Operophtera brumata

WINTER MOTH

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COMMON NAMES Winter moth (Eng.); Arpenteuse Tardive (Fr.)
SCIENTIFIC NAME *Operophtera brumata*
FAMILY Geometridae

RANGE/KNOWN DISTRIBUTION

Winter Moth is native to northern Europe and northern Asia. Winter Moth was introduced to North America through Nova Scotia prior to 1930, and became an established Maritime region pest by mid-century. Introduced to Vancouver Island in the 1970s, Winter Moth outbreaks were soon observed up to 100 km north of Victoria on southeastern Vancouver Island, as well as on the lower mainland surrounding Vancouver, and in Oregon.

Winter Moth is a detrimental defoliator of several host trees including Garry Oak (*Quercus garryana*), aspen and poplar (*Populus* spp.), birch (*Betula* spp.), and Bigleaf Maple (*Acer macrophyllum*) as well as some agricultural berry crops, such as blueberries and cranberries.

IMPACTS ON GARRY OAK AND ASSOCIATED ECOSYSTEMS

Winter Moth is a pest on Garry Oak and associated broadleaf species, including Common Snowberry (*Symphoricarpus albus*). Winter Moth outbreaks put significant stress on Garry Oak trees. Severe outbreaks of Winter Moth larvae lead to death of individually defoliated branches and sometimes of entire trees when outbreaks are sustained over multiple years. Tree death, especially at the landscape level, can have significant impacts on associated native insects and plants, along with other elements of the ecosystems.

A joint federal-provincial biological control program was initiated on Vancouver Island in 1978, involving the importation and release of two European Winter Moth parasites. This followed a similar release program in Nova Scotia which resulted in the reduction of Winter Moth populations at the release sites down to manageable levels within 6 years. Despite these biological controls, Winter Moth populations have been increasing in the Victoria area.

FIELD DESCRIPTION

Winter Moths can be identified at various life stages, depending on time of year. Winter Moth eggs are laid over the winter. The small, round, green eggs can be found in loose clusters under bark snags or under

lichen along tree trunks of host species. Eggs become orange and finally dark red prior to hatching in early spring.

The larvae of Winter Moth hatch from eggs in the spring. They are small "inchworms" that eventually grow to 1.8 cm long. Their light-green bodies bear a dark green mid-dorsal stripe with three cream-coloured lines on each side. Head plate is light green.

After feeding, individuals drop to the ground and pupate below the soil where they remain for the entire summer. Pupae are light brown and 7.5–7.9 mm in length. Pupae can be further identified by their bifurcated disto-apical spine.

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Winter Moth larva

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Male (below) and female (above) Winter Moth—female has only vestigial wings

Adult Winter Moths exhibit pronounced sexual dimorphism. Only males bear full wings, with a wingspan to 3.0 cm. The males have narrow brown bodies and brown-gray wings that appear hairy due to the elongate scales along the wing margins. Females are drab brown and bear only vestigial wings. Females grow to 0.8 cm long.

LIFE HISTORY

Winter Moths are typical Lepidoptera in that they follow complete metamorphosis: egg, larva, pupa, adult. Moths emerge from the pupal cases after the first hard frost in late October or early November. Adult male moths generally emerge four days prior to the females. Males fly in the evening. The flightless females crawl up the tree trunks to lay eggs in the tree crown. Adult Winter Moths can be observed between October and later January on Vancouver Island.

Females can lay up to 400 eggs, one at a time, either in loose clumps or individually. Eggs hatch in early spring and larvae disperse by walking and by ballooning from silk threads, like

spiders. It has been suggested that hatching may be synchronous to, or occur just prior to, bud breaking and that the phenology (timing) of these two events may be a significant factor of outbreaks. First instar larvae generally embed themselves within buds which they will consume from the inside. Larvae develop and grow over 3–4 weeks when air temperature is suitable (14°C–20°C). Later instars are inactive and can be found on the underside of leaves. At the end of their feeding period, Winter Moth larvae drop to the ground to pupate. Pupation occurs below the soil (1.5 cm–15 cm) and lasts 3–4 months.

Winter Moth outbreaks apparently occur in a cyclical pattern. However, complex generational effects may sustain outbreaks and lessen density dependent responses that would normally limit outbreaks. Natural enemies, including predatory beetles and an introduced parasite, *Cyzenis albicans,* may also affect the life history and outbreak cycles of Winter Moths.

HABITAT

Because of their broad host range, Winter Moths are able to occupy many habitat types. The larvae are generalist feeders and will defoliate a variety of tree and shrub species. This insect favours mild climates at northern latitudes and can tolerate temperatures to -15°C in the short term. The adult males are most often observed flying after twilight at temperatures between 7°C–12°C and are strongly attracted to light. With changing climate, Winter Moth outbreaks are enduring longer and are now reaching historically colder regions in Europe.

MANAGEMENT

Winter Moth is an established pest on Vancouver Island. Managing Winter Moth populations can be difficult because the moths occur in sensitive ecosystems for which there remain large information gaps regarding species interactions. A number of strategies have been employed to control Winter Moth in both eastern and western North America.

Develop a long-term, realistic program for invasive species removal before undertaking any work. Before taking action, obtain expert advice. Please refer to the introductory section of this manual.

PHYSICAL CONTROL: Tree bands have been widely used in North America to stop adult females from climbing up trees in fall and winter to lay their eggs. Sticky bands are wrapped tightly around the tree trunk over a layer of cotton batting and a layer of plastic wrap. The BC Ministry of Environment provides step-by-step instructions on tree banding for Winter Moth on their website (see Gilkeson and Adams in Select References below). Tree bands should be removed and disposed of by late January.

Tree bands minimize the number of eggs that a female can lay in favourable sites and can also kill climbing females before they are able to lay their eggs. Tree bands are useful for managing low to moderate levels of Winter Moth populations but in high populations, traps fill up with bodies, allowing other females to crawl over the dead bodies and move up the tree. In years of high Winter Moth populations, two traps per tree have been used. Tree bands are potentially harmful to other insects.

Photo Credit: © CITY OF VICTORIA

Tree banded against Winter Moth

BIOLOGICAL CONTROL: A number of well-established biological controls are used to mitigate Winter Moth outbreaks and to maintain low population numbers following population declines.

1) *Cyzenis albicans* is an endoparasitic tachinid fly (Diptera) that occurs with Winter Moth in its native range. *C. albicans* parasitizes the larvae of Winter Moth. *C.albicans* eggs are laid along the margins of leaves to be consumed by caterpillars and then remain dormant within the larvaes' cheek until pupation. While studies in Britain did not find this endoparasite to exert substantive control on Winter Moth populations, when introduced out of its ecological context in Nova Scotia, *C. albicans* proved a very successful biological control for Winter Moth. *C. albicans* was introduced to Vancouver Island following the Winter Moth's introduction.

Agrypon flaveola is another natural parasitoid of Winter Moth that has been introduced as a biological control in Nova Scotia, Vancouver Island, the lower mainland of British Columbia, and in Oregon following Winter Moth outbreaks. Its success is apparently more limited and site-specific than that of *C. albicans*.

2) Predatory beetles that feed on Winter Moth pupae in the soil are also important for regulating low density Winter Moth populations. Predation and parasitism are thought to act synergistically to control invasive Winter Moth.

3) *Bacillus thuringienis* Kustaki (Btk) is a bacterium that is sprayed on foliage when Winter Moth larvae are actively feeding on the outside of buds. While Btk is effective at controlling young larvae, it does not penetrate to control larvae feeding inside of buds.

Btk has detrimental effects on other Lepidoptera species, which may include uncommon and rare native species, limiting its usefulness in Garry Oak ecosystems.

4) The entomopathogenic nematode *Heterorhabditis megidis* may be a potential biocontrol, since Winter Moth larvae descending to pupate are susceptible to infection. However, the winter moth pupae themselves are not parasitized by this nematode. *H. megidis* can be applied at the time of larval descent by ground-spraying with a low application rate. More research is needed to determine broader ecological implications of using *H. megidis* as a biocontrol.

CHEMICAL CONTROL: Dormant oil sprays are used to suffocate Winter Moth eggs. The oil spray may be paired with a chemical to enhance the reach of the spray to target eggs hidden under bark and lichens.

Outside of Canada, pyrethroids have been used as effective chemical agents for the control of Winter Moth larvae. Chemical controls may have detrimental effects on other organisms, including non-target Lepidoptera and other insects. Consult local bylaws and chemical listings in your region before using any chemical control. Consult local bylaws and pesticide listings in your region before using any chemical control. *Chemical control should only be used under expert advice and with extreme caution in Garry Oak ecosystems.*

OTHER TECHNIQUES: Vegetation suffering attack by Winter Moth will be severely stressed. To mitigate the impact of Winter Moth devastation, watering defoliated trees is critical. Substantial watering may allow defoliated trees to produce a second set of leaves in a season.

PREVENTATIVE MEASURES: New Winter Moth invasions could be limited using pheromone traps. This method of mass trapping has been used to successfully control Gypsy Moth on Salt Spring Island as an alternative to overhead spraying. In regions where Winter Moth is already established, pheromone traps provide a method for monitoring population numbers. Pheromone traps for Winter Moth contain sex attractant chemicals that lure the males. Where Winter Moth is already

established, pheromone traps are a useful method for monitoring population numbers and for early detection of outbreaks, so that follow-up with an appropriate control can be better planned.

PERSISTENCE: As with many lepitopterous defoliators, Winter Moth outbreaks in BC have been observed to occur where the population has increased for 2 to 3 years in a row. However, it is not yet known what triggers the population increase. Changing climate and environmental conditions might make outbreak dynamics even less predictable.

SELECT REFERENCES

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A comprehensive bibliography of literature specific to Winter Moth is available at www.goert.ca/invasive.

For more information contact the Garry Oak Ecosystems Recovery Team, or see the website at www.goert.ca