Veronicella spp.*

*In April 2013, the family Veronicellidae, a target on the 2013 and 2014 AHP Prioritized Pest Lists, was broken down into six genera of concern, including *Veronicella* 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 Tropical Terrestrial Gastropods (USDA-APHIS, 2010a).

Figure 1. *Veronicella cubensis* (Pfeiffer), (Image courtesy of David Robinson, USDA-APHIS-PPQ)

Figure 2. *Veronicella sloanei* (Cuvier), (Image courtesy of David Robinson, USDA-APHIS-PPQ)

Scientific Names

Veronicella cubensis (Pfeiffer, 1840)
Veronicella sloanii (Cuvier, 1817)

Synonyms:

Veronicella cubensis
Onchidium cubense Pfeiffer, 1840,
Onchidium cubensis,
Veronicella cubensis Thomé [Thomé], 1975

Veronicella sloanei
Vaginulus sloanei Férussac, [Férussac]
Vaginulus laevis de Blainville, 1817

Common Name

No common name, leatherleaf slugs

***Veronicella cubensis*:** Cuban slug
***Veronicella sloanii*:** Pancake slug

Type of Pest

Mollusk

Taxonomic Position

Class: Gastropoda, **Order**: Systellommatophora, **Family**: Veronicellidae

Reason for Inclusion in Manual
CAPS Target: AHP Prioritized Pest List for FY 2011 – 2015*

*Originally listed under the family Veronicellidae.

Pest Description
Veronicellidae are anatomically distinct from many other terrestrial slugs in that they have a posterior anus, eyes on contractile tentacles, and no pulmonate lung. The sensory tentacles are bilobed. This family also lacks a mantel cavity (Runham and Hunter, 1970).

Although this family is fairly easy to tell apart from others, species within this family can be difficult to distinguish due to similar morphology between species and multiple color variations within a single species. Taxonomy is based on the morphology of the hermaphroditic reproductive system.

Veronicella cubensis
Veronicella cubensis can be variable in color ranging in shades of brown, although albino versions exist. Some have two dark bands running down the dorsal side. They may also have a lighter stripe down the midline of the dorsal side. The adult is approximately 5 to 7 cm (2 to 2 $^{3}/_{4}$ in) long (von Ellenrieder, 2004) but can reach up to 12 cm (4 $^{3}/_{4}$ in) (McDonnell et al., 2009). The pneumostome of the slug opens on the underside of the mantle, behind the foot (von Ellenrieder, 2004).

Veronicella sloanii
Extended length is approximately 12 cm (4 $^{3}/_{4}$ in) (Stange, 2006). Coloration can be highly variable but is usually a pale yellow, cream or white; slugs may have black spots on the dorsal side that may form two poorly defined longitudinal bands (Stange, 2006). Bands are usually better defined and grey in color in juveniles (Stange, 2006). The eyestalks are a constant bluish-grey with a light brown tip (Stange, 2006). This characteristic is found only in this species of Veronicellidae making it easy to distinguish from similar species (Robinson et al., 2009).

Biology and Ecology
The biology of Veronicellidae is not well known; they are known to be nocturnal herbivores (Runham and Hunter, 1970).

Both ovoviviparity (eggs hatch in the body of the parent) and viviparity (live birth) occur in *Veronicella* spp. (Barker, 2001).

Veronicella cubensis
Veronicella cubensis is nocturnal and usually found near water bodies or moist soil (von Ellenrieder, 2004). On Rota, the southernmost island of the Commonwealth of the Northern Mariana Islands, this pest is found in almost all habitats ranging from undisturbed natural habitats to agricultural areas (Robinson and Hollingsworth, 2004).

Veronicella sloanii
Veronicella sloanii is nocturnal. It was found in both lab and field conditions to mate in pairs, triplets, or groups (Clarke and Fields, 2005).

Damage
Due to their apparent lack of host specificity, few reports as to specific damage caused by Veronicellidae species to agriculture have been published in the malacological or agricultural literature.

Visual signs of *Veronicella* can include chewing or rasping damage to plants, presence of eggs, juveniles and adults, mucus and slime trails, and/or ribbon like feces.

Pest Importance
Veronicellidae can be pests in tropical regions of America, Africa, and Asia where distribution is limited (Runham and Hunter, 1970). This family can also transmit pathogens to humans indirectly when they consume vegetables and fruits that have been contaminated with mucus and feces. The slugs can also transmit pathogens to plants and livestock. Displacement of native mollusk species may also occur (USDA-APHIS, 2010a).

Veronicella species can cause damage by feeding on agricultural and horticultural crops as well as native plants, thereby lowering crop yield and quality.

Veronicella cubensis
In Hawaii, Rota, and Guam, *Veronicella cubensis* is considered an agricultural and horticultural pest (McDonnell et al., 2009). This species is specifically a pest on potted-foliage (Hata et al., 1995). *Veronicella cubensis* can damage plants it feeds on including many ornamental and agricultural plants like banana, cabbage, cassava, citrus, coffee, eggplant, mango, noni, papaya, pepper, pumpkin, star fruit, sweet potato, taro, and yam (USDA, 2006). Like *Sarasinula plebeia*, this species can become very abundant and serve as a public nuisance in both urban and suburban areas (Cowie et al., 2009).

Veronicella leydigi
This species is a pest on coffee, tobacco, sweet potatoes, sugarcane, and vegetables in the West Indies and India. It is also a pest of *Coffea* (coffee tree) in South America (Godan, 1983).

Veronicella sloanii
In Barbados, *Veronicella sloanii* is an important garden and plant nursery pest (Clarke and Fields, 2005). *Veronicella sloanei* attacks many agricultural and horticultural crops including various beans, banana, *Brassica* cultivars (*e.g.*, broccoli, cabbage, cauliflower), carrot, citrus, dasheen, eddo, eggplant, lettuce, peanut, peas, hot and sweet peppers, plantain, sweet potato, tannia, tomato, and yam (Stange, 2006). *Veronicella sloanii* causes leaf damage and can also debark portions of plant stems on *Datura* and gardenia; *Hibiscus* and *Bougainvillea* can also be attacked by this pest

(Fields and Robinson, 2004) as well as orchids (Godan, 1983). This slug is considered an important pest in the Caribbean (Fields and Robinson, 2004).

Known Food Sources*

These species are polyphagous, eating many different plants, organic material, and detritus (USDA-APHIS, 2010a).

Food sources specifically mentioned for each pest are listed below (lists are not meant to be all inclusive):

Veronicella cubensis

Annona muricata (sour sop), *Artocarpus altilis* (breadfruit), *Averrhoa bilimbi* (pickle tree), *Averrhoa carambola* (star fruit), *Brassica* spp. (cabbage), *Brassica oleracea* (cabbage), *Brugmansia* spp. (angel trumpet), *Capsicum* spp. (pepper), *Carica papaya* (papaya), *Cecropia peltata* (trumpet-tree), *Citrus* spp. (citrus), *Coffea* spp. (coffee), *Colocasia* spp. (taro), *Colocasia esculenta* (taro), *Crotalaria retusa* (rattlebox), *Cucumis* spp. L. (melon), *Cucurbita* spp. (pumpkin), *Dioscorea* spp. (yam), *Eulophia alta* (wild coco), *Eupatorium odoratum* (bitterbush), *Euphorbia cyathophora* (Mexican fire plant), *Hibiscus* spp. (hibiscus), *Ipomoea batatas* (sweet potato), *Lactuca* spp. (lettuce), *Lantana camara* (lantana), *Mangifera indica* (mango), *Manihot esculenta* (cassava), *Mentha spicata* (spearmint), *Miconia* spp. (johnnyberry), *Mikania micrantha* (bittervine), *Mimosa pudica* (action plant), *Morinda citrifolia* (noni), *Musa* spp. (banana), *Nephrolepis biserrata* (giant sword fern), *Nephrolepis multiflora* (Asian sword fern), *Ocimum basilicum* (basil), *Paspalum* spp. (crowngrass), *Passiflora* spp. (passionfruit), *Peperomia meriannensis* (pot popot), *Philodendron* spp. (philodendron), *Piper aduncum* (spiked pepper), *Pipturus albidus* (mamaki), *Pteridium* spp. (brackenfern), *Sida rhombifolia* (Cuban-jute), *Solanum melongena* (eggplant), *Spermacoce laevis* (buttonplant), *Tacca leontopetaloides* (Polynesian arrowroot), *Thunbergia* spp. (thunbergia), *Trimezia* spp. (trimezia), *Urena lobata* (aramina), *Veronia* spp., *Veronia* cinerea (little ironweed), *Vinca* spp. (periwinkle) (Maceira, 2002; Robinson and Hollingsworth, 2004, Hollingsworth, 2008; NMC-CREES, 2009).

Veronicella sloanii

Arachis spp. (peanut), *Bougainvillea* spp. (bougainvillea), *Brassica oleracea* (broccoli, cabbage, cauliflower), *Carica papaya* (papaya), *Citrus* (citrus), *Colocasia esculenta* (dasheen, eddo), *Datura* spp. (Datura), *Daucus carota* (carrot), *Dioscorea* spp. (yam), *Gardenia* spp. (Gardenia), *Hibiscus* spp. (hibiscus), *Lactuca sativa* (lettuce), *Lycopersicon esculentum* (tomato), *Musa* spp. (banana), *Phaseolus* spp. (bean), *Piper* spp. (pepper), *Plantago* spp. (plantain), *Pisum* spp. (pea), *Solanum melongena* (eggplant), *Spinacia oleracea* (spinach), *Xanthosoma* spp. (tannia) (Stange, 2006; Fields and Robinson, 2004).

*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

Species of this family have been found to carry several nematode parasites, including *Angiostrongylus cantonensis* (rat lungworm), *A. costaricensis*, and *A. malaysiensis*. *Angiostrongylus cantonensis* can cause symptoms similar to meningitis in humans including headache, stiff neck, tingling or painful feelings in the skin, lowgrade fever, nausea, and vomiting (USDA-APHIS, 2010a).

Veronicella cubensis is known to carry *Angiostrongylus cantonensis* in Hawaii (Hollingsworth et al., 2004).

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

Unknown.

Known Distribution

Distribution lists may not be all inclusive.

Veronicella cubensis

This pest may have originated in Cuba but it is now present throughout parts of the Caribbean (Cowie, 1998; McDonnell et al., 2009).

Caribbean: Antigua, Bahamas, Barbados, Cuba, Dominica, Dominican Republic, Haiti, Jamaica, Puerto Rico, St. Croix, St. Kitts and Nevis; **Oceania:** American Samoa (including Olosega and Tutuila), Australia, Guam, Hawaii, the Northern Mariana Islands (including Rota) and Pohnpei (part of Micronesia) (McDonnell et al., 2009).

Veronicella sloanii

Barbados, Bermuda, Dominica, Dominican Republic, Jamaica, St. Lucia and St. Vincent (Stange, 2006), Bahamas, Cayman Islands, Colombia, Honduras, Nicaragua (Thompson, 2008), Cuba (Maceira, 2003) and Guadeloupe (Robinson et al., 2009).

Pathway

This genus can move through international trade. From 1985 to 2009, *Veronicella cubensis* and *C. sloanii* have been intercepted a total of 71 times on 35 different plant genera. Interceptions occurred most frequently on: *Amaranthus*, *Eryngium*, *Heckeria*, *Limnophila*, and *Momordica* (USDA-APHIS, 2010a).

Veronicella leydigi has previously been intercepted on cars in the United States, while *V. floridana* has been intercepted on soil and rubber trees in Canada (Godan, 1983). *Veronicella sloanii* has previously been intercepted in Great Britain on bananas from

Jamaica (reviewed in South, 1992). This species was likely accidentally introduced into Hawaii (Cowie, 1998).

Potential Distribution within the United States

No risk documents exist for any of the tropical terrestrial mollusks that give potential distribution in the United States. Host material is unlikely to limit their distribution since they are all polyphagous, but these species are limited by climate. If introduced, the tropical terrestrial mollusks would most likely be limited to the southern part of the United States and possibly the West Coast where the climate is similar to native ranges. This is supported by detections of these species which have all been in either the southern United States or West Coast (USDA-APHIS, 2010a).

Veronicella cubensis

This pest may have originated in Cuba. Interceptions have occurred in New Orleans and southern Florida. It was found in one California county, Santa Barbara (2006) (McDonnell et al., 2008; McDonnell et al., 2009).

Veronicella sloanii

This species is thought to have been introduced to southern Florida; however, this is only based on photographic evidence (D. Robinson, personal comm., 2010). This species is present in Hawaii (Capinera et al., 2011) and Guam (Gomes and Thomé, 2004).

Survey

CAPS-Approved Method*:

Visual. See the Introduction to the mollusk manual for specific information on visual surveys.

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; and
- Under flower pots, planters, rubber mats, tires, and other items in contact with the soil.

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 and Molecular: Differentiation from the native species is only by dissection and only if the specimen is mature enough. All veronicellid samples should be sent to Dr. Robinson for morphological identification. All specimens will then be confirmed through molecular diagnostics performed at the CPHST Mission lab.

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

In April 2013, the family Veronicellidae, a target on the 2013 and 2014 AHP Prioritized Pest Lists, was broken down into six genera of concern. When conducting a general mollusk survey, if samples are negative for Veronicellidae, then negative data may be reported for each of these six genera: *Belocaulus, Colosius, Laevicaulis, Sarasinula, Semperula,* and *Veronicella*. All positives must be reported at the species level.

Refer to “Appendix N - Data Entry Guide for Selected Taxonomic Groups” of the most recent year’s CAPS Guidelines for additional information on data entry for mollusks. https://caps.ceris.purdue.edu/caps_agreement_guidelines.

*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

Veronicella spp. can be confused with one native species, *Leidyula floridana.* It may also be confused with exotic species that are either not known to be established or of limited distribution in the United States, including: *Leidyula* aff. *floridana, , Sarasinula plebeia, Laevicaulis alte, Veronicella cubensis,* and *Veronicella sloanii*.

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