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Cheilosia grossa Thistle stem hoverfly

Cheilosia grossa is a biological control agent approved in the USA for release against introduced thistles.

SYNONYMS

Cheilosia corydon (Harris)

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Diptera	Flies
Family	Syrphidae	Hover flies
Genus	<i>Cheilosia</i>	
Species	<i>Cheilosia grossa</i> (Fallén)	Thistle stem hoverfly

DESCRIPTION

Larvae are tan maggots (Fig. 1a) growing up to 19 mm long. Adults are fuzzy with orange-tan hairs, large black eyes, and clearish wings (Fig. 1b). Adults can be up to 15 mm long, including their wings.

LIFE CYCLE

Adults emerge very early in the spring (Fig. 2) and deposit eggs on young leaves as host plants bolt. Larvae soon emerge and mine into shoots and stems. As the season progresses,

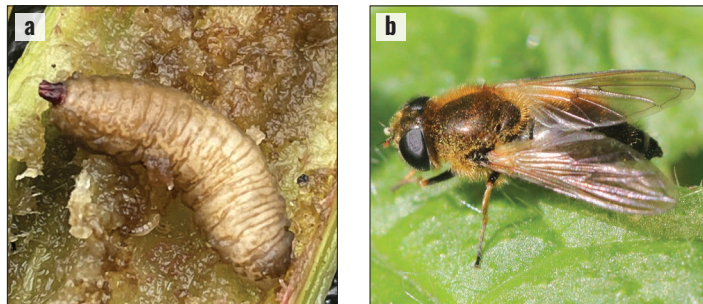


Figure 1. *Cheilosia grossa* (a) larva; (b) adult (a: Jennifer Andreas, Washington State University Extension; b: Philip Mark Osso, iNaturalist.org CC BY-NC 4.0)

larvae then mine into roots and continue feeding as they develop through three instars. Pupae overwinter in roots or in plant litter. There is one generation per year.

HOST SPECIES IN NORTH AMERICA

Bull, musk, Italian, slenderflower, and (rarely) plumeless thistle

DAMAGE

Larval mining (Fig. 3a) interferes with water and nutrient transport, ultimately resulting in decreased seed production (Fig. 3b,c) and sometimes plant death.

FIELD IDENTIFICATION

Throughout the spring, adults may be observed around thistle shoot tips and rosettes. Eggs are laid on young leaves as host thistles bolt. Larvae tunnel away from the eggs and feed completely within stems (Fig. 3a), making them difficult to detect in early stages unless stems are dissected. In late season, dead flower heads (Fig. 3b,c) can be indicative of larval presence. Feeding damage can be difficult to distinguish from other mining species if larvae are no longer present.

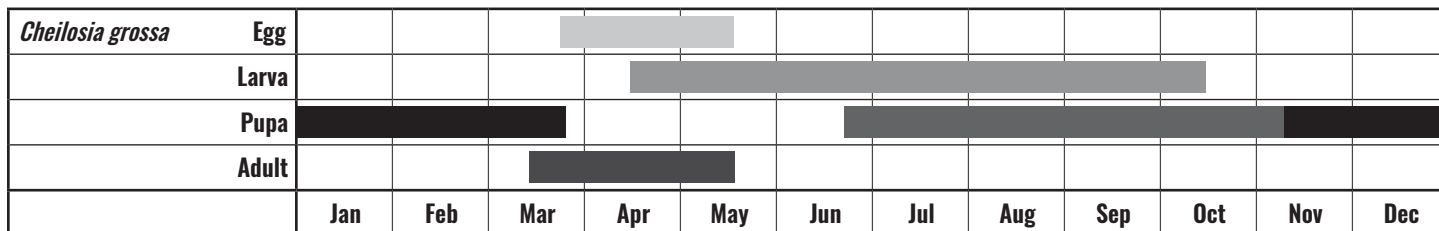


Figure 2. Schematic life cycle of *Cheilosia grossa* in North America. Bars indicate the approximate length of activity for each life stage; dates will vary depending on local conditions. Black bars represent the inactive and/or overwintering periods. There is typically one generation per year.



Figure 3. *Cheilosia grossa* (a) larval tunnel; (b) damage to slenderflower thistle flower heads; (c) damage to bull thistle flower heads (a-c: Eric Coombs, Oregon Department of Agriculture, Bugwood.org, CC BY-3.0 US)

PREFERRED HABITAT

This species survives a wide array of climatic conditions throughout the range of its host thistles. It tends to do better in areas where host plants flower early.

HISTORY AND CURRENT STATUS

Cheilosia grossa is native to Europe. A population sourced from Italy was released on musk and slenderflower thistle in the USA beginning in 1990 (Maryland, Montana, New Jersey, Nevada Oregon, Texas) and on Italian thistle in Oregon in 1993. It was also found feeding on bull thistle in the western USA by 2001.

In the eastern USA (Fig. 4), *C. grossa* has only established on slenderflower thistle in Maryland, though its abundance and impact there are unknown. In the western USA, *C. grossa*

has been confirmed established on bull thistle in California, Oregon and Washington, slenderflower thistle in Oregon and Washington, Italian thistle in Oregon, and musk thistle in California. However, it is generally not abundant on any of these species. *Carduus* species are preferred over *Cirsium*, but it is rarely found on plumeless thistle. Where established on any of the above species in the western USA, plants with large stem diameters (>10 mm) are most often attacked, reducing seed production and (infrequently) causing plant death. The overall impact of this biocontrol agent is typically minor. **This species is not approved for release in Canada.**

NONTARGET EFFECTS

Damage similar to what is caused by this biocontrol agent has been observed in several native thistles species (*Cirsium edule* group). However, despite multiple surveys of native *Cirsium* spp. in California, *C. grossa* has never been observed causing nontarget impact in that state. **Nevertheless, caution should be used when considering the introduction of this fly into new areas.**

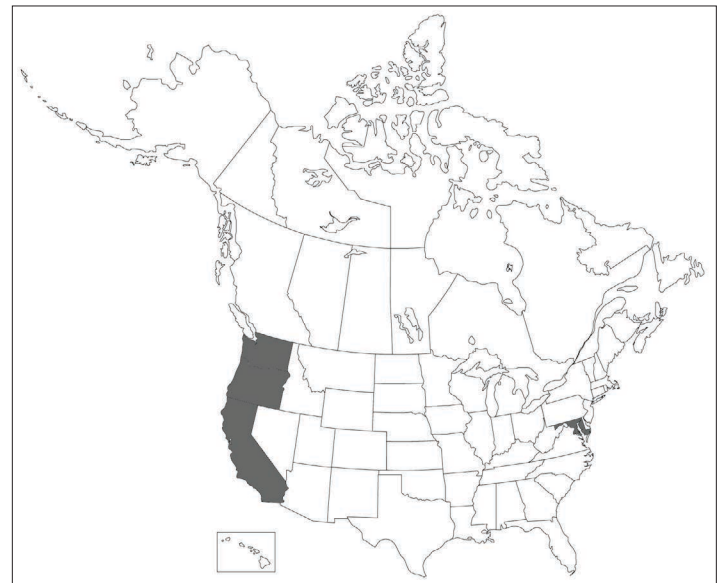


Figure 4. *Cheilosia grossa* distribution in North America (Winston et al. 2023)

Hadroplontus litura Canada thistle stem weevil

Hadroplontus litura is a biological control agent approved in North America for release against introduced thistles.

SYNONYMS

Ceutorhynchus litura (Fabricius)

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Coleoptera	Beetles
Family	Curculionidae	Weevils
Genus	<i>Hadroplontus</i>	
Species	<i>Hadroplontus litura</i> (Fabricius)	Canada thistle stem weevil

DESCRIPTION

Larvae are white, C-shaped, and may appear pointed in the front end. They grow up to 3 mm long and have brown head capsules (Fig. 5a). Adults are mottled black and white with a “t”-shaped marking on their backs. The adults also have thick bodies, very long, curved snouts (Fig. 5b), and can be up to 4 mm long.

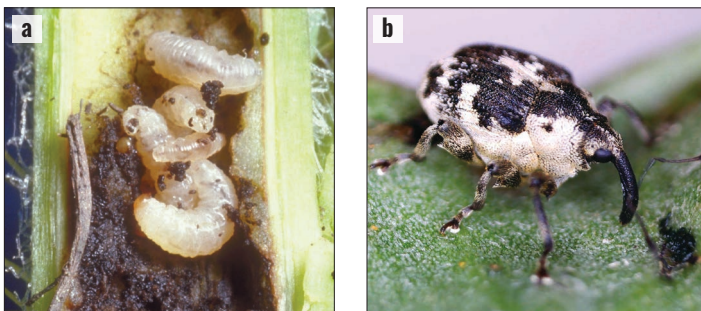


Figure 5. *Hadroplontus litura* (a) larva and damage to a seed; (b) adult (a: Norman E. Rees, USDA ARS, Bugwood.org, CC BY-3.0 US; b: Bazwal, iNaturalist.org CC BY-4.0)

LIFE CYCLE

Overwintering adults emerge from plant litter early in the spring (Fig. 6) and feed on Canada thistle leaf and stem tissue. Eggs are laid in spring in the midvein on the underside of new rosette leaves. Emerging larvae mine leaf veins, stems (Fig. 7), and root crowns of Canada thistle throughout spring and summer as they develop through three larval instars. Pupation occurs in the soil, and emerging adults overwinter in plant litter. There is one generation per year.

<i>Hadroplontus litura</i>	Egg	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Larva												
	Pupa												
	Adult												

Figure 6. Schematic life cycle of *Hadroplontus litura* in North America. Bars indicate the approximate length of activity for each life stage; dates will vary depending on local conditions. Black bars represent the inactive and/or overwintering periods. There is typically one generation per year.



Figure 7. *Hadroplontus litura* larval mines in a Canada thistle stem (Norman E. Rees, USDA ARS, Bugwood.org, CC BY-3.0 US)

HOST SPECIES IN NORTH AMERICA

Canada thistle

DAMAGE

Larval mining and adult feeding do not significantly impact weed populations directly because only non-essential tissues are typically consumed. Feeding does cause secondary damage, however, as pathogens and other organisms are able to enter the stems of targeted plants via holes made by exiting larvae. One pathogen, *Puccinia punctiformis* (listed below), may opportunistically enter Canada thistle stems in this manner, causing a synergistic negative effect on attacked Canada thistle stems; however, this has not been explicitly studied

FIELD IDENTIFICATION

Adults may be observed around Canada thistle rosette leaves and shoots throughout spring and early summer. Eggs are difficult to detect because they are laid in the midvein on the underside of rosette leaves. Larval mining is also not readily visible unless stems are dissected (Fig. 7).

Several other beetle species feed on thistles in North America, including some natives. Of the introduced species, the most commonly encountered are listed in Table 1, along with key diagnostic traits that help differentiate these species from each other.

PREFERRED HABITAT

This species does well in moist, disturbed areas where Canada thistle is dense and where plants are not stressed by drought, grazing, or other control methods.

HISTORY AND CURRENT STATUS

Hadroplontus litura is native to Europe. Populations sourced from France, Germany, Italy, and Switzerland were released in Ontario, Canada beginning in 1965. Following establishment, field populations were redistributed throughout much of southern Canada. A population sourced from Germany was also released throughout the USA beginning in 1971.

In the USA (Fig. 8), some reports indicate this weevil is very effective due to reduced overwintering survival of the weed; however, most studies show a lack of impact, likely due to larvae consuming only non-essential parenchyma tissue and leaving vascular tissues untouched. Though this weevil is established at most release sites on Canada thistle in Canada, it has low reproductive and dispersal ability, so populations are typically small. Over multiple years, mining decreases root biomass when in conjunction with other stresses. However, even in combination with other biocontrol agents, the overall impact of this weevil appears to be limited.

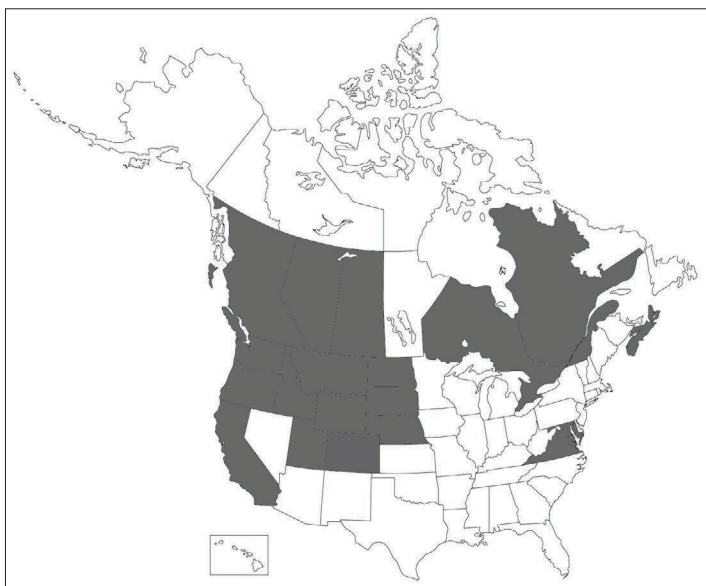


Figure 8. *Hadroplontus litura* distribution in North America (Winston et al. 2023)

NONTARGET EFFECTS

None reported

NOTES

Some weevil populations are infected with microsporidia (*Nosema* sp.), which are internal parasites of the digestive tract. Weevil populations suspected of being infected should not be used in redistribution efforts.

Puccinia punctiformis

Canada thistle rust fungus

Puccinia punctiformis is a rust fungus that was inadvertently introduced to North America but has since been studied as a host-specific biological control agent against introduced thistles.

SYNONYMS

Puccinia suaveolens (Pers.) Rostr.

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Fungi	Fungus
Phylum	Basidiomycota	Club fungi
Class	Pucciniomycetes	
Order	Pucciniales	Rust fungi
Family	Pucciniaceae	
Genus	<i>Puccinia</i>	
Species	<i>Puccinia punctiformis</i> (F.Strauss) Röhl.	Canada thistle rust fungus

DESCRIPTION AND LIFE CYCLE

This fungus has several spore stages in its life cycle, all of which are microscopic and may be observed on Canada thistle throughout the growing season. Systemically diseased Canada thistle shoots emerge in spring bearing fragrant, orange-colored pustules and pycniospores on the undersides of leaves (Fig. 9a). These eventually give rise to powdery

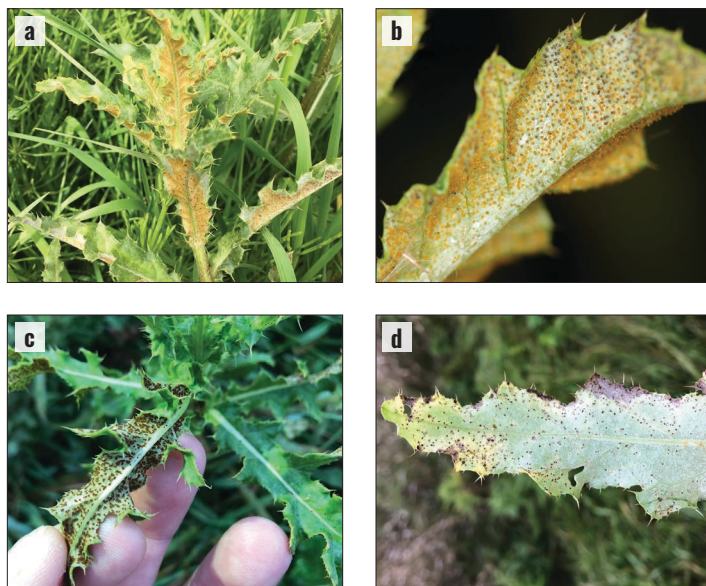


Figure 9. *Puccinia punctiformis* a: orange pustules with pycniospores; b: orange pustules intermixed with reddish-brown aecia; c: reddish-brown aecia; d: brown pustules with teliospores (a,c,d: Carol Randall, USDA Forest Service; b: Marina Gorbunova, iNaturalist.org CC BY-NC 4.0)

reddish-brown aecia (Fig. 9b,c) that produce aeciospores, darker brown uredia that produce primary urediniospores, and very dark brown telia that produce primary teliospores. The primary urediniospores and teliospores are wind-borne and cause local infections of neighboring Canada thistle shoots and leaves in late spring and early summer. These local infections result in the formation of uredinia that produce secondary urediniospores and also telia that produce secondary teliospores throughout summer (Fig. 9d). As plants with localized infections senesce in autumn, the leaves bearing urediniospores and teliospores are shed throughout the local area. When conditions are right, shed primary or secondary teliospores germinate in contact with living Canada thistle tissue, producing basidiospores that infect Canada thistle tissue and establish the rust as mycelium in the rootstock. Infection may be present as mycelium with no aboveground spores. When mycelium infects the adventitious root buds, new Canada thistle shoots are morphologically discernible as being systemically diseased, beginning the spore cycle again.

HOST SPECIES IN NORTH AMERICA

Canada thistle

DAMAGE

Infected plants can experience stunted growth, reduced seed production, and a higher susceptibility to competition from other plant species and/or attack from additional biocontrol agents. Systemically infected stems die, and roots directly beneath infected stems will not regrow.

FIELD IDENTIFICATION

Puccinia punctiformis pycniospores arise from orange pustules with a sweet floral fragrance and can be found (typically) on the lower leaf surfaces of infected Canada thistle plants in spring (Fig. 9a). The pustules and structures producing aeciospores, urediniospores, and teliospores are all brown (Fig. 9b–d). No other, similar rust fungi are known to infect Canada thistle in North America. The distantly related *Puccinia carduorum* also produces brown urediniospores from raised brown pustules; however, *P. carduorum* only infects slenderflower and musk thistle (see Table 1).

PREFERRED HABITAT

Successful germination of spores requires optimal temperatures (60°F, 15.5°C), dew, and healthy Canada thistle tissue. There are several spore stages throughout the growing season, so this rust does best at undisturbed sites.

HISTORY AND CURRENT STATUS

Puccinia punctiformis was likely introduced into North America in the 1600s in diseased Canada thistle roots and is

now widespread throughout the USA and Canada wherever its host plant occurs (Fig. 10). This rust was first proposed as a biological control agent in 1893, although too many questions regarding its life cycle prevented its use at the time. Following several more studies exploring its host specificity and control potential, the rust was officially approved for redistribution in the USA in 2017. Since then, it has been intentionally redistributed to several states in the western USA, though it is believed to have already been established in each.

Although it is widely established, usually only some plants in a patch will be diseased; occasionally more widespread outbreaks occur naturally. Systemically infected stems die, and roots directly beneath infected stems will not regrow. More studies are needed to determine how extensively the fungus travels through the root system. While stem densities have been reduced by up to 90% at some intentionally inoculated sites, other factors may be involved. Superficial foliar infections are more common. Although they may stunt plant growth and reduce flowering, the impacts of foliar infections are limited because they do not reduce plant populations.

As of 2024 in the USA, *Puccinia punctiformis* can only be redistributed for research purposes and only with a permit granted by the Animal and Plant Health Inspection Service.

NONTARGET EFFECTS

None reported



Figure 10. *Puccinia punctiformis* is likely distributed in most countries worldwide where its host Canada thistle has spread (Berner et al. 2013, Berner et al. 2015a). North American distribution extrapolated from Canada thistle distribution reported on EDDMapS, www.eddmaps.org, USDA PLANTS Database, plants.usda.gov, and iNaturalist.org; all accessed 11 December 2023.

Rhinocyllus conicus

Thistle seedhead weevil

Rhinocyllus conicus is a biological control agent that was released in North America against introduced thistles.

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Coleoptera	Beetles
Family	Curculionidae	Weevils
Genus	<i>Rhinocyllus</i>	
Species	<i>Rhinocyllus conicus</i> (Frölich)	Thistle seedhead weevil

DESCRIPTION

When eggs are deposited in spring (Fig. 11), they are covered over with chewed plant material that becomes tan-colored with age (Fig. 12a), appearing as part of the plant. Larvae are white with brown head capsules, C-shaped, and reach up to 4 mm long (Fig. 12b). Adults are dark brown or black with yellowish tufts of hair, giving them a mottled appearance in spring (Fig. 12c). As they age, adults shed some of these hairs and turn brownish-black (Fig. 12d). They can be up to 6 mm long and have short snouts.

LIFE CYCLE

Overwintering adults emerge in early spring and deposit eggs on bracts of thistle seed heads and stems (Fig. 12a). Larvae hatch in late spring and early summer and develop through four instars. Larvae burrow through bracts or mine plant stems until they reach the seed head where they feed on receptacle tissue and developing seeds. Pupation occurs within seed heads in late summer as seeds mature. Adults emerge for a brief time before overwintering in sheltered areas. There is one generation per year.

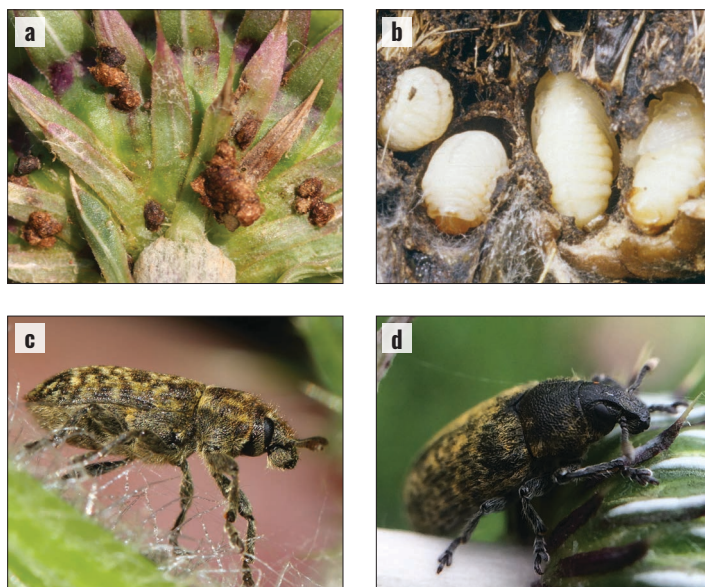


Figure 12. *Rhinocyllus conicus* (a) eggs covered with chewed plant material; (b) larvae and pupae; (c) adult with tufts of yellowish hairs; (d) adult starting to lose many of its yellowish hairs (a: Whitney Cranshaw, Colorado State University, Bugwood.org, CC BY-3.0 US; b: Mark Schwarzländer, University of Idaho, Bugwood.org, CC BY-3.0 US; c: Alan Manson, iNaturalist.org CC BY-4.0; d: Dusty, iNaturalist.org CC BY-NC 4.0)

HOST SPECIES IN NORTH AMERICA

Musk, plumeless, Italian, slenderflower, milk, bull, Canada, and marsh thistle

DAMAGE

Adults feed on foliage and leave signature rounded feeding holes over the entire leaf surface (Fig. 13a), though this damage is typically minor. Larval mining and feeding on receptacle and seed tissue (Fig. 13b) reduces viable seed production. This does not kill existing plants but does reduce the rate of thistle spread.

FIELD IDENTIFICATION

Adult *Rhinocyllus conicus* may be observed on thistle seed heads and stems throughout spring and early summer. After laying eggs on the bracts of thistle seed heads and stems, females cover them with chewed plant material that turns tan-colored with age. These covered eggs are readily visible to the naked eye (Fig. 12a). Larval mining is not readily visible during early stages unless seed heads are dissected (Fig.

<i>Rhinocyllus conicus</i>	Egg	Larva	Pupa	Adult	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	█															
		█														
			█													
				█												

Figure 11. Schematic life cycle of *Rhinocyllus conicus* in North America. Bars indicate the approximate length of activity for each life stage; dates will vary depending on local conditions. Black bars represent the inactive and/or overwintering periods. There is typically one generation per year.

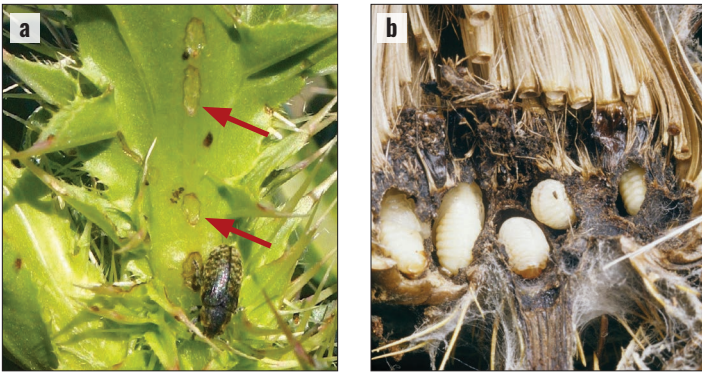


Figure 13. *Rhinocyllus conicus* (a) adult feeding damage with characteristic rounded holes (red arrows); (b) larval feeding damage to musk thistle seeds and receptacle tissue (a: Eric Coombs, Oregon Department of Agriculture, Bugwood.org, CC BY-3.0 US; b: Mark Schwarzländer, University of Idaho, Bugwood.org, CC BY-3.0 US)

13b). Later in the season, attacked seed heads turn a straw color and do not release seeds in a typical manner. Multiple larvae typically occur in the same seed head.

Several other beetle species feed on thistles in North America, including some natives. Of the introduced species, the most commonly encountered are listed in [Table 1](#), along with key traits that help differentiate these species from each other.

PREFERRED HABITAT

This species does best in meadows and moist areas with moderate temperatures. In areas where summer arrives quickly, *R. conicus* is unable to utilize later-developing seed heads.

HISTORY AND CURRENT STATUS

Rhinocyllus conicus is native to Europe. Three strains have been collected for use against introduced thistles in the USA, originating from three host species in France and Italy. Releases throughout the USA began in 1969 on musk, plumeless, Scotch (failed), Italian, slenderflower, and milk thistle. The weevil spread naturally to bull and Canada thistle in the western USA. In Canada, weevils sourced from France were released on plumeless and musk thistle in Manitoba, Ontario, and Quebec beginning in 1968. The weevil spread naturally and via intentional redistributions to bull, Canada, and marsh thistle in western Canada and bull thistle in eastern Canada. Redistributions to Canada thistle in Nova Scotia and Scotch thistle in western Canada failed to establish.

This weevil typically prefers *Carduus* species (musk, plumeless, Italian, and slenderflower) over other thistles. It is abundant on musk and plumeless thistle throughout much of North America ([Fig. 14](#)), where its overall impacts are variable. In some states, substantial declines in musk and plumeless thistle densities have been attributed at least in part to *R. conicus* alone or in combination with another biocontrol

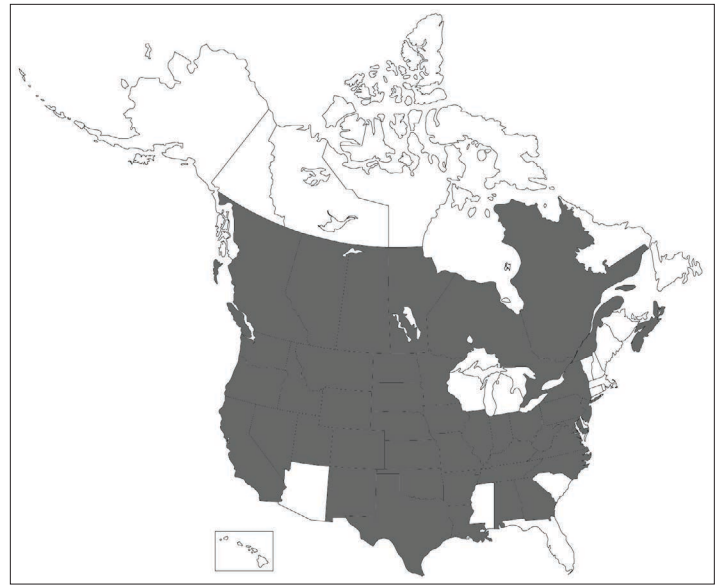


Figure 14. *Rhinocyllus conicus* distribution in North America (Winston et al. 2023). **Redistribution of this species is no longer permitted in the USA.**

agent, *Trichosirocalus horridus*. At several other locations, reductions have not been observed as some seeds escape herbivory within attacked seed heads, and seed heads that develop late in the growing season may escape attack entirely. Recent studies indicate *R. conicus*, alone or in combination with *T. horridus*, is only effective on musk and plumeless thistle when interspecific plant competition is high.

Rhinocyllus conicus is fairly abundant on Italian and slenderflower thistle in the western USA, where it can be effective on early blooming plants, but only in combination with plant competition. It can also be somewhat abundant on Canada and bull thistle in western North America (and milk thistle in the western USA), though its impact on these species is minimal as most plants continue to produce seed heads after *R. conicus* is finished laying eggs. Canada thistle is also less affected because it can continue to spread vegetatively via its roots. *Rhinocyllus conicus* is established on marsh thistle in western Canada, but its impact to that species is minimal. **Due to nontarget attack to native thistle species (see next section), the weevil is no longer approved for redistribution in the USA.**

NONTARGET EFFECTS

This species was approved for release in the USA before the Endangered Species Act and modern regulatory processes were established. Its broad host range on multiple thistle species (including natives) was considered a positive aspect at the time; however, this species would never be released under current regulations. **It attacks at least 22 of 90 *Cirsium* thistle species native to North America, and its redistribution permits in the USA were revoked in 2000.**

Trichosirocalus horridus

Musk thistle crown weevil

Trichosirocalus horridus is a biological control agent that was released in North America against introduced thistles.

SYNONYMS

Ceuthorhynchidius horridus (Panzer)

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Coleoptera	Beetles
Family	Curculionidae	Weevils
Genus	<i>Trichosirocalus</i>	
Species	<i>Trichosirocalus horridus</i> (Panzer)	Musk thistle crown weevil

DESCRIPTION

Eggs are opaque, white, and small. Larvae are white with dark brown head capsules (Fig. 15a) and can be up to 3 mm long. Adults are small (approximately 4 mm long), round, and brown with white mottling. They have obvious spines on their thorax and long snouts (Fig. 15b).

LIFE CYCLE

Overwintering adults emerge in spring and feed on rosettes of host plants (Fig. 16). Eggs are deposited on leaf

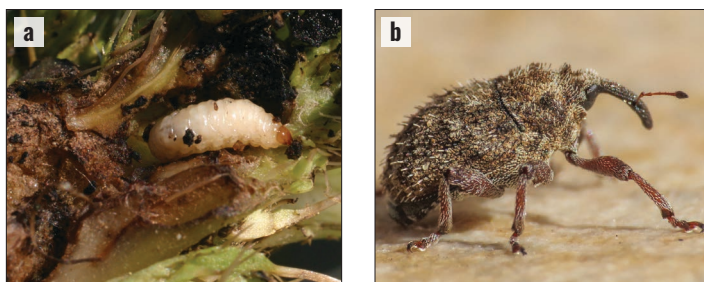


Figure 15. *Trichosirocalus horridus* (a) larva and root crown damage; (b) adult (a: Eric Coombs, Oregon Department of Agriculture; b: Emanuele Santarelli, iNaturalist.org CC BY-NC-SA 4.0)

<i>Trichosirocalus horridus</i> Egg	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Larva												
Pupa												
Adult								not active				

Figure 16. Schematic life cycle of *Trichosirocalus horridus* in North America. Bars indicate the approximate length of activity for each life stage; dates will vary depending on local conditions. Black bars represent the overwintering periods. There is typically one generation per year.

undersides, along the midrib and primary veins of young plants. Hatching larvae move down and feed on tissue at the root-stem junction, developing through three instars. Pupation occurs in the soil in early summer. Adults emerge over the summer but are inactive until fall when they feed superficially on host plant foliage. Adults overwinter in plant litter, emerging again in spring and often living until the next generation of adults begin to emerge. There is only one generation per year.

HOST SPECIES IN NORTH AMERICA

Musk, plumeless, Italian, slenderflower, and bull thistle

DAMAGE

Adult feeding on foliage in spring (Fig. 17a) is superficial and has minimal impacts. Larval mining of the root crown can kill developing stems (Fig. 17b). Though secondary stems often develop later, flowering is delayed and seed production may be reduced.

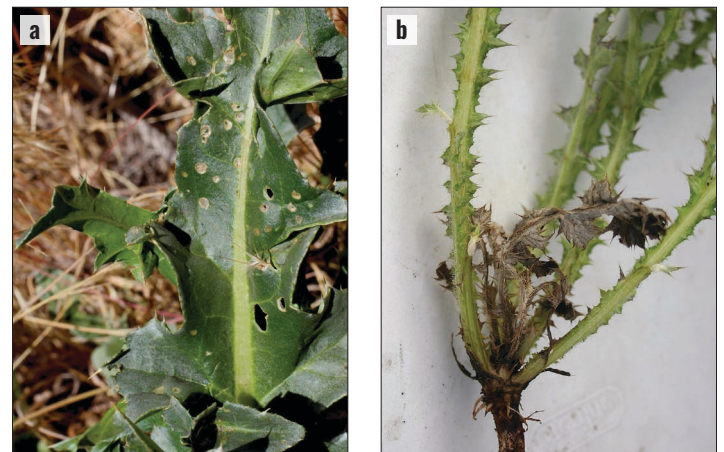


Figure 17. *Trichosirocalus horridus* (a) superficial adult feeding damage on musk thistle; (b) larval feeding damage on center stems of slenderflower thistle (a,b: Eric Coombs, Oregon Department of Agriculture, Bugwood.org CC BY-3.0 US)

FIELD IDENTIFICATION

Adult *Trichosirocalus horridus* may be observed on thistle foliage in spring or fall. Larval mining is not readily visible during very early stages unless stems are dissected. Later in the season, larval mining may kill central stems (Fig. 17b), leading to the subsequent growth of secondary stems.

Several other beetle species feed on thistles in North America, including some natives. Of the introduced species, the most commonly encountered are listed in [Table 1](#), along with key diagnostic traits that help differentiate these species from each other.

PREFERRED HABITAT

This species does best at open infestations of its target weed and on the perimeter of infestations where stems do not grow as tall. It is widely distributed throughout portions of North America, but does not do as well at high elevations or under marshy conditions.

HISTORY AND CURRENT STATUS

Trichosirocalus horridus is native to Europe. In the USA, individuals sourced from Italy were released on musk and plumeless thistle throughout the country beginning in 1974. After establishing, the weevil spread naturally to bull and slenderflower thistle. It was later intentionally redistributed to Italian and Scotch thistle in 1994, but failed to establish on Scotch thistle. In Canada, weevils collected in Germany were released on musk and plumeless thistle beginning in 1975 and on bull thistle in 1991. After establishing, the weevil spread naturally to Scotch thistle and was later intentionally redistributed further on Scotch thistle and marsh thistle in 2007. It is no longer considered established on Scotch and marsh thistle in Canada.

Trichosirocalus horridus is moderately abundant on musk and plumeless thistle in the USA ([Fig. 18](#)), though it prefers musk. On both, this weevil can be effective when in combination with plant competition and other biocontrol



Figure 18. *Trichosirocalus horridus* reported distribution in North America (Winston et al. 2023)

agents; however, alone, it is often ineffective. This weevil is less effective on Italian and slenderflower in the USA, and its impacts on bull thistle are minimal. **Due to nontarget attack to native thistle species (see next section), the weevil is no longer approved for interstate redistribution in the USA.** In Canada, the weevil is established on musk and plumeless thistle, though its impact on both species is limited. Where large rosettes are attacked, plants frequently survive to produce seed later in the season.

NONTARGET EFFECTS

This weevil has been observed feeding on *Cirsium* thistle species native to the USA. Consequently, interstate transport is not permitted in the USA, and some states have prohibited its redistribution within their borders. Where this biocontrol agent is approved for redistribution, it is imperative to refrain from making releases at sites where known related or susceptible native species co-occur.

NOTES

Some weevil populations are infected with *Nosema* pathogens. Weevil populations suspected of being infected should not be used in redistribution efforts.

In 2002, it was determined that *T. horridus* was in fact a complex of three species, each with distinct host plant preferences. An analysis in 2015 concluded there are only two species in this complex, of which only *T. horridus* is established in North America.

Urophora cardui Canada thistle stem gall fly

Urophora cardui is a biological control agent approved in North America for release against [introduced thistles](#).

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Diptera	Flies
Family	Tephritidae	Fruit flies
Genus	<i>Urophora</i>	
Species	<i>Urophora cardui</i> (Linnaeus)	Canada thistle stem gall fly

DESCRIPTION

Larvae are barrel-shaped, white, have dark brown anal plates (Fig. 19a), and can be up to 5 mm long at maturity. Adults can be up to 8 mm long and have dark bodies and dark bands on their white wings that form a ‘W’ pattern (Fig. 19b). Males have a rounded abdomen and females have a long, pointed ovipositor for laying eggs.

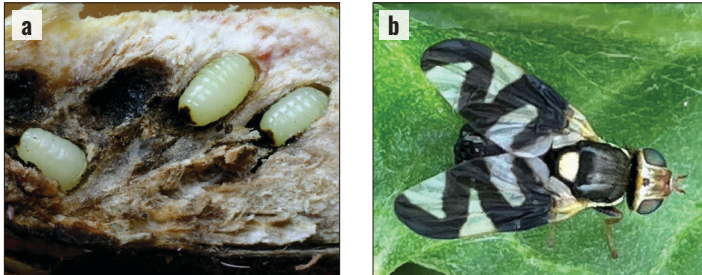


Figure 19. *Urophora cardui* (a) larvae with dark anal plates; (b) adult with dark wing bands forming a “W” pattern (a: Eric Coombs, Oregon Department of Agriculture; b: Jennifer Andreas, Washington State University Extension)

LIFE CYCLE

Overwintering larvae pupate inside galls in early spring (Fig. 20) as plants start bolting. Adults emerge in late spring and early summer when new Canada thistle stems are bolting and forming buds. Eggs are deposited on plant shoots in axillary buds throughout summer. Hatching larvae burrow into stems and cause galls to form. There are often multiple larvae in one gall (Fig. 19a). Larvae overwinter in the third (final) instar. There is one generation per year.

HOST SPECIES IN NORTH AMERICA

Canada thistle

DAMAGE

Larval feeding causes gall formation (Fig. 21). Galls act as metabolic sinks, diverting resources away from normal plant development. This does not kill existing plants; however, attacked plants produce fewer seeds, are less competitive, and may be more susceptible to pathogens and other insects.

FIELD IDENTIFICATION

Adult *Urophora cardui* may be observed on Canada thistle foliage throughout spring and early summer. Larval mining is not readily visible during very early stages unless stems are



Figure 21. *Urophora cardui* gall in a Canada thistle stem (Travis McMahon, MIA Consulting)

dissected. Later in the season, larval mining causes obvious swollen galls to form in Canada thistle stems (Fig. 21). Multiple larvae can often be found in the same gall.

Three additional introduced Tephritidae flies feed on thistles in North America, and all have similar dark banding on their wings (Table 1). *Urophora stylata* attacks bull thistle; its wing bands are grayish-brown and form a “VI” or “IV” pattern. *Urophora solstitialis* primarily attacks musk thistle; its wing bands are black and form a “VII” or “IIV” pattern. *Terellia ruficauda* has a gray body, and its three wing bands are only dark on the leading margins of its wings.

PREFERRED HABITAT

This species does well in moist, open, and partially shaded areas where its host plant is scattered, especially areas with high grass competition.

HISTORY AND CURRENT STATUS

Urophora cardui is native to Europe. In the USA, individuals sourced from Austria and France were released beginning in 1977. In eastern Canada, flies sourced from Austria, France, and Germany were released on Canada thistle beginning in 1974. An additional strain from Finland was released in western Canada in 1987.

Urophora cardui is moderately abundant in the USA, though primarily in western states (Fig. 22). Attacked plants may

<i>Urophora cardui</i>	Egg	Larva	Pupa	Adult	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Black bar from mid-May to mid-July	Black bar from mid-May to mid-July	Black bar from mid-May to mid-July	Black bar from mid-May to mid-July												

Figure 20. Schematic life cycle of *Urophora cardui* in North America. Bars indicate the approximate length of activity for each life stage; dates will vary depending on local conditions. Black bars represent the inactive and/or overwintering periods. There is typically one generation per year.

be stunted and produce fewer seeds, especially when galls occur at terminal growing tips. However, its overall impact in the USA is largely limited and often restricted to shaded infestations close to riparian areas. In Canada, this species is more widely distributed (Fig. 22). Populations vary by location and year but are highest in areas with sheltering canopy, near water, and in climates with mild winter temperatures. Under favorable conditions, this fly can reduce Canada thistle density and stature. In other areas, even in combination with the biocontrol agent *Hadroplontus litura*, this fly has no measurable impact. Several species of parasitic wasps attack the larval stage of *U. cardui* and can reduce their effectiveness.

NONTARGET EFFECTS

None reported

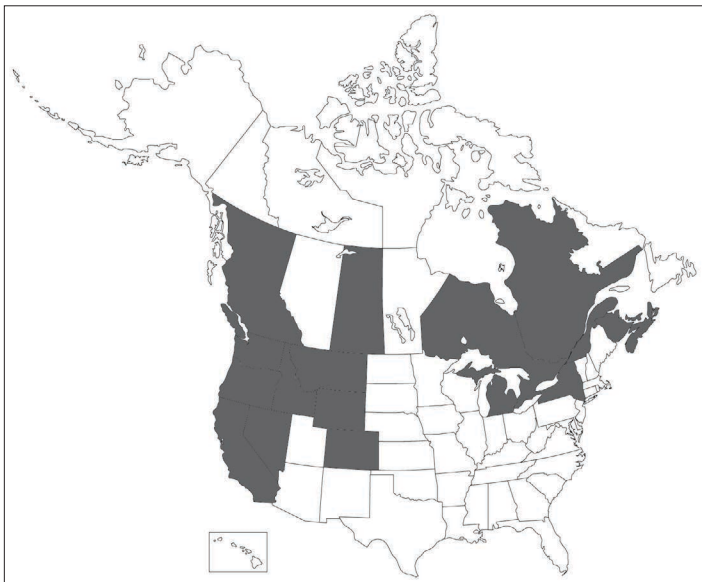


Figure 22. *Urophora cardui* reported distribution in North America (Winston et al. 2023)

Urophora solstitialis Musk thistle seedhead fly

Urophora solstitialis is a biological control agent approved in North America for release against introduced thistles.

DESCRIPTION

Larvae are barrel-shaped, off-white, have dark anal plates (Fig. 23a), and can reach lengths of 4 mm at maturity. Adults are brownish-black with a yellow head and legs. Wings are clear and with two black “VII” or “IIV” markings with the “V” occurring near the tip of the wing (Fig. 23b). Adults are 3–5 mm long; males have a rounded abdomen, and females have a long, pointed ovipositor for laying eggs.

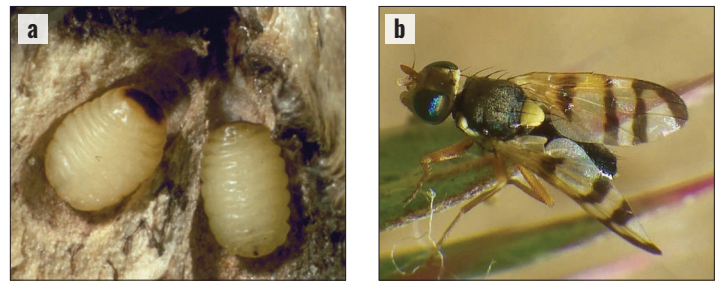


Figure 23. *Urophora solstitialis* (a) larvae with dark anal plates; (b) adult with dark wing bands forming a “VII” or “IIV” pattern (a: Peter Harris Agriculture and Agri-Food Canada, Bugwood.org CC BY-3.0 US; b: Michael Cripps, iNaturalist.org CC BY-NC 4.0)

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Diptera	Flies
Family	Tephritidae	Fruit flies
Genus	<i>Urophora</i>	
Species	<i>Urophora solstitialis</i> (Linnaeus)	Musk thistle seedhead fly

LIFE CYCLE

In spring, overwintering larvae pupate inside galls when thistle host plants are bolting. Adults emerge throughout late spring and early summer and deposit eggs in developing thistle seed heads. Hatching larvae burrow into seed heads and feed on seed-producing tissue, inducing the formation of hardened galls. There may be multiple larvae per seed head (Fig. 23a). Most larvae overwinter in galls during the third (final) instar, but early maturing larvae may pupate in early summer as a second generation. There are up to two generations per year (Fig. 24).

HOST SPECIES IN NORTH AMERICA

Musk, plumeless thistle

DAMAGE

Larval feeding reduces seed production, and seeds in infested seed heads are physically stuck to gall tissue, thereby reducing dispersal distance. Galls from larval feeding act as metabolic sinks, diverting resources away from normal plant development. Though these actions do not kill existing plants, they can help reduce the rate of thistle spread.

FIELD IDENTIFICATION

Adult *Urophora solstitialis* may be observed on musk thistle foliage throughout summer. Larval feeding is not readily visible unless seed heads are dissected. Multiple larvae can often be found in the same seed head (Fig. 23a).

<i>Urophora solstitialis</i>	Egg	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Larva												
	Pupa												
	Adult												

Figure 24. Schematic life cycle of *Urophora solstitialis* in North America. Bars indicate the approximate length of activity for each life stage; dates will vary depending on local conditions. Black bars represent the inactive and/or overwintering periods. There is typically one generation per year.

Three additional Tephritidae flies feed on thistles in North America, and all have similar dark banding on their wings (**Table 1**). *Urophora cardui* attacks Canada thistle in North America; its wing bands are black and form a “W” pattern. *Urophora stylata* attacks bull thistle; its wing bands are grayish-brown and form a “VI” or “IV” pattern. *Terellia ruficauda* has a gray body, and its three wing bands are only dark on the leading margins of its wings.

PREFERRED HABITAT

Specific habitat requirements of this species in North America are unknown.

HISTORY AND CURRENT STATUS

Urophora solstitialis is native to Europe. In the USA, individuals sourced from Italy were released on both musk and plumeless thistle beginning in 1993. In Canada, flies sourced from Austria were released on plumeless thistle beginning in 1990. A second shipment sourced in Germany was released on musk thistle in 1991.

Urophora solstitialis failed to establish in the USA. In Canada, it is established on both musk and plumeless thistle (**Fig. 25**); however, it is infrequent on both, and its overall impact is considered limited.

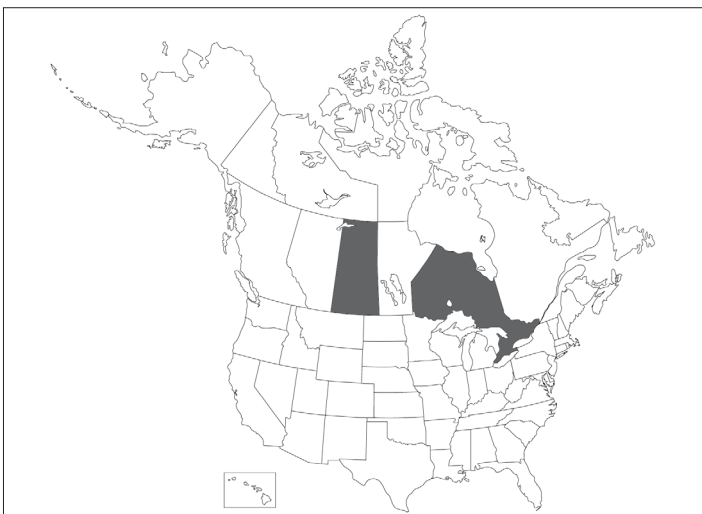


Figure 25. *Urophora solstitialis* reported distribution in North America on plumeless thistle (ON) and musk thistle (SK and ON) (Winston et al. 2023)

NONTARGET EFFECTS

None reported

Urophora stylata Bull thistle seedhead gall fly

Urophora stylata is a biological control agent approved in North America for release against **introduced thistles**.

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Diptera	Flies
Family	Tephritidae	Fruit flies
Genus	<i>Urophora</i>	
Species	<i>Urophora stylata</i> (Linnaeus)	Bull thistle seedhead gall fly

DESCRIPTION

Larvae are barrel-shaped, off-white, have dark anal plates (**Fig. 26a**), and can be up to 5 mm long. Adults are brownish-gray with a yellow head and brown legs. Wings are clear with gray-brown “VI” or “IV” markings, the “V” occurring near the wing tip (**Fig. 26b**). Adult males have rounded abdomens and can be up to 5 mm long while females have a long, pointed ovipositor for laying eggs and can be up to 7 mm long.

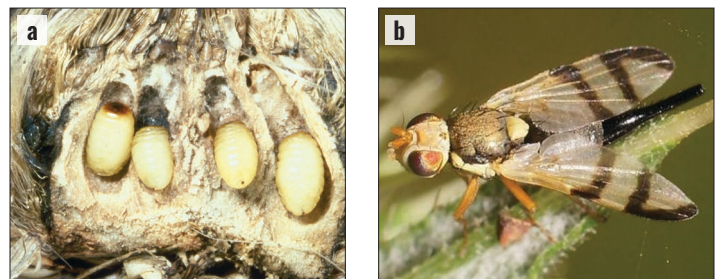


Figure 26. *Urophora stylata* (a) larvae with dark anal plates; (b) adult with dark wing bands forming a “VI” or “IV” pattern (a: Peter Harris Agriculture and Agri-Food Canada, Bugwood.org CC BY-3.0 US; b: Reiner Richter, iNaturalist.org CC BY-NC-SA 4.0)

<i>Urophora stylata</i>	Egg	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Egg													
Larva													
Pupa													
Adult													

Figure 27. Schematic life cycle of *Urophora stylata* in North America. Bars indicate the approximate length of activity for each life stage; dates will vary depending on local conditions. Black bars represent the inactive and/or overwintering periods. There is typically one generation per year.

LIFE CYCLE

As bull thistle plants are bolting in spring, overwintering larvae pupate inside galls produced the previous year. Adults emerge in early summer and deposit eggs on maturing bull thistle buds. Hatching larvae burrow into seed heads and feed on seed-producing tissue, which induces the formation of galls. There may be multiple larvae per seed head (Fig. 26a). Third (final) instars overwinter within galls. There is one generation per year (Fig. 27).

HOST SPECIES IN NORTH AMERICA

Bull thistle

DAMAGE

Larval feeding reduces seed production, and seeds in infested seed heads are physically stuck to gall tissue, thereby reducing dispersal distance. Galls from larval feeding act as metabolic sinks, diverting resources away from normal plant development. Though these actions do not kill existing plants, they can help reduce the rate of bull thistle spread.

FIELD IDENTIFICATION

Adult *Urophora stylata* may be observed on bull thistle foliage throughout summer. Larval feeding is not readily visible unless seed heads are dissected. Multiple larvae can often be found in the same seed head (Fig. 26a).

Three additional Tephritidae flies feed on thistles in North America, and all have similar dark banding on their wings (Table 1). *Urophora cardui* attacks Canada thistle in North America; its wing bands are black and form a “W” pattern. *Urophora solstitialis* primarily attacks musk thistle in North America; its wing bands are black and form a “VII” or “IIV” pattern. *Terellia ruficauda* has a gray body, and its three wing bands are only dark on the leading margins of its wings.

PREFERRED HABITAT

This species does best in open meadows with scattered plants. It does not do as well in dense stands of thistle or at sites with flooding and high winds.

HISTORY AND CURRENT STATUS

Urophora stylata is native to Europe. Individuals from Germany and Switzerland were released on bull thistle in Canada beginning in 1973. After establishment, these were redistributed to the USA beginning in 1983. A second shipment from Austria and France was released in Quebec in 1976, but it failed to establish.

In the USA, *U. stylata* is established only in western states (Fig. 28) where its abundance and impact on bull thistle vary. Most populations are cyclical or limited. 60–90% of seed heads are attacked in some areas, which has reduced seed production by up to 60%. However, in general, it is difficult to maintain large fly populations on the short-lived bull thistle. In addition, bull thistle infestations tend to decrease when disturbance is low, further reducing *U. stylata* populations. In Canada, this fly naturally dispersed from all release sites and is now abundant on bull thistle. The host plant has decreased at most sites, likely due to a combination of land use and attack by *U. stylata* and *Rhinocyllus conicus*.

NONTARGET EFFECTS

None reported

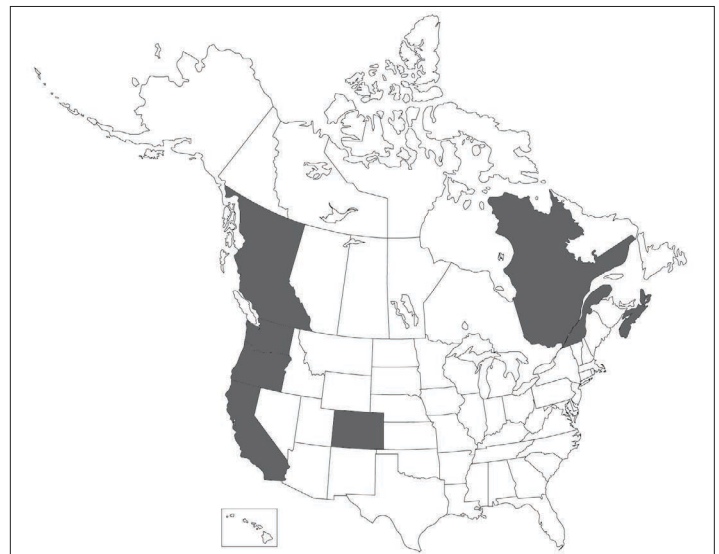


Figure 28. *Urophora stylata* reported distribution in North America (Winston et al. 2023)

NON-ESTABLISHED SPECIES

Altica carduorum (Coleoptera: Chrysomelidae)

DESCRIPTION AND LIFE CYCLE

Adults are metallic blue-black, have long segmented antennae, and their rounded bodies are up to 4 mm long (Fig. 29). They emerge in late spring and feed on young Canada thistle leaves. Oviposition occurs on the underside of leaves. Larvae emerge in mid to late summer, and feed on Canada thistle leaves. When mature, larvae drop to the soil for overwintering.



Figure 29. *Altica carduorum* adult (André Gassmann, CABI-Switzerland)

HISTORY AND CURRENT STATUS

Altica carduorum sourced from France and Switzerland were released on Canada thistle in Canada beginning in 1963 and the USA starting in 1966. Despite multiple releases, establishment failed at all sites. An additional population from Italy was released in Maryland, USA but also failed to establish, possibly influenced by predation. **This species is not currently permitted and is no longer being pursued for use as a biocontrol agent.**

Lema cyanella (Coleoptera: Chrysomelidae)

DESCRIPTION AND LIFE CYCLE

Overwintering adults emerge in spring and oviposit on Canada thistle stems and leaf undersides. Adults are dark metallic-blue, up to 5 mm long, and have narrow heads, bulging eyes, and long segmented antennae (Fig. 30). Larvae feed on the undersides of leaves while the upper epidermis remains intact, forming a characteristic feeding window. Mature larvae drop to the soil in midsummer, pupating within cocoons made of



Figure 30. *Lema cyanella* adult (Vlad50, iNaturalist.org CC BY-NC 4.0)

foam they secrete. Adults emerge in late summer and feed on Canada thistle foliage prior to overwintering in soil.

HISTORY AND CURRENT STATUS

Lema cyanella introduced from Switzerland was released on Canada thistle in Canada beginning in 1983. After establishment failed, individuals sourced from Switzerland and France, obtained via New Zealand, were released in western Canada beginning in 1993. **One population initially established, but concerns over nontarget attack led to its eradication. It is no longer considered established, and it is not approved for release in the USA.**

Psylliodes chalconera (Coleoptera: Chrysomelidae)

DESCRIPTION AND LIFE CYCLE

Overwintering adults emerge in spring and oviposit on musk thistle plant bases. Adults are shiny and dark with a metallic blue-green sheen and large femurs on their hind legs (Fig. 31). Larvae are slender and white with brown head plates. Adults and larvae can be up to 3 mm long. Larvae develop through three instars, feeding on musk thistle leaves, buds, and flowers throughout the growing season. Pupation occurs in plant litter. There is one generation per year.

HISTORY AND CURRENT STATUS

Psylliodes chalconera individuals from Italy were released on musk thistle in the USA in 1997 but failed to establish. This flea beetle is not widespread in its native range; as a result, it has been difficult to collect large enough numbers for re-release and establishment in North America. **It is not approved for release in Canada and is not currently being pursued in the USA.**



Figure 31. *Psylloides chalconera* adult (Felix Riegel, iNaturalist.org CC BY-NC 4.0)

UNAPPROVED BIOCONTROL AGENTS

Six accidentally introduced species are established on introduced thistles in North America. Though some have been intentionally redistributed at different times, all six species are not approved for use. **It is illegal to intentionally move these species to new areas in the USA.** Care should be taken when transferring approved agents to ensure that these unapproved species are not also included in transferred material.

Aceria anthocoptes (Acari: Eriophyidae)

DESCRIPTION AND LIFE CYCLE

Mites appear on foliage in spring as Canada thistle plants bolt. Larvae, nymphs, and adults are white, tan, pink, or yellow, depending on the developmental stage. All stages are tiny (0.15–0.20 mm long) and best viewed with a microscope (Fig. 32). Females exist in reproductive (summer) and overwintering forms. Feeding mites suck out the contents

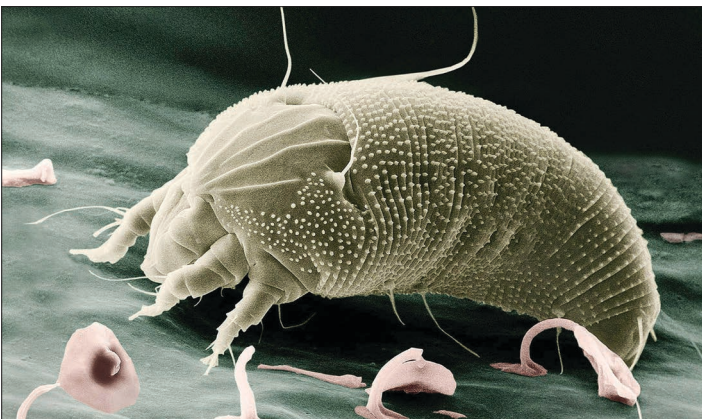


Figure 32. *Aceria anthocoptes* adult (Eric Erbe, USDA ARS, Bugwood.org CC BY-3.0 US)

of leaf cells. There are multiple generations per year, and overwintering is likely on roots or root buds.

HISTORY AND CURRENT STATUS

Aceria anthocoptes was discovered on Canada thistle in Maryland, USA in 1998. It is now scattered throughout the USA and is also established in Alberta, Canada. It can cause thinning and leaf deformation in the lab, but has not been properly evaluated in the field where it appears to have minimal impact. **It has been collected from numerous thistles native to North America and is not approved for redistribution in the USA.**

Cassida rubiginosa (Coleoptera: Chrysomelidae)

DESCRIPTION AND LIFE CYCLE

Adults emerge in early spring and feed on new Canada thistle foliage. Adults are oval, up to 7½ mm long, and have a hard, green protective covering (Fig. 33a) and black undersides (Fig. 33b). Eggs are laid in spring and summer. Young larvae feed on the undersides of new leaves, leaving behind a thin layer of leaf tissue (“window feeding”), while older larvae make irregular feeding holes from the top sides of leaves (Fig. 33c). Larvae are green and up to 6 mm long. They have spines on their margins and a forked tail spine on which they accumulate molted skins and waste to serve as a protective parasol (Fig. 33d). Larvae develop through five instars and then pupate in late summer. Pupae are brown, oval-shaped, and have black spikes along their margins. Emerging adults feed on young Canada thistle foliage until late fall and then overwinter in soil litter. There is one generation per year.

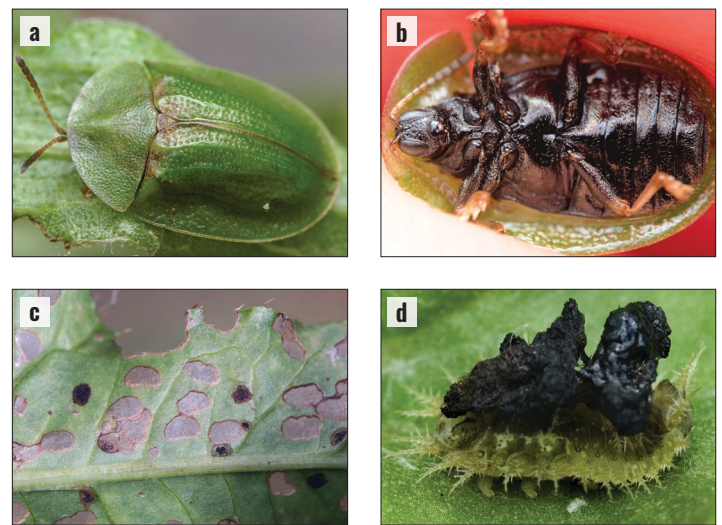


Figure 33. *Cassida rubiginosa*: (a) adult with protective covering; (b) adult undersides; (c) larval feeding damage; (d) larva with accumulations of molted skins and waste (a,b: Gilles San Martin, iNaturalist.org CC BY-SA 4.0; c: Whitney Cranshaw, Colorado State University, Bugwood.org CC BY-3.0 US; d: David Cappaert, Bugwood.org CC BY-3.0 US)

HISTORY AND CURRENT STATUS

Cassida rubiginosa was recorded on Canada thistle in North America in 1901 and was intentionally redistributed in the USA through the early 2000's. It is currently established in scattered populations throughout the USA and Canada. In some areas, it can significantly reduce Canada thistle biomass and survival, but its overall impact is typically minimal, likely hindered by predation and parasitism. **It feeds on numerous native or economically important Cardueae species and is not approved for redistribution in the USA.**

Cleonis pigra

(Coleoptera: Curculionidae)

DESCRIPTION AND LIFE CYCLE

Overwintering adults emerge in spring and feed on young leaves. Adults are oval-shaped, up to 7 mm long, mottled brown, and have many tiny black lumps scattered over their thorax and elytra (Fig. 35). Their wide snouts appear grooved. Eggs are deposited about one month after adult emergence, and larvae hatch throughout summer. Larvae bore into the stem base of their target plant, where they feed internally. They are white with a brown head capsule, C-shaped, and up to 3 mm long. Larvae develop through four instars and pupate in soil litter near the base of host plants during late summer. Adults emerge throughout fall and then overwinter in soil litter. There is one generation per year.



Figure 35. *Cleonis pigra* adult (Marie-Lise Beaudin, iNaturalist.org CC BY-NC 4.0)

HISTORY AND CURRENT STATUS

Cleonis pigra was recorded on Canada thistle in the USA by 1919 and in Canada by 1933. It is established in Indiana, Michigan, New York, and Pennsylvania in the USA, and New Brunswick, Ontario, and Quebec in Canada. Larval root-mining may kill plants, but plant regeneration is typical. **It feeds on several important species in the Asteraceae, including several natives and species of economic importance, but its overall impact to introduced thistles is minimal. This species is not approved for redistribution in the USA.**

Larinus carlinae (= *L. planus*)

(Coleoptera: Curculionidae)

DESCRIPTION AND LIFE CYCLE

Adults emerge in early spring and feed on young foliage, resulting in leaf holes (Fig. 36a) and deformed bracts and seed heads (Fig. 36b). Adults are elongate (≤ 8 mm long) and have long snouts. They have black bodies with mottled tan-yellow hairs (Fig. 36c), though the hairs can sometimes rub off (Fig. 36d). Eggs are laid inside developing seed heads. Larvae feed on developing seeds and receptacle tissue throughout summer. Larvae are white with brown head capsules, C-shaped, and are up to 5 mm long (Fig. 36e). They develop through three instars and pupate within seed heads. Adults emerge in late summer and early fall, then overwinter in plant litter. There is one generation per year.

HISTORY AND CURRENT STATUS

Larinus carlinae was an accidental introduction recorded in the USA by 1968 and in Canada by 1988. It was later intentionally redistributed in both countries. It is established on Canada thistle in populations scattered throughout the USA and

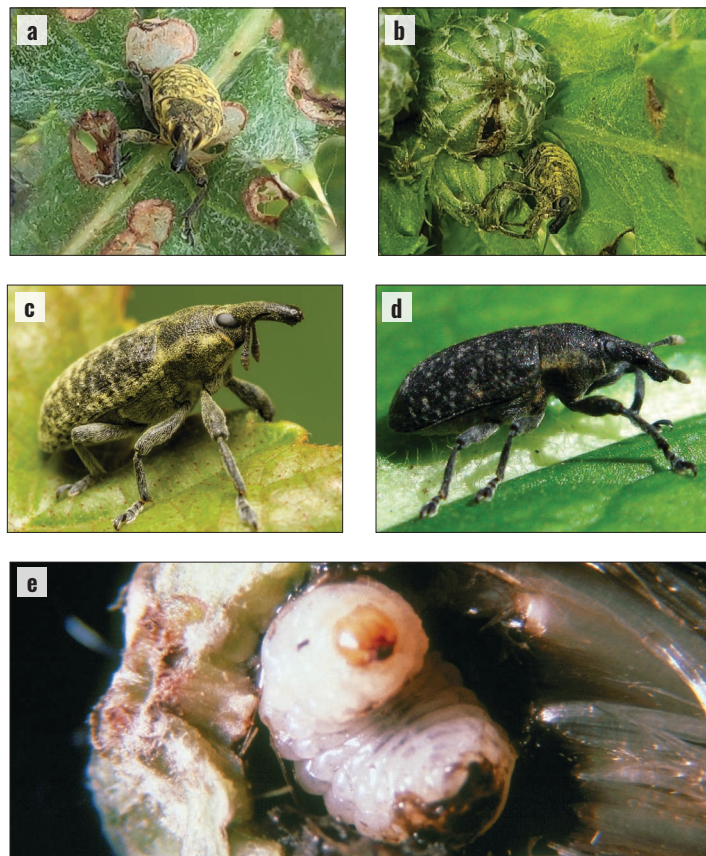


Figure 36. *Larinus carlinae*: (a) adult feeding damage to leaves; (b) adult feeding damage to a seed head; (c) adult with tan-yellow hairs; (d) adult with many hairs rubbed off; (e) larva in a seed head (a: Matt Webb; b: Fernhollow; c: Stuguy; d: Michi1; a-d iNaturalist.org CC BY-NC 4.0; e: Alec McClay, Bugwood.org CC BY-3.0 US)

Canada, as well as on bull, musk, and plumeless thistle in western Canada. **It attacks numerous native thistle species, and damage to natives often exceeds damage to introduced species. It is not approved for redistribution in the USA.**

Puccinia carduorum (Pucciniales: Pucciniaceae)

DESCRIPTION AND LIFE CYCLE

This fungus has a complicated life cycle that includes five different spore stages throughout the year. Teliospores can withstand freezing temperatures and are the overwintering stage. Teliospores germinate in spring, leading to the production of basidiospores that infect musk thistle plants in the early rosette and bolting stages. The rust then develops through two subsequent spring stages (pycniospore [presumed] and aeciospore). Symptoms include reddish-brown pustules (**Fig. 37**) that produce large amounts of urediniospores. Urediniospores are microscopic, golden to dark brown, flat, round, and have short spines covering their surface. Urediniospores spread rapidly from plant to plant as they are easily dispersed by both wind and rain, allowing multiple “generations” of uredinia infection to occur during the spring and summer.



Figure 37. *Puccinia carduorum* infecting musk thistle. Photo: USDA-ARS, Bugwood.org CC BY-3.0 US

HISTORY AND CURRENT STATUS

One strain was found present (inadvertently) on slenderflower thistle in California, USA by 1951. It is specific to that species and is established only in California and Oregon, though its overall impact is unknown. A new strain was intentionally introduced on musk thistle in Virginia, USA in 1987 for experimental field release. It spread naturally and now occurs throughout North America, as far west as California and British Columbia, Canada. It is specific to one subspecies of musk thistle, *Carduus nutans* ssp. *leiophyllus*, on which it reduces seed set and quality, and also increases the host plant's susceptibility to interspecific plant competition and

attack from additional biological control agents. It is easily spread by various thistle biocontrol insects. **Neither strain is approved for redistribution in the USA.**

Terellia ruficauda (Diptera: Tephritidae)

DESCRIPTION AND LIFE CYCLE

Adults emerge in early spring as host plants begin to bolt. Adults are up to 5 mm long and have gray bodies with dark-spotted abdomens and yellow-orange legs. The wings are clear with three black marks along the leading margins and fainter marks on hind margins (**Fig. 38**). Eggs are laid in immature female seed heads of Canada thistle. Larvae feed on seeds and receptacle tissue. They are white maggots that develop through three instars are up to 6 mm long at maturity. Just before seeds begin to disseminate, larvae form cocoons of tangled pappus hairs in which they overwinter. Pupation occurs in spring, and there is one generation per year.



Figure 38. Adult *Terellia ruficauda* (Janet Graham, Wikipedia.org CC BY 2.0)

HISTORY AND CURRENT STATUS

Terellia ruficauda was discovered on Canada thistle in the USA and Canada by 1873. Populations are widely distributed in eastern North America; the fly is abundant in Canada but generally limited in the USA. Larvae destroy some seeds, but its overall impact on Canada thistle is minimal. **It attacks several species of *Cirsium* thistle and is not approved for redistribution in the USA.**

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Table 1. Key traits for differentiating introduced natural enemies established on introduced thistles in North America.





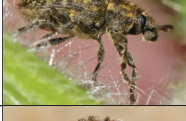


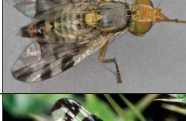






	SPECIES	APPROVAL STATUS	HOSTS	ATTACK	ADULT DESCRIPTION	ADULT
BEETLES	<i>Cassida rubiginosa</i>	Not approved in the USA	Canada: many species in Cardueae of native or economic importance	Adults: feed on foliage Larvae: feed on foliage	Oval, hard green protective covering, black undersides, ≤7½ mm long	
	<i>Cleonis pigra</i>	Not approved in the USA	Several species in Asteraceae, including introduced, native, and many of economic importance	Adults: feed on foliage Larvae: mine stems and root crowns	Oval, mottled brown, many shiny black lumps, grooved snouts, ≤7 mm long	
	<i>Hadroplontus litura</i>	Approved in the USA and Canada	Canada	Adults: feed on leaf and stem tissue Larvae: mine leaves, stems, and roots	Mottled black/white, “t” marking on backs, thick bodies, long curved snouts, ≤4 mm long	
	<i>Larinus carlinae</i> (= <i>L. planus</i>)	Not approved in the USA	Canada, bull, musk, and plumeless: many native thistles	Adults: feed on leaf and stem tissue Larvae: feed on seeds and receptacle tissue	Elongate, long snouts, black bodies with mottled tan-yellow hairs, hairs can sometimes rub off, ≤8 mm long	
	<i>Rhinocyllus conicus</i>	No longer approved in the USA; approved in Canada	Musk, plumeless, Italian, slenderflower, milk, bull, Canada, and marsh: many native thistles	Adults: feed on leaf and stem tissue Larvae: mine receptacle and seed tissue	Dark brown with mottled yellow hairs that may rub off, short snouts, ≤6 mm long	
	<i>Trichosirocalus horridus</i>	No longer approved for interstate transport in the USA, some states prohibit redistribution; approved in Canada	Musk, plumeless, Italian, slenderflower, and bull: many native thistles	Adults: superficially feed on leaf tissue Larvae: mine root crowns	Brown with white mottling, obvious spines on their thorax, long snouts, ≤4 mm long	
FLIES	<i>Cheilosia grossa</i>	Approved in the USA; not approved for release in Canada	Bull, musk, Italian, slenderflower, and (rarely) plumeless	Adults: none Larvae: mine stems and roots	Fuzzy with orange-tan hairs, large black eyes, clear wings, ≤15 mm long including wings	
	<i>Terellia ruficauda</i>	Not approved in the USA	Canada, other <i>Cirsium</i> thistles	Adults: none Larvae: feed on seeds and receptacle tissue	Gray and spotted body, yellow-orange legs, wings clear with three bands only dark on leading margins, ≤5 mm long	
	<i>Urophora cardui</i>	Approved in the USA and Canada	Canada	Adults: none Larvae: feed on stem tissue, causing formation of galls	Dark brown, wings white with dark bands forming “W” pattern, ≤8 mm long	
	<i>Urophora solstitialis</i>	Approved in the USA and Canada, though not established in the USA	Musk, plumeless	Adults: none Larvae: feed in seed heads, causing formation of galls	Dark brown body, yellow head and legs, wings clear with dark bands forming “VII” or “IIV” pattern, 3–5 mm long	
	<i>Urophora stylata</i>	Approved in the USA and Canada	Bull	Adults: none Larvae: feed in seed heads, causing formation of galls	Brown gray body, yellow head, brownish legs, wings clear with dark bands forming “VI” or “IV” pattern, males 5 mm, females 7 mm	
FUNGI	<i>Puccinia carduorum</i>	Not approved in the USA	Musk, slenderflower	Urediniospore pustules infect leaves	Urediniospores gold brown, flat, round, 25 µm, covered with short spines; urediniospore pustules reddish-brown and powdery	
	<i>Puccinia punctiformis</i>	Approved in the USA for research releases only	Canada	Spore-producing pustules infect leaves; systemic infections attack roots and stems	Spore-producing pustules vary from orange to dark brown; on lower (and sometimes upper) leaf surfaces	
MITE	<i>Aceria anthocoptes</i>	Not approved in the USA	Canada: native thistles	Feeding mites suck out the contents of leaf cells	Pinkish-yellow, tiny (0.15–0.20 mm long) and best viewed with a microscope	

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