Monacha spp.*

*Information in the datasheet may be at the family, genus, or species level. Information for specific species within the genus is included when known and relevant; other species may occur in the genus and are still reportable at the genus level.

Portions of this document were taken directly from the New Pest Response Guidelines for Temperate Terrestrial Gastropods (USDA-APHIS, 2010).

Figure 1. *Monacha cartusiana* (Image courtesy of Luboš R. Kolouch, Bugwood.org)

Scientific Name

Monacha cantiana (Montagu, 1803)
Monacha cartusiana (O.F. Müller, 1774)
Monacha syriaca (Ehrenberg, 1831)

Synonyms:

Monacha cantiana
Fruticicola cantiana Montagu, W. G. Binney, 1886
Helix cantiana Montagu, 1803
Helix cantiana var. *minor* Moq., Cockerell, 1889
Monacha cemenelea Risso, 1826
Theba cantiana (Montagu), Taylor, 1917

Monacha cartusiana
Helix cartusiana Müller, 1774
Monocha cartusiana (Müller, 1774)
Theba cartusiana Müller

Monacha syriaca
Helix syriaca (Ehrenberg, 1831)
Theba haifensis Pallary, 1936

Common Names

***Monacha* spp.: Helicid snail**

***Monacha cantiana*:** Kentish garden snail, clover land snail

***Monacha cartusiana*:** Carthusian snail, chartreuse snail

***Monacha syriaca*:** None

Type of Pest
Mollusk

Taxonomic Position
Class: Gastropoda, **Order:** Stylommatophora, **Family:** Hygromiidae

Reason for Inclusion
CAPS Target: AHP Prioritized Pest List for FY 2011

Pest Description
Technical description applicable to *Monacha* spp. from Pilsbry (1939):

Shell – In general, “the shell is thin, depressed, narrowly umbilicate, the periphery rounded or keeled; lip slightly or not expanded, thickened within” [= internal rib].

Internal – “Penis with epiphallus and a short flagellum, but often lacking retractor muscle. Dart sac rudimentary or represented by an empty eversible sac, the finger-shaped or branching mucous glands inserted well above it. Spermatheca irregular, its duct of medium length. The right ocular retractor lies to the left of the genitalia.”

Many snail pests can be provisionally identified by studying shell characteristics. The following shell descriptions are from USDA-APHIS (2010).

Monacha cantiana
“The medium sized shell of this snail is 10.5 to 14 mm [approx. $^{7}/_{16}$ to $^{9}/_{16}$ in] high and 15.5 to 20 mm [approx. $^{5}/_{8}$ to $^{13}/_{16}$ in] wide with 5 $^{1}/_{2}$ - 6 whorls. The shell has a narrow umbilicus (navel-like opening at the base of the shell), is globosely depressed, and slightly transparent. The top of the shell is somewhat whitish in color and becomes progressively brownish toward the base. This thin shell is glossy in appearance and possesses fine, weak, irregular lines and coarser growth wrinkles. The aperture of the shell is broadly lunate while the lip is slightly expanded and shortly dilated at the columellar insertion. A narrow white or brown rib strengthens this insertion” (White-McLean, 2011).


Figure 2. *Monacha cartusiana* specimens in Germany (Fritz Geller-Grimm, wikipedia.org).

Monacha cartusiana
Maximum dimension is usually up to 15 mm [approx. $^{9}/_{16}$ in]. in diameter. Shell is somewhat solid, translucent (the mantle pattern showing through the shell), depressed helicoid, with a low convex spire of up to 5.5 convex

whorls; sutures are shallow. Whorl outline is rounded, with the periphery higher than the mid-point. Shell sculpture consists of faint axial growth striations that become a little stronger at the suture; under magnification, the surface may show indistinct hair scars—the shell of juveniles is often covered with fine periostracal hairs. Aperture is ovate, with a strong, thickened apertural rib just inside the lip (in adults only); the apertural rib shows up as a distinct white to brown to bright red band. Juvenile and immature shells lack any apertural coloration. The umbilicus is variable; it may be narrow or just a pin prick, but is always present; it may be partially obscured by the flaring aperture in the adult. Color is white to pale brown.

The mantle of the snail is irregularly but strongly marbled with black, brown and pure white, producing a very different appearance to the living animal as compared with the empty shell" (Kerney and Cameron, 1979).

Figures 3 to 5. *Monacha cartusiana* (Müller) shell (David Robinson, USDA).

Monacha syriaca

Maximum dimension is up to 13.5 mm [approx. $^{1}/_{2}$ in] in diameter. Shell is somewhat solid, depressed helicoid with a low spire; the apex may protrude somewhat, producing a mamillate appearance. Shell shape is depressed-globular, with 4½ and 5½ barely convex whorls, and very shallow sutures. Sculpture is generally smooth, with only fine axial growth-lines and vague incised spiral striations; on the base, irregular malleations are evident. Coloration is translucent brown (the mantle pattern showing through the shell), with two opaque, well-defined white bands: one below the suture and one at the periphery. Aperture is ovate to almost circular, with a strong, thickened apertural rib just inside the lip (in adults only); the apertural rib shows up as a distinct white to brown to bright red band. There is no umbilicus, being completely filled by the apertural callus.

Figures 6 to 8. *Monacha syriaca* (Ehrenberg) shell (David Robinson, USDA).

More information on morphology can be found in Kerney and Cameron (1979).

Biology and Ecology

When population levels are high, *Monacha* spp. will exhibit massing behavior in which large numbers of individuals will congregate. In general, snails can be found within microhabitats that can include cool refuges, vegetation, under rocks and refuse. Snails use calcium-carbonate ($CaCO_3$) for shell formation and the creation of eggshell for their offspring. This compound is found in alkaline soils as well as other places within the environment (USDA-APHIS, 2010).

Monacha cantiana

From USDA (2011):

> In England, *M. cantiana* completes more than one generation per year, but most adults (living 12 to 18 months) breed only once. Eggs are laid (60 to 90 per female) from May to October in loose, damp soil, and most eggs are found during autumn months (Chatfield, 1968). In Britain they burrow into the soil in cold weather (Chatfield, 1977)…newly established populations may attain high numbers fairly rapidly (Hlavac and Peltanova, 2010; Sternberg, 2000). In England, population densities of up to 230/m^2 have been recorded (Chatfield, 1972). Juveniles often remain attached high up on the vegetation for long periods (Schultes, 2011).
>
> This snail generally inhabits the herbal layer of hedges, waste grounds, scrublands, roadsides and railways, and prefers grassy habitats on dry calcareous soils (Hlavac and Peltanova, 2010). In southeastern England, it is also found in quarries and the margins of old fields (Chatfield, 1968). This species is essentially a snail of open habitats and, while it may occur in the shade of hedgerow trees, it does not live in woodlands (Chatfield, 1972). *Monacha cantiana* prefers neutral or alkaline soils (pH ≥ 7) but can live in areas where the calcium content and pH of the soil have been increased through disturbances; this snail can live on soils of different water contents (dry sand dunes, dry chalk grasslands, damp alluvial fields) (Chatfield, 1972). It feeds on the litter cover of the soil (Moreno et al., 2006) but also feeds upon many

plants…*Monacha* species, like most phytophagous snails, would feed on a wide variety of (often quite unrelated) plant species (Robinson, 2011).

Monacha cartusiana
According to Chatfield (1968), *M. cartusiana* has an annual life cycle in France and will lay between 40 to 80 eggs in loose, damp soil between mid-September and October. This species may have a biennial life cycle in warmer climates (Chatfield, 1968). Chatfield (1968) found that mature individuals laid eggs in autumn (mid September to October) when kept in a laboratory setting. These eggs hatched between 15 to 18 days. The tentacles slowly extend after hatching (Chatfield, 1968). In Europe, this species is found in grassland, hedges, roadsides and other similar areas. It is not usually found in woods. This species is rare above 500 m and is restricted to dry sunny sites at the north of its range (Kerney and Cameron, 1979).

Damage
Damage to host plants is not specific to snail species. In general, snails lack host specificity making them polyphagous. This lack of specificity means that there are few published documents in either the malacological or agricultural literature that discuss specific damage to agriculture caused by snails (USDA-APHIS, 2010).

Signs that snails are present in an area include eggs, empty snail shells, mucus and slime trails and ribbon-like feces (USDA-APHIS, 2010).

Pest Importance
In general, temperate terrestrial snails can damage horticultural and agricultural crops through feeding, lowering crop yield and quality, as well as damage native plants through feeding activities. Temperate terrestrial snails can also transmit pathogens and displace native snail species (USDA-APHIS, 2010).

Species in the Hygromiidae family are considered pests of fodder crops and serious pests in Europe. *Monacha* species exhibit a massing behavior when populations reach high levels that can disrupt agricultural operations (USDA-APHIS, 2010). Both *M. cartusiana* and *M. cascaloides* are considered snail pests in Bulgaria (Godan, 1983).

Monacha cantiana
This species has shown an ability to spread and establish outside its native range and could be a potentially significant plant feeding snail capable of moderately significant economic and ecological impact (reviewed in USDA, 2011).

Monacha cartusiana
This species has not been reported as a pest from other countries, but it does pose an animal health risk as it vectors several parasites (Garland, 2005).

Monacha syriaca
In Israel, *M. syriaca* has caused damage to both *Ruscus hypoglossum* (butcher's room) and *Aspidistra elatior* (cast iron plant) in shade houses (Moran et al., 2004).

Monacha umbrosa
Monacha umbrosa is an important snail pest in fruit growing regions of southern Germany; it causes damage to the leaves of gooseberries and the leaves and fruits of plums (Godan, 1983).

Known Food Sources*

Monacha cantiana
Anthriscus sylvestris (cow parsley, wild chervil), *Brassica oleracea* (cauliflower), *Lactuca sativa* (lettuce), *Taraxacum officionale* (dandelion), and *Urtica dioica** (stinging nettle, common nettle) (reviewed in USDA, 2011).

This species has also been found on:
Arrhenatherum elatius (tall oatgrass), *Armoracia rusticana* (horseradish), *Brachypodium pinnatum* (tor-grass, heath false brome), *Elymus repens* (quackgrass), *Rheum rabarbarus* (rhubarb), *Vicia sativa* (common vetch) (reviewed in USDA, 2011).

Monacha cartusiana
This species has been intercepted on *Aconitum* (monkshood), *Brassia oleracea* (cauliflower), *Clematis* spp., *Cynara* spp. (artichoke), *Onobrychis* (sainfoin), *Origanum* spp., *Petroselinum* spp. (parsley), *Phaseolus* spp. (beans), and *Rosa* spp. (Garland, 2005; USDA-APHIS, 2010).

It has specifically been found to be a host on *Festuca arundinacea* (tall fescue), *Festuca elatior*, *Heracleum sphondylium* (hogweed), and *Plantago media* (hoary Plantain) (Garland, 2005).

Experimental hosts include: *Anthriscus sylvestris* (Wild chervil), *Armoracia rusticana* (horseradish), *Avena* spp. (oat), *Lactuca* spp. (lettuce), *Taraxacum* spp. (dandelion), and *Urtica dioica* (stinging nettle) (Garland, 2005).

Monacha syriaca
This species has been intercepted on *Aconitum* (monkshood), *Phlox*, and *Ruscus* spp.; it has specifically been found to be a host of *Aspidistra elatior* (barroom-plant) and *Ruscus hypoglossum* (spineless butcher's-broom) (USDA-APHIS, 2010).

*Terrestrial mollusks do not show host specificity and can feed on multiple crops as well as other materials, like decaying organic matter.

Pathogen or Associated Organisms Vectored

Human and Animal Pathogens

Monacha cantiana

This species can vector *Brachylaimus* sp. (trematodes) which may infect mammals or birds (reviewed in USDA, 2011).

Monacha cartusiana

This species can serve as an intermediate host for *Dicrocoelium dendriticum* (lancet liver fluke), *Müllerius capillaris* (sheep and cattle lungworm), *Prostrongylus rufescens* (sheep lungworm), and *Taenia bothrioplitis* (a cestode) (Godan, 1983).

Monacha syriaca

This species can serve as an intermediate host for *Protostrongylus rufenscens* (sheep lungworm) (Godan, 1983).

Note: While most cases of human infections result from consumption of raw or partially cooked snail meat, government inspectors, officers and field surveyors are at-risk due to the handling of live snail, samples, and potential exposure to mucus secretions. ***Wear gloves when handling mollusks and wash hands thoroughly after any mollusk survey or inspection activities.***

Plant Pathogens

Monacha umbrosa

Feeding by this species can lead to subsequent contamination by fungi on blackcurrent (Godan, 1983).

Known Distribution

Distribution lists may not be all inclusive.

Monacha cantiana

This species is native to the Mediterranean region and Northwestern Europe (White-McLean, 2011).

Asia: Saudi Arabia; **Europe:** Austria, Belgium, Croatia, Czech Republic, France, Germany, Italy, Netherlands, Romania, Slovenia, Spain, Sweden, and the United Kingdom; **North America:** Canada (Bank, 2011a; reviewed in USDA, 2011; Al-Sarar et al., 2012).

This species may also be present in Egypt; however, this has not been confirmed (reviewed in USDA, 2011).

Monacha cartusiana

This species is native to the Mediterranean region and Southeastern Europe (White-McLean, 2011).

Africa: Morocco, Turkey, United Arab Emirates; **Asia:** Lebanon; **Europe:** Albania, Andorra, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Luxembourg, Macedonia, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Switzerland, Ukraine, United Kingdom, and former Yugoslavia (Kerney and Cameron, 1979; Garland, 2005; Bank, 2011b).

Monacha syriaca
This species is native to the Mediterranean region (White-McLean, 2011).

Asia: Israel, Jordan, Lebanon, Syria, and Turkey; **Europe:** Cyprus and Greece (USDA-APHIS, 2010; Bank, 2011c).

Pathway
Monacha spp. have been intercepted in storerooms and containers of ships in the United States as well as on baggage, soil (with or without plants), and cargo (Godan, 1983). Established populations have arrived on rail cars containing tiles from Italy via Canada, and military containers from Turkey.

These species can also be found on plant material:

Monacha cantiana has been intercepted on *Cynara scolymus* (artichokes), *Petroselinum crispum* (parsley), *Clemantis vitacella*, *Gladiolus* sp., and *Lactuca sativa* (lettuce) (Godan, 1983). It has been intercepted at U.S. ports of entry on containers and pallets associated with tiles, machinery, and marble. Interceptions have also occurred on goods from Canada (reviewed in USDA, 2011).

Monacha cartusiana has been intercepted on *Solanum tubersum* (potato), *Brassica oleracea* (cabbage), *Lathyrus sativus* (sweet peas), *Lactuca sativa* (lettuce), *Althea* sp., *Citrus sinensis* (sweet oranges), *Triticum* sp. (wheat straw), and seeds of boxtree, *Clemantis viticella*, and *Tilia* sp. (Godan, 1983).

Monacha obstructa has been intercepted on *Malus sylvestris* (apple), *Allium ampeloprasum* (leeks), and other miscellaneous plants (Godan, 1983).

Monacha olivieri has been intercepted on *Brassica oleracea* (cabbage), *Lactuca sativa* (lettuce), and miscellaneous herbs (Godan, 1983).

Potential Distribution within the United States
No NAPPFAST risk or host map is currently available.

Monacha cantiana
Monacha cantiana was detected in a Michigan rail yard in 2011. The infestation was determined to be limited to a 0.5 acre area. The area was subsequently treated to eradicate the population (USDA, 2011). According to USDA (2011)

"the native and introduced range of this species includes most of the plant hardiness zones and many of the climate types found in the United States, including Mediterranean, Desert, Humid Subtropical, Humid Continental Cool Summer, Subtropical, and possibly Steppe".

Monacha cartusiana
Monacha cartusiana was detected in Chicago, Illinois in 2001, Wilmington, Delaware in 2001 and Detroit, Michigan in 2004; the current status in the United States is unknown (USDA-APHIS, 2010).

Monacha syriaca
Monacha syriaca was detected in Sunny Point, North Carolina in 2000 and was eradiated by 2001 (USDA-APHIS, 2010).

Survey

CAPS-Approved Method*:
Visual. See the Introduction to the mollusk manual for specific information on visual surveys.

Notes: Negative data for the genera *Cernuella*, *Cochlicella*, and *Monacha* can be entered at the genus level if no individuals of that genus are found in the sample and if the sampling method used will capture individuals of that genus if they are present in the environment from which that sample was taken. All species of these genera are exotic and not native to the U.S. All positives, regardless of genus, must be reported at the species level; no positive entries at the genus level are allowed.

Survey Site Selection
New introductions of terrestrial mollusks will likely be related to commerce and human-assisted movement. The habitat and land-use type of each survey site may be variable, ranging from agricultural land, to residential or industrial features. When planning the survey route for a particular site, examine the following microhabitats:

- Near heavily vegetated areas, especially gardens and fields where plants have been damaged by feeding;
- Under rocks, asphalt or cement pieces that are in loose contact with the ground surface;
- Discarded wooden boards and planks, fallen trees, logs, and branches;
- Damp leaf litter (not wet or soggy), compost piles, and rubbish heaps;
- Under flower pots, planters, rubber mats, tires, and other items in contact with the soil; and
- Standing rock walls, cement pilings, broken concrete, and grave markers.

Trap Placement

Trapping ***cannot*** be used alone but can be used to supplement visual surveying. Trapping for terrestrial mollusks is not species-specific and will attract non-target species, including non-mollusks. Platform or baiting traps can be used to supplement visual inspection. Trap placement can occur in the same areas that visual surveys occur.

Time of year to survey

Most species of terrestrial mollusks are active during nocturnal hours, when environmental conditions are cool and wet. Some species may also be active during daylight, especially during overcast and rainy days in the spring and fall. If possible, plan surveys during spring and fall, during the early morning, and on overcast days. Many slugs and snails have diurnal patterns of activity, so early morning and evening hours may be the best time to carry out a survey (Pearce and Örstan, 2006).

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Key Diagnostics/Identification

CAPS-Approved Method*:

Morphological: Confirmation requires a morphological identification. All specimens should be submitted to Patrick Marquez. He is able to identify (even immature specimens) to the species level for this genus.

A key to snails found in Central Europe, including *M. cartusiana* and *M. cantiana* can be found in Godan (1983).

A key to terrestrial mollusks (including *Monacha* spp.) is found here: http://idtools.org/id/mollusc/index.php.

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Easily Confused Species

Monacha cartusiana

Monacha cartusiana is similar to *M. cantiana* and *M. dissimulans*, both of which are currently not found in the United States (Garland, 2005). *Monacha cartusiana* can only be distinguished from *M. dissimulans* through anatomical dissection (Dhora and Welter-Schultes, 1996).

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