

## *Pterolonche inspersa* Strg.

**INVASIVE SPECIES ATTACKED:** Diffuse knapweed (*Centaurea diffusa* Lam.)  
Spotted knapweed (*C. biebersteinii* auct.)

**TYPE OF AGENT:** Root feeding moth

**COLLECTABILITY:** Passive distribution

**ORIGIN:** Hungary and Austria

### DESCRIPTION AND LIFE CYCLE

#### Adult:

*Pterolonche inspersa* moths measure 14-28 mm long, are grey-white coloured, and exhibit a silvery sheen on their wings. They have narrow wings spanning 1.9-2.5 cm and when at rest the wings are held close to their sides. The larvae create a 'chimney like' tube which the adults use to exit the root from June to early September while peak emergence occurs in mid-August. Mating begins immediately and 5-9 days later oviposition starts. Egg-laying occurs mainly from late afternoon through the night. An average 142 eggs are laid individually or up to six in a cluster on the underside of rosette leaves. Males live 10-12 days while females live 15-18 days. The male/female ratio is 1:1.5.

#### Egg:

The black oval eggs are 0.039 x 0.025 mm with a slight depressed centre. They incubate for 12 days at 24.6°C. It is essential that the weather remain dry during this time to prevent the egg chorion (membrane around the yolk) from firming, which would prevent the larvae from emerging from the eggs.



Fig. 2. *P. inspersa* larva in root (credit Powell et al. 1994)



Fig. 3. *P. inspersa* "chimney" on diffuse knapweed plant

#### Larva:

*P. inspersa* larvae are pearly white with inflated segments and small brown head capsules. New larvae instar mine down the root, feeding on the woody central portion or the soft tissue near the outer edges. They will fight and kill competing larvae

until a sustainable number remain. Normally one or two develop on a single root, however, as many as four have been observed. Webbing is spun to cover the feeding area resulting in a tube. By summer, the tube is 2-2.5 mm wide and extends 3-5 cm above ground to form a "chimney", which provides a downward route for hibernation. During sunny days the larvae often lie in the tube above the soil surface and move downward when they encounter vibrations, their movement within the tube can cause it to "wave". They overwinter in the third instar and resume feeding the following spring. In July of the following year, the mature larvae prepare to pupate.

#### Pupa:

Pupation takes about 15 days within the tube. Fully formed adults can be observed through the clear pupal casing. When the new adults emerge from the roots, they shed the pupal casing or "cocoon" inside the feeding tube.

#### Overwintering stage:

The third instar larvae overwinter in a silken tube in the root.

#### EFFECTIVENESS ON HOST PLANT

Larvae feed on roots, interrupting the vascular flow of nutrients to the plants. Larvae that hatch near the center of the plant root mine into the woody core. Larvae that hatch near the outer area of the crown feed on the cortex and outer root areas. Feeding reduces the plants' ability to store nutrients which decreases the plants' height and flowering ability. Roots become spongy and fragile and easily break



Fig. 1. *P. inspersa* adult (credit Powell et al. 1994)

apart. Damaged roots attract other predators which move into the roots and provide secondary attack.

## HABITAT AND DISTRIBUTION

### Native:

Its native geographic range is south and southeast Europe. It occurs in Spain, France, southern Russia, Hungary, Turkey, Romania, Bulgaria, Italy and Yugoslavia. Its occurrence ends abruptly in eastern Europe. It is found in central Hungary, but is scarce in northwest Hungary and Austria. It is notably absent in eastern Romania. Most common establishments occur on diffuse knapweed stands in northern Greece and western Turkey. Populations favour diffuse knapweed stands that become drought stressed from June to late September.

### North America:

*P. inspersa* thrives in hot dry sites with low to moderate plant density. It requires an arid environment with a period of drought during summer. Preferred soils are loose compositions of sand or gravel. Sites with aspen, Douglas fir or lodgepole pine indicate a moist environment which is probably less suitable. *P. inspersa* feeds on both spotted knapweed and diffuse knapweed, favouring the latter. It was originally believed that the Canadian climate was too moist for the moth to thrive.

### British Columbia:

The release sites occur in the Bunchgrass, Interior cedar-hemlock and Ponderosa pine biogeoclimatic zones. It does best in the Bunchgrass and Ponderosa Pine biogeoclimatic zones. Dispersal monitoring has shown the moth has now established itself into several subzones of the three biogeoclimatic zones.

## BRITISH COLUMBIA RECORD

### Origin:

*P. inspersa* populations released in B.C. originate from Hungary and Austria.

### History:

The first *P. inspersa* releases were made in 1986 in the field near Osoyoos and into rearing plots in Kamloops. The original field release was made with seven adults in poor physical condition and during a rainy period. Subsequent releases of several thousand adults, eggs, larvae, and pupae were made between 1987 and 2008. These releases were made in the southern interior near Kamloops, McLure, Grand Forks (Gilpin), Castlegar, and Summerland. Establishment has successfully occurred and the moths are dispersing well in the Kamloops, Grand Forks, and Summerland areas. All releases have been made on diffuse knapweed with the exception of two on spotted knapweed in the Castlegar area.

### Propagation results:

Between 1986 and 1989, over 4700 *P. inspersa* adults, pupae and eggs were put into two diffuse knapweed rearing tents at the Kamloops Propagation Facility. In 1989, only 63 adults emerged from a shipment containing 244 pupae and eight of the emerging adults suffered deformities. Recorded observations noted that the smaller pupae were less likely to develop into an adult. Historical records indicate poor survival rates for future generations. Records do not indicate there were any collections made from the tents, however, it is possible 99 of the adults released in 1991 at Lac Du Bois (Kamloops) may have come from the tents.

For a short time, Selkirk College in Castlegar supported propagation tents and in 1987, two adults and 77 pupae were released into a single rearing tent (cage). Further records of this tent and propagation facility are unavailable.



Fig. 4. *P. inspersa* attacked diffuse knapweed plant at release site near Kamloops



Fig. 5. *P. inspersa* release area at Summerland (Ponderosa pine zone)



### Field results:

Repeat visits to the original release at Osoyoos with predicted favourable habitat did not yield establishment. The reason for failure is presumed to be a result of the poor condition of the few adults involved and the weather conditions at the time of release. However, the subsequent treatments made on diffuse knapweed in 1987 and 1991 in Summerland, near Grand Forks (Gilpin), and near Kamloops (Lac du Bois) have established. The single spotted knapweed treatment occurred in Castlegar in 1987 and reported historic establishment, however, dispersal monitoring carried out in 2008 resulted in no larvae found on spotted knapweed, whereas larvae were readily found on diffuse knapweed. In 2007, 25 larvae infested plants collected from Lac du Bois (Kamloops) were transplanted to a site approximately 30 km away in Barnhartvale to test this method for redistribution. The following year 20 of the 25 transplanted roots were recovered and examined and two of the roots had exit chimneys and four had questionable evidence. This confirmed if adequate quantities of plants with ample larvae or pupae infesting the roots were available, transplanting could be considered a viable releasing method. In 2015, diffuse plants were excavated in the general area of the Barnhartvale site and one *P. inspersa* larva was found. In May 2008, 25 plants were excavated from Summerland to allow for adults to emerge in a warm lab environment. By late June, six adults had emerged and were released into a field site north of McLure. In 2010, 25 plants were excavated at this site and the dissection revealed one plant with *P. inspersa* evidence. *P. inspersa* has established at release or dispersal sites on diffuse knapweed growing at elevations between 352-825 m.

*P. inspersa* appears to have the ability to establish and disperse on a limited supply of preferred target plants in desired habitats. Plants attacked by *P. inspersa* have appeared to be shorter than normal and may produce a single bolting stalk or multiple weak bolting stalks, with smaller, or no flowers. Since 2001, extensive sampling near Kamloops has shown the moth has dispersed over 20 km in 15 years, but its dispersal may be limited by the availability of diffuse knapweed. Similar monitoring in Summerland has shown dispersal to be less than that in Kamloops, however, the moth faces different obstacles in the Okanagan. It encounters the same widely spaced diffuse knapweed patches in the Okanagan, but it does so within ongoing development which is limiting its preferred habitat and may encounter possible insecticide drift from orchards and commercial operations. In the Okanagan *P. inspersa* has crossed the Okanagan Lake to disperse to the Naramata bench and in Kamloops the moths have crossed the North Thompson River to reach dispersal sites. Spotted knapweed has been found attacked at neither Kamloops nor Summerland, even when it was growing next to larvae-occupied diffuse knapweed plants. Dispersal monitoring near Grand Forks and Castlegar was performed in 2008 and the moth was found dispersed, but, the distances were not recorded. Recent revisits to some of these areas have shown no establishment on spotted knapweed growing in the Interior cedar-hemlock biogeoclimatic zone, however, larvae were found on diffuse knapweed growing in their preferred habitat in this same zone.



Fig. 6. *P. inspersa* release site at Lac Du Bois grasslands near Kamloops (Bunchgrass zone)



Fig. 7. *P. inspersa* release in Barnhartvale (Kamloops) (Ponderosa pine zone)



Fig. 8. *P. inspersa* dispersal site north of Kamloops (Ponderosa pine zone)

### NOTES

- *P. inspersa* larvae kill and consume larvae and pupae of *Sphenoptera jugoslavica*, *Agapeta zoegana* and *Pelochrista medullana*.

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