie Canal and Lake Ontario) in 1989. Quagga mussels can live up to 300 feet deep, if well oxygenated. They can live in deeper, colder waters than zebra mussels and can attach to much softer substrates. North American distribution includes most of the Eastern states and several western states including Arizona, California, Colorado, Nevada, and Utah. Within Colorado quagga mussels have been detected in Grand Lake, Granby Reservoir, Jumbo Reservoir, Pueblo Reservoir, Shadow Mountain Reservoir, Tarryall Reservoir, and Willow Creek Reservoir. Blue Mesa is considered suspect for quagga mussels. Quagga and zebra mussels are being transported overland on

recreational and commercial watercraft and equipment. Because they can live out of water for up to 30 days depending on temperature and humidity, it is imperative that researchers, boaters and anglers keep their boats, equipment and gear clean and dry in between each use to prevent accidentally introducing these species to new waters.

NOTES

This invasive species may represent a greater threat to higher altitude lakes in the Rocky Mountain Region than the less cold tolerant zebra mussel, as they have been detected in several headwaters reservoirs in Colorado. Researchers are concerned about the spread of this species, as reproduction is prolific and colonization rapid. Like the zebra mussel, quagga mussels cause both environmental degradation and economic loss by fouling habitat waters and clogging water supply and distribution structures. Both species are spread by human recreational and commercial

activities involving overland transfer from one water to another in addition to larval drift in river systems. All watercraft and equipment used in the water must be clean and dry in between each use to prevent further spread by humans.

The State Aquatic Nuisance Species Law requires that any information regarding the known or suspect locations of quagga mussels are reported to the CDOW by calling (303) 291-7362 or emailing ReportANS@state.co.us within 48 hours.

Phylum: Molluska

Class: Bivalvia

Sub class: Heterodonta

Order: Veneroidea

Family: Dreissenidae

Genus: *Dreissena*

Species: *Dreissena bugensis*
(Andrusov
1897)



Dreissena bugensis and dime, actual size.

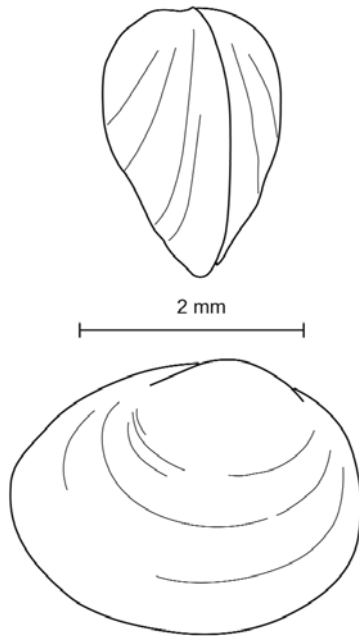


Class: Bivalvia

Sub class: Heterodonta

Order: Veneroidea

Family: Sphaeriidae



In Colorado, sphaerids are commonly called "fingernail clams", "pea clams", "pill clams" or sometimes "seed shells". They live in almost all freshwater environments in the Rocky Mountain region, including springs, seeps, and deep, marshy earth, as well as riffles and pools in streams and rivers.

Sphaerids are clams with a distinctively different shape than mussels. As the name implies, sphaerids are more round in shape and the shells are inflated rather than flat-looking. Most sphaerid shells are nearly symmetrical, with the umbo or beak usually at the center of the hinge area, although there is variation between species. Shells (valves) are whitish, cream-colored or sometimes yellowish brown. The nacre (pearly finish) is white or bluish. Defining characteristics are the placement of concentric striations on the shells, the shape of the shell, and details of the hinge teeth.

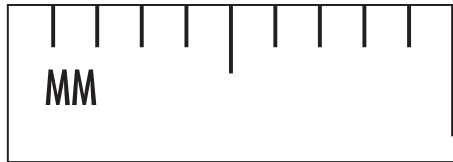
Sphaerids are all suspension (filter) feeders. They have two siphons (incurrent and excurrent or anal) which are sometimes fused, for removing food particles from water that is sucked in, and for pushing out unwanted food and waste.

All sphaerids are hermaphroditic, and brood their offspring within marsupia (brood pouches) in the gills. The young are quite large relative to parental size, and can be between 20 and 50 percent of the volume of the parent! Some sphaerids have broods of differing stages, and some have broods that release at the same time. Once they are released by way of the excurrent siphon, young crawl away to begin life on the substrate, feeding on organic material and bacteria. Some are burrowers, which allow them safety from dry spells and predatory fish and aquatic insects.

Sphaerid clams make up a large portion of biomass in freshwater ecosystems and play an important role in nutrient and energy cycling. It has been observed that sphaerids go into decline when stressed by introduced species, such as *Corbicula fluminea* (Asian clams) and *Dreissena polymorpha* (zebra mussels).



Musculium lacustre (lake fingernail clam)



Musculium lacustre, magnified to show detail.

DESCRIPTION

Shell thin, up to 8 mm in length, round and slightly to highly inflated. Umbo central and quite pronounced; shell somewhat triangular in shape or outline. Light color.

HABITAT

High altitude lakes in Western Colorado and lower elevations in Eastern Colorado. Found in small and large lakes and reservoirs, marshes, ditches, rivers, and streams. Observed in the Arkansas, Colorado, Platte, Republican, Rio Grande, and San Juan River drainages and in the San Luis Valley.

NOTES

Musculium lacustre carries broods most of the year. Individual offspring vary in size and age class.

Phylum: Mollusca

Class: Bivalvia

Sub class: Heterodonta

Order: Veneroidea

Family: Sphaeriidae

Genus: *Musculium*

Species: *Musculium lacustre*
(Müller 1774)



Musculium lacustre and dime, actual size.



Sphaerium striatinum (striated fingernail clam)



Sphaerium striatinum, magnified to show detail.

DESCRIPTION

Medium to large (for this family), up to 14 mm in length and 7 mm in width. Shell oval, quite inflated, and sturdy. Hinge is long and thick, umbones have no cap. Shell is variable in shape, valve and hinge sculpture; umbo is not as pronounced nor as centrally placed as in *Musculium*.

HABITAT

Found in creeks and rivers rather than lakes. In Colorado, inhabits the Arkansas, Colorado, Platte, Rio Grande, White, and Yampa River drainages.

NOTES

Look for these fingernail clams on the banks of rivers and creeks in mud/clay substrate under two to three inches of water. This species is thought to be tolerant of semi-arid environmental conditions.

Phylum: Molluska

Class: Bivalvia

Sub class: Heterodonta

Order: Veneroidea

Family: Sphaeriidae

Genus: *Sphaerium*

Species: *Sphaerium striatinum*
(Lamarck 1818)



Sphaerium striatinum and dime, actual size.



Pisidium spp.

(pea clams)



(Photo by Peter Walker)

DESCRIPTION (general for all species)

Cream colored with shiny or dull periostracum. 1 mm at birth, growing up to 6 mm. Shell rounded and inflated, with fine concentric elevated lines. Umbones closer to posterior end of shell.

HABITAT

Creeks, rivers, ponds, springs, marshes, lakes, burrowed into sediment. Overwinters in Colorado in alpine ecosystems as well as warmer areas of the state.

NOTES

Genus *Pisidium* has many species, all of them very small and difficult to identify. Pisids are a bivalve genus with unusual feeding habits. They do not live in the water column, but burrow down into sediment and obtain food (mostly bacteria) from the sluggish, watery substrate. They have specialized cilia on their gills as well as on the muscular foot that draw water into the shell. When food has been extracted, water and waste are ejected forcefully through the anal siphon. There is no distinctive incurrent siphon.

Existing taxonomy is in flux as research continues. Most *Pisidium* are very small and are difficult to identify without a hand lens. Even with a lens, it is difficult to distinguish one pea-clam species from another and the range of variation due to environment is likely as great within species as is found between some species.

Phylum: Mollusca

Class: Bivalvia

Sub class: Heterodonta

Order: Veneroidea

Family: Sphaeriidae

Genus: *Pisidium*

Species: (see pages 120–123)



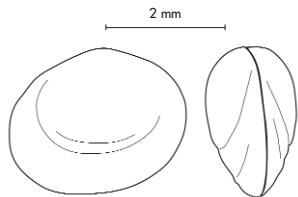
Pisidium spp. and dime, actual size.



Pisidium casertanum

(ubiquitous pea clam)

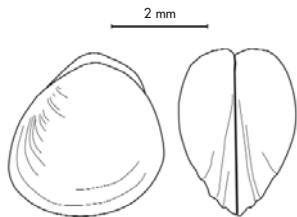
Most common freshwater mollusk species in Western Colorado. Tolerant of environmental stress. Difficult to discern from *P. hallae*. Shell thick, compressed and rear end truncate, surface dull. Variable in shape and size.



Pisidium compressum

(ridged-back pea clam)

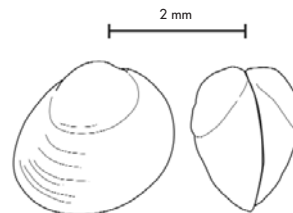
Shell thick. Prominent umbones with curved ridges. Surface dull. The shell is rare in that it is as long as wide, with a triangular shape and relatively prominent and sharp umbones. Found almost exclusively at lower elevations (below 6,000 ft.)



Pisidium ferrugineum

(rusty pea clam)

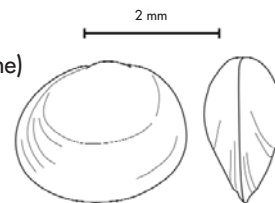
Shell thin, small, inflated, with prominent umbones, surface glossy. Found in high elevation lakes in Colorado.



Pisidium hallae

(no designated common name)

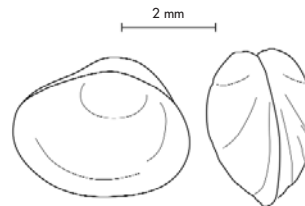
Found at almost all elevations.



Pisidium lilljeborgi

(Lilljeborg pea clam)

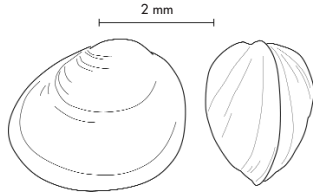
A larger shelled pea clam, with a distinctive rounded appearance, as long as wide in shape. Found in high elevation lakes.



Pisidium milium

(quadrangular pea clam)

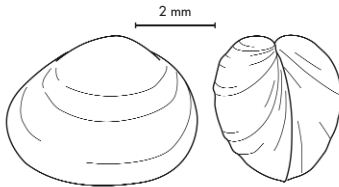
A very small pea clam found in high elevation lakes (above 8,000 ft.). *P. milium* has medium to high umbones located centrally on its usually inflated shell. Hard to distinguish from *P. nitidum*.



Pisidium nitidum

(shiny pea clam)

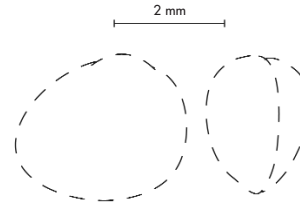
Shell small, thin, umbones low and less pronounced than other small species, shell moderately inflated. Glossy periostracum. Less common than previously thought.



Pisidium sanguinichristi

(Sangre de Cristo pea clam)

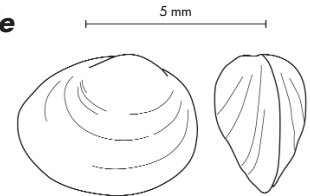
A potentially endemic species to Sangre de Cristo Mountains, but more research needs to be done to verify this.



Pisidium variable

(triangular pea clam)

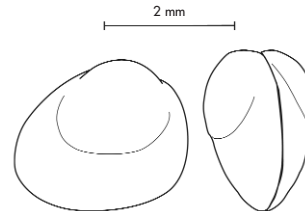
A larger pea clam located in high elevation lakes and ponds



Pisidium ventricosum

(globular pea clam)

Shell thin, much inflated. Umbones very prominent, glossy periostracum. Has shorter hinge than *P. ferrugineum*. Very small.



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Taxonomic references based on Robert T. Dillon, Jr. (2000) with the exception of Family Pisidiidae, changed to Family Sphaeridae, with Genus *Pisidium*, according to Robert Guralnick (2005).

GLOSSARY

anterior—front end (for bivalves, looks shorter when looking from the umbo)

aperture—opening of gastropod shell

apex—very top of the spire on a snail shell

byssal—“thread” produced by some bivalves in order to anchor to a substrate

callus—calcareous deposit on the aperture of some snails, secreted by the mantle organ

carina—pronounced ridge or edge on the outer shell of some gastropods

columellar lip—“folded over” margin on the outside snail shell closest to the interior spiral

dextral—“right sided”, referring to the aperture on a gastropod

discoidal—“flattened” spiral on snail shells

dorsal—top part of a bivalve shell where the hinge is located

elliptical—oval in shape

elongate—lengthened

globose—rounded shape; globular

glochidia—larvae that develop in brood chambers of a bivalve and attach themselves temporarily to fish gills or skin upon discharge from parent

gonochoristic—species with sexes separate

hermaphroditic—having both male and female reproductive organs

hinge—structures of the dorsal region of bivalve shells that function in opening and closing the valves

hinge teeth—shelly structures (usually in series) along or under the dorsal margin of a bivalve shell, fitting into sockets in the opposite valve and serving to assure strong accurate closure

malleated—“hammered” appearance of a shell

mantle—organ found in all mollusks that covers the main soft body. Secretes calcium carbonate which creates shells and nacre coating

mantle cavity—space within mantle that contains some organs for gas exchange, digestion, and reproduction

montane—mountainous or high in elevation

nacre—pearly interior of a shell, often iridescent purple, salmon, pink or ivory colored produced by the mantle organ, also called “mother of pearl”

operculum—“trap door” that prosobranch gastropods have attached to their soft bodies that can be closed to seal the aperture opening

palp—two small organs that help carry food to the mouth of a bivalve

parthenogenic—organisms that are able to reproduce with unfertilized female ova. Populations are most always all female and genetically identical

periostracum—thin, often colored outer layer of a shell

planispiral—coiled on one plane, similar to discoidal

posterior—“back end” of bivalve, longer when seen from the umbo

prosobranch—subclass of gastropods having opercula, or “trap doors” that can seal the apertural opening

pulmonate—subclass of gastropods that “breathe” by means of a lung-like structure in the mantle cavity. Lack operculum

radula—ribbon of “teeth” most snails have for scraping food (algae) from surfaces

relict—"left over" species that have survived in certain places while disappearing from others

sinistral—"left handed" or apertural opening for gastropods on the left side

spire—the whorls of a snail shell from where the main body ends to the apex

striae—fine lines, grooves, or streaks on the periostracum of a shell

suture—indentation on a snail shell where two joining whorls come together

umbilicus—indentation on snail shell on the underside of the apex, sometimes deeply pronounced

umbo (*pl. umbones*)—dorsal prominence on bivalve shell located adjacent to the hinge; the oldest part of the shell

valve—one half of two shells in bivalves

veligers—planktonic swimming larvae

ventral—bottom edge of bivalve shell—opposite dorsal, which is located at the hinge

whorl—one complete 360 degree turn or revolution of a snail shell

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Freshwater Mollusk Conservation Society:

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Integrated Taxonomic Information System:

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<http://www.Mkohl1.net/FWShells.html>

Man and Mollusks:

<http://www.manandmollusc.net/>

Tree of Life Project:

<http://tolweb.org/tree/phylogeny.html>

USFWS-Freshwater Mussels of the Upper Mississippi River system

Image Library:

<http://www.fws.gov/midwest/mussel/>

Various Freshwater Snails:

http://www.applesnail.net/content/snails_various.php



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